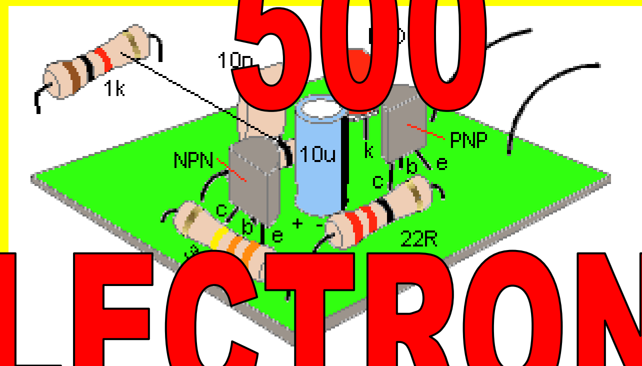
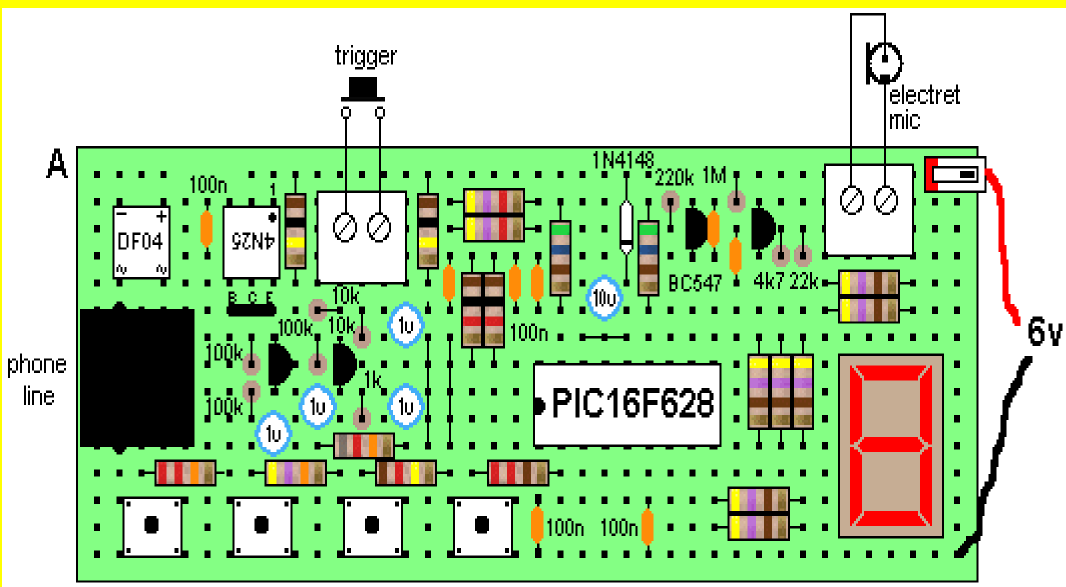
500 ELECTRONIC PROJECTS





AUDIO, AMPLIFIER, LIGHT, LED, TELEPHONE, RADIO, TRANSMITTER, RECEIVER, REMOTE CONTROL, TIMER, OSCILLATOR, AUTOMOTIVE, POWER, ALARM, SENSOR, TOOLS, MEASUREMENT ETC.

1. AUDIO & AMPLIFIER

2. LIGHT & LED

3. TELEPHONE

4. RADIO, TRANSMITTER, RECEIVER, REMOTE CONTROL

5. TIMER & OSCILLATOR

6. AUTOMOTIVE, MOTOR, CARS & MOTORCYCLES

7. POWER & HIGH VOLTAGE

8. ALARM, SENSOR, CONTROL, TOOLS, MEASUREMENT ETC

P399 Beeper
P400 Infrared beam barrier/ proximity sensor
P401 Magnetic proximity sensors
P402 Dew sensor
P403 Color Sensor
P404 Metal Detector
P405 Optical toggle switch using a single Chip
P406 Sound Controlled Filp Flop
P407 Light Barrier Detector
P408 Temperature Sensor with Digital Output
P409 Programmable Digital Code Lock
P410 Dark-activated LED or Lamp Flasher
P411 UltraSonic Radar
P412 Economy radar detector
P413 Simple Lie Detector
P414 Ultrasonic Pest Repeller
P415 Gate Alarm
P416 5 Zone Alarm System
P417 Miniature Loop Alarm
P418 Modular Burglar Alarm
P419 Novel Buzzer
P420 Radio Wave Alarm
P421 5 Digit Alarm Keypad
P422 4 Digit Alarm Keypad
P423 Motorcycle Alarm
P424 Single Zone Alarm
P425 Single Zone CMOS Alarm
P426 Mini Alarms
P427 Car Alarm and Immobilizer
P428 Hijack Alarm
P429 Snore Alarm

EXTRA PROJECTS

Ref: electronicsZone, electronics-lab, talkingelectronics, zen22142, ymya, electronics2day, coolcircuit.

AUDIO

&

AMPLIFIER

P1. 2N3055 Power Amplifier

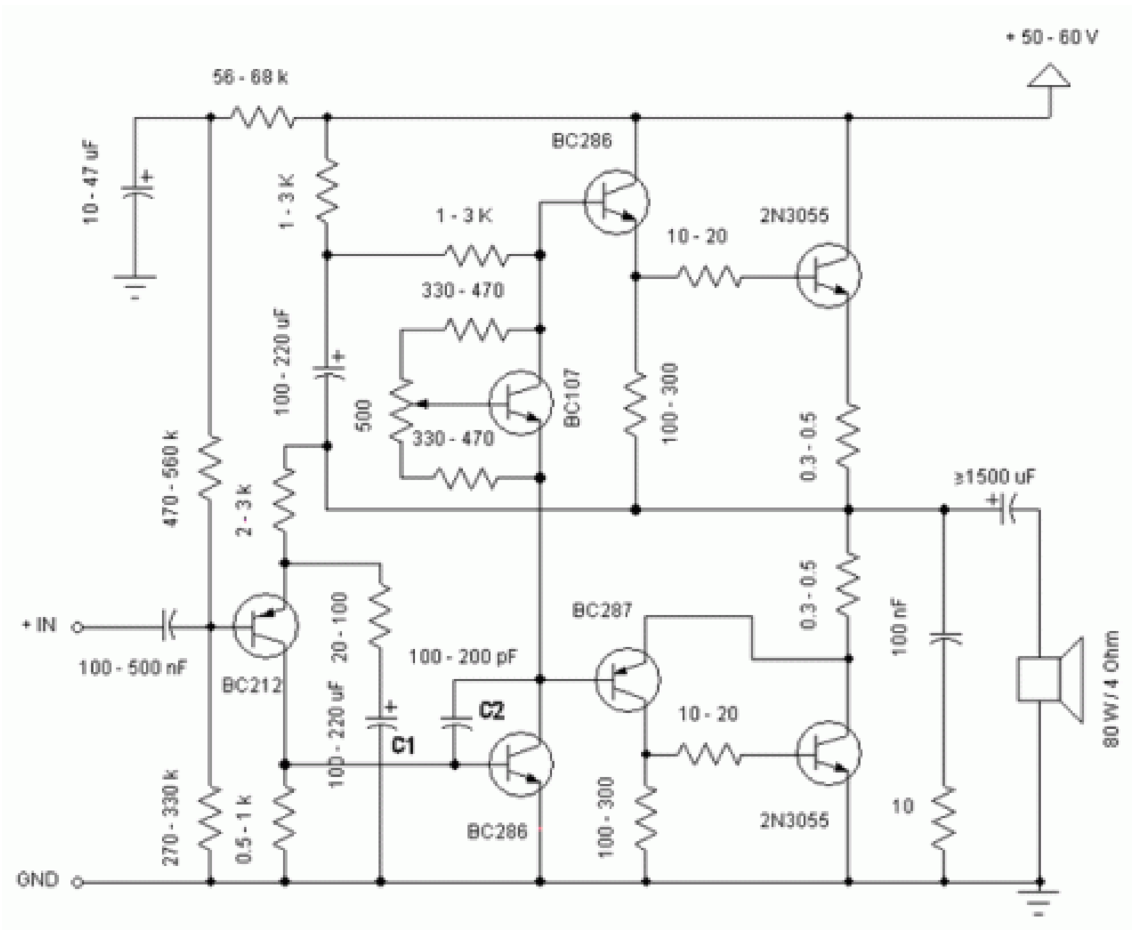
Simple and low cost. The optimal supply voltage is around 50V, but this amp work from 30 to 60V. The maximal input voltage is around 0.8 - 1V. As you can see, in this design the components have a big tolerance, so you can build it almost of the components, which you find at home. The and transistors can be any NPN type power transistor, but do not use Darlington types... The output power is around 60W.

Some comments:

- capacitor C1 regulates the low frequencies (bass), as the capacitance grows, the low frequncies are getting louder.

- capacitor C2 regulates the higher frequencies (treble), as the capacitance grows, the higher frequencies are getting quiter.

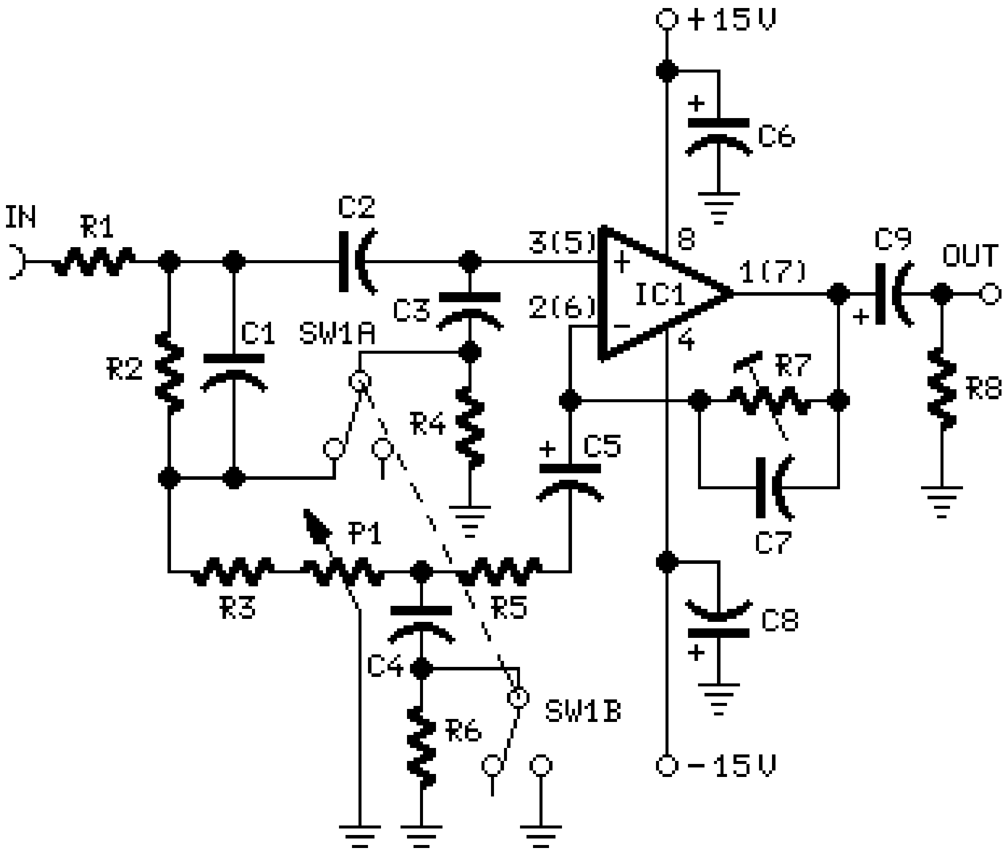
- this is a class B amplifier, this means, that a current must flow through the end transistors, even if there is no signal on the input. This current can be regulated with the 500ohm; trimmer resistor. As this current incrases, the sound of the amplifier gets better, but the end transistors are more heating. But if this current decrases, the transistors are not heating so much, but the sound gets worse...



Circuit diagram

P2. Automatic Loudness Control

circuit diagram:



Parts:
P1 10K Linear Potentiometer (Dual-gang for stereo)
R1,R6,R8 100K 1/4W Resistors
R2 27K 1/4W Resistor
R3,R5 1K 1/4W Resistors
R4 1M 1/4W Resistor
R7 20K 1/2W Trimmer Cermet
C1 100nF 63V Polyester Capacitor
C2 47nF 63V Polyester Capacitor
C3 470nF 63V Polyester Capacitor
C4 15nF 63V Polyester Capacitor
C5,C9 1µF 63V Electrolytic or Polyester Capacitors
C6,C8 47µF 63V Electrolytic Capacitors
C7 100pF 63V Ceramic Capacitor
IC1 TL072 Dual BIFET Op-Amp
SW1 DPDT Switch (four poles for stereo)

Comments:
In order to obtain a good audio reproduction at different listening levels, a different tone-controls setting should be necessary to suit the well known behaviour of the human ear. In fact, the human ear sensitivity

varies in a non-linear manner through the entire audible frequency band, as shown by Fletcher-Munson curves.

A simple approach to this problem can be done inserting a circuit in the preamplifier stage, capable of varying automatically the frequency response of the entire audio chain in respect to the position of the control knob, in order to keep ideal listening conditions under different listening levels.

Fortunately, the human ear is not too critical, so a rather simple circuit can provide a satisfactory performance through a 40dB range.

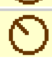
The circuit is shown with SW1 in the "Control-flat" position, i.e. without the Automatic Loudness Control. In this position the circuit acts as a linear preamplifier stage, with the voltage gain set by means of Trimmer R7.

Switching SW1 in the other position the circuit becomes an Automatic Loudness Control and its frequency response varies in respect to the position of the control knob by the amount shown in the table below.

C1 boosts the low frequencies and C4 boosts the higher ones. Maximum boost at low frequencies is limited by R2; R5 do the same at high frequencies.

Technical data:

Frequency response referred to 1KHz and different control knob positions:

Knob	100Hz	10KHz
	+ 14dB	+ 9.5dB
	+ 12.6dB	+ 11.1dB
	+ 8.2dB	+ 11.1dB
	+ 7.2dB	+ 9.5dB
	+ 5dB	+ 6.8dB

Total harmonic distortion at all frequencies and 1V RMS output: < 0.01%

Notes:

SW1 is shown in "Control flat" position.

Schematic shows left channel only, therefore for stereo operation all parts must be doubled except IC1, C6 and C8.

Numbers in parentheses show IC1 right channel pin connections.

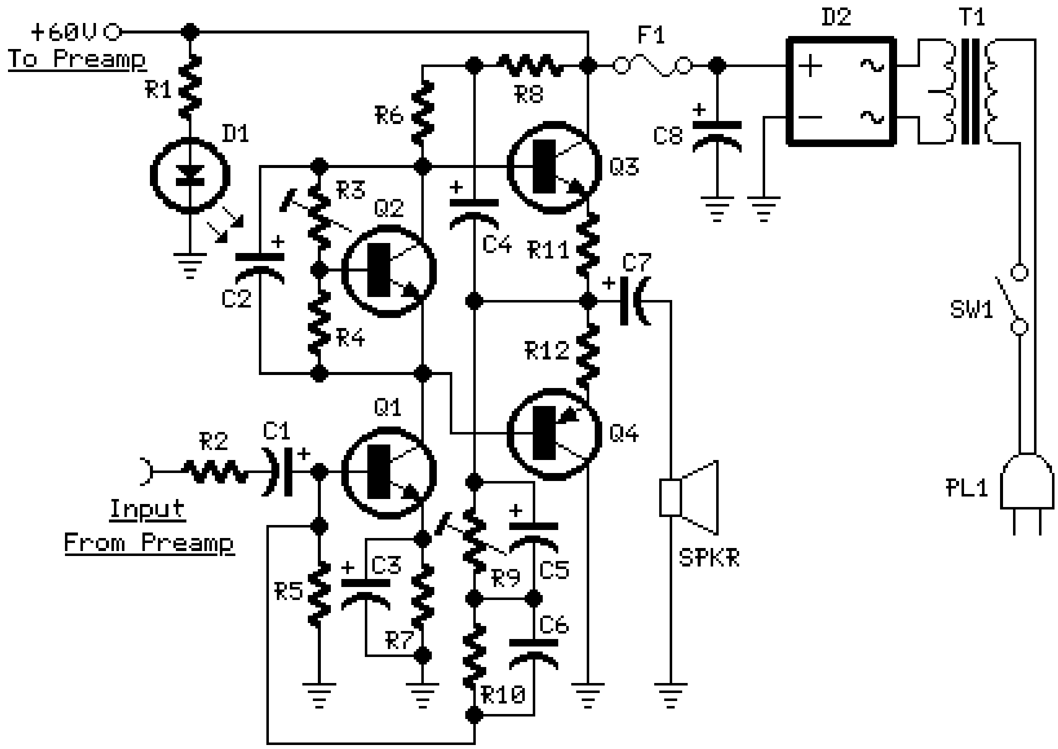
R7 should be set to obtain maximum undistorted output power from the amplifier with a standard music programme source and P1 rotated fully clockwise.

P3. 60W Guitar Amplifier

Bass, Treble, Harmonic modifier and Brightness controls .

Output power: 40W on 8 Ohm and 60W on 4 Ohm loads

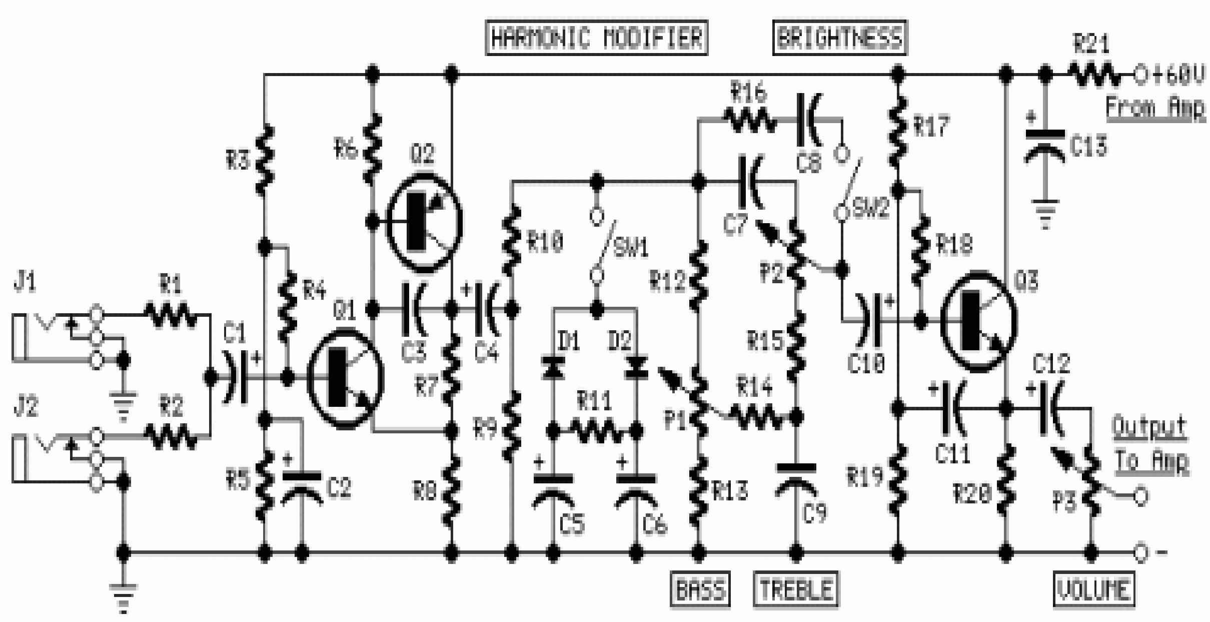
Amplifier circuit diagram:



Amplifier parts:
R1 6K8 1W Resistor
R2,R4 470R 1/4W Resistors
R3 2K 1/2W Trimmer Cermet
R5,R6 4K7 1/2W Resistors
R7 220R 1/2W Resistor
R8 2K2 1/2W Resistor
R9 50K 1/2W Trimmer Cermet
R10 68K 1/4W Resistor
R11,R12 R47 4W Wirewound Resistors
C1,C2,C4,C5 47µF 63V Electrolytic Capacitors
C3 100µF 25V Electrolytic Capacitor
C6 33pF 63V Ceramic Capacitor
C7 1000µF 50V Electrolytic Capacitor
C8 2200µF 63V Electrolytic Capacitor (See Notes)
D1 LED Any type and color
D2 Diode bridge 200V 6A
Q1,Q2 BD139 80V 1.5A NPN Transistors
Q3 MJ11016 120V 30A NPN Darlington Transistor (See Notes)
Q4 MJ11015 120V 30A PNP Darlington Transistor (See Notes)
SW1 SPST Mains switch

F1 4A Fuse with socket
T1 220V Primary, 48-50V Secondary 75 to 150VA Mains transformer (See Notes)
PL1 Male Mains plug
SPKR One or more speakers wired in series or in parallel. Total resulting impedance: 8 or 4 Ohm. Minimum power handling: 75W

Preamplifier circuit diagram:



Preamplifier parts:
P1,P2 10K Linear Potentiometers
P3 10K Log. Potentiometer
R1,R2 68K 1/4W Resistors
R3 680K 1/4W Resistor
R4 220K 1/4W Resistor
R5 33K 1/4W Resistor
R6,R16 2K2 1/4W Resistors
R7 5K6 1/4W Resistor
R8,R21 330R 1/4W Resistors
R9 47K 1/4W Resistor
R10 470R 1/4W Resistor
R11 4K7 1/4W Resistor
R12,R20 10K 1/4W Resistors
R13 100R 1/4W Resistor
R14,R15 47R 1/4W Resistors
R17,R18,R19 100K 1/4W Resistors
C1,C4,C5,C6 10μF 63V Electrolytic Capacitors
C2 47μF 63V Electrolytic Capacitor
C3 47pF 63V Ceramic Capacitor
C7 15nF 63V Polyester Capacitor
C8 22nF 63V Polyester Capacitor
C9 470nF 63V Polyester Capacitor
C10,C11,C12 10μF 63V Electrolytic Capacitors
C13 220μF 63V Electrolytic Capacitor
D1,D2 BAT46 100V 150mA Schottky-barrier Diodes (see Notes)
Q1,Q3 BC546 65V 100mA NPN Transistors
Q2 BC556 65V 100mA PNP Transistor

J1,J2 6.3mm. Mono Jack sockets
SW1,SW2 SPST Switches

Circuit description:

This design adopts a well established circuit topology for the power amplifier, using a single-rail supply of about 60V and capacitor-coupling for the speaker(s). The advantages for a guitar amplifier are the very simple circuitry, even for comparatively high power outputs, and a certain built-in degree of loudspeaker protection, due to capacitor C8, preventing the voltage supply to be conveyed into loudspeakers in case of output transistors' failure.

The preamp is powered by the same 60V rails as the power amplifier, allowing to implement a two-transistors gain-block capable of delivering about 20V RMS output. This provides a very high input overload capability.

Technical data:
Sensitivity:
35mV input for 40W 8 Ohm output
42mV input for 60W 4 Ohm output
Frequency response:
50Hz to 20KHz -0.5dB; -1.5dB @ 40Hz; -3.5dB @ 30Hz
Total harmonic distortion @ 1KHz and 8 Ohm load:
Below 0.1% up to 10W; 0.2% @ 30W
Total harmonic distortion @ 10KHz and 8 Ohm load:
Below 0.15% up to 10W; 0.3% @ 30W
Total harmonic distortion @ 1KHz and 4 Ohm load:
Below 0.18% up to 10W; 0.4% @ 60W
Total harmonic distortion @ 10KHz and 4 Ohm load:
Below 0.3% up to 10W; 0.6% @ 60W
Treble control:
+9 / -16dB @ 1KHz; +12 / -24dB @ 10KHz
Brightness control:
+6.5dB @ 500Hz; +7dB @ 1KHz; +8.5dB @ 10KHz
Bass control:
-17.5dB @ 100Hz; -26dB @ 50Hz; -28dB @ 40Hz

Notes:
The value listed for C8 is the minimum suggested value. A 3300µF capacitor or two 2200µF capacitors wired in parallel would be a better choice.

The Darlington transistor types listed could be too over sized for such a design. You can substitute them with MJ11014 (Q3) and MJ11013 (Q4) or TIP142 (Q3) and TIP147 (Q4).

T1 transformer can be also a 24 + 24V or 25 + 25V type (i.e. 48V or 50V center tapped). Obviously, the center-tap must be left unconnected.

D1 and D2 can be any Schottky-barrier diode types. With these devices, the harmonic modifier operation will be hard. Using for D1 and D2 two common 1N4148 silicon diodes, the harmonic modifier operation will be softer.

In all cases where Darlington transistors are used as the output devices it is essential that the sensing transistor (Q2) should be in as close thermal contact with the output transistors as possible. Therefore a TO126-case transistor type was chosen for easy bolting on the heatsink, very close to the output pair.

R9 must be trimmed in order to measure about half the voltage supply from the positive lead of C7 and ground. A better setting can be done using an oscilloscope, in order to obtain a symmetrical clipping of the output waveform at maximum output power.

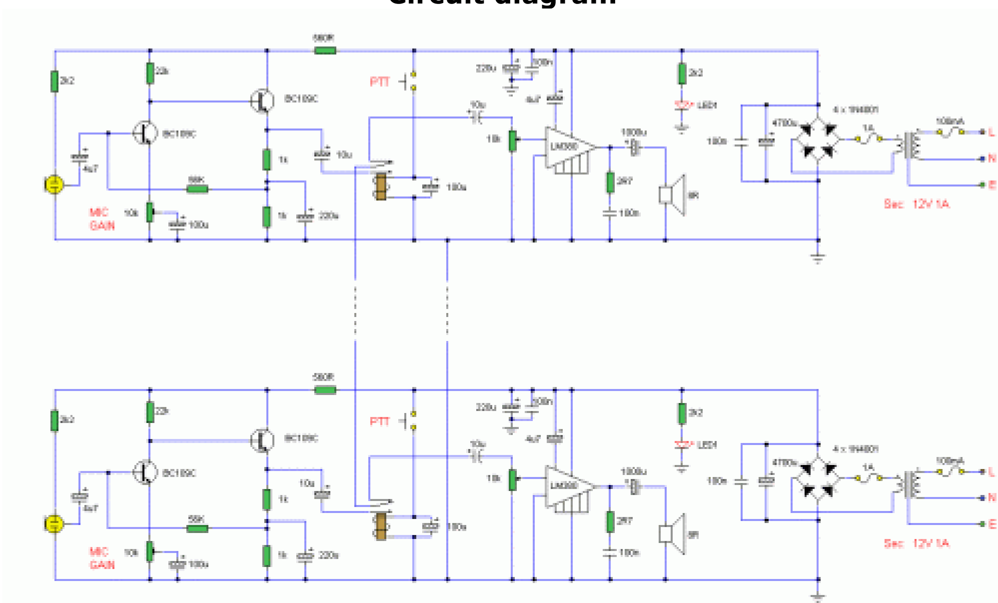
To set quiescent current, remove temporarily the Fuse F1 and insert the probes of an Avo-meter in the two leads of the fuse holder.

Set the volume control to the minimum and Trimmer R3 to its minimum resistance.
Power-on the circuit and adjust R3 to read a current drawing of about 30 to 35mA.
Wait about 15 minutes, watch if the current is varying and readjust if necessary.

P4. High Quality Intercom

Description:
A very high quality intercom, which may also be used for room monitoring.

Circuit diagram



Notes:
This circuit consists of two identical intercom units. Each unit contains a power supply, microphone preamplifier, audio amplifier and a Push To Talk (PTT) relay circuit. Only 2 wires are required to connect the units together. Due to the low output impedance of the mic preamp, screened cable is not necessary and ordinary 2 core speaker cable, or bell wire may be used.

The schematic can be broken into 34 parts, power supply, mic preamp, audio amplifierand PTT circuit. The power supply is designed to be left on all the time, which is why no on / off switch is provided. A standard 12 V RMS secondary transformer of 12VA will power the unit. Fuses are provided at the primary input and also secondary, before the rectifier. The 1 A fuse needs to be a slow blow type as it has to handle the peak rectifier current as the power supply electrolytics charge from zero volts.

The microphone amplifier is a 2 transistor direct coupled amplifier. BC108B transistors will work equally well in place of the BC109C transistors. The microphone used is a 3 terminal electret condenser microphone insert. These are popular and require a small current to operate. The preamp is shown in my audio circuit section as well, but has a very high gain and low distortion. The last transistor is biased to around half the supply voltage; this provides the maximum overload margin for loud signals or loud voices.

The gain may be adjusted with the 10k preset. Sensitivity is very high, and a ticking clock can easily be heard from the distant loudspeaker.

The amplifier is based on the popular National Semiconductor LM380. A 50 mV input is all thats required to deliver 2W RMS into an 8 ohm loudspeaker. The choice of loudspeaker determines overall sound quality. A small loudspeaker may not produce a lot of bass, I used an old 8 inch radio loudspeaker. The 4.7u capacitor at pin 1 of the LM380 helps filter out any mains hum on the power supply. This can be increased to a 10u capacitor for better power supply rejection ratio.

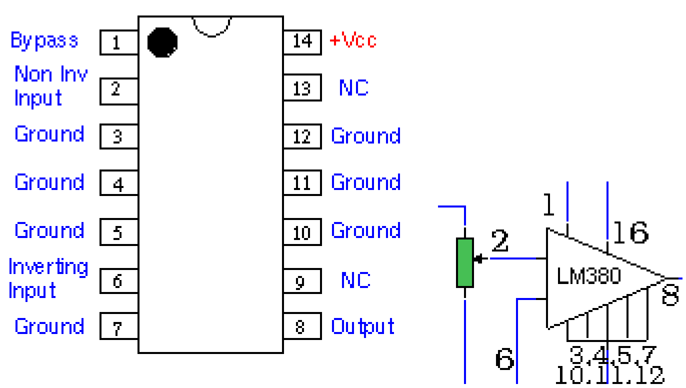
The push to talk (PTT) circuit is very simple. A SPDT relay is used to switch between mic preamplifier output or loudspeaker input. The normally closed contact is set so that each intercom unit is "listening". The non latching push button switch must be held to talk. The 100u capacitor across the relay has two functions. It prevents the relays back emf from destroying the semiconductors, and also delays the release of the relay. This delay is deliberate, and prevents any last word from being "chopped" off.

Setting Up and Testing:

This circuit does not include a "call" button. This is simply because it is designed to be left on all the time, someone speaking from one unit will be heard in the other, and vice versa. Setup is simple, set to volume to a comfortable level, and adjust the mic preset while speaking with "normal volume" from one meter away. You do not need to be in close contact with the microphone, it will pick up a conversation from anywhere in a room. If the units are a long way away, there is a tendency for the cable to pick up hum, or radio interference. There are various defenses against this. One way is to use a twisted pair cable, each successive turn cancels the interference from the turn before. Another method is to use a small capacitor of say 100n between the common terminal of each relay and ground. This shunts high frequency signals to earth. Another method is to use a low value resistor of about 1k. This will shunt interference and hum, but will shunt the speech signal as well. However as the output impedance of each mic preamp is low, and the speech signals are also low, this will have little effect on speech but reduce interference to an acceptable level.

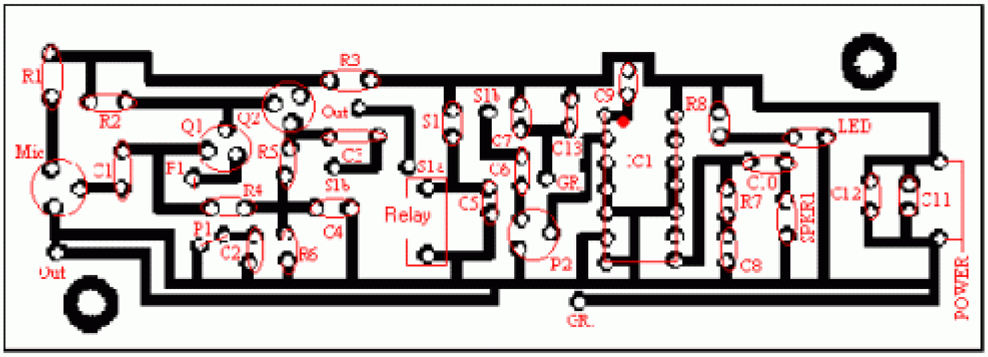
IC Pinout:

The LM380 pinout viewed from above is shown below on the left. In the schematic, the LM380 has been represented as a triangle, the pins are shown on the right hand diagram. Pins marked "NC" have no connection and are not used.

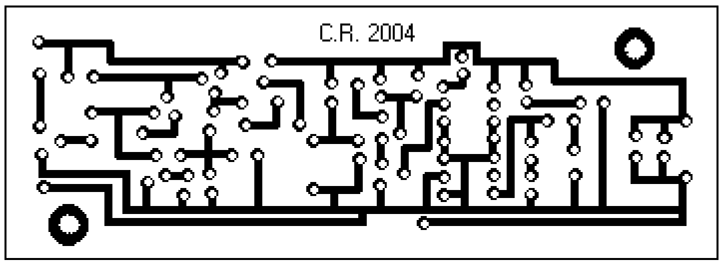


PCB Layout:

Corey Rametta has kindly drafted a PCB layout for this project. First an oversized version to show component placement. Note the tracks on the bottom side, components on the top side.

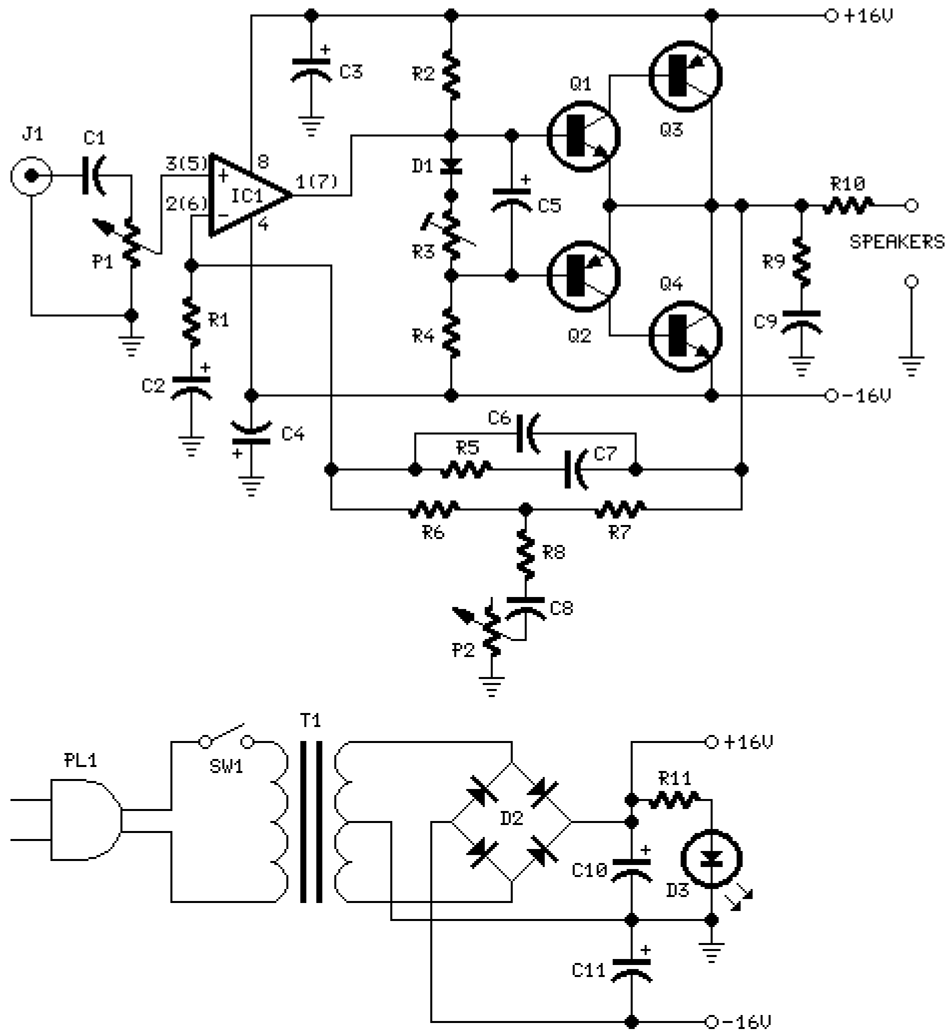


Below is the actual size version shown track side.



P5. 10W Audio Amplifier with Bass-boost

circuit diagram



Parts:
P1 22K Log.Potentiometer (Dual-gang for stereo)
P2 100K Log.Potentiometer (Dual-gang for stereo)
R1 820R 1/4W Resistor
R2,R4,R8 4K7 1/4W Resistors
R3 500R 1/2W Trimmer Cermet
R5 82K 1/4W Resistor
R6,R7 47K 1/4W Resistors
R9 10R 1/2W Resistor
R10 R22 4W Resistor (wirewound)
C1,C8 470nF 63V Polyester Capacitor
C2,C5 100uF 25V Electrolytic Capacitors
C3,C4 470uF 25V Electrolytic Capacitors
C6 47pF 63V Ceramic or Polystyrene Capacitor
C7 10nF 63V Polyester Capacitor
C9 100nF 63V Polyester Capacitor
D1 1N4148 75V 150mA Diode
IC1 NE5532 Low noise Dual Op-amp
Q1 BC547B 45V 100mA NPN Transistor

Q2 BC557B 45V 100mA PNP Transistor
Q3 TIP42A 60V 6A PNP Transistor
Q4 TIP41A 60V 6A NPN Transistor
J1 RCA audio input socket

Power supply parts:
R11 1K5 1/4W Resistor
C10,C11 4700uF 25V Electrolytic Capacitors
D2 100V 4A Diode bridge
D3 5mm. Red LED
T1 220V Primary, 12 + 12V Secondary 24-30VA Mains transformer
PL1 Male Mains plug
SW1 SPST Mains switch

Comments:
This design is based on the 18 Watt Audio Amplifier, and was developed mainly to satisfy the requests of correspondents unable to locate the TLE2141C chip. It uses the widespread NE5532 Dual IC but, obviously, its power output will be comprised in the 9.5 - 11.5W range, as the supply rails cannot exceed ±18V.

As amplifiers of this kind are frequently used to drive small loudspeaker cabinets, the bass frequency range is rather sacrificed. Therefore a bass-boost control was inserted in the feedback loop of the amplifier, in order to overcome this problem without quality losses. The bass lift curve can reach a maximum of +16.4dB @ 50Hz. In any case, even when the bass control is rotated fully counterclockwise, the amplifier frequency response shows a gentle raising curve: +0.8dB @ 400Hz, +4.7dB @ 100Hz and +6dB @ 50Hz (referred to 1KHz).

Notes:
Can be directly connected to CD players, tuners and tape recorders.
Schematic shows left channel only, but C3, C4, IC1 and the power supply are common to both channels.
Numbers in parentheses show IC1 right channel pin connections.
A log type for P2 ensures a more linear regulation of bass-boost.
Don't exceed 18 + 18V supply.
Q3 and Q4 must be mounted on heatsink.
D1 must be in thermal contact with Q1.
Quiescent current (best measured with an Avo-meter in series with Q3 Emitter) is not critical.
Set the volume control to the minimum and R3 to its minimum resistance.
Power-on the circuit and adjust R3 to read a current drawing of about 20 to 25mA.
Wait about 15 minutes, watch if the current is varying and readjust if necessary.
A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of J1, P1, C2, C3 &C4. Connect C9 at the output ground.
Then connect separately the input and output grounds at the power supply ground.

Technical data:
Output power: 10 Watt RMS @ 8 Ohm (1KHz sinewave)
Sensitivity: 115 to 180mV input for 10W output (depending on P2 control position)
Frequency response: See Comments above
Total harmonic distortion @ 1KHz: 0.1W 0.009% 1W 0.004% 10W 0.005%
Total harmonic distortion @ 100Hz: 0.1W 0.009% 1W 0.007% 10W 0.012%
Total harmonic distortion @10KHz: 0.1W 0.056% 1W 0.01% 10W 0.018%
Total harmonic distortion @ 100Hz and full boost: 1W 0.015% 10W 0.03%
Max. bass-boost referred to 1KHz: 400Hz = +5dB; 200Hz = +7.3dB; 100Hz = +12dB; 50Hz = +16.4dB; 30Hz = +13.3dB

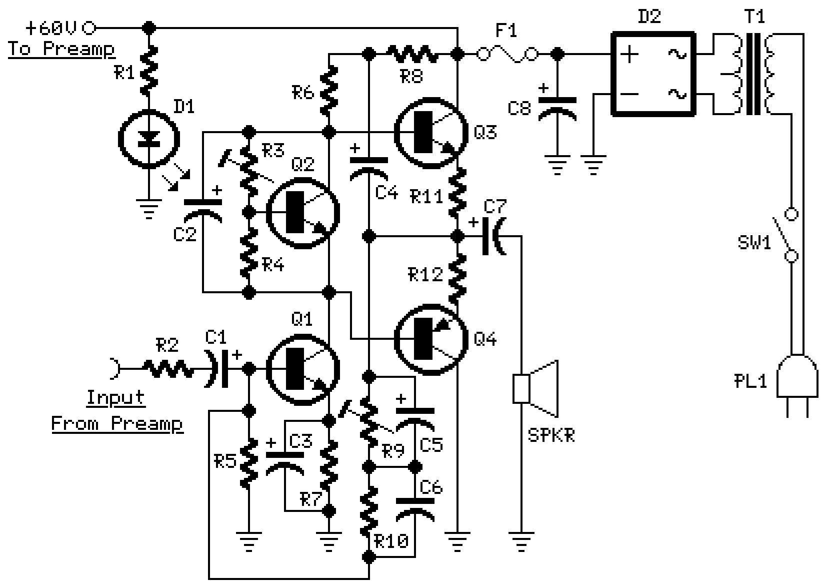
Unconditionally stable on capacitive loads

P6. 60W Bass Amplifier

Low-cut and Bass controls.

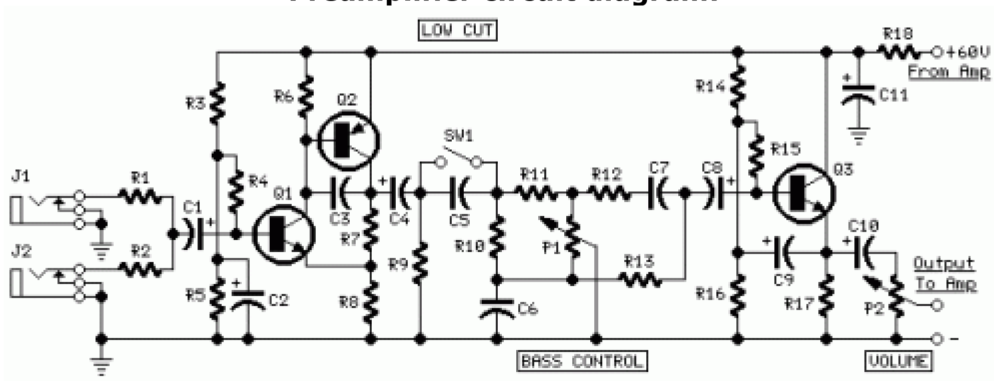
Output power: 40W on 8 Ohm and 60W on 4 Ohm loads

Amplifier circuit diagram:



Amplifier parts:
R1 6K8 1W Resistor
R2,R4 470R 1/4W Resistors
R3 2K 1/2W Trimmer Cermet
R5,R6 4K7 1/2W Resistors
R7 220R 1/2W Resistor
R8 2K2 1/2W Resistor
R9 50K 1/2W Trimmer Cermet
R10 68K 1/4W Resistor
R11,R12 R47 4W Wirewound Resistors
C1,C2,C4,C5 47µF 63V Electrolytic Capacitors
C3 100µF 25V Electrolytic Capacitor
C6 33pF 63V Ceramic Capacitor
C7 1000µF 50V Electrolytic Capacitor
C8 2200µF 63V Electrolytic Capacitor (See Notes)
D1 LED Any type and color
D2 Diode bridge 200V 6A
Q1,Q2 BD139 80V 1.5A NPN Transistors
Q3 MJ11016 120V 30A NPN Darlington Transistor (See Notes)
Q4 MJ11015 120V 30A PNP Darlington Transistor (See Notes)
SW1 SPST Mains switch
F1 4A Fuse with socket
T1 220V Primary, 48-50V Secondary 75 to 150VA Mains transformer
PL1 Male Mains plug
SPKR One or more speakers wired in series or in parallel. Total resulting impedance: 8 or 4 Ohm. Minimum power handling: 75W

Preamplifier circuit diagram:



Preamplifier parts:
P1 10K Linear Potentiometer
P2 10K Log. Potentiometer
R1,R2 68K 1/4W Resistors
R3 680K 1/4W Resistor
R4 220K 1/4W Resistor
R5 33K 1/4W Resistor
R6 2K2 1/4W Resistor
R7 5K6 1/4W Resistor
R8,R18 330R 1/4W Resistors
R9 47K 1/4W Resistor
R10 18K 1/4W Resistor
R11 4K7 1/4W Resistor
R12 1K 1/4W Resistor
R13 1K5 1/4W Resistor
R14,R15,R16 100K 1/4W Resistors
R17 10K 1/4W Resistor
C1,C4,C8,C9,C10 10µF 63V Electrolytic Capacitors
C2 47µF 63V Electrolytic Capacitor
C3 47pF 63V Ceramic Capacitor
C5 220nF 63V Polyester Capacitor
C6 470nF 63V Polyester Capacitor
C7 100nF 63V Polyester Capacitor
C11 220µF 63V Electrolytic Capacitor
Q1,Q3 BC546 65V 100mA NPN Transistors
Q2 BC556 65V 100mA PNP Transistor
J1,J2 6.3mm. Mono Jack sockets
SW1 SPST Switch

Circuit description:

This design adopts a well established circuit topology for the power amplifier, using a single-rail supply of about 60V and capacitor-coupling for the speaker(s). The advantages for a guitar amplifier are the very simple circuitry, even for comparatively high power outputs, and a certain built-in degree of loudspeaker protection, due to capacitor C8, preventing the voltage supply to be conveyed into loudspeakers in case of output transistors' failure.

The preamp is powered by the same 60V rails as the power amplifier, allowing to implement a two-transistors gain-block capable of delivering about 20V RMS output. This provides a very high input overload capability.

Technical data:
Sensitivity:
70mV input for 40W 8 Ohm output
63mV input for 60W 4 Ohm output
Frequency response:
50Hz to 20KHz -0.5dB; -1.5dB @ 40Hz; -3.5dB @ 30Hz
Total harmonic distortion @ 1KHz and 8 Ohm load:
Below 0.1% up to 10W; 0.2% @ 30W
Total harmonic distortion @ 10KHz and 8 Ohm load:
Below 0.15% up to 10W; 0.3% @ 30W
Total harmonic distortion @ 1KHz and 4 Ohm load:
Below 0.18% up to 10W; 0.4% @ 60W
Total harmonic distortion @ 10KHz and 4 Ohm load:
Below 0.3% up to 10W; 0.6% @ 60W
Bass control:
Fully clockwise = +13.7dB @ 100Hz; -23dB @ 10KHz
Center position = -4.5dB @ 100Hz
Fully counterclockwise = -12.5dB @ 100Hz; +0.7dB @ 1KHz and 10KHz
Low-cut switch:
-1.5dB @ 300Hz; -2.5dB @ 200Hz; -4.4dB @ 100Hz; -10dB @ 50Hz

Notes:
The value listed for C8 is the minimum suggested value. A 3300µF capacitor or two 2200µF capacitors wired in parallel would be a better choice.

The Darlington transistor types listed could be too oversized for such a design. You can substitute them with MJ11014 (Q3) and MJ11013 (Q4) or TIP142 (Q3) and TIP147 (Q4).

T1 transformer can be also a 24 + 24V or 25 + 25V type (i.e. 48V or 50V center tapped). Obviously, the center-tap must be left unconnected.

SW1 switch inserts the Low-cut feature when open.

In all cases where Darlington transistors are used as the output devices it is essential that the sensing transistor (Q2) should be in as close thermal contact with the output transistors as possible. Therefore a TO126-case transistor type was chosen for easy bolting on the heatsink, very close to the output pair.

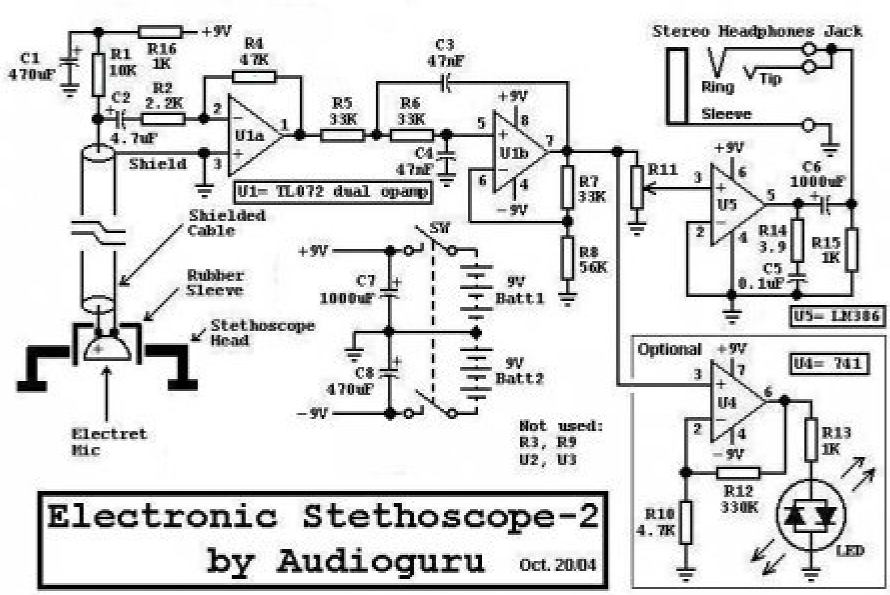
R9 must be trimmed in order to measure about half the voltage supply from the positive lead of C7 and ground. A better setting can be done using an oscilloscope, in order to obtain a symmetrical clipping of the output waveform at maximum output power.

To set quiescent current, remove temporarily the Fuse F1 and insert the probes of an Avo-meter in the two leads of the fuse holder.

Set the volume control to the minimum and Trimmer R3 to its minimum resistance.
Power-on the circuit and adjust R3 to read a current drawing of about 30 to 35mA.
Wait about 15 minutes, watch if the current is varying and readjust if necessary.

P7. Electronic Stethoscope

Circuit diagram



Circuit Description:
U1a operates as a low-noise microphone preamp. Its gain is only about 3.9 because the high output impedance of the drain of the FET inside the electret microphone causes U1a's effective input resistor to be about 12.2K. C2 has a fairly high value in order to pass very low frequency (about 20 to 30Hz) heartbeat sounds.

U1b operates as a low-noise Sallen and Key, Butterworth low-pass-filter with a cutoff frequency of about 103Hz. R7 and R8 provide a gain of about 1.6 and allow the use of equal values for C3 and C4 but still producing a sharp Butterworth response. The rolloff rate is 12dB/octave. C3 and C4 can be reduced to 4.7nF to increase the cutoff frequency to 1KHz to hear respiratory or mechanical (automobile engine) sounds.

The U4 circuit is optional and has a gain of 71 to drive the bi-colour LED.

U5 is a 1/4W power amplifier IC with built-in biasing and inputs that are referred to ground. It has a gain of 20. It can drive any type of headphones including low impedance (8 ohms) ones.

Parts
R1 10K 1/4W Resistor
R2 2.2K 1/4W Resistor

R3, R9 Not used
R4 47K 1/4W Resistor
R5, R6, R7 33K 1/4W Resistor
R8 56K 1/4W Resistor
R10 4.7K 1/4W Resistor
R11 2.2K to 10K audio-taper (logarithmic) volume control
R12 330K 1/4W Resistor
R13, R15, R16 1K 1/4W Resistor
R14 3.9 Ohm 1/4W Resistor
C1, C8 470uF/16V Electrolytic Capacitor
C2 4.7uF/16V Electrolytic Capacitor
C3, C4 0.047uF/50V Metalized plastic-film Capacitor
C5 0.1uF/50V Ceramic disc Capacitor
C6, C7 1000uF/16V Electrolytic Capacitor
U1 TL072 Low-noise, dual opamp
U2, U3 Not used
U4 741 opamp
U5 LM386 1/4W power amp
MIC Two-wire Electret Microphone
J1 1/8" Stereo Headphones Jack
LED Red/green 2-wire LED
Batt1, Batt2 9V Alkaline Battery
SW 2-pole, single throw Power Switch
Misc. Stethoscope head or jar lid, Rubber Sleeve for microphone.

Assembly:

1) Assemble the circuit using Veroboard (stripboard) or a PCB.

2) Use a shielded cable for the microphone as shown on the schematic.

3) Fasten the microphone to the stethoscope head with a rubber isolating sleeve or use a short piece of rubber tubing on its nipple. A thick jar lid can be used as a stethoscope head. The microphone must be spaced away from the skin but the stethoscope head must be pressed to the skin, sealing the microphone from background noises and avoiding acoustical feedback with your headphones.

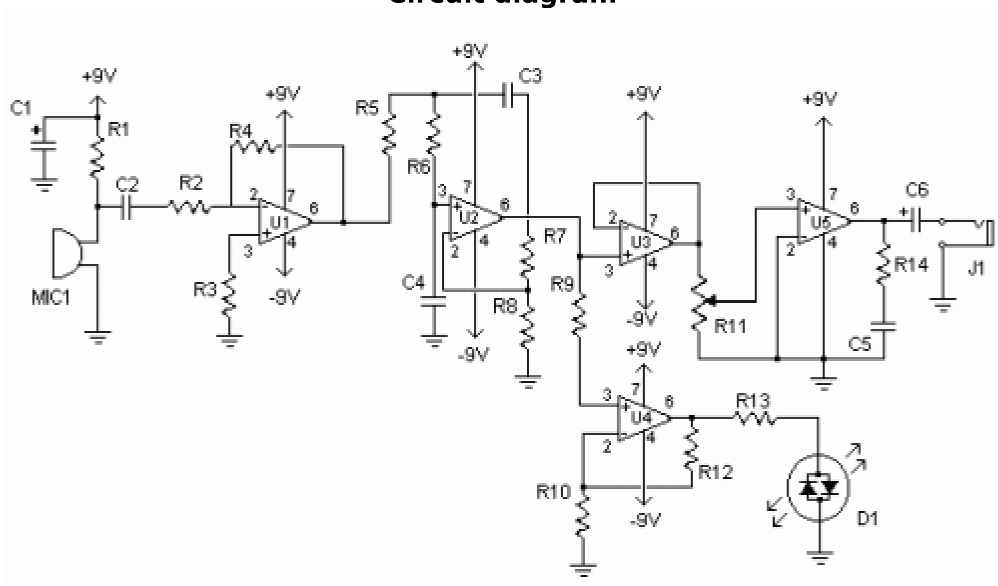
4) The microphone/stethoscope head must not be moved while listening to heartbeats to avoid friction noises.

5) Protect your hearing. Keep the microphone away from your headphones to avoid acoustical feedback.

P8. Electronic Stethoscope II

Stethoscopes are not only useful for doctors, but home mechanics, exterminators, spying and any number of other uses. Standard stethoscopes provide no amplification which limits their use. This circuit uses op-amps to greatly amplify a standard stethoscope, and includes a low pass filter to remove background noise.

Circuit diagram

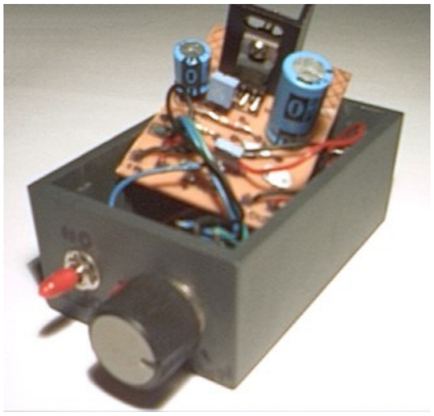


Parts:
R1 10K 1/4W Resistor
R2, R3, R9 2.2K 1/4W Resistor
R4 47K 1/4W Resistor
R5, R6, R7 33K 1/4W Resistor
R8 56K 1/4W Resistor
R10 4.7K 1/4W Resistor
R11 2.5K Pot
R12 330K 1/4W Resistor
R13 1K 1/4W Resistor
R14 3.9 Ohm 1/4W Resistor
C1 470uF Electrolytic Capacitor
C2, C3, C4 0.047uF Capacitor
C5 0.1uF Capacitor
C6 1000uF Electrolytic Capacitor
D1 Bi-Colour LED
U1, U2, U3, U4, U5 741 Op-Amp
MIC1 Electret Mic
J1 1/4" Phone Jack
MISC Board, Wire, Sockets for ICs, Knob for pot, Stethoscope, Rubber tube

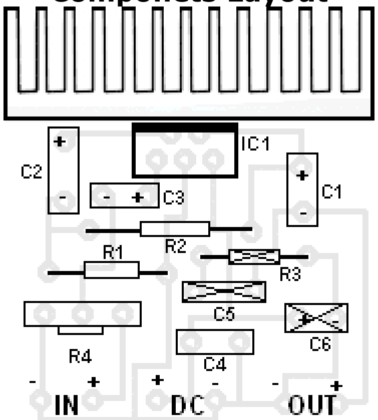
Notes:
1. MIC1 is an assembly made out of a stethoscope head and electret mic. Cut the head off the stethoscope and use a small piece of rubber tube to join the nipple on the head to the mic.
2. Be careful with the volume, as excess noise level may damage your ears.
3. The + and - 9V may be supplied by two 9V batteries wired in series and tapped at the junction.
4. R11 is the volume control.

P9. 10W Mini Audio Amplifier

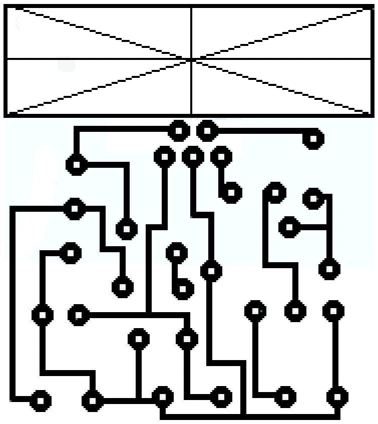
finished device



Componets Layout



PCB



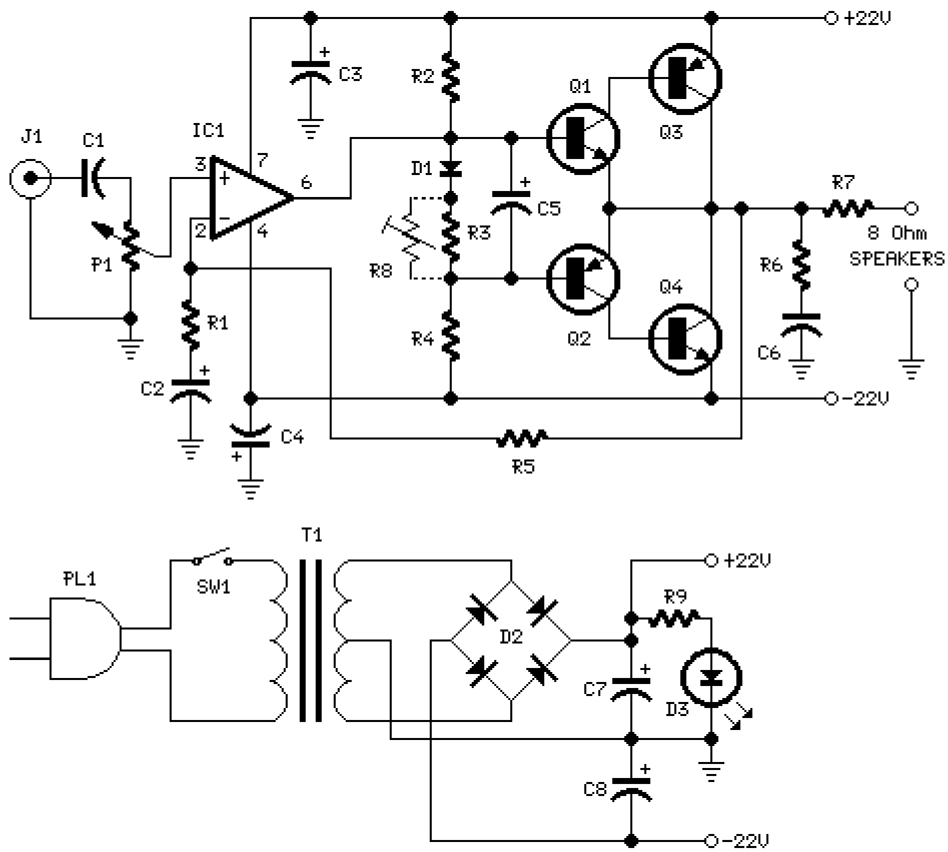
Componets List

R1 : 6 Ohm
R2 : 220 Ohm
R3 : nothing
R4 : 10 KOhm pontesiometer
C1 : 2200 uF / 25V
C2 : 470 uF / 16V
C3 : 470 nF / 63V
C4 : 100 nF

C5 : nothing
C6 : nothing
IC1 : TDA 2003

P10. 18W Audio Amplifier

circuit diagram



Amplifier parts:
P1 = 22K Log.Potentiometer (Dual-gang for stereo)
R1 = 1K 1/4W Resistor
R2 = 4K7 1/4W Resistor
R3 = 100R 1/4W Resistor
R4 = 4K7 1/4W Resistor
R5 = 82K 1/4W Resistor
R6 = 10R 1/2W Resistor
R7 = R22 4W Resistor (wire wound)
R8 = 1K 1/2W Trimmer Cermet (optional)
C1 = 470nF 63V Polyester Capacitor
C2,C5 = 100uF 3V Tantalum bead Capacitors
C3,C4 = 470uF 25V Electrolytic Capacitors
C6 = 100nF 63V Polyester Capacitor
D1 = 1N4148 75V 150mA Diode

IC1 = TLE2141C Low noise,high voltage,high slew-rate Op-amp
Q1 = BC182 50V 100mA NPN Transistor
Q2 = BC212 50V 100mA PNP Transistor
Q3 = TIP42A 60V 6A PNP Transistor
Q4 = TIP41A 60V 6A NPN Transistor
J1 RCA audio input socket

Power supply parts:
R9 = 2K2 1/4W Resistor
C7,C8 = 4700uF 25V Electrolytic Capacitors
D2 100V 4A Diode bridge
D3 5mm. Red LED
T1 220V Primary, 15 + 15V Secondary 50VA Mains transformer
PL1 Male Mains plug
SW1 SPST Mains switch

Notes:
Can be directly connected to CD players, tuners and tape recorders.
Don't exceed 23 + 23V supply.
Q3 and Q4 must be mounted on heat sink.
D1 must be in thermal contact with Q1.

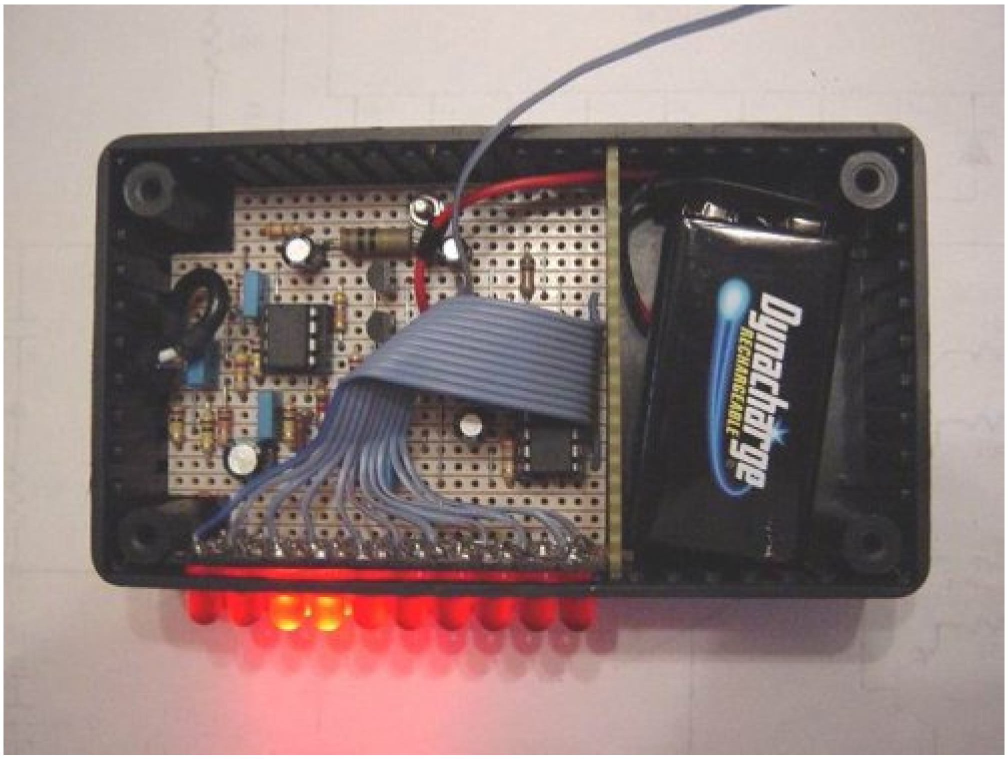
Quiescent current (best measured with an Avo-meter in series with Q3 Emitter) is not critical.
Adjust R3 to read a current between 20 to 30 mA with no input signal.
To facilitate current setting add R8 (optional).

A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of J1, P1, C2, C3 &C4. Connect C6 at the output ground.
Then connect separately the input and output grounds at the power supply ground.

Technical data:
Output power: 18 Watt RMS @ 8 Ohm (1KHz sine wave)
Sensitivity: 150mV input for 18W output
Frequency response: 30Hz to 20KHz -1dB
Total harmonic distortion @ 1KHz: 0.1W 0.02% 1W 0.01% 5W 0.01% 10W 0.03%
Total harmonic distortion @10KHz: 0.1W 0.04% 1W 0.05% 5W 0.06% 10W 0.15%
Unconditionally stable on capacitive loads

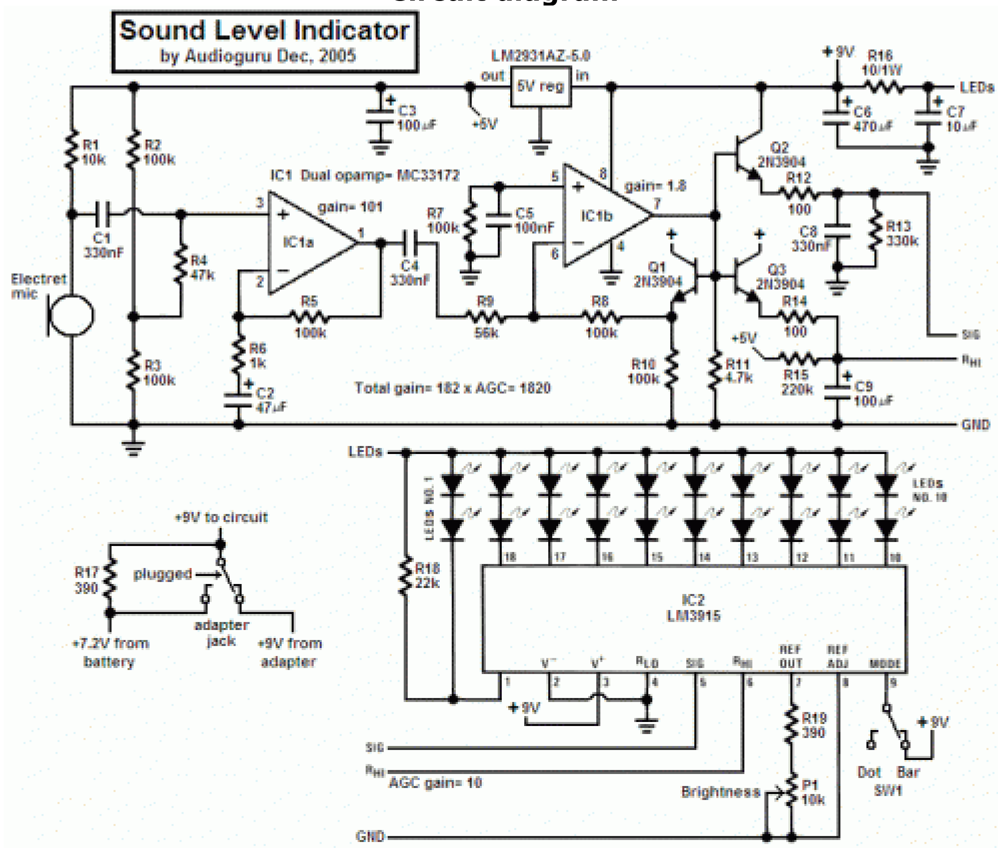
P11. Sound Level Indicator

This project uses an LM3915 bar-graph IC driving two sets of ten LEDs for a 30dB range. The circuit is unique because it has an additional range of 20dB provided by an automatic gain control to allow it to be very sensitive to low sound levels but it increases its range 20dB for loud sounds.



The LEDs are operating at 26mA each with the brightness control at maximum, which is very bright. The circuit has a switch to select the modes of operation: a moving dot of light, or a bar with a changing length.
My prototype has a little 9V Ni-Cad rechargeable battery in it to be portable and the battery is trickle-charged when the project is powered by a 9V AC-DC adapter.

Circuit diagram



Circuit Description

1) The electret microphone is powered by and has a load of R1 from an LM2931 5V low-dropout regulator.

2) The 1st opamp stage is an audio preamp with a gain of 101.

3) The 2nd opamp stage is a single-supply opamp which works fine with its inputs and output at ground and is used as a rectifier driver with a gain of 1.8. It is biased at ground. Since it is inverting, when its input swings negative, its output swings positive.

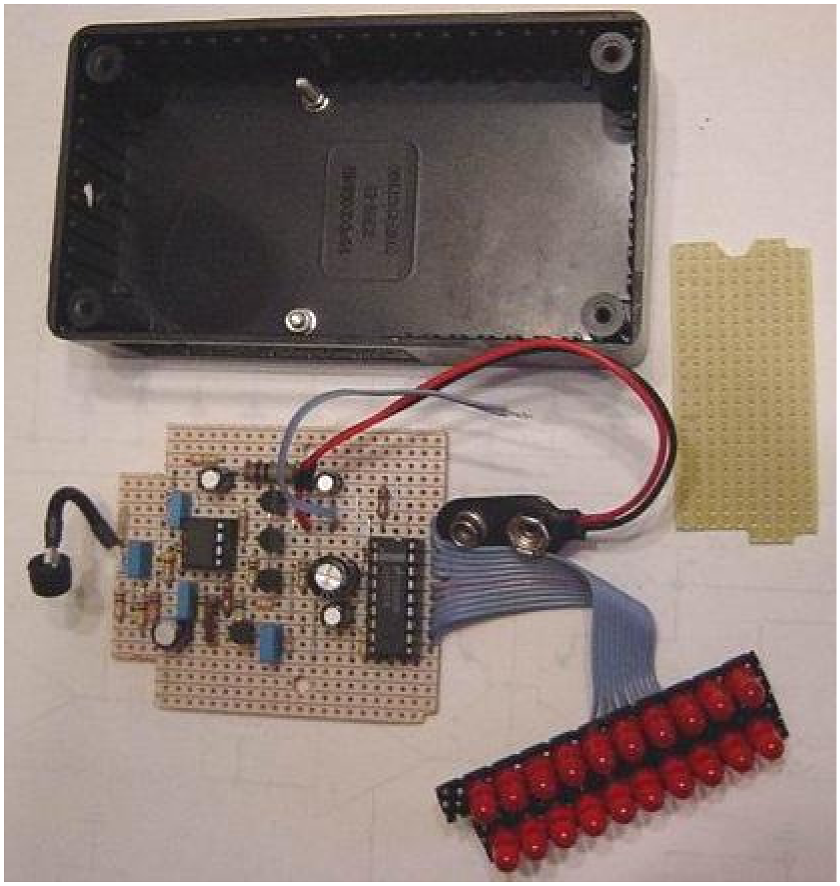
4) Three 2N3904 transistors are used as emitter-followers:

a) Q1 is inside the negative feedback loop of the 2nd opamp as a voltage reference for the other two transistors. Hopefully the transistors match each other.

b) Q2 emitter-follower transistor quickly charges C8 which discharges slower into R13 and is used as a peak detector.

c) Q3 transistor is the automatic gain control. It is also a peak detector but has slower charge and discharge times. It drives the comparators' resistor ladder in the LM3915 to determine how sensitive it is. R15 from +5V is in a voltage divider with the ladder's total resistance of about 25k and provides the top of the ladder with about +0.51V when there is a very low sound level detected. Loud sounds cause Q3 to drive the top of the ladder to 5.1V for reduced sensitivity.

5) The LM3915 regulates the current for the LEDs so they don't need current-limiting resistors. In the bar mode with all LEDs lit then the LM3915 gets hot so the 10 ohm/1W resistor R16 shares the heat.



Options

1) You could use a switch to change the brightness instead of a pot, or leave it bright.

2) You could use an LM358 dual opamp (I tried it) but its output drops above 4Khz. The MC33172 is flat to 20kHz with this high gain.

3) You could add a 1uF to 2.2uF capacitor across R5 so the indicator responds only to bass or “the beat” of music. Then an LM358 dual opamp is fine.

Dot | Bar

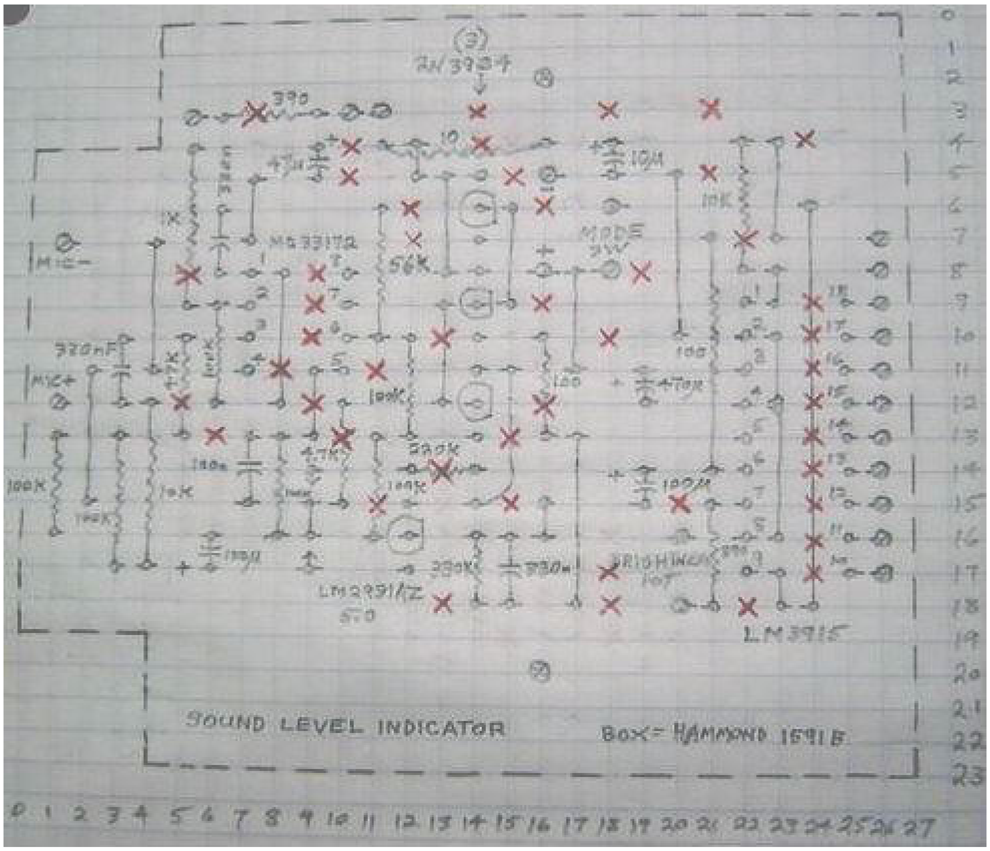
Construction
1) The stripboard layout was designed for a Hammond 1591B plastic box with space in the lower end for a rechargeable 9V battery. One bolt holds the circuit board and a second bolt was cut short as a guide.

2) A second piece of stripboard was used on a diagonal to space the LEDs closely together. A few LEDs needed their rim to be filed slightly to fit.

3) A third piece of stripboard was used as a separating wall for the battery and it interlocks with the LEDs stripboard to hold it in place.

4) 11-wire flexible ribbon cable connects to the LEDs.

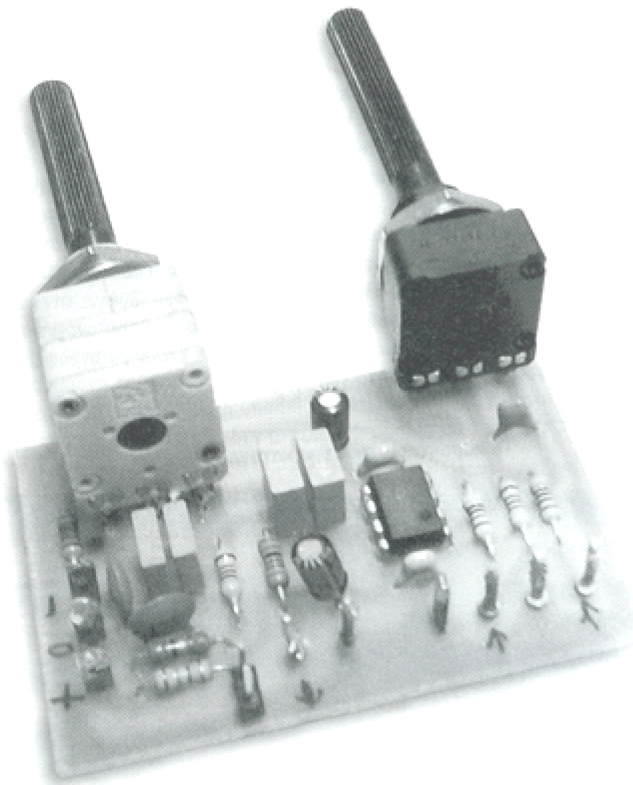
5) Use shielded audio from the microphone and a rubber grommet holding it.



Parts
R1--10k
R2, R3, R5, R7, R8, R10--100k
R4--47k
R6--1k
R9--56k
R11--4.7k
R12, R14--100
R13--330k
R15--220k
R16--10/1W
R17, R19--390
R18--22k
P1--10k audio-taper (log) pot
C1, C4, C8--330nF
C2--47uF/10V
C3, C9--100uF/10V
C5--100nF
C6--470uF/16V
C7--10uF/16V
IC1--MC33172P
IC2--LM3915P

5V reg--LM2931AZ5.0
LEDs--MV8191 super-red diffused
Electret microphone--two-wire type Box--Hammond 1591B
Battery--9V Ni-Cad or Ni-MH
SW1--SPST switch
Adapter jack--switched

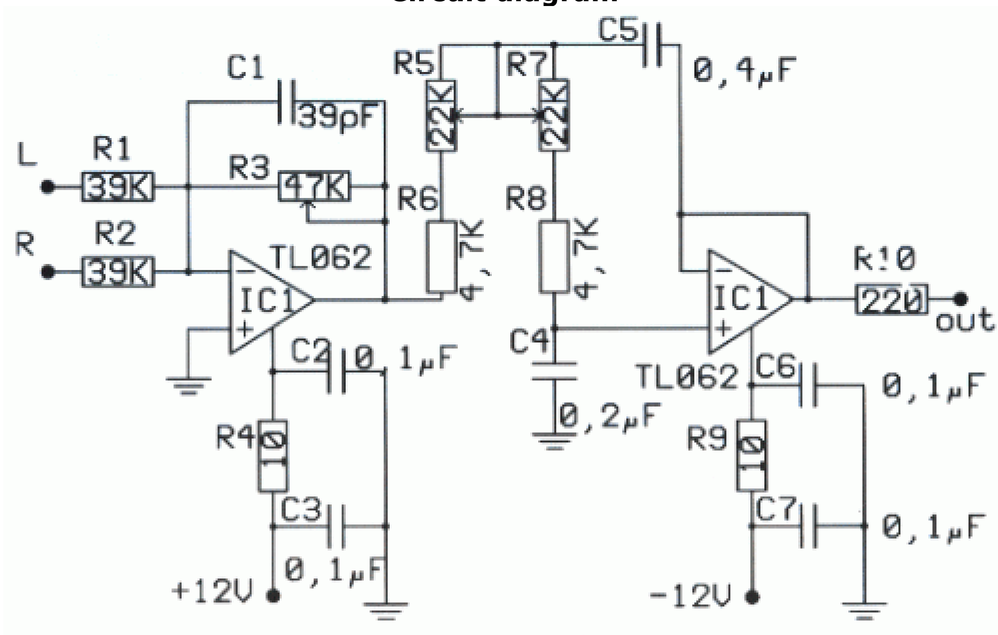
P12. Low pass filter - Subwoofer



The acoustic spectrum is extended by very low frequencies 20Iz and reaches as the 20000Iz in high frequencies. In the low frequencies is degraded the sense of direction. This reason us leads to the utilization speaker for the attribution of very low frequencies. The manufacture that to you we propose distinguishes these frequencies, in order to him we lead to the corresponding amplifier. The acoustic filters are met in various points in the sound systems. The knownest application they are the filters baxandal for regulating tone low and high frequencies and filters crossover where the acoustic region is separated in subareas, in order to it leads the corresponding loudspeakers. The application that to you we propose is a simple filter of region that limits the acoustic region (20-20000Hz) in the region 20-100Hz.

With the manufacture that to you we propose you can make a active filter in order to you lead a loudspeaker of very low frequencies. With this you will place one bigger speaker between the HIFI speakers of you. In order to you have a complete picture of sound you will need also the corresponding amplifier. In the entry of circuit you will connect the two exits of preamplifier or the exit of line of some preamplifier. The circuit of manufacture allocates a exit in order to is led means of circuit of force subwoofer. If for some reason you do not have space in order to you place the third speaker in space of hearing, then you can select smaller speaker. The output will depend from the type of music that you hear. If in deed you have space, then after you make a filter and remain thanked, you can him recommend in your friends or still make other same for your friends.

Circuit diagram



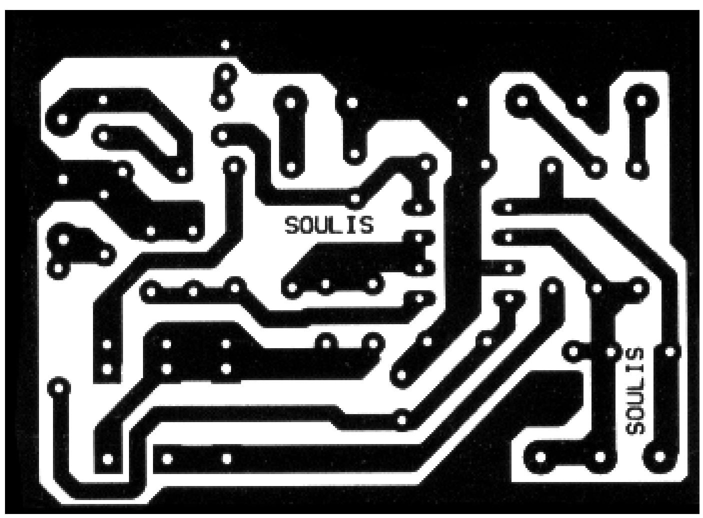
In the form it appears the theoretical circuit of filter. In first glance we see three different circuits that are mainly manufactured round two operational amplifiers. This circuits constitute mixed, amplifier with variable aid and a variable filter. The manufacture end needs a circuit of catering with operational tendency of catering equal with ±12. the operational amplifiers that constitute the active elements for this circuits of are double operational type as the TL082 and NE5532. The operational these amplifiers belong in a family provided with transistor of effect of field IFET in their entries. Each member of family allocates in their circuit bipolar transistor and effect of field. This circuits can function in his high tendency, because that they use transistor of high tendency. Also they have high honor of rhythm of elevation (slew rate), low current of polarization for the entries and are influenced little by the temperature. The operational these amplifiers have breadth of area unity gain bandwidth 3MHz. A other important element for their choice is the big reject of noise, when this exists in the line of catering.

The price of reject is bigger than 80dB, their consumption is small, from 11 until 3 mA. They are internally sold in nutshell with eight pins and allocate two operational amplifiers, In the same line in nutshell 14 pins they incorporate four operational, In the trade they are sold with code TL074, TL084 and TL064, In nutshell with eight pins they are sold operational amplifiers TL061 TL071 kajTL081. In the manufacture we used the TL082 that has two operational. First operational from the TL082 it works as amplifier and mixed for the two channels, In his negative entry he exists one small mixed with two resistances. A potentiometer in this rung determines the aid of circuit. In the point this left winger and the right channel of preamplifier they are added means of two resistances. En continuity the operational strengthens signal with aid made dependent from the price that has the potentiometer.

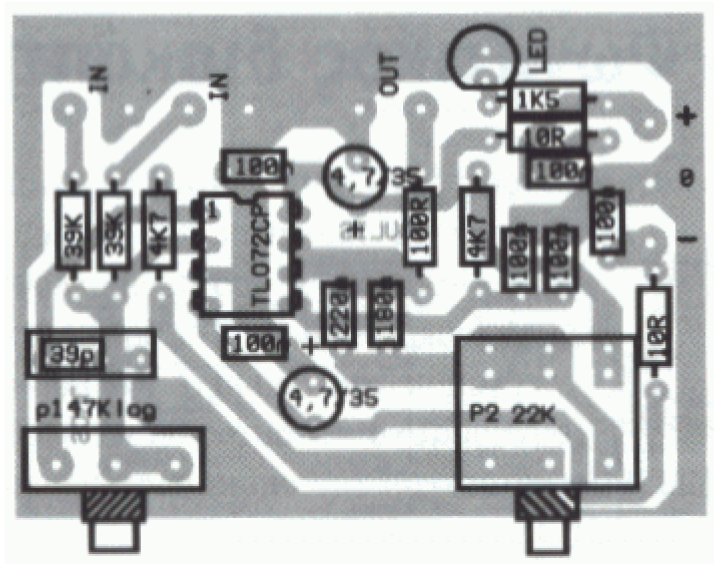
The place of runner is proportional with the aid of circuit. The second operational amplifier is the filter of manufacture. The filter of is acoustic frequency of second class and he is made with the materials that are round the operational amplifier. The filter of is low passage with variable frequency of cutting off. This frequency can be altered and take prices from very low frequency the 30Hz or still exceed 150Hz. The frequency of cutting off of filter depends from the prices that have the elements of circuit. Altering the values of elements we can have frequency of cutting off 150Iz, 130Iz, J00Iz, 7Ïz, 6Íz even 3Íz, this prices they can be achieved with the simple rotation of double potentiometer. The circuit of filter has been made around one operational' that it has completed TL082 that is double operational amplifier. In the exit of filter we will link the plug of expense where is connected the amplifier. In the exit of circuit is presented, the limited as for the breadth of frequencies, signal that we apply in the entry of circuit.

Manufacture

Parts
R1 = 39 Kohm
R2 = 39 Kohm
R3 = 47 Kohm
R4 = 10 Ohm
R5 = 22 Kohm
R6 = 4,7 Kohm
R7 = 22 Kohm
R8 = 4,7 Kohm
R9 = 10 Ohm
R10 = 220 Ohm
C1 = 39 pF
C2 = 0.1 uF
C3 = 0.1 uF
C4 = 0.2 uF
C5 = 0.4 uF
C6 = 0.1 uF
C7 = 0.1 uF
IC1 = TL064



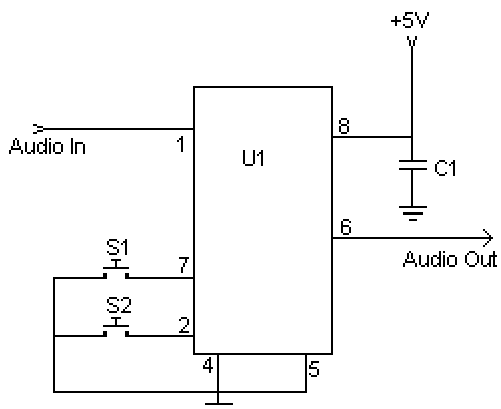
In order to you make the manufacture you will need printed that appears in the form. In this you will place the materials according to the following form. The materials are enough also easy can become certain errors. With few attention however you can him avoid. If they are presented difference malfunctions, you check carefully the circuit. The circuit, as we said, is filter and it should they are used materially good precision and quality, particularly for the capacitors. The capacitors of filters will have tolerance 5%. Of course, the manufacture will also work with material of lower quality, the trial of manufacture can become with acoustic signal of generator We apply the generator in the entry of manufacture and we measure with a voltmeter the tendency in the exit of filter. If we alter the potentiometer and are altered the tendency, then all have well.



P13. Simple Digital Volume Control

This digital volume control has no pot to wear out and introduces almost no noise in the circuit. Instead, the volume is controlled by pressing UP and DOWN buttons. This simple circuit would be a great touch to any home audio project.

Schematic:

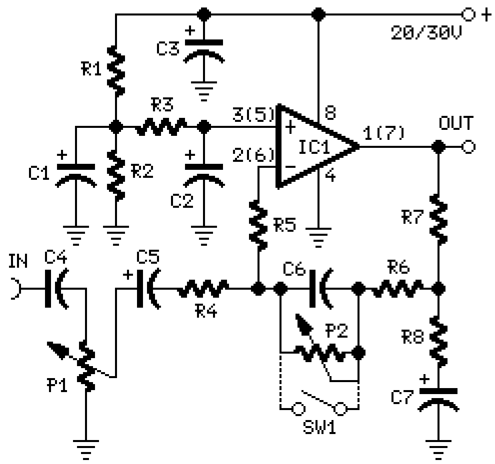


Parts:
C1 0.1uf Ceramic Disc Capacitor
U1 DS1669 Digital Pot IC (See Notes)
S1, S2 Momentary Push Button Switch
MISC Board, Wire, Socket For U1

Notes:
1. U1 is available from Dallas Semiconductor.
2. S1 turns the volume up, S2 turns it down.
3. The input signal should not fall below -0.2 volts.
4. Using a dual polariity power supply (+-5V works fine) will cure most clipping problems. You will have to check the data sheet for the correct pins to connect your voltages.

P14. Stereo Preamplifier with Bass-boost

circuit diagram:



Comments:
This preamplifier was designed to cope with CD players, tuners, tape recorders etc., providing a gain of 4, in order to drive less sensitive power amplifiers. As modern Hi-Fi home equipment is frequently fitted with small loudspeaker cabinets, the bass frequency range is rather sacrificed. This circuit features also a bass-boost, in order to overcome this problem. You can use a variable resistor to set the bass-boost from 0 to a maximum of +16dB @ 30Hz. If a fixed, maximum boost value is needed, the variable resistor can be omitted and substituted by a switch.

Notes:
Schematic shows left channel only, but R1, R2, R3 and C1, C2, C3 are common to both channels.
For stereo operation P1, P2 (or SW1), R4, R5, R6, R7, R8 and C4, C5, C6, C7 must be doubled.
Numbers in parentheses show IC1 right channel pin connections.

A log type for P2 ensures a more linear regulation of bass-boost.
Needing a simple boost-in boost-out operation, P2 must be omitted and SW1 added as shown in the diagram.

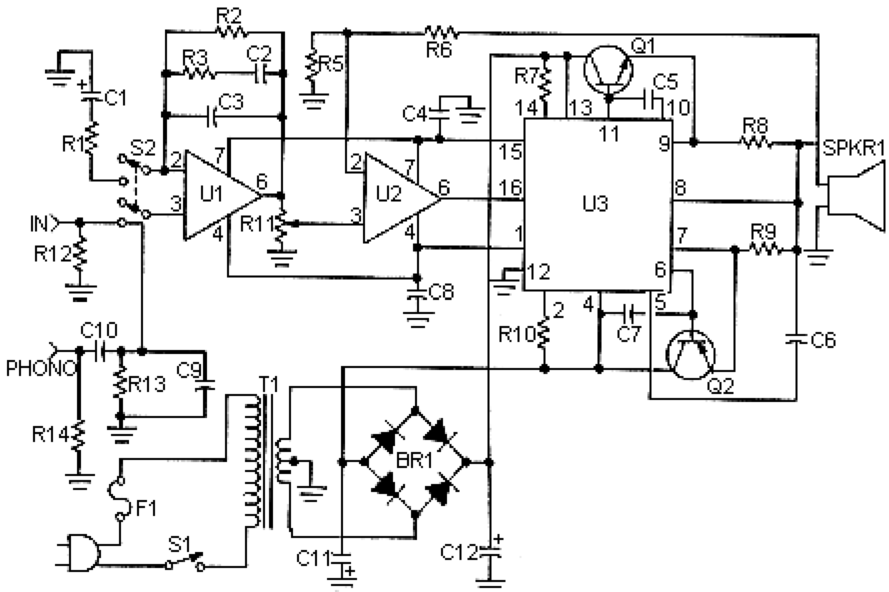
For stereo operation SW1 must be a DPST type.
Please note that, using SW1, the boost is on when the switch is open, and off when the switch is closed.

Technical data (30V supply):
Gain @ 1KHz: 4
Max. input voltage @ 50Hz: 500mV RMS (280mV RMS @ 20V supply)
Max. input voltage @ 100Hz: 700mV RMS (460mV RMS @ 20V supply)
Max. output voltage: >8V RMS (>5V RMS @ 20V supply)
Max. bass-boost referred to 1KHz: 400Hz = +2dB; 200Hz = +5dB; 100Hz = +10dB; 50Hz = +14dB; 30Hz = +16dB
Total harmonic distortion @ 100Hz and 1V RMS output: 0.02%
Total harmonic distortion @ 1KHz and 1V RMS output: 0.006%
Total harmonic distortion @10KHz and 1V RMS output: 0.007%
Total harmonic distortion @ 100Hz and 5V RMS output: 0.02%
Total harmonic distortion @ 1KHz and 5V RMS output: 0.0013%
Total harmonic distortion @10KHz and 5V RMS output: 0.005%
Current drawing: 2mA

P15. 50 Watt Amplifier

This is a handy, easy to build general purpose 50 watt amp. The amp has an input for a radio, TV, stereo or other line level device. It also has a phono input for a record player, guitar, microphone or other un-amplified source. With the addition of a low pass filter at the input, it makes a great amp for a small subwoofer.

circuit diagram



parts
R1 200 Ohm 1/4 W Resistor
R2 200K 1/4 W Resistor
R3 30K 1/4 W Resistor
R5 1K 1/4 W Resistor
R6 5K 1/4 W Resistor
R7,R10 1 Meg (5%) 1/2 W Resistor
R8,R9 0.4 Ohm 5 W Resistor
R11 10K Pot
R12,R13 51K 1/4 W Resistor
R14 47K 1/4 W Resistor
C1 100uF 35V Electrolytic Capacitor
C2 0.011uF Capacitor
C3 3750pF Capacitor
C4,C6 1000pF Capacitor
C5,C7,C8 0.001uF Capacitor
C9 50pF Capacitor
C10 0.3uF Capacitor
C11,C12 10,000uF 50V Electrolytic Capacitor
U1,U2 741 Op Amp
U3 ICL8063 Audio Amp Transister Driver thingy
Q1 2N3055 NPN Power Transistor
Q2 2N3791 PNP Power Transistor

notes
1. I know I skipped R4. That is not a problem :-)
2. Distortion is less than 0.1% up to 100HZ and increases to about 1% at 20kHz.
3. I haven't been able to find anyone who sells a suitable T1. You can always use two 24V 5A units in series. If you are building two amps (for stereo), then I would suggest using an old microwave transformer and rewinding it.
4. Q1 and Q2 will require heatsinks.
5. You may have trouble finding U3 because it is discontinued.

P16. Amplifier 2x30W with STK465

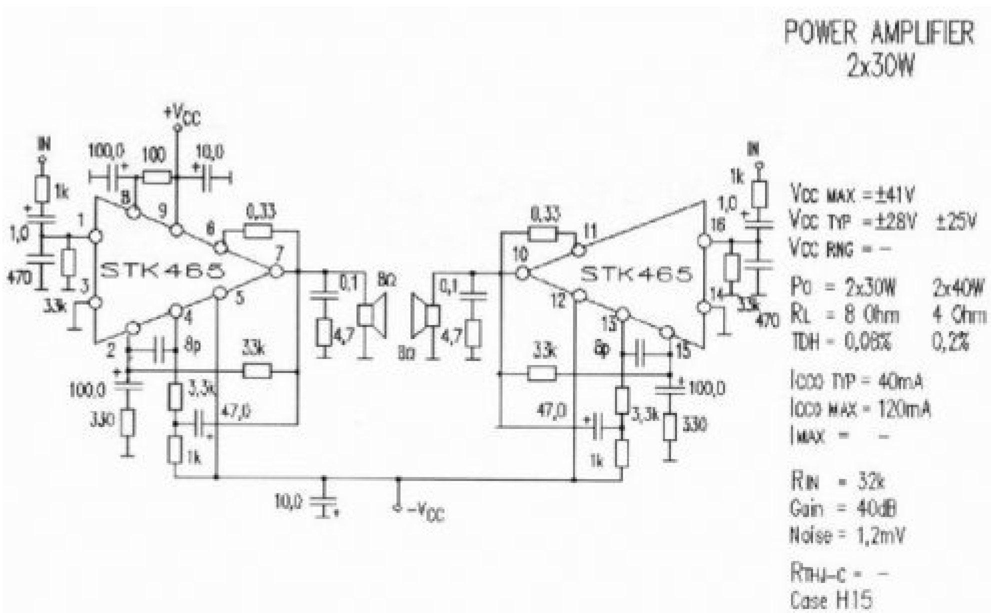
A amplifier of acoustic frequencies can be manufactured with discernible materials, despite is known so much the difficulties of finding of materials, what the problem of regulations. These difficulties are overcome relatively easily if we find amplifier in form completed.

Completed STK465 is an amplifier of acoustic frequencies that offers qualitative output, using minimal exterior elements. Substantially he is one of big completed force. Has a line pins and incorporated metal surface for adaptation in cooler. The provision pins in a line, facilitates the placement completed in the end printed and his support in cooler. The circuit functions in a big range of benefits of catering, from 20V as 60V, and it attributes 30WRMS, when the tendency of catering is above 50V and composer resistance of loudspeaker is the 4 or 8 Ohm. The catering should be symmetrically.

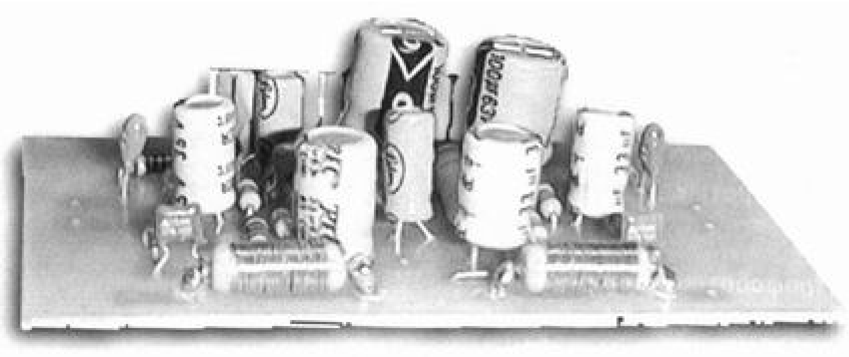
When it functions with tendency 56V then the tendency will be ± 28V as for the ground. With this recommended tendency of catering, the attributed force is 30 WRMS in charge 8W. The price of deformity is acceptable and oscillates around in the 0,08% for force of expense from 1W until 30W. Curve response his it is extended from 10Hz and reaches 100 KHz, with divergence 0dB and -3dB respectively, measured in force 1W. Using evolved techniques, completed amplifier STK465, can minimise the deformities even in highest levels of force. Other characteristically that determines the completed circuit they are: the wide area and the high aid.

Schematic
STK465 is drawn to be constant, when it functions in conjunction closed bronchi with big gain. As all the amplifiers, thus and this, under certain unfavourable conditions, can turn in oscillations. These oscillations have as result of returning in the same phase from the exit in the entry, or from bad designing PCB, or

from bad choice of corridors in the circuits of entry. When you draw a printed circuit, it is important to return the current of charge and the current of signal of entry in the ground, via different corridors. Generally, positive is the charge it is connected directly in pin the catering and in particular in common pin electrolytic the catering. If entry and charge are connected directly in the 0V via the same road, then are created retroactions, what have as consequence oscillations and the deformity. To you we propose maintaining as much as possible smaller the cables of ground 0V and the capacitors of unharnessing, so that are limited the results of self-induction and resistance of lines of copper PCB. Sometimes the oscillation is owed in big length drivers between entry and expense, particularly if these have big length and the complex resistance of source are high. Can anticipate the oscillation that is owed in long wirings, adding capacitor from 50 - 500pf between pins entry. For the low deformity, important role plays also the placement of conductors of catering. This should be kept as much as possible more far from the wiring of entry, so that is deterred thus the not linear catering in the entry of IC. STK 465 does not have system of thermal protection, so that are avoided the thermal elations. If the temperature of JC reaches in high price, then the amplifier changes the polarisation of rung of expense. If the temperature is increased, then in order to is ensured the operation it should you grow cooler. The amplifier functions with catering of double polarity. In form 1 we see the electronic circuit of amplifier that Is based on the STK 465.

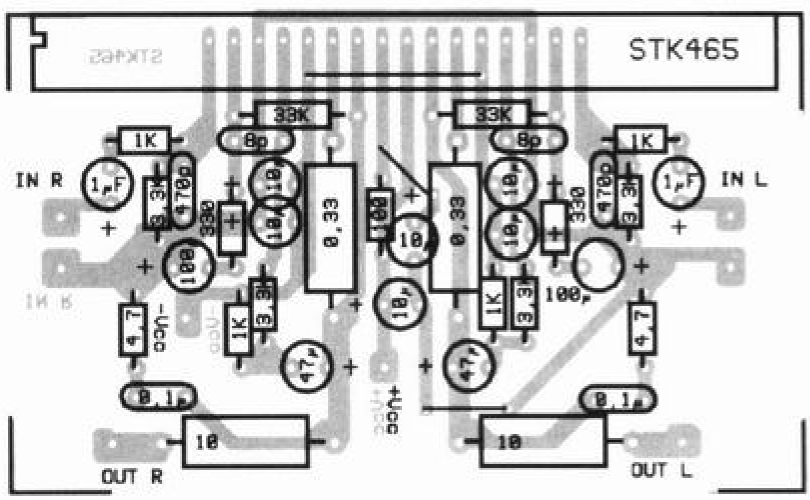


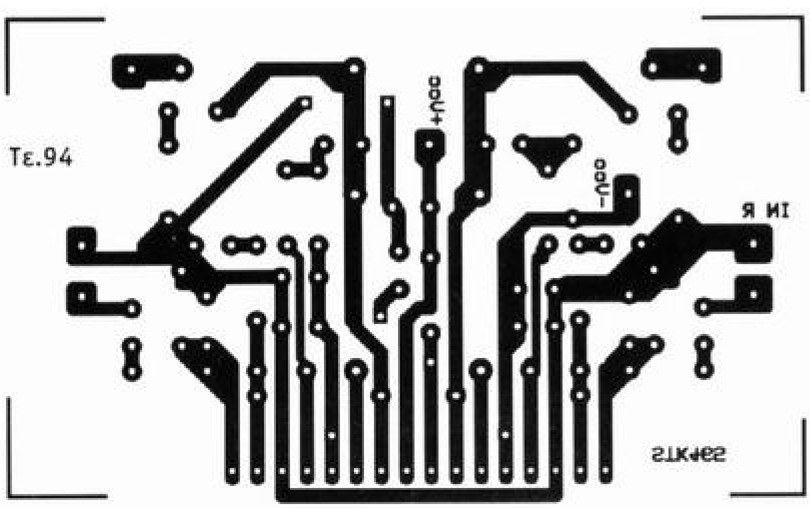
The circuit is stereo and has two channels of amplifier in a nutshell. It is a formal designing that develops positively all the particularities completing. Concretely, we observe that the not inverting entry completed (pins 2 and 15, for each channel), is supplied from divider of tendency, which ensures tendency from the tendency of expense completing. At the same time with the entry in each channel, exists a capacitor 470rF, which achieves the unharnessing, in that it concerns the AC components of high frequency, while en line a capacitor 1mF allows in the amplifier to be supplied from desirable flourish acoustic frequencies, fence simultaneous the continuous component. Bronchi unharnessing it is realised with the help of networking of two resistances 33KW and 330W and a capacitor 100mF, which finally ensures factor of aid equal with 100. Finally, at the same time with the exit exists networking RC (0,1mF - 4,7 Ohm) that it attends to the minimisation of phenomenon crossover. The amplifier can be supplied from a line of double polarity. Still it can function under a wide region of tendencies (±10V as ±28V). The requirements of current depend from the force of expense and it can they begin from 120mA up to 1A. It is very important the catering to be sufficiently unharnessing, so that is avoided imports of annoying noises.



The manufacture by Soylis Papanastasioy

For the realisation of manufacture you are consulted the forms 2 and 3 that portray the PCB and placement of materials in this. Does not exist a dangerous element in the manufacture that it should him you are careful particularly, so much at the soldering, what at the use. Be careful the electrolytic capacitors, the placement cooler completed and naturally the polarity of lines of catering. One still directive in what it concerns the catering: good it is it is used power supply with big capacitors standardisation or still better stabilised.



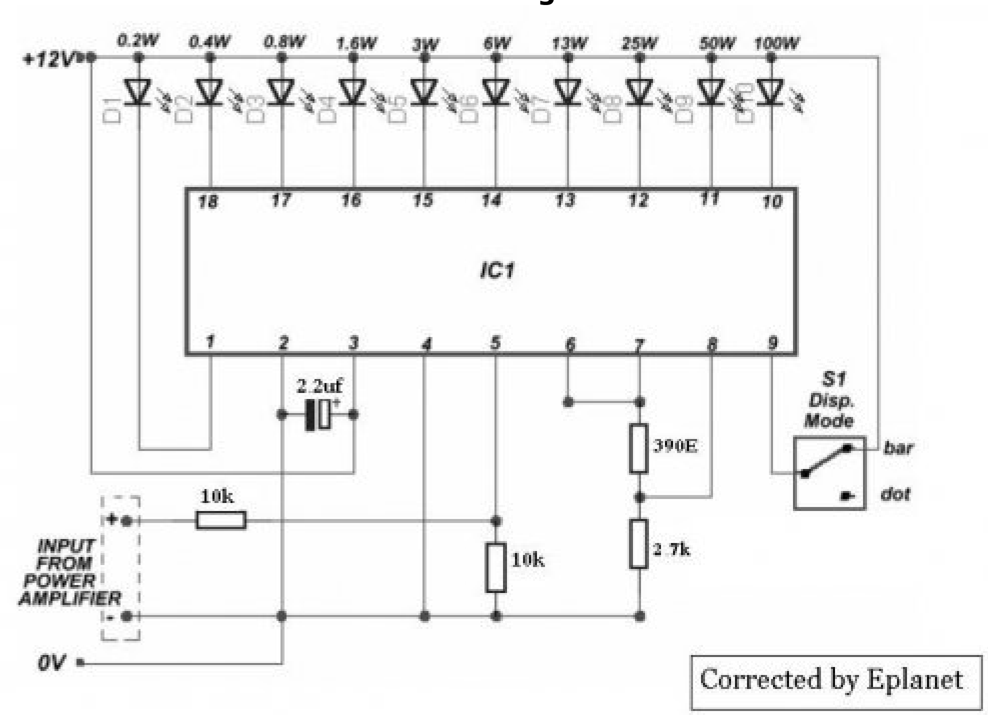


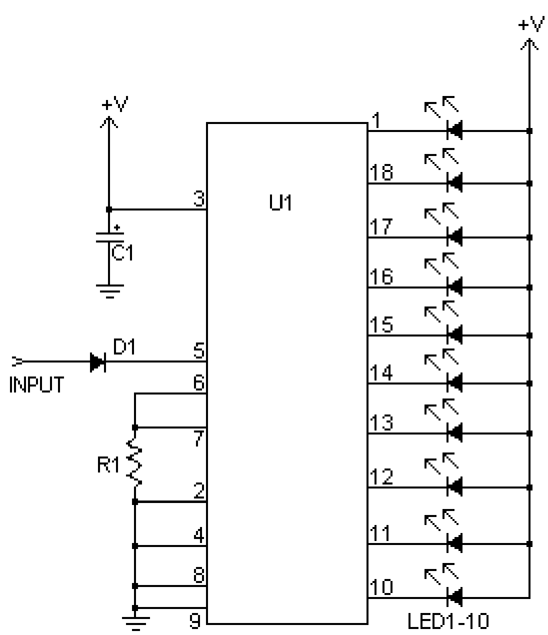
parts
R1 = 1K
C1 = 1uF/35V
R2 = 3,3K
C2 = 470pF
R3 = 100
C3 = 100uF/60V
R4 = 330
C4 = 100uF/60V
R5 = 3,3K
C5 = 10uF/60V
R6 = 1K
C6 = 47uF/60V
R7 = 0,33
C7 = 8,2pF
R8 = 33k
C8 = 0,1uF
R9 = 4,7
C9 = 1uF/35V
R10 = 1k
C10 = 470pF
R11 = 3,3k
C11 = 100uF/60V
R12 = 100
C12 = 100uF/60V
R13 = 330
C13 = 10uF/60V
R14 = 3,3k
C14 = 47uF/60V
R15 = 1k
C15 = 8,2pF
R16 = 0,33
C16 = 0,1uF
R17 = 33k
R18 = 4,7
IC1 = STK465
LS1 = Speaker 40W 8 or 4 Ohm

P17. Sound Level Meter

This nifty sound level meter is a perfect one chip replacement for the standard analog meters. It is completely solid state and will never wear out. The whole circuit is based on the LM3915 audio level IC and uses only a few external components.

Circuit diagram





Original Schematic

Parts
C1 2.2uF 25V Electrolytic Capacitor
R1 1K 1/4W Resistor
D1 1N4002 Silicon Diode
LED1-LED10 Standard LED or LED Array
U1 LM3915 Audio Level IC
MISC Board, Wire, Socket For U1

Notes
1. V+ can be anywhere from 3V to 20V.
2. The input is designed for standard audio line voltage (1V P-P) and has a maximum input voltage of 1.3V.
3. Pin 9 can be disconnected from ground to make the circuit use a moving dot display instead of a bar graph display.

P18. Portable Mixer

High-quality modular design. 9V Battery powered - Very low current drawing.

Design description:

The target of this project was the design of a small portable mixer supplied by a 9V PP3 battery, keeping high quality performance.

The mixer is formed assembling three main modules that can be varied in number and/or disposition to suit everyone needs.

The three main modules are:

Input Amplifier Module: a low noise circuit equipped with a variable voltage-gain (10 - 100) pre-set, primarily intended as high quality microphone input, also suitable for low-level line input.

Tone Control Module: a three-band (Bass, Middle, Treble) tone control circuit providing unity-gain when its controls are set to flat frequency response. It can be inserted after one or more Input Amplifier Modules and/or after the Main Mixer Amplifiers.

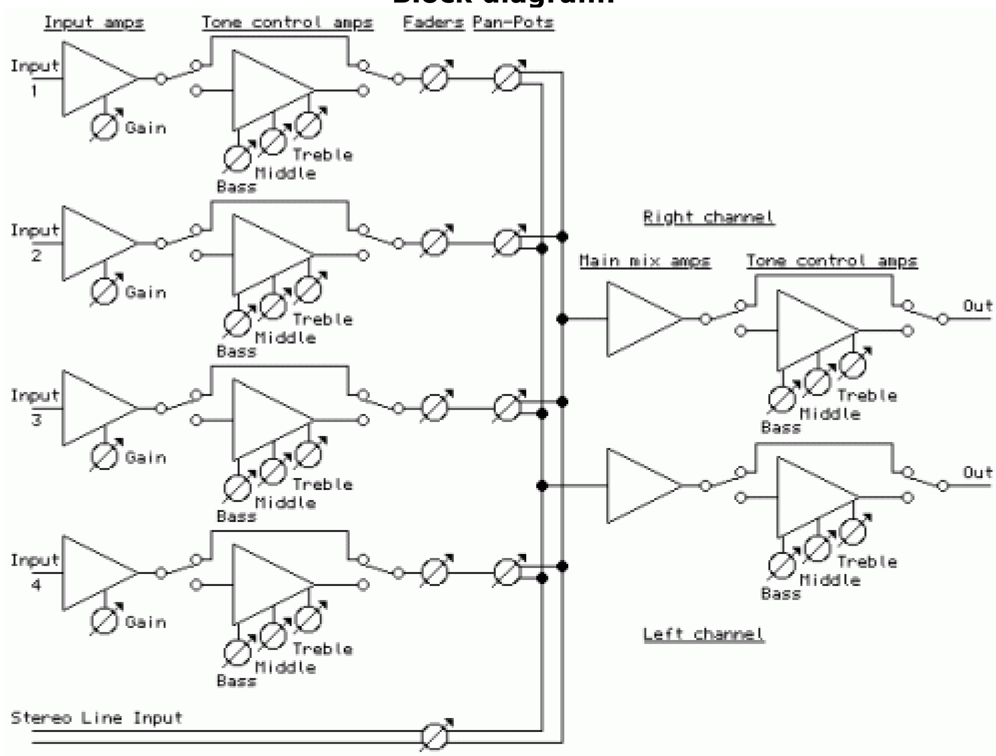
Main Mixer Amplifier Module: a stereo circuit incorporating two virtual-earth mixers andshowing the connection of one Main Fader and one Pan-Pot.

The image below shows a Block diagram of the entire mixer featuring four Input Amplifier Modules followed by four in-out switchable Tone Control Modules, one stereo Line input, four mono Main Faders, one stereo dual-ganged Main Fader, four Pan-Pots, a stereo Main Mixer Amplifier Module and two further Tone Control Modules switchable in and out for each channel, inserted before the main Left and Right outputs.

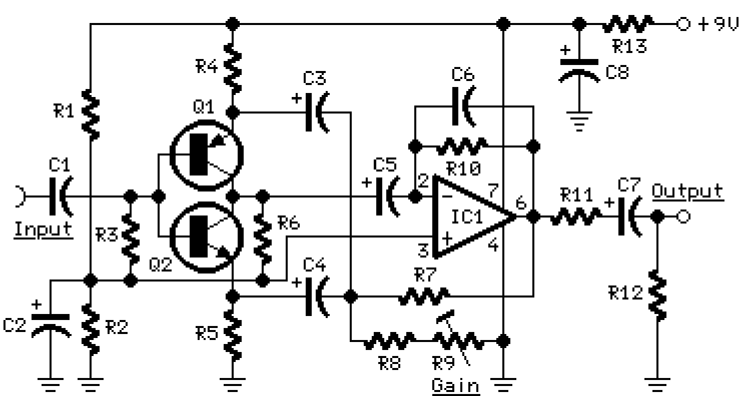
Obviously this layout can be rearranged at everyone wish.

An astonishing feature of this design lies in the fact that a complete stereo mixer as shown below in the Block diagram draws less than 6mA current!

Block diagram:



Input Amplifier Module



Parts:
R1,R2,R7 22K 1/4W Resistors
R3,R4,R5 47K 1/4W Resistors
R6 4K7 1/4W Resistor
R8,R13 220R 1/4W Resistors
R9 2K 1/2W Trimmer Cermet (See Notes)
R10 470K 1/4W Resistor
R11 560R 1/4W Resistor
R12 100K 1/4W Resistor
C1 470nF 63V Polyester Capacitor
C2,C8 100uF 25V Electrolytic Capacitors
C3,C4,C5 2u2 63V Electrolytic Capacitors
C6 47pF 63V Ceramic Capacitor
C7 4u7 63V Electrolytic Capacitor
Q1 BC560C 45V 100mA Low noise High gain PNP Transistor

Q2 BC550C 45V 100mA Low noise High gain NPN Transistor
IC1 TL061 Low current BIFET Op-Amp

Circuit description:

The basic arrangement of this circuit is derived from the old Quad magnetic pick-up cartridge module.
The circuit was rearranged to cope with microphone input and a single-rail low voltage supply.
This low-noise, fully symmetrical, two-transistor head amplifier layout, allows the use of a normal FET input Op-Amp as the second gain stage, even for very sensitive microphone inputs.
The voltage-gain of this amplifier can be varied by means of R9 from 10 to 100, i.e. 20 to 40dB.

Notes:
R9 can be a trimmer, a linear potentiometer or a fixed-value resistor at will.
When voltage-gain is set to 10, the amplifier can cope with 800mV peak-to-peak maximum Line levels.
Current drawing for one Input Amplifier Module is 600uA.

Frequency response is 20Hz to 20KHz - 0.5dB.

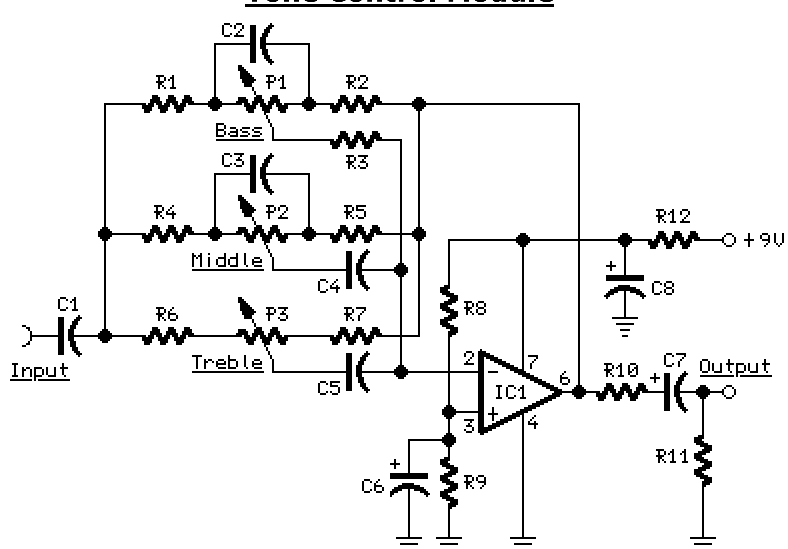
Total Harmonic Distortion measured with voltage-gain set to 100: 2V RMS output = < 0.02% @ 1KHz; < 0.04% @ 10KHz.

Total Harmonic Distortion measured with voltage-gain set to 10 & 33: 2V RMS output = < 0.02% @ 1KHz & 10KHz.

THD is much lower @ 1V RMS output.

Maximum undistorted output voltage: 2.8V RMS.

Tone Control Module



Parts:
P1,P2 100K Linear Potentiometers
P3 470K Linear Potentiometer
R1,R2,R3 12K 1/4W Resistors
R4,R5 3K9 1/4W Resistors
R6,R7 1K8 1/4W Resistors
R8,R9 22K 1/4W Resistors

R10 560R 1/4W Resistor
R11 100K 1/4W Resistor
R12 220R 1/4W Resistor
C1 1uF 63V Polyester Capacitor
C2 47nF 63V Polyester Capacitor
C3,C5 4n7 63V Polyester Capacitors
C4 22nF 63V Polyester Capacitor
C6,C8 100uF 25V Electrolytic Capacitors
C7 4u7 63V Electrolytic Capacitor
IC1 TL061 Low current BIFET Op-Amp

Circuit description:

This is a straightforward design using the Baxandall-type active circuitry slightly modified to obtain a three-band control. Total voltage gain of this module is 1 when controls are set in their center position.

Notes:

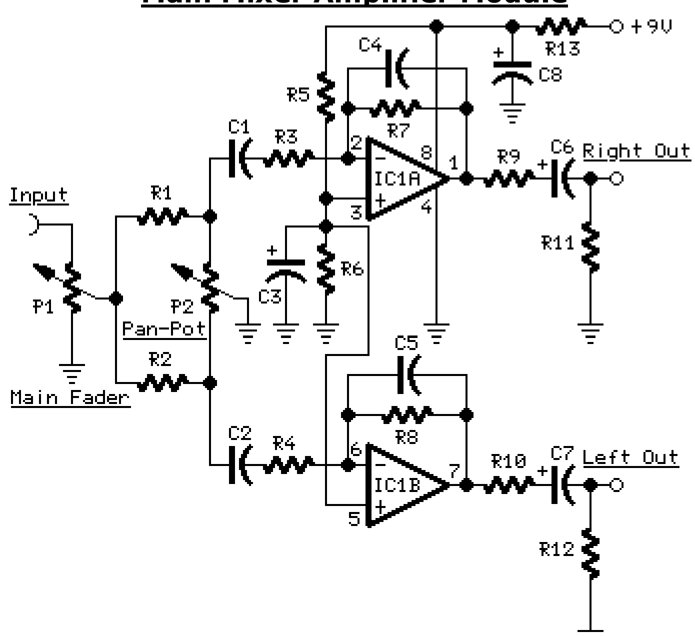
Current drawing for one Tone Control Module is 400uA.

Frequency response is 20Hz to 20KHz - 0.5dB, controls flat.

Tone control frequency range: ± 15dB @ 30Hz; ± 19dB @ 1KHz; ± 16dB @ 10KHz.
Total Harmonic Distortion measured @ 2V RMS output = < 0.012% @ 1KHz; < 0.03% @ 10KHz.
HD is below 0.01% @ 1V RMS output.

Maximum undistorted output voltage: 2.5V RMS.

Main Mixer Amplifier Module



Parts:
P1 100K Linear Potentiometer
P2 10K Linear Potentiometer
R1,R2 15K 1/4W Resistors
R3,R4,R11,R12_100K 1/4W Resistors

R5,R6 22K 1/4W Resistors
R7,R8 390K 1/4W Resistors
R9,R10 560R 1/4W Resistors
R13 220R 1/4W Resistor
C1,C2 330nF 63V Polyester Capacitors
C3,C8 100uF 25V Electrolytic Capacitors
C4,C5 10pF 63V Ceramic Capacitors
C6,C7 4u7 63V Electrolytic Capacitors
IC1 TL062 Low current BIFET Dual Op-Amp

Circuit description:

The schematic of this circuit is drawn as a stereo unit to better show the input Main Fader and Pan-Pot connections. The TL062 chip contains two TL061 in the same 8 pin case and is wired as two virtual-earth mixer amplifiers having a voltage gain of about 4, to compensate for losses introduced in the passive Pan-Pot circuitry. Therefore, total voltage-gain is 1.

Each channel added to the mixer must include the following additional parts:

P1, P2, R1, R2, R3, R4, C1 and C2.

These parts must be wired as shown in the above circuit diagram, connecting R3 and R4 to pin #2 and pin #6 of IC1 for Right and Left channel respectively. These IC1 pins are the "virtual-earth mixing points" and can sum together a great number of channels.

Notes:

Current drawing for one stereo Main Mixer Amplifier Module is 800uA.

Frequency response is 20Hz to 20KHz - 0.5dB.

Total Harmonic Distortion measured @ 2V RMS output = < 0.008% @ 1KHz; < 0.017% @ 10KHz.
THD is 0.005% @ 1V RMS output.

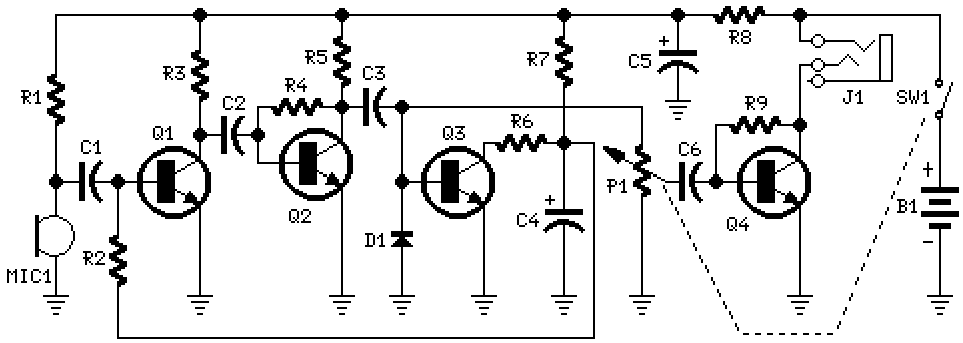
Maximum undistorted output voltage: 2.8V RMS.

Further Parts:

To parts listed above should be added: one Main on-off SPST switch, a LED used as pilot-light with its dropping 2K2 1/4W series-resistor, DPDT switches to enable or omit Tone Control Modules as shown in the Block diagram, input and output connectors of the type preferred, one stereo dual-gang 100K potentiometer to fade the Stereo Line Input as shown in the Block diagram, battery clip, PP3 9V battery, knobs etc.

P19. Amplified Ear

circuit diagram



Parts:
P1 22K Log. Potentiometer (see Notes)
R1,R9 10K 1/4W Resistors
R2 1M 1/4W Resistor
R3 4K7 1/4W Resistor
R4,R7 100K 1/4W Resistor
R5 3K9 1/4W Resistor
R6 1K5 1/4W Resistor
R8 100R 1/4W Resistor
C1,C2 100nF 63V Polyester or Ceramic Capacitors
C3,C6 1uF 63V Polyester or Ceramic Capacitors
C4 10uF 25V Electrolytic Capacitor
C5 470uF 25V Electrolytic Capacitor
D1 1N4148 75V 150mA Diode
Q1,Q2,Q3 BC547 45V 100mA NPN Transistors
Q4 BC337 45V 800mA NPN Transistor
MIC1 Miniature electret microphone
SW1 SPST Switch (Ganged with P1)
J1 Stereo 3mm. Jack socket
B1 1.5V Battery (AA or AAA cell etc.)

Device purpose:

This circuit, connected with 32 Ohms impedance mini-earphones, can detect very remote sounds. Useful for theatre, cinema and lecture goers: every word will be clearly heard. You can also listen to your television set at a very low volume, avoiding to bother relatives and neighbours. Even if you have a faultless hearing, you may discover unexpected sounds using this device: a remote bird twittering will seem very close to you.

Circuit operation:

The heart of the circuit is a constant-volume control amplifier. All the signals picked-up by the microphone are amplified at a constant level of about 1 Volt peak to peak. In this manner very low amplitude audio signals are highly amplified and high amplitude ones are limited. This operation is accomplished by Q3, modifying the bias of Q1 (hence its AC gain) by means of R2.

A noteworthy feature of this circuit is 1.5V battery operation.

Typical current drawing: 7.5mA.

Notes:
Due to the constant-volume control, some users may consider P1 volume control unnecessary. In most cases it can be omitted, connecting C6 to C3. In this case use a SPST slider or toggle switch as SW1.

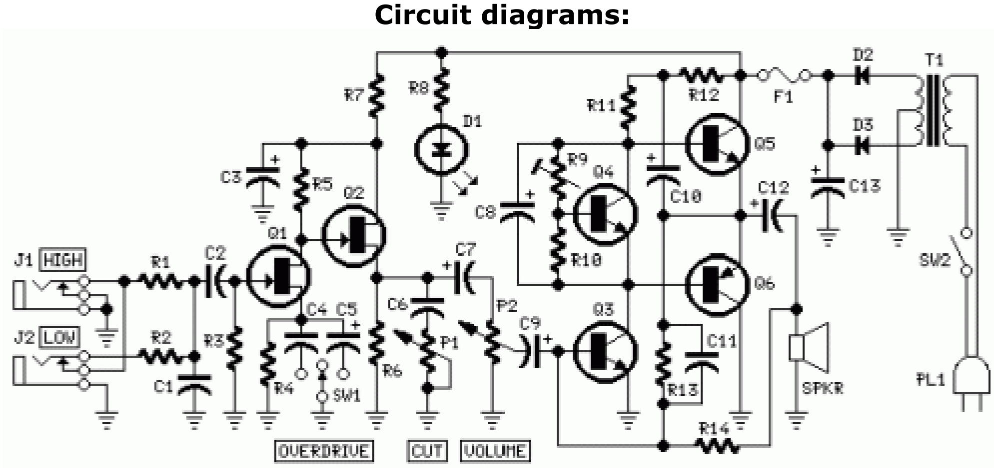
Note the stereo output Jack socket (J1) connections: only the two inner connections are used, leaving open the external one. In this manner the two earpieces are wired in series, allowing mono operation and optimum load impedance to Q4 (64 Ohms).

Using suitable miniature components, this circuit can be enclosed in a very small box, provided by a clip and hanged on one's clothes or slipped in a pocket.

P20. Guitar Amplifier

10W Old-Style ultra-compact Combo
Two inputs - Overdrive - Treble-enhancement

Circuit diagrams:



Parts:
P1 4K7 Linear Potentiometer
P2 10K Log. Potentiometer
R1,R2 68K 1/4W Resistors
R3 220K 1/4W Resistor
R4,R6,R11 4K7 1/4W Resistors
R5 27K 1/4W Resistor
R7 1K 1/4W Resistor
R8 3K3 1/2W Resistor
R9 2K 1/2W Trimmer Cermet
R10 470R 1/4W Resistor
R12 1K5 1/4W Resistor

R13 470K 1/4W Resistor
R14 33K 1/4W Resistor
C1 100pF 63V Ceramic Capacitor
C2 100nF 63V Polyester Capacitor
C3 470µF 35V Electrolytic Capacitor
C4 220nF 63V Polyester Capacitor (Optional, see Notes)
C5 47µF 25V Electrolytic Capacitor (Optional, see Notes)
C6 1µF 63V Polyester Capacitor
C7,C8,C9,C10 47µF 25V Electrolytic Capacitors
C11 47pF 63V Ceramic Capacitor
C12 1000µF 35V Electrolytic Capacitor
C13 2200µF 35V Electrolytic Capacitor
D1 5mm. Red LED
D2,D3 1N4004 400V 1A Diodes
Q1,Q2 2N3819 General-purpose N-Channel FETs
Q3 BC182 50V 200mA NPN Transistor
Q4 BD135 45V 1.5A NPN Transistor (See Notes)
Q5 BDX53A 60V 8A NPN Darlington Transistor
Q6 BDX54A 60V 8A PNP Darlington Transistor
J1,J2 6.3mm. Mono Jack sockets
SW1 1 pole 3 ways rotary switch (Optional, see Notes)
SW2 SPST Mains switch
F1 1.6A Fuse with socket
T1 220V Primary, 48V Center-tapped Secondary 20 to 30VA Mains transformer
PL1 Male Mains plug
SPKR One or more speakers wired in series or in parallel. Total resulting impedance: 8 or 4 Ohm. Minimum power handling: 20W

Circuit description:

The aim of this design is to reproduce a Combo amplifier of the type very common in the 'sixties and the 'seventies of the past century. It is well suited as a guitar amplifier but it will do a good job with any kind of electronic musical instrument or microphone.

5W power output was a common feature of these widespread devices due to the general adoption of a class A single-tube output stage (see the Vox AC-4 model).

Furthermore, nowadays we can do without the old-fashioned Vib-Trem feature frequently included in those designs.

The present circuit can deliver 10W of output power when driving an 8 Ohm load, or about 18W @ 4 Ohm.

It also features a two-FET preamplifier, two inputs with different sensitivity, a treble-cut control and an optional switch allowing overdrive or powerful treble-enhancement.

Technical data are quite impressive for so simple a design:

Sensitivity: 30mV input for 10W output

Frequency response: 40 to 20KHz -1Db

Total harmonic distortion @ 1KHz and 10KHz, 8 Ohm load: below 0.05% @ 1W, 0.08% @ 3.5W, 0.15% at the onset of clipping (about 10W).

Notes:
SW1 and related capacitors C4 & C5 are optional.
When SW1 slider is connected to C5 the overdrive feature is enabled.
When SW1 slider is connected to C4 the treble-enhancer is enabled.
C4 value can be varied from 100nF to 470nF to suit your treble-enhancement needs.

In all cases where Darlington transistors are used as the output devices it is essential that the sensing transistor (Q4) should be in as close thermal contact with the output transistors as possible. Therefore a TO126-case transistor type was chosen for easy bolting on the heatsink, very close to the output pair.

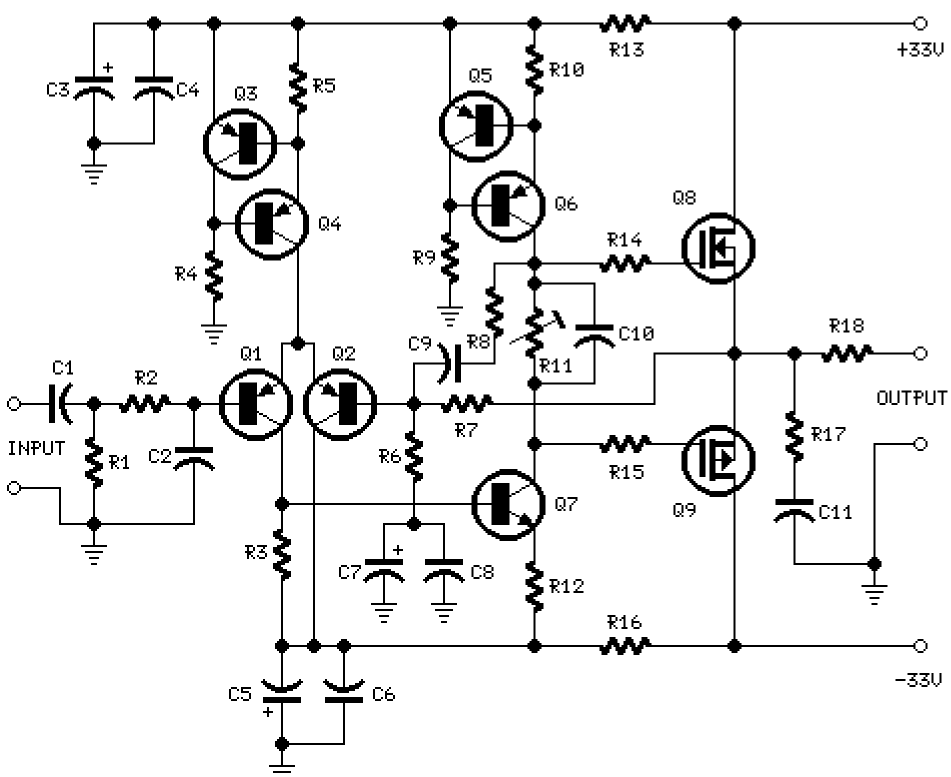
To set quiescent current, remove temporarily the Fuse F1 and insert the probes of an Avo-meter in the two leads of the fuse holder.

Set the volume control to the minimum and Trimmer R9 to its minimum resistance.
Power-on the circuit and adjust R9 to read a current drawing of about 25 to 30mA.
Wait about 15 minutes, watch if the current is varying and readjust if necessary.

P21. 25W Mosfet audio amplifier

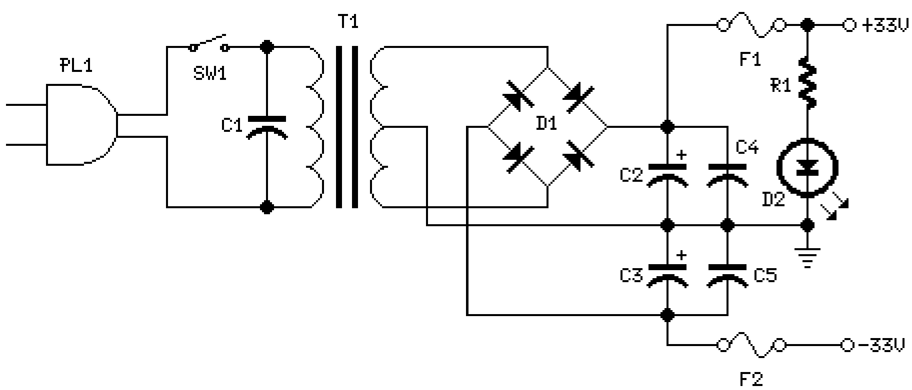
High Quality simple unit
No need for a preamplifier

circuit diagram



Parts:
R1,R4 = 47K 1/4W Resistors
R2 = 4K7 1/4W Resistors
R3 = 1K5 1/4W Resistors
R5 = 390R 1/4W Resistors
R6 = 470R 1/4W Resistors
R7 = 33K 1/4W Resistors
R8 = 150K 1/4W Resistors
R9 = 15K 1/4W Resistors
R10 = 27R 1/4W Resistors
R11 = 500R 1/2W Trimmer Cermet
R12,R13,R16 = 10R 1/4W Resistors
R14,R15 = 220R 1/4W Resistors
R17 = 8R2 2W Resistor
R18 = R22 4W Resistor (wirewound)
C1 = 470nF 63V Polyester Capacitor
C2 = 330pF 63V Polystyrene Capacitor
C3,C5 = 470uF 63V Electrolytic Capacitors
C4,C6,C8,C11 = 100nF 63V Polyester Capacitors
C7 = 100uF 25V Electrolytic Capacitor
C9 = 10pF 63V Polystyrene Capacitor
C10 = 1uF 63V Polyester Capacitor
Q1-Q5 = BC560C 45V100mA Low noise High gain PNP Transistors
Q6 = BD140 80V 1.5A PNP Transistor
Q7 = BD139 80V 1.5A NPN Transistor
Q8 = IRF532 100V 12A N-Channel Hexfet Transistor
Q9 = IRF9532 100V 10A P-Channel Hexfet Transistor

Power supply circuit diagram:



Parts:
R1 = 3K3 1/2W Resistor
C1 = 10nF 1000V Polyester Capacitor
C2,C3 = 4700u901;F 50V Electrolytic Capacitors
C4,C5 = 100nF 63V Polyester Capacitors
D1 200V 8A Diode bridge
D2 5mm. Red LED
F1,F2 3.15A Fuses with sockets
T1 220V Primary, 25 + 25V Secondary 120VA Mains transformer
PL1 Male Mains plug
SW1 SPST Mains switch

Notes:
Can be directly connected to CD players, tuners and tape recorders. Simply add a 10K Log potentiometer (dual gang for stereo) and a switch to cope with the various sources you need.

Q6 & Q7 must have a small U-shaped heatsink.
Q8 & Q9 must be mounted on heatsink.

Adjust R11 to set quiescent current at 100mA (best measured with an Avo-meter in series with Q8 Drain) with no input signal.

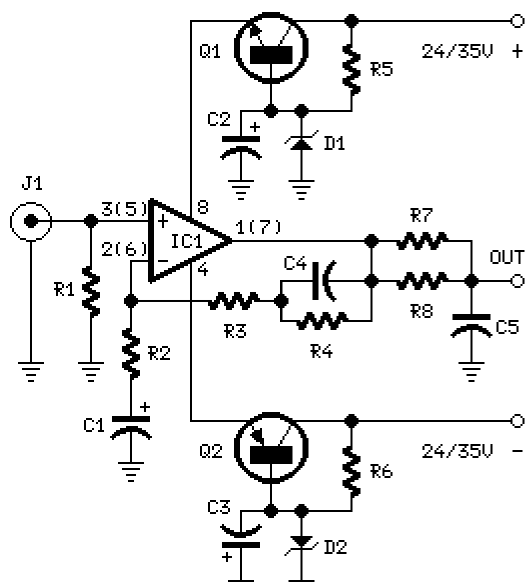
A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of R1, R4, R9, C3 to C8. Connect C11 at output ground. Then connect separately the input and output grounds at power supply ground.

Technical data:
Output power: well in excess of 25Watt RMS @ 8 Ohm (1KHz sinewave)
Sensitivity: 200mV input for 25W output
Frequency response: 30Hz to 20KHz -1dB
Total harmonic distortion @ 1KHz: 0.1W 0.014% 1W 0.006% 10W 0.006% 20W 0.007% 25W 0.01%
Total harmonic distortion @10KHz: 0.1W 0.024% 1W 0.016% 10W 0.02% 20W 0.045% 25W 0.07%

Unconditionally stable on capacitive loads

P22. Phono Preamplifier

circuit diagram



Parts:
R1 47K 1/4W Resistor
R2 100R 1/4W Resistor
R3 6K8 1/4W Resistor
R4 68K 1/4W Resistor
R5,R6 2K7 1/4W Resistor

R7 2K2 1/4W Resistor
R8 39K 1/4W Resistor
C1-C3 100uF 25V Electrolytic Capacitors
C4,C5 47nF 63V Polyester Capacitors 5% tolerance
D1,D2 BZX79C18 18V 500mW Zener Diodes
IC1 LM833 Low noise Dual Op-amp
Q1 BC337 45V 800mA NPN Transistor
Q2 BC327 45V 800mA PNP Transistor
J1 RCA audio input socket

Comments:
In recent years, following CD's introduction, vinyl recordings are almost disappeared. Nevertheless, a phono preamplifier is still useful for listening old vinyl discs from a well preserved collection. This simple but efficient circuit devised for cheap moving-magnet cartridges, can be used in connection with both audio power amplifiers shown in preceding pages, featuring low noise, good RIAA frequency response curve, low distortion and good high frequency transients behaviour due to passive equalization in the 1 to 20KHz range. Transistors and associated components provide ± 18V supply to the op-amp, improving headroom and maximum output voltage.

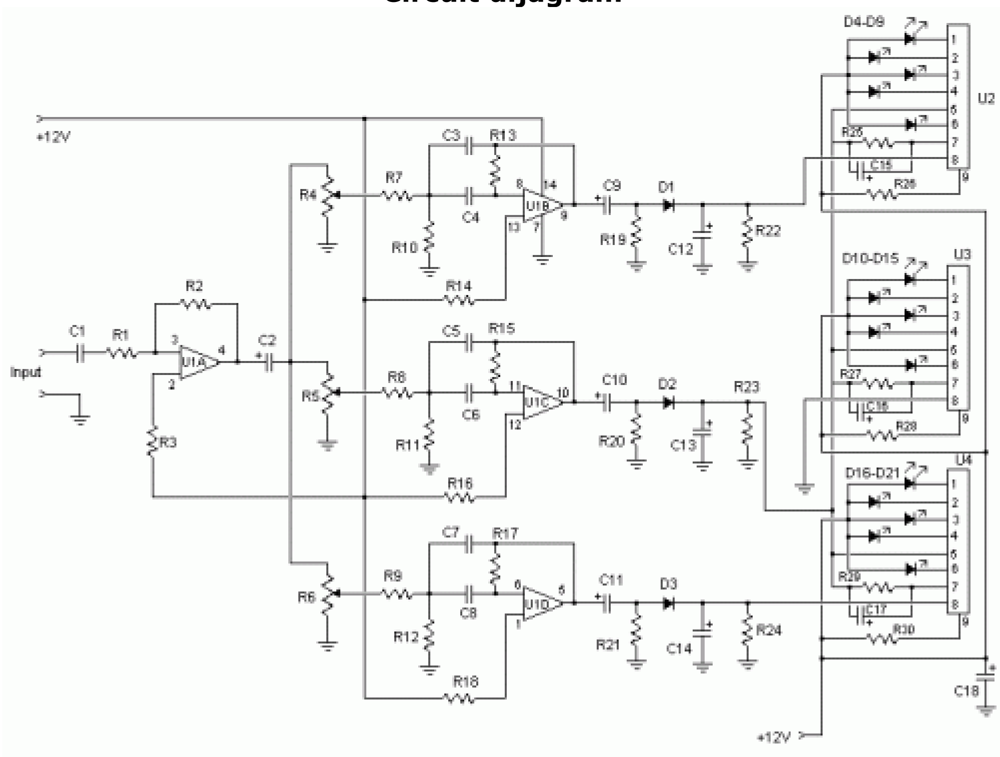
Notes:
R2, R3, R4, R7, R8, C4 & C5 should be low tolerance types.
Schematic shows left channel and power supply.
For stereo operation R1, R2, R3, R4, R7, R8; J1; C1, C4 & C5 must be doubled.
Numbers in parentheses show IC1 right channel pin connections.

Technical data:
Sensitivity @ 1KHz: 2.5mV RMS input for 200mV RMS output
Max. input voltage @ 1KHz: 120mV RMS
Max. input voltage @ 10KHz: 141mV RMS
Max. input voltage @ 20KHz: 127mV RMS
Frequency response @ 1V RMS output: 100Hz to 20KHz ± 0.5dB; -0.75dB @ 30Hz
Total harmonic distortion @ 1KHz and 6V RMS output: 0.006%
Total harmonic distortion @10KHz and 1V RMS output: 0.02%

P23. 3 Channel Spectrum Analyzer

This 3 channel 15 LED spectrum analyzer is the perfect addition to any audio amp project. It produces fantastic displays on three LED bars that can be individually adjusted for any particular frequency range. The circuit will take line level output from most any audio source, and operates on 12V DC. This means that it can even be run in a car.

Circuit dijagram



Parts:
R1 100K 1/4W Resistor
R2 820K 1/4W Resistor
R3, R14, R16, R18 2.2 Meg 1/4W Resistor
R4, R5, R6 22K Pot
R7, R8, R9, R25, R27, R29 10K 1/4W Resistor
R10, R11, R12 680 Ohm 1/4W Resistor
R13. R15, R17 580K 1/4W Resistor
R19, R20, R21 39K 1/4W Resistor
R22, R23, R24 47K 1/4W Resistor
R26, R28, R30 33 Ohm 1/4W Resistor
C1, C5, C6 0.012uF Polystyrene Capacitor
C2, C9, C10, C11 3.3uF Electrolytic Capacitor
C3, C4 0.0022uF Polystyrene Capacitor
C7, C8 47nF Polystyrene Capacitor
C12, C13, C14 0.47uF Electrolytic Capacitor
C15, C16, C17 22uF Electrolytic Capacitor
D1, D2, D3 1N4002 Silicon Diode
D4, D5, D6, D8, D8 Green LED
D10, D11, D12, D13, D14 Amber LED
D16, D17, D18, D19, D20 Red LED

U1 LM3900 Quad Op Amp
U2, U3, U4 AN6884 Bar Graph IC
MISC Board, Wires, Sockets For ICs

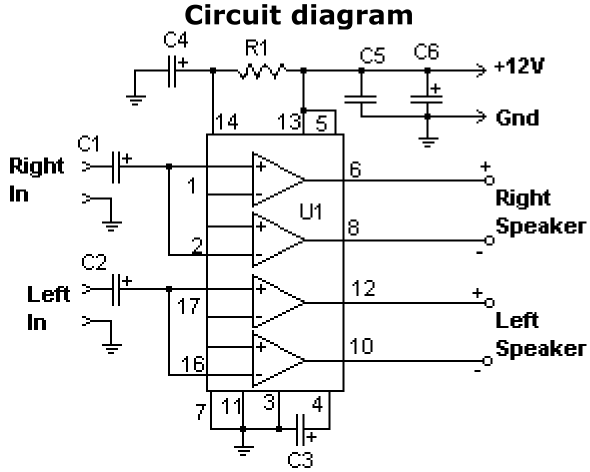
Notes:
1. The circuit expects line level inputs. If you connect it to speaker level, you will have to readjust the circuit every time you change the volume.

2. After the circuit is connected, apply power and signal. Now adjust the pots until the corresponding group of LEDs reacts.

P24. 22 Watt Audio Amplifier

The 22 watt amp is easy to build, and very inexpensive. The circuit can be used as a booster in a car audio system, an amp for satellite speakers in a surround sound or home theater system, or as an amp for computer speakers. The circuit is quite compact and uses only about 60 watts.

Circuit diagram

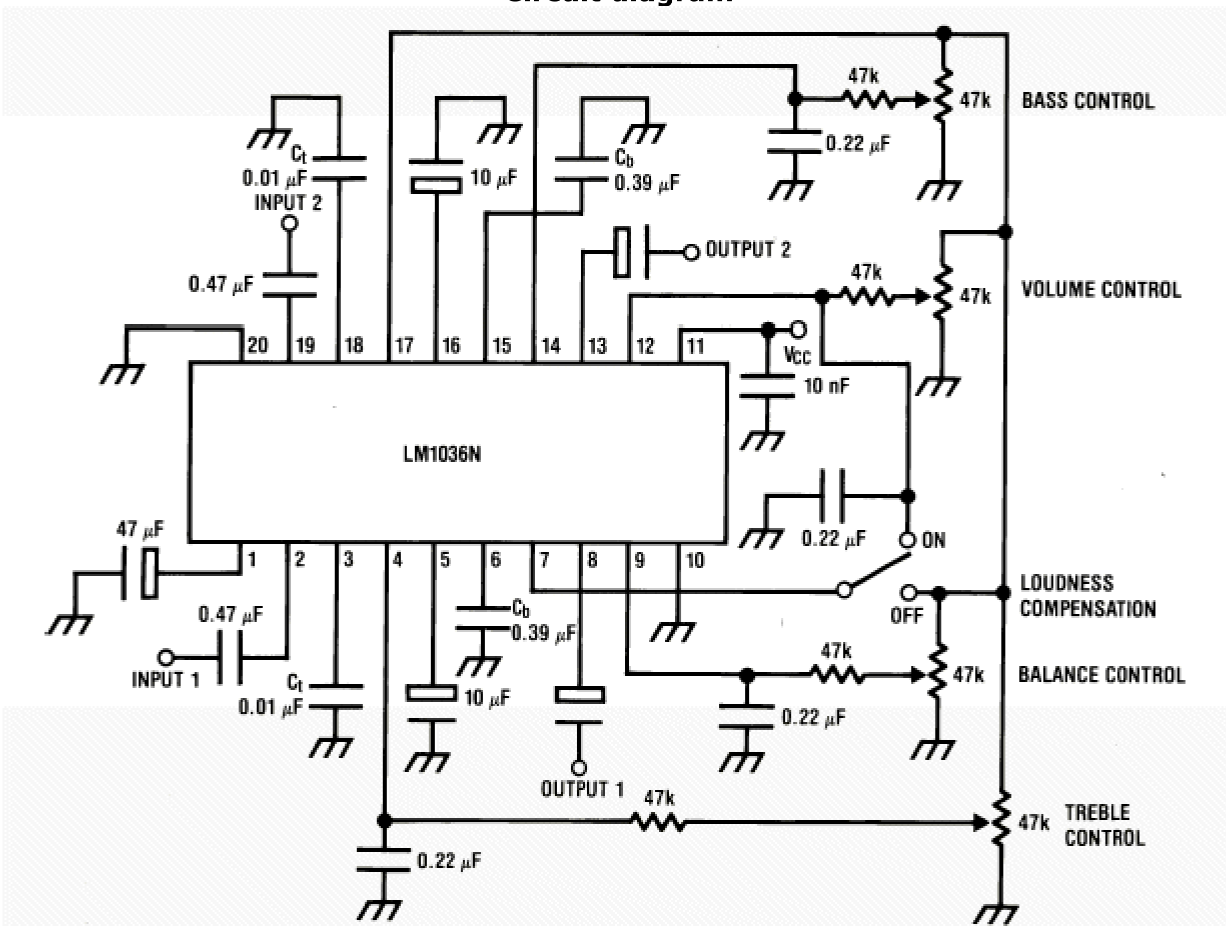


Parts
R1 39K 1/4 Watt Resistor
C1,C2 10uf 25V Electrolytic Capacitor
C3 100uf 25V Electrolytic Capacitor
C4 47uf 25V Electrolytic Capacitor
C5 0.1uf 25V Ceramic Capacitor
C6 2200uf 25V Electrolytic Capacitor
U1 TDA1554 Two Channel Audio Amp Chip
MISC Heatsink For U1, Binding Posts (For Output), RCA Jacks (For Input), Wire, Board

Notes
1. The circuit works best with 4 ohm speakers, but 8 ohm units will do.
2. The circuit dissipates roughly 28 watts of heat, so a good heatsink is necessary. The chip should run cool enough to touch with the proper heatsink installed.
3. The circuit operates at 12 Volts at about 5 Amps at full volume. Lower volumes use less current, and therefore produce less heat.
4. Printed circuit board is preferred, but universal solder or perf board will do. Keep lead length short.

P25. Bass-treble tone control circuit

Circuit diagram



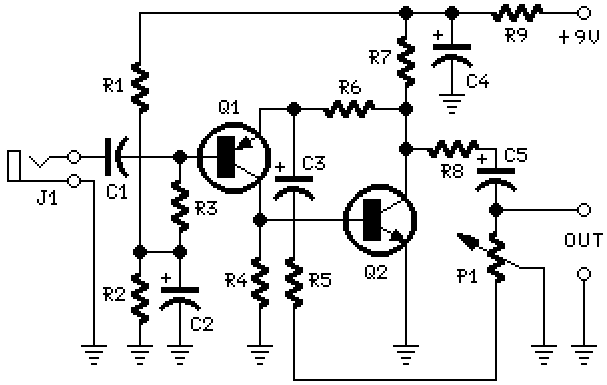
The LM1036 is a DC controlled tone (bass/treble), volume and balance circuit for stereo applications in car radio, TV and audio systems. An additional control input allows loudness compensation to be simply effected. Four control inputs provide control of the bass, treble, balance and volume functions through application of DC voltages from a remote control system or, alternatively, from four potentiometers which may be biased from a zener regulated supply provided on the circuit. Each tone response is defined by a single capacitor chosen to give the desired characteristic.

Features:
Wide supply voltage range, 9V to 16V
Large volume control range, 75 dB typical
Tone control, ±15 dB typical
Channel separation, 75 dB typical
Low distortion, 0.06% typical for an input level of 0.3 Vrms
High signal to noise, 80 dB typical for an input level of 0.3 Vrms
Few external components required

Note:
Vcc can be anything between 9V to 16V and the output capacitors are
10uF/25V electrolytic.

P26. Portable Microphone Preamplifier

circuit diagram



Parts:
P1 2K2 Linear Potentiometer
R1,R2,R3 100K 1/4W Resistors
R4 8K2 1/4W Resistor
R5 68R 1/4W Resistor
R6 6K8 1/4W Resistor
R7,R8 1K 1/4W Resistors
R9 150R 1/4W Resistor
C1 1uF 63V Polyester Capacitor
C2,C3,C4 100uF 25V Electrolytic Capacitors
C5 22uF 25V Electrolytic Capacitor
Q1 BC560C 45V 100mA Low noise High gain PNP Transistor
Q2 BC550C 45V 100mA Low noise High gain NPN Transistor
J1 Jack socket (Mono 3 or 6 mm.)

Device purpose:

This circuit is mainly intended to provide common home stereo amplifiers with a microphone input. The battery supply is a good compromise: in this manner the input circuit is free from mains low frequency hum pick-up and connection to the amplifier is more simple, due to the absence of mains cable and power supply.

Using a stereo microphone the circuit must be doubled. In this case, two separate level controls are better than a dual-ganged stereo potentiometer.

Low current drawing (about 2mA) ensures a long battery life.

Circuit operation:

The circuit is based on a low noise, high gain two stage PNP and NPN transistor amplifier, using DC negative feedback through R6 to stabilize the working conditions quite precisely. Output level is attenuated by P1 but, at the same time, the stage gain is lowered due to the increased value of R5. This unusual connection of P1, helps in obtaining a high headroom input, allowing to cope with a wide range of input sources (0.2 to 200mV RMS for 1V RMS output).

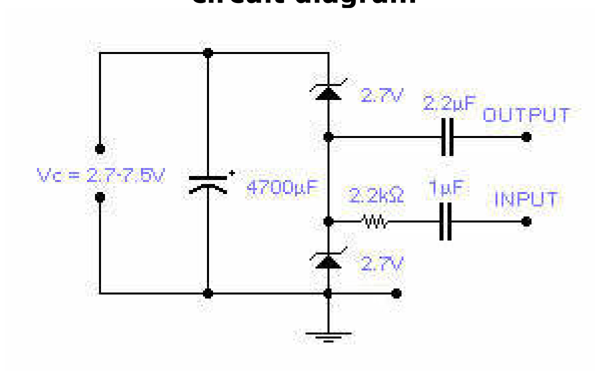
Notes:
Harmonic distortion is about 0.1% @ 1V RMS output (all frequencies).
Maximum input voltage (level control cursor set at maximum) = 25mV RMS

Maximum input voltage (level control cursor set at center position) = 200mV RMS
Enclosing the circuit in a metal case is highly recommended.

Simply connect the output of this device to the Aux input of your amplifier through screened cable and suitable connectors.

P27. Electronics Attenuator

circuit diagram

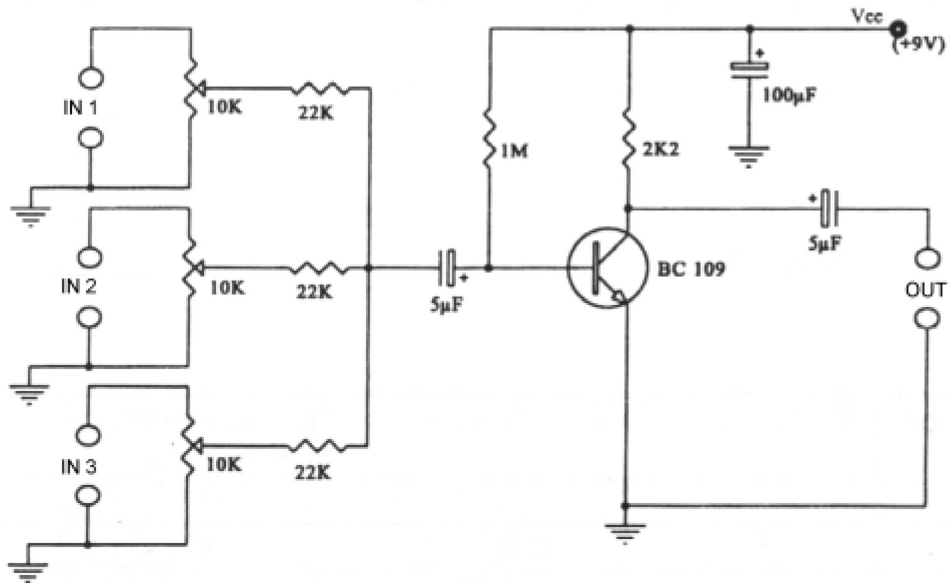


Two low voltage, low power zeners are used to control electronically the level of an audio signal. The attenuation range is from 6 to 58dB for an input current from 0.042 to 77 mA corresponding to a control voltage from 2.7 to 7.5V. If control voltage is limited to 5V, the attenuation is around 30dB at a control current of 2mA. This is not an HiFi attenuator but might come useful as a general purpose audio attenuator.

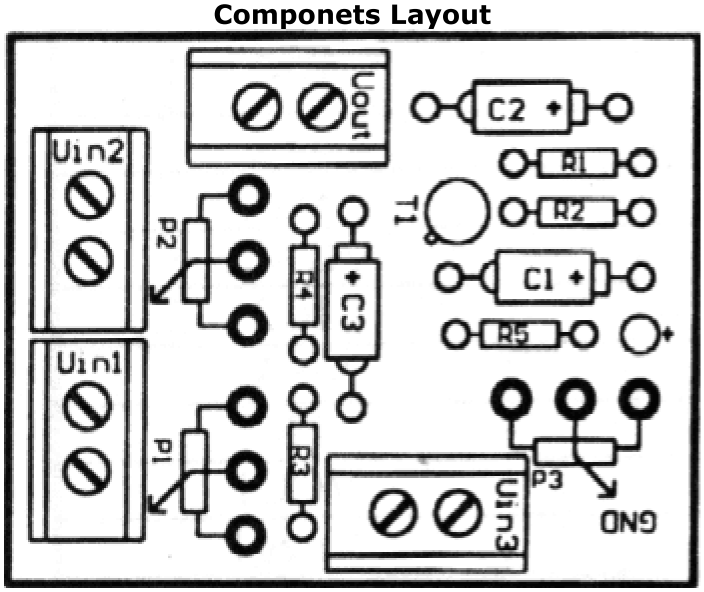
P28. 3 Line Mixer

This project is a 3 or more lines mixer. For more than 3 inputs you can repeat the input parts (P=10K R=22K). It powered with 9Vdc.

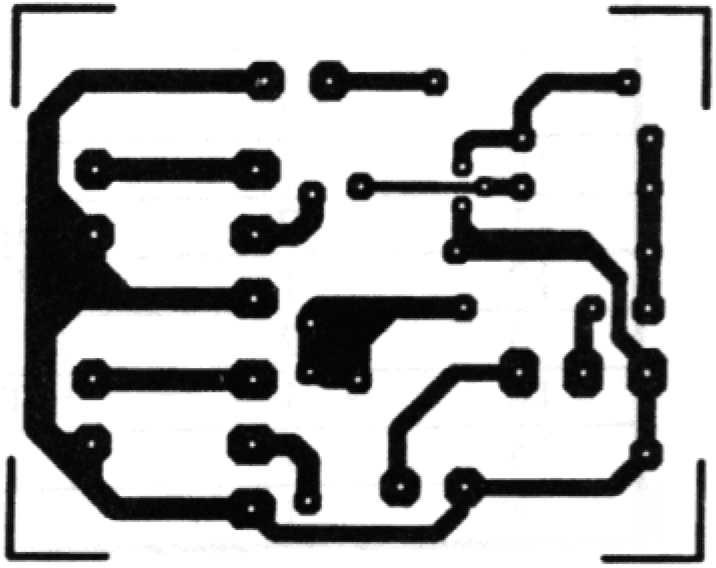
circuit diagram



Componets Layout

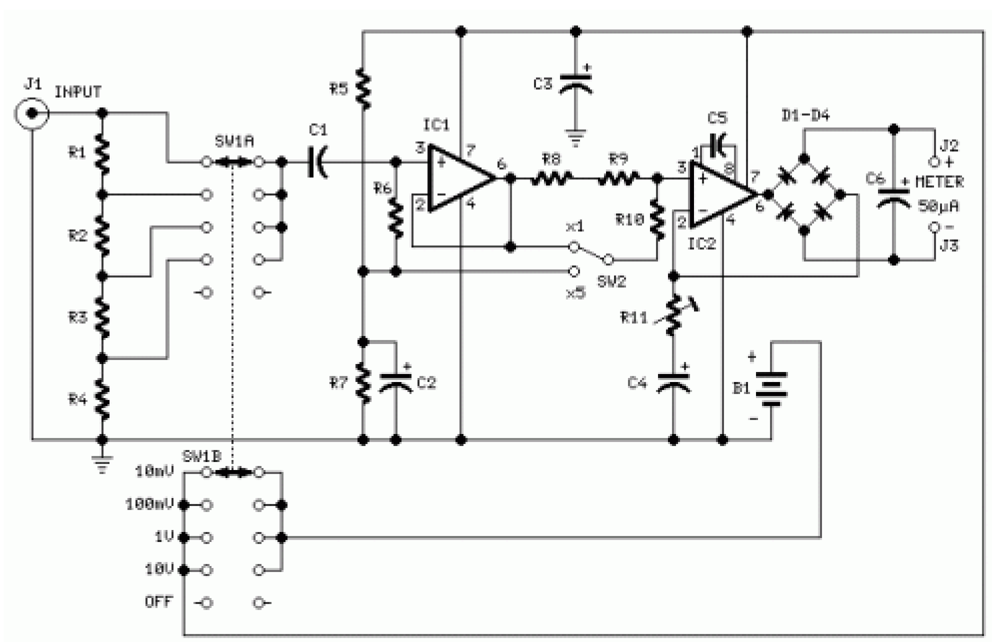


PCB (5,5cm x 4,4cm)



P29. Precision Audio Millivoltmeter

Measures 10mV to 50Volt RMS in eight ranges
Simply connect to your Avo-meter set @ 50uA range



Parts:
R1 909K 1/2Watt 1% Metal Oxide Resistor
R2 90K9 1/2Watt 1% Metal Oxide Resistor
R3 9K09 1/2Watt 1% Metal Oxide Resistor
R4 1K01 1/2Watt 1% Metal Oxide Resistor
R5 100K 1/4W Resistor
R6 2M2 1/4W Resistor
R7 82K 1/4W Resistor

R8 12K 1/4W Resistor
R9 1K2 1/4W Resistor
R10 3K3 1/4W Resistor
R11 200R 1/2W Trimmer Cermet
C1 330nF 63V Polyester Capacitor
C2,C3 100uF 25V Electrolytic Capacitor
C4 220uF 25V Electrolytic Capacitor
C5 33pF 63V Polystyrene Capacitor
C6 2u2 63V Electrolytic Capacitor
D1-D4 1N4148 75V 150mA Diodes
IC1 CA3140 Op-amp
IC2 CA3130 Op-amp
SW1 2 poles 5 ways rotary switch
SW2 SPDT switch
J1 RCA audio input socket
J2,J3 4mm. output sockets
B1 9V PP3 Battery
Clip for PP3 Battery

Notes:
Connect J2 and J3 to an Avo-meter set @ 50uA range
Switching SW2 the four input ranges can be multiplied by 5
Total fsd ranges are: 10mV, 50mV, 100mV, 500mV, 1V, 5V, 10V, 50V
Set R11 to read 1V in the 1V range, with a sinewave input of 1V @ 1KHz

Compare the reading with that of another known precision Millivoltmeter or with an The oscilloscope reading must be a sinewave of 2.828V peak to peak amplitude

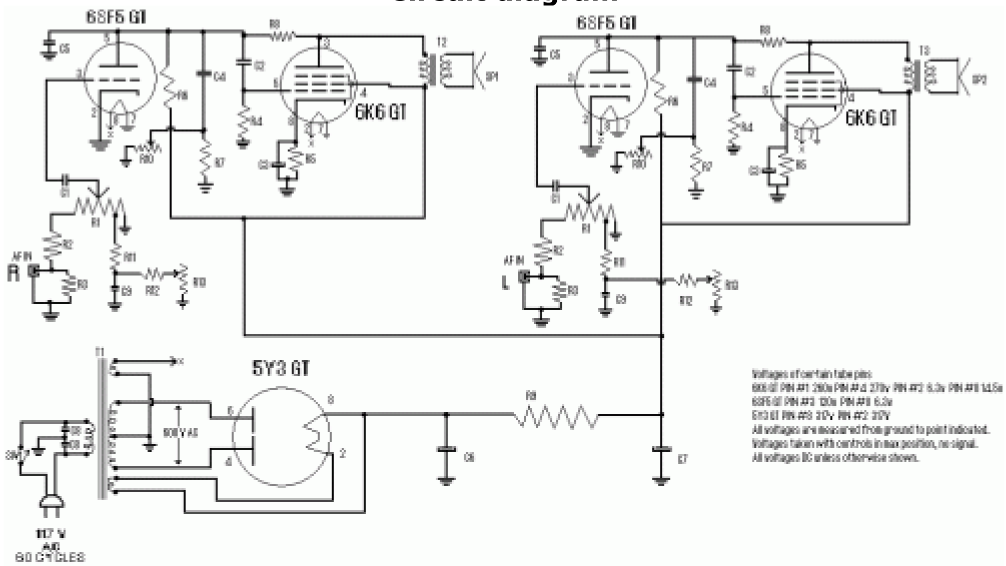
Frequency response is flat in the 20Hz-20KHz range
If you have difficulties in finding resistor values for R1, R2, R3 & R4, you can use the following trick:

R1 = 10M + 1M in parallel
R2 = 1M + 100K in parallel
R3 = 100K + 10K in parallel
R4 = 1K2 + 6K8 in parallel
All resistors 1% tolerance

P30. Stereo Tube Amplifier

The circuit is simple, yet is capable of excellent performance. I designed it specifically for use as an amplifier for the digital sound card in my computer. Audio input can be from any two-channel line level device such as a television, CD player, or VCR. It is of the tube type, using only 5 tubes total with no more than about 45 Watts power consumption from the outlet. It uses 3 types of tube 1 5Y3 GT vacuum rectifier, 2 6SF5 GT high-mu triodes, and 2 6K6 power beam amplifiers. These are all full-size octal type tubes which are commonly available today for between $3-5 each.

Circuit diagram



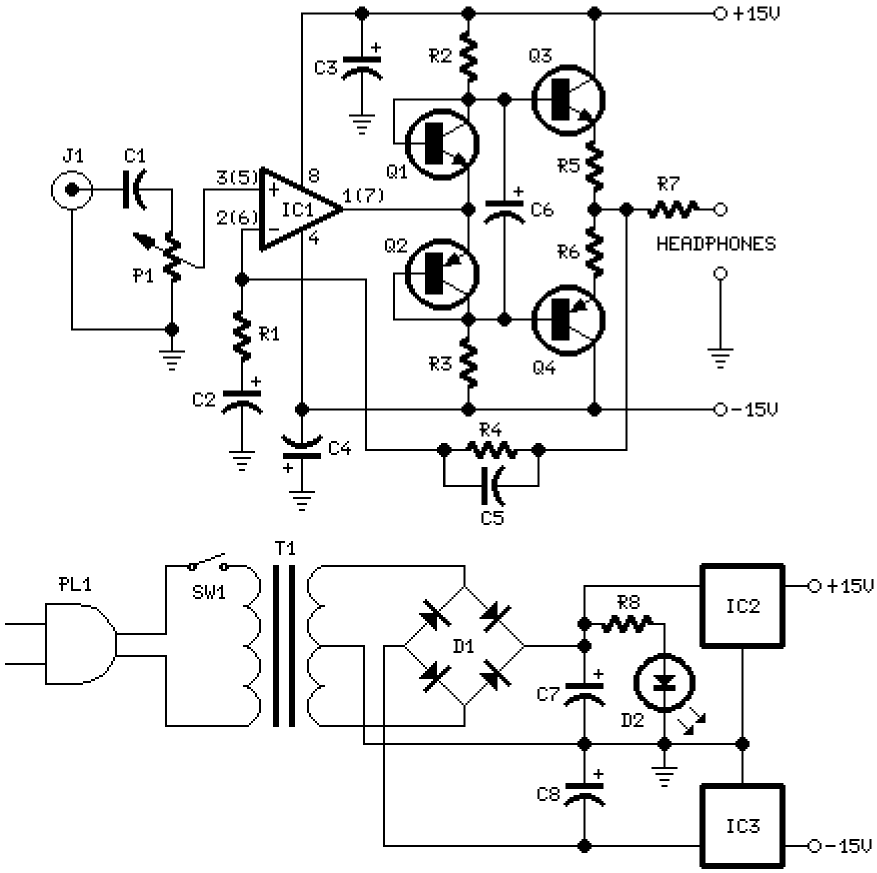
Parts:
R1, R10, R13 2.2Meg Pot
R2 470K 1/2W Resistor
R3 1 Meg 1/2W Resistor
R4 220K 1/2W Resistor
R5 330 Ohm 2W Resistor
R6 220K 1/2W Resistor
R7 2.2Meg 1/2W Resistor
R8 1Meg 1/2W Resistor
R9 720 Ohm 20W Resistor
R11 33K 1/2W Resistor
R12 22K 1/2W Resistor
C1, C9 0.005uF 400V Capacitor
C2 0.05uF 600V Capacitor
C3 20uF 25V Electrolytic Capacitor
C4 0.01uF 400V Capacitor
C5 200uuF 400V Ceramic Disc Capacitor
C6, C7 15uF 450V Capacitor
C8 15uF 400V Capacitor
T1 117V Primary, 350VCT Secondary, 6.3V Secondary, 6.3V Secondary
T2 7600 Ohm Primary, 4 or 8 Ohm Secondary
SW1 SPST Switch
SP1, SP2 12" or smaller, 4 or 8 ohm speakers
MISC 5 tube sockets, 2 RCA jacks, PC board or chassis, wire, knobs, etc.

Notes:
1. Email Weslee Kinsler with questions, comments, etc.
2. The 6V6 GT tube may be substituted for the 6K6 to lower power requirements.
3. C8 is for radio interference suppression and may be omitted.
4. The 5Y3 GT tube should be mounted in a vertical position and be well ventilated. The 6K6 and 6SF5 tubes can be mounted in any position.
5. Controls should have an audio taper.
6. The power supply portion of this unit may be used for anything requiring 290-320v DC up to about 3 amps.

P31. **Headphone Amplifier**

High Quality unit. No need for a preamplifier.

circuit diagram



Amplifier parts:
P1 22K Log.Potentiometer (Dual-gang for stereo)
R1 560R 1/4W Resistor
R2,R3 10K 1/4W Resistors
R4 12K 1/4W Resistor
R5,R6 2R2 1/4W Resistor
R7 22R 1/2W Resistor
C1 1uF 63V Polyester Capacitor
C2,C3,C4 100uF 25V Electrolytic Capacitors
C5 22pF 63V Polystyrene or Ceramic Capacitor
C6 22uF 25V Electrolytic Capacitor
IC1 LM833 or NE5532 Low noise Dual Op-amp
Q1,Q3 BC337 45V 800mA NPN Transistors
Q2,Q4 BC327 45V 800mA PNP Transistors
J1 RCA audio input socket

Power supply parts:
R7 2K2 1/4W Resistor
C7,C8 2200uF 25V Electrolytic Capacitors
D1 100V 1A Diode bridge
D2 5mm. or 3mm. Red LED
IC2 7815 15V 1A Positive voltage regulator IC

IC3 7915 15V 1A Negative voltage regulator IC
T1 220V Primary, 15 + 15V Secondary 5VA Mains transformer
PL1 Male Mains plug
SW1 SPST Mains switch

Notes:
Can be directly connected to CD players, tuners and tape recorders.
Tested with several headphone models of different impedance: 32, 100, 245, 300, 600 & 2000 Ohms.
Can drive old 8 Ohms impedance headphones, but these obsolete devices are not recommended.
Schematic shows left channel and power supply.
Numbers in parentheses show IC1 right channel pin connections.
A correct grounding is very important to eliminate hum and ground loops. Connect in the same point the ground sides of J1, P1, C2, C3 & C4. Then connect separately the input and output grounds at the power supply ground.

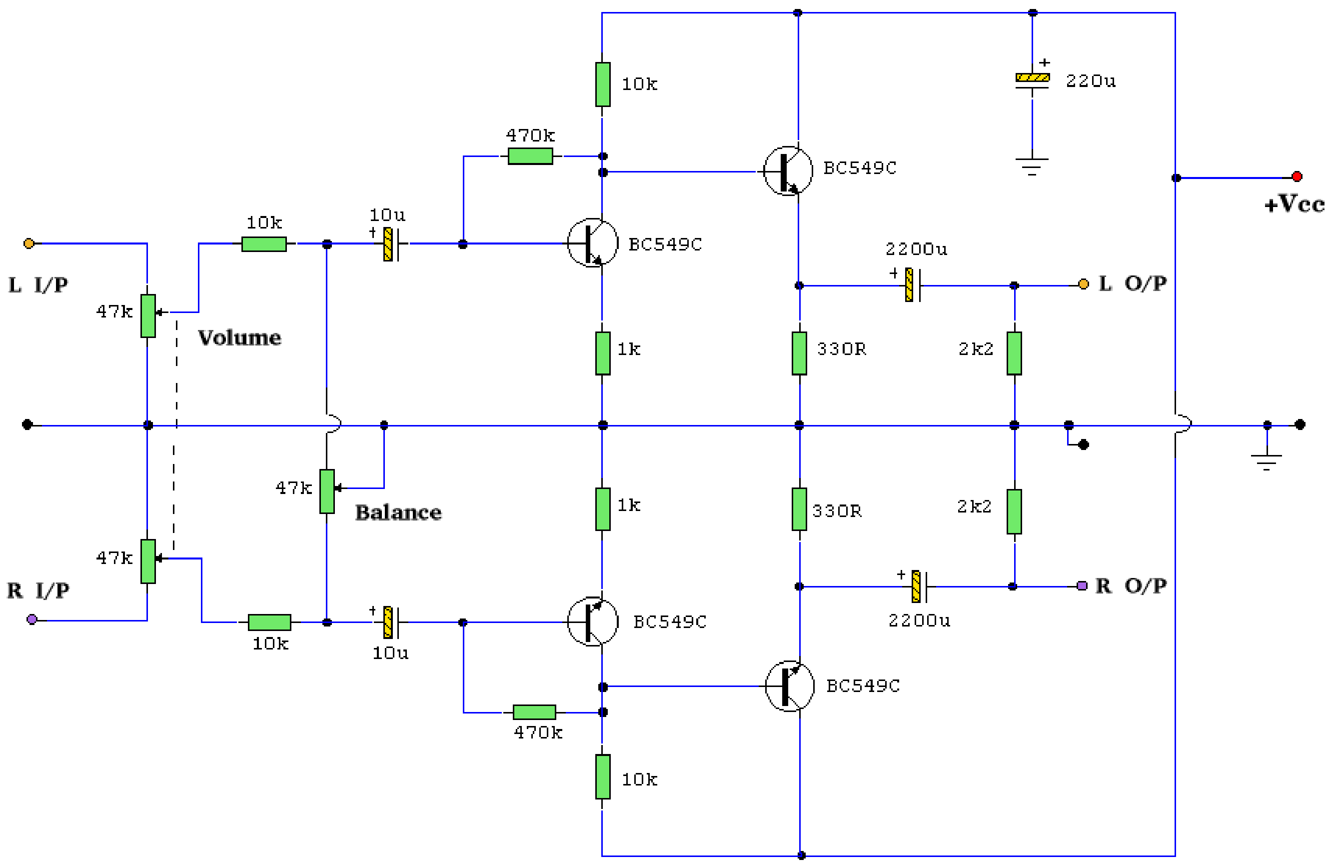
Technical data:
Output voltage: Well above 5V RMS on all loads
Sensitivity: 250mV input for 5V RMS output
Frequency response: Flat from 30Hz to 20KHz
Total harmonic distortion @ 1KHz & 10KHz: Below 0.005% on 32 Ohms load and up to 4V RMS output (typical 0.003%)
Total harmonic distortion @ 1KHz & 10KHz: Below 0.005% on 100 to 2000 Ohms load and up to 5V RMS output (typical 0.003%)

Unconditionally stable on capacitive loads

P32. Headphone Amplifier II

Description:

An amplifier to drive low to medium impedance headphones built using discrete components.



Description:

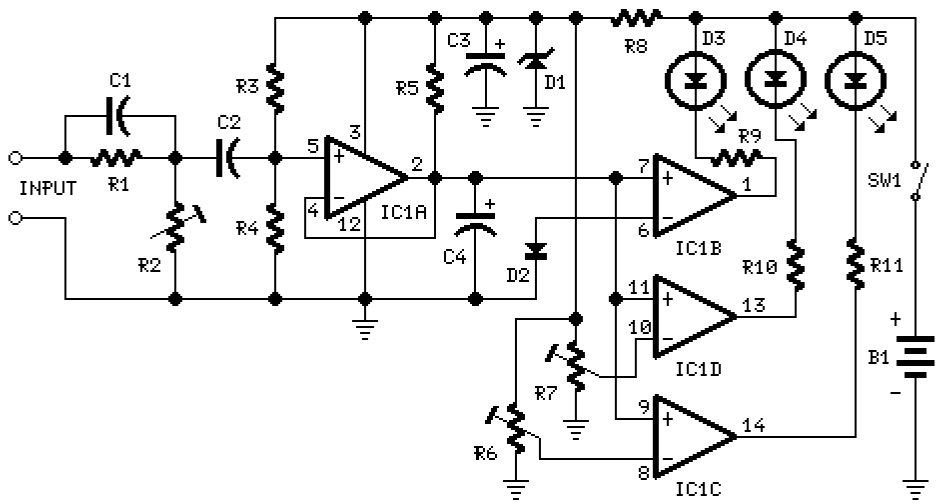
Both halves of the circuit are identical. Both inputs have a dc path to ground via the input 47k control which should be a dual log type potentiometer. The balance control is a single 47k linear potentiometer, which at center adjustment prevents even attenuation to both left and right input signals. If the balance control is moved towards the left side, the left input track has less resistance than the right track and the left channel is reduced more than the right side and vice versa. The preceding 10k resitors ensure that neither input can be "shorted" to earth.

Amplification of the audio signal is provided by a single stage common emitter amplifier and then via a direct coupled emitter follower. Overall gain is less than 10 but the final emitter follower stage will directly drive 8 ohm headphones. Higher impedance headphones will work equally well. Note the final 2k2 resistor at each output. This removes the dc potential from the 2200u coupling capacitors and prevents any "thump" being heard when headphones are plugged in. The circuit is self biasing and designed to work with any power supply from 6 to 20 Volts DC.

P33. Three-Level Audio Power Indicator

Battery-operated 3 LED display
Simply connect it to loudspeaker output

Circuit diagram



Parts:
R1 100K 1/4W Resistor
R2 50K 1/2W Trimmer Cermet
R3 330K 1/4W Resistor
R4 1M2 1/4W Resistor
R5 470K 1/4W Resistor
R6,R7 500K 1/2W Trimmers Cermet
R8 1K5 1/4W Resistor
R9-R11 470R 1/4W Resistors
C1 47pF 63V Ceramic Capacitor
C2 100nF 63V Polyester Capacitor
C3 47µF 25V Electrolytic Capacitor
C4 1µF 25V Electrolytic Capacitor
D1 BZX79C5V1 5.1V 500mW Zener Diode
D2 1N4148 75V 150mA Diode
D3-D5 3mm. Yellow LEDs
IC1 LM339 Quad Voltage Comparator IC
SW1 SPST Slider Switch
B1 9V PP3
Clip for 9V PP3 Battery

Circuit operation:

This circuit is intended to indicate the power output level of any audio amplifier. It is simple, portable, and displays three power levels that can be set to any desired value. For a standard HiFi stereo power amplifier like the 25W one described in these pages, the power output values suggested are as followings:

D5 illuminates at 2W
D4 illuminates at 12.5W
D3 illuminates at 24.5W

The above values were chosen for easy setup, but other settings are possible.

IC1A is the input buffer, feeding 3 voltage comparators and LEDs drivers by means of a variable dc voltage obtained by R5 and C4 smoothing action. In order to achieve setting stability, the supply of IC1 and trimmers R6 & R7 is reduced and clamped to 5.1V by Zener diode D1.

Notes:
The simplest way to connect this circuit to the amplifier output is to use a twisted pair cable terminated with two insulated crocodile clips.

Setup is best accomplished with an oscilloscope or an audio millivoltmeter like the one described in these pages.

A 1KHz sine wave generator with variable output is also required (see a suitable circuit in this website also).

Connect the generator to the amplifier input and the Audio Power Indicator to the output of the amplifier, in parallel with the oscilloscope probe or the audio millivoltmeter input.

When using high power outputs disconnect the loudspeakers to avoid Tweeters damage and connect in their place an 8 Ohm 20-30 Watt wirewound resistor.

Remember that VRMS output is equal to output Peak-to-Peak Voltage divided by 2.828.
RMS power output in Watts is equal to VRMS2 divided by speaker impedance (usually 8 or 4 Ohms).

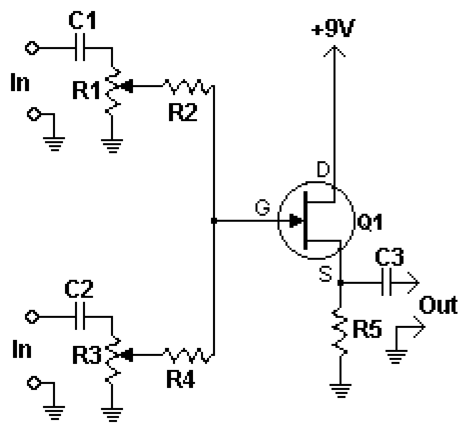
Example: set the output of the 1KHz sinewave generator to read 14V on the audio millivoltmeter (24.5W 8 Ohms). Set R2 until D3 illuminates, and be sure that D3 turns-off when diminishing a little the generator's output.

Do the same with R7 for D4 and R6 for D5. The readings of the audio millivoltmeter must be 10V (12.5W 8 Ohms) and 4V (2W 8 Ohms) respectively.

P34. FET Audio Mixer

This simple circuit mixes two or more channels into one channel (eg. stereo into mono). The circuit can mix as many or as few channels as you like and consumes very little power. The mixer is shown with two inputs, but you can add as many as you want by just duplicating the "sections" which are clearly visible on the schematic.

Circuit diagram



Parts
R1, R3 10K Pot
R2, R4 100K 1/4 W Resistor
R5 6.8K 1/4 W Resistor
C1, C2, C3 0.1uF Capacitor
Q1 2N3819 Junction FET
MISC Wire, Shielded (Metal) Case, Phono Or Other Plug For Output

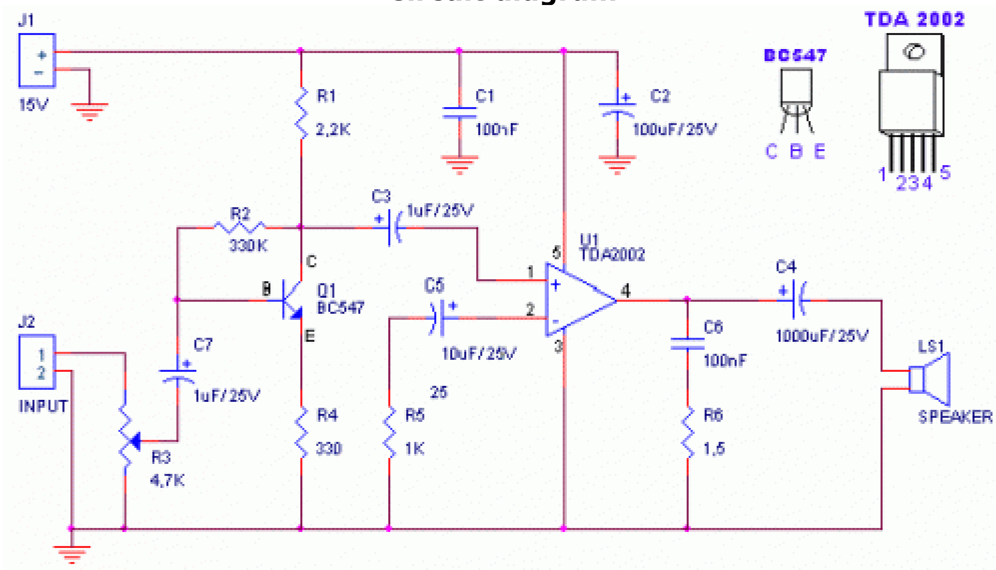
Notes
1. As many or as few channels as are required can be added to the mixer. Do this by just duplicating the input "sections" which are clearly shown on the schematic. One version of this mixer I saw had 25 inputs!
2. A shielded case is probably needed to reduce hum and help stop oscillations.
3. The circuit can be powered by a single 9 volt battery.

P35.

Amplifier of acoustic frequencies with preamplifier

Technical characteristics:
Tendency of catering: 15V
Force of expense: 4,2Wrms in the 4W
Minimal signal of entry: 94mVp-p with preamplifier, 0,65Vp-p without the preamplifier.

Circuit diagram

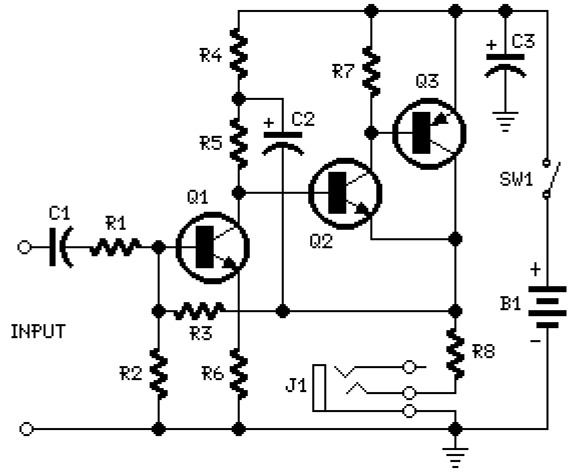


Parts:
R1 2,2KW
R2 330KW
R3 4,7KW logarithmic potentiometer
R4 330W
R5 1KW
R6 1,5W
C1, C6 100nF polyester
C2 100mF/25V ilektrolytjko's
C3, C7 1mF/25V electrolytic
C4 1000uF/25V electrolytic
C5 10uF/25V electrolytic
Q1 BC547
U1 TDA2002
LS1 Loudspeaker.

Notes:
Proportionally the resistance of loudspeaker changes the force that it can give the amplifier:
LS1 Force of expense
2W 6,5Wrms
4W 4,2Wrms
6W 3Wrms
8W 2,25Wrms

P36. Portable Headphone Amplifier

Circuit diagram:



Parts
R1 = 10K 1/4W Resistor
R2 = 100K 1/4W Resistor
R3 = 68K 1/4W Resistor (see notes)
R4 = 1K5 1/4W Resistor
R5 = 3K3 1/4W Resistor
R6 = 330R 1/4W Resistor
R7 = 4K7 1/4W Resistor
R8 = 2R2 1/4W Resistor
C1 = 1uF 63V Polyester Capacitor
C2 = 100uF 25V Electrolytic Capacitor
C3 = 470uF 25V Electrolytic Capacitor
Q1 = BC239C 25V 100mA NPN High-gain Low-noise Transistor
Q2 = BC337 45V 800mA NPN Transistor
Q3 = BC327 45V 800mA PNP Transistor
J1 = Stereo 3mm. Jack socket
SW1 = SPST Switch
B1 = 3V Battery (two 1.5V AA or C cells in series)

Notes:
Can be directly connected to CD players, tuners and tape recorders.
Tested with several headphone models of different impedance: 32, 100, 245, 300, 600 & 2000 Ohms.

Schematic shows left channel only.

B1, SW1, J1 & C3 are common to both channels.
R3 value was calculated for headphone impedance up to 300 Ohms. Using 600 Ohms loads or higher, change R3 value to 100K.

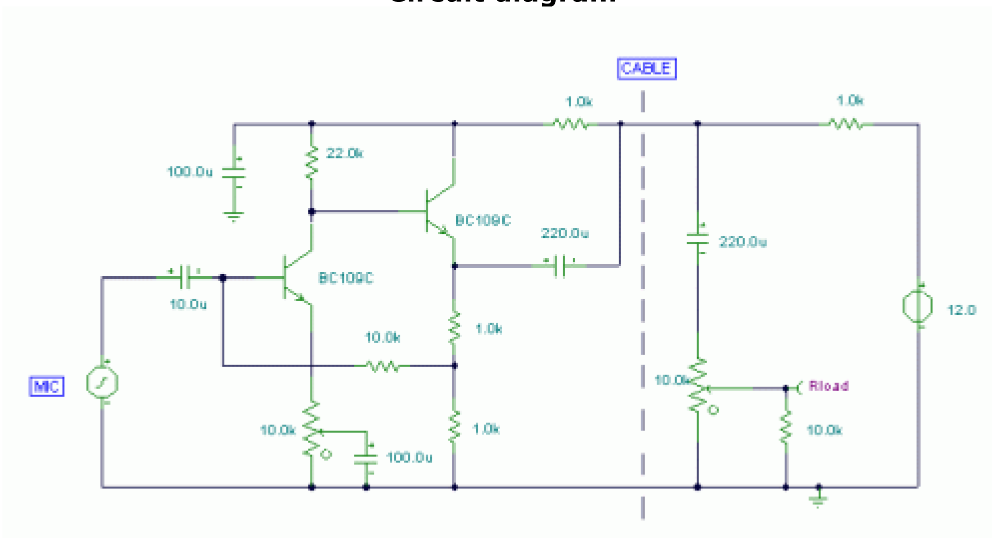
Technical data:
Current drain: 35mA per channel with 32 Ohms impedance headphones. Much less with higher impedance loads
Output voltage: Above 2V peak-to-peak on all loads
Sensitivity: 90mV RMS input for 2V peak-to-peak output
Frequency response: Flat from 30Hz to 20KHz

Total harmonic distortion @ 1KHz & 10KHz: Below 0.05% on 32 to 600 Ohms load and up to 1.5V peak-to-peak output. Below 0.1% at maximum output

Unconditionally stable on capacitive loads

P37. Audio Perimeter Monitor

Circuit diagram



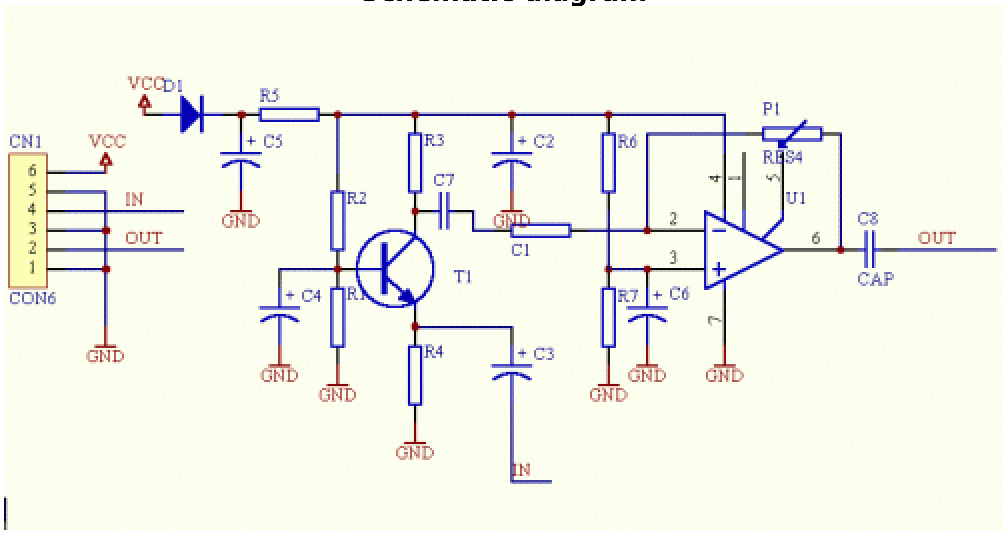
Notes:
Using a single cable such as speaker wire or doorbell cable, this circuit can be remotely positioned, for example, at the bottom of a garden or garage, and used to detect all sound in that area. The cable can be buried in a hosepipe or duct and is concealed out of sight. The mic is an ordinary dynamic mic insert and should be housed in a waterproof enclosure with the rest of the circuit.

The mic output is amplified by the two transistors, the output is fed down the cable via the 220u capacitor. Here, it has a dual purpose of preventing the DC supply from upsetting the bias of the circuit, and also allowing the smaller ac audio output to pass down the line. At the power supply, the audio is recovered by the 10k preset and 220u capacitor. It is used to feed a small audio amplifier (such as the 2watt design) shown earlier on this site.

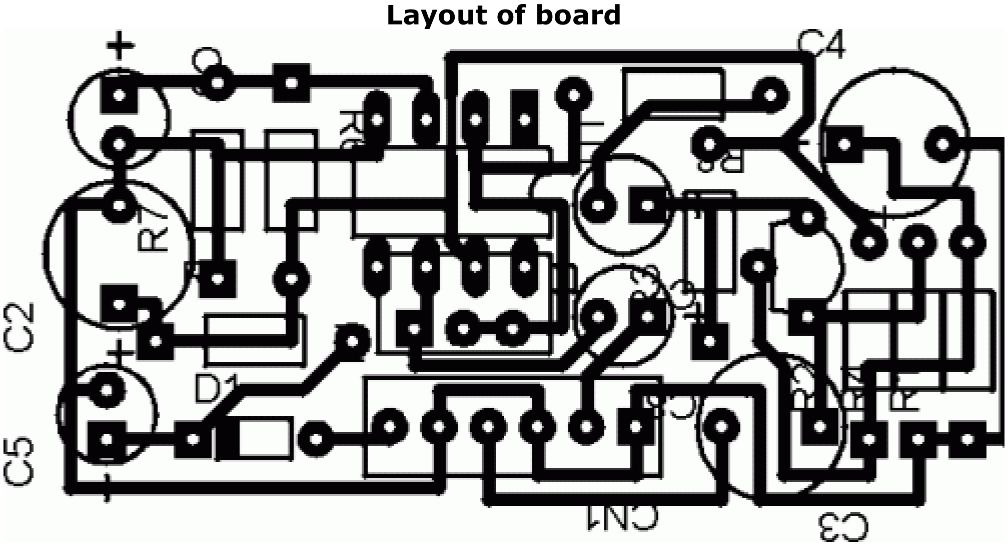
P38. Low impedance microphone amplifier

Description
The circuit is a microphone amplifier for use with low impedance (~200 ohm) microphones. It will work with stabilized voltages between 6-30VDC. If you don't build the impedance adapter part with T1, you get a micamp for higher impedance microphones. In this case, you should directly connect the signal to C7.

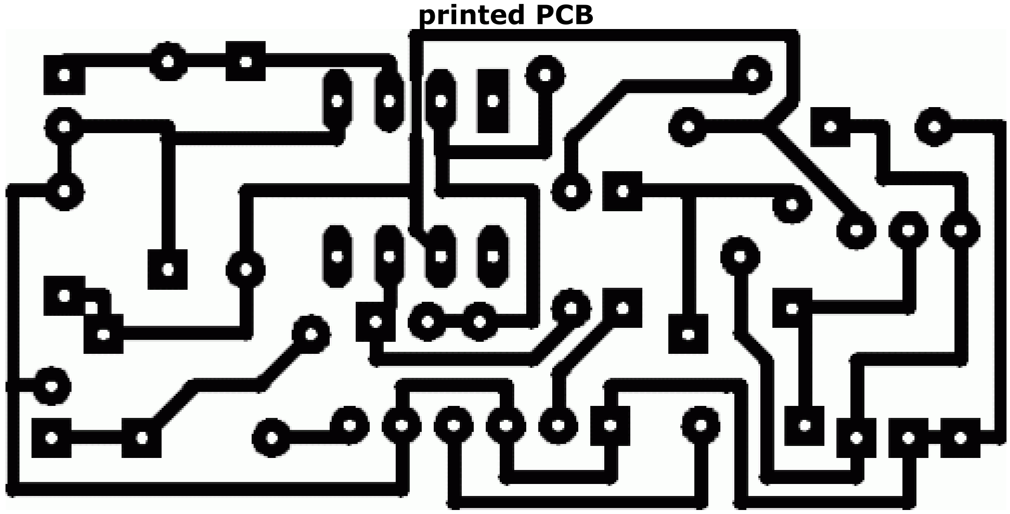
Schematic diagram



Layout of board



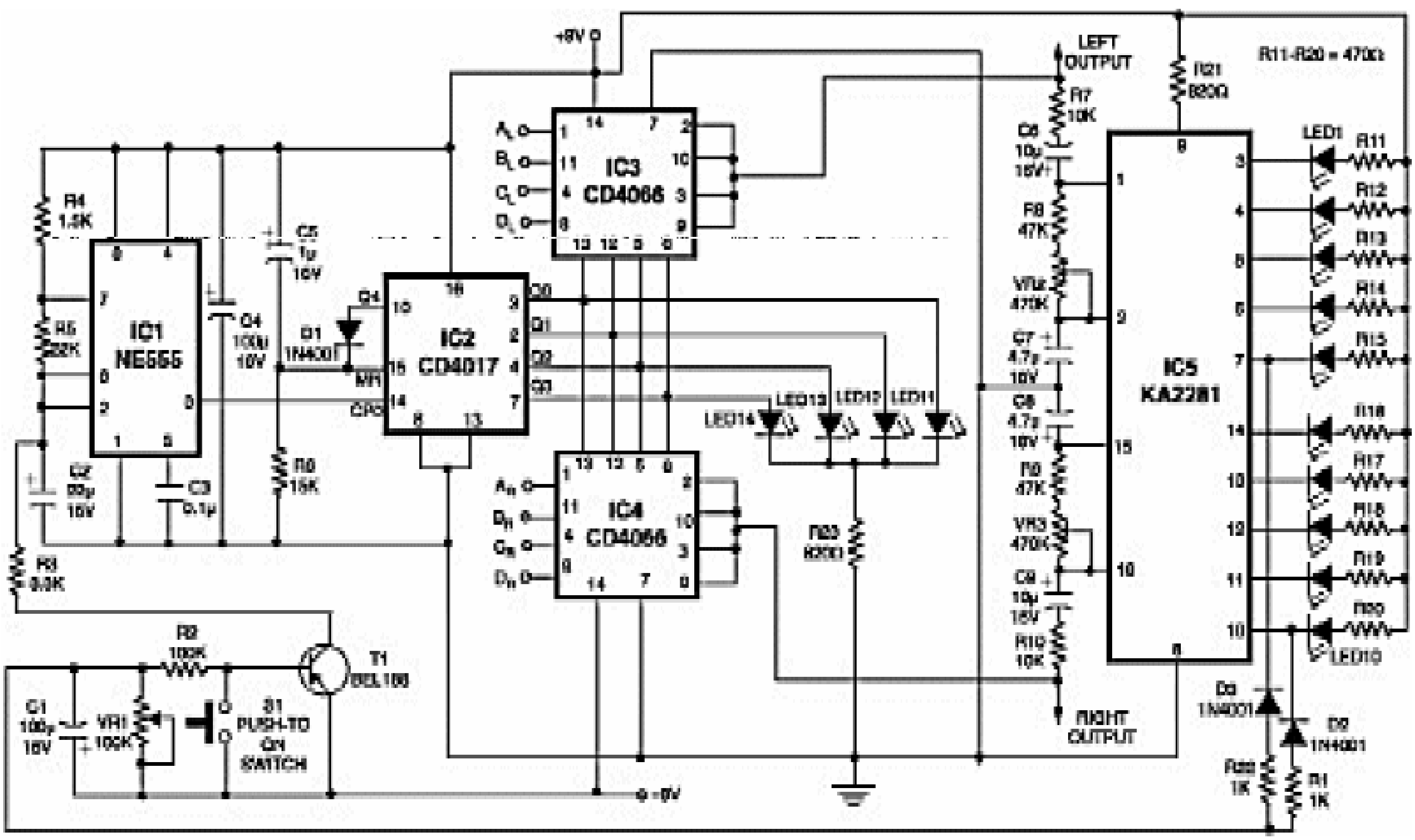
printed PCB



Parts

R1=15k
R2= 150k
R3= 2k2
R4= 820
R6= 10k
R7= 10k
P1= 1M
C1= 3k9
C2= 100u
C3= 22u
C4= 4u7
C5= 470u
C6= 10u
C7= 100n
C8= 47u UNIPOLAR
D1= 1N4148
U1= TL081
CN1= SIL6

P39. Stereo Channel Selector



The add-on circuit presented here is useful for stereo systems. This circuit has provision for connecting stereo outputs from four different sources/channels as inputs and only one of them is selected/connected to the output at any one time.

When power supply is turned 'on', channel A (AR and AL) is selected. If no audio is present in channel A, the circuit waits for some time and then selects the next channel (channel B). This search operation continues until it detects audio signal in one of the channels. The inter-channel wait or delay time can be adjusted with the help of preset VR1. If still longer time is needed, one may replace capacitor C1 with a capacitor of higher value.

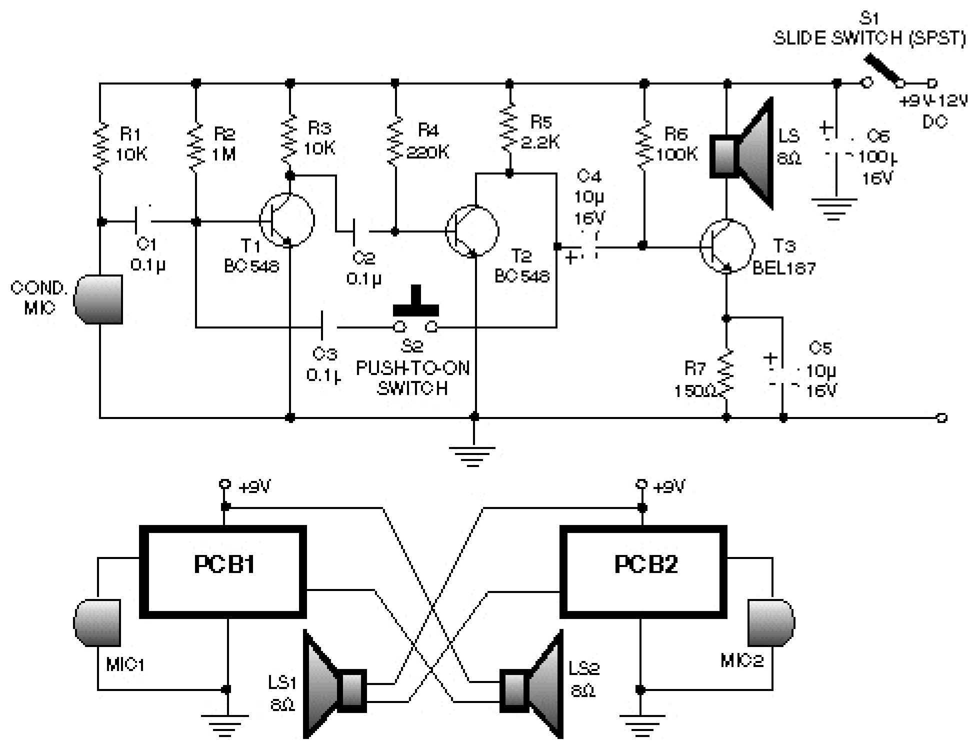
Suppose channel A is connected to a tape recorder and channel B is connected to a radio receiver. If initially channel A is selected, the audio from the tape recorder will be present at the output. After the tape is played completely, or if there is sufficient pause between consecutive recordings, the circuit automatically switches over to the output from the radio receiver. To manually skip over from one (selected) active channel to another (non-selected) active channel, simply push the skip switch (S1) momentarily once or more, until the desired channel input gets selected. The selected channel (A, B, C, or D) is indicated by the glowing of corresponding LED (LED11, LED12, LED13, or LED14 respectively).

IC CD4066 contains four analogue switches. These switches are connected to four separate channels. For stereo operation, two similar CD4066 ICs are used as shown in the circuit. These analogue switches are controlled by IC CD4017 outputs. CD4017 is a 10-bit ring counter IC. Since only one of its outputs is high at any instant, only one switch will be closed at a time. IC CD4017 is configured as a 4-bit ring counter by connecting the fifth output Q4 (pin 10) to the reset pin. Capacitor C5 in conjunction with resistor R6 forms a power-on-reset circuit for IC2, so that on initial switching 'on' of the power supply, output Q0 (pin 3) is always ‘high’. The clock signal to CD4017 is provided by IC1 (NE555) which acts as an astable multivibrator when transistor T1 is in cut- off state.

IC5 (KA2281) is used here for not only indicating the audio levels of the selected stereo channel, but also for forward biasing transistor T1. As soon as a specific threshold audio level is detected in a selected channel, pin 7 and/or pin 10 of IC5 goes ‘low’. This low level is coupled to the base of transistor T1, through diode-resistor combination of D2-R1/D3-R22. As a result, transistor T1 conducts and causes output of IC1 to remain ‘low’ (disabled) as long as the selected channel output exceeds the preset audio threshold level.

Presets VR2 and VR3 have been included for adjustment of individual audio threshold levels of left and right stereo channels, as desired. Once the multivibrator action of IC1 is disabled, output of IC2 does not change further. Hence, searching through the channels continues until it receives an audio signal exceeding the preset threshold value. The skip switch S1 is used to skip a channel even if audio is present in the selected channel. The number of channels can be easily extended up to ten, by using additional 4066 ICs.

P40. Low cost intercom using transistors



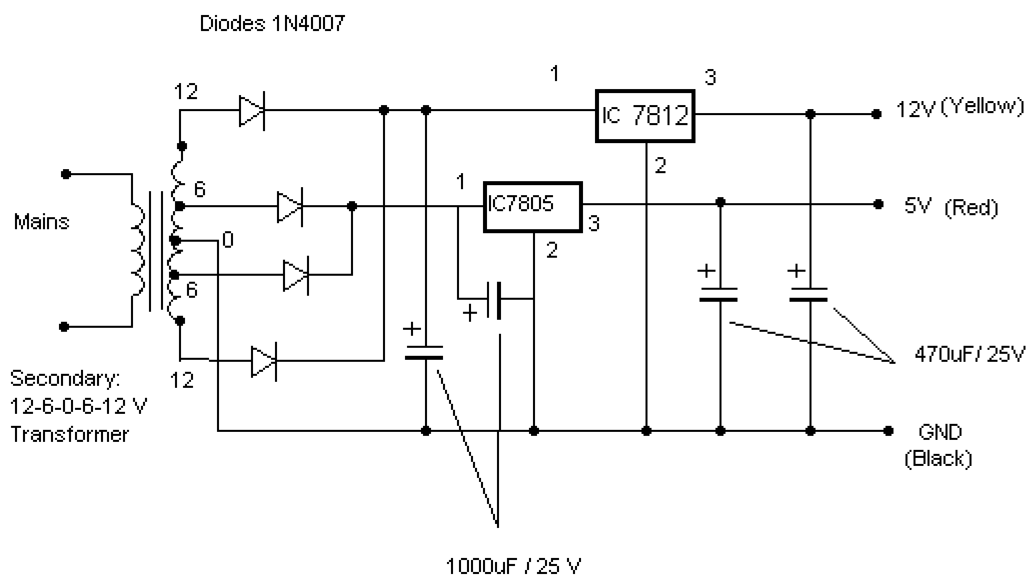
The circuit comprises a 3-stage resistor-capacitor coupled amplifier. When ring button S2 is pressed, the amplifier circuit formed around transistors T1 and T2 gets converted into an asymmetrical astable multivibrator generating ring signals. These ring signals are amplified by transistor T3 to drive the speaker of earpiece.

Current consumption of this intercom is 10 to 15 mA only. Thus a 9-volt PP3 battery would have a long life, when used in this circuit.

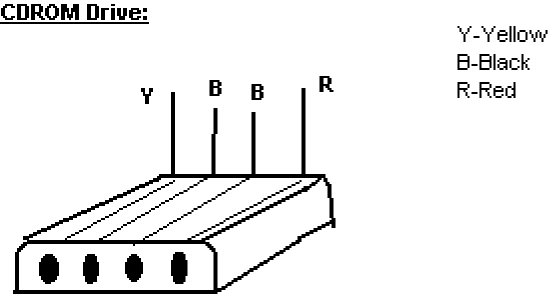
For making a two-way intercom, two identical units, as shown in figure, are required to be used. Output of one amplifier unit goes to speaker of the other unit, and vice versa. For single-battery operation, join corresponding supply and ground terminals of both the units together.

The complete circuit, along with microphone and earpiece etc, can be housed inside the plastic body of a cellphone toy, which is easily available in the market. Suggested cellphone cabinet is shown.

P41.
Use the CD-ROM drive as a audio CD player without the computer



D-Type Power Connector for the CDROM Drive:



Most of the CDROMS available have an Audio-Out Output to either plug in the headphones or connect it to an amplifier.

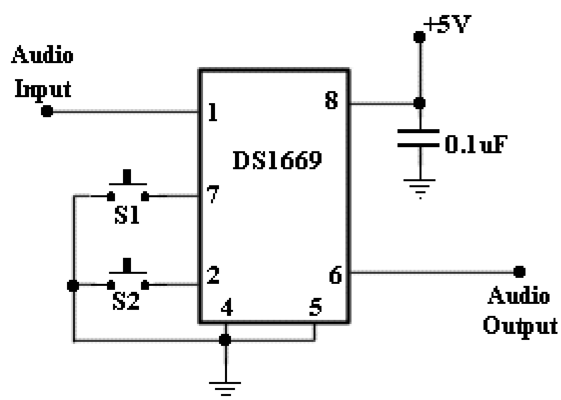
This circuit enables one to use the CDROM as a stand alone Audio CD player without the computer.
This circuit is nothing but a power supply which supplies +5v, +12V and Ground to the CDROM drive and hence can be used without the computer.

You should buy a D-type power connecter to connect this circuit's outputs to the CDROM.
The details of the D connector are shown along with the circuit diagram.
Note that the D-connector goes into the CDROM in only one way and hence prevents any damage due to wrong connection.

Ensure that the 12V(yellow) wire is connected to the right of the D-connector(as seen from behind ,i.e the connector holes away from you with the curved portion of the connector upwards).

As soon as an Audio CD is inserted, the CD begins to play. To move to the next track, press the Skip-Track button on the CDROM front Panel.

P42. Digital Volume Control II



This circuit could be used for replacing your manual volume control in a stereo amplifier. In this circuit, push-to-on switch S1 controls the forward (volume increase) operation of both channels while a similar switch S2 controls reverse (volume decrease) operation of both channels.

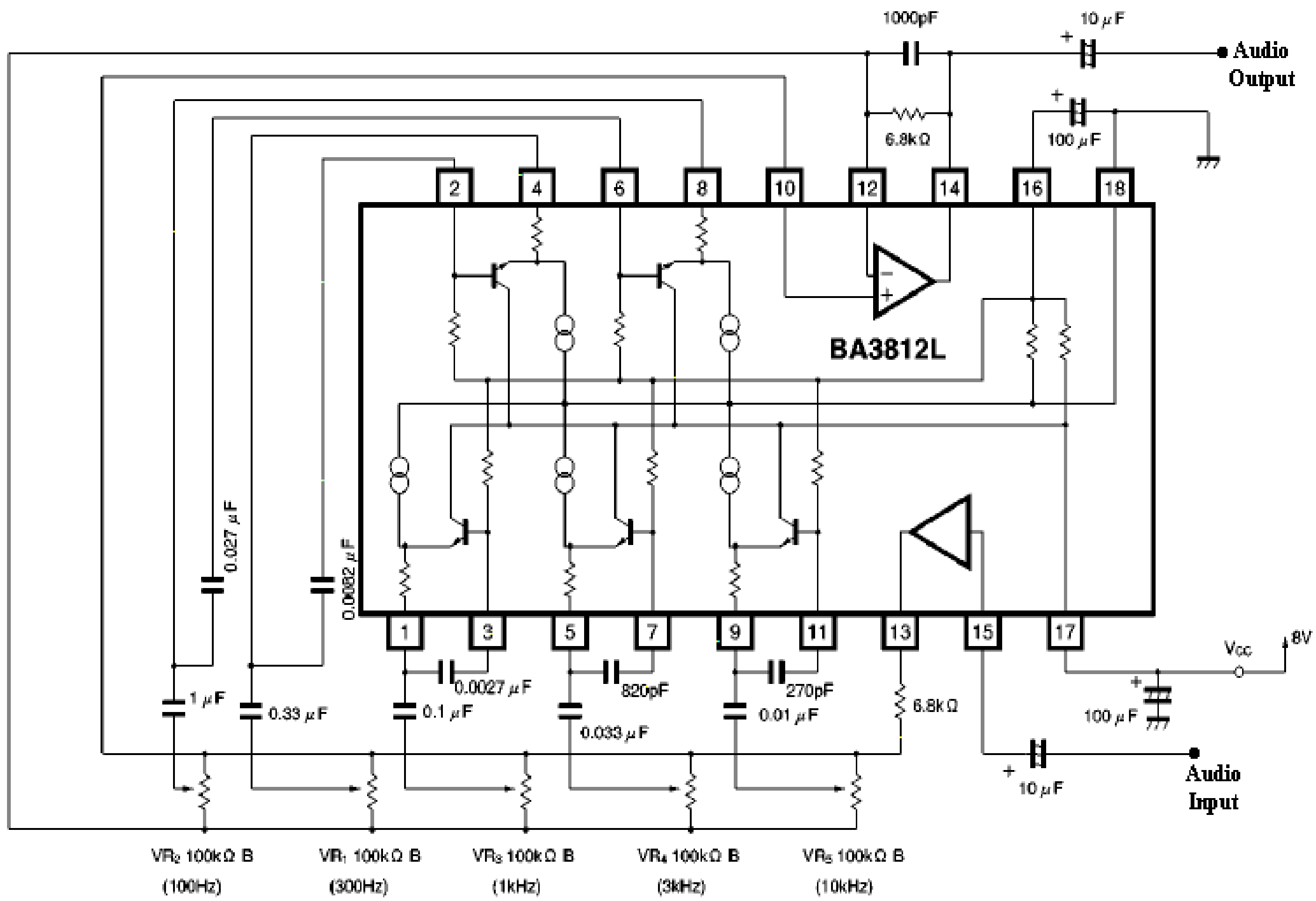
A readily available IC from Dallas semiconductor, DS1669 is used here.

FEATURES:

- Replaces mechanical variable resistors
- Electronic interface provided for digital as well as manual control
- Wide differential input voltage range between 4.5 and 8 volts
- Wiper position is maintained in the absence of power
- Low-cost alternative to mechanical controls
- Applications include volume, tone, contrast,brightness, and dimmer control

The circuit is extremely simple and compact requiring very few external components.
The power supply can vary from 4.5V to 8V.

P43.
5 band graphic equalizer using a single IC/chip



This circuit uses a single chip, IC BA3812L for realizing a 5 band graphic equalizer for use in hi-fi audio systems.The BA3812L is a five-point graphic equalizer that has all the required functions integrated onto one IC. The IC is comprised of the five tone control circuits and input and output buffer amplifiers. The BA3812L features low distortion, low noise, and wide dynamic range, and is an ideal choice for Hi-Fi stereo applica-tions. It also has a wide operating voltage range (3.5V to 16V), which means that it can be adapted for use with most types of stereo equipment.

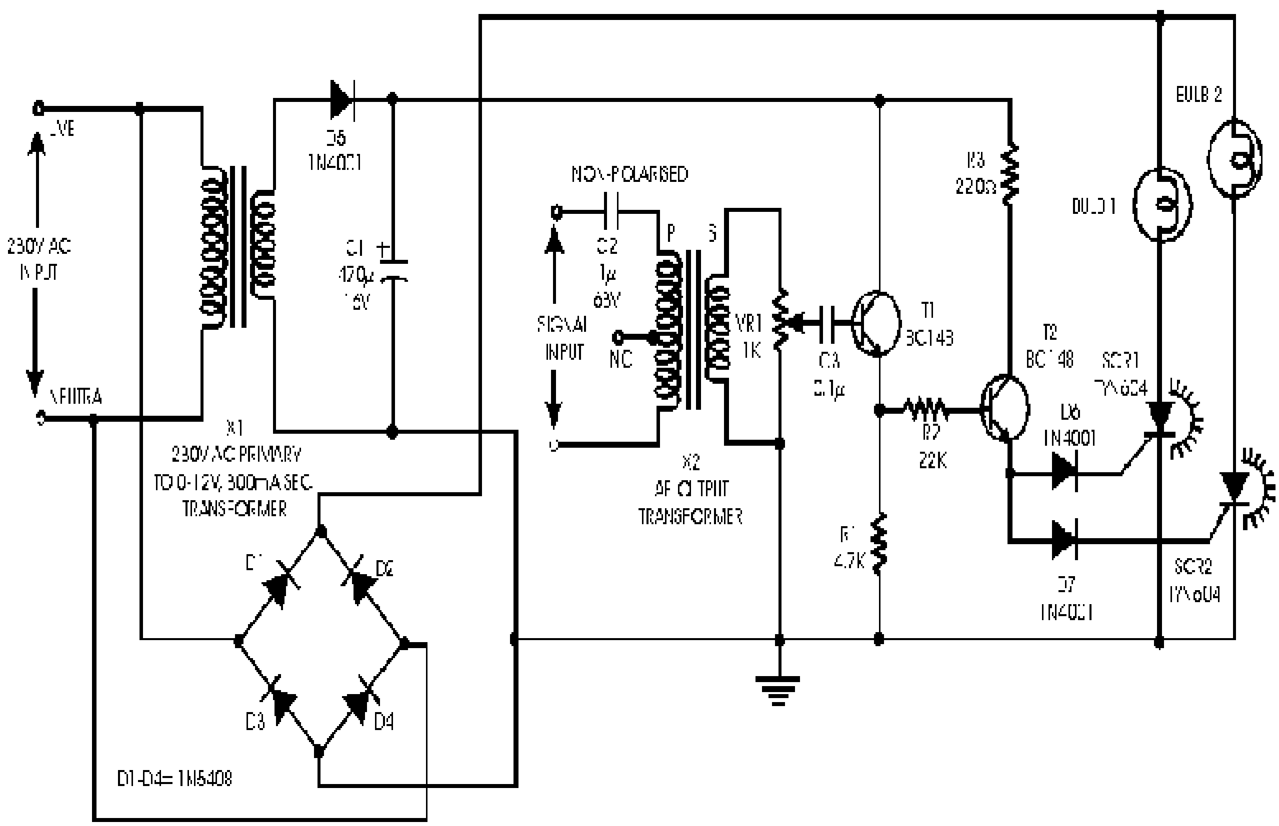
The five center frequencies are independently set using external capacitors, and as the output stage buffer amplifier and tone control section are independent circuits, fine control over a part of the frequency bandwidth is possible, By using two BA3812Ls, it is possible to construct a 10-point graphic equalizer. The amount of boost and cut can be set by external components.

The recommended power supply is 8V, but the circuit should work for a supply of 9V also. The maximum voltage limit is 16V.

The circuit given in the diagram operates around the five frequency bands:

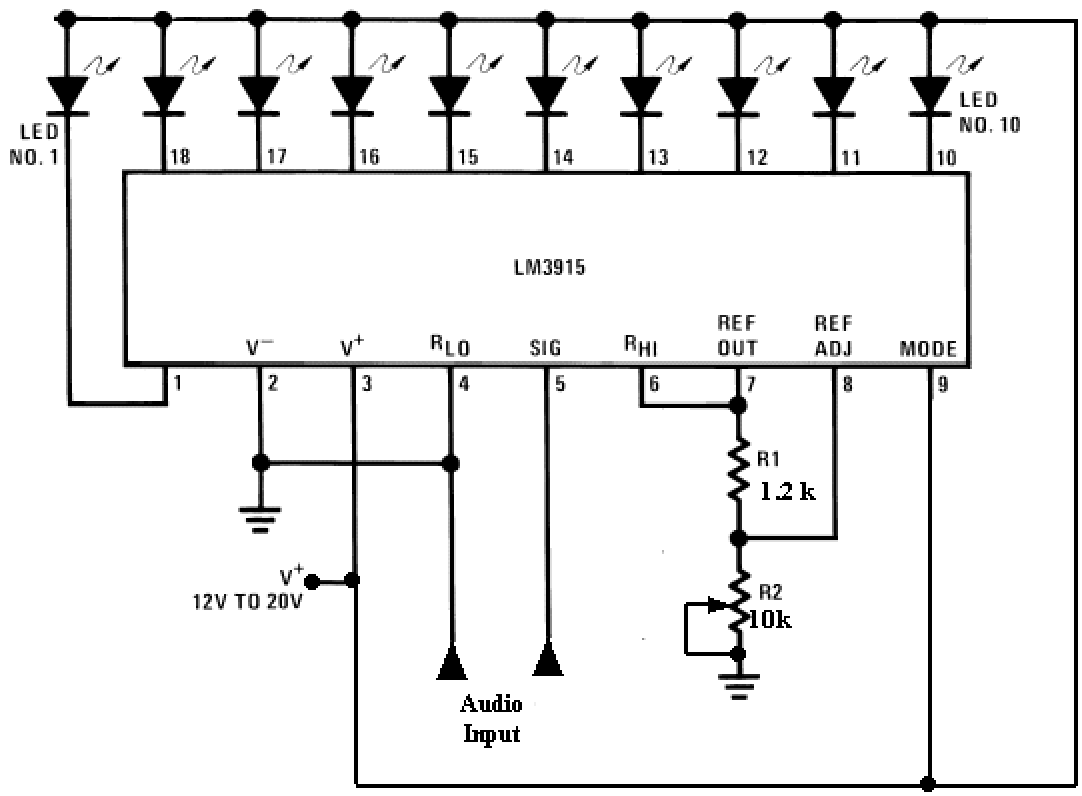
- 100Hz
- 300Hz
- 1kHz
- 3kHz
- 10kHz

P44. Audio Light Modulator



Audio light modulations add to the enjoyment of music during functions organised at home or outdoors. Presented here is one such simple circuit in which light is modulated using a small fraction of the audio output from the speaker terminals of the audio amplifier. The output from the speaker terminals of audio amplifier is connected to a transformer (output transformer used in transistor radios) through a non-polarised capacitor. The use of transformer is essential for isolating the audio source from the circuit in The sensitivity control potentiometer VR1 provided in the input to transistor T1 may be adjusted to ensure that conduction takes place only after the AF exceeds certain amplitude. This control has to be adjusted as per audio source level. The audio signal Proper earthing of the circuit is quite essential. The diode bridge provides pulsating DC output and acts as a guard circuit between the mains input and pulsating DC output. Extreme care is necessary to avoid any electric shock

P45. Audio level meter (vumeter)



This circuit uses just one IC and a very few number of external components. It displays the audio level in terms of 10 LEDs. The input voltage can vary from 12V to 20V, but suggested voltage is 12V.

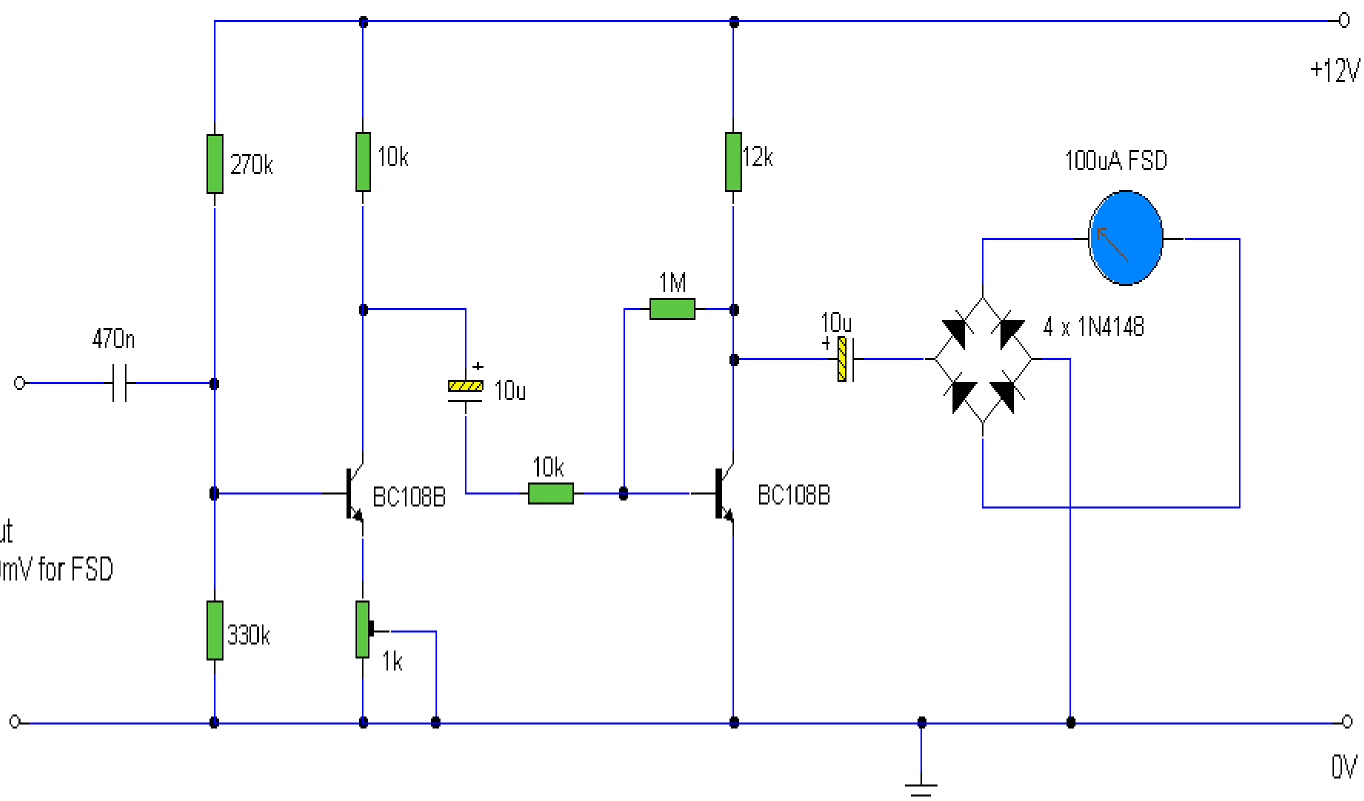
The LM3915 is a monolithic integrated circuit that senses analog voltage levels and drives ten LEDs providing a logarithmic 3 dB/step analog display. LED current drive is regulated and programmable, eliminating the need for current limiting resistors.

The IC contains an adjustable voltage reference and an accurate ten-step voltage divider. The high-impedance input buffer accepts signals down to ground and up to within 1.5V of the positive supply. Further, it needs no protection against inputs of ±35V. The input buffer drives 10 individual comparators referenced to the precision divider. Accuracy is typically better than 1 dB.

P46. Audio Level Meter

Description:

Audio levels can be monitored using a small panel meter with this circuit built from discrete components.



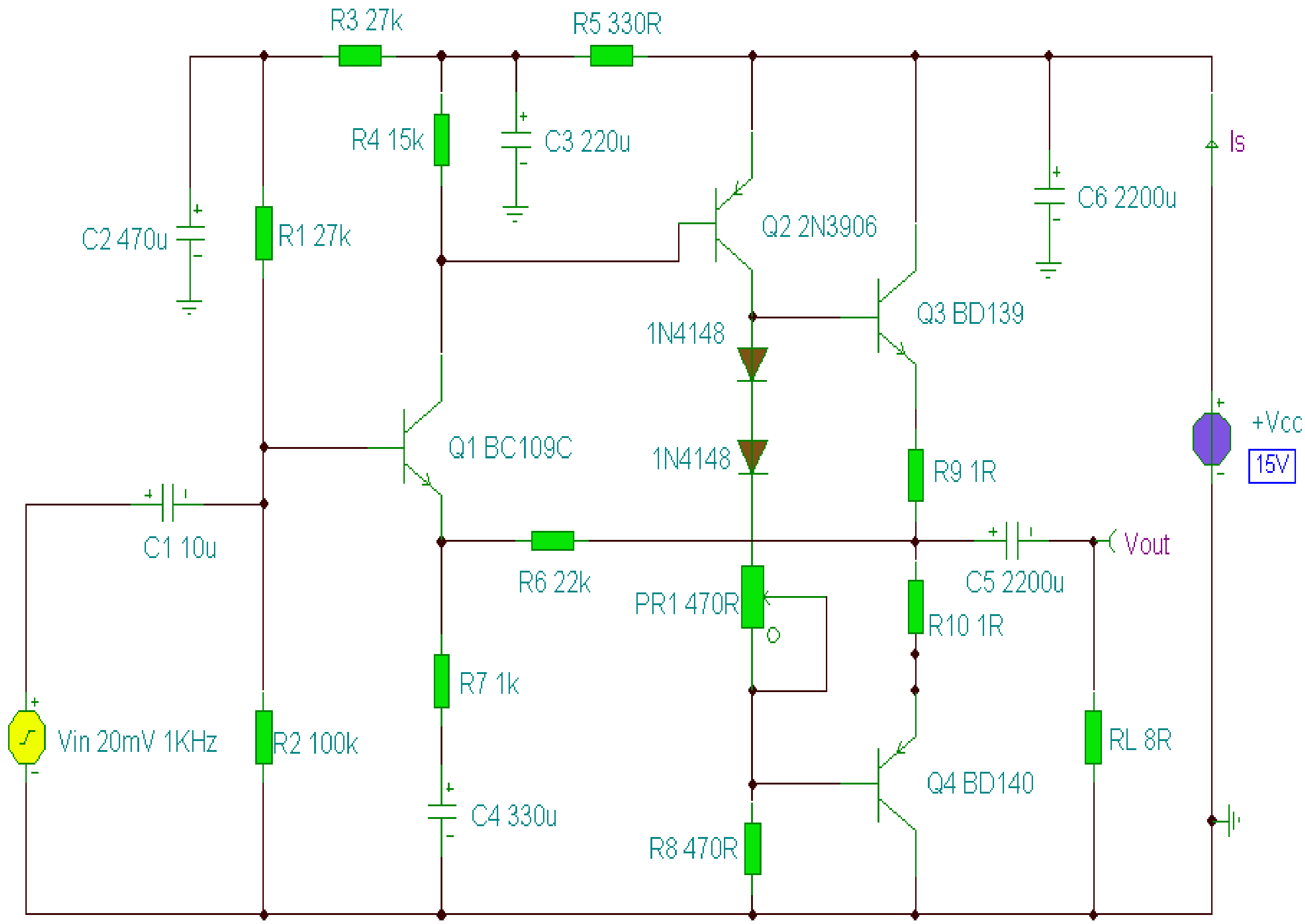
Notes:

The circuit has a flat frequency response from about 20Hz to well over 50Khz. Input sensitivity is 100mV for a full scale deflection on a 100uA meter. Built on two common emitter amplifiers, the first stage has a preset resistor which may be adjusted for a FSD. The last stage is biased to operate at roughly half the supply voltage for maximum ac voltage swing. Audio frequencies are passed through the 10u dc blocking capacitor and the full wave bridge rectifier converts the signal to a varying dc voltage. Note that the meter reading is instantaneous and will not provide a "peak" reading. A peak reading audio level meter is also available on this site click this link.

P47. 2 Watt Amplifier

Description:

A 2 Watt audio amplifier made from discrete components.

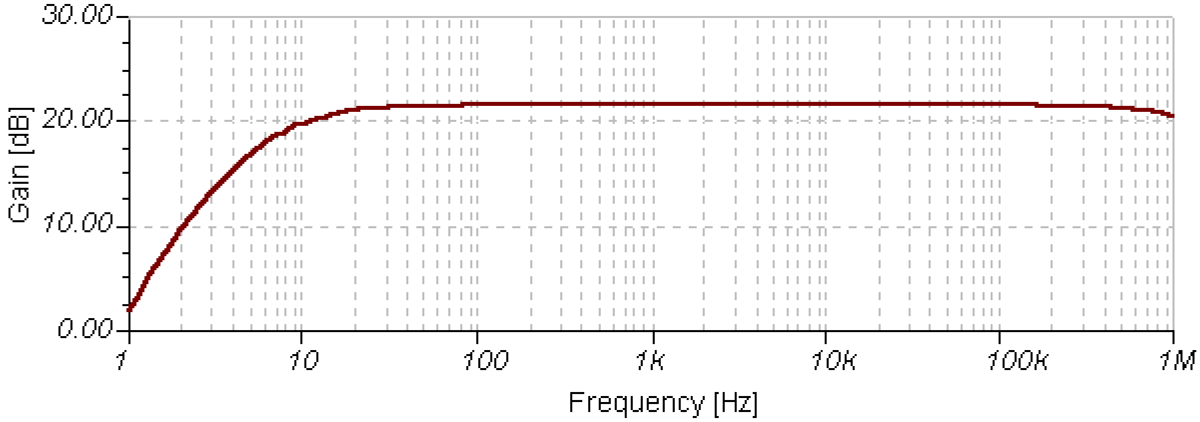


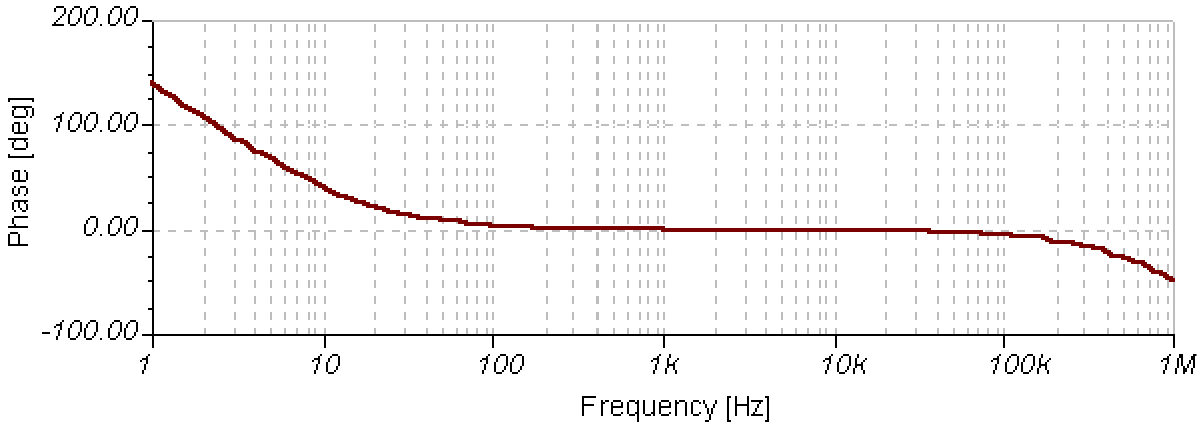
Notes:

This was one of the earliest circuits that I ever designed and built, in Spring 1982. At that time I had only an analogue meter and a calculator to work with. Although not perfect, this amplifier does have a wide frequency response, low harmonic distortion about 1.5%, and is capable of driving an 8 ohm speaker to output levels of around 5 watts with slightly higher distortion. Any power supply in the range 12 to 18 Volts DC may be used.

Circuit Description

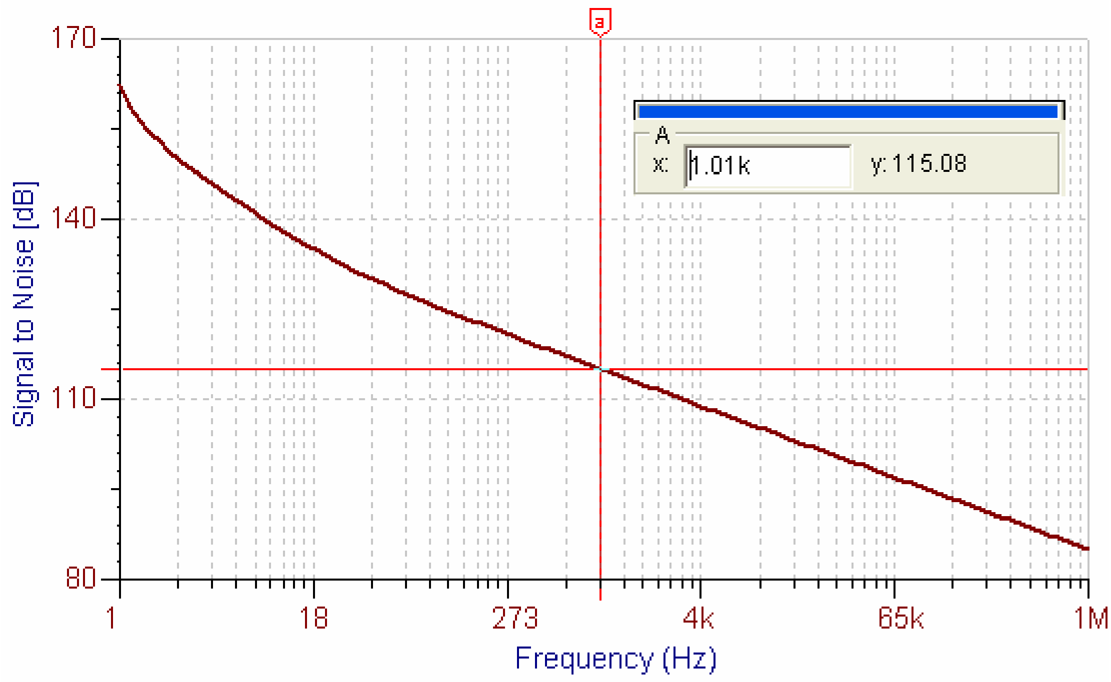
The amplifier operates in Class AB mode; the single 470R preset resistor, PR1 controls the quiescent current flowing through the BD139/140 complimentary output transistors. Adjustment here, is a trade-off between low distortion and low quiescent current. Typically, under quiescent conditions, current is about 15 mA rising to 150 mA with a 50 mV input signal. The frequency response is shown below and is flat from 20Hz to 100kHz:





The circuit is DC biased so that the emitters of the BD139 and BD140 are at approximately half supply voltage, to allow for a maximum output voltage swing. R9 and R10 provide a degree of temperature stabilisation which works as follows. Ifthe output transistors are warm, the emitter currents will increase. This causes a greater voltage drop across R9 and R10 reducing the available bias current. All four transistors are direct coupled which ensures:-
(i) A good low frequency response
(ii) Temperature and bias change stability.

The BC109C and 2N3906 operate in common emitter. This alone will provide a very high open loop gain. The output BD139/140 pair operate in emitter follower, allowing the amplifier to drive low impedance speakers. The signal to noise ration is shown below:

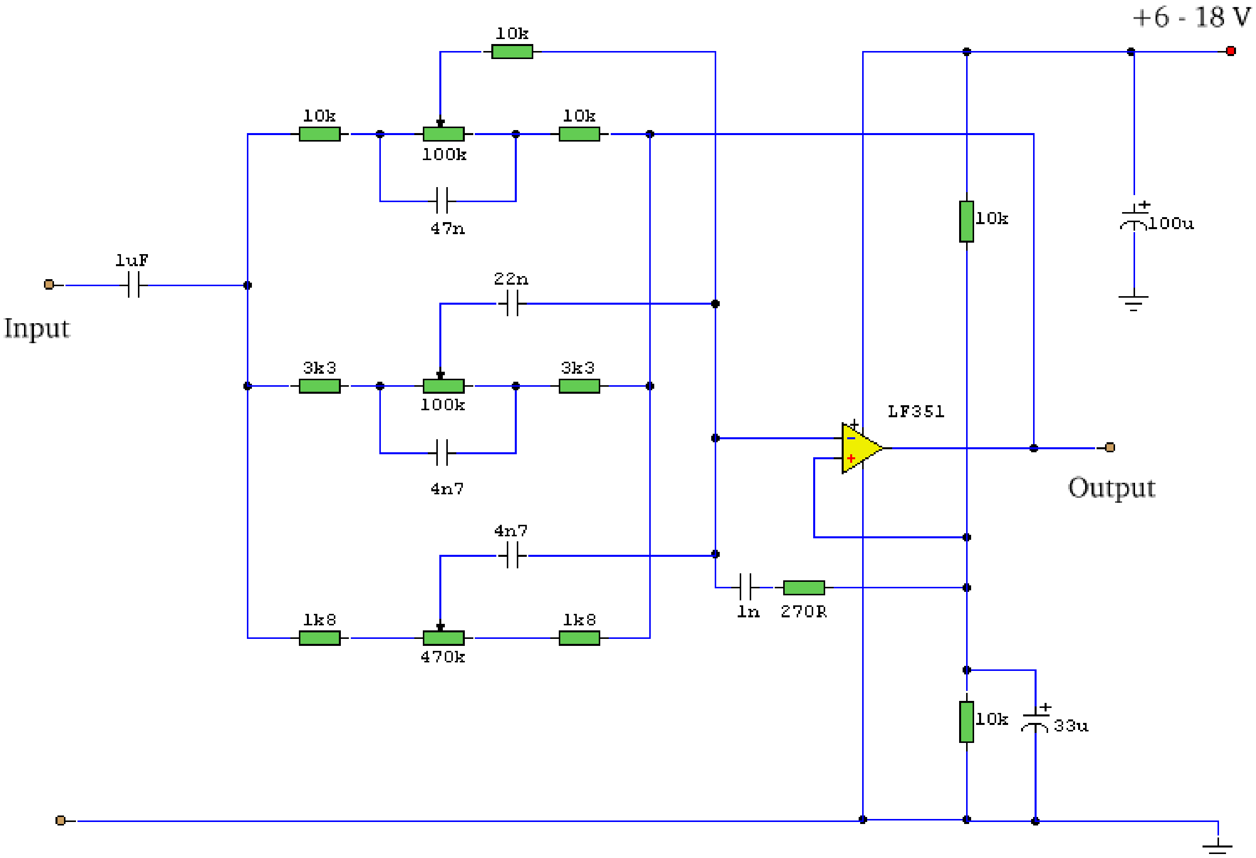


This amplifier has a S/n ratio of 115dB at 1kHz. Overall gain is provided by the ratio of the 22k and 1k resistor. A heat sink on the BD139/140 pair is recommended but not essential, though the transistors will run "hot" to the touch.

P48. 3 Band Equalizer

Description:

A tone control circuit made with a single op-amp and having three ranges, bass, middle and treble controls.



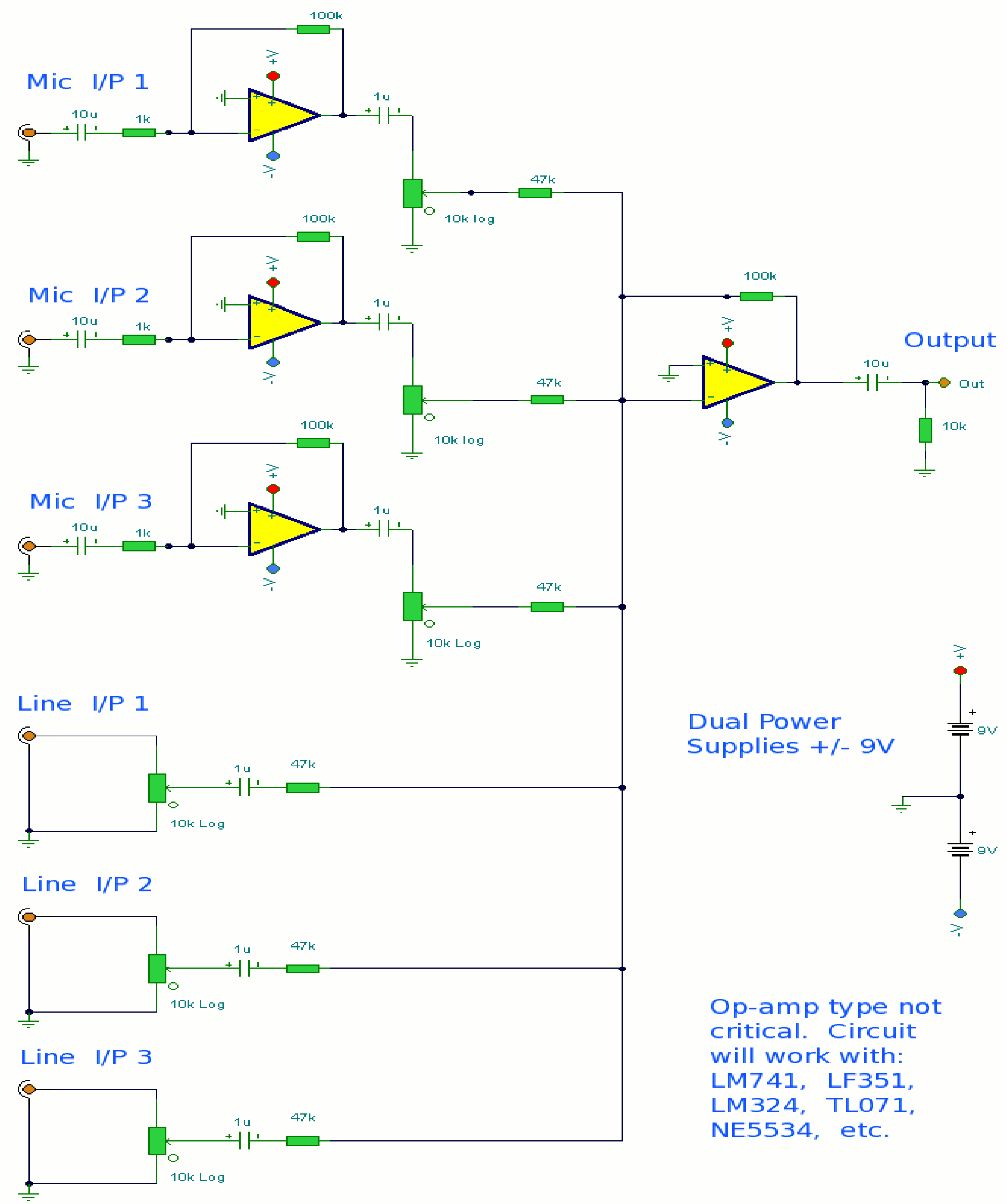
Notes:

Using a single op-amp this easy to make equalizer offers three ranges, low frequency,mid frequency,and high. With component values shown there is approximately 20dB of boost or cut at frequencies of 50Hz, 1kHz and 10kHz. Supply voltage may be anything from 6 to 30 Volts. Maximum boost 20dB is only realized with maximum supply voltage of 18 Volt.

P49. 6 Input Mixer

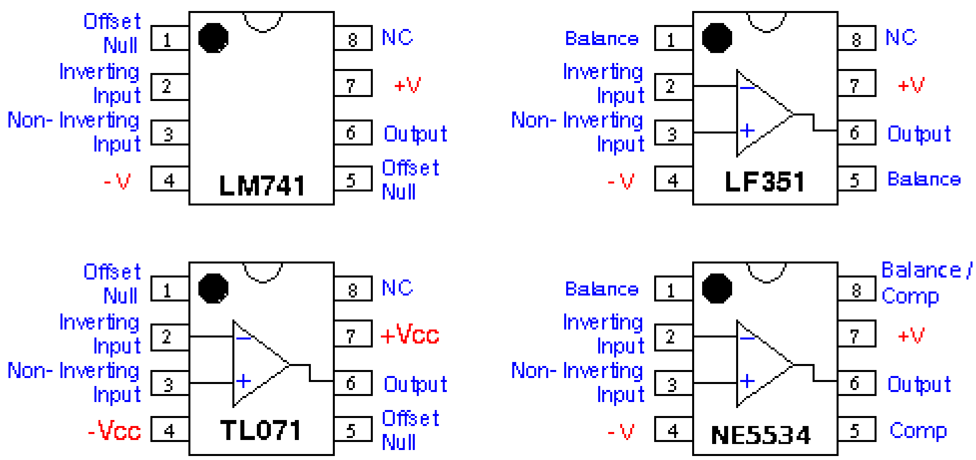
Description:

A simple mixer with 3 line inputs and 3 mic inputs using commonly available parts.



Notes:

The mixer circuit above has 3 line inputs and 3 mic inputs. The mic inputs are suitable for low impedance 200-1000R dynamic microphones. An ECM or condenser mic can also be used, but must have bias applied via a series resistor. As with any mixer circuit, a slight loss is always introduced. The final summing amplifier has a gain of 2 or 6dB to overcome this. The Input line level should be around 200mV RMS. The Pinouts for LM741, LF351 ,TL071 and NE5534 are shown below. Pinouts for other IC's can be found on the pinout page.



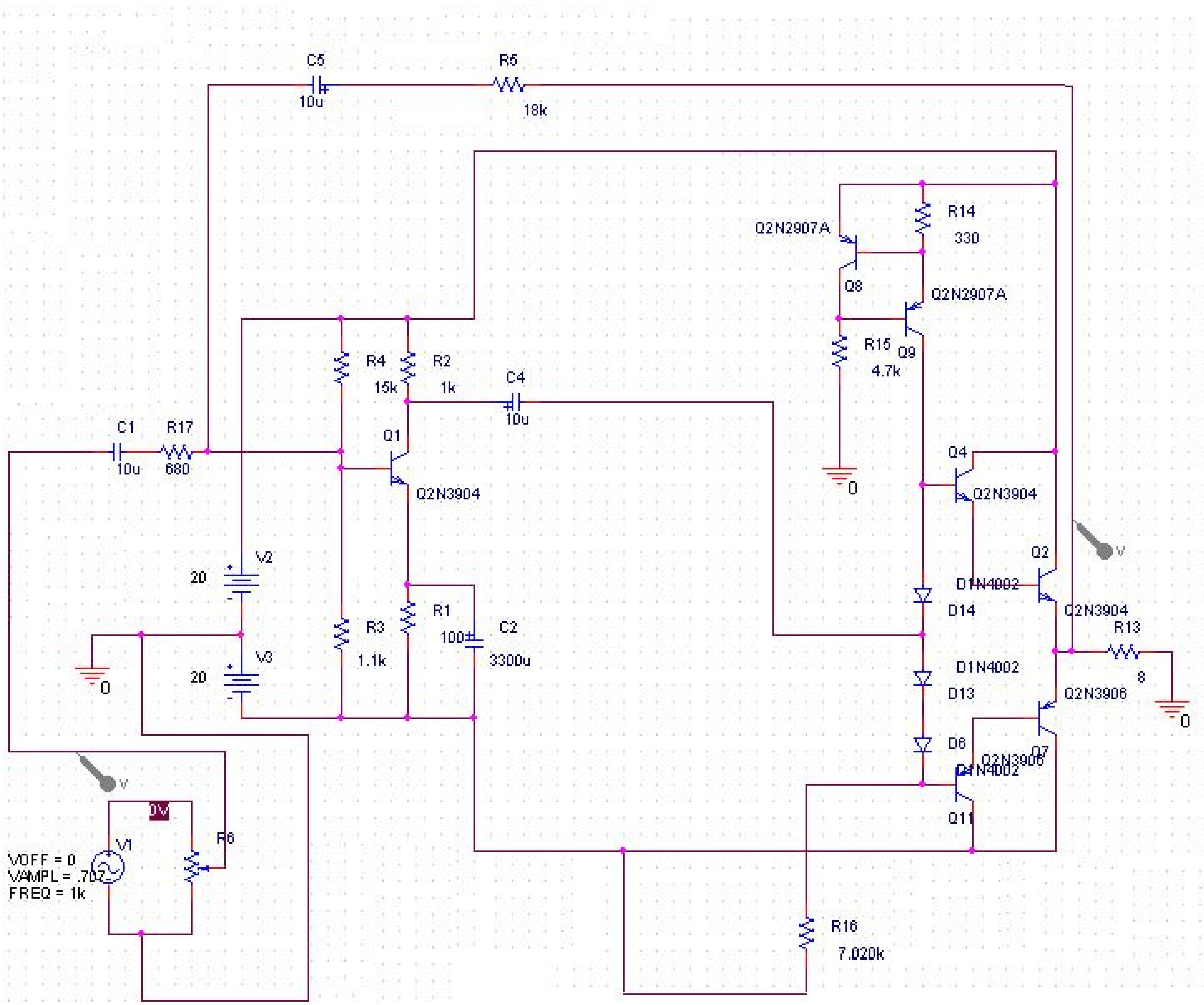
The mic inputs are amplified about 100 times or 40dB, the total gain of the mixer including the summing amplifier is 46dB. The mic input is designed for microphones with outputs of about 2mV RMS at 1 meter. Most dynamic microphones meet this standard.

The choice of op-amp is not critical in this circuit. Bipolar, FET input or MOS type op-amps can therefore be used; i.e 741, LF351, TL061, TL071, CA3140 etc. The power supply is a dual positive and negative supply, two 9 Volt batteries may be used as shown above or a power supply is recommended for longer periods of use.

P50. 15 Watt Amplifier

Description:

A 15 watt amplifier made using discrete components. Sergio designed this circuit for his Electronics Level II course.



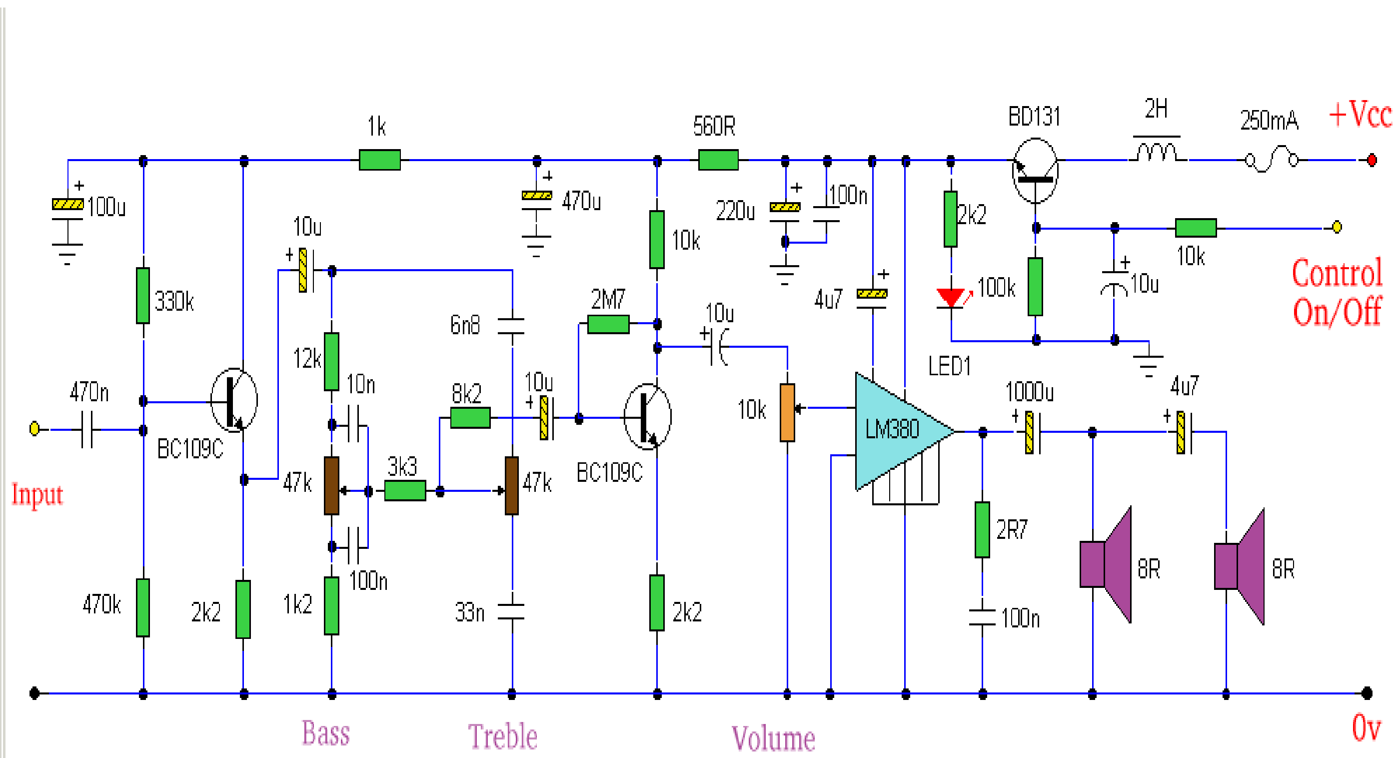
Notes:

This amplifier uses a dual 20 Volt power supply and delivers 15 watts RMS into an 8 ohm load. Q1 operates in common emitter, the input signal being passed to the bias chain consisting of Q8, Q9, D6, D13 and D14. Q8 and Q9 provide a constant current through the bias chain to minimize distortion, the output stage formed by a discrete darlington pair (Q2,Q4) and (Q7,Q11). The last two transistors are power Transitors, specifically the 2N3055 and MJ2955. The 7.02K resistor, R16 was made using a series combination of a 4.7K, 680 Ohms, and two 820 Ohms. The 1.1K resistor, R3 was made using a 100 Ohms and a 1K resistor. You can use this circuit with any walkman or CD player since it is designed to take a standard 500mv RMS signal.

P51. Amp with Tone Controls & Soft Switching

Description:

Built around an LM380, this amplifier includes tone controls and electronic "soft switching". The soft switching circuitry ensures power is built up gradually eliminating the dc thump.



Notes:

The soft switching is enabled by a BD131 transistor wired as a switch in emitter follower configuration. The collector is wired to a permanent supply voltage, the 2H series inductor serves only to filter out power supply hum. This inductor is not too important and may be omitted if the DC supply is adequately smoothed. The control voltage is applied to the BD131 base terminal, the 10u capacitor and 10k resistor

having a dual purpose:-
i) a gradual charge of the 10u capacitor ensures that the transistor will switch linearly from 0 volts to full supply, and
ii) serves as a hum filter ensuring a very smooth dc supply to the amplifier and tone controls.
LED1 will light when the amplifier is on. The control voltage should ideally be 0 volts when the amplifier is off and full supply voltage when on. The LM380 is shown driving two 8 ohm loupspeakers, the load is therefore 4 ohms. The 4u7 capacitor acts as a crude crossover, lower frequencies are impeded and so this loudspeaker may be a "tweeter" type.

Tone Controls:

The input of this is amplifier is via a tone control based on the baxendall design. The first BC109C serves as a buffer, offering a high input impedance. The output signal fed via a 10u capacitors reaches the tone control network. This passive network of resistors and capacitors attenuates high and low frequencies. The bass control is centered on 100Hz

P52. Audio Voice-Over Circuit

Description:

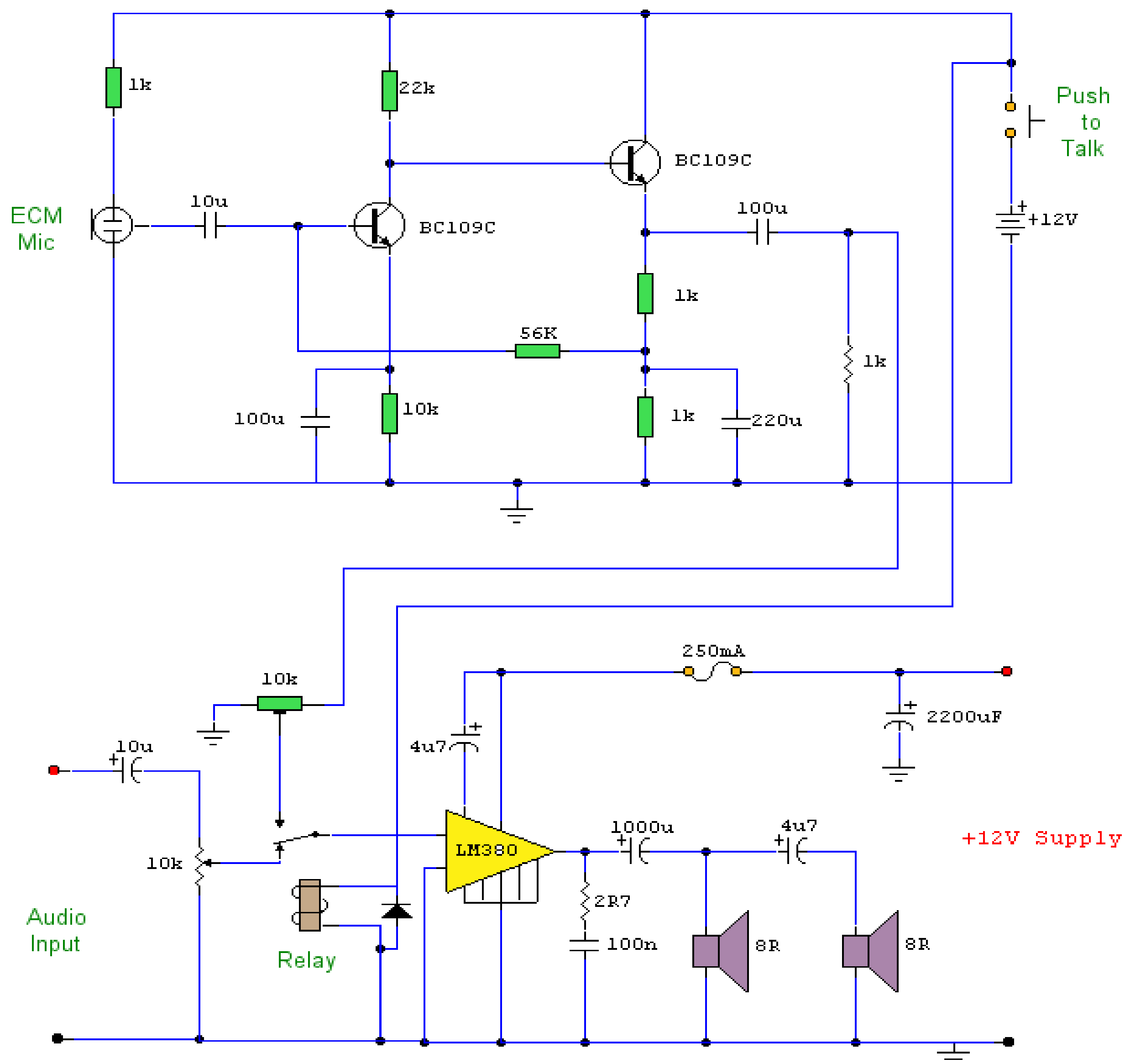
This is a circuit where a microphone and preamp circuit (voice circuit) have priority over any other audio signal. You can think of this as a one way intercom, if the main amplifier is used for listening to music, then when the push to talk switch is pressed, the amplifier is switched to the voice signal.

Application Notes:

In its simplest form, a voice-over unit is just a microphone and change-over switch feeding an amplifier, the output from the microphone having priority over the amplifiers audio signal when the "push-to-talk" switch is pressed. In this circuit, a preamplifier immediately follows the microphone and is designed to be used some distance away from the main amplifier. The changeover switch is nothing more than a relay with a single changeover contact. For completion, an amplifier based on the LM380 is shown. Three wires are needed to connect the remote microphone unit to the amplifier and switching unit.

Circuit Notes:

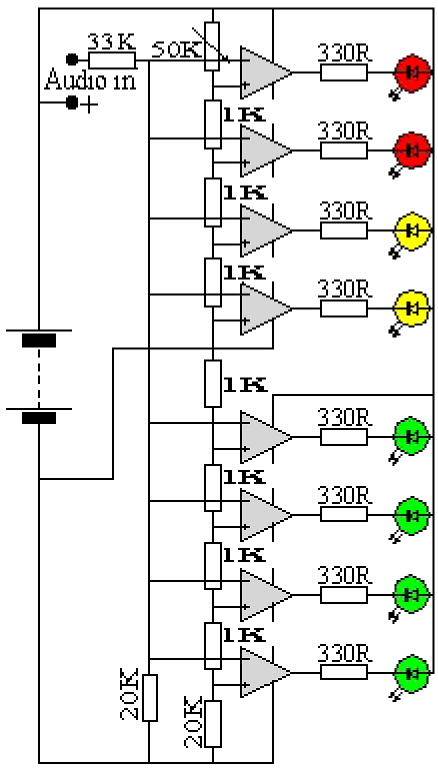
With reference to the above schematic, the two BC109C transistors are used to make a microphone preamplifier. The left hand BC109C operates in common emitter mode, the right hand emitter follower. The combination form a high gain, low output impedance amplifier, capable of driving a long audio cable. Screened cable is not required as the output impedance from the microphone pre-amp is very low, and will be immune to mains hum and background noise. The input is shown as a three wire Electret Condenser Microphone though two wire ECM's may also be used. The output of the pre-amp is via a 100uF capacitor and 1k resistor. The 1k resistor here plays an important role, eliminating the dc component of the audio output. (See also eliminating the DC "thump" also on this web site.) A cable of three or more wires is wired to the remote amplifier. The amplifier shown here is based on the National Semiconductor LM380. The input signal is passed via the normally closed contact of a changeover relay, the 10k potentiometer being the volume control for the audio input source. The 10k preset at the normally open contact allows volume control of the voice input, note that this signal has by-passed the normal volume control. At the remote end, when the push-to-talk switch is pressed, the relay will operate and the "voice" signal will be heard in the speaker. There will be no "thump" or "thud" on voice-over as direct current has been eliminated as already mentioned. A suitable application for this circuit would be for use in a remote location such as a workshop or shed.

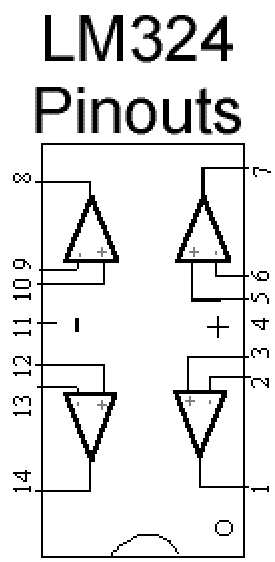


1k
22k
BC109C
Push
to
Talk
ECM
Mic
10u
BC109C
100u
+12V
1k
56K
1k
100u
10k
1k
220u
10k
250mA
10u
4u7
2200uF
10k
1000u
4u7
+12V Supply
LM380
2R7
Audio
Input
Relay
100n
8R
8R

P53. Audio VU Meter

Description:
This circuit uses two quad op-amps to form an eight LED audio level meter. The op-amp used in this particular circuit is the LM324. It is a popular IC and should be available from many parts stores.





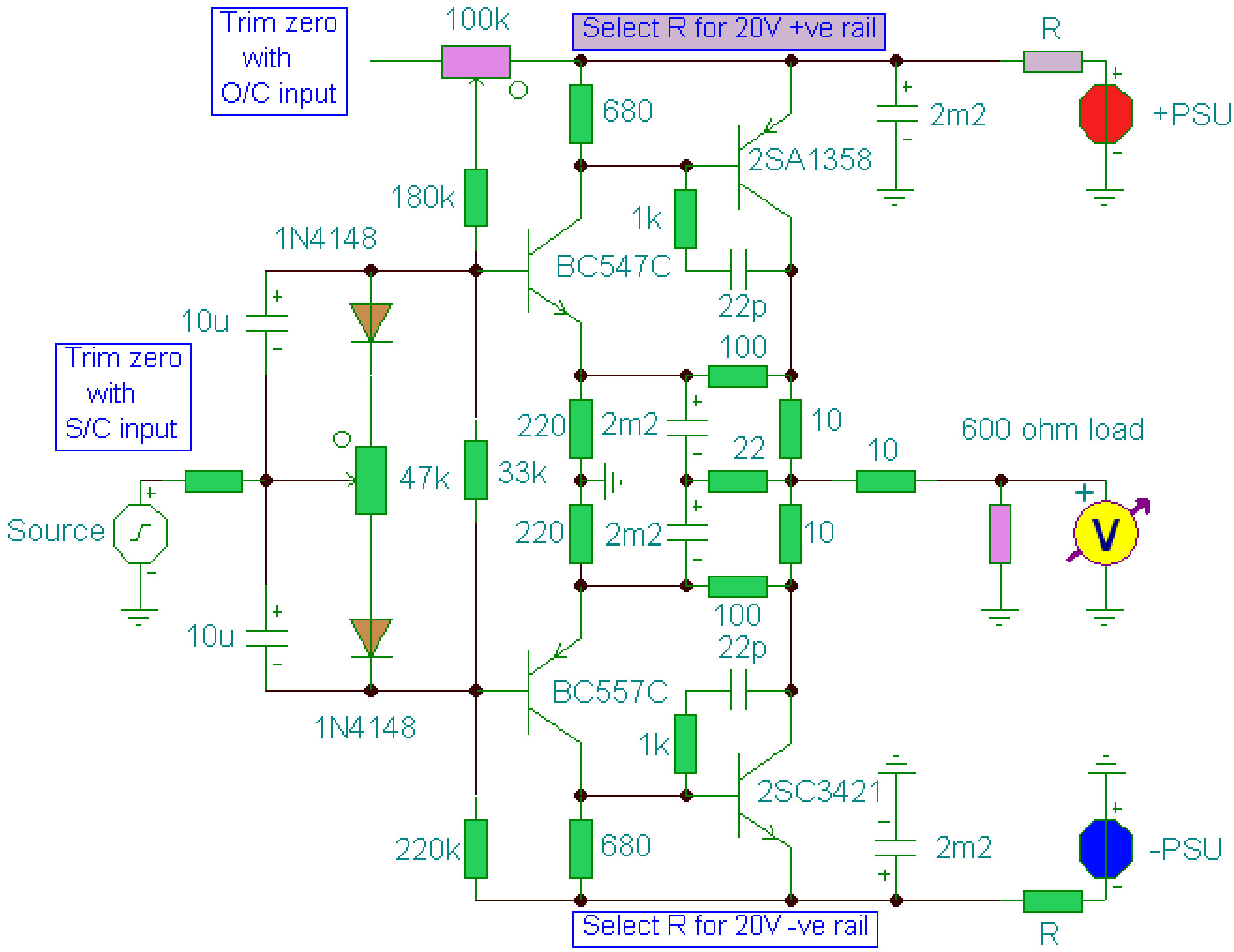
Notes
The 1K resistors in the circuit are essential so that the LED's turn on at different audio levels. There is no reason why you can't change these resistors, although anything above 5K may cause some of the LED's to never switch on. This circuit is easily expandable with more op-amps, and is not limited to use with the LM324. Pretty much any op-amp will work as long as you look up the pinouts and make sure everything is properly connected.

The 33K resistor on the schematic is to keep the signal input to the circuit at a low level. It is unlikely you will find a 33K resistor, so the closest you can get should do. The value of this resistor may need to be changed, so it is best you breadboard this circuit before actually constructing it on PCB. The circuit in it's current form will accept line level inputs from sources such as the aux out on a Hi-Fi, all though could be easily modified to accept speaker inputs.

The audio + is connected to the main positive rail, while the audio - is used for signal input. The 50k pot can be used to vary the sensitivity of the circuit.

P54. Buffer Amplifier

Description:
A hifi preamplifier designed to convert high output impedance amplifiers to 600 ohm outputs.

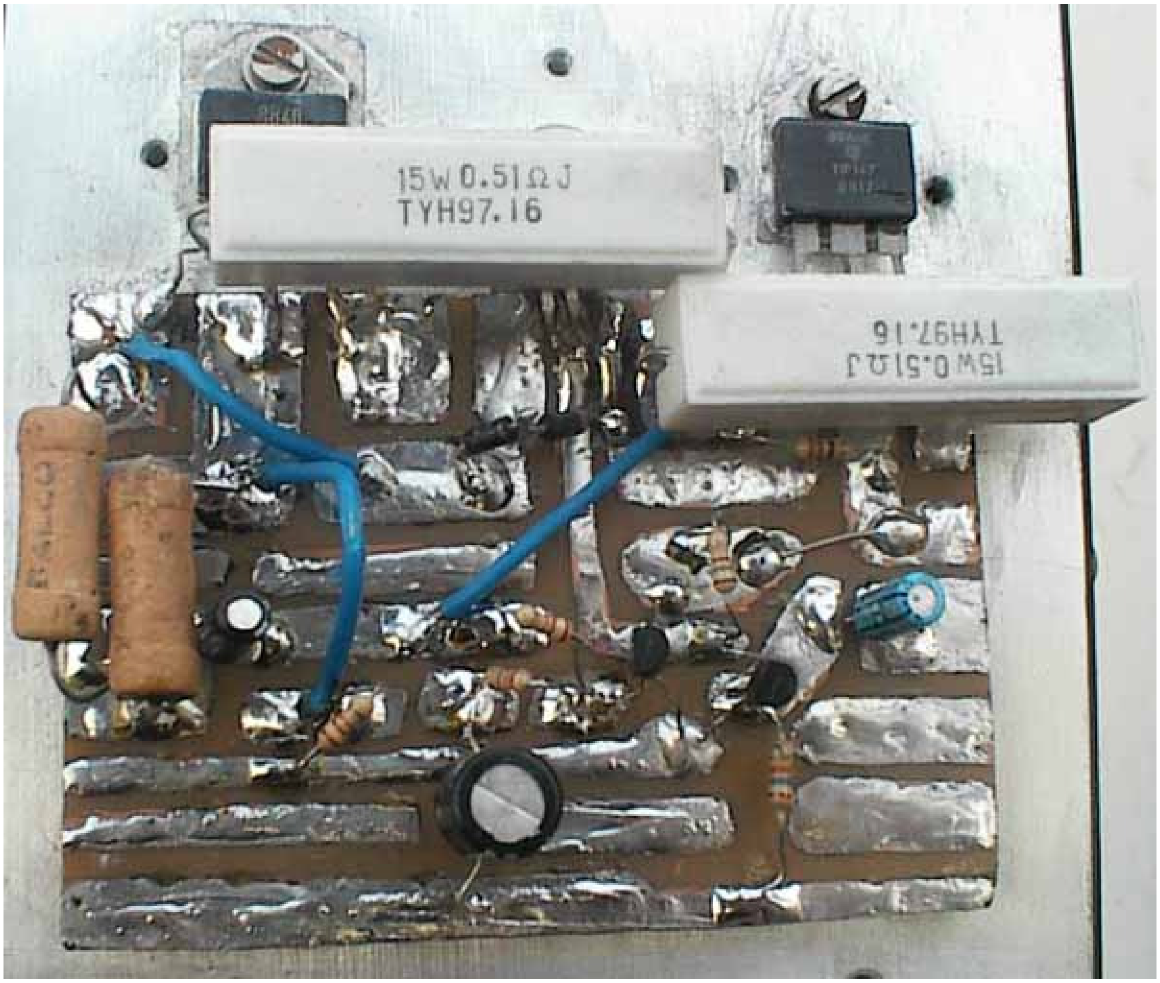


Buffer Circuit: To drive a feeder with 600 ohm load.

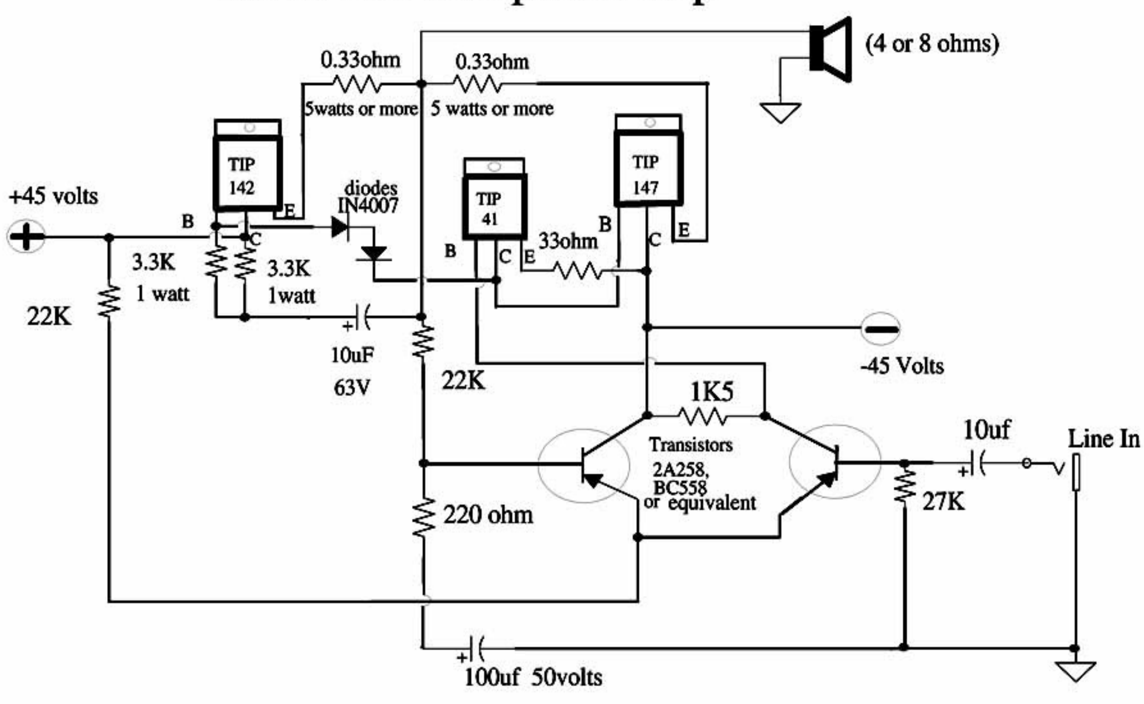
May be used to convert a 600 ohm amplifier to 100k (tube like) input impedance.

Finished Buffer Amplifier

P55. Cheap 100 to 150 Watt Amp



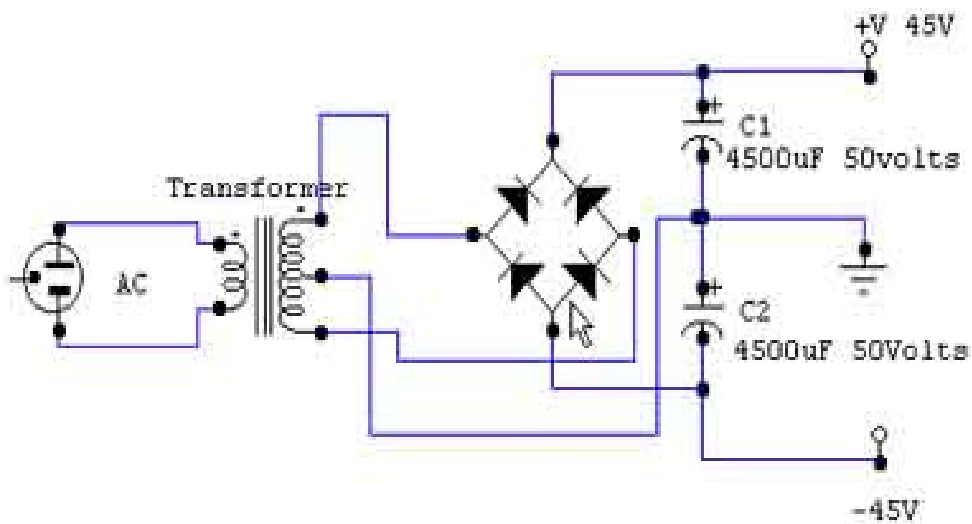
100 to 150 watt power amp



Note : This circuit was handed down to me from a friend of a friend.
It works amazingly well and is cheap to make.
It is so simple that I have even built it without a PCB.
The power is dependent on how much
voltage you put in it so it also depends on what Darlington's you use.

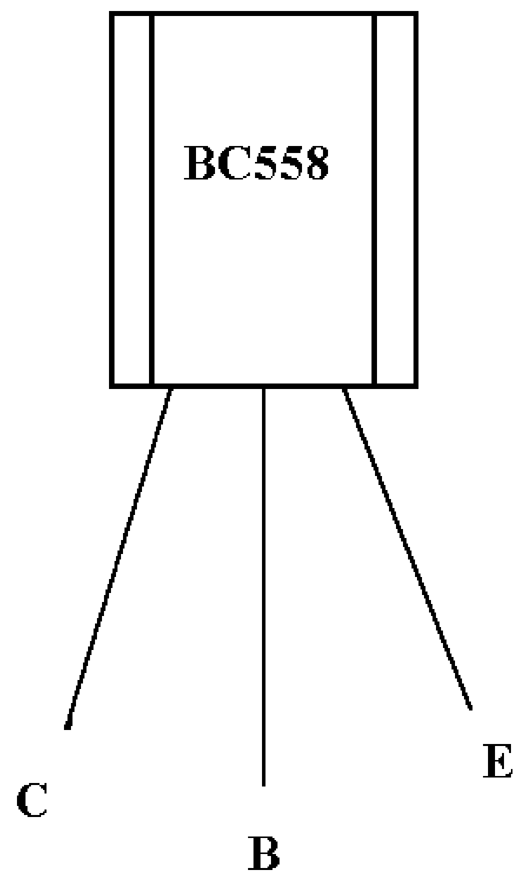
SPLIT POWER SUPPLY

The transformer primary is 110V or 220V depending on your wall voltage.
The secondary is 35V + 35V AC. Transformer should be about 4 amperes.
Once it is rectified you will get about 45V + 45V DC volts.
The diodes should be rated at 3 amperes and for at least 100 volts.



Here is a suggested circuit for the power supply.

Front view with flat side facing you

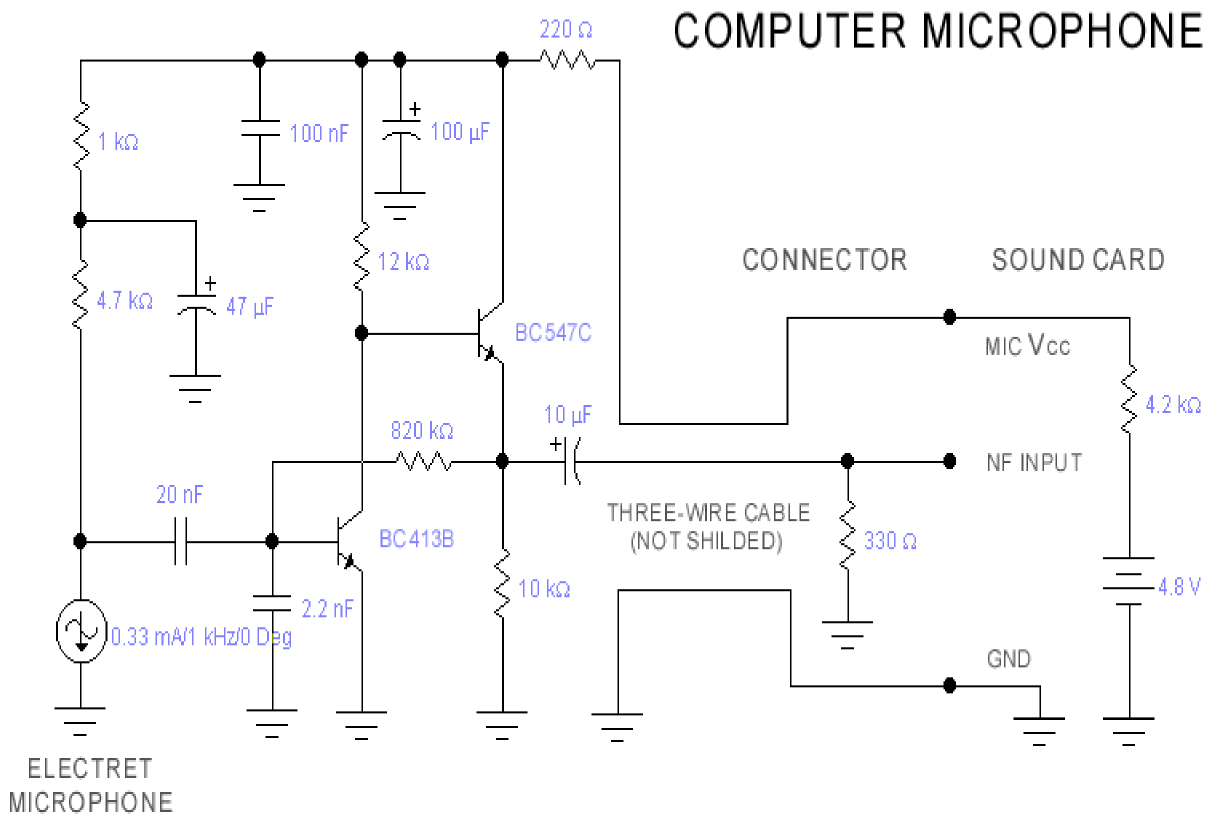


Please note:

I have been getting some e-mail's from people with problems to discover that there is a discrepancy with the pinouts on the BC558.

If you look up in the cross reference of the ECG or NTE semiconductor manual, you will notice that the BC558 substitute will differ in the pin configuration from the stock BC558. This goes for the BC549, BC549 and the majority of the BC transistors. So if you are using a BC558, please refer to my above drawing for the pinouts.

P56. Computer Microphone



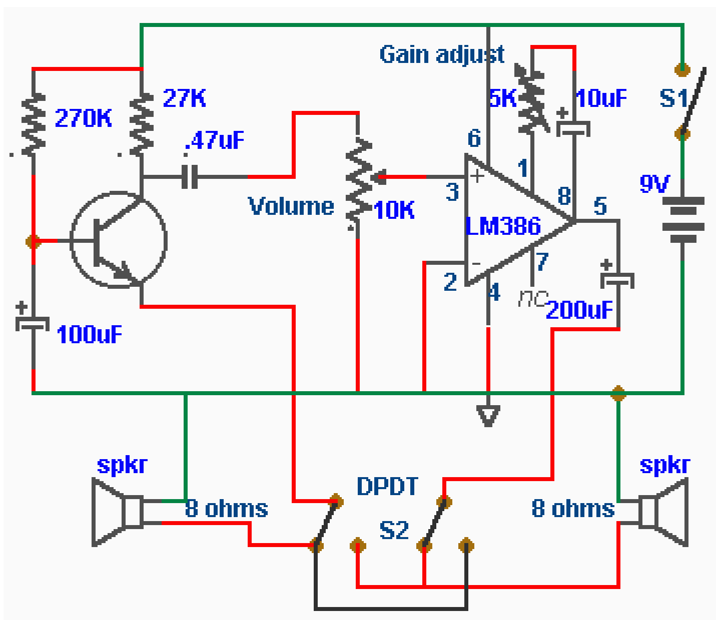
Notes

This circuit was submitted by Lazar Pancic from Yugoslavia. The sound card for a PC generally has a microphone input, speaker output and sometimes line inputs and outputs. The mic input is designed for dynamic microphones only in impedance range of 200 to 600 ohms. Lazar has adapted the sound card to use a common electret microphone using this circuit. He has made a composite amplifier using two transistors. The BC413B operates in common emitter to give a slight boost to the mic signal. This is followed by an emitter follower stage using the BC547C. This is necessary as the mic and circuit and battery will be some distance from the sound card, the low output impedance of the circuit and screened cable ensuring a clean signal with minimum noise pickup.

P57. Doorphone Intercom

Description:

A simple 2 way Intercom based on the LM386386 using 8 ohm speakers.



Notes:

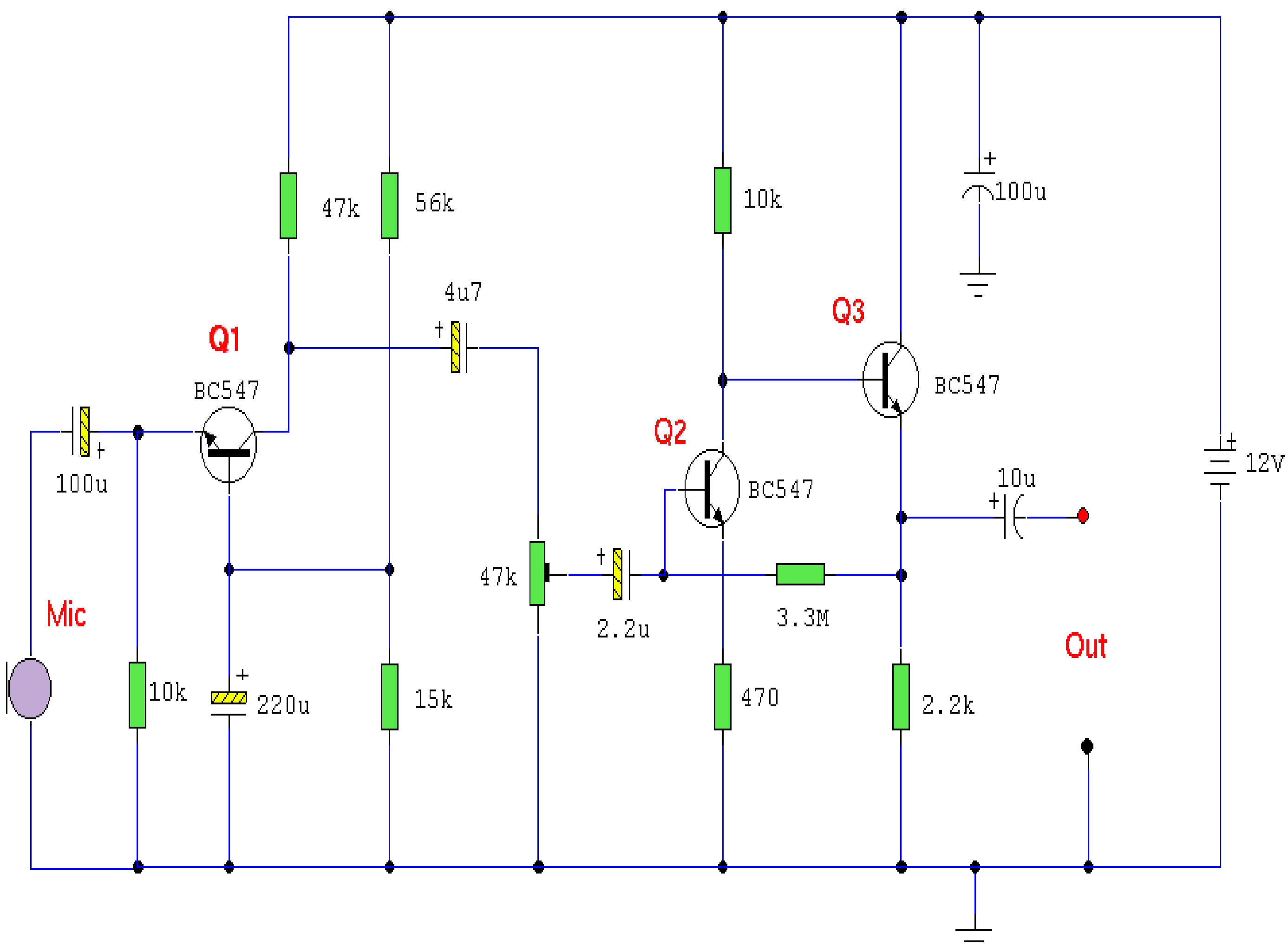
For the first time, this circuit was designed by two authors, Mr Laurier Gendron of Burnaby in British Columbia, Canada, and myself. Please make sure you visit Laurier's web site, Handy Dandy Little Circuits. This page is also available in French by clicking on the flag.

In this doorphone circuit, an 8 ohm speaker is used both as a microphone and also an output device. The BC109C stage amplifies in common base mode, giving good voltage gain , whilst providing a low impedance input to match the speaker. Self DC bias is used allowing for variations in transistor current gain. An LM386 is used in non-inverting mode as a power amplifier to boost voltage gain and drive the 8 ohm speaker. The 10k potentiometer acts as the volume control, and overall gain may be adjusted using the 5k preset. The double pole double throw switch, reverses the loudspeaker positions, so that one is used to talk and the other to listen. Manually operating the switch (from inside the house) allows two way communication.

P58. Dynamic Microphone Preamp

Description:

A low noise pre-amplifier suitable for amplifying dynamic microphones with 200 to 600 ohm output impedance.

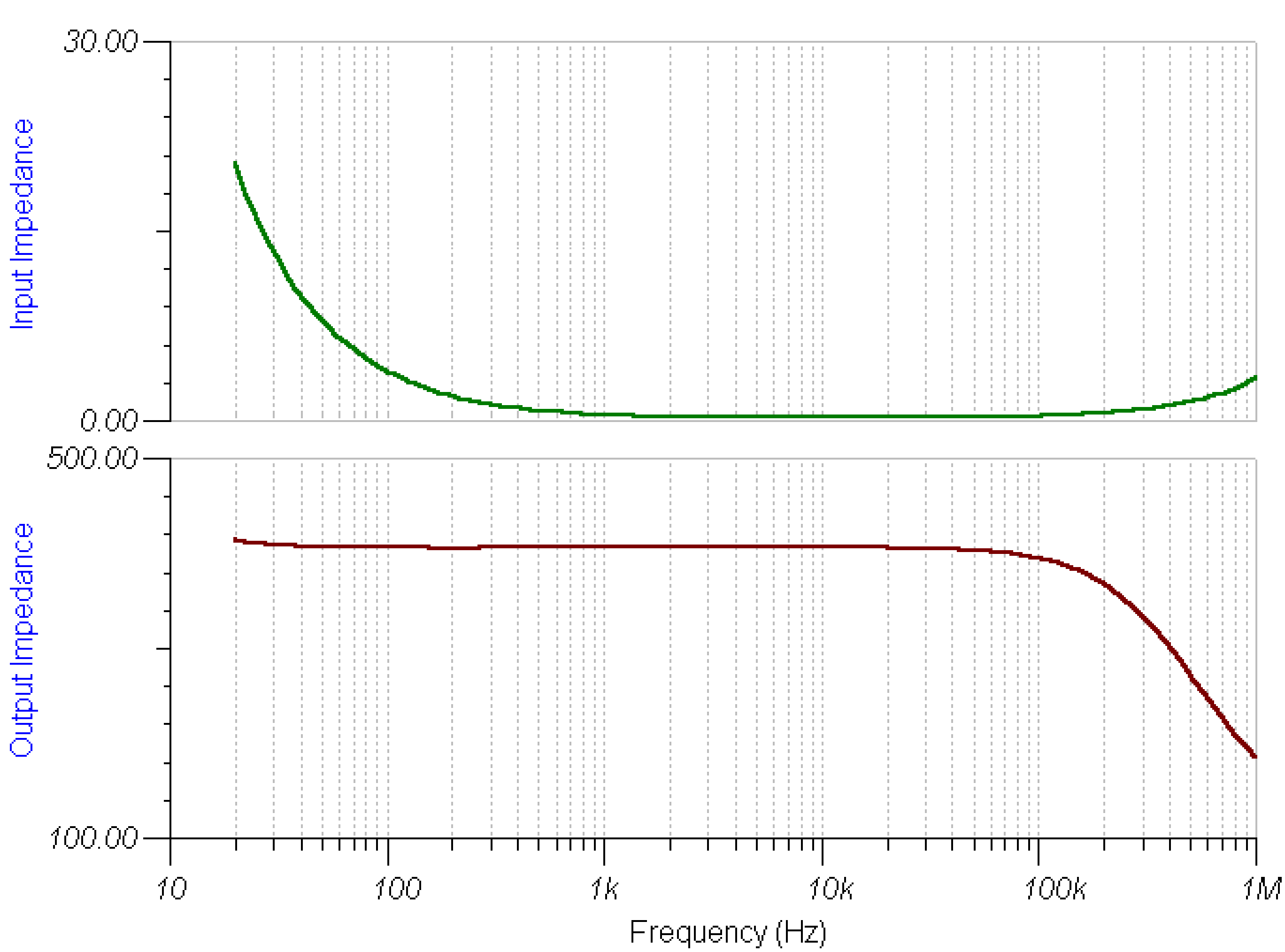


Notes:

This is a 3 stage discrete amplifier with gain control. Alternative transistors such as BC109C, BC548, BC549, BC549C may be used with little change in performance. The first stage built around Q1 operates in common base configuration. This is unusable in audio stages, but in this case, it allows Q1 to operate at low noise levels and improves overall signal to noise ratio. Q2 and Q3 form a direct coupled amplifier, similar to my earlier mic preamp.

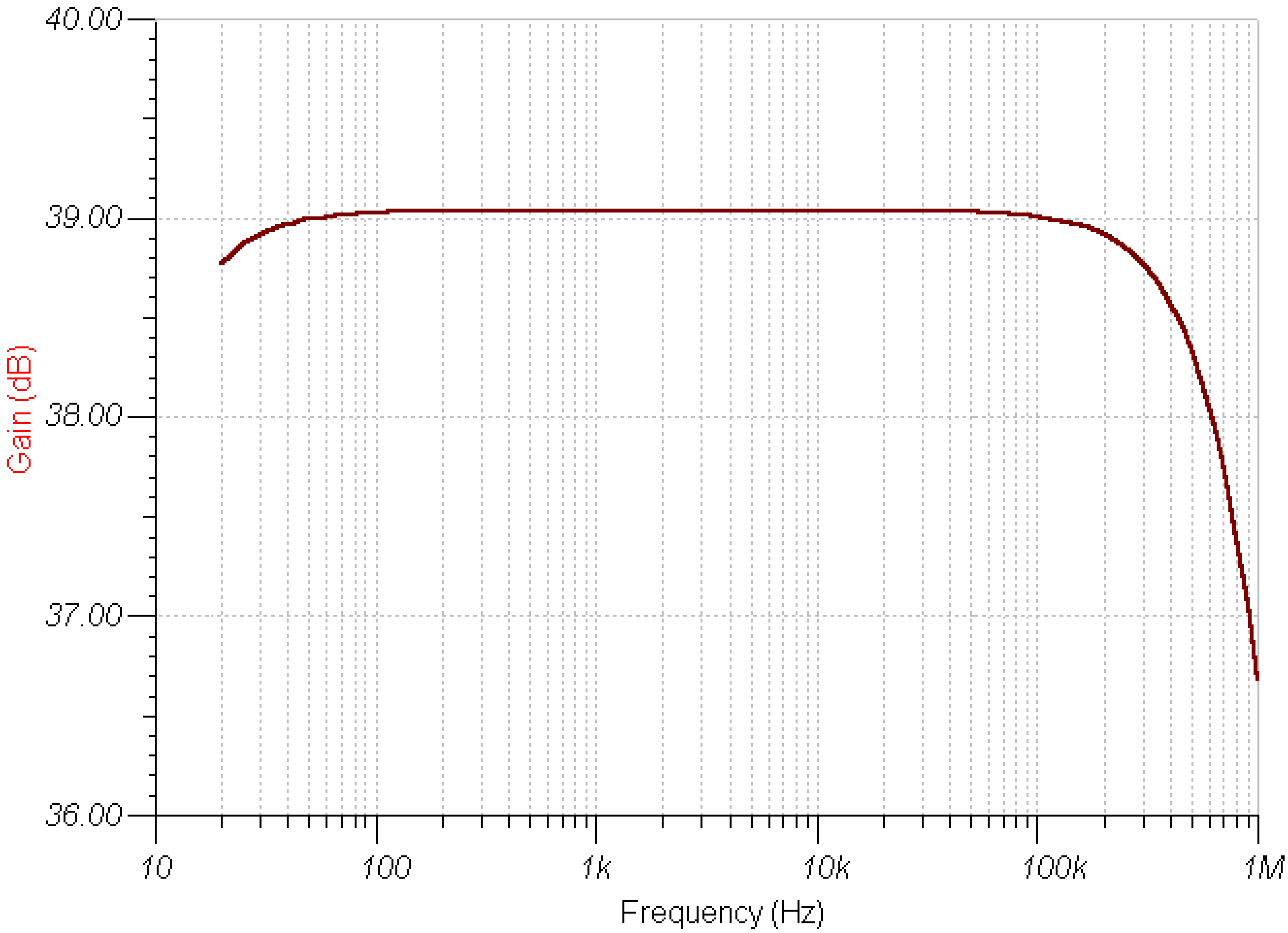
Input and Output Impedance:

As the signal from a dynamic microphone is low typically much less than 10mV, then there is little to be gained by setting the collector voltage voltage of Q1 to half the supply voltage. In power amplifiers, biasing to half the supply voltage allows for maximum voltage swing, and highest overload margin, but where input levels are low, any value in the linear part of the operating characteristics will suffice. Here Q1 operates with a collector voltage of 2.4V and a low collector current of around 200uA. This low collector current ensures low noise performance and also raises the input impedance of the stage to around 400 ohms. This is a good match for any dynamic microphone having an impedance's between 200 and 600 ohms. The output impedance at Q3 is low, the graph of input and output impedance versus frequency is shown below:



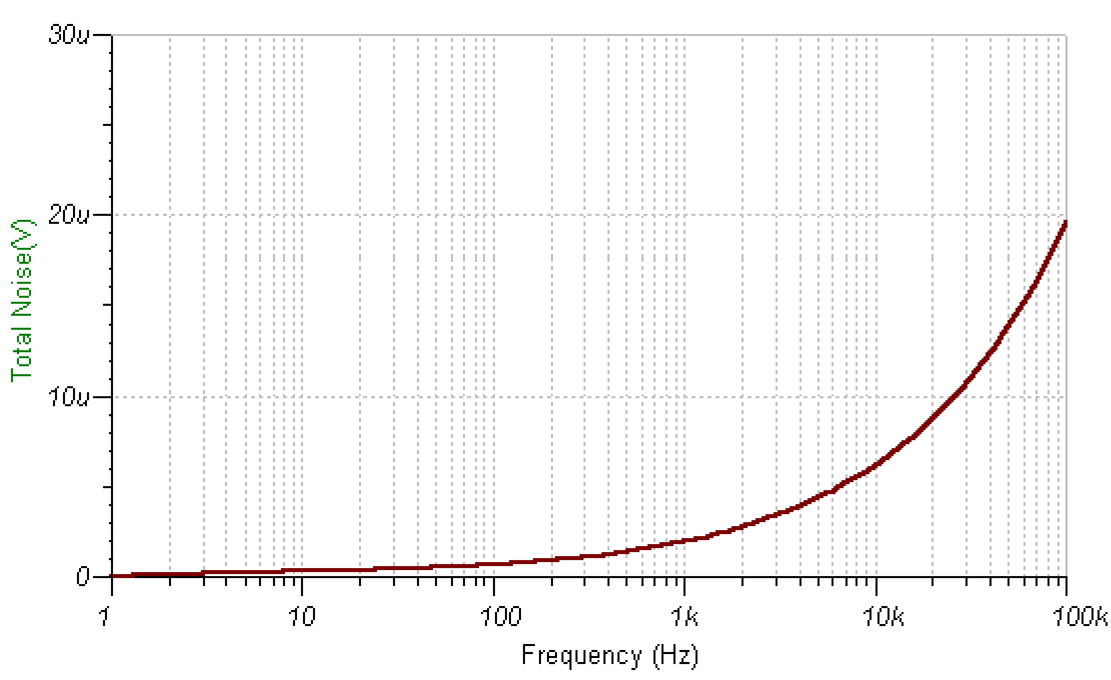
Gain and Frequency Response:

The overall gain of this pre-amplifier is around +39dB or about 90 times. The first stage Q1 has a gain of roughly Rc / Re or 4.7. This is however reduced by feeding into the input impedance of Q2 and Q3, and the shunt formed by the 47k preset. The amplifier formed with Q2 and Q3 has a gain of roughly Rc / Re as Q3 is an emitter follower and has unity gain. The gain of Q2 and Q3 is roughly 10 / 0.47 = 21 and overall gain therefore 4.7 x 21 = 98. The gain of the circuit may be reduced to 0 by the 47k preset. The response is flat to 100kHz, low frequency rolloff at 30Hz, a simulated plot is shown below:

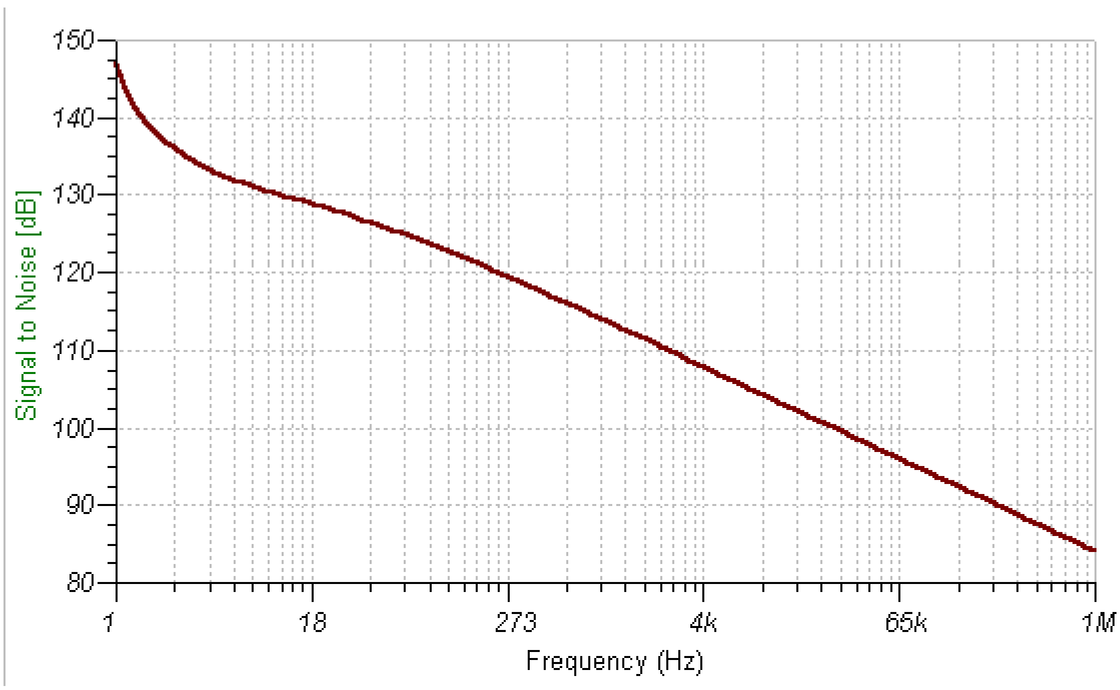


[Output Noise and Overall S/N Ratio:]

Any amplifier will add its own noise to the signal, degrading the overall performance. The noise of this preamp measured with a 10k load resistor is shown below.



The Signal to Noise ratio is shown below. Note that the input was simulated as a 200 ohm source at 1 mV amplitude.



[Bias Conditions and Operating Point:]

The first stage, Q1 was designed to operate with a collector current of 200 uA. With 15k and 47k bias resistors and a 12 V supply voltage the base voltage will be 12 x (15 / (15+47)) = 2.9 Volts. The emitter voltage will be the base voltage -0.7 V or 2.2 V. For a 200 uA collector current the emitter resistor will be 2.2 / 0.2 mA =11k. A 10k resistor was used. As Ic and Ie are approximately equal then the collector voltage is 12 - (0.2 * 47) = 2.6 V.

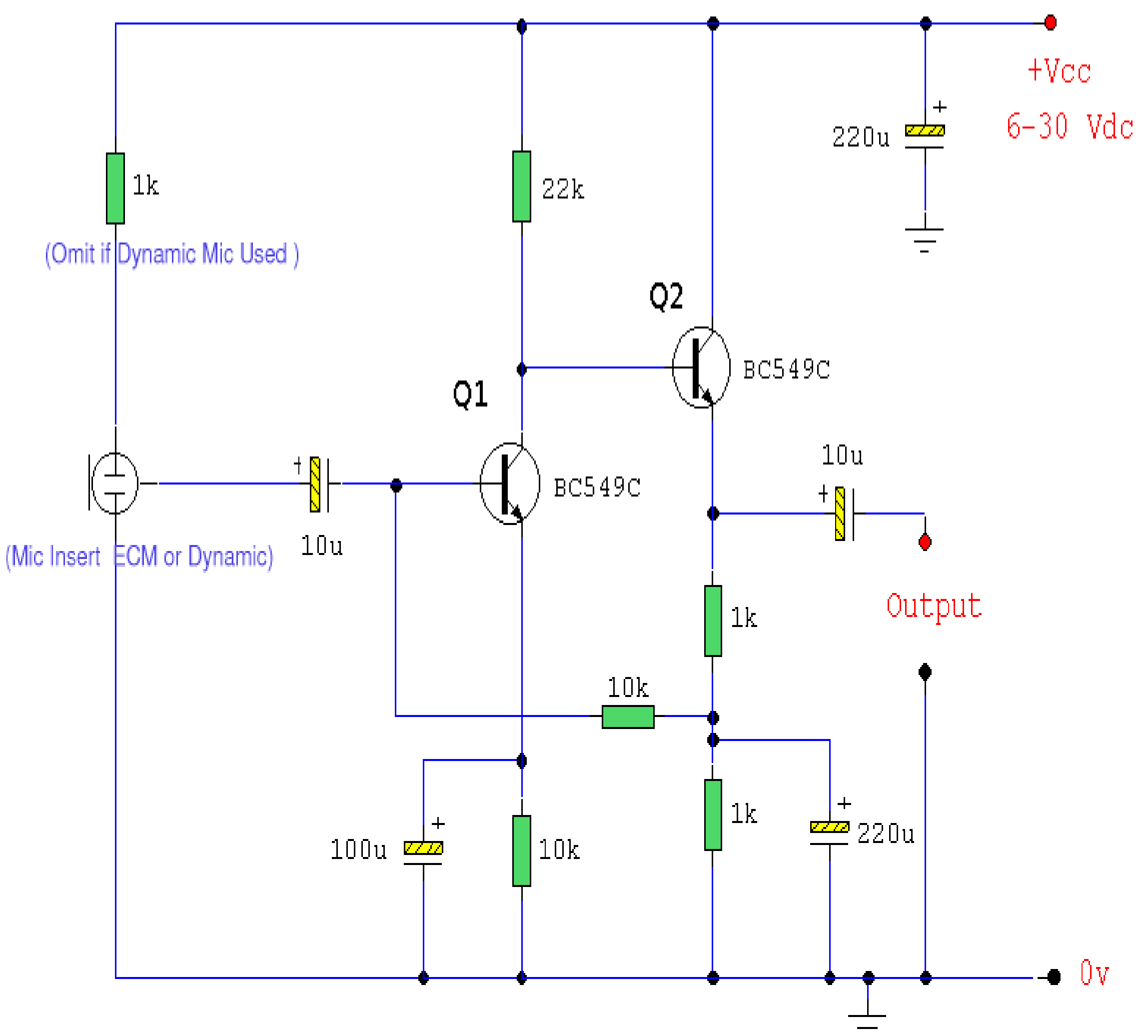
The last stage is a composite amplifier similar to my ECM preamp. Q2 operates in common emitter and provides the voltage gain while Q3 operates in emitter follower, buffering the output and has a low impedance output, suitable for driving long cables, if required. The last stage, Q3 was designed for maximum voltage swing, hence Q3 emitter voltage should be around 6V. Variation in transistor parameters however, means that measured voltages will be different to calculated voltages.

Q2 collector voltage is a base-emitter voltage drop higher or 6.7 V and collector current is set at (12 - 6.7) / 10k = 530 uA. This is also the emitter current for Q2 and hence emitter voltage will be (0.53 * 0.47) = 0.24 V. The base voltage will be higher by 0.7 V. As the base of Q2 is connected to the emitter of Q3, then the biasing is stabilized to a certain degree against changes in temperature and current gain variation. However if a meter is available for testing transistor beta, then the transistor with the highest current gain should be used for Q2.

P59. ECM Mic Preamplifier

Description:

A microphone amplifier that may be used with either Electret Condenser Microphone (ECM) inserts or dynamic inserts, made with discrete components.

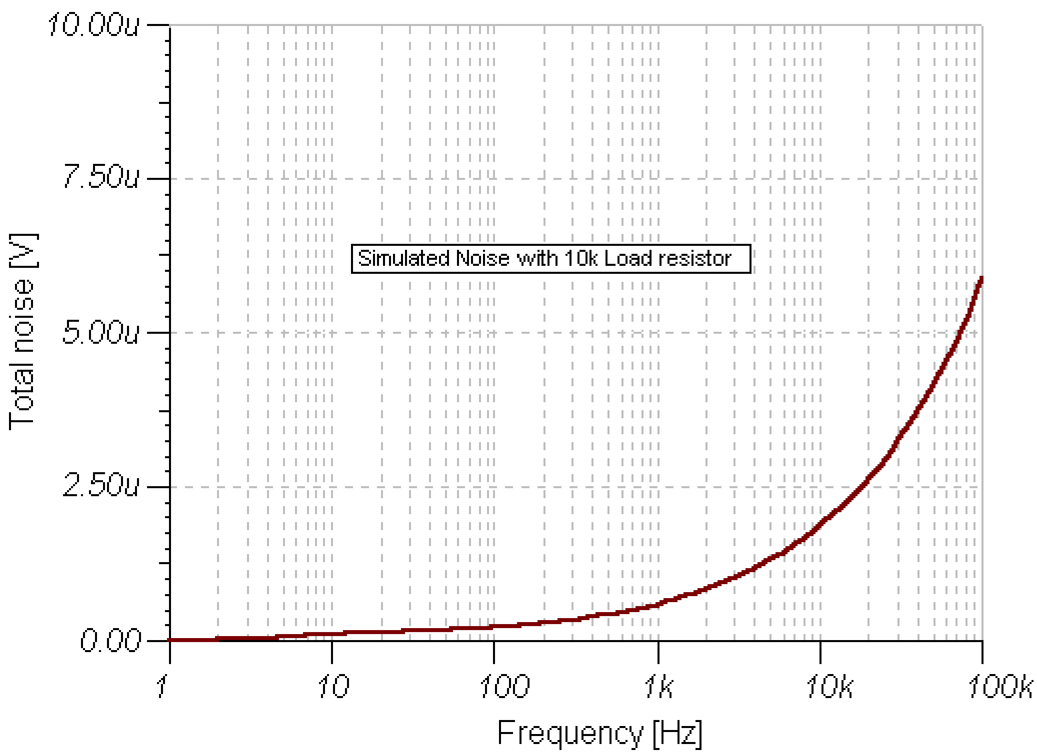


Notes:

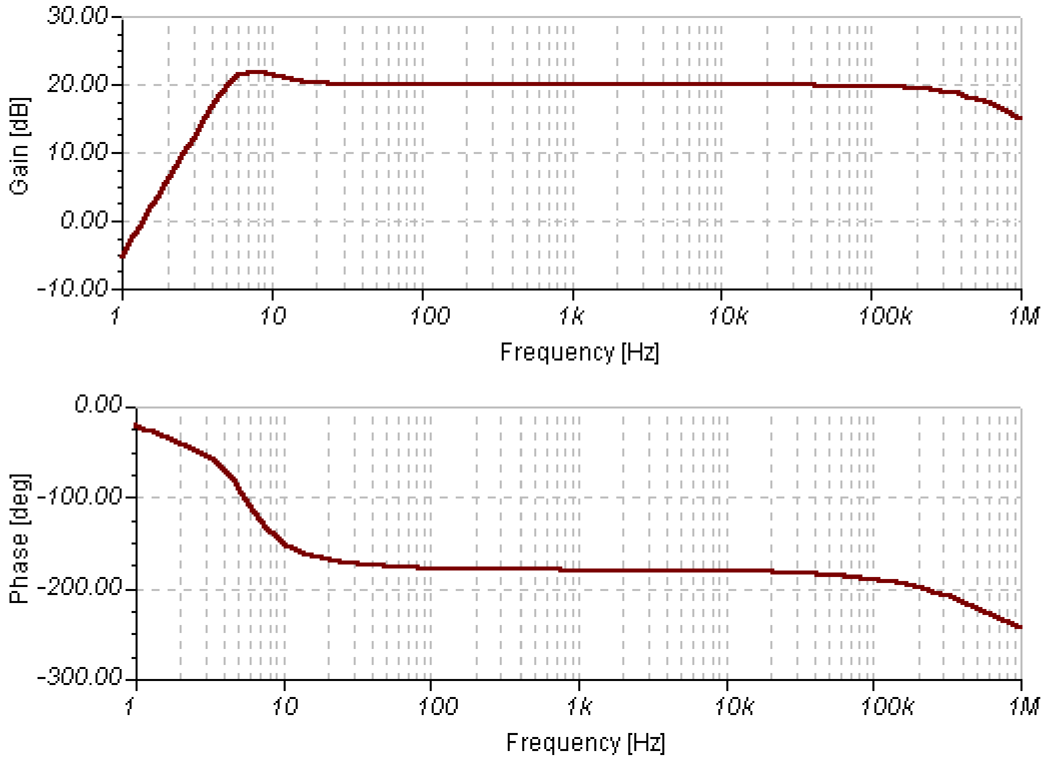
Both transistors should be low noise types. In the original circuit, I used BC650C which is an ultra low noise device. These transistors are now hard to find but BC549C or BC109C are a good replacement. The circuit is self stabilizing and will set its quiescent point at roughly half the supply voltage at the emitter of Q2. This allows maximum output voltage swing and also the highest dynamic range.

The electret condenser microphone (ECM) contains a very sensitive microphone element and an internal FET preamp, a power supply in the range 2 to 10 volts DC is therefore necessary. Suitable ECM's may be obtained from Maplin Electronics. Although the schematic is drawn showing a three terminal ECM, two terminal ECM's may be used, the following page in the practical section shows the changes.

The 1k resistor limits the current to the mic. This resistor should be increased to 2k2 if a supply voltage above 12 Volts DC is used and is not needed if the Mic insert is dynamic. The first stage amplifier built around Q1 is run at a very low collector current. This factor contributes to a very high overall signal to noise ratio and low overall noise output. The emitter resistor of Q1 is decoupled by the 100u realizing a maximum gain for this stage. The noise response of the amplifier measured across the 10k load is shown below. Please note that this plot was made with the mic insert replaced by a signal generator.



The second stage, built around Q2 is direct coupled, this minimizes phase shift effects (introduced with capacitive and inductive coupling methods) and acheives a flat output response from 20Hz to over 100kHz. The frequency response measured across a 10k load resistor is plotted below simulated using a 12V power source:

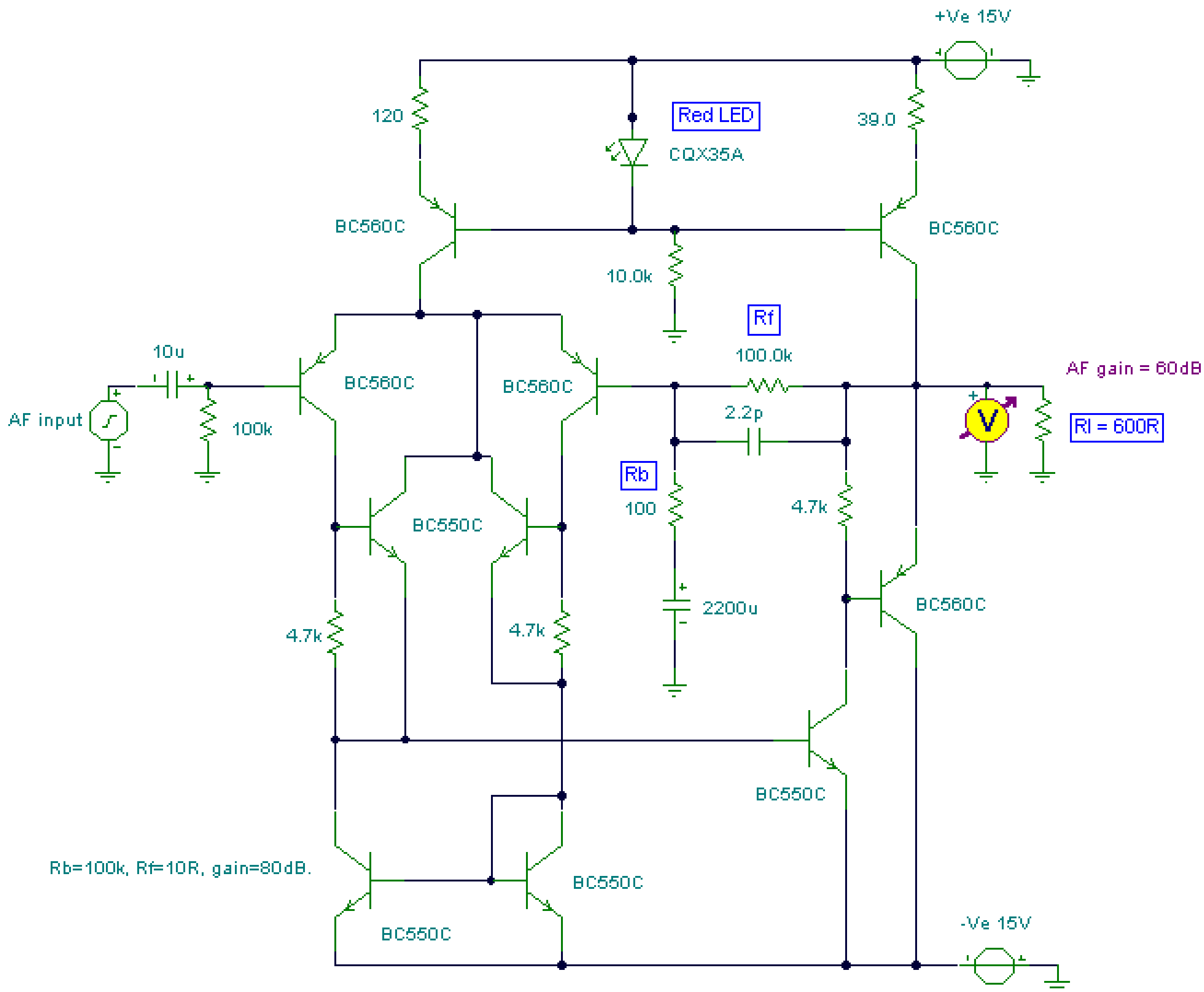


The emitter voltage of Q2 is also fed back to the base of Q1 via resistive coupling. This also ensures bias stabilization againt temperature effects. Q2 operates in emitter follower mode, the voltage gain of this stage is less than unity, however, the overall voltage gain of the preamplifier is about 100x or 20dB as shown in the bode plot above. The output impedance is very low and well suited to driving cables over distances up to 50 meters. Screened cable therefore is not necessary.

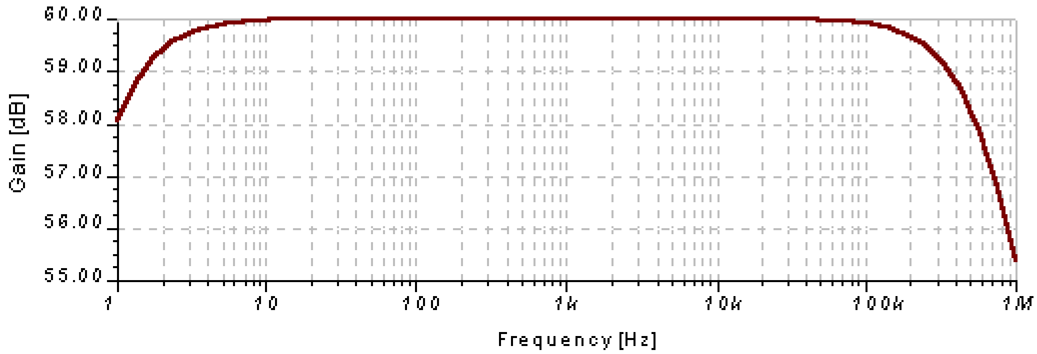
This preamplifier has excellent dynamic range and can cope with anything from a whisper to a loud shout, however care should be taken to make sure that the auxiliary equipment i.e. amplifier or tape deck does not overload.

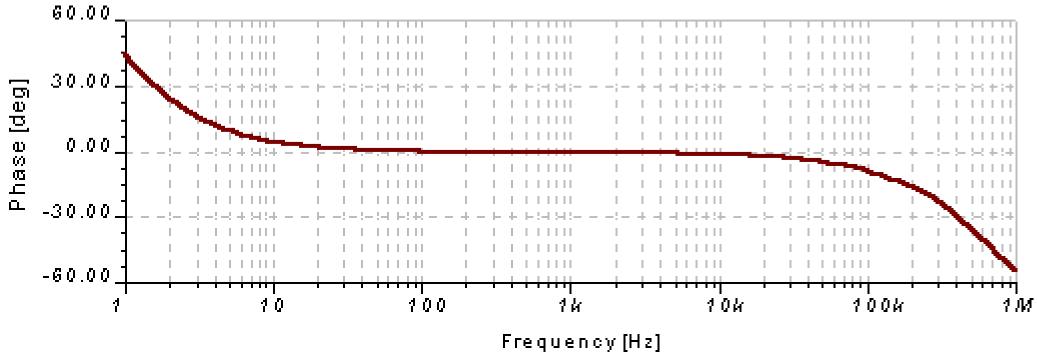
P60. Hi-Fi Preamplifier

Notes
This circuit was submitted by Graham Maynard from Newtownabbey, Northern Ireland. It has an exceptionally fast high frequency response,as demonstrated by applying an 100kHz squarewave to the input. All graphs were produced using Tina Pro.

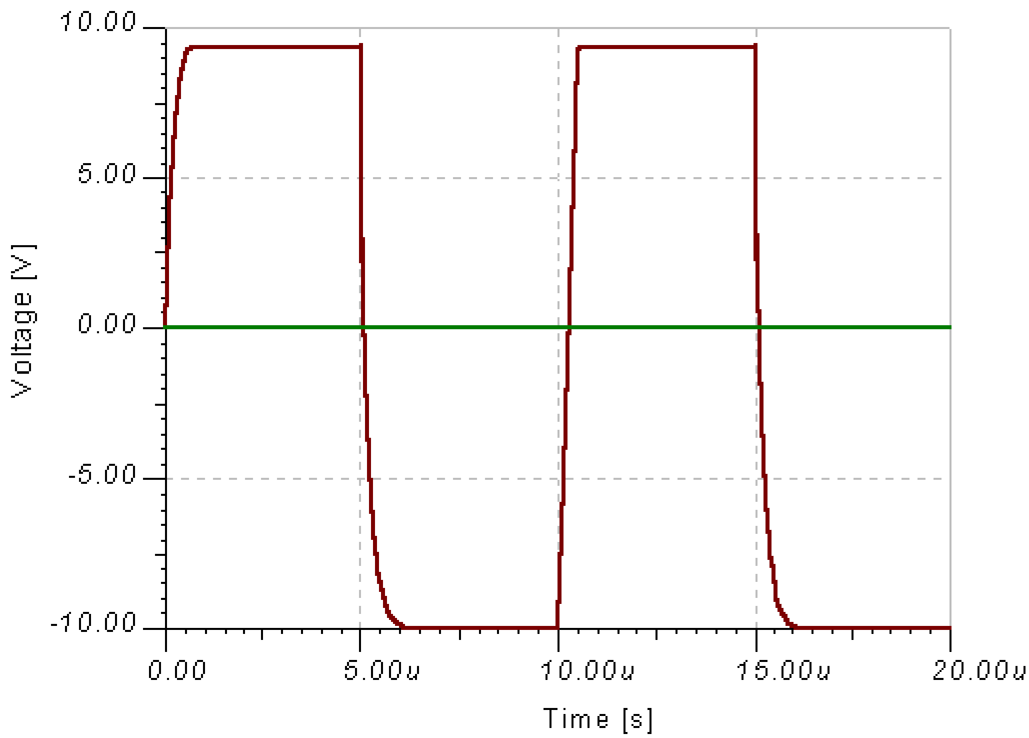


The Preamp's Bode Response

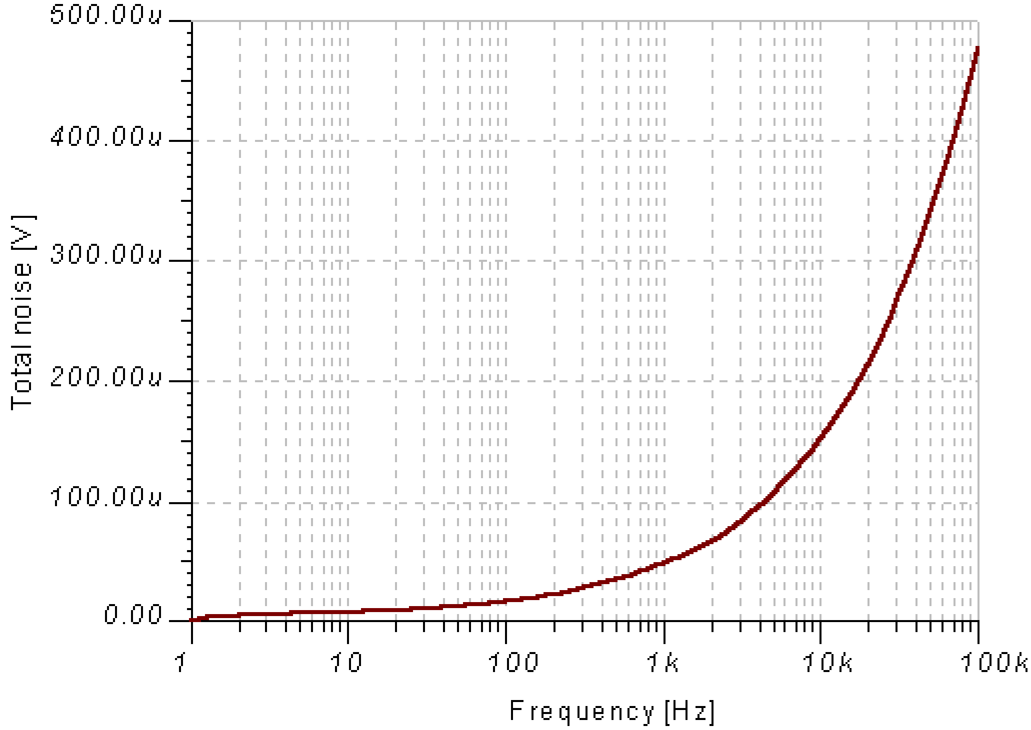




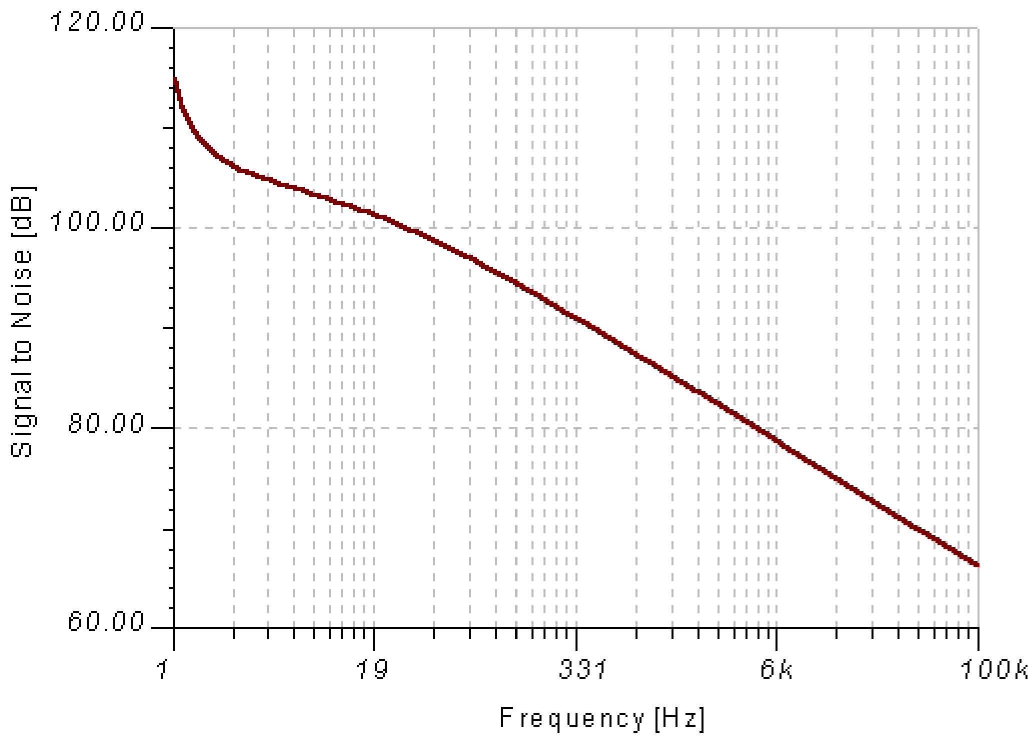
Squarewave Response with 100kHz Input Signal Applied



Total Noise at Output Measured with 600R Load



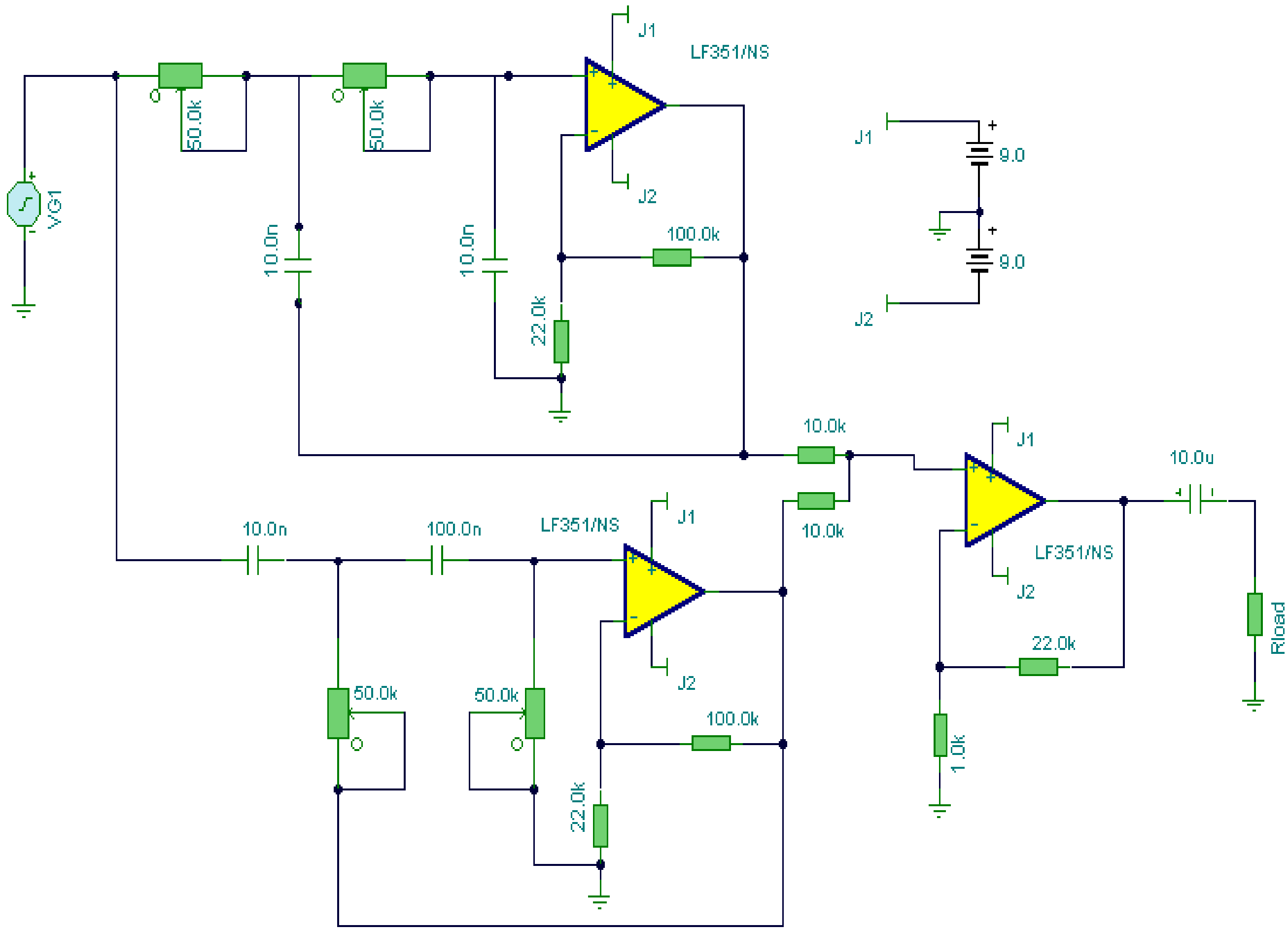
Signal to Noise Ratio at Output



P61. Notch Filter

Description:

A variable notch filter with both high and low pass filters.



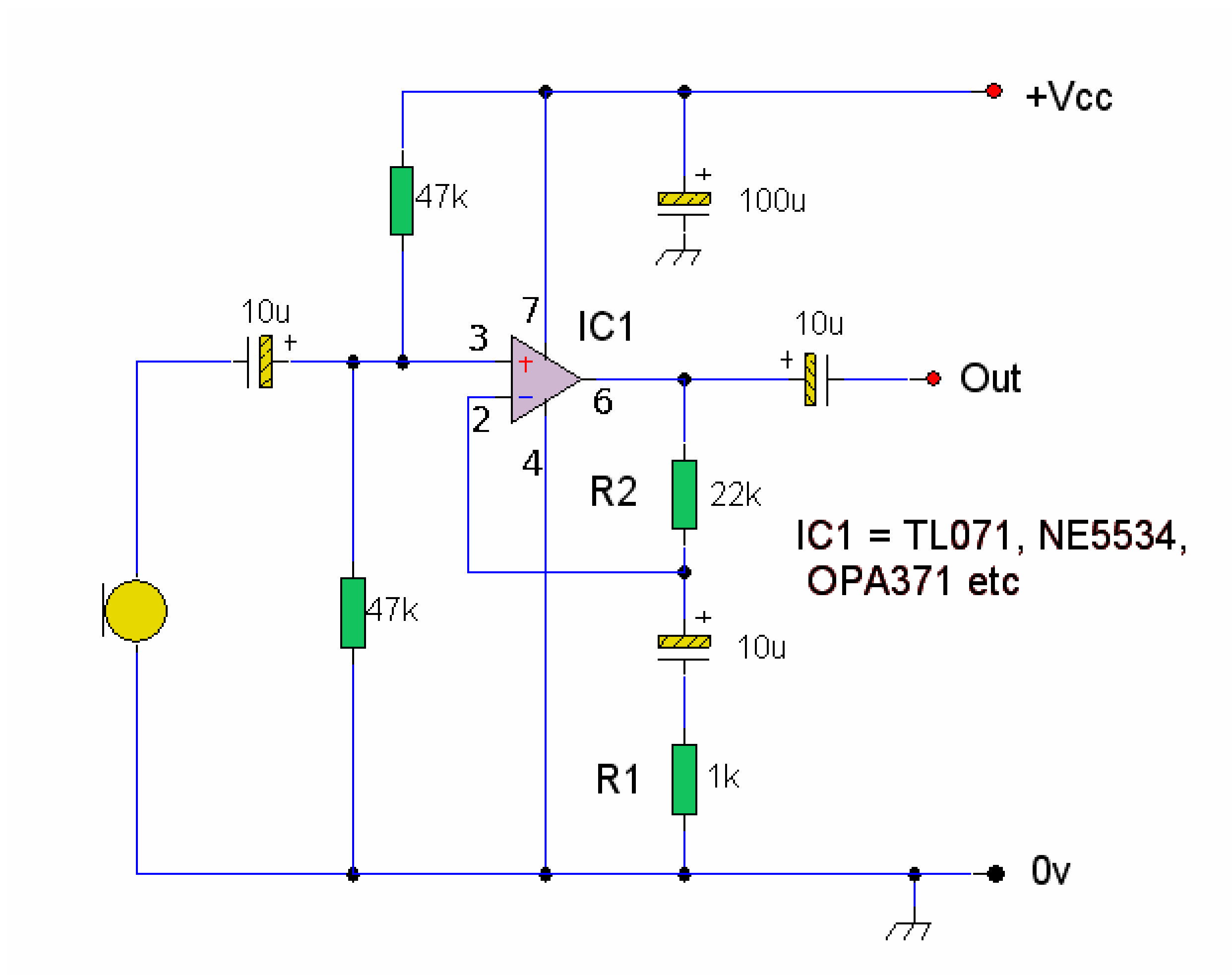
Notes

At first glance this circuit looks fairly complex, but when broken down,can be divided into high pass and low pass filter sections followed by a summing amplifier with a gain of around 20 times. Supply rail voltage is 9V DC. The controls may also be adjusted for use as a band stop (notch) filter or band pass filter.

P62. Op-Amp Mic Preamp

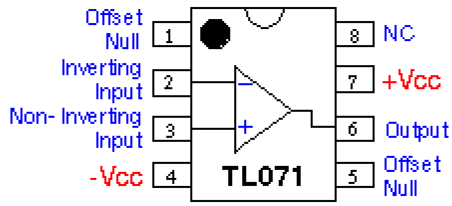
Description:

A high quality microphone preamplifier using a single power supply, suitable for dynamic or electret microphones. The opamp used can be any low noise, high performance type, e.g. NE5534,TL071, OPA 371 etc



Notes

Nothing too special here. The schematic is shown using a dynamic microphone, for use with an electret a suitable biasing resistor is required to power the electret microphone, see this page for more help. The pinout for the TL071 is shown below:

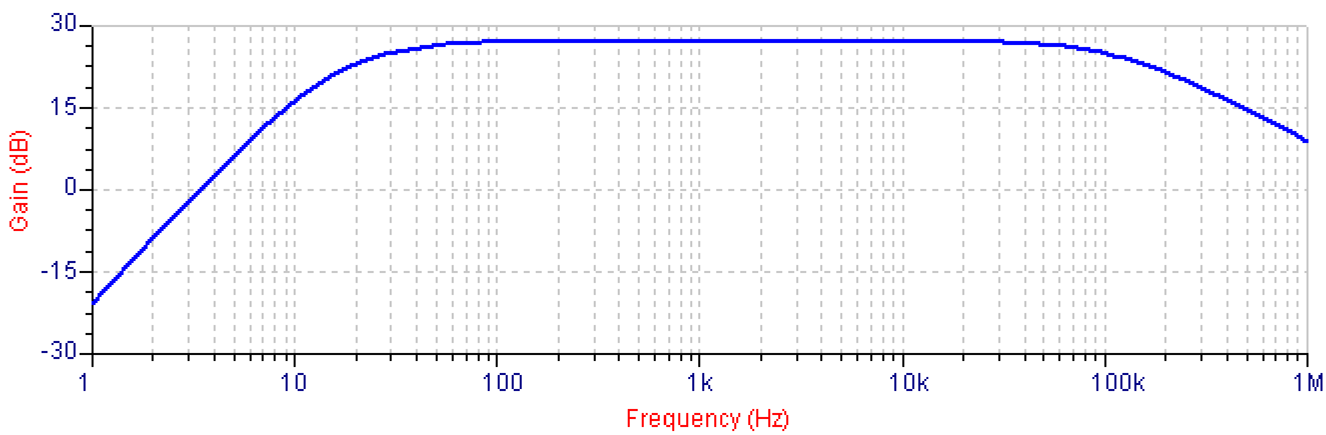


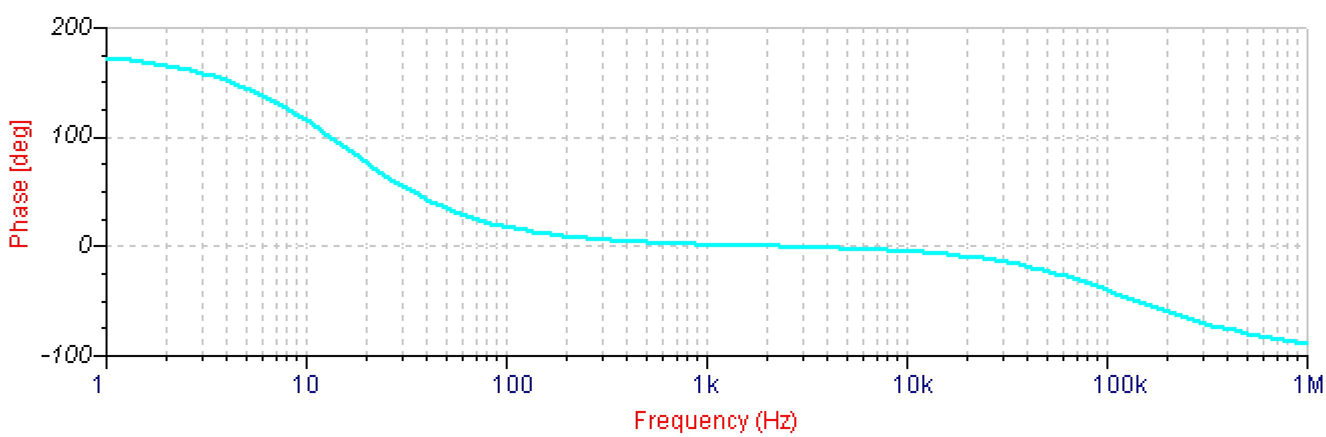
TL071 Pinout

The design is a standard non-inverting design, the input is applied to the non-inverting input of the op-amp which is pin 3 in most cases. The input impedance is 23.5k, the overall voltage gain is determined by R2 and R1according to the following formula:

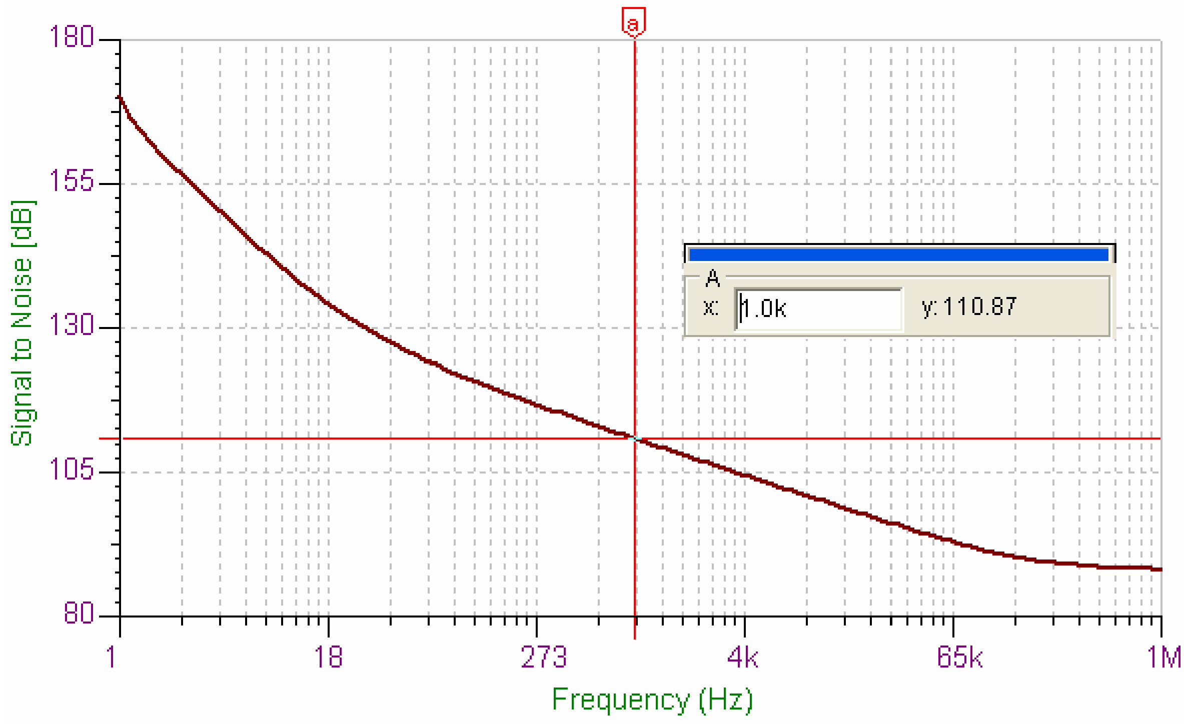
$$Vo = (R2 / R1) + 1$$

With the values of R2 and R1 on the diagram the voltage gain (for mid band, 1KHz) is approximately 23x or 27.2dB The gain bandwidth (bode) plot is shown below. This plot is simulated using the TL071 op-amplifier.





Operational amplifiers feature high gain bandwidth products, have a fast slewing rate and have extremely low noise. It is difficult to acheive the same performance using discrete components. Finally the overall signal to noise ratio has been calculated, the source was a 1k impedance microphone generating a 1mV pk-pk sine wave.

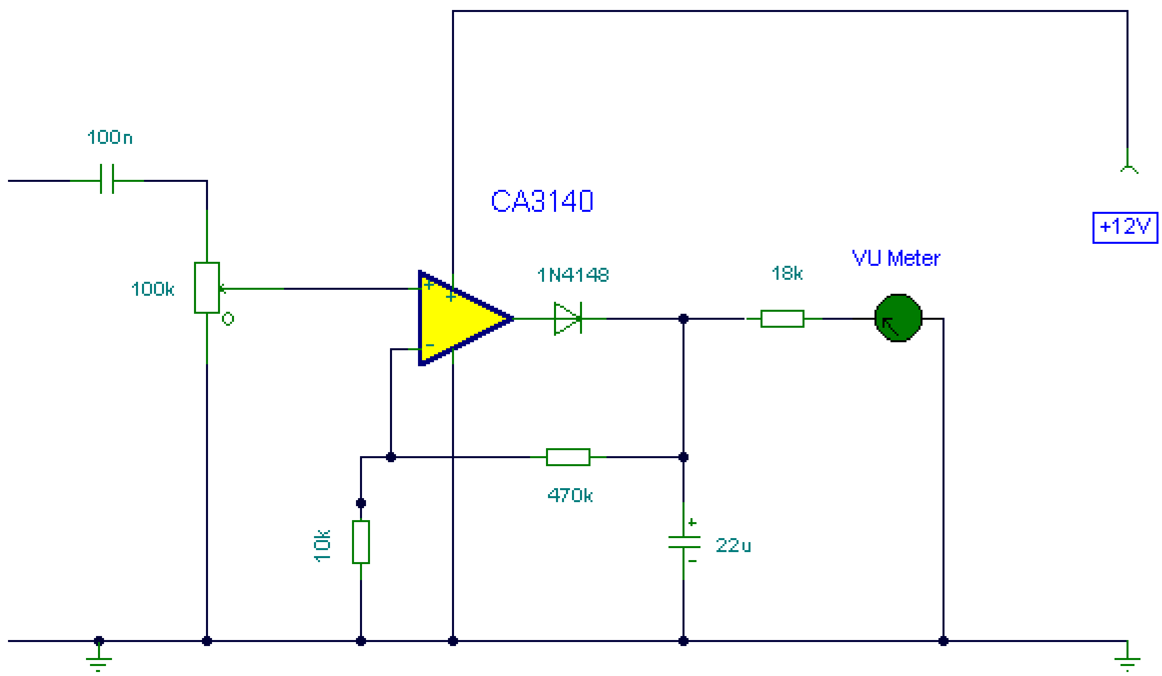


An impressive result of 110dB S/n at 1KHz is acheived. In practise this figure will be lower and determined by the quality of the microphone used.

P63. Audio Peak Level Meter

Description:

Using a single Mosfet Op-amp this circuit samples the audio input and displays peak readings.



Important Note: This circuit will only work with a MOSFET opamp !

Notes

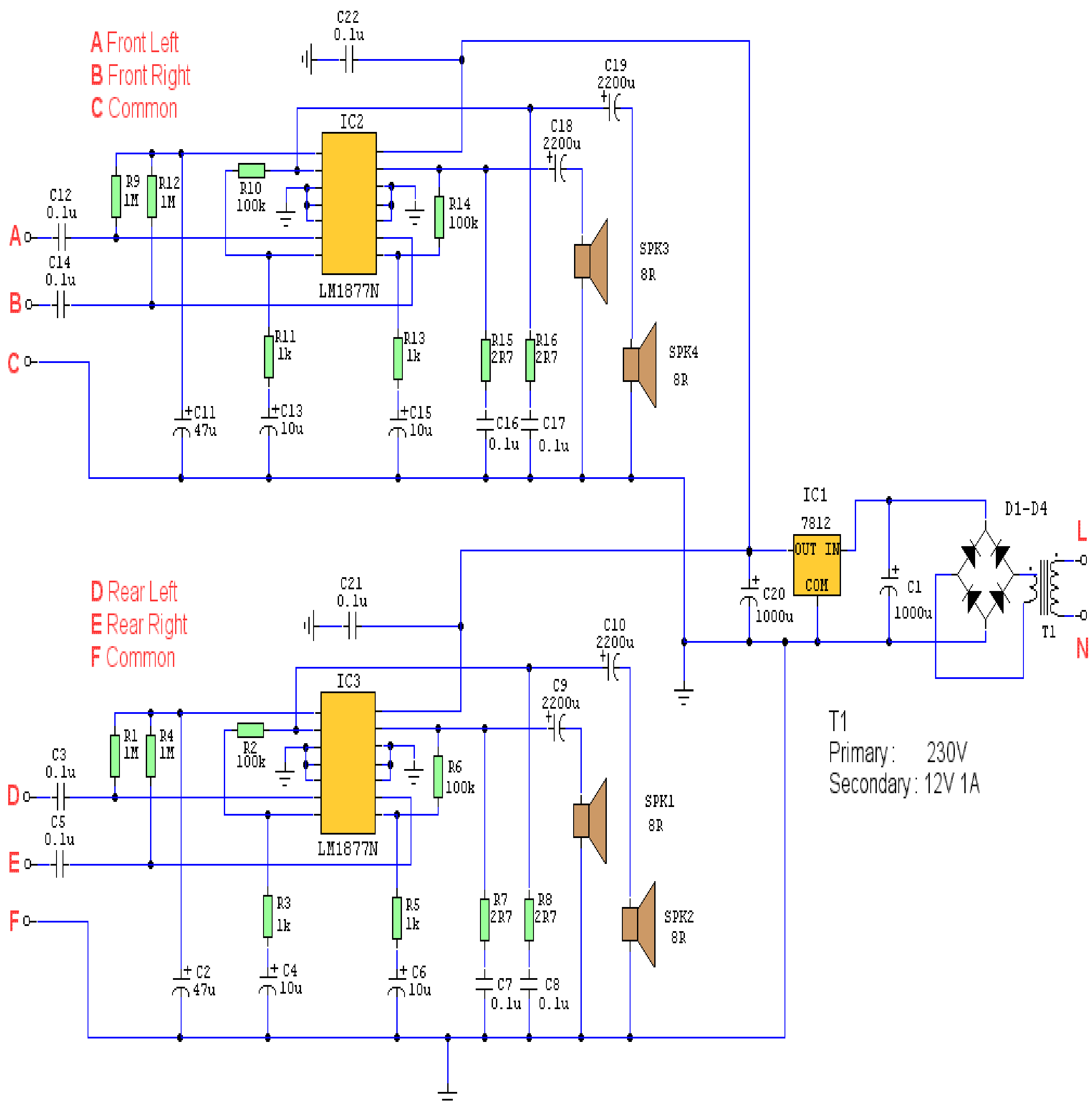
Using minimum component count; this simple circuit will indicate peak audio response on an analogue meter, similar to a tape recorders meter. The circuit uses an opamp as a non inverting amplifier, but with one addition - a diode in the feedback loop. The circuit has a fast response time and slow decay time to indicate peak readings. The 1N4148 diode provides half wave rectification of the input signal, the dc output being smoothed by the 22u capacitor. the capacitor will charge to the peak value of the input waveform, and then discharge via the meter and 18k resistor. I used a meter with a FSD of 150uA, but any meter with a FSD in the range 50-250uA may be used. The discharge time is around a quarter of a second. Increase the 22uF cap for a longer discharge time, or omit altogether to make an instantaneous reading level meter.

This circuit will only work with a MOSFET type opamp, bipolar types i.e. 741 and J-FET opamps such as LF351 will not work in this circuit.

P64. Quadraphonic Amplifier

Description:

This is a four channel amplifier ideally suited for use with quadraphonic equipment such as a Sound Blaster Live card. There is no volume control,audio levels being directly controlled from the sound card itself.



Parts List:
D1-D4: 1N4001 (4)
C1,C20: 1000u CAP (2)
C2,C11: 47u CAP (2)
C3,C5,C7,C8,C12,C14,C16,C17,C21,C22: 0.1u CAP (10)

C4,C6,C13,C15: 10u CAP (4)
C9,C10,C18,C19: 2200u CAP (4)
R1,R4,R9,R12: 1M RESISTOR (4)
R2,R6,R10,R14: 100k RESISTOR (4)
R3,R5,R11,R13: 1k RESISTOR (4)
R7,R8,R15,R16: 2R7 RESISTOR (4)
IC1: 7812 (1)
IC2,IC3: LM1778N (2)
SPK1,SPK2,SPK3,SPK4: 8R 2 Watt speakers (4)

Notes:

Construction is straight forward and is suitable for Verobaord. Overall gain is controlled by the ratio R14/R13 and R6/R5. Used with small hi-fi speakers the volume was too loud for my room so I reduced R14 and R6 to 33k. The zobel network formed by R7,C7,R8,C8,R15,C16,R16,C17 prevents instability which can happen with long speaker wires. The input impedance is high, 1M and if very long input cables are present could pick up noise. Screened cable should be used, in my case I used 10k resistors between points A & C, B & C, D & F, E & F. This provides a DC path to ground and higher noise immunity. If instability does occur, then you will notice sound distortion and the LM1877N will become hot to touch.

Connections:

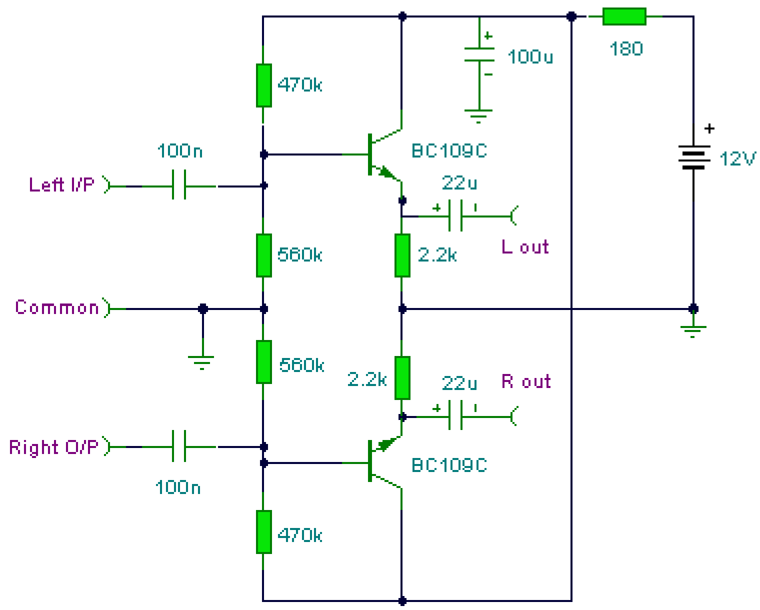
The back of a sound blaster live card has colour coded 3.5mm stereo jacks. The image below shows a close up of the rear of my Sound Blaster Live card. As well as colour coding, each connector has an appropriate marking, for easy connectivity.

The normal output connector is green and the rear speaker connector is black. Creative provide utilities and sound mixer for use with Windows. Under Linux the utility Gamix can be used, which allows independent volume control for all channels.

P65. Line Driver

Description:

A stereo line driver for feeding long cables or buffering an audio source.



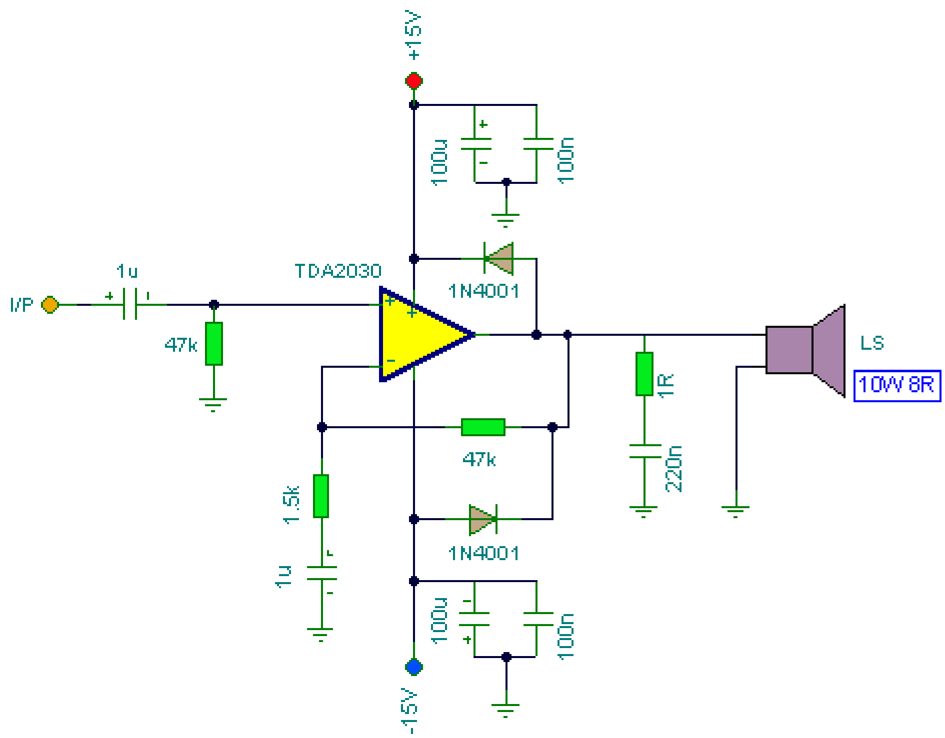
Notes

This preamplifier has a low output impedance, and is designed to drive long cables, allowing you to listen to a remote music source without having to buy expensive screened cables. The very low output impedance of around 16 ohms at 1KHz, makes it possible to use ordinary bell wire,loudspeaker or alarm cable for connection. The preamplifier must be placed near the remote music source, for example a CD player. The cable is then run to a remote location where you want to listen. The output of this preamp has a gain of slightly less than one, so an external amplifier must be used to drive loudspeakers.

P66. TDA2030 8W Amplifier

Description:

An 8 watt amplifier made with the TDA2030 IC. Built two such units for a stereo amplifier.



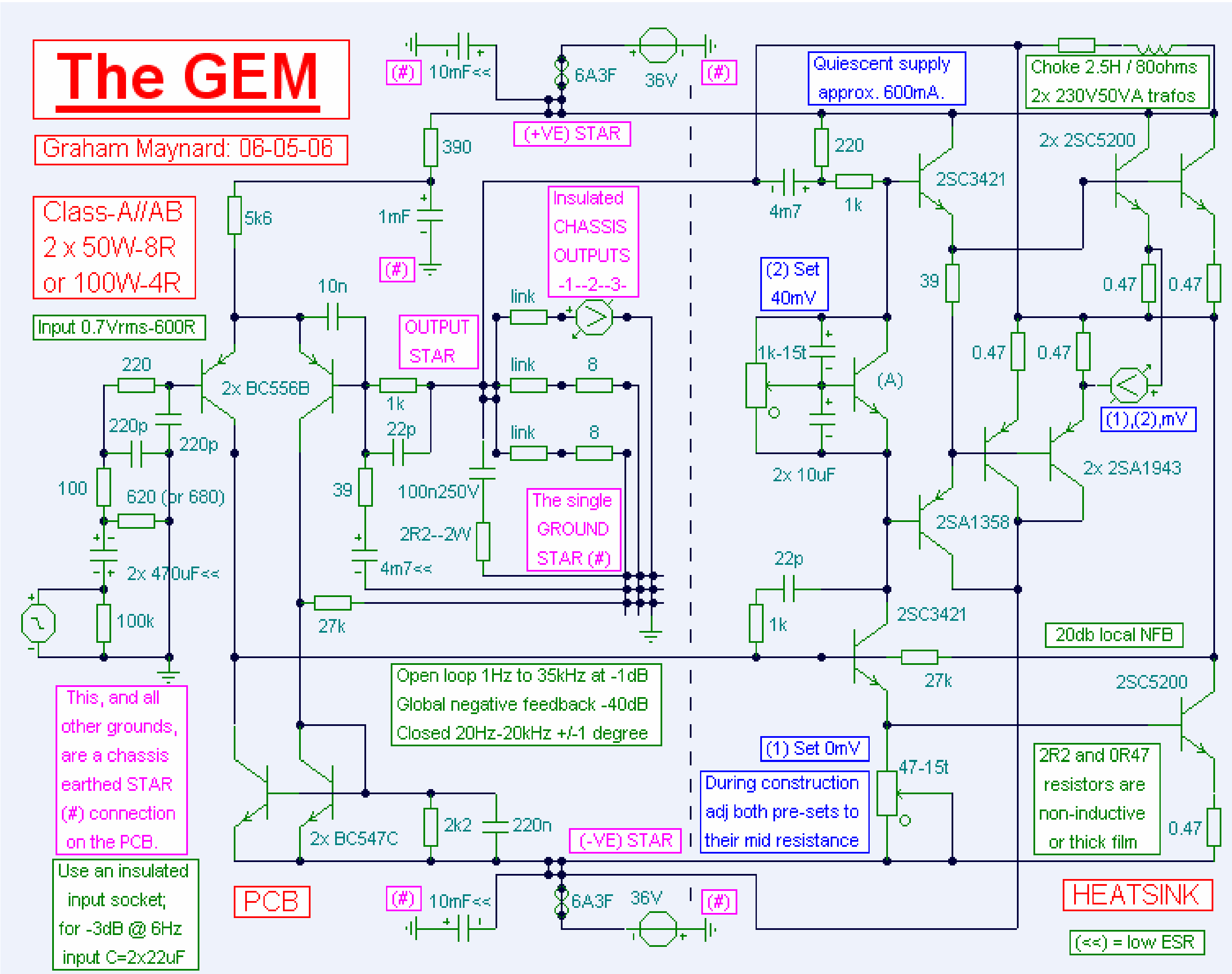
Notes

Although the TDA2030 is capable of delivering 20 watts of audio power, I deliberately reduced the output to about 8 watts to drive 10 watt speakers. This is more than adequate for a smaller room. Input sensitivity is 200mV. Higher input levels naturally will give greater output, but no distortion should be heard. The gain is set by the 47k and 1.5k resistors. The TDA2030 IC is affordable and makes a good replacement amplifier for low to medium audio power systems. Incidentally, it is speaker efficiency that determines how "loud" the sound is. Speaker efficiency or sound pressure level (SPL) is usually quoted in dB/meter. A speaker with an SPL of 97dB/m will sound louder than a speaker with an SPL of 95dB/m.

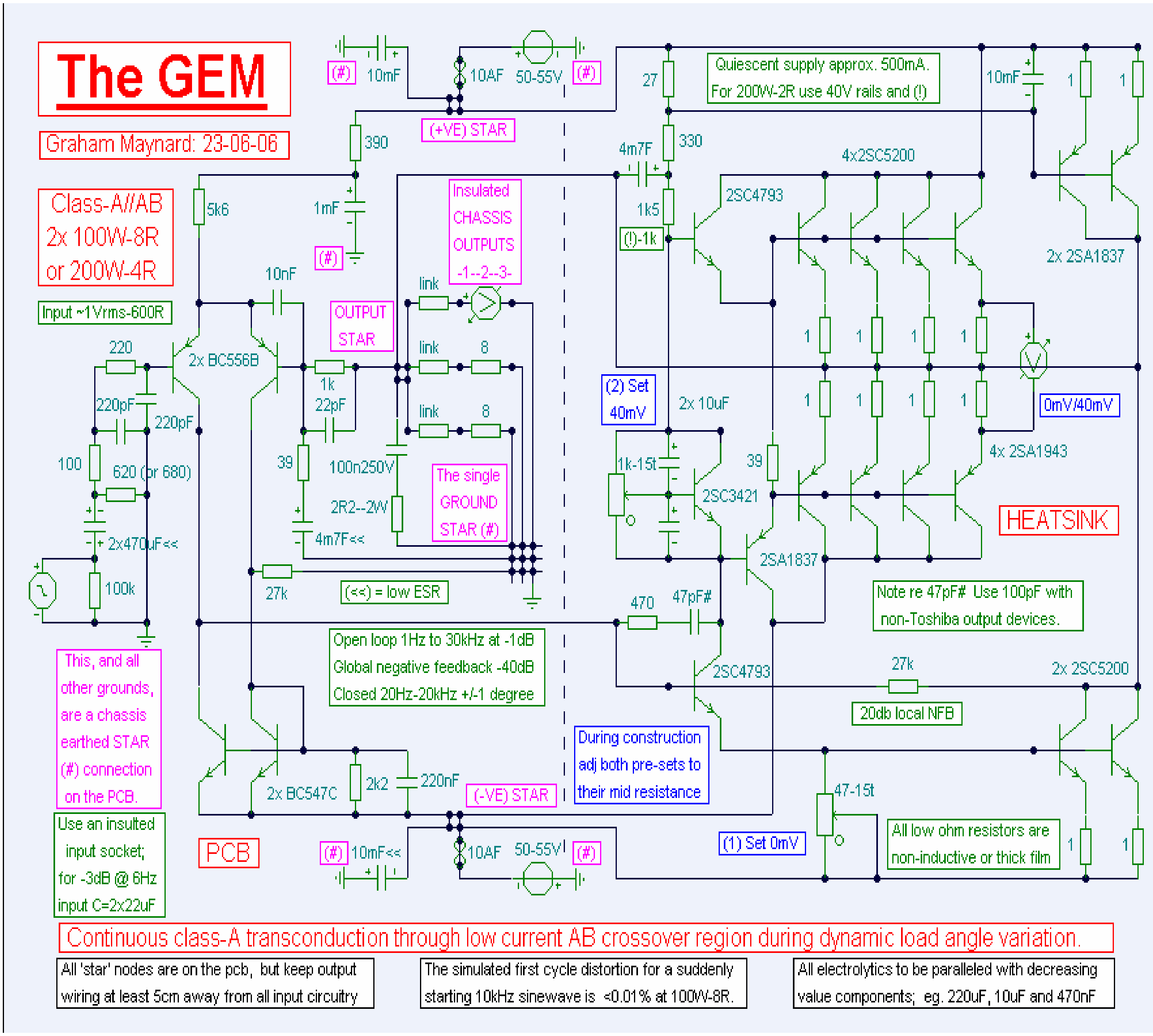
P67. The GEM: Class-A//AB Amplifier

Description:

The GEM is an audio power amplifier embodying simultaneously active Class A and Class AB output stages for 100+ Watts into a 4 ohm loudspeaker. The front end pcb will drive up to 100+W variants, or the 200+ Watts version into a 4 ohm loudspeaker load.



Continuous class-A transconductance through low current 'AB' crossover region at any angle of dynamic loudspeaker loading		
All 'star' nodes are on the pcb, but keep output wiring at least 5cm away from all input circuitry	The simulated first cycle distortion for a suddenly starting 10kHz sinewave is ~0.01% at 50W-8R.	All electrolytics to be paralleled with decreasing value components; eg. 220uF, 10uF and 470nF



Notes

The circuit for this design developed out of some 35 years of on/off investigations into the John Linsley-Hood, MIEE, 1969 class-A amplifier. It has been named in remembrance of my late father, Gordon Ernest Maynard, who supported my interest in audio/electronics/radio/etc. from a young age. It is not claimed to be the best amplifier for anyone to use, for indeed there are so many system design ideals and requirements that not one of them can be expected to suit everyone, no matter how well any one might measure and perform in relation to original requirements. As always there is more than one way of studying any problem and achieving a given end result.

The original and 'simple' 1969 JLH class-A amplifier design provides excellent first cycle accuracy through mid and high frequencies, thus its delivery is both neutral and clean. Being class-A there are no output stage conduction crossovers, and, if properly constructed there is no need for the stabilization components or the series output choke that so often introduce NFB control delay to a real world amplifier's output terminals when dynamic loudspeakers are being driven. The JLH not only amplifies percussion transients and spoken sibilants cleanly, it is also silent behind voices and notes, such that an artificial brightness or smear does not affect the reproduction of detail, and thus its output is instantly recognisable as being correct. So many 'distortion' analysts study an amplifier's forward linearity characteristics under steady sinewave drive with a passive resistor load whilst ignoring the complex circuit activity that arises when dynamic loudspeakers are driven by dynamic and asymmetric music signal waveforms. The JLH amplitude 'distorts' more than most amplifiers under forward analysis, and yet it sounds much better because of the way its circuit damps without delay or overshoot in the presence of secondary dynamically generated loudspeaker system back-EMFs which attempt to reverse drive the output terminal.

For more in-depth information and construction details about JLH class-A amplifiers, see Geoff Moss's excellent Website:-

http://www.tcaas.btinternet.co.uk/index.htm

The two most significant reasons for a JLH class-A amplifier presenting a sonically neutral output relate to it having an open loop bandwidth adequate for audio requirements *before* NFB is applied, then to it possessing a natural closed loop stability without need for additional dominant pole filtering which might then infringe upon those open loop capabilities; hence the closed NFB loop's ability to maintain phase linear control of output terminal potential in the presence of loudspeaker generated back-EMF up to the very highest of audio frequencies.

So often it is a need to add stabilisation components to other amplifier designs where NFB is used to reduce amplitude distortion, that leads to these very same components introducing a NFB delay which then colours dynamic loudspeaker reproduction in a manner steady sine measurements simply cannot ever reveal. This colouration arises when output stage driven amplifier-loudspeaker system current flow becomes back-EMF modified by the dynamically induced milli-second to milli-second variation of reactive loudspeaker system elements, as their impedance and phase angle change due to the momentary sequential elemental delays related to storage and release of audio waveform energies. If loudspeaker current flow becomes leading with respect to audio amplifier input waveform voltage, and the necessary correcting NFB loop response is fractionally delayed by a bandwidth limiting dominant pole filter or internal series output choke, then the amplifier's output current correction becomes lagging at higher frequencies and the output terminal cannot quickly enough be prevented from developing a fractional error potential. The amplifier does quickly 'catch up', but in the meantime a tiny additional loudspeaker system dependent 'dominant pole and/or choke related' interaction error has already been generated at the amplifier-loudspeaker interface, and no amount of NFB can completely erase this because it was NFB control delay with respect to priorly energised loudspeaker back-EMF that caused it in the first place!

So why then does not everyone use good JLH, Nelson Pass or other class-A amplifiers ?
(1) They run constantly hot when compared to other amplifier types.
(2) Pure biased class-A designs lack dynamic powering capabilities.
(3) Some provide marginal low frequency phase response or damping.

STEPPING STONES.

During the early 1970s I constructed a large JLH class-A monoblock. It had a genuine 100W measured sine output, sounded very clean, and could generate surprisingly noisy short circuit sparks to raise thoughts about output stage survival. (It never blew, and still runs!) However when it was compared with a physically smaller and cooler running 2x KT88 Ultralinear Leak TL50+ this solid state monster lacked dynamic attack. It also sounded like a purely voiced but wimpish choirboy when beside the maturely rocking muscle outputs of other typical 100W class-AB solid state chassis.

The reason for this 'weakness' relates to loudspeaker current flow, whereby dynamically induced momentary requirements can far exceed the peak sinusoidal output capability of a pure class-A biased output stage. This, combined with an inability for the JLH upper output transistor to conduct as deeply as the lower transistor, leads to what sounds like a pop-rock music output linearity weakness developing as soon as half power levels are reached. With modern H-pak plastic power transistors it is possible to obtain up to 50W of pure class-A output from a single pair of JLH connected output devices, but there will still be that positive going output current limitation when the amplifier is used to drive dynamic loudspeaker systems.

I returned to this problem many times, and at first attempted to overcome it by upping the class-A rating whilst implementing different dynamic biasing arrangements to hold down the quiescent dissipation. These designs worked, and I achieved 100W of class-A output for 100W of quiescent heat. Generally though the resulting amplifier was not temperature stable through different audio duty cycles; or their biasing arrangements had an audible impact upon transients; or they were unacceptably complex.

More recently I tried numerous arrangements where individual output devices were replaced by identical composite sub-circuits running in class-A at low level, though conducting as if class-AB during periods of increased output demand. This type of arrangement simulated well, they also worked and were less complex than with additional biasing arrangements, but they sounded 'punchy' as if the amplifier was over reacting to loudspeaker generated back-EMFs; as if the phase splitting JLH driver could not maintain balanced drive splitting control when the individual composite output device dynamic characteristics became externally altered on a per-half basis by varying loudspeaker system demand.

A NEW CROSSING.

More recently it occurred to me that the JLH current splitting transistor *collector* could be used to drive a conventional class-AB output stage, whilst its *emitter* controlled a lower JLH class-A output device exactly as before. Also the upper half of that class-AB output stage could then simultaneously be used as the upper half for the lower class-A output device; in other words, both class-A plus class-AB output stages in one circuit, with a common output termination, each operating simultaneously, with the class-A connection maintaining transconduction continuity through low current class-AB crossovers at no matter what voltage angle any loudspeaker current might momentarily flow.

Now this did work, and well too, but I was still not convinced that the sound could hold its own against good tube power amplifiers, so I was still not able to hang up my imagineering hat. I reasoned that further improvement would be possible through providing a 'stand alone' upper half class-A collector load in order to fully separate class-A current flow from the class-AB biasing arrangement. My options for this were resistors, a transistor current sink, or an output choke similar to those that went out of fashion long before transistors were invented!

Now resistor current flow between the positive rail and the class-A collector could not remain constant through large output voltage amplitude swings; this means that the A-AB bias balance would be correct at zero output potential only, and whilst adequate for high quality at low output levels only, bias interaction would increase through loud asymmetrical music waveforms; also the resistors could not be bootstrapped due to their need for low value. Transistor current sinks can introduce their own amplitude/slew induced non-linearities plus an inconstant reference bias variation with temperature, this resulting in a quiescent A-AB bias null offset variation with temperature. An output choke is simple and realisable, and although winding heat dissipation would be a problem I still felt that this option could be successfully implemented. As indeed it was for the 100+W version. However additional heat dissipation from a choke suitable for the 200+W version would require this component to being specially wound, so although I had a perfectly functional base design my thinking was still not over. Eventually I realised that the VAS bias chain could simultaneously set the reference potential for a positive rail based current source, as is shown in the higher power circuit. Both of the above circuits have been fully tested, thus either the choke or transistor constant current source class-A output stage option may be chosen.

So now, and at very - very - long last, I actually have a most capable solid state ***'audio'*** power amplifier that is capable of the low level refinement normally available only via genuine class-A amplification, yet with equal refinement throughout its excellent high power class-AB drive reserve, plus, and this too is at all levels, a 'blackness' behind notes and voices that is more often associated with top flight tube amplifiers only. Some might say it is the silence between the notes that makes a performance, but when it comes to audio reproduction it is that lack of cerebral distraction due to the silence behind the notes, which then allows us the pleasure of imagining ourselves as being 'live' at the recording performance.

KEEPING DRY

I have always studied music waveforms from a dynamic viewpoint - as if they are an irregular series of 'splashy' and ever changing asymmetrical first cycles; not the smoothly liquid streams of sinusoidal components that theoreticists so often encourage us to dip and waggle our toes in whilst we are encouraged to follow their academically correct but time isolated examination methodologies. Unless our thoughts stay with initially coherent audio wavefronts and the turbulently reactive myriad of circuit and interface responses subsequently arising, simplistic applications of established theory can so blinker that we become distracted from more meaningful fundamental matters.

It is here worth noting (1) the original JLH class-A has no additional signal or NFB path capacitance capable of delaying transient response capabilities, also, (2) the integral NFB cannot become positive at a high frequency because of the tailored overall gain-bandwith product with so few active devices being enclosed by the NFB loop.

Of particular importance is that NFB is applied to the emitter of the first transistor with respect to the input base plus any audio input carried thereon. This is a classic series connected voltage feedback arrangement. So, although the JLH class-A has two distinct 180 degree phase changes along its signal path, both of these are not then encompassed by the closed NFB loop, and this is why with sensible construction topology and loading, these amplifiers cannot splash over into device induced phase shift instability at higher frequencies. The high frequency output voltage does not become fully out of phase with potential at the input transistor *emitter*!

Unfortunately any circuit more complex than the basic bipolar JLH class-A naturally introduces additional high frequency phase change, whether this is through Mosfet gate capacitance or the utilisation of additional bipolar devices. Generally there is then a need to compromise between stability and open loop bandwidth control, and this can end up audibly impacting upon first cycle (transient) response capabilities.

Thus, opting to use a differential input stage in order to minimise input transconductance distortion and output zero offset drift; or, mirroring the differential input stage to reduce power-up thump and maximise open loop gain plus NFB - which further minimises amplitude non-linearity; or, running an output stage using Mosfets or separate drivers and output transistors; can, individually or together, be said to introduce 'audible' change - if - the dominant pole turnover frequency must subsequently be pulled down to, or be reduced to a lesser open loop audio frequency in order that closed loop stability be ensured.

Yet I implement all three of these individual circuit arrangements whilst still retaining excellent first cycle and signal to (noise + control delay induced error) figures, plus good stability and low distortion. It is fact that a good total harmonic distortion specification cannot guarantee a good first sinewave cycle response because sine measurements are not taken until after the first cycle has passed and the waveform has become steady; whereas a low first sinewave cycle distortion figure cannot be achieved without the overall thd. figure already being better at the same frequency.

AVOIDING SPRAY.

To overcome additional semiconductor device induced phase change at high frequency I implement a base emitter connected 10nF capacitor at the differential input pair NFB sensing node, plus a 220nF base-emitter connected capacitor on the NFB leg of the differential mirror. These values are chosen to have minimal impact upon the forward audio frequency signal path with regard to the established tail current plus output stage loading of the differential pair. At higher frequencies however, where additional device usage could introduce unavoidable phase changes within the closed NFB loop and cause closed loop instability, these capacitors make the differential pair behave like an original single JLH input transistor with series emitter voltage feedback, and make the current mirror behave like an inactive current source!

The separate but simultaneously driven and parallel output connected single ended class-A output stage actively minimises inherent transconduction variation and switching delays through the relatively low current class-AB crossovers at moments when a dynamic loudspeaker load presents the output terminal with leading load current (momentary reverse current drive). Additionally, the local, plain 27k resistor derived, A//AB output stage degeneration sets up a constant minimum of crossover error damping without reliance upon the global NFB loop! The output stage is further additionally stabilised in its own right via a Miller connected 22pF plus 1k series capacitor-resistor pair at the VAS/splitter transistor, yet again though, using component values which cannot impact upon the open loop audio bandwidth. With higher rail voltages and twice the number of output devices used in the 200+W circuit, these values become 47pF and 470 ohms, though when equivalent / fake / non-Toshiba / older devices are used, then the Miller connected values should become 47pF + 1k for the 100+W, and 100pF + 470 ohms for the 200+W circuits.

Overall then, if this circuit is physically constructed using the recommended star ground, star rail and star output nodes which prevent current peak induced hf voltage drops along the connector to one sub-circuit interconnect from co-coupling into another, the resulting GEM amplifier will present a low and flat phased output impedance which renders it highly impervious to composite dynamic loudspeaker system impedance variation and the back-EMF induced interface errors that can so often arise with global NFB amplifier designs due to their dominant pole filters delaying output current generated control of output terminal voltage.

In spite of what some designers claim, there is no way of completely eradicating or displacing crossover distortion arising when a lone class-AB amplifier dynamically drives a reactive loudspeaker. NFB might reduce the resultant load induced distortion, but cannot fully eradicate it because loudspeaker back-EMF generated currents can reverse drive the class-AB output stage through a fraction of its crossover bias potential before dominant pole delayed NFB control can attempt correction. When the dominant pole is at an open loop audio frequency, the effect upon the closed loop response becomes audible because the control of loudspeaker generated back-EMF becomes phase shifted, and thus fractionally delayed, with a new additional momentarily uncontrolled output terminal voltage error arising that has nothing to do with the original input signal waveform. Thus output terminal voltage error generated due to say a bass or mid driver section back-EMF can become directly coupled into mid and tweeter drivers.

It is loudspeaker system current flow causing the development of these output terminal error voltages which the amplifier cannot quickly enough prevent, that then becomes recognisable as a typical 'solid state sound'. This often manifests as a falsely bright, occasionally a more desirable 'live' response, a perception like 'glassy' or 'ice cold', a jittery high treble, or occasionally as an uncomfortable upper mid-range peak. It can 'inexplicably' arise after a set of loudspeakers has been changed, yet actually be due to flawed amplifier design! Thus there is considerable difference between designing an amplifier capable of amplifying audio frequencies at low distortion when resistively loaded, and designing an ***'audio'*** amplifier capable of competently driving real-world loudspeaker systems! If you doubt this statement, then please compare in a directly switched A-B fashion, this class-A//AB amplifier with other conventional class-AB types.

THAT'S IT!!!

During the 1970s the Quad Hi-Fi company patented their '405' Current Dumping design. It was powerful, good sounding, compact and reliable. I used one myself and marvelled at their theoretical ingenuity, though for me the 2x KT88 Leak TL50+ still provided better reproduction. Since then that Current Dumping circuit has been repeatedly refined for professional or home use, and yet whilst updated models remain available today, so does a more recent Quad 2x KT88 II-40 monoblock chassis! The Current Dumping circuit cleverly combines both class-B and class-A output stages through a reactive output bridge which allows for the slower class-B switching. With my own circuit however, I have combined class-AB and class-A outputs in real time, this to provide powerful audio reserves with a class-A like cleanliness, whilst retaining the kind of transparency at higher output powers more often associated with expensive push-pull triodes or those ultralinear kinkless tetrode (KT) designs. (Prior to this my favourite power amplifier had been my own hybrid 100W 4x KT88 UL PP-AB1). I also believe the performance of the GEM is future proof and will not be superceded by digital amplifier designs, because dynamically energised loudspeaker system back-EMFs cannot fail to interact with the integral filters necessary to prevent their switching output stages from becoming RF noise transmitters.

CONSTRUCTION NOTES.

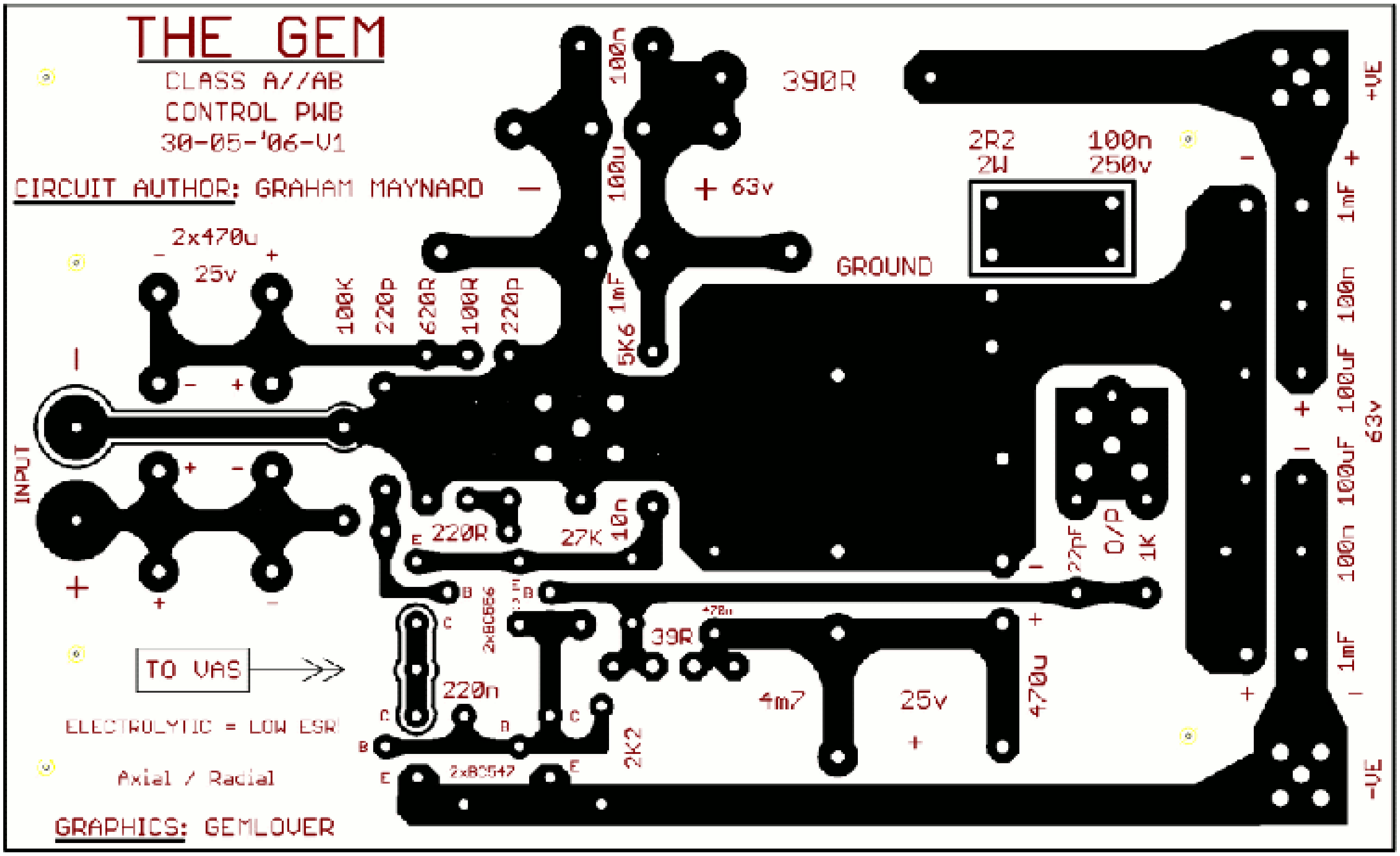
This circuit was intended for use with modern 2SC5200-2SA1943 power transistors, yet it has been successfully constructed using other device types, including a single Sanken 2SA1216+2SC2922 pair in place of the paralleled 100+W AB outputs. Feel free to use whatever transistors are to hand or in your 'salvage' box because the parallel class-A plus class-AB operation will make better use of obsolete / scrap devices than can conventional amplifier circuits, including the old and almost indestructible industrial 2N3055 based series.

Keep VAS, Zobel and output related wires at least 5cm/2" away from input devices and wiring. Use a star earth, star power distribution points from each fused psu rail low ESR 10mF at the pcb, and a star output node connection. It is also essential to use separate wires between the negative star node, the PNP output collectors, and the class-A emitter resistor to prevent class-AB current peaks from voltage modulating the class-A stage via wire impedance. See the illustrations for a universal pcb layout kindly contributed by Daniel Bosch in South Africa. This board has been designed to use any locally available axial or radial capacitor types, including larger low ESR variants. Parallel all of the large electrolytic capacitors with lower value components to minimise the risk of effects due to an unexpected series impedance peak. Do not twist any extender e-b-c wires used to connect out to heatsink mounted output stage devices. Mount the VAS, the drivers, also the Vbe multiplier on the output heatsink for automatic temperature compensation. During assembly check/adjust the pre-sets sliders for 50% setting; note that these should be 15 or 10 turn components. If long wires cannot be avoided with your choice of layout, then fit additional 1uF capacitors between each class-AB output device collector and the heatsink ground. The series input capacitor comprises two 470uF components in parallel, though mutually connected plus to minus, my own being low ESR types.

I recommend, after checking the circuit wiring for correct assembly, first powering up using two 9V transistor radio batteries, then with 22 ohm per rail power resistors in place of the fuses as protection for any error at initial switch-on. However, do not try to set any bias with either of these testing options. If everything is okay the amplifier should present an unbiased open circuit zero output potential within 100mV. It should also cleanly drive a test loudspeaker for low level signal testing without any bias being set up, as the two amplifier output stages will automatically compensate for each other's lack of bias; you should not hear anything through the loudspeaker after a possible low level initial power-up charge. I suggest your testing input could be taken from the headphone output of a portable CD player or an i-Pod, whereupon the unbiased amplifier should produce limited audio, even on rails as low as +/-9V!

PCB Layout

Click the image for a larger view.



If all is well, power up with a fully fused psu connection. Clip a pair of test multimeter wires to class-AB output emitter resistors as indicated on the circuit diagram. Slowly increase the value of the class-A bias trimpot until the class-AB 'imbalance' reading nulls to zero; then adjust the class-AB trimpot for an average 40mV of quiescent bias per output pair. Re-set the bias from zero current after two hours of normal use.

For 70W/4R=2x35W/8R use 30V rails. For 50W/4R=2/25W-8R use 25V rails with just a single pair of class-AB power transistors. Daniel has my thanks for checking out every modification update as it arose, whilst running his 200+W GEMs to drive Apogee loudspeakers throughout the last 12 months.

Always re-bias from zero current if you alter the rail voltages. If necessary insert a 0.22 ohm resistor in series with the output terminal to maintain stability when driving capacitively reactive loads, or use any series output resistor value up to 2.2 ohm if you wish to imitate different types of tube power amplifier output impedance and damping. Also don't forget to bi- or tri-wire out to composite loudspeaker system sections and drivers in order to obviate single cable developed dynamic voltage drops due to varying crossover-loudspeaker system generated back-EMFs, no matter how expensive your loudspeaker cable might be!

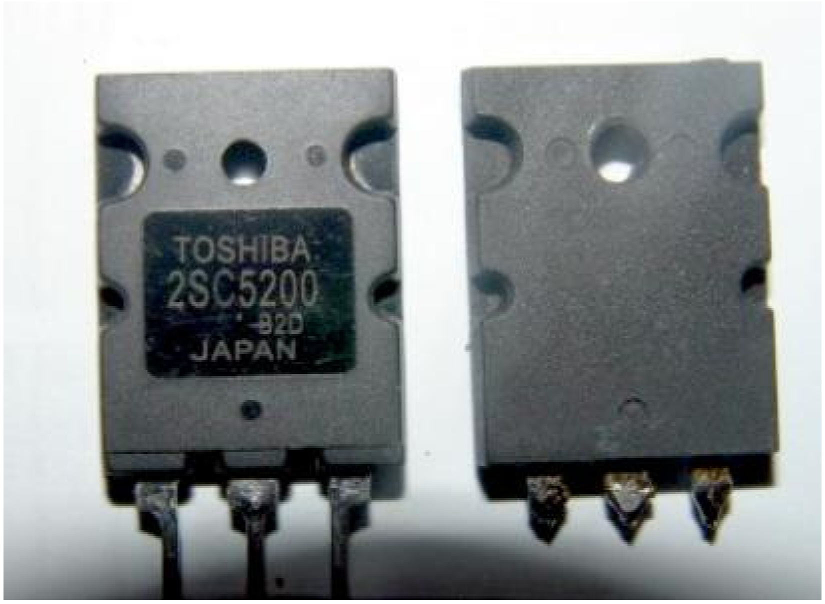
Better still, use these amplifiers as they are intended - as line driven and loudspeaker sited monoblocks! A simple line driver circuit appears on another page, this may be used to buffer the output of a tube DAC or pre-amplifier, or be combined with the GEM amplifier to raise its stand alone input impedance. Pcb outlines are also shown.

Finally and very importantly, in relation to the single ended output choke option!
Whilst it is possible to run this amplifier without any choke, say by series connecting four 22 ohm heatsink mounted resistors in its place, for the lower power version I use two 230V 50VA mains transformers

primaries connected in series. These have a resistance of approximately 40 ohms each, and do become rather hot, so free air ventilation is essential. My transformers were cut apart, then re-assembled as a thick paper gapped twin 'E' core assembly. See photo.

Fake Transistors

Beware of fake Toshiba Transistors. The genuine article is shown below on the left. The center and right most image are fake Toshiba transistors. The fakes have higher junction capacitance and limit the high frequency response having an adverse effect on sound quality.



WARNING !

Do not manually attempt to connect or disconnect the output choke once this amplifier has been powered up. If you are holding the connecting wire and the wire insulation breaks down under back-EMF potential, it will not be the amplifier that is damaged, but *YOU*.

My Conclusion

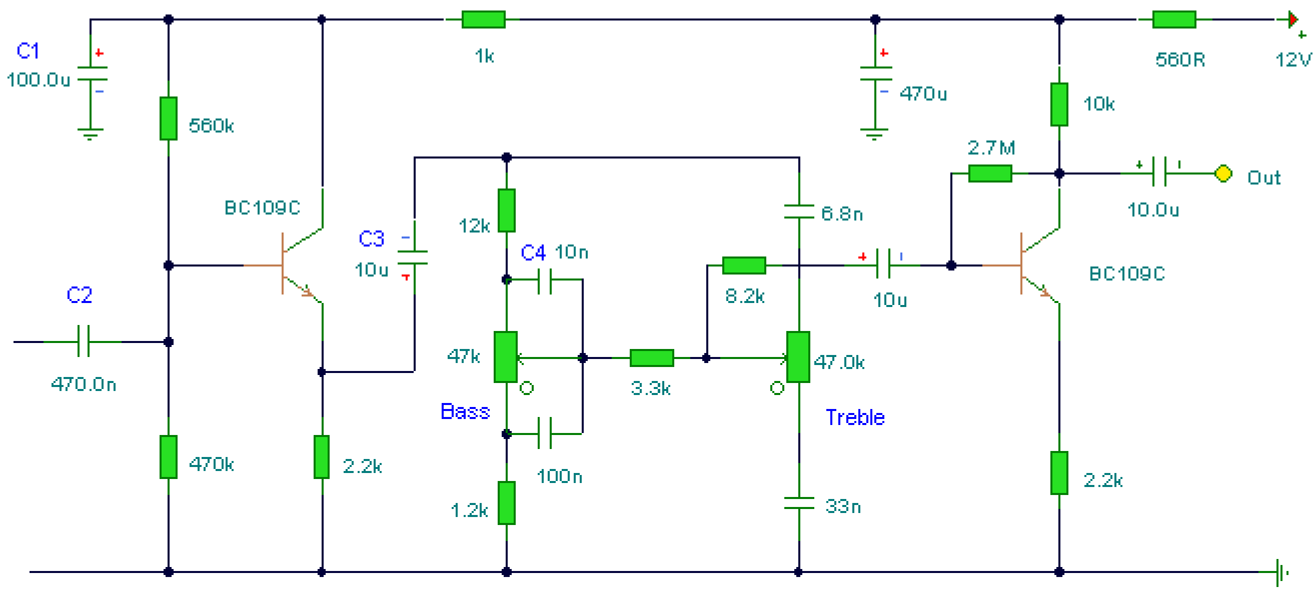
I have enjoyed music listening through several fine amplifiers, but for me this development supersedes all because it imparts notable loudspeaker control without generating the secondary amplifier-loudspeaker interface current flow related error components which so often spoil solid-state amplification.
Thus I wish everyone who constructs this GEM - the very best of listening....

..... Graham Maynard.

P68. Tone Control

Description:

Based on the classic Baxendall tone control circuit, this provides a maximum cut and boost of around 10dB at 10K and 50Hz.

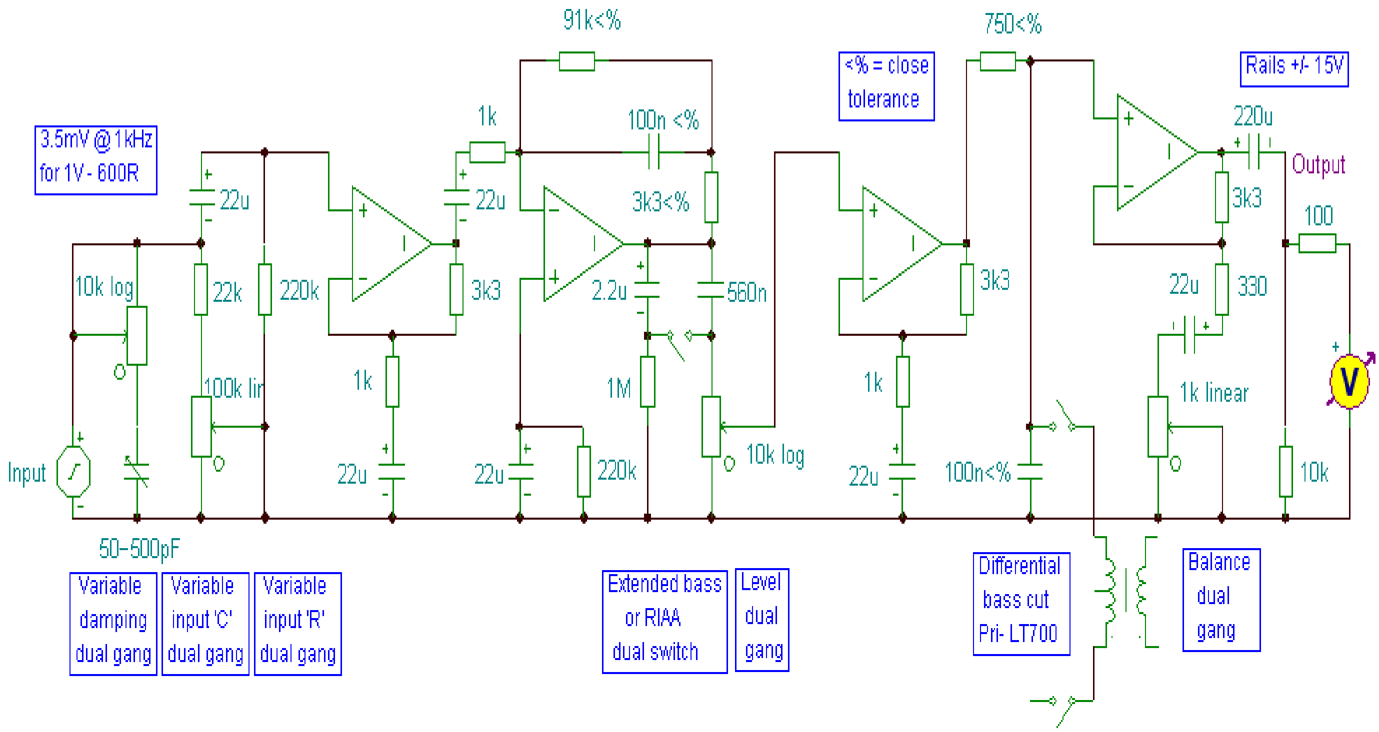


Notes

The first BC109C transistor (left hand side) is acting as a buffer. It provides the circuit with a high input impedance, around 250k has a voltage gain of slightly less than unity. As the Baxendall tone control circuit is a passive design, all audio frequencies are attenuated. The position of the controls and reactance of the capacitors alters the audio response. The last transistor provides a slight boost of about 3x. The output is designed to feed an amplifier with input impedance of 10k to 250k. Both tone controls should be linear type potentiometers.

P69. Vinyl Pre-Amplifier

Originally built using 741 type ICs; finished with TDA1034NB. Later type NE5534. Redrawn Jan 2006.



The 'ACE'. Vinyl pre-amplifier - 1975. by Graham Maynard.

Notes:

Back in the 1970's I became disheartened by audio 'progress', for in spite of them presenting much superior specifications, mainstream transistor amplifiers sounded worse than the tube (valve) designs they were supposed to replace. Ultralinear KT88s made good power amplifiers, but transistor circuitry could be much better for pre-amplifiers. Integrated circuits had also developed well, but these were often thought of as offering a lesser performance when compared to discrete construction.

For those who might wish to 'save' to their computer hard-drive a digital copy of their own vinyl record collection, I have redrawn my 1975 vinyl pre-amplifier circuit. It remains capable of optimising disc playback and offers features still not repeated today.

Many designers opinionate that NFB loop controlled amplifiers are inferior because they degrade the sound, and yet I wonder what it is that these individuals think they actually listen to ? The fact is that most vinyl waveforms and CD pits, as pressed into their own disc collections, have already been mastered through a myriad of NFB loop controlled pre-amplifier and mixer stages - this long before anyone can start listening. Indeed, that Mullard developed TDA1034NB integrated circuit which initially cost me Â£67 for ten, went on to be used by the hundred within what became a classic series of world famous Neve mixing consoles.

Properly designed NFB loop controlled IC gain stages can set standards for excellence, and thus I separately list five elements embodied within my 'old' pre-amplifier design.

(1) A moving magnet pick-up cartridge is an inductive transducer that must be resistively damped and reactively tuned to optimise reproduction.

Hence I fitted a sub-miniature twin gang 500pF variable and screen earthed twin gang potentiometers directly to the input circuitry.

It is only *after* you have actually used these input damping and tuning controls whilst music listening to optimise your own equipment line-up, that you can understand just how much mind distracting spin has been repeated about fractional 'dB' variation with respect to an ideal RIAA characteristic.

Cartridge to pre-amplifier matching has a much more significant effect upon reproduction than does the achievement of perfect RIAA equalisation !!!

(2) Another factor greatly affecting reproduction relates to NFB loop controlled gain stage interactions and terminations.

For example, it is possible to build a moving magnet stage using just one or two gain stages per channel, and they can measure near ideal under steady sinewave examination, but this cannot guarantee that they will actually sound good when coping with highly dynamic music waveforms. NFB loop controlled equalisation stages should be buffered at input as well as output. The input terminal of a stage that is called upon to output current not retaining a linear relationship with voltage at all frequencies, will itself not respond with amplitude linearly if fed at high impedance, and this is especially so with bipolar input circuitry.

(Stage interaction often arises, and this is why some power amplifier plus pre-amplifier combinations can reproduce less cleanly than expected.)

Interconnects are not the only cause of audible degradation, thus a separate additional NFB loop controlled line output driving stage that does not load previous circuitry whilst providing a lower output impedance can further improve rather than degrade the final sound by its own presence.

(3) The components used for upper and lower RIAA equalisation characteristics are better separated, as in this circuit.

Passive (non distorting) 750 ohm (or 2x 1k5 in //) plus 100nF close tolerance components not only perform the RIAA hf cut between stages three and four, but they also reduce higher audio frequency noise and distortion from the earlier stages.

Here the line driver stage is already operating at good input signal level with falling input input impedance as frequency increases, and the resulting improvement in sound reproduction becomes instantly recognisable.

Additionally, the uncompensated series feedback unity gain error seen on some other vinyl pre-amplifier circuits is automatically covered.

(4) The original RIAA characteristic was, *is*, sub-bass weak, with a low frequency roll-off that introduces notable bass phase distortion.

For this reason I extended the low frequency equalisation to 25Hz instead of 50Hz, with a switchable option for 'standard' reproduction.

Do not try to use the extended bass response for loud real-time playback (via a computer is okay) unless you have solid floors or your turntable is brick wall mounted.

The 22uF capacitors then introduce multi-pole passive roll-off below 20Hz to more sharply cut turntable and pressing rumbles.

(5) At high live playback levels the extended bass response can set up feedback via differentially energised room resonances. This was easily remedied by connecting the primary of a subminiature transistor radio output transformer between channels, thereby mono-ing the sub-bass without affecting other stereo reproduction. Thus this pre-amp offered a new method for bass feedback reduction that has minimal impact upon the overall bass reproduction level, yet which allows higher 'pop-party' sound levels in undamped rooms.

Don't just look at this circuit and think 'Yeah ?' or 'Sure ?' and say to yourself 'Look at all those capacitors !'.

This analogue pre-amp is a tested design providing not just both a cleaner and quieter background to the music we are meant to hear, but also an optimisable clarity of reproduction that few are likely to have heard before, or even imagined could ever have become a realisable experience.

Today there are many internally compensated audio integrated circuits to choose from, several offering fet input devices. Remotely power your construction with at least four 470uF or 1mF capacitors per 15V rail, and place it beside the tone arm with no more than two feet of screened interconnect.

Do please let me know how you can get on, and let me know which ICs performed well so that they can be mentioned here for other constructors.

Unfortunately I do not have any photographs of my original construction.

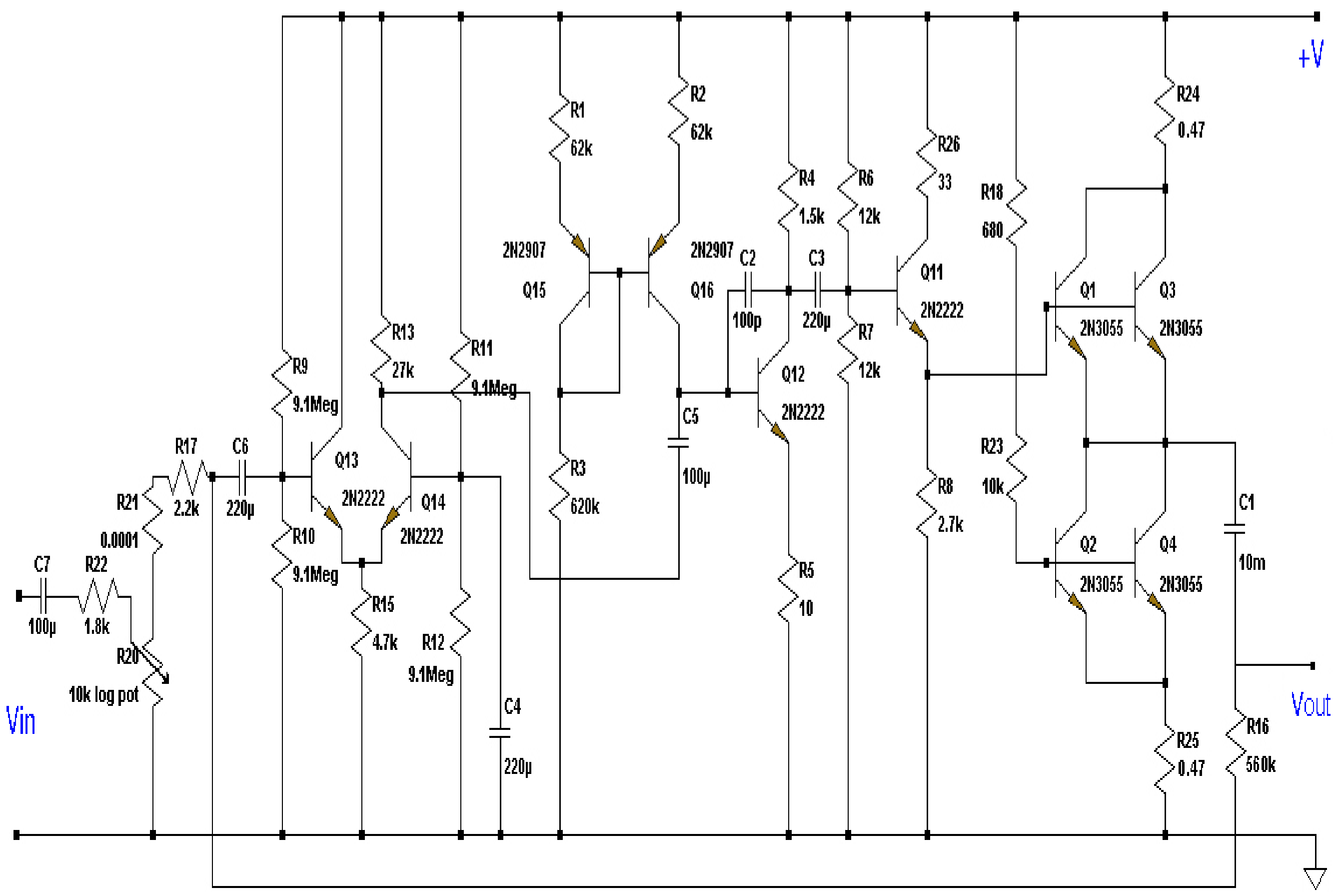
Good Luck .... Graham.

PS. After the 1980's I became even more disheartened by the next supposedly superior technical improvement - the CD. Those who construct this pre-amp might come to understand the significance of our loss !!!

P70. 24 Watt Class A Amplifier

Description:

A 24 Watt Class A Amplifier made from discrete semiconductors, built and tested by Marc Klynhans from South Africa.



Specifications:

Here are the specifications:
24W Class A into 8 Ohm
100mHz - 100kHz flat
305mV input for 24W into 8 Ohm (33dB gain)
THD is very low, although I have not been able to measure it properly

Notes:

The supply voltage can be between 34V and 46V and the quiescent current should be set to 1.7A measured through R25 (a voltage of 0.75V must be measured over R25 for a quiescent current of just under 1.7A). R23 is a trimmer and must be set to maximum resistance (10kOhm) when powering up. Then the resistance of R23 must be decreased until the the quiescent current is achieved. If the amplifier is mounted on a big enough heatsink (0.6K/W at most) then the amplifier is very safe from thermal runaway. Intelligence must be used when choosing power and voltage ratings of resistors and capacitors.

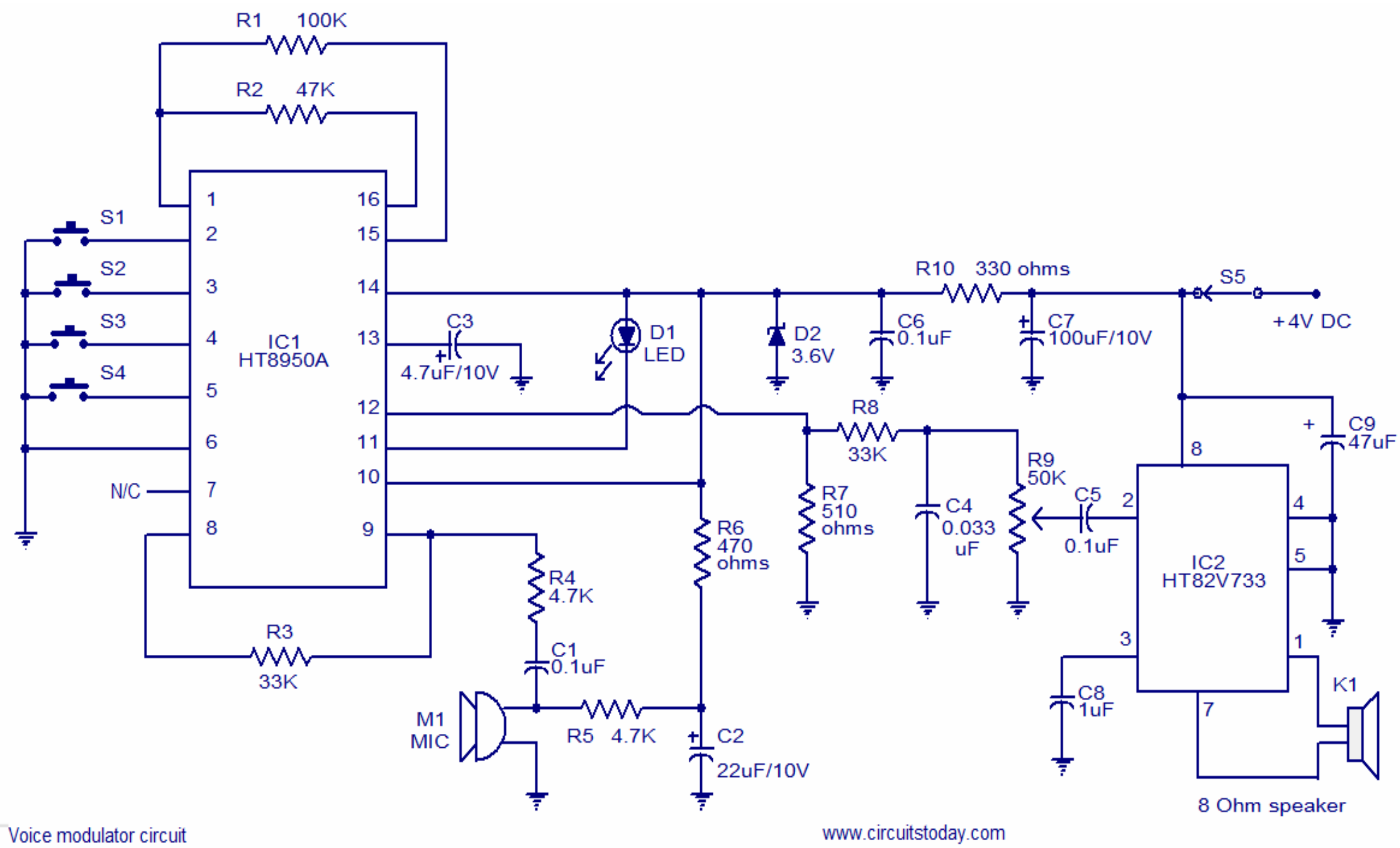
I have been using this amplifier with a pair of Celestion F20's and the sound is unbelievable!

P71. Voice modulator circuit

Description.

This is a very versatile voice modulator circuit using IC HT8950A from Holtek Semiconductors. The IC is capable of creating 7 upward or downward steps on the frequency of the input voice at a rate of 8Hz. There is also two special variation effects namely Vibrato mode and Robot mode. This circuit finds a lot of application in systems like telephone, speech processors, toys, mixers etc. A microphone is used to pick up the input voice. Push button switches S2 and S3 can be used for the upward and downward frequency stepping .Push button switch S1 can be used to activate Vibrato mode and push button switch S4 can be used to activate the Robot mode. IC HT82V733 (also from Holtek) is used to amplify the output of the voice modulator.LED D1 indicates the voice level.

Circuit diagram.



Notes.

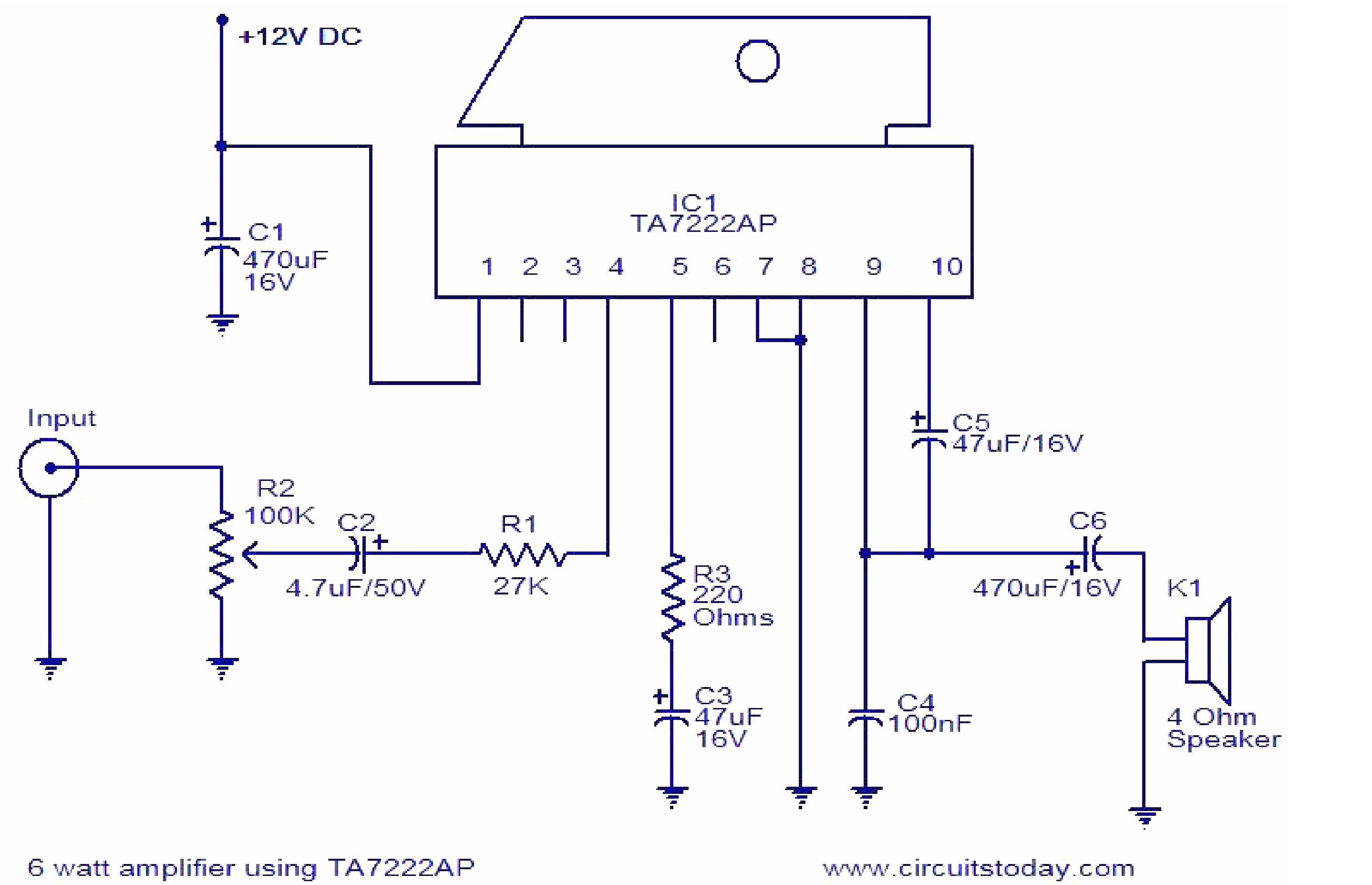
- The circuit can be assembled on a Vero board.
- Do not give more than 4.5v to the circuit.
- Switches S1 to S4 can be miniature push button switches.
- S5 can be a miniature ON/OFF switch.
- K1 can be an 8 ohm speaker.
- IC1 and IC2 must be mounted on holders.

P72. 6W amplifier using TA7222AP

Description.

Here is the circuit diagram of a 6W amplifier using the TA7222AP from Toshiba.TDA7222AP is an excellent integrated audio amplifier which can deliver 5.8W to a 4 Ohms load at 12V supply voltage. The IC has very good features like, muting function, low distortion, high ripple rejection, short circuit protection, thermal shut down etc. This amplifier can be operated from 8 to 12V and this makes it ideal for car radio applications.

Circuit diagram.



Notes.

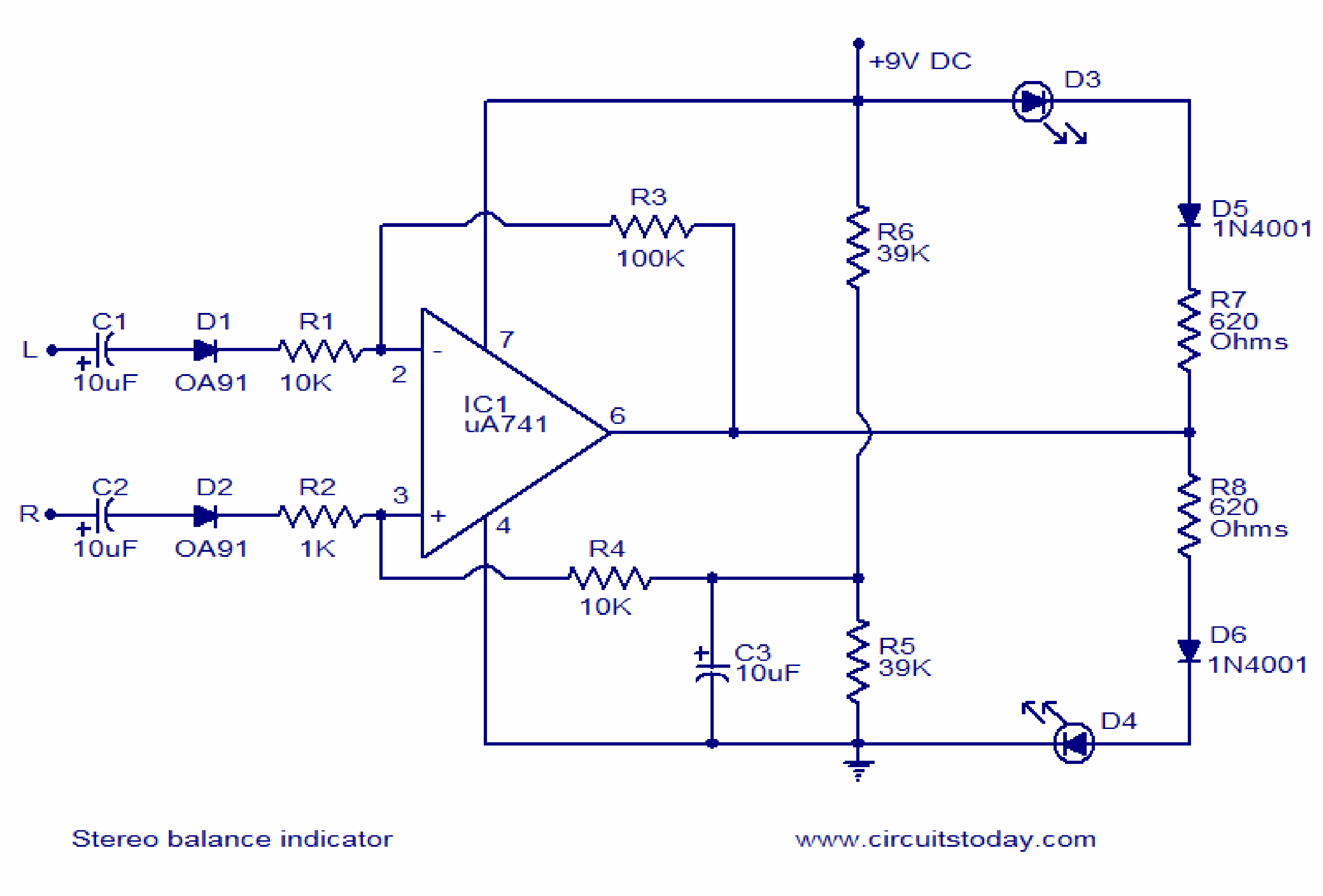
- The circuit can be assembled on a Vero board.
- Use 12V DC for powering the circuit.
- The IC must be heatsinked.
- Speaker can be a 4 ohms one.
- For optimum performance input and output must be separately grounded.

P73. Stereo balance indicator

Description.

This is one of the simplest stereo balance indicator circuit that you can have. The circuit will give a visual indication (using two LEDs) proportional to the difference in balance between the left and right channels of a stereo system. The circuit is based on a uA741 opamp IC. The IC compares the signals from the two channels and when both signals are in balance, the output of the IC will be steady and the LEDs will glow in same brightness. Unbalance in sound causes the two LEDs to vary in brightness proportionally.

Circuit diagram.



Notes.

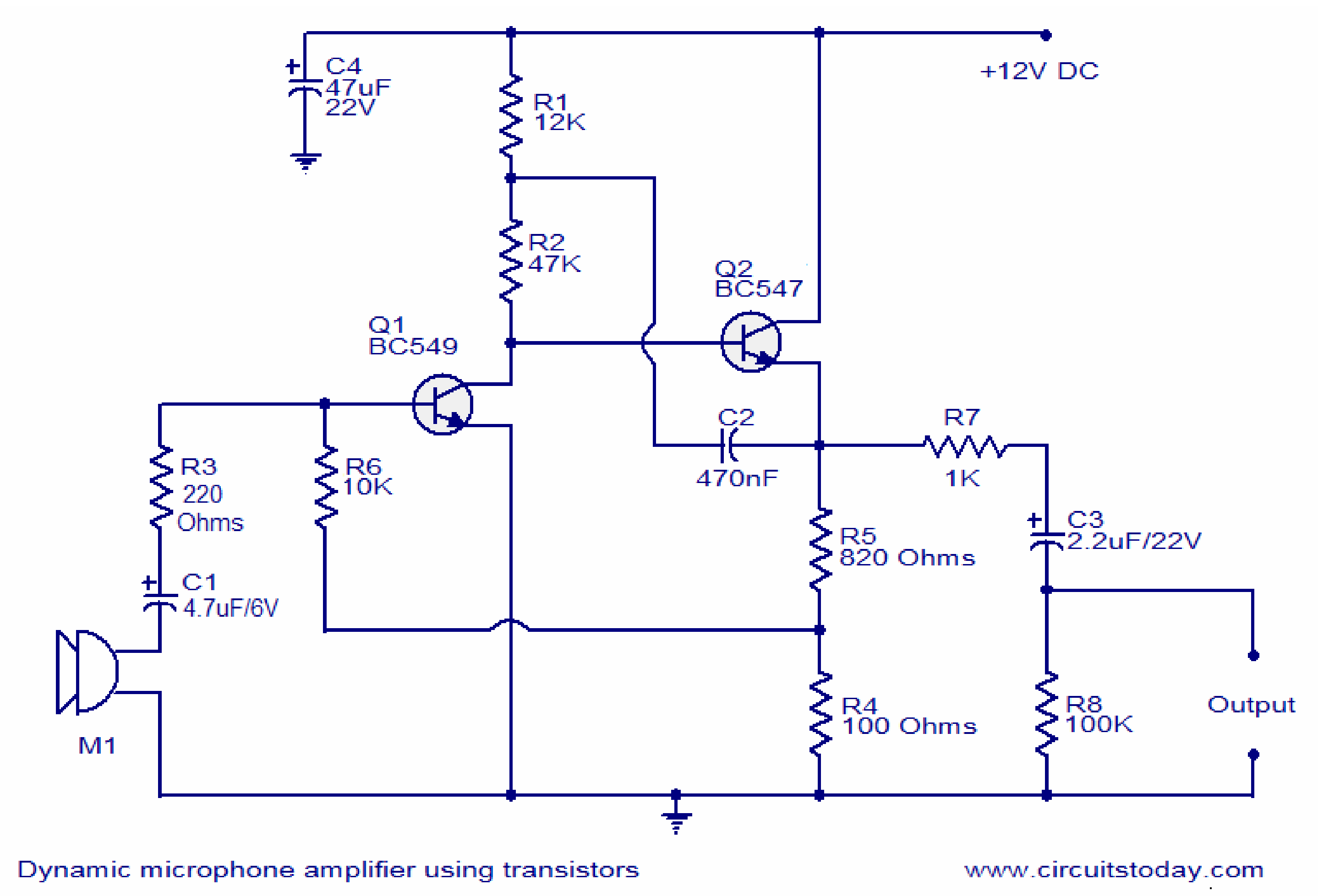
- The circuit can be assembled on a Vero board.
- Use 9V DC for powering the circuit.
- Mount IC1 on a holder.
- C1 ,C2 and C3 must be rated at least 6V.

P74. Dynamic microphone amplifier using transistors

Description.

Here is the circuit diagram of a simple dynamic microphone amplifier using two transistors. The amplification factor of this circuit is around 150 and can handle signals from 50Hz to 100Khz.These features make it ideal for audio applications. The audio signal from the microphone is coupled to the base of Q1 via the capacitor C1 and resistor R3. Q1 works as a preamplifier here. The preamplified signal will be coupled to the base of Q2 for further amplification. Resistor network comprising of R4, R5 and R6 provides the necessary negative feedback. Final output signal will be available at the emitter of Q2.

Circuit Diagram.



Notes.

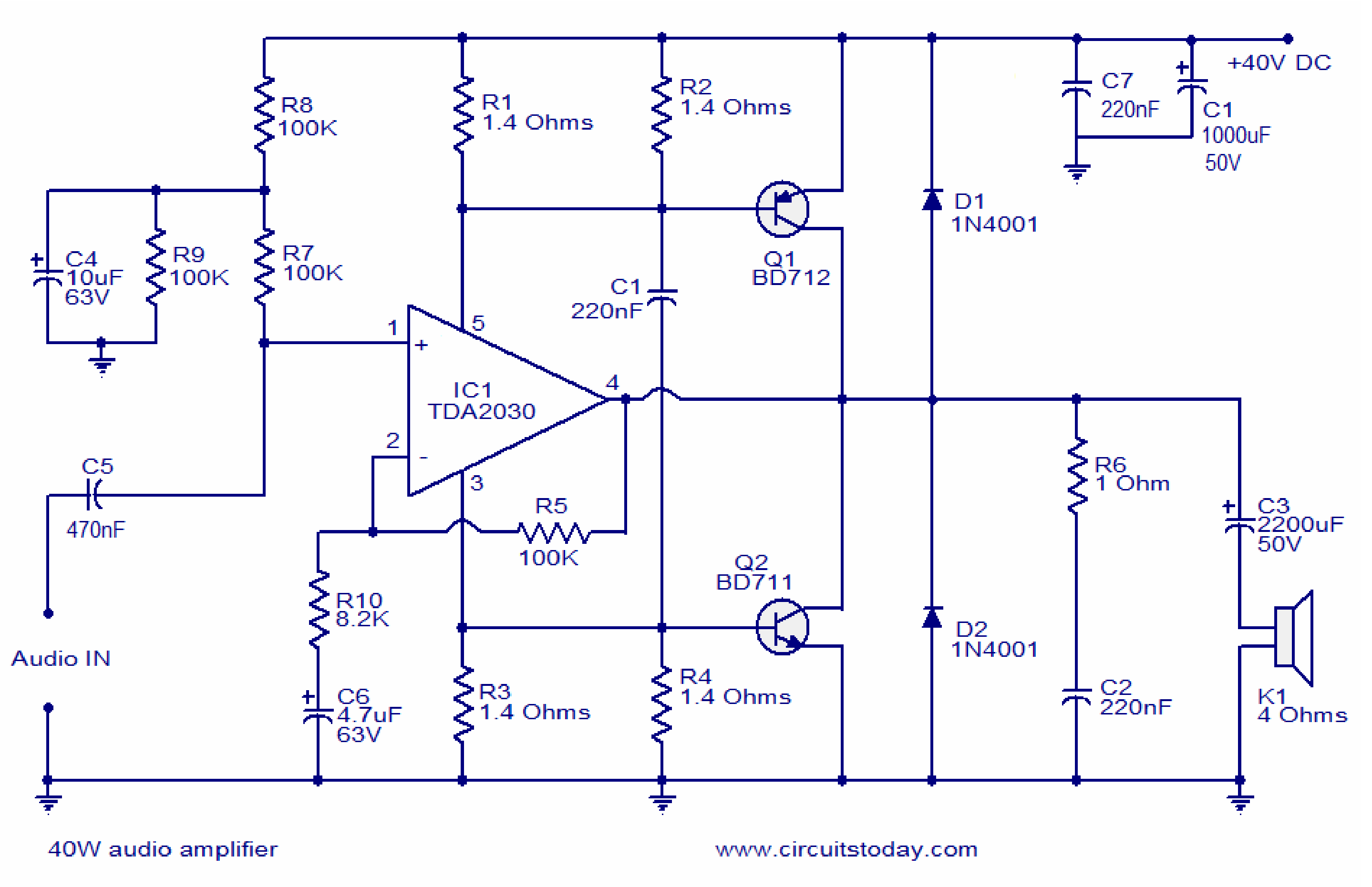
- The circuit can be assembled on a vero board.
- Use 12V DC powering the circuit.
- This circuit is designed for use with 200 Ohm dynamic microphones. For usage with low impedance microphones, the value of R3 must be increased to around 47o Ohms and C1 must be decreased to around 2.2uF.
- The circuit can be also operated from a 9V PP3 battery with a little compromise on performance.

P75. 40W audio amplifier

Description.

This is a very excellent 40W power amplifier design using TDA2030 IC and two transistors. The circuit employs only few components and does not require a dual power supply. The input signal is coupled to the non inverting input of TDA2030 through the DC decoupling capacitor C5. The TDA 2030 performs the major part of voltage amplification. As the IC performs amplification, the power supply current to the IC varies according to the input signal. The variations in the positive supply pin are coupled to the base of Q1 and variations in the negative supply pin are coupled to the base of Q2.The major part of current amplification is done by these two complementary transistors.

Circuit Diagram.



Notes.

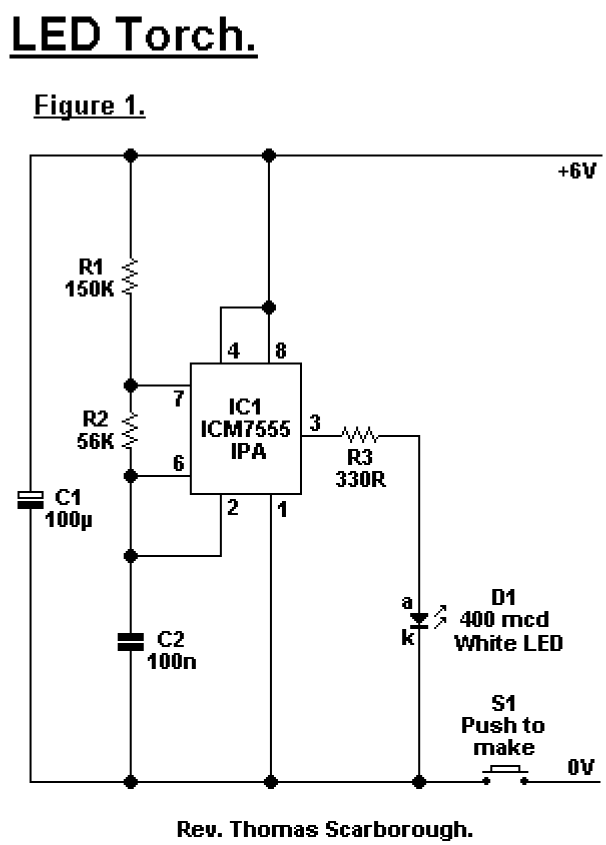
- The circuit must be assembled on good quality PCB.
- The PCB tracks through which there is high current flow should be made broader.
- 12V to 40V can be used for powering the circuit. For maximum output, use 40V supply and 4 Ohms speaker.
- Transistors and IC must be heatsinked.
- Input and output grounds must be properly decoupled for optimum performance.

LIGHT

&

LED

P76. LED Torch



A common problem with small torches is the short life-span both of the batteries and the bulb. The average incandescent torch, for instance, consumes around 2 Watts. The LED Torch in Fig. 1 consumes just 24 mW, giving it more than 80 times longer service from 4 AA alkaline batteries (that is, up to one month's continuous service). Although the torchs light output is modest, it is nonetheless quite sufficient to illuminate a pathway for walking.

The LED Torch is based on a 7555 timer running in astable mode (do not use an ordinary 555). A white LED (Maplin order code NR73) produces 400 mcd light output, which, when focussed, can illuminate objects at 30 metres. Try Conrad Electronic for what appears to be a stronger white LED (order code 15 37 45-11).

A convex lens with short focal length is placed in front of the LED to focus the beam. If banding occurs at the beams perimeter, use another very short focal length lens directly in front of the LED to smooth the beam.
If a different supply voltage is preferred, the value of resistor R3 is modified as follows:

9V - 470 Ohm
12V - 560 Ohm

P77. 6V Ultra-Bright LED Chaser

General

This is a spectacular but completely useless project. It lights Ultra-Bright LEDs in a sequence and each LED flashes brightly very briefly. The LEDs light-up going around and around since they are mounted in a circle (on a CD), then they pause before chasing again. The very brief flash of each LED (15ms) and the pauses (1 second) reduce the average current so the battery should last a long time.

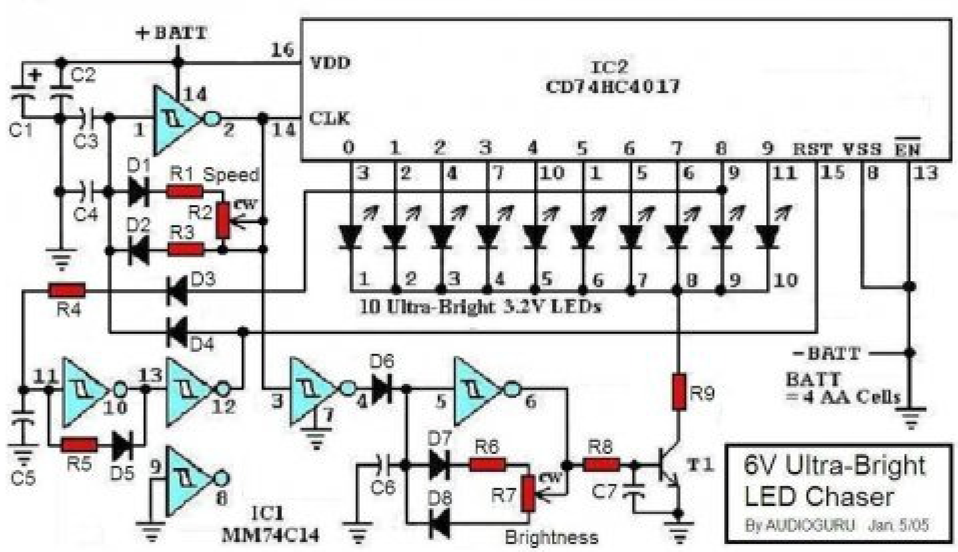
For user convenience, this project has a stepper speed control and a brightness control. At slower speeds and/or reduced brightness, the battery's life is extended considerably.

At full brightness, the LEDs flash extremely brightly. More than one of this project grouped together occasionally synchronize, lighting the whole room for a moment.

Operation

At maximum speed, the LEDs don't appear to flash, instead they appear to move from one lighted one to the next, around and around. They rotate completely for 4 rotations in two seconds, and then turn off for a one second pause then repeat the sequence. At a lower speed, the number of rotations before the pause is less. It will do three rotations, two or even only one rotation at its slowest speed. A sequence of rotations starts with LED #2 and end with LED #9.

Circuit diagram



Specifications

Battery: Four AA alkaline cells.
Battery life:
Minimum speed and brightness 2.3 years
Medium speed and brightness 1 year
Minimum speed, maximum brightness 4.1 months
Maximum speed and brightness 3.8 weeks
Brightness: controlled with Pulse width Modulation, from off to extremely bright (4000mcd).
Stepper speed: 2 LEDs/sec to 2 revolutions/sec.

Pulse Width Modulation frequency: 3.9KHz.
LED current: 24mA pulses.
LED voltage drop: 3.2V at 24mA. Blue, green and white Ultra-Bright LEDs are suitable.
Minimum battery voltage:
3V, oscillators do not run.
3V, LEDs are very dim.
4V, LEDs reach almost full brightness.
Radio interference: none.

Circuit Description

The CD74HC4017N high-speed Cmos IC is rated for a maximum supply voltage of 7V. It is rated for a maximum continuous output current of 25mA. In this project, the maximum supply voltage is 6.4V with brand new battery cells and the 24mA output current is so brief that the IC runs cool.

The MC14584BCP* IC (Motorola) is an ordinary "4XXX series" 3V to 18V Cmos IC, with a very low operating current and low output current. Its extremely high input resistance allows this project to use high value resistors for its timers and oscillators, for low supply current. Its 6 inverters are Schmitt triggers for simple oscillators and very quick switching.
IC2 is a 10 stage Johnson counter/decoder. On the rising edge of each clock pulse its outputs step one-at-a-time in sequence. It drives the anode of each conducting LED toward the positive supply.

IC1 pins 1 and 2 is a Schmitt trigger oscillator with C3 and C4 paralleled for a very low frequency. R1 and R2 control its frequency and the diodes with R3 combine with the capacitors to produce the 15mS on time for the LEDs.

IC1 pins 5 and 6 is the brightness Pulse Width Modulation oscillator. The pot R7 with the associated diodes and resistors allow it to change the duty-cycle of its output for PWM brightness control. It drives the transistor.

IC1 pins 3 and 4 is an inverter. It takes the low time (LEDs off) from the clock oscillator, inverts it to a high and shuts-off the brightness oscillator through diode D6.

IC1 pins 11 and 10 is a sample-and-hold stage. It takes a sample of the pulse driving LED #9 though D3 and R4 and charges C5 in steps. At maximum speed it takes 4 steps for C5 to charge to the Schmitt switching threshold voltage. R5 and D5 slowly discharge C5 for the pause time.

IC1 pins 13 and 12 is an inverter that resets the counter/decoder and shuts-off the clock oscillator through D4, during the pause time.

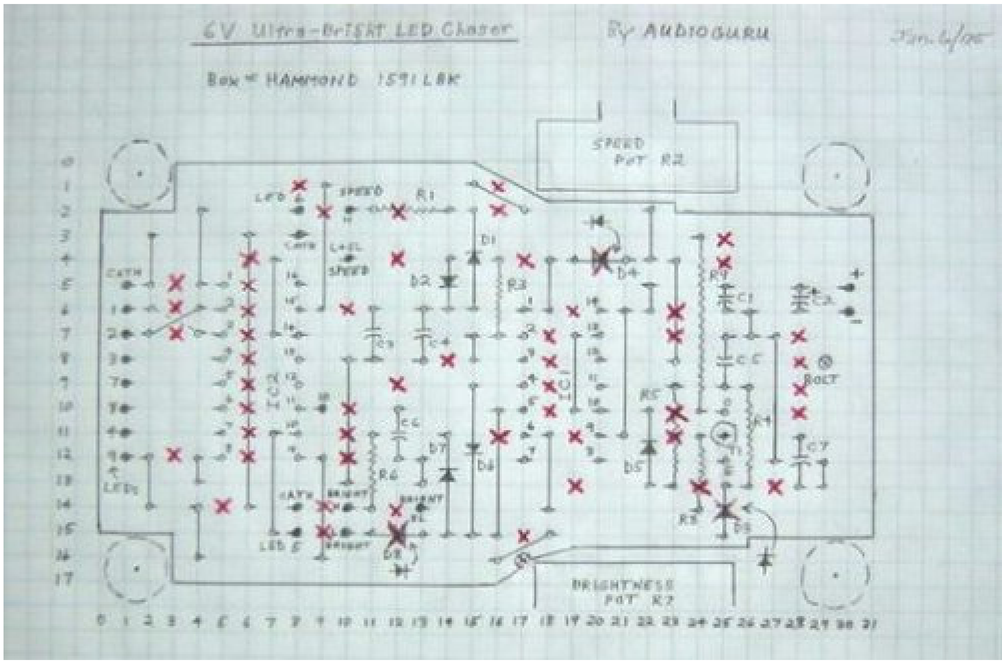
IC1 pins 9 and 8 is not used and is shut-off by grounding its input.

T1 is the PWM switching transistor. R9 limits the maximum LED current to 24mA.

Construction

The 10 LEDs mount on a Compact-Disc which is glued to a plastic box with contact cement. The box houses the Veroboard circuit in its lower main part with the battery holders on its lid. Multiconductor ribbon cable joins the LEDs to the circuit. The pots mount on the sides of the box.

If you turn it down each night, its current is so low an on-off switch isn't needed.



Parts

IC1 MC14584BCP (Motorola) * Ordinary Cmos hex Schmitt trigger inverters
IC2 CD74HC4017N High-speed Cmos decade counter/decoder
T1 2N3904 or 2N4401 NPN transistor
D1 to D8 1N4148 or 1N914 Diodes
10 LEDs Blue, green or white Ultra-Bright LEDs with Vf = 3.2V or less at 20mA
R1 100K 1/4W resistor
R2 1M Linear-taper potentiometer
R3 33K 1/4W resistor
R4 2.2M 1/4W resistor
R5 22M 1/4W resistor
R6 47K 1/4W resistor
R7 1M Audio-taper (logarithmic) potentiometer
R8 1.8K 1/4W resistor
R9 68 ohms 1/4W resistor
C1 100uF/16V Electrolytic capacitor
C2 0.1uF/50V Ceramic capacitor
C4 and C4 1uF/63V Metalized poly capacitor
C5 470nF Metalized poly capacitor
C6 and C7 1nF Metalized poly capacitor

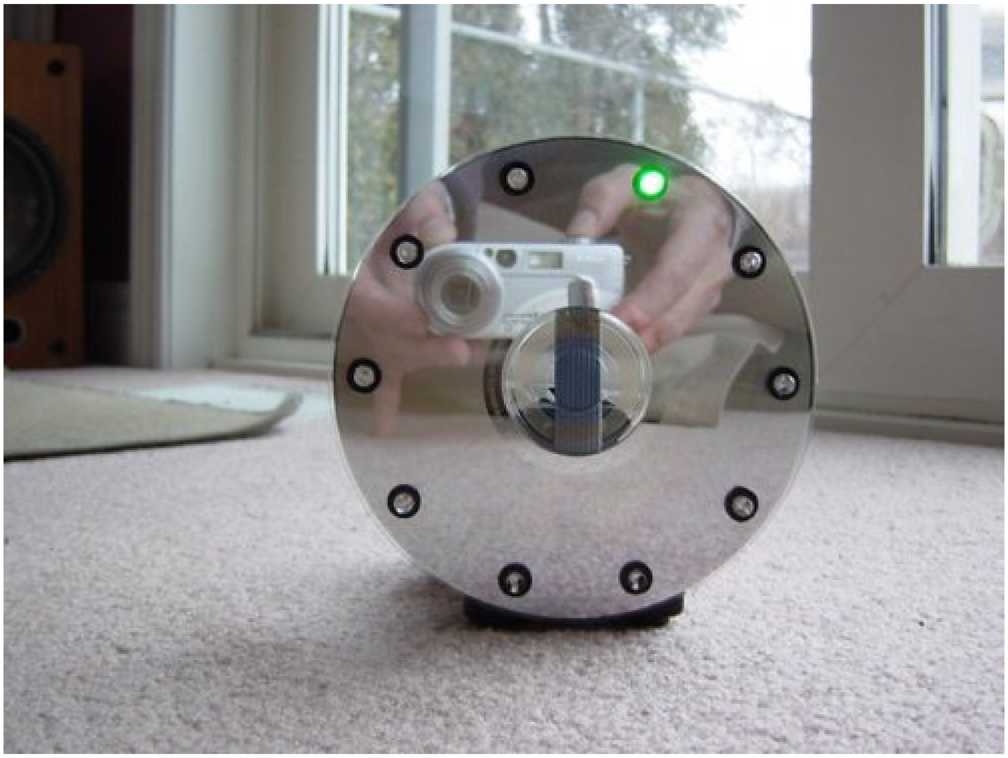
A CD74C14 can also be used for IC1 but R4 = 1M, R5 = 10M, C3 and C5 = 330nF, C4 = 470nF.
A 3V LED Chaser project also works well with these changed parts but using a CD74HC14N for IC1.

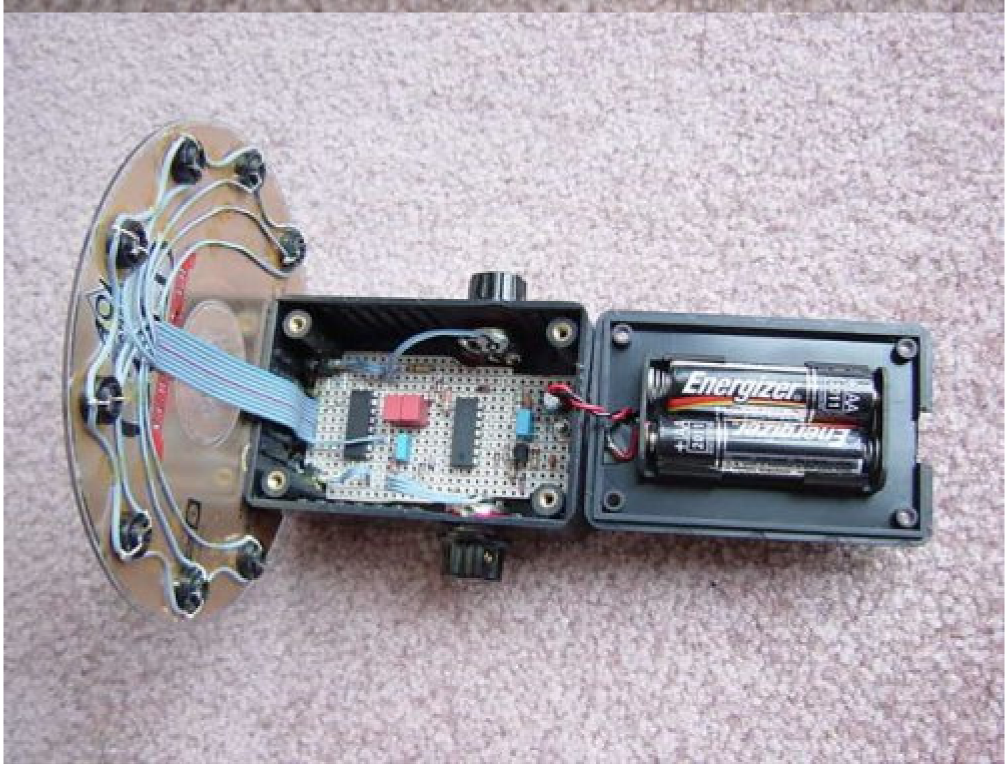
In addition to these changes, R8 = 680 ohms and R9 = 22 ohms. I built one using low-voltage (1.8V at 20mA) orange Ultra-Bright LEDs. The orange one looks good beside the green one.

Attachments: 6V LED Ultra-Bright Chaser schematic, Veroboard layout and 3 pictures.

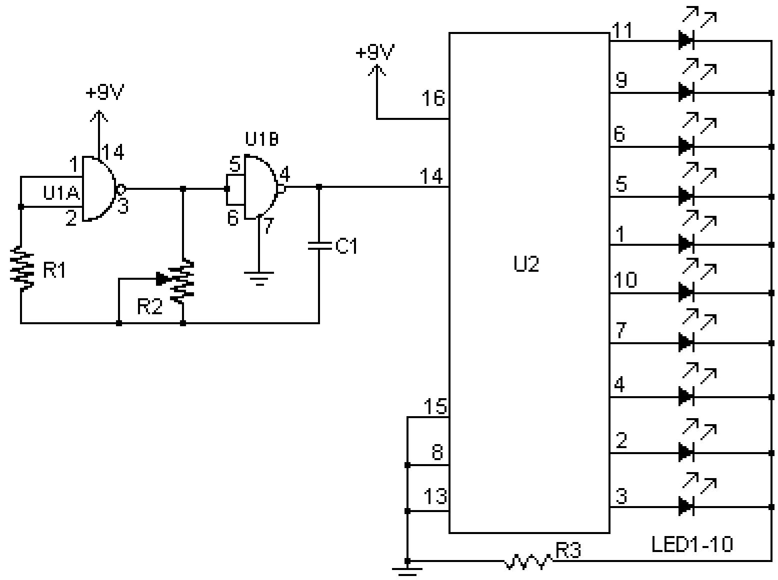
I wish I knew how to take a slow picture with my son’s digital camera, so all the LEDs would be lighted, and if I moved it would make nice lighted smears in the picture.

Photos




Energizer

P78. LED Chaser



Circuit diagram

I don't know why, but people like blinking lights. You see LED chasers everywhere, in TV shows (Knight Rider), movies, and store windows. This schematic is my version of a simple 10 LED chaser. There is no 555 timer used because at my local electronics store they are over $4 Cdn. Instead, an oscillator made up of two sections of a 4011 NAND gate is employed. This chip is very inexpensive and extremely common.

Parts:

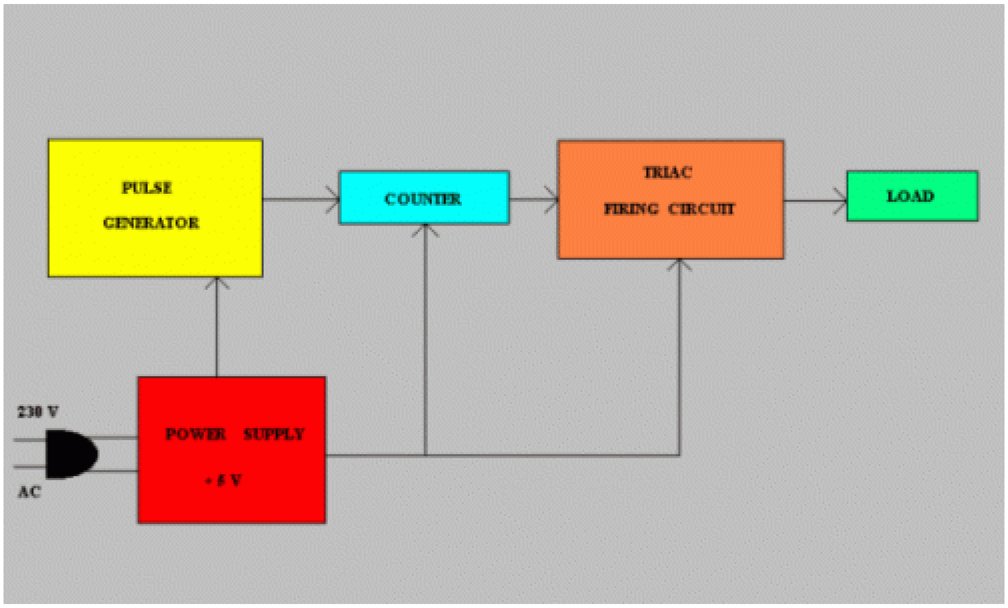
R1 1 Meg 1/4W Resistor
R2 100K Pot
R3 1K 1/4W Resistor or 220Ohm if using blue LEDs
C1 0.1uF 16V Ceramic Disk Capacitor
U1 4011 CMOS NAND Gate
U2 4017 CMOS Counter
LED1-10 LEDs Of Any Colour
MISC Board, Sockets For ICs, Knob For R2

Notes:

1. Use R2 to adjust the "chase rate".
2. You may need to use a lower value resistor if you wish to use blue LEDs. Try 220 Ohm.
3. You can also use incandescent lamps instead of LEDs. Use transistors to drive them by connecting the base of the transistors to each of the outputs of the 4017 through a 1K resistor. Connect one end of the lamp to the positive supply. Then connect the other end to the collector of the transistor. The emitter then goes to ground. Depending on the lamps, you may need power transistors that are heat sinked.
4. C1 may be replaced with a larger value for a slower "chase rate".
5. If you have problems with weird circuit behavior, try replacing R1 with a 33K resistor, and increasing C1 to 1uF.
6. If you plan to use this circuit in your car, be warned that in some areas it is illegal to have red, blue or yellow flashing lights unless you are an emergency vehicle.

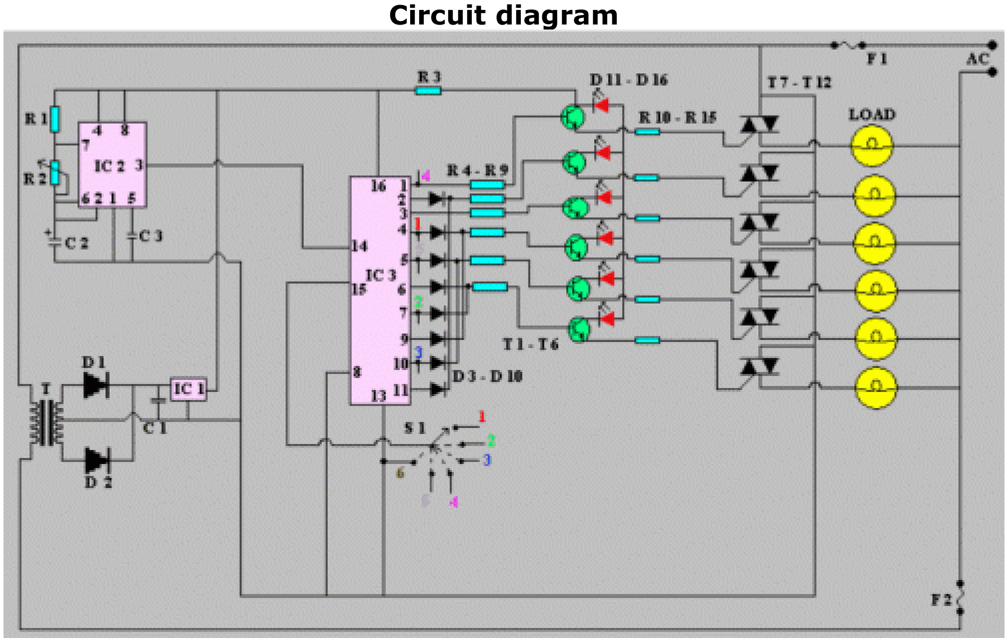
P79.

6 Channel Auto Reverse Sequential Disco Running Lights



From 230 V AC a DC supply of + 5 V is obtained. The power supply is given to the other blocks. The pulse generator at a particular frequency generates the clock pulses. The clock pulses are counted by a counter and gives output after every 10 pulses. The counter drives the transistors, which form the triac firing circuit. The transistors fire the triacs and they provide sufficient current to the load. Decorative bulbs are connected as load for each triac. The bulbs are sequentially turned ON and OFF in forward and reverse way.

Circuit diagram



The IC 555 works as the pulse generator and feeds the clock pulses to IC 4017. IC 4017 is the heart of this circuit. It works as a counter and gives the output after every 10 pulses. It drives the transistors, which in turn fire the triacs. The triac provides sufficient current to the load.

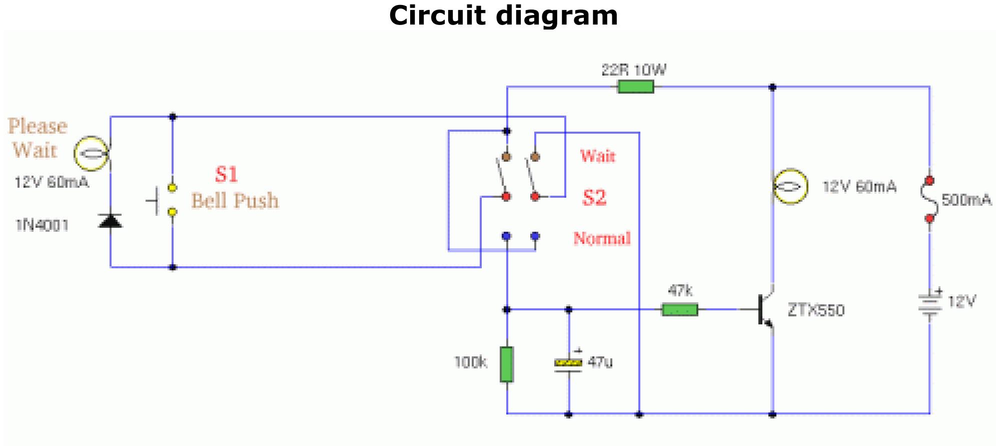
Parts
R 1 47 KW
R2 100 KW Potentiometer
R3 56 W
R4 – R9 8.2 KW
R10 – R15 47 W
All resistors are carbon composition type of ¼ watt and tolerance of maximum 5%.
C 1 1000m¦, 16 V Electrolytic
C 2 1m¦, 16 V Electrolytic
C 3 0.01m¦ Ceramic
D 1, D 2 IN 4007
D 3 – D 10 IN 4148
D 11 – D16 LED, Red color, 5mm
T 1 – T 6 BEL 187, NPN Transistor
T 7 – T 12 BT 136, 4A/400V
IC 1 7805, Voltage regulator
IC 2 555, Timer IC
IC3 4017, Decade counter
Switch (S1) 1 Pole 6 way
Transformer (T) 230 V / 9 – 0 – 9, 500mA
F 1, F 2 Fuse

P80. Doorbell for the Deaf

Description:

This circuit provides a delayed visual indication when a door bell switch is pressed. In addition, a DPDT switch can be moved from within the house which will light a lamp in the door bell switch. The lamp can illuminate the words "Please Wait" for anyone with walking difficulties.

Circuit diagram



Notes:

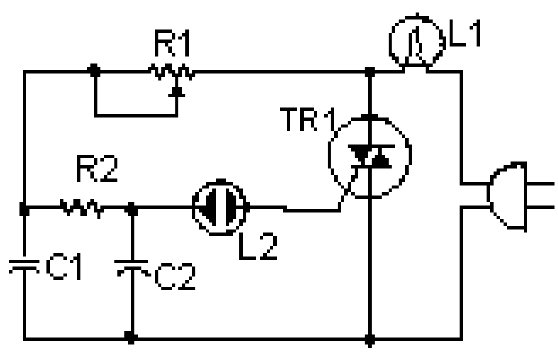
The circuit uses standard 2 wire doorbell cable or loudspeaker wire. In parallel with the doorbell switch, S1, is a 1N4001 diode and a 12 volt 60mA bulb. The bulb is optional, it may be useful for anyone who is slow to answer the door, all you need to do is flick a switch inside the house, and the bulb will illuminate a label saying Please Wait inside the doorbell switch or close to it. The double pole double throw switch sends the doorbell supply to the lamp, the 22 ohm resistor is there to reduce current flow, should the doorbell switch, S1 be pressed while the lamp is on. The resistor needs to be rated 10 watts, the 0.5 Amp fuse protects against short circuits.

When S2 is in the up position (shown as brown contacts), this will illuminate the remote doorbell lamp. When down, (blue contacts) this is the normal position and will illuminate the lamp inside the house. Switch S1 will then charge the 47u capacitor and operate the transistor which lights the lamp. As a door bell switch is only pressed momentarily, then the charge on the capacitor decays slowly, resulting in the lamp being left on for several seconds. If a longer period is needed then the capacitor may be increased in value.

P81. TRIAC Light Dimmer

This little circuit can be used to dim lights up to about 350 watts. It uses a simple, standard TRIAC circuit that, in my expirience, generates very little heat. Please note that this circuit cannot be used with fluorescent lights.

Circuit diagram

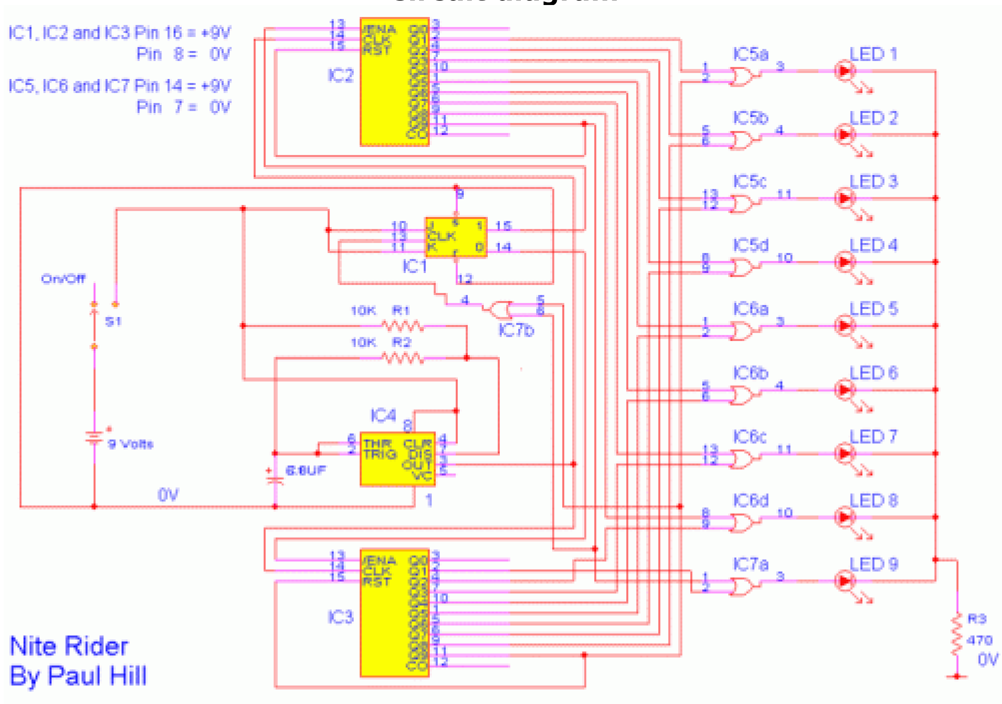


Parts
R1 50K Pot
R2 15K 1/2W Resistor
C1, C2 0.068 250V Capacitor
L1 Lamp To Be Controlled (up to 350 watts)
L2 Neon Lamp
TR1 40502 TRIAC
MISC Case, Knob, Heatsink For TR1, Wire, Socket For L1

Notes
1. This circuit is for 117VAC only. 220 or 240 V will burn up the circuit. L1 can be a maximum of 350 watts.
2. The circuit must be installed and used in a case.

P82. Nite Rider Lights

Circuit diagram



As a keen cyclist I am always looking for ways to be seen at night. I wanted something that was a novelty and would catch the motorists eye. So looking around at my fellow cyclists rear lights, I came up with the idea of 'NITE-RIDER'. NINE extra bright LED's running from left to right and right to left continuously. It could be constructed with red LEDs for use on the rear of the bike or white LED's for an extra eye catcher on the front of the bike.

All IC's are CMOS devices so that a 9V PP3 battery can be used, and the current drawn is very low so that it will last as long as possible.

Parts
1 555 timer IC4.
1 4027 flip flop IC1.
2 4017 Decade Counter IC2 and IC3.
3 4071 OR gate IC5, IC6 and IC7.
1 470 Ohm resistor 1/4 watt R3.
2 10K resistors 1/4 watt R1 and R2.
1 6.8UF Capasitor 16V C1.
9 Super brght LED's 1 to 9.
1 9V PP3 Battery.
1 single pole switch SW1.
1 Box.

How The Circuit Works.

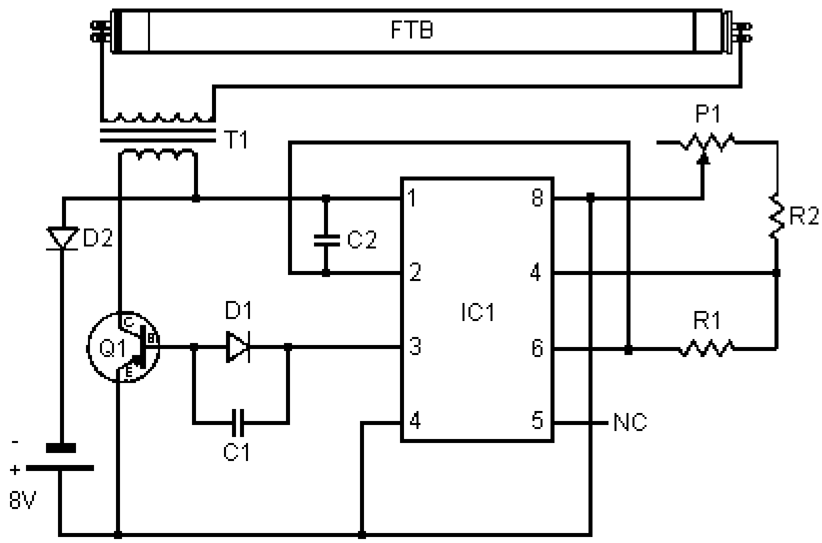
IC4, C1, R1 and R2 are used for the clock pulse which is fed to both the counters IC2 and IC3 Pin 14.
IC1 is a Flip Flop and is used as a switch to enable ether IC2 or IC3 at pin 13.

IC7a detects when ether IC2 or IC3 has reached Q9 of the counter pin 11.
IC5, IC6 and IC7a protects the outputs of the counters IC2 and IC3 using OR gates which is then fed to the Anodes of the
LED's 1 to 9.

P83. Black Light

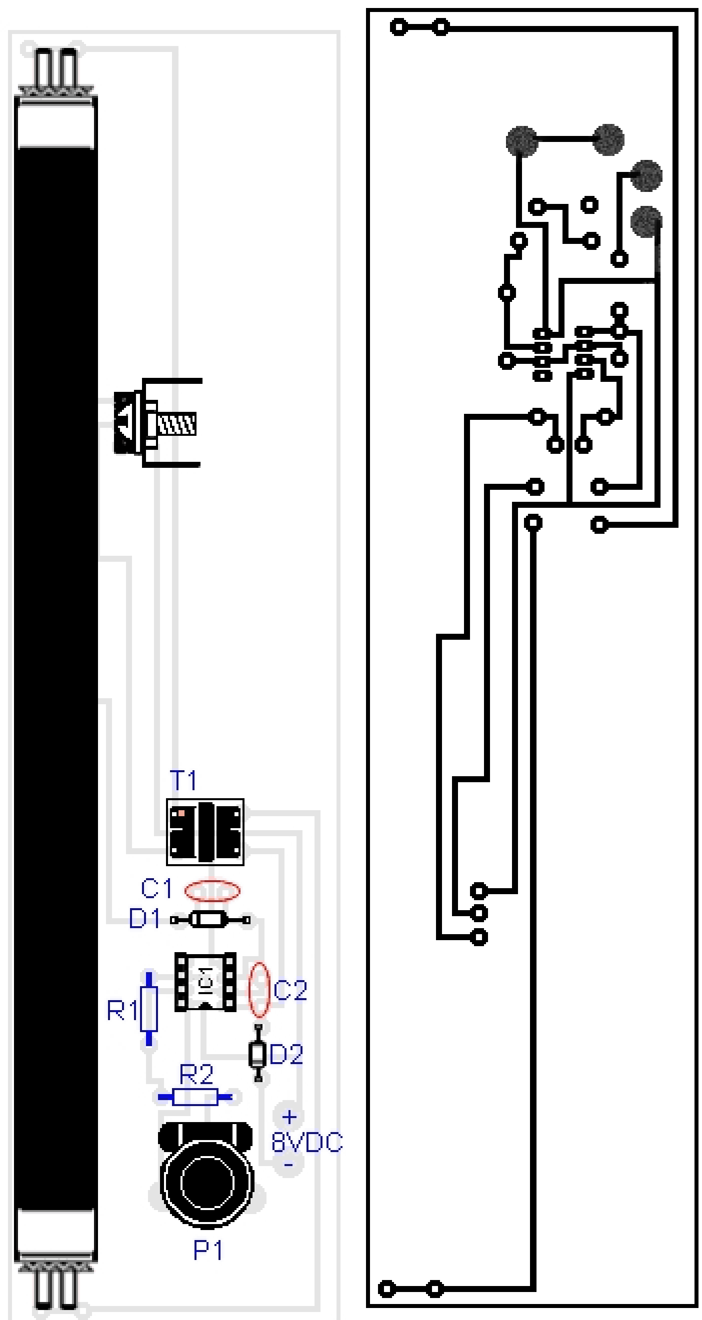
This circuit is a simple ultraviolate light that can be powered by a 6 volt battery or power supply that is capable of supplying 1 or more amps.

Circuit diagram



Parts
C1 0.0047uf Mono Capacitor
C2 0.1uf Disc Capacitor
D1, D2 1N4007 Diode
FTB Filtered Blacklight Tube
IC1 555 Timer IC
P1 10k Trim Pot
Q1 TIP30 PNP Power Transistor
R1 470 Ohm Resistor
R2 270 Ohm Resistor
T1 Medium Yellow Inverter Transformer
MISC IC Socket, Heat Sink For Q1, Screw, Nut, Wire and PC Board

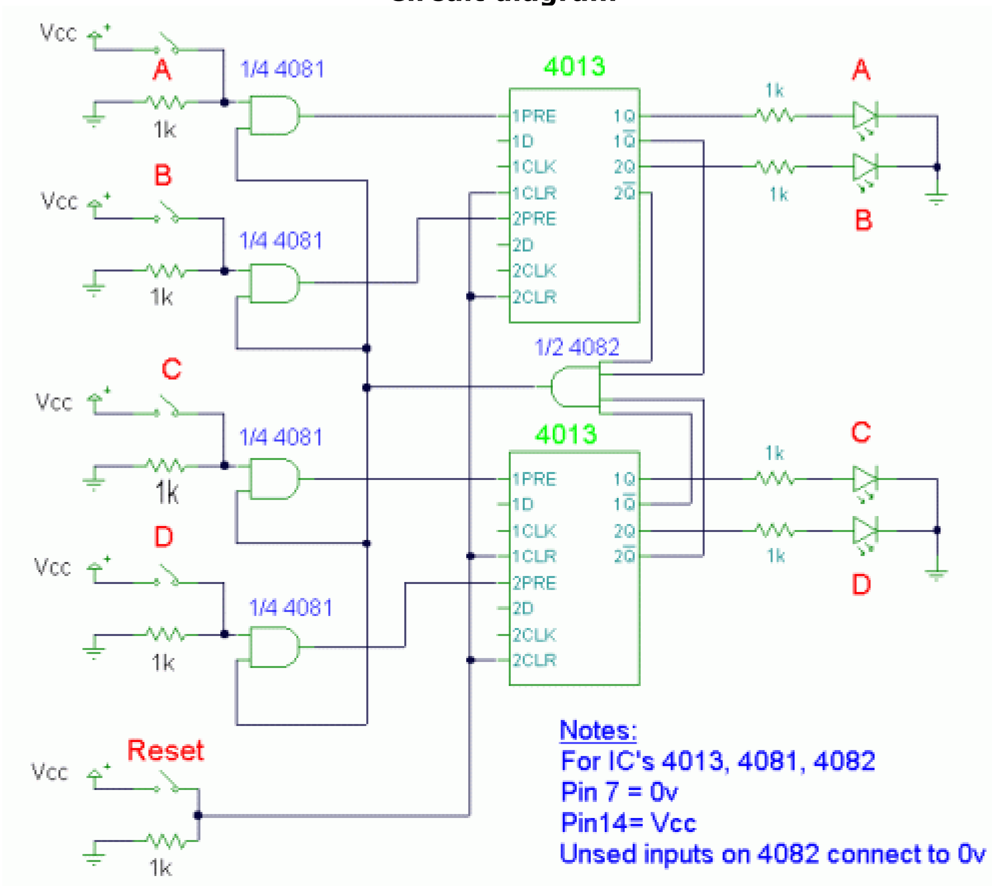
Notes:
1. P1 changes brightness of the black light tube.


T1
C1
D1
IC1
C2
R1
D2
R2
+
8VDC
-
P1

P84. Quiz Circuit

I've had a few requests for a quiz circuit, so here is a 4 input design which can easily be modified. Maybe, I should write the application notes in the style of a game show host...

Circuit diagram



Notes:

This design uses four IC's and has four input circuits and four independent outputs and a single master reset switch. The outputs here are LED's but may be modified to drive lamps or buzzers. Only one output LED can be lit at any time. The first person to press their input switch, A,B,C,D will light the corresponding output LED, disabling the other inputs.

The circuit uses all CMOS IC's part numbers shown on the diagram. The supply voltage may be anything between 3 and 15 volts. Alternatively, it may be built using equivalent TTL IC's and powered on 5 volts. The main component in this circuit is a bistable latch, here it is based on the dual 4013 D-type flip flop.

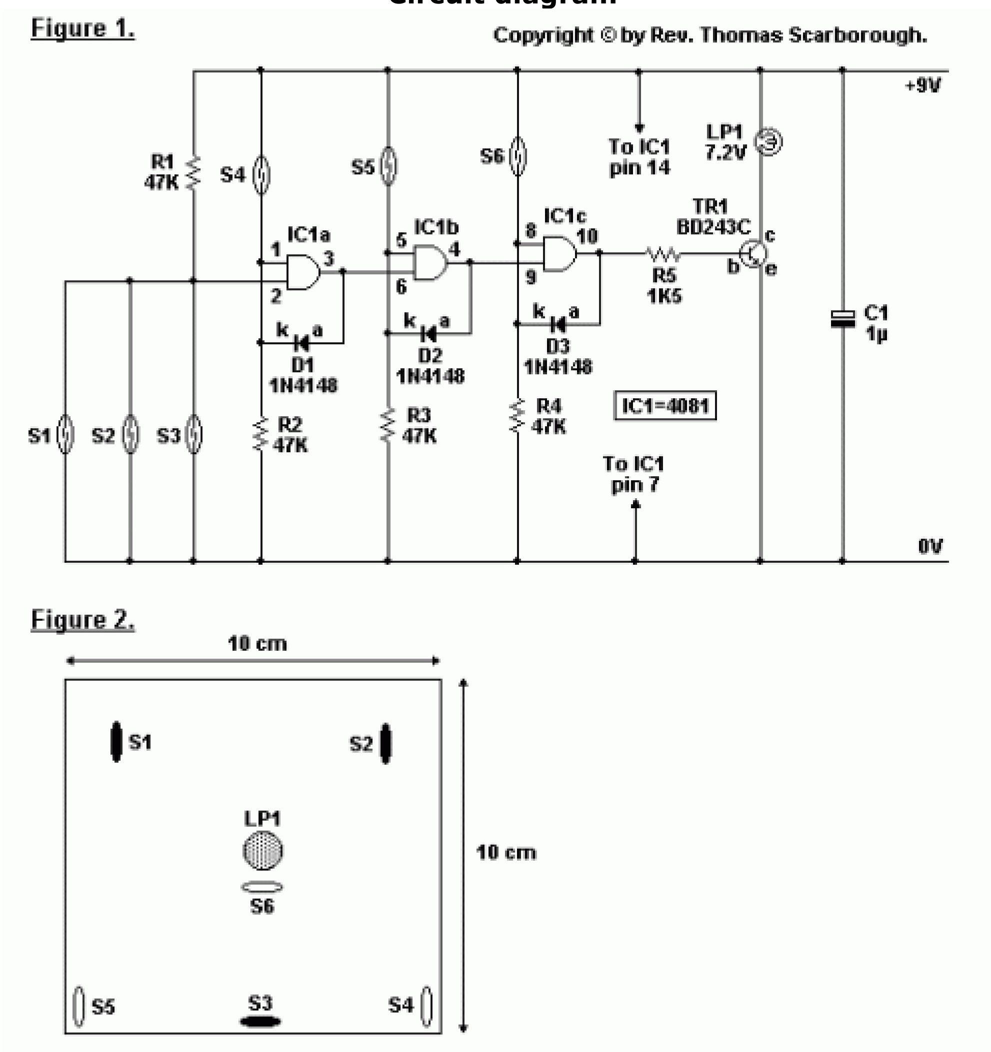
Circuit Operation:

Pressing the reset switch will clear all flip flops and extinguish any lit LED's. Under this condition the Q outputs will all be low (logic 0) and NOT Q outputs will be high (logic 1). All four NOT Q outputs are fed to a 4 input AND gate, the 4082 whose output will also be high. The output of the 4082 is wired to one input of each 2 input AND gate (4081). Switch inputs A,B,C,D are all non latching push button switches, the first person to press their switch will cause the corresponding AND gate (4081) to go high and trigger the preset input of the 4013 D-type flip flop. This will latch and light the appropriate LED. Also the triggered flip flop will have its NOT Q output, set at low, this changes the 4082 output to low and prevents any further triggering of the other flip flops. Switch contact de-bouncing is not required as the first press will latch one of the bistables. Pressing the reset switch, restores the circuit to its former state. I would recommend using heavy duty push button switches, as in use they are likely to be under some stress.

P85. Magic Wand Conjuring Trick

The simple conjuring trick in Figure 1 is intended to provide some enjoyment for the beginner in electronics or conjuring, and should take only an hour or two to build.

Circuit diagram



The trick works as follows: a wand (with a magnet mounted in one end) must pass in a 1-2-3 sequence over reed switches S4 to S6 before the bulb LP1 will light. If the wand passes over reed switches S1, S2, or S3, the 1-2-3 sequence will be reset (that is, cancelled). Or, if the bulb is already burning, the activation of reed switches S1, S2, or S3 will extinguish it.

All the reed switches - S1 to S6 - are glued just beneath the surface of a 10 cm² box (Figure 2). A general purpose adhesive is suggested, so that the reed switches may later be moved if necessary. The bulb, LP1, is mounted in the centre of the box. A small PP3 9V battery may be used. The prototype box was built using balsa wood.

The wand may be waved back and forth in various motions over the box, on condition that it finally passes in the correct 1-2-3 sequence over S4 to S6 (at which point LP1 will light). This should thoroughly confuse any onlooker and make it virtually impossible for another person to repeat the correct motions with the same wand. The wand may also be lifted just high enough over reed switches S1 to S3 so as not to trigger them.

A 7.2V filament bulb, LP1, was used - instead of, say, a LED - so as not to give the trick an "electronic" appearance.

The operation of the circuit is fairly simple. Three AND logic gates of a 4081 CMOS IC are employed, with gates IC1a to IC1c being configured as a standard cascaded latch circuit. S1 to S3 serve as reset switches. The output at pin 10 will only switch to logic high when reed switches S4 to S6 are closed in sequence. Power transistor TR1 amplifies the output current to light bulb LP1.

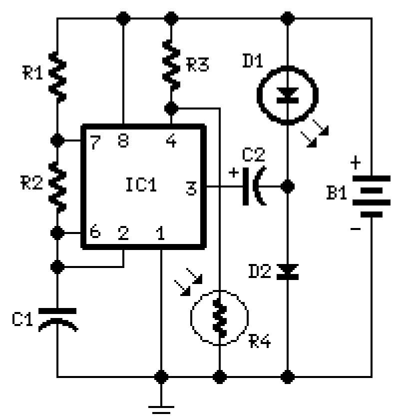
Instead of a wand, a small neobdymium (super-strength) magnet may be stuck to one finger, and one's finger used in place of the wand.

In "stand-by" mode (with the bulb extinguished) the circuit will use very little current. Therefore a switch is not included in the circuit (of course, one may be added). The box may be opened and the battery simply clipped on or off.

P86. Battery-powered Night Lamp

Ultra-low current drawing
1.5V battery supply

Circuit diagram



Parts:
R1,R2 1M 1/4W Resistors
R3 47K 1/4W Resistor (optional: see Notes)
R4 Photo resistor (any type, optional: see Notes)
C1 100nF 63V Polyester Capacitor
C2 220µF 25V Electrolytic Capacitor
D1 LED Red 10mm. Ultra-bright (see Notes)
D2 1N5819 40V 1A Schottky-barrier Diode (see Notes)
IC1 7555 or TS555CN CMos Timer IC
B1 1.5V Battery (AA or AAA cell etc.)

Device purpose:

This circuit is usable as a Night Lamp when a wall mains socket is not available to plug-in an ever running small neon lamp device. In order to ensure minimum battery consumption, one 1.5V cell is used, and a simple voltage doubler drives a pulsating ultra-bright LED: current drawing is less than 500µA.

An optional Photo resistor switches-off the circuit in daylight or when room lamps illuminate, allowing further current economy.

This device will run for about 3 months continuously on an ordinary AA sized cell or for around 6 months on an alkaline type cell but, adding the Photo resistor circuitry, running time will be doubled or, very likely, triplicated.

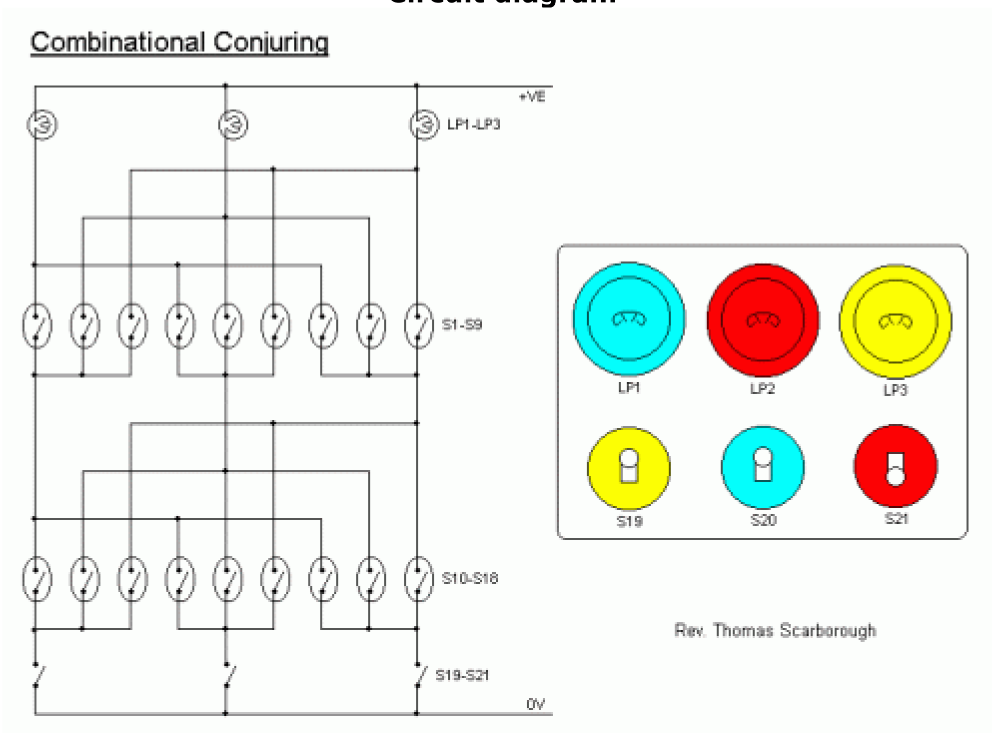
Circuit operation:

IC1 generates a square wave at about 4Hz frequency. C2 & D2 form a voltage doubler, necessary to raise the battery voltage to a peak value able to drive the LED.

Notes:
IC1 must be a CMos type: only these devices can safely operate at 1.5V supply or less.
If you are not needing Photo resistor operation, omit R3 & R4 and connect pin 4 of IC1 to positive supply.
Ordinary LEDs can be used, but light intensity will be poor.
An ordinary 1N4148 type diode can be used instead of the 1N5819 Schottky-barrier type diode, but LED intensity will be reduced due to the higher voltage drop.
Any Schottky-barrier type diode can be used in place of the 1N5819.

P87. Combinational Conjuring Trick

Circuit diagram



The simple circuit of Fig.1 emulates a similar conjuring trick which sells for hundreds of Pounds. The trick seems to do the almost-impossible from an electronic point of view, let alone from the point of view of common sense.

It consists of a bank of three on-off switches (S19-S21), which have three switch covers, each of a different colour. These switch a bank of three lightbulbs (LP1-LP3), each of a different colour. The colours of the lightbulbs correspond with the colours of the switch covers.

Now comes the interesting part. The switch covers may be exchanged at will, but still they switch the lightbulbs of corresponding colour. Similarly, the lightbulbs may be exchanged at will, but still they respond to the switches of corresponding colour. On the surface of it, there would seem to be 64 possible connections between switches and lighbulbs, and no possible way that the conjurer can manipulate them all.

However, add some sleight-of-hand, and things become a lot simpler. Each switch cover is symmetrical, in such a way that it looks the same whether facing N, E, or W. Further, each lightbulb is screwed into a circular base, which looks the same whether facing N, E, or W.

Let us consider just one of the switch covers (S19). Three reed switches (S10-S12) are positioned beneath the cover, at positions N, E, and W, and each of these activates a different lightbulb. Any one of the three reed switches may be closed by a single magnet positioned strategically under the switch cover. Depending on the orientation of the switch cover, therefore, the switch will activate any one of the three reed switches, and thus the selected lightbulb.

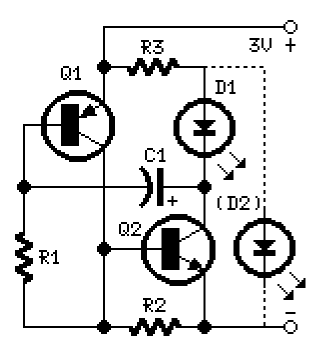
On discussing this with an accomplished magician, the author was told that this alone would be sufficient for the full effect described - reed switches S1-S9 may be omitted. Nevertheless, the lightbulbs may similarly be surrounded with three reed switches each, which are activated by the orientation of the circular base - a magnet being strategically positioned within it. These reed switches may thus reroute the power to the conjurer's selected lightbulb.

There is just one caveat from an electronic point of view. Carefully consider the voltage and power ratings of the reed switches and on-off switches, to match these with the chosen lightbulbs. Failing this, your trick may demonstrate how none of the switches will activate none of the lightbulbs.

P88. LED or Lamp Flasher

Minimum parts counting
Designed for 3V battery operation

Circuit diagram



Parts:
R1 33K 1/4W Resistor
R2,R3 47R 1/4W Resistors
C1 10µF 25V Electrolytic Capacitor
D1,(D2 LED(s) (Any type and color)
Q1 BC560 45V 100mA PNP Transistor
Q2 BC337 45V 800mA NPN Transistor

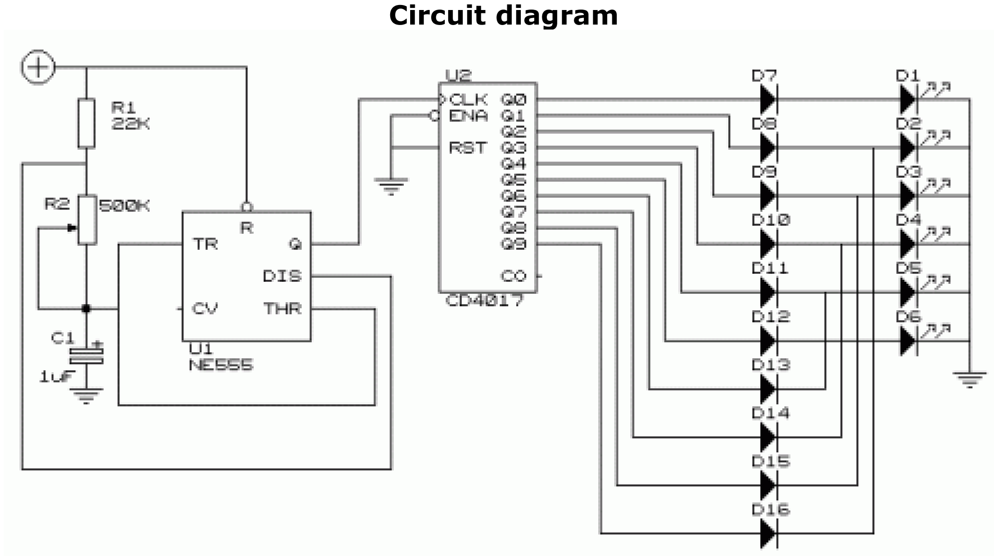
Notes:
Power supply can vary from 2 to 4.5V.
Add D2 to obtain two LED alternate blinking.
D1's on-time is shorter than off-time. The opposite regarding D2.
You can also use D2 only, shorting D1.
Don't change resistors' values.

Flashing frequency can be varied changing C1 value from 2.2µF to 100µF and higher.
This circuit is very efficient when driving a 3.2V lamp. In this case omit the LEDs and R3, connecting the lamp at Q2's collector and to positive supply, further reducing parts counting.

P89. Knightrider lights for model cars

This simple circuit drives 6 LEDs in 'Knightrider scanner mode'. Power consumption depends mainly on the type of LEDs used if you use a 7555 (555 CMOS version).

Circuit diagram



Note that VDD and GND for the ICs are not shown in the circuit drawing.

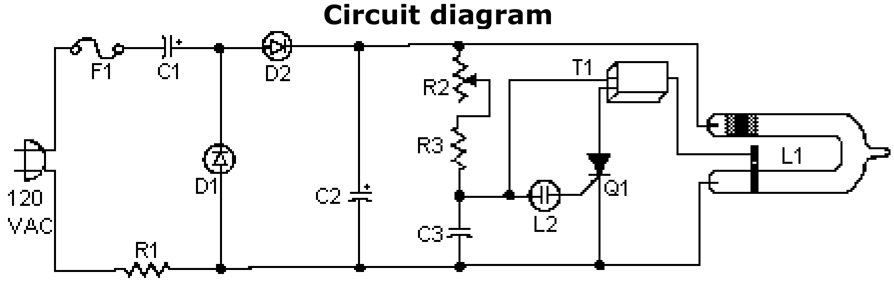
Pin-outs:
<u>(7)555</u>
1 GND
2 TRIGGER
3 OUTPUT
4 RESET
5 CONTROL VOLTAGE
6 THRESHOLD
7 DISCHARGE
8 VDD

4017
1 Q5
2 Q1
3 Q0
4 Q2
5 Q6
6 Q7
7 Q3
8 GND
9 Q8
10 Q4
11 Q9
12 CO
13 NOT ENABLE
14 CLK
15 RESET
16 VDD

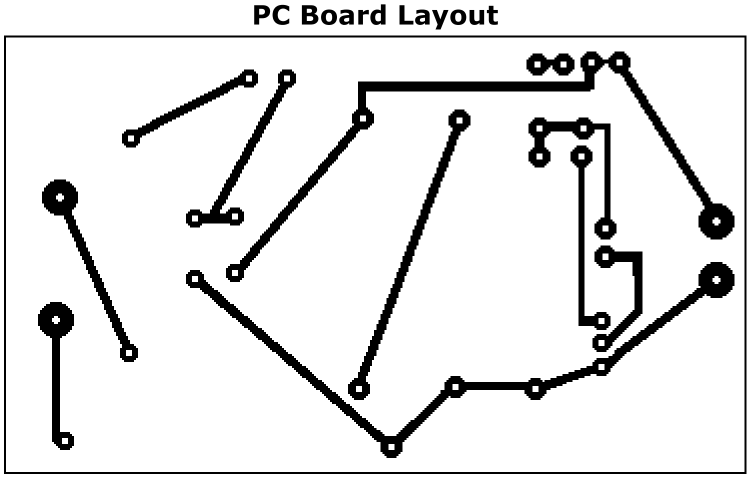
P90. Adjustable Strobe Light

This one uses a much more powerful "horse shoe" Xenon tube which produces more light. You can also control the flash rate up to about 20Hz. Do not look directly at the flash tube when this thing is on!

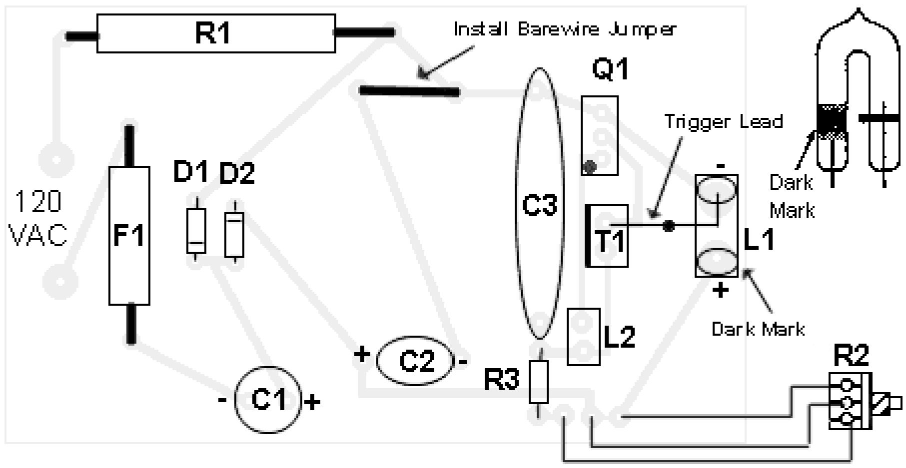
Circuit diagram



PC Board Layout



Parts Placement

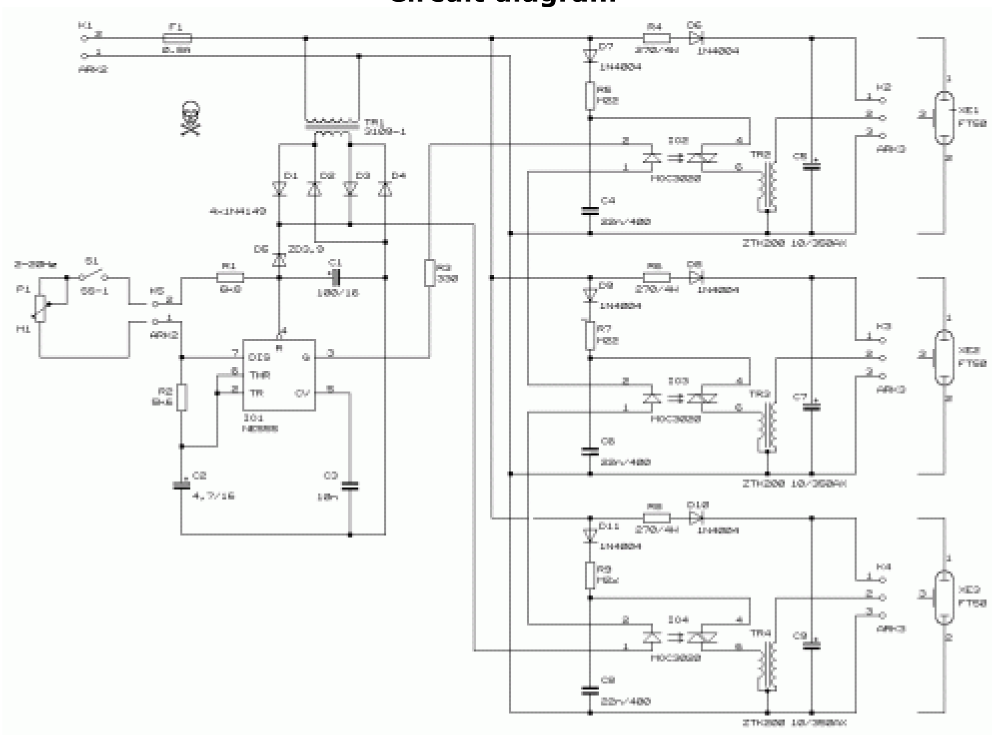


Parts
R1 250 Ohm 10 Watt Resistor
R2 500K Pot
R3 680K 1/4 Watt Resistor
D1,D2 1N4004 Silicon Diode
C1, C2 22 uF 350V Capacitor
C3 0.47uF 400 Volt Mylar Capacitor
T1 4KV Trigger Transformer (see "Notes")
L1 Flash Tube (see "Notes")
L2 Neon Bulb
Q1 106 SCR
F1 115V 1A Fuse
Misc Case, Wire, Line Cord, Knob For R2

Notes
1. T1 and L1 are available from The Electronics Goldmine
2. This ciruits is NOT isolated from ground. Use caution when operating without a case. A case is required for normal operation. Do not touch any part of the circuit with the case open or not installed.
3. Most any diodes rated at greater then 250 volts at 1 amp can be used instead of the 1N4004's.
4. Do not operate this circuit at high flash rates for more than about 30 seconds or else C1 and C2 will overheat and explode.
5. There is no on/off switch in the schematic, but you can of course add one.

P91. Triple Stroboscope

Circuit diagram



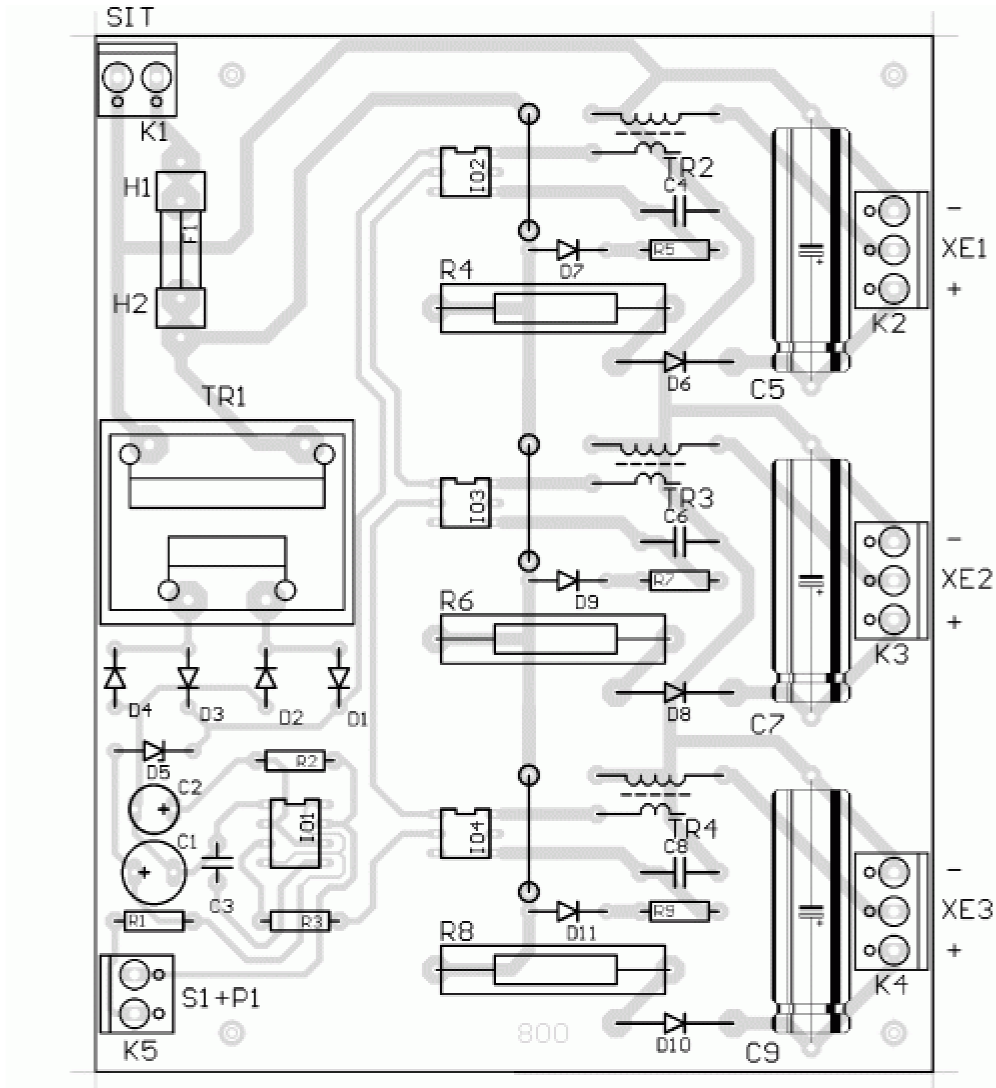
This circuit enables observation of movement between other stroboscopes. Generation of rectangular signal is based on NE555. This circuit requires a low power supply that is made from a simple transformer TR1, traditional rectifier bridge and zener diode.

NE555 works in multivibrator mode generating astable pulses of 2Hz to 20Hz.

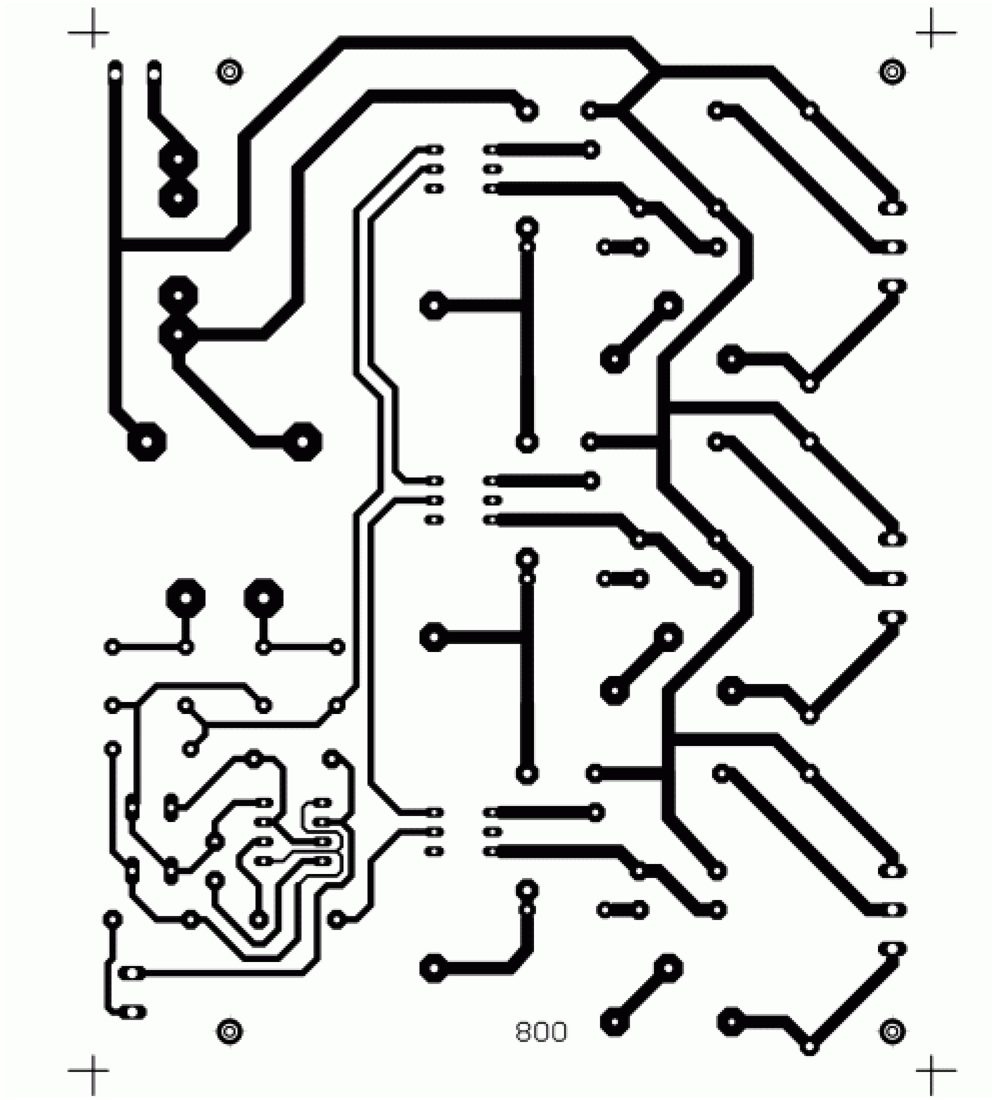
The frequency is adjusted by potentiometer P1. The control potentiometer P1 can be placed as far as 30 meters away, for suspension of stroboscope’s work from far away.

It is east to find all parts with facility in every electronic store, but it may be difficult to find the transformers TR2, TR3, TR4.

Take extreme care handling this circuit because near C5-C7-C9 high voltages are present.



SIT
K1
H1
F1
H2
TR1
D4
D3
D2
D1
D5
C2
C1
C3
R2
IO1
R1
R3
K5
S1+P1
IO2
IO3
IO4
TR2
TR3
TR4
C4
C6
C8
D7
D9
D11
R5
R7
R9
R4
R6
R8
D6
D8
D10
C5
C7
C9
K2
K3
K4
XE1
XE2
XE3
800



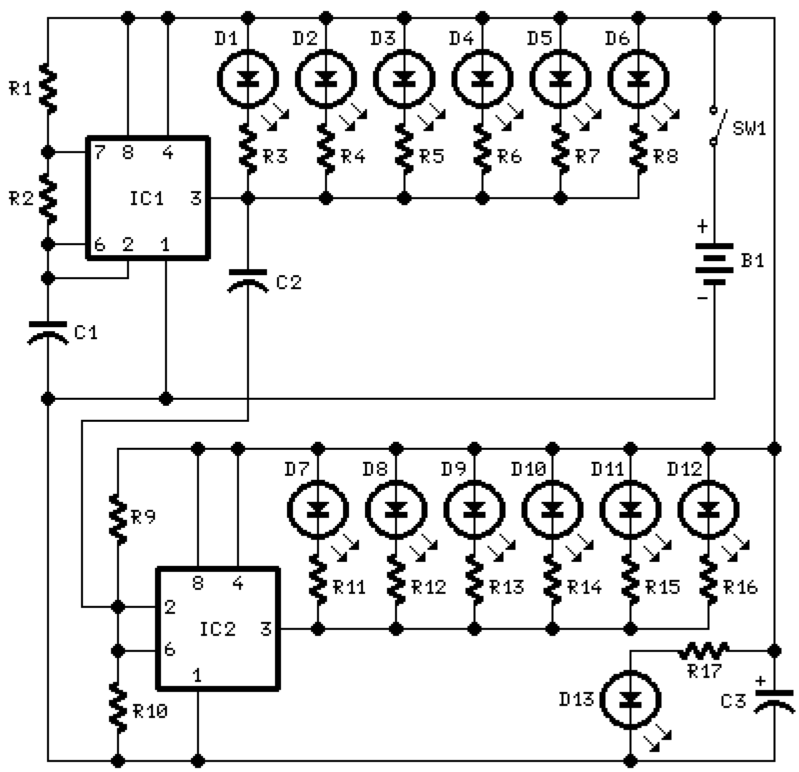
Parts
R1 = 6,8 k
R2 = 5,6 k
R3 = 330
R4,R6,R8 = 270 / 5 W
R5,R7,R9 = 220 k
P1 = 100 k linear potentiometer
C1 = 100 uF / 16 V
C2 = 4,7 uF / 16 V
C3 = 10 nF
C4,C6,C8 = 22 nF / 400 V, MKS
C5,C7,C9 = 10 uF / 350 V, electrolytic (high quality)
TR1 = Ordinary transformer 230 V / 9 V, 1,5 VA
TR2,TR3,TR4 = stroboscope transformer np (ZTK200)
D1,D2,D3,D4 = 1N4149
D5 = BZX85V Zener 3.9
D6,D7,D8,D9,D10,D11 = 1N4004
IO1 = NE555
IO2,IO3,IO4 = MOC3020
XE1,XE2,XE3 = stroboscope lamps FT50
F1 = Fuse 0.8 A, 20 mm
K1,K5 = connectors ARK200-2

K2,K3,K4 = connectors ARK200-3
S1 = Switch

P92. Bicycle back Safety Light

Flashing 13 LED unit, 3V supply
Also suitable for jogger/walkers

Circuit diagram



Parts:
R1 10K 1/4W Resistor
R2,R9,R10 100K 1/4W Resistors
R3-R8,R11-R16 10R 1/4W Resistors
R17 150R 1/4W Resistor
C1 1µF 63V Polyester Capacitor
C2 10nF 63V Polyester Capacitor
C3 100µF 25V Electrolytic Capacitor
D1-D13 Red LEDs 5mm. or bigger, high efficiency
IC1,IC2 7555 or TS555CN CMos Timer IC
SW1 SPST Slider Switch
B1 3V Battery (2 AA 1.5V Cells in series)

Device purpose:

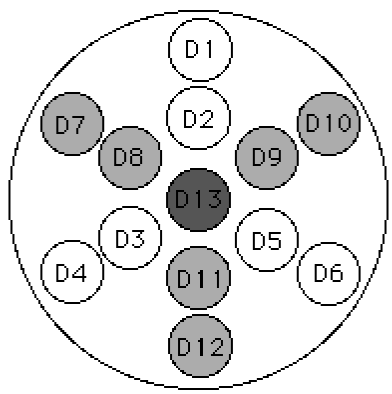
This circuit has been designed to provide a clearly visible light, formed by 13 high efficiency flashing LEDs arranged in a pseudo-rotating order. Due to low voltage, low drain battery operation and small size, the device is suitable for mounting on bicycles as a back light, or to put on by jogger/walkers.

Circuit operation:

IC1 is a CMos version of the 555 IC wired as an astable multivibrator generating a 50% duty-cycle square wave at approx. 4Hz frequency. At 3V supply, 555 output (pin 3) sinking current operation is far better than sourcing, then LED D1-D6 are connected to positive supply. In order to obtain an alternate flashing operation, a second 555 IC is provided, acting as a trigger plus inverter and driving LEDs D7-D12. D13 is permanently on.

The LEDs are arranged in a two series display as shown below, with a center LED permanently on. This arrangement and the alternate flashing of the two series of LEDs provide a pseudo-rotating appearance.

LED arrangement:



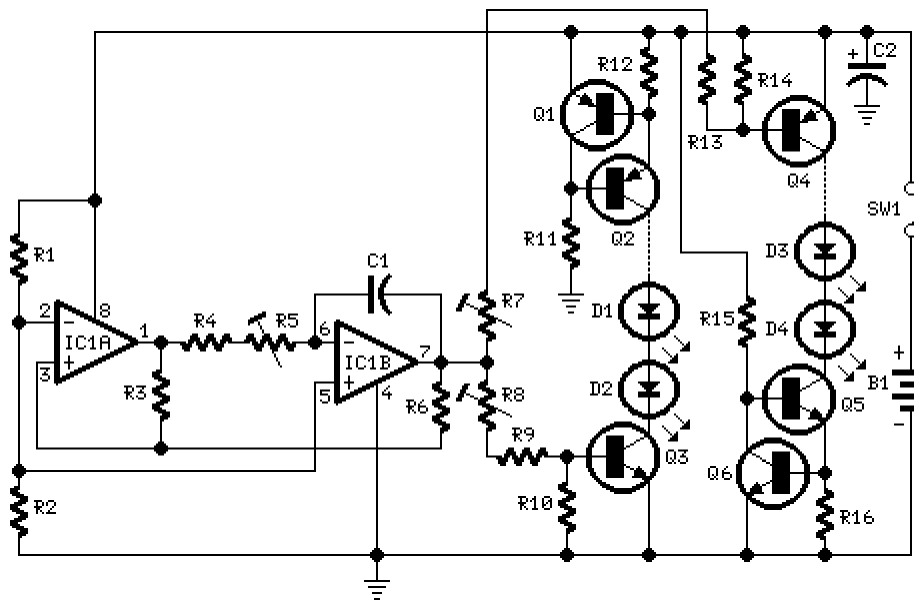
Notes:

Flashing frequency can be varied changing C1 value.
High efficiency LEDs are essential.

P93. Fading LEDs

Two strips of LEDs fading in a complementary manner
9V Battery-operated portable unit

Circuit diagram



Parts:
R1,R2 4K7 1/4W Resistors
R3 22K 1/4W Resistor
R4 1M 1/4W Resistor (See Notes)
R5 2M2 1/4W Carbon Trimmer (See Notes)
R6,R10,R11,R14,R15 10K 1/4W Resistors
R7,R8 47K 1/4W Carbon Trimmers (See Notes)
R9,R13 27K 1/4W Resistors
R12,R16 56R 1/4W Resistors
C1 1µF 63V Polyester Capacitor
C2 100µF 25V Electrolytic Capacitor
D1-D4 etc 5 or 3mm. LEDs (any type and color) (See Notes)
IC1 LM358 Low Power Dual Op-amp
Q1,Q2,Q4 BC327 45V 800mA PNP Transistors
Q3,Q5,Q6 BC337 45V 800mA NPN Transistors
SW1 SPST miniature Slider Switch
B1 9V PP3 Battery
Clip for PP3 Battery

Device purpose:

This circuit operates two LED strips in pulsing mode, i.e. one LED strip goes from off state, lights up gradually, then dims gradually, etc. while the other LED strip do the contrary.

Each strip can be made up from 2 to 5 LEDs at 9V supply.

Circuit operation:

The two Op-Amps contained into IC1 form a triangular wave generator. The rising and falling voltage obtained at pin #7 of IC1 drives two complementary circuits formed by a 10mA constant current source (Q1, Q2 and Q5, Q6) and driver transistor (Q3 and Q6).

R4, R5 & C1 are the timing components: the total period can be varied changing their values. R7 & R8 vary the LEDs brightness.

Notes:

For those whishing to avoid the use of trimmers, suggested values for a 9V supply are:
R4=3M9, R9 & R13=47K and trimmers replaced by a short.

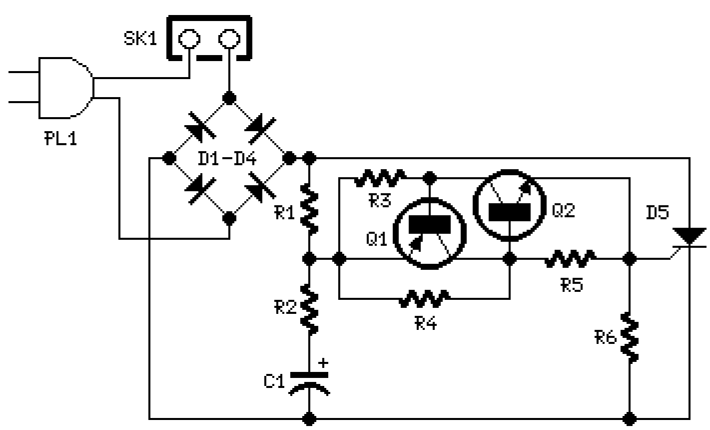
Whishing to use a wall-plug transformer-supply instead of a 9V battery, you can supply the circuit at 12V, allowing the use of up to 6 LEDs per strip, or at 15V, allowing the use of up to 7 LEDs per strip.

In this case, the value of the trimmers R7 & R8 should be changed to 100K.

P94. 220 Volts Flashing Lamps

Especially designed for Christmas tree lamps
Replaces old thermally-activated switches

Circuit diagram



Parts:
R1 100K 1/4W Resistor
R2,R5 1K 1/4W Resistors
R3,R6 470R 1/4W Resistors
R4 12K 1/4W Resistor
C1 1000µF 25V Electrolytic Capacitor
D1-D4 1N4007 1000V 1A Diodes
D5 P0102D 400V 800mA SCR
Q1 BC327 45V 800mA PNP Transistor
Q2 BC337 45V 800mA NPN Transistor

PL1 Male Mains plug
SK1 Female Mains socket

Device purpose:

This circuit is intended as a reliable replacement to thermally-activated switches used for Christmas tree lamp-flashing. The device formed by Q1, Q2 and related resistors triggers the SCR. Timing is provided by R1,R2 & C1. To change flashing frequency don't modify R1 and R2 values: set C1 value from 100 to 2200µF instead.

Best performances are obtained with C1=470 or 1000µF and R4=12K or 10K. Due to low consumption of normal 10 or 20 lamp series-loops intended for Christmas trees (60mA @ 220V typical for a 20 lamp series-loop), very small and cheap SCR devices can be used, e.g. C106D1 (400V 3.2A) or TICP106D (400V 2A), this last and the suggested P0102D devices having TO92 case.

Important Note:

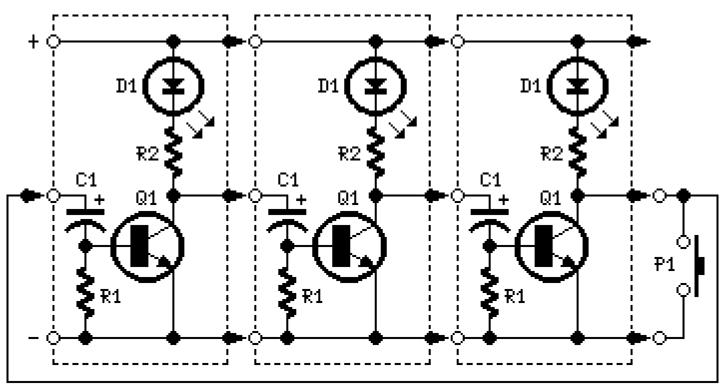
For proper operation it's absolutely necessary to employ high Gate-sensitive SCRs.

If you are unable to find these devices you can use Triacs instead. In this case the circuit operates also with relatively powerful devices. A recommended Triac type is the ubiquitous TIC206M (600V 4A) but many others can work.Note that in spite of the Triac, diode bridge D1-D4 is in any case necessary.

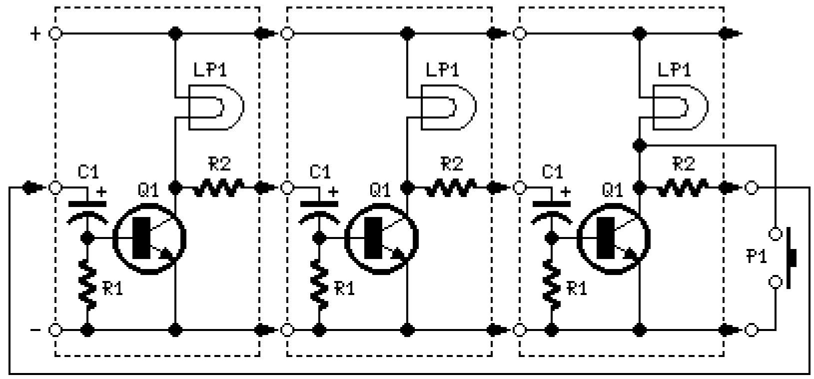
P95. LEDs or Lamps Sequencer

Very simple, versatile modular design
No limits to the number of modules used in the ring

Circuit diagram using LEDs:



Circuit diagram using Lamps:



Parts:
R1 1K5 1/4W Resistor
R2 680R 1/4W Resistor (Optional, see text)
C1 47µF 25V Electrolytic Capacitor
D1 LED any type
Q1 BC337 45V 800mA NPN Transistor
P1 SPST Pushbutton
LP1 Filament Lamp 12 or 24V (See text)

Comments:

The purpose of this circuit was to create a ring in which LEDs or Lamps illuminate sequentially. Its main feature is a high versatility: you can build a loop containing any number of LEDs or Lamps, as each illuminating device has its own small circuit.

The diagrams show three-stage circuits for simplicity: you can add an unlimited number of stages (shown in dashed boxes), provided the last stage output was returned to the first stage input, as shown.

P1 pushbutton purpose is to allow a sure start of the sequence at power-on but, when a high number of stages is used, it also allows illumination of more than one LED or Lamp at a time, e.g. one device illuminated and three out and so on.

After power-on, P1 should be held closed until only the LED or Lamp related to the module to which the pushbutton is connected remains steady illuminated. When P1 is released the sequencer starts: if P1 is pushed briefly after the sequence is started, several types of sequence can be obtained, depending from the total number of stages.

Notes:

If one LED per module is used, voltage supply can range from 6 to 15V.

You can use several LEDs per module. They must be wired in series and supply voltage must be related to their number.

Using 24V supply (the maximum permitted voltage), about 10 LEDs wired in series can be connected to each module, about 7 at 15V and no more than 5 at 12V.

The right number of LEDs can vary, as it is depending by their color and brightness required.

Using lamps, voltage supply can range from 9 to 24V. Obviously, lamp voltage must be the same of supply voltage.

In any case, lamps may also be wired in series, e.g. four 6V lamps wired in series can be connected to each module and powered by 24V supply.

If you intend to use lamps drawing more than 400mA current, BC337 transistors should be substituted by Darlington types like BD677, BD679, BD681, 2N6037, 2N6038, 2N6039 etc.

As Darlington transistor usually have a built-in Base-Emitter resistor, R1 may be omitted, further reducing parts counting.

Sequencer speed can be varied changing C1 value.

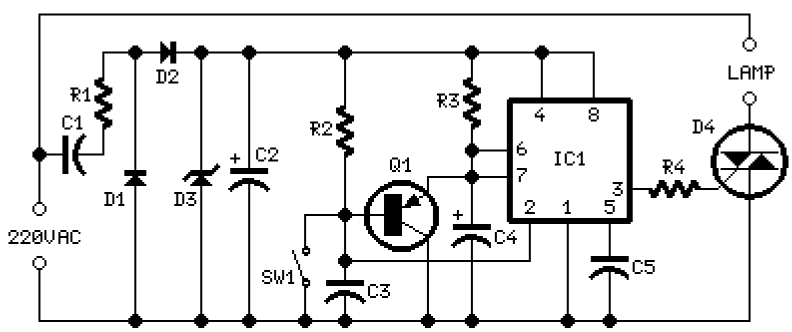
A similar design appeared in print about forty years ago. It used germanium transistors and low voltage lamps. I think the use of LEDs, silicon transistors, Darlington transistors and 24V supply an interesting improvement.

P96. Courtesy Light

Warning! The circuit is connected to 220Vac mains, then some parts in the circuit board are subjected to lethal potential!. Avoid touching the circuit when plugged and enclose it in a plastic box.

15 seconds delayed switch-off
A good idea for bedroom lamps

Circuit diagram



Parts:
R1 470R 1/2W Resistor
R2 100K 1/4W Resistor
R3 1M5 1/4W Resistor
R4 1K 1/4W Resistor
C1 330nF 400V Polyester Capacitor
C2 100µF 25V Electrolytic Capacitor
C3,C5 10nF 63V Polyester or Ceramic Capacitors
C4 10µF 25V Electrolytic Capacitor
D1,D2 1N4007 1000V 1A Diodes
D3 BZX79C10 10V 500mW Zener Diode
D4 TIC206M 600V 4A TRIAC
Q1 BC557 45V 100mA PNP Transistor

IC1 7555 or TS555CN CMos Timer IC
SW1 SPST Mains suited Switch

Device purpose:

This circuit is intended to let the user turn off a lamp by means of a switch placed far from bed, allowing him enough time to lie down before the lamp really switches off.

Obviously, users will be able to find different applications for this circuit in order to suit their needs.

Circuit operation:

Due to the low current drawing, the circuit can be supplied from 220Vac mains without a transformer. Supply voltage is reduced to 10Vdc by means of C1 reactance, a two diode rectifier cell D1 & D2 and Zener diode D3. IC1 is a CMos 555 timer wired as a monostable, providing 15 seconds on-time set by R3 & C4. When SW1 is closed, IC1 output (pin 3) is permanently on, driving Triac D4 which in turn feeds the lamp. Opening SW1 operates the monostable and, after 15 seconds, pin 3 of IC1 goes low switching off the lamp.

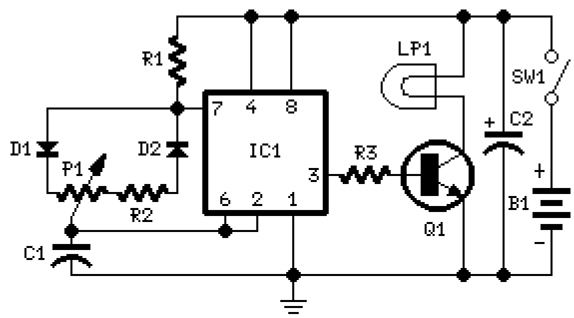
Notes:

The circuit is wired permanently to the mains supply but current drain is negligible.
Due to transformerless design there is no heat generation.
The delay time can be varied changing R3 and/or C4 values.
Taking C4=10µF, R3 increases timing with approx. 100K per second ratio. I.e. R3=1M Time=10 seconds, R3=1M8 Time=18 seconds.
Low Gate-current Triacs are recommended.
Use a well insulated mains-type switch for SW1.

P97. Brightness Control for small Lamps

Switching operated 1.5V bulbs
Portable unit, 3V battery supply

Circuit diagram



Parts:
P1 470K Linear Potentiometer
R1 10K 1/4W Resistor
R2 47K 1/4W Resistor (See Notes)
R3 1K5 1/4W Resistor
C1 22nF 63V Polyester Capacitor
C2 100µF 25V Electrolytic Capacitor
D1,D2 1N4148 75V 150mA Diodes
IC1 7555 or TS555CN CMos Timer IC
Q1 BD681 100V 4A NPN Darlington Transistor
LP1 1.5V 200mA Bulb (See Notes)
SW1 SPST Switch
B1 3V (Two 1.5V AA or AAA cells in series, etc.)

Circuit operation:

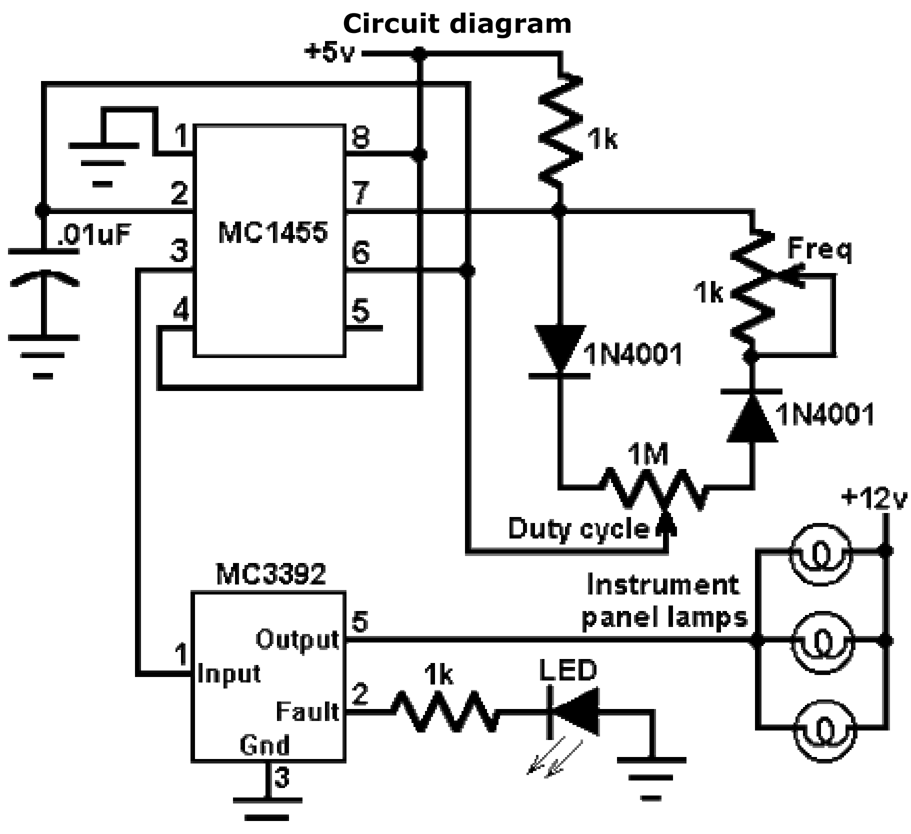
This device was designed on request, to control the light intensity of four filament lamps (i.e. a ring illuminator) for close-up pictures with a digital camera, powered by two AA or AAA batteries. Obviously it can be used in other ways, at anyone's will.

IC1 generates a 150Hz squarewave having a variable duty-cycle. When the cursor of P1 is fully rotated towards D1, the output positive pulses appearing at pin 3 of IC1 are very narrow. Lamp LP1, driven by Q1, is off as the voltage across its leads is too low. When the cursor of P1 is rotated towards R2, the output pulses increase in width, reaching their maximum amplitude when the potentiometer is rotated fully clockwise. In this way the lamp reaches its full brightness.

Notes:

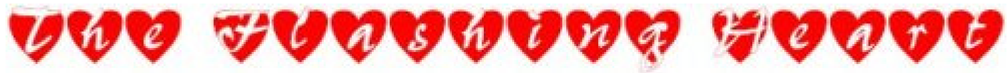
LP1 could be one or more 1.5V bulbs wired in parallel. Maximum total output current allowed is about 1A.
R2 limits the output voltage, measured across LP1 leads, to 1.5V. Its actual value is dependent on the total current drawn by the bulb(s) and should be set at full load in order to obtain about 1.5V across the bulb(s) leads when P1 is rotated fully clockwise.

P98. Instrument panel lamp dimmer control



This circuit uses an MC3392 low side protected switch and an MC1455 timing circuit to form an automotive instrumentation panel lamp dimmer control. The brightness of incandescent lamps can be varied by Pulse Width Modulating the input of the MC3392. The modulating signal can be obtained directly from the MC1455 timer (or a microprocessor). The MC1455 is configured as a free-running clock having a frequency and duty cycle control. The typical timer frequency is approximately 80 Hz when the frequency potentiometer is adjusted to 1.0k. This frequency was chosen so as to avoid any perceptible lamp flicker. The duty cycle potentiometer controls the duty cycle over a range of about 3% to 97%. When at 3% the lamps are essentialy off, at 97% the lamps are essentially full on. Any number of lamps can be control, so long as the total load current is less than 1 amp. The LED is used to signal the existence of a system fault (overvoltage, current limiting, or thermal shutdown).

P99. The flashing Heart

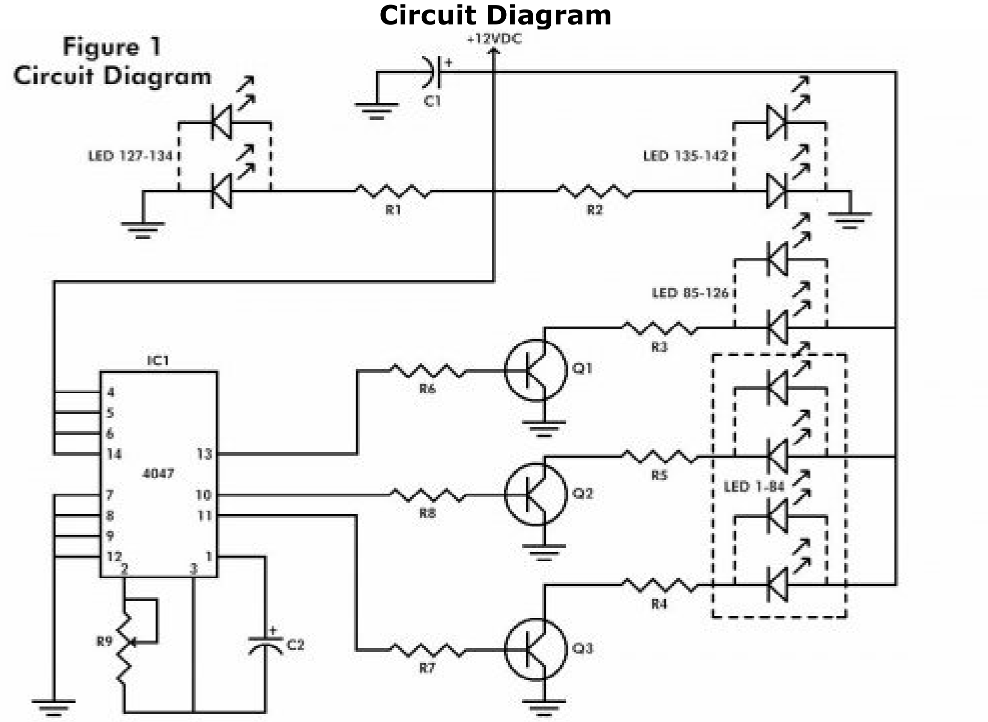


Buying a gift for someone special or a loved one can sometimes be difficult or expensive. The flashing heart is the answer. It is easy to build and even the inexperienced hobbyist should be able to build it. The estimated cost for the circuit is $25 if all the parts are purchased new. With The Flashing Heart, you can get your message across in bright lights.

Circuit Description

The Circuit Diagram is shown in Figure 1. It consists of a 4047 low-power monostable/astable multivibrator, IC1, used in the astable mode to provide the timing pulses to control the flash rate of the LEDs. To accomplish the astable mode, pins 4, 5, 6, and 14 are connected to +12VDC and pins 7, 8, 9, and 12 are connected to ground. Pins 1 and 3 are connected to C2 and pins 2 and 3 are connected to potentiometer R9. A fixed value resistor can be used in place of the potentiometer R9, if the flash rate does not need to be adjusted. These three pins make up the R-C timing circuit. The output pulses from the 4047 are taken from pins 10, 11, and 13. Pin 10 is the Q output and pin 11 is the Q-not output. These two pins are onnected to R6 and R7 respectively.

Circuit Diagram



The collectors of Q2 and Q3 are connected to R4 and R5 respectively, which are connected to the cathodes of the Yellow LEDs. Pin 13 is the oscillator output and is connected to R8, which is connected to the base of Q1. The collector of Q1 is connected to R3, which is connected to the cathodes of the Red LED's. The emitters of the three transistors are connected to ground. The Green LEDs are connected to R1 and R2, which are connected to +12VDC. Resistors R1-R8 are current limiting resistors and the correct wattage for these resistors should be used to prevent excessive heat. The resistive values may be changed to vary the brightness of the LEDs. The circuit is powered by PS1, a wall transformer, which is connected to a filter capacitor C1. It must be between 10 to 15 VDC and at least 500mA.

Figure 2
Circuit Board

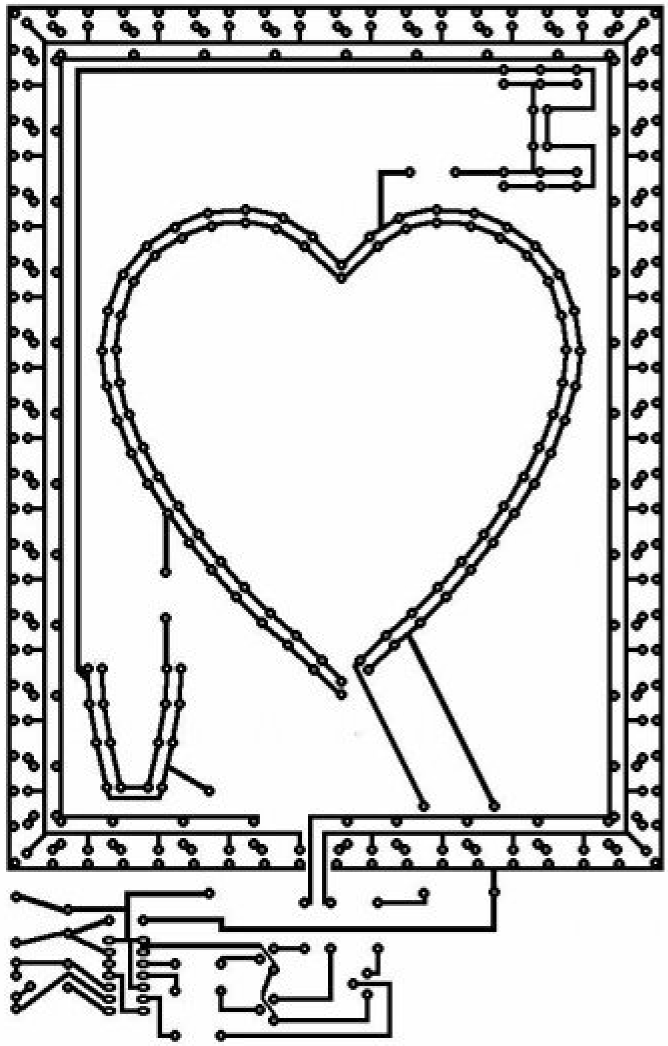
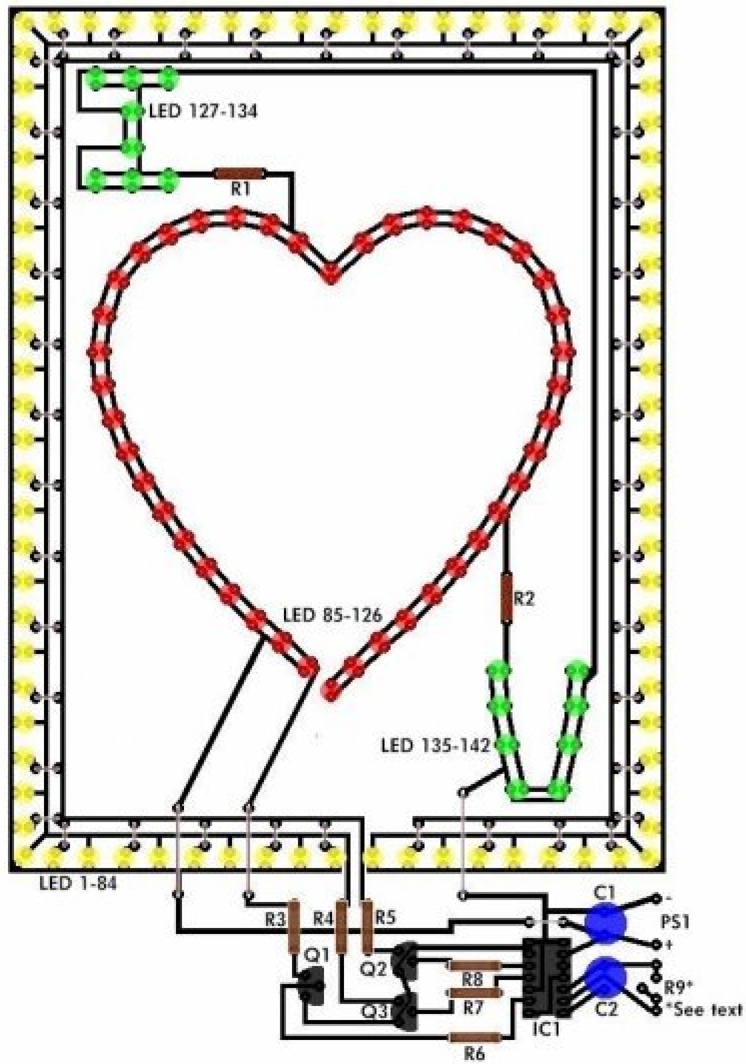


Figure 3
Component Placement



Construction

Probably the most difficult part of this project is making the printed circuit board, Figure 2. The board used in the prototype took several hours to make using dry transfers. Using a different technique, such as photo resist, may be faster for the experienced hobbyist. Once the board is etched and drilled, the jumper wires should be placed on the board and soldered, as shown on Figure 3. Next the 84 Yellow LEDs should be placed around the border of the board, followed by the 42 Red LEDs that make up the heart and then the 16 Green LEDs that make up the letters I and U. Resistors R1-R9 and capacitors C1and C2 should be placed on the board next and then the power supply, PS1. Sockets were used in the prototype for the I.C. and transistors. A socket for the I.C. is required, but the sockets for the transistors are not. Special care should be taken when handling the CMOS I.C., as a static discharge will destroy it. When you are finished soldering, check the board over for mistakes. If everything looks okay, apply power.

Operation

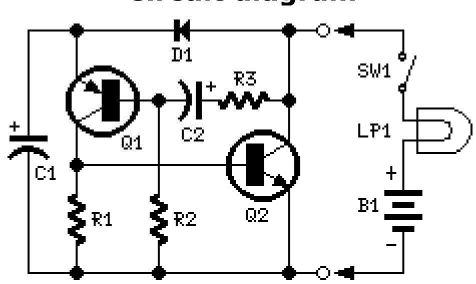
Once power has been applied to the circuit, the Red LEDs should all be flashing on and off together. The Yellow LEDs should be flashing on and off, but only every other Yellow LED should be on at one time. The Green LEDs will stay on at all times. The flash rate can be adjusted by turning R9. Connections for a fixed value resistor for R9 are provided on the board layout if preferred.To dress up the project, a favorite photograph can be placed in the heart, and a frame can be made to fit the circuit board.

Parts
R1, R2 - 470 ohm, 1/2-watt
R3-R5 - 100 ohm, 3-watt
R6-R8 - 1000 ohm, 1.4-watt
R9 - 5000 ohm potentiometer
C1, C2 - 100uF, 16 volts, electrolytic radial
IC1 - 4047, low power monostable/astable multivibrator
Q1-Q3 - 2n3643 NPN transistor or equivalent
LED1-LED84 - yellow light-emitting diode
LED85-LED126 - red light-emitting diode
LED127-LED142 - green light-emitting diode
PS1 - 12VDC @ 500mA wall transformer
Miscellaneous: Jumper wire, solder, printed circuit board,
drill and bits,14 pin I.C. socket, and a frame or case.

P100. Two-wire Lamp Flasher

Ideal to operate 3 to 24V DC existing on-circuit lamps
LED operation is also possible

Circuit diagram



Parts:
R1 6K8 1/4W Resistor
R2 270K 1/4W Resistor
R3 22K 1/4W Resistor
C1 220µF 25V Electrolytic Capacitor
C2 10µF 25V Electrolytic Capacitor
D1 1N4002 100V 1A Diode
Q1 BC557 45V 100mA PNP Transistor
Q2 BD139 80V 1.5A NPN Transistor
LP1 Existing filament Lamp: any type in the range 3-24V 10W max.
SW1 Existing On-Off switch
B1 Existing V DC source: any type in the range 3-24V
suited to the lamp adopted

Device purpose:

This circuit has been designed to provide that continuous light lamps already wired into a circuit, become flashing. Simply insert the circuit between existing lamp and negative supply.

Especially suited for car or panel pilot lights, this device can drive lamps up to 10W.

Notes:
Break lamp(s) to negative supply connection(s), then insert the circuit between existing lamp(s) connection(s) and negative supply (respecting polarities!).

C1 value can be varied from 100 to 1000μF or higher, in order to change flashing frequency.
Although rather oversized, this circuit can also drive any LED, providing a suitable resistor is fitted in series with the light emitting device.

The resistor should be in the range 47R to 2K2, depending on supply voltage.

P101. Light Flasher

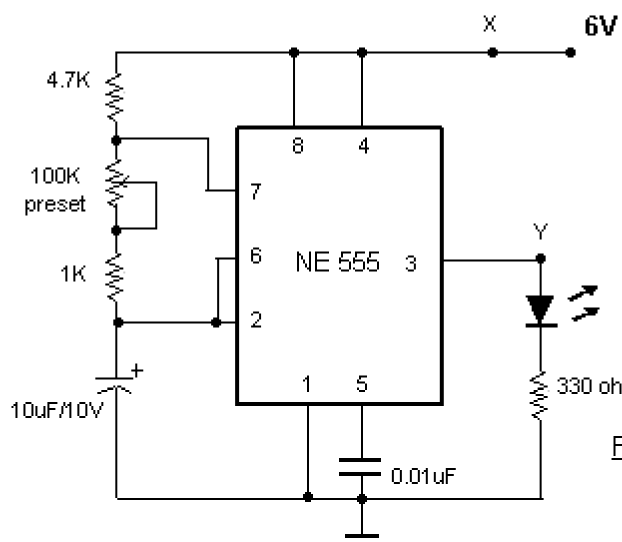


Fig.1

Setup for alternating flasher (see text for more information):

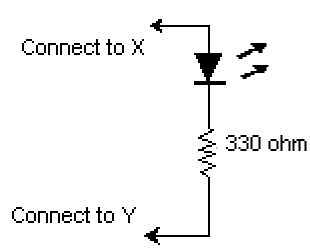


Fig.2

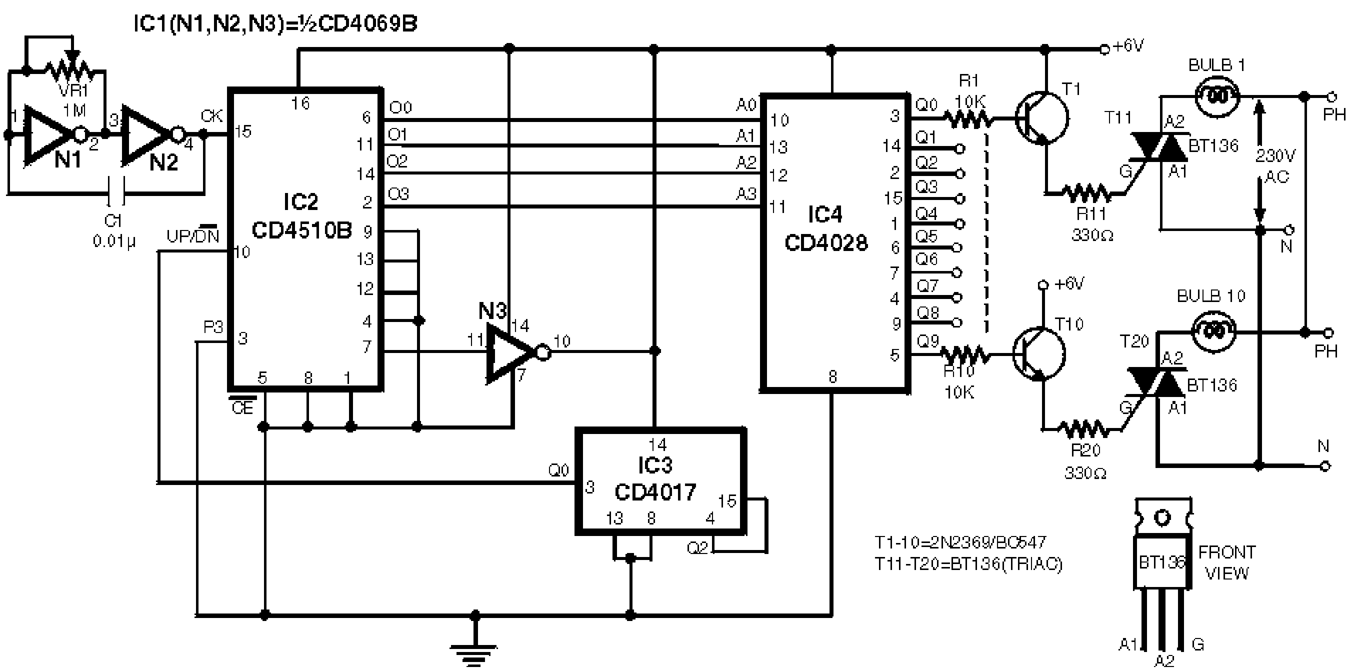
This is a very basic circuit for flashing one or more LEDS and also to alternately flash one or more LEDs. It uses a 555 timer setup as an astable multivibrator with a variable frequency.

With the preset at its max. the flashing rate of the LED is about 1/2 a second. It can be increased by increasing the value of the capacitor from 10uF to a higher value. For example if it is increased to 22uF the flashing rate becomes 1 second.

There is also provision to convert it into an alternating flasher. You just have to connect a LED and a 330ohm as shown in Fig.2 to the points X and Y of Fig.1. Then both the LEDs flash alternately.

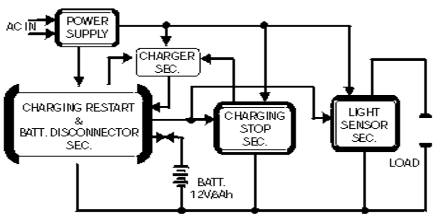
Since the 555 can supply or sink in upto 200mA of current, you can connect upto about 18 LEDS in parallel both for the flasher and alternating flasher (that makes a total of 36 LEDs for alternating flasher).

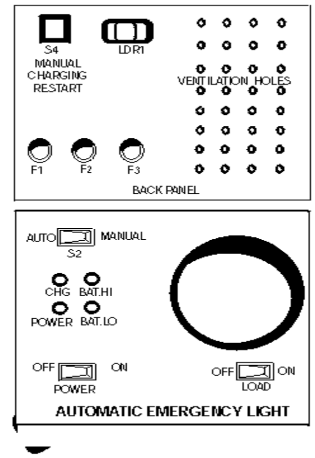
P102. Automatic Dual output Display

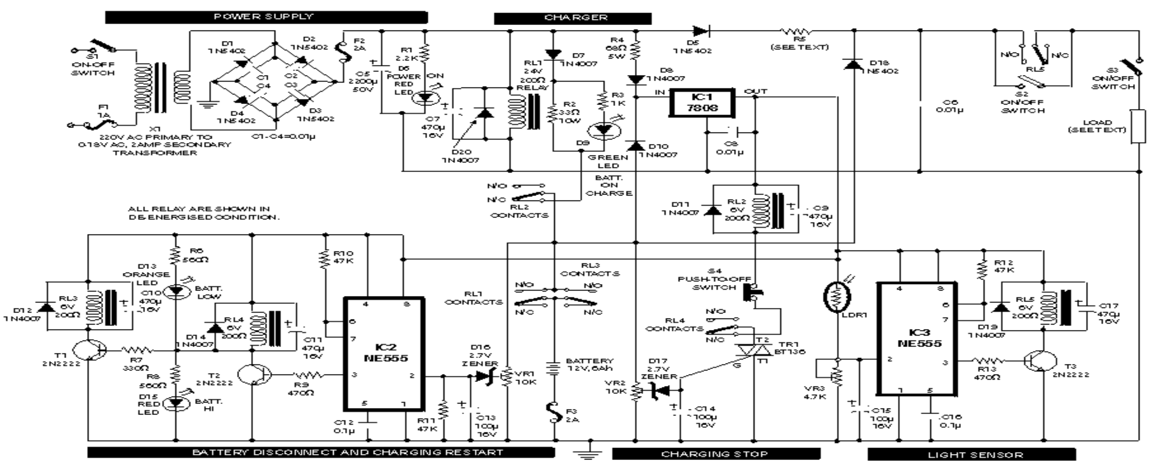


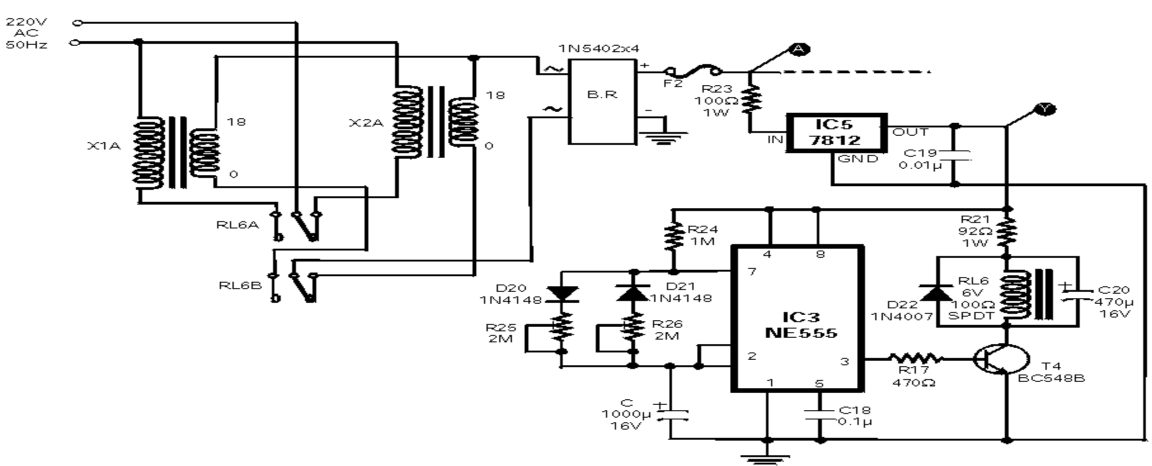
This circuit lights up ten bulbs sequentially, first in one direc- tion and then in the opposite direction, thus presenting a nice visual effect. In this circuit, gates N1 and N2 form an oscillator. The output of this oscillator is used as a clock for BCD up/down counter CD4510 (IC2). Depending on the logic state at its pin 10, the counter counts up or down. During count up operation, pin 7 of IC2 outputs an active low pulse on reaching the ninth count. Similarly, during count-down operation, you again get a low-going pulse at pin 7. This terminal count output from pin 7, after inversion by gate N3, is connected to clock pin 14 of decade counter IC3 (CD4017) which is configured here as a toggle flip-flop by returning its Q2 output at pin 4 to reset pin 15. Thus output at pin 3 of IC3 goes to logic 1 and logic 0 state alternately at each terminal count of IC2. Initially, pin 3 (Q0) of IC3 is high and the counter is in count-up state. On reaching ninth count, pin 3 of IC3 goes low and as a result IC2 starts counting down. When the counter reaches 0 count, Q2 output of IC3 momentarily goes high to reset it, thus taking pin 3 to logic 1 state, and the cycle repeats. The BCD output of IC2 is connected to 1-of-10 decoder CD4028 (IC4). During count-up operation of IC2, the outputs of IC4 go logic high sequentially from Q0 to Q9 and thus trigger the triacs and lighting bulbs 1 through 10, one after the other. Thereafter, during count-down operation of IC2, the bulbs light in the reverse order, presenting a wonderful visual effect

P103. Emergency Light



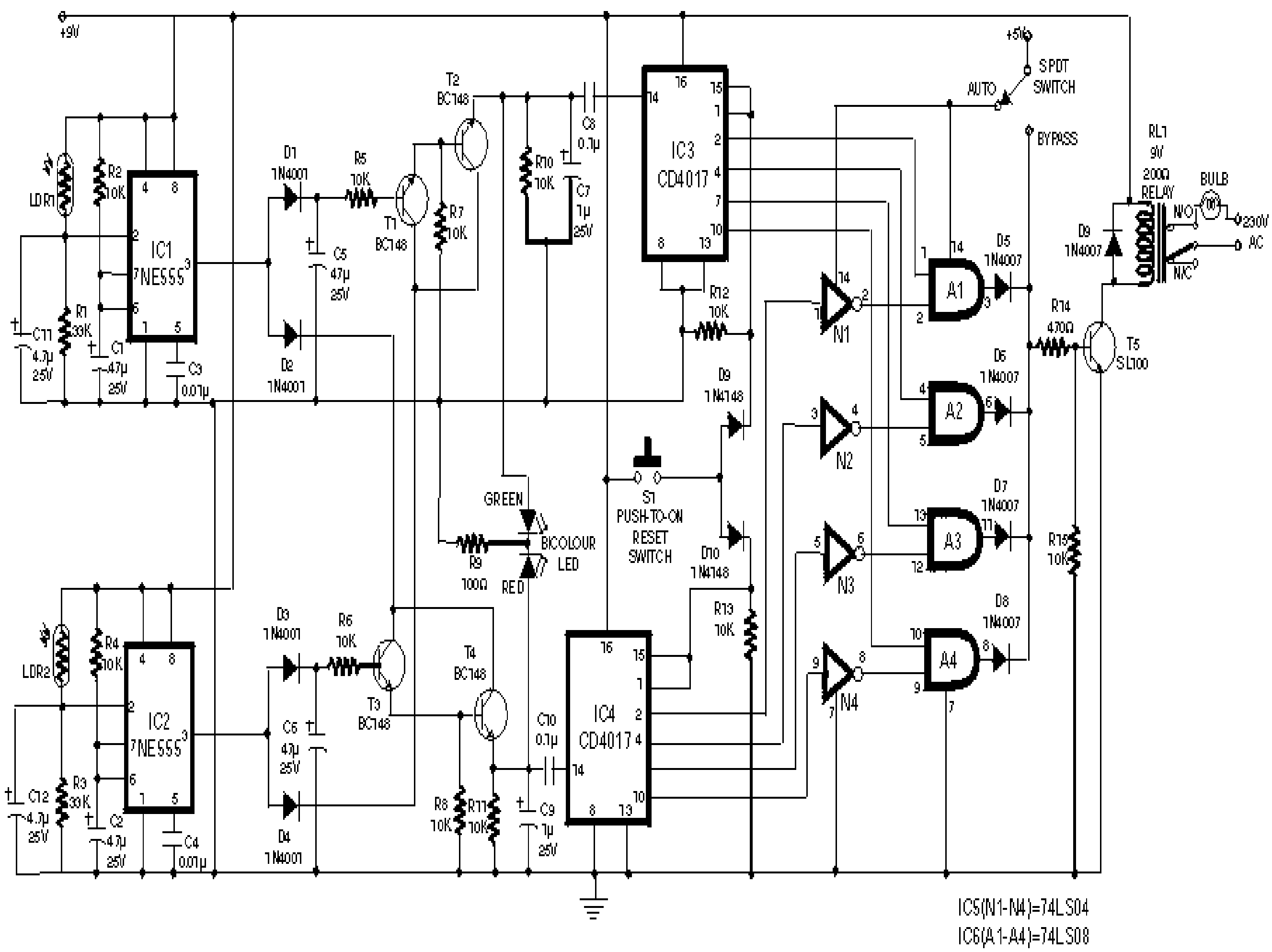






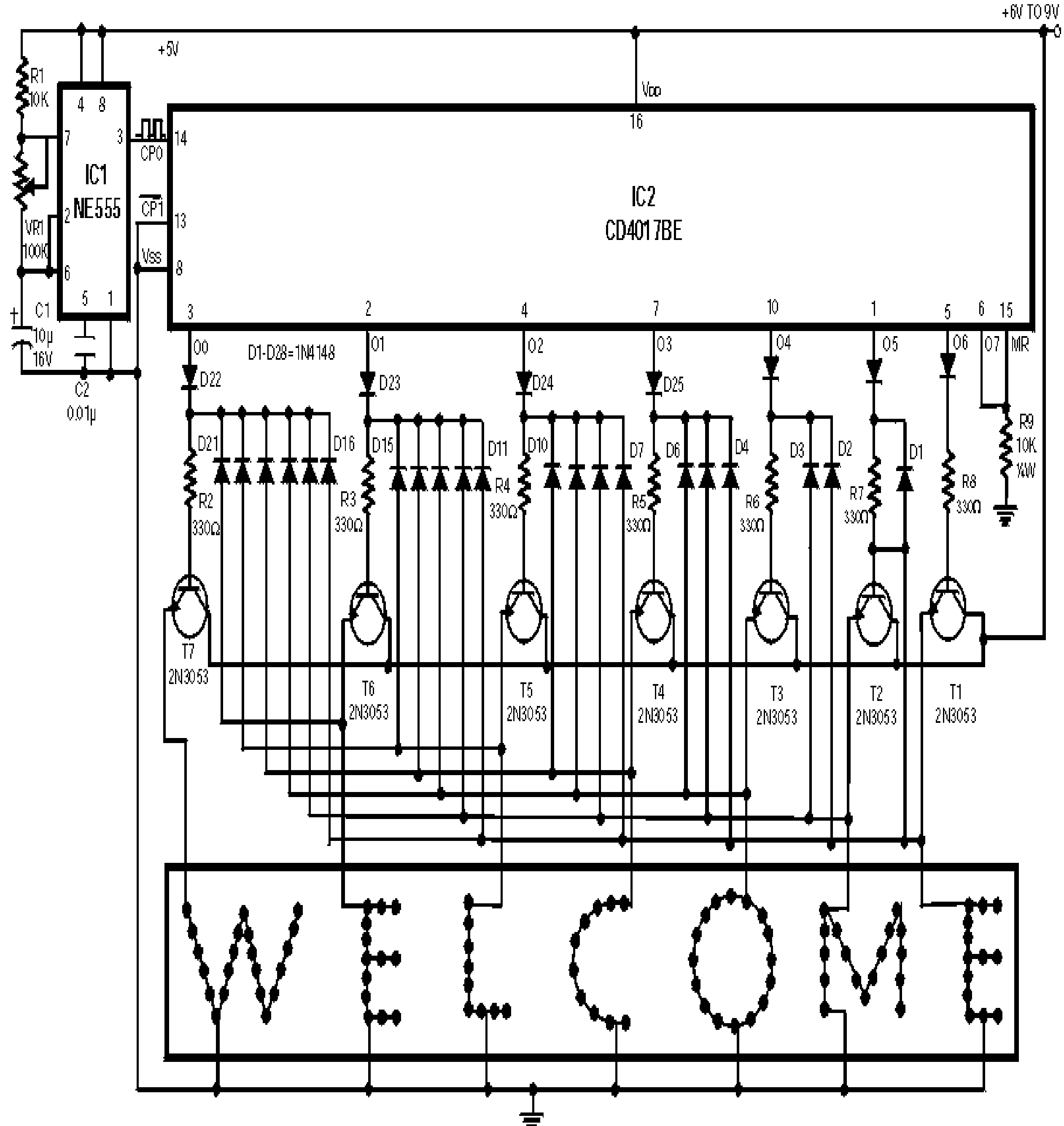
The circuit of automatic emergency light presented here has the following features: 1. When the mains supply (230V AC) is available, it charges a 12V battery up to 13.5V and then the battery is disconnected from the charging section. 2. When the battery discharges up to 10.2V, it is disconnected from the load and the charging process is resumed. 3. If the mains voltage is available and there is darkness in the room, load (bulb or tube) is turned on by taking power from the mains; otherwise the battery is connected to the load. 4. When the battery discharges up to 10.2V and if the mains is not yet available, the battery is completely disconnected from the circuit to avoid its further discharge. The mains supply of 230V AC is stepped down to 18V AC (RMS) using a 230V AC primary to 0-18V AC, 2A secondary transformer (X1), generally used in 36cm B&W TVs. Diodes D1 through D4 form bridge rectifier and capacitor C5 filters the voltage, providing about 25V DC at the output. Charging section includes 33-ohm, 10-watt resistor R2 which limits the charging current to about 425 mA when battery voltage is about 10.2V, or to 325 mA when battery voltage is about 13.5V. When the battery charges to 13.5V (as set by VR2), zener diode D17 goes into breakdown region, thereby triggering triac TR1. Now, since DC is passing through the triac, it remains continuously 'on' even if the gate current is reduced to zero (by disconnecting the gate terminal). Once the battery is fully charged, charging section is cut-off from the battery due to energisation of relay RL2. This relay remains 'on' even if the power fails because of connection to the battery via diode D10. S4, a normally closed switch, is included to manually restart the charging process if required. Battery disconnect and charging restart section comprises an NE555 timer (IC2) wired in monostable mode. When the battery voltage is above 10.2V (as indicated by red LED D15), zener diode (D16) remains in the breakdown region, making the trigger pin 2 of IC2 high, thereby maintaining output pin 3 in low voltage state. Thus, relay RL3 is 'on' and relay RL4 is 'off.' But as soon as the battery voltage falls to about 10.2V (as set by preset VR1), zener diode D16 comes out of conduction, making pin 2 low and pin 3 high to turn 'on' relay RL4 and orange LED D13. This also switches off relay RL3 and LED D15. Now, if the mains is available, charging restarts due to de-energisation of relay RL2 because when relay RL4 is 'on,' it breaks the circuit of relay RL2 and triac TR1. But if the mains supply is not present, both relays RL3 and RL1 de-energise, disconnecting the battery from the remaining circuit. Thus when battery voltage falls to 10.2 volts, its further discharge is eliminated. But as soon as the mains supply resumes, it energises relay RL1, thereby connecting the battery again to the circuit. Light sensor section also makes use of a 555 timer IC in the monostable mode. As long as normal light is falling on LDR1, its resistance is comparatively low. As a result pin 2 of IC3 is held near Vcc and its output at pin 3 is at low level. In darkness, LDR resistance is very high, which causes pin 2 of IC3 to fall to near ground potential and thus trigger it. As a consequence, output pin 3 goes high during the monostable pulse period, forward biasing transistor T3 which goes into saturation, energising relay RL5. With auto/bypass switch S2 off (in auto mode), the load gets connected to supply via switch S3. If desired, the load may be switched during the day-time by flipping switch S2 to 'on' position (manual). Preset VR3 is the sensitivity control used for setting threshold light level at which the load is to be automatically switched on/off. Capacitors with the relays ensure that there is no chattering of the relays. When the mains is present, diode D8 couples the input voltage to regulator IC1 whereas diode D10 feeds the input voltage to it (from battery) in absense of mains supply. Diode D5 connects the load to the power supply section via resistor R5 when mains is available (diode D18 does not conduct). However, when mains power fails, the situation reverses and diode D18 conducts while diode D5 does not conduct. . The load can be any bulb of 12 volts with a maximum current rating of 2 amperes (24 watts). Resistor R5 is supposed to drop approximately 12 volts when the load current flows through it during mains availability . Hence power dissipated in it would almost be equal to the load power. It is therefore desirable to replace R5 with a bulb of similar voltage and wattage as the load so that during mains availability we have more (double) light than when the load is fed from the battery. For setting presets VR1 and VR2, just take out (desolder one end) diodes D7, D10 and D18. Connect a variable source of power supply in place of battery. Set preset VR1 so that battery-high LED D15 is just off at 10.2V of the variable source. Increase the potential of the variable source and observe the shift from LO BAT LED D13 to D15. Now make the voltage of the source 13.5V and set preset VR2 so that relay RL2 just energises. Then decrease the voltage slowly and observe that relay RL2 does not de-energise above 10.2V. At 10.2V, LED D15 should be off and relay RL2 should de-energise while LED D13 should light up. Preset VR3 can be adjusted during evening hours so that the load is 'on' during the desired light conditions

P104. Automatic Room Lights



An ordinary automatic room power control circuit has only one light sensor. So when a person enters the room it gets one pulse and the lights come 'on.' When the person goes out it gets another pulse and the lights go 'off.' But what happens when two persons enter the room, one after the other? It gets two pulses and the lights remain in 'off' state. The circuit described here overcomes the above-mentioned problem. It has a small memory which enables it to automatically switch 'on' and switch 'off' the lights in a desired fashion. The circuit uses two LDRs which are placed one after another (separated by a distance of say half a metre) so that they may separately sense a person going into the room or coming out of the room. Outputs of the two LDR sensors, after processing, are used in conjunction with a bicolour LED in such a fashion that when a person gets into the room it emits green light and when a person goes out of the room it emits red light, and vice versa. These outputs are simultaneously applied to two counters. One of the counters will count as +1, +2, +3 etc when persons are getting into the room and the other will count as -1, -2, -3 etc when persons are getting out of the room. These counters make use of Johnson decade counter CD4017 ICs. The next stage comprises two logic ICs which can combine the outputs of the two counters and determine if there is any person still left in the room or not. Since in the circuit LDRs have been used, care should be taken to protect them from ambient light. If desired, one may use readily available IR sensor modules to replace the LDRs. The sensors are installed in such a way that when a person enters or leaves the room, he intercepts the light falling on them sequentially—one after the other. When a person enters the room, first he would obstruct the light falling on LDR1, followed by that falling on LDR2. When a person leaves the room it will be the other way round. In the normal case light keeps falling on both the LDRs, and as such their resistance is low (about 5 kilo-ohms). As a result, pin 2 of both timers (IC1 and IC2), which have been configured as monostable flip-flops, are held near the supply voltage (+9V). When the light falling on the LDRs is obstructed, their resistance becomes very high and pin 2 voltages drop to near ground potential, thereby triggering the flip-flops. Capacitors across pin 2 and ground have been added to avoid false triggering due to electrical noise. When a person enters the room, LDR1 is triggered first and it results in triggering of monostable IC1. The short output pulse immediately charges up capacitor C5, forward biasing transistor pair T1-T2. But at this instant the collectors of transistors T1 and T2 are in high impedance state as IC2 pin 3 is at low potential and diode D4 is not conducting. But when the same person passes LDR2, IC2 monostable flip-flop is triggered. Its pin 3 goes high and this potential is coupled to transistor pair T1-T2 via diode D4. As a result transistor pair T1-T2 conducts because capacitor C5 retains the charge for some time as its discharge time is controlled by resistor R5 (and R7 to an extent). Thus green LED portion of bi-colour LED is lit momentarily. The same output is also coupled to IC3 for which it acts as a clock. With entry of each person IC3 output (high state) keeps advancing. At this stage transistor pair T3-T4 cannot conduct because output pin 3 of IC1 is no longer positive as its output pulse duration is quite short and hence transistor collectors are in high impedance state. When persons leave the room, LDR2 is triggered first followed by LDR1. Since the bottom half portion of circuit is identical to top half, this time with the departure of each person red portion of bi-colour LED is lit momentarily and output of IC4 advances in the same fashion as in case of IC3. The outputs of IC3 and those of IC4 (after inversion by inverter gates N1 through N4) are ANDed by AND gates (A1 through A4) are then wire ORed (using diodes D5 through D8). The net effect is that when persons are entering, the output of at least one of the AND gates is high, causing transistor T5 to conduct and energise relay RL1. The bulb connected to the supply via N/O contact of relay RL1 also lights up. When persons are leaving the room, and till all the persons who entered the room have left, the wired OR output continues to remain high, i.e. the bulb continues to remains 'on,' until all persons who entered the room have left. The maximum number of persons that this circuit can handle is limited to four since on receipt of fifth clock pulse the counters are reset. The capacity of the circuit can be easily extended for up to nine persons by removing the connection of pin 1 from reset pin (15) and utilising Q1 to Q9 outputs of CD4017 counters. Additional inverters, AND gates and diodes will, however, be required

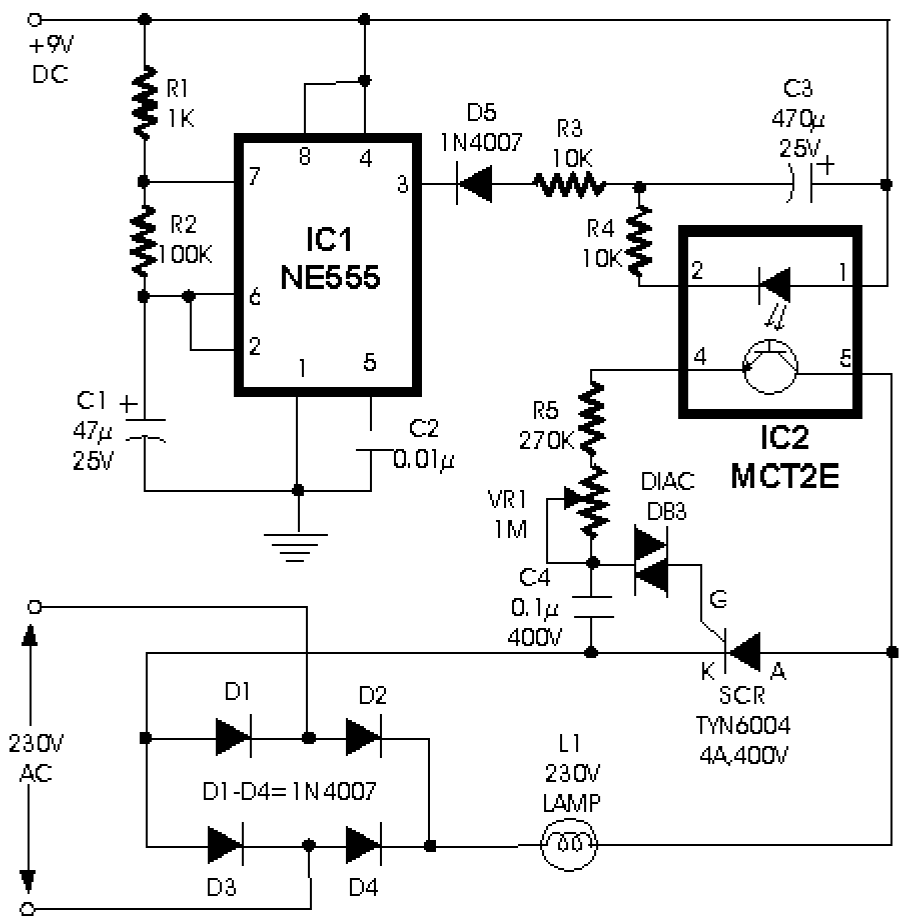
P105. Running Message Display



Light emitting diodes are advan- tageous due to their smaller size, low current consumption and catchy colours they emit. Here is a running message display circuit wherein the letters formed by LED arrangement light up progressively. Once all the letters of the message have been lit up, the circuit gets reset. The circuit is built around Johnson decade counter CD4017BC (IC2). One of the IC CD4017BE's features is its provision of ten fully decoded outputs, making the IC ideal for use in a whole range of sequencing operations. In the circuit only one of the outputs remains high and the other outputs switch to high state successively on the arrival of each clock pulse. The timer NE555 (IC1) is wired as a 1Hz astable multivibrator which clocks the IC2 for sequencing operations. On reset, output pin 3 goes high and drives transistor T7 to 'on' state. The output of transistor T7 is connected to letter 'W' of the LED word array (all LEDs of letter array are connected in parallel) and thus letter 'W' is illuminated. On arrival of first clock pulse, pin 3 goes low and pin 2 goes high. Transistor T6 conducts and letter 'E' lights up. The preceding letter 'W' also remains lighted because of forward biasing of transistor T7 via diode D21. In a similar fashion, on the arrival of each successive pulse, the other letters of the display are also illuminated and finally the complete word becomes visible. On the following clock pulse, pin 6 goes to logic 1 and resets the circuit, and the sequence repeats itself. The frequency of sequencing operations is controlled with the help of potmeter VR1.

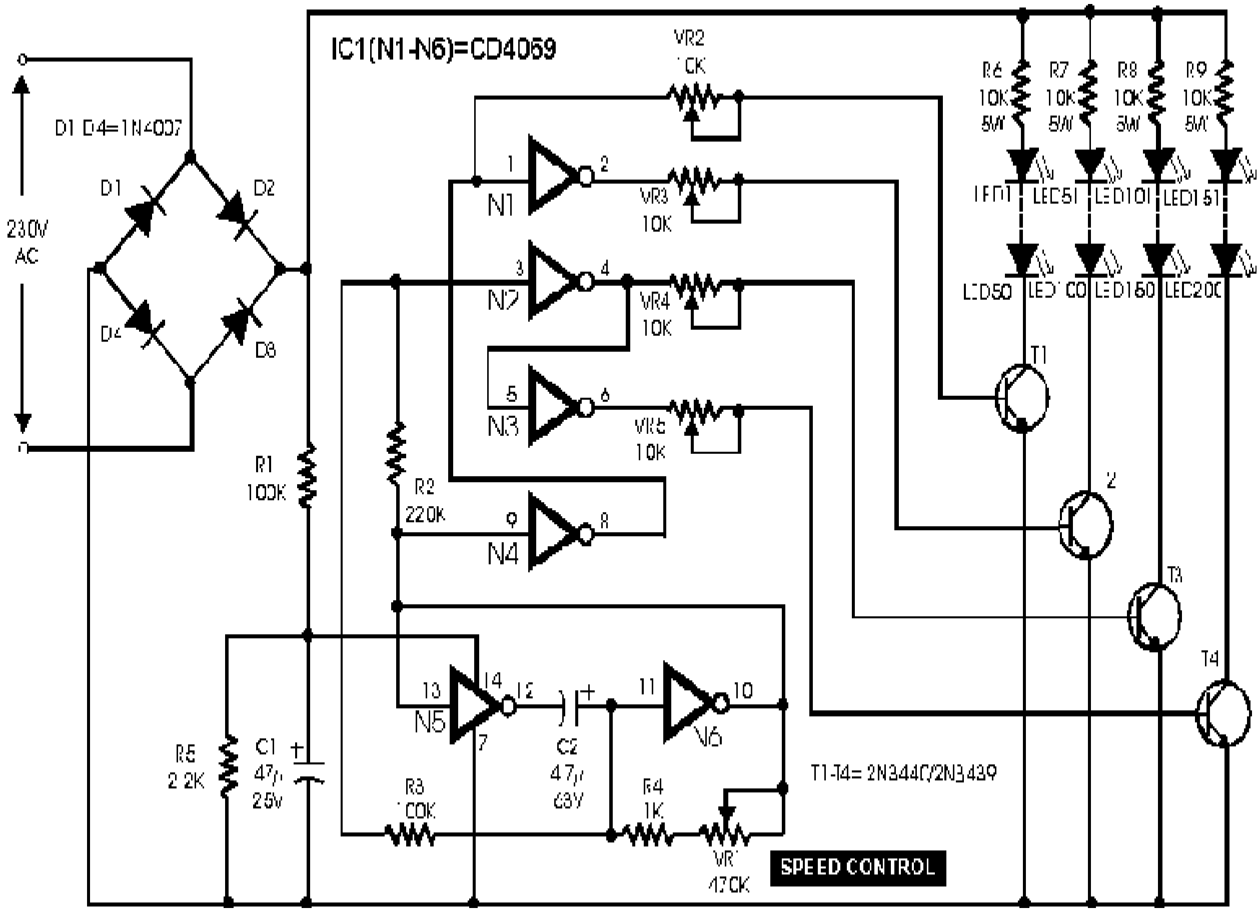
The display can be fixed on a veroboard of suitable size and connected to ground of a common supply (of 6V to 9V) while the anodes of LEDs are to be connected to emitters of transistors T1 through T7 as shown in the circuit. The above circuit is very versatile and can be wired with a large number of LEDs to make an LED fashion jewellery of any design. With two circuits connected in a similar fashion, multiplexing of LEDs can be done to give a moving display effect

P106. Christmas Star



This circuit can be used to construct an attractive Christmas Star. When we switch on this circuit, the brightness of lamp L1 gradually increases. When it reaches the maximum brightness level, the brightness starts decreasing gradually. And when it reaches the minimum brightness level, it again increases automatically. This cycle repeats. The increase and decrease of brightness of bulb L1 depends on the charging and discharging of capacitor C3. When the output of IC1 is high, capacitor C3 starts discharging and consequently the brightness of lamp L1 decreases. IC2 is an opto-isolator whereas IC1 is configured as an astable multivibrator. The frequency of IC1 can be changed by varying the value of resistor R2 or the value of capacitor C1. Remember that when you vary the frequency of IC1, you should also vary the values of resistors R3 and R4 correspondingly for better performance. The minimum brightness level of lamp L1 can be changed by adjusting potentiometer VR1. If the brightness of the lamp L1 does not reach a reasonable brightness level, or if the lamp seems to remain in maximum brightness level (watch for a minute), increase the in-circuit resistance of potmeter VR1. If in-circuit resistance of potmeter VR1 is too high, the lamp may flicker in its minimum brightness region, or the lamp may remain in 'off' state for a long time. In such cases, decrease the resistance of potmeter VR1 till the brightness of lamp L1 smoothly increases and decreases. When supply voltage varies, you have to adjust potmeter VR1 as stated above, for proper performance of the circuit. A triac such as BT136 can be used in place of the SCR in this circuit. Caution: While adjusting potmeter VR1, care should be taken to avoid electrical shock

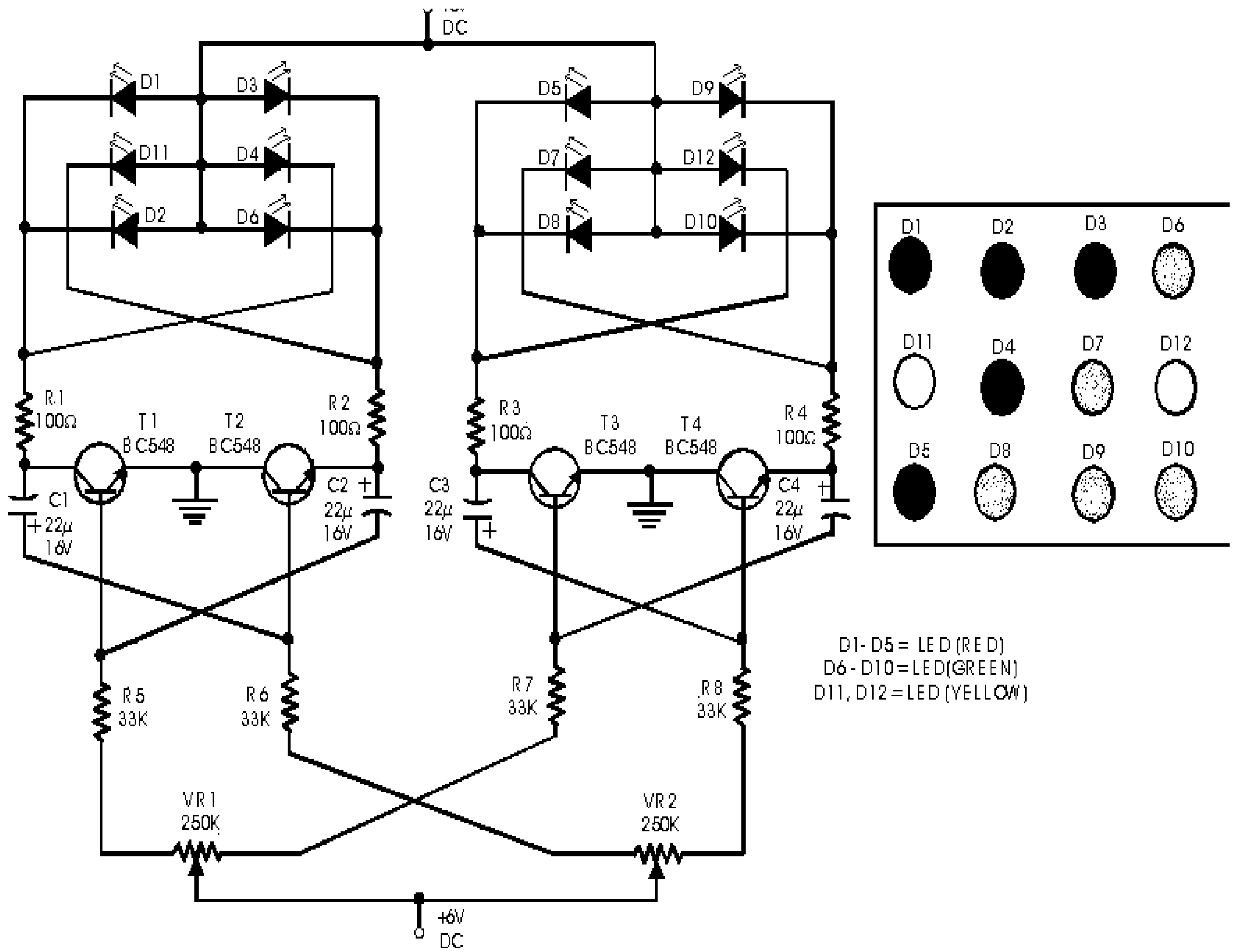
P107. Flashy Christmas Lights



This simple and inexpensive circuit built around a popular CMOS hex inverter IC CD4069UB offers four sequential switching outputs that may be used to control 200 LEDs (50 LEDs per channel), driven directly from mains supply. Input supply of 230V AC is rectified by the bridge rectifiers D1 to D4. After fullwave rectification, the average output voltage of about 6 volts is obtained across the filter comprising capacitor C1 and resistor R5. This supply energises IC CD4069UB.

All gates (N1-N6) of the inverter have been utilised here. Gates N1 to N4 have been used to control four high voltage transistors T1 to T4 (2N3440 or 2N3439) which in turn drive four channels of 50 LEDs each through current limiting resistors of 10-kilo-o Base drive of transistors can be adjusted with the help of 10-kilo-ohm pots provided in their paths. Remaining two gates (N5 and N6) form a low frequency oscillator. The frequency of this oscillator can be changed through pot VR1. When pot VR1 is adjusted To get the best results, a low leakage, good quality capacitor must be used for the timing capacitor C2

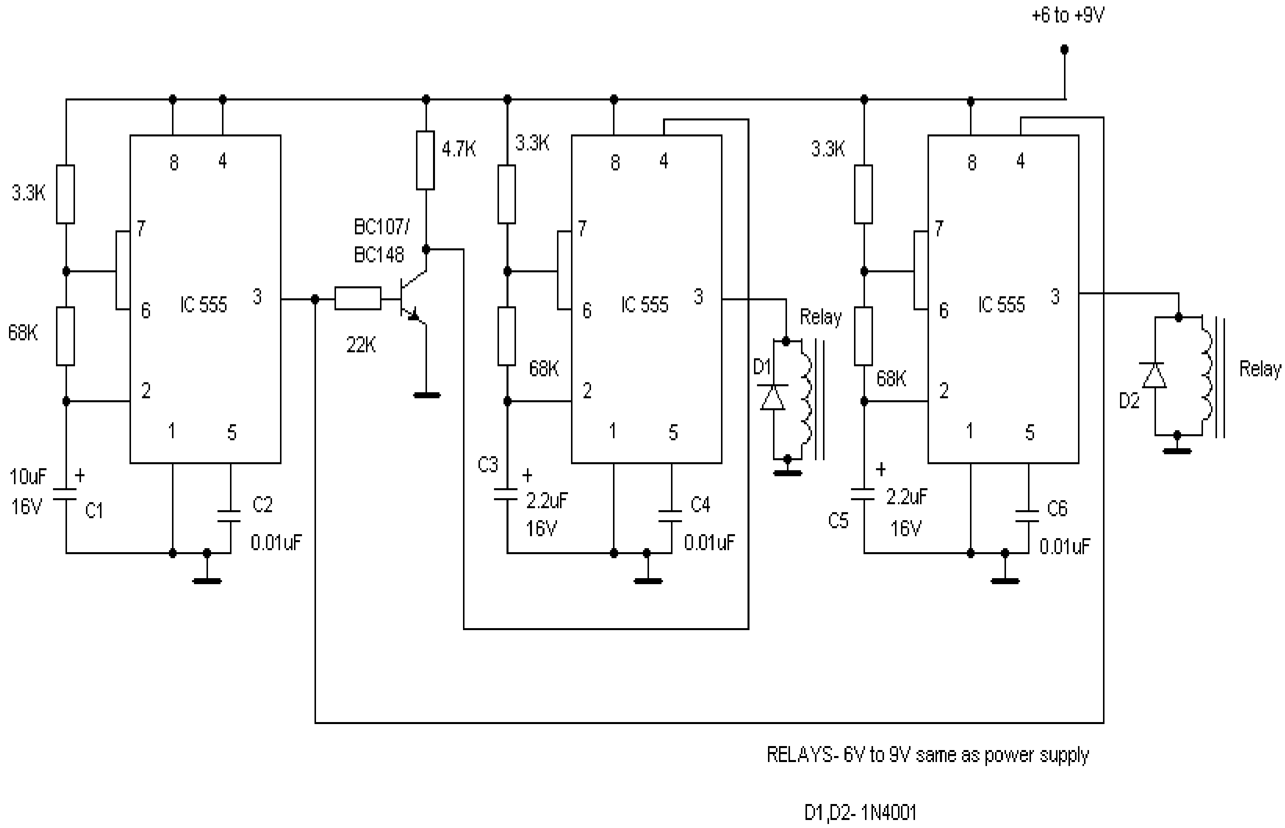
P108. Dancing Lights



Here is a simple circuit which can be used for decoration purposes or as an indicator. Flashing or dancing speed of LEDs can be adjusted and various dancing patterns of lights can be formed.

The circuit consists of two astable multivibrators. One multivibrator is formed by transistors T1 and T2 while the other astable multivibrator is formed by T3 and T4. Duty cycle of each multivibrator can be varied by changing RC time constant. This can be done through potentiometers VR1 and VR2 to produce different dancing pattern of LEDs. Total cost of this circuit is of the order of Rs 30 only. Potentiometers can be replaced by light dependent resistors so that dancing of LEDs will depend upon the surrounding light intensity. The colour LEDs may be arranged as shown in the Figure

P109. Alternating Flasher



This circuit uses three easily available 555 timer ICs. All three work as astable multivibrators. The first 555 has an on period and off period equal to 1 sec. This IC controls the on/ off periods of the other 2 555s which are used to flash two bulbs through the relay contacts.

The flashing occurs at a rate of 4 flashes per second.

The diodes are used to protect the 555 ICs from peaks. The relays should have an impedance greater than 50ohms i.e, they should not draw a current more than 200mA.

The flashing sequence is as follows:

The bulb(s) connected to the first relay flashes for about 1 sec at a rate of 4 flashes per second. Then the bulb(s) connected to the second relay flashes for 1 sec at a rate of 4 flashes per second. Then the cycle repeats.

The flashing rates can be varied by changing the capacitors C3 and C5. A higher value gives a lower flashing rate.

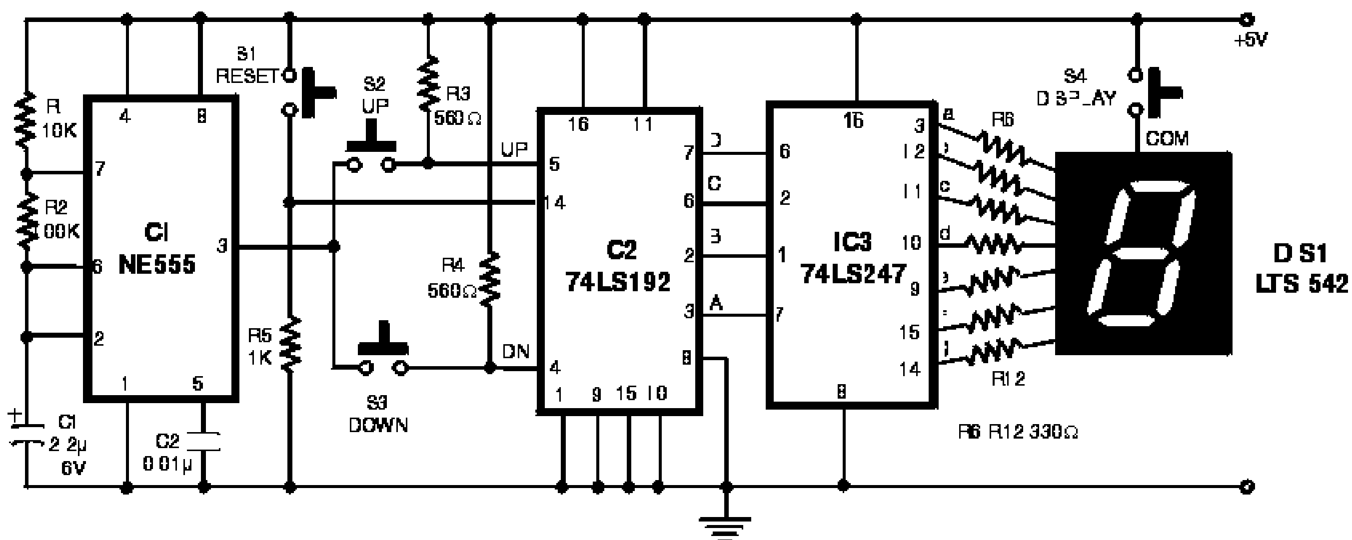
Note that the values of C3 and C5 should be equal and should be less than that of C1.

The value of C1 controls the change-over rate (default 1sec). A higher value gives a lower change-over rate.

If you use the normally open contacts of the relay, on bulb will be OFF while other is flashing,and vice versa.

If normally closed contacts are used, one bulb will be ON while the other is flashing.

P110. Electronic Scoring Game

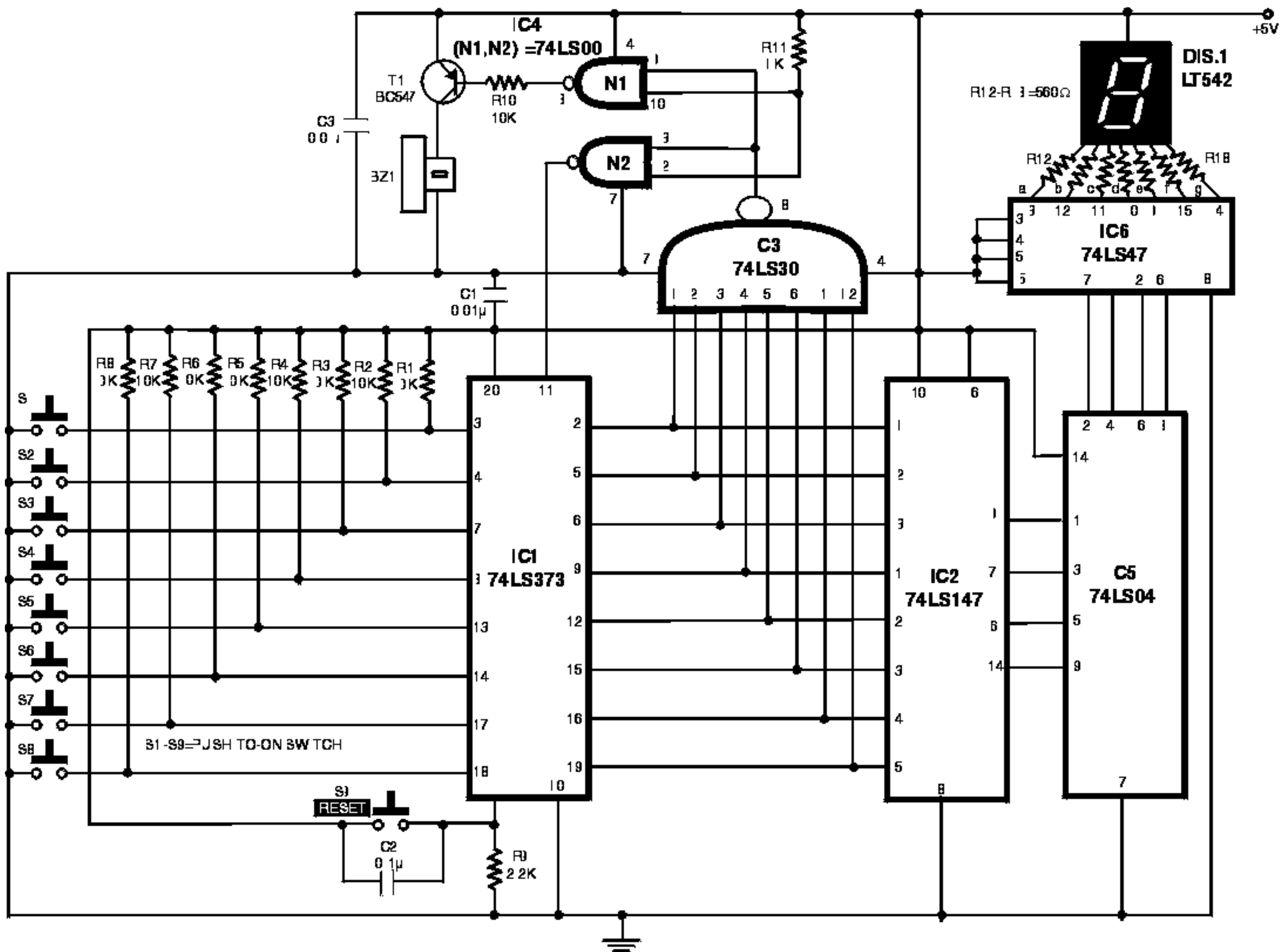


You can play this game alone or with your friends. The circuit comprises a timer IC, two decade counters and a display driver along with a 7-segment display. The game is simple. As stated above, it is a scoring game and the competitor who scores 100 points rapidly (in short steps) is the winner. For scoring, one has the option of pressing either switch S2 or S3. Switch S2, when pressed, makes the counter count in the forward direction, while switch S3 helps to count downwards. Before starting a fresh game, and for that matter even a fresh move, you must press switch S1 to reset the circuit. Thereafter, press any of the two switches, i.e. S2 or S3. On pressing switch S2 or S3, the counter's BCD outputs change very rapidly and when you release the switch, the last number remains latched at the output of IC2. The latched BCD number is input to BCD to 7-segment decoder/driver IC3 which drives a common-anode display DIS1. However, you can read this number only when you press switch S4. The sequence of operations for playing the game between, say two players 'X' and 'Y', is summarised below:

1. Player 'X' starts by momentary pressing of reset switch S1 followed by pressing and releasing of either switch S2 or S3. Thereafter he presses switch S4 to read the display (score) and notes down this number (say X1) manually.
2. Player 'Y' also starts by momentary pressing of switch S1 followed by pressing of switch S2 or S3 and then notes down his score (say Y1), after pressing switch S4, exactly in the same fashion as done by the first player.
3. Player 'X' again presses switch S1 and repeats the steps shown in step 1 above and notes down his new score (say, X2). He adds up this score to his previous score. The same procedure is repeated by player 'Y' in his turn.
4. The game carries on until the score attained by one of the two players totals up to or exceeds 100, to be declared as the winner.

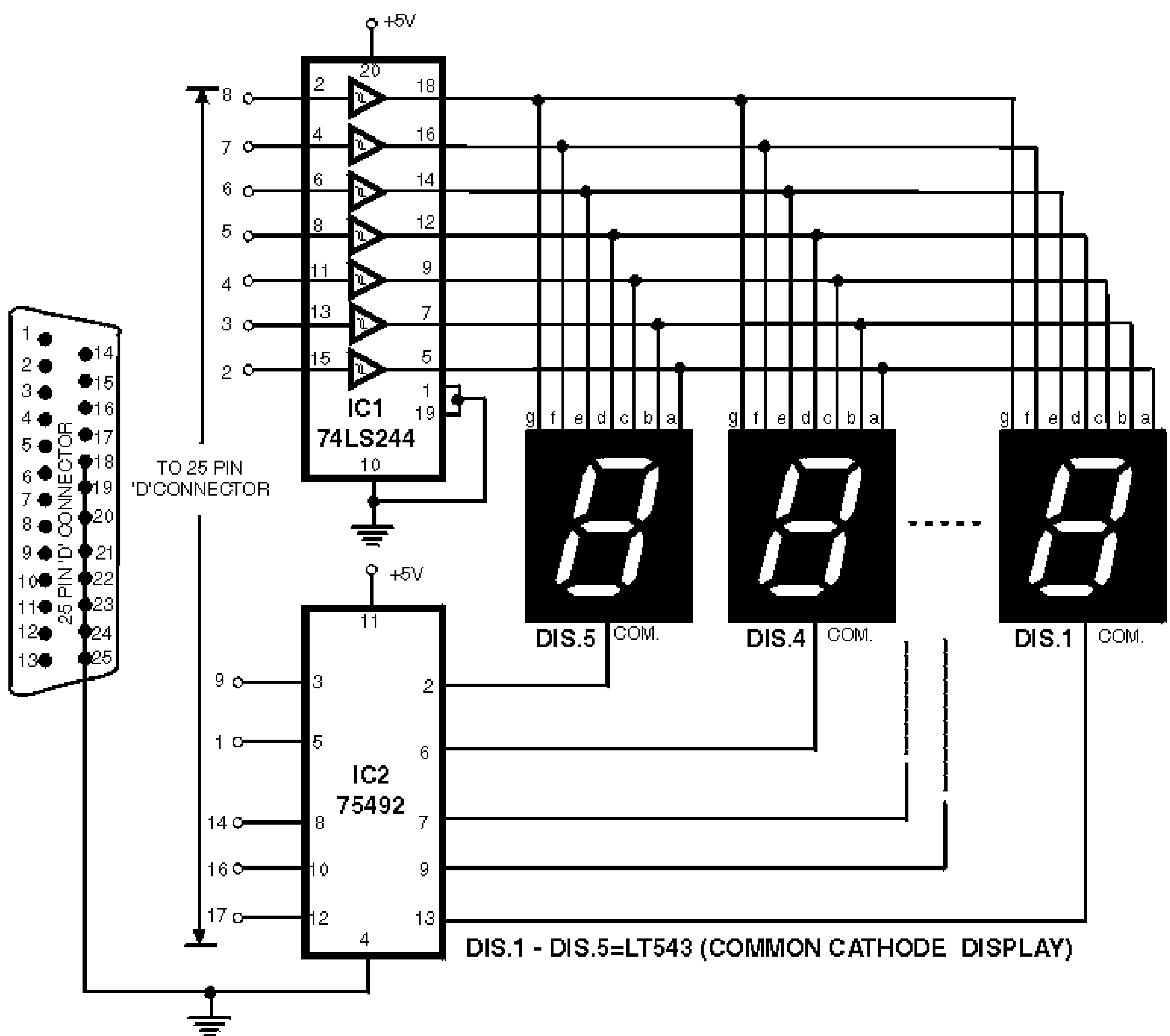
Several players can participate in this game, with each getting a chance to score during his own turn. The assembly can be done using a multipurpose board. Fix the display (LEDs and 7-segment display) on top of the cabinet along with the three switches. The supply voltage for the circuit is 5V.

P111. JAM(Just A Minute) Circuit



This jam circuit can be used in quiz contests wherein any par- ticipant who presses his button (switch) before the other contestants, gets the first chance to answer a question. The circuit given here permits up to eight contestants with each one allotted a distinct number (1 to 8). The display will show the number of the contestant pressing his button before the others. Simultaneously, a buzzer will also sound. Both, the display as well as the buzzer have to be reset manually using a common reset switch. Initially, when reset switch S9 is momentarily pressed and released, all outputs of 74LS373 (IC1) transparent latch go 'high' since all the input data lines are returned to Vcc via resistors R1 through R8. All eight outputs of IC1 are connected to inputs of priority encoder 74LS147 (IC2) as well as 8-input NAND gate 74LS30 (IC3). The output of IC3 thus becomes logic 0 which, after inversion by NAND gate N2, is applied to latch-enable pin 11 of IC1. With all input pins of IC2 being logic 1, its BCD output is 0000, which is applied to 7-segment decoder/driver 74LS47 (IC6) after inversion by hex inverter gates inside 74LS04 (IC5). Thus, on reset the display shows 0. When any one of the push-to-on switches—S1 through S8—is pressed, the corresponding output line of IC1 is latched at logic 0 level and the display indicates the number associated with the specific switch. At the same time, output pin 8 of IC3 becomes high, which causes outputs of both gates N1 and N2 to go to logic 0 state. Logic 0 output of gate N2 inhibits IC1, and thus pressing of any other switch S1 through S8 has no effect. Thus, the contestant who presses his switch first, jams the display to show only his number. In the unlikely event of simultaneous pressing (within few nano-seconds difference) of more than one switch, the higher priority number (switch no.) will be displayed. Simultaneously, the logic 0 output of gate N1 drives the buzzer via pnp transistor BC158 (T1). The buzzer as well the display can be reset (to show 0) by momentary pressing of reset switch S9 so that next round may start. Lab Note: The original circuit sent by the author has been modified as it did not jam the display, and a higher number switch (higher priority), even when pressed later, was able to change the displayed number.

P112. 7 segment rolling display using PC

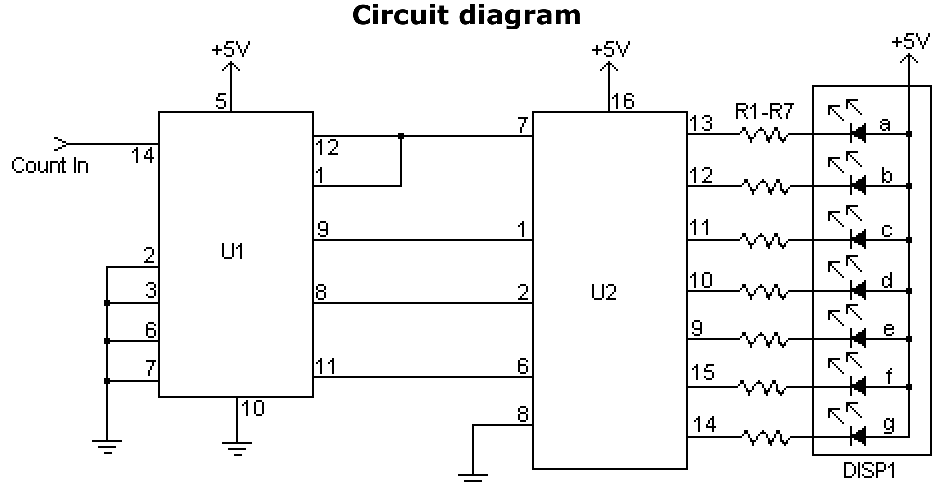


It is very interesting and convenient to be able to control everything while sitting at your PC terminal. Here, a simple hardware circuit and software is used to interface a 7-segment based rolling display. The printer port of a PC provides a set of points with some acting as input lines and some others as output lines. Some lines are open collector type which can be used as input lines. The circuit given here can be used for interfacing with any type of PC's printer port. The 25-pin parallel port connector at the back of a PC is a combination of three ports. The address varies from 378H-37AH. The 7 lines of port 378H (pins 2 through 8) are used in this circuit to output the code for segment display through IC1. The remaining one line of port 378H (pin 9) and four lines of port 37AH (pins 1, 14, 16, 17) are used to enable the display digits (one a time) through IC2. The bits D0, D1 and D3 of port 37AH connected to pins 1, 14 and 17 of 'D' connector are inverted by the computer before application to the pins while data bit D2 is not inverted. Therefore to get a logic high at any of former three pins, we must send logic 0 output to the corresponding pin of port 37AH. Another important concept illustrated by the project is the time division multiplexing. Note that all the five 7-segment displays share a common data bus. The PC places the 7-segment code for the first digit/character on the data bus and enables only the first 7-segment display. After delay of a few milliseconds, the 7-segment code for the digit/character is replaced by that of the next charter/digit, but this time only second display digit is enabled. After the display of all characters/digits in this way, the cycle repeats itself over and over again. Because of this repetition at a fairly high rate, there is an illusion that all the digits/characters are continuously being displayed. DISP1 is to be physically placed as the least significant digit. IC1 (74LS244) is an octal buffer which is primarily used to increase the driving capability. It has two groups of four buffers with non-inverted tri-state outputs. The buffer is controlled by two active low enable lines. IC2 (75492) can drive a maximum of six 7-segment displays. (For driving up to seven common-cathode displays one may use ULN2003 described elsewhere in this section.) The program for rolling display is given in the listing DISP.C above. Whatever the message/characters to be displayed (here five characters have been displayed), these are separated and stored in an array. Then these are decoded. Decoding software is very simple. Just replace the desired character with the binary equivalent of the display code. The display code is a byte that has the appropriate bits turned on. For example, to display character 'L', the segments to be turned on are f, e and d. This is equivalent to 111000 binary or 38 hex. Please note that only limited characters can be formed using 7-segment display. Characters such as M, N and K cannot be formed properly

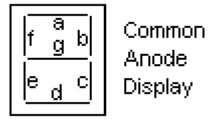
P113. 7 Segment LED Counter

This simple counter can be used to count pulses, as the basis for a customer counter (like you see at the doors of some stores), or for anything else that may be counted. The circuit accepts any TTL compatible logic signal, and can be expanded easily (see Notes).

Circuit diagram



7 Segment Display Reference



Parts:
R1-R7 470 Ohm 1/4 Watt Resistor
U1 74LS90 TTL BCD Counter IC or 7490,74HC90
U2 74LS47 TTL Seven Segment Display Driver IC or 7447,74HC47
DISP1 Common Anode 7 Segment LED Display
MISC Board, Sockets For ICs, Wire

Notes:

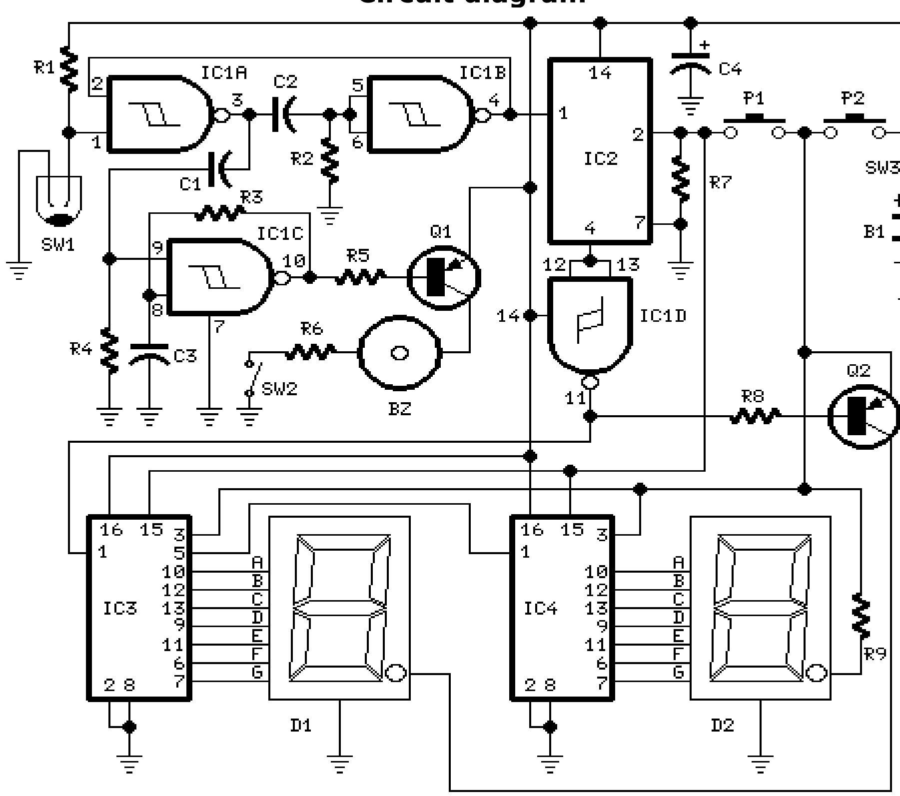
1. All pulses to be counted are to be TTL compatible. They should not exeed 5V and not fall below ground.

2. You can add more digits by building a second (or third, or fourth, etc...) circuit and connecting the pin 11-6 junction of the 74LS90 and 74LS47 to pin 14 of the 74LS90 in the other circuit. You can keep expanding this way to as many digits as you want.

P114. Digital Step-Km Counter

Max. range: 9.950 meters with two digits
Slip it in pants' pocket for walking and jogging

Circuit diagram



Parts:
R1,R3 22K 1/4W Resistor
R2 2M2 1/4W Resistor
R4 1M 1/4W Resistor
R5,R7,R8 4K7 1/4W Resistor
R6 47R 1/4W Resistor
R9 1K 1/4W Resistor
C1 47nF 63V Polyester Capacitor
C2 100nF 63V Polyester Capacitor
C3 10nF 63V Polyester Capacitor
C4 10µF 25V Electrolytic Capacitor
D1 Common-cathode 7-segment LED mini-display (Hundreds meters)
D2 Common-cathode 7-segment LED mini-display (Kilometers)
IC1 4093 Quad 2 input Schmitt NAND Gate IC
IC2 4024 7 stage ripple counter IC
IC3,IC4 4026 Decade counter with decoded 7-segment display outputs IC
Q1,Q2 BC327 45V 800mA PNP Transistors
P1 SPST Pushbutton (Reset)
P2 SPST Pushbutton (Display)
SW1 SPST Mercury Switch, called also Tilt Switch
SW2 SPST Slider Switch (Sound on-off)
SW3 SPST Slider Switch (Power on-off)
BZ Piezo sounder
B1 3V Battery (2 AA 1.5V Cells in series)

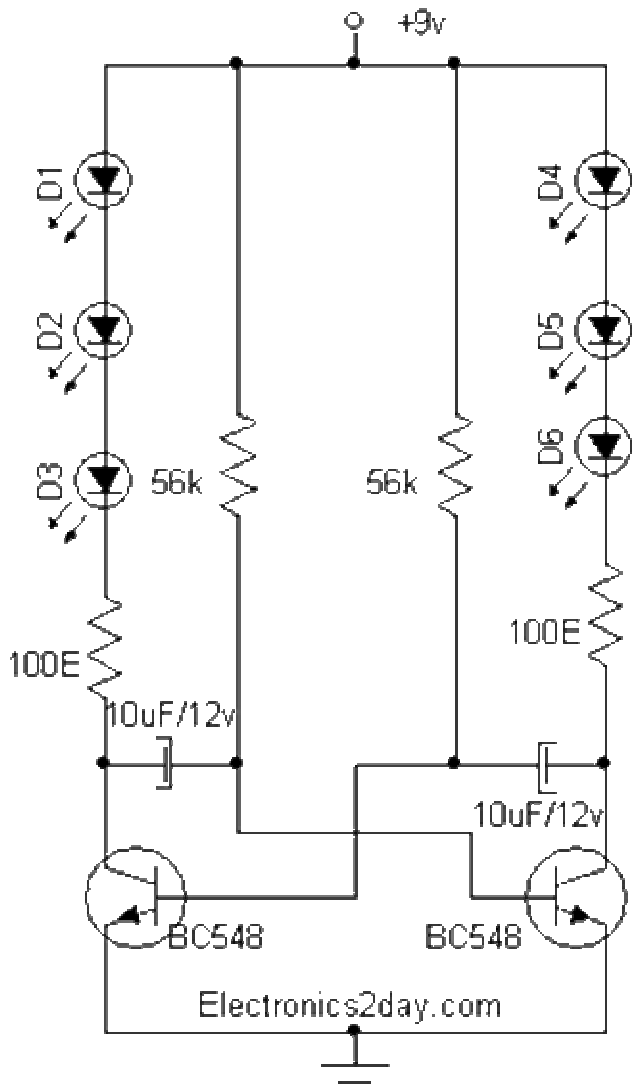
Device purpose:

This circuit measures the distance covered during a walk. Hardware is located in a small box slipped in pants' pocket and the display is conceived in the following manner: the leftmost display D2 (the most significant digit) shows 0 to 9 Km. and its dot is always on to separate Km. from hm. The rightmost display D1 (the least significant digit) shows hundreds meters and its dot lights after every 50 meters of walking. A beeper (excludable), signals each count unit, which occurs every two steps. A normal step is calculated to span approx. 78 centimeters, thus the LED signaling 50 meters lights after 64 steps or 32 mercury switch's operations, the display indicates 100 meters after 128 steps and so on. For low battery consumption the display lights only on request, pushing P2. Accidental reset of the counters is avoided because to reset the circuit both pushbuttons must be operated together. Obviously this is not a precision meter, but its approximation's degree was found good for this kind of device. In any case, the most critical thing to do is placement and sloping degree of the mercury switch inside the box.

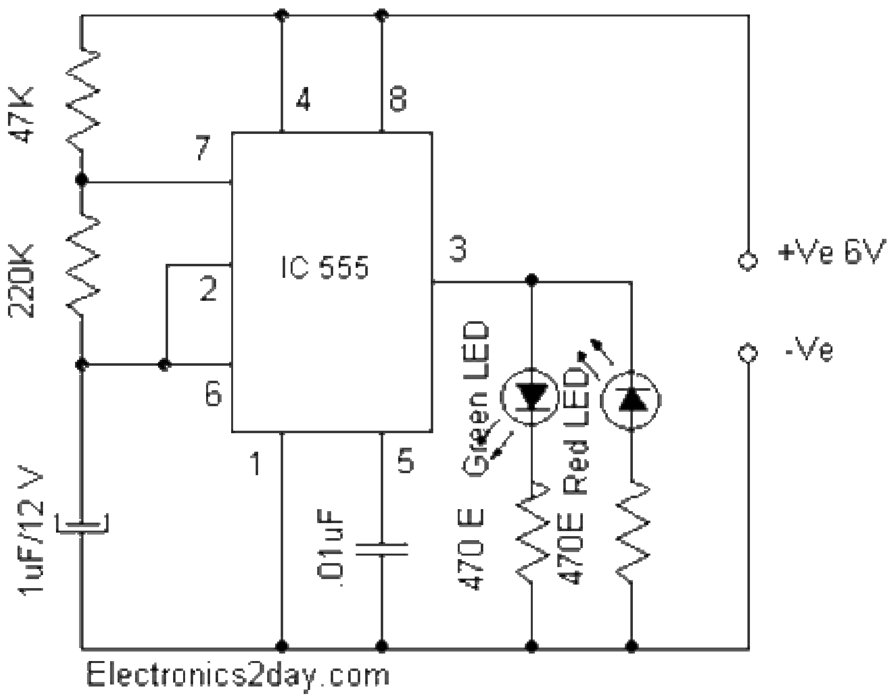
Circuit operation:

IC1A & IC1B form a monostable multivibrator providing some degree of freedom from excessive bouncing of the mercury switch. Therefore a clean square pulse enters IC2 that divide by 64. Q2 lights the dot of D1 every 32 pulses counted by IC2. IC3 & IC4 divide by 10 each and drive the displays. P1 resets the counters and P2 enables the displays. IC1C generates an audio frequency square wave that is enabled for a short time at each monostable count. Q1 drives the piezo sounder and SW2 let you disable the beep.

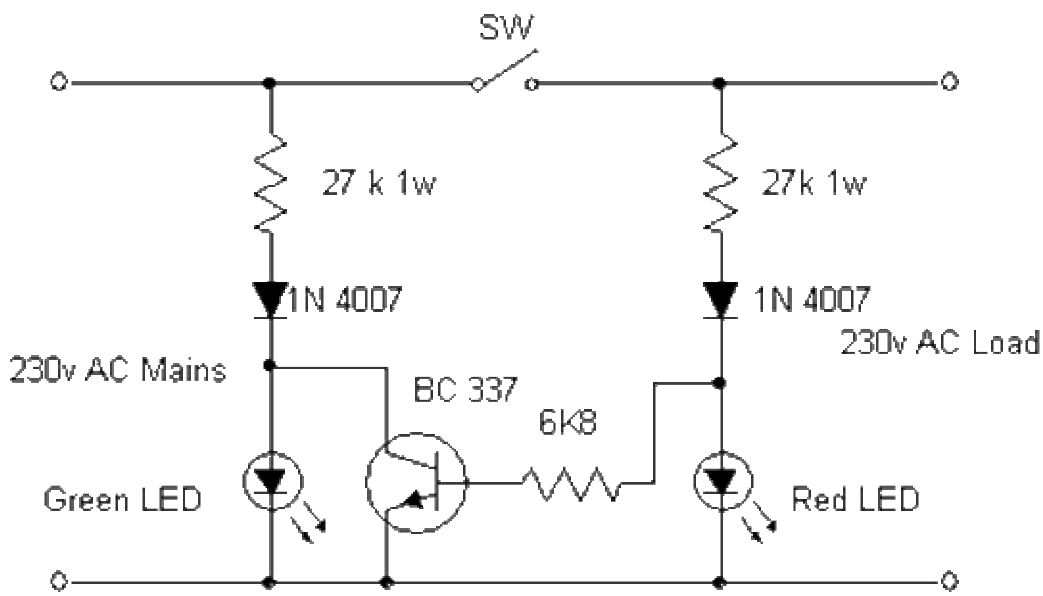
P115. Dancing Light



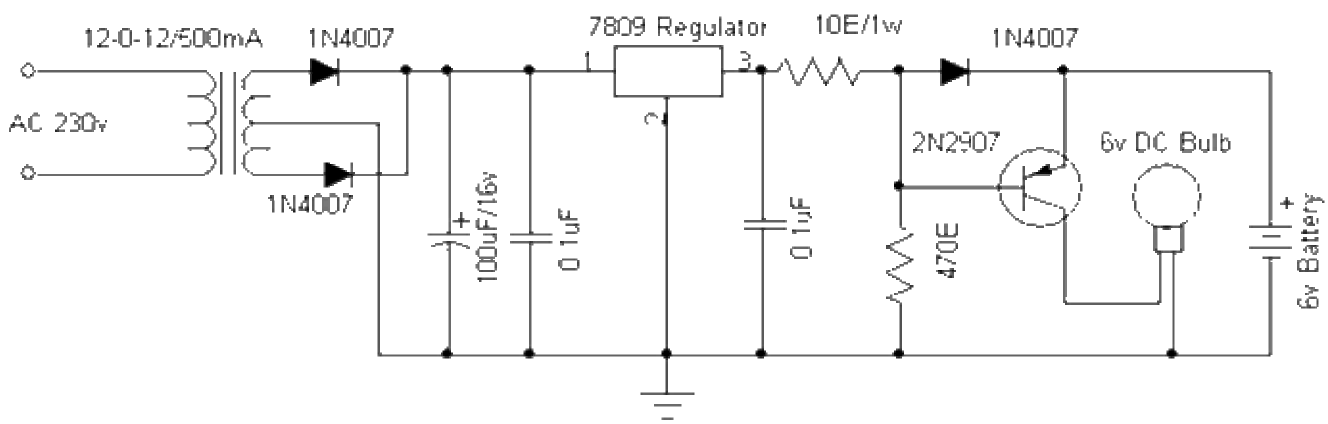
P116. LED Flasher



P117. Pilot Light



P118. Simple Emergency Light



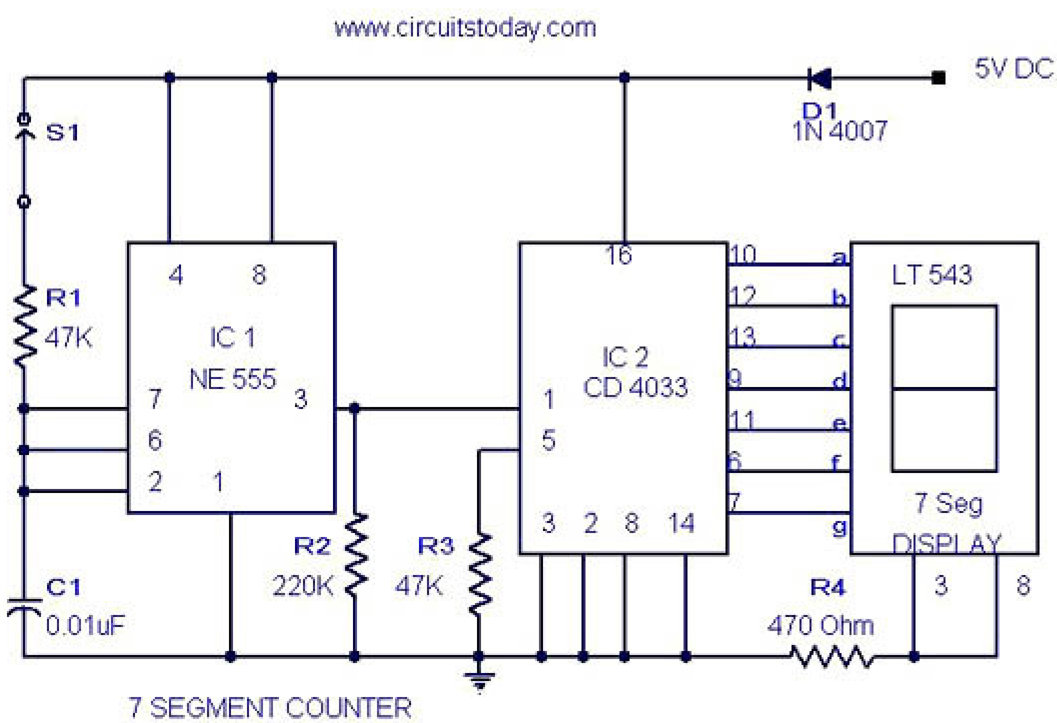
P119. 7 Segment Counter Circuit

Â Description

Here is the circuit diagram of a seven segment counter base don the counter IC CD 4033.This circuit can be used in conjunction with various circuits where a counter to display the progressÂ adds some more attraction.

IC NE 555 is wired as an astable multivibrator for triggering the CD 4033.For each pulse the out put of CD 4033 advances by one count.The output of CD 4033 is displayed by the seven segment LED display LT543.Switch S1 is used to initiate the counting.Diode D1 prevents the risk of accidental polarity reversal.

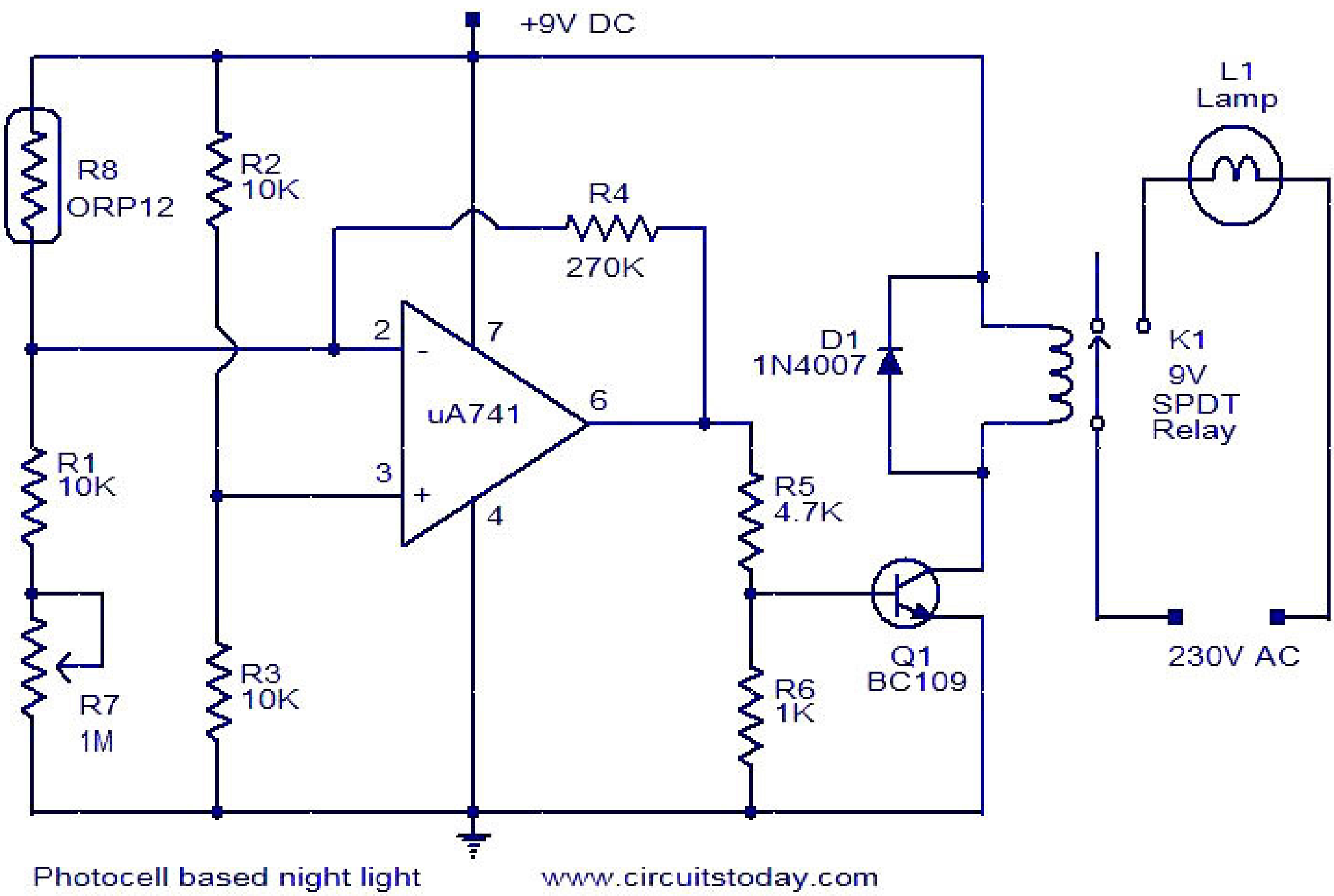
Circuit Diagram with Parts List.Â



P120. Photocell based night light_

Description.
Many automatic night light circuits had been published here. This one uses a photocell for detecting the light intensity. At full light the resistance of the photocell will be few ten ohms and at darkness it will rise to several hundred ohms. The IC1 uA741 is wired as a comparator here. At darkness the resistance of photocell increases and so the voltage at the inverting input of the IC1 will be less than the reference voltage at the non inverting input. The output of the IC1 goes to positive saturation and it switches ON the transistor to activate the relay. By this way the lamp connected through the relay contact glows. The diode D1 works as a freewheeling diode.

Circuit diagram.



Notes.

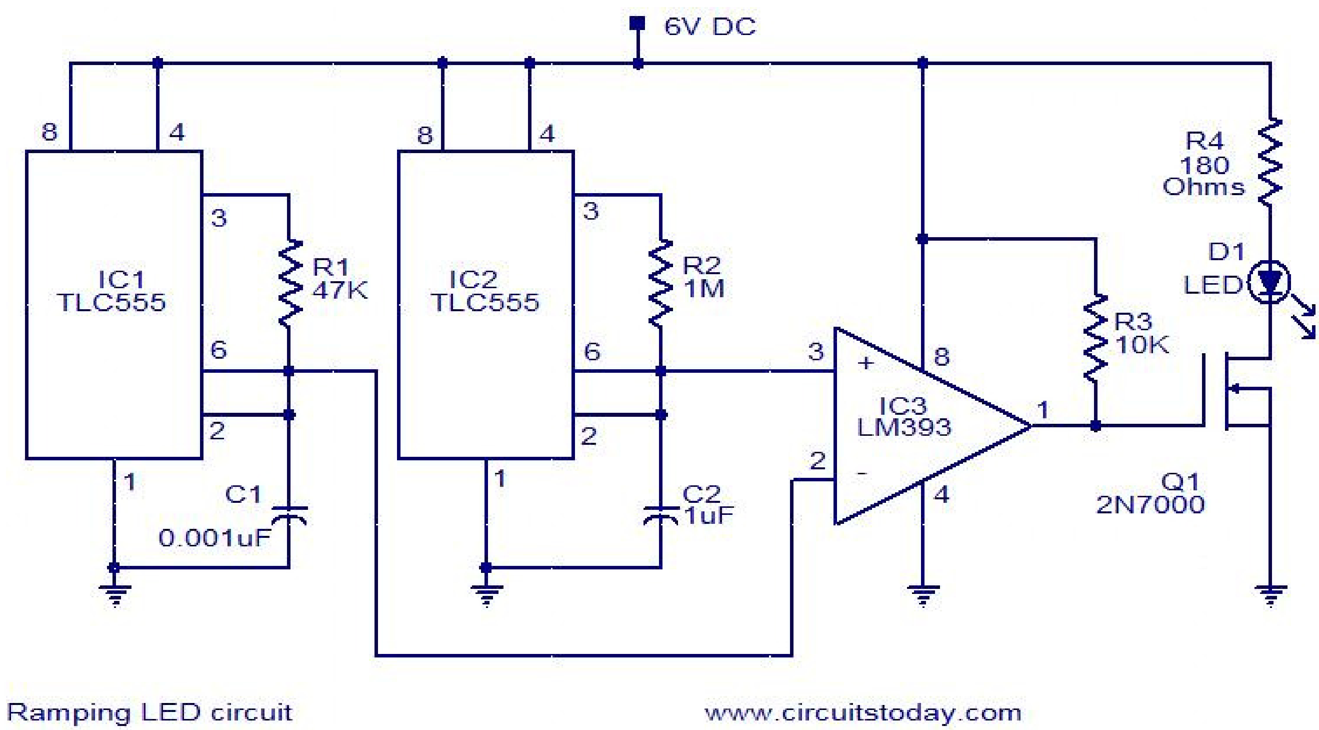
- The circuit can be assembled on a Vero board.
- Use 9V DC for powering the circuit.
- POT R7 can be used to adjust the sensitivity of the circuit.
- The relay K1 can be a 9V, 200 Ohm SPDT type.
- L1 can be a 230V,60W lamp.
- R8 can be a ORP 12 photocell.

P121. LED ramping circuit

Description.

In this circuit the intensity of LED will vary in a ramping fashion. The circuit consists of three ICs: Two 555 timer ICs and one LM393 op-amp. IC1 and IC2 are wired as oscillators to produce 10 KHz and 1 Hz frequencies respectively.These two frequencies are given to the inputs of the op-amp LM393.LM393 is wired as a comparator and its output will be a PWM signal. This PWM signals controls the FET Q1 to drive the LED. The LED will rise from OFF state to full brightness slowly and then slowly fades to OFF state and this operation repeats. The resistor R4 controls current through the LED.

Circuit diagram with Parts list.



Notes.

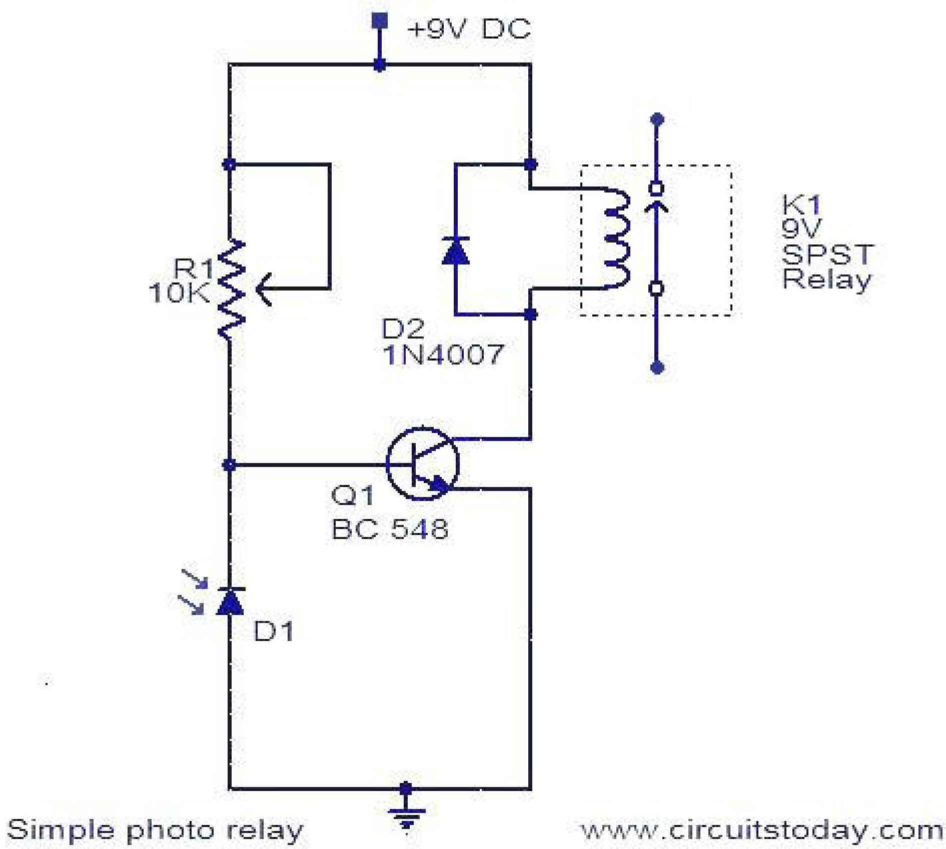
- Assemble the circuit on a general purpose PCB.
- The ICs must be mounted on holders.
- The power supply for this circuit can be anything between 3 to 12V.
- I recommend 6V for this circuit.
- The effect can be varied by changing the values of C1, C2, R1 or R2.

P122. Photo relay circuit

Description.

A photo relay or light activated relay is a circuit which opens and closes the relay contacts according to the light.Here a photo diode is used to sense the light.The photo diode offers a high resistance when there is no light falling on it.Here the photo diode is connected in reverse biased condition.The only current flowing through it will be due to the minority carriers.When light falls on it, the current due to the minority carriers increase and the diode offers a low resistance.As a result the voltage across the diode will not be sufficient to make the transistor Q1 forward biased and the relay will OFF.When there is darkness the photo diode resistance increases and the voltage across it will become enough to forward bias the transistor Q1 making the relay ON.The diode D2 is used as a freewheeling diode to protect the transistor from transients produced to the switching of relay. By this way the load connected through the relay contacts can be switched ON and OFF according to the light falling on the photo diode.

Circuit diagram with Parts list.



Notes.

- Assemble the circuit on a general purpose PCB.
- The circuit can be powered from 9V DC.
- The preset R1 can be used to adjust the sensitivity of the circuit.
- The D1 can be any general purpose photo diode.

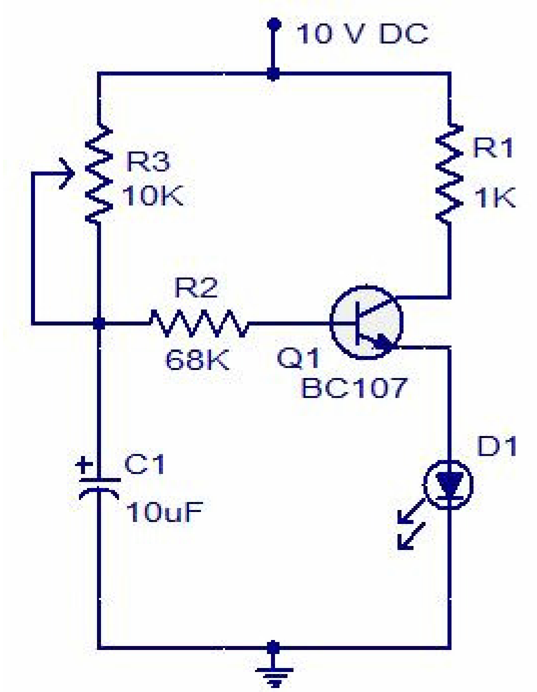
P123. Delayed ON LED

Description.

Here is very simple circuit in which the LED becomes ON only after a preset time the power supply is switched ON. When the power supply is switched on the transistor will be OFF. The capacitor now charges via the preset R3 and when the voltage across C1 is sufficient, the transistor switches ON and LED glows. The ON delay depends on the value of POT R3 .You can increase the time delay by increasing the resistance of POT R3.

This circuit alone may not have much practical applications but this can be used in many other projects where a delayed ON indication is required.

Circuit diagram with Parts list.



Notes.

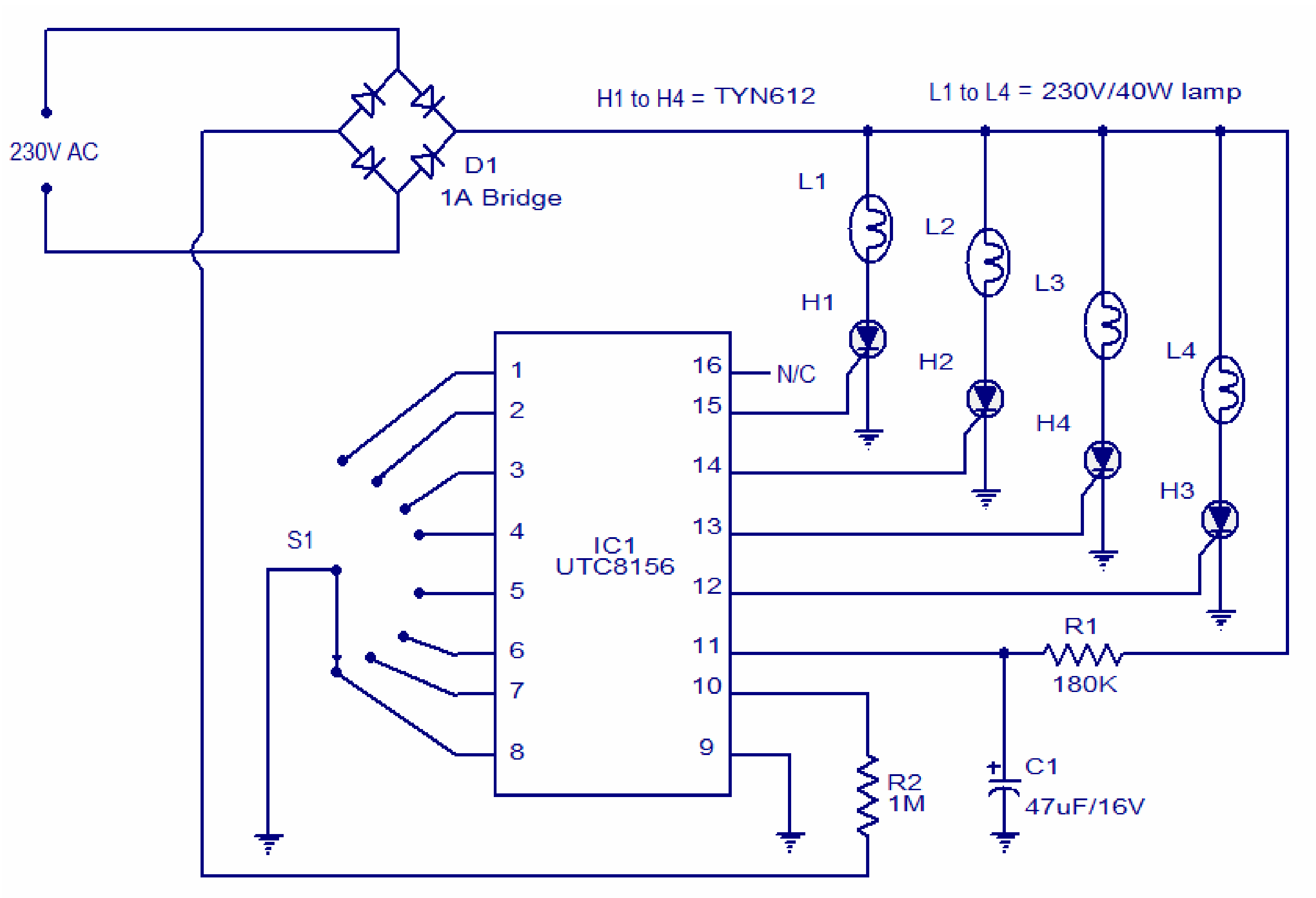
- Assemble the circuit on a genral purpose PCB.
- The circuit can be powered from a 10V DC power supply.
- Anyway you can use from 6 to 18V for powering this cicuit, but you need to adjust the POT R3 for getting the required delay.

P124. 8 function christmas lamp

Description.

This 8 function serial Christmas lamp controller is based on the IC UTC 8156 from Unisonic. Specially designed for the same purpose, the UTC 8156 can control the four lamps in 8 modes namely waves, sequential, slo-gol, chasing/flash, slow fade, twinkle/flash, steady ON and auto scan. Control signals for controlling the lamps will be available at pin 12 to pin 15 of the IC. SCRs are used to drive the lamps according to these control signals.

Circuit diagram.



Notes.

- The circuit can be assembled on a Vero board.
- L1 to L4 can be 230V/40W lamps.
- H1 to H4 can be TYN612 SCRs.
- Heat sinks are recommended for the SCRs.
- IC1 must be mounted on a holder.
- If 1A bridge is not available, make one using four 1N4007 diodes.
- S1 can be an 8 through rotary type selector switch.
- S1 can be used to select the modes.

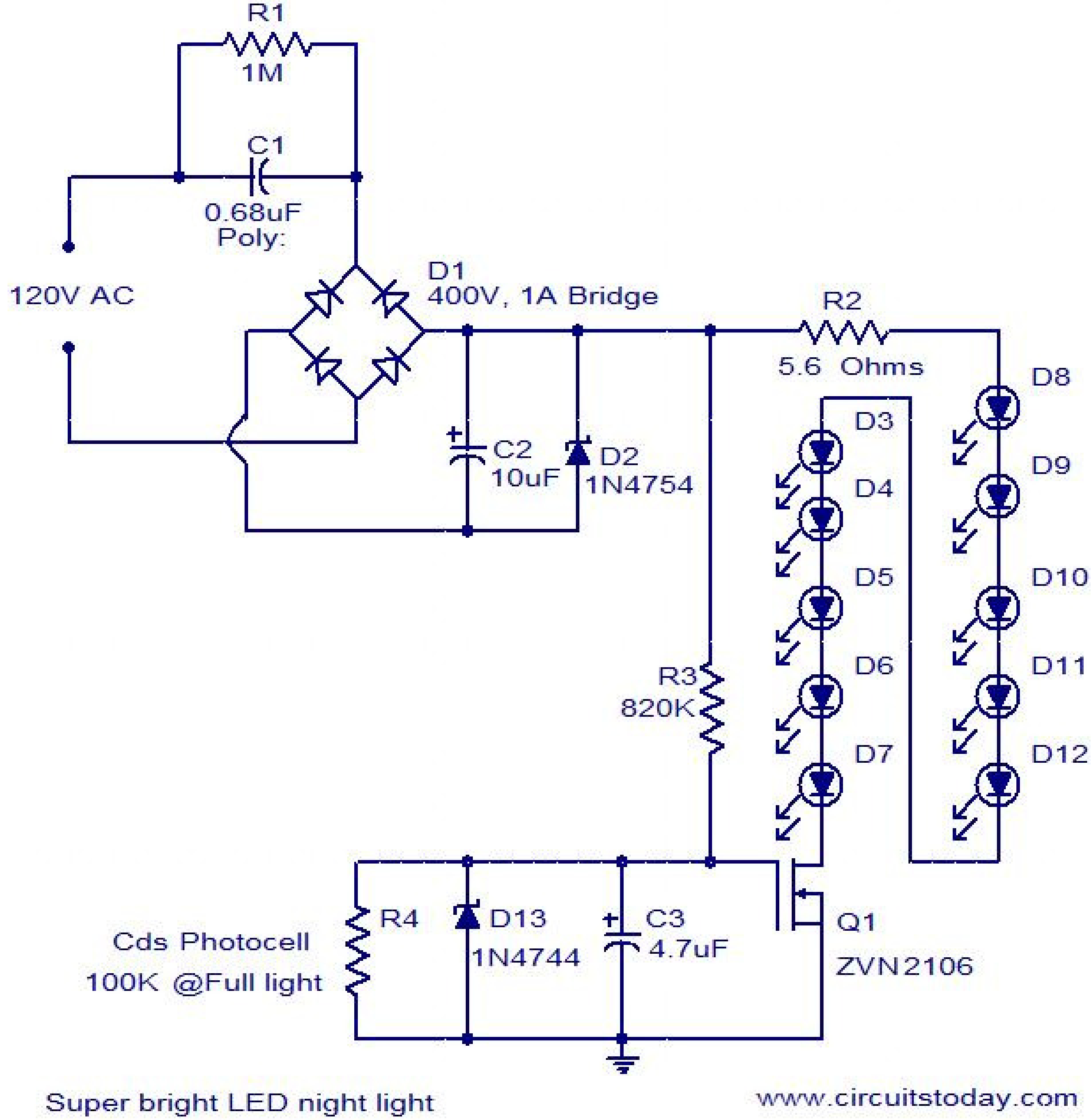
P125. Super bright LED night light

Description.
Here is the circuit diagram of a super bright LED night lamp that can be operated from the mains supply. Bridge D1 is used to rectify the AC mains voltage. The capacitor C1 and resistor R1 forms the current limiting circuit. 10 ultra bright white LEDs are wired in series to produce the required light. The n-channel FET Q1(ZVN 2106) is used to automatically switch the lamp OFF at full light. The photo cell resistance is set to be 100K at full brightness. Anything less than this 100K will instantly switch the LEDs OFF. Zener diode D2 is used to limit the peak voltage across C1 during the switching of LEDs.

Notes.

- Assemble the circuit on a general purpose PCB.
- The capacitor C1 is a 0.68uF/250V Polyester capacitor.
- Capacitors C2 and C3 must be rated at least 50V.
- If 1A Bridge is not available make one using four 1N4007 diodes.

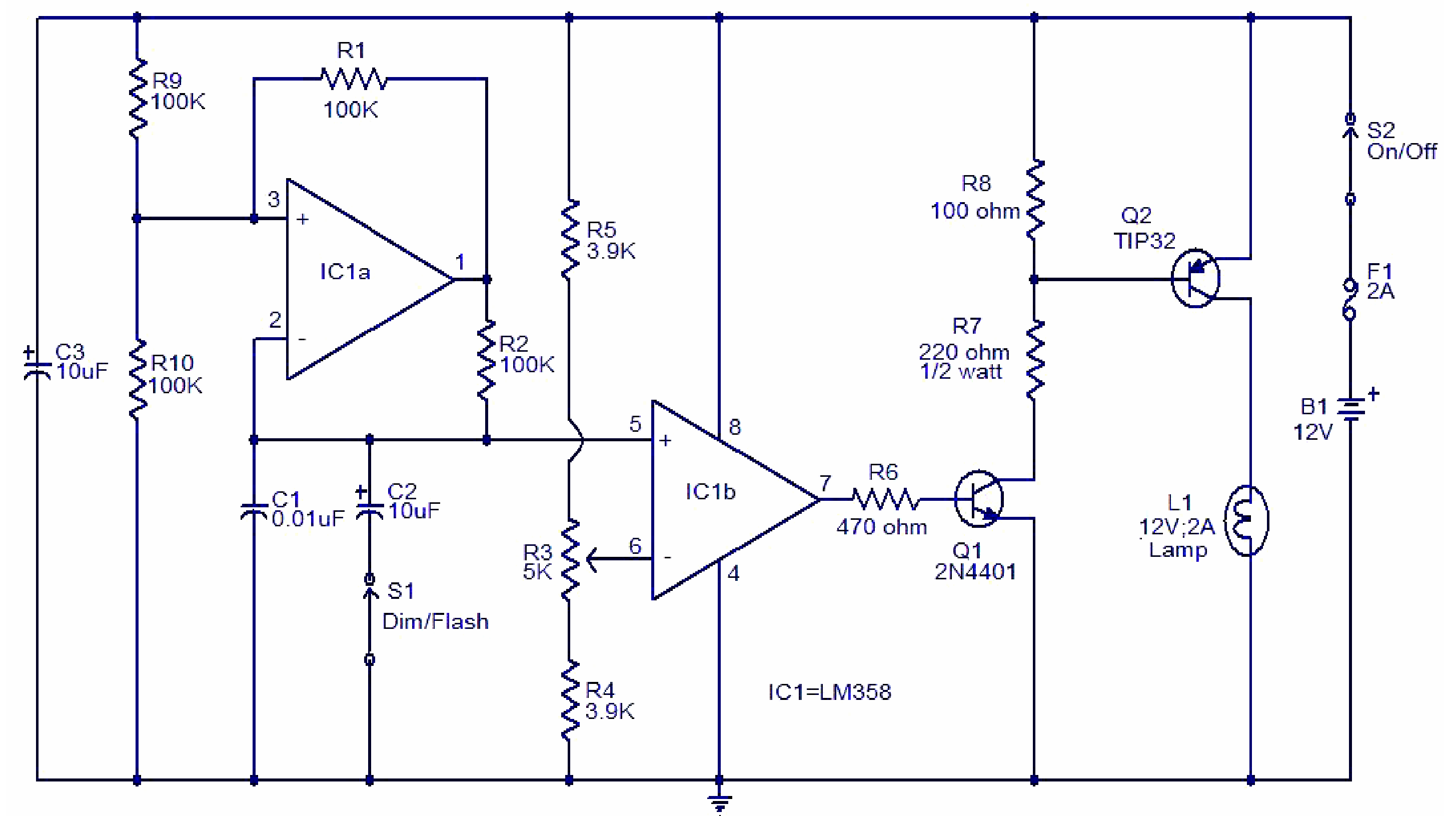
Circuit diagram with Parts list.



P126. Versatile emergency lamp

Description.
Here is the circuit diagram of a very versatile emergency lamp that can be operated in two modes (flasher and dimmer). The circuit is based on the dual op-amp IC LM358.The dimmer and flasher mode can be selected by using the switch S1. In the dimmer mode the output of IC1b will be pulses whose width can be adjusted by using POT R3. Transistors T1 and T2 forms the driver stage which drives the lamp L1 according to the output of IC1b. In the flasher mode, output of IC1b will be a variable frequency pulse which can be adjusted by POT R3 to obtain 1 to 25 flashes from the lamp.

Circuit diagram.



Notes.

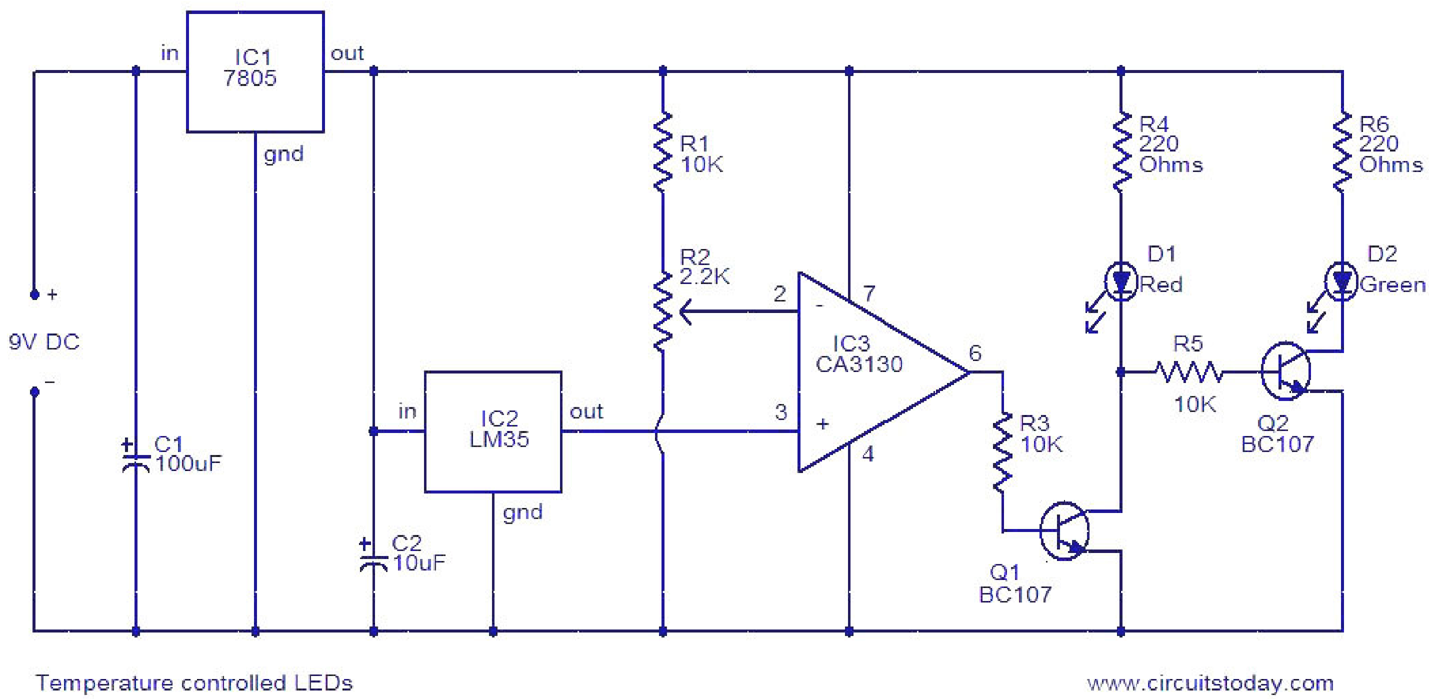
- The circuit can be assembled on a Vero board.
- Use a 12V battery for powering the circuit.
- A heatsink must be fitted on transistor T2.
- S2 can be used as an ON/OFF switch.
- F1 should be a 2A fuse.
- L1 can be a 12V; 2A incandescent lamp.
- IC1 must be mounted on a holder.

P127. Temperature controlled LEDs

Description.

The circuit is nothing but two LEDs (D1 and D2), whose status are controlled by the temperature of the surroundings. The famous IC LM35 is used as the temperature sensor here. Output of LM35 increases by 10mV per degree rise in temperature. Output of LM35 is connected to the non inverting input of the opamp CA3130.The inverting input of the same opamp can be given with the required reference voltage using POT R2. If the reference voltage is 0.8V, then the voltage at the non inverting input (output of LM35) becomes 0.8V when the temperature is 80 degree Celsius. At this point the output of IC3 goes to positive saturation. This makes the transistor Q1 On and LED D1 glows. Since the base of Q2 is connected to the collector of Q1, Q2 will be switched OFF and LED D2 remains OFF. When the temperature is below 80 degree Celsius the reverse happens.IC1 produces a stable 5V DC working voltage from the available9V DC supply. If you already have a 5V DC supply then you can use it directly.

Circuit diagram.



Notes.

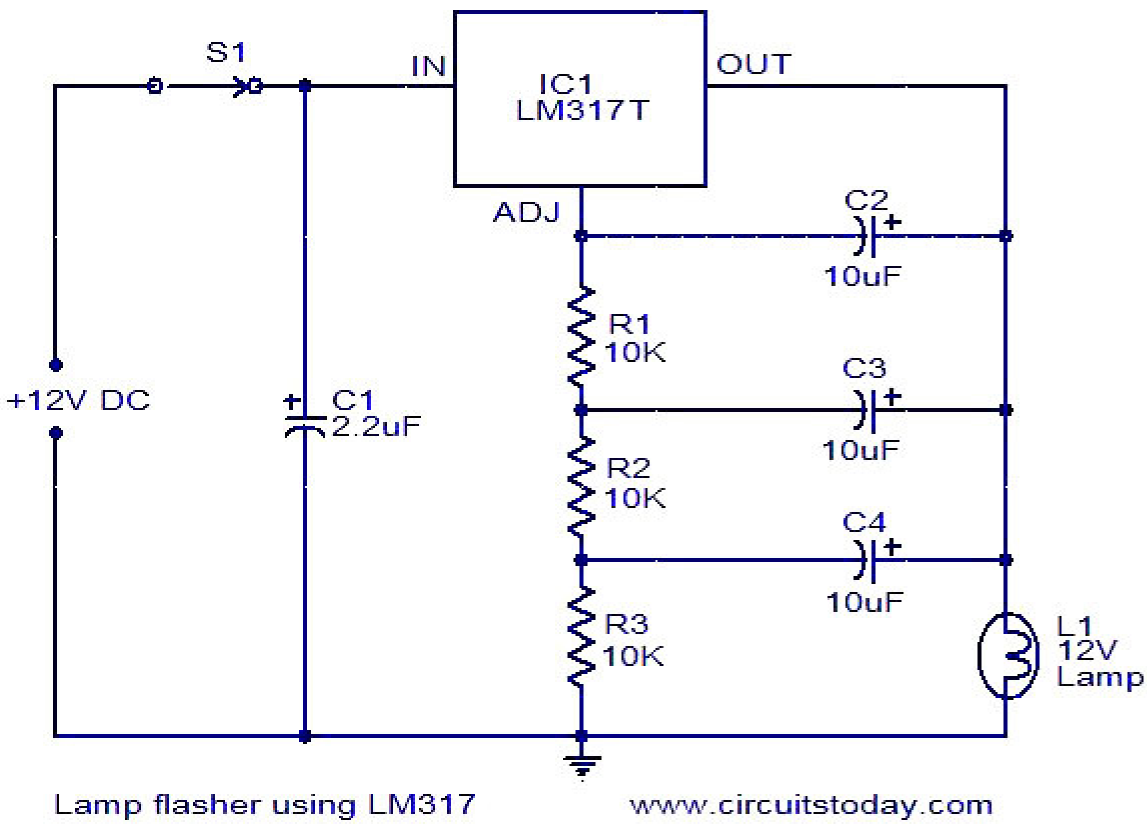
- The circuit can be assembled on a Vero board.
- IC3 must be mounted on a holder.
- The temperature trip point can be set by adjusting POTR2.
- Type no of Q1 and Q2 are not very critical. Any general purpose NPN transistors will do it.

P128. Lamp flasher using LM317

Description.

Here is a very useful lamp flasher circuit using the famous adjustable voltage regulator IC LM317T. LM317 can source up to 1A of current and so up to 12W lamps can be used with this flasher. Such a circuit finds huge application in automobiles. The frequency of the flashing depends on the value of resistors R1 to R3 and capacitors C2 to C4.With the given values; the flashing rate is around 5 flashes per second.

Circuit diagram.



Notes.

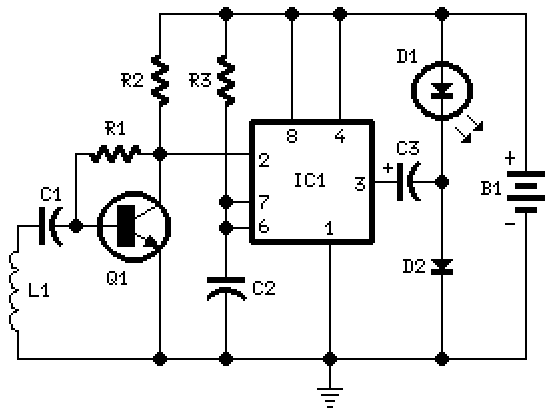
- The circuit can be assembled on a Vero board.
- Use 12V DC for powering the circuit.
- Use a proper heat sink with the IC1.
- Switch S1 can be a ON/OFF switch.

TELEPHONE

P129. Cellular Phone calling Detector

Flashes a LED when detecting an incoming call
Powered by one 1.5V cell

Circuit diagram



Parts:
R1 100K 1/4W Resistor
R2 3K9 1/4W Resistor
R3 1M 1/4W Resistor
C1,C2 100nF 63V Polyester Capacitors
C3 220µF 25V Electrolytic Capacitor
D1 LED Red 10mm. Ultra-bright (see Notes)
D2 1N5819 40V 1A Schottky-barrier Diode (see Notes)
Q1 BC547 45V 100mA NPN Transistor
IC1 7555 or TS555CN CMos Timer IC
L1 Sensor coil (see Notes)
B1 1.5V Battery (AA or AAA cell etc.)

Device purpose:
This circuit was designed to detect when a call is incoming in a cellular phone (even when the calling tone of the device is switched-off) by means of a flashing LED.

The device must be placed a few centimeters from the cellular phone, so its sensor coil L1 can detect the field emitted by the phone receiver during an incoming call.

Circuit operation:
The signal detected by the sensor coil is amplified by transistor Q1 and drives the monostable input pin of IC1. The IC's output voltage is doubled by C2 & D2 in order to drive the high-efficiency ultra-bright LED at a suitable peak-voltage.

Notes:
Stand-by current drawing is less than 200µA, therefore a power on/off switch is unnecessary.
Sensitivity of this circuit depends on the sensor coil type.

L1 can be made by winding 130 to 150 turns of 0.2 mm. enameled wire on a 5 cm. diameter former (e.g. a can). Remove the coil from the former and wind it with insulating tape, thus obtaining a stand-alone coil.

A commercial 10mH miniature inductor, usually sold in the form of a tiny rectangular plastic box, can be used satisfactorily but with lower sensitivity.

IC1 must be a CMos type: only these devices can safely operate at 1.5V supply or less.
Any Schottky-barrier type diode can be used in place of the 1N5819: the BAT46 type is a very good choice.

P130. 8 Line Intercommunication using 89c51

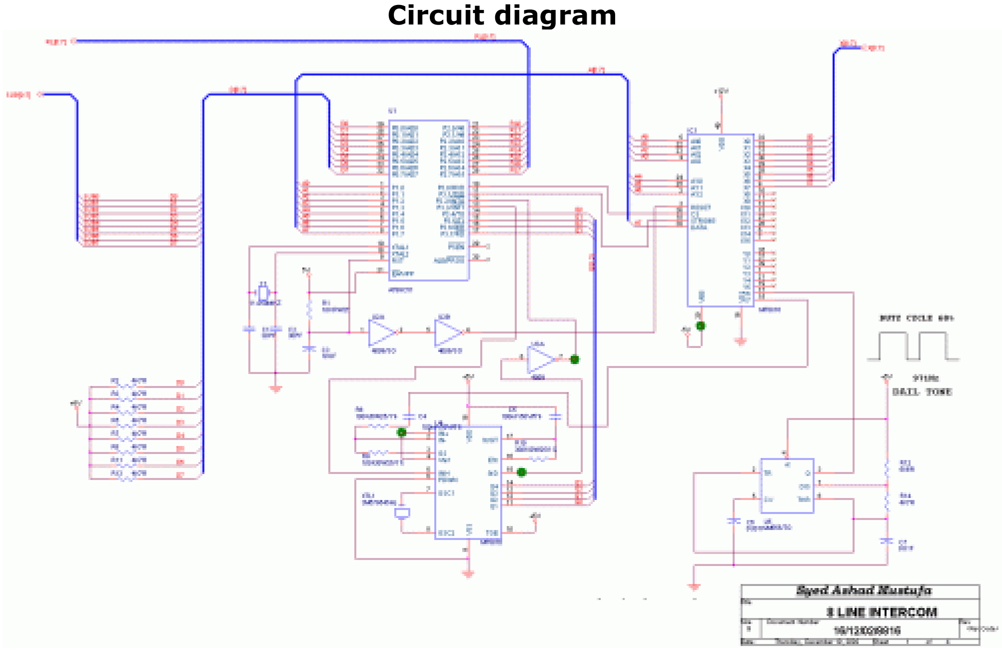
Private branch exchange
This project is aimed to make the low cost intercom system by which eight telephone lines can be interfaced with this hardware.

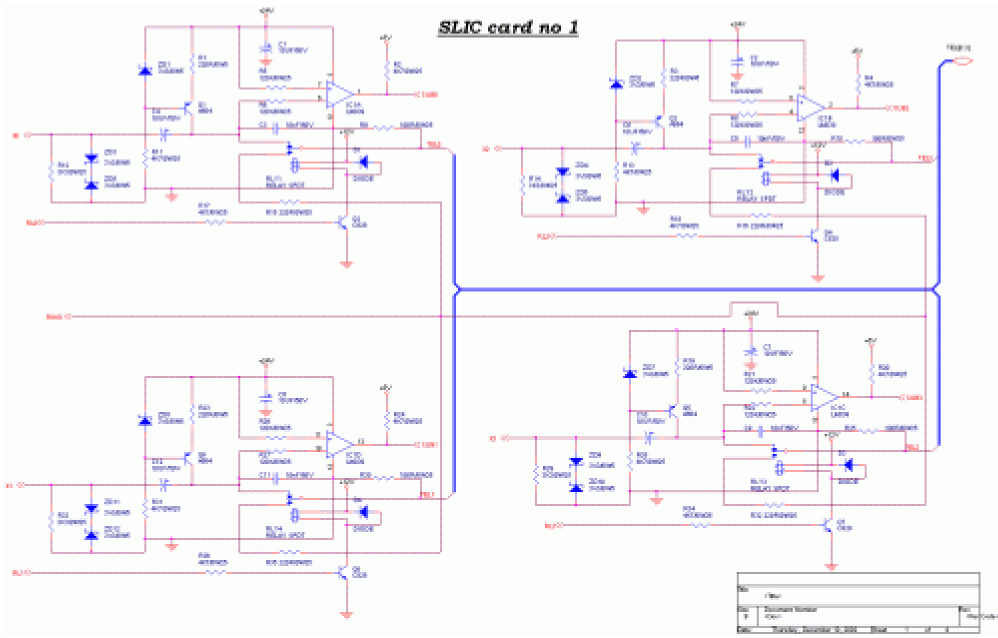
Main card:
In this card there is 89c51 micro controller is used. Micro controller is controller the DTMF encoder MT8870 and the Analog switch MT8816.

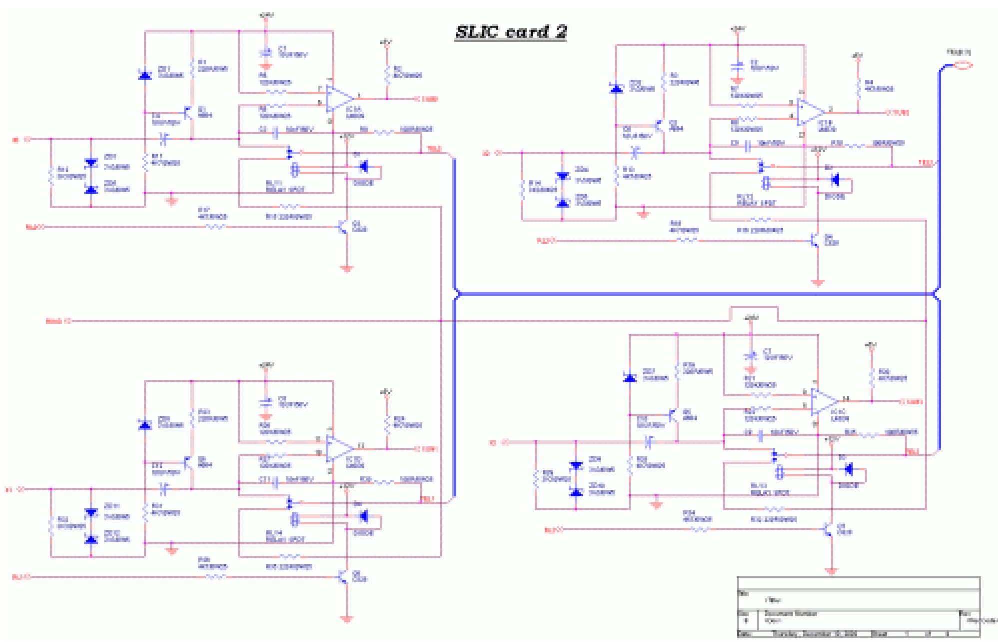
SLIC card:
In this card there is constant current source is used to activate the telephone. The lm339 is used to detect the hand off and hand on condition. There is same circuit are repeated because we have to interface the 8 telephone.

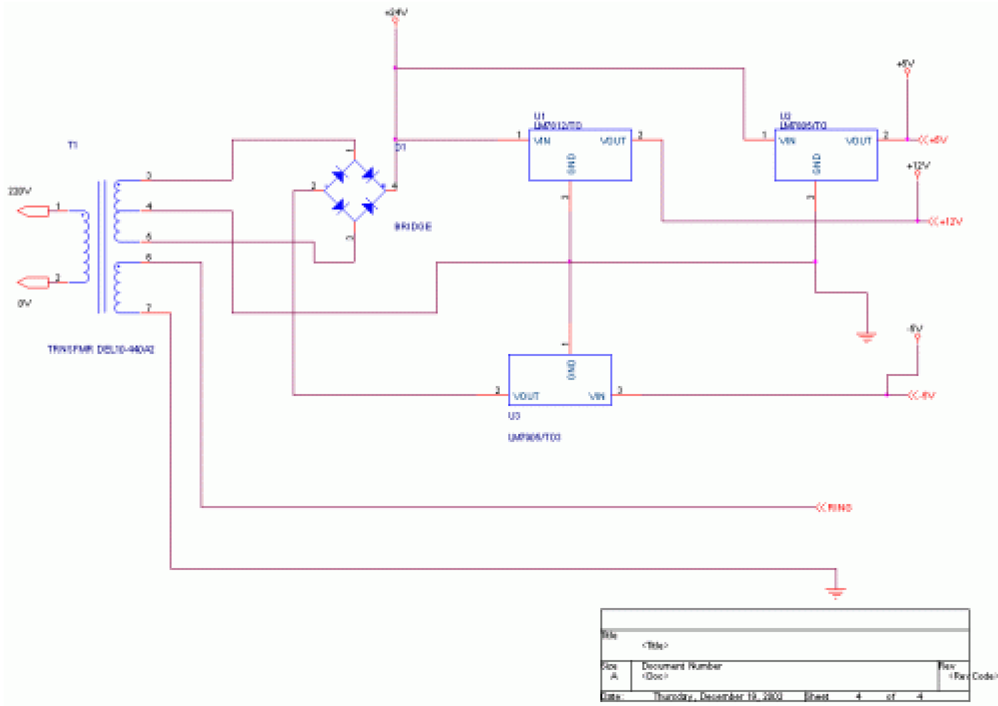
Summary:
When the telephone is hand on the output of the lm339 change, it is detected by micro controller that the telephone is hand on, then micro controller is make the analog switch channel by using the MT8816. the LM555 is used to generate the dial tone.

Circuit diagram



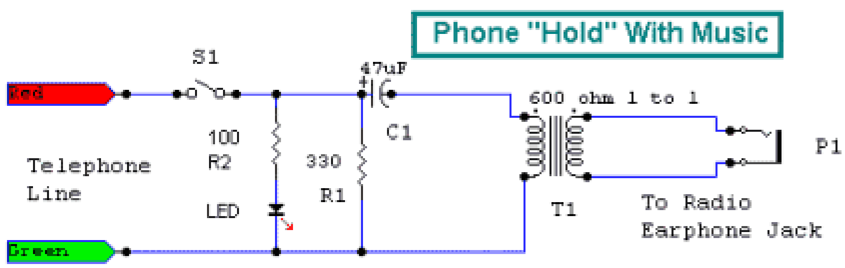

SLIC card no 1


SLIC card 2



P131. Phone "Hold" With Music

Circuit diagram



This circuit will allow you to place a phone call on hold and if you wish to have them listen to music while they are on hold. The circuit operates as follows: The RED wire from the phone jack is typically positive and the GREEN wire is negative or ground. When you want to place a call on hold, close S1 and hang up the handset. The resistor R1 simulates another phone off hook and allows enough

current to pass through to prevent the phone company from disconnecting the call. The resistor R2 and LED provide a visual indication that you have someone on hold (this is optional)

The capacitor C1 and the transformer provide the interface to a radio or CD player headphone jack. Before you hook up the project to the phone line you must determine the polarity of the line. Place a voltmeter across the red and green wires of the telephone line, there should be about 48 volts

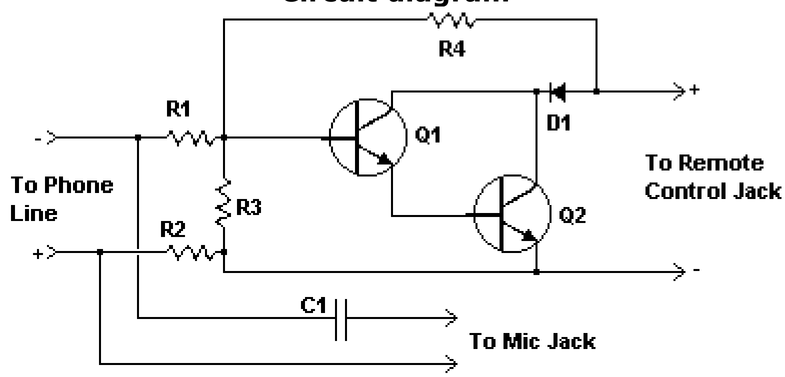
DC positive when the black lead of your meter is connected to the green phone wire. If it is negative 48 volts then reverse the wires.

P132. Telephone line monitor

Telephone Recorder

This nifty little circuit lets you record your phone conversations automatically. The device connects to the phone line, your tape recorder's microphone input, and the recorder's remote control jack. It senses the voltage in the phone line and begins recording when the line drops to 5 volts or less.

Circuit diagram



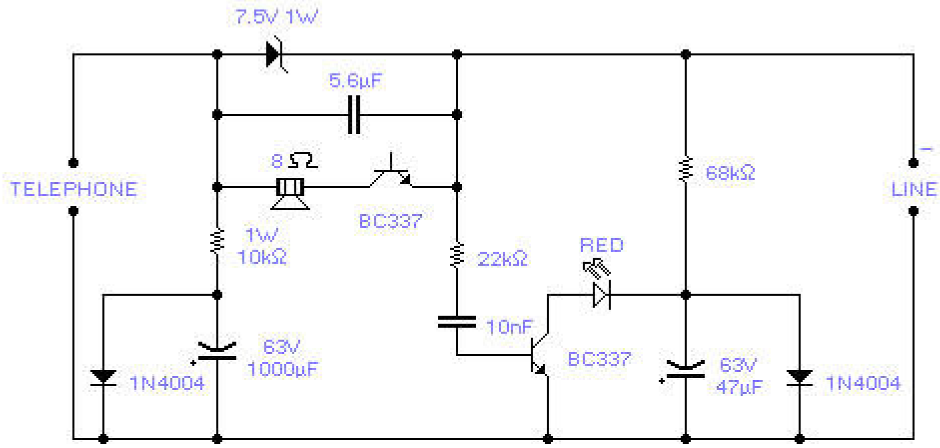
Parts
R1 270K 1/4 W Resistor
R2 1.5K 1/4 W Resistor
R3 68K 1/4 W Resistor
R4 33K 1/4 W Resistor
C1 0.22uF 150 Volt Capacitor
Q1, Q2 2N4954 NPN Transistor
D1 1N645 Diode
MISC Wire, Plugs To Match Jacks On Recorder, Board, Phone Plug

Notes

1. The circuit can be placed anywhere on the phone line, even inside a phone.
2. Some countries or states require you to notify anyone you are talking to that the conversation is being recorded. Most recoders do this with a beep-beep. Also, you may have to get permission from the phone company before you connect anything to their lines.

P133. Telephone line monitor II

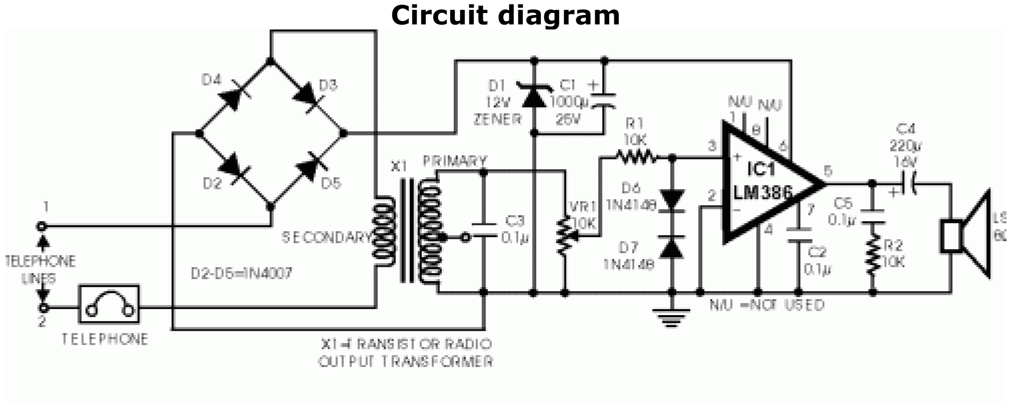
Circuit diagram



If you feel that somebody is tampering with your telephone line you might find this little circuit useful. It detects if there is another telephone connected to the line, if there is a short or an open line. Sound and a flashing light will tell you which is the current situation. The speaker is practically cut out during a normal conversation thus preserving privacy, only the LED will flash occasionally. The circuit does not require any battery and takes the supply from the telephone line itself. The transistors used are wired in a reversed biased fashion thus behaving as oscillators. You might try the 2N2222A as an alternative (not tested). This monitor is, of course, suitable only for analogue lines. Watch the polarity of the input line: the circuit will not be damaged by a polarity reversal but it will not operate correctly.

P134. Telephone amplifier

Circuit diagram



While talking to a distant subscriber on telephone, quite often we feel frustrated when the voice of the distant subscriber is so faint that it is barely intelligible. To overcome the problem, circuit of an inexpensive amplifier is presented here. It can be assembled and tested easily. There is no extra power source needed to power up the circuit, as it draws power from the telephone line itself. The amplifier will provide fairly good volume for the telephone conversation to be properly heard in a living room. A volume control is included to adjust the volume as desired.

The circuit is built around IC LM386. Diodes D6 and D7 are used to limit the input signal strength. Transformer X1 is a transistor radio's output transformer used in reverse. As original secondary (output) winding is connected in series with the telephone lines, the speech signals passing through the lines cause change in the magnetic flux in the core of transformer and thereby induce signal voltage across the primary winding. This audio signal is used as input for IC LM386. Diodes D2 through D5 connected in bridge configuration constitute a polarity guard so that the amplifier is powered with correct polarity, irrespective of the line polarity, Zener diode D1 may have any breakdown voltage between 6 and 12 volts range. e.

There is no need of a separate power switch as the circuit energises (via the normally open contacts of the cradle switch) when one lifts the handset.

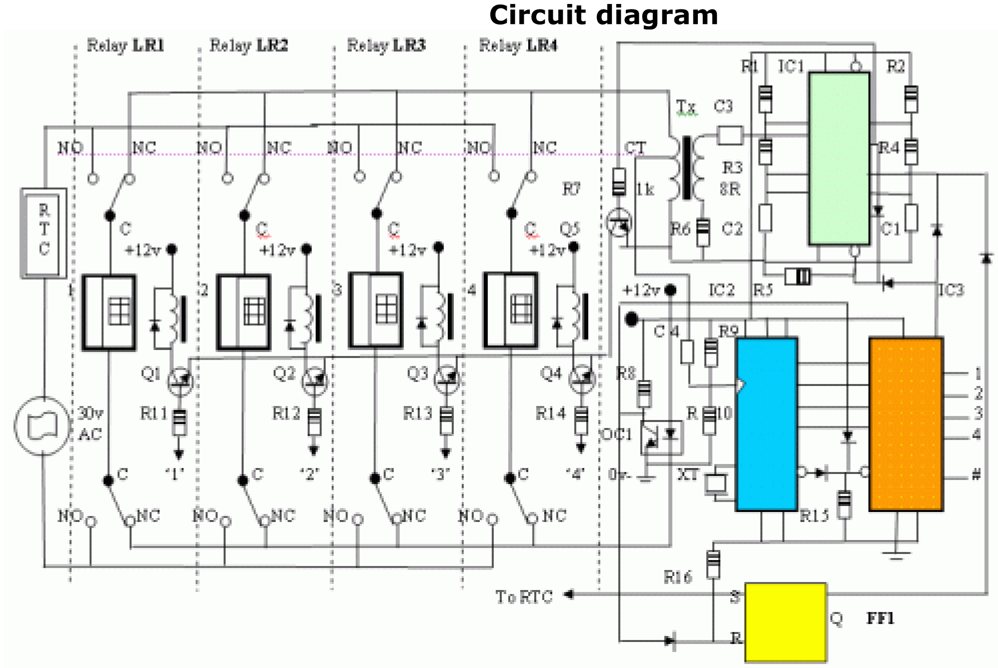
The circuit may be wired on a general-purpose PCB or by etching a PCB for this circuit.
The circuit can be easily tested by connecting a 6 volts supply to line terminals 1 and 2. A hissing sound will be heard from the loudspeaker. Now connect 6V AC from a transformer to terminals 1 and 2 and observe hum in the loudspeaker. The volume of the hum can be changed through potentiometer VR1. Diodes D6 and D7 limit the input below ± 700 mV.

The circuit is to be connected to the telephone lines in series with the telephone instrument, as shown in the figure

P135. The Link 4+0 – Internal Intercom

This version of the Link provides four internal intercom phones with no outside line access.

Circuit diagram



The Link 4+0

This version of the Link is for those who really need a good cheap intercom that will work reliably, but without access to an outside Telco line. This could be in a pre school, a hobby farm or a small workshop or factory, where external phone traffic needs to be kept separate and protected from phone abusers and kids playing around… It follows mainly the principals of the Link pulse dial circuit, but with the modifications and additions of the Link A2B+1 for DTMF dialing.

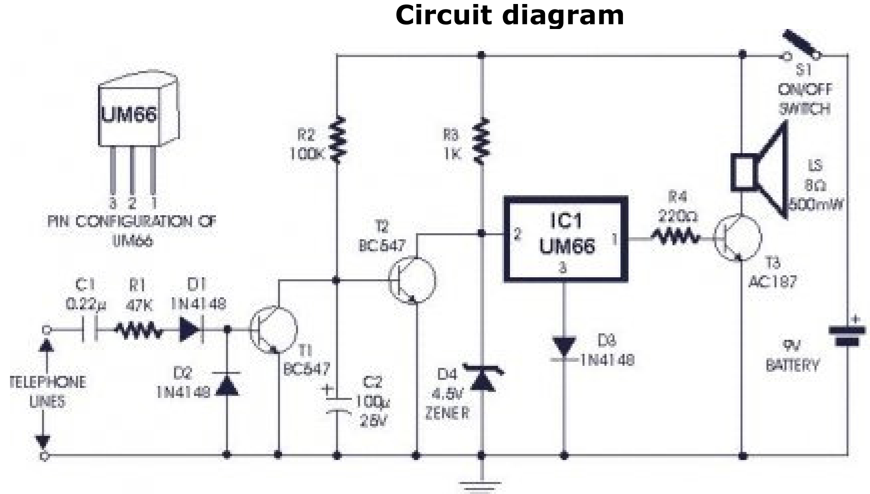
Circuit Explanation

Basically what I've done is remove the OSL relay and the flip flop (FF2) that controlled its activation and release, and added an extra two internal handsets and their associated relays and components. FF1 (as part of the Ring Trip Circuit or RTC) is still there, but is now shown down the bottom of the diagram for simplicity's sake. Internal wiring for the RTR relay is as per the Link A2B circuit. When any phone is picked up off hook and a number from 1 to 4 on the keypad is pressed, the DTMF decoder chip (IC2) decodes this into IC3 (1 x 16 decoder) and the output of IC3 is then fed to the appropriate base resistor of Q1 to Q4 (R11 through R14).

Pin 11 of IC3 goes low, removing the high from pins 12 and 8 of IC1 and impulsing of the selected line relay (LR1 to LR4) begins, via driver transistor Q5 and the appropriate buffer transistor (Q1 to Q4). When the called party answers the call, the RTC circuit 'trips' the ring current, impulsing along with the ring tone is halted, and the conversation can proceed. When the conversation is completed and both phones are hung up, the collector of OC1's phototransistor goes high and resets both FF1 and IC3. Pin 11 of IC3 goes high again, halting the impulsing action of IC1 but providing dial tone from pin 5 in the reset state, ready for the next call. One extra nifty little feature involves the # output (pin 14 of IC3). If you connect this to the set (S) input of FF1, you can halt the ringer if someone calls your extension while you're away. You can pick up another extension anywhere else and press the # key and effectively 'pick up' the call. This feature prevents the other phone from continuing to ring and also halts the ring tone from overpowering your conversation. In principal, it follows very closely the features of the Link pulse dialing version, except that there's only a two wire circuit between each handset and the 'black box' switcher. In reality, tone dialing is more efficient, and you could easily use some of the other unused outputs of IC3 for remote control purposes (turning on sprinklers or low voltage garden lights, door entry systems etc.)

P136. Soft Musical Telephone Ringer

Circuit diagram



The normal telephone bell, at times (specially during night when one does not want to be disturbed), appears to be quite irritating. The circuit shown here converts the loud sounding bell into a soft and pleasing musical tone.

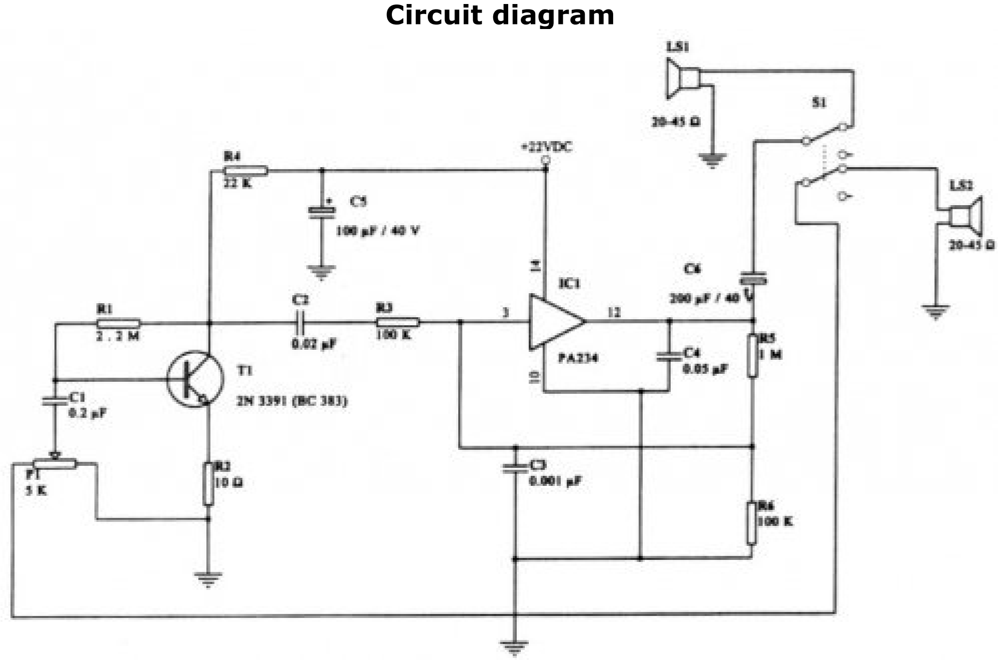
The incoming ring is detected by transistor T1 and components wired around it. In absence of ringing voltage, transistor T1 is cut off while transistor T2 is forward biased as resistor R2 is returned to the positive supply rails. As a result collector of transistor T2 is at near-ground potential and hence IC1 (UM66) is off. Also capacitor C2 is charged to a slightly positive potential.

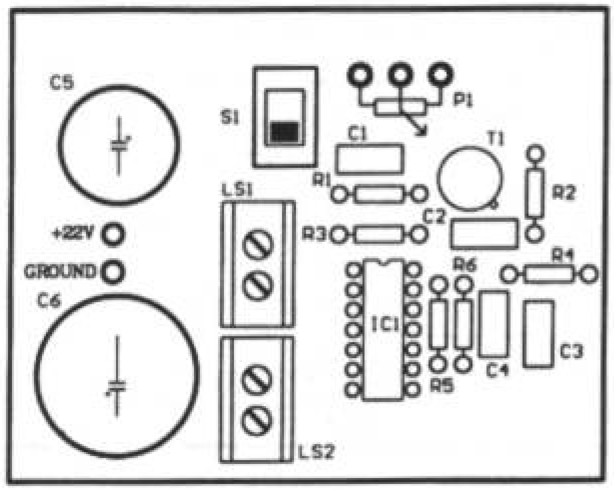
During positive half of the ringing voltage, diode D1 forward biases transistor T1 and rapidly discharges capacitor C2 to near ground potential and cuts off transistor T2 which, in turn, causes IC1 to be forward biased and music signal is applied to base of transistor T3 which drives the speaker. During negative half of the ringing voltage, capacitor C2 cannot charge rapidly via resistor R2 and hence transistor T2 remains cut off during the ringing interval. Thus the soft musical note into the loudspeaker sounds in synchronism with the ringing signal. When handset is lifted off the cradle, the ringing voltage is no more available and hence the soft musical note switches off.

P137. Intercommunication (Intercom)

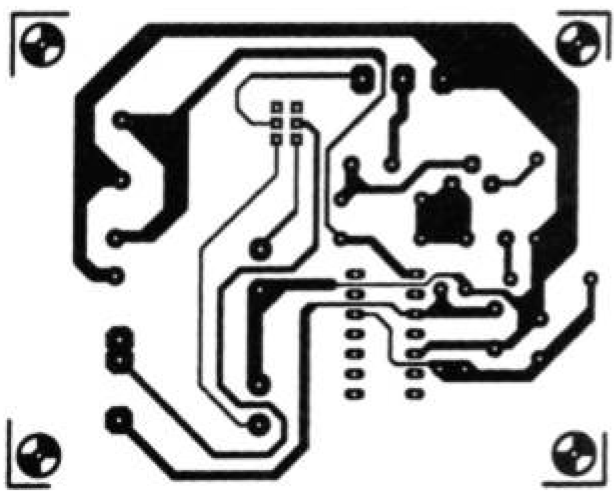
This is a great intercom circuit that can be used in many ways. It uses 22V to operate and maybe it will work at a lower voltage (you can try it). For input/output it uses a loundspeaker (20-45 Ohm) on each side.

Circuit diagram



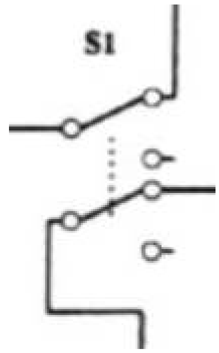


Componets Layout



PCB

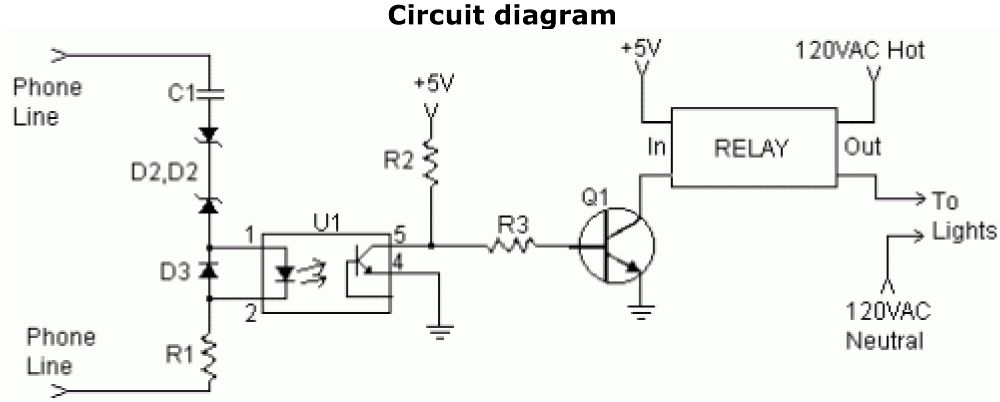
Parts
R1: 2,2 M
R2: 10 Ohm
R3,R6: 100K
R4: 22K
R5: 1M
C1: 0,2uF
C2: 0,02uF
C3: 0,001uF
C4: 0,05uF
C5: 100uF/40V
C6: 200uF/40V
IC1: PA234
LS1,2: 20-45 Ohm
T1: 2N3391 (BC383)
P1: 5K
S1: SW-DPDT *



See here how the SW should be. See also the large theoritical image.

P138. Ringing Phone Light Flasher

Circuit diagram



Parts:
C1 0.47uF 250V Capacitor
R1, R2 10K 1/4 W Resistor
R3 1K 1/4W Resistor
D1, D2 20V 1/4W Zener Diode
D3 1N4148 Diode
Q1 2N3904 NPN Transistor or 2N2222
U1 4N27 Opto Isolator
RELAY Solid State Or Regular Relay (See Notes)
MISC Case, Wire, Board

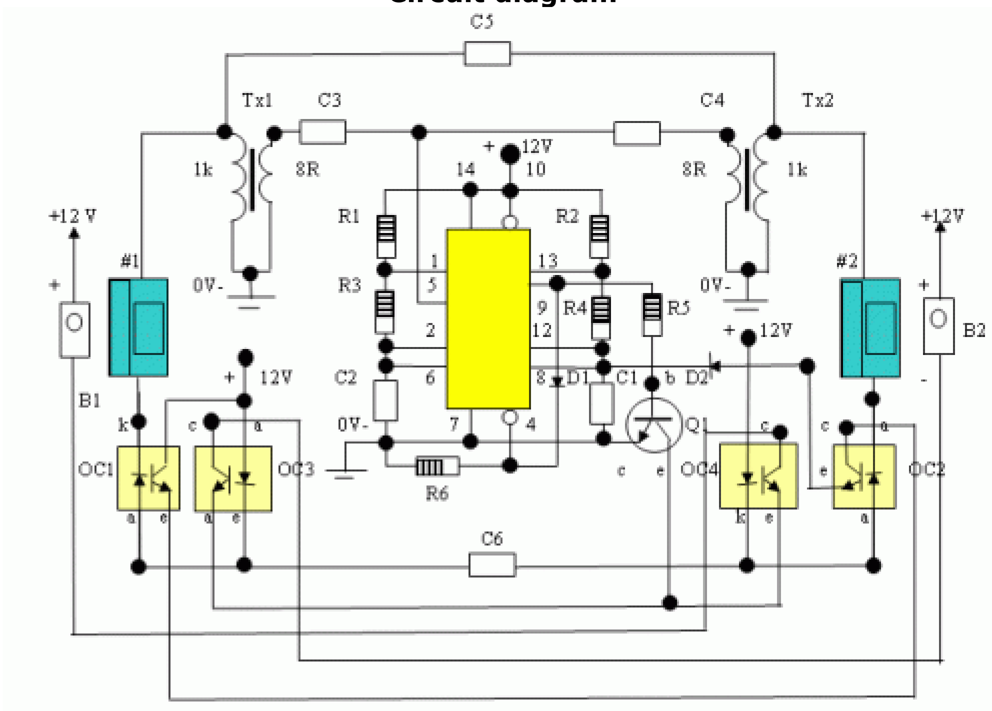
Notes:
1. You may need to use a lower voltage zener for D1 and D2.
2. You can use a regular relay instead of a solid state relay, but the arcing accross the contacts may destroy it pretty quickly.

3. Be very sure that you have not accidentally connected 120V to the phone line when building and installing this circuit.

P139. The Original 2 Phone Link Design

This is the circuit that sparked off all the other Link Telephone Intercom designs. Originally designed back in 1996 with heavy duty relays and their contact banks, it was updated late last year with the addition of IC1 in place of a simpler transistor multivibrator, the replacement of all relays and contact banks with optocouplers, and the addition of the two transformers as part of the transmission bridge (see explanation below) which was comprised partly of the relay coils. If you just want simple 'no frills' communication from one phone to another, then this is the right circuit for you! This version is much more compact, more economic on power drain (yes, you can run it off of batteries – eg: a 12 volt Gel Cell!) and has no moving parts, except for the switch hooks inside each of the phone handsets.

Circuit diagram



Circuit Description

This was one of the earliest Link designs. It works by either caller simply picking up their handset and 'buzzing' the other phone. There are no numbers to dial (in fact, no dial tone either – just ring tone, which pulses on and off in unison with the buzzer at either end when a call is in progress.) Let's assume that #1 picks up their handset. This forms a DC loop between the handset, the 1k winding of Tx1, the 0v_ earth terminal, the +12 volts terminal and the leds inside OC1 and OC3.

IC1 (an NE556 dual timer chip) is always 'on' –that is, it's always pulsing on and off at output pin 9, which then drives the second half of the timer chip on and off via D1 to pin 4, producing ring pulses, and ring tone from pin 5 via C3 and C4 to the 8R windings of Tx1 and Tx2. The transistor inside OC1 switches on hard, taking its collector lead low, and ring pulses are fed from pin 9 of IC1 via R5 and Q1, to the emitter of OC1, through to its collector lead, and then on to the –ve lead of buzzer B2, thus 'buzzing' the other phone.

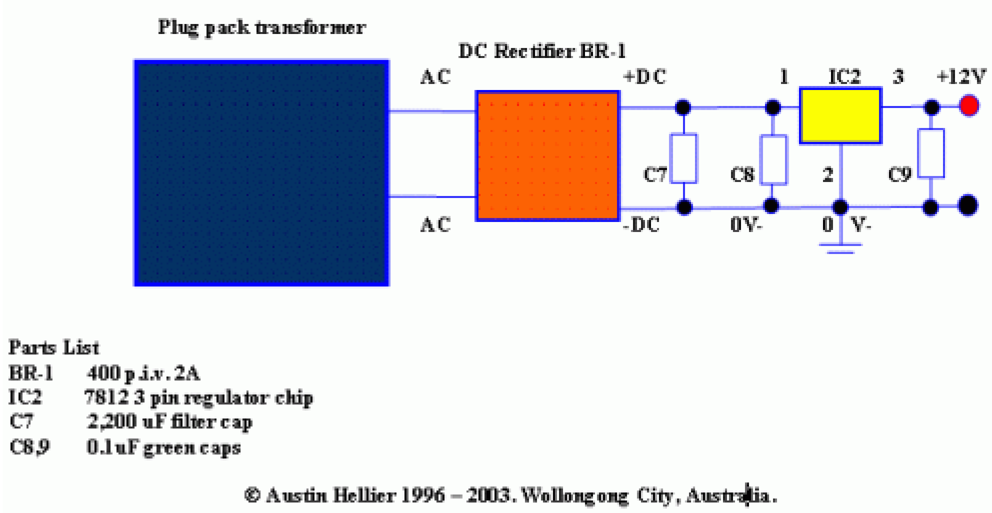
When that phone is picked up off hook, OC2 and OC4 also form a DC loop along with the 1k winding of Tx2 and the leds inside the optocouplers. The transistors inside OC1 and OC2 now form a 'link' (no pun intended) from the +12 volts supply (shown at left near phone #1) through to the junction of pins 12 and 8 of IC1, via diode D2. This effectively halts the ringer, and both ring pulses from pin 9 and ring tone from pin 5 cease for the duration of the call.

When both phones are hung up back to the on hook position, all four optocouplers (OC1 to OC4) are switched off. IC1 will now resume pulsing and providing ring tone, but neither one of these outputs will have any effect on either phone handset, until one or the other is picked up off hook again, to make the next call. The 'transmission bridge' mentioned earlier, comprises of Tx1 and OC3 along with Tx2 and OC4, as well as C5 and C6. Basically, the 1k windings prevent speech signals (which are an AC signal) from being grounded through the earth connection. The two capacitors allow these signals to pass between the handsets, but block any DC voltages from interfering with them. This circuit is known as a "Stone Transmission Bridge" and although I have employed a simplified version of it, it's quite suitable for our purposes. Happy chatting on the line… ©Austin Hellier 1996 - 2003. 

Parts
R1 10k
R2 4k7
R3 100k
R4 100k
R5 4k7
R6 4k7
C1 22uF
C2 .022uF
C3 1uf
C4 1uF
C5 2u2
C6 2u2
D1,2 1N4148 or 1N 914
Q1 BC 547 (NPN small signal transistor) or equivalent
IC1 NE 556 dual timer chip
OC1-4 4N25 or 4N28 optocouplers
Tx1,2 1k/8R matching transformers
B1,2 9 volt DC buzzers

Miscellaneous Two phone handsets (preferably the same make and model – stay away from plastic one piece 'cheapies' Plug pack power supply (see diagram below) 15 volts DC at 200 mA output. Wire, solder, pc or prototyping matrix board, four wire cable, phone connectors, etc.

Power Supply Circuit



P140.

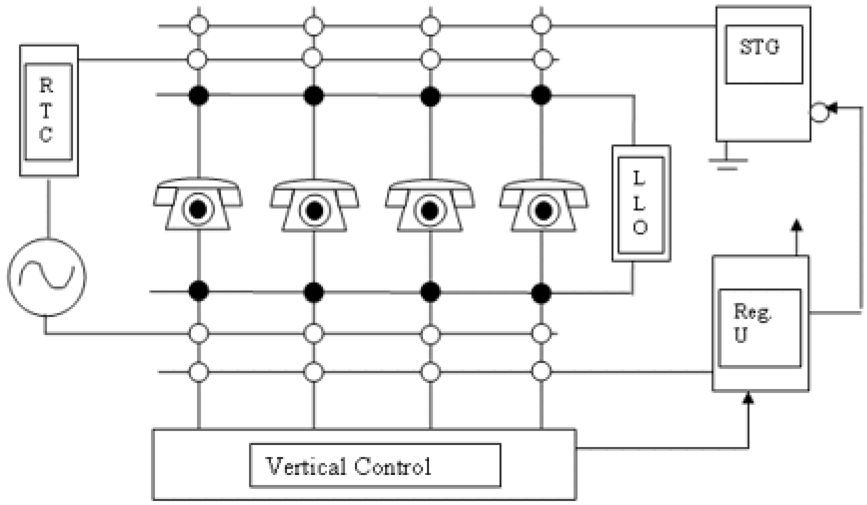
The Link "P" - Privacy Link! (Telephone Intercom)

Yes folks, it's time for another horse to bolt from the Downunder stable of telephone intercoms (unfortunately before the gate could be shut on it...) and other zany electronics type ideas. The circuit you are about to see is the culmination of some effort at improving the basic Link intercom design. You may think that pulse dialing is 'old hat' nowadays, but the exercise of building and testing the Link 'P' in this format, and understanding how it all works, is well worth the effort. Not to mention all those out there who have the old style rotary dial phones as collectables - you can now make them work for you, or display them actually working with confidence.

Counting, pulsing, timing and simple logic circuits are at the heart of this design, as with all other 'Link' versions. In a day where PIC controllers are popping up in electronics magazines by the dozen (about half the projects in some magazines now contain a PIC chipset,) I feel that we could be losing the art of designing in simple 'hard wired' logic, and thus this approach is used partly for educational purposes. Many readers who may decide to build up the Link 'P' will 'see the logic' (pardon the pun) after they have a working model servicing their home, small workshop, factory, preschool or other application. Besides, there's an easy upgrade to Tone Dialing if you really want it anyway... Happy switching! AH Downunder.

The New 'Link P' - Privacy Link

This version of the Link goes beyond anything previously attempted by me in the area of telephone type projects. Having achieved genuine ring trip I'm now heading down the track for 'two calls at the same time (either two internal calls, or one internal and one external on the outside line - providing it's legal in your state/country of origin...) but several things have to be achieved first.

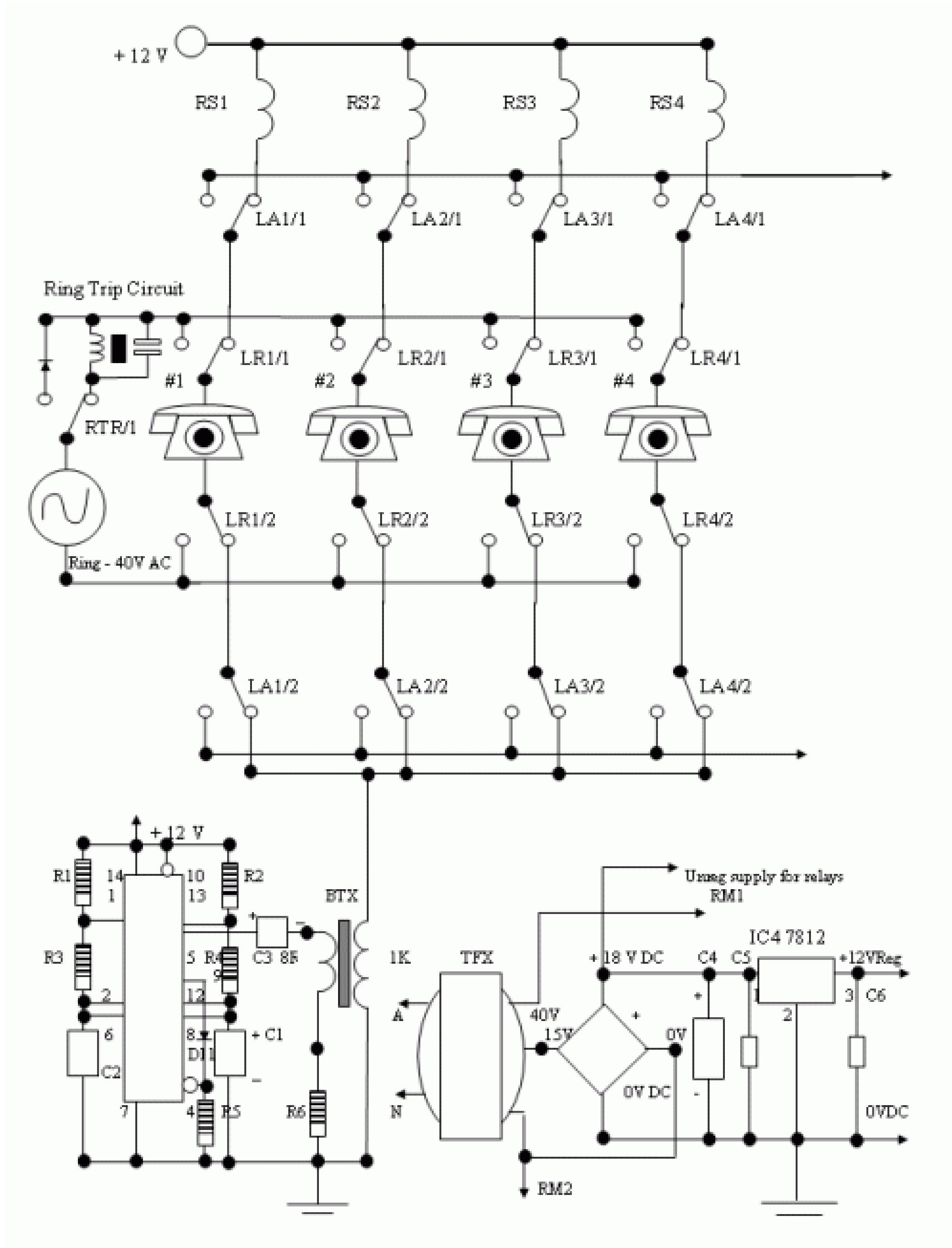


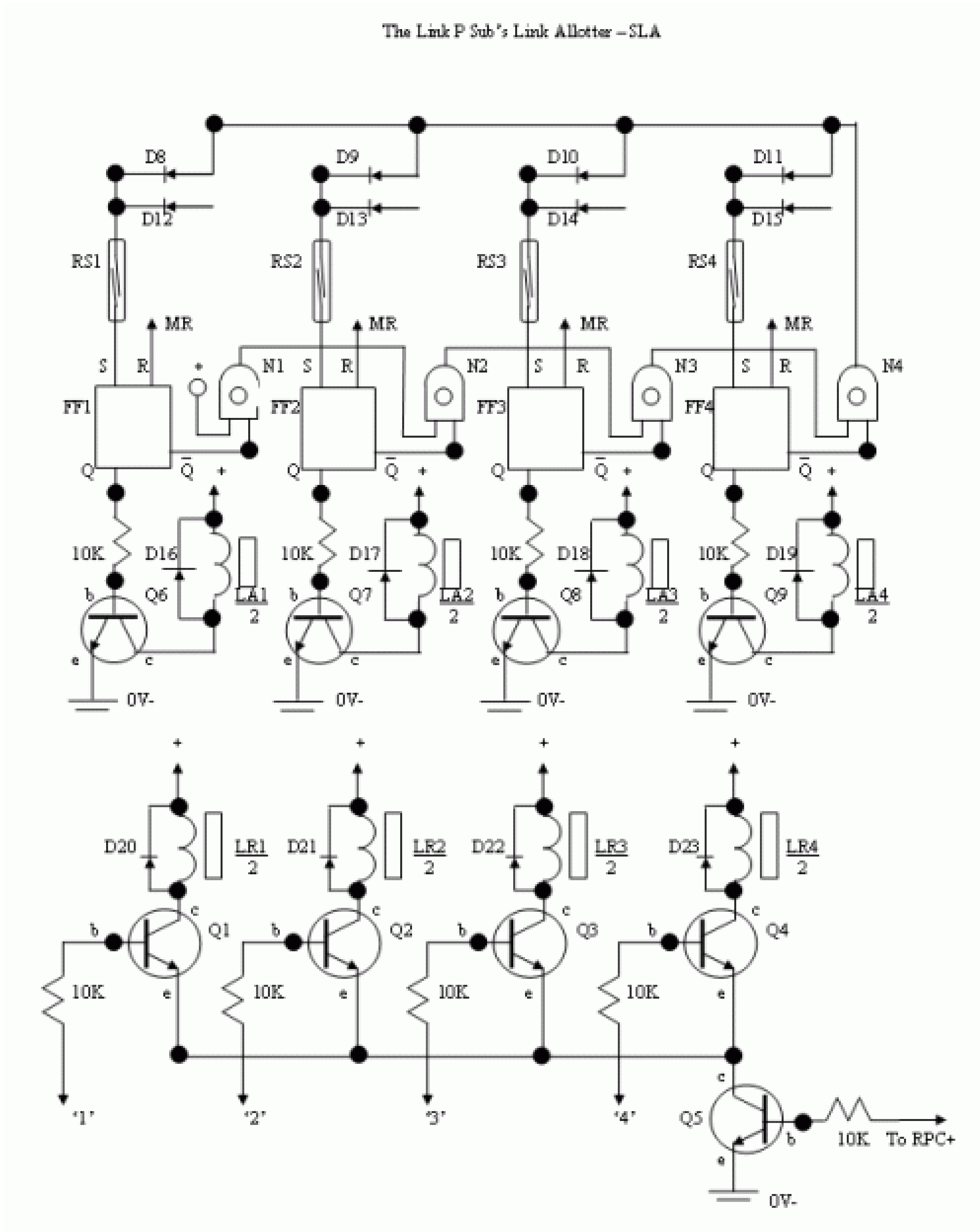
The Link 'P' Block Diagram

In order to achieve a status between two levels of switching for two calls at the same time, you must first establish privacy on each call. Otherwise, you will end up with all four phones talking to each other, and that just won't do. So the Link 'P' is an intermediate stage between the basic Link design, and the fully blown one (yet to be realized, but not that far away,) with all the 'bells and whistles' features. In the diagram above, you can see in block format, how this is achieved. The RTC (Ring Trip Circuit,) Reg. U (Register, which acts like an old style Uniselector,) and the STG (Service Tone Generator,) are all part of the basic Link design. However, I've added in two new 'blocks' of circuitry, and these are LLO (Line Lock Out, which provides busy tone back to callers who can't access the Link to make a call,) and Vertical Control (which governs who can and can't make a call - simple logic circuitry to determine who's first in and best dressed!) The relay switching matrix is akin to a simplified 'crossbar (XBAR) system.

There is a full circuit diagram spread over several pages later on in this article, which gives the details for connections and components for all four phones, and I will refer to these a little later on, but we'll just stick with the block diagram for now. When a phone is picked up 'off hook' in the basic Link, it receives dial tone from the STG, and then the caller proceeds to dial a one digit number into the Register. This arrangement works well, except for those occasions when someone else picks their phone up 'off hook' at the same time, and tries to dial a number too. The Link 'P' upgrade avoids this situation, by enabling only one phone in the 'off hook' state for the purposes of making a call, and if you are the first one to do so, you will be connected to the Reg. U and the STG. Any other caller will remain on Line Lock Out (LLO) and will receive Busy Tone, to indicate that the Link is busy with a call. You can then dial any one of the other three phones, and the call will progress as per normal with the Link type circuitry.

The called party's phone will ring at around one ring per second (real 40 Volt AC ring this time, no more buzzers,) and when the called party picks their phone up 'off hook' to answer the call the RTC circuit will trip the ring, and they too, will be connected to the same level of the Link 'P' as the caller. Thus privacy will be maintained on all calls, and all other phones who are excluded from any particular call will receive a 'busy' signal, indicating that they need to try again a little later on.


+ 12 V
RS1
RS2
RS3
RS4
LA1/1
LA 2/1
LA 3/1
LA 4/1
Ring Trip Circuit
LR1/1
LR2/1
LR3/1
LR4/1
#1
#2
#3
#4
RTR/1
LR1/2
LR2/2
LR3/2
LR4/2
Ring - 40V AC
LA1/2
LA 2/2
LA3/2
LA 4/2
+ 12 V
R1
R2
R3
R4
R5
R6
C1
C2
C3
D11
BTX
1K
TFX
A
N
40V
15V
+ 18 V DC
0V
0V DC
C4
C5
C6
IC4 7812
+12VReg
0VDC
Using supply for relays
RM1
RM2



Why Not A PIC Controller?

Never say never, is the old saying, and I can see the day coming when there are two Link 'P' circuits joined together, and switching calls between the LLO and the 'P' levels of the Link, so that two calls at the same time can occur. This will be a more likely task for a PIC type controller, but as you can see, the more features you add, the more complex and costly the link becomes. But at the end of the day, you will end up with a worthwhile project that will serve you well for many years, with just this current upgrade, if that's what you want.

Why stick with relays when an electronic switch can be bought, virtually on the one chip? For starters, they're expensive (between $60 and $80 for a commercial chip) and secondly they require address decoding, which is best done by a PIC anyway. Admittedly, relays are expensive to buy, but then again, a lot of hobbyists and technicians have a 'relay drawer' as part of their spare parts on the workbench, and the Link 'P' can be built up with just about any assortment of DPDT !2 volt relays (I know, my current model uses nine relays - originally half of them were of the larger 'heavy duty variety, with the other half being of the DIL mini variety - the Link worked just as well, but the larger ones do cost some room on the SK-10 prototyping boards, and suck a bit more current when in operation.)

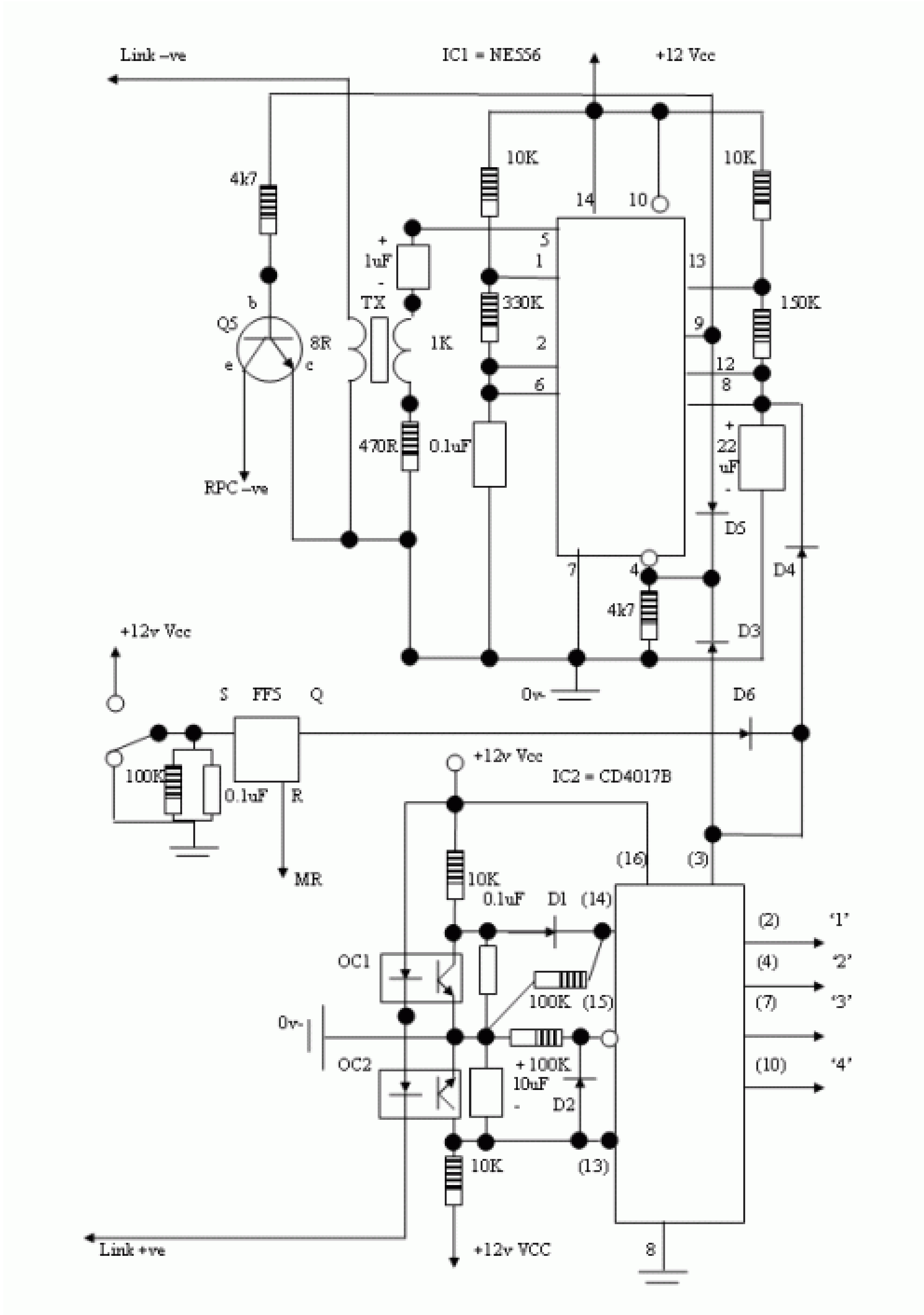
The electronic type of switching chips are basically an addressable array of SCR's, (triacs) and maybe we'll locate a cheaper version for an upgrade at a later date, but for now, simple line relays will have to do.

Switching a Call on the Link 'P' Version

See diagrams further down from here on. Each line circuit consists of a Line Relay (LR1 to LR4) a Link Access relay (LA1 to LA4) a flip flop (one half of a CD 4013B per line) and a line optocoupler (OC1 to OC4 - a 4N25 or equivalent) two diodes, two resistors and two transistors, and of course, each individual phone handset. Note that the original version of the Link 'P' had reed switches installed where the optocouplers now are, and this arrangement worked quite well. The optocouplers are not as robust (that's why I call them 'poptocouplers'!!!) but are more economical on current drain.

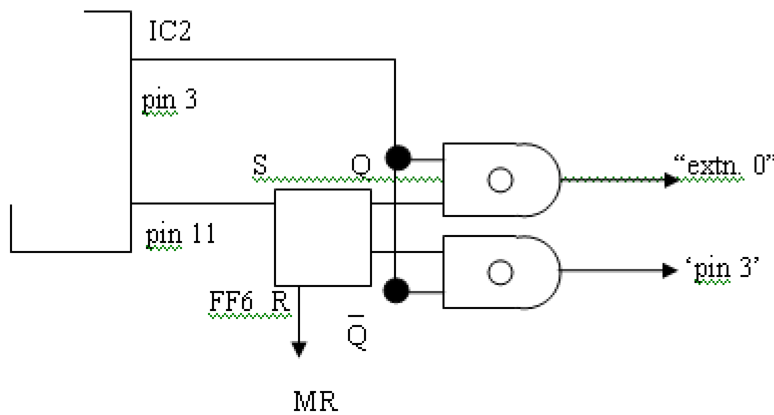
There are two methods of detecting a pickup of a phone into its 'off hook' status. The first is a simpler version, requiring no 'scanner' circuitry, and I will describe this briefly first. With all four phones in their 'on hook' status (ie: hung up) all Q bar outputs of each individual flip flop are at logic high. Each of these outputs is monitored by an AND gate daisy chain, so that with all four outputs remaining high, the output of the last of the four AND gates will be a logic high too. This logical outcome also appears on the collector lead of each line optocoupler (OC1 to OC4). When a caller picks up their phone off hook, they form a DC loop from +Vcc down through the LED of their line optocoupler, through the contacts of their LR and LA line relay contacts, through the phone handset, and down to ground via the 1K winding of transformer, BTX. The LED lights up and switches the internal phototransistor hard on, which then allows that line flip flop (FF1 to FF4) to operate their LA relay set, and this in turn, switches them to the dialing and service tone generation part of the Link 'P'.

At the same time, the AND gate daisy chain 'sees' the chain broken by one of the four Q bar outputs going low, as the flip flop changes state, and this 'breaks the chain' thus making the output of the last AND gate in the chain change to a logic low. This output at logic low, allows none of the other three phones to pick up 'off hook' and enable their LA relays. They cannot now gain access to the dial up level of the Link, unless they are the 'called party' whose number the caller will now dial into the REG U Register device (IC2.) Dial pulses are received via OC5 into IC2 pin 14, and the Link then operates as per normal. Pin 3 of IC2 goes low, allowing C1 to charge up and produce Ring Pulses out of pin 9. This also enables IC1a to produce an interrupted Ring Tone into the 8R winding of TX via C3 and R6, coupling this signal to the calling party's phone. When both parties have hung up back to the 'on hook' status, the link P will reset itself due to capacitor C5 charging up, after the dialing loop has been broken, the two LEDS inside OC1 and OC2 have extinguished, and the two phototransistors have switched off. The positive going pulse is sent to pin 15 of IC2 via diode D2, and to all four flip flop reset pins, so that the link P will be reset and waiting for the next call.



Advanced Link 'P' Circuitry

You can have up to ten phones connected to the Link 'P' version. Now wait a minute, there's only nine viable outputs on the 4017 decade counter (IC2). That's true, but by adding another flip flop and two AND gates, extension "0" can be realized. If you dial a 0 normally, the decade counter chip fully cycles from pin 3 through pins 2, 4, 7, 10, then 1, 5, 6, 9 and 11 and then back to pin 3. If you wire the extra circuit as shown below, then when you dial a '0' (zero) the flip flop will 'set' on the 9th pulse (pin 11 of IC2) switch in the extra AND gate, so that pin 3 AND the Q output of FF6 will form extension '0'. This would then be connected to a base resistor for a driver transistor, that would pulse relay LR10 on and off. Also don't forget the addition of RS10 and LA10 and all other associated line circuit components. The flip flop resets along with all other flip flops (FF1 to FF5) on Link reset from the master reset line (MR) with both phones on the call hanging up.

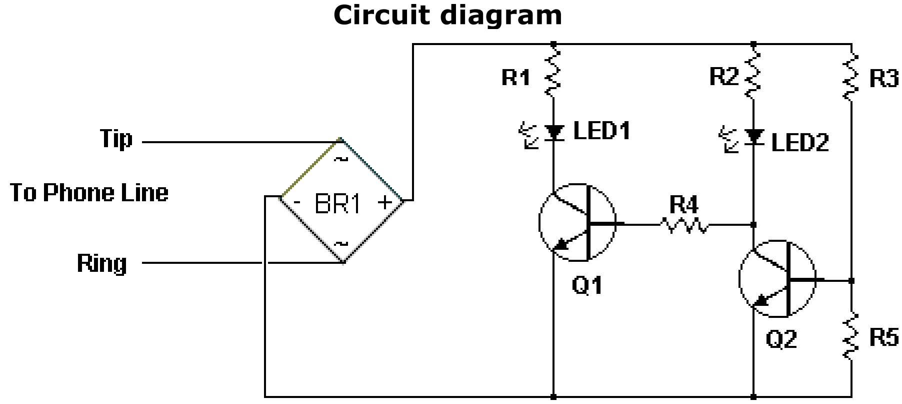


P141. Phone Busy Indicator

This circuit may cause problems for some when used. You may want to build a different circuit.

Have you ever been using the modem or fax and someone else picks up the phone, breaking the connection? Well, this simple circuit should put an end to that. It signals that the phone is in use by lighting a red LED. When the phone is not in use, a green LED is lit. It needs no external power and can be connected anywhere on the phone line, even mounted inside the phone.

Circuit diagram



Parts:
R1 3.3K 1/4 W Resistor
R2 33K 1/4 W Resistor
R3 56K 1/4 W Resistor
R4 22K 1/4 W Resistor
R5 4.7K 1/4 W Resistor
Q1, Q2 2N3392 NPN Transistor
BR1 1.5 Amp 250 PIV Bridge Rectifier
LED1 Red LED

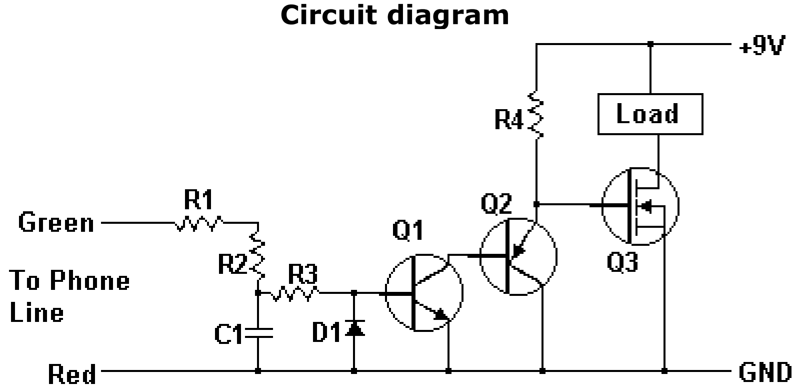
LED2 Green LED
MISC Wire, Case, Phone Cord

Notes:
1. This is a very simple circuit and is easily made on a perf board and mounted inside the phone.
2. LED1 and LED2 flash on and off while the phone is ringing.
3. Do not worry about mixing up the Tip and Ring connections.
4. The ring voltage on a phone line is anywhere from 90 to 130 volts. Make sure no one calls while you are making the line connections or you'll know it. :-)
5. In some countries or states you will have to ask the phone company before you connect this to the line. It might even require an inspection.
6. If the circuit causes distortion on the phone line, connect a 680 ohm resistor in between one of the incoming line wires and the bridge rectifier.

P142. Cut Phone Line Detector

A while ago I got an email asking for the schematic of a circuit to detect cut phone lines. It didn't take me long to find this circuit in Electronics Now. When the circuit detects that a phone line has been cut, it activates a MOSFET which can be used to drive a relay, motor, etc. It can also be connected to a security system.

Circuit diagram



Parts
R1, R2, R3 22 Meg 1/4 W Resistor
R4 2.2 Meg 1/4 W Resistor
C1 0.47uF 250V Mylar Capicitor
Q1 2N3904 Transistor or 2N2222
Q2 2N3906 Transistor
Q3 IRF510 Power MOSFET
D1 1N914 Diode
Load See "Notes"
MISC Wire, Phone Connectors, Circiut Board

Notes
1. The "Load" can be a relay, lamp, motor, etc. The circuit can also be connected to a security system to sound an alarm in case the phone line is cut.

2. If the circuit is connected to a security system or other circuit, both circuits must be electrically isolated from each other using an opto-isolator, relay, etc. This also means that the Cut Phone Line Detector must be powered by a seperate 9V supply.

P143.

The Link A2B+1 (the Link Telephone Intercom - DTMF version)

The Link A2B+1 – Explanation

Since the recent publication of 'The Link Telephone Intercom' on the net, a number of email requests have come in asking for a DTMF version, with 2 or more phones that can in fact access an outside line. So, back to the 'drawing board' (read: PC screen) I went, and what you see above (somewhat more complicated, but nevertheless extremely reliable design) is the result of some ten hours of designing, building and testing not one, but two identical Link circuits. The original DTMF version is now set up between my bed sitter unit at the back of my shop – extension #1, and my elderly next door neighbour, who lives in the unit behind the shop – extension #2. It is proving very handy and although my outside line is not connected to that version at this stage, initial tests proved that both making and receiving calls works perfectly… Important Note: All chips run off a +5 V regulator and all relays and telephone handsets run off a +12 V regulator!!! DO NOT screw this one up – or you'll be having Kentucky Fried Chips for dinner…

Tone Dialling – At Last!

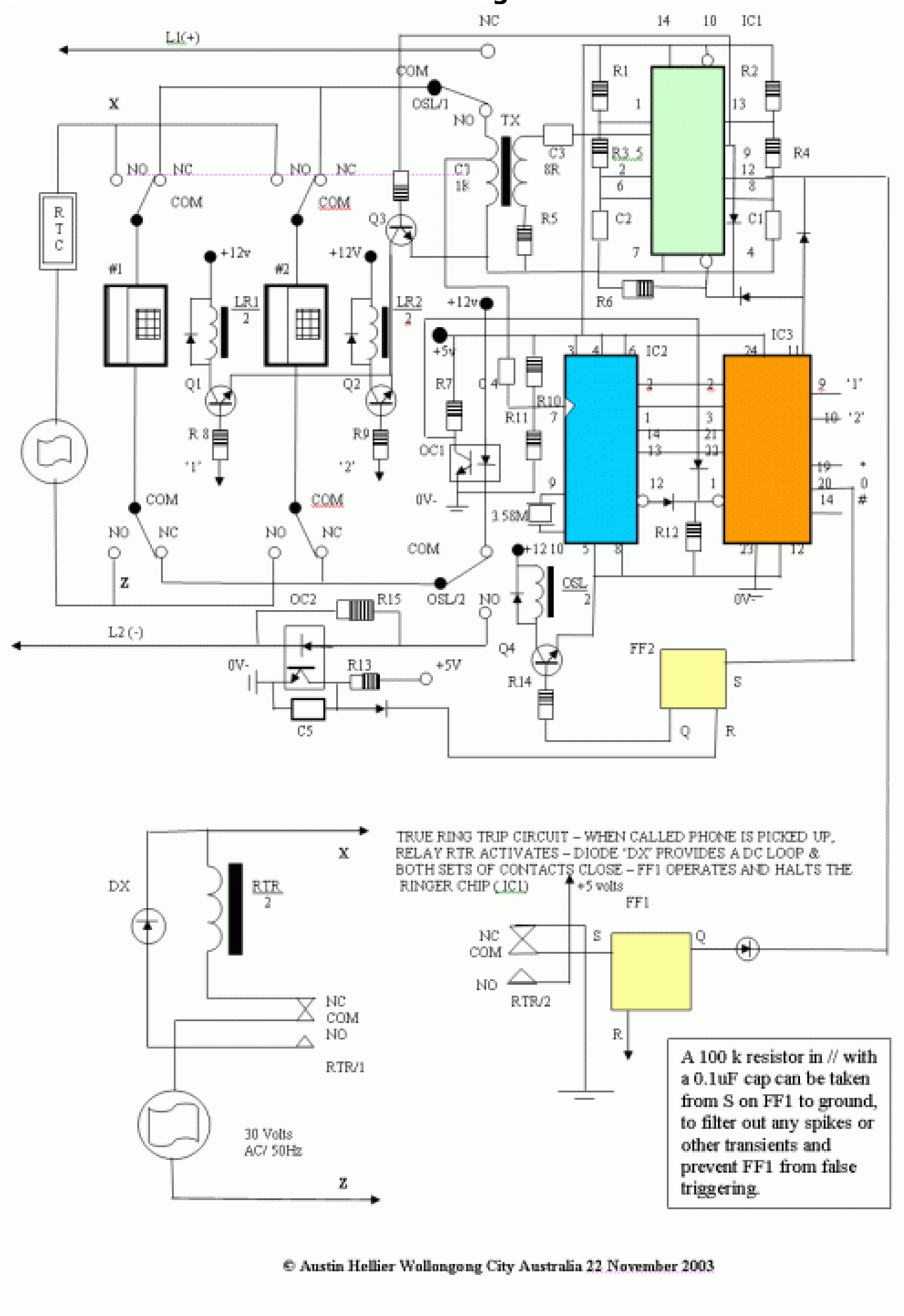
This version of the Link uses DTMF tones for dialling both internally between handsets, and externally for outside calls. Remember, in some countries, it is ILLEGAL to simply connect unapproved and untested equipment to Telco lines, so avoid the fine and confiscation of your equipment, and ask nicely… OK – now, the link A2B as shown has only 2 handsets, numbered '1' and '2'. When the Link is at reset, both phones are 'on hook' and no external incoming call is present. If an outside call rings the electronic bell ringer (EBR - not shown, but connected across L1 and L2) then anyone near either of the two phones can answer that call by simply picking up a handset ('off hook') and dialling a zero (0) This provides a 'set' pulse for FF2 and operates the OSL relay, and places BOTH handsets across the outside Telco line. Remember, both handsets are wired across the inside LINK and so their bells won't respond to the AC ring current present on the outside line, on an incoming call – that's why we need the EBR across the line…

When you've finished the outside call, simply hang up and line optocoupler OC2 will monitor for an open circuit, reset FF2 (after about a one second delay,) and release relay OSL via buffer/driver transistor Q4, returning both phones to the inside Link circuit. . On an internal call, simply pick up your handset and dial either '1' or '2' and then you'll hear ring tone, and the electronic bells/beeper on the other phone handset will ring at about one second intervals (US style ring cadence). When the called party picks up their handset, the Ring Trip circuit (RTC) will trip, both ring tone and ring current will cease, and you can talk. When you've finished, both hang up and the Link will reset itself, ready for the next call.

Link A2B Circuitry

A basic DC loop is formed by an off hook handset, the 1K winding of Tx and ground, followed by the +12 v terminal, the led inside OC1 and back to the handset via both normally closed (NC) contacts of LR1. When a phone is taken off hook, the led lights up, turning the phototransistor inside OC1 hard on, and grounding its collector terminal, and thus removing the 'reset' pulse via a diode, from the 'R' terminal of FF1 and the junction of pin 1/IC3 and the top of R12 via another diode .When a digit (say '2' in this case) is dialled, the DTMF decoder chip (IC2 – MC 45436) will feed the hex coding into the inputs of IC3 (CD4514, a '1 of 16' decoder) and at the same time, pin 12 of IC2 (indicates a valid DTMF tone pair) will provide a momentary high pulse to pin 1 of IC3, strobing it so that its outputs can change appropriately. Pin 10 of IC3 will go high turning on Q2 in unison with pulses from pin 9 of IC1, via driver transistor Q3. This chip is the NE 556 dual timer, set up much the same as in the Link pulse dial version, except that it now puts out a high pitched dial and ring tone. This is because the DTMF decoder ship likes service tones to be around the 350 to 400 hz tone range – low frequency tones seem to send it rather cross eyed…

Circuit diagram



When the Link is at reset, pin 11 of IC3 is high, holding IC2 from pulsing via a diode to pins 12 and 8, while at the same time enabling the other half of the oscillator (producing the high pitched dial tone) via another diode to pin 4. When a DTMF tone is received, pin 11 of IC3 goes low, removing these two highs, and allowing IC1 to provide ring pulses from pin 9 via Q3 to the called party's line circuit relay driver transistor (in this case – Q2). This then allows Q2 to pulse the relay on and off in unison with the interrupted ring tone, which also applies interrupted ring current to the called party's handset, while still in its 'on hook'state. When the call is answered, the RTR relay operates momentarily. The first set of RTR/1 contacts disconnects the AC ring from one side of the relay and feeds it through diode DX, forming an instant but temporary DC loop. The 2nd set of RTR/2 relay contacts 'sets' FF1 and halts the ringer via a diode from the 'Q' output, to pins 12 and 8 of IC1 for the duration of that call (see diagram at bottom of page 1 above).

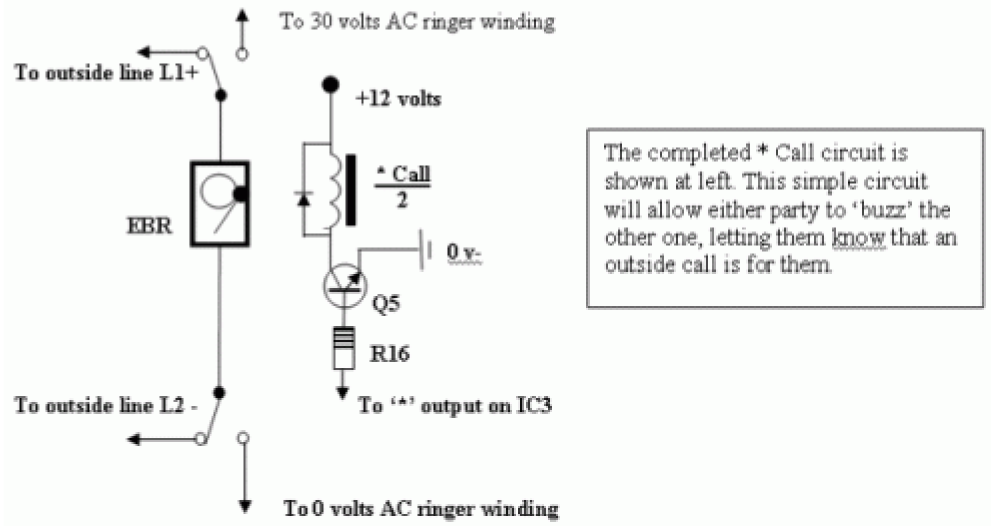
When the call is completed, and both parties hang up, the internal DC loop is broken and OC1's led will turn off, turning the phototransistor off, and allowing its collector to go high again, resetting FF1via a diode, and clearing IC3 with the same reset pulse via another diode to pin 1. Dial tone is restored as pin 11 of IC3 will go high again in the reset state, and the Link A2B is ready for the next call. Sometimes on an outside call, relay OSL will activate too fast and the outside line will 'hear' the '0' you just dialled to get the outside line. You can wire a 22uF electro cap across Q4 (+ve to collector and -ve to emitter) to slow down the relay activation time and thus avoid this hassle if you need to. Designing a true Ring Trip circuit that works 100% reliably was the hardest part of the exercise. It's best to answer a phone call during the 'ring on' part of the ring cycle. If you answer it during the 'ring off' part then there's a short delay, and it sounds like a glitch when the RTR relay actually trips the ring. While I could have added a couple of optocouplers to tidy this part up, I think that the simpler the arrangement is for AC currents, the better in CMOS type circuitry...

There we have it folks – another Link from the 'Downunder' stable – have fun building it and using it around the home, office, school etc – and – watch out for suspicious characters using eye glasses – they could be Telco inspectors…

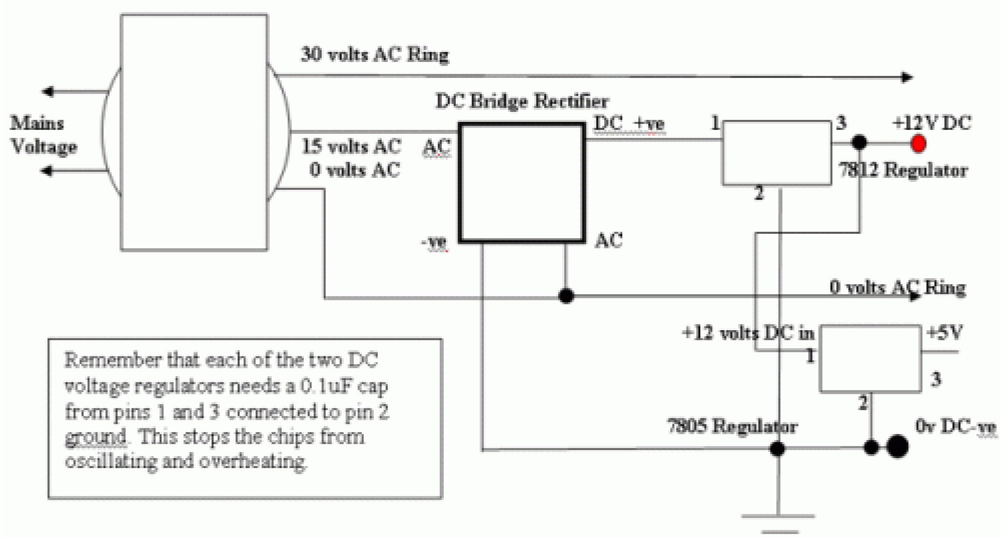
A Neat Trick You Can Try – '* Call'

With the Link A2B as it is, there's no provision to transfer incoming calls between handsets. Seeing that they're both switched to the outside line (due to the simple nature of the relay switching matrix,) this can't happen without extra relays (could become expensive and complicated). However, there is a way to let the other person know that an incoming call is for them. If you take two 0.1uF capacitors – each wired between the COM (common) terminals of relay OSL – one going to circuit ground and the other one to the input of IC2 (DTMF decoder chip) instead of the centre tap of Tx, then whenever you're on the outside line, you still have access to the tone decoder. You can wire the EBR (electronic bell ringer) via a set of relay contacts, so that when the relay is at rest, the EBR is across the line.

You can then activate the relay (called * Call or *C) by pressing the '*' key on your phone keypad, to momentarily ring the EBR from the 30 volt AC supply inside the Link. Take two wires from the NO (Normally Open) contacts of this extra relay and wire them to either end of the 30 volt AC winding of the ringer transformer. This lets the other extension know that an incoming call is for them, not the person who answered it. To complete the wiring of this extra feature, simply take a wire from pin 19 of IC3 (CD 4514 chip) wire it to a 4.7k resistor and then to an extra driver transistor that will operate the relay *C. When the other person picks up their phone (both phones are now in parallel and on the outside line) you can hang up and the other extension phone will hold up the call until they hang up, and then the Link will reset itself back to the internal Link. Wiring the two caps this way prevents harmful voltages and ring currents from reaching the +5 volt CMOS chips when the OSL relay has both phones wired to the internal Link circuit.



The Link AC and DC Power Supply circuit.



Parts
R1 10k
R2 4k7
R3 100k
R4 100k
R5 470R
R6 4k7
R7 4k7
R8 4k7
R9 4k7
R10 10k
R11 10k
R12 100k
R13 22k
R14 4k7
R15 4k7 (base of Q3)
C1 22uF
C2 .022uF (change to suit pitch of dial and ring tone)
C3 1uf
C4 0.1uF

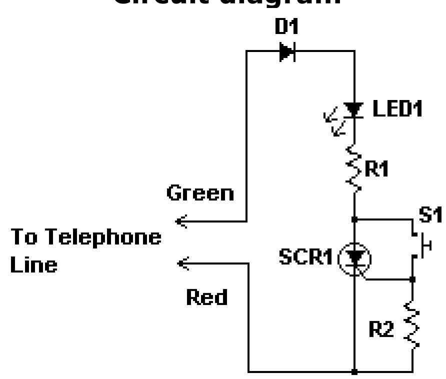
C5 10uF
Q1-4 BC547 or equivalent
Diodes use 1N4148 or 1N914
IC1 NE556 dual timer chip
IC2 MC 45436 DTMF decoder
IC3 CD 4515B 1x16 decoder
IC4a/b CD 4013B dual RS flip flop (FF1 and FF2)
Xtal 3.579 Mhz
OC1-2 4N25 or 4N28
Relays 12 volt DC DPDT
POWER SUPPLY PARTS
Mains transformer with secondary winding of 15 – 0 – 15 volts AC
Bridge rectifier PB100 or equivalent (2Amp/400piv minimum)
7805 5 volt positive regulator
7812 12 volt positive regulator
4 x 0.1uF filter caps
1 x 2,200 uF filter cap

Note:
It's best to use the more modern two piece electronic phone handsets that have a good quality electronic ringer installed. Cheap type handsets (usually of the one piece variety) suck too much current, and will cause a downgrade of speech volume during conversations. It's also best to use the same kind of handset throughout to avoid mismatches and differing current drains, which can cause glitches and background hum.

P144. Telephone Hold Button

Although a hold feature is standard on most new phones, a lot of us still use the origional bell phones. Those of us that require a hold feature will find this circuit very useful. It is easy to build, and is compact enough to be installed inside the phone with no real problem. It is also powered by the phone line itself, eliminating the need for batteries.

Circuit diagram

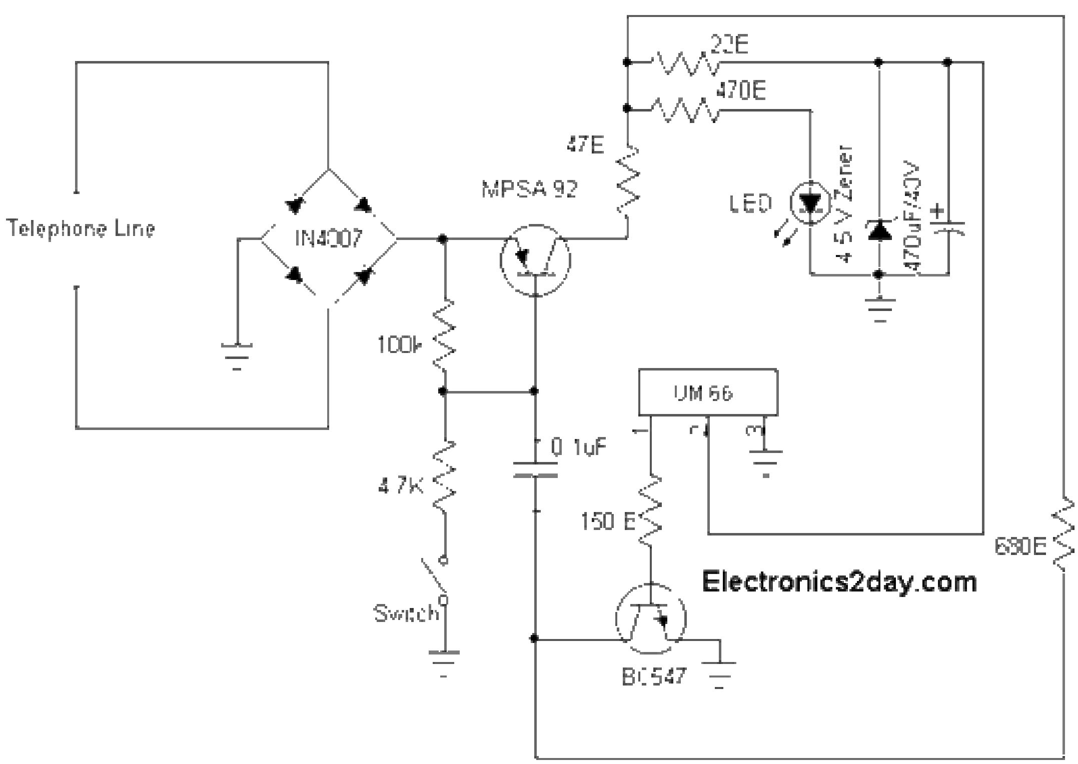


Parts
R1 1.5K 1/4 W Resistor
R2 1K 1/4W Resistor
D1 1N4002 Silicon Diode or 1N4003, 1N4004, 1N4005, 1N4006, 1N4007
SCR1 C106Y SCR
LED1 Red LED or Green LED, Yellow LED

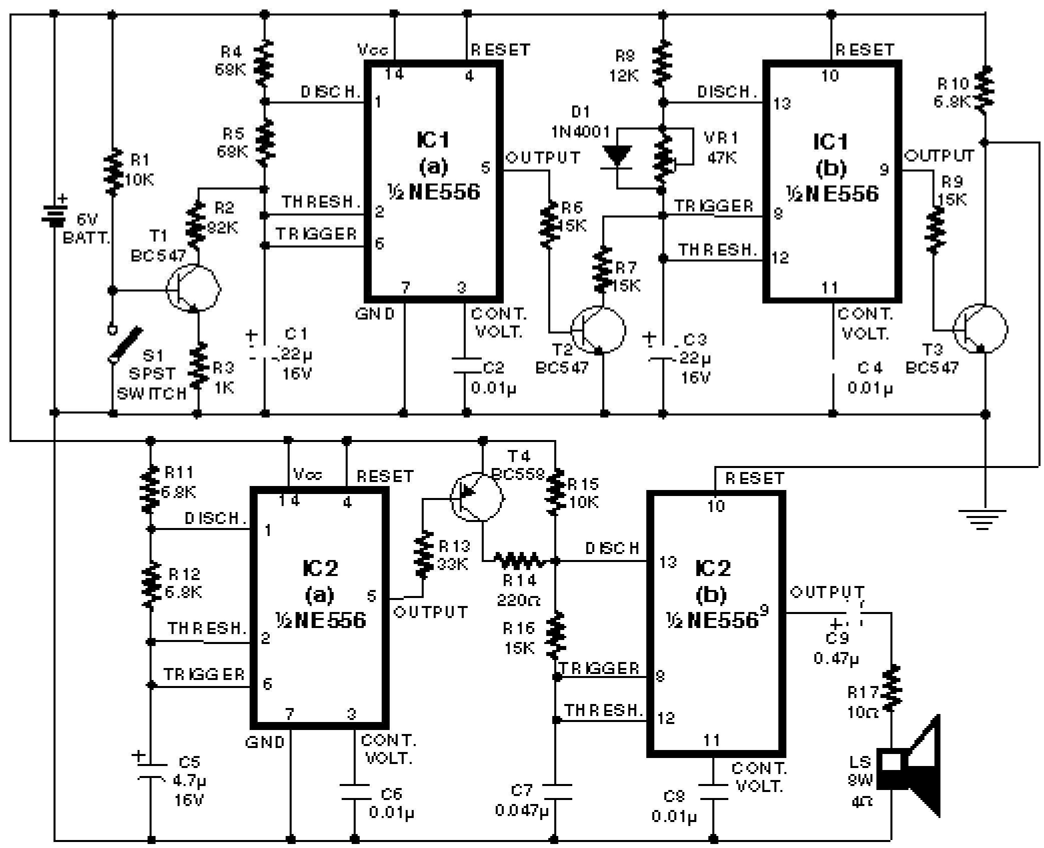
S1 Normally Open Push-Button Switch
MISC Wire, Board, Case (If Used)

Notes
1. To place a call on hold, simply hold down the button while hanging up the phone. To take a call off hold, just pick up the phone, or any extension.
2. Even though this is a simple circuit, you may have to check with your phone company before use.

P145. Telephone Hold on



P146. Telephone Ringer using 556 dual timers



Using modulated rectangular waves of different time periods, The circuit presented here produces ringing tones similar to those produced by a telephone.

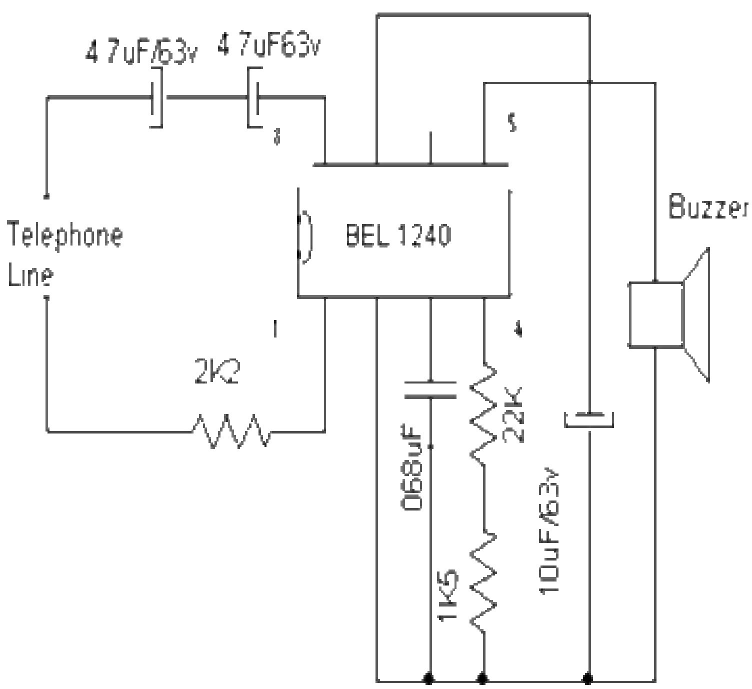
The circuit requires four astable multivibrators for its working. Therefore two 556 ICs are used here. The IC 556 contains two timers (similar to 555 ICs) in a single package. One can also assemble this circuit using four separate 555 ICs. The first multivibrator produces a rectangular waveform with 1-second 'low' duration and 2-second 'high' duration. This waveform is used to control the next multivibrator that produces another rectangular waveform.

A resistor R7 is used at the collector of transistor T2 to prevent capacitor C3 from fully discharging when transistor T2 is conducting. Preset VR1 must be set at such a value that the two ringing tones are heard in one second. The remaining two multivibrators are used to produce ringing tones corresponding to the ringing pulses produced by the preceding multivibrator stages.

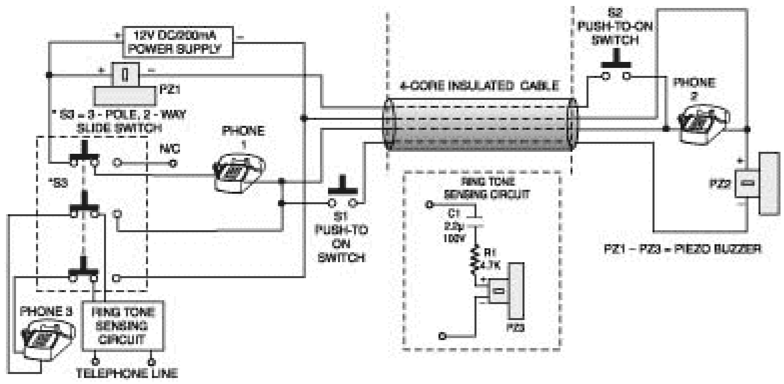
When switch S1 is closed, transistor T1 cuts off and thus the first multivibrator starts generating pulses. If this switch is placed in the power supply path, one has to wait for a longer time for the ringing to start after the switch is closed. The circuit used also has a provision for applying a drive voltage to the circuit to start the ringing.

Note that the circuit is not meant for connecting to the telephone lines. Using appropriate drive circuitry at the input (across switch S1) one can use this circuit with intercoms, etc. Since ringing pulses are generated within the circuit, only a constant voltage is to be sent to the called party for ringing.

P147. Telephone Extra Ringer



P148.
Two line intercom plus a telephone changeover switch



The circuit presented here can be used for connecting two telephones in parallel and also as a 2-line intercom.

Usually a single telephone is connected to a telephone line. If another telephone is required at some distance, a parallel line is taken for connecting the other telephone. In this simple parallel line operation, the main problem is loss of privacy besides interference from the other phone. This problem is obviated in the circuit presented here.

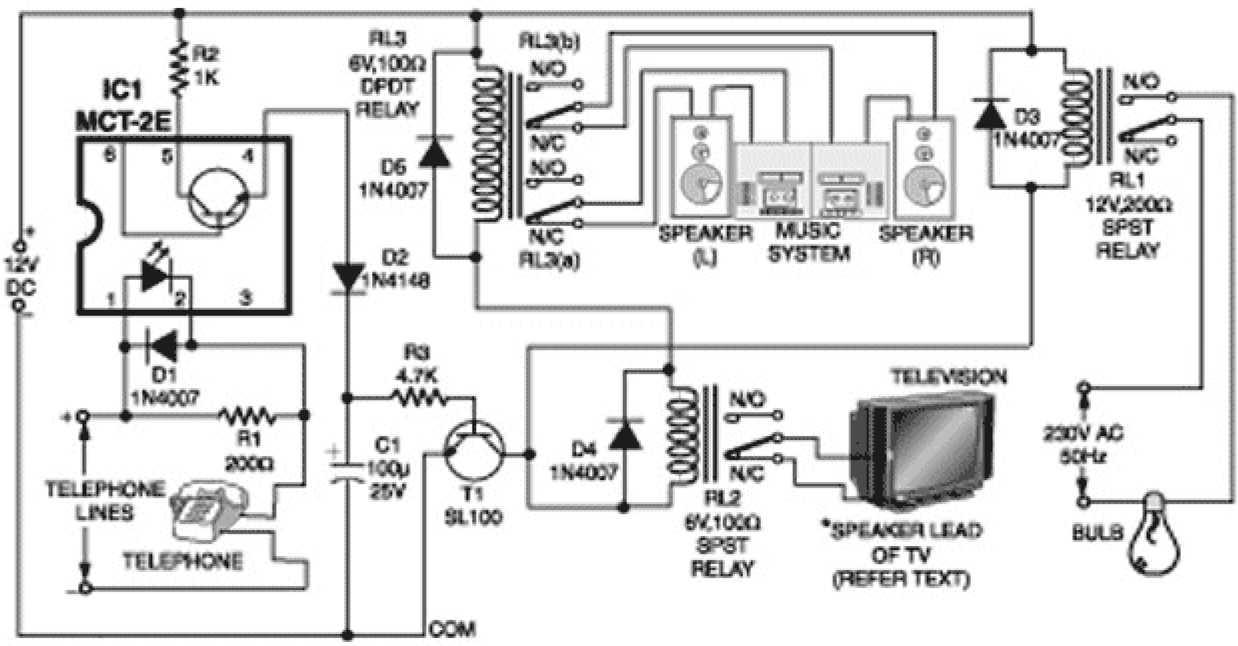
Under normal condition, two telephones (telephone 1 and 2) can be used as intercom while telephone 3 is connected to the lines from exchange. In changeover mode, exchange line is disconnected from telephone 3 and gets connected to telephone 2.

For operation in intercom mode, one has to just lift the handset of phone 1 and then press switch S1. As a result, buzzer PZ2 sounds. Simultaneously, the side tone is heard in the speaker of handset of phone 1. The person at phone 2 could then lift the handset and start conversation. Similar procedure is to be followed for initiation of the conversation from phone 2 using switch S2. In this mode of operation, a 3-pole, 2-way slide-switch S3 is to be used as shown in the figure.

In the changeover mode of operation, switch S3 is used to changeover the telephone line for use by telephone 2. The switch is normally in the intercom mode and telephone 3 is connected to the exchange line. Before changing over the exchange line to telephone 2, the person at telephone 1 may inform the person at telephone 2 (in the intercom mode) that he is going to changeover the line for use by him (the person at telephone 2). As soon as changeover switch S3 is flipped to the other position, 12V supply is cut off and telephones 1 and 3 do not get any voltage or ring via the ring-tone-sensing unit.

Once switch S3 is flipped over for use of exchange line by the person at telephone 2, and the same (switch S3) is not flipped back to normal position after a telephone call is over, the next telephone call via exchange lines will go to telephone 2 only and the ring-tone-sensing circuit will still work. This enables the person at phone 3 to know that a call has gone through. If the handset of telephone 3 is lifted, it is found to be dead. To make telephone 3 again active, switch S3 should be changed over to its normal position.

P149.
Telephone line based audio muting and light on circuit



Very often when enjoying music or watching TV at high audio level, we may not be able to hear a telephone ring and thus miss an important incoming phone call. To overcome this situation, the circuit presented here can be used. The circuit would automatically light a bulb on arrival of a telephone ring and simultaneously mute the music system/TV audio for the duration the telephone handset is off-hook. Lighting of the bulb would not only indicate an incoming call but also help in locating the telephone during darkness.

On arrival of a ring, or when the handset is off-hook, the inbuilt transistor of IC1 (opto-coupler) conducts and capacitor C1 gets charged and, in turn, transistor T1 gets forward biased. As a result, transistor T1 conducts, causing energisation of relays RL1, RL2, and RL3. Diode D1 connected in anti-parallel to inbuilt diode of IC1, in shunt with resistor R1, provides an easy path for AC current and helps in limiting the voltage across inbuilt diode to a safe value during the ringing. (The RMS value of ring voltage lies between 70 and 90 volts RMS.) Capacitor C1 maintains necessary voltage for continuously forward biasing transistor T1 so that the relays are not energised during the negative half cycles and off-period of ring signal. Once the handset is picked up, the relays will still remain energised because of low-impedance DC path available (via cradle switch and handset) for the in-built diode of IC1. After completion of call when handset is placed back on its cradle, the low-impedance path through handset is no more available and thus relays RL1 through RL3 are deactivated.

As shown in the figure, the energised relay RL1 switches on the light, while energisation of relay RL2 causes the path of TV speaker lead to be opened. (For dual-speaker TV, replace relay RL2 with a DPDT relay of 6V, 200 ohm.) Similarly, energisation of DPDT relay RL3 opens the leads going to the speakers and thus mutes both audio speakers. Use 'NC' contacts of relay RL3 in series with speakers of music system and 'NC' contacts of RL2 in series with TV speaker. Use 'NO' contact of relay RL1 in series with a bulb to get the visual indication.

P150. Having secrecy in parallel telephones

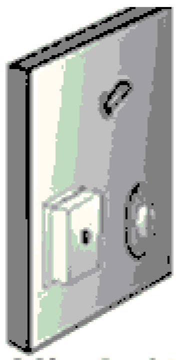


Fig. 3: Mounting details of DPDT switch, RINGER and and telephone terminal box

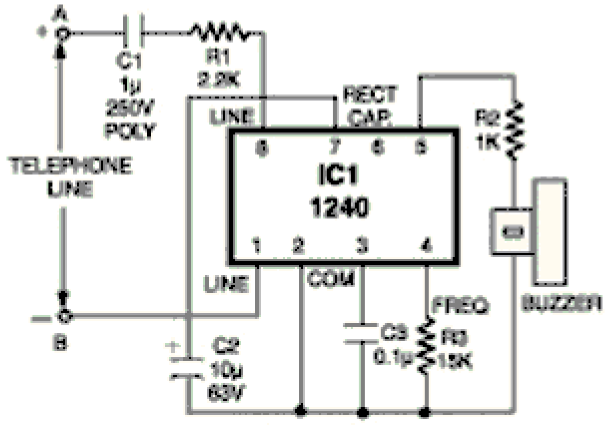


Fig. 2: Circuit diagram of external ringer

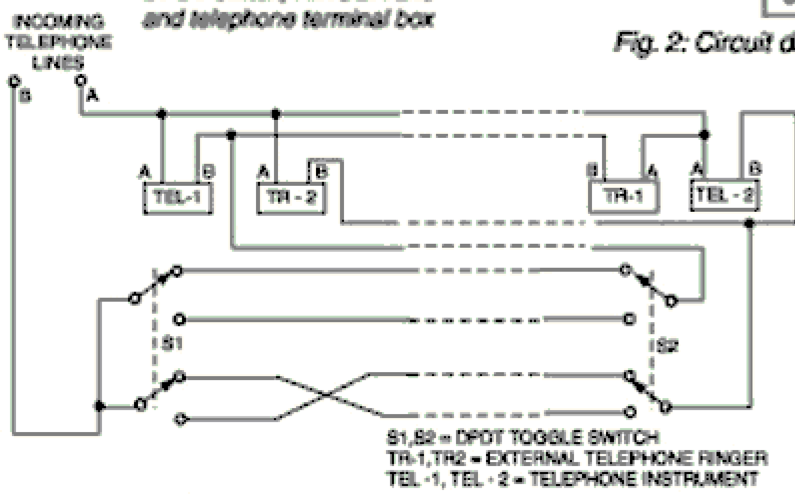


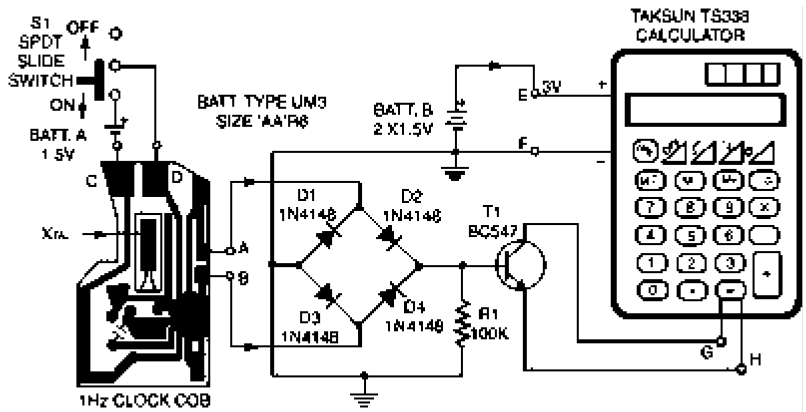
Fig. 1: Scheme for connecting two parallel telephones along with addional external ringers

Often a need arises for connection of two telephone instruments in parallel to one line. But it creates quite a few problems in their proper performance, such as overloading and overhearing of the conversation by an undesired person. In order to eliminate all such problems and get a clear reception, a simple scheme is presented here (Fig. 1).

This system will enable the incoming ring to be heard at both the ends. The DPDT switch, installed with each of the parallel telephones, connects you to the line in one position of the switch and disconnects you in the other position of the switch. At any one time, only one telephone is connected to the line. To receive a call at an end where the instrument is not connected to the line, you just have to flip the toggle switch at your end to receive the call, and act as usual to have a conversation. As soon as the position of the toggle switch is changed, the line gets transferred to the other telephone instrument.

Mount one DPDT toggle switch, one telephone ringer, and one telephone terminal box on two wooden electrical switchboards, as shown in Fig. 3. Interconnect the boards using a 4-pair telephone cable as per Fig. 1. The system is ready to use. Ensure that the two lower leads of switch S2 are connected to switch S1 after reversal, as shown in the figure.

P151. Telephone call meter using calculator & COB



In this circuit, a simple calculator, in conjunction with a COB (chip-on-board) from an analogue quartz clock, is used to make a telephone call meter. The calculator enables conversion of STD/ISD calls to local call equivalents and always displays current local call-meter reading.

The circuit is simple and presents an elegant look, with feather-touch operation. It consumes very low current and is fully battery operated. The batteries used last more than a year.

Another advantage of using this circuit is that it is compatible with any type of pulse rate format, i.e. pulse rate in whole number, or whole number with decimal value. Recently, the telephone department announced changes in pulse rate format, which included pulse rate in whole number plus decimal value. In such a case, this circuit proves very handy.

To convert STD/ISD calls to local calls, this circuit needs accurate 1Hz clock pulses, generated by clock COB. This COB is found inside analogue quartz wall clocks or time-piece mechanisms. It consists of IC, chip capacitors, and crystal that one can retrieve from scrap quartz clock mechanisms. These can be purchased from watch-repairing shops for less than Rs 20.

Normally, the COB inside clock mechanism will be in good condition. However, before using the COB, please check its serviceability by applying 1.5V DC across terminals C and D, as shown in the figure. Then check DC voltage across terminals A and B; these terminals in a clock are connected to a coil. If the COB is in good condition, the multimeter needle would deflect forward and backward once every second. In fact, 0.5Hz clock is available at terminals A and B, with a phase difference of 90o. The advantage of using this COB is that it works on a 1.5V DC source.

The clock pulses available from terminal A and B are combined using a bridge, comprising diodes D1 to D4, to obtain 1Hz clock pulses. These clock pulses are applied to the base of transistor T1. The collector and emitter of transistor T1 are connected across calculator’s ‘=’ terminals.

The number of pulses forming an equivalent call may be determined from the latest telephone directory. However, the pulse rate (PR) found in the directory cannot be used directly in this circuit. For compatibility with this circuit, the pulse rate applicable for a particular place/distance, based on time of the day/holidays, is converted to pulse rate equivalent (PRE) using the formula PRE = 1/PR.

You may prepare a look-up table for various pulse rates and their equivalents (see Table). Suppose you are going to make an STD call in pulse rate 4. Note down from the table the pulse rate equivalent for pulse rate 4, which is 0.25. Please note that on maturity of a call in the telephone exchange, the exchange call meter immediately advances to one call and it will be further incremented according to pulse rate. So one call should always be included before counting the calls.

For making call in pulse rate 4, slide switch S1 to ‘off’ (pulse set position) and press calculator buttons in the following order: 1, ‘+’, 0.25, ‘=’. Here, 1 is initial count, and 0.25 is PRE. Now calculator displays 1.025. This call meter is now ready to count. Now make the call, and as soon as the call matures, immediately slide switch S1 to ‘on’ (start/standby position). The COB starts generating clock pulses of 1 Hz. Transistor T1 conducts once every second, and thus ‘=’ button in calculator is activated electronically once every second. The calculator display starts from 1.25, advancing every second as follows:

1.25, 1.5, 1.75, 2.00, 2.25, 2.50, and so on.

After finishing the call, immediately slide switch S1 to ‘off’ position (pulse set position) and note down the local call meter reading from the calculator display. If decimal value is more than or equal to 0.9, add another call to the whole number value. If decimal value is less than 0.9, neglect decimal value and note down only whole numbers.

To store this local call meter reading into calculator memory, press ‘M+’ button. Now local call meter reading is stored in memory and is added to the previous local call meter reading. For continuous display of current local call meter reading, press ‘MRC’ button and slide switch S1 to ‘on’ (start/standby position). The current local call meter reading will blink once every second.

In prototype circuit, the author used TAKSUN calculator that costs around Rs 80. The display height was 1 cm. In this calculator, he substituted the two button-type batteries with two externally connected 1.5V R6 type batteries to run the calculator for more than an year.

The power ‘off’ button terminals were made dummy by affixing cellotape on contacts to avoid erasing of memory, should someone accidentally press the power ‘off’ button. This calculator has auto ‘off’ facility. Therefore, some button needs to be pressed frequently to keep the calculator ‘on’. So, in the idle condition, the ‘=’ button is activated electronically once every second by transistor T1, to keep the calculator continuously ‘on’. Useful hints. Solder the ‘=’ button terminals by drilling small holes in its vicinity on PCB pattern using thin copper wire and solder it neatly, such that the ‘=’ button could get activated electronically as well as manually. Take the copper wire through a hole to the backside of the PCB, from where it is taken out of the calculator as terminals G and H. At calculator’s battery terminals, solder two wires to ‘+’ and ‘–’ terminals. These wires are also taken out from calculator as terminals E and F. Affix COB on a general-purpose PCB and solder the remaining components neatly. For giving the unit an elegant look, purchase a jewellery plastic box with flip-type cover (size 15cm x 15cm). Now fix the board, calculator, and batteries, along with holder inside the jewellery box. Then mount the box on the wall and paste the look-up table inside the box cover in such a way that on opening the box, it is visible on left side of the box.

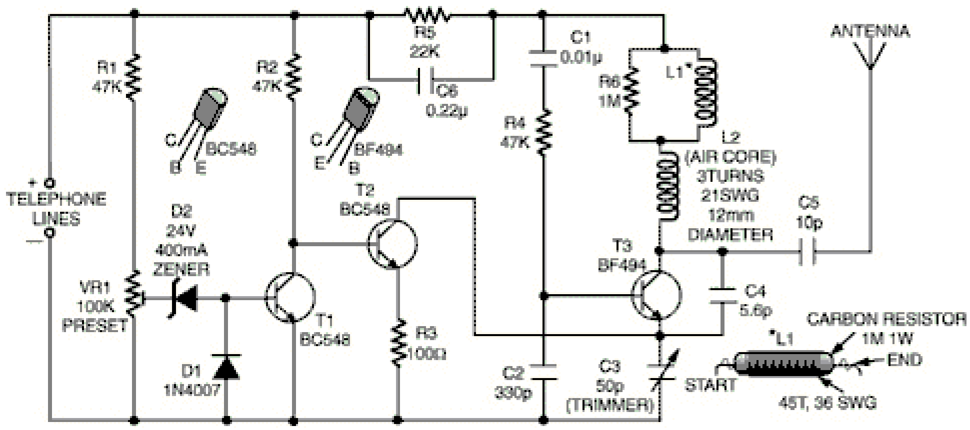
Caution. The negative terminals of battery A and battery B are to be kept isolated from each other for proper operation of this circuit.

LookUp Table

Pulse rate (PR)	2	2.5	3	4	6	8	12	16	24	32	36	48
Pulse rate eqlt. (PRE)	0.5000	0.4000	0.333	0.250	0.166	0.125	0.083	0.062	0.041	0.031	0.027	0.020

Note : Here PRE is shown up to three decimal places. In practice, one may use up to five or six decimal places.

P152. Phone Broadcaster



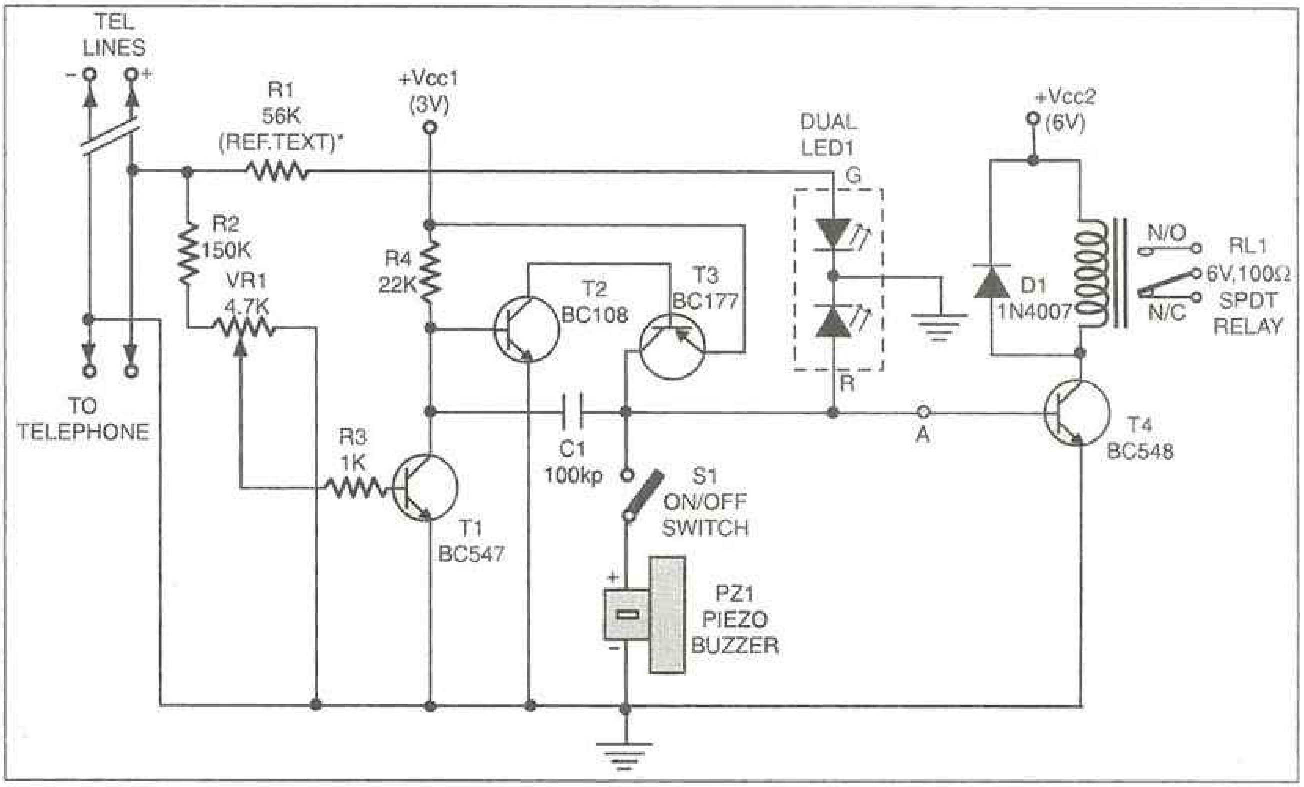
Here is a simple yet very useful circuit which can be used to eavesdrop on a telephone conversation. The circuit can also be used as a wireless telephone amplifier. One important feature of this circuit is that the circuit derives its power directly from the active telephone lines, and thus avoids use of any external battery or other power supplies. This not only saves a lot of space but also money. It consumes very low current from telephone lines without disturbing its performance. The circuit is very tiny and can be built using a single-IC type veroboard that can be easily fitted inside a telephone connection box of 3.75 cm x 5 cm. The circuit consists of two sections, namely, automatic switching section and FM transmitter section.

Automatic switching section comprises resistors R1 to R3, preset VR1, transistors T1 and T2, zener D2, and diode D1. Resistor R1, along with preset VR1, works as a voltage divider. When voltage across the telephone lines is 48V DC, the voltage available at wiper of preset VR1 ranges from 0 to 32V (adjustable). The switching voltage of the circuit depends on zener breakdown voltage (here 24V) and switching voltage of the transistor T1 (0.7V). Thus, if we adjust preset VR1 to get over 24.7 volts, it will cause the zener to breakdown and transistor T1 to conduct. As a result collector of transistor T1 will get pulled towards negative supply, to cut off transistor T2. At this stage, if you lift the handset of the telephone, the line voltage drops to about 11V and transistor T1 is cut off. As a result, transistor T2 gets forward biased through resistor R2, to provide a DC path for transistor T3 used in the following FM transmitter section.

The low-power FM transmitter section comprises oscillator transistor T3, coil L1, and a few other components. Transistor T3 works as a common-emitter RF oscillator, with transistor T2 serving as an electronic 'on'/'off' switch. The audio signal available across the telephone lines automatically modulates oscillator frequency via transistor T2 along with its series biasing resistor R3. The modulated RF signal is fed to the antenna. The telephone conversation can be heard on an FM receiver remotely when it is tuned to FM transmitter frequency.

Lab Note: During testing of the circuit it was observed that the telephone used was giving an engaged tone when dialed by any subscriber. Addition of resistor R5 and capacitor C6 was found necessary for rectification of the fault.

P153. Multipurpose Circuit for telephone



This add-on device for telephones can be connected in parallel to the telephone instrument.
The circuit provides audio-visual indication of on-hook, off-hook, and ringing modes. It can also be used to connect the telephone to a cid (caller identification device) through a relay and also to indicate tapping or misuse of telephone lines by sounding a buzzer.

In on-hook mode, 48V dc supply is maintained across the telephone lines. In this case, the bi-colour led glows in green, indicating the idle state of the telephone. The value of resistor r1 can be changed somewhat to adjust the led glow, without loading the telephone lines (by trial and error).

In on-hook mode of the hand-set, potentiometer vr1 is so adjusted that base of t1 (bc547) is forward biased, which, in turn, cuts off transistor t2 (bc108). While adjusting potmeter vr1, ensure that the led glows only in green and not in red.

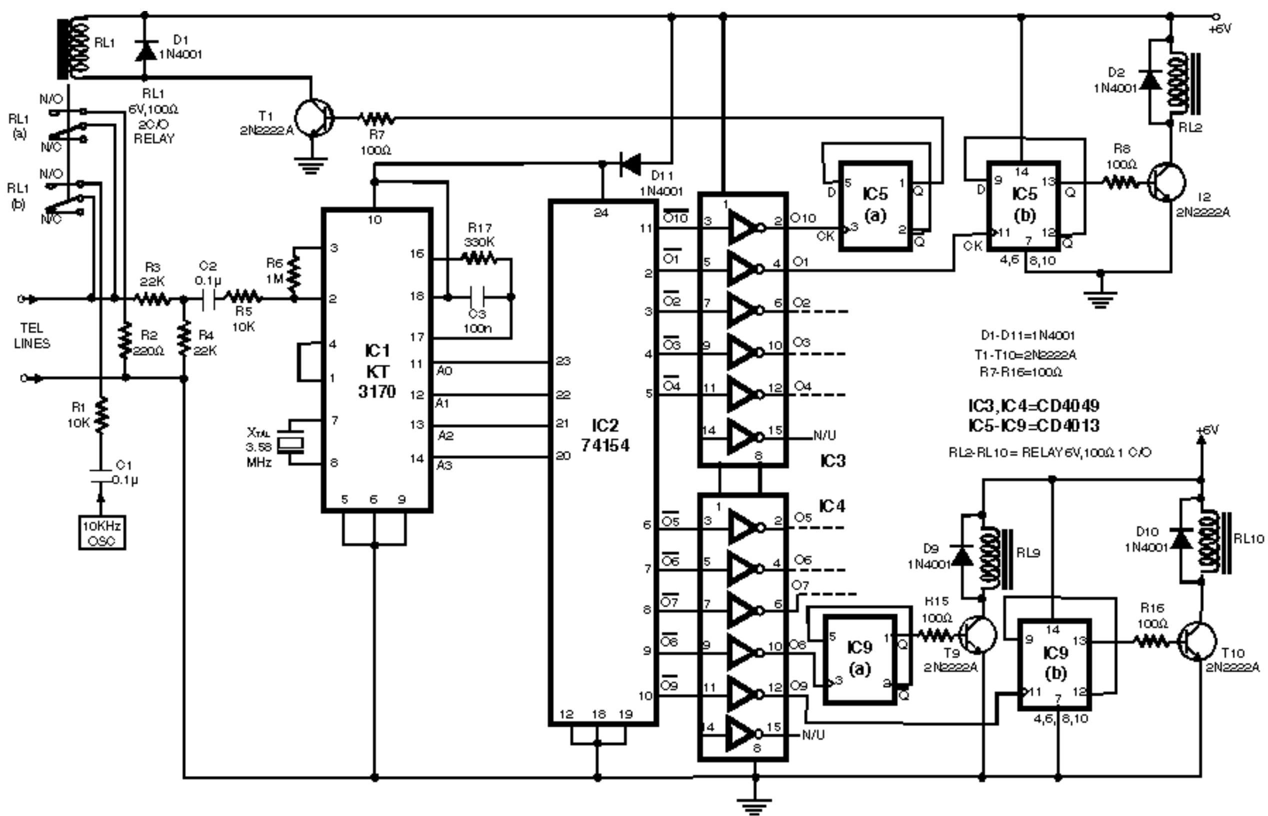
When the hand-set is lifted, the voltage drops to around 12V dc. When this happens, the voltage across transistor t1's base-emitter junction falls below its conduction level to cut it off. As a result transistor pair t2-t3 starts oscillating and the piezo-buzzer starts beeping (with switch s1 in on position). At the same time, the bi-colour led glows in red.

In ringing mode, the bi-colour led flashes in green in synchronisation with the telephone ring.

A cid can be connected using a relay. The relay driver transistor can be connected via point a as shown in the circuit. To use the circuit for warning against misuse, switch s1 can be left in on position to activate the piezo-buzzer when anyone tries to tap the telephone line. (When the telephone line is tapped, it's like the off-hook mode of the telephone hand-set.)

Two 1.5V pencil cells can provide Vcc1 power supply, while a separate power supply for Vcc2 is recommended to avoid draining the battery. However, a single 6-volt supply source can be used in conjunction with a 3.3V zener diode to cater to both Vcc2 and Vcc1 supplies.

P154. Remote control using telephone



Here is a teleremote circuit which enables switching 'on' and 'off' of appliances through telephone lines. It can be used to switch appliances from any distance, overcoming the limited range of infrared and radio remote controls.

The circuit described here can be used to switch up to nine appliances (corresponding to the digits 1 through 9 of the telephone key-pad). The DTMF signals on telephone instrument are used as control signals. The digit '0' in DTMF mode is used to toggle between the appliance mode and normal telephone operation mode. Thus the telephone can be used to switch on or switch off the appliances also while being used for normal conversation.

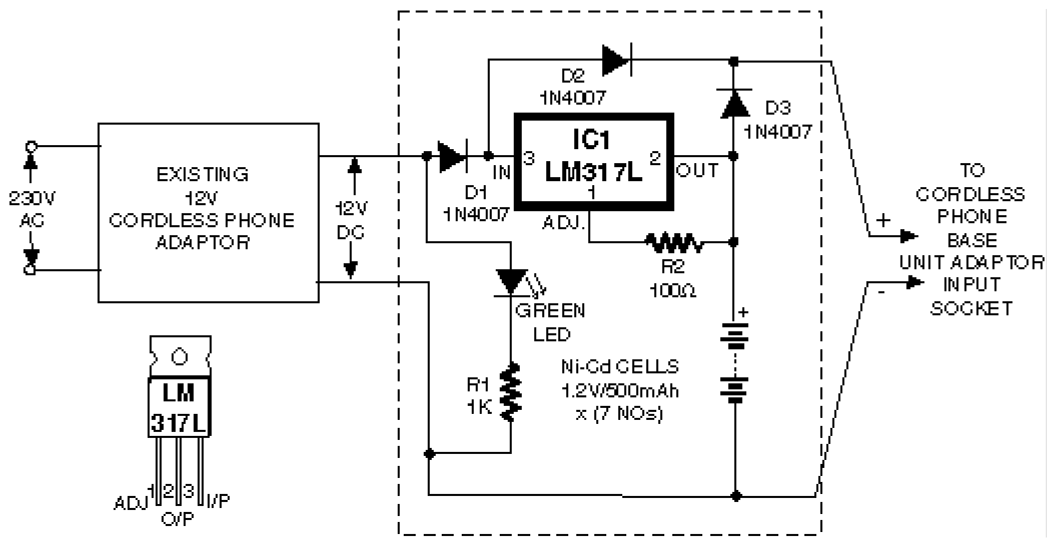
The circuit uses IC KT3170 (DTMF-to-BCD converter), 74154 (4-to-16-line demult-iplexer), and five CD4013 (D flip-flop) ICs. The working of the circuit is as follows.

Once a call is established (after hearing ring-back tone), dial '0' in DTMF mode. IC1 decodes this as '1010,' which is further demultiplexed by IC2 as output O10 (at pin 11) of IC2 (74154). The active low output of IC2, after inversion by an inverter gate of IC3 (CD4049), becomes logic 1. This is used to toggle flip-flop-1 (F/F-1) and relay RL1 is energised. Relay RL1 has two changeover contacts, RL1(a) and RL1(b). The energised RL1(a) contacts provide a 220-ohm loop across the telephone line while RL1(b) contacts inject a 10kHz tone on the line, which indicates to the caller that appliance mode has been selected. The 220-ohm loop on telephone line disconnects the ringer from the telephone line in the exchange. The line is now connected for appliance mode of operation.

If digit ‘0’ is not dialed (in DTMF) after establishing the call, the ring continues and the telephone can be used for normal conversation. After selection of the appliance mode of operation, if digit ‘1’ is dialed, it is decoded by IC1 and its output is ‘0001’. This BCD code is then demultiplexed by 4-to-16-line demultiplexer IC2 whose corresponding output, after inversion by a CD4049 inverter gate, goes to logic 1 state. This pulse toggles the corresponding flip-flop to alternate state. The flip-flop output is used to drive a relay (RL2) which can switch on or switch off the appliance connected through its contacts. By dialing other digits in a similar way, other appliances can also be switched ‘on’ or ‘off.’

Once the switching operation is over, the 220-ohm loop resistance and 10kHz tone needs to be removed from the telephone line. To achieve this, digit ‘0’ (in DTMF mode) is dialed again to toggle flip-flop-1 to de-energise relay RL1, which terminates the loop on line and the 10kHz tone is also disconnected. The telephone line is thus again set free to receive normal calls.This circuit is to be connected in parallel to the telephone instrument.

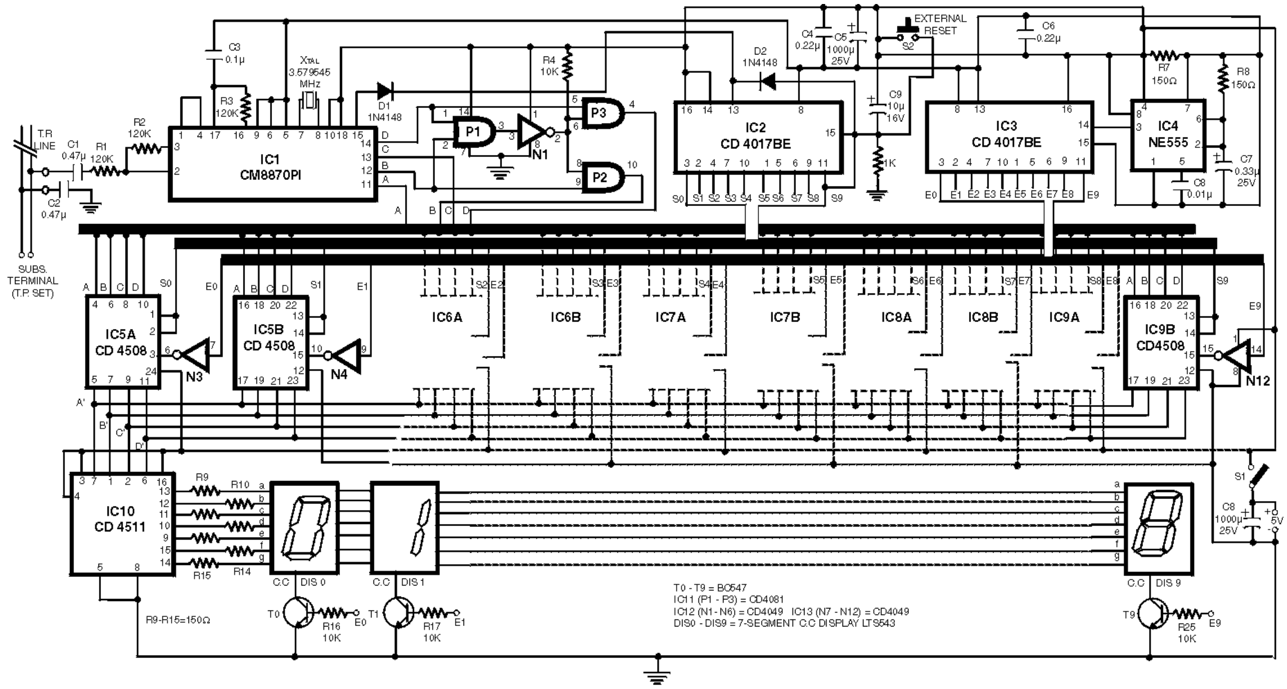
P155. Cordless phone backup

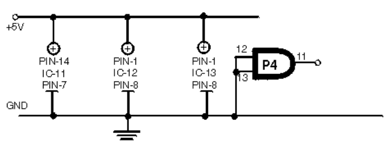


Normally the base of a cordless phone has an adaptor and the handset has Ni-Cd cells for its operation. The base unit becomes inoperative in case of power failure. In such conditions, it is better to provide a backup using Ni-Cd cells externally. Here is a simple circuit which can be used with cordless phone SANYO CLT-420 or similar sets.

The working is simple. When AC mains is present, Ni-Cd cells are charged through IC LM317L, which is wired as a current source. Also, diode D3 is reverse-biased, which keeps Ni-Cd cells isolated from positive rail. When AC mains goes off, the Ni-Cd cells provide supply to the cordless phone base unit through diode D3. A green LED is used to indicate the presence of AC mains. Each Ni-Cd cell costs around Rs 34, and the cost of the backup unit, including the box and cells, would not exceed Rs 300. Hence the circuit is well worth the investment.

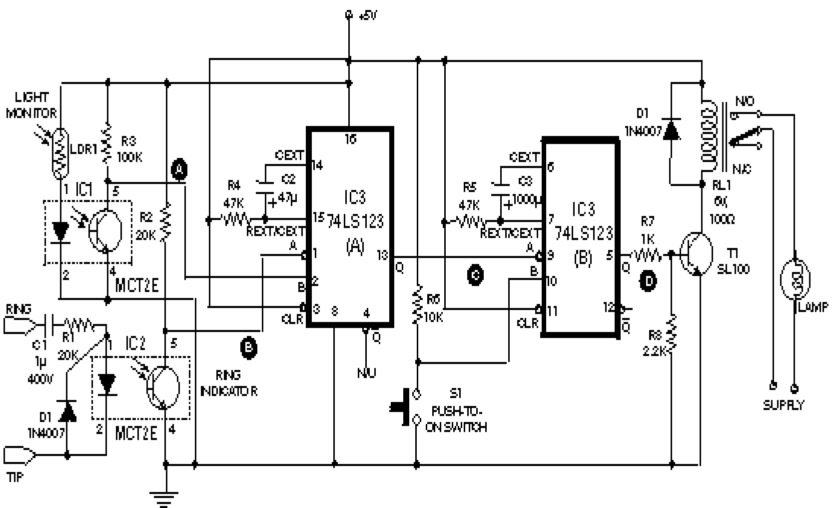
P156. Telephone Number Display

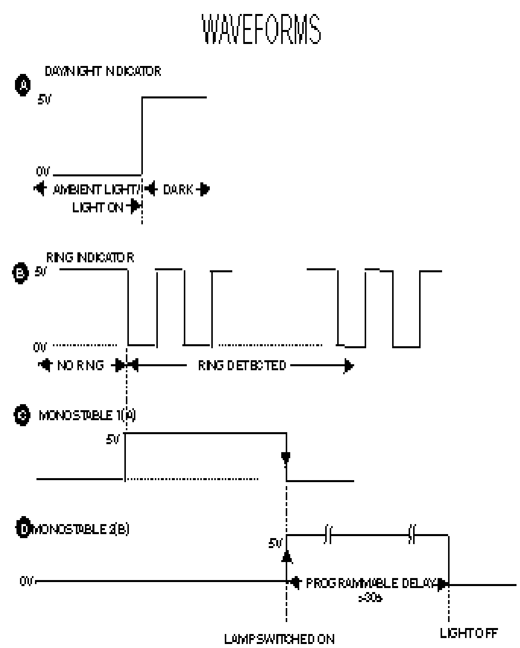




The given circuit, when connected in parallel to a telephone, dis- plays the number dialled from the telephone set using the DTMF mode. This circuit can also show the number dialled from the phone of the called party. This is particularly helpful for receiving any number over the phone lines. The DTMF signal—generated by the phone on dialling a number—is decoded by DTMF decoder CM8870P1 (IC1), which converts the received DTMF signal into its equivalent BCD number that corresponds to the dialled number. This binary number is stored sequentially in 10 latches each time a number is dialled from the phone. The first number is stored in IC5A (1/2 of CD4508) while the second number is stored in IC5B and so on. The binary output from IC1 for digit '0' as decoded by IC1 is 10102 (=1010), and this cannot be displayed by the seven-segment decoder, IC10. Therefore the binary output of IC1 is passed through a logic-circuit which converts an input of '10102' into '00002' without affecting the inputs '1' through '9'. This is accomplished by gates N13 through N15 (IC11) and N1 (IC12). The storing of numbers in respective latches is done by IC2 (4017). The data valid output from pin 15 of IC1 is used to clock IC2. The ten outputs of IC2 are sequentially connected to the store and clear inputs of all the latches, except the last one, where the clear input is tied to ground. When an output pin of IC2 is high, the corresponding latch is cleared of previous data and kept ready for storing new data. Then, on clocking IC2, the same pin becomes low and the data present at the inputs of that latch at that instant gets stored and the next latch is cleared and kept ready. The similar input and output pins of all latches are connected together to form two separate input and output buses. There is only one 7-segment decoder/driver IC10 for all the ten displays. This not only reduces size and cost but reduces power requirement too. The output from a latch is available only when its disable pins (3 and 15) are brought low. This is done by IC3, IC12 and IC13. IC3 is clocked by an astable multivibrator IC4 (555). IC3 also drives the displays by switching corresponding transistors. When a latch is enabled, its corresponding display is turned on and the content of that latch, after decoding by IC10, gets displayed in the corresponding display. For instance, contents of IC5A are displayed on display 'DIS1,' that of IC5B on 'DIS2' and so on. The system should be connected to the telephone lines via a DPDT switch (not shown) for manual switching, otherwise any circuit capable of sensing handset's off-hook condition and thereby switching relays, etc. can be used for automatic switching. The power-supply switch can also be replaced then. Though this circuit is capable of showing a maximum of ten digits, one can reduce the display digits as required. For doing this, connect the reset pin of IC2, say, for a 7-digit display, with S6 output at pin 5. The present circuit can be built on a veroboard and housed in a suitable box. The displays are common-cathode type. To make the system compact, small, 7-segment displays can be used but with some extra cost. Also, different colour displays can be used for the first three or four digits to separate the exchange code/STD code, etc. The circuit can be suitably adopted for calling-line display.

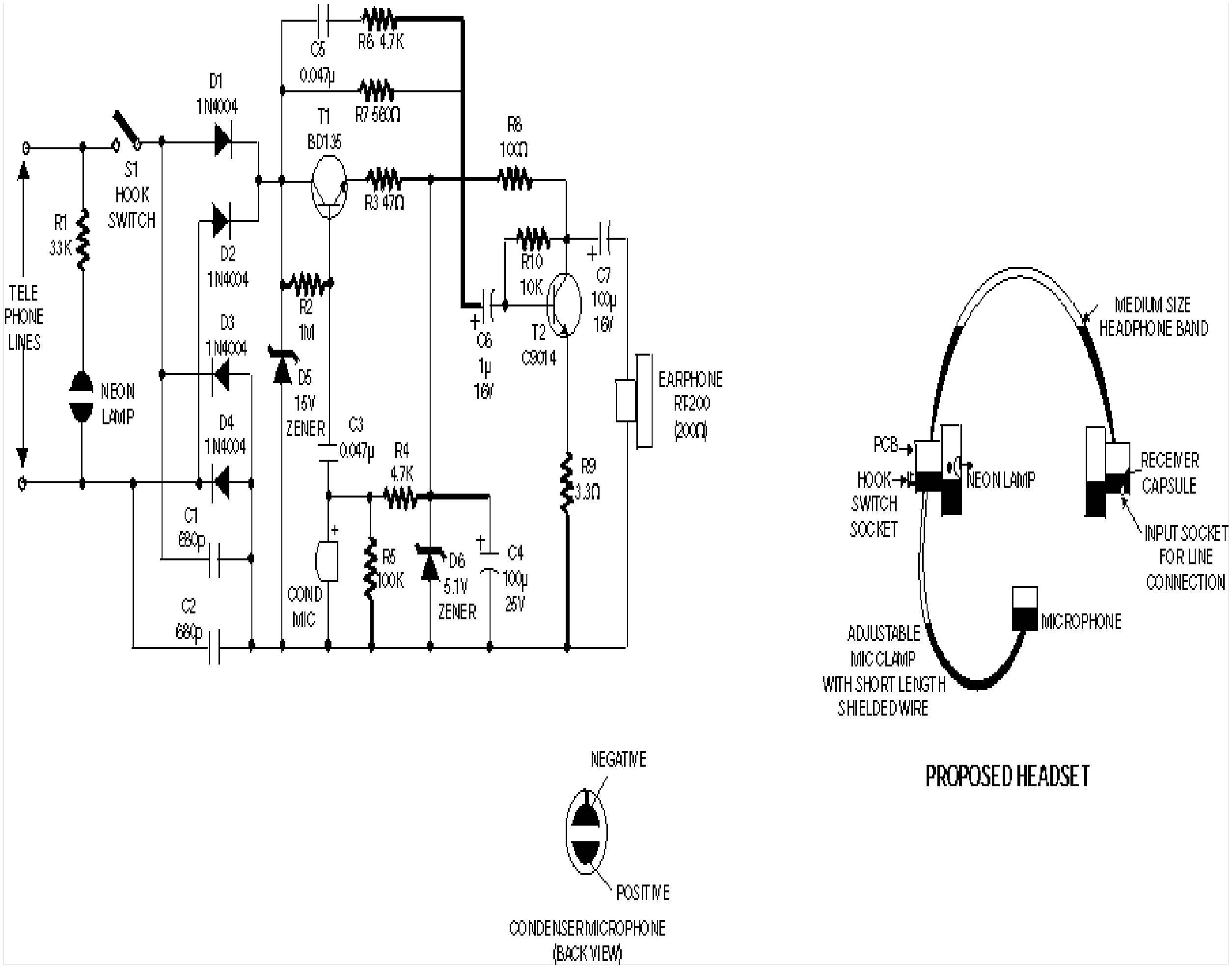
P157. Smart Phone light





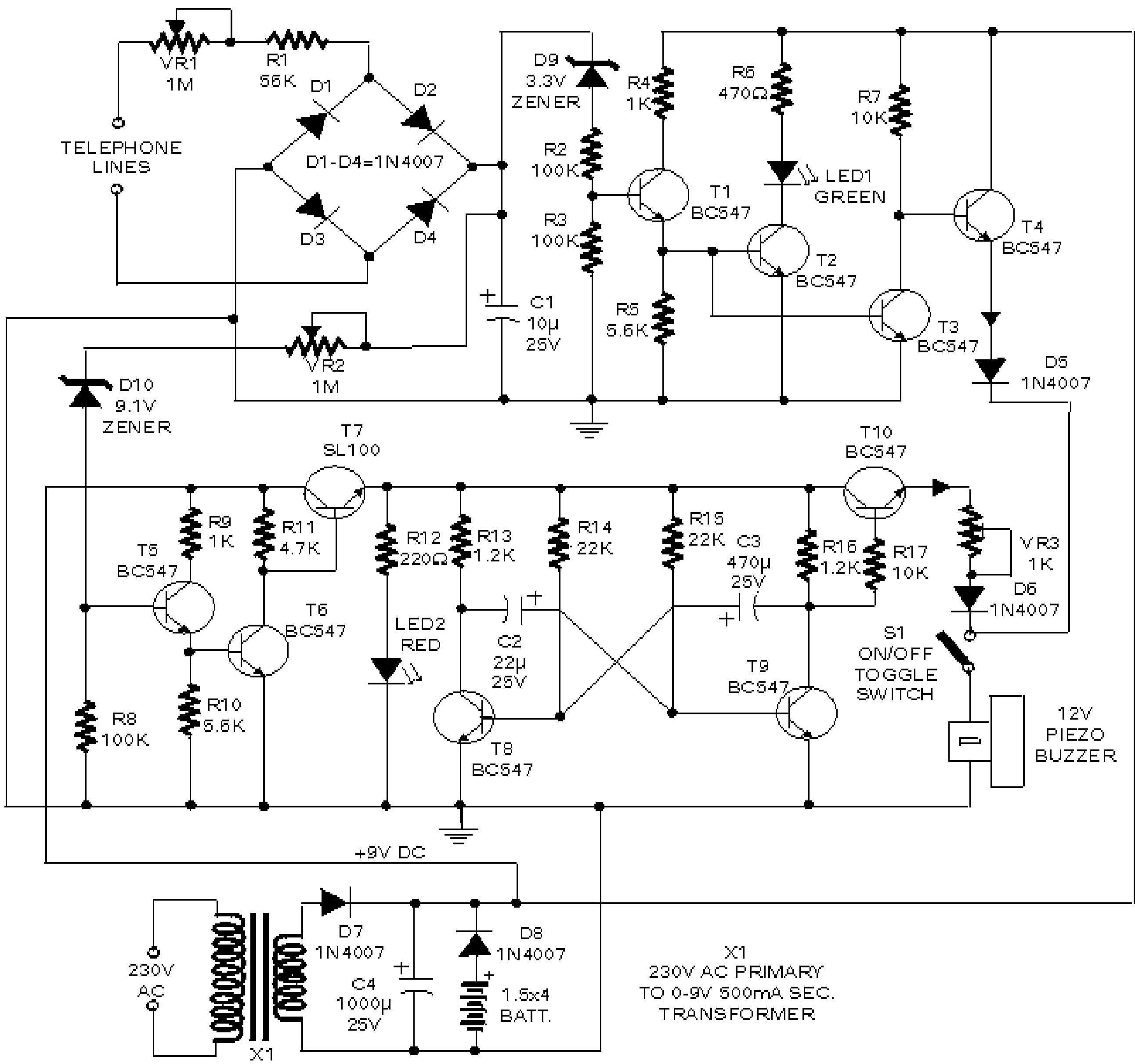
The circuit shown here is used to switch on a lamp when the tele- phone rings, if the ambient light is insufficient. The circuit uses only two ICs and it can be implemented very easily. A light dependent resistance (LDR), with about 5 kilo-ohms resistance in the ambient light and greather than 100 kilo-ohms in darkness, is at the heart of the circuit. The circuit is fully isolated from the phone lines and it draws current only when the phone rings. The circuit provides automatic switching on of a lamp during darkness when the phone is kept in a place such as the bedroom. The lamp can be battery powered to provide light during power failure or load shedding. This avoids delay in attending to a call. The light switches off automatically after a programmable time period and it needs no attention at all. If required, the lamp lighting period can be extended by simply pressing a pushbutton switch (S1). The first part of the circuit functions as a ring detector. When telephone is on-hook, around 48V DC is present across the TIP and RING terminals. The diode in the opto-coupler is 'off' during this condition and it draws practically no current from he telephone lines. The opto-coupler also isolates the circuit from the telephone lines. Transistor in the opto-coupler is normally 'off' and a voltage of +5V is present at the ring indicator line. When telephone rings, an AC voltage of around 70-80V AC, which is present across the telephone lines, is used to turn on the diode inside the opto-coupler (IC2) which in turn switches on transistor inside the opto-coupler. The voltage at its collector passes through 0-volt level during ringing to trigger IC3 74LS123(A) monostable flip-flop. The other opto-coupler (IC1) is used to detect the ambient light condition. When there is sufficient light, LDR has a low resistance of about 5 kilo-ohms and the transistor inside the opto-coupler is in 'on' state. When there is insufficient light available, the resistance of LDR increases to a few mega-ohms and the transistor switches to 'off' state. Thus the DC voltage present at the collector of transistor inside the opto-coupler is normally 0V and it jumps to 5V when there is no light or insufficient light. The 74LS123 retriggerable monostable multivibrator is used to generate a programmable pulse-width. The first monostable 74LS123(A) generates a pulse from the trigger input available during ringing, provided its pin 2 input (marked B) is logic high (i.e. during darkness). It remains high for the programmed duration and switches back to 0V at the end of the pulse period. This high-to-low transition (trailing edge) is used to trigger the second monostable flip-flop 74LS123(B) in the same package. Output of the second monostable is used to control a relay. The lamp being controlled via the N/O contacts of the relay gets switched 'on.' The 'on' period can be extended by simply pressing pushbutton switch S1. If nobody attends the phone, the light turns off automatically after the specific time period equal to the pulse-width of the second flip-flop. The light sensitivity of LDR can be changed by changing resistance R2 connected at collector of the transistor in light monitor circuit. Similarly, switch-on period of the lamp can be controlled by changing capacitor C3's value in the second 74123(B) monostable circuit.

P158. Telephone Headgear



Acompact, inexpensive and low component count telecom head- set can be constructed using two readily available transistors and a few other electronic components. This circuit is very useful for hands-free operation of EPABX and pager communication. Since the circuit draws very little current, it is ideal for parallel operation with electronic telephone set. Working of the circuit is simple and straightforward. Resistor R1 and an ordinary neon glow- lamp forms a complete visual ringer circuit. This simple arrangement does not require a DC blocking capacitor because, under idle conditions, the telephone line voltage is insufficient to ionise the neon gas and thus the lamp does not light. Only when the ring signal is being received, it flashes at the ringing rate to indicate an incoming call. The bridge rectifier using diodes D1 through D4 acts as a polarity guard which protects the electronic circuit from any changes in the telephone line polarity. Zener diode D5 at the output of this bridge rectifier is used for additional circuit protection. Section comprising transistor T1, resistors R2, R3 and zener diode D6 forms a constant voltage regulator that provides a low voltage output of about 5 volts. Dial tone and speech signals from exchange are coupled to the receiving sound amplifier stage built around transistors T2 and related parts, i.e. resistors R7, R6 and capacitor C5. Amplified signals from collector of transistor T2 are connected to dynamic receiver RT-200 (used as earpiece) via capacitor C7. A condenser microphone, connected as shown in the circuit, is used as transmitter. Audio signals developed across the microphone are coupled to the base of transistor T1 via capacitor C3. Resistor R4 determines the DC bias required for the microphone. After amplification by transistor T1, the audio signals are coupled to the telephone lines via the diode bridge. The whole circuit can be wired on a very small PCB and housed in a medium size headphone, as shown in the illustration. For better results at low line currents, value of resistor R2 may be reduced after testing.

P159. Telephone Line Vigilant



Here is a telephone line vigilant circuit to guard against mis- use of your telephone lines. It monitors telephone lines round the clock and provides visual as well as an audio warning (when someone is using your telephone lines) which can be heard anywhere in the house. Another advantage of using this circuit is that one comes to know of the misuse and snapping of the lines (due to any reason) instantaneously on its occurance. This enables the subscriber to take necessary remedial measures in proper time. Various telephone line conditions and audio-visual indications available are summarised in Table I.

TABLE I

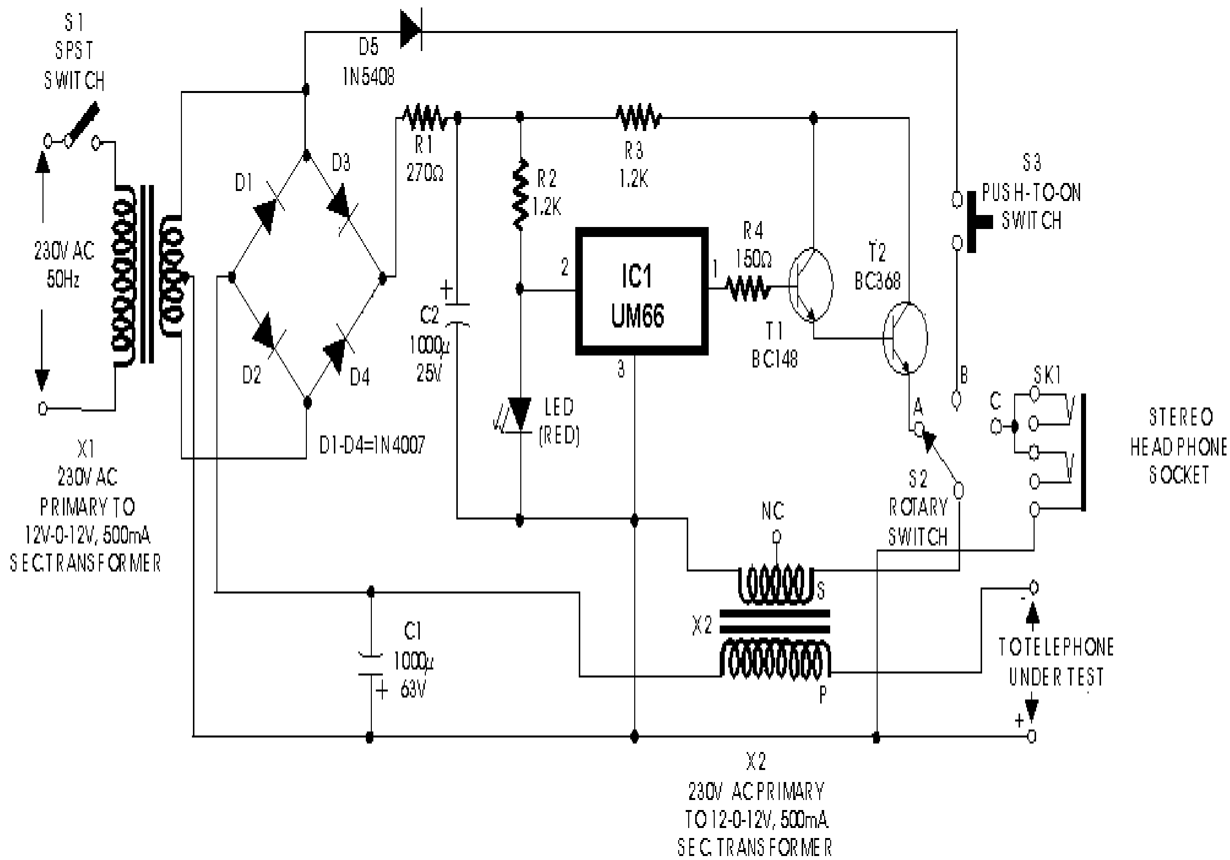
S. No.	Telephone line condition	Green LED	Red LED	Line Voltage	Audio indication
1.	Telephone line disconnected	Not Lit	Lit	0V	Continuous sound
2.	Phone line in use (H/S off-cradle)	Lit	Lit	9V DC (approx.)	Beep, once every 5-seconds
3.	Phone line not in use	Lit	Not Lit	48V DC	No sound

Even when the subscriber himself is using his telephone (handset off-cradle) while the vigilant circuit is on, the buzzer beeps once every 5 seconds since the vigilant circuit cannot distinguish between self-use of the subscriber lines or by any unauthorised person. Thus to avoid unnecessary disturbance, it is advisable to install the vigilant unit away from the phone. However, if one wishes to fit the unit near the telephone then switch S1 may be flipped to 'off' position to switch off the buzzer. But remember to flip the switch to 'on' position while replacing the handset on cradle.

Irrespective of telephone line polarity at the input to the circuit, proper DC polarity is maintained across C1 due to bridge rectifier comprising diodes D1 to D4. The DC voltage developed across capacitor C1 is used to check telephone line condition as per Table I. This circuit draws negligible current from telephone line; thus when it is connected to the telephone line, the normal telephone operation is not affected. The circuit may be divided into two parts. The first part comprises zener D9, transistors T1 to T4 and diode D5. It is used to verify whether telephone line loop is intact or discontinuous. The second part comprising zener D10 and transistors T5 to T10 is used to check whether telephone line is in use (or misuse) or not. The zener diode D9 (3.3V) conducts when phone line loop is intact and not broken. Zener D9 sets control voltage for transistors T1, T2 and T3 to conduct and for T4 to cut off. As a result, green LED lights but no sound is heard from the buzzer.

When phone line loop is discontinuous, no voltage is available across capacitor C1. Thus zener D9 and transistors T1, T2 and T3 do not conduct while T4 conducts. Now green LED extinguishes and a continuous sound is heard from the buzzer. When telephone line is alright but is not in use, zener D10 conducts as voltage across capacitor C1 is quite high. This results in conduction of transistors T5 and T6 and cutting off of transistor T7 (as collector of transistor T6 is near ground potential). Thus positive 9V rail is not extended to the following multivibrator circuit built around transistors T8 and T9. Consequently, the red LED is not lit and buzzer does not sound. When phone line is in use, zener D10 does not conduct. As a result, transistors T5 and T6 also do not conduct, while transistor T7 conducts. Now +9V is extended to multivibrator circuit. This multivibrator is designed such that collector of transistor T9 goes high once every 5 seconds to forward bias transistor T10 and it conducts. Thus at every 5-second interval a beep sound is heard from buzzer. The beep sound interval can be increased or decreased by changing the value of capacitor C3 while the volume can be adjusted with the help of preset VR3.

P160. Off line Telephone tester



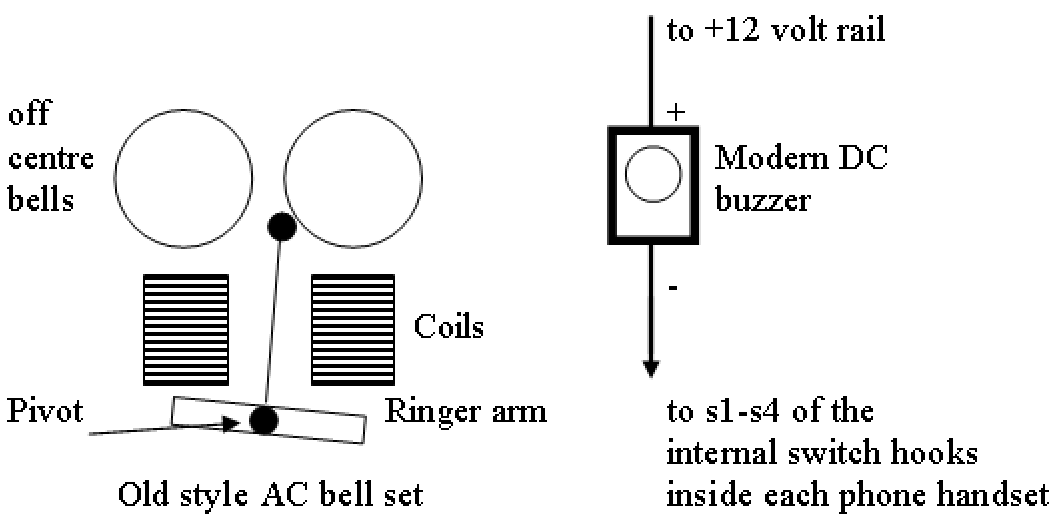
Here is a circuit of an off-line telephone tester which does not require any telephone line for testing a telephone instrument. The circuit is so simple that it can be easily assembled even by a novice having very little knowledge of electronics. A telephone line may be considered to be a source of some 50 volts DC with a source impedance of about 1 kilo-ohm. During ringing, in place of DC, an AC voltage of 70 to 80 volts (at 17 to 25 Hz) is present across the telephone line. When the subscriber lifts the handset, the same is sensed by the telephone exchange and the ringing AC voltage is disconnected and DC is reconnected to the line. Lifting of the handset from the telephone cradle results in shunting of the line's two wires by low impedance of the telephone instrument. As a result, 50V DC level drops to about 12 volts across the telephone instrument. During conversation, the audio gets superimposed on this DC voltage. Since any DC supply can be used for testing a telephone instrument, the same is derived here from AC mains using step-down transformer X1. Middle point of the transformer's secondary has been used as common for the two full-wave rectifiers—one comprising diodes D1 and D2 together with smoothing capacitor C1 and the other formed by diodes D3 and D4 along with filter capacitor C2. The former supplies about 12 volts for the telephone instrument through primary of transformer X2 which thus simulates a source impedance, and a choke which blocks AC audio signals present in the secondary of transformer X2. The AF signal available in secondary of X2 is sufficiently strong to directly drive a 32-ohm headset which is connected to the circuit through headphone socket SK1 via rotary switch S2. During ringing, a pulsating DC voltage from transformer X1 via rectifier diode D5, push-to-on switch S3, and contact 'B' of rotary switch S2 is applied across secondary of transformer X2. The boosted voltage available across primary of transformer X2 is sufficient to drive the ringer in the telephone instrument. Please avoid pressing of switch S3 for more than a few seconds at a time to prevent damage to the circuit due to high voltage across primary of transformer X2. The circuit also incorporates a music IC (UM66) whose output is connected to secondary of transformer X2 via switch S2 after suitably boosting its output with the help of darlington transistor pair T1 and T2. This output can be used to test the audio section of any telephone instrument. After having assembled the circuit satisfactorily, the following procedure may be followed for testing a telephone instrument:

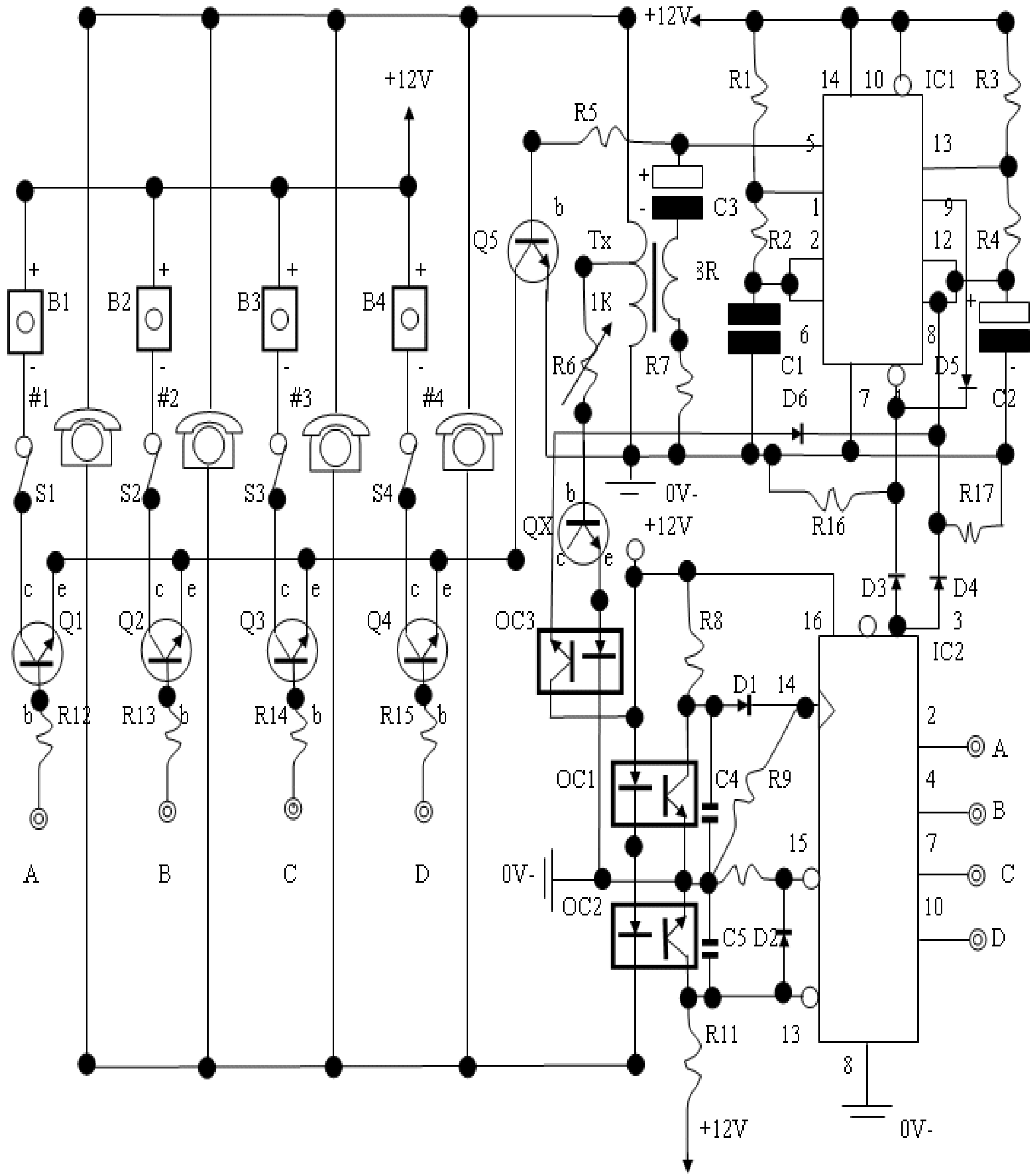
1. Connect the telephone to the terminals marked 'To Telephone Under Test'and switch on mains (switch S1).

2. To test the ringer portion, flip switch S2 to position 'B' and press S3 for a moment. You should hear the ring in case the ringer circuit of the telephone under test is working. Please ensure that handset is on cradle during this test.

3. For testing the audio section, flip switch S1 to position 'C' and connect a headphone to socket SK1. Pick the telephone handset and speak into its microphone. If audio section is working satisfactorily, you should be able to hear your speach via the headphone. If you dial a number, you should be able to hear the pulse clicks or pulse tone in the headphone, depending on whether the telephone under test is functioning in pulse or tone mode. If the telephone under test has a built-in musical hold facility, on pressing the 'hold' button you should be able to hear the music. Now flip switch S2 to position 'A'. You should be able to hear music generated by IC1 through earpiece of the handset of the telephone under test, indicating propor functioning of the AF amplifier section. The circuit can be assembled on a small piece of veroboard. Try to mount the two transformers on opposite sides of the board, displaced by 90 degrees. Always keep handy multi-type modular plugs for testing various types of telephones. Mount all switches, sockets and LEDs on the front of testing panel.

P161. The link telephone intercom





The Link circuitry is simple and efficient, employing just two ICs, half a dozen transistors, and a handful of garden variety components. It all runs on 12 volts and is easily assembled. You can have your own home intercom between the kitchen, the garage, the rumpus room and at your poolside 'barby'.

The "Link" intercom has been designed in such a way that you can buy parts for it 'off the shelf' at just about any decent electronics retail chain. It uses old pulse dial handsets and replaces the AC bell set with a 9 volt DC buzzer. The whole circuit runs from a 12 volt regulated DC supply and is suitable for short term battery operation (eg: 'Gel Cell'). It is suitable for radio field days and sporting events (providing you can scrounge enough 4 wire cable) and may find a place in pre-schools, old folk's homes, boy scout/girl guide halls, churches, kids' tree houses/fortresses, or maybe even more serious uses such as small offices, factories, workshops and many other applications.

The "Link" is designed to enable one call at a time within a small area (about 100 meters from the 'black box' is about the max per handset) and is not suitable for connection to the PSTN (public network) as the voltages and currents used by the PSTN are higher, and will damage the simpler 12 volt circuitry, that employs CMOS ICs etc. The Link will run quite happily off a 12 volt regulated DC supply of only 200mA or so, and this can be a simple affair, such as a DC plug pack, wired to a 7812 regulator chip and appropriate filter caps on the output. Add some leds if you want!

Overview

The Link telephone intercom is designed around two ICs. The first, IC1, is an NE 556 dual timer chip, which is wired up to provide dial tone, ring tone (busy tone too, which will be explained along with a few add-ons to be mentioned later on) and ring pulses for the ringer circuit attached to each line circuit. The other chip, IC 2, is a CD 4017B decade counter, which is wired to count each train of dial pulses as they are received and buffered by the two opto-couplers, OC1 and OC 2 and their associated R/C networks.

Line Circuits

Each phone handset is connected by a four wire circuit from the 'black box'. Two wires (normally tagged 'white' and 'blue' here in Oz) are for speech and dialing functions, whereas the other two (tagged locally as 'red' and 'black') are for the ring pulses supplied by the ringer circuit to each DC buzzer inside the handsets. When a phone (eg: #1 for our discussion) is picked up in its 'off hook' condition, a DC loop is formed by the following components: DC circuitry inside the phone, the 1K winding of transformer TX, and back to 0V- earth. Taken from the +12 volts terminal, through the Leds inside OC1 and OC2 and back to the phone handset.

Making A Call

Dial tone is provided to the calling party's phone when the Link is in its 'reset' condition (no calls in progress) via capacitor C3 and the 8 ohm winding (8R) of TX to 0v- earth. This and the other service tones are generated by IC1a, while ring pulses are generated by IC1b. When a calling party's phone is 'off hook', the leds force the photo transistors to switch on hard, pulling pins 13 and 14 of IC2 to 0 volts ground. When the dial inside the phone handset is pulled back and released, the collector lead of OC2's transistor is held low at 0 volts by the slow release charging of C5. Pin 13 of IC2 is a CE (chip enable) input, and needs to stay at a logic low (near 0 volts) to enable pin 14 to count the dial pulses. So while 'impulsing' occurs, pin 13 stays low, and pin 14 alternates between logic high and low as the led emulates each dial pulse train, until the last pulse in the train is received.

Dialing Into The Register

When caller number #1 dials phone number # 4, those four pulses appear across the leds inside OC1 and OC2. The decade counter, acting as a Register (a storage device used in communications equipment for storing dialed digits) counts these pulses, turning its output pins on and off inn unison, with the last dial pulse causing the counter to rest on the last output pin that is turned on. The complete sequence for a maximum of ten pulses in the one pulse train, is (pin 3 is always at logic high at 'reset') 2,4,7,10, and then 1,5,6,9,11 and then finally pin 3. So when the number '4' is dialed, the counter would step through pins 2,4,7, and then land on pin 10, which is connected to phone #4's ringer circuit via Q4's base lead.

The Ringer Circuit

Each line circuit consists of the individual phone handset, the DC buzzer mounted inside it, the common connections to TX and the cathode of OC2's led, as well as transistors Q1 to Q4 and common driver transistor Q5. With pin 3 of IC2 at logic high on 'reset', diode D3 enables IC2a to provide a Dial Tone from pin 5. When a number is dialed, pin 3 of IC2 goes low on the first dial pulse, removing the logic high via D4 from pins 12 and 8 of IC1b, thus enabling it to charge up C3, and produce ring pulses to IC1a via diode D5, (from pin 9 to pin 4). After about 2 seconds, ring pulses commence, and the modulated dial tone (which then by default becomes an interrupted Ring Tone to the caller) is produced at pin 5 of IC1a, indicating the progress of the call.

True Ring Trip

When the called party answers the call, transistor QX with trimpot R6, (adjusted to detect both phones being 'off-hook',) triggers the led and phototransistor inside OC3. This halts the ring pulses and ring tone supplied by IC1a and IC1b for the duration of that call, by supplying a logic high potential to pins 12 and 8 of IC1b via D6. When the call is over, and both parties have hung up their phone handsets (eg: back to the 'on-hook' status,) the DC loop formed by the handsets, TX and OC1/OC2 is broken. Pin 13 of IC2 returns to its reset potential of logic high, and extends this high to pin 15 (Reset) of the 4017 decade counter chip, which disables the output selected during the dialing operation, and enables pin 3 to high, thus restoring Dial Tone to the next caller via pin 4 of IC1a.

Resetting The Link

Thus the Link is fully reset and ready for another call. As you can see, it may seem a little complicated to follow the progression through a call, particularly if you haven't been involved with phones and logic chips much before. At the end of the day, you have some simple counting, pulsing and interfacing circuitry, which will perform all the necessary tasks of a basic intercom, and all at a reasonable cost. I used some formatted matrix board for the p.c.b and IC sockets for all ICs and OC/OC2. I also found that a heat sink fin for the 7812 regulator chip was unnecessary. A box could be used for housing the Link circuitry, and some kind of screw terminal block or ID block (like a small 10 pair KRONE junction box) could be used to terminate the wiring at the box to make it look more professional. Remember these two things. If you leave a phone 'off-hook' you will lock up the Link and if you pick up a phone when someone else is dialing, wrong numbers will result. Apart from that, have fun!

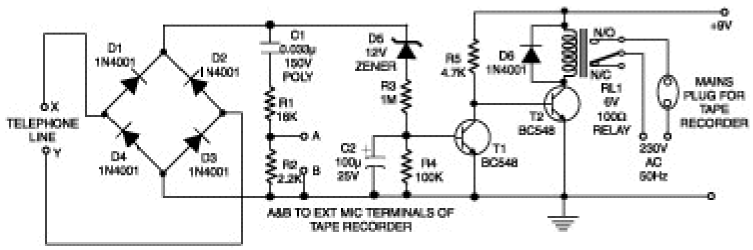
Parts List:

R10	100k
R1	10k
R2	150k
R3	4k7
R4	47k
R5	2k2
R6	4k7 trimpot
R7	390R
R8	10k
R9	100k
R11	22k
R12-R15	2k2
R16	4k7
R17	4k7
C1	0.22uF
C2	47uF
C3	1uF
C4	2,200uF (power filter cap – not shown, but wired across +12volts & 0v- ground points
Q1-Q5	BC547 n.p.n low gain
Q6	BC 549C high gain with a beta of at least 250+
D1-D7	1N4148 or 1N914 small signal diodes
IC1	NE 556 dual timer chip
IC2	CD 4017B decade counter chip
OC1-OC3	4N25 or 4N28 opto couplers
Tx	1k/8R transformer, with 1k centre tapped

B1-B4 9 volt DC buzzers mounted inside phone handsets

Miscellaneous – wire, cable, matrix or prototyping board, solder, case, 15 volt DC 200ma plug pack power supply, phone sockets, zip ties, 7812 regulator and filter caps etc.

P162. Conversation Recorder



This circuit enables automatic switching-on of the tape recorder when the handset is lifted. The tape recorder gets switched off when the handset is replaced. The signals are suitably attenuated to a level at which they can be recorded using the 'MIC-IN' socket of the tape recorder.

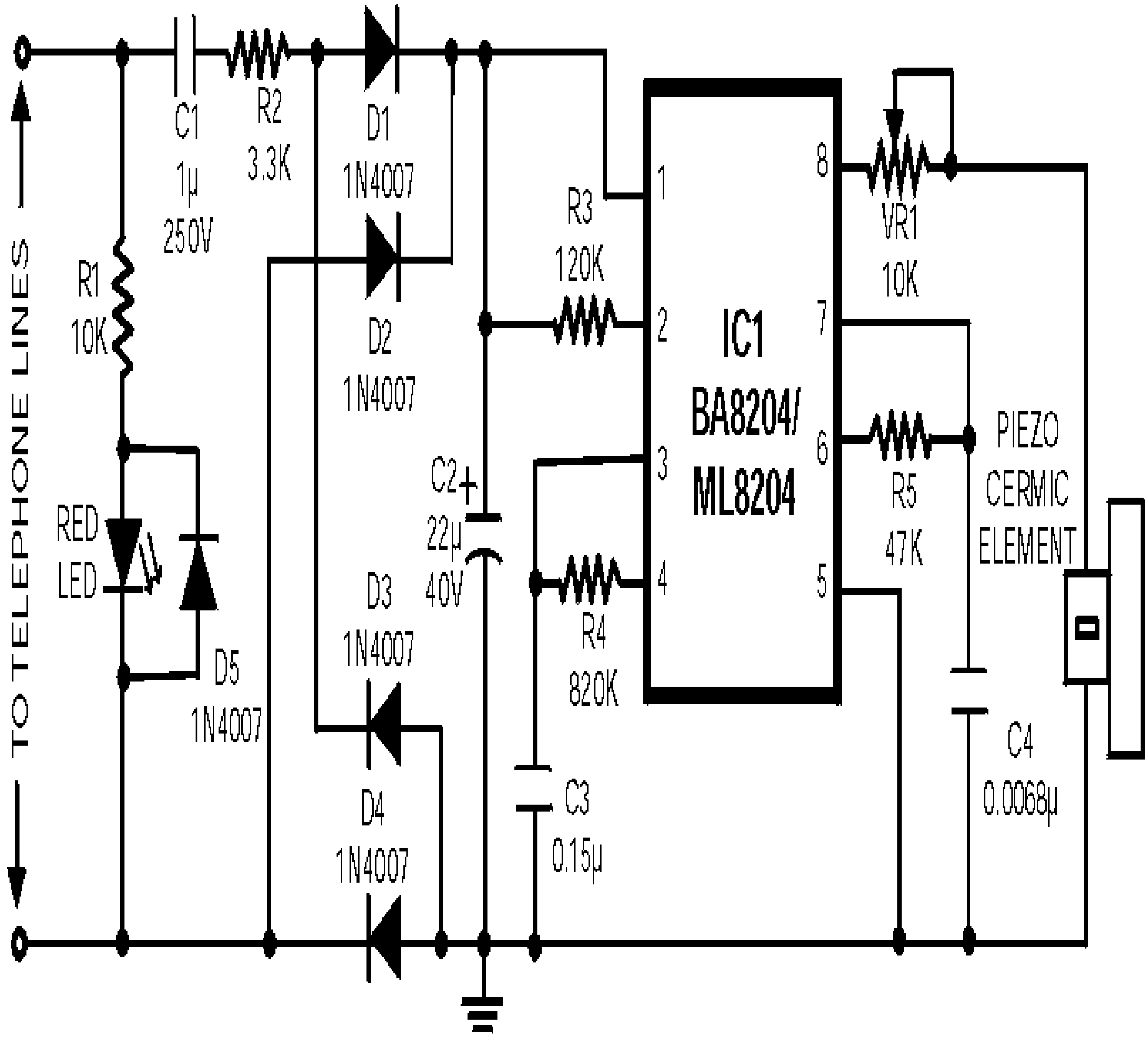
Points X and Y in the circuit are connected to the telephone lines. Resistors R1 and R2 act as a voltage divider. The voltage appearing across R2 is fed to the 'MIC-IN' socket of the tape recorder. The values of R1 and R2 may be changed depending on the input impedance of the tape recorder's 'MIC-IN' terminals. Capacitor C1 is used for blocking the flow of DC.

The second part of the circuit controls relay RL1, which is used to switch on/off the tape recorder. A voltage of 48 volts appears across the telephone lines in on-hook condition. This voltage drops to about 9 volts when the handset is lifted. Diodes D1 through D4 constitute a bridge rectifier/polarity guard. This ensures that transistor T1 gets voltage of proper polarity, irrespective of the polarity of the telephone lines.

During on-hook condition, the output from the bridge (48V DC) passes through 12V zener D5 and is applied to the base of transistor T1 via the voltage divider comprising resistors R3 and R4. This switches on transistor T1 and its collector is pulled low. This, in turn, causes transistor T2 to cut off and relay RL1 is not energised.
When the telephone handset is lifted, the voltage across points X and Y falls below 12 volts and so zenor diode D5 does not conduct. As a result, base of transistor T1 is pulled to ground potential via resistor R4 and thus is cut off. Thus, base of transistor T2 gets forward biased via resistor R5, which results in the energisation of relay RL1. The tape recorder is switched 'on' and recording begins.

The tape recorder should be kept loaded with a cassette and the record button of the tape recorder should remain pressed to enable it to record the conversation as soon as the handset is lifted. Capacitor C2 ensures that the relay is not switched on-and-off repeatedly when a number is being dialled in pulse dialing mode.

P163. Audio Visual Indicator for Telephones



Many a times one needs an ex- tra telephone ringer in an ad- joining room to know if there is an incoming call. For example, if the telephone is installed in the drawing room you may need an extra ringer in the bedroom. All that needs to be done is to connect the given circuit in parallel with the existing telephone lines using twin flexible wires. This circuit does not require any external power source for its operation. The section comprising resistor R1 and diodes D5 and LED1 provides a visual indication of the ring. Remaining part of the circuit is the audio ringer based on IC1 (BA8204 or ML8204). This integrated circuit, specially designed for telec- om application as bell sound generator, requires very few external parts. It is readily available in 8-pin mini DIP pack.

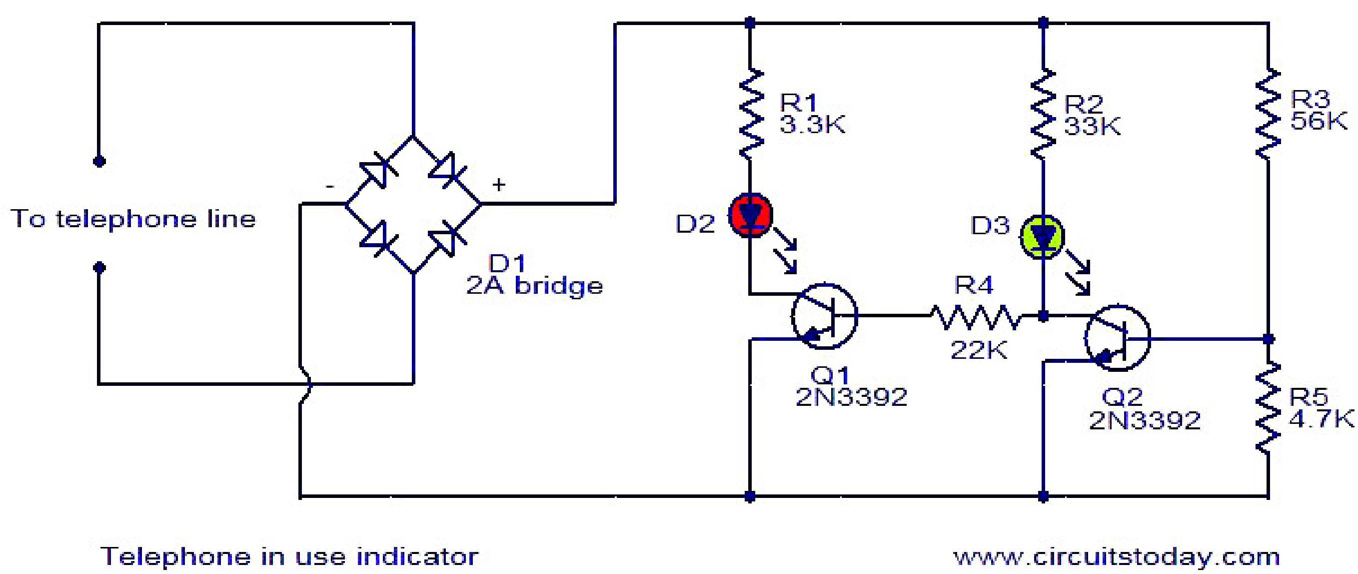
Resistor R3 is used for bell sensitivity adjustment. The bell frequency is controlled by resistor R5 and capacitor C4, and the repeat frequency is controlled by resistor R4 and capacitor C3. A little experimentation with the various values of the resistors and capacitors may be carried out to obtain desired pleasing tone. Working of the circuit is quite simple. The bell signal, approximately 75V AC, passes through capacitor C1 and resistor R2 and appears across the diode bridge comprising diodes D1 to D4. The rectified DC output is smoothed by capacitor C2. The dual-tone ring signal is output from pin 8 of IC1 and its volume is adjusted by volume control VR1. Thereafter, it is impressed on the piezo-ceramic sound generator.

P164. Telephone in use indicator

Description.

Here is a simple circuit that can be used as a telephone status indicator. When the telephone is in use (off hook) the transistor Q1 switches ON making the red LED D2 glow. When the telephone is not in use (on hook) the Q1 turns OFF and Q2 turns ON. This makes the red LED D2 off and green LED D3 ON. The circuit is powered from the phone line itself and no external power supply is required.

Circuit diagram with Parts list.



Notes.

- The circuit can be assembled on a general purpose PCB.
- IF 2A ampere bridge is not available, make one using diodes like 1N4007.
- Note that some countries prohibit people from connecting other devices to the phone line.

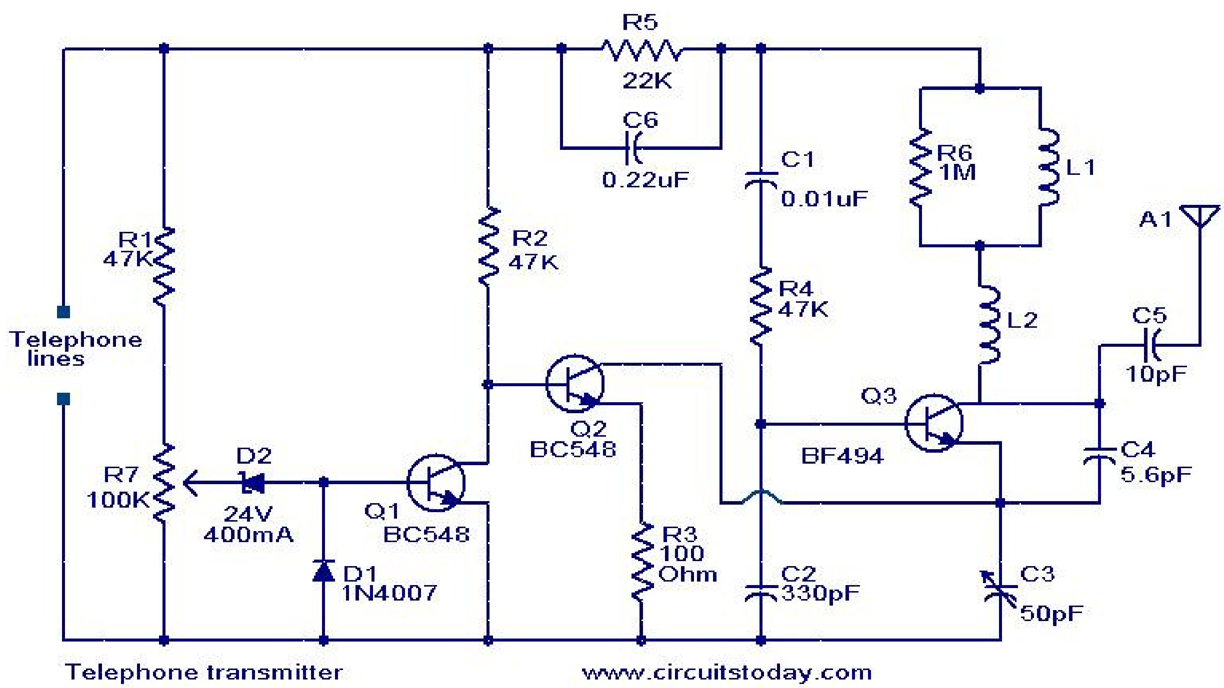
P165. Telephone transmitter

Description.

This is a simple, but very useful circuit that can be used to transmit telephone conversations. When the telephone receiver is on hook the voltage across the lines will be about 48 volts. The preset R7 is so adjusted to obtain a 24.7 V across between the cathode of D2 and ground. At this voltage the Zener diode D2 will be in breakdown and the transistor T1 will conduct. This makes the transistor T2 OFF. When the receiver is off hook, the line voltage drops to about 11 volts. This makes the transistor T1 OFF and subsequently the T2 ON. The T2 in switched ON condition will provide a DC path for the transistor T3 used in the FM transmitter section.

The transistor T3 is wired as a common emitter radio frequency oscillator. In simple words the transistor T2 serves as an ON/OFF switch for this oscillator. The modulated signal will be available at the collector of transistor T3 and the signal id fed to the antenna via capacitor C5.

Circuit diagram with Parts list.



Notes.

- Assemble the circuit on a good quality PCB.
- For L1 make 45 turns of 36 SWG enameled copper wire on the resistor R6 itself.
- The resistor R6 must be a 1M, 1 watt resistor.
- For L2 make 3 turns of 21 SWG enameled copper wire on a 12 mm plastic former.
- For antenna, use a 1 meter insulated copper wire.
- The capacitor C3 can be a 50pF trimmer.

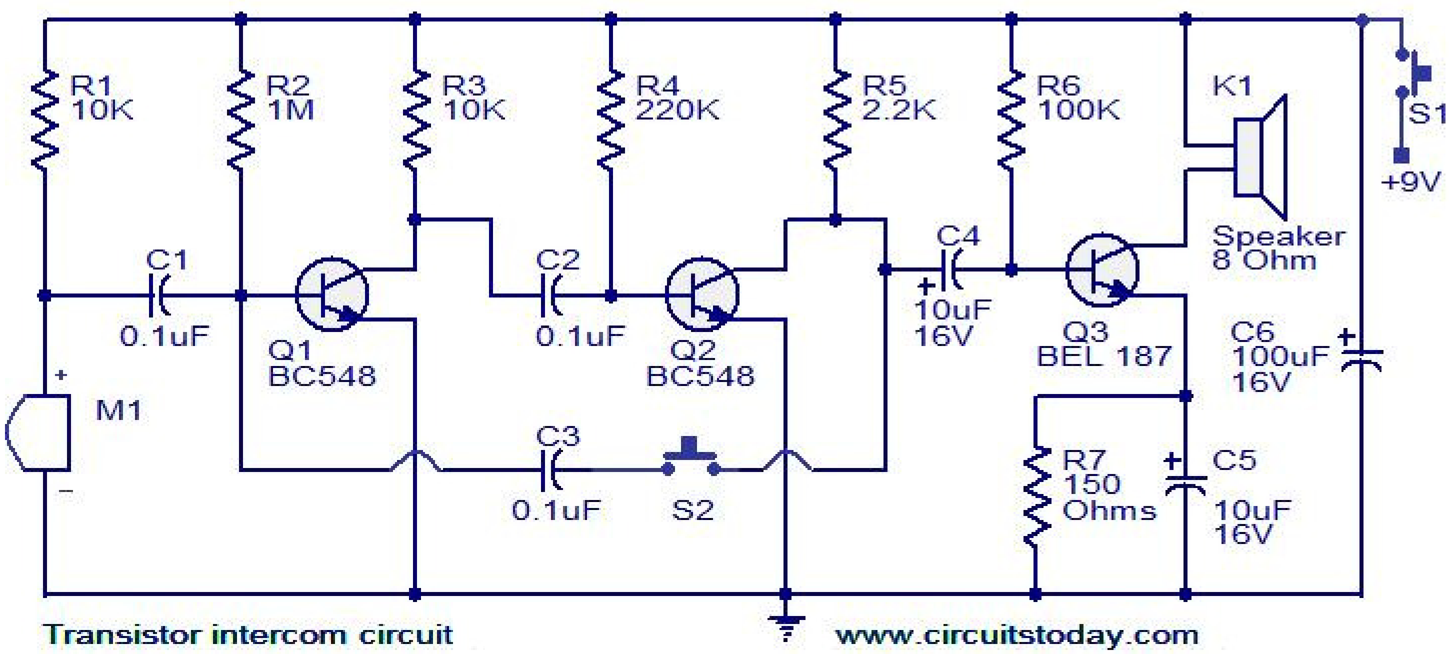
P166. Transistor intercom circuit

Description.

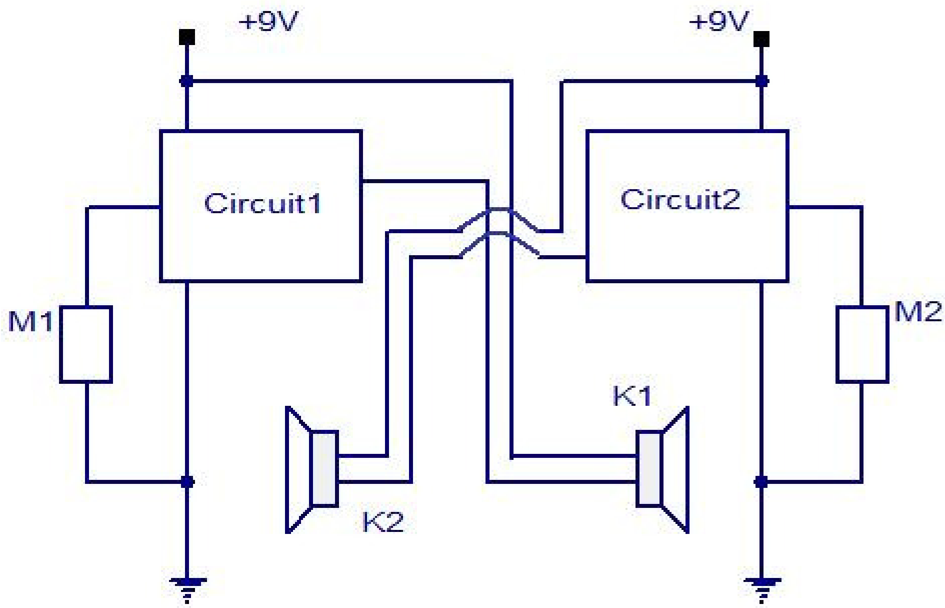
Here is a simple but effective intercom circuit that is based fully on transistors.The circuit is based on a three stage RC coupled amplifier. When the pushbutton S2 is pressed, the amplifier circuit wired around T1 & T2 becomes an astable multivibrator and starts producing the ringing signals. These ringing signals will be amplified by the transistor T3 to drive the speaker. When the push button S2 is released the circuit will behave as an ordinary amplifier and you can talk to the other side through it.

To construct a two way intercom, make two identical copies of the circuit given below and connect it according to the given connection diagram. The stand by current consumption of this circuit is around 20mA.

Circuit diagram with Parts list.



Connection diagram.Â



Â Transistor intercom connection diagram

Notes.

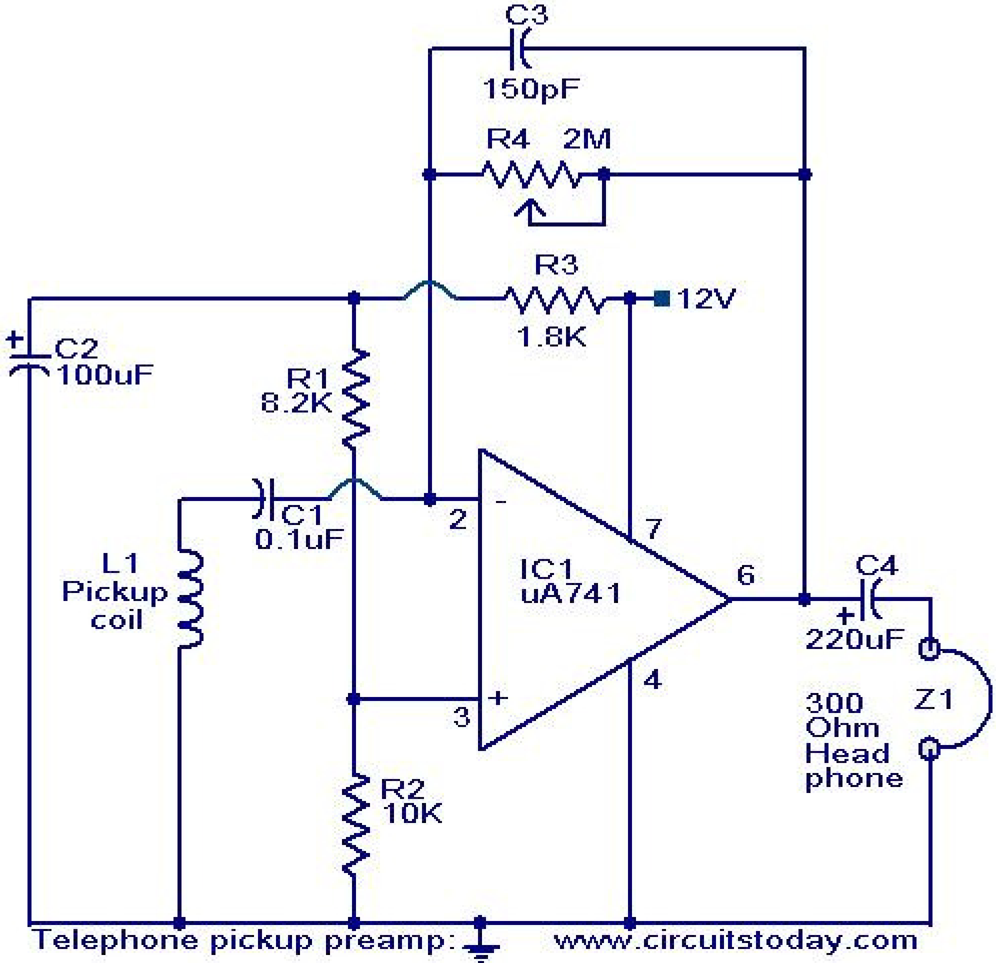
- Assemble the circuit on a good quality PCB.
- Use 9V PP3 battery for powering the circuit.
- The Mic M1 can be condenser micro phone.
- Â Use push to ON type push button switch for S2.
- Use a slide switch for switch S1.S1 can be used to power the circuit.

P167. Telephone pickup preamplifier_

Description.

Here is a simple circuit based on IC uA 741 that can be used to pickup voice from telephone lines without even contacting the line. If a high impedance magnetic core is placed near a telephone instrument or near one of the telephone wires, it picks up inductively both sides of the telephonic conversation without any electrical contact. A preamplifier based on IC uA741 is used to pickup these signals. The circuit is nothing but an inverting amplifier whose gain depends on the feedback resistance R4.The Op-Amp produces the necessary gain to drive the headphone. The circuit can be used as a telephone bug too.

Circuit diagram with Parts list.Â



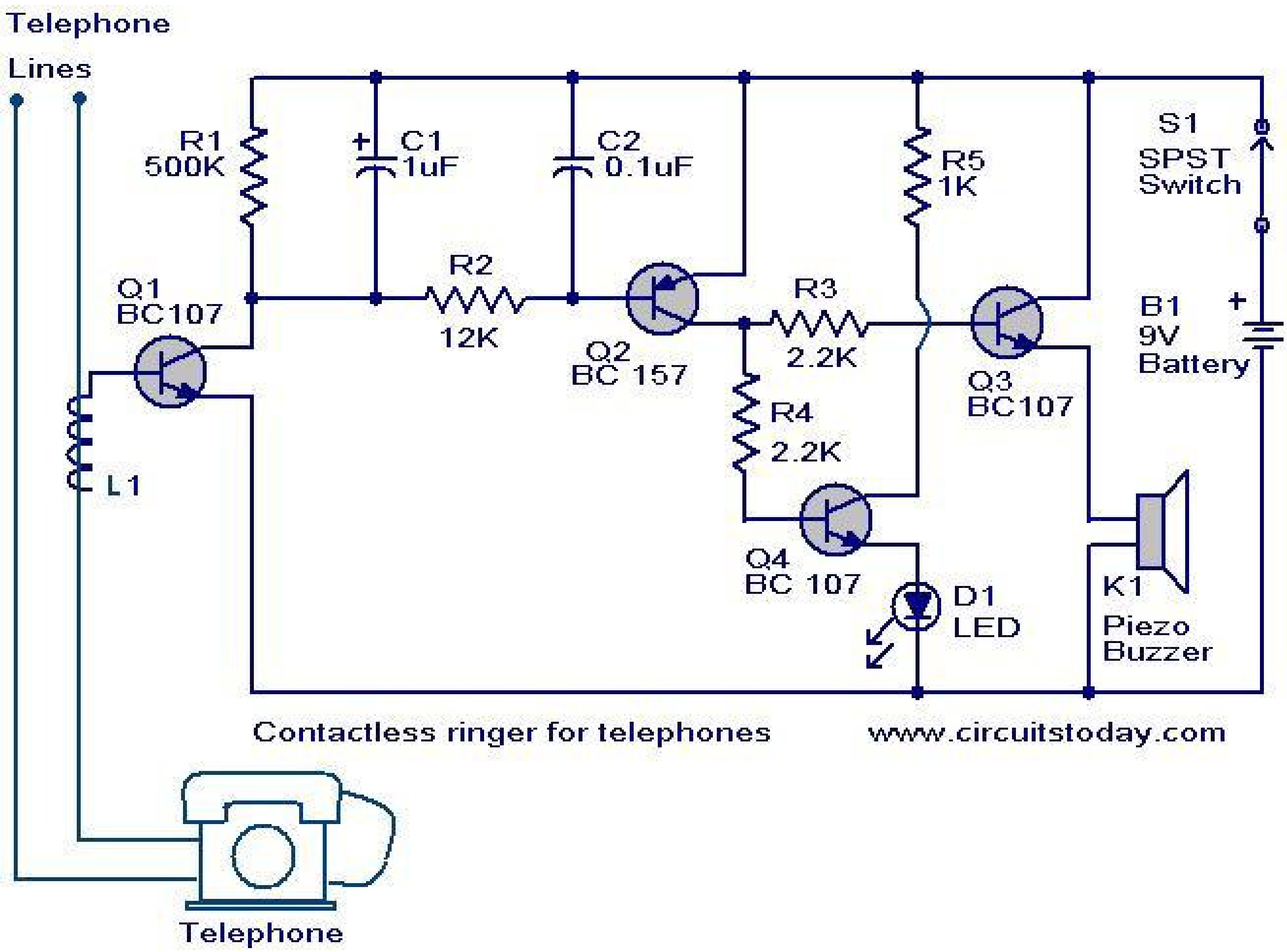
Â

Notes.

- Assemble the circuit on a good quality PCB or common board.
- You can use 9 to 24 V DC for powering the circuit.I prefer 12V.
- The coil L1 can be made by winding 3000 turns ofÂ 0.4mm insulated copper wire on aÂ plastic former.
- If the pickup is bad increase the no of turns to 5000 and try.
- The POT R4 can be used for gainÂ adjustments.

P168. Contactless telephone ringer circuit

Circuit diagram with Parts List.



Description.

The contact less telephone ringer circuit can produce a ring as well as a visual indication when a call comes.The main advantage is that since there is no direct contact between the phone line and the circuit there is no chance for a loading or disturbance in the telephone line.

When the telephone rings 60 Hz AC signal is generated which produces a proportional magnetic field around the telephone lines.These magnetic field will be picked up by the coil L1 due to electromagnetic induction.A proportional voltage is developed across L1 and it will bias transistor Q1 to ON.This results in the conduction of transistors Q2,Q3 andQ4.The buzzer will ring and the LED will glow.The switch S1 acts as an ON/OFF switch.

Notes.

- For L1 make 50 close turns of 28 SWG enameled copper wire on any of the two telephone wires.Connect one end of the coil to base of Q1 and leave other end free.
- If the circuit not works by try by changing the end of the L1 connected to base of Q1.
- A 9V transistor radio battery can be used as the power source.
- Assemble the circuit on a good quality PCB or common board.
- Use of this type or any other devices other than the allowed telephones and devices with the telephone line may be a law violation in some nations.Check it properly before trying.

RADIO,

TRANSMITTER,

RECEIVER,

REMOTE CONTROL

P169. 15W Fm-transmitter

Warning: Take care with transmitter circuits. It is illegal in most countries to operate radio transmitters without a license

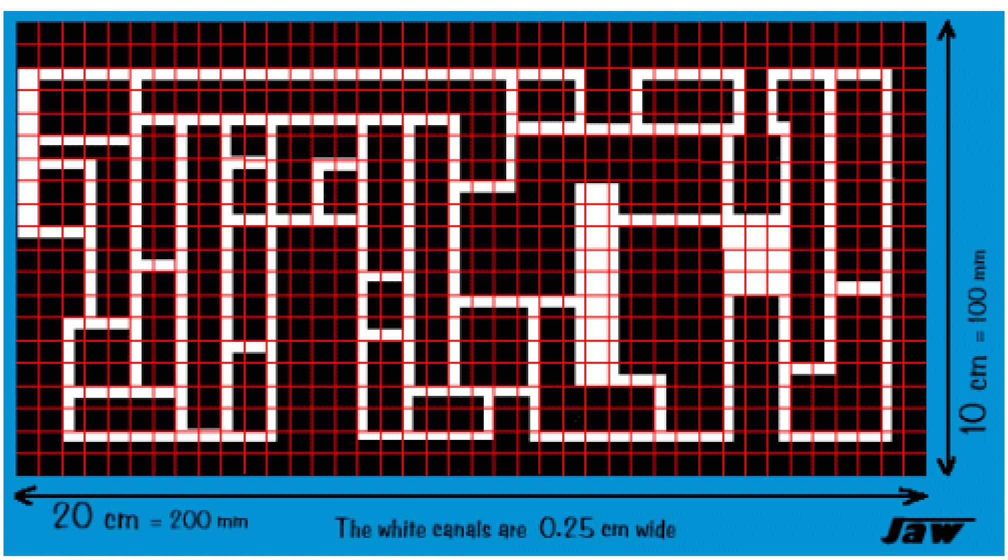
It was five years ago when I did an attempt to build my first fm-transmitter. It ended in a giant faillure. The only thing it did was interferring with our tv-set. Looking back it was due to the lack of information I had. A schematic was my only help. Now, five years later, I know a lot more about electro-technics. So I searched for a schematic of a stable, tested fm-transmitter with a far reach. I will put all information you'll have to know in my page. I made drawings to make things clearer. As said before: I'm still building it, so I will add information every time I made progress. It would be wise for you out there not to start building untill I'm ready and have tested it. It has been succesfully built before, but my succes will give you a double security.

I remind you of the fact that I can also fail.

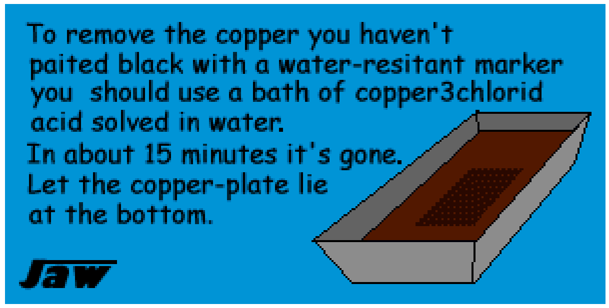
Intro
Building a good fm-transmitter(88-110Mhz) begins with getting a good schematic. You don't have to understand the precise working of the transmitter to build it. But some basic information won't harm. A transmitter alone is, as you probably know, is not enough to start your radio-station. In the simplest form you need 4 things. First an input device such as an amplifiler you also use with your home-stereo.

You can also use a walkman. Details about input-devices in the page: "Input". Second you need a regulated power-supply. In this case a 14-18 Volts/2,5-3,5 Ampere. One of the most influencial things you need is antenna and coax-cable. More about this later on. And finally the transmitter itself. You can devide the transmitter in two main parts: the oscilator and the amplifiler. The oscilator converts electric sound information into electromagnetic waves. The amplifiler gives these waves a bigger amplitude.

Building
It's stable and has output of 15-18 watts. This enough to terrorize your wide surroundings at the fm-band.
The most often used technique to connect the components to each other is soldering them on a double sided copper-board. Another way is connecting the components floating. It is cheaper but very tricky. Below you see the copper-board layout(PCB). I designed it looking closely at the root scheme.



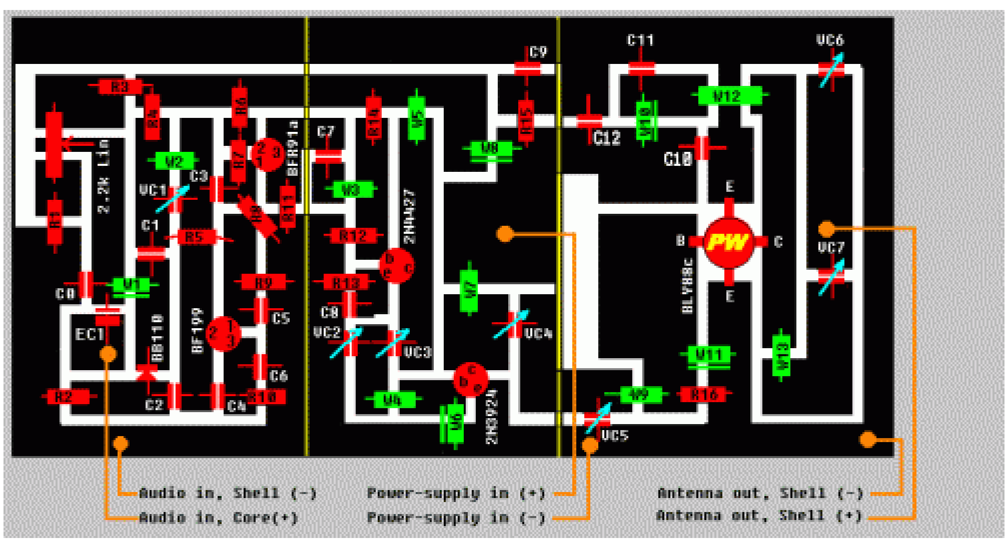
To get this pattern in copper surface you use a acid bath. Use a water-resistant permanent marker to paint your own copper-board black in the pattern the shown above. Color the back side ompletely black. The grid-squares are 0,5*0,5 cm each.

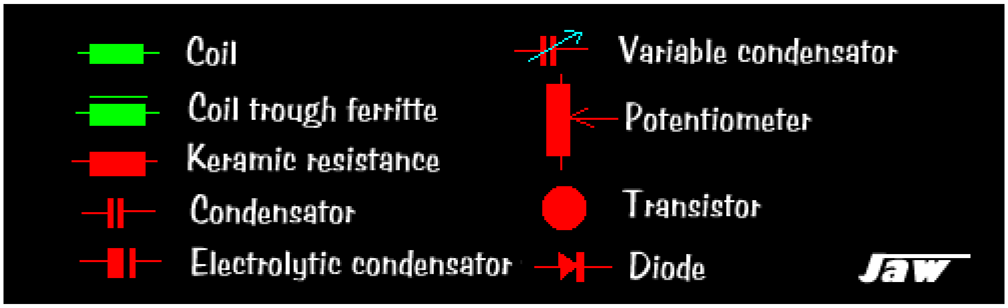


When the acid has eaten the non-painted copper away you must remove the complet thin layer of black paint with sandpaper. Don't remove too much copper with it.
So, now you have the surface to solder the electric components on.

Now a few basic rules for good soldering:
1. Use a special electronics-solderingrod with a slim top.
2. Use soldering-metal with an anti-oxidant-fluid core.
3. Don't heat the components! Heat the connection-point on your PCB.
4. Make sure that the surface is not too smooth.
5. Don't use too much metal.
6. Don't let the soldering metal form a bridge beetween two copper-surfaces.
7. If you're smart you start from the middle of your prepaired board.
In this way you'll have enough space.

Below the schematic. The yellow lines are pieces of copperboard that devide the transmitter in 3 parts. This is essential. Without them, internal interferrence will ruin your signal.

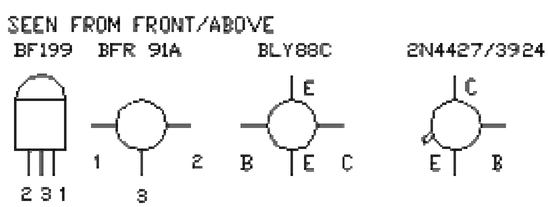




Parts

R1 =56 OHM	W1 = 3*5*10 ferrite	C0 =1nf	VC1 =4-40pf
R2 =100K	W2 = 9mm/3x/l=10mm	C1 =18pf	VC2 =8-40pf
R3 =27K	W3 = 12mm/1x	C2 =18pf	VC3 =8-40pf
R4 =100 OHM	W4 = 12mm/1x	C3 =6,8pf	VC4 =8-40pf
R5 =4,7K	W5 = 9mm/4x/l=12mm	C4 =6,8pf	VC5 =8-40pf
R6 =4,7K	W6 = 2,5*5*10 HF ferrite	C5 =1nf	VC6 =5-65pf mauve
R7 =15K	W7 = 9mm/3x/l=8mm	C6 =22nf	VC7 =5-65pf mauve
R8 =2,2K	W8 = 2,5*5*10 ferrite	C7 =56pf	
R9 =1K	W9 = 12/1x	C8 =1nf	EC1 =4,7uf
R10 =1K	W10 = 2,5*5*10 ferrite	C9 =0,1uf	
R11 =100 OHM	W11 = 2,5*5*10 ferrite	C10 =1nf	
R12 =2,2K	W12 = 9mm/7x/l=19mm	C11 =1nf	
R13 =47 OHM	W13 = 13mm/3x/l=7mm	C12 =1nf	
R14 =47K			
R15 =10 OHM			
R16 =15 OHM			

There are some components that need extra attention. Transistors usually have 3 or 4 different wires comin' out. If you connect these wires in the wrong way the transmitter won't work. It may even explode. The picture below shows how to prevent from such an event.



You can find the numbers and letters back in the soldering schematic.

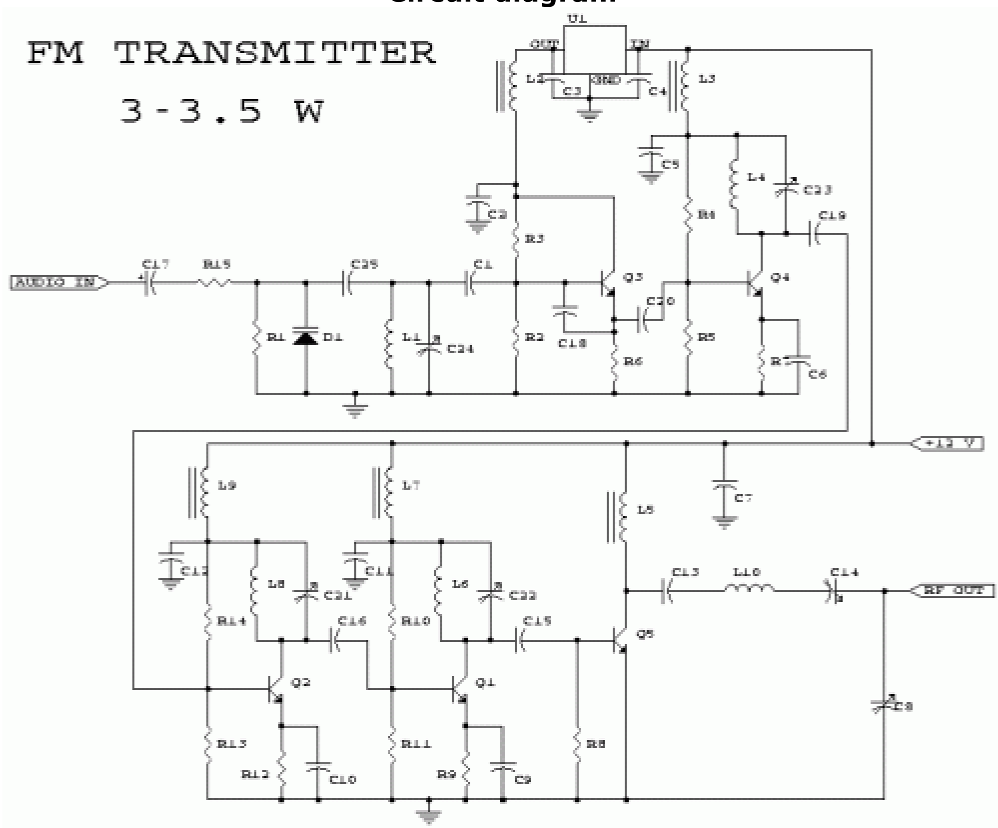
Coils also require extra attention. You can buy the coils trough ferrite in the shop, but the other ones have to be made yourself. Use 1mm AgCu wire. A coil like 7x/d=10mm/l=15mm, goes round 7 times, has an diameter of 10 millimeter and is long 15 millimeters. The best way to make a coil is to bend it around a pencil or other cilindrical shaped object tight. The diameter of the object is always d-coil minus 1 mm. In this case 9mm. As I said: bend the wire round (in this case 7times) with the revolves tight together. To get the desired length stretch the coil when still around the pencil.

P170. 3W FM Transmitter

This is the schematic for an FM transmitter with 3 to 3.5 W output power that can be used between 90 and 110 MHz. Although the stability isn't so bad, a PLL can be used on this circuit.

This is a circuit that I've build a few years ago for a friend, who used it in combination with the BLY88 amplifier to obtain 20 W output power. From the notes that I made at the original schematic, it worked fine with a SWR of 1 : 1.05 (quite normal at my place with my antenna).

Circuit diagram



Parts:
R1,R4,R14,R15 10K 1/4W Resistor
R2,R3 22K 1/4W Resistor
R5,R13 3.9K 1/4W Resistor
R6,R11 680 Ohm 1/4W Resistor
R7 150 Ohm 1/4W Resistor
R8,R12 100 Ohm 1/4W Resistor
R9 68 Ohm 1/4W Resistor
R10 6.8K 1/4W Resistor
C1 4.7pF Ceramic Disc Capacitor
C2,C3,C4,C5,C7,C11,C12 100nF Ceramic Disc Capacitor
C6,C9,C10 10nF Ceramic Disc Capacitor
C8,C14 60pF Trimmer Capacitor
C13 82pF Ceramic Disc Capacitor
C15 27pF Ceramic Disc Capacitor

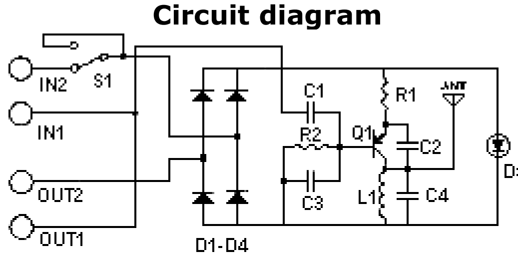
C16 22pF Ceramic Disc Capacitor
C17 10uF 25V Electrolytic Capacitor
C18 33pF Ceramic Disc Capacitor
C19 18pF Ceramic Disc Capacitor
C20 12pF Ceramic Disc Capacitor
C21,C22,C23,C24 40pF Trimmer Capacitor
C25 5pF Ceramic Disc Capacitor
L1 5 WDG, Dia 6 mm, 1 mm CuAg, Space 1 mm
L2,L3,L5,L7,L9 6-hole Ferroxcube Wide band HF Choke (5 WDG)
L4,L6,L8 1.5 WDG, Dia 6 mm, 1 mm CuAg, Space 1 mm
L10 8 WDG, Dia 5 mm, 1 mm CuAg, Space 1 mm
D1 BB405 or BB102 or equal (most varicaps with C = 2-20 pF [approx.] will do)
Q1 2N3866
Q2,Q4 2N2219A
Q3 BF115
Q5 2N3553
U1 7810 Regulator
MIC Electret Microphone
MISC PC Board, Wire For Antenna, Heatsinks

Notes:
1. Email Rae XL Tkacik with questions, comments, etc.
2. The circuit has been tested on a normal RF-testing breadboard (with one side copper). Make some connections between the two sides. Build the transmitter in a RF-proof casing, use good connectors and cable, make a shielding between the different stages, and be aware of all the other RF rules of building.
3. Q1 and Q5 should be cooled with a heat sink. The case-pin of Q4 should be grounded.
4. C24 is for the frequency adjustment. The other trimmers must be adjusted to maximum output power with minimum SWR and input current.
5. Local laws in some states, provinces or countries may prohibit the operation of this transmitter. Check with the local authorities.

P171. FM Telephone Bug

Here is a simple transmitter that when connected to a phone line, will transmit anything on that line (execpt the dial tone) to any FM radio. The frequency can be tuned from 88 to about 94Mhz and the range is about 200 feet. It is extremely easy to build and is therefore a good, useful beginner project.

Circuit diagram



Parts
R1 180 Ohm 1/4 W Resistor
R2 12K 1/4 W Resistor
C1 330pF Capacitor
C2 12pF Capacitor
C3 471pF Capacitor
C4 22pF Capacitor
Q1 2SA933 Transistor

D1, D2, D3, D4 1SS119 Silicon Diode
D5 Red LED
S1 SPDT Switch
L1 Tuning Coil
MISC Wire, Circuit Board

Notes
1. L1 is 7 turns of 22 AWG wire wound on a 9/64 drill bit. You may need to experiment with the number of turns.
2. By stretching and compressing the coils of L1, you can change the frequency of the transmitter. The min frequency is about 88 Mhz, while the max frequency is around 94 Mhz.
3. The green wire from the phone line goes to IN1. The red wire from the phone line goes to IN2. The green wire from OUT1 goes to the phone(s), as well as the red wire from OUT2.
4. The antenna is a piece of thin (22 AWG) wire about 5 inches long.
5. All capacitors are rated for 250V or greater.
6. The transmitter is powered by the phone line and is on only when the phone is in use. S1 can be used to turn the transmitter off if it is not needed.
7. If you have problems with the LED burning out, then add a 300 ohm 1/4W resistor in series with it.

P172. The "UnFETtered Crystal Radio!

Introduction
Several weeks ago I became aware, via the Internet, of an experimental AM 'crystal set' style of receiver, that uses what is known as a ZVB (Zero Voltage Bias) device. This is in the form of an IC, which contains either a 2 pack or 4 pack of specialised FETs (Field Effect Transistors) that require no bias voltage on their gates to conduct current from source to drain. They simply rely on signal voltages to turn them partially or fully on. This new IC, dubbed the ALD110900A, is made by Advanced Linear Devices in the US and is basically an array of zero voltage MOSFETs, configured in the receiver as a 'synchronous detector'. The original article, which appeared in the January 2007 edition of QST magazine, authored by Bob Cutler (callsign N7FKI,) uses such a device, and both medium wave and short wave receiver versions are illustrated for constructors to build. Readers can access the QST website (just Google a few keywords) and obtain a copy of the article, free of charge.

Many years ago, crystal sets and such were basically abandoned by manufacturers and constructors, as a very poor cousin to modern superhet receivers, and even the novelty effect of 'toy' radios for the kids had all but lost its appeal. The discovery of the germanium diode during WW2 and the subsequent discovery of the point contact transistor by Bell Labs in 1947, rekindled the joys of simple receivers, as those components came onto the market via disposals shops and hobby stores. During the 1970's and 80's, the Ferranti ZN414 and its later incarnation, the MK 484 (AM radio chips) enjoyed tremendous success in the hobby market. Now, they have all but had their day, as manufacturers and retailers once again, move away from the hobby end of the market. If it were not for a band of very dedicated enthusiasts, the hobby part of radio may well have died a long time ago. I'm so glad they didn't give up, as we now have a whole new generation of up and coming technicians, engineers and operators, who can once again "cut their teeth" on 'crystal set' style radios, albeit with the context of a 21st Century update.

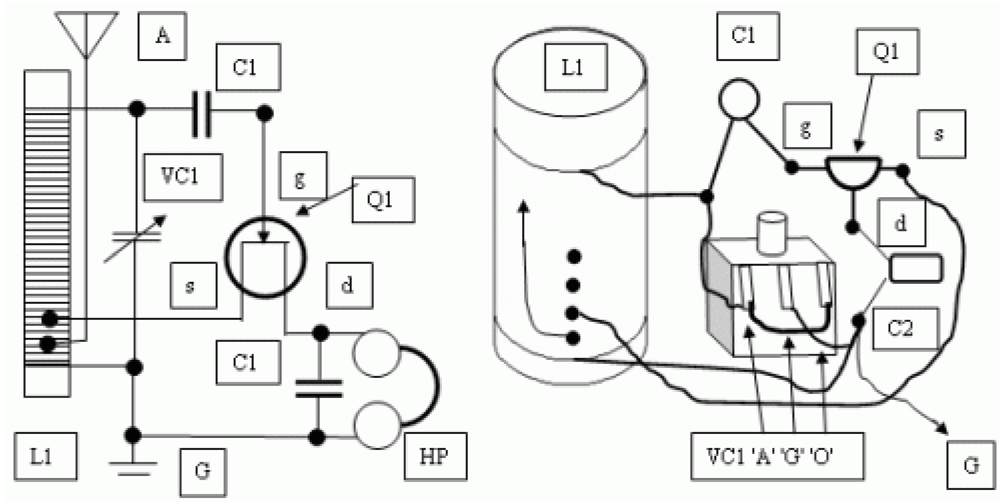
What is presented in this article, is my version of the QST arrangement, and I'm using the humble 2N5484 JFET, purchased from JAYCAR Electronics for around $2.00. Yes, a JFET, not a MOSFET! Why? Well, my basic knowledge of FET devices at the time of acquiring the QST design was a little rusty, to say the least, not having experimented with them for some time, so after a bit of scratching around on the net, and down at the local library, I reclued myself as to their peculiarities. Devices that are static sensitive have protection diodes on the inputs, and the ALD device certainly has those. Basic JFETs also have a protective diode between the gate and source connections, presumably for the same reason, but neither the QST design, nor my adaptation of it, use any internal diodes as a rectifier. You can experiment with that as a start - simply replace your germanium or Schottky diode with the gate and source of a JFET device, and you'll get reception all right - but it does seem a bit mushy or scratchy, somewhat like a poor Schottky diode that distorts on low signal levels (BAT46's come to mind…) You can still obtain reasonable results by tapping the gate further up the tuning coil, if you want to.

The basic premise behind the QST article, is that you drive the gate of the FET with an RF voltage derived from the top of the tank circuit via C1, and the gate switches on and off very rapidly, at the resonant frequency that you are tuned to. The source connection is tapped into the tuning coil low down, as a means of impedance matching with the headphones and acts as the anode, while the drain connects with your headphones as the cathode, to complete the detector part of the circuit. According to the experts on the net, much success has been enjoyed by one and all, and there's a lot of chatter about this most recent innovation in the realm of simple AM receivers (292 posts so far, to the 'Rap'n'tap' chatroom of the American Crystal Set Society alone!- www.midnightscience.com). One of the most curious aspects of this little beauty is that the antenna/ground system I employ basically entails a 'short' antenna, and a water pipe ground. Ideally, short antenna wires work best near the top of the tuning coil, but in this case, the best position seems to be right at the bottom tap! Normally, this would send all my weak locals into a spin, and shift the whole band up towards the top end of the tuning cap's range. The JFET device seems to act like a FET, (not a diode) as connecting it to the tank circuit via the gate lead does not appear to cause any loading, and flatten out the 'Q' of the LC tank, in any discernable way.

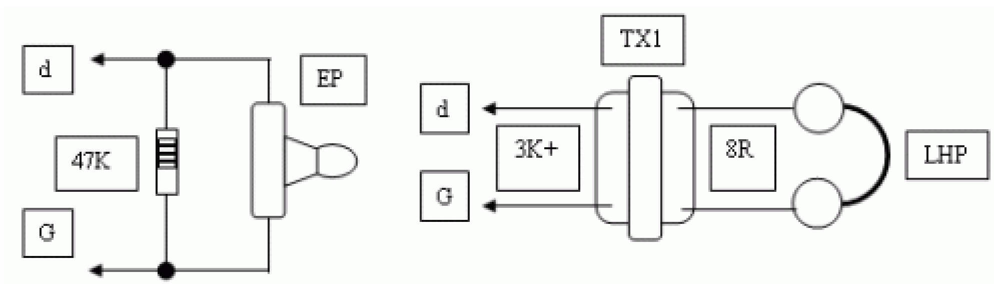
Another aspect of using a JFET in this manner, is the actual sound quality that you get in the headphones. The audio is very clear ans is in no way muffled, or distorted. Diode detectors often produce poor results, and while this can sometimes be attributed to bad antenna/ground systems & poor layout and construction of the receiver, at the end of the day, a FET device has it over a simple diode on a number of fronts. Diodes tend to introduce various distortions, and they also exhibit very high output impedance. With this design using the 2N5484 device, it is possible to get rid of most distortions and at the same time, use just about any kind of audio transducer that you may have on hand. I have successfully used a crystal earphone, my pair of 'Scientific' 2KR headphones, and a couple of low impedance telecom style inserts, and all work reasonably well, without the need for matching transformers, or extra passive components, beyond the usual 0.001uF cap, or 47KR ballast resistor. Diode detectors can also cause loading on the tank circuit if they are tapped too high up the coil windings. The JFET in this circuit is tapped way down, at around 10 turns, with the antenna lead sitting just under that on 5 turns from the grounded end of the coil. Sensitivity is OK, and selectivity is quite good, for a simple AM receiver

A Word about Coils, Caps, and Connections

This version of the receiver will work quite OK with air cored inductors, providing you use PVC insulated wire. I don't recommend enamelled copper wire, as it can be down a bit on sensitivity and selectivity. Get some good quality, thinnish and untinned (copper colour, not silvered colour) multi stranded hookup wire for winding the tuning coil and a tube made of plastic, rather than cardboard. If you want to use a ferrite rod antenna coil instead, then go right ahead, Ones that come from el-cheapo pocket radios will work but you will need to remove some of the turns from the primary coil for them to work with a combined 160+60pF PVC tuning cap, and then create one low Z tap, by soldering the end of the primary coil to the start of the smaller secondary coil. If you can get your hands on some high Q 'litz' wire, then use that on a bare ferrite rod. Simply fasten the wire onto one end of the rod using some tape, then wind on around 50 to 60 turns, with two taps - one at five turns from the grounded end (for the antenna lead in) and the other one at ten turns for the Source (anode) connection. You may need to experiment with the number of turns, and the tapping points on the coil, depending on the value of VC1.



To the left you can see a basic circuit diagram of my radio, based on the QST design, and to the right, a physical wiring diagram of how it all goes together. Note that both sections of VC1's fixed plates (A and O) are wired together, and that your headphone connections go between 'd' of the FET and the common ground 'G' point.

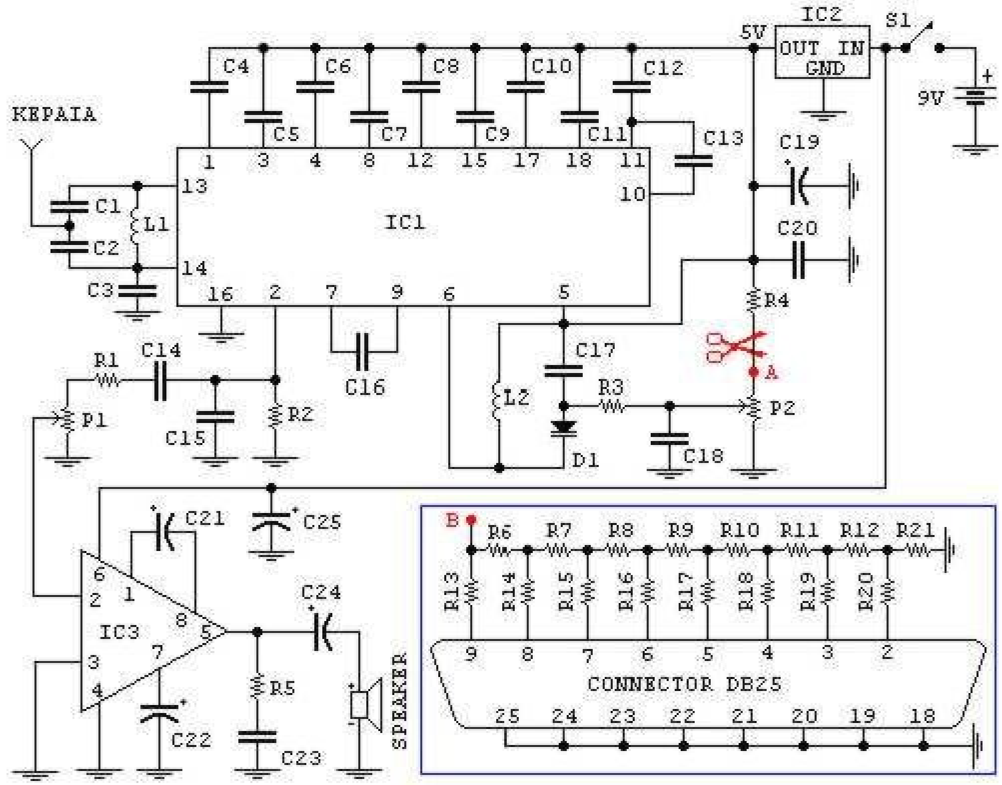


Two alternative methods for connecting either a crystal earphone (left) or low impedance headphones (right).

Parts List
C1 470pF styroseal capacitor
C2 0.001uF MKT capacitor
VC1 240pF (160+60 dual gang) Polyvaricon tuning capacitor
L1a 90 turns of pvc insulated wire wound on 3" diameter pvc tube or BCB ferrite rod with tapped coil
L1b 50 to 60 turns of litz wire wound around a good quality ferrite rod 100mm long by 10mm Ø
Q1 2N5484 JFET device
HP high impedance (2K-4KR) magnetic, dynamic headphones
EP crystal earphone and 47K ballast resistor
LHP low impedance headphones 8R up to 64R
TX1 impedance matching transformer - JAYCAR cat.# M-1109 or similar

P173. FM radio (may be used with PC)

TECHNICAL CHARACTERISTICS:
Stabilised tendency of catering: Vcc=9~12V
Frequency of reception: 88~108MHz
Consumption: 100mA



Materially:
The resistances are 1/4W.
R1 47K
R2 22K
R3 100K
R4 39K
R5 10
R6-r12 7,5K - Optionally
R13-r21 15K - Optionally
P1 10K Logarithmic potentiometer
P2 100K Linear potentiometer
C1 39pF Ceramic
C2 47pF Ceramic
C3 2,2nF Polyester
C4, c14 220nF Polyester
C5 22nF Polyester
C6 10nF Polyester
C7, c18 180pF Ceramic
C8 150pF Ceramic
C9 100nF Polyester
C10, c13 330pF Ceramic
C11 220pF Ceramic
C12, c16 3300pF Ceramic

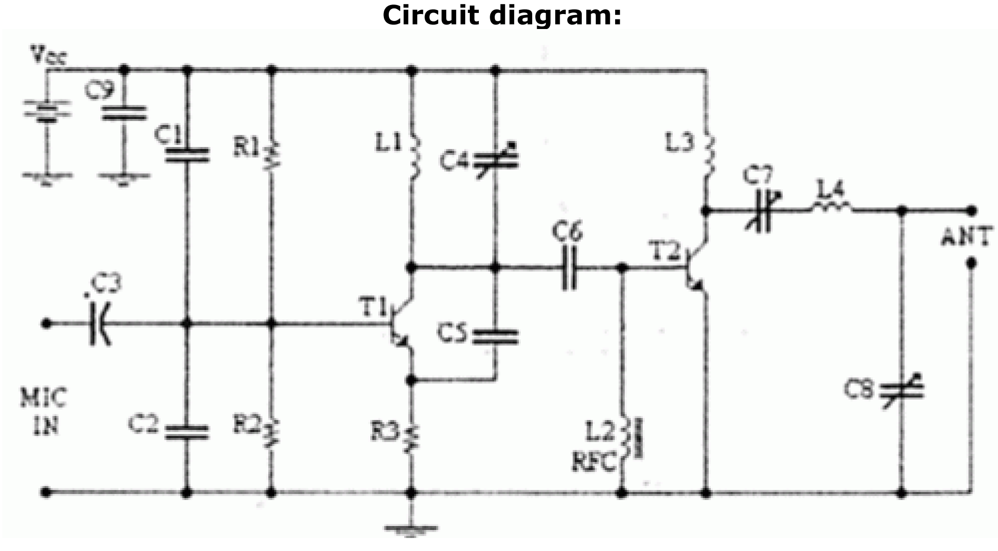
C15, c17 1800pF Ceramic
C19, c21, c22 10mF/16V electrolytic
C20 10nF Polyester
C23 47nF Polyester
C24, c25 470mF/16V electrolytic
L1, l2 5 Coils linked with internal diameter 4mm from cupreous isolated wire 0,6mm.
IC1 TDA7000 with base DIL18
IC2 LM7805
IC3 LM386 with base DIL 8
D1 BB329 or BB105 or other than old tuner televisions.
SPEAKER Loudspeaker 8W/1W.
S1 Switch of catering.
AERIAL 50cm isolated wire
CONNECTOR DB25 Fastener of 25 pin parallel door PC (LPT) -Optional

REGULATIONS:
A) With the P1 we regulate the intensity of sound.
B) With the P2 we regulate the frequency of reception.
C) Optionally: If you want to check the frequency with your PC it will be supposed you make the following energies:
- You assemble and the circuit that is in the blue frame.
- You cut the driver dj'pla in point A, as it appears in the circuit and you connect points A,V.
- If you know some language of programming as C ++, PASCAL, VISUAL BASIC, DELPHI etc you can write a program which will send in the parallel door (378 I) of PC a number from 0 until 255 checking thus the tendency of expense of simple D/A of converter (that it is in blue frame) and consequently and frequency of radio via passage VARICAP.
(As long as grows the number that sends in the parallel door, so much minimizes the frequency that receives the radio.)

P174. 4W FM Transmitter

TECHNICAL CHARACTERISTICS:
Stabilised tendency of catering: Vcc=12~16V
Frequency of emission: 88~108MHz
Consumption: 100~400mA

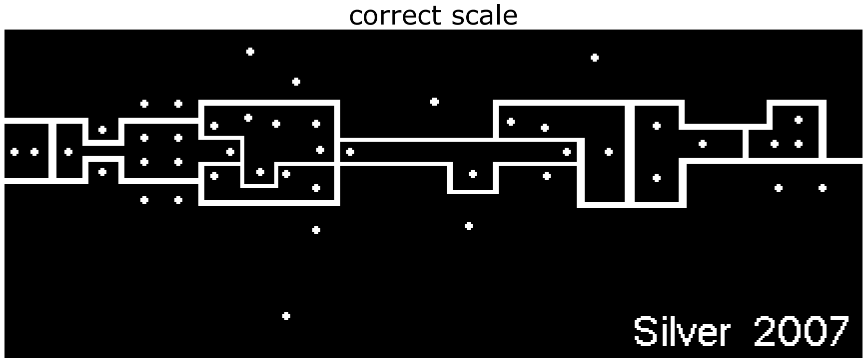
Circuit diagram:



Materially:
The resistors are 1/4W.
R1, R2 10KOhm
R3 47Ohm
C1, C2 1nF
C3 4,7uF/16V
C4, C7, C8 0~45pF trimmer
C5, C6 10pF
C9 100nF
L1 4 turns, 7mm diameter *
L3 3 turns, 7mm diameter *
L4 5 turns, 7mm diameter *
L2 RFC (resistance 1MOhm with wrapped around her inductor of enough coils from fine isolated wire. Scratch of utmost inductor and you stick in utmost the resistance making thus a parallel L-r circuit.)
T1, T2 2N2219
ANT Simple dipole l/2.
MIC IN Microphone dynamic or other type. (It can also connected to a cassette player unit)
* The inductors is air from wire of coaxial 75W or other 1mm roughly.

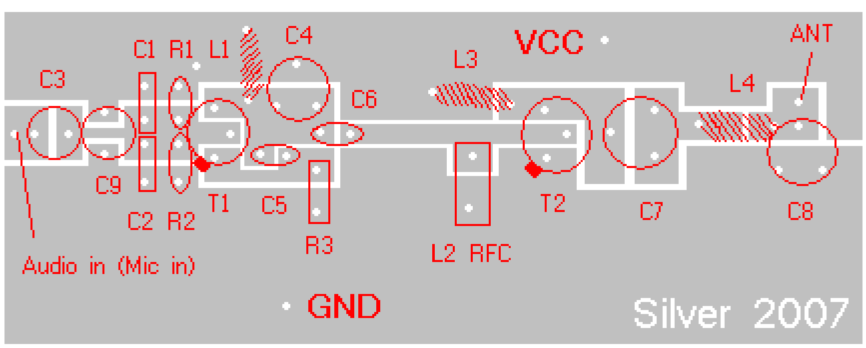
PCB:

Before you print it out with microsoft paints, set the screen resolution to 1280 by 1024 in order to get the correct scale



code1700@hotmail.com

Components layout



June 2007

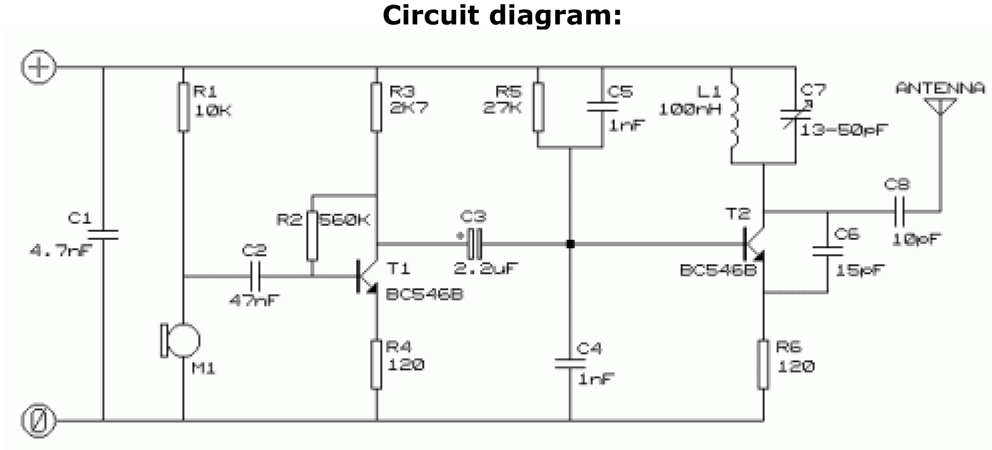
Regulations:
With the C4 we regulate the frequency.
With their C7, C8 we adapt the resistance of aerial (practically to them we regulate so that it is heard our voice in the radio as long as you become cleaner).

Notes:
The T2 wants refrigerator.

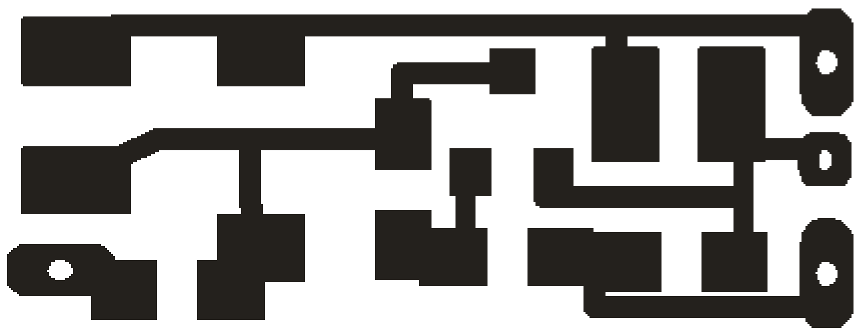
P175. A small FM transmitter (SMD)

This SMD FM transmitter has an operating frequency of about 80 to 115MHz. Under reasonable circumstances you will be able to receive its signal at a distance of about 200 meters. Although it is low-power, it might be illegal in your part of the planet.

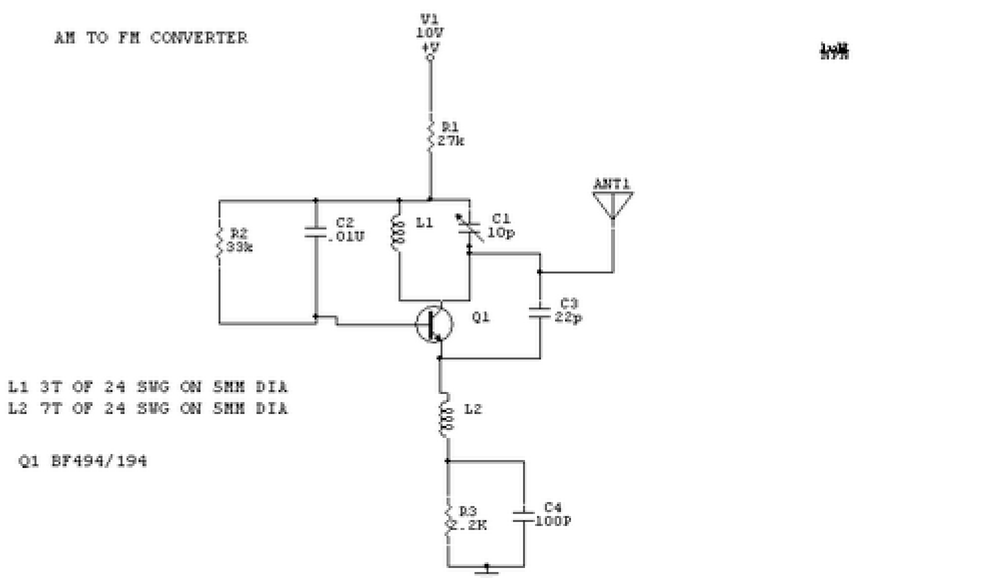
Circuit diagram:



Depending on the electret microphone you use, you might have to tweek R4 to set the gain of the pre-amplifier. Depending on the Q of the LC-part (usually not very good when using off-the-shelf SMD parts) you may also have to re-bias the end stage of the circuit. For the coil you can use a [ECM45T Series Inductor](#) .



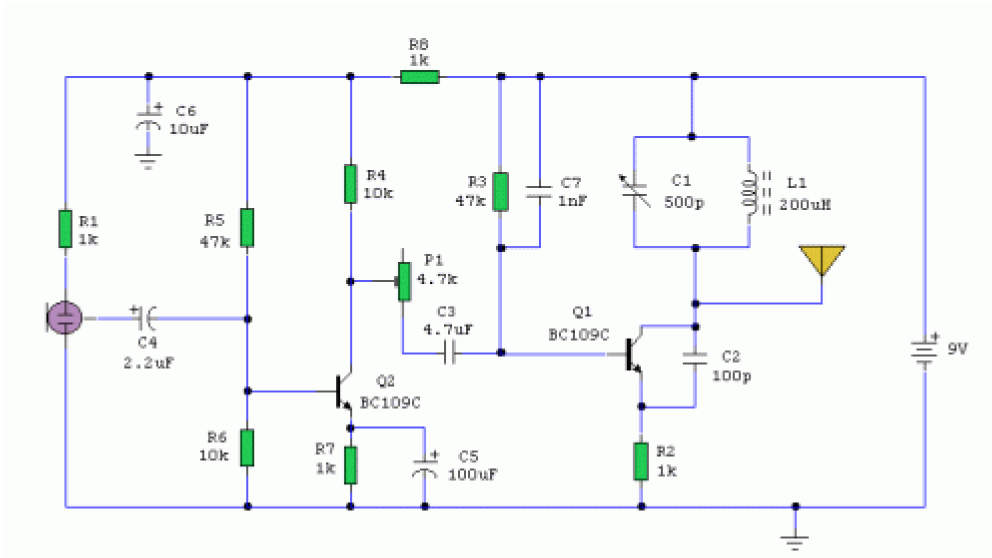
P176. AM To FM converter



The above circuit can be used to hear am statons in ur fm radio .It is a regenerative circuit that samples am signals of all frequency and re transmits them in the fm band (88-108) an even in the TV band .The capacitor C1 can be varied to receive different am stations thus providing remote tuning facility .Increase the power supply for increased sensitivity .Use an long wire antennae, switch on the circuit and keep it near the fm radio ,now you can hear many am stations.Tune between the stations using c1

P177. AM Transmitter

Circuit diagram



Notes:

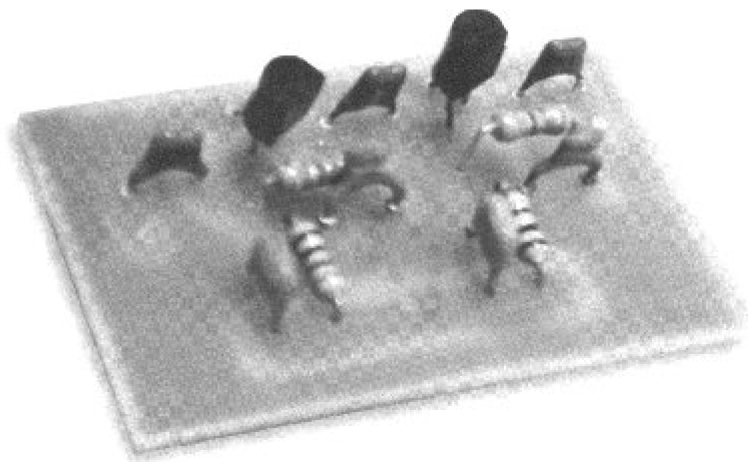
It is illegal to operate a radio transmitter without a license in most countries. This ircuit is deliberately limited in power output but will provide amplitude modulation (AM) of voice over the medium wave band.
The circuit is in two halfs, an audio amplifier and an RF oscillator. The oscillator is built around Q1 and associated components. The tank circuit L1 and VC1 is tunable from about 500kHz to 1600KHz. These components can be used from an old MW radio, if available. Q1 needs regenerative feedback to oscillate and this is achieved by connecting the base and collector of Q1 to opposite ends of the tank circuit. The 1nF capacitor C7, couples signals from the base to the top of L1, and C2, 100pF ensures that the oscillation is passed from collector, to the emitter, and via the internal base emitter resistance of the transistor, back to the base again. Resistor R2 has an important role in this circuit. It ensures that the oscillation will not be shunted to ground via the very low internal emitter resistance, re of Q1, and also increases the input impedance so that the modulation signal will not be shunted. Oscillation frequency is adjusted with VC1.

Q2 is wired as a common emitter amplifier, C5 decoupling the emitter resistor and realising full gain of this stage. The microphone is an electret condenser mic and the amount of AM modulation is adjusted with the 4.7k preset resistor P1.

An antenna is not needed, but 30cm of wire may be used at the collector to increase transmitter range.

P178. 20dB VHF Amplifier

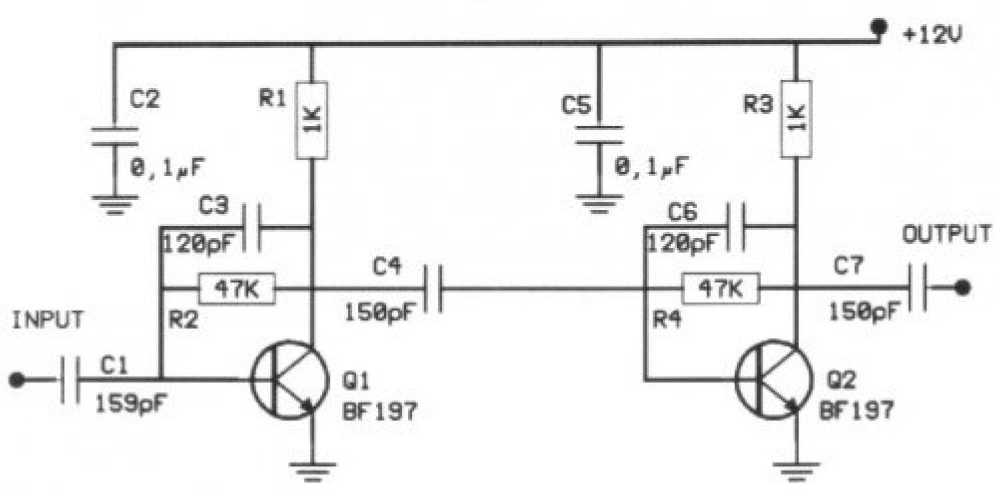
The text is AUTO translated from Greek version



Many times we needed to strengthen a small signal in the region of VHF or FM, or it is we lead a body, or a receptor. The preamplifier that to you we propose offers 20dB in all the region of VHF and it still can reach also their 500MHZ.

The amplifier is a circuit of high frequency RF with distinguishable materials. The amplifier as circuit strengthens the tendency of signal with concrete aid, depending on the frequency of signal. If the frequency of signal is included in the limits of spectrum of frequencies of amplifier, then it is strengthened, otherwise it is downgraded. Each amplifier of this category, accordingly with his designing, strengthens a concrete region of frequencies and obeys in same characteristics. The one that to you we present today concerns the regions of VHF where they exist and the corresponding television stations for channels 5 until 12. His circuit he is enough simple, so that it is made easily with materials that exist in the trade. It is based on transistors with aid until the 500MHZ. The type of transistor can be BF197 or some other.

Circuit diagram

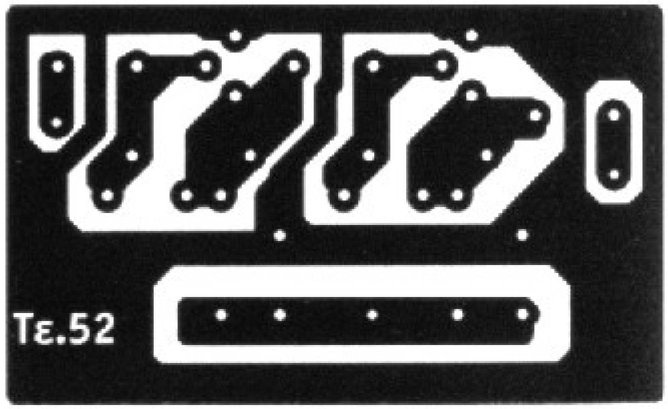


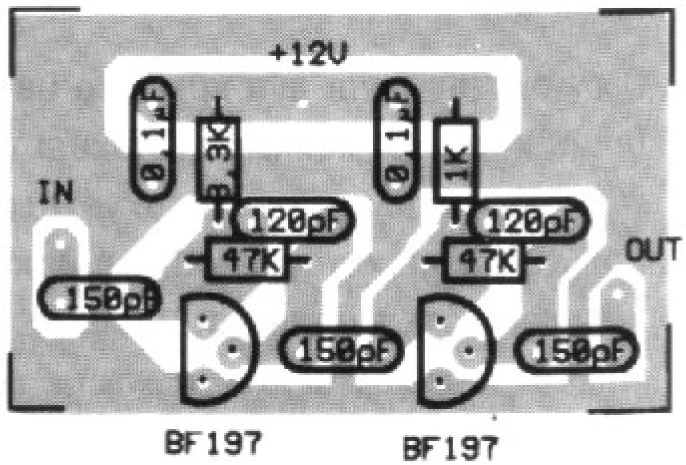
In form 1 appears the theoretical circuit of amplifier. As we see it is constituted from two similar circuits (rungs). In this circuits are not included in joint action circuits. With that way is covered a wide spectrum of frequencies, without is differentiated abruptly the aid as for the frequency. With this provision we have smaller gain but big breadth of frequencies. The two rungs are same, with the same prices of materials and each rung offer aid roughly 10dB. The transistors and the remainder materials, because the industrial manufacture, have almost the same characteristics. Associates the particular characteristics of demagogues are altered mainly the aid of rung. Each rung uses a transistor of type npn in provision of common emitter that functions in order A. his rungs works in provision of common emitter with null resistance in emitter. In each rung a network of resistances between the collectors and the bases polarize the transistors and ensures the operation of circuit. The junction between the rungs becomes via ceramic capacitors of small capacity from 0,1nF until 0,22nF (at preference ceramic). In the place of two rungs we can try various transistors of independent company or even different between them. The circuit of course cannot work with all of them. The tendency of catering should emanate from stabilised power supply with tendency 12V. Depending on the tendency of catering and the type of transistor, in each rung of amplifier it needs enter also different resistances. Force of expense, under conditions of high excitation it can exceed the 1 mW

Manufacture

The total aid of circuit, according to the elements of transistors, reaches 20dB. Enough aid for a lot of applications. The amplifier is drawn in order to it has big response of frequency up to 0,5Ghz. According to the particular characteristics of manufacture, the better application that we could to you propose for this designing would be the aid of television signal emanating from a small transmitter of television or the preamplifier of a frequency meter. The assembly of amplifier is realised above in printing form 2. In this you will place all the materials according to form 3. The manufacture, in order to it works right it needs one small stabilised power supply 12V. The consumption of circuit is small hardly some mA. The resistance en line with the collector is 10 000. When you finish the construction and the control of manufacture, place the PCB in metal box of suitable dimensions.

Parts
R1 1K
C3 120pF
R2 47K
C4 150pF
R3 1K
C5 0,1uF
R4 47K
C6 120pF
C1 150pF
C7 150pF
C2 0,1uF
Q1 Q2 BF197

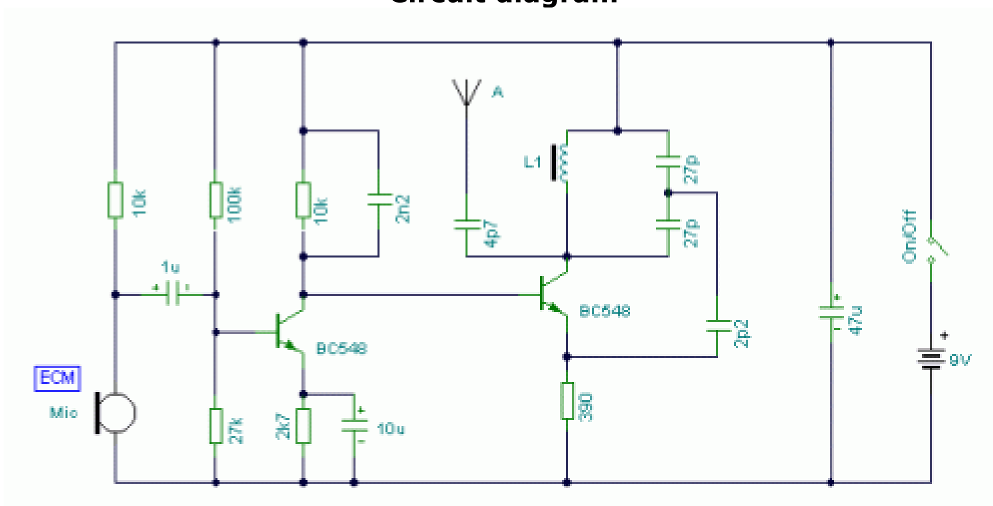

Tε.52


+12V
0,1μF
3,3K
0,1μF
1K
IN
120pF
120pF
OUT
47K
47K
150pF
150pF
150pF
BF197
BF197

P179. 2 Transistor FM Voice Transmitter

Warning: Take care with transmitter circuits. It is illegal in most countries to operate radio transmitters without a license. Although only low power this circuit may be tuned to operate over the range 87-108MHz with a range of 20 or 30 metres.

Circuit diagram



Notes:
I have used a pair of BC548 transistors in this circuit. Although not strictly RF transistors, they still give good results. I have used an ECM Mic insert from Maplin Electronics, order code FS43W. It is a two terminal ECM, but ordinary dynamic mic inserts can also be used, simply omit the front 10k resistor. The coil L1 was again from Maplin, part no. UF68Y and consists of 7 turns on a quarter inch plastic former with a tuning slug. The tuning slug is adjusted to tune the transmitter. Actual range on my prototype tuned from 70MHz to around 120MHz. The aerial is a few inches of wire. Lengths of wire greater than 2 feet may damp oscillations and not allow the circuit to work. Although RF circuits are best constructed on a PCB, you can get away with veroboard, keep all leads short, and break tracks at appropriate points.

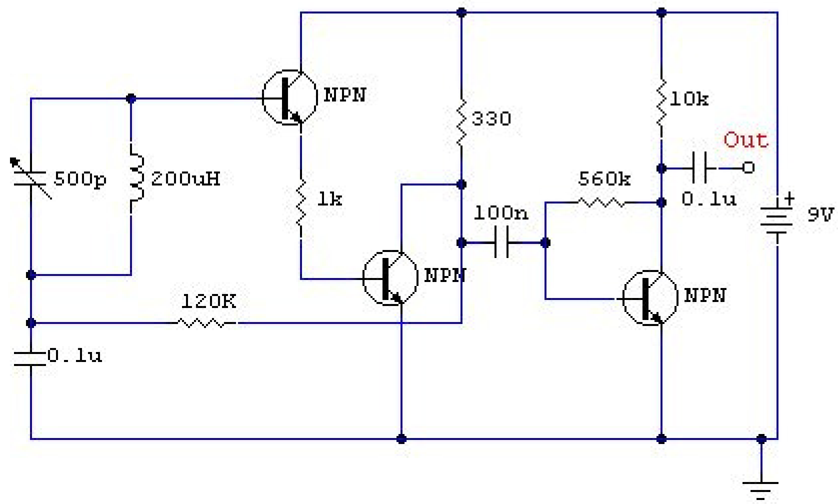
One final point, don't hold the circuit in your hand and try to speak. Body capacitance is equivalent to a 200pF capacitor shunted to earth, damping all oscillations. I have had some first hand experience of this problem.

P180. AM Receiver

Description:

This is a compact three transistor, regenerative receiver with fixed feedback. It is similar in principle to the ZN414 radio IC which is now no longer available. The design is simple and sensitivity and selectivity of the receiver are good.

Circuit diagram



Notes:

All general purpose transistors should work in this circuit, I used three BC109C transistors in my prototype.The tuned circuit is designed for medium wave. I used a ferrite rod and tuning capacitor from an old radio which tuned from approximately 550 - 1600kHz. Q1 and Q2 form a compund transistor pair featuring high gain and very high input impedance. This is necessary so as not to unduly load the tank circuit.

The 120k resistor provides regenerative feedback,between Q2 output and the tank circuit input and its value affects the overall performance of the whole circuit. Too much feedback and the circuit will become unstable producing a "howling sound". Insufficient feedback and the receiver becomes "deaf". If the circuit oscillates,then R1's value may be decreased; try 68k. If there is a lack of sensitivity, then try increasing R1 to around 150k. R1 could also be replaced by a fixed resisor say 33k and a preset resistor of 100k. This will give adjustment of sensitivity and selectivity of the receiver.

Transistor Q3 has a dual purpose; it performs demodulation of the RF carrier whilst at the same time, amplifying the audio signal. Audio level varies on the strength of the received station but I had typically 10-40 mV. This will directly drive high impedance headphones or can be fed into a suitable amplifier.

Construction:

All connections should be short, a veroboard or tagstrip layout are suitable. The tuning capacitor has fixed and moving plates. The moving plates should be connected to the "cold" end of the tank circuit, this is the base of Q1, and the fixed plates to the "hot end" of the coil, the juction of R1 and C1. If connections on the capacitor are reversed, then moving your hand near the capacitor will cause unwanted stability and oscillation.

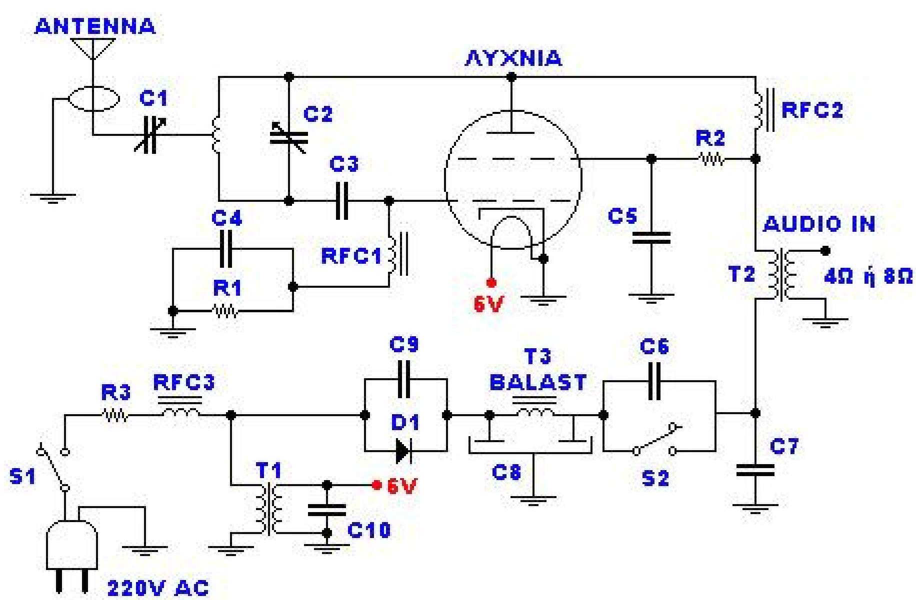
Finally here are some voltagee checks from my breadboard prototype.This should help in determining a working circuit:-

All measurements made with a fresh 9volt battery and three BC109C transistors with respect to the battery negative terminal.

parts
Q1 (b) 1.31V
Q2 (b) 0.71V
Q2 (c) 1.34V
Q3 (b) 0.62V
Q3 (c) 3.87V

P181. Transmitter FM 45W with valve

TECHNICAL CHARACTERISTICS:
Tendency of catering: 220V AC
Frequency of emission at FM: 88~108MHz
Force of expense: max 45W (without the R3),



Materially:
R1 15KW/2W
R2 1KW/10W
R3 1KW/10W (for biggest force in the exit you replace with short-circuit).
C1 50pF trimmer
C2 30pF trimmer
C3 22pF/4KV
C4, c6, c9 10nF/1KV
C5, c7 1nF/1KV
C8 100mF+100mF/450V (Double electrolytic)
C9, c10 10nF
RFC1, rfc2, rfc3 air Inductors: 15 coils diameter 8mm, from wire 1mm.
T1 Transformer 220V/6V-1A
T2 Transformer of configuration with being first 4 or 8W
T3 Inductor with core ferrite (externally it resembles with small transformer but has a turn only).
D1 BY127 rectifier
Lamp 807 SYLV USA or EL34 or equivalent
ANTENNA Simple dipole L/2. (L= wave length)
S1 Main switch of catering.
S2 Switch of catering of rise (him we close after zestacej' the thread).

Most elements you can him find in a old back-white television with lamps.

Regulations:

With the C2 we regulate the frequency.
With the C1 we adapt the resistance of aerial (practically him we regulate so that it is heard our voice in the radio as long as you become cleaner).

Notes:

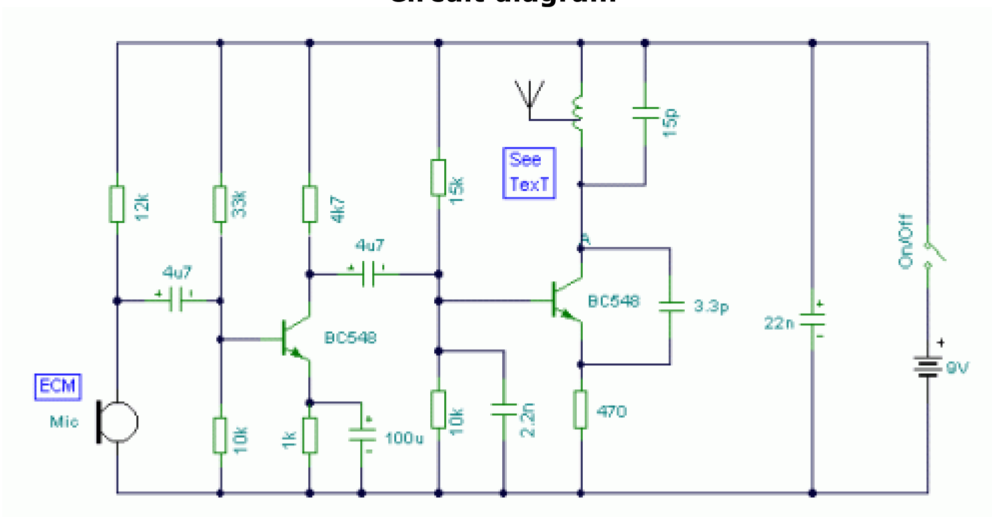
The catering better it does not become at straight line from the network 220V but via transformer 220V/220V of isolation and safety 1A.

When does not exist the R3, the force of expense is bigger, but respectively is increased also the hum 50Hz, because the simplicity of designing.

The control (Audio In) can become from a kasseto'fwno or other powerful source. If it is microphone it will be supposed precedes amplifier so that it acquires a force of order of 8W roughly.

P182. FM Transmitter Bug

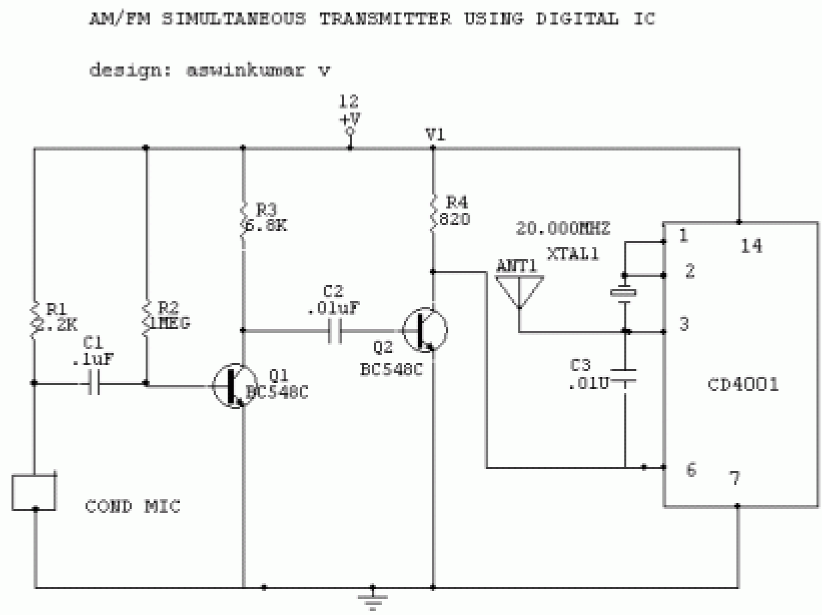
Circuit diagram



Notes:
This small transmitter uses a hartley type oscillator. Normally the capacitor in the tank circuit would connect at the base of the transistor, but at VHF the base emitter capacitance of the transistor acts as a short circuit, so in effect, it still is. The coil is four turns of 18swg wire wound around a quarter inch former. The aerial tap is about one and a half turns from the supply end. Audio sensitivity is very good when used with an ECM type microphone insert

P183.

AM FM Simultaneous Transmitter Using Digital IC

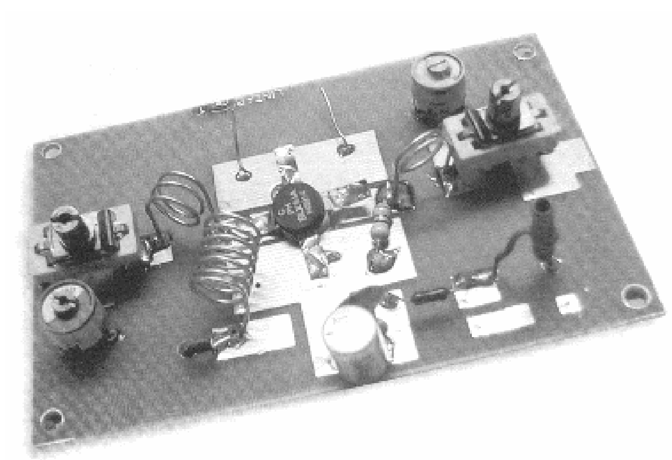


We are familiar with transmitters either working in AM or or in FM.But this circuit transmits both am and fm signal simultaneously at two different frequencies AM in 20 Mhz and FM in 100 Mhz .

The 5th harmonics of the fundamental 20mhz is used to transmit the fm signal,hence it's range will be less than am signal One can also directly feed the audiosignal .Transistors Q1, Q2 forms the amplifier stage which is fed to the modulator formed by the nor gates .Use a long wire antenna for good reception

P184. Linear FM 30Watt

The text is AUTO translated from Greek version



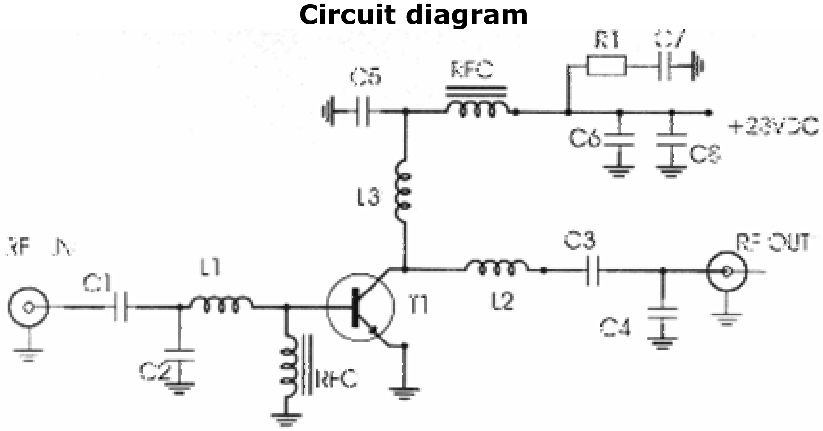
A amplifier of medium force RF for the FM, is always essential for the amateur that wants it strengthens some small transmitter, that likely it has already it manufactured! The present circuit can give force 25-30W, with control no bigger than 4-5 W.

As it appears in the analytic drawing, the amplifier is manufactured with the transistor TR1 of type ΒLY89 of Phillips. The transistor this is specifically drawn for operation in frequencies up to 175Μhz, with very good results. His special characteristics appear below:

Tendency of operation: 18V
Current of Collector: max 3 5th
Gain: max 10dB
Force of Expense: 25-30 W
Output (order C): > 60%

Variable capacitors C1, C2, with inductor L1, constitute the coordinated circuit that adapts the exit of our transmitter in this amplifier RF. the circuit has been calculated suitably, so that it covers all band the FM with the biggest possible output. Inductor RFC1 polarize the transistor, so as to it works in order C that is to say with the biggest output. Inductor L2 in the collector of TR1, constitutes the charge of amplifier, while RFC2 prevents the RF signals escape in the line of catering. Capacitor C2 and resistance R1, protect the circuit from auto polarize.

Circuit diagram



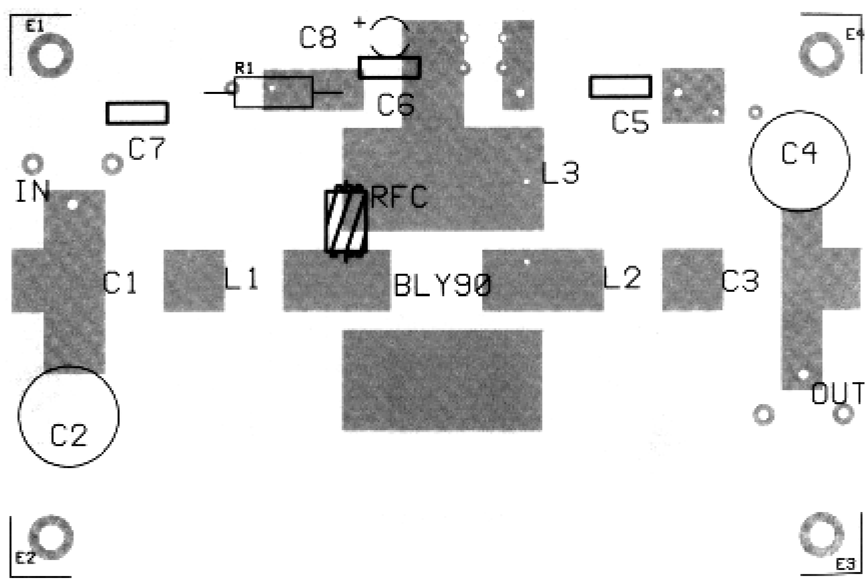
The coordinated circuit of expense that is constituted by inductor L2 and variable capacitors C3, C4, adapts the exit of amplifier RF with the next stage that can be some amplifier RF of high force (> 100W) or a aerial.

MANUFACTURE

The manufacture of amplifier is very simple and easy. Puncture the point PCB that will pass the nutshell of TR1. Stick the capacitors, variable, the resistance, the RF tsok and the inductors. Finally you stick the TR1, being careful not overheats at the welding and blend pin his. Clean finally PCB from the residues of soldering. Make a very careful control for by any chance errors, omissions, short-circuits, chills you stick also anything other that could you make wonder why does not work the amplifier.

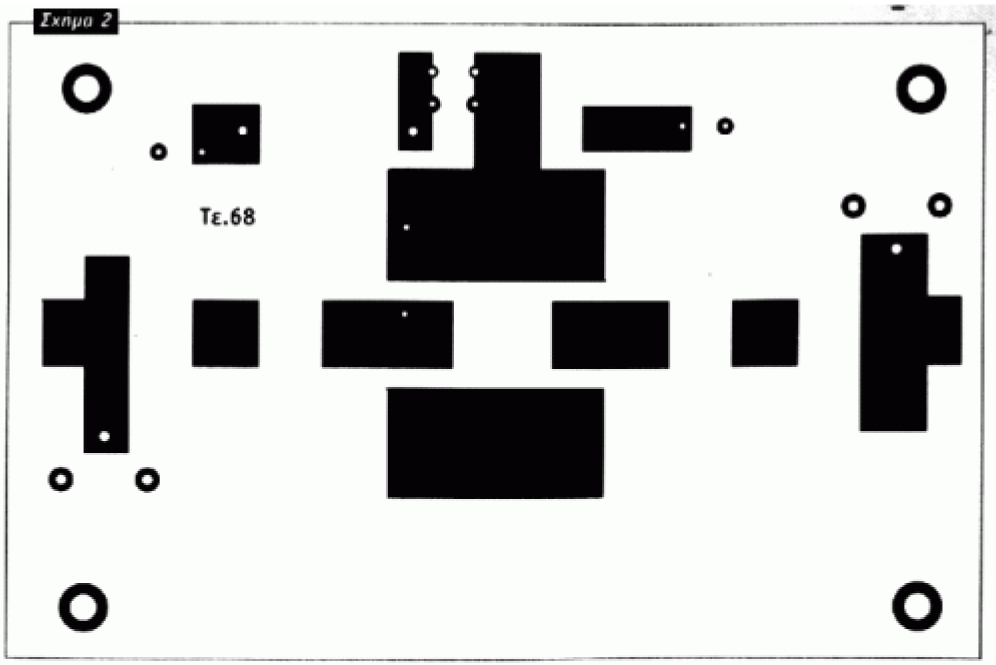
Parts
C1, C2, C3, C4 = 10 – 80pF
C 5 10nF
C6 1000pF
C7 100nF
C8 2200mF/35V
L1 1 coil with diameter of 10 mms, 1 mm
L2 7 coils with diameter of 10 mms, 0,8 mm
L3 3 coils with diameter of 10 mms, 1 mm
TR1 BLY89
RFC RF tsok

If all they are it includes, you connect the exit of your transmitter (3-4W) in the entry of amplifier. The exit of amplifier him you will connect in some charge (dummy load) or in the aerial, through a bridge stagnant. Be supplied with tendency 11-15V your amplifier. (Power supply it should it provides current 45th). Regulate the 4 variable (C1-C4, until you take the biggest force of expense. The amplifier is ready.



Note:

The TK1 needs a wiper of dimensions 5x10cm for trouble free operation. This wiper screw in the TR1 without isolators, after his central screw has electric isolation from remainder pins.



P185. Lightning Detector

Egor! Come quick! A storm approaches!

Here is a VLF receiver tuned to 300 kHz designed to detect the crackle of approaching lightning. A bright lamp flashes in sychrony with the lightning bolts indicating the proximity and intensity of the storm. Figure 1 shows the simple receiver which consists of a tuned amplifier driving a modified flasher circuit. The flasher is biased to not flash until a burst of RF energy, amplified by the 2N3904, is applied to the base of the 2N4403. The receiver standby current is about 350 microamps which is nothing at all to a couple of D cells, hardly denting the shelf life. Of course, the stormier it gets, the shorter the battery life.

Circuit diagram

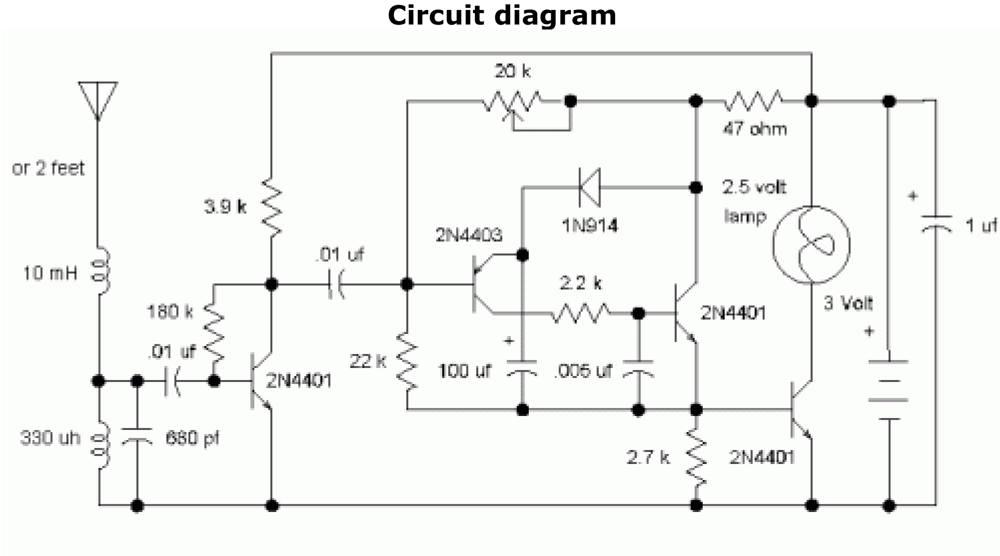
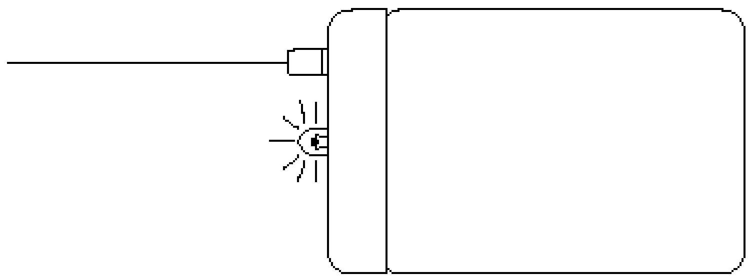


Figure 1: Lightning receiver repeats lightning flashes.

For best effect, mount the lamp in an old-fashioned holder with an extra-large colored glass lense. Or construct your own fixture with a plate of textured colored glass behind a panel painted with black-crackle paint. Watch a few old science fiction movies for other ideas.

A totally different approach is to mount the circuit in an empty glass jar with the antenna and bulb protruding through the top. (A malted-milk jar has a nice, red plastic lid which is easy to work and looks good.) Use a pin jack for the antenna. The gadget looks quite home-made but fascinating.
Boat owners may wish to replace the lamp with a 3-volt beeper to provide an early warning of approaching bad weather. Choose one of those unbreakable clear plastic jars like the large jars of coffee creamer. A little silicone rubber will seal the antenna hole in the lid of the jar. Use a longer antenna for increased sensitivity since there are few electrical noise sources on the lake.



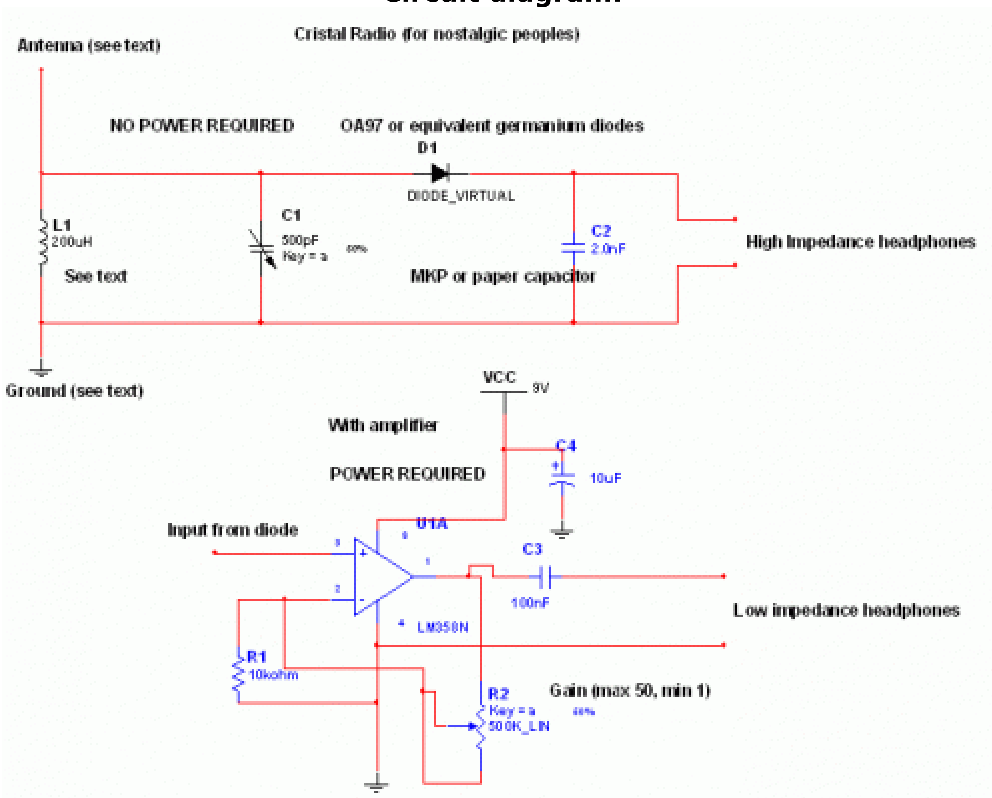
Tune-up is simple: adjust the potentiometer until the regular flashing just stops. (Use a multi-turn trimmer.) When properly adjusted, the lamp will occasionally flash when large motors or appliances switch on and off and an approaching storm will give quite a show. Obviously, tune-up is a bit more difficult during stormy weather. Adjust the pot with no antenna if lightning is nearby. Tune an AM radio to the bottom of the dial to monitor the pulses that the lightning detector is receiving.

This lightning detector is not so sensitive that it will flash with every crackle heard on the radio but will only flash when storms are nearby. Increased sensitivity may be achieved by increasing the antenna length. The experienced experimenter may wish to add another gain stage after the first by duplicating the 2N3904 circuitry including capacitor coupling with the addition of a 47 ohm emitter resistor to reduce the gain somewhat. This additional gain can cause stability problems if the layout is poor so novices are advised to use a longer antenna or adjust the sensitivity potentiometer more delicately instead! (When operating properly, the additional gain makes the pot adjustment much less critical.)

P186. Nostalgic Crystal Radio

It was the first circuit i started with, and it can be build with really junk items. Apart from the diode (which replacement would need a PbS, Lead Sulphyde, galena cristal) everything you can see in the circuit (for the no power version) can be built with enamel wire, alluminium cooking foil, carton wax and so on. The real painful part is to find a high impedance headphone, it is unlikely yo find one at present day but it is possible. In addition I substituted an high internal impedance headphone with a opamp and normal headphone but doing so you need power. Anyway if you are lucky you can find such a headphone.

Circuit diagram:



Operating Principle:

The AM signal is captured by the antenna , 10 mt long horizontal wire, WELL insulated from earth (I mean distant, to lower the stray capacitance coupling with ground which will adsorb some signal). The Inductor and capacitor forms a resonator, that will tune with the station which frequency is F= 1/ (2*pi*sqrt(L*C)), so adjust C1 for tuning. The signal is rectified (demodulated) and smoothed by C2. The high impedance headphones has fine internal wiring and lots of windings, so even a small current will produce an audio output.

Construction of components:

<u>Antenna:</u>
10 mt of electrical wire, WELL insulated from ground (use plastic bottle caps and hoowup wire to keep it high). This must be the arrangement |=wall ..=hookup wire o=plastic cap --=wire antenna :
| 10 mt |
wall |...O...O...O----------------------------------O...O...O...| wall
| | |
to receiver

Inductor:
wind 60 windings of enamel copper wire onto a 2 inch ferrite core (1 cm diameter or a bit less)

RF GROUND:
Like for tesla coils, it must be a good ground, otherwire the signal will be poor. Place a metal nail and connect to the circuit with alligator clips.

C1:
It would be difficult to make it reliable, in addition needs a capacitance meter, better buing it or finding it in old broken radios.
But if you want to build it use the parallel plate capacitance formula and make two carton disks (10 cm diameter with a alu foil semi disk each separated through paper, place a nail in center (make sure to not short the capacitor) and connect it with small wires, rotating a disk respect to the other will change shared surface and increase capacitance, but how i said this is not reliable because as soon ase you approach it, you will detune it. So better use a commercial variable cap with insulated lever.

C2:
use paper, alu foil or ldpe (but i don't think that you will be interested in a 10KV capacitor so use thin LDPE)

Diode:
Buy it. I don't advice you looking for Lead Sulphyde cristals....

High impedance headphones: Difficult to find , the only substitute is an amplifier (see below)

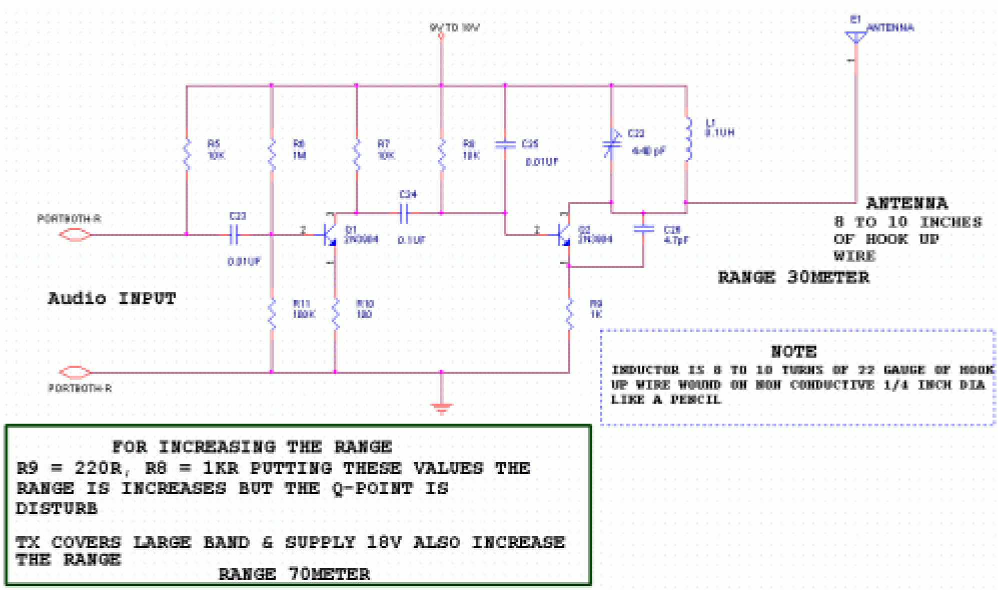
Amplifier + low impedance headphones: Use a general purpose opamp with feedback resistors and a low impedance headphone (as these of cassette, cd players), but you need power... :-(

It is very nice to build, hearing a sound of a radio station without power is very fun. I reconstrected it basing on my fathers rememberings and very old texts, improved a bit with some physics. Constructing from almost anything is possible , even the headphone, as many cristal radios have been found in nazis prison camps build by prisoners from very limited resources (as everything in a prison camp) and some in foxholes (called foxhole radios).

Anyway, as i ever say, learn and have fun

P187. Medium range transmitter

This is a medium range transmitter circuit diagram. This is also improved by changing the values of the resistor.



P188. Small Radio Transmitter

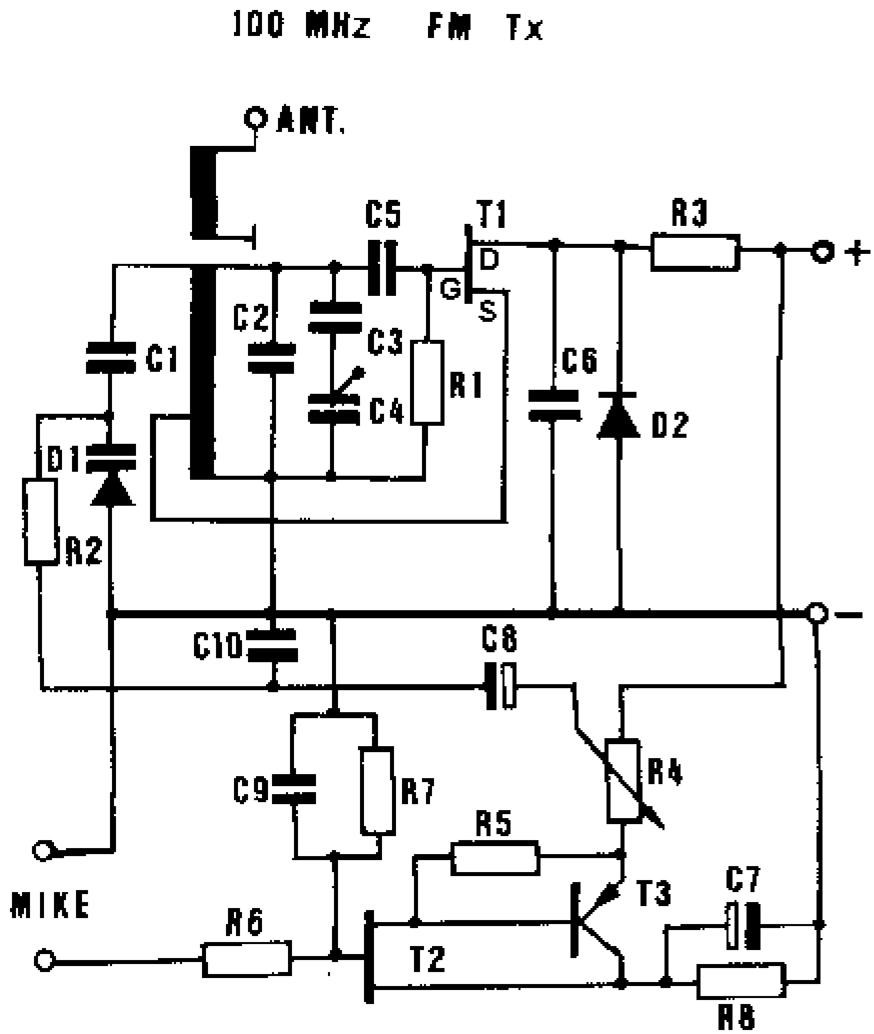
DESCRIPTION

Contains information about building a small radio transmitter, which has a PCB 1.75" x 2.5" (45mm x 68 mm) and has a range of about 30 yards or so. The documentation with the circuit says the freq range is 100-108 MHz, but I have found it to be more like 85-100 MHz.

The circuit is (of course) only mono, and accepts an audio input from either a microphone or other source. The input impedance is 1Mohm. The input sensitivity is 5mV and the max input signal is 10mV. The transmitted signal can be picked up on a FM radio. The circuit can be used for short-range transmission, eg. for wireless microphones.

The actual circuit comes from a 'Kit', available from Veleman electronics (USA distributor is Tapto Corp., PO Box 1339, CLAREMONT NH-03743-US. UK distributor is High-Q Electronics, 382 Edgware Road, London, W2 1EB). The kit number is K1771. It is a very good transmitter.

I bought the kit, and made the circuit, which worked very well. I wanted two transmitters, so I made my own 'copy' PCB and built the circuit, and in fact my home-made version seems to work better than the original!! So there is no need to buy the kit really, as it is quite a simple circuit, and is the best 'home-made' transmitter I have seen.



Circuit diagram

PCBPLAN.GIF shows the PCB layout from above (components shown). PCBPLAN.GIF is an accurate layout, scanned from the instruction sheet. I have used * to mark one corner for reference.
TRACKS.GIF shows the track layout on the soldering side of the board. This is NOT a very accurate layout. This is because I didn't actually have a plan of the track layout. To get TRACKS.GIF, I put a bit of OHP film onto the bottom of the PCB, and traced the tracks with an OHP pen. I then scanned this in. I have marked the component leg holes (approximately) with white blobs.

CONSTRUCTION

Start off by scaling PCBPLAN.GIF and TRACKS.GIF by the same amount so that they measure approximately the correct size (1.75" x 2.5") when printed out.

Then make your PCB. As mentioned earlier, PCBPLAN.GIF gives the accurate positioning of the holes, whereas TRACKS.GIF gives the positions only approximately. So use PCBPLAN when drilling the holes in your PCB board. Then draw on the tracks, using TRACKS.GIF as a guide. The important thing is to make sure you draw the 'printed coil' correctly on the PCB - those lines are there for a reason!

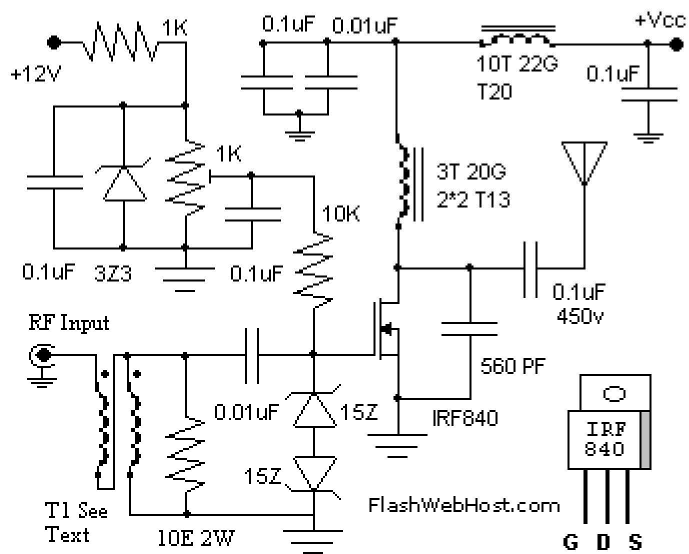
Parts
D1 Varicap diode (eg. BB119)
D2 1N4148
R1 100K
R2 220K
R3 22R
R4 1K trimmer
R5 1K
R6 56K
R7 1M
R8 1K2
C1 5pF ceramic
C2 6pF ceramic
C3 15pF ceramic
C4 trimmer cap
C5 15pF ceramic
C6 1nF ceramic
C7 100uF electrolytic
C8 4.7uF electrolytic
C9 100pF ceramic
T1 BF244A or BF245A FET
T2 2N3819 FET
T3 BC307/8/9 or BC557/8/9 PNP

Bear in mind that in addition to the components, there is a jumper wire which needs to be fitted (marked with a dashed line in PCBPLAN.GIF).

The power supply to use is 9-14 V DC, one of the little rectangular 9V batteries is fine. Connect this to the + and - points on the PCB. The sound input goes to the points marked "MIKE". The antenna should be connected to the point marked "ANT". The emitter's output impedance is 50 ohms. You can make your own fancy antenna if you like, but I have found that a foot or so of wire is fine.

Good luck with the transmitter. If you have any improvements to the circuit, I would be glad to hear from you. --Dan Evans.

P189. 60W Linear amplifier



The 60 Watt linear amplifier is simple all solid state circuit using power mosfet IRF840. The IRF series of power transistors are available in various voltage and power ratings. A single IRF840 can handle maximum power output of 125 watts. Since these transistors are used in inverters and smps they are easily available for around Rs: 20/-.

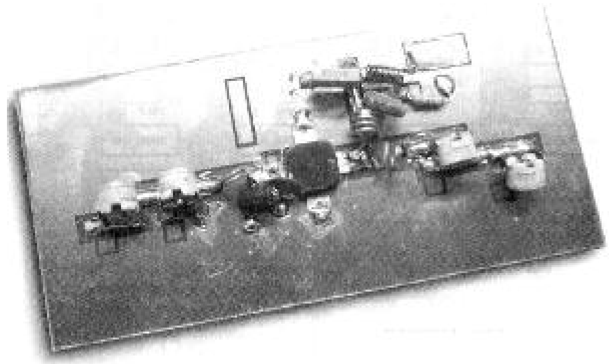
The IRF linear amplifier can be connected to the out put of popular VWN-QRP to get an output of 60 Watts. The circuit draws 700 ma at 60 Volt Vcc. Good heat sink is a must for the power transistor.

Alignment of the circuit is very easy. Connect a dummy load to the out put of the circuit. You can use some small bulb like 24V 6Watts as the dummy load. I have even used 230V 60Watts bulb as dummy load with my IRF840 power amplifier working at 120Volts. Adjust the 10K preset to get around 100 ma Drain current. I used gate voltage of 0.8V with my linear amplifier. A heigh gate voltage can make the power transistor get distroyed by self oscillation. So gate voltage must be below 2V and fixing at 1V will be safe.

Bifalar transformaer T1 is wound with 8 turns 26SWG on 1.4 x 1 balun core.

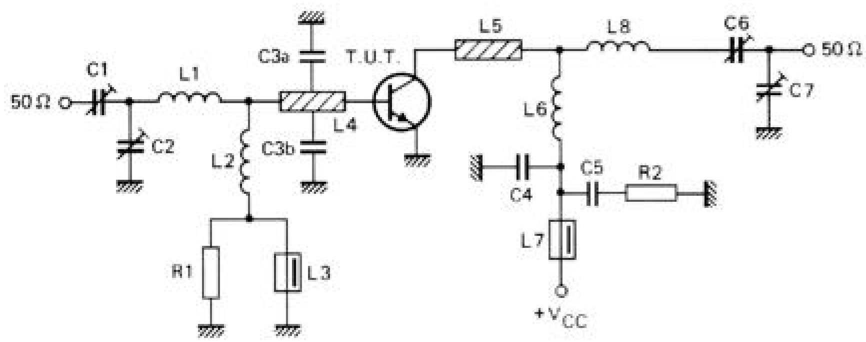
The coil on the drain of IRF is 3 turns 20 SWG wound on 4 number of T13.9 torroids (two torroids are stacked to form a balun core). The RFC at the Vcc line is 20 Turns 20 SWG wound on T20 torroid.

P190. Linear FM 50Watt with BLY90



A amplifier of force RF for the FM, is always essential for the amateur that wants it strengthens some small transmitter, that likely already it has manufactured or has been supplied ready. The present circuit can give 50-60W RF force of expense, with control smaller than 15-20W in the region of frequencies of FM, that is to say in the 88-108MHZ. Transistor that we selected for this manufacture is the BLY90, that has gain 5dB.

Circuit diagram



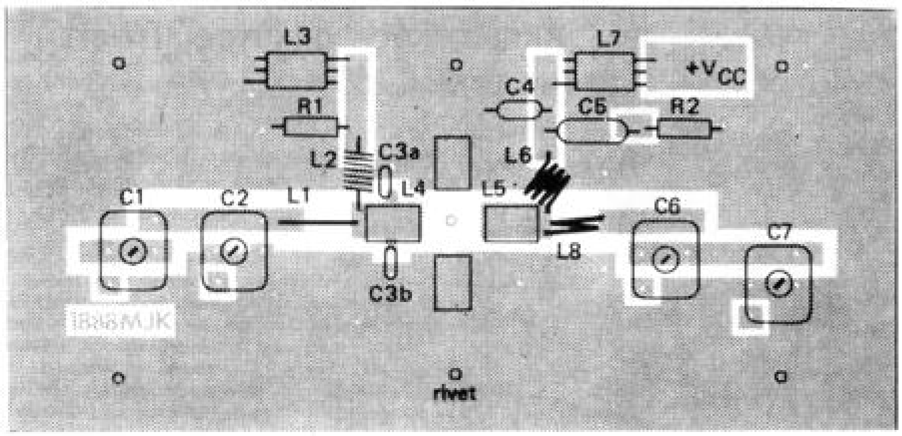
Description

As it appears in the analytic drawing (image 1) the amplifier is manufactured with transistor TR1, type BLY90 of Philips. The transistor this is specifically drawn for operation in frequencies up to 175MHZ, with very good results of linearity and record of force. In his technical' characteristics they are included the tendency of operation in the 12V the current of collector in the gain expense in the 5dB (measured in order C) and force of entry in the 16W. Variable capacitors C1, C2, with inductor L1, constitute the circuit of co-ordination, that adapts the exit of our transmitter in amplifier RF. This circuit has been calculated suitably, so that it covers all band the FM with the biggest possible output.

Inductor RFC1 polarized the transistor, so as to it works in order C, that is to say with the biggest output. Inductor L2 in the collector of TR1, constitutes the charge of amplifier, while RFC2 prevents the RF signals leak in the line of catering. Capacitor C2 and resistance R1, protect the circuit from auto polarization. The coordinated circuit of expense that is constituted by inductor L2 and variable capacitors C3, C4, adapts the exit of amplifier RF with the next stage, which can be constituted from some amplifier RF of high force (> 300W) or a aerial. This circuit can be supplied with 12V f.e from the battery of one automotive, so that it renders the system emitter portable. Thus, easily it can be moved in points with bigger altitude, in order that from there are achieved radio transmissions, something that was also got used in the past by romantic amateur of radio band.

The manufacture

The manufacture of amplifier, is very simple and easy, it is enough to look the images 3 and 2 that portray pcb the amplifier and the placement of materials in this. Puncture the point pcb, that pass the nutshell of TR1. Sticks the capacitors, variable, the resistance, RF tsok and the inductors. Finally you stick TR1, being careful not overheating at the welding and bend the pins his. Clean finally pcb from the residues of iron. Make a very careful control for by any chance errors, omissions, short-circuits, chills you stick also anything other that could you make think that will not work the amplifier.

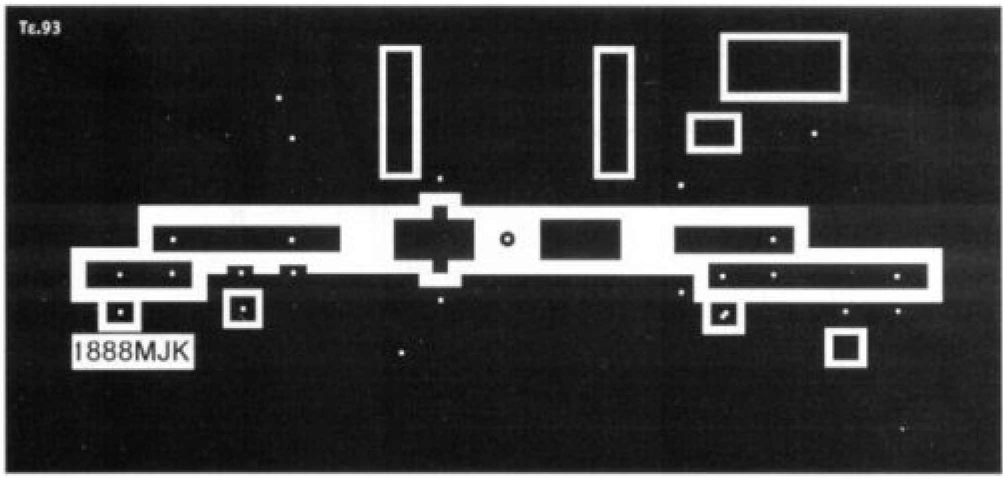


If all they are it includes, you connect the exit of your transmitter (15-20W) in input the amplifier. The exit of amplifier him you will connect in some charge (dummy load) or in the aerial, through bridge stagnant waves. Supply with tendency 11-15V your amplifier (power supply it should gives current 4-5A). Regulate the 4 variable C1-C4, until you take the biggest force of expense. The amplifier is ready.

Note:

TR1 needs a wiper of dimensions 5x10cm for trouble free operation. This wiper in TR1, without insulator, after his central screw has electric isolation from remainder pins.

Parts
C1-C4 = 10-80pF
C5 = 10nF
C6 = 1000pF
C7 = 100nF
C8 = 2200mF/35V
L1 = 1 coils of diameter of 10mms, 1mm
L2 = 7 coils of diameter of 10mms, 0,8mms
L3 = 3 coils of diameter of 10mms, 1mm
TR1 = BLY90



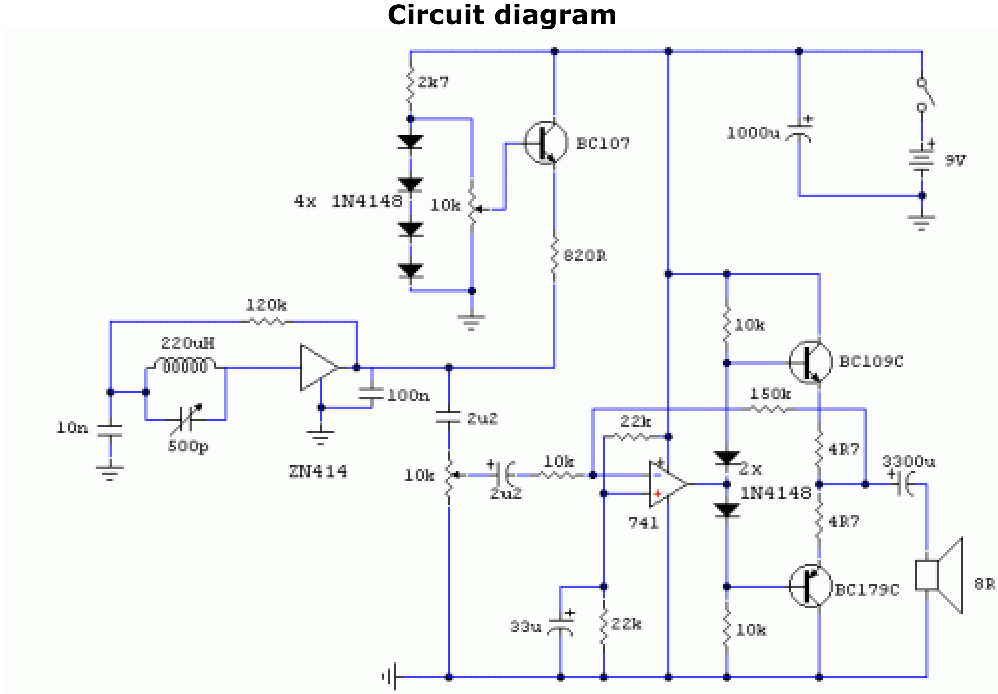
The printed circuit of amplifier of is double aspect but the down aspect is all coper

P191. ZN414 Portable AM Receiver

Notes:
Designed around the popular ZN414 ic this receiver covers the AM band from 550 - 1600 KHz with the values shown. For Longwave the coil needs to be changed. Use one from an old MW radio to save time. The ZN414 is a tuned radio frequency designed and incorporates several RF stages and an AM detector. It is easily overloaded and the operating voltage is critical to achieve good results.

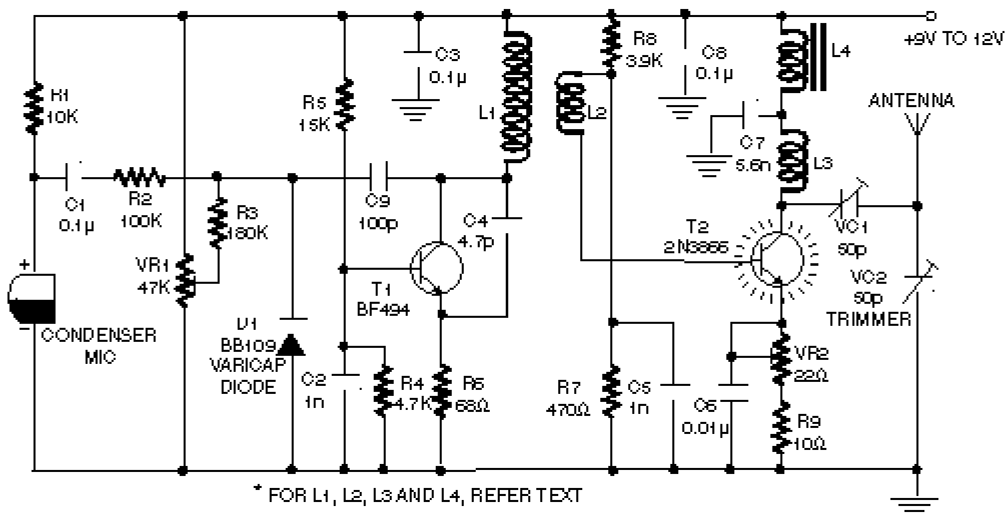
The BC107 acts as a voltage follower, the four 1N4148 diodes providing a stable 2.4V supply. With the 10k pot , which acts as a selectivity control, and the b-e voltage drop of the BC107, the operating voltage for the ZN414 is variable from 0 to 1.8volts DC. If you live in an area that is permeated with strong radio signals, then the voltage will need to be decreased. I found optimum performance with a supply of around 1.2 volts.

Circuit diagram



The audio amplifier is built around an inverting 741 op-amp. Extra current boost is provided using the BC109 / BC179 complementary transistor pair. The voltage gain of the complete audio amplifier is around 15. The audio output of the complete receiver is really quite good and free from distortion. I may provide some sound samples later..

P192. Long range FM transmitter



The power output of most of these circuits are very low because no power amplifier stages were incorporated.

The transmitter circuit described here has an extra RF power amplifier stage, after the oscillator stage, to raise the power output to 200-250 milliwatts. With a good matching 50-ohm ground plane antenna or multi-element Yagi antenna, this transmitter can provide reasonably good signal strength up to a distance of about 2 kilometres.

The circuit built around transistor T1 (BF494) is a basic low-power variable-frequency VHF oscillator. A varicap diode circuit is included to change the frequency of the transmitter and to provide frequency modulation by audio signals. The output of the oscillator is about 50 milliwatts. Transistor T2 (2N3866) forms a VHF-class A power amplifier. It boosts the oscillator signals' power four to five times. Thus, 200-250 milliwatts of power is generated at the collector of transistor T2.

For better results, assemble the circuit on a good-quality glass epoxy board and house the transmitter inside an aluminium case. Shield the oscillator stage using an aluminium sheet. Coil winding details are given below:

L1 - 4 turns of 20 SWG wire close wound over 8mm diameter plastic former.
L2 - 2 turns of 24 SWG wire near top end of L1.
(Note: No core (i.e. air core) is used for the above coils)
L3 - 7 turns of 24 SWG wire close wound with 4mm diameter air core.
L4 - 7 turns of 24 SWG wire-wound on a ferrite bead (as choke)

Potentiometer VR1 is used to vary the fundamental frequency whereas potentiometer VR2 is used as power control. For hum-free operation, operate the transmitter on a 12V rechargeable battery pack of 10 x 1.2-volt Ni-Cd cells. Transistor T2 must be mounted on a heat sink. Do not switch on the transmitter without a matching antenna. Adjust both trimmers (VC1 and VC2) for maximum transmission power. Adjust potentiometer VR1 to set the fundamental frequency near 100 MHz.

This transmitter should only be used for educational purposes.

P193. Remote control using VHF modules

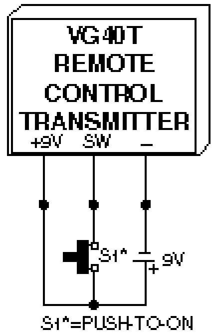


FIG. 1

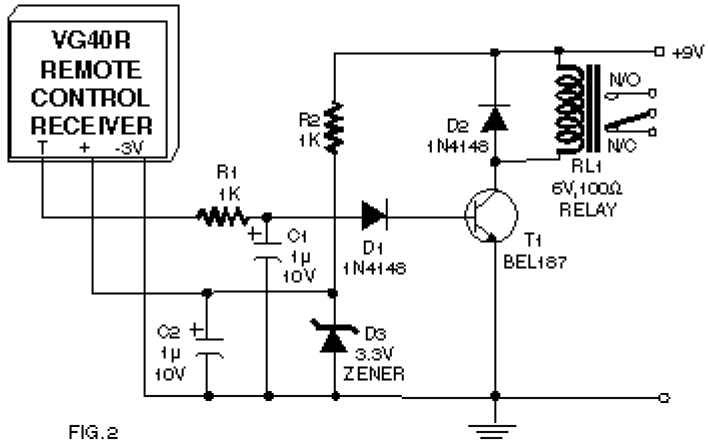


FIG.2

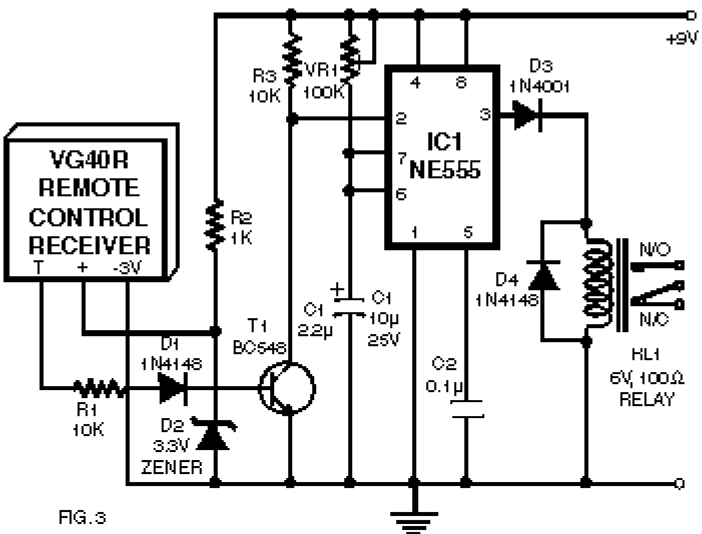


FIG.3

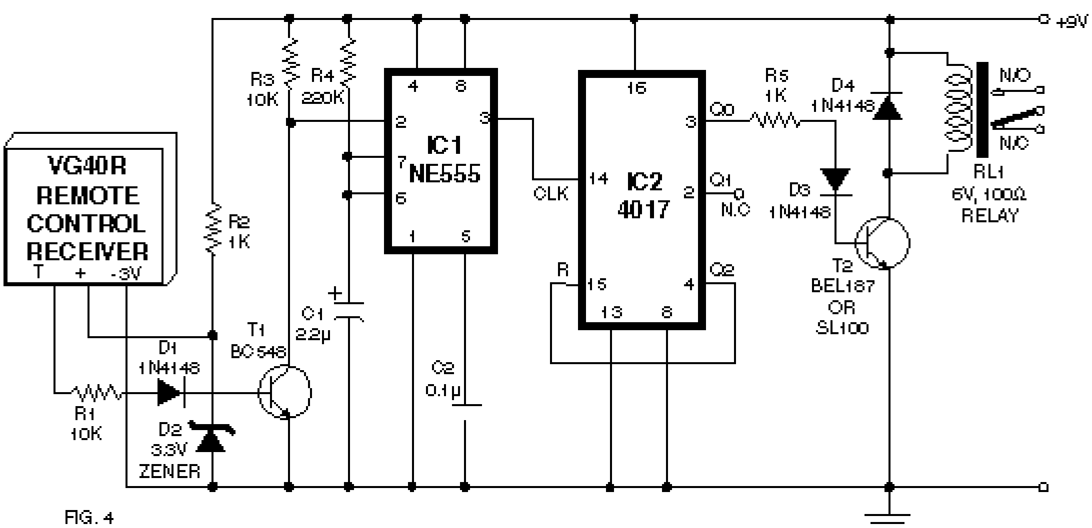


FIG. 4

A few designs for remote control switches, using VG40T and VG40R remote control pair, are shown here. The miniature transmitter module shown in Fig. 1, which just measures 34 mm x 29 mm x 10 mm, can be used to operate all remote control receiver-cum-switch combinations described in this project. A compact 9-volt PP3 battery can be used with the transmitter. It can transmit signals up to 15 metres without any aerial. The operating frequency of the transmitter is 300 MHz. The following circuits, using VG40R remote control receiver module measuring 45 mm x 21 mm x 13 mm, can be used to:

(a) activate a relay momentarily,
(b) activate a relay for a preset period,
(c) switch on and switch off a load.

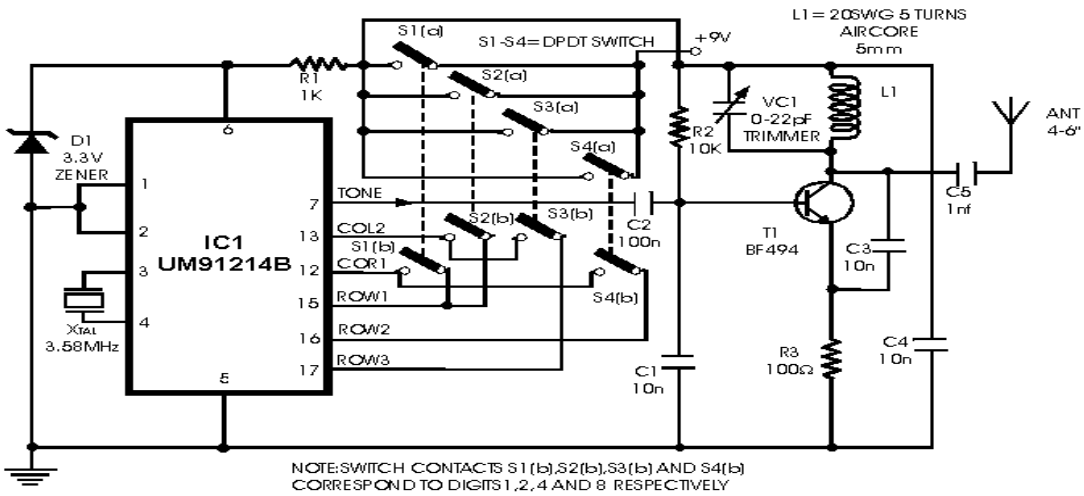
To activate a relay momentarily (see Fig. 2), the switch on the transmitter unit is pressed, and so a positive voltage is obtained at output pin of VG40R module. This voltage is given to bias the relay driver transistor. The relay gets activated by just pressing push-to-on micro switch on the transmitter unit. The relay remains energised as long as the switch remains pressed. When the switch is released, the relay gets deactivated. Any electrical/electronic load can be connected via N/O contacts of the relay.

To activate a relay for a preset period (refer Fig. 3), the switch on the transmitter unit is pressed momentarily. The transistor gets base bias from VG40R module. As a result the transistor conducts and applies a trigger pulse to IC 555, which is wired as a monostable multivibrator. The relay remains activated till the preset time is over. Time delay can be varied from a few seconds to a few minutes by adjusting timing components.

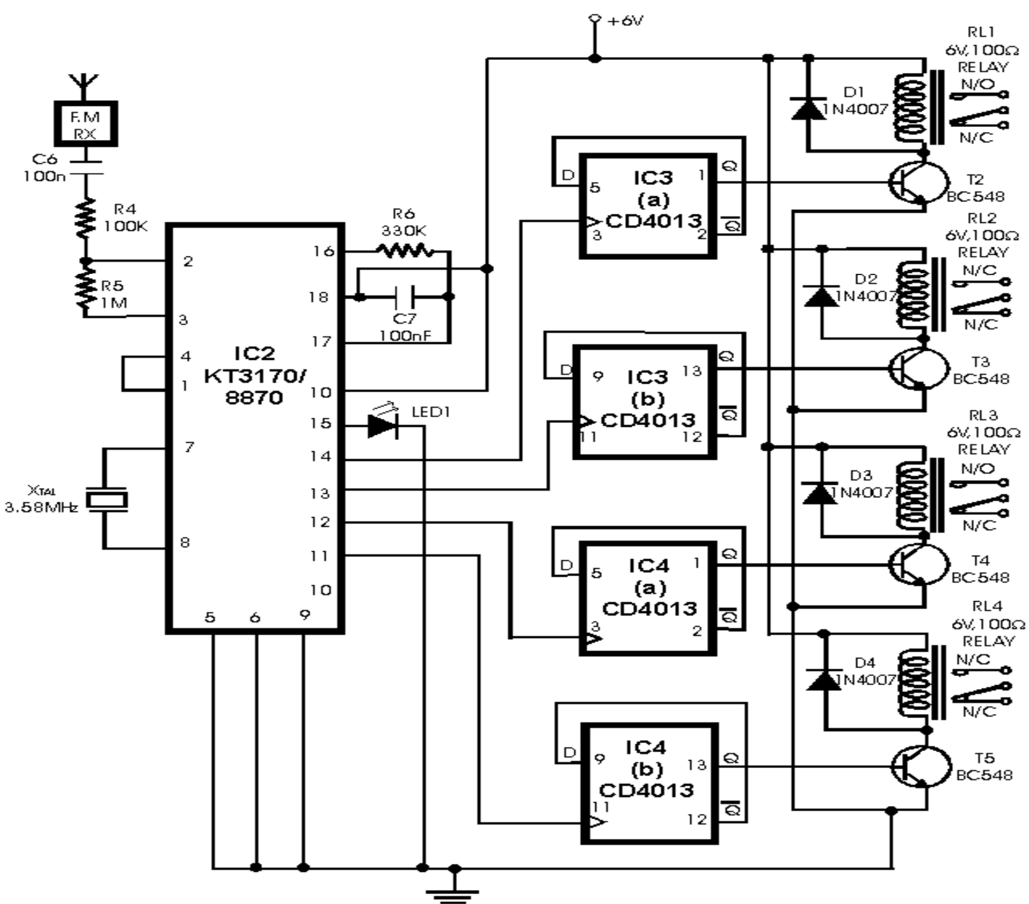
To switch on and switch off a load (refer Fig. 4), a 555 IC and a decade counter 4017 IC are used. Here the 4017 IC is wired as a flip-flop for toggle action. This is achieved by connecting Q2 output to reset terminal while Q1 output is unused. Q0 output is used for energising the relay. The relay is activated and deactivated by pressing the transmitter switch alternately. So, to activate the load, just press the transmitter switch once, momentarily. The relay will remain activated. To switch off the relay, press the transmitter switch again. This process can be repeated. Time delay of monostable multivibrator is set for about one second.

Note: Short length of shielded wire should be used between VG40R receiver module output and the rest of the circuit. The transmitter with 9V battery must be housed inside a nonmetallic (say, plastic) cabinet for maximum range of operation.

P194. Radio Remote Control using DTMF

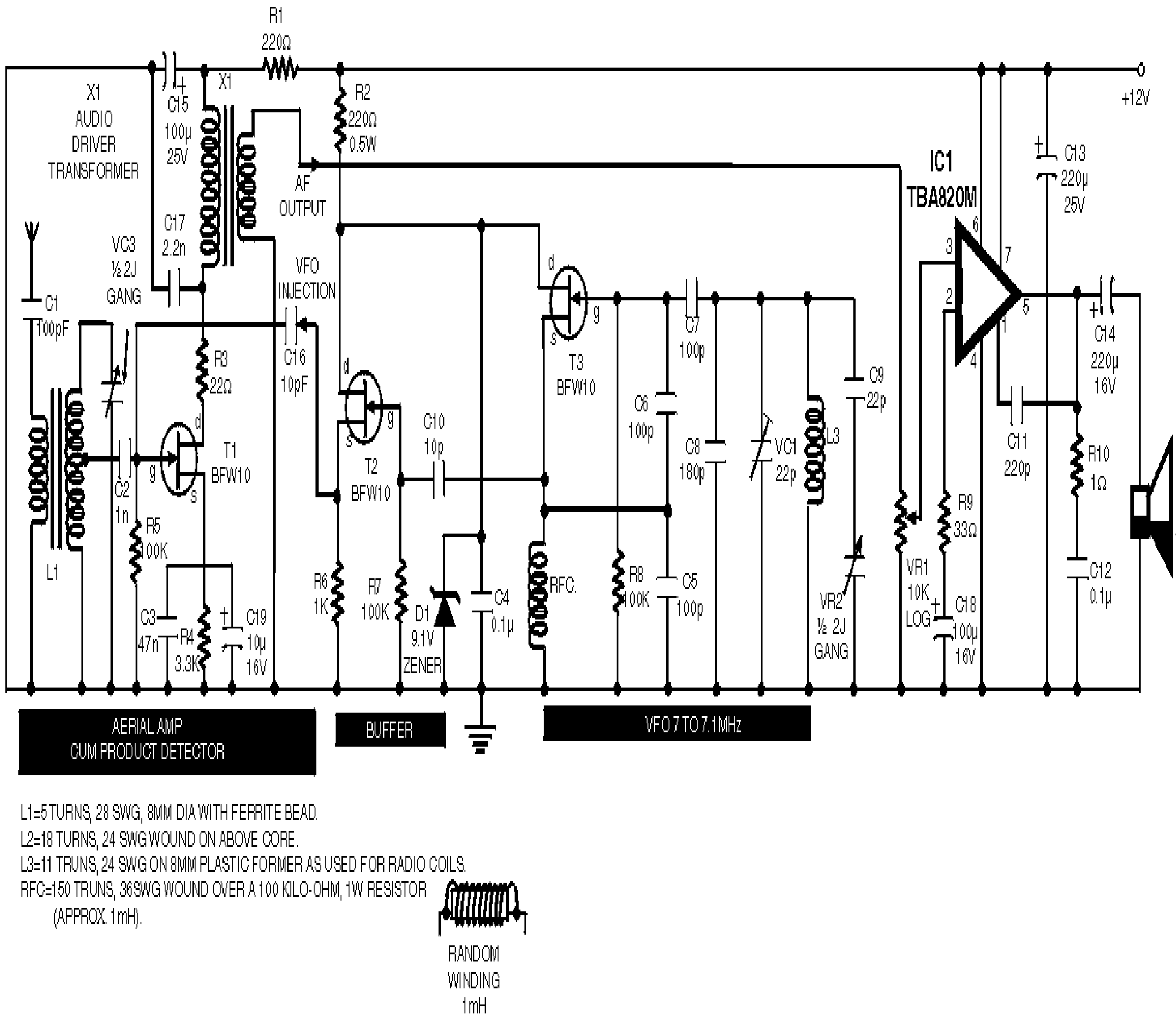


NOTE: SWITCH CONTACTS S1(b), S2(b), S3(b) AND S4(b) CORRESPOND TO DIGITS 1, 2, 4 AND 8 RESPECTIVELY OF TELEPHONE PAD SWITCHES.



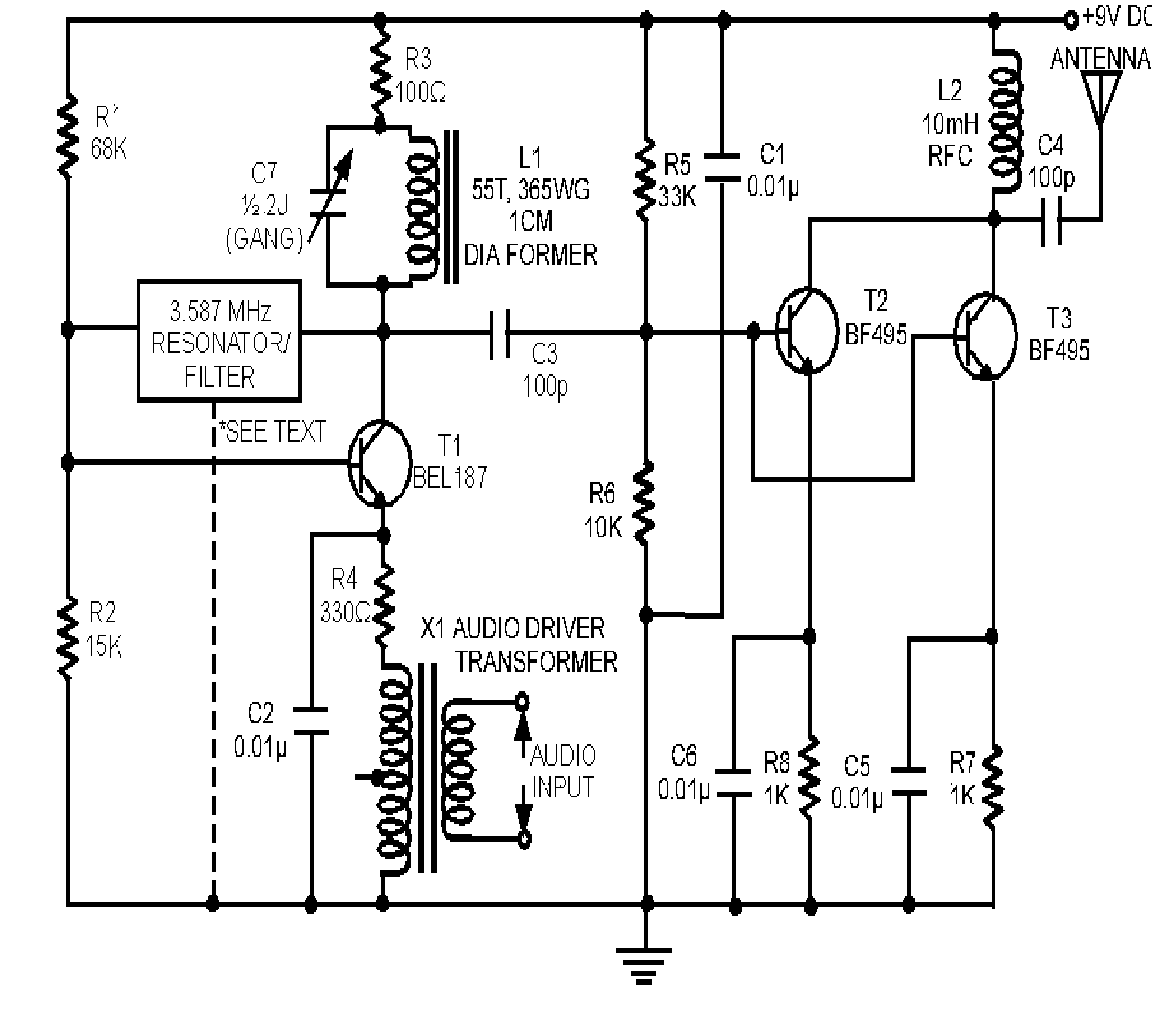
Here is a circuit of a remote control unit which makes use of the radio frequency signals to control various electrical appliances. This remote control unit has 4 channels which can be easily extended to 12. This circuit differs from similar circuits in view of its simplicity and a totally different concept of generating the control signals. Usually remote control circuits make use of infrared light to transmit control signals. Their use is thus limited to a very confined area and line-of-sight. However, this circuit makes use of radio frequency to transmit the control signals and hence it can be used for control from almost anywhere in the house. Here we make use of DTMF (dual-tone multi frequency) signals (used in telephones to dial the digits) as the control codes. The DTMF tones are used for frequency modulation of the carrier. At the receiver unit, these frequency modulated signals are intercepted to obtain DTMF tones at the speaker terminals. This DTMF signal is connected to a DTMF-to-BCD converter whose BCD output is used to switch-on and switch-off various electrical applicances (4 in this case). The remote control transmitter consists of DTMF generator and an FM transmitter circuit. For generating the DTMF frequencies, a dedicated IC UM91214B (which is used as a dialler IC in telephone instruments) is used here. This IC requires 3 volts for its operation. This is provided by a simple zener diode voltage regulator which converts 9 volts into 3 volts for use by this IC. For its time base, it requires a quartz crystal of 3.58 MHz which is easily available from electronic component shops. Pins 1 and 2 are used as chip select and DTMF mode select pins respectively. When the row and column pins (12 and 15) are shorted to each other, DTMF tones corresponding to digit 1 are output from its pin 7. Similarly, pins 13, 16 and 17 are additionally required to dial digits 2, 4 and 8. Rest of the pins of this IC may be left as they are. The output of IC1 is given to the input of this transmitter circuit which effectively frequency modulates the carrier and transmits it in the air. The carrier frequency is determined by coil L1 and trimmer capacitor VC1 (which may be adjusted for around 100MHz operation). An antenna of 10 to 15 cms (4 to 6 inches) length will be sufficient to provide adequate range. The antenna is also necessary because the transmitter unit has to be housed in a metallic cabinet to protect the frequency drift caused due to stray EM fields. Four key switches (DPST push-to-on spring loaded) are required to transmit the desired DTMF tones. The switches when pressed generate the specific tone pairs as well as provide power to the transmitter circuit simultaneously. This way when the transmitter unit is not in use it consumes no power at all and the battery lasts much longer. The receiver unit consists of an FM receiver (these days simple and inexpensive FM kits are readily available in the market which work exceptionally well), a DTMF-to-BCD converter and a flip-flop toggling latch section. The frequency modulated DTMF signals are received by the FM receiver and the output (DTMF tones) are fed to the dedicated IC KT3170 which is a DTMF-to-BCD converter. This IC when fed with the DTMF tones gives corresponding BCD output; for example, when digit 1 is pressed, the output is 0001 and when digit 4 is pressed the output is 0100. This IC also requires a 3.58MHz crystal for its operation. The tone input is connected to its pin 2 and the BCD outputs are taken from pins 11 to 14 respectively. These outputs are fed to 4 individual 'D' flip-flop latches which have been converted into toggle flip-flops built around two CD4013B ICs. Whenever a digit is pressed, the receiver decodes it and gives a clock pulse which is used to toggle the corresponding flip-flop to the alternate state. The flip-flop output is used to drive a relay which in turn can latch or unlatch any electrical appliance. We can upgrade the circuit to control as many as 12 channels since IC UM91214B can generates 12 DTMF tones. For this purpose some modification has to be done in receiver unit and also in between IC2 and toggle flip-flop section in the receiver. A 4-to-16 lines demultiplexer (IC 74154) has to be used and the number of toggle flip-flops have also to be increased to 12 from the existing 4

P195. meter Direct Conversion Receiver



Using the circuit of 40-metre band direct-conversion receiver descr- ibed here, one can listen to amateur radio QSO signals in CW as well as in SSB mode in the 40-metre band. The circuit makes use of three n-channel FETs (BFW10). The first FET (T1) performs the function of ant./RF amplifier-cum-product detector, while the second and third FETs (T2 and T3) together form a VFO (variable frequency oscillator) whose output is injected into the gate of first FET (T1) through 10pF capacitor C16. The VFO is tuned to a frequency which differs from the incoming CW signal frequency by about 1 kHz to produce a beat frequency in the audio range at the output of transformer X1, which is an audio driver transformer of the type used in transistor radios. The audio output from transformer X1 is connected to the input of audio amplifier built around IC1 (TBA820M) via volume control VR1. An audio output from the AF amplifier is connected to an 8-ohm, 1-watt speaker. The receiver can be powered by a 12-volt power-supply, capable of sourcing around 250mA current. Audio-output stage can be substituted with a readymade L-plate audio output circuit used in transistor amplifiers, if desired. The necessary data regarding the coils used in the circuit is given in the circuit diagram itself.

P196. Powerful AM transmitter

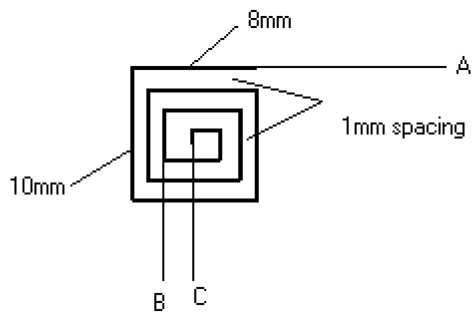


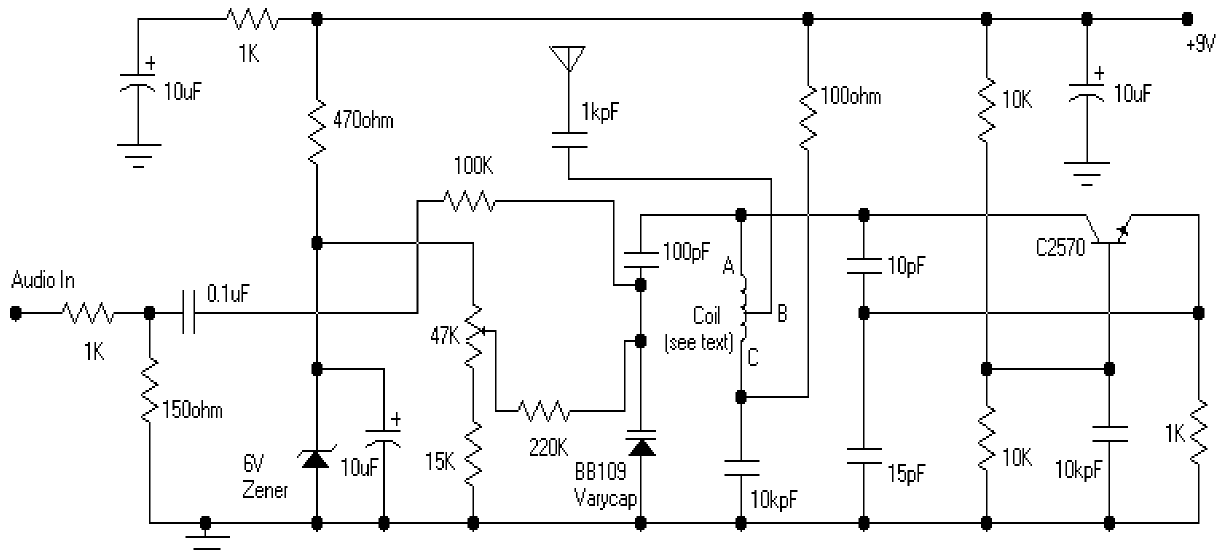
The circuit for a powerful AM transmitter using ceramic resonator/filter of 3.587 MHz is presented here. Resonators/filters of other frequencies such as 5.5 MHz, 7 MHz and 10.7 MHz may also be used. Use of different frequency filters/resonators will involve corresponding variation in the value of inductor used in the tank circuit of oscillator connected at the collector of transistor T1.

The AF input for modulation is inserted in series with emitter of transistor T1 (and resistor R4) using a transistor radio type audio driver transformer as shown in the circuit. Modulated RF output is developed across the tank circuit which can be tuned to resonance frequency of the filter/resonator with the help of gang condenser C7. The next two stages formed using low-noise RF transistors BF495 are, in fact, connected in parallel for amplification of modulated signal coupled from collector of transistor T1 to bases of transistors T2 and T3. The combined output from collectors of T2 and T3 is fed to antenna via 100pF capacitor C4.

The circuit can be easily assembled on a general-purpose PCB. The range of the transmitter is expected to be one to two kilometers. The circuit requires regulated 9-volt power supply for its operation. Note: Dotted lined indicates additional connection if a 3-pin filter is used in place.

P197. FM transmitter





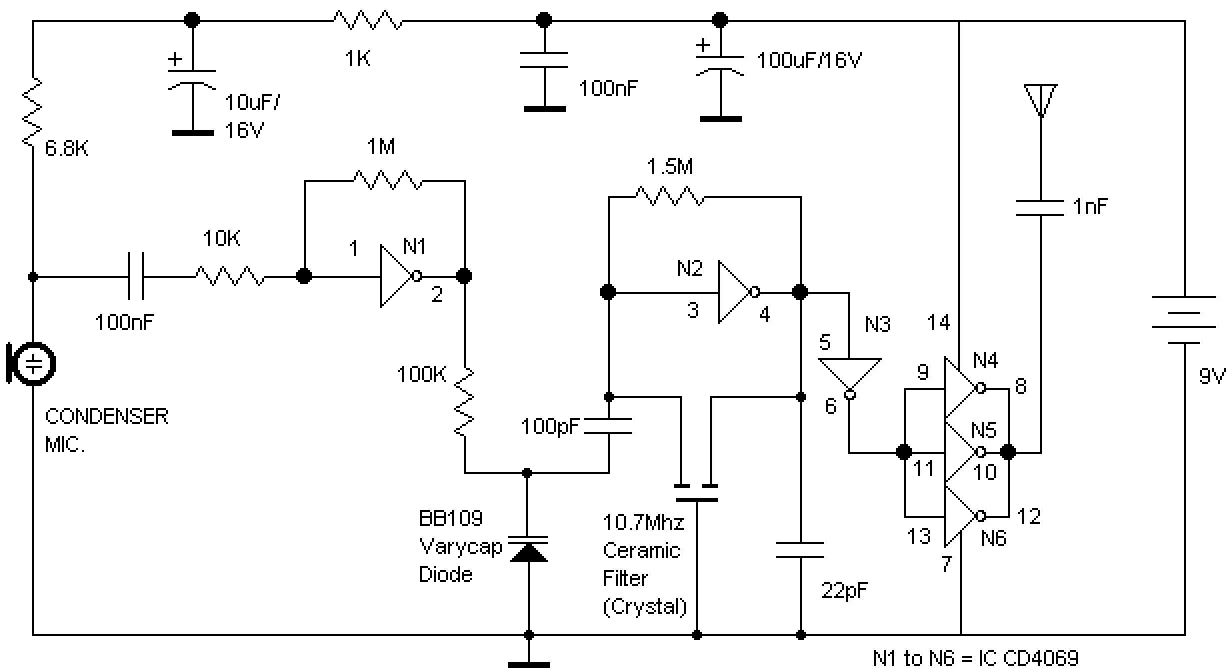
Colpitts oscillator. Its frequency depends on the capacitance of the vary cap diode. The center frequency is changed by varying the biasing voltage of the vary cap through the 47K pot. You can use a 75cm telescopic antenna or simply a length of hook-up wire. Mine worked fine with a 6cm hook-up wire and gave a range of 100m with a good FM receiver.

Coil Details (Print on the PCB itself)

The coil shown below can be constructed on the PCB itself as PCB track. Just transfer the dimensions on a copper board and etch it. If the 1mm spacing is difficult use a sharp blade to remove unwanted copper.
You can also use a copper wire and construct a square spiral of the dimensions shown below. Please note that a small deviation from the given dimensions is permissible.

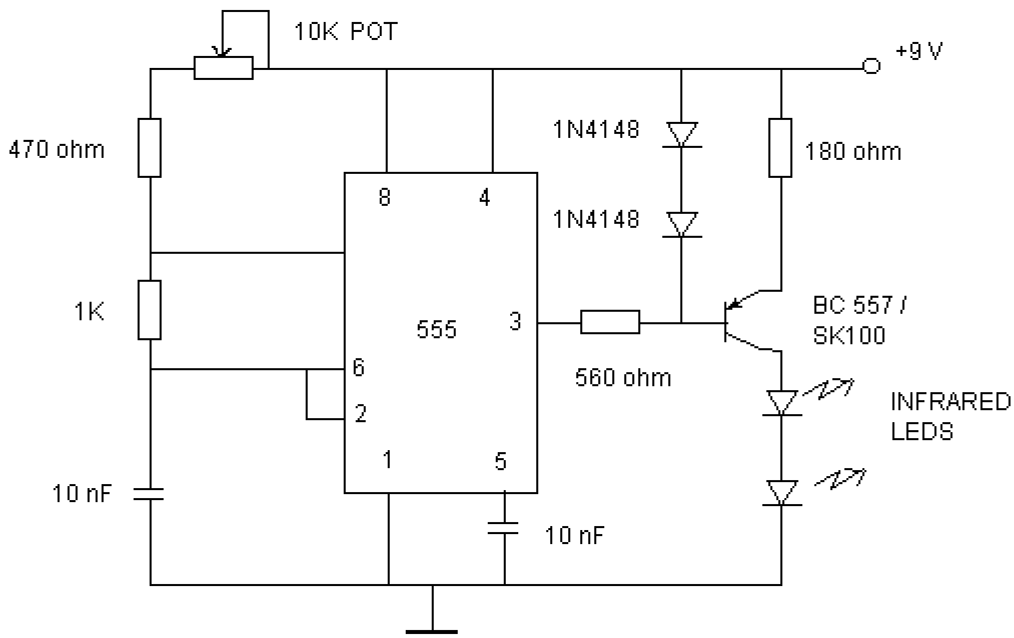
Note: You can even try a coil made of 18SWG copper wire of 5 turns and 5mm dia with air core. The center tap can then be taken at the 2nd or 3rd turn.(I have'nt tried it tell me if it works well)

P198. Coilless FM transmitter



The RF oscillator using the inverter N2 and 10.7Mhz ceramic filter is driving the parallel combination of N4 to N6 through N3.Since these inverters are in parallel the output impedance will be low so that it can directly drive an aerial of 1/4th wavelength. Since the output of N4-N6 is square wave there will be a lot of harmonics in it. The 9th harmonics of 10.7Mhz (96.3Mhz) will hence be at the center of the FM band .
N1 is working as an audio amplifier. The audio signals from the microphone are amplified and fed to the varycap diode. The signal varies the capacitance of the varycap and hence varies the oscillator frequency which produce Frequency Modulation.

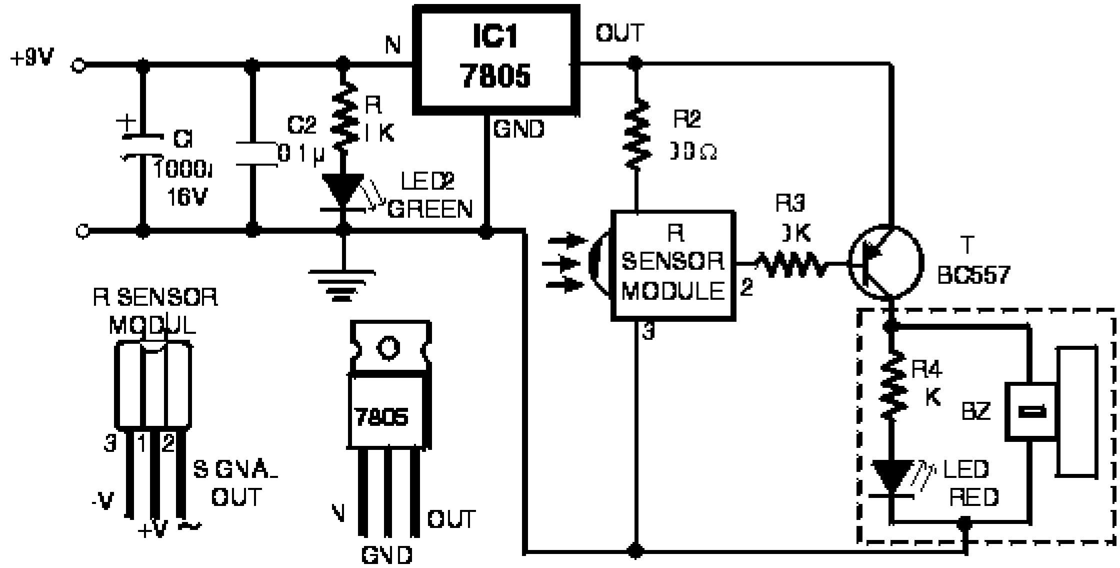
P199. TV remote control Blocker

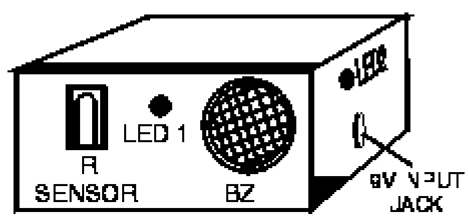


Just point this small device at the TV and the remote gets jammed . The circuit is self explanatory . 555 is wired as an astable multivibrator for a frequency of nearly 38 kHz. This is the frequency at which most of the modern TVs receive the IR beam . The transistor acts as a current source supplying roughly 25mA to the infra red LEDs. To increase the range of the circuit simply decrease the value of the 180 ohm resistor to not less than 100 ohm.

It is required to adjust the 10K potentiometer while pointing the device at your TV to block the IR rays from the remote. This can be done by trial and error until the remote no longer responds.

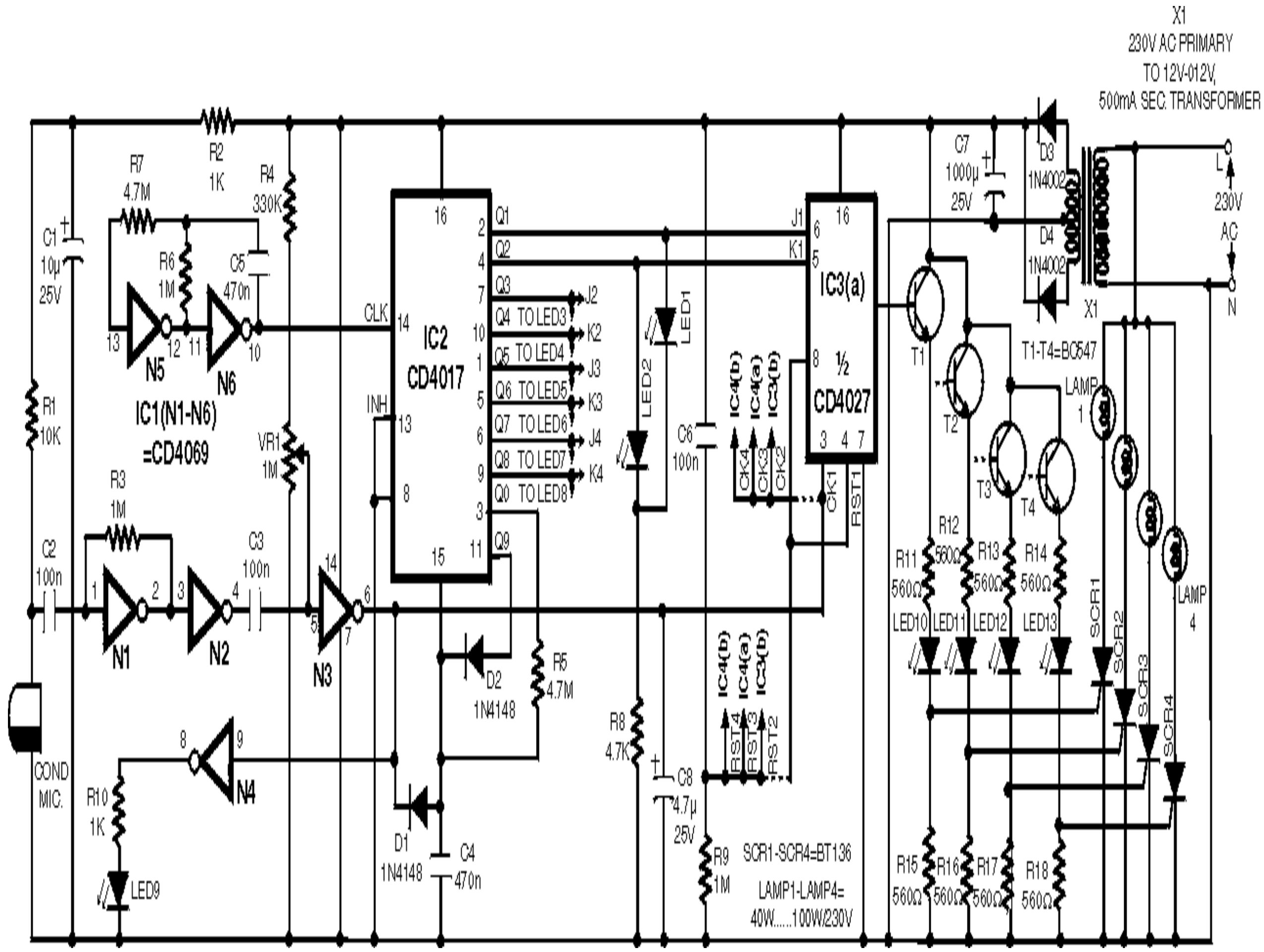
P200. A simple Remote control Tester





Here is a handy gadget for test- ing of infrared (IR) based re- mote control transmitters used for TVs and VCRs etc. The IR signals from a remote control transmitter are sensed by the IR sensor module in the tester and its output at pin 2 goes low. This in turn switches on transistor T1 and causes LED1 to blink. At the same time, the buzzer beeps at the same rate as the incoming signals from the remote control transmitter. The pressing of different buttons on the remote control will result in different pulse rates which would change the rate at which the LED blinks or the buzzer beeps. When no signal is sensed by the sensor module, output pin 2 of the sensor goes high and, as a result, transistor T1 switches off and hence LED1 and buzzer BZ1 go off. This circuit requires 5V regulated power supply which can be obtained from 9V eliminator and connected to the circuit through a jack. Capacitor C1 smoothes DC input while capacitor C2 suppresses any sudden spikes appearing in the input supply. Here, a plastic moulded sensor has been used so that it can easily stick out from a cut in the metal box in which it is housed. It requires less space. Proper grounding of the metal case will ensure that the electromagnetic emissions which are produced by tube-lights and electronic ballasts etc (which lie within the bandwidth of receiver circuit) are effectively grounded and do not interfere with the functioning of the circuit. The proposed layout of the box containing the circuit is shown in the figure. The 9-volt DC supply from the eliminator can be fed into the jack using a banana-type plug. Tech. Editor’s note: In fact, the complete gadget can be assembled in the eliminator’s housing itself and a cut can be made in its body for exposing the IR module’s sensor part.

P201. Clap Activated Remote



An infra-red or wireless remote control has the disadvantage that the small, handy, remote transmitter is often misplaced. The sound operated switch has the advantage that the transmitter is always with you. This project offers a way to control up to four latching switches with two claps of your hand. These switches may be used to control lights or fans – or anything else that does not produce too loud a sound. To prevent an occasional loud sound from causing malfunction, the circuit is normally quiescent. The first clap takes it out of standby state and starts a scan of eight panel-mounted LEDs. Each of the four switches are accompanied with two LEDs – one for indicating the 'on' and the other for indicating the 'off' state. A second clap, while the appropriate LED is lit, activates that function. For example, if you clap while LED10 used in conjunction with Lamp 1 is lit then the lamp turns on. (If it is already on, nothing happens and it remains on.) A condenser microphone, as used in tape recorders, is used here to pick up the sound of the claps. The signal is then amplified and shaped into a pulse by three inverters (N1 through N3) contained in CMOS hex inverter IC CD4069. A clock generator built from two of the inverter gates (N5 and N6) supplies clock pulses to a decade counter CD4017 (IC2). Eight outputs of this IC drive LEDs (1 through 8). These outputs also go to the J and K inputs of four flip-flops in two type CD4027 ICs (IC3 and IC4). The clock inputs of these flip-flops are connected to the pulse shaped sound signal (available at the output of gate N3). Additional circuitry around the CD4017 counter ensures that it is in the reset state, after reaching count 9, and that the reset is removed when a sound signal is received. Outputs of the four flip-flops are buffered by transistors and fed via LEDs to the gates of four triacs. These triacs switch the mains supply to four loads, usually lamps. If small lamps are to be controlled, these may be directly driven by the transistors. If this circuit is to be active, i.e. scanning all the time, some components around CD4017 IC could be omitted and some connections changed. But then it would no longer be immune to an occasional, spurious loud sound. The condenser microphone usually available in the market has two terminals. It has to be supplied with power for it to function. Any interference on this supply line will be passed on to the output. So the supply for the microphone is smoothed by resistor-capacitor combination of R2, C1 and fed to it via resistor R1. CD4069, a hex unbuffered inverter, contains six similar inverters. When the output and input of such an inverter is bridged by a resistor, it functions as an inverting amplifier. Capacitor C2 couples the signal developed by the microphone to N1 inverter in this IC, which is configured as an amplifier. The output of gate N1 is directly connected to the input of next gate N2. Capacitor C3 couples the output of this inverter to N3 inverter, which is connected as an adjustable level comparator. Inverter N4 is connected as an LED (9) driver to help in setting the sensitivity. Preset VR1 supplies a variable bias to U3. If the wiper of VR1 is set towards the negative supply end, the circuit becomes relatively insensitive (i.e. requires a thunderous clap to operate). As the wiper is turned towards resistor R4, the circuit becomes progressively more sensitive. The sound signal supplied by gate N2 is added to the voltage set by preset VR1 and applied to the input of gate N3. When this voltage crosses half supply voltage, the output of gate N3 goes low. This output is normally high since the input is held low by adjustment of preset VR1. This output is used for two things: First, it releases the reset state of IC2 via diode D1. Second, it feeds the clock inputs to the four flip-flops contained in IC3 and IC4. In the quiescent state, IC2 is reset and its 'Q0' output is high. Capacitor C4 is charged positively and it holds this charge due to the connection from R5 to this output (Q0). IC2 is a decade counter with fully decoded outputs. It has ten outputs labelled Q0 to Q9 which go successively high, one at a time, when the clock in put is fed with pulses. IC3 and IC4 are dual JK flip-flops. In this circuit they store (latch) the state of the four switches and control the output through transistors and triacs. At the first clap, the output of gate N3 goes low. Diode D1 is forward biased and it conducts, discharging capacitor C4. The reset input of IC2 goes low, releasing its reset state. All the J and K inputs of the four flip-flops are low and so these do not change state, even though their clock inputs receive pulses. When the reset input of IC2 is low, each clock pulse causes IC2 to advance by one count and its outputs go high successively, lighting up the corresponding LEDs and pulling high the J and K inputs of the four flip-flops, one after the other. Resistor R8 limits the current through LEDs 1 through 8 to about 2 mA. Larger current might cause malfunction due to the outputs of IC2 being pulled down below the logic 1 state input voltage. If a second clap is detected while the J input of a particular flip-flop is high, its Q output will go high, regardless of what state it was in previously. Similarly, if its K input was high, the output will go low. (If both J and K are high, the output will change state at each clock pulse.) Thus although all flip-flops receive the clap signal at their clock inputs, only the one selected by the active output of IC2 will change state. Resistor R9 and capacitor C6 ensure that the flip-flops start in the off state when power to the circuit is switched on, by providing a positive power-on-reset pulse to the reset input pins when power is applied. The preset input pins are not used and are therefore connected directly to ground. When, after eight clock pulses, output Q8 of IC2 becomes high, diode D2 conducts, charging capacitor C4, thereby resetting IC2 and making its Q0 output high. And there it stays, awaiting the next clap. The four Q outputs of IC3 and IC4 are buffered by npn transistors, fed through current limiting resistors and LEDs (to indicate the on/off state of the loads) to the gates of four triacs. Four lamps operating on the mains may thus be controlled. For demonstrations, it might be better to drive small lamps (drawing less than 100 mA at 12V) directly from the emitters of the transistors. In this case the triacs, LEDs and their associated current limiting resistors may be omitted. It has to be noted that one side of the mains has to be connected to the negative supply line of this circuit when mains loads are to be controlled. This necessitates safe construction of the circuit such that no part of it is liable to be touched. The advantage is that it may be mounted out of reach of curious hands since it does not need to be handled during normal operation. It is advisable to start with the low voltage version and then upgrade to mains operation, once you are sure everything else is working satisfactorily. CMOS ICs are used in this circuit for implementing the amplifying and logic functions. Use of a dedicated supply is recommended because the integrated circuits will be damaged if the supply voltage is too high, or is of wrong polarity. An external power supply may get connected up the wrong way around, or be inadvertently set to too high a voltage. Therefore it is a good idea to start by constructing the power supply section and then add the other components of the circuit. If the clock is working, you may turn your attention to the amplifier. LED9 should be off, and should flash when the terminals of capacitor C2 are touched with a wet finger (the classic wet finger test). Preset VR1 may need to be adjusted until LED9 just turns off. The output of gate N2 will be at about half the supply voltage. The output of gate N3 would normally be high. The voltage at the input of gate N3 should vary when preset VR1 is varied. High-efficiency LEDs should preferably be used in this circuit. The microphone has two terminals, one of which is connected to its body. This terminal has to be connected to circuit ground, and the other to the junction of resistor R2 and capacitor C2. These wires are preferably kept short (one or two centimetres) to avoid noise pickup. With the microphone connected, a loud sound (a clap) should result in LED9 blinking. Adjust preset VR1 so that LED9 stays off on the loudest of background noises but starts glowing when you clap. If the clap-to-start feature is not required, it may be disabled by omitting components D1, D2, R5, C4 and connecting a wire link in place of diode D2. Then IC2 will be alive and kicking all the time.

P202. Ultrasonic switch

Circuit of a new type of remote control switch is described here. This circuit functions with inaudible (ultrasonic) sound. Sound of frequency up to 20 kHz is audible to human beings. The sound of frequency above 20 kHz is called ultrasonic sound. The circuit described generates (transmits) ultrasonic sound of frequency between 40 and 50 kHz. As with any other remote control system this cirucit too comprises a mini transmitter and a receiver circuit. Transmitter generates ultrasonic sound and the receiver senses ultrasonic sound from the transmitter and switches on a relay. The ultrasonic transmitter uses a 555 based astable multivibrator. It oscillates at a frequency of 40-50 kHz. An ultrasonic transmitter transducer is used here to transmit ultrasonic sound very effectively. The transmitter is powered from a 9-volt PP3 single cell. The ultrasonic receiver circuit uses an ultrasonic receiver transducer to sense ultrasonic signals. It also uses a two-stage amplifier, a rectifier stage, and an operational amplifier in inverting mode. Output of op-amp is connected to a relay through a complimentary relay driver stage. A 9-volt battery eliminator can be used for receiver circuit, if required. When switch S1 of transmitter is pressed, it generates ultrasonic sound. The sound is received by ultrasonic receiver transducer. It converts it to electrical variations of the same frequency. These signals are amplified by transistors T3 and T4. The amplified signals are then rectified and filtered. The filtered DC voltage is given to inverting pin of op-amp IC2. The non- inverting pin of IC2 is connected to a variable DC voltage via preset VR2 which determines the threshold value of ultrasonic signal received by receiver for operation of relay RL1. The inverted output of IC2 is used to bias transistor T5. When transistor T5 conducts, it supplies base bias to transistor T6. When transistor T6 conducts, it actuates the relay. The relay can be used to control any electrical or electronic equipment. Important hints:

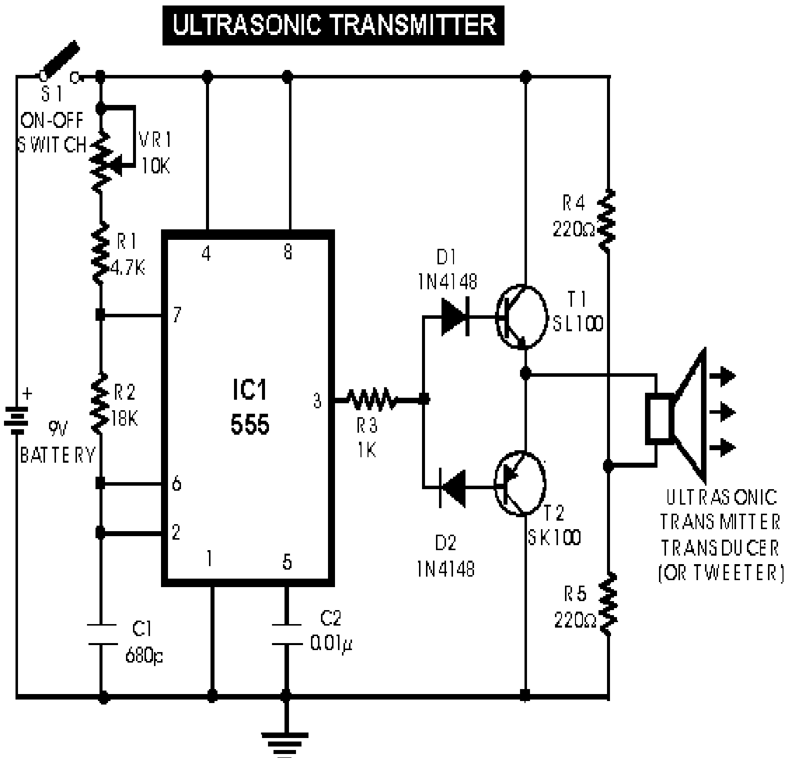
1. Frequency of ultrasonic sound generated can be varied from 40 to 50 kHz range by adjusting VR1. Adjust it for maximum performance.

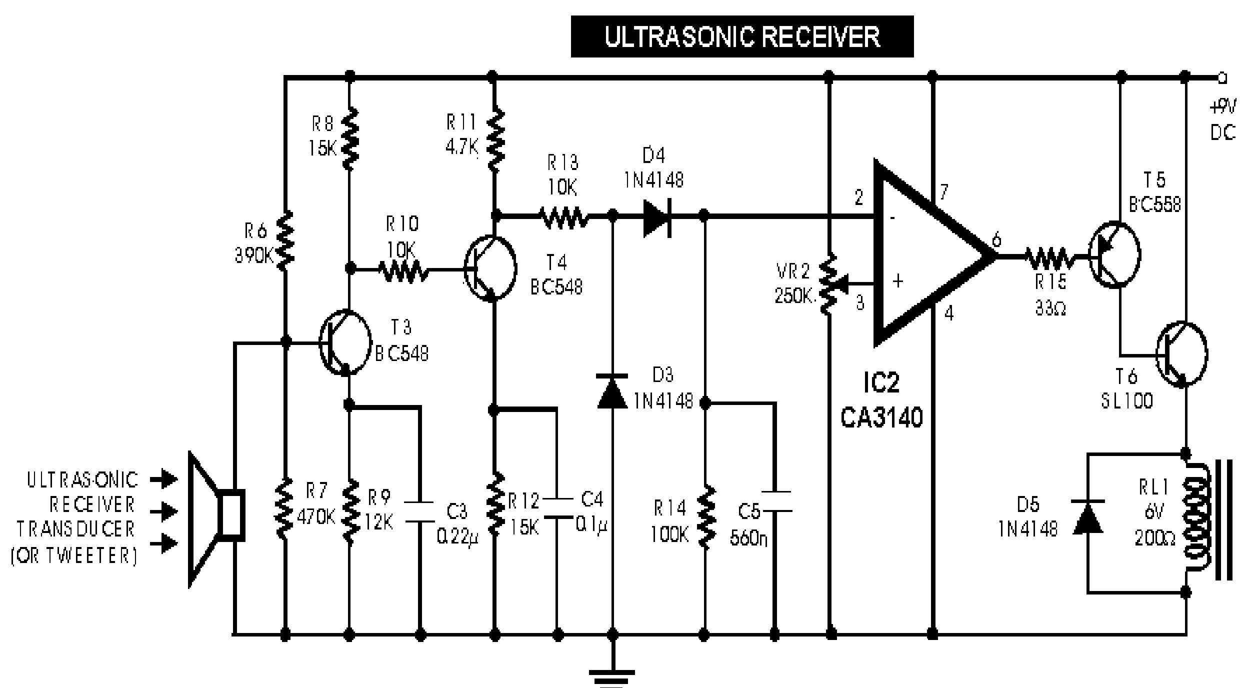
2. Ultrasonic sounds are highly directional. So when you are operating the switch the ultrasonic transmitter transducer of transmitter should be placed towards ultrasonic receiver transducer of receiver circuit for proper functioning.

3. Use a 9-volt PP3 battery for transmitter. The receiver can be powered from a battery eliminator and is always kept in switched on position.

4. For latch facility use a DPDT relay if you want to switch on and switch off the load. A flip-flop can be inserted between IC2 and relay. If you want only an ‘ON-time delay’ use a 555 only at output of IC2. The relay will be energised for the required period determined by the timing components of 555 monostable multivibrator.

5. Ultrasonic waves are emitted by many natural sources. Therefore, sometimes, the circuit might get falsely triggered, espically when a flip-flop is used with the circuit, and there is no remedy for that.


ULTRASONIC TRANSMITTER
S1
ON-OFF
SWITCH
VR1
10K
R1
4.7K
R2
18K
9V
BATTERY
IC1
555
R3
1K
D1
1N4148
D2
1N4148
T1
SL100
T2
SK100
R4
220Ω
R5
220Ω
C1
680p
C2
0.01μ
ULTRASONIC
TRANSMITTER
TRANSDUCER
(OR TWEETER)

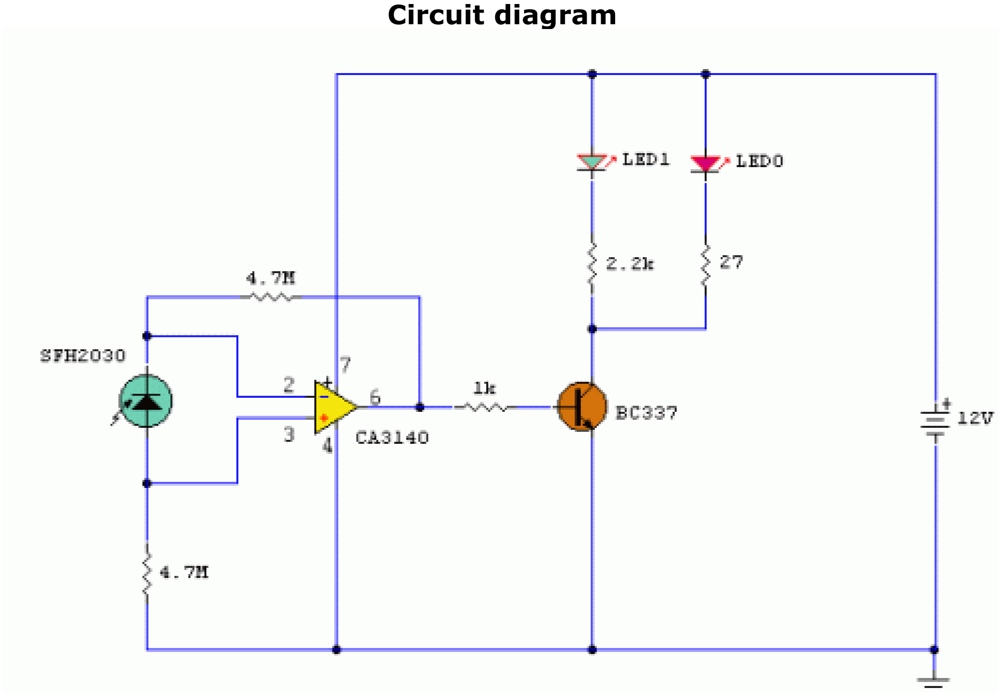

ULTRASONIC RECEIVER
+9V
DC
R8
15K
R11
4.7K
R13
10K
D4
1N4148
R6
390K
R10
10K
T4
BC548
T3
BC548
VR2
250K
IC2
CA3140
T5
BC558
R15
33Ω
T6
SL100
D3
1N4148
ULTRASONIC
RECEIVER
TRANSDUCER
(OR TWEETER)
R7
470K
R9
12K
C3
0.22μ
R12
15K
C4
0.1μ
R14
100K
C5
560n
D5
1N4148
RL1
6V
200Ω

P203. Infra Red Remote Control Extender

Description
This circuit is used to relay signals from an Infra Red remote control in one room to an IR controlled appliance in another room.

Forward
I have seen these devices advertised in magazines, they sell for around £40-£50 and use radio to transmit between receiver and transmitter. This version costs under £5 to make and uses a cable connection between receiver and transmitter. For example, if you have a bedroom TV set that is wired to the video or satellite in another room, then you can change channels on the remote satellite receiver using this circuit. The idea is that you take your remote control with you, aim at the IR remote control extender which is in the same room, and this will relay the IR signal and control the remote appliance for you. The circuit is displayed below:

Circuit diagram



Parts
1 SFH2030 Photodiode
1 TIL38 IR emitting diode
1 5mm Red LED
2 4.7M 1/4W resistors
1 1k 1/4W resistor
1 2.2k 1/4W resistor
1 27ohm 1/2W resistor
1 BC337 transistor
1 CA3140 MOSFET opamp
The LPC661 opamp Radio Shack # 900-6332 can be used as a substitute for the CA3140

Circuit Benefits

This circuit has an advantage over other similar designs in that there is nothing to adjust or set-up. Also bellwire or speaker cable can be used to remotely site the IR emitting diode, since this design uses low output impedance and will not pick up noise. Some systems require coaxial cable which is expensive and bulky. The wireless variety of remote control extenders need two power supplies, here one is used and being radio are inevitably EM noise pollution. A visual indication of the unit receiving an Infra Red signal is provided by LED1. This is an ordinary coloured LED, I used orange but any colour will do. You will see LED1 flash at a rate of 4 - 40Hz when a remote control button is pressed. LED0 is an Infra Red Emitter Diode, this is remotely wired in the room with the appliance to be controlled. I used the type SFH487 which has a peak wavelength of 880nm. This is available in the UK from Maplin Electronics, order code CY88V. Most IR remote controls operate at slightly different wavelengths, between the range of 850 - 950nm. If you cannot obtain the SFH487 then any IR emitter diode that has an output in the above range should work.

About IR Remote Controls

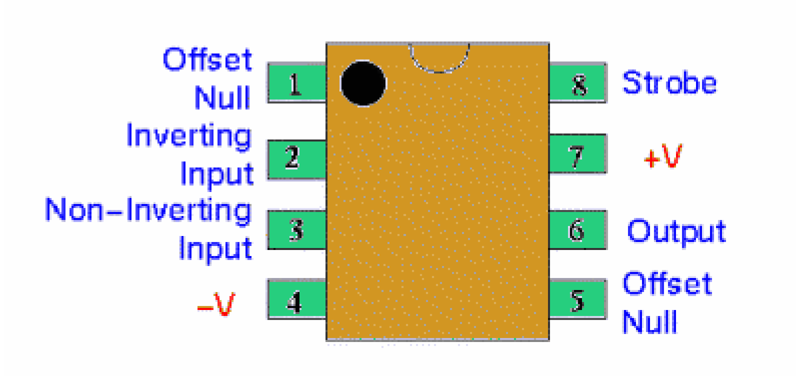
As previously stated IR remote controls use wavelengths between 850 - 950nm. At this short wavelength, the light is invisible to the human eye, but a domestic camcorder can actually view this portion of the electromagnetic spectrum. Viewed with a camcorder, an IR LED appears to change brightness. All remote controls use an encoded series of pulses, of which there are thousands of combinations. The light output intensity varies with each remote control, remotes working at 4.5V dc generally will provide a stronger light output than a 3V dc control. Also, as the photodiode in this project has a peak light response at 850nm, it will receive a stronger signal from controls operating closer to this wavelength. The photodiode will actually respond to IR wavelengths from 400nm to 1100nm, so all remote controls should be compatible.

Circuit Description

The receiver is built around a silicon photodiode, the SFH2030 available from Maplin, order code CY90X. This photodiode is very sensitive and will respond to a wide spectral range of IR frequencies. There is a small amount of infra red in direct sunlight, so make sure that the diode does not pick up direct sunlight. If this happens, LED1 will be constantly lit. There is a version of the SFH2030 that has a daylight filter built in, the SFH2030F order code CY91Y. A TIL100 will also give good results here. A photodiode produces minute pulses of current when exposed to infra red radiation. This current (around 1uA with the SFH2030 and a typical IR control used at a distance of 1 meter) is amplified by the CA3140 opamp. This is configured as a differential amplifier and will produce an output of about 1 volt per uA of input current. The photodiode, can be placed up to a meter or so away from the circuit. Screened cable is not necessary, as common mode signals (noise) will be rejected. It is essential to use a MOSFET input type here as there is zero output offset and negligible input offset current. A 741 or LF351 can not be used in this circuit. The output from the opamp is amplified by the BC337 operating in common emitter mode. As a MOSFET opamp IC is used, its quiescent voltage output is zero and this transistor and both LED's will not be lit. The 1k resistor makes sure that the BC337 will fully saturate and at the same time limits base current to a safe level. Operating an IR remote control and pointing at the photodiode (SFH2030) will cause both LED's to illuminate, you will only see the visable coloured LED (LED1) which will flicker. Remote controls use a system of pulse code modulation, so it is essential that the signal is not distorted by any significant amount. Direct coupling, and a high speed switching transistor avoid this problem.

Construction

No special PCB is required, I built my prototype on a small piece of Veroboard. The pinout for the CA3140 is shown below. Note that only the pins labeled in the schematic are used, pins 1, 5 and 8 are not used and left unconnected.



Alignment

There is nothing to set-up or adjust in this circuit. The only thing to watch is that the emitting diode is pointing at the controlled device (video, CD player, etc). I found that the beam was quite directional. Also make sure that there is a direct line of sight involved. It will not work if a 5 foot spider plant gets in the way, for example. I had a usable range at 5 meters, but possibly more distance may be possible. As a check, place a dc volt meter across the 27 ohm resistor. It should read 0 volts, but around 2 or 3 volts when a remote control is aimed at the photodiode.

Specifications of Prototype

Having made my prototype, I ran a few tests :-
Current consumption 2mA standby 60mA operating (with 12V supply)
2mA standby 85mA operating (with 15V supply)
IR receiver range < 1 meter
IR transmitter range > 5 meters
It is difficult to measure the IR transmitter range as this is dependent upon a number of factors. The type of infra red control used and its proximity to the receiving photodiode, the voltage supply, the wavelength and efficiency of the IR emitter and the sensitivity of the controlled appliance all affect overall performance.

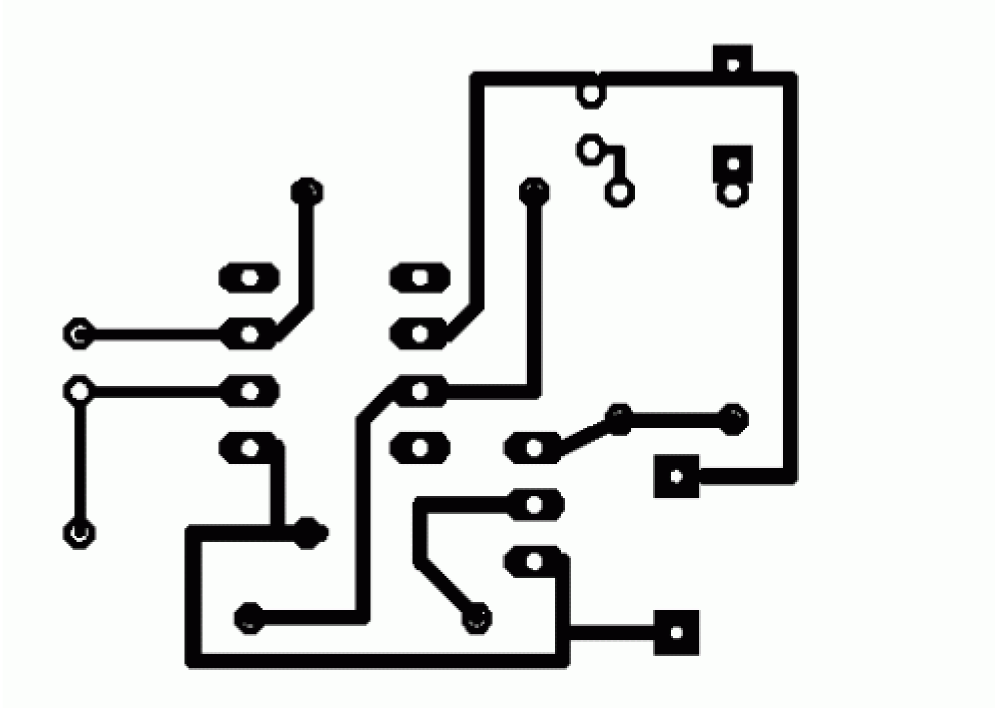
In Use

The reception range of the IR remote control to the photodiode depends on the strength of the remote control, but I had a working range of a meter or so, this needs bearing in mind when placing the circuit. Its also a good idea to wire LED1, the coloured LED near to the photodiode, that way, you know that the unit has received a signal. The IR emitter has a larger range, I had no problems at 5 meters but may possibly work further distances. The emitting diodes are quite directional, so make sure it is aimed directly at the appliance to be controlled. The IR emitting diode is small and can be placed out of sight. I drilled a small hole above the door frame. The emitter diode leads were insulated and pushed through this hole, leaving an inch or so to adjust the angle and position of the LED. From a distance, the clear plastic lens of the diode could not be seen.

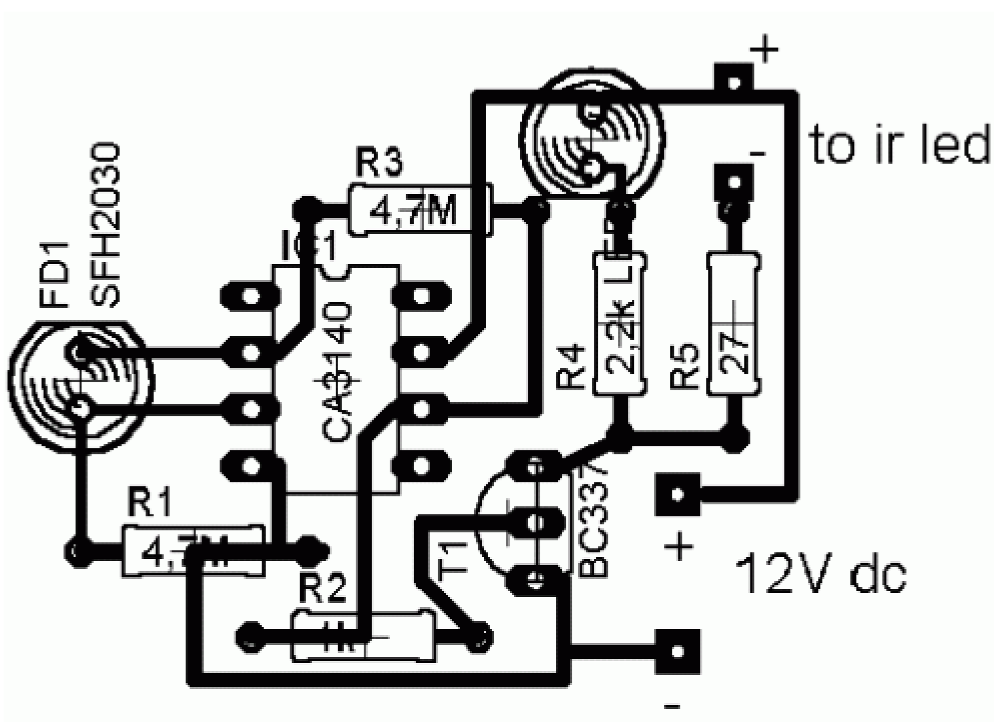
Final Comments and Fault Finding

To date this has proved to be one of the most popular circuits on my site. Of all the email I receive about this circuit, most problems relate to the Infra Red photo diode. You must make sure that this is pointed away from sunlight, or use a type with daylight filter, otherwise LED1 will be constantly lit, and LED0 will be in operation also. This will draw excessive current and in some case overheat the BC337. The main problem is when using a different photo diode to the SFH2030. Any other photo diode LED should work, but you need to know its operating wavelength range beforehand. This will generally be described in the manufacturers data sheet or possibly described if you order from an electronic component catalogue. With these last two points in mind, you should be rewarded with a useful and working circuit.

PCB Template
This has been very kindly drafted by Domenico from Italy. First the copper side:



A magnified view from the component side is shown below:

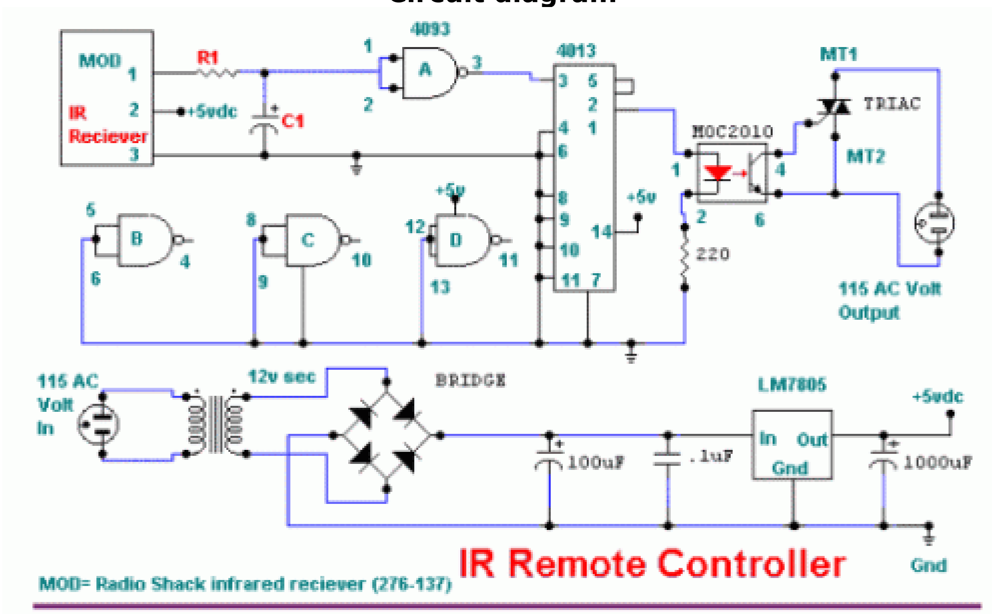


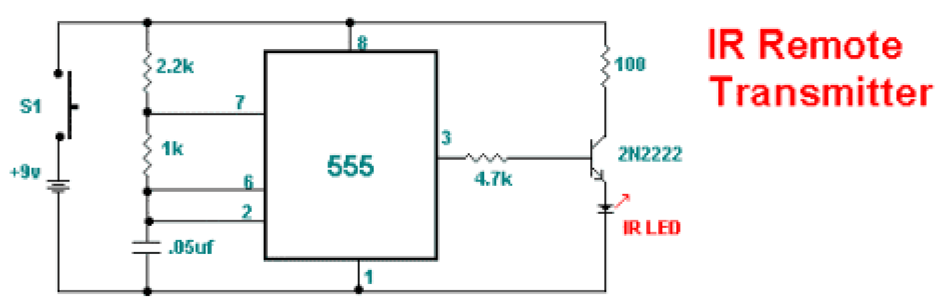
P204. Infrared Remote Control

This circuit will allow you to turn on any piece of equipment that operates on 115 volts ac. The reciever circuit is based on the Radio Shack infrared receiver module(MOD), part number 276-137. It is also available from some of the other sources listed on my Links page. The MOD accepts a 40khz IR signal that is modulated at 4 khz. When a signal is recieved the MOD will go low. The sensitivity of the MOD is set by different values for R1 and C1.

The values for R1 may need to be as high as 10,000 ohms and for C1 40uf. This will prevent the unit from turning on under normal lighting conditions. You will need to experiment with the vaules that work best for you. The output of the 4013 chip a flip flop toggles on and off with the reception of a IR pulse. The output of the 4013 turns on the MOC optical coupler which in turn switches on the triac and supplies power to the AC load.

Circuit diagram



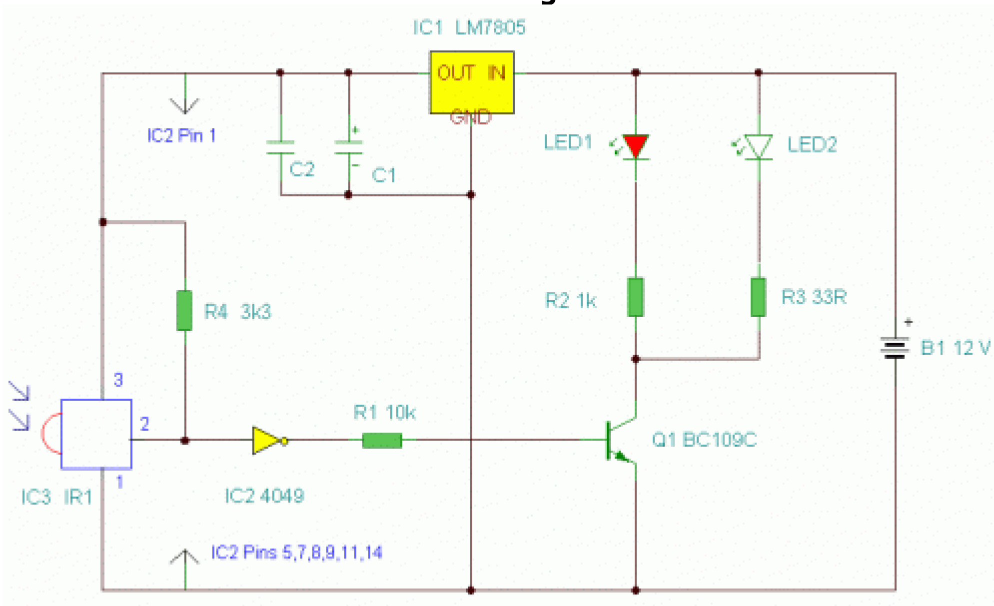


P205. IR Remote Control Extender Circuit

Description:

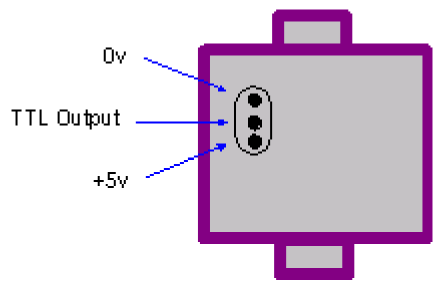
This is an improved IR remote control extender circuit. It has high noise immunity, is resistant to ambient and reflected light and has an increased range from remote control to the extender circuit of about 7 meters. It should work with any domestic apparatus that use 36-38kHz for the IR carrier frequency. Please note that this is NOT compatible with some satellite receivers that use 115KHz as a carrier frequency.

Circuit diagram



Notes:
The main difference between this version and the previous circuit, is that this design uses a commercially available Infra Red module. This module, part number IR1 is available from Harrison Electronics in the UK. The IR module contains a built in photo diode, amplifier circuit and buffer and decoder. It is centerd on the common 38kHz carrier frequency that most IR controls use. The module removes most of the carrier allowing decoded pulses to pass to the appliance. Domestic TV's and VCR's use extra filtering is used to completely remove the carrier. The IR1 is packaged in a small aluminium case, the connections viewed from underneath are shown below:

Infra Red Module, IR1 Pinout



IR1 Module Bottom View

How It works:

The IR1 module (IC3) operates on 5 Volt dc. This is provided by the 7805 voltage regulator, IC1. Under quiescent (no IR signal) conditions the voltage on the output pin is high, around 5 volts dc. This needs to be inverted and buffered to drive the IR photo emitter LED, LED2. The buffering is provided by one gate (pins 2 & 3) of a hex invertor the CMOS 4049, IC2. The IR1 module can directly drive TTL logic,but a pull-up resistor, R4 is required to interface to CMOS IC's. This resistor ensures that the signal from a remote control will alternate between 0 and 5 volts. As TTL logic levels are slightly different from CMOS, the 3.3k resistor R4 is wired to the +5 volt supply line ensuring that the logic high signal will be 5 volts and not the TTL levels 3.3 volts. The resistor does not affect performance of the IR module, but DOES ensure that the module will correctly drive the CMOS buffer without instability.

The output from the 4049 pin 2 directly drives transistor Q1, the 10k resistor R1 limiting base current. LED1 is a RED LED, it will flicker to indicate when a signal from a remote control is received. Note that in this circuit, the carrier is still present, but at a reduced level, as well as the decoded IR signal. The CMOS 4049 and BC109C transistor will amplify both carrier and signal driving LED2 at a peak current of about 120 mA when a signal is received. If you try to measure this with a digital meter, it will read much less, probably around 30mA as the meter will measure the average DC value, not the peak current. Any equipment designed to work between 36 and 40kHz should work, any controls with carrier frequencies outside this limit will have reduced range, but should work. The exception here is that some satellite receivers have IR controls that use a higher modulated carrier of around 115KHz. At present, these DO NOT work with my circuit, however I am working on a Mark 3 version to re-introduce the carrier.

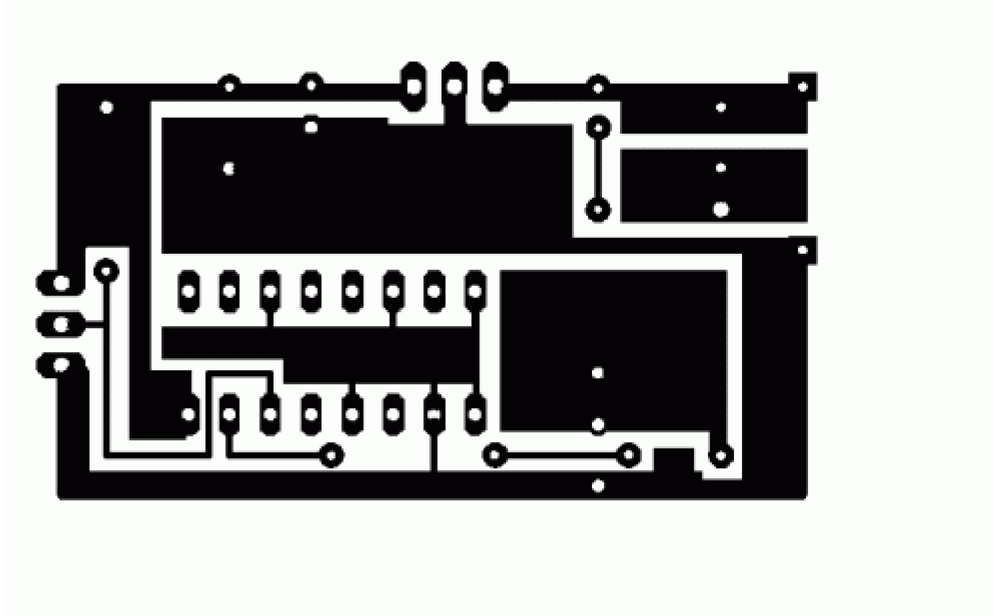
Parts
C1 100u 10V
C2 100n polyester
R1 10k
R2 1k
R3 33R 1W
R4 3k3
Q1 BC109C
IC1 LM7805
IC2 CMOS 4049B
IC3 IR1 module from
LED1 Red LED (or any visible colour)
LED2 TIL38 or part YH70M from Maplin Electronics

Testing:

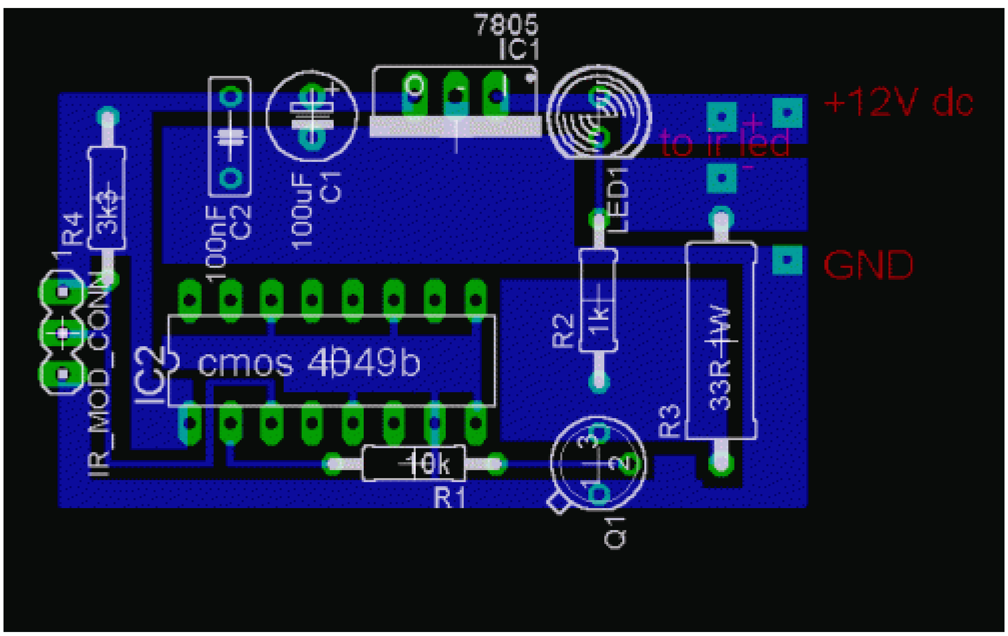
This circuit should not present too many problems. If it does not work, arm yourself with a multimeter and perform these checks. Check the power supply for 12 Volt dc. Check the regulator output for 5 volt dc. Check the input of the IR module and also Pin 1 of the 4049 IC for 5 volts dc. With no remote control the output at pin 2 should be zero volts. Using a remote control pin 2 will read 5 volts and the Red LED will flicker. Measuring current in series with the 12 volt supply should read about 11mA quiescent, and about 40/50mA with an IR signal. If you still have problems measure the voltage between base and emitter of Q1. With no signal this should be zero volts, and rise to 0.6-0.7 volts dc with an IR signal. Any other problems, please email me, but please do the above tests first.

PCB Template:

Once again a PCB template has been kindly drafted for this project by Domenico.



A magnified view showing the component side is shown below:



Alternatives to IC3:

The part number IR1 from Harrison Electronics is no longer available. They do supply an alternative IR decoder which I have tested and works. Other alternative Infrared decoders are shown below, note however that all DO NOT share the same pinout. I advise anyone making this to check the corresponding data sheets.

Vishay TSOP 1738
Vishay TSOP 1838
Radio Shack 276-0137

Sony SBX 1620-12
Sharp GP1U271R

Equipment Controlled Successfully:

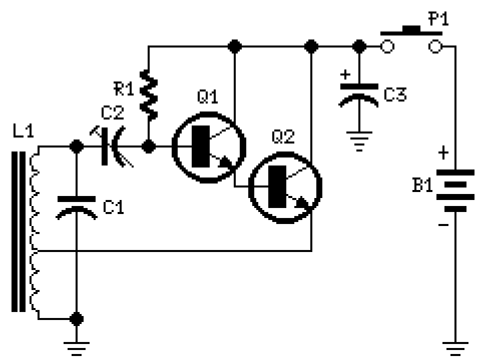
If you have built this circuit and it works successfullt please let me know and I will build the list. Email details of the Manufacturer, device and remote control model number. The remote model number is usually on the front or back of the remote.

Technics CDP770 Remote: EUR64713

P206. Magnetic-Radiation Remote-Control

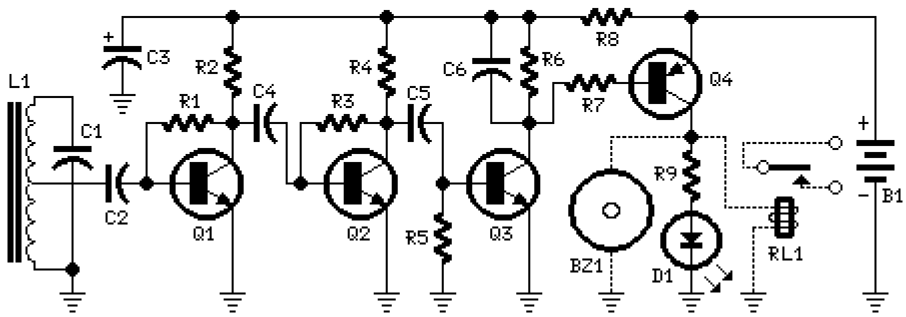
Short-range 35KHz operation, single-channel unit
Simple circuitry, no outer antennas required

Transmitter circuit diagram:



Transmitter parts:
R1 68K 1/4W Resistor
C1 4n7 630V Ceramic or Polyester Capacitor
C2 60-80pF 63V Ceramic Trimmer
C3 100µF 25V Electrolytic Capacitor
Q1 BC337 45V 800mA NPN Transistor
Q2 BD139 80V 1.5A NPN Transistor
L1 500 turns on a 10mm. diameter, 10cm. long ferrite rod.
Enameled wire diameter: 0.2mm.
The tap is made after 200 turns, ground side
P1 SPST Pushbutton
B1 6-9V Battery (4 to 6 AA 1.5V Cells in series, see Notes)

Receiver circuit diagram:



Receiver parts:
R1,R3 1M 1/4W Resistors
R2,R4 47K 1/4W Resistors
R5 330K 1/4W Resistor
R6,R7 68K 1/4W Resistors
R8 180R 1/4W Resistor
R9 100R 1/4W Resistor
C1 470pF 63V Ceramic Capacitor (See Notes)
C2 10nF 63V Polyester or Ceramic Capacitor
C3 100µF 25V Electrolytic Capacitor
C4,C5 100nF 63V Polyester or Ceramic Capacitors
C6 1µF 63V Polyester, Ceramic or Electrolytic Capacitor
D1 5 or 3mm. Red LED
Q1,Q2,Q3 BC549C 25V 100mA NPN High-gain Low-noise Transistors
Q4 BD328 30V 800mA PNP Transistor
L1 700 turns on a 10mm. diameter, 10cm. long ferrite rod.
Enameled wire diameter: 0.2mm.
The tap is made after 350 turns, i.e. at the center of the winding
BZ1 Piezo sounder (incorporating 3KHz oscillator, optional, see Notes)
RL1 5V DIL Reed-Relay SPDT or DPDT (Optional, see Notes)
B1 3V Battery (2 x 1.5V AA, AAA or AAAA Cells in series or 1 x 3V Lithium Cell)

Device purpose:

This unit can be useful as a short-range, single-channel remote-control. When the pushbutton in the transmitter circuit is briefly activated, the LED D1 in the receiver illuminates and an optional beeper or relay can be operated.

Circuit operation is based on a non-modulated 35KHz frequency carrier transmitter, and on a high-gain two-stage 35KHz amplifier receiver, followed by a frequency-voltage converter and DC load driver.
Outstanding features for this design are as follows:

No outer antenna is required on both transmitter and receiver sections, due to the very low frequency operation. The antennas are 10mm. diameter, 10cm. long ferrite rods supporting the coils.
Unlike Infra-red remote-controls, this unit operates through the walls etc.

No radio-frequency interference in spite of simple circuitry.
The receiver operates at ultra-low voltage supply (3V) and standing current (100µA): in this manner it can be left in stand-by mode for years before a battery replacement is needed.
Snags are: the short-range operation (about a medium-sized apartment), the high number of windings for the coils and the high current drawn by the transmitter.
Luckily, this latter snag is compensated by the fact that only a short pulse from the transmitter is needed

to operate the receiver. Therefore, if the transmitter is not operated continuously, its battery should last long.

Transmitter circuit operation:

Q1 and Q2 are wired as a Darlington pair to obtain the highest possible output from a Hartley type oscillator. C2 must be trimmed to obtain the highest sinewave output (best viewed on oscilloscope). In the prototype the sinewave amplitude measured at C1 leads reached 800V peak-to-peak at 9V supply and 450mA current.

Receiver circuit operation:

Q1 and Q2 form a two-stage linear amplifier. Therefore, the small 35KHz signal picked-up by L1 is highly amplified by these devices and feds Q3 wired as a pulse-to-DC converter.

When the input signal reaches Q3, the collector voltage of this transistor goes low, thus activating the LED D1 (or the optional beeper or relay) by means of Q4.

Stand-by current is only 100μA. Current drawing is about 10mA when the LED is on and about 20mA when a relay is activated.

Notes:

Q2 in the transmitter should have a small heatsink.

A good compromise is to use a 6V supply for the transmitter (four 1.5V AA cells in series). In this case current drawing is 300mA.

Needing a shorter range operation, Q2 in the transmitter can be omitted. Therefore, the emitter of Q1 will be connected to the tap of L1 coil. In this case the circuit could be powered by a 9V PP3 alkaline battery, drawing about 100mA current.

The receiver must be tuned to the transmitter frequency. Starting with a 470pF value for C1, you should try to modify its value by means of small capacitors wired in parallel to it, in order to obtain the highest AC voltage output at Q2 or Q1 collector (best measured with an oscilloscope). C1 value might vary from about 400 to 800pF.

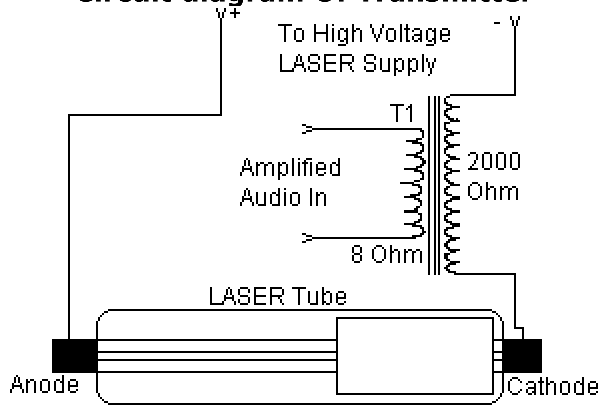
Do this setup with transmitter placed 4-5 meters away from receiver. During setup it is wise to temporarily connect the transmitter to a 6 or 9V regulated power supply, in order to save batteries.

A small DIL 5V reed-relay was used in spite of the 3V supply of the receiver. Several devices of this type were tested and it was found that they switch-on with a coil voltage value comprised in the 1.9 - 2.1V range. The coil resistance values varied from 140 to 250 Ohm.

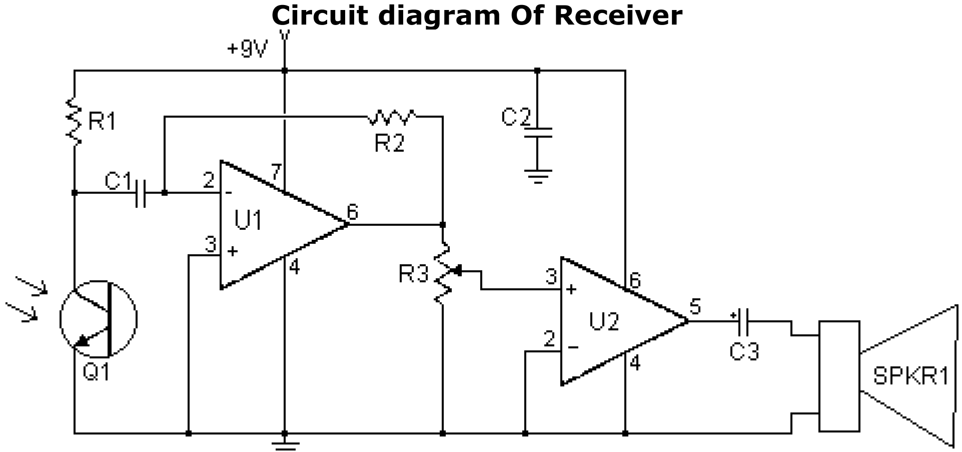
P207. LASER Transmitter/Receiver

This set of two circuits from the basis for a very simple light wave transmitter. A LASER beam is modulated and then aimed at a receiver that demodulates the signal and then presents the information (voice, data, etc..). The whole thing is very easy to build and requires no specialized parts execpt for the LASER itself. LASERs are available from MWK Industries.

Circuit diagram Of Transmitter



Circuit diagram Of Receiver



Parts:
C1, C2 0.1uf Ceramic Disc Capacitor
C3 100uf 25V Electrolytic Capacitor
R1 100K Ohm 1/4W Resistor
R2 1M Ohm 1/4W Resistor
R3 10K Pot
Q1 NPN Phototransistor
U1 741 Op Amp
U2 LM386 Audio Amp
SPKR1 8 Ohm Speaker
T1 8 Ohm:2K Audio Transformer
MISC Wire, Board, Knob For R3, LASER Tube and Power Supply

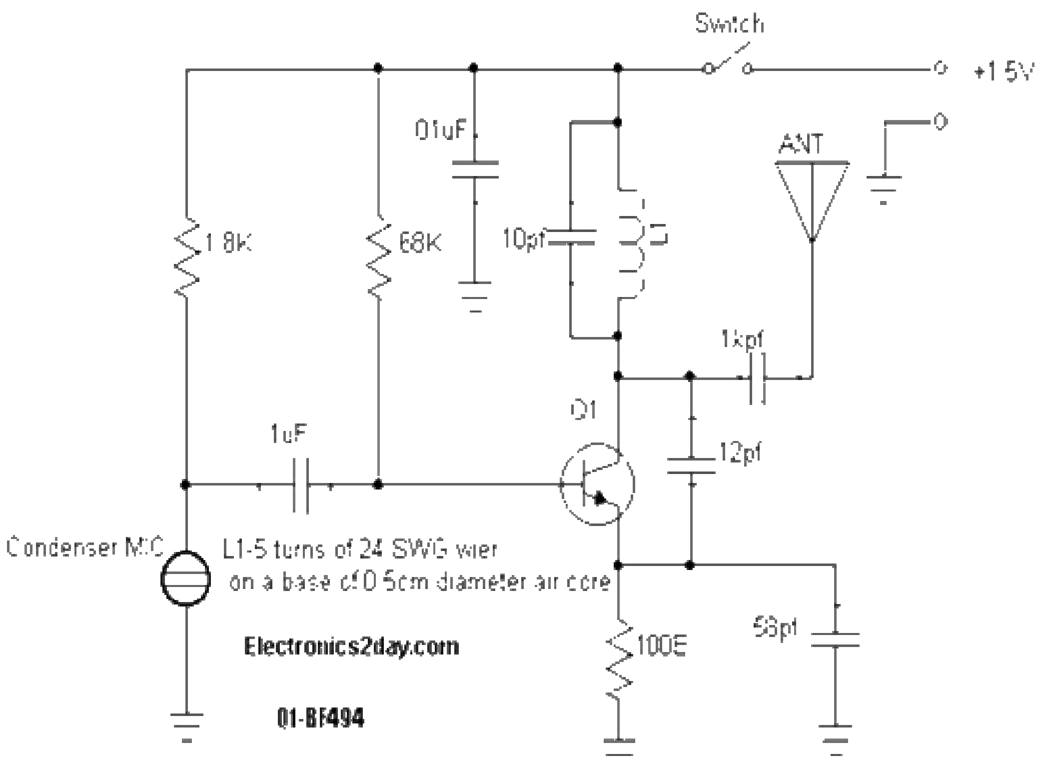
Notes:
1. In the transmitter schematic, no ballast resistor is shown because most small LASER power supplies already have one built in. Yours may differ, and a resistor may be needed.

2. The receiver should be kept away from bright lights. You may want to put a piece of wax paper in front of Q1 to keep the LASER from swamping it.

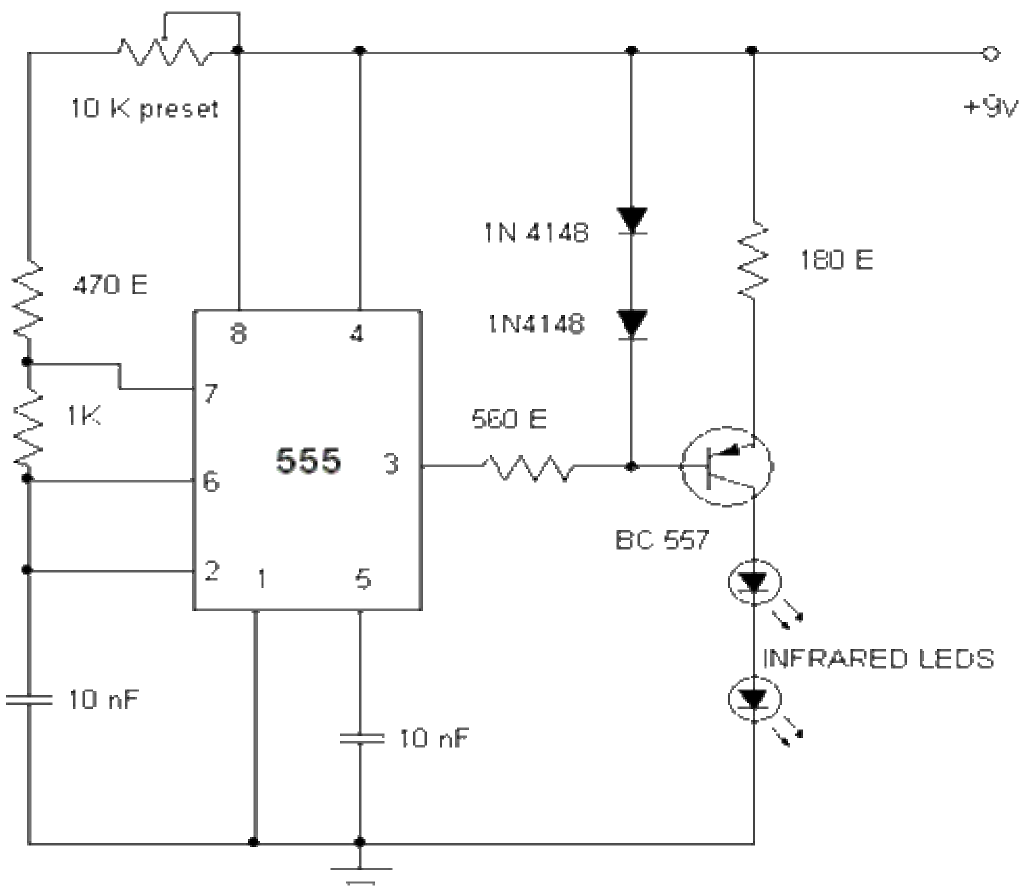
3. In order to get any decent amount of modulation, you may need to drive T1 with more then a watt.

4. The circuit can be made to transmit computer data with the use of two modem chips.

P208. FM Transmitter II



P209. Remote Blocker

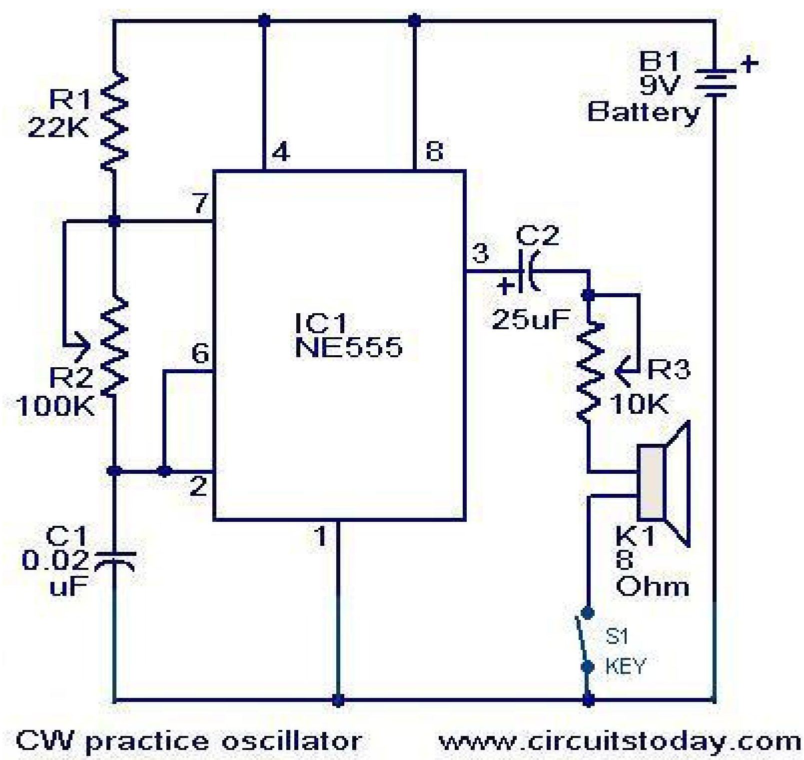


P210. CW Practice oscillator

Description.

A circuit diagram that can be used for the generation of CW Morse code is shown here.This circuit can be very useful those who would like practice Ham Radio.The circuit is nothing but an astable multivibrator based on NE 555.The frequency of oscillations of the circuit depends on the components R1,R2 & C1.The circuit can be powered from a 9V PP3 battery.

Circuit diagram with Parts list.



Notes.

- The POT R2 can be used for frequency adjustments.
- POT R3 can be used for volume adjustments.
- The switch S1 canÂ be a Morse code key.

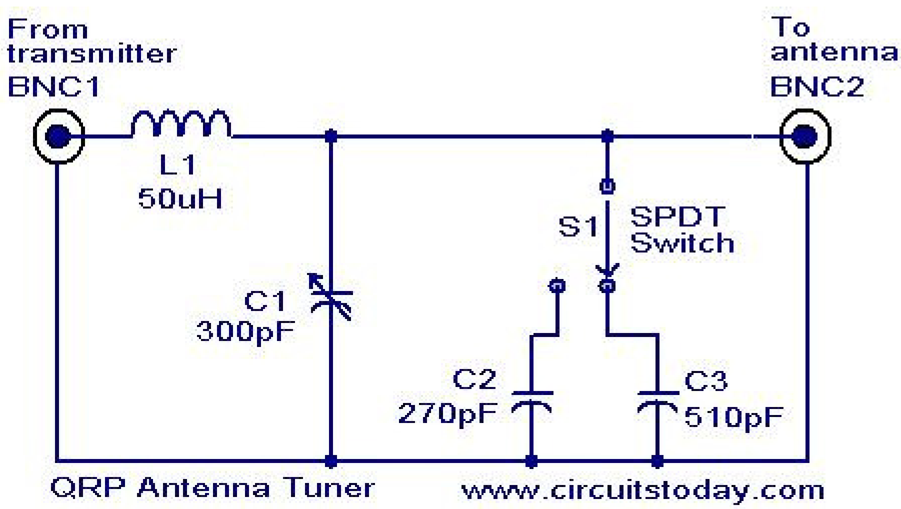
P211. QRP antenna tuner circuit_

Description.

Low power (3 to 30 MHz)Â transmitters constructed by hams are generally called QRP's. For such transmitters a well tuned antenna is a must.If the impedance is not properly matched there will be a little or no output.But if properly matched there will be great results.A circuit for matching the antenna properly with the transmitter id given below.

The output of the transmitter is given to the input of the tuner(connector BNC1). The output of the tuner(connector BNC2) must be connected to antenna.Then adjust the L1 and C1 to obtain the maximum transmission power.The transmission power can be checked using a SWR meter.

Circuit diagram with Parts list.Â



Notes.Â

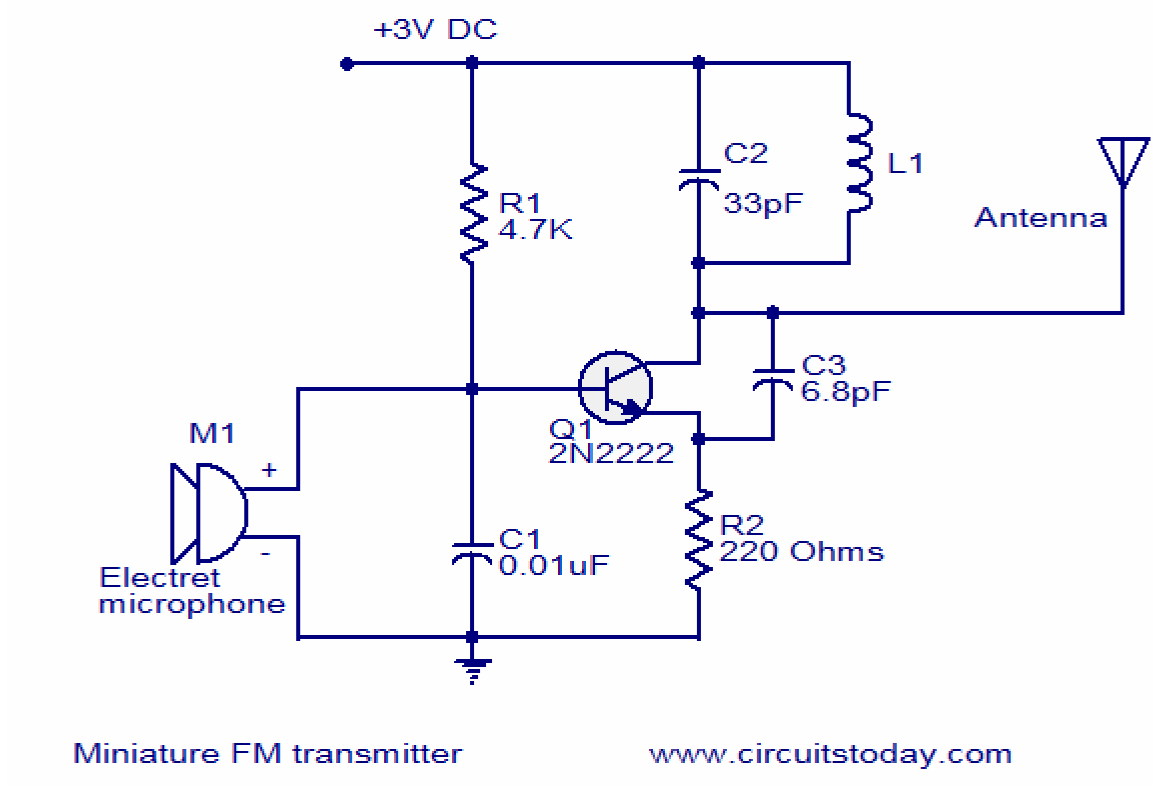
- Assemble the circuit on a goos quality PCB or common board.
- If the matching is not satisfactory then change the values of L1,C1,C2&C3Â to the next close value and tune again.
- Proper tuning requires some trial and error.
- The circuit can be enclosed in an aluminum casing for better performance.

P212. Miniature FM transmitter

Description.

This could be the simplest FM transmitter circuit you can find on the internet. Only using a single transistor and few passive components, this transmitter can deliver signals up to 50 meters. The transistor Q1 serves as the modulator as well as oscillator. Capacitor C2 and inductor L1 forms the necessary tank circuit for making oscillation. The voice to be transmitted is coupled to the base of Q1 using an electret microphone. The FM signal available at the collector of Q1 is radiated using the antenna.

Circuit diagram.



Notes.

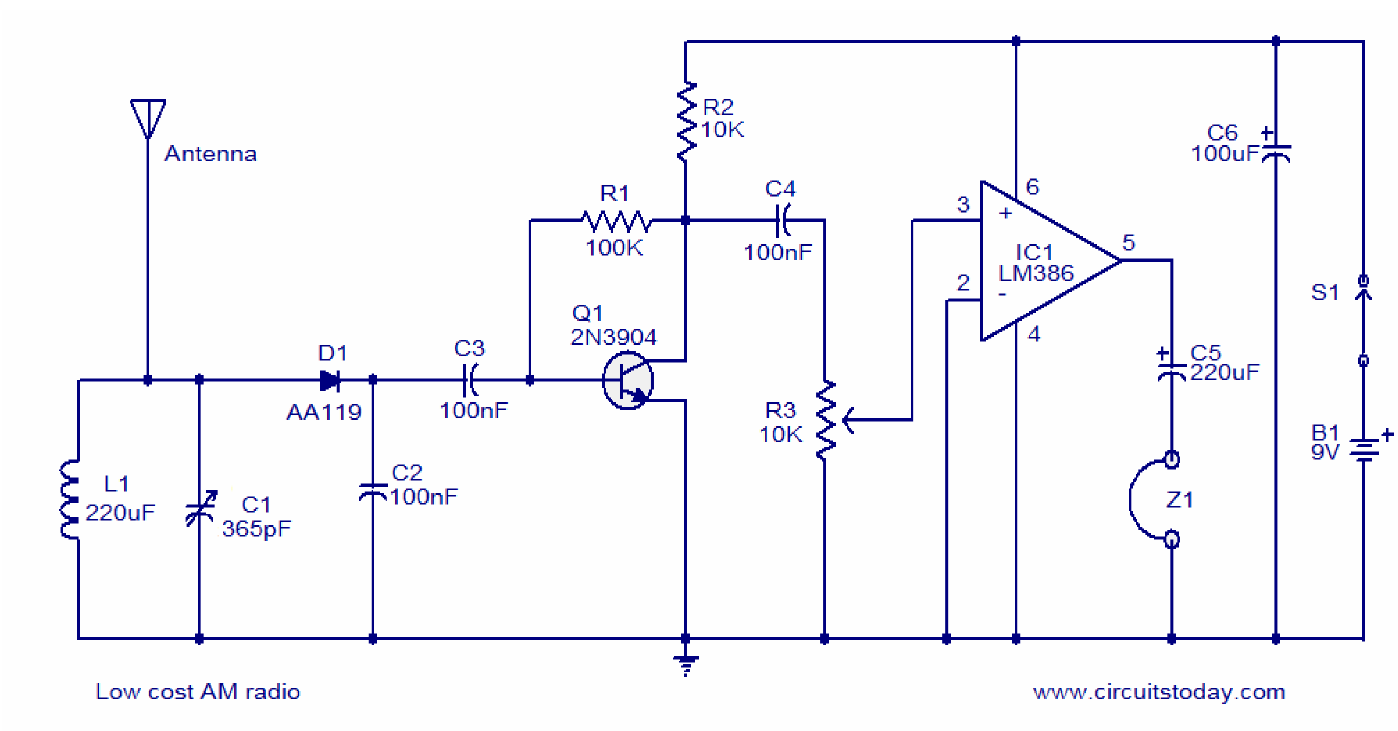
- Use a 3V battery for powering the circuit.
- The circuit can be assembled on a Vero board.
- Coil L1 can be made by making 5 turns of 24AWG wire on a 1cm plastic former.
- Adjustments in the transmission frequency can be made by compressing or relaxing the coil.
- Antenna can be a 25cm long 18AWG wire.

P213. Low cost AM radio_

Description.

Here is the circuit diagram of a simple and low cost AM radio. The working of this radio circuit is straight forward. Inductor L1 and capacitor C1 forms the necessary tank circuit. Diode D1 performs the job of de-modulation. Transistor T1 is wired as a preamplifier whose output is further amplified by the IC LM386 to drive the head phone Z1. The 10K POT R3 can be used as a volume controller.

Circuit diagram.



Notes.

- The circuit can be powered from a 9V PP3 battery.
- Use a 100cm long metal wire as antenna.
- Experiment with the value of L1 for catching other bands.
- The circuit can be assembled on a Vero board.

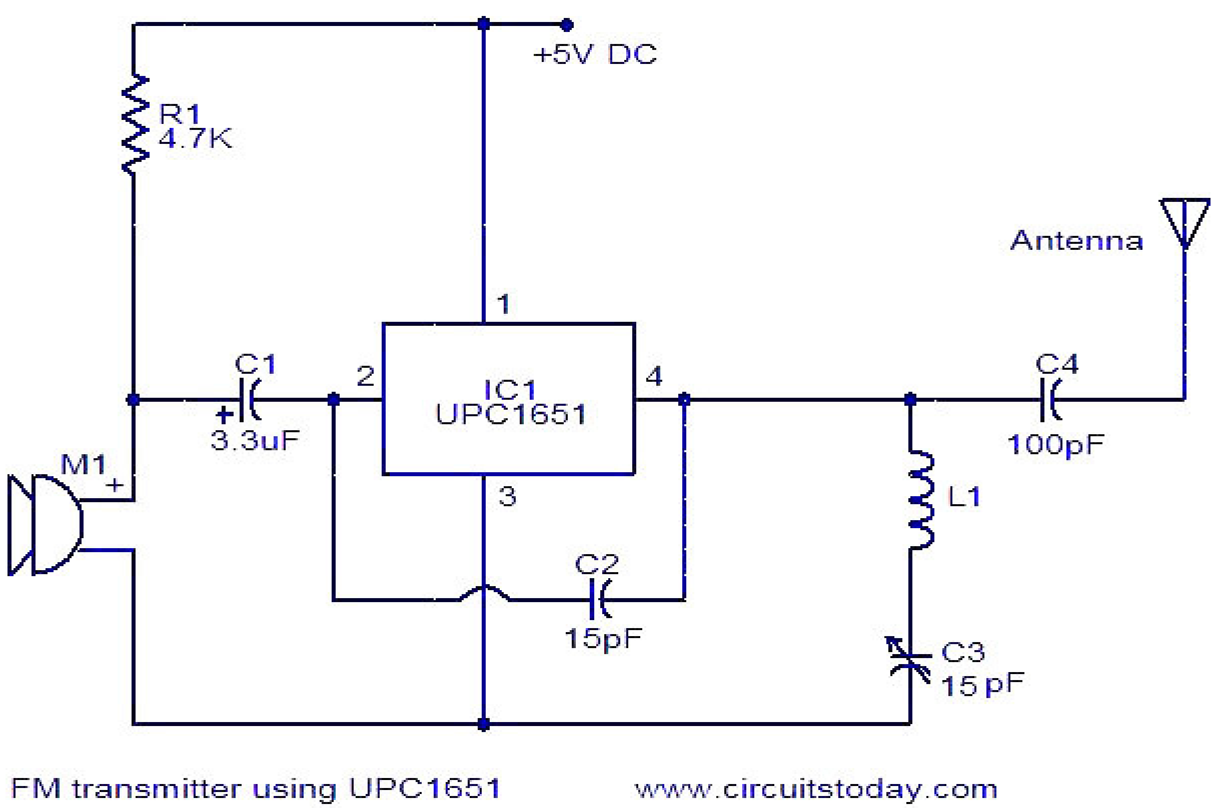
P214. FM transmitter using UPC1651_

Description.

Here is the circuit diagram of an FM transmitter using the IC UPC1651. UPC1651 is a wide band UHF Silicon MMIC amplifier. The IC has a broad frequency response to 1200MHz and power gain up to 19dB.The IC can be operated from 5V DC.

The audio signals picked by the microphone are fed to the input pin (pin2) of the IC via capacitor C1. C1 acts as a noise filter. The modulated FM signal will be available at the output pin (pin4) of the IC. Inductor L1 and capacitor C3 forms the necessary LC circuit for creating the oscillations. Frequency of the transmitter can be varied by adjusting the capacitor C3.

Circuit diagram with Parts list.



Notes.

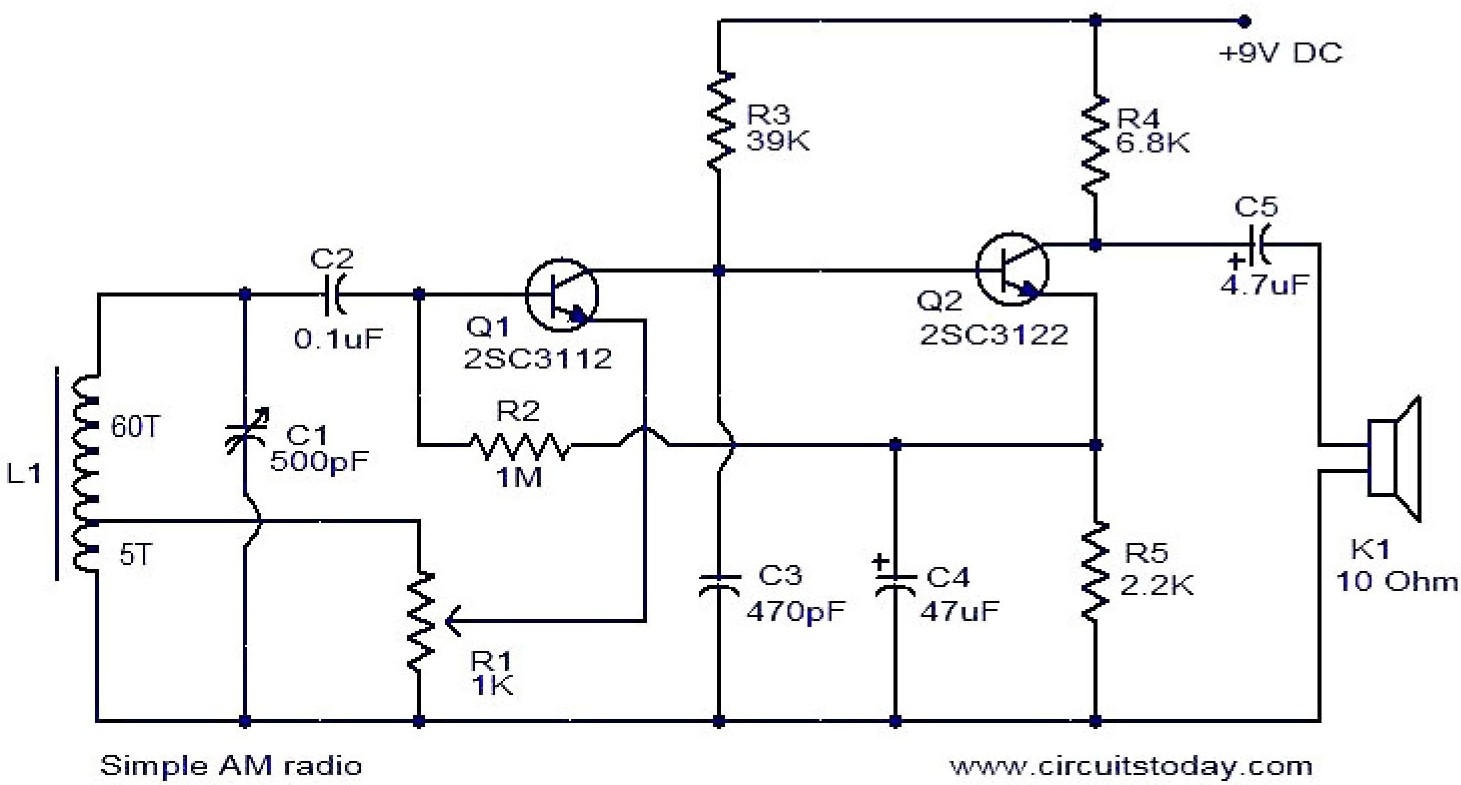
- The circuit can be assembled on a Vero board.
- Inductor L1 can be made by making 5 turns of 26SWG enameled copper wire on a 4mm diameter plastic former.
- A Â¾ meter insulated copper wire can be used as the antenna.
- Do not give more than 6V to the IC.
- Mic M1 can be a condenser microphone.

P215. Simple AM radio

Description.

This is a very simple AM radio circuit using only two transistors. The coil L1 and variable capacitor C1 forms the tank circuit. Transistor Q1 does the job of demodulation. The demodulated signal will be available at the base of Q1.This audio signal is coupled to the base of Q2 for further amplification. The amplified audio signal will be available at the collector of Q2. Please note that, this circuit will work properly only in places with good signal strength.

Circuit diagram.



Notes.

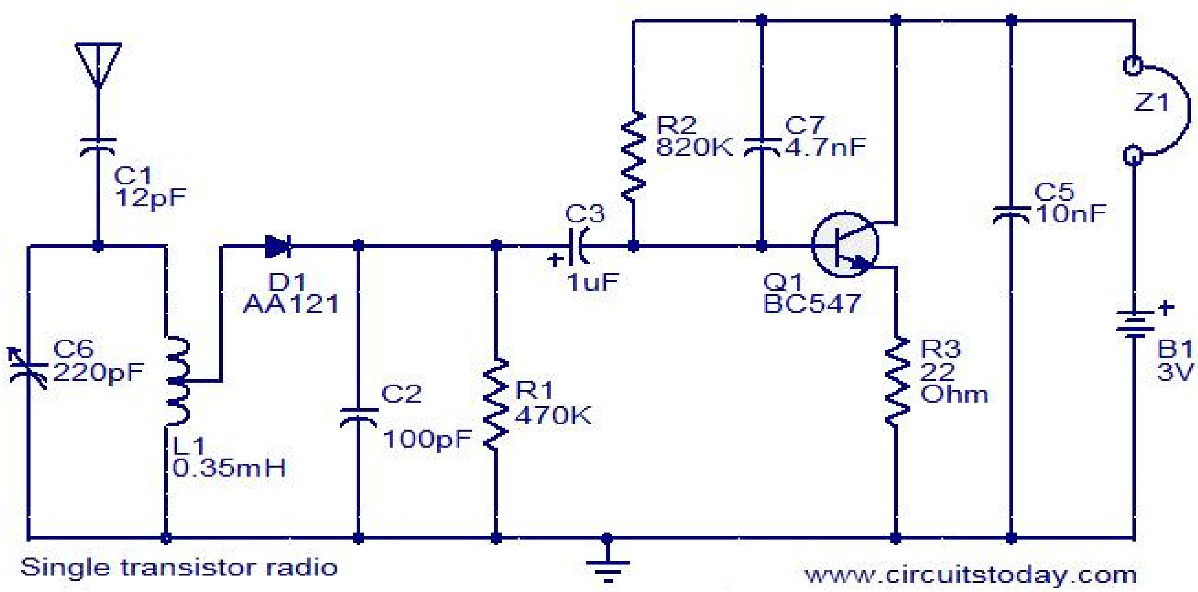
- The circuit can be assembled on a Vero board.
- A 9V PP3 battery can be used for powering the circuit.
- Coil L1 can be made by making 65 turns of 24SWG enameled copper wire on a 100mm long, 10mm diameter ferrite rod. A tapping must be made on the fifth turn.

P216. Single transistor radio

Description.

Here is the circuit diagram of a simple radio that uses one transistor and few other passive components.The C6 and L1 forms a tank circuit which picks up the signal from your desired radio station.Diode D1, capacitor C2 and resistor R1 does the detection of the picked signal.The detected signal is coupled to the base of Q1 through capacitor C3.The Q1 gives required amplification to the signal.The resistor R2 is used to bias Q1.R3 limits the collector current of Q1.The audio output will be available at the collector of Q1 and it can be heard by using a high impedance head phone.This radio will work only at places where there isÂ reasonable radio signal strength.

Circuit diagram with Parts list.



Notes.

- Assemble the circuit on a general purpose PCB.
- The circuit can be powered from a 3V battery.
- The antenna can be a 1 M long wire.
- The headphone must be a high impedance(2 to 3K) type.
- If diode AA121 is not available you can use AA112, AA116 or 1N34.
- The inductor L1 must be a 0.35mH, center tapped one.
- The radio can be tuned by adjusting the variable capacitor C6.

P217. Ultrasonic switch

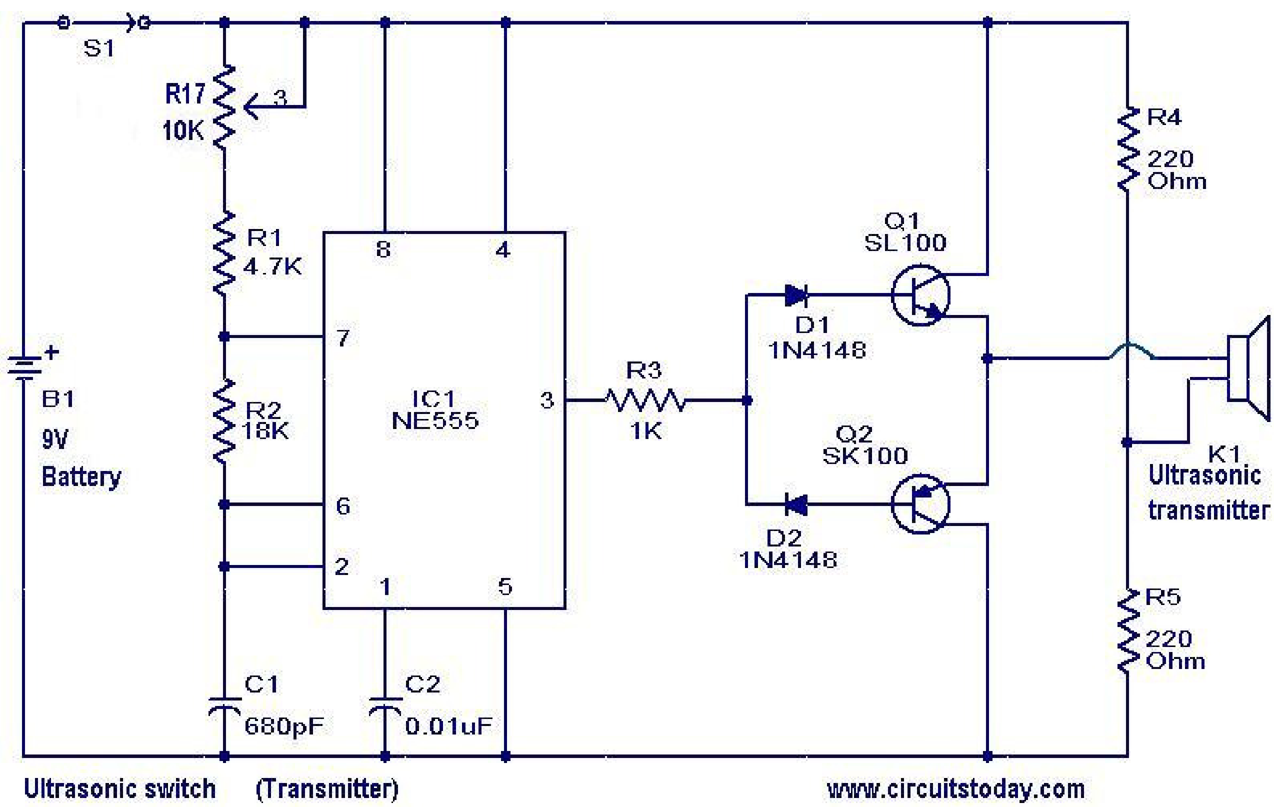
Description.

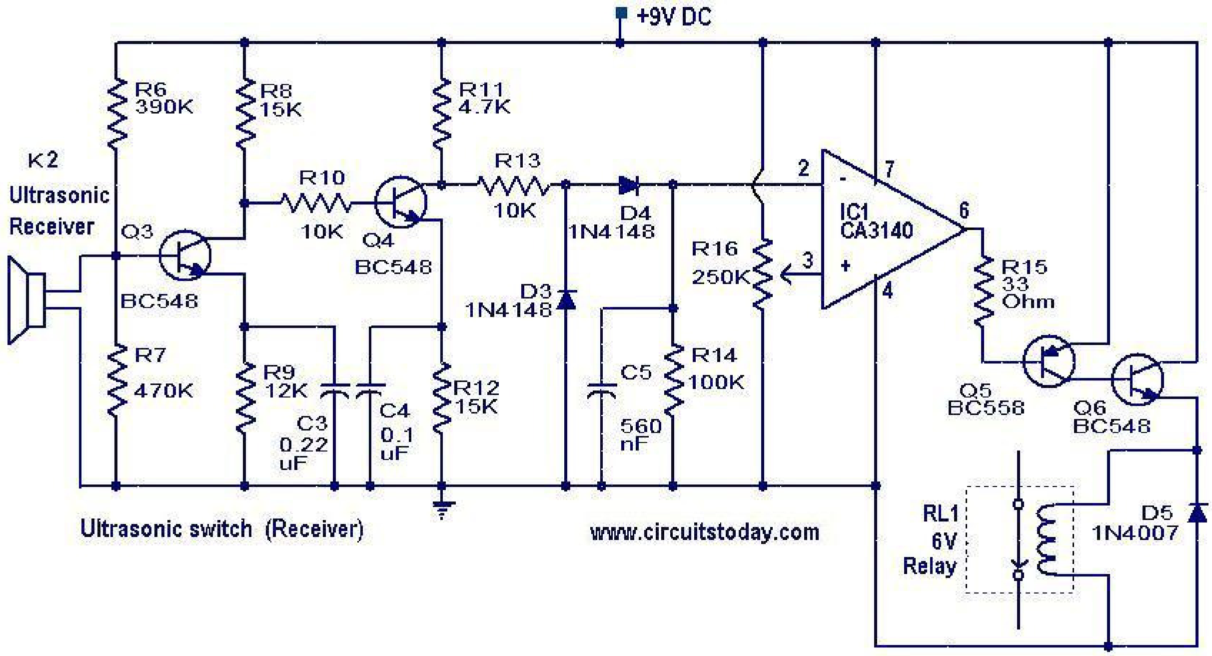
A different type of remote control circuit employing ultrasonic signals is given here.

The transmitter part of the circuit is build around IC1(NE 555).The IC1 is wired as an astable multi vibrator operating at 40KHz.The output of IC1 is amplifier the complementary pair of transistors (Q1 & Q2) and transmitted by the ultrasonic transmitter K1.The push button switch S1 is used the activate the transmitter.

The receiver uses an ultrasonic sensor transducer (K2) to sense the ultrasonic signals. When an ultrasonic signal is falling on the sensor, it produces a proportional voltage signal at its output. This weak signal is amplified by the two stage amplifier circuit comprising of transistors Q3 and Q4.The output of the amplifier is rectified by the diodes D3 & D4.The rectified signal is given to the inverting input of the opamp which is wired as a comparator. When ever there is an ultrasonic signal falling on the receiver, the output of the comparator activates the transistors Q5 & Q6 to drive the relay. In this way the load connected via the relay can be switched. The diode D5 is used as a free wheeling diode.

Circuit diagram with Parts list.





Notes.

- Assemble the the circuit on good quality boards.
- The switch S1 can be a push button switch.
- The ICs must be mounted on holders.
- The transmitter can be powered from a 9V PP3 battery.
- For low power applications the receiver can be also powered from a 9V PP3 battery.For high power applications, use aÂ 9V DC power supply.
- The preset R16 can be used to adjust the sensitivity of the receiver.
- The frequency of the ultrasonic signal can be varied by adjusting the preset R17.Adjust it for optimum performance.

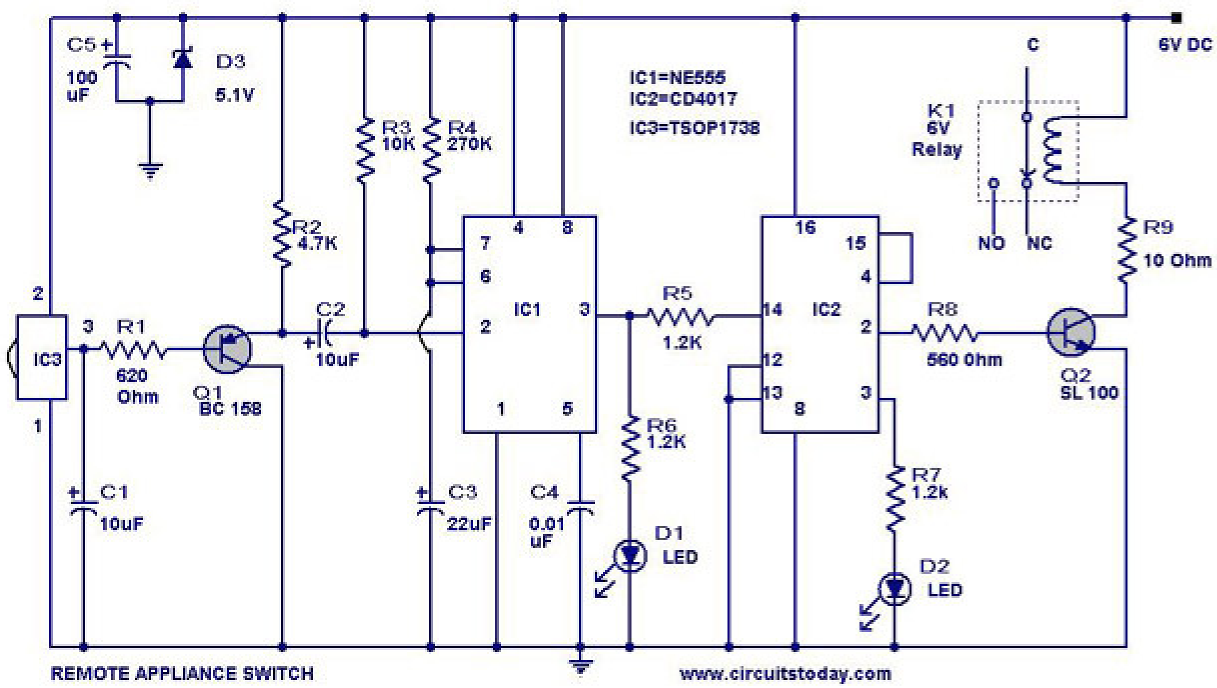
P218. Remote controlled appliance switch circuit

Description.

Here is a versatile remote controlled appliance switch that can ON or OFF any appliance connected to it using a TV remote.

IR remote sensor IC TSOP 1738 is used for recieving the signal. Normally when no signal is falling on IC3 the output of it will be high.This makes Q1 OFF.When a signal of 38 KHz from the TV remote falls on the IC3 its output goes low.This makes Q1 conduct and a negative pulse is obtained at pin 2 of IC 1Â NE 555.Due to this IC1 wired as a monostable multivibrator produces a 4 SecÂ long high signal at its out put.This high out put is the clock for IC 2 which is wired as a Flipflop and of , its two outputs pin 3 goes low and pin 2 goes high.The high output at pin 2 is amplified to drive the relay .For the next signalÂ the outputs of IC2 toggles state. Result, we get a relay toggling on each press on the remote.Any appliance connected to this circuit can be switched ON or OFF.

Circuit Diagram with Parts List .



Notes.

- Before wiring the circuit make sure that the carrier frequencyÂ of the TV remote you have is 38 KHz.For that wire the sensor part only ,point your remote to the TSOP1738 and press any switch.IfÂ out put of TSOP1738Â goesÂ low them ok, your remote is of 38Khz type.Nothing to worry almost all TV remote are of this type.
- You can use any switch because for any switch the code only changes,the carrier frequency remains same.We need this carrier frequency only.
- Assemble the circuit on a good quality PCB or common board.
- The appliance can be connected through NO or NCÂ and contacts of the relay .

P219. 1KHz IR transmitter circuit

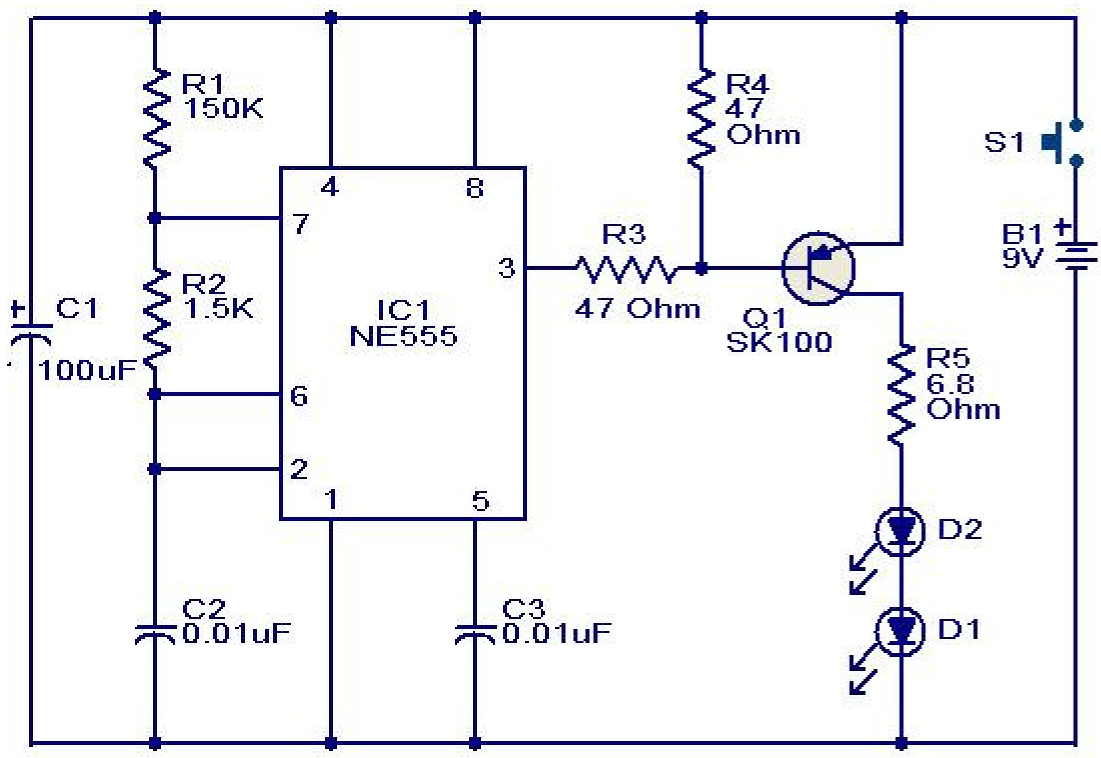
Description.

This circuit was designed in response to a request from my reader. What he asked for was a 1KHz IR transmitter circuit for some remote control application. I think this circuit may satisfy him. Any way this circuit can be used where ever a low power IR transmitter of 1 KHz operating frequency is needed. This transmitter can transmit up to a distance of about 10 meters.

The circuit is based on a NE555 timer IC (IC1) which is wires as an astable multivibrator to produce 1KHz pulses. The output pulses of the IC1 will be amplified by the Q1(SK100) to drive the two IR transmitter

LEDs wired serially. The resistors R1, R2 and capacitor C2 determines the operating frequency of the IC.The circuit starts emitting IR pulses when ever the push button switch S1 is pressed.

Circuit diagram with Parts list.



Notes.

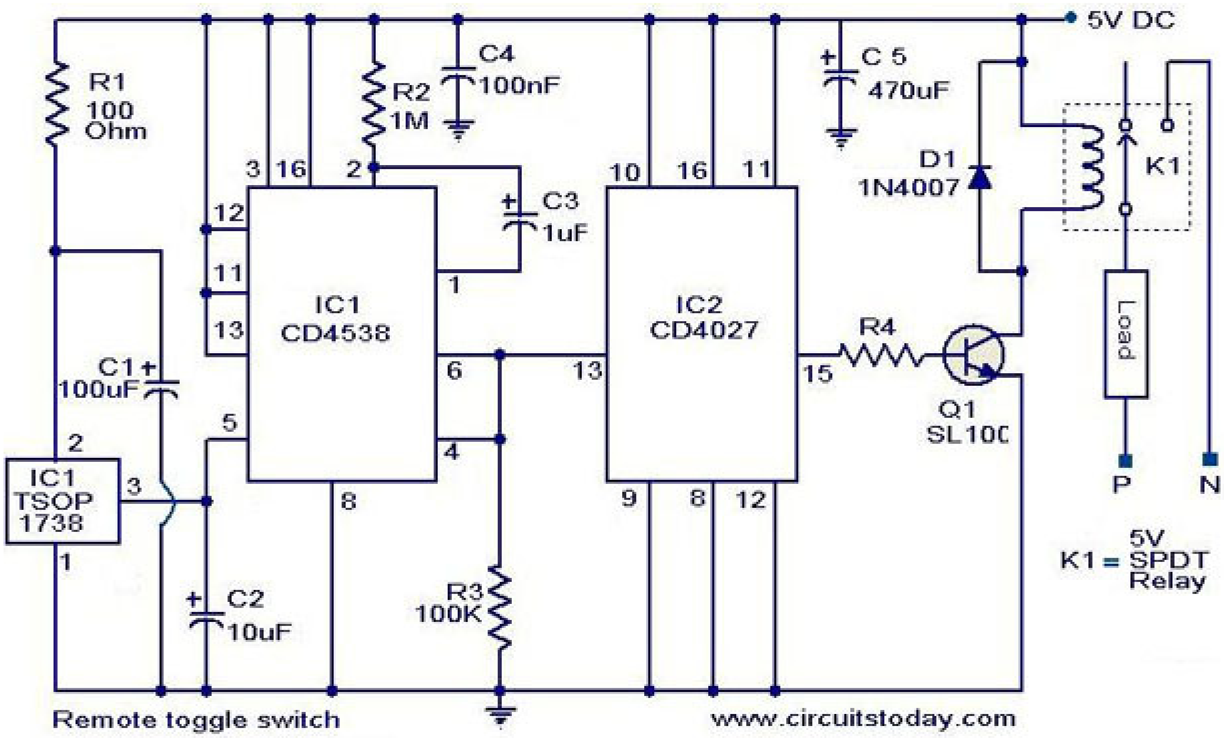
- The circuit can be powered from a 9V PP3 battery.
- The switch S1 is a push button type switch.
- The IC 1 must be mounted on a holder.

Description.

In application level this circuit is similar to that of the circuit given previously. The only difference is in the approach. This circuit is designed by using another method. Using this circuit you can toggle any electrical appliance between ON and OFF states by using your TV remote. The only requirement is that your TV remote should be operating in the 38 KHz.

The IC1 (TSOP 1738) is used to receive the infrared signals from the remote. When no IR signal from remote is falling on IC1, its output will be high. When the IR signal from the remote falls on the IC1, its output goes low. This triggers the IC2 which is wired as a monostable multivibrator.The output of the IC2 (pin6) goes high for a time of 1S (set by the values of R2 and C3.This triggers the flip flop (IC2) and its Q output (pin 15) goes high. This switches on the transistor, which activates the relay and the appliance connected via relay is switched ON. For the next press of remote the IC1 will be again triggered which in turn makes the IC2 to toggle its output to low state. The load will be switched OFF. This cycle continues for each press of the remote. The pin 6 and pin 4 of IC1 are shorted to avoid false triggering.The diode D1 can be used as a freewheelingÂ diode.

Circuit diagram with Parts list.



Notes.

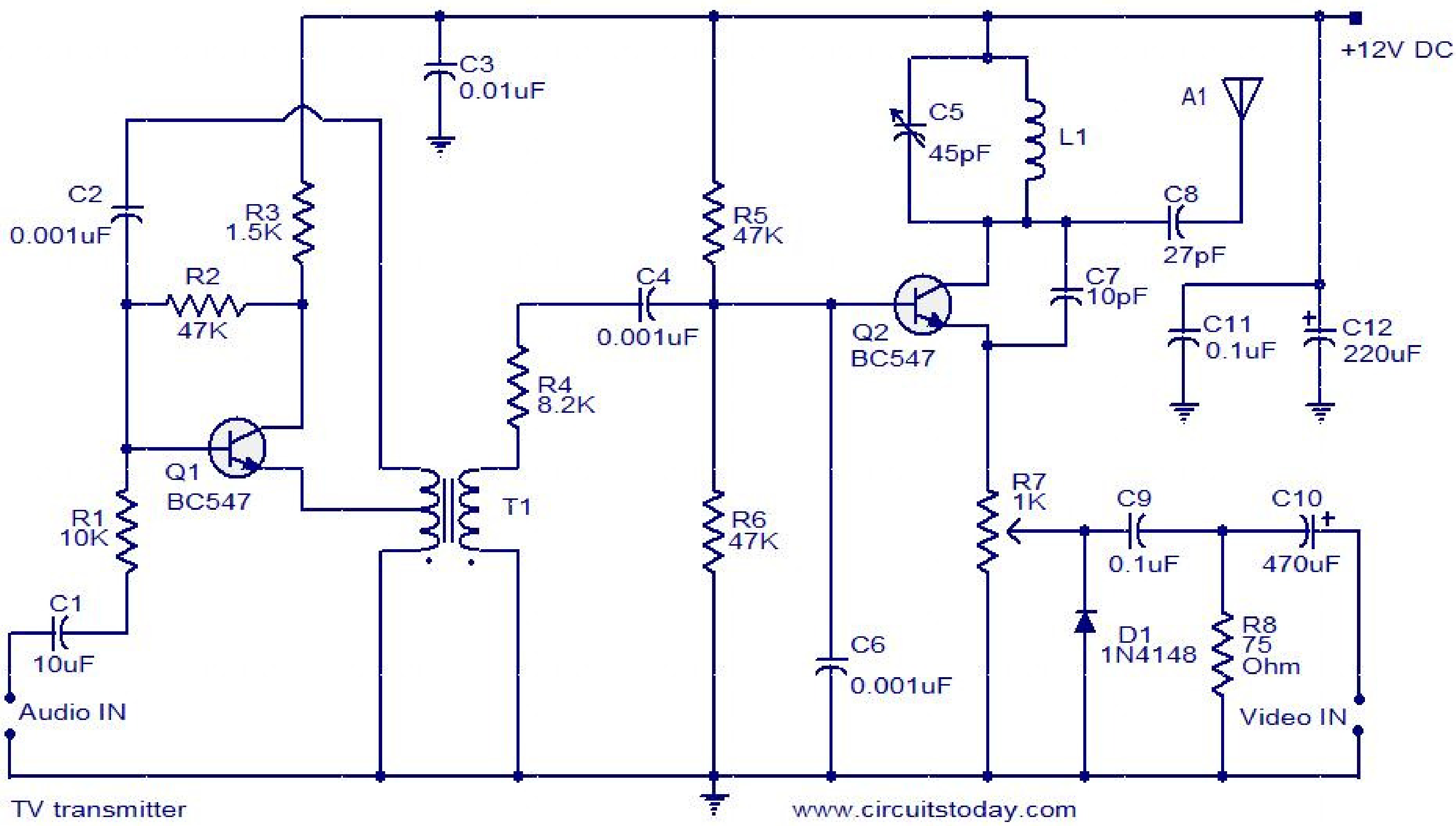
- Assemble the circuit on a good quality PCB or common board.
- The circuit can be powered fromÂ a 5V DC regulated power supply.
- The capacitors must be rated 15 V.
- The IC1&IC2 must be mounted on holders.
- The current capacityÂ of relay determines the load circuit can switch.Use a high amperage(`10A or above) relay for driving large loads like motor,heater etc.

P220. TV transmitter circuit_

Description.

The TV transmitter given here uses UK standard 1 FM modulation for sound and PAL for video modulation. The audio signal to be modulated is pre-amplified using the transistor Q1 and associated components. The transistor Q2 has two jobs: production of carrier frequency and modulation. The pre-amplified audio signal is fed to the base of transistor Q2 for modulation. Capacitor C5 and inductor L1 forms the tank circuit which is responsible for producing the carrier frequency. The video signal is fed to the emitter of transistor Q2 via POT R7 for modulation. The modulated composite signal (audio+video) is transmitted by the antenna A1.

Circuit diagram with Parts list.



Notes.

- Assemble the circuit on a good quality PCB.
- Inductor L1 can be made by making 4 turns of 24SWG enameled copper wire on a 6mm dia: plastic former.
- T1 can be a radio frequency transformer with built in capacitor. (Can be found on old transistor radio boards).
- Antenna A1 can be a 1M long copper wire. (Experiment with the length to get optimum performance).
- This transmitter is working in VHF band somewhat between 50 â€“ 210MHz.
- This transmitter is compatible only with PAL B and PAL G systems.

P221. Audio monitoring system

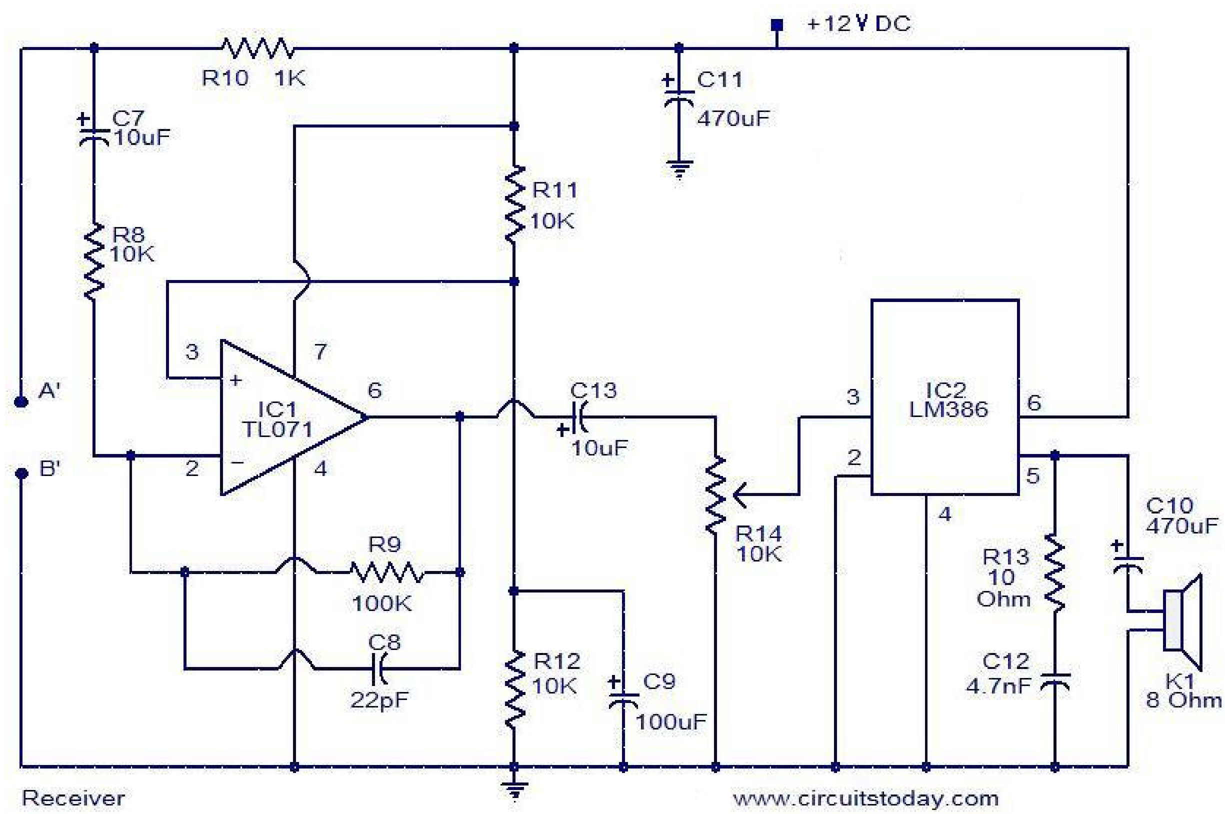
Description.

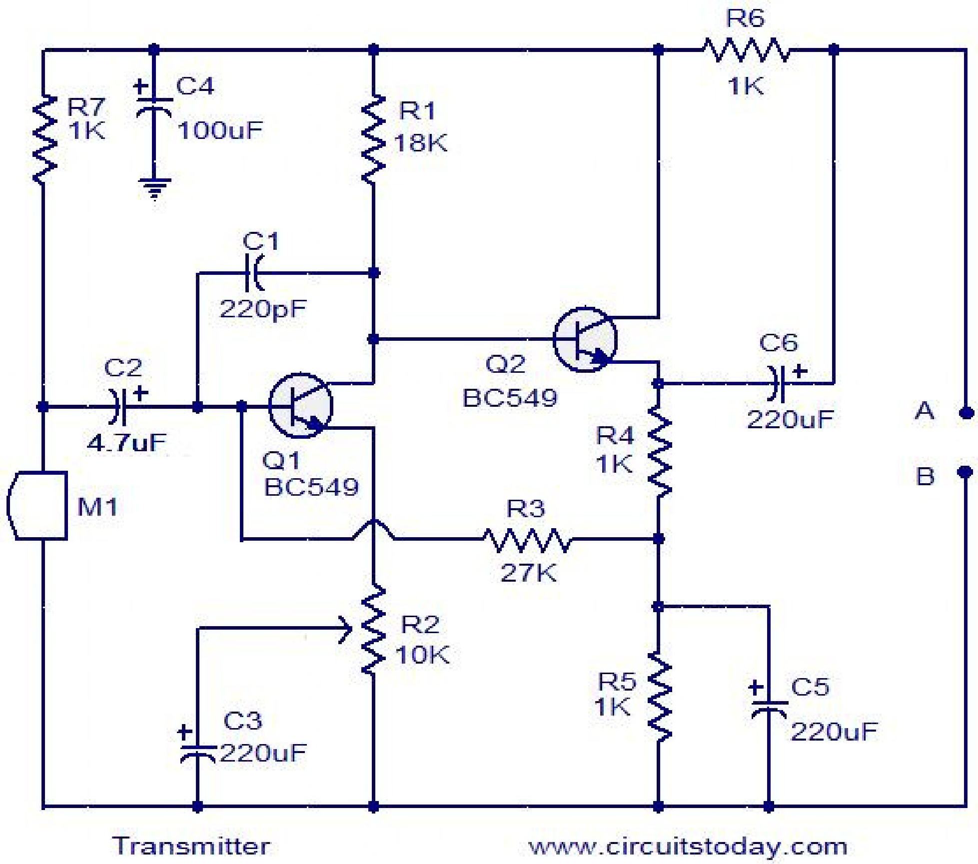
Here is the circuit schematic of a simple audio surveillance system in which the transmitter will pickup sound from one location and the receiver at other location will reproduce it. The receiver and transmitter are connected by only one set of wire. Here both power supply and transmitted signal share the same wire.

The audio signals picked up by the microphone will be amplified by the double stage amplifier build around transistors Q1 and Q2.The POT R2 controls gain of the amplifier. The power supply for this circuit is drawn from the interconnection lines itself. The capacitor C4 bypasses all audio frequencies & noise from the line and ensures pure DC for the circuit. The output of the amplifier (audio signal) is coupled to the line via the capacitor C6.

At the receiver end the capacitor C7 extracts the audio signal from the line and feds it to the inverting input of IC1 (TL071) which is wired as a voltage amplifier. Output of IC1 is given to the input of IC2 (LM386) which is a integrated power amplifier.IC2 provided necessary current gain to drive the speaker. The POT R14 can be used control the gain of receiver. Capacitor C11 isolates audio frequencies and noise from the power supply of both the ICs.

Circuit diagram with Parts list.





Notes.

- Assemble the circuit on a general purpose PCB.
- Terminal A must be connected to Aâ€™ using the wire of required length. Do the same with B, Bâ€™.
- The microphone M1 can be a general purpose one.
- The speaker k1 can be 8 Ohm/2 Watt.
- POT R2 can be used to control gain of the transmitter.
- POT R14 can be used to control gain of the receiver.
- The circuit can be powered from a 12V battery or 12V DC power supply.
- IC1 and IC2 must be mounted on holders.

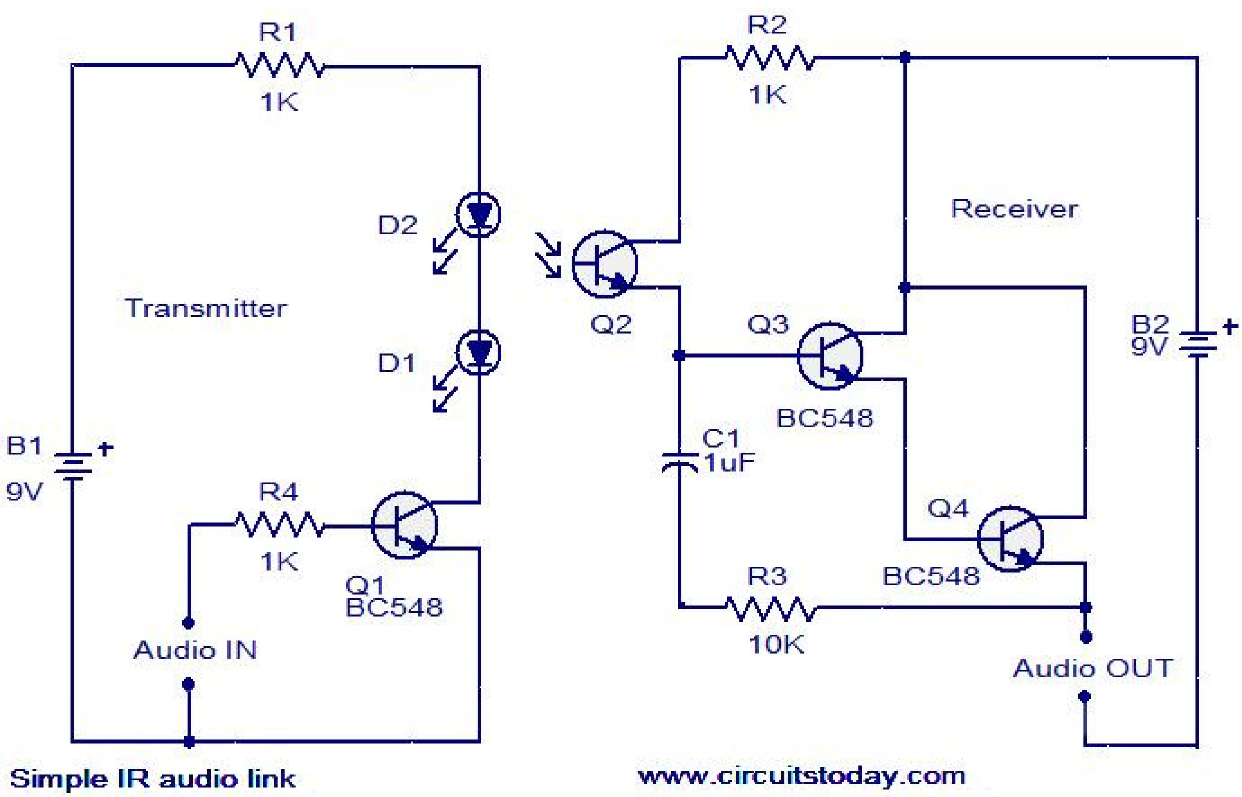
P222. Simple IR audio link

Description.

Here is a simple IR audio link that can be used to transmit audio signals up to 4 meters. The signal to be transmitted is applied to the base of Q1 via resistor R4.The transistor Q1 drives the IR transmitting diodes D1 and D2.The audio input will be modulated to the IR signals transmitted.

The transmitted IR signals will be picked by the photo transistor Q2.The emitter voltage of the transistor Q2 will change according to the sound modulated to the IR signal. The transistors Q3 and Q4 amplifies this signal to drive the speaker or headphone.C1 and R3 forms a filter to avoid interference from stray IR signals.

Circuit diagram with Parts list.



Notes

The circuit can be assembled on a general purpose PCB.

Use 9V PP3 batteries for powering the transmitter and receiver.

The phototransistor Q2 can be any NPN phototransistor like PNZ154, PNA1605F, BPW77NA or BPW85.

An 8 Ohm speaker or a headphone can be used to hear the sound.

TIMER

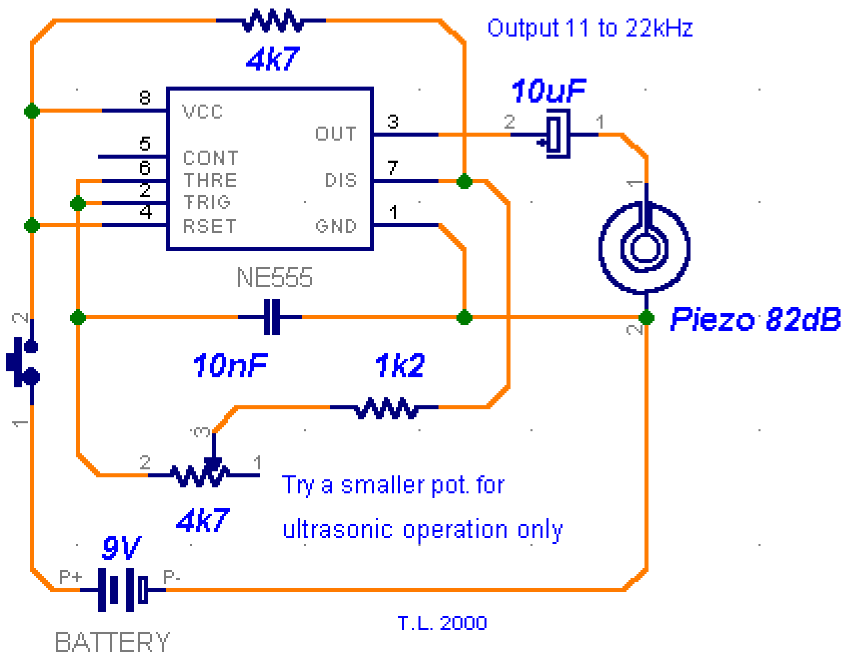
&

OSCILLATOR

P223. Ultrasonic Dog Whistle

It's well known that many animals are particularly sensitive to high-frequency sounds that humans can't hear. Many commercial pest repellers based on this principle are available, most of them operating in the range of 30 to 50 kHz. My aim was, however, to design a slightly different and somewhat more powerful audio frequency/ultrasonic sound generator that could be used to train dogs. Just imagine the possibilities - you could make your pet think twice before barking again in the middle of the night or even subdue hostile dogs (and I guess burglars would love that!). From what I've read, dogs and other mammals of similar size behave much differently than insects. They tend to respond best to frequencies between 15 and 25 kHz and the older ones are less susceptible to higher tones. This means that an ordinary pest repeller won't work simply because dogs can't hear it. Therefore, I decided to construct a new circuit (based on the venerable 555, of course) with a variable pitch and a relatively loud 82 dB miniature piezo beeper. The circuit is very simple and can be easily assembled in half an hour. Most of the components are not really critical, but you should keep in mind that other values will probably change the operating frequency. Potentiometer determines the pitch: higher resistance means lower frequency. Since different dogs react to different frequencies, you'll probably have to experiment a bit to get the most out of this tiny circuit. The circuit is shown below:

Circuit diagram

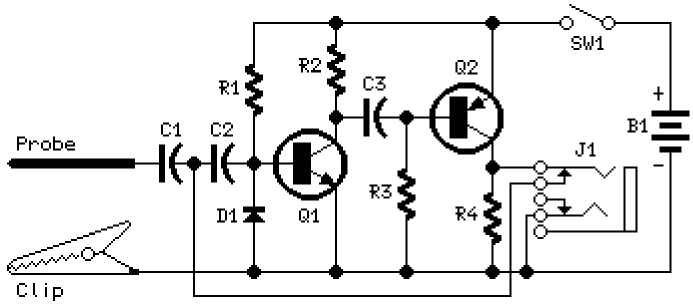


Despite the simplicity of the circuit, there is one little thing. The 10nF (.01) capacitor is critical as it, too, determines the frequency. Most ceramic caps are highly unstable and 20% tolerance is not unusual at all. Higher capacitance means lower frequency and vice-versa. For proper alignment and adjustment, an oscilloscope would be necessary. Since I don't have one, I used Winscope. Although it's limited to only 22 kHz, that's just enough to see how this circuit works. There is no need to etch a PCB for this project, perf board will do. Test the circuit to see how it responds at different frequencies. A 4k7 potentiometer in conjunction with a 10nF (or slightly bigger) capacitor gives some 11 to 22kHz, which should do just fine. Install the circuit in a small plastic box and if you want to, you can add a LED pilot light. Power consumption is very small and a 9V battery should last a long time. Possible further experimentation: I'm working on an amplified version of the whistle to get a louder beep. All attempts so far haven't been successful as high frequency performance tends to drop dramatically with the 555. Perhaps I could use a frequency doubler circuit - I just don't know and I've run out of ideas. One other slightly more advanced project could be a simple "anti-bark" device with a sound-triggered (clap) switch that sets off the ultrasonic buzzer as soon as your dog starts to bark.

P224. Pulse-Generator & Signal-Tracer

Dual-purpose test-instrument
Very simple circuitry, 1.5V Battery-operated

Circuit diagram



Parts:
R1 1M 1/4W Resistor
R2,R4 2K7 1/4W Resistors
R3 150K 1/4W Resistor
C1 2n2 630V Ceramic or Polyester Capacitor (See Notes)
C2,C3 4n7 63V Ceramic or Polyester Capacitors
D1 1N4148 75V 150mA Diode
Q1 BC547 45V 100mA NPN Transistor
Q2 BC557 45V 100mA PNP Transistor
SW1 SPST miniature Slider Switch (See Notes)
J1 Stereo switched 3mm. Jack socket (See Notes)
Probe Metal Probe 3 to 5 cm. long
Clip Miniature Crocodile Clip
B1 1.5V Battery (AA or AAA cell etc.)

Device purpose:

This simple circuit generates narrow pulses at about 700-800Hz frequency. The pulses, containing harmonics up to the MHz region, can be injected into audio or radio-frequency stages of amplifiers, receivers and the like for testing purposes. A high-pitched tone can be heard from the speaker of the device under test when all is working properly. The clip must be connected to the ground of the device under test, touching with the probe the different stages of the circuit, starting from the last stage and going up towards the first. When the tone is no longer heard, the defective stage has been found.

Connecting an earclip or headphone to J1, the circuit will automatically change into a two-stage amplifier and any audio signal coming from the device under test and picked-up by the probe will be heard through the headphones. The testing of a circuit should be made in the reverse manner, i.e. starting from the first stage and going down until the last stage. When nothing is heard, the defective stage has been found.

Circuit operation:

Q1 & Q2 form a complementary astable multivibrator, whose operating frequency is set mainly by R3, C2 & C3 values. Output pulses are taken at Q2 Collector and applied to the probe by means of decoupling capacitor C1. D1 provides a symmetrical shape for the output waveform.

If an earclip or headphone jack is plugged into J1, the connection from Q2 Collector and C1-C2 is broken by the switch incorporated into J1: in this case the circuit becomes a two-stage amplifier.

Notes:

If you intend to use the circuit to test valve operated devices C1 must be a 630V type. Working with low voltage supply transistor devices the voltage of C1 can be lowered to 63 or 100V.

If instead of a short probe, you intend to connect the circuit to the device under test by means of a piece of wire longer than a few centimeters, a small ceramic capacitor (470 to 1000pF) should be added in parallel to D1 to prevent unwanted RF oscillation.

Current drawing when in Pulse-Generator mode is about 60µA and 1.2mA when in Signal-Tracer mode operation. Therefore SW1 can be omitted, provided that the earclip or headphones are unplugged when the circuit is unused.
J1 is a stereo switched jack socket wired to obtain a series connection of the two earpieces forming a stereo headphone. In this manner the circuit is loaded with a higher impedance and sensitivity will be improved.
Therefore, the higher the load impedance the more sensitive the Signal-Tracer. In any case, common 32 Ohm impedance mini-headphones suitable for walkman sets will work fine.

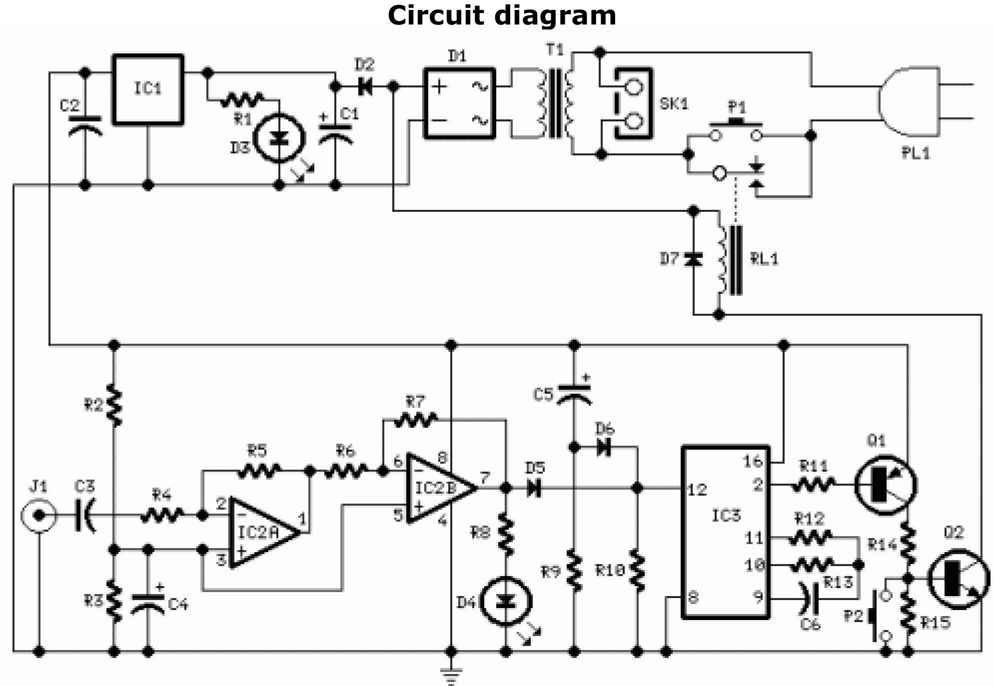
A crystal (high impedance) earpiece is a good solution, provided you substitute J1 with a mono switched jack socket.

The entire circuit can be easily fitted into a pen-like enclosure, with the probe protruding like a nib.

P225. Amplifier Timer

Turns-off your amplifier when idle for 15 minutes
Fed by amplifier tape-output

Circuit diagram



Parts:
R1,R8 1K 1/4W Resistors
R2,R3 4K7 1/4W Resistors
R4 22K 1/4W Resistor
R5 4M7 1/4W Resistor
R6,R9 10K 1/4W Resistors
R7 1M5 1/4W Resistor
R10 100K 1/4W Resistor
R11 15K 1/4W Resistor
R12 10M 1/4W Resistor
R13 1M 1/4W Resistor
R14 8K2 1/4W Resistor
R15 1K8 1/4W Resistor
C1 470µF 25V Electrolytic Capacitor
C2,C3,C6 100nF 63V Polyester Capacitors
C4,C5 10µF 25V Electrolytic Capacitors
D1 Diode bridge 100V 1A
D2,D7 1N4002 100V 1A Diodes
D3 Red LED 5mm.
D4 Yellow LED 5mm.
D5,D6 1N4148 75V 150mA Diodes
IC1 78L12 12V 100mA Voltage regulator IC
IC2 LM358 Low Power Dual Op-amp
IC3 4060 14 stage ripple counter and oscillator IC
Q1 BC557 45V 100mA PNP Transistor
Q2 BC337 45V 800mA NPN Transistor
J1 RCA audio input socket
P1 SPST Mains suited Pushbutton
P2 SPST Pushbutton
T1 220V Primary, 12V Secondary 3VA Mains transformer
RL1 10.5V 270 Ohm Relay with SPST 5A 220V switch
PL1 Male Mains plug
SK1 Female Mains socket

Circuit operation:
This circuit turns-off an amplifier or any other device when a low level audio signal fed to its input is absent for 15 minutes at least.

Pushing P1 the device is switched-on feeding any appliance connected to SK1. Input audio signal is boosted and squared by IC2 A & B and monitored by LED D4. When D4 illuminates, albeit for a very short peak, IC3 is reset and restarts its counting. Pin 2 of IC3 remains at the low state, the two transistors are on and the relay operates. When, after a 15 minutes delay, no signal appeared at the input, IC3 ends its counting and pin 2 goes high. Q1 & Q2 stop conducting and the relay switches-off. The device is thus completely off as also are the appliances connected to SK1. C5 & R9 reset IC3 at power-on. P2 allows switch-off at any moment.

Notes:
Simply connect left or right channel tape output of your amplifier to J1.

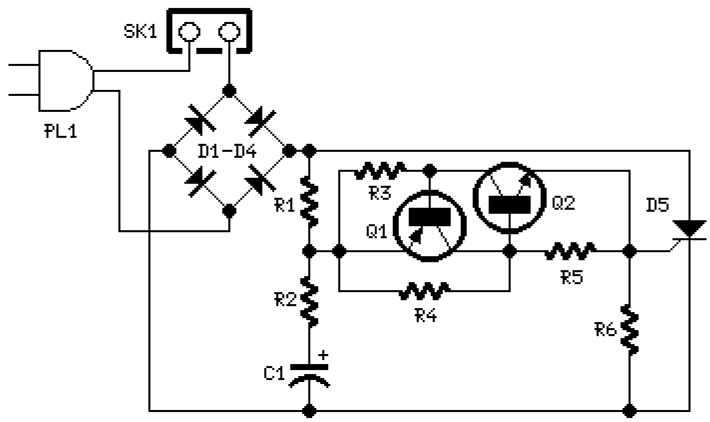
You can employ two RCA input sockets wired in parallel to allow pick-up audio signals from both stereo channels.
The delay time can be varied changing R13 and/or C6 values.

Needing to operate a device not supplied by power mains, use a double pole relay switch, connecting the second pole switch in series with the device's supply.

P226. 220 Volts Flashing Lamps

Especially designed for Christmas tree lamps
Replaces old thermally-activated switches

Circuit diagram



Parts:
R1 100K 1/4W Resistor
R2,R5 1K 1/4W Resistors
R3,R6 470R 1/4W Resistors
R4 12K 1/4W Resistor
C1 1000µF 25V Electrolytic Capacitor
D1-D4 1N4007 1000V 1A Diodes
D5 P0102D 400V 800mA SCR
Q1 BC327 45V 800mA PNP Transistor
Q2 BC337 45V 800mA NPN Transistor
PL1 Male Mains plug
SK1 Female Mains socket

Device purpose:

This circuit is intended as a reliable replacement to thermally-activated switches used for Christmas tree lamp-flashing. The device formed by Q1, Q2 and related resistors triggers the SCR. Timing is provided by R1,R2 & C1. To change flashing frequency don't modify R1 and R2 values: set C1 value from 100 to 2200µF instead.

Best performances are obtained with C1=470 or 1000µF and R4=12K or 10K. Due to low consumption of normal 10 or 20 lamp series-loops intended for Christmas trees (60mA @ 220V typical for a 20 lamp series-loop), very small and cheap SCR devices can be used, e.g. C106D1 (400V 3.2A) or TICP106D (400V 2A), this last and the suggested P0102D devices having TO92 case.

Important Note:

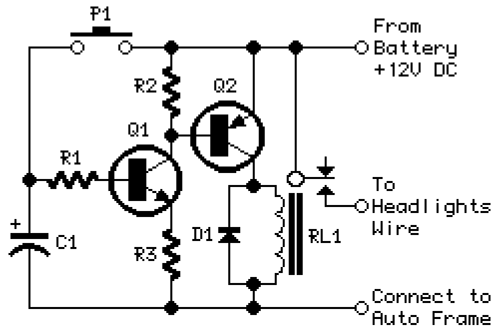
For proper operation it's absolutely necessary to employ high Gate-sensitive SCRs.
If you are unable to find these devices you can use Triacs instead. In this case the circuit operates also with relatively powerful devices. A recommended Triac type is the ubiquitous TIC206M (600V 4A) but many others can work.Note that in spite of the Triac, diode bridge D1-D4 is in any case necessary.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", June 2000 issue, page 458

P227. Headlights Timer

Pushbutton activated
Very simple circuitry

Circuit diagram



Parts:
R1 4K7 1/4W Resistor
R2,R3 1K 1/4W Resistors
C1 100μF 25V Electrolytic Capacitor (See Notes)
D1 1N4002 100V 1A Diode
Q1 BC547 45V 100mA NPN Transistor
Q2 BC327 45V 800mA PNP Transistor
P1 SPST Pushbutton
RL1 Relay with SPDT 10A min. switch
Coil Voltage 12V. Coil resistance 150-600 Ohms

Comments:
This device is a simple timer, allowing to keep on the headlights of your vehicle for about 1min. and 30sec., e.g. when accessing some dark place, without the necessity of coming back to switch-off the lights.

Circuit operation:

Pushing on P1 allows C1 charging to full 12V battery supply. Therefore Q1 is driven hard-on, driving in turn Q2 and its Relay load. The headlights are thus activated by means of the Relay contact wired in parallel to the vehicle's headlights switch. RL1 remains activated until C1 is almost fully discharged, i.e. when its voltage falls below about 0.7V.

The timing delay of the circuit depends by C1 and R1 values and was set to about 1min. and 30sec.
In practice, due to electrolytic capacitors wide tolerance value, this delay will vary from about 1min. and 30sec. to 1min. and 50sec.

An interesting variation is to use the inside lamp as a command source for the timer. In this way, when the door is opened C1 is charged, but it will start to discharge only when the door will be closed, substituting pushbutton operation.

To enable the circuit acting in this way, simply connect the cathode of a 1N4002 diode to R1-C1 junction and the anode to the "live" lead of the inside lamp.

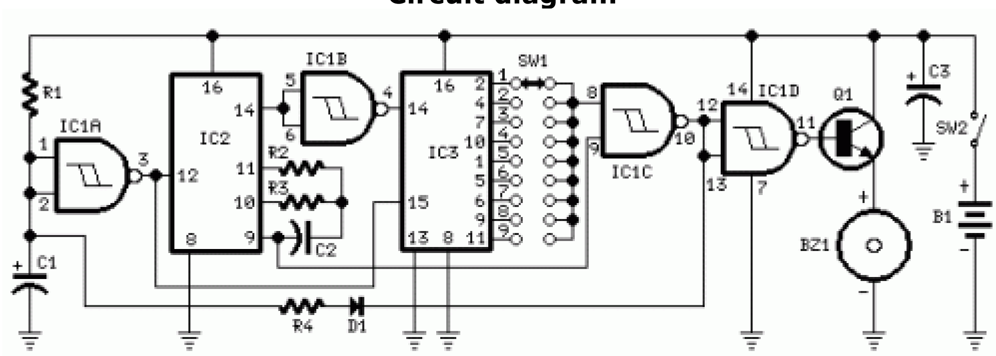
This lead can be singled-out using a voltmeter, as it is the lead where a 12V voltage can be measured in respect to the vehicle frame when the lamp is on.

Notes:
The Relay contact must be rated at 10A or more.
Timings obtained trying different tolerance electrolytic capacitors for C1:
100µF = 1'30" to 1'50"
47µF = 0'45" to 1'05"
220µF = 3'15" to 4'15"

P228. Jogging Timer

3V Battery powered
Beeps after a fixed number of minutes

Circuit diagram



Parts:
R1 47K 1/4W Resistor
R2 10M 1/4W Resistor
R3 1M 1/4W Resistor
R4 12K 1/4W Resistor (see notes)
C1,C3 10µF 25V Electrolytic Capacitors
C2 100nF 63V Polyester Capacitor
D1 1N4148 75V 150mA Diode
IC1 4093 Quad 2 input Schmitt NAND Gate IC
IC2 4060 14 stage ripple counter and oscillator IC
IC3 4017 Decade counter with 10 decoded outputs IC
Q1 BC337 45V 800mA NPN Transistor
SW1 1 pole 9 ways Rotary Switch (see notes)
SW2 SPST Slider Switch
BZ1 Piezo sounder (incorporating 3KHz oscillator)
B1 3V Battery (two 1.5V AA or AAA cells in series etc.)

Device purpose:

This circuit was developed since a number of visitors of this website requested a timer capable of emitting a beep after one, two, three minutes and so on, for jogging purposes.

As shown in the Circuit diagram, SW1 is a 1 pole 9 ways Rotary Switch. Setting the switch in position 1, the Piezo sounder emits three short beeps every minute. In position 2 the same thing happens after 2 minutes, and so on, reaching a maximum interval of 9 minutes in position 9.

Notes:
Needing only one time set, rotary switch can be replaced by an hard-wired link.
A DIP-Switch can be used in place of the rotary type. Pay attention to use only a switch at a time, or the device could be damaged.

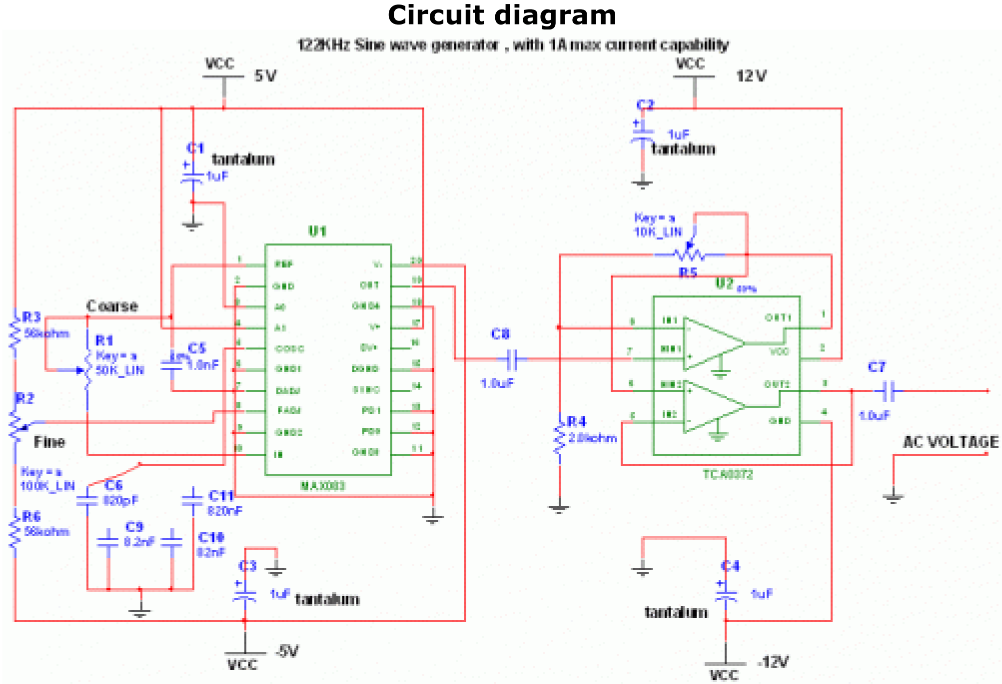
Varying R4 from 10K to 15K you can obtain more or less than three short beeps after the preset time delay.

To obtain a one-second beep only, after the preset time delay, disconnect pin 9 of IC1C from pin 9 of IC2 and connect it to pin 8 of IC1C.

P229.

Adjustable High/Low Frequency Sine wave generator

Circuit diagram



This circuit uses the versatile MAX038 function generator. Although in this circuit some of the advanced characteristics of this IC are disabled, you can generate Sine, Triangle, Square waves (adjusting A0 and A1 pins see datasheet on www.maxim-ic.com if you want other waves, use a switch).
The signal is amplified through a TCA0372 (from ONSEMI) Power opamp with current capability up to 1A and bandwitch up to 1 MHz.

I selected this particular frequency (122 Khz) because i needed a cheapo ESR-o-meter for my electrolytic capacitors to monitor their health as they have to discharge tens of amperes in less than 2 ms. At 122 KHz capacitive reactance is very low, and inductive reactance isn't so high, so forcing a current (es 200mA, using a precision resistor) through a capacitor and reading AC voltage drop accross it gives me an estimation of ESR (Vdrop/current). Of course inductive and capacitive reactance are still present, but negligible.

Let's back to the circuit.

Operation:
The 122 khz 2V p-p sine wave is generated by the MAX038 IC, its frequency can be calculated by the formula Freq (MHz) = Iin(uA) / C6 (pf) . Iin = 2,5V / R1 (25Kohm default). So the freq is 0,122 MHz . The resistor is for small adjustments, don't go under 10000 Kohm or above 40000 Kohm because the accuracy will drop. If you want multifrequency just use the multiposition switch with 820 pF, 8,2 nF , 82nF , 820 nf for 122Khz range 12,2Khz range 1220 Hz and 122 Hz. Fine tuning can be done adjusting R2 , the frequency can vary from 1,7x (Vfadj = -2,4) to 0,3x (Vfadj = 2,4) of the main frequency (when fadj is at 0V).

The sine wave output is feed into a TCA0372 1/2 opamp to achieve a gain from 1 to 5 (2V p-p, 10 V p-p), adjust the potenziometer and into a TCA0372 2/2 opamp buffer stage also present on the same IC.

Important:
Adjusting the frequency needs a frequency counter, so this circuit should be used on conjunction with a freq couter. The max current is 1A, but i would suggesto to not go above 0,5A to remain accurate. Needs a computer power supply with 12V,5V,-5V,-12V,GND to be operated, if you don't have one just use a multivoltage mains transformer (15 watt is enough) diode bridges (low current 1-2 Amps), smoothing capacitors 10000uF 16V, and voltage regulators such as LM7905 and LM7912.

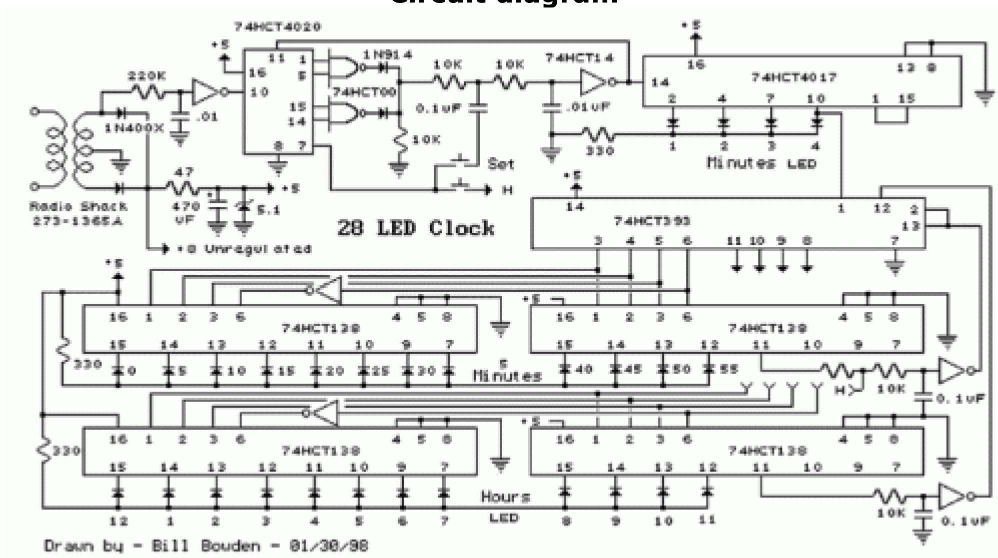
P230. 28 LED Clock Timer

This is a programmable clock timer circuit that uses individual LEDs to indicate hours and minutes. 12 LEDs can be arranged in a circle to represent the 12 hours of a clock face and an additional 12 LEDs can be arranged in an outer circle to indicate 5 minute intervals within the hour. 4 additional LEDs are used to indicate 1 to 4 minutes of time within each 5 minute interval.

The circuit is powered from a small 12.6 volt center tapped line transformer and the 60 cycle line frequency is used for the time base. The transformer is connected in a full wave, center tapped configuration which produces about 8.5 volts unregulated DC. A 47 ohm resistor and 5.1 volt, 1 watt zener regulate the supply for the 74HCT circuits.

A 14 stage 74HCT4020 binary counter and two NAND gates are used to divide the line frequency by 3600 producing a one minute pulse which is used to reset the counter and advance the 4017 decade counter. The decade counter counts the minutes from 0 to 4 and resets on the fifth count or every 5 minutes which advances one section of a dual 4 bit binary counter (74HCT393). The 4 bits of this counter are then decoded into one of 12 outputs by two 74HCT138 (3 line to 8 line) decoder circuits. The most significant bit is used in conjunction with an inverter to select the appropriate decoder. During the first eight counts, the low state of the MSB is inverted to supply a high level to enable the decoder that drives the first 8 LEDs. During counts 9 to 12, the MSB will be high and will select the decoder that drives the remaining 4 LEDs while disabling the other decoder. The decoded outputs are low when selected and the 12 LEDs are connected common anode with a 330 ohm current limiting resistor to the +5 volt supply.

Circuit diagram



The 5th output of the second decoder (pin 11) is used to reset the binary counter so that it counts to 11 and then resets to zero on the 12th count. A high reset level is required for the 393 counters, so the low output from the last decoder stage (pin 11) is inverted with one section of a 74HCT14 hex Schmitt trigger inverter circuit. A 10K resistor and 0.1uF cap are used to extend the reset time, ensuring the counter receives a reset signal which is much longer than the minimum time required. The reset signal is also connected to the clock input (pin 13) of the second 4 bit counter (1/2 74HCT393) which advances the hour LEDs and resets on the 12th hour in a similar manner.

Setting the correct time is accomplished with two manual push buttons which feed the Q4 stage (pin 7) of the 4020 counter to the minute and hour reset circuits which advance the counters at 3.75 counts per second. A slower rate can be obtained by using the Q5 or Q6 stages. For test purposes, you can use Q1 (pin 9) which will advance the minutes at 30 per second.

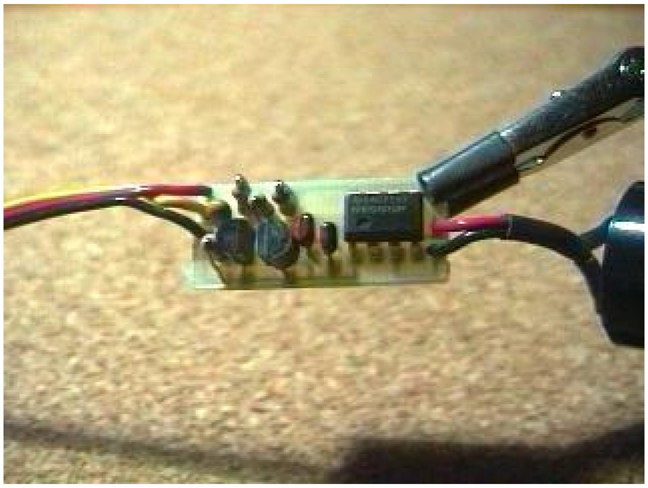
The time interval circuit (shown below the clock) consists of a SET/RESET flipflop made from the two remaining NAND gates (74HCT00). The desired time interval is programmed by connecting the anodes of the six diodes labeled start, stop and AM/PM to the appropriate decoder outputs. For example, to turn the relay on at 7:05AM and turn it off at 8:05AM, you would connect one of the diodes from the start section to the cathode of the LED that represents 7 hours, the second diode to the LED cathode that represents 5 minutes and the third diode to the AM line of the CD4013. The stop time is programmed in the same manner.

Two additional push buttons are used to manually open and close the relay. The low start and stop signals at the common cathode connections are capacitively coupled to the NAND gates so that the manual push buttons can override the 5 minute time duration. That way, you can immediately reset the relay without waiting 5 minutes for the start signal to go away.

The two power supply rectifier diodes are 1N400X variety and the switching diodes are 1N914 or 4148s but any general purpose diodes can be used. 0.1 uF caps (not shown on schematic) may be needed near the power pins of each IC. All parts should be available from Radio Shack with the exception of the 74HCT4017 decade counter which I didn't see listed. You can use either 74HC or 74HCT parts, the only difference between the two is that the input switching levels of the HCT devices are compatible with worst case TTL logic outputs. The HC device inputs are set at 50% of Vcc, so they may not work when driven from marginal TTL logic outputs.

You can use a regular 4017 in place of the 74HCT4017 but the output current will much lower (less than 1 mA) and 4 additional transistors will be required to drive the LEDs. Without the buffer transistors, you can use a 10K resistor in place of the 330 and the LEDs will be visible, but very dim.

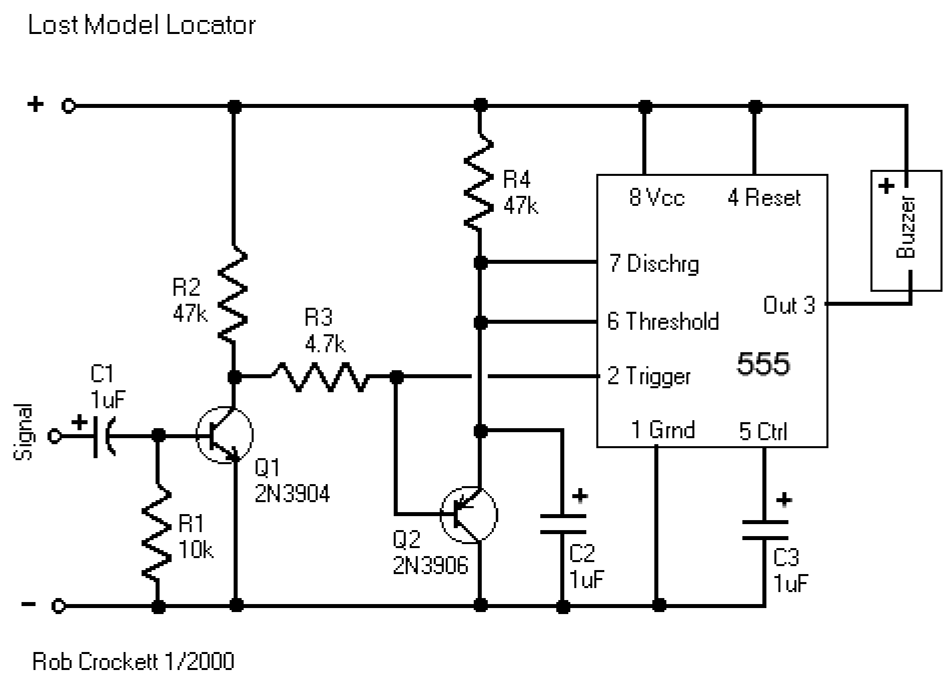
P231. Downed Model Locator

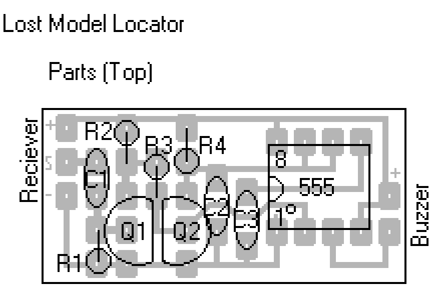


If you know people who fly slope gliders frequently, you probably know someone who has lost a glider in the weeds or bushes. Here is a circuit I've shamelessly swiped from George Steiner's book "A to Z - Radio Control Electronic Journal" that may help you find your glider. I modified the circuit to use parts currently available at your local Radio Shack store, and modified it to decrease false triggering from low voltage spikes in the on-board power system when full sized or higher torque servos are used.
Your transmitter sends a set of pulses to your receiver every 20 milliseconds, and your receiver in turn sends an individual pulse to each of your servos at the same interval. This circuit is a pulse omission detector--an alarm sounds when the pulses, originating from your transmitter, are no longer present. By plugging this circuit into an unused servo socket on your receiver, you can turn on the alarm by turning off your transmitter.

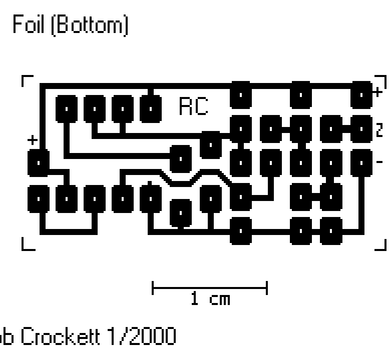
The first capacitor C1 filters out DC voltage, preventing an aggressive automatic gain control of some current receivers from shutting off the alarm even when your transmitter is off. The first transistor Q1 serves to flip the pulse to negative modulation that the 555 needs. The C2 capacitor and the R4 resistor establish the time interval--if no pulse is received in the time it takes to charge the capacitor through the resistor, the alarm sounds. The interval is the resistance multiplied by the capacitance: 1uF x 47k = 0.000001F x 47000 ohms = 0.047sec = 47msec which is a little over twice the standard 20msec R/C frame rate--this device uses a little longer interval than the frame rate to prevent false triggering. The other capacitor C3 smoothes the control voltage on the 555, preventing false triggering from spikes in the supply voltage. Unless a pulse opens the Q2 transistor to drain the C2 capacitor before the capacitor is fully charged, the pin 6 threshold senses a high voltage and triggers the output pin 3 to go low, sinking current across the buzzer and making noise. With the reset pin 4 high, the discharge pin 7 drains the capacitor, and the cycle starts again.

Circuit diagram





R1 10k (brn-blk-ora)
R2 47k (yel-vio-ora)
R3 4.7k (yel-vio-red)
R4 47k (yel-vio-ora)
C1 1uF (105)
C2 1uF (105)
C3 1uF (105)
Q1 2N3904 (NPN)
Q2 2N3906 (PNP)



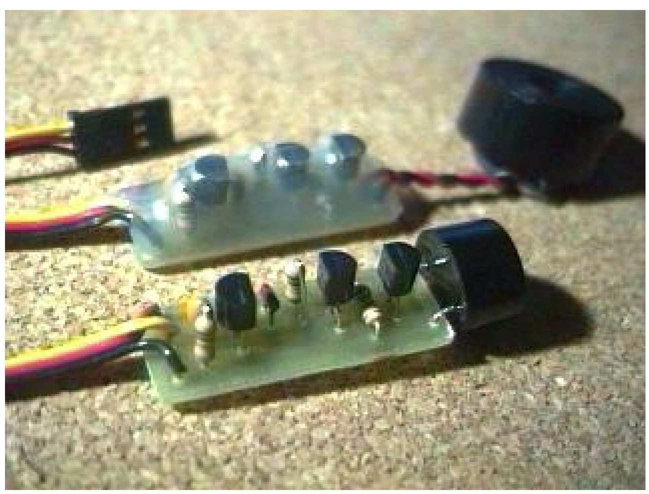
The circuit draws 1mA (!) when idle and 4 mA when buzzing. I've been using large peizo buzzers (see part numbers below) because they are light and loud, and the 6 volt electromagnetic buzzer where weight is not so much of a concern.

The circuit uses your receiver battery for power. For the ultimate in reliability, you can use an additional battery to supply the alarm as follows. Connect only signal and negative leads to your receiver socket, and connect the second battery positive to positive circuit lead and negative to negative circuit lead. You will need to put some kind of switch in series with the second battery to keep it from running the alarm when you are not flying. With the extra battery, you will still be able to find your plane if your plane went down because of a receiver battery failure, or if your receiver battery fell out in the crash. You can use a nine volt battery for this, but be careful to NOT connect the nine volt battery to your receiver--or you will smoke your receiver. Note: Do NOT solder to a button battery--they explode.

Here are few Radio Shack parts numbers. You can substitute other types of capacitors; tantalum capacitors are just physically smaller. Polarity of the tantalum capacitor probably does not matter at this low voltage (compared to the rated maximum voltage), but to be particular, the positive lead would be directed toward the input signal lead and away from the negative side. Power in this circuit is minimal and you can use the smallest resistors you can get your hands on (get 1/8 watt if you can, but any power rating will work).

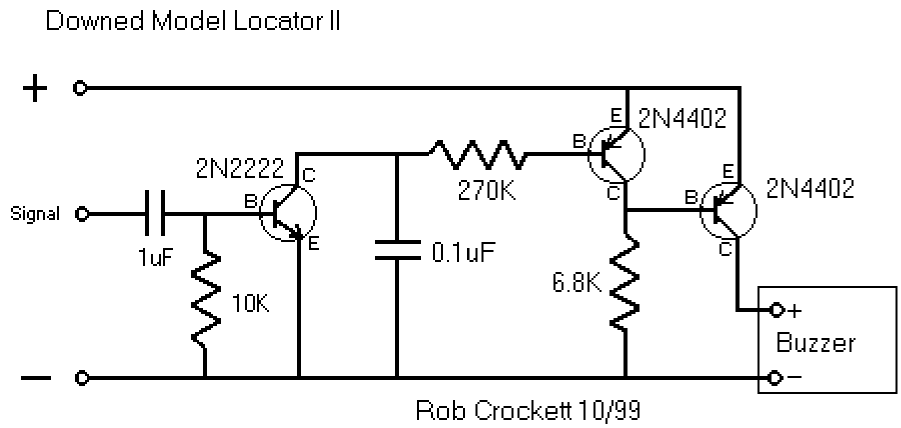
273-065 peizo buzzer
273-054 electric buzzer
276-1604 2N3906-type PNP transistors, 15 per
276-2016 2N3904 NPN transistor
276-1723 LM555 timer IC
272-1434 1uF tantalum capacitor
271-xxx 1/4 watt resistors (10k, 47k, 4.7k, 5 per)
George Steiner's book, crammed with cool R/C radio info, can be had for $19.95 postage paid from the following:
GSP AZ Journal
2238 Rogue River Drive
Sacramento CA 95826
phone: 916-362-1962

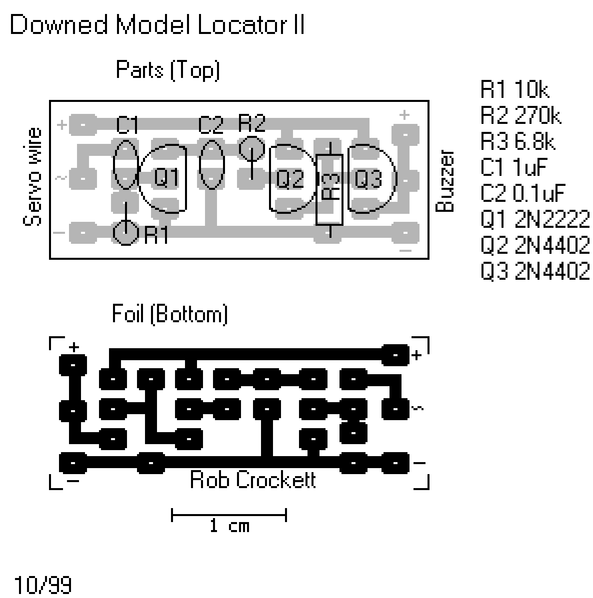
P232. Downed Model Locator II



Here is another device to help you locate your downed R/C sailplane in the bushes and weeds. Similar to the other design, this circuit plugs into a spare servo socket on your receiver, and it is a pulse omission detector. The alarm sounds when pulses originating from your transmitter are no longer being received--turn off your transmitter to turn on the alarm and help you find your plane. This circuit is simpler than the other design, is much easier to build, but is not quite as specific. While the other design tests for a specific frequency of pulses, this design is less picky, and may not work quite as well in areas with more radio frequency background noise. This design was originally collected from another web site, but the site has gone off-line and I'm unable to give proper credit to the individual. I modified the original design a little to make it work more reliably with the more aggressive automatic gain control of some of the current receivers.

Circuit diagram





The circuit draws 1mA (!) when idle and 7 when buzzing. You can use a piezo buzzer right on the board (light and compact), a large piezo buzzer on a short wires (louder and easier to hear tone), or use the magnetic buzzer (a little heavier but good raspy sound). With the transmitter off, the alarm is mostly on, punctuated now and then by a servo wiggle and alarm silence from background radiofrequency noise pulses. This device is easy to build and works great. It's amazing how much your search time will be cut even with wind or surf noise in the background. Being able to hear it from 20 feet away often makes the difference between finding and not finding a plane.

If your plane went down because of radio interference, this device may not sound much. If you think it may have been interference from another pilot's transmitter on your frequency, be sure to have the other transmitter turned off before you go hunting for your plane.

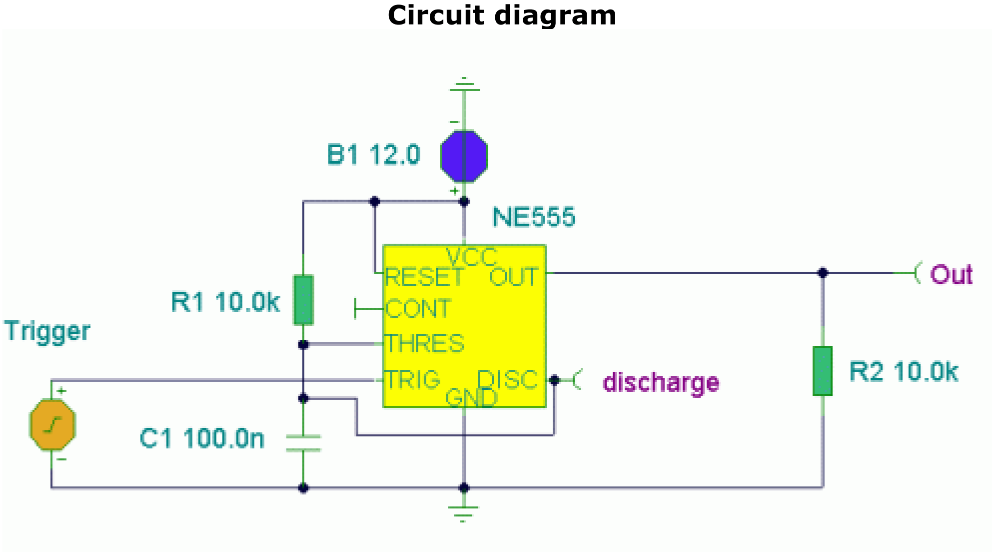
The circuit uses your receiver battery for power. For the ultimate in reliability, you can use an additional battery to supply the alarm as follows. Connect only signal and negative leads to your receiver socket, and connect the second battery positive to positive circuit lead and negative to negative circuit lead. You will need to put some kind of switch in series with the second battery to keep it from running the alarm when you are not flying. With the extra battery, you will still be able to find your plane if your plane went down because of a receiver battery failure, or if your receiver battery fell out in the crash. Note: Do NOT solder to a button battery--they explode.

Here are few Radio Shack parts numbers. Please note that any type of capacitor will work (ceramic, electrolytic, etc.) but that the tantalum and monolithic capacitors are very small. The tantalum capacitors are polarized, but at these low voltages, the polarity probably does not matter.

Parts
273-074 board mount tiny 12 volt piezo buzzer, one per
273-065 larger and louder 12 volt piezo buzzer, one per
273-054 6 volt electromagnetic buzzer, one per
276-1617 2N2222-type NPN switching transistors (box of 15)
276-2023 2N4402-type PNP transistor (MPS2907), one per
272-109 0.1uF monolithic capacitors, five per
272-1434 1uF tantalum capacitor
271-312 1/4 watt resistor assortment, 100 pieces

P233. NE555 Basic Monostable

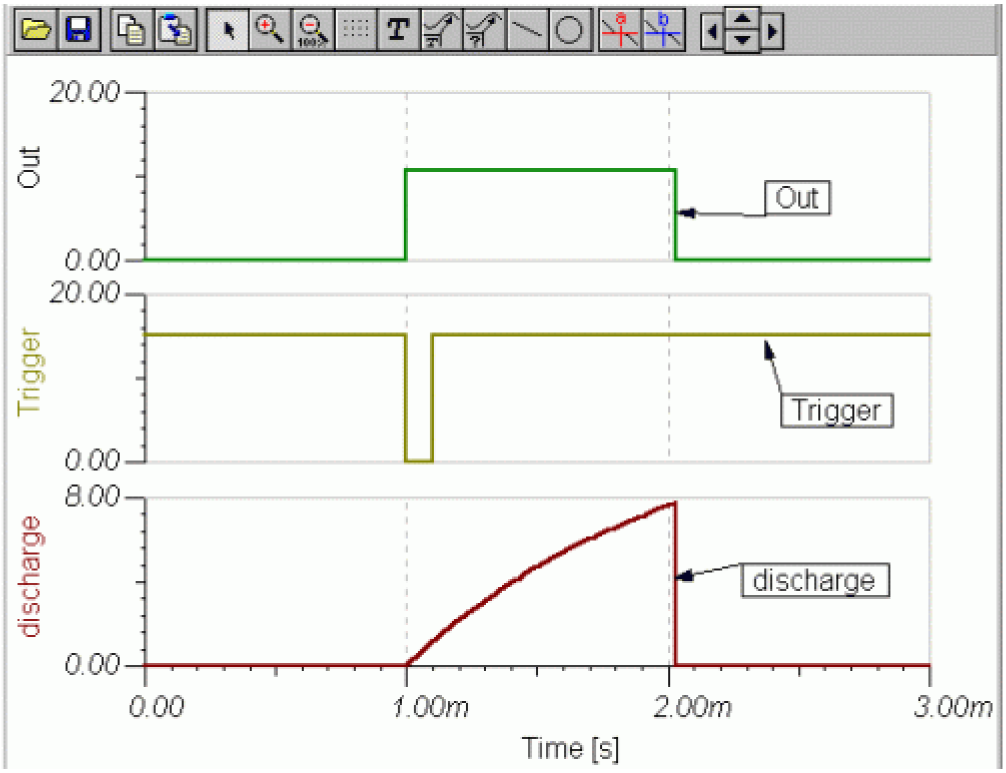
Circuit diagram



Notes:
Here the popular 555 timing IC, is wired as a monostable. The timing period is precise and equivalent to:-

1.1 x R1 x C1

With component values shown this works out at approximately 1.1msec.The output duration is independant of the input trigger pulse, and the output from the 555 is buffered and can directly interface to CMOS or TTL IC's, providing that the supply voltages match that of the logic family.

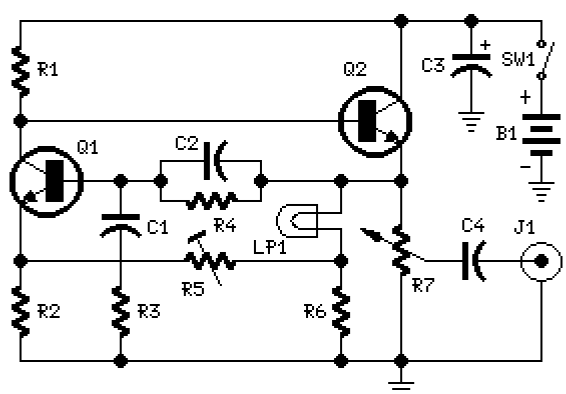


The timing diagram above shows the output pulse duration, the trigger input and the output at the discharge terminal of the IC.

P234. 1KHz Sinewave Generator

Simple circuitry, low distortion, battery operated
Variable, low impedance output up to 1V RMS

Circuit diagram



Parts:
R1 5K6 1/4W Resistor
R2 1K8 1/4W Resistor
R3,R4 15K 1/4W Resistors
R5 500R 1/2W Trimmer Cermet
R6 330R 1/4W Resistor

R7 470R Linear Potentiometer
C1,C2 10nF 63V Polyester Capacitors
C3 100µF 25V Electrolytic Capacitor
C4 470nF 63V Polyester Capacitor
Q1,Q2 BC238 25V 100mA NPN Transistors
LP1 12V 40mA Lamp (See Notes)
J1 Phono chassis Socket
SW1 SPST Slider Switch
B1 9V PP3
Clip for 9V PP3 Battery

Circuit description:

This circuit generates a good 1KHz sinewave using the inverted Wien bridge configuration (C1-R3 & C2-R4). Features a variable output, low distortion and low output impedance in order to obtain good overload capability. A small filament lamp ensures a stable long term output amplitude waveform. Useful to test the Audio Millivoltmeter, Audio Power Meter and other audio circuits published in this site.

Notes:
The lamp must be a low current type (12V 40-50mA or 6V 50mA) in order to obtain good long term stability and low distortion.

Distortion @ 1V RMS output is 0.15% with a 12V 40mA lamp, raising to 0.5% with a 12V 100mA one.
Using a lamp differing from specifications may require a change in R6 value to 220 or 150 Ohms to ensure proper circuit's oscillation.

Set R5 to read 1V RMS on an Audio Millivoltmeter connected to the output with R7 fully clockwise, or to view a sinewave of 2.828V Peak-to-Peak on the oscilloscope.

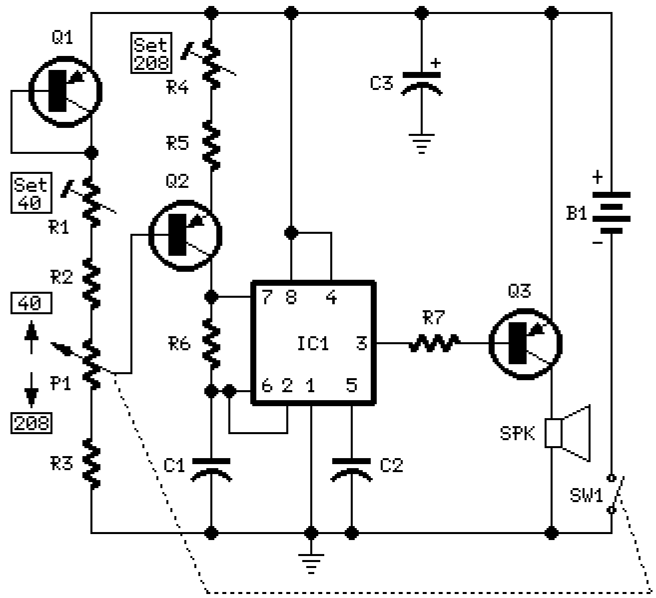
With C1,C2 = 100nF the frequency generated is 100Hz and with C1,C2 = 1nF frequency is 10KHz but R5 is needing adjustment.

High gain transistors preferred for better performance.

P235. Mini Metronome

Linear scale Small size
40 to 208 beats per minute

Circuit diagram



Parts:
P1 100K Linear Potentiometer
R1 10K 1/2W Trimmer Cermet
R2 10K 1/4W Resistor
R3 330K 1/4W Resistor
R4 50K 1/2W Trimmer Cermet
R5 100K 1/4W Resistor
R6,R7 1K 1/4W Resistor
C1 1µF 63V Polyester Capacitor
C2 10nF 63V Polyester Capacitor
C3 47µF 25V Electrolytic Capacitor
IC1 NE555 General purpose timer IC
Q1,Q2 BC560 45V 100mA Low noise High gain PNP Transistors
Q3 ZTX753 100V 2A PNP Transistor
SW1 SPST Switch (Ganged with P1)
SPK 8 Ohm 40mm. Loudspeaker
B1 12V Battery (MN21, GP23A or VR22 type)

Notes:
Q1 & Q2 provide linear frequency operation of IC1 following P1 resistance variation.
Q3 was added in order to obtain a louder click, similar to clockwork metronomes.
12V micro battery was used to obtain more output power and more compactness.

Rotate P1 fully towards R2, then set R1 to obtain 40 beats per minute (compare with another metronome).
Rotate P1 fully towards R3, then set R4 to obtain 208 beats per minute.

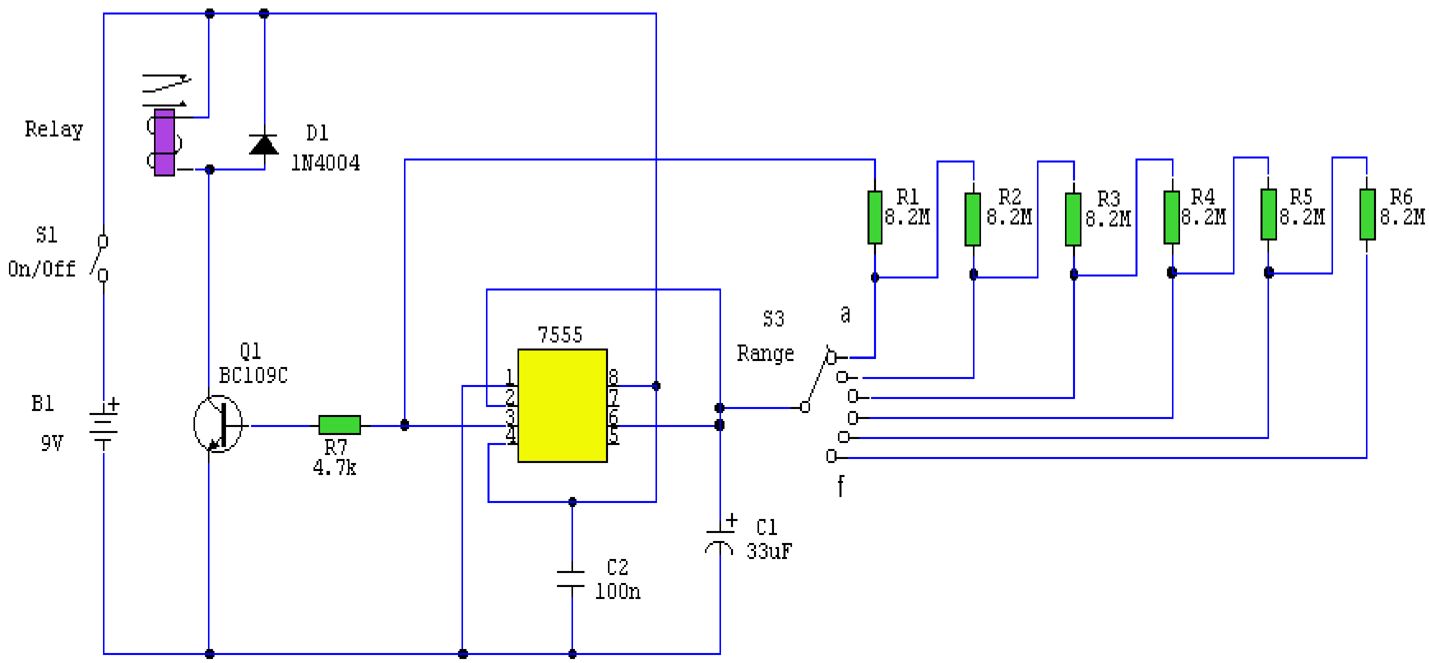
Finally mark the entire scale with the usual metronome steps as following:

40 - 42 - 44 - 46 - 48 - 50 - 52 - 54 - 58 - 60 - 63 - 66 - 69 - 72 - 76 - 80 - 84 - 88 - 92 - 96 - 100 - 104 - 108 - 112 - 116 - 120 - 126 - 132 - 138 - 144 - 152 - 160 - 168 - 176 - 184 - 192 - 200 - 208.

P236. Periodic Timer

Description:

A switched timer with equal make and equal space periods timing adjustable from over 6 minutes to 38 minutes.



Notes:

This timer circuit is similar to the 5 to 30 minute timer except that when switch S1 is closed, the on/off action of the circuit will continue indefinately until S1 is opened again. A 7555 time and low leakage type capacitor for C1 must be used. The 6 way rotary switch S3 adds extra resistance in series to the timing chain with each rotation, minimum resistance point "a" maximum point "f". The 7555 is wired as an equal mark/space ratio oscillator, the timing resistor chain R1 to R6, being connected back to the output of the timer at pin 3.The output pulse duration is defined as:-

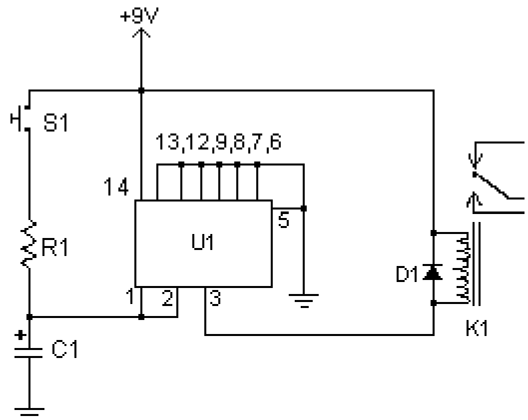
$$T = 1.4\ R1\ C1$$

This gives on and off times of about 379 seconds for postion "a" of S3 (just over 6 minutes), to about 38 minutes at point "f". The times may of coourse be varied by altering R1 to R6 or C1.

P237. Time Delay Relay

When activated by pressing a button, this time delay relay will activate a load after a specified amount of time. This time is adjustable to whatever you want simply by changing the value of a resistor and/or capacitor. The current capacity of the circuit is only limited by what kind of relay you decide to use.

Circuit diagram



Parts:
C1 See Notes
R1 See Notes
D1 1N914 Diode
U1 4011 CMOS NAND Gate IC
K1 6V Relay
S1 Normally Open Push Button Switch
MISC Board, Wire, Socket For U1

Notes:

1. To calculate the time delay, use the equation R1 * C1 * 0.85=T, where R1 is the value of R1 in Ohms, C1 is the value of C1 in uF, and T is the time delay in seconds.

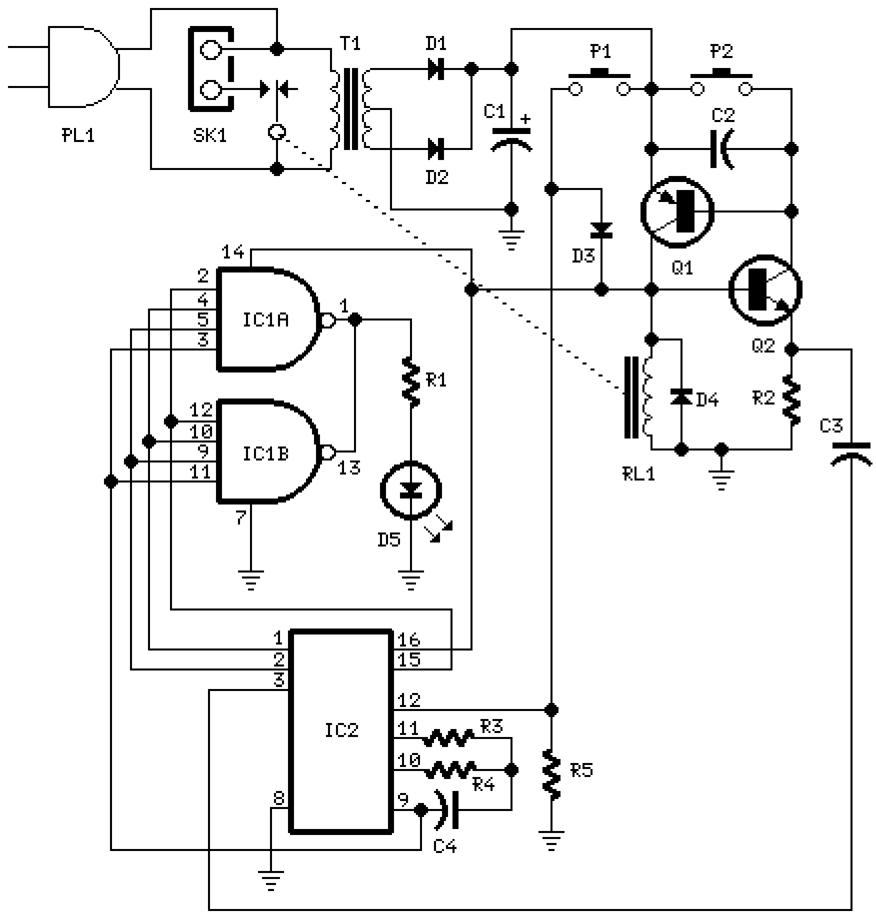
2. S1 may be replaced with an NPN transistor so the circuit can be triggered by a computer, other circuits, etc.

3. Most any 6V relay will work for K1. If you use a large relay, you my need to add a transistor to the output of the circuit in order to drive the larger load.

P238. Bedside Lamp Timer

30 minutes operation
Blinking LED signals 6 last minutes before turn-off

Circuit diagram



Parts:
R1 1K 1/4W Resistor
R2 4K7 1/4W Resistor
R3 10M 1/4W Resistor
R4 1M 1/4W Resistor
R5 10K 1/4W Resistor
C1 470µF 25V Electrolytic Capacitor
C2-C4 100nF 63V Polyester Capacitors
D1-D4 1N4002 100V 1A Diodes
D5 5mm. Red LED
IC1 4012 Dual 4 input NAND gate IC
IC2 4060 14 stage ripple counter and oscillator IC
Q1 BC328 25V 800mA PNP Transistor
Q2 BC238 25V 100mA NPN Transistor
P1,P2 SPST Pushbuttons
T1 220V Primary, 9 + 9V Secondary 1VA Mains transformer
RL1 10.5V 470 Ohm Relay with SPDT 2A 220V switch

PL1 Male Mains plug
SK1 Female Mains socket

Device purpose:

The purpose of this circuit is that of power a lamp or other apparatus for a given time (30 minutes in this case), and then to turn it off. It's useful when reading at bed by night, turning off the bedside lamp automatically in case the reader falls asleep... After turn-on by P1 pushbutton, an LED lights for c25 minutes, but 6 minutes before the turn-off, start blinking for two minutes, then stop blinking for other two minutes and finally blinks for other two minutes, thus signaling that the on-time is ending. If the user want to prolong the reading, can earn another half-hour of light by pushing on P1. Turning-off the lamp at user's ease is obtained pushing on P2.

Circuit operation:

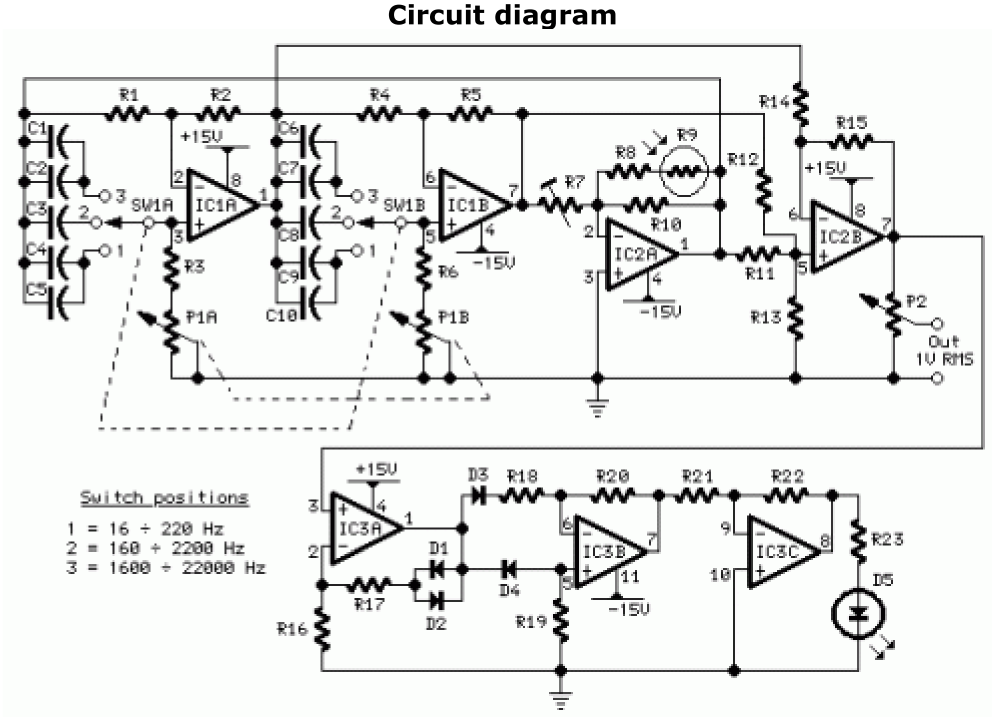
Q1 and Q2 forms an ALL-ON ALL-OFF circuit that in the off state draw no significant current. P1 starts the circuit, the relay is turned on and the two ICs are powered. The lamp is powered by the relay switch, and IC2 is reset with a positive voltage at pin 12. IC2 start oscillating at a frequency settled by R4 and C4. With the values shown pin 3 goes high after c30 minutes, turning off the circuit via C3. During the c6 minutes preceding turn-off, the LED does a blinking action by connections of IC1 to pins 1,2 & 15 of IC2. Blinking frequency is provided by IC2 oscillator at pin 9. The two gates of IC1 are in parallel to source an higher current. If needed, a piezo sounder can be connected at pins 1 & 14 of IC1. Changing IC2 brand name, varies the oscillation frequency. In particular Motorola's ICs run faster. Obviously, time can be varied changing C4 and R4 values.

This circuit was awarded with publication in ELECTRONICS WORLD "Circuit Ideas", October 1999 issue, page 819.

P239. Low-distortion Audio-range Oscillator

Generates very low-distortion sine waves up to 1V RMS
No thermistors required - No settling time

Circuit diagram



Parts:
P1 10K Log. Potentiometer (Dual-ganged)
P2 2K2 Linear Potentiometer
R1,R2,R4,R5 3K3 1/4W Resistors
R3,R6 820R 1/4W Resistors
R7 10K 1/2W Trimmer Cermet
R8 22K 1/4W Resistor
R9 Photo resistor (any type)
R10 8K2 1/4W Resistor
R11,R12,R14,R15 3K3 1/4W Resistors
R13 2K7 1/4W Resistor
R16--R20 3K3 1/4W Resistors
R21 56K 1/4W Resistor
R22 68K 1/4W Resistor
R23 1K 1/4W Resistor
C1,C6 220pF 63V Polystyrene Capacitors
C2,C7 8n2 63V Polyester Capacitors
C3,C8 82nF 63V Polyester Capacitors
C4,C9 150nF 63V Polyester Capacitors
C5,C10 680nF 63V Polyester Capacitors
D1--D4 1N4148 75V 150mA Diodes
D5 LED 5mm. Red
IC1,IC2 NE5532 Low noise Dual Op-amps
IC3 TL084 Quad BIFET Op-Amp
SW1 2 poles 3 ways rotary switch

Comments:
Producing low-distortion sine waves, this oscillator operates over the range 16 to 22000 Hz. The circuit is based on two articles that have appeared earlier in Wireless World - Roger Rosens' "Phase -Shifting Oscillator", February 1982 pp. 38-41, and J. L. Linsley Hood's "Wien-Bridge Oscillator with low harmonic distortion" from May 1981 pp. 51-53.

This design features the simplicity of the Rosens' circuit but avoids the use of a thermistor. Instead, oscillator stability is controlled by means of a common photo-resistor driven by a LED, as suggested in the Linsley Hood article.

There is no settling time when the oscillator's frequency is changed and no bouncing of the output waveform. Use of an expensive and sometimes difficult to obtain thermistor is avoided.

Technical data:
Output voltage:
Sine wave, 1V RMS max.
Total harmonic distortion @ 1V RMS output:
Frequency Reading
100Hz = 0.0035%
300Hz = 0.0028%
1kHz = 0.002 %
3kHz = 0.002 %
10kHz = 0.001 %

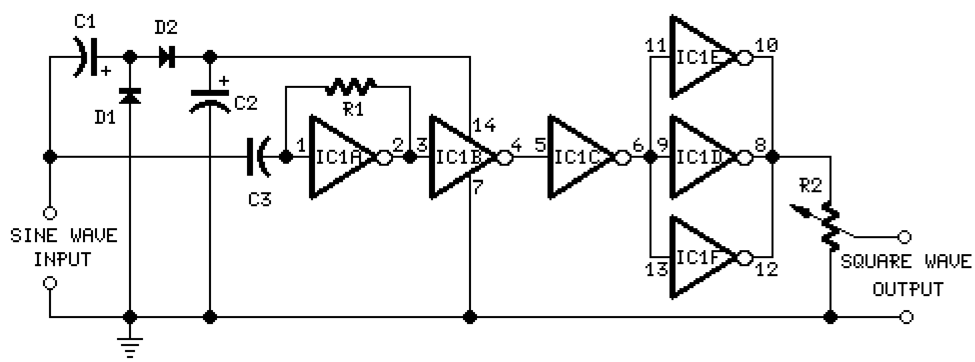
Notes:
Any common photo-resistor and 5mm. red LED can be used, provided they are in close contact and enclosed in a light-proof small box. I used the metal screen of a small IF transformer for AM transistor radios sealed with black insulating tape.

The 10K trimmer must be set to obtain a 1V RMS output.
The circuit must be supplied by a + and - 15V dual regulated supply. Common 7815 and 7915 regulator ICs should be used for this purpose.

P240. Self-powered Sine to Square wave Converter

Converts sine to square waves without a power-source
Useful as a test instrument for audio purposes

Circuit diagram



Parts:
R1 1M 1/4W Resistor
R2 100K Linear Potentiometer
C1,C2 100µF 25V Electrolytic Capacitors
C3 10nF 63V Polyester Capacitor
D1,D2 1N4148 75V 150mA Diodes
IC1 4069 Hex Inverter IC

Device purpose:

This circuit is intended to provide good square waves converting a sine wave picked-up from an existing generator. Its major feature consists in the fact that no power-source is needed: thus it can be simply connected between a sine wave generator and the device under test.

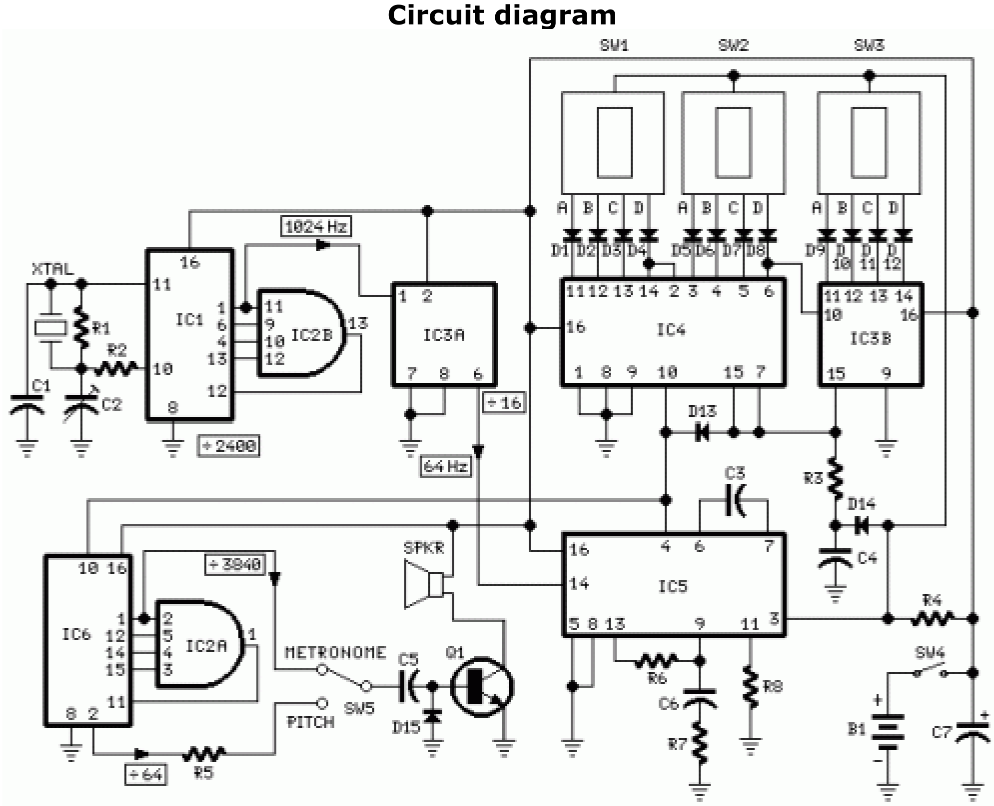
The input sine wave feeds a voltage doubler formed by C1, C2, D1 & D2 that powers the IC. IC1A amplifies the input sine wave, other inverters included in IC1 squaring the signal and delivering an output square wave of equal mark/space ratio and good rise and fall times through the entire 20Hz-20KHz range.

Notes:
Best performances are obtained with an input sine wave amplitude from 1V RMS onwards.
Output square wave amplitude is proportional to input amplitude.
Minimum sine wave input amplitude needed for good performance: 750mV RMS.
Output square wave amplitude with 1V RMS input: 3V peak to peak, with R2 set at max.
Minimum output square wave amplitude: 2V peak to peak, with R2 set at max.
Substituting the two silicon diodes with germanium types (e.g. AA118, AA119), the minimum input threshold can be lowered.

P241. Precision Metronome and Pitch generator

Precision Frequency generator 1 to 999 Hz
Precision Metronome 1 to 999 beats per minute

Circuit diagram



Parts:
R1 1M 1/4W Resistor
R2 22K 1/4W Resistor
R3 6K8 1/4W Resistor
R4 4K7 1/4W Resistor
R5 47K 1/4W Resistor
R6 100K 1/4W Resistor
R7 39K 1/4W Resistor
R8 12K 1/4W Resistor
C1 47pF 63V Ceramic Capacitor
C2 2-22pF 63V Ceramic Trimmer
C3 470pF 63V Ceramic Capacitor
C4 10pF 63V Ceramic Capacitor
C5 100nF 63V Polyester Capacitor
C6 220nF 63V Polyester Capacitor
C7 22µF 25V Electrolytic Capacitor
D1-D15 1N4148 75V 150mA Diodes
IC1 4060 14 stage ripple counter and oscillator IC
IC2 4082 Dual 4 input AND gate IC
IC3 4520 Dual binary up-counter IC
IC4 4518 Dual BCD up-counter IC
IC5 4046 Micropower Phase-locked Loop IC
IC6 4040 12 stage ripple counter IC
Q1 BC337 45V 800mA NPN Transistor
XTAL 2.4576 MHz Miniature Quartz crystal

SW1 BCD Miniature Thumbswheel Switch (units)
SW2 BCD Miniature Thumbswheel Switch (tens)
SW3 BCD Miniature Thumbswheel Switch (hundreds)
SW4 SPST Slider Switch (On-off)
SW5 SPDT Slider Switch (Metronome-Pitch)
SPKR 8 Ohm, 50 mm. Loudspeaker
B1 9V PP3 Battery
Clip for 9V PP3 Battery

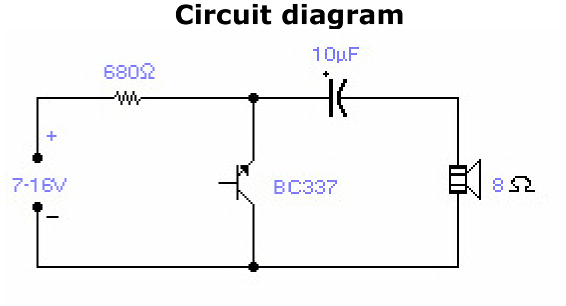
Circuit operation:

CMos IC1 and IC2B quad AND gate form a 2.4576 MHz crystal oscillator plus a 2400 times divider. IC3A provides further division by 16, obtaining a 64 Hz stable frequency square wave. This frequency is multiplied by operation of Phase Locked Loop IC5, double decade divider IC4 and IC3B 4 bit binary divider, by the number set by three miniature BCD thumbswheel switches SW1, SW2 and SW3: units, tens and hundreds respectively.

Connecting, by means of SW5, Q1 base to pin 2 of IC6, we obtain after a 64 times division, the same frequency set by thumbswheel switches with quartz precision, and no need for a scale indicator.
Volume regulation of the pitch generator is obtained trimming resistor R5. In the same manner, with SW5 set to metronome, the small speaker reproduces the frequency set by thumbswheel switches but divided by 3840, thus obtaining beats per minute ratio

P242. Reverse Bias Oscillator

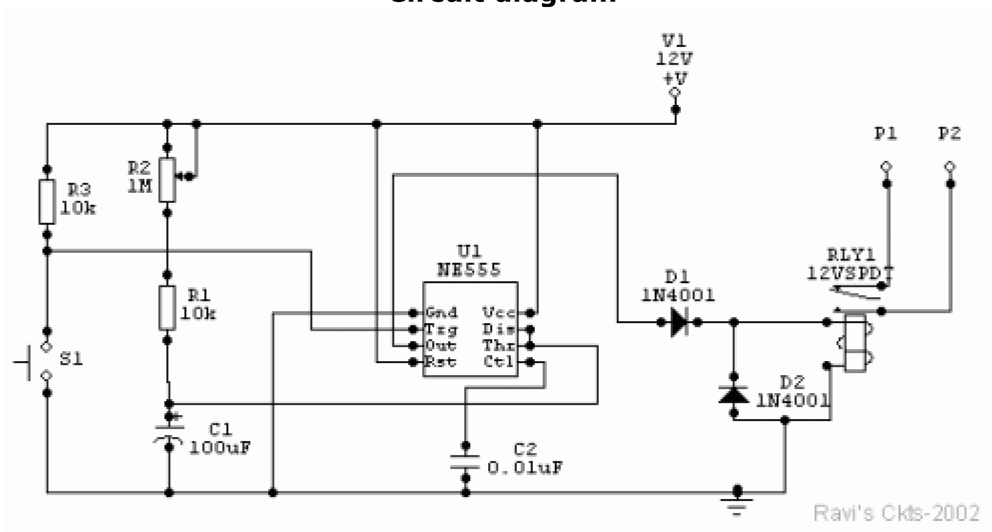
Circuit diagram



There are a number of npn transistors that will oscillate in the audio range when reverse biased. Minimum supply voltage is 7V for low power transistors such as BC109, BC238 and 2N2222A, it becomes 12V for medium power transistors such as BD139 and is 16V for power transistors as BUX22 and 2N6543. Current drain is 4mA at 9V and frequency of oscillation is 550Hz. The base is normally left open.

P243. Photo Timer Circuit

Circuit diagram

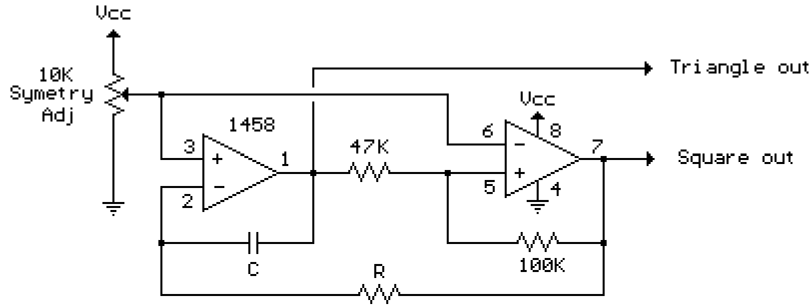


Time is set by potentiometer R2 which provides a range or 1 sec. To 100 seconds with timing capacitor C1 of 100uF. The output at pin 3 is normally low and the relay is held off. A momentary push on switch S1 energies the relay which is held closed for a time 1.1 X (R1+R2). C1 and then released. The exact length of the timing interval will depend on the actual capacitance of C1. Most electrolytic capacitors are rated on the basis of minimum guaranteed value and the actual value may be higher. The circuit should be calibrated for various positions of the control knob of R2 after the timing capacitor has had a chance to age. Once the capacitor has reached its stable value, the timings provided should be well within the photographic requirements.

Parts
C1 - 100uF, 25V electrolytic
C2 - 0.01uF, disc ceramic
D1, D2 - DR50 or 1N4001
R!,R2 - 10K ohms, ¼ watts
R3 - 1 M ohms, potentiometer
RLY1 - 12V, DC relay, operating current less than 200mA
S1 - Push-to-on switch
U1 - NE555 timer IC
P1 & P2 are for exposure lamp ckt.

P244. Triangle / Squarewave Generator

Circuit diagram

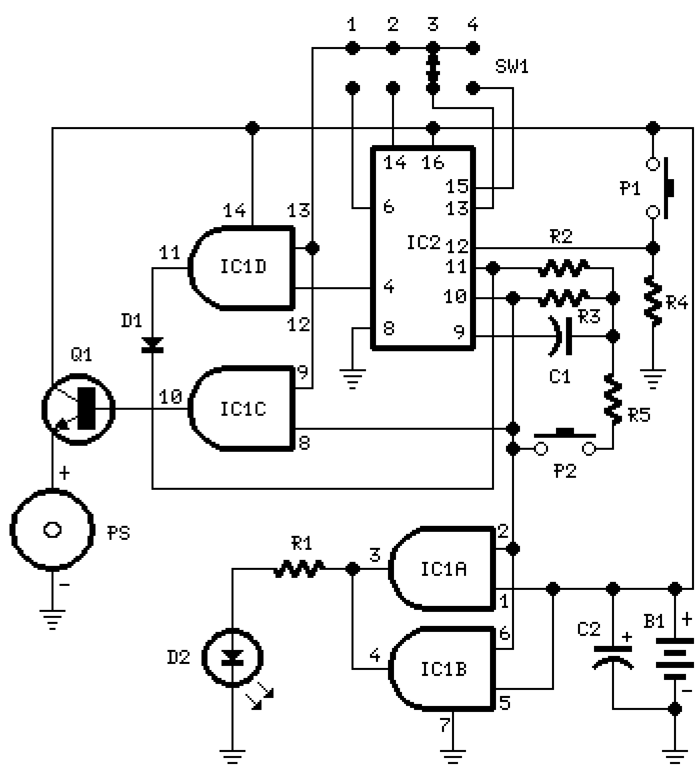


Here is a simple triangle/squarewave generator using a common 1458 dual op-amp that can be used from very low frequencies to about 10 Khz. The time interval for one half cycle is about R*C and the outputs will supply about 10 milliamps of current. Triangle amplitude can be altered by adjusting the 47K resistor, and waveform offset can be removed by adding a capacitor in series with the output.

P245. Timed Beeper

Beeps 7.5 seconds after a preset time
Adjustable time settings: 15 sec. 30 sec. 1 min. 2 min. & others

Circuit diagram



Parts:
R1 220R 1/4W Resistor
R2 10M 1/4W Resistor

R3 1M 1/4W Resistor
R4 10K 1/4W Resistor
R5 47K 1/4W Resistor
C1 100nF 63V Polyester Capacitor
C2 22µF 25V Electrolytic Capacitor
D1 1N4148 75V 150mA Diode
D2 3mm. Red LED
IC1 4081 Quad 2 input AND Gate IC
IC2 4060 14 stage ripple counter and oscillator IC
Q1 BC337 45V 800mA NPN Transistor
P1 SPST Pushbutton (Start)
P2 SPST Pushbutton (Reset)
SW1 4 ways Switch (See notes)
PS Piezo sounder (incorporating 3KHz oscillator)
B1 3V Battery (2 AA 1.5V Cells in series)

Device purpose:

This circuit is intended for alerting purposes after a certain time is elapsed. It is suitable for table games requiring a fixed time to answer a question, or to move a piece etc. In this view it's a modern substitute for the old sandglass. Useful also for time control when children are brushing teeth (at least two minutes!), or in the kitchen, and so on.

Circuit operation:

Pushing P1 resets IC2 that start oscillating at a frequency fixed by R3 & C1. With values shown, this frequency is approx. 4Hz. The LED D2, driven by IC1A & B, flashing at the same oscillator frequency, signals proper circuit operation. SW1 selects the appropriate pin of IC2 thus adjusting timing duration:

Position 1 = 15 seconds
Position 2 = 30 seconds
Position 3 = 1 minute
Position 4 = 2 minutes

When the selected pin of IC2 goes high, IC1C drives Q1 and the piezo sounder beeps intermittently at the same frequency of the LED. After approx. 7.5 seconds pin 4 of IC2 goes high and IC1D stops the oscillator through D1. If you want to stop counting in advance, push P2.

Notes:
SW1 can be any type of switch with the desired number of ways. If you want a single fixed timing duration, omit the switch and connect pins 9 & 13 of IC1 to the suitable pin of IC2.

The circuit's reset is not immediate. Pushing P2 forces IC2 to oscillate very fast, but it takes some seconds to terminate the counting, especially if higher timer's duration is chosen and the pushbutton is operated when the circuit has just started. In order to speed the reset, try lowering the value of R5, but pay attention: too low a value can stop oscillation.

Frequency operation varies with different brand names for IC2. E.g. Motorola's ICs run faster, therefore changing of C1 and/or R3 values may be necessary.

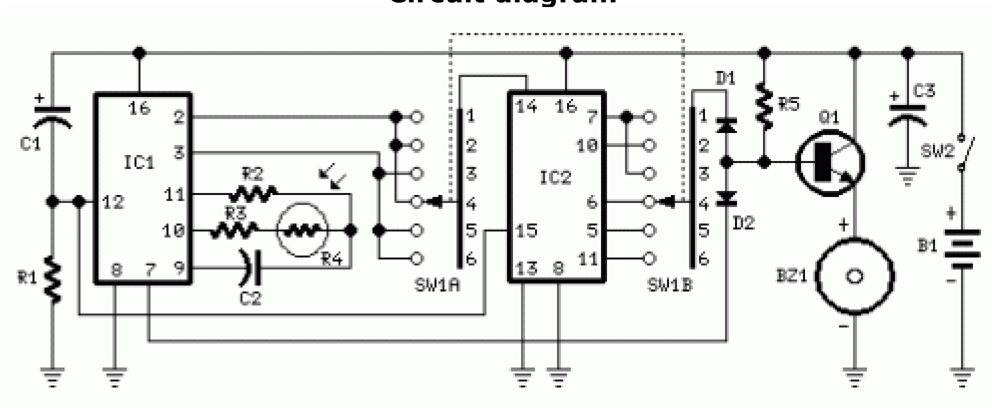
You can also use pins 1, 2, 3 of IC2 to obtain timings of 8, 16 and 32 minutes respectively.

An on-off switch is not provided because in the off state the circuit draws no significant current.

P246. Tan Timer

Six timing positions suited to different skin types
Timing affected by sunlight intensity

Circuit diagram



Parts:
R1 47K 1/4W Resistor
R2 1M 1/4W Resistor
R3,R5 120K 1/4W Resistors
R4 Photo resistor (any type)
C1,C3 10µF 25V Electrolytic Capacitors
C2 220nF 63V Polyester Capacitor
D1,D2 1N4148 75V 150mA Diodes
IC1 4060 14 stage ripple counter and oscillator IC
IC2 4017 Decade counter with 10 decoded outputs IC
Q1 BC337 45V 800mA NPN Transistor
SW1 2 poles 6 ways Rotary Switch (see notes)
SW2 SPST Slider Switch
BZ1 Piezo sounder (incorporating 3KHz oscillator)
B1 3V Battery (two 1.5V AA or AAA cells in series etc.)

Device purpose:

This timer was deliberately designed for people wanting to get tanned but at the same time wishing to avoid an excessive exposure to sunlight.

A Rotary Switch sets the timer according to six classified Photo-types (see table).
A Photo resistor extends the preset time value according to sunlight brightness (see table).

When preset time ends, the beeper emits an intermittent signal and, to stop it, a complete switch-off of the circuit via SW2 is necessary.

Photo-type, Features and Exposure time

I & children Light-eyed, red-haired, light complexion, freckly 20 to 33 minutes
II Light-eyed, fair-haired, light complexion 28 to 47 minutes
III Light or brown-eyed, fair or brown-haired, light or slightly dark complexion 40 to 67 minutes
IV Dark-eyed, brown-haired, dark complexion 52 to 87 minutes
V Dark-eyed, dark-haired, olive complexion 88 to 147 minutes
VI The darkest of all 136 to 227 minutes
Note that pregnant women belong to Photo-type I

Notes:
Needing only one time set suitable for your own skin type, the rotary switch can be replaced by hard-wired links.
A DIP-Switch can be used in place of the rotary type. Pay attention to use only a switch at a time when the device is off, or the ICs could be damaged.

P247. Digital Stopwatch 0-60sec

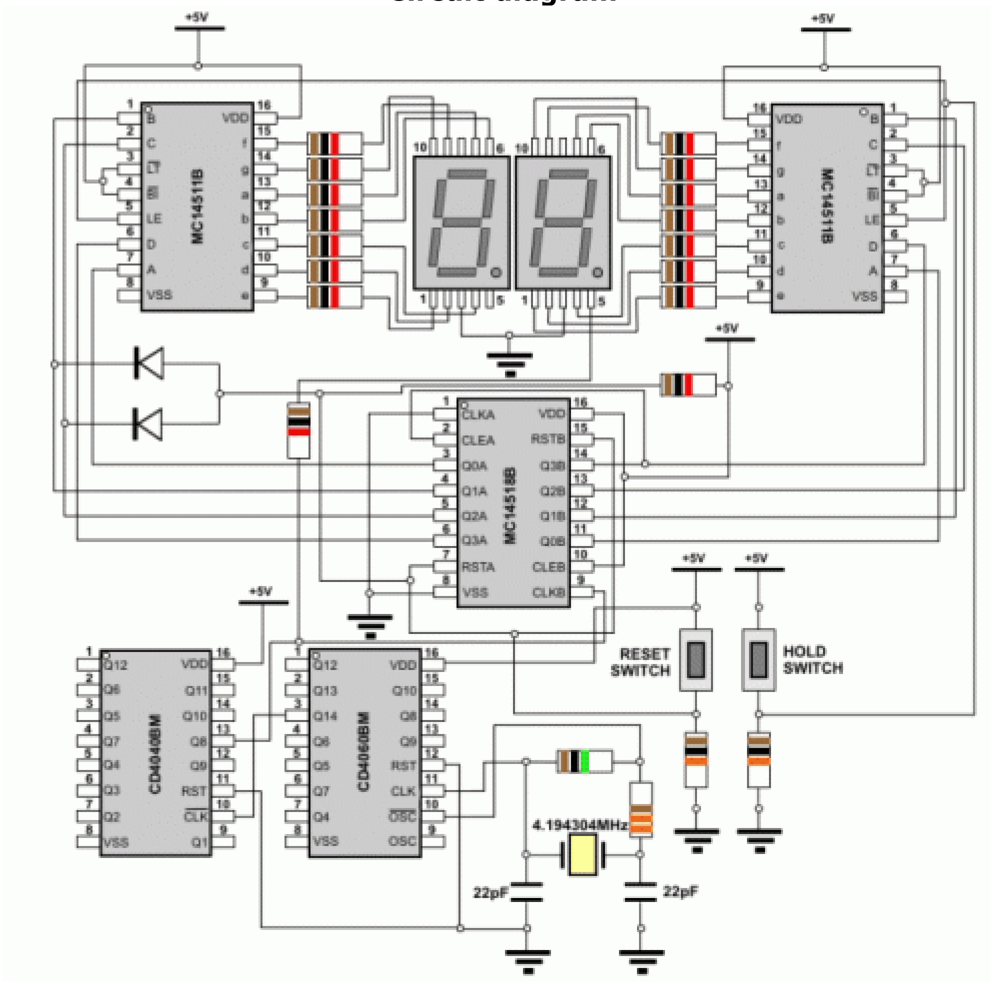
Introduction

By using the same circuit of the "Digital Stopwatch 0-99sec", we can add an AND gate, and transform the 0 – 99sec stopwatch to a 0 – 60sec stopwatch.

We must find a way to control the RESET function of the BCD counter, which is responsible for the counting of the seconds. As we studied above, the circuit resets when we have 99 to 100, that is 1001 1001 à 0001 0000 0000. To make a transformation successfully we must force the pulse from 59 to 60 0011 1001 à 0100 0000 on the output of the BCD counter.

By placing the AND gate, with its inputs on the Q1 and Q2 of the BCD counter of the decades, we make sure that when the gate closes, the RST input of the BCD counter will be set to logical “1”, which on its turn, will force the circuit to start over. The transformed circuit appears in picture 2.

Circuit diagram



P248. Digital Stopwatch 0-99sec

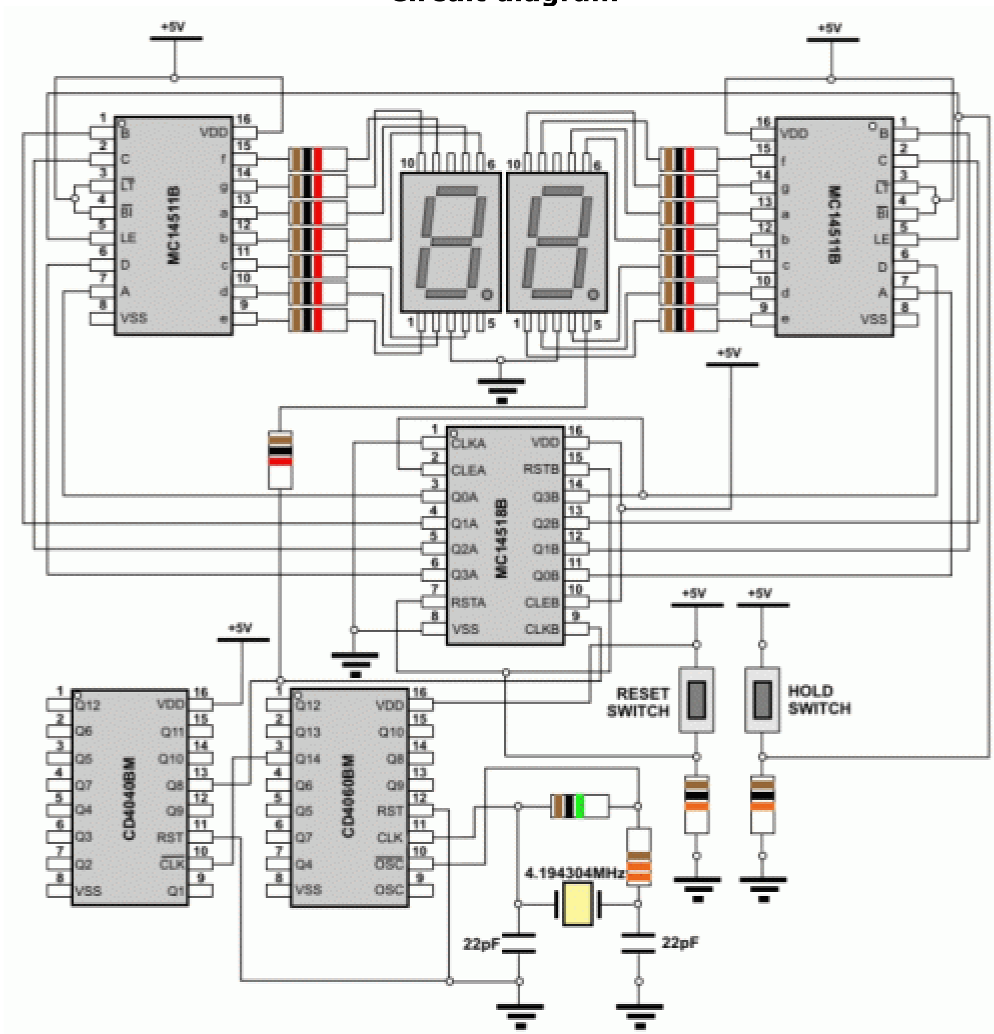
Introduction

In the present article, we will describe the function of a digital stopwatch, 0 – 99 sec. The function of the stopwatch, relies in the use of 4 integrated circuits, which in this case belong to National Semiconductor (http://www.national.com)./ It is obvious that other integrated circuits can be used to achieve the same result, however in this case we have used the following parts:

Α. 1 x CD4060BM (14 stage ripple carry binary counter)
B. 1 x CD4040BM (14 stage ripple carry binary counter)
C. 1 x MC14518B (BCD counter)
D. 2 x MC14511B (BCD to seven segment driver)
E. 2 x 7 segment LED displays

The circuit that has been used is shown in picture 1. Through the experimental part we will explain each of the parts function, but in order to have a notion of the basic idea, let just say, that this circuit besides the 5V power supply, is fed with a pulse which comes from a crystal. The crystal's pulse is devided properly in order to obtain the 1 Hz pulse which we need in order for the circuit to work properly, and display the seconds on the 7 segment displays, through a procedure which we will explain through the experimental part.

Circuit diagram



Description

We will begin the description of the digital circuit above. For our convenience we will devide the circuit to 2 parts: the generator, which produces the pulse of the desired frequency, and the part that does the actual counting.

Generator:

The generator of the circuit comprises of the integrated circuits CD4040CM and CD4060CM. We use a crystal which oscillates at a frequency of 4,194,304MHz. It is obvious that this frequency is completely useless, as it is too big to be used as it is to our circuit. What we should is devide this frequency, in a way that in its final form, the pulse will have a frequency of 1Hz, which is the desirable frequency. Initially we use the integrated CD4060, which devides the imported frequency in its input, by forces of 2. As we can see on the integrated circuit the outputs are marked as Q4, Q5,… Qn. By importing a pulse in the CLK input of the 4060, with a frequency f Hz, we take out of output Qn, a signal which has a frequency equal to f/2n,. So, by exporting the signal out of Q14, knowing that the imported signal has a frequency of 4,194,304Hz, we take a signal, which has a frequency of 256Hz.

By importing this signal, to 4040 and by exporting the signal through Q8 we have finally taken an inverted signal, at the frequency of 1Hz. The fact that the signal is inverted, firstly doesn't affect the proper function of our circuit and secondly is due to the inversion of the CLK input as we can see. This inversion just causes, the following circuit to be triggered with a logical "0". By putting a LED on the same output, we have a visual of the counting, as in each positive pulse the diode polarizes positively, and a current passes through it.

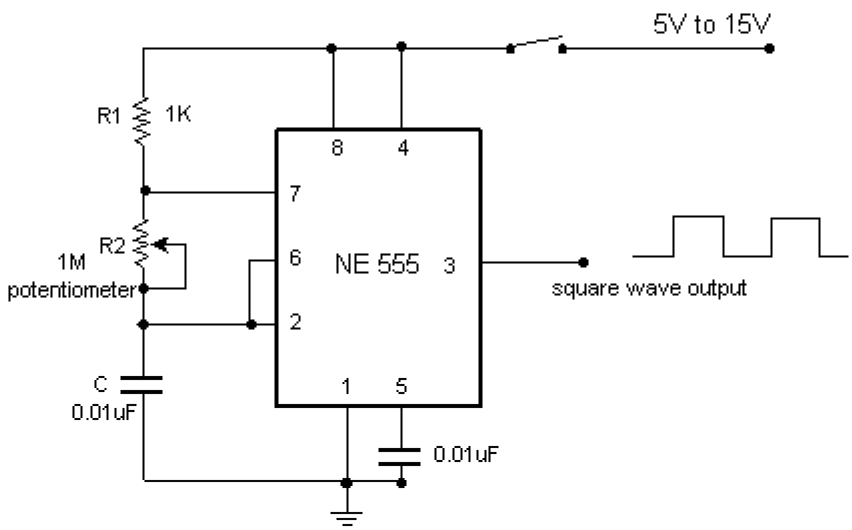
Counter:
The signal of 1Hz, which we have taken from the generator, is imported to a BCD counter MC14518. This integrated circuit adds a logical "1" at each pulse, on its output.του. .The MC14518 is virtually divided into two segment. One counts the units of the seconds, while the other the decades. As we can see in picture 1, the generators pulse is imported to the part which counts the units. This is very logical, as we want in each secont the number of the display to be raised by 1. On the other hand, we want the first display to raise by 1, every 10 seconds. This is why, we ground the CLK input, and we use the signal of Q3 to the CKE input.

By using this means, we make sure that the first display will be triggered, only when we have a decreasing signal on Q3; that is, only when the signal drops from logical "1" to logical "0". As we can see, the first display increments every 10 seconds, which means that after 9 on the second display (1001 on the output of the BCD counter) the first display must be set to zero, while the first must be set to +1. That is that from 1001 à 0000, and we have a descending pulse, as the last digit descends from logical "1" to logical "0" and triggers the BCD counter of the decades. When the decades display becomes 9 then the circuit goes to the next state, which is zero, and the counting begins once more.

The integrated circuits MC14511 are BCD to 7 segment drivers. As its name clearly state, their sole purpose is to translate the BCD information of MC14518, to a code understandable by the 7 segment displays. The inputs (Lamp Test, Blanking) are used to test the LEDs of the display and pulse modulate the brightness of the display. In this case we these inputs to logical "0", as we don't need them. The LE input (Latch Enable) is used to keep the number of the displays while the pulse still runs. It is a HOLD function similar to the one of the modern stopwatches.

In addition, at any given moment we can restart the counting, by pressing the reset switch. By this means we set the RST input of the MC14518 to logical "1", which resets the counting to 0000.

P249. Simple variable frequency oscillator



This is a very simple circuit utilising a 555 timer IC to generate square wave of frequency that can be adjusted by a potentiometer.

With values given the frequency can be adjusted from a few Hz to several Khz.
To get very low frequencies replace the 0.01uF capacitor with a higher value.

The formula to calculate the frequency is given by:

1/f = 0.69 * C * (R1 + 2*R2)

The duty cycle is given by:

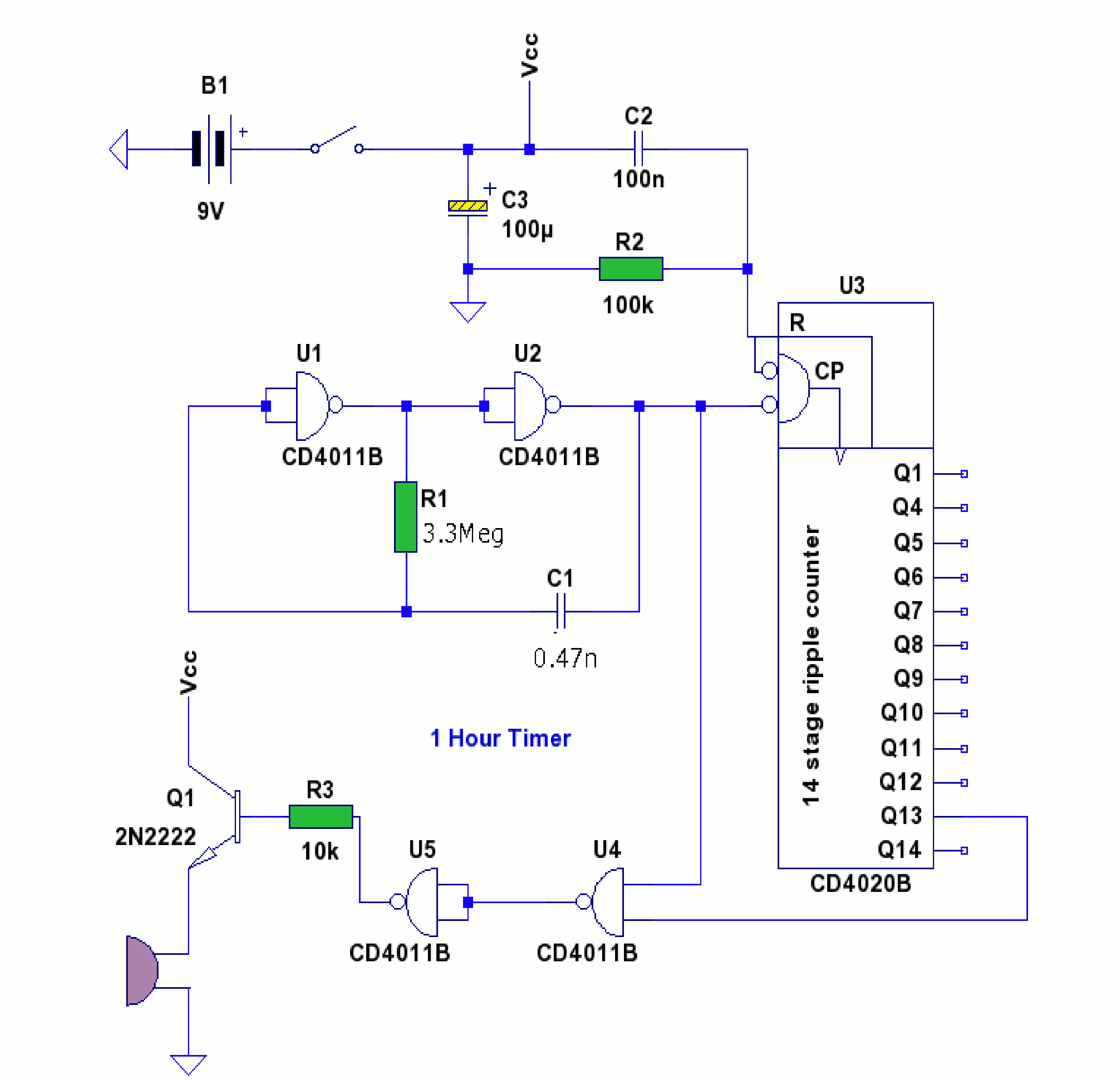
% duty cycle = 100*(R1+R2)/(R1+ 2*R2)

In order to ensure a 50% (approx.) duty ratio, R1 should be very small when compared to R2. But R1 should be no smaller than 1K. A good choice would be, R1 in kilohms and R2 in megaohms. You can then select C to fix the range of frequencies.

P250. 1 Hour Timer

Description

A simple battery operated one hour timer device with an audible warning. May be used as a parking meter timer.



Circuit Notes:

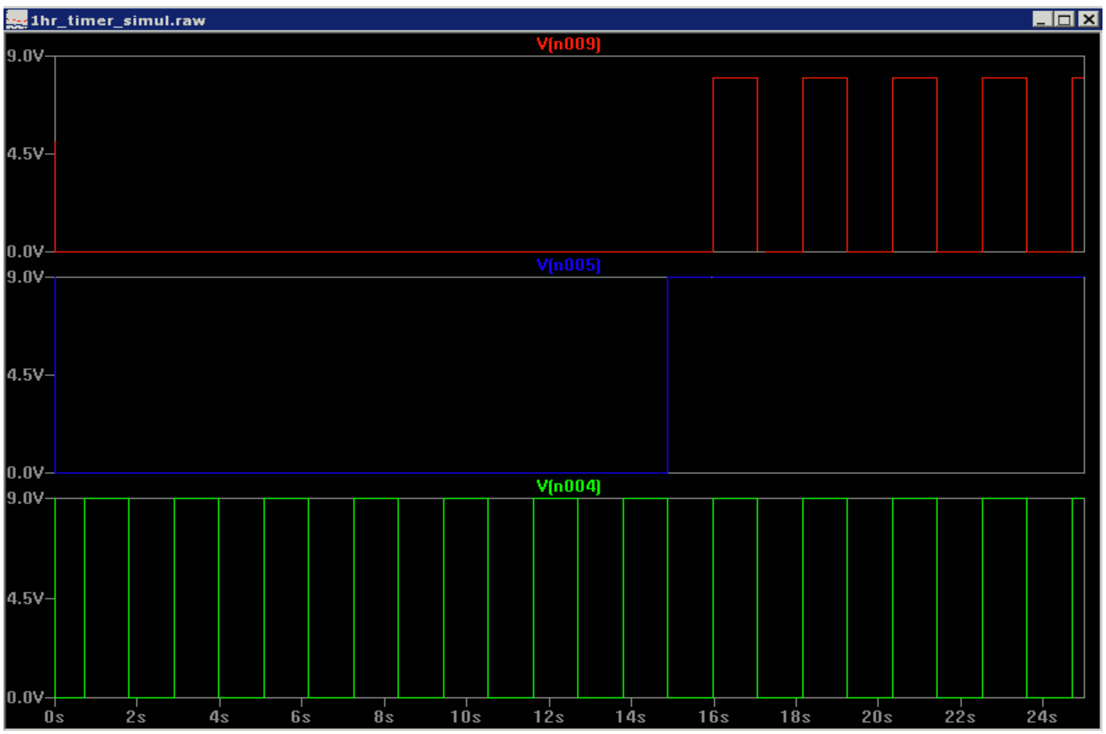
This circuit uses just two CMOS IC's, a 4011 quad 2 input NAND gate, and a 4020 14-stage ripple binary counter. At switch on R2 and C2 provide a brief reset pulse, which will ensure the output pin Q1 of the 4020 is high. Gates U1 and U2 form a simple astable R1 and C1 determining the timing period. The tolerances of capacitors vary widely, so for more control, you may use a 470n capacitor for C1 and use a fixed 3.3M resistor in series with a 250k preset for R1. A timing period of just less than 1.76seconds is required.

The output of the oscillator at U2 drives the input of the 14-stage ripple counter, U3. The outputs divide sequentially by two and the output signal is taken from Q13, requiring 2048 input pulses before the signal becomes high.

When the ouput Q13 goes high, the output sounder will become active. Gate U4 of the 4011 is used to "modulate" the output sounder. As U4 is also connected to the output of U2, the output sounder will turn on and off at the same rate as the oscillator.

Suitable output sounders can be found at [Maplin Electronics]() part code KU56L or CR34M. These are self contained DC piezo buzzers, requiring 10mA at 12V DC but work with supply voltages from 3 to 15 Volts DC.

The graph below is from the simulation version of this circuit. In the simulated version I have tapped the output of the CMOS4020 at Q5, therefore only 8 input pulses from the oscillator (shown in green trace) are required before the Q5 output switches to high (shown as blue trace). The top waveform in red, is the output across the output sounder. As can be seen, this output is switched on and off as long as the output pin, Q5 is active. To simulate the sounder, I have used a fixed resistor.



Calibration:

Here comes the maths. One hour or 3600 seconds divided by 2048 pulses (Q13) requires a timed period of 1.7578 seconds. The timing for a CMOS oscillator, varies with supply voltage, but is approximately 1.1 RC. To acheive the timed period, C1 is 0.47u and R1 is made from a fixed 3.3M resistor in series with a 250k preset.

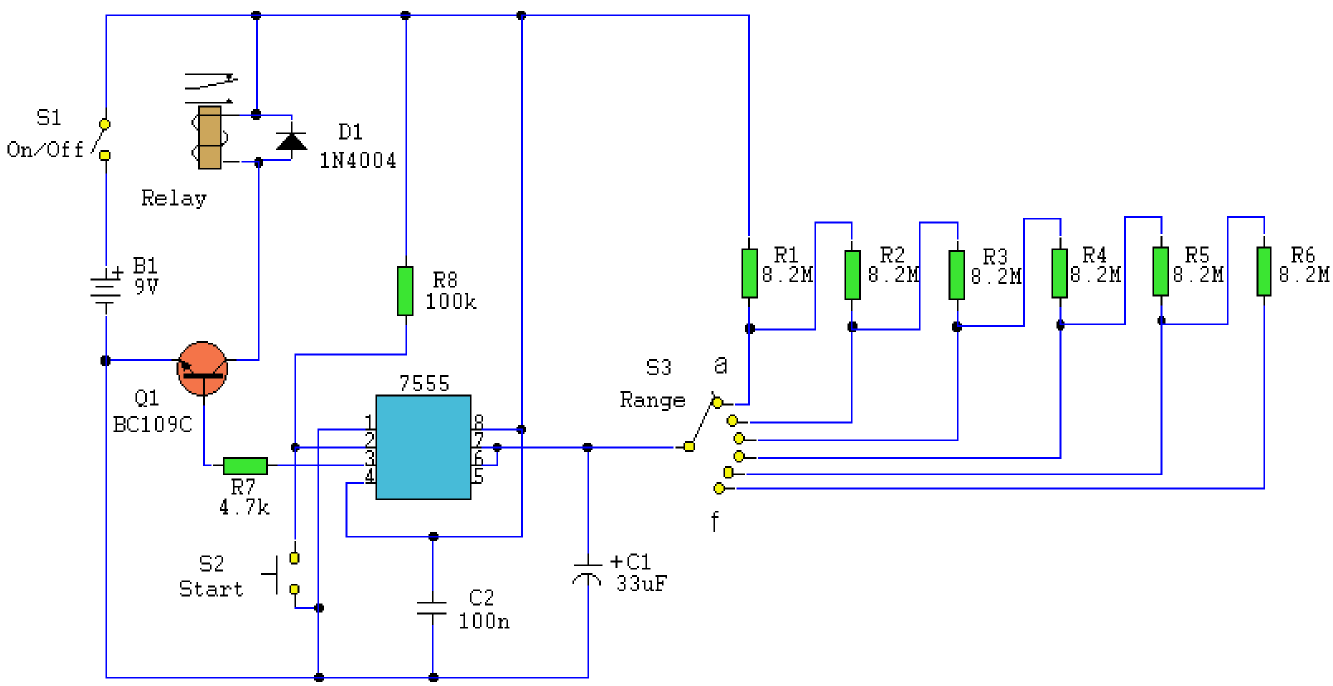
To adjust this value, connect a low current LED and dixed 2.2k resitor to the output of IC2. The LED should illuminate on each pulse. Adjust the 250k preset until the LED flashes about 34 times per minute (60/34 =

1.76s). If you would like to use this a parking meter timer, then set the unit to trigger before the hour is up or start the timer before you feed the meter to allow extra time.

P251. 5 to 30 Minute Timer

Description

A switched timer for intervals of 5 to 30 minutes incremented in 5 minute steps.



Notes:

Simple to build, simple to make, nothing too complicated here. However you must use the CMOS type 555 timer designated the 7555, a normal 555 timer will not work here due to the resistor values. Also a low leakage type capacitor must be used for C1, and I would strongly suggest a Tantalum Bead type. Switch 3 adds an extra resistor in series to the timing chain with each rotation, the timing period us defined as :-

$$\text{Timing} = 1.1\ C_1 \times R_1$$

Note that R_1 has a value of 8.2M with S3 at position "a" and 49.2M at position "f". This equates to just short of 300 seconds for each position of S3. C_1 and R_1 through R_6 may be changed for different timing periods. The output current from Pin 3 of the timer, is amplified by Q1 and used to drive a relay.

Parts List:
Relay 9 volt coil with c/o contact (1)
S1: On/Off (1)
S2: Start (1)
S3: Range (1)
IC1: 7555 (1)
B1: 9V (1)
C1: 33uF CAP (1)
Q1: BC109C NPN (1)
D1: 1N4004 DIODE (1)

C2: 100n CAP (1)
R6,R5,R4,R3,R2,R1: 8.2M RESISTOR (6)
R8: 100k RESISTOR (1)
R7: 4.7k RESISTOR (1)

P252. 24 Hour Timer

Description:

These two circuits are multi-range timers offering periods of up to 24 hours and beyond. Both are essentially the same. The main difference is that when the time runs out, Version 1 energizes the relay and Version 2 de-energizes it. The first uses less power while the timer is running; and the second uses less power after the timer stops. Pick the one that best suits your application.

Notes:

The Cmos 4060 is a 14 bit binary counter with a built in oscillator. The oscillator consists of the two inverters connected to Pins 9, 10 & 11; and its frequency is set by R3, R4 & C3.The green Led flashes while the oscillator is running: and the IC counts the number of oscillations. Although it's a 14 bit counter, not all of the bits are accessible. Those that can be reached are shown on the drawing.

By adjusting the frequency of the oscillator you can set the length of time it takes for any given output to go high. This output then switches the transistor; which in turn operates the relay. At the same time, D1 stops the count by disabling the oscillator. Ideally C3 should be non-polarized; but a regular electrolytic will work, provided it doesn't leak too badly in the reverse direction. Alternatively, you can simulate a non-polarized 10uF capacitor by connecting two 22uF capacitors back to back (as shown).

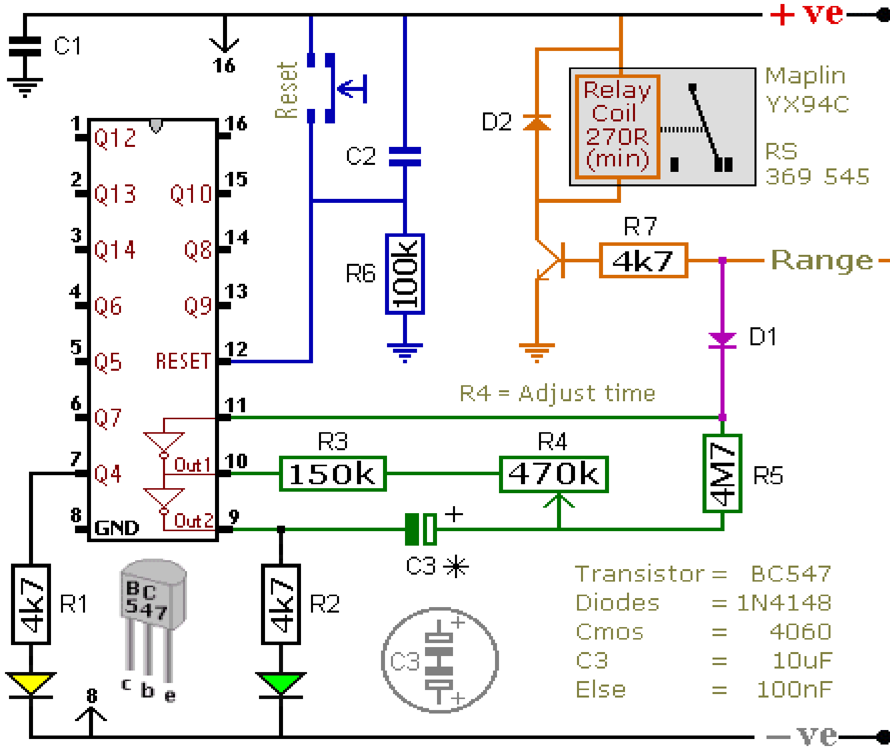
Using "Trial and Error" to set a long time period would be very tedious. A better solution is to use the Setup tables provided; and calculate the time required for Pin 7 to go high. The Setup tables on both schematics are interchangeable. They're just two different ways of expressing the same equation.

For example, if you want a period of 9 Hours, the Range table shows that you can use the output at Pin 2. You need Pin 2 to go high after 9 x 60 x 60 = 32 400 seconds. The Setup table tells you to divide this by 512; giving about 63 seconds. Adjust R4 so that the Yellow LED lights 63 seconds after power is applied. This will give an output at Pin 2 after about 9 Hours.

The Support Material for the timers includes a detailed circuit description - parts lists - a step-by-step guide to construction - and more. A suitable Veroboard layout for each version is shown below:

The timer was designed for a 12-volt supply. However, provided a suitable relay is used, the circuit will work at anything from 5 to 15-volts. Applying power starts the timer. It can be reset at any time by a brief interruption of the power supply. The reset button is optional; but it should NOT be used during setup. The time it takes for the Yellow LED to light MUST be measured from the moment power is applied. Although R1, R2 and the two LEDs help with the setup, they are not necessary to the operation of the timer. If you want to reduce the power consumption, disconnect them once you've completed the setup. If you need a longer period than 24-hours, increase the value of C3.

24 - Hour Timer {1}



RANGE

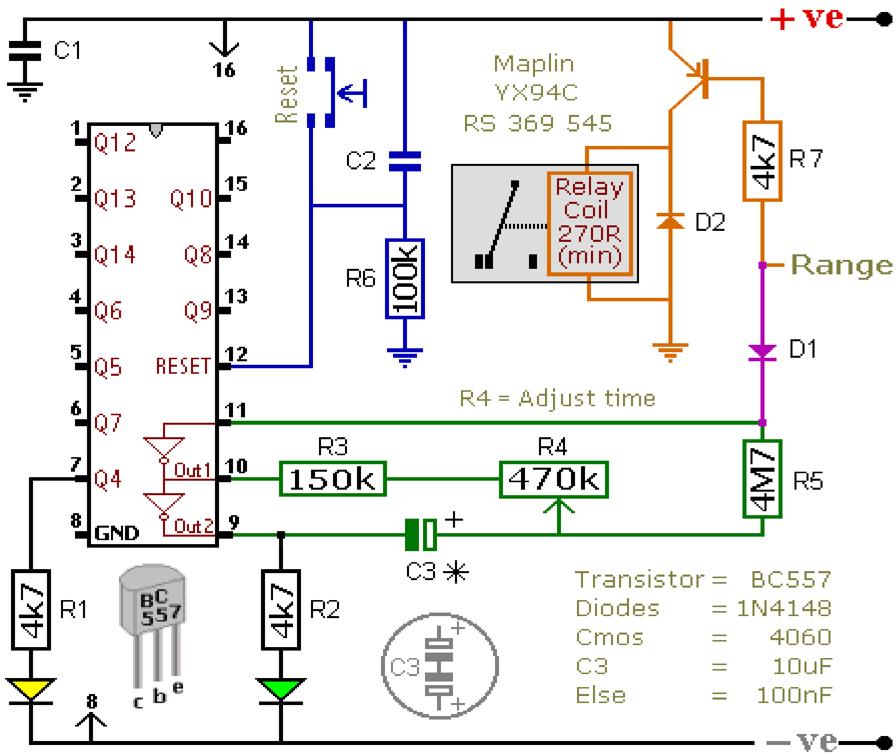
Pin	Approximate Range
7	30 s to 90 sec
5	1 m to 3 min
4	2 m to 6 min
6	4 m to 12 min
14	8 m to 20 min
13	15 m to 45 min
15	30 m to 90 min
1	2 h to 6 hrs
2	4 h to 12 hrs
3	8 h to 24 hrs

SETUP

Pin	Setting Pin 7
5	Q5 ÷ 2 = Pin 7
4	Q6 ÷ 4 = --
6	Q7 ÷ 8 = --
14	Q8 ÷ 16 = --
13	Q9 ÷ 32 = --
15	Q10 ÷ 64 = --
1	Q12 ÷ 256 = --
2	Q13 ÷ 512 = --
3	Q14 ÷ 1024 = --

✳ Ideally C3 should be non-polarized. Maplin JA75S. RS 768 728. See Text

24 - Hour Timer {2}



RANGE

Pin	Approximate Range
7	30 s to 90 sec
5	1 m to 3 min
4	2 m to 6 min
6	4 m to 12 min
14	8 m to 20 min
13	15 m to 45 min
15	30 m to 90 min
1	2 h to 6 hrs
2	4 h to 12 hrs
3	8 h to 24 hrs

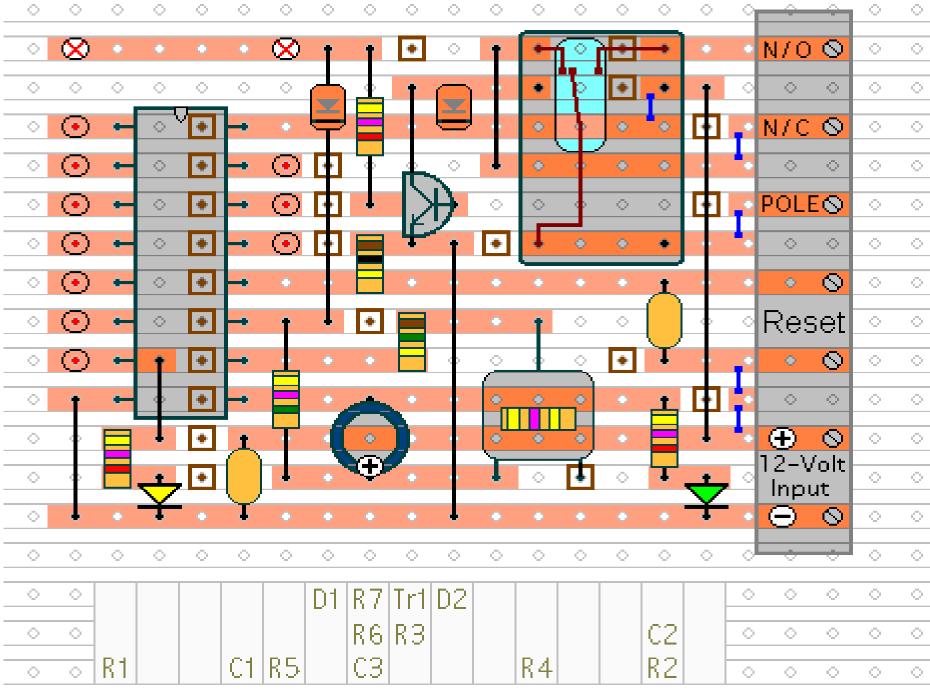
SETUP

Pin	Setting Pin 7
5	Q5 = Pin 7 × 2
4	Q6 = -- × 4
6	Q7 = -- × 8
14	Q8 = -- × 16
13	Q9 = -- × 32
15	Q10 = -- × 64
1	Q12 = -- × 256
2	Q13 = -- × 512
3	Q14 = -- × 1024

✳ Ideally C3 should be non-polarized. Maplin JA75S. RS 768 728. See Text

24 - Hour Timer {1}

component side



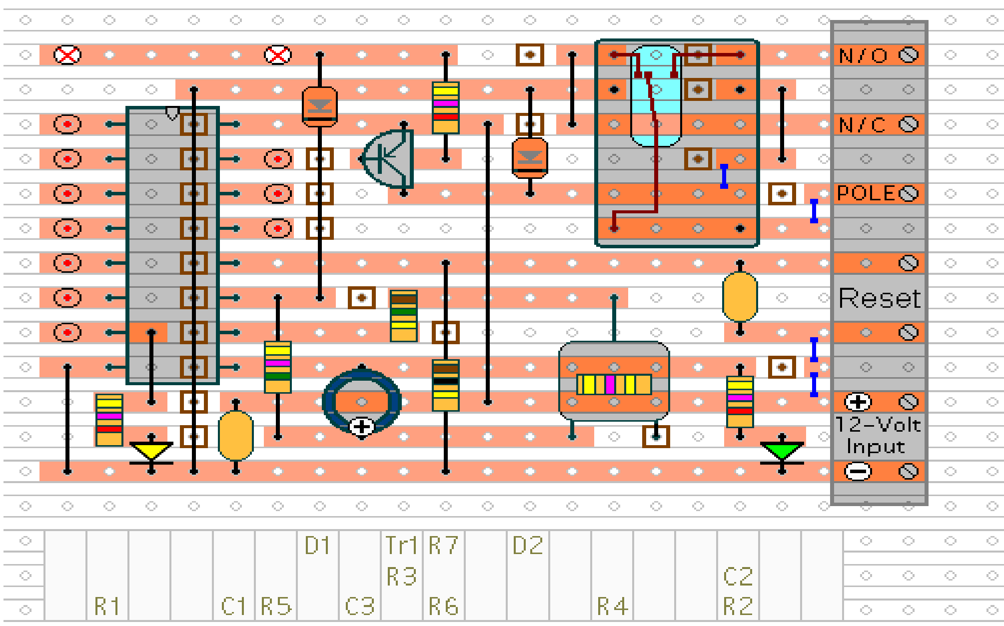
Choose the range you require and connect a link between one of the points marked ⊗ and one of the points marked ⊙

Pin	Approximate Range
7	30 s to 90 sec
5	1 m to 3 min
4	2 m to 6 min
6	4 m to 12 min
14	8 m to 20 min
13	15 m to 45 min
15	30 m to 90 min
1	2 h to 6 hrs
2	4 h to 12 hrs
3	8 h to 24 hrs

CUT TRACK [23] SOLDER BRIDGE [5] WIRE LINKS [5+1]

24 - Hour Timer {2}

component side



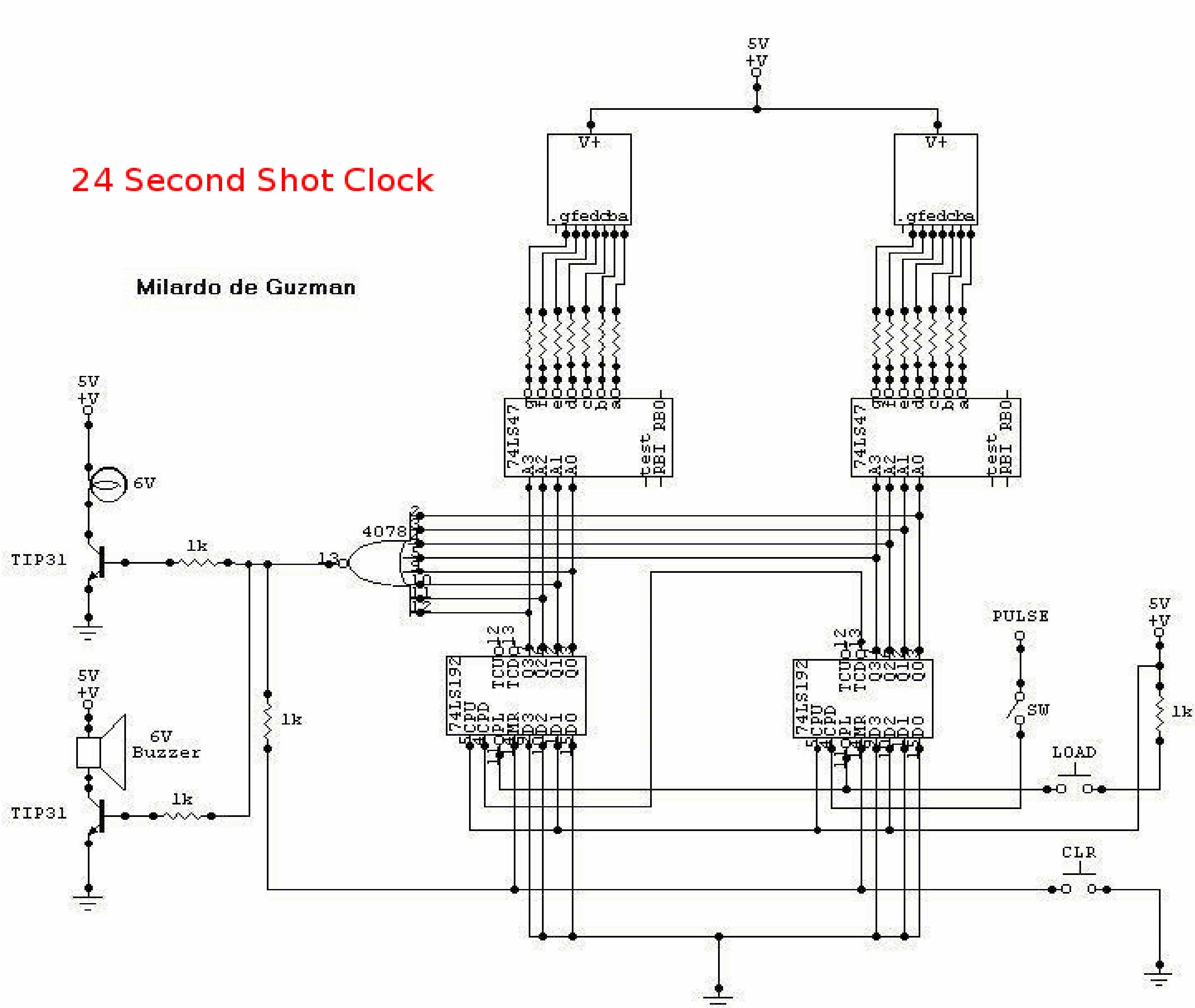
Choose the range you require and connect a link between one of the points marked ⊗ and one of the points marked ⊙

Pin	Approximate Range
7	30 s to 90 sec
5	1 m to 3 min
4	2 m to 6 min
6	4 m to 12 min
14	8 m to 20 min
13	15 m to 45 min
15	30 m to 90 min
1	2 h to 6 hrs
2	4 h to 12 hrs
3	8 h to 24 hrs

CUT TRACK [23] SOLDER BRIDGE [4] WIRE LINKS [6+1]

P253. 24 Second Shot Clock

Description:
This is a circuit intended to be used in basketball shot clock.



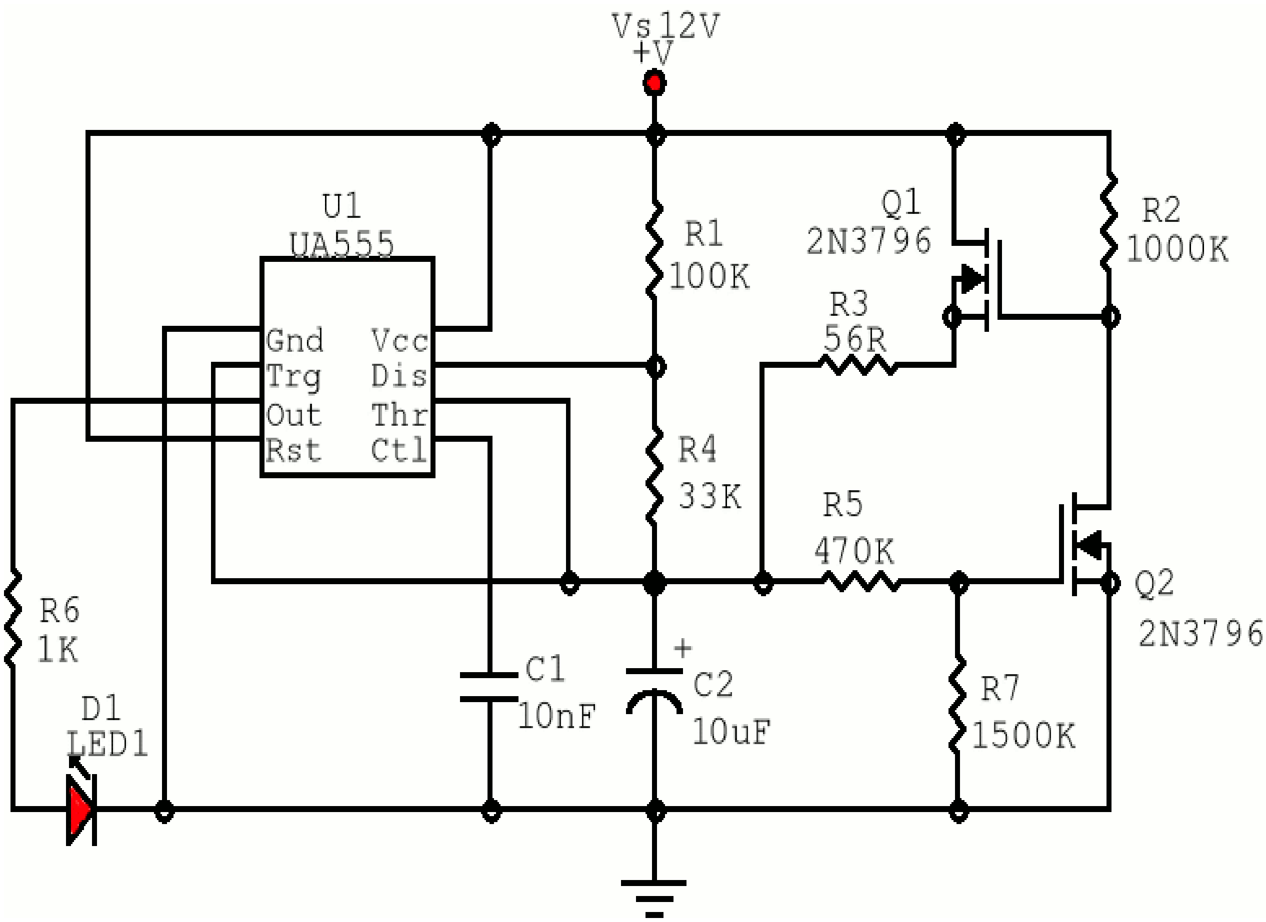
Notes:

To start in 24 seconds; 24s LOAD SW and Reset SW should be push simultaneously. If not, the count will start in 99. Pulse input can be connected to 555 astable multivibrator but must be calibrated for real time clock. The PAUSE SW must have a Switch Debouncer so that the counter will count normal when counting is paused and then turn-on.

When the count reach 00, the NOR gate will have an output of logic1 that will turn on the two transistor. The buzzer will rung and light will turn on. The two transistors are continuously turn-on not until LOAD SW and Reset SW is push. All have a +5v power supply.

P254. 555 Pulse Generator

Description:
A 555 pulse generator circuit with a difference, the initial pulse is tailored by additional circuitry to match the duration of subsequent pulses.



Notes:
The NE555 and the First Pulse

The first positive pulse from a classic 555-based oscillator is always 1.6 times longer than the following pulses. The difference is caused by the fact that only during the first cycle C2 starts charging up from 0 V. This is generally not a problem, but sometimes this first pulse just should be the same length as the rest - at least approximately.

The picture shows the oscillator and an addition to it (everything to the right from the Vs-Gnd axis) that can solve the problem. Immediately after switch-on, C2 is empty and the voltage on the gate of Q2 is low. Q2 is off and it makes C2 charge up very quickly through Q1 and R3 until it reaches just below Vs/3. Then Q2 turns on, Q1 turns off, and the classic circuit continues to charge and discharge C2 relatively slowly between 2Vs/3 and Vs/3. As the voltage on C2 never again drops below Vs/3, Q2 now conducts all the time and Q1 is permanently off.

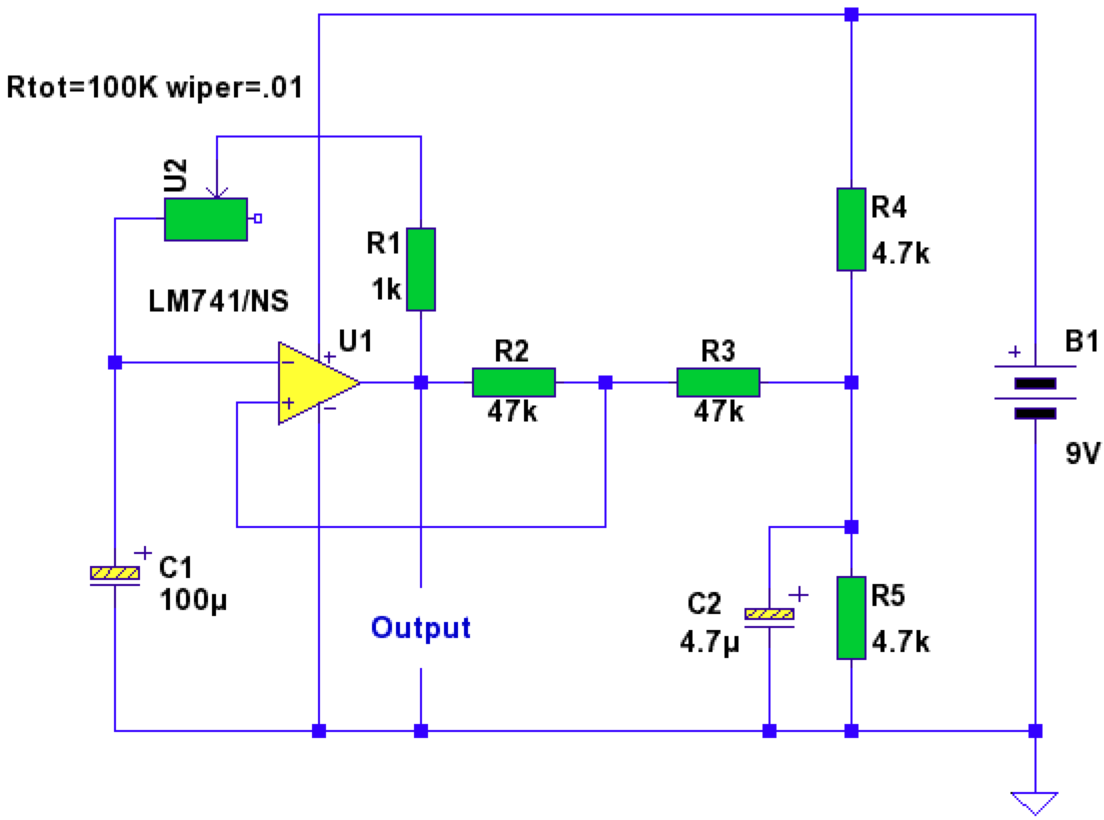
A MOSFET with a lower D-S resistance would charge up C2 even quicker.
The component values may be critical. For best results, the R5/R7 voltage divider should turn Q2 on when C2 is charged up to just a little below Vs/3. This point is set by the R5/R7 ratio. But if the value of R5 is too high or if R7 is too small (depending on the supply voltage and the G-S threshold voltage of Q2), the

oscillator may not work at all. The sum of R5 and R7 should be as high as possible in order to minimize the influence on the main part of the circuit after the first pulse.

P255. 741 Astable Timer

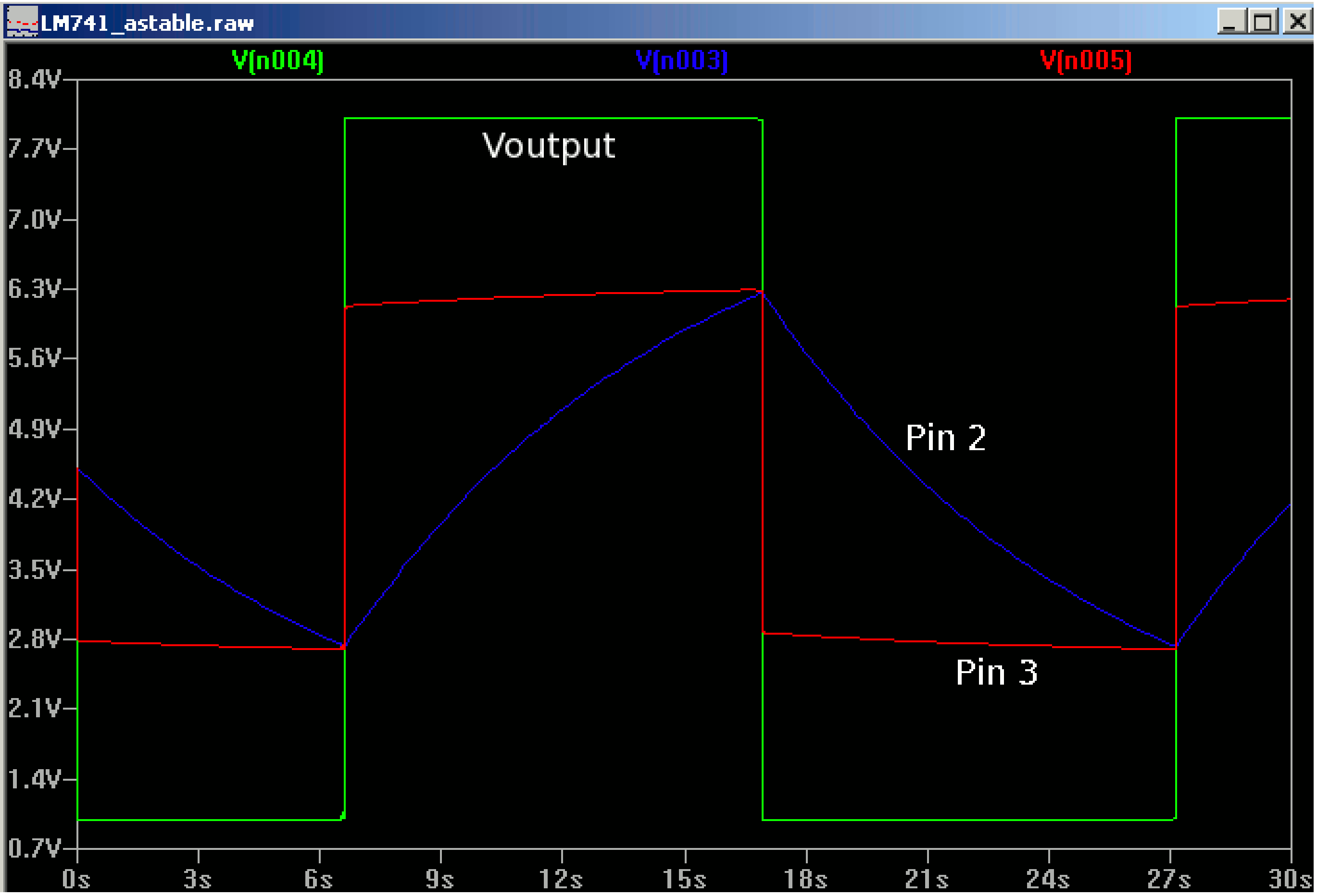
Description

An astable timing circuit made from the ubiquitous 741 op-amp.

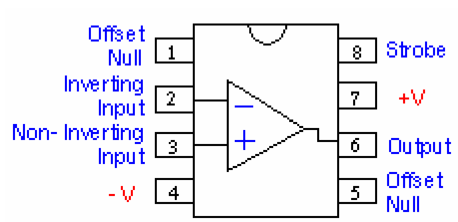


Circuit Notes:

In this circuit a standard op-amp is wired as an astable multivibrator. The output is non-symmetrical but has the advantage that the timing is controlled by only 1 resistor and capacitor, in this case, the 100k variable resistor, U2 and 100u capacitor C1. Because of the high loop gain the output rise and fall times are very low, slope times better than 30uS can be acheived even with a 5V supply. Waveforms are shown below:



The green trace is the output voltage at Pin 6 of the op-amp, the blue trace is the voltage at Pin C and also the charge and discharge of C1, and the voltage at the op-amps pin 3 is shown in red. The pinout for the 741 is shown below:

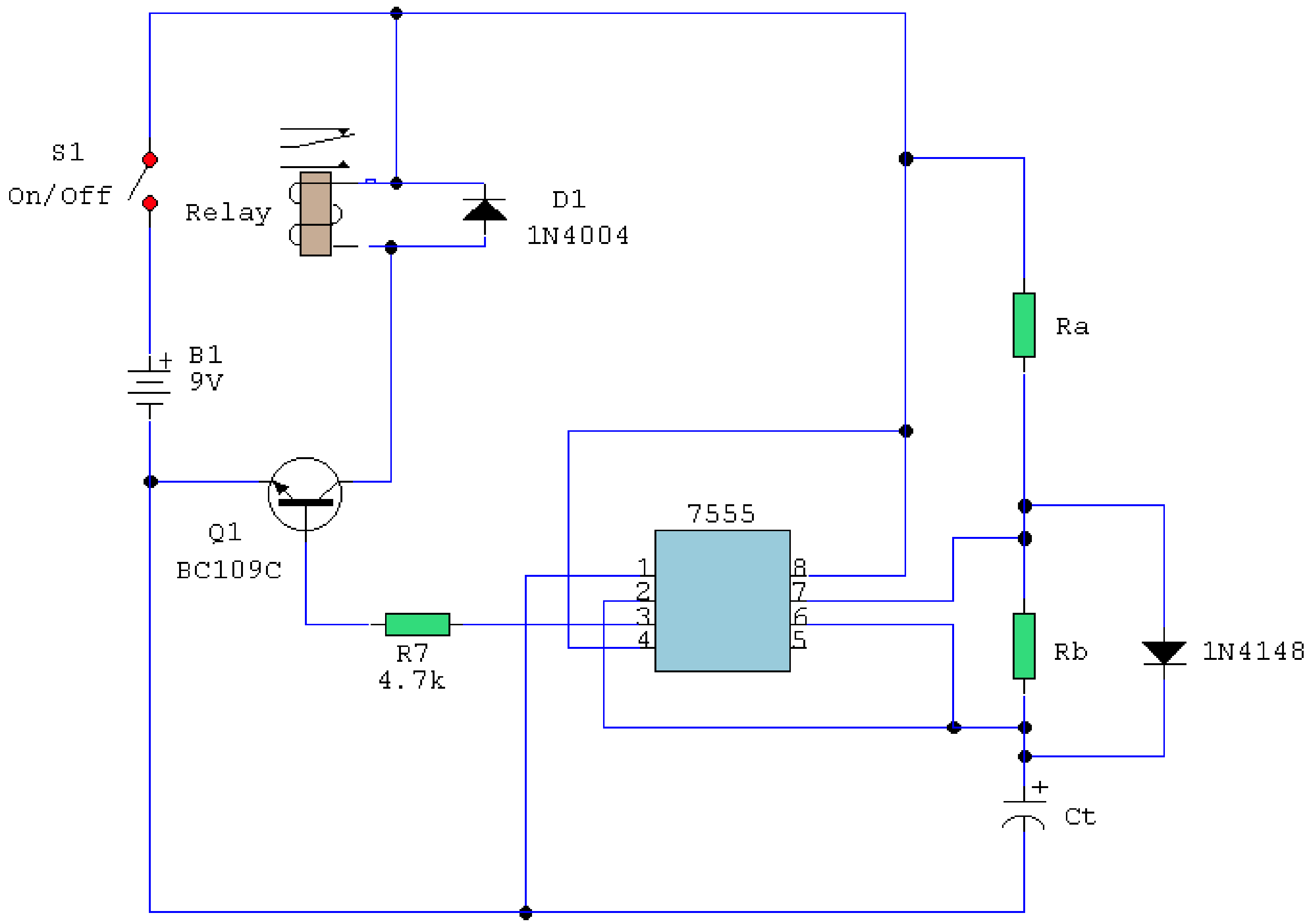


Please note that the the inverting input is pin 2 and non-inverting input is pin 3 on the in the schematic. The timing is shown below. The "on" time is for a positive half cycle, "off" time is the negative cycle, although being run from a single supply, the off voltage is slightly higher than 1 Volt. The frequency is the reciprocal of one half postive and one half negative cycle.

	On Time	Off Time	Freq
VR1 = Max	10.31s	10.21s	48.7mHz
VR1 = Min	0.223s	0.222s	2.25Hz

P256. Asymmetric Timer

Description:
A timer circuit with independent mark and space periods.



Notes:

A simple astable timer made with the 555, the mark (on) and space (off) values may be set independently. The timing chain consists of resistors Ra, Rb and capacitor Ct. The capacitor, Ct charges via Ra which is in series with the 1N4148 diode. The discharge path is via Rb into into pin 7 of the IC. Both halves of the timing period can now be set independently.

The charge time (output high) is calculated by:

T(on) = 0.7 Ra Ct

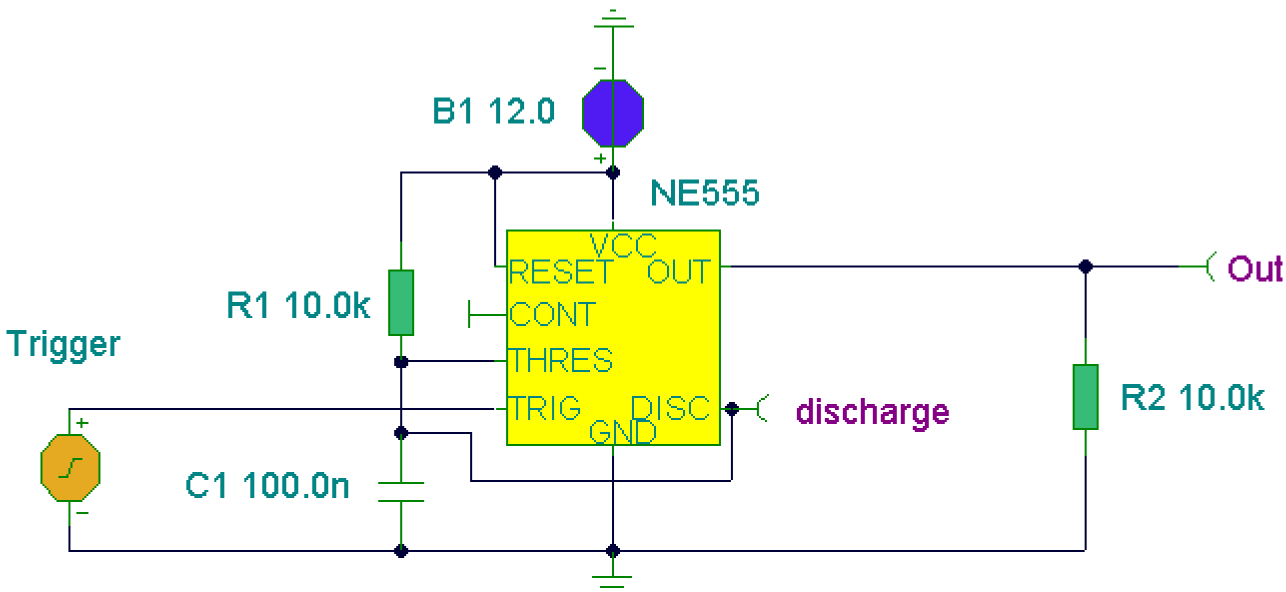
The discharge time (output low) is calculated by:

T(off) = 0.7 Rb Ct

Please note that the formula for T(on) ignores the series resistance and forward voltage of the 1N4148 and is therefore approximate, but T(off) is not affected by D1 and is therefore precise.

P257. NE555 Monostable

Description
Use of the ubiquitous 555 timer in monostable mode.

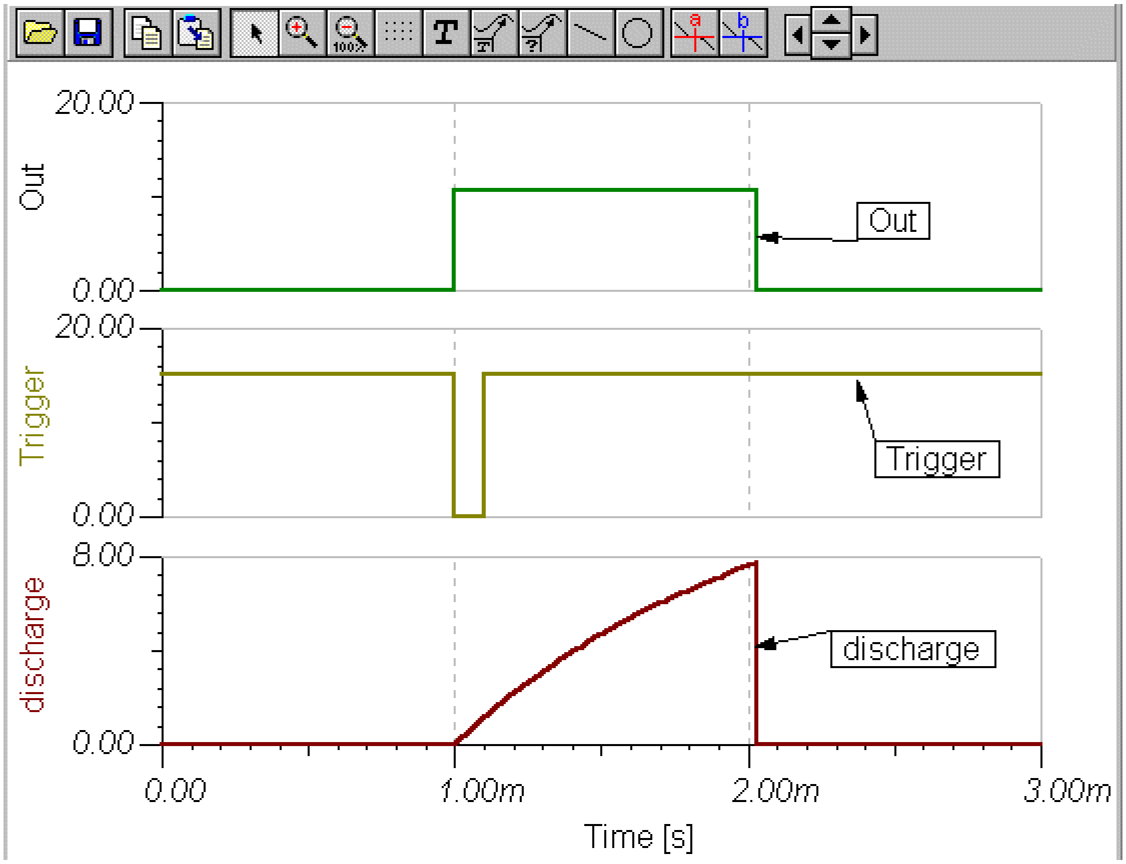


Circuit Notes:

Here the popular 555 timing IC, is wired as a monostable. The timing period is precise and equivalent to:-

$1.1 \times R_1 \times C_1$

With component values shown this works out at approximately 1.1msec.The output duration is independant of the input trigger pulse, and the output from the 555 is buffered and can directly interface to CMOS or TTL IC's, providing that the supply voltages match that of the logic family.

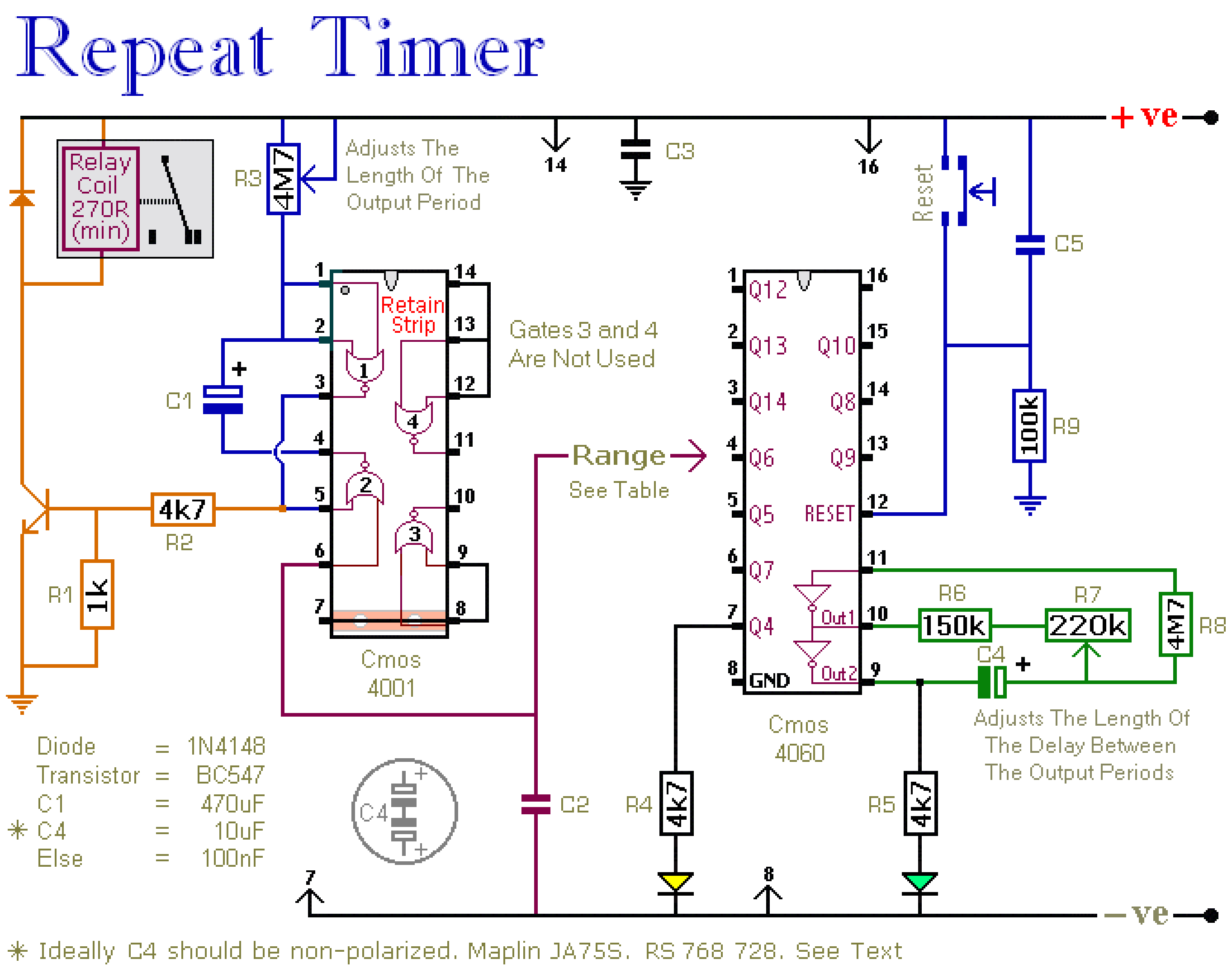


The timing diagram above shows the output pulse duration, the trigger input and the output at the discharge terminal of the IC.

P258. Repeating Interval Timer

Description:

This circuit has an adjustable output timer that will re-trigger at regular intervals. The output period can be anything from a fraction of a second to half-an-hour or more - and it can be made to recur at regular intervals of anything from seconds to days and beyond.



The Output Section:

The output section is a simple Monostable Circuit. When Pin 6 of the Cmos 4001 is taken high - the monostable triggers - and the relay energizes. It will remain energized for a period of time set by C1 & R3.

With the values shown - R3 will provide output periods of up to about 30-minutes. However, you can choose component values to suit your requirements. For example, if you reduce R3 to 1meg - and C1 to 4.7uF - the maximum output period is between 3 and 5 seconds. Owing to manufacturing tolerances - the precise length of the time period available depend on the characteristics of the actual components you've used.

The Cmos 4060:

The Cmos 4060 is a 14-bit binary counter with a built-in oscillator. The oscillator consists of the two inverters connected to Pins 9, 10 & 11 - and its frequency is controlled by R7. The output from the oscillator is connected internally to the binary counter. While the oscillator is running - the IC counts the number of oscillations - and the state of the count is reflected in the output pins.

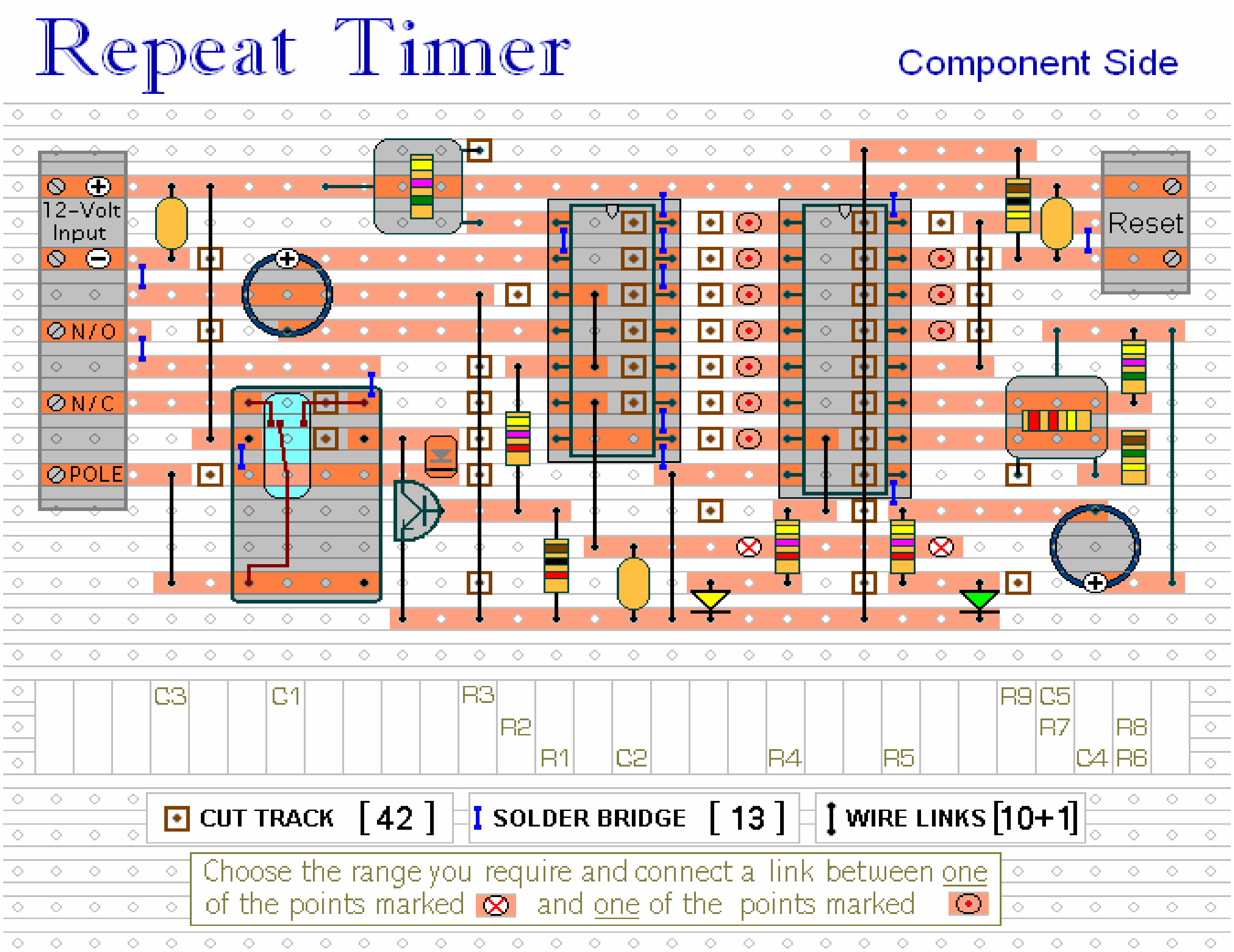
By adjusting R7 - you can set the length of time it takes for any given output pin to go high. Connect that output to Pin 6 of the Cmos 4001 and - every time it goes high - it'll trigger the monostable.

Ideally C4 should be non-polarized - but a regular electrolytic will work - provided it doesn't leak too badly in the reverse direction. Alternatively - you can simulate a non-polarized 10uF capacitor by connecting two 22uF capacitors back to back - as shown.

Important

Do not use the "on-board" relay to switch mains voltage. The board's layout does not offer sufficient isolation between the relay contacts and the low-voltage components. If you want to switch mains voltage - mount a suitably rated relay somewhere safe - Away From The Board. I've used a SPCO/SPDT relay - but you can use a multi-pole relay if you wish.

Veroboard Layout:



Since the delays between outputs can last for hours - or even days - using "Trial and Error" to set-up the timer would be very tedious. A better solution is to use the Setup Table provided - and calculate the time required for Pin 7 of the Cmos 4060 to go high.

For example, if you want the monostable to trigger every Six Hours - the Range Table tells you to use Pin 1 of the Cmos 4060. You need Pin 1 to go high every 6 x 60 x 60 = 21 600 seconds. The Setup table tells you that for Pin 1 you should divide this figure by 512 - giving about 42 seconds. Adjust R7 so that the Yellow LED lights 42 seconds after power is applied. This will cause Pin 1 to go high after about 3 Hours.

Setup Tables:

RANGE

Pin	Approximate Range
7	1 m to 2 min
5	2 m to 4 min
4	4 m to 8 min
6	8 m to 16 min
14	15 m to 30 min
13	30 m to 60 min
15	1 h to 2 hrs
1	4 h to 8 hrs
2	8 h to 16 hrs
3	16 h to 32 hrs

SETUP

Pin	Setting Pin 7
7	Q4 ÷ 2 = Pin 7
5	Q5 ÷ 4 = --
4	Q6 ÷ 8 = --
6	Q7 ÷ 16 = --
14	Q8 ÷ 32 = --
13	Q9 ÷ 64 = --
15	Q10 ÷ 128 = --
1	Q12 ÷ 512 = --
2	Q13 ÷ 1024 = --
3	Q14 ÷ 2048 = --

When Pin 1 goes high it will stay high for three hours. It will then go low for three hours - before going high once again. Thus, Pin 1 goes high once every six hours. It's the act of going high that triggers the monostable. So - after an initial delay of three hours - the relay will energize. It will then re-energize every six hours thereafter.

The reset button should NOT be used during setup. The time it takes for Pin 7 to go high - and the Yellow LED to light - MUST be measured from the moment power is applied.

Although R4, R5 and the two LEDs help with the setup - they are not necessary to the operation of the timer. If you want to reduce the power consumption - disconnect them once you've completed the setup.

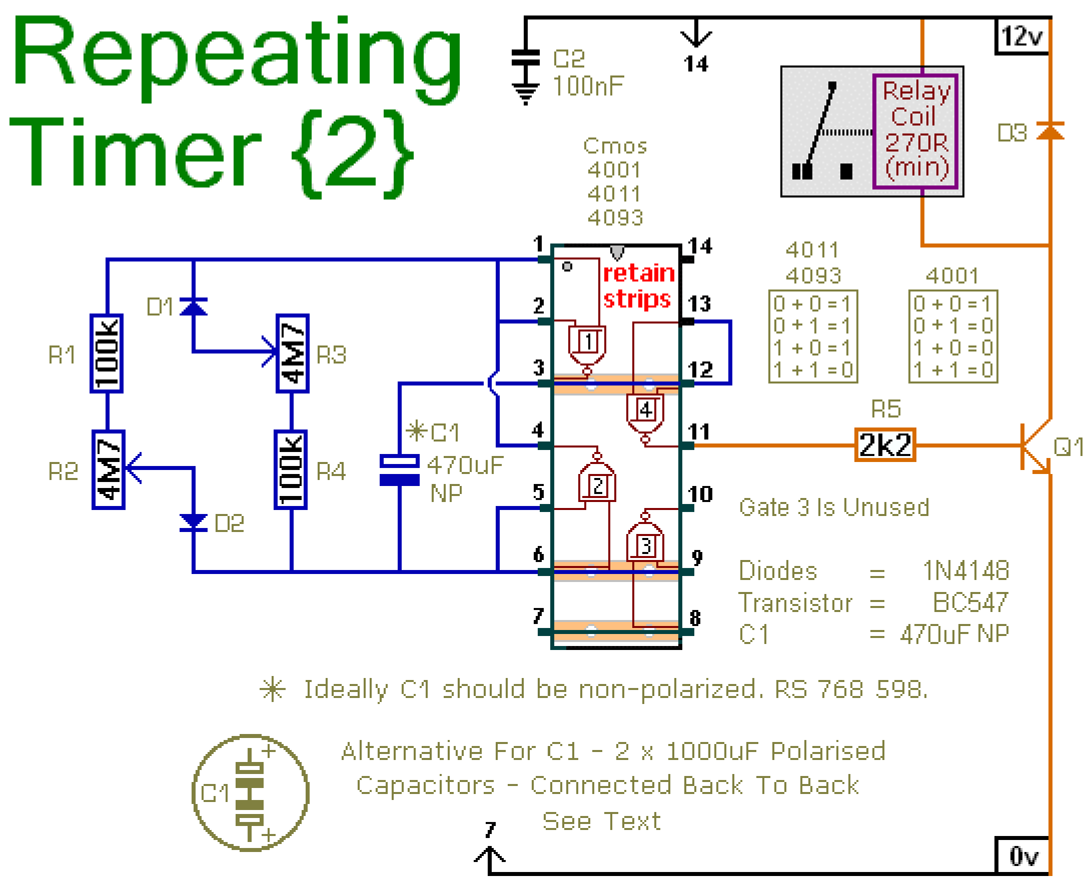
The timer is designed for a 12-volt supply. However - provided a suitable relay is used - it will work at anything from 5 to 15-volts. Applying power starts the timer. It can be reset at any time by a brief interruption of the power supply - so a reset button is not strictly necessary. If you need delays in excess of 32-hours - increase the value of C4.

The Support Material for this circuit includes a step-by-step guide to the construction of the circuit-board - a parts list - a detailed circuit description - and more.

P259. Repeating Timer No.2

Description:

This circuit is based on a simple asymmetric oscillator. The length of time the relay remains energized - and the length of time it remains de-energized - are set independently. With the component values shown in the diagram - both periods are adjustable from about 1 to 30 minutes.



Setting The Timer:

The frequency of the Astable Oscillator depends on the value of C1 and the speed at which it charges and discharges through the resistor network. The length of time the relay remains energized is controlled by R2. And the length of the time it remains de-energized is controlled by R3.

Owing to manufacturing tolerances - the precise length of the time periods available depends on the characteristics of the actual components you've used. R1 & R4 set the minimum period lengths at about 1-minute - while R2 & R3 set the maximum periods at about 30-minutes. You can choose component values that suit your own requirements. If your time periods don't need to be too precise - and more-or-less is close enough - you can leave out the pots altogether - and simply rely on R1 & R4 to set the times.

Alternative Capacitor:

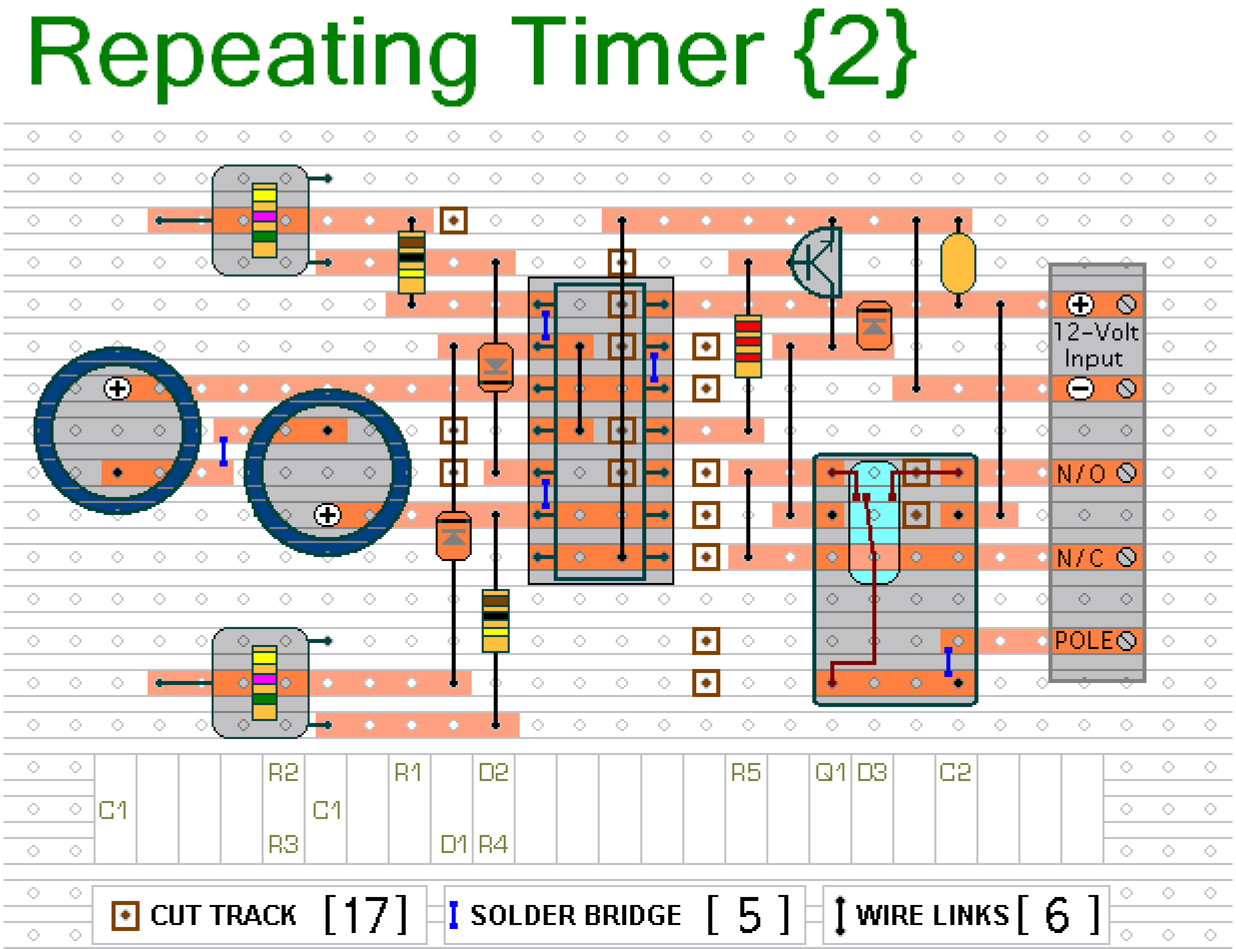
A regular electrolytic capacitor is polarised. If the charge on its plates is the wrong way round - DC current will flow through the capacitor. If the current is high enough - the capacitor will heat up and explode.

When the oscillator is running - the polarity of the charge on C1 keeps reversing. So C1 needs to be non-polarised. However - you can simulate a non-polarised 470uF capacitor by connecting two 1000uF polarised capacitors back to back - as shown. How and why this works is explained in the Detailed Circuit Description. Because non-polarised capacitors aren't widely available - the prototype was built using two polarised capacitors.

Important

Do not use the "on-board" relay to switch mains voltage. The board's layout does not offer sufficient isolation between the relay contacts and the low-voltage components. If you want to switch mains voltage - mount a suitably rated relay somewhere safe - Away From The Board. I've used a SPCO/SPDT relay - but you can use a multi-pole relay if you wish.

Veroboard Layout:



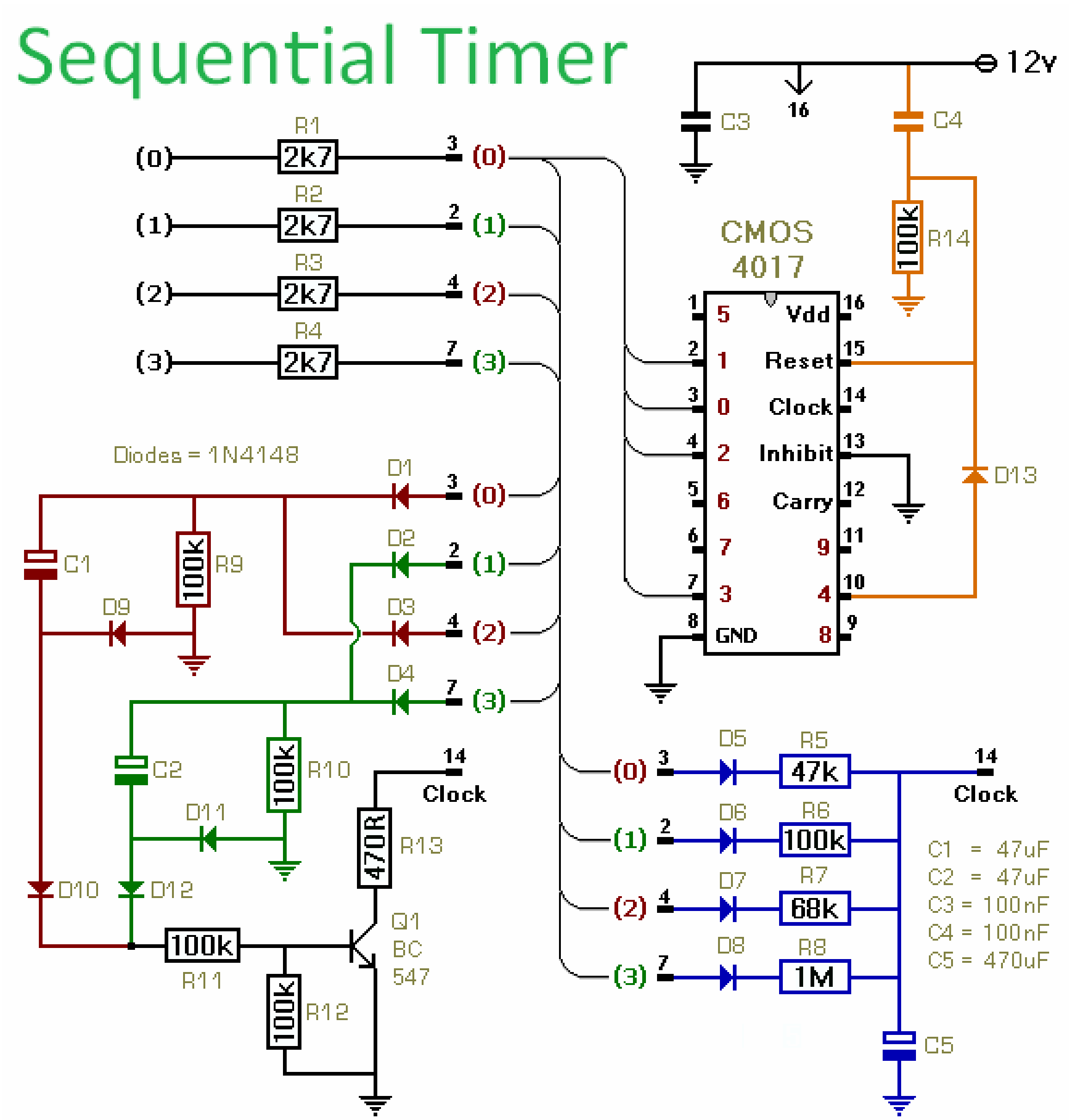
The timer is designed for a 12-volt power supply. However - it will work at anything from 5 to 15-volts. All you need do is select a relay to suit your supply voltage. The Cmos gates are being used as simple inverters. So - although I've used a Cmos 4093 in the circuit diagram - a Cmos 4001 or Cmos 4011 will work just as well.

P260. Sequential Timer

Description

This circuit uses a Cmos 4017 decade counter to create a sequence of four separate events. The number of events in the sequence may be increased to nine or ten. And the length of each event is controlled independently. D13 causes the sequence to repeat continuously. If you leave out D13 - the sequence will run only once.

You're not limited to a series of - "one after the other" - events. You can produce More Complex Sequences - with overlapping and repeating events. You can also fix the total number of times your sequence will repeat - as well as the point in the sequence where the repetition will stop.



Circuit Notes:

The four outputs are taken from pins 3, 2, 4 & 7 - in that order. The current available from each output pin is controlled by R1, R2, R3 & R4. Each resistor will supply more than enough current to operate a transistor switch. And the switch can be used to energize a relay - sound a buzzer etc.

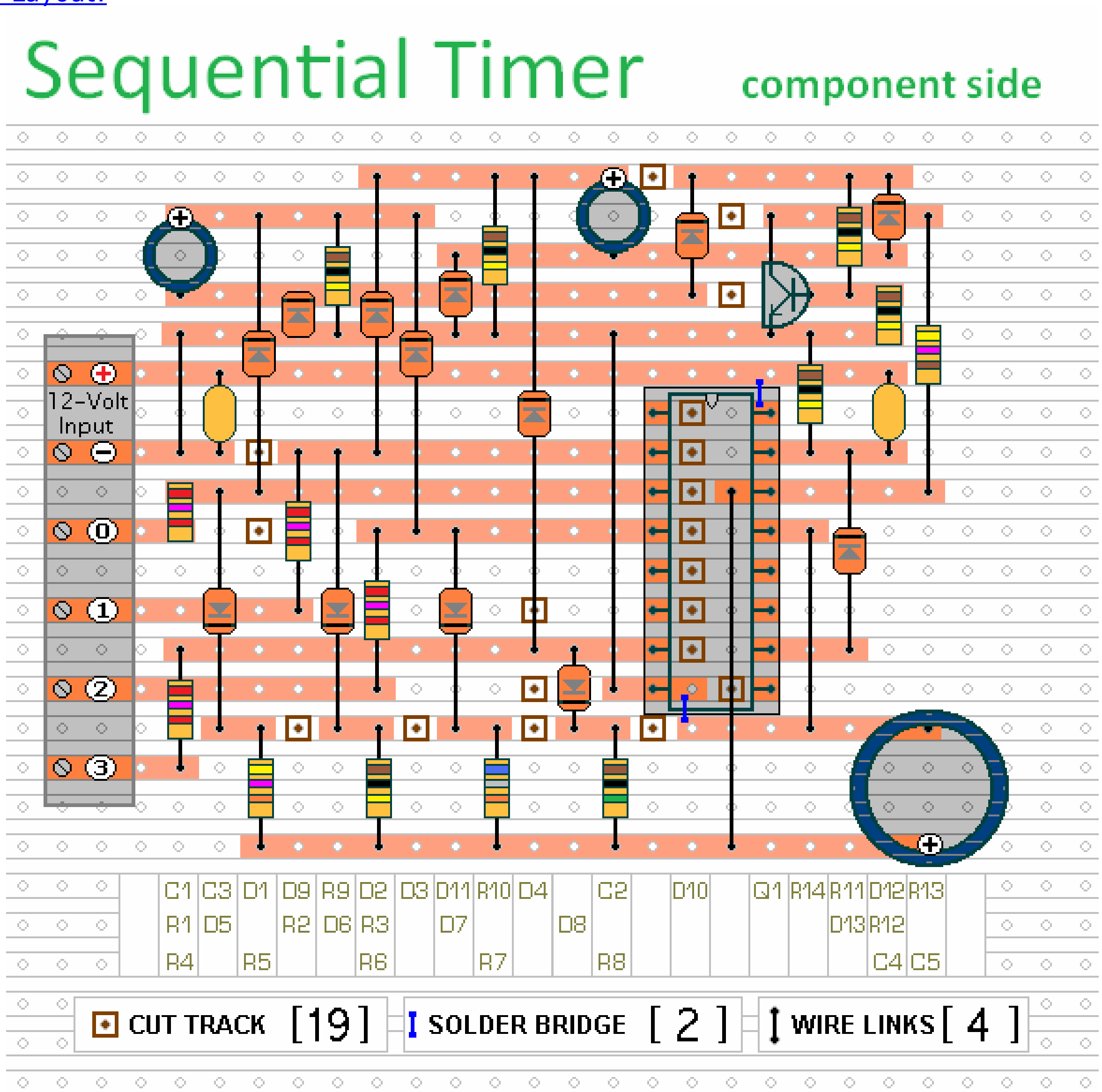
The individual output times are controlled by the value of C5 - and the values of R5, R6, R7 & R8 respectively. At the beginning of each event - Q1 discharges C5. Then the relevant timing resistor takes over - and charges C5 up again. I used a 470uF capacitor in the prototype. And with the resistor values shown in the diagram - the events lasted 38 seconds, 67 seconds, 49 seconds and 9 minutes - respectively. These times each include an initial delay of about 14 seconds - while Q1 discharges C5. Until Q1 switches off - the timing resistors cannot begin to charge C5.

Manufacturing tolerances mean that your results are likely to be different from mine. However - because you're always using the same capacitor to activate the same input pin - the length of each step in your sequence should be fairly predictable. All you need is one reliable practical observation. Then you can calculate the rest.

I got roughly 12 seconds for every 100k/100uF combination. So a 1M resistor and a 100uF capacitor will give about 120 seconds - or two minutes. To this must be added the initial 14 seconds - while Q1 discharges C5. If you want to shorten this discharge time - reduce the value of R11.

There's no theoretical limit on the size of C5. With the 470uF capacitor and the 1M resistor I got just under 9 minutes. So - with a 4700uF capacitor - the 1M resistor should give me just under 90 minutes. And if I increase the resistor to 4M7 - the output should last for around 7 hours.

Veroboard Layout:



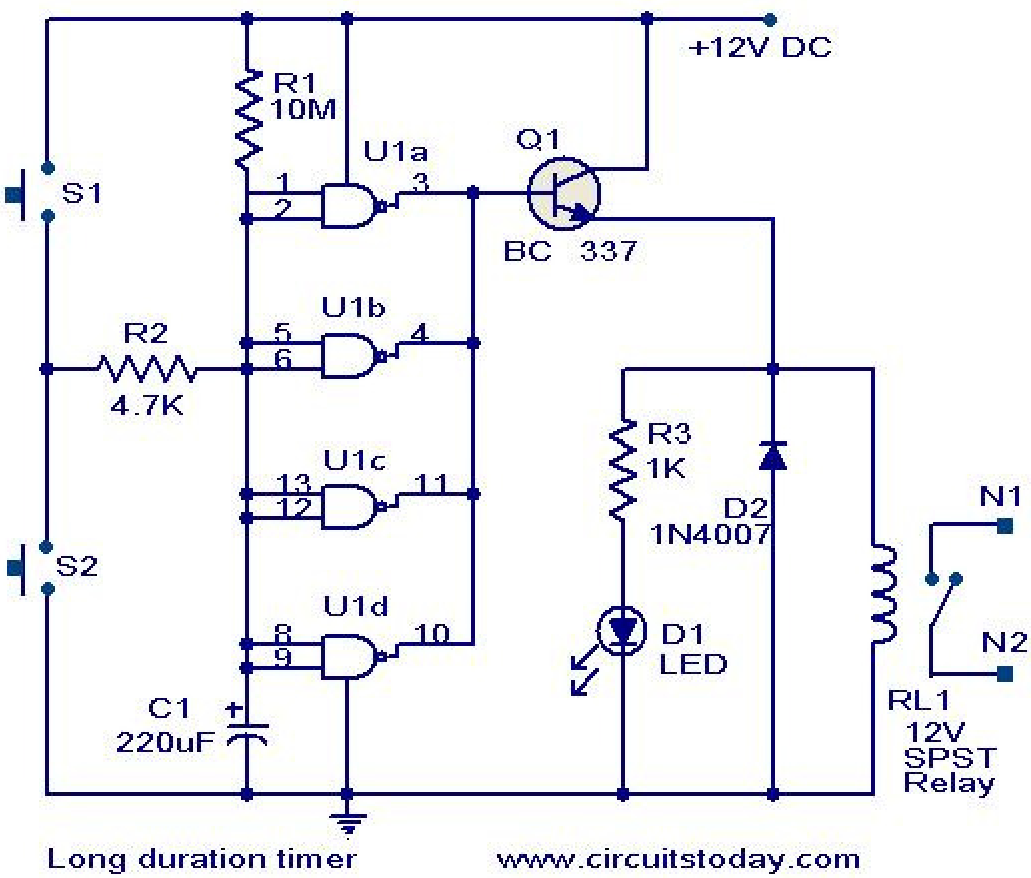
P261. Long duration timer circuit

Description.

This timer circuit can be used to switch OFF a particular device after around 35 minutes. The circuit can be used to switch OFF devices like radio, TV, fan, pump etc after a preset time of 35 minutes. Such a circuit can surely save a lot of power.

The circuit is based on quad 2 input CMOS IC 4011 (U1).The resistor R1 and capacitor C1 produces the required long time delay. When pushbutton switch S2 is pressed, capacitor C1 discharges and input of the four NAND gates are pulled to zero. The four shorted outputs of U1 go high and activate the transistor Q1 to drive the relay. The appliance connected via the relay is switched ON. When S2 is released the C1 starts charging and when the voltage at its positive pin becomes equal to Â½ the supply voltage the outputs of U1 becomes zero and the transistor is switched OFF. This makes the relay deactivated and the appliance connected via the relay is turned OFF. The timer can be made to stop when required by pressing switch S1.

Circuit diagram with Parts list.



Notes.

- Assemble the circuit on a good quality PCB or common board.
- The circuit can be powered from a 9V PP3 battery or 12V DC power supply.
- The time delay can be varied by varying the values of C1&R1.
- The push button switch S2 is for starting the timer and S1 for stopping the time.
- The appliance can be connected via contacts N1 & N2 of the relay RL1.
- The IC U1 is 2 input quad NAND gate 4011.

AUTOMOTIVE

CARS

&

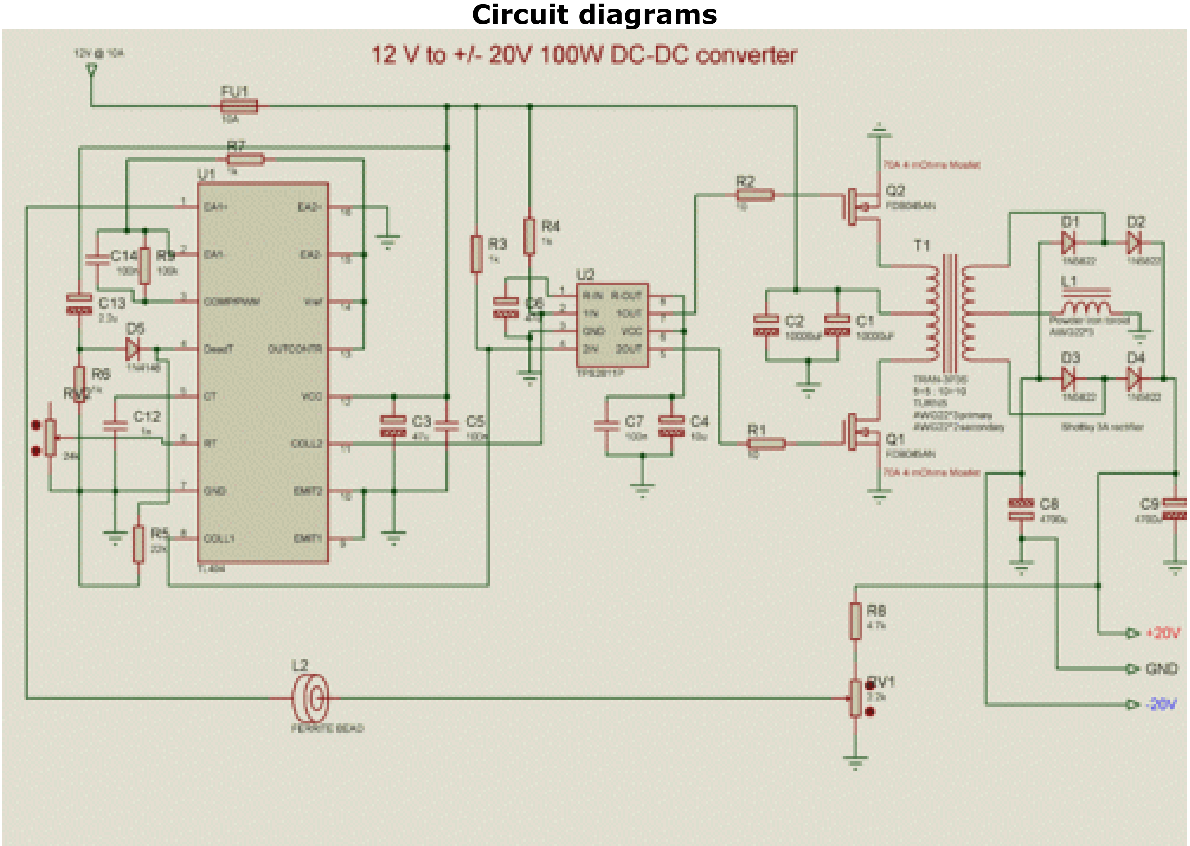
MOTORCYCLE

P262.

Automotive 12V to +-20V converter (for audio amplifier)

ATTENTION Keep in mind that THIS IS NOT A PROJECT FOR A BEGINNER, IT CAN BE VERY DANGEROUS IN CASE OF PROBLEMS, NEVER BRIDGE, BYPASS OR AVOID FUSES THESE WILL SAVE YOUR BACK FROM FIRE RISK.

Circuit diagrams



The limitation of car supply voltage (12V) forces to convert the voltages to higher in order to power audio amplifiers.

In fact the max audio power x speaker (with 4 ohm impedance) using 12V is (Vsupply+ - Vsupply-)^2/(8*impedance) 12^2/32 = 4.5Watts per channel, that is laughable...

For powering correctly an amplifier the best is to use a symmetric supply with a high voltage differential. for example +20 - -20 = 40Volts in fact 40^2/32 = 50 Watts per channel that is respectable.

This supply is intended for two channels with 50W max each (of course it depends on the amplifier used). Though it can be easily scaled up or the voltages changed to obtain different values.

Overview - How it works

It is a classic push-pull design , taking care to obtain best symmetry (to avoid flux walking). Keep in mind that this circuit will adsorb many amperes (around 10A) so take care to reinforce power tracks with lots of solder and use heavy wires from the battery or the voltage will drop too much at the input.

The transformer must be designed to reduce skin effect, it can be done using several insulated magnet wire single wires soldered together but conducting separately. The regulation is done both by the transformer turn ratio and varying the duty cycle. In my case i used 5+5 , 10+10 turns obtaining a step up ratio of 2 (12->24) and downregulating the voltage to 20 via duty cycle dynamic adjust performed by the PWM controller TL494.

The step-up ratio has to be a little higher to overcome diode losses, winding resistance and so on and input voltage drop due to wire resistance from battery to converter.

Transformer design

The transformer must be of correct size in order to carry the power needed, on the net there are many charts showing the power in function of frequency and core size for a given topology. My transformer size is 33.5 mm lenght, 30.0 height and 13mm width with a cross section area of 1,25cm^2, good for powers around 150W at 50khz.

The windings , especially the primary must be heavy gauged, but instead of using a single wire it is better to use multiple wires in parallel each insulated from the other except at the ends. This will reduce resistance increase due to skin effect. The primary and secondary windings are centertapped, this means that you have to wind 5 turns, centertap and 5 windings again. The same goes for the secondary, 10 turns, centertap and 10 turns again.

The important thing is that the transformer MUST not have air gaps or the leakage inductance will throw spikes on the switches overheating them and giving a voltage higher than expected by turn ratio prediction, so if your voltage output (at fully duty cycle) is higher than Vin*N2/N1 - Vdrop diode, your transformer has gap (of course permit me saying you that you are BLIND if you miss it), and this is accompanied with a drastical efficiency reduction. Use non-gapped E cores or toroids (ferrite).

Output diodes, capacitors and filter inductor

For rectification i preferred to use shottky diodes since they have low forward voltage drop, and are incredibly fast. I used the cheap 1N5822, the best alternative for low voltage converters (3A for current capability).

The output capacitors are 4700uF 25V, not very big, since at high frequency the voltage ripple is most due to internal cap ESR fortunately general purpose lytics have enough low esr for a small ripple (some tens of millivolts). Also at high duty cycle they are feed almost with pure DC, giving small ripple. The filter inductor on the secondary centertap furter increases the ripple and helps the regulation in asymmetrical transients

Power switch and driving

I used d2pak 70V 80A 0.004 ohms ultrafets (Fairchind semiconductor), very expensive and hard to find. In principle any fet will work, but the lower the on-resistance, the lower the on-state conduction losses, the lower the heat produced on the fets, the higher efficiency and smaller the heatsinks needed. With this fets i am able to run the fets with small heatsinks and without fan at full rated power (100W) with an efficiency of 82% and perceptible heating and with small heating at 120W (some degrees) (the core starts to saturate and the efficiency is a bit lower, around 75%).

Try to use the lowest resistance mosfet you can put your dirty hand :-) on or the efficiency will be lower than rated and you will need even a small fan. The fet driver i used is the TPS2811P, from Texas instruments, rated for 2A peak and 200ns. Is important that the gate drive is optimized for minimal inductance or the switching losses will be higher and you risk noise coupling from other sources. Personally i think that twisted pair wires (gate and ground/source) are the best to keep the inductance small. Place the gate drive resistor near the Mosfet, not near the IC.

Controller

I used the trusty TL494 PWM controller with frequency set at around 40-60 Khz adjustable with a potentiometer. I also implemented the soft start (to reduce powerup transients). The adjust potentiometer (feedback) must be set to obtain the desired voltage. The output signals is designed with two pull-up resistors on the collector of the PWM chip output transistor pulling them to ground each cycle alternatively. This signal is sent to the dual inverting MOSFET driver (TPS2811P) obtaining the correct waveform.

Power and filtering

How i said before the power tracks must be heavy gauged or you will scarify regulation (since it depends of transformer step up ratio and input voltage) and efficiency too. Don't forget to place a 10A (or 15A) fuse on the input because the car batteries can supply very high currents in case of shorts and this will save you face from a mosfet explosion in case of failture or short, remember to place a fuse also on the battery side to increase the safety (accidental shorts->fire, battery explosion, firemen, police and lawyers around). Input filtering is important, use at least 20000uF 16V in capacitors, a filter inductor would be useful too (heavygauged) but i decided to leave it..

Final considerations

This supply given me up to 85% efficiency (sometimes even 90% at some loads) with an input of 12V because i observed all these tricks to keep it functional and efficient. An o-scope would be useful, to watch the ripple and gate signals (watching for overshoots), but if you follow these guidelines you will avoid these problems.

The cross regulation is good but keep in mind that only the positive output is fully regulated, and the negative only follows it. Place a small load between the negative rail and ground (a 3mm led with a 4.7Kohm resistor) to avoid the negative rail getting lower then -20V. If the load is asymmetric you can have two cases:

-More load on positive rail-> no problems, the negative rail can go lower than -20V, but it is not a real issue for an audio amplifier.

-More load on negative rail-> voltage drop on negative rail (to ground) especially if the load is only on the negative rail.

Fortunately audio amplifiers are quite symmetrical as a load, and the output filter inductor/capacitors helps to maintain the regulation good during asymmetrical transients (Basses)

FOR FIRST TESTING USE A SMALL 12V power supply and use resistors as load monitoring switches heat and current consumption (and output) and try to determine efficiency, if it is higher then 70-75% you are set, it is enough. Adjust the frequency for best compromise between power and switching losses, skin effect and hysteresis losses

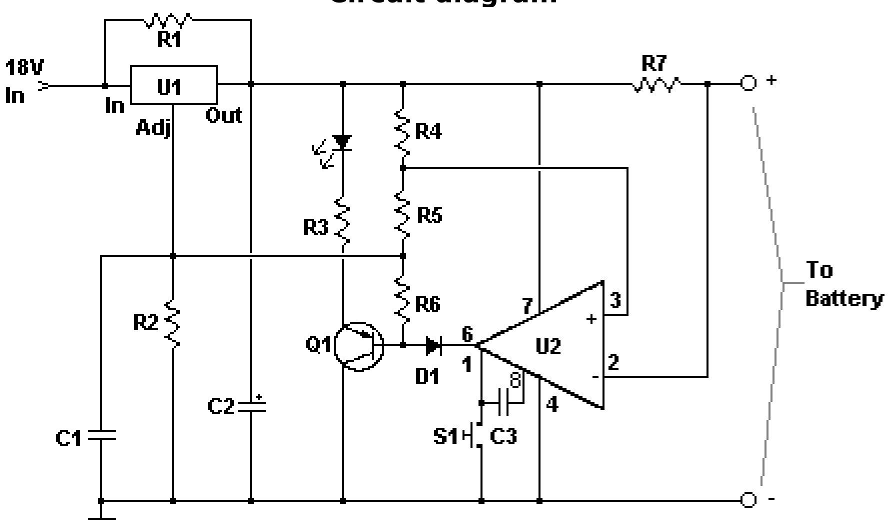
Parts
2 R1,R2 = 10
4 R3,R4,R6,R7 = 1k
1 R5 = 22k

1 R8 = 4.7k
1 R9 = 100k
2 C1,C2 = 10000uF
2 C3,C6 = 47u
1 C4 = 10u
3 C5,C7,C14 = 100n
2 C8,C9 = 4700u
1 C12 = 1n
1 C13 = 2.2u
1 U1 = TL494
1 U2 = TPS2811P
2 Q1,Q2 = FDB045AN
4 D1-D4 = 1N5822
1 D5 = 1N4148
1 FU1 = 10A
1 L1 = 10u
1 L2 = FERRITE BEAD
1 RV1 = 2.2k
1 RV2 = 24k
1 T1 = TRAN-3P3S

P263. Car Battery Charger

This charger will quickly and easily charge most any lead acid battery. The charger delivers full current until the current drawn by the battery falls to 150 mA. At this time, a lower voltage is applied to finish off and keep from over charging. When the battery is fully charged, the circuit switches off and lights a LED, telling you that the cycle has finished.

Circuit diagram



Parts
R1 500 Ohm 1/4 W Resistor
R2 3K 1/4 W Resistor
R3 1K 1/4 W Resistor
R4 15 Ohm 1/4 W Resistor

R5 230 Ohm 1/4 W Resistor
R6 15K 1/4 W Resistor
R7 0.2 Ohm 10 W Resistor
C1 0.1uF 25V Ceramic Capacitor
C2 1uF 25V Electrolytic Capacitor
C3 1000pF 25V Ceramic Capacitor
D1 1N457 Diode
Q1 2N2905 PNP Transistor
U1 LM350 Regulator
U2 LM301A Op Amp
S1Normally Open Push Button Switch
MISC Wire, Board, Heatsink For U1, Case, Binding Posts or Alligator Clips For Output

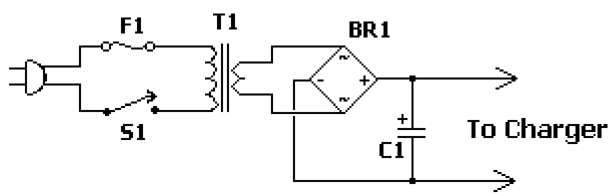
Notes

1. The circuit was meant to be powered by a power supply, which is why there is no transformer, rectifier, or filter capacitors on the schematic. There is no reason why you cannot add these.

2. A heatsink will be needed for U1.

3. To use the circuit, hook it up to a power supply/plug it in. Then, connect the battery to be charged to the output terminals. All you have to do now is push S1 (the "Start" switch), and wait for the circuit to finish.

4. If you want to use the charger without having to provide an external power supply, use the following circuit.

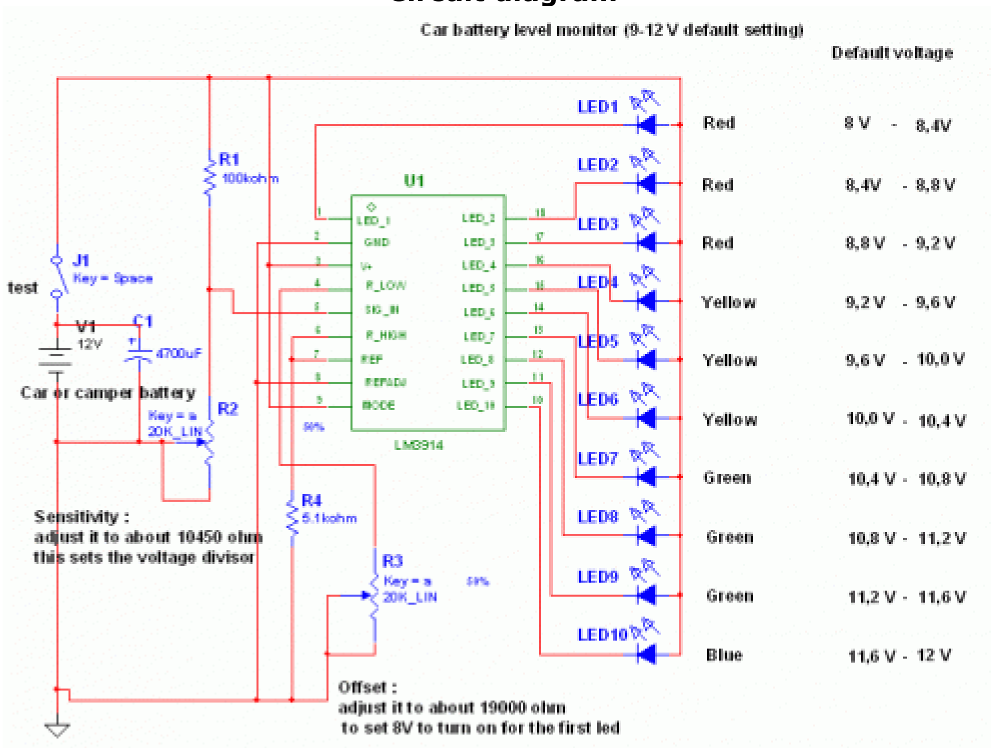


C1 6800uF 25V Electrolytic Capcitor
T1 3A 15V Transformer
BR1 5A 50V Bridge Rectifier 10A 50V Bridge Rectifier
S1 5A SPST Switch
F1 4A 250V Fuse

5. The first time you use the circuit, you should check up on it every once and a while to make sure that it is working properly and the battery is not being over charged.

P264. Simple but reliable car battery tester

Circuit diagram



This circuit uses the popular and easy to find LM3914 IC. This IC is very simple to drive, needs no voltage regulators (it has a built in voltage regulator) and can be powered from almost every source.

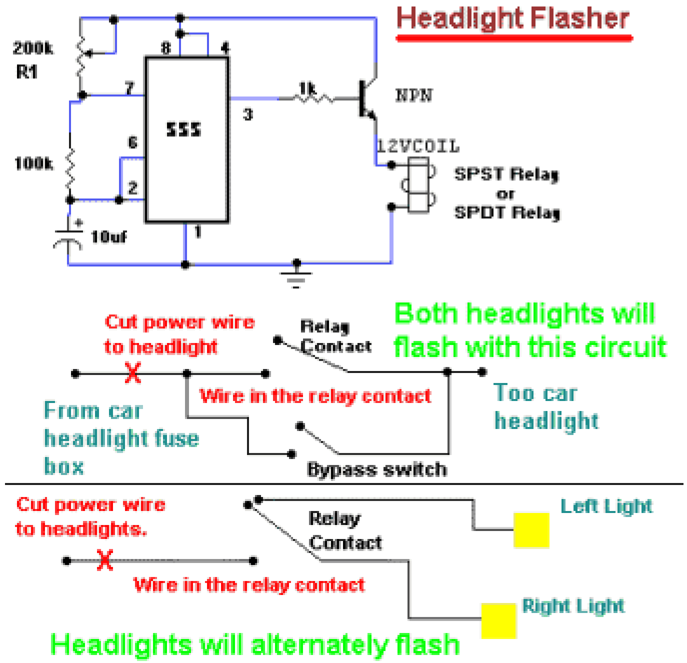
This circuit is very easy to explain:

When the test button is pressed, the Car battery voltage is feed into a high impedance voltage divider. His purpose is to divide 12V to 1,25V (or lower values to lower values). This solution is better than letting the internal voltage regulator set the 12V sample voltage to be feed into the internal voltage divider simply because it cannot regulate 12V when the voltage drops lower (linear regulators only step down). Simply wiring with no adjust, the regulator provides stable 1,25V which is fed into the precision internal resistor cascade to generate sample voltages for the internal comparators. Anyway the default setting let you to measure voltages between 8 and 12V but you can measure even from 0V to 12V setting the offset trimmer to 0 (but i think that under 9 volt your car would not start). There is a smoothing capacitor (4700uF 16V) it is used to adsorb EMF noise produced from the ignition coil if you are measuring the battery during the engine working. Diesel engines would not need it, but I'm not sure. If you like more a point graph rather than a bar graph simply disconnect pin 9 on the IC (MODE) from power.

The calculations are simple (default)
For the first comparator the voltage is : 0,833 V corresponding to 8 V
* * * * * voltage is : 0,875 V corresponding to 8,4 V
for the last comparator the voltage is : 1,25 V corresponding to 12 V
Have fun, learn and don't let you car battery discharge... ;-)

P265. Headlight Flasher

Circuit diagram



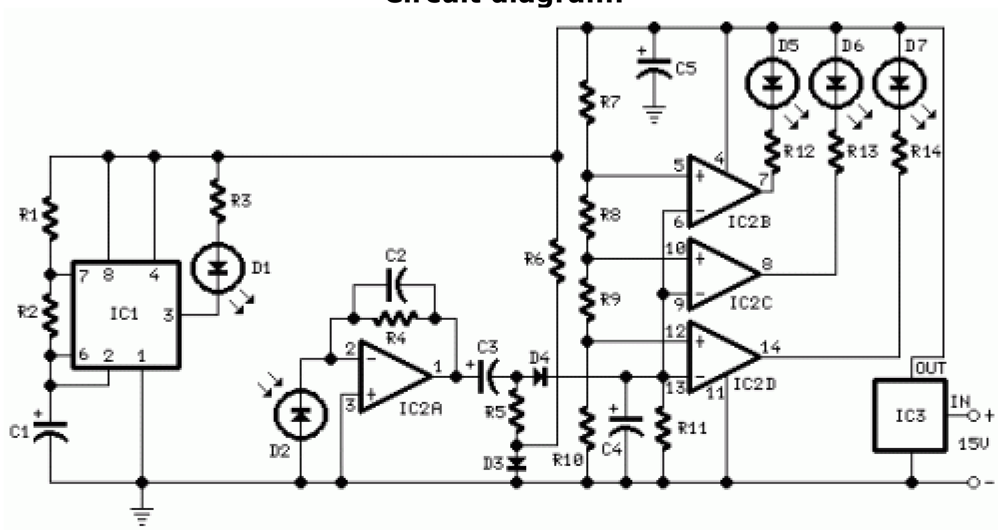
It will allow your car headlights to flash on and off at the same time or it will cause them to flash alternately. The circuit is based on the 555 timer. It is used in the astable mode. The 555 timer output will go high for an adjustable period of time and then turn off. It will then repeat the procedure.

The time is adjusted by R1. To hook up the circuit to your car you must locate the positive wire from the fuse box to the headlights. Cut the wire and insert the relay contact and bypass switch. The bypass switch will allow you to bypass the relay contact for normal headlight operation. In the alternateing headlight configuration you must cut the positive wire to each headlight and wire in the relay contact.

P266. Park Aid

Three LEDs signal bumper-barrier distance
Infra-red operation, indoor use

Circuit diagram:



Parts:
R1 10K 1/4W Resistor
R2,R5,R6,R9 1K 1/4W Resistors
R3 33R 1/4W Resistor
R4,R11 1M 1/4W Resistors
R7 4K7 1/4W Resistor
R8 1K5 1/4W Resistor
R10,R12-R14 1K 1/4W Resistors
C1,C4 1µF 63V Electrolytic or Polyester Capacitors
C2 47pF 63V Ceramic Capacitor
C3,C5 100µF 25V Electrolytic Capacitors
D1 Infra-red LED
D2 Infra-red Photo Diode (see Notes)
D3,D4 1N4148 75V 150mA Diodes
D5-7 LEDs (Any color and size)
IC1 555 Timer IC
IC2 LM324 Low Power Quad Op-amp
IC3 7812 12V 1A Positive voltage regulator IC

Device purpose:

This circuit was designed as an aid in parking the car near the garage wall when backing up. LED D7 illuminates when bumper-wall distance is about 20 cm., D7+D6 illuminate at about 10 cm. and D7+D6+D5 at about 6 cm. In this manner you are alerted when approaching too close to the wall.

All distances mentioned before can vary, depending on infra-red transmitting and receiving LEDs used and are mostly affected by the color of the reflecting surface. Black surfaces lower greatly the device's sensitivity.

Obviously, you can use this circuit in other applications like liquids level detection, proximity devices etc.

Circuit operation:

IC1 forms an oscillator driving the infra-red LED by means of 0.8mSec. pulses at 120Hz frequency and about 300mA peak current. D1 & D2 are placed facing the car on the same line, a couple of centimeters apart, on a short breadboard strip fastened to the wall. D2 picks-up the infra-red beam generated by D1 and reflected by the surface placed in front of it. The signal is amplified by IC2A and peak detected by D4 & C4. Diode D3, with R5 & R6, compensate for the forward diode drop of D4. A DC voltage proportional to the distance of the reflecting object and D1 & D2 feeds the inverting inputs of three voltage comparators. These comparators switch on and off the LEDs, referring to voltages at their non-inverting inputs set by the voltage divider resistor chain R7-R10.

Notes:

Power supply must be regulated (hence the use of IC3) for precise reference voltages. The circuit can be fed by a commercial wall plug-in power supply, having a DC output voltage in the range 12-24V.
Current drawing: LEDs off 40mA; all LEDs on 60mA @ 12V DC supply.

The infra-red Photo Diode D2, should be of the type incorporating an optical sunlight filter: these components appear in black plastic cases. Some of them resemble TO92 transistors: in this case, please note that the sensitive surface is the curved, not the flat one.

Avoid sun or artificial light hitting directly D1 & D2.

If your car has black bumpers, you can line-up the infra-red diodes with the (mostly white) license or number plate.

It's wiser to place all the circuitry near the infra-red LEDs in a small box. The 3 signaling LEDs can be placed far from the main box at an height making them well visible by the car driver.

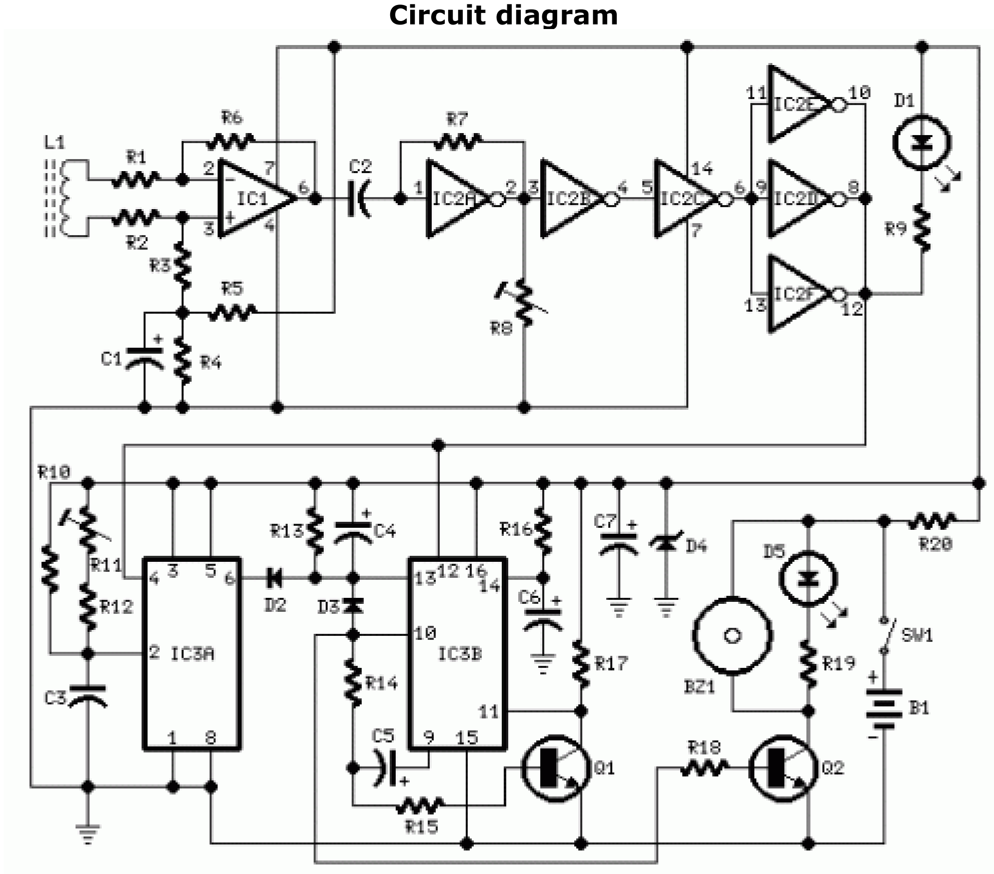
The best setup is obtained bringing D2 nearer to D1 (without a reflecting object) until D5 illuminates; then moving it a bit until D5 is clearly off. Usually D1-D2 optimum distance lies in the range 1.5-3 cm.

If you are needing a simpler circuit of this kind driving a LED or a relay, click Infra-red Level Detector

P267. Speed-limit Alert

Wireless portable unit
Adaptable with most internal combustion engine vehicles

Circuit diagram



Parts:
R1,R2,R19 1K 1/4W Resistors
R3-R6,R13,R17 100K 1/4W Resistors
R7,R15 1M 1/4W Resistors
R8 50K 1/2W Trimmer Cermet
R9 470R 1/4W Resistor
R10 470K 1/4W Resistor
R11 100K 1/2W Trimmer Cermet (see notes)
R12 220K 1/4W Resistor (see notes)
R14,R16 68K 1/4W Resistors
R18 22K 1/4W Resistor
R20 150R 1/4W Resistor (see notes)
C1,C7 100µF 25V Electrolytic Capacitors
C2,C3 330nF 63V Polyester Capacitors
C4-C6 4µ7 25V Electrolytic Capacitors
D1,D5 Red LEDs 3 or 5mm.
D2,D3 1N4148 75V 150mA Diodes
D4 BZX79C7V5 7.5V 500mW Zener Diode
IC1 CA3140 or TL061 Op-amp IC
IC2 4069 Hex Inverter IC
IC3 4098 or 4528 Dual Monostable Multivibrator IC
Q1,Q2 BC238 25V 100mA NPN Transistors

L1 10mH miniature Inductor (see notes)
BZ1 Piezo sounder (incorporating 3KHz oscillator)
SW1 SPST Slider Switch
B1 9V PP3 Battery (see notes)
Clip for PP3 Battery

Device purpose:

This circuit has been designed to alert the vehicle driver that he has reached the maximum fixed speed limit (i.e. in a motorway). It eliminates the necessity of looking at the tachometer and to be distracted from driving.

There is a strict relation between engine's RPM and vehicle speed, so this device controls RPM, starting to beep and flashing a LED once per second, when maximum fixed speed is reached.
Its outstanding feature lies in the fact that no connection is required from circuit to engine.

Circuit operation:

IC1 forms a differential amplifier for the electromagnetic pulses generated by the engine sparking-plugs, picked-up by sensor coil L1. IC2A further amplifies the pulses and IC2B to IC2F inverters provide clean pulse squaring. The monostable multivibrator IC3A is used as a frequency discriminator, its pin 6 going firmly high when speed limit (settled by R11) is reached. IC3B, the transistors and associate components provide timings for the signaling part, formed by LED D5 and piezo sounder BZ1. D3 introduces a small amount of hysteresis.

Notes:

D1 is necessary at set-up to monitor the sparking-plugs emission, thus permitting to find easily the best placement for the device on the dashboard or close to it. After the setting is done, D1 & R9 can be omitted or switched-off, with battery saving.

During the preceding operation R8 must be adjusted for better results. The best setting of this trimmer is usually obtained when its value lies between 10 and 20K.

You must do this first setting when the engine is on but the vehicle is stationary.The final simplest setting can be made with the help of a second person. Drive the vehicle and reach the speed needed. The helper must adjust the trimmer R11 until the device operates the beeper and D5. Reducing car's speed the beep must stop.

L1 can be a 10mH small inductor usually sold in the form of a tiny rectangular plastic box. If you need an higher sensitivity you can build a special coil, winding 130 to 150 turns of 0.2 mm. enameled wire on a 5 cm. diameter former (e.g. a can). Extract the coil from the former and tape it with insulating tape making thus a stand-alone coil.
Circuit's current drawing is approx. 10mA. If you intend to use the car's 12V battery, you can connect the device to the lighter socket. In this case R20 must be 330R.

Depending on the engine's cylinders number, R11 can be unable to set the device properly. In some cases you must use R11=200K and R12=100K or less.

If you need to set-up the device on the bench, a sine or square wave variable generator is required. To calculate the frequency relation to RPM in a four strokes engine you can use the following formula:

Hz= (Number of cylinders * RPM) / 120.

For a two strokes engine the formula is: Hz= (Number of cylinders * RPM) / 60.

Thus, for a car with a four strokes engine and four cylinders the resulting frequency @ 3000 RPM is 100Hz.

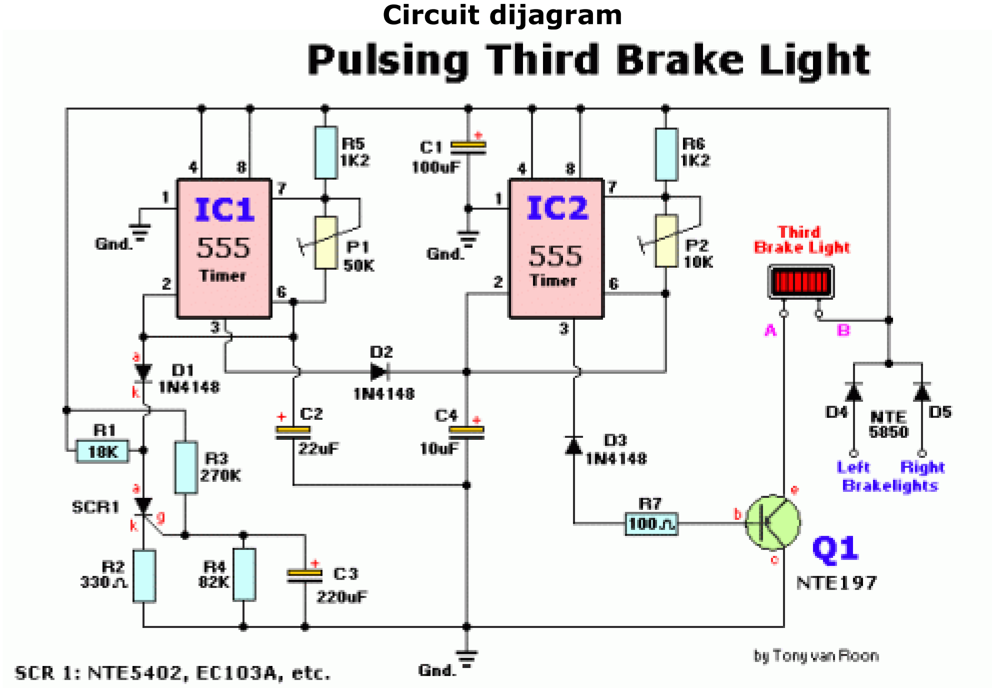
Temporarily disconnect C2 from IC1's pin 6. Connect the generator's output to C2 and Ground. Set the generator's frequency to i.e. 100Hz and regulate R11 until you hear the beeps and LED D5 flashes. Reducing the frequency to 99 or 98 Hz, beeping and flashing must stop.

This circuit is not suited to Diesel engines.

P268. Pulsing Third Brake Light

I'm checking into the legalities of this particular circuit at this time. Any type of flashing light on the main brake lights is prohibited and illegal in most states of the U.S.A. I'm verifying for the same here in Canada. In the mean time, use this circuit at your own risk and be aware that the possibility exists to be stopped by law enforcement if you implement this circuit in your vehicle.

Circuit dijagram



Parts
IC1,IC2 = 555 Timer, RS #276-1723
SCR1 = NTE/ECG5402, RS #276-1067, EC103A, MCR104, etc.
Q1 = NTE/ECG197, SK3083, TIP125, or equivalent
D1,D2,D3 = 1N4148, 1N914, NTE/ECG519, RS #276-1122
D4,D5 = 1N5400, NTE/ECG5850, RS #276-1141, or equivalent
R1 = 18K
R2 = 330 ohm (RS #271-1315)
R3 = 270K
R4 = 82K
R5,R6 = 1K2
R8 = 100 ohm (RS# 271-1311)

P1 = 50K, 10-turn
P2 = 10K, 10-turn
C1 = 100µF/16V (RS# 272-1016)
C2 = 22µF/16V (RS# 272-1014)
C3 = 220µF/16V (RS# 272-1017)
C4 = 10µF/16V (RS# 272-1013)

Q1 is a PNP Silicon Audio Power Out/Medium Power Switch Transistor, 7A, with a TO-220 case. As long as you have a transistor which is close it will work fine. The SCR is a 100vrm, 0.8A, sensitive gate with a TO-92 case. Diodes D1, D2 and D3 are standard small signal diodes. Power diodes D4 and D5 are the 6A, 50prv types, cathode case. The 60vrm type will work as well. I used for IC1 & IC2 the LM555 type. P1 controls the 'on' and pulse-duration, P2 controls the pulse-timing.

Applying the Brakes:

When you first press the brakes, this circuit will turn on your 3rd brake light via the main brake lights. After about a second a series of short strobe pulses occur. The number of pulses range from approximately 1 to 10, depending on the setting of P1/P2 and when the brake pedal was applied last. After the pulses have been applied the third brake light assumes normal operation. The prototype was set for five flashes which seemed more than enough. Two days later I re-adjusted the trimmer potentiometers for 4 flashes--1/2 second pause--4 flashes. Looks pretty cool!

Circuit Description:

The schematic consists of two 555 timer/oscillators in a dual timer configuration both setup in astable mode. When power is applied via the brake pedal, the brake light driver Q1 is switched on via the low-output pin 3 of IC2, and timer IC1 begins its timing cycle. With the output on pin 3 going high, inhibiting IC2's pin 2 (trigger) via D2, charge current begins to move through R3, R4 and C2.

When IC1's output goes low, the inhibiting bias on pin 2 of IC2 is removed and IC2 begins to oscillate, pulsing the third brake light via the emitter of Q1, at the rate determined by P2, R6, and C4. That oscillation continues until the gate-threshold voltage of SCR1 is reached, causing it to fire and pull IC1's trigger (pin 2) low. With its trigger low, IC1's ouput is forced high, disabling IC2's trigger. With triggering disabled, IC2's output switches to a low state, which makes Q1 conduct turning on the 3rd Brake Light until the brakes are released. Obviously, removing the power from the circuit at any time will reset the Silicon Controlled Rectifier SCR1, but the RC network consisting of R4 and C2 will not discharge immediately and will trigger SCR1 earlier. So, frequent brake use means fewer flashes or no flashes at all. But I think that's okay. You already have the attention from the driver behind you when you used your brakes seconds before that.

The collector/emitter voltage drop accross Q1 together with the loss over the series fed diodes D4/D5, will reduce the maximum available light output, but if your car's electrical system is functioning normally in the 13 - 14volt range, these losses are not noticeable.

Building Tips:

Keep in mind that Q1 will draw most likely 2 or 3 amps and mounting this device on a heat sink is highly recommended. Verify that the scr is the 'sensitive gate' type. In incandecent bulbs, there is a time lag between the introduction of current and peak brightness. The lag is quite noticeable in an automotive bulb, so the duration of a squarewave driving such a bulb should be set long enough to permit full illumination. For that reason, and because lamps and car electrical systems vary, adjustment via P1 and P2 is necessary to provide the most effective pulse timing for your particular vehicle.

The reason that the third light is connected to both brake lights is to eliminate the possibility of a very confusing display when you use your turn signal with the brakes applied.

The cathode of D4 and D5 are tied together and go to point 'B' of the third brake light in the component layout diagram. Point 'A' goes to the other leg of the third brake light. Most if not all third brake lights in Canada & USA have two wires, the metal ones also have a ground wire which obviously goes to ground. I don't know the wiring schema for Australian and European third brake lights.

Don't forget the three jumpers on the pcb; two jumpers underneath IC1/IC2 between pin 4/8 and the one near Q1/R6.

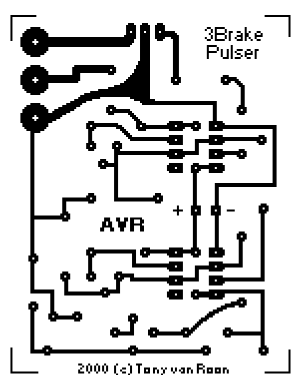
If you use a metal case, don't forget to insulate the D4/D5 diodes.

Some 90's cars, like my 1992 Mercury Sable, have two bulbs inside the third brake light, each bulb is hooked up seperately to the left and right brake light for reasons only Ford knows. Click here for a possible 2-bulb hookup. It shows how I modified mine to get it working; and that was easier than I expected. Current draw with the two bulbs was measured at 1.85Amps (1850mA). Even with double the current none of the circuit components were getting hot. I had to re-adjust the two pots to make it flash since the bench testing was done with one bulb.

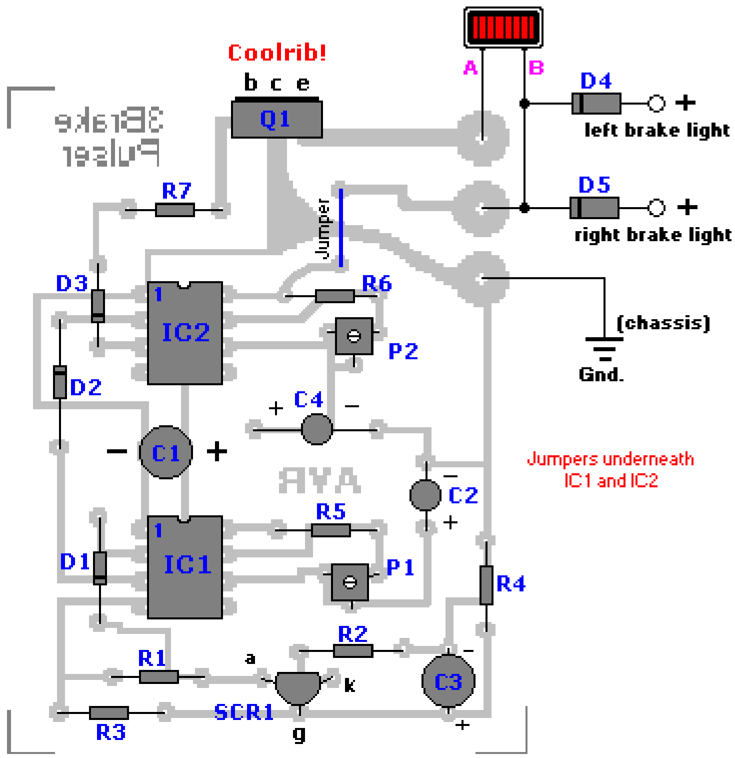
Bench Testing:

I tested different semiconductors like the 1N5401/1N5404, NTE153, and 4A type powerdiodes for D4/D5. All worked very well. As expected, Q1 is getting very hot. Current draw was measured between 680 - 735mA with a regular automotive 'headlight' bulb, extra heavy duty to make sure the circuit was safe. I tested several other power transistors including some darlingtons like the TIP125 and the TIP147. I eventually settled for the TIP125 myself because I had it available but any thing with 5A or more will do fine.

The actual third brake bulb is a lot smaller. Adjusting the trimpots (P1/P2) may take a bit of patience but really fine-tunes the circuit well. The only drawback of this circuit is the discharge lag coming from the electrolytic capacitor C2 and the R4 resistor. Especially if the brakes are used often or at short intervals the third brake light will not flash or maybe flash once or twice. Again, this is because the R-C combo does not have enough time to discharge in between braking. It takes about 12 seconds to discharge C2.



The pcb measures 2 x 2.5 inch (5 x 6.4cm or 170 x 200 pixels)at 2 colors and is shown smaller when you print these pages. If you need a direct, full size copy of the pcb I suggest to load the gif file into a program like Paint Shop Pro or one of the many gif viewers available.



PCB Component Lay-out
(c) Tony van Roon

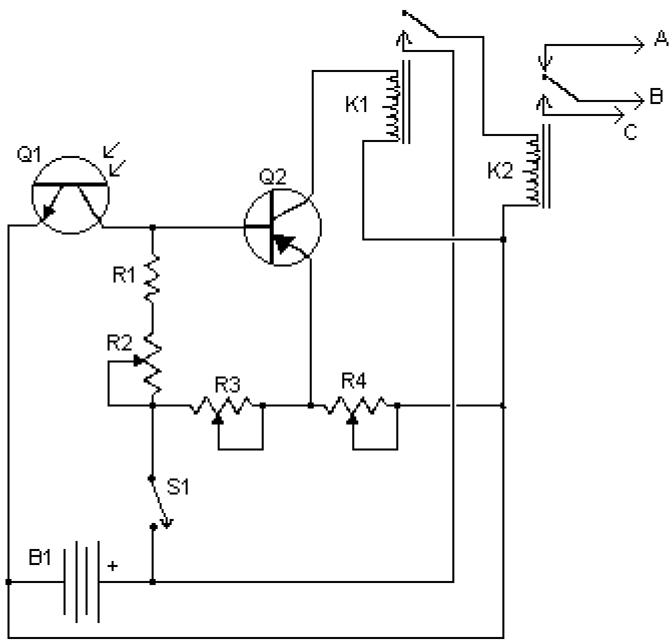
The layout is enlarged a bit for a better component view. Note that Q1 is drawn soldered on the pcb but if you have a metal case you can put it anywhere on the metal case (as a coolrib) and use havy duty wiring between Q1 and the PCB.

CORRECTION: SCR1's anode/kathode
were shown reversed (fixed: 2-26-2000).

P269. Automatic Headlight Brightness Switch

Driving the highway with your high-beam headlights can really increase your visibility, but can he a blinding hazard for other drivers. This simple circuit can be wired into your headlight switch to provide automatic switching between high and low beam headlights when there is oncoming traffic. It does this by sensing the lights of that traffic. In this way, you can drive safely with your high-beams on without blinding other drivers.

Circuit diagram



Parts:
R1 5K 1/4W Resistor
R2, R3, R4 5K Pot
Q1 NPN Phototransistor
Q2 2N3906 PNP Transistor
K1 Low Current 12V SPST Relay
K2 High Current 12V SPDT Relay
S1 SPST Switch
B1 Car Battery
MISC Case, wire, board, knobs for pots

Notes:

1. Q1 should me mounted in such a way so it points toward the front of the car with a clear line of site. Suitable places are on the dashboard, in the front grill, etc.

2. Adjust all the pots for proper response by testing on a deserted road.

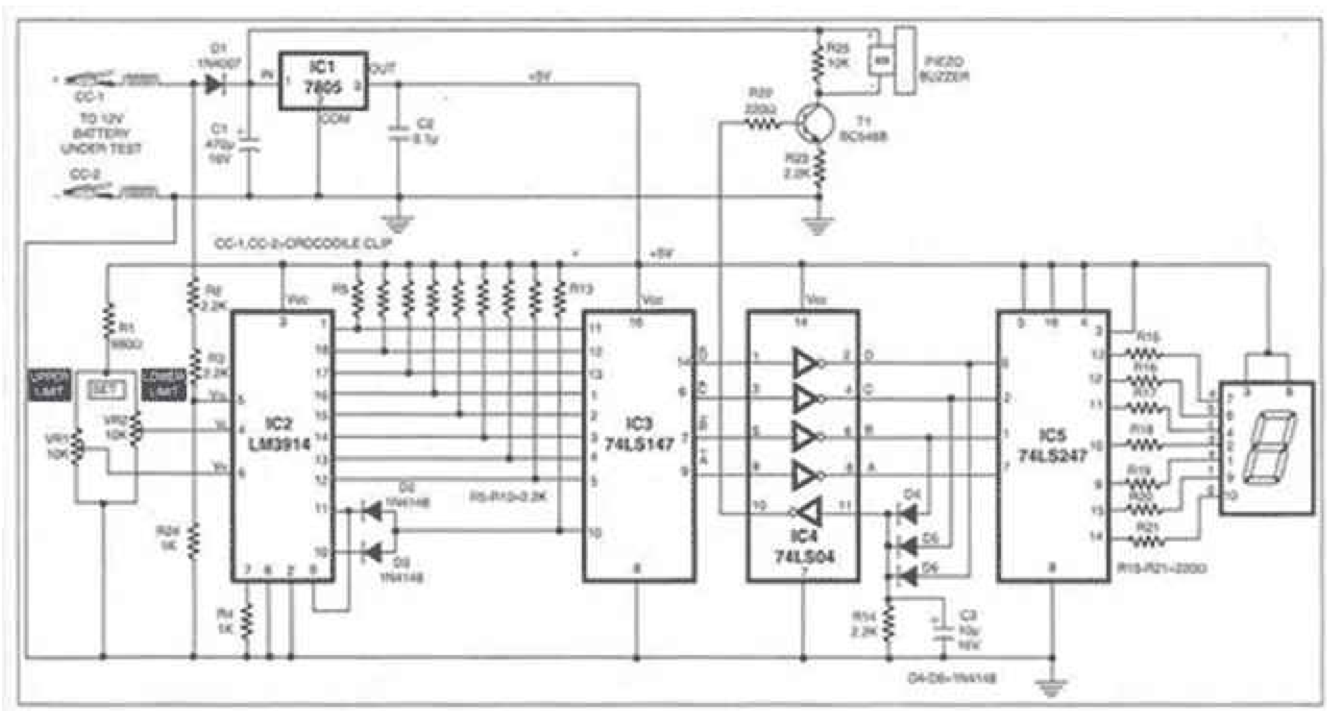
3. S1 enables and disables the circuit.

4. B1 is, obviously, in the car already.

5. Before you try to connect this circuit, get a wiring diagram for your car. Some auto manufacturers do weird things with wiring.

6. Connection A goes to the high beam circuit, B goes to the headlight switch common and C connects to the low beam circuit.

P270. Charge Monitor for 12V lead acid battery



A battery is a vital element of any battery-backed system. In many cases the battery is more expensive than the system it is backing up. Hence we need to adopt all practical measures to conserve battery life.

As per manufacturer's data sheets, a 12V rechargeable lead-acid battery should be operated within 10. IV and 13.8V. When the battery charges higher than 13.8V it is said to be overcharged, and when it discharges below 10.IV it can be deeply discharged. A single event of overcharge or deep discharge can bring down the charge-holding capacity of a battery by 15 to 20 per cent.

It is therefore necessary for all concerned to monitor the charge level of their batteries continuously. But, in practice, many of the battery users are unable to do so because of non-availability of reasonably-priced monitoring equipment. The circuit idea presented here will fill this void by providing a circuit for monitoring the charge level of lead-acid batteries continuously. The circuit possesses two vital features:

First, it reduces the requirement of human attention by about 85 per cent.

Second, it is a highly accurate and sophisticated method.

Input from the battery under test is applied to LM3914 1C. This applied voltage is ranked anywhere between 0 and 10, depending upon its magnitude. The lower reference voltage of 10.IV is ranked '0' and the upper voltage of 13.8V is ranked as '10.' (Outputs 9 and 10 are logically ORed in this circuit.) This calibration of reference voltages is explained later.

1C 74LS147 is a decimal-to-BCD priority encoder which converts the output of LM3914 into its BCD complement. The true BCD is obtained by using the hex inverter 74LS04. This BCD output is displayed as a decimal digit after conversion using IC5 (74LS247), which is a BCD-to-seven-segment decoder/driver. The seven-segment LED display (LTS-542) is used because it is easy to read compared to a bar graph or, for that matter, an analogue meter. The charge status of the battery can be quickly calculated from the display. For instance, if the display shows 4, it means that the battery is charged to 40 per cent of its maximum value of 13.8V.

The use of digital principles enables us to employ a buzzer that sounds whenever there is an overcharge or deep discharge, or there is a need to conserve battery charge. A buzzer is wired in the circuit such that it sounds whenever battery-charge falls to ten per cent. At this point it is recommended that unnecessary load be switched off and the remaining charge be conserved for more important purposes.

Another simple combinational logic circuit can also be designed that will sound the buzzer when the display shows 9. Further charging should be stopped at this point in order to prevent overcharge.

The circuit is powered by the battery under test, via a voltage regulator 1C. The circuit takes about 100 mA for its operation.

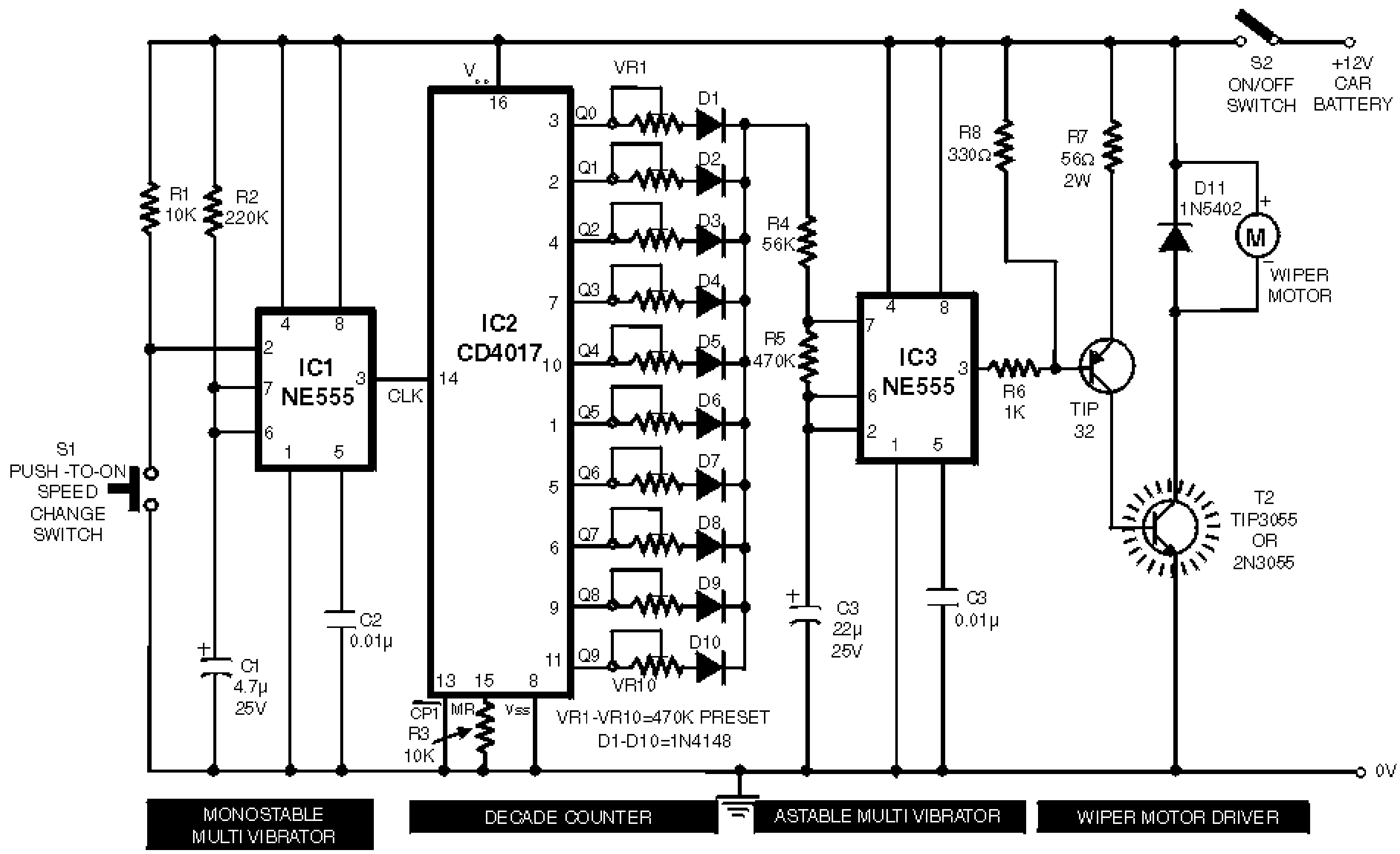
For calibrating the upper and lower reference levels, a digital multimeter and a variable regulated power supply source are required. For calibrating the lower reference voltage, follow the steps given below:

Set the output of power supply source to 10. IV.
Connect the power supply source in place of the battery.

Now the display will show some reading. At this point vary preset VR2 until the reading on the display just changes from 1 to 0.

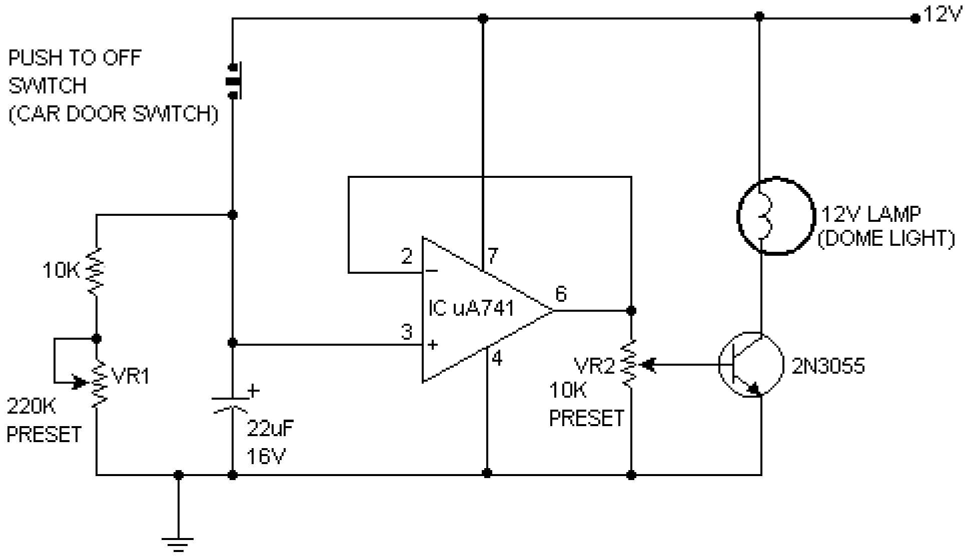
The higher reference voltage is calibrated similarly by setting the power supply to 13.8V and varying preset VR1 until reading on the display just changes from 8 to 9.

P271. Wiper Speed Control



A continuously working wiper in a car may prove to be a nuisance, especially when it is not raining heavily. By using the circuit described here one can vary sweeping rate of the wiper from once a second to once in ten seconds. The circuit comprises two timer NE555 ICs, one CD4017 decade counter, one TIP32 driver transistor, a 2N3055 power transistor (or TIP3055) and a few other discrete components. Timer IC1 is configured as a mono- stable multivibrator which produces a pulse when one presses switch S1 momentarily. This pulse acts as a clock pulse for the decade counter (IC2) which advances by one count on each successive clock pulse or the push of switch S1. Ten presets (VR1 through VR10), set for different values by trial and error, are used at the ten outputs of IC2. But since only one output of IC2 is high at a time, only one preset (at selected output) effectively comes in series with timing resistors R4 and R5 connected in the circuit of timer IC3 which functions in astable mode. As presets VR1 through VR10 are set for different values, different time periods (or frequencies) for astable multivibrator IC3 can be selected. The output of IC3 is applied to pnp driver transistor T1 (TIP32) for driving the final power transistor T2 (2N3055) which in turn drives the wiper motor at the selected sweep speed. The power supply for the wiper motor as well as the circuit is tapped from the vehicle's battery itself. The duration of monostable multivibrator IC1 is set for a nearly one second period.

P272. Dome light dimmer for Cars



This unique circuit makes your dome light look cool. Usually when the car door is closed, the dome light just goes OFF. With this circuit, you can have our dome light fade slowly in brightness and finally go OFF. This slow dimming of the light gives a very good feeling at night. It looks very romantic!

The circuit can be explained as follows: When the car door is open, the push to off switch of the door is ON and hence it charges the 22uF capacitor fully. The opamp is acting as a voltage follower and its output is same as the voltage across the capacitor, which is 12V when the capacitor is fully charged. Due to a high voltage at the output of the IC, the transistor saturates, turning ON the bulb to full brightness.

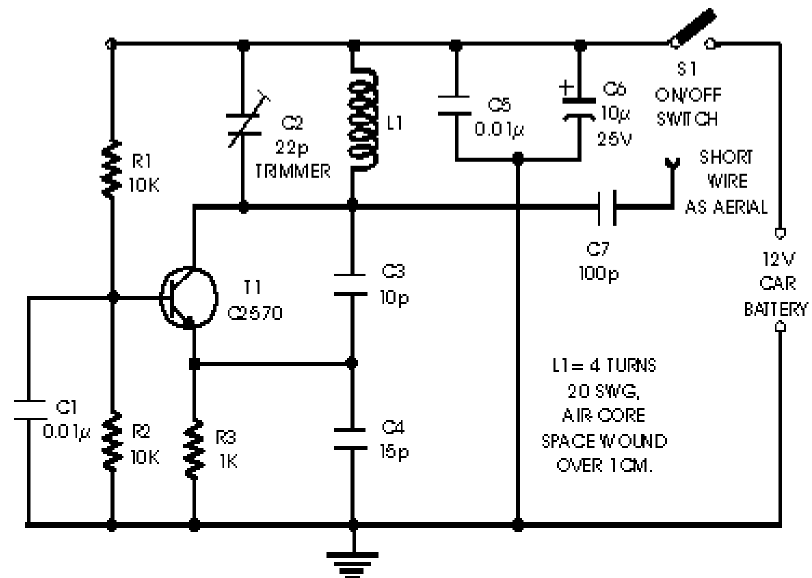
Now when the door is closed, the door switch is pushed in and hence the switch goes OFF. When the switch is OFF, the capacitor starts discharging slowly through VR1 and the 10K resistor and the voltage across it decreases slowly. Hence at the output of IC 741 also the voltage decreases gradually, hence decreasing the base current to the transistor. This produces a slowly decreasing current through the bulb and the bulb fades out and finally when the capacitor is fully discharged, the bulb goes OFF.

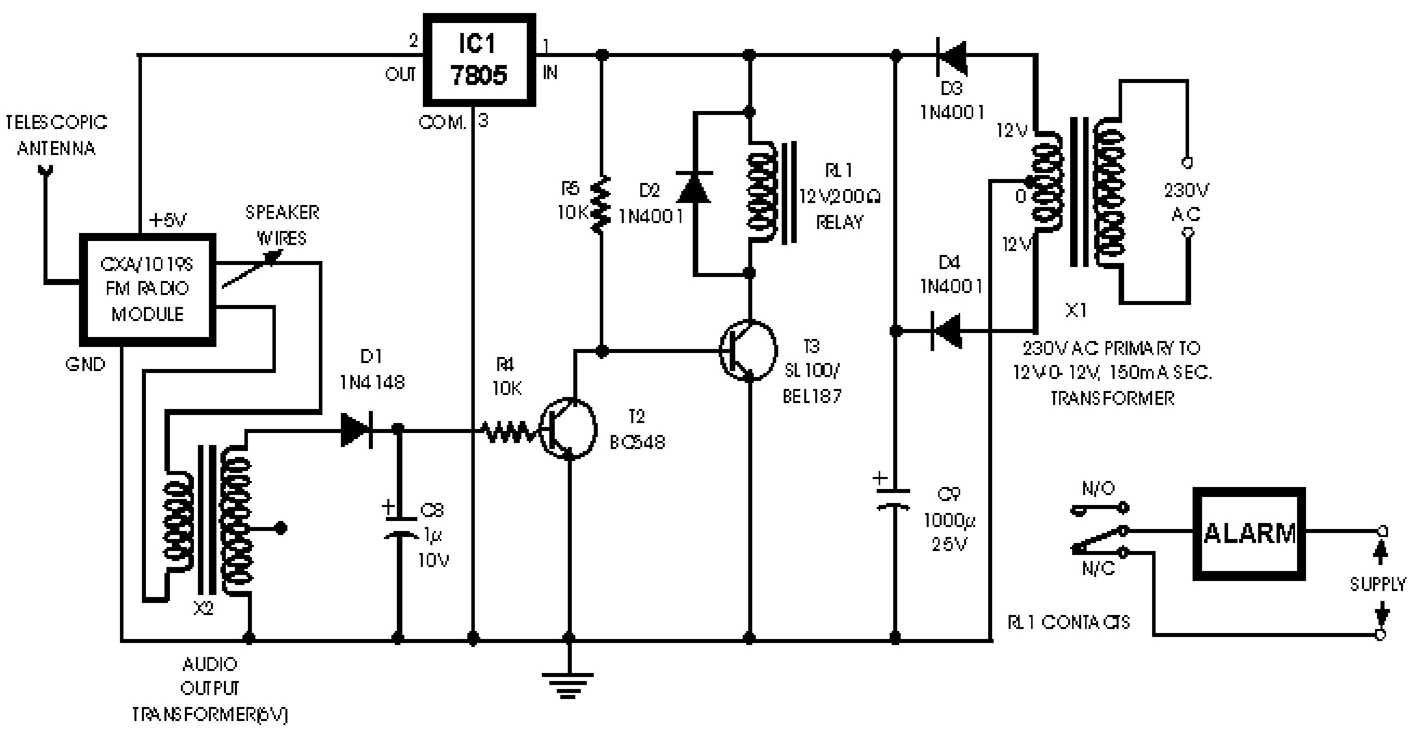
After building the circuit, with the push-to-off switch in ON position (not pushed in) i.e. the car door open, adjust the preset VR2 to the required initial brightness of the bulb. Then push the switch in to turn it OFF(or close the door) and adjust VR1 for the time to bring the bulb from full brightness to OFF.

I would suggest you set VR1 and VR2 to their maximum values.

<u>Note: 2N3055 power transistor needs proper heat sink.</u>

P273. Car anti theft wireless alarm





This FM radio-controlled anti- theft alarm can be used with any vehicle having 6- to 12-volt DC supply system. The mini VHF, FM transmitter is fitted in the vehicle at night when it is parked in the car porch or car park. The receiver unit with CXA1019, a single IC-based FM radio module, which is freely available in the market at reasonable rate, is kept inside. Receiver is tuned to the transmitter's frequency. When the transmitter is on and the signals are being received by FM radio receiver, no hissing noise is available at the output of receiver. Thus transistor T2 (BC548) does not conduct. This results in the relay driver transistor T3 getting its forward base bias via 10k resistor R5 and the relay gets energised. When an intruder tries to drive the car and takes it a few metres away from the car porch, the radio link between the car (transmitter) and alarm (receiver) is broken. As a result FM radio module gene-rates hissing noise. Hissing AC signals are coupled to relay switching circ- uit via audio transformer. These AC signals are rectified and filtered by diode D1 and capacitor C8, and the resulting positive DC voltage provides a forward bias to transistor T2. Thus transistor T2 conducts, and it pulls the base of relay driver transistor T3 to ground level. The relay thus gets de-activated and the alarm connected via N/C contacts of relay is switched on. If, by chance, the intruder finds out about the wireless alarm and disconnects the transmitter from battery, still remote alarm remains activated because in the absence of signal, the receiver continues to produce hissing noise at its output. So the burglar alarm is fool-proof and highly reliable.

P274. Automatic Speed Controller for fans & Coolers

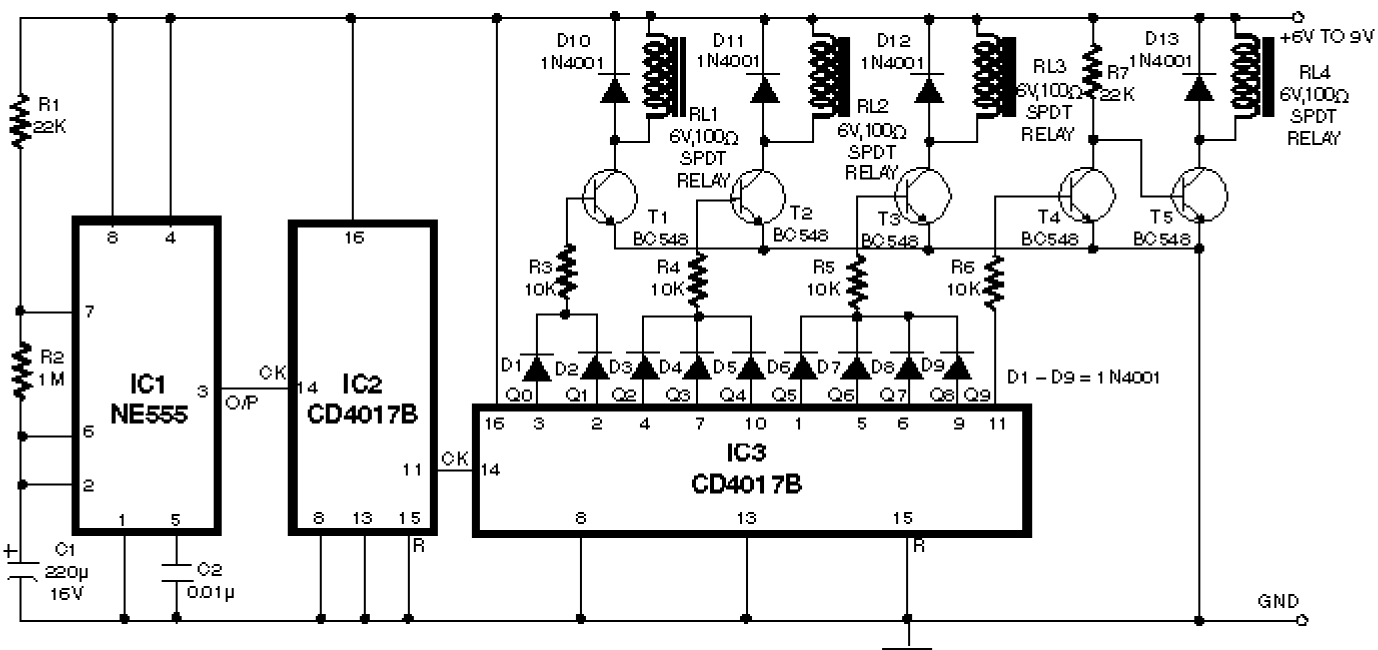


Fig. 1. Circuit diagram for automatic speed control for fans/air-coolers

During summer nights, the temperature is initially quite high. As time passes, the temperature starts dropping. Also, after a person falls asleep, the metabolic rate of one’s body decreases. Thus, initially the fan/cooler needs to be run at full speed. As time passes, one has to get up again and again to adjust the speed of the fan or the cooler.The device presented here makes the fan run at full speed for a predetermined time. The speed is decreased to medium after some time, and to slow later on. After a period of about eight hours, the fan/cooler is switched off.Fig. 1 shows the circuit diagram of the system. IC1 (555) is used as an astable multivibrator to generate clock pulses. The pulses are fed to decade dividers/counters formed by IC2 and IC3. These ICs act as divide-by-10 and divide-by-9 counters, respectively. The values of capacitor C1 and resistors R1 and R2 are so adjusted that the final output of IC3 goes high after about eight hours.The first two outputs of IC3 (Q0 and Q1) are connected (ORed) via diodes D1 and D2 to the base of transistor T1. Initially output Q0 is high and therefore relay RL1 is energised. It remains energised when Q1 becomes high. The method of connecting the gadget to the fan/cooler is given in Figs 3 and 4.

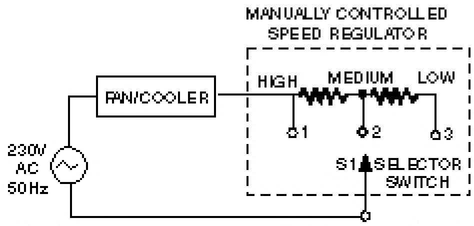


Fig. 2. Existing arrangement for fan speed control

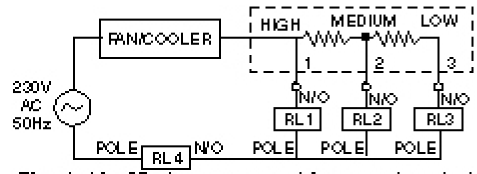


Fig. 3. Modified arrangement for speed control

It can be seen that initially the fan shall get AC supply directly, and so it shall run at top speed. When output Q2 becomes high and Q1 becomes low, relay RL1 is turned ‘off’ and relay RL2 is switched ‘on’. The fan gets AC through a resistance and its speed drops to medium. This continues until output Q4 is high. When Q4 goes low and Q5 goes high, relay RL2 is switched ‘off’ and relay RL3 is activated. The fan now runs at low speed.Throughout the process, pin 11 of the IC is low, so T4 is cut off, thus keeping T5 in saturation and RL4 ‘on’. At the end of the cycle, when pin 11 (Q9) becomes high, T4 gets saturated and T5 is cut off. RL4 is switched ‘off’, thus switching ‘off’ the fan/cooler.Using the circuit described above, the fan shall run at high speed for a comparatively lesser time when either of Q0 or Q1 output is high. At medium speed, it will run for a moderate time period when any of three outputs Q2 through Q4 is high, while at low speed, it will run for a much longer time period when any of the four outputs Q5 through Q8 is high.If one wishes, one can make the fan run at the three speeds for an equal amount of time by connecting three decimal decoded outputs of IC3 to each of the transistors T1 to T3. One can also get more than three speeds by using an additional relay, transistor, and associated components, and connecting one or more outputs of IC3 to it.

In the motors used in certain coolers there are separate windings for separate speeds. Such coolers do not use a rheostat type speed regulator. The method of connection of this device to such coolers is given in Fig. 4.

The resistors in Figs 2 and 3 are the tapped resistors, similar to those used in manually controlled fan-speed regulators. Alternatively, wire-wound resistors of suitable wattage and resistance can be used.

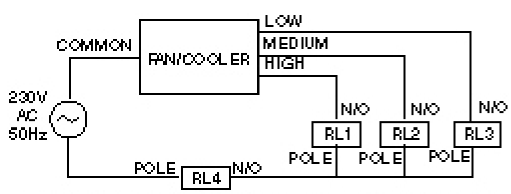
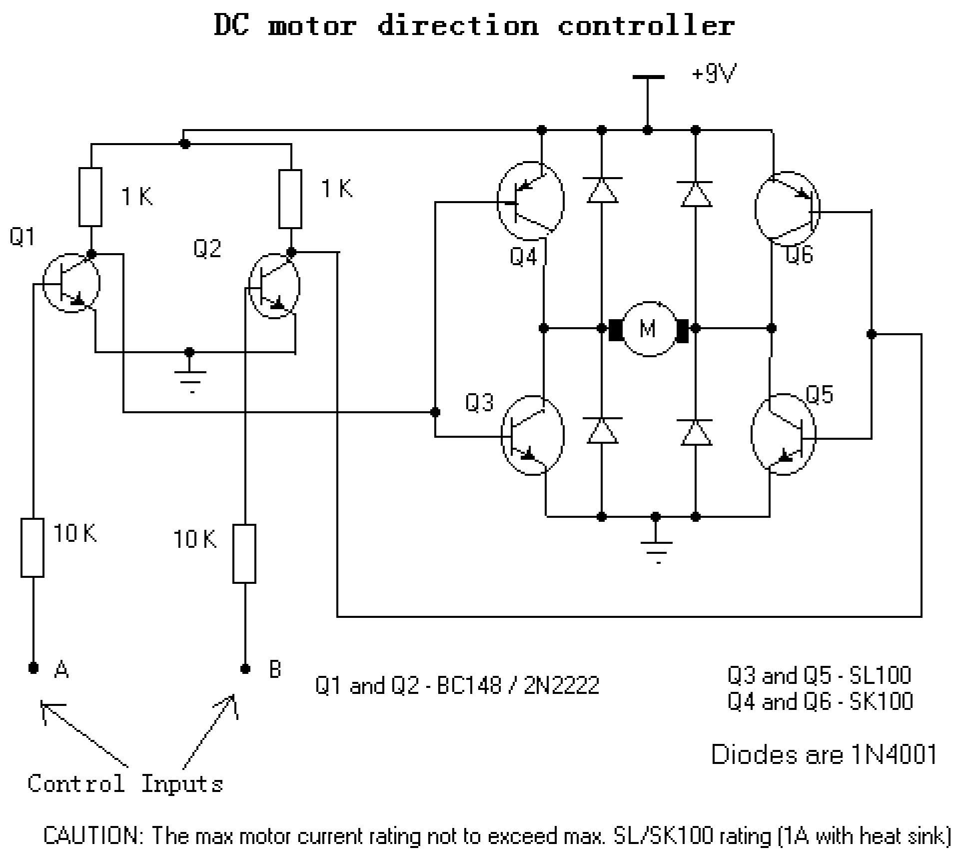


Fig. 4. Speed-control arrangement for cooler with different windings for various speeds

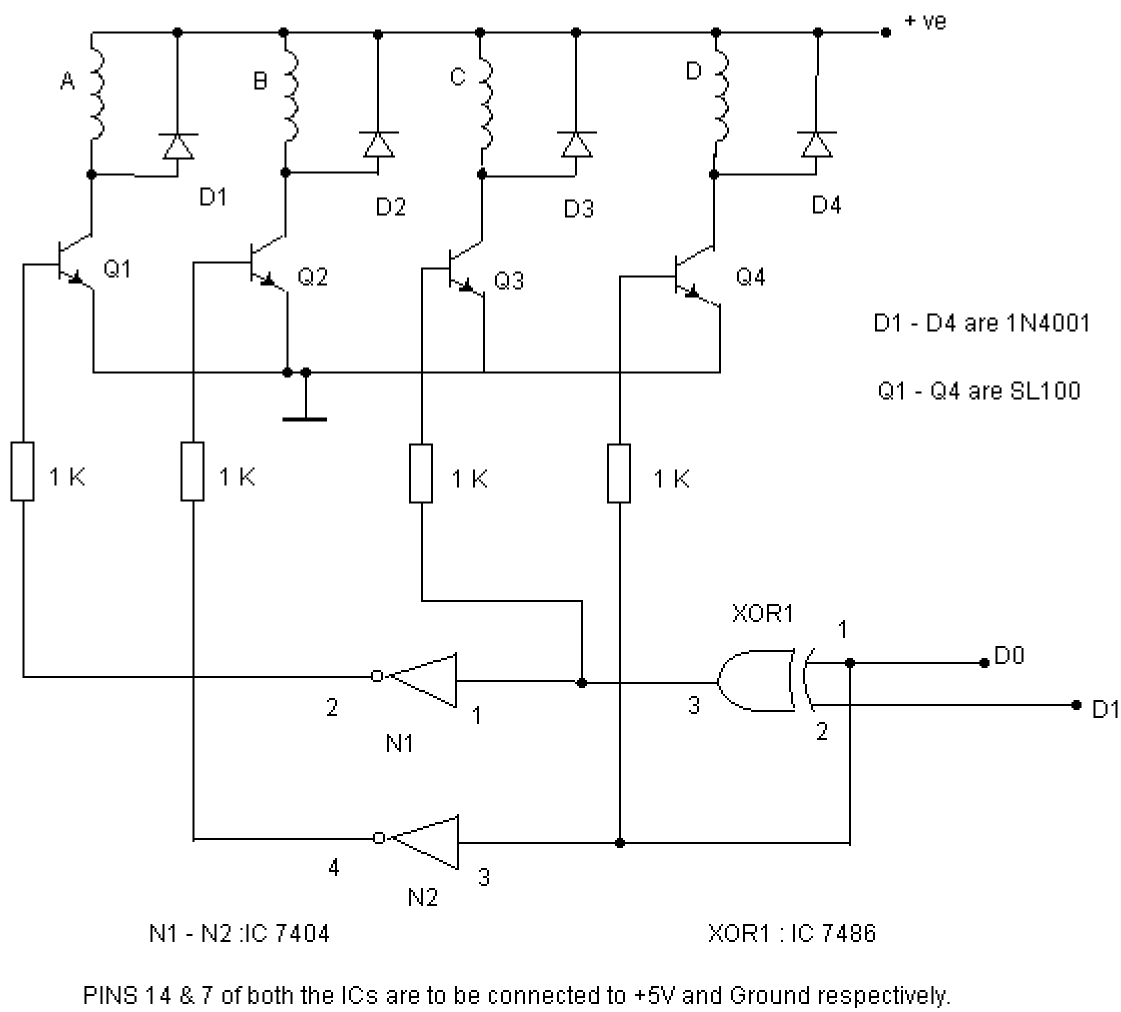
P275. Discrete component motor direction controller



This circuit can control a small DC motor, like the one in a tape recorder. When both the points A & B are "HIGH" Q1 and Q2 are in saturation. Hence the bases of Q3 to Q6 are grounded. Hence Q3,Q5 are OFF and Q4,Q6 are ON . The voltages at both the motor terminals is the same and hence the motor is OFF. Similarly when both A and B are "LOW" the motor is OFF.

When A is HIGH and B is LOW, Q1 saturates ,Q2 is OFF. The bases of Q3 and Q4 are grounded and that of Q4 and Q5 are HIGH. Hence Q4 and Q5 conduct making the right terminal of the motor more positive than the left and the motor is ON. When A is LOW and B is HIGH ,the left terminal of the motor is more positive than the right and the motor rotates in the reverse direction. I could have used only the SL/SK100s ,but the ones I used had a very low hFE ~70 and they would enter the active region for 3V(2.9V was what I got from the computer for a HIGH),so I had to use the BC148s . You can ditch the BC148 if you have a SL/SK100 with a decent value of hFE (like 150).The diodes protect the transistors from surge produced due to the sudden reversal of the motor. The approx. cost of the circuit without the motor is around Rs.40.
Note: You can change the supply voltage depending on the motor, only thing is that it should be a 2 or 3V more than the rated motor voltage(upto a max. of 35V).

P276. Super simple stepper motor controller



The circuit shown above can be used to control a unipolar stepper motor which has FOUR coils (I've swiped it off an old fax machine). The above circuit can be for a motor current of up to about 500mA per winding with suitable heat sinks for the SL100. For higher currents power transistors like 2N3055 can be used as darlington pair along with SL100. The diodes are used to protect the transistor from transients.

Activating sequence:-

Inputs		Coils Energised
D0	D1	
0	0	A,B
0	1	B,C
1	0	C,D
1	1	D,A

To reverse the motor just reverse the above sequence viz. 11,10,01,00.

Alternately a 2bit UP/DOWN counter can also be used to control the direction , and a 555 multi-vibrator can be used to control the speed.

P277. Dome Lamp Dimmer

There are times when a little light inside the car would greatly assist one of the passengers but the dome light is too bright for safe driving. The dimmer circuit in fig. 1 may be added to an existing dome light or included with a new passenger spot lamp. The upper op-amp generates a 700 Hz sawtooth waveform which is compared to a setpoint voltage by the lower op-amp. When the sawtooth voltage is above the setpoint, the transistors turn on supplying current to the bulb.

The setting of the potentiometer determines the width of the pulses sent to the lamp and therefore the average voltage. The lamp is dim when the potentiometer is set near the higher voltage. Since the TIP32 switches on and off instead of simply dropping the voltage like a power rheostat, the power it dissipates remains low and a heat sink is not necessary.

Circuit diagram

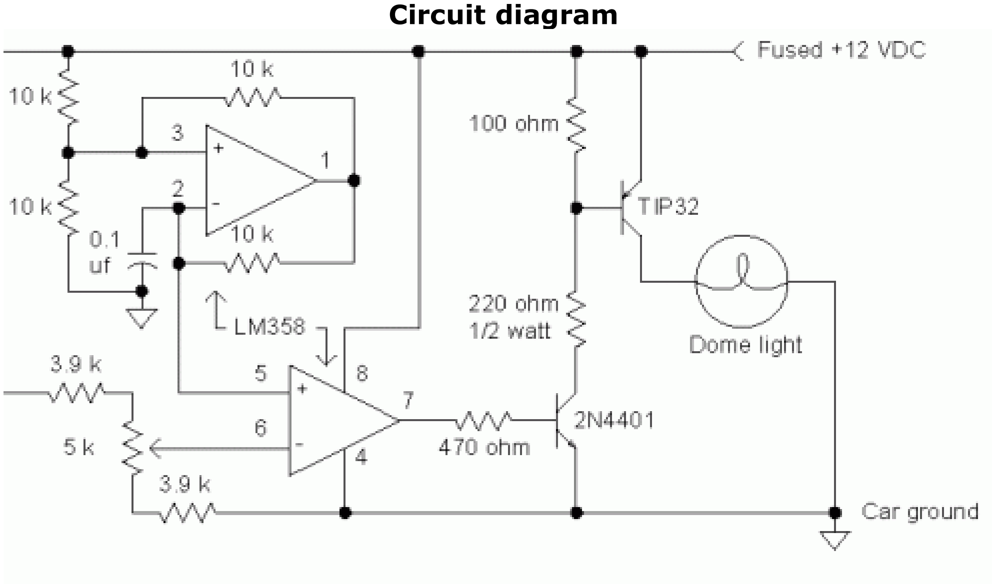


Figure 1: High-efficiency dome light dimmer runs cool.

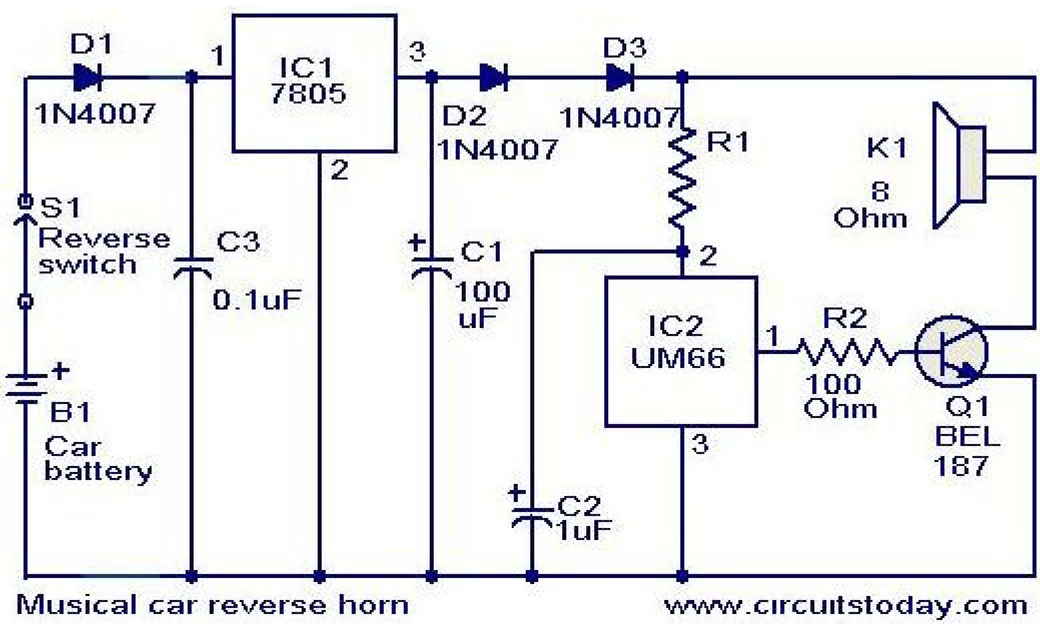
Many autos run power to lamps with only one wire using the car body for the return current path so the dimmer must interrupt the positive lead as shown. Simply cut the wire leading to the lamp and connect the lamp end to the collector of the TIP32 and connect the battery end to the circuit power input. Run an additional ground wire to the auto chassis from the circuit. This ground wire will not carry much current and may be a smaller gauge.

P278. Musical car reverse horn circuit

Description.

Here is a simple circuit that will produce a musical horn when ever your car is in reverse gear.The circuit uses two ICs for the operation ,voltage regulator 7805(IC1) and musical tone generator UM66(IC2).The IC1 reduces the car battery voltage to 5V.The diodes D1 & D2 in combinationÂ produces an additionalÂ drop of 1.4 V to give a 3.6 V supply for the UM66.The supply voltage of UM 66 should notÂ be more than 4V.When ever the car is in reverse gear ,the reverse gear switch of the car gets activated and the circuit gets connected to the car battery.The UM66 starts playing the music tone.The transistor T1 amplifies the output of UM66 to drive the loudspeaker.

Circuit diagram with Parts list.



Notes.

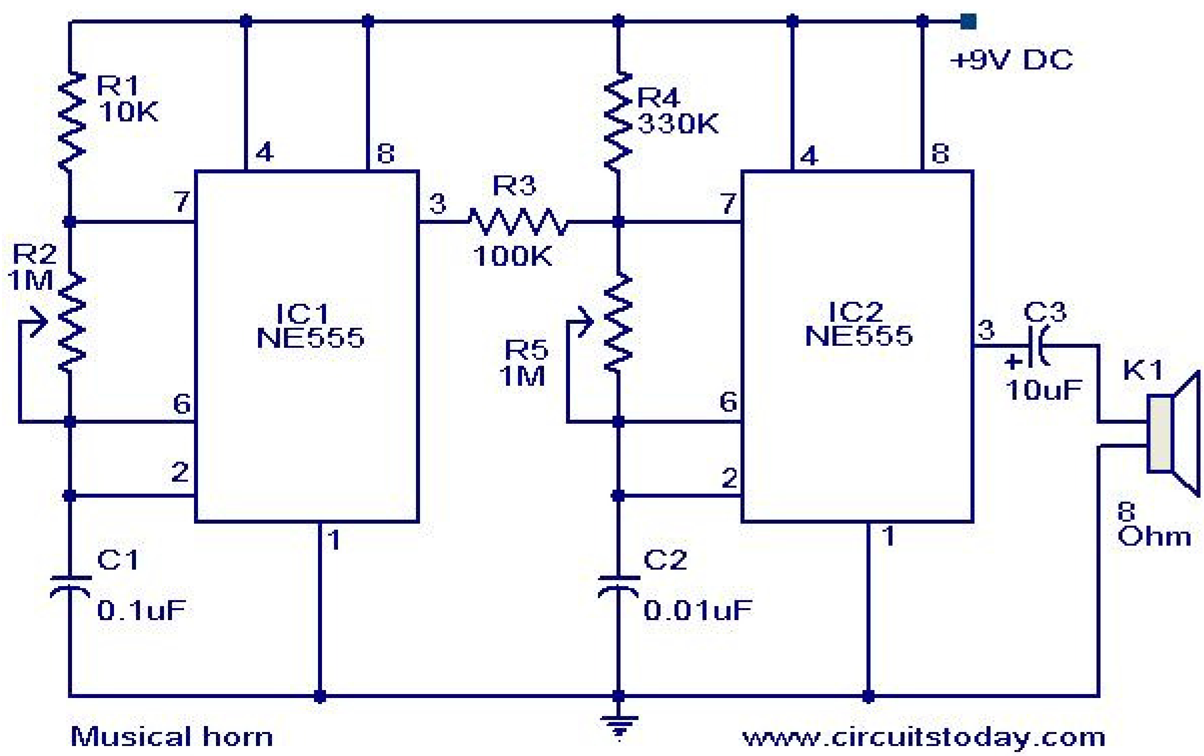
- Assemble the circuit onÂ a good quality PCB or common board.
- Place the circuit on a waterproof place in the dashboard.
- The switch S1 is the reverse gear switch of the car.
- Before attempting the circuit,haveÂ a good idea about the electrical wiring of your car.A wrong connection may damage your car’s electricals.
- The transistor Q1 is not very specific.Any medium power NPNÂ audio transistor will do the job.You could easily find one from your electronics junk box.

P279. Musical horn circuit

Â Description.

Here is a simple circuit diagram of a simple musical horn using two NE555 ICs.Two ICs are wired as astable mutivibrators.The ouput of first multivibrator is given to the discharge (pin 7) of the second astable multivibrator.The combined effect of the astable multivibrators produce a musical tone at the output.

Circuit diagram with Parts list.



Notes.Â

- The sound effect can be adjusted by varying the POTs R2&R5.
- The speaker can be a 8 Ohm tweeter.
- The circuit can be powered from a 9V PP3 battery.
- The ICs must be mounted on holders.
- Â All capacitors must be rated 15V.

POWER

&

HIGH

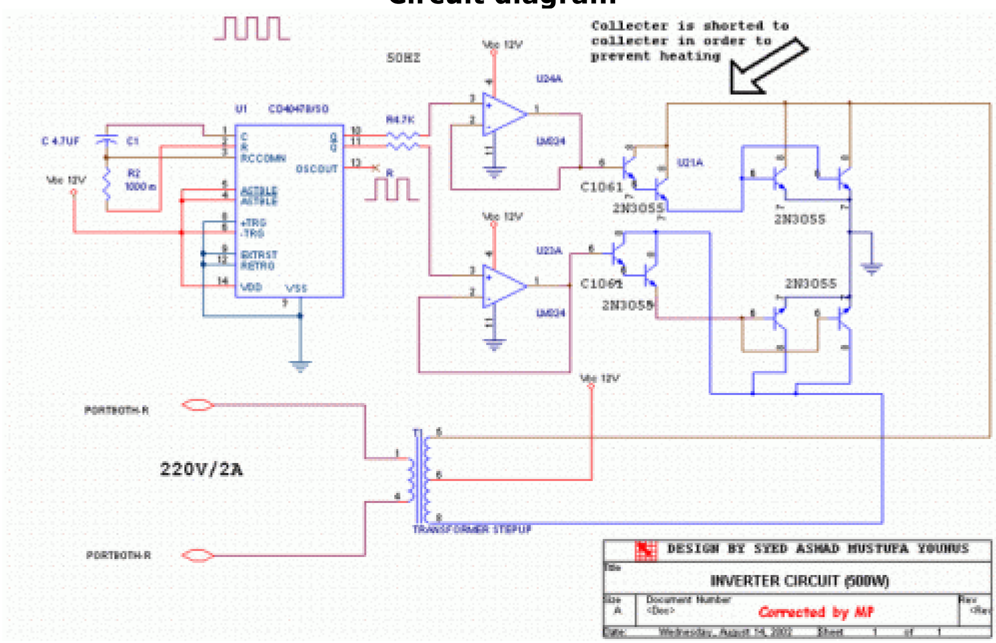
VOLTAGE

P280. 500W low cost 12V to 220V inverter

Attention: This Circuit is using high voltage that is lethal. Please take appropriate precautions

Using this circuit you can convert the 12V dc in to the 220V Ac. In this circuit 4047 is use to generate the square wave of 50hz and amplify the current and then amplify the voltage by using the step transformer.

Circuit diagram



How to calculate transformer rating.

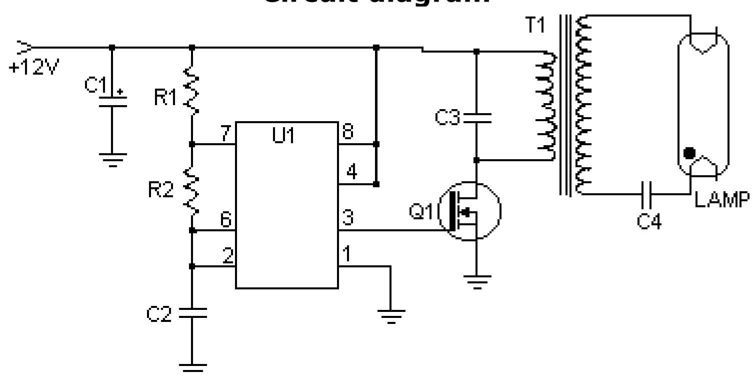
The basic formula is P=VI and between input output of the transformer we have Power input = Power output

For example if we want a 220W output at 220V then we need 1A at the output. Then at the input we must have at least 18.3V at 12V because: 12V*18.3 = 220v*1
So you have to wind the step up transformer 12v to 220v but input winding must be capable to bear 20A.

P281. 12VDC Fluorescent Lamp Driver

It uses a normal 120 to 6V stepdown transformer in reverse to step 12V to about 350V to drive a lamp without the need to warm the filaments.

Circuit diagram



Parts:
C1 100uf 25V Electrolytic Capacitor
C2,C3 0.01uf 25V Ceramic Disc Capacitor
C4 0.01uf 1KV Ceramic Disc Capacitor
R1 1K 1/4W Resistor
R2 2.7K 1/4W Resistor
Q1 IRF510 MOSFET
U1 TLC555 Timer IC
T1 6V 300mA Transformer
LAMP 4W Fluorescent Lamp
MISC Board, Wire, Heatsink For Q1

Notes:

1. Q1 must be installed on a heat sink.

2. A 240V to 10V transformer will work better then the one in the parts list. The problem is that they are hard to find.

3. This circuit can give a nasty (but not too dangerous) shock. Be careful around the output leads.

P282. High And Low Voltage Cut Off With Time Delay

Overview
The power line fluctuations and cut-offs cause damages to electrical appliances connected to the line. It is more serious in the case of domestic appliances like fridge and air conditioners. If a fridge is operated on low voltage, excessive current flows through the motor, which heats up, and get damaged.
The under/over voltage protection circuit with time delay presented here is a low cost and reliable circuit for protecting such equipments from damages. Whenever the power line is switched on it gets connected to the appliance only after a delay of a fixed time. If there is hi/low fluctuations beyond sets limits the appliance get disconnected. The system tries to connect the power back after the specific time delay, the delay being counted from the time of disconnection. If the power down time (time for which the voltage is beyond limits) is less than the delay time, the power resumes after the delay: If it is equal or more, then the power resumes directly.

This circuit has been designed, built and evaluated by me to use as a protector for my home refrigerator. This is designed around readily available semi-conductor devices such as standard bipolar medium power NPN transistor (D313/SL100/C1061), an 8-pin type 741 op-amp and NE555 timer IC. Its salient feature is that no relay hunting is employed. This draw back is commonly found in the proctors available in the market.

The complete circuit is consisting of various stages. They are: - Dual rail power supply, Reference voltage source, Voltage comparators for hi/low cut offs, Time delay stage and Relay driver stage. Lets now look at the step-by-step design details.

Dual rail power supply.

This is a conventional type of power supply as shown in Figure 1. The power is applied through the step-down transformer (230/12-0-12V/500mA). The DC proportional to the charging input voltage is obtained from bridge rectifier. Two electrolytics are there to bypass any spikes present. Bridge is capable of handling currents up to 1 Amp.

Output is given by: -
V(out) = 0.71 X V (secondary)
= 0.71 X 24V
= 17.04 V
(This equation is similar for the negative rail as well)

Circuit diagram

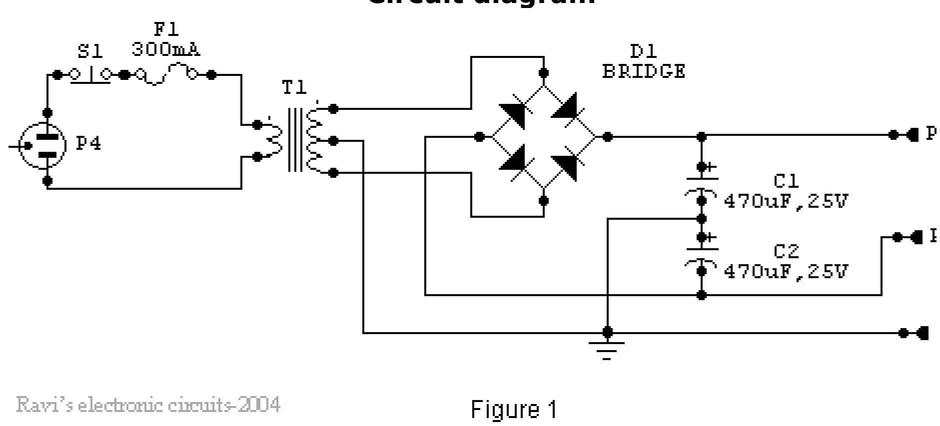


Figure 1

Low voltage cut off op-amp

Figure 2 shows the use of very common and easily available op-amp 741 as a comparator. The op-amp is available in TO-5 and DIP type packing.

Circuit diagram

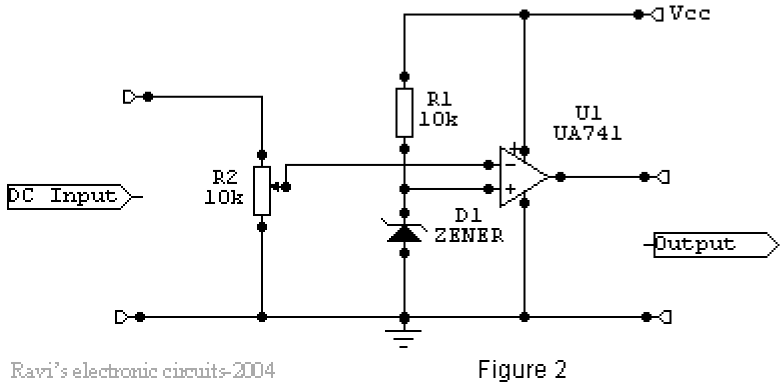


Figure 2

In this ckt the zener diode D1 and it's associated resistor R1 are connected to the non-inverting terminal (+ve) of 741 to give the suitable reference voltage. The DC voltage from the sensor is given to the inverting (-ve) terminal through pre-set R2.This is used to set the input level.

When the sensor input is less than Zener voltage the output from the Op-amp remains high and when it is greater than Zener voltage the output goes low. When the sensing voltage is equal to Zener voltage the output of the op-amp is approximately zero.

This phenomenon is used as a decision for switching the relay and to give cutoff in a low voltage situation.

High voltage cut off op-amp

Here the op-amp is used as a inverted amplifier. See Figure 3.Zener and resistor network gives reference voltage to the inverting terminal (-ve) of op-amp. Sensing voltage derived through the 10 K pre-set is given to the non- inverting (+ve) terminal and this sets the high level cut.

When the input DC from the sensor is less than Zener voltage the output of the op-amp is low and vice-versa. When the input DC voltage is equal to the zener voltage, the op-amps output is approximately zero.

Circuit diagram

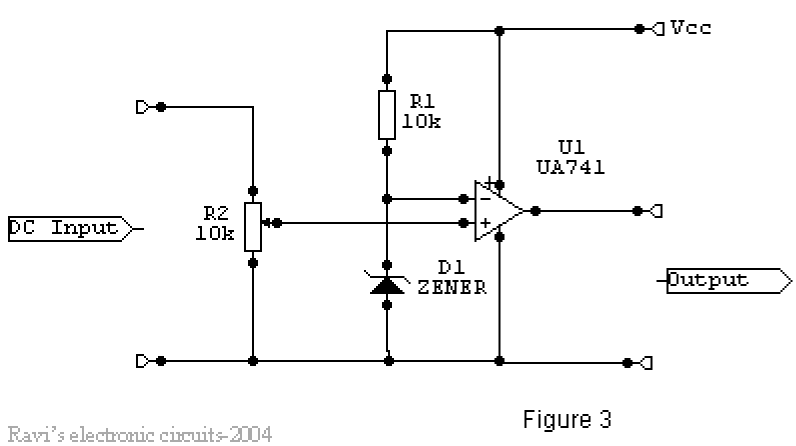


Figure 3

Time delay

I’ve selected the 555 timer due to following reasons.
1. Timing from microseconds through hours.
2. Ability to operate from wide range of supply voltages.
3. High temperature stability.
4. Easily Available.
5. Its triggering circuit is quite sensitive.

This is basically a monostable. The external timing capacitor C2 is held initially discharged by the timer. The circuit triggers upon receiving a pulse to its pin 2 when the level reaches 1/3 Vcc. Once triggered., the circuit will remain in that state until the set time is elapsed or power to the circuit cuts off. The delayed period in seconds is 1.1 C2.R1 where R1 is in megohms and C2 is in microfarads. In practice, R1 should not exceed 20 M. If you use an electrolytic capacitor for C2, select a unit for low leakage. The time delay may have to be adjusted by varying R1 to compensate for the wide tolerance of electrolytics.

Circuit diagram

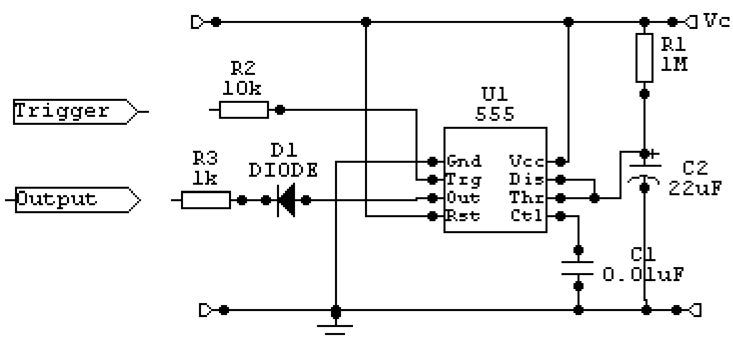


Figure 4

Relay Driver

The output from the voltage level detectors cannot directly drive the relay and hence the relay driver is used.

Circuit diagram

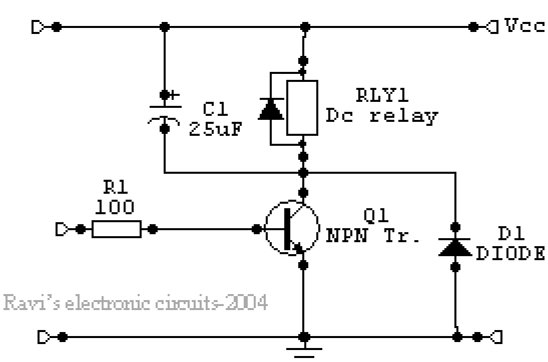


Figure 5.

In this a relay (12V <500 ohms) is connected to the collector of NPN transistor. The out put voltage from the comparator is applied to the base of NPN transistor through a resistance R1. When the output from the comparator is low the transistor is in OFF state and the relay is in de-energized state. Similarly when the output from the comparator goes high the transistor switches ON and the flow of current from the collector to emitter of transistor energizes the relay.

Generally in a relay driver circuit, parallel to the relay coil, a diode or a capacitor is used. This is to eliminate the back e.m.f generated by the relay coil when currents are suddenly broken. Capacitor C1 is connected in parallel to the coil, which filters out the back emf but it, slows down the working of relay.
A better method is to connect two diodes (as shown in the figure 5) that stop the relay – transistor junction swinging more than 600mV above the positive rail or below the zero-volt rail. During normal operation the diodes are reverse biased and have no effect on the performance of circuit. But when back emf is induced, the diodes conduct heavily and absorb all transient voltages. However, I have employed the both methods.

The Complete Circuit

Circuit diagram

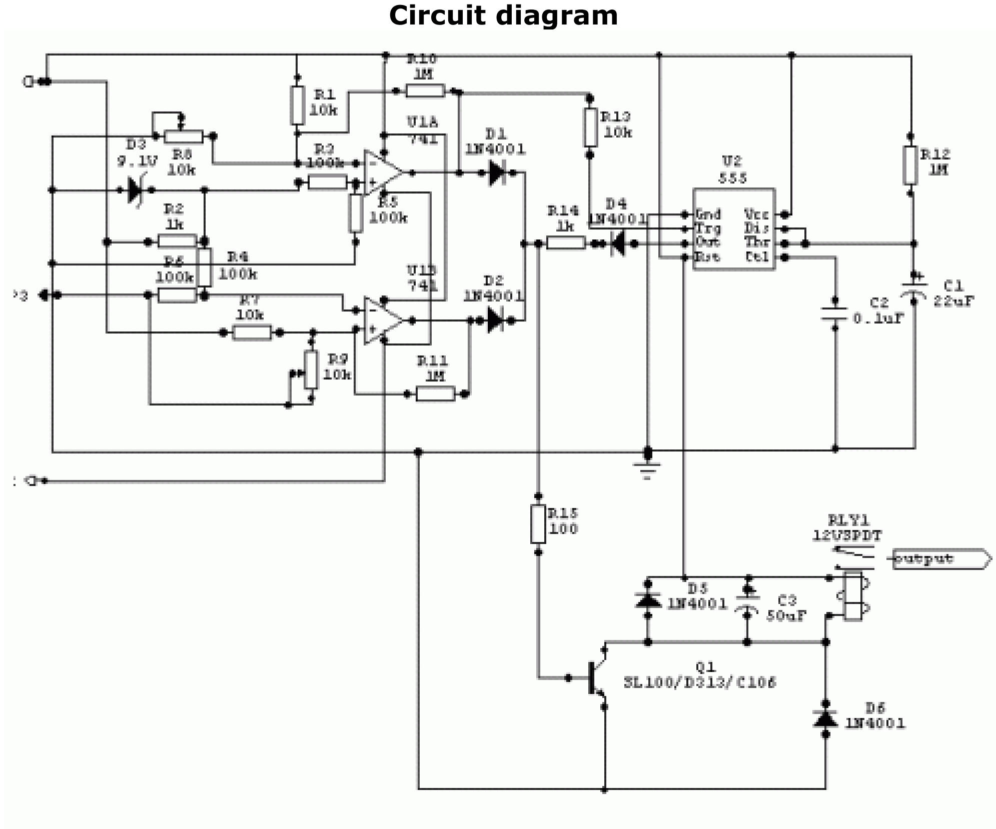


Figure 6

Under normal operating conditions i.e. when the input voltage is between maximum and minimum limit the output from the both the comparators are low. The transistor Q1 is OFF and the relay is in de-energized (pole connected to N/C pin) state and the output is obtained.

When the input voltage is below or above the limits set by the pre-sets R8 or R9, the output of the Op-Amps goes either low or high and diodes D1 or D2 would be forward biased depending on the situation. Transistor Q1 switches ON and the flow of current from collector to emitter energizes the relay and the output is cutoff.

A small amount of hystersis has been added via feed back resistors R10 & R11 so that the relay turns on when the level falls to a particular value but does not turn again until it raises a substantial amount above this value. Other wise the relay contacts will frequently turn on/off and produce chattering.

Construction Hints

1) I used a piece of varoboard, which has copper strips on one side to mount the components, and housed the entire circuit and the transformer in a discarded ATX PC power supply box.

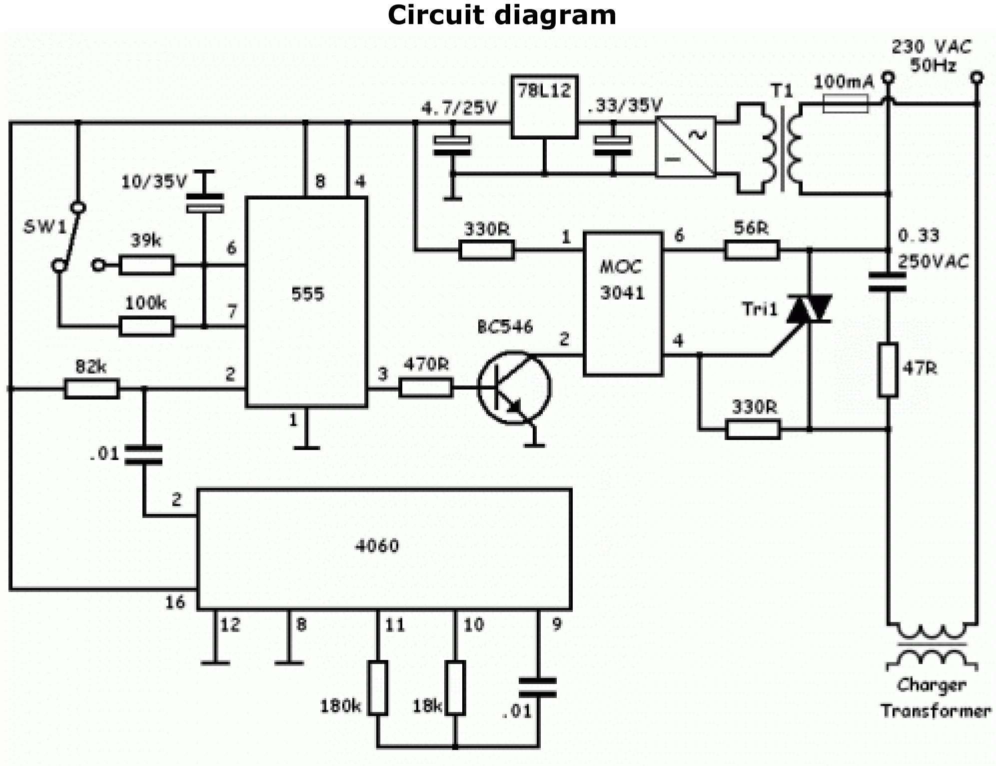
2) An autotransformer has been used to set the limits. Set the output of the autotransformer to 250V AC and connect it to the primary of transformer T1 (see Figure 1). Then adjust the pre-set R9 such that relay just energizes. This is the high limit. Next set the output of the autotransformer to 200V AC and adjust the pre-set R8 such that the relay energizes. Please note that these are my preferred limits but you may select any range from say 170 to 270V AC.
3) A neon with a suitable resistor could be connected between the AC supply lines as an ON indicator. Alternatively, LED with a current limiting resistor could be connected between the relay coil so when the relay is energized LED will indicate the situation.

P283.

Pulse Charger for reviving tired Lead Acid batteries

CAUTION: Before you begin a project like this remember: mains voltage is dangerous so if you are not 100% sure of what you're doing consult a friend who has the skills or, don't do it at all !

Circuit diagram



If you own a motorcycle, a motor home, a caravan, a lawn mover, a day cruiser or maybe a vintage car you must at some point had to write off a lead acid battery. When a battery is improperly charged or allowed to self-discharge as occurs during non-use, sulphate crystals build up on the battery's plates. The sulphate preventing the battery from being fully charged and therefore it is unable to deliver its full capacity. When trying to charge a battery in this state it only gets hot and looses water, the gravity of the electrolyte is not increasing to its normal "full charge" state. The only thing you do is killing the battery completely. If a battery has a resting voltage of at least 1.8 Volts/cell and no cells are shorted, desulphation of its plates can be done. This circuit is an add-on and part for a modification of a normal charger and it takes care of the sulphate problem.

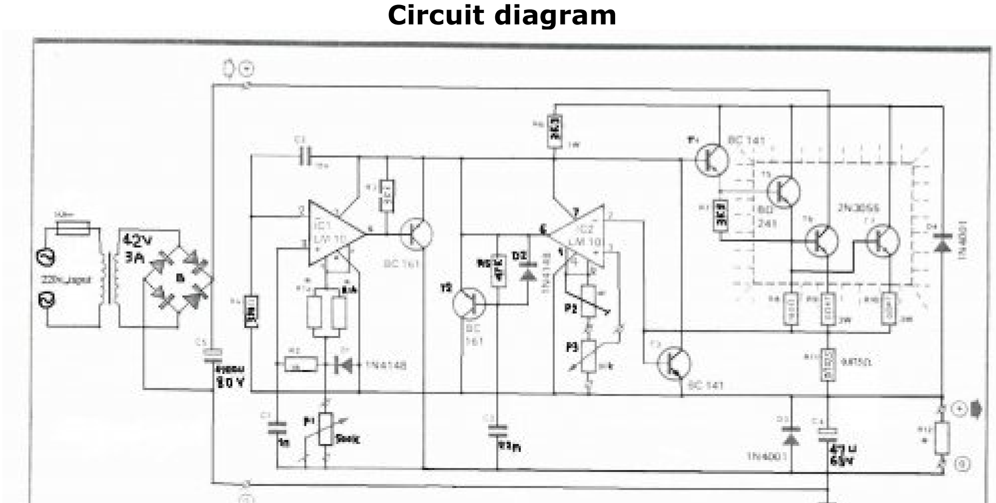
The project: get hold of an old charger, big or small it's your choice depending on the size of batteries you normally handle (bigger is better). There are some tricks to boost the performance if you need it. Start by ripping out everything except the transformer and the rectifier. Some older chargers are equipped with fin rectifiers, which have high voltage drop and must be replaced. Replace with a rugged bridge rectifier that can cope with the amperes. All wiring on secondary should be short and heavy wire. The rectifier should be bolted to the chassis to keep cool. If the charger have a high/low switch it's a bonus, if not you can in some cases add a few turns of wire on the secondary winding. The circuit; a 14-stage ripple counter and oscillator IC 4060 produce a pulse, which is the heartbeat of the circuit. The pulse is feed to the 555 timer that deicide the length of the active output. With the switch you can select long or short pulse output. The output of the 555 timer triggers the zero-cross optoisolator triac driver MOC 3041 via a transistor. This gives the charger transformer a soft start via the triac and the snubber circuit. A small power supply is necessary for the circuit and consists of T1 a transformer 15V 0.1A secondary, a bridge rectifier, a regulator and two caps. Because this project include a charger that is (X) the outcome can differ in performance from one case to another. However this do not mean that your project doesn't work, but the efficiency can vary. Some notes the snubbercap is a high voltage AC type (X) and the resistors on the mains side is at least 0.5W type. Use a triac that can take 400V+ and 10A+, I use BTA 25.600 but this is overkill in most cases. No PCB sorry!

How it works:

Well the short version. The object is to get the cell voltage high enough for the sulphate to dissolve without boiling or melting the battery. This is achieved by applying higher voltage for shorter periods and let the battery rest for a while. The pulses on short range is about 0.5s on / 3s off and the long pulse range is 1.4s on / 2s off. These times can vary depending on component tolerances. Start on long pulse and if you discover "boiling" (more than with normal charging) in the electrolyte switch to short puls. Don't leave the process unattended, at least until you know how your specific version of this project turns out. I built ver.1 of this circuit some 10 years ago and have experimented with it but I'm sure someone can improve it further.

P284. 0-50V 2A Bench power supply

Circuit diagram



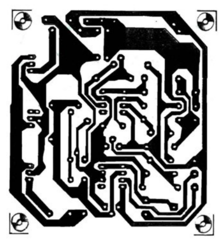
0-50v,,2A dc power suppl y

I use the lm10 IC because it has a reference voltage and that’s useful for dc power supply. With two ICs can take different output voltage and amperage. This circuit is protected from short circuit.P2 is for controlling the current at the range of 0-2A. Stabilize the output voltage with R4 on negative pin on op-amp and with R2 & P1 on positive pin.

Op-amp output controls T1 that not let ripple of voltage.T1 increase or decrease ampere of R6 and control the voltage of T5 & T4. Pin 1 is the reference voltage and reference voltage is losing some voltage on R1 that has 100uA . This current passes through P1 too.

Vlose p1=100uA*Rp1

This lose voltage regulate output voltage rate of output current is compare between reference voltage of P3 and lose voltage on R11.T3 is protecting short circuit with R11. For reduce out put voltage to 0v should parallel one resistor 470 ohm in out put. Minimum voltage is 0.4v. The maximum output voltage is fixed with R1b and should not become over of 50v. Therefore your transformer should give 36V, 3A with 4700uF capacitor. T6, T5, T7 need heatsilk.



R1a = 2,2 K
R1b = read the text
R2 = 10 K
R3, R7 = 3.3 k
R4 = 390 Ohm
R5 = 47 K
R6 = 3.3 K 1Watt
R8 = 180 Ohm
R9, R10 = 0.47 Ohm 3Watt
R11 = 0.075 Ohm 2Watt
R12 = 470 Ohm
P1 = 500K liner potentiometer
P2 = 4.7 K potentiometer
P3 = 10 K potentiometer
C1 = 1nF
C2 = 10nF
C3 = 22nF
C4 = 47mF 63v electrolytic
C5 = 4700mF 80v electrolytic
T1, T2 = BC161
T3, T4 = BD141
T5 = BD241
T6, T7 = 2V3055
D1, D2 = 1N4148
D3, D4 = 1N4001
IC1, IC2 = LM10C

P285. 10 Amp 13.8 Volt Power Supply

Sometimes amateurs like to home-brew their power supplies instead of purchasing one off the shelf at any of the major ham radio retail dealers. The advantage to rolling your own power supply is that it teaches us how they work and makes it easier to troubleshoot and repair other power supply units in the shack. It should be noted that there is no real cost advantage to building your own power supply unless you can get a large power transformer and heat sink for a super low price. Of course rolling our own gives us the ability to customize the circuit and make it even more reliable than commercial units. The circuit in Figure 1 will give us 10 amps (12 amps surge) with performance that equals or exceeds any commercial unit. The circuit even has a current limiting feature which is a more reliable system than most commercial units have. Just like other commercial units, this circuit uses the LM723 IC which gives us excellent voltage regulation. The circuit uses 3 pass transistors which must be heat sinked. Resistor R9 allows the fine tuning of the voltage to exactly 13.8 volts and the resistor network formed by resistors R4 through R7 controls the current limiting. The LM723 limits the current when the voltage drop across R5 approaches .7 volts. To reduce costs, most commercial units rely on the HFE of the pass transistors to determine the current limiting. The fault in that system is that the HFE of the pass transistors actually increases when the transistors heat up and risks a thermal runaway condition causing a possible failure of the pass transistors. Because this circuit samples the collector current of the pass transistors, thermal runaway is not a problem in this circuit making it a much more reliable power supply. The only adjustment required is setting R9 to the desired output voltage of anywhere between 10 and 14 volts. You may use a front panel mounted 1K potentiometer for this purpose if desired. Resistor R1 only enhances temperature stability and can be eliminated if desired by connecting pins 5 and 6 of IC-1 together. Although it really isn't needed due to the type of current limiting circuit used, over voltage protection can be added to the circuit by connecting the circuit of Figure 2 to Vout. The only way over voltage could occur is if transistors Q2 or Q3 were to fail with a collector to emitter short. Although collector to emitter shorts do happen, it is more much more likely that the transistors will open up when they fail.

Circuit diagram

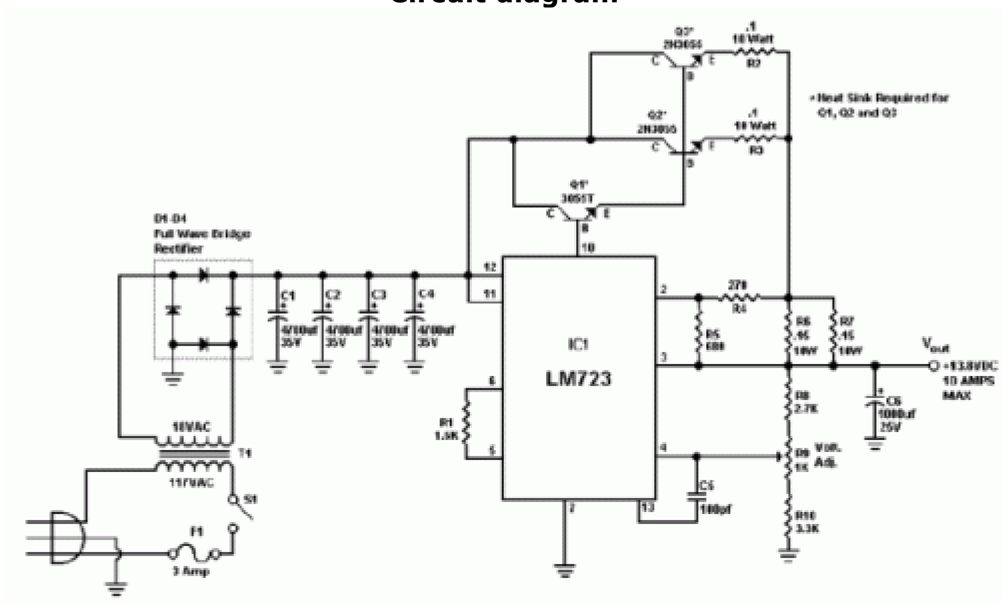


Figure 1

I actually tested this and purposely destroyed several 2N3055's by shorting the emitters to ground. In all cases the transistors opened up and no collector to emitter short occurred in any transistor. In any event, the optional circuit in Figure 2 will give you that extra peace of mind when a very expensive radio is used with the power supply. The circuit in Figure 2 senses when the voltage exceeds 15 volts and causes the zener diode to conduct. When the zener diode conducts, the gate of the SCR is turned on and causes the SCR to short which blows the 15 amp fuse and shuts off the output voltage. A 2N6399 (Tech America) was used for the SCR in the prototype but any suitable SCR can be used. While over voltage protection is a good idea, it should not be considered a substitute for large heat sinks. I personally feel the best protection from over voltage is the use of large heat sinks and a reliable current limiting circuit. Be sure to use large heat sinks along with heat sink grease for the 2N3055 transistors. I have used this power supply in my shack for several months on all kinds of transceivers from HF, VHF to UHF with excellent results and absolutely no hum. This power supply will be a welcome addition to your shack and will greatly enhance your knowledge of power supplies.

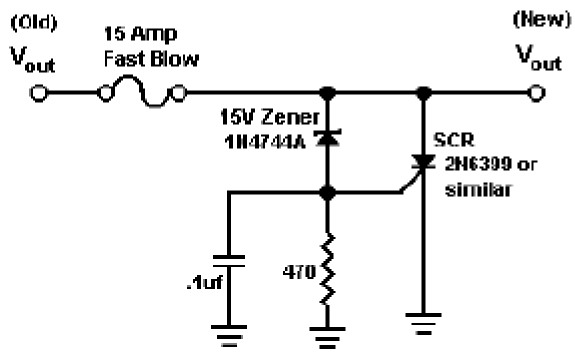


Figure 2

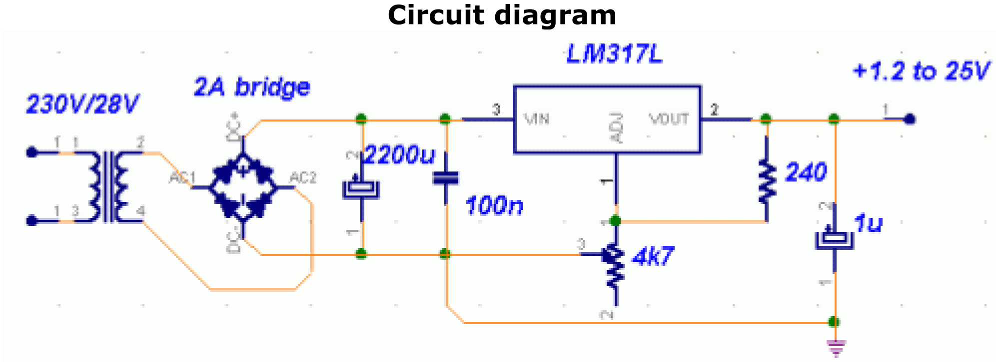
Parts

R1 1.5K ¼ Watt Resistor (optional, tie pins 6 & 5 of IC1 together if not used.)
R2,R3 0.1 Ohm 10 Watt Resistor (Tech America 900-1002)
R4 270 Ohm ¼ Watt Resistor
R5 680 Ohm ¼ Watt Resistor
R6,R7 0.15 Ohm 10 Watt Resistor (Tech America 900-1006)
R8 2.7K ¼ Watt Resistor
R9 1K Trimmer Potentiometer (RS271-280)
R10 3.3K ¼ Watt Resistor
C1,C2,C3,C4 4700 Microfarad Electrolytic Capacitor 35 Volt (observe polarity)
C5 100 Picofarad Ceramic Disk Capacitor
C6 1000 Microfarad Electrolytic Capacitor 25 Volt (observe polarity)
IC1 LM723 (RS276-1740) Voltage Regulator IC. Socket is recommended.
Q1 TIP3055T (RS276-2020) NPN Transistor (TO-220 Heat Sink Required)
Q2,Q3 2N3055 (RS276-2041) NPN Transistor (Large TO-3 Heat Sink Required)
S1 Any SPST Toggle Switch
F1 3 Amp Fast Blow Fuse
D1-D4 Full Wave Bridge Rectifier (RS276-1185)
T1 18 Volt, 10 Amp Transformer Hammond #165S18 (Tech America 900-5825)

P286. LM317 VARIABLE POWER SUPPLY

Follow all the safety precautions when working with mains voltage. Insulate all connections on the transformer.

Circuit diagram



Description:

A truly timeless circuit. LM317 is a versatile and highly efficient 1.2-37V voltage regulator that can provide up to 1.5A of current with a large heat sink. It's ideal for just about any application. This was my first workbench power supply and I still use it.

Since LM317 is protected against short-circuit, no fuse is necessary. Thanks to automatic thermal shutdown, it will turn off if heating excessively. All in all, a very powerful (and affordable!) package, indeed.

Although LM317 is capable of delivering up to 37V, the circuit pictured here is limited to 25V for the sake of safety and simplicity. Any higher output voltage would require additional components and a larger heat sink.

Make sure that the input voltage is at least a couple of Volts higher than the desired output. It's ok to use a trimmer if you're building a fixed-voltage supply.

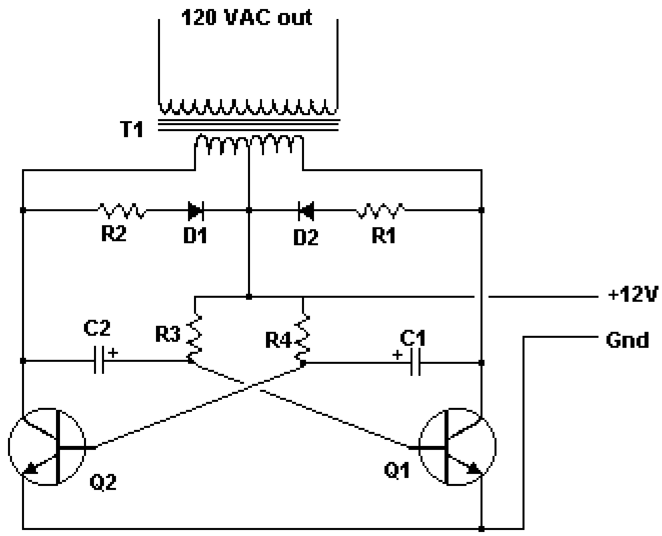
Possible uses:

Variable workbench power supply, fixed-voltage supply... Just about any possible application when no more than 1.5A is necessary.

P287. Inverter

Have you ever wanted to run a TV, stereo or other appliance while on the road or camping? Well, this inverter should solve that problem. It takes 12 VDC and steps it up to 120 VAC. The wattage depends on which tansistors you use for Q1 and Q2, as well as how "big" a transformer you use for T1. The inverter can be constructed to supply anywhere from 1 to 1000 (1 KW) watts.

Circuit diagram



Parts:
C1, C2 68 uf, 25 V Tantalum Capacitor
R1, R2 10 Ohm, 5 Watt Resistor
R3, R4 180 Ohm, 1 Watt Resistor
D1, D2 HEP 154 Silicon Diode
Q1, Q2 2N3055 NPN Transistor (see "Notes")
T1 24V, Center Tapped Transformer (see "Notes")
MISC Wire, Case, Receptical (For Output)

Notes:

Q1 and Q2, as well as T1, determine how much wattage the inverter can supply. With Q1,Q2=2N3055 and T1= 15 A, the inverter can supply about 300 watts. Larger transformers and more powerful transistors can be substituted for T1, Q1 and Q2 for more power.

The easiest and least expensive way to get a large T1 is to re-wind an old microwave transformer. These transformers are rated at about 1KW and are perfect. Go to a local TV repair shop and dig through the dumpster until you get the largest microwave you can find. The bigger the microwave the bigger transformer. Remove the transformer, being careful not to touch the large high voltage capacitor that might still be charged. If you want, you can test the transformer, but they are usually still good. Now, remove the old 2000 V secondary, being careful not to damage the primary. Leave the primary in tact. Now, wind on 12 turns of wire, twist a loop (center tap), and wind on 12 more turns. The guage of the wire will depend on how much current you plan to have the transformer supply. Enamel covered magnet wire works great for this. Now secure the windings with tape. Thats all there is to it. Remember to use high current transistors for Q1 and Q2. The 2N3055's in the parts list can only handle 15 amps each.

Remember, when operating at high wattages, this circuit draws huge amounts of current. Don't let your battery go dead :-).

Since this project produces 120 VAC, you must include a fuse and build the project in a case.

You must use tantalum capacitors for C1 and C2. Regular electrolytics will overheat and explode. And yes, 68uF is the correct value. There are no substitutions.

This circuit can be tricky to get going. Differences in transformers, transistors, parts substitutions or anything else not on this page may cause it to not function.

P288. POT-PLANT POWER

Following a hunch, the author discovered (or re-discovered?) that all plants carry an electric charge relative to the ground. This charge is more or less constant regardless of the size of the plant - a kind of "background voltage" in nature. This electric charge suffuses the entire plant, from its roots to its leaves and fruit. It was measured between a chrome-plated pin inserted into the plant (the positive terminal) and an iron spike driven into the ground (the negative terminal).

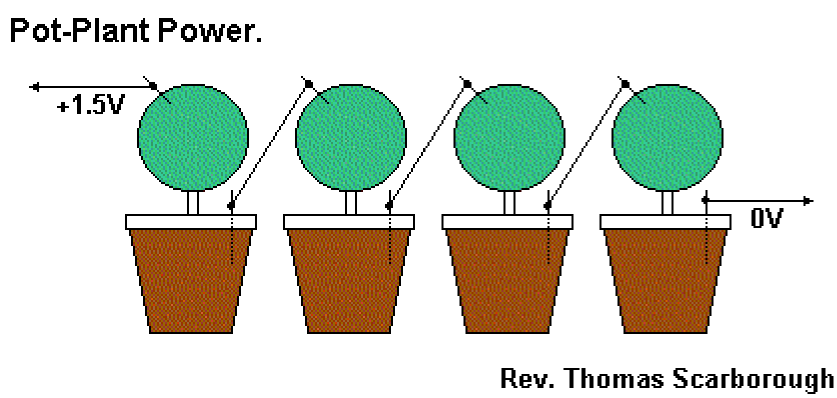
A number of explanations have been suggested in discussions:

• That the plant itself generates an electric charge to control its various functions.

• That the plant is picking up electromagnetic waves from power pylons or radio transmissions. Or

• That the pin and iron spike are generating a small voltage by means of electrolysis.

At any rate, the voltage present in plants may be harnessed to power a highly efficient circuit such as a "potato clock". This is done by wiring four or more plants in series. Garden plants, of course, share a common earth, and cannot therefore be wired in series. However, the author found that pot-plants can be wired in series, since each has a separate earth (see Fig.1).



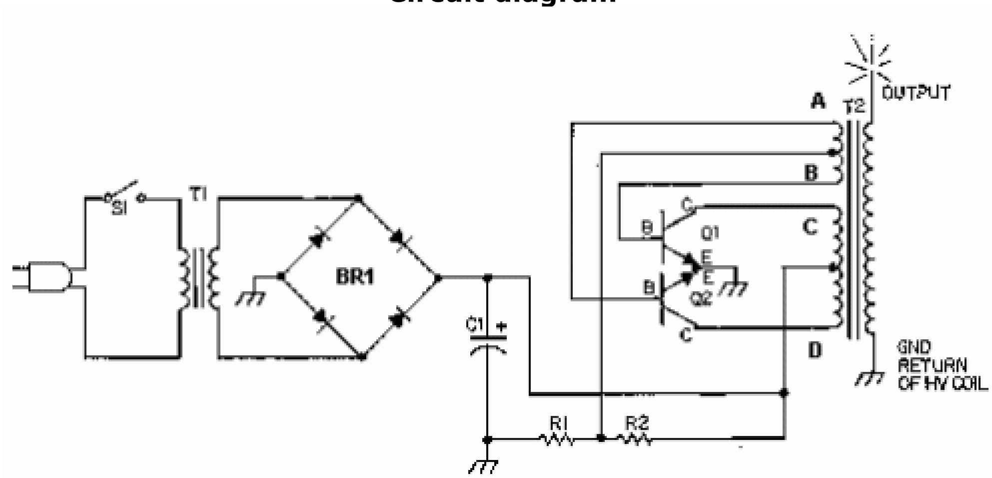
When electrical energy is tapped from a plant, the voltage in the plant drops about 20% within half a second, then settles at around 400mV, while current settles more slowly to one or two µA d.c. D.c. current may be increased by wiring together a few positive terminal pins across the same plant.

A curious feature noted by the author is that plants generated a variable a.c. waveform of a few kilohertz. This could also have a number of explanations. Do contact the author if you have any interesting experiments or new observations (see the e-mail address at the top of this article).

P289. Solid State Tesla Coil/High Voltage Generator

This is a fun and useful circuit for demonstrating high frequency high voltge. It can produce up to about 30KV, depending on the transformer used. It is cheap and easy to make, thanks to the standard TV flyback transformer used. It can power LASERS (although I have never tried), demonstrate St.Elmo's fire, and even cause a fluorescent bulb to light from as much as 2 feet away.

Circuit diagram



Parts
R1 27 Ohm 5W Resistor or 27 Ohm 10W Resistor
R2 240 Ohm 5W Resistor or 240 Ohm 10W Resistor
BR1 50 Volt, 6 Amp Bridge Rectifier
C1 8000uf, 35 Volt Capacitor
Q1, Q2 2N3055 NPN Power Transistor
T1 24V 5A Transformer (See "Notes")
T2 TV Flyback Transformer (See "Notes")
S1 115V 3A SPST Switch
MISC Case, Wire, Heatsinks, Line Cord

Notes

1. T2 is a high voltage flyback transformer salvaged from an old TV, or ordered from Fair Radio Sales (see Where To Get Parts). Look for the biggest, most intimidating transformer you can find. Old tube TV's are a good place to look. The transformer should not have a rectifier built in.
2. You will need to rewind the transformer's primary. First, remove the old primary, being careful not to damage the high voltage secondary. If the transformer is wound with all windings incased in plastic, use another transformer. Second, wind on 5 turns of 18 AWG wire, twist a loop (center tap), and then wind on 5 more turns. This becomes winding C-D. Now, wind on 2 turns of 22 AWG wire, twist a loop, and wind on 2 more turns. This becomes winding A-B.
3. Q1 and Q2 will run HOT if not used with a large heatsink. After the circuit has been running for a minute or two, you should still be able to put your finger on the transistors without being burnt. Also, R1 and R2 will run hot.
4. If you experience arcing on the exposed transformer leads, select a lower voltage for T1. If you are powering the circuit with a power supply (see Power Supply), just crank down the voltage.
5. For a real high voltage output, connect a voltage multiplier (from an old TV or computer monitor) to the output of T2.
6. If the circuit does not work, reverse connections A and B.
7. I finally got around to taking some pictures of the circuit in operation. Here they are:

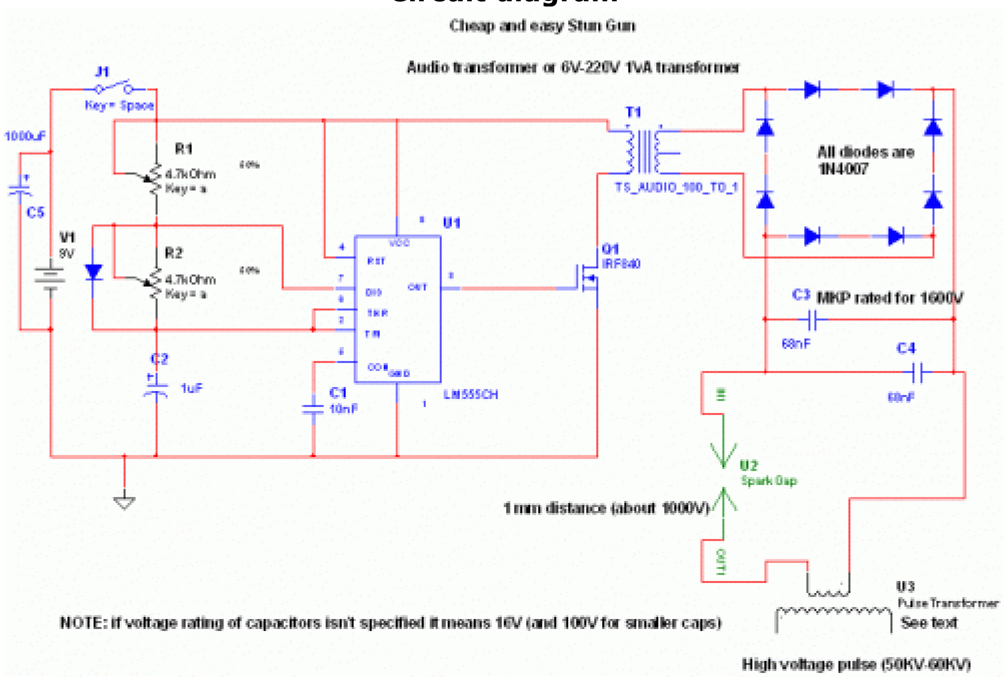
The first picture is the high voltage generator without the voltage multiplier. Notice how hot the arc looks. The second picture is the high voltage generator with a voltage multiplier installed. Notice how much brighter the arc is.

The above pictures of myself were taken with me standing on an pie plate that was resting on the top of a plastic bucket. The pie plate was connected to the high voltage generator and charged to about 40,000V. If you do this, be sure to have someone else turn on and off the high voltage generator. Also, don't touch anything when you are charged. Have everything you are going to hold/play with already sitting on the bucket and away from grounded objects. Remember to take off your watch...

P290. High Voltage Stun Gun

Disclaimer: As i have seen before, IT IS NOT A TOY, DON'T DO ANYTHING STUPID WITH IT. I DON'T ACCEPT ANY RESPONSIBILITY OF DAMAGES DONE TO OTHER PEOPLE OR YOURSELF WITH THIS DEVICE. IF YOU WANT TO BUILD IT YOU MUST ACCEPT THIS CONDITION. Using the procedures described above would prevent you from any damages/troubles. Don't carry it in streets or public places if they are banned in your country, and don't use it near electronic devices. As the wise man says use it like a deterrent, even against animals.

Circuit diagram



Read before building:

This device produces high voltage pulses discrupting muscles and nervous sYstem, leaving anyone who touches it in a state of menthal confusion. Can be used agains ferocious animals or attackers, BUT REMEMBER, this device may be illegal in your state (for eg where I live, these devices are banned). It is quite dangeros for peoples experiencing cardiac problems, and for electronic equipment (like peacemakers), since it generates some RF. Don't attept irresponsible actions with this device, it is not a toy.

After the introduction let's pass to the circuit.

The 555 IC is wired as a astable to produce square wave with adjustable freq and duty cycle (notice the potentiomenters and diode). This square wave is feed to a IRF840 Mosfet (no need of totem transistors since freq is low and the IC has enough current capability to rapidly charge/discharge the gate). As a substitute of the mosfet, a bipolar transistor can be used (and a 100ohm resistor between 555 and base of the transistor). Valid BJT can be BU406, but also smaller BJT can be ok, keep in mind that it must handle at least 2A continuous. The inductive kick snubber isn't needed because the power is low and it is almost totally adsorbed to charge the tank capacitor, in addition since this device is battery operated we don't want to dissipate the power on a resistor but we want it in sparks. With a snubbing network you will experience lower firing rates. USE A PUSHBUTTON SWITCH FOR SAFETY

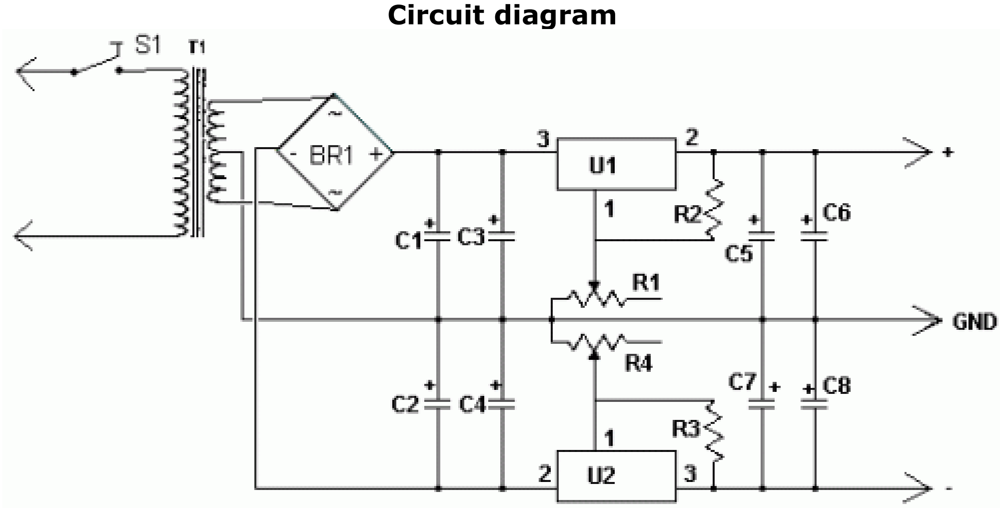
Construction of T2: this is the real boring part. Since it is unlikely to find it in shops we need to build them. Materials needed: enamel copper wire (0,20 mm or 0,125 mm), ferrite stick, LDPE sheets (0,25 mm). Secure the ferrite stick with a layer of ldpe (polyethilene, as a substiture use electric insulating tape) and glue it (or tape it) Place 200-250 windings on the ldpe (even more windings if the stick is more than 1'), another ldpe layer, another 200-250 windings and so on to finally have 5-6 layers (approx 1000-1400 turns but even more doesn't hurt performance, but be careful for internar arcing that will ruin it). Insulate it again and place the primary winding, 15-20 turns of 1mm wire are just ok, too much windings (too mush resistance and inductance) will lead to smaller current and smaller spike in T2 secondary because of lower rise time,and too few will not saturate the core. I chosen MKP capacitors because they have low ESR and ESL (they are widely used in tesla coils as mmc capacitors).

The spark gap can be simple two crossed (but not touching) 1 mm spaced wires. It acts as a voltage controlled switch, firing when the voltage is enough to ionize the air between them (turning it to plasma with small resistance). Keep in mind that it would be wise do place it into a small plastic container and fill with oil letting bubbles out (don't use motor oir or frying oil but pure mineral oil which has no water in it.

P291. Dual Polarity Power Supply

This dual polarity power supply is easy to build, requires few parts, and is adjustable from 0-15 volts. It is great for powering op amp circuits, as well as other circuits that require a dual supply voltage.

Circuit diagram



Parts
C1, C2 2200uF 35V Electrolytic Capacitor
C3, C4, C5, C7 1uF 35V Electrolytic Capacitor
C6, C8 100uF 35V Electrolytic Capacitor
R1, R4 5K Pot
R2, R3 240 Ohm 1/4 W Resistor
BR1 2A 30V Bridge Rectifier
U1 LM317 Adjustable Positive Regulator
U2 LM337 Adjustable Negative Regulator
T1 30V Center Tapped 2 Amp Transformer

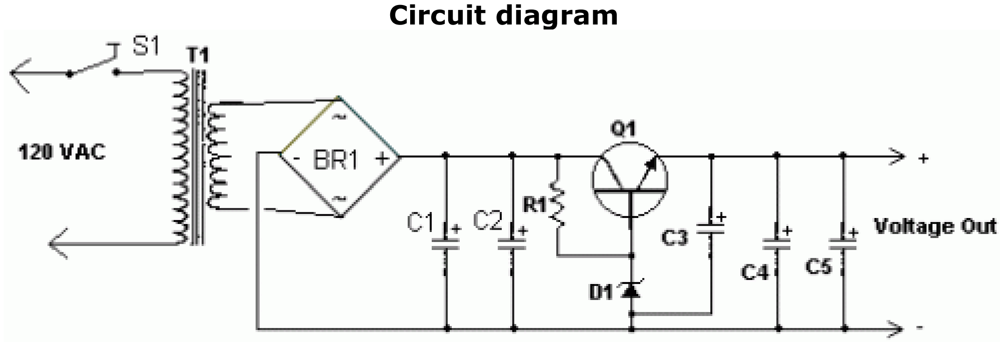
S1 SPST 2 Amp Switch
MISC Heatsinks For U1 And U2, Line Cord, Case, Knobs For Pots, Wire

Notes
1. Since this project operates from 120 (or 220, or 240, etc.) volts AC, it MUST be built inside a case.
2. U1 and U2 get quite hot and will require heatsinks. A fan is usually not needed.
3. You can, of course, add a volt and amp meter.
4. U1 and U2 can only go down to a minimum of +-1.2V. If you need to go lower, you can add two 1N4003 diodes in series with the output of the regulator. The diodes drop about 0.6V each, which will allow the supply to go to 0. Note that this will also decrease your maximum output voltage by 1.2V. (Thanks to Steve Horvath, horvaths@techcomnet.com for the suggestion).

P292. High Current Power Supply

Since my page was first posted, I have received a number of emails asking about a high current power supply. I looked around, but couldn't find one that was suitable. So, I designed this. It is a linear supply, which might have a few of you rolling your eyes, but it takes very few parts, is simple to build and can supply huge currents.

Circuit diagram



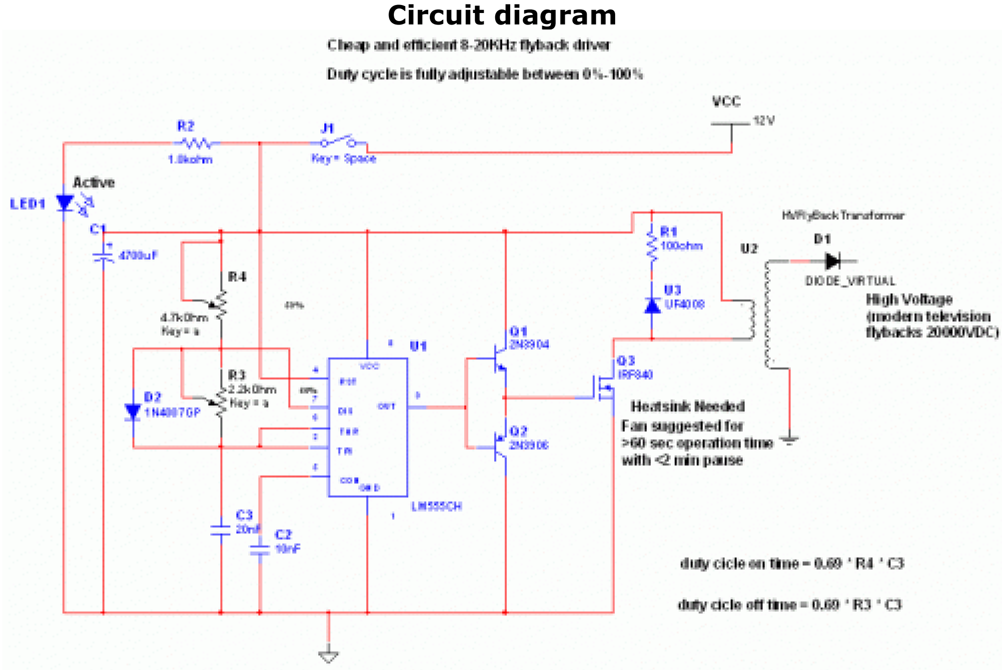
Parts
R1 680 Ohm 1/4 Watt Resistor
C1 20,000 - 50,000uF 20-40 Volt Capacitor
C2, C3 100uF 50 Volt Capacitor
C4 0.1uF 50 Volt Capacitor
C5 0.01uF 50 Volt Capacitor
D1 Zener Diode (See Notes)
Q1 2N3055 Or Other (See Notes)
T1 Transformer (See Notes)
BR1 Bridge Rectifier (See Notes)
S1 SPST 250 VAC 10 A Switch
MISC Case, Line Cord, Heatsink For Q1, Binding Posts For Output

Notes
1. D1 should be rated at about one volt higher than then desired output of the supply. A half watt diode will do.
2. Q1 can be a transistor similar to the 2N3055. I chose the 2N3055 for it's availability and power handling (150 watts).
3. T1 should be about 5 volts higher than the desired output of the supply, and rated for about one amp more of current. The voltage overhead is required by the regulator section. The extra current is to keep the

transformer from over heating.
4. The choice of BR1 will depend on the voltage and current of your transformer. The rectifier should be rated for 50 volts more than the transformer, and 5 amps more than the transformer.
5. The value of R1 will be smaller when supplying high currents. Expiriment until you get what you need.
6. Heatsink and fans are absolutely necessary!

P293. Flyback Transformer Driver

Circuit diagram



General Description and circuit operation:

This is an efficient flyback driver for modern cylindrical rectified television flybacks. Many sites doesn't provide circuits driving these transformers, they simply say that they are bad.

I don't agree. In fact I built this circuit. I spent a lot of time for finding resonant frequency (around 15Khz) and duty cycle. These transformers best work at around 90% duty cycle. You may notice corona breakdown at terminals and pfffff sound (as well as the ozone smell) when adjusting the off time trimmer to near 500-300 ohms. Of course it will work for other tipes of flyback as frequency and duty cycle have a large range.

Frequency range can be increased using multiposition switch for other values of C3 capacitor ,for example 2 nF for 80KHz-200000KHz, but didn't found flybacks with so high resonant frequencies, in addition with higher values of c3 , eg 200nF, 2uF the

frequency will drop making possible the use of ignition coils, and rectified power transformers @50Hz to charge high voltage electrolitic caps at 300-400V). Unfortunately my ignition coil died because insulation breakdown (too long drawn arcs)...

I was able to power a small (20cm) Spark Gap tesla coil Using these dc rectified flybacks to charge primary tank capacitor.

The operation is simple

The 555 is wired as an astable and the capacitor is charged only through the 4,7Kohm trimmer (notice the diode) and discharged only through the 2.2 Kohm trimmer, making the duty cycle full adjustable. The square wave is then feed in a totem pole made up of a 2N3904 and a 2N3906, which are cheap, and easy to find. The totem pole ensures the gate being charged and discharged very fast (approx 50nS i think). The IRF840 is a cheap (i found it for 4euros) reliable and powerful power mosfet, it has current capability of 8 A continuous and 32A pulse, 800V drain source voltage, protecting internal zener diode. There is a snubbing network to ensure that voltage spikes are kept low (unless the insulation of the transformer start to leak) protecting both transistors and 555 IC. 100 ohm is a compromise between decay time and voltage spike.

Comments and specifications:

The 100 ohm snubber must me a 5W resistor, or it will burn at long operations
The led is only for safety purposes
Use a dead man switch (pushbutton) for safety
The power supply must supply at least 2-3 A if you want decent arcs (20000 KV)

Dangers:

The flyback driven in this way can supply a significant current, aldough the heart fibrillation starts at 30Ma.

I recommend caution to avoid painful arc-burns.

The arc is a hot plasma, never operate the circuit in presence of flammable substances.

Charging high voltage capacitors is a serious life threat, so if you arent unexperienced just draw arcs and no more.

This device when rectified generates static voltage that can be a little annoying.... (or fun, i sprayed with corona a plastic pen from positive terminal and then i was able to attract little pieces of paper)

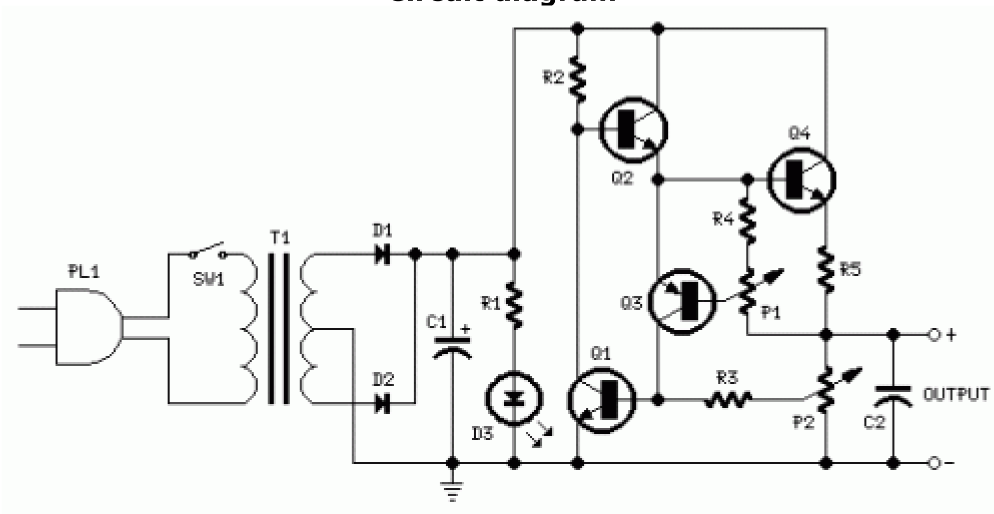
Disclaimer:

I don't assume any responsibility of the damages or discruptions dove by this device, to persons or things. Any irresponsable action would be a serios danger. This is high voltage threat it with respect.

P294. Variable DC Power Supply

Voltage range: 0.7 - 24V
Current limiting range: 50mA - 2A

Circuit diagram



Parts:
P1 500R Linear Potentiometer
P2 10K Log. Potentiometer
R1,R2 2K2 1/2W Resistors
R3 330R 1/4W Resistor
R4 150R 1/4W Resistor
R5 1R 5W Resistor
C1 3300µF 35V Electrolytic Capacitor (see Notes)
C2 1µF 63V Polyester Capacitor
D1,D2 1N5402 200V 3A Diodes
D3 5mm. Red LED
Q1 BC182 50V 100mA NPN Transistor
Q2 BD139 80V 1.5A NPN Transistor
Q3 BC212 50V 100mA PNP Transistor
Q4 2N3055 60V 15A NPN Transistor
T1 220V Primary, 36V Center-tapped Secondary 50VA Mains transformer (see Notes)
PL1 Male Mains plug
SW1 SPST Mains switch

Device purpose:

A Variable DC Power Supply is one of the most useful tools on the electronics hobbyist's workbench. This circuit is not an absolute novelty, but it's simple, reliable, "rugged" and short-proof, featuring variable voltage up to 24V and variable current limiting up to 2A. It's well suited to supply the circuits shown in this website. You can adapt it to your own requirements as explained in the notes below.

Notes:

P1 sets the maximum output current you want to be delivered by the power supply at a given output voltage.

P2 sets the output voltage and must be a logarithmic taper type, in order to obtain a more linear scale voltage indication.

You can choose the Transformer on the grounds of maximum voltage and current output needed.

Best choices are: 36, 40 or 48V center-tapped and 50, 75, 80 or 100VA.

Capacitor C1 can be 2200 to 6800µF, 35 to 50V.

Q4 must be mounted on a good heatsink in order to withstand sustained output short-circuit.

In some cases the rear panel of the metal box in which you will enclose the circuit can do the job.

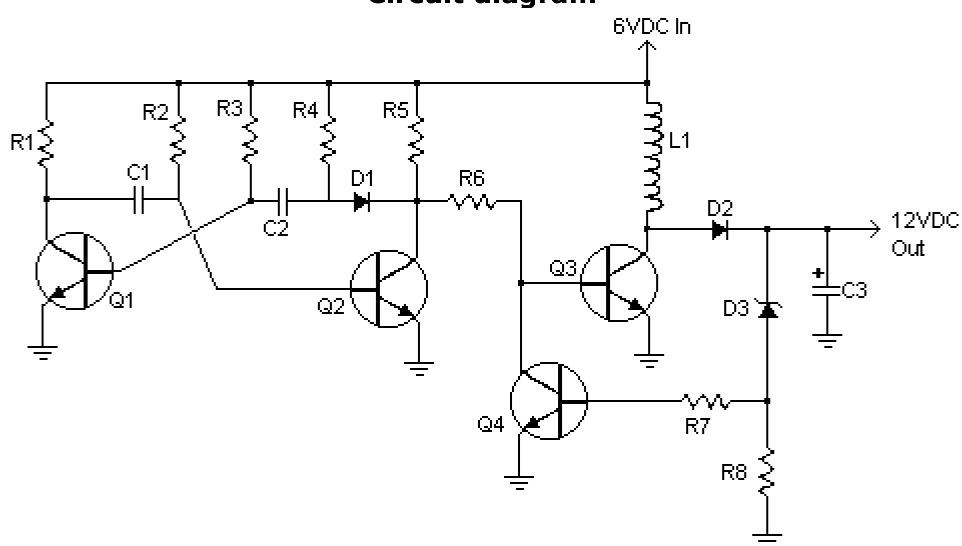
The 2N3055 transistor (Q4) can be replaced with the slightly less powerful TIP3055 type.

Excellent quality-price ratio: enjoy!

P295. 6V to 12V Converter

This inverter circuit can provide up to 800mA of 12V power from a 6V supply. For example, you could run 12V car accessories in a 6V (British?) car. The circuit is simple, about 75% efficient and quite useful. By changing just a few components, you can also modify it for different voltages.

Circuit diagram



Parts
R1, R4 2.2K 1/4W Resistor
R2, R3 4.7K 1/4W Resistor
R5 1K 1/4W Resistor
R6 1.5K 1/4W Resistor
R7 33K 1/4W Resistor
R8 10K 1/4W Resistor
C1,C2 0.1uF Ceramic Disc Capacitor
C3 470uF 25V Electrolytic Capcitor
D1 1N914 Diode
D21N4004 Diode

D3 12V 400mW Zener Diode
Q1, Q2, Q4 BC547 NPN Transistor
Q3 BD679 NPN Transistor
L1 See Notes
MISC Heatsink For Q3, Binding Posts (For Input/Output), Wire, Board

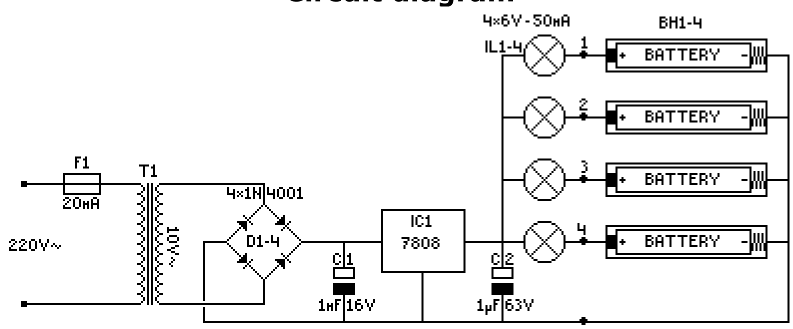
Notes

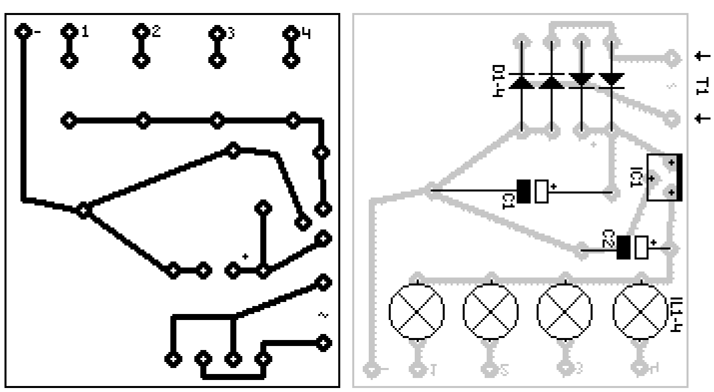
1. L1 is a custom inductor wound with about 80 turns of 0.5mm magnet wire around a toroidal core with a 40mm outside diameter.
2. Different values of D3 can be used to get different output voltages from about 0.6V to around 30V. Note that at higher voltages the circuit might not perform as well and may not produce as much current. You may also need to use a larger C3 for higher voltages and/or higher currents.
3. You can use a larger value for C3 to provide better filtering.
4. The circuit will require about 2A from the 6V supply to provide the full 800mA at 12V.

P296. Ni-Cd Batteries Charger

The NiCd charger takes approximately 12-15 hours of charge at 50mA (For AA-batteries).

Circuit diagram



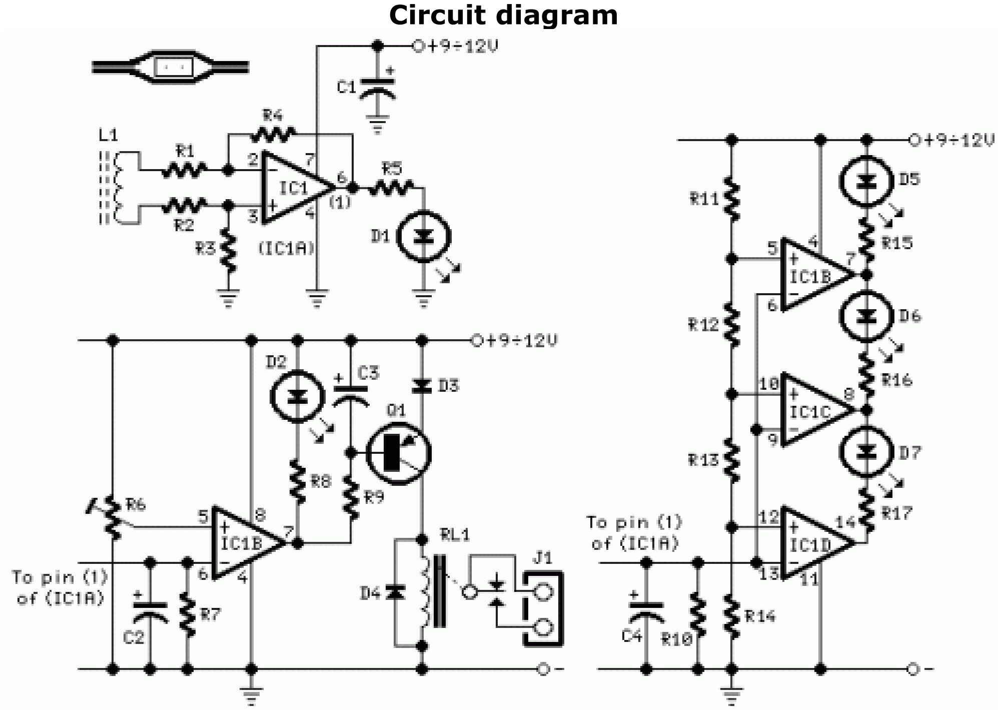


Parts
D1-4 = 1N4001
IC1 = 7808 (voltage regulator)
C1 = 1000uF/16V
C2 = 1uF/63V
IL1-4 = 6V/0,05A BULB
BH1-4 = AA BATTERY-HOLDER
F1 = 20mA FUSE + HOLDER
T1 = TRANSFORMER (10V/0,25A)

P297. AC Current Monitor

Senses high current-flow into power cables
No wire-cutting, three versions available

Circuit diagram



Parts:
R1,R2,R8 1K 1/4W Resistors
R3,R4 220K 1/4W Resistors
R5 100R 1/4W Resistor (See Notes)
R6 10K 1/2W Trimmer Cermet
R7,R10 1M 1/4W Resistors
R9 22K 1/2W Resistor
R11 to R17 1K 1/4W Resistors
C1,C3 100µF 25V Electrolytic Capacitors
C2,C4 1µF 63V Electrolytic Capacitors
D1 5mm. Red LED
D3,D4 1N4002 100V 1A Diodes
D2,D5,D6,D7 LEDs (Any color and size)
Q1 BC327 45V 800mA PNP Transistor
IC1 TL061 Low current BIFET Op-Amp (First version)
IC1 LM358 Low Power Dual Op-amp (Second version)
IC1 LM324 Low Power Quad Op-amp (Third version)
L1 10mH miniature Inductor (See Notes)
RL1 Relay with SPDT 2A @ 220V switch
Coil Voltage 12V. Coil resistance 200-300 Ohm
J1 Two ways output socket

Device purpose:

This circuit was designed on request, to remotely monitor when a couple of electric heaters have been left on. Its sensor must be placed in contact with the feeder to be able to monitor when the power cable is drawing current, thus causing the circuit to switch-on a LED.

The circuit and its sensor coil can be placed very far from the actual load, provided an easy access to the power cable is available.

Any type of high-current load or group of loads can be monitored, e.g. heaters, motors, washing machines, dish-washers, electric ovens etc., provided they dissipate a power comprised at least in the 0.5 - 1KW range.

This design features three versions. The basic one illuminates a LED when the load is on. The second version drives a Relay when a pre-set current value flows into the power cable. The third version switches-on D7 when the load power is about 1KW, D6 when the load power is about 2KW and D5 when the load power is about 3KW.

Circuit operation:

The basic circuit is shown top left in the drawing and must be used in all three versions. IC1 acts as a differential amplifier having a gain of 220. The small AC voltage picked-up by L1 is therefore amplified to a value capable of driving the LED D1.

The second version is drawn bottom left, must be connected to the basic circuit and uses a dual op-amp, therefore IC1 will be labeled IC1A and its pin connection varies slightly. IC1B acts as a voltage comparator and its threshold voltage can be precisely set by means of trimmer R6. Q1 is the Relay driver and D2 illuminates when the Relay is on. You can use the Relay contacts to drive an alarm or a lamp when the AC load exceeds a pre-set value, e.g. 2KW.

The third version is shown to the right of the drawing, must be connected to the basic circuit and uses a quad op-amp, therefore IC1 will be labeled IC1A and its pin connection varies slightly. IC1B, C and D are wired as comparators. They switch on and off the LEDs, referring to voltages at their non-inverting inputs set by the voltage divider resistor chain R11-R14.

Notes:

The pick-up coil L1 is a common 10mH miniature inductor, having the shape of a small rectangular plastic box of 10x7x4 mm. with radial leads.

This inductor must be placed tightly against one wire of the power cable, leaving the other wire some centimeters apart.

The sensitivity will be doubled if the inductor is placed tightly between the two wires as shown in the diagram, top left. On the contrary, do not place the inductor against paired wires as the signal tends to cancel and the circuit will not work.

The LED limiting resistor R5 should have a value comprised in the 100R - 1K range, depending on the output voltage obtained.

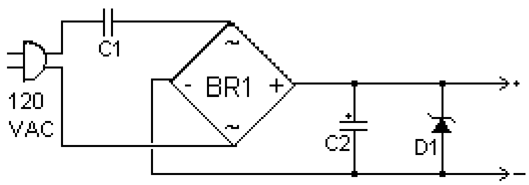
LED D1 and its limiting resistor R5 can be omitted in versions two and three of the circuit.

Versions one and three draw a small current, thus allowing possible 9V battery operation.

P298. Transformerless Power Supply

I have received a few emails asking for a transformerless power supply. Here is such a supply. This supply uses no heavy step down transformer and has an extremely low parts count. The circuit can be built very small and can supply small currents for small projects. The major downfall of this supply is that it is not isolated from the AC line and can only supply small currents.

Circuit diagram



Parts:

C1 0.39uF 250V Capacitor
C2 220uF 25V Electrolytic Capacitor
D1 1N4741 11V Zener Diode (See Notes)
BR1 1 Amp 200V Bridge Rectifier
MISC Line Cord, Board, Wire, Case

Notes:

1. The value of C1 can be increased to increase the amount of current the circuit can supply. With the values shown, the circuit can supply up to about 15mA. Remember to increase the size of C2 also.
2. A different value can be used for D1 to increase or decrease the voltage as needed.
3. Please note that this circuit is not isolated from 120VAC. Because of this, the circuit must be treated with caution and encosed at all times. Do not work on the circuit (or any other circuits attached to it) when it is plugged in.
4. You may want to add a resisor in series with C1 to limit current if the circuit is plugged in and the mains is at its full voltage.
5. If you are running the circuit from 220VAC, then use a capacitor rated at greater than 400V for C1.
6. If you want isolation from the AC line, you can connect up a small isolation transformer at the inputs of the circuit. Small 600ohm:600ohm audio transformers work nicely.

P299. Transformerless Power Supply II

Note:

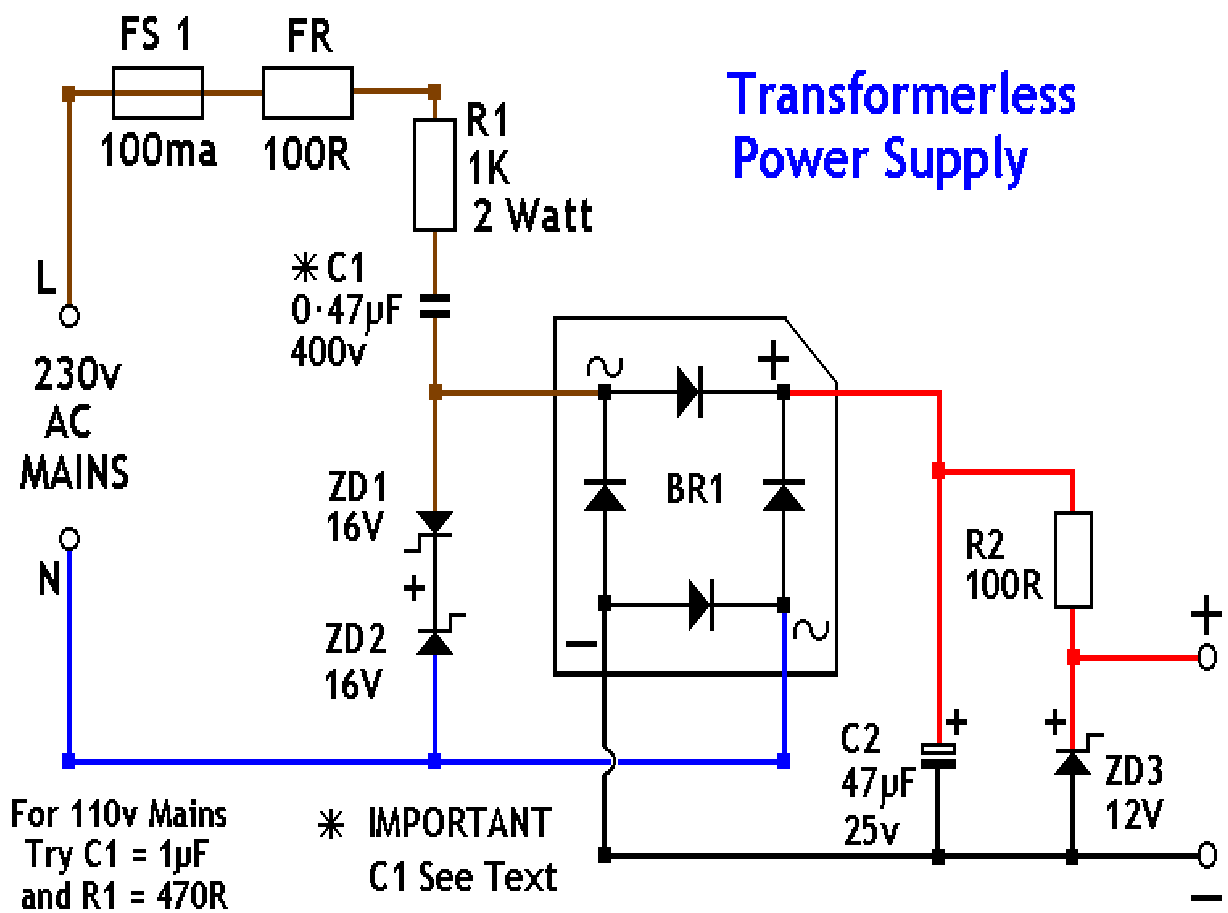
I have had several requests for a power supply project without using a power supply. This can save the expense of buying a transformer, but presents potentially lethal voltages at the output terminals. Under no circumstances should a beginner attempt to build such a project.

Important Notice

Electric Shock Hazard. In the UK,the neutral wire is connected to earth at the power station. If you touch the "Live" wire, then depending on how well earthed you are, you form a conductive path between Live and Neutral. DO NOT TOUCH the output of this power supply. Whilst the output of this circuit sits innocently at 12V with respect to (wrt) the other terminal, it is also 12V above earth potential. Should a component fail then either terminal will become a potential shock hazard.

Below is a project by Ron J, please heed the caution above and Ron's design notes.

MAINS ELECTRICITY IS VERY DANGEROUS.



If you are not experienced in dealing with it, then leave this project alone.Although Mains equipment can itself consume a lot of current, the circuits we build to control it, usually only require a few milliamps. Yet the low voltage power supply is frequently the largest part of the construction and a sizeable portion of the cost.
This circuit will supply up to about 20ma at 12 volts. It uses capacitive reactance instead of resistance; and it doesn't generate very much heat.The circuit draws about 30ma AC. Always use a fuse and/or a fusible resistor to be on the safe side. The values given are only a guide. There should be more than enough power available for timers, light operated switches, temperature controllers etc, provided that you use an optical isolator as your circuit's output device. (E.g. MOC 3010/3020) If a relay is unavoidable, use one with a mains voltage coil and switch the coil using the optical isolator.C1 should be of the 'suppressor type'; made to be connected directly across the incoming Mains Supply. They are generally covered with the logos of several different Safety Standards Authorities. If you need more current, use a larger value capacitor; or put two in parallel; but be careful of what you are doing to the Watts. The low voltage 'AC' is supplied by ZD1 and ZD2.

The bridge rectifier can be any of the small 'Round', 'In-line', or 'DIL' types; or you could use four separate diodes. If you want to, you can replace R2 and ZD3 with a 78 Series regulator. The full sized ones will work; but if space is tight, there are some small 100ma versions available in TO 92 type cases. They look like a BC 547. It is also worth noting that many small circuits will work with an unregulated supply. You can, of course, alter any or all of the Zenner diodes in order to produce a different output voltage. As for the mains voltage, the suggestion regarding the 110v version is just that, a suggestion. I haven't built it, so be prepared to experiment a little.

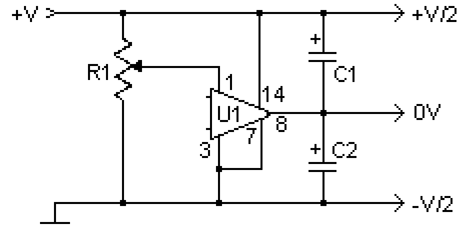
I get a lot of emails asking if this power supply can be modified to provide currents of anything up to 50 amps. It cannot. The circuit was designed to provide a cheap compact power supply for Cmos logic circuits that require only a few milliamps. The logic circuits were then used to control mains equipment (fans, lights, heaters etc.) through an optically isolated triac. If more than 20mA is required it is possible to increase C1 to 0.68uF or 1uF and thus obtain a current of up to about 40mA. But 'suppressor type' capacitors are relatively big and more expensive than regular capacitors; and increasing the current means that higher wattage resistors and zener diodes are required. If you try to produce more than about 40mA the circuit will no longer be cheap and compact, and it simply makes more sense to use a transformer.

The Transformerless Power Supply Support Material provides a complete circuit description including all the calculations.

P300. Voltage Inverter

This simple and inexpensive circuit can produce a dual (positive and negative) voltage from a single supply input. It is therefore extremely useful for powering opamp and other circuits that require a dual voltage from a single battery. The circuit will operate at an input voltage from around 5V to 20V and produce a output from +-2.5V to +-10V.

Circuit diagram

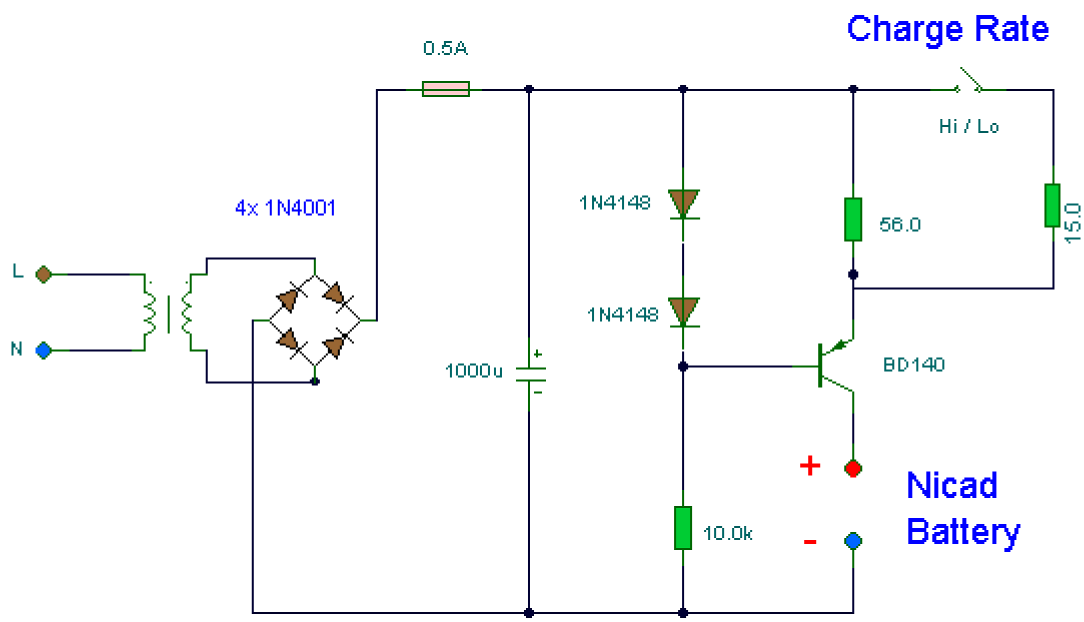


Parts
R1 1M Linear Pot
C1,C2 15uf 25V Electrolytic Capacitor
U1 LM380 Audio Amp Chip
MISC Heatsink For U1, Binding Posts (For Input/Output), Wire, Board

Notes
1. U1 dissipates around 1W and will therefore require a heatsink.
2. R1 is used to equalize the outputs. The first time you use the circuit, it should be set to mid range and then adjusted with the aid of a voltmeter. Measure each output while adjusting. The circuit is calibrated when both outputs read the same voltage (either positive or negative).

P301. Nicad Battery Charger

Description
A basic nicad battery charger using a single medium power transistor.



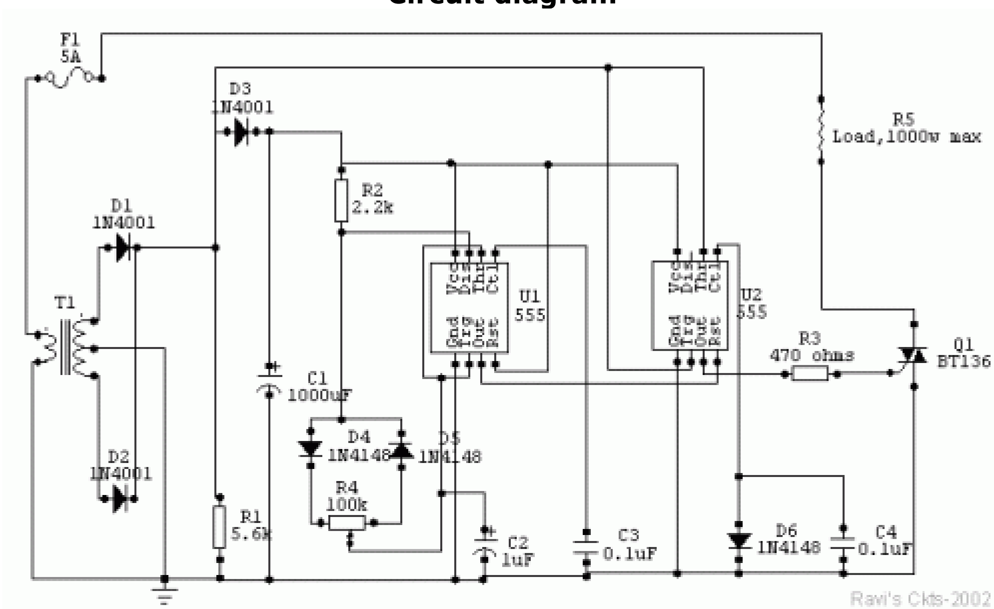
Notes
This simple charger uses a single transistor as a constant current source. The voltage across the pair of 1N4148 diodes biases the base of the BD140 medium power transistor. The base-emitter voltage of the transistor and the forward voltage drop across the diodes are relatively stable. The charging current is approximately 15mA or 45mA with the switch closed. This suits most 1.5V and 9V rechargeable batteries. The transformer should have a secondary rating of 12V ac at 0.5amp, the primary should be 220/240volts for Europe or 120volts ac for North America.

Warning
Please take care with this circuit. Use a voltmeter to observe correct polarity. Nicads can explode if short circuited or connected with the wrong polarity.

P302. Solid State Power Controller

Disclaimer Please take the greatest of care in handling AC mains supply while constructing this project. If you have no knowledge of mains wiring or unfamiliar with household mains supply, PLEASE DO NOT ATTEMPT CONSTRUCTION. I take no responsibility in any personal injury or loss of life or properties suffered by any person while undertaking the construction of this project or using the end product by following my instructions.

Circuit diagram



About the Circuit

The ckt is built around two 555 timer ICs. U1 and U2. U1 is wired as a variable duty cycle oscillator with a constant time period of around 0.1 second. Duty cycle can be varied from 0 to 100 per cent by R4 potentiometer. The output of U1 (pin 3) is connected to the rest input (pin 4) of U2.

U2 is wired as a comparator with hystereis, i.e a Schmitt trigger. Diode D6 brings the potential at control voltage (pin 5) terminal at 0.7V. The threshold (pin 6) and trigger (pin 2) terminals connected together constitute the input. The output (pin 3) of the Schmitt trigger goes high when Vin equals or below 0.35V and goes low when it is equals or above 0.7V.

Transformer T1 with rectifying diodes D1 and D2 delivers unidirectional AC voltage across R1 with a peak voltage of 8.5V and 100Hz frequency. C1 is the filtering capacitor. D3 prevents the voltage across R1 from being filtered.

Since the input of the Schmitt trigger is connected across R1, its out put will be high when input voltage falls below 0.35V and remains so till it exceeds 0.7V. If pin 4 of U2 is left unconnected, the triac will be fired at the start of each half cycle of AC by a short pulse. Hence full power will be delivered to the load. But since output of U1 is connected to the rest input of U2, the Schmitt trigger delivers pulses to the gate of triac only when output of U1 is high. This explains how variable duty cycle zero crossover switching is accomplished. I have used a 5-amp triac, which is capable of switching loads up to 1000W. Using a triac with larger current rating can also control higher loads. Of course, size of the heat sink will have to be suitably increased.

Construction

You can build this circuit in a general purpose IC strip board. Potentiometer R4 should be linear with a plastic shaft. It can be mounted on the front portion of the enclosure, with a dial marked from 0 to 100 per cent power at, say 5 per cent intervals. If a metallic enclosure is used, care must be taken to ensure that the heat sink of triac does not touch it anywhere.

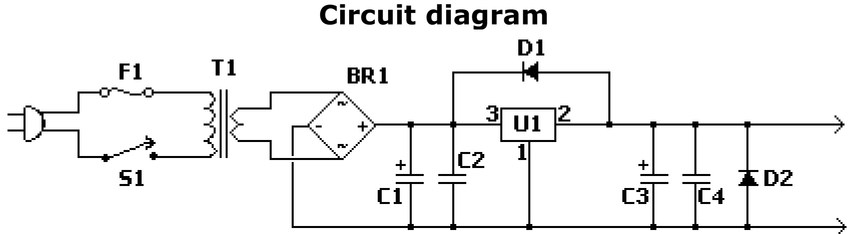
To avoid shock, do not touch any part of circuitry while in operation.

Parts
U1 & U2 - NE555 timer
Q1 - 5A, 400 PIV triac (BT136)
D1-D3 - IN4001 rectifier diodes
D4-D6 - IN4148 switching diodes
R1 - 5.6K
R2 -2.2K
R3 -470 ohms
R4 - 100K linear potentiometer with plastic shaft
(all resistors ¼ watt, 5% tolerance)
C1 - 1000mfd, 12V
C2 - 1mfd, 12V
C3,C4 - 0.1mfd,50V ceramic
T1 - 220V primary 6V-0-6V secondary, 150ma
F1 - 5-amp fuse
(You will have to connect the AC line to T1 primary. I have not shown that)

P303. Fixed Voltage Power Supply

The fixed voltage power supply is useful in applications where an adjustable output is not required. This supply is simple, but very flexable as the voltage it outputs is dependant only on the regulator and transformer you choose. The maximum output current is 1.5A.

Circuit diagram



Parts
C1 2200uF 35V Electrolytic Capacitor
C2, C4 0.1uF Ceramic Disc Capacitor
C3 10uF 35V Electrolytic Capacitor
D1, D2 1N4007 Silicon Diode
BR1 2A 30V Bridge Rectifier
U1 Regulator (See Notes)
T1 Transformer (See Notes)
S1 SPST 2 Amp Switch
F1 2A 250V Fuse and Holder
MISC Heatsink For U1, Line Cord, Case, Wire

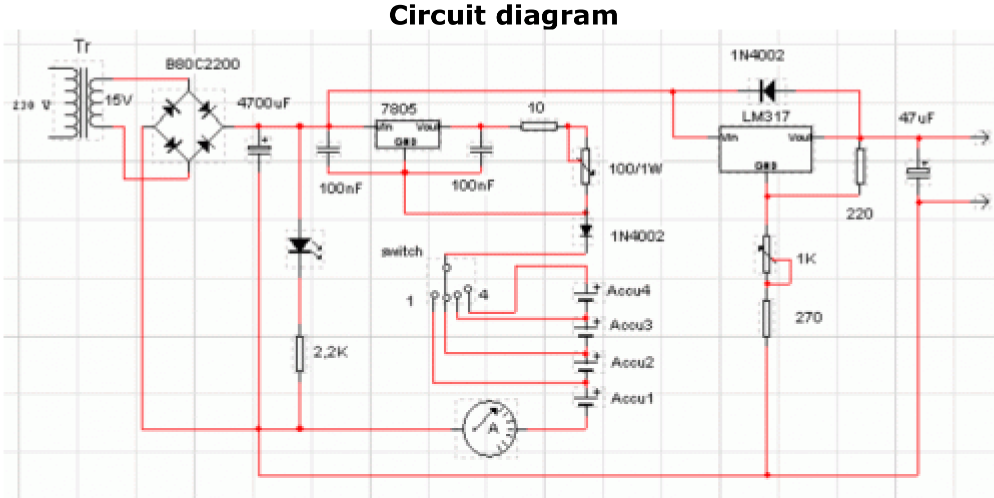
Notes
1. Since this project operates from 120 (or 220, or 240, etc.) volts AC, it MUST be built inside a case.
2. U1 will require a heatsink.
3. You will need to choose T1 and U1 to match the voltage you want. Use the table below as a reference.

Output Voltage, T1, U1
5V - 6V, 1.5A - 7805
6V - 6V, 1.5A - 7806
9V - 12V, 1.5A - 7809
12V - 12V, 1.5A - 7812
15V - 24V, 1.5A - 7815
18V - 24V, 1.5A - 7818

P304.

Batteries charger & PSU - ideal for digital cameras

Circuit diagram



This circuit was created for digital cameras. It's known the digital cameras have considerable power consumption. For example my camera Minolta E223 requires approximately 800 mA. In practice a mains power supply or high capacity NiMH accumulators (batteries) can satisfy this demand.

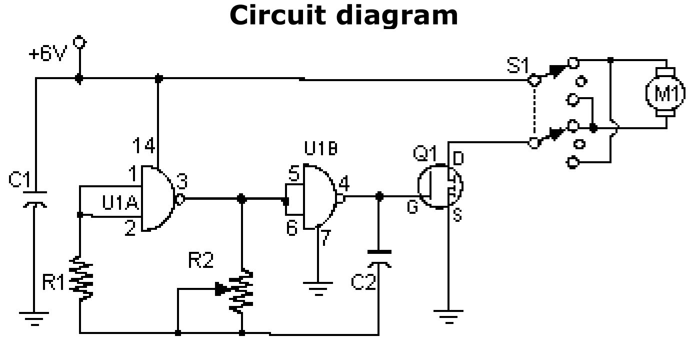
This circuit consists of two parts, charger and adapter. The transformer, rectifier bridge and buffer condensator are common. Adapter is quite simply its main part is an adjustable voltage regulator LM 317 according to usual setting. Output is a suitable for camera jack plug. Voltage can be adjusted in range 2-9 V.

In the charger circuit a 7805 fixed voltage regulator works as current generator assured constant current during charging. This charging current can be adjusted with the 100 /1W potentiometer in range about 50-300 mA indicated by a small current measuring instrument. From one to four batteries can be charged simultaneously. The switch must be set according to number of batteries, and charging current of batteries given by manufacturer must be adjusted. This circuit doesn't measure charging time and charging condition of batteries. Manufacturers give charging time, usually 14-16 h. I solved this problem with a simply, cheap mechanical mains timer. I think its accuracy is sufficient.

P305. Pulse Width Modulation DC Motor Control

Often, people attempt to control DC motors with a variable resistor or variable resistor connected to a transistor. While the latter approach works well, it generates heat and hence wastes power. This simple pulse width modulation DC motor control eliminates these problems. It controls the motor speed by driving the motor with short pulses. These pulses vary in duration to change the speed of the motor. The longer the pulses, the faster the motor turns, and vice versa.

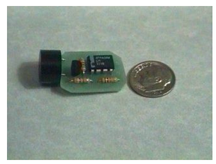
Circuit diagram



Parts
R1 1 Meg 1/4W Resistor
R2 100K Pot
C1 0.1uF 25V Ceramic Disc Capacitor
C2 0.01uF 25V Ceramic Disc Capacitor
Q1 IRF511 MOSFET or IRF620
U1 4011 CMOS NAND Gate
S1 DPDT Switch
M1 Motor (See Notes)
MISC Case, Board, Heatsink, Knob For R2, Socket For U1

Notes
1. R2 adjusts the speed of the oscillator and therefore the speed of M1.
2. M1 can be any DC motor that operates from 6V and does not draw more than the maximum current of Q1. The voltage can be increased by connecting the higher voltage to the switch instead of the 6V that powers the oscillator. Be sure not to exceed the power rating of Q1 if you do this.
3. Q1 will need a heatsink.
4. Q1 in the parts list can handle a maximum of 5A. Use the IRF620 for 6A, if you need any higher.

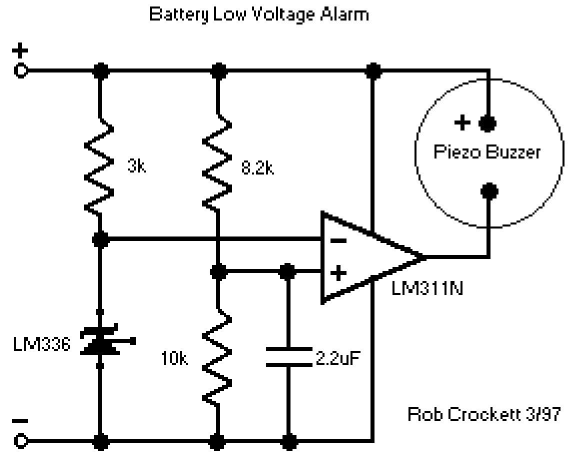
P306. Precision Receiver Battery Low Voltage Alarm

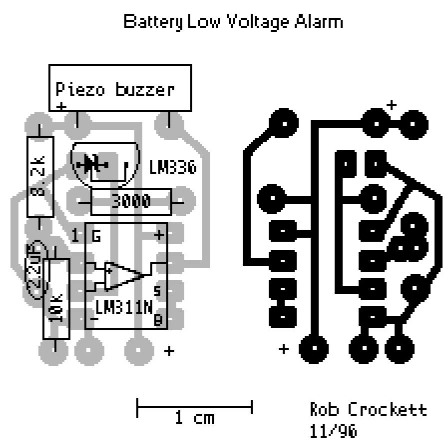


Flying hand launch gliders means living with small capacity receiver NiCad battery packs. These small packs are light, but have the distinct disadvantage of rapidly depleting. You can carefully time your flights, but you end up either crashing when your plane seizes or using only a portion of the already small capacity of the battery. If you charge the battery in a slightly suboptimal fashion, your plane dies and bites the dirt (done that, crashed). This devices will allow you to use a small mA pack and use the full capacity of your battery.

This device of my design uses seven componants on a single side PC board. With a 6 inch connector, the whole thing weighs about 0.2 oz. The alarm sounds with a voltage at or below 4.5v, and the circuit draws 2.4-2.7 mA when quiet and 5.6mA with the alarm (in my Hitec system, a receiver and two servos draw an average 75-100mA when flying). The LM336 and 3k resistor provide a precision reference 2.5 volts, and the two other resistors are a voltage divider that provide the sample voltage. The LM311 is a voltage comparator, and powers the buzzer when the sample voltage crosses the reference. Since servos draw current abruptly and intermittantly, the ambient battery voltage is puncuated by a series of low voltage spikes. The capacitor (not in the original design in the picture) smooths these spikes somewhat so that the alarm does not chirp with every servo motion. These inverted voltage spikes are not so pronounced with larger capacity batteries; the capacitor may not always be be needed. While it is possible to smooth the voltage completely, this chirping provides a continuous and early indication of battery voltage. With the circuit here, the alarm chirps while slewing both servos of a reciever/two servo system when a 150mA battery is about half discharged, chirps with any servo motion when near completely discharged, and alarms continuously with about 5 minutes of flying time left. With a larger capacity battery, the sequence occurrs much nearer to complete discharge--perhaps no capacitor or a smaller one (say 1uf or 0.1uf) would do--and initial comparison with your measured voltages would be important to calibrate to your system. You can adjust the divider resistors for a higher or lower voltage alarm: Vout=Vin(R2/(R1+R2)) where Vout=2.5v and Vin is your selected alarm voltage, and R1 is the positive side and R2 is the negative side. Note that the LM336 has three pins and you only use two (break off the third). Solder a battery or servo connector to the board with positive and negative as shown, and plug the connector into an unused slot in your receiver.

Circuit diagram



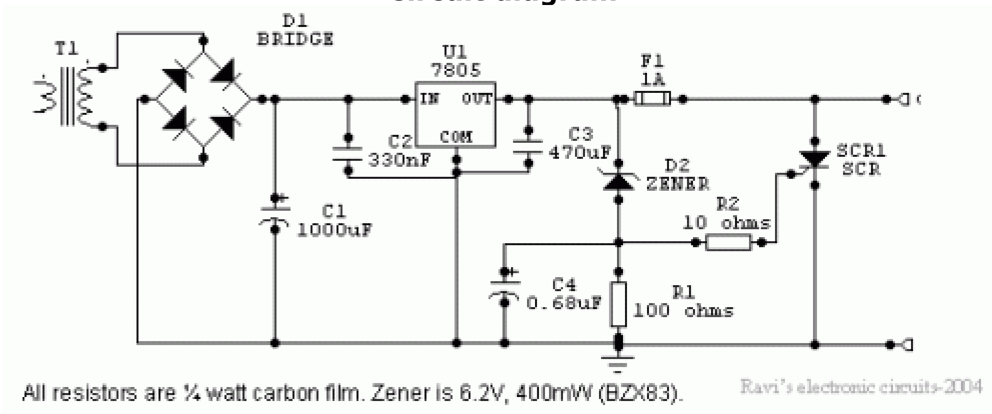


RadioShack parts:
273-074 $2.99 Miniature Piezo Buzzer, 12v, PC board mount
271-312 $7.99 1/4 watt 5% carbon film resistors, 500 pieces (Just do it!)

JDR Microdevices parts
LM336 2.5v precision reference diode (has a third unused "adjust" pin)
LM311 Voltage comparator
T2.2-16 2.2uf 16v tantalum capacitor

P307. TTL Power Supply with 'Crowbar' protection

Circuit diagram



Overview

Power supplies that are intended to be used with TTL logic circuitry must guard against over-voltage, which can destroy TTL chips very rapidly. The duration of over-voltage that can destroy TTL chips is much too brief to trigger any conventional fuse, so that only other semiconductor circuits can play any useful part in protecting a circuit against the type of failure of a stabilizer that leads to excessive voltage. As it happens, this is the most common type of stabilizer failure, so that the protection is necessary for any TTL circuit of any significance. Many modern digital circuits make extensive use of MOS devices, which are less susceptible to damage from over-voltage, but it is unusual to find a large digital circuit, which does not contain at least one or more TTL devices.

In the circuit shown below, if the voltage at the output terminals rises above 6.2V, zener conducts charging capacitor C4. This voltage will fire the silicon-controlled rectifier (SCR), which quickly shorts-or puts a 'crowbar' – across the supply rails blowing the fuse.

Circuit Description

The regulator IC is the familiar fixed voltage type such as LM7805. The 7805 is a three-pin regulator which requires a minimum voltage input of 7.5V to sustain stabilization, which an absolute maximum input voltage of 35V. The maximum load current is 1A and the regulation against input changes is typically 3-7mV for a variation of input between 7.1V and 25V. The regulation against load changes is of the order of 10mV for a change between 5mV and 1.5A load current. The noise voltage in the band from 10Hz to 100KHz is 40-50uV, and the ripple rejection is around 70db. Maximum junction temperature is 215 degrees C, and the thermal resistance from junction to case is 5 degrees C/W. This stabilizer is used extensively for power supplies in digital equipments.

In the circuit, the capacitors that are shown connected each side of the IC are very important for suppressing oscillations and must not be omitted. In particular, the 330nF capacitor at the input must be wired across the shortest possible path at the pins of the IC.

I chose a TIC 106A SCR because it can handle an anode current up to 4A at 100V, but has a very sensitive gate requiring only about 200uA to fire it. The SCR is only 'on' for a very short time and thus does not need a heat sink. If you use another type, it is not likely to display the same characteristics. Most SCR's with a heavy anode current rating have insensitive gates. SCR's with a lower anode current rating will need a heat sink.

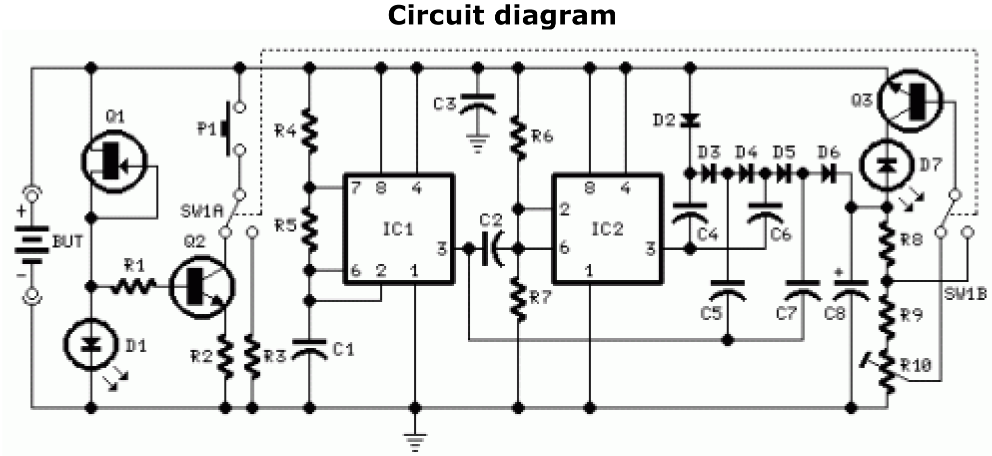
The rating of fuse depends on the power supply you are using the circuit with. Assuming a maximum power supply output current of about 200 to 300 mA, you can fit a 500mA fuse.

The voltage at which the SCR switches on is largely dependent on the value of the zener. You can experiment with different values of zeners to protect other types of circuits. The 4000 series CMOS ICs have supply voltage limits of 15V (AE suffix) or 20V (BE suffix) and crowbar protection can be used for these too.

P308. Self-powered Fast Battery-Tester

Tests 1.5 to 15 Volt cells
Two-LED display, no power supply required

Circuit diagram



Parts:
R1 2K2 1/4W Resistor
R2 3R3 1/4W Resistor
R3 10R 1/4W Resistor
R4 4K7 1/4W Resistor
R5 33K 1/4W Resistor
R6,R7 100K 1/4W Resistors
R8 220K 1/4W Resistor
R9 330K 1/4W Resistor
R10 500K Trimmer Cermet
C1,C2 10nF 63V Polyester Capacitors
C3-C7 100nF 63V Polyester Capacitors
C8 220µF 35V Electrolytic Capacitor
D1,D7 LEDs Red 5mm. (see Notes)
D2-D6 1N4148 75V 150mA Diodes
Q1 2N3819 General purpose FET
Q2,Q3 BC337 45V 800mA NPN Transistors
IC1,IC2 7555 or TS555CN CMos Timer ICs
P1 SPST Pushbutton
SW1 DPDT Switch
BUT Battery under test
Holder or clips to connect the Battery under test to the circuit

Device purpose:
This circuit runs a fast battery test without the need of power supply or expensive moving-coil voltmeters.

It has two ranges: when SW1 is set as shown in the circuit diagram, the device can test 3V to 15V batteries. When SW1 is switched to the other position, only 1.5V cells can be tested.

Testing 3V to 15V batteries:
Switch SW1 as shown in the circuit diagram.
Place the battery under test in a suitable holder or clip it to the circuit.
Wait some seconds in order to let C8 reach its full charge.
LED D1 illuminates at a constant intensity, independent of battery voltage.
If D1 illuminates very weakly or is fully off the battery is unusable.
If D1 has a good illumination, press P1 and keep an eye to LED D7. If D7 remains fully off, the battery is in a very good state.
If D7 illuminates brightly for a few seconds, the battery is weak. This condition is confirmed by a noticeable weakening of D1 brightness.
If D7 illuminates weakly for a few seconds but D1 maintain the same light intensity, the battery is still good but is not new.

Testing 1.5V batteries:
Switch SW1 in the position opposite to that shown in the circuit diagram.
Place the battery under test in a suitable holder or clip it to the circuit.
Wait some seconds in order to let C8 reach its full charge.
LED D1 illuminates very weakly only in presence of a new battery, otherwise is off.
Press P1 and keep an eye to LED D7. If D7 remains fully off the battery can be in very good state.
If D7 illuminates brightly for a few seconds, the battery is weak.
If D7 illuminates weakly for a few seconds, the battery is still good but is not new.
If you are suspecting a 1.5V cell to be completely discharged, a better test can be made wiring two 1.5V batteries in series, then running the 3V test.

Circuit operation:

FET Q1 provides a constant current generator biasing LED D1 and Q2 Base. In this manner D1 illuminates at a constant intensity, independent of battery voltage from 3 to 15V and Q2 (when P1 is closed) applies a constant current load of about 120mA to the battery. IC1 is a square wave generator oscillating at about 3KHz. IC2 acts as an inverter and drives, together with IC1 but in anti-phase, Diodes D2-D6 and Capacitors C4-C7, obtaining a voltage multiplication. C8 is charged by this raised voltage and R8-R10 form a voltage divider biasing the Base of Q3. When P1 is open, a very light load is applied to the battery under test and Q3 Base is biased in order to maintain LED D7 in the off state.

Closing P1, a 120mA load is applied to the battery under test. If the battery is not fully charged, its output voltage starts reducing: when this voltage falls 0.6V below the battery nominal voltage, Q3 Emitter becomes more negative than the Base, transistor is hard biased and D7 illuminates. Obviously, this state of affairs lasts a few seconds: the time spent by C8 to reduce its initial voltage to the new one, proportional to the voltage of the loaded battery. If the battery under test is in a good charging state, its output voltage did not fall under a 120mA loading current, so LED D7 stays off.

When testing 1.5V batteries, the circuit formed by Q1, Q2, D1, R1 & R2 doesn't work well at this supply voltage, so a 150mA load current is applied to the BUT by means of the 10 Ohm resistor R3 after switching SW1A. Q3 bias is also changed via SW1B.

Notes:

To set-up this circuit apply a 6 to 7.5V voltage source to the input and trim R10 until LED D7 is fully off (without pushing on P1).

1.5V test position needs no set-up.
CMos 555 ICs must be used for IC1 & IC2 because they are the only cheap devices able to oscillate at 1.5V supply or less.

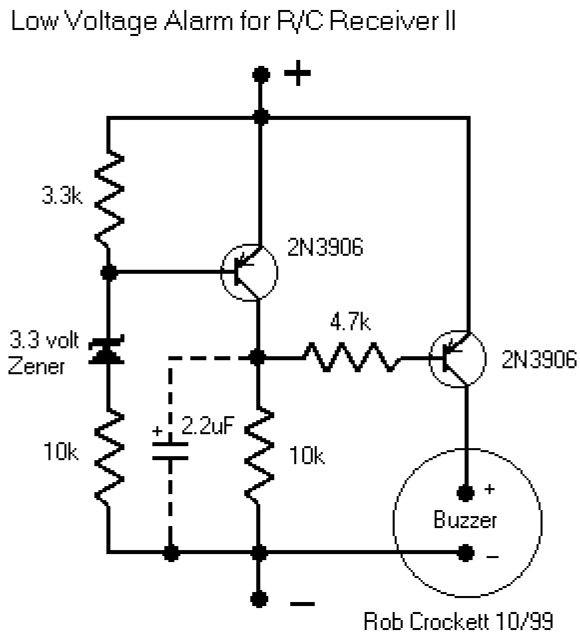
P309. Receiver Battery Low Voltage Alarm

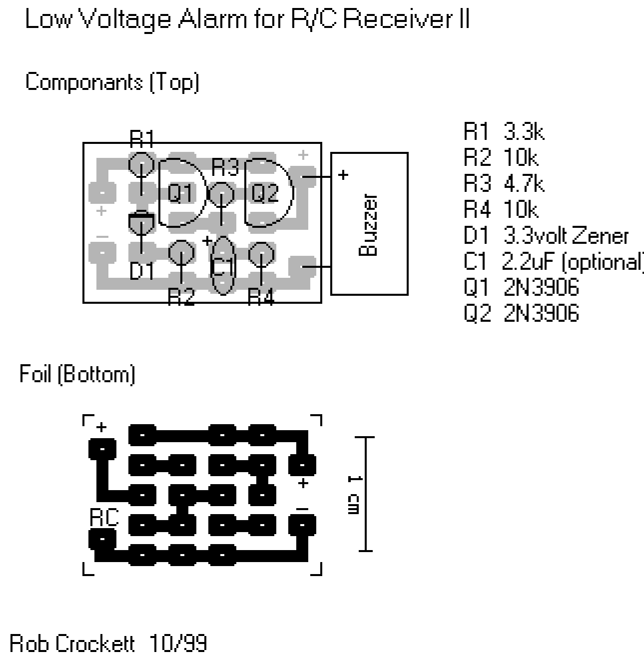
Here is another equally cool low voltage alarm circuit for your glider receiver battery that I've shamelessly stolen from George Steiner's book "A to Z--Radio Control Electronic Journal" (see below). I've modified it to use with small battery packs in R/C gliders. This design has a trigger voltage at about 4.3 volts, and it draws 1mA or less when quiet and about 4mA when buzzing. This can be constructed from parts fromt Radio Shack, though you may need to order a few through them.

The voltage of a receiver system is punctuated by low-voltage spikes every time the servo motors spin up, since the servos draw more than the battery can deliver. With large receiver battery packs, this is not as much of an issue, and it may not be noticeable. However with 270mA and smaller battery packs, particularly with more than two servos, low voltage alarms can chirp constantly, every time a servo moves. The challenge is to design in a little slack or delay, just enough so that you are not annoyed by constant chirping, but not too much so that the chirps can give you a warning before the battery is completely exhausted. Here, this "hysteresis" is adjusted with the capacitor. For large packs (600mA and above), no capacitor is probably needed, although I've been using a 1uF capacitor on my open class ship with 6 servos and a 600mA battery. For 270 mA and two servos, I'd suggest trying a 1uF capacitor. For 150mA or less, a 2.2uF capacitor works well. If you want to know only when the battery has finally reached the trigger voltage, try a 5uF (or 4.7uF) capacitor. The actual type of capacitor is not critical, but tantalum capacitors are physically smaller. If you want to worry about the polarity of the capacitor, the negative side should be directed toward the negative pole of the battery, but at these relatively low voltages compared to the capacitor rating, the polarity probably does not matter.
This circuit is set up for a four cell receiver battery pack at a trigger voltage of about 4.3 volts (about 1.1volts/cell). You can adjust R1 (here a 3.3k resistor) to change the trigger voltage of the circuit. For example, for a 5 cell pack, to change the trigger voltage to 5.5 volts, change R1 to 2.2k. For a three cell pack, to change the trigger voltage to 3.3 volts, change R1 to 6.8 k (or use two 3.3k resistors in parallel by soldering a resistor in each hole and twisting together the top leads). Because of slight variability in tolerances of the componants, you should check this little device with a variable power source and a voltmeter to confirm its trigger point. Alternately, use your digital voltmeter or expanded scale voltmeter to calibrate its chirp pattern by measuring the voltage of the onboard battery pack intermittently as you fly.

Make sure the band on the Zener diode is toward the "+" side (toward R1). Solder a battery connector or servo connector to the board with positive and negative as shown, and plug the connector into an unused slot in your receiver.

Circuit diagram





Radio Shack parts: Here again, you can use smaller rated resistors if you can get them--1/8 watt or less is fine. Tantalum capacitors are physically smaller, but any composition will work.

273-074 Miniature Piezo Buzzer, 12v, PC board mount
271-312 1/4 watt 5% carbon film resistors, 500 pieces (Take the plunge!)
276-1604 Package of 15 PNP small signal 2N3906-type transistors.

2N3904 PNP transistors

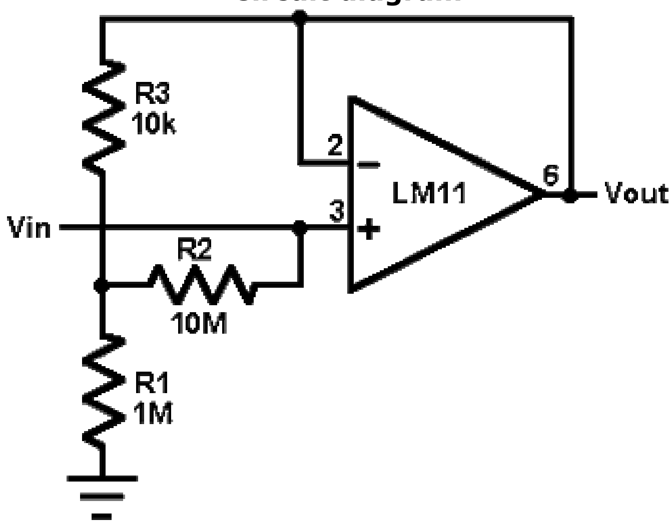
RSU 11673505 3.3v Zener diode (not on shelf--need to order 1-800-THE-SHACK)
272-1434 1uf tantalum capacitor (see above for choice of capacitor)
RSU 11295888 2.2uF tantalum capacitor (not on shelf--need to order)
272-1024 4.7uF radial-lead electrolytic capacitor

2N3906-ND PNP general purpose amp/switch transistor
1N5226BMSCT-ND 3.3v Zener diode 500mA
3.3KEBK-ND 1/8 watt resistors
4.7KEBK-ND 1/8 watt resistors
10KEBK-ND 1/8 watt resistors
P2105-ND 1.0uF Tantalum capacitor 16volt
P2022-ND 2.2uF Tantalum capacitor 10volt

P2024-ND 4.7uF Tantalum capacitor 10 volt
FP012C-5-ND 3M clear 0.5" heat shrink tubing, 5 feet

P310. Voltage follower with 1G ohm input resistance

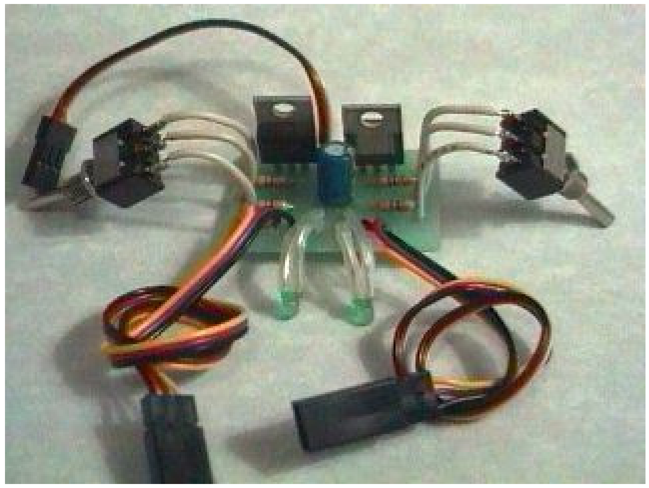
Circuit diagram



This circuit uses an LM11 to form a voltage follower with 1G ohm input resistance built using standard resistor values. With the input disconnected, the input offset voltage is multiplied by the same factor as R2; but the added error is small because the offset voltage of the LM11 is so low. When the input is connected to a source less than 1G ohm, this error is reduced. For an ac-coupled input a second 10M resistor could be connected in series with the inverting input to virtually eliminate bias current error; bypassing it would give minimal noise.

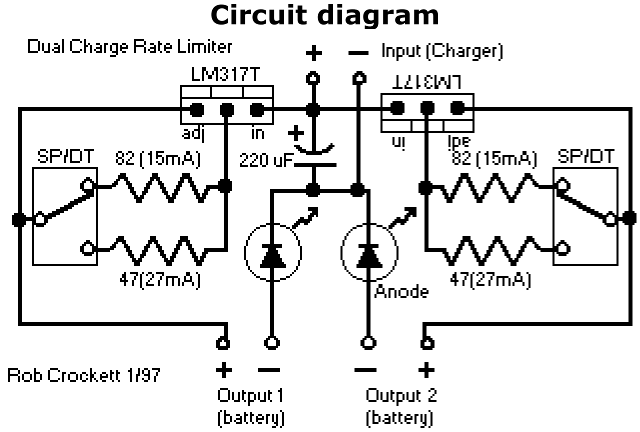
P311.

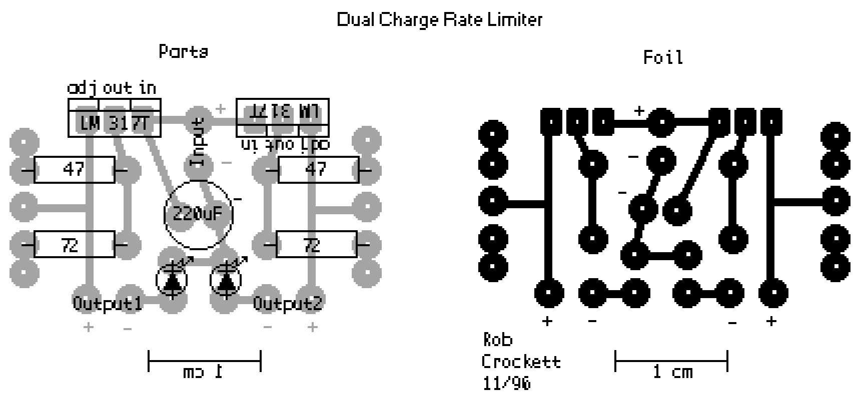
Deluxe Charge Rate Limiter for Small Capacity NiCad Batteries

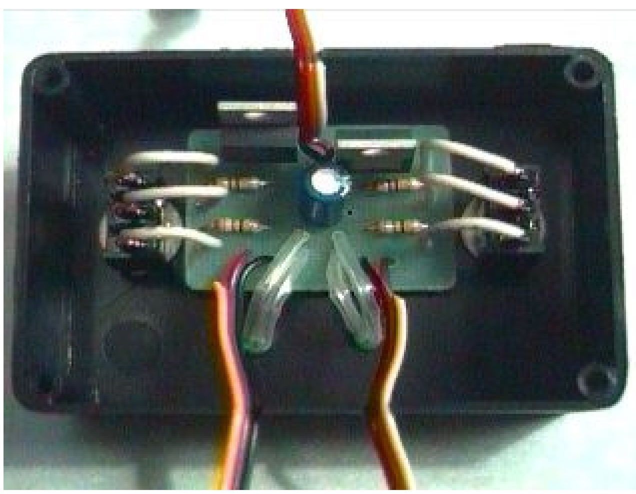


Here is a deluxe version of the simple charge rate limiter, using the same idea but with the ability to charge two packs simultaneously from a single wall charger. For circuit description and parts list, see the simple charger page. Since wall chargers provide about 55 mA, you should not use this dual circuit to charge batteries at rates greater than 27 mA (for a total of 54 mA).

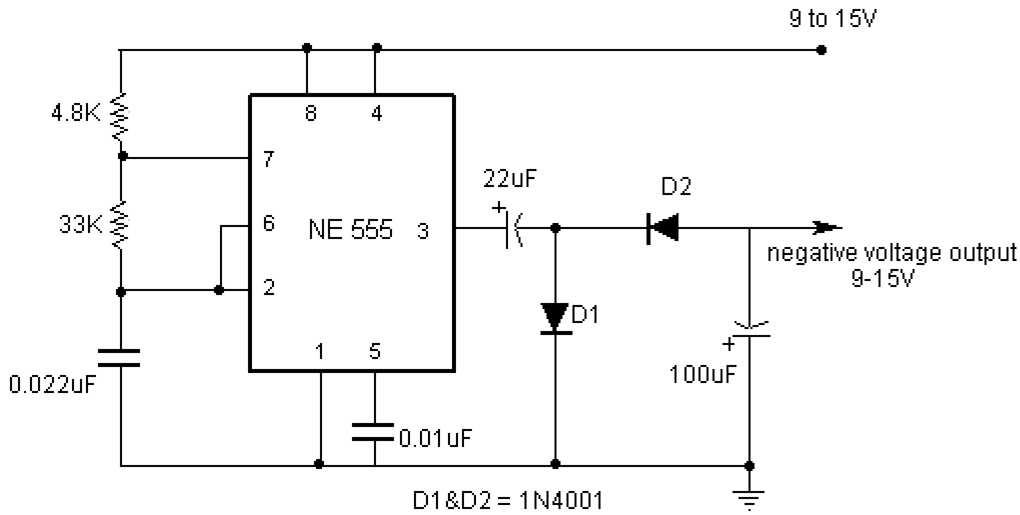
Circuit diagram




Dual Charge Rate Limiter
Parts
Foil
adj out in
LM 317T
Input
47
220uF
72
Output1
Output2
1 cm
Rob
Crockett
11/96



P312. Negative Supply from single positive Supply



Opamps are very useful. But one of their major drawbacks is the requirement of a dual supply. This seriously limits their applications in fields where a dual supply is not affordable or not practicable.

This circuit solves the problem to a certain extent. It provides a negative voltage from a single positive supply. This negative voltage together with the positive supply can be used to power the opamps and other circuits requiring a dual supply.

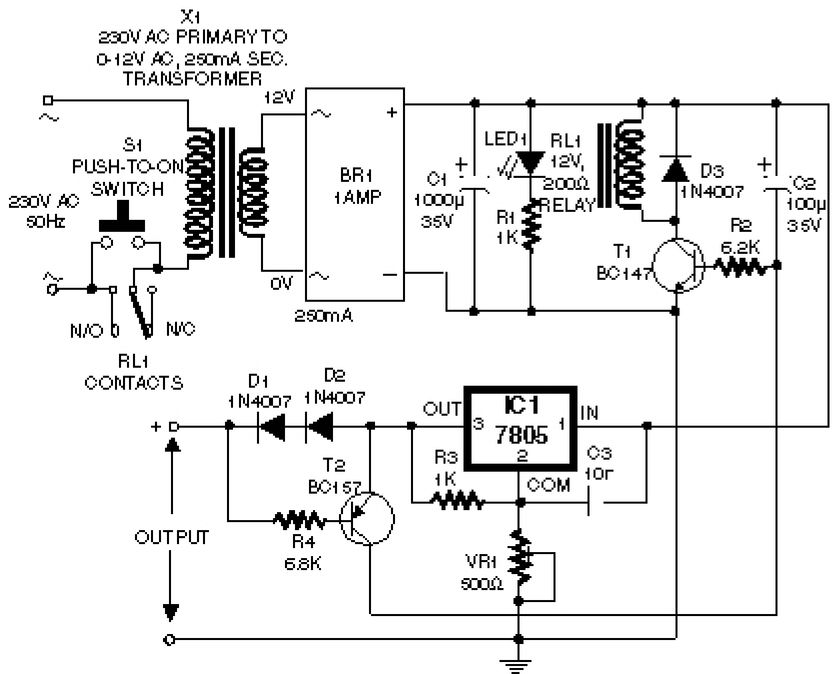
The circuits operation can be explained as follows:

The 555 IC is operating as an astable multivibrator with a frequency of about 1kHz. A square wave is obtained at the pin 3 of the IC . When the output is positive, the 22uF capacitor charges through the diode D1. When the output at pin 3 is ground, the 22uF discharges through the diode D2 and charges the 100uF capacitor is charged. The output is taken across the 100uF capacitor as shown in the figure.

A disadvantage of this circuit is its poor voltage regulation and current limit. The max. current that can be drawn from this circuit is about 40mA. If you draw more current, the regulation will be lost.

Also the output negative voltage will be a little less than the positive supply due to the diode drops. For example if the voltage is +9V then the output voltage will be about 7.5 V.

P313. Self switching Power Supply

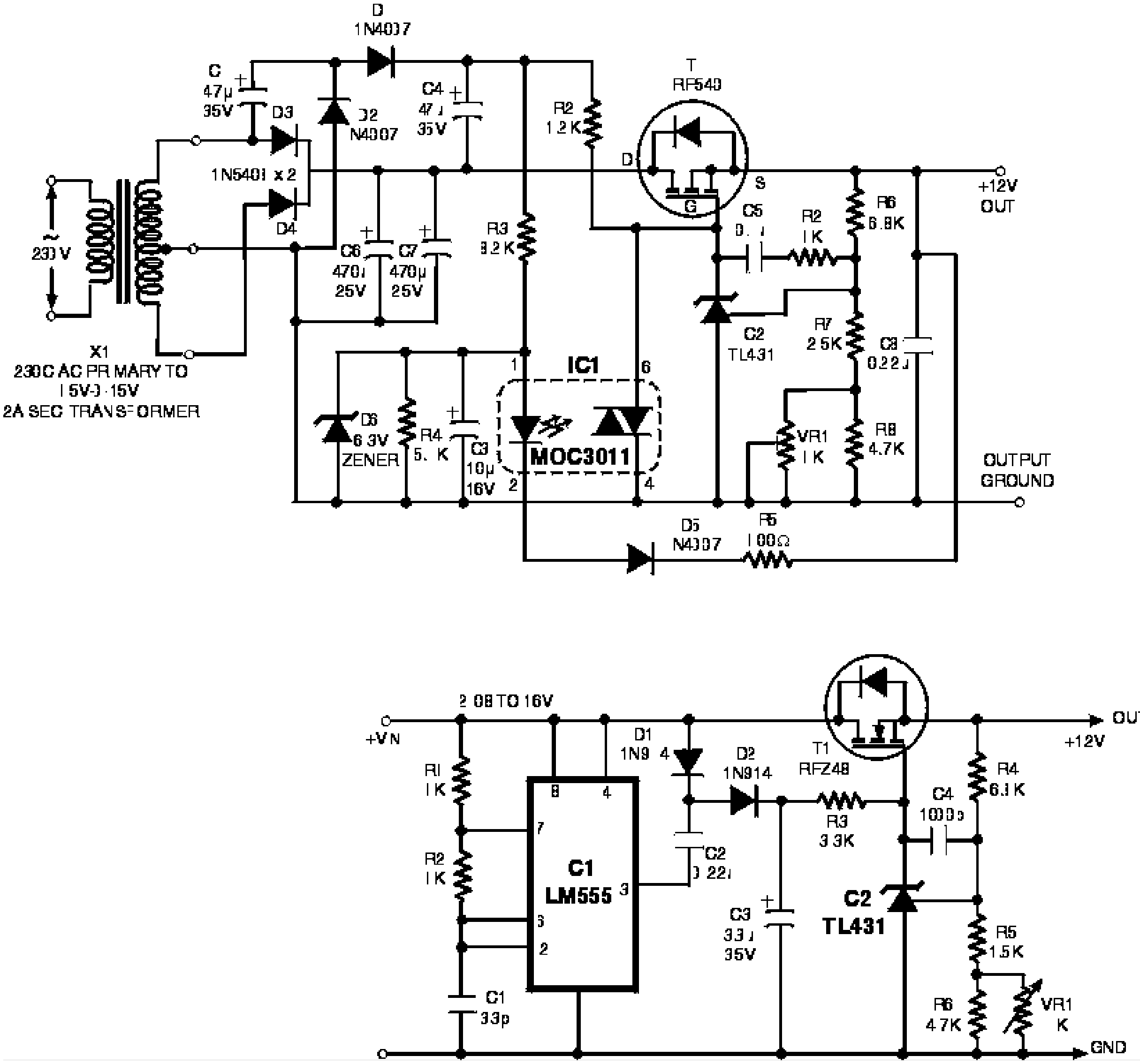


One of the main features of the regulated power supply circuit being presented is that though fixed-voltage regulator LM7805 is used in the circuit, its output voltage is variable. This is achieved by connecting a potentiometer between common terminal of regulator IC and ground. For every 100-ohm increment in the in-circuit value of the resistance of potentiometer VR1, the output voltage increases by 1 volt. Thus, the output varies from 3.7V to 8.7V (taking into account 1.3-volt drop across diodes D1 and D2).

Another important feature of the supply is that it switches itself off when no load is connected across its output terminals. This is achieved with the help of transistors T1 and T2, diodes D1 and D2, and capacitor C2. When a load is connected at the output, potential drop across diodes D1 and D2 (approximately 1.3V) is sufficient for transistors T2 and T1 to conduct. As a result, the relay gets energised and remains in that state as long as the load remains connected. At the same time, capacitor C2 gets charged to around 7-8 volt potential through transistor T2. But when the load is disconnected, transistor T2 is cut off. However, capacitor C2 is still charged and it starts discharging through base of transistor T1. After some time (which is basically determined by value of C2), relay RL1 is de-energised, which switches off the mains input to primary of transformer X1. To resume the power again, switch S1 should be pressed momentarily. Higher the value of capacitor C2, more will be the delay in switching off the power supply on disconnection of the load, and vice versa.

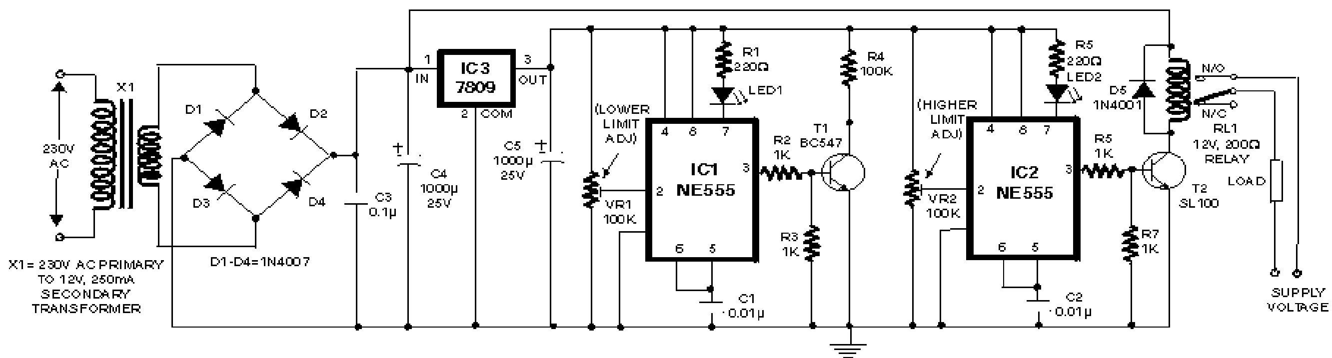
Though in the prototype a transformer with a secondary voltage of 12V-0V, 250mA was used, it can nevertheless be changed as per user's requirement (up to 30V maximum. and 1-ampere current rating). For drawing more than 300mA current, the regulator IC must be fitted with a small heat sink over a mica insulator. When the transformer's secondary voltage increases beyond 12 volts (RMS), potentiometer VR1 must be redimensioned. Also, the relay voltage rating should be redetermined.

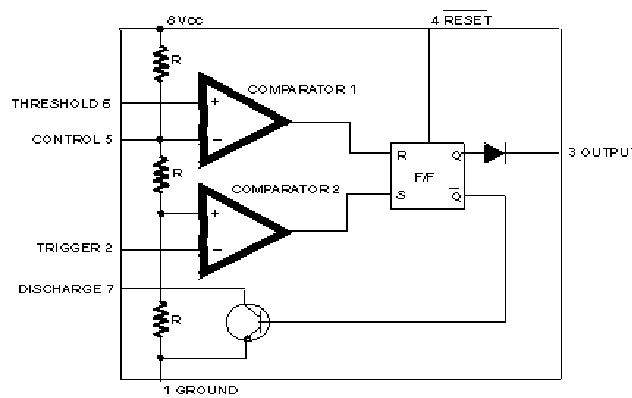
P314. Ultra low drop linear voltage regulator



The circuit is a MOSFET based linear voltage regulator with a voltage drop of as low as 60 mV at 1 ampere. Drop of a fewer millivolts is possible with better MOSFETs having lower RDS(on) resistance. The circuit in Fig. 1 uses 15V-0-15V secondary from a step-down transformer and employs an n-channel MOSFET IRF 540 to get the regulated 12V output from DC input, which could be as low as 12.06V. The gate drive voltage required for the MOSFET is generated using a voltage doubler circuit consisting of diodes D1 and D2 and capacitors C1 and C4. To turn the MOSFET fully on, the gate terminal should be around 10V above the source terminal which is connected to the output here. The voltage doubler feeds this voltage to the gate through resistor R1. Adjustable shunt regulator TL431 (IC2) is used here as an error amplifier, and it dynamically adjusts the gate voltage to maintain the regulation at the output. With adequate heatsink for the MOSFET, the circuit can provide up to 3A output at slightly elevated minimum voltage drop. Trimpot VR1 in the circuit is used for fine adjustment of the output voltage. Combination of capacitor C5 and resistor R2 provides error-amplifier compensation. The circuit is provided with a short-circuit crow-bar protection to guard the components against over-stress during accidental short at the output. This crow-bar protection will work as follows: Under normal working conditions, the voltage across capacitor C3 will be 6.3V and diode D5 will be in the off state since it will be reverse-biased with the output voltage of 12V. However, during output short-circuit condition, the output will momentarily drop, causing D5 to conduct and the opto-triac MOC3011 (IC1) will get triggered, pulling down the gate voltage to ground, and thus limiting the output current. The circuit will remain latched in this state, and input voltage has to be switched off to reset the circuit. The circuit shown in Fig. 2 follows a similar scheme. It can be utilised when the regulator has to work from a DC rail in place of 15V-0-15V AC supply. The gate voltage here is generated using an LM555 charge pump circuit as follows: When 555 output is low, capacitor C2 will get charged through diode D1 to the input voltage. In the next half cycle, when the 555 output goes high, capacitor C3 will get charged to almost double the input voltage. The rest of the circuit works in a similar fashion as the circuit of Fig. 1. These circuits above will help reduce power-loss by allowing to keep lower input voltage range to the regulator during initial design or even in existing circuits. This will keep the output regulated with relatively low input voltage compared to the conventional regulators. The minimum voltage drop can be further reduced using low RDS(on) MOSFETs or by paralleling them

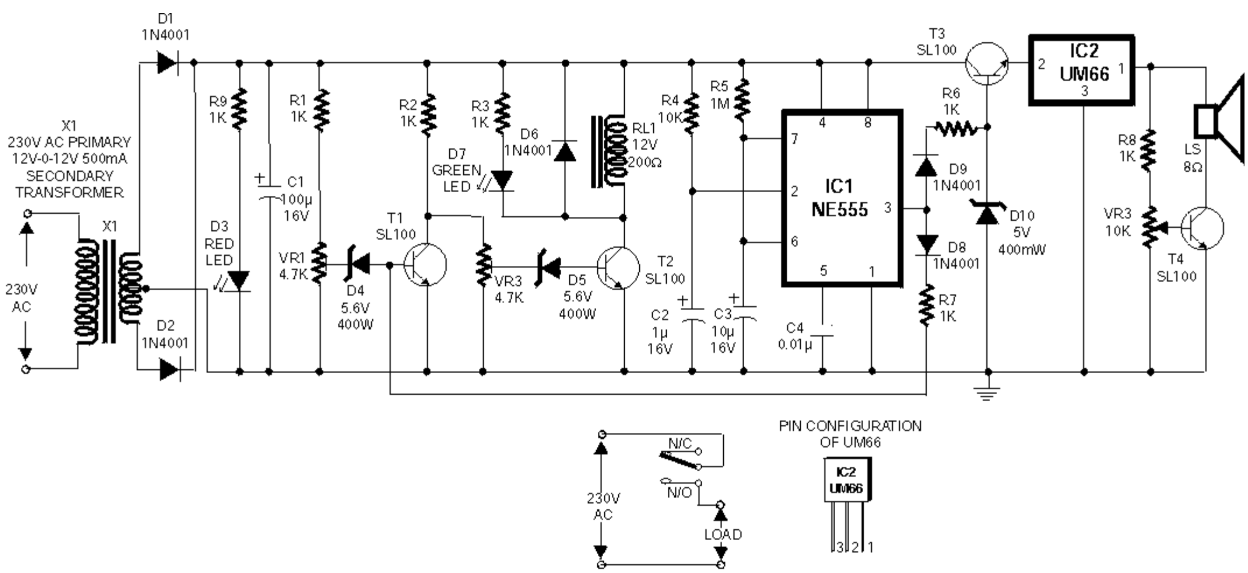
P315. Over / Under Voltage Cut-Out





This over/under voltage cut-out will save your costly electrical and electronic appliances from the adverse effects of very high and very low mains voltages. The circuit features auto reset and utilises easily available components. It makes use of the comparators available inside 555 timer ICs. Supply is tapped from different points of the power supply circuit for relay and control circuit operation to achieve reliability. The circuit utilises comparator 2 for control while comparator 1 output (connected to reset pin R) is kept low by shorting pins 5 and 6 of 555 IC. The positive input pin of comparator 2 is at 1/3rd of Vcc voltage . Thus as long as negative input pin 2 is less positive than 1/3 Vcc, comparator 2 output is high and the internal flip-flop is set, i.e. its Q output (pin 3) is high. At the same time pin 7 is in high impedance state and LED connected to pin 7 is therefore off. The output (at pin 3) reverses (goes low) when pin 2 is taken more positive than 1/3 Vcc. At the same time pin 7 goes low (as Q ouptput* of internal flip- flop is high) and the LED connected to pin 7 is lit. Both timers (IC1 and IC2) are configured to function in the same fashion. Preset VR1 is adjusted for under voltage (say 160 volts) cut-out by observing that LED1 just lights up when mains voltage is slightly greater than 160V AC. At this setting the output at pin 3 of IC1 is low and transistor T1 is in cut-off state. As a result RESET* pin 4 of IC2 is held high since it is connected to Vcc via 100 kilo-ohm resistor R4. Preset VR2 is adjusted for over voltage (say 270V AC) cut-out by observing that LED2 just extinguishes when the mains voltage is slightly less than 270V AC. With RESET* pin 4 of IC2 high, the output pin 3 is also high. As a result transistor T2 conducts and energises relay RL1, connecting load to power supply via its N/O contacts. This is the situation as long as mains voltage is greater than 160V AC but less than 270V AC. When mains voltage goes beyond 270V AC, it causes output pin 3 of IC2 to go low and cut-off transistor T2 and de-energise relay RL1, in spite of RESET* pin 4 still being high. When mains voltage goes below 160V AC, IC1's pin 3 goes high and LED1 is extinguished. The high output at pin 3 results in conduction of transistor T1. As a result collector of transistor T1 as also RESET* pin 4 of IC2 are pulled low. Thus output of IC2 goes low and transistor T2 does not conduct. As a result relay RL1 is de-energised, which causes load to be disconnected from the supply. When mains voltage again goes beyond 160V AC (but less than 270V AC) the relay again energises to connect the load to power supply

P316.
High and Low Voltage Cutout with delay and Music



Voltage variations and power cuts adversely affect various equip- ment such as TVs, VCRs, music systems and refrigerators. This simple circuit will protect the costly equipment from high as well as low voltages and the voltage surges (when power resumes). It also gives a melodious tune when mains power resumes. When mains voltage is normal, the DC voltage at the cathode of zener diode D4 is less then 5.6V. As a result transistor T1 is in 'off' state. The DC voltage at the cathode of zener diode D5 is greater than 5.6V and as a result transistor T2 is in 'on' state. Consequently, relay RL1 gets energised, which is indicated by lighting up of green LED. Under high mains voltage condition, transistor T1 switches to 'on' state because the voltage at cathode of zener diode D4 becomes greater than 5.6V. Consequently, transistor T2 switches to 'off' state, making the relay to de-energise Under low mains voltage condition, transistor T1 switches to 'off' state and as a result transistor T2 also switches to 'off' state, making the relay to de-energise.

Timer IC 555 in the circuit is configured to operate in a monostable mode. The pulse width is about 10 seconds with the timing component values used in the circuit. When the power resumes after a break, pin 2 of IC 555 goes low briefly and this triggers it. Its output makes music IC UM66 to operate through transistor T3. Simultaneously, transistor T1 also gets forward biased as the monostable IC1 output is connected to its base via diode D8 and resistor R7. As a result, transistor T1 conducts and biases transistor T2 to cut off. Thus relay RL1 remains de-energised for the duration of mono pulse and the load is protected against the voltage surges.

To adjust presets VR1 and VR2, you may use a manually variable auto-transformer. Set the output of auto-transformer to 270V AC and connect it to the primary of transformer X1. Adjust preset VR1 such that relay RL1 just de-energises. Next set the output of auto-transformer to 170V AC. Now adjust preset VR2 such that relay RL1 again de-energises. Volume control VR3 may be adjusted for the desired output volume of the tune generated by IC UM66

P317. High Voltage, Low Current Supply

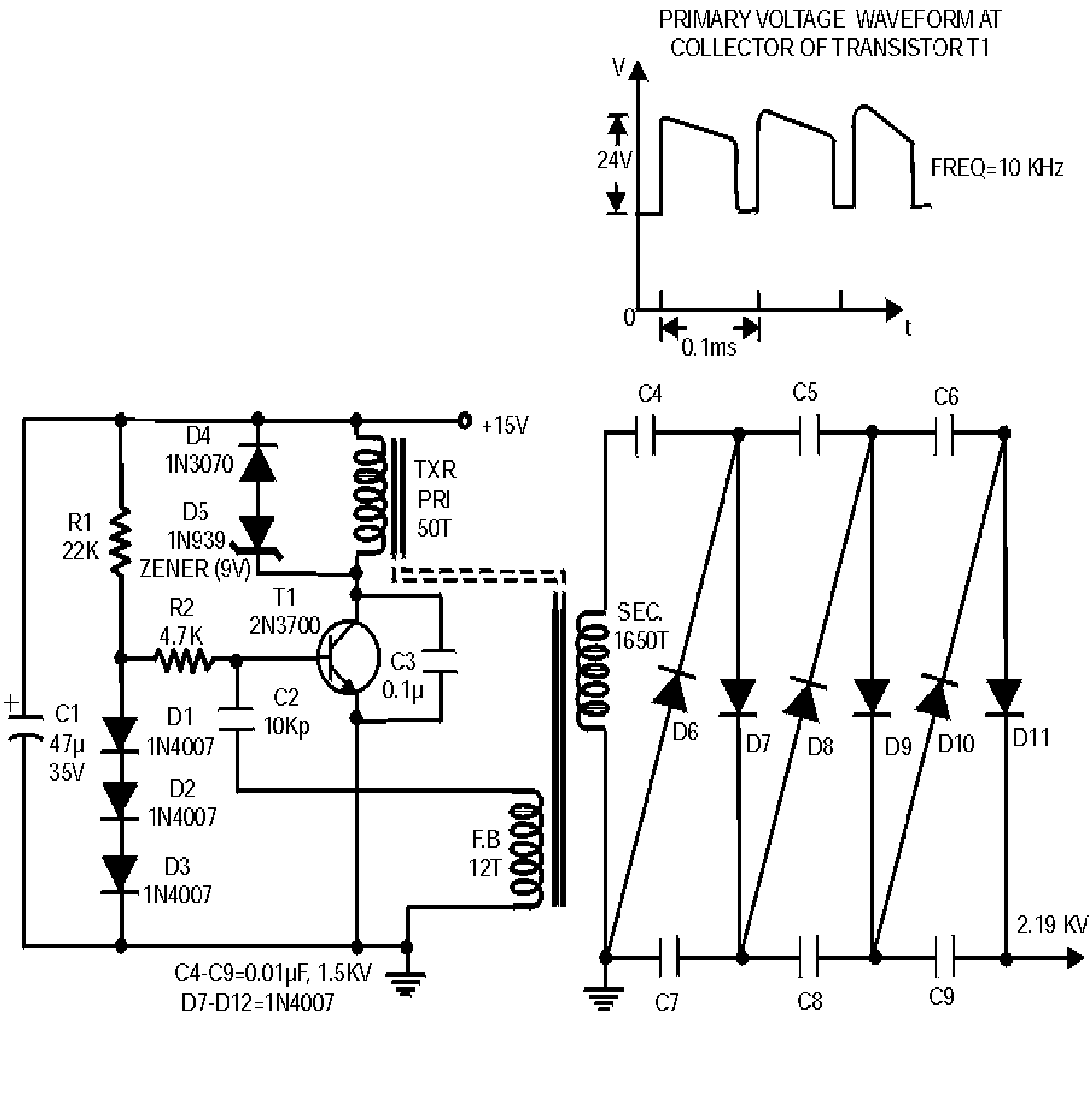


TABLE
Details of the Transformer Windings

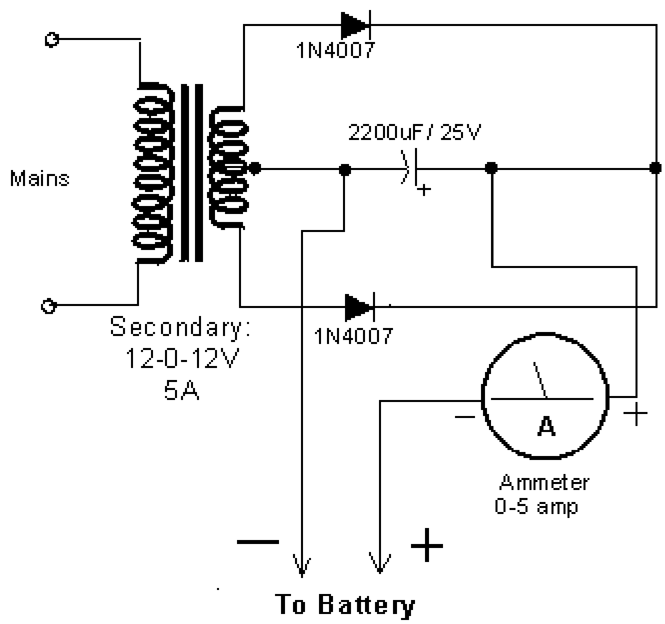
Windings	No. of turns	Standard wire gauge (SWG)
Primary	50	31
Feedback	12	31
Secondary	1650	41

A high voltage power supply is a very useful source which can be effectively used in many applications like biasing of gas-discharge tubes and radiation detectors etc. Such a power supply could also be used for protection of property by electric charging of fences. Here the current requirement is of the order of a few microamps. In such an application, high voltage would essentially exist between a 'live' wire and ground. When this 'live' wire is touched, the discharge occurs via body resistance and it gives a non-lethal but deterrent shock to an intruder. The circuit is built around a single transistorised blocking oscillator. An important element in this circuit is the transformer. It can be fabricated on easily available ferrite cores. Two 'E' sections of the core are joined face-to-face after the enamelled copper wire wound on former is placed in it. The details of the transformer windings are given in the Table.

In this configuration, the primary winding and the feedback winding are arranged such that a sustaining oscillation is ensured once the supply is switched on. The waveform's duty cycle is asymmetrical, but it is not very important in this application. Please note that if the oscillations do not occur at the 'switch-on' time, the transformer winding terminals of the feedback or the primary winding (but not both) should be reversed. The primary oscillation amplitude is about 24V(p-p). This gets amplified with the large step-up ratio of the transformer and we get about 800V(p-p) across the secondary. A simple series voltage multiplier (known as Cockroft-Walton circuit) is used to boost up this voltage in steps to give a final DC of about 2 kV. The output voltage, however, is not very well regulated. But if there is a constant load, the final voltage can be adjusted by varying the supply voltage.

The present configuration gives 2 kV for an input DC voltage of 15 V. Though higher voltages could be achieved by increasing input supply, one word of caution is necessary: that the component ratings have to be kept in mind. If the ratings are exceeded then there will be electrical discharges and breakdowns, which will damage the device

P318. Simple Car Battery Charger



This very simple circuit uses a transformer ,two diodes , a capacitor and an ammeter.

To charge a battery just connect the + and - terminals of the circuit to the corresponding terminals of the battery.

When the battery is not charged, the ammeter reading shows 1-3 amps.

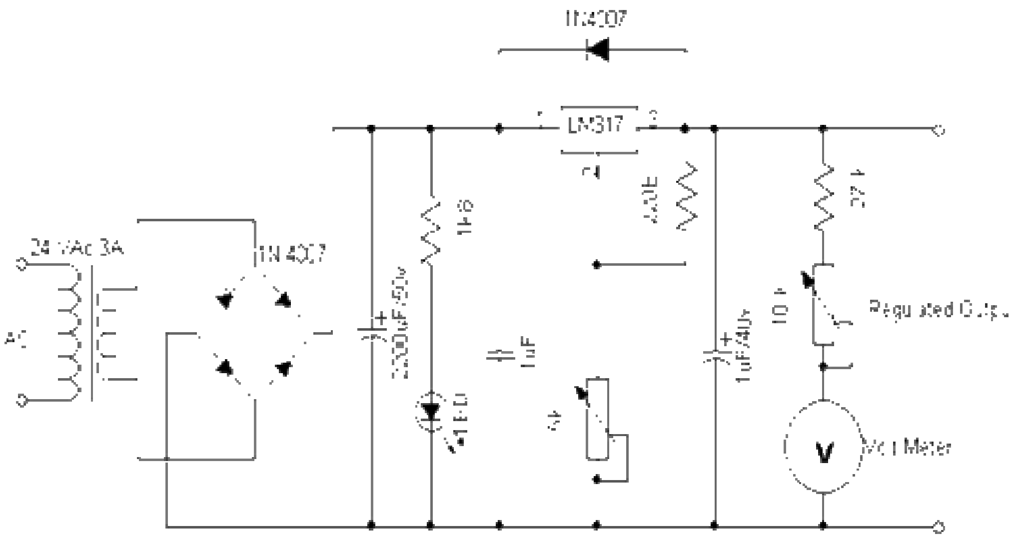
When the battery is fully charged the ammeter reads Zero or nearly zero, after which the battery should be removed from the charger.

The circuit is a full wave rectifier using 2 diodes for rectification. The capacitor is used for smoothing.

I think the circuit works fine without the capacitor since the battery itself acts a BIG capacitor. But when you are using the circuit to supply 12V (as a battery eliminator) the capacitor needs to be present.

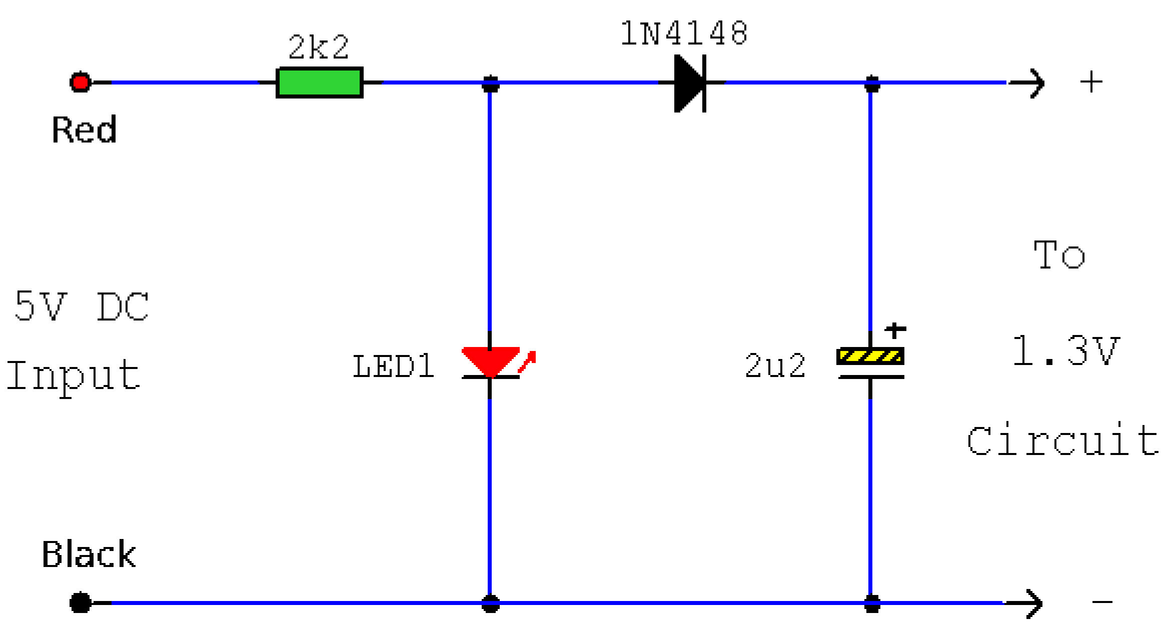
Care should be taken NOT to reverse the + and - terminals while connecting it to the battery.

P319. 1.5 to 30 Volt Variable Power Supply



P320. 1.3 Volt Power Source

Description
This is a replacement power source for 1.3V mercury cells or other small batteries. It has many uses and I use this circuit in my computer to power a front panel multi adapter which has a digital thermometer.



Notes

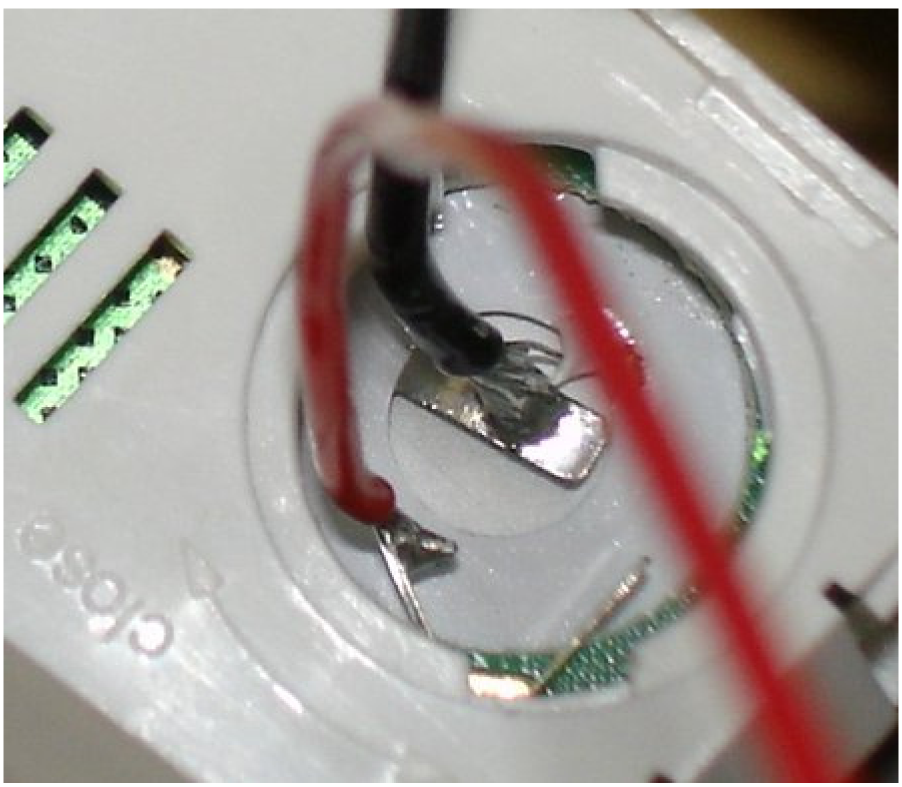
This circuit takes it power from a PC. The power connectors have colour coded wiring, red and black are a 12V supply, black and yellow are a 5V supply. These are extremely high current so absolute care must be taken to avoid short circuits and an inline fuse of 100mA is recommended.

The 1.3V is derived from a Red LED. When on and forward biased the LED's voltage drop between anode and cathode is about 1.9V, this is too high for mercury cell powered equipment, but fed in series with a 1N4148 signal diode drops around 0.6V, the supply is then ideal to drive battery powered peripherals.

This is not suitable for clocks, because when the computer is turned off the 5V supply is also switched off. It is however ideal for the independent temperature displays often included with PC preripherals such as case mounted usb connectors.

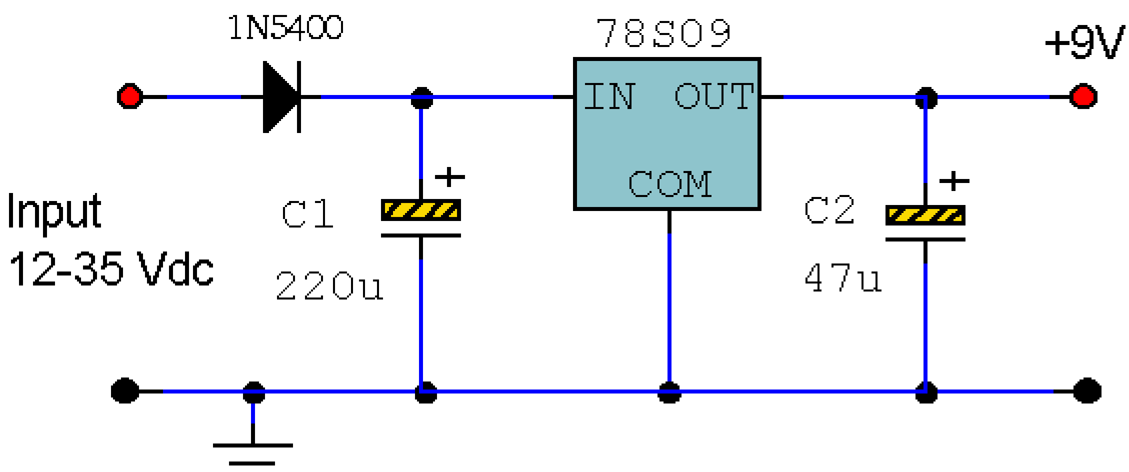
Connections

Please note that if you choose to solder connections onto the battery compartment like me it will void the warrantry of your equipment. Do so, only at your own risk. Below is a close up shot of the battery connections.



Soldering here requires care, as excess heat will melt the surrounding plastic and you will be working in a small space, typically less than the width of a battery or less than 10mm. Flexible stranded wire is the best to use here. Below is the finished view of my front panel adapter.

P321. 9 Volt 2 Amp PSU



Notes

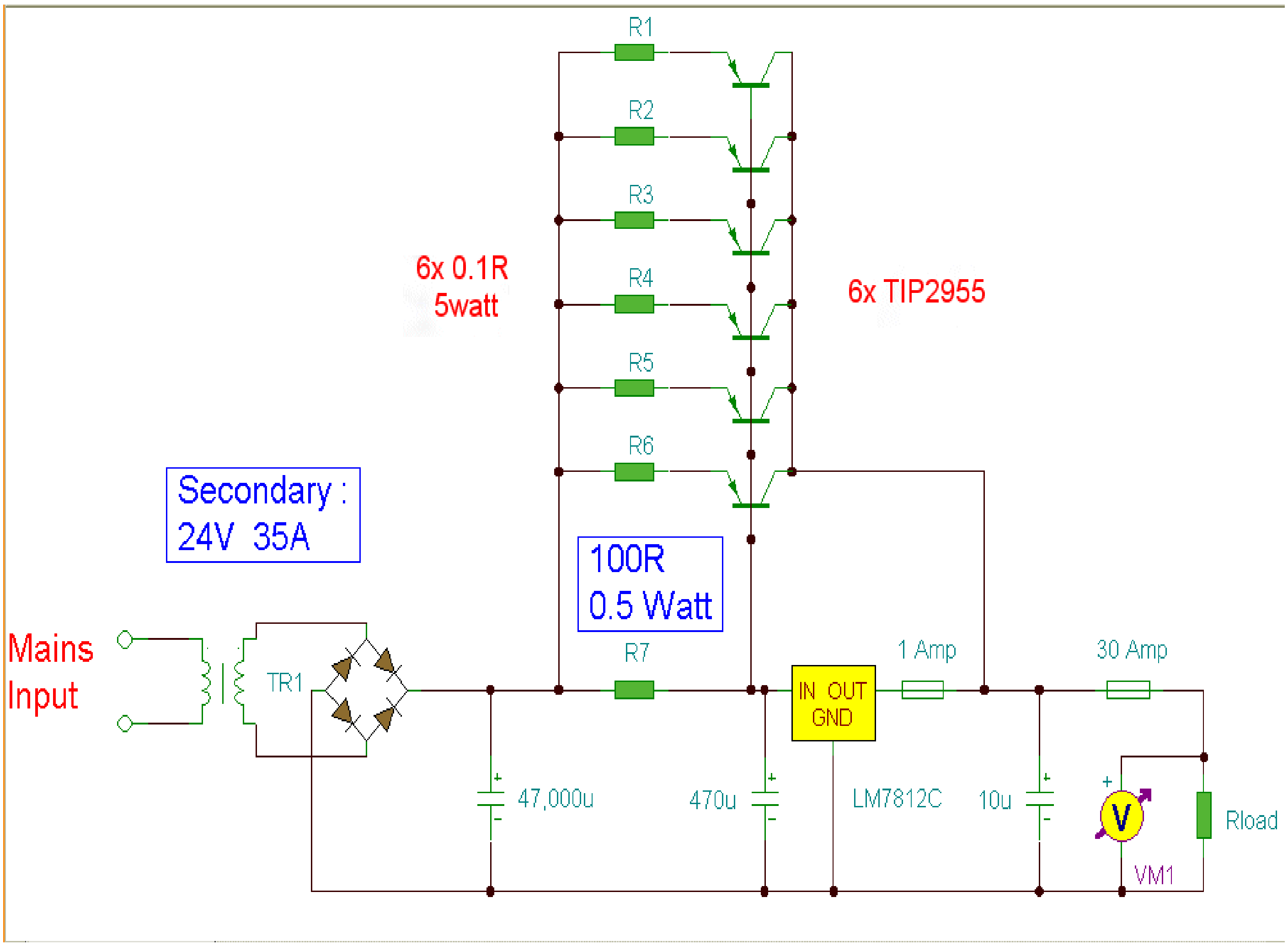
There is little to be said about this circuit. All the work is done by the regulator. The 78S09 can deliver up to 2 amps continuous output whilst maintaining a low noise and very well regulated supply.

The circuit will work without the extra components, but for reverse polarity protection a 1N5400 diode is provided at the input, extra smoothing being provided by C1. The output stage includes C2 for extra filtering, if powering a logic circuit than a 100nF capacitor is also desirable to remove any high frequency switching noise.

P322. 12 Volt 30 Amp Power Supply

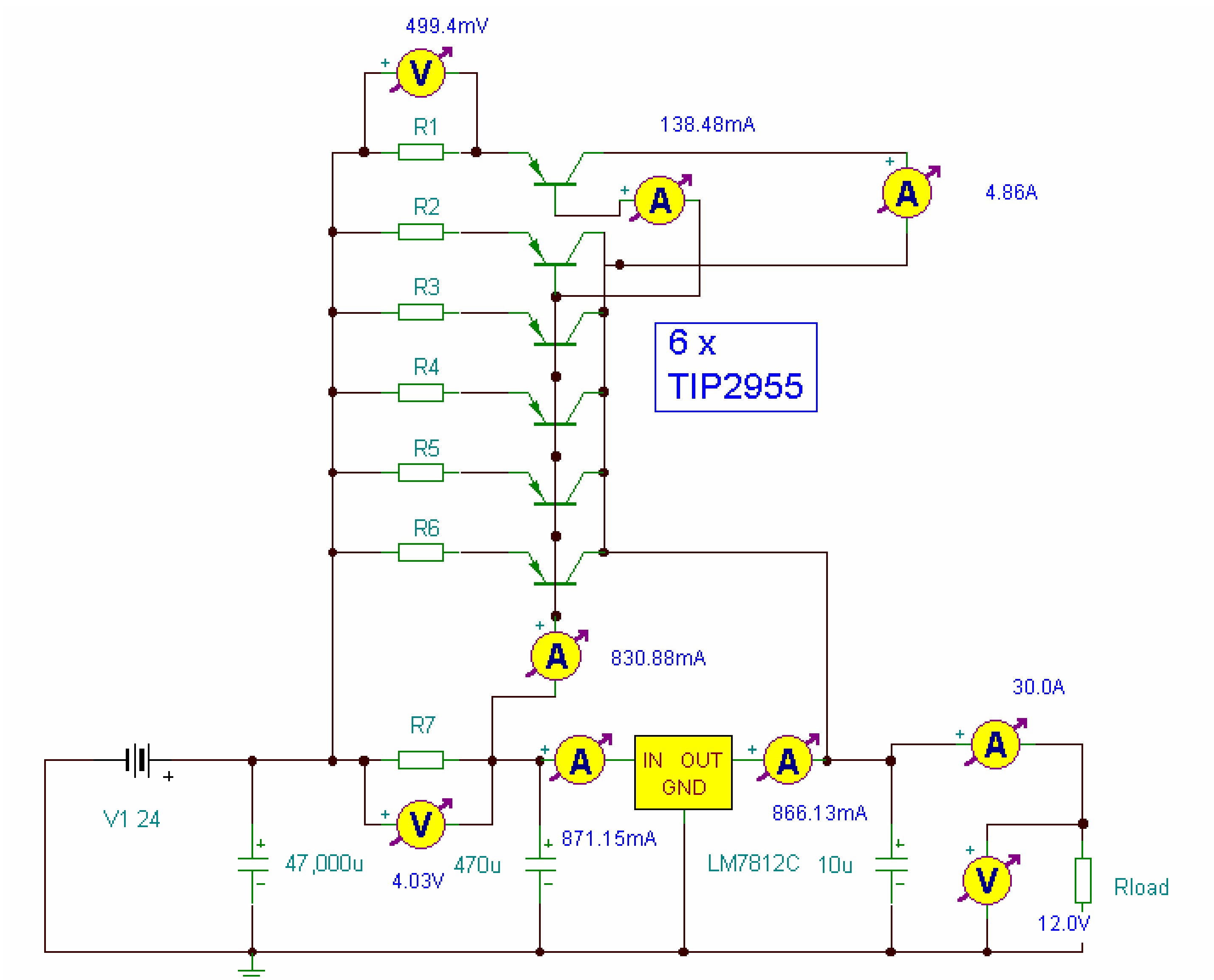
Description

Using a single 7812 IC voltage regulator and multiple outboard pass transistors, this power supply can deliver output load currents of up to 30 amps. The design is shown below:



Notes

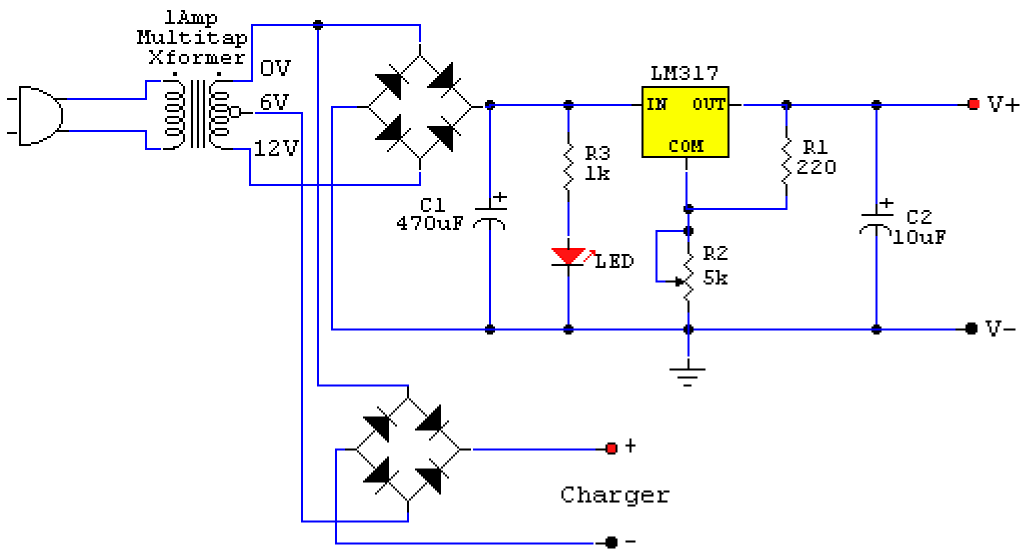
The input transformer is likely to be the most expensive part of the entire project. As an alternative, a couple of 12 Volt car batteries could be used. The input voltage to the regulator must be at least several volts higher than the output voltage (12V) so that the regulator can maintain its output. If a transformer is used, then the rectifier diodes must be capable of passing a very high peak forward current, typically 100amps or more. The 7812 IC will only pass 1 amp or less of the output current, the remainder being supplied by the outboard pass transistors. As the circuit is designed to handle loads of up to 30 amps, then six TIP2955 are wired in parallel to meet this demand. The dissipation in each power transistor is one sixth of the total load, but adequate heat sinking is still required. Maximum load current will generate maximum dissipation, so a very large heat sink is required. In considering a heat sink, it may be a good idea to look for either a fan or water cooled heat sink. In the event that the power transistors should fail, then the regulator would have to supply full load current and would fail with catastrophic results. A 1 amp fuse in the regulators output prevents a safeguard. The 400mohm load is for test purposes only and should not be included in the final circuit. A simulated performance is shown below:



Calculations

This circuit is a fine example of Kirchoff's current and voltage laws. To summarise, the sum of the currents entering a junction, must equal the current leaving the junction, and the voltages around a loop must equal zero. For example, in the diagram above, the input voltage is 24 volts. 4 volts is dropped across R7 and 20 volts across the regulator input, 24 -4 -20 =0. At the output :- the total load current is 30 amps, the regulator supplies 0.866 A and the 6 transistors 4.855 Amp each , 30 = 6 * 4.855 + 0.866. Each power transistor contributes around 4.86 A to the load. The base current is about 138 mA per transistor. A DC current gain of 35 at a collector current of 6 amp is required. This is well within the limits of the TIP2955. Resistors R1 to R6 are included for stability and prevent current swamping as the manufacturing tolerances of dc current gain will be different for each transistor. Resistor R7 is 100 ohms and develops 4 Volts with maximun load. Power dissipation is hence (4^2)/200 or about 160 mW. I recommend using a 0.5 Watt resistor for R7. The input current to the regulator is fed via the emitter resistor and base emitter junctions of the power transistors. Once again using Kirchoff's current laws, the 871 mA regulator input current is derived from the base chain and the 40.3 mA flowing through the 100 Ohm resistor. 871.18 = 40.3 + 830. 88. The current from the regulator itself cannot be greater than the input current. As can be seen the regulator only draws about 5 mA and should run cold.

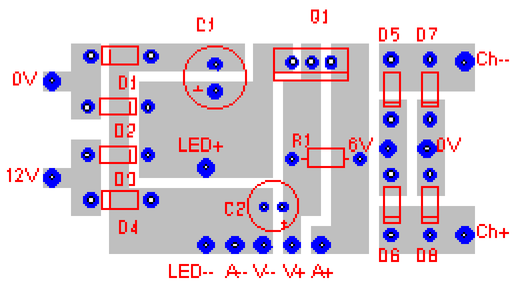
P323. Adjustable Power Supply with Charger Output

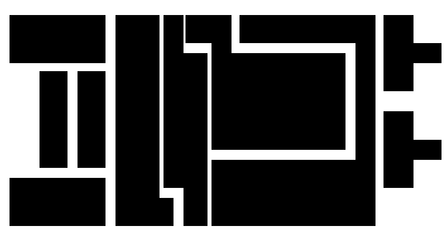


Notes

This power supply has adjustable and charger output. The charger circuit can be use for cellular phone. The adjustable output serves as multipurpose power supply. It can handle a 1 ampere current. The 317 must have a heat sink.

PCB Layout





Parts List
Semiconductor:
LM 317 - 1pc
LED - 1pc
1N 4001 - 8pcs

Capacitors:
25V/470uF - 1pc
25V/10 uF - 1pc

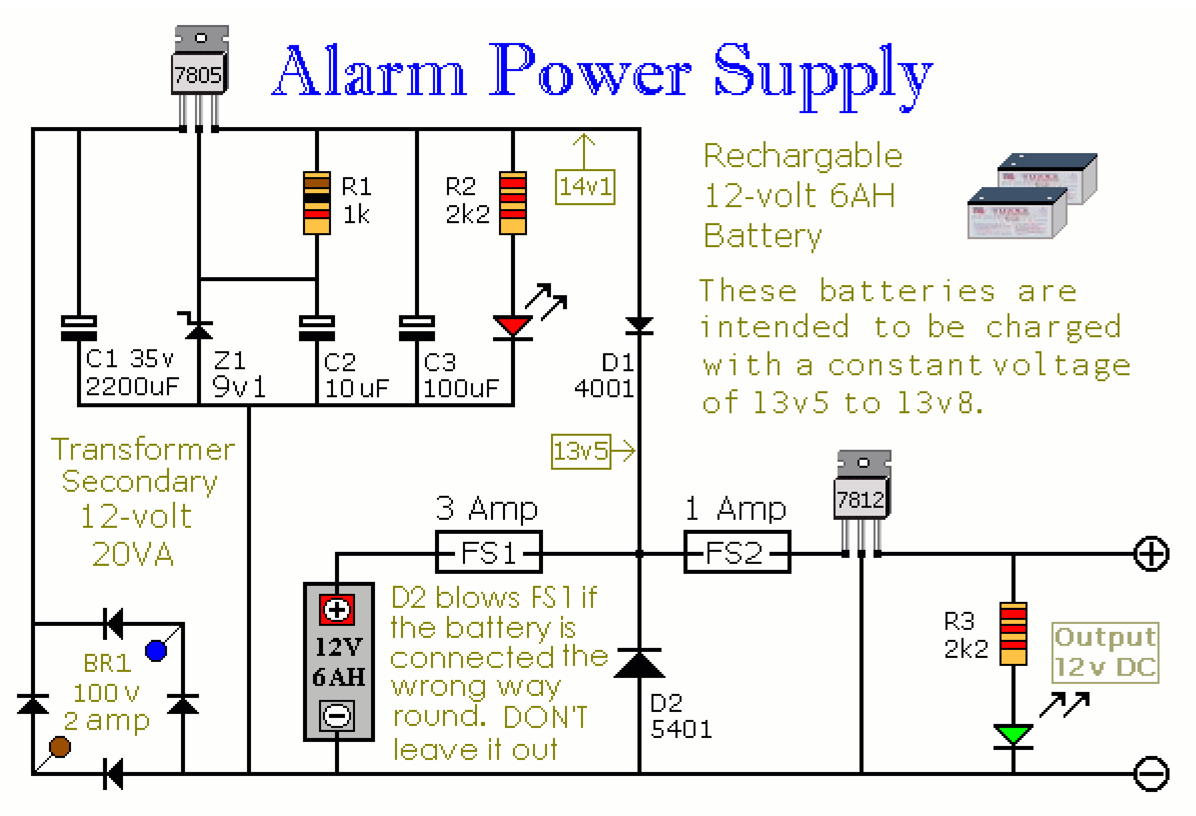
Resistors:
1k, 1/2W - 1pc
220R , 1/2W - 1pc
5kR Potentiometer - 1pc

Others:
1Ampere, Multi-tap Transformer - 1pc
AC Chord - 1pc
Casing - 1pc
#22 Stranded Wire - 3m
Heatsink for TO220

P324. Alarm Power Supply

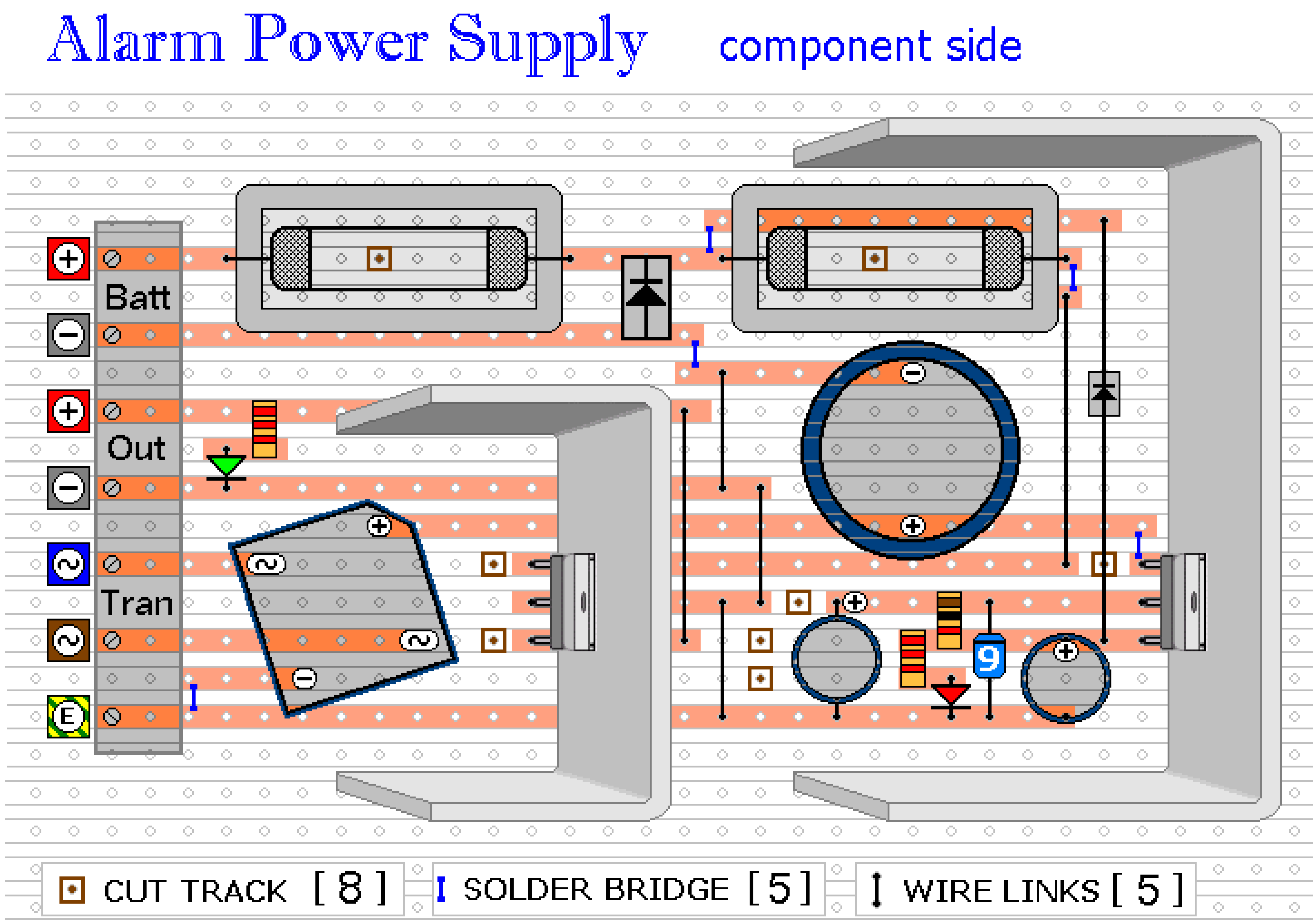
Description

A 12 Volt power suppiled designed for Ron's Modular Burglar Alarm. However, being a popular supply voltage this circuit will have many other uses as well.



Notes

This Power Supply is suitable for the Modular Burglar Alarm. However, it has other applications. It is designed to provide an output of 12-volts, with a current of up to 1-amp. In the event of mains failure, the back-up battery takes over automatically. When the mains is restored, the battery recharges. Use a genuine alarm type back-up battery. They are maintenance-free, and their terminals can be held at 13v8 for many years, with no ill effects. A smaller or larger capacity battery may be used, without circuit modification. Use the 2-amp version of the 7805. It needs the larger heatsink because it has to dissipate a lot of energy, especially when called upon to recharge a flat battery. This heatsink is at 9v1, and must NOT be connected to ground. The 7812 never has to dissipate more than 2-watts, so its heatsink can be smaller.Many of the components, which are shown lying flat on the board, are actually mounted upright. The links are bare copper wire on the component side. The heatsinks are folded strips of aluminium, about 2mm thick. Use a well-insulated panel mounted fuse holder for the mains supply to the transformer, and fit it with a 1-amp fuse.



P325. Add-On Current Limiter for Power Supplies

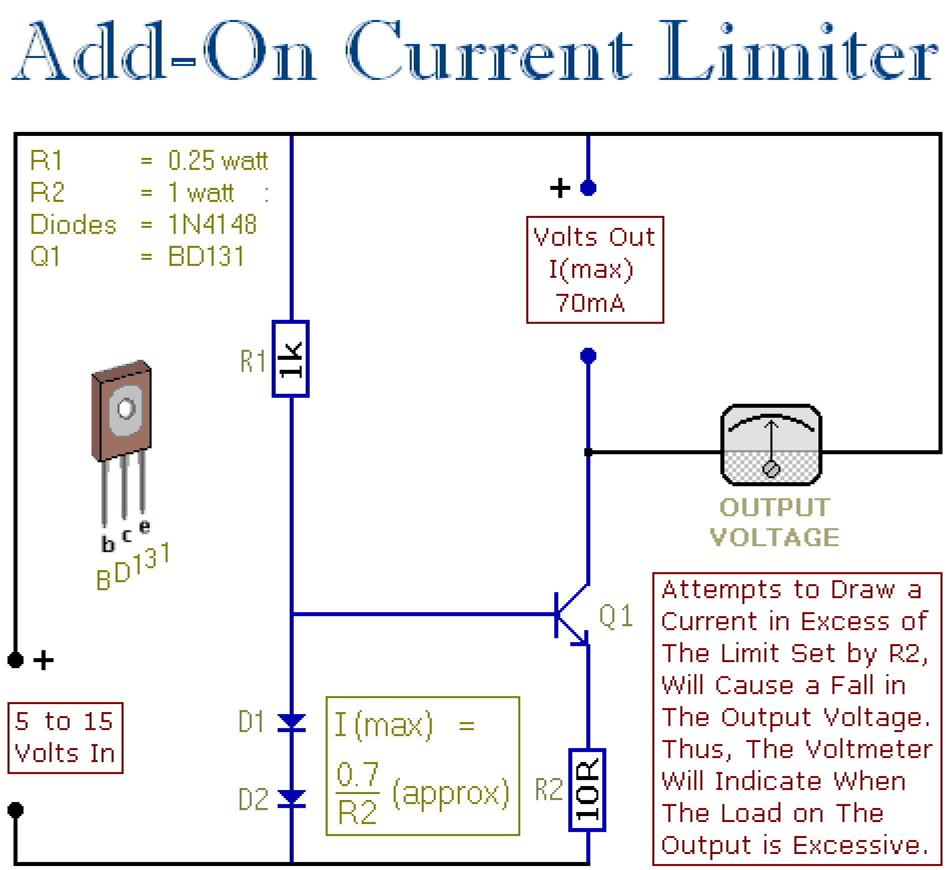
Description

This circuit allows you to set a limit on the maximum output current available from your PSU. It's very useful when you power-up a project for the first time - or carry out a soak-test. By setting an upper limit on the current available from your PSU - you can protect both your power supply - and any device connected to it. It offers a simple and cheap alternative to the Current Limiting Power Supply

Notes

The basic circuit is shown in the first schematic. The two diodes fix the voltage on the base of the Power Transistor at about 1v4. This means that the voltage across R2 is fixed at about 0v7. If R2 is 10 ohms, then the maximum emitter current is (0v7 ï¿½10) about 70mA.

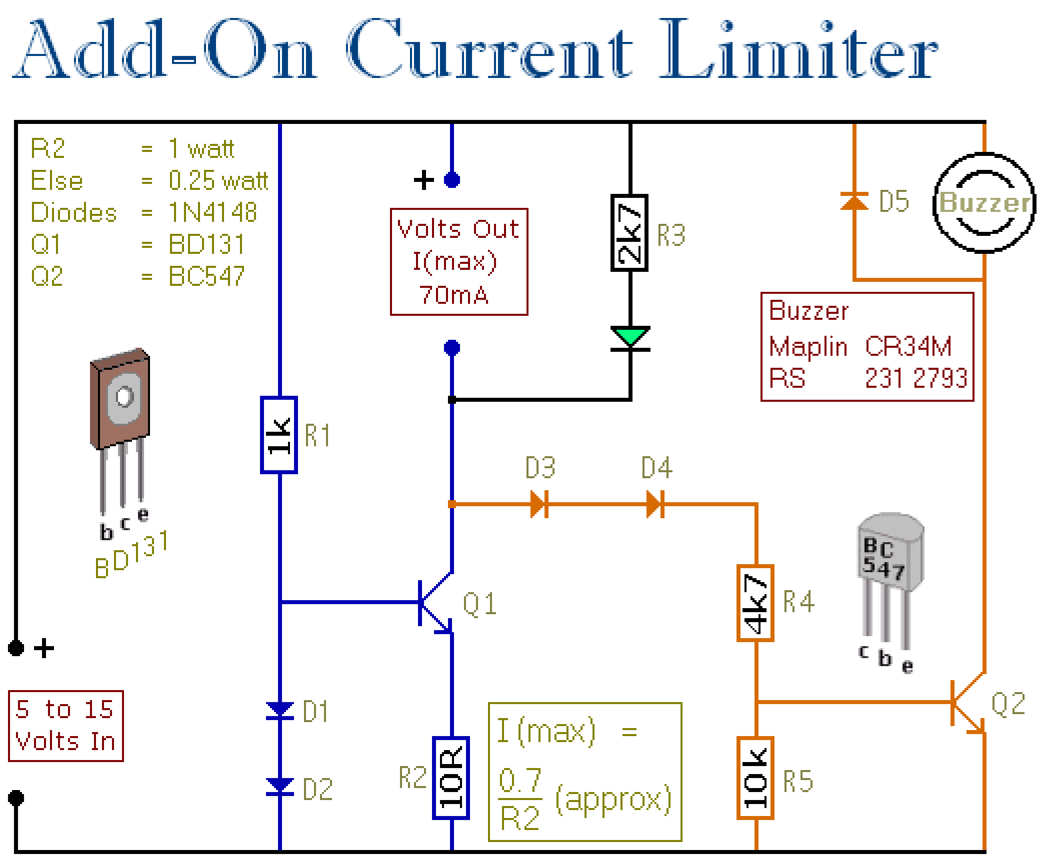
Since the collector current is always more or less equal to the emitter current - you cannot draw more than 70mA from the output terminals. If you try to do so - the output voltage will fall.



I used a BD131 because that was what I had available. However, any NPN Power Transistor with a similar - or better - spec should work fine. I had no special reason for chosing a 70mA maximum. If you want to set a different current limit - change the value of R2. The formula is in the diagram. Always remember that if you increase the current - you'll also increase the watts.

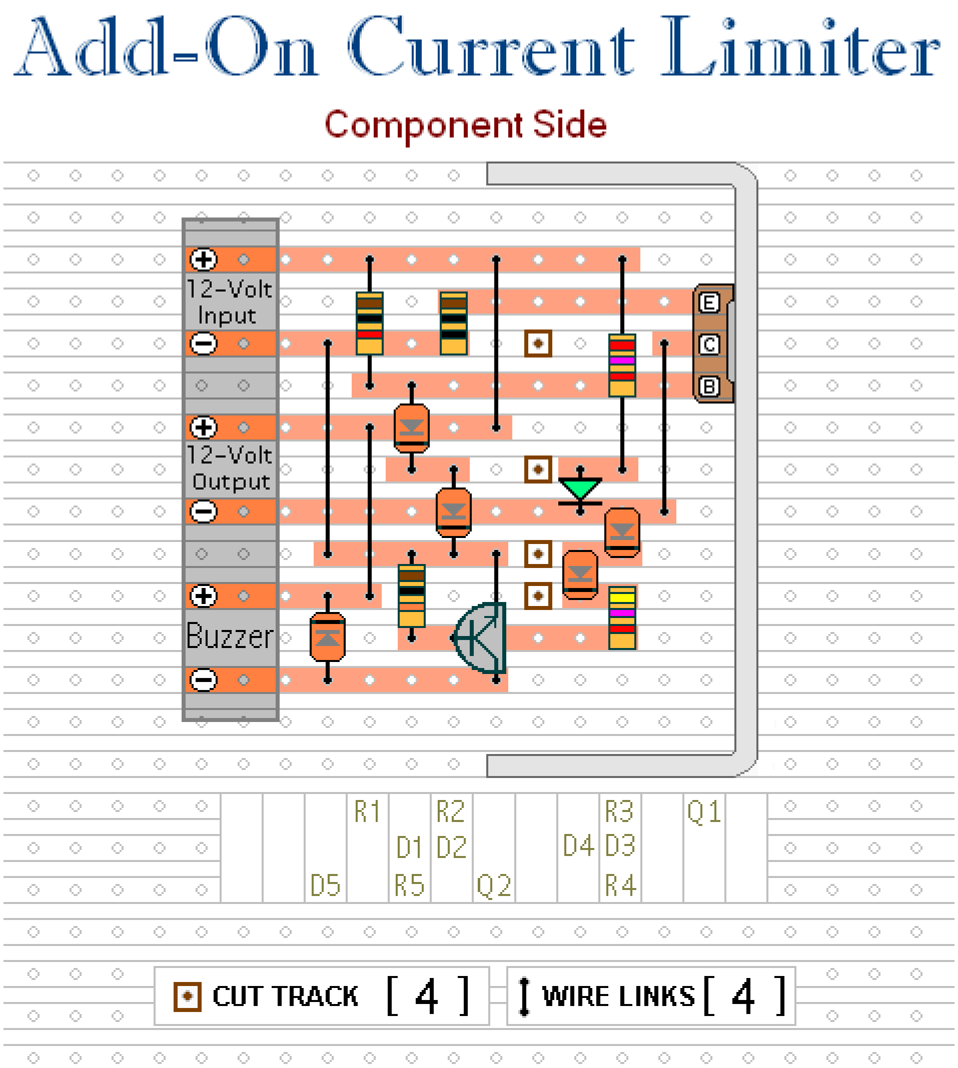
The second schematic has a couple of added features. If you don't want to use a voltmeter on the output - use an LED instead. If the output voltage falls - the LED will dim or extinguish completely. This is enough to let you know that the load on the output is excessive.

Where the Current Limiter is to be left unattended for any length of time - say during a soak-test - the Buzzer is useful. Should a problem develope - and the output voltage fall by 2-volts or more - the circuit will sound the alarm.



Veroboard Layout

The layout provided is for the second schematic - but it's flexible. If you don't want the LED feature - just leave out the LED and R3. If you don't want the alarm feature - leave out D3, D4, D5, R4, R5 & Q2.

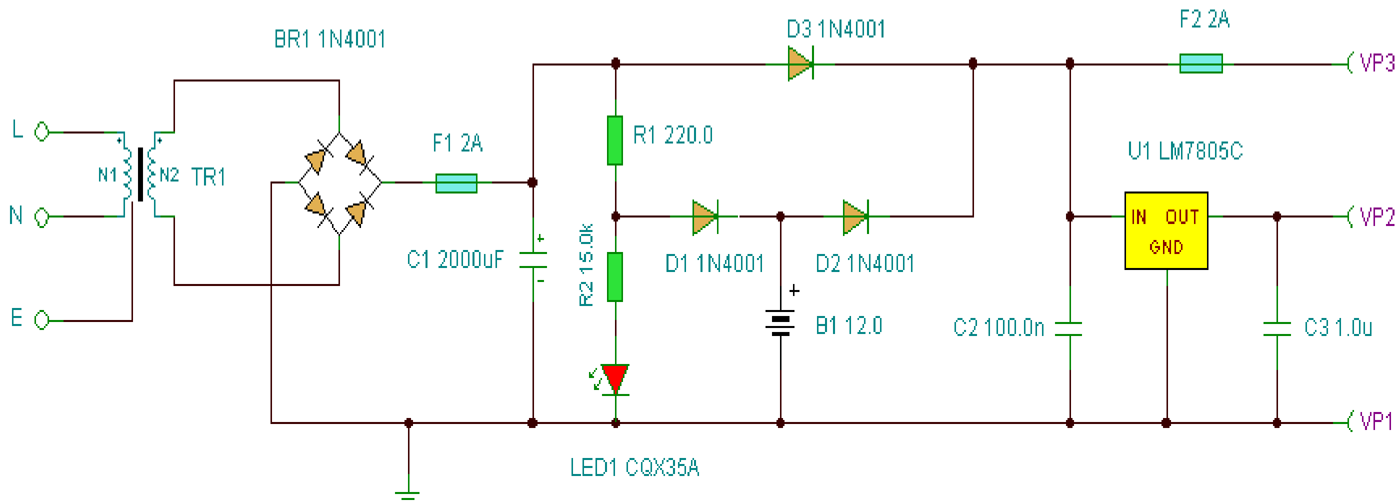


The heatsink is a folded strip of aluminium about 2mm thick, 6cm long and 3cm tall. If you increase significantly the maximum current available from the limiter circuit - you'll probably need to increase the size of the heatsink as well.

P326. Basic UPS

Description

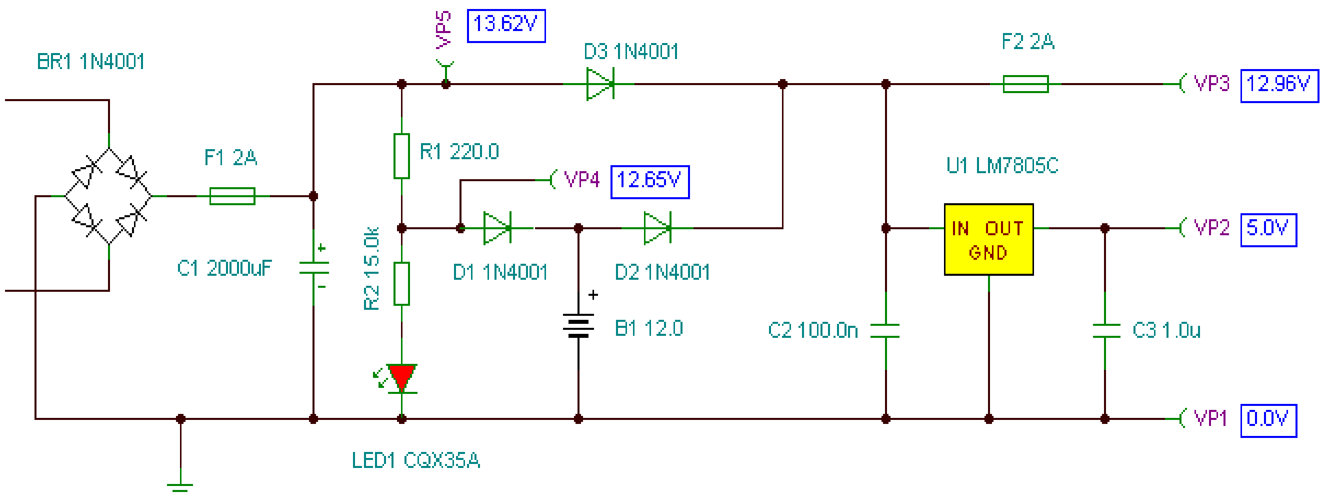
This circuit is a simple form of the commercial UPS, the circuit provides a constant regulated 5 Volt output and an unregulated 12 Volt supply. In the event of electrical supply line failure the battery takes over, with no spikes on the regulated supply.



Notes

This circuit can be adapted for other regulated and unregulated voltages by using different regulators and batteries. For a 15 Volt regulated supply use two 12 Volt batteries in series and a 7815 regulator. There is a lot of flexibility in this circuit.

TR1 has a primary matched to the local electrical supply which is 240 Volts in the UK. The secondary winding should be rated at least 12 Volts at 2 amp, but can be higher, for example 15 Volts. FS1 is a slow blow type and protects against short circuits on the output, or indeed a faulty cell in a rechargeable battery. LED 1 will light ONLY when the electricity supply is present, with a power failure the LED will go out and output voltage is maintained by the battery. The circuit below simulates a working circuit with mains power applied:

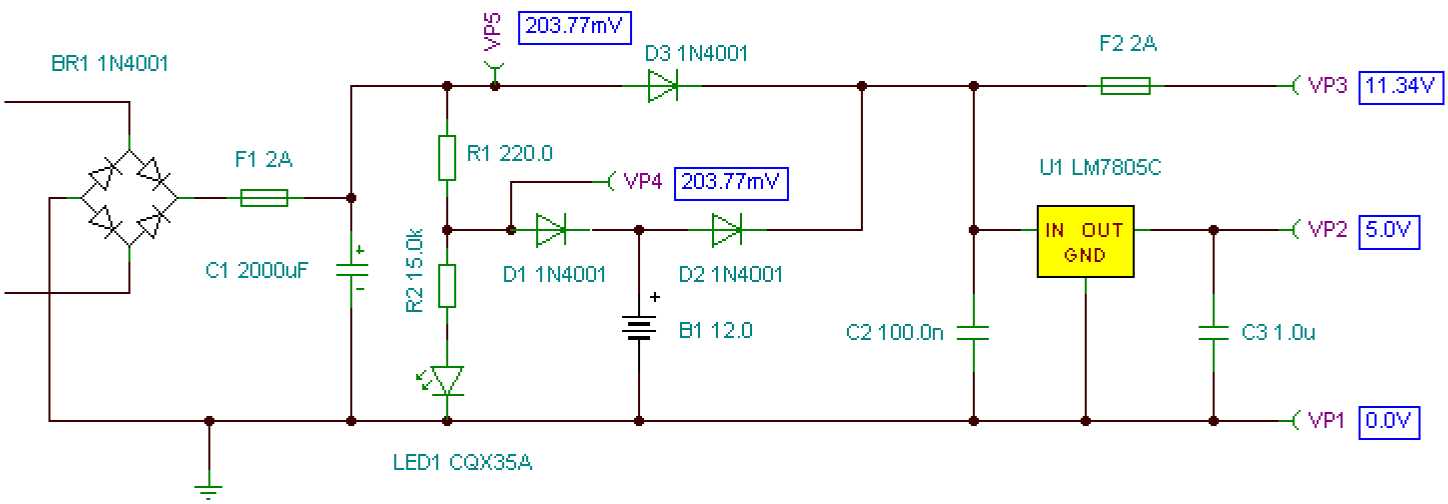


Between terminals VP1 and VP3 the nominal unregulated supply is available and a 5 Volt regulated supply between VP1 and VP2. Resistor R1 and D1 are the charging path for battery B1. D1 and D3 prevent LED1 being illuminated under power fail conditions. The battery is designed to be trickle charged, charging current defined as :-

(VP5 - 0.6) / R1

where VP5 is the unregulated DC power supply voltage.

D2 must be included in the circuit, without D2 the battery would charge from the full supply voltage without current limit, which would cause damage and overheating of some rechargeable batteries. An electrical power outage is simulated below:



Note that in all cases the 5 Volt regulated supply is maintained constantly, whilst the unregulated supply will vary a few volts.

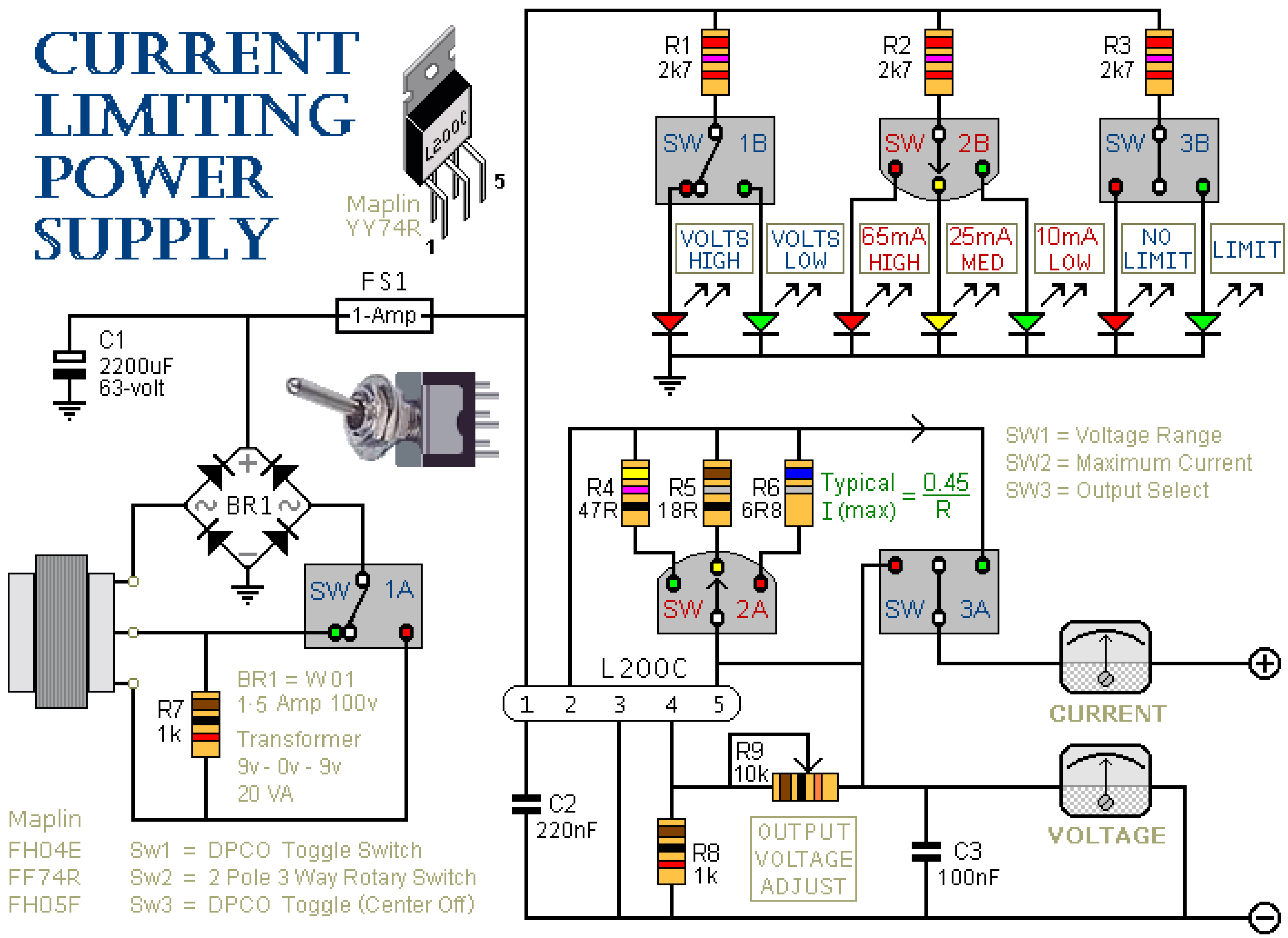
Standby Capacity

The ability to maintain the regulated supply with no electrical supply depends on the load taken from the UPS and also the Ampere hour capacity of the battery. If you were using a 7A/h 12 Volt battery and load from the 5 Volt regulator was 0.5 Amp (and no load from the unregulated supply) then the regulated supply would be maintained for around 14 hours. Greater A/h capacity batteries would provide a longer standby time, and vice versa.

P327. Current Limiting Power Supply

Description

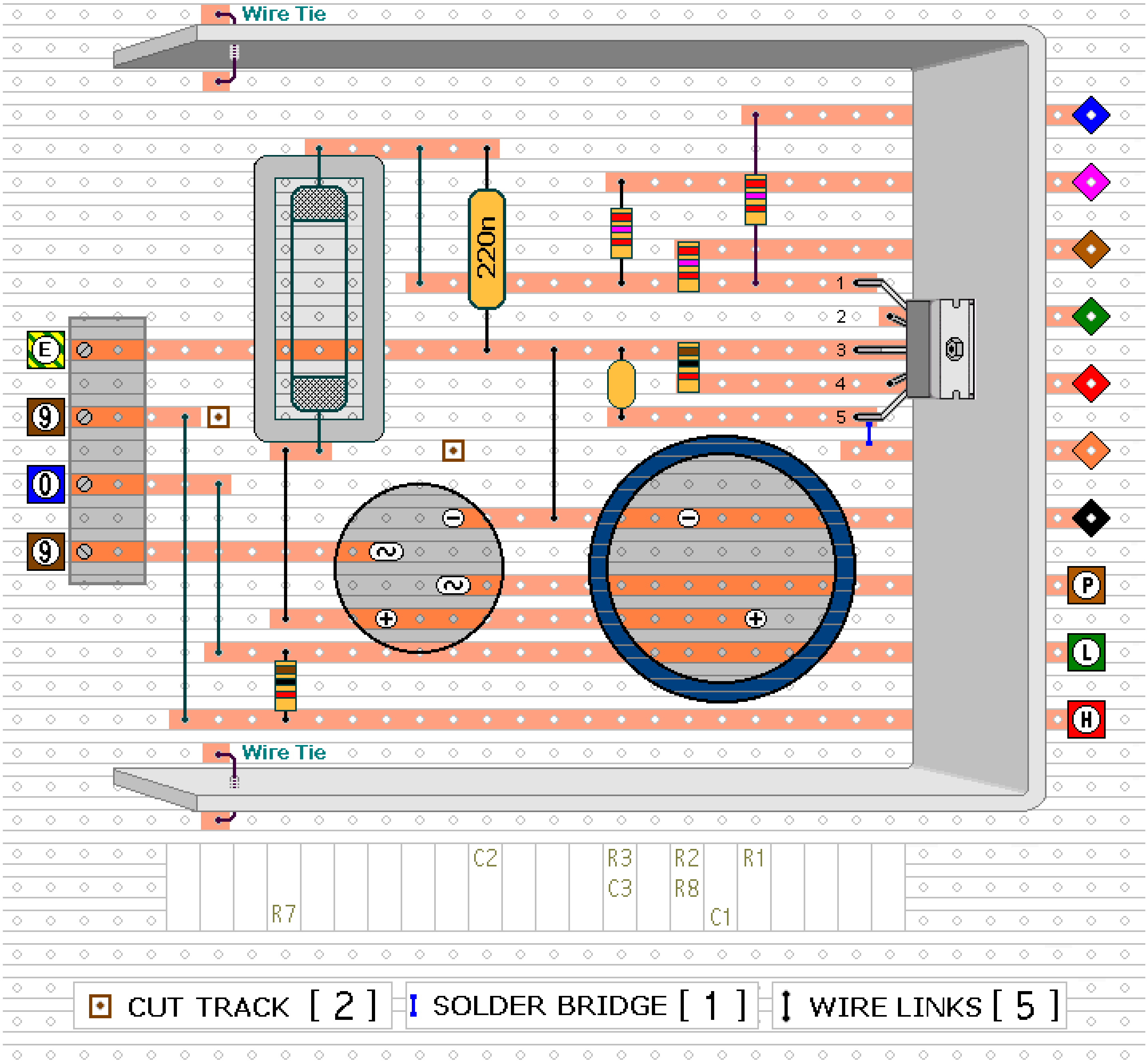
This is a 1-amp variable-voltage PSU. It adjusts from about 3v to 24v: and has the added feature that you can limit the maximum output current. This is invaluable when (for example) you power-up a project for the first time or soak-test a piece of equipment.



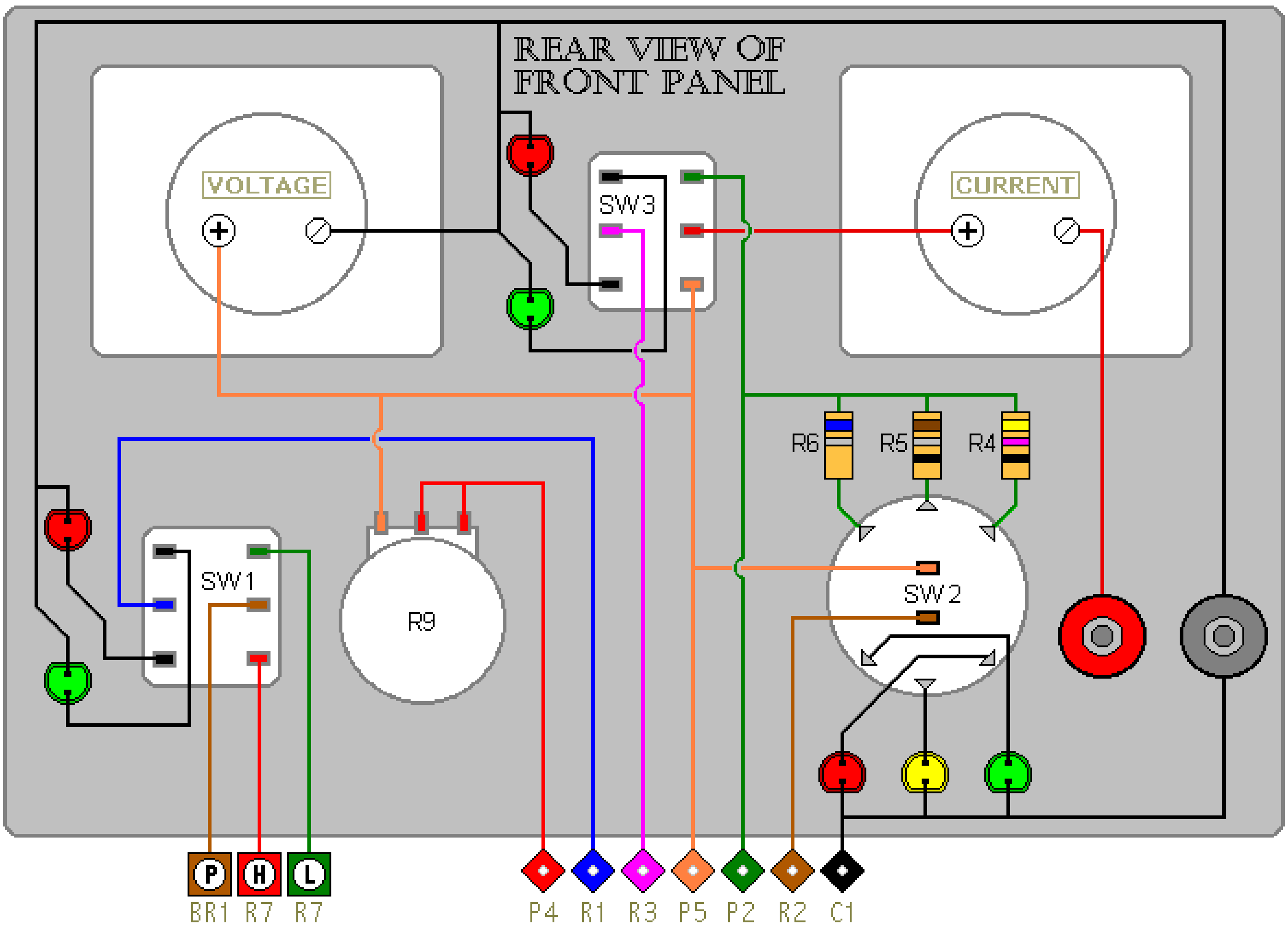
Notes

SW3 is the on/off switch. It also lets you choose between the output with the current limit and the one without. SW2 provides a selection of three different limits. You can increase or decrease this number if you wish. The limits are fixed by R4, R5 & R6. They are set at 10mA, 25mA & 65mA respectively; but you can choose whatever limits you like. If you try to draw a current above the limit you've selected, the output voltage will fall. Thus, the voltmeter indicates when the load on the output is excessive.

CURRENT LIMITING POWER SUPPLY

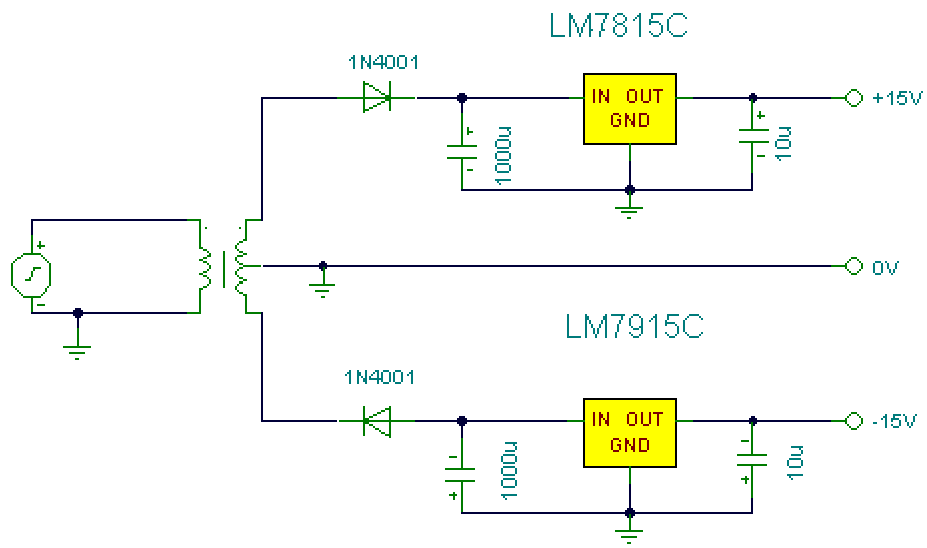


The housing should be well ventilated. The heatsink is a folded strip of aluminium about 2mm thick, 18cm long and 6cm tall. SW1 allows you to choose between the (3v to 12v) and (3v to 24v) outputs. This reduces the power the heatsink has to dissipate when the output voltage is low.



The drawing of the front panel is intended mainly as a wiring diagram - you can choose your own layout. The pin spacing of the L200C doesn't suit the stripboard; but with a little persuasion it can be made to fit. Since the limiting resistors may have a relatively low value, a few ohms between the contacts of the wafer-switch will have a significant effect. If (with time) you find that the limits have fallen, use a spray-cleaner on the switch.

P328. Dual Regulated Power Supply

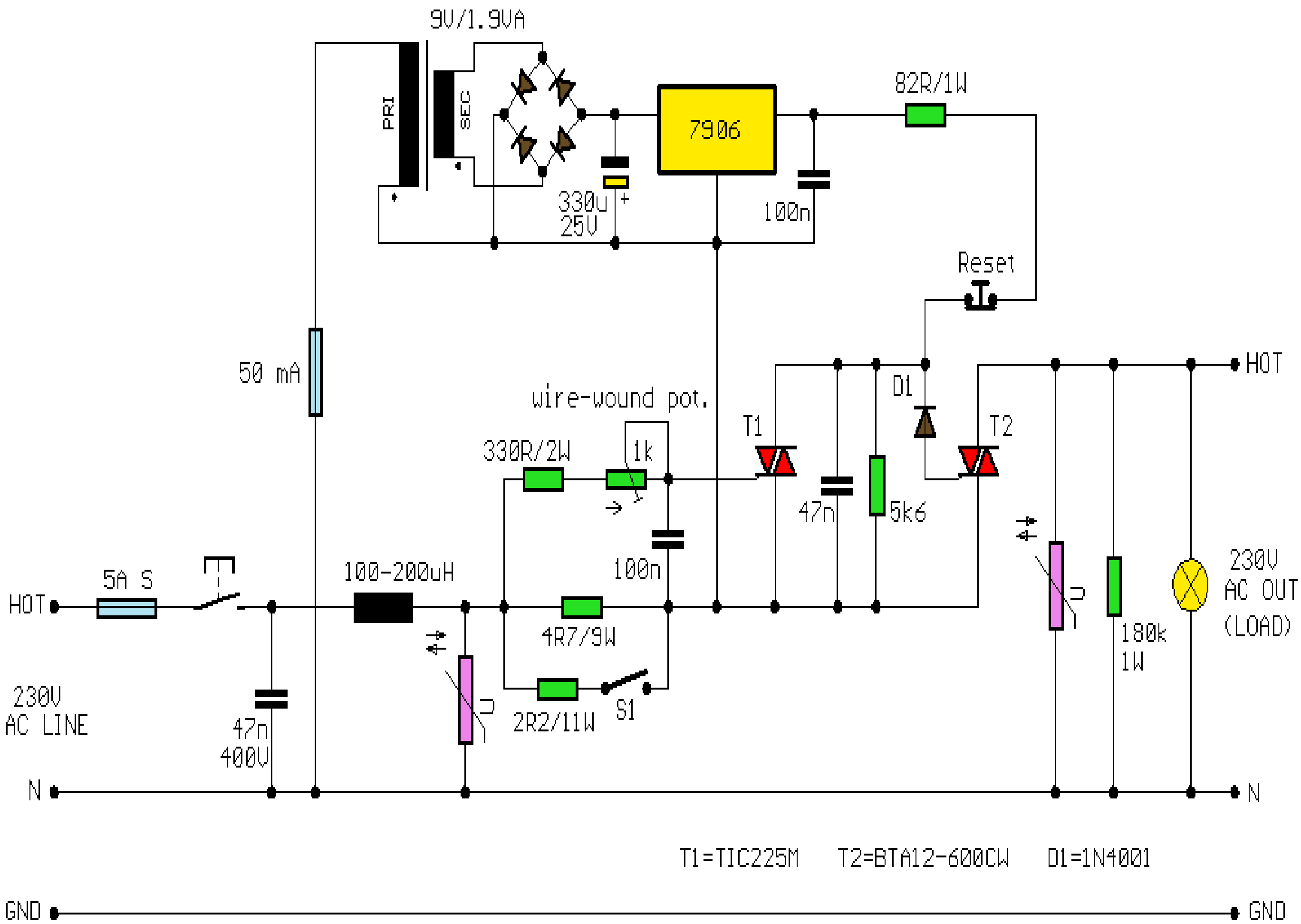


Notes

In this circuit, the 7815 regulatates the positive supply, and the 7915 regulates the negative supply. The transformer should have a primary rating of 240/220 volts for europe, or 120 volts for North America. The centre tapped secondary coil should be rated about 18 volts at 1 amp or higher,allowing for losses in the regulator. An application for this type of circuit would be for a small regulated bench power supply.

P329. Fast Electronic Fuse

Description
A fast electronic fuse designed to operate on 230V AC with an adjustable trip current.



Notes

When the current through the load exceeds a level determined by the position of the wiper on the 1k wire-wound pot, this circuit cuts off the load immediately. If S1 is open, the range is approximately 300-650 mA, and 0.8-2A when it is closed.

The key variable in the operation of the fuse is the voltage drop across the power resistor(s) which are connected in series with the load. This voltage drop is directly proportional to the current the load draws. When this current is low, the voltage across the resistors is also small and cannot trigger T1. At the same time the gate of T2 is fed from a little power supply built around a negative voltage regulator. T2 is conducting and the load is on.

If the current through the load then gets too high, so that the voltage created across the resistor(s) can trigger the gate of T1 through the 330R resistor and the pot: T1 starts to conduct, swiftly taking away all the current from the gate of T2. The voltage drop across T1 (MT1-MT2) will then be only 0.7 V and T2 will be firmly off. T1 stays this way all until the momentary (normally closed, "push-to-break") Reset push-button is pressed: this causes the current through T1 to drop below the hold level and forces this triac to turn off. Releasing the Reset button re-enables the current flow to and through the gate of T2, switching it on.

T1 must be a TIC225M, as this particular type has a very low trigger current. T2 is a snubberless BTA12-600CW which cannot be replaced with a 'normal' triac, but maybe with a BTA12-600BW which also can be used without a snubber circuit, but has a little less sensitive gate (not a problem in this design). If the gates of snubberless triacs are DC-controlled and they are switching AC, the DC to control the gates MUST be negative - flowing from the gate, hence the negative voltage regulator. (Snubberless is in fact a registered trade mark belonging to ST.)

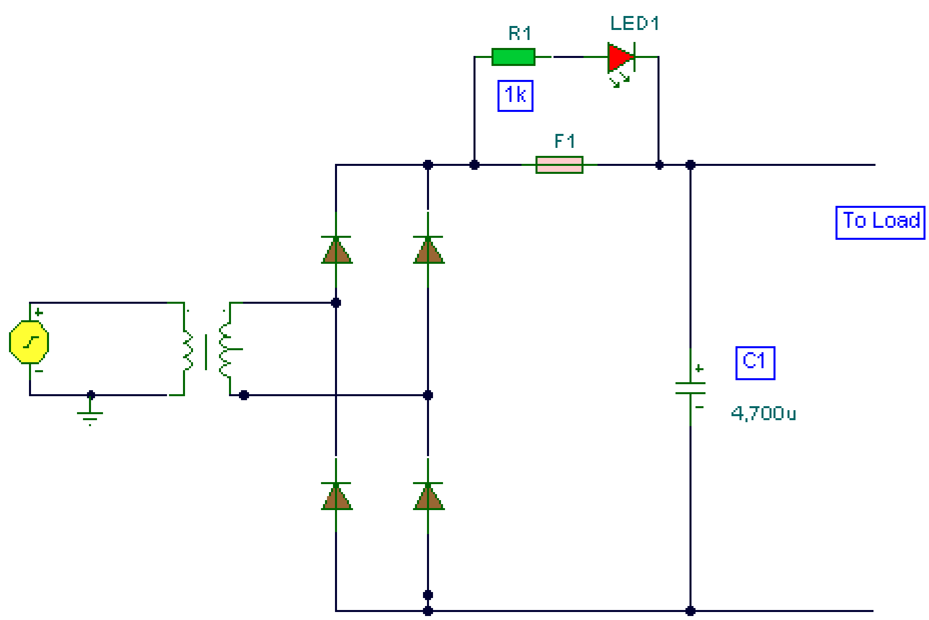
The output AC voltage will be 1-5 volts below the input level, depending on the load. Varistors are 250V AC. Pay attention to the "reverse" polarities of the electrolytic capacitor and the diodes before the 7906.

DANGER! This circuit connects directly to 220-230V AC which can be lethal! Please do not attempt to build any of the circuits/projects unless you have the expertise, skill and concentration that will help you avoid an injury. Please see Disclaimer on this site.

P330. Fuse Monitor Indicator

Description:

The idea for this project may have come to me in a flash of inspiration, and its a very simple way to check if a fuse has blown without removing it from its holder.



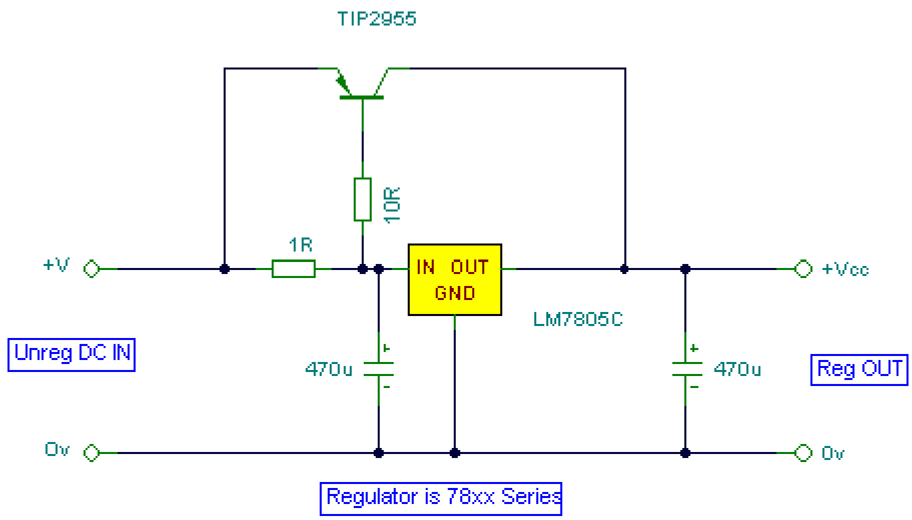
Notes

The simplicity of this circuit uses just two components, but with just one resistor and an LED this circuit gives visual indication of when a fuse has blown. LED1 is normally off, being "short circuited " by the fuse, F1. Should the inevitable "big-bang" happen in your workshop then LED1 will illuminate and led you know all about it! Please note that the LED will only illumininatet under fault conditions, i.e. with a short circuit or shunt on the load. In this case the current is reduced to a safe level by R1.

P331. Increasing Regulator Current

Description:

An outboard pass transistor used to increase the current output of a voltage regulator IC.



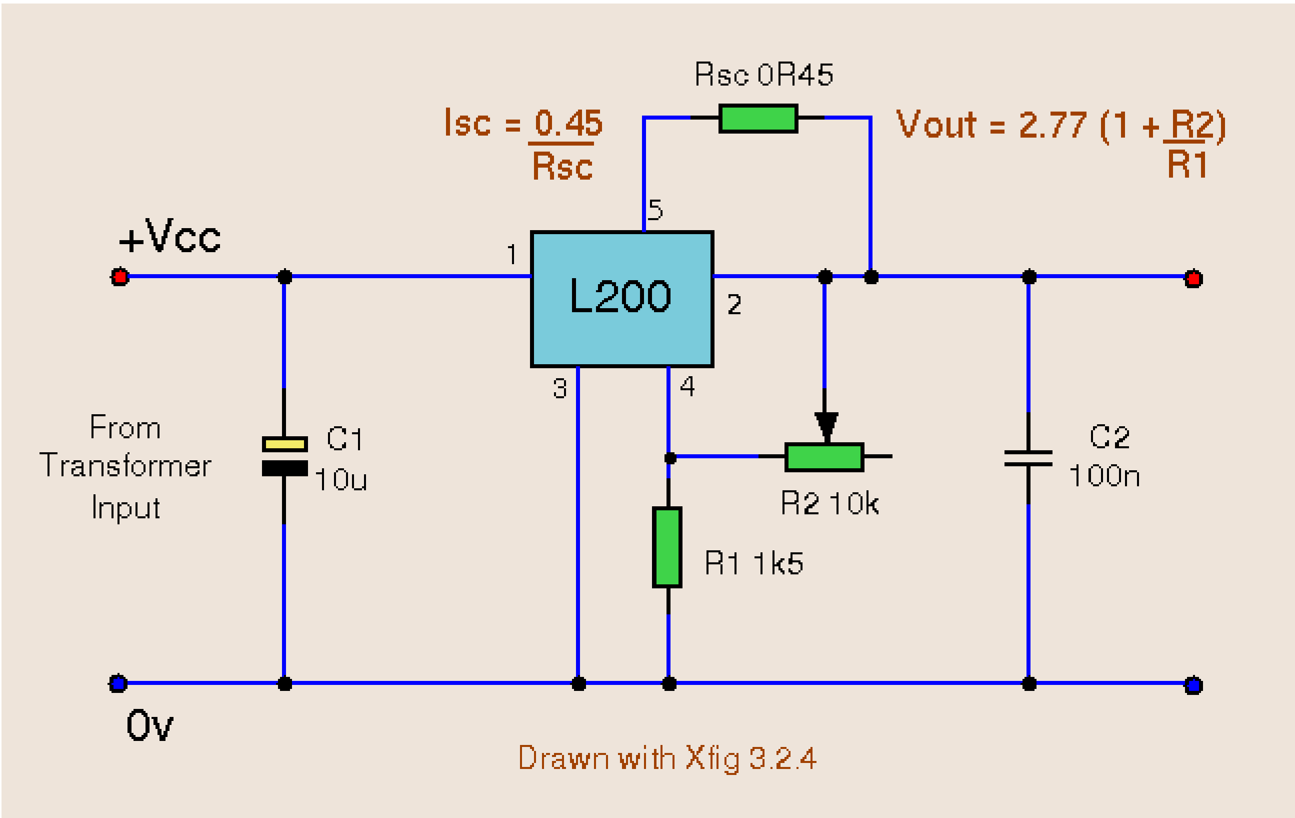
Notes

Although the 78xx series of voltage regulators are available with different current outputs, you can boost the available current output with this circuit. A power transistor is used to supply extra current to the load the regulator, maintaining a constant voltage. Currents up to 650mA will flow through the regulator, above this value and the power transistor will start to conduct, supplying the extra current to the load. This should be on an adequate heat sink as it is likely to get rather hot. Suppose you use a 12v regulator, 7812. The input voltage should be a few volts higher to allow for voltage drops. Assume 20 volts. Lets also assume that the load will draw 5amps. The power dissipation in the transistor will be Vce * Ic or (20-12)*8=40watt. It may keep you warm in the Winter, but you will need a large heatsink with good thermal dissipation. If you want to increase the output current with a negative regulator, such as the 79xx series, then the circuit is similar, but an NPN type power transistor is used instead.

P332. L200 Power Supply

Description

Power supply with voltage and current regulation built with the L200C regulator.



Notes

The versatile 5 pin L200C regulator offers both voltage and current regulation in a single package. The IC also features thermal shutdown and input over voltage protection up to 60 Vdc. The package is also available as L200CV which has straight pins for mounting onto a PCB. The above circuit has current limiting of 1 amp, hence Rsc = 0.45 ohm. The supply voltage must always a few volts higher than the maximum output voltage. If you wanted to make a 9 Volt current limited PSU then the input voltage should be a minimum of 12 Volts.

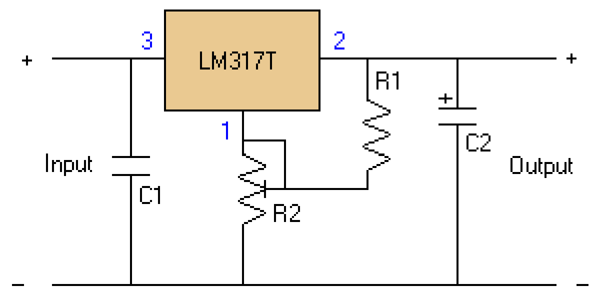
Specifications:

DC Input Voltage: 40V max.
Peak Input Voltage: 60V max. for 10ms
Output Voltage Range: 2.85 to 36V
Output Current Range: 0.1 to 2A
Quiescent Current: 4.2mA
Output Noise: 80Uv

P333. LLM317 Voltage Regulator

Description:

I constructed this voltage regulator to power my two way mobile radio from the car cigarette lighter circuit. It has many other uses and the voltage can easily be adjusted by the use of a potentiometer. The voltage regulator is an LM317T, and should accept up to about 14 volts without problems. It can handle up to 1 amp, but you WILL need a heatsink on the voltage regulator.

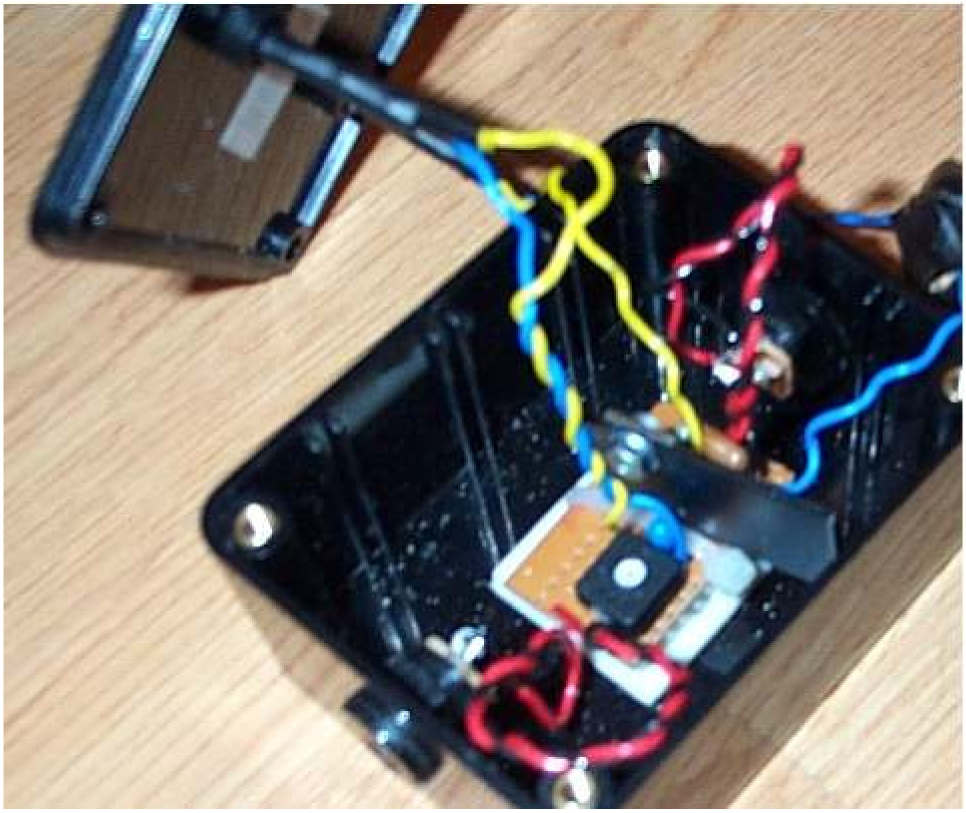


The components are

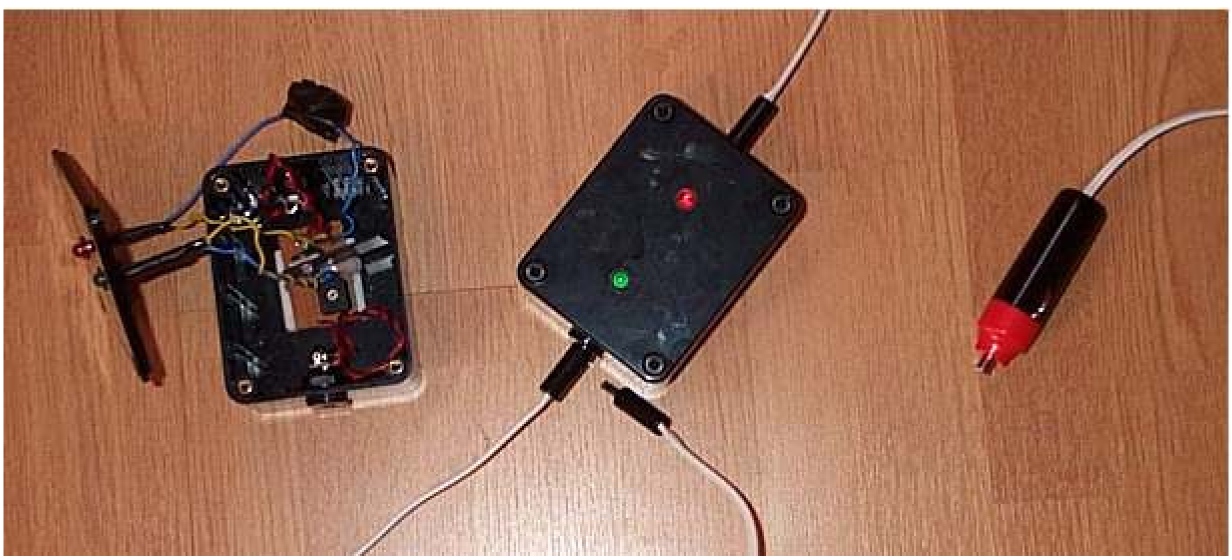
R1: 270R
R2: 2K Cermet or carbon preset potentiometer
C1: 100nF
C2: 1uF tantalum
LM317T Voltage regulator
Heatsink
PCB board

I also added DC power jacks for input and output on my voltage regulator, a green power LED, and a red over-voltage LED. The over voltage LED uses a zener diode to switch on the LED at a certain preset voltage, this can be varied depending on the voltage of the zener diode, I used a 6.2v zener diode. If you plan to vary the voltage for the different items you power, don't bother adding this feature. If you only plan to use items that run on one voltage, this is a very useful feature and will save plugging in and damaging your valuable (or not so valuable) equipment. You can even add a relay to switch off the power if the over voltage LED turns on, but bear in mind it will have to work from the voltage of the zener diode right up to the input voltage. I couldn't add a relay because I couldn't find any that operated from 6.2-13.8 volts. Anyway, the schematic is shown above, the over voltage and power LED are not included in them because it is assumed that anybody who makes this will understand how to use a zener diode:

This is what the final product should look like inside:



This is an outside view of the finished voltage regulator:



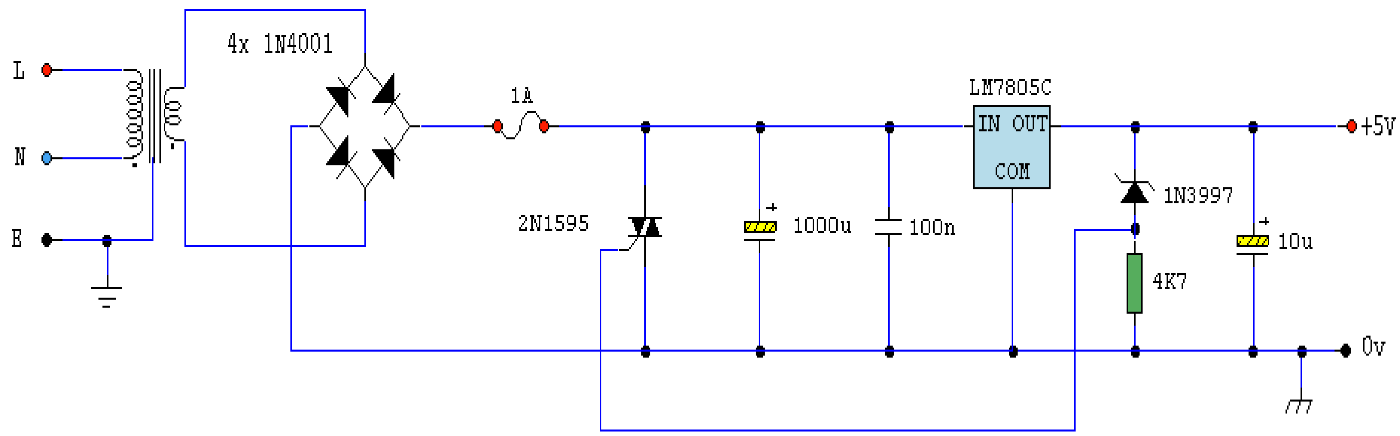
Here is what my voltage regulator is intended to power:


GPMR116
MENU
CHANNEL
MIC
Goodmans
GPMR116
MENU
CHANNEL
MIC
Goodmans

P334. Logic PSU with Overvoltage Protection

Description:

A simple 5 Volt regulated PSU featuring overvoltage protection.



Notes

The 5 volt regulated power supply for TTL and 74LS series integrated circuits, has to be very precise and tolerant of voltage transients. These IC's are easily damaged by short voltage spikes. A fuse will blow when its current rating is exceeded, but requires several hundred milliseconds to respond. This circuit will react in a few microseconds, triggered when the output voltage exceeds the limit of the zener diode.

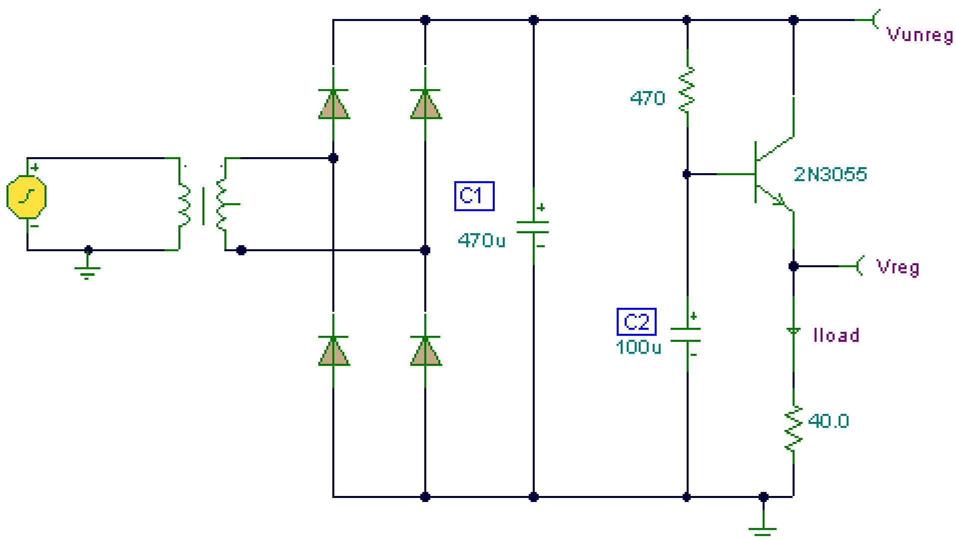
This circuit uses the crowbar method, where a thyristor is employed and short circuits the supply, causing the fuse to blow. This will take place in a few microseconds or less, and so offers much greater protection than an ordinary fuse. If the output voltage exceed 5.6Volt, then the zener diode will conduct, switching on the thyristor (all in a few microseconds), the output voltage is therefore reduced to 0 volts and sensitive logic IC's will be saved. The fuse will still take a few hundred milliseconds to blow but this is not important now because the supply to the circuit is already at zero volts and no damage can be done. The dc input to the regulator needs to be a few volts higher than the regulator voltage. In the case of a 5v regulator, I would recommend a transformer with secondary voltage of 8-10volts ac.

By choosing a different regulator and zener diode, you can build an over voltage trip at any value.

P335. Gyrator Circuit

Description

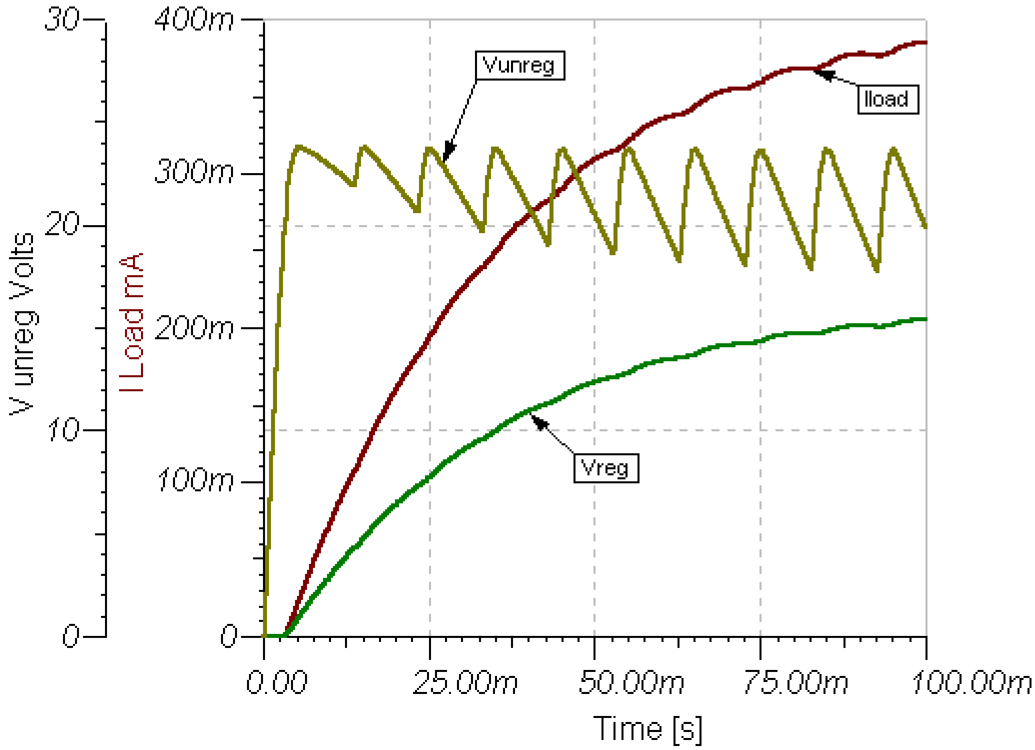
An electronic recitification circuit. The use of large, heavy and expensive electrolytic capacitors is avoided, being replaced by an active transistor in this gyrator circuit.



Circuit Notes

To avoid excess ripple output on a power supply feeding a heavy load, usually a large value capacitor is chosen following the rectifier. In this circuit, C1's value is only a 470uF. The gyrator circuit works on the principle that the value of input capacitance at the base-emitter terminals of a transitor is effectively multiplied by the static forward current gain, H_{FE} of the transistor. In this circuit C2, a 100uF capacitor is effectively magnified at the ouput (Vreg).

If you assume a dc current gain, H_{FE} of 50 for the 2N3055 power transistor, then the effective value of the smoothing capacitor would be 50x this value; or be the same as using a 5000uF capacitor without the power transistor. The graph below shows the output voltage and current through the load :-

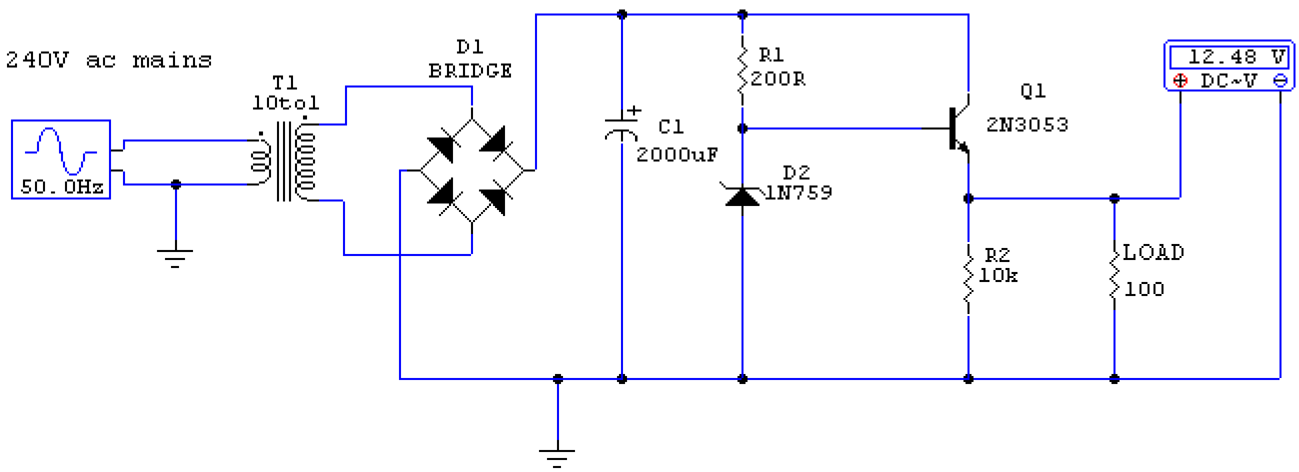


The load draws nearly 400mA. With the output directly from the rectifier there is about 5v pk-pk ripple in the output. Using the output at the emitter of the transistor things are much better. The circuit will take a few hundred milliseconds for the output voltage to stabilize and reach maximum value. The advantages are that a smaller, less costly reservoir capacitor can be used with this circuit to give a high quality smoothed supply.

P336. Regulated 12 Volt Supply

Description

A basic regulated 12 Volt power supply



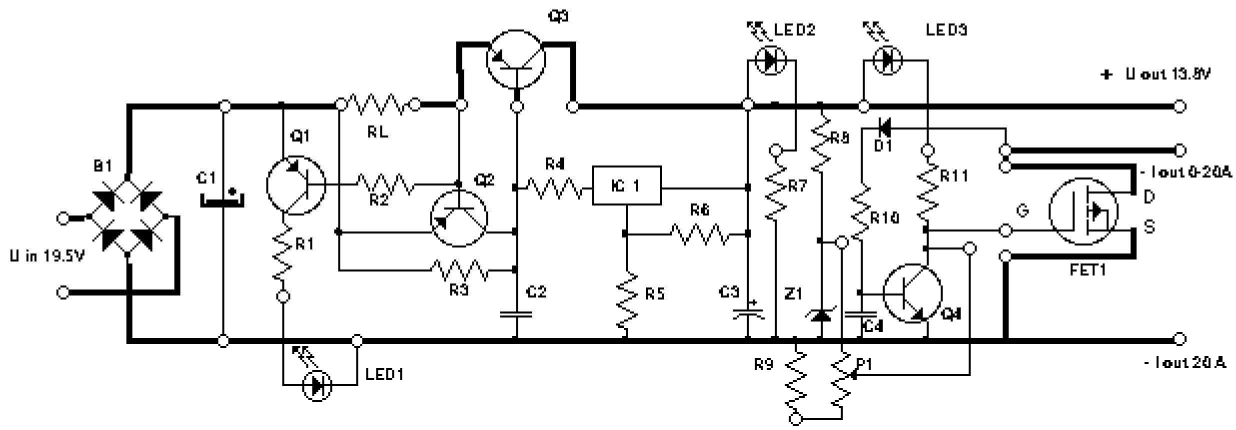
Notes

This circuit above uses a 13 volt zener diode, D2 which provides the voltage regulation. Aprroximately 0.7 Volts are dropped across the transistors b-e junction, leaving a higher current 12.3 Volt output supply. This circuit can supply loads of up to 500 mA.This circuit is also known as an amplified zener circuit.

P337. Regulated DC power supply

Description
This is a Regulated DC power supply with short circuit protection and with current limiter.

DC POWER SUPPLY 13.8 V / 20 A / REG 1-20 A



Q1 = BC 557B
Q2 = BD 330
Q3 = 2N5683
Q4 = BC 547

IC 1 = 7812

FET1 = BUZ 11

B1= B80C35
D1= 1N4148
LED1,3= RED
LED2= GREEN
Z1= Z 9V6

R1,7,11= 330R
R2= 470R
R3= 47R
R4= 18R
R5= 73R
R6= 470R
R8= 1 KR
R9= 10 KR
R10= 10KR
RL= 0,03R

C1 = 40.000 µF
C2 = 33 nF
C3 = 1µF Tantal
C4 = 100nF *

Notes

This PSU has been especially designed for current-hungry ham radio transceivers. It delivers safely around 20Amps at 13.8V. For lower currents, a separate current limiting output, capable of 15ma up to a total of 20A has been added.

The power transformer should be capable to deliver at least 25A at 17.5 to 20V. The lower the voltage, the lower power dissipation.

The rectified current will be "ironed" by C1, whose capacity should not be less than 40.000uF, (a golden rule of around 2000uF/A), but we recommend 50.000uF. This capacity can be built up by several smaller capacitors in parallel.

The base of this design is a simple 12V regulator (7812). The output voltage can be brought to desired value (here 13.8V) by two external resistors (R5 and R6) using this formula:

$$U= 12(1+R5/R6)$$

The low currents (here 15mA) will keep the 7812 in its regular function. As soon as the current rises over 15ma, the voltage drop on R4 will "open" the Q3, actually handling the high output current. This is a PNP transistor (Ic > 25) and current amplification factor of at least 20. The one that has been tested and proven here is the 2N5683.

The current limiting resistance RL, for the maximum output of 20 Amps should be 0.03 Ohms, rated at least 15W. You can use the resistance wire or switch several resistors in parallel, totaling the resistance/power values. Values for other currents can be calculated by the rule:

$$RL=0.7/Imax$$

The RL and Q2 (3A PNP such as BD330) form a short circuit automatic fuse. As soon as the maximum current reaches 20Amps, the voltage drop over the resistor RL will open Q2, and thus limit the B-E Current of Q3. Parallel to Q2 is Q1, which lights the LED 1 whenever the current limiting circuit is active. When the fuse is active, the Q2 bridges the R3, so the full current would flow through the IC1, and damage it. Therefore the R4 is inserted, as to limit the IC1 current to 15mA. This makes it possible to run the IC1 without any cooling aid.

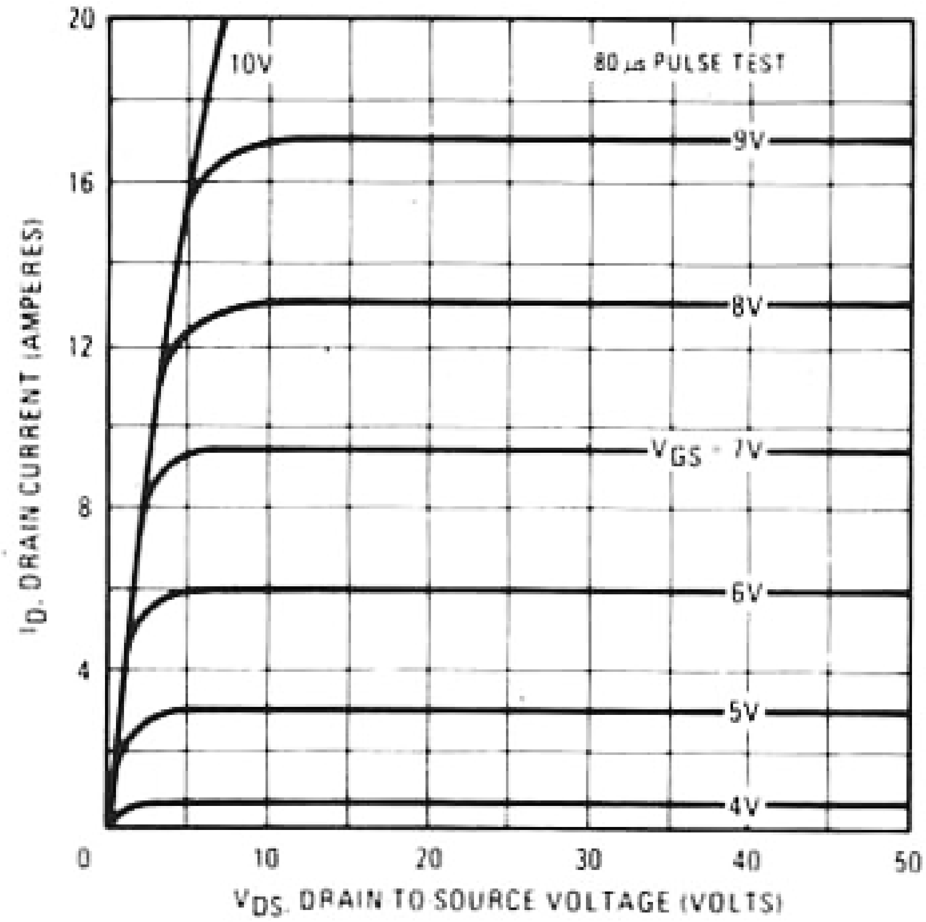
The LED 2 will light up every time the PSU is switched on.

There is an adjustable current limiter in parallel to the fixed output, thus providing adjustable current source for smaller currents.

This circuit is very simple too. You will notice that there is no current sensing resistor. But it is really there, in a form of the Rds-on resistance of the N-channel FET, which actually handles the load cutoff from the source. The function of the FET is shown in the diagram 2. When the current Id is rising, the tension Uds over the resistance Rds rises very slowly in the beginning, but very fast after the knick. This means, that before the knick the FET behaves as a resistor but after it, works as constant current source.

The D2, R3 and B-E connection of the Q4 will sense the Uds voltage of the FET1. When the voltage rises enough, the Q4 will shortcut the FET1 gate to mass, and cut the current flow through the FET 1 off.

However, to enable the FET1 to open, there is certain gate voltage necessary, which in this case is brought up by the voltage divider consisting of R8, Z1, P1 and R9. So the maximum Gate voltage will be the one of the Z1, and the minimal will be around 3V6. The Z1 voltage (Uz1) will thus determine the max current flowing through the FET 1. The diagram 2 will show that for 5 Amps the Uz1 should be 5V6, and for 20Amps around 9V6.



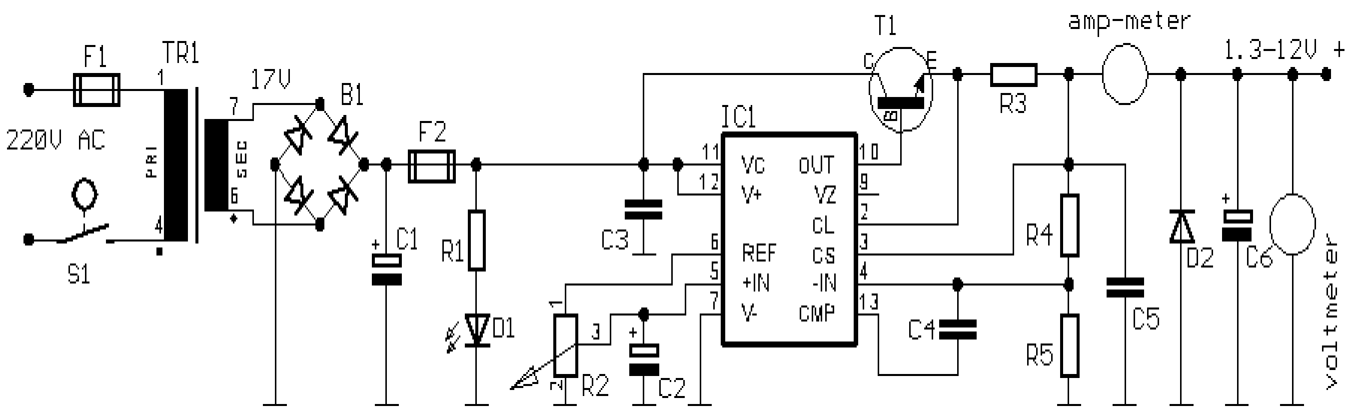
The Capacitor C4 will determine the “velocity” or the reaction time of the limiter. 100 uF will make the reaction time to be around 100ms, and 1n will make it 1us. Within the designed limits, the P1 will limit the current output in the range of 15mA to 20A.

You can use both output simultaneously, but the total output current will be limited by the value of the RL. This PSU can be built also for higher outputs, as long as the transformer will handle the current requirements, and you provide sufficient cooling for the Q3.

P338. Small Variable power Supply

Description

Features: 1.3-12.2 V, 1 A, over-current protection. This is a simple but reliable device based one of the oldest integrated voltage regulators of them all - the LM723.



Notes

R2 sets the output voltage. The maximum current is determined by the value of R3: the over-current protection circuitry inside the LM723 senses the voltage across R3 and starts shutting the output stage off as soon as this voltage approaches 0.65 V. This way the current through R3 can never exceed 0.65/R3, even if the output is shorted.

C3 and C4, both ceramic, must be placed as close as possible to the integrated circuit, because the LM723 can be prone to unwanted oscillations. It is not an overkill to solder them directly (and very carefully) to the pins of the IC. All other connections should also be kept short.

The LM723 works with input DC voltages from 9.5 to 40 V and the IC itself can source some 150 mA if the output voltage is not more than 6-7 V below the input. When an external pass transistor is used (in the usual emitter-follower mode), the base-emitter junction of T1 represents a significant resistance and the integrated circuit's output stage is relatively lightly loaded. All the current drawn by the load passes through T1 and it dissipates an amount of power that is directly proportional to the current and the difference between the input and the output DC voltage.

Finished project

The plastic box is only 160x140x60 mm, yet everything found its place in it somehow. Both meters are second-hand items, but properly shunted, with new face plates and freshly calibrated dials.

Specification
Output (approximate values):

Vmin = (R4 + R5) / (R5*1.3)
Vmax = (7.15 / R5) * (R4 + R5)

Imax = 0.65/R3

Max. Power on R3: 0.42/R3

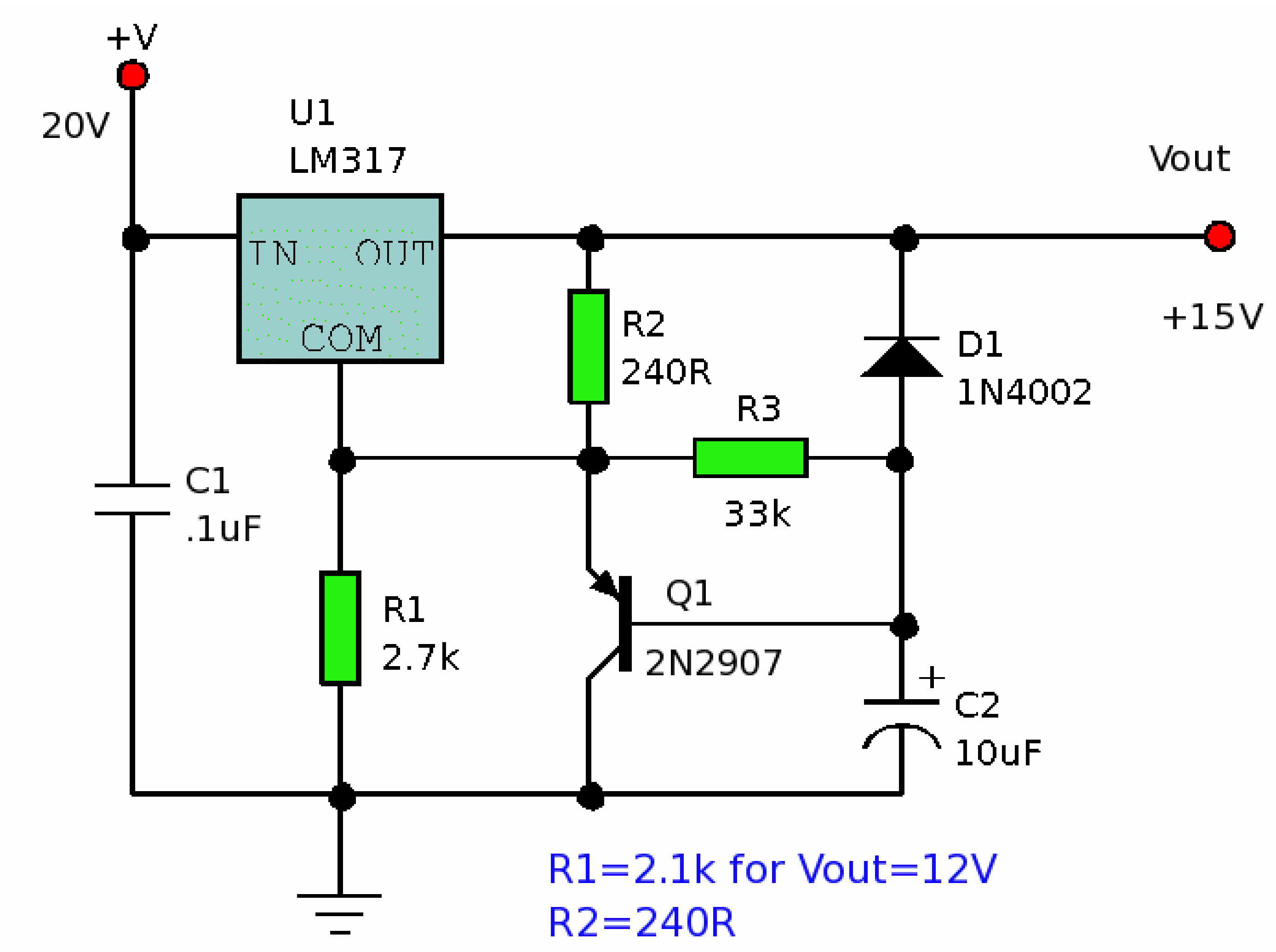
Min. Input DC Voltage (pin 12 to pin 7): Vmax + 5

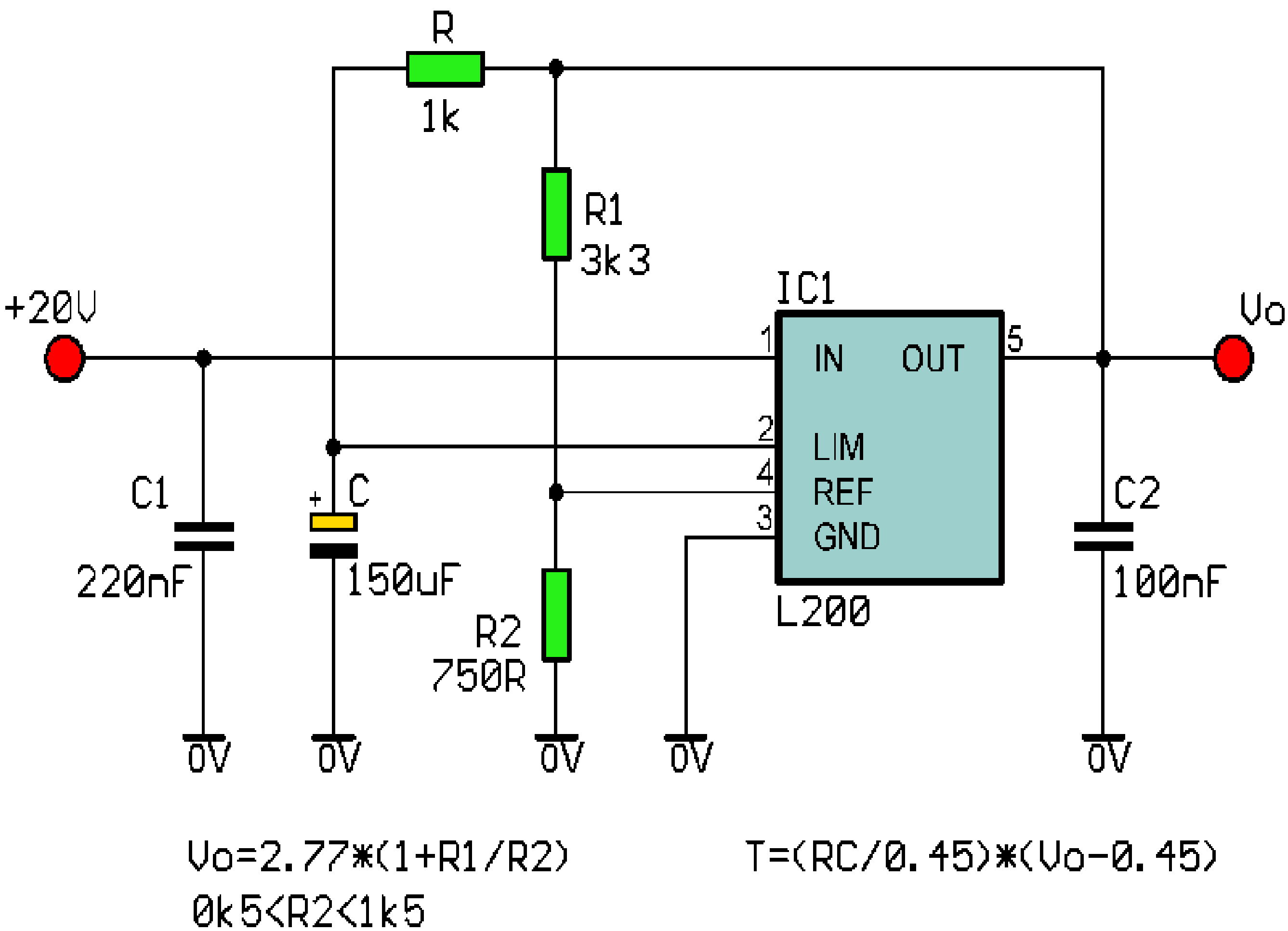
Parts List
B1 40V/2.5A
C1 2200uF (3300uF even better)
C2 4.7uF
C3 100nF
C4 1nF
C5 330nF
C6 100uF
D1 Green LED
D2 1N4003
F1 0.2A F
F2 2A M
IC1 LM723 (in a DIL14 plastic package)
R1 1k
R2 Pot. 5k
R3 0.56R/2W

R4 3.3k
R5 4.7k
S1 250V/1A
T1 2N3055 on a heatsink 5K/W
TR1 220V/17V/1.5

P339. Soft Start PSU

Description
Two soft start power supplies. The output voltage slowly increases to the desired output.





Notes

The output voltage rises slowly and reaches 15 V in 5 seconds.

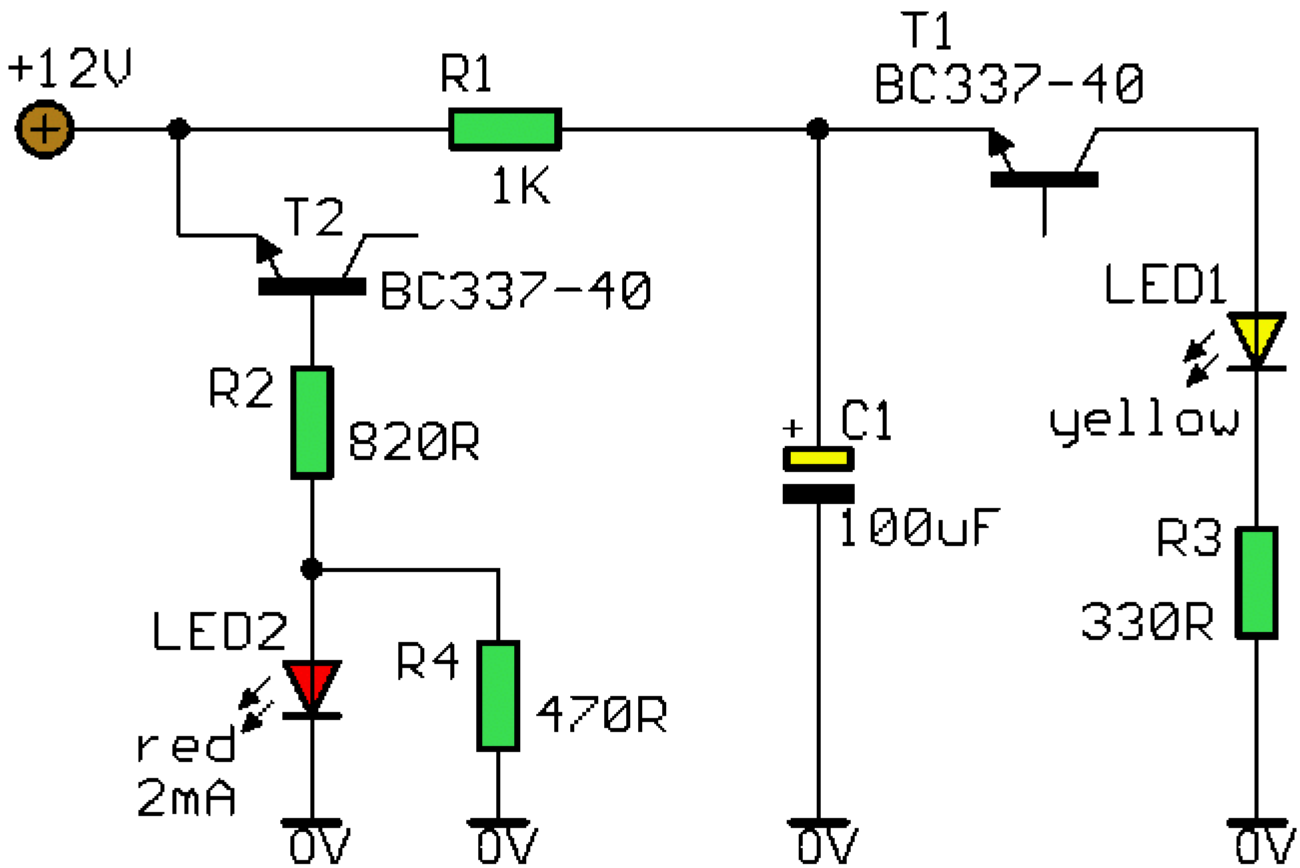
In order to perform this soft-start function, the LM317 voltage regulator IC requires an external universal PNP transistor and the L200 uses its internal comparator (pin 2).

After switch-on, the rising voltage on the positive side of the charging electrolytic capacitor slowly turns the (initially conducting) transistor off, thus raising the voltage (relative to ground) on the adjustment pin of the LM317. In the L200 circuit, the corresponding electrolytic capacitor's rising voltage gradually relaxes the current-regulation loop inside the L200.

P340. Supply Voltage Indicator

Description

A novel supply voltage monitor which uses a LED to show the status of a power supply.



Notes

This simple and slightly odd circuit can clearly show the level of the supply voltage (in a larger device): as long as the indicator has good 12 volts at its input, LED1 gives steady, uninterrupted (for the naked eye) yellow light. If the input voltage falls below 11 V, LED1 will start to blink and the blinking will just get slower and slower if the voltage drops further - giving very clear and intuitive representation of the supply's status. The blinking will stop and LED1 will finally go out at a little below 9 volts.

On the other hand, if the input voltage rises to 13 V, LED2 will start to glow, getting at almost full power at 14 V.

The characteristic voltages can be adjusted primarily by adjusting the values of R1 and R4.

The base-emitter diode of T2 basically just stands in for a zener diode. The emitter-collector path of T1 is inversely polarized and if the input voltage is high enough - T1 will cause oscillations and the frequency will be proportional to the input voltage. The relaxation oscillator ceases cycling when the input voltage gets so low that it no longer can cause breakdown along the emitter-collector path.

Not all small NPN transistors show this kind of behavior when inversely polarized in a similar manner, but many do. BC337-40 can start oscillations at a relatively low voltage, other types generally require a volt or two more. If experimenting, be careful not to punch a hole through the device under test: they oscillate at 9-12 V or not at all.

P341. The Output Adjustable Flyback Converter

Description

A high voltage step-up DC power supply using adjustable flyback conversion.

Specification

Vin = 220Vac +-10% @ 50/60Hz
Vout =0~600Vdc @ 0.25A
Switching Frequency: 70~100KHz

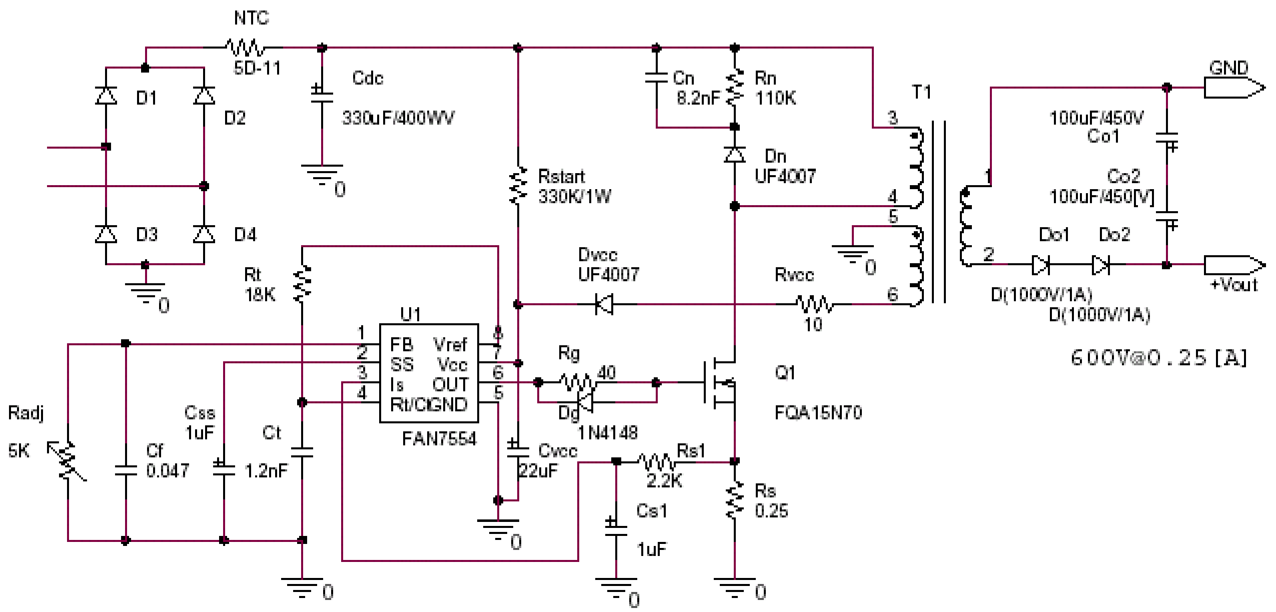


Fig. 1 Main schematic diagram

Design Guidelines

DCM mode, output power is 200W

The input RMS current in worse condition with discontinuous current mode may be calculated as:

$$I_{rms} = \frac{P_o}{V_{dc}} = \frac{200}{220 \times 0.9 \times \sqrt{2}} \cong 0.72[A]$$

If the optimum operating duty cycle is set at D=0.35, then input peak current can be found as:

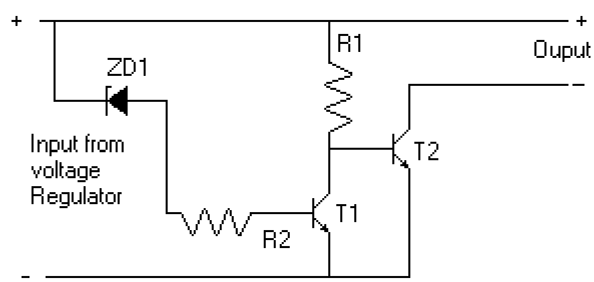
$$I_{peak} = \frac{I_{rms}}{D} \times 2 = \frac{0.72}{0.35} \times 2 \approx 4.11[A]$$

Therefore the voltage sensing limit voltage level from the FAN7554 data sheet is 1.5V

P342. Overvoltage Protection for the LM317

Description:

This is an add-on Over Voltage Circuit for the LM317 Regulator Circuit submitted by Matthew Hewson. The original circuit may be viewed here.



Notes:

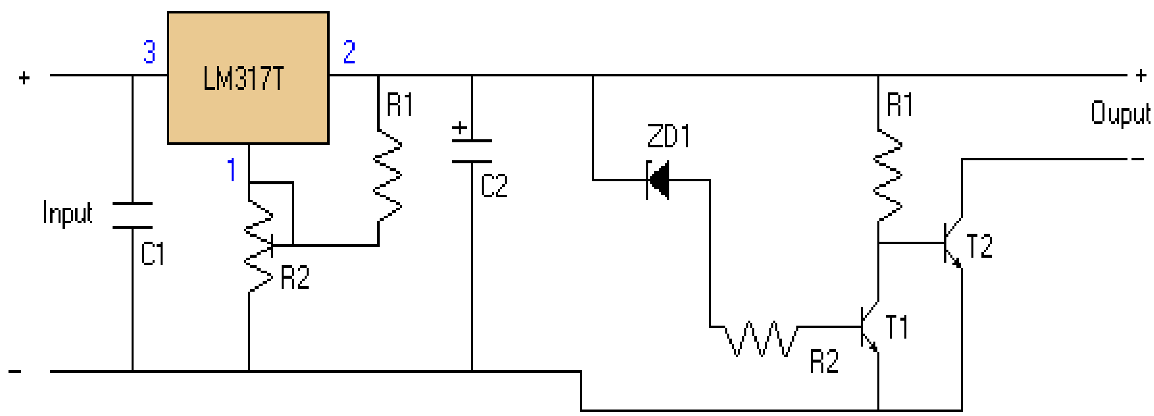
It is a voltage regulator that allows a 6v portable supply to be derived from the 12v car battery. You can add a 6.2V zener diode and a LED to warn you when the input supply is overvoltage. If you could find a relay that would operate from 6.2v right up to 12v that you could connect in such a way that if over voltage occurred, then the relay would automatically switch off the output preventing damage to any connected equipment.

Such a relay would be quite difficult to find, so I designed this, it is a simple two transistor circuit which will switch off the output should the voltage raise above 6.2v (this can be changed by selecting a different value of zener diode).

Components are as follows:
ZD1 =3D 6.2v Zener diode (you can change this to any value, the circuit will switch off the output if the input voltage raises above the value of the zener diode)
R1 = 1K Resistor (this can be of any power rating, it carries very little power)
R2 = 1K Resistor (this can be of any power rating, it carries very little power)
T1 = Low power NPN Transistor (BC108 or BC547 will do fine)

T2 = NPN transistor transistor capable of switching the equipment you are running (BFY51 or BC140 can switch 1 Amp, which is the maximum the voltage regulator circuit can handle)

It is advisable to test this circuit with a voltmeter, slowly increasing the voltage on the regulator circuit and make sure that this circuit switches off the output when the value of the zener diode is reached, before plugging in your expensive equipment. This circuit is intended to be used with the voltage regulator posted by Matthew Hewson, my overvolatge add-on circuit is shown with the original below:-

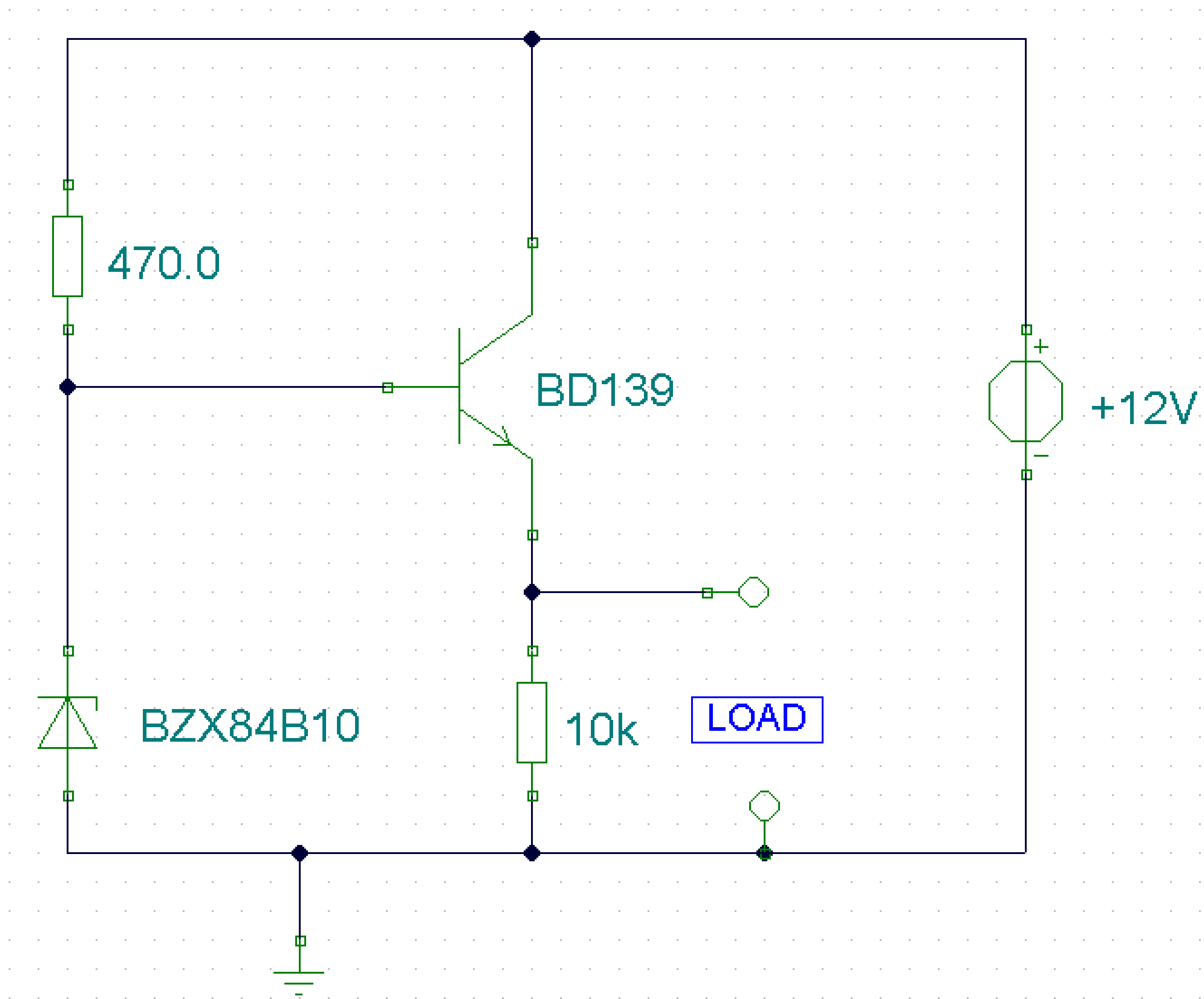


Double check the polarity, It is very easy to blow up components in the eqipment that you are powering if you reverse the polarity. Also, if you want to increase the power output of the voltage regulator circuit above 1 Amp then connect several LM317's in parallel, be sure to make sure that transistor T2 on this circuit is of a high enough rating if you do this.

P343. Universal DC-DC Convertor

Description:

This circuit will generate a smaller DC output voltage from a larger DC input voltage.It is quick and simple to make and by changing the value of the zener diode, the circuit can be universally adapted to provide other output voltages.The circuit and all diagrams represent a DC convertor with 12V battery input and 9Volt DC output.

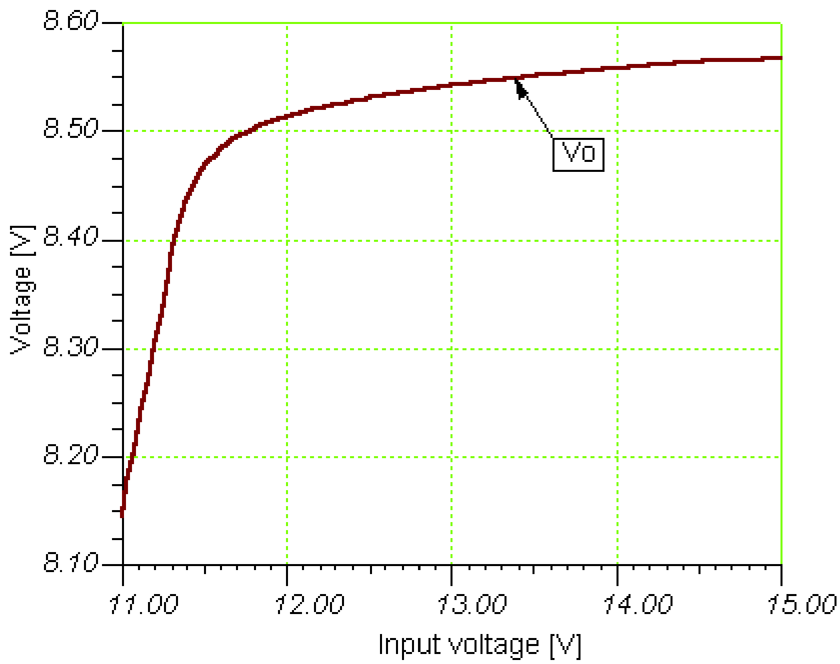


The output voltage is equal to the zener diode voltage less 0.7 volts, or :-

$V_o = V_z - 0.7$ where V_z is the value of the zener diode.

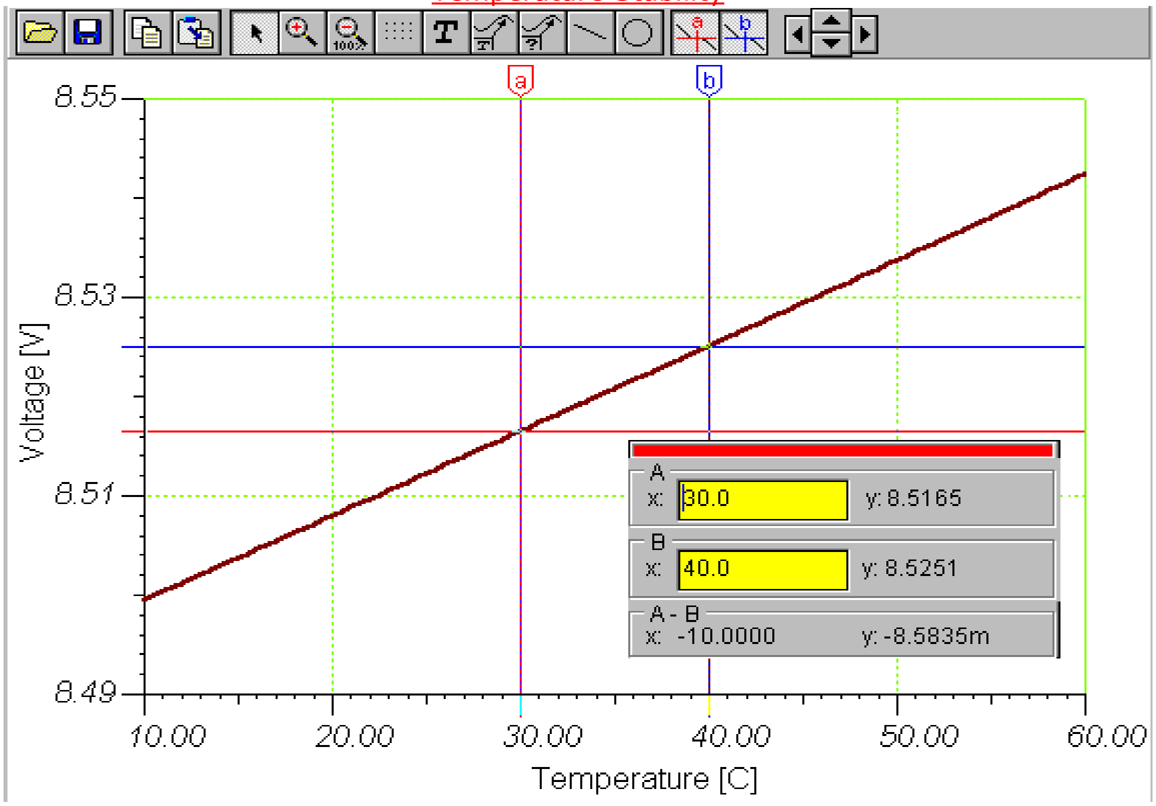
With the 10V zener diode as shown in the diagram the output voltage is about 9.3 Volts DC. The supply voltage used must always be at least a few volts higher than the zener voltage. In this example I have used a 12 Volt DC battery to provide the regulated 9 Volt DC output.

Output Regulation Versus Input Voltage



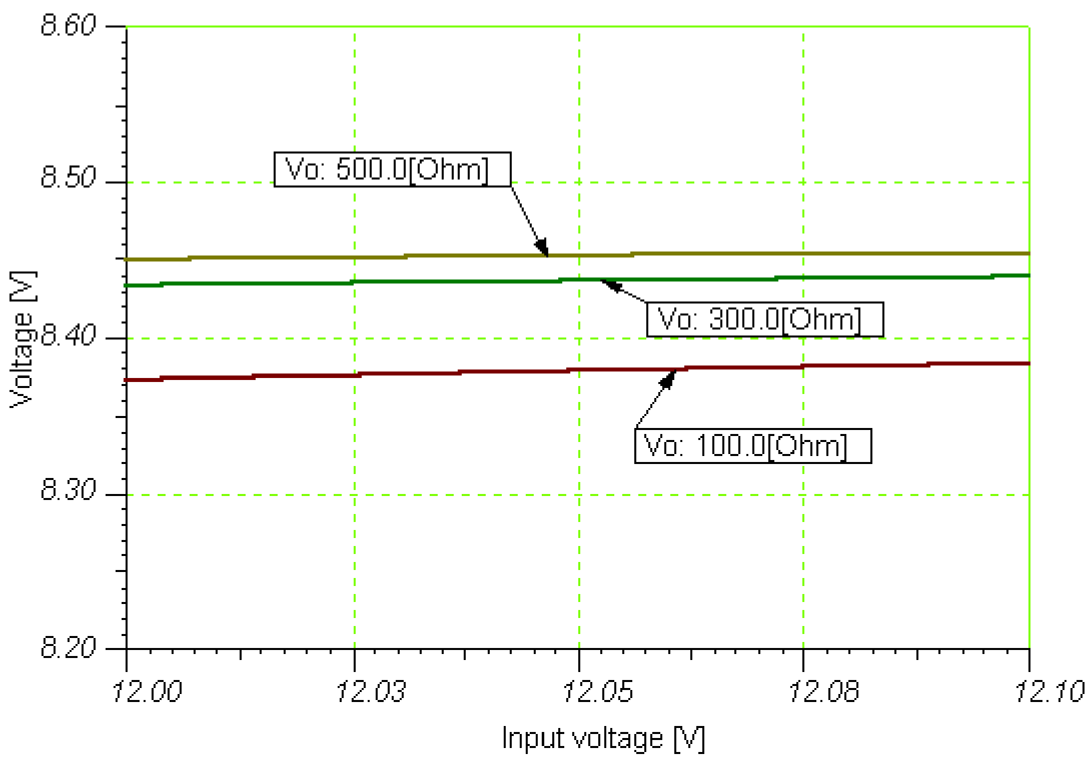
The above graph shows how the output is affected by input voltage variations. This was produced with a load current of 100mA and using a 10 volt rated zener diode. Note that the circuit falls sharply out of regulation when the input voltage falls to 11.5 volt, hence the requirement for an adequate supply voltage.

Temperature Stability



Temperature stability is very good as the above graph shows. The output voltage changes by 8.5mV for every 10 degree rise in temperature. This is less than 1 mV / degree.

Output Voltage versus Load Current



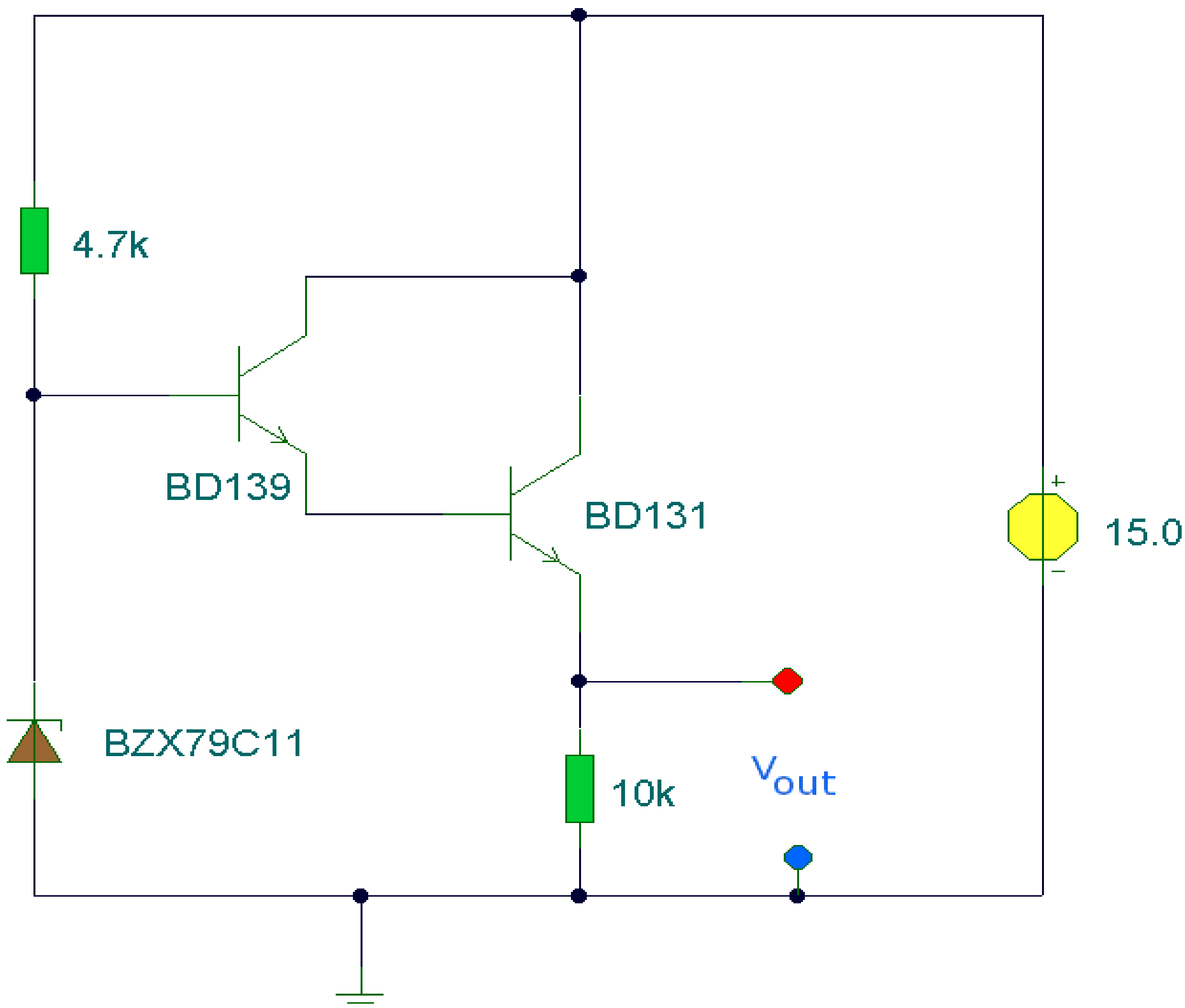
Power Dissipation

With a DC-DC convertor, the most important consideration is power dissipation in the output device. Power dissipation is the product of the transistors emitter current and collector-emitter voltage. With this circuit the maximum power dissipation of the BD139 or maximum collector current cannot be exceeded, otherwise the transistor will be destroyed.

Example:
With a 12 Volt supply and a 9 Volt, 100 mA load the dissipation is as follows. Using a 10 volt zener the output voltage will be about 9.3 volts DC therefore:

$$V_{CE} * I_C = (12 - 9.3) * 100 \text{ mA} = 2.7 \text{ Watts}$$

This is well within the maximum limits of power dissipation and collector current, which for the BD139 are 8 watts and 1 amp respectively. If higher load currents are required then the following circuit may be used.

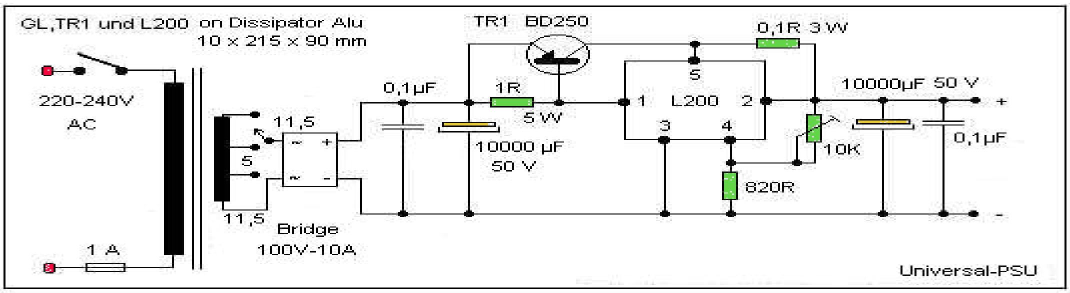


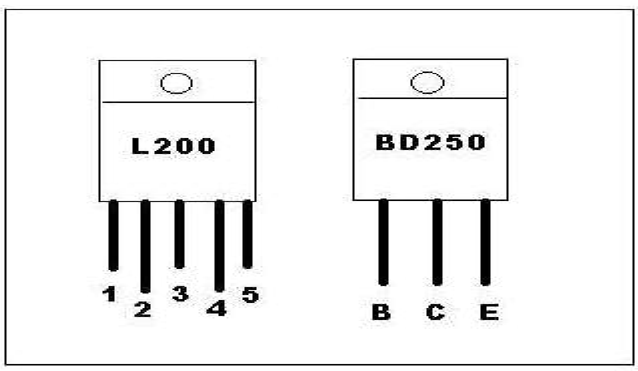
Output dissipation is calculated in the same way, the BD131 has a maximum power dissipation of 15 watts and collector current of 3 amps. The output voltage is approximately 1.4 volts less than the zener diode voltage and supply voltage must be higher than the input voltage by at least 3 volts.

P344. Universal PSU

Description

A Universal Power supply based on the L200 regulator, which includes an outboard pass transistor to boost output currents up to 4 amps.





3 Transformer:

2 x 230V primary / 11,5 V - 4A sec.

1 x 230V primary/ 5 V - 4A sec.

The Output Condenser of 10000 µF is necessary.Otherwise the Regulation devices shut down immediately,when heavy loads are connected to the Output.

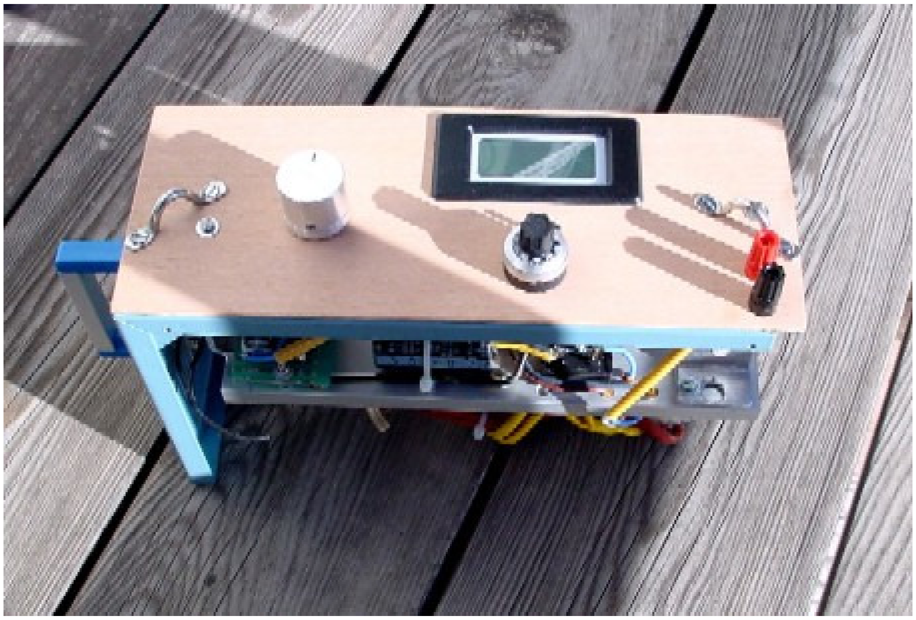
The max.Ratings are :

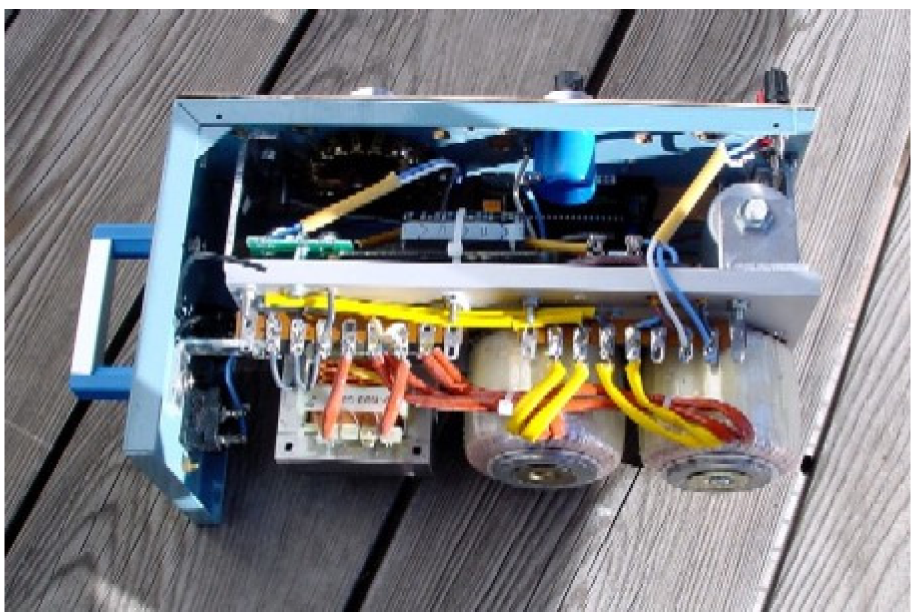
at 6 Volt-DC with 11,5 V-AC Input : 4 A

at 12 Volt-DC with 16,5 V-AC Input : 4 A

at 24 Volt-DC with 28,0 V-AC Input : 3 A (Dissipation Limit of BD250 on Dissipator!)

At 28,0 AC- Input the Regulator shuts down when regulated DC- Voltage is lower than 12 Volt at 3 A Rating.That´s normal,due to the protection device of L 200 Regulator.In this case lower to 16,5 V-AC Input

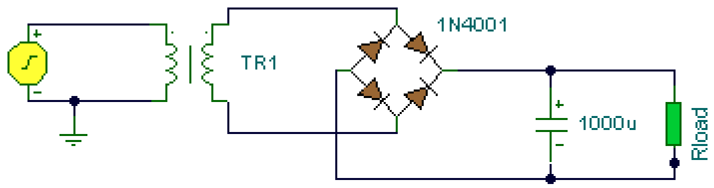




P345. Unregulated PSU

Description:

A basic full wave rectified power supply is shown below. The transformer is chosen according to the desired load. For example, if the load requires 12V at 1amp current, then a 12V, 1 amp rated transformer would do. However, when designing power supplies or most electronic circuits, you should always plan for a worst case scenario. With this in mind, for a load current of 1 amp a wise choice would be a transformer with a secondary current rating of 1.5 amp or even 2 amps. Allowing for a load of 50% higher than the needed value is a good rule of thumb. The primary winding is always matched to the value of the local electricity supply.

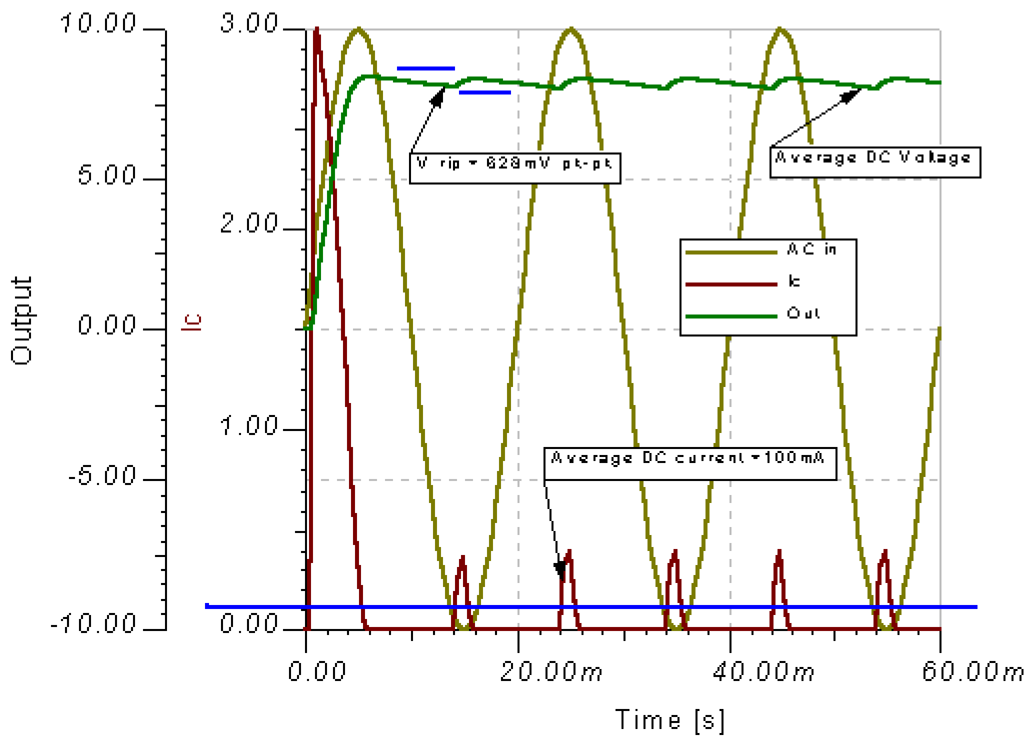


Notes

An approximate formula for determining the amount of ripple on an unregulated supply is:

Vrip = Iload * 0.007 / C

where I load is the DC current measured through the load in amps and C is the value of the capacitor in uF.The diagram below shows an example with a load current of 0.1 amp and a smoothing capacitor value of 1000uF.

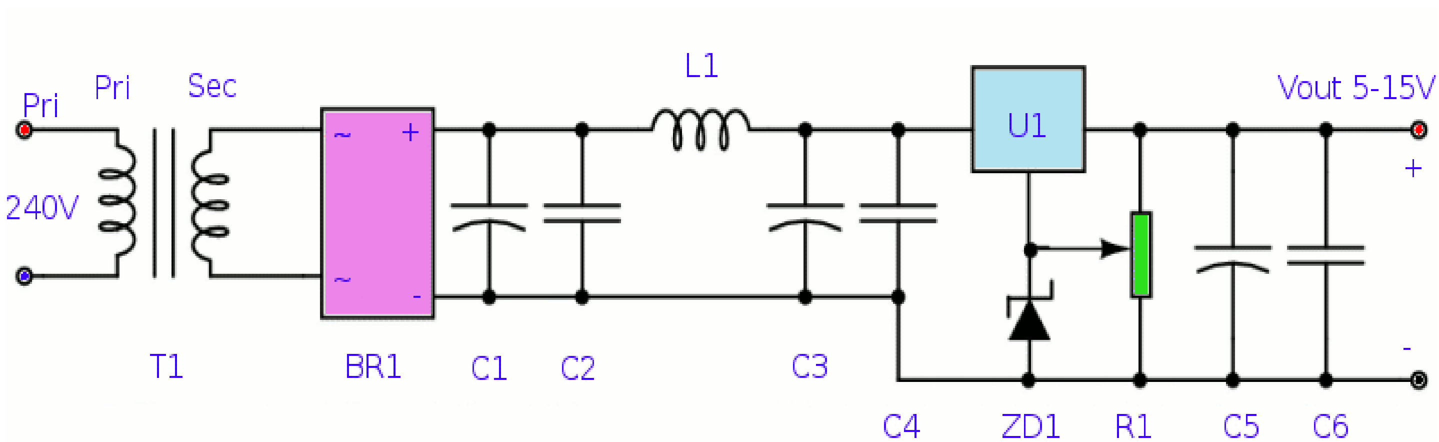


The calculated value of ripple is (0.1 * 0.007) / 1000e-6 = 0.7 volts or 700mV. The value of peak-peak ripple measured from the graph is 628mV. Therefor, the equation is a good rule of thumb guide for choosing the correct value for a smoothing capacitor in a power supply.

P346. Variable Power Supply Using Fixed Regulator

Description

This is a similar power supply that I used to power my FM Transmitter. After suffering long problems with mains hum, this design using a pi filtered C-L-C approach. This circuit offers excellent ripple rejection.



Parts List:
T1 Transformer 10:1 Secondary 24V @ 2A
BR1 Bridge Rectifier 50V PIV 2A rating
C1 4700u (35V)
C2 0.001u
C3 2200u (35V)
C4 0.001u
C5 4.7u (25)
C6 0.01u
R1 10k potentiometer
L1 see text
U1 7805 N.B. This may be changed for different output voltages e.g. 7812 for higher output voltage
ZD1 15V zener @ 1.3W

Notes

Looking at the above schematic, the specific inductance of the ferrite (core)is important. A core should be chosen to work within the specific frequency as stated by the manufacturer. L1 is a powder core and has 32 turns of 0.75mm wire.

The transformer has a 240V primary and has a secondary rated 24V at 2A. The bridge rectifier contains 4 diodes, their current rating needs to be high with respect to the transformers output current; if not the current may damage the diodes. I used MR751 which is rated 6 amps, but another good choice is 1N5400. C1 is the mainfiltering capacitor, the supply is further smoothed by the combination of L1 and C3. C2 and C4 are decoupling capacitors; their action further reduce ripple factor.

The regulator, U1 utilizes the action of zener diode ZD1 which is in parallel with the potentiometer, R1. The tuning action of R1 produces a variable regulator output. The output voltage is variable from the regulator output to the regulator output plus the zener voltage. E.G. A 7805 regulator and 10V zener give an output adjustable from 5 to 15 Volts. The regulator may be changed to provide different output voltages as may the zener. the zener should be rated a minimum of 1.3 Watts. All the parts should be available at local electronic shops.

Formula for calculating Ripple Factor in Filters:

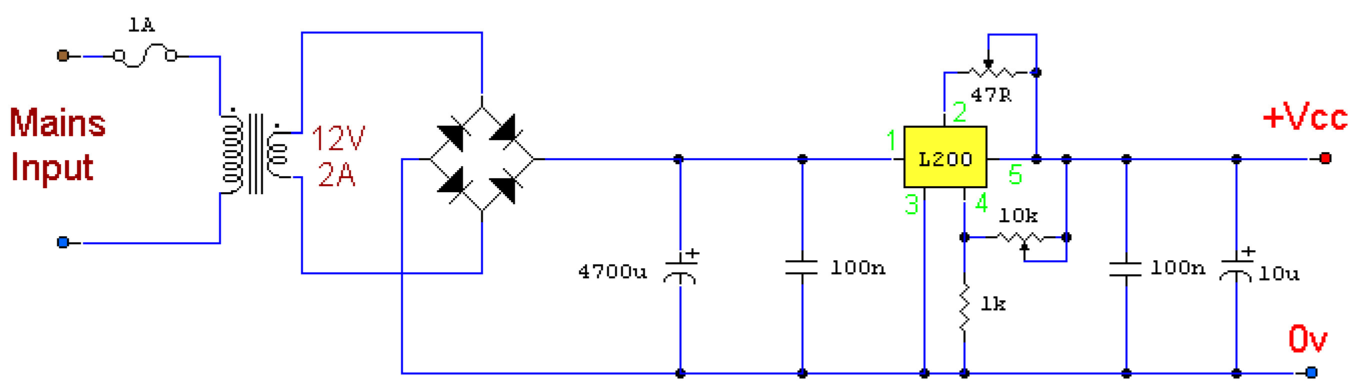
$$\text{Ø} = \frac{5.701\,x\,10^{-9}}{8\,\Pi^3 F^3 L_1 C_1 C_3 R_L}$$

Where:
Φ = Ripple Factor
F = frequency of supply in Hz
L = inductance of L1 in uH
C1 = capacitance of C1 in uF
C3 = capacitance of C3 in uF
RL = load resistance in ohms

P347. Variable PSU

Description:

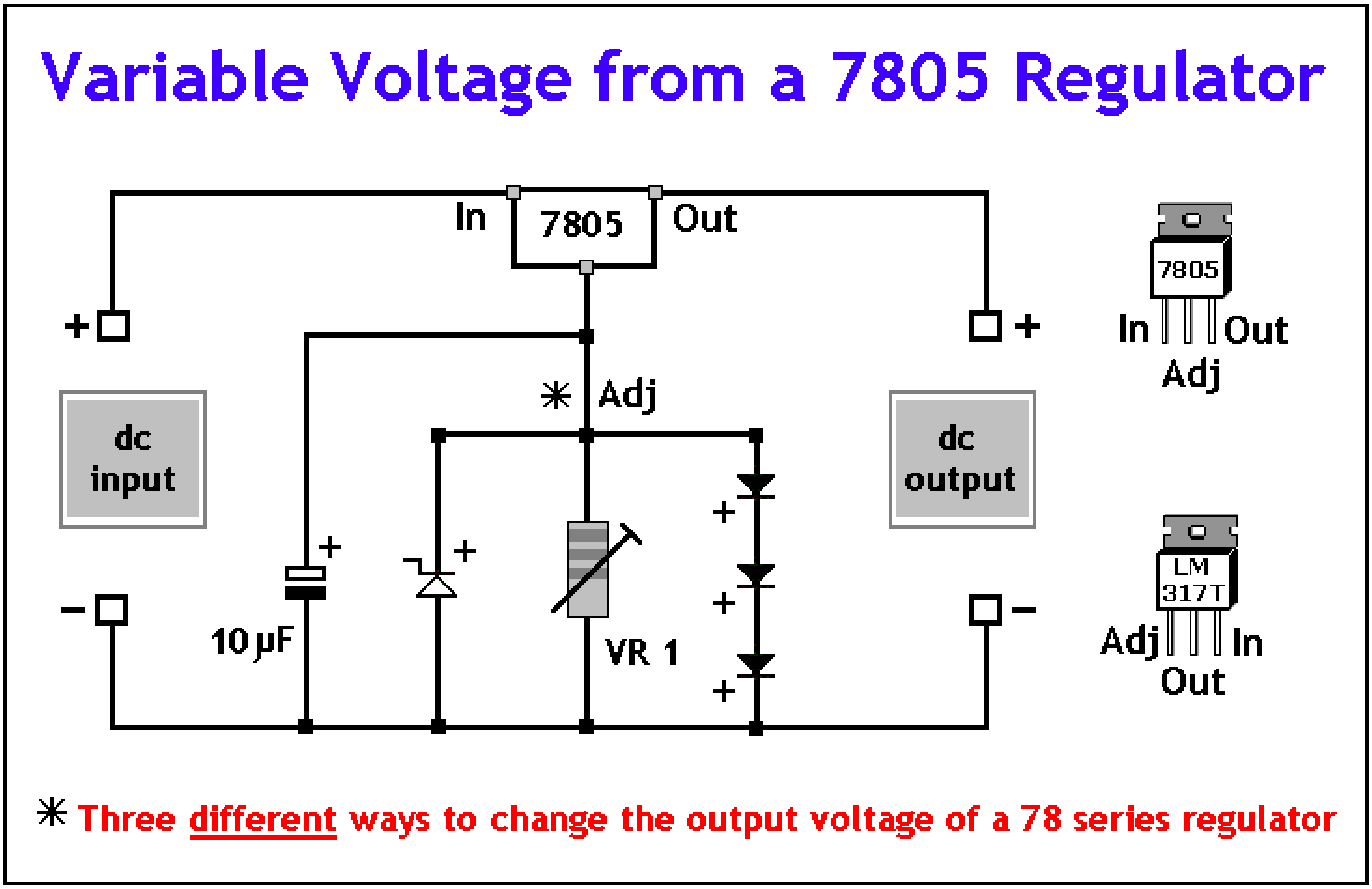
A variable power supply with adjustable voltage and current outputs made with the L200 regulator.



Notes

Using the versatile L200 voltage regulator, this power supply has independent voltage and current limits. The mains transformer has a 12volt, 2 amp rated secondary, the primary winding should equal the electricity supply in your country, which is 240V here in the UK. The 10k control is adjusts voltage output from about 3 to 15 volts, and the 47 ohm control is the current limit. This is 10mA minimum and 2 amp maximum. Reaching the current limit will reduce the output voltage to zero.

P348. Variable Voltage Regulator



Notes

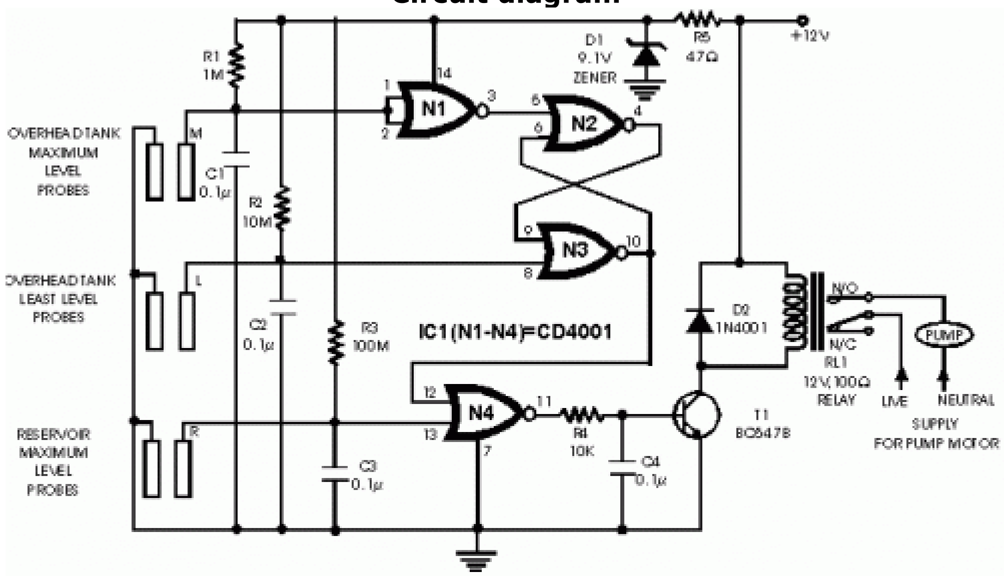
As Ron suggests, controlling the output voltage from a regulator can be made variable in three ways:-

1. Using a fixed reference zener diode to increase the output by the value of the zener
2. A variable resistor for variable output, note that a voltage less than the nominal regulator is not possible
3. A chain of diode such as 1N4001, this increases the output by +0.7 V for every diode used.

SENSOR, CONTROL, TOOLS, MEASUREMENT, ETC

P349. Economical Pump Controller

Circuit diagram

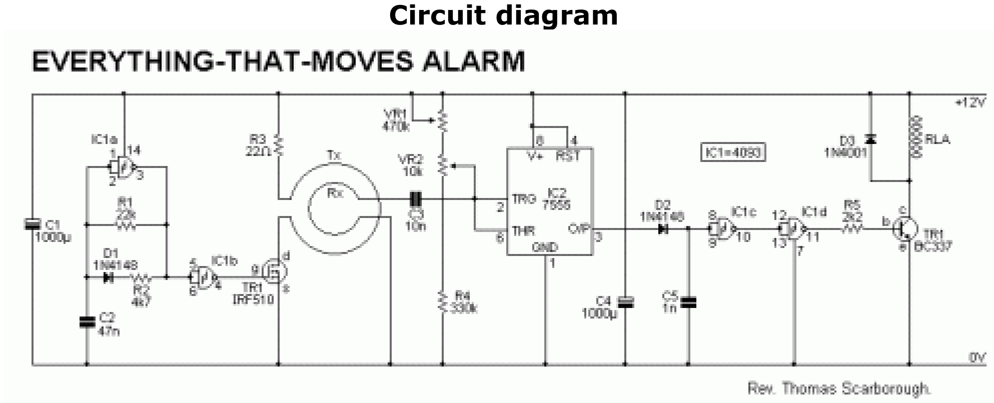


The automatic pump controller eliminates the need for any manual switching of pumps installed for the purpose of pumping water from a reservoir to an overhead tank (refer Fig. 1). It automatically switches on the pump when the water level in the tank falls below a certain low level (L), provided the water level in the reservoir is above a certain level (R). Subsequently, as the water level in the tank rises to an upper level (M), the pump switched off automatically. The pump is turned on again only when the water level again falls below level L in the tank, provided the level in the reservoir is above R. This automated action continues. The circuit is designed to ‘overlook’ the transient oscillations of the water level which would otherwise cause the logic to change its state rapidly and unnecessarily. The circuit uses a single CMOS chip (CD4001) for logic processing. No use of any moving electro-mechanical parts in the water-level sensor has been made. This ensures quick response, no wear and tear, and no mechanical failures. The circuit diagram is shown in Fig. 2. The device performed satisfactorily on a test run in conjunction with a 0.5 HP motor and pump. The sensors used in the circuit can be any two conducting probes, preferably resistant to electrolytic corrosion. For instance, in the simplest case, a properly sealed audio jack can be used to work as the sensor. The circuit can also be used as a constant fluid level maintainer. For this purpose the probes M and L are brought very close to each other to ensure that the fluid level is maintained within the M and L levels. The advantage of this system is that it can be used in tanks/reservoirs of any capacity whatsoever. However, the circuit cannot be used for purely non-conducting fluids. For non-conducting fluids, some modifications need to be made in the fluid-level sensors. The circuit can however be kept intact.

P350. Everything-that-moves ALARM

A crucial failing of proximity detectors is their unreliable and tricky nature. This is where they are used to detect humans, not to speak of smaller living beings. One common approach is to detect eddy currents in a living body, which are induced in the body through a.c. mains wiring. However, such circuits become altogether unusable in the case of mains failure, or in the absence of mains electricity, or even where adjacent mains circuits are switched in and out.

Circuit diagram



The circuit of Fig.1 takes the guesswork out of proximity detection by inducing eddy currents in a living being, whether animal or human. Five turns of enamelled copper wire (say 30 s.w.g.) are wound around the area within which detection is to take place (4m x 4m in tests), and an audio signal of about ¼ Watt is pulsed through this, the Tx, coil. A smaller Rx coil (say 100 turns of 30 s.w.g. enamelled copper wire wound on a 150mm dia. former) is used as a pick-up coil. The circuit is adjusted by means of tune and fine-tune controls VR1 and VR2, so that it is deactivated when one stands back from the Rx coil.

A simple clock generator (IC1a-IC1b) and power MOSFET (TR1) are used for the transmitter, and a 7555 timer (IC2) is wired as a sine-square convertor for the receiver. IC2's inputs are biased through VR1, VR2 and R4. IC2 in turn switches NAND gates IC1c and IC1d, to drive relay RLA. Capacitor C5 switches the relay for about two seconds, and its value may be increased or decreased to give different timing periods. D2 is critical to prevent back-e.m.f. from re-triggering the circuit. Supply decoupling capacitors C1 and C4 are also critical, and should be located close to IC1 and IC2 respectively.

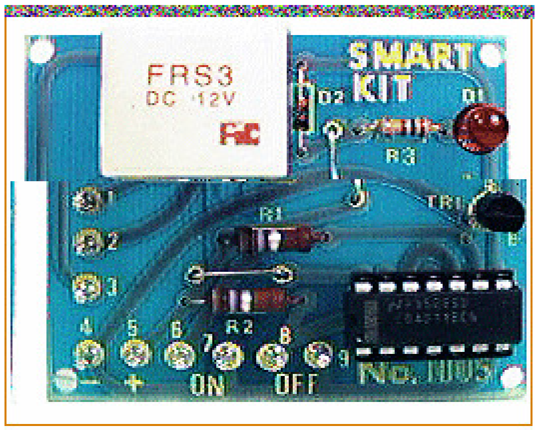
When a living being - animal or human - comes within tens of centimetres of the Rx coil, the circuit is triggered. This coil may be placed in the threshold of a door, under a carpet, or around a hatch, at the base of a tree, and so on. A number of such coils may also be wired in series.

Coils may be wound with a larger or smaller diameter, with more or less turns, and the power of the transmitter may be varied, as well as the sensitivity of the receiver. Note that a.m. radio reception may be affected at close proximity to the Tx coil.

P351. Touch Switch

General Description

A touch switch is an electronic device that enables us to control a circuit by simply touching a sensor. Smart Kit 1005 is a very easy project to built and will make you the proud owner of a magic switch that will respond to the slightest touch of your hand on its sensitive plates.



Technical Specifications - Characteristics
Supply voltage: 12 VDC
Max. current:30 mA
Relay rating: 250 V/2 A

How it Works

The circuit as you can see from its diagram is very simple and only uses 8 components. The heart of the circuit is the IC CD 4011 that is connected as a FLIP-FLOP. Pins 9 and 13 of the IC are the «SET» and «RESET» contacts of the FLIP-FLOP. The IC is of the CMOS type and requires a very low current to in its gates to control it. This high sensitivity of the circuit makes the touch operation possible. The two gates are held at logic state «1» continuously by means of the two resistors R1 and R3 that connect them to the positive supply rail. These resistors have a very large resistance of 10 Mohm. If we now touch a set of contacts the skin resistance closes the circuit between the corresponding gate and the negative supply rail. The skin resistance for small areas of the skin is normally much lower than 10 Mohm and the gate is effectively brought to logic condition «0» which makes the FLIP-FLOP change state. For any given state of the FLIP-FLOP touching the corresponding set of contacts will make the circuit to reverse its state of balance and in effect toggle the switch. As a switch is used a relay driven by a transistor which is driven from the out put of the FLIP-FLOP.

Construction

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up

considerably and reduces the possibility of making errors. Smart Kit boards also come pre-drilled and with the outline of the components and their identification printed on the component side to make construction easier. To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and makes soldering easier. Soldering the components to the board is the only way to build your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it.

DO NOT file or sandpaper a dirty or worn out tip. If the tip cannot be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time.

DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work. In order to solder a component correctly you should do the following:

Clean the component leads with a small piece of emery paper. - Bend them at the correct distance from the component body and insert the component in its place on the board. You may find sometimes a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board.

In this case use a mini drill to enlarge the holes slightly. Do not make the holes too large as this is going to make soldering difficult afterwards.

Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead emerges from the board.

The iron tip must touch the lead slightly above the p.c. board.

When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and let the solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked, or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it.

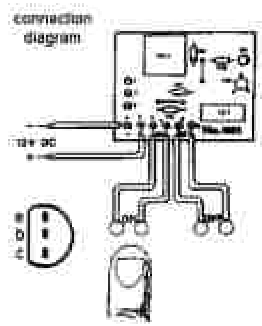
Take care not to overheat the tracks as it is very easy to lift them from the board and break them.

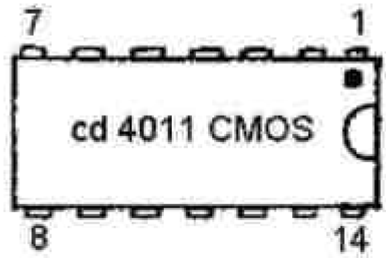
When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component.

Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together. - After having finished your work cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that still remain on it.

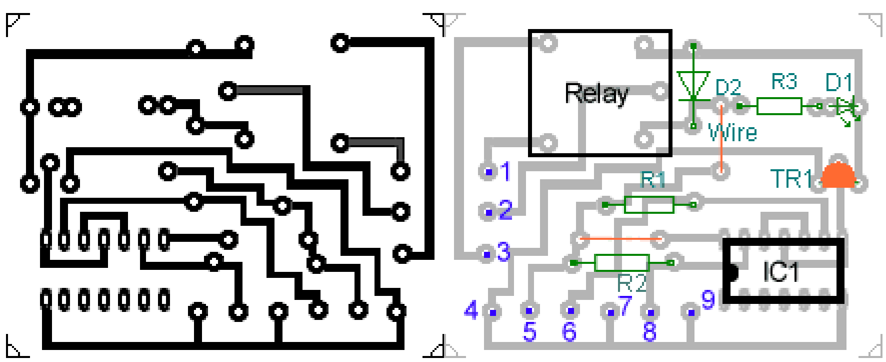
The switch only has eight components and its construction is very easy even for the most inexperienced. As usual construction must start from the least sensitive to heat components, which in this case are the IC socket and the pins. After soldering the pins and the socket, make the two jumper connections that are marked on the component side of the board, solder the relay in its place and continue with the transistor the diode and the LED. Once everything is in its place clean the board very well from flux residues and check it for short circuits and possible mistakes.

Then, place the IC in its socket. The IC is of the CMOS family and should be handled with great care as it can be damaged very easily from static discharges. Avoid touching its pins and keep your body and the circuit board grounded during insertion. You should also take care not to bent any pins underneath the IC body during this operation.





Now connect the points marked + & - on the board with 12 VDC and touch lightly the set of contacts marked «ON». You should hear the clicking of the relay and the LED should light up. (In case the LED turns on at power up then touch the other set of contacts that are marked «OFF».) Touching the contacts marked «OFF» will turn the LED off and the relay should be released. It is up to you to connect any device you want to control with the touch switch but please remember that you should not exceed the power rating of the relay which is 250 V/2 A.



Dimensions 5,5cm x 4,2cm

If it does not work

Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems.

-Check again all the external connections to and from the circuit to see if there is a mistake there.
See that there are no components missing or inserted in the wrong places.
Make sure that all the polarised components have been soldered the right way round.
Make sure the supply has the correct voltage and is connected the right way round to your circuit.
Make sure that you have inserted the IC in its socket correctly and that you have not bent any pins during insertion.
Check your project for faulty or damaged components.

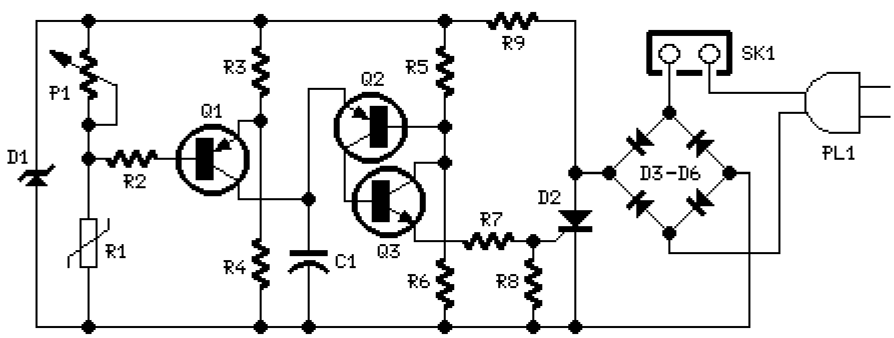
Parts
R1 10MOhm 1/4 W
R2 10MOhm 1/4 W
R3 1KOhm 1/4 W
D1 Led red
D2 1N4148 diode
TR1 BC558 PNP Transistor - BC327
C1 CD4011 CMOS IC
RL1 12V relay rated at 250 V / 2A

P352. Temperature-controlled Fan

Warning! The circuit is connected to 230Vac mains, then some parts in the circuit board are subjected to lethal potential! Avoid touching the circuit when plugged and enclose it in a plastic box.

Gradually increases speed as temperature increases
Widely adjustable temperature range

Circuit diagram



Parts:
P1 22K Linear Potentiometer (See Notes)
R1 15K @ 20°C n.t.c. Thermistor (See Notes)
R2 100K 1/4W Resistor
R3,R6 10K 1/4W Resistors
R4,R5 22K 1/4W Resistors
R7 100R 1/4W Resistor
R8 470R 1/4W Resistor
R9 33K 4W Resistor
C1 10nF 63V Polyester Capacitor
D1 BZX79C18 18V 500mW Zener Diode
D2 TIC106D 400V 5A SCR
D3-D6 1N4007 1000V 1A Diodes
Q1,Q2 BC327 45V 800mA PNP Transistors
Q2 BC337 45V 800mA NPN Transistor
SK1 Female Mains socket
PL1 Male Mains plug & cable

Device purpose:

This circuit adopt a rather old design technique as its purpose is to vary the speed of a fan related to temperature with a minimum parts counting and avoiding the use of special-purpose ICs, often difficult to obtain.

Circuit operation:

R3-R4 and P1-R1 are wired as a Wheatstone bridge in which R3-R4 generates a fixed two-thirds-supply "reference" voltage, P1-R1 generates a temperature-sensitive "variable" voltage, and Q1 is used as a bridge balance detector.
P1 is adjusted so that the "reference" and "variable" voltages are equal at a temperature just below the required trigger value, and under this condition Q1 Base and Emitter are at equal voltages and Q1 is cut off. When the R1 temperature goes above this "balance" value the P1-R1 voltage falls below the "reference" value, so Q1 becomes forward biased, pulse-charging C1.

This occurs because the whole circuit is supplied by a 100Hz half-wave voltage obtained from mains supply by means of D3-D6 diode bridge without a smoothing capacitor and fixed to 18V by R9 and Zener diode D1. Therefore the 18V supply of the circuit is not true DC but has a rather trapezoidal shape. C1 provides a variable phase-delay pulse-train related to temperature and synchronous with the mains supply "zero voltage" point of each half cycle, thus producing minimal switching RFI from the SCR. Q2 and Q3 form a trigger device, generating a short pulse suitable to drive the SCR.

Notes:

The circuit is designed for 230Vac operation. If your ac mains is rated at about 115V, you can change R9 value to 15K 2W. No other changes are required.

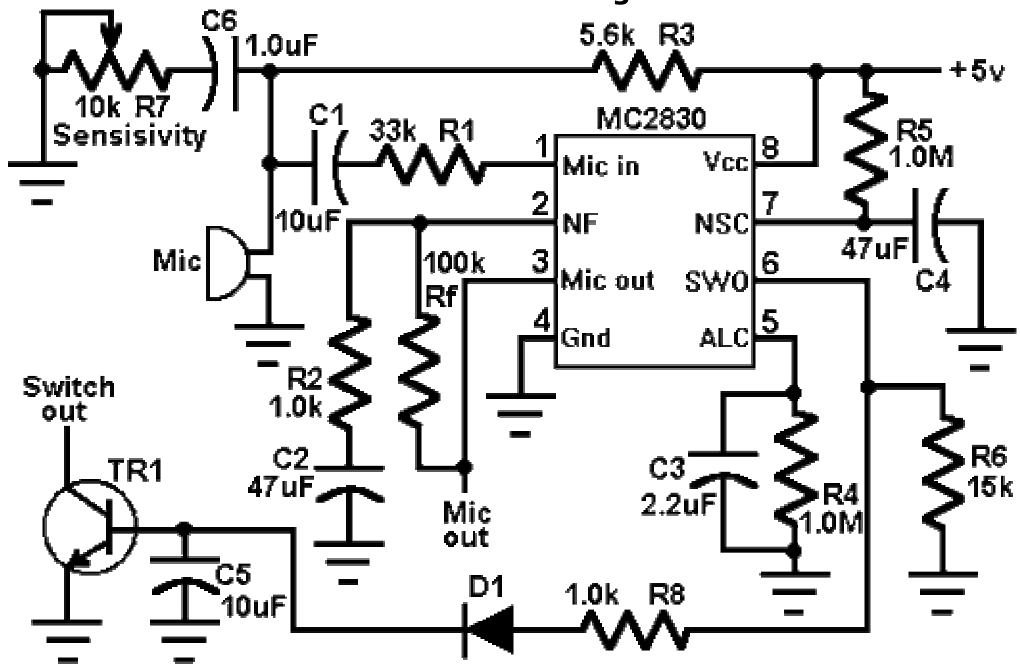
Circuit operation can be reversed, i.e. the fan increases its speed as temperature decreases, by simply transposing R1 and P1 positions. This mode of operation is useful in controlling a hot air flux, e.g. using heaters.

Thermistor value is not critical: I tried also 10K and 22K with good results.

In this circuit, if R1 and Q1 are not mounted in the same environment, the precise trigger points are subject to slight variation with changes in Q1 temperature, due to the temperature dependence of its Base-Emitter junction characteristics. This circuit is thus not suitable for use in precision applications, unless Q1 and R1 operate at equal temperatures.
he temperature / speed-increase ratio can be varied changing C1 value. The lower the C1 value the steeper the temperature / speed-increase ratio curve and vice-versa.

P353. Voice activated switch

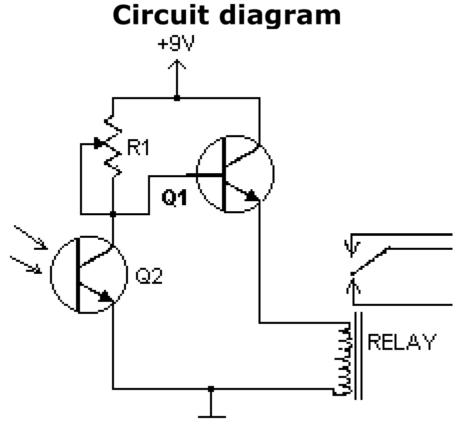
Circuit diagram



This circuit uses an MC2830 to form a voice activated switch (VOX). A traditional VOX circuit is unable to distinguish between voice and noise in the incoming signal. In a noisy environment, the switch is often triggered by noise, or the activation sensitivity must be turned down. This circuit overcomes this weakness. The switch is activated by voice level above the noise and not activated by background noise. This is done by utilizing the differences in voice and noise waveforms. Voice waveforms generally have a wide range of variation in amplitude, whereas noise waveforms are more stable. The sensitivity of the voice activation depends on the value of R6. The voice activation sensitivity is reduced from 3.0dB to 8.0dB above the noise if R6 changes from 14k to 7.0k .

P354. Light/Dark Detector

Circuit diagram

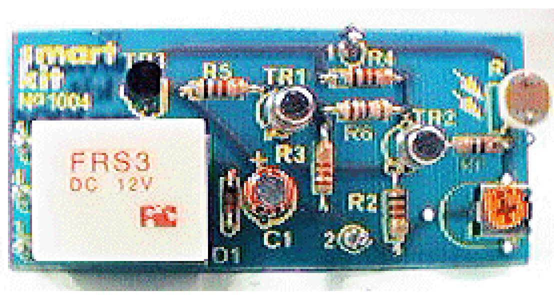


This handy little circuit can tell the difference between darkness and light, making it very useful for switching on and off signs, porch lights or other things when it gets dark or light.

Parts:
R1 100K Pot
Q1 2N3904 NPN Transistor or 2N2222
Q2 NPN Phototransistor
RELAY 9V Relay
MISC Board, Wire, 9V Battery Snap (if battery used), Knob For R1

Notes:
1. R1 Adjusts sensitivity

P355. Light switch



General Description

This project will let you make a switch that will be activated by light falling on a sensor. It is a very useful device and can be used in automatism's, security systems, counters, remote controls etc. It is very sensitive, fast acting and reliable. The circuit uses a Light Dependent Resistor (LDR) as a sensor and three transistors to amplify the signals from the LDR and drive the relay which does the switching.

Technical Specifications - Characteristics
Working voltage: .... 12 VDC
Maximum current: .... 50 mA

How it Works

As you can see from the circuit diagram in the input of the circuit there is a trimmer (R7) connected in series with the LDR in such a way as to form a voltage divider. When light falls on the LDR it causes its resistance to change and this causes the voltage across the LDR to change accordingly. These voltage changes are used to change the state of the transistor TR2 switching it ON and OFF. The

output from TR2 drives TR1 and this in turn TR3 which drives the output relay. The diode D1 protects the transistor from the back emf that is produced from the relay coil when it is turned off. The trimmer R7 adjusts the sensitivity of the circuit so it is possible to use it under widely different conditions. The circuit operates from a 9-12 VDC power supply and the relay contacts are rated at 250 V/2 A.

Construction

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up considerably and reduces the possibility of making errors. Smart Kit boards also come pre-drilled and with the outline of the components and their identification printed on the component side to make construction easier.

To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and makes soldering easier.

Soldering the components to the board is the only way to build your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it. DO NOT file or sandpaper a dirty or worn out tip. If the tip can not be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time. DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work. In order to solder a component correctly you should do the following: Clean the component leads with a small piece of emery paper - Bend them at the correct distance from the component body and insert the component in its place on the board. You may sometimes find a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board.

In this case use a mini drill to increase the diameter of the holes slightly. Do not make the holes too large as this is going to make soldering difficult afterwards.

Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead merges from the board. The iron tip must touch the lead slightly above the p.c. board. When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and leave the solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked, or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it. Take care not to overheat the tracks as it is very easy to lift them from the board and break them. When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component. Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together.

After finishing your work cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that still remain on it. You shouldn't face any special problems with this project. The only unusual component is the LDR and you should decide where you want to put your project and how you are going to activate it as it will be necessary to leave a hole in the case for the sensor and possibly orientated the whole case towards the light beam. As usual start building the circuit with the resistors leaving the LDR for the final stage. Mount the relay on the board and solder the transistors and the diode in their places making sure that nothing went in the wrong place or the wrong way round. When everything is in its place solder the LDR carefully, as it is very fragile and can be easily damaged if overheated. Make the last visual check and if you are satisfied that all is well you can connect the circuit to a power supply or a battery of at least 9 VDC. Cover the sensitive surface of the LDR and turn the trimmer till you hear the relay clicking. If you uncover the sensor the relay should click again. You will probably have to read just the trimmer once the circuit is cased and you are ready to use it in some application, in order to fine-tune it to the conditions that you want it to operate in.

Warning

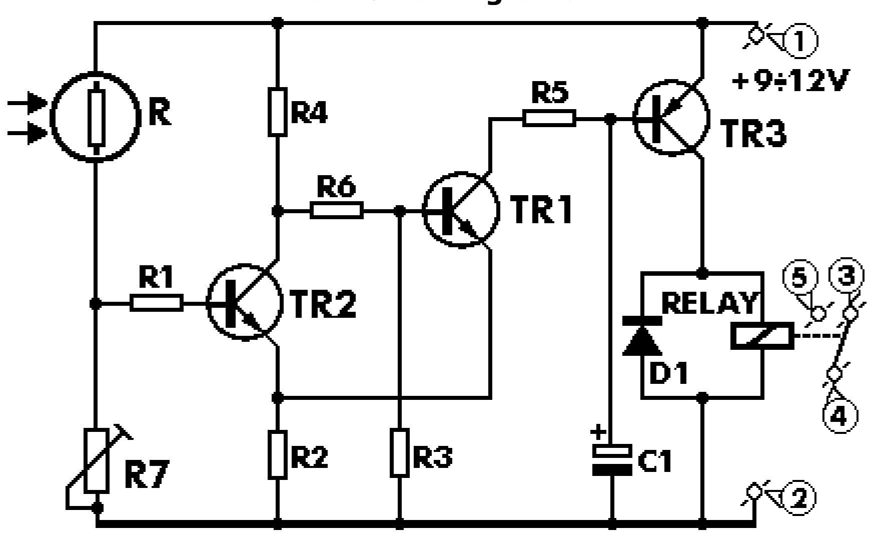
Smart kits are sold as stand alone training kits. If they are used as part of a larger assembly and any damage is caused, our company bears no responsibility.

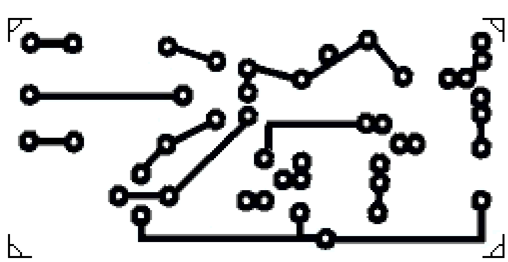
While using electrical parts, handle power supply and equipment with great care, following safety standards as described by international specs and regulations.

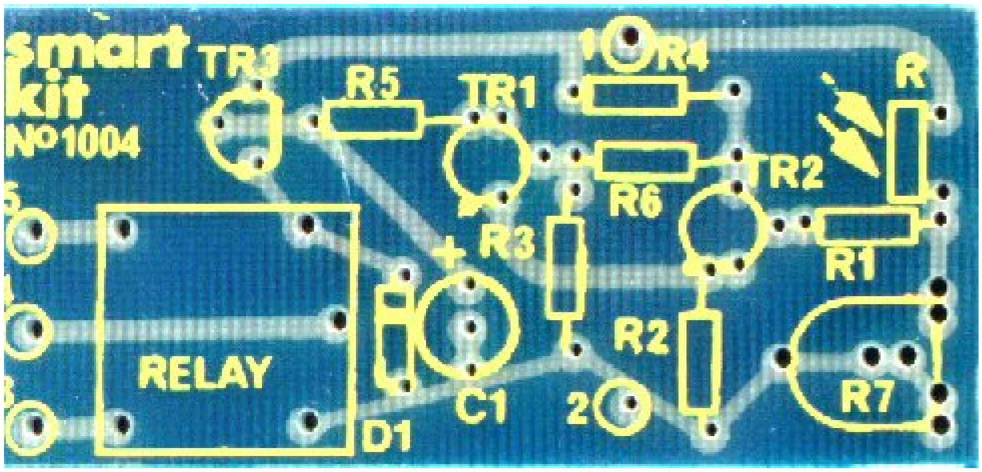
If it does not work

Check the power supply to make sure there are at least 9 VDC across the circuit, and that the polarity is correct. Make sure the transistors and the diode are connected the right way round. Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems.

Electronic Diagrams.







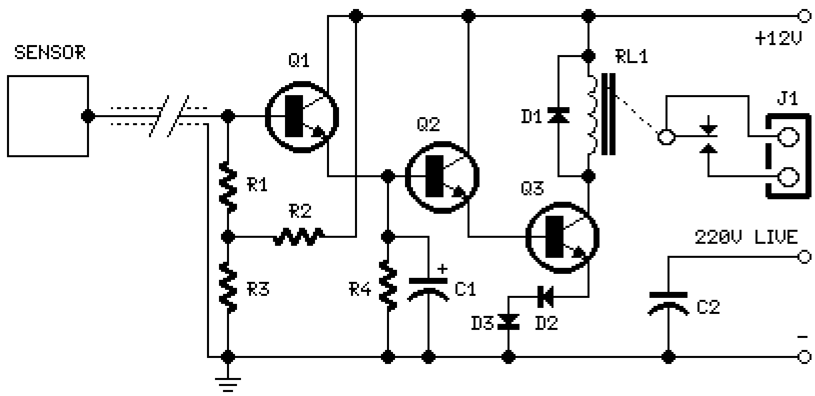
Parts
R light resistor
R1 4,7 K
R2 1,2 K
R3 2,2 K
R4 1,2 K
R5 1,2 K
R6 2,7 K
R7 100 K
C1 10 μf/16V
TR1 BC107-BC108 NPN (CV7644)
TR2 BC107-BC108 NPN (CV7644)
TR3 BC557-BC558-BC327 PNP
D1 1N4148 Diode
RELAY 12V relay

P356. Capacitive Sensor

Note: For proper operation, circuit ground must be connected via a small value, high voltage-rating capacitor to one side of the mains supply socket. The "Live" side is the right one.

Special design for shop-windows animation
Useful for many types of touch controls

Circuit diagram



Parts:
R1,R2 1M 1/4W Resistors
R3,R4 47K 1/4W Resistors
C1 10µF 25V Electrolytic Capacitor
C2 470pF 630V Ceramic or Polyester Capacitor
D1-D3 1N4002 100V 1A Diodes
Q1-Q3 BC337 45V 800mA NPN Transistors
RL1 Relay with SPDT 2A @ 220V switch
Coil Voltage 12V. Coil resistance 200-300 Ohm
J1 Two ways output socket
Sensor Aluminium or copper thin sheet with the dimensions of a post-card, glued at the rear of the same (approx. 15x10.5 cm.)
Thin screened cable

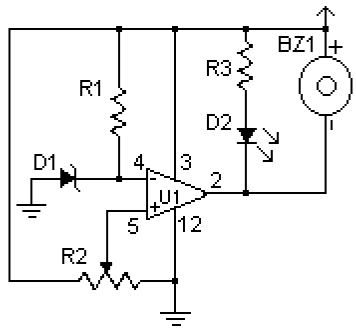
Circuit description:

The purpose of this circuit is to animate shop-windows by means of a capacitive sensor placed behind a post-card-like banner. The card is placed against the glass inside the shop-window, and the visitor can activate the relay placing his hand on the card, from the outside. Especially suited for toy-shops, the circuit can activate model trains, small electric racing cars, lights etc. Further applications are left at user's imagination. Adopt it to increase the impact of your shop-window on next Christmas season!
Q1, Q2 & Q3 form a high impedance super-Darlington that drives the relay, amplifying the 50Hz alternate mains-supply frequency induced in the sensor by the human body. C1 & D2, D3 ensure a clean relay's switching. Power supply can be any commercial wall plug-in transformer with rectifier and smoothing capacitor, capable of supplying the voltage and current necessary to power the relay you intend to use.

P357. Low Voltage Alarm

This low voltage circuit can be used to monitor batteries and other volatile sources of current for problems. The circuit sounds an alarm and lights an LED, but can be interfaced to any number of other circuits for many different uses.

Circuit diagram



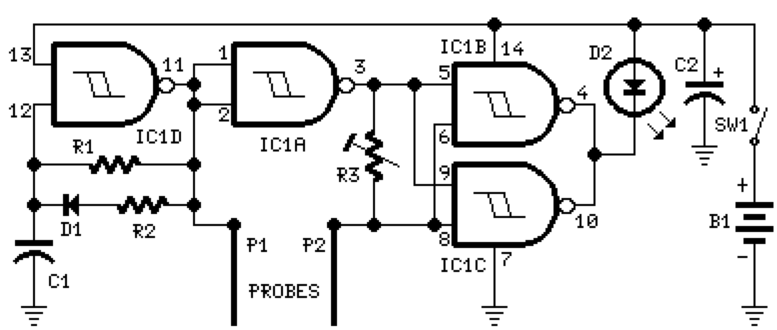
Parts:
R1, R3 1K 1/4W Resistor
R2 5K Pot
U1 LM339 Voltage comparator IC
D1 1N5233B Zener Diode
D2 LED
BZ1 Piezo Buzzer
MISC Board, wire, socket for IC

Notes:
1. The circuit will operate from 9V to 12V.
2. Adjust R2 until the alarm goes off at the correct voltage.

P358. Plants Watering Watcher

Varying brightness LED signals the necessity to water a plant
Very low consumption, 3V powered circuit

Circuit diagram



Parts:
R1 470K 1/4W Resistor
R2 3K3 1/4W Resistor
R3 100K 1/2W Trimmer Cermet
C1 1nF 63V Polyester Capacitor
C2 47µF 25V Electrolytic Capacitor
D1 1N4148 75V 150mA Diode
D2 5mm. Red LED
IC1 4093 Quad 2 input Schmitt NAND Gate IC
P1,P2 Probes (See text)
SW1 SPST Slider Switch
B1 3V Battery (2 AA 1.5V Cells in series)

Device purpose:

This circuit is intended to signal when a plant is needing water. A LED illuminates at maximum brightness when the ground in the flower-pot is too dry: it dims gradually as the water's content in the pot grows, turning off when the optimum moisture's level is reached. This condition is obtained trimming R3.

Circuit operation:

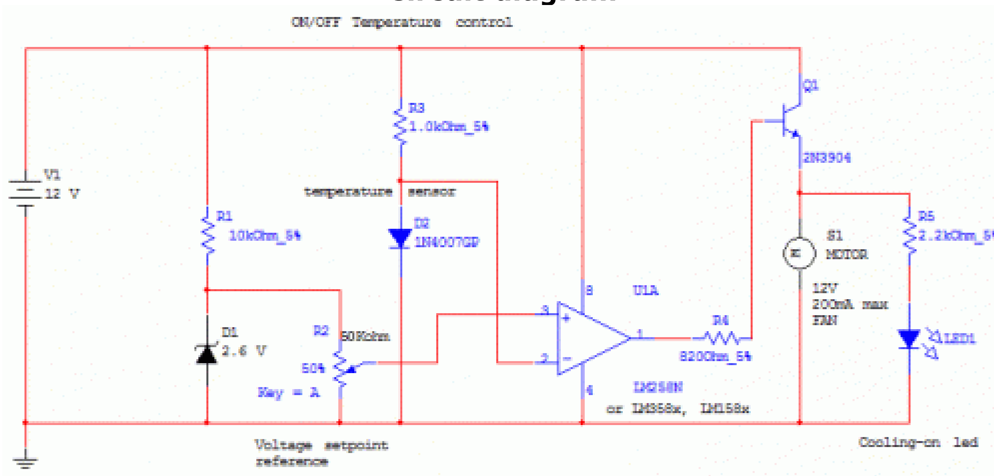
IC1D forms a square wave oscillator with approx. 10/90 mark-space ratio. It feeds the output probe P1 and its signal, inverted by IC1A is compared with that picked-up by P2 in the NAND gates IC1B & IC1C in parallel, driving the LED. When a low resistance exists between the probes, due to an high water's content in the flower-pot, the LED is off, turning gradually on as the resistance between the probes increases.

Notes:

A square wave is used to avoid probes' oxidization.
Probes can be long nails, carbon rods obtained from disassembled exhausted 1.5V batteries, or even a couple of screwdrivers.
The probes must be driven in the pot's ground a few inches apart.
Due to 3V supply, the LED needs not a limiting resistor.
Power consumption: LED off = 50µA; LED full on = 1mA.
To switch-off the circuit, you can short the probes. In this case SW1 can be omitted.
Using an high-efficiency LED, brightness variations are better emphasized. In this case a limiting resistor could be necessary.

P359. On-Off Temperature Control

Circuit diagram



This circuit controls a load (in this case a dc brushless fan) based on a temperature compared with a setpoint. THe transduced is a diode in the forward polarization regime. In fact when forward biased, the forward voltage drop accross a diode has a temperature dependance, in particular has a negative linear(ish) slope. This because of the boltzmann distribuition, causing electrons to pass to the conduction band thermically, lowering the voltage drop accross the diode. Anyway this circuit comparates a precise voltage reference (zener) with the forward voltage drop of the diode forward biased with 11mA of current.

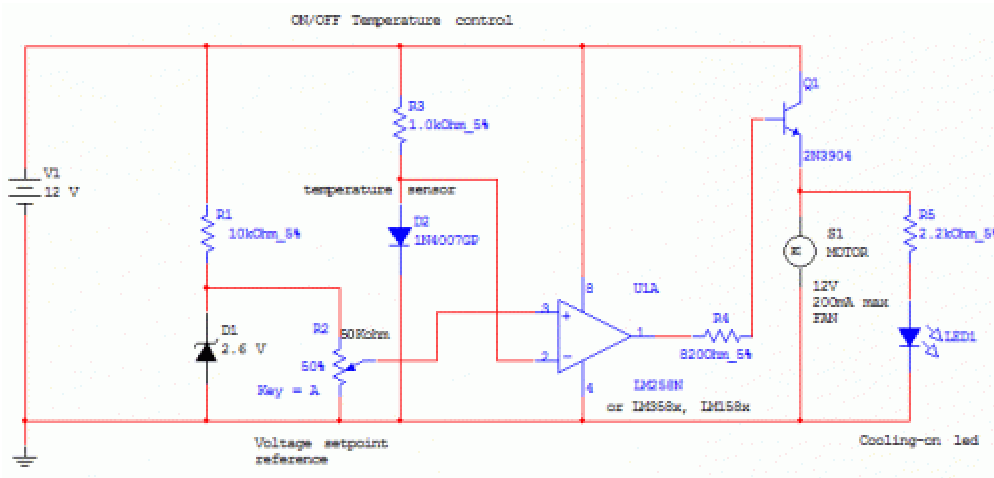
The comparator is simply a LM158/258/358 working in open-loop mode, the inverting input is connected to the diode sensor, and the noninverting to the reference voltage. Se when the temperature rises above the setpoint, the forward voltage drops under the voltage reference and the comparator output is vccturning on the transistor and so the fan. Higher power transistor can be substituted for bigger fans, or you can substitute a relay, IGBT, mosfet etc to control higher loads (and higher voltages).

The setpoint is adjusted with the potentiometer, and you can use a LM3914 led driver to make a temperature setpoint indicator (needs careful calibrations and the use of excel to calculate slope and intercept).

Many modifications can be done, but the circuit works very well in its basic form.
THe comparator can distinguish 10uV differences so approx 0.01°C differences (carefully adjusting the potentiometer can allow to feel body heat from 1/2 cm from the sensor, or feel ambient heat, making to turn the fan on and off continuosly).

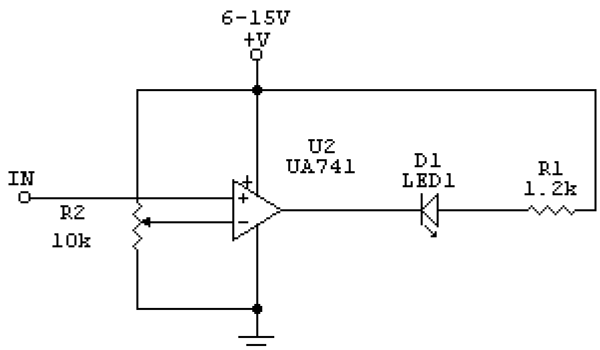
You can control temperatures up to 140°C (150 max diode temperature), but linearity is not ensured
Possible uses? Heatsink cooling, computer emergency cooling (but i thint that a linear device would be better than a on-off) metal cooling when drilling etc...

Ah! One note: you can even heat with this circuit but you need the reverse comparator inputs and substitute the fan with a relay controlling the heater.



P360. Voltage Monitor

Circuit diagram



Parts
D1 LED
R1 1.2k Resistor
R2 10k Var. Resistor
U1 UA741 OP AMP

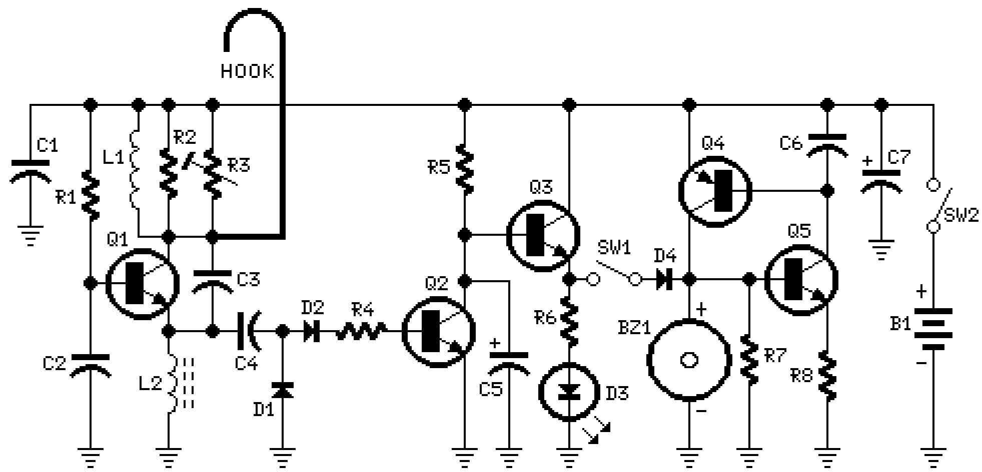
Description

When the input voltage is 0 the LED glows. The LED stops glowing when the voltage rises to the level determined by R2. Reverse + and - pins to reverse operating mode. To set voltage at which LED goes off, (1) Set 0V at input. (2) Set input voltage at desired level. (3) Adjust R2 to point right after LED goes out.

P361. Door Alarm

Hangs up on the door-handle
Beeps when someone touches the door-handle from outside

Circuit diagram



Parts:
R1 1M 1/4W Resistor
R2 3K3 1 or 2W Resistor (See Notes)
R3 10K 1/2W Trimmer Cermet (See Notes)
R4 33K 1/4W Resistor
R5 150K 1/4W Resistor
R6 2K2 1/4W Resistor
R7 22K 1/4W Resistor
R8 4K7 1/4W Resistor
C1,C2 10nF 63V Ceramic or Polyester Capacitors
C3 10pF 63V Ceramic Capacitor
C4,C6 100nF 63V Ceramic or Polyester Capacitors
C5 2µ2 25V Electrolytic Capacitor
C7 100µF 25V Electrolytic Capacitor
D1,D2,D4 1N4148 75V 150mA Diodes
D3 5 or 3mm. Red LED
Q1,Q2,Q3,Q5 BC547 45V 100mA NPN Transistors
Q4 BC557 45V 100mA PNP Transistor
L1 (See Notes)
L2 10mH miniature Inductor
Hook (See Notes)
BZ1 Piezo sounder (incorporating 3KHz oscillator)
SW1,SW2 SPST miniature Slider Switches
B1 9V PP3 Battery
Clip for PP3 Battery

Device purpose:

This circuit emits a beep and/or illuminates a LED when someone touches the door-handle from outside. The alarm will sound until the circuit will be switched-off.

The entire circuit is enclosed in a small plastic or wooden box and should be hanged-up to the door-handle by means of a thick wire hook protruding from the top of the case.

A wide-range sensitivity control allows the use of the Door Alarm over a wide variety of door types, handles and locks. The device had proven reliable even when part of the lock comes in contact with the wall (bricks, stones, reinforced concrete), but doesn't work with all-metal doors. The LED is very helpful at setup.

Circuit operation:

Q1 forms a free-running oscillator: its output bursts drive Q2 into saturation, so Q3 and the LED are off. When part of a human body comes in contact with a metal handle electrically connected to the wire hook, the body capacitance damps Q1 oscillations, Q2 biasing falls off and the transistor becomes non conducting. Therefore, current can flow into Q3 base and D3 illuminates. If SW1 is closed, a self-latching circuit formed by Q4 & Q5 is triggered and the beeper BZ1 is activated.

When the human body part leaves the handle, the LED switches-off but the beeper continues to sound, due to the self-latching behavior of Q4 & Q5. To stop the beeper action, the entire circuit must be switched-off opening SW2. R3 is the sensitivity control, allowing to cope with a wide variety of door types, handles and locks.

Notes:

L1 is formed winding 20 to 30 turns of 0.4mm. diameter enameled copper wire on R2 body and soldering the coil ends to the resistor leads. You should fill R2 body completely with coil winding: the final turn's number can vary slightly, depending on different 1 or 2W resistor types actual length (mean dimensions for these components are 13-18mm. length and 5-6mm. diameter). The hook is made from non-insulated wire 1 - 2mm. diameter (brass is well suited). Its length can vary from about 5 to 10cm. (not critical).

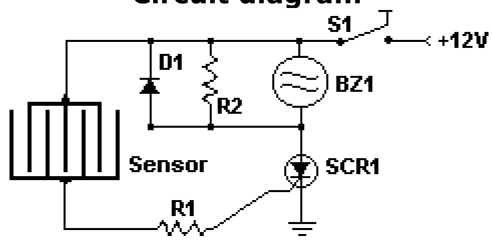
If the device is moved frequently to different doors, Trimmer R3 can be substituted by a common linear potentiometer fitted with outer knob for easy setup. To setup the device hang-up the hook to the door-handle (with the door closed), open SW1 and switch-on the circuit. Adjust R3 until the LED illuminates, then turn slowly backwards the screwdriver (or the knob) until the LED is completely off. At this point, touching the door-handle with your hand the LED should illuminate, going off when the hand is withdrawn. Finally, close SW1 and the beeper will sound when the door-handle will be touched again, but won't stop until SW2 is opened.

In regular use, it is advisable to hang-up and power-on the device with SW1 open: when all is well settled, SW1 can be closed. This precautionary measure is necessary to avoid unwanted triggering of the beeper.

P362. Rain Detector

This circuit uses a sensor made of a small piece of etched PC board and a simple SCR circuit to detect rain and sound a buzzer. The SCR could also be used to activate a relay, turn on a lamp, or send a signal to a security system.

Circuit diagram



Parts
R1 1K 1/4 W Resistor
R2 680 Ohm 1/4 W Resistor
D1 1N4001 Silicon Diode
BZ1 12V Buzzer
S1 SPST Switch
SCR1 C106B1 SCR 106CY
SENSOR See Notes
MISC Board, Wire, Case, PC Board (For Sensor)

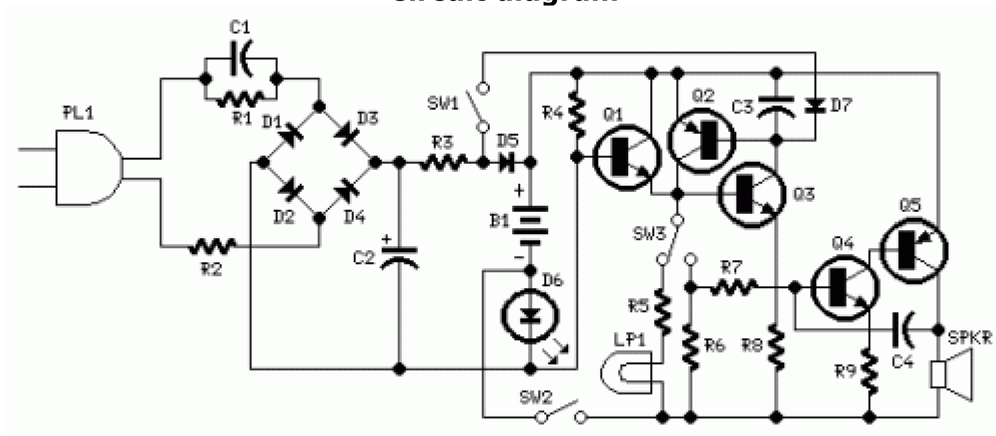
Notes
1. The sensor is a small piece of PC board etched to the pattern showen in the schematic. The traces should be very close to each other, but never touching. A large spiral pattern would also work.
2. Make sure to use a loud buzzer.

P363. Emergency Light & Alarm

Warning! The circuit is connected to 220Vac mains, then some parts in the circuit board are subjected to lethal potential!. Avoid touching the circuit when plugged and enclose it in a plastic box.

Powered by two AA NI-CD batteries
Four switchable options

Circuit diagram



Parts:
R1 220K 1/4W Resistor
R2 470R 1/2W Resistor
R3 390R 1/4W Resistor
R4 1K5 1/4W Resistor
R5 1R 1/4W Resistor
R6 10K 1/4W Resistor
R7 330K 1/4W Resistor
R8 470R 1/4W Resistor
R9 100R 1/4W Resistor
C1 330nF 400V Polyester Capacitor
C2 10µF 63V Electrolytic Capacitor
C3 100nF 63V Polyester Capacitor
C4 10nF 63V Polyester Capacitor
D1-D5 1N4007 1000V 1A Diodes
D6 LED Green (any shape)
D7 1N4148 75V 150mA Diode
Q1,Q3,Q4 BC547 45V 100mA NPN Transistors
Q2,Q5 BC327 45V 800mA PNP Transistors
SW1,SW2 SPST Switches
SW3 SPDT Switch
LP1 2.2V or 2.5V 250-300mA Torch Lamp
SPKR 8 Ohm Loudspeaker
B1 2.5V Battery (two AA NI-CD rechargeable cells wired in series)
PL1 Male Mains plug

Device purpose:

This circuit is permanently plugged into a mains socket and NI-CD batteries are trickle-charged. When a power outage occurs, the lamp automatically illuminates. Instead of illuminating a lamp, an alarm sounder can be chosen.

When power supply is restored, the lamp or the alarm is switched-off. A switch provides a "latch-up" function, in order to extend lamp or alarm operation even when power is restored.

Circuit operation:

Mains voltage is reduced to about 12V DC at C2's terminals, by means of the reactance of C1 and the diode bridge (D1-D4). Thus avoids the use of a mains transformer.

Trickle-charging current for the battery B1 is provided by the series resistor R3, D5 and the green LED D6 that also monitors the presence of mains supply and correct battery charging.

Q2 & Q3 form a self-latching pair that start operating when a power outage occurs. In this case, Q1 biasing becomes positive, so this transistor turns on the self latching pair.

If SW3 is set as shown in the circuit diagram, the lamp illuminates via SW2, which is normally closed; if set the other way, a square wave audio frequency generator formed by Q4, Q5 and related components is activated, driving the loudspeaker.

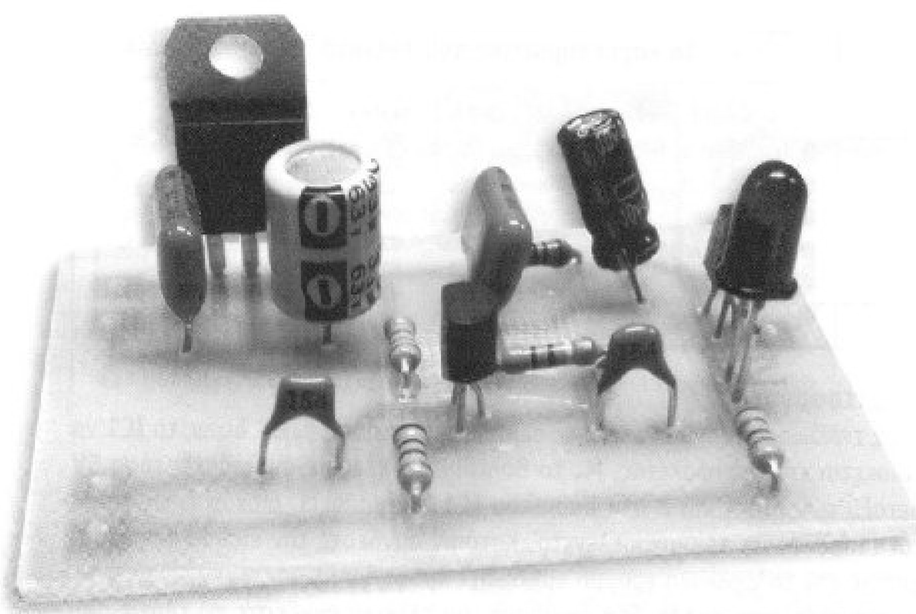
If SW1 is left open, when mains supply is restored the lamp or the alarm continue to operate. They can be disabled by opening the main on-off switch SW2.

If SW1 is closed, restoration of the mains supply terminates lamp or alarm operation, by applying a positive bias to the Base of Q2.

Notes:
Close SW2 after the circuit is plugged.

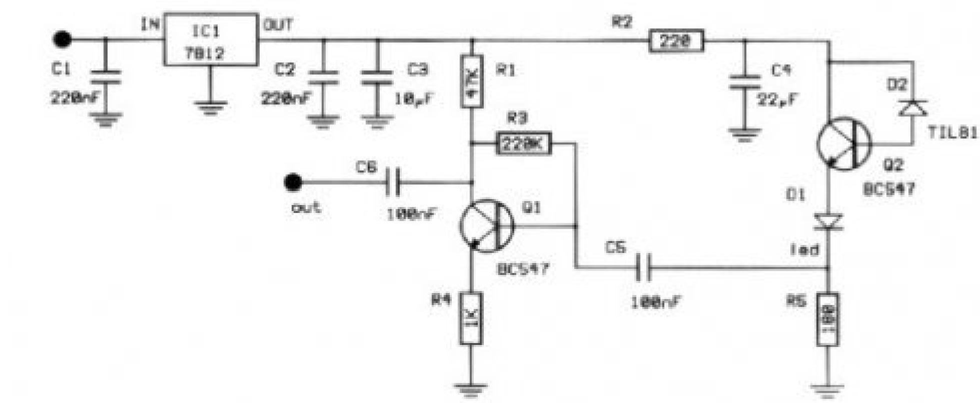
P364. Infrared Detector

Note: The text is AUTO translated from Greek version



The infra red radiation is a region with bigger length of wave from the visible spectrum. It is a region which our eye does not conceive, the consequences however which we felt as heat of. The manufacture that to you we propose receives this region and on one side us notice with optical clue, otherwise we can observe the configuration of width of radiation.

Theoretical circuit



The circuit of manufacture appears in form. sensory is a passage of silicon with relatively big surface. This passage when it is not litted up by infra red light has very big resistance of order of Mohm. this resistance is reversely proportional at approach of brightness. The type of passage is not critical, in the place can enter anyone. The resistance of passage him we use in order to polarize a transistor of npn type BC547. The photodiode enters between in the collector and in the base. The current that leak the passage is multiplied by the b of transistor and it is presented in the emitter of transistor. This current is enough in order to it leads and it turns on a Led ". En line with this circuit exists a resistance in order to it limits his current.

The infra red radiation has very a lot of applications in the industry and in the trade. The more important perhaps application they are telecontrols, that exist everywhere. The proposed manufacture is based on a passage of silicon which is connected in amplifier. The exit of amplifier leads a Led. Each time where lights it means that hits infrared radiation in the sensor. The circuit allocates moreover a exit in that we can connect a small acoustic amplifier or even a oscilloscope.

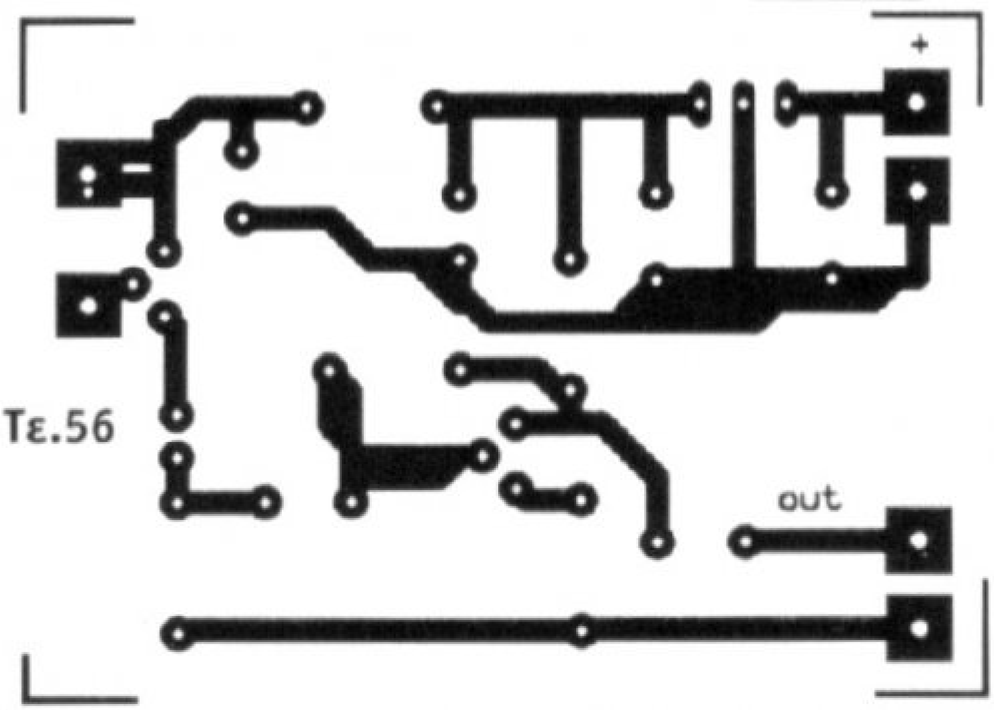
In utmost this resistance is presented a tendency of proportional incident radiation. If in deed the radiation has been shaped at width then will be presented in utmost her component of configuration. If for example falls in the photodiode for some reason a fraction of beam from infrared laser with configuration by sound then in utmost the resistance will be presented wave the sound. In this point we added a exit for oscilloscope for a small amplifier. The tendency of catering should have noise and be clean. Stabilised power supply it ensures this operation. The stabilisation becomes with stabilizer of tendency 7808.

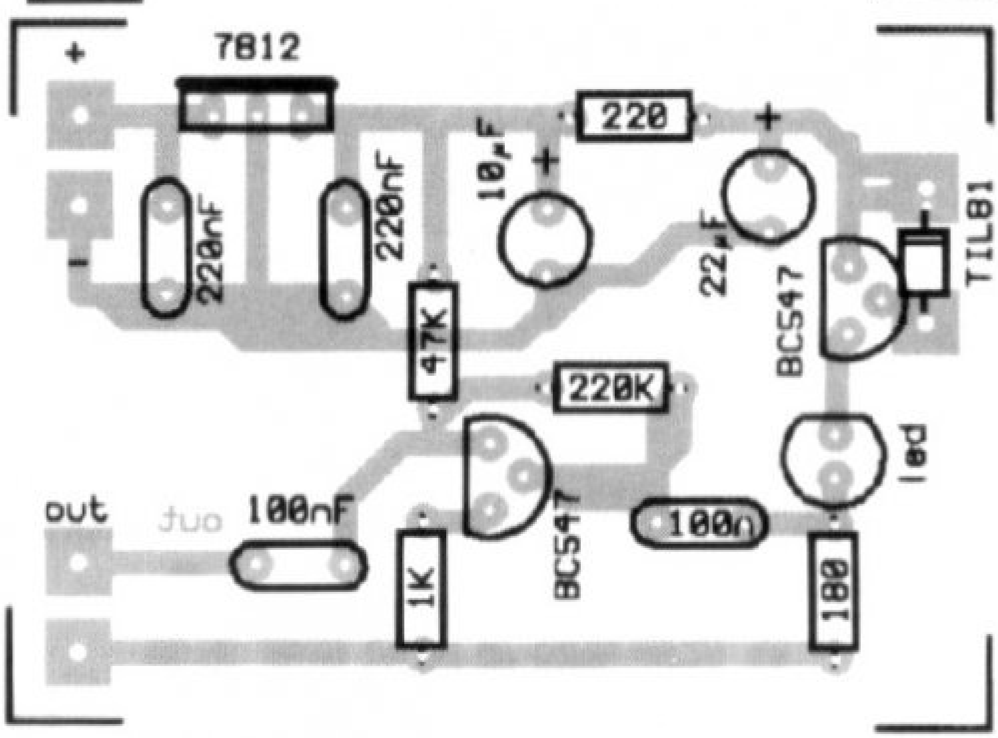
Manufacture

In order to you make the manufacture you will need printed that exists in what form , in you will place the materials according to form. At the placement it should you give few attention in the right time of semiconductors, transistors passages and stabilizer of tendency. In the circuit of emitter Q2 it exists a led, which it will turn on each time where incident infrared radiation in the photodiode. In the exit of Q1 you will find the same signal strengthened. This signal will contain the at width unmodulate information that will have the radiation (or this emanates from telecontrols, or from laser).

Parts
R1 47K
R2 220
R3 220K
R4 1K
R5 180
C1,2 220nF
C3 10uF

C4 22uF
C5 100nF
C6 100nF
IC1 7812
Q1 BC547
Q2 BC547
D1 Led
D2 TIL81

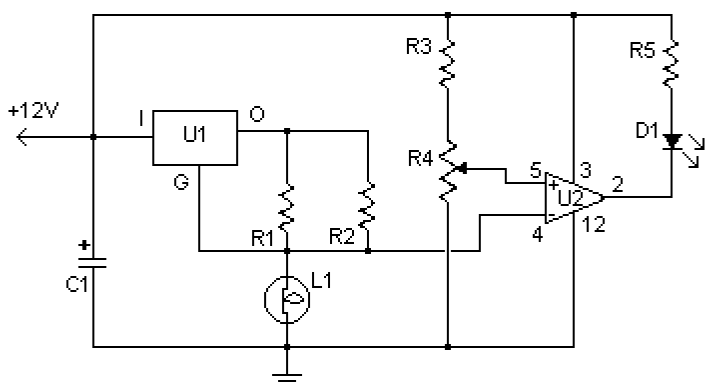




P365. Air Flow Detector

This simple circuit uses an incandescent lamp to detect airflow. With the filament exposed to air, a constant current source is used to slightly heat the filament. As it is heated, the resistance increases. As air flows over the filament it cools down, thus lowering it's resistance. A comparator is used to detect this difference and light an LED. With a few changes, the circuit can be connected to a meter or ADC to provide an estimation on the amount of air flow.

Circuit diagram



Parts:
R1 100 Ohm 1/4W Resistor
R2 470 Ohm 1/4W Resistor
R3 10k 1/4W Resistor
R4 100K 1/4W Resistor
R5 1K 1/4W Resistor
C1 47uF Electrolytic Capacitor
U1 78L05 Voltage Regulator
U2 LM339 Op Amp
L1 #47 Incandescent lamp with glass removed (See "Notes")
D1 LED
MISC Board, Wire, Sockets for ICs, etc.

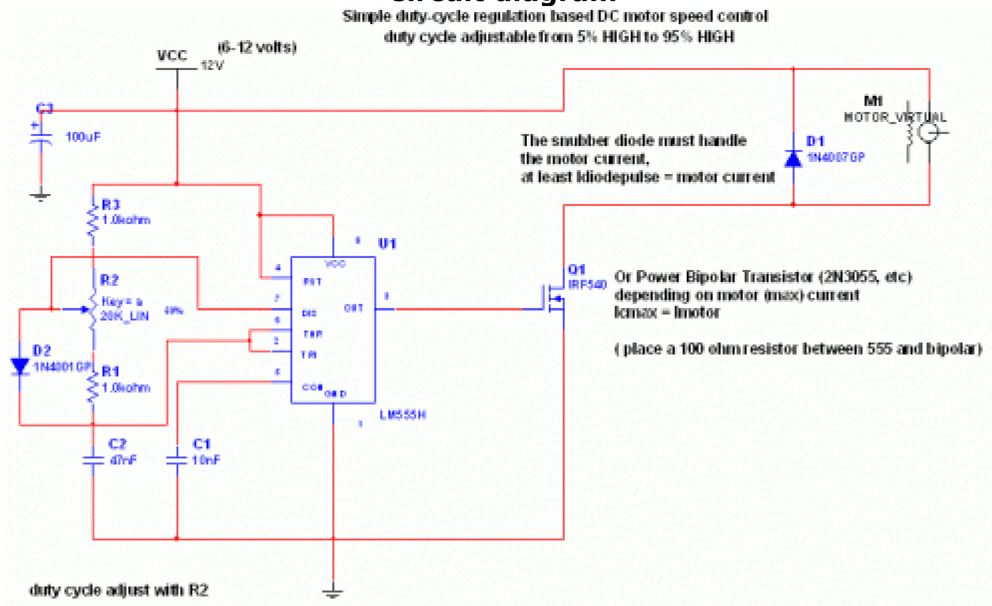
Notes:

1. The glass will have to be removed from L1 without breaking the filament. Wrap the glass in masking tape and it in a vise. Slowly crank down until the glass breaks, then remove the bulb and carefully peel back the tape. If the filament has broken, you will need another lamp.

P366. Simple DC motor PWN speed control

The 555 is ubiquitous and can be used as simple PWM speed control

Circuit diagram



Circuit Explaination:

The 555 Ic is wired as an astable and the frequency is constant and independent of the duty cycle, as the total resistance (R charge + R discharge, notice the diode) is constant and equal to 22Kohm (givin a frequency of about 1Khz, notice the hum).

When the potentiomenter is all up, the Rcharge resistance is 1,0 Kohm (the diode prevents the capacitor to charge through the second potentiometer section and the other 1,0 Kohm resistor) , and Rdischarge is 21 Kohm, giving a 5% on duty cycle and a 1Khz frequency.

When the potentiomenter is all down, the Rcharge resistance is 21,0 Kohm (the diode prevents the capacitor to charge through the second potentiometer section and the other 1,0 Kohm resistor) , and Rdischarge is 1 Kohm, giving a 95% on duty cycle and a 1Khz frequency.

When the potentiomenter is at 50% , the Rcharge resistance is 11,0 Kohm (the diode prevents the capacitor to charge through the second potentiometer section and the other 1,0 Kohm resistor) , and Rdischarge is 11 Kohm, giving a 50% on duty cycle and a 1Khz frequency.

The 555 provide good current capability to drive the mosfet fast and to drive a bipolar transistor.
I actually use this system to drive the DC motor of my small Rotary spark gap Tesla coil at variable speed
If you are disgusted by the 1Khz hum of the motor try to rise the frequency out of the audible range (replacing the potenziometer), but rembember that at higher frequency inductive reactance of motor rises so the the efficiency would drop.

Important:

Obviously the mosfet (or bipolar) must have enough current capability to drive the motor, so the drain (or collector) current must be equal to maximum motor current (at power supply voltage, when it is blocked). The snubber diode too, because it shorts the motor on the off cycle. Both mosfet (or bipolar) and diode have to be hooked (if you don't want them cooked ;-)) to a heatsink if the max motor current is more than

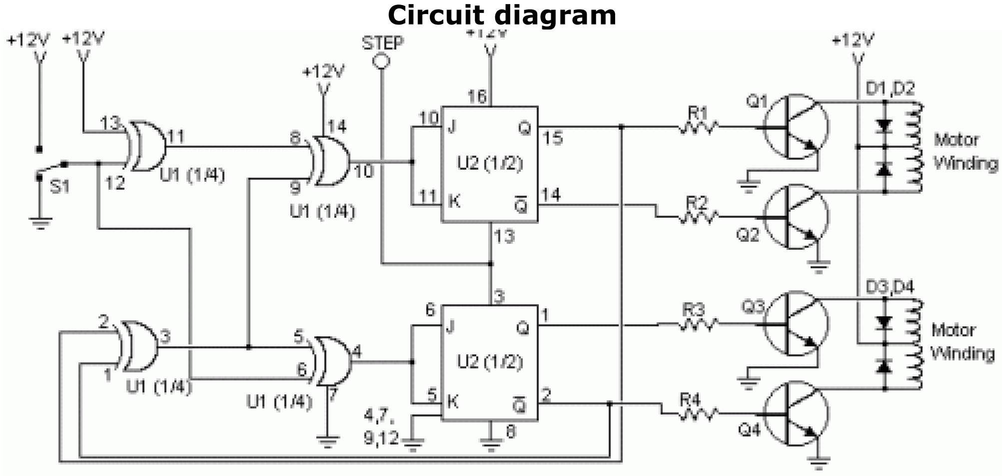
100 or 200mA. I suggest to not stress to much the motor with too much work because it overheats both motor, transistor and diode.

If you don't want braking in the off cycle just place a resistor in series with the snubber diode, it should rise a bit efficiency but have more inertia when slowing the motor down. The value of the resistor must be R=V(breakdown transistor) / Imax, and the power should be 5W. Mosfets have internal zener diode, but don't count on it ;-)

P367. Stepper Motor Controller

The circuit is very simple and inexpensive. This is good thing because most commercial stepper motor controller ICs are quite expensive. This circuit is built from standard components and can easily be adapted to be controlled by a computer.

Circuit diagram

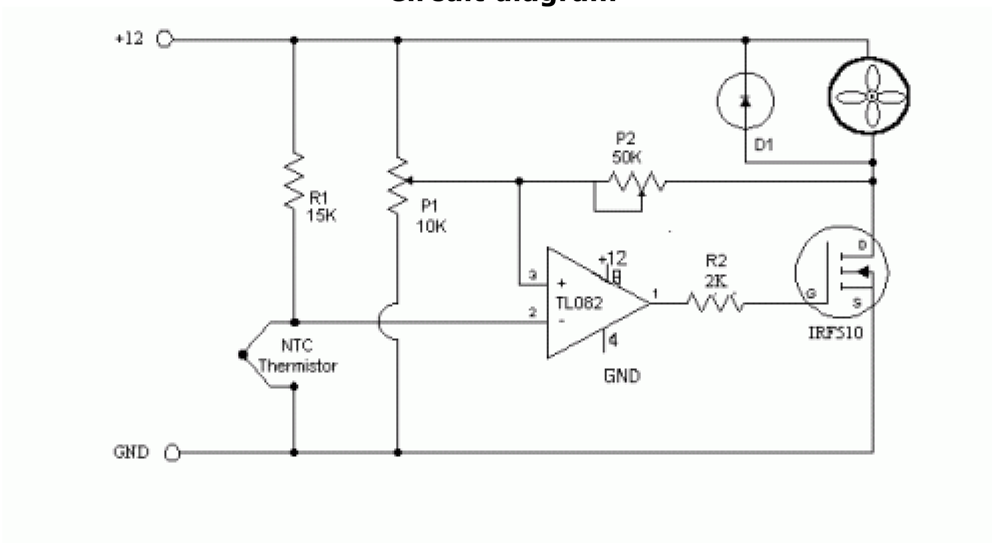


Parts
R1, R2 ,R3, R4 1K 1/4W Resistor
D1, D2, D3, D4 1N4002 Silicon Diode
Q1, Q2, Q3, Q4 TIP31 NPN Transistor (See Notes) or TIP41, 2N3055
U1 4070 CMOS XOR Integrated Circuit
U2 4027 CMOS Flip-Flop
S1 SPDT Switch
MISC Case, Board, Wire, Stepper Motor

Notes
1. You should be able to substitute any standard (2N3055, etc.) power transistor for Q1-Q4.
2. Every time the STEP line is pulsed, the motor moves one step.
3. S1 changes the motors direction.

P368. Fan control

Circuit diagram



This is a simple circuit that will do what you want I believe.

R1 15k ohm resistor
NTC Thermistor- 10k ohm, sold at Radio Shack in the states.
P1 10k ohm potentiometer - sets the low speed(voltage) of the fans at the cool temperature.

P2 50K ohm potentiometer - sets the gain of the circuit - how fast the voltage will rise to full output when the temp is higher.

TL082 a op-amp that I had handy, most any single voltage op-amp should work. The TL082 is a dual op-amp if you want more then one controller on a board. note that the power and ground connections for the op-amp are not shown on the schematic.

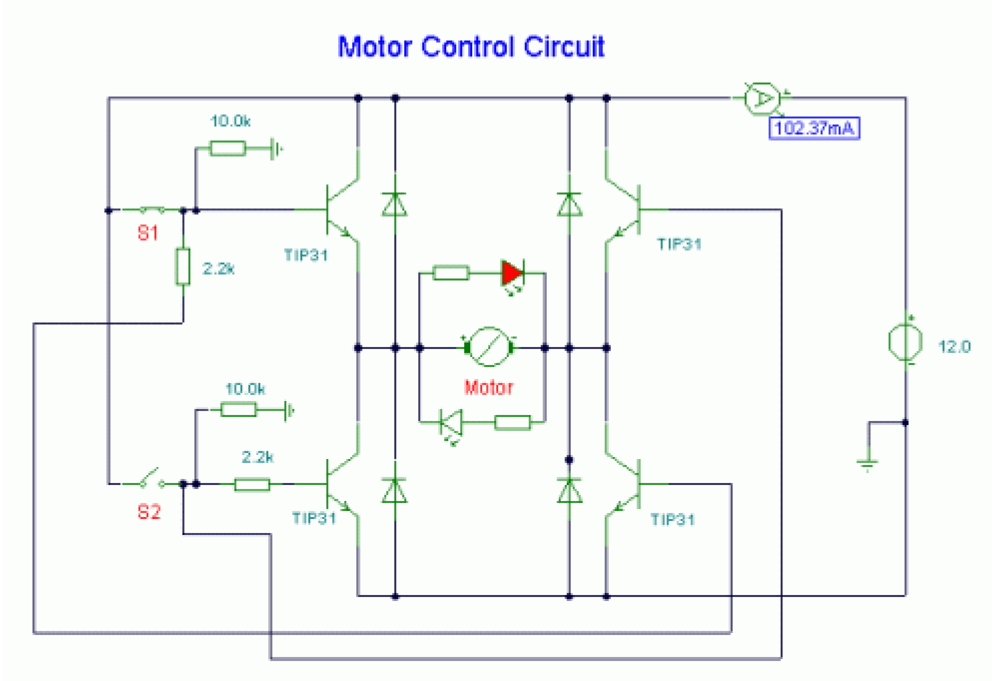
R2 - The TL082 is a fast op-amp, needed R2 to reduce oscillation.

IRF-510 A 4 amp mos-fet in a TO-220 case. Bascially as the voltage on the gate rises the mos-fet will conduct more current. note 1 there are also IRF-520 and 530 versions that will handle more current. note 2 Even at 5 watts the mos-fet will disapate some heat and will need to be heat-sinked or at least in the air flow path. the large metal part of the fet will be at drain(D) voltage level. Do not attach to case.

D1, almost any diode, 1N4001 should work,it conducts back around the fan when the mos-fet turns off. As the fan continues spinning it will produce a voltage on the drain lead of the fet. D1 will limit that voltage. Adjustment, easiest if you have a voltmeter but can be done without. Get the thermistor at room temp. Adjust P1 for the low speed that you want your fans to run at. Heat the thermistor to the high temp you want the fans at full speed. (I stuck it under my tongue) Adjust P2 until the fans are at full speed(with voltmeter the highest voltage you can get) then adjust P2 until the speed/voltage just begins to drop off. Most fan specs that I have seen show a low voltage limit of around 7 volts. Some of the smaller 80mm fans have a lower limit of 8 volts. If you set the low voltage to low the fans may stall until the thermistor heats up enough. Let me know if you build this circuit and how it works for you. corrected, single voltage op-amps should be used, OP-07 is a dual voltage.

P369. DC Motor Control Circuit

Circuit diagram



Notes:

Here, S1 and S2 are normally open , push to close, press button switches. The diodes can be red or green and are there only to indicate direction. You may need to alter the TIP31 transistors depending on the motor being used. Remember, running under load draws more current. This circuit was built to operate a small motor used for opening and closing a pair of curtains. As an advantage over automatic closing and opening systems, you have control of how much, or how little light to let into a room. The four diodes surriunding the motor, are back EMF diodes. They are chosen to suit the motor. For a 12V motor drawing 1amp under load, I use 1N4001 diodes.

P370. PWM Motor/Light Controller

Pulse Width Modulator for 12 and 24 Volt applications

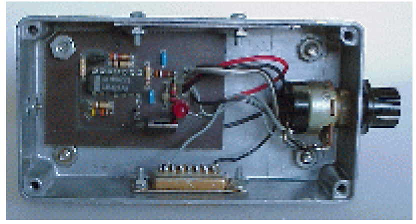
INTRODUCTION

A pulse width modulator (PWM) is a device that may be used as an efficient light dimmer or DC motor speed controller. The circuit described here is a general purpose device that can control DC devices which draw up to a few amps of current. The circuit may be used in 12 Volt and 24 Volt systems with a few minor changes. This device has been used to control the brightness of an automotive tail lamp and as a motor speed control for small DC fans of the type used in computer power supplies. A PWM circuit works by making a square wave with a variable on-to-off ratio, the average on time may be varied from 0 to 100 percent. In this manner, a variable amount of power is transferred to the load. The main advantage of a PWM circuit over a resistive power controller is the efficiency, at a 50% level, the PWM will use about 50% of full power, almost all of which is transferred to the load, a resistive controller at 50% load power would consume about 71% of full power, 50% of the power goes to the load and the other 21% is wasted heating the dropping resistor. Load efficiency is almost always a critical factor in alternative energy systems. An additional advantage of pulse width modulation is that the pulses are at the full supply voltage and will produce more torque in a motor by being able to overcome the internal motor resistances more easily. Finally, in a PWM circuit, common small potentiometers may be used to control a wide variety of loads whereas large and expensive high power variable resistors are needed for resistive controllers. The main Disadvantages of PWM circuits are the added complexity and the possibility of generating radio frequency interference (RFI). RFI may be minimized by locating the controller near the load, using short leads, and in some cases, using additional filtering on the power supply leads. This circuit has some RFI bypassing and produced minimal interference with an AM radio that was located under a foot away. If additional filtering is needed, a car radio line choke may be placed in series with the DC power input, be sure not to exceed the current rating of the choke.

SPECIFICATIONS
PWM Frequency: 400 Hz
Current Capacity: 3 Amps with IRF521 FET, more with IRFZ34N FET
PWM circuit current: 1.5 ma @ 12V with no LED and no load
Operating Voltage: 12V or 24V depending on the configuration.

THEORY

The PWM circuit requires a steadily running oscillator to operate. U1a and U1d form a square/triangle waveform generator with a frequency of around 400 Hz. U1c is used to generate a 6 Volt reference current which is used as a virtual ground for the oscillator, this is necessary to allow the oscillator to run off of a single supply instead of a +/- voltage dual supply. U1b is wired in a comparator configuration and is the part of the circuit that generates the variable pulse width. U1 pin 6 receives a variable voltage from the R6, VR1, R7 voltage ladder. This is compared to the triangle waveform from U1-14. When the waveform is above the pin 6 voltage, U1 produces a high output. Conversely, when the waveform is below the pin 6 voltage, U1 produces a low output. By varying the pin 6 voltage, the on/off points are moved up and down the triangle wave, producing a variable pulse width. Resistors R6 and R7 are used to set the end points of the VR1 control, the values shown allow the control to have a full on and a full off setting within the travel of the potentiometer. These part values may be varied to change the behavior of the potentiometer. Finally, Q1 is the power switch, it receives the modulated pulse width voltage on the gate terminal and switches the load current on and off through the Source-Drain current path. When Q1 is on, it provides a ground path for the load, when Q1 is off, the load's ground is floating. Care should be taken to insure that the load terminals are not grounded or a short will occur. The load will have the supply voltage on the positive side at all times. LED1 is optional and gives a variable brightness response to the pulse width. Capacitor C3 smooths out the switching waveform and removes some RFI, Diode D1 is a flywheel diode that shorts out the reverse voltage kick from inductive motor loads. In the 24 Volt mode, regulator U2 converts the 24 Volt supply to 12 Volts for running the pwm circuit, Q1 switches the 24 Volt load to ground just like it does for the 12 Volt load. See the schematic for instructions on wiring the circuit for 12 Volts or 24 Volts. At the 1 amp current level, no heat sink is needed on Q1, if you will be switching more current, a heat sink is recommended. Q1 may be replaced with a higher current device such as an IRFZ34N, all of the current handling devices, switch S1, fuse F1, and the wiring between the FET, power supply, and load should be able to handle the maximum load current.



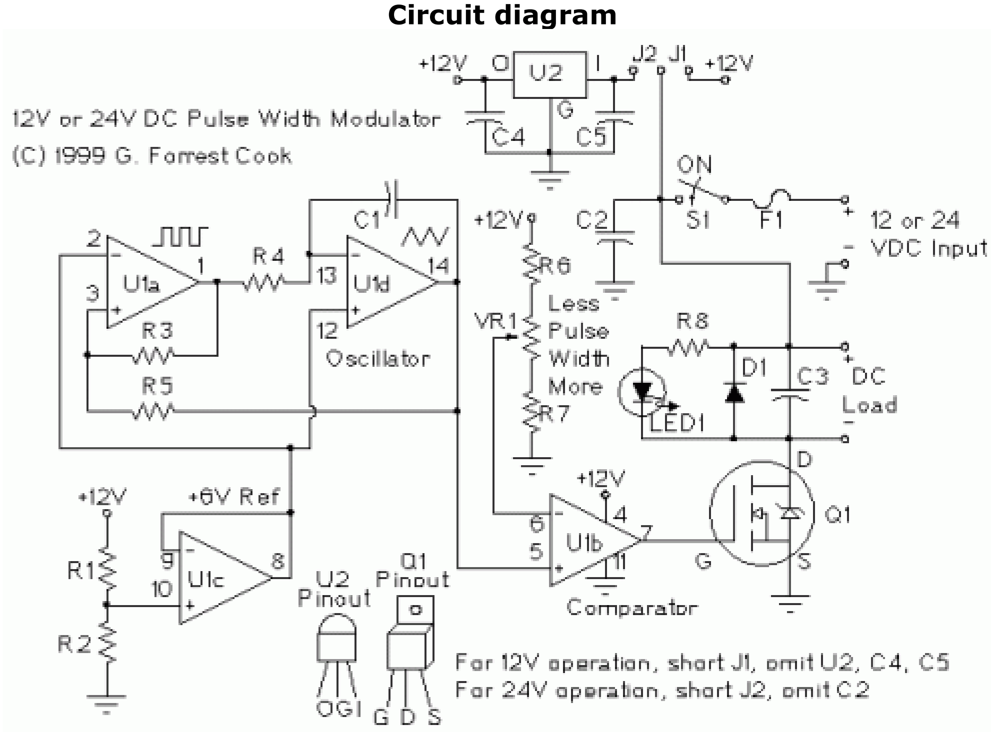
CONSTRUCTON

The prototype for this circuit was constructed on a regular IC proto board with parts and wires stuck into the proto board holes. One version of the finished circuit was used to make a variable speed DC fan, the fan was mounted on top of a small metal box and the PWM circuit was contained inside of the box (Fig 1). I built a simple circuit board (Fig 2) using a free circuit board CAD program, PCB (1) that runs on the Linux operating system. The circuit board image was printed on a PostScript laser printer onto a mask transfer product called Techniks Press-n-Peel blue film (2). The printed on film is then ironed on to a cleaned piece of single sided copper clad board. The board is etched with Ferric Chloride solution. Holes are drilled with a fine gauge drill bit, parts are soldered in, and the board is wired to the power and load. This technique is great for producing working boards in a short time but is not suitable for large numbers of boards. A board pattern is shown in Fig 3, this may be photo-copied onto a piece of press-n-peel blue film. Alternately, the dead-bug construction method may be used, this involves taking a piece of blank copper PC board, glueing a wire-wrap IC socket to the board with 5 minute epoxy, then soldering all of the parts to the wire wrap pins. Grounded pins can be soldered directly to the copper board.

ALIGNMENT

No alignment should be necessary with this circuit.

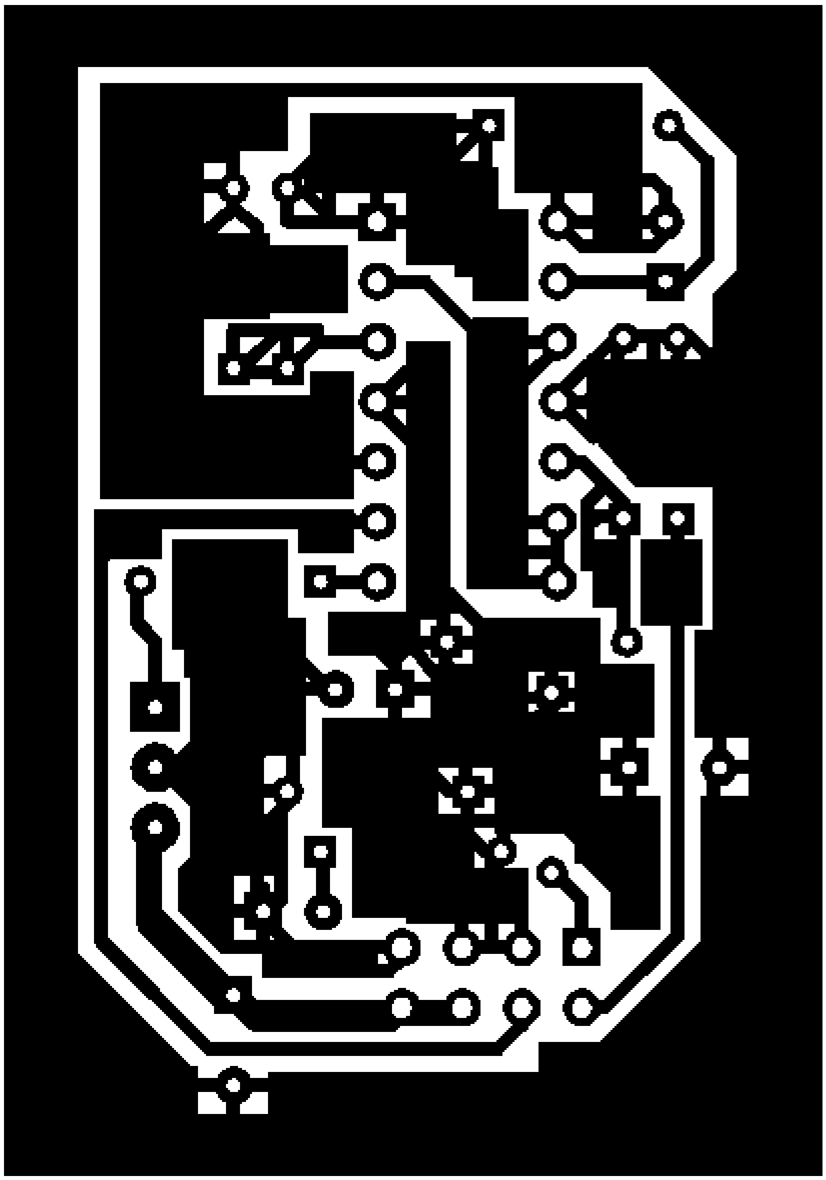
Circuit diagram

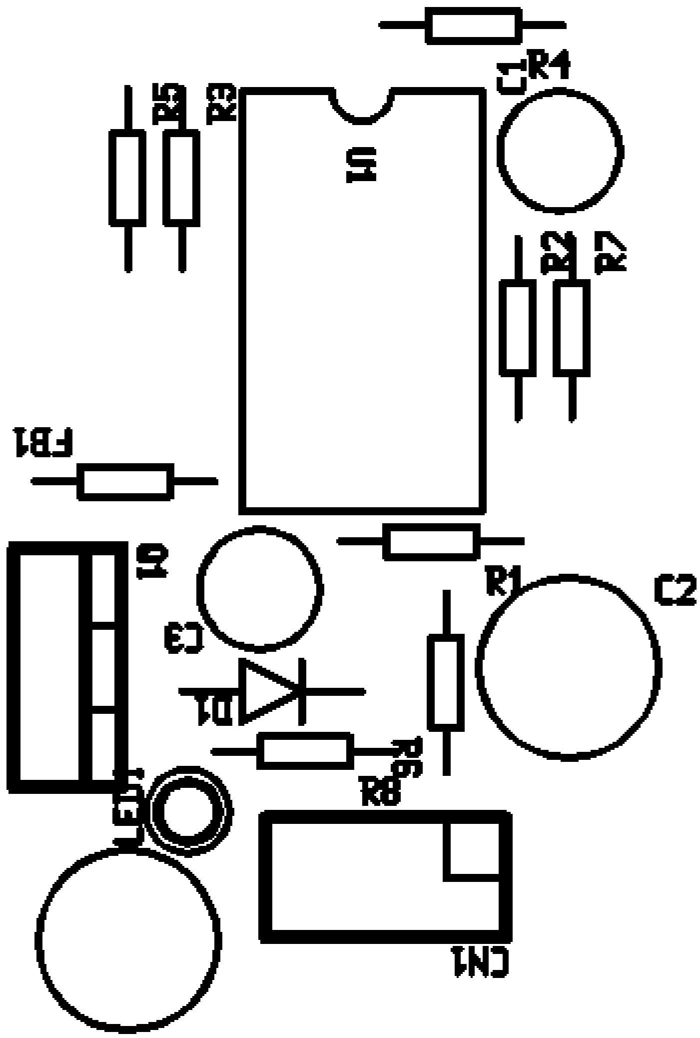


USE

This circuit will work as a DC lamp dimmer, small motor controller, and even as a small heater controller. It would make a great speed control for a solar powered electric train. I have not tried the circuit with larger motors, in theory, it should work in applications such as a bicycle motor drive system, if you experiment with this, be sure to include an easily accessible emergency power disconnect switch in case the FET shorts on. Wire the circuit for 12 Volts or 24 Volts as per the schematic, connect the battery to the input terminals, and connect the load to the output terminals, be sure not to ground either output terminal or anything connected to the output terminals such as a motor case. Turn the potentiometer knob back and forth, the load should show variable speed or light.

Parts
U1:LM324N quad op-amp
U2:78L12 12 volt regulator
Q1:IRF521 N channel MosFet
D1:1N4004 silicon diode
LED1 Red LED
C1: 0.01uF ceramic disc capacitor, 25V
C2-C5:0.1uF ceramic disk capacitor, 50V
R1-R4:100K 1/4W resistor
R5:47K 1/4W resistor
R6-R7:3.9K 1/4W resistor
R8:2.7K 1/4W resistor
VR1:10K linear potentiometer
F1:3 Amp, 28V DC fast blow fuse
S1:toggle switch, 5 Amps

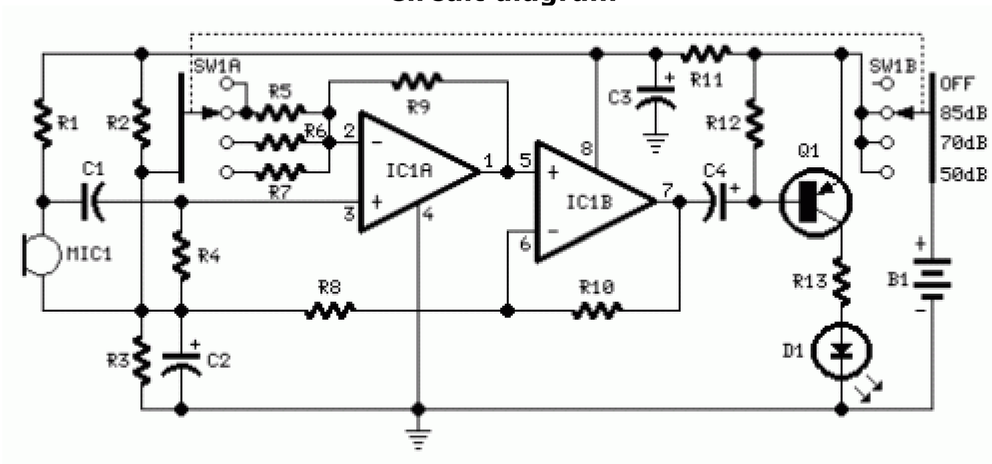



R4
C1
R5
R3
U1
R2
R7
FB1
R1
C2
C3
D1
R6
R8
LED1
CN1

P371. Room Noise Detector

One LED monitors three levels: 50, 70 & 85 dB
Useful to detect too noisy environments

Circuit diagram



Parts:
R1 10K 1/4W Resistor
R2,R3 22K 1/4W Resistors
R4 100K 1/4W Resistor
R5,R9,R10 56K 1/4W Resistors
R6 5K6 1/4W Resistor
R7 560R 1/4W Resistor
R8 2K2 1/4W Resistor
R11 1K 1/4W Resistor
R12 33K 1/4W Resistor
R13 330R 1/4W Resistor
C1 100nF 63V Polyester Capacitor
C2 10µF 25V Electrolytic Capacitor
C3 470µF 25V Electrolytic Capacitor
C4 47µF 25V Electrolytic Capacitor
D1 5mm. Red LED
IC1 LM358 Low Power Dual Op-amp
Q1 BC327 45V 800mA PNP Transistor
MIC1 Miniature electret microphone
SW1 2 poles 4 ways rotary switch
B1 9V PP3 Battery
Clip for PP3 Battery

Device purpose:

This circuit is intended to signal through a flashing LED, the exceeding of a fixed threshold in room noise, chosen from three fixed levels, namely 50, 70 & 85 dB. Two Op-amps provide the necessary circuit gain for sounds picked-up by a miniature electret microphone to drive a LED. With SW1 in the first position the circuit is off. Second, third and fourth positions power the circuit and set the input sensitivity threshold to 85, 70 & 50 dB respectively.

Current drawing is <1mA with LED off and 12-15mA when the LED is steady on.

Use:

Place the small box containing the circuit in the room you intend to measure ambient noise.
The 50 dB setting is provided to monitor the noise in the bedroom at night. If the LED is steady on, or flashes bright often, then your bedroom is inadequate and too noisy for sleep.
The 70 dB setting is for living-rooms. If this level is often exceeded during the day, your apartment is rather uncomfortable.

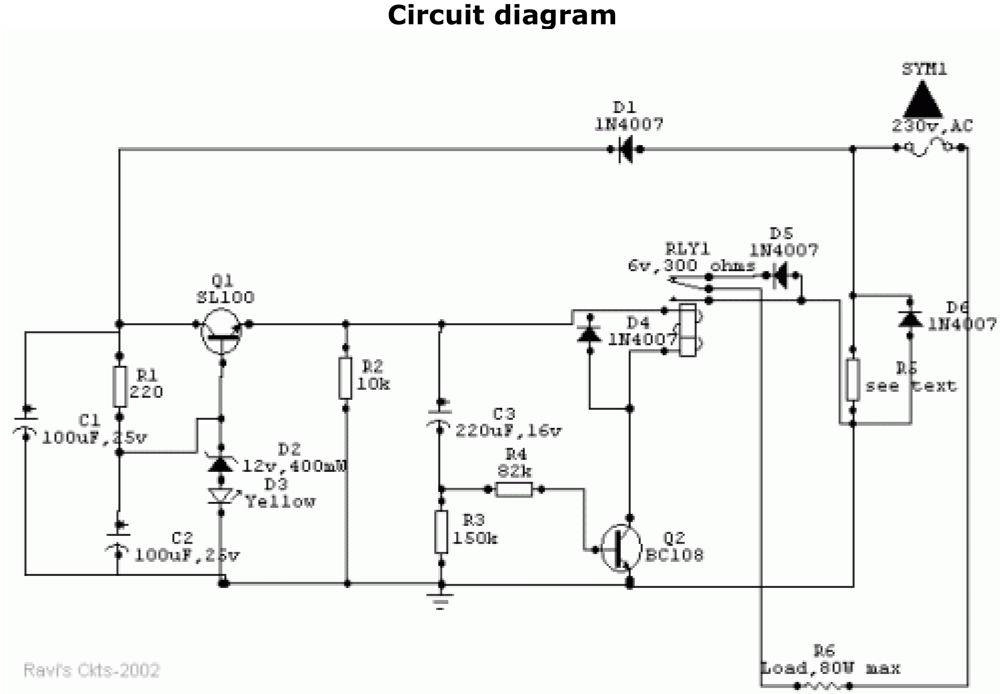
If noise level is constantly over 85 dB, 8 hours a day, then you live in a dangerous environment.

dB Example of sound sources
20 Quiet garden, electric-clock ticking, drizzling rain
30 Blast of wind, whisper @ 1 m.
40 Countryside areas, quiet apartment, wrinkling paper @ 1 m.
50 Residential areas, quiet streets, fridges, conversation @ 1 m.
55 Offices, air-conditioners
60 Alarm-clocks, radio & TV sets at normal volume
64 Washing machines, quiet typewriters
67 Hair-dryers, crowded restaurants
69 Dish-washers, floor-polishers
70 Loud conversation, noisy street, radio & TV sets at high volume
72 Vacuum cleaners
78 Telephone ring, mechanical workshop
80 Passing trucks, noisy hall or plant, shuffling @ 1 m.
90 Passing train, pneumatic hammer, car hooter @ 1 m.
95 Mega "disco", circular saw
100 Motorcycle without silencer

372. Auto Heat Limiter for Soldering Iron

Caution: Certain part of this circuit is directly connected to AC mains. Therefore, do not touch whilst in operation. Disclaimer Please take the greatest of care in handling AC mains supply while constructing this project. If you have no knowledge of mains wiring or unfamiliar with household mains supply, PLEASE DO NOT ATTEMPT CONSTRUCTION. I take no responsibility in any personal injury or loss of life or properties suffered by any person while undertaking the construction of this project or using the end product by following my instructions.

Circuit diagram



Wattage of load 10W 18W 25W 35W 65W 80W
Value of R5 (in ohms) 330 180 136 (68+68) 100 56 44 (22+22)
Wattage of R5 (in watts) 01 02 02 04 05 6.5

Usually a soldering iron takes a couple of minutes to get adequately heated up to melt the solder, after which the heat generated is much above the requirement and is wasted. Moreover, excessive heat decreases the life of the bit and the element, causing serious damage to the components.

The above circuit solves this problem in a simple and inexpensive way and could be used to various types of loads up to 80watts.

How it works

Once the main is switched on, an approximate 15v drop of the positive half cycle across R5 is detected and supplied to Q1 (SL100 or D313), which acts as a voltage regulator. Zener diode D2 together with diode D3 (yellow LED) stabilizes the emitter voltage of Q1 at 13.2Vdc, which is then delivered to the relay circuit built around Q2 and C3. Capacitor C3 charges through the base-emitter path of Q2 and causes the relay to actuate, which in turn allows both the half cycles of the AC mains to flow through diode D6 and R5 to the load to heat it up at a normal rate.

After a certain lapse of time (about 2 minutes preset) C3 saturates and Q2 stops conducting through the relay, thus switching on series diode D5 to allow only half of the Ac cycle through the load.
After switching off the system, C3 discharges very slowly through R2 and R3. Before C3 gets completely discharged, if the power is switched on again, C3 takes a shorter time to reach the saturation level, thus switching series diode D5 much earlier than the preset time to prevent double heating of the load.
However, if the circuit is switched on only after a few seconds of switching off, C3 gets no time to discharge and the relay does not actuate at all. Moreover, if the relay circuit fails due to any reason and Q2 does not conduct, no harm is done to the load because in that case D5 remains in series with it. Thus the circuit offers complete protection to the load.

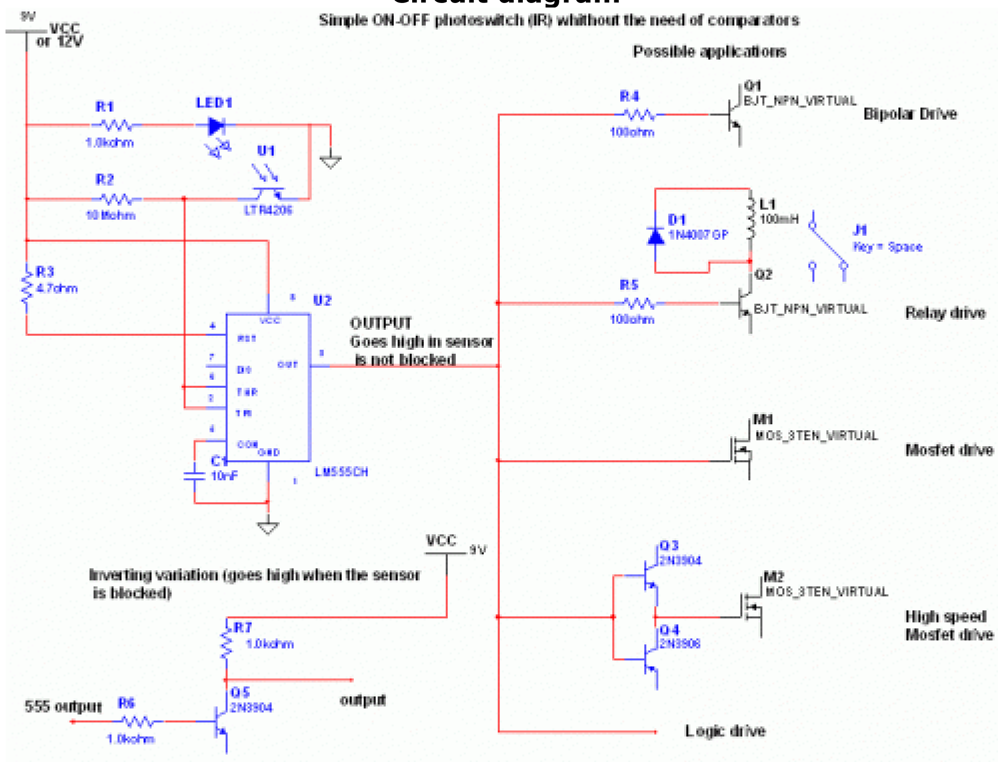
As stated earlier, the given value of C3 gives a delay of 2 minutes. However, a 1000mfd capacitor can also be used to produce a 4.5-minute delay. R5 maintains a drop of about 15V across itself.

The whole circuit can be mounted on a PCB and fitted in an adapter case (7.6cm X 5.1cm X 6.4cm) and used as a mains plug. Since R5 gets heated up during the operation, it should be kept well isolated from the other components.

Parts
R1 - 220 ohms
R2 – 10K
R3 – 150K
R4 – 82K
(all resistors should be 5% close tolerance)
C1- 100 uf, 25V dc working electrolytic
C2 – 100 uf, 25V dc working electrolytic
C3 – 220 uf, 16V dc working electrolytic
(advisable to use close tolerance Caps. to obtain correct timings)
D1, D4, D5, & D6 – IN4007
D2 – 12V 400mw, Zener diode
D3 – Yellow LED
RLY1 – 6V, 300 ohms DC relay
Q1 – SL100 or D313
Q2 – BC108

P373. Simple optical switch

Circuit diagram



Introduction

The 555 is proved to be the most versatile and ubiquitous IC all over the world.This is a possible use: simple inverting schmitt trigger.

Circuit explanation

When the phototransistor is stroken by IR light it conducts and the voltage between the 1Mohm resistor(arbitrary) and the phototrans drops from VCC to lower values. When the voltage drops lower than VCC/3 the 555 is triggered and goes high (from 0 TO VCC). The amount of light that strike the phototrans necessary to bring his collector to VCC/3 is determined by the resistor (Vdrop = Icollector * R , so , if Vdrop= 2*VCC/3, the resistance needed to set the threshold on current is R=2*VCC/(Icollector*3)). High sensibility phototrans would need a smaller resistor, and weaker phototransistors higher value resistor, you can also use a trimmer to set the on threshold level with precision. The time of phototransistor isn't critical. The 555 has high current capability and can drive various devices, such as Bipolars, relays, bipolars+relays, mosfets, mosfets + totem pole , or give a logic output (see pic).

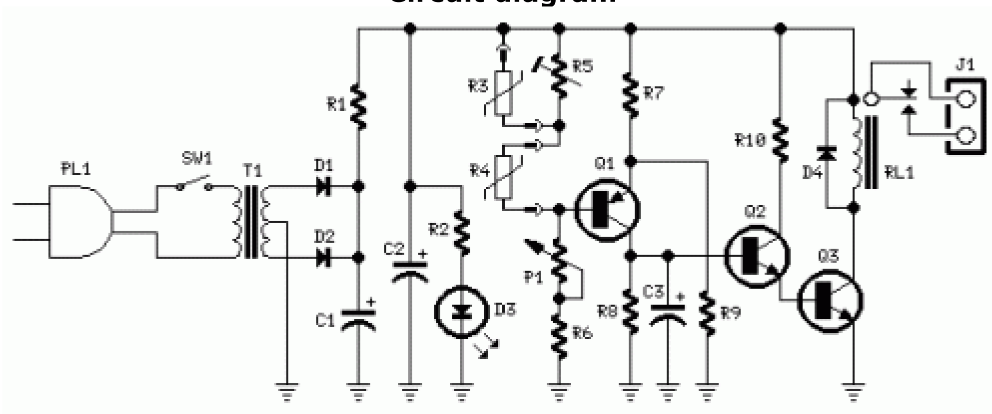
In case you need to trigger something when the gate is blocked (for example a burglar alarm, or a multistage coilgun) you need to invert the output, which is accomplished using a small bipolar transistor wired in an inverting setup (see pic) or swapping the positions of phototransistor with the resistor, so the voltage will drop under VCC/3 when blocked: The formula to determine the resistance to turn off at Icollector is R=VCC/(Icollector*3).

Have fun!

P374. Heating System Thermostat

Controlled by indoor and outdoor temperature
Simple, high reliability design

Circuit diagram



Parts:
P1 1K Linear Potentiometer
R1 10R 1/4W Resistor
R2 1K 1/4W Resistor
R3 3K3 @ 20°C n.t.c. Thermistor (see Notes)
R4 2K2 @ 20°C n.t.c. Thermistor (see Notes)
R5 10K 1/2W Trimmer Cermet
R6 3K3 1/4W Resistor
R7,R9 4K7 1/4W Resistors
R8 470K 1/4W Resistor
R10 10K 1/4W Resistor
C1,C2 470µF 25V Electrolytic Capacitors
C3 1µF 63V Electrolytic Capacitor
D1,D2,D4 1N4002 100V 1A Diodes
D3 LED Red 3 or 5mm.
Q1 BC557 45V 100mA PNP Transistor
Q2 BC547 45V 100mA NPN Transistor
Q3 BC337 45V 800mA NPN Transistor
RL1 Relay with SPDT 2A @ 220V switch
Coil Voltage 12V. Coil resistance 200-300 Ohm
J1 Two ways output socket
SW1 SPST Mains Switch
T1 220V Primary, 12 + 12V Secondary 3VA Mains transformer
PL1 Male Mains plug & cable

Device purpose:

This circuit is intended to control a heating system or central heating plan, keeping constant indoor temperature in spite of wide range changes in the outdoor one. Two sensors are needed: one placed outdoors, in order to sense the external temperature; the other placed on the water-pipe returning from heating system circuit, short before its input to the boiler. The output from the Relay contact must be connected to the boiler's start-stop control input.

This circuit, though simple, has proven very reliable: in fact it was installed over 20 years ago at my parents' home. I know, it's a bit old: but it's still doing its job very well and without problems of any kind.

Circuit operation:

When Q1 Base to ground voltage is less than half voltage supply (set by R7 & R9), a voltage is generated across R8 and the driver transistors Q2 & Q3 switch-on the Relay. When Q1 Base to ground voltage is more than half voltage supply, caused when one of the n.t.c. Thermistors lowers its value due to an increase in temperature, no voltage appears across R8 and the Relay is off.

C3 allows a clean switching of the Relay. P1 acts as main temperature control.

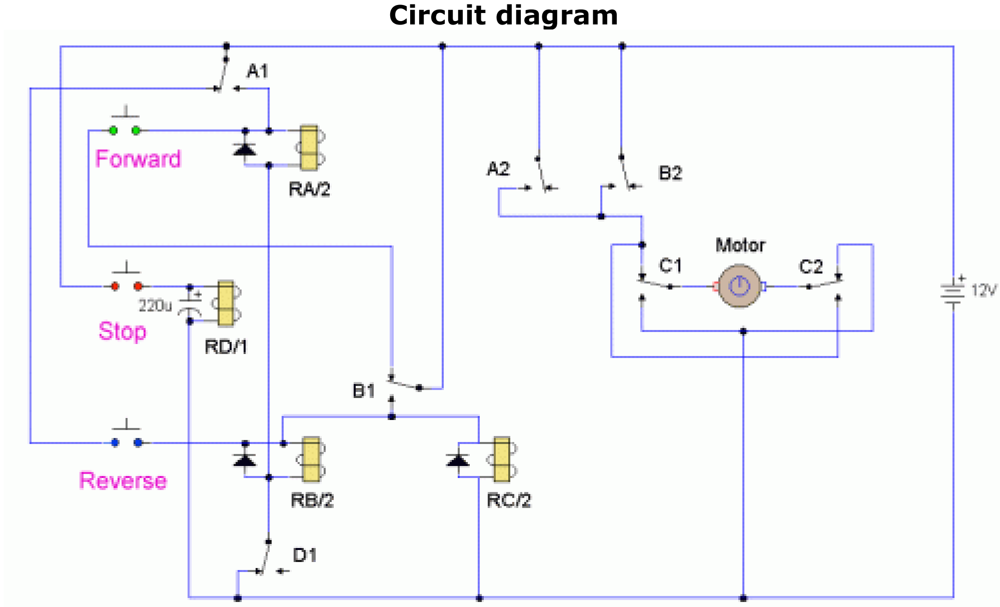
Notes:
R3 is the outdoor sensor, R4 the indoor sensor.
If you are unable to find a 3K3 Thermistor for R3 you can use a 4K7 value instead. The different value can be easily compensated by means of Trimmer R5.
R5 allows to set the heating system for outdoor temperatures ranging from about +10°C downwards. The higher R5's resistance the hotter the heating system and vice versa.
The existing boiler thermostat should be set to its maximum value and not bypassed: it is necessary for safety's sake.
This circuit can be dispensed with its differential feature and converted into a simple precision thermostat omitting R3.

P375. DC Motor Reversing Circuit

Description:

A DC motor reversing circuit using non latching push button switches. Relays control forward, stop and reverse action, and the motor cannot be switched from forward to reverse unless the stop switch is pressed first.

Circuit diagram



Notes:

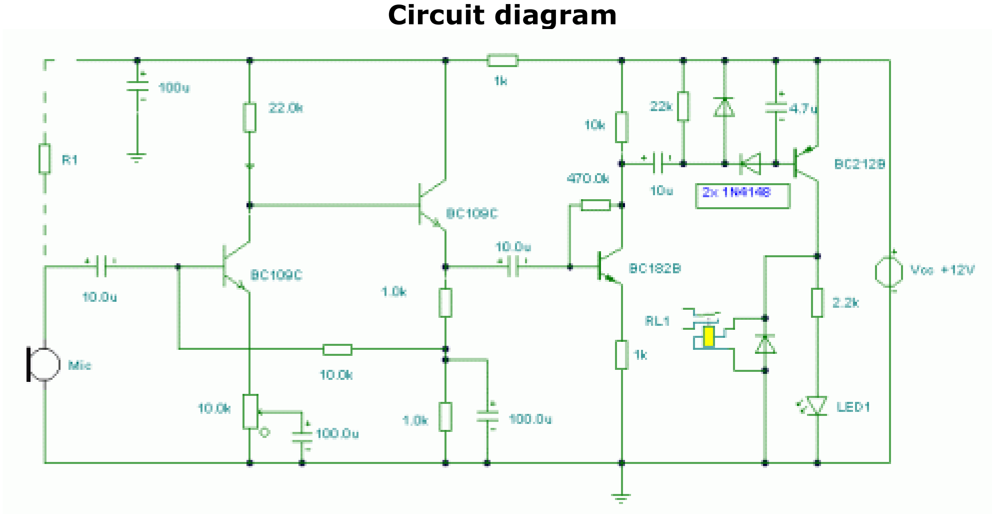
At first glance this may look over-complicated, but this is simply because three non-latching push button switches are used. When the forward button is pressed and released the motor will run continuously in one direction. The Stop button must be used before pressing the reverse button. The reverse button will cause the motor to run continuously in the opposite direction, or until the stop button is used. Putting a motor straight into reverse would be quite dangerous, because when running a motor develops a back emf voltage which would add to current flow in the opposite direction and probably cause arcing of the relay contacts. This circuit has a built-in safeguard against that condition.

Circuit Operation:

Assume that the motor is not running and that all relays are unenergized. When the forward button is pressed, a positive battery is applied via the NC contacts of B1 to the coil of relay RA/2. This will operate as the return path is via the NC contacts of D1. Relay RA/2 will operate. Contacts A1 maintain power to the relay even though the forward button is released. Contacts A2 apply power to the motor which will now run continuously in one direction. If now the reverse button is pressed, nothing happens because the positive supply for the switch is fed via the NC contact A1, which is now open because Relay RA/2 is energized. To Stop the motor the Stop switch is pressed, Relay D operates and its contact D1 breaks the power to relays A and B, (only Relay A is operated at the moment). If the reverse switch is now pressed and released. Relay B operates via NC contact A1 and NC contact D1. Contact B1 closes and maintains power so that the relay is now latched, even when the reverse switch is opened. Relay RC/2 will also be energized and latched. Contact B2 applies power to the motor but as contacts C1 and C2 have changed position, the motor will now run continuously in the opposite direction. Pressing the forward button has no effect as power to this switch is broken via the now open NC contact B1. If the stop button is now pressed. Relay D energizes, its contact D1 breaks power to relay B, which in turn breaks power to relay C via the NO contact of B1 and of course the motor will stop. All very easy. The capacitor across relay D is there to make sure that relay D will operate at least longer than the time relays A,B and C take to release.

P376. Sound Operated Switch

Circuit diagram



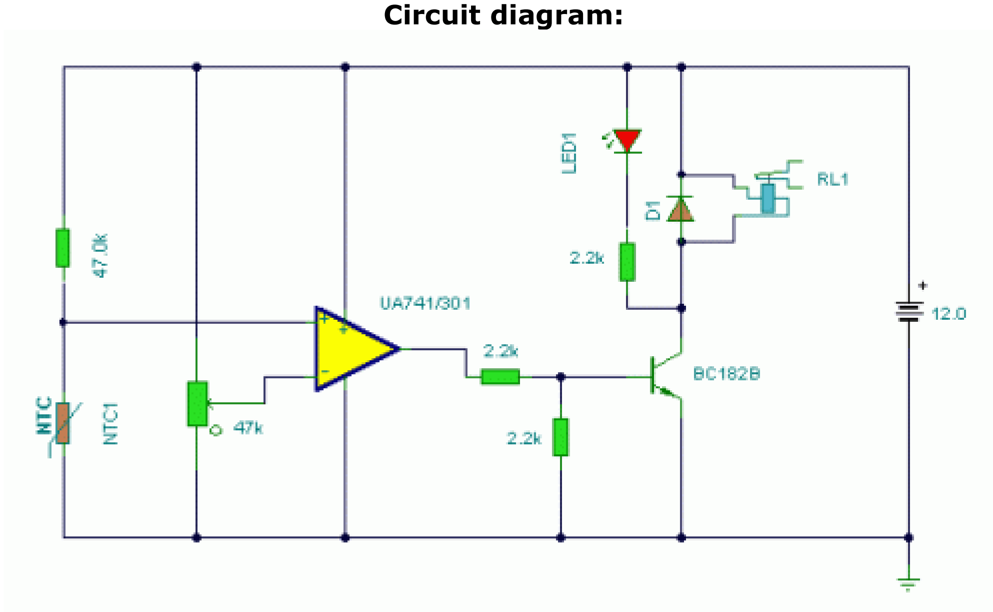
Notes:
This sensitive sound operated switch can be used with a dynamic microphone insert as above, or be used with an electret (ECM) microphone. If an ECM is used then R1 (shown dotted) will need to be included. A suitable value would be between 2.2k and 10kohms.

The two BC109C transitors form an audio preamp, the gain of which is controlled by the 10k preset. The output is further amplified by a BC182B transistor. To prevent instability the preamp is decoupled with a 100u capacitor and 1k resistor. The audio voltage at the collector of the BC182B is rectified by the two 1N4148 diodes and 4.7u capacitor. This dc voltage will directly drive the BC212B transistor and operate the relay and LED.

It should be noted that this circuit does not "latch". The relay and LED operate momentarily in response to audio peaks

P377. Temperature Monitor

Circuit diagram:



Notes:
Using a thermistor in the position shown makes a heat activated sensor. A change in temperature will alter the output of the opamp and energize the relay and light the LED. Swapping the position of the<
thermistor and 47k resistor makes a cold or frost alarm.

P378. Hot Water Level Indicator

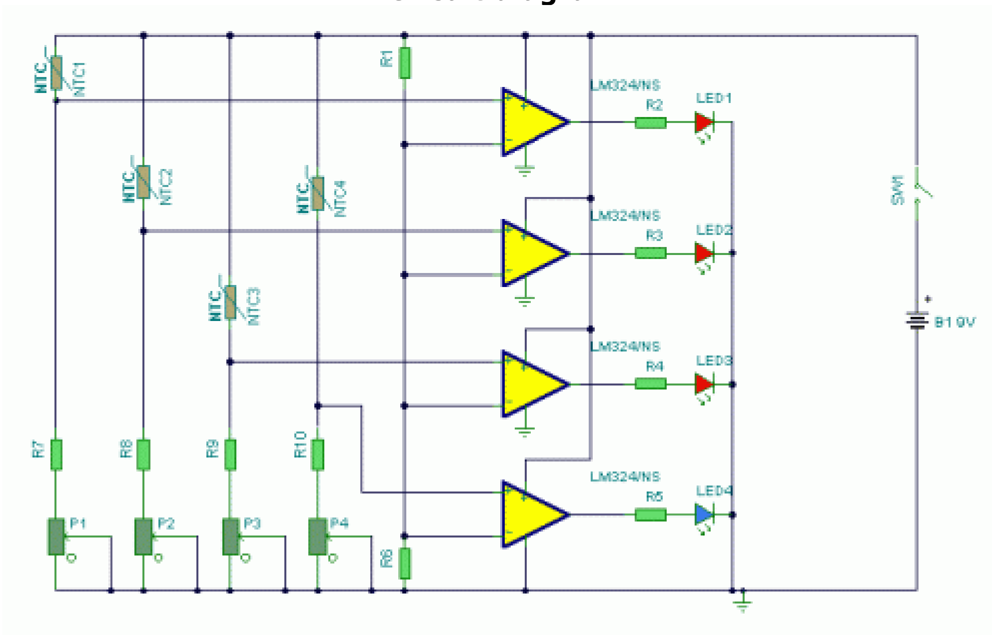
Description:

A simple device to indicate various levels of hot water in a tank.

Notes:

Save fuel bills and the economy of the planet with this circuit. SW1 is a normally open press button switch which allows you to view the level of hot water in a hot water tank. When pressed the voltage difference at the junction of the thermistor and preset is compared to the fixed voltage on the op-amps non-inverting input. Depending on the heat of the water in the tank, the thermistors resistance will toggle the op-amp output to swing to almost full voltage supply and light the appropriate LED.

Circuit diagram



Construction:

Masking tape was used to stick the bead thermistors to the tank. Wires were soldered and insulated at the thermistors ends. A plastic box was used to house the circuit. Battery life will probably be 4 to 5 years depending on how often you use the push switch, SW1.

Sensor Placement:

Thermistors NTC1-4 should be spread evenly over the height of the tank. I placed NTC1 roughly 4 inches from the top of my tank and the others were spaced evenly across the height of the hot water tank. As hot water rises the lowest sensor indicates the fullest height of hot water and should be about 8 to 10 inches from the bottom of the tank.

Calibration:

With a full tank of hot water adjust P1-4 so that all LED's are lit. As hot water rises, the sensor at the bottom of the tank will be the maximum level of hot water. "Hot" can be translated as 50C to 80C the presets P1-4 allow adjustment of this range.

Parts:

I have used a quad version of the LM324 but any quad opamp can be used or even four single op-amps.
R2-R5 I used 330ohm resistors, but value is not critical. Lower values give brighter LED output.
NTC1-4 The thermistors maximum resistance must roughly equal the resistance of the fixed resistor and preset. As negative temparature coefficient (NTC) thermistors are used, then their resistance decreases for increases in temperature. I used a thermistor from the Maplin Catalogue. Cold resistance was around 300K, hot resistance 15k. Alternative thermistors may be used with different resistance ranges, but the presets P1 to P4 must also be changed as well.

R7-10 series resistance, only required if your thermistors resistance is several ohms at the hottest temperature.

P1 - P4 Chosen to match the resistance of the thermistor when cold.

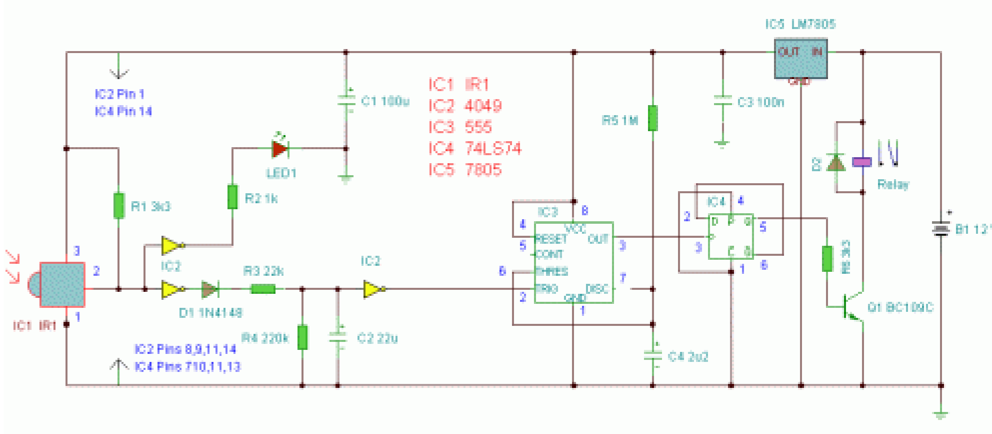
R1 & R6. These resistors are equal and bias the op-amp inverting input to half the supply voltage. I used 100k.

P379. Infra Red Switch

Description:

This is a single channel (on / off) universal switch that may be used with any Infra Red remote control that uses wavelengths between 850-950nm.

Circuit diagram

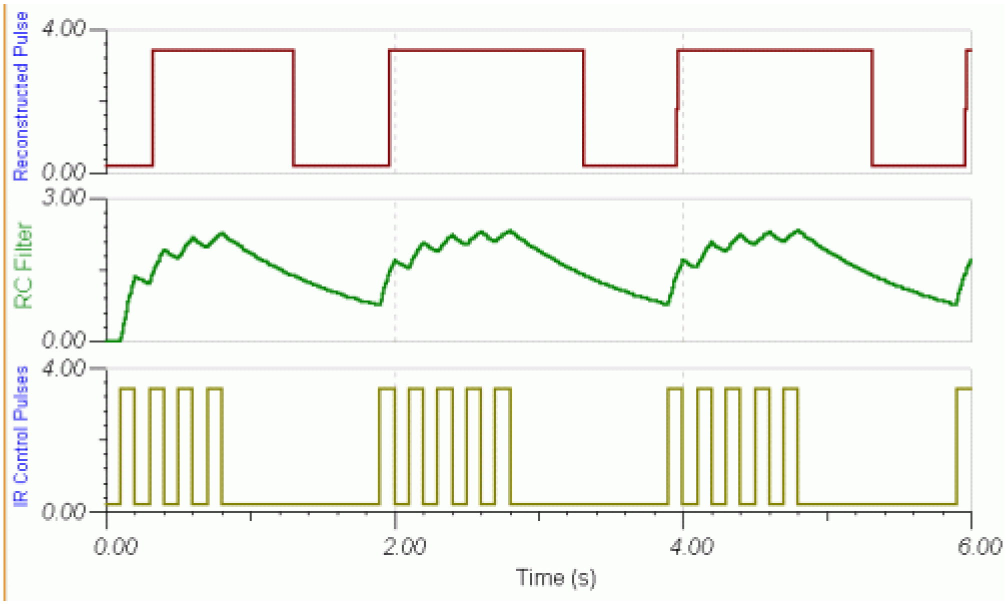


Notes:

Any "button" of any remote control may be used to work this universal switch. The button must be pressed for two seconds (determined by R3 and C2) before the relay will operate. Once operated the circuit will remain in this state (latched) until reset. To reset, any button is pressed and held for the delay.
For example, if you were watching TV, and your set was tuned to Channel 3, you could press and hold the TV remote controls channel 3 button for two seconds. That way the TV viewing would not be affected and the relay would activate. You can connect anything to the relay, for example a lamp, but make sure that the relay contacts can handle the rated voltage and current.

Circuit Operation:

IC1 is an Infra Red module. IR modulated pulses are received and buffered by this IC. It has a standard TTL output, the output with no signal is logic 1. One gate of a CMOS inverter and drives Red LED1 as a visible switching aid. Another gate buffers the signal and applies it to the time constant circuit, comprising R3,C2,R4 and D1. C2 charges via R3, and discharges via R4, D1 prevents quick discharge via the low output impedance of the CMOS buffer.



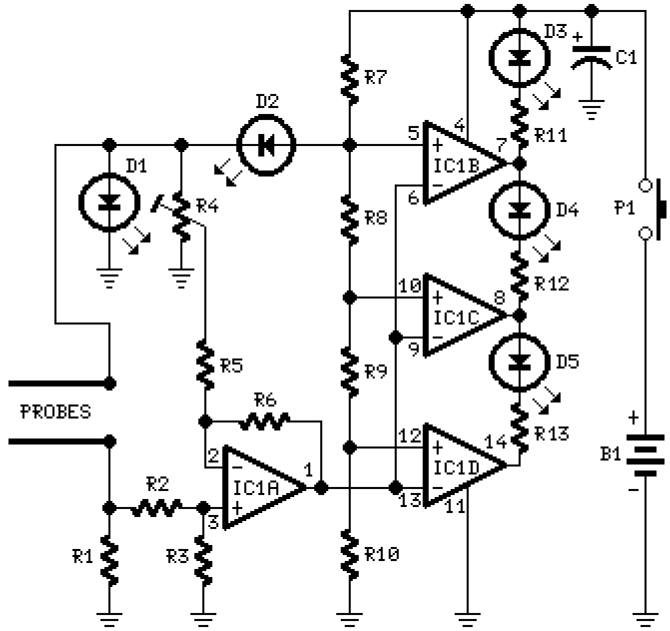
The pulses are further buffered and contain "jaggered edges" as shown above. These edges are produced by the modulated IR data, which has to be removed. This is achieved using IC3, a 555 timer wired as a monostable, pulse duration R5, C4. These cleanly reconstructs a single clean pulse to activate the bistable latch. A D type flip flop, IC4 is configured as a bistable. The input is applied to the clock pin, the inverted output fed back to the data input and clear and preset lines are tied to ground. For every pulse the relay will operate and latch, the next pulse will turn off the relay and so on. Note that quick turn on and off of the relay is not possible. The output pulse is set at about 1.5 seconds and input delay by R3, C2 set at two seconds.

Parts
R1 3k3
R2 1k
R3 22k
R4 220k
R5 1M
R6 3k3
B1 12 V
D1 1N4148
D2 1N4003
Q1 B109
LED1 CQX35A
IC1 IR1 available from Harrison Electronics
IC2 4049
IC3 CA555
IC4 SN74HCT74
IC5 LM7805
Relay 12 Volt coil with changeover contact
C1 100u
C2 22u
C3 100n
C4 2u2

P380. Salt Taster

Detects the amount of salt contained in liquid foods
Three-level LED indicator

Circuit diagram



Parts:
R1 470R 1/4W Resistor
R2,R5 10K 1/4W Resistors
R3,R6 220K 1/4W Resistors
R4 5K 1/2W Trimmer Cermet
R7 680R 1/4W Resistor
R8 2K2 1/4W Resistor
R9,R10,R11,R12,R13 1K 1/4W Resistors
C1 100µF 25V Electrolytic Capacitor
D1,D2,D3 3 or 5mm. Red LEDs
D4 3 or 5mm. Green LED
D5 3 or 5mm. Yellow LED
IC1 LM324 Low Power Quad Op-amp
P1 SPST Pushbutton
Probes (See Text)
B1 9V PP3 Battery
Clip for PP3 Battery

Device purpose:

This circuit was designed to detect the approximate percentage of salt contained in a liquid. After careful setting it can be useful to persons needing a quick, rough indication of the salt content in liquid foods for diet purposes etc.

Circuit operation:

IC1A op-amp is wired as a DC differential amplifier and its output voltage increases as the DC resistance measured at the probes decreases. In fact, fresh water has a relatively high DC resistance value that will decrease proportionally as an increasing amount of salt is added.

IC1B, IC1C and IC1D are wired as comparators and drive D5, D4 and D3 in turn, as the voltage at their inverting inputs increase. Therefore, no LED will be on when the salt content of the liquid under test is very low, yellow LED D5 will illuminate when the salt content is low, green LED D4 will illuminate if the salt content is normal and red LED D3 will illuminate if the salt content is high.

D1 and D2 are always on, as their purpose is to provide two reference voltages, thus improving circuit precision. At D2 anode a stable 3.2V supply feeds the non-inverting inputs of the comparators by means of the reference resistor chain R8, R9 and R10. The 1.6V reference voltage available at D1 anode feeds the probes and the set-up trimmer R4.

One of these two red LEDs may be used as a pilot light to show when the device is on.

Probes:

It was found by experiment that a good and cheap probe can be made using a 6.3mm. mono jack plug. The two plug leads are connected to the circuit input by means of a two-wire cable (a piece of screened cable works fine).

The metal body of the jack is formed by two parts of different length, separated by a black plastic ring. You should try to cover the longest part with insulating tape in order to obtain an exposed metal surface of the same length of the tip part, i.e. about 8 to 10mm. starting from the black plastic ring.
In the prototype, three tablespoons of liquid were poured into a cylindrical plastic cap of 55mm. height and 27mm. diameter, then the metal part of the jack probe was immersed in the liquid.

Notes:

Wait at least 30 seconds to obtain a reliable reading.

Wash and wipe carefully the probe after each test.

To setup the circuit and to obtain a more precise reading, you may use a DC voltmeter in the 10V range connected across pin #1 of IC1A and negative supply.

Set R4 to obtain a zero reading on the voltmeter when the probe is immersed in fresh water.

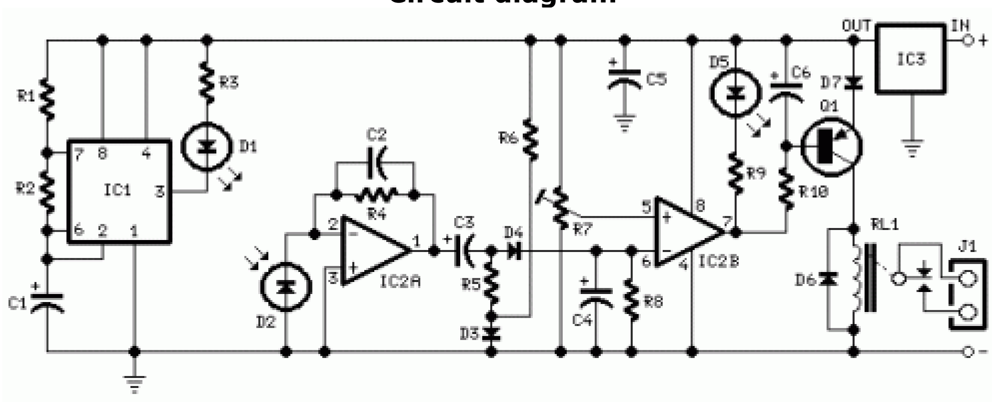
You may change at will the threshold voltage levels at which the LEDs illuminate by trimming R4. Vary R8 value to change D4 range and R9 value to change D5 range.

P1 pushbutton may be substituted by a common SPST switch.

P381. Infra-red Level Detector

Useful for liquids level detection and proximity devices
Up to 50 cm. range, optional relay operation

Circuit diagram



Parts:
R1 10K 1/4W Resistor
R2,R5,R6,R9 1K 1/4W Resistors
R3 33R 1/4W Resistor
R4,R8 1M 1/4W Resistors
R7 10K Trimmer Cermet
R10 22K 1/4W Resistor
C1,C4 1µF 63V Electrolytic or Polyester Capacitors
C2 47pF 63V Ceramic Capacitor
C3,C5,C6 100µF 25V Electrolytic Capacitors
D1 Infra-red LED
D2 Infra-red Photo Diode (see Notes)
D3,D4 1N4148 75V 150mA Diode
D5 LED (Any color and size)
D6,D7 1N4002 100V 1A Diodes
Q1 BC327 45V 800mA PNP Transistor
IC1 555 Timer IC
IC2 LM358 Low Power Dual Op-amp
IC3 7812 12V 1A Positive voltage regulator IC
RL1 Relay with SPDT 2A @ 220V switch
Coil Voltage 12V. Coil resistance 200-300 Ohm
J1 Two ways output socket

Device purpose:

This circuit is useful in liquids level or proximity detection. It operates detecting the distance from the target by reflection of an infra-red beam. It can safely detect the level of a liquid in a tank without any contact with the liquid itself. The device's range can be set from a couple of cm. to about 50 cm. by means of a trimmer.

Range can vary, depending on infra-red transmitting and receiving LEDs used and is mostly affected by the color of the reflecting surface. Black surfaces lower greatly the device's sensitivity.

Circuit operation:

IC1 forms an oscillator driving the infra-red LED by means of 0.8mSec. pulses at 120Hz frequency and about 300mA peak current. D1 & D2 are placed facing the target on the same line, a couple of centimeters apart, on a short breadboard strip. D2 picks-up the infra-red beam generated by D1 and reflected by the surface placed in front of it. The signal is amplified by IC2A and peak detected by D4 & C4. Diode D3, with R5 & R6, compensate for the forward diode drop of D4. A DC voltage proportional to the distance of the reflecting object and D1 & D2 feeds the inverting input of the voltage comparator IC2B. This comparator switches on and off the LED and the optional relay via Q1, comparing its input voltage to the reference voltage at its non-inverting input set by the Trimmer R7.

Notes:

Power supply must be regulated (hence the use of IC3) for precise reference voltages. The circuit can be fed by a commercial wall plug-in power supply, having a DC output voltage in the range 12-24V.
Current drawing: LED off 40mA; LED and Relay on 70mA @ 12V DC supply.

R10, C6, Q1, D6, D7, RL1 and J1 can be omitted if relay operation is not required.

The infra-red Photo Diode D2, should be of the type incorporating an optical sunlight filter: these components appear in black plastic cases. Some of them resemble TO92 transistors: in this case, please note that the sensitive surface is the curved, not the flat one.

Avoid sun or artificial light hitting directly D1 & D2.

Usually D1-D2 optimum distance lies in the range 1.5-3 cm.

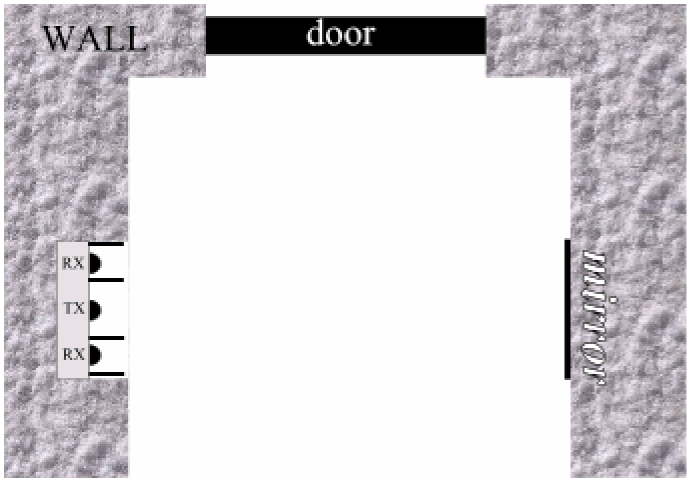
If you are needing a similar circuit driving 3 LEDs in sequence, also suitable as a parking aid, click here

P382. Infrared gate 2

Description

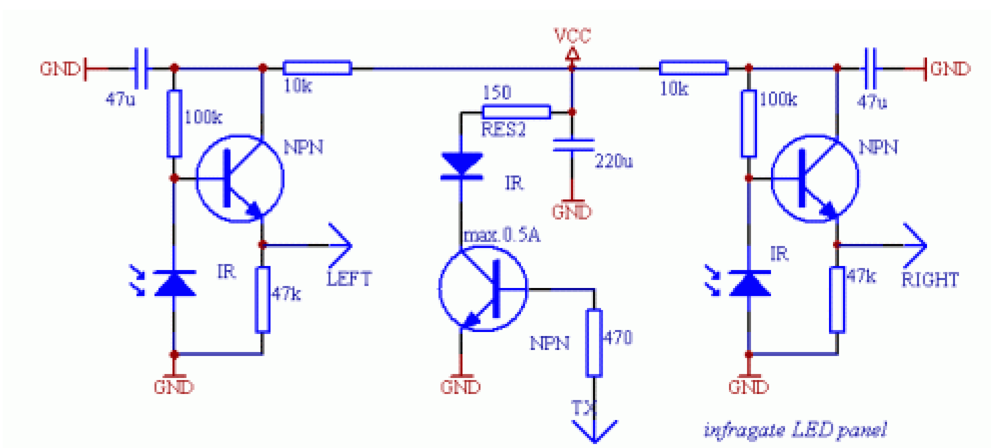
This is an infrared gate with two sensors planned to use in the wall in the way behind a door. It can be applied in a toilet to keep track of that someone is inside exceeding a certain amount of time. After that time elapsed, the circuit triggers the digital output wich can turn on a ventillator. The time period the output is turned on can be separately controlled by a second timer.

If you plan to build this circuit, beware that you may have lots of difficulties though the schematic may seem simple. The construction of the circit requires some amount of equipment like an oscilloscope and a DVM, too. Without them, the device will do weird things you wouldn't expect, and even if it is correctly put together, you must adjust it with care both mechanically in its final place and electronically with the help of an oscilloscope. Only if you want to span about less than 20-30 inches with the infra diodes can forget about this calibration. Alternatively you can take ideas from this construction.

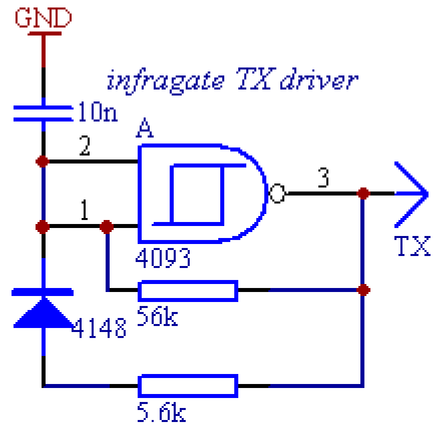


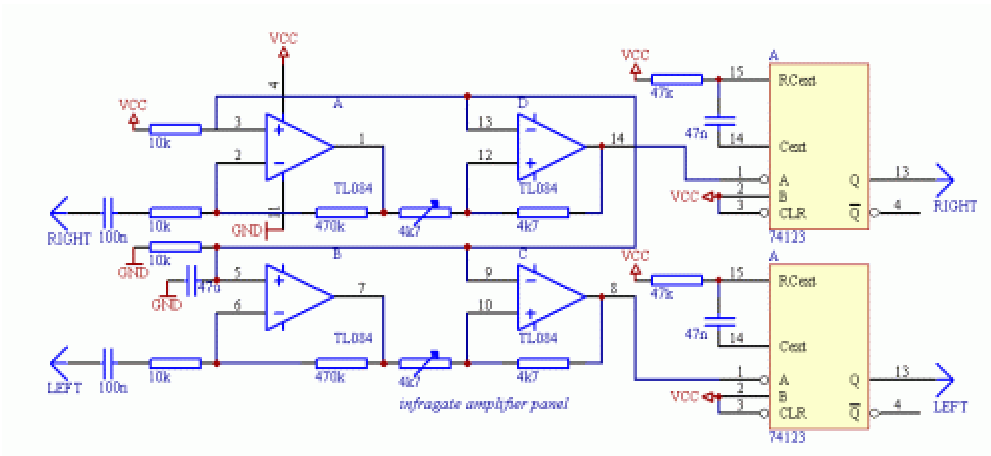
Schematics

The device consists of several parts, the most critical one is the panel with the infra LEDs. I tried to use several receiver transistors, but best result was given by infra receiver diodes used in TV remote control receivers. The receiver diodes must be properly shielded from the transmitter LED(s) otherwise the infra light will surely drive the receiver with a large enough signal. These photodiodes should only see infrared light coming from the mirror. The two very sensitive receiver parts should also be isolated from the transmitter electrically or the TX signal will get across the wires to the RX lines, which results the same effect as weak optical shielding. Use metal shielding around the receiver amplifiers where possible. The infrared transmitter LEDs should be close in wavelength to the max. sensitivity band of the receivers. You can experiment with using more LEDs and more current testing several resistor values, but don't exceed the 500 mA current limit flowing on the diodes or they will burn out. Do not shield the transmitters, allow the maximum amount of infralight to reach the mirror to extend the possible range.

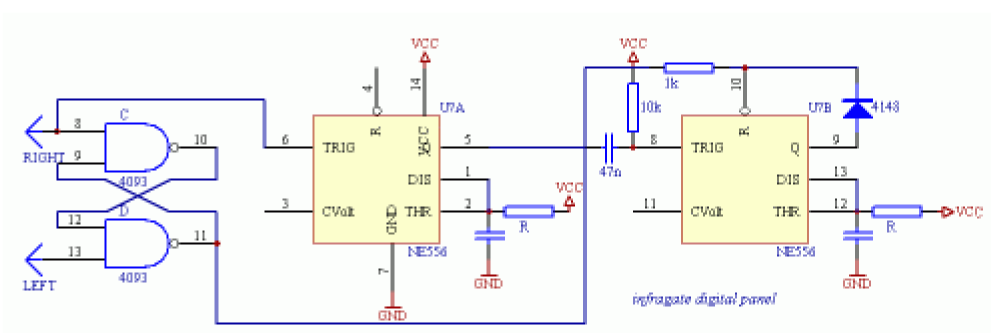


To start testing the infra LED panel, you wil need the infragate amplifier panel and the small transmiter driver. The TX driver will generate the digital signal for the LED driver on the LED panel. The digital signal is 1:10 on/off to achive good performance with lower power dissipation on the LEDs. Connect GND, VCC planes and LEFT, RIGHT wires of the LED panel with the amplifier panel, and drive the TX line from the TX driver. Now you are able to start testing and calibrating the analogue part of the circuit. If everything is ok, holding a mirror in front of the LED panel will reflect enough signal to overdrive the amplifier and you can check the output on the OPA 1, 7 pins with an oscilloscope. Taking the mirror farther on will result a weakening signal on the amplifier output. Set the orientation of the diodes to be able to get the maximum signal amplitude on the oscilloscope screen. This is the heaviest part of the work, don't deal too much with it until the complete circuit is not built. Just adjust a static state of the construction to give the maximum signal amplitude on the output when nothing is between the diodes and the mirror and give a small noise only when the line of sight is covered. If you are ready with it, you can adjust the schmitt triggers built of the other two OPA parts to generate TTL pulses when the analog signal is at its maximum and stay on the same DC level when the received signal is missing.





It is also important to protect the receiver diodes from direct light as natural light will weaken the sensitivity of the diodes, and lamps will transform the 50/60 Hz modulation present in the line power. Small noise is not problem, but the received signal from the TX generator should be stronger to be able to detect it. After the ST adjustments, connect LEDs to the 74123's TTL outputs through proper value resistors. The 74123 here is used as a demodulator. If there is a periodic signal change on the input, the output will be high, while if there is no activity on the input for a given period of time, the output falls low. When you cover the line of sight of one receiver diode, the corresponding LED turns off. There should not be any flickering in the turning on/off, the output should immediately respond to the change without blinking.

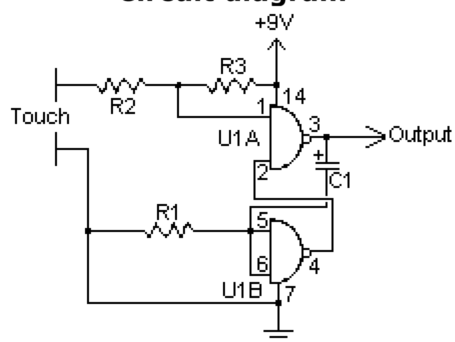


If still everything is correctly working at this point, the remaining digital circuit is the easy part of the work. The outputs of the previous circuit (LEFT, RIGHT) directly connect to the remaining part. The RS memory built from two NAND gates remembers the way of the last movement direction, so if someone is in or not. If you experience problems, connect another LED to pin 10 of the RS and check if this part does what it should. If there was any activity in the past minutes, the first timer is running, but it can only trigger the second timer part, if someone is still inside. The diode from the second timer output prevents resetting itself before the timing period is over in case of another movement. For a 1 minute timing (first timer) R=470k C=100u can be used, the second part would use R=1.5M C=470u for about a 15 minute timing (t=1.1RC). The output of the second timer (pin 9) can drive a relay activating the ventillator.

P383. Touch Switch II

A touch switch is a switch that is turned on and off by touching a wire contact, instead of flicking a lever like a regular switch. Touch switches have no mechanical parts to wear out, so they last a lot longer than regular switches. Touch switches can be used in places where regular switches would not last, such as wet or very dusty areas.

Circuit diagram



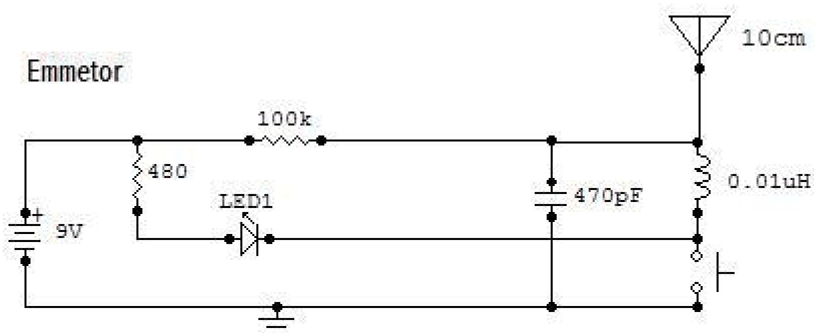
Parts
C1 10uF 16V Electrolytic Capacitor
R1, R2 100K 1/4 Watt Resistor
R3 10 Meg 1/4 Watt Resistor
U1 4011 CMOS NAND Gate IC
MISC Board, Wire, Socket For U1

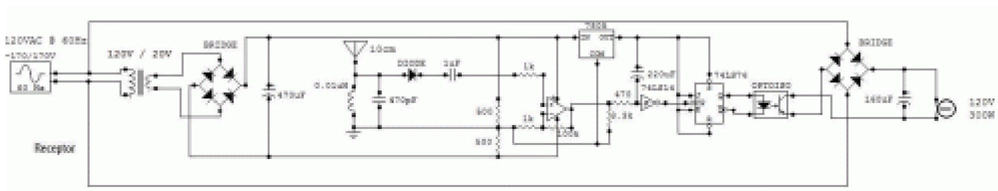
Notes:

1. The contacts an be made with just two loops of wire close together, or two squares etched close together on a PC board.
2. When activated, the output of the circuit goes high for about one second. This pulse can be used to drive a relay, transistor, other logic, etc.
3. You can vary the length of the output pulse by using a smaller or larger capacitor for C1.

P384. 73 MHz Hallogene Lamp Radio-Controlled

Circuit diagram





This circuit is a 73 MHz Hallogene Lamp Radio-Controlled. The purpose of it is to control the power state of a hallogene lamp by a remote control. When we press the push botton of the remonte control, the power state of the lamp will be changed, so, if the lamp was turned on, it will turned off and if it was turned on, it will turned off. If we press to the button another time, the same action will be occured. When the button is pressed, a LED indicator lights on the remote control.

The system is consisted by two separate circuit. One is the remote control, or the emmetor. The other is the receptor, or the hallogene lamp controller. We plug the input of the lamp controller circuit to the 120VAC source of the sector to supply it. The lamp must be pluged to the output of the circuit to be supplied and controlled.

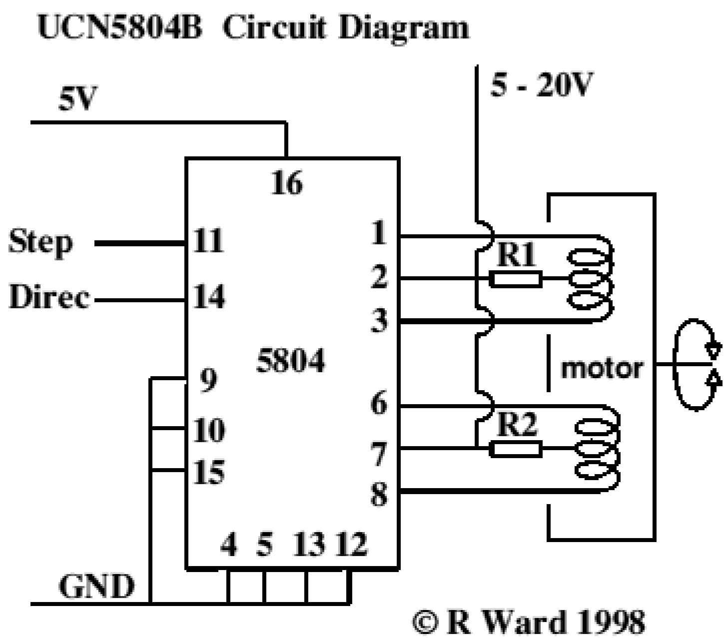
The controller circuit has also an antenna to receive the signal of the remote control. The remote control has also an antenna to transmit the signal to the controller circuit and have to be powered by a 9V battery. Two things important for my circuit are not mentioned in the schematic. There are about the two logic component.

The first one is the Schmitt trigger NOT gate (74LS14). Its Vcc pin must be connected to the output of the +5V regulator (7805). And its GND pin must be connected to the ground of the circuit. The second one is the JK Flip-Flop (74LS76). Its Vcc pin must be connected to the output of the +5V regulator (7805). And its GND pin must be connected to the ground of the circuit.

P385. Unipolar Stepper Motor Controller

This is a very good integrated circuit. There is no need for any external glue logic to drive the circuit, there is only 2 pins to drive the motor, one for controlling the direction and the other to trigger the stepping pulses. It provides a very compact design that drives 5 or 6 or 8 wire stepper motors. The 5 or 8 wire stepper motors are treated as a variation on the 6 wire motor. That is, the 5 has the two common wires from the coils center taps joined inside the motor (saves joining them outside the motor), however some confusion may occur with the ends of the other coils as to which joins with which, however trial and error to determine this will not hurt anything. In the 8 wire motor case the joined center taps will have to worked out by you. You will know which coil is joined to which coil, however experimentation may be required to determine polarity.

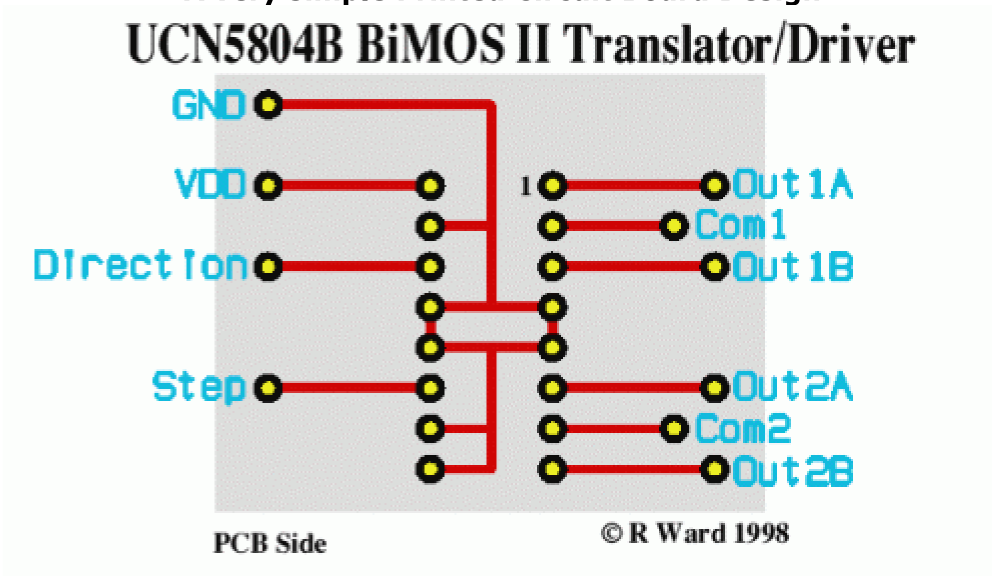
Circuit diagram



The resistors R1 & R2 are only necessary if the supply voltage to the motors is above 10 volts or so, and are really only necessary near max voltages and tuning the response times of the motor for high speeds. See data sheets for details.

There should be very little problem getting hold of six wire motors that make the connections obvious. These motors are by far the most common where any degree of power is required, e.g. in printers. Non-working dot matrix printers are fairly common now-a-days and the motors in them are excellent starting points for experimentation. You will also get belts, pulleys and gears thrown in (may be even a power supply if your are adventurous).

A very simple Printed Circuit Board Design



Features of the chip:
1.5A Maximum Output Current
35 V Output Sustaining voltage
Wave-Drive, Two-Phase, and Half Step Formats
Internal Clamp Diodes
Output enable control
Power on reset
Internal Thermal Shutdown
Sequence Connections
Two-Phase Drive Sequence Pin 9 GND Pin 10 GND (Simplest choice)
Wave Drive Sequence Pin 9 5v Pin 10 GND
Half Step Drive Sequence Pin 9 GND Pin 10 5V

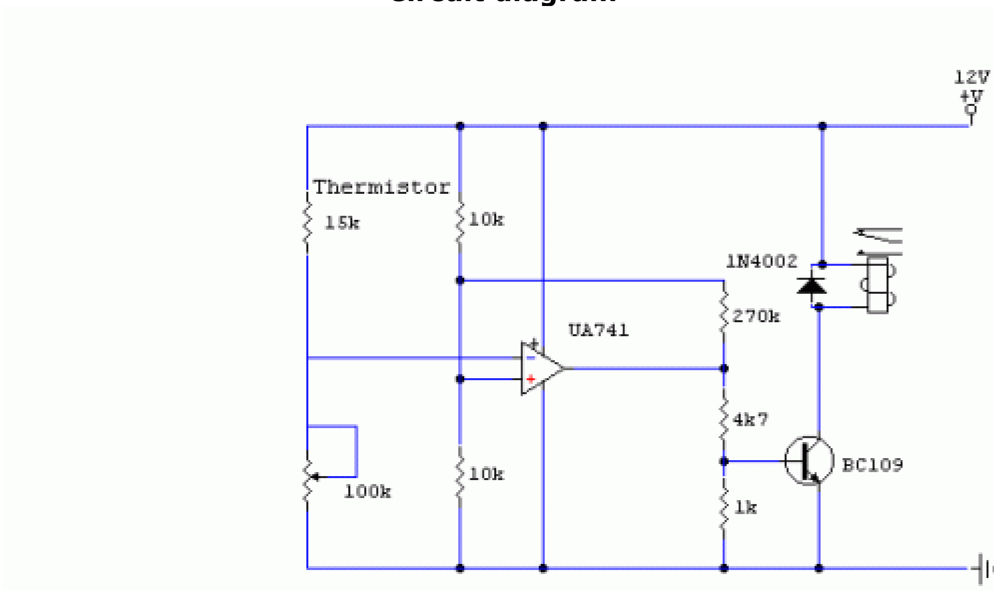
This driver will allow you to scale up your project considerably as the power will be much greater with the bigger motors and higher voltages and currents. The draw back is that the engineering that goes along with them will also have to be more substantial. The larger stepper motors are very heavy for desktop models but will be very versatile for the larger experiment.

Commercial Kit and Data Sheets
An excellent, high quality kit (Nos:109) to experiment with this driver can be purchased from
Wiltronics Research PTY LTD
5-7 Ripon St (North)
Ballarat 3350
AUSTRALIA
Phone (03)5331 1947

It provides a 5 volt regulated supply, indicator LEDs, 555 oscillator for pulses and miniature switches to control direction and stepping modes. Single step or free funning can be chosen as well full data sheets provided. They also provide data sheets with the circuit. Contact them for prices. While not the cheapest way to go it is the best seen so far.

P386. Frost Alarm

Circuit diagram



Notes:

The thermistor used has a resistance of 15k at 25 degrees and 45k at 0 degrees celsius. A suitable bead type thermistor is found in the Maplin catalogue. The 100k pot allows this circuit to trigger over a wide range of temperatures. A slight amount of hysteresis is provided by inclusion of the 270k resistor. This prevents relay chatter when temperature is near the switching threshold of this circuit.

P387. Mains Remote-Alert

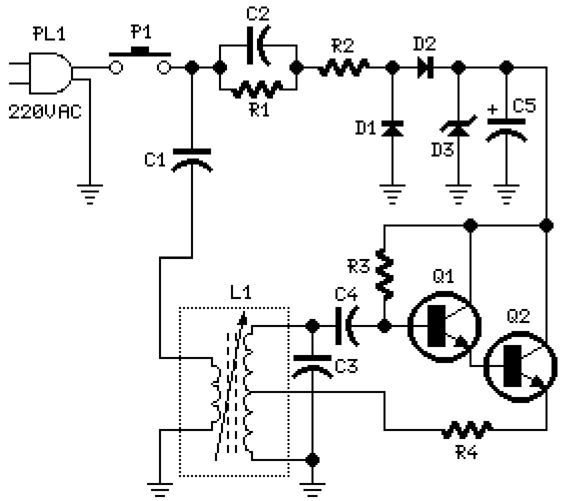
Warning! These units are connected to 220Vac mains, then some parts in the circuit boards are subjected to lethal potential!. Avoid touching the circuits when plugged and enclose them in plastic boxes.

Remotely-operates a Beeper and/or a LED via mains supply line
Simple circuitry, easy to build unit

Device purpose:

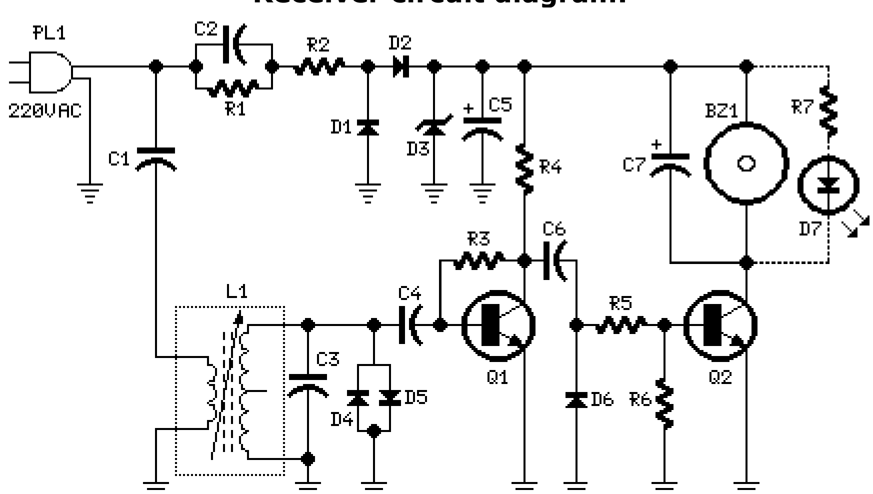
Pressing the pushbutton of the transmitter, a sound and/or light alert is activated in the receiver. The system uses no wiring or radio frequencies: the transmitted signal is conveyed into the mains supply line. It can be used at home, in any room from attic to cellar, simply plugging transmitter and receiver in the wall mains sockets. Transmission range can be very good, provided both units are connected to the mains supply within the control of the same light-meter.

Transmitter circuit diagram:



Transmitter parts:
R1 220K 1/4W Resistor
R2 470R 1/2W Resistor
R3 100K 1/4W Resistor
R4 1K 1/4W Resistor
C1 10nF 400V Ceramic or Polyester Capacitor
C2 330nF 400V Polyester Capacitor
C3 1n5 63V Ceramic Capacitor (See Notes)
C4 10nF 63V Ceramic or Polyester Capacitor
C5 100μF 25V Electrolytic Capacitor
D1,D2 1N4007 1000V 1A Diodes
D3 BZX79C30 30V 500mW Zener Diode
Q1,Q2 BC546 65V 100mA NPN Transistors
L1 IF Transformer for AM receivers, 445-470KHz
P1 SPST Mains suited Pushbutton
PL1 Male Mains plug & cable

Receiver circuit diagram:



Receiver parts:
R1 220K 1/4W Resistor
R2 470R 1/2W Resistor
R3 150K 1/4W Resistor
R4 2K2 1/4W Resistor
R5 100K 1/4W Resistor
R6 47K 1/4W Resistor
R7 2K2 1/4W Resistor (Optional)
C1 100nF 400V Polyester Capacitor
C2 330nF 400V Polyester Capacitor
C3 1n5 63V Ceramic Capacitor (See Notes)
C4,C6 330pF 63V Ceramic Capacitors
C5,C7 100µF 25V Electrolytic Capacitors
D1,D2 1N4007 1000V 1A Diodes
D3 BZX79C12 12V 500mW Zener Diode
D4,D5,D6 1N4148 75V 150mA Diodes
D7 5mm. Red LED (Optional)
Q1,Q2 BC547 45V 100mA NPN Transistors
L1 IF Transformer for AM receivers, 445-470KHz
BZ1 Piezo sounder (incorporating 3KHz oscillator)
PL1 Male Mains plug & cable

Transmitter circuit operation:

Q1 and Q2 are wired as a Darlington pair to obtain the highest possible output from a Hartley type oscillator running at about 135KHz frequency. The 220Vac mains is reduced to 30Vdc without the use of a transformer by means of C1 reactance, a two diode rectifier cell D1 & D2 and Zener diode D3.
The oscillator output is taken from L1 secondary winding and injected into the mains wiring by means of C1.

Receiver circuit operation:

The 135KHz sinewave generated by the transmitter is picked-up from mains wiring by C1 and selected by the tuned circuit L1-C3. Q1 greatly amplifies the incoming sinewave and converts it in a 12V-peak squarewave. D4 & D5 limit the input voltage at Q1 base to less than 1V-peak to avoid damaging of the transistor due to the high voltage transients frequently occurring on the mains line. D6 eliminates any negative component of the signal and Q2 drives the load. C7 is necessary to smooth the signal residues appearing across the load.

The 12Vdc supply for this unit is obtained as described above for the transmitter circuit.

Notes:

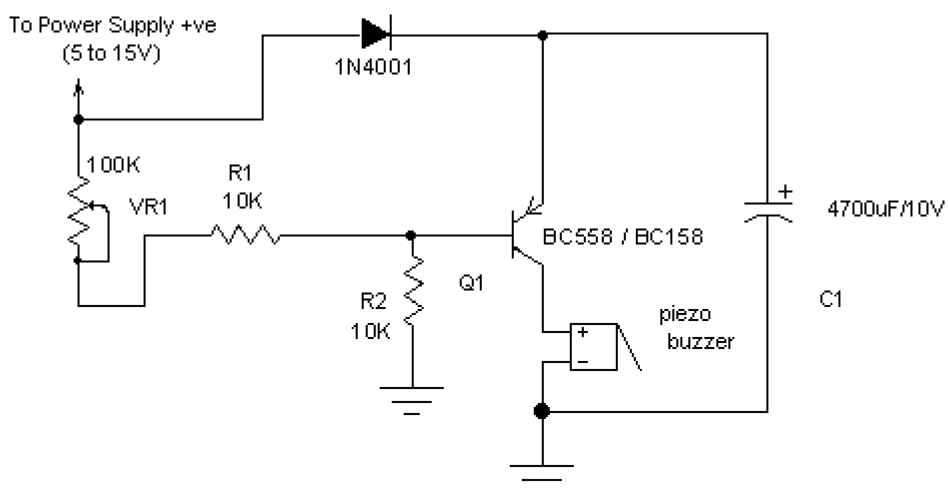
Transmitter and receiver coils L1s must be tuned regulating their ferrite cores to obtain maximum output at C3 leads, both in transmitter and receiver.

This setup is better done using an oscilloscope and placing the two units as far as possible to each other.
The tuning of the coils at 135KHz frequency should be obtained with the ferrite core almost totally inserted in its slot, if 455KHz IF transformers are used for both L1s.

Using IF transformers different from those specified, a change in both C3s value can be needed. The value of these capacitors may be varied from 1 to 3.3nF but must be the same in transmitter and receiver.
The load can be a beeper, a LED or both. Omitting the beeper and choosing the LED as the only load, its

limiting resistor R7 should be reduced in value to about 1K, to increase device brightness. In this case, a 10mm. diameter LED type or greater, can also be useful .

P388. Power supply failure alarm

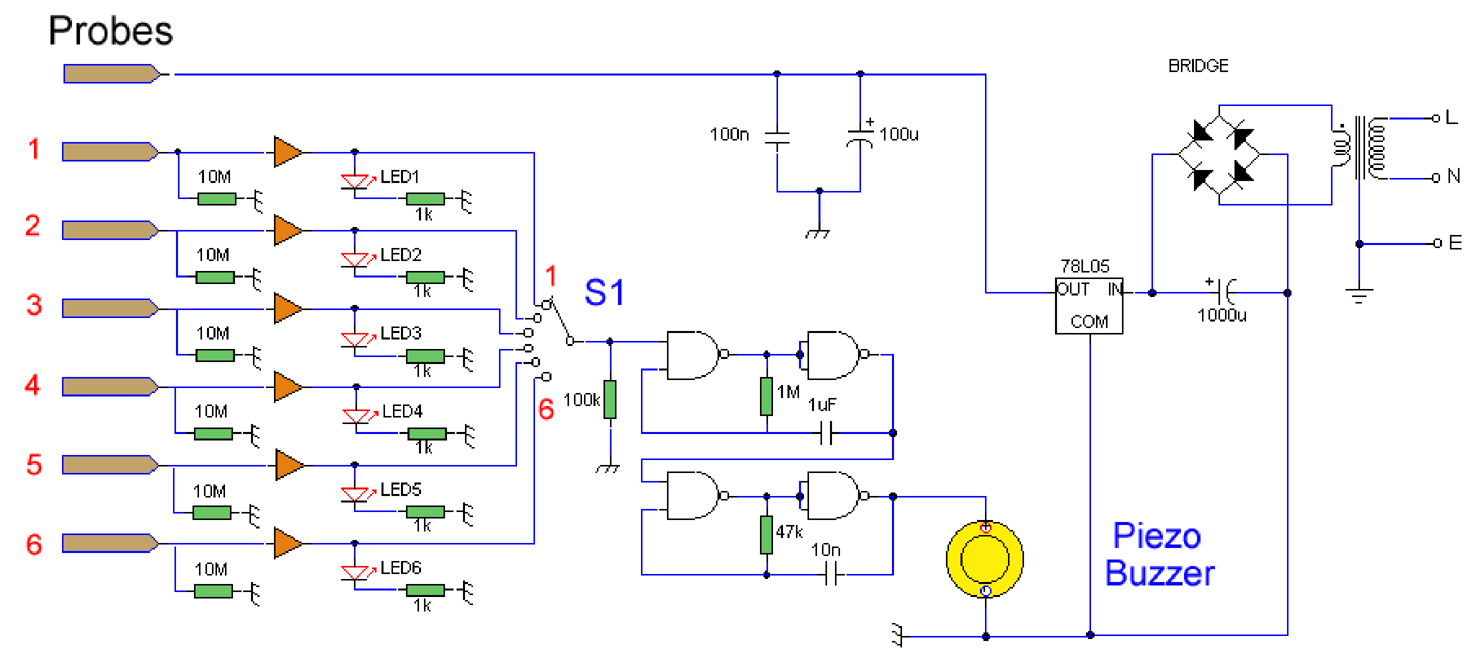


Most of the power supply failure indicator circuits need a separate power supply for themselves. But the alarm circuit presented here needs no additional supply source. It employs an electrolytic capacitor to store adequate charge, to feed power to the alarm circuit which sounds an alarm for a reasonable duration when the supply fails.

This circuit can be used as an alarm for power supplies in the range of 5V to 15V.
To calibrate the circuit, first connect the power supply (5 to 15V) then vary the potentiometer VR1 until the buzzer goes from on to off.

Whenever the supply fails, resistor R2 pulls the base of transistor low and saturates it, turning the buzzer ON.

P389. Water Level Alarm



Description

A circuit that offers visual indication of fluid level in a vessel, with a switchable audible alarm. Example uses would be to monitor the level of water in a bath or cold storage tank.

The Conductance of Fluids

Conductance is the reciprocal of resistance. The conductance of fluids vary with temperature, volume and separation distance ofthe measurement probes. Tap water has a conductance of about 50 uS / cm measured at 25°C. This is 20k/cm at 25°C

Circuit Notes

This circuit will trigger with any fluid with a resistance under 900K between the maximum separation distance of the probes. Let me explain further. The circuit uses a 4050B CMOS hex buffer working on a 5 volt supply. All gates are biased off by the 10M resistors connected between ground and buffer input. The "common" probe the topmost probe above probe 1 in the diagram above is onnected to the positive 5 volt supply. If probe 1 is spaced 1 cm away from the common probe and tap water at 25 C is detected between the probes (a resistance of 20k) then the top gate is activated and the LED 1 will light. Similarly if probe 2 at 2 cm distance from the common probe detects water, LED 2 will light and so on. Switch 1 is used to select which output from the hex buffer will trigger the audible oscillator made from the gates of a CMOS 4011B IC.

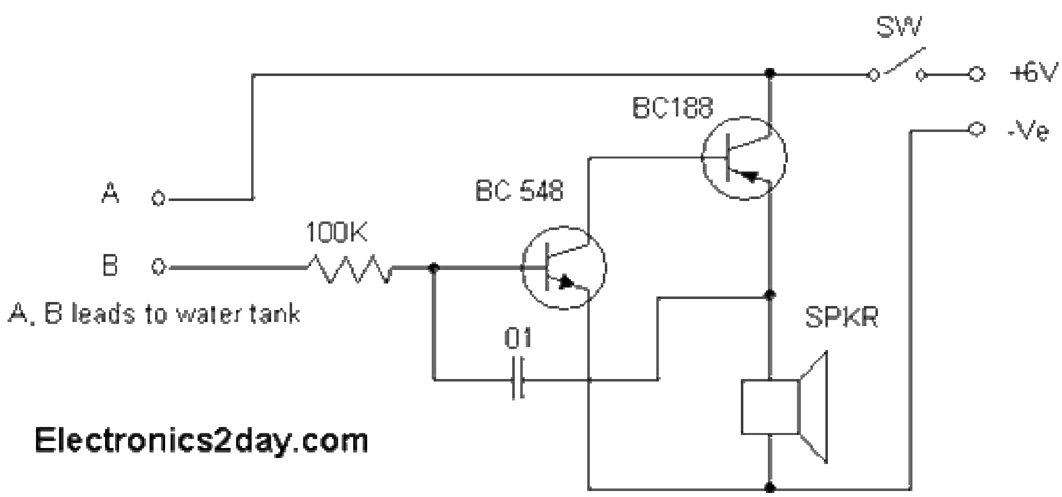
[Placement of Probes](#)

As 7 wires are needed for the probe I reccommend the use of 8 way computer ribbon cable. The first two wires may be doubled and act as the common probe wire. Each subsequent wire may be cut to required length, if required a couple of millimetres of insulation may be stripped back, though the open "cut off" wire end should be sufficient to act as the probe. The fluid and distance between probe 6 and the common probe wire must be less than 900k. This is because any voltage below 0.5 Volt is detected by the CMOS IC as logic 0. A quick potential check using a 900k resistance and the divider formed with the 10M resistor at the input proves this point:

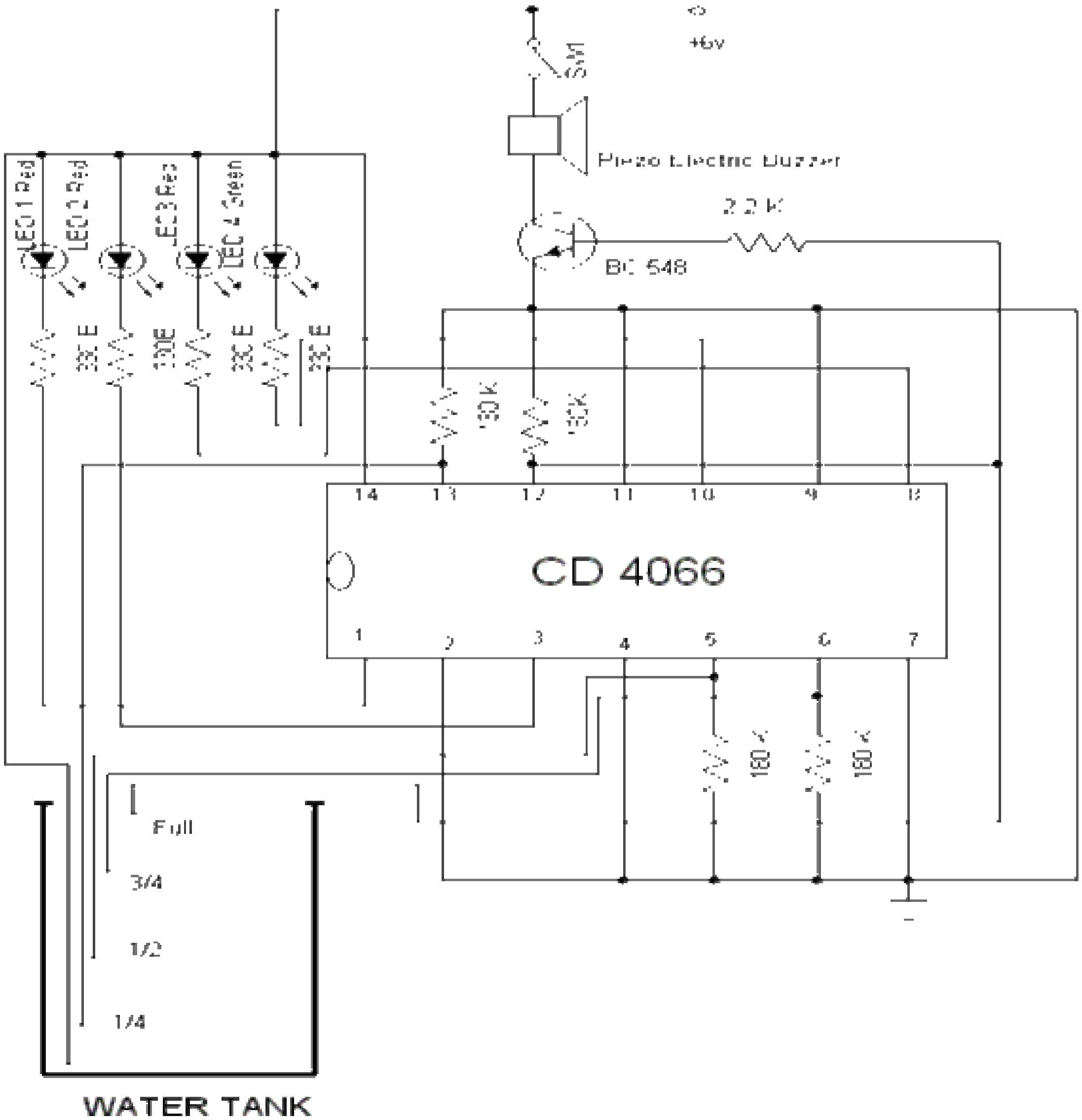
5 x (0.9 / (0.9+10) = 0.41 Volt

As this voltage is below 0.5 volt it is interpreted as a logic 0 and the LED will light. If measuring tap water at 25 C then the distance between top probe and common may be up to 45 cm apart. For other temperatures and fluids, it is advisable to use an ohmmeter first. When placing the probes the common probe must be the lowest placed probe, as the water level rises, it will first pass probe 1, then 2 and finally probe 6.

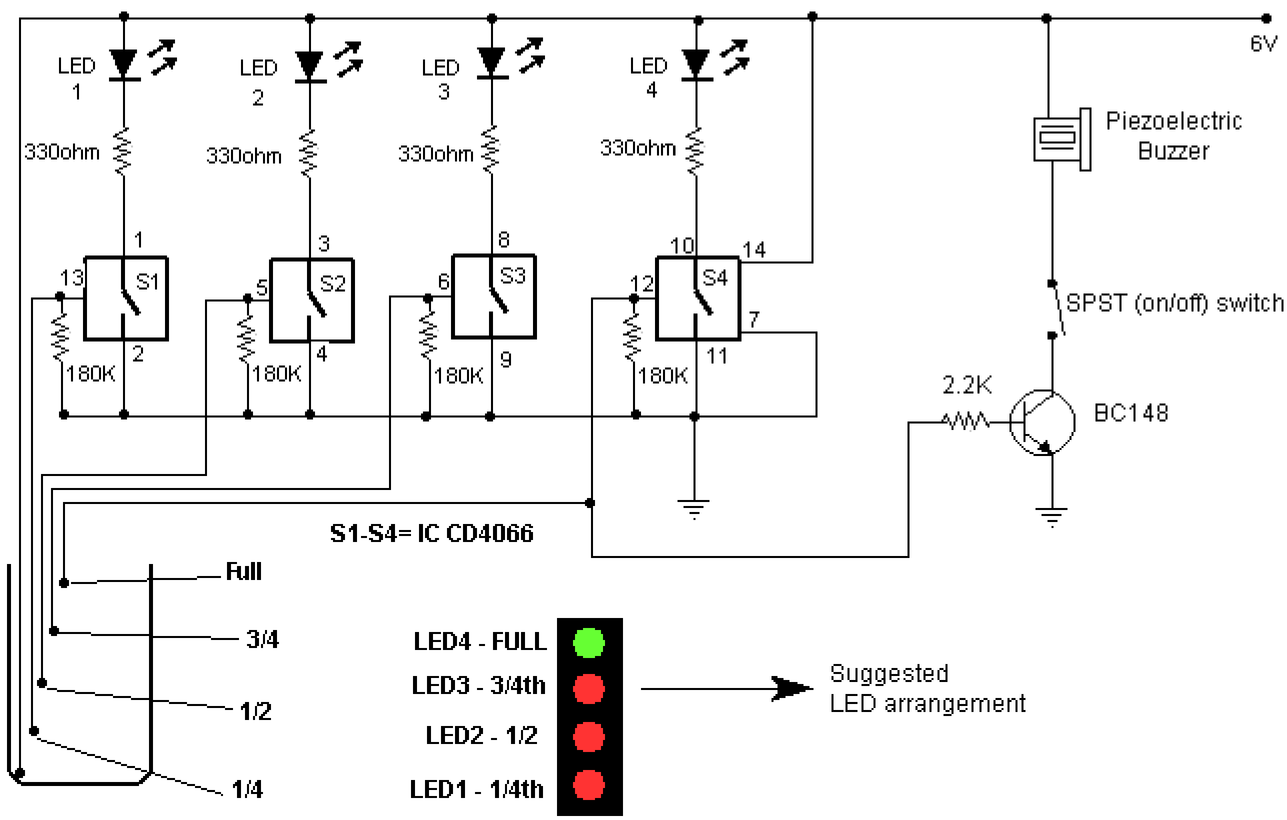
P390. Water level indicator 1



P391. Water level indicator 2



P392. Water Level Indicator with alarm



This circuit not only indicates the amount of water present in the overhead tank but also gives an alarm when the tank is full.

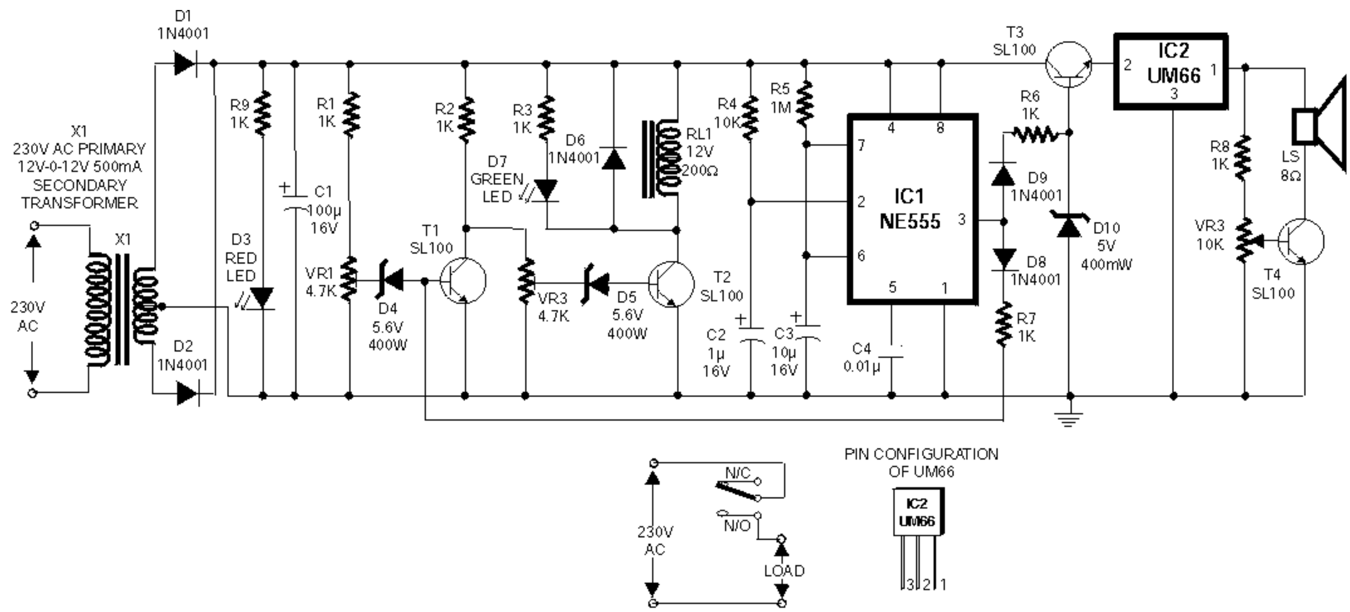
The circuit uses the widely available CD4066, bilateral switch CMOS IC to indicate the water level through LEDs.

When the water is empty the wires in the tank are open circuited and the 180K resistors pulls the switch low hence opening the switch and LEDs are OFF. As the water starts filling up, first the wire in the tank connected to S1 and the + supply are shorted by water. This closes the switch S1 and turns the LED1 ON. As the water continues to fill the tank, the LEDs2 , 3 and 4 light up gradually.

The no. of levels of indication can be increased to 8 if 2 CD4066 ICs are used in a similar fashion.

When the water is full, the base of the transistor BC148 is pulled high by the water and this saturates the transistor, turning the buzzer ON. The SPST switch has to be opened to turn the buzzer OFF.
Remember to turn the switch ON while pumping water otherwise the buzzer will not sound!

P393. Melody generator for greeting cards



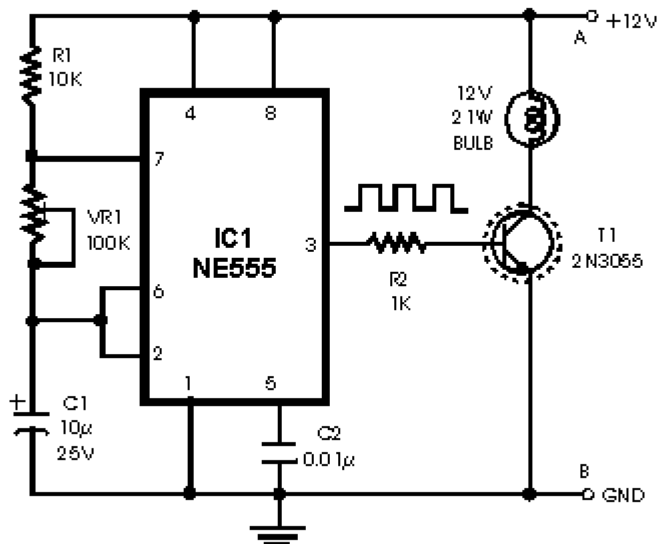
This tiny circuit comprising of a single 3 terminal IC UM66 can be built small enough to be placed inside a greeting card and operated off a single 3V flat button cell.

There is not much to the circuit. The UM66 is connected to its supply and its output fed to a transistor for amplification. You can either use a 4ohm speaker or a " flat" piezoelectric tweeter like the one found in alarm wrist watches.

If you use the piezo, then it can be connected directly between the output pin 1 and ground pin 3 without the transistor.

The UM66 looks like a transistor with 3 terminals. It is a complete miniature tone generator with a ROM of 64 notes, oscillator and a preamplifier. When it first came into market, it was programmed for the "Jingle bells" tune. Now they come with a wide variety of different tunes.

P394. Brakelight Flasher



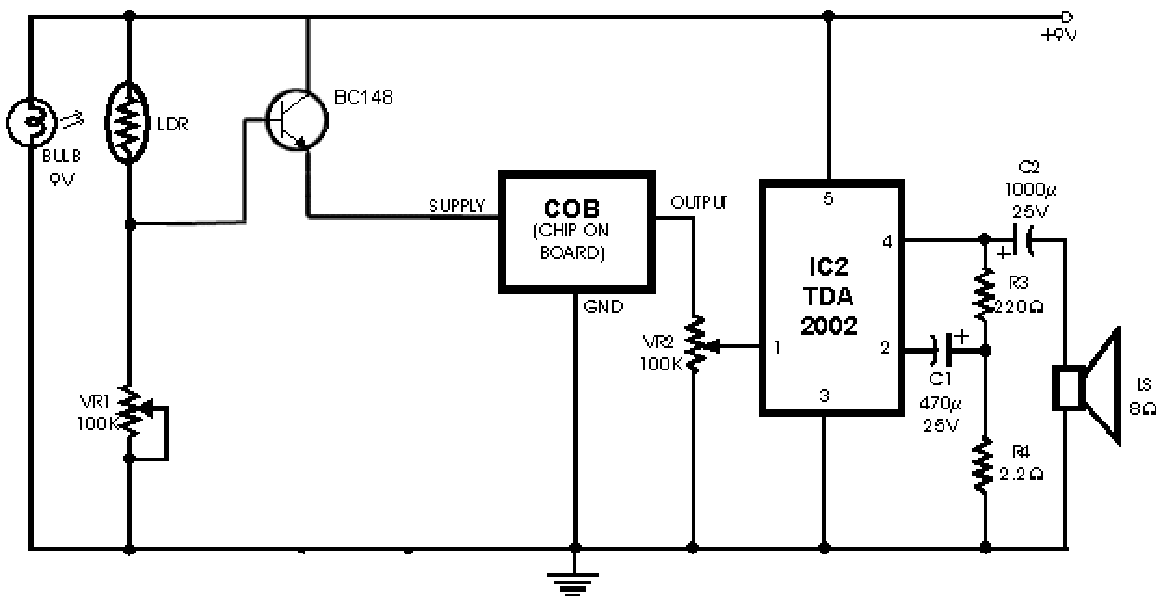
This is basically a flasher circuit modified to turn on and off a bulb instead of a LED. It uses a 555 timer IC working as an astable multivibrator. The flashing rate can be varied from very fast to a maximum of once in 1.5 sec by varying the preset VR1.

The ON time of the circuit is given by:
TON= 0.69xC1x(R1 + VR1) second

and the OFF time is:
TOFF= 0.69xC1xVR1 second

You can increase the value of C1 to 100uF to get a slower flashing rate of upto once in 10 sec.

P395. Fire Alarm



This circuit warns the user against fire accidents. It relies on the smoke that is produced in the event of a fire. When this smoke passes between a bulb and an LDR, the amount of light falling on the LDR decreases. This causes the resistance of LDR to increase and the voltage at the base of the transistor is pulled high due to which the supply to the COB (chip-on-board) is completed. Different COBs are available in the market to generate different sounds.

The choice of the COB depends on the user. The signal generated by COB is amplified by an audio amplifier. In this circuit, the audio power amplifier is wired around IC TDA 2002. The sensitivity of the circuit depends on the distance between bulb and LDR as well as setting of preset VR1. Thus by placing the bulb and the LDR at appropriate distances, one may vary preset VR1 to get optimum sensitivity.

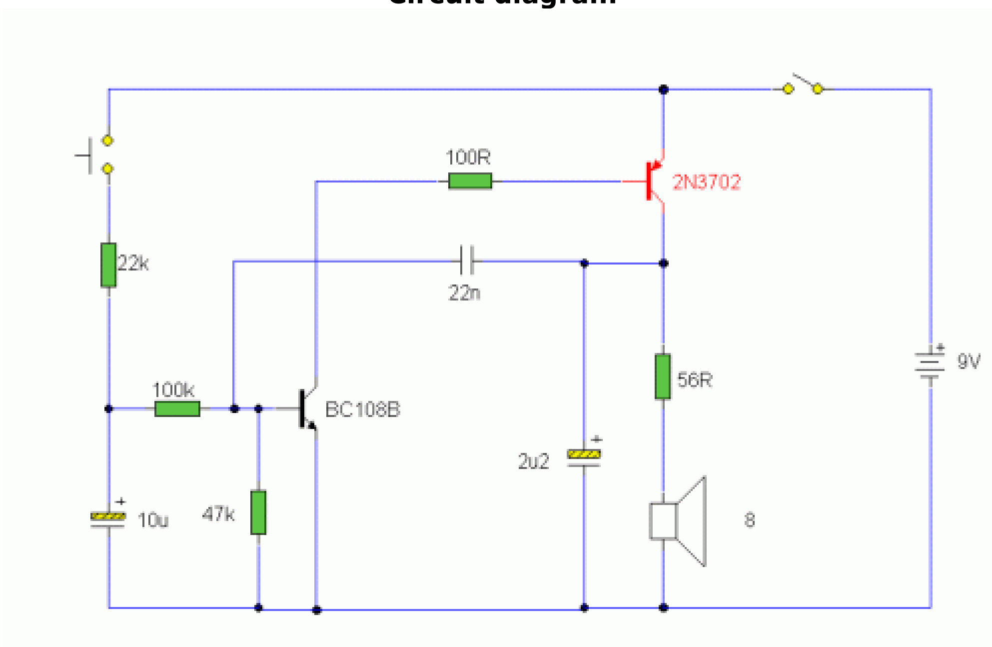
An ON/OFF switch is suggested to turn the circuit on and off as desirable.

P396. Electronic Siren

Description:

An electronic siren made from discrete components.

Circuit diagram



Notes:

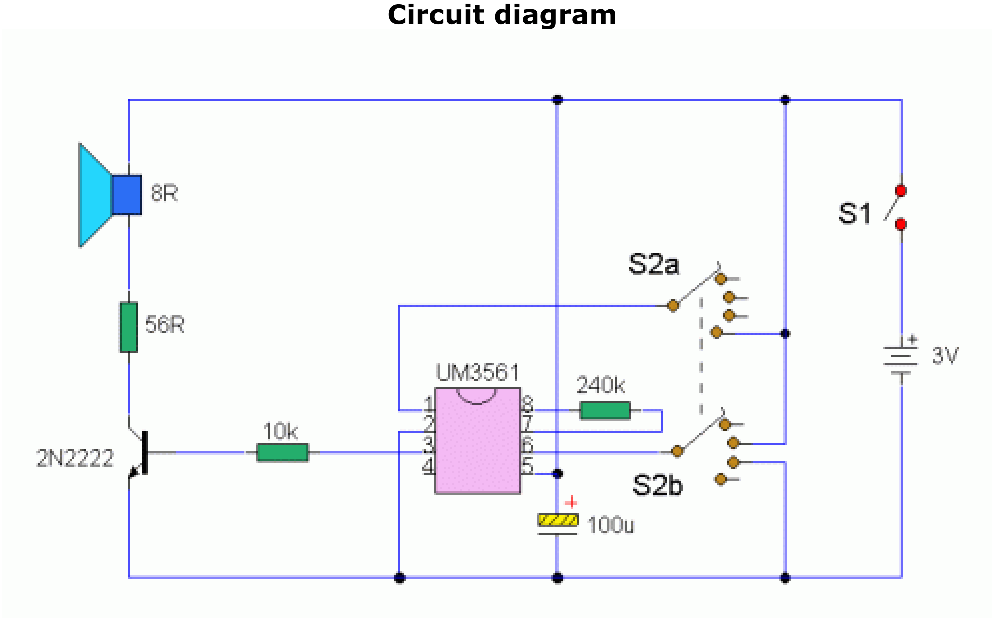
The sound produced imitates the rise and fall of an American police siren. When first switched on the 10u capacitors is discharged and both transistors are off. When the push button switch is pressed to 10u capacitor will charge via the 22k resistor. This voltage is applied to the base of the BC108B which will turn on slowly. When the switch is released the capacitor will discharge via the 100k and 47k base resistors and the transistor will slowly turn off. The change in voltage alters the frequency of the siren. The oscillator action is more difficult to work out. As the BC108B transistor switches on its collector voltage falls and so the 2N3702 transistor is switched on. This happens very quickly (less than 1us). The 22n capacitor will charge very quickly as well. As this capacitor is connected between the collector of the 2N3702 and the base of the BC108B, it soon reaches almost full supply voltage. The charging current for the capacitor is then much reduced and the collector emitter voltage of the 2N3072 is therefore increased; the collector potential will fall. This change in voltage is passed through the 22n capacitor to the base of the BC108B causing it to come out of saturation slightly. As this happens its collector voltage will rise and turn off the 2N3072 transistor more. This continues until both transistors are off. The 22n capacitor will then discharge via the 100k, 22k resistor, the closed push button switch, 9V battery, the speaker and 56 ohm resistor. The discharge time takes around 5-6msec. As soon as the 22n capacitor is discharged, the BC108B transistor will switch on again and the cycle repeats. The difference in voltage at the collector of the BC108B (caused by the charging 10u capacitor) causes the tone of the siren to change. As the 10u capacitor is charged, the tone of the siren will rise, and as it is discharged, it will fall. A 64 ohm loudspeaker may be used in place of the 8 ohm and 56 resistor, and the values of components may be altered to produce different sound effects.

P397. Sound Effects Generator

Description:

This circuit uses a UM3561 IC to produce four different sound effects.

Circuit diagram



Notes:

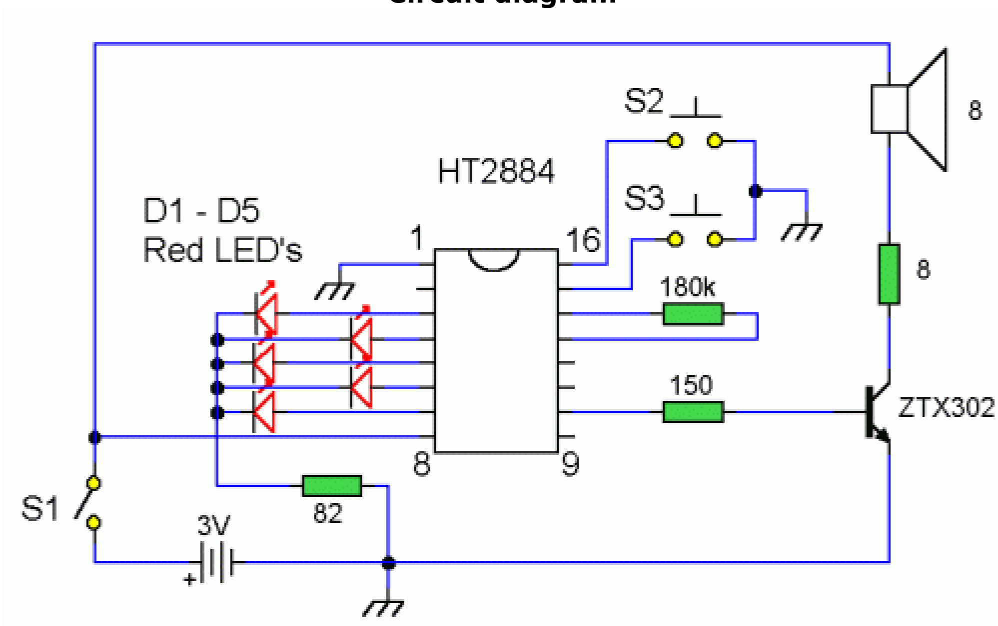
Nothing too complicated here. The IC produces all the sound effects, the output at Pin 3 being amplified by the transistor. A 64 ohm loudspeaker can be substituted in place of the 56 ohm resistor and 8 ohm loudspeaker. The 2 pole 4 way switch controls the sound effects. Position 1 (as drawn) being a Police siren, position 2 is a fire engine sound, 3 is an ambulance and position 4 is a machine gun effect. The IC is manufactured by UMC and was available from Maplin electronics code UJ45Y. At the time of writing this has now been discontinued, but they have have limited stocks available.

P398. Sound Effects Generator 2

Description:

This circuit uses the Holtek HT2884 IC to produce 8 different sound effects.

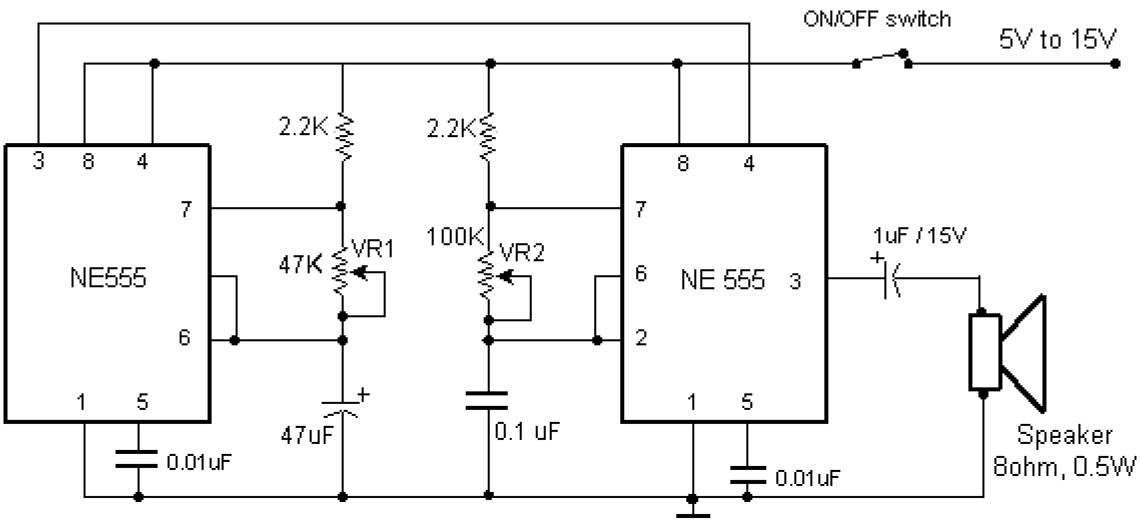
Circuit diagram



Notes:

All sound effects are generated internally by the HT2884 IC. Power is a 3 Volt battery, but the IC will work with any voltage between 2.5 and 5 Volts. Switch S1 is the on / off switch. The output at pin 10 is amplified and drives a small 8 ohm loudspeaker. Pressing S3 once will generate all the sounds, one after another. S2 can be used to produce a single sound effect, next depression gives the next sound effect. There are 2 lazer guns, 1 dual tone horn sound, 2 bomb sounds, 2 machine gun sounds and a rifle shot sound. Standby current is about 1 uA at 3 Volt, so battery life is very economical.

P399. Beeper



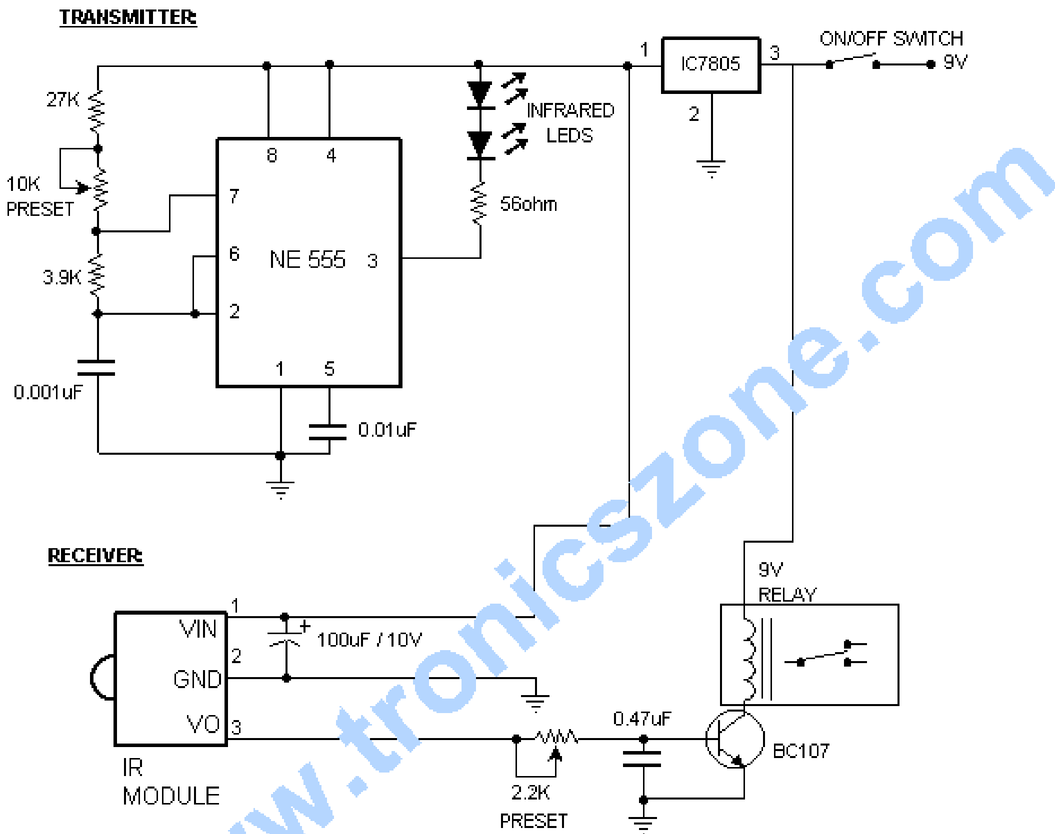
This circuit produces the sound of a beeper like the one in pagers which produces a "beep-beep" sound. Basically the circuit consists of a 555 timer oscillator which is turned ON and OFF periodically.

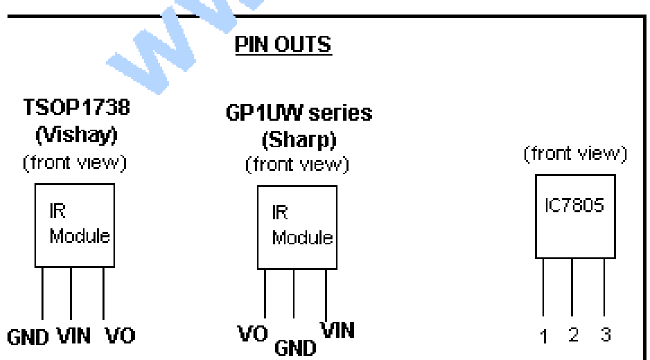
The first IC(left) oscillates at about 1Hz. The second IC is turned ON and OFF by the first IC.
The first IC determines how fast the second IC is turned ON/OFF and second IC determines the tone of the final output.

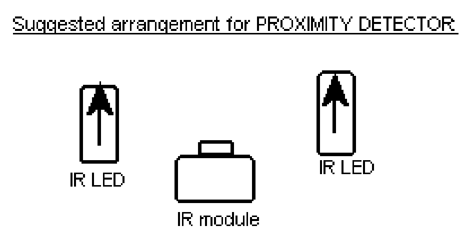
By varying the VR1, the changeover rate can be adjusted. By varying VR2 the tone can be adjusted.

If you know something about electronics, you can try replacing the 2nd 555 IC circuit with a piezoelectric buzzer. This saves one IC and associated components but the buzzer cannot give a loud sound as the speaker and also its tone cannot be varied.

P400. Infrared beam barrier/ proximity sensor







This circuit can be used as an Infrared beam barrier as well as a proximity detector.
The circuit uses the very popular Sharp IR module (Vishay module can also be used). The pin nos. shown in the circuit are for the Sharp & VIshay modules. For other modules please refer to their respective datasheets.

The receiver consists of a 555 timer IC working as an oscillator at about 38Khz (also works from 36kHz to 40kHz) which has to be adjusted using the 10K preset. The duty cycle of the IR beam is about 10%. This allows us to pass more current through the LEDS thus achieving a longer range.

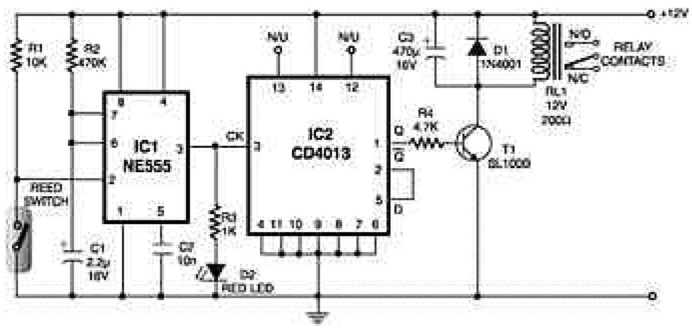
The receiver uses a sharp IR module. When the IR beam from the transmitter falls on the IR module, the output is activated which activates the relay and de-activated when the beam is obstructed. The relay contacts can be used to turn ON/OFF alarms, lights etc. The 10K preset should be adjusted until the receiver detects the IR beam.

The circuit can also be used as a proximity sensor, i.e to detect objects in front of the device without obstructing a IR beam. For this the LEDs should be pointed in the same direction as the IR module and at the same level. The suggested arrangement is shown in the circuit diagram. The LEDs should be properly covered with a reflective material like glass or aluminum foils on the sides to avoid the spreading of the IR beam and to get a sharp focus of the beam.

When there is nothing in front of them, the IR beam is not reflected onto the module and hence the circuit is not activated. When an object comes near the device, the IR light from the LEDs is reflected by the object onto the module and hence the circuit gets activated.

If there still a lot of mis-triggering, use a 1uF or higher capacitor instead of the 0.47uF.

P401. Magnetic proximity sensors

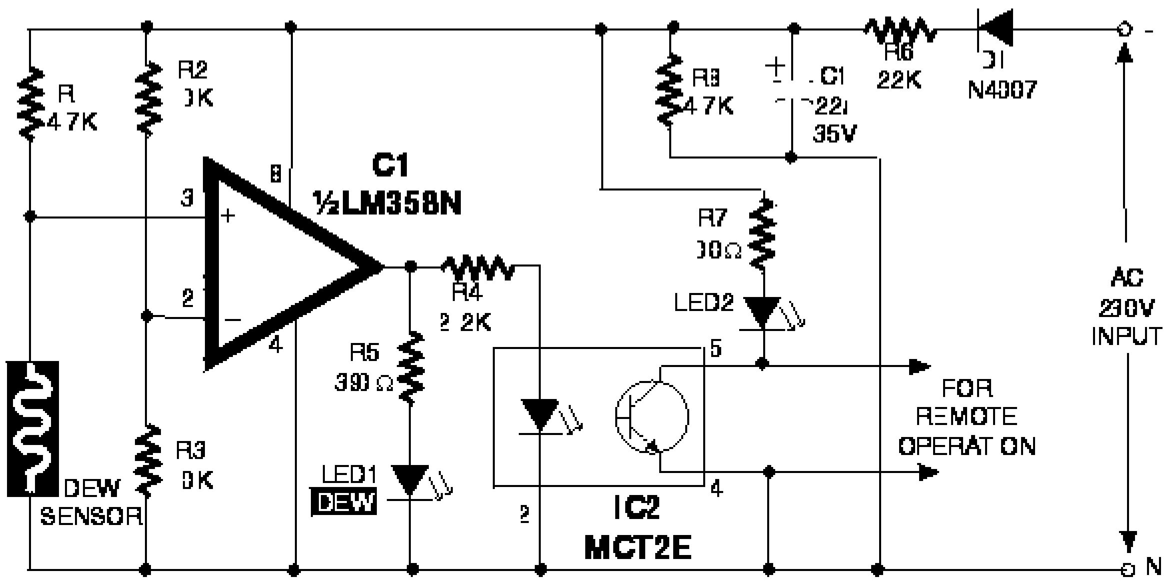


Here is an interesting circuit for a magnetic proximity switch which can be used in various applications. The magnetic proximity switch circuit, in principle, consists of a reed switch at its heart. When a magnet is brought in the vicinity of the sensor (reed switch), it operates and controls the rest of the switching circuit. In place of the reed switch, one may, as well, use a general-purpose electromagnetic reed relay (by making use of the reed switch contacts) as the sensor, if required. These tiny reed relays are easily available as they are widely used in telecom products. The reed switch or relay to be used with this circuit should be the 'normally open' type.

When a magnet is brought/placed in the vicinity of the sensor element for a moment, the contacts of the reed switch close to trigger timer IC1 wired in monostable mode. As a consequence its output at pin 3 goes high for a short duration and supplies clock to the clock input (pin 3) of IC2 (CD4013—dual D-type flip-flop). LED D2 is used as a response indicator.

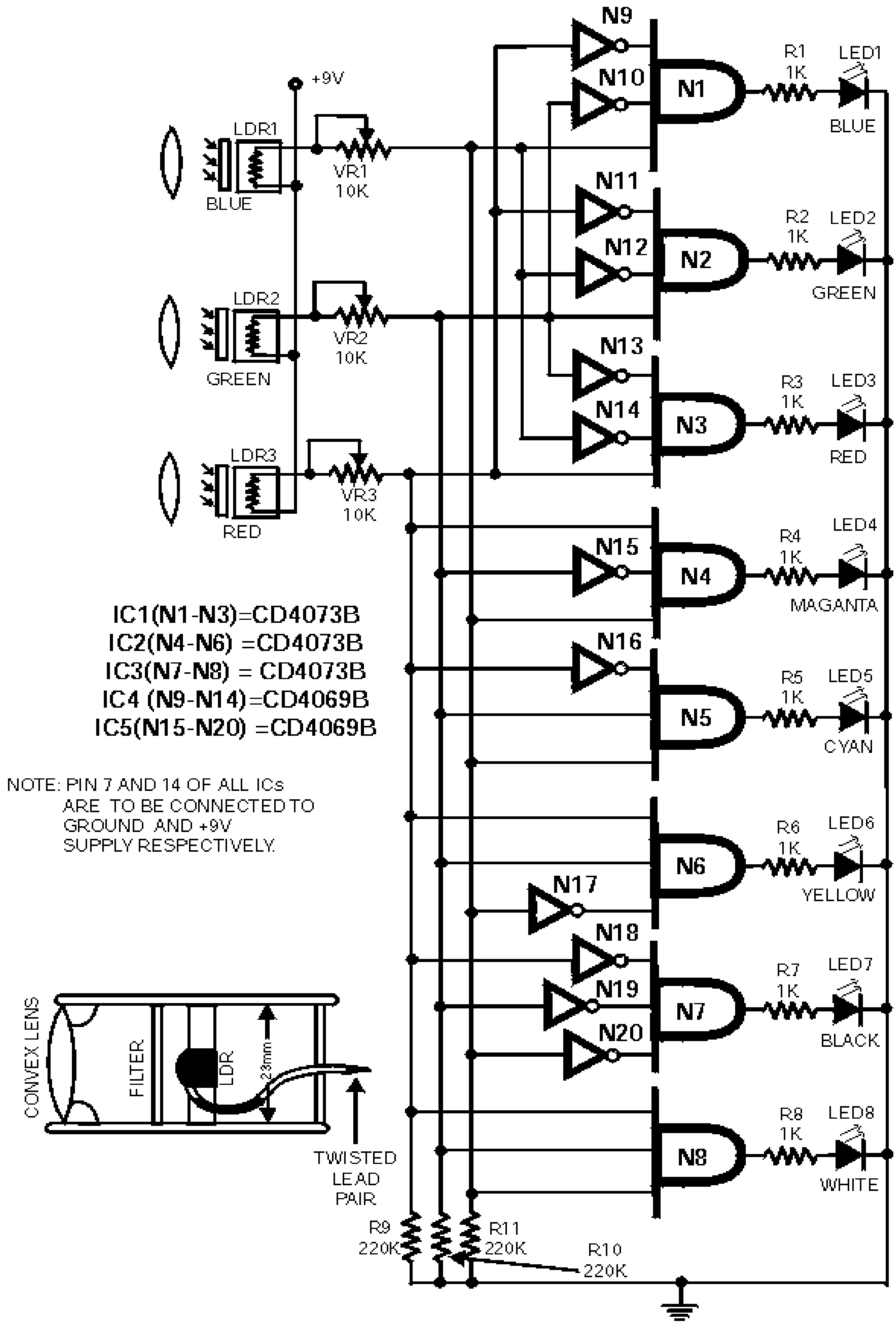
This CMOS IC2 consists of two independent flip-flops though here only one is used. Note that the flip-flop is wired in toggle mode with data input (pin 5) connected to the Q (pin 2) output. On receipt of clock pulse, the Q output changes from low to high state and due to this the relay driver transistor T1 gets forward-biased. As a result the relay RL1 is energised.

P402. Dew sensor



Dew (condensed moisture) ad- versely affects the normal per- formance of sensitive electronic devices. A low-cost circuit described here can be used to switch off any gadget automatically in case of excessive humidity. At the heart of the circuit is an inexpensive (resistor type) dew sensor element. Although dew sensor elements are widely used in video cassette players and recorders, these may not be easily available in local market. However, the same can be procured from authorised service centres of reputed companies. The author used the dew sensor for FUNAI VCP model No. V.I.P. 3000A (Part No: 6808-08-04, reference no. 336) in his prototype. In practice, it is observed that all dew sensors available for video application possess the same electrical characteristics irrespective of their physical shape/size, and hence are interchangeable and can be used in this project. The circuit is basically a switching type circuit made with the help of a popular dual op-amp IC LM358N which is configured here as a comparator. (Note that only one half of the IC is used here.) Under normal conditions, resistance of the dew sensor is low (1 kilo-ohm or so) and thus the voltage at its non-inverting terminal (pin 3) is low compared to that at its inverting input (pin 2) terminal. The corresponding output of the comparator (at pin 1) is accordingly low and thus nothing happens in the circuit. When humidity exceeds 80 per cent, the sensor resistance increases rapidly. As a result, the non-inverting pin becomes more positive than the inverting pin. This pushes up the output of IC1 to a high level. As a consequence, the LED inside the opto-coupler is energised. At the same time LED1 provides a visual indication. The opto-coupler can be suitably interfaced to any electronic device for switching purpose. Circuit comprising diode D2, resistors R5 and R6 and capacitor C1 forms a low-voltage, low-current power supply unit. This simple arrangement obviates the requirement for a bulky and expensive step-down transformer.

P403. Color Sensor



Colour sensor is an interesting project for hobbyists. The cir- cuit can sense eight colours, i.e. blue, green and red (primary colours); magenta, yellow and cyan (secondary colours); and black and white. The circuit is based on the fundamentals of optics and digital electronics. The object whose colour is required to be detected should be placed in front of the system. The light rays reflected from the object will fall on the three convex lenses which are fixed in front of the three LDRs. The convex lenses are used to converge light rays. This helps to increase the sensitivity of LDRs. Blue, green and red glass plates (filters) are fixed in front of LDR1, LDR2 and LDR3 respectively. When reflected light rays from the object fall on the gadget, the coloured filter glass plates determine which of the LDRs would get triggered. The circuit makes use of only 'AND' gates and 'NOT' gates.

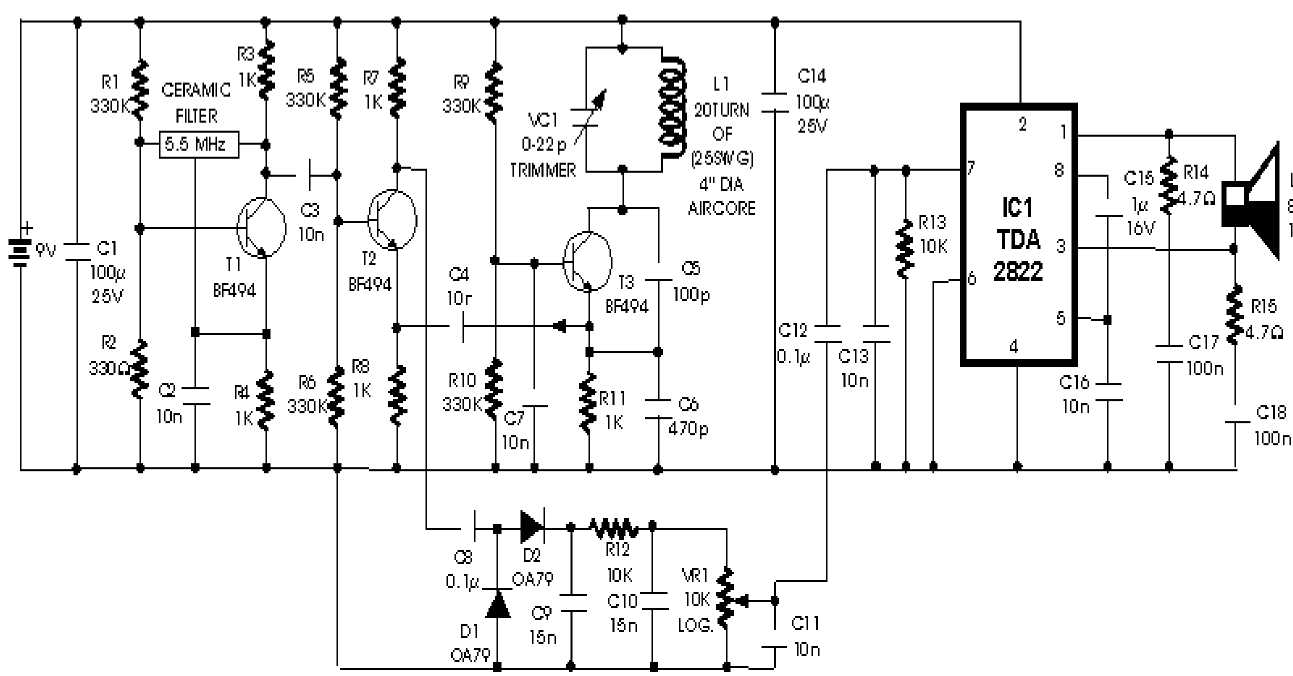
When a primary coloured light ray falls on the system, the glass plate corresponding to that primary colour will allow that specific light to pass through. But the other two glass plates will not allow any light to pass through. Thus only one LDR will get triggered and the gate output corresponding to that LDR will become logic 1 to indicate which colour it is. Similarly, when a secondary coloured light ray falls on the system, the two primary glass plates corres- ponding to the mixed colour will allow that light to pass through while the remaining one will not allow any light ray to pass through it. As a result two of the LDRs get triggered and the gate output corresponding to these will become logic 1 and indicate which colour it is.

When all the LDRs get triggered or remain untriggered, you will observe white and black light indications respectively. Following points may be carefully noted :

1. Potmeters VR1, VR2 and VR3 may be used to adjust the sensitivity of the LDRs.
2. Common ends of the LDRs should be connected to positive supply.
3. Use good quality light filters.

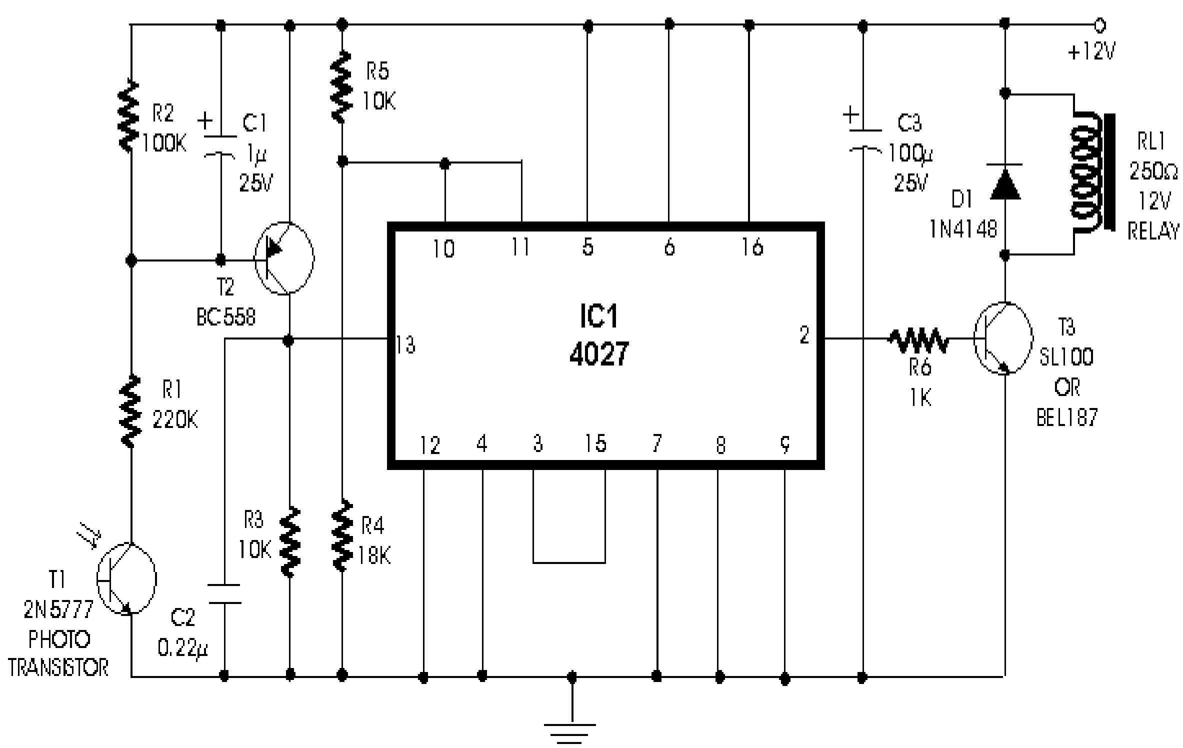
The LDR is mounded in a tube, behind a lens, and aimed at the object. The coloured glass filter should be fixed in front of the LDR as shown in the figure. Make three of that kind and fix them in a suitable case. Adjustments are critical and the gadget performance would depend upon its proper fabrication and use of correct filters as well as light conditions

P404. Metal Detector



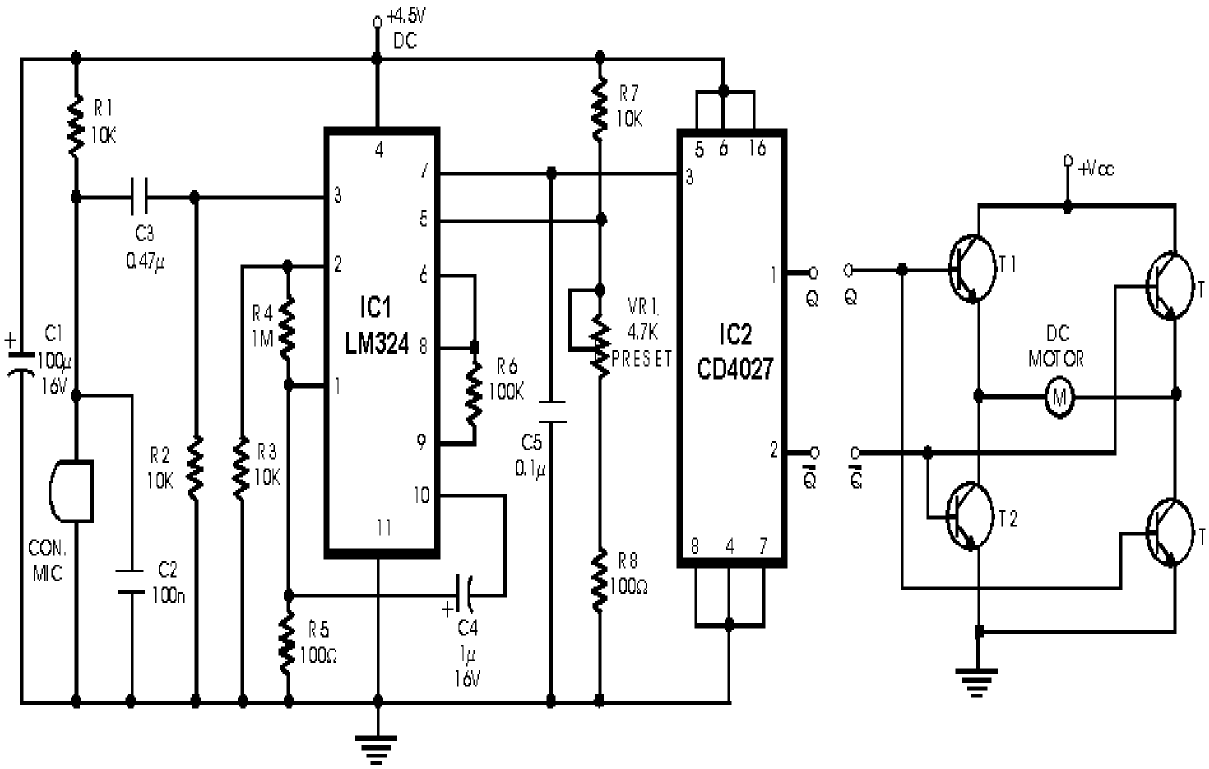
The circuit described here is that of a metal detector. The opera- tion of the circuit is based on superheterodyning principle which is commonly used in superhet receivers. The circuit utilises two RF oscillators. The frequencies of both oscillators are fixed at 5.5 MHz. The first RF oscillator comprises transistor T1 (BF 494) and a 5.5MHz ceramic filter commonly used in TV sound-IF section. The second oscillator is a Colpitt's oscillator realised with the help of transistor T3 (BF494) and inductor L1 (whose construction details follow) shunted by trimmer capacitor VC1. These two oscillators' frequencies (say Fx and Fy) are mixed in the mixer transistor T2 (another BF 494) and the difference or the beat frequency (Fx-Fy) output from collector of transistor T2 is connected to detector stage comprising diodes D1 and D2 (both OA 79). The output is a pulsating DC which is passed through a low-pass filter realised with the help of a 10k resistor R12 and two 15nF capacitors C6 and C10. It is then passed to AF amplifier IC1 (2822M) via volume control VR1 and the output is fed to an 8-ohm/1W speaker. The inductor L1 can be constructed using 15 turns of 25SWG wire on a 10cm (4-inch) diameter air-core former and then cementing it with insulating varnish. For proper operation of the circuit it is critical that frequencies of both the oscillators are the same so as to obtain zero beat in the absence of any metal in the near vicinity of the circuit. The alignment of oscillator 2 (to match oscillator 1 frequency) can be done with the help of trimmer capacitor VC1. When the two frequencies are equal, the beat frequency is zero, i.e. beat frquency=Fx-Fy=0, and thus there is no sound from the loudspeaker. When search coil L1 passes over metal, the metal changes its inductance, thereby changing the second oscillator's frequency. So now Fx-Fy is not zero and the loudspeaker sounds. Thus one is able to detect presence of metal

P405. Optical toggle switch using a single Chip



Using dual flip-flop IC CD4027 employ a 555 based monostable circuit to supply input clock pulses. The circuit described here obviates this requirement. One of the two flip-flops within IC CD4027 itself acts as square wave shaper

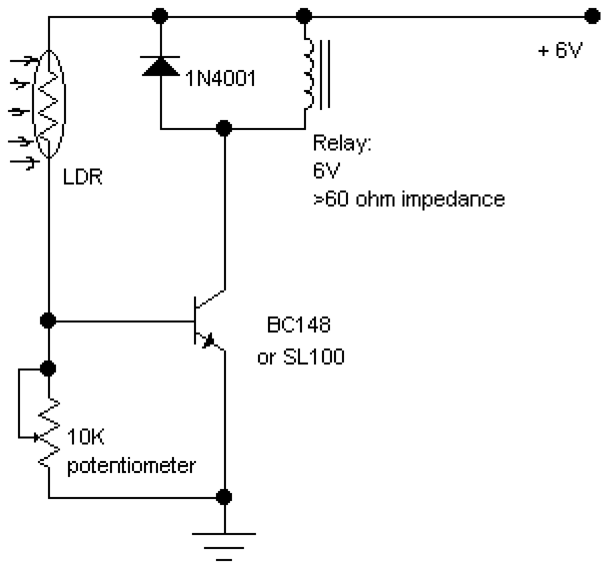
P406. Sound Controlled Filp Flop



Described here is a very inexpensive solution to many phono-controlled applications like remote switching on, for instance, or activating a camera, tape recorder, burglar alarms, toys, etc. The circuit given here employs a condenser microphone as the pick-up. A two-stage amplifier built around a quad op-amp IC LM324 offers a good gain to enable sound pick-up upto four metres. The third op-amp is configured as a level detector whose non-inverting terminal is fed with the amplified and filtered signal available at the output of the second op-amp. The inverting input of the third op-amp is given a reference voltage from a potential divider consisting of a 10k resistor and a 4.7k preset. The 100-ohm resistance in series with the potential divider ensures against the mis-triggering of the circuit by noise. Thus by adjusting the preset one can control the sensitivity (threshold) of the circuit. The sensitivity control thus helps in rejecting any external unwanted sounds which may be picked up by the amplifier. The output of the level detector are square pulses which are used to trigger a flip-flop. The 100mF capacitor connected across the supply also helps in bypassing noise.

A well regulated supply is recommended for proper functioning of the circuit because an unregulated supply can cause noise pulses to appear in the supply rails when the circuit changes-over state (especially when a load is connected to the circuit). These pulses can be picked up by the sensitive amplifier which will cause the circuit to again switch-over states, resulting into motor-boating noise.
Since the circuit operates at 4.5V, it can be easily incorporated in digital circuits. Fig. (b) shows how the circuit can be employed to control the direction of a DC motor. The circuit employs four npn transistors. Transistors T1 and T4 have their bases tied together and they switch-on simultaneously when Q output is logic 1. Similarly T2 and T3 conduct when Q output is logic 1. Thus current through the motor changes direction when the flip-flop toggles. Filters connected in the circuit and tuned to different bands of audio frequencies will enable the same circuit to control more than one device. For instance, a high frequency sound (such as whistle) can switch on device 1 and a low frequency sound (such as clapping) can control device 2.

P407. Light Barrier Detector



This simple circuit using a single transistor turns ON the relay when light falls on the LDR.

The potentiometer is adjusted for the required sensitivity.

The power supply is 6V.

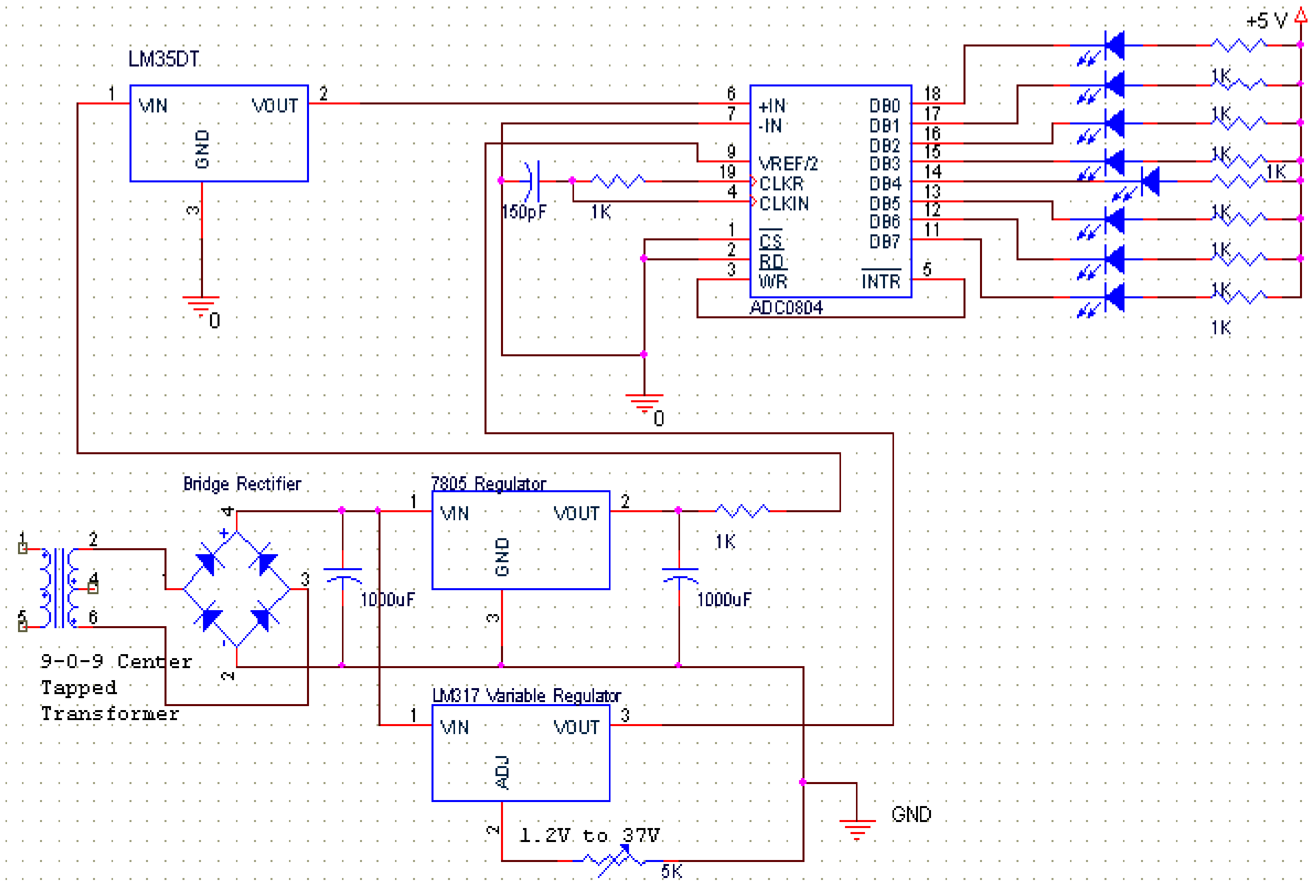
Be careful about the impedance of the relay. Its impedance should not be less that 60ohm.

Its working can be explained as follows:

With the light falling on the LDR,its resistance is low and the transistor is saturated and turns the relay ON.

When light is obstructed, the LDRs resistance becomes very high. The potentiometer shorts the transistors base to ground and it is cut off. Hence the relay is OFF.

P408. Temperature Sensor with Digital Output



This is a very simple to implement Temperature Sensor. It uses LM35DT as a semiconductor temperature sensor which operates with a +5 volt DC.

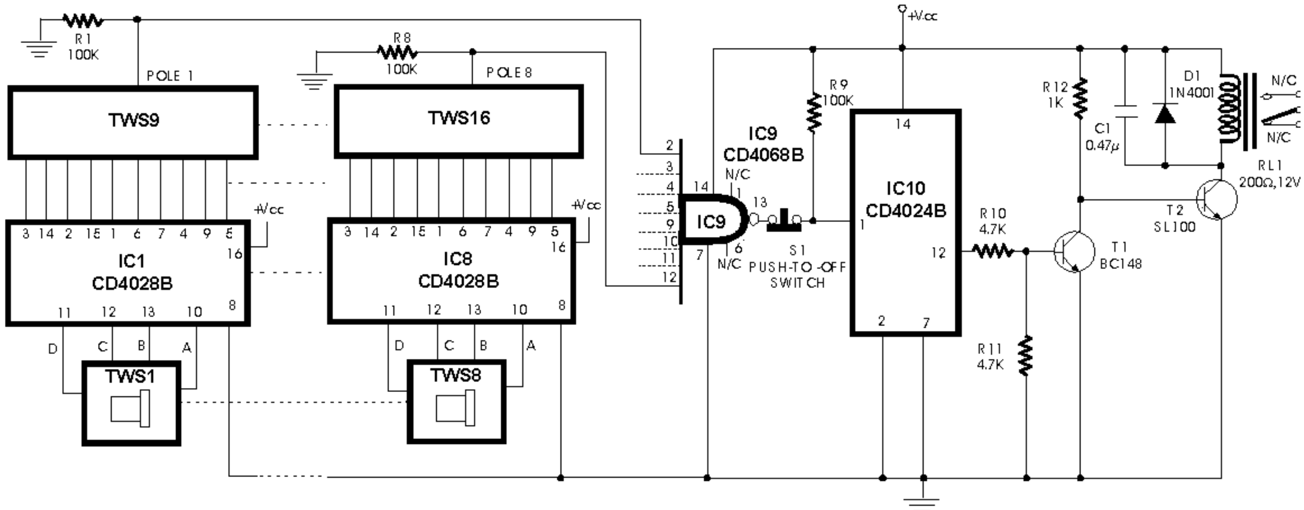
It produces an analog output voltage, proportional to the change in surrounding temperature in Celsius scale (2mv/C). The analog output of the sensor is then passed to the ADC0804 IC which produces an 8-bit binary output (digital output) correspoding to the analog input voltage. The digital output from ADC is then used to glow the LED which indicates the high/low logic (LED ON: Logic 0, LED OFF: Logic 1).

The output of the ADC can be interfaced to a 7-segment diaply using a 7-segment driver or the digital output can be interfaced to a PC / microcontroller. The bottom portion of the schematic shows a fixed and a variable power supply which inputs 220 volts AC from the wall outlet in your house, the transformer then steps-down it to 18 volts AC (9-0-9 centre-tapped), which is then converted to DC using bridge rectifier.

The fixed regulator IC (7805) produces a +5 volts regulated output which is used to operate the Sensor and the ADC0804 IC. It also outputs a variable voltage controlled by a 5K variable resistor which is used to adjust the scaling of the ADC0804 (normally for full scale, it is set to 2.5 volts).

Further modification may include an automatic control circuitry interfaced to the ADC which automatically ON/Off the device whose temperature is to be control/monitor. The automatic control can be achieved by OP-AMP based comparators or using a microcontroller/microprocessor.

P409. Programmable Digital Code Lock



A programmable code lock can be used for numerous applications in which access to an article/gadget is to be restricted to a limited number of persons. Here is yet another circuit of a code lock employing mainly the CMOS ICs and thumbwheel switches (TWS) besides a few other components. It is rugged and capable of operation on voltages ranging between 6 and 15 volts. The supply current drain of CMOS ICs being quite low, the circuit may be operated even on battery.

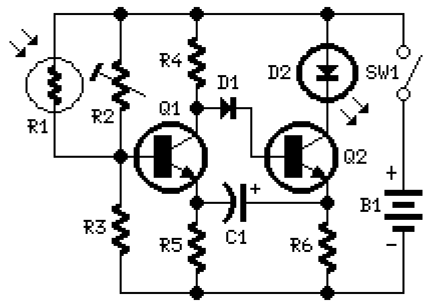
The circuit uses two types of thumbwheel switches. switch numbers TWS1 through TWS8 are decimal-to-BCD converter type while switch numbers TWS9 through TWS16 are 10-input multiplexer type in which only one of the ten inputs may be connected to the output (pole). One thumbwheel switch of each of the two types is used in combination with IC CD4028B (BCD to decimal decoder) to provide one digital output.Eight such identical combinations of thumbwheel switches and IC CD4028 are used. The eight digital outputs obtained from these combinations are connected to the input of 8-input NAND gate CD4068.For getting a logic high output, say at pole-1, it is essential that decimal numbers selected by switch pair TWS1 and TWS9 are identical, as only then the logic high output available at the Specific output pin of IC1 will get transferred to pole-1. Accordingly, when the thumbwheel pair of switches in each combination is individually matched, the outputs at pole-1 to pole-8 will be logic high.This will cause output of 8-input NAND gate IC CD4068b to change over from logic high to logic low, thereby providing a high-to-low going clock pulse at clock input pin of 7-stage counter CD4024B, which is used here as a flip-flop (only Q0 output is used here).The output (Q0) of the flip-flop is connected to a relay driver circuit consisting of transistors T1 and T2. The relay will operate when Q0 output of flip-flop goes low. As a result transistor T1 cuts off and T2 gets forward biased to operate the relay.Switch S1 is provided to enable switching off (locking) and switching on (unlocking) of the relay as desired, once the correct code has been set.

With the code set correctly, the NAND gate output will stay low and flip-flop can be toggled any number of times, making it possible to switch on or switch off the relay, as desired. Suppose we are using the system for switching-on of a deck for which the power supply is routed via the contacts of the relay. The authorised person would select correct code which would cause the supply to become available to the deck. After use he will operate switch S1 and then shuffle the thumbwheel switches TWS1 through TWS8 such that none of the switches produces a correct code. Once the code does not match, pressing of switch S1 has no effect on the output of the flip-flop.Switches TWS9 through TWS16 are concealed after setting the desired code. In place of thumbwheel switches TWS1 through TWS8 DIP switches can also be used.

P410. Dark-activated LED or Lamp Flasher

Simple photo-sensitive circuit
3V battery supply

Circuit diagram



Parts:
R1 Photo resistor (any type)
R2 100K 1/2W Trimmer Cermet
R3,R4 10K 1/4W Resistors
R5 470R 1/4W Resistor
R6 47R 1/4W Resistor
C1 220µF 25V Electrolytic Capacitor
D1 1N4148 75V 150mA Diode
D2 LED Any type and color (See Notes)
Q1,Q2 BC337 45V 800mA NPN Transistors
SW1 SPST Switch
B1 3V (Two 1.5V AA or AAA cells in series, etc.)

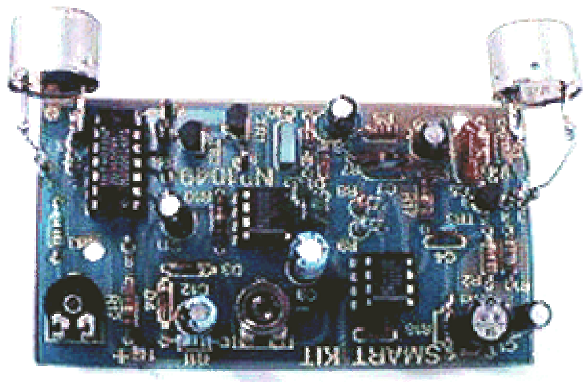
Circuit operation:

This circuit adopts the rather unusual Bowes/White emitter coupled multivibrator circuit. The oscillation frequency is about 1Hz and is set by C1 value. The LED starts flashing when the photo resistor is scarcely illuminated. The onset of flashing can be set by trimming R2.

Notes:

Best results in flashing frequency can be obtained using for C1 a value in the 100 to 1000µF range.
To drive a filament lamp the following changes must be made:
Use a 2.2 to 3V, 250-300mA lamp in place of the LED
R2 = 10K 1/2W Trimmer Cermet
R3, R4 = 1K 1/4W Resistors
R6 = 1R 1/4W Resistor
C1 = 470 to 1000µF 25V Electrolytic Capacitor
In LED-mode operation the stand-by current consumption is less than 400µA.
In Lamp-mode operation the stand-by current consumption is about 3mA.

P411. UltraSonic Radar



General Description

This is a very interesting project with many practical applications in security and alarm systems for homes, shops and cars. It consists of a set of ultrasonic receiver and transmitter which operate at the same frequency. When something moves in the area covered by the circuit the circuit's fine balance is disturbed and the alarm is triggered. The circuit is very sensitive and can be adjusted to reset itself automatically or to stay triggered till it is reset manually after an alarm.

Technical Specifications – Characteristics

Working voltage: 12V DC
Current: 30 mA

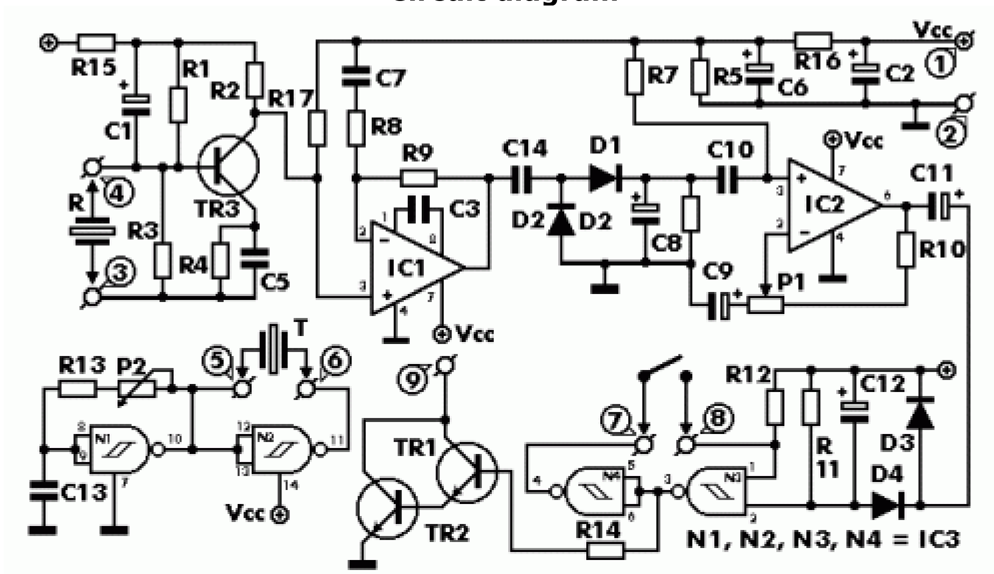
How it Works

As it has already been stated the circuit consists of an ultrasonic transmitter and a receiver both of which work at the same frequency. They use ultrasonic piezoelectric transducers as output and input devices respectively and their frequency of operation is determined by the particular devices in use.

The transmitter is built around two NAND gates of the four found in IC3 which are used here wired as inverters and in the particular circuit they form a multivibrator the output of which drives the transducer. The trimmer P2 adjusts the output frequency of the transmitter and for greater efficiency it should be made the same as the frequency of resonance of the transducers in use. The receiver similarly uses a transducer to receive the signals that are reflected back to it the output of which is amplified by the transistor TR3, and IC1 which is a 741 op-amp. The output of IC1 is taken to the non inverting input of IC2 the amplification factor of which is adjusted by means of P1. The circuit is adjusted in such a way as to stay in balance as long the same as the output frequency of the transmitter. If there is some movement in the area covered by the ultrasonic emission the signal

that is reflected back to the receiver becomes distorted and the circuit is thrown out of balance. The output of IC2 changes abruptly and the Schmitt trigger circuit which is built around the remaining two gates in IC3 is triggered. This drives the output transistors TR1,2 which in turn give a signal to the alarm system or if there is a relay connected to the circuit, in series with the collector of TR1, it becomes activated. The circuit works from 9-12 VDC and can be used with batteries or a power supply.

Circuit diagram



Construction

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up considerably and reduces the possibility of making errors. Smart Kit boards also come pre-drilled and with the outline of the components and their identification printed on the component side to make construction easier. To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and also makes soldering easier. Soldering the components to the board is the only way to build your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it. DO NOT file or sandpaper a dirty or worn out tip. If the tip cannot be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time. DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work. In order to solder a component correctly you should do the following:

@Clean the component leads with a small piece of emery paper.

@Bend them at the correct distance from the component’s body and insert the component in its place on the board.

@You may find sometimes a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board.

@In this case use a mini drill to enlarge the holes slightly. Do not make the holes too large as this is going to make soldering difficult afterwards.

@Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead emerges from the board. The iron tip must touch the lead slightly above the p.c. board.

@When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and allow the solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked,or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it.

@Take care not to overheat the tracks as it is very easy to lift them from the board and break them.

@When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component.

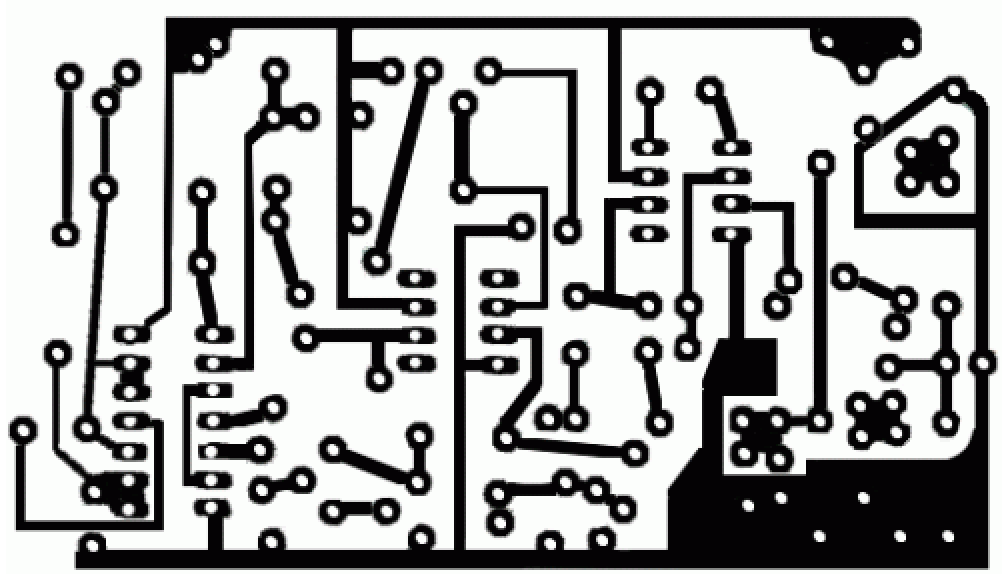
@Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together.

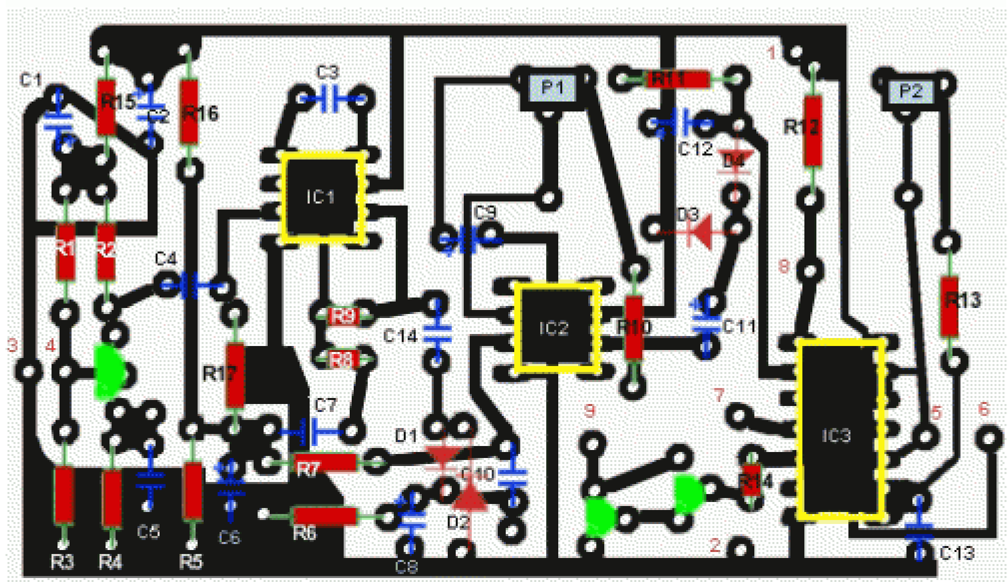
@When you finish your work cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that may still remain on it.

@There are quite a few components in the circuit and you should be careful to avoid mistakes that will be difficult to trace and repair afterwards. Solder first the pins and the IC sockets and then following if that is possible the parts list the resistors the trimmers and the capacitors paying particular attention to the correct orientation of the electrolytic.

@Solder then the transistors and the diodes taking care not to overheat them during soldering. The transducers should be positioned in such a way as they do not affect each other directly because this will reduce the efficiency of the circuit. When you finish soldering, check your work to make sure that you have done everything properly, and then insert the IC's in their sockets paying attention to their correct orientation and handling IC3 with great care as it is of the CMOS type and can be damaged quite easily by static discharges. Do not take it out of its aluminium foil wrapper till it is time to insert it in its socket, ground the board and your body to discharge static electricity and then insert the IC carefully in its socket. In the kit you will find a LED and a resistor of 560 — which will help you to make the necessary adjustments to the circuit. Connect the resistor in series with the LED and then connect them between point 9 of the circuit and the positive supply rail (point 1).

Connect the power supply across points 1 (+) and 2 (-) of the p.c. board and put P1 at roughly its middle position. Turn then P2 slowly till the LED lights when you move your fingers slightly in front of the transducers. If you have a frequency counter then you can make a much more accurate adjustment of the circuit. Connect the frequency counter across the transducer and adjust P2 till the frequency of the oscillator is exactly the same as the resonant frequency of the transducer. Adjust then P1 for maximum sensitivity. Connecting together pins 7 & 8 on the p.c. board will make the circuit to stay triggered till it is manually reset after an alarm. This can be very useful if you want to know that there was an attempt to enter in the place which are protected by the radar.




C1
R15
C2
R16
C3
IC1
P1
R11
C12
D4
R12
P2
C9
D3
R1
R2
C4
R9
R8
C14
IC2
R10
C11
R13
R17
C7
D1
C10
D2
R7
R6
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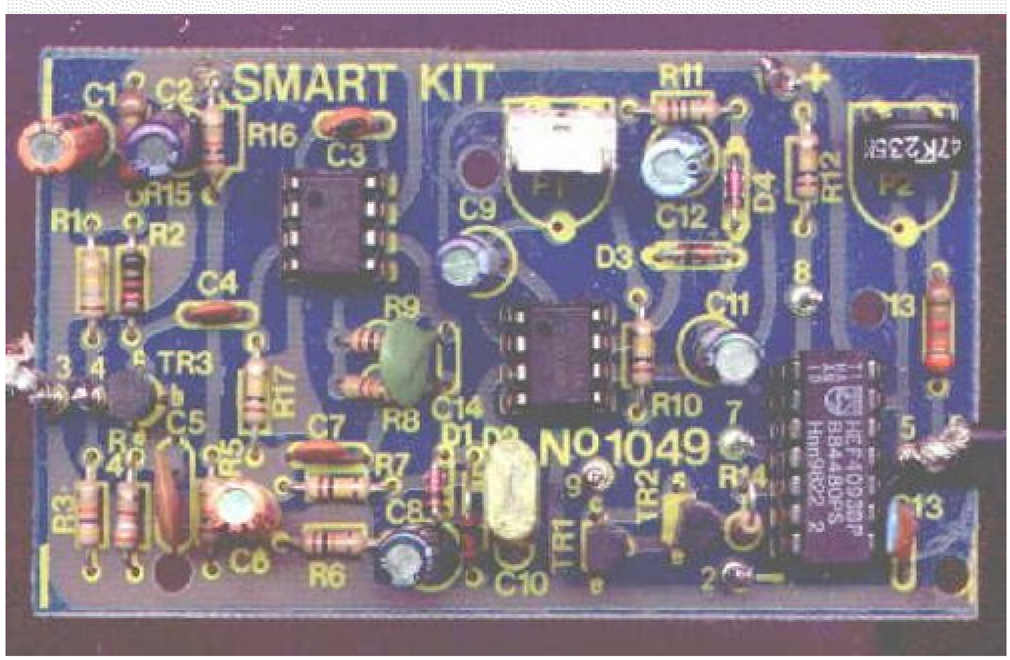

SMART KIT
No1049

Adjustments
This kit does not need any adjustments, if you follow the building instructions.

Warning
If they are used as part of a larger assembly and any damage is caused, our company bears no responsibility.

While using electrical parts, handle power supply and equipment with great care, following safety standards as described by international specs and regulations.

If it does not work

Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems. Check again all the external connections to and from the circuit to see if there is a mistake there.

See that there are no components missing or inserted in the wrong places.

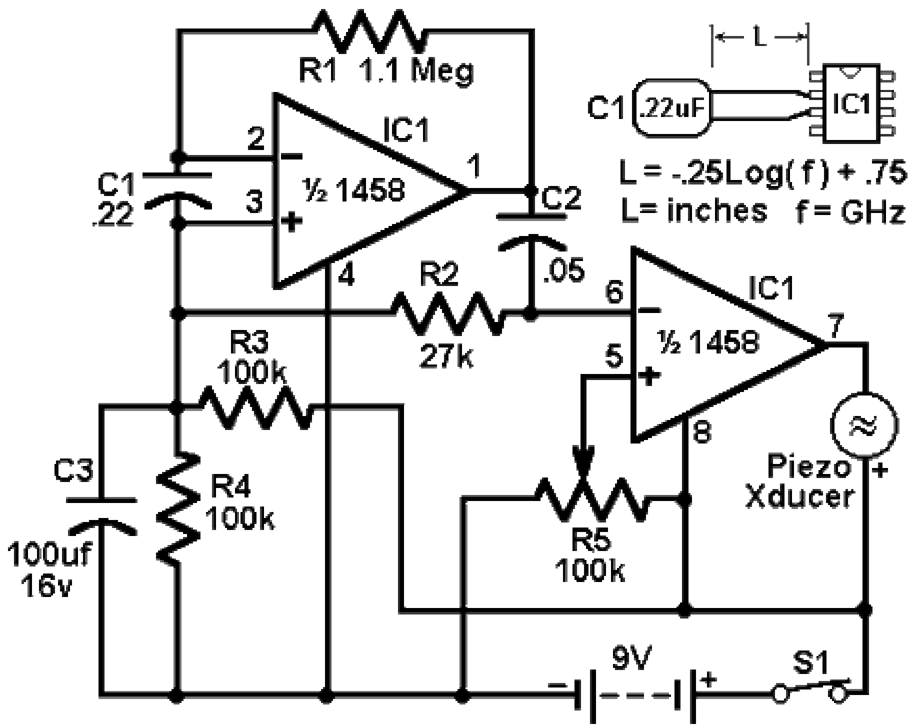
Make sure that all the polarised components have been soldered the right way round. Make sure that the supply has the correct voltage and is connected the right way round to your circuit. Check your project for faulty or damaged components.

If everything checks and your project still fails to work, please contact your retailer and the Smart Kit Service will repair it for you.

Parts
R1 180 KOhm
R2 12 KOhm
R3, 8 47 KOhm
R4 3,9 KOhm
R5, 6, 16 10 KOhm
R7, 10, 12, 14, 17 100 KΩ
R9, 11 1 MOhm
R13, 15 3,3 KOhm
C1, C6 10uF/16V
C2 47uF/16V
C3 4,7 pF
C4, C7 1 nF
C5 10nF
C8, C11 4,7 uF/16V
C9 22uF/16V
C10 100 nF
C12 2,2 uF/16V
C13 3,3nF
C14 47nF
TR1, 2, 3 BC547 , BC548
P1 10 KOhm trimmer
P2 47 KOhm trimmer
IC1, 2 741 OP-AMP
IC3 4093 C-MOS
R TRANSDUCER 40KHz
T TRANSDUCER 40KHz
D1, 2, 3, 4 1N4148

P412. Economy radar detector

Circuit diagram

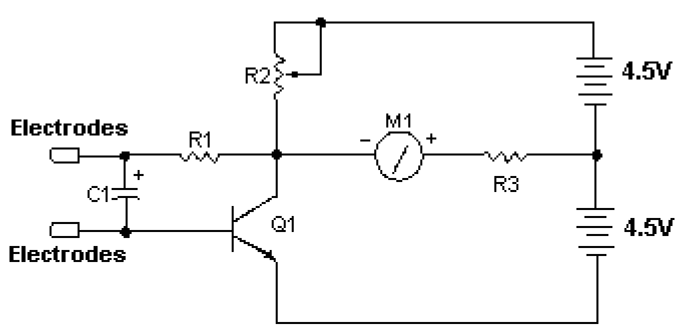


This circuit uses a 1458 dual op-amp to form a radar detector. C1 is the detector of the radar signal. The first op-amp forms a current-to-voltage converter and the second op-amp buffers the output to drive the piezo transducer. R5 sets the switching threshold of the second op-amp; normally it is adjusted so that the circuit barely triggers on background noise, then it's backed off a bit. The response of the circuit may be tuned by adjusting the length of the leads on C1. For typical road-radar systems, the input capacitor's leads should be about 0.5 to 0.6 inches long.

P413. Simple Lie Detector

Here's a simple lie detector that can be built in a few minutes, but can be incredibly useful when you want to know if someone is really telling you the truth. It is not as sophisticated as the ones the professionals use, but it works. It works by measuring skin resistance, which goes down when you lie.

Circuit diagram

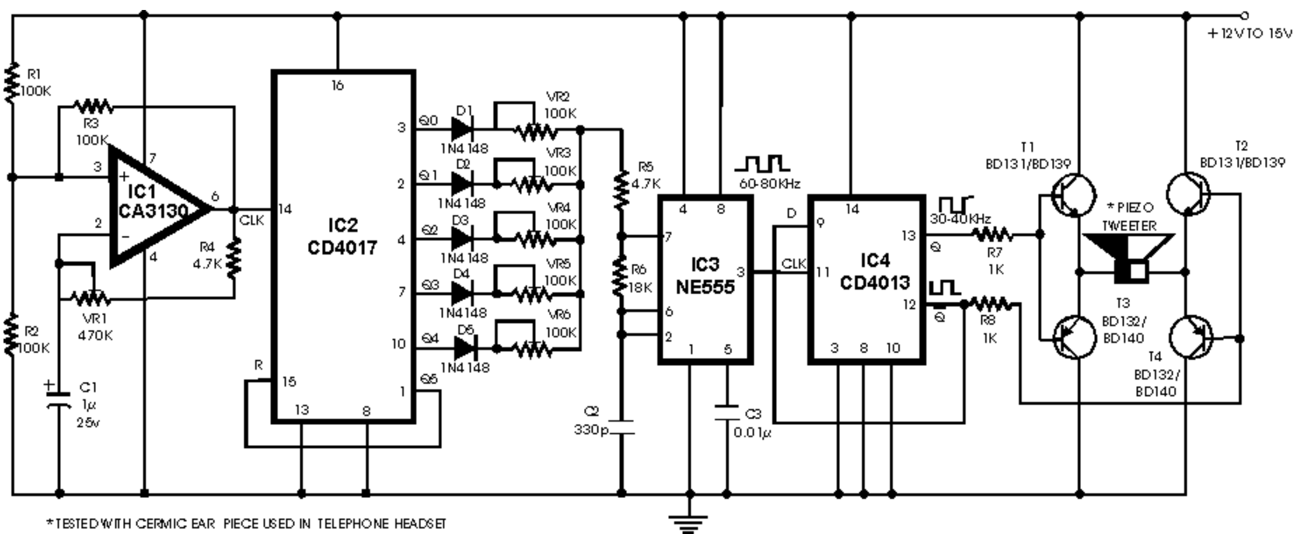


Parts
R1 33K 1/4W Resistor
R2 5K Pot
R3 1.5K 1/4W Resistor
C1 1uF 16V Electrolytic Capacitor
Q1 2N3565 NPN Transistor
M1 0-1 mA Analog Meter
MISC Case, Wire, Electrodes (See Nots)

Notes
1. The electrodes can be alligator clips (although they can be painful), electrode pads (like the type they use in the hospital), or just wires and tape.

2. To use the circuit, attach the electrodes to the back of the subjects hand, about 1 inch apart. Then, adjust the meter for a reading of 0. Ask the questions. You know the subject is lying when the meter changes.

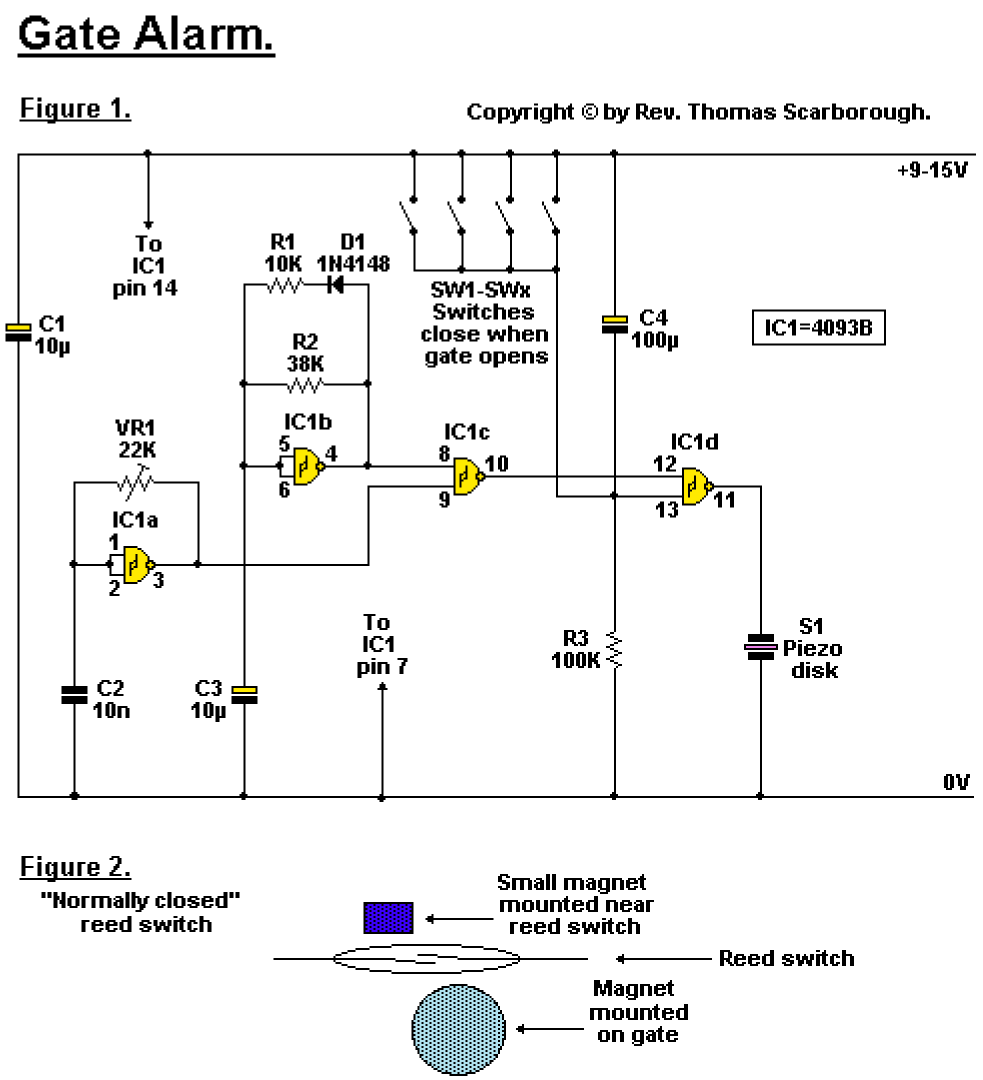
P414. Ultrasonic Pest Repeller



*TESTED WITH CERMIC EAR PIECE USED IN TELEPHONE HEADSET
VR1 TO VR6 ARE SET FOR DIFFERENT VALUES TO GENERATE DIFFERENT FREQUENCIES IN ULTRASONIC FREQUENCY RANGE

It is well know that pests like rats, mice etc are repelled by ultrasonic frequency in the range of 30 kHz to 50 kHz. Human beings can't hear these high-frequency sounds. Unfortunately, all pests do not react at the same ultrasonic frequency. While some pests get repelled at 35 kHz, some others get repelled at 38 to 40 kHz. Thus to increase the effectiveness, freque- ncy of ultrasonic oscillator has to be continuously varied between certain limits. By using this circuit design, frequency of emission of ultrasonic sound is continuously varied step-by-step automatically. Here five steps of variation are used but the same can be extended up to 10 steps, if desired. For each clock pulse output from op-amp IC1 CA3130 (which is wired here as a low-frequency square wave oscillator), the logic 1 output of IC2 CD4017 (which is a well-known decade counter) shifts from Q0 to Q4 (or Q0 to Q9). Five presets VR2 through VR6 (one each connected at Q0 to Q4 output pins) are set for different values and connected to pin 7 of IC3 (NE555) electronically. VR1 is used to change clock pulse rate. IC3 is wired as an astable multivibrator operating at a frequency of nearly 80 kHz. Its output is not symmetrical. IC4 is CD4013, a D-type flip-flop which delivers symmetrical 40kHz signals at its Q and Q outputs which are amplified in push-pull mode by transistors T1, T2, T3 and T4 to drive a low-cost, high-frequency piezo tweeter. For frequency adjustments, you may use an oscilloscope. It can be done by trial and error also if you do not have an oscilloscope. This pest repeller would prove to be much more effective than those published earlier because here ultrasonic frequency is automatically changed to cover different pests and the power output is also sufficiently high. If you want low-power output in 30-50 kHz ultrasonic frequency range then the crystal transducer may be directly connected across Q and Q outputs of IC4 (transistor amplifier is not necessary.

P415. Gate Alarm



Description:

A cheap and simple gate alarm made from a single CMOS Integrated Circuit.

Circuit Notes

Figure 1 represents a cheap and simple Gate Alarm, that is intended to run off a small universal AC-DC power supply.

IC1a is a fast oscillator, and IC1b a slow oscillator, which are combined through IC1c to emit a high pip-pip-pip warning sound when a gate (or window, etc.) is opened. The circuit is intended not so much to sound like a siren or warning device, but rather to give the impression: "You have been noticed." R1 and

D1 may be omitted, and the value of R2 perhaps reduced, to make the Gate Alarm sound more like a warning device. VR1 adjusts the frequency of the sound emitted.

IC1d is a timer which causes the Gate Alarm to emit some 20 to 30 further pips after the gate has been closed again, before it falls silent, as if to say: "I'm more clever than a simple on-off device." Piezo disk S1 may be replaced with a LED if desired, the LED being wired in series with a 1K resistor.

Figure 2 shows how an ordinary reed switch may be converted to close (a "normally closed" switch) when the gate is opened. A continuity tester makes the work easy. Note that many reed switches are delicate, and therefore wires which are soldered to the reed switch should not be flexed at all near the switch. Other types of switches, such as microswitches, may also be used.

P416. 5 Zone Alarm System

Description

This is a complete alarm system with 5 independent zones suitable for a small office or home environment. It uses just 3 CMOS IC's and features a timed entry / exit zone, 4 immediate zones and a panic button. There are indicators for each zone a "system armed" indicator. The schematic is as follows:

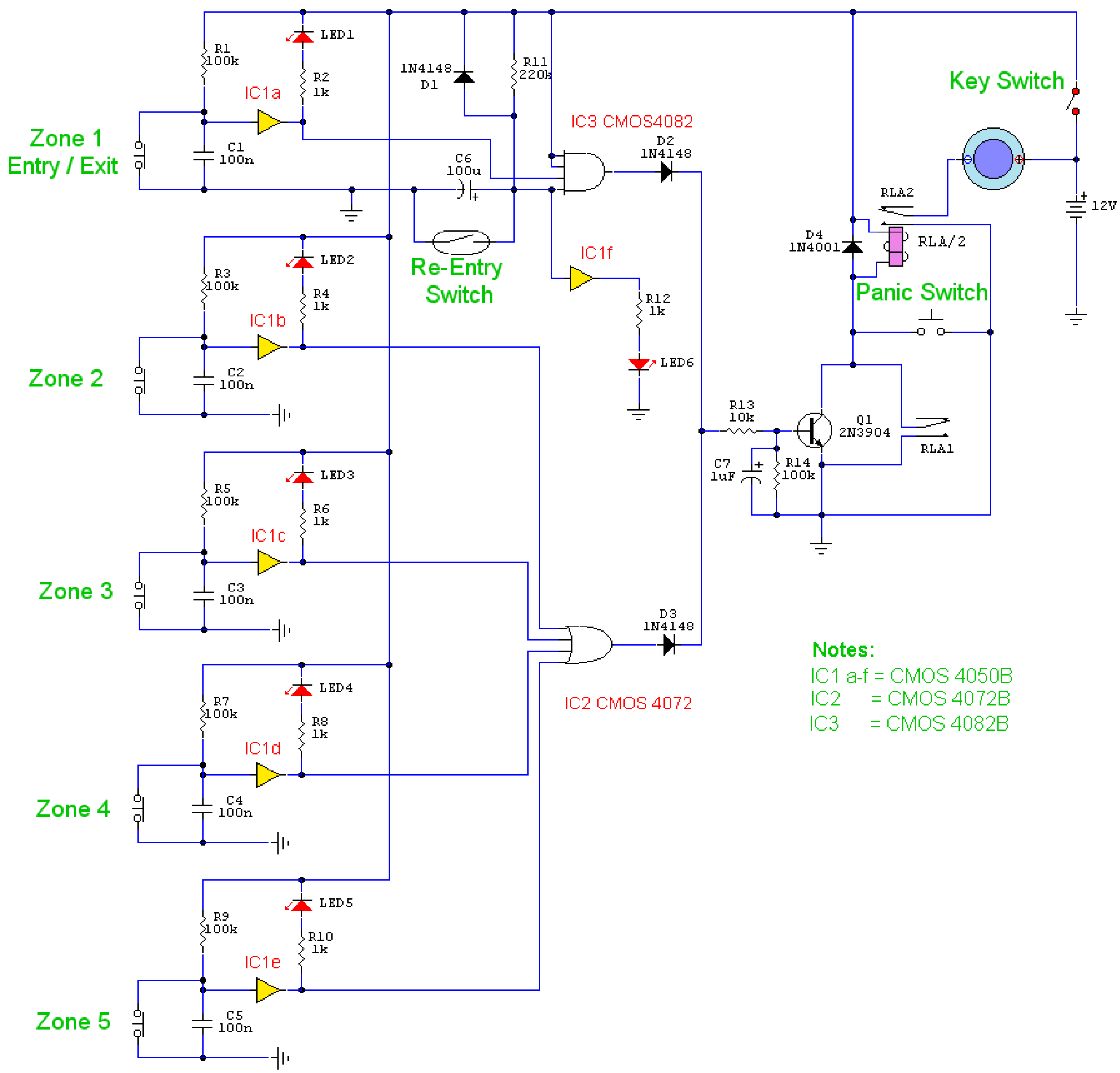
Circuit Notes:

Each zone uses a normally closed contact. These can be micro switches or standard alarm contacts (usually reed switches). Suitable switches can be bought from alarm shops and concealed in door frames, or window ledges.

Zone 1 is a timed zone which must be used as the entry and exit point of the building. Zones 2 - 5 are immediate zones, which will trigger the alarm with no delay. Some RF immunity is provided for long wiring runs by the input capacitors, C1-C5. C7 and R14 also form a transient suppresser. The key switch acts as the Set/Unset and Reset switch. For good security this should be the metal type with a key.

Operation:

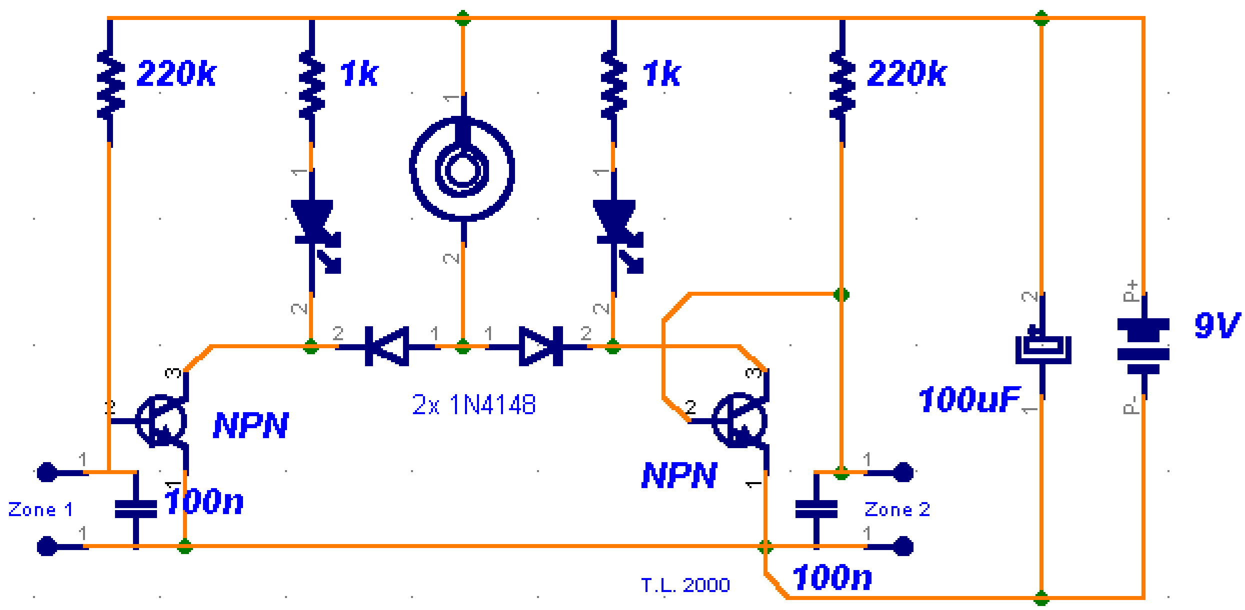
At switch on, C6 will charge via R11, this acts as the exit delay and is set to around 30 seconds. This can be altered by varying either C6 or R11. Once the timing period has elapsed, LED6 will light, meaning the system is armed. LED6 may be mounted externally (at the bell box for example) and provides visual indication that the system has set. Once set any contact that opens will trigger the alarm, including Zone 1. To prevent triggering the alarm on entry to the building, the concealed re-entry switch must be operated. This will discharge C6 and start the entry timer. The re-entry switch could be a concealed reed switch, located anywhere in a door frame, but invisible to the eye. The panic switch, when pressed, will trigger the alarm when set. Relay contacts RLA1 provide the latch, RLA2 operate the siren or buzzer.



Notes:
IC1 a-f = CMOS 4050B
IC2 = CMOS 4072B
IC3 = CMOS 4082B

P417. Miniature Loop Alarm

A few months ago, I decided to build a compact, yet effective alarm. My demands were:- simple construction, reliable operation, very small power consumption, and, most of all, small size. I started with CMOS logic gates, but was soon forced to abandon the concept after a few unsuccessful (and far too complicated) attempts. Then I suddenly realized that a simple transistor switch might do the job and I was right.

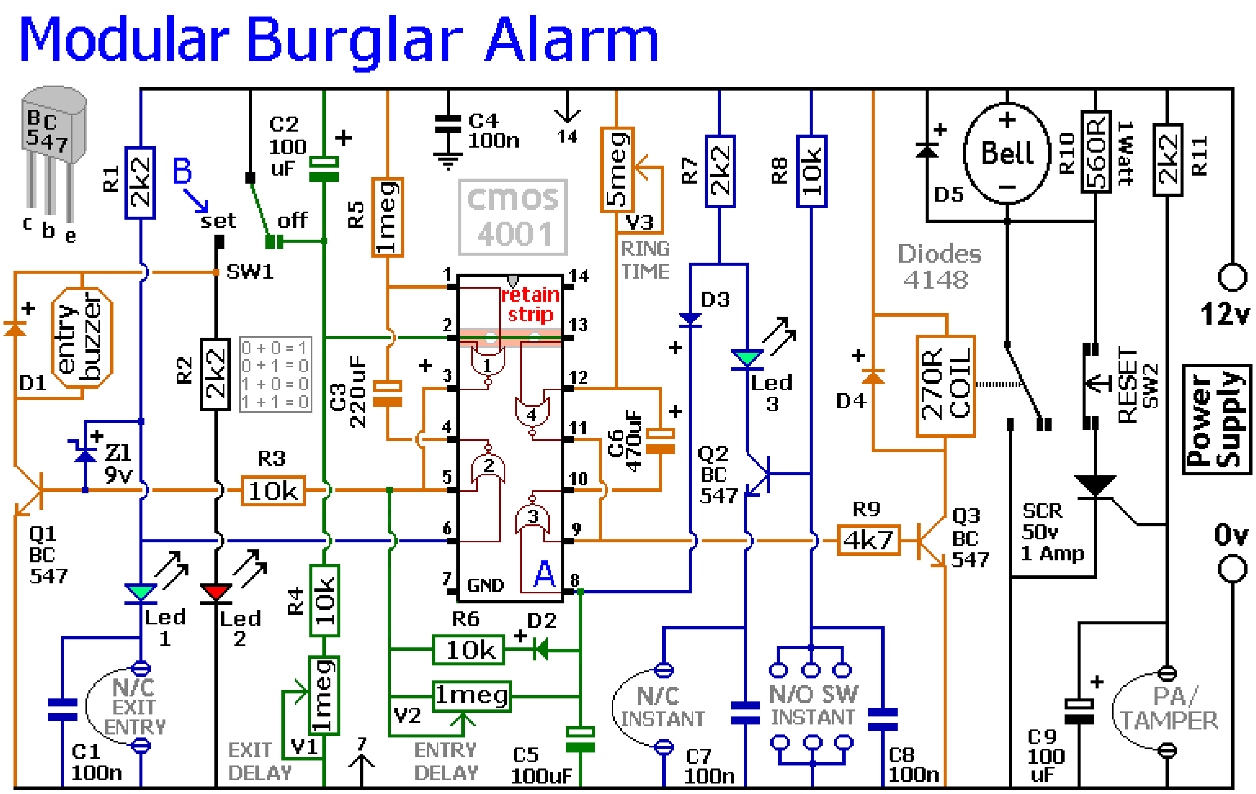


As you can clearly see from the schematics, the circuit is utterly primitive and consists of two identical transistor switches. Each has its own alarm LED and they're coupled to a neat 82dB buzzer. The two 1N4148 diodes are used to prevent a signal from one sensor from triggering both LEDs. The sensors used are either wire loops or normally closed reed switches or even a combination of both. You could, for example, tie a wire loop to your suitcase and place a reed switch to the door of your hotel room.

Since this little alarm is intended to be kept in arms reach at all times, there aren't any provisions for automatic shutdown after a certain period of time. The buzzer will sound until you turn the whole circuit off or connect the wire loop back to the jumpers. The same goes for the two LEDs, each indicating its own zone.

Construction is not critical and there aren't any traps for the novice. The two 100n capacitors aren't really necessary, I just included them to make sure that there is no noise interference coming from the long wire loops. For transistors, you can use any NPN general-purpose audio amplifiers/switches (BC 107/108/109, BC 237/238, 2N2222, 2N3904...). Assemble the circuit on perf board. Together with the buzzer and a 9V battery, it should easily fit in a pocket-sized plastic box smaller than a pack of cigarettes. A fresh battery should suffice for weeks of continuous operation.

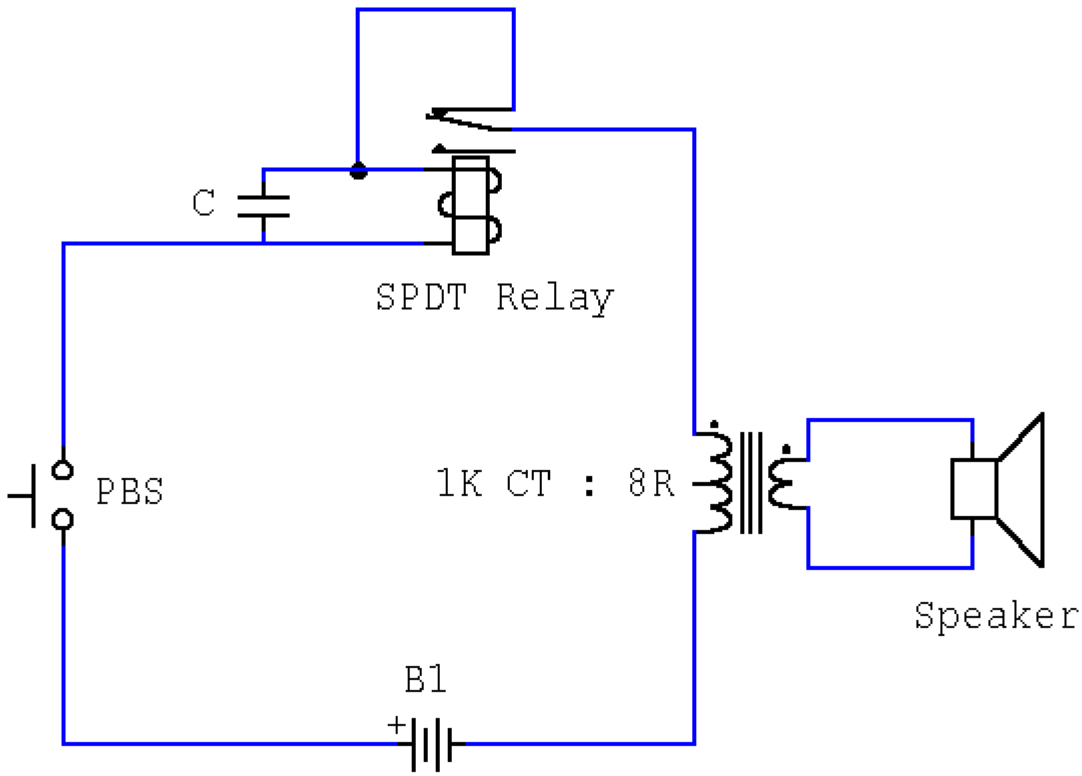
P418. **Modular Burglar Alarm**



Circuit Notes

This circuit features automatic Exit and Entry delays and a timed Bell Cut-off. It has provision for both normally-closed and normally-open contacts, and a 24-hour Personal Attack/Tamper zone. It is connected permanently to the 12-volt supply and its operation is "enabled" by opening SW1. By using the expansion modules, you can add as many zones as you require; some or all of which may be the inertia (shock) sensor type. All the green LEDs should be lighting before you open SW1. You then have up to about a minute to leave the building. As you do so, the Buzzer will sound. It should stop sounding when you shut the door behind you. This indicates that the Exit/Entry loop has been successfully restored within the time allowed. When you re-enter the building you have up to about a minute to move SW1 to the off position. If SW1 is not switched off in time, the relay will energise and sound the main bell. It will ring for up to about 40 minutes. But it can be turned off at any time by SW1. The "Instant" zone has no Entry Delay. If you don't want to use N/O switches, leave out R8, C8 and Q2; and fit a link between Led 3 and C7. The 24 Hour PA/Tamper protection is provided by the SCR/Thyristor. If any of the switches in the N/C loop is opened, R11 will trigger the SCR and the bell will ring. In this case the bell has no time limit. Once the loop is closed again, the SCR may be reset by pressing SW2 and temporarily interrupting the current flow. The basic circuit will be satisfactory in many situations. However, it's much easier to find a fault when the alarm is divided into zones and the control panel can remember which zone has caused the activation. The expansion modules are designed to do this. Although they will work with the existing instant zone, they are intended to replace it. When a zone is activated, its red LED will light and remain lit until the reset button is pressed. All the modules can share a single reset button.

P419. **Novel Buzzer**



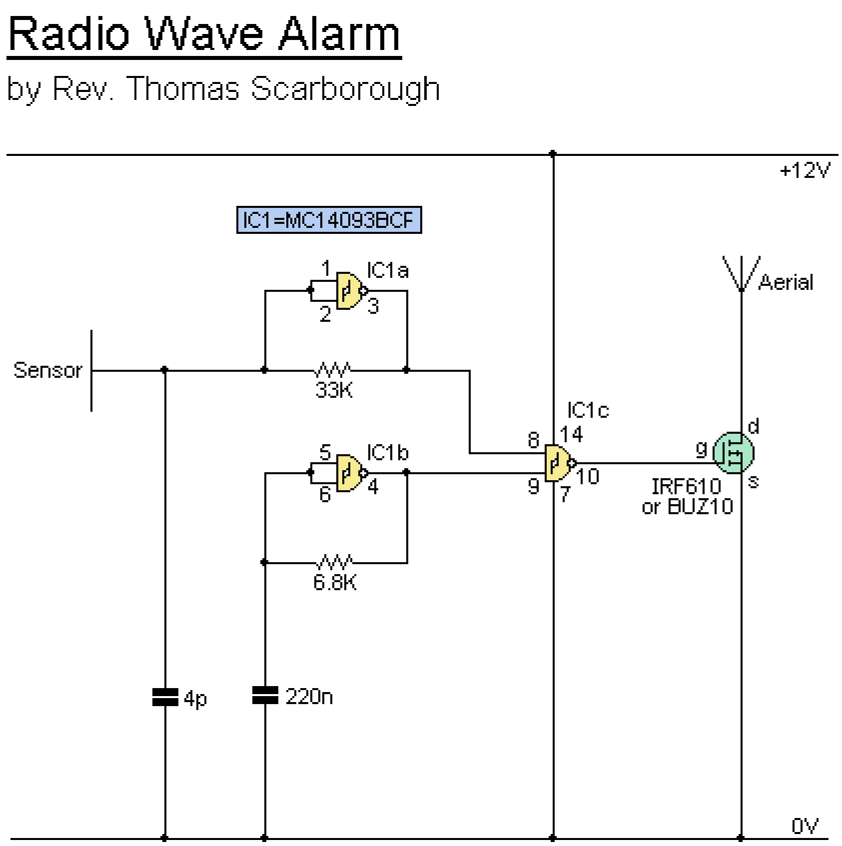
Circuit Notes

This novel buzzer circuit uses a relay in series with a small audio transformer and speaker. When the switch is pressed, the relay will operate via the transformer primary and closed relay contact. As soon as the relay operates the normally closed contact will open, removing power from the relay, the contacts close and the sequence repeats, all very quickly...so fast that the pulse of current causes fluctuations in the transformer primary, and hence secondary. The speakers tone is thus proportional to relay operating frequency. The capacitor C can be used to "tune" the note. The nominal value is 0.001uF, increasing capacitance lowers the buzzers tone.

P420. Radio Wave Alarm

Description:

This simple circuit is sure to have the police beating a path to your door- however, it has the added advantage of alerting you to their presence even before their footsteps fall on the doormat.



Circuit Notes

The circuit transmits on Medium Wave (this is the small problem with the police). IC1a, together with a sensor (try a 20cm x 20cm sheet of tin foil) oscillates at just over 1MHz. This is modulated by an audio frequency (a continuous beep) produced by IC1b. When a hand or a foot approaches the sensor, the frequency of the transmitter (IC1a) drops appreciably.

Suppose now that the circuit transmits at 1MHz. Suppose also that your radio is tuned to a frequency just below this. The 1MHz transmission will therefore not be heard by the radio. But bring a hand or a foot near to the sensor, and the transmitter's frequency will drop, and a beep will be heard from the radio.

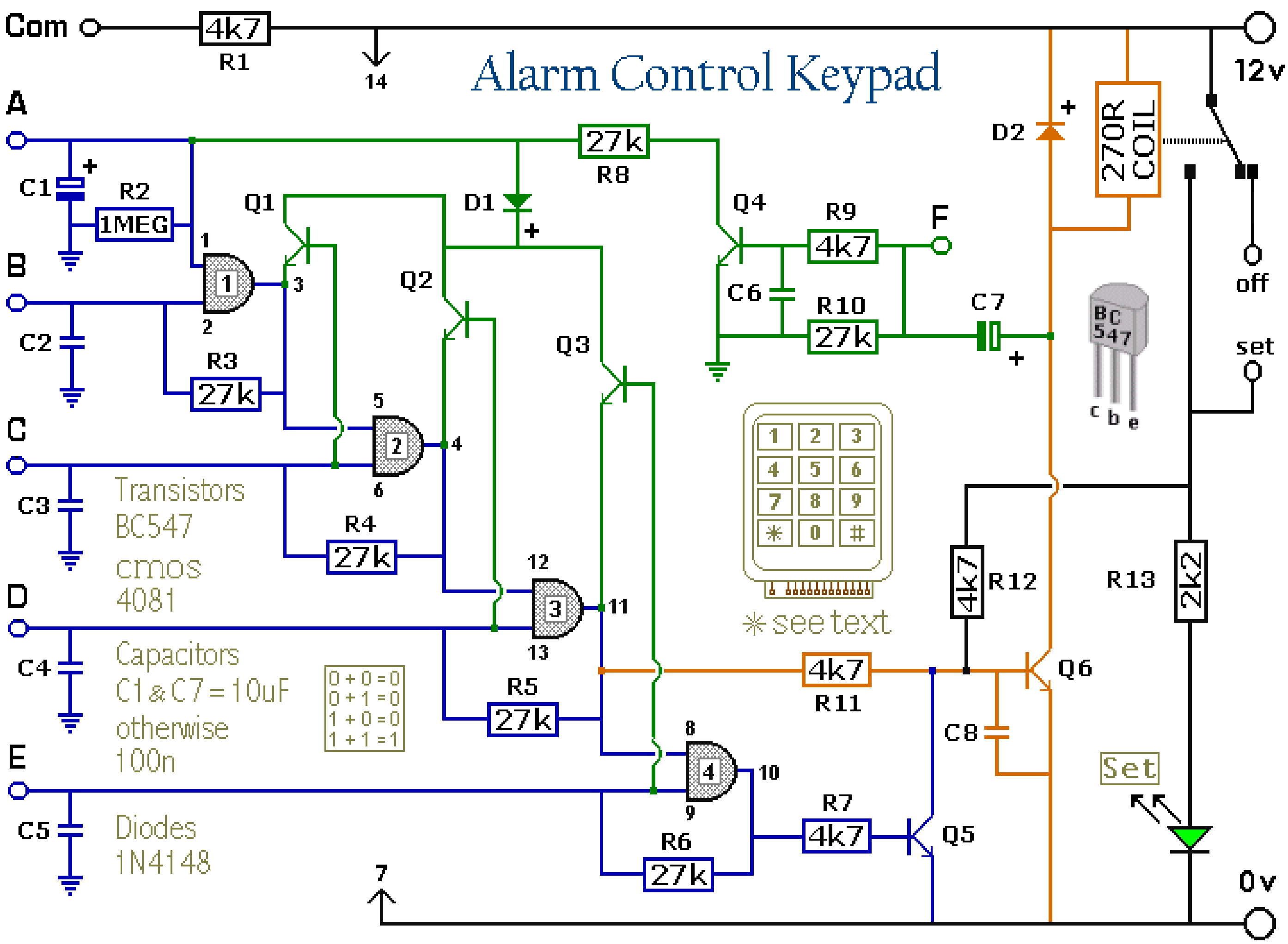
Attach the antenna to a multiplug adapter that is plugged into the mains, and you will find that the Medium Wave transmission radiates from every wire in your house. Now place a suitably tuned Medium Wave radio near some wires or a plug point in your house, and an early-warning system is set up.

Instead of using the sheet of tin foil as the sensor, you could use a doorknob, or burglar bars. Or you could use a pushbutton and series resistor (wired in series with the 33K resistor - the pushbutton would short it out) to decrease the frequency of IC1a, so activating the system by means of a pushbutton switch. In this case, the radio would be tuned to a frequency just below that of the transmitter.

P421. 5 Digit Alarm Keypad

Description

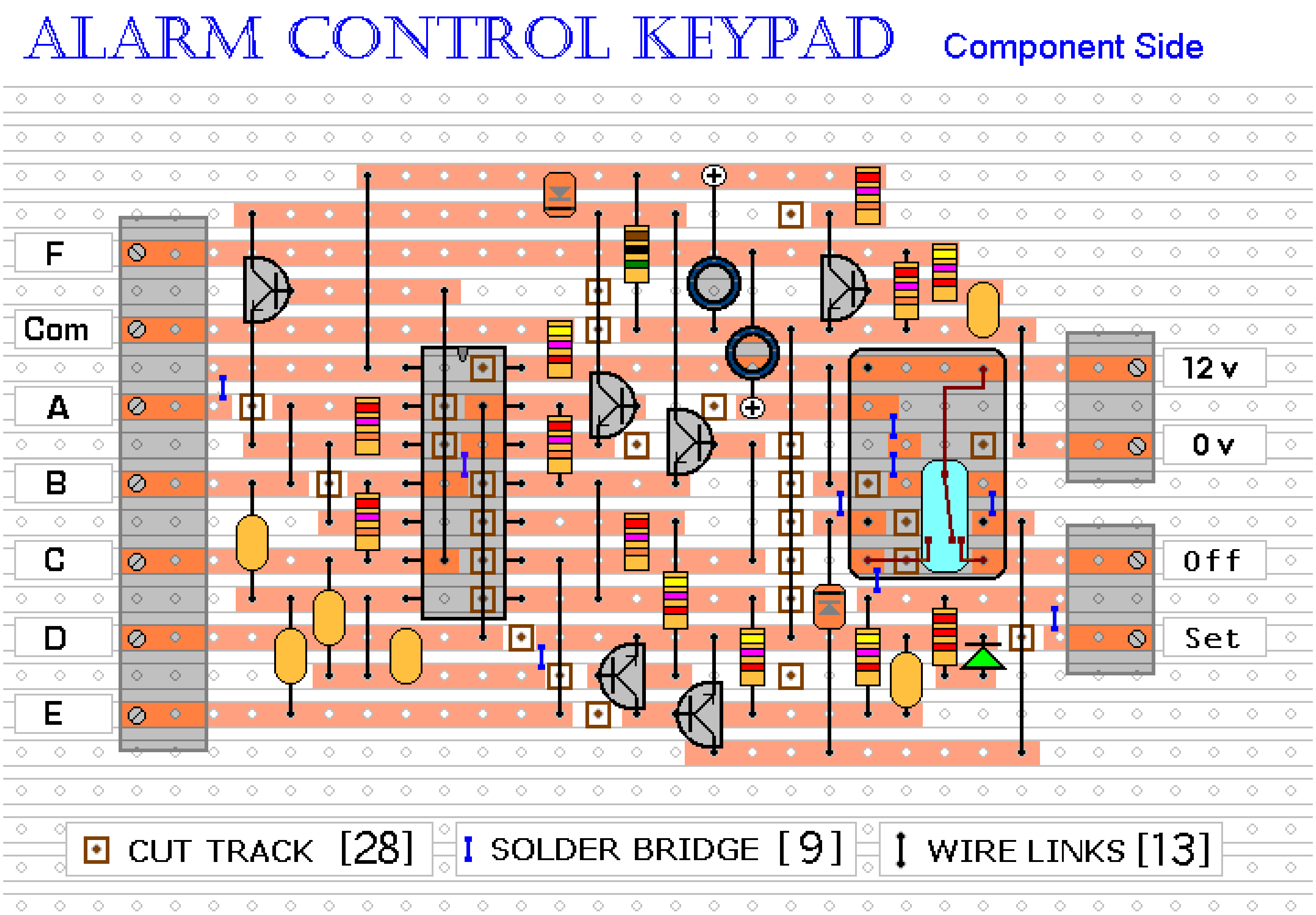
This is an enhanced 5 digit keypad which may be used with the Modular Alarm System



Circuit Notes

This switch will suit the Modular Burglar Alarm circuit. However, it also has other applications. The Keypad must be the kind with a common terminal and a separate connection for each key. On a 12-key pad, look for 13 terminals. The matrix type with 7 terminals will NOT do. Choose the five keys you want as your code, and connect them to 'A, B, C, D & E'. Wire the common to R1 and all the remaining keys to 'F'. Because your choice can include the non-numeric symbols, almost 100 000 different codes are available. The Alarm is set using the first four of your five chosen keys. When 'A, B, C & D' are pressed in the right order and within the time set by C1 and R2 (about 10 seconds), current through R11 switches Q6 on. The relay energizes, and then holds itself on by providing base current for Q6 through R12. The 12-volt output switches from the "off " to the "set " terminal, and the LED lights. To switch the Alarm off again it is necessary to press A, B, C, D & E in the right order. The IC is a quad 2-input AND gate, a Cmos 4081. These gates only produce a high output when both inputs are high. Pressing 'A' takes pin 1 high for a period of time set by C1 and R2. This 'enables' gate 1, so that when 'B' is pressed, the output at pin 3 will go high. This output does two jobs. It locks itself high using R3 and it enables gate 2 by taking pin 5 high. The remaining gates operate in the same way, each locking itself on through a resistor and enabling its successor. If the correct code is entered within the time allowed, pin 10 will switch Q5 on and so connect the base of Q6 to ground. This causes Q6 to switch off and the relay to drop out. Any keys not wired to 'A, B, C, D or E ' are connected to the base of Q4 by R9. Whenever one of these 'wrong' keys is pressed, Q4 takes pin 1 low. This removes the 'enable' from gate 1, and the code entry process fails. If C, D or E is pressed out of sequence, Q1, Q2 or Q3 will also take pin 1 low, with the same result. You can change the code by altering the keypad connections. If you make a mistake entering the code, just start again. If you need a more secure code you can use a bigger keypad with more 'wrong' keys wired to 'F'. A 16-key pad gives over half a million different codes. All components are shown lying flat on the board; but some are actually mounted upright. The links are bare copper wires on the component side. Two of the links must be fitted before the IC.

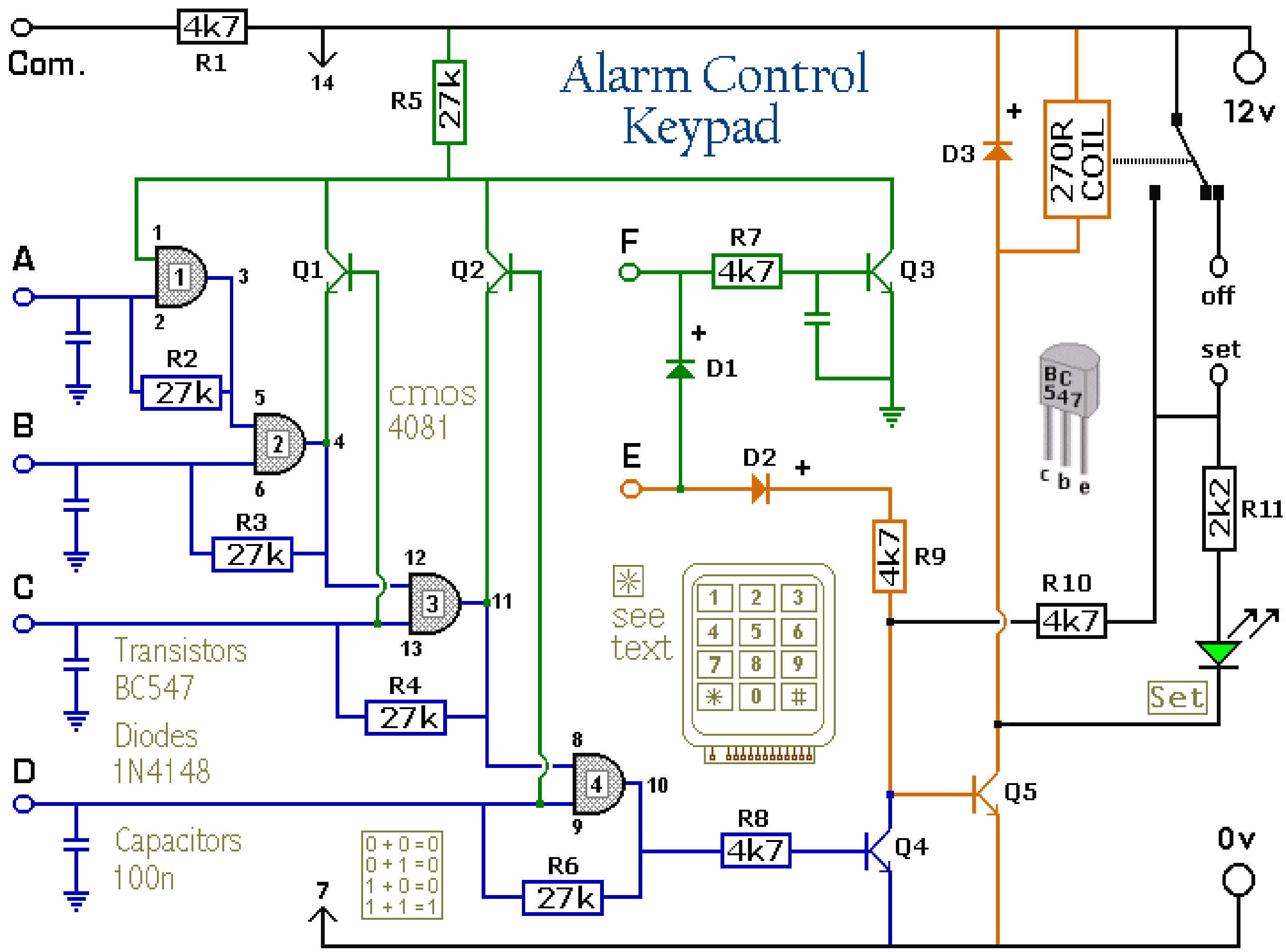
Veroboard Layout



P422. 4 Digit Alarm Keypad

Description

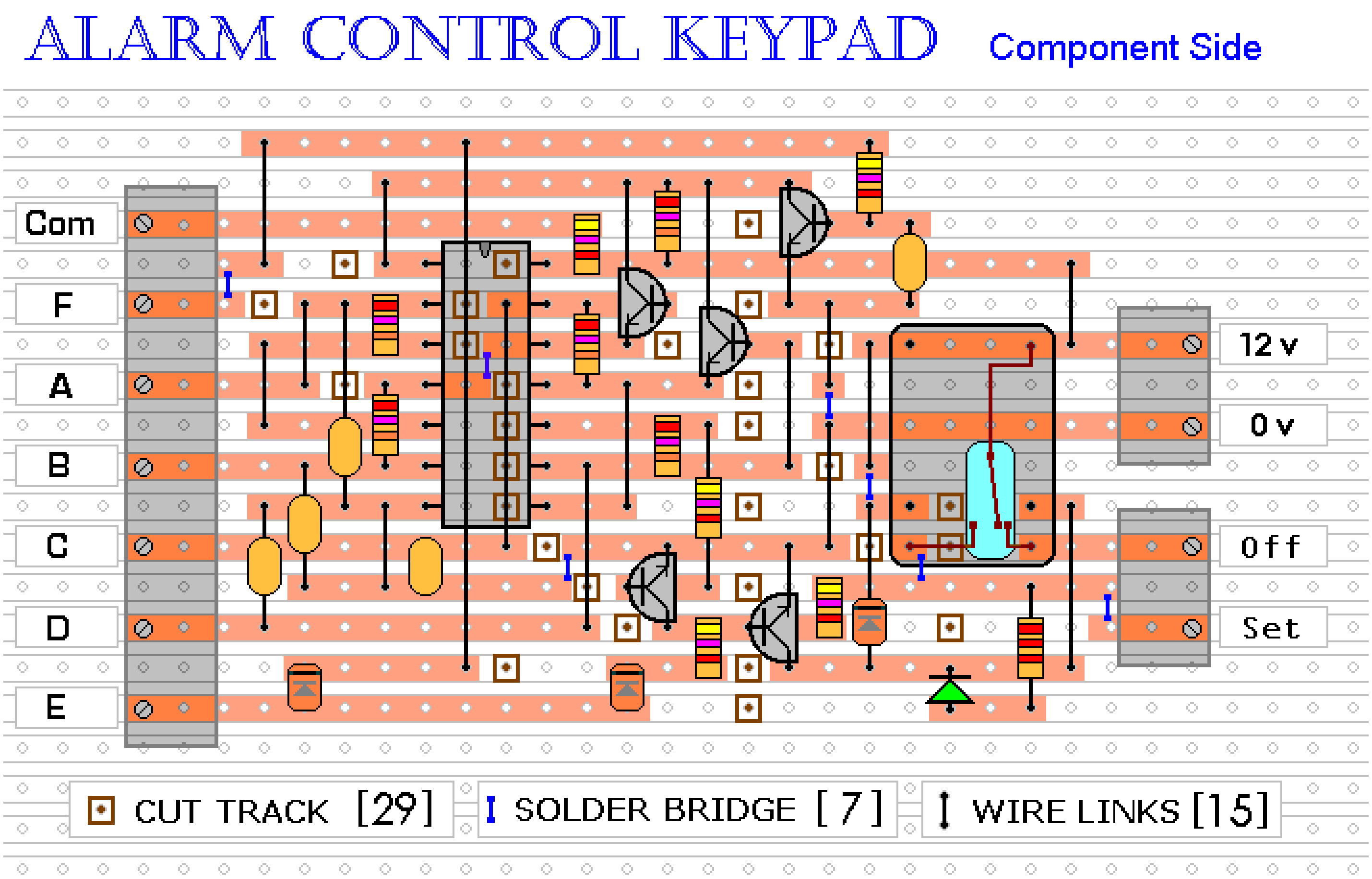
This is an enhanced 4 digit keypad which may be used with the Modular Alarm System.



Notes

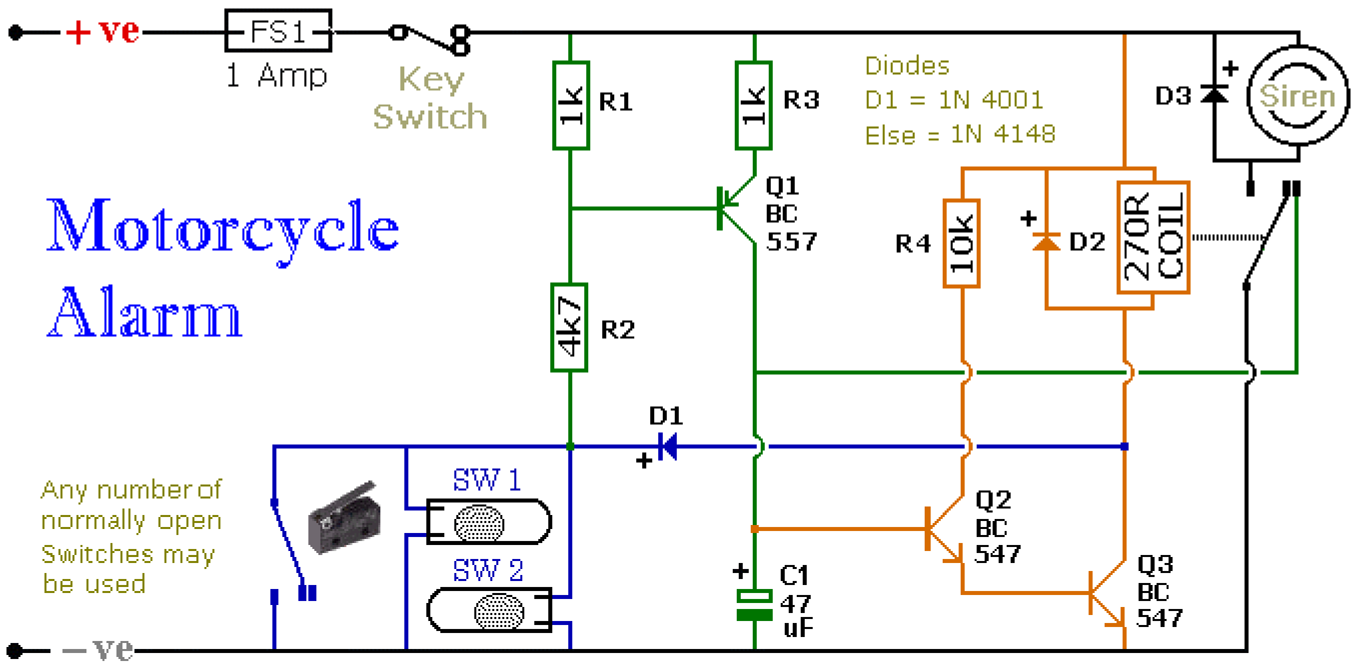
The Keypad must be the kind with a common terminal and a separate connection for each key. On a 12-key pad, look for 13 terminals. The matrix type with 7 terminals will NOT do. The Alarm is set by pressing a single key. Choose the key you want to use and wire it to 'E'. Choose the four keys you want to use to switch the alarm off, and connect them to 'A B C & D'. Your code can include the non-numeric symbols. With a 12-key pad, over 10 000 different codes are available. Wire the common to R1 and all the remaining keys to 'F'. When 'E' is pressed, current through D2 and R9 switches Q5 on. The relay energises, and then holds itself on by providing base current for Q5 through R10. The 12-volt output is switched from the "off " to the "set " terminal, and the LED lights. To switch the Alarm off again it is necessary to press A, B, C & D in the right order. The IC is a quad 2-input AND gate, a Cmos 4081. These gates only produce a high output when both inputs are high. Pin 1 is held high by R5. This 'enables' gate 1, so that when 'A' is pressed, the output at pin 3 will go high. This output does two jobs. It locks itself high using R2 and it enables gate 2 by taking pin 5 high. The remaining gates operate in the same way, each locking itself on through a resistor and enabling its successor. If the correct code is entered, pin 10 will switch Q4 on and so connect the base of Q5 to ground. This causes Q5 to switch off and the relay to drop out. Any keys not wired to 'A B C D or E' are connected to the base of Q3 by R7. Whenever one of these 'wrong' keys is pressed, Q3 takes pin 1 low. This removes the 'enable' from gate 1, and the code entry process fails. If 'C' or 'D' is pressed out of sequence, Q1 or Q2 will also take pin 1 low, with the same result. You can change the code by altering the keypad connections. If you need a more secure code use a bigger keypad with more 'wrong' keys wired to 'F'. A 16-key pad gives over 40 000 different codes. All components are shown lying flat on the board; but some are actually mounted upright. The links are bare copper wires on the component side. Two of the links must be fitted before the IC.

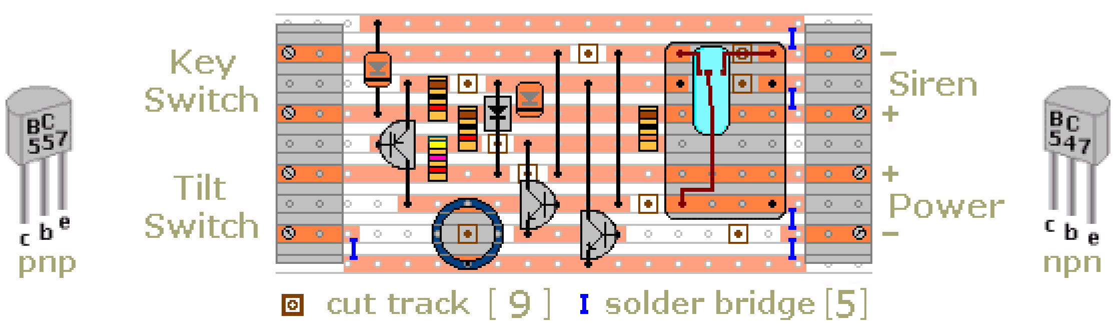
Veroboard Layout



The Support Material for this circuit includes a step-by-step guide to the construction of the circuit-board, a parts list, a detailed circuit description and more.

P423. Motorcycle Alarm





Notes:

Any number of normally open switches may be used. Fit the mercury switches so that they close when the steering is moved or when the bike is lifted off its side-stand or pushed forward off its centre-stand. Use micro-switches to protect removable panels and the lids of panniers etc. While at least one switch remains closed, the siren will sound. About two minutes after the switches have been opened again, the alarm will reset. How long it takes to switch off depends on the characteristics of the actual components used. But, up to a point, you can adjust the time to suit your requirements by changing the value of C1.

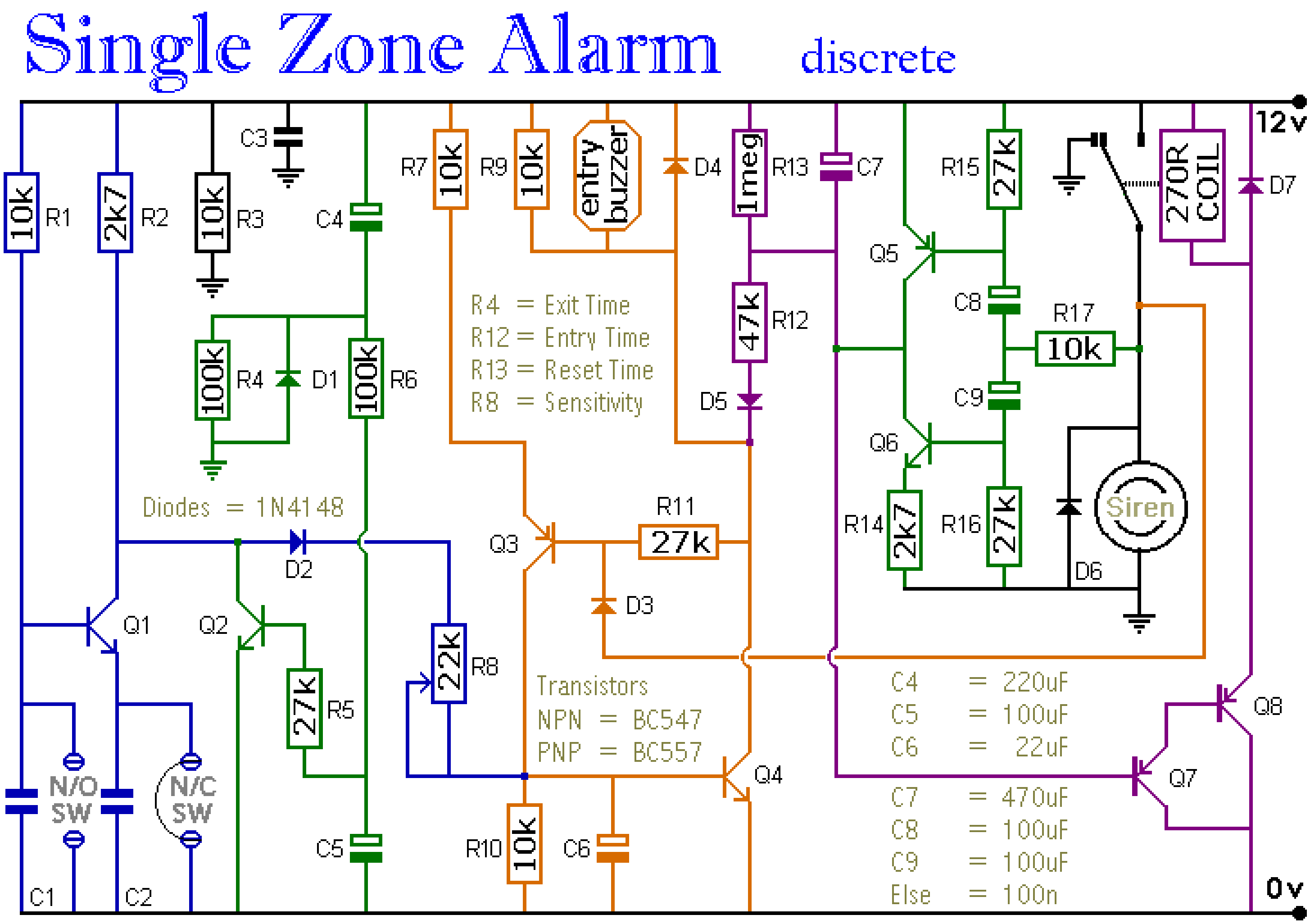
The circuit board and switches must be protected from the elements. Dampness or condensation will cause malfunction. Without its terminal blocks, the board is small. Ideally, you should try to find a siren with enough spare space inside to accommodate it. Fit a 1-amp in-line fuse close to the power source. This protects the wiring. Instead of using a key-switch you can use a hidden switch; or you could use the normally closed contacts of a small relay. Wire the relay coil so that it is energized while the ignition is on. Then every time you turn the ignition off, the alarm will set itself.

When it's not sounding, the circuit uses virtually no current. This should make it useful in other circumstances. For example, powered by dry batteries and with the relay and siren voltages to suit, it could be fitted inside a computer or anything else that's in danger of being picked up and carried away. The low standby current and automatic reset means that for this sort of application an external on/off switch may not be necessary.

P424. Single Zone Alarm

Description:

A single zone alarm circuit with entry and exit delay and other facilities.



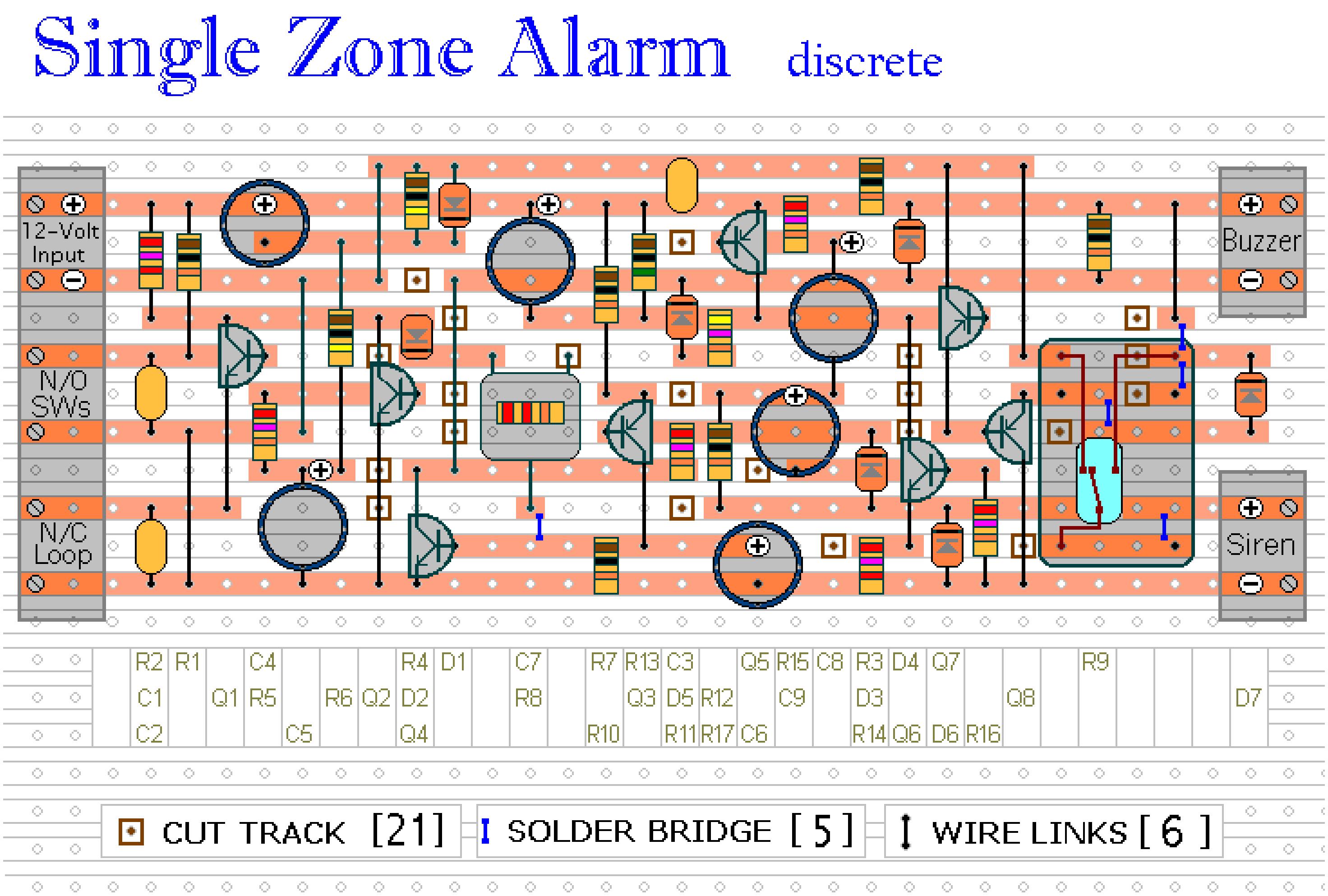
Notes:

The circuit features automatic exit and entry delays, timed bell cut-off and system reset. It has provision for normally open and normally closed switches and will suit the usual input devices (Pressure Mats, Magnetic Reed contacts, Foil Tape, PIRs and Inertia Sensors). When the power is applied, if there's a fault the buzzer will sound and you should switch off again and check for open doors, windows, etc. If everything is in order the buzzer will NOT sound and the exit delay will begin. You have about 30 seconds to leave the building. When you return the buzzer will sound. You then have about 30 seconds to switch off; otherwise the siren will sound. It will go on sounding indefinitely. However, if the building is re-secured the siren will switch off after about 10 minutes and the alarm will reset.

The Exit delay, Entry delay and Bell Cut-off times can be changed by altering the values of R4, R12 & R13 respectively. Q5 and Q6 ensure that the Entry delay and Bell cut-off timers always start with C7 either fully charged or fully discharged as required. If you can live with slightly less precise time intervals then leave out Q5, Q6, R14, R15, R16, R17, C8 & C9. If you don't want a Bell Cut-off at all then leave out D3 as well.

The sensitivity of the Inertia Sensors is adjusted by R8. Set to minimum value, a light tap will activate the alarm. Set to maximum value, a heavy blow is required. If you are not using Inertia Sensors then replace R8 with a 27k fixed resistor. If you are not using normally open switches then leave out R1, C1 & Q1 and fit a link between R2 and C2.

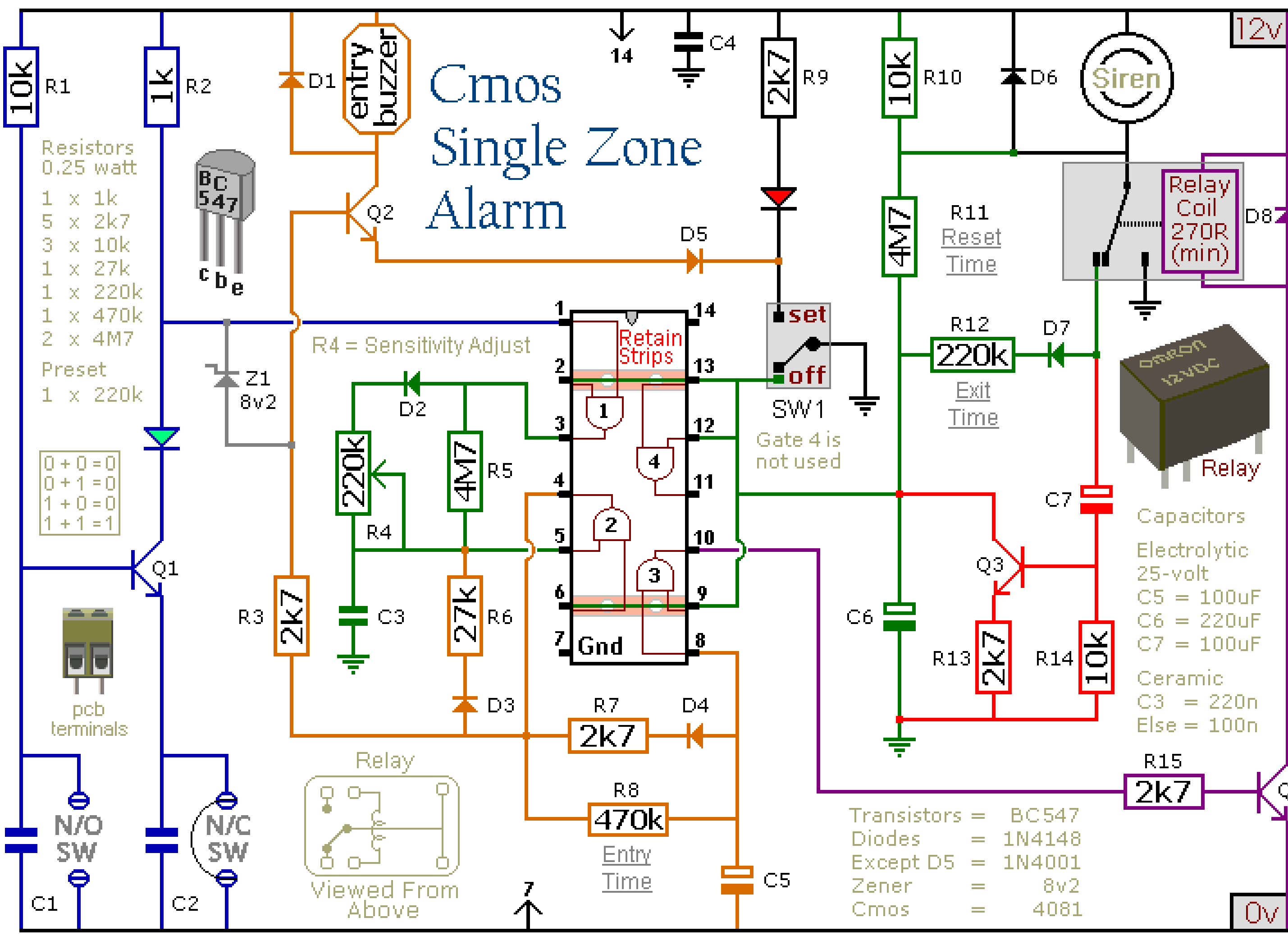
Veroboard Layout:



P425. Single Zone CMOS Alarm

Description:

This circuit features automatic Exit/Entry delays, timed Bell Cut-off and System Reset. It has provision for normally open and normally closed switches and will accommodate the usual input devices such as Foil Tape, Pressure Mats, Magnetic Reed Contacts, Passive Infrared Detectors and Inertia (Shock) Sensors.



Notes:

The green Led should be lighting before you set the alarm. When you open SW1 The red Led will light and the Exit delay will begin. You have about 30 to 40 seconds to leave the building. As you do so the buzzer will sound. It should stop sounding when you close the door behind you; indicating that the trigger circuit has been successfully restored within the time allowed. On returning, when you open the door the buzzer will sound again. You then have about 30 to 40 seconds to move SW1 to the "off" position. If you fail to do so, the siren will sound. After about 15 to 20 minutes, when the relay drops out, the alarm will attempt a Reset by using Q3 to switch itself "off" briefly. If the trigger circuit has been restored the alarm will reset.

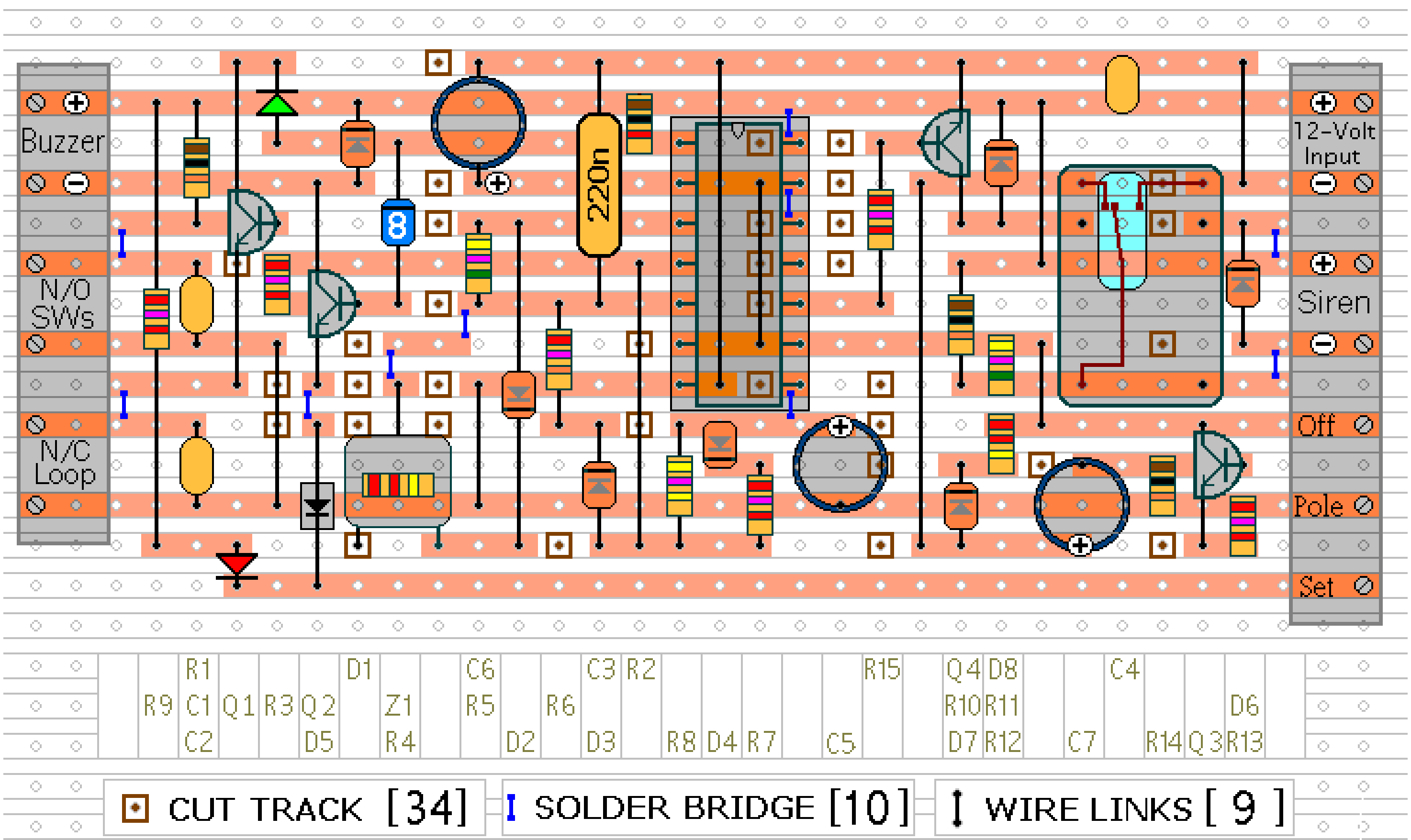
If not, the attempt will fail and the alarm will reactivate. It will go on trying to reset itself every 15 to 20 minutes until the trigger circuits are restored; or the alarm is switched off.

The Exit delay, Entry delay and Bell Cut-off times may be changed by altering the values of R12, R8 & R11 respectively. The sensitivity of the Inertia Sensors is adjusted by R4. Set to minimum value, a light tap will activate the alarm. Set to maximum value, a heavy blow is required. If you are not using Inertia Sensors then replace R4 with a 220k fixed resistor. If you are not using normally open switches then leave out R1, C1 & Q1 and fit a link between the green Led and C2.

Construction:

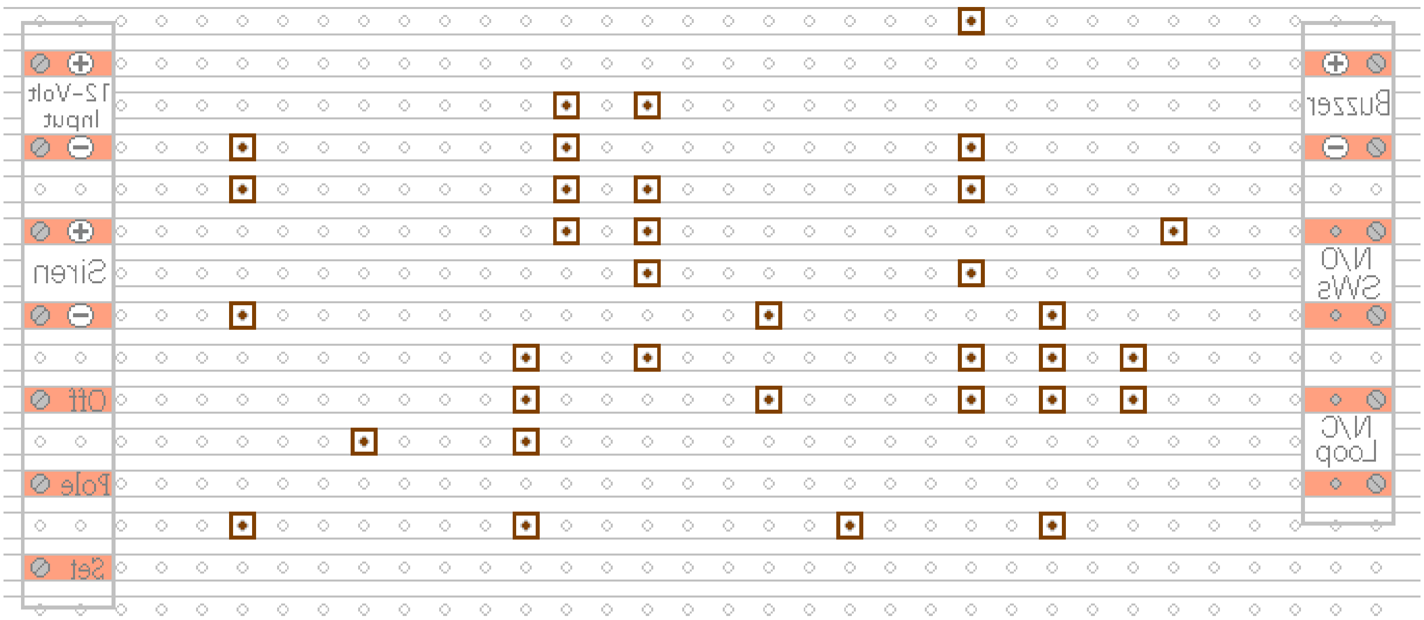
The terminals are a good set of reference points. To fit them you'll need to enlarge the holes to 1.3mm. Now turn the board over and cut the tracks in the 34 places shown. Make sure that the copper is cut all the way through. Sometimes a small strand of copper remains at the side of the cut and this will cause malfunction. If you don't have the proper track-cutting tool, then a 6 to 8mm drill-bit will do. Just use the drill-bit as a hand tool; there is no need for a drilling machine.

Cmos Single Zone Alarm component side

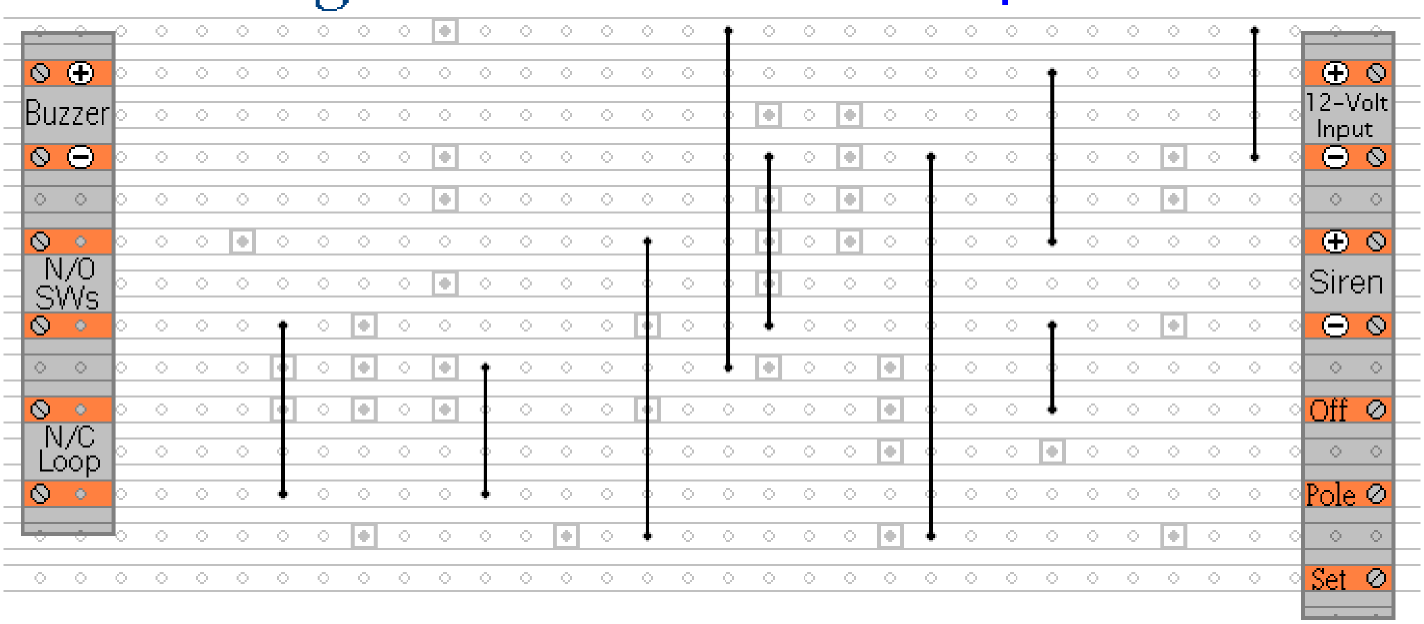


Next fit the 9 wire links. I used bare copper wire on the component side of the board. Telephone cable is suitable; the single stranded variety used indoors to wire telephone sockets. Stretching the core slightly will straighten it; and also allow the insulation to slip off.

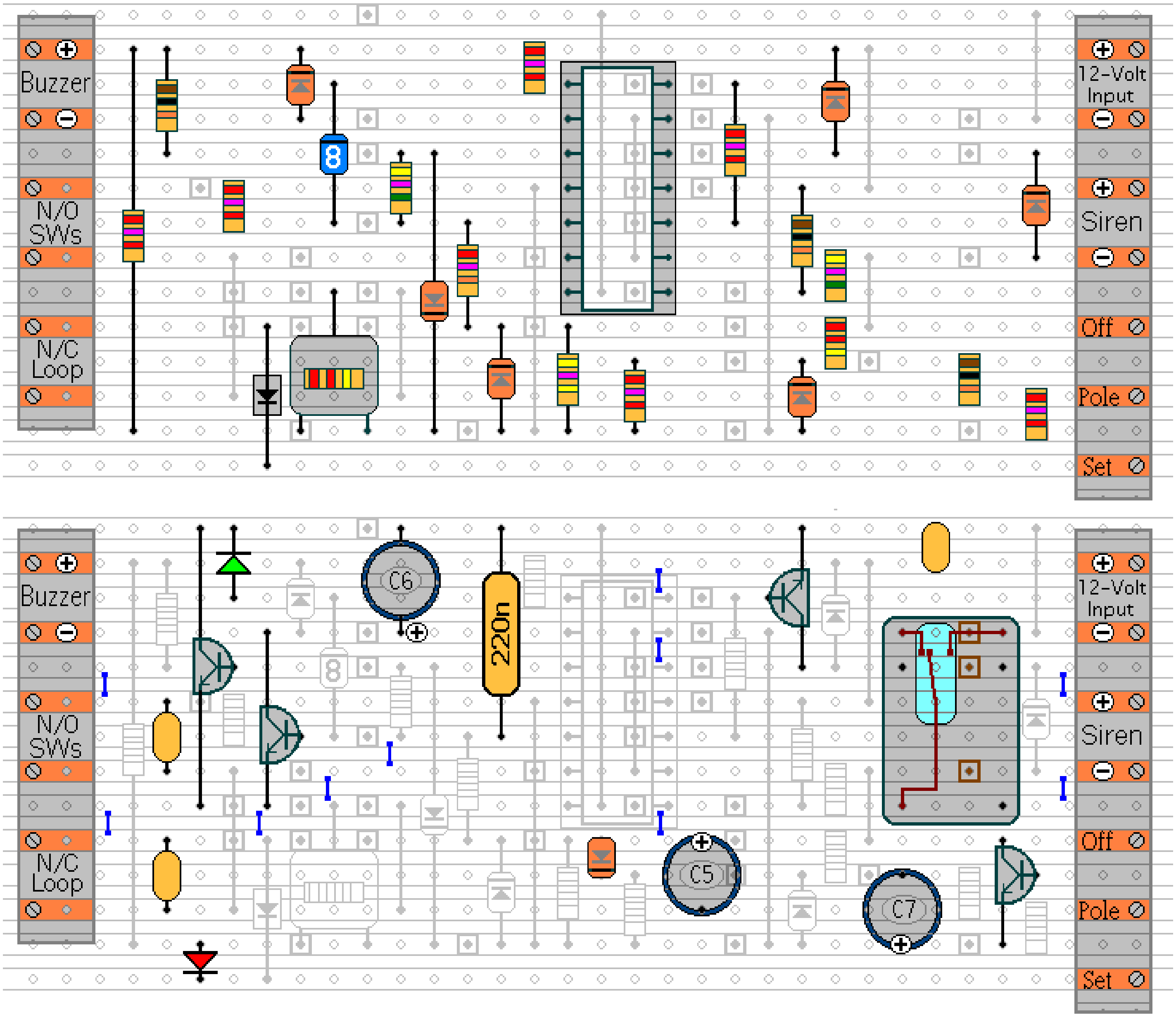
Cmos Single Zone Alarm Underside



Cmos Single Zone Alarm Component Side



Cmos Single Zone Alarm   Component Side



The next stage is to fit the resistors, most of the diodes, and the IC socket. Using a socket reduces the chances of damaging the IC; and makes it easier to replace if necessary. The resistors are all shown lying flat on the board. However, those connected between close or adjacent tracks are mounted standing upright; as are some of the diodes.

Finally, fit the remaining components (capacitors, transistors, diodes and relay); add the 10 solder bridges to the underside of the board; and finish off by inserting the Cmos 4081 into the socket.

P426. Mini Alarms

Description:

This is a selection of small self-contained alarm circuits. They have a very low standby current; and are suitable for battery operation.

Notes:

Sw1 is drawn as either a micro-switch or a magnetic-reed contact; but so long as it does the job you can use whatever type of switch you like. Use more than one switch if it suits your application. The output device is a "piezo" buzzer, requiring a current of about 10mA. Provided the buzzer's voltage is suitable, the circuits will work from 5 to 15-volts. The main features of each alarm are described on the circuit diagram itself. Each pair of circuits will print out on an A4 sheet.

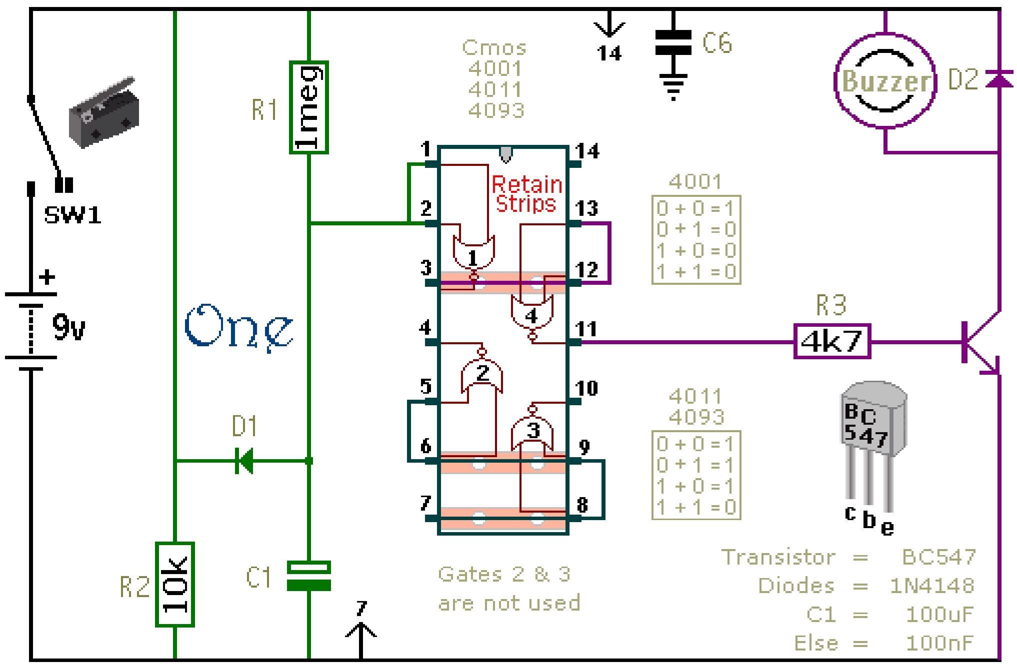
The Cmos 4093 is the Schmidt-trigger version of the Cmos 4011. For present purposes the two are interchangeable. However, the 4093 has an improved switching performance that is most noticeable if the time periods are substantially extended.

The precise length of any time period will depend on the characteristics of the actual components used; especially the tolerance of the capacitors and the exact switching points of the Cmos Gates.

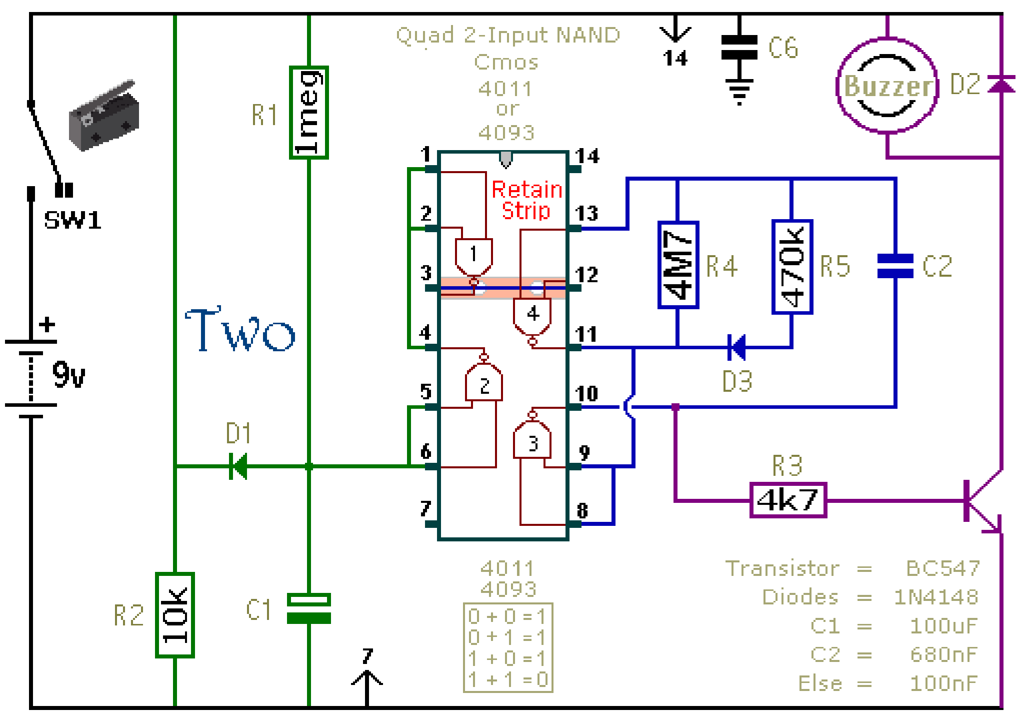
In the case of circuits 11 & 12, treat the values of R6 & R7 as a rough guide. The switching point of Gate 3 and the characteristics of the thermistor will determine the actual temperature range available. Changing the value of R6 will allow you to access different areas of the temperature scale; while changing the value of R7 will allow you to alter the width of adjustment available.

Although they are described as alarm circuits, they will have other applications. The buzzer may be replaced by a small relay or an optical isolator; and the timing components may be changed to produce the required output performance. Any relay should have a coil resistance of at least 270 ohms; but for battery operation, the higher the better. If you're using an optical isolator, connect a 1k resistor in series with its LED.

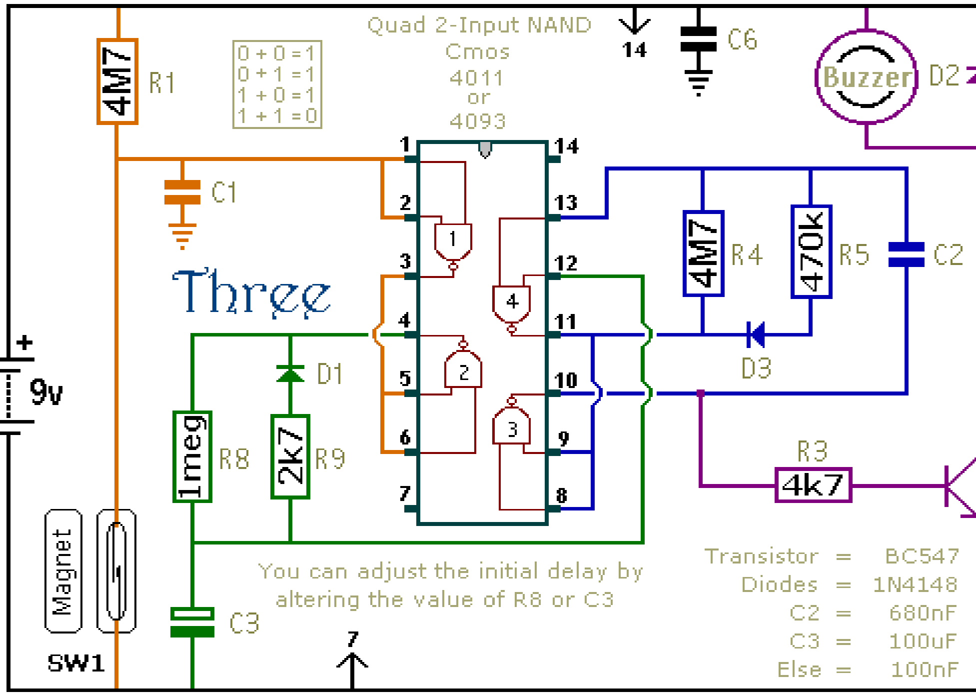
1. Until SW1 is CLOSED the circuit uses no current.
About 90 seconds after SW1 is closed the Buzzer will sound.
The exact delay depends on the actual components used.
You can adjust the delay by altering the values of R1 and/or C1.
Any of the three Cmos ICs may be used.



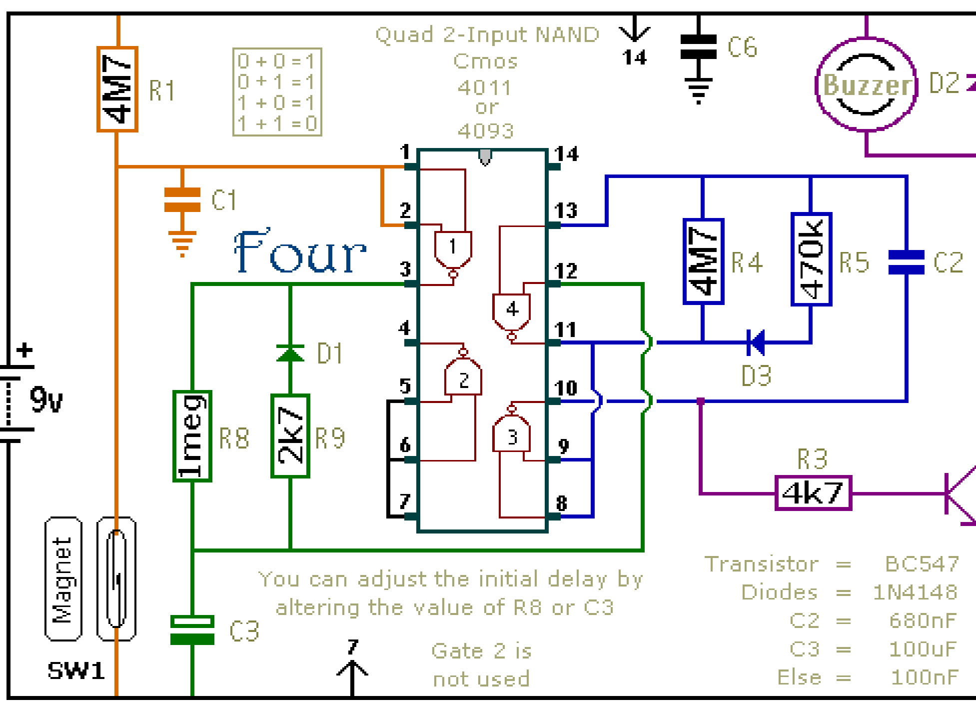
2. Until SW1 is CLOSED the circuit uses no current.
About 90 seconds after SW1 is closed the Buzzer will begin a series of short Beeps, 3 to 5 seconds apart. This saves battery power.
R5 & C2 set the length of the beeps; R4 & C2 the delay between them.
A Cmos 4001 IC is NOT suitable for this circuit.



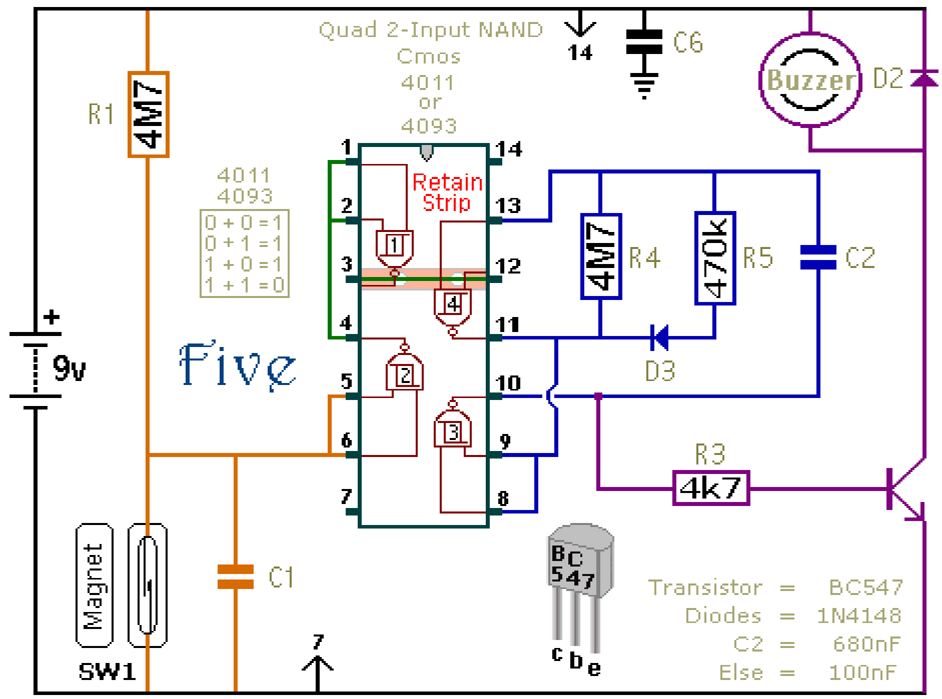
3. While Sw1 remains CLOSED the circuit uses virtually no current. About 90 seconds after SW1 is OPENED, the Buzzer will begin a series of short Beeps, 3 to 5 seconds apart. This saves battery power. R5 & C2 set the length of the beeps; R4 & C2 the delay between them. A Cmos 4001 CANNOT be used for this circuit.



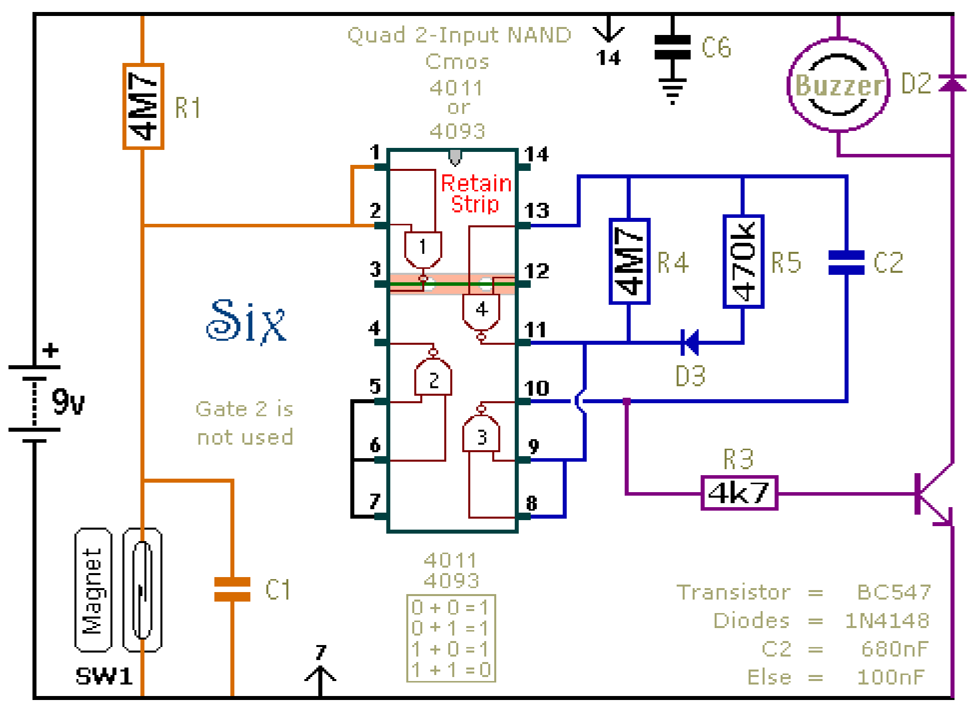
4. While Sw1 remains OPEN the circuit uses virtually no current. About 90 seconds after SW1 is CLOSED, the Buzzer will begin a series of short Beeps, 3 to 5 seconds apart. This saves battery power. R5 & C2 set the length of the beeps; R4 & C2 the delay between them. A Cmos 4001 CANNOT be used for this circuit.



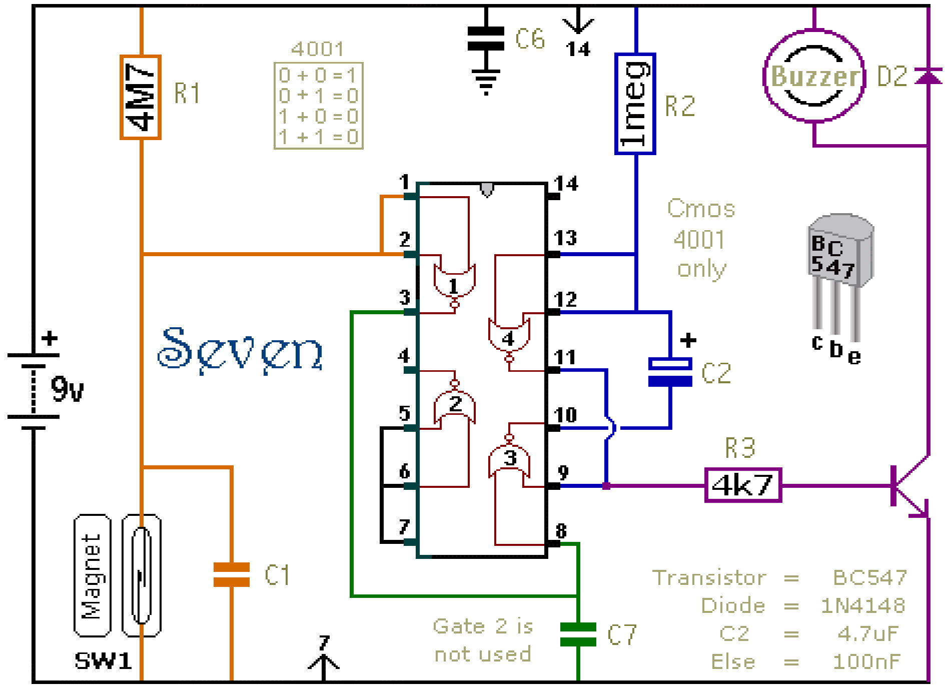
5. While Sw1 remains CLOSED the circuit uses virtually no current.
When the switch is OPENED the Buzzer produces a series of beeps at 3 to 5 second intervals. This increases battery life.
R5 & C2 set the length of the beeps; R4 & C2 the delay between them.
A Cmos 4001 CANNOT be used for this circuit.



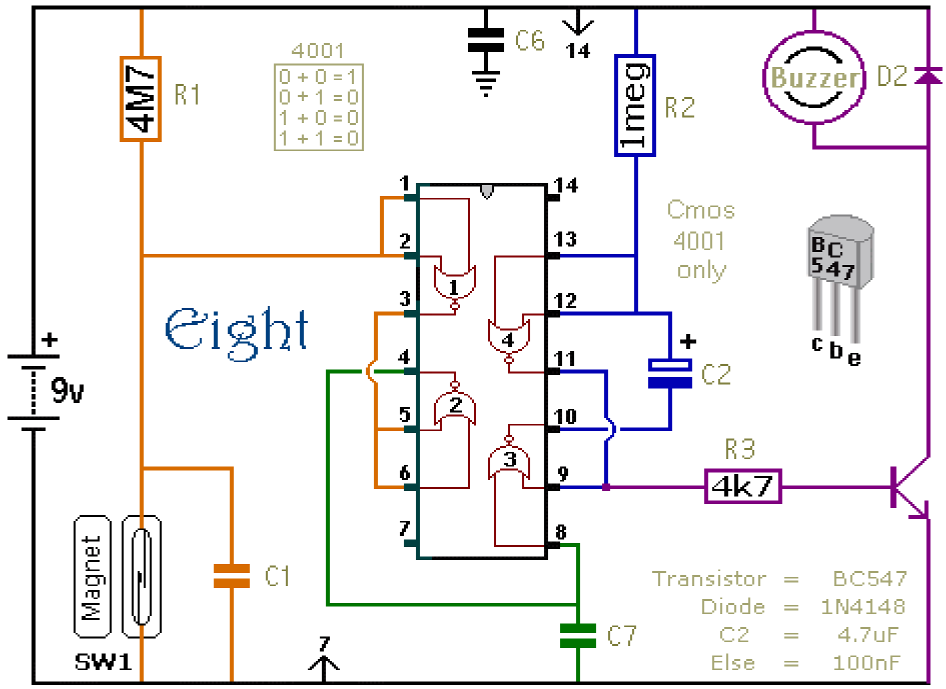
6. While Sw1 remains OPEN the circuit uses virtually no current.
When the switch is CLOSED the Buzzer produces a series of beeps at 3 to 5 second intervals. This increases battery life.
R5 & C2 set the length of the beeps; R4 & C2 the delay between them.
A Cmos 4001 CANNOT be used for this circuit.



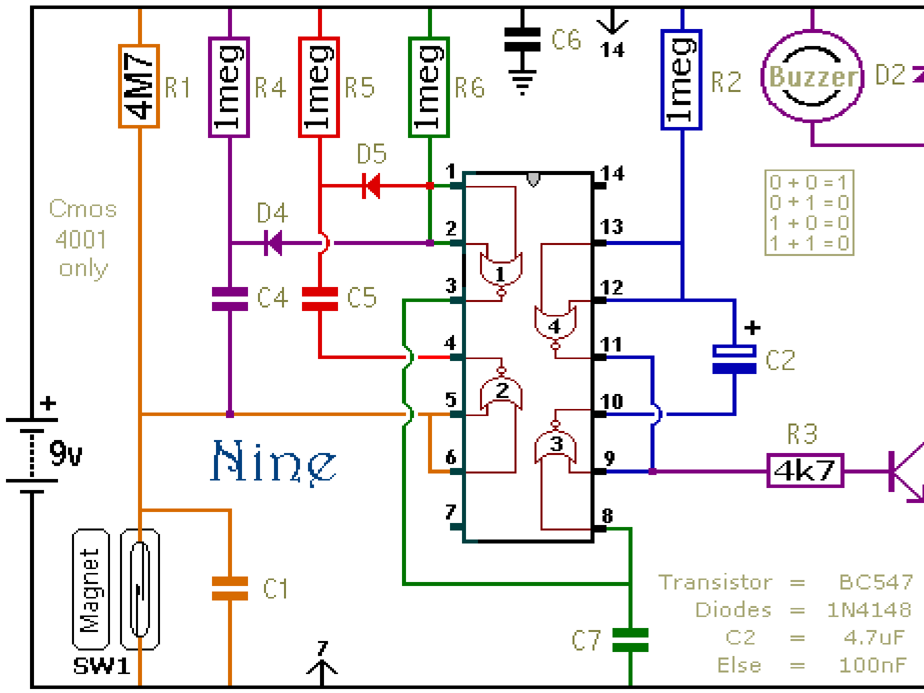
7. While Sw1 remains OPEN the circuit uses virtually no current.
Every time Sw1 is CLOSED the Buzzer will sound for 3 to 5 seconds.
The length of time depends on R2 & C2.
A Cmos 4001 MUST be used for this circuit.



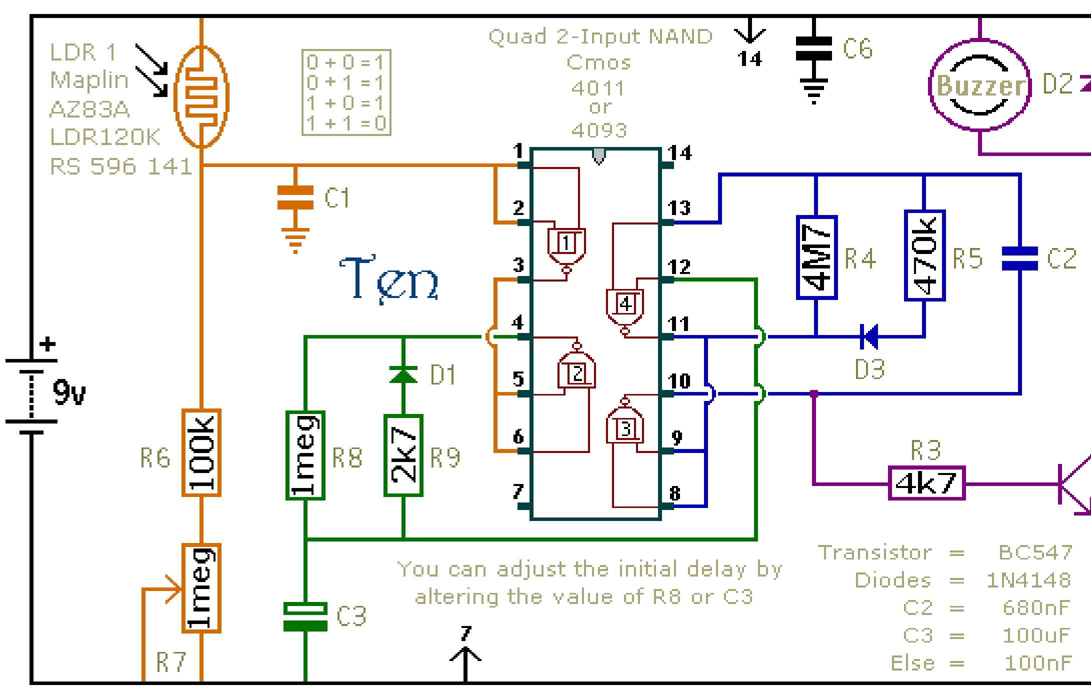
8. While Sw1 remains CLOSED the circuit uses virtually no current.
Every time Sw1 is OPENED the Buzzer will sound for 3 to 5 seconds.
The length of time depends on R2 & C2.
A Cmos 4001 MUST be used for this circuit.



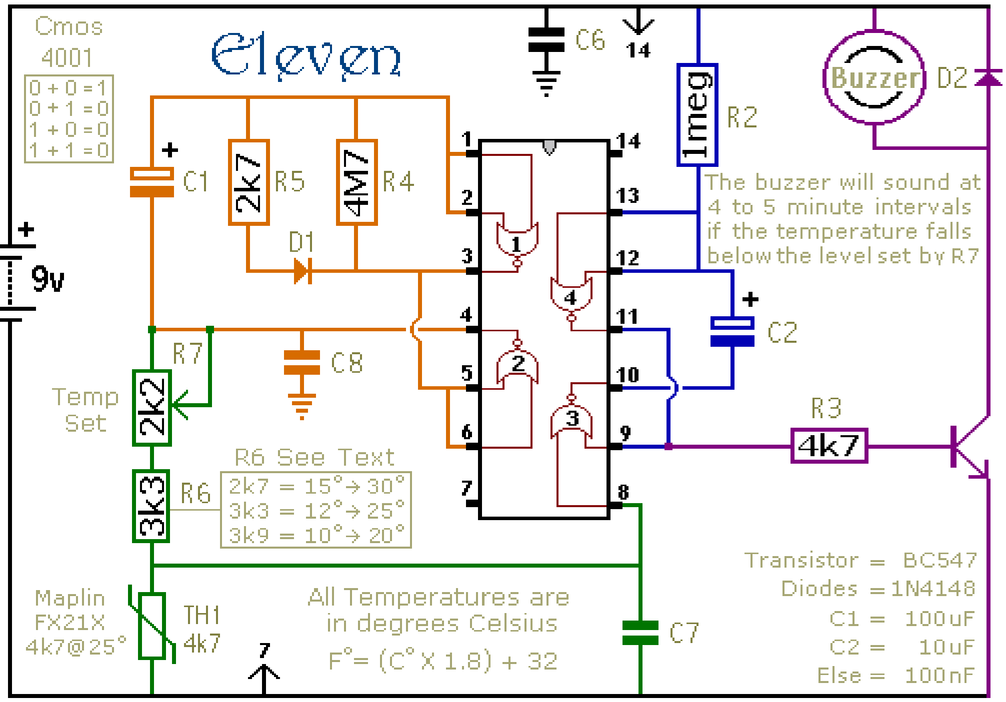
9. In standby mode this circuit uses virtually no current.
When Sw1 is EITHER opened or closed, the buzzer will sound for 3 to 5 seconds. The length of time depends on R2 & C2.
A Cmos 4001 MUST be used for this circuit.



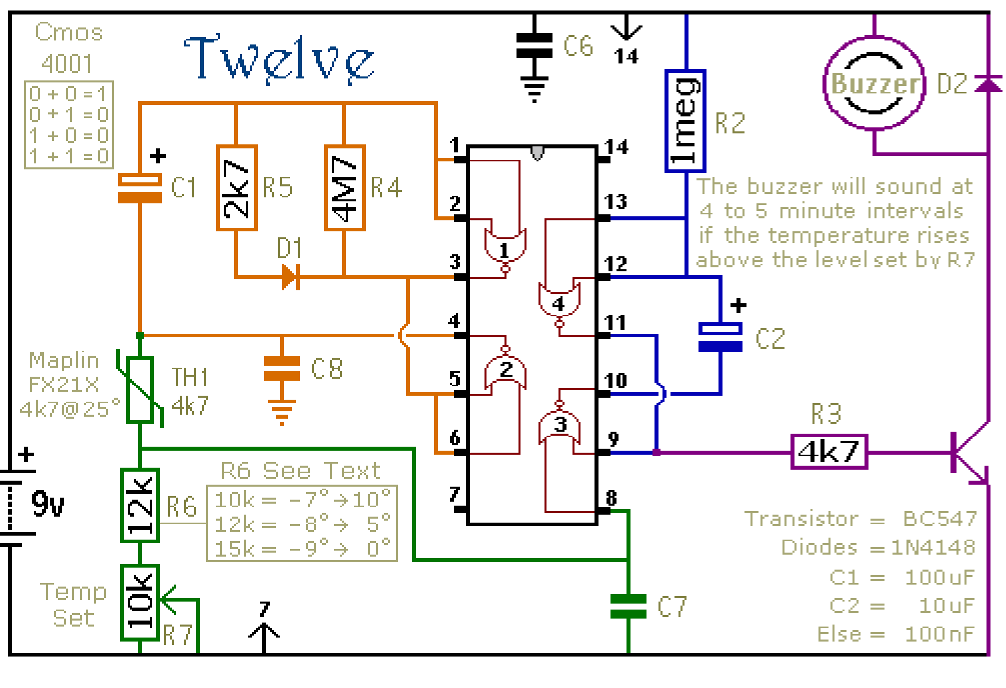
10. The dark resistance of The LDR should be 2 Megs or more.
While the LDR is in TOTAL darkness the circuit uses virtually no current.
About 60 to 90 seconds after it's exposed to the light, the Buzzer will begin a series of short Beeps, 3 to 5 seconds apart.
R5 & C2 set the length of the beeps; R4 & C2 the delay between them.
A Cmos 4001 CANNOT be used for this circuit.



11. Every 4 to 5 minutes the circuit measures the temperature. If it's BELOW the level set by R7, the Buzzer will sound for about 5 seconds.
The frequency of measurement is set by C1 & R4
and the length of the Buzz is set by C2 & R2.
A Cmos 4001 MUST be used for this circuit.



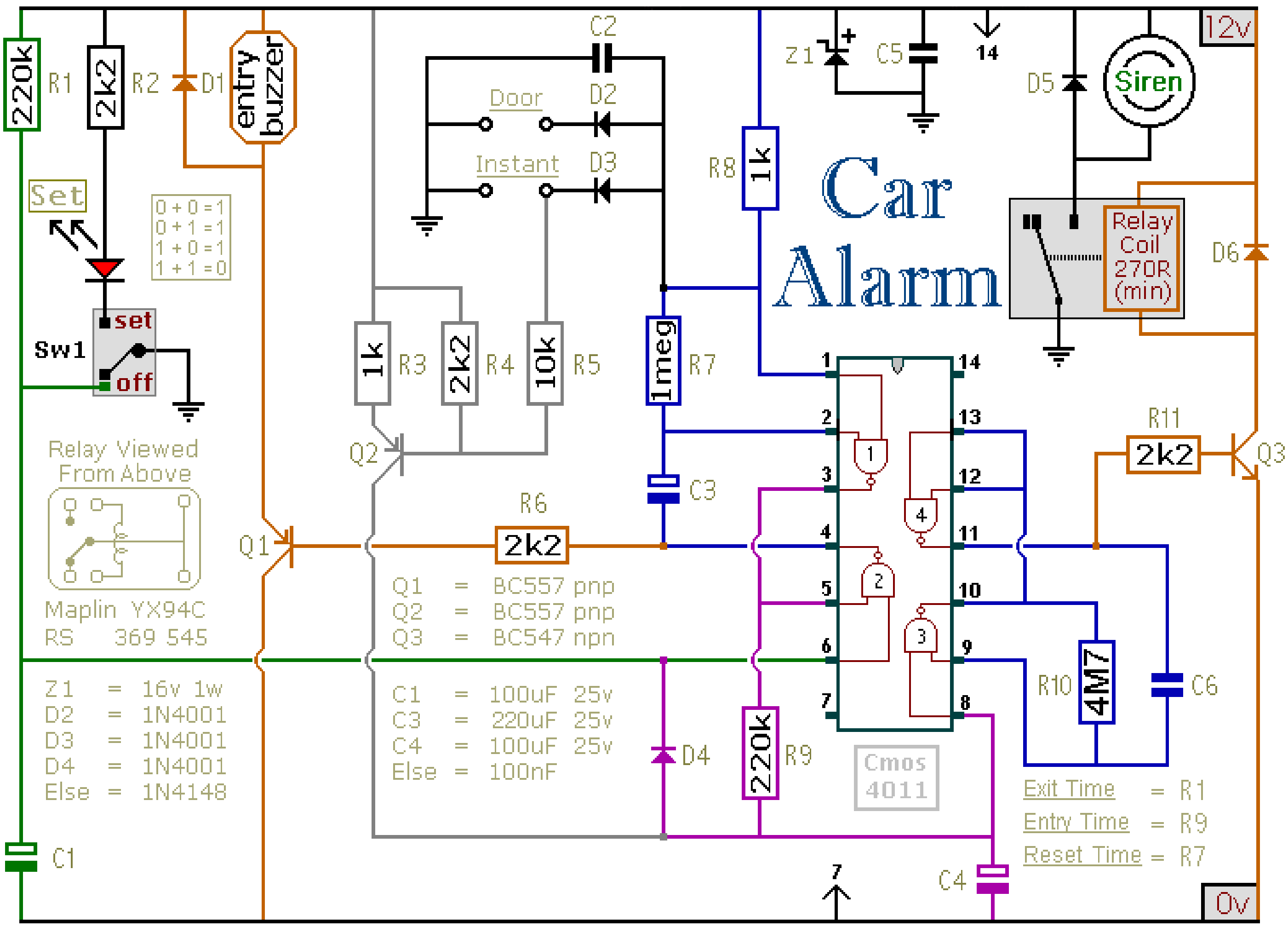
12. Every 4 to 5 minutes the circuit measures the temperature. If it's ABOVE the level set by R7, the Buzzer will sound for about 5 seconds.
The frequency of measurement is set by C1 & R4
and the length of the Buzz is set by C2 & R2.
A Cmos 4001 MUST be used for this circuit.



P427. Car Alarm and Immobilizer

Description:

This circuit features exit and entry delays, an instant alarm zone, an intermittent siren output and automatic reset. By adding external relays you can immobilize the vehicle and flash the lights.



Notes

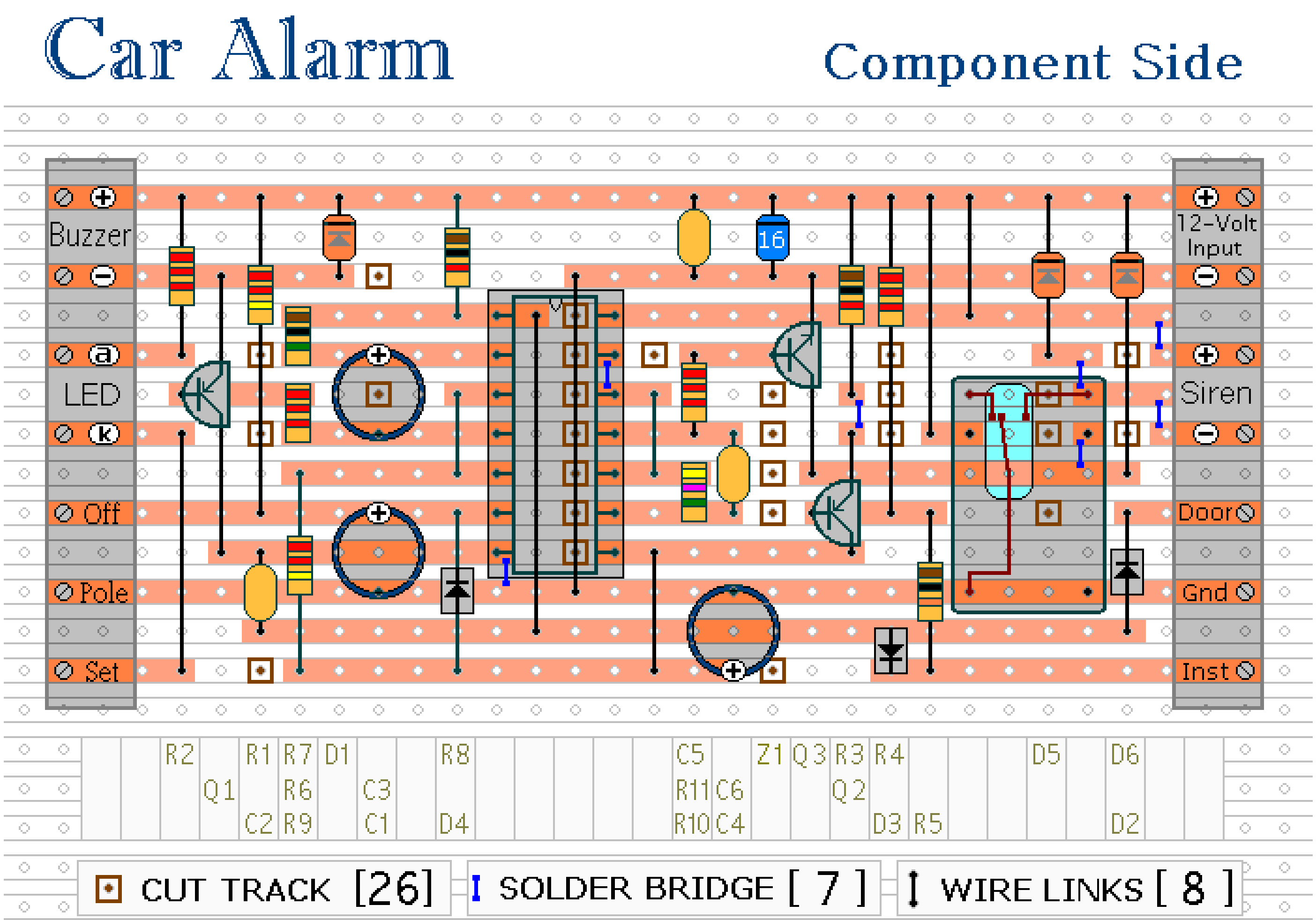
The alarm is "set" by opening Sw1. It can be any small 1-amp single-pole change-over switch - but for added security you could use a key-switch. Once Sw1 is opened you have about 10 to 15 seconds to get out of the vehicle and close the door behind you. When you return and open the door the buzzer will sound. You have 10 to 15 seconds to move Sw1 to the "off" position. If you fail to do so, the siren will sound. The output to the siren is intermittent - it switches on and off. The speed at which it switches on and off is set by C6 and R10. While any trigger-switch remains closed, the siren will continue to sound. About 2 to 3 minutes after all of the switches have been opened, the circuit will reset.

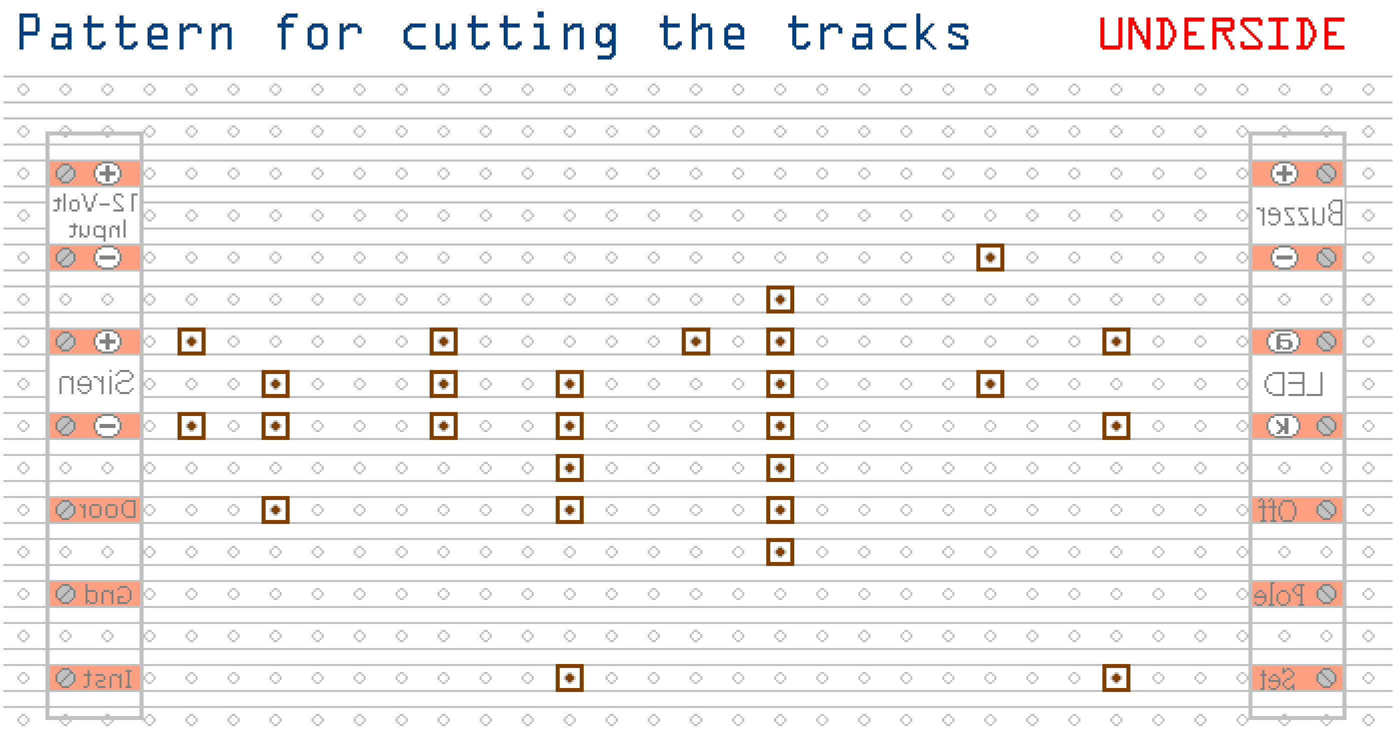
One of the inputs is connected to the vehicle's existing door-switches. This provides the necessary exit and entry delays. It's usually sufficient to connect a SINGLE wire to just ONE of the door switches - they're generally all connected in parallel with the return through the chassis. You can add extra normally-open switches to the door-circuit if you wish; but note that any additional switches will have to be able to carry the current required by your vehicle's interior light.

Any number of normally-open switches may be connected - in parallel - to the "Instant" input. Since they don't have to carry the current for the interior light, you can use any type of switch you like. You may want an instant alarm on the bonnet, the boot, the rear-hatch, the rear-doors etc. It doesn't matter if these already have switches connected to the door-circuit. Simply fit a second switch and connect it to the instant input. It will override the delay circuit. You can use the chassis for the return. However, a ground terminal is provided if - for any reason - you need to run a separate return wire for either zone. If you're not using the instant zone then leave out Q2, R3, R4, R5 & D3.

The exit delay is set by R1 & C1, the entry delay by R9 & C4, and the reset time by R7 & C3. The precise length of any time period depends on the characteristics of the actual components used - especially the tolerance of the capacitors and the exact switching points of the Cmos Gates. However, for this type of application really accurate time periods are unnecessary.

The circuit board and switches must be protected from the elements. Dampness or condensation will cause malfunction. Fit a 1-amp in-line fuse AS CLOSE AS POSSIBLE to your power source. This is VERY IMPORTANT. The fuse is there to protect the wiring - not the alarm. Exactly how the system is fitted will depend on the make of your particular vehicle. Consequently, I CANNOT give any further advice on installation.



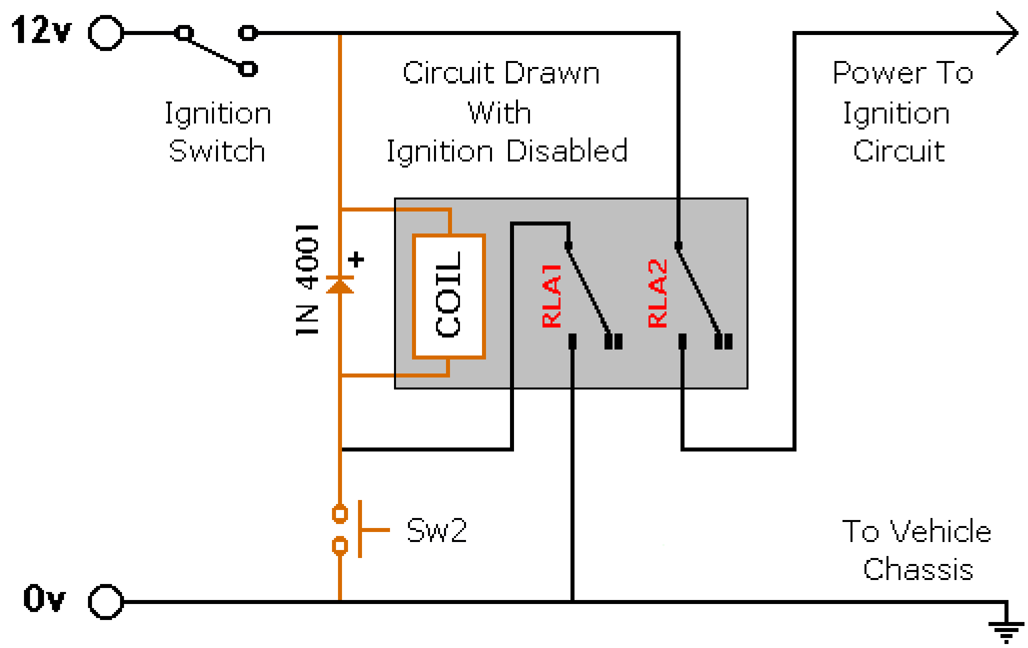


The circuit is designed to use an electronic Siren drawing 300 to 400mA. It's not usually a good idea to use the vehicle's own Horn because it can be easily located and disconnected. However, if you choose to use the Horn, remember that the alarm relay is too small to carry the necessary current. Connect the coil of a suitably rated relay to the "Siren" output. This can then be used to sound the Horn, flash the lights etc.

[Add an Automatic Immobilizer.]

Before fitting this immobilizer to your vehicle, carefully consider both the safety implications of its possible failure - and the legal consequences of installing a device that could cause an accident.

Automatic Immobilizer



If YOU decide to proceed, you will need to use the highest standard of materials and workmanship. Remember that the relay MUST be large enough to handle the current required by your ignition system. Choose one specifically designed for automobiles - it will be protected against the elements and will give the best long-term reliability. You don't want it to let you down on a cold wet night - or worse still - in fast moving traffic!!! Please note that I am UNABLE to help any further with either the choice of a suitable relay - or with advice on its installation.

When you turn-off the ignition, the relay will de-energize and the second set of contacts (RLA2) will break the ignition circuit - automatically immobilizing the vehicle. When the ignition is switched on again the relay will not energize; and the vehicle's ignition circuit will remain broken. You must press Sw2 to energize the relay. It then latches itself on using the first set of contacts (RLA1); while the second set of contacts (RLA2) complete the connection to the ignition circuit.

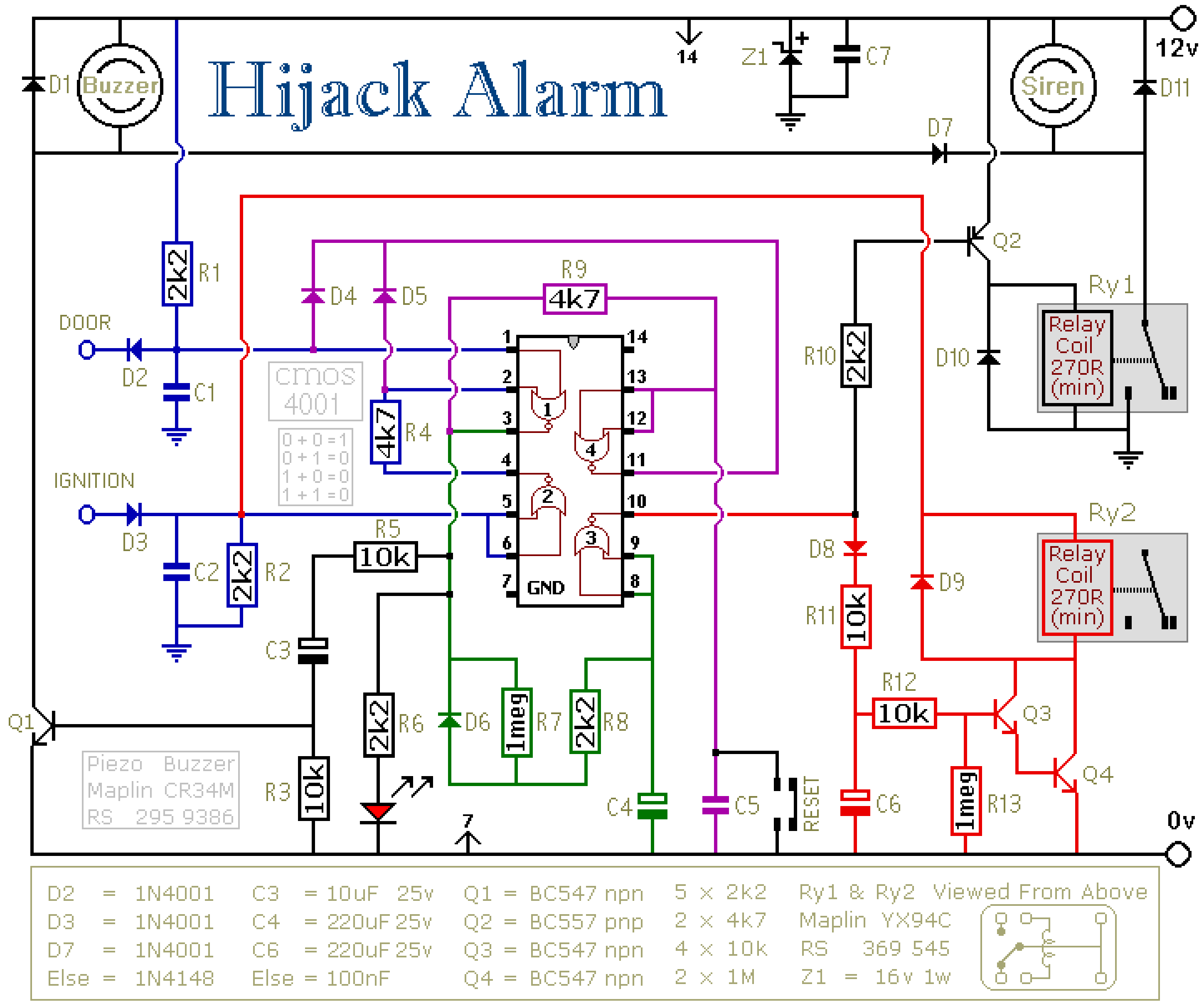
The design has a number of advantages. It operates automatically when you turn the ignition off - so there's no need to remember to activate it. The relay uses no current while the ignition is off - so there's no drain on the battery. To de-activate it you'll need to have the ignition key and you'll need to know the whereabouts of the push-switch. Sw2 only requires a single wire because its return is through the chassis. It carries no load other than the current required by the relay-coil. So almost any small "momentary-action, push-to-make" switch will do. For extra security Sw2 could be key-operated.

The Support Material for this alarm includes a step-by-step guide to the construction of the circuit-board, a parts list, and a detailed circuit description.

P428. Hijack Alarm

Description:

The first circuit was designed for the situation where a hijacker forces the driver from the vehicle. If a door is opened while the ignition is switched on - the circuit will trip. After a few minutes delay - when the thief is at a safe distance - the alarm will sound and the engine will fail.



Important

Before fitting this or any other engine cut-out to your vehicle - carefully consider both the safety implications of its possible failure - and the legal consequences of installing a device that could cause an accident. If you decide to proceed - you will need to use the highest standards of materials and workmanship.

Notes:

You're going to trip this alarm unintentionally. When you do - the LED will light and the Buzzer will give a short beep. The length of the beep is determined by C3. Its purpose is to alert you to the need to push the reset button. When you push the button - the LED will switch-off. Its purpose is to reassure you that the alarm has in fact reset.

If the reset button is not pressed then - about 3 minutes later - both the Siren and the Buzzer will sound continuously. The length of the delay is set by R7 & C4. For extra effect - fit a second siren inside the vehicle. With enough noise going on - you may feel that it's unnecessary to fit the engine cut-out. In which case - you can leave out D8, D9, R11, R12, R13, C6, Q3, Q4 & Ry2.

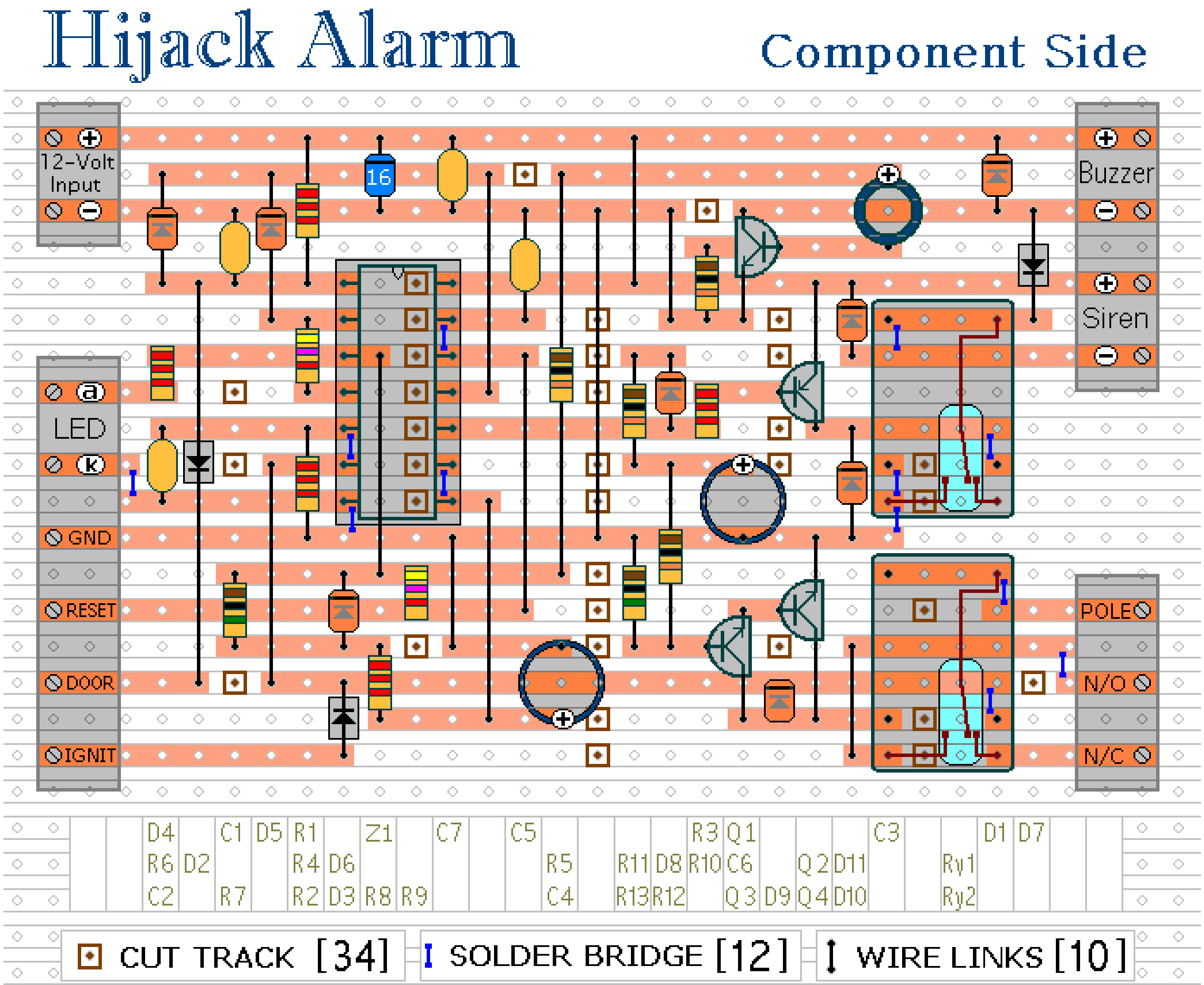
Even if you missed the early warning provided by the Buzzer - there is still time to reset the alarm before Ry2 de-energizes - and the engine fails. This additional delay - currently about 1 minute - is set by C6 and R13.

To reset the circuit you must - EITHER turn off the ignition - OR close all of the doors - before you press the reset button. While BOTH the ignition is on - AND a door remains open - the circuit will NOT reset.

The reset button carries virtually no current - so any small normally-open switch will do. Eric Vandel from Canada suggests using a reed-switch hidden behind (say) the dash - and operated by a magnet. I think this is an excellent idea. As Eric said in his email: - "... that should keep any thief guessing for a while."

The Flow Chart is another of Eric's suggestions. It will help you to visualize how the alarm is operated. It also explains the sequence of events that lead to siren activation - and subsequent engine failure.

Veroboard Layout:



How you bring your vehicle to a standstill is up to you. It should happen when Ry2 de-energizes. The contacts of Ry2 are too small to do the job themselves. So use them to switch the coil of a larger relay. Remember that the relay must be suitable for the current it's required to carry. Choose one specifically designed for automobiles - it will be protected against the elements - and will give the best long-term reliability. You don't want it to let you down on a cold wet night - or worse still - in fast moving traffic!!! Remember also that you must fit a 1N4001 diode across YOUR relay's coil - to prevent damage to the Cmos IC.

YOUR relay should drop-out when Ry2 de-energizes. Wire YOUR relay so that when it drops-out the engine will stop. Because turning-off the ignition will cause both Ry2 and YOUR relay to de-energize - the standby current will be low - and the engine will be disabled while the vehicle is parked.

The circuit board must be protected from the elements. Dampness or condensation will cause malfunction. Fit a 1-amp in-line fuse AS CLOSE AS POSSIBLE to your power source. This is VERY IMPORTANT. The fuse is there to protect the wiring - not the components on the circuit board. Please note that I am UNABLE to help any further with either the choice of a suitable relay - or with advice on installation.

Both the Siren and the Buzzer will go on sounding until the alarm is reset. The circuit is designed to use an electronic Siren drawing up to about 500mA. It's not usually a good idea to use the vehicle's own Horn because it can be easily located and disconnected. However, if you choose to use the Horn, remember that Ry1 is too small to carry the necessary current. Connect the coil of a suitably rated relay to the "Siren" output. This can then be used to sound the Horn.

Enhanced HiJack Alarm

The second alarm is a variation on the first. My original idea was to have the circuit sit quietly in the background - and only require the driver to intervene if the alarm were tripped accidentally. However, I'm obliged to Jeff Chia from Canada who suggested the following enhancement.

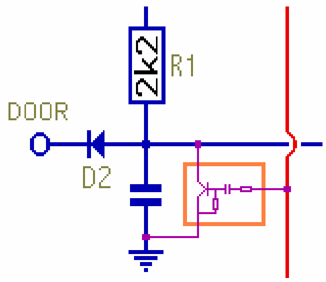
By making the alarm trip automatically the moment the ignition is switched on - it will protect the vehicle in many more situations. For example at the Service Station - while you're filling the tank - checking the tyre pressure - paying at the cash desk etc. In fact it works whenever you leave the vehicle unattended with its ignition switched off - even overnight in your driveway.

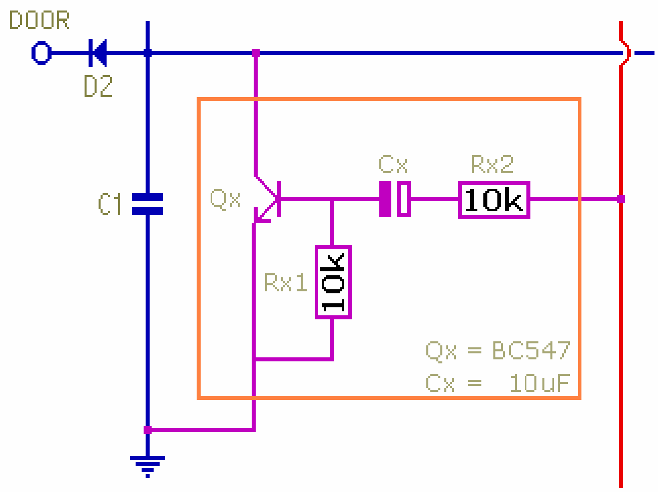
Jeff's suggestion has made me reconsider the value of the initial design approach - and I think that having to press the reset button every time you turn on the ignition - is a small price to pay for the added protection.

If you've already built the original version - and want to add the modification - remove the 12-volt input terminals. That should provide enough space for the additional components.

The Flow Chart for the Enhanced Alarm will help you to visualize how it's operated. It also explains the sequence of events that lead to siren activation - and subsequent engine failure.

Hijack Alarm Modification





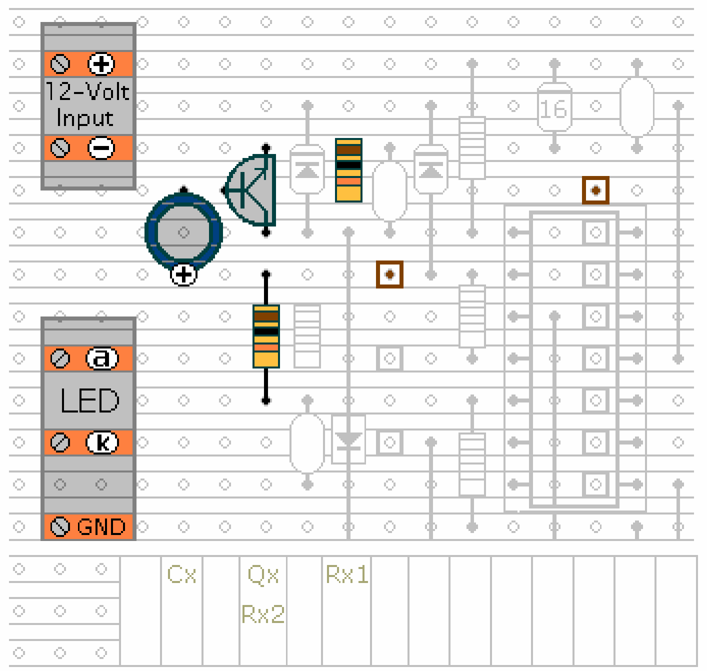
When the ignition is turned on - current flows briefly through Rx2 and Cx. This turns the transistor on. It takes pin 1 low - simulating an open door.

Because pin 1 goes low while the ignition is on - the circuit will trip. The buzzer will give a brief warning - the LED will light - and the normal sequence of alarm and engine failure will begin.

The additional components work in exactly the same way as the warning buzzer. Once Cx has charged - current through the base of the transistor ceases - and it switches off. It won't switch on again until the next time the ignition is switched on.

Rx1 keeps it switched firmly off once it's done its job. Rx2 limits the peak surge current through the base-emitter junction - and slows down the rate at which Cx charges.

Qx remains switched on for about half a second. This is much longer than necessary. The prototype activated with Cx = 10nF. So - with a 10uF capacitor - it's absolutely certain to work every time.

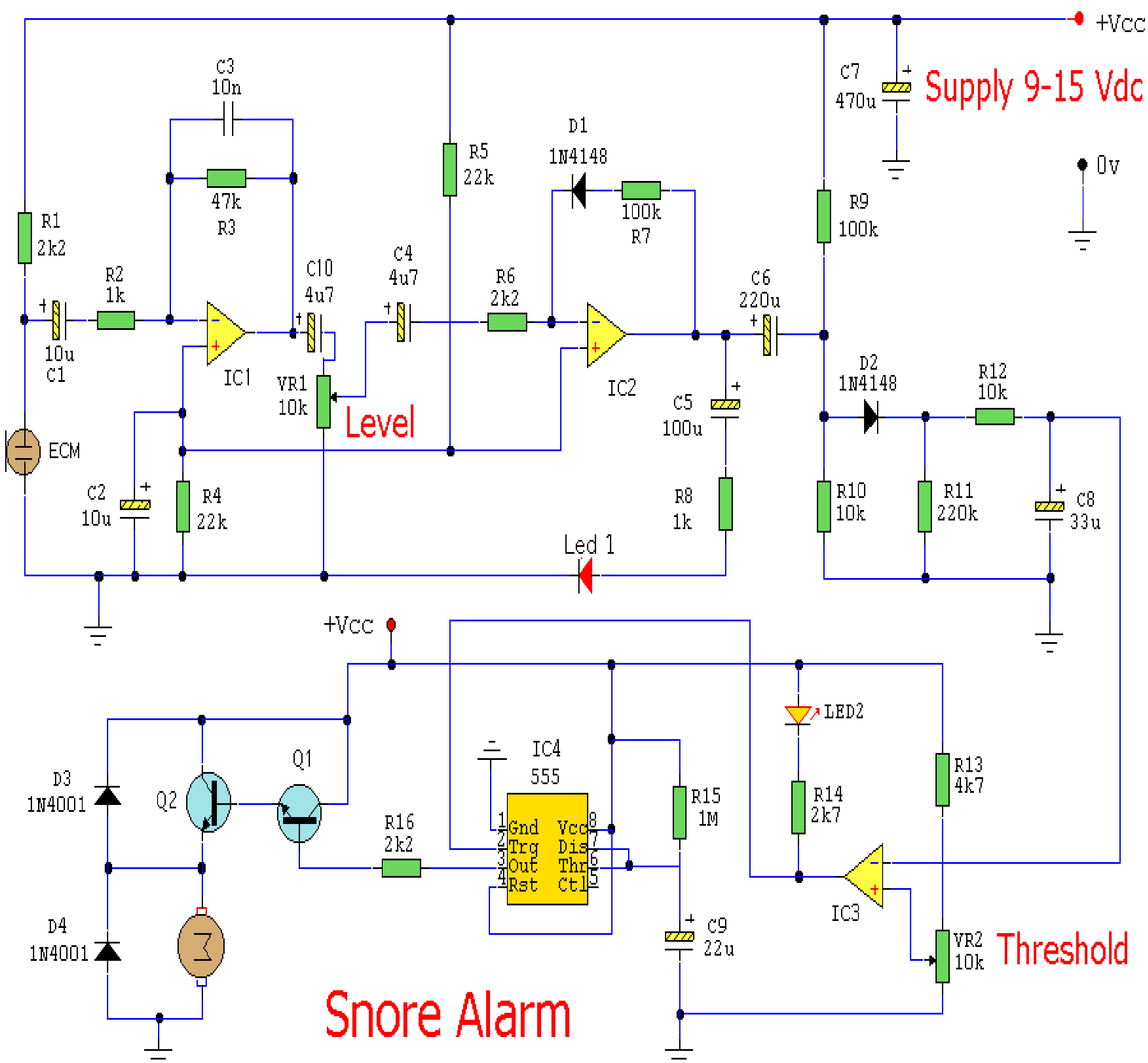


The stripboard needs to be slightly wider - an extra three columns will do. I found enough space on the prototype by removing the 12-volt input terminals. Mount the four components as shown - and make the two extra cuts in the tracks.

P429. Snore Alarm

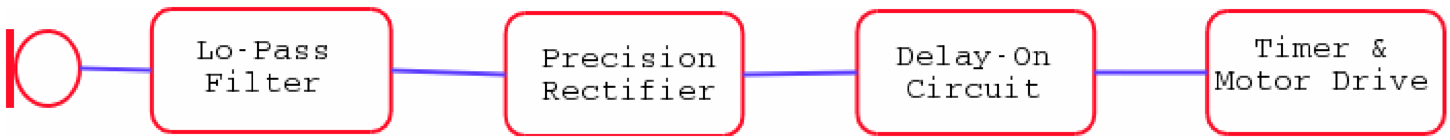
Description:

The idea behind this snore alarm, is just to rouse the snorer, not the entire household. To wake the sleeper, vibration is used, not an audible alert. The vibration is provided by a small motor housed in a small 35mm film case, which can be placed under the sleepers mattress or pillow. This circuit has a level control and peak display indicator, a variable trigger threshold and trigger indication.



Notes:

This snore alarm is designed to trigger after a preset period, adjustable by VR2. It is designed not to activate with short noises, i.e. doors slamming, car horns etc, but instead wait for a set delay before triggering. A snore after all, is continuous for several seconds, and so the delay before triggering can be set by the threshold control. The loudness of the snore is controlled by setting VR1, so for loud snorers VR1 will be backed off and advanced for quiet snorers. Once activated, vibration is relied upon to gently wake the snorer. I suggest using a small dc motor in a 35mm film case connected by a 3.5mm jack plug to the main unit. The circuit can be broken down into four parts, as shown in the block diagram below.



From left to right we have the input transducer, which is a small ecm microphone insert. A low pass filter and amplifier built around op-amp IC1, to filter out some high frequency noises. The amplified sound is then converted to DC by a precision rectifier formed by op-amp IC2. The DC component is then filtered again and must be present for a few seconds to activate the delay circuit. The delay circuit uses op-amp IC3 as a level shifter and compares the charge on capacitor C8 to its reference input set by the threshold control, VR2. Once the threshold is reached, this triggers the timer and motor drive. The delay for the motor to run is fixed, but can be made variable by using a potentiometer for R15.

How it Works:

Sound is received by the microphone and amplified with IC1. An electret mic insert (ecm) was used in my prototype, but a dynamic mic insert of impedance 200 to 1k may also be used. If a dynamic mic is used, omit R1. IC1 functions as an active filter and reduces high frequency gain. At low frequencies gain is 47 times, starting to fall off above 1kHz. VR1 is the level control for this stage. Op-amp IC2 is a precision rectifier. It has a stage gain of R7/R6 to boost signal levels, the 1N4148 diode in the feedback loop now converts the audio signal into a positive half wave rectified signal. R4, R5 and C2 bias the non-inverting inputs of op-amps IC1 and IC2 to half the supply voltage. Peak signal levels pass through C5 and R8 to LED 1 which provides visual indication of peak levels. LED1 will not illuminate continuously but flash in response to peak sound. VR1 is adjusted so that LED1 flickers with each snore.

As a snore is an interrupted signal, the circuit must only trigger after someone begins to snore. If there was no delay, then the circuit would be set off by any background noise. Even though some degree of high frequency roll-off is employed in this snore alarm, all sounds consist of a fundamental frequency, plus a number of harmonics. Thus a car horn, or a car door opening in the middle of the night could set off the alarm, hence the need for an input delay.

The input delay is provided by C8 and R12. The half wave rectified signal from IC2 is now filtered again and used to slowly charge up C8, a 33u electrolytic capacitor. C8 will only charge when an input signal is present, i.e. by a loud noise such as a snore. With no input signal, C8 discharges through R12 and R11. The signal is further rectified by D2, R9 and R10 providing a slight forward bias to bring D2, a 1N4148 diode into conduction. This also precharges C8 with no signal to a few tenths of a volt. To provide the delay, op-amp IC3 is used as a variable level detector. VR2 now acts as a threshold control, so that the charge on C8 must equal the voltage at pin 3 of the op-amp, set by VR2. When this happens the circuit will trigger as indicated by LED2. Note that the output of IC3 is normally high, changing to low output on trigger.

If a capacitor is charged by a fixed DC current then its charge time can be calculated, however as the charging current to this circuit is not fixed, and provided by an intermittant noise source (a snore) then calculation becomes difficult. The easy option was experimentation, and with the values shown on the schematic, my prototype made on a breadboard provided between 2 and 10 seconds worth of delay.

Finally the trigger stage. The output from the delay circuit is normally high, changing momentarily to low on detection of a prolonged snore. This is of the correct polarity to trigger a 555 timer, IC4 configured as a monostable. The delay is set by R15 and C9 and calculated as 1.1 xR15 xC9. This is 24.2 seconds with the values shown. R15 can be made variable if required, a 4M7 pot would provide an output for 114 seconds. The output from the 555 timer can supply loads up to 200mA, however Q1 and Q2 form a darlington emitter follower and can source up to 3 amps. As both transistors are fully on, all the power is dissipated in the load and they do not require heatsinks.

Setting Up:

Before building the project some experimentation with the motor is required. I suggest using a small 9 or 12 Vdc electric motor and placing this in an empty 35mm film case. High torque and high power motors must not be used, and any running motor must not exceed 1 amp drawn from the power supply.The assembly then needs to be powered and placed under a pillow or mattress. If the vibration is too excessive then a resistor may be added in series with the motor. You need to measure the dc current with a multimeter with the motor running. This will vary depending on the power supply used and the motor. The 555 timer can source loads up to 200mA, so if the current drawn by the motor is less than this, then Q1, Q2 and R16 are not required. The vibration should not be enough to wake a sleeping person, hence the need for some experimentation.

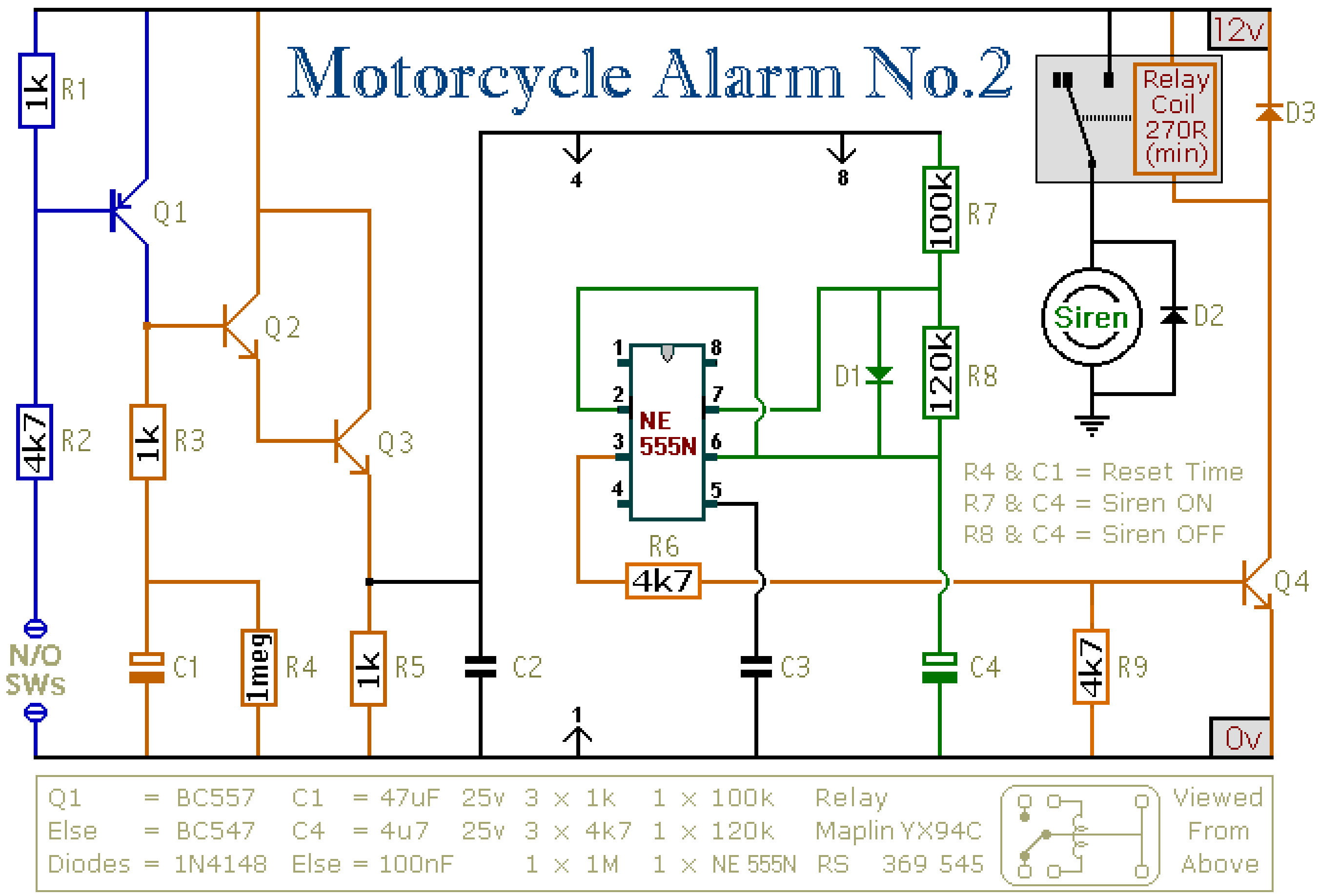
VR1 is adjusted so that with a snore, LED1 will flicker. As LED1 functions as a peak detector, brief flashes are emitted. It is these brief pulses that slowly charge C8. The threshold control, VR2 is adjusted so that after a few seconds the circuit will trigger. A trigger condition is indicated by LED2. In the interval between a snore, the charge on C8 starts to decay, so short bursts of noise should not give a false alarm. One way to test this circuit is to lay down and make snoring sounds.

Parts List:
C2,C1: 10u (2)
C3: 10n CAP (1)
C4: 4u7 (1)
C5: 100u (1)
C6: 220u (1)
C7: 470u (1)
C8: 33u (1)
C9: 22u (1)
D1,D2: 1N4148 DIODE (2)
D3,D4: 1N4001 DIODE (2)
LED1 Red LED (1)
LED2 Red (or any colour)(1)
IC1,2,3: 741,TL071 or 1 quad opamp, i.e TL084 (3)
IC4: 555 (1)
Q1: 2N3053 (1)
Q2: BD131 or TIP31C (1)
R1,R6,R16: 2k2 RESISTOR (3)
R2,R8: 1k RESISTOR (2)
R3: 47k RESISTOR (1)
R5,R4: 22k RESISTOR (2)
R7,R9: 100k RESISTOR (2)
R10,R12: 10k RESISTOR (2)
R11: 220k RESISTOR (1)
R13: 4k7 RESISTOR (1)
R14: 2k7 RESISTOR (1)
R15: 1M RESISTOR (1)
VR1,VR2: 10k RESISTOR (2)

P430. Motorcycle Alarm No. 2

Description:

This circuit features an intermittent siren output and automatic reset. It can be operated manually using a key-switch or a hidden switch; but it can also be wired to set itself automatically when you turn-off the ignition. By adding external relays you can immobilize the bike, flash the lights etc.



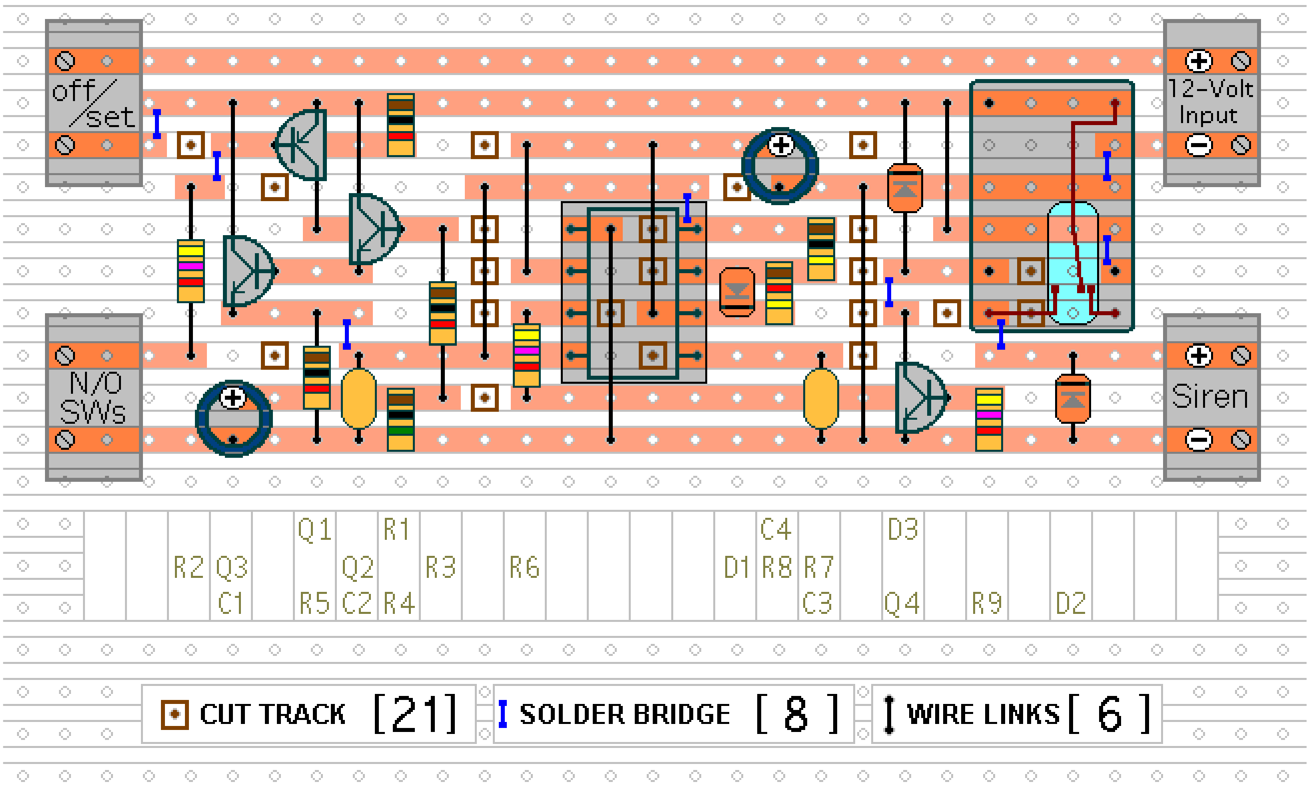
Notes:

Any number of normally-open switches may be used. Fit "tilt" switches that close when the steering is moved or when the bike is lifted off its side-stand or pushed forward off its centre-stand. Use micro-switches to protect removable panels and the lids of panniers etc.

Once activated, the rate at which the siren switches on and off is controlled by R7, R8 & C4. For example, increasing R7 will make the sound period longer; while increasing R8 gives longer silent periods.

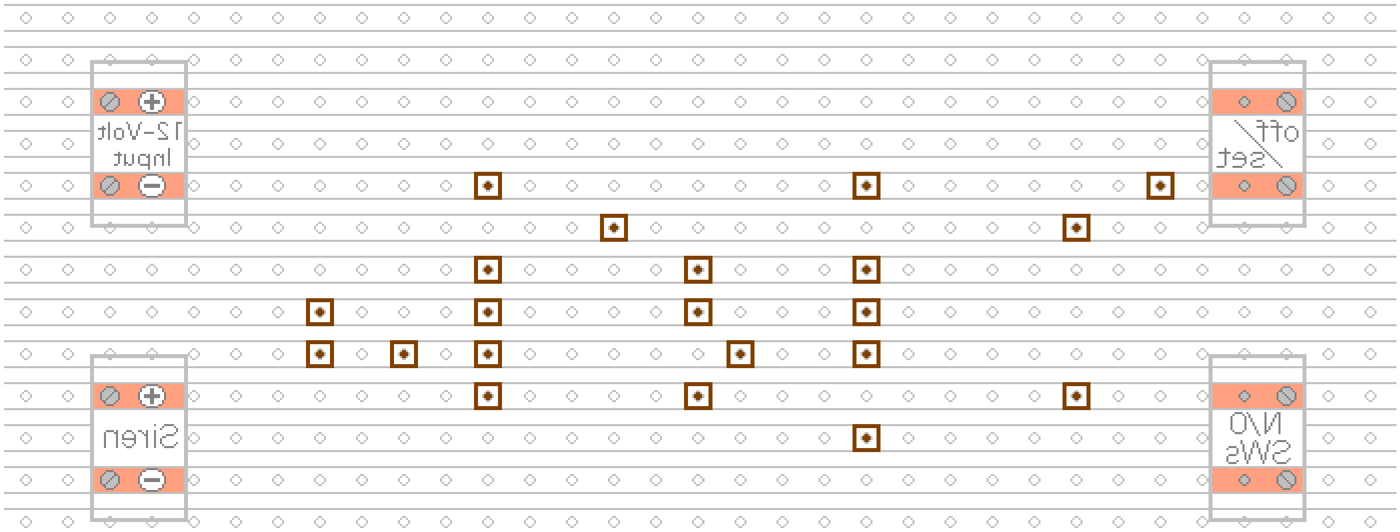
While at least one switch remains closed the siren will sound. About one minutes after all of the switches have been opened, the alarm will reset. How long it takes to switch off depends on the characteristics of the actual components used. You can adjust the time to suit your requirements by changing the value of R4 and/or C1.

Motorcycle Alarm No.2 Component Side



The circuit is designed to use an electronic Siren drawing 300 to 400mA. It's not usually a good idea to use the bike's own Horn because it can be easily located and disconnected. However, if you choose to use the Horn, remember that the alarm relay is too small to carry the necessary current. Connect the coil of a suitably rated relay to the "Siren" output. This can then be used to sound the Horn, flash the lights etc.

Pattern for cutting the tracks UNDERSIDE



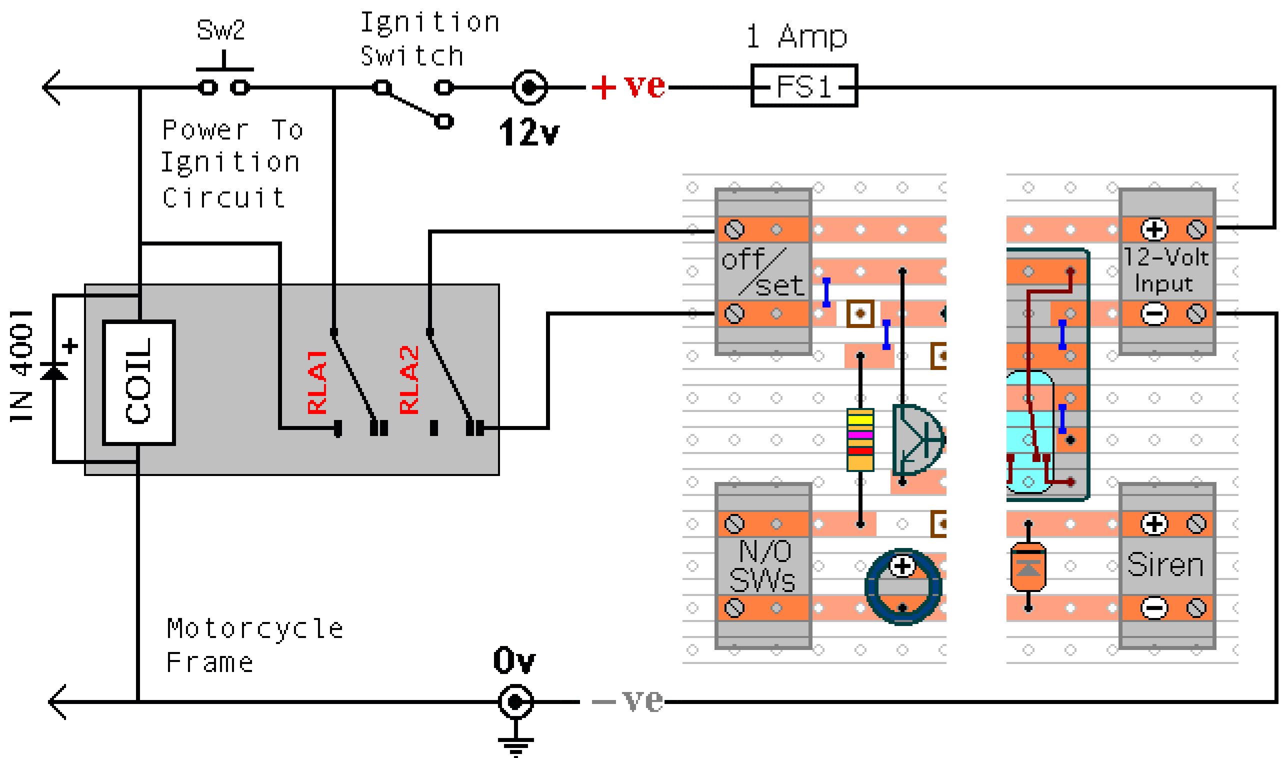
Turn the board over and cut the tracks in the 21 places shown. Make sure that the copper is cut all the way through. Sometimes a small strand of copper remains at the side of the cut and this will cause malfunction. If you don't have the proper track-cutting tool, then a 6 to 8mm drill-bit will do. Just use the drill-bit as a hand tool; there is no need for a drilling machine.

Connect a 1-amp in-line fuse AS CLOSE AS POSSIBLE to your power source. This is VERY IMPORTANT. The fuse is there to protect the wiring - not the alarm. Exactly how the system is fitted will depend on the make of your particular machine - so I'm unable to provide any further help or advice in this regard.

You can use a key-switch or a hidden switch to set the alarm - or you could use the normally-closed contacts of a small relay. Wire the relay coil so that it's energized while the ignition is on. Then every time you turn the ignition off - the alarm will set itself. The quiescent (standby) current is virtually zero - so there is no drain on the battery.

Add an Automatic Immobilizer.

Automatic Immobilizer



Before fitting this or any other immobilizer to your bike, carefully consider both the safety implications of its possible failure - and the legal consequences of installing a device that could cause an accident.

If you decide to proceed, you will need to use the highest standard of materials and workmanship. Remember that the relay MUST be large enough to handle the current required by your ignition system. Choose one specifically designed for automobiles - it will be protected against the elements and will give the best long-term reliability. You don't want it to let you down on a cold wet night - or worse still - in fast moving traffic!!! Please note that I am UNABLE to help any further with either the choice of a suitable relay - or with advice on its installation.

When you turn-off the ignition, the relay will de-energize and the first set of contacts (RLA1) will break the ignition circuit - automatically immobilizing the bike. The second set of contacts (RLA2) will turn-on the alarm.

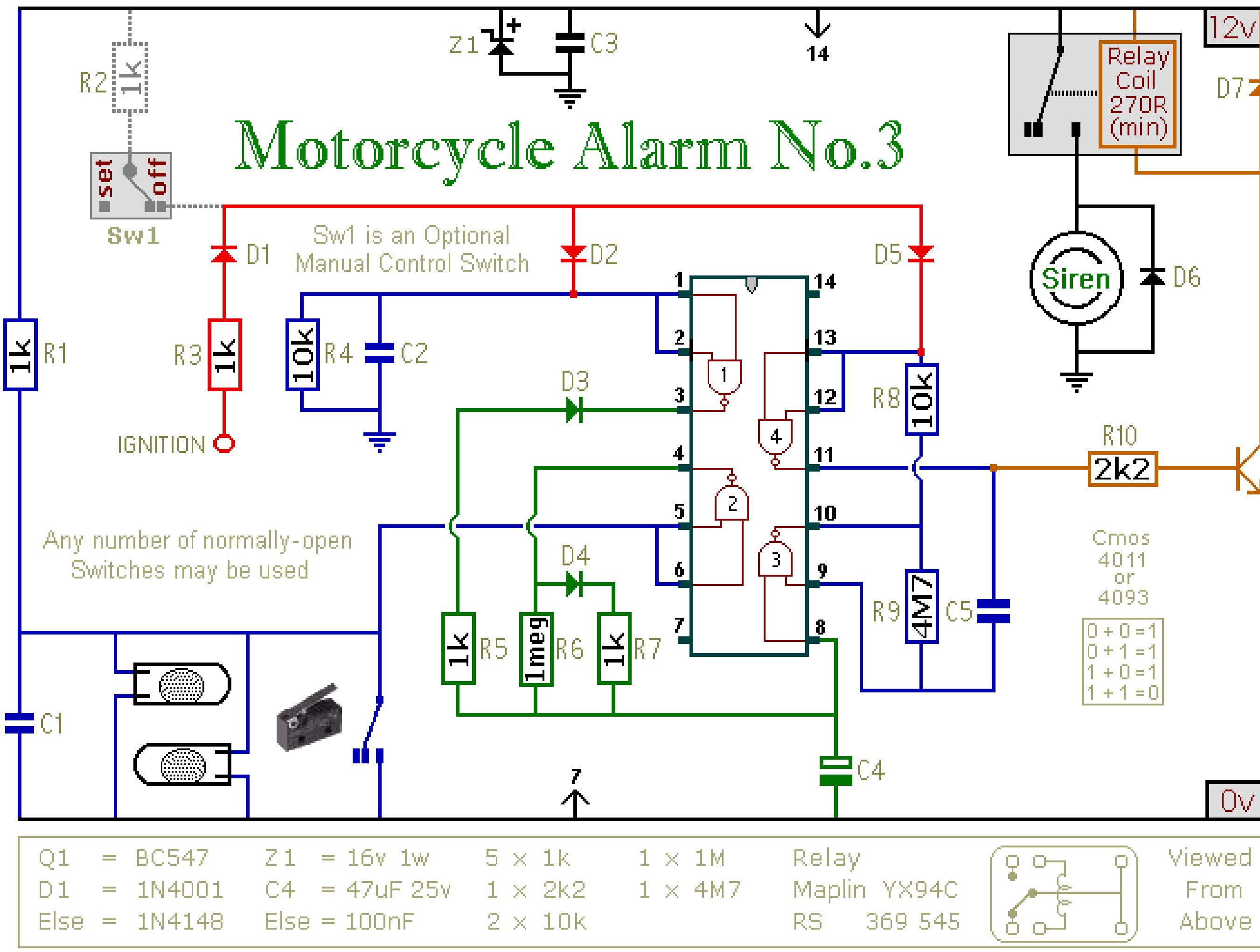
When the ignition is switched on again the relay will not energize. The bike's ignition circuit will remain broken; and the alarm will continue to protect the machine. You must press Sw2 to energize the relay. It then latches itself on using the first set of contacts (RLA1). The same set of contacts completes the connection to the ignition circuit; while the second set of contacts (RLA2) opens and switches off the alarm.

The design has a number of advantages. It operates automatically when you turn-off the ignition - so there's no need to remember to activate it. The relay uses no current while the ignition is off - so there's no drain on the battery. To de-activate it you'll need to have the ignition key and you'll need to know the whereabouts of the push-switch. For extra security Sw2 could be key-operated.

P431. Motorcycle Alarm No. 3

Description:

This circuit features an intermittent siren output and automatic reset. It can be operated manually using a key-switch or a hidden switch; but it can also be wired to set itself automatically when you turn-off the ignition. By adding external relays you can immobilize the bike, flash the lights etc.

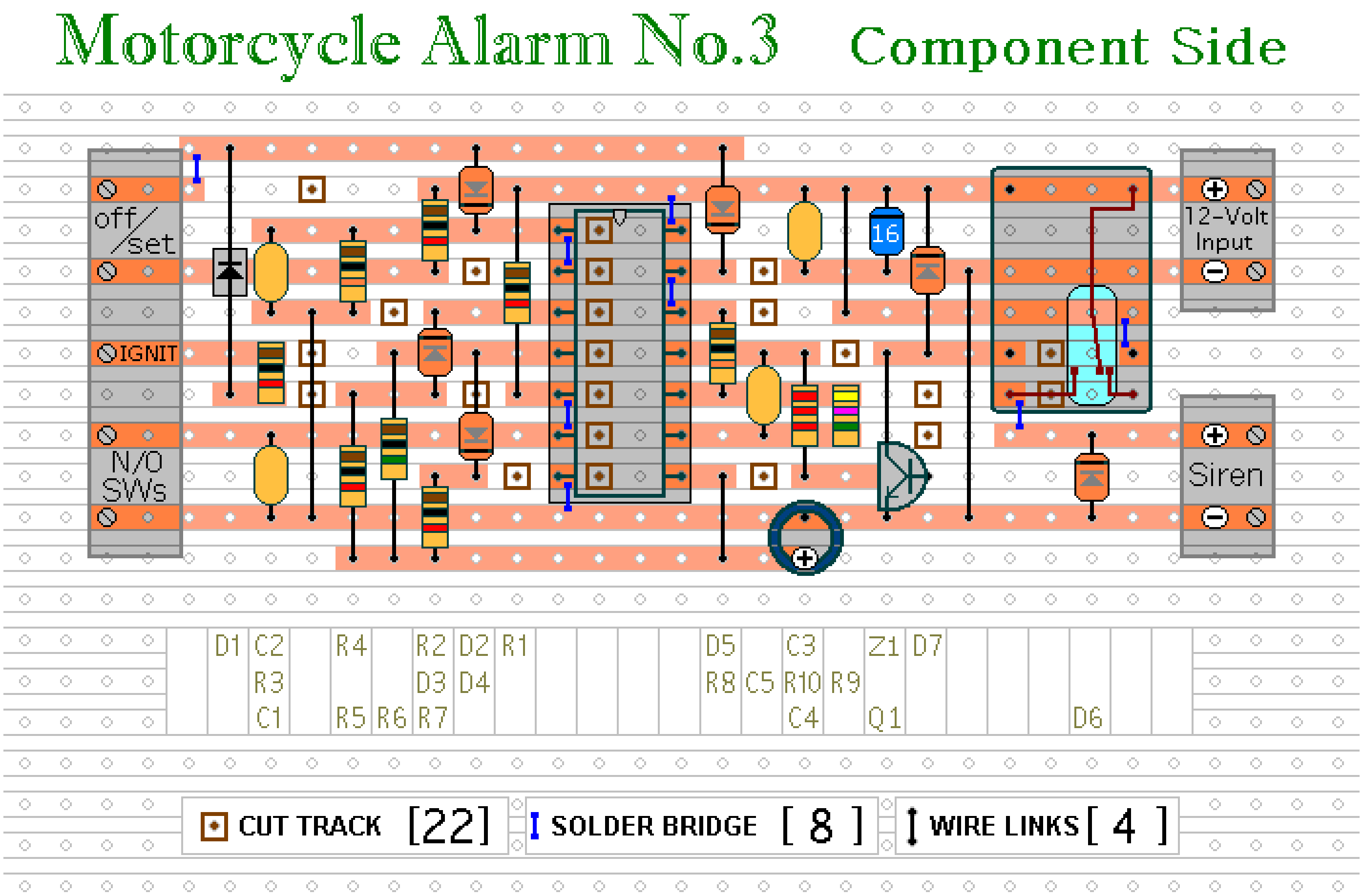


Notes:

Any number of normally-open switches may be used. Fit "tilt" switches that close when the steering is moved or when the bike is lifted off its side-stand or pushed forward off its centre-stand. Use micro-switches to protect removable panels and the lids of panniers etc.

Once activated, the rate at which the siren switches on and off is controlled by R9 & C5. For example - increasing the value of C5 will slow it down, while reducing the value of R9 will make it faster.

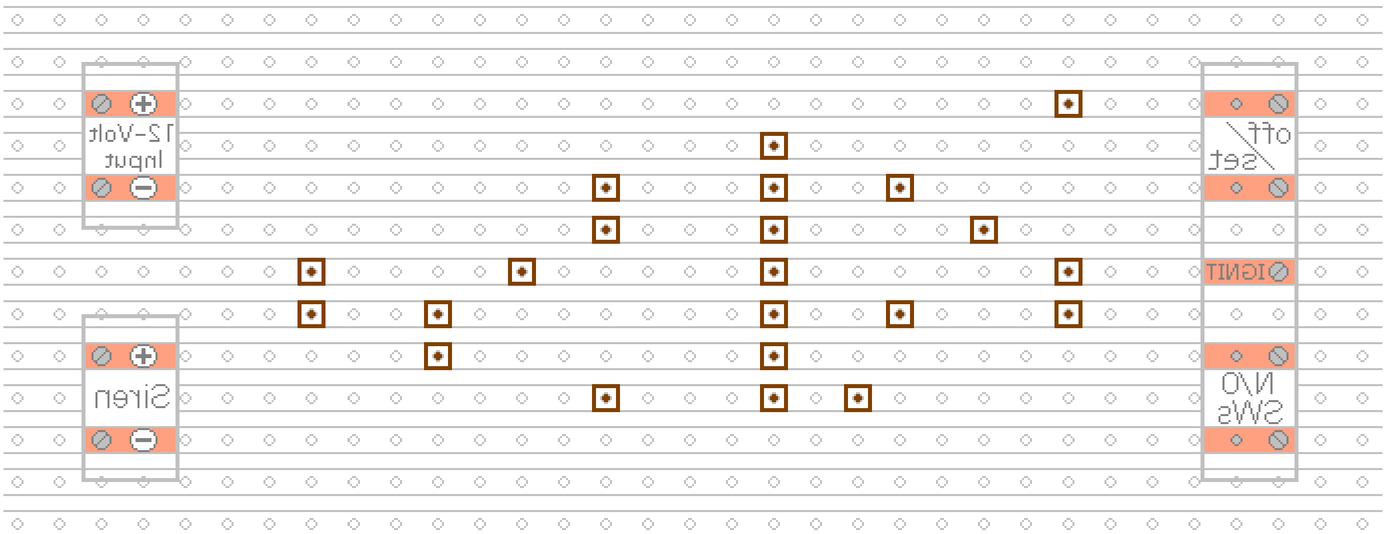
While at least one switch remains closed the siren will sound. About thirty seconds after all of the switches have been opened, the alarm will reset. How long it takes to switch off depends on the characteristics of the actual components used. You can adjust the time to suit your requirements by changing the value of R6 and/or C4.



The circuit is designed to use an electronic Siren drawing 300 to 400mA. It's not usually a good idea to use the bike's own Horn because it can be easily located and disconnected. However, if you choose to use the Horn, remember that the alarm relay is too small to carry the necessary current. Connect the coil of a suitably rated relay to the "Siren" output. This can then be used to sound the Horn, flash the lights etc.

The circuit board and switches must be protected from the elements. Dampness or condensation will cause malfunction. The components are all drawn lying flat on the board - but those connected between close or adjacent tracks are mounted standing upright. The links are bare copper wire on the component side.

Pattern for cutting the tracks UNDERSIDE



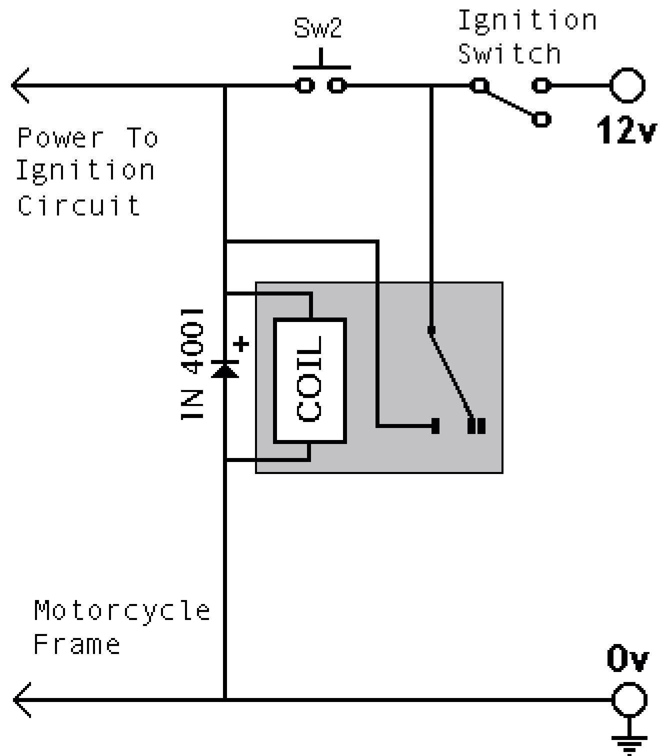
Turn the board over and cut the tracks in the 22 places shown. Make sure that the copper is cut all the way through. Sometimes a small strand of copper remains at the side of the cut and this will cause malfunction. If you don't have the proper track-cutting tool, then a 6 to 8mm drill-bit will do. Just use the drill-bit as a hand tool; there is no need for a drilling machine.

Connect a 1-amp in-line fuse AS CLOSE AS POSSIBLE to your power source. This is VERY IMPORTANT. The fuse is there to protect the wiring - not the alarm. Exactly how the system is fitted will depend on the make of your particular machine - so I'm unable to provide any further help or advice in this regard.

The quiescent (standby) current of the circuit is virtually zero - so there is no drain on the battery. If you want to operate the alarm manually use a key-switch or a hidden switch connected to the "off/set" terminals. For automatic operation connect a wire from the ignition circuit to the "ignit" terminal. Then every time you turn-off the ignition - the alarm will set itself. Remember that this wire from the ignition switch is not protected by your 1-amp inline fuse. So unless its run is very short - fit the wire with its own 1-amp fuse as close as possible to its source.

Add an Automatic Immobilizer.

Automatic Immobilizer



Before fitting this or any other immobilizer to your bike, carefully consider both the safety implications of its possible failure - and the legal consequences of installing a device that could cause an accident.

If you decide to proceed, you will need to use the highest standard of materials and workmanship. Remember that the relay MUST be large enough to handle the current required by your ignition system. Choose one specifically designed for automobiles - it will be protected against the elements and will give the best long-term reliability. You don't want it to let you down on a cold wet night - or worse still - in fast moving traffic!!! Please note that I am UNABLE to help any further with either the choice of a suitable relay - or with advice on its installation.

When you turn-off the ignition the relay will de-energize and the contacts will break the ignition circuit - automatically immobilizing the bike.

When the ignition is switched on again the relay will not energize. The bike's ignition circuit will remain broken until you press Sw2. The relay then uses its own contacts to latch itself on. The same contacts complete the connection to the ignition circuit.

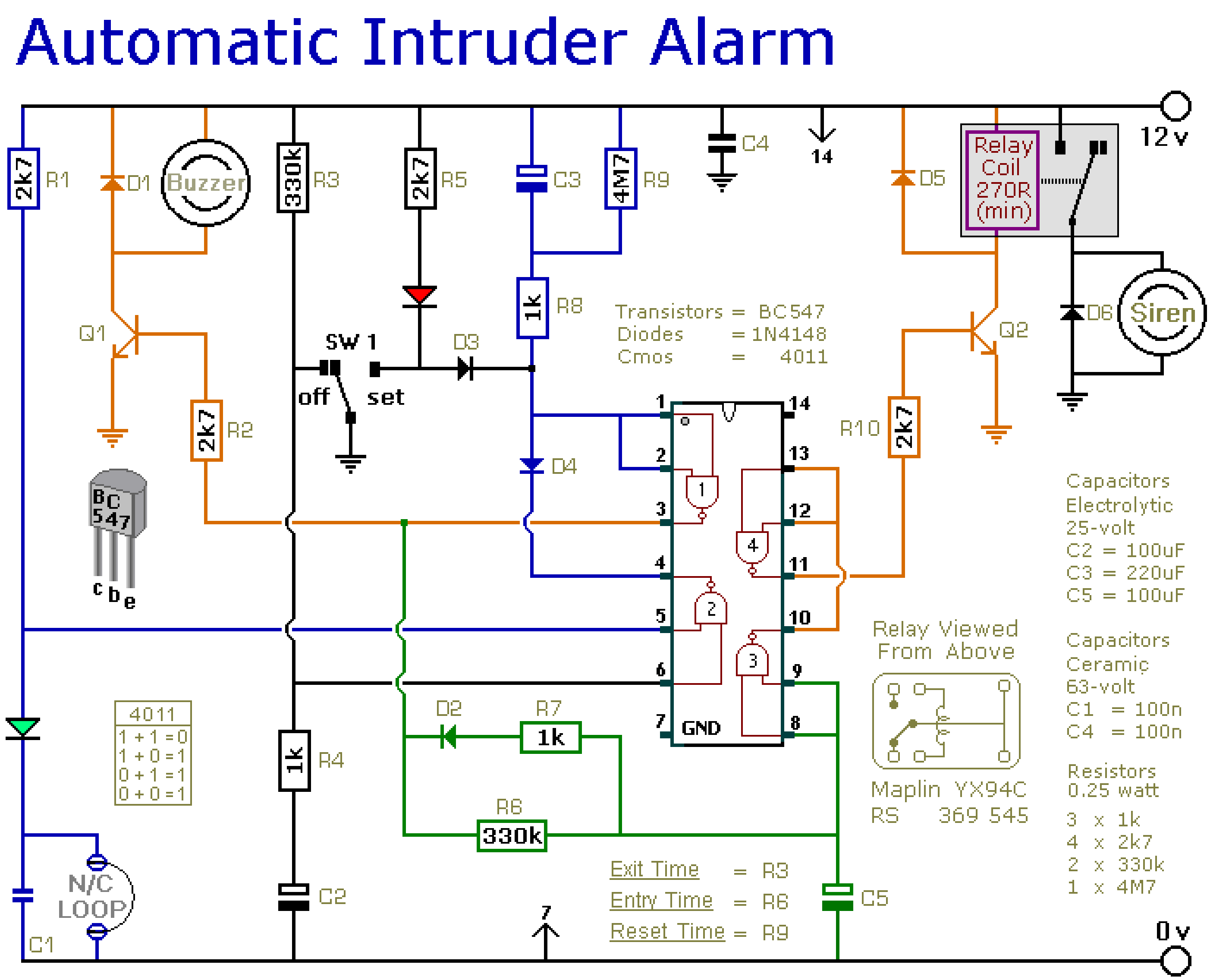
The design has a number of advantages. It operates automatically when you turn-off the ignition - so there's no need to remember to activate it. The relay uses no current while the ignition is off - so there's no drain on the battery. To de-activate it you'll need to have the ignition key and you'll need to know the whereabouts of the push-switch. For extra security Sw2 could be key-operated.

P432. Automatic Intruder Alarm

Description:

This is a simple single-zone burglar alarm circuit. Its features include automatic Exit and Entry delays and a timed Bell/Siren Cut-Off. It's designed to be used with the usual types of normally-closed input devices such as - magnetic reed contacts - micro switches - foil tape - and PIRs. But it can be **Easily Modified** to accept normally-open triggering devices - such as pressure mats.

Schematic Diagram:



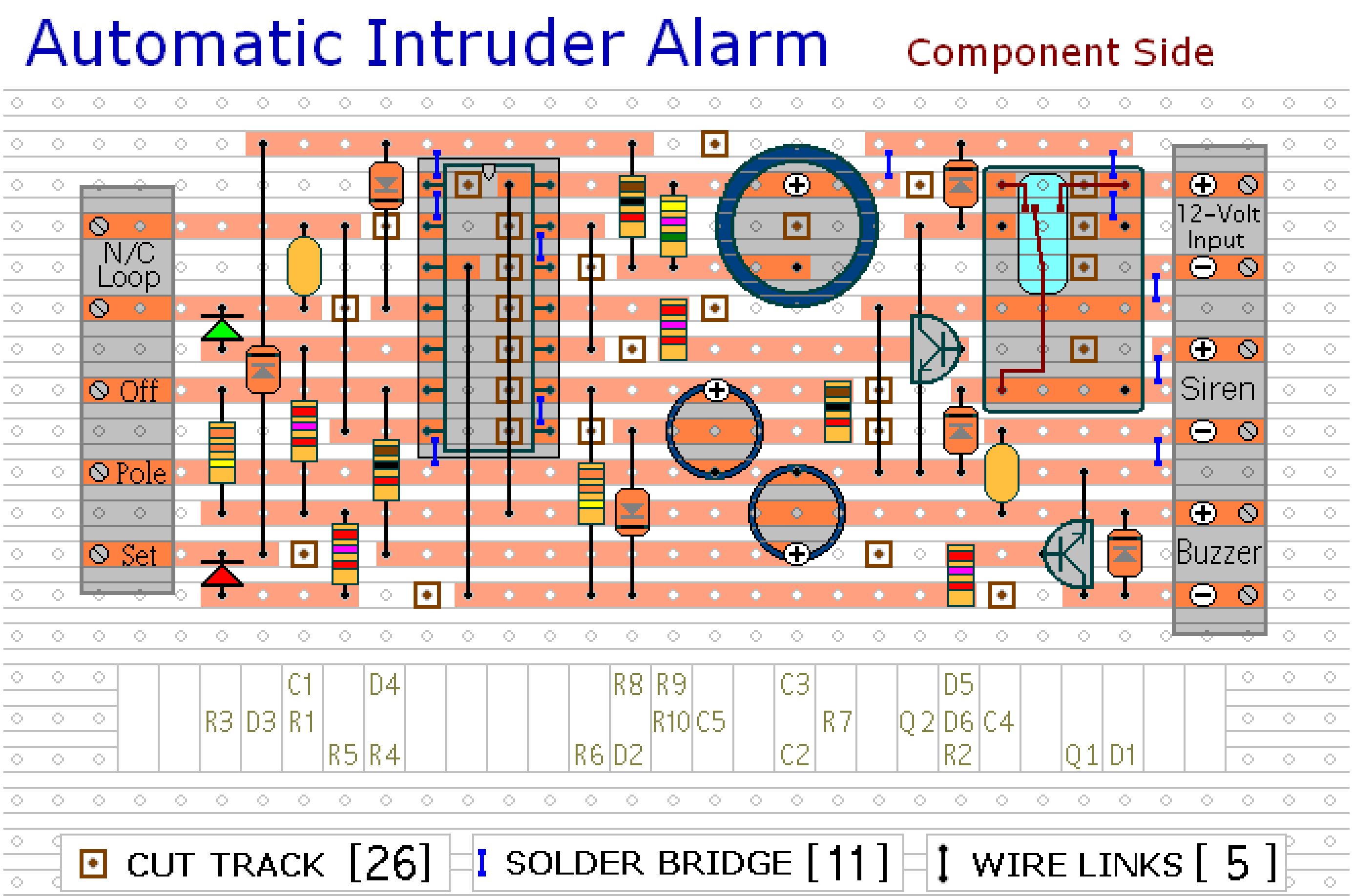
Notes:

It's easy to use. First check that the building is secure and that the green LED is lit. Then move SW1 to the "set" position. The red LED will light. You now have about 30 seconds to leave the building. When you return and open the door - the Buzzer will sound. You then have about 30 seconds to move SW1 to the "off" position. If you fail to do so - the relay will energize and the Siren will sound.

While at least one of the switches in the normally-closed loop remains open - the Siren will continue to sound. However, about 15-minutes after the loop has been restored - the relay will de-energize - the Siren will Cut-Off - and the alarm will Reset. Of course, you can turn the Siren off at any time by moving SW1 to the "off" position.

Because of manufacturing tolerances - the precise length of any delay depends on the characteristics of the actual components you've used in your circuit. But by altering the values of R3, R6 & R9 you can adjust the Exit, Entry and Bell Cut-Off times to suit your requirements. Increasing the values increases the time - and vice-versa.

Veroboard Layout:



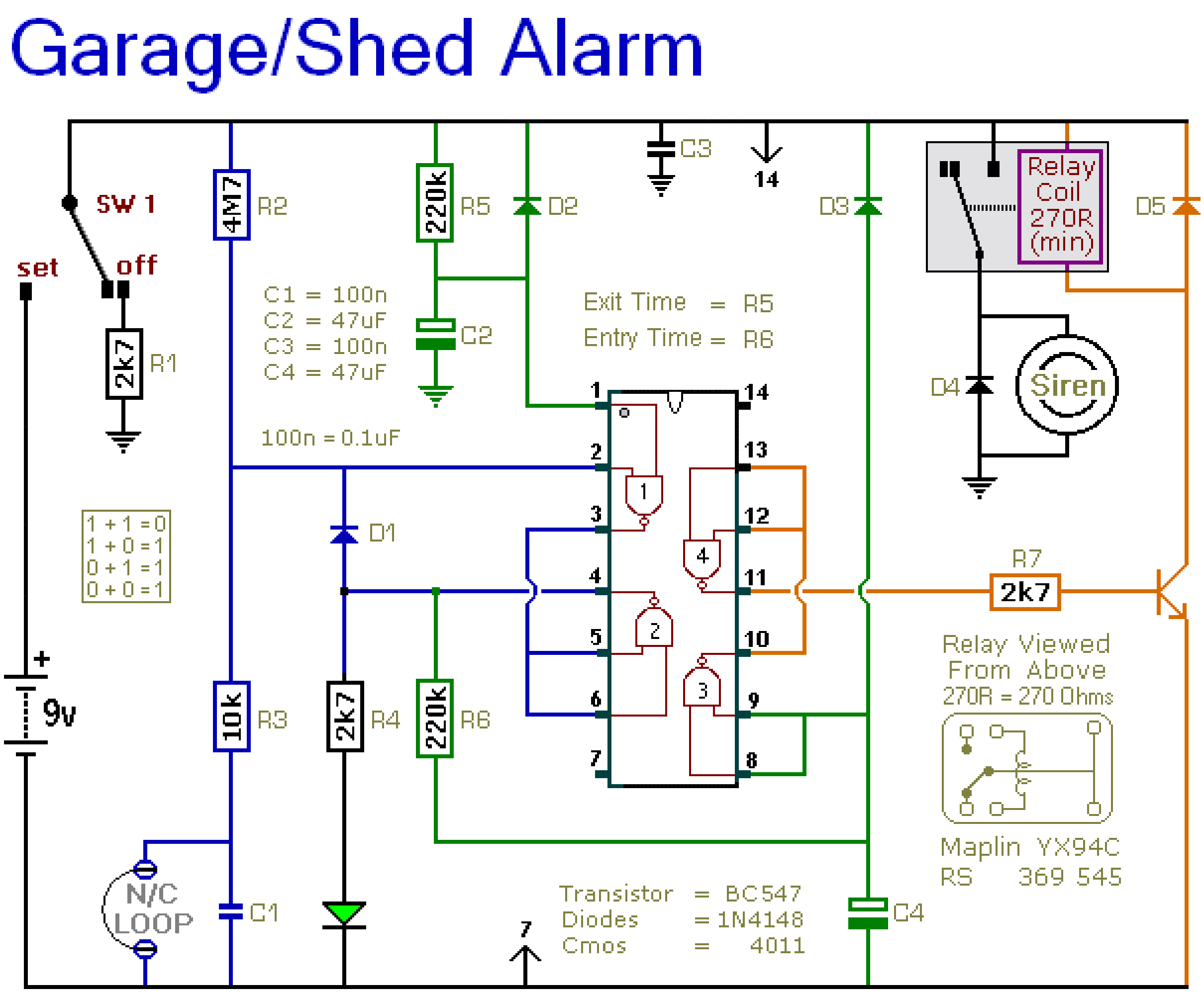
P433. Shed/Garage Alarm

Description:

This is a simple single-zone burglar alarm circuit. Its features include automatic Exit and Entry delays. It's designed to be used with the usual types of normally-closed input devices such as - magnetic-reed contacts - micro switches - foil tape - and PIRs.

It has an extremely small standby current - making it ideal for battery-powered operation. I've used a 9-volt battery in the diagram - but the circuit will work at anything from 5 to 15-volts. Just choose a relay and Siren suitable for the voltage you want to use.

Schematic Diagram:

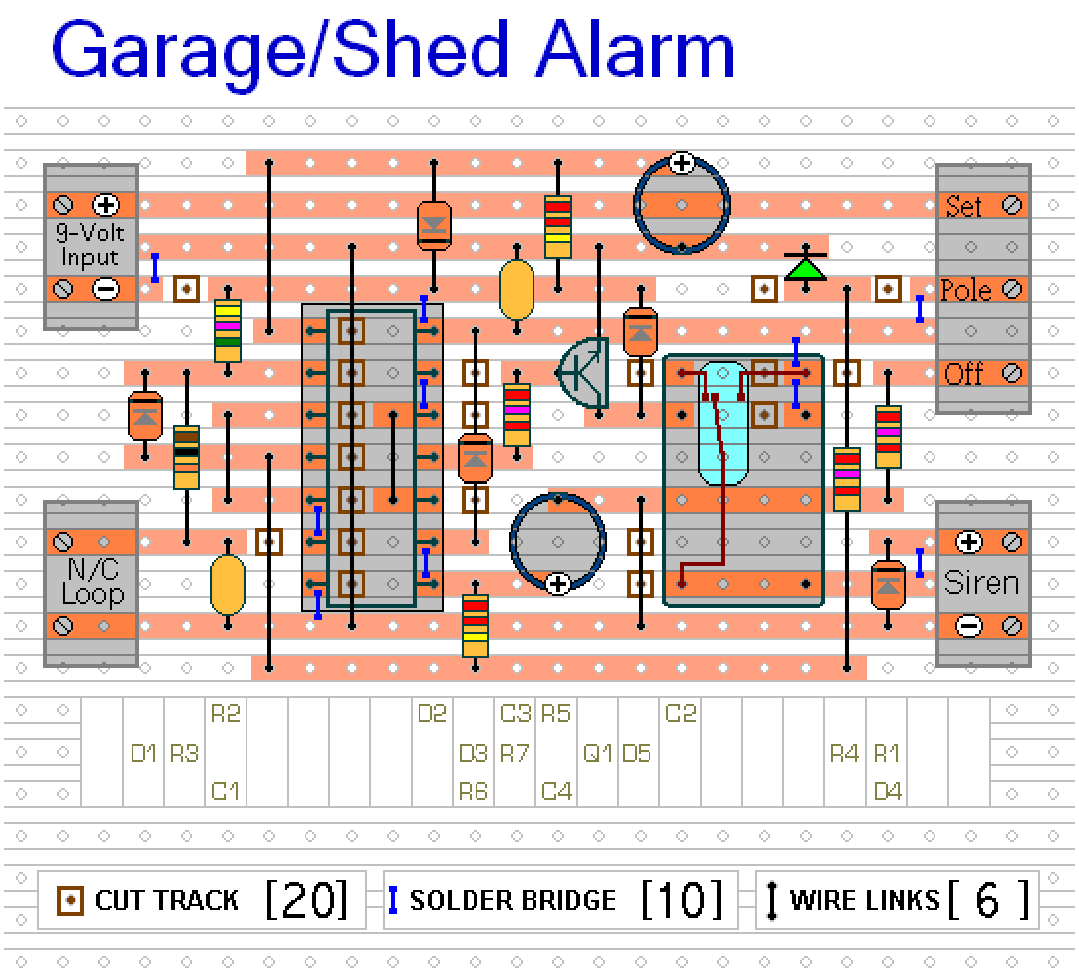


Notes:

It's easy to use. To set the alarm move SW1 to the "set" position. You now have about 10 to 15 seconds to leave the building. When you return and open the door - the green LED will light. You then have about 10 to 15 seconds to move SW1 to the "off" position. If you fail to do so - the relay will energize and the Siren will sound. Of course - you can turn the Siren off at any time by moving SW1 to the "off" position.

Because of manufacturing tolerances - the precise length of any delay depends on the characteristics of the actual components you've used in your circuit. But by altering the values of R5 & R6 you can adjust the Exit and Entry times to suit your requirements. Increasing the values increases the time - and vice-versa.

Veroboard Layout:

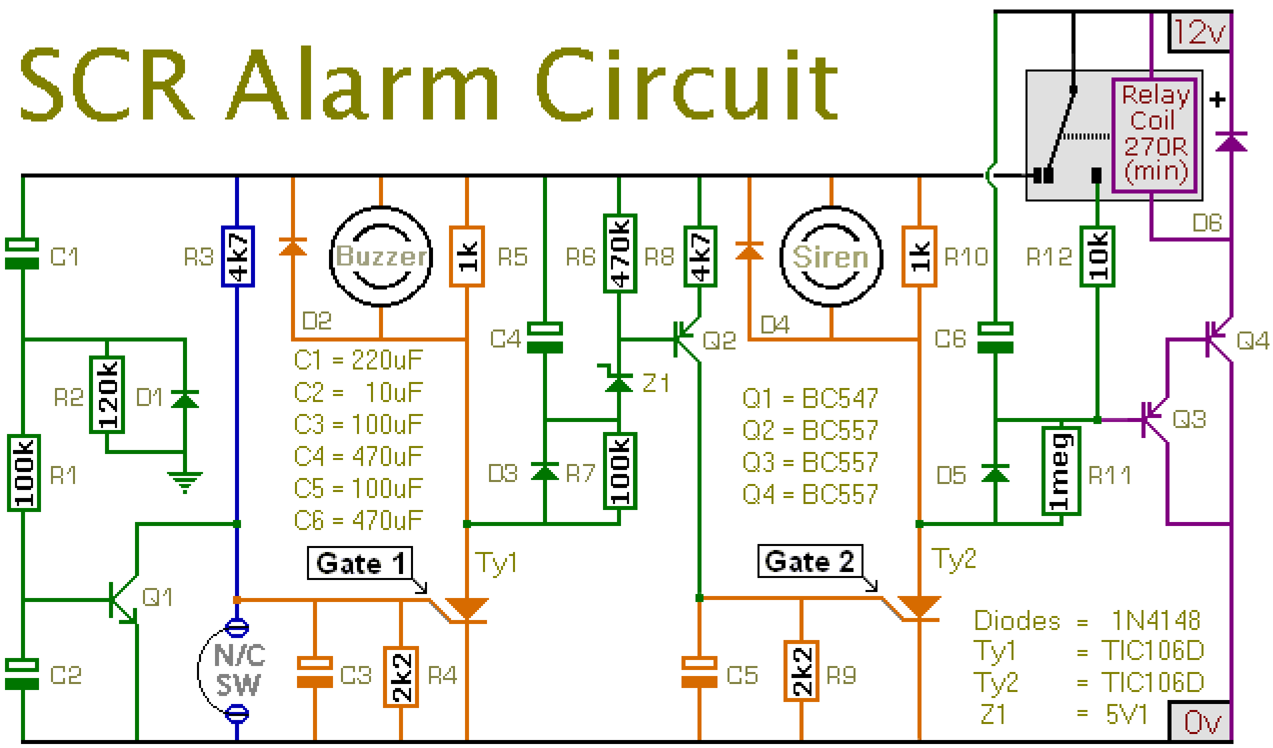


P434. An SCR Based Burglar Alarm

Description:
This is a simple SCR based burglar alarm circuit. Its features include automatic Exit and Entry delays - together with a timed Bell cut-off and Reset. It's designed to be used with the usual types of normally-closed input devices such as - magnetic-reed contacts - micro switches - foil tape - and PIRs.

The basic alarm has a single zone with "Exit/Entry" delays. This will be adequate in many situations. However - larger buildings are better divided into zones. The modular design means that you can Add Any Number Of Zones to the system. These "Instant" zones may be triggered by normally-open as well as normally-closed input devices.

Schematic Diagram:



Notes:

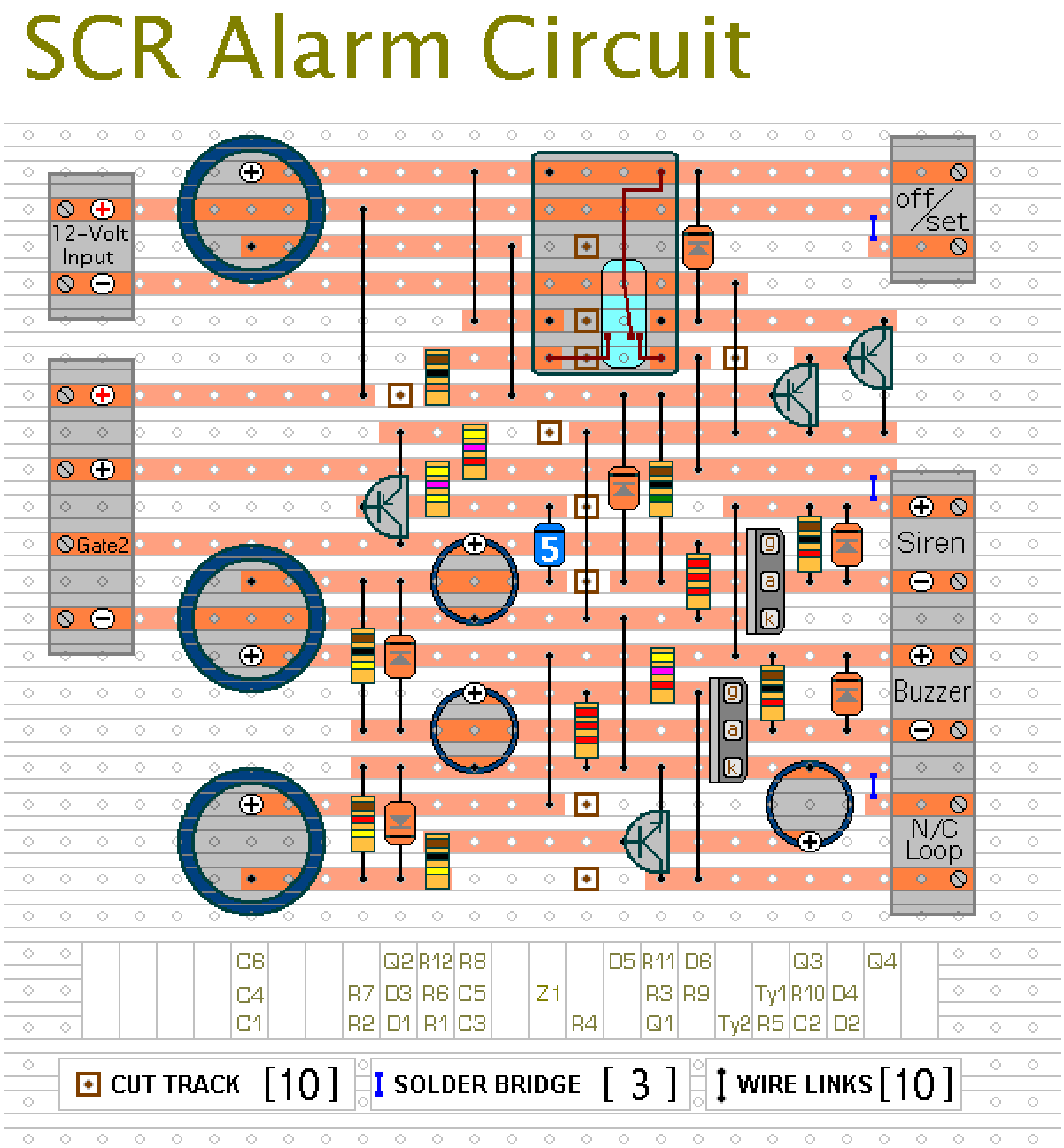
It's easy to use. When you switch on the alarm - you have about 30 seconds to leave the building. When you return and open the door - the Buzzer will sound. You have about 30 seconds to switch off the alarm. If you fail to do so - the Siren will sound.

After about 10 minutes - the alarm will attempt to reset itself. If the trigger circuit has been restored - the attempt will be successful. But - if the loop is still open - the attempt will fail - and the alarm will re-activate. Of course - you can turn the Siren off at any time by switching off the alarm.

A conventional bell uses up to about 400ma. An electronic siren generally uses less. If you intend to draw a heavier current from either the Buzzer or Siren terminals - the SCR in question will need to be bolted to a metal heatsink - and the relay contacts may need upgrading.

If you don't want the timed "cut-off and reset" feature - leave out D5, D6, R11, R12, Q3, Q4, C6 and the Relay.

Veroboard Layout:



P435. One Time Only Alarm

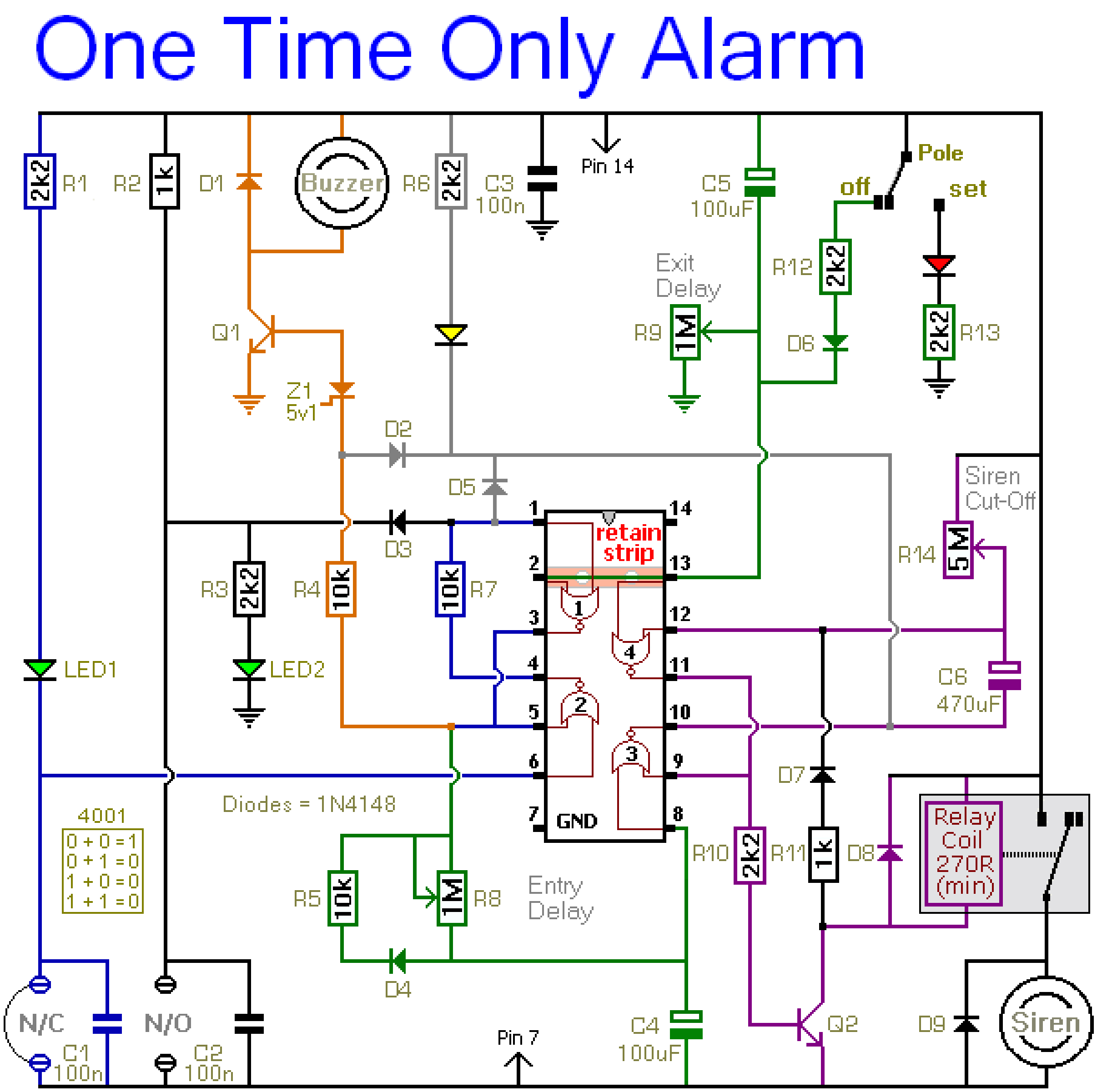
Description:

This alarm is designed to sound its Siren only once. That is - when the alarm is activated - the Siren will sound for a preset length of time. Then it will switch off and remain off. The alarm will not re-activate.

The basic circuit has a single zone with independently adjustable Exit and Entry delays. The zone will accommodate the usual types of normally-open and normally-closed input devices - such as pressure mats, magnetic-reed contacts, micro switches, foil tape and PIRs.

A range of Expansion Modules allow you to add any number of Instant Alarm Zones, Personal Attack Zones and Tamper Zones to your system. There's also an Untimed Output Module. It will keep an internal sounder, strobe-light, lamp or whatever going after the siren has stopped.

Schematic Diagram:



Notes:

The alarm may be operated by a simple hidden two-way switch - such as a light switch. If you want more security - you can use a key switch - or one of a number of code operated Keypad Switches.

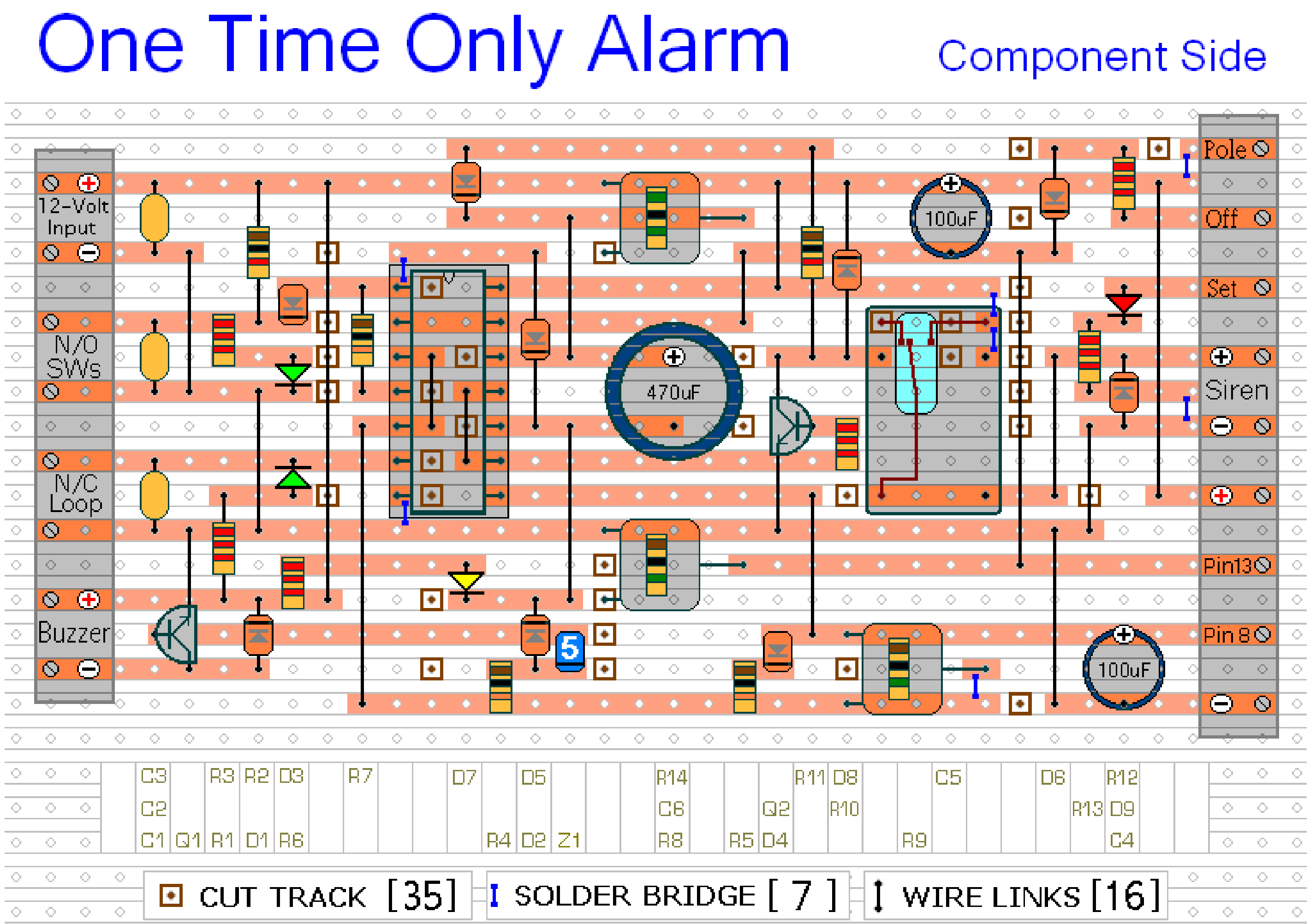
Before you set the alarm - make sure that the building is secure - that ALL of the Green LEDs are lighting - and that the Yellow LED is off. If the Yellow LED is lighting - there's a fault in one of the zones - and THE ALARM WILL NOT SET.

Depending on the setting of R9 - when you move Sw1 to the "set" position - you have up to about a minute to leave the building. When you return and open the door - the Buzzer will sound. Depending on the setting of R8 - you have up to about a minute to switch the alarm off. If you fail to do so - the Siren will sound.

Depending on the setting of R14 - the Siren will sound for up to about 20-minutes. Then it will switch off - and remain off. Of course - you can stop the noise at any time by moving Sw1 to the "off" position.

When you return - if the Buzzer does not sound and the Yellow LED is lighting - then there's been an activation while you were away.

Veroboard Layout:



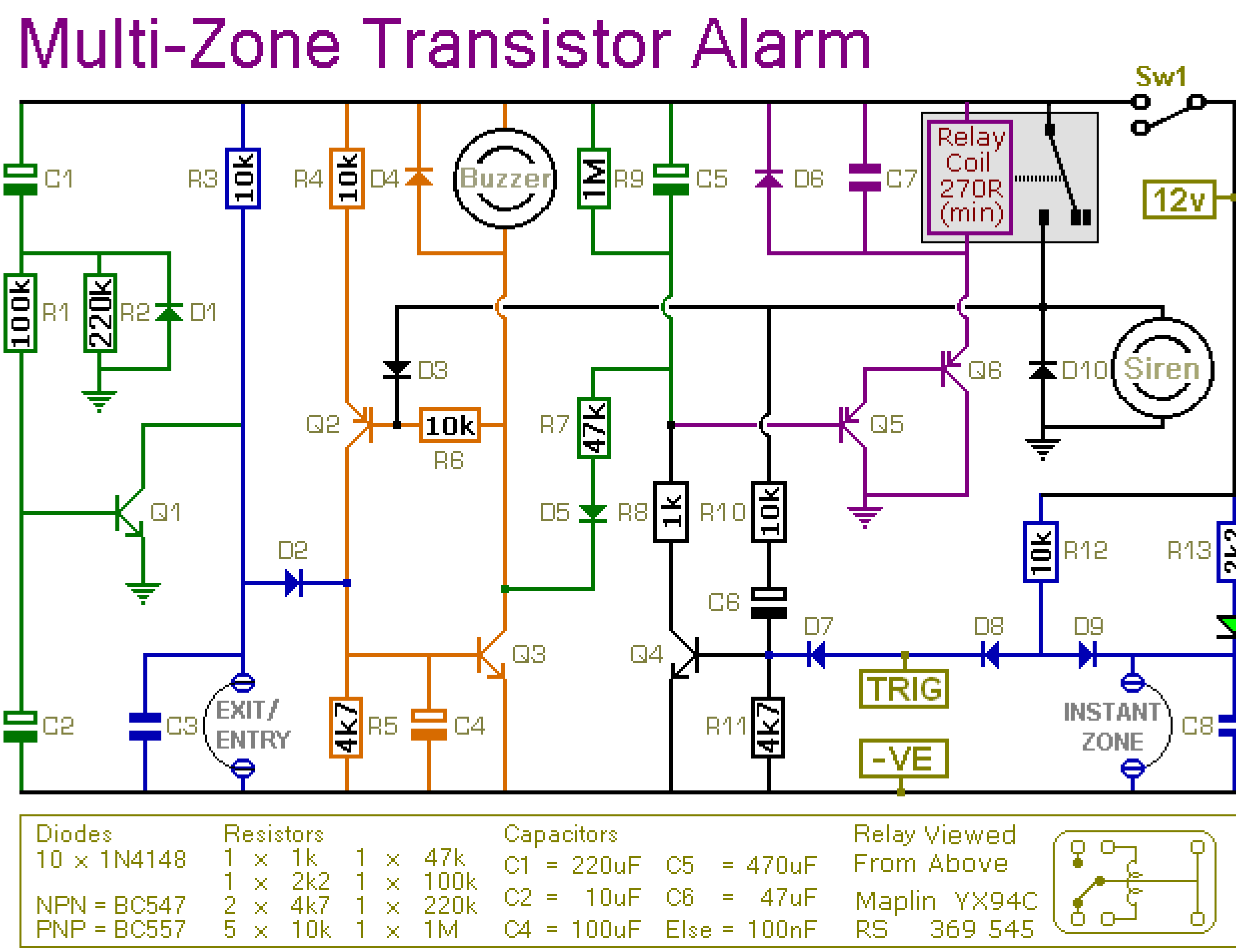
P436. Multi-Zone Transistor Alarm

Description:

This is a simple transistor-based burglar alarm circuit. Its features include automatic Exit and Entry delays - together with a timed Bell cut-off and Reset. It's designed to be used with the usual types of normally-closed input devices such as - magnetic-reed contacts - micro switches - foil tape - and PIRs.

The basic alarm has an "Exit/Entry" zone and an "Instant" zone. This will be adequate in many situations. However - larger buildings are best divided into a number of smaller zones. The design allows you to Add As Many Zones As You Like to the basic system. They are "Instant Zones" - and may be triggered by both normally-open and normally-closed input devices.

Schematic Diagram:



Notes:

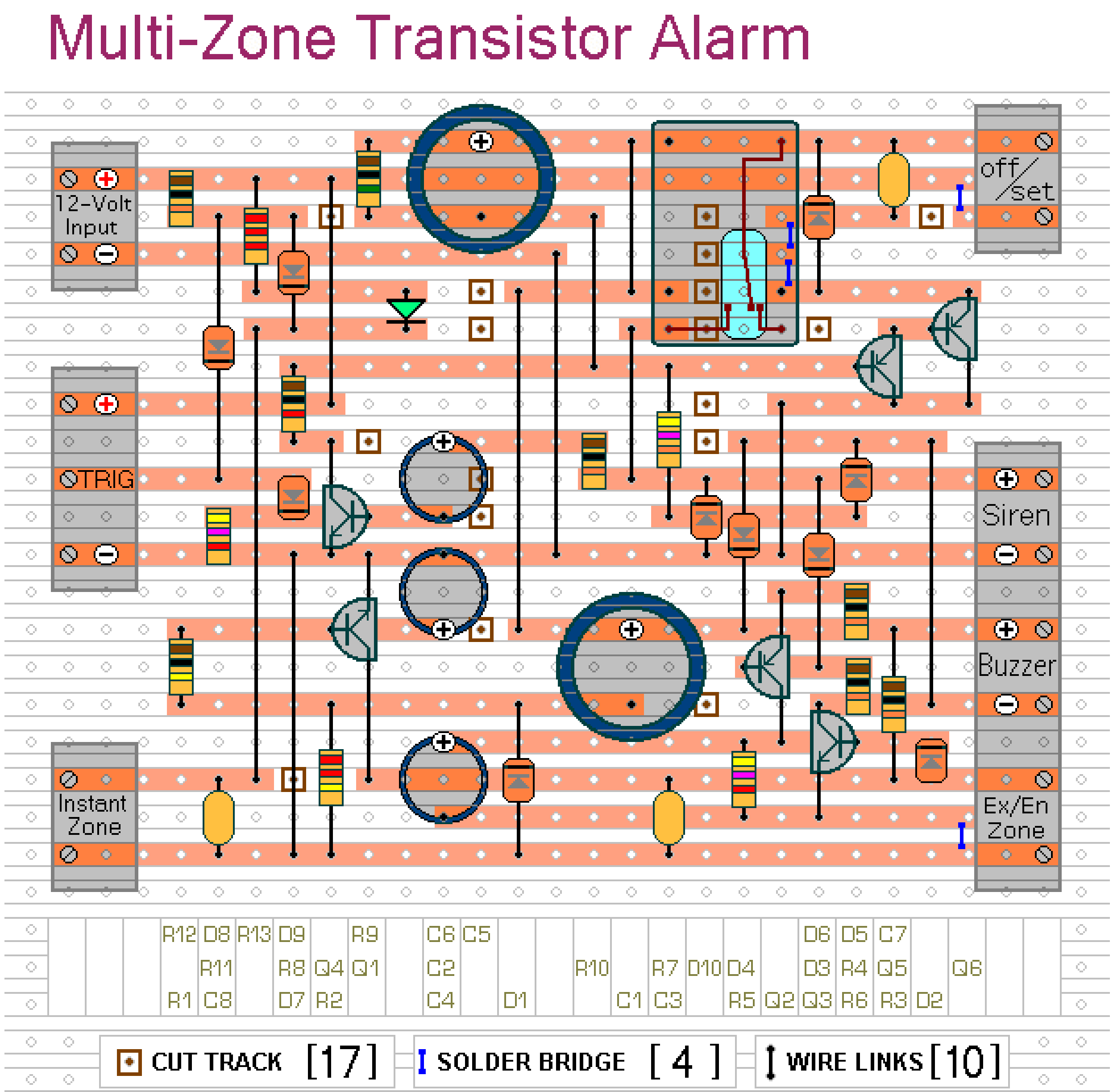
It's easy to use. Make sure that the green LED is lighting - then switch the alarm on using Sw1. You have about 30 seconds to leave the building. When you return and open the door - the Buzzer will sound. You have about 30 seconds to switch off the alarm. If you fail to do so - the Siren will sound.

While at least one of the trigger switches remains open - the Siren will continue to sound. However - if the trigger circuits have been restored - the alarm will reset itself after about 10 minutes. Of course - you can turn the Siren off at any time by switching off the alarm.

Because of manufacturing tolerances - the precise length of any delay depends on the characteristics of the actual components you've used in your circuit. But - to some degree - by altering the values of R2, R7 & R9 you can adjust the Exit, Entry and Reset times to suit your requirements. Increasing the values increases the time - and vice-versa.

If you don't want the "Instant" zone - leave out D7, D8, D9, R12, R13, C8 and the Green LED.

Veroboard Layout:



P437. Battery Powered Burglar Alarm

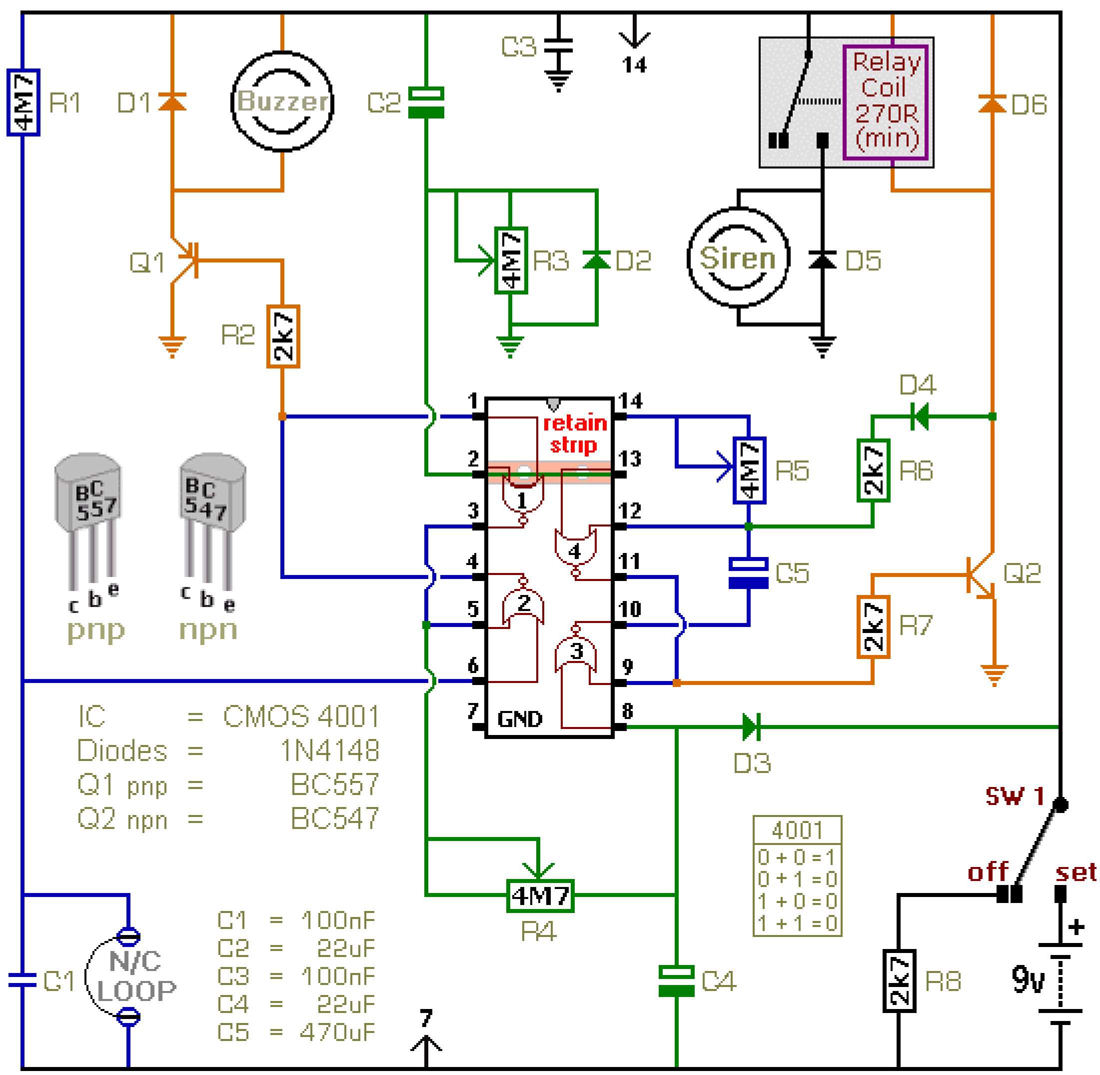
Description:

This is a single zone alarm - with independently adjustable Exit, Entry and Siren Cut-Off timers. It will accommodate the usual types of normally-closed input devices - such as magnetic-reed contacts, foil tape and PIRs.

When the alarm is activated - the Siren will sound for up to 20-minutes. Then it will switch off - and remain off. The alarm will not re-activate.

If you wish - you can use a mains power supply. But the extremely low standby current makes battery power a realistic option. I've used a 9-volt supply in the drawing - but the circuit will work at anything from 5 to 15-volts. All you need do is select a Siren, Buzzer, and Relay to suit the voltage you're using.

Schematic Diagram:



[Notes:](#)

The alarm is easy to operate. Sw1 can be any type of two-way switch. If the Buzzer sounds when you switch the alarm on - the normally-closed loop is open. Switch off again - and check the building for open doors or windows. If the Buzzer does not sound - the loop is intact.

Depending on the setting of R3 - you have up to about a minute to leave the building. As you do so - the Buzzer will sound. When you close the door behind you - it should stop sounding. This confirms that the loop has been restored within the time allowed.

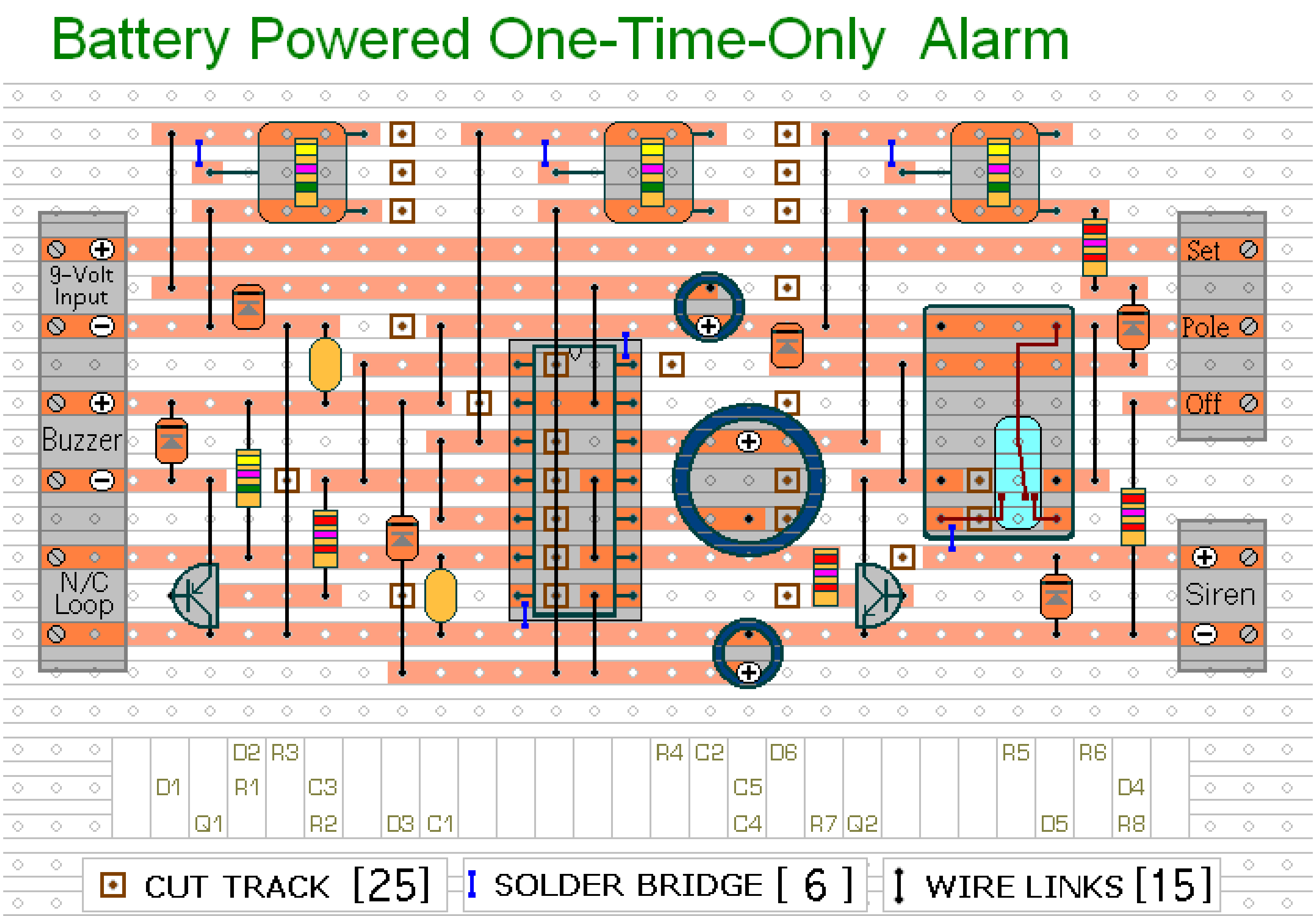
When you return and open the door - the Buzzer will sound. Depending on the setting of R4 - you have up to about a minute to switch the alarm off. If you fail to do so - the Siren will sound.

Depending on the setting of R5 - the Siren will sound for up to about 20-minutes. Then it will switch off - and remain off. Of course - you can stop the noise at any time by moving Sw1 to the "off" position.

For this type of device - really precise times are not necessary. If you like - you can replace the pots with fixed resistors. For example - 2M2 resistors should give you exit and entry delays of about 30-seconds - and a Siren cut-off time of about 10-minutes.

After the cut-off timer has switched the Siren off - the Buzzer will continue to sound. So when you return - if the Buzzer is sounding - you'll know that the alarm has been activated.

[Veroboard Layout:](#)



P438. Cmos 4060 Burglar Alarm

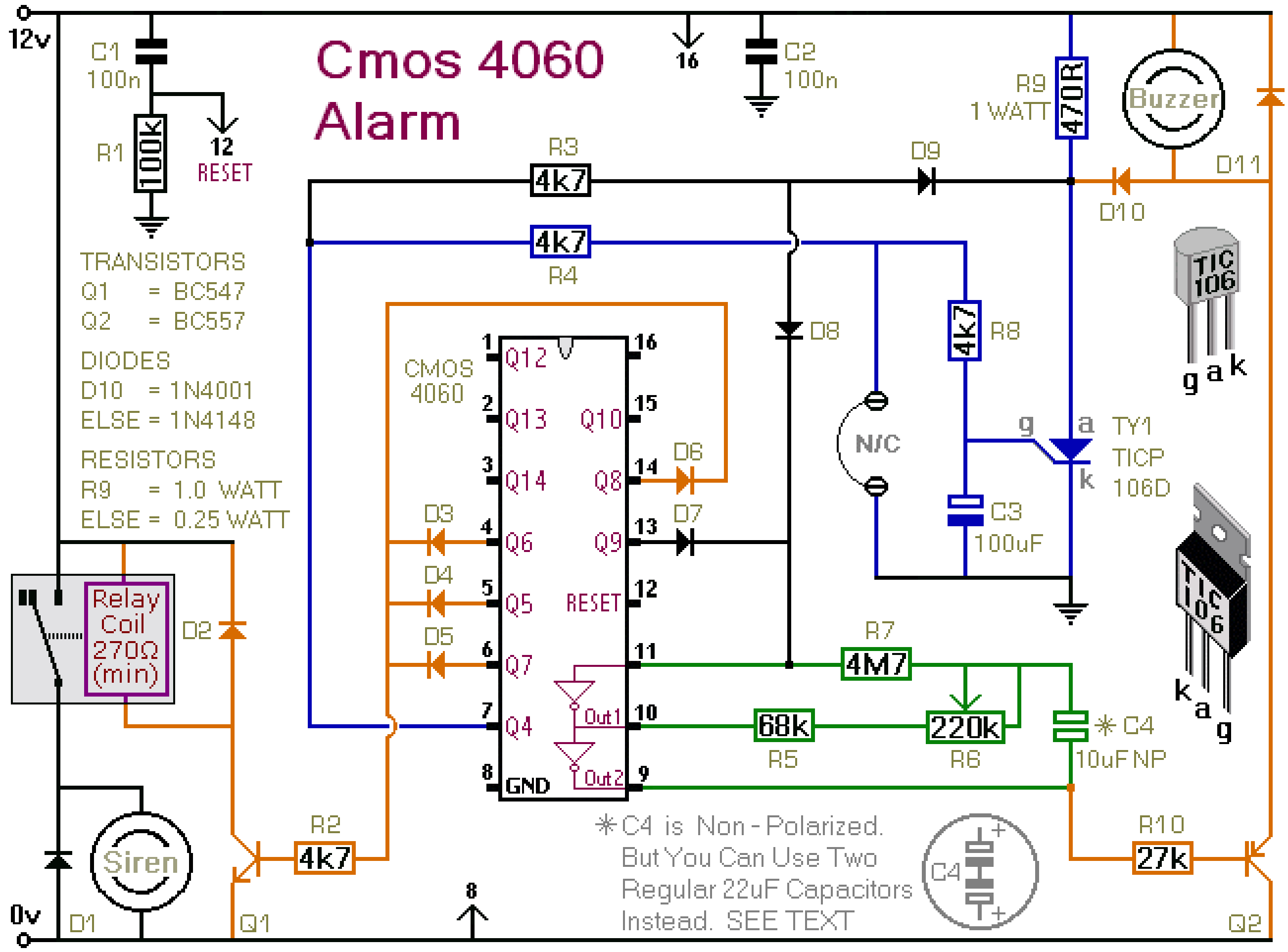
Description:

This is a single zone alarm - with automatic exit, entry and siren cut-off timers. It will accommodate all the usual types of normally-closed input devices - such as magnetic-reed contacts - foil tape - PIRs etc.

When the alarm is activated - the siren will sound for a fixed length of time. Then it will switch off - and remain off. The alarm will not re-activate.

I've used a 12-volt supply in the drawing - but the circuit will work at anything from 5 to 15-volts. All you need do is select a siren, buzzer, and relay to suit the voltage you're using.

Schematic Diagram:



Notes:

When you switch the alarm on - the buzzer will sound eight times. This is the exit delay. Before the end of the eighth beep - you can leave the building without activating the alarm.

R6 controls the length and speed of the beeps. It can be adjusted to give an exit delay of anything from about ten seconds - up to about a minute. After the eighth beep - the buzzer should stop sounding. This confirms that the loop has been restored within the time allowed.

If the buzzer does not stop - but changes instead to a continuous beep - the loop is open and the building isn't secure. When this happens - you should switch off the alarm - and check for open doors, windows etc.

When you return and open the door - the buzzer will sound again - and the entry delay will start. The entry delay is the same length as the exit delay. But to distinguish it from the exit delay - the buzzer will sound continuously.

If the buzzer is sounding continuously - the alarm has been activated - and the entry delay has begun. If you don't switch the alarm off before the entry delay expires - the siren will sound.

The siren will sound only once. Just as R6 sets the lengths of the exit and entry delays - it also sets the siren cut-off time. The siren cut-off delay is 30 times the length of the exit delay. With the exit delay set at 30-seconds - the siren will sound for about 15-minutes. Then it will switch off - and remain off.

Of course - you can stop the noise at any time by switching off the alarm.

After the cut-off timer has switched the siren off - the buzzer will continue to sound. So when you return - if the buzzer is sounding - you'll know that the alarm has been activated.

Note that D10 is optional. Its job is to sound the buzzer constantly during the entry delay. It's also responsible for keeping the buzzer going after the siren has stopped.

If you leave out D10 - the buzzer will beep eight times during both the exit and entry delays. And - when the siren cuts-off - the buzzer will cut off also.

Alternative Capacitor:

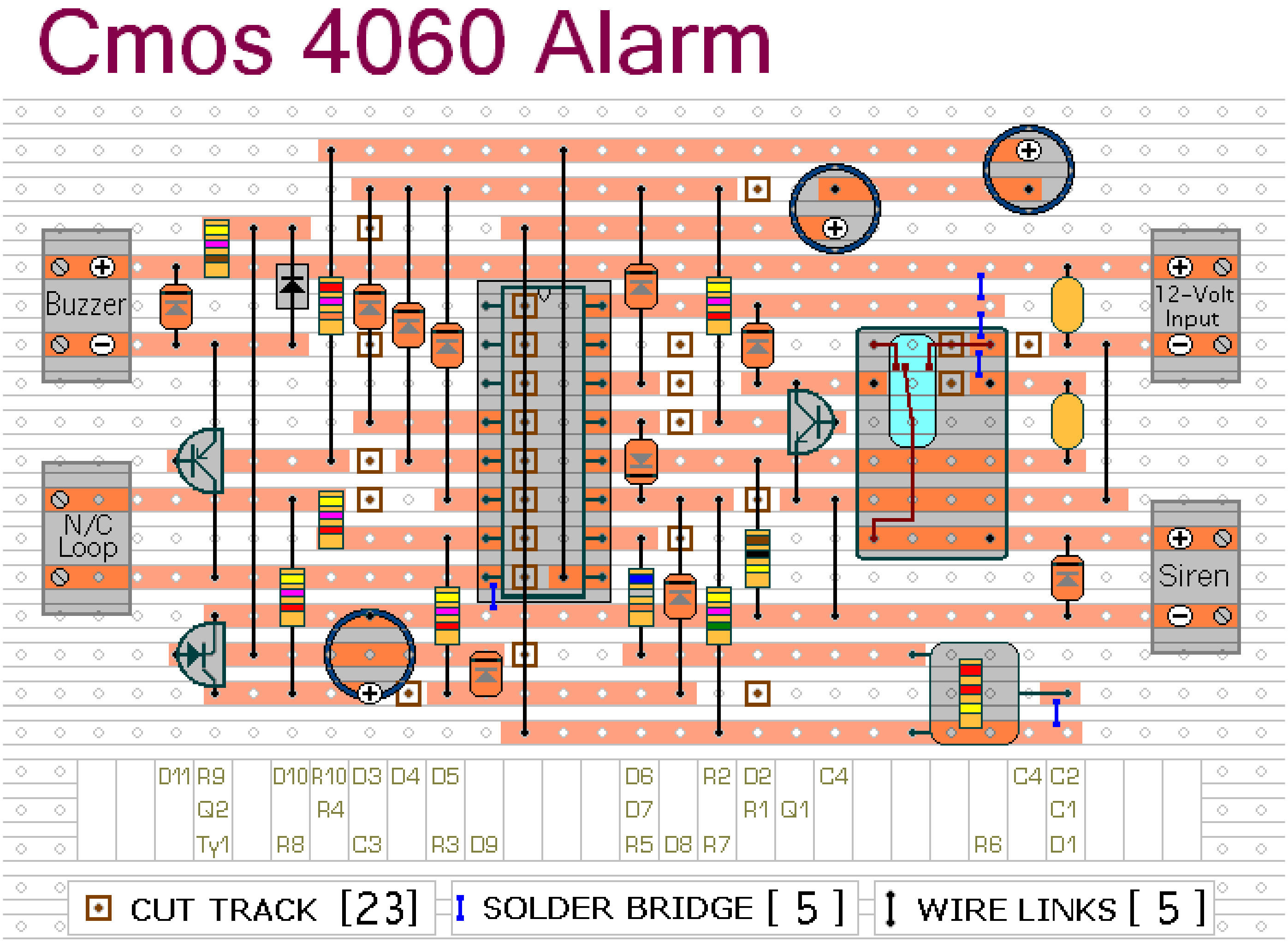
A regular electrolytic capacitor is polarised. If the charge on its plates is the wrong way round - DC current will flow through the capacitor. If the current is high enough - the capacitor will heat up and explode. The presence of R5 in the circuit means that this is not going to happen. But if you use a polarised capacitor - it may mean that the oscillator won't run - or won't run reliably.

While the oscillator is running - the polarity of the charge on C4 keeps reversing. So C4 needs to be non-polarised. However - you can simulate a non-polarised 10uF capacitor by connecting two 22uF polarised capacitors back to back - as shown.

How and why this works is explained in the Support Material - which also includes a photograph of the prototype - a detailed circuit description - a parts list - a step-by-step guide to construction - and more.

Because non-polarised capacitors aren't widely available - the prototype was built using two polarised capacitors.

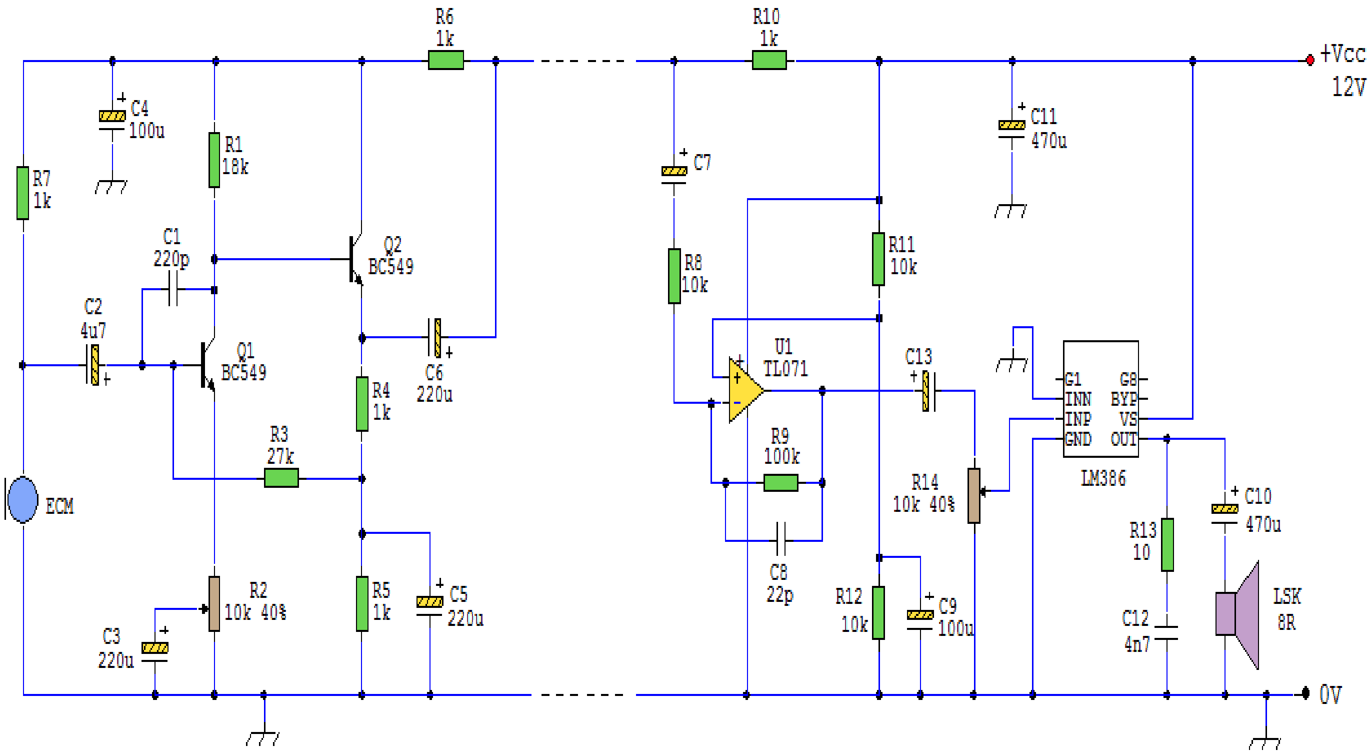
[Veroboard Layout:]



P439. Security Monitor

Description:

A remote listening circuit. The area to be monitored is connected via a cable and allows remote audio listening.



Notes:

You can use this in your garden and listen for any unusual sounds, or maybe just wildlife noises. If you have a car parked in a remote location, the microphone will also pick up any sounds od activity in this area. The cable may be visible or hidden, screened cable is not necessary and you can use bellwire or speaker cable if desired.

Circuit Description:

Starting from the right hand side, the power supply. I have used 12V as a standard power supply voltage, or a 12V car battery may be used. The circuit is in two halves, a remote microphone preamp, and an audio amplifier based around the National Semiconductor LM386 audio amplifier.

The remote preamp uses an ECM microphone to monitor sound. A direct coupled 2 stage amplifier built around Q1 and Q2 amplify the weak microphone signal. Preset resistor R2 acts as a gain control, and C1 provides some high frequency roll off to the overall audio response. Q1 is run at a low collector current for a high signal to noise ratio, whilst Q2 collector is biased to around half the supply voltage for maximum dynamic range. The power supply for this preamp is fed via R10 and R6 from the 12V supply. C4 ensures that the preamp power supply is decoupled and no ac voltages are present on the power lines. The amplified audio output from Q2 collector is fed onto the supply lines via C6 a 220u capacitor. The output impedance of Q2 is low, hence the relatively high value of C6. C6 also has a second purpose of letting the output audio signals pass, whilst blocking the dc voltage of the power supply.

At the opposite end, C7 a 10u capacitor, brings home the amplified audio to the listening location. The signal is first further amplifier by a x10 voltage gain amplified using the TL071. C8, a 22p capacitor again rolls off some high frequency response above 100kHz. This is necessary as long wires may pick up a little radio interference. After amplification by the op-amp, the audio is finally passed to the LM386 audio amplifier. R14 acts as volume control. R13 and C12 prevent possible instability in the LM386 and are recommended by the manufacturer. Audio output is around 1 watt into an 8 ohm loudspeaker, distortion about 0.2%. If preferred headphones could be used, although I'd recommend a series resistor of the same value impedance as the headphones.

P440. Hijack Alarm No. 3

Description:

Like the first two Hijack Alarms - this circuit was designed primarily for the situation where a hijacker forces the driver from the vehicle. If a door is opened while the ignition is switched on - the circuit will trip. After a few minutes delay - when the thief is at a safe distance - the Siren will sound.

Where it differs from the first two alarms - is in what happens next. I'm obliged to Victor Montanez from the USA who suggested that the engine cut-out should not operate - until the vehicle comes to a stop. That way - the engine will not fail suddenly or unexpectedly. And the hijacker will retain control.

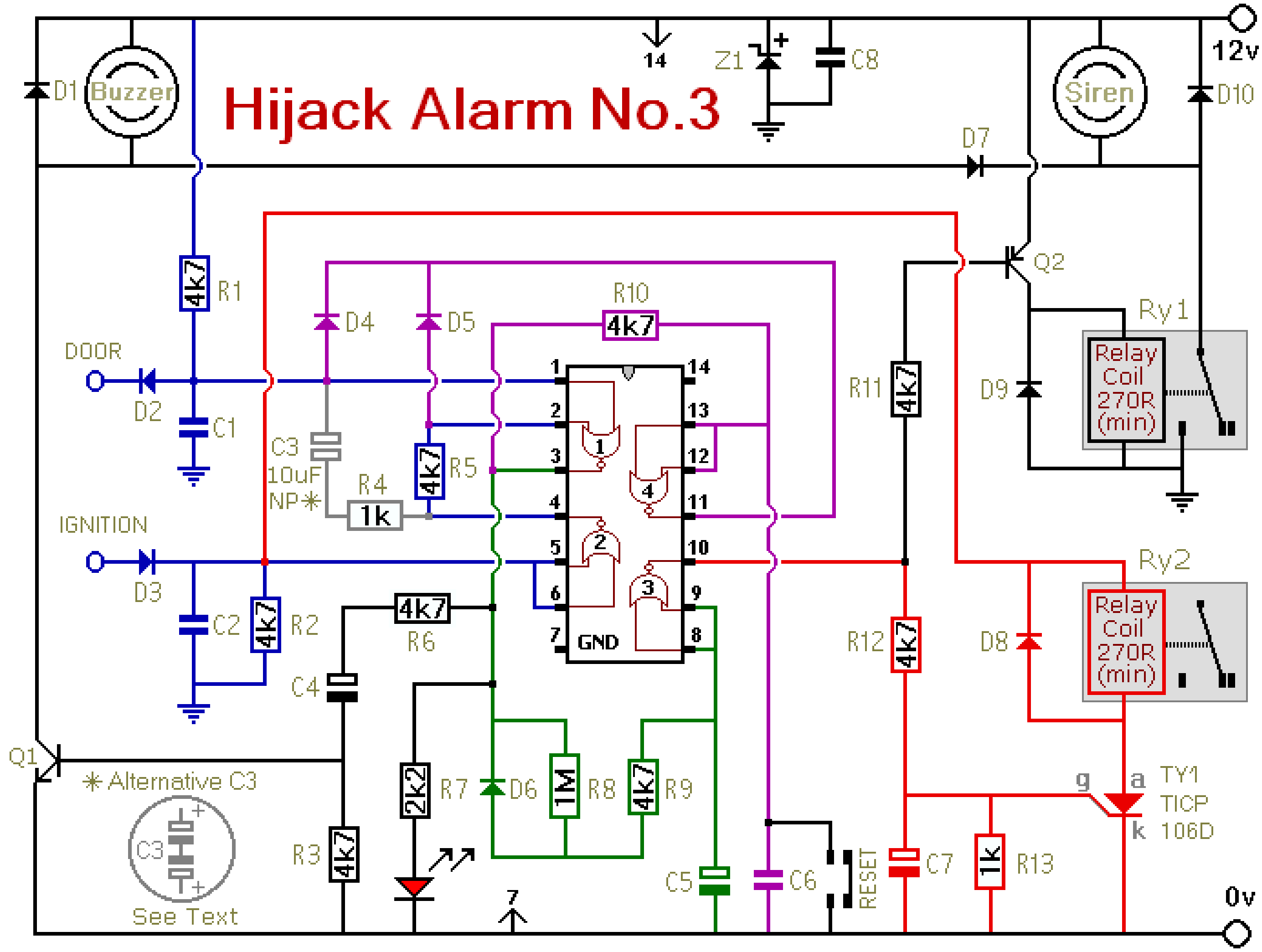
I haven't been able to implement Victor's excellent suggestion completely - because I couldn't think of a simple, reliable and universally applicable way of sensing when the vehicle has come to a stop.

Instead - I have postponed engine failure until the ignition is switched off. Once the thief turns off the ignition - the engine will not re-start. Clearly - there is no certainty as to when this will occur. But I think it will occur sooner rather than later. Because there's a strong possibility that the hijacker will turn off the ignition - in an attempt to silence the siren.

As well as acting as a Hijack Alarm - this circuit offers some added protection. Like the Enhanced Hijack Alarm - it incorporates Jeff Chia's suggestion. That is - every time the ignition is switched on - the alarm will trip. So it will protect the vehicle whenever you leave it unattended with the ignition switched off - even overnight in your driveway.

Important

Before fitting this or any other engine cut-out to your vehicle - carefully consider both the safety implications of its possible failure - and the legal consequences of installing a device that could cause an accident. If you decide to proceed - you will need to use the highest standards of materials and workmanship.



[Notes:](#)

You're going to trip this alarm unintentionally. When you do - the LED will light and the Buzzer will give a short beep. The length of the beep is determined by C4. Its purpose is to alert you to the need to push the reset button. When you push the button - the LED will switch-off. Its purpose is to reassure you that the alarm has in fact reset.

If the reset button is not pressed then - about 3 minutes later - both the Siren and the Buzzer will sound continuously. The length of the delay is set by R8 & C5. For extra effect - fit a second siren inside the vehicle. With enough noise going on - you may feel that it's unnecessary to fit the engine cut-out. In which case - you can leave out C7, D8, R12, R13, Ty1 & Ry2.

When the ignition is switched on - C3 & R4 are responsible for tripping the alarm. By taking pin 1 low momentarily - they simulate the opening of a door. If you don't want the alarm to trip every time you turn on the ignition - simply leave out C3 & R4.

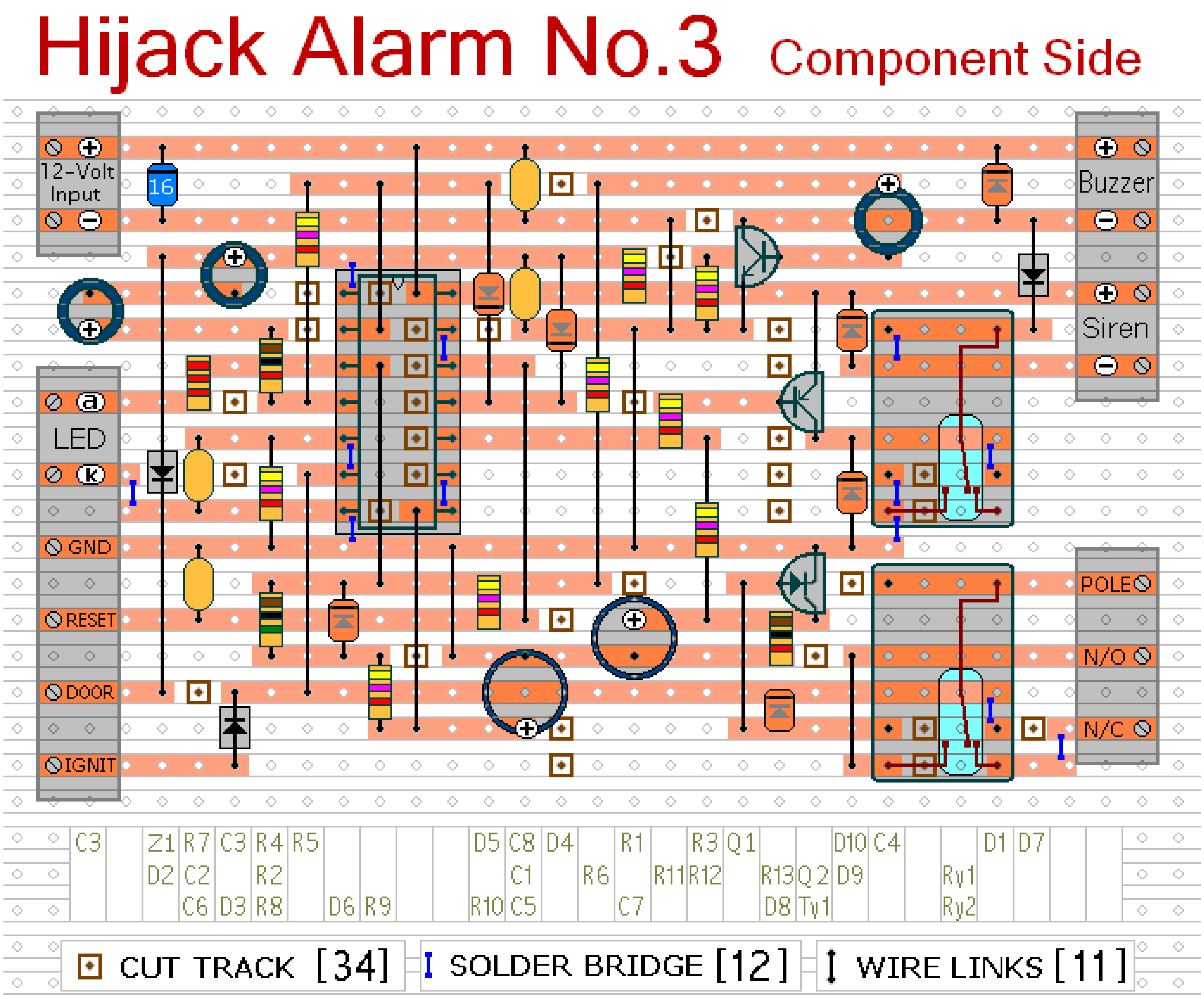
Because the voltage on C3 may be reversed - the capacitor needs to be non-polarized. But connecting two regular 22uF capacitors back to back as shown - will work just as well. Because non-polarized capacitors are not widely available - the prototype was built using two polarized capacitors.

To reset the circuit you must - EITHER turn off the ignition - OR close all of the doors - before you press the reset button. While BOTH the ignition is on - AND a door remains open - the circuit will NOT reset.

The reset button carries virtually no current - so any small normally-open switch will do. Eric Vandel from Canada suggests using a reed-switch hidden behind (say) the dash - and operated by a magnet. I think this is an excellent idea. As Eric said in his email: - "... that should keep any thief guessing for a while."

The Flow Chart is another of Eric's suggestions. It will help you to visualize how the alarm is operated. It also explains the sequence of events that lead to siren activation - and the engine's subsequent failure to re-start.

Veroboard Layout:



How you prevent the engine from starting is up to you. It should happen when Ry2 de-energizes. The contacts of Ry2 are too small to do the job themselves. So use them to switch the coil of a larger relay. Remember that the relay must be suitable for the current it's required to carry. Choose one specifically designed for automobiles - it will be protected against the elements - and will give the best long-term reliability. You don't want it to let you down on a cold wet night - or worse still - in fast moving traffic!!!
Remember also that you must fit a 1N4001 diode across YOUR relay's coil - to prevent damage to the Cmos IC.

YOUR relay should drop-out when Ry2 de-energizes. Wire YOUR relay so that when it drops-out the engine will not start. Because turning-off the ignition will cause both Ry2 and YOUR relay to de-energize - the standby current will be low - and the engine will be disabled while the vehicle is parked.

The circuit board must be protected from the elements. Dampness or condensation will cause malfunction. Fit a 1-amp in-line fuse AS CLOSE AS POSSIBLE to your power source. This is VERY IMPORTANT. The fuse is there to protect the wiring - not the components on the circuit board. Please note that I am UNABLE to help any further with either the choice of a suitable relay - or with advice on installation.

Both the Siren and the Buzzer will go on sounding until the alarm is reset. The circuit is designed to use an electronic Siren drawing up to about 500mA. It's not usually a good idea to use the vehicle's own Horn because it can be easily located and disconnected. However, if you choose to use the Horn, remember that Ry1 is too small to carry the necessary current. Connect the coil of a suitably rated relay to the "Siren" output. This can then be used to sound the Horn.

P441. 6 Zone Alarm

Description

This alarm system has 6 independent zones, 1 timed entry/exit zone, a 7 segment LED display and a test or walkthrough facility. Suitable for a small office or home environment, it can also be adapted to use a combination lock or keypad to set and reset the alarm.

Please Note: All orange +V terminals connect to the point marked +5V at the side of the set switch, S1. IC's U1,U2,U3,U4,U5 and U7 are drawn without power connections for clarity. The power connections need to go +5V and ground.

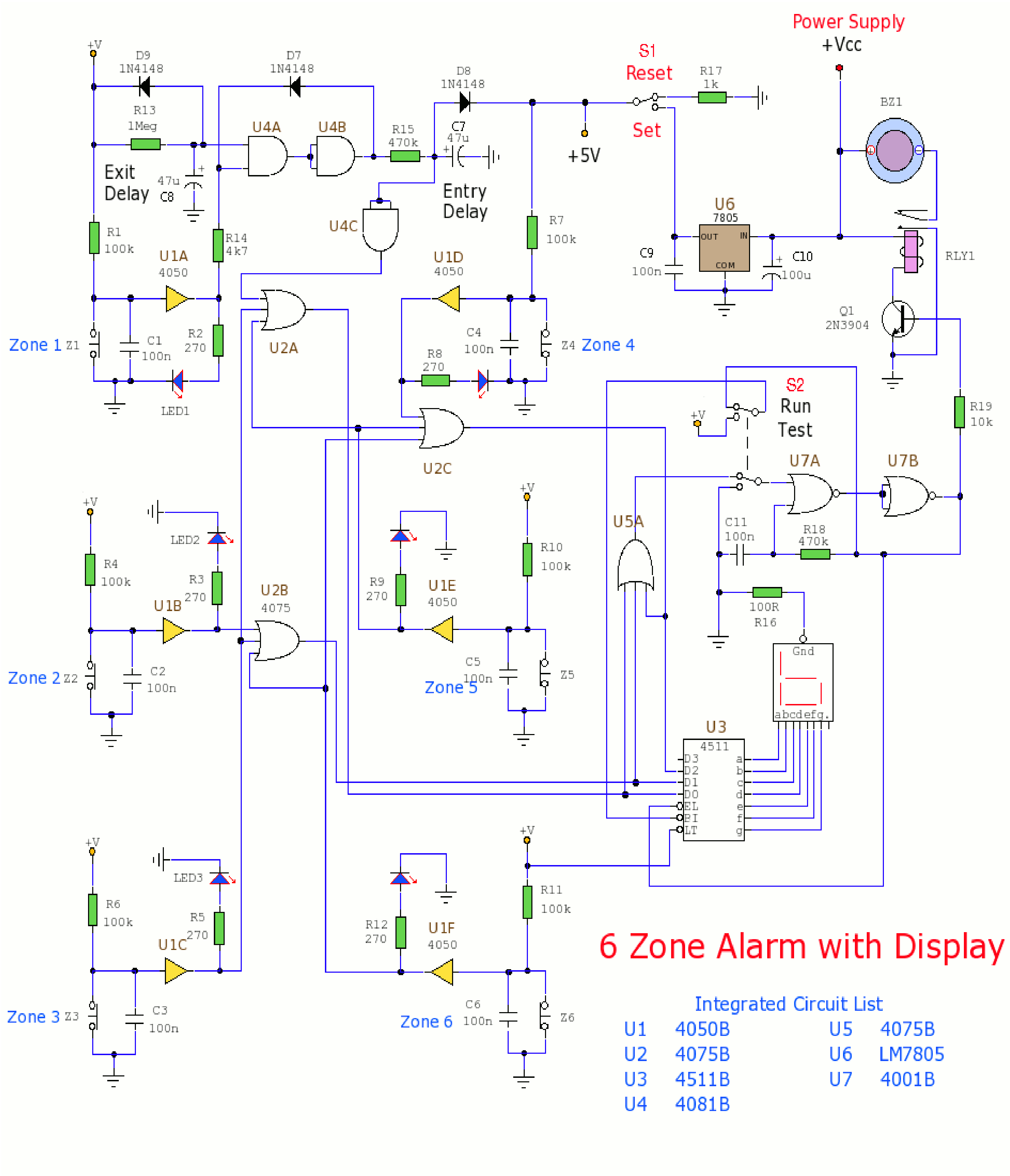
Circuit Notes:

All zones Z1 to Z6 use normally closed alarm contacts. Zone 1 is a timed zone which must be used as the entry and exit point of the building. Zones 2 to 6 are immediate zones, which will trigger the alarm with no delay. Some RF immunity is provided for long wiring runs by the input capacitors, C1 - C6. The key switch, S1 acts as the Set and Reset/Unset switch. For best security this should be the metal type switch with a key.

All IC's except IC6 are CMOS types with buffered outputs, these are denoted by the suffix "B". Unbuffered CMOS IC's have a suffix starting "U" and will not work in this circuit. IC6 is a 5 Volt regulator providing power to the main CMOS IC's, the alarm power supply can be any suitable 12 to 15V power supply.

In operation the dpdt switch S2 is set to the "run" position. When keyswitch S1 is turned reset, this is the unset (off) state of the alarm. In this condition capacitor C8 will discharge via D9, R1 aand Z1 and capacitor C7 will have discharged via D8, R17 and S1. Relay RLY1 will not be energized and all CMOS IC's and the display will have no power.

When S1 is turned to set all CMOS IC's receive 5 Volt power. C11 will breifly charge and apply a low input signal to one half of U7A a CMOS4001B, a dual input OR gate. The output of U5A will also be low (make sure all windows and doors zones 2 to 5 are shut) and the ouput of U7A is high. The output of U7A is then inverted by U7B and feb back via R18 to U7A's input keeping the circuit latched. The output of U7B is low and so Q1 and the relay RLY1 is off and no alarm will sound.



Also when S1 is set, C8 slowly charges via R13. C8 and R13 form the exit timer and allow time to vacate the building. The delay is approximately 1.1 x the value of C8 (in uF) or about 52 seconds with values shown. During the exit delay zone switch Z1 can be opened and closed without triggering the alarm. After the exit time ends, C8 will be charged and one half of the 2 input AND gate, U5A will be high. Any opening of zones 2 through 6 will cause the alarm to trigger and relay RLY1 will energize. If an intruder attempts a break-in via zone 4 for example, the output of U1D will change state from low to high. When this happens, the high signal is forwarded by U2C a triple input OR gate CMOS4075 and is sent to input D2 on the CMOS4511 BCD to Decimal display driver. D2 is the binary code for four and the LED display will illuminate digit 4. The high output from U2C is also forwarded to U5A, again a triple input OR gate. The output of U5A is now sent via S2 to the input of U7A. U7A and U7B form a bistable latch, the change in state causing the output of U7A to change to low, the output of U7B to become high and fed back via R18 to the input of U7A again. The circuit is now latched in the high state. The high output of U7B does two things. First it switches on Q1 and relay RLY1 sounding the alarm. Secondly the high output at U7B is applied to the blanking input of the CMOS4511B via S2 and also to the enable latching pin. The display will now continually show the number of the triggered zone, even if the zone switch is opened or closed again. It is a similar process for any of the other immediate zones.

If the building is entered via Zone 1 then the entry timer starts. The output of U1A (in the set condition) is low. Entry via Z1 triggers U1A to become momentarily high as the door is opened. U4A then produces a high output, as does U4B. The high signal is now passed via D7 to the input of U1A latching it in the high state. C7 then charges via R15. This is the entry delay and is approximately 1.1 x 0.47 x C7 or about 24 seconds with values shown. Once charged U4C will become high, trigger the alarm and cause the LED display to be latched, as per the preceeding paragraph.

Switch S2 is normally used in the run position. However in the test position, this allows a useful "walkthrough" test of the alarm. In the test position the input of U7A is alawys low and will not trigger the alarm, also the blanking input is lawys high, meaning that the 7 segment display is always illuminated. With all zones closed, open any zone, the corresponding number will be shown on the display. Note that if two zones are opened the diplay will not necessarily indicate the correct zone, this is not a fault, just the way the circuit is designed. When in run mode, the first zone to trigger the alarm is "caught" and latched and will be displayed until the alarm is reset.

Features:

This alarm has a 7 segment LED display to indicate which zone triggered the alarm.
Each zone Z1 to 6 has its own indicator.

Switch S1 is a single pole, double throw switch. One position is set, the other is reset/unset.
Switch S2 enables a "walkthrough" test to test all zones and the display.

Zone 1 has independent exit and entry times.

Operation:

Turn S2 to run. The alarm is now set using S1, exit delay is determined by C8 and R13. Any entry via zones Z2 to Z6 will now immediately trigger the alarm. If alarm is triggered, reset using S1. Entering via Z1 starts the entry delay. Switch S1 to reset before the entry timer expires. If S2 is in test mode, then a walkthrough test of zones can be made.

Expansion:

To use with a keypad e.g. Ron J's 5 digit enhanced keypad use a dpdt relay in the keypad. The unused dpdt relay contact will replace the switch S1 in this alarm circuit.

R13 and R15 may be changed for preset resistors to create variable entry and exit delays. Using a 2M2 preset will allow larger entry and exit delays when set to maximum resistance.

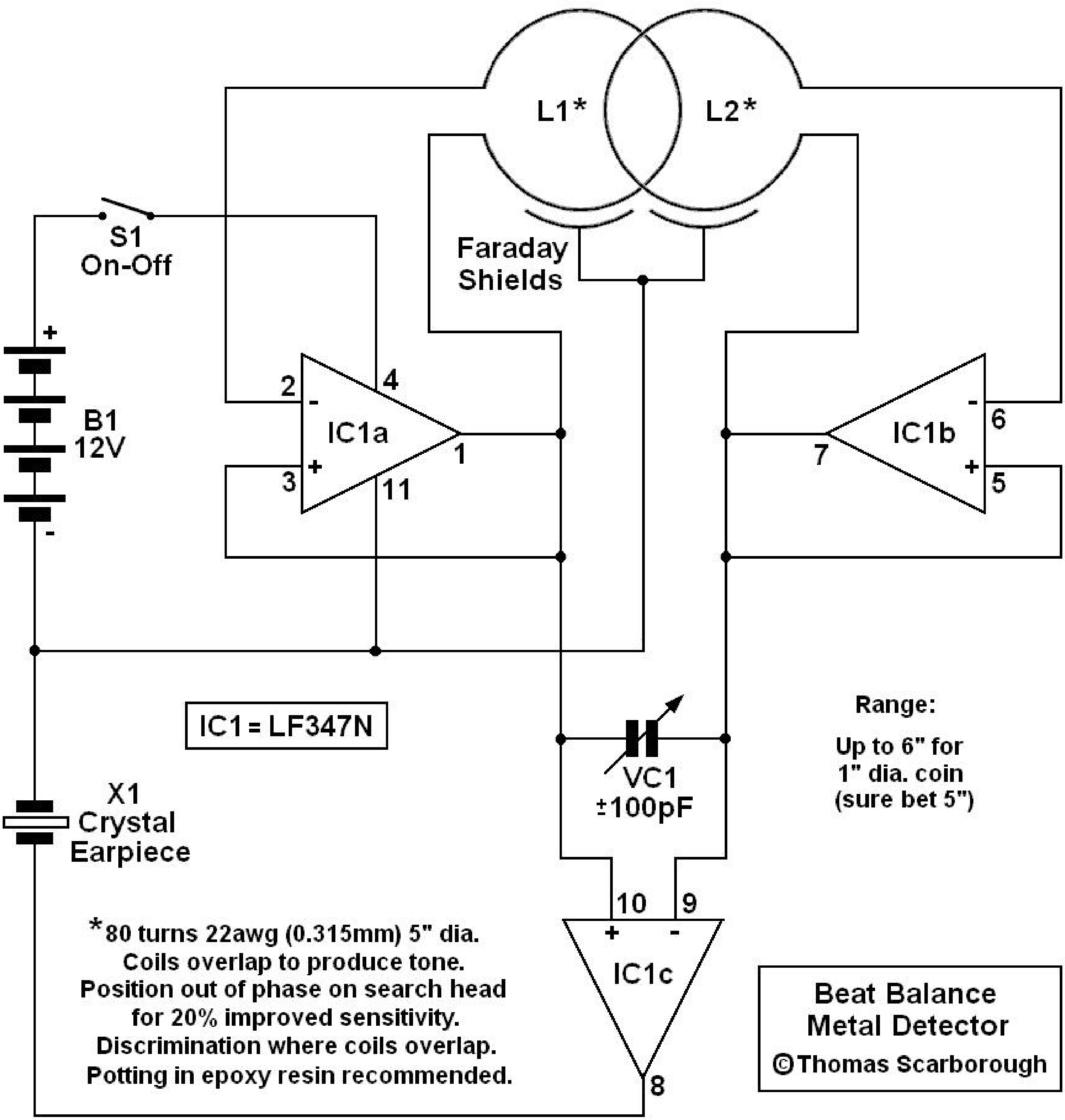
Parts List:

Designation	Value	Quantity
BZ1	12V Buzzer or Siren	1
C1,C2,C3,C4,C5,C6,C9,C11	100n	8
C7,C8	47u	2
C10	100u	1
LED1 to LED6	Red LED	6
D7,D8,D9	1N4148	3
DISP1	7 segment CC	1
Q1	2N3904	1
R1,R4,R6,R7,R10,R11	100k	6
R2,R3,R5,R8,R9,R12	270R	6
R13	1M	1
R14	4k7	1
R15,R18	470k	2
R16	100R	1
R17	1K	1
R19	10K	1
RLY1	12V Relay Coil 500R	1
Z1,Z2,Z3,Z4,Z5,Z6	NC Contacts	6
S1	SPDT	1
S2	DPDT	1
U1	4050B	1
U2,U5	4075B	2
U3	4511B	1
U4	4081B	1
U6	7805	1
U7	4001B	1

P442. Beat Balance Metal Detector

Description

A Beat Balance Metal Detector made from discrete components.



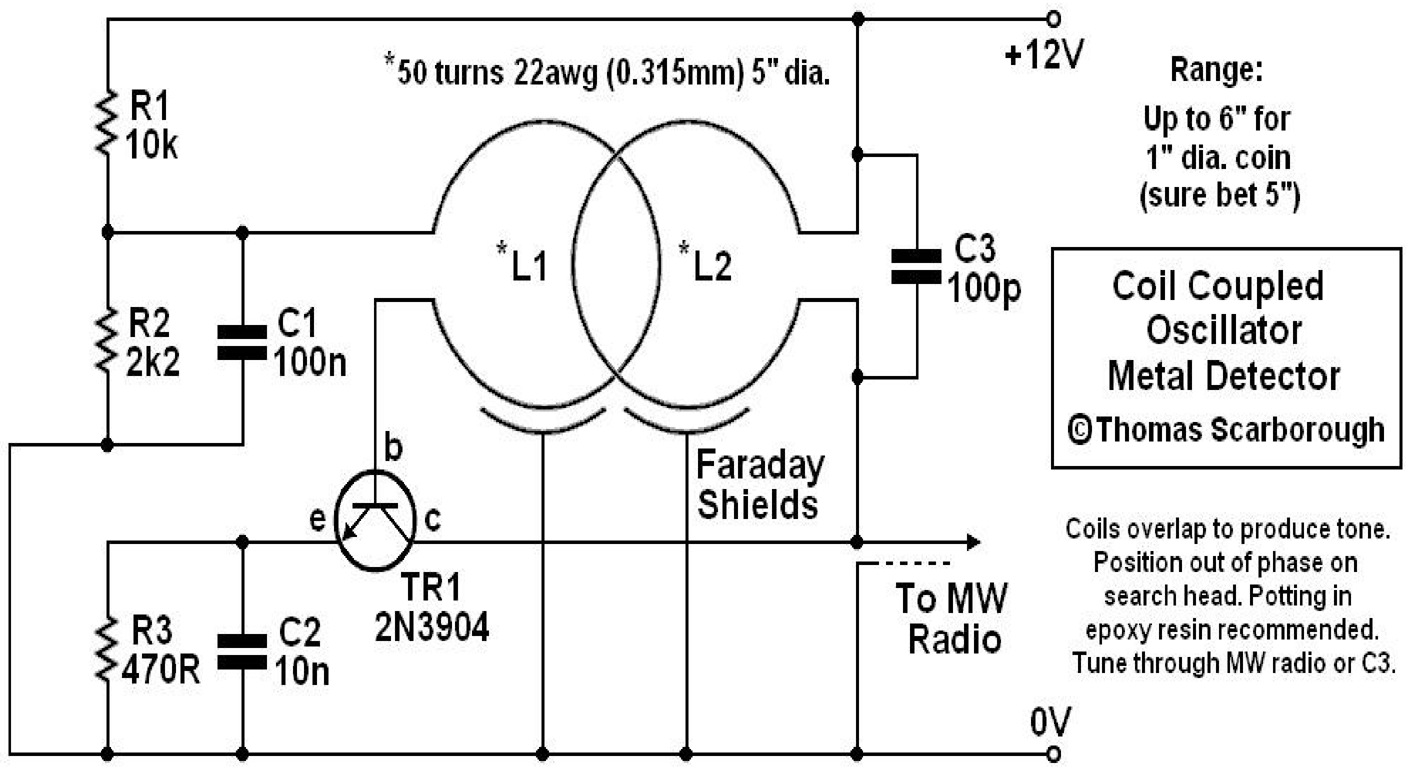
Notes

Various embodiments of the BB metal detector have been published, and it has been widely described in the press as a new genre. Instead of using a search and a reference oscillator as with BFO, or Tx and Rx coils as with IB, it uses two transmitters or search oscillators with IB-style coil overlap. The frequencies of the two oscillators are then mixed in similar fashion to BFO, to produce an audible heterodyne. On the surface of it, this design would seem to represent little more than a twinned BFO metal detector. However, what makes it different above all else, and significantly increases its range, is that each coil modifies the frequency of the adjacent oscillator through mutual coupling. This introduces the "balance" that is present in an IB metal detector, and boosts sensitivity well beyond that of BFO. Since the concept borrows from both BFO and IB, I have given a nod to each of these by naming it a Beat Balance Metal Detector, or BB for short. Happy hunting!

P443. Coil Coupled Operation Metal Detector

Description

A Coil Coupled Operation Metal Detector made from readily obtainable components and using an ordinary medium receiver as a detector.



Notes

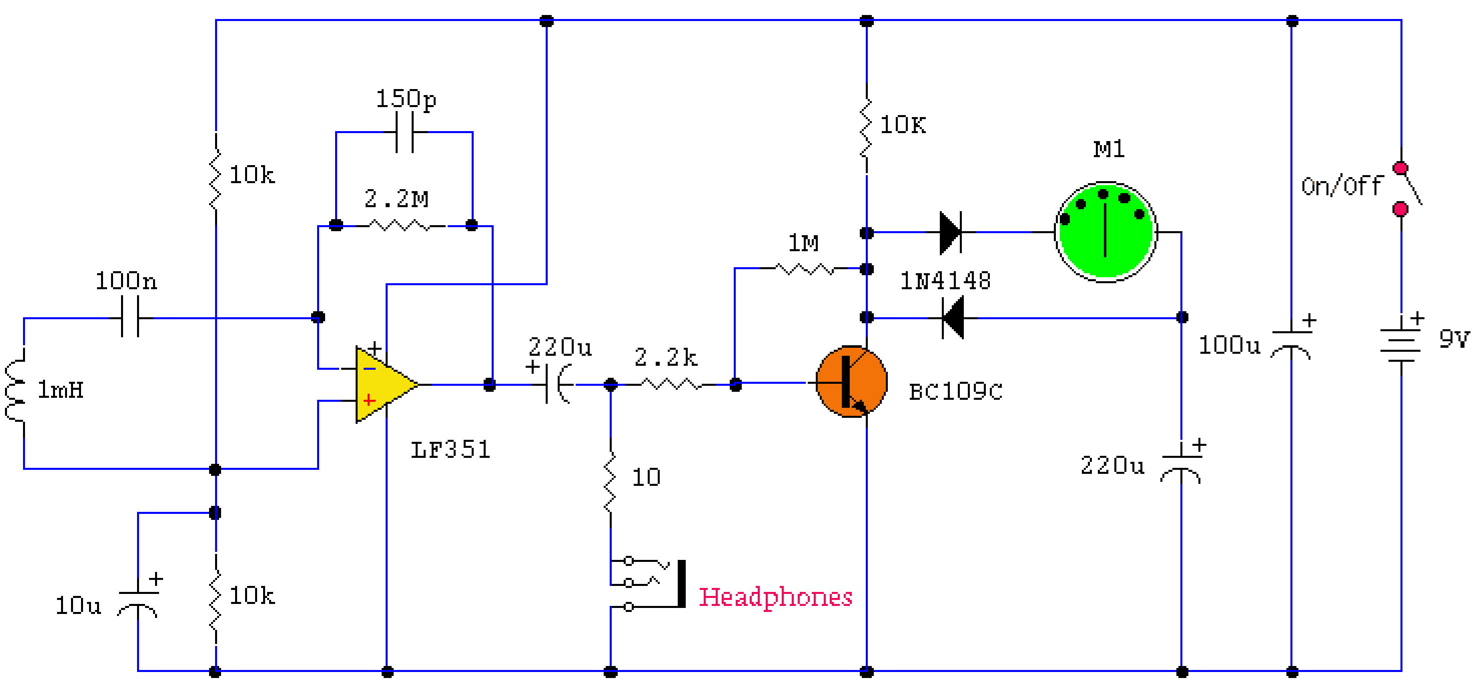
The metal detector shown here may well represent a new genre. At any rate, after some exposure, it is regarded as such by those who have seen it. It is based on a standard transformer coupled oscillator (TCO) - hence the name Coil Coupled Operation (CCO) Metal Detector. Although requiring a BFO (in this case provided by a Medium Wave radio), it differs from a typical BFO detector in that its performance far outstrips that of BFO. Also, unlike BFO, it is dependent on the balance of two coils to boost sensitivity. It also differs from IB, in that its Rx section is an active, rather than passive, component of the oscillator.

Further, unlike IB, the design does not require critical placement of the coils. As with both BFO and IB, the design provides discrimination. Experiments with different embodiments of the idea have shown that it has the potential to match the best of IB. Happy hunting!

P444. EMF Probe with Meter

Description

An electromagnetic field probe designed to detect changing electric and magnetic fields. The probe has a meter output and headphone socket as well.



Circuit Notes

This tester is designed to locate stray electromagnetic (EM) fields. It will easily detect both audio and RF signals up to frequencies of around 100kHz.Note, however that this circuit is NOT a metal detector, but will detect metal wiring if it conducting ac current. Frequency response is from 50Hz to about 10kHz gain being rolled off by the 150p capacitor, the gain of the op-amp and input capacitance of the probe cable. Stereo headphones may be used to monitor audio frequencies at the socket, SK1.

Probe Construction

I used a radial type inductor with 50cm of screened cable threaded through a pen tube. The cable may be used with a plug and socket if desired. My probe is shown below:

A layer of insulating tape or glue is used to secure the pen body to the inductor.

Meter Circuit

The output signal from the op-amp is an ac voltage at the frequency of the electro-magnetic field. This voltage is further amplified by the BC109C transistor, before being full wave rectified and fed to the meter circuit. The meter is a small dc panel meter with a FSD of 250uA. Rectification takes place via the diodes, meter and capacitor.

Testing

If you have access to an audio signal generator you can apply an audio signal to the windings of a small transformer. This will set up an electromagnetic field which will be easily detected by the probe. Without a signal generator, just place the probe near a power supply, mains wiring or other electrical device. There will be a deflection on the meter and sound in the headphones if the frequency is below 15KHz.

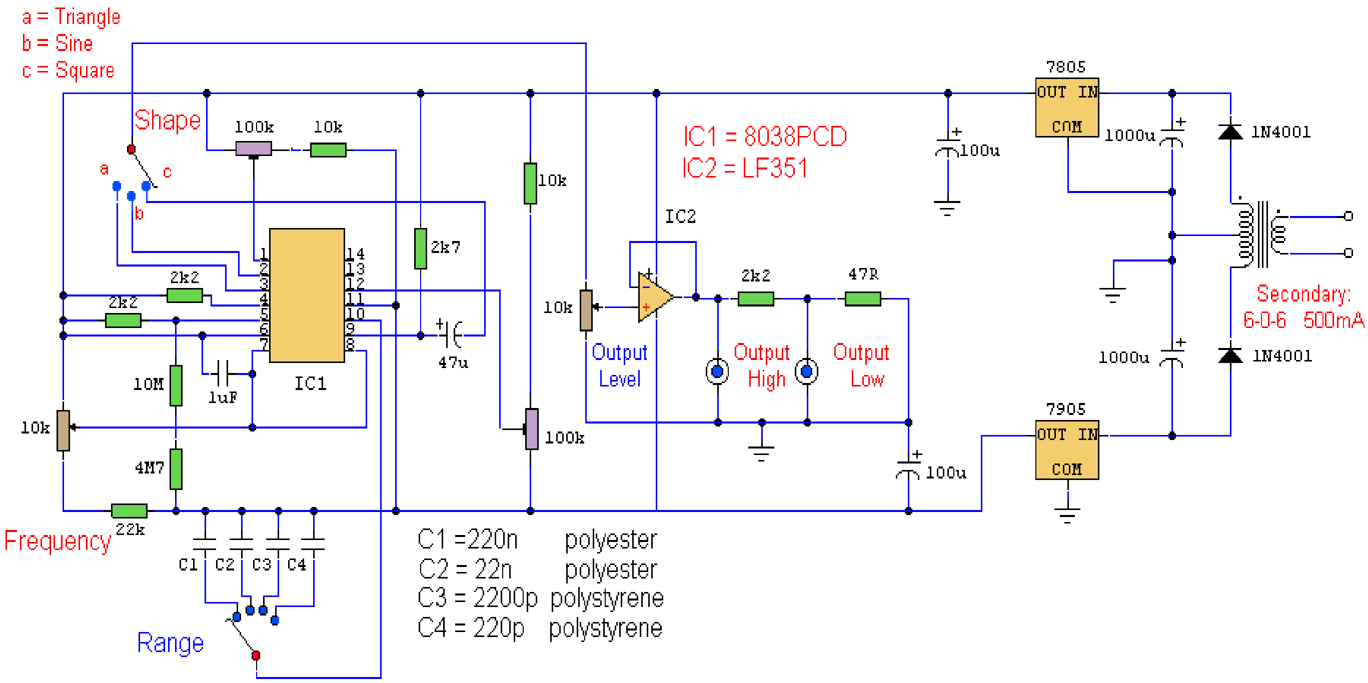
In Use

Switch on, plug in headphones (optional) and move the probe around. Any electrical equipment should produce a hum and indicate on the meter.I remember once building a high gain preamp (for audio use). I made a power supply in the same enclosure. The preamp worked, but suffered from an awful mains hum. This was not directly from ripple on the power supply as it was regulated and well smoothed.What I had done was built the audio circuit on a small piece of veroboard, and placed it within a distance that was less than the diameter of the transformer. The transformers own electromagnetic field was responsible for the induced noise and hum. I should however note, that this was when I was new to electronics with very little practical experience. You can now buy toroidal transformers which have a much reduced hum field.

P445. Function Generator

Description:

A function generator using the ICL8038 integrated circuit. Is has four ranges and capable of sine, square and triangle outputs.



Notes

Built around a single 8038 waveform generator IC, this circuit produces sine, square or triangle waves from 20Hz to 200kHz in four switched ranges. There are both high and low level outputs which may be adjusted with the level control. This project makesa useful addition to any hobbyists workbench as well.

Allof the waveform generation is produced by IC1. This versatile IC even has a sweep input, but is not used in this circuit. The IC contains an internal squarewave oscillator, the frequency of which is controlled by timing capacitors C1 - C4 and the 10k potentiometer. The tolerance of the capacitors should be 10% or better for stability. The squarewave is differentiated to produce a triangular wave, which in turn is shaped to produce a sine wave. All this is done internally, with a minimum of external components. The purity of the sine wave is adjusted by the two 100k preset resistors.

The wave shape switch is a single pole 3 way rotary switch, the wiper arm selects the wave shape and is connected to a 10k potentiometer which controls the amplitude of all waveforms. IC2 is an LF351 op-amp wired as a standard direct coupled non-inverting buffer, providing isolation between the waveform generator, and also increasing output current. The 2.2k and 47 ohm resistors form the output attenuator. At the high output, the maximum amplitude is about 8V pk-pk with the square wave. The maximum for the triangle and sine waves is around 6V and 4V respectively. The low amplitude controls is useful for testing amplifiers, as amplitudes of 20mV and 50mV are easily achievable.

Setting Up:

The two 100k preset resistors adjust the purity of the sine wave. If adjusted correctly, then the distortion amounts to less than 1%. The output waveform ideally needs to be monitored with an oscilloscope, but most people reading this will not have access to one. There is however, an easy alternative:- Winscope. This piece of software uses your soundcard and turns your computer into an oscilloscope. It even has storage facility and a spectrum analyser, however it will only work up to around 20KHz or so. Needless to say, this is more than adequate for this circuit, as alignment on any range automatically aligns other ranges as well. Winscope is available at my download page click here. Winscope is freeware and designed by Konstantin Zeldovich. After downloading, read the manual supplied with winscope and make up a lead to your soundcard. My soundcard is a soundblaster with a stereo line input, i made up a lead with both left and right inputs connected together. Connect the lead to the high output of the function genereator, set the output level to high, shape to sine, and use the 1k to 10k range, (22nF capacitor). A waveform should be displayed, see the Figure 1 below:-

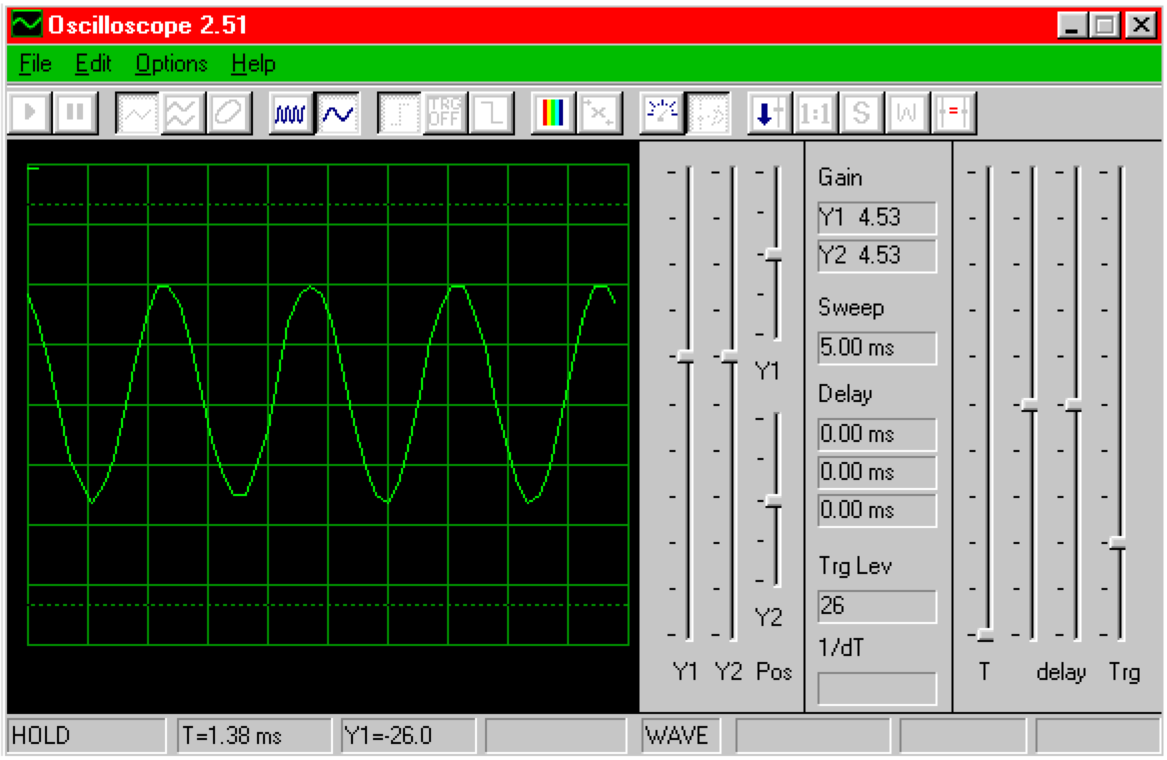
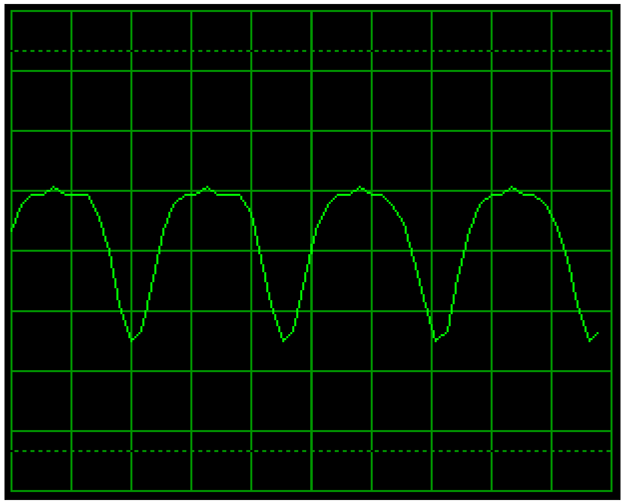


Figure 1.

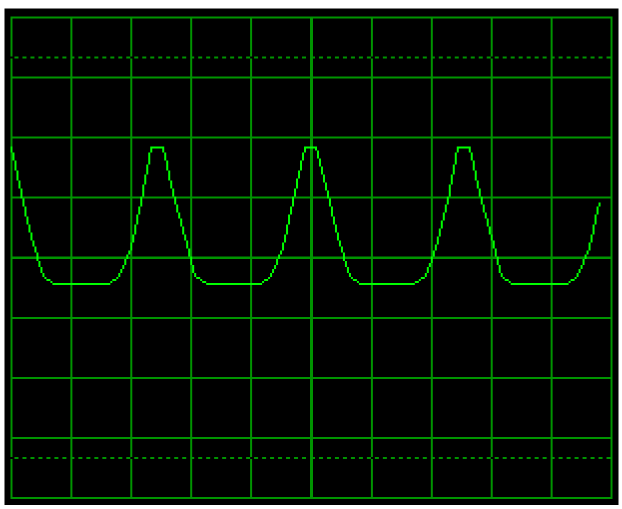
Here an undistorted sine wave is being displayed. The display on winscope may flicker, this is normal as it uses your soundcard to take samples of the input waveform. The "hold" button on winscope will display a steady waveform.

Alignment:

First adjust the 100k preset connected to Pin 1 of the 8038. An incorrect setting will look similar to the waveform below:-



Adjust the preset so that the top of the sine wave has a nicely rounded peak. Then adjust the other preset, again an incorrectly adjusted waveformis shown below:



The two presets work together, so adjusting one affects the other. A little is all that's needed. When your waveform is asjusted and looks similar to Figure 1 press the FFT button on winscope. This will preform a fast fourier transform and the displayed output will be a spectrogram of the input.For a pure sine wave, only one signal is present, the fundamental frequency, no harmonics will be present and so a spectrogram for a pure sine should contain a single spike, see Figure 2 below:-

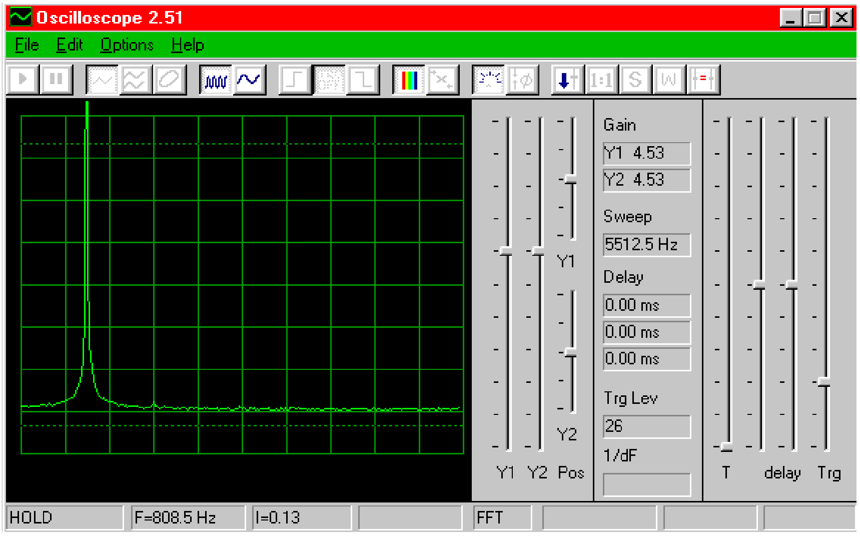
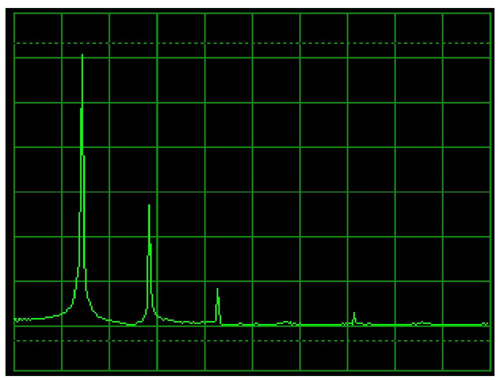
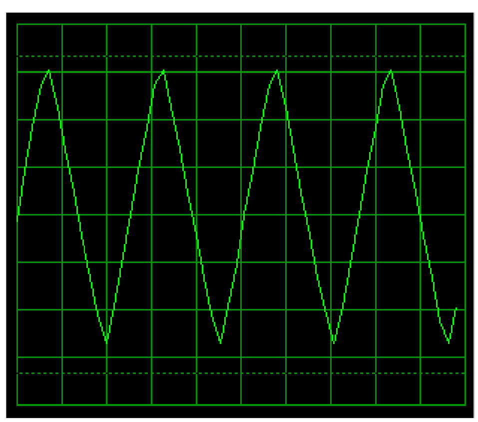


Figure 2.

A distorted sine wave will contain odd and even harmonics, and although the shape of the sine may look good, the spectrogram will reveal spikes at the hormonics, see below:-



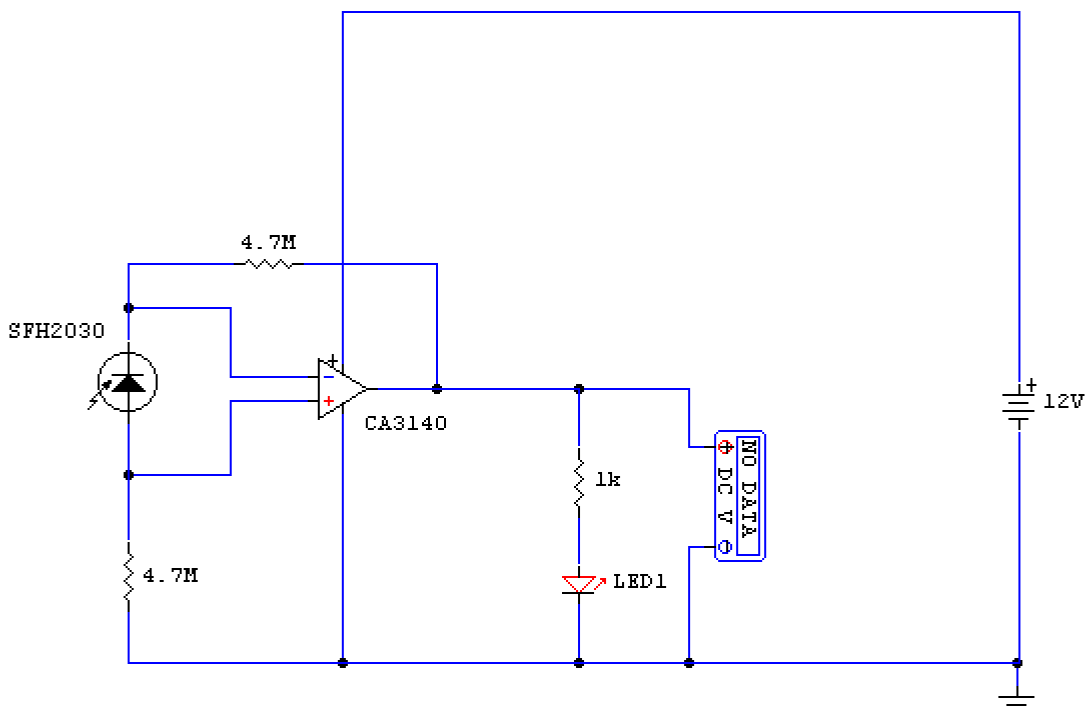
Once alignment of the sine wave is complete, the other wave shapes will also be set up correctly. Below is a picture of the triangle waveform generated from my circuit:-



P446. Infra Red Remote Control Tester

Description

A simple IR receiver to facilitate in testing of Infra Red Remote Control handsets.



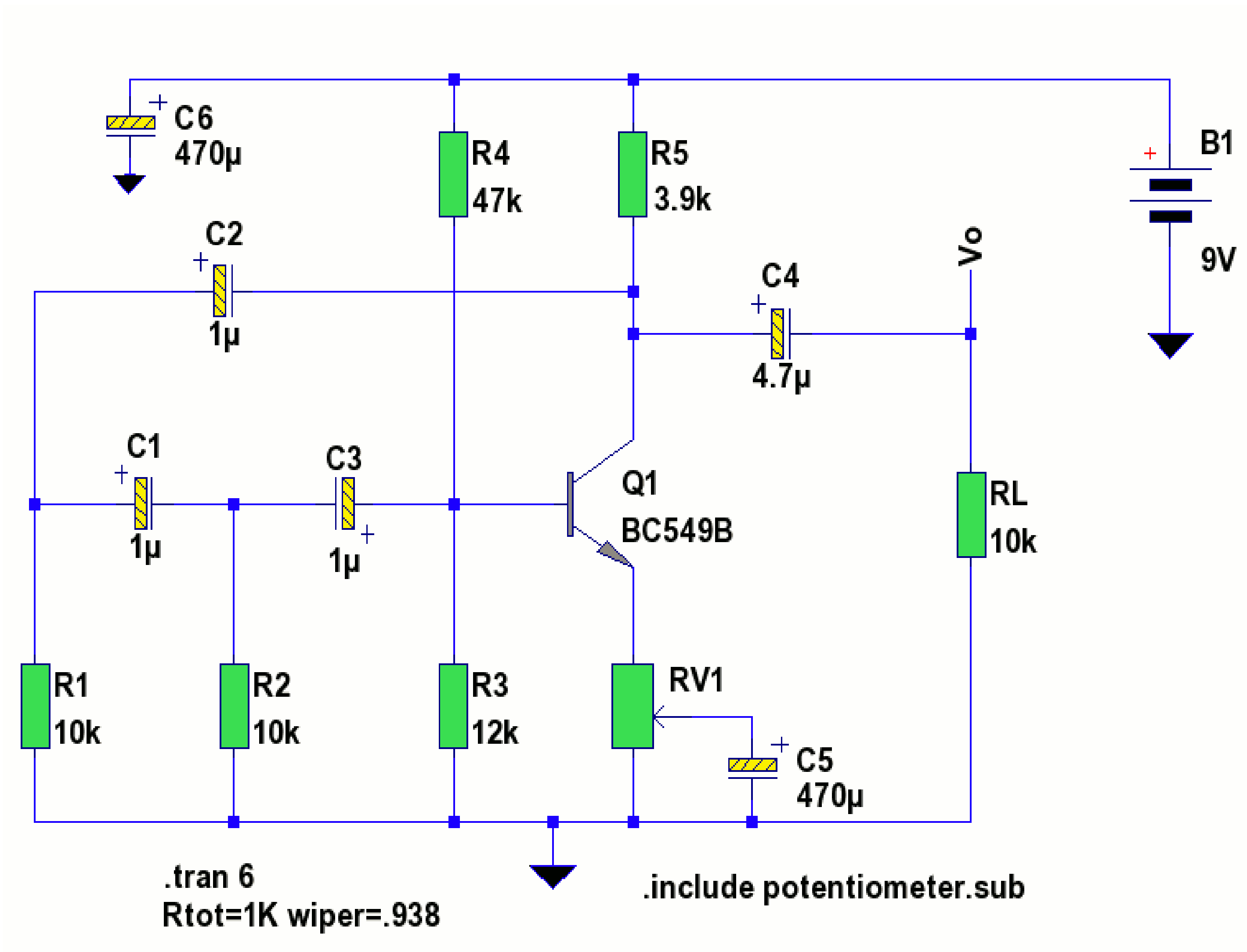
Notes

As I was developing my IR Extender Circuit, I needed to find a way of measuring the relative intensities of different Infra red light sources. This circuit is the result of my research. I have used a photodiode, SFH2030 as an infra red sensor. A MOSFET opamp, CA3140 is used in the differential mode to amplify the pulses of current from the photodiode. LED1 is an ordinary coloured led which will light when IR radiation is being received. The output of the opamp, pin 6 may be connected to a multimeter set to read DC volts. Infra red remote control strengths can be compared by the meter reading, the higher the reading, the stronger the infra red light. I aimed different remote control at the sensor from about 1 meter away when comparing results. For every microamp of current through the photodiode, about 1 volt is produced at the output. A 741 or LF351 will not work in this circuit. Although I have used a 12 volt power supply, a 9 volt battery will also work here.

P447. Low Frequency Oscillator

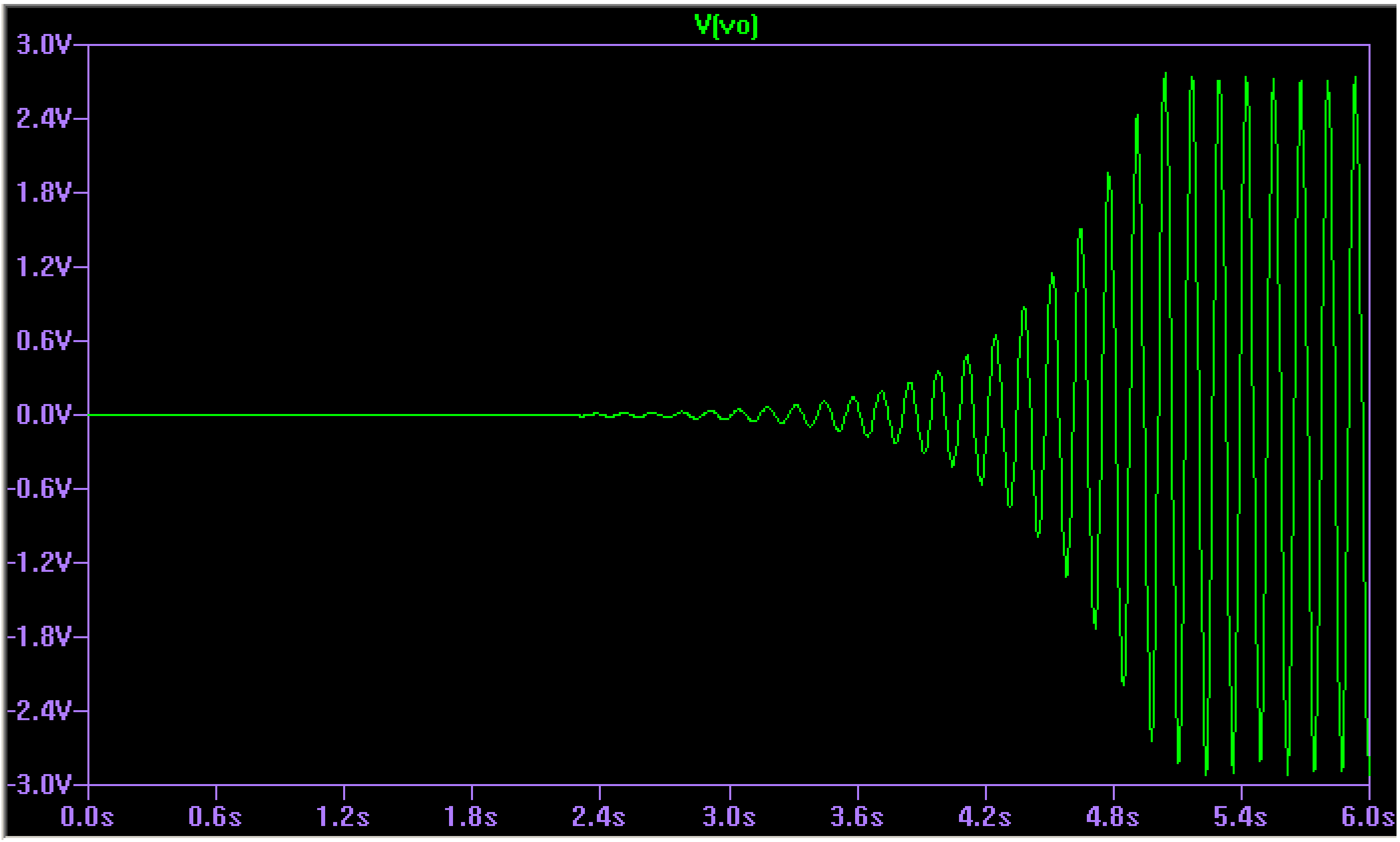
Description

A low frequency test oscillator for testing tone controls and experimenting.



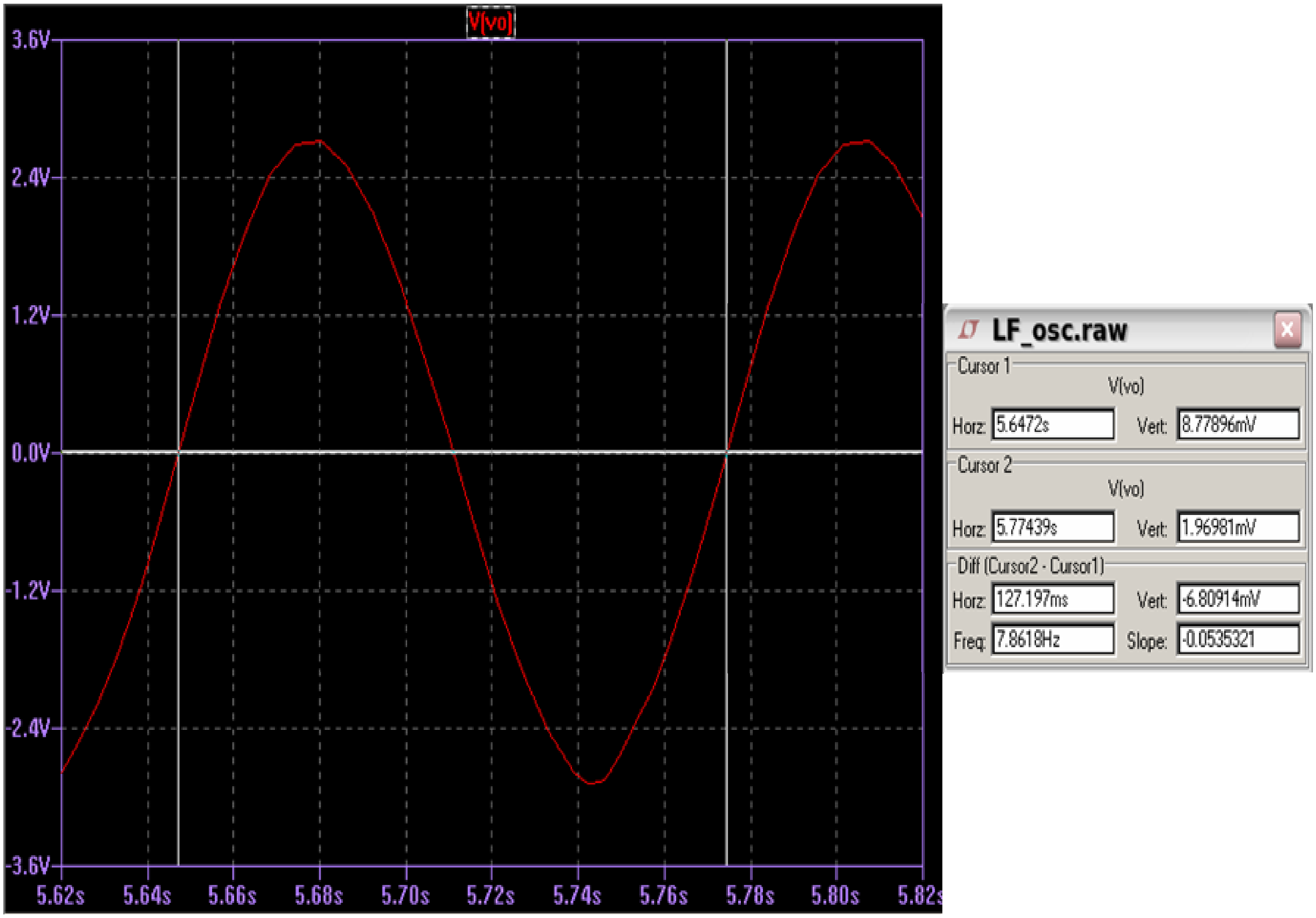
Circuit Notes

The circuit is a standard wien bridge oscillator using a single bipolar transistor as the active element. When power is applied regenerative feedback is applied via C2 from collector to base of the transistor. The timing components, R1, R2, C1 and C3 dictate the oscillation frequency. In use preset RV1 is adjusted so that oscillation just begins. With values shown full amplitude oscillation takes about 4.8 seconds (see diagram below).



Frequency Calculation

This oscillator is designed and simulated on LTSpice IV. Once simulated click the "probe" cursor on the ouput wire "Vo", the above waveform is produced. To calculate the frequency, place your mouse on the graph where oscillations have reached full amplitude and draw a rectangle, ensuring maximum and minimum apmplitude is enclosed within the rectangle. The diagram below shows such a zoomed portion of the output waveform, starting around 5.6 seconds into the simulation.



To add cursors left click on the name of the output waveform, this is called "V(vo)". A single cursor is added to the graph which can be moved with the mouse or keyboard arrows. Now right click the mouse on the Vvo waveform. In the window that appears click on the attached cursor menu and change to "1st & 2nd". Now two cursors will be visable and controllable. Make sure both cursors pass through the zero volt horizontal meridian and measure one output cycle. A sub window allows you to read the value as shown above, for this oscillator the time for one cycle is 127.2ms and frequency a little under 8Hz.

P448. Milligaus Meter

Description

The circuit of Fig.1 provides an easy yet reliable way to detect the intensity of a.c. (or e.l.f.) fields around the home or workplace. It is doubly effective because it does not merely detect the electromagnetic radiation emitted by electrical appliances, but the electromagnetic energy actually absorbed by the body.

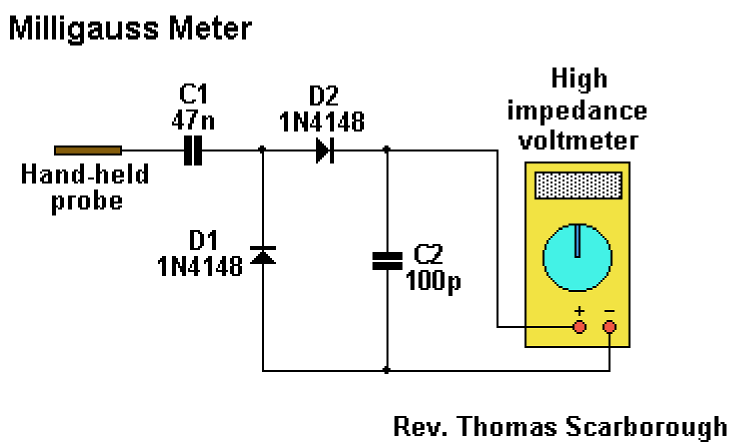


Fig. 1

The circuit in Fig.1 is a standard charge pump which is charged by the alternating eddy currents induced in the human body by a.c. fields. C1 charges virtually instantly, and is read by a digital (or high impedance) voltmeter.

To obtain a very rough translation from millivolts to milligauss (the unit of magnetic field strength), divide the millivolts reading by four. For example, 1000mV will yield 250 milligauss. A rough guide to the readings follows:

Up to 3 milligauss - Low electromagnetic radiation

25 milligauss - Significant electromagnetic radiation

100 milligauss - High electromagnetic radiation

250 milligauss - Maximum risk exposure

Detrimental effects have been reported at doses as low as 3 milligauss, and a series of studies since the 1970's has shown that sustained exposure to high e.l.f. doses heightens the risk of certain cancers and miscarriage.

Readings are taken while holding the probe in one hand. The closest proximity to the electromagnetic source does not necessarily give the highest reading, probably because the induced currents in the body remain localised at close proximity.

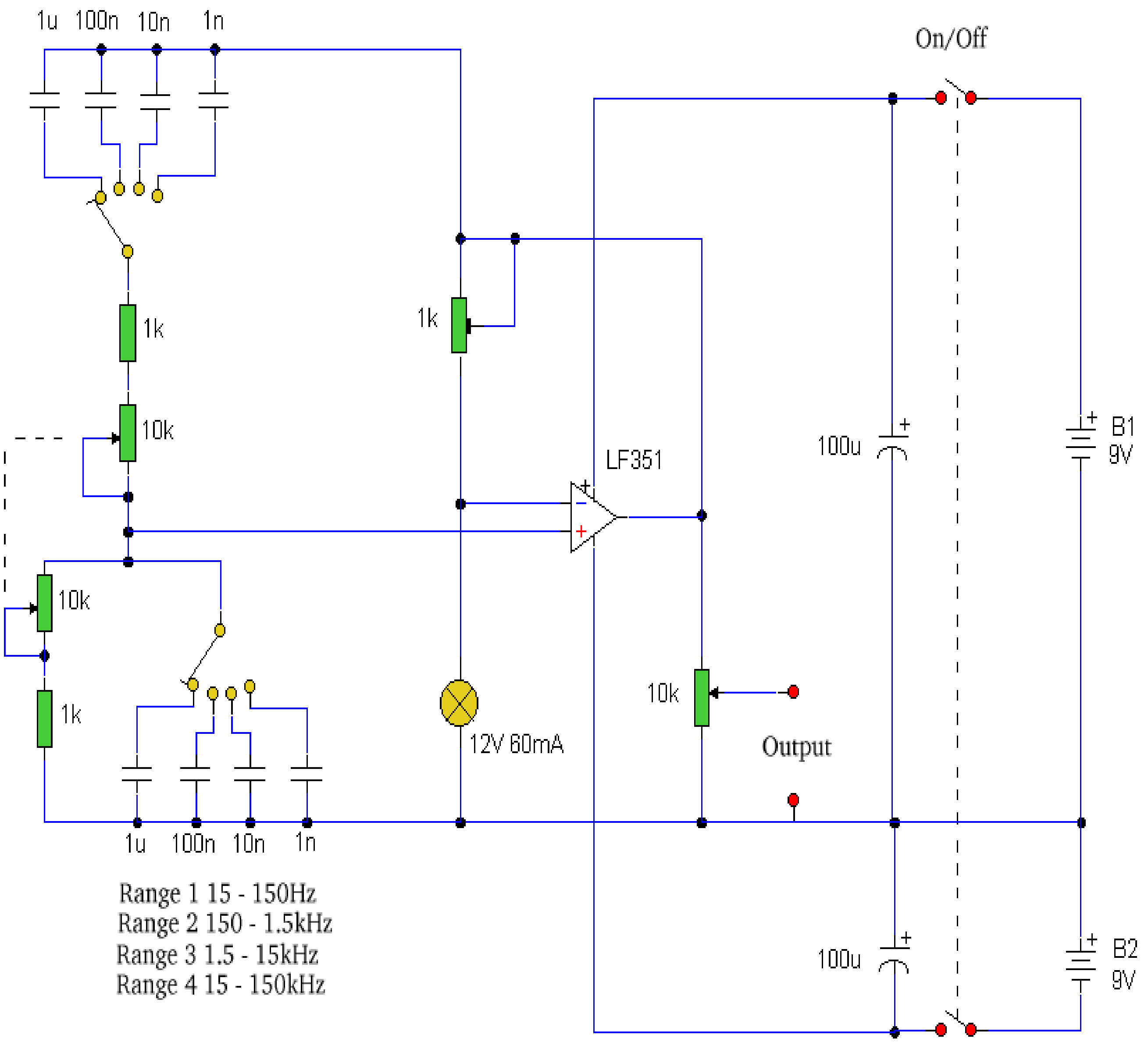
The Sensor

Is any piece of metal (e.g. a short stub of copper piping, even a short piece of fencing wire) that makes good contact with the hand.

P449. Sine Wave Generator

Description

A classic Wien Bridge oscillator using an Op-Amp covering a frequency range of 15 to 150kHz in four switched steps.



Notes

Two conditions exist for a sinusoidal oscillator. Regenerative or positive feedback, and a closed loop gain of unity. The losses in the wien feedback circuit, are such that the open loop gain of the amplifier must also exceed 3. The following link also provides the wien oscillator theory:

Wien Oscillator Theory

In this circuit the gain is provided by a FET type op-amp. I have used an LF351, which may be hard to obtain, but the TL071CN or TL081CN may be used and have a faster slewing rate than the LF351. The Maplin order codes are RA67X and RA70M respectively. The wien network is a parallel combination of resistor and capacitor, in series with a serial R-C network. Regenerative feedback is applied from the op-amp output, to the serail R-C input and continues. Stabilization is required to prevent the otherwise uncontrolled oscillation from building up and becoming unstable.

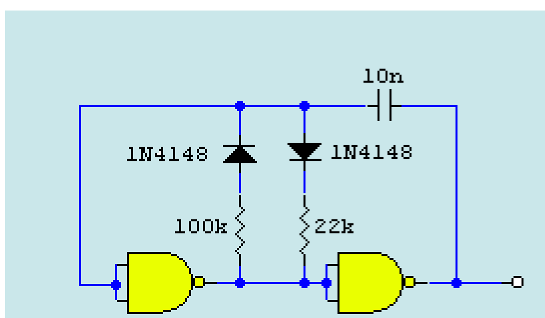
Stability and Distortion

There are two common methods of stabilizing a wien type oscillator. A thermistor with a NTC in the series leg of the feedback loop or an incandescent lamp (with a positive temperature coefficient) in the shunt leg of the feedback loop. The bulb used here is a 6V 60mA type Maplin code BT99H. A 12 Volt bulb rated 60mA or 40mA will also work. The feedback arrangement works as follows. As a bulb heats up its filament resistance increases. This will decrease the overall gain of the amplifier, as the output signal is fed back to the input.Similarly, if the output amplitude decreased the signal appearing at the bulb would be less, its filament resistance would drop and gain would be increased. Therefore a stable output amplitude is produced. The 1k preset is adjusted for minimum distortion. Note that split supplies are used and a ganged 10k potentiometer controls frequency with a 10:1 range.

P450. Square Wave Oscillator

Description:

A very basic square wave generator using a CMOS 4011 NAND gate.



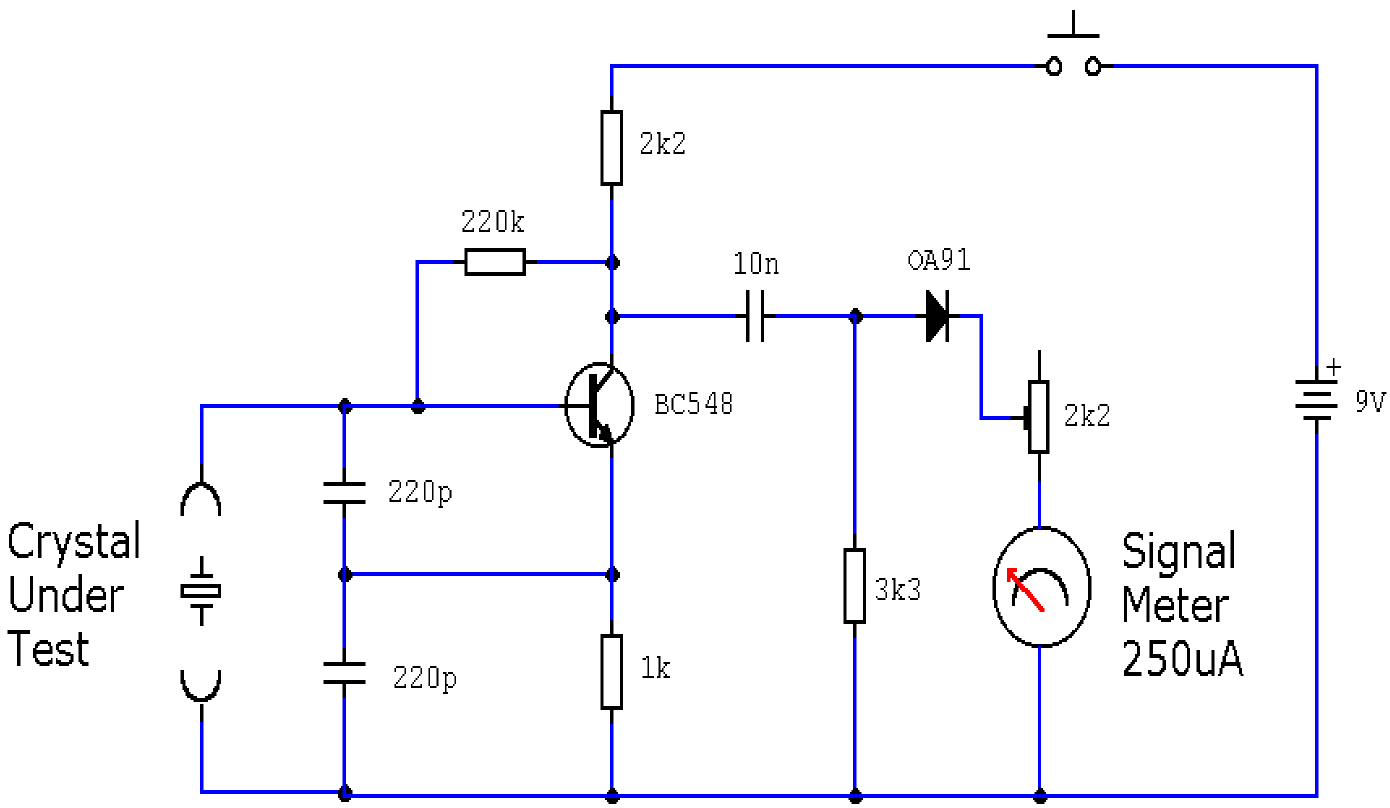
Notes

Using two gates from a CMOS 4011 NAND chip, a simple aquarewave oscillator can br made. Alternatively a CMOS 4001 chip can also be used, or a TTL equivalent. In this circuit the mark space ratio can also be independantly controlled by varying the value of the resistors. The rise and fall times of the output pulses depend on the operating voltage of the IC and type of IC, but will be typically in the order on tens of nanoseconds.

P451. Two Simple Crystal Test Circuits

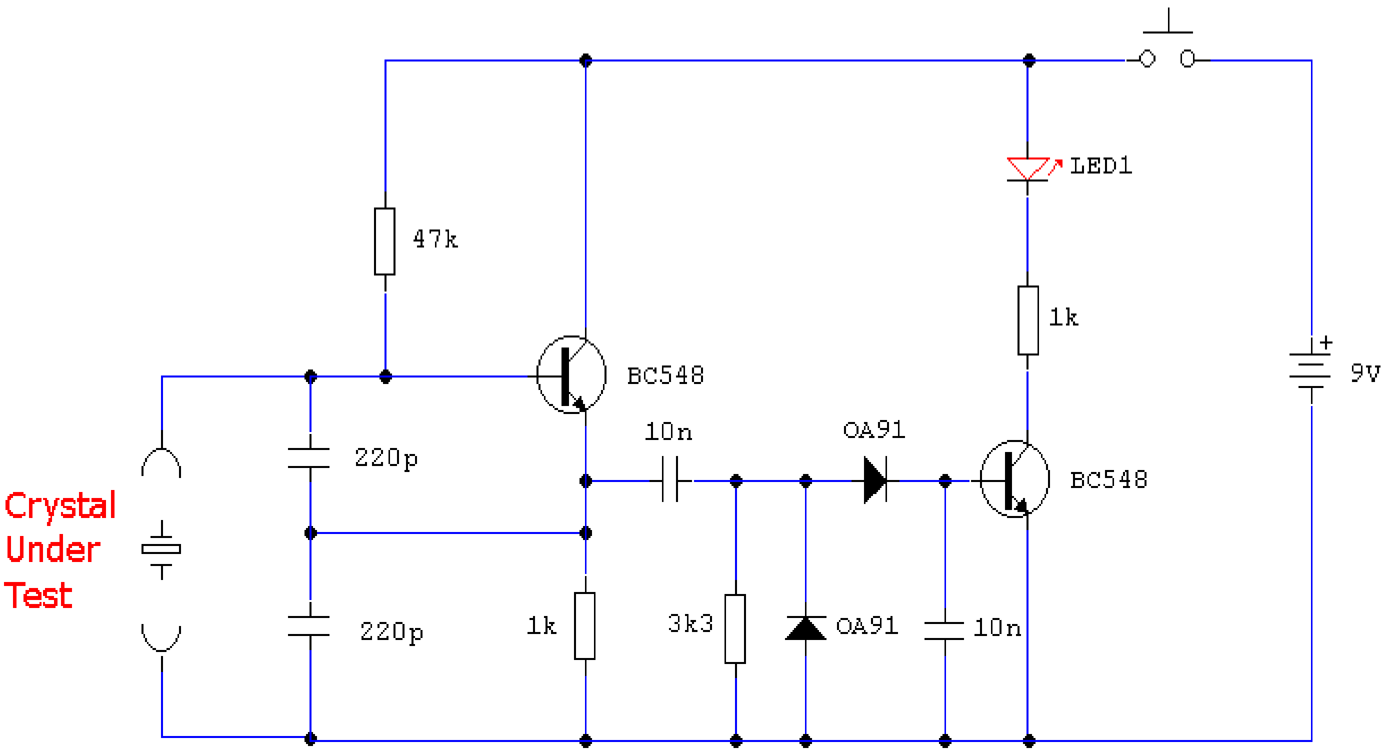
Description:

Two simple test circuits to check operation of quartz crystals.



Notes

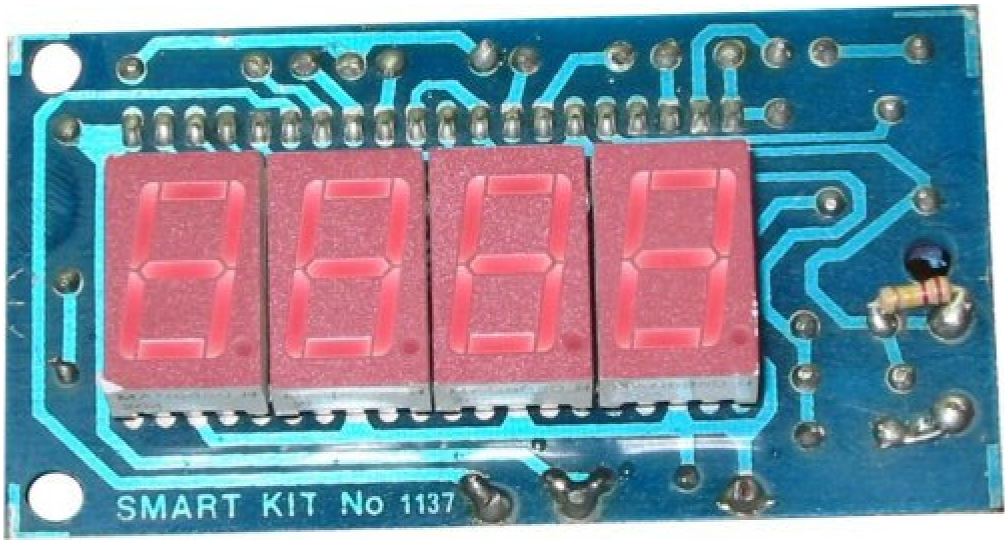
In the first circuit, above the BC548 is wired as a colpitts oscillator, the frequency tuned by insertion of a crystal. A good crystal will create high frequency oscillations, the output at the collector is rectified by the germanium OA91 diode and a deflection will appear on the meter. Thw more active the crystal, the higher the output deflection which may be adjusted with the preset.



Notes

The next circuit uses a working crystal again used to control the frequency of a colpitts oscillator. This time the output from the oscillator is taken from the emitter and is full wave rectified, the small dc bias will then directly cause the second BC548 to light the LED.

P452. LED display digital Voltmeter



front side

Copyright of this circuit belongs to smart kit electronics. In this page we will use this circuit to discuss for improvements and we will introduce some changes based on original schematic.

General Description

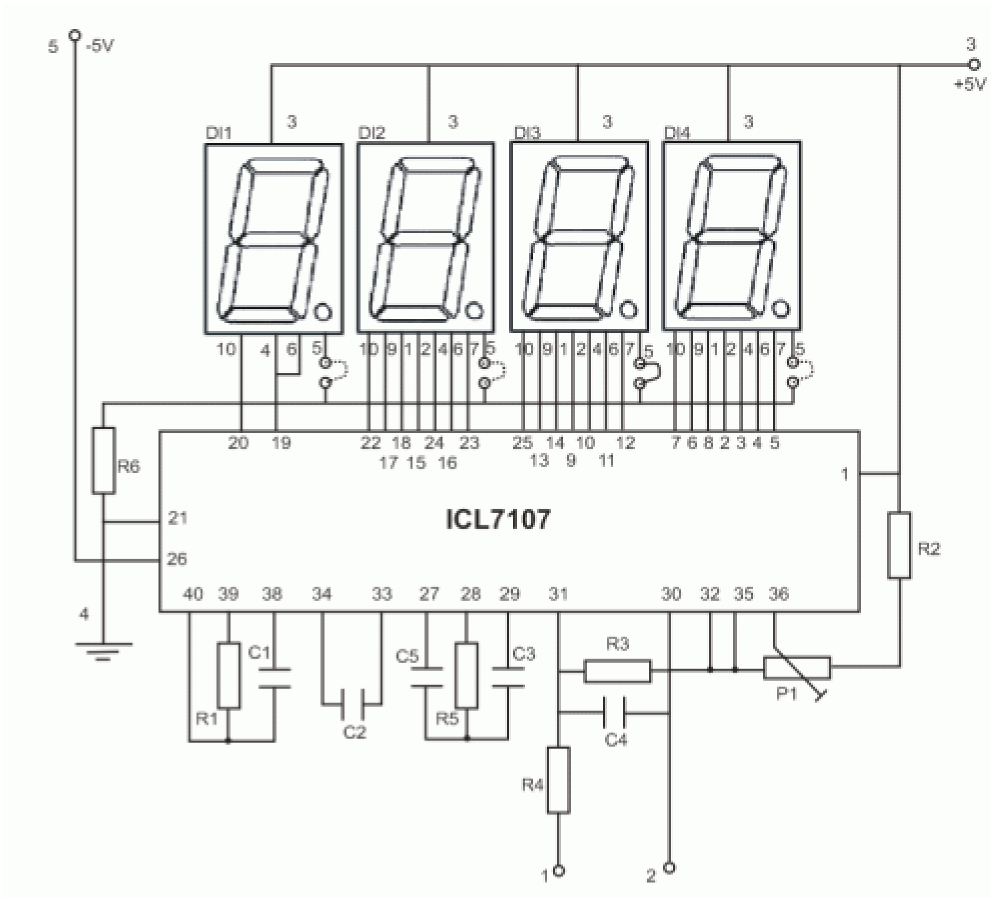
This is an easy to build, but nevertheless very accurate and useful digital voltmeter. It has been designed as a panel meter and can be used in DC power supplies or anywhere else it is necessary to have an accurate indication of the voltage present. The circuit employs the ADC (Analogue to Digital Converter) I.C. CL7107 made by INTERSIL. This IC incorporates in a 40 pin case all the circuitry necessary to convert an analogue signal to digital and can drive a series of four seven segment LED displays directly. The circuits built into the IC are an analogue to digital converter, a comparator, a clock, a decoder and a seven segment LED display driver. The circuit as it is described here can display any DC voltage in the range of 0-1999 Volts.

Technical Specifications - Characteristics
Supply Voltage: .... +/- 5 V (Symmetrical)
Power requirements: ..... 200 mA (maximum)
Measuring range: .... +/- 0-1,999 VDC in four ranges
Accuracy: .... 0.1 %
FEATURES
- Small size
- Easy construction
- Low cost.
- Simple adjustment.
- Easy to read from a distance.
- Few external components.

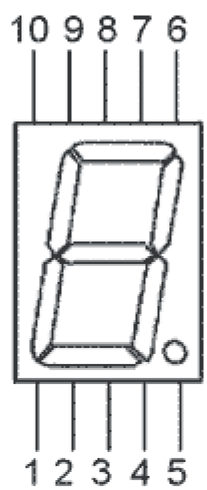
How it Works

In order to understand the principle of operation of the circuit it is necessary to explain how the ADC IC works. This IC has the following very important features:

- Great accuracy.
- It is not affected by noise.
- No need for a sample and hold circuit.
- It has a built-in clock.
- It has no need for high accuracy external components.



Schematic (fixed 22-2-04)



PIN NO.	E MAN6960
1	Cathode E
2	Cathode D
3	Com. Anode
4	Cathode C
5	Cathode D.P.
6	Cathode B
7	Cathode A
8	Com. Anode
9	Cathode F
10	Cathode G

7-segment display pinout MAN6960

An Analogue to Digital Converter, (ADC from now on) is better known as a dual slope converter or integrating converter. This type of converter is generally preferred over other types as it offers accuracy, simplicity in design and a relative indifference to noise which makes it very reliable. The operation of the circuit is better understood if it is described in two stages. During the first stage and for a given period the input voltage is integrated, and in the output of the integrator at the end of this period, there is a voltage which is directly proportional to the input voltage. At the end of the preset period the integrator is fed with an internal reference voltage and the output of the circuit is gradually reduced until it reaches the level of the zero reference voltage. This second phase is known as the negative slope period and its duration depends on the output of the integrator in the first period. As the duration of the first operation is fixed and the length of the second is variable it is possible to compare the two and this way the input voltage is in fact compared to the internal reference voltage and the result is coded and is send to the display.

back side

All this sounds quite easy but it is in fact a series of very complex operations which are all made by the ADC IC with the help of a few external components which are used to configure the circuit for the job. In detail the circuit works as follows. The voltage to be measured is applied across points 1 and 2 of the circuit and through the circuit R3, R4 and C4 is finally applied to pins 30 and 31 of the IC. These are the input of the IC as you can see from its diagram. (IN HIGH & IN LOW respectively). The resistor R1 together with C1 are used to set the frequency of the internal oscillator (clock) which is set at about 48 Hz. At this clock rate there are about three different readings per second. The capacitor C2 which is connected between pins 33 and 34 of the IC has been selected to compensate for the error caused by the internal reference voltage and also keeps the display steady. The capacitor C3 and the resistor R5 are together the circuit that does the integration of the input voltage and at the same time prevent any division of the input voltage making the circuit faster and more reliable as the possibility of error is greatly reduced. The capacitor C5 forces the instrument to display zero when there is no voltage at its input. The resistor R2 together with P1 are used to adjust the instrument during set-up so that it displays zero when the input is zero. The resistor R6 controls the current that is allowed to flow through the displays so that there is sufficient brightness with out damaging them. The IC as we have already mentioned above is capable to drive four common anode LED displays. The three rightmost displays are connected so that they can display all the numbers from 0 to 9 while the first from the left can only display the number 1 and when the voltage is negative the «-« sign. The whole circuit operates from a symmetrical ρ 5 VDC supply which is applied at pins 1 (+5 V), 21 (0 V) and 26 (-5 V) of the IC.

Construction

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up considerably and reduces the possibility of making errors. To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and also makes soldering easier.

Soldering the components to the board is the only way to build your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it.

DO NOT file or sandpaper a dirty or worn out tip. If the tip cannot be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time.

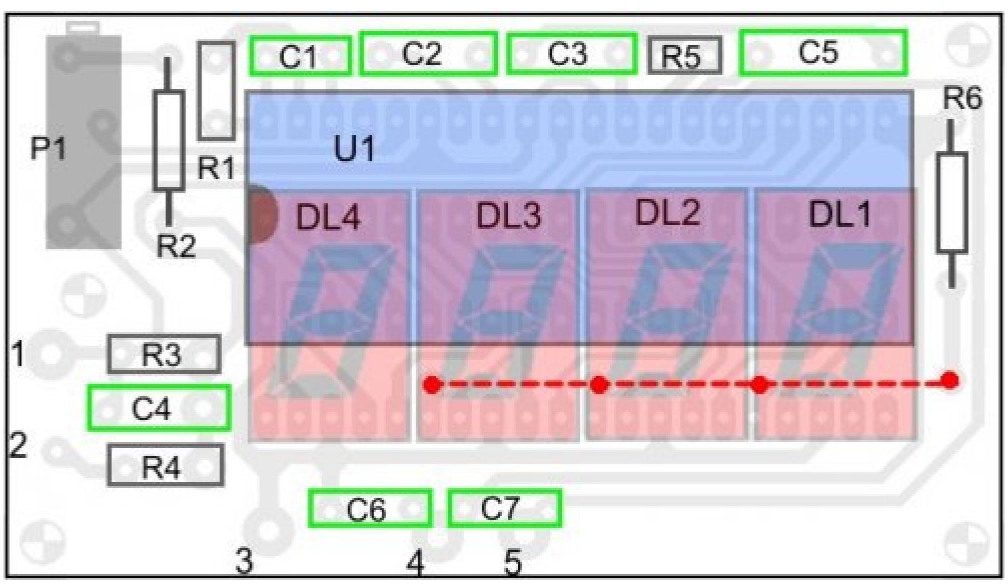
DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work.

In order to solder a component correctly you should do the following:

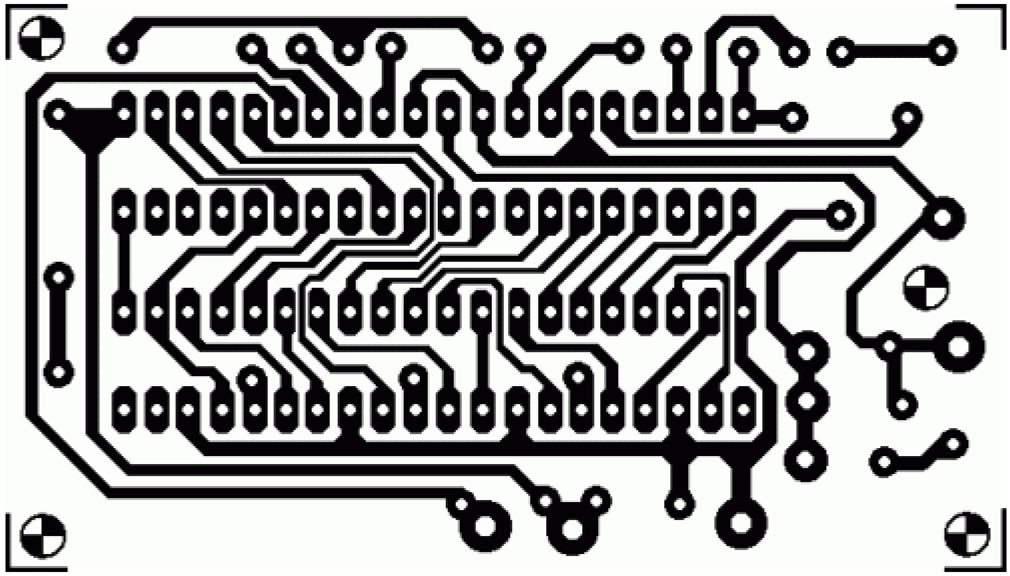
- Clean the component leads with a small piece of emery paper.

- Bend them at the correct distance from the component's body and insert the component in its place on the board.

- You may find sometimes a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board. In this case use a mini drill to enlarge the holes slightly. Do not make the holes too large as this is going to make soldering difficult afterwards.



Parts placement



PCB dimensions: 77,6mm x 44,18mm or scale it at 35%

- Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead emerges from the board. The iron tip must touch the lead slightly above the p.c. board.

- - When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and allow the solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked, or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it.

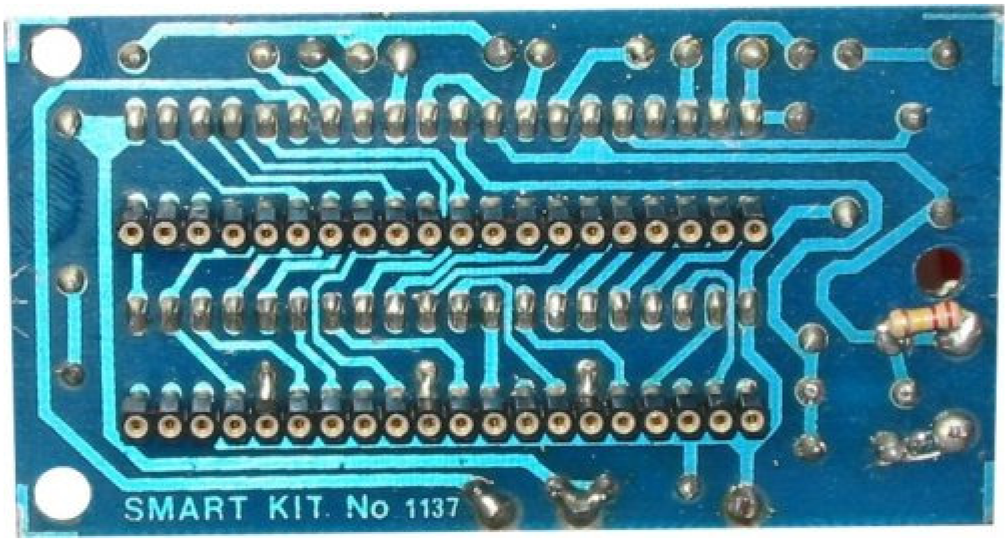
- - Take care not to overheat the tracks as it is very easy to lift them from the board and break them.

- - When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component.

- - Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together.

- - When you finish your work, cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that may still remain on it.

-



As it is recommended start working by identifying the components and separating them in groups. There are two points in the construction of this project that you should observe:

First of all the display IC's are placed from the copper side of the board and second the jumper connection which is marked by a dashed line on the component side at the same place where the displays are located is not a single jumper but it should be changed according to the use of the instrument. This jumper is used to control the decimal point of the display.

If you are going to use the instrument for only one range you can make the jumper connection between the rightmost hole on the board and the one corresponding to the desired position for the decimal point for your particular application. If you are planning to use the voltmeter in different ranges you should use a single pole three position switch to shift the decimal point to the correct place for the range of measurement selected. (This switch could preferably be combined with the switch that is used to actually change the sensitivity of the instrument).

Apart from this consideration, and the fact that the small size of the board and the great number of joints on it which calls for a very fine tipped soldering iron, the construction of the project is very straightforward.

Insert the IC socket and solder it in place, solder the pins, continue with the resistors the capacitors and the multi-turn trimmer P1. Turn the board over and very carefully solder the display IC's from the copper side of the board. Remember to inspect the joints of the base of the IC as one row will be covered by the displays and will be impossible to see any mistake that you may have made after you have soldered the displays into place.

The value of R3 controls in fact the range of measurement of the voltmeter and if you provide for some means to switch different resistors in its place you can use the instrument over a range of voltages.
For the replacement resistors follow the table below:

0 - 2 V .... R3 = 0 ohm 1%
0 - 20 V .... R3 = 1.2 Kohm 1%
0 - 200 V .... R3 = 12 Kohm 1%
0 - 2000 V .... R3 = 120 Kohm 1%

When you have finished all the soldering on the board and you are sure that everything is OK you can insert the IC in its place. The IC is CMOS and is very sensitive to static electricity. It comes wrapped in aluminium foil to protect it from static discharges and it should be handled with great care to avoid damaging it. Try to avoid touching its pins with your hands and keep the circuit and your body at ground potential when you insert it in its place.

Connect the circuit to a suitable power supply ρ 5 VDC and turn the supply on. The displays should light immediately and should form a number. Short circuit the input (0 V) and adjust the trimmer P1 until the display indicates exactly «0».

Parts
R1 180k
R2 22k
R3 12k
R4 1M
R5 470k
R6 560 Ohm
C1 100pF
C2, C6, C7 100nF
C3 47nF
C4 10nF
C5 220nF
P1 20k trimmer multi turn
U1 ICL 7107
LD1,2,3,4 MAN 6960 common anode led displays

If it does not work

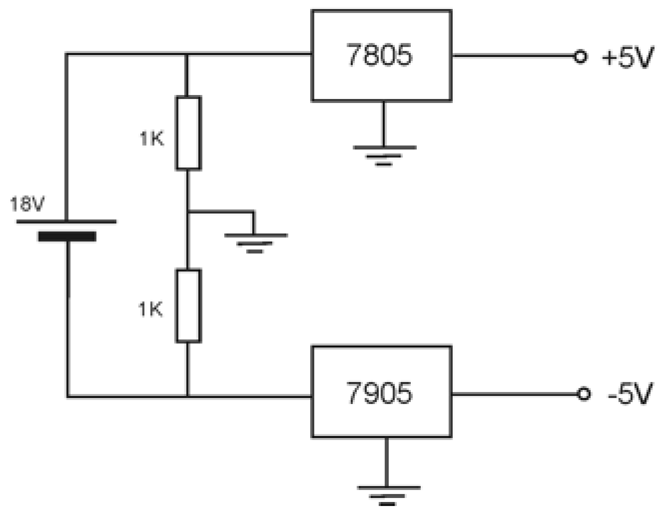
Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems.

Check again all the external connections to and from the circuit to see if there is a mistake there.
- See that there are no components missing or inserted in the wrong places.

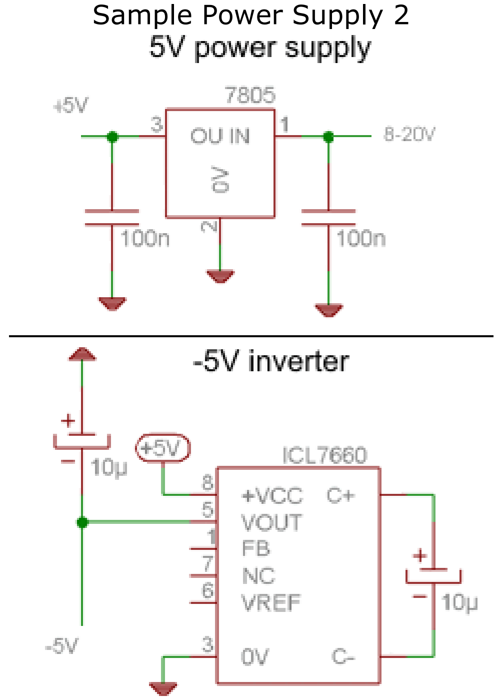
- Make sure that all the polarised components have been soldered the right way round. - Make sure the supply has the correct voltage and is connected the right way round to your circuit.

- Check your project for faulty or damaged components.

Sample Power supply 1



Sample Power Supply 2

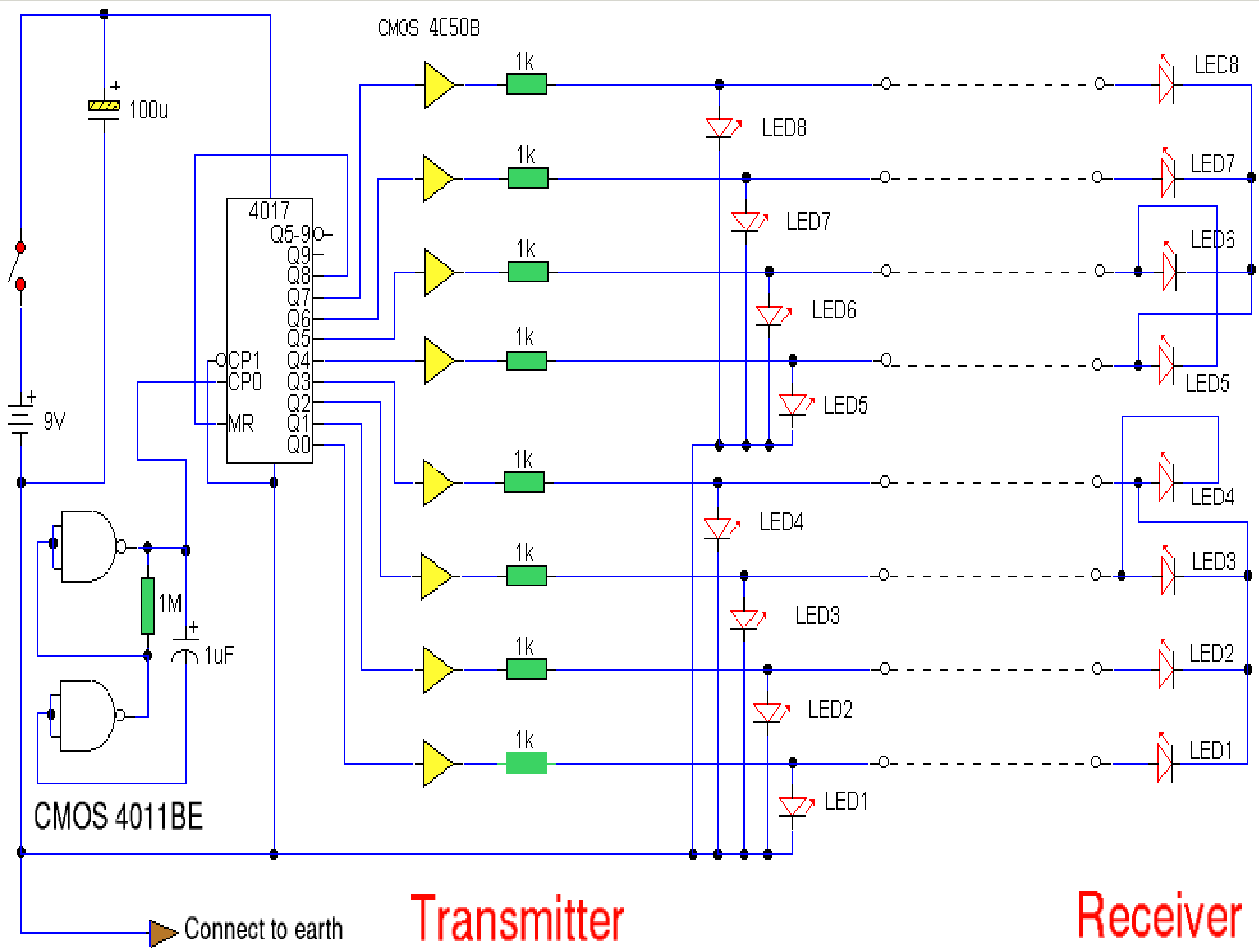


P453. Multi Wire Cable Tester

Description:

A multi wire cable tester with a separate LED for each wire. Will show open circuits, short circuits, reversals, earth faults, continuity and all with four IC's. Designed initially for my intercom, but can be used with alarm wiring, CAT 5 cables and more.

Full circuit can be viewed with resolution of 1024x768



Notes

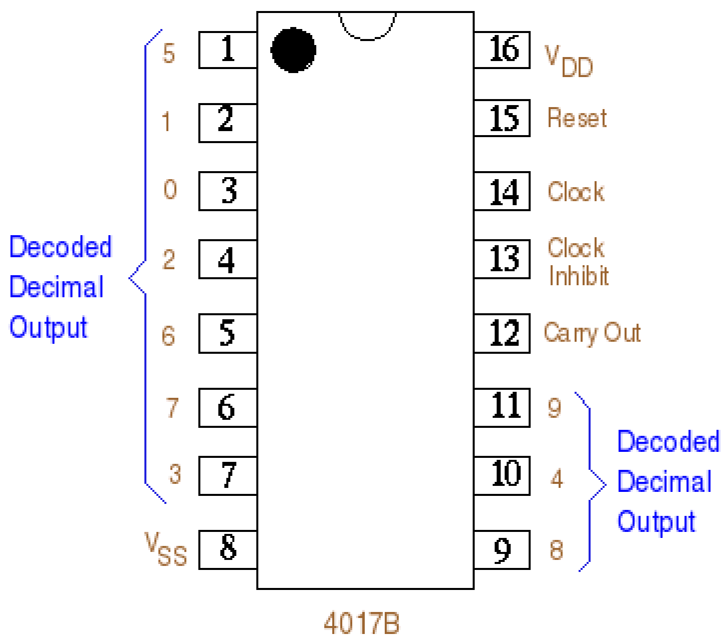
Please note that for clarity this circuit has been drawn without showing power supplies to the CMOS 4011 and CMOS 4050 IC's. The positive battery terminal connects to Pin 14 of each IC and negative to Pin 7. The CMOS 4017 uses Pin 16 and Pin 8 respectively. Note also that as the CMOS 4050 is only a hex buffer, you need 8 gates so two 4050's are required, the unused inputs are connected to ground (battery negative terminal).

Circuit Description

The circuit comprises transmitter and receiver, the cable under test linking the two. The transmitter is nothing more than a "LED chaser" the 4011 IC is wired as astable and clocks a 4017 decade counter divider. The 4017 is arranged so that on the 9th pulse,the count is reset. Each LED will light sequentially from LED 1 to LED 8 then back to LED 1 etc. As the 4017 has limited driving capabilities, then each output is buffered by a 4050. This provides sufficient current boost for long cables and the transmitter and receiver LED's. The receiver is simply 8 LED's with a common wire...read on.

Wiring the CMOS 4017

The pinout for the CMOS 4017B is shown below. Please note that in the main schematic above, alternate naming of the pins has been used. The pin equivalence is as follows:-



CP0 (clock pulse zero) is the Clock input, Pin 14 on the diagram above.
CP1 (clock pulse one) is the clock inhibit or Pin 13 on the pinout above.
MR (master reset) is the reset pin 15 in the diagram above.
Q0-9 represent the decoded decimal outputs. Hence Q0 is Pin 3 on the pinout and Q8 is Pin9.

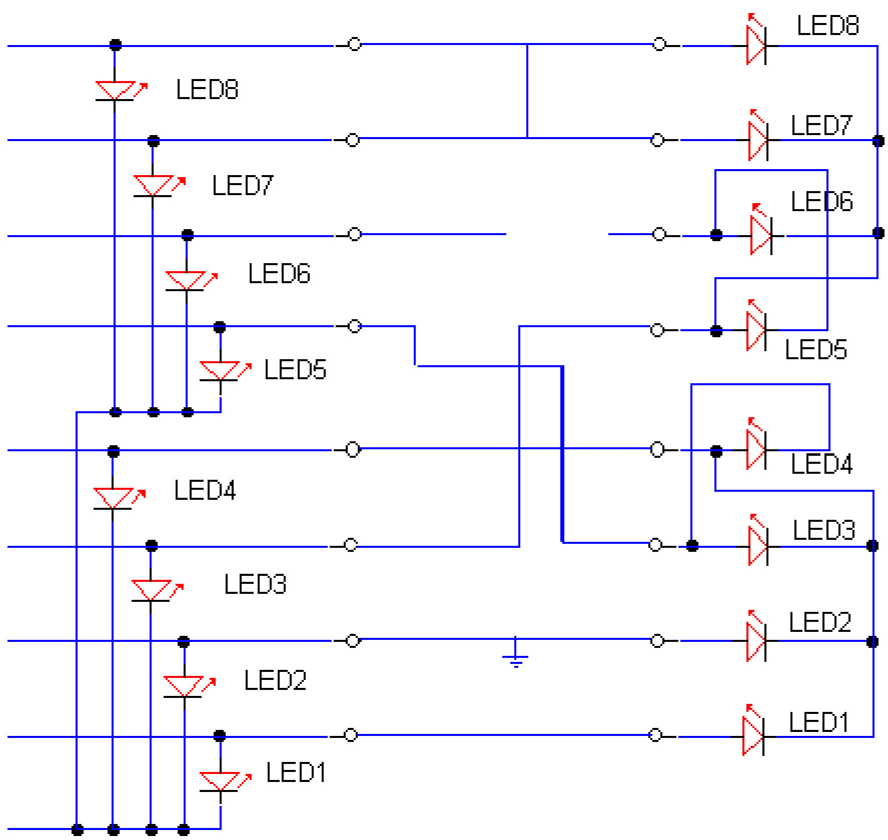
7 Led's 8 Wires

Not a mistype. The problem with testing each wire individually is that if you had 7 individually addressable LED's, then you would need an eighth return or common wire. In the case of testing 8 wires you would need a ninth wire. You could use a domestic earth but its not really practical, and also if the cable was shorting to earth anyway it would be no good anyway. The solution had me thinking for a while, but since this is a logic circuit, there are only two conditions, logic high or zero. As the 4017 outputs are either high or low, any output can provide a common return path for a LED. So LED's 1 - 3 use the 4th output of the 4017, which will be zero, and the 4th LED is wired with reverse polarity. On the 4th pulse, output 4 is high, output 3 is low and so the LED will light. If the common return wire is open circuit then LED's 1-4 will not light. A similar situation occurs with outputs 5 to 8. The common wire in can be taken from any output terminal from the 4017, but the same rule would still apply. The ability to test all wires quickly outweighs this small disadvantage. If a cable of just 4 or 6 wires is tested then it must use the wires with LED's numbered 1 to 4 or 1 to 6, which is why the LED's are numbered that way.

Testing

With a good cable and all wires connected then LED 1 will light at both cable ends, followed in sequence by LED 2 ,3, 4 etc to LED 8, the sequence then repeating. If a 4 wire cable is used, it must be connected to use the common return wire as described in the preceding paragraph. The sequence would be LED 1,2,3,4 repeating with a delay as the 4 unused outputs are stepped through.

To check for earth contact faults, the probe labeled "to earth connection" would be physically connected to a local earth. A wire that is earthing will dim or extinguish the LED's at both ends of the cable. An LED not lighting at the receiver, indicates a broken or open circuit. If two wires are short circuit, example 3 and 4 then at the receiver the sequence would be 1, 2, 34, 43, 5, 6, 7, 8. A reversal would be indicated by an out of pattern sequence of LED's. Here's an example, the probe is connected to an earth at the transmitter, the cable is very faulty, wire 1 is OK, 2 is earthing, 3 and 5 are reversed 4 is OK, 6 is open circuit and 7 and 8 are short circuit. See below.



Test Result for Above Faulty Cable:

The transmitter pattern:	The receiver pattern would be:
1 ON	1 ON
2 OFF or Faint	2 OFF or faint
3 ON	3 (would show LED 5)
4 ON	4 ON
5 ON	5 (would show LED 3)
6 ON	6 OFF

7 ON	7 (would show 7 & 8)
8 ON	8 (would show 7 & 8)

The LED sequence of course is stepped through, as you know the transmitter "pattern" it is easy to tell the state of the cable by viewing the receiver pattern. The earth condition will only show up if the contact to earth is less than 1000 ohms, a better but more time consuming method for earth faults is to use a meter on the Megaohms range.

P454. Mosfet TESTER

This is a variation on the astable multivibrator. Circuit was recently developed to test for N-mosfets (the power kind e.g irf830)

I don’t claim circuit can test all bad mosfets or all fault mosfet conditions. If mosfet is working it will operate in the astable multivibrator circuit causing the Led to flash.

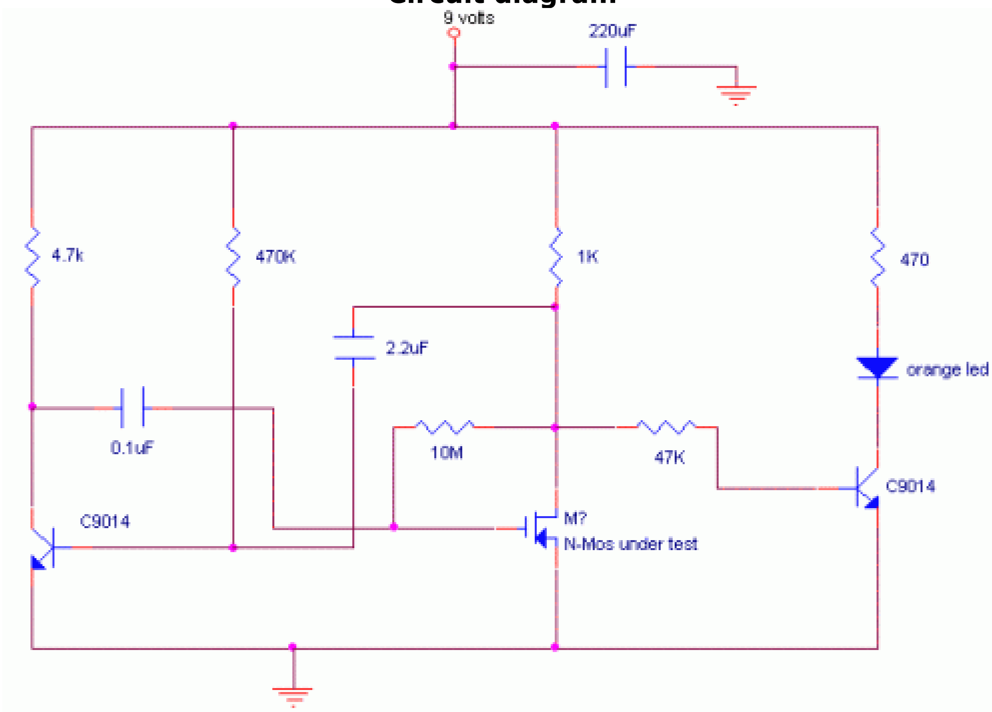
A bad mosfet will not cause the LED to flash.

Below is the circuit diagram, the other half of the astable utilizes an npn transistor to make the circuit cheap.

Almost any npn transistor will work in this circuit.

The npn transistor to the right is used as a common emitter buffer that also drives the led as it receives pulses from the mosfet drain.

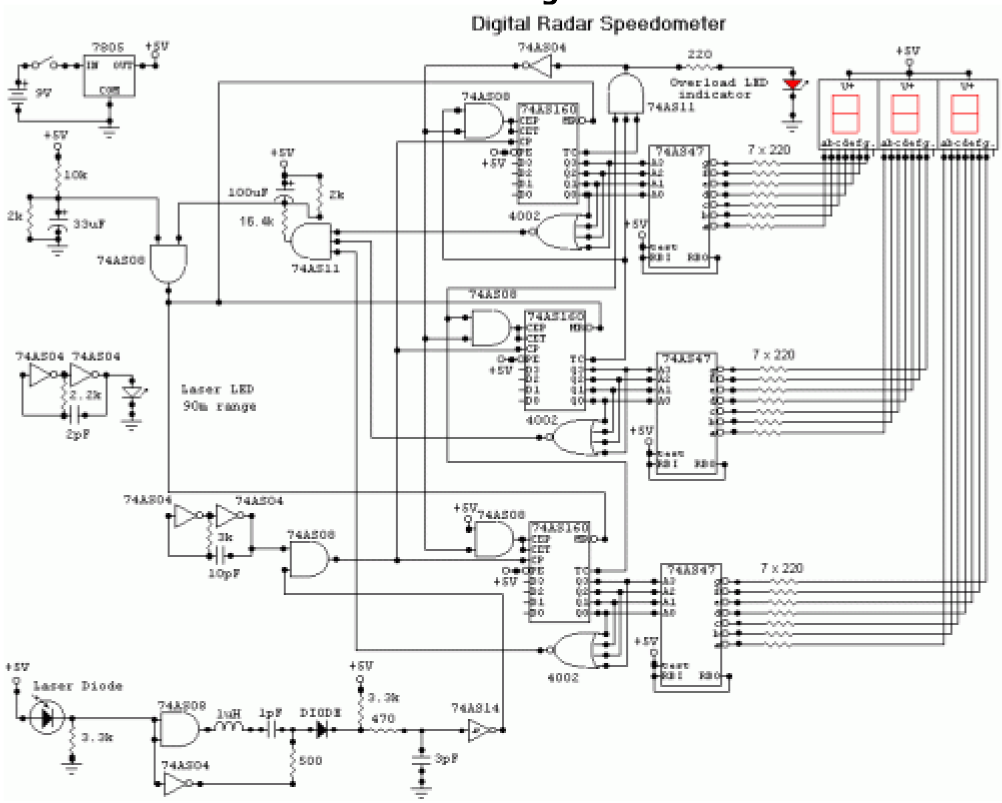
Circuit diagram



Note: diode is a light emitting Diode

P455. Digital Radar Speedometer

Circuit diagram



This circuit is a Digital Radar Speedometer. It allows us to evaluate the speed of any object moving, especially cars and other vehicles. The speed is calculated in kilometers per hour (KPH). Its display has three digits. This radar works with the laser reflexion. It sends laser radiation to the object and this object reflects the laser radiation to the radar. To evaluate the speed of a vehicle, we must be in front of it. In other words, the vehicle must come in our direction. The front of the radar must point the front of the vehicle. The radar has the shape of a pistol. In this radar, it has a laser LED and a laser diode. Both have a lens.

The laser LED can send a spot of light to a distance of 90 m (295 ft). It's very important that the distance range of the laser LED is 90 m, if not, the speed will not be calculated properly. The laser diode, which receives the light signal by the laser LED, must be able to detect the light which is same color as that emitted by the laser LED. The laser diode and the laser LED must be placed one beside the other. They are protected by a tinted pane. They must be placed at the front of the radar and point the outside. The radar is powered by a 9V battery and it has a SPST switch to control its power state.

The display, or the speed indicator, is placed at the rear of the radar, just on the right of the overload LED indicator. All the logic components of the circuit must be of the 74AS series and TTL type. Because they have short time of response (less than 1.7 ns) and have high frequency supports (more than 200 MHz). The radar can evaluate the speed of an object moving between 0 to 999 km/h. After this speed, the overload LED indicator will turn on and the "999" will still displayed. The radar displays the speed during 3 seconds, after this time, it displays "zero" (0).

P456. Linear Resistance Meter

Most analogue multimeters are capable of measuring resistance over quite a wide range of values, but are rather inconvenient in use due to the reverse reading scale which is also non-linear. This can also give poor accuracy due to cramping of the scale that occurs at the high value end of each range. This resistance meter has 5 ranges and it has a forward reading linear scale on each range.The full-scale values of the 5 ranges are 1K, 10K, 100K, 1M &10M respectively and the unit is therefore capable of reasonably accurate measurements from a few tens of ohms to ten Megohms.

Circuit diagram

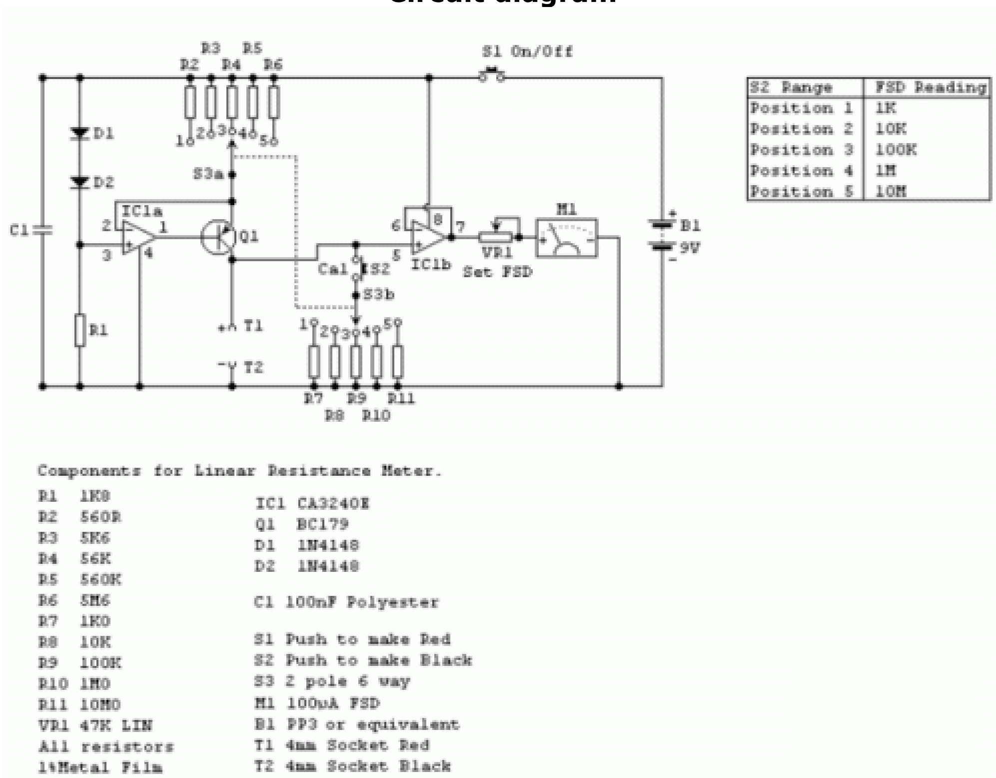


Figure 1

The Circuit

Most linear scale resistance meters including the present design, work on the principle that if a resistance is fed from a constant current source the voltage developed across that resistance is proportional to its value. For example, if a 1K resistor is fed from a 1 mA current source from Ohm's Law it can be calculated that 1 volt will be developed across the resistor (1000 Ohms divided by 0.001 amps = 1 volt). Using the same current and resistance values of 100 ohms and 10K gives voltages of 0.1volts (100 ohms / 0.001amps = 0.1volts) and 10 volts (10000 ohms / 0.001amps = 10 volts).

Thus the voltage developed across the resistor is indeed proportional to its value, and a voltmeter used to measure this voltage can in fact be calibrated in resistance, and will have the desired forward reading linear scale. One slight complication is that the voltmeter must not take a significant current or this will alter the current fed to the test resistor and impair linearity. It is therefore necessary to use a high impedance voltmeter circuit.

The full circuit diagram of the Linear Resistance Meter is given in Figure 1. The constant current generator is based on IC1a and Q1. R1, D1 and D2 form a simple form a simple voltage regulator circuit, which feeds a potential of just over 1.2 volts to the non-inverting input of IC1a. There is 100% negative feedback from the emitter of Q1 to the inverting input of IC1a so that Q1's emitter is stabilised at the same potential as IC1a's non-inverting input. In other words it is stabilised a little over 1.2 volts below the positive supply rail potential. S3a gives 5 switched emitter resistances for Q1, and therefore 5 switched emitter currents. S3b provides 5 reference resistors across T1 & T2 via S2 to set full-scale deflection on each range using VR1.

As the emitter and collector currents of a high gain transistor such as a BC179 device used in the Q1 are virtually identical, this also gives 5 switched collector currents. By having 5 output currents, and the current reduced by a factor of 10 each time S3a is moved one step in a clockwise direction, the 5 required measuring ranges are obtained. R2 to R6 must be close tolerance types to ensure good accuracy on all ranges. The high impedance voltmeter section uses IC1b with 100% negative feedback from the output to the inverting input so that there is unity voltage gain from the non-inverting input to the output. The output of IC1b drives a simple voltmeter circuit using VR1 and M1, and the former is adjusted to give the correct full-scale resistance values.

The CA3240E device used for IC1 is a dual op-amp having a MOS input stage and a class A output stage. These enable the device to operate with the inputs and outputs right down to the negative supply rail voltage. This is a very helpful feature in many circuits, including the present one as it enables a single supply rail to be used where a dual balanced supply would otherwise be needed. In many applications the negative supply is needed simply in order to permit the output of the op-amp to reach the 0volt rail. In applications of this type the CA3240E device normally enables the negative supply to be dispensed with.

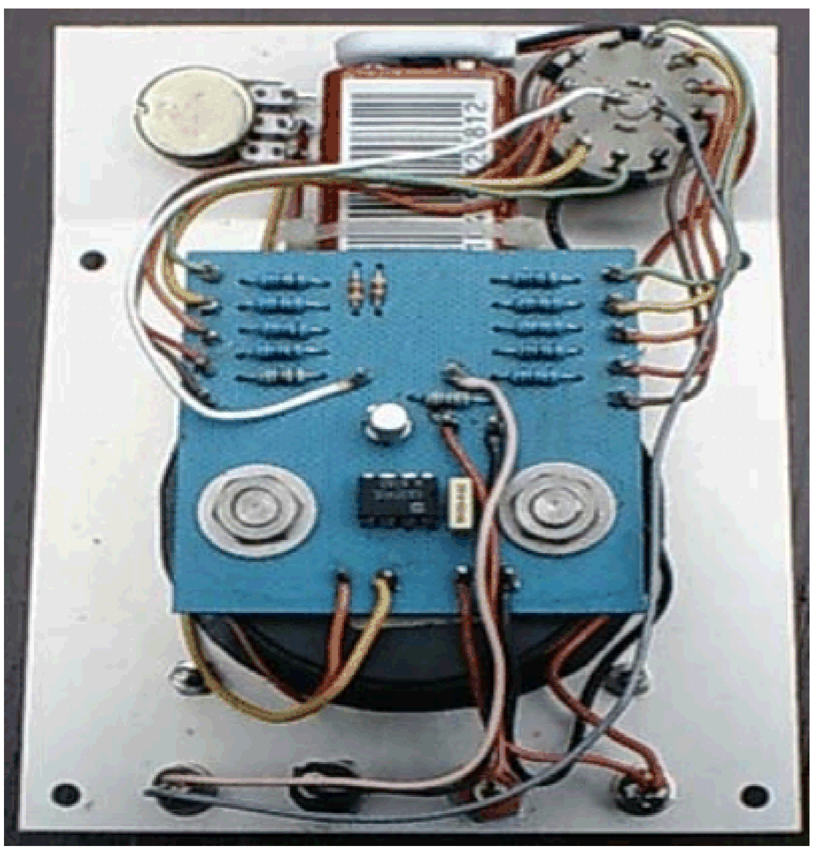
As the CA3240E has a MOS input stage for each section the input impedance is very high (about 1.5 million Megohms!) and obviously no significant input current flows into the device. This, together with the high quality of the constant current source, and the practically non-existent distortion through IC1b due to the high feedback level gives this circuit excellent linearity.

With no resistor connected across T1 & T2 M1 will be taken beyond full-scale deflection and overloaded by about 100 or 200%. This is unlikely to damage the meter, but to be on the safe side a push-to-test on/off switch (S1) is used. Thus the power is only applied to the circuit when a test resistor is connected to the unit, and prolonged meter overloads are thus avoided.

A small (PP3 size) 9 volt battery is a suitable power source for this project which has a current consumption of around 5mA and does not require a stabilised supply.

Photos showing inside and outside of the completed Linear Resistance Meter.


×1K
×10K
×100K
×1M
×10M
0
0·2
0·4
0·6
0·8
1·0
ON
+
−
CAL

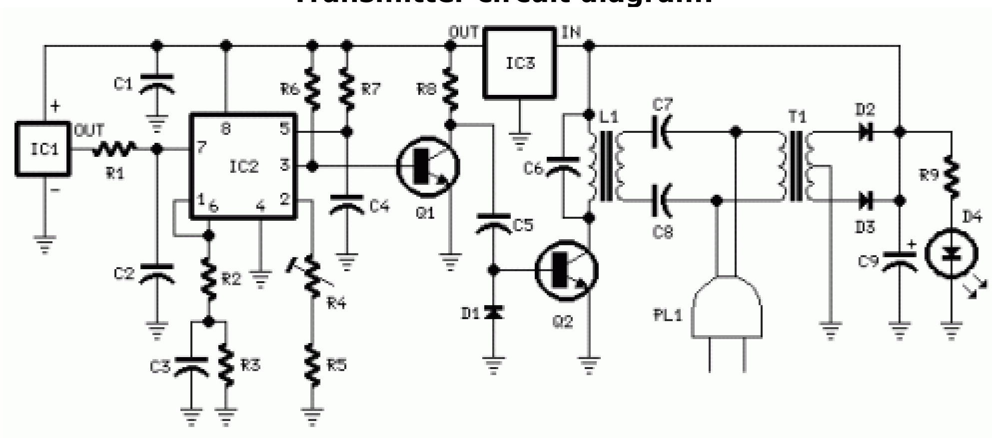


P457. Digital Remote Thermometer

Warning! The circuits are connected to 220Vac mains, then some parts in the circuit boards are subjected to lethal potential!. Avoid touching the circuits when plugged and enclose them in plastic boxes.

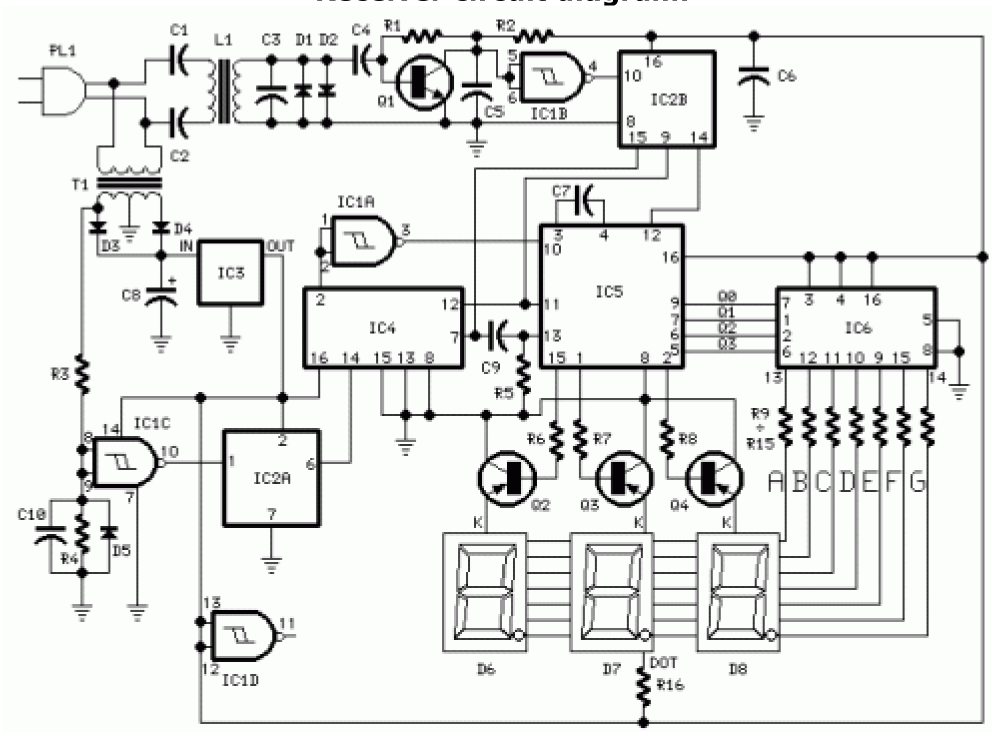
Remote sensor sends data via mains supply
Temperature range: 00.0 to 99.9 °C

Transmitter circuit diagram:



Transmitter parts:
R1,R3 100K 1/4W Resistors
R2 47R 1/4W Resistor
R4 5K 1/2W Trimmer Cermet
R5 12K 1/4W Resistor
R6 10K 1/4W Resistor
R7 6K8 1/4W Resistor
R8,R9 1K 1/4W Resistors
C1 220nF 63V Polyester Capacitor
C2 10nF 63V Polyester Capacitor
C3 1µF 63V Polyester Capacitor
C4,C6 1nF 63V Polyester Capacitors
C5 2n2 63V Polyester Capacitor
C7,C8 47nF 400V Polyester Capacitors
C9 1000µF 25V Electrolytic Capacitor
D1 1N4148 75V 150mA Diode
D2,D3 1N4002 100V 1A Diodes
D4 5mm. Red LED
IC1 LM35 Linear temperature sensor IC
IC2 LM331 Voltage-frequency converter IC
IC3 78L06 6V 100mA Voltage regulator IC
Q1 BC238 25V 100mA NPN Transistor
Q2 BD139 80V 1.5A NPN Transistor
L1 Primary (Connected to Q2 Collector): 100 turns
Secondary: 10 turns
Wire diameter: O.2mm. enameled
Plastic former with ferrite core. Outer diameter: 4mm.
T1 220V Primary, 12+12V Secondary 3VA Mains transformer
PL1 Male Mains plug & cable

Receiver circuit diagram:



Receiver Parts:
R1 100K 1/4W Resistor
R2 1K 1/4W Resistor
R3,R4,R6-R8 12K 1/4W Resistors
R5 47K 1/4W Resistor
R9-R15 470R 1/4W Resistors
R16 680R 1/4W Resistor
C1,C2 47nF 400V Polyester Capacitors
C3,C7 1nF 63V Polyester Capacitors
C4 10nF 63V Polyester Capacitor
C5,C6,C10 220nF 63V Polyester Capacitors
C8 1000µF 25V Electrolytic Capacitor
C9 100pF 63V Ceramic Capacitor
D1,D2,D5 1N4148 75V 150mA Diodes
D4,D4 1N4002 100V 1A Diodes
D6-D8 Common-cathode 7-segment LED mini-displays
IC1 4093 Quad 2 input Schmitt NAND Gate IC
IC2 4518 Dual BCD Up-Counter IC
IC3 78L12 12V 100mA Voltage regulator IC
IC4 4017 Decade Counter with 10 decoded outputs IC
IC5 4553 Three-digit BCD Counter IC
IC6 4511 BCD-to-7-Segment Latch/Decoder/Driver IC
Q1 BC239C 25V 100mA NPN Transistor
Q2-Q4 BC327 45V 800mA PNP Transistors
L1 Primary (Connected to C1 & C2): 10 turns
Secondary: 100 turns
Wire diameter: O.2mm. enameled
Plastic former with ferrite core. Outer diameter: 4mm.
T1 220V Primary, 12+12V Secondary 3VA Mains transformer
PL1 Male Mains plug & cable

Device purpose:

This circuit is intended for precision centigrade temperature measurement, with a transmitter section converting to frequency the sensor's output voltage proportional to the measured temperature. The output frequency bursts are conveyed into the mains supply cables.

The receiver section counts the bursts coming from mains supply and shows the counting on three 7-segment LED displays. The least significant digit displays tenths of degree and then a 00.0 to 99.9 °C range is obtained.

Transmitter-receiver distance can reach hundred meters, provided both units are connected to the mains supply within the control of the same light-meter.

Transmitter circuit operation:

IC1 is a precision centigrade temperature sensor with a linear output of 10mV/°C driving IC2, a voltage-frequency converter. At its output pin (3), an input of 10mV is converted to 100Hz frequency pulses. Thus, for example, a temperature of 20°C is converted by IC1 to 200mV and then by IC2 to 2KHz. Q1 is the driver of the power output transistor Q2, coupled to the mains supply by L1 and C7,C8.

Receiver circuit operation:

The frequency pulses coming from mains supply and safely insulated by C1,C2 & L1 are amplified by Q1; diodes D1,D2 limiting peaks at its input. Pulses are filtered by C5, squared by IC1B, divided by 10 in IC2B and sent for the final count at the clock input of IC5.

IC4 is the time-base generator: it provides reset pulses for IC1B and IC5 and enables latches and gate-time of IC5 at 1Hz frequency. It is driven by a 5Hz square wave obtained from 50Hz mains frequency picked-up from T1 secondary, squared by IC1C and divided by 10 in IC2A.

IC5 drives the displays' cathodes via Q2,Q3 & Q4 at a multiplexing rate frequency fixed by C7. It drives also the 3 displays' paralleled anodes via the BCD-to-7 segment decoder IC6.

Summing up, input pulses from mains supply at, say, 2KHz frequency, are divided by 10 and displayed as 20.0°C.

Notes:
D6 is the Most Significant Digit and D8 is the Least Significant Digit.
R16 is connected to the Dot anode of D7 to permanently light the decimal point.

Set the ferrite cores of both inductors for maximum output (best measured with an oscilloscope, but not critical).

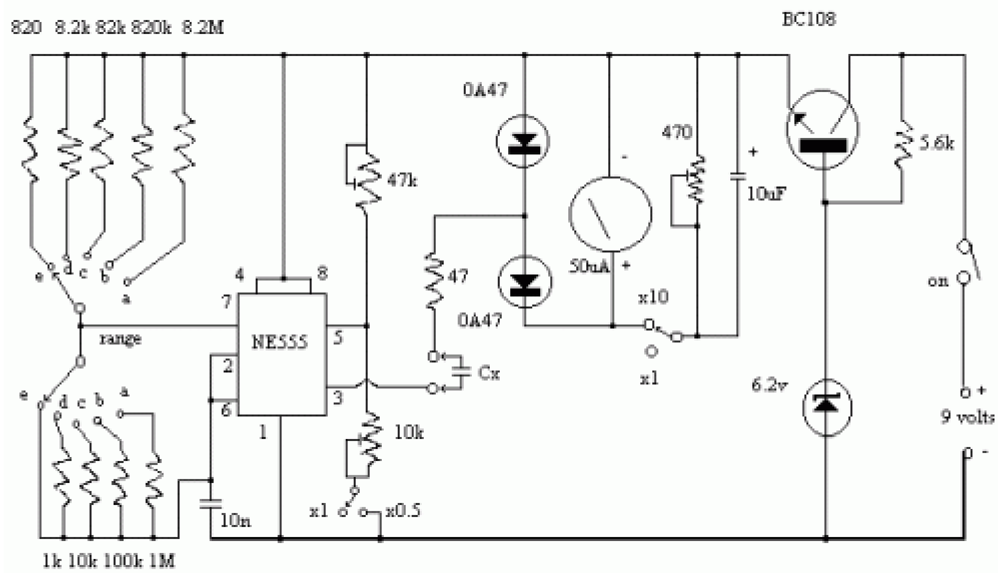
Set trimmer R4 in the transmitter to obtain a frequency of 5KHz at pin 3 of IC2 with an input of 0.5Vcc at pin 7 (a digital frequency meter is required).

More simple setup: place a thermometer close to IC1 sensor, then set R4 to obtain the same reading of the thermometer in the receiver's display.

Keep the sensor (IC1) well away from heating sources (e.g. Mains Transformer T1). Linearity is very good.

P458. Capacitance Meter

Circuit diagram



Position Range
a 1 uf
b 100 nf
c 10 nf
d 1 nf
e 100 pf
Use X10 switch to measure up 10uf.
Use X0.5 switch for better readings on low values.

This project is more complex than the others described earlier. However, when finished, you will have an instrument capable of measuring all but the largest capacitors used in radio circuits. Unlike variable resistors, most variable capacitors are not marked with their values. As well, the markings of capacitors from salvaged equipment often rub off. By being able to measure these unmarked components, this project will prove useful to the constructor, vintage radio enthusiast or antenna experimenter.

The common 555 timer IC forms the heart of the circuit (Figure Three). Its function is to charge the unknown capacitor (Cx) to a fixed voltage. The capacitor is then discharged into the meter circuit. The meter measures the current being drawn through the 47 ohm resistor. The 555 repeats the process several times a second, so that the meter needle remains steady.

The deflection on the meter is directly proportional to the value of the unknown capacitor. This means that the scale is linear, like the voltage and current ranges on an analogue multimeter.

The meter has five ranges, from 100pF to 1uF, selected by a five position two pole switch. In addition, there is a x10 switch for measuring higher values and a divide-by-two facility to allow a better indication on the meter where the capacitor being measured is just above 100, 1000pF, 0.01, 0.1 or 1 uF.

Component values are critical. For best accuracy, it is desirable that the nine resistors wired to the Range switch have a 2% tolerance. If 0A47 diodes are not available, try OA91 or OA95 germanium diodes instead. Construct the meter in a plastic box; one that is about the size of your multimeter but deeper is ideal. The meter movement should as large as your budget allows; you will be using it to indicate exact values. A round 70mm-diameter movement salvaged from a piece of electronic equipment was used in the prototype. The meter you buy will have a scale of 0 to 50 microamps. This scale needs to be converted to read 0 to 100 (ie 20, 40, 60, 80, 100 instead of 10, 20, 30, 40, 50). Use of white correction fluid or small pieces of paper will help here.

The components can be mounted on a piece of matrix board or printed circuit board. Use a socket for the IC should replacement ever be needed. Keep wires short to minimise stray capacitance; stray capacitance reduces accuracy.

Calibrating the completed meter can be done in conjunction with a ready-built capacitance meter. Failing this, a selection of capacitors of known value, as measured on a laboratory meter, could be used. If neither of these options are available, simply buy several capacitors of the same value and use the one which is nearest the average as your standard reference. Use several standards to verify accuracy on all ranges.

To calibrate, disable both the x10 and divide-by-two functions (ie both switches open). Then connect one of your reference capacitors and switch to an appropriate range. Vary the setting of the 47k trimpot until the meter is reading the exact value of the capacitor. Then switch in the divide-by-two function. This should change the reading on the meter. Adjust the 10k trimpot so that the needle shows exactly twice the original reading. For example, if you used a 0.01 uF reference, and the meter read 10 on the 0.1 uF range, it should now read 20. Now switch out the divide-by-two function.

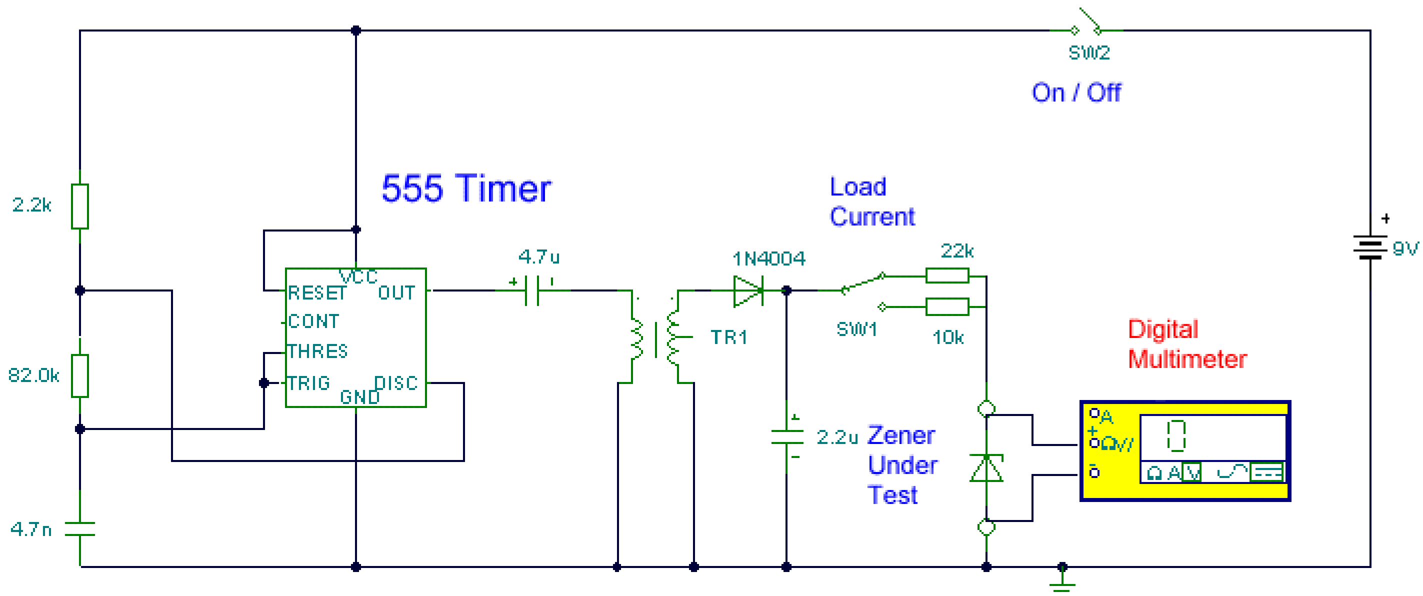
If you are not doing so already, change to a reference with a value equal to one of the ranges (eg 1000pF, 0.01uF, 0.1uF etc). Switch to the range equal to that value (ie the meter reads full-scale (100) when that capacitor is being measured. Switching in the x10 function should cause the meter indication to drop significantly. Adjust the 470 ohm trimpot so that the meter reads 10. Move down one range (eg from 0.01uF to 1000pF). The meter should read 100 again. If it does not, vary the 470 ohm trimpot until it does. That completes the calibration of the capacitance meter. Now try measuring other components to confirm that the measurements are reasonable.

With care, an accuracy of five percent or better should be possible on most ranges.

P459. Zener Diode Tester

Description

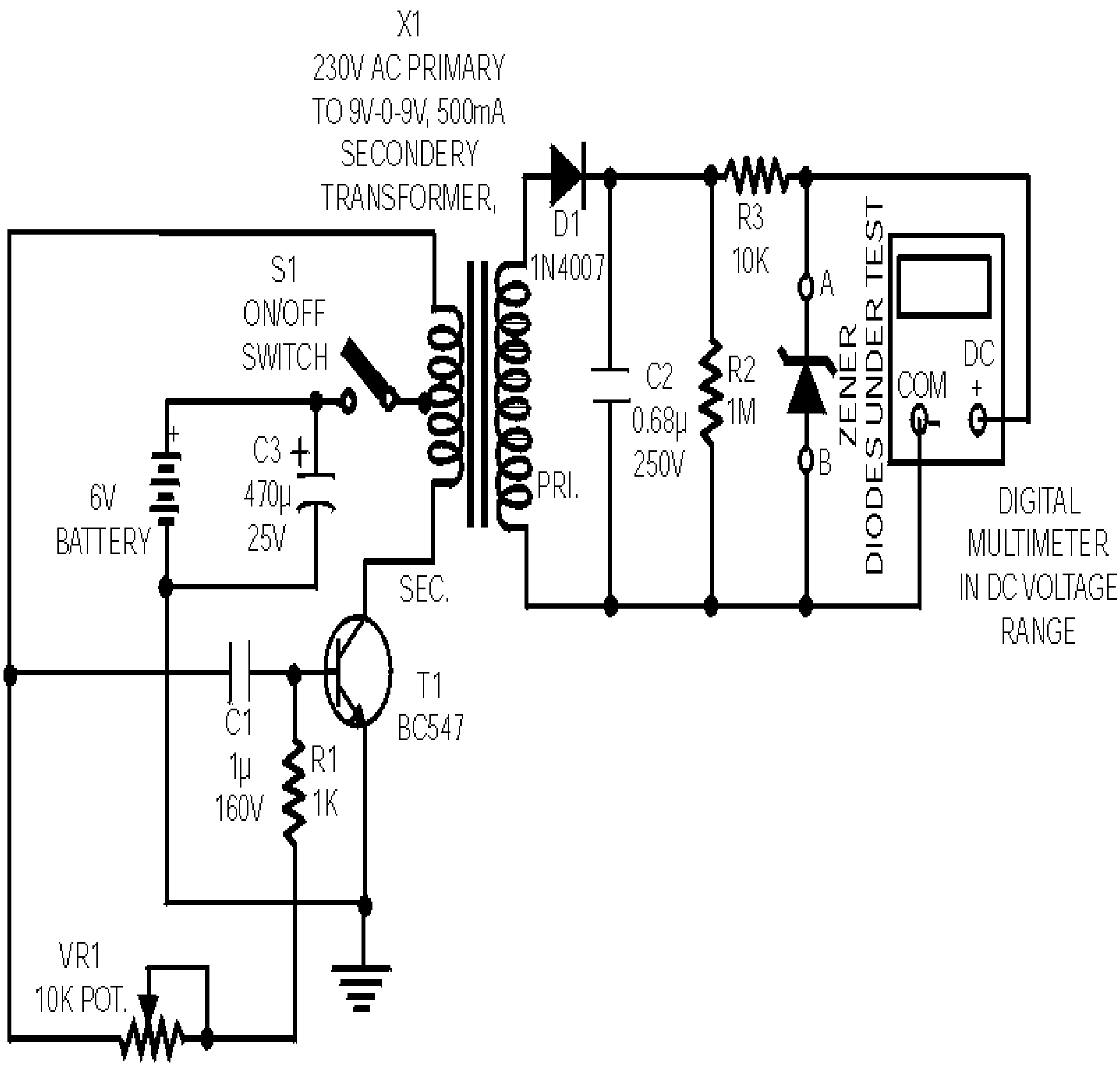
I have teamed up with Magazine Mikro Elektronica for this project. Please visit their site. I am very grateful to Aleksandar Dakic for the kind translation into Serbian and Romanian languages.



Notes

Using a single 555 Timer IC and a small transformer to generate a high voltage, this circuit will test zener diodes of voltage ratings up to 50VDC. The 555 timer is used in the astable mode, the output at pin3 drives a small audio transformer such as the LT700. This has a primary impedance of 1K and a secondary impedance of 8 ohms. Used in reverse the unloaded ac voltage is around 120volts ac. This is rectified by the 1N4004 diode and smoothed by the 2.2u capacitor which MUST be rated at 150 VDC. The zener under test is measured with a multimeter set to DC volts as shown. The load current switch enables the zener to be tested at 1 or 2mA DC. The rectified DC load, but a good zener should maintain the reading on the volt meter.

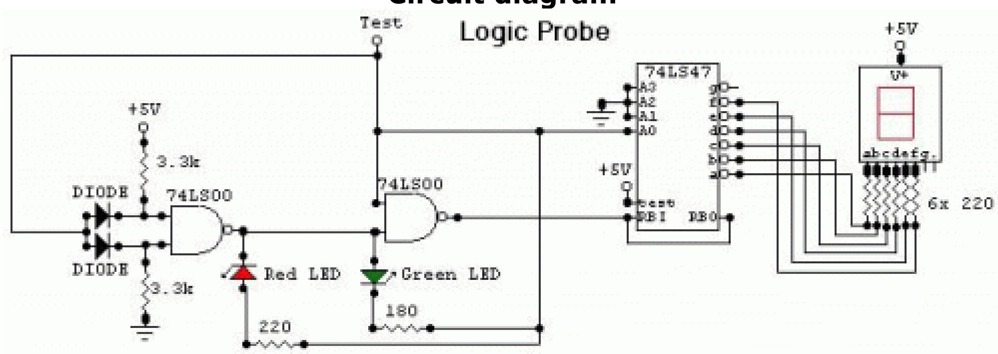
P460. Zener Diode Tester II



Here is a handy zener diode tester which tests zener diodes with breakdown voltages extending up to 120 volts. The main advantage of this circuit is that it works with a voltage as low as 6V DC and consumes less than 8 mA current. The circuit can be fitted in a 9V battery box. Two-third of the box may be used for four 1.5V batteries and the remaining one-third is sufficient for accommodating this circuit. In this circuit a commonly available transformer with 230V AC primary to 9-0-9V, 500mA secondary is used in reverse to achieve higher AC voltage across 230V AC terminals. Transistor T1 (BC547) is configured as an oscillator and driver to obtain required AC voltage across transformer's 230V AC terminals. This AC voltage is converted to DC by diode D1 and filter capacitor C2 and is used to test the zener diodes. R3 is used as a seri- es current limiting resistor. After assembling the circuit, check DC voltage across points A and B without connecting any zener diode. Now switch on S1. The DC voltage across A-B should vary from 10V to 120V by adjusting potmeter VR1 (10k). If every thing is all right, the circuit is ready for use. For testing a zener diode of unknown value, connect it across points A and B with cathode towards A. Adjust potmeter VR1 so as to obtain the maximum DC voltage across A and B. Note down this zener value corresponding to DC voltage reading on the digital multimeter. When testing zener diode of value less than 3.3V, the meter shows less voltage instead of the actual zener value. However, correct reading is obtained for zener diodes of value above 5.8V with a tolerance of ± 10per cent. In case zener diode shorts, the multimeter shows 0 volts.

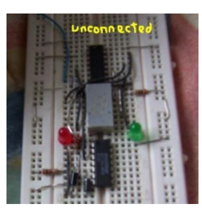
P461. Logic Probe

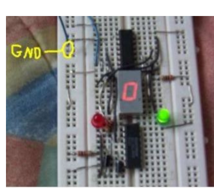
Circuit diagram

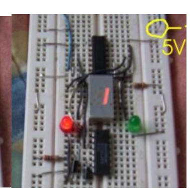


This circuit is a Logic Probe. It indicates the logic state of the node of any TTL logic circuit. To do that, we have to supply the probe with the same power of the circuit that we want to analyse: same Vcc and same GND. To check the logic level, we must connect the "Test" wire of the probe to the desired node of the circuit that we want to check.

If the level is Low, the probe will display a "zero" (0) and only the green LED will be lighted. If the level is High, the probe will display a "one" (1) and only the red LED will be lighted. If the level is Impedance, the probe will display a nothing and no LED will be lighted. The logic level is "Low" when the "Test" wire is connected to the ground of the circuit (the voltage is between 0V and 2V). The logic level is "Impedance" when the "Test" wire is unconnected (it has no voltage or the voltage is between 2V and 3V). The logic level is "High" when the "Test" wire is connected to the positive supply of the circuit (the voltage is between 3V and 5V).

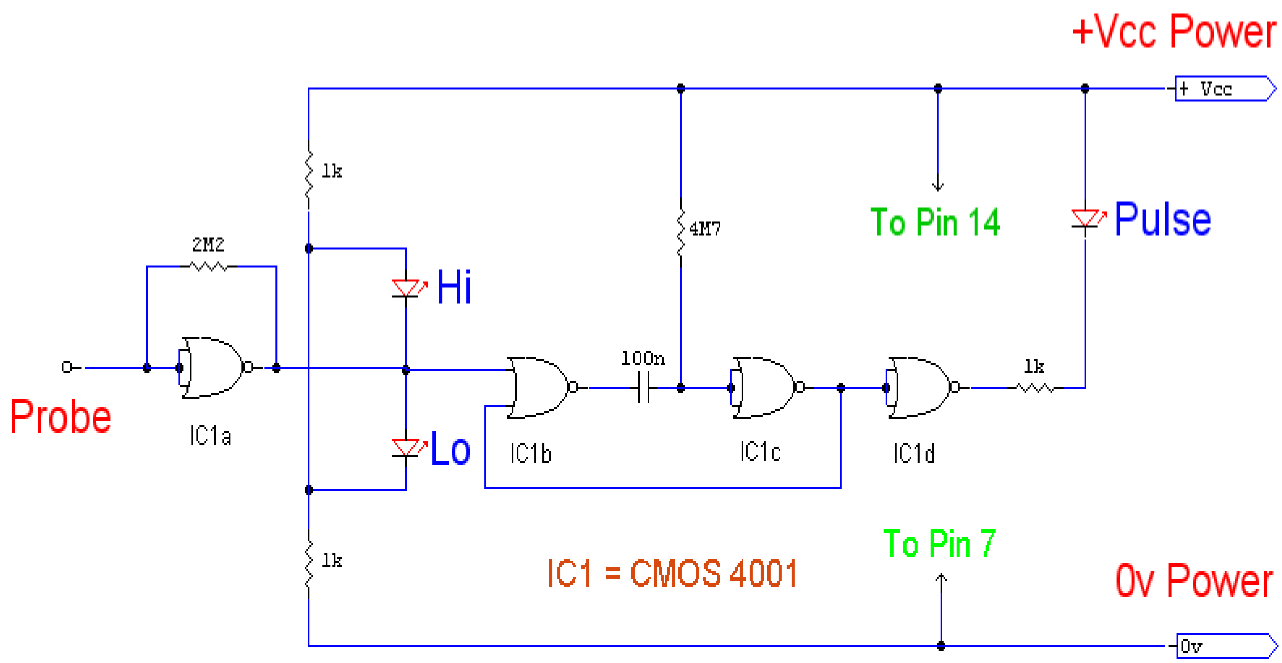






P462. **Logic Probe II**

Description:
A single CMOS 4011 IC makes this handy logic probe. Displays high, low and pulsing outputs.

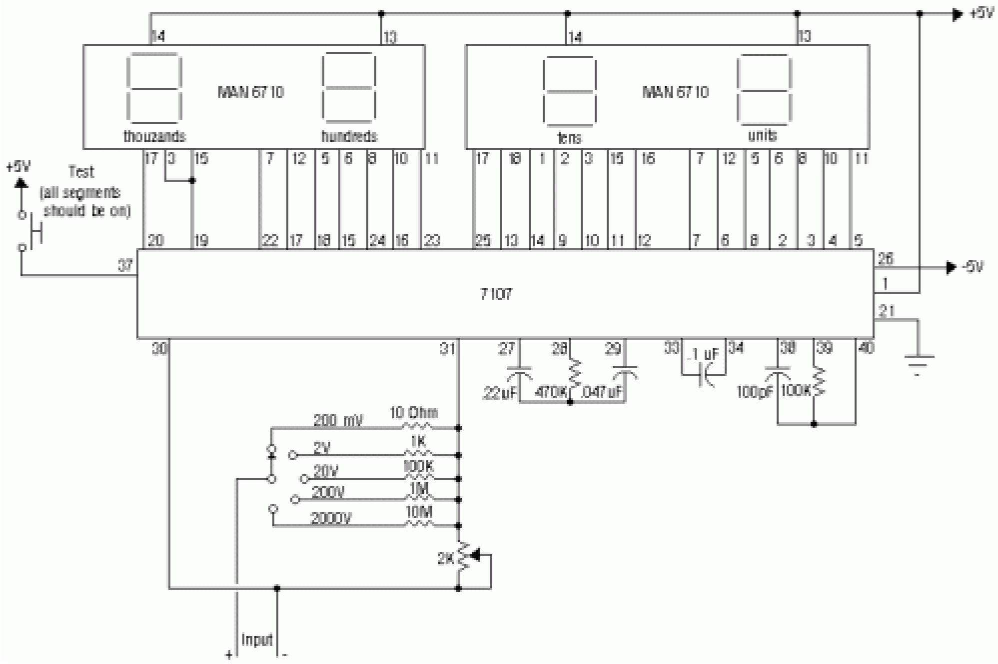


Notes

This logic probe uses a single CMOS IC and shows three logic conditions, High, Low and Pulsing. In addition if the probe input is neither hi or low (the high impedance state of tri-output logic ic's) then no LED's will light. Power from the logic probe is taken from the logic circuit under test; using a CMOS IC enables logic circuits to be tested using voltages from 3 to 15 volts. IC1a is arranged as a buffer with a difference. Under no input, i.e. probe not connected to circuit the gate will oscillate due to feedback from the 2M2 resistor. Output voltage at IC1a is approximately half supply voltage. The Hi and Lo logic indicator LED's are also connected to a potential divider consisting of the two 1k resistors. Voltage at the junction is half supply voltage hence with no input , or high impedance no LED's will light. A Hi or Lo logic condition will cause IC1a to rest in a permanent state indicated by either the Hi or Lo LED illuminating. With a fast oscillator or clock signal both Hi and Lo LED's will light but will be quite dim. This is the reason for IC1b and IC1c. These two gates form a monostable oscillator, time constant determined by the 100n capacitor and 4M7 resistor. With a clock signal this is effectively slowed as the monostable is continually triggered and retriggered. IC1d acts as a buffer to drive the pulsing LED.

P463. Digital Voltmeter

Circuit diagram

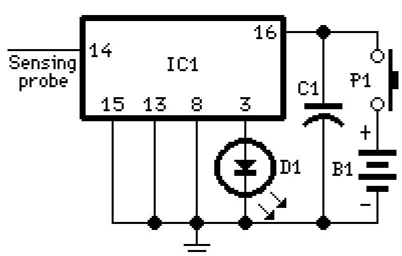


The ICL7107 is a 3 1/2 digit LED A/D convertor. It contains an internal voltage reference, high isolation analog switches, sequential control logic, and the display drivers. The auto-zero adjust ensures zero reading for 0 volts input.

P464. Live-line Detector

Detects the presence of a live mains conductor
Minimum parts counting

Circuit diagram



Parts:
C1 100nF 63V Polyester or Ceramic Capacitor
D1 Red LED (any type)
IC1 4017 Decade counter with 10 decoded outputs IC
P1 SPST Pushbutton
B1 3V Battery (two 1.5V AA or AAA cells in series etc.)
Sensing probe__3 to 15 cm. long, stiff insulated piece of wire

Circuit operation:

If the unit is brought close to a live conductor (insulated, and even buried in plaster) capacitive coupling between the live conductor and the probe clocks the counter, and causes the LED to flash 5 times per second, because the 4017 IC divides the mains 50Hz frequency by 10.

When remote from a live line, the unit stops counting, the LED resulting permanently off.

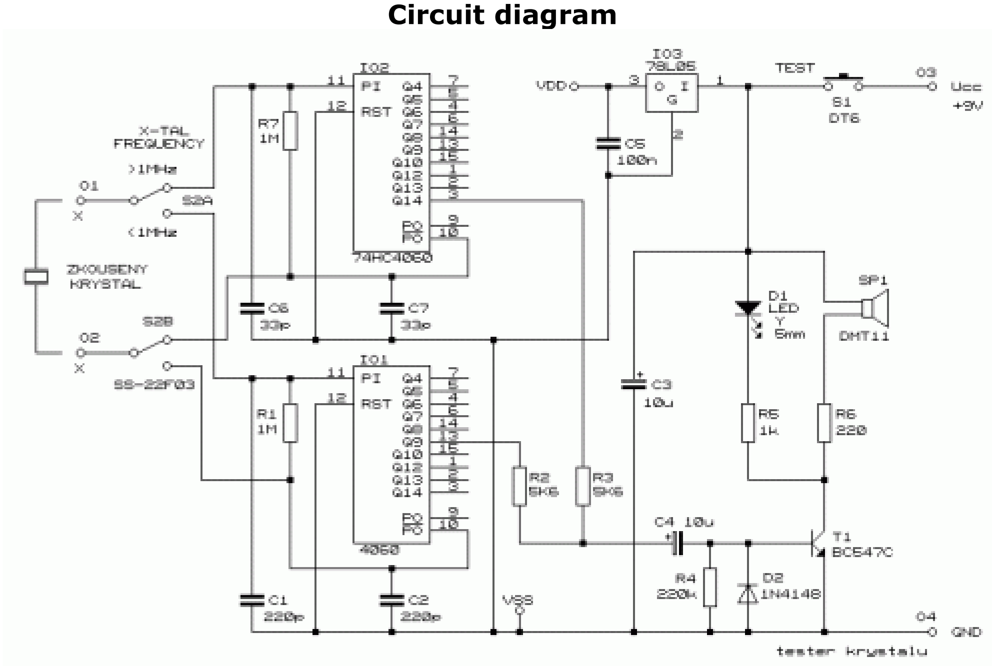
Notes:

Sensitivity can be varied using a more or less long sensing probe.
Due to 3V operation, the LED's current limiting resistor can be omitted.

P465. Crystal Tester

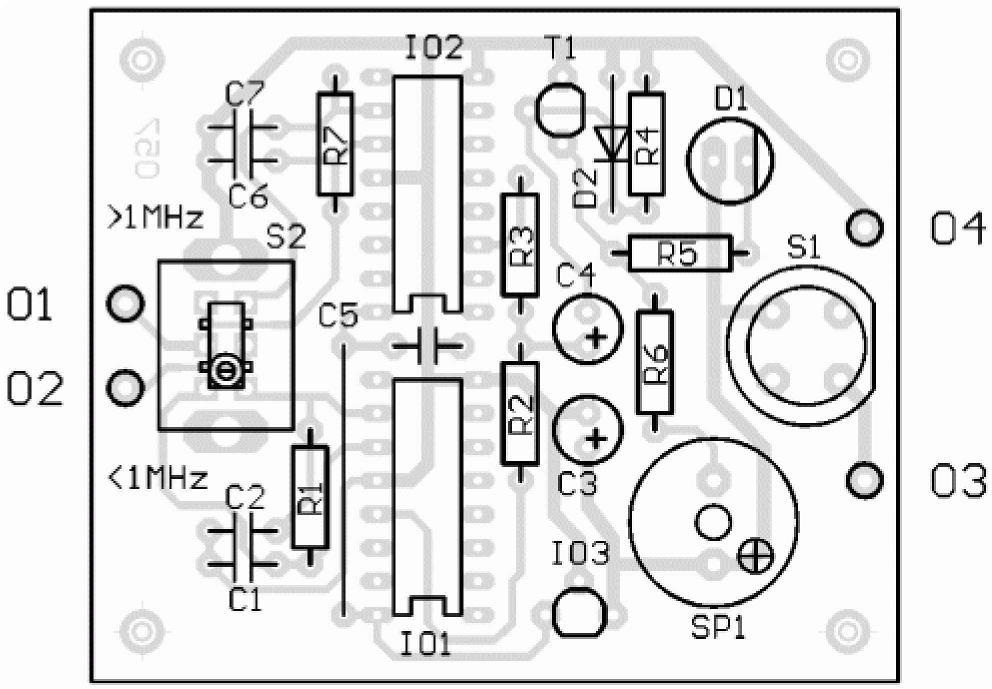
This circuit enables you to test quartz resonators at the range values from 32kHz to 24MHz. Confirmation of good state of quartz resonator is done by diode signalling LED and acoustic signal. Switch S2 enables change of range .

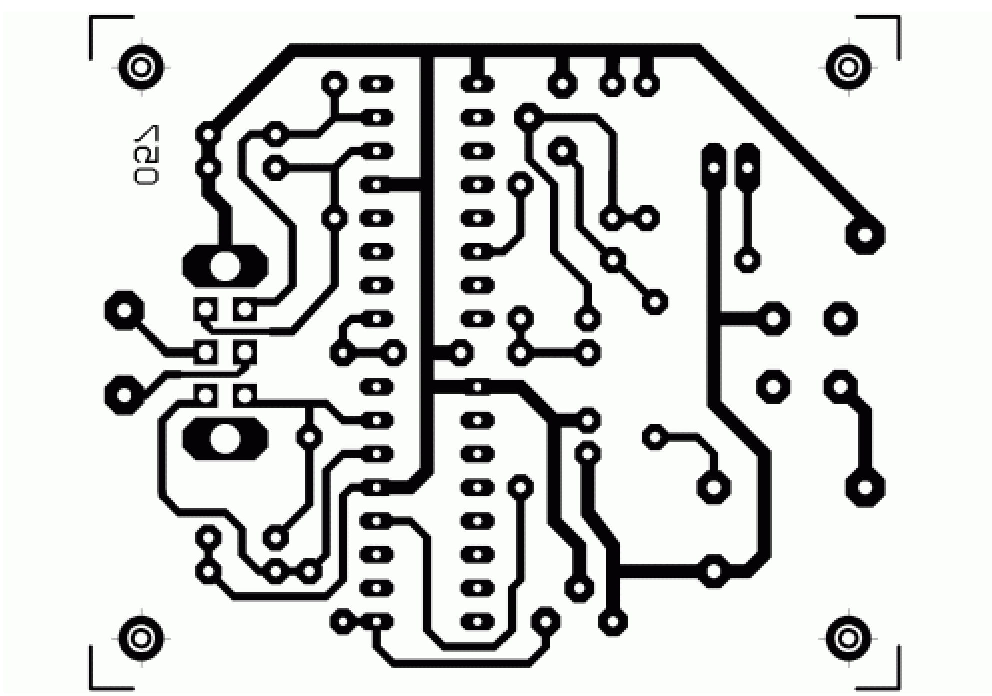
Circuit diagram



Parts
R1,R7 1 M
R2,R3 5,6 k
R4 220 K
R5 1 k
R6 220
C1,C2 220 pF
C3,C4 10 F/25V RSM
C5 100 nF
C6,C7 33 pF

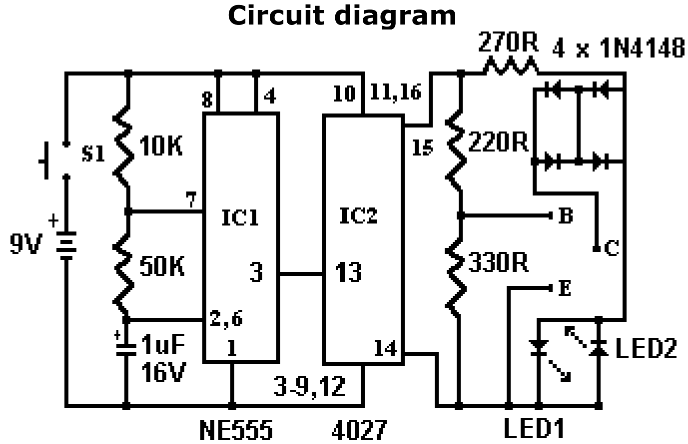
D1 LED 5 mm, yellow
D2 1N4148
T1 BC547C
IO1 4060
IO2 74HC4060
IO3 78L05
S1 push button (normally open)
S2 Two-positional switch





P466. Transistor Tester

Circuit diagram

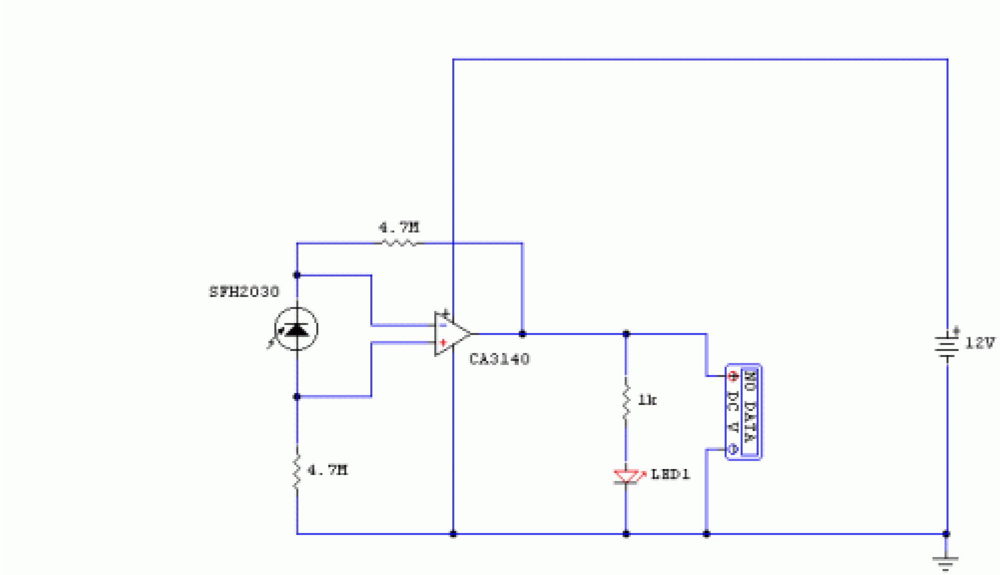


This simple circuit has helped me out on many occasions. It is able to check transistors, in the circuit, down to 40 ohms across the collector-base or base-emitter junctions. It can also check the output power transistors on amplifier circuits.

Circuit operation is as follows. The 555 timer (IC1) is set up as a 12hz multi vibrator. The output on pin 3 drives the 4027 flip-flop (IC2). This flip-flop divides the input frequency by two and delivers complementary voltage outputs to pin 15 and 14. The outputs are connected to LED1 and LED2 through the current limiting resistor R3. The LED's are arranged so that when the polarity across the circuit is one way only one LED will light and when the polarity reverses the other LED will light, therefore when no transistor is connected to the tester the LED's will alternately flash. The IC2 outputs are also connected to resistors R4 and R5 with the junction of these two resistors connected to the base of the transistor being tested. With a good transistor connected to the tester, the transistor will turn on and produce a short across the LED pair. If a good NPN transistor is connected then LED1 will flash by itself and if a good PNP transistor is connected then LED2 will flash by itself. If the transistor is open both LED's will flash and if the transistor is shorted then neither LED will flash.

P467. IR Remote Control Tester

Circuit diagram



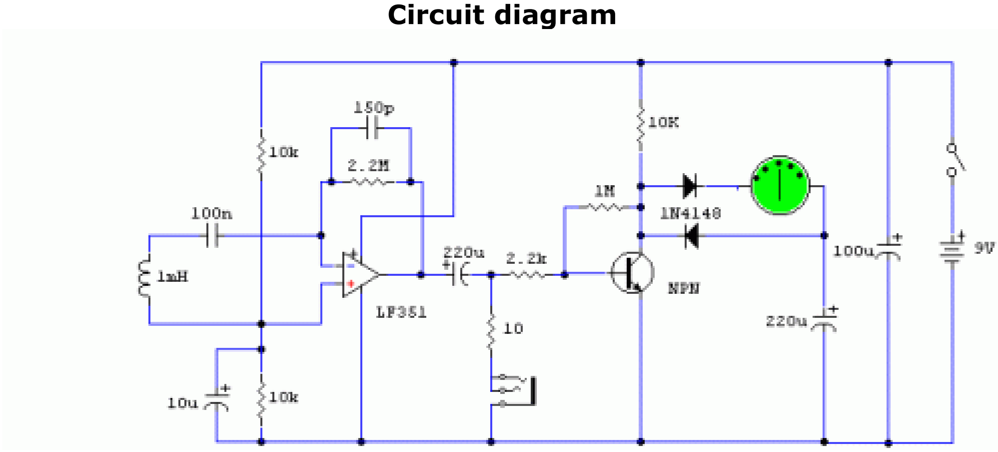
Notes:

As I was developing my IR Extender Circuit, I needed to find a way of measuring the relative intensities of different Infra red light sources. This circuit is the result of my research. I have used a photodiode, SFH2030 as an infra red sensor. A MOSFET opamp, CA3140 is used in the differential mode to amplify the pulses of current from the photodiode. LED1 is an ordinary coloured led which will light when IR radiation is being received. The output of the opamp, pin 6 may be connected to a multimeter set to read DC volts.

Infra red remote control strengths can be compared by the meter reading, the higher the reading, the stronger the infra red light. I aimed different remote control at the sensor from about 1 meter away when comparing results. For every microamp of current through the photodiode, about 1 volt is produced at the output. A 741 or LF351 will not work in this circuit. Although I have used a 12 volt power supply, a 9 volt battery will also work here.

P468. Electromagnetic field detector

Circuit diagram



Description:

This lovely circuit is a real gem! Easy to assemble and more sensitive than many commercial devices available. It's based around an LF351 low-noise operational amplifier and a 1mF choke acting as the sensor. Unlike most other simple EMF detectors, this one has a meter output for accurate reading, but alternatively, you can also roughly estimate the frequency of the field by plugging in headphones. It can detect any field from 50Hz to 100kHz, making it highly versatile and a worthwhile addition to any hobbyist's workbench.

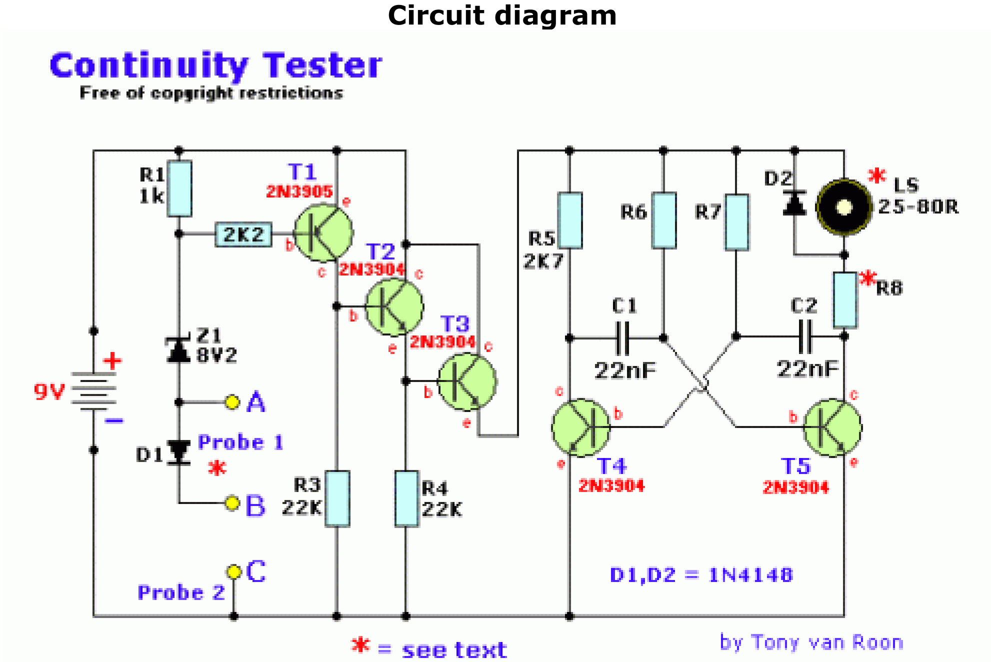
Problems:
I just couldn't find any.

Possible uses:
Find out how far electromagnetic fields extend in your room, house, office...

Are you a ghost hunter? Then this is the circuit that you've been waiting for! Since it has been observed that appearance of a ghost tends to disturb the EMF, you can now detect any such changes with this little detector.

P469. Continuity Tester

Circuit diagram



Parts
R1 1K
R2 2K2
R3,R4 22K
R5 2K7
R6,R7 56K
R8 *See text
C1,C2 22nF
D1,D2 1N4148
Z1 8V2, 1/4 watt
T1 2N3905 (PNP)

T2,3,4,5 2N3904 (NPN)
9volt Alkaline battery
suitable loudspeaker
housing & probes

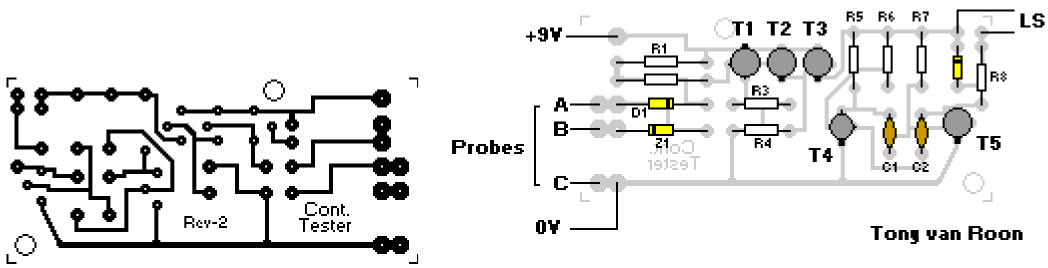
An on-off switch is unnecessary. D1 is used when the battery is brand-new and giving over the nominal 9volt, T1, T2 and T3 acting as the switch for supplying power to the multivibrator.

Design Considerations:

Several simple circuits were tried -- a lamp, battery and probes still demanded the attention of the eyes; replacing the lamp with a buzzer was more successful but needed some three to four volts and gave no indication of a series semiconductor junction if the polarity was correct while the current flow was large enough to damage the more delicate devices within the circuit under test. An extension of the principle to operate an astable (multivibrator) type of oscillator gave good audibility but would operate from zero through to several thousands of ohms and so was too general an indication.

A set of specification was becoming apparent; (1) probe current to be small; (2) probe voltage to be as low as possible, preferable less than 0.3V to avoid seeing germanium or silicon junctions as a continuous circuit; (3) no on/off switch to be used.

The above circuit was the result and several have been designed and are earning their keep for both "heavy" electricians and electronic technicians.



The pcb pattern above is shown full-size at 73mm x 33mm (2-7/8" x 1-1/4")

How it works:

Starting with a 9 volt supply, when the probes are shortcircuited there is a 8.2 volt drop accross the zener diode Z1 leaving a maximum of 0.8 volt across R1. Aplication of Ohms' Law shows that a maximum current of 0.8/1,000 = 0.8 mA lows via the probes and this satisfies the first design requirement of low probe current.

T1 is a silicon type and the bse-emitter voltage will need to be about 0.5 to 0.6 volt to forward-bias the junction and initiated collector current. With a maximum of 0.8 volt availabe across R1 it is seen that if a semiconductor junction or resistor is included in the outside circuit under test and drops only 0.3 volt then there will be 0.5 volt remaining across R1, barely enough to bias T1 into conduction.

Assuming that the probes are joined by nearly zero resistance, the pd across R1 is 0.7 - 0.8 volt and T1 turns on, its collector voltage rising positively to give nearly 9 volt across R3. T2 is an emitter follower and its emitter thus rises to about 8.3 volt and this base voltage on T3 (a series regulator circuit or another emitter-follower if you prefer it) results in some 7.7 volt being placed across the T4 - T5 oscillator circuit. All the transistors are silicon types and unless the probes are joined, the only leakage current flows from the battery thus avoiding the need for an On-Off switch. When not in use, the battery in the tester should have a life in excess of a year. My own unit lasted for more than 2 years with one Alkaline battery.

Descriptive Notes:

The output from the speaker is not loud but is more than adequate for the purpose. I used a small transistor radio loudspeaker with an impedance of 25 - 80 Ohms. The resistance should be brought up to 300 ohms by adding series resistor R8. Example, if your speaker is 58 ohms, then R8 = 242 ohms.

An experiment worth doing is to select the value of either C1 or C2 to produce a frequency oscillation that coinsides with the mechanical resonant frequency of the particular loudspeaker in use. Having choosen the right value, which probably lies in the range of 10n - 100n, the tone will be louder and more earpiercing. A "freewheel" diode D2 is connected across the transducer since fast switching sction of the oscillator circuit can produce a surprisingly high back e.m.f. across the coil and these high voltages might other wise lead to transistor damage of breakdown.

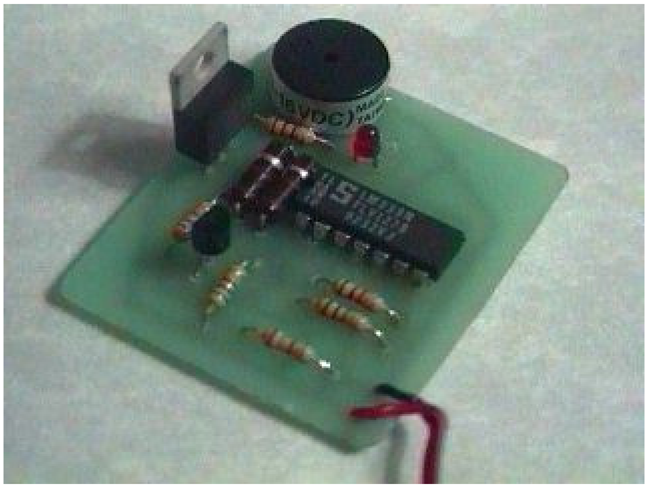
Zener diodes do not provide an absolutely constandt volt-drop regardless of current; at the 0.8 mA design current an 8.2 volt diode will quite possibly give only about 8.0 volt drop since test current for zener selection and marking is typically 5 mA or more. A further possible source of error is the battery; the one suggested nominally provides 9V but a brandnew one may be as much as 9.5 to 9.8V until slightly run-down and this "surplus" voltage, combined with an "under-voltage" znere volt-drop will leave considerably more than the forecast voltage available at the probes. A silicon diode D1 is therefore connected in series with the zener to decrease the probe voltage by a further 0.6 volt or so.

During your final testing and before boxing your circuit, the most suitable connection, A or B, is selected for the positive probe wire. The aim is to have the circuit oscillating with short circuited probes but to stop oscillation with the least amount of resistance or the inclusion of a diode (try both ways) between the probes.

No sensitivity control is fitted because I don't think it is worthwhile nor necessary and would spoil the simplicity of the circuit.

There is no easy way to proof the unit against connection to the supply. Be careful if checking AC line wiring and switch off first. In a similar way, if checking electronic apparatus for unwanted bridging between Veroboard tracks, for instance or a suspected crack in a PCB (Printed Circuit Board) track switch off power first also. Good luck!

P470. Discharger for Receiver Battery Packs



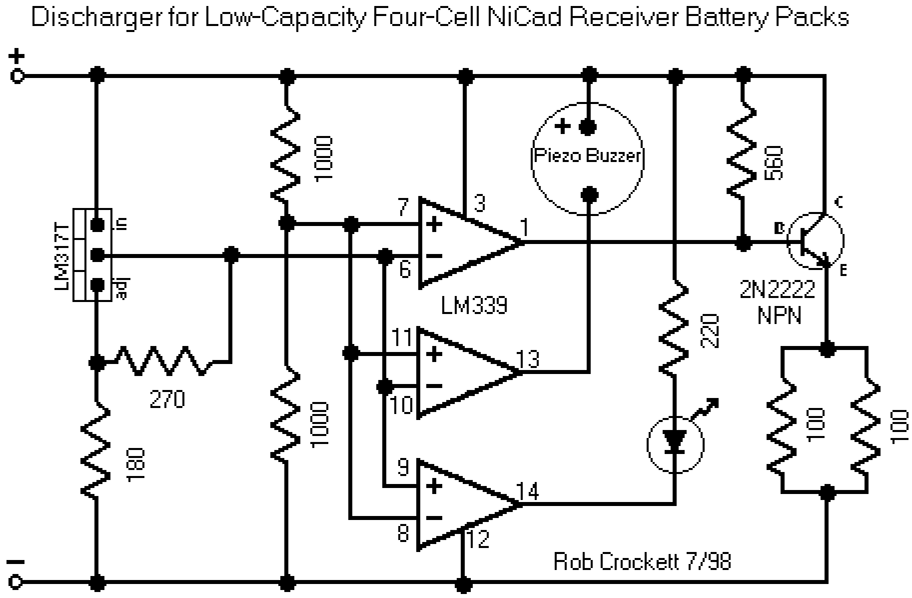
You may have read about cycling NiCad batteries. If not, read a little here (Red's R/C Battery Clinic) for an excellent overview. Overcharging apparently leads to voltage depression, which can be corrected by one or two complete discharges (to 1 to 1.1 volts per cell). On the other hand, over discharging the batteries to a low or zero voltage can damage them, and if the batteries have not been overcharged and have no voltage depression, cycling just uses up regular battery life. I designed and use this discharger occasionally to remove voltage depression and insure battery capacity is still ok for those planes that have no low voltage alarm.

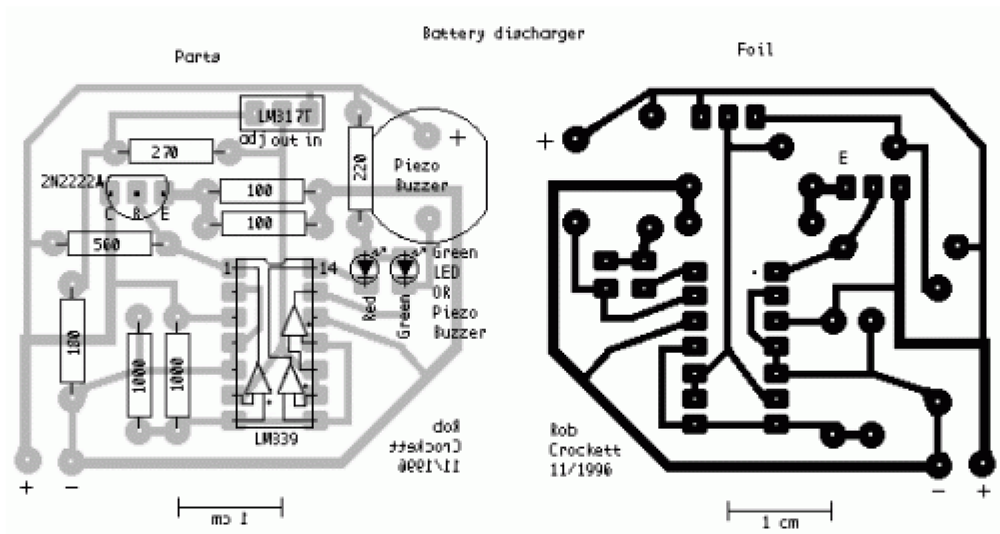
Note that the 100 ohm resistors are 1/2 watt (these are the load resistors), the rest are 1/4 watt. The red LED lights while discharging, buzzer sounds and discharge rate drops to 15-25mA (for the buzzer) when complete. The discharge load is 60mA to 110mA depending on the battery voltage. Since that's about the same current draw as my Hitec receiver and two HS-80's draw while flying handlaunch, I can use discharge time almost directly to indicate flying time. The buzzer uses enough current to keep a 150mA battery down, but when discharging a 600mA battery, the battery recovers quickly when the load is removed--the buzzer/discharger cycles on and off. Threshold voltage of the discharger is set to 4.2 volts. Since the discharger still draws some current when buzzing, try to disconnect the discharger once the alarm sounds--don't leave it going for hours lest the battery be over discharged.

There are a couple ways you could modify the circuit to work with a 5-cell 6-volt receiver battery pack. The two 1k resistors are a divider network, so one way would be to change the resistors to change the sampling voltage at the comparator. The formula for a divider network is Vout=Vin(R2/(R1+R2)) or R1=R2*((Vin/Vout)-1). Here, R1 is the resistor connected to the positive lead and pin 7 of the comparator, Vin is 5.25 volts (1.05 volts per cell discharge shutoff threshold), and Vout is the reference 2.1 volts (the voltage produced by the LM317T and the 180 and 270 ohm resistors). You can use R2 as the same 1k value that was there before. So R1=1000*((5.25/2.1)-1)=1500=1.5k. So swap the top 1k resistor in the schematic for a 1.5k, and the new shutoff voltage for your device will be 5.25 volts.

To increase the discharge rate, decrease the resistance of the load resistors. You could use four 100 ohm resistors in parallel instead of two, for example, and it would discharge twice as fast. Resistance of a number of resistors in parallel is the value of the resistor devided by the number of the resistors. Here, 100 ohms/ four resistors is 25 ohms. At five volts, current is (5 volts)/(25 ohms)=0.2 ampere or 200mA. Be careful not to decrease resistance too much however--the small signal transistor used in this particular circuit is probably only rated for maximum 500 mA.

Circuit diagram





Custom electronics:

I post this design not because I think this is a brilliant piece of circuit design but because the design works, and it can give you a start on your own experimentation. The idea is to use the power available from the discharging battery to monitor the voltage of the battery, shut off discharging at a preset voltage (here 1.05 volts/cell), and sound an alarm when discharging is complete. To do so means a voltage reference powered by the changing voltage of the battery, here the LM317T and the 180 with 270 ohm resistors. You could just as easily use a LM336 (see the low voltage warning buzzer page) or a zener with resistor, or something else as a reference. Since the reference voltage must be below the ambient battery voltage, a pair of 1k resistors provides the divided test voltage. The LM339 is a four way comparator.

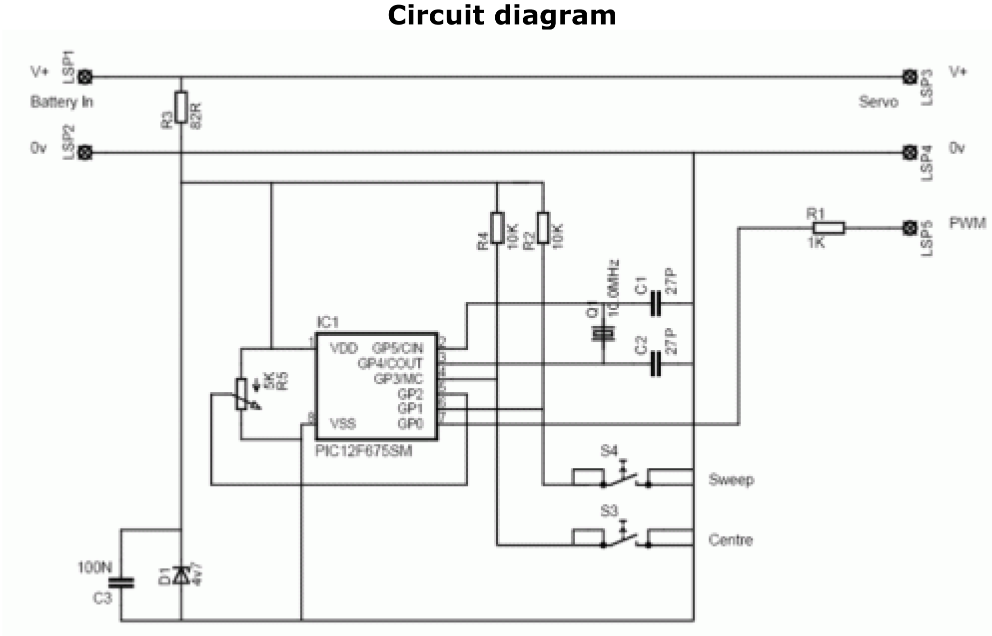
This design uses really three comparators: in addition to the one driving the transistor, a comparator drives the LED and another drives the buzzer. But you could use a single comparator (like the LM311) with the buzzer across the emitter and collector of the transistor, and the LED in series with a 270 ohm resistor across (parallel with) the 100 ohm load resistors. With the transistor conducting, the voltage drop across base and emitter is low, and the buzzer is quiet. The tiny current in a piezo buzzer (7 mA), when the transistor is not conducting, would be divided between the load resistors and the LED, and the LED is dark.

A word about the comparator. The output of the comparator serves as a meager source of current, but can sink current nicely. In other words, the high logic output of the comparator will not drive the base of a NPN transistor as here. The 560 ohm resistor provides the current here for the transistor base--the comparator takes it away when its output drops to ground. Hmmm . . . . so, maybe use a PNP transistor like a 2N3906 instead with emitter to + and collector to load, remove the 560 resistor and connect the base through a 1k resistor to the output of the comparator, then reverse the logic of the comparator by swapping the reference with the test. . . hmmmmm. Could work. Yep . . . works.

Parts:
273-074 Miniature Piezo Buzzer, 12v, PC board mount
271-312 1/4 watt 5% carbon film resistors, 500 pieces (Just do it!)
276-1778 LM317T adjustable voltage regulator
276-1712 Quad comparator LM339
276-1622 LED assortment (20 count)
276-2009 NPN Silicon transistor MPS2222A (2N2222)

P471. Simple Servo Tester

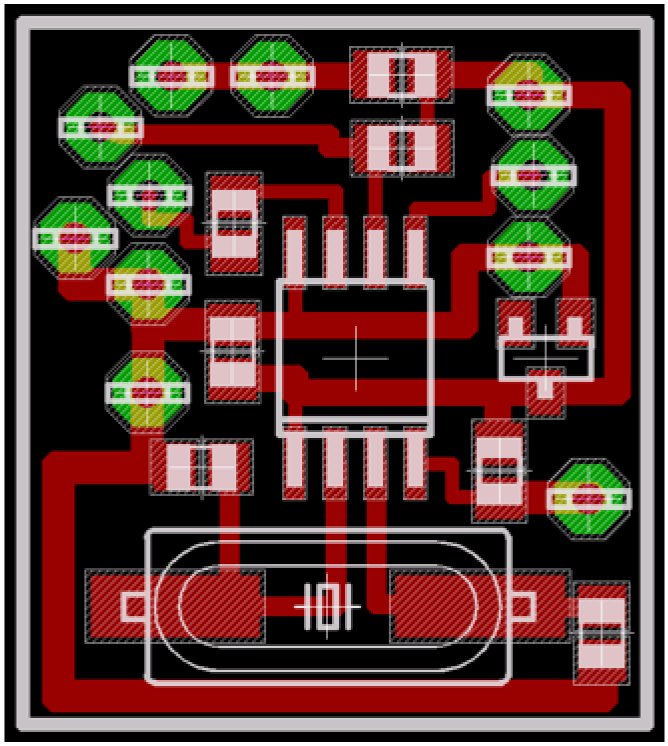
Circuit diagram



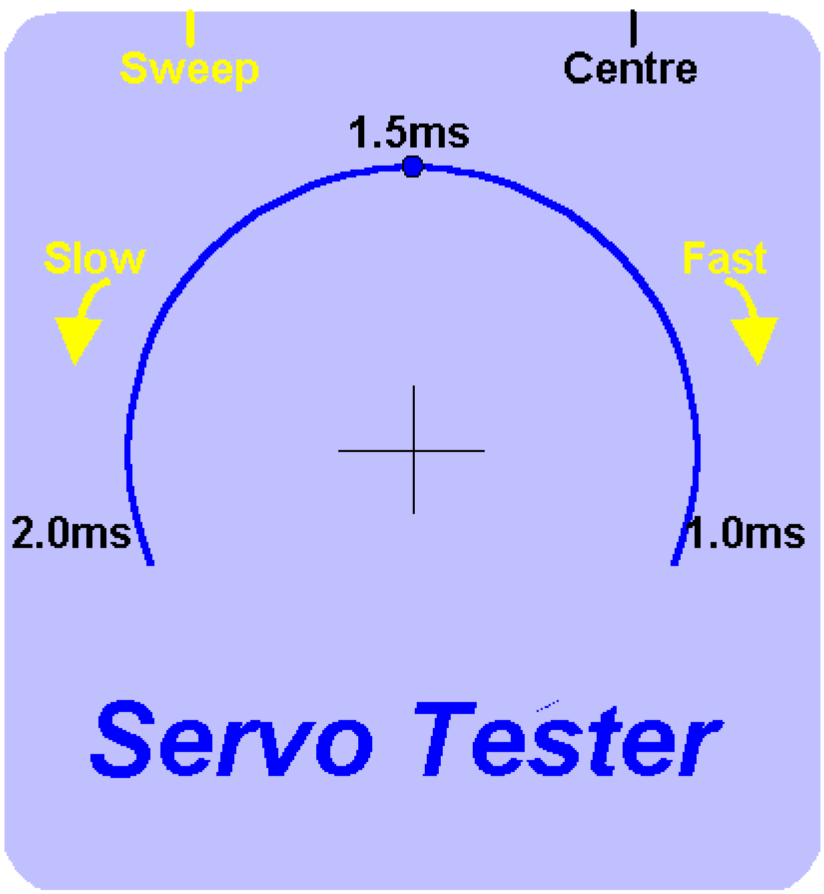
This is a simple servo tester which will comprehensively test the capabilities of almost any modern servo. It has two pushbuttons, CENTRE and SWEEP and a potentiometer which works as follows:

- CENTRE Does exactly that, centers the servo, afterwards the potentiometer determines position. SWEEP Sweeps the servo back and forth at a rate determined by the potentiometer setting.

- The PIC uses its internal timer to set up a constant frame duration of 20ms and the on/off ratio is set by the user.



PCB board

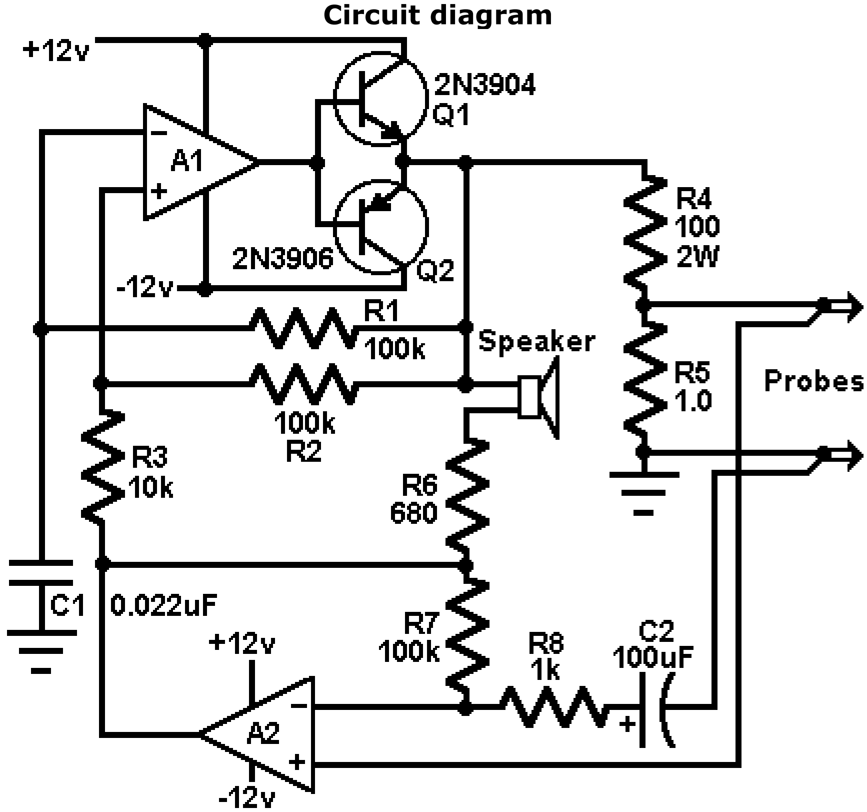


suggested panel decal

Parts
R1 = 1K
R2 = 10K
R3 = 82R
R4 = 10K
R5 = 5K potentiometer
C1 = 27pF
C2 = 27pF
C3 = 100nF
D1 = 4,7V zener diode
Q1 = 10MHz crytal
IC1 = PIC12F675

P472. Beeper to find short circuits

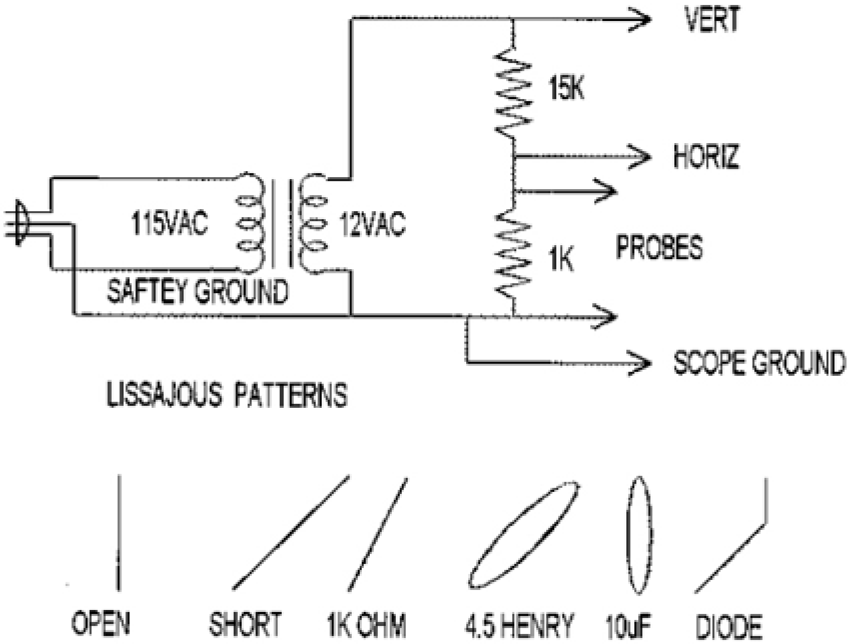
Circuit diagram



This circuit uses two 741s or equivalent op amp to form a beeper that is used to detect short circuits. This design offers a way to trace resistance in the milliohm range, right to a short between bridged traces beneath a solder mask. A1 is configured as a multivibrator. R1 and C1 determine the frequency of oscillation and Q1 and Q2 boost the output. Assuming a virtual ground at the output of A2, free-run frequency is about 1kHz. Q1 and Q2 deliver a +/-10v squarewave to R4, dumping a +/-100mA through a short circuit placed across the probe tips. R5 ensures that the open circuit voltage never exceeds +/-0.1v. A2 monitors the voltage between the probes. When the probes are open, A2's gain equals the R4/R5 divider loss, and the output of both amplifiers is identical. This has two effects: First, hysteresis is greatly increased and frequency falls to a low growl, and secondly, the loudspeaker that bridges the two in-phase outputs is effectively silenced. A dead short across the probe tips will return nothing to A2 and the circuit will squeal at its nominal 1kHz rate. Anything less than a perfect short produces some output from A2, increasing multivibrator hysteresis and lowering the pitch.

P473. Oscilloscope testing module (huntron circuit)

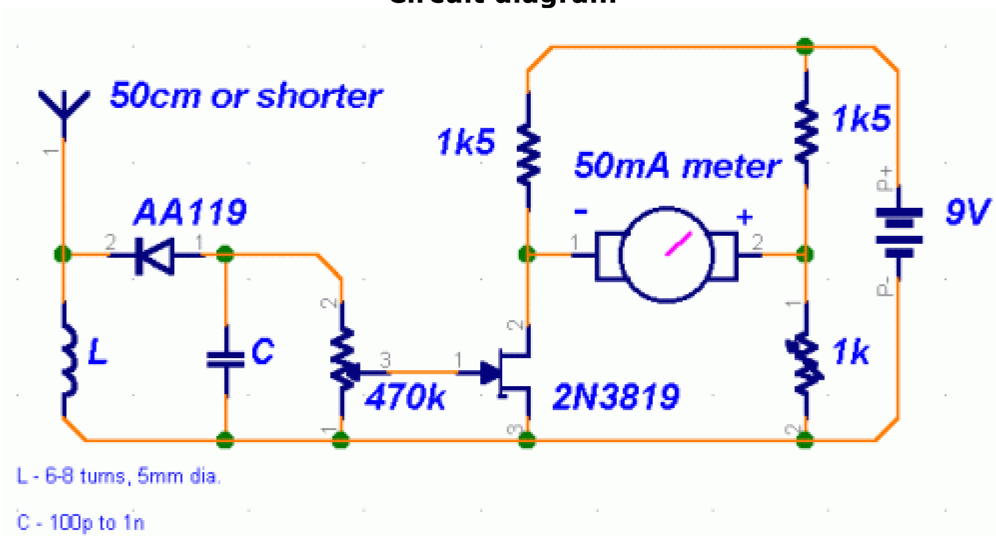
Circuit diagram



I call this the "huntron circuit" because a company by that name made a similar device. It is useful for trouble-shooting. I used it with digital PC boards where I did not have a schematic, or even know how it worked. I recorded the patterns found on a good board and compared them with the patterns from a defective board. Any low power 12 volt transformer will work, the resistors are ¼ watt.

P474. Field-strength meter

Circuit diagram



Original source:

I saw this circuit in an old issue of "73 Radio Electronics". I built it, but it didn't work well, so I changed a few components to get better sensitivity.

Description:

This is a very straightforward circuit. The first stage acts as a crystal receiver. Use a germanium detector diode (like 1N34, but AA119 is much more common in Europe), a silicon one won't do. The frequency is determined by L and C. For the FM band and VHF, wind a coil 5mm in diameter, 6-8 turns of coated wire 1mm thick. You can always vary the frequency by spacing the turns a bit looser or tighter. C is much less critical. Something around 100p is preferable, though.

The second stage is based around the versatile 2N3819 JFET high-impedance amplifier. With the 470k potentiometer you can adjust sensitivity of the circuit. The trimmer is used to zero the meter. Use any old 50mA or slightly smaller ammeter from the junk box.

Problems:

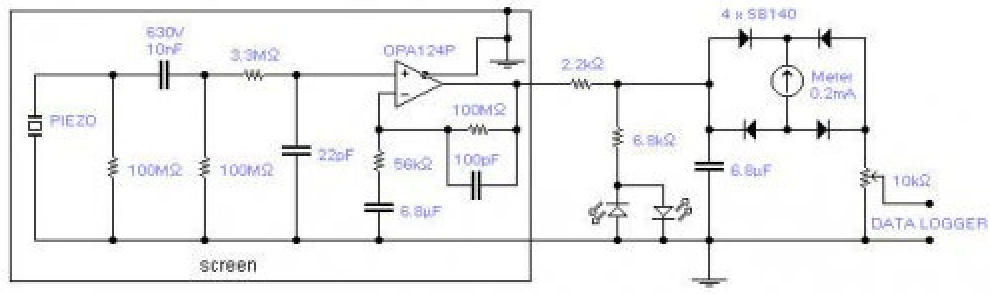
You can't expect great performance from such a simple detector-based meter. Sensitivity is just adequate enough to get a basic idea of the power that your transmitter is capable of.

Possible uses:

Use the field-strength meter to find out when a transmitter is operating at optimal power. It can be very handy when aligning stages (like in case of the 4W transmitter) or experimenting with different antennas.

P475. Seismic detector

Circuit diagram

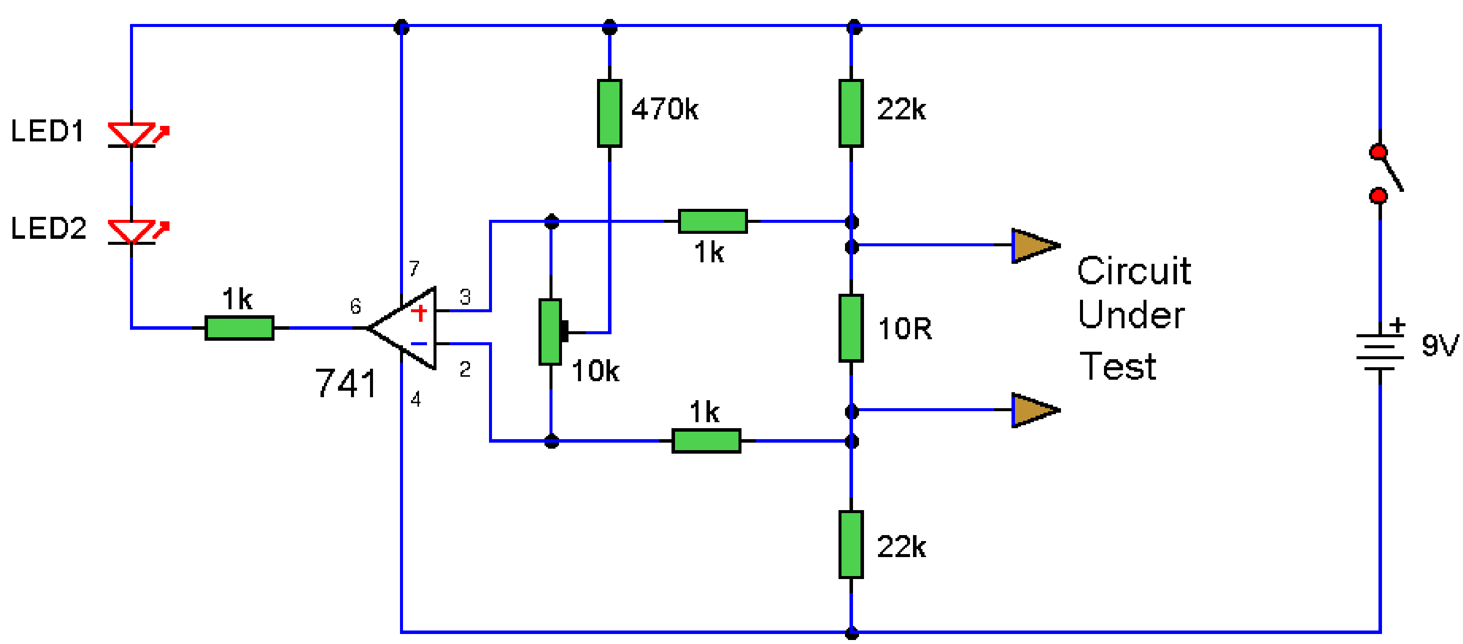


The piezoelectric element of a kitchen gas lighter is used in this simple, yet effective seismic detector. The piezo element must be placed vertically, one end solidly to ground. A 2-3 pound weight of fine gravel in a loose package should be placed on top at the other end. The high voltage lead goes to the IC, placed close to the piezo element. The whole box is acoustically and electromagnetically screened. A 3 core shielded cable brings the signal to the rest of the circuit and to the power supply (+/- 15V). The SB140 diodes are Schottky type and pin 8 (substrate) of the IC should be connected to ground.

P476. Connection Tester

Description

A low resistance (0.25 - 4 ohm) continuity tester for checking soldered joints and connections.



Notes

This simple circuit uses a 741 op-amp in differential mode as a continuity tester. The voltage difference between the non-inverting and inverting inputs is amplified by the full open loop gain of the op-amp. Ignore the 470k and the 10k control for the moment, and look at the input of the op-amp. If the resistors were perfectly matched, then the voltage difference would be zero and output zero. However the use of the 470k and 10k control allows a small potential difference to be applied across the op-amp inputs and upset the balance of the circuit. This is amplified causing the op-amp output to swing to full supply voltage and light the LED's.

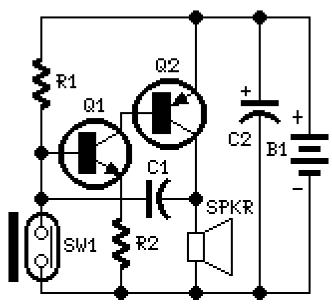
Setting Up and Testing

The probes should first be connected to a resistor of value between 0.22 ohm and 4ohm. The control is adjusted until the LED's just light with the resistance across the probes. The resistor should then be removed and probes short circuited, the LED's should go out. As the low resistance value is extremely low, it is important that the probes, (whether crocodile clips or needles etc) be kept clean, otherwise dirt can increase contact resistance and cause the circuit to mis-operate. The circuit should also work with a MOSFET type op-amp such as CA3130, CA3140, and JFET types, e.g. LF351. If the lED's will not extinguish then a 10k preset should be wired across the offset null terminals, pins 1 and 5, the wiper of the control being connected to the negative battery terminal.

P477. Field-strength meter II

Small, portable, anti-bag-snatching unit
Also suitable for doors and windows control

Circuit diagram



Parts:
R1 330K 1/4W Resistor
R2 100R 1/4W Resistor
C1 10nF 63V Polyester or Ceramic Capacitor
C2 100µF 25V Electrolytic Capacitor
Q1 BC547 45V 100mA NPN Transistor
Q2 BC327 45V 800mA PNP Transistor
SW1 Reed Switch and small magnet (See Notes)
SPKR 8 Ohm Loudspeaker (See Notes)
B1 3V Battery (two A or AA cells wired in series etc.)

Device purpose:

This circuit, enclosed in a small plastic box, can be placed into a bag or handbag. A small magnet is placed close to the reed switch and connected to the hand or the clothes of the person carrying the bag by means of a tiny cord.

If the bag is snatched abruptly, the magnet looses its contact with the reed switch, SW1 opens, the circuit starts oscillating and the loudspeaker emits a loud alarm sound.

The device can be reverse connected, i.e. the box can be placed in a pocket and the cord connected to the bag.

This device can be very useful in signalling the opening of a door or window: place the box on the frame and the magnet on the movable part in a way that magnet and reed switch are very close when the door or window is closed.

Circuit operation:
A complementary transistor-pair is wired as a high efficiency oscillator, directly driving a small loudspeaker. Low part-count and 3V battery supply enable a very compact construction.

Notes:
The loudspeaker can be any type, its dimensions are limited only by the box that will contain it.
An on-off switch is unnecessary because the stand-by current drawing is less than 20µA.
Current consumption when the alarm is sounding is about 100mA.

If the circuit is used as anti-bag-snatching, SW1 can be replaced by a 3.5mm mono Jack socket and the magnet by a 3.5mm. mono Jack plug with its internal leads shorted. The Jack plug will be connected with the tiny cord etc.

Do not supply this circuit with voltages exceeding 4.5V: it will not work and Q2 could be damaged. In any case a 3V supply is the best compromise.

P478. Latching Continuity Tester

"This Latching Continuity Tester can help you locate those difficult-to-find intermittent short and opens that other testers always seem to miss. It has been part of my workbench for many years and performs superb. I have solved many intermittend problem with this highly flexible unit."

Latching Continuity TesterA continuity tester is a must on every service bench for testing cables, pcboards, switches, motors, plugs, jacks, relays, and many other kinds of components. But there are times when a simple continuity test doesn't tell the whole story. For example, vibration-induced problems in automobile wiring can be extremely difficult to detect because a short or open is not maintained long enough for a non-latching tester to respond.

This latching continuity tester detects intermittent (and steady state) opens and shorts. The tester will detect and latch on an intermittent condition with a duration of less than a millisecond. In addition, it provides both visual and (defeatable) audio indicators, uses only one inexpensive and easy-to-find IC, and can be built from all new parts for about $35, or less if you have a well-stocked junkbox.

Circuit Elements:

Schmitt Trigger The heart of the circuit is a 4093 quad tow-input NAND Schmitt trigger, one gate of which is shown in Fig. 1-a. The gate functions as shown in Fig. 1-b. Nothing happens until the enable input goes high. When that happens, the output responds to the input as follows.

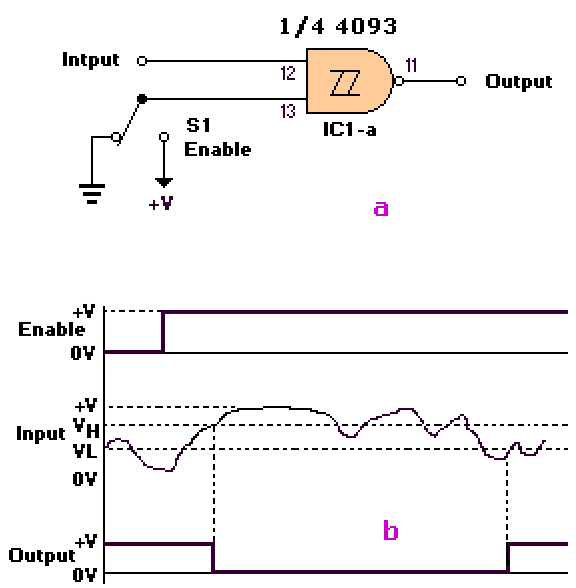


Fig. 1 -- A Schmitt Trigger (a) is insensitive to input signals between V_H and V_L (b). The output changes state only when the enable input is high.

As long as the input voltage stays between VH and VL, the output stays high. But when the input goes above VH, the output goes low. The output will not go high again until the input goes below VL. That characteristic is what gives the Schmitt trigger its ability to "square-up" a slowly changing input signal. The Schmitt trigger is ideally suited for our application because it is not dependent on edge triggering, and because both slow and fast signals trigger it when either threshold is exceeded.

We use two gates of the 4093 as a combination detector and latch. The gates are cross connected to form an SR (Set-Reset) flip-flop. When pin 12 goes low, pin 11 will go high. That high may be used to enable an LED or other indicator. Switch S1 is used to select whether the tester will provide ouput when it detects an open or a short. In the OPEN position, pin 12 is held low, so the output of the gate is normally high. When the test leads are connected across a short, pin 12 is pulled high, so the output drops low. The circuit works in the converse manner when S1 is in the CLOSED position.

As shown in Fig. 2-a, we use another Schmitt trigger to build a gated astable oscillator. A gated astable oscillator produces output as long as the GATE input is high. Fig. 2-b shows the waveforms that are present at various points in the circuit. When the pin-8 input goes high, pin 10 goes low, and C1 starts discharging through R1. When VC falls below VL, the output of the gate goes high, so C1 starts charging through R1. When VC exceeds VH, the output again drops low. Oscillation continues in that way as long as the gate input remains high. The frequency of oscillation is given by a fairly complex equation that can be simplified, for purposes of approximation, as F = 1 / R1C1.

Putting it all together:

The complete circuit is shown in Fig. 3. In that circuit, IC1-a and IC1-b funtion as the flip-flop/detector. The output of IC1-a is routed through S4, AUDIO. When that switch is closed, IC1-d is enabled and an audio tone will be output by BZ1. The frequency of that tone can vary from 1000Hz to well above the audio range (100KHz), according to the setting of R4. In addition, R4 varies frequency and volume simultaneously, so you can set it for the combination that pleases you best. Originally we used a PM (Permanent Magnet) speaker. Whe the detector has not been tripped, the full power-supply voltage is across the buzzer, but no current is drawn. The reason is that the piezo element is like a capacitor and does not conduct DC current. Whe the circuit is oscillating, the buzzer consumes a current of only about 0.5 milliamp. The output of the flip-flop/detector circuit also drives IC1-c. If S2 is in the AUTO position, the output of IC1-c will automatically reset the flip-flop after a period of two to six seconds, depending on the position of R7. If S2 is in the MANUAL position, the LED will remain lit (and the buzzer will continue buzzing, if S4 is on) until maual RESET switch S3 is pressed

Construction:

Astable OscillatorThe circuit may be built on a piece of perforated construction board or Vero-board, or on a PCB. The PCB is designed to take board-mounted switches, which makes a neat package and eliminates a rat's nest.

Referring to Fig. 4, mount and solder the components in this order: diodes, fixed resistors, IC-sockets, capacitors, variable resistors, and then the pcb mounted switches. The regular ones will work too it just means more wire. Mount the buzzer and the LED last as described below. Trimmer potentiometer R7 is manufactured by Piher (903 Feehanville Drive, Mount Prospect, IL 60056); it has a shaft that extends through the panel. If the Piher pot is unavailable, an alternate is available from Digi-Key (701 Brooks Ave South, P.O. Box 677, Thief River Falls, MN 56701). The disadvantage of the alternate is that it has no shaft, so it must be adjusted using a miniature screwdriver.

The circuit board is helf approximately 1/2-inch from the cover by the shafts of the switches. The LED and the buzzer should be inserted in the approproate holes in the pcb now. Then install the top cover, and adjust the height of the LEDso that it protrudes through the top cover. Then solder its leads. Attach the buzzer to the top cover, using silicone rubber adhesive (RTV or double side foam tape.

We mounted a pair of banana jacks on the top of our prototype's case, but you could solder the wires directly to the appropriate points on the circuit board, tie strain reliefs in the wires, and then solder alligator clips to the ends of the wires. However, a set of good leads are really all that expensive and it does give the tester more flexible usage as you have the opportunity to use a variety of different leads to suit your purpose.

The nine-volt battery is secured to the side of the case with a clip or use a holder. Your completed pcb should appear as in Fig. 5.

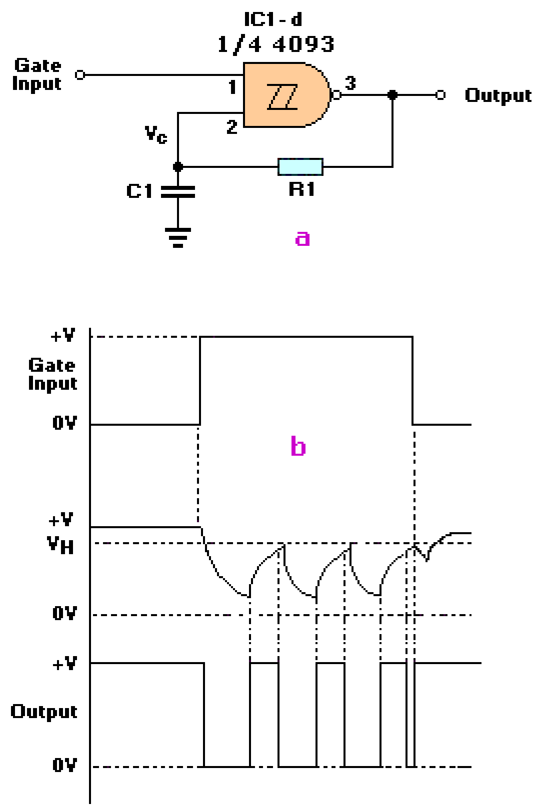


Fig. 2 -- An Astable Oscillator (a) may be built from a single gate, a resistor and a capacitor. The circuit oscillates at a frequency of about 1/R1C1 whenever th gate input is high (b).

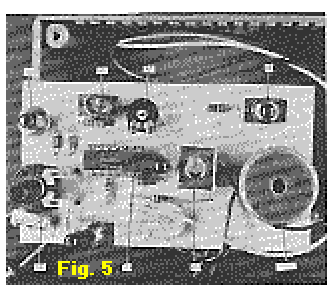


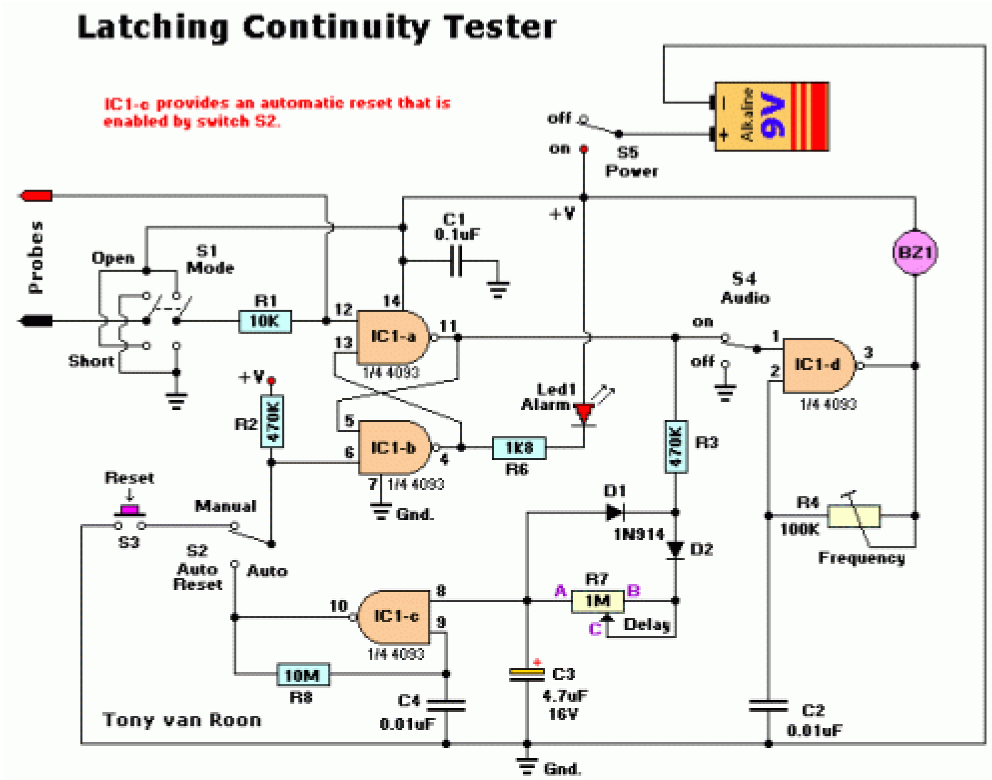
Fig. 5

The assembled pcboard reveals the low parts-count and easy assembly of the continuity tester

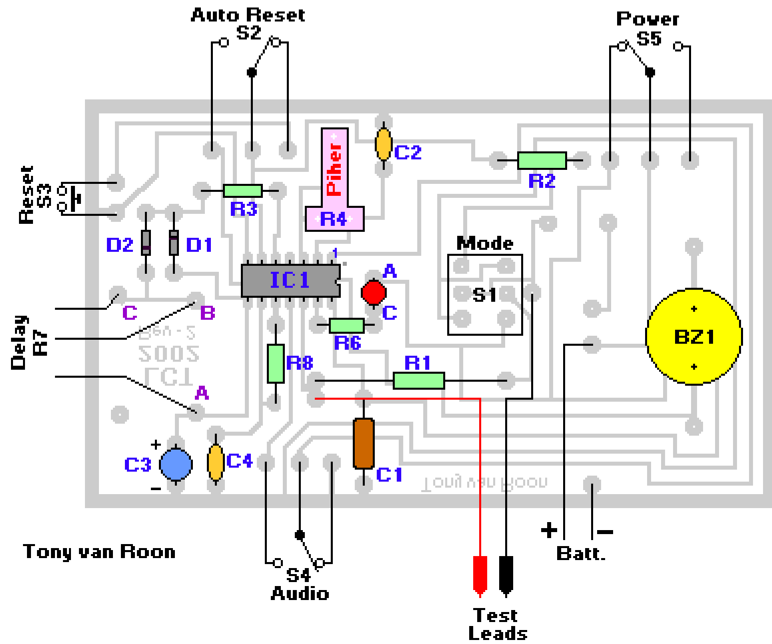
Usage Hints:

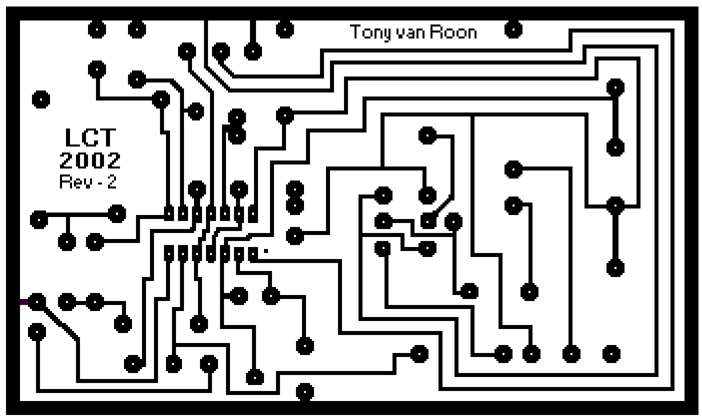
Set S1 for short or open depending on the condition to be tested. Then connect the test leads across the circuit to be tested. If an intermittent condition is detected, the LED will illuminate, and the buzzer will sound (if S4 is on). If you don't remove the test leads (assuming if S2 is set for AUTO Reset, the LED will flash and audio will warble at a rate determined by the reset circuit.

It is very important that the test leads make a positive connection with the circuit to be tested. In fact, clips should be used instead of test leads. There are good test leads available for about $15 which are hardened stainless-steel and have sharpened points which were my personal choice. This detector is so sensitive that, when it is initially connected across a long length of parallel wires or traces, it may latch due to capacitance between the wires. As a matter of fact, it happens with my model all the time. Just press the reset switch S3 when that occurs.



Parts
R1 10K
R2,R3 470K
R4 100K potentiometer
R5 Not used
R6 1.8K (1800 ohm)
R7 1M Trim pot
R8 10M
C1 0.1μF, ceramic
C2,C4 0.01μF ceramic
C3 4.7μF, 16V, Elec. .
IC1 4093B Quad Nand Schmitt Trigger (NTE4093B/ECG4093B)
D1,D1 1N914 or 1N4148 (NTE519/ECG519)
LED1 Red, 5mm, High Brightness
BZ1 Piezzo Buzzer
S1 DPDT, miniature toggle, pcb mount
S2,S4,S5 SPDT, miniature toggle, pcb mount
S3 SPST, momentary push, normally open
Additionally: IC socket, plastic case (4.75" x 2.5" 1.5"),
banana jacks, wire, solder, battery clip,couple cold beers

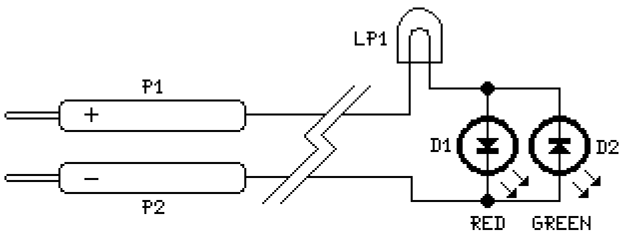

Auto Reset
S2
Power
S5
Reset
S3
Piher
R4
R3
C2
R2
D2
D1
IC1
Mode
S1
A
C
R6
Delay
R7
C
B
A
BZ1
R8
R1
C3
C4
C1
+
Batt.
Tony van Roon
S4
Audio
Test
Leads


Tony van Roon
LCT
2002
Rev - 2

P479. Ultra-simple Voltage Probe

Detects 1.8 to 220 Volts DC or AC
Minimum parts counting

Circuit diagram



Parts:
D1 5 or 3mm. Red LED
D2 5 or 3mm. Green or Yellow LED
LP1 220V 6W Filament Lamp
P1 Red Probe
P2 Black Probe

Device purpose:

This circuit is not a novelty, but it proved so useful, simple and cheap that it's worth building.
When the positive (Red) probe is connected to a DC positive voltage and the Black probe to the negative, the Red LED illuminates.

Reversing polarities the Green LED illuminates.
Connecting the probes to an AC source both LEDs go on.

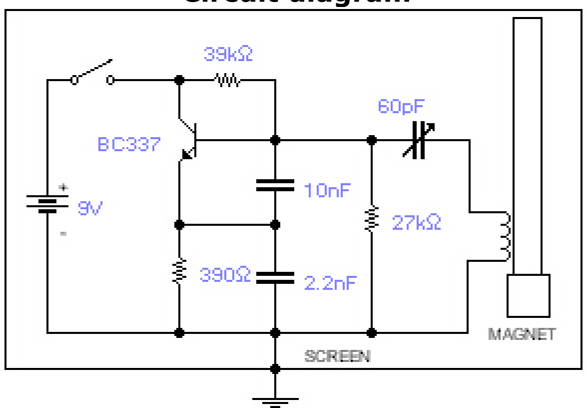
The lamp limits the LEDs current to 40mA @ 220V AC and its filament starts illuminating from approx. 30V, shining more brightly as voltage increases.

Therefore, due to the lamp's filament behaviour, any voltage in the 1.8 to 220 Volts range can be detected without changing component values.

Note:
A two colors LED (Red and Green) can be used in place of D1 & D2.

P480. Geomagnetic field detector

Circuit diagram



This basic oscillator will detect the Earth magnetic field. The ferrite rod and coil are taken from an old Medium Wave receiver and a small magnet is glued at one end. Tune to a medium wave commercial station until you hear a beat note. Any movement of the ferrite rod will produce an audible note that depends on the prevailing Earth magnetic field. Screening is essential. Use a plastic box padded, on the inside, with copper wires running parallel to the rod and grounded in one place only. A small hole is made in the box in order to adjust the trimmer capacitor with a plastic screwdriver. An American equivalent to the BC337 could be the 2N2369A but I did not try it out.

P481. Signal Tracer and Injector

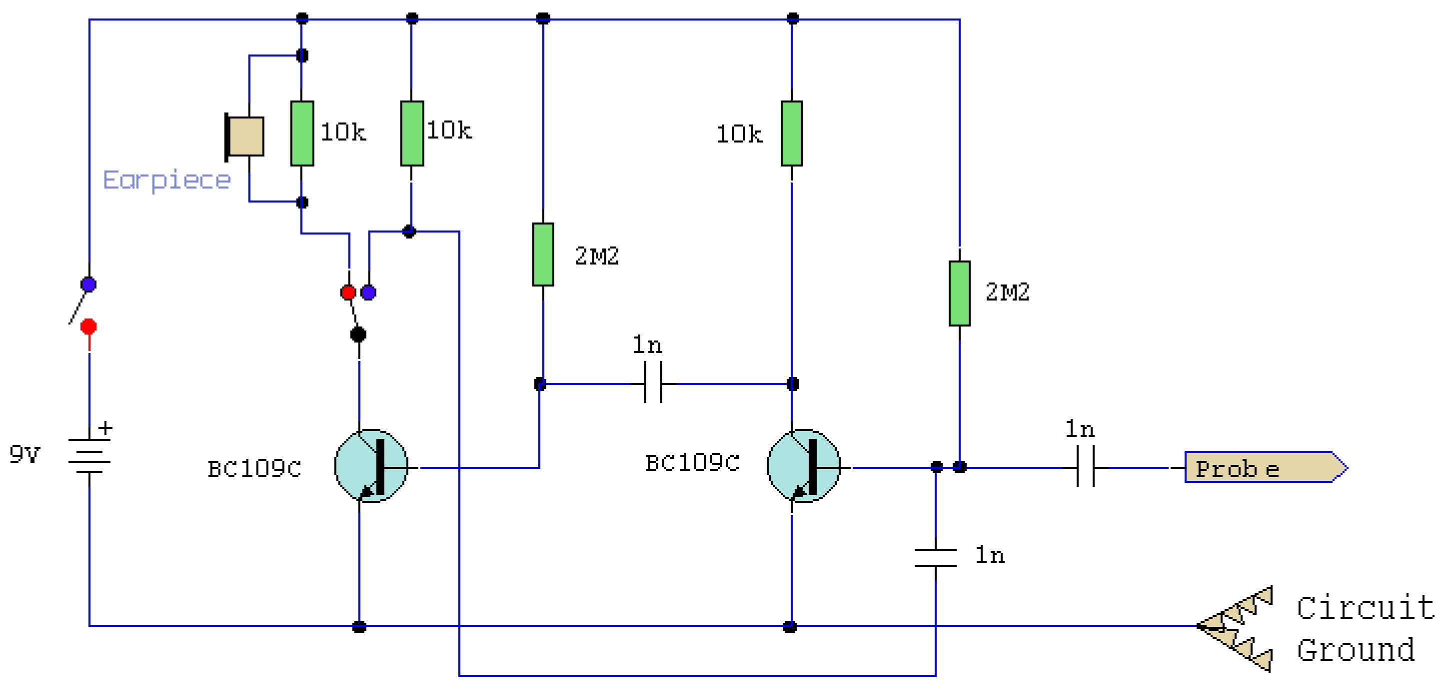
Description

A simple test circuit to fault find audio and radio equipment. Can be used to inject a square wave signal, rich in harmonics, or used with headphones as an audio tracer.

Notes

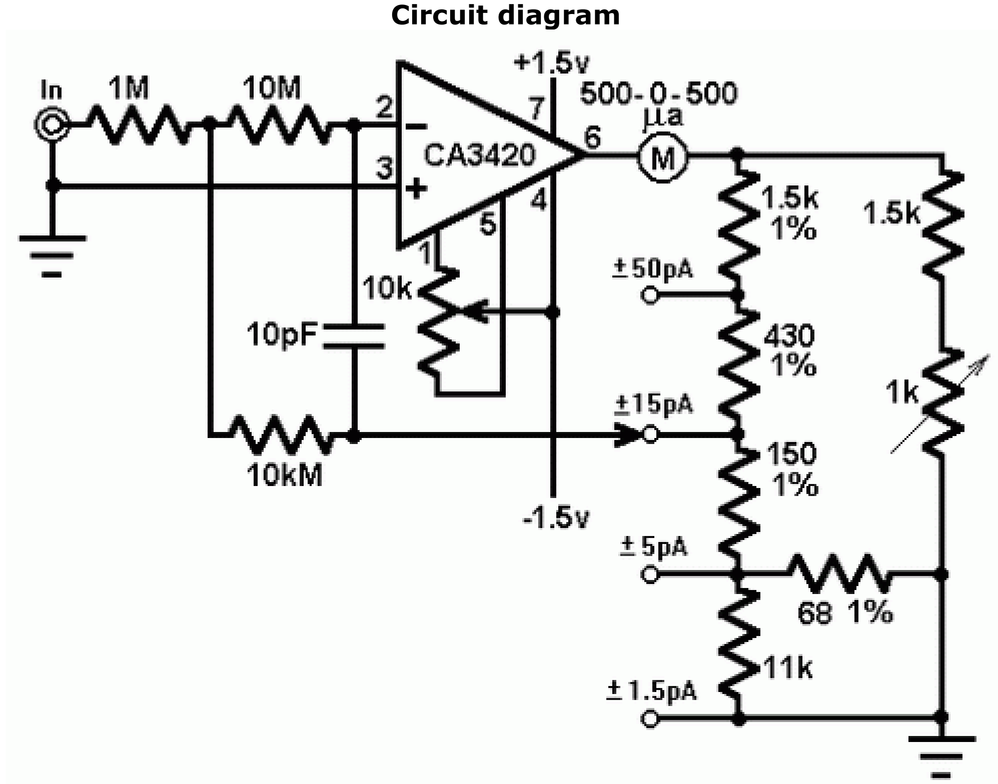
A single pole double throw sitch is used to switch between inject and trace modes. The diagram is drawn in trace mode, the earpiece being connected to the collector of the last transistor. Both transistors are wired as emitter followers, providing high gain. DC blocking is provided by the 1n capacitor at the probe end, and the two stages are capacitively coupled.

when the switch is thrown the opposite way (to the blue dot) both transistors are wired as an astable square wave generator. This provides enough harmonics from audio up to several hundred kilohertz and is useful for testing AM radio Receivers.



P482. Picoammeter circuit with 4 ranges

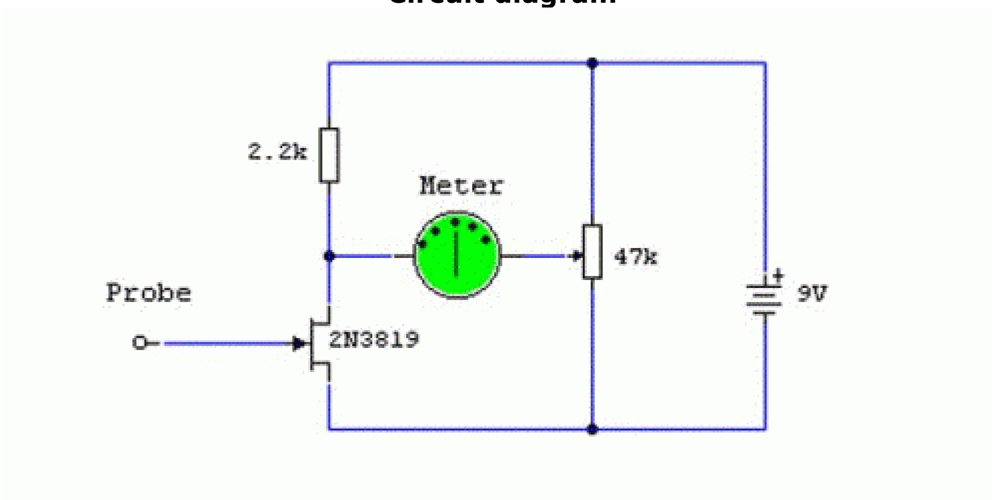
Circuit diagram



This circuit uses a CA3420 BiMOS op amp to form a picoammeter with 4 ranges. The exceptionally low input current (typically 0.2pA) makes the CA3420 highly suited for use in a picoammeter circuit. Input transient protection is provided by the 1 megohm resistor in series with the input. The 10 megohm resistor connected to pin 2 decouples the potentially high input capacitance often associated with lower current circuits and reduces the tendency for the circuit to oscillate under these conditions. The 10k potentiometer is used for null offset.

P483. Static Electricity / Negative Ion Detector

Circuit diagram



Notes
This circuit relies upon the extra high input impedance of a FET, and also demonstrates

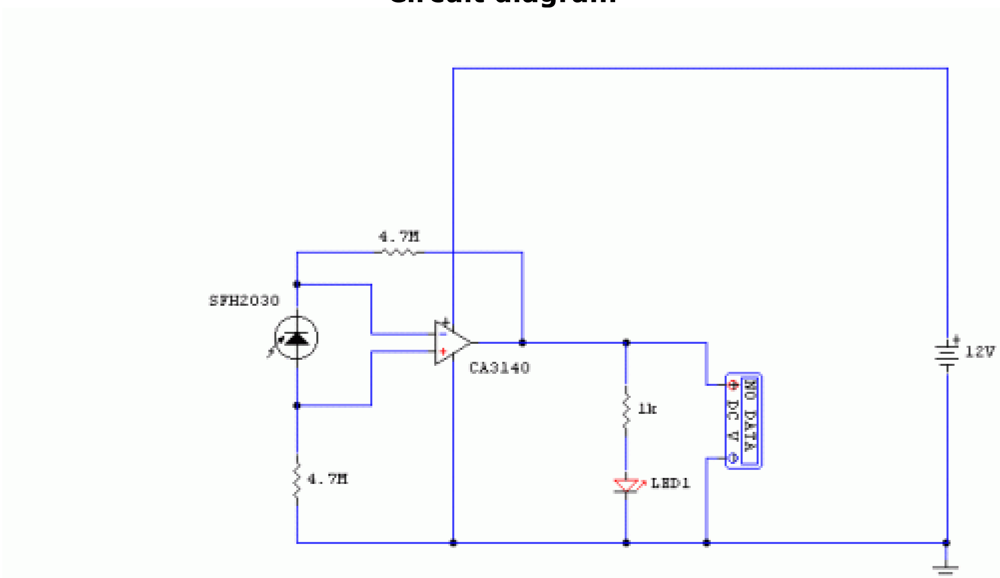
the gate terminals sensitivity to changes in voltage. The gate terminal here is left open circuit, connected only to the "probe" this being just a few inches of bare copper wire. With no fixed DC biasing, the gate terminal will respond to micro changes in voltage or "field strength". It is important not to make this circuit on veroboard or PCB material as this will reduce the effective gate impedance. Instead use an "open" construction technique soldering each component

together. The probe should not be touched directly and is best insulated in a plastic pen sleeve.
As static electricity can have either a positive or negative charge, the meter used
should be a centre zero type. Full scale deflection can be 1mA or 250uA for greater sensitivity. Remove the meter and use a multimeter to measure the voltage between FET drain and the preset resistor. Adjust the preset for 0 volts and then replace the meter. This will avoid "bending" the needle.

If placed in a room the meter will detect changes in static charge, positive charge deflecting the needle one way and negative the other way. You can test the circuit by placing the unit say 5 feet away from a TV set. When switched on, the meter needle should jump to full scale deflection and then drop down again. If you have a room ioniser, its output can be monitored by moving the probe in front of it. As the detector responds to changes in charge, you may need to move the detector around to see the effect, but it will prove the output from such an ioniser.

P484. IR Remote Control Tester II

Circuit diagram

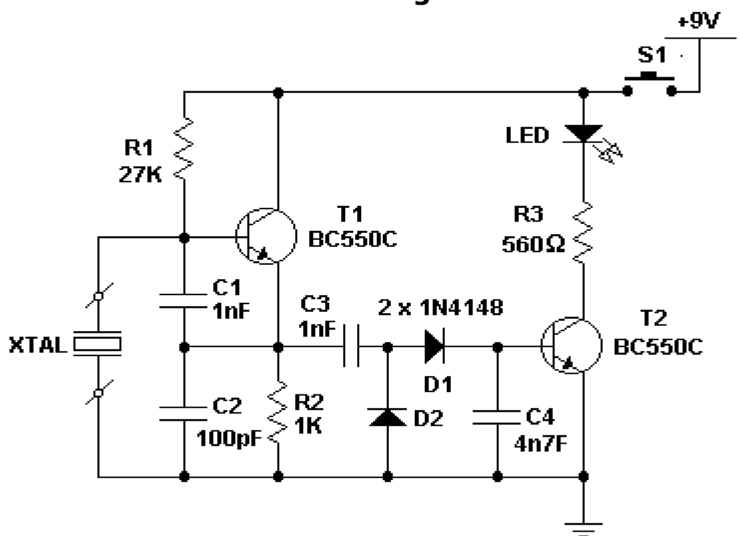


Notes:

I have used a photodiode, SFH2030 as an infra red sensor. A MOSFET opamp, CA3140 is used in the differential mode to amplify the pulses of current from the photodiode. LED1 is an ordinary coloured led which will light when IR radiation is being received. The output of the opamp, pin 6 may be connected to a multimeter set to read DC volts. Infra red remote control strengths can be compared by the meter reading, the higher the reading, the stronger the infra red light. I aimed different remote control at the sensor from about 1 meter away when comparing results. For every microamp of current through the photodiode, about 1 volt is produced at the output. A 741 or LF351 will not work in this circuit. Although I have used a 12 volt power supply, a 9 volt battery will also work here.

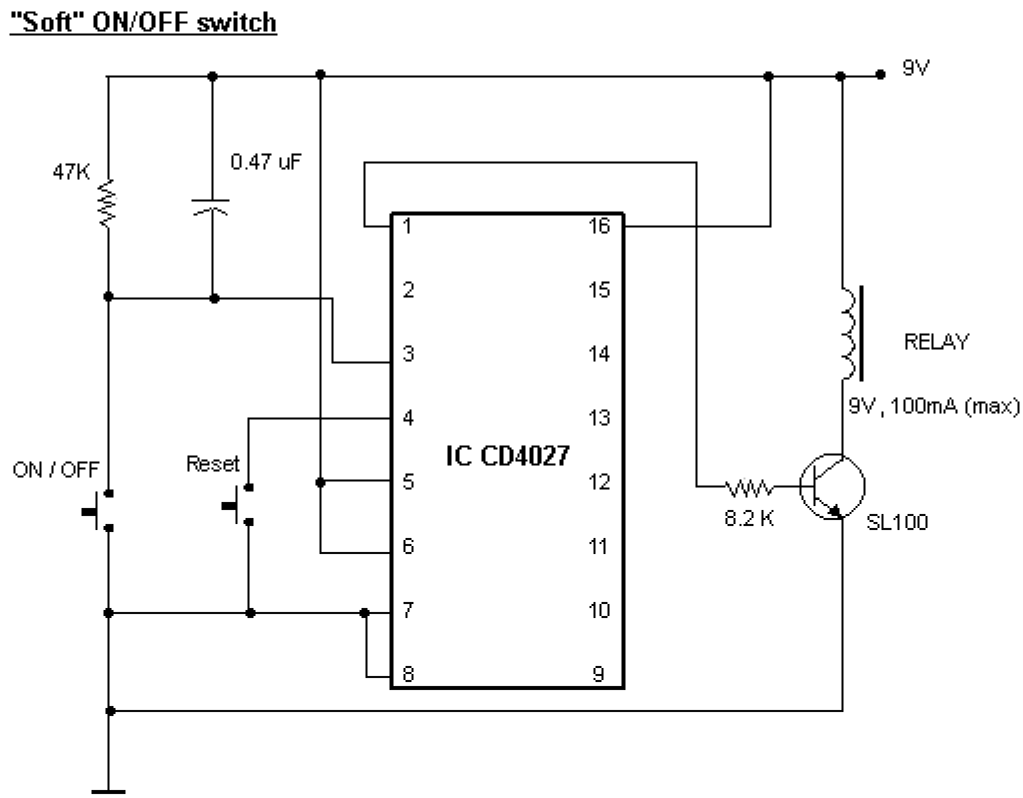
P485. XTal Tester

Circuit diagram



This is a simple XTal tester circuit. T1 and XTal have formed an oscillator. C1 and C2 are voltage divider for oscillator. if the XTal is safe, the oscillator will work well and its output voltage will be rectified by C3, C4, D1 and D2, then T2 will run and LED will light. The circuit is suitable to test 100KHz - 30MHz Xtal.

P486. Soft ON/OFF switch



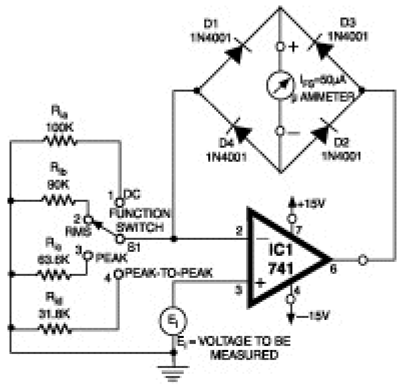
Modern electronic equipment incorporate "push-to-on-push-to-off" switches that do not make the clicking noise as with old equipment. An example of this is the power button on a ATX computer cabinet. Here is a circuit that does the same. It can be used to turn on/off any electronic/electrical equipment that operates on any range of voltages.

When the "ON/OFF" button is pressed once, the equipment goes on and stays on. It goes off when the button is pressed again. The circuit is straight forward. It uses a JK CMOS FlipFlop to with its JK terminals tied high to achieve the toggling action. The clock is provided by the push button used for on/off action. The resistor and the capacitor near the on/off switch debounces the contacts.

Note that when the circuit is switched on, the relay may land in a on or off state. It can be brought to the off state by pressing the RESET button.

Care should be taken that the relay's current does not exceed 100mA. Since the IC is CMOS, it can be operated from 3V to 15V, but in this circuit it is operated at 9V for a 9V relay. The relay circuit needs to be modified for other operating voltages.

P487. High Resistance Voltmeter



The full-scale deflection of the universal high-input-resistance voltmeter circuit shown in the figure depends on the function switch position as follows:

(a) 5V dc on position 1
(b) 5V ac rms in position 2
(c) 5V peak ac in position 3
(d) 5V ac peak-to-peak in position 4

The circuit is basically a voltage-to-current converter. The design procedure is as follows:

Calculate RI according to the application from one of the following equations:

(a) dc voltmeter: RIA = full-scale EDC/IFS
(b) rms ac voltmeter (sine wave only): RIB = 0.9 full-scale ERMS/ IFS
(c) Peak reading voltmeter (sine wave only): RIC = 0.636 full-scale EPK/IFS
(d) Peak-to-peak ac voltmeter (sine wave only): RID = 0.318 full-scale EPK-TO-PK / IFS

The term IFS in the above equations refers to meter's full-scale deflection current rating in amperes.
It must be noted that neither meter resistance nor diode voltage drops affects meter current.

A high-input-resistance op-amp, a bridge rectifier, a microammeter, and a few other discrete components are all that are required to realise this versatile circuit. This circuit can be used for measurement of dc, ac rms, ac peak, or ac peak-to-peak voltage by simply changing the value of the resistor connected between the inverting input terminal of the op-amp and ground. The voltage to be measured is connected to non-inverting input of the op-amp.

TABLE I
Position 1 of Function Switch

E_{dc} input	Meter Current
5.00V	44 µA
4.00V	34 µA
3.00V	24 µA
2.00V	14 µA
1.00V	4 µA

TABLE II
Position 2 of Function Switch

E_{rms} input	Meter Current
5V	46 µA
4V	36 µA
3V	26 µA
2V	18 µA
1V	10 µA

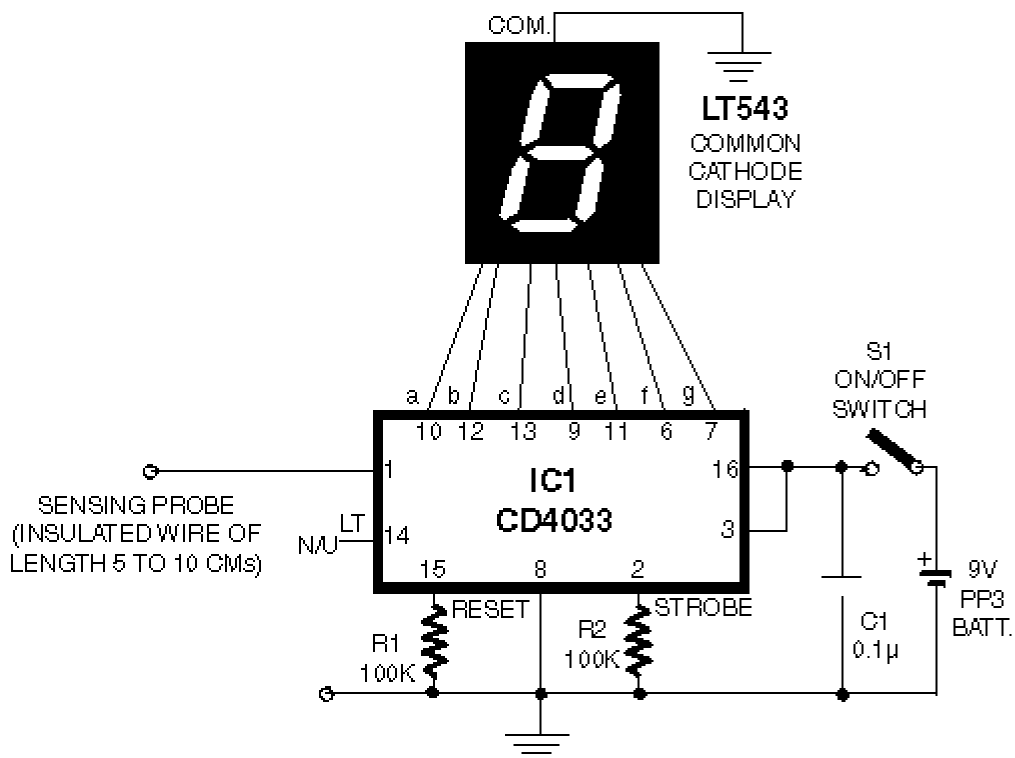
TABLE III
Position 3 of Function Switch

E_{Pk} input	Meter Current
5V peak	46 µA
4V peak	36 µA
3V peak	26 µA
2V peak	16 µA
1V peak	6 µA

TABLE IV
Position 4 of Function Switch

$E_{Pk\text{-}To\text{-}Pk}$	Meter Current
5V peak to peak	46 µA
4V peak to peak	36 µA
3V peak to peak	26 µA
2V peak to peak	16 µA
1V peak to peak	7 µA

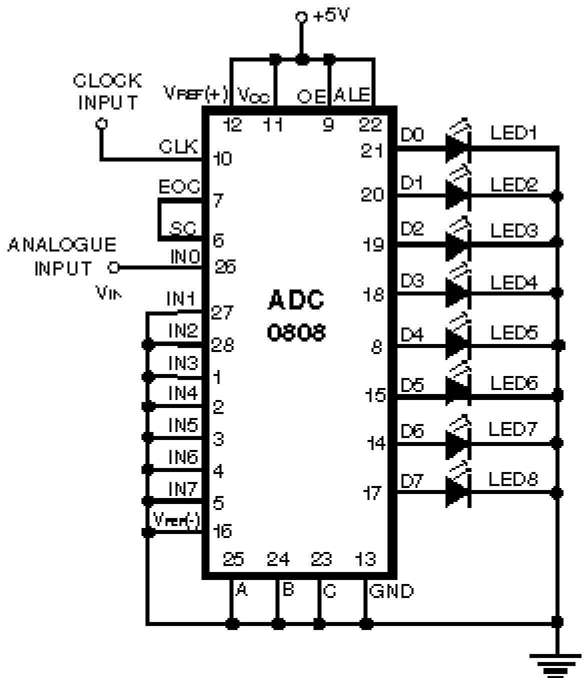
P488. Contactless Mains Voltage Indicator



This is a CMOS IC (CD4033) based circuit which can be used to detect presence of mains AC voltage without any electrical contact with the conductor carrying AC current/voltage. Thus it can be used to detect mains AC voltage without removing the insulation from the conductor. Just take it in the vicinity of the conductor and it would detect presence of AC voltage. If AC voltage is not present, the display would randomly show any digit (0 through 9) permanently. If mains supply is available in the conductor, the electric field would be induced into the sensing probe. Since IC used is CMOS type, its input impedance is extremely high and thus the induced voltage is sufficient to clock the counter IC. Thus display count advances rapidly from 0 to 9 and then repeats itself. This is the indication for presence of mains supply.

Display stops advancing when the unit is taken away from the mains carrying conductor. For compactness, a 9-volt PP3 battery may be used for supply to the gadget.

P489. Simple Analog to Digital Converter



Normally analogue-to-digital con-verter (ADC) needs interfacing through a microprocessor to convert analogue data into digital format. This requires hardware and necessary software, resulting in increased complexity and hence the total cost.

The circuit of A-to-D converter shown here is configured around ADC 0808, avoiding the use of a microprocessor. The ADC 0808 is an 8-bit A-to-D converter, having data lines D0-D7. It works on the principle of successive approximation. It has a total of eight analogue input channels, out of which any one can be selected using address lines A, B and C. Here, in this case, input channel IN0 is selected by grounding A, B and C address lines.

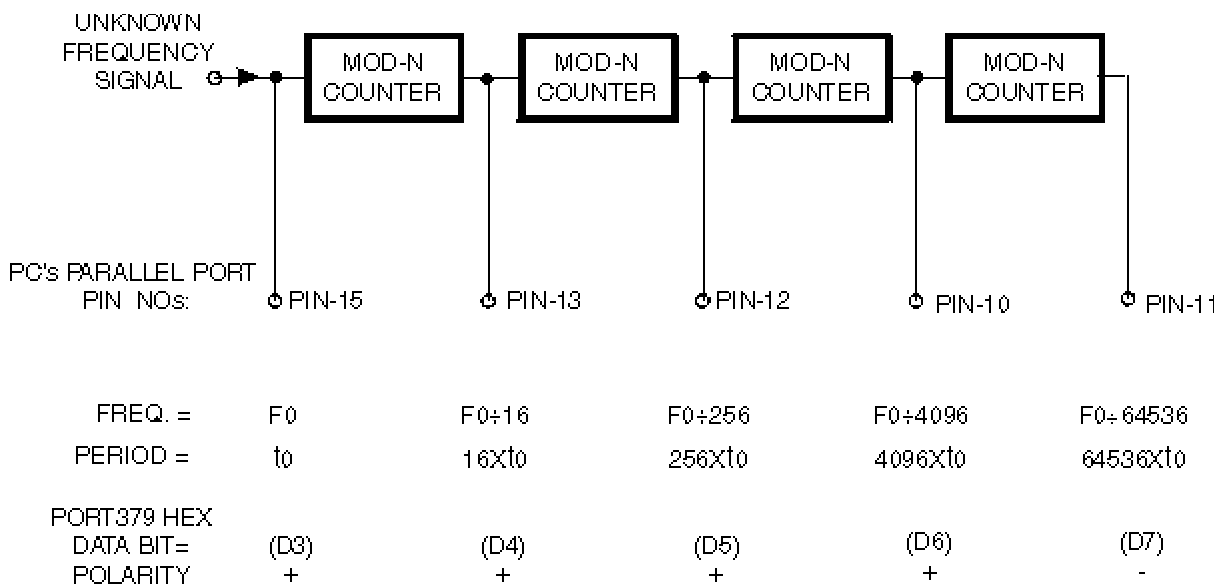
Usually the control signals EOC (end of conversion), SC (start conversion), ALE (address latch enable) and OE (output enable) are interfaced by means of a microprocessor. However, the circuit shown here is built to operate in its continuous mode without using any microprocessor. Therefore the input control signals ALE and OE, being active-high, are tied to Vcc (+5 volts). The input control signal SC, being active-low, initiates start of conversion at falling edge of the pulse, whereas the output signal EOC becomes high after completion of digitisation. This EOC output is coupled to SC input, where falling edge of EOC output acts as SC input to direct the ADC to start the conversion.

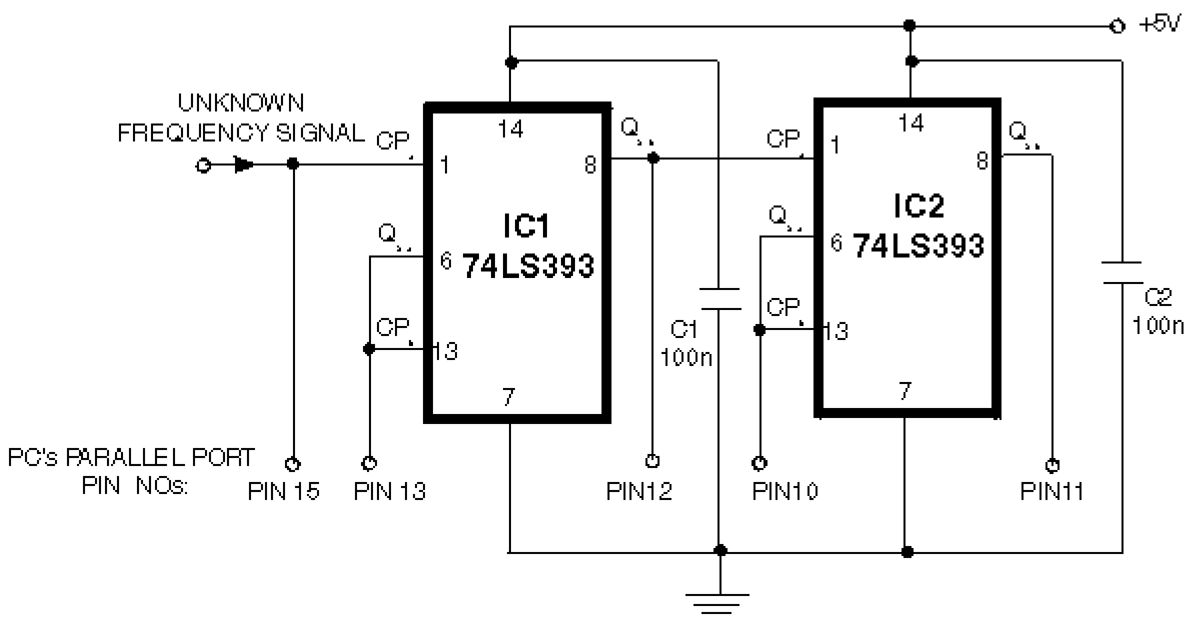
As the conversion starts, EOC signal goes high. At next clock pulse EOC output again goes low, and hence SC is enabled to start the next conversion. Thus, it provides continuous 8-bit digital output corresponding to instantaneous value of analogue input. The maximum level of analogue input voltage should be appropriately scaled down below positive reference (+5V) level.

The ADC 0808 IC requires clock signal of typically 550 kHz, which can be easily derived from an astable multivibrator constructed using 7404 inverter gates. In order to visualise the digital output, the row of eight LEDs (LED1 through LED8) have been used, wherein each LED is connected to respective data lines

D0 through D7. Since ADC works in the continuous mode, it displays digital output as soon as analogue input is applied. The decimal equivalent digital output value D for a given analogue input voltage Vin can be calculated from the relationship.

P490. PC based Frequency Meter



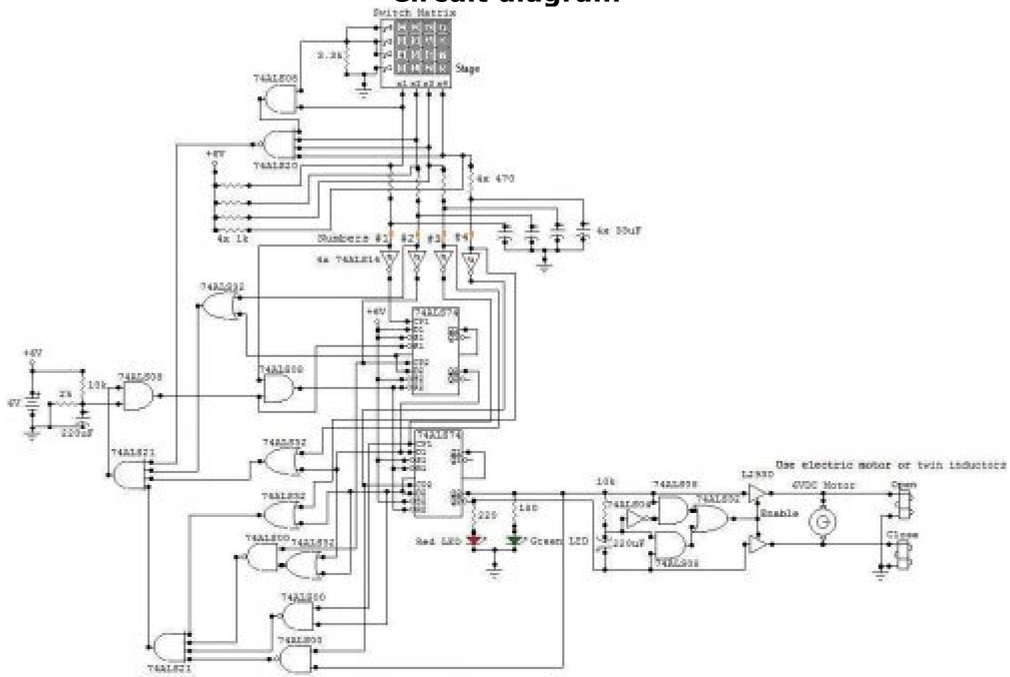


Here is a simple technique for measuring frequencies over quite a wide frequency range and with acceptable accuracy limits using a PC. It follows the basic technique of measuring low frequencies, i.e. at low frequency, period is measured for a complete wave and frequency is calculated from the measured time-period. Cascaded binary counters are used for converting the high-frequency signals into low-frequency signals. The parallel port of a computer is used for data input from binary counters. This data is used for measuring time and calculating the frequency of the signal. The block diagram shows the basic connections of the counters and parallel port pin numbers on 25-pin 'D' connector of a PC (control register 379 Hex is used for input). External hardware is used only for converting the higher frequency signals into low frequency signals. Thus, the major role in frequency-measurement is played by the software. The PC generates a time-interrupt at a frequency of 18.21 Hz, i.e. after every 54.92 millisecond. Software uses this time-interrupt as a time-reference. The control register of the PC's parallel port is read and the data is stored continuously in an array for approximately 54.9 ms using a loop. This stored data is then analysed bit-wise. Initially, the higher-order bit (MSB or the seventh-bit) of every array element is scanned for the presence of a complete square wave. If it is found, its time period is measured and if not then the second-highest order bit (sixth bit) is scanned. This operation is performed till the third bit and if no full square wave is still found, an error message is generated which indicates that either there is an error in reading or the frequency signal is lower than 19 Hz. Lower three bits of the control register are not used. When a wave is found, along with its time-period and frequency components, its measurement precision in percentage is also calculated and displayed. Number of data taken in 54.9 ms is also displayed. As stated above, the lower starting range is about 19 Hz. Data is read for approximately 54.9 ms. Thus, the lowest possible frequency that can be measured is 1/.0549 Hz. Lower range depends only on the sampling time and is practically fixed at 19 Hz (18.2 Hz, to be precise). Upper range depends on factors such as value of the MOD counter used and the operating frequency range of the counter IC. If MOD-N counter is used (where N is an integer), upper limit (UL) of frequency is given by UL=19xN5 Hz. Thus for MOD 16 counters UL@20 MHz, and for MOD 10 counters UL@1.9 MHz. Care should be taken to ensure that this upper limit is within the operating frequency range of counter IC used. Precision of measurement is a machine-dependent parameter. High-speed machines will have better precision compared to others. Basically, precision depends directly upon the number of data read in a standard time. Precision of measurement varies inversely as the value of MOD counter used. Precision is high when MOD 10 counters are used in place of MOD 16 counters, but this will restrict the upper limit of frequency measurement and vice-versa.

P491. Electronic Locker

This circuit is an Electronic Locker. It is controlled by a switches combination (by a code). There is a switch matrix on the door of the locker. This one is a unit of switches connected into 4 arranged of 4 columns for a total of eight terminals. When we press on a switch, this one establishes the contact between its column and its line. This switch matrix is also used in the telephones, for example. But it is numbered from 0 to 9 and from A to F for a total of 16 switches. To open the locker, we have to press 4 specific and different switches in the good order. If for example the code is 0,1,2,3 and we press two times to the same switches: 0,1,2,2,3 the locker won't open. In this circuit, the code is 0,1,2,3 but we can set the desired code when we built de circuit. The desired line (called "stage" in the schematic) is connected to the ground and to a pin of the 3.3k resistor and the other line is connected to an input of the 7408 and to the other pin of the resistor.

Circuit diagram



All the desired numbers of the code are in the same line. To set the order of the number of the code, we have to set the good connection between the node of the 7414 input and the appropriate node of the capacitor. For example, if we select the first line (y1) and the code is 0,1,2,3 the first number (#1) is connected to the top left contact (x1). The switch 0 is corresponding to x1/y1. These points of contact are colored in orange in the schematic. When the locker is locked, the red LED is turned on and the green LED is turned off. When the locker is opened, the red LED is turned off and the green LED is turned on. To lock the locker, we can push any of the 16 switches of the matrix. The locker is powered by a 6V source. I recommend using a 6V rechargeable battery because this one lasts a long time (at least 3 full days) and can be re-used. Otherwise, we can use four 1.5V battery connected in serial. These least only 5 hours but are less expensive.

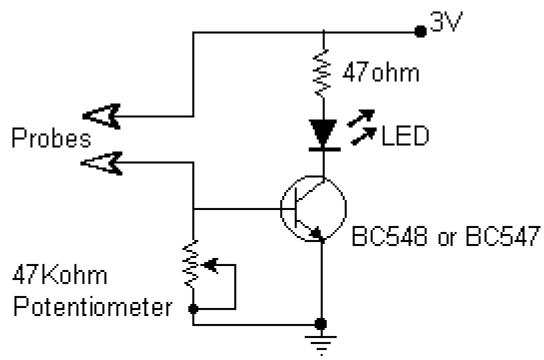
To save energy, we can remove the red LED. When the locker is powered on, it is locked. The electric motor or the inductors close the door while a bit of time and after, stop working. When we open the locker, the electric motor or the inductors open the door while a bit of time and after, stop working. To control the state of the door (open or lock) we can use an electric motor or a pair of inductors. If we use a electric motor, when the locker is closed, the motor turns in the anti-clockwise direction during a certain time and moves down a toothed bar. After this time, the motor stops turning and the locker remains closed. When the locker is opened, the motor turns in the clockwise direction during a certain time and moves up the toothed bar.

Parts List

1	6V Battery
1	Switch Matrix
1	180Ω Resistor
1	220Ω Resistor
4	470Ω Resistor
4	1kΩ Resistor
1	2kΩ Resistor
1	3.3kΩ Resistor
2	10kΩ Resistor
4	33μF Capacitor
2	220μF Capacitor
1	Red LED
1	Green LED
1	74ALS14
2	74ALS08
2	74ALS32
1	74ALS21
1	74ALS20
1	74ALS00
1	74ALS04
2	74ALS74
1	74293D
1	6VDC motor / pair of inductors

After this time, the motor stops turning and the locker remains opened. If we use two inductors, when the locker is closed, the second inductor works during a certain time and moves left a magnetic bar by attraction. After this time, the inductor stops working and the locker remains closed. When the locker is opened, the first inductor works during a certain time and moves right the magnetic bar. After this time, the inductor stops turning and the locker remains opened. The buffer (L293D) who controls the motor or the inductors has two Vcc inputs and four ground connections. The both Vcc inputs must be connected to the +6V and all ground connections must be connected to the ground of the circuit. All the parts of the circuits are placed in the rack except the DELs and the switch matrix which them, are placed on the door.

P492. Pot plant water tester



This simple device checks if their is water in a pot plant. You stick the two probes(paperclips)into the pot plant and if the LED lights, it means there is water in the pot plant.

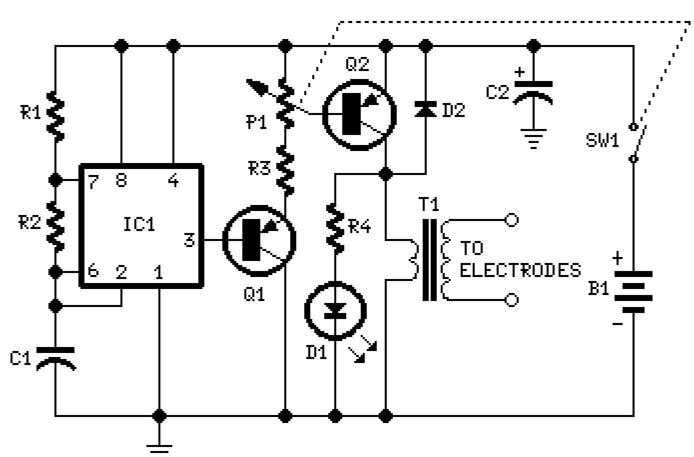
You need to adjust the 47k potentiometer to set the level at which the LED goes on.

P493. Muscular Bio-Stimulator

Warning: The use of this device is forbidden to Pace-Maker bearers and pregnant women. Don't place the electrodes on cuts, wounds, injuries or varices. Obviously we can't claim or prove any therapeutic effectiveness for this device. Disclaimer: we can't claim or prove any therapeutic effectiveness for this device.

Particularly suitable for cellulitis treatment
3V battery supply, portable set

Circuit diagram



Parts:
P1 4K7 Linear Potentiometer
R1 180K 1/4W Resistor
R2 1K8 1/4W Resistor (see Notes)
R3 2K2 1/4W Resistor
R4 100R 1/4W Resistor
C1 100nF 63V Polyester Capacitor
C2 100µF 25V Electrolytic Capacitor
D1 LED Red 5mm.
D2 1N4007 1000V 1A Diode
Q1,Q2 BC327 45V 800mA PNP Transistors
IC1 7555 or TS555CN CMos Timer IC
T1 220V Primary, 12V Secondary 1.2VA Mains transformer (see Notes)
SW1 SPST Switch (Ganged with P1)
B1 3V Battery (two 1.5V AA or AAA cells in series etc.)

Device purpose:

This is a small, portable set, designed for those aiming at look improvement. The Bio-Stimulator provides muscles' stimulation and invigoration but, mainly, it's an aid in removing cellulitis.

Tape the electrodes to the skin at both ends of the chosen muscle and rotate P1 knob slowly until a light itch sensation is perceived. Each session should last about 30 - 40 minutes.

Circuit operation:

IC1 generates 150µSec. pulses at about 80Hz frequency. Q1 acts as a buffer and Q2 inverts the pulses' polarity and drives the Transformer. Output pulses' amplitude is set by P1 and approximately displayed by LED D1 brightness. D2 protects Q2 against high voltage peaks generated by T1 inductance during switching.

Notes:
T1 is a small mains transformer 220 to 12V @ 100 or 150mA. It must be reverse connected i.e.: the 12V secondary winding to Q2 Collector and ground, and the 220V primary winding to output electrodes.

Output voltage is about 60V positive and 150V negative but output current is so small that there is no electric-shock danger.

In any case P1 should be operated by the "patient", starting with the knob fully counter-clockwise, then rotating it slowly clockwise until the LED starts to illuminate. Stop rotating the knob when a light itch sensation is perceived.

Best knob position is usually near the center of its range.

In some cases a greater pulse duration can be more effective in cellulitis treatment. Try changing R2 to 5K6 or 10K maximum: stronger pulses will be easily perceived and the LED will shine more brightly.
Electrodes can be obtained by small metal plates connected to the circuit's output via usual electric wire and can be taped to the skin. In some cases, moistening them with little water has proven useful.
SW1 should be ganged to P1 to avoid abrupt voltage peaks on the "patient's" body at switch-on, but a stand alone SPST switch works quite well, provided you remember to set P1 knob fully counter-clockwise at switch-on.

Current drawing of this circuit is about 1mA @ 3V DC.

Some commercial sets have four, six or eight output electrodes. To obtain this you can retain the part of the circuit comprising IC1, R1, R2, C1, C2, SW1 and B1. Other parts in the diagram (i.e. P1, R3, R4, D1, D2, Q2 & T1) can be doubled, trebled or quadrupled. Added potentiometers and R3 series resistors must be wired in parallel and all connected from Emitter of Q1 to positive supply.

Commercial sets have frequently a built-in 30 minutes timer. For this purpose you can use the Timed Beeper the Bedside Lamp Timer or the Jogging Timer circuits available in this Website, adjusting the timing components to suit your needs.

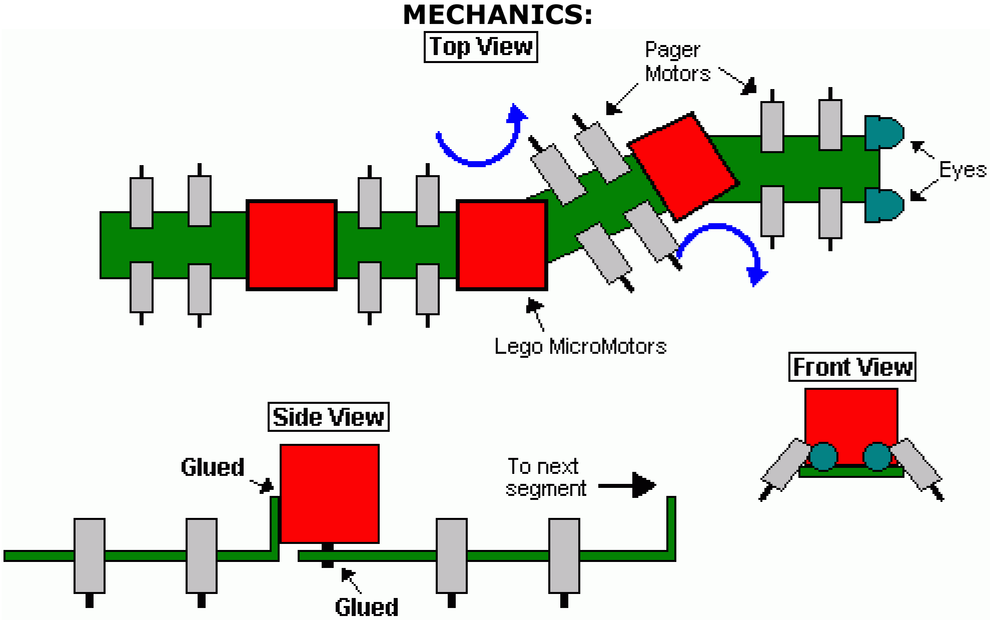
P494. The Millipede

Me and a friend are both trying to build a millipede. Because of obvious reasons, the millipede is NOT going to have 1000 feet!!! Instead, it's going to have 16 pager motors as feet. It will also have 3 MicroMotors to ''bend'' towards light, and a backup sensor.

FEATURES:

16 PagerMotors as feet
3 MicroMotors to seek light
PhotoTrophic
Obstacle avoidance
Looks Cool!!!

MECHANICS:



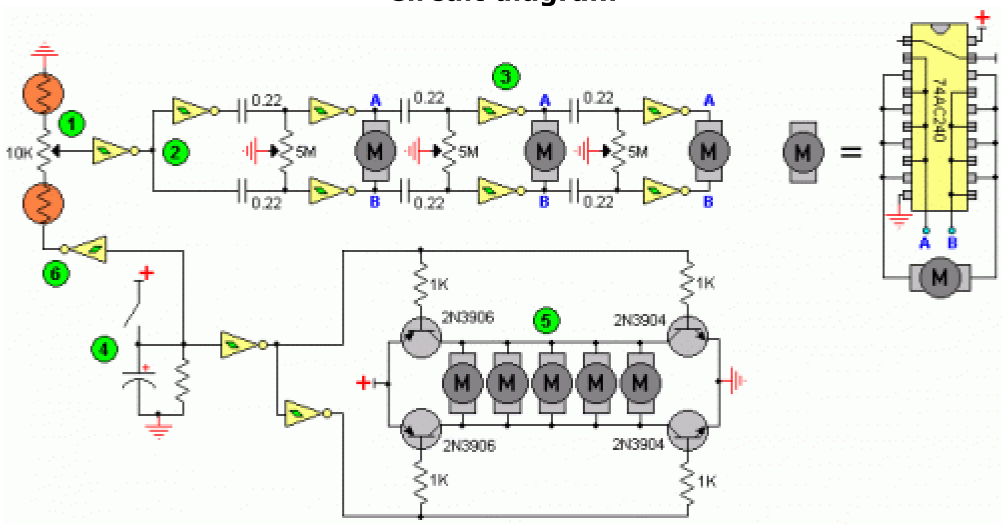
Millipede is divided in four segments. Each segment (except the first one) is glued to a MicroMotor turned upside-down. The motor shaft is then glued to the next segment. Each segment can rotate left/right and has 2 PagerMotors on each side. This way, the millipede should turn towards the most lighted area. I've calculated that the waist motors should turn only 30o-45o every second or so. This means that I will need the motors to be 7-15 rpm. Candidates for this job can be the Lego MicroMotor

(http://costaricabeam.solarbotics.net/Info/Lego%20MicroMotor.htm), Solarbotics GM or BabyGM (unless I can get some MU915L Escaps!!!).

Weigth was a major concern since the whole bot was impulsed by pagermotors. The waist motors should weigth no more than 70g and the body (including electronics) is about <100g. Actually, it seems that 16 pagermotors are more than enough to move the bot!!!

ELECTRONICS:

Circuit diagram



I made up this circuit, as this is my first ''big'' BEAM creation I have no idea if it works properly. The upper 3 Ms are the Lego MicroMotors and the lower Ms should be the 16 PagerMotors. On the right, you can see the MicroMotors driver.

Here is the explanation:

1 This is the voltage divider. It divides voltage depending on which side is more iluminated, then, the schmitt changes the signal from a wave to a straight pulse.

2 The (usual) Nv only works when the input receives a HIGH, and that is the job of the schmitts. If the first schmitt outputs a HIGH the the lower strip of Nvs will work, the upper strip should stay calm because the second schmitt inverts the signal to a LOW. Thanks Math!!!

3 I can now be sure that there won't be 2 pulses on a same motor, and that when the first motor turns left (or right) the next one will also turn that same way, and the next and the next.... Only the first motor is affected by light, the others follow (in a wave pattern) the one before themselves. Since the millipede is moving forward while all this happens, a nice wave should appear when the bot has locked his path towards the light source.

4 This is the backup switch. When the bot bumps into something like... Hmm....anything, the cap is discharged trough the right schmitt. The (now LOW) output of the schmitt will reverse the PagerMotors, thus, reversing the whole bot.

5 This is the PagerMotors driver. I took the 4 transistor circuit design and modified it to be used with only one input signal. I know I won't be able to drive the 16 motors with 2N390X transistors, I used them in the schematic only because I need to find more powerful ones. Probably FETs?

6 As an extra (Yupeee), when the bot reverses it also makes the ''spinal column'' think that light is fully comming only from one direction. Because of this, when the millipede reverses, it also turns to one side all the body.

I still need to order the components (Let's just say there are not many 74**14s or 240s in Costa Rica), so the final version may be different than the drawings. I'm also thinking about using the Baby GMs that Solarbotics sell instead of the Lego MicroMotors. If you can help me with anything about the schematic, just email me.

P495. Keys Finder

General:

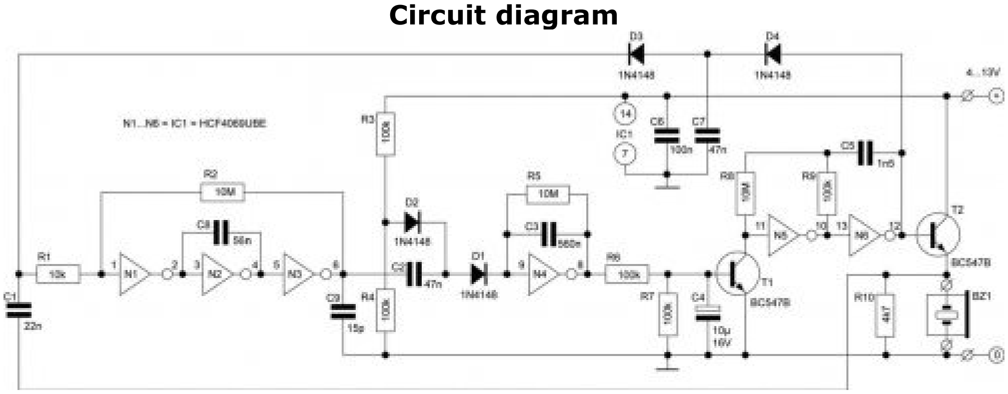
Imagine that is morning , you barely anticipate the bus for work and you can't find your keys. If you suffer from this situation frequently, this circuit is ideal for you. A fizzle is the only thing you have to do. The overall circuit is small enough to attach it to your keys.

Description:

The ear and mouth of the circuit is a piezoelectric buzzer. Fizzling in a frequency of 3...4 KHz produced sound waves that piezoelectric buzzer converts them to an oscillation. This oscillation passes thought C1 and thought inverters N1...N3.The inverters along with R1 and R2, compose an amplifier with gain 400 ! .The C8 and C9 stabilize and reduce the signal's level.

Next the signal rectified from D2 and D3. The integral circuit n4, C3 and R5 ensures that the circuit will not triggered from common noises but only from late fizzle. When the output voltage increases at N4, T1 cuts off and the input of n4 goes to high logical level. It's output goes to <0> and C5 is charged, through R9 until N5 changes operation state.

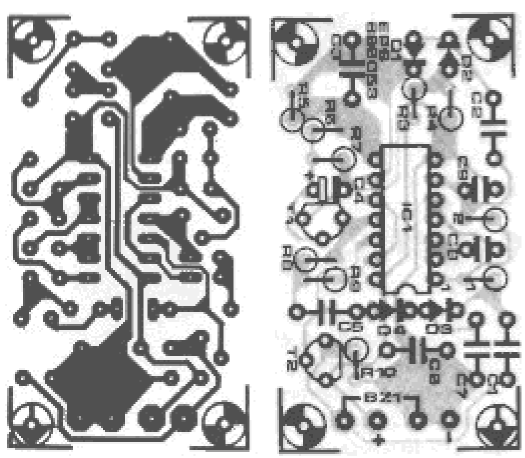
Circuit diagram



Next C5 discharges and everything is starting from beginning .The AC voltage goes thought the buffer circuit of T2 to buzzer witch starts to fizzle. There is a small problem in this point, the buzzer will never stop fizzling because the output signal triggering the circuit again thought C1. This is solved in this way: when the buzzer sounds (until C3 discharges thought R5), the input of n1 goes through D4, C7 and D3, to high logical state. In this way until the buzzer stops the input of the amplifier can't receive and amplify any given signal.

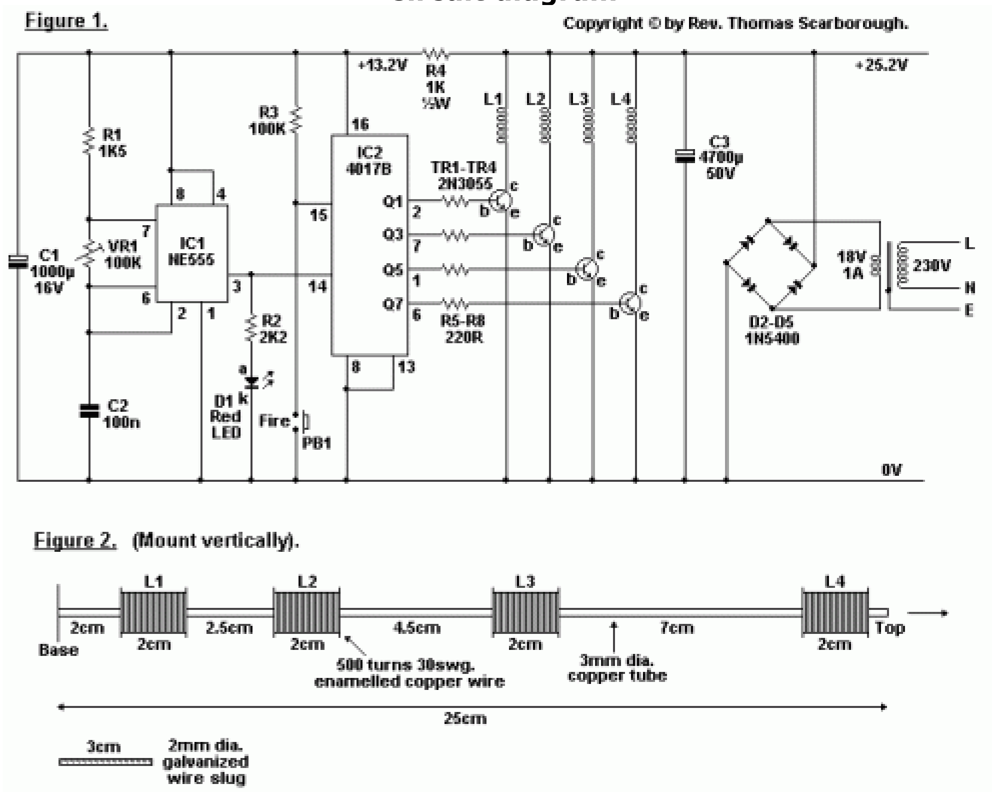
Parts
R1 =10k
R2, R5, R8 =10M
R3, R4, R6, R7, R9 = 100k
R10 = 4k7
C1 = 22n
C2, C7 = 47n
C3 = 560n
C4 = 10u;/16V Tantalum
C5 = 1n5
C6 = 100n
C8 = 56n
C9 = 15p
D1...D4 = 1N4148
T1, T2 = BC547B
IC1 = HCF4069UBE

PCB



P496. Magnetic Gun

Circuit diagram



Picured in Figure 1 is a miniature magnetic gun. When optimally tuned, it will propel a small slug about 1.5 metres high, or 2.5 metres horizontally.

IC1 is a 555 timer in astable mode, sending approx. 10 ms pulses to decade counter IC2. IC2 is continually reset through R3, until pin 15 is taken low through the "Fire" button. IC2 then sequences through outputs Q1 to Q7, to feed power transistors TR1 to TR4, which fire electromagnets L1 to L4 in rapid sequence.

Transformer T1 secondary is 18 volts 1 amp A.C. When rectified and smoothed, this provides 25.2 V D.C for electromagnets L1 to L4. Resistor R4 drops 12 V to obtain a supply voltage low enough for IC1 and IC2.

The electromagnets are wound on a 25 cm long, 3 mm dia. copper tube (available at hobby shops). Two "stops" may be cut from tin for each electromagnet, and 500 turns of approx. 30 swg. enamelled copper wire wound between them. The electromagnets should be wound on a base of reversed sellotape, so that one may slide them on the copper tube. The slug (or "bullet") is a 3 cm long piece of 2 mm dia. galvanized wire, which should slide loosely inside the copper tube.

Most crucial to the effectiveness of the gun are the setting of VR1 and the positions of electromagnets L1 to L4 on the copper tube (the values and measurements shown are merely a guide). Firstly, with L2 to L4 disconnected, VR1 should be tuned and L1 positioned for optimum effectiveness (place a wire inside the tube to feel how far the slug jumps with L1). Then L2 (now connected) should be positioned for optimum effectiveness (the slug will now exit the tube). Repeat with L3 and L4.

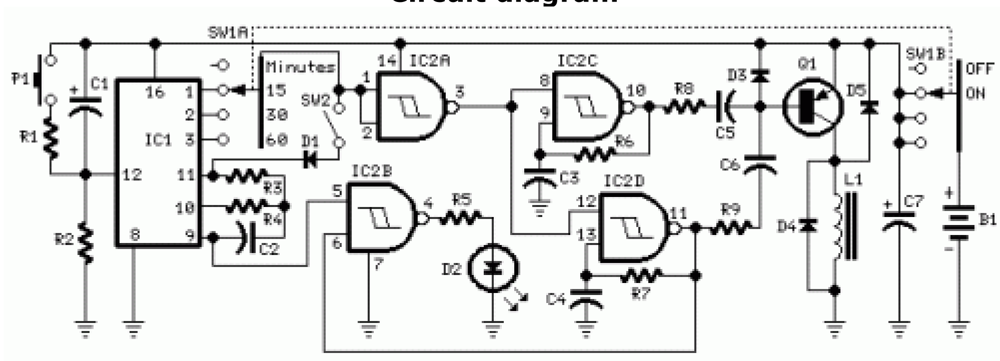
Electromagnets L2 to L4 were each found to substantially increase the range of the gun. In a forthcoming edition of EPE, the author will describe how readers may land a small projectile on Mars.

P497. Sleeping-Aid

Disclaimer: we can't claim or prove any therapeutic effectiveness for this device.

Based on electromagnetic-field radiation
Place it under the pillow - Built-in timer

Circuit diagram



Parts:
R1,R5 1K 1/4W Resistors
R2 10K 1/4W Resistor
R3,R6 10M 1/4W Resistors
R4,R7 2M2 1/4W Resistors
R8,R9 4K7 1/4W Resistors
C1,C7 47µF 25V Electrolytic Capacitors
C2 100nF 63V Polyester Capacitor
C3,C4 330nF 63V Polyester Capacitors
C5,C6 15nF 63V Polyester Capacitors
D1,D3,D4,D5 1N4148 75V 150mA Diodes
D2 LED (any type) (see Notes)
IC1 4060 14 stage ripple counter and oscillator IC
IC2 4093 Quad 2 input Schmitt NAND Gate IC
Q1 BC327 45V 800mA PNP Transistor
L1 Radiator coil (see Notes)
P1 SPST Pushbutton
SW1 2 poles 4 ways rotary switch
SW2 SPST Slider Switch
B1 9V PP3 Battery
Clip for PP3 Battery

Features:
Generates a natural electromagnetic-field
Makes easier to fall asleep
nduces a prolonged and sound sleep without drugs
No side effects

Device purpose:

Many people experienced sleeping well in natural surroundings, into a tent or a wooden hut. This fact is due not only to the healthy atmosphere but also from our unconscious ability to perceive natural Earth's magnetic-fields.

The circuit generates this type of Geo-magnetic-fields and lets us perceive them: in this manner our brain is surrounded by an ideal environment for a sound sleep.

(N.B. Basic ideas for this circuit are coming from German papers).

Use:

Select a timing option by means of the rotary switch SW1.
Choose 15, 30 or 60 minutes operation.
Select "Stop" or "Alternate" mode operation by means of SW2.

With SW2 closed (Stop mode operation) the electromagnetic radiation stops after the pre-set time is elapsed.

With SW2 opened (Alternate mode operation) the device operates for the pre-set time, then pauses for the same amount of time: this cycle repeats indefinitely.

Place the unit under the pillow and sleep like a log.

To reset a cycle press P1 pushbutton.

Circuit operation:

IC2C and IC2D generate two square waves at about 1.2 and 5 Hz respectively. These wave-forms are converted into 60µS pulses at the same frequencies by means of C5 & C6 and mixed at Q1's Base. This transistor drives the Radiator coil with a scalar series of pulses of 60µS length and 9V amplitude.

IC1, IC2A & IC2B form the timer section. C1 & R2 provide auto-reset of IC1 at switch-on. The internal oscillator of IC1 drives the 14 stage ripple counter and, after about 15 minutes, output pin 1 goes high. Pin 3 of IC2A goes low and stops IC2C & IC2D oscillation.

If SW2 is left open (Alternate mode operation), after 15 minutes pin 1 of IC1 goes low, pin 3 of IC2A goes high and oscillators are enabled again.

If SW2 is closed (Stop mode operation), the first time output pin 1 of IC1 goes high, the internal oscillator of the IC is disabled by means of D1. Therefore the circuit remains off until a reset pulse is applied to pin 12 by means of P1 or when the whole device is switched-off and then restarted.

The same thing occurs when SW1 is switched on 30 or 60 minutes positions, obviously changing time length.

IC2B drives pilot LED D2 which operates in the following three modes:

flashes quickly and almost randomly when the Radiator coil is driven
flashes somewhat slowly and regularly when the Radiator coil is pausing during the Alternate mode operation is off when the circuit auto-stops (Stop mode operation)

Notes:

L1 is obtained by winding randomly 600 turns of 0.2 mm. enameled wire on a 6 mm. diameter, 40 mm. long, steel bolt. Secure the winding with insulating tape.

Mean current drawing is about 7mA, decreasing to less than 4mA during pauses when in Alternate mode operation.

Battery life can be dramatically increased omitting LED D2 and its associated resistor R5.
Use a plastic box to enclose the circuit: metal cases can severely limit electromagnetic radiation.

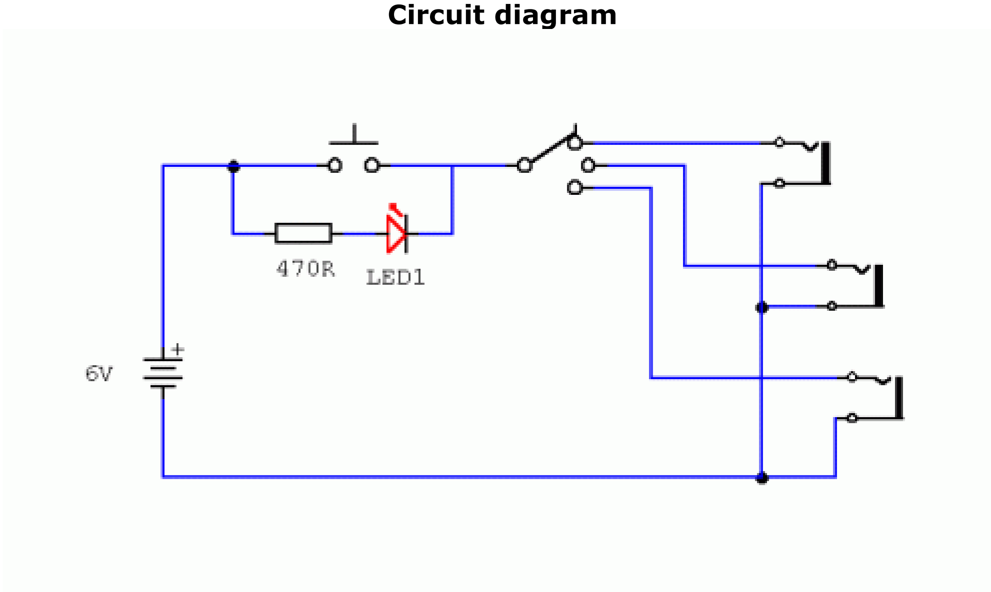
P498. Multi Rocket Launcher

Description
This launch controller can be used with low voltage battery igniters, which fire rocket engines in model rockets such as the Estes range. These circuits are electrical, only switches and contacts are involved. First the circuit for a single rocket:

The only thing to note here is that this controller uses "C" cells, providing more current than "AA" batteries and that the push button switch has contacts rated 1 amp or higher. The wire to the igniter is isolated via a 3.5 inch jack plug and socket. Connect the igniter, then plug in to control box and then press button, making sure you are the recommended distance away. Below is an internal and external picture of my controller:-

Ok, does anyone think my grass needs cutting? Moving on to the multi launch controller:-

Circuit diagram



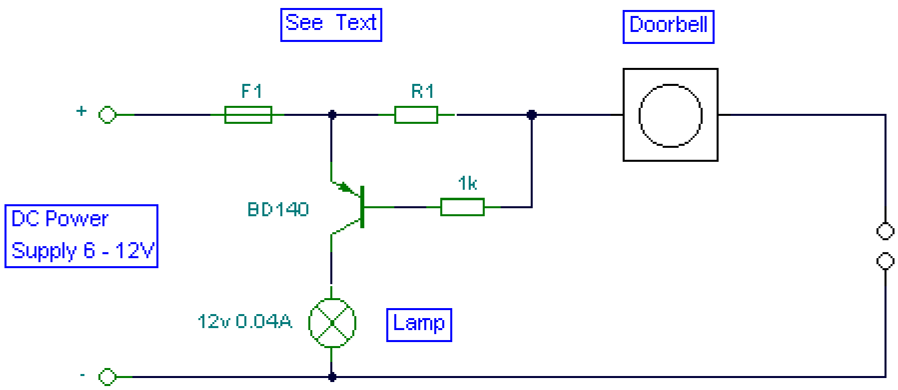
Once again, nothing too complicated. The single pole rotary switch has contacts rated 1 amp so can easily handle the 400 mA of current that the igniter takes. Here three rockets can be launched by rotating the switch. The Green LED provides continuity between battery,igniter and wiring. This extinguishes as the launch switch is pressed. Once again, observe safety precautions.

Mission Critical:

Heres a story about my own Estes space shuttle, on its one and only mission. This is what happens when you're too eager to get a rocket flying and don't pay attention to balance. It was a late November afternoon in 1998 when I first launched the shuttle. Lift off was perfect, no wind, clear skies (doesn't sound at all like England), and the rocket motor was a C6-5. At launch, the rocket motor fired, though lift off acceleration was not as good as I expected, I blame too much paint and excess weight). As my rocket reached apogee, (estimated height about 100 meters) and acceleration became zero there was no immediate separation between the shuttle and main fuel tank. There was of course a delay of 5 seconds between the rocket engine blowing its ejection charge. Five seconds is a long time too wait, especially when the forces excerted of gravity take hold. At 9.8 meters/second, the rocket plunged towards earth losing at least half its height. Then, thankfully the ejection charge blew, separation was achieved the the main fuel tank with SRB's drifted slowly down to earth on its parachute. However all was not well with the shuttle. It was only after separation that I realized there was too much nose weight (hence a heavy lift up and not enough height). The shuttle did glide, but only at about 45 degrees downward, picking up speed until eventually it crash landed in some soft mud. Luckily it survived the impact, I cleaned it up but have not yet removed the nose cone to balance the shuttle. I like it as an ornament anyway.

P499. Remote Doorbell Warning Switch

Circuit diagram



Important Note:

This circuit should only be used with the solenoid type chime doorbells, the electronic type that play tunes will not work here.

Notes:

The hardest part for this circuit was the title. It is quite easy to miss the sound of a doorbell if you are watching TV , this circuit gets round the problem by providing a visual indication, i.e. a lamp. As an alternative, a LED could also be used. You could just parallel a lamp across the doorbell, but this would mean extra drain from the doorbell batteries or transformer. Using a series resistor R1 actually reduces current flow , and if run from batteries, will give them a longer life. The value of R1 is chosen so that about 0.6 to 0.7 volts is dropped across it, and the doorbell should

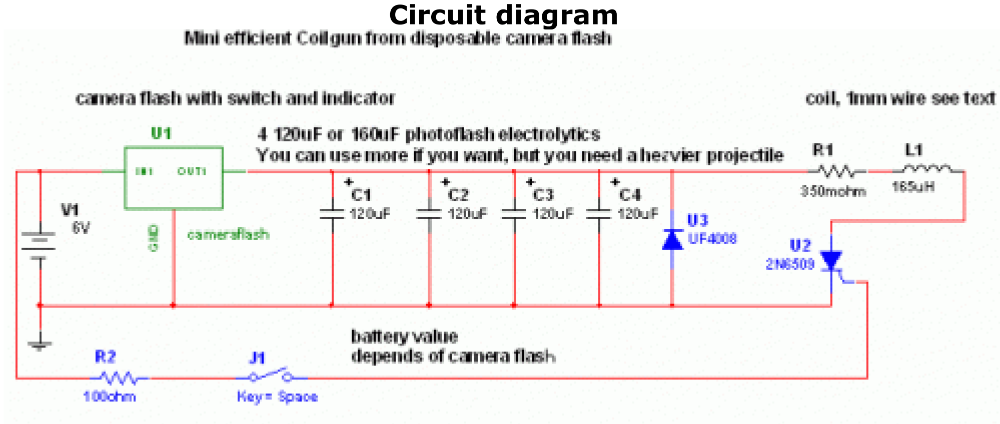
still ring. I used a combination of a 22 ohm resistor in parallel with a 50 ohm. The doorbell still rang and circuit operated correctly. I used to have an electromechanical counter that registered each time when someone pressed the switch....in fact, I remember a time when I had more "hits" at my doorbell then at my web site=:)

P500.

Mini efficient coil launcher from disposable camera flash

Disclaimer: I don't accept any responsibility for the damages done with this device to peoples, things, animals, fragile things etc , if you build it, you must accept this condition.

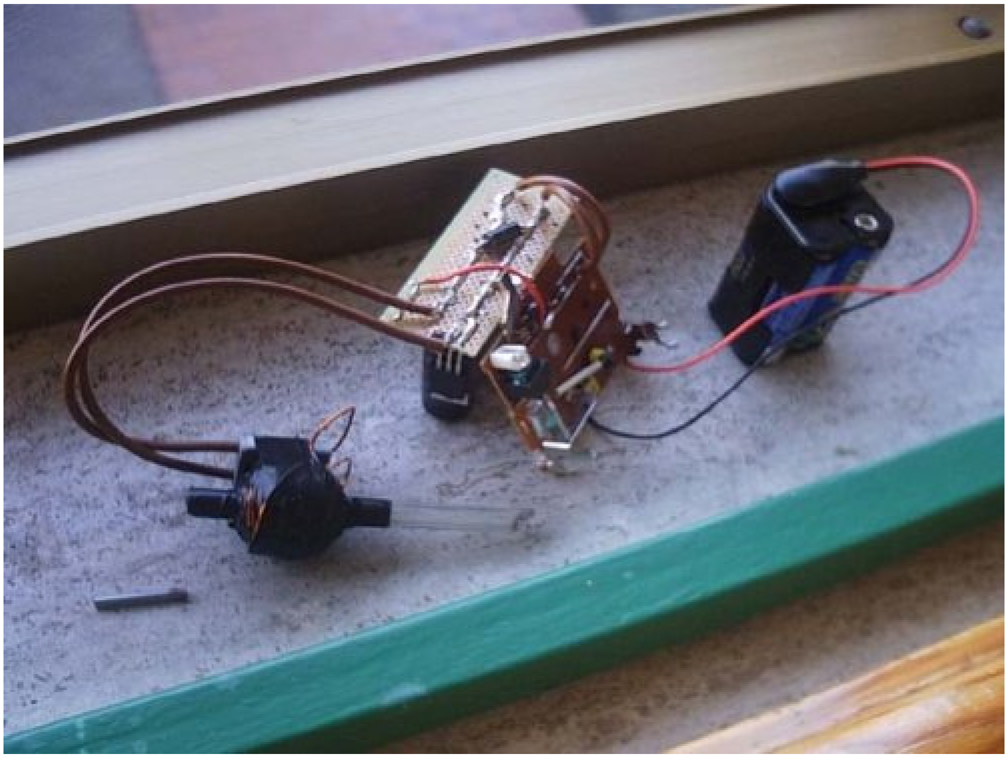
Circuit diagram



This is a fun and non-dangeros project for those people who like to throw projectiles magnetically. It simply works by placing a ferromagnetic projectile at one end of a coil and pulsing some power in it. The trick is to switch off power when the projectile is at the middle of the coil, there are some ways to do it but it isn't important now. The second trick is to use a coil as close as possible to projectile to waximize coupling and the third to avoid saturation, that means keeping the current not to high.

I've been messing with coil launchers for a year. The first model was a straw with some wire wrapped on it and an electrolityc capacitor (200V) pulsed in it. Lots of sparks and metal flying but was able to shoot a nail accross my room. I started esperimentation wrapping wire on glass and using more litycs charged by mains power, very bulky and disappointing (100J of energy where only able to blast through 2 sheets). After holydays I started more mature experimentation employing SCRs (solid state switching) photoflash electrolytics and optical sensors, and built a bi-coil launcher (2 stages), complicated but poweful (blasted through a can) but the timing is critical, so transient simulations were a must (and a L-C-R meter). The next launcher will be mosfet-switched with 3 coils and optical sensors, but i don't have the funds/parts yet to build such an expensive launcher, but already designed plans and models. For now i decided to build a small funny coil launcher using one scr and coil on glass. Using my LCR meter and multisim simulator i designed it for max efficiency.

For first you need some disposable camera flashes, so try to search at your local photo shop. You need 4 of more of them. Desolder the caps and collect them. They have ratings of 330V 120-160uF and can survive pulses up to 300A (each), or even dead shorts (but don't do it because it is quite a bang). Paralleling them reduces the ESR (internal resistance) and ESL and highers peak current capability. I used 4 of them and my coil launcher has a pulse current of 400A (about 100A for cap). The more caps , the more energy but more longer pulse, so the additional energy may slow down the projectile instead of fastening it so I would advice to keep them only 4. I trusted the simulations and have almost broken a window with this thing ;-) fortunately the curtains slowed it down .

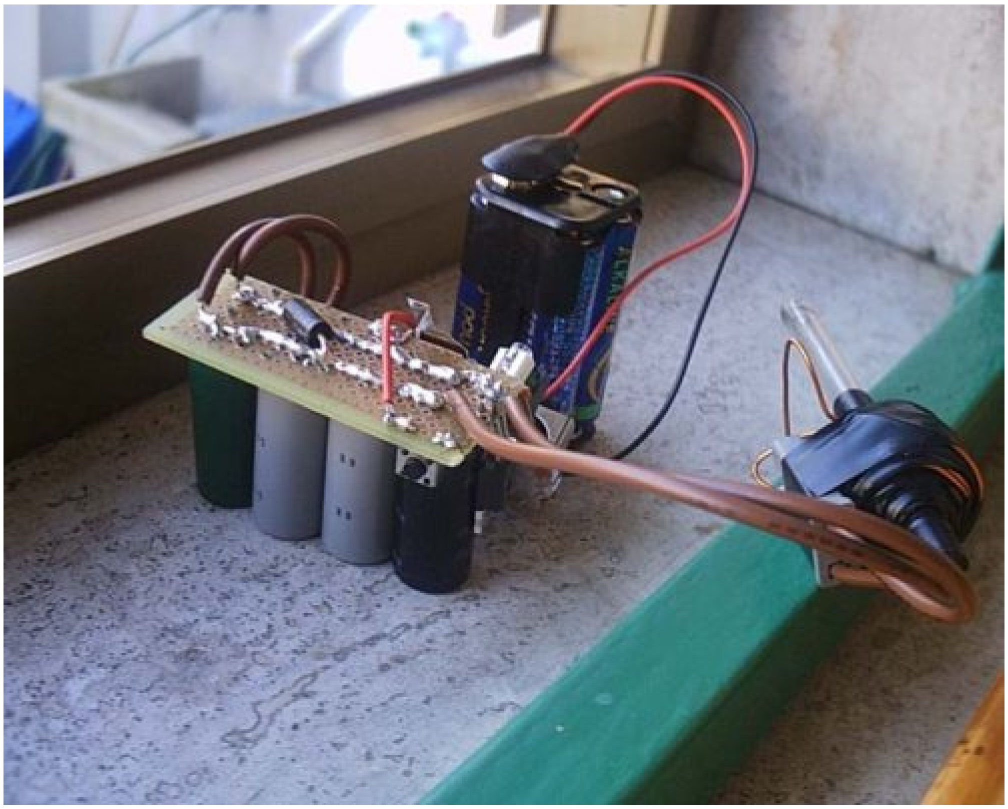


Concerning the charging circuit, use the largest you got, and try to use more batteries than originally if you want a fast charge. I used a max kodak disposable flash and it works fire with 4 1.5V batteries (originally it was designed to use one) and doesn't burn out. The caps where soldered on a small breadboard with parallel tracks made with lots of solder (otherwise the solder will blow).

The coil was made with 200 turns distributed on 10 layers (rembember to insulate eachover) of insulated magnet wire with 1mm diameter on a glass pipe with 6 mm external diameter and 3 mm internal diameter. Also plastic works good as barrel but must be hard , metals must be NON-Ferromagnetic and must have a cut along the barrel lenght (to limit eddy currents).

The resistance is 350 milliohm and inductance is 165 uH (according to my LCR meter) giving a pulse lenght of 1 ms (Multisim simulation) and peak current of 400A, limited by inductance. Using more caps would increase pulse current because the resistance is low and the current is Inductance-limited, so i advice to use only 4 caps (maximum 5).

Concerning the switching i used 2N6509 SCRs (Onsemi) (25A 800V) which have a pulse rating of 300A x 6 ms (450 x 1ms). They are very good cheap and small and requires small signal to drive. A reverse diode was added to the caps because the simulations showed a peak reverse voltage in capacitors (it is an undamped LCR circuit) that could damage them. This solution limits reverse charging (to -0.5 V to 1V) and makes the current decay better reducing the such-back effect. The projectile is a 2.5 mm diameter nail with the same lenght as the winding.



When placing the projectile the projectile starting position is critical, make various shots at different positions to see which is better.

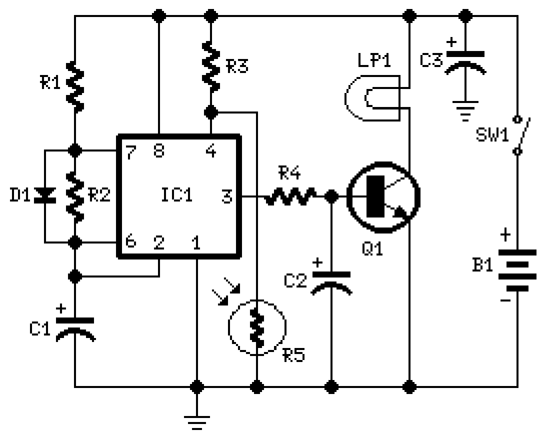
Rembember: this circuit is low power but propels metal projectiles at speeds of 20-25 m/s and although can make no harm (to skin) it would break fragile things, also dangerous for eyes so don't point to peoples's or animals's head . Use it to shoot down small things or to shoot people's back (but watch who you shoot, some peoples don't like such jokes and you would be in trouble...)

There is alse electrical shock hazard. This circuit stores 30 or more Joules at 310V and can shock you badly, use only one hand and insulate high voltage sections. Be wise, have fun, learn, and be safe.

P501. Nocturnal Animals Whisker

A low-rate flashing lamp drives away undesired visitors
Automatic on-off operation

Circuit diagram



Parts:
R1 100K 1/4W Resistor
R2 2M2 1/4W Resistor
R3 10K 1/4W Resistor (see Notes)
R4 4K7 1/4W Resistor
R5 Photo resistor (any type, see Notes)
C1,C2,C3 47µF 25V Electrolytic Capacitors
D1 1N4148 75V 150mA Diode
IC1 7555 or TS555CN CMos Timer IC
Q1 BD681 100V 4A NPN Darlington Transistor
LP1 6V 3W Lamp (see Notes)
SW1 SPST Switch
B1 6V 1.2A Lead acid sealed rechargeable Battery (see Notes)

Device purpose:

This circuit proved very useful in keeping away from a terrace or a porch some bats and other nocturnal animals. You can use it for similar or different purposes. The lamp illuminates at a 4-5 seconds delay and stays off about one minute and 15 seconds. The photo resistor allows automatic switch-on of the circuit at dusk and switch-off at dawn. Supposing an eight hours operation per night, the lamp stays on for a total of about 30 minutes, allowing great current economy.

Circuit operation:

IC1 is wired as an astable multivibrator with on and off time-delays as explained before. R1 & C1 set the on time-delay, R2 & C1 set the off time-delay. As there is no critical parameter, you can set these delays at your wish. Q1 is the lamp driver and can feed rather big lamps. C2 prevents some brief instability when voltage at pin 4 of IC1 is very close to switching threshold.

Notes:

Mount the photo resistor's sensitive surface at an angle of 90 degrees or more compared with the lamp, in order to avoid light interaction.

Owing to the photo resistor's type or to suit your own special needs, R3 can be varied to set the operating threshold.

If you are not needing automatic on-off operation, omit R3 & R5 and connect pin 4 of IC1 to positive supply.

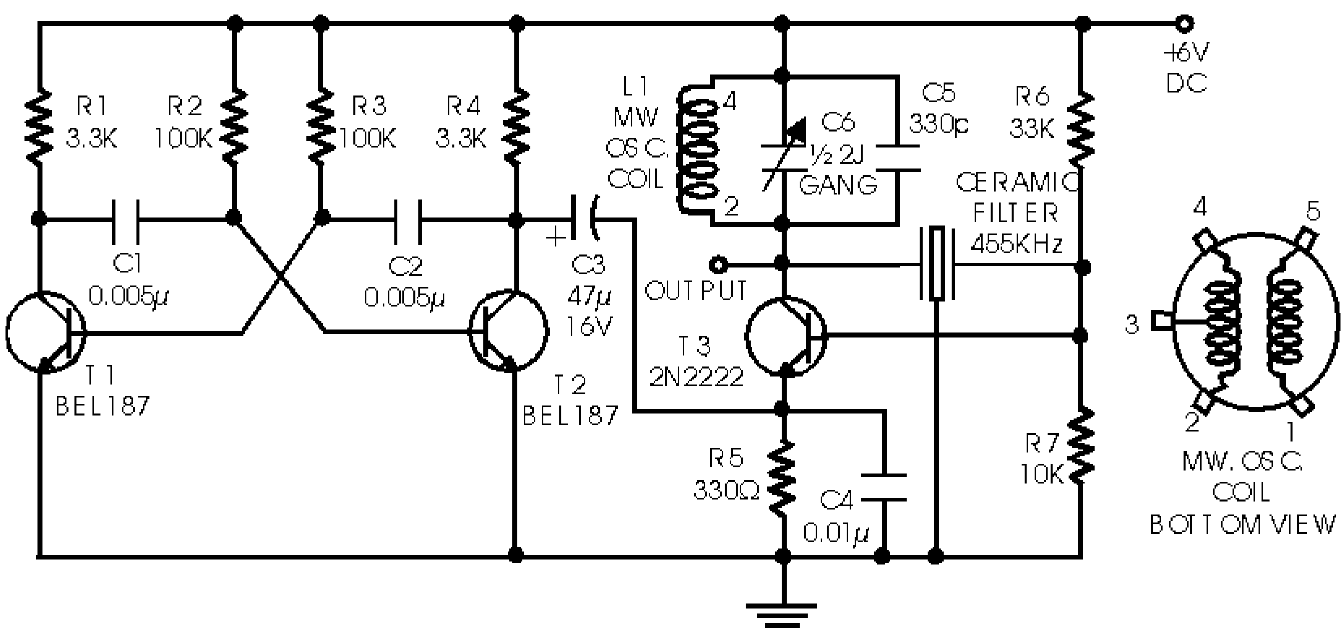
The lamp can be any 6V type up to 10-12W, but a 3W one is a very good compromise.

Batteries can be of the rechargeable type: lead acid sealed, NI-CD, NI-MH packages ranging from 3.6 to 12V, making sure that suitable lamps are provided.

Using 1.2 Ampere-hour batteries, you should probably recharge them once a week or less.

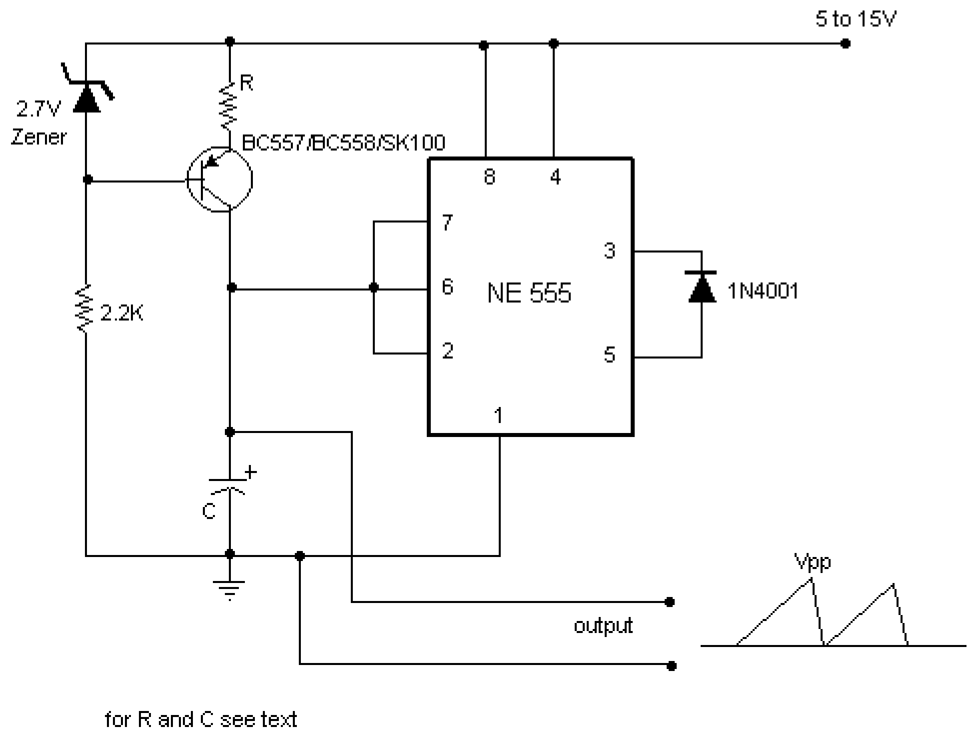
Obviously you can feed permanently the circuit by means of a suitable mains power supply.

P502. Simple IF Signal Generator



Here is a versatile circuit of IF signal generator which may be of interest to radio hobbyists and professionals alike.Transistors T1 and T2 form an astable multivibrator oscillating in the audio frequency range of 1 to 2 kHz. RF oscillator is built around transistor T3. Here again a 455kHz ceramic filter/resonator is employed for obtaining stable IF. The AF from multivibrator is coupled from collector of transistor T2 to emitter of transistor T3 through capacitor C3. The tank circuit at collector of transistor T3 is formed using medium wave oscillator coil of transistor radio, a fixed 100pF capacitor C5 and half section of a gang capacitor (C6). The oscillator section may be easily modified for any other intermediate frequency by using ceramic filter or resonator of that frequency and by making appropriate changes in the tank circuit at collector of transistor T3. Slight adjustment of bias can be affected by varying values of resistors R6 and R7, if required.

P503. Sawtooth wave generator



Sawtooth wave generators using opamp are very common. But the disadvantage is that it requires a bipolar power supply.

A sawtooth wave generator can be built using a simple 555 timer IC and a transistor as shown in the circuit diagram.

The working of the circuit can be explained as follows:

The part of the circuit consisting of the capacitor C, transistor,zener diode and the resistors form a constant current source to charge the capacitor. Initially assume the capacitor is fully discharged. The voltage across it is zero and hence the internal comparators inside the 555 connected to pin 2 causes the 555's output to go high and the internal transistor of 555 shorting the capacitor C to ground opens and the capacitor starts charging to the supply voltage. As it charges, when its voltage increases above 2/3rd the supply voltage, the 555's output goes low, and shorts the C to ground, thus discharging it. Again the 555's output goes high when the voltage across C decreases below 1/3rd supply. Hence the capacitor charges and discharges between 2/3rd and 1/3rd supply.

Note that the output is taken across the capacitor. The 1N4001 diode makes the voltage across the capacitor go to ground level (almost).

The frequency of the circuit is given by:

f = (Vcc-2.7)/(R*C*Vpp)

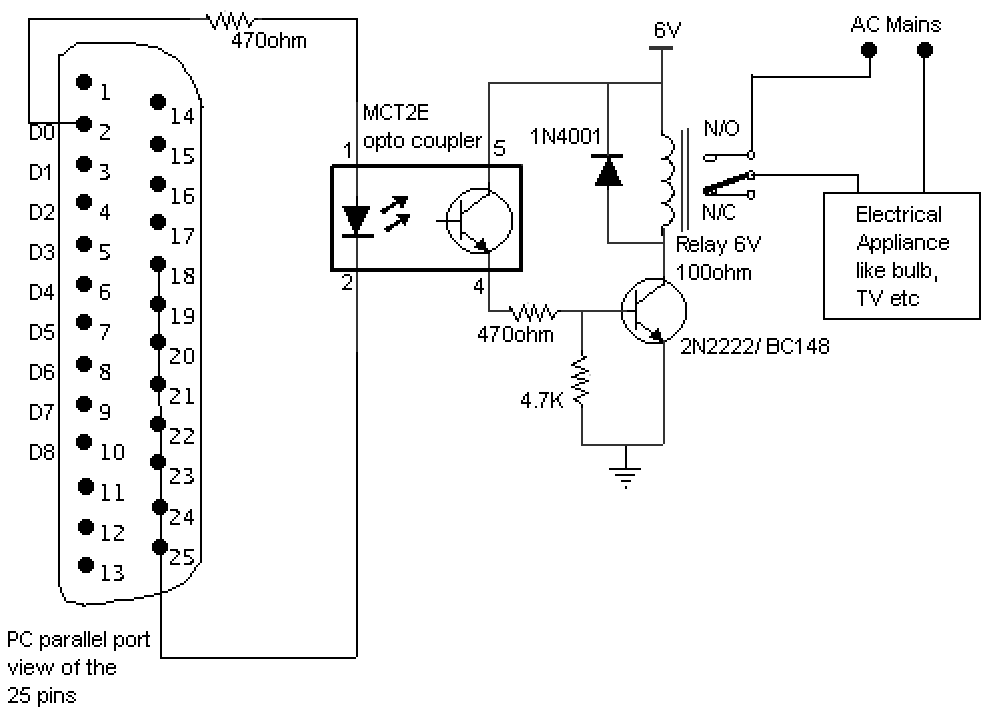
where:

Vcc= Supply voltage.

Vpp= Peak to peak voltage of the output required.

Choose proper R,C,Vpp and Vcc values to get the required 'f' value.

P504. Control electrical appliances using PC



Here is a circuit for using the printer port of a PC, for control application using software and some interface hardware. The interface circuit along with the given software can be used with the printer port of any PC for controlling up to eight equipment.

The interface circuit shown in the figure is drawn for only one device, being controlled by D0 bit at pin 2 of the 25-pin parallel port. Identical circuits for the remaining data bits D1 through D7 (available at pins 3 through 9) have to be similarly wired. The use of opto-coupler ensures complete isolation of the PC from the relay driver circuitry.

Lots of ways to control the hardware can be implemented using software. In C/C++ one can use the outportb(portno,value) function where portno is the parallel port address (usually 378hex for LPT1) and 'value' is the data that is to be sent to the port. For a value=0 all the outputs (D0-D7) are off. For value=1 D0 is ON, value=2 D1 is ON, value=4, D2 is ON and so on. eg. If value=29

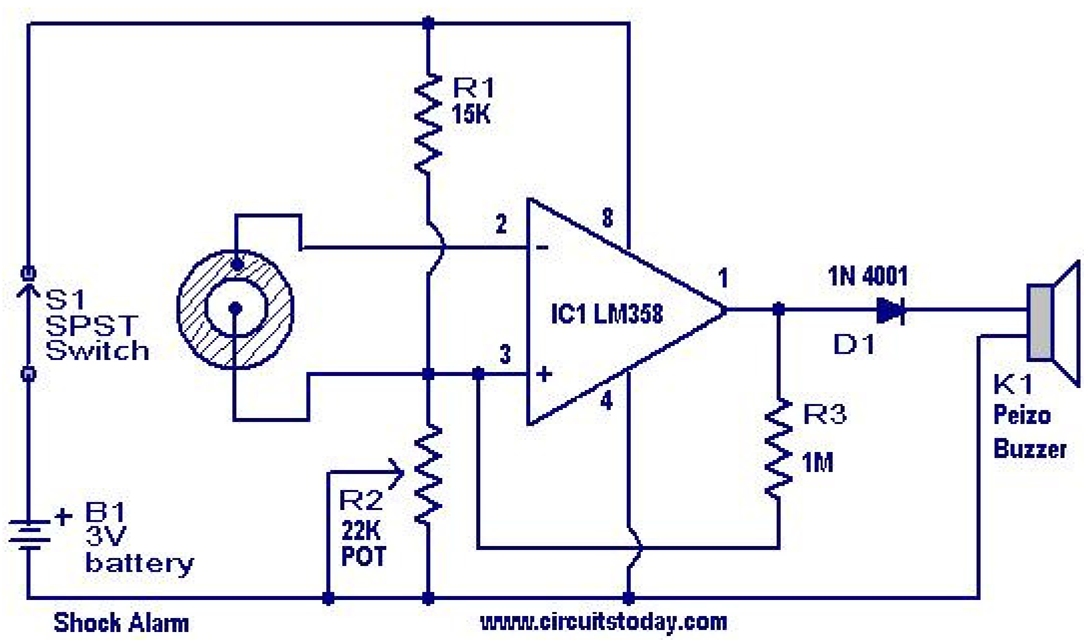
P505. Shock alarm circuit_

A Description.

Here is a simple shock sensitive alarm circuit that has many many applications fro home to automobiles.The main application of this circuit is to use it as an anti theft alarm in automobiles.A peizo electric sensor is used as the shock sensor which has to mounted on the door which you have to protect.

Here the IC1Â LM 3558 is wired as an inverting Schmitt Trigger.The POT R1 sets the threshold voltage of the circuit.R1 is used as a feed back resistor.When not activated the out put from the piezo sensor will be low and so do the output of the IC.When the piezo sensor is activated its output voltage goes high and triggers the Schmitt trigger.This results the beeping of the buzzer.The buzzer remains beeping for some time even if the vibration is removed.this is because the increase in the inverting input has little effect when the IC is triggered and the state can’t be easily reversed.

Circuit diagram with Parts list .



Notes.

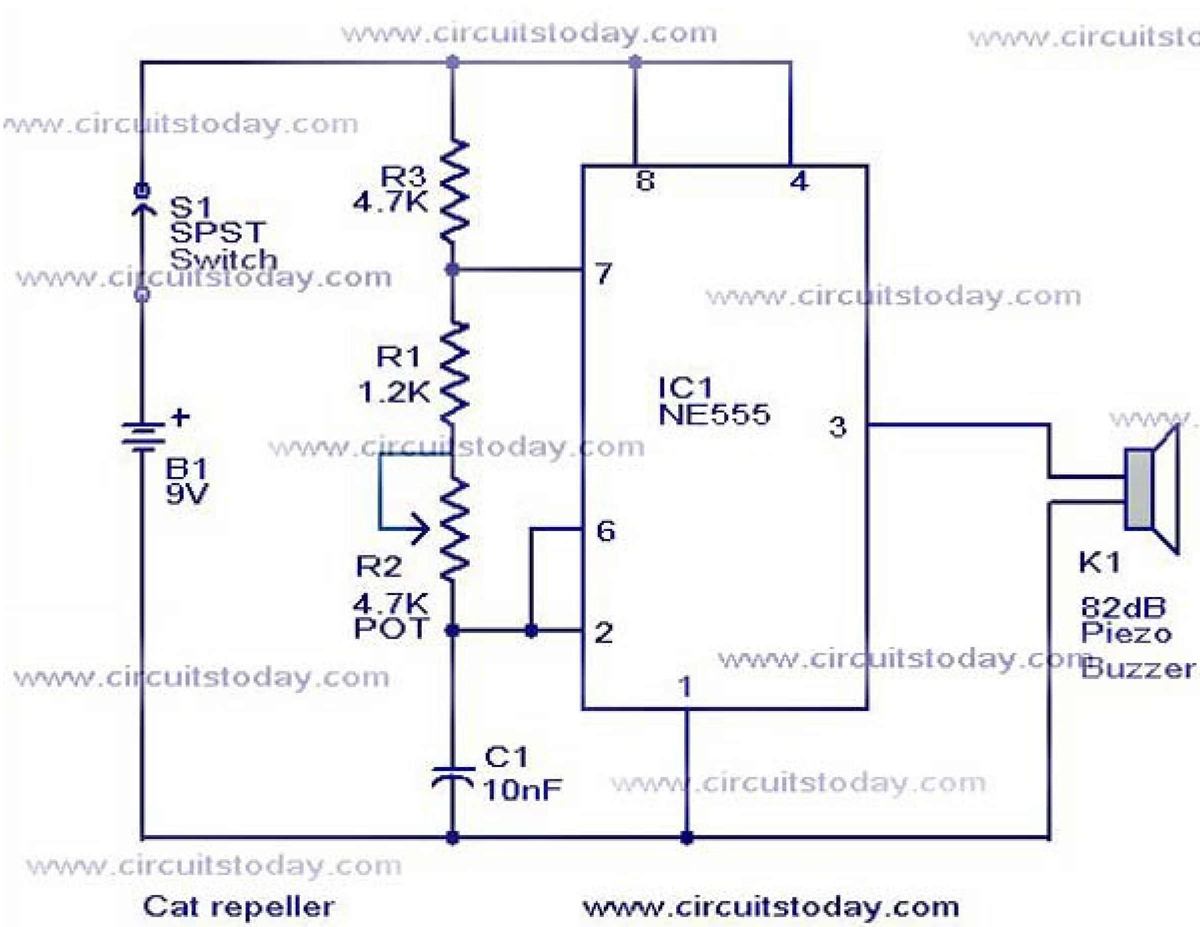
- A 3 v battery can be used asÂ power supply.
- Fix the sensor firmly to the surface,where ever you place it.
- It is always good to place the sensor near to the door knob.
- Adjust R2 to obtain the required sensitivity.
- Assemble the circuit on a good quality PCB or common board.
- Use a IC holder for mounting the IC.

P506. Cat repeller circuit

With this cool cat repeller circuit you could chase the catsÂ offÂ from any where you want.In fact, I designed this circuit to chase my cat from my computer table.Most of the animals like cats respond violently to ultrasonic sound and in fact it's the best way to chase them off.This principle is employed in this circuit.

The circuit here is nothing but an astable multi vibrator wired around NE555 (IC1).The produces an ultrasonic sound in the range 15-20Khz.The NE 555 is enough to drive a small piezo buzzer and no amplification stages are needed.The POT R2 can be used to adjust the frequency of sound.

Circuit diagram with Parts list.Â



Notes.

- The circuit can be powered from a 9V battery or the power can be tapped from your computer SMPS.
- The circuit can be assembledÂ on a general purpose PCB.

Authors view.Â

I do not guarantee the full effectiveness of the circuit.You have try a lot of frequency settings to make your cat feel discomfort at last.More over the cat may get accustomed to the sound after some time.For me the circuit was only a partial successÂ and now my cat feels nothing even if the speaker is placed in it's ear.You try your luck.Best of luck.

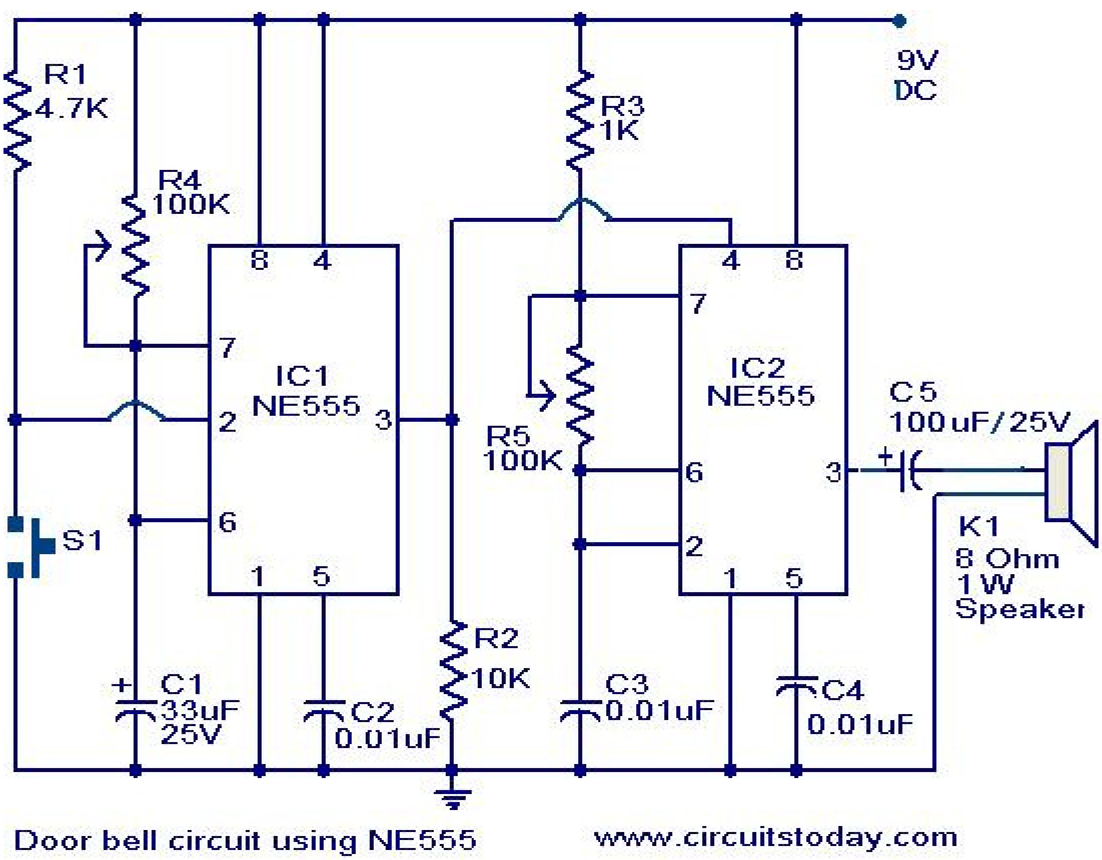
P507. Door bell circuit using NE555

Description.

The main part of this doorbell circuit are two NE555 timer ICs.When some one presses switch S1 momentarily ,the loud speaker sounds a bell tone as long as the time period of the monostable multivibrator built around IC1.

When the switch S1 pressed, IC1 is triggered at its pin 2 and output pin 3 goes high for a time period previously set by the values of POT R4 and POT R5.When the output ofIC1 goes high it resets IC2 and it starts to oscillate to make a bell sound through the speaker.The IC2 is configured as an astable multivibrator whose oscillation frequency can be varied with the help of POT R5.By adjusting the values of R4 & R5, modifications on the tone are possible.

Circuit diagram with Parts list.



Notes.

- The circuit has to assembled on a good quality PCB or common board.
- The IC1 & IC2 has to be mounted on IC holders.
- Power the circuit from a 9V battery or 9V DC power supply.
- Switch S1 is push button switch.

P508. Digital code lock

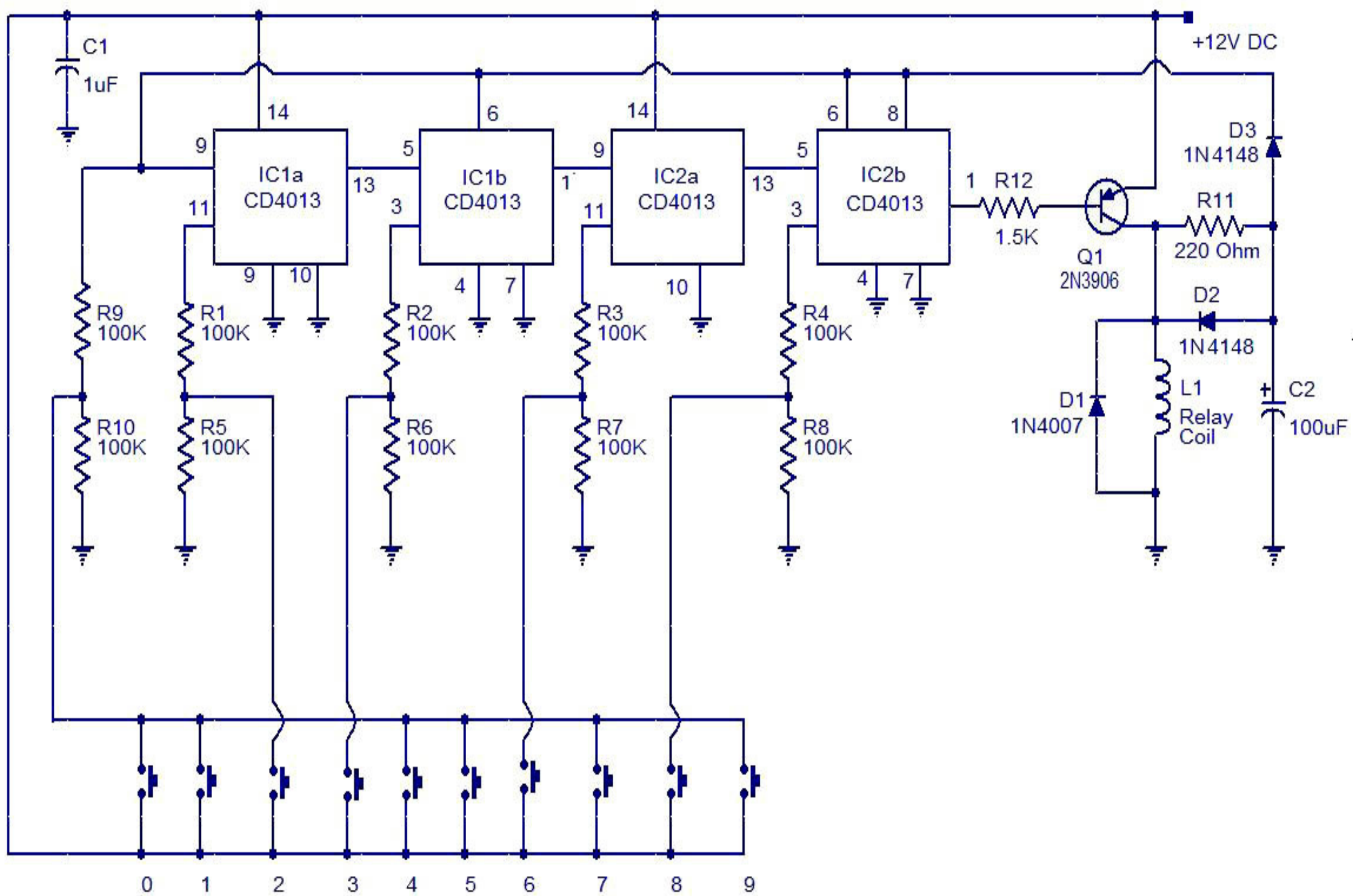
Description.

This is a simple but effective code lock circuit that has an automatic reset facility. The circuit is made around the dual flip-flop IC CD4013.Two CD 4013 ICs are used here. Push button switches are used for entering the code number. One side of all the push button switches are connected to +12V DC. The remaining end of push buttons 2,3,6,8 is connected to clock input pins of the filp-flops. The remaining end of other push button switches are shorted and connected to the set pin of the filp-flops.
The relay coil will be activated only if the code is entered in correct sequence and if there is any variation, the lock will be resetted. Here is correct code is 2368.When you press 2 the first flip flop(IC1a) will be triggered and the value at the data in (pin9) will be transferred to the Q output (pin13).Since pin 9 is grounded the value is â€œ0â€ and so the pin 13 becomes low. For the subsequent pressing of the remaining code digits in the correct sequence the â€œ0â€ will reach the Q output (pin1) of the last flip flop (IC2b).This makes the transistor ON and the relay is energised.The automatic reset facility is achieved by the resistor R11 and capacitor C2.The positive end of capacitor C2 is connected to the set pin of the filp-flops.When the transistor is switched ON, the capacitor C2 begins to charge and when the voltage across it becomes sufficient the flip-flops are resetted. This makes the lock open for a fixed amount of time and then it locks automatically. The time delay can be adjusted by varying the values of R11 and C2.

Notes.

- Assemble the circuit on a good quality PCB.
- The circuit can be powered from 12V DC.
- Mount the ICs on holders.
- The L1 can be a 12V, 200 Ohm SPDT relay.
- Capacitor C1 should be tantalum type.
- The C1 and C2 must be rated at least 25V.

Circuit diagram with Parts list.



Digital code lock using CD 4049

www.circuitstoday.com

P509.
Simple Electronic Combination Lock using IC LS 7220

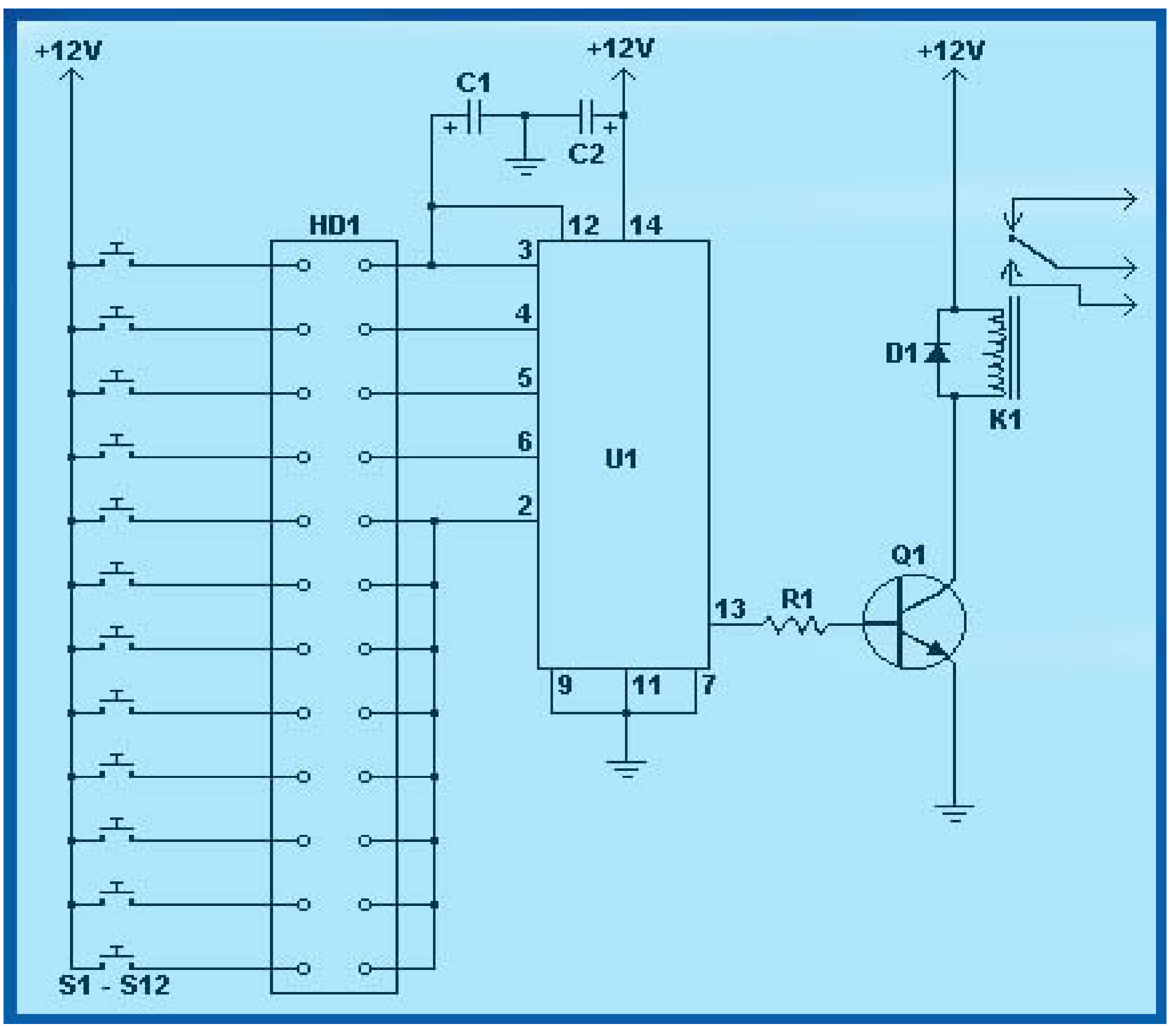
Description

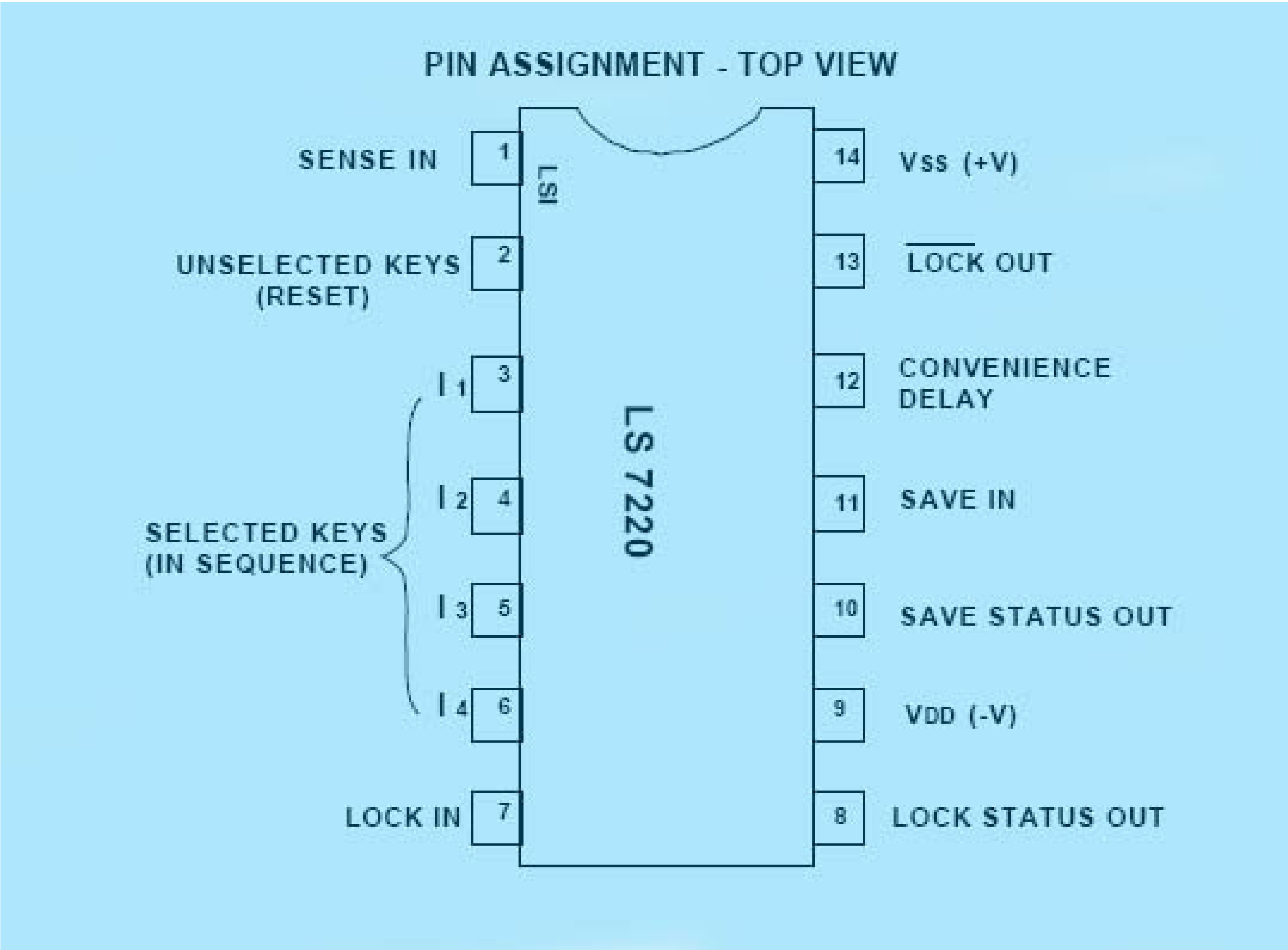
This is the circuit diagram of a simple electronic combination lock using IC LS 7220.This circuit can be used to activate a relay for controlling (on & off) any device when a preset combination of 4 digits are pressed.The circuit can be operated from 5V to 12V.

To set the combination connect the appropriate switches to pin 3,4,5 and 6 of the IC through the header.As an example if S1 is connected to pin 3, S2 to pin 4 , S3 to pin 5, S4 to pin 6 of the IC ,the combination will be 1234.This way we can create any 4 digit combinations.Then connect the rest of the switches to pin 2 of IC.This will cause the IC to reset if any invalid key is pressed , and entire key code has to be re entered.

When the correct key combination is pressed the out put (relay) will be activated for a preset time determined by the capacitor C1.Here it is set to be 6S.Increase C1 to increase on time.

For the key pad, arrange switches in a 3X4 matrix on a PCB.Write the digits on the keys using a marker.Instead of using numbers I wrote some symbols!.The bad guys will be more confused by this.





Parts List

C1 - 1uF 25V Electrolytic Capacitor
C2 - 220uF 25V Electrolytic Capacitor
R1 - 2.2K 1/4W Resistor
Q1 - 2N3904 NPN Transistor 2N2222
D1 - 1N4148 Rectifier Diode 1N4001-1N4007
K1 - 12V SPDT Relay Any appropriate relay with 12V coil
U1 - LS7220 Digital Lock IC
S1-S12 SPST Momentary Pushbutton Keypad (see notes)
HD1 - 12 Position Header

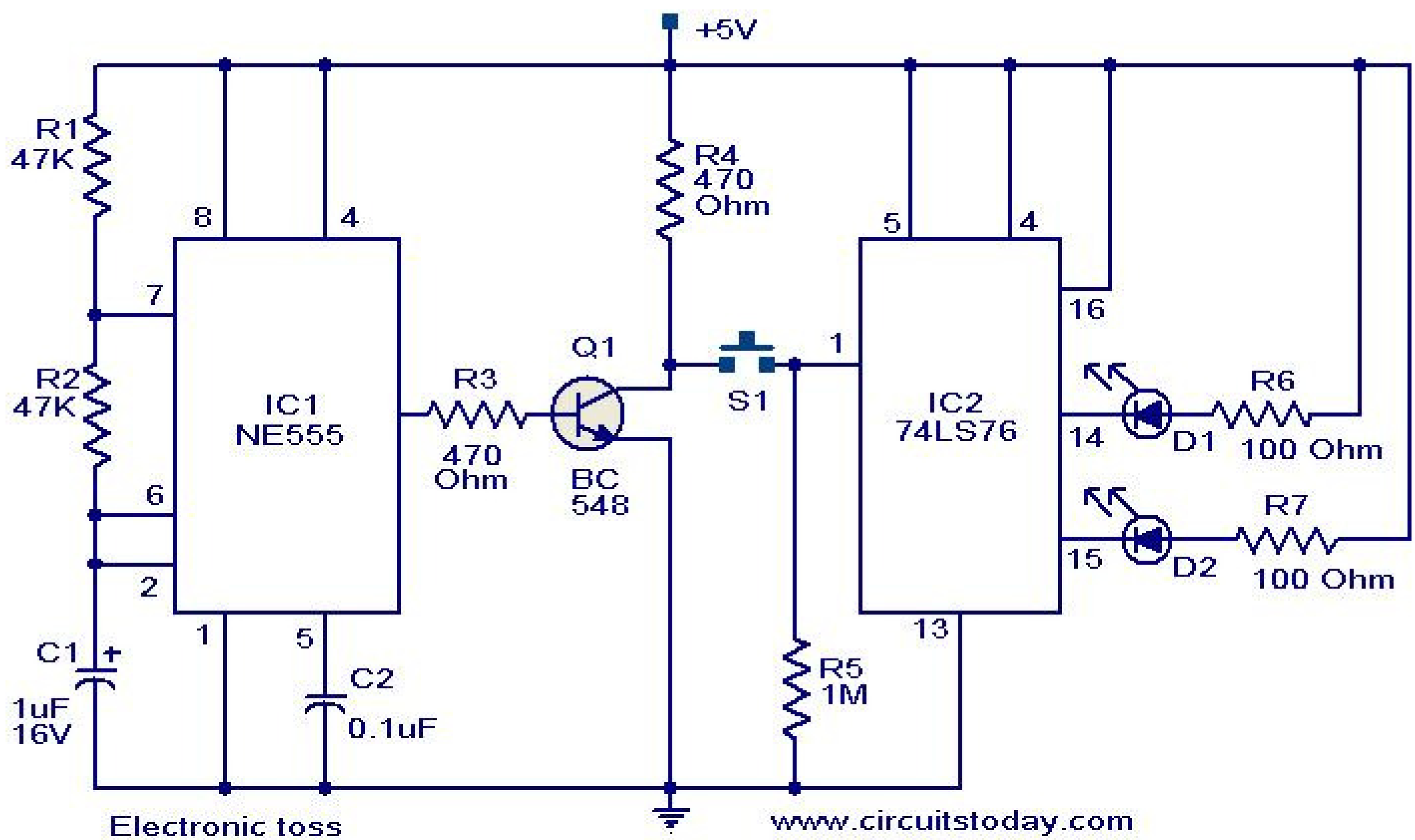
P510. Electronic toss circuit_

Description.

The circuit given here can be used for tossing head or tail. There are many games in which a tossing is required to start and this circuit can be used in all such instances.

The circuit uses two ICs NE 555 timer (IC1) and 74LS76 dual JK flip flop (IC2).The IC 1 is wired as an astable multi vibrator operating at 10Hz.The output of IC1 is inverted by using the transistor Q1.The collector of Q1 is connected to the pin 1 of IC2 via the push button switch S1.The IC2 is wired in toggle mode. When push button S1 is pressed the output pins 14 and 15 of IC2 starts toggling in state. The LEDs connected to these pins also toggles (Since the frequency of toggling is 10Hz, we feel both LEDs glowing).When push button S1 is released either one of the LED remains ON indicating the head or tail.

Circuit diagram with Parts list.



Notes.

- The circuit can be powered from 5 V DC.
- Switch S1 is a push button switch.
- The ICs must be mounted on holders.
- The circuit can be assembled on a general purpose PCB.

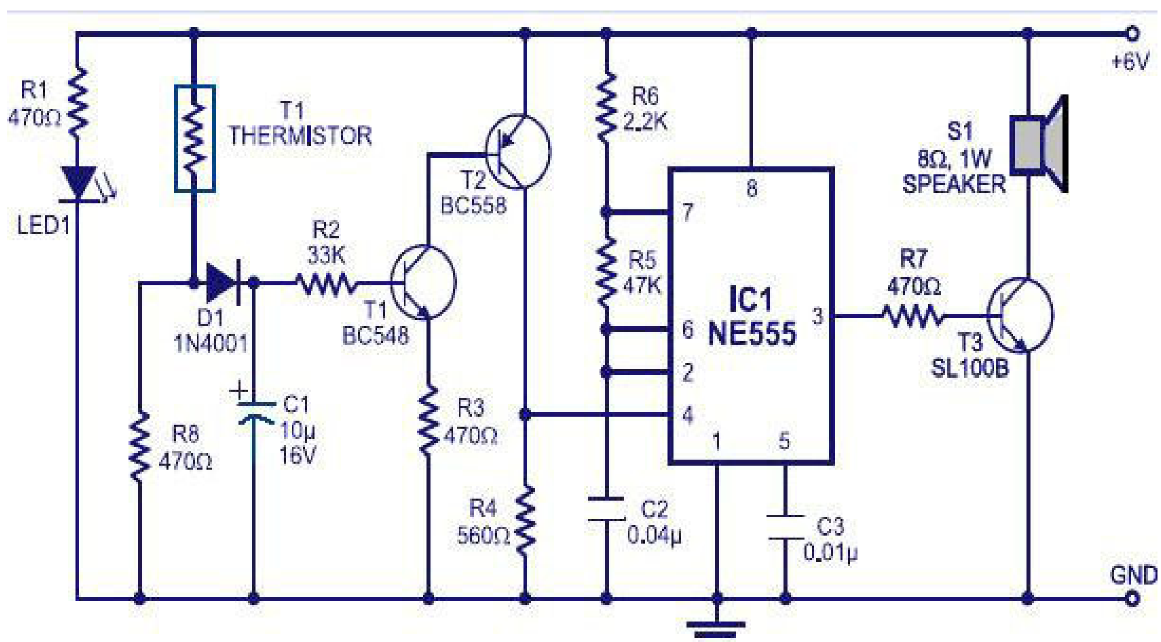
P511. Fire alarm circuit

Description.

Many fire alarm circuits are presented here,but this time a new circuit using a thermistor and a timer to do the trick. The circuit is as simple and straight forward so that , it can be easily implemented.The thermistor offers a low resistance at high temperature and high resistance at low temperature. This phenomenon is employed here for sensing the fire.

The IC1 (NE555) is configured as a free running oscillator at audio frequency. The transistors T1 and T2 drive IC1. The output(pin 3) of IC1 is couples to base of transistor T3(SL100), which drives the speaker to generate alarm sound. The frequency of NE555 depends on the values of resistances R5 and R6 and capacitance C2.When thermistor becomes hot, it gives a low-resistance path for the positive voltage to the base of transistor T1 through diode D1 and resistance R2. Capacitor C1 charges up to the positive supply voltage and increases the the time for which the alarm is ON. The larger the value of C1, the larger the positive bias applied to the base of transistor T1 (BC548). As the collector of T1 is coupled to the base of transistor T2, the transistor T2 provides a positive voltage to pin 4 (reset) of IC1 (NE555). Resistor R4 is selected s0 that NE555 keeps inactive in the absence of the positive voltage. Diode D1 stops discharging of capacitor C1 when the thermistor is in connection with the positive supply voltage cools out and provides a high resistance path. It also inhibits the forward biasing of transistor T1.

Circuit diagram with Parts list.



Notes.

- The circuit can be powered from a 6V battery or a 6V power supply.
- ***Click Here !*** for the circuit diagram of a power supply circuit for this project.
- The thermistor can be mounted on a heat resistant material like mica to prevent it from damage due to excessive heat.
- The LED acts as an indication when the power supply is switched ON.

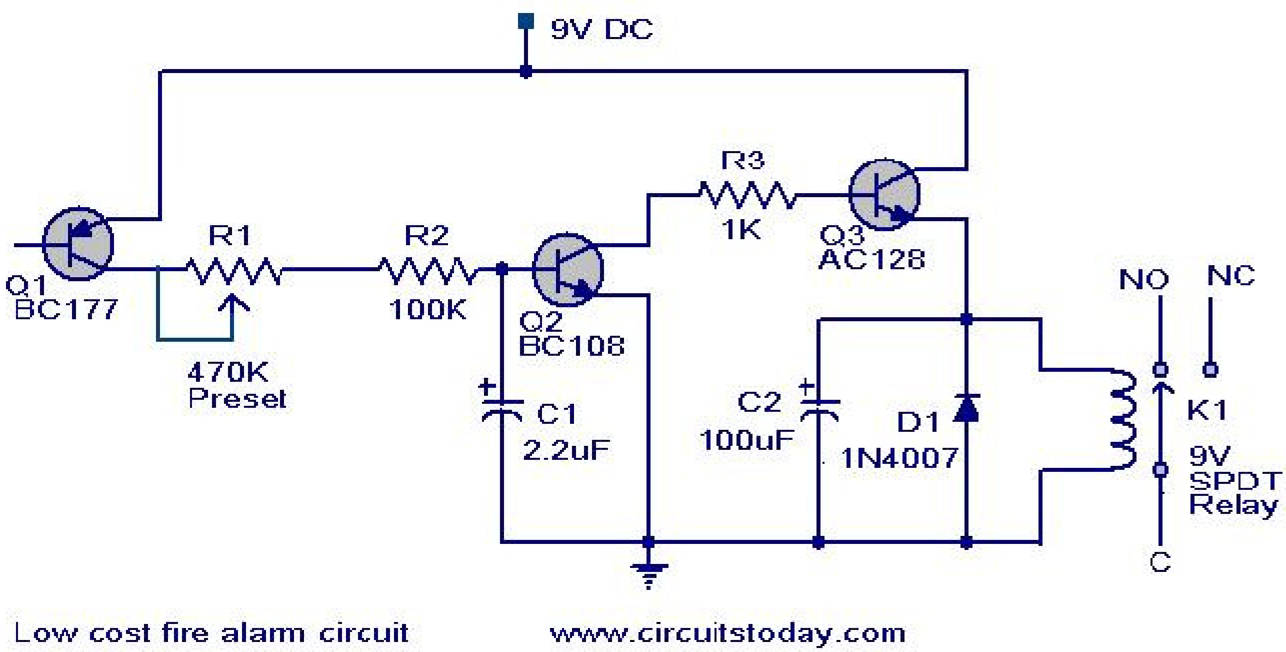
P512. Low cost fire alarm circuit_

Description.

When there is a fire breakout in the room the temperature increases.This ultra compact and low cost fire alarm senses fire breakout based on this fact.

Transistor BC177 (Q1) is used as the fire sensor here.When the temperature increases the leakage current of this transistor also increases.The circuit is designed so that when there is an increase in the leakage current of Q1 ,transistor Q2 will get biased.As a result when there is a fire breakout the transistor Q2 will be on.The emitter of Q2 (BC 108)is connected to the base of Q3(AC 128).So when Q2 is ON Q3 will be also ON.The transistor Q3 drives the relay which is used to drive the load ie,light,bell,horn etc as an indication of the fire.The diode D1 is used as a free wheeling diode to protect it from back EMF generated when relay is switched.

Circuit diagram with Parts list.



Notes.

- The Preset R1 can be used to desired temperature level for setting the alarm ON.
- This is not a latching alarm,ie;when the temperature in the vicinity of the sensor decreases below the set point the alarm stops.
- The circuit can be powered usingÂ a 9V battery or a 9V battery eliminator.
- All capacitors are electrolytic and must be rated at least 10V.
- The load can be connected through the C,NC,NO points of the relay according to your need.
- The calibration can be done using a soldering iron,and a thermo meter.Switch ON the power supply.Keep the tip of soldering iron near to the Q1.Same time also keep the thermometer close to it.When the temperature reaches your desired value adjust R1 so that relay gets ON.Done!

P513. Digital dice circuit

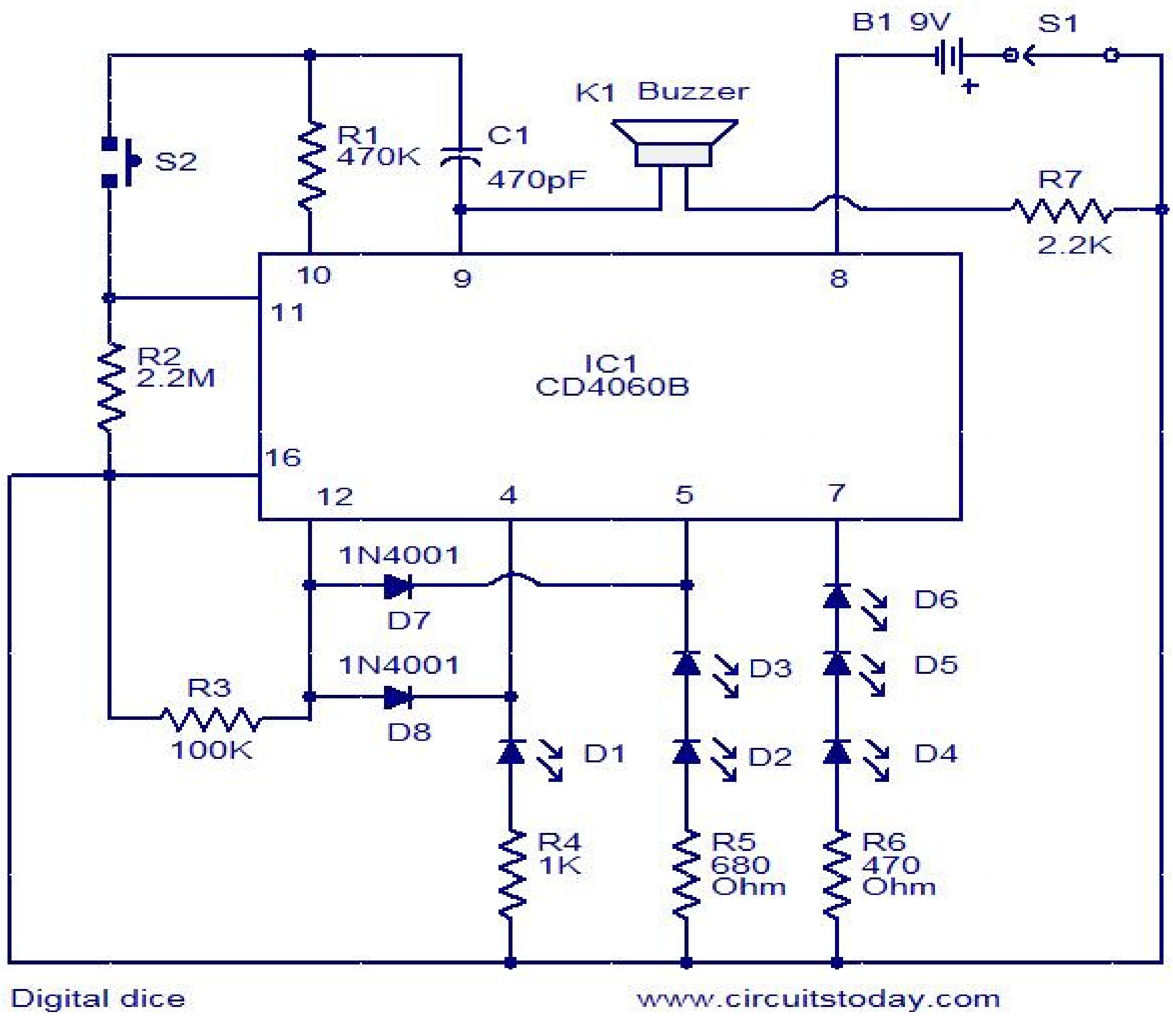
Description.

This is a simple and easy to construct digital dice circuit. The circuit is based on a single IC, CD4060B.The dice consists of six LEDs marked D1 to D6.The number of LEDs glowing indicates the numeral.

The heart of this circuit is 14 stage binary ripple counter IC CD4060B.The IC also has a built-in oscillator. The oscillator output (here 2 KHz) is used to clock the binary ripple counter. The counter increments by one in its natural count sequence each time it is clocked. The oscillator in initially inhibited as long as the pushbutton switch S2 is not pressed. The counter outputs will be in logic zero state and all the six LEDs will be ON.As the push button S2 is pressed, oscillator is enabled and the counter starts counting. The counter outputs (pin 4, 5 & 7) changes from 000 to 101 and then resets to 000 to repeat the sequence. After 101 the counter does not advances to 110 because of R3, D7 & D8.When the counter just advances from 101 to 110 the diodes D7 & D8 become reverse biased and makes the reset pin (pin 12) high to reset the counter.

The counter counts as long as the push button switch S2 is pressed. Also the micro buzzer will sound as long as the IC is counting. When the push button switch S2 is released, the counting is stopped and holds the existing state to represent the random number.

Circuit diagram with Parts list.



Notes.

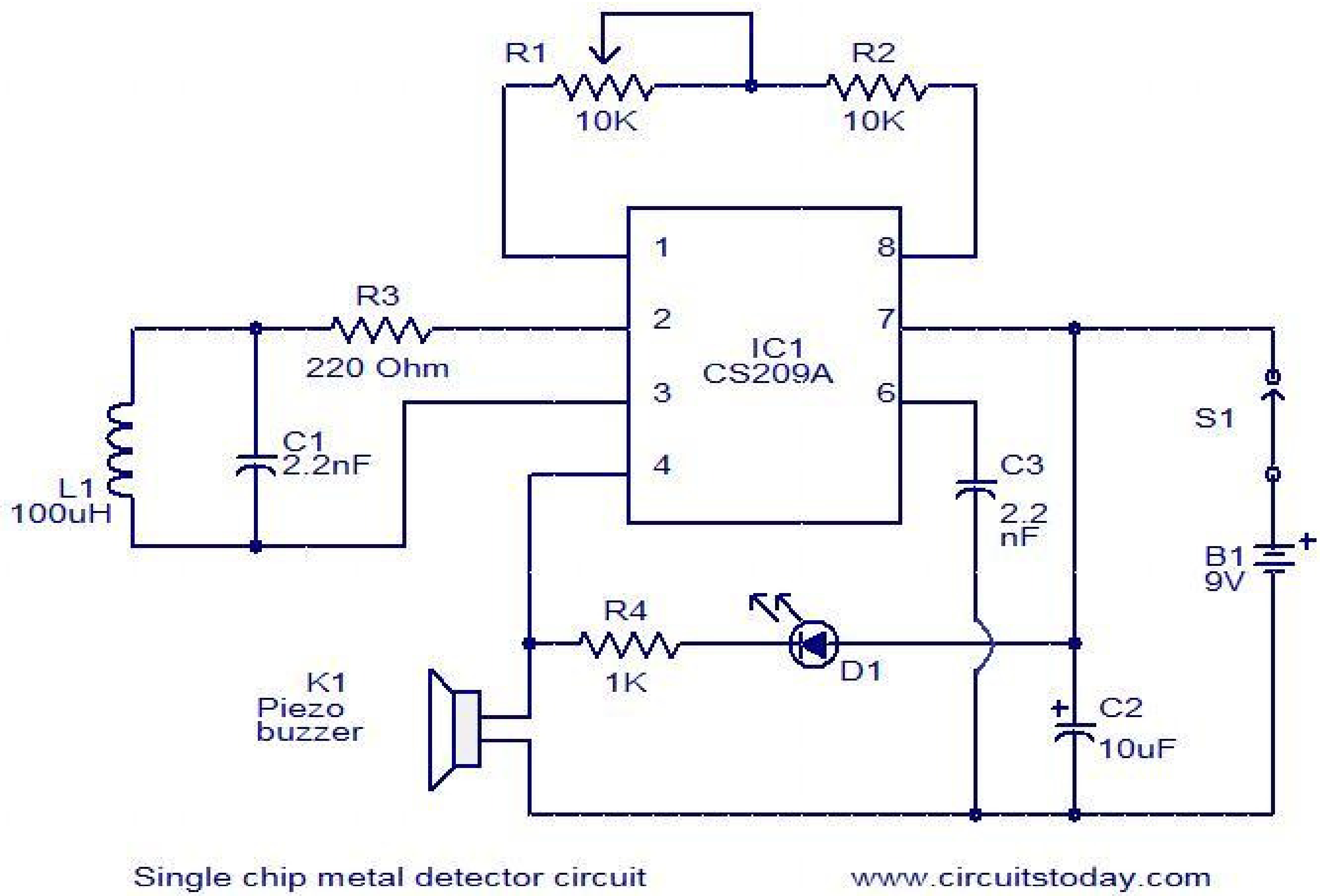
- Switch S1 is the ON/OFF switch.
- Switch S2 can be a push button switch.
- Buzzer K1 is a piezo buzzer.
- The circuit can be powered from a 9V PP3 battery.
- The IC must be mounted on a holder.

P514. Single chip metal detector circuit_

Description.

This is a simple single chip metal detector circuit based on IC CS209A from the Cherry Semiconductors. A 100uH coil is used to sense the presence of metal. The IC CS209A has a built in oscillator circuit and the coil L1 forms a part of its external LC circuit which determines the frequency of oscillation. The inductance of the coil change in the presence of metals and the resultant change in oscillation is demodulated to create an alarm. The LED gives a visual indication too. This circuit can sense metals up to a distance of few inches.

Circuit diagram with Parts list.



Notes.

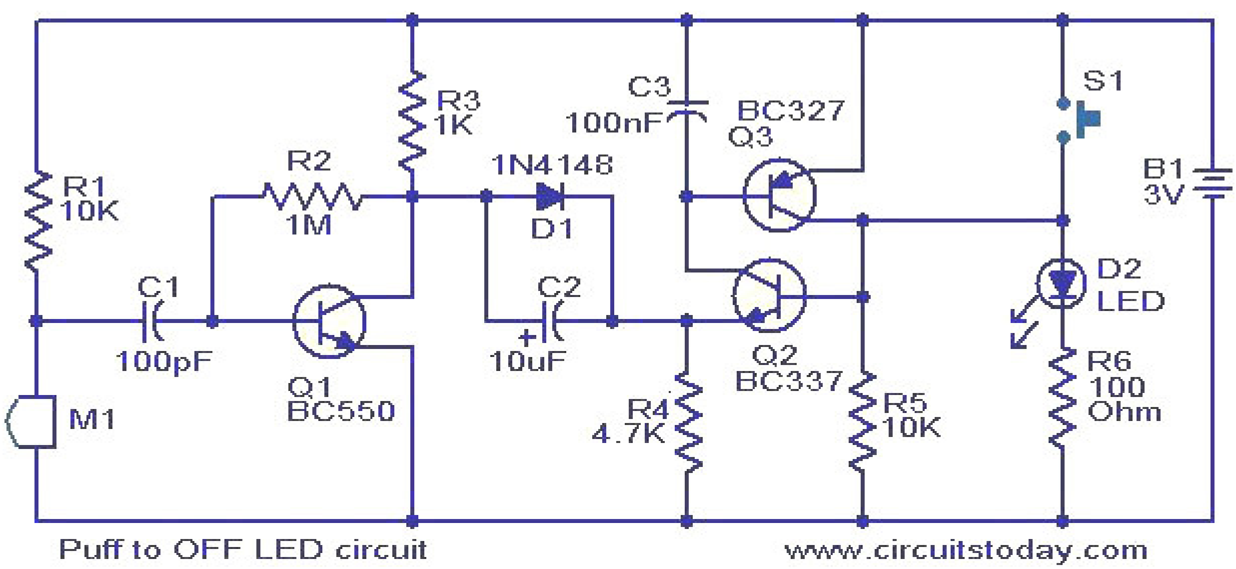
- Assemble the circuit on a general purpose PCB.
- The switch S1 can be a slide type ON/OFF switch.
- The IC must be mounted on a holder.
- The POT R1 can be used to adjust the sensitivity of the circuit.

P515. Puff to OFF LED circuit

Descrption.

This is a simple circuit in which the glowing LED can be switched OFF just by a puff. A condenser mic (M1) is used to sense your puff. When the push button S1 is pressed, the transistors Q2 and Q3 wired as latching pair gets activated and drives the LED to glow. The LED remains in this condition. When you puff on the condenser mic, the sound pressure is converted into a voltage signal at its output. This voltage signal will be amplified by the transistor Q1.Since the collector of the Q1 is coupled to the emitter of the latching pair, the pair will stop conducting when ever there is a signal from the condenser mic due to puffing and the LED will go OFF.Â The push button switch S1 has to be pressed again to switch the LED ON.

Circuit diagram with Parts list.



Notes.

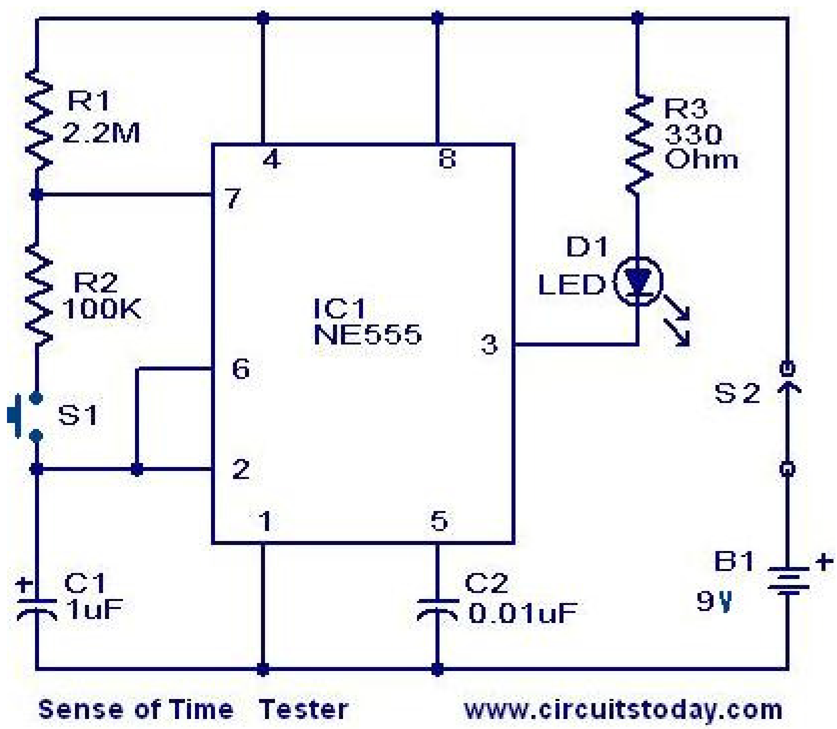
- The circuit can be powered from a 3V battery.
- The M1 can be a general purpose condenser microphone.
- The switch S1 can be push button switch.
- The circuit can be assembled on a good quality PCB or common board.
- Instead of the LED, you can also try a low power 3V bulb.

P516. Sense of Time tester circuit

Description.

When S2 is ON ,the circuit here operates as an astable multi vibrator and the LED is lit for about o.1sec,flasing every 1.5 seconds.Since the human reaction time is more than this,you cannot catch it once it is seen o,by pressing S1.If your sense of time interval is good,and you press S1 with in that 0.1 sec,the discharging of C1 stops and then the lamp stays lit.you may change the ON and OFF periods by changing R1 and R2 or C1 to suit your convenience.

Circuit diagram with Parts list.



Notes

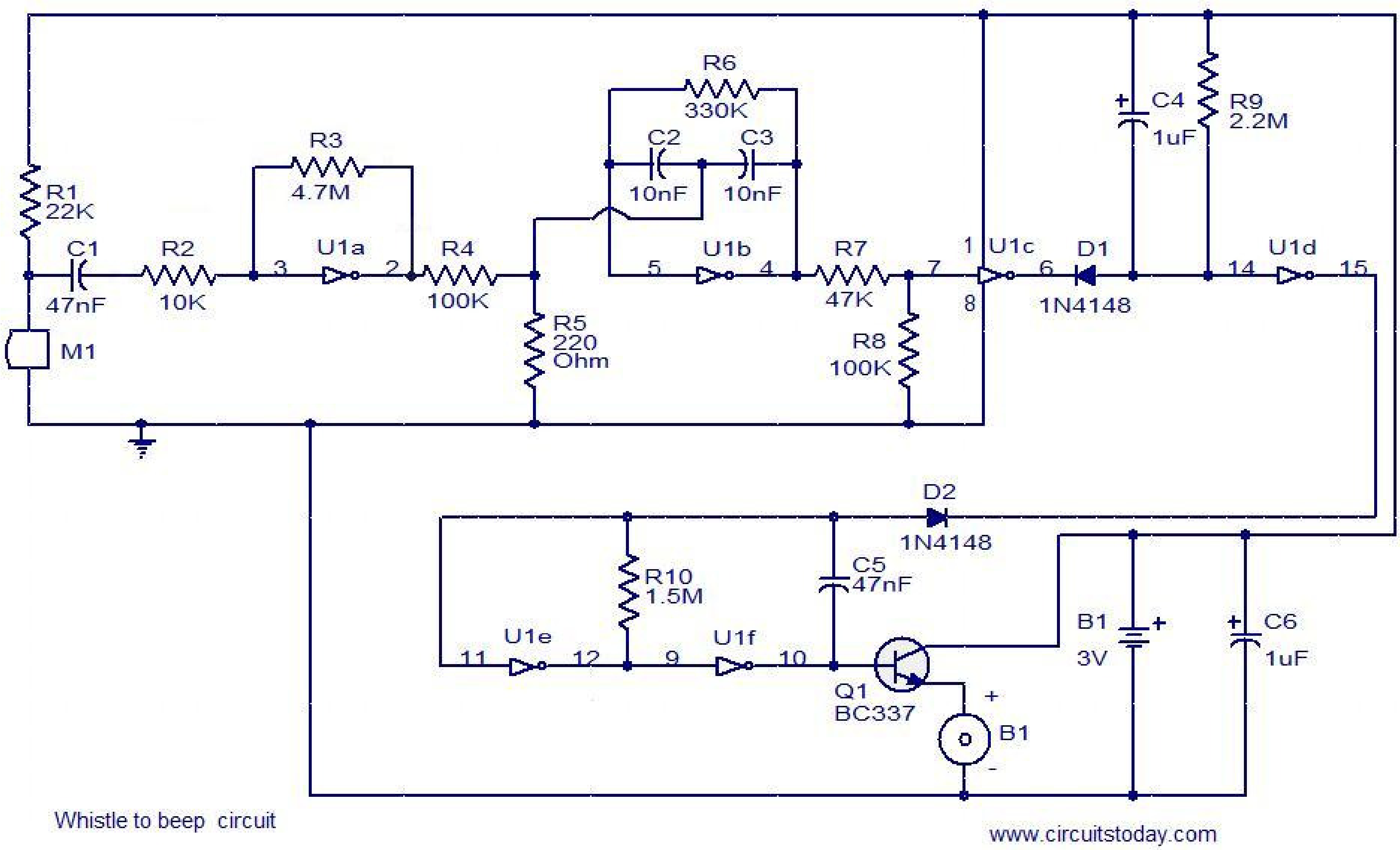
- Switch S1 can be a pushbutton switch.
- Switch S2 can be a SPST switch.
- The circuit can be powered from a 9V battery or 9V DC power supply.

P517. Whistle to beep circuit_

Description.

This simple circuit produces a beeping sound that lasts for around 3 seconds whenever you make a whistle. The CMOS Hex inverter CD4049 is the heart of this circuit. Out of the six inverters in CD4049, U1a is wired as an audio amplifier which amplifies the signal picked up by the microphone M1.The U1b is wired as a band pass filter with center frequency around 2KHz.The filter is necessary in order to pass the frequency corresponding to whistling sound and suppress all other frequencies .If the filter is not there, the circuit could easily get false triggered.U1d is wired as a 3S delay monostable multivibrator.The output U1d drives the astable multivibrator formed by U1e and U1f.The astable multivibrator is operating around 4Hz.The combined effect is a intermittent beeping sound that lasts for around 3S.Transistor Q1 is used to drive the buzzer B1.

Circuit diagram with Parts list.



Notes.

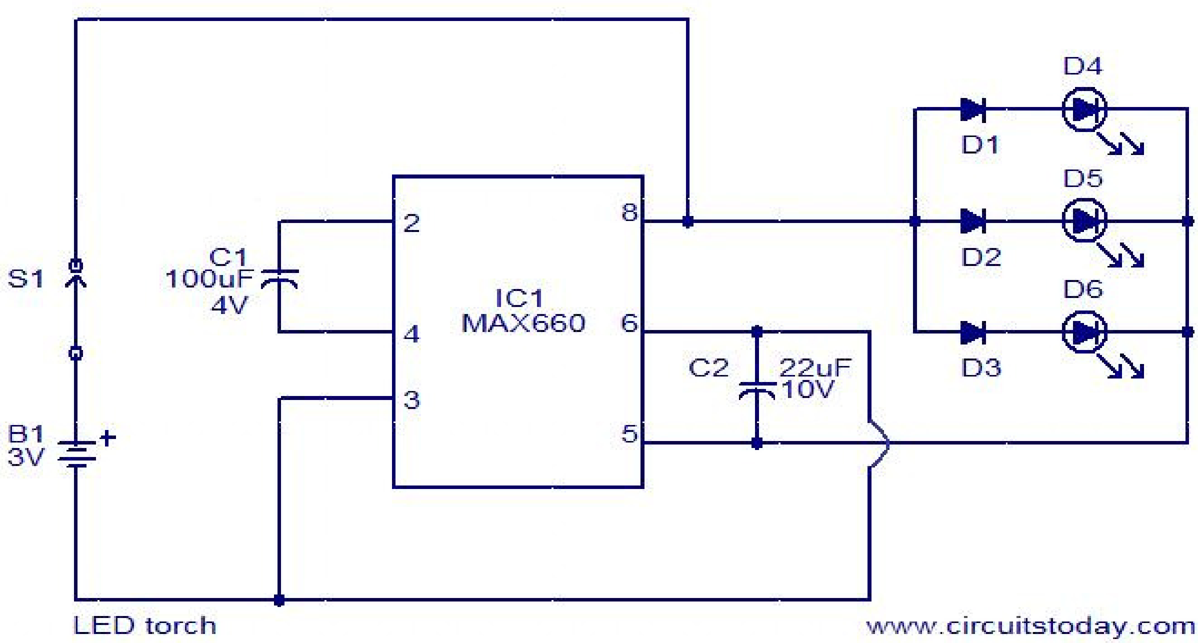
- Assemble the circuit on a good quality PCB.
- The circuit can be powered from a 3V battery.
- IC U1 is a CMOS CD4049 Hex inverter.
- M1 can be an electret microphone.
- B1 can be a 3V piezo buzzer.
- Mount the IC on a holder.
- The duration of beeping can be adjusted by varying the components C4 and R9.

P518. LED torch using MAX660

Description.

This is a simple LED torch circuit based on IC MAX660 from MAXIM semiconductors. The MAX 660 is a CMOS type monolithic type voltage converter IC. The IC can easily drive three extra bright white LEDs.The LEDs are connected in parallel to the output pin 8 of the IC. The circuit has good battery life. The switch S1 can be a push to ON switch.

Circuit diagram with Parts list.



Notes.

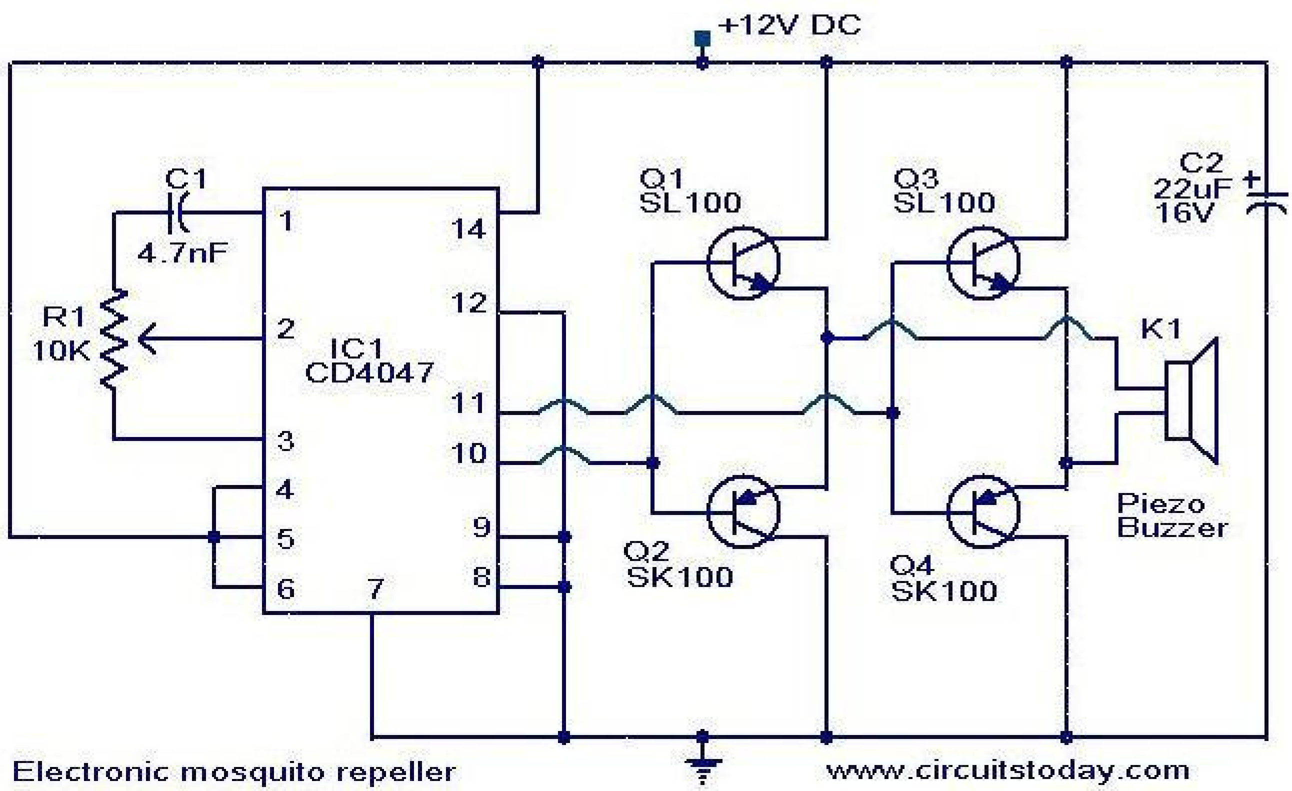
- Assemble the circuit on a general purpose PCB.
- The IC must be mounted on a holder.
- The circuit can be powered from two torch cells connected in series.
- The capacitors C1 and C2 must be Tantalum type.
- The diodes D1 to D3 must be of 1N4148.

P519. Electronic mosquito repeller

Description.

Here is the circuit diagram of an ultrasonic mosquito repeller.The circuit is based on the theory that insects like mosquito can be repelled by using sound frequencies in the ultrasonic (above 20KHz) range.The circuit is nothing but a PLL IC CMOS 4047 wired as an oscillator working at 22KHz.A complementary symmetry amplifier consisting of four transistor is used to amplify the sound.The piezo buzzer converts the output of amplifier to ultrasonic sound that can be heard by the insects.

Circuit diagram with Parts list.



Notes.

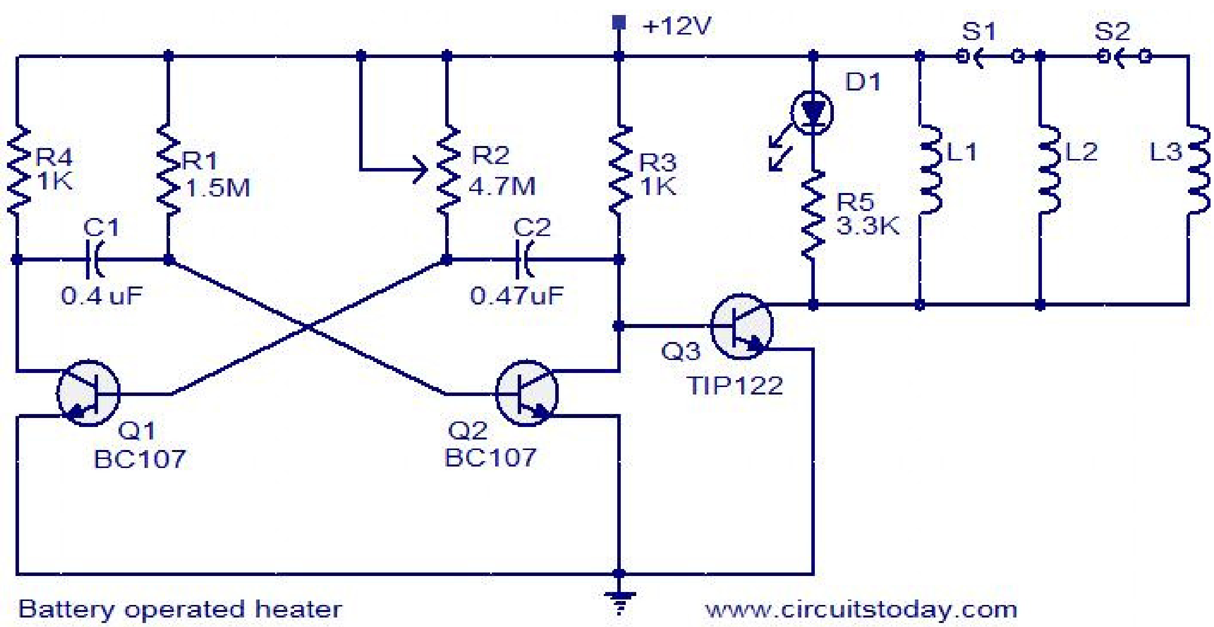
- Assemble the circuit on a general purpose PCB.
- The circuit can be powered from 12V DC.
- The buzzer can be any general purpose piezo buzzer.
- The IC1 must be mounted on a holder.

P520. Battery operated heater_

Description.

Here is a simple heater circuit that can be operated from a 12V battery. The first part of the circuit is an astable multivibrator build around the two transistors Q1 and Q2 .The ON time of transistor Q2 is set to 0.5 S. The ON time of transistor Q1 can be varied by using the POT R2.The output pulses at the collector of Q2 is used to drive the Darlington power transistor Q3(TIP122).The transistor Q3 drives the heating elements L1 to L3.The net heat produced can be varied byÂ selecting the desired combination of heating elements at the output circuit sing switches S1 and S2.The net heat can be also varied by varying the duty cycle of the triggering pulse using POT R2.

Circuit diagram with Parts list.



Notes.

- The circuit can be assembled on a general purpose PCB.
- The transistor Q3 must be fitted with a heat sink.
- The elements L1 to L3 can be 10W heating coils.
- The switches S1 and S2 must be able to withstand at least 5A.
- The circuit can be powered from a 12V battery.
- The LED D1 gives a visual indication of the duty cycle of the circuit.

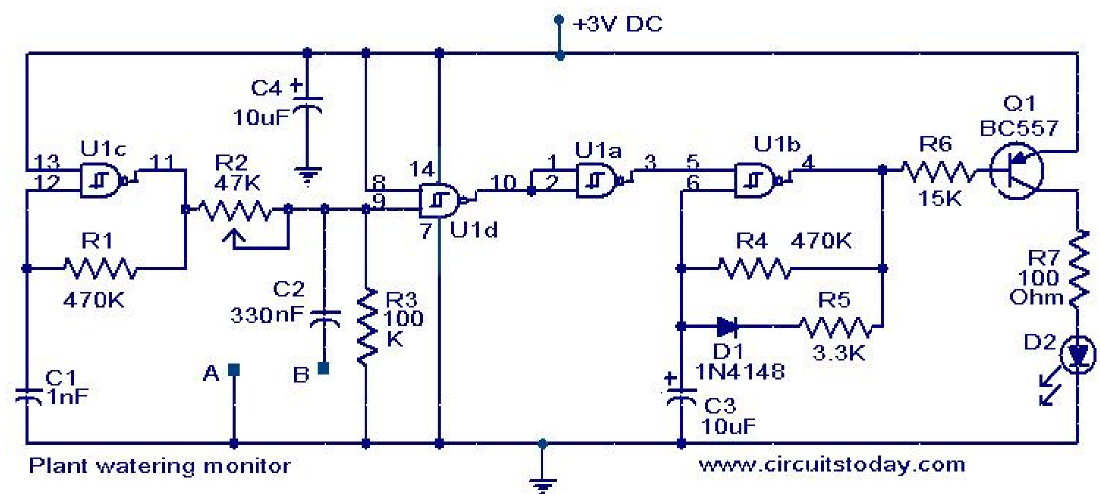
P521. Plant moisture level monitor

Description.

Here is a simple circuit that will give a visual indication when the soil water level inside your flower pot goes low below a certain limit.

The U1C and associated components are wired as an oscillator producing a 2KHz square wave. This square wave is given to one gate input of U1D via a variable potential divider former by R1 and R2.When the resistance across the probes A and B are low that is when soil moisture level is high, the C2 will divert the square wave to ground. The output of U1D will be high. The U1 A inverts this high state to low and so the IC U1B is blocked from producing oscillations. The LED will remain OFF. When there is no moisture across the probes, the C2 cannot bypass the 2KHz signal to the ground and it appears at the gate input of U1D.The output of U1D goes low, and it is inverted to high by U1A.The oscillator wired around U1B is activated and it starts oscillating. These oscillations are amplified by Q1 to drive the LED and LED starts pulsating as an indication of low moisture. Since square wave is used there wonâ€™t be any oxidation on the probes. The resistor R7 limits the current through LED and ensures a longer battery life.

Circuit diagram with Parts list.



Notes.

- Power the circuit from a 3V battery.
- Two metal wires 10 cm long and 5cm apart driven into the soil will do the job for probes.
- The probes are to be connected at the terminals A and B shown in circuit.
- Capacitors C1 and C2 must be polyester type.
- The IC U1 is a quad two input Schmitt NAND IC 4093.
- The sensitivity can be adjusted by varying the preset R2.
- Mount the IC on a holder.

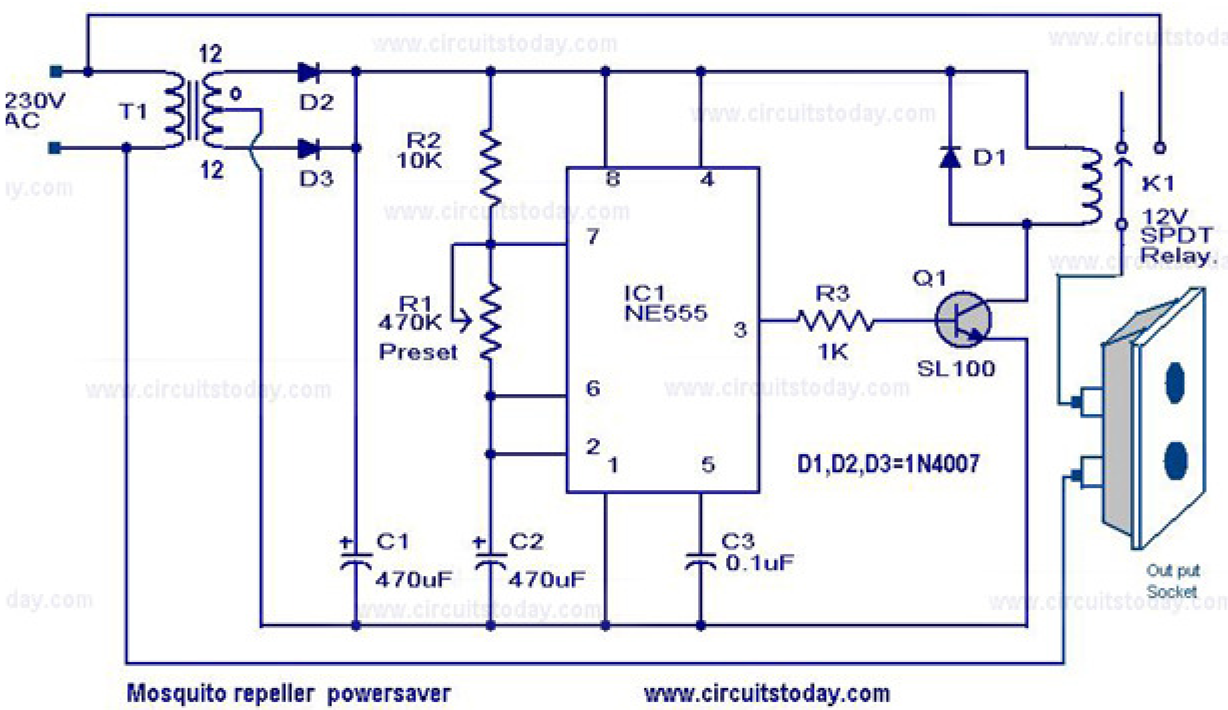
P522. Mosquito repeller power saver

Description.

Almost all liquidator type mosquito repellers are rated 5Watts.It is a pretty energy consuming gameÂ when these repellers are operated through out the night.Even though these liquidators are switched ON and OFF in discrete intervals there will be no considerable loss in the effectiveness,and more over there will be a great saving of energy.Then why can't we do that and that's why I designed this circuit.

The circuit is nothing but an astable multivibrator designed of IC NE 555Â (IC1)Â operates in a frequency determined by the values of R1 and C2.When the power is switched on the out put of the IC goes high .This makes Q1 to conducts and the relay connects the mains supply to the repeller plugged in the socket shown.After the set time theout put of the IC goes low and now the repeller is removed from mains by the relay.This cycle repeats and the repeller will be switched On and OFF in frequent intervals,saving a lot of power.Diodes D2,D3 forms a half wave rectifier with C1 as the filter,supplies the circuit with power .

Circuit diagram with Power supply.



Notes.

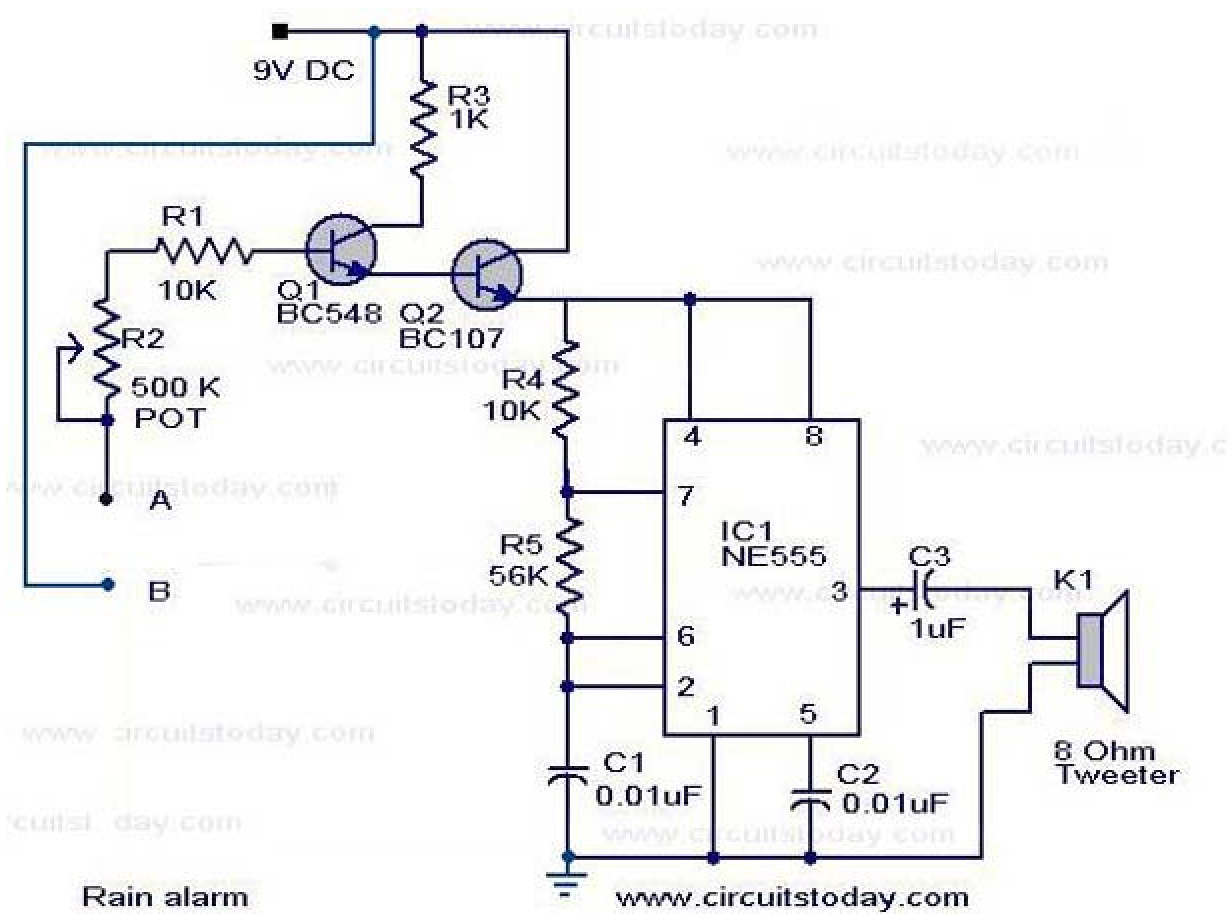
- Assemble the circuit on a good quality common board or PCB.
- The intervals of ON and OFF can be adjusted by varying Preset R1.
- Some parts of the circuit are live with potential shock hazard.Be carefull.

P523. Rain alarm circuit_

Description.

Here is a simple circuit that produces an audible alarm when ever rain falls.The circuit is based on two transistors (Q1 & Q2) and a NE555IC (IC1) .The two transistors are wired as a switch which goes on when the base of Q1 is shorted to the positive of the supply by the rainwater falling on the sensor.When the transistors are ON power supply is available to the IC1 which is wired as an astable multivibrator .The out put of IC1 drives the speaker to produce a alarm.

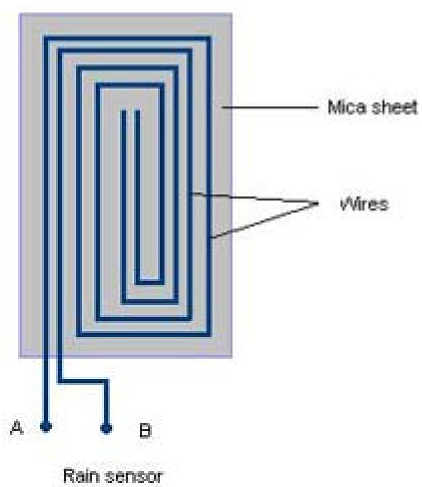
Circuit diagram with Parts list.



Notes:

- Assemble the circuit on a good quality PCB or common board.
- For assembling the sensorÂ cut a 2×2 inch mica or plastic sheet. Arrange twoÂ single stranded wires (running parallel 2mm close to each other)Â on the sheet as shown in figure below.Remember the wires have to be non-insulated.Sensor ready.
- Now you can connect the points A&B on the sensor to corresponding points A&B on the circuit.
- POT R2 can be used to adjust the sensitivity.
- To test the circuit ,make all connections and power up.Place a drop of water on the sensor so that two wires become shorted through water .Now the alarm starts sounding.If not adjust R2 to get the alarm sounding.
- Use a 9v battery orÂ a 9VÂ regulated DC supply for powering the circuit.
- Do not connect speakersÂ less than8 Ohm impedance as load.It will damage the IC.
- A piezo buzzer can be also used instead of the speaker.

Sensor schematic.

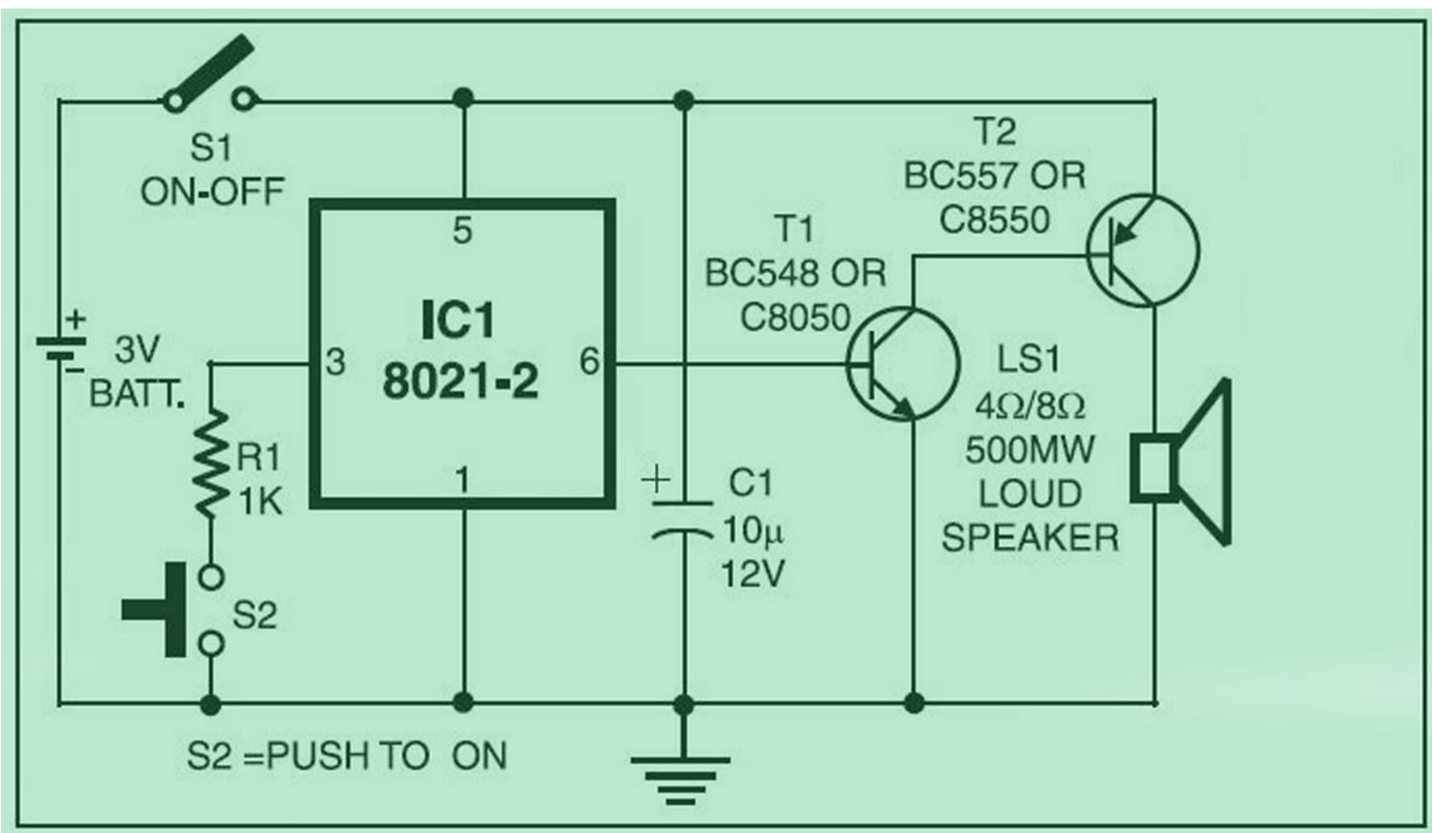


P524. Simple Ding-Dong Bell_

Description

Here we present a simple an low cost ding dong bell suitable for calling bell purposes.It is made around IC 8021-2 .It is a 8 pin IC but only four pins are shown here. 8021 has an in-built circuitry to produce ding dong sound each time its pin 3 is pulled low.The sound is stored in a 4 bit ROM.a complementary-pair, two-transistor amplifier is used to amplify the sound to a fair level of audibility.A piezo tweeter or an 8-ohm, 500mW speakerÂ can be used at the output.

Each time when switch S2 is pressed, ding dong sound is produced twice. If you try to press switch S2 a second time when the first ding dong sound is still being produed, it has no effect whatever and the two ding-dong bell sounds will be invariably produced.S1 is the ON- OFF switch.Assemble the circuit on a good quality all pupose PCB.Don't forget to use an IC holder for IC 8021.



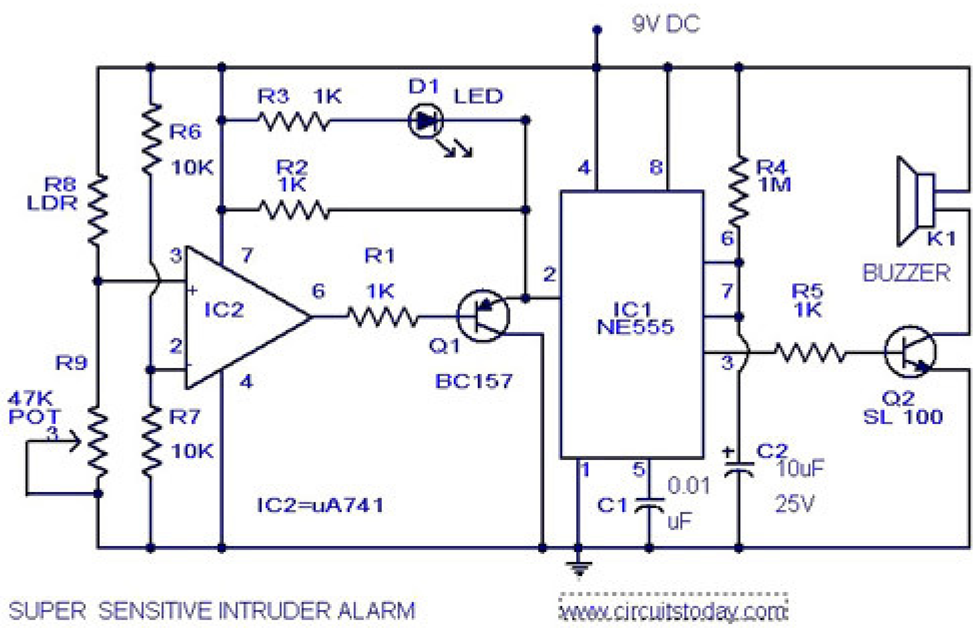
P525. Super Sensitive Intruder Alarm

Description

Here is the circuit diagram of an ultra sensitive intruder alarm.The shadow of an intruder passing few meters nearby the circuit is enough to trigger the alarm.

Here IC2 uA 741 is wired as a sensitive comparator ,whose set point is set by R6 &R7.TheÂ voltage divide by LDR and R9 is given at non inverting pin of IC2.At standby mode these two voltages are set equal by adjusting R9.Now the out put (pin6) of comparator will be high.Transistor Q1 will be off.The voltage at trigger pin of IC1 will be positive and there will be no alarm.When there is an intruder near the LDR the shadowÂ causes its resistance to increase.Now the voltages at the inputs of comparator will be different and the out put of IC2 will be low.This makes Q1 on.This makes a negative going pulse to trigger the IC1 which is wired as a monostable multivibrator.The out put of IC1 will be amplified by Q2 (SL 100) to produce alarm.

Circuit Diagram with Parts List



Notes

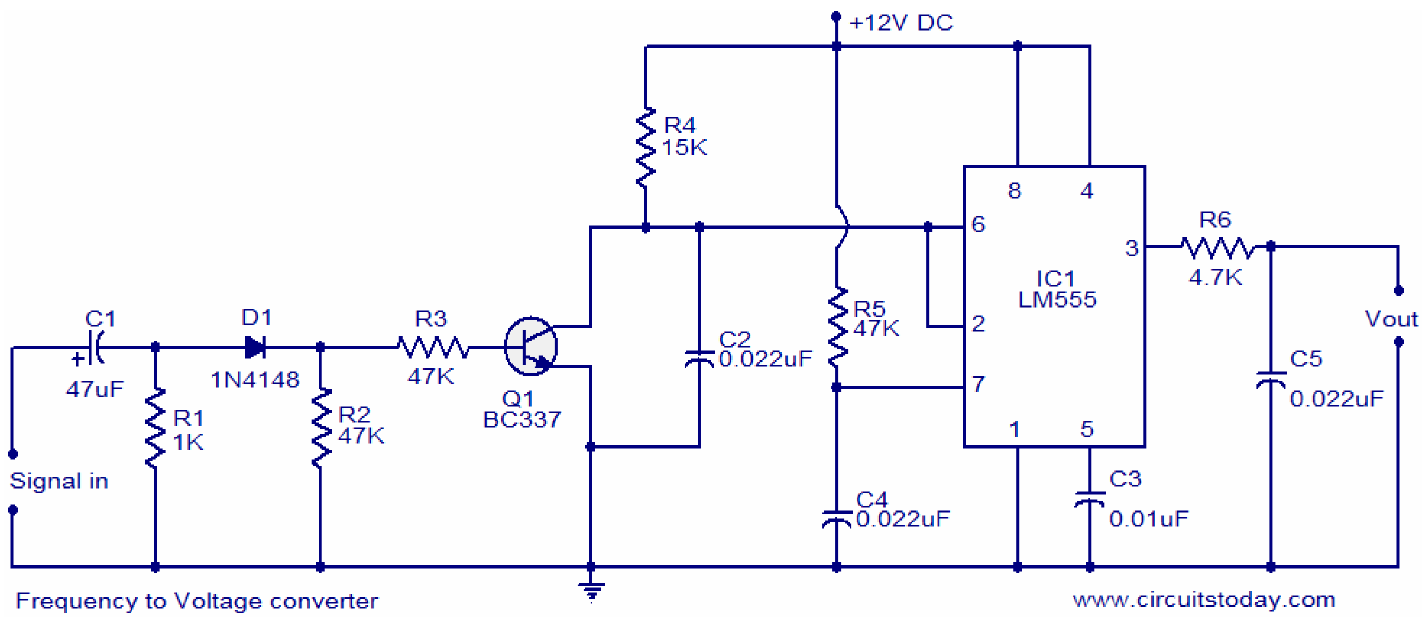
- To setup the alarm ,power up the circuit and adjust R9 so that LEDÂ D1 goes off.
- The LDR can be housed in a dark tube to increase sensitivity.
- The sensitivity is very important here.If you cannot adjust the required sensitivity properly, use one LOW resistance (~1K) POT in series withÂ R9 for fine adjustment.

P526. Frequency to voltage converter

Description.

Here is a very simple circuit diagram of a frequency to voltage (F to V) converter. Such a circuit finds numerous applications in projects like digital frequency meters, tachometers etc. The circuit is mainly based on a LM555 timer IC. The IC is wired in mono shot mode to convert the input frequency into a fixed pulse width, variable frequency PWM signal. Resistors R4 and capacitor C2 provides the necessary timing for the circuit. The transistor T1 forms a discharge path parallel to C2 which is necessary for re triggering the IC. Capacitor C1 acts as an input DC decoupler.

Circuit diagram.



Notes.

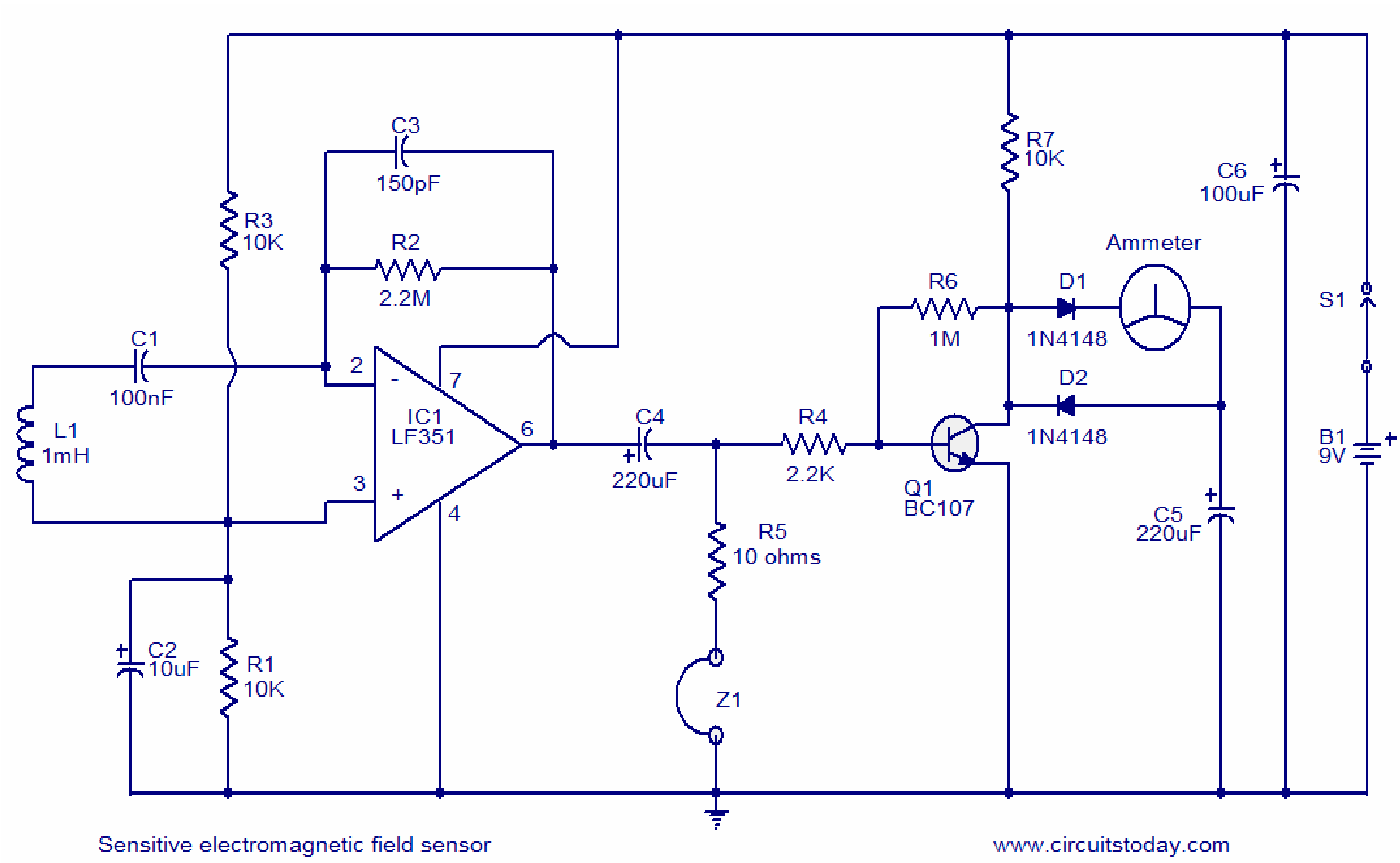
- The circuit can be assembled on a Vero board.
- Use 12V DC for powering the circuit.
- LM555 must be mounted on a holder.
- The output of the circuit is not a pure DC but a PWM waveform. Additional circuitry is required to convert this PWM waveform to pure DC.

P527. Sensitive electromagnetic field sensor

Description.

This is the circuit diagram of a very sensitive electromagnetic field sensor which can sense electromagnetic field from 40Hz to 140Hz. The low noise opamp LF351 and associated components forms the pick-up section. 1uH coil L1 is used for sensing the field and the IC1 performs the necessary amplification. If the picked electromagnetic field is in the audio frequency range, it can be heard through the head phone Z1.There is also a meter arrangement for accurate measuring of the signal strength. Transistor Q1 performs additional amplification on the picked signal in order to drive the meter.

Circuit diagram.



Notes.

- The circuit can be assembled on a Vero board.
- Use a 9V PP3 battery for powering the circuit.
- IC1 must be mounted on a holder.
- Z1 can be a common walkman head phone.
- Switch S1 is the ON/OFF switch.
- All electrolytic capacitors must be rated at least 10V.

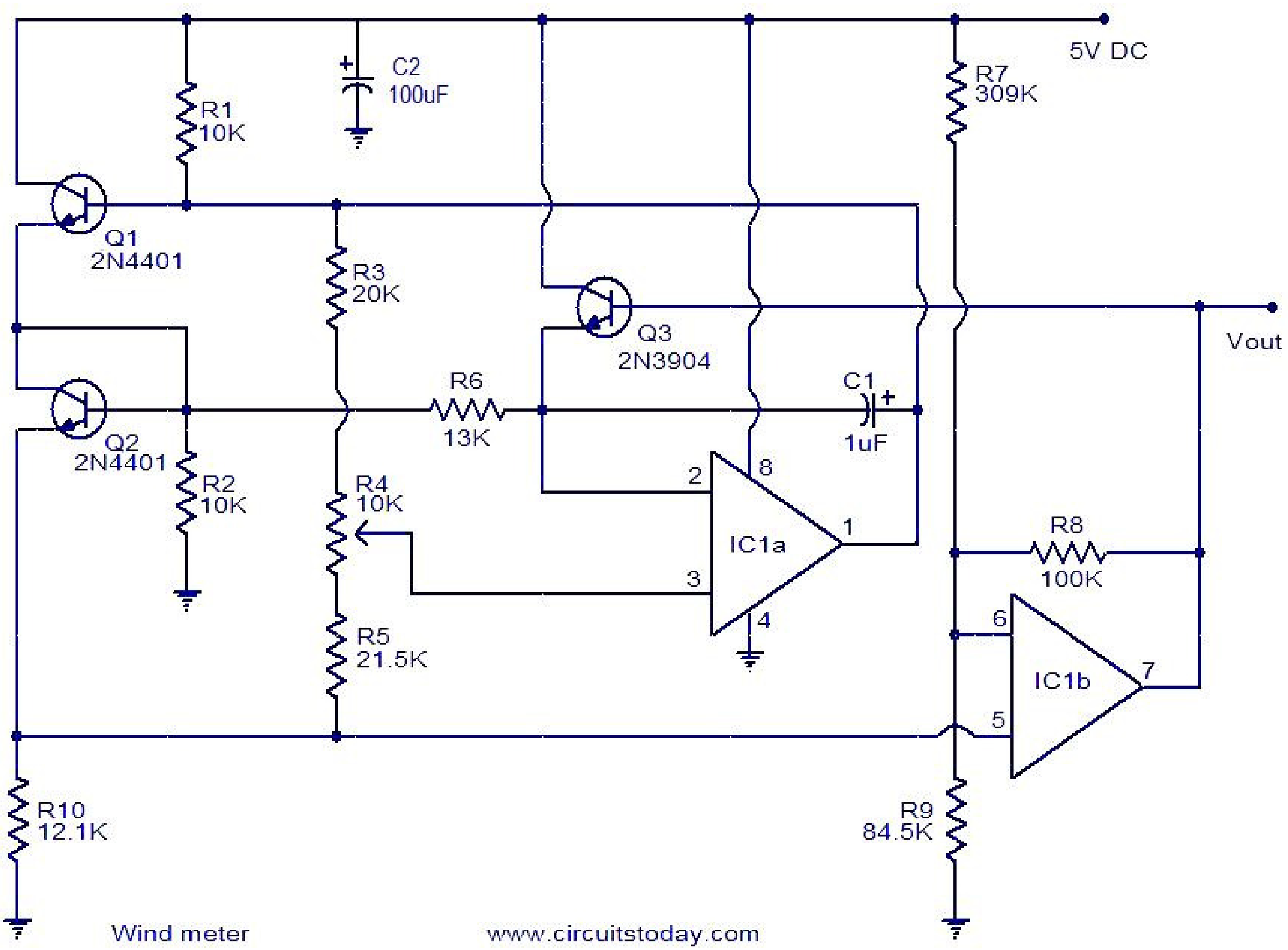
P528. Wind meter

Description.

Here is a very simple wind meter (anemometer) circuit. I can't guarantee much on the accuracy of this circuit but it circuit works quite fine. You can measure wind speeds up to 75m/s using this circuit.

The transistors Q1 and Q2 are used for sensing the wind. The relationship between thermal impedance of the transistor and the surrounding wind speed is utilized here. Transistors Q1 and Q2 are wired so that the Vce of Q1 is higher than Q2 and therefore there will be a higher power dissipation. The wind causes cooling and so the Vce of Q1 changes. The ends in different power dissipations and different voltages across R10.This variation is detected by the opamp and amplified to produce the Vout which is proportional to the wind speed. For still air Vout will be 0V and at 75m/s wind speed the Vout will be 2.5V. A 3V FSD voltmeter connected across the Vout terminal and ground can be used as the display.

Circuit diagram with Parts list.



Notes.

- The circuit can be assembled on a Vero board.
- The circuit can be powered from 5V DC.
- For proper working, the air must pass over both the transistors (Q1 and Q2).
- Most of the resistors used here are not standard values. So you need to use the combination (series or parallel) of resistors to attain the specified values. Please note that the resistor values are very critical in this circuit.
- IC1 is an LT1013 dual opamp.

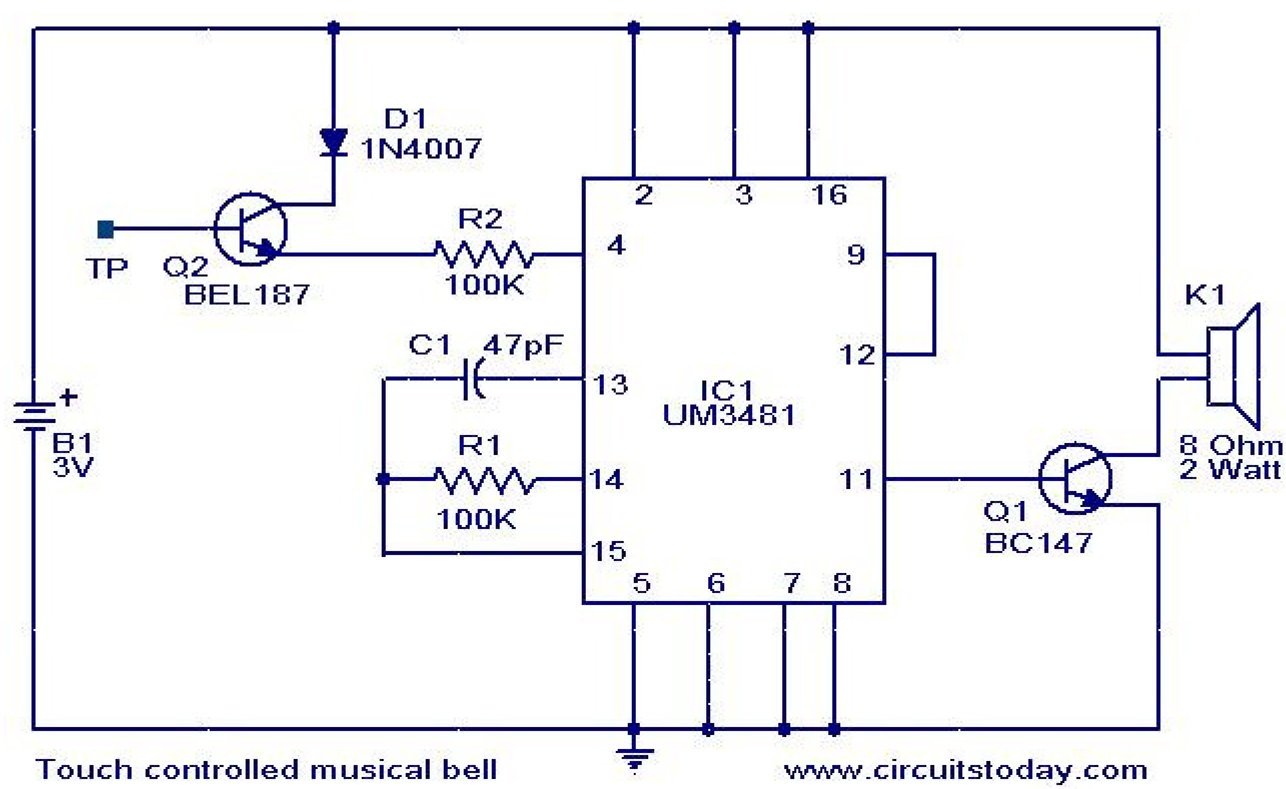
P529. Touch controlled musical bell_

Description.

This circuit produces a musical tone whenever someone touches the touch point designated as TP in the circuit. The circuit works from two AA cells and produces enough sound.

The circuit uses IC UM 3481 commonly used in musical circuits. The IC contains a ROM with 512 musical notes, tone generator, rhythm generator, modulator, run off control, oscillators, frequency divider and preamplifiers,.Â So a very few number of components isÂ required for this circuit.C1 and R1 act asÂ the timing components forÂ the built in oscillator. The transistor Q1 is used for driving the loud speaker. The base of the transistor Q2 is used as the touch point to trigger the musical bell.

Circuit diagram with Parts list.



Notes.

- The circuit can be assembled on a general purpose PCB.
- Use two AA cells in series for powering the circuit.
- The speaker can be 2 W, 8 Ohm.

P530. Continuity Tester II

This is another invaluable piece of test equipment for digital work. It has been designed by us to cater for a particular application . . . servicing digital projects sent in for repair.

The first thing you have to do with an unknown project is test the trackwork. This consists of testing all the tracks for continuity and all the pins for absence of "shorts."

A Continuity Tester looks to be a fairly unimportant device and hardly seems worthwhile constructing, but after you have used it, you will realize how important it is.

A multimeter can be used but it takes much longer to do the same job.

Our Continuity Tester has been specially designed and has three very interesting features.

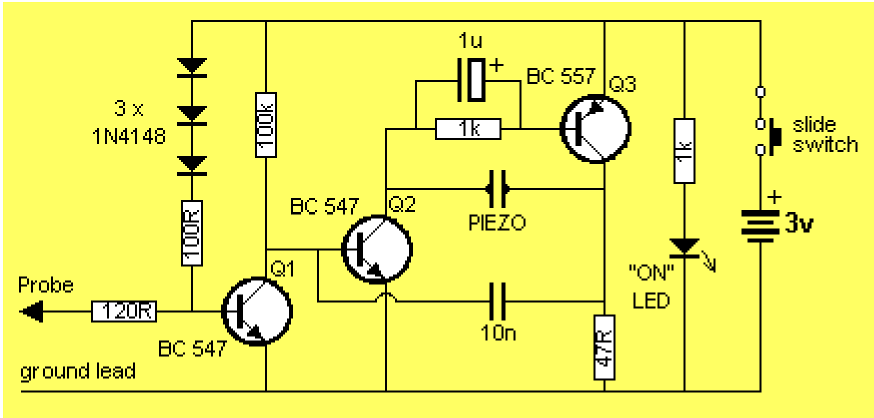
I'm sure you will add it to your set of test equipment . . .

Top view of the Continuity Tester

You can use tinned copper wire, a nail or a paper clip for the probe.

Keep the ground lead as long as possible so you can reach from top to bottom of any project.

The "ON" LED prevents the Continuity Tester being left ON



CONTINUITY TESTER CIRCUIT

Our **CONTINUITY TESTER** gives an audible indication of continuity between the probes so you can keep your eyes on the probe tip. Secondly its response-time is very short so that you can make lots of tests very quickly while listening for the beep.

And thirdly it only responds to a definite short circuit or one that has a resistance of 50 ohms or less. It will not respond to values above 80 ohms or the voltage drop across a diode.

This is where the multimeter falls down. When you are measuring the resistance between pins of a chip on a digital circuit, a protection diode is often present inside the chip and if you measure with a multimeter, it will be difficult to determine if the meter is detecting the presence of a diode or a low resistance.

The **Continuity Tester** eliminates this problem. We have found it invaluable for diagnosing some of the computers sent in for repair. Most of the problems have been poor soldering but some have been shorts between lands and cracks in the tracks.

To find a short between two pins of say a 24 pin chip, requires 24 x 24 tests and this would take quite a while.

With the **Continuity Tester** we place the negative lead on the first pin of the chip and quickly wipe the probe down the other pins of the same side then the 12 pins on the other side. The only time you will hear a beep is if a short is present or if the two probes touch.

When you hear a beep, you should examine the track-work carefully to see if a fault is present or if the pins are joined by a track, or some other component.

Continue this procedure with pins 2, 3, 4 etc. until all the possible combinations have been covered.

This is repeated with all the chips in the project and any other connections you can find on the board. This is the only way to locate a hidden short and even though it involves thousands of tests, it will be much quicker than using a multimeter.

HOW THE CIRCUIT WORKS

As we mentioned, the circuit detects resistance values of 50 ohms or less between the probes and allows an oscillator to turn ON and produce a tone from the piezo diaphragm.

A LED is also included on the board to indicate when the unit is ON as the circuit consumes about 2-4mA and the battery would eventually go flat if left on for long periods.

Actually the circuit doesn't detect resistance at all. It detects a threshold voltage across the base-emitter junction of the first transistor. When the tester is in the "rest" state, the first transistor is turned ON and this inhibits the oscillator.

It gets its turn-on voltage from the 100R resistor. The 3v supply is taken through 3 diodes and these drop a total of about 1.9v, leaving about 1.1v for the base bias.

When the transistor is turned on, the base-emitter voltage (the junction-voltage) is .7v and thus .4v is dropped across the 100R resistor. This means we have only .4v leeway for the batteries to fall and when they drop to below 2.6v, the tester will fail to work. That's why we have to conserve energy as much as possible by putting an indicator LED on the board to prevent it being left on.

0.4v across the 100R delivers about 4mA into the base of the gating transistor and this keeps the oscillator OFF. When a resistance of 50R or less is placed between base and emitter, the voltage on the base falls sufficiently to turn the transistor off.

This allows the 2-transistor feedback oscillator to come into operation and produce a tone.

A diode placed between base and emitter of the first transistor will have no effect on the circuit as it will allow .6v to .7v to be appear across the probes and this will not change the state of the circuit. The voltage must drop to .5v or less and this requires a resistance of about 50 ohms or less.

The 2-transistor feedback oscillator is set into operation by the 100k base bias resistor. This turns on the middle transistor and thus its collector voltage falls. The collector is connected to the base of the third transistor and this is also turned on.

The result of this action is to raise the voltage on the collector of the BC 557, to which a 47R is connected. Also connected to the collector is a 10n capacitor and it has presently been charged to about .6v.

As the voltage on the collector rises, it pulls the capacitor up with it and pushes the charge into the base of the middle transistor. This causes the transistor to turn on even harder and very soon we have a situation where both transistors are SATURATED.

The base does not rise above .65v while the other end of the capacitor has been pulled high by the BC 557. This causes it to charge in the opposite direction and after a short period of time its charging current cannot hold the middle transistor ON as hard. The result is the BC 547 turns off slightly and this action is passed to the BC 557 via the 1k & 1u, and the voltage on its collector falls. This action is passed back to the base of the BC 547 via the 10n capacitor and it gets turned off even further.

Both transistors are now completely off and the cycle starts again by the 100k charging the 10n and turning on the BC 547.

The 1k and 1u electrolytic couple the two transistors and the purpose of these has been discussed in the theory sections.

The two leads of the piezo see an AC voltage that is slightly higher than 3v.

Each time the circuit changes state, a click is produced in the piezo and since these clicks are produced in rapid succession, the result is a tone.

Continuity Tester Kit

PARTS LIST

1 - 82R
1 - 1N4148
for test purposes

1 - 47R
1 - 100R
1 - 120R
2 - 1k
1 - 100k

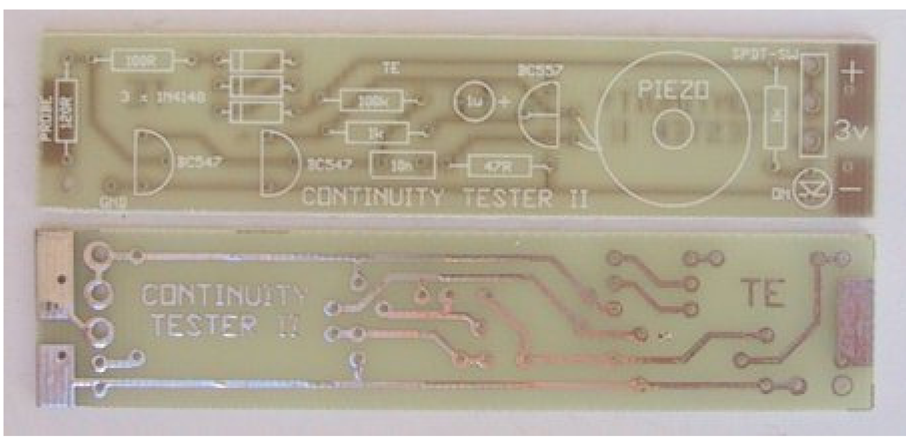
1 - 10n greencap
1 - 1u 16v PC mount electrolytic

3 - 1N 4148diodes
2 - BC 547 transistors
1 - BC 557 transistor
1 - 3mm red LED
1 - Mini piezo diaphragm

1 - SPDT slide switch
2 - AAA cells

2 - small nails
1 - 10cm tinned copper wire
1 - 50cm hook-up flex

1 - CONTINUITY TESTER PC BOARD



Continuity Tester PCB

CONSTRUCTING THE TESTER

All the components are mounted on a small PC board that is designed to fit into a toothbrush case. There are a number of suitable cases and even a small one will fit the board. At first we thought the soft type would not be suitable but after we tried it, we found it was the best. The soft plastic is more durable and will not fracture if dropped or bumped. Rigid styrene cases tends to crack very easily and one of ours was crushed under foot when it fell on the floor!

The case is the first item to purchase as it is needed to give you a guide as to the maximum height for the components. If some of the parts are too high, they can be bent over during assembly and its important to know this before you start.

Next you need to make sure the slide switch is the right size for the board. The switch supplied in the kit fits exactly into the holes and any mounting flanges must be cut off so that the board will slide neatly into the case. Make sure you do not take too long to solder it or the operation of the contacts will become faulty due to flux running down the lead. Once this is done, the rest of the components can be fitted.

Start assembly at one end of the board and fit each component as you come to it. The LED, transistors, diodes and electrolytic must be fitted around the correct way and the layout on the board will assist you. If you are not sure, refer to the photos for placement or get someone to assist you, but don't guess!

The probe tip is made from a small nail and soldered to the underside of the board. The two cells are soldered to the board with short lengths of tinned cop-per wire, provided in the kit.

The wander lead can have either an alligator clip, E-Z clip or nail attached to it.

When everything has been soldered in place, slide the switch ON and the LED will illuminate. Touch the two probes together and the oscillator will emit a tone.

TESTING THE UNIT

You will require a diode, and an 82R resistor.

Place the probes across the diode, firstly in one direction then the other. The tone should not be heard. Place the probes across the 82R resistor and once again the tone should not be emitted. You may find the tester will operate on a resistor which is one value higher or lower than this. The actual value will depend on the battery voltage. But don't worry too much about the actual turn-on and turn-off values as most digital projects have resistors of about 470R in their lines and the tester will not detect them.

IF IT DOESN'T WORK

If the tester does not emit a tone when the two leads are touched together, follow these steps:

Check the voltage of the cells. They should give at least .1v drop across the 100R resistor. If there is no voltage drop, check the voltage-dropping diodes. They should each drop .65v. Also check the supply voltage. It should be higher than 2.6v.

Remove the gating transistor (the first transistor) and turn the unit ON. This will allow the tone circuit to operate. If not, check the value of the 1k and 100k resistors and also their positions. Next check the 10n capacitor and also the BC 547 and BC 557 transistors, they will not work if swapped over or if fitted the wrong way around.

You can determine if the oscillator is jammed in the ON mode or OFF mode by taking a current reading across the switch. If the current is more than 20mA, it is jammed in the ON mode and this means the BC 547 in the oscillator is conducting.

The transistor could be shorted between collector and emitter or the 10n feedback capacitor is open circuit. Create a short between base and emitter of the BC 547 to bump the circuit into oscillation or replace the 10n.

If the circuit is jammed in the OFF mode, either of the transistors in the oscillator may be open circuit or incorrectly fitted. Try new transistors. If the circuit remains in the OFF state, remove the 10n feedback capacitor and the circuit should turn ON. If it does, the fault will lie in the capacitor being shorted or open circuit.

Once the tone circuit operates, the only other stage to be checked is the gating transistor. If it fails to turn the tone off, the fault will lie in the base bias.

If the gating transistor still fails to turn the tone off, replace it. You may have damaged the base-emitter junction.

This should be sufficient to get the tester working. If not, ask another hobbyist to help you.

HOW TO USE THE TESTER

The project you are going to test must be switched OFF and no part of it should have any voltages present. This is because the input of the tester connects the base of the gating transistor to the probe via a very small value resistor and high voltages (greater than 6v) will destroy the junction by allowing high currents to flow.

Switch the tester ON and the indicator LED will illuminate. Touch the two probes together and the tone will be produced. This is the tone you will be listening for during the tests.

It is important to have a set plan of approach as lots of tests will be required for even the simplest circuit and a logical diagnosis will prevent you going over the same area twice or missing a test.

On this CD we have presented a number of projects using a PIC microcontroller. This type of project is one of the reasons why we designed the **Continuity Tester.**

If the project fails to work, you have quite a number of lines that need checking. All lines need to be checked for continuity and/or shorts and the Continuity Tester will make this task very easy.

We have used it many times for microcontroller projects sent to us for repair. It has found cracks and dry joints the eye missed.
We keep it on the workbench and I am sure you will find it invaluable too.