TALKING ELECTRONICS®

THE CONSTRUCTION MAGAZINE

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Issue No 6.

HANGMAN

an electronic version
of HANG THE BUTCHER

We Introduce....

Designer board.

See P. 66

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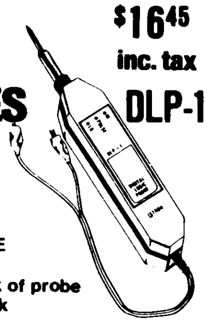

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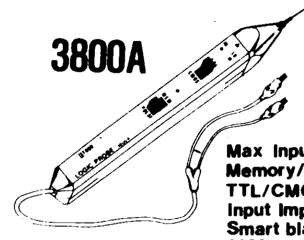

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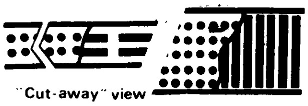

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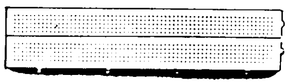

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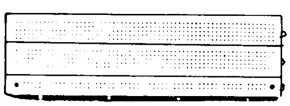

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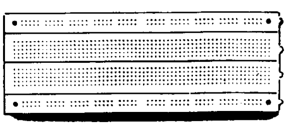

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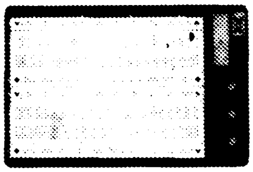

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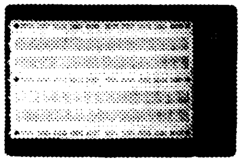

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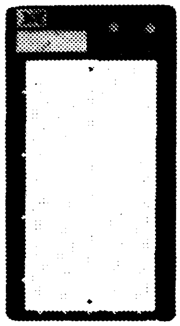

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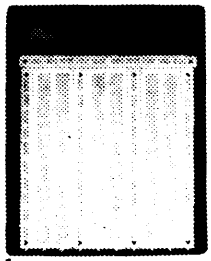

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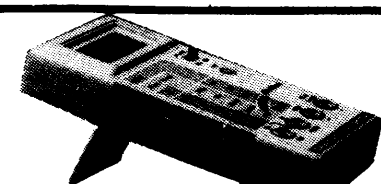

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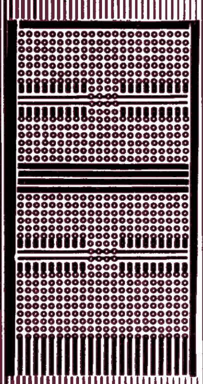

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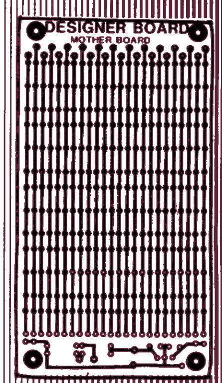

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TALKING ELECTRONICS

Editorial... Vol.1 No.6

This must be our best issue yet. And still we have more, bigger and better things planned. Introducing a circuit board with the magazine has opened up new dimensions for presenting a great range of exciting projects and has been greeted most favourably.

Of the Frequency Counter, one reader wrote: "most underhanded, it forces me to make the project!". If we can get more experimenters to make the project, we will go to any lengths to do so.

Surprisingly enough, one copy of the Mini Frequency Counter appeared in California, USA. It was shown to a University lecturer in Electronics at one of the Universities, who immediately offered to buy it. We later learnt the PC board alone was worth US$10. No wonder he wanted to buy it! So you see, you are getting very good value with the PC boards attached to the magazine.

The HANGMAN is our first venture. It is a light game (no pun intended). Everyone knows how to play it. After you finish two hours construction and hours of playing, it will make an ideal gift for a youngster. Meanwhile you will have learnt from the 6 building blocks it contains.

Next issue we have planned a couple of test-equipment boards, then a reaction timer which doubles as a shoot game - then a HI-FI VU meter, then ... let's get back down to earth and start with this issue. I'm sure you will agree it's packed with good ideas and basic facts to build upon.

So, now let's down to construction.....

Cheers,

Colin Mitchell.

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Ken Stone

ARTWORK

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ENQUIRIES

10 Minute queries will be tackled on 550-2386

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*Maximum recommended retail price only.

On our Cover:

Apart from the PC board, you will notice the cover shows the completed HANGMAN. Inspired by a writer, it was completely re-designed using transistors and IC's. The inset shows our designer board modular building system.

STAFF

Cumulative Index A-Z

CODE
eg 1-10 indicates
ISSUE 1 Page 10

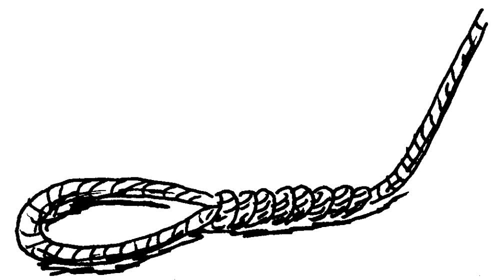
HANGMAN

AN OLD GAME - UPDATED.

PROJECT COST..$9 ***(since you already have the board)***

This is a HYBRID circuit - meaning it is composed of two different species. We have combined transistors with IC's to achieve an update of an old game. The complexity of the circuit comes from the repetition of the transistor stages. Due to the number of biasing resistors required it is strongly suggested that you use a PC board. Not only has the layout of the board been carefully designed to make it look symmetrical when completed but also allows the project to go together so much easier. The boards are printed with an overlay and will fit directly on top of a Zippy box so the whole game looks professional.

BUILD IT ON THE ATTACHED PRINTED CIRCUIT BOARD TODAY ! IT USES STANDARD COMPONENTS



Everybody likes re-discovering something they did years ago. Here's a game we all played at school. Possibly under the name of HANG THE BUTCHER. The game is quite simple. One player thinks of a word and writes down the number of letters in that word in the form of boxes or dashes. The object of the game is for the opponent to suggest letters of the alphabet and if they are correct, are placed on the dashes in the correct order so that the word gradually appears. To make the game more interesting, a side issue is introduced which effectively counts the number of incorrect letters. Each tme an incorrect letter is suggested a systematic framework is created made up of straight lines in the form of a gallows. A stick man representing a person being hung completes the diagram. The game is concluded when the correct word is created or the stick man is completed, whichever comes first.

This is an electronic version of the game. The stickman and gallows are made from 15 LEDs and each time the touch plate is touched, one more section of the cartoon is illuminated. The last LEDs to be lit are 14 and 15 which represent the feet of the man. When these LEDs are full brightness, the 8th LED begins to flash, indicating the man is "HANGED". The game can be played two ways. The "normal" way involves the secret word and using the hangman to count the incorrect letter. The other suggestion is to take it in turns illuminating the LEDs until the flashing LED is set into oscillation. The player creating the first sign of continued flashing is the winner. In either game you will have lots of fun, especially in a darkened room where the full effect of the LEDs will be realised.

Empty vessels make the most noise.

HOW THE CIRCUIT WORKS

7 BLOCKS

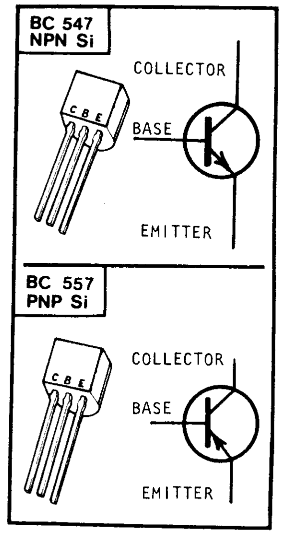
The HANGMAN game consists of 7 main building blocks. These are shown in the block diagram and are identified as follows:

1. 2Hz oscillator with voltage trip.
2. 2 KHz multivibrator
3. Voltage doubling
4. Staircase voltage detector
5. ½ second debounce
6. 1/10th second "one shot".
7. Shut down.

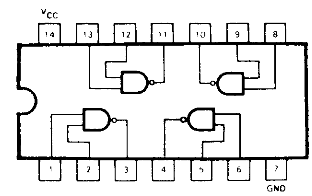
When the power is applied, the only building block to come into operation is the 2 KHz multivibrator, block 2. It is made up of gates c and d of IC2 and feeds the push-pull buffer consisting of Q11 and Q12 to charge the 100mfd electrolytic. The oscillator runs at a fairly high frequency and this reduces the size of the coupling capacitor. This building block is called a VOLTAGE DOUBLER and the voltage appearing at the output terminal is very close to double the 9v supply minus the voltage drops across the two diodes. Under no-load conditions this voltage appears at the output as 14v. We call this BOOST and we have labelled it 12v BOOST because it reduces to 12 volts under full-load conditions.

The mechanics of the voltage doubling circuit are very easy to follow. The multivibrator c and d produces a square wave which is fed to the bases of the two complementary transistors. When one transistor turned hard on, the other is full off. For the first cycle, the output gate c is LOW and the BC 557 is turned ON. The negative end of the 22mfd is taken to the negative rail and charges quickly via the top IN 4002 diode to 7.5v. At the same time the 100mfd electrolytic is charging to 7.6v via the two diodes. When the multivibrator swings HIGH, the top BC 547 transistor turns ON and the BC 557 turns off. The negative end of the 22mfd is now brought to the positive rail and its stored 7.5v will be added to that of the 100mfd electrolytic to bring the total voltage up to 15.2 volts minus .7v drop across the lower diode. In fact the voltage drop across the diodes have a double effect on reducing the voltage since they are used for each part of the voltage doubling action. They account for nearly 3v drop. We must also include the collector-emitter voltage drop of each transistor as this reduced the maximum voltage available on the 22mfd boosting electrolytic. Thus the resulting voltage out of the doubler is considerably less than you would expect. All these diode and transistor voltage drops are constant for any voltage doubler and would obviously be less noticeable when using higher voltages. This arrangement is capable of delivering 15 to 20 milliamps and since it does not have a very good regulation, the voltage under load drops to about 11 or 12 volts. This is just enough to illuminate LEDs 14 and 15 in the staircase circuit.

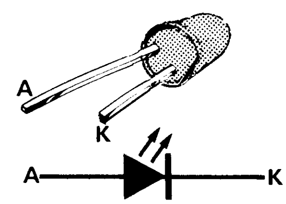
PIN OUTS:



CD4011

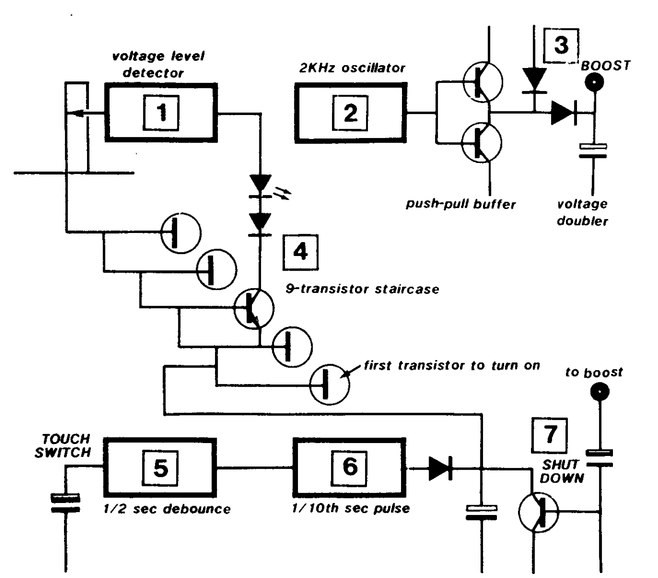


QUAD 2-INPUT NAND GATE

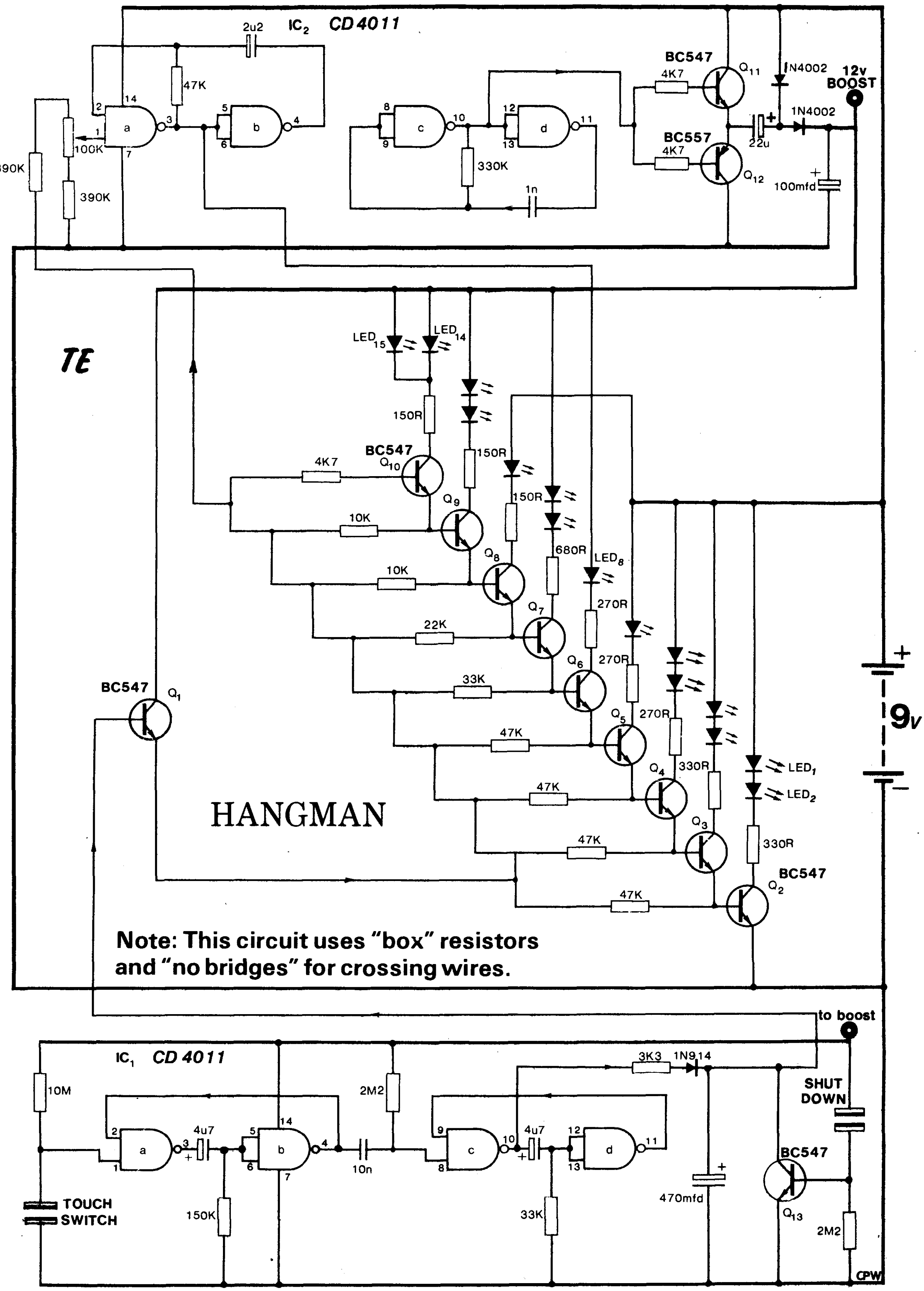


LEDs 14 and 15 are positioned as the feet of the man being hung and are controlled by transistor Q10. The reason for providing a voltage doubler circuit is two-fold. It introduces a new building block into our "library" and adds interest to the project while providing an economical way of producing the necessary higher voltage rather than using a 12v battery.

When a player places his finger on the TOUCH SWITCH, the first monostable multivibrator consisting of gates a and b in IC_1 will be triggered into its unstable state and produce



HANGMAN BLOCK DIAGRAM



There is no short cut to knowledge

HOW THE CIRCUIT WORKS

a spike through the 10n capacitor to operate the second monostable. The output pin 10 is normally HIGH. It will go LOW for 1/10 second then return HIGH. It will remain in this state until your finger is removed and re-applied. The time delay of the first monostable has been carefully chosen to be longer than the second so that the circuit is fully debounced and can only be triggered every half-second. The second monostable has a time delay completely independent of the first and produces a short pulse which charges the 470mfd electrolytic via the 3k3 resistor and diode. The purpose of the diode is to prevent discharging of the electrolytic once the monostable has fallen back into its stable state and produced a LOW on pin 10.

The charging of the electrolytic is exponential and each pulse from pin 10 produces sufficient energy to raise the voltage of the 470mfd approximately .75v to turn on one transistor at a time in the staircase. At the bottom of the staircase, one pulse will be sufficient to illuminate one of these steps but as they increase towards the top, more than one pulse will be required. Transistor Q1 is connected as an emitter-follower, the load being the base resistors in the staircase. The voltage across this load will be directly proportional to the voltage on the electrolytic (i.e. the base voltage) minus the .75v base-emitter voltage drop. The main purpose of the transistor is to separate the 470mfd electrolytic from the load of the staircase. If we were to remove this transistor the circuit would function as before except that the load of the 9 staircase transistors would tend to discharge the electrolytic rather quickly.

So, in effect, the emitter-follower transistor is providing an impedance matching arrangement to reduce the drain on the electrolytic, to a value about one-hundredth of a directly-coupled version.

The base resistors have been chosen according to the voltage they will be required to drop. Many factors influence the actual value selected for each base resistor as the impedance of the circuit changes with rising voltage and this alters the conditions considerably.

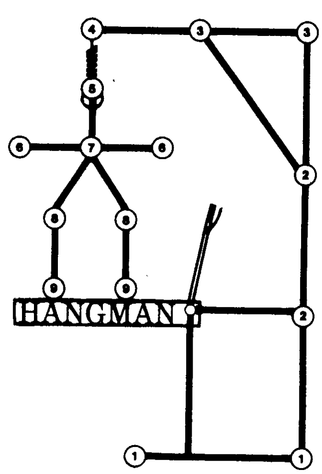
The first transisitor in the staircase is Q2. It will turn on when its base voltage is .75v higher than the emitter voltage. The second transistor, instead of being connected to the ground, is connected to the base of the first transistor. It too will turn on when its base voltage is .75v higher than its emitter. This means the incoming voltage will need to be .75v + .75v or 1.5v before it will be fully turned on. This reasoning continues up the staircase so that the top transistor will require 6.75v to be turned on.

Extending back, the 470mfd electrolytic requires 6.75 + .75v or 7.5v and the output of the IC .6v higher again to account for the diode drop. The IC needs an even higher output voltage to be able to supply a charging current through the 3k3 current limit resistor. To be on the safe side, the supply rail should be 7.5v + 5v + 2v = 10.1v. The need for a high supply voltage is even more important when illuminating the top LEDs 14 and 15. So much of the supply has been lost in the base-emitter junctions that 11.5v is the absolute minimum voltage if we expect to get adequate brightness from the top LEDs. This will allow us just 4v for the dropper resistor and LEDs.

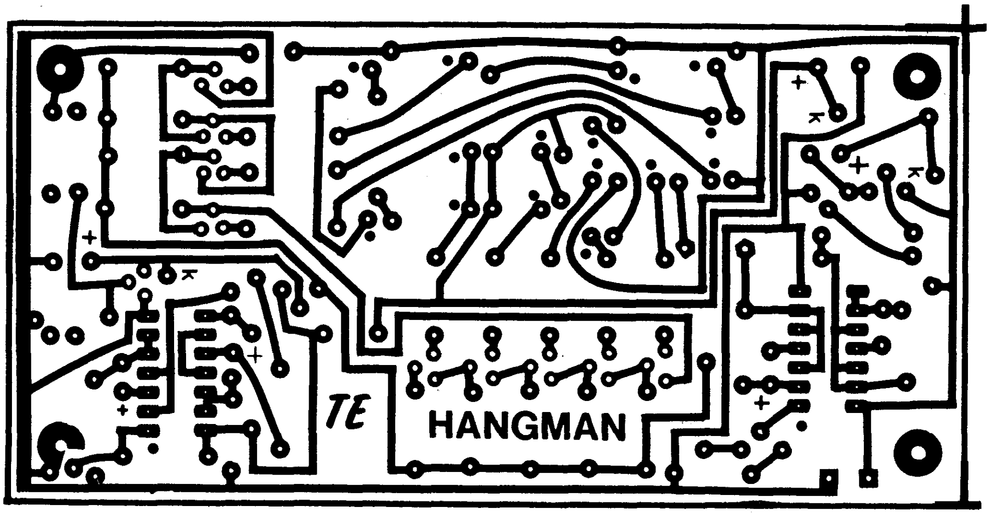
You will notice the power to the 15 LEDs comes from 3 different sources. LEDs 1 to 7 and 11 are supplied directly from the 9v supply. LED 8 derives its supply from a slow cycling oscillator. This is made up of gates a and b of IC2. It forms a gated oscillator with pin 3 normally HIGH. The oscillator is triggered via pin 1. When it detects approximately half supply voltage through the high impedance resistor network comprising the 390k, 100k pot and 390k resistor, it will flash LED 8 at about 2 cycles per second.

LEDs 9 and 10 are series LEDs and need to be driven from a source slightly higher than 9v. To achieve this we must take them to the BOOST rail. LED 7, being a single LED will just operate from the 9v rail. The remaining 4 LEDs need 12v to operate. LEDs 14 and 15 are paralleled together so that they can attain full brightness from the 12v rail.

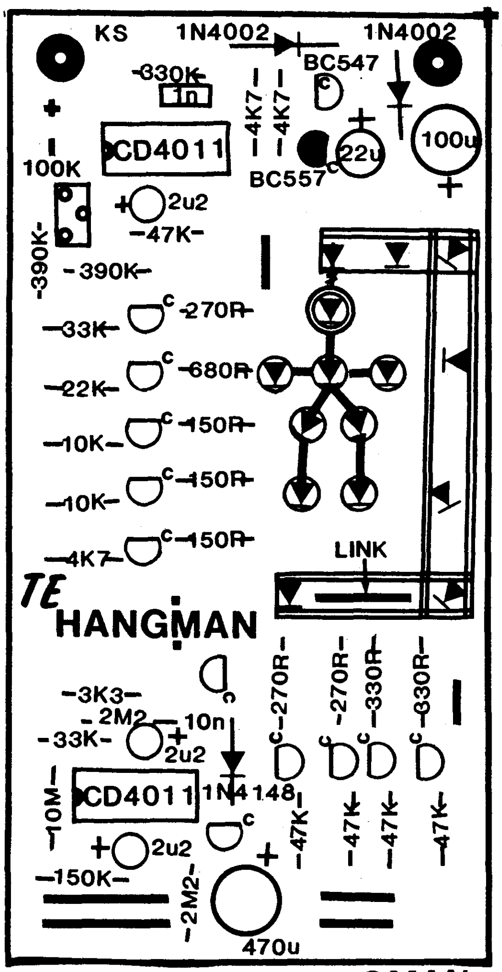
Resetting the game is accomplished by discharging the 470mfd electrolytic via Q13. This transistor is normally biased in the off condition with the 2M2 base-emitter resistor. When you touch the SHUT DOWN wires with your finger, a small forward bias is applied to the transistor and it turns ON to bleed the electrolytic. The light-emitting diodes will gradually turn off as the voltage on the electrolytic falls. When all the LEDs are off the quiescent current for the game is only about 100 microamps. This is so small that no on/off switch is required and even small penlite cells will last their normal shelf life.



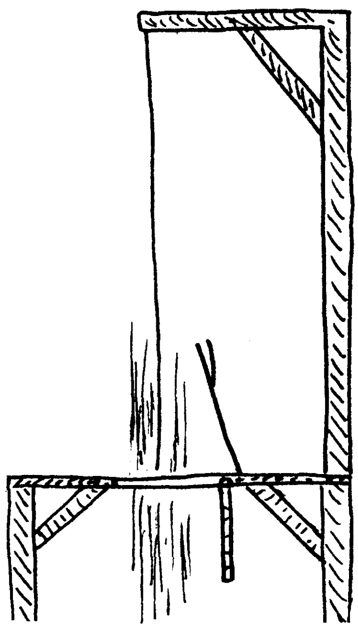
LEDS TURN ON IN THIS ORDER



PC LAYOUT



OVERLAY FOR HANGMAN



An overlay makes construction so easy. It will take the best part of an hour to assemble the HANGMAN, even with all the parts ready at your fingertips. See the cover photo if you are not sure where any of the components are placed. Use only DURACELL's to power this game. Ordinary 'dry cells' will not last very long as their voltage soon falls to 8v or less for a 9v battery. At this voltage the doubling circuit will be incapable of supplying sufficient voltage to light LEDs 14 and 15.

When words fail, music speaks.

HANGMAN PARTS

R1	"	10M
R2	"	150K
R3	"	2M2
R4	"	33K
R5	"	3K3
R6	"	2M2
R7	"	47K
R8	"	330R
R9	"	47K
R10	"	330R
R11	"	47K
R12	"	270R
R13	"	47K
R14	"	270R
R15	"	33K
R16	"	270R
R17	"	22K
R18	"	680R
R19	"	10K
R20	"	150R
R21	"	10K
R22	"	150R
R23	"	4K7
R24	"	150R
R25	"	390K
R26	"	390K
R27	"	47K
R28	"	330K
R29	"	4K7
R30	"	4K7

C1	electrolytic	4.7mfd 16v
C2	capacitor	10n 100v
C3	electrolytic	4.7mfd 16v
C4	"	470mfd 16v
C5	"	22mfd 16v
C6	capacitor	1n 100v
C7	electrolytic	22mfd 16v
C8	"	100mfd 16v
Q1 - Q11	Transistor	BC 547 (11 off)
Q12	"	BC 557 (1 off)
Q13	"	BC 547 (1 off)
IC1	Quad Nand	CD 4011
IC2	" "	CD 4011

LED 1 - 15 3mm Red Leds. BUY 20 LEDS.
1 - 100k mini trimpot
1 - Diode 1N914 or 1N4148
2 - Diodes 1N4002
battery snap
9v battery
HANGMAN PC BOARD

CONSTRUCTION

Examine the printed circuit board for any holes which may be filled-in with solder. This happens during manufacture, when the copper tracks are being tinned. Clean these out with a soldering iron and needle or a length of copper wire. Whether you use a ready-made printed circuit board or a home made board, some form of printed construction is essential for a circuit of this complexity.

Follow the usual method of fitting the parts by firstly soldering the resistors in position. Refer to the layout for their positions. They can be inserted either-way-round but it's best to fit them so that the colour bands can be easily read when you are checking them later. Some boards have been silk-screened with an overlay of the parts. This will assist enormously with construction and show you which side of the board to mount the components as well as their exact positions.

Next fit the jumper wires including those making up the touch switches. You can use tinned copper wire or the ends of resistors. Do not use plain copper wire as its appearance will deteriorate and become tarnished after a period of time.

The 100k mini trim pot, 3 diodes and 2 capacitors are fitted next. The diodes must be inserted with their cathode end as shown. This is identified on the component by a band. In the case of the small signal diode, it may have a blue, red or black band, depending on the type supplied. The 5 electrolytics must be inserted with the positive end as marked on the board. The positive lead is the long lead so don't cut them off until they have been inserted and soldered.

Next fit the 15 light-emitting diodes. These are very temperature sensitive and will be destroyed if allowed to get too hot during soldering. Hold them in position during soldering with your fingers to prevent them getting too hot. The cathode all face one direction and are marked on the board with a dot. This is the short lead and if you look into the body of the LED you will see it is the largest portion inside the LED.

Lastly insert the semiconductors most vulnerable to damage. The 13 transistors are inserted as shown in the layout diagram. You will notice a uniformity about the way they are inserted and this should prevent too many mistakes. Finally the two chips are fitted to the board. Locate pin 1 on the chip via the dimple and align it up with pin 1 on the board as marked with a dot. Double check this against the layout before soldering as you will not be able to remove the IC after it is soldered.

IF IT DOESN'T WORK

If your unit fails to operate for some unknown reason, it can be diagnosed with the aid of a simple piece of test equipment. This is a LED and 330R resistor connected to two jumper leads. A multimeter will also be handy but not essential. Connect the cathode of the test LED to ground and use the resistor lead as a probe. Switch on the game and test these points on IC2 for a HIGH: Pins 3, 5, 6, 10, 11, 12, 13 and 14.

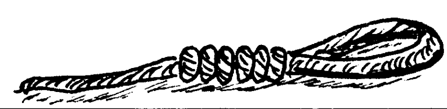
Pins 10, 11, 12, and 13 will be supplying the BOOST circuit. Notice the LED will light up very brightly when connected to the positive of the 100mfd electrolytic. Also connect to the common emitter terminal of the transistors for a HIGH. Once you have BOOST, IC1 will be obtaining its power and will be ready for test. Before checking the second IC, test each of the LEDs by taking the flying lead of the resistor to each of the resistors connected to the collectors. The test LED will light up as well as a single or pair of LEDs on the game. If only 1 LED of a pair lights up as well as the test LED, you will know that one LED has shorted during assembly due to soldering. If no LEDs light up, one of the LEDs is open circuit, and if only the test LED lights up, both LEDs are shorted. If one section of LEDs is not being turned on, the transistor could be getting incorrect biasing or suffering from a base-emitter short.

The 470mfd electrolytic can be charged externally via a 10k resistor connected to the positive of the battery. This will sequentially turn on the LEDs. Once the LEDs are alight, they should stay illuminated for 5 minutes or so without the voltage on the electrolytic draining away. Any gradual decline will indicate a leakage path. Remove the shut-down transistor and the staircase base resistors starting from Q10, to locate the fault. Q1 should also be checked.

The second 1/10 second TOUCH SWITCH delay output is detected on pin 4. It is normally HIGH and goes low for 1/10 second. Pin 10 is the pulse output and will flash briefly when gates c and d are pulsed via the 10n capacitor. You will be able to detect this pulse on the test LED.

If LEDs 14 and 15 do not illuminate, the battery will be slightly LOW. The circuit is fairly critical on voltage. The supply cannot deviate more than 1 volt either side of 9v.

Use this same reasoning to investigate any other of the blocks you feel are not operating satisfactorily. Once you have run over the whole circuit, connect up the battery firmly and mount the board on a Zippy box. The board will accept 2 small screws to finish the job. All that is left now is find an opponent and meet your challenge.



You can't turn the clock back, but you can wind it up.

NEW

unibox PACKAGING SYSTEM

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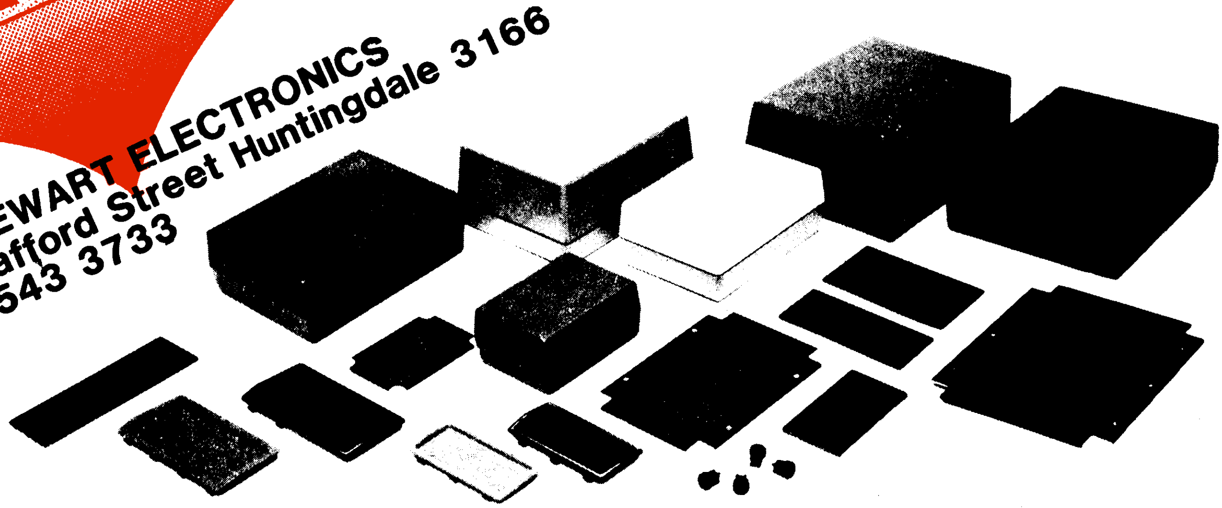
(03) 543 3733



ENCLOSURES

PART NUMBER	DIMENSIONS X		Y		Z	Price
110 - *	1.25"	X	2.07"	X	2.77"	$3.48
120 - *	1.50"	X	2.65"	X	3.75"	$4.28
130 - *	1.50"	X	3.25"	X	4.38"	$4.68
133 - *	2.00"	X	3.25"	X	4.38"	$5.22
140 - *	1.50"	X	4.00"	X	5.30"	$5.76
144 - *	2.00"	X	4.00"	X	5.30"	$6.30

* SPECIFY COLOR – GRAY, BROWN, ORANGE, GREEN, BLUE

END X Y — SIDE Z

MATERIAL – ABS

WINDOWS and PANELS

PART NUMBER	COLOR	DESCRIPTION	SIZE	Price
201	RED	WINDOW	A	$2.68
202	SMOKE GRAY	WINDOW	A	$2.68
211	RED	WINDOW	B	$3.22
212	SMOKE GRAY	WINDOW	B	$3.22
221	GRAY	PANEL	A	$2.28
222	GRAY	PANEL	B	$2.54

APPLICATION: SIZE A windows and panels fit **UNIBOX** part numbers **120** (side), **130** and **133** (side and end), **140** and **144** (side and end).

SIZE B windows and panels fit part numbers **133** (side) and **144** (side and end).

USEFUL FLAT AREA A – .80" X 2.06" B – 1.12" X 2.70"

MATERIAL – ACRYLIC (201–212)

MATERIAL – NORYL (221–222)

GRIDBOARDS

PART NUMBER	DIMENSIONS	ENCLOSURE	APPLICATION	Price
301	1.60" X 2.30"	110	HORIZONTAL	$3.08
302	2.20" X 3.30"	120	HORIZONTAL	$4.30
303	2.80" X 3.90"	130 and 133	HORIZONTAL	$5.10
304	3.60" X 4.90"	140 and 144	HORIZONTAL	$7.40
311	1.25" X 2.29"	120	VERTICAL	$2.68
312	1.25" X 2.80"	130 and 133	VERTICAL	$2.94
313	1.75" X 2.80"	133	VERTICAL	$3.22
314	1.25" X 3.55"	140 and 144	VERTICAL	$3.22
315	1.75" X 3.55"	144	VERTICAL	$3.76

MATERIAL – FR-4/G-10 EPOXY – GLASS

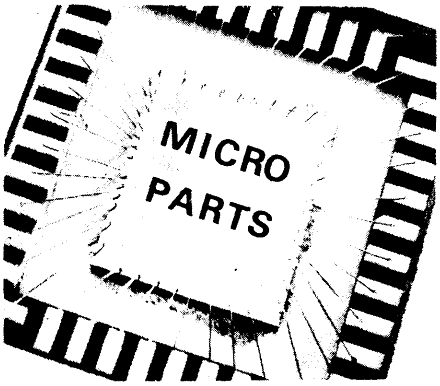
All Prices + 17½% Sales Tax

P&P $1.50

ENCLOSURE FEET

PART NUMBER			Price
200	(PACKAGE OF FOUR) FIT ALL SIZES OF ENCLOSURES		$ .92

MATERIAL – ELASTOMER



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100 1/4 Watt 5% resistors $1.50 Worth $4.50

400 1/4 Watt 5% resistors $4.00 Worth $16.00

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100 1N914 DIODES $2.00

2 1/4" speaker $1.00

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15 electros $1.00

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Tuning Capacitors for your xtal set 85c each two for $1.50

25 Capacitors. $1.00

50 K Lin Pots (sliders) 30¢ ea

100 K Slide Pots 30¢ ea

1000 mfd 16V only 75¢ ea

1000 mfd 25V only 85¢ ea

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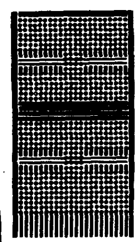
capacitors, trimpots etc.

$2 + $1 p+p

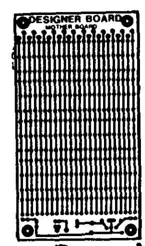


NEW!

Designer Board

Designed by T.E.

for Proto typing.



Designer #1 Only $3.50

See P66

Mother Board Only $3.00

1 Kg bag of mixed components $7 + $3 p+p

1 kilogram of mixed electronic components. ALL NEW including $4 worth of 5% 1/4 watt resistors (LIMITED OFFER) and Lots of other goodies

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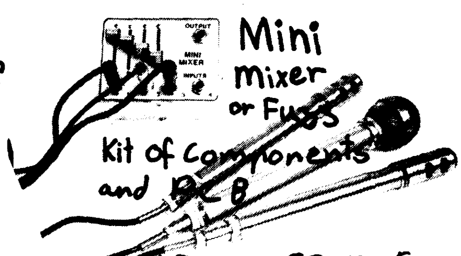

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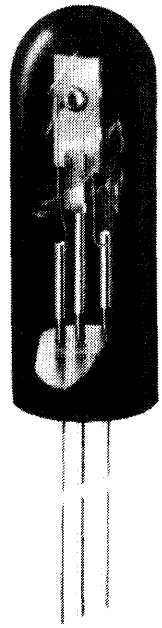
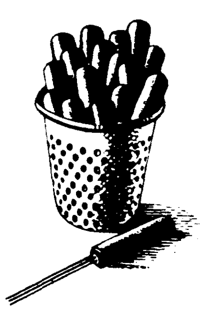
33 YEARS



Germanium alloy transistor for small-signal applications of the "OC" series. The case is glass.



"20 transistors in a thimble".

The release of this issue marks the 33rd anniversary of the discovery of the transistor. It was just before Christmas 1947, when Dr Shockley and two colleagues, Drs J Bardeen and W H Brattain finally clinched months of work and created the first successful transistor. It was not an accidental invention but the culmination of a long line of study of the electrical properties of crystals, going back to the mid-nineteenth century.

It would be difficult to say how many contributions from other scientist aided these researchers in producing the final success but it was certainly made up of a lot of peculiar phenomenons all along the line. So many "reverse reactions" were occuring in the experiments on conduction that could not be explained by the knowledge of the day. The most mystifying of all occured at the Bell laboratories in New York. Metallurgists were preparing pure silicon for rectifier experiments and found that some of the rectifiers worked, others operated around the other way, while some did not work at all. They concluded that the silicon must still contain a microscopic amount of trace elements which were dramatically affecting the effectiveness of the silicon. They worked to isolate these impurities and found Arsenic and phosphorus produced one type of silicon while Boron or Indium produced another type. They called the first type "P" and the latter "N"-type. Using these characteristics, they produced the first PN silicon diode in 1940. Although the first semiconductor diode was silicon, they had also detected a similar effect when "doping" germanium. Small amounts of impurities added to pure germanium caused it to behave as a P-type material while others created an N-type material. Far more was known about germanium than silicon and so a special research department was set up at Bell laboratories to continue with this exciting field in the hope that an amplifying device may be possible. They worked on designing a controlling layer between the P-N junction to produce a device similar to a triode valve.

On December 23rd 1947 they succeeded. And the transistor was born. The original transistor (actually a very accurate copy) has been preserved to this very day in the Science Museum London and it looks just like a jumble of curly wires. Even the laboratory notes for that day are preserved and in a typical scientific fashion, are barely ledgible. The transistor looks so primitive that you would hardly credit such a remarkable device was born in so humble a beginning. During the next two years the transistor was improved upon out of sight, and the technique for refining the germanium and mounting the

A ship in harbour is safe, but that's not what ships are for.

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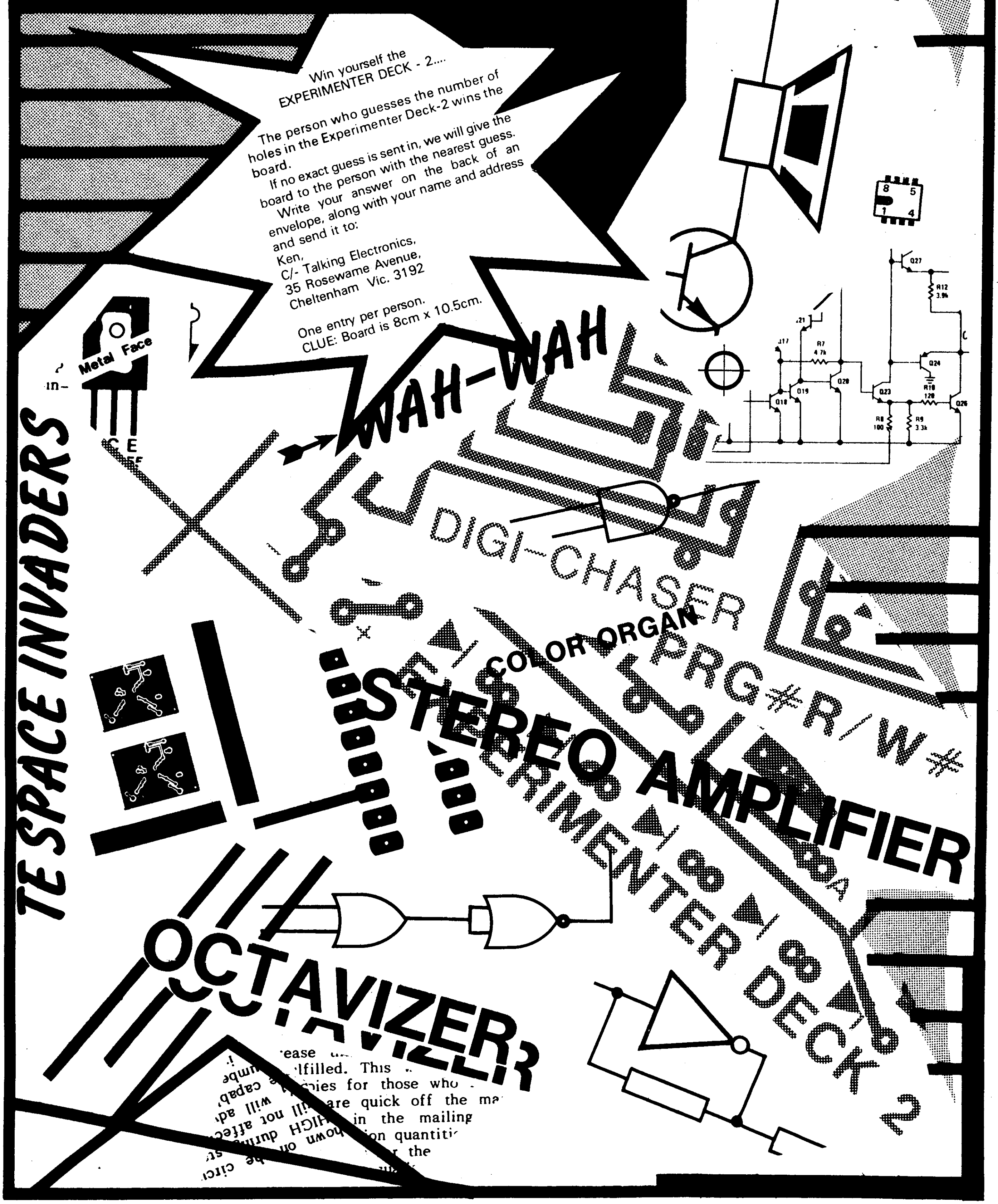
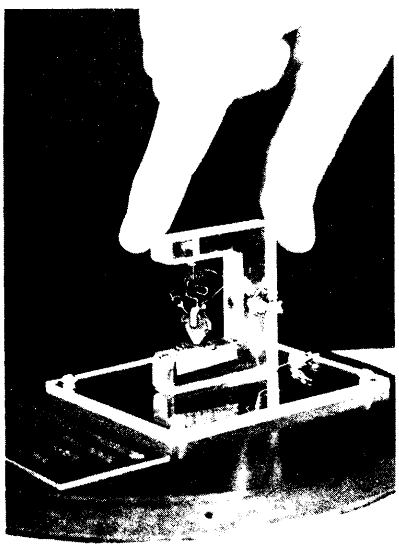
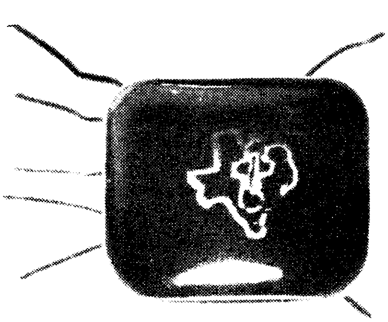
One entry per person.
CLUE: Board is 8cm x 10.5cm.



John Bardeen, Walter Brattain and William Shockley (seated) - inventors of the transistor.



A model of the first transistor invented in 1947.



Early Texas mesa integrated circuit showing the vitreous enamel package, from the underside of which the connecting leads protrude.

material, were made commercialised. Every step along the way produced a new challenge. Never before had such purity been required. Whole **factories had to be absolutely free of contaminants, the wires had to be finer than that available and the connections had to be extremely accurately positioned.**

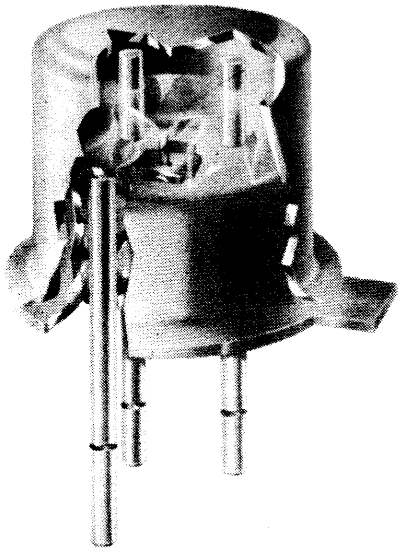
At the beginning of 1950 the transistor was still a novelty. Their cost precluded them from most applications. They had not yet achieved any of the ratings of a valve. Their reliability was not yet proven and the circuit technology had not yet filtered down to the manufacturers. Transistor circuit design was vastly different to valve design and this required time to be accepted by designers. Apart from this, a number of different types were being developed and the best of the range would only come out in time. Even the text books of the day argued in favour of one type while others suggested another but at least the electronics industry did not reject the introduction in any way.

By 1952 the British Post Office Research at Dollis Hill had demonstrated the first line-amplifier using junction transistors and a year later, in America, Texas Instruments produced the first pocket transistor radio. The first commercial use for the transistor in the UK was in the production of hearing aids. Up to this time only valve aids were available and these required relatively large batteries (a 1.5v battery and a 22.5v battery). These were heavy and expensive and required constant replacement. Some of the first transistor types to be marketed were designed for hearing aids and were the "OC" series. By 1955 the first batch of three hundred, 5-transistor aids was released. By comparison, they were extremely amateurish, being hand-wired into a birds-nest circuit without any sign of a tag-strip or PC board. The stiffness of the leads served to separate the components and no insulation or potting was used. The equivalent price of these transistors in today's values would be $10 to $15 each, so you can appreciate the cost of a hearing aid to the wearer. But the reduction in weight was well-worth the added cost.

Some of those early-series transistors were placed on the components market and engineers soon began designing and building with them. Many an engineer scraped the black paint off the glass-case to use them as sensitive photocells. As production techniques improved the devices were fitted into metal cases and sealed with solder. In one batch this produced flux contamination and this led to hermetic sealing for future runs.

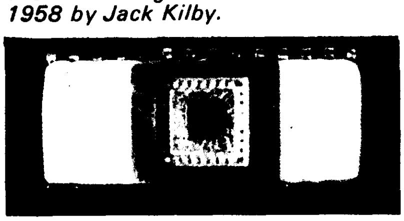
Mastering transistor manufacture was enormously costly. One manufacturer produced **TWO** successful devices in one week while another claimed the first device represented an investment of two million dollars. It is interesting to note how the "OC" series came about. It was an

He best can pity who has felt the woe.

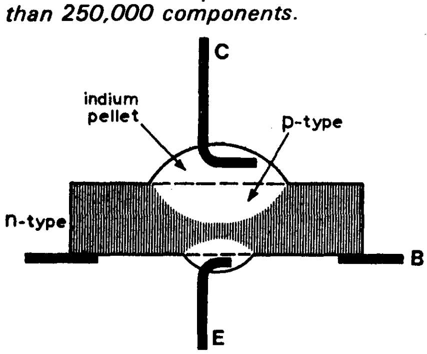


An enlarged view of a Germanium alloy diffused switching transistor.

The first integrated circuit invented in 1958 by Jack Kilby.



A modern micro electronic circuit, shown in the smallest square, can have more than 250,000 components.



Slab of N-type germanium with two Indium-doped pellets alloyed to it so that it will be modified to P-type immediately below them after heating resulting in an alloy-junction transistor.

extension of valve numbering. The Philips group have always produced a sensible code for all their components and the transistor was just an extension of that code. The normal valve abbreviations were: A for diodes, B for double diodes and C for triodes. The first symbol of the type number was reserved for the heater voltage, zero for transistors. So the OC series was clearly a triode with no heater.

The first devices were germanium but this material was in very short supply. Only 3 sources were known and the cost of the raw material proportionally high. The only alternative was silicon, another group IV element, but at the melting point of 1420°C produced a number of problems with the quartz crucibles. They tended to dissolve in the silicon.

Texas instruments were the first in the field in 1952 with silicon transistors and had a virtual monopoly for 3 years. Initially these transistors were low-gain and the frequency response was poor but the leakage current was considerably less. Meanwhile in Japan, Sony started manufacturing transistors in 1953. A year later they produced their first transistor radio and started a monopoly on short-wave and FM transistorized receivers which was to last for more than 10 years. With all these improvements to production, the price of transistors began to fall. In 1956 the price had dropped to $12 each, $10 in 1957, $4-$6 in 1960 and $2 each for large quantities. Firms such as Philco had decided to stay with germanium devices and as sales fell, so did the profits. They were finally wound up in 1969. Such is the result of bad decisions and technological mistakes, losing not only customers, but key staff and research engineers.

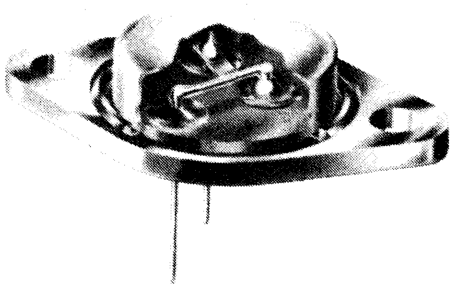
Perhaps one interesting example is the BC 107. Introduced in 1963, it is a planar epitaxial silicon transistor. It still sells some 10 million devices per year and were originally made in the same factory that had formerly produced 50 million valves per year. The only difference being the size of the factory floor required. It needed only one tenth the production area.

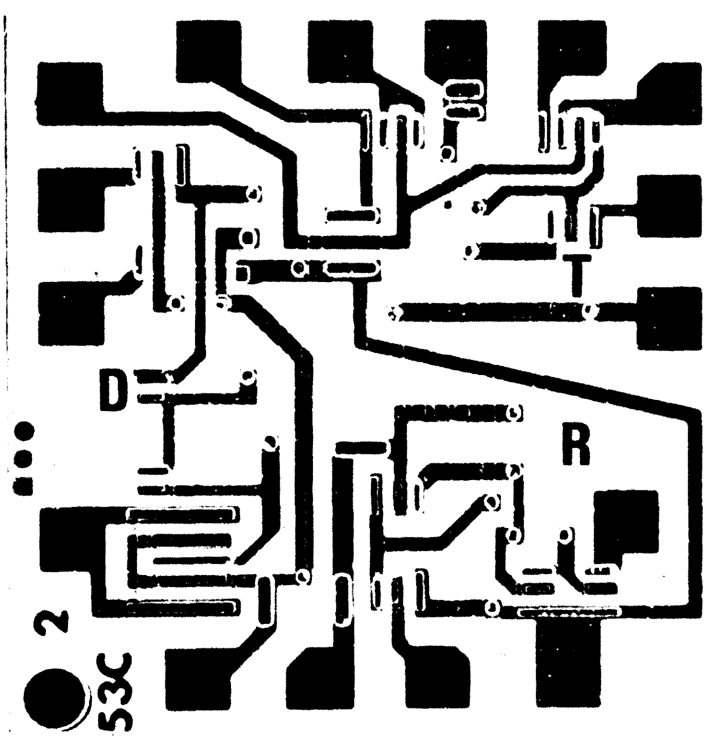
The transistor saw so many additional improvements. This led to the massive number of types and we now have over 5,000 different types of transistors. This has produced a bewildering array of cases and ratings which has proven to be far beyond any possible co-ordination. In fact the design of transistors has got out of hand with over a dozen manufacturers producing the same device under a different part number. Fortunately things have advanced on the high technology side of things. The next generation of semiconductor devices has well and truly swamped the humble transistor so much so that it is almost obsolete as a discrete component. For some time it was realised that a number of transistors could be constructed on the same base substrate with accompanying passive components to pro-

Type number	Comparable Miniwatt types	Type number	Comparable Miniwatt types	Type number	Comparable Miniwatt types
OC65	**OC65**	OC623	OC65, OC66	T34F	OC72, 2N281
OC66	**OC66**	OC624	OC65, OC66	TS161	2-OC72
OC70	**OC70, 2N279**	OD603	OC30	TS162	OC71
OC71	**OC71, 2N280**	OD604	OC30	TS163	OC71
OC72	**OC72, 2N281**	RL31	OA81, 1N476	TS164	OC71
OC73†	**OC71**	RL32	OA81, 1N476	TS165	OC72, 2N281
OC74	**OC74**	RL41	OA70	TS166	OC70, OC65
OC75	**OC75**	RL43	OA81, 1N476	TS620	OC65, OC66
OC76	**OC76, 2N284**	RL44	OA81, 1N476	TS621	OC70, OC65
OC77	**OC77**	RL143	OA81, 1N476	*ZJ13*†	OC72
OC601	OC70	RL231	2-OA79	CV442	OA81, 1N476
OC602	OC70	RL232/B	2-OA79, 2-OA72		**OA73, 1N616**
OC602 (spez.)	OC76	T34A	OC65, OC66	CV1353	**OA81, 1N476**
OC603	OC71	T34B	OC65, OC66	CV1354	**OA85, 1N478**
OC604	OC71	T34C	OC65, OC66	CV2400	OC71
OC604 (spez.)	OC72	T34D	OC72, 2N281	CV5105	**OC45**
OC612	OC45	T1040	OC16		
OC613	OC44	T1041	OC16		
OC622	OC65, OC66	T34E	OC72, 2N281		

One of the first transistor cross-reference lists. (1958)

A close-up of a Germanium alloy transistor in a TO3 package for power applications.





An integrated circuit showing a transistor T a resistor R and a diode D.

duce an integrated package. In 1958 this is what Texas Instruments did. The key to this was the planar process developed by Fairchild. The first units were very primitive to look at, being a vitreous package from which the wires protruded. Initially the package contained only one type of device, either a set of transistors or a set of resistors. When these were merged together in later arrangements, it was realised that a resistor required the space of 4 to 6 transistors. New circuit designs were introduced to replace a resistor with a number of transistors and today resistors are limited to the range of 30 ohms to 1k ohms.

Improved transistors of the Field Effect type and high speed switching came about with the inclusion of the Shottky diode in which the knee voltage is only .3v instead of .5v for a silicon junction diode. Integrated circuit prices plummeted just like transistor prices a decade before. In 1963 an integrated circuit sold for $30. Once the production line was set up, the price fell to $2. This has been gradually pared away to the current price of about 30¢ for the average integrated circuit incorporating 20 or so transistors. During this price fall, the quality of the IC's has improved with Japan coming heavily onto the market. Without a doubt, the integrated circuit has taken over the vast majority of individual transistor operations and it seems the life of the most phenominal little device ever to be invented will be less than 40 years. It is heart-warming to think that almost every device made during those 40 years will outlive its own destiny.

It is easier to ruin a kingdom than set up a pie stall.

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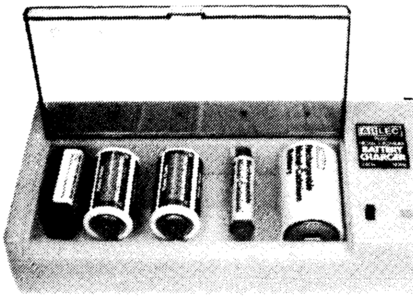
Charges AA, C, D and 9 volt Nicad Batteries. The charger is able to monitor if the battery is receiving a charge. It also tests batteries.



$15.28

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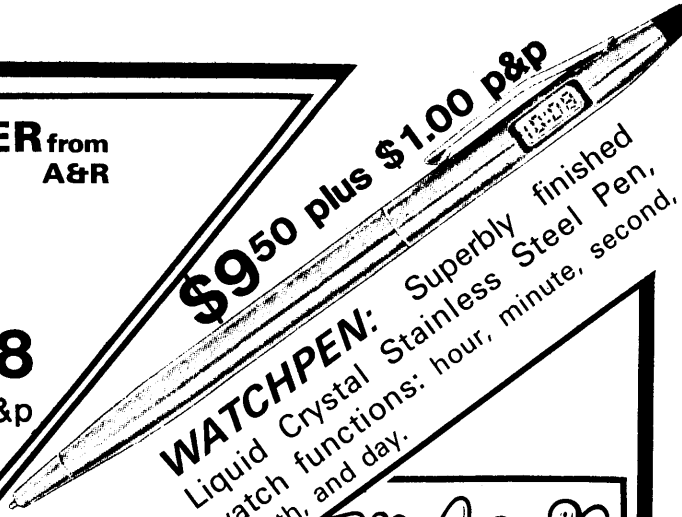

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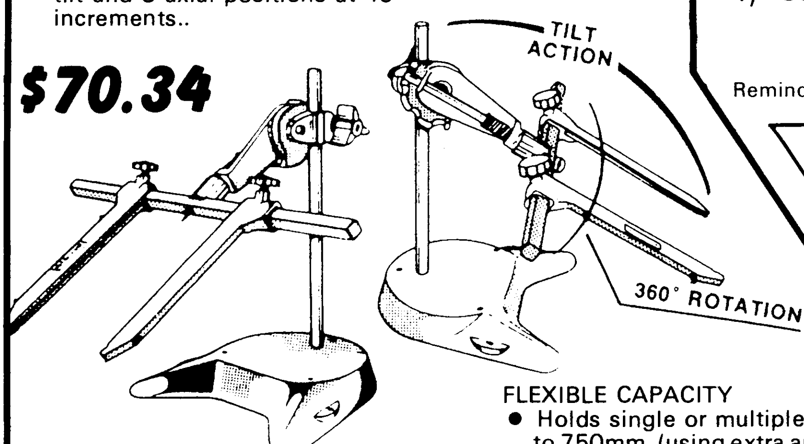

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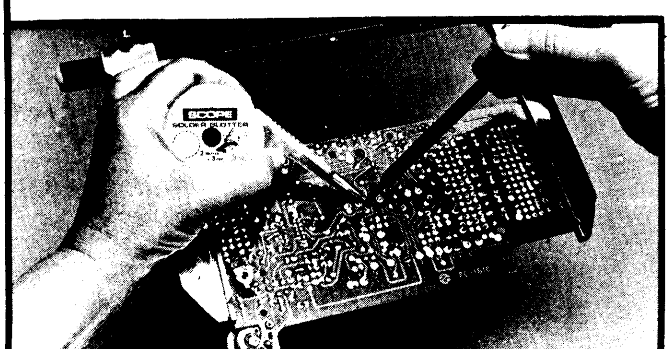

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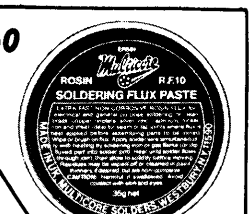
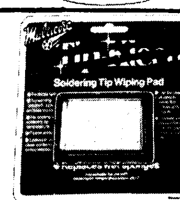


$1.00

$1.60



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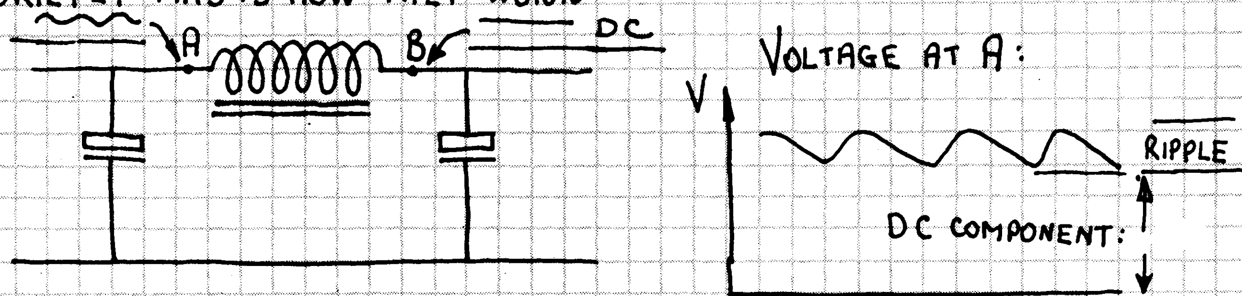
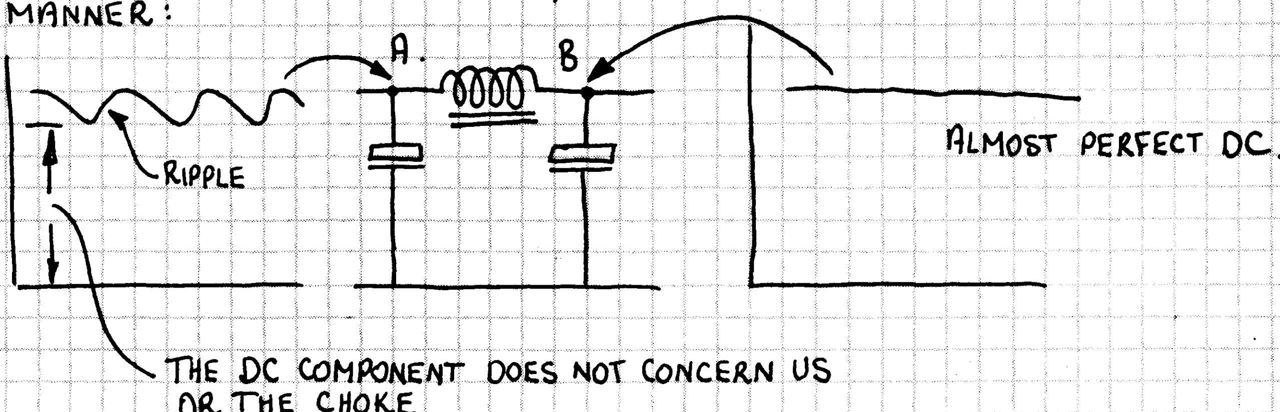
2. LC FILTER

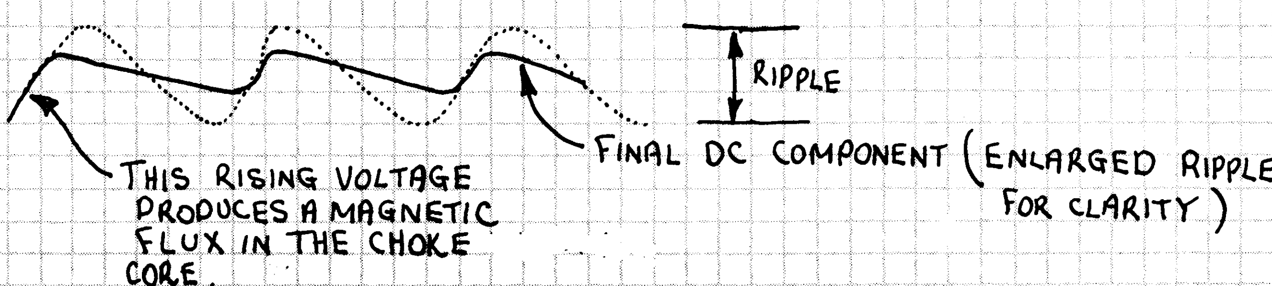
THE NEXT STAGE IN FILTERING (SMOOTHING) INTRODUCES A CHOKE. THEY PROVIDE EFFECTIVE AND EFFICIENT FILTERING BUT ARE VERY EXPENSIVE & WEIGHTY. (QUITE OFTEN ABOUT THE SAME SIZE AS THE POWER TRANSFORMER ITSELF.) THUS WE WILL NOT BE SUGGESTING THEM OR DESCRIBING THEM IN DETAIL. THEY HAVE BEEN MADE COMPLETELY REDUNDANT BY MODERN VOLTAGE REGULATOR CHIPS.

BRIEFLY THIS IS HOW THEY WORK:



THE VOLTAGE AT "A" CAN BE CONSIDERED AS CONSISTING OF TWO PARTS: A DC-COMPONENT & AN AC-RIPPLE.
A CHOKE IS SIMILAR TO A POWER TRANSFORMER WITHOUT THE SECONDARY WINDING. THEY BOTH WORK ON AC. THE CHOKE ONLY "SEES" THE RIPPLE PORTION OF THE INPUT VOLTAGE. THIS IS THE AC PORTION. NO MATTER HOW SMALL THIS AC COMPONENT, THE CHOK WILL "REACT" IN THE FOLLOWING MANNER:





TOWARDS THE TOP OF THE WAVEFORM THE "RATE OF CHANGE OF VOLTAGE" IS REDUCED AND THUS THE MAGNETIC FLUX CANNOT BE MAINTAINED. THE FLUX BUILT UP IN THE CORE BEGINS TO TAKE OVER AND SINCE THIS IS IN THE OPPOSITE DIRECTION, PRODUCES A VOLTAGE WHICH IS IN OPPOSITION. THUS THE VOLTAGE PEAKS ARE REDUCED DRAMATICALLY.
IN SIMPLE TERMS, THE EXCESS ENERGY OBTAINED FROM THE PEAKS IS "ABSORBED BY THE CHOKE AND DELIVERED INTO THE "TROUGHS" (LOWS).

The only trouble about being a good sport is that you have to lose to prove it.

NOTES: 1. A CHOKE THE SAME SIZE AS THE POWER TRANSFORMER WILL SMOOTH 100 TIMES BETTER THAN AN R-C NETWORK

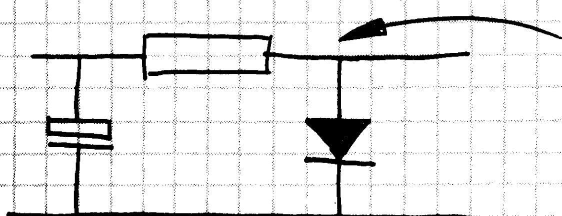
2. THE VOLTAGE DROP ACROSS A CHOKE WILL BE 1/10 THAT OF AN R-C NETWORK.

3. CHOKES ARE VERY EXPENSIVE AND HEAVY AND ALMOST UNOBTAINABLE.

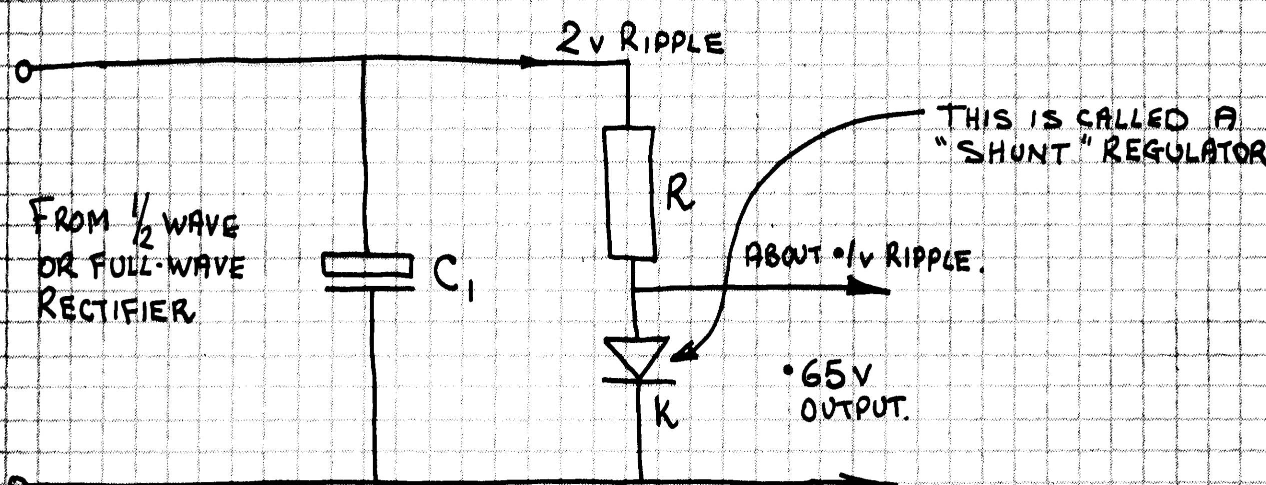
CHOKE SMOOTHING AND RESISTOR SMOOTHING HAVE GONE OUT OF FAVOUR FOR A NUMBER OF REASONS. APART FROM THE COST AND SIZE, MOST EQUIPMENT REQUIRES A FIXED VOLTAGE AS WELL AS VERY LITTLE AC COMPONENT, SUCH AS 12v ±1v AT •01v RIPPLE OR 35v ±3v @ •1v RIPPLE. THIS MEANS THE 12v CIRCUIT DOES NOT WANT MORE THAN 13v OR LESS THAN 11v. FOR EXAMPLE A 12v PORTABLE TV WILL OVER-SCAN THE PICTURE IF FED 13v OR WILL HAVE LACK OF HEIGHT AT 11v. KEEPING THE VOLTAGE AT 12v IS CALLED REGULATION. A CHOKE OR RESISTOR SMOOTHING DOES NOT PROVIDE ANY REGULATION AND THUS HAS ONLY LIMITED USE.

A REGULATOR A REGULATOR HAS THE ABILITY TO REDUCE ANY RIPPLE WHILE SUPPLYING A FIXED VOLTAGE UNDER VARYING CURRENT LOADS. THE SIMPLEST FORM OF REGULATOR IS A DIODE

A DIODE REGULATOR



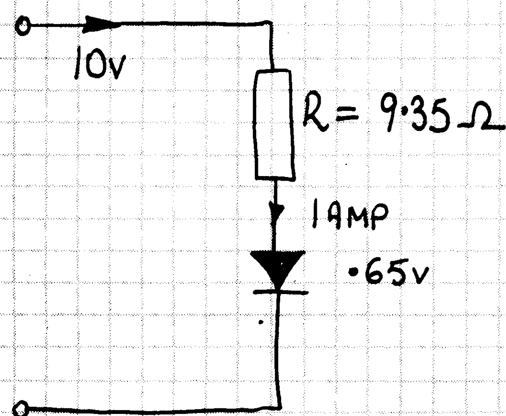
THIS CIRCUIT IS BEST DRAWN AS BELOW TO SHOW THAT THE OUTPUT IS AT A MUCH LOWER VOLTAGE AND THE RESISTOR IS DROPPING THE VOLTAGE.



A SINGLE PLACED AS ABOVE WILL PRODUCE AN OUTPUT OF •65v EVEN IF THE VOLTAGE FROM THE RECTIFIERS IS 6v 12v OR 35v. THE DIFFERENCE BETWEEN •65v AND SAY 12v IS DROPPED IN THE RESISTOR R AND THIS CAN BE A VERY WASTEFUL CIRCUIT AS YOU WILL SEE.

FOR AN OUTPUT CURRENT OF 1 AMP @ ·65v AND WITH A SUPPLY VOLTAGE OF 12v FROM THE RECTIFIER DIODES, THE RESISTOR R WILL DROP 11·35v AND WILL DISSIPATE 11·35 × 1 AMP = 11·35 WATTS. THE WATTAGE AVAILABLE AT THE OUTPUT TERMINALS = ·65 × 1 AMP = ·65 WATTS. THUS MOST OF THE POWER IS BEING LOST. IF WE ONLY WISH TO DRAW ·2 AMP FROM THE OUTPUT, THE VOLTAGE WILL REMAIN AT ·65 AND THE WATTAGE DROPPED BY THE RESISTOR R WILL BE 11·35 × ·2 = 2·27 W.

HOW THE DIODE WORKS

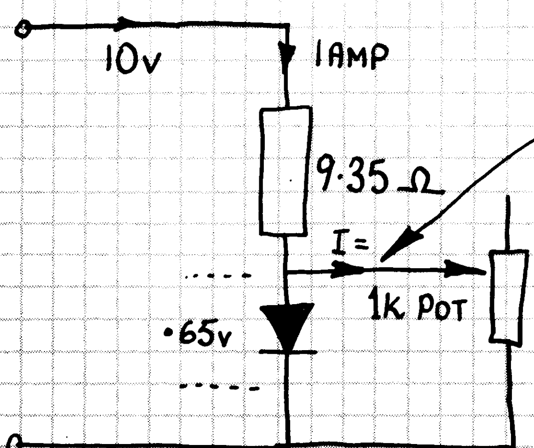


TO PRODUCE A CURRENT FLOW OF 1 AMP IN THE DIODE THE RESISTOR R MUST BE 9·35 OHMS.

THIS IS OBTAINED FROM OHMS LAW:

VOLTAGE ACROSS R = 10 − ·65v
= 9·35v

$$I = \frac{V}{R} \Rightarrow R = \frac{9{\cdot}35}{1} = 9{\cdot}35\,\Omega$$



IF WE ADD A 1K POT ACROSS THE DIODE, CURRENT WILL FLOW IN THE POT. THE VOLTAGE ACROSS THE POT WILL REMAIN AT ·65v AND INITALLY THE CURRENT WILL BE 1mA. THIS MEANS THE CURRENT THROUGH THE DIODE IS 999mA. AS THE CURRENT THROUGH THE POT INCREASES IT IS "TAKEN" FROM THE DIODE. THE DIODE HAS THIS AMAZING ABILITY. FINALLY THE CURRENT THROUGH THE POT WILL BE 999mA AND ONLY 1mA WILL BE FLOWING THROUGH THE DIODE.

AS SOON AS YOU DRAW 1001 mA THROUGH THE POT, THE DIODE WILL NOT BE PASSING ANY CURRENT AND REGULATION WILL BE LOST. THE OUTPUT VOLTAGE WILL DROP TO ·64V OR LOWER AND THE DIODE WILL CEASE TO HAVE ANY EFFECT.

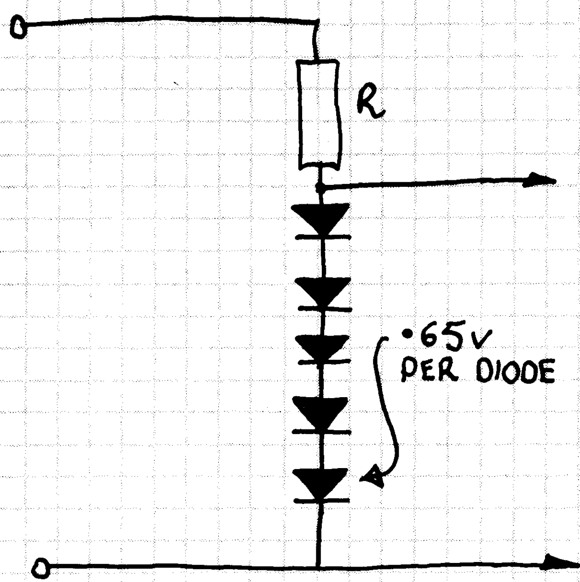
IN SUMMARY FOR A CURRENT FLOW THROUGH THE DIODE — FROM A FEW MILLIAMPS TO 1 AMP — THE OUTPUT WILL REMAIN CLOSE TO ·65V.

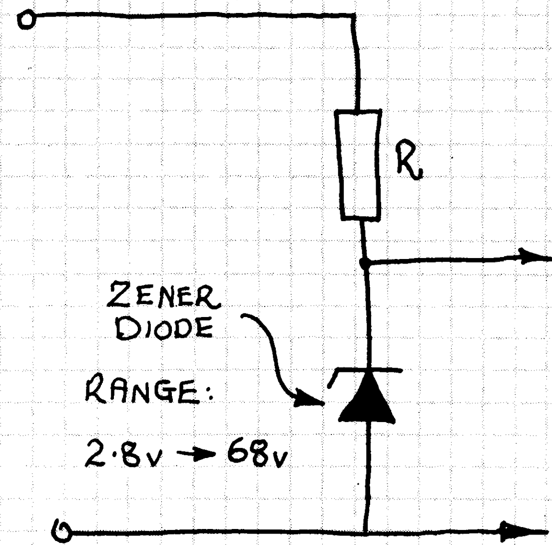
THUS WE HAVE ACHIEVED 2 FUNCTIONS:

1. SMOOTHING — ANY RIPPLE IN THE INPUT WILL BE REMOVED
2. VOLTAGE STABILISATION — THE OUTPUT WILL REMAIN AT ·65v FOR VARYING CURRENT DEMAND.

When all else is lost, the future still remains.

TO INCREASE THE OUTPUT VOLTAGE WE CAN USE A NUMBER OF DIODES AS SHOWN IN THE DIAGRAM <u>OR</u> USE A ZENER DIODE.





THE ZENER IS CONNECTED AROUND-THE-OPPOSITE-WAY TO A SHUNT DIODE. A ZENER IS BASICALLY AN ORDINARY DIODE WHICH BREAKS DOWN AT A SPECIFIED VOLTAGE. IF CONNECTED IN THE SAME DIRECTION AS A SHUNT DIODE, IT WOULD DROP ONLY •65V.

IN ALL THESE CIRCUITS, THE CURRENT FROM THE RECTIFIER DIODES IS CONSTANT AND MOST OF THE POWER IS WASTED IN THE DROPPER RESISTOR.

THESE CIRCUITS ARE VERY WASTEFUL AND THUS VERY INEFFICIENT.

THE FOLLOWING SIX PROBLEMS CAN BE SOLVED........

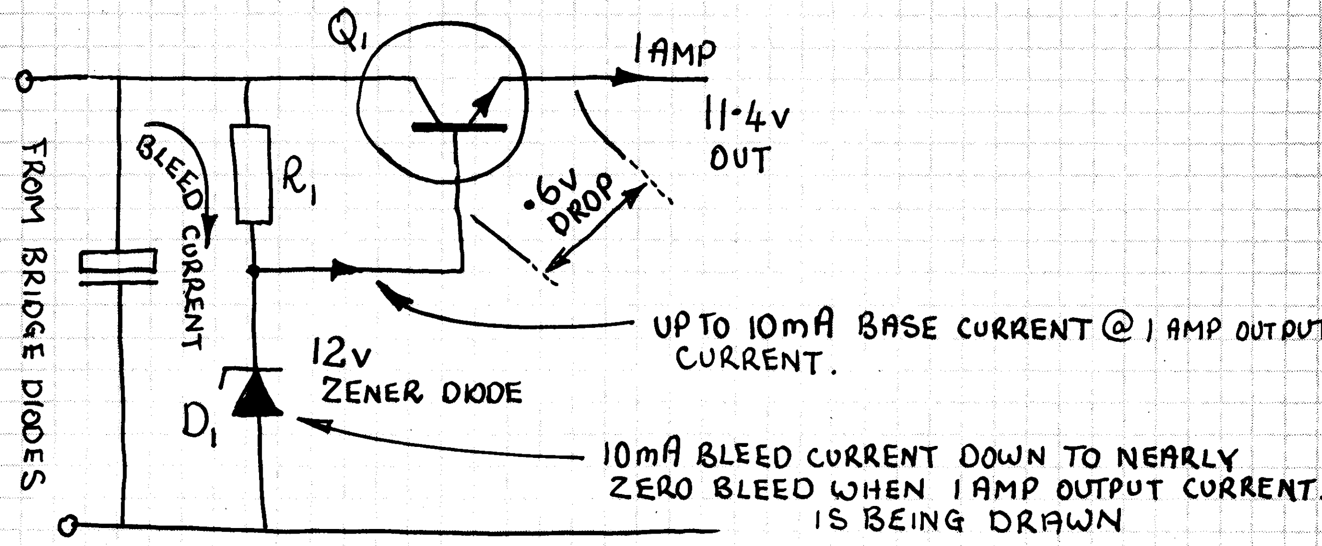
* REGULATION — KEEPING THE VOLTAGE CONSTANT
* SMOOTHING — REDUCING THE RIPPLE
* EFFICIENCY — REDUCING HEAT LOSSES
* WEIGHT — KEEPING THE WEIGHT DOWN
* COST — " " COST "
* SIZE — " " SIZE "

.......WITH AN ELECTRONIC FILTER.

3 ELECTRONIC FILTER:

WE HAVE SEEN HOW A DIODE CAN PERFORM 2 FUNCTIONS BY ITSELF, BUT VERY INEFFICIENTLY. TO MAKE IT "100 TIMES MORE EFFECTIVE" WE CAN COMBINE IT WITH A TRANSISTOR IN A SERIES REGULATOR CIRCUIT TO PRODUCE AN ELECTRONIC FILTER.

SIMPLE SERIES REGULATOR:



NOTES:

* R_1 & D_1 FORM A SHUNT REGULATOR
* D_1 IS A ZENER DIODE
* D_1 MUST NEVER BE TAKEN OUT OF BREAK-DOWN OR REGULATION WILL BE LOST i.e. IT MUST ALWAYS PASS A BLEED CURRENT.
* R_1 & D_1 ARE DESIGNED TO PASS 10 OR 11 mA
* THUS 10mA IS AVAILABLE FOR THE BASE CURRENT. ◆
* Q_1 HAS A GAIN OF 100 TIMES (AS PER DATA SHEET) 10mA × 100 = 1,000mA = 1 AMP THUS THE REGULATOR WILL SUPPLY 1 AMP TO THE LOAD.
* Q_1 HAS A VOLTAGE DROP OF ·6v FROM BASE TO EMITTER THUS IF ZENER VOLTAGE IS 12v THE OUTPUT VOLTAGE WILL BE 12 − ·6 = 11·4v.

IN THIS 1 AMP POWER SUPPLY ONLY 10mA "BLEED CURRENT" IS LOST THIS IS 100 TIMES MORE EFFICIENT THAN USING JUST A DIODE. THE VOLTAGE REGULATION IS OBTAINED FROM THE ZENER DIODE THE TRANSISTOR AMPLIFIES THE CURRENT CAPABILITIES OF THE DIODE BY 100 TIMES.

◆ THIS POINT NEEDS TO BE UNDERSTOOD. IF WE DRAW TOO MUCH CURRENT OUT OF THE CIRCUIT THE BASE WILL DRAW MORE THAN 10mA THROUGH R_1 BUT THIS WOULD DIMINISH THE CURRENT THROUGH THE ZENER DIODE TO ZERO AND REGULATION WOULD BE LOST.

THE ABOVE CIRCUIT IS ONLY CAPABLE OF A FIXED OUTPUT VOLTAGE. THIS VOLTAGE IS MAINTAINED OVER 0 → 1 AMP RANGE. BY SELECTING A SUITABLE VALUE OF ZENER DIODE AND ADDING AN "ERROR SENSING" TRANSISTOR WE CAN VARY THE OUTPUT VOLTAGE FROM THE ZENER-VOLTAGE TO SLIGHTLY LESS THAN THE INPUT VOLTAGE. (FOR GOOD SMOOTHING Q_1 SHOULD DROP AT LEAST 4 → 5 VOLTS).

PEACH TAKES OFF

A new computer has recently been released on the Australian market. In fact it is a promotional release and the distributors are offering an up-and-running package for a price which is lower than in Japan. "How can they do that?" you ask. It's simple, the Australian market is test scene for software production and three firms in Australia are already engaged in designing a wide range of business programmes. After all, the two most popular competitors had very little back-up programmes at the beginning.

"What's the name of the computer and who makes it?", you ask. It's the new 'Peach' by Hitachi. When you look at the line up of features you will see why it has outstripped the two competitors and gained a firm percentage of the market.

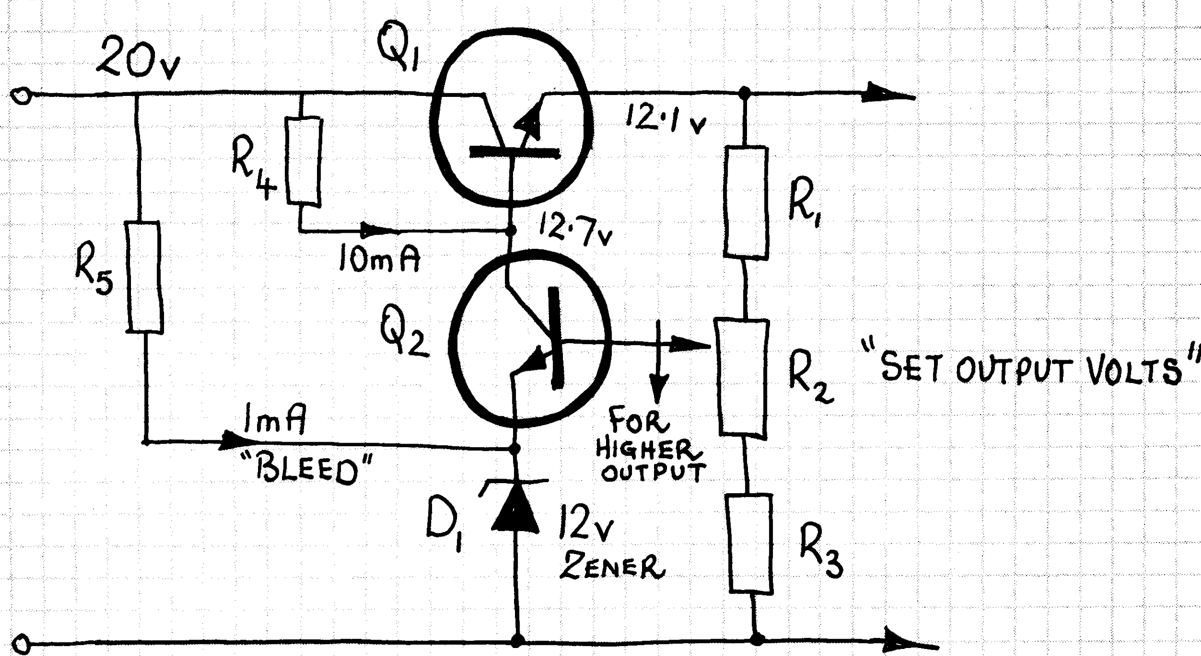
The basic has a Numeric Key Pad, 10 Programmable Functions Keys (5 with Shift Key), Clock, Speaker with Volume Control, RS232, "Centronics", Cassette, Light Pen, Interface, and other connections, 6 Expansion Slots, 32k RAM (Compressed Memory), 24k ROM, Machine Language, Protected Break Key, capable of providing on the Screen: 40 and/or 80 Columns, Upper and Lower Case, Eight Colours, 640 by 200 Dot Graphics, Two Additional Slots for Memory Expansion, 6809 Computer Architecture - which allows great Speed and Power, called the "Ultimate 8 Bit Computer Chip", far more recent and more advanced than any other widely-accepted Chip; and excellent AUSTRALIAN Software with the ability to operate with UNIX, FLEX, PASCAL, CIS COBOL, FORTRAN, is available for the "PEACH" as well as additional memory at reasonable extra cost.

Every purchaser of a PEACH computer will be given free membership of the Peach Computer Club to keep you up to date with the most recent releases. As a special to T.E. readers, you will also get a free B&W TV modulator to connect to your B&W TV to make it into a monitor.

Don't forget, nearly every programme for this computer is priced below any other software programme and the graphics have twice the resolution.

Rob's Computer Centre in Dandenong are Peachs' authorised dealer, so give them a ring or call in to their shop at 295 Thomas Street, Dandenong. Rob is on the phone at 791 2900 for any advice. This is a beautifully presented machine which will keep you ahead for many years to come. At a cost of $1,756, the system is sure to be a winner.

SERIES REGULATOR WITH ADJUSTABLE OUTPUT VOLTAGE



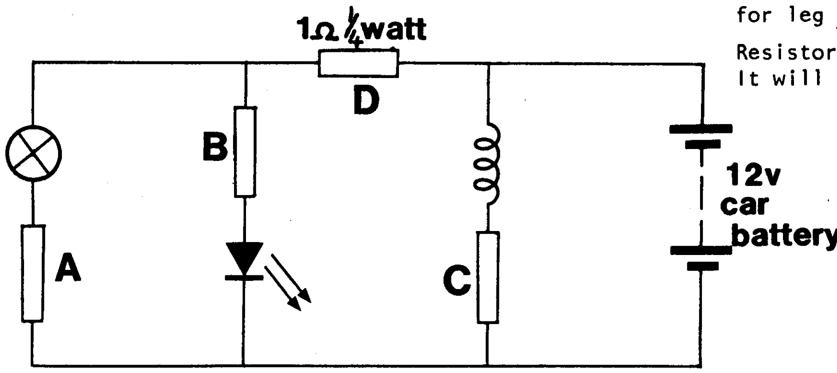
THE CIRCUIT STARTS UP AS FOLLOWS (TAKEN IN SLOW MOTION)

D_1 IS A 12v ZENER DIODE THE 20v INPUT FEEDS THE DIODE VIA R_5. R_4 PROVIDES TURN-ON VOLTAGE FOR Q_1. $R_1 R_2$ & R_3 PROVIDE A VOLTAGE DIVIDER NETWORK TO TURN ON Q_2.
WHEN POWER IS APPLIED, R_4 PROVIDES THE BASE OF Q_1 WITH ALMOST FULL INPUT VOLTAGE TO TURN IT ON. AS THE EMITTER VOLTAGE RISES (ACTUALLY IT FOLLOWS THE COLLECTOR VOLTAGE) THE VOLTAGE DIVIDER NETWORK CONSISTING OF R_1 R_2 & R_3 WILL PRODUCE A VOLTAGE AT THE BASE OF Q_2. Q_2 WILL BE FULLY TURNED ON AT 12·6v AND THE COLLECTOR OF Q_2 WILL BE 12·7v. (WHICH IS THE ZENER VOLTAGE PLUS THE COLLECTOR— EMITTER VOLTAGE DROP) THE OUTPUT OF Q_1 WILL BE ·6v LOWER THAN THIS AT 12·1 VOLTS.
THE CURRENTS FLOWING AT THIS STAGE WILL BE THE 1mA BLEED THROUGH R_5 10mA THROUGH THE TURN-ON RESISTOR R_4 & THE CURRENT THROUGH THE VOLTAGE DIVIDER NETWORK.
THE CIRCUIT WILL SUPPLY 0→1 AMP AS IN THE PREVIOUS CIRCUIT WITHOUT Q_2 PLAYING ANY FURTHER PART.
R_2 IS THE "SET OUTPUT VOLTS" AND ALLOWS THE OUTPUT TO BE ADJUSTED ABOVE 12·1 VOLTS TO 16VOLTS. R_2 IS INITIALLY SET AT THE TOP. AS THE SLIDER IS MOVED TOWARDS GROUND, Q_2 IS TURNED OFF AND Q_1 RECEIVES A HIGHER TURN-ON VOLTAGE VIA R_4. THE OUTPUT VOLTAGE RISES AND BEGINS TO TURN ON Q_2 AND THIS TURNS OFF Q_1, UNTIL A NEW OUTPUT VOLTAGE EQUILIBRIUM IS OBTAINED. THE CIRCUIT WILL NOW PROVIDE 0→1 AMPS AT THE NEW VOLTAGE WITHOUT Q_2 PLAYING ANY FURTHER PART.
THIS APPLIES TO THE QUIESCENT OR DC CONDITION. WHAT HAPPENS WHEN A RIPPLE VOLTAGE IS APPLIED TO THE CIRCUIT?

Basic Electricity

PART 4

Resistors can have up to 10 functions when placed in a circuit. In this course we will consider only a few of these functions.



Here is a simple circuit containing 4 resistors, and supplying 3 different loads. Leg A is a globe rated at 7v and 300mA, Leg B is a Light-Emitting Diode and requires 1.7v at 20mA. LegC is a small drink heater similar to those available for heating up a cup of water in the car to make tea or coffee on a picnic. It is rated at 10v and 100 watts.
Calculate the resistance of each resistor and the wattage it is required to dissipate.

NOTES:

In this circuit resistors A,B & C are voltage dropping resistors. Resistor D is a safety resistor.
We will assume the car battery supplies a constant 12v.

We will neglect the voltage drop across the 1 ohm safety resistor.

The 1 ohm ¼watt resistor is designed to burn out when the rating of the resitor is exceeded. Calculate the current it can handle.

Write down the known values:
R = 1 ohm, P = .25 watts, I = ?

From $P = V \times I$
$.25 = V \times I$

and from Ohms Law:

$$I = \frac{V}{R}$$

$$I \times R = V$$
$$V = I \times 1$$

substituting:

$$.25 = I \times 1 \times I$$
$$I^2 = .25$$

take the square root of both sides:

$$I = .5 \text{ amps}$$

LEG A

We will neglect the voltage drop across the fusable resistor D and assume 12v is available for leg A.

Resistor A will drop 12 - 7v = 5v
It will pass 300mA.

$$\text{Power} = V \times I$$
$$= 5 \times .3 \text{ watts}$$
$$= 1.5 \text{ watts}$$

from ohms law:

$$I = \frac{V}{R}$$
$$R = \frac{V}{I}$$
$$= \frac{5}{.3}$$
$$= 16.6 \text{ ohms}$$

LEG B

Resistor B will drop 12 - 1.7v = 10.3v
Current flow = 20mA.

$$I = \frac{V}{R}$$
$$R = \frac{V}{I}$$
$$= \frac{10.3}{.02}$$
$$= 515 \text{ ohms}$$

$$\text{Power} = V \times I$$
$$= 10.3 \times 0.02$$
$$= .206 \text{ watts}$$

LEG C

Resistor C will drop 12 - 10 = 2 volts
Current flow must be obtained from heater rating:

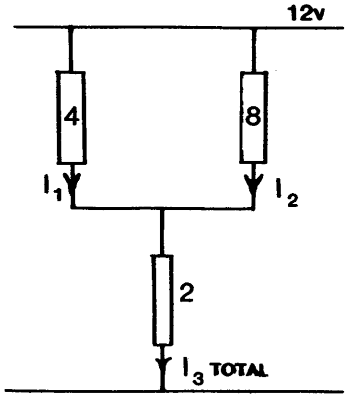
$$P = V \times I$$
$$100 = 10 \times I$$
$$I = 10 \text{ amps}$$

Current through leg C must be 10 amps even at 12v supply, so that the current through resistor C = 10 amps

$$I = \frac{V}{R}$$
$$10 = \frac{2}{R}$$
$$R = \frac{2}{10} \text{ ohms}$$

$$\text{power} = V \times I$$
$$= 2 \times 10$$
$$= 20 \text{ watts}$$

ANSWERS TO PROBLEMS IN LAST ISSUE



$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{2 + 1}{8}$$

$$= \frac{3}{8}$$

$$\frac{R_T}{1} = \frac{8}{3} \text{ ohms}$$

Total resistance of the circuit:

$$= 2 + \frac{8}{3} \text{ ohms}$$

$$= 4\frac{2}{3} \text{ ohms} \quad \left(\frac{14}{3} \text{ ohms}\right)$$

Current through circuit:

$$= \frac{V}{R}$$

$$= \frac{12}{14/3} = \frac{12}{14} \times 3$$

$$= \frac{36}{14} \text{ amps} = \frac{18}{7} \text{ amps}$$

The voltage across the 4 ohm and 8 ohm resistors is the same:

From ohms law:

$V_1 = I_1 \times R_1$ for 4 ohm resistor

$V_2 = I_2 \times R_2$ for 8 ohm resistor

but $V_1 = V_2$

$$I_1 \times R_1 = I_2 \times R_2$$

$$4I_1 = 8I_2$$

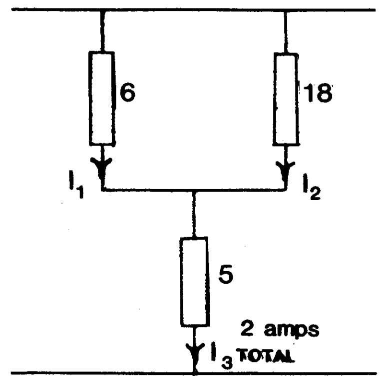
$$I_1 = 2I_2$$

and $I_1 + I_2 = \frac{18}{7}$ amps

$$I_1 + \tfrac{1}{2}I_1 = \frac{18}{7}$$

$$I_1 = \frac{18}{7} \times \frac{2}{3}$$

$$= \frac{12}{7} \text{ amps}$$



Voltage across the parallel pair:

$$I = \frac{V}{R}$$

$$2 = \frac{V}{}$$

$$I = \frac{V}{R}$$

$$V = I \times R$$

$$= 2 \times \frac{18}{4}$$

$$= 9 \text{ volts}$$

Total voltage across the circuit:

= 10v + 9v

= 19 volts.

$$\frac{1}{R_T} = \frac{1}{6} + \frac{1}{18}$$

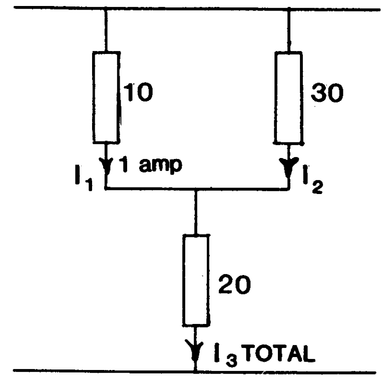
$$= \frac{18 + 6}{6 \times 18}$$

$$\frac{R}{1} = \frac{6 \times 18}{18 + 6}$$

$$= \frac{6 \times 18}{24}$$

$$= \frac{18}{4} \text{ ohms}$$

Using three resistors in parallel and/or series, we can produce six different voltage dividers. This can be thought of as using one resistor as the pick-off voltage resistor and arranging the other two in parallel to produce three different circuits. Three additional circuits can be arranged by placing the upper resistors in series. With this information you should be able to determine the voltage out of the six arrangements. In the second three series circuits we can tap off a voltage which is only one resistor from the top, making a total of nine output voltages. See if you can get more than this.



Resistance of the parallel pair:

$$\frac{1}{R} = \frac{1}{10} + \frac{1}{30}$$

$$= \frac{3 + 1}{30}$$

$$\frac{R}{1} = \frac{30}{4}$$

Voltage across the parallel pair:

$$V = I \times R$$

$$= 1 + \frac{1}{3} \text{ amp} \times \frac{30}{4} \text{ ohms}$$

$$= \frac{4}{3} \times \frac{30}{4}$$

$$= 10 \text{ volts}$$

$V_1 = I_1 R_1$ for the 10 ohm

$V_2 = I_2 R_2$ for the 30 ohm

but $V_1 = V_2$

$$I_1 R_1 = I_2 R_2$$

$$1 \times 10 = I_2 \times 30$$

$$I_2 = \frac{10}{30} = \frac{1}{3} \text{ amps}$$

Current in 20 ohm resistor:

$$= 1 + \frac{1}{3} \text{ amps}$$

Voltage across 20 ohm resistor:

$$= I \times R$$

=

$$= \frac{4}{3} \times 20$$

$$= 26\frac{2}{3} \text{ volts}$$

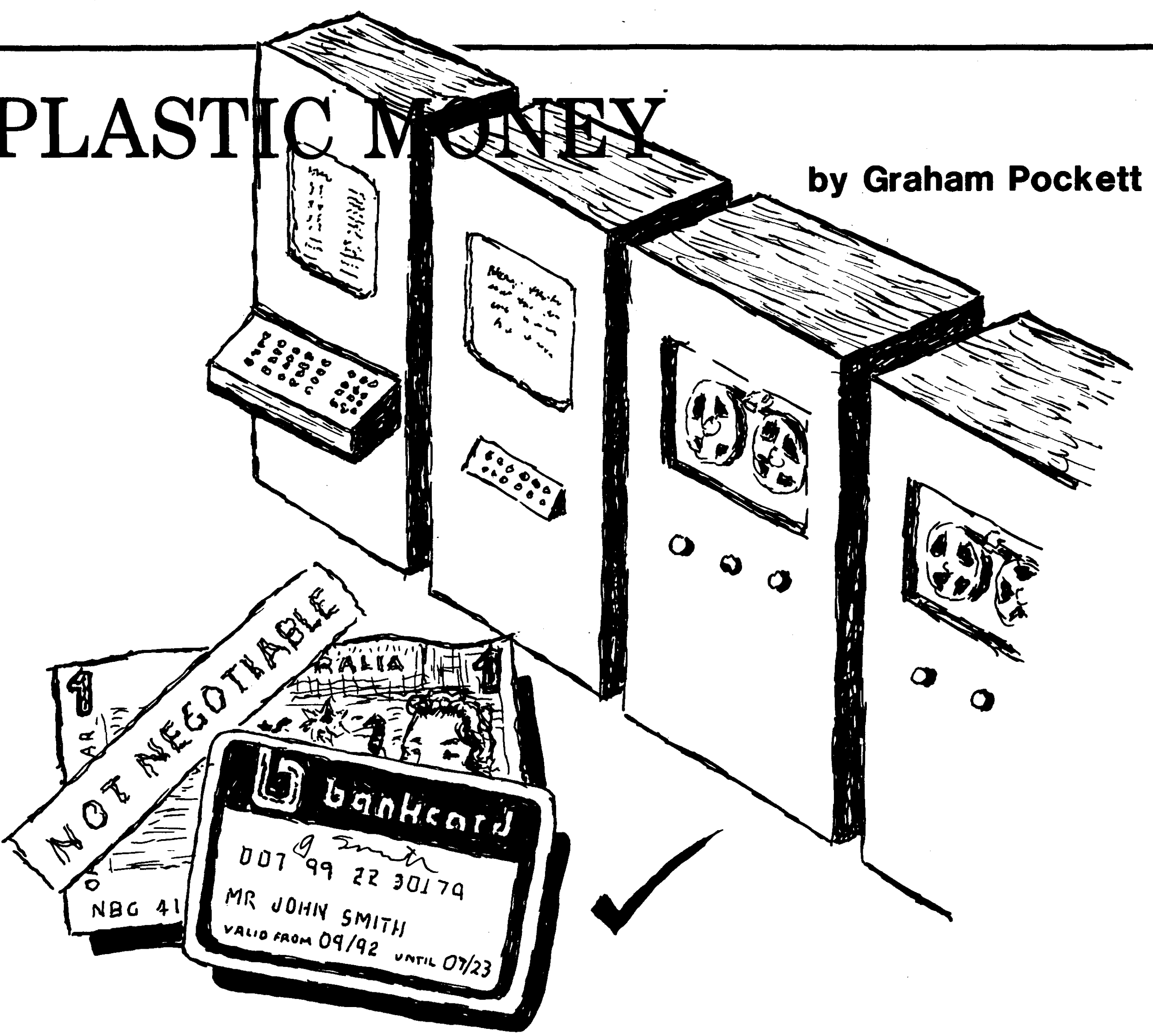
Total voltage across circuit:

$$= 26\frac{2}{3} + 10$$

$$= 36\frac{2}{3} \text{ volts.}$$

PLASTIC MONEY

by Graham Pockett



The electronic revolution of the sixties and seventies has meant enormous changes in our everyday life. The multi-million dollar computer of the fifties is the $5 pocket calculator of today.

Solid state electronic devices, no larger than the tip of your little finger, have replaced many thousands of valves with faster, more reliable and cheaper computing. The outlook for the next 20 years will be no less spectacular.

One major area of computers is just being investigated, and its implementation will change the whole concept of our society - the need for hard currency could virtually cease. And we're not talking about the Bankcard-type credit system. What we're talking about is the network computer system which could soon link all major banks with your local super market - and then be extended to cover almost every small store.

Make a purchase at your local electronics shop and instead of writing out a cheque or handing over currency, you hand over a small plastic card. Your account at the bank is automatically debited with the amount and you walk out of the shop having paid for your purchase in full.

Each month you receive a statement from the bank outlining all purchases made - your accountant will love you.

CASHLESS SOCIETY

As part of the overall move towards a cashless society - and anyone who believes it will never happen is deluding him or her self - our television set and telephone will mean that not only won't we carry money, but we won't have to leave the comfort of our lounge room to do our basic shopping.

The answer is there in one word - viewdata. Sometimes called videotex or by its proprietary names of Prestel, Telidon, etc, our television sets will become more than just a vehicle for being entertained with yet another repeat of 'I Love Lucy'. The 'Box' will cease to be an annoyance when we have guests - it will cease to be used to keep the 'little woman' amused when she does the ironing (that is if they have ironing in the year 2000).

Our television sets will be the focal point of the home. Our computer will use the humble television set to let us know when burglars enter our house - and exactly where in the house they are at any one time. Our television sets will be linked to the telephone and we'll see the person on the other end of the line. Also on the telephone connection, our television sets will present us with viewdata.

Viewdata is more than just a means for finding out railway timetables. It is more than just a vehicle for presenting news. Viewdata will change the habits of our world - not in itself maybe, but as a forerunner to even greater things.

Before we look further along these lines, let's examine quickly how the system works. In your home you have a television set with a lead off to a small hand control - sort of a cross between a calculator and a remote control unit for your tele. Another lead runs from your television set to a telephone connection, and from there to a central computer which houses all the information you want.

When you want to look up a particular piece of information - let's say a flight from Sydney to Perth - you can either go to a master reference catalogue (something like a small telephone book) or you can search for the information by going through the master index which is flashed onto the screen at your command.

The master index is separated into catagories - first you select travel , then

Retirement should be based on the tread, not the mileage.

domestic, then flights, and then inter-capital flights. From there you key in the city where you want to go and all the information is relayed to your television screen.

But we've jumped ahead of ourselves. First thing we must do is to connect ourselves into the central computer and to do that we must press an automatic dialler on our remote control box - having ensured we are on the correct television channel. A bit like using a video recorder.

This connection to the central computer will have cost us a local telephone call (even for country people) and our telephone code will have been registered with the central computer. The computer now knows it is connected to our home. We then select the information we want, in this case a flight from Sydney to Perth.

The information is selected from one of the two sources mentioned above and shortly we are sitting in our lounge room looking at the flight schedules for the route. At this stage we can phone Aunt Mary in Perth and tell her we could be on the five o'clock flight if she can pick us up from the airport or we can go ahead and book the flight, having the costs of the plane fare debited to our telephone account.

We can tell the central computer the flight we wish to be on, whether we will travel from the city terminus or arrive directly at the airport. The ticket will be at whichever location we choose. We can also let the computer know if we want first class by pushing the '1' button or second class by pushing the '2' button. The central computer by this time has checked with the airlines computer, the booking has been confirmed and the ticket is already printed and waiting - where we want it. The whole exercise has taken less than five minutes!

By using our telephone account we have organised our travel arrangements in less time than it takes for us to phone the airlines, get the schedules, and make a booking with the sweet-sounding young lady at the reservation desk. When we pick up the ticket we know we have to pay cash (well, maybe a cheque).

By using the viewdata service, we can choose between the two domestic airlines, with all the correct up-to-date information laid out on the screen. Bewdy Newc.

For that one call we also could have booked a cab to the airport or terminus, we could have organised all travel and accommodation on the other end, and we could be happy knowing that as far as everyone is concerned, their bills have been paid. No-one hassling for a cheque, no travellers cheques, everything organised.

Of course a travel agency could have done the same thing, but they would not only have wanted a cheque with the full amount beforehand, but they'd also want a week's notice to make sure the cheque cleared through the bank before they issued the tickets.

There is only one country in the world with open access viewdata, England. Experience with their Prestel system has confirmed that the amount of information available to the public is enormous - and is probably the fastest growing business in the world. In a few short years, hundreds of thousands of 'pages' (the amount of information on the screen at any one time) of information has been made available to the British public. You can virtually name your subject and it is available through viewdata.

Of course it might cost you a little extra for information from one of the private companies using the system, but it rarely exceeds about 5p (10¢) a page.

Information on the screen is usually changed at least once every fortnight (many times a day for news) so it is as up-to-date as it can possibly be. Yearly rates to put information on viewdata in England are so cheap many larger companies hire hundreds of pages each year - not that you get all that much information on one page.

TWO YEARS OFF

Viewdata is definitely coming to Australia within the next two years. Shortly after it arrives, it is believed companies like Safeways (Red S), Myers, Coles New World, K-Mart and Target will probably introduce shopping-at-home through this system.

How it works is like this. When you want to do the week's shopping, you switch on the viewdata and hook up to your local store. Main shopping lines would be listed on the screen and you would pick the category you want - food, clothing, books. In fact anything which is carried at your supermarket.

Having decided, say, on food, you would press the button for that item and a second list would appear on the screen. If you are a browser who likes to buy on impulse, you could ask the computer to slowly scan all food lines, stopping the scan at any item you either wished to buy or at least have a second look. Alternatively you could go to a particular section, say, soups, and scan all the soups available.

Having made your selection, you proceed onto the next item and make further selections. When your shopping is finished, your total food bill is debited to your Bank account and the items are selected and packed automatically in a huge wharehouse. Your order is sent to your home later in the day.

For the cost of a telephone call, you have done your weekly shopping without getting out of your favourite chair.

Everybody benefits from this arrangement. Local supermarkets can be kept small for personal shoppers (there will always be a few) and the large wharehouses can be almost fully automated.

The cost of a person travelling by car to a supermarket, doing the shopping, and then driving home is enormous. Not only are there obvious savings in petrol and vehicle running expenses, but supermarkets need less car parking space (a real problem in many areas) and staff can be kept down. There would be less handling of the products and the food would be fresher.

There could even come a time when supermarkets, as such, ceased to exist and there was an upsurge again in the small local shopkeeper.

These people would cater for fresh fruit and vegetables (wouldn't like to buy them sight unseen), as well as the small general store for people who like to admire and touch every purchase.

While there may be no real limit to the goods one can purchase or the services which may be hired, there will be quite an amount of shopping resistance to some products. As previously mentioned, fruit and vegetables would be better served with personal shopping, as would meat.

What would probably happen is that supermarkets as we know them would be replaced by shopping emporiums carrying items which can be sold via the television. Many small electrical appliances, some car accessories, even stationary could be sold through viewdata but books, giftware, pharmaceutical and similar products would still find an outlet through established stores.

The corner milk bar would again flourish and the era of the large shopping complex (Roselands, Southland, etc) would probably end. A far cry from the sixties when everyone was prophesising the downfall of the small business.

Electronic shopping will become the accepted form in the nineties and the era of the dollar bill will be near its end. That only leaves one final problem, security.

Computer crime is already the fastest growing criminal activity and the master criminal of the nineties will be a university graduate with honours in computer science.

Whether he will ever surpass the shop lifter is another matter. It costs millions of dollars each year in goods shoplifted (the reason why almost all stores now prosecute) and the advent of the supermarket has added greatly to the shoplifiting bill we all pay.

COMPUTER CRIME

Whatever man can design as a safeguard against computer crime, another man can circumvent and one would assume that as less and less money was used in our society, there would be less and less armed holdups of banks and business payrolls. As with shoplifting, computer criminals would only change the source of their illicit income and we would still have to make good about the same amount of money.

Police forces throughout the world would have to increase the number of computer experts and the old image of a dumb copper would slowly disappear. The law enforcement officer of the future could well be the 'top' job for the geniuses - when only the best will do ....

To combat computer crime on a large scale, police forces throughout the world would have to co-operate with each other - sharing information on the latest electronic trick used by computer criminals to help stop it being repeated in other areas. State and country boundries could well start to dwindle and cease to be important early next century.

On a local level, many measures will be used to prevent the unauthorised use of another person's credit card.

Australian banks have already started the ball rolling with their automatic teller machines which require not only your card but also a number which you must remember. Having put the card inside the machine, you must then enter a specific number which is not listed on the card.

If the card has been reported stolen or if the number you enter isn't correct, the machine retains your card. If the error was yours in that you reported the card stolen or lost and then found it without notifying the bank, you can get another card on application. At least that's better than having your account milked by a credit card thief.

There is little doubt that in a few years much more sophisticated methods will be devised. They may take the form of a 'palm' print, so loved by science fiction writers for many years.

When electronics has really come of age, maybe a computer will be able to easily determine voice prints and the number on your card might relate to a digital version of your voice - the computer checking your speaking voice against that recorded on your card. When they match, you've made your purchase and the amount of the goods are debited to your account. If they don't match, your card is retained and both the store manager and the police are called.

However sophisticated card checking becomes, there will always be a percentage of criminals who will devise ways of beating the system. As their methods are discovered, new methods will be introduced to thwart them. This will help reduce the total number of criminals, but the ones left will be master computer criminals, with incomes in the millions each year.

UNEMPLOYMENT?

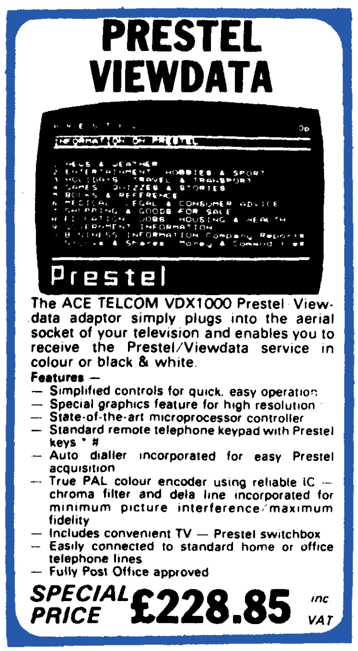
There are two major problems with a computerised society. The first is an increasing unemployment rate, the second is the Big Brother syndrome.

The problem of unemployment is one with very few easy answers, though we're sure there must have been a lot of problems with farriers and others directly involved with horses when the motorcar was introduced. While the farrier (horse shoer) has just about become a lost art, the motorcar itself created much more employment than it cost in terms of lost jobs.

For every 10 jobs which the computer takes through automation, possibly five could be re-employed in the computer field - though maybe not five of the original ten. They would find jobs in fields allied to their old employment and the five created positions in the computer field would come from other industries or from school leavers. Maybe the remaining five could get a job in the leisure field?

One answer to the employment problem comes to mind. That is to levy a tax on the computers and their automated bretheren in direct proportion to the number of jobs lost by that machine. If a computer can replace five clerks who would be paying, say, $4,000 per year in income tax, then the computer has a levied tax of $20,000 per year. Employers are still better off because the computer doesn't take a sickie, doesn't demand holiday pay, doesn't go on strike and will happily work all day and all night - three shifts for the price of one.

The government could then afford to pay every man, woman and child in Australia an amount sufficient to live - say $150 per adult per week.



Anyone who didn't want to work could sit back and lead a life of Riley, but this would bore the average person after a very short period. So a working week of 10 hours could be introduced - at one quarter of the current salary.

A husband and wife team is already being paid $300 each week and the additional income (taxable as well) would make the difference between subsistance living and sitting back and having some of life's small luxuries. Not that someone couldn't work 20 or even 30 hours per week if they liked. As usual, the taxman would get his fair share (?) of the newly divided cake.

Most medium businesses rate labour as their biggest single expenditure and, union problems not withstanding, would probably give their eye teeth for the chance to go at least partially automated.

For your information, only one man is employed for every million dollars invested in the mining industry - it is so well automated - compared to as little as one man for every $10,000 in a labour intensive field or small business. A very small part of the hundreds of millions of dollars spent each year on mining is actually spent on employment. So much for the resources boom to help our unemployment problems.

We aren't trying to say that the above suggestion is *the* answer to all our unemployment problems, but it surely should be examined in detail before being confined to the bureacratic pigeon holes, there to gather dust and be scorned by lesser men who haven't had the guts to present a better idea.

Our second problem with a computerised society is the Big Brother syndrome - as anyone who has had nightmares over the book *1984* will attest. However, computers are not to blame themselves - they're only a pile of semi-conductors and other electronic wizardry. It's the designers and programmers who must be guided in the right direction by non-totalitarian governments.

For a start, human memory fades in time and a small 'sin' is soon forgotten. On the other hand, we remember a large 'sin' for much longer. Why can't we program our computers the same way. Instead of the computer 'remembering' our small sins forever and a day, these could be programmed to be erased after a certain period.

Let's say you were a little late in your car payment and the computer filed this information away for later. After a reasonable period, say three months, the computer would erase your entry if there had been no further breaches in this regard.

A second breach of this nature within the specified three months, and the computer would add another three months onto the balance.

A very major breach - skipping the state and selling the vehicle elsewhere without informing the finance company, or without continuing the payments - could mean a black mark on your file for, say, seven years (after you've come out of jail?).

A computer need not be anything more than a servant - it's certainly not the monster some writers (and unionists) claim it to be. Its only drawback is in its programming and this could easily be controlled by law - with very stiff penalties for anyone caught misusing the computer.

Situations like that which occurred recently in Sydney should never happen. In that case a computer billed a customer for $0.00 and when the bill wasn't paid, it started sending out letters of demand and threats to take legal action.

The man apparently solved the problem by sending off a cheque for the full amount, ie $0.00, and the computer was happy. This would have occurred because a clerk wrote $0.00 instead of 'nil' on a docket and the unthinking computer took it from there. The computer's program was not done properly and allowances - such as a clerk writing $0.00 instead of 'nil' - should always be written into the program.

Computer people have a word for it - garbage in, garbage out. Assuming the program was right in the first place...

* * * *

Computers, automation, viewdata, 'plastic' money - who would have believed it 20 years ago? What won't we believe in another 20?

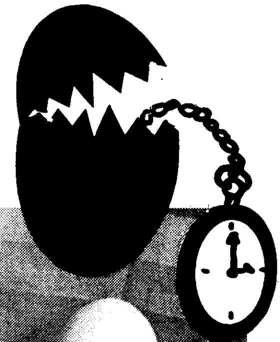
We are only limited by our imagination which, incidently, is the only thing which puts us above every other animal on this planet.

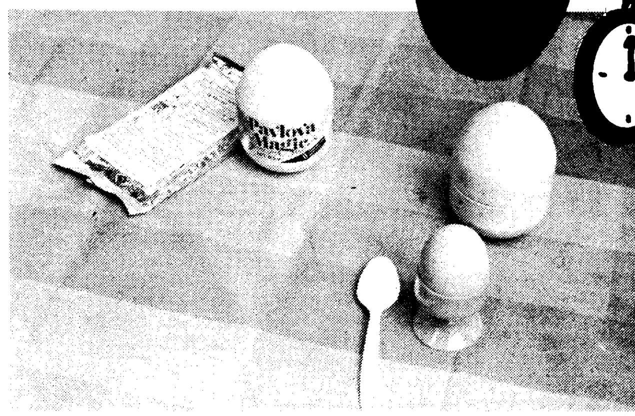
We've come a long way since Benz got us moving.

Collecting things seem silly when we see how easily things collect by themselves.

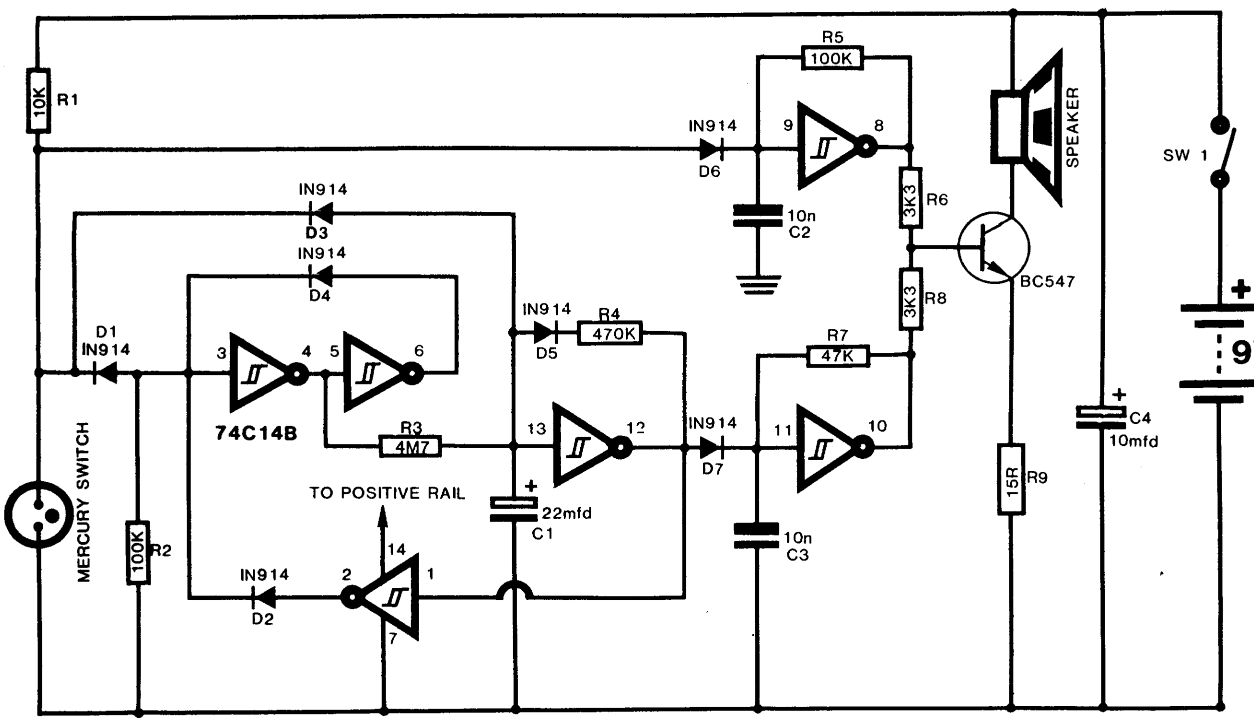
EGG Timer

Ken Stone





How many times have you forgotten your egg and come back later to find the saucepan has boiled dry? Here is the answer to all of your problems. This egg timer will let you know when your egg is ready, by giving out a long clear beep. The operation of the timer is quite simple. Simply shake it or tip it up-side down to hear the commencement beep, then put it on the bench as shown in the photo.



The circuit diagram of the Egg Timer.

EGG TIMER

The EGG TIMER consists of four basic sections or building blocks. The first of these is the gated oscillator. We have two in this circuit. The first is formed by R5, C2 and D6 and the Schmitt inverter between pins 9 and 8 of the 74C14 chip. The second consists of R7 C3 and D7 and between pins 11 and 10.

They operate as follows:

The top oscillator is held in the off condition via the 10k resistor R1 so that when the mercury switch is closed, the diode will cease to provided a high on the input pin and the charged 10n capacitor will discharge through the 100k resistor R5. The inverter input voltage will fall and when it reaches ⅓ of the supply voltage the Schmitt inverter will change states so that the output will become **HIGH**. This action enables the 10n capacitor to begin to charge via the 100k resistor. When the voltage rises to ⅔ of the supply rail, the inverter will again change state. During the changes of state or oscillation, the input diode D6 has no effects at all on the operation. The sharp on/off from the inverter output is transferred to the buffer transistor via the 3k3 resistor to operate the speaker. When the anode of D6 is taken **HIGH** (this occurs when the mercury switch is not making contact), the diode is forward biased via the 10k resistor and charges C2 to above the switch on threshold. The output of the Schmitt inverter switches **LOW** but D6 provides a voltage which keeps the input in the **HIGH** state. The inverter is unable to switch off and does not oscillate. It is jammed **LOW**. This jamming is called gating the oscillator. Thus the top oscillator is designed to signal when the mercury switch is making contact.

The second oscillator works on exactly the same principle except that its frequency will be higher due to the frequency determining resistor R7 being lower in value.

The second basic unit is the **LATCH**. It consists of R2 D1 D2 D4 and the inverter between pins 3, 4 and between pins 5, 6.

The latch is a bistable switch having two states in which it is stable. In one of its stable states pin 4 is **LOW** and pin 6 **HIGH**, the other state reverses these values.

Initially we will assume pin 6 is **HIGH** and through D4 it holds the input of the other inverter **HIGH**. The output pin 4 is **LOW** and holds pin 5 **LOW**. This keeps pin 6 **HIGH**. The latch is completely stable in this condition unless disrupted by either of the two input diodes D1 or D2. If pin 3 is pulsed **LOW** through D1 (as when the mercury switch is closed) pin 4 goes **HIGH**, changing the output of the second inverter to **LOW**. When the cathode of D1 is taken **HIGH** (when the mercury switch is opened) pin 3 does not receive a **HIGH** from any other source and thus the latch remains in this stable condition. The 100k resistor R2 prevents the input from floating and resetting the latch.

Retriggering the latch is provided by the inverter between pins 1 and 2. When pin 2 goes **HIGH**, D2 produces a **HIGH** on pin 3 to reset the latch. It remains in this state.

The third basic unit is the **DELAY**, which consists of R3, C1 and the inverter between pins 13 and 12. The latch directly drives one side of R3. The other side is connected to C1. These components form the timing circuit. C1 is initially uncharged. When pin 4 of the latch goes **HIGH**, C1 is slowly charged through R3. When the voltage across C1 reaches the switch-on threshold of the Schmitt inverter, the output pin 12 goes **LOW**. This takes about 3 minutes. The output drives the inverter between pins 1 and 2 which applies a positive voltage to the anode of D2, which then resets the latch. Normally C1 would be slowly discharged again through R3 when the output of the latch drops **LOW**. This would take 3 minutes but as the second gated oscillator is switched on during this discharge time to inform you that your egg is ready, this beep would be too long.

Therefore the discharge time is reduced by using the fourth basic unit, D5 and R4.

When C1 is charging, pin 12 is **HIGH**, applying a positive voltage to the cathode of D5, through R4. In this situation D5 is reverse biased so that it has no effect on the charge cycle.

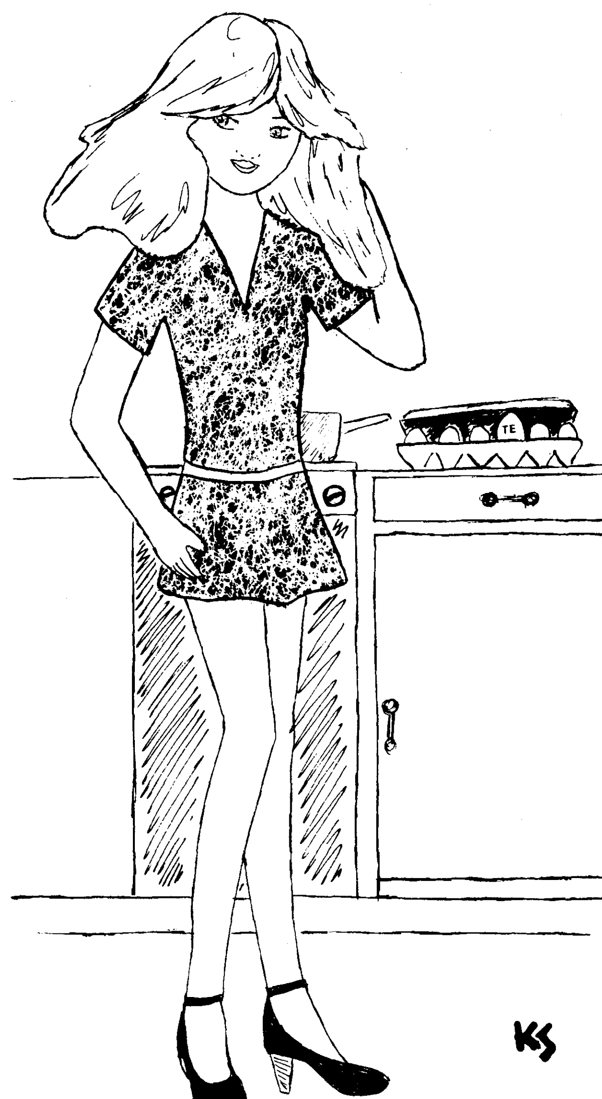
When C1 is charged and the output of the inverter switches **LOW**, the diode becomes forward biased and discharges C1 through R4. R4 determines the time the second oscillator is operating. A 470k resistor gives a 20 second discharge or call-tone.

R6, R8, R9 and the BC 547 form the amplifier. The first gated oscillator is activated by the mercury switch. At the same time the latch is set. D3 provides an accurate time length each time the egg timer is reset by discharging any voltage on C1.

Inverting the egg timer will, through the mercury switch, activate the gated oscillator, set the latch and discharge any voltage from C1.

When the egg timer is stood upright the start beep ceases and the timing begins. In three minutes the second oscillator will sound for 20 seconds.

Hopefully your egg will be just right.



"Now where could I have put that egg timer?"

A man begins cutting his wisdom teeth the first time he bites off more than he can chew.

CONSTRUCTION

The construction of the egg timer is straight forward. The 74C14 chip can be mounted directly on the board or using an IC socket. If you do mount the chip directly on the board, solder pins 7 and 14 first to allow the internal protection circuitry to work. Make sure all of your diodes have the correct orientation or the circuit will not work. We mounted our egg timer in a "Pavlova Magic" container, which looks like a large plastic egg. The speaker was mounted in the bottom of the container, facing downwards. Some holes could be drilled in the bottom if it is found that the sound is not loud enough. The PC board and battery are mounted side by side on the back of the speaker magnet. It is important that the board is positioned so that the mercury switch is off when the container is left sitting on the bench. You will know if you accidentally mount the board up-side down because the timer will not stop oscillating.

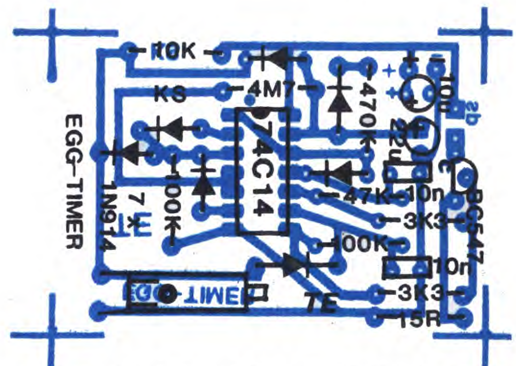
The power switch is a miniature SPST toggle and it may be mounted where convenient, either on the top of the egg or the side.

If you wish to change the length of the time-period, the 4M7 resistor should be replaced with a resistor of different value, or the value of C1 can be changed.

The beep can be shortened by reducing R4 to 47k.

Note: We take no responsibility for overcooked eggs!

Buy a Pavlova Magic just for container - We did.



PC OVERLAY FOR THE EGG TIMER

EGG TIMER PARTS LIST

R1	resistor	10K
R2	"	100K
R3	"	4M7
R4	"	470K
R5	"	100K
R6	"	3K3
R7	"	47K
R8	"	3K3
R9	"	15R
C1	electrolytic	22mfd
C2	capacitor	10n
C3	"	10n
C4	electrolytic	10mfd
D1-7	diodes	1N914
IC 1	74C14	

Sw1 spst mini toggle
Sw2 mercury switch
Q1 transistor BC547
8R speaker
battery snap

The works fit neatly into the shell.

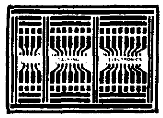
OUR COMPLETE RANGE OF PC BOARDS

All boards drills as required and roll tinned
Check your local electronics supplier or send directly to TE
These boards make your project look really first rate
Your requirement now is to make 2 projects per issue.

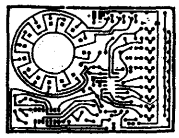
( ) Light the LED
A CD 4017 puzzle
95c

( ) LED Zeppelin
A game of skill
$1^80

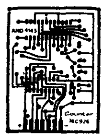
( ) Experimenter Board
fits an 8 pin 14 pin & 16 pin IC for breadboarding
$1^85



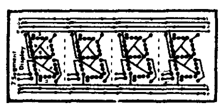
( ) Experimenter Deck
10 projects on 1 board
$3^75



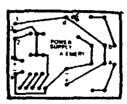
( ) Counter Module
A complete Counter on 1 PC board
$3^25



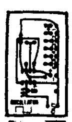
( ) 7 Segment Display
A 2.5cm readout
$3^95



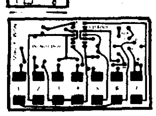
( ) Power Supply
1 Amp regulated supply
$1^80



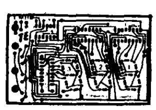
( ) Square Wave Oscillator
6 ranges from 1Hz to 100KHz
$1^80



( ) NOISE-A-TRON
Star Wars type noises
$1^70

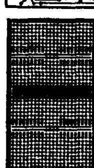


( ) MINI FREQUENCY COUNTER
100Hz to 5MHz **$2^50**

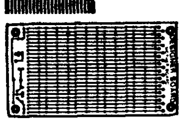


( ) Designer Board
accepts 4 to 8 IC's **$3^50**

( ) 5 Designer Boards **$15**

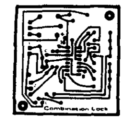


( ) Mother Board
accepts 5 designer boards **$3**



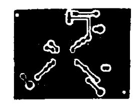
( ) Quick Draw
Reaction tester for 2 players
$1^85

( ) Combination Lock
Another CD 4017 puzzle
$1^70

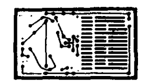


( ) Door Chime
Ding Ding Dong Door Chime
$1^60

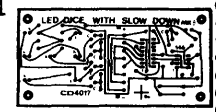
( ) Simplicity Amplifier
4 Watt amplifier
$2^10



( ) Super Bug
Picks up faint noises in another room
$1^80

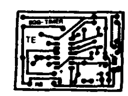


( ) LED Dice with Slow Down MK II
Real dice readout with rolling action
$2^95



ISSUE 6 PROJECTS

( ) Egg Timer
Saves making rockhard eggs **$1^80**

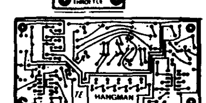


( ) Mini Mixer
and Fuzz unit **$1^50**

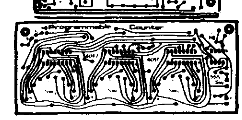
( ) Diode Tester
& black box puzzle **$1^50**

( ) Throttle
realistic train control **$1**

( ) Hangman
ideal gift **$2^95**



( ) Programmable Counter
Count your gold coins.
$3^10



Post & pack 1st board: 60c
each additional board: 30c

TALKING ELECTRONICS
35 Rosewarne Ave.,
Cheltenham, 3192.

Name__________________________

Address__________________________

Post Code_____

Please find enclosed
MO/cheque for $________

CUT OFF

CUT OFF

Printed circuit boards for these projects are on P37

COMPLETE KIT

LIGHT THE LED

2 - 22k ¼ watt
2 - 2k2 "
1 - 1k "
1 - BC 547
1 - 4.7mfd 10v
6 - 1N 4148
1 - Red 5mm LED
1 - CD 4017 IC
1 - Battery Clip
1 - Springy brass strip

Enclose $3.00 Plus 60c P&P

LED ZEPPELIN

1 - 270R ¼ watt
1 - 330R "
1 - 390R "
3 - 470R "
1 - 560R "
3 - 1k "
2 - 2k2 "
1 - 3k3 "
1 - 4k7 "
1 - 10k "
1 - 22k "
1 - 56k "
1 - 470k "
1 - 4.7mfd 16v
1 - 470mfd 16v
7 - BC547
1 - BC 557
1 - CD 4001 IC
6 - Large Red LEDs
1 - Mini red LED
2 - 1N 4148
1 - Push-on switch
1 - battery clip

Enclose $5.00 Plus $1 P&P

EXPERIMENTER BOARD

For Circuits 1-5
1 - 1k ¼ watt
1 - 2k2 "
1 - 10k "
1 - 100k "
1 - .01mfd ceramic
1 - .1mfd ceramic
1 - 10mfd electro 10v
1 - 555 IC
1 - CD 4017 IC
1 - PE cell ORP12 or similar
2 - Red Leds
1 - Push-on switch
1 - battery clip

Enclose $5.30 Plus $1 P&P

Circuit 6
2 - 10M ¼ watt
1 - 1mfd 16v
1 - BC 557
6 - 5mm Red LEDs
30cm hook-up wire

Enclose $1.50 Plus 60c P&P

Circuit 7
7 - 680R ¼ watt
1 - 3k9 "
1 - 22k "
1 - 2.2mfd 16v
1 - CD 4024 IC
1 - 5mm red LED

Enclose $2.00 Plus 60c P&P

EXPERIMENTER DECK

Projects 1-10
1 - CD 4001 IC
1 - CD 4017 IC
1 - 15R ¼ watt
1 - 22R "
1 - 120R "
1 - 3k3 "
2 - 4k7 "
5 - 10k "
1 - 47k "
1 - 100k "
1 - 1n 100v
1 - 3n3 "
1 - 3n9 "
3 - 6n8 "
2 - 22n "
1 - 4.7mfd 10v
1 - 22mfd 10V
6 - 1N 4148 diodes
1 - 100k mini trim
1 - 500k " "
24 - Red 5mm LEDs
1 - Green 5mm LED
1 - BC 557
3 - BC547
1 - 2¼" spkr 8 or 15 ohm
30cm of 10-core ribbon
30cm tinned copper wire
Roll of fine solder

Enclose $11.50 Plus $1 P&P

COUNTER MODULE

7 - 100R ¼ watt
7 - 180R "
7 - 220R "
7 - 270R "
7 - 330R "
4 - 3k3 "
4 - 1M "
4 - BC 547
1 - 74C926 IC
1 - AND 4145R display

Enclose 15.50 Plus $1 P&P

7 SEGMENT DISPLAY

FOR ONE DIGIT
15 - 3mm Red LEDs
Enclose $1.50 plus 60c P&P
FOR FOUR DIGITS
60 - 3mm Red LEDs

Enclose $6.00 Plus 60c P&P

POWER SUPPLY

1 - 39R ½ watt
1 - 150R "
1 - 270R "
1 - 470R "
1 - 500R trim pot
1 - .1mfd 100v
1 - 2500 25v
4 - 1N4004
1 - 7805 regulator
5mm red LED

Enclose $3.50 Plus $1 P&P

All other parts from your local electronics supplier

□ WAVE OSCILLATOR

1 - 1k ¼ watt
1 - 3k9 "
1 - 68k "
1 - 100pf
1 - 1n
2 - 10n
1 - 100n
1 - 1mfd 16v
1 - 10mfd "
1 - 5mm red LED
1 - 555 IC
battery snap
6 molex pins
hook-up flex

Enclose $2.00 Plus 60c P&P

TALKING ELECTRONICS MAGAZINE. 35 ROSEWARNE AVE., Ch

Lift Out

PHOTOCOPY THIS FORM

TS ISSUES 1 - 5

BINARY COUNTER

7 - 680R ¼ watt
1 - 3k9 "
1 - 22k "
1 - 100k "
1 - 2.2mfd 16v
1 - NE 555 IC
1 - CD 4024 IC
7 - 5mm red LEDs
battery clip
switch
molex pin
hook-up wire
Enclose $3.45 plus 60¢ P&P

Enclose $3.45 Plus 60c P&P

NOISE-A-TRON

1 - 15R ¼ watt
1 - 2k2 "
1 - 4k7 "
2 - 10k "
1 - 33k "
1 - 2M2 "
1 - CD 4001 IC
1 - BC 557
1 - In 100v
1 - 3n9 "
1 - 10n "
1 - 22n "
2 - 47n "
1 - 100mfd 16v
1 - Speaker 8 ohm
1 - battery clip

Enclose $2.80 Plus 80c P&P

SUPER-BUG

1 - 270R
1 - 470R
1 - 1k
1 - 1k5
1 - 2k2
1 - 4k7
1 - 10k
1 - 33k
1 - 56k
1 - 100k
1 - 2,2mfd 16v
1 - 10mfd
2 - 22mfd
2 - 100mfd
4 - BC 547
2 - BC 557
2 - speaker 8 ohm
1 - battery clip

Enclose $5.00 Plus 80c P&P

CHELTENHAM, 3192

SB

SHOOT GAME Extras

1 - 1k ¼ watt
5 - 10k "
1 - 100k "
1 - 470k "
2 - 47n 100v
1 - 10mfd 16v
1 - 100mfd "
2 - BC 547
15cm Ribbon cable
2 - pushbuttons

Enclose $1.60 Plus 80c P&P

SIMPLICITY AMPLIFIER

1 - 2R2 ¼ watt
1 - 22k "
1 - 50k trim pot
1 - 330pf
1 - 10n
2 - 100n
1 - 4.7mfd
1 - 10mfd
1 - 470mfd
2 - 1N 4148
1 - 1N 4001
1 - LM 380 IC

Enclose $3.20 Plus $1 P&P

QUICK DRAW

3 - 1k
4 - 2M2
1 - 2.2mfd 16v
1 - CD 4001
2 - Red LEDs
1 - Green LED
1 - battery snap

Enclose $1.20 Plus 80c P&P

COMBINATION LOCK

2 - 2k2
1 - 10k
2 - 22k
1 - 10n
1 - 22mfd
1 - CD 4017 IC
2 - BC 547
6 - 1N 4148
1 - 1N 4002
1 - 6v relay
1 - push-to-make switch
1 - battery snap

Enclose $4.80 Plus $1 P&P

BINARY HIGH LOW

Project 8
1 - 74C85
1 - 470R
6 - Molex pins

Enclose $1.80 Plus 80c P&P

LED DICE

3 - 330R
1 - 1k
9 - 10k
1 - 3M3
1 - 4M7
1 - 10M
1 - 100n
1 - 1mfd
1 - 1mfd 16v
3 - BC 547
2 - BC 557
1 - CD 4017 IC
1 - 555 IC
7 - 5mm LEDs
1 - push-to-make switch
1 - battery snap

Enclose $5.00 Plus $1 P&P

( ) I like the PC board attached to the magazine
( ) I don't like the PC board attached to the magazine

Enclose P&P up to a maximum of $3.50

Name:

Address

Bankcard number

P&P

bankcard

Signature

MONEY ORDER/CHEQUE TOTAL $

Lift Out

KITS FOR THIS ISSUE

HANGMAN

( )

3 - 150R
3 - 270R
2 - 330R
1 - 680R
1 - 3k3
3 - 4k7
2 - 10k
1 - 22k
2 - 33k
5 - 47k
1 - 150k
2 - 390k
2 - 2M2
1 - 10M
1 - 100k mini trim pot
1 - 1n 100v Cap.
1 - 10n 100v Cap.
2 - 4.7mfd 16v
2 - 22mfd 16v
1 - 100mfd 16v
1 - 470mfd 16v
12 - BC 547
1 - BC 557
2 - CD 4011
1 - 1N914
2 - 1N4002
20 - 3mm Red LEDs
1 - battery snap

Enclose $8 plus $1 P&P

MINI MIXER

( )

1 - 150R
1 - 1k
1 - 2k2
1 - 5k6
6 - 10k
1 - 220k
2 - 10mfd 16v
1 - 100mfd 16v
2 - BC 547
2 - 1N914
1 - 5mm Red LED
1 - battery snap

Enclose $2 plus 80¢ p&p

EGG TIMER

( )

1 - 15R
2 - 3k3
1 - 10k
1 - 47k
2 - 100k
1 - 470k
1 - 4M7
2 - 10n 100v
1 - 10mfd 16v
1 - 22mfd 16v
7 - 1N914
1 - 74C14 IC
1 - BC 547
1 - speaker 8R
1 - battery snap
1 - mercury switch

Enclose $5.30 plus 80¢

PROGRAMMABLE COUNTER

( )

1 - 330R
1 - 470R
1 - 10k
3 - 22k
1 - 100k
2 - 330k
2 - 1n 100v
1 - 100mfd 16v
1 - 555 timer IC
3 - CD 4017 IC's
1 - BC 547
3 - 1N914
2 - 5mm Red LEDs
1 - push switch
30 - Molex pins
1 - battery snap

Enclose $7.10 plus $1 p&p

CAPACITANCE METER

( )

1 - 330R
1 - 3k3
1 - 100k
1 - 1M
1 - 100pf styro
1 - 1n 100v
1 - 2n2
1 - 10n
1 - 22n
1 - 100mfd 16v
1 - 2k mini trim pot
1 - 10k mini trim pot
2 - 100k mini trim pot
2 - 555 timer IC's
1 - CD 4011 IC

Tinned copper wire

Enclose $3.60 plus 80¢ p&p

DIODE TESTER

( )

2 - 1k
1 - 3k9
1 - 47k
1 - 10n
1 - 555 timer IC
2 - 3mm Red LEDs

Enclose 90¢ plus 50¢ p&p

THROTTLE

( )

2 - 39R
1 - 220R
1 - 1k mini trim pot
2 - 1N4002
1 - BC 547
1 - 2N3055

Enclose $1.80 plus 80¢ p&p

TALKING ELECTRONICS MAGAZINE,
35 ROSEWARNE AVE., CHELTENHAM, 3192.

NAME: SIGNATURE bankcard

ADDRESS:

P&P

Bankcard Number ---/--/---/------ TOTAL $

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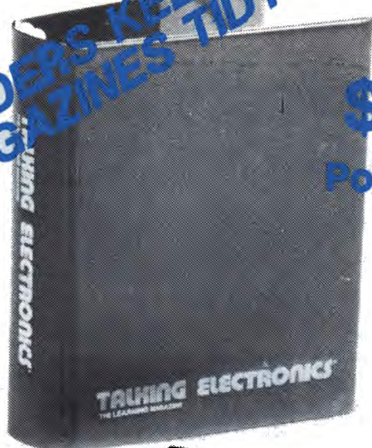

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Mini Frequency Counter

COMPLETE KIT OF COMPONENTS

ONLY 13^{50}

P&P $1.00

4 ICs, 45 LEDs, 2 caps, diode, 3 mini trim pots, 4 resistors, 6 Molex pins, battery snap, red screen, copper wire, hook -up wire, fine solder.

BE DIFFERENT!

GREEN LED VERSION

$15.75

P&P $1

CAPACITANCE METER

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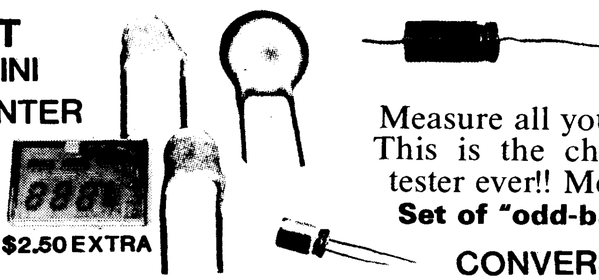
EXPAND YOUR MINI FREQUENCY COUNTER TO 5 DIGITS



$8.50 PCB $2.50 EXTRA

POST 80c

Measure all your "odd-ball" capacitors. This is the cheapest digital capacitor tester ever!! Measures 100pf to 10mfd.

Set of "odd-ball" capacitors $1.00!!

CONVERSION KIT **$3.60**

ALSO REQUIRED: 3 IC's EXPEREMENTER BOARD $1.85

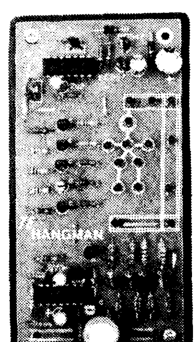
SPECIAL!

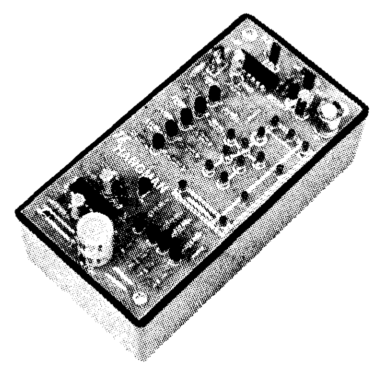
HANGMAN

HANGMAN - This circuit uses transistors & IC's to produce an electronic version of Hangman. It makes an ideal fun game for younger members of your family.

$8.00

Post & Pack $1





TALKING ELECTRONICS

bankcard welcome here

35 Rosewarne Ave Cheltenham 3192 584 2386

SHOP TALK

The past eight weeks has seen a flurry of activity. Apart from a two week period when communications ceased due to a postal strike, we have received an encouraging response to the magazine and its pheripherals. We managed to get the MINI FREQUENCY COUNTER booklet into the shops before the rush period and was quite elated to see them disappear in two days. Our local newsagent received 8 copies on the Friday and had two copies left at the end of Saturday trading. OK, you say that isn't much, but when you multiply that by the number of newsagents around Australia, the figure comes to 5,000 sales in the week. The demand in electronic shops is even more encouraging. The confirmed sales are a complete sellout from Stewart Electronics in a week with the same happening the next week. Ellistronics a plentiful supply and maintained stocks for 3 weeks. Other shops were sent copies by post so I don't know when they will arrive. If you want to see a copy of the booklet, you could try your local newsagent or electronics shop. Failing that we have a few copies left. More boards are in the process of being etched and screen printed to cater for mail orders. The idea represents extremely good value. You get the project and board for the price of the PC board alone. We are already well into the next project. It should have even more appeal. Everyone has a stereo. Everyone likes to know how much power they are pumping into the speakers. Our project will give you an LED readout of the power from each channel. It will be a self-contained unit needing only a simple attachment to the speaker wires. Each unit will be mono so you will need two units for a stereo system. But don't be deterred. Start with one and when it works satisfactorily, send for a complete kit of parts and PC board for the other unit. Preferably try your local electronics supplier for the parts as it is our intention to build up the demand from these suppliers to help both yourself and them. Quite understandably, they are not prepared to take the punt unless they are assured of reasonable sales. Prove it to them.

A couple of constructors have telephoned us regarding the difficulty in obtaining the CD 4026 IC. This is a bit disappointing. We try to use only readily available parts and consider this IC to be a popular component. Unfortunately Tandy don't stock it but most of our regular advertisers have them in stock.

Following the response for the Experimenter Deck project, we have designed the next circuit in this series. As you may know, this series is intended as a forerunner to calculators and computing. The next deck is so simple you couldn't get anything simpler. It introduces you to some of the terms necessary to understand programming terms such as SHIFT and MEMORY. The first stage has only a couple of IC's and 4 push buttons. In each issue we add a similar amount of circuitry until the total $25 project is complete. You will be able to write a very simple program into the memory and recall it at a later date. But don't get too carried away, its only binary input and output, with the readout appearing on a row of LEDs.

It's exactly what you need as a starter project. It's a first-time ever. We have not seen anything remotely like it in any publication. So it should be good.

As I mentioned. The postal strike obliterated two weeks response to all our offers. This included the contest for the multimeter. In fairness, we will extend the closing date to the end of February 1982. This will enable those in other states to get their entry in. Distribution of the magazine takes anything up to 3 weeks to the farthest states and at the time of writing, the mail has not yet returned to normal, so we don't know how many entries are in the pipeline.

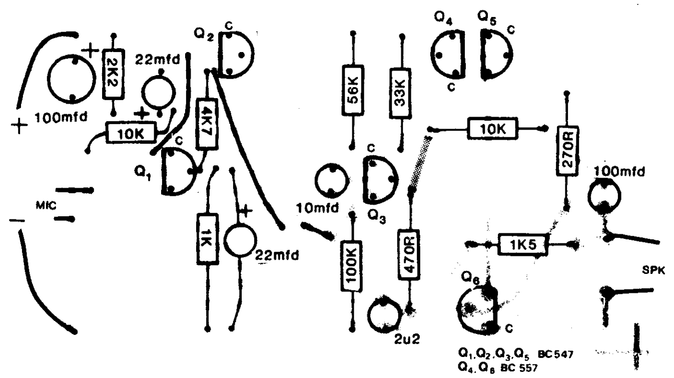
Corrections to Issue 5

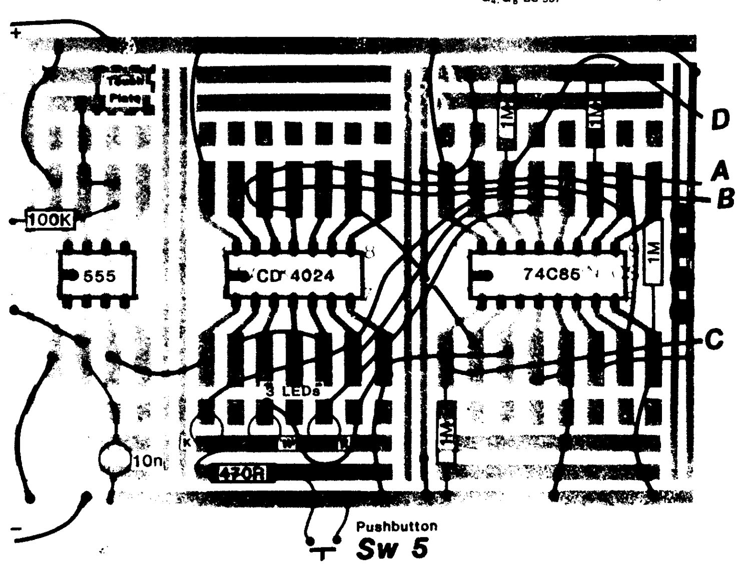
P24. Designing your own power supplies...Under the heading NOTES: point 2. The transformer will not work if you connect the SECONDARY to the mains.

P38. LED DICE parts list. Add 555 timer IC

P42. Noise-A-Tron R4 can be anything between 4k7 and 220k. Try experimenting.

2 diagrams which "dropped out" in issue 5:





As long as I have want - I have reason to live.

LETTERS...

Not a flood of letters this month but a constant trickle of requests and praise for the magazine. This is heartening but more important than the feedback is the knowledge being gained through its pages. We are getting more 10 minute calls from readers expressing their appreciation for the introduction of the magazine than letters, so most of the communication cannot be presented in words. It will be interesting to receive comments on the inclusion of PC boards with the magazine. We intend to divide our range of projects into 3 sections: TEST EQUIPMENT, GAMES and LEARNING AIDS. If you have a preference to the type of project you would prefer, please let us know.

Now back to the letters we received this month.

We have been quite surprised with the requests for specific power supply projects. Here are two from last month:

20 AMP POWER SUPPLY

Dear Sir,

I wish to enquire about the availability of a design or kit for a 0-30 volt, 20 amp variable Power Supply. If a design is not readily available, is there a chance that in the future one of your technical staff will introduce such a project for your magazine? I would imagine that the demand would be high, especially from those associated with the aviation industry where the systems utilise 24-28 volts.

Hope to hear from you soon as it looks as if the only way I will get one here in Darwin is to build one myself. All the best with Talking Electronics.

P Alman

Dear Sir,

On reading your publication I have noted various schematics for a variety of projects as well as your other educational items.

I personally, being a CB operator and a ham operator, am interested in obtaining a suitable schematic for a power supply with a rating of 12vDC 10 amp or better. One that would not be over expensive to build up.

The reason I am looking for something heavier is that I've found that the "Transwest Mark III" I possess doesn't appear to be sufficient on test, for my Yaesu FT7 transceiver.

It is my opinion that many of your readers as well as myself would appreciate the publication of such a project or references to sister publications where this information can be obtained.

Brian J Lawrence

(We have one on the way.........Ed.)

MAG SIZE STD

Dear Sir,

Although I have thoroughly enjoyed your magazine, there is one thing that has disappointed me. As I wish to keep these magazines I was going to have a number of them bound together for safekeeping. I have just discovered that this will be a difficult task as the magazines are not of a uniform size.

I should be pleased therefore if you could possibly have this matter rectified in future editions.

P Plat

We are standardising at 72 pages quarter-fold and will have them trimmed to a standard size. Our magazine binder will accept 12 issues and will prevent them from being lost, damaged, borrowed, or cut up.

LIGHT ALARM

Dear Sir,

Enclosed is my project, "LIGHT ALARM" from page 28, issue #1 of your magazine.

The problem with it is that batteries don't last very long. On checking I found that the circuit draws 60ma in operation and strangely more than this at rest (i.e. in the darkness). This is no doubt the reason for my batteries going flat. In the article it mentions that the circuit should only draw about 1ma at rest. Mine draws 100 times this amount!!!! HELP!! (so that the wife and kids can eat again as I'm spending all my money on batteries!)

Please tick one or more of the following

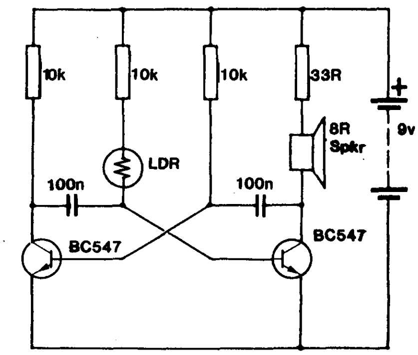
- ☐ Give up electronics and take up fishing.
- ☐ Stick with electronics but take up drinking.
- ☐ Errata for this project hasn't appeared yet.
- ☐ People with I.Q's under 50 shouldn't attempt these difficult projects.
- ☐ I have reprimanded the designer and he is now working on a s.p.s.t. switch for a light bulb.
- ☐ I have fixed your project (you dummy) and the problem was:

....

....

- ☐ I have not cancelled your subscription to the magazine but will do so if you attempt any more projects.

Another one of our mistakes!! The PE cell is in the wrong base lead. The corrected circuit is shown here:-



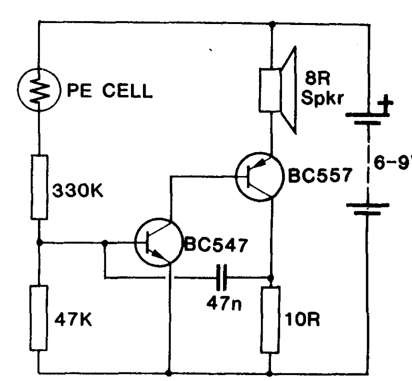
LIGHT ALARM

Circuit activated when light falls on Light dependent resistor.

We had a look at your model. The first transistor was around the wrong way. We also rewired the PE cell. Under normal operating conditions the circuit takes 60 to 100 mA. This falls to 1 mA when the photocell is in darkness.

An even lower current consumption can be achieved with the second circuit. Its operating current is 10mA and this falls to 1 microamp during dark conditions. This circuit is the better choice of the two due to its extremely low quiescent current and its reliable starting. For a higher output drive an additional buffer transistor can be fitted.

An even lower current consumption can be achieved with this circuit.



BEEPER

Very low current alarm circuit consumes 1 micro amp quiescent and 10mA operating.

This next letter reminds me of the way I would have felt 20 years ago on a seeing a magazine such a T.E., in the newsagents. We get similar requests for back issues and kits for every project from lots of readers. They must be sensing a similar reaction.

ELECTRONICS CLUB

Dear Sir,

Firstly I would like to congratulate you on a marvellous magazine. I remember the first time I saw it. I was in the newsagent picking up the magazines I have held for me, and was browsing through the rack and saw 'Talking Electronics', any experimenters magazine, ...I buy it! (after all, Mum pays for it!). So I bought it, thinking it was another ...... publication, but was not disappointed to find out it wasn't.

I saw the next issue, and was hooked, right up to issue 5, and I am looking forward to seeing issue 6. The reason I've written this letter, is to let you know I'm interested in joining 'our' electronics club if it eventuates. Who knows, one day I may be able to see you and have a bit of a chin-wag, anyone who can design a magazine this good must be a great thinker. I have now finished school, and am waiting on a reply from an apprenticeship Electronics Technician position I applied for.

Wayne Brown
7 Manna Street,
Dromana 3936

(I hope you get it......Ed)

GOLD!

Dear Sir,

First may I congratulate you on the introduction of a much needed electronics magazine. We now have a magazine which sort of takes off from where the other left off.

I would like to relate a story on how electronics is affecting our quiet life up here "in the bush".

We are situated on the north west point of the Golden Triangle, made famous by that new innovation of electronic wizardry, the Metal Detector, and to this district comes hordes of amateur gold seekers armed with their professional detectors, their cars fitted to the roof with shovels, picks, pans, wheelbarrows and even with an odd cement mixer or two strapped to the roof. Most people go on a holiday to get away from it all - for a while - these gold seeking terrorists take the whole lot with them even down to their super "Yoo Beaut" special VCR's just in case they can't get local TV.

It is not unusual to see 4 or 5 "Toorak Tanks" loaded with camping equipment, parked outside the Motel units over the week-end, while their occupants busily run around taking piccy's of the "we were here" type.

There is also a surprising amount of cars sporting CB antennae, yet when you try to contact them on all possible frequencies you are greeted with a silent speaker. They don't even answer on the impossible frequencies. On asking why, the reply is usually "I only turn it on when I need it", yet if they get lost, which is very easy and many have, they expect everyone to have their radios on and help them immediately.

Most of the visitors go home very disappointed both with the locals and the Council for not putting up enough signs in the right area. Simple signs like "Dig here", "Gold 1 ft down", "2oz nugget here" and so on. Well, I mean, who wants to spend all day digging up bits of wire and nails?

Must go now as I have just had a call on the radio, someone has lost their car, an occurrence becoming more and more regular.

Reminds me about the prospector who after waking in the morning, found his car missing from his camp. Car was stacked with all the best of goodies. 26 - 28 MHz radio, 250 watt Linear, $2,500, Super Yeu Beaut detector, and various other very expensive items. After searching around the camp and surrounding scrub, believing it was the work of a couple of mates, he was then tempted by a mate to report the incident to the local police who as it was explained to him, were more experienced at this, and if he went stumbling through the scrub in search of his beloved motor, he himself could end up being the subject being searched for.

On entering the main street of the town, he was suddenly hit by the realisation and the guilt of calling so many people so many names, for there was his car, waiting patiently for him outside the local hotel where he had left it the night before. He and his mates had forgotten he got a lift with them back to camp. The car with all the super goodies in it had been there for 15 hours completely devoid of any security system, even the windows were wound down!!

Luke Turner

BRING BACK BRIDGES

Dear Sir,

Very pleased to see another decent electronics magazine on the market in the form of T.E., it will fill the hole left by another well known electronics magazine that faded away with progress. Unfortunately I didn't know you were around until issue 4.

I would like to say that on the subject mentioned about the hump backed bridges to indicate a wire crossing over another which is not a junction. I am very disappointed, as for many years this type of crossover has been used without any problems, but now I have had lots of trouble with projects in the past because of the straight line crossings which are not a junction and a dot which is.

It is surprising how many draftsmen forget to put a dot at a junction and those who are too lazy to make a well defined dot at a junction.

Hours have been spent working out circuits that apparently have open circuits and even those that appear to have closed circuits due to an ink speck.

Although the circuit on page 4/55 is straight forward enough, I have difficulty in defining a crossover from a joint, many of us have failing eyesight and even with my reading specs I still have trouble, so please, oh please bring back the hump backed bridges.

Glyn G-Johns

PC's IN NZ

Dear Sir,

I am concerned at the difficulty in obtaining the printed circuit boards for your projects.

In New Zealand the availability of your circuit boards, and other for Australian magazine projects is very poor. Also, the chemicals for making circuit boards using the photo-resist method are not available (unless you buy the minimum quantity from Kodak costing $50). As for the Dalo pen method, trying to copy complex circuit boards is time consuming and frustrating. I feel certain that I echo the sentiments of many electronic enthusiasts who look anxiously at your projects but cannot build them.

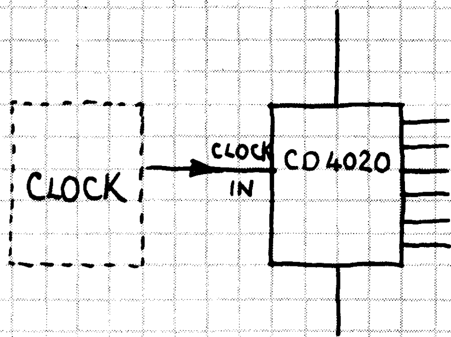
I am aware of your mail service but I feel that New Zealanders are reluctant to cut all the 'red tape' necessary to obtain bank drafts. As well as this, the time factor in posting items across the Tasman has to be considered.

M J Bryham

This letter and at least 7 others have been the initiation to getting PC boards attached to the magazine. As you possibly realise, making one board is an afternoons effort. Imagine making 20,000!! This has been our commitment. Obviously we didn't make them ourselves but the co-ordinating and organising is enormous. We have had to choose phenolic due to the dimensions of the board. Super punch (fibre-glass mat either side of a phenolic board would have produced a considerable amount of waste from the large sheets whereas phenolic left no waste. Maybe with a different size board, we will be able to bring out a fibre-glass board. We will see how this project takes off first. Let us know how you like it.

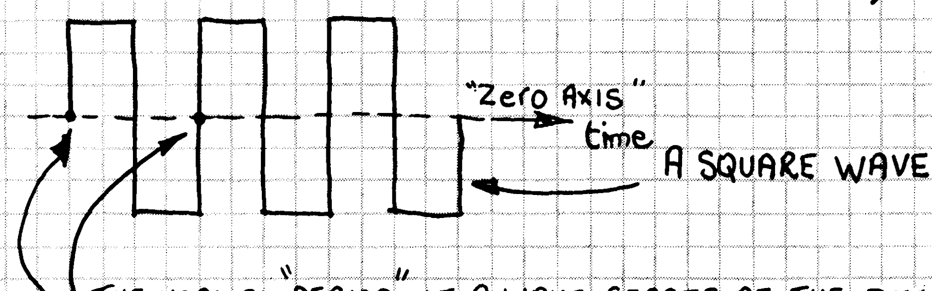
A budget is what you stay within if you go without.

41 CLOCKS



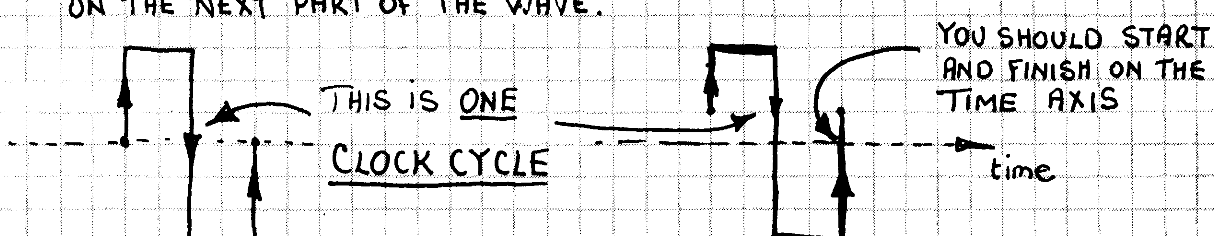
ALL OUR CIRCUITS REQUIRE PULSES INTO THE IC TO MAKE THEM "COUNT". THESE PULSES ARE GENERATED BY A CLOCK.

A CLOCK IS A SQUARE WAVE OSCILLATOR WHICH RUNS AT A FREQUENCY RANGING FROM LESS THAN 1 Hz (CYCLE PER SECOND) TO MANY MHz. (MILLIONS OF CYCLES PER SECOND)

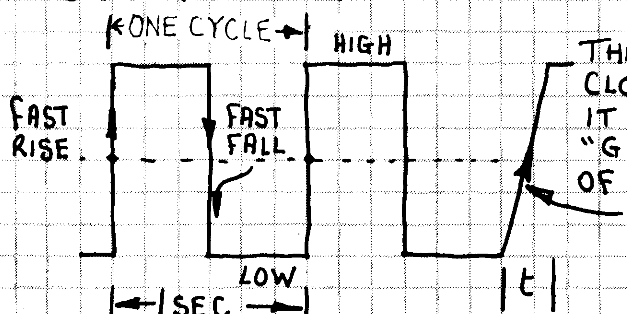


THE NORMAL "PERIOD" OF A WAVE STARTS AT THE ZERO AXIS AND FINISHES AT THE ZERO AXIS (AFTER RISING AND FALLING ONCE)

TO MEASURE ONE CYCLE, YOU CAN START ANYWHERE ON THE WAVEFORM PROVIDING YOU RETURN TO THE SAME RELATIVE POINT ON THE NEXT PART OF THE WAVE.



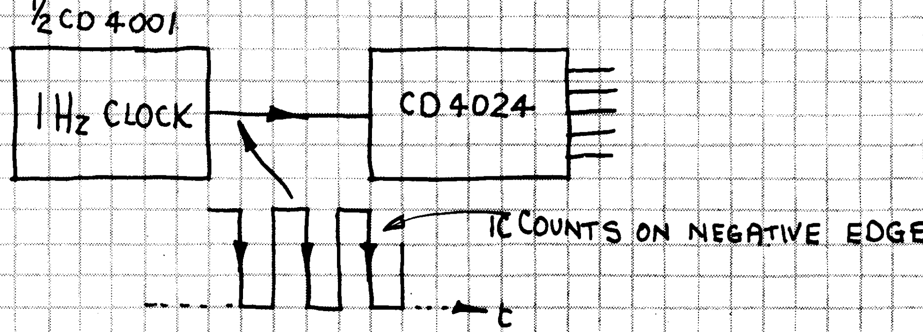
FOR 1 CYCLE PER SECOND:



THE MOST IMPORTANT FEATURE OF A CLOCK IS THE RISE AND FALL TIME. IT MUST BE VERY FAST TO PREVENT "GLITCHES" OR ERRATIC OPERATION OF THE COUNTING IC.

THIS WAVE IS NOT SUITABLE AS IT HAS TAKEN THE TIME 't' TO RISE.

42 ONE CYCLE OF A 1Hz SQUARE-WAVE CONSISTS OF ½ SEC OF HIGH & ½ SEC OF LOW.



THE CD 4024 ADVANCES ONE COUNT WHEN THE OUTPUT OF THE CLOCK GOES NEGATIVE. THE RISING WAVEFORM HAS NO EFFECT. BUT IF THE RISING WAVEFORM WAS TOO SLOW, NOISE WOULD TRIGGER THE COUNTING IC AND MAKE IT RECORD A FALSE COUNT.

TO CREATE A CLOCK, WE HAVE TWO CHOICES:

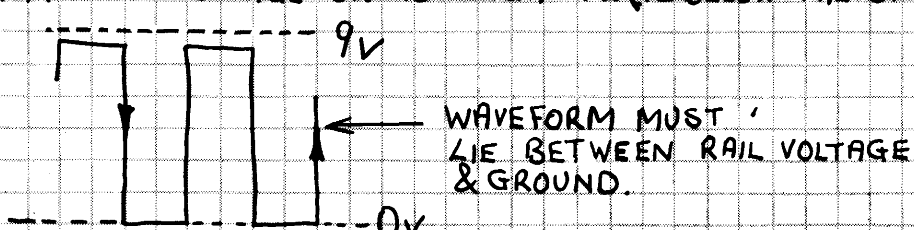
1. MECHANICAL
2. ELECTRONIC.

A MECHANICAL CLOCK (OR SWITCH) IS QUITE USELESS IN DIGITAL ELECTRONIC CIRCUITS. THEY PRODUCE SO MUCH "SWITCH BOUNCE" THAT NO ACCURATE CLOCKING CAN BE ACHIEVED. MECHANICAL SWITCHES COME AS PUSH SWITCHES, TOGGLE SWITCHES, MICRO SWITCHES AND REED SWITCHES. ALL THESE DEVICES ARE FAR TOO SLOW IN OPERATION FOR A LOGIC GATE, AS GATES CAN RESPOND TO OVER ONE MILLION PULSES PER SECOND.

THE ONLY SUITABLE CLOCK IS AN ELECTRONIC OSCILLATOR.

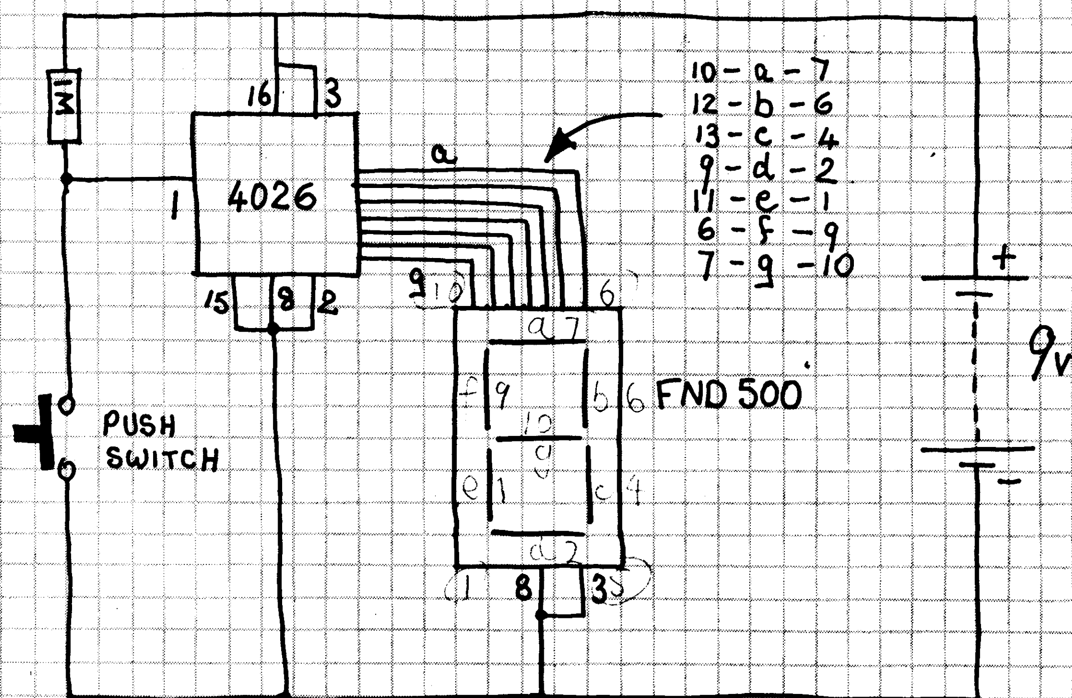
AN OSCILLATOR WHICH CYCLES ONLY ONCE IS CALLED A "ONE SHOT"
AN OSCILLATOR WHICH CYCLES LESS THAN ONE CYCLE PER SECOND IS CALLED A DELAY.
AN OSCILLATOR WHICH CYCLES 1Hz → 10MHz IS CALLED A "CLOCK".

IN DIGITAL WORK THE OUTPUT OF THE OSCILLATOR MUST NOT BE MORE THAN RAIL VOLTAGE OR GO NEGATIVE (IE BELOW THE 0v LINE)



43 Random number generator

showing the effect of switch "bounce"

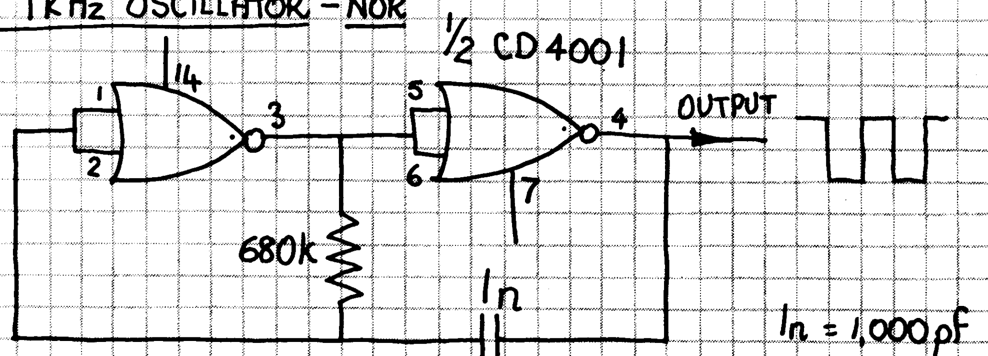


THIS CIRCUIT USES THE HIGH NOISE FACTOR OF A PUSH BUTTON SWITCH TO CLOCK THE 4026 IC AND GENERATE A RANDOM NUMBER. THIS IS ABOUT THE ONLY CIRCUIT FOR A NOISY SWITCH. IN ALL OTHER CIRCUITS, THE FIRST REQUIREMENT IS TO REMOVE THE "NOISE".

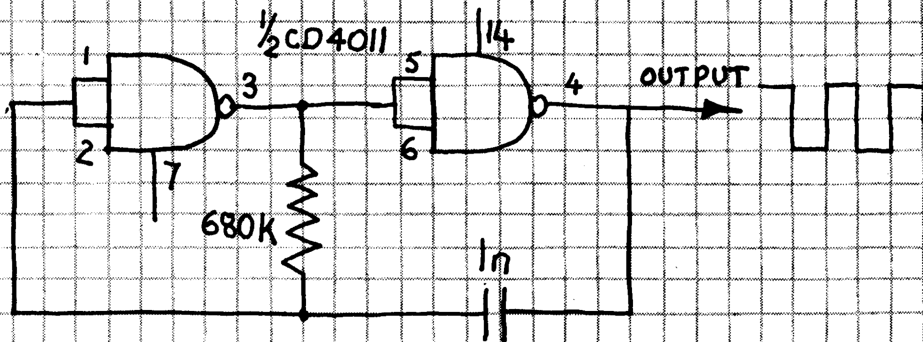
Clock circuits

A NUMBER OF RELIABLE CLOCK CIRCUITS CAN BE CREATED FROM SIMPLE GATES: HERE ARE 4 CIRCUITS:

1. BASIC 1KHz OSCILLATOR - NOR

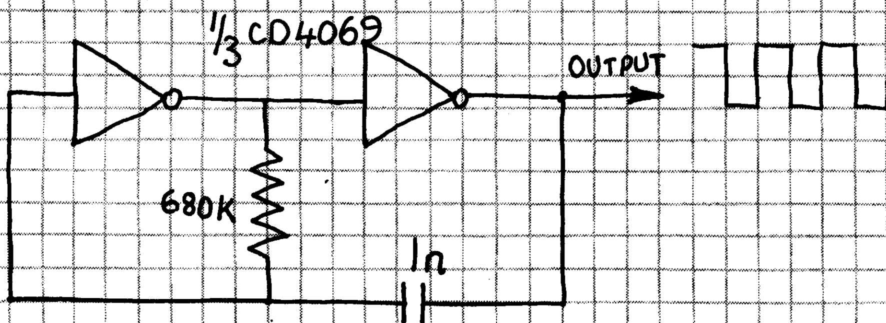


44 2. BASIC 1KHz OSCILLATOR - NAND

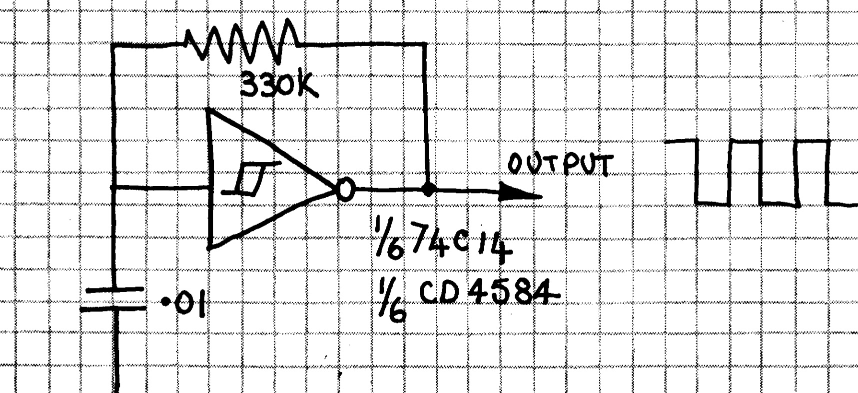


SINCE THE ABOVE NOR & NAND GATES ARE WIRED AS INVERTERS, WE CAN USE AN INVERTER CHIP FOR THE OSCILLATOR.

3. BASIC 1KHz OSCILLATOR - INVERTER



4. BASIC 1KHz OSCILLATOR - SCHMITT TRIGGER

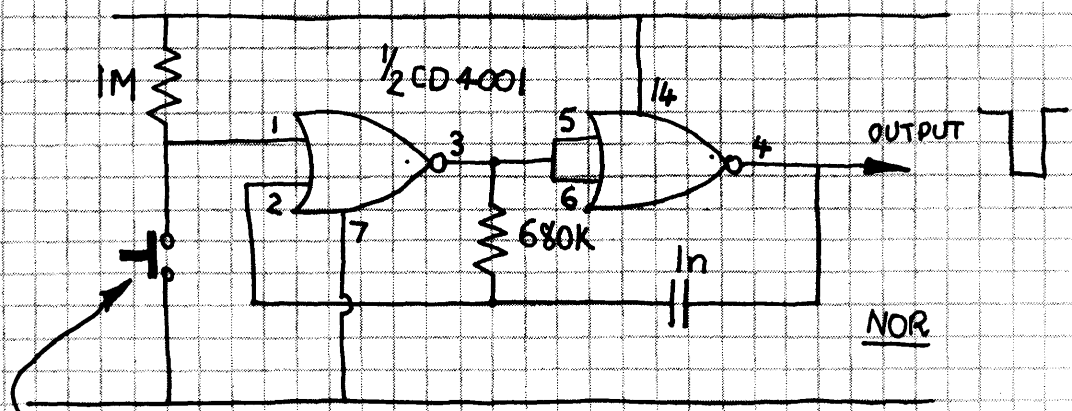


A SCHMITT TRIGGER WILL PRODUCE A SQUARE WAVE AT 1KHz WITH THE COMPONENTS SHOWN. WHEN THE SCHMITT OUTPUT IS HIGH, THE CAPACITOR CHARGES VIA THE 330K RESISTOR. WHEN THE VOLTAGE ON THE INPUT RISES TO THE UPPER TRIP POINT OF THE SCHMITT, THE OUTPUT DROPS LOW. THE CAPACITOR THEN DISCHARGES THROUGH THE RESISTOR TO THE LOWER TRIP POINT TO CHANGE THE SCHMITT OUTPUT TO HIGH. THE CYCLE REPEATS AT APPROX 1KHz. THIS CIRCUIT IS VERY ECONOMICAL ON PARTS.

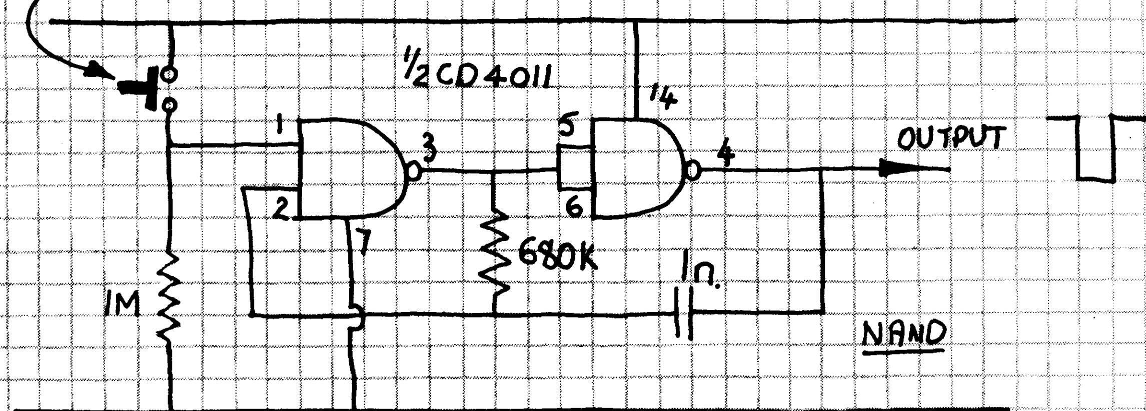
The quickest way to do things is one at a time.

45 Gating

CIRCUITS 1 & 2 CAN BE GATED SO THAT THEY OPERATE WHEN A PUSH-BUTTON IS PRESSED. (SWITCH NOISE DOES NOT CONCERN US.)

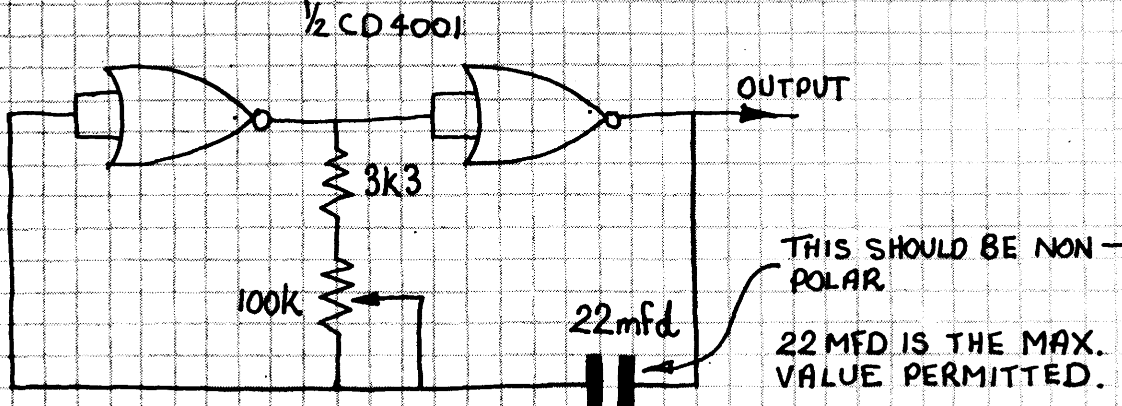


THE OSCILLATOR OPERATES WHEN THE BUTTON IS PRESSED

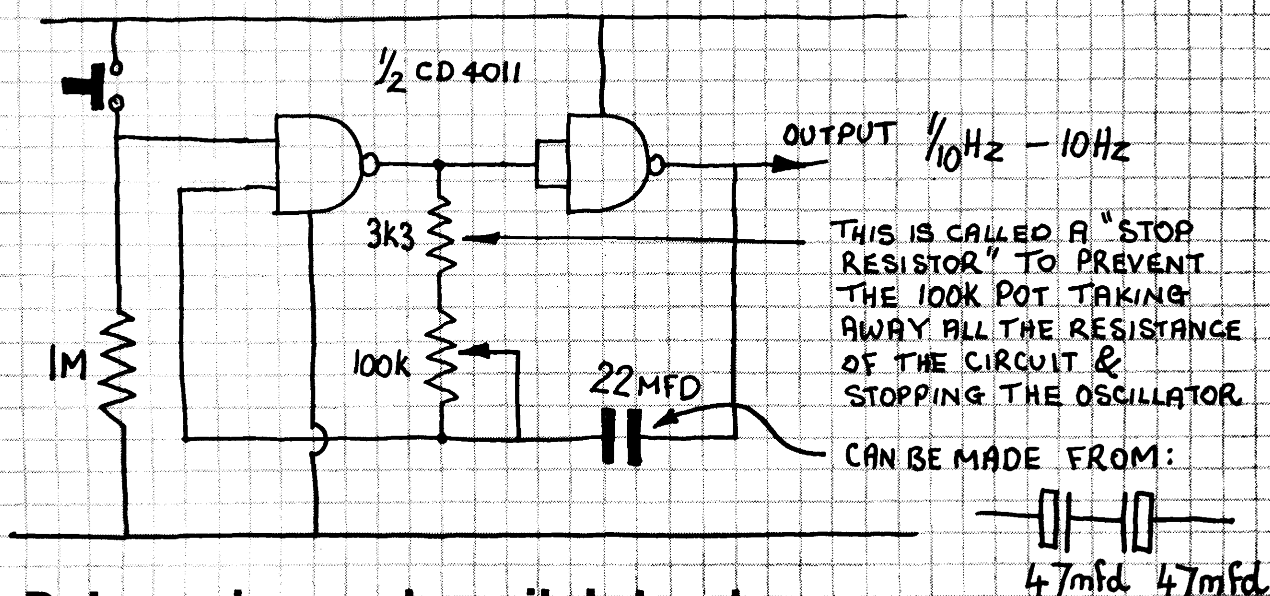


Low frequency oscillators

OSCILLATIONS FROM 10 CYCLES PER SECOND TO ONE CYCLE PER 10 SECONDS ARE POSSIBLE WITH CIRCUITS 1 & 2.

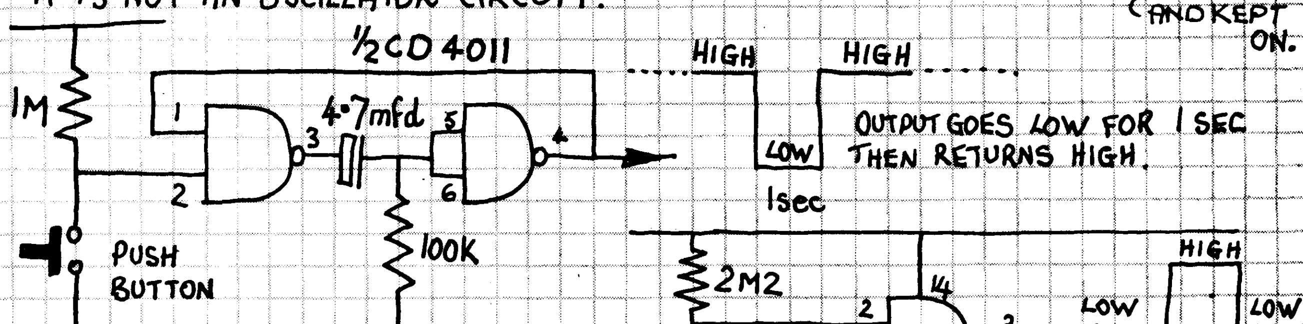


46 A LOW FREQUENCY OSCILLATOR CAN BE GATED TO TURN ON VIA A PUSH-SWITCH. THE TIMING CEASES AT THE END OF THE CYCLE IN PROGRESS (OPERATION) WHEN THE SWITCH IS RELEASED.

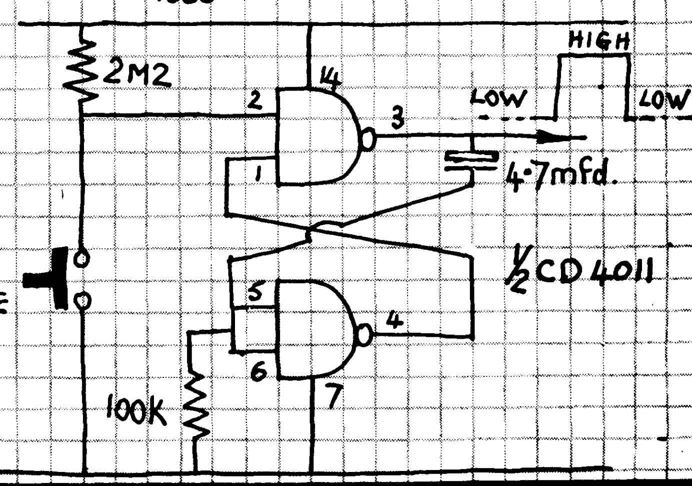


Debouncing push-switch to give a 1Hz clock

A SIMPLE METHOD OF DEBOUNCING A MECHANICAL SWITCH IS TO PROVIDE A "ONE SHOT" CIRCUIT. THIS IS A MULTI-VIBRATOR WHICH PERFORMS ONE CYCLE THEN STOPS. IT MUST BE TRIGGERED INTO OPERATION EACH TIME. THE SWITCH IS PUSHED, THEN RELEASED. THE CIRCUIT WILL NOT CYCLE IF THE BUTTON IS PRESSED ON, (AND KEPT ON.) IT IS NOT AN OSCILLATOR CIRCUIT.



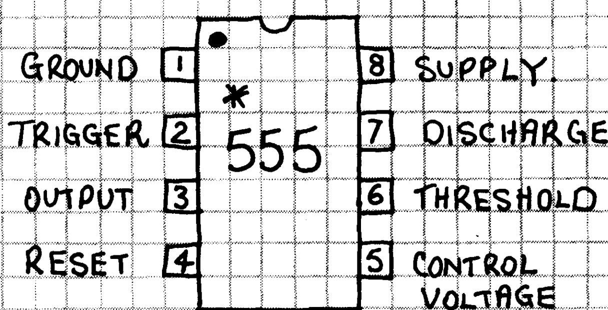
WHEN THE BUTTON IS PRESSED, OUTPUT GOES HIGH FOR ONE SECOND THEN RETURNS LOW.



Friendship is like money, easier made than kept.

47 The 555

OUR FIRST DEDICATED IC IN THIS SERIES IS A 555 (PRONOUNCED "TRIPLE FIVE") THIS IS A SHORT-FORM WAY OF SAYING LM555 OR SE 555 OR NE 555. IT IS SPECIALLY DESIGNED TO OPERATE AS A MULTIVIBRATOR WHICH CAN TIME FROM MICRO-SECONDS TO SEVERAL HOURS. IT IS A TTL DEVICE AND AS SUCH IS NOT PRONE TO STATIC ELECTRICITY. BUT ITS POWER CONSUMPTION IS CONSIDERABLY MORE THAN CMOS IC'S AND MUST BE TAKEN INTO ACCOUNT WHEN DESIGNING FOR BATTERY OPERATION. THE 555 TAKES 10mA FROM THE SUPPLY WHEN THE OUTPUT IS HIGH AND 1mA WHEN THE OUTPUT IS LOW. WHEN OPERATING AS AN OSCILLATOR WE CAN CONSIDER THE POWER CONSUMED TO BE EQUAL TO THAT OF A LED. A CMOS VERSION HAS BEEN INTRODUCED WITH THE PART NUMBER LM 7555 BUT AS YET IS CONSIDERABLY MORE EXPENSIVE THAN THE 555. WHEN THE PRICE FALLS IT WILL BE A VERY GOOD CHOICE AS IT CONSUMES ONLY 120 μA. TO DATE IT DOES HAVE A NUMBER OF LIMITATIONS SUCH AS OUTPUT CURRENT CAPABILITY & MAXIMUM VOLTAGE LEVELS ON THE TRIGGERING PINS BUT THESE MAY BE OVERCOME IN LATER VERSIONS.



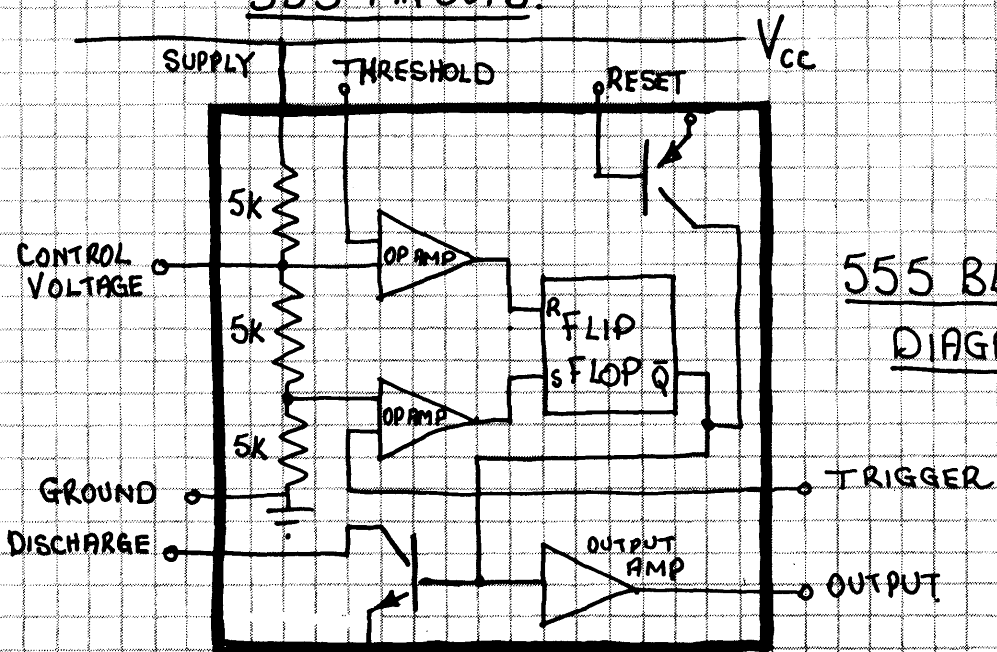
* MAY BE:

LM 555

NE 555

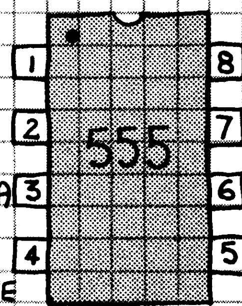
SE 555

555 PIN OUTS.



555 BLOCK DIAGRAM

48 555 PIN FUNCTIONS



1 — CONNECTS TO GROUND

2 — DETECTS 1/3 SUPPLY VOLTAGE TO TURN IC ON.

3 — OUTPUT CAN SUPPLY 200mA

4 — RESET OR INHIBIT. WHEN TAKE 0V THE IC STOPS. NORMALLY CONNECTED TO SUPPLY.

8 — CONNECTS TO THE SUPPLY RAIL

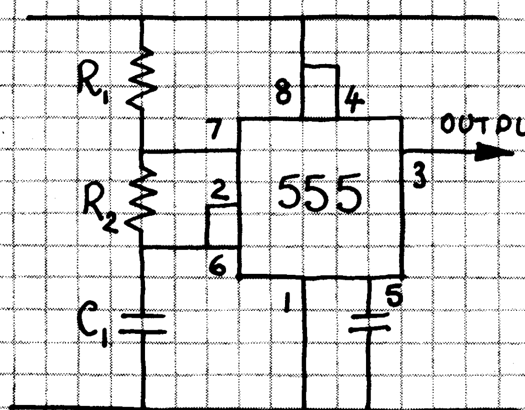
7 — DISCHARGES THE CAP VIA R_2

6 — DETECTS 2/3 SUPPLY TO TURN IC OFF

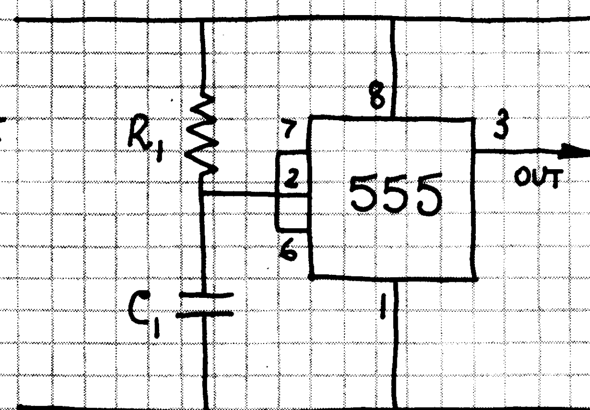
5 — CONTROL VOLTAGE AND CAN ADJUST FREQUENCY VIA EXTERNAL POT. CAPACITOR TO THIS PIN REMOVES EXTERNAL NOISE.

THE EFFECT OF EACH PIN.

THE 555 CONTAINS SOME 28 TRANSISTORS AND A SET OF RESISTORS TO PRODUCE AN EXTREMELY VERSATILE AND CHEAP TIMING DEVICE. WE WILL BE MAINLY CONCERNED WITH ITS USE AS AN OSCILLATOR AND ITS ABILITY TO PRODUCE A "ONE-SHOT" TO EFFECTIVELY DEBOUNCE A SWITCH. IT CAN ALSO BE MADE TO TURN ON AND OFF VIA AN INHIBIT SWITCH.
THE 555 IS WIRED INTO A CIRCUIT AS FOLLOWS:



STANDARD 555 CIRCUIT.



THE SIMPLEST 555 CIRCUIT

HOW THE CIRCUIT WORKS:

THE 555 IS DESIGNED TO DETECT THRESHOLD VOLTAGE LEVELS. PIN 2 DETECTS A VOLTAGE BELOW 1/3 OF THE SUPPLY VOLTAGE TO TURN THE IC ON AND PIN 6 DETECTS A VOLTAGE ABOVE 2/3 OF THE SUPPLY VOLTAGE TO TURN THE IC OFF.

WHEN THE SUPPLY IS CONNECTED C_1 CHARGES VIA R_1 & R_2. WHEN 2/3 V_{cc} (THE SUPPLY VOLTAGE) IS DETECTED, PIN 6 TURNS THE IC OFF. THIS PIN IS THEN EFFECTIVELY DISCONNECTED FROM THE CIRCUIT AND DOES NOT HAVE ANY FURTHER FUNCTION UNTIL THE IC IS TURNED BACK ON AGAIN. AT THE SAME INSTANT PIN 7

Enthusiasm is infectious - and so is the lack of it.

TEST EQUIPMENT

☆ Add-on to our Digital Frequency Counter

☆ Reads 100pf to 10mfd.

DIGITAL CAPACITANCE METER

For about $8 you can extend the value of the Mini Frequency Counter to test capacitors.

Our first project book in the series of five has been recently released. It seems to have sold out in most shops in a matter of weeks. Maybe you missed out? To avoid any disappointments, we have prepared a second release of this project book and it is available from us via mail order. At a cost of $3.95 the project book includes a printed circuit board and presents very good value for money. The kit of parts is also available from us.

Now you can double the value of the Mini Frequency Counter by adding this DIGITAL CAPACITANCE METER to the front end. By simply attaching this pulse circuit to the input of the counter, you can measure capacitors from 100pf to about 10mfd. This is very handy as a double-check for those values which are hard to decipher or where the value has rubbed off.

Once the unit is set up accurately, you will be quite surprised how much capacitors vary in value, especially electrolytics. When a manufacturer says his electrolytics can vary by as much as +80% −20%, this variation really comes home when the values are read. Two electrolytics from the same batch can vary by as much as 50%.

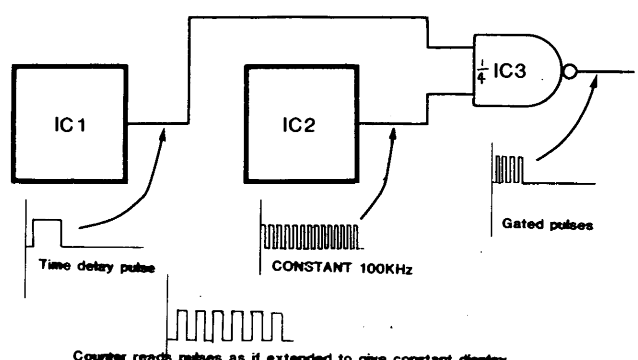
HOW THE CIRCUIT WORKS

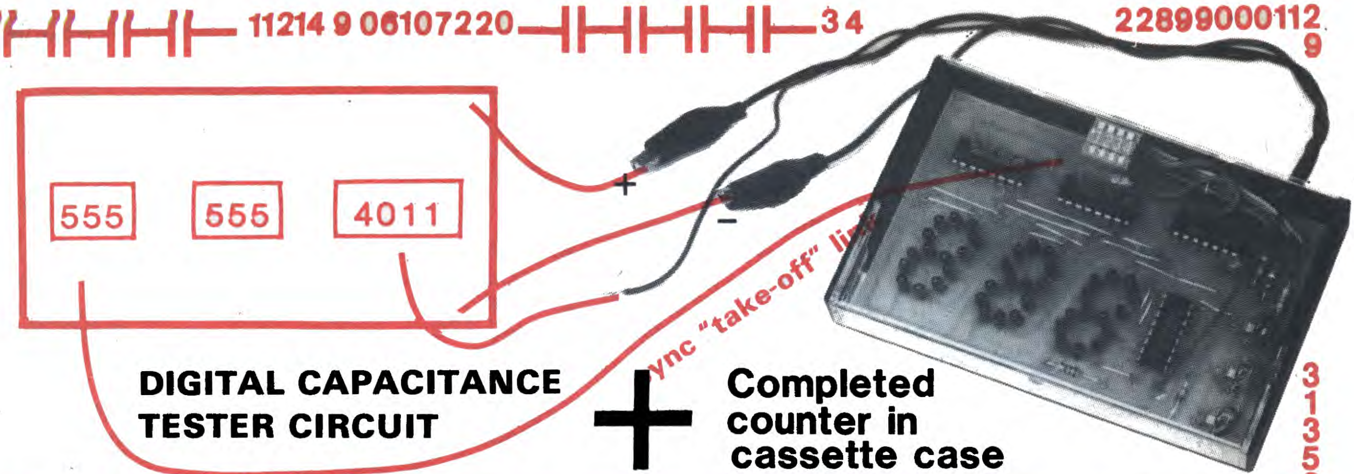
IC1 is a 555 timer arranged as a "one-shot". This is a monostable multivibrator in which the unknown capacitor provides the time delay. When the capacitor is included in the circuit, the 555 is triggered from the count-display pulse of the mini frequency counter. This keeps the two units synchronised so that the display is steady. The output of the first 555 is initially LOW and goes HIGH for a period according to the time delay provided by the value of the unknown capacitor. This is fed to pin 2 of the NAND gate contained in IC3.

The second 555 is a free running oscillator set at 100kHz. The output pin 3 constantly feeds the NAND gate and becomes our reference source. The output pin 3 of the NAND gate could be fed into the mini frequency counter for quite a successful reading except for one small problem.

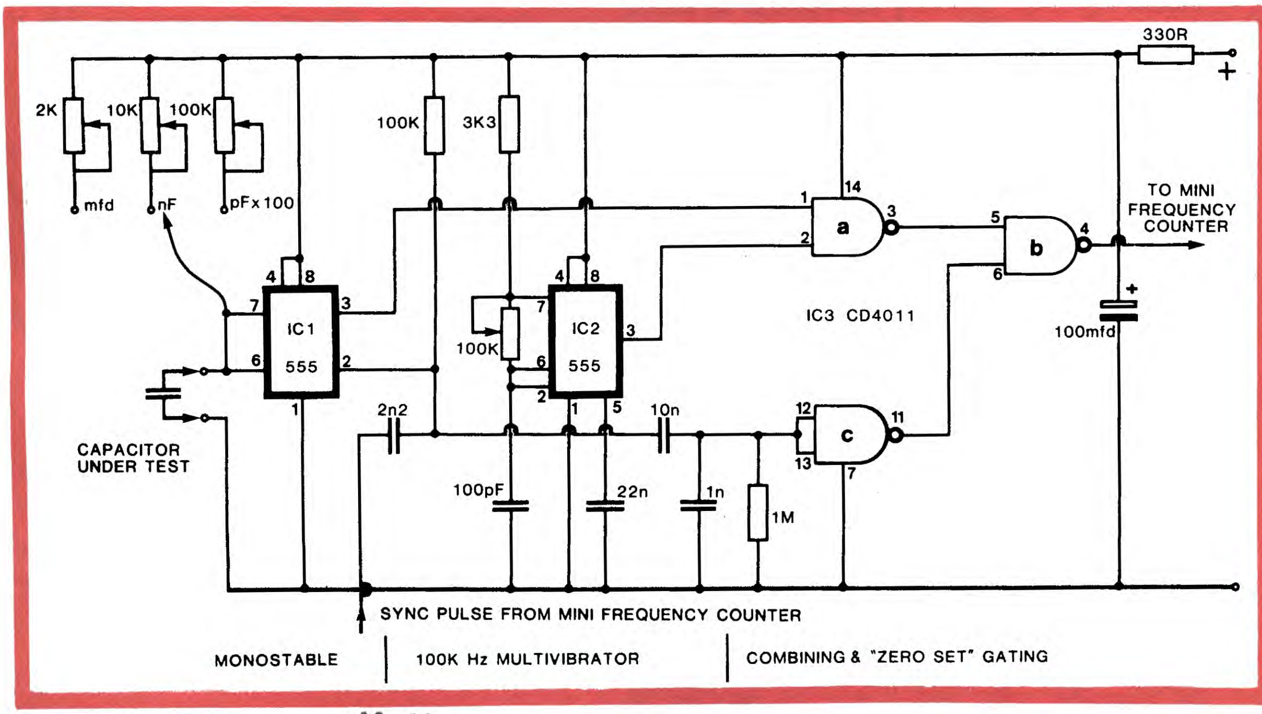
The gated 555 (IC1) is triggered into timing from pin 2. If no unknown capacitor is present at the input, the sync pulse still trips the IC and the small internal capacitance of the IC causes it to perform a short cycle. In fact a very short cycle. This would open up gate 'a' of the CD 4011 for a short time and allow a few cycles of the reference frequency to pass through. Thus we could not obtain a zero-set on the frequency counter. To overcome this problem we have gated the sync pulses out of the transmission time via gates 'b' and 'c' to obtain a zero set.

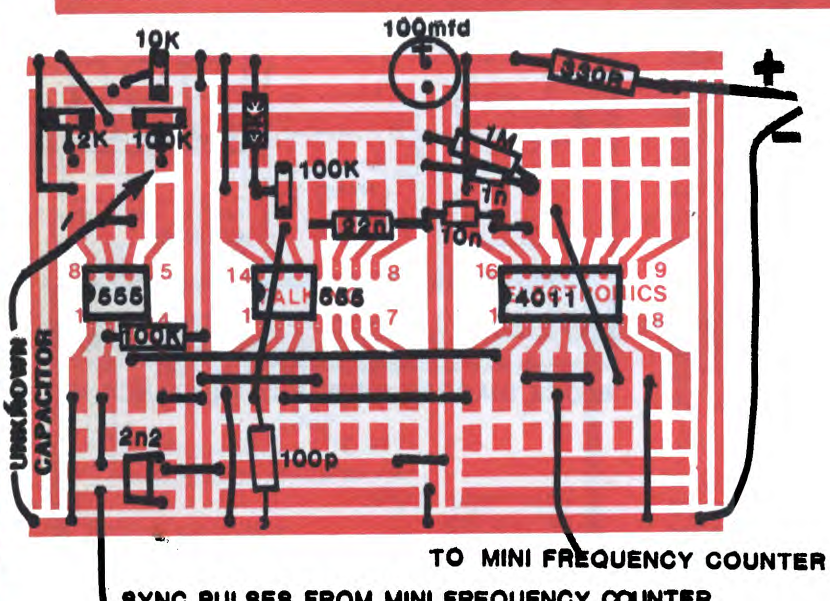
It works like this: gate 'b' will pass the burst coming from pin 3 except when the sync pulse is detected at pins 12 and 13 of gate 'c'. It is delayed and extended by the integrating network made up of the 1n and 1M components. The





DIGITAL CAPACITANCE TESTER CIRCUIT + Completed counter in cassette case





PARTS LIST

R1	Mini trim pot	2K
R2	"	10K
R3	"	100K
R4	Resistor	100K
R5	Mini trim pot	100K
R6	Resistor	3K3
R7	"	1M
R8	"	330R
C1	Capacitor	2n2
C2	"	100pf
C3	"	22n
C4	"	10n
C5	"	1n
C6	"	100mfd
IC1	555	timer
IC2	"	"
IC3	CD4011	

3 IC's PC board

Today is a new day. You will get out of it just what you put in.

result is 3 zero's on display when no capacitor is being tested.

To explain how the Mini Frequency Counter converts the pulses to a reading, we will take two examples:

Firstly we will exaggerate the count-display interval of time to make it easy to describe. Suppose the counter had a count period of one-half second and a display time of half-second. This means pulses present for the first half second will be displayed but those appearing for the remaining half second will not be counted. Now our capacitance meter sends out bursts of pulses and to prevent them overshooting into the display time, we provide a sync pulse. This means our circuit will only send pulses when the counter is ready to accept them.

Let us compare the different effects of a 1n capacitor with a .47mfd capacitor. When the 1n capacitor is being tested, the sync pulse turns on the first 555 and its output goes HIGH for a period of time to let 100 cycles of the 100kHz frequency through gate 'a' of the CD 4011. When the .47mfd capacitor is tested, the monostable time is lengthened considerably and 47,000 cycles are gated through the NAND gate. This gives the display reading of 470.

You can see that accurate timing is required and this is entirely possible with digital circuits and accurate timers such as the 555, having a linear response to RC values.

CONSTRUCTION

Our model was assembled on an experimenter board designed to take 3-IC's. All the parts fit on the top of the board and this makes designing and construction very easy. Next month we are planning to have two printed circuit boards on the front of the magazine. One will be the capacitance meter PC board and the other will be a dual tracking power supply. These are only in the planning stage and if you are wanting to make the capacitance project, it's best to start now. When the PC board comes along, you can transfer the parts across for a professional finish.

Start construction by mounting the IC's. This is not the normal sequence but in this case you will need to use the IC's as a reference for the pin numbering as we have put smaller IC's into the centre section and the third section. When fitting the resistors and capacitors, leave the leads long so that they can be soldered easily. There are 21 links on the board and these are made from tinned copper wire. Bend the ends square like a staple and hold them with a small pair of pliers.. The 4 mini trim pots fit onto the board so that they can be adjusted with an insulated screwdriver.

SETTING UP

IC2 provides the reference frequency and should be set to 100kHz. You can use the Mini Frequency Counter to adjust this frequency via the 100k mini trim pot. Connect the input of the counter to pin 3 and adjust the pot with an insulated screwdriver. Do not touch any of the components when performing this task as it will alter the frequency of the oscillator.

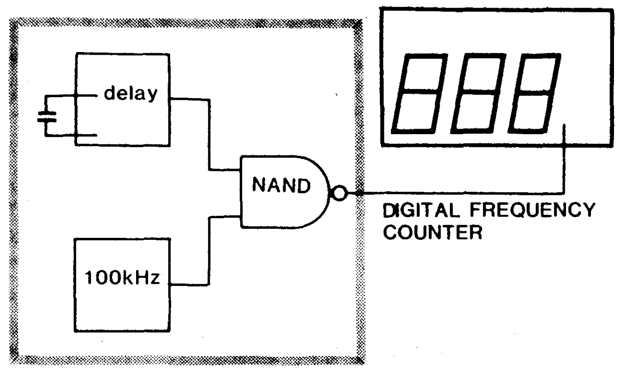
You will now need 3 capacitors of known value. They should also have a close tolerance as the accuracy of your piece of test equipment can only be as accurate as the test specimen. Try for 2% or 5% tolerance components having these values: 330pf, 3300pf 330n amd 3.3mfd. They should be either mica or polyester. Do not use tantalum or electrolytic at this stage.

Move the flying jumper lead to the first terminal to bring the 2k mini pot into circuit. This range will test capacitors from 1 to 10mfd.

Connect the 3.3mfd capacitor and turn the 2k2 trim pot until the reading is 330. If you have a 6.8mfd or a 1mfd polyester capacitor, you can double check the acuracy and linear response. Ours was spot on. Move the jumper to the mid position. This is the nanofarad range. In other words you can consider the three zeros as .000mfd. Select the 330n capacitor and set the readouts to 330 via the 10k pot. Double check the reading with the 3n3 capacitor. You should get 003 on the readout.

Finally set the jumper to the pf x 100 range, and set the readout to 33 for the 3n3 capacitor. The 330pf capacitor will read 003 on the scale. This completes the setting up. Now you can go through your parts box and test all those "odd -ball" capacitors. You may get a surprise too, seeing how widespread capacitors really are! Some types are inherently accurate while others don't come anywhere near the stated value.

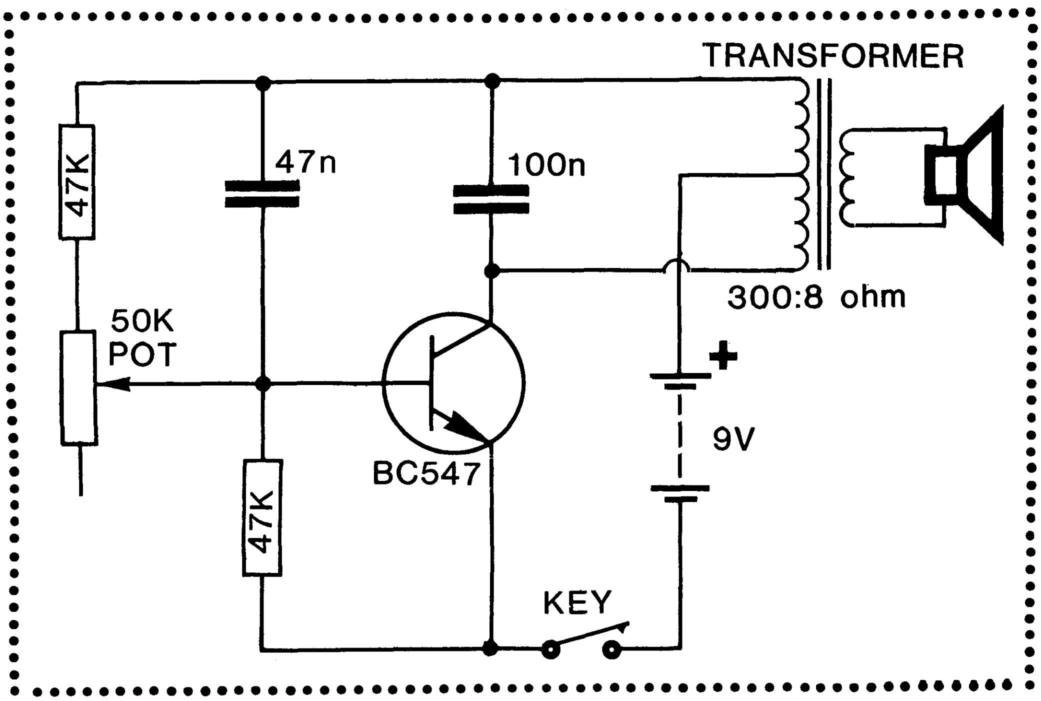
If you have any other ideas or improvements to this circuit, let us know soon. Our final design will have automatic shutdown and any other ideas will be welcomed before we get the printed circuit boards made.



BLOCK DIAGRAM DIGITAL CAPACITANCE METER

NOVICE AMATEUR MORSE CODE PRACTICE OSCILLATOR (CPO)

S Fontana



CPO Circuit

MORSE CODE

A •–
B –•••
C –•–•
D –••
E •
F ••–•
G ––•
H ••••
I ••
J •–––
K –•–
L •–••
M ––
N –•
O –––
P •––•
Q ––•–
R •–•
S •••
T –
U ••–
V •••–
W •––
X –••–
Y –•––
Z ––••

1 •––––
2 ••–––
3 •••––
4 ••••–
5 •••••
6 –••••
7 ––•••
8 –––••
9 ––––•
0 –––––

PARTS LIST

R_1	Resistor	47K
R_2	Potentiometer	50K
R_3	Resistor	47K
C_1	Capacitor	47n (.047)
C_2	"	100n
Q_1	Transistor	BC547
T_1	Speaker transformer	300:8 ohm with centre tap.

Morse code key
Battery snap
9v battery
speaker 8ohm

The biggest bug facing potential novice operators appears to be the requirement of morse code. Although various arguments have been put forward against such a requirement, the regulations still stands and a novice operator must be proficient in CW (morse code) at a speed of five words per minute. The only way to achieve this speed is a lot of determination and practice.

Numerous cassettes are available which allow you to listen to Morse Code up to 12 words per minute and if you have a communications receiver then you can listen to slow morse transmissions. Both these methods will teach you good reception but you also have to be able to send. For this you need a morse key and an audio oscillator. You can then practice your speed and also tape yourself so that you can pick faults in your own transmission.

Morse keys are available from $5.00 upwards, and although audio oscillators can also be purchased, a simple, efficient oscillator can be built in a short time from odds and ends you probably have laying around.

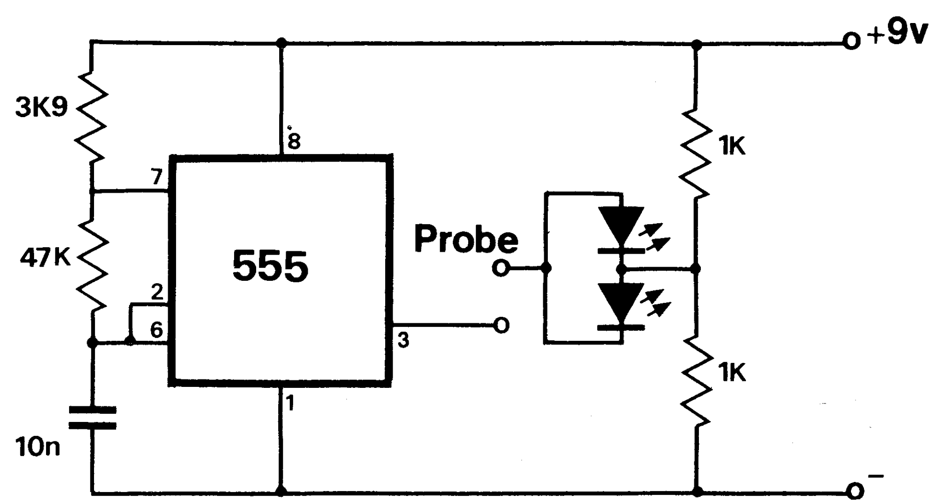
The morse code circuit is a blocking oscillator. Parts from an old transistor radio can be used for the speaker transformer, and speaker. The transformer should be a centre-tapped type. If the oscillator does not start-up, reverse the two primary leads.

Never search for a complicated solution when a simple answer is at hand.

DIODE TESTER & BLACK BOX PUZZLE

KEN STONE

Cost: $2.50



DIODE TESTER

Circuit diagram of the Diode tester/Signal injector

DIODE TESTER

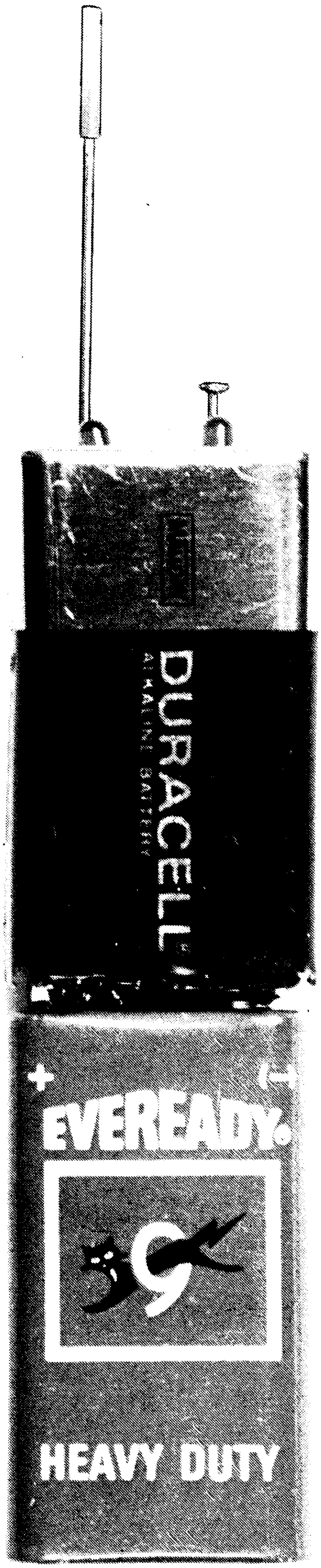
Would you believe this project has three uses?

Taken in order of priority, our circuit can be used as a singal injector, diode tester, and a black box puzzle.

The puzzle idea sounds interesting, let's look at it. From the photo you can see the completed project is housed in a small metal container having a couple of terminals on one end. Now the object of the game is to ask someone to guess the contents of the box. You are allowed to give only a couple of clues. I suggest you try this with only "qualified" electronic experts as the thinking required to put out a suitable circuit is quite involved. The only information you are permitted to give your opponent is a demonstration. By placing a diode across the two terminals on the top of the case, one of the LEDs will illuminate to indicate the cathode end. Apart from this, nothing else need be said, except that a short circuit will illuminate both LEDs. Obviously you cannot open up the case as this will defeat the object of the game. You will be pleasantly surprised to find very few people capable of producing a suitable circuit as their first thoughts will be of a pure DC nature. Once they realise this arrangement is unsuitable, most of them will give up. You can then show them the contents of the case.

As the circuit is called a diode tester. we had better describe how this came about. The author, being a money miser, bought a lot of computer circuit boards from bargain centres and these contained lots of diodes. To save testing each diode individually for performance and cathode identification it was a simpler matter to place them across two terminals to give both answers at the same time. Thus the compact diode tester was developed.

As a side issue, a probe was fitted to the end of the case so that it could be used as a signal injector. This bonus has proven very handy. We have used it on three occasions to trace through a pocket radio, an amplifier and a car radio. The square wave output will pass through all stages of these sets and will give a loud buzz in the speaker. This means you will have to start any diagnosis at the output end of the amplifier and work towards the front end. As you move through each stage, the resulting tone in the speaker will increase. A drop in



volume will indicate a fault stage. These units should be used in conjunction with other test equipment and preferably a circuit diagram. However they will make your job a lot easier if the circuit is unobtainable.

Your hand and body act as an earth for the oscillator and it can be probed into almost any part of the set without damaging either the oscillator or the radio. Since the bleed current and the 555 current is fairly high, it is suggested that the battery is removed after each use. Otherwise the 9v battery will last but a few days.

We haven't given any detailed construction notes for this project. The enlarged photos speak for themselves. Any values of resistors will be suitable for the oscillator provided they are near to the values suggested.

A printed circuit board has been created for the project and this enables you to mount the whole assembly inside a battery case. A really neat idea.

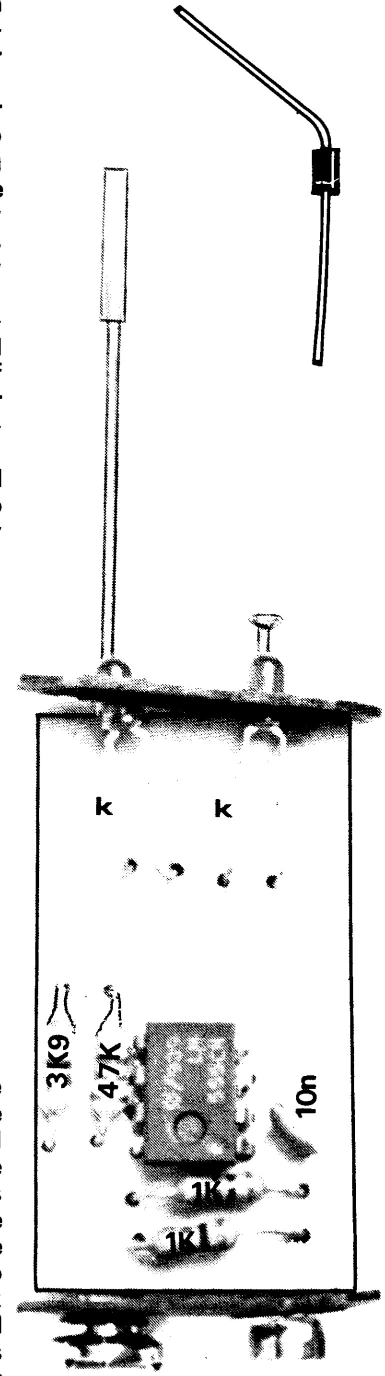
PARTS LIST

R1	resistor	3k9
R2	"	47k
R3	"	1k
R4	"	1k
C1	capacitor	10n
IC1	555 timer	
LED 1	3mm red LED	
LED2	3mm red LED	

salvaged 9v battery case
large pins to be used as terminals
large needle to be used as probe
9v battery
DIODE TESTER PC board

HOW THE CIRCUIT WORKS

The 555 IC is wired as a square wave oscillator running at about 2kHz. A square wave is rich in harmonics and when injected into a radio or amplifier, will produce a tone in the speaker indicating that the set is operating. This same square wave can be rectified by a diode placed between the output pin and rail to light one of the two light emitting diodes. The two output 1k resistors provide a voltage divider as well as a load resistor to give the LEDs its correct operating voltage. You can see that both LEDs will light if the diode under test has a short circuit. This is due to the AC from the 555 being passed to both LEDs. This circuit puts a 5mA current through the diode and very small point-contact diodes should not be tested. Other than that any diode can be tested.



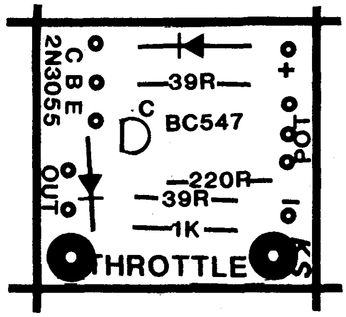
COMPONENT LAYOUT

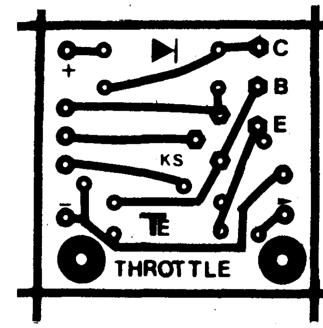
Procrastination is the thief of time.

Train Throttle

Ian Bird 4054
& K Stone 3192

PART 2





As promised, we have produced a Printed circuit board for the train throttle in issue 5. The interest shown by model enthusiasts has encouraged us to provide a number of model projects which are currently in the pipeline.

This circuit is suitable for simple layouts containing virtually no sets of points, so that no reverse loops are created. The output is preset via the 220R and 39R resistors and will suit almost any type of locomotive. It has one slight disadvantage. It lacks overload protection. Build this simple controller first and test its performance. If you find it is too limited, see our next improved circuit.

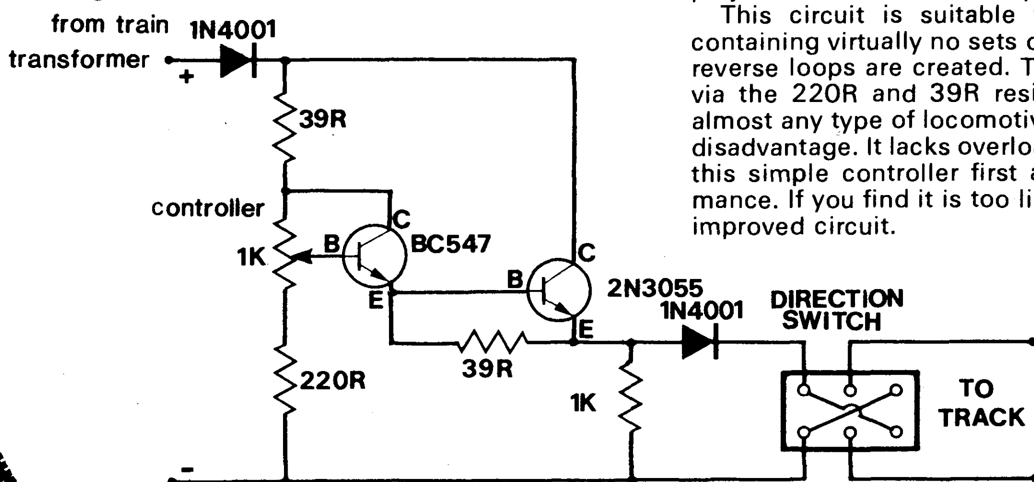
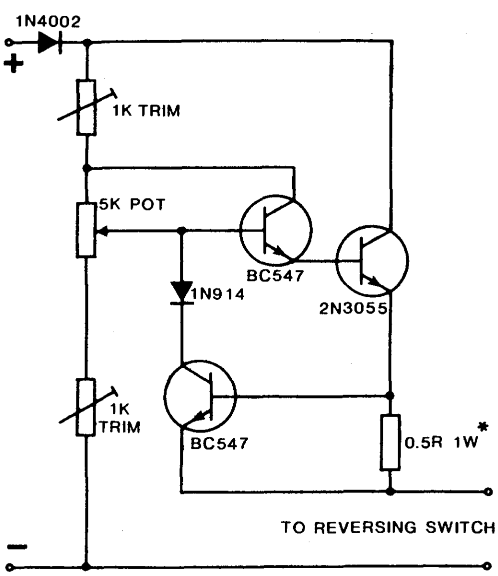


Figure 2 is an improved circuit and will be followed up next issue with a PC board. You will notice an extra BC 547 transistor has been included. The first problem you will encounter with complex loop layouts is the formation of reverse loops. This occurs when a side track is taken off the main track and brought back again at a point prior to the take-off point. This effectively reverses the rail polarities and requires careful layout planning. You may find 2 or 3 throttles will be required for involved layouts - one for each section. This is where model railway becomes involved and expensive. See how you can manage with one unit.

The top 1k trim pot sets the maximum speed and the bottom trim pot sets the start-off voltage. This is handy as different locomotives have different characteristics. Should a short circuit occur due to a train derailment or loop problem, the voltage across the R5 resistor (½ohm) will rise and turn on the lower BC 547 transistor. This will reduce the base voltage of the driver BC 547 and thus shut down the 2N 3055. The current level at which this occurs depends on the value of this special resistor. We suggest using 4 x 2R2 resistors in parallel, although a couple of 1 R resistors will do the same job. The choice of resistors allows us to adjust the value of the maximum current from ½ amp (using a 1 R 1 watt resistor) to 1.5 amp (using 3 x 1 R resistors). This will depend on the rating of the power transformer. The 2N 3055 will need to be mounted on a heatsink since the "roll off" point will range from .5 amp to 1.5 amp and the transistor will get very hot.



* see text

TV Servicing

This month we concentrate on the AWA model 3500 colour TV chassis. This set was the first fully transistorised set to be released on the market employing the PAL-D system. It is now 10 years old and quite noticeably shows the advancements made in module construction over the past decade. In some respects the design is still ahead of some of the current range of sets. The advantage of the 3500 construction means every component is located on a module leaving no components behind in the cabinet. This is by far the best approach to designing a set. The idea of a mother-daughter board in which modules plug into a base board is not a good idea. So often we have found the faulty component to be one of the few remaining parts on the mother board, defeating the purpose of a modular system.

Since these model 3500 sets were fairly popular and used by large rental companies, they are quite often seen in Auction rooms and second-hand shops.

Although they do NOT represent a good investment for viewing purposes, they are quite suitable for experimenting. These notes refer almost entirely to this model as every make of set uses a different circuit for the power supply section.

We have previously detailed the Switch Mode Power Supply for the Luxor set. The AWA also uses a "switched" power supply but of an older design. It starts-up much slower and and has a lower regulation performance and in general has a lower rate of breakdown.

Even so, we have carried out suffient repairs to this type of power supply to be able to help others to locate some of the more common faults. The first thing you will notice with the power supply module is its very awkward attachment to the main frame. Once the module has been extracted, open out the back clips so that it can be inserted and withdrawn with ease. You will notice the module consists of two printed circuit boards which have been wired in-situ making repairs very difficult. We overcome most of this trauma by cutting the components off the board and soldering onto the remaining short leads.

There are only about 5 regular faults with this module, and once these are known, its not so bewildering.

Its an interesting points to note: We have never had a blown fuse on any of these modules, even though they contain 4 safety fuses. This emphasises the worthlessness of fuses in electronic circuits. Even when parts short-out in the supply, the mains fuse has never reacted. The 2 amp cut-out on the back of the set is generally triggered by a crow-bar thyristor to turn the set off. Any intermittent faults are best left to run their course until the supply fails completely. This will make it so much easier to repair and reduce the frustration enormously.

This is the order in which we approach a repair on the module:

1. VT608 is a "TIP" type transistor mounted on the right hand side of the module frame. Use a TIP31A with its centre lead cut off.

2. W605 is located at the top right hand corner of the module. It is a large zener diode with a flag heat sink. Use 2 x 15v 1watt zener diodes in series. The flange on the old diode is the cathode and by cutting the leads carefully, the new diodes can be attached to the top of the board via the old leads. Solder a flag to the centre of the two new zener diodes for heat dissipation.

3. VT 604 is the chopper transistor. Use eithera BU 126 or 2SD 350A or any type with ratings in between. We have found it fails for no apparent reason. The top PC board will have to be loosened to remove the transistor.

4. Diode 610 is a 1N4002. It is mounted just below the driver transistor containing the finned heat sink.. It goes intermittently open.

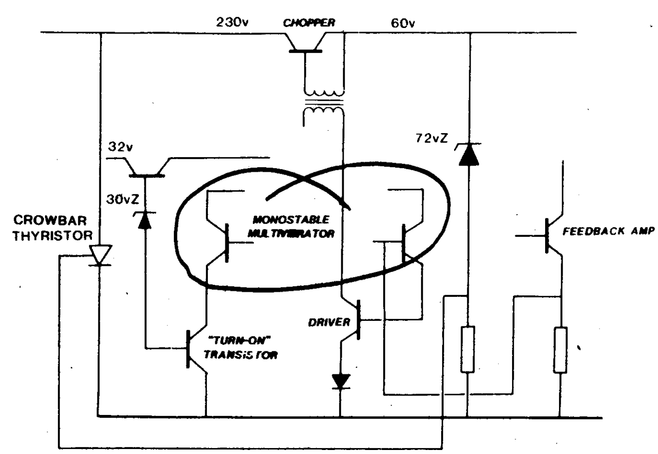
5. C 607 is 1,000mfd 63v electrolytic mounted in a clip on the top side of the module. These can go open or dry out.

Other components fail on a less frequent basis and to locate them you will have to know a little bit of how the circuit works.

Without using a highly technical approach, this is

HOW THE CIRCUIT WORKS

When the set is switched on, 230v and 32v appears as shown in the block diagram. The 400mfd electrolytic C609 charges to turn on the 30v regulator transistor and the anode end of the 30v zener diode W605 switch the "turn-on" transistor into conduction. This enables the multivibrator consisting of VT 603 and VT 606 to start up and feed the driver transistor VT 605 which is transformer coupled to the chopper transistor. The mark-space ratio of the multivibrator is adjusted via the feedback voltage and this sets the high tension voltage to about 60v. The multivibrator is kept in operation by pulses from the horizontal output section via line 3/2. Two sensing trips are provided in the circuit which have a "crowbar" effect. The main thyristor shorts the 230v line to deck and trips the circuit breaker. This occurs when the 72v zener diode senses 72v since the excess voltage above 72v will appear directly across the resistor in its anode line and this will trigger the thyristor. The other thyristor shorts out the pulses from the driver transistor To date, we have never had this thyristor take any action on clamping the circuit.



3500 POWER SUPPLY BLOCK DIAGRAM

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☐ 33R	☐ 2k2	☐ 270k
☐ 39R	☐ 2k7	☐ 330k
☐ 47R	☐ 3k3	☐ 390k
☐ 56R	☐ 3k9	☐ 470k
☐ 68R	☐ 4k7	☐ 560k
☐ 82R	☐ 5k6	☐ 680k
☐ 100R	☐ 6k8	☐ 820k
☐ 120R	☐ 8k2	☐ 1M
☐ 150R	☐ 10k	☐ 1M2
☐ 180R	☐ 12k	☐ 1M5
☐ 220R	☐ 15k	☐ 1M8
☐ 270R	☐ 18k	☐ 2M2
☐ 330R	☐ 22k	☐ 2M7
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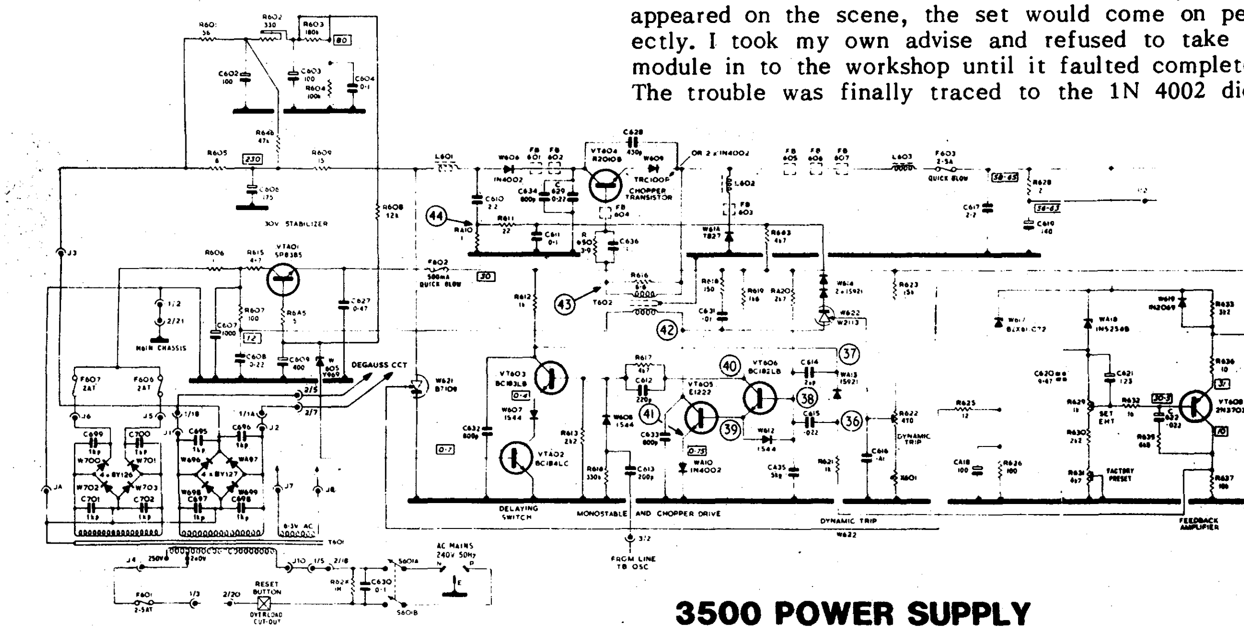
TESTING POWER SUPPLIES

This may come as a surprise. I consider the most dangerous part of repairing a TV is replacing the fuse. I have received more annoying bites when fitting a fuse than all the other operations put together. Even though the power plug may be pulled from the wall socket, the main electrolytic in the power supply can be fully charged even hours after the fuse has blown.

The fuse can generally be removed with the aid of a screwdriver but re-insertion must be with your fingers to avoid smashing the glass tube. This is where the danger comes in. One end of the fuse will have a high potential while the other will be low. And Zap! So don't forget to short across the end-clips before removing a blown fuse.



3500 POWER SUPPLY

the possibility of the supply blowing up again.

I can well remember the first time I had to service one of these modules. The hiddeous mess and difficulty of repair put me off for quite some time. It was only afer a few of the bugs were ironed out, that I was prepared to tackle one of these problem sets in the home. A Change-over service does exist from time-to-time but the added inconvenience of sending in your module before receiving a replacement means an extended delay and makes the final repair very expensive. The more jobs you can carry out in the home, the higher will be your return along with a greater satisfaction.

As is always the way, the first fault with a 3500 power supply was an intermittent fault. The set would sometimes refuse to come on. However every time I appeared on the scene, the set would come on perfectly. I took my own advise and refused to take the module in to the workshop until it faulted completely. The trouble was finally traced to the 1N 4002 diode mentioned in point 4 above and to my surprise, has occured on two other occasions.

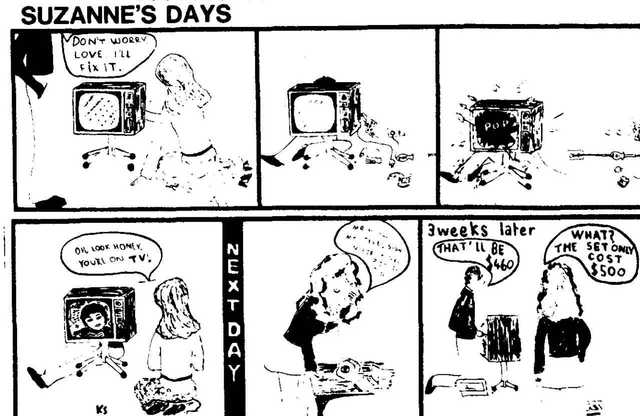
I hope this list of points helps you in diagnosing your faulty module.

This just about brings me to the end of power supply faults. Next time I will move to the other end of the signal and describe how you can locate faults by looking at the built-in CRO, the picture tube.

With the most dangerous part of servicing understood, the actual repair of the power supply module should be done the aid and safety of an isolating transformer. This may be feasable in the workshop, but what about repairs in the home? I know of not one technician who carries a large isolating transformer with him in the car. So obviously he must take added precautions to avoid shock, just like me. All pliers and tools are of the well-insulated variety and any soldering iron or CRO must have the earth pin physically removed so that they are isolated from the mains as far as earthing is concerned. This is most important on hot-chassis sets such as Blaupunkt, Siemens, Nordemende, and Finlux as the chassis will be at least 120v above earth. Fortunately the 3500 chassis has a mains transformer supplying a set of rectifying diodes so the chassis will be at earth potential in this case. Still the same, it is better to be careful at all times. Never forgetting my first rule of safety: Put only one hand at a time into a set.

For the cost of replacing the 5 components we have singled out, you can perform an overhaul on the power supply at very little cost. Before the unit is switched on, it is also wise to check the forward and reverse "resistance" of all the other zener diodes to reduce

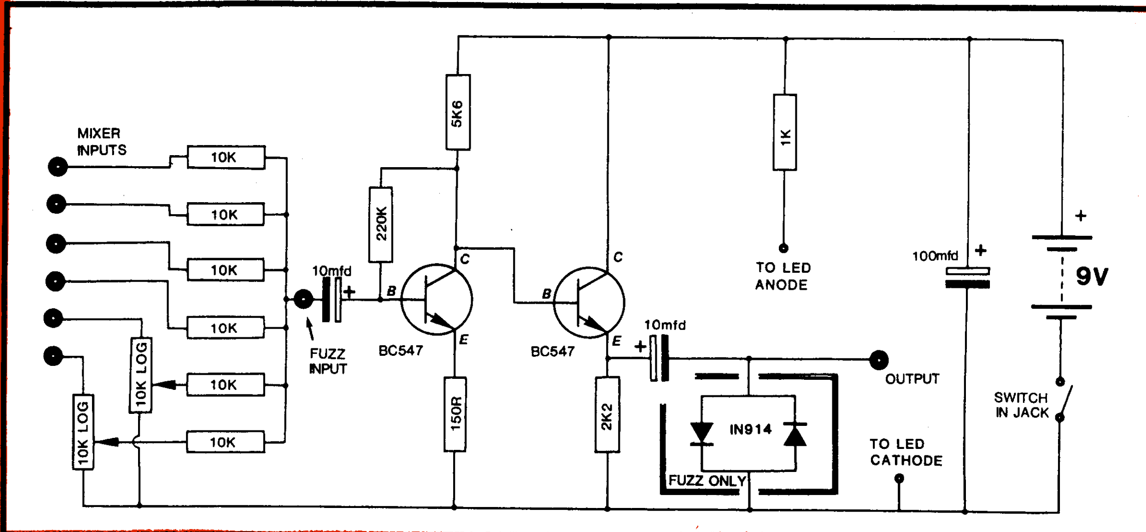
SUZANNE'S DAYS



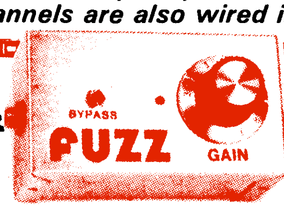
Many a man who thinks he is a free thinker is only a free talker.

TRANSISTOR PAGE

MINI MIXER & FUZZ UNIT



The circuit diagram for the Mini Mixer and the Fuzz unit. The diodes are included in the fuzz version only. For clarity, only two volume pots are shown in the diagram. The other four channels are also wired in the same way.



MINI MIXER

This mixer is handy for those practice sessions where there are SIX instrumentalists and only TWO input jacks!!

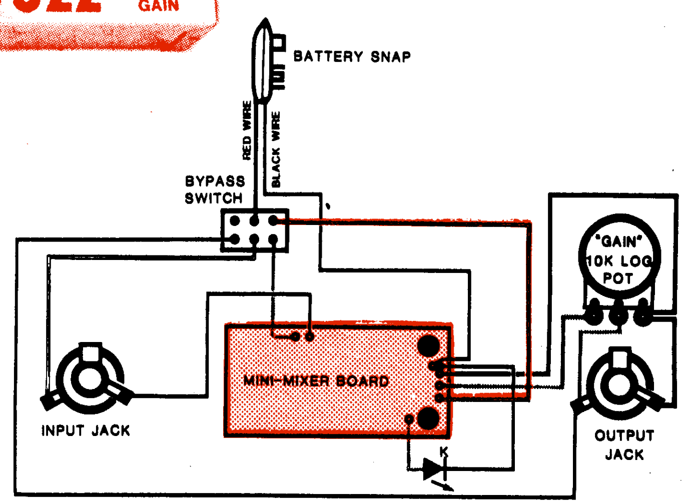
The circuit of the Mini Mixer can be divided into three sections: the passive mixer, the pre-amplifier, and the fuzz circuit.

A signal at the input of the mixer is attenuated by the 10K log pot, which is wired as a voltage divider and is fed into the mixer (which consists of the 10K fixed resistors).

The preamplifier can be divided into two sections, the first transistor is a common-emitter amplifier, and the second transistor is an emitter follower.

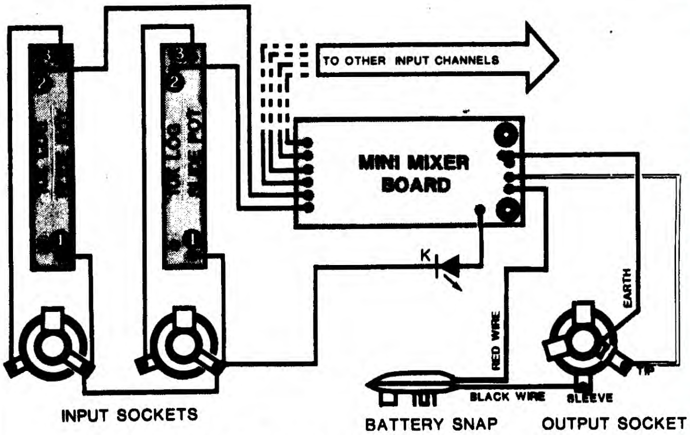
The overall gain of the Mini Mixer, with its inputs at full volume is about unity.

In the fuzz version of the circuit, the passive stage is omitted, and two diodes are added across the output of the preamp. With the guitar at full volume the amplifier is overdriven and distorts. The distorted signal is then clipped by the diodes. Across each diode is a voltage drop of about .7 volts so when a signal greater than this is placed across the diodes, the voltage in excess of .7 is taken to ground.

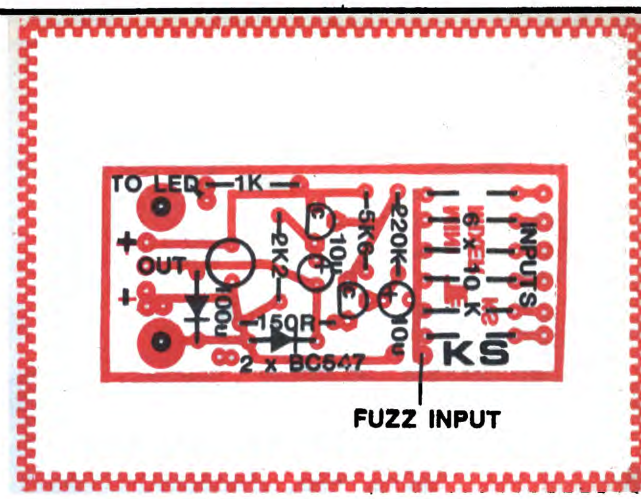


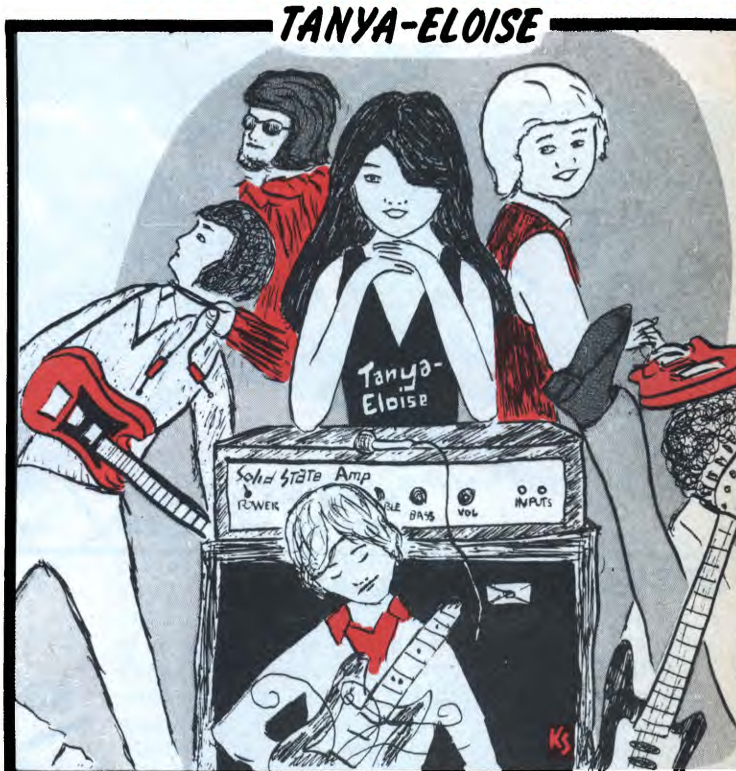
FUZZ UNIT WIRING

Mount the fuzz unit in a metal case to keep radio interference to a minimum.

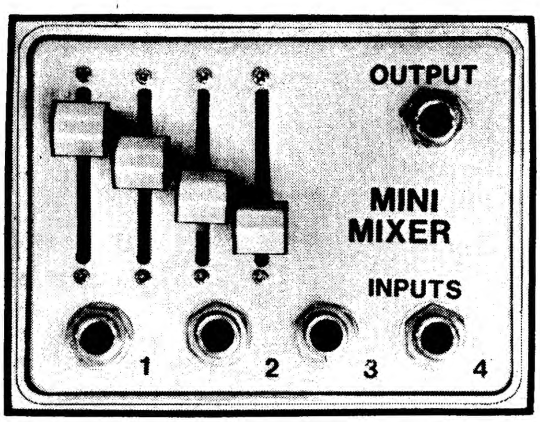


MIXER WIRING





"You see, there are only two input jacks!"



CONSTRUCTION

For the mixer version, construction is straightforward. Omit the diodes. The output jack is a stereo jack, and it is used to switch the power on, when a plug is inserted into it. To achieve this, the negative terminal of the battery is connected to the earth pin of the jack.

When a MONO plug is inserted in this jack, it shorts the sleeve to the earth connection, completing the circuit. If a stereo plug is inserted, nothing will happen.

For the fuzz version, omit all the 10K resistors and follow the wiring diagram. The power switch has been incorporated in the "effect bypass" switch, but a stereo jack could be used, as in the mixer version.

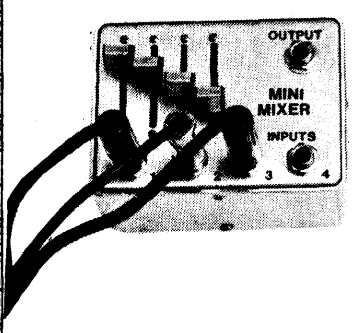
If you desire to use the unit as a preamplifier, connect your signal to the fuzz input, and omit the 10K resistors and the diodes. If it is necessary to connect the preamp to a supply other than a battery, add a 56R resistor between the positive rail of the board and the power supply. Do not try to run the preamp on a voltage above 15v.

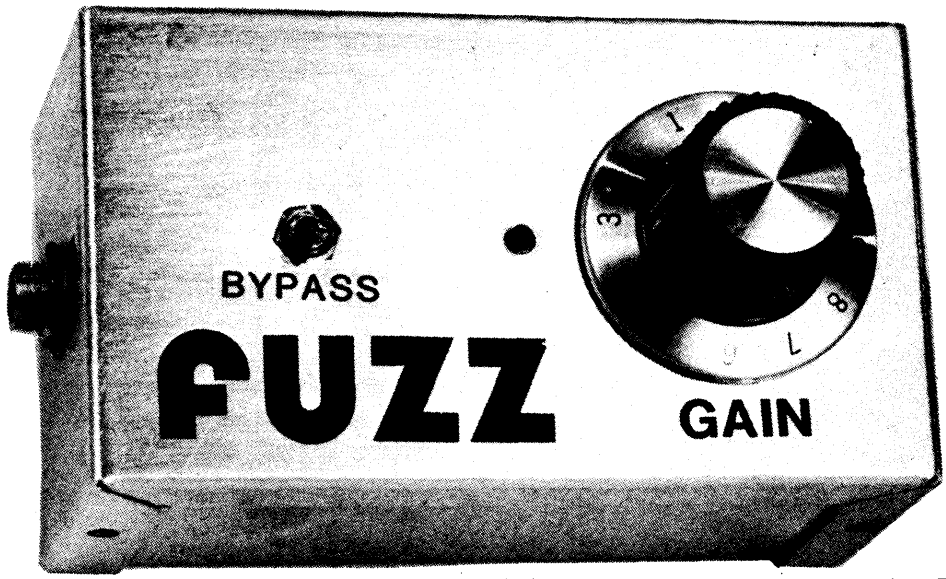
PARTS LIST

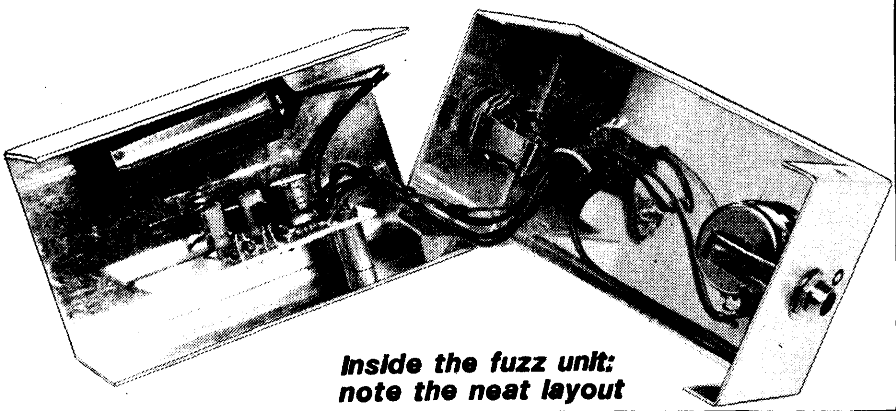
R1 - 6	resistor	10k	
R7	"	220k	
R8	"	5k6	
R9	"	150R	
R10	"	2k2	
R11	"	1k	
C1	electrolytic	10mfd	16v
C2	"	10mfd	16v
C3	"	100mfd	16v
Q1	transistor	BC547	
Q2	"	BC547	
D1	diode	1N914	
D2	"	1N914	
LED	5mm red led		
Pots 1-6	10k	log sliders	

Success is the achievement of what you set out to do.

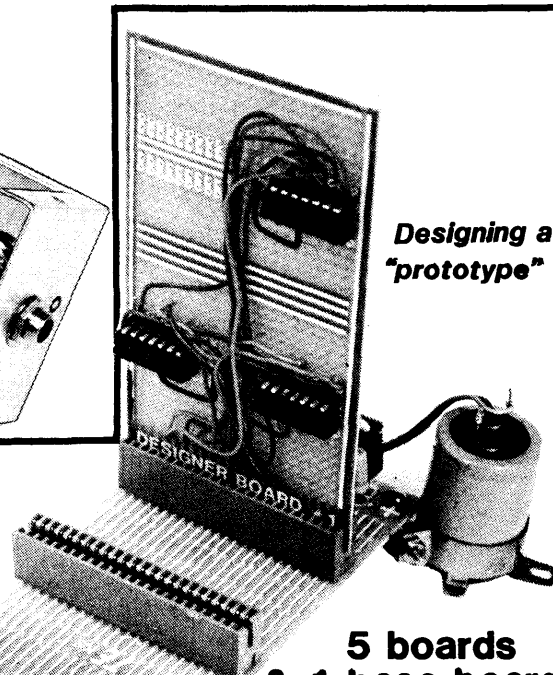
MINI MIXER & FUZZ







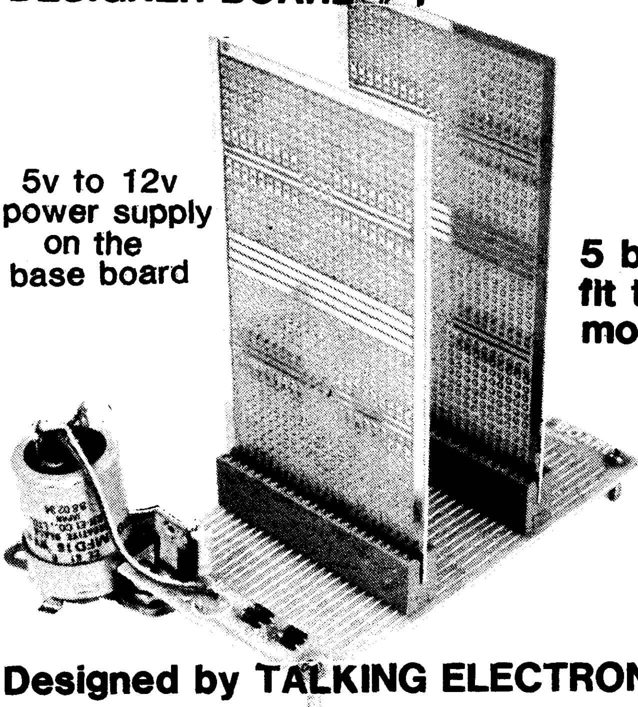
Inside the fuzz unit: note the neat layout



Designing a "prototype"

DESIGNER BOARD #1

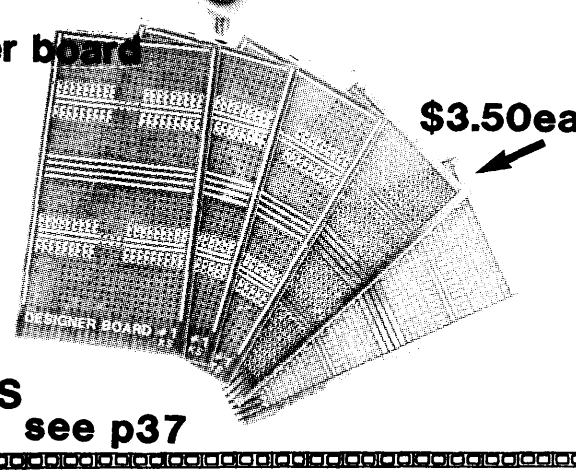
5v to 12v power supply on the base board



$3ea

5 boards & 1 base board $18

5 boards fit the mother board



$3.50ea

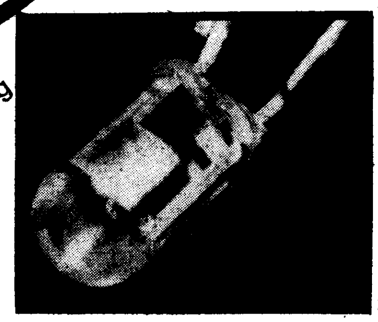
Designed by TALKING ELECTRONICS

see p37

FLASHING LEDS

from a Dick Smith catalogue

by Colin Mitchell
& Paul Jones
inspired by Dick Smith



New Blue Led
When will we get flashing green and blue leds?

With the recent price-tumble for flashing LEDs, we couldn't resist investigating these little wonders. With a little experimenting we came up with these useful circuits. Try a couple for yourself, they produce an interesting effect with very few components.

One of the most amazing features of the flashing LED is the size of the chip performing the flashing function. When you look inside the opaque shell a tiny square speck is visible on the end of the anode lead. With the aid of a strong light and a sharp pair of eyes you will be able to see two fine wires connecting between the chip and the two other leads inside the LED. These wire up the chip to the light emitting diode. Don't bother to explore any further into the construction of the LED by opening up the plastic package...... you won't get past first base. We tried and found the chip to be contained inside an epoxy package. The silicon wafer was layered and far too microscopic to see any detail. So far we have been unable to obtain any further details on the construction of the chip.

The other astonishing feature of the flashing LED was detected by accident during our experimenting.

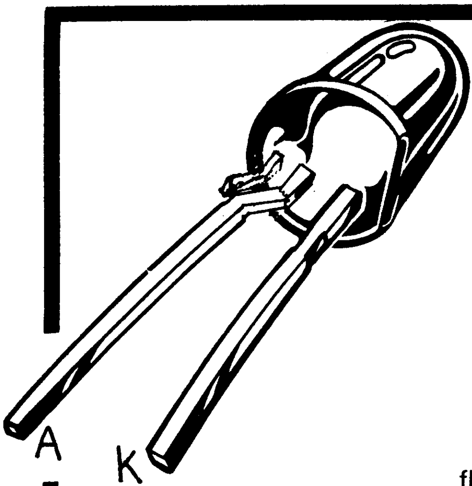
We were just finishing the alternate flashing circuit when we brought the overhead light closer to the birds-nest of wiring when we noticed the pulse rate changed slightly. Then all of a sudden the ammeter in the line with the circuit fell back to zero and the circuit stopped working. The silicon chip inside the flashing led was light sensitive! From an average current of 10mA it suddenly dropped off to 10 microamps. A truly amazing reaction. Unfortunately we have not been able to make any use of the phenomonen as the 60 watt lamp had to be within 10cm of the LED.

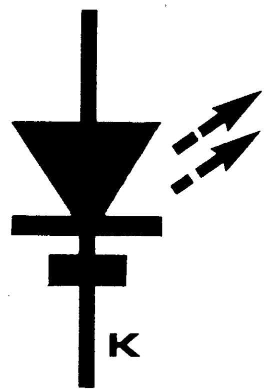
PULSE RATE

Under normal conditions the flash rate is about 3 flashes per second. (3PPS). This is the minimum flash rate and it coincides with a supply of 5v. If the voltage is reduced or increased above this value, the flash rate increases. It is also increased if an electrolytic is placed across the series dropper resistor.

Simply speaking you can treat a flashing LED exactly like an ordinary LED. The only difference is its minimum working voltage. Flashing LEDs prefer a voltage around 5v although they will operate quite satisfactorily on a voltage as low as 3v. They can be put into circuits using normal LEDs to give a rather startling result. The SHELL GAME described later in the article uses a flashing LED in this situation.

Blessed is he who gets what he likes, but more blessed is he who likes what he gets.

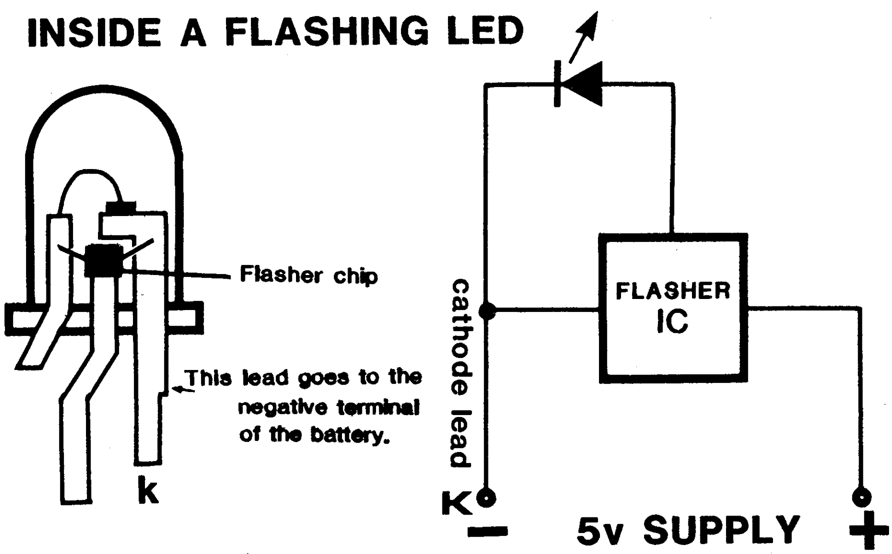


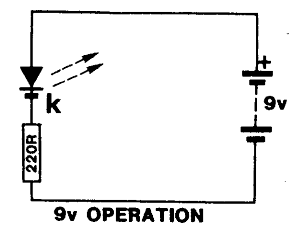


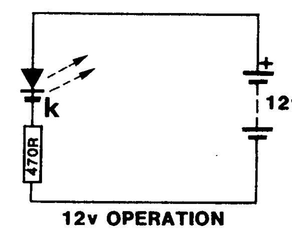
COLIN's still trying to light the LED

This is our schematic representation of a flashing LED. Note the dashed arrows to indicate the flash and the block below the cathode representing the chip.

INSIDE A FLASHING LED



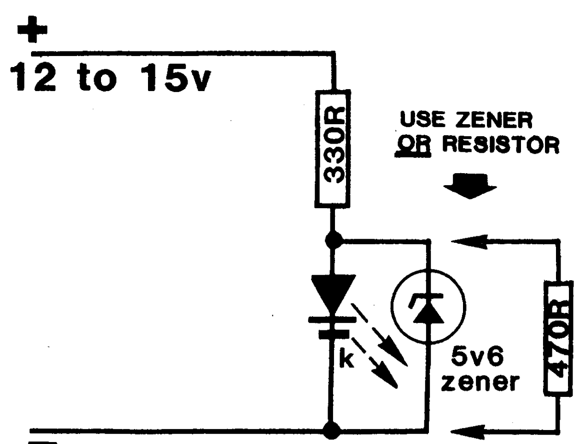




USING A FLASHING LED ON HIGH VOLTAGE

The recommended voltage for a flashing LED is 5v. The manufacturers have designed for this voltage so that the LEDs can be directly coupled to either TTL or CMOS circuits without any additional components. The chip contains an effective 220 ohm resistor to provide the LED with 1.7 volts. Since the flasher chip is connected across the two input leads the maximum direct voltage should be 7 volts to prevent overloading. For operation on voltages higher than 6v, a dropping resistor should be included in one lead. During the OFF periods the voltage across the chip will be full rail voltage. If you experience faulty operation of a flashing LED, you can insert a 5v6 zener diode across the LED. If you don't have a zener diode, a 470 ohm resistor will provide nearly the same effect.

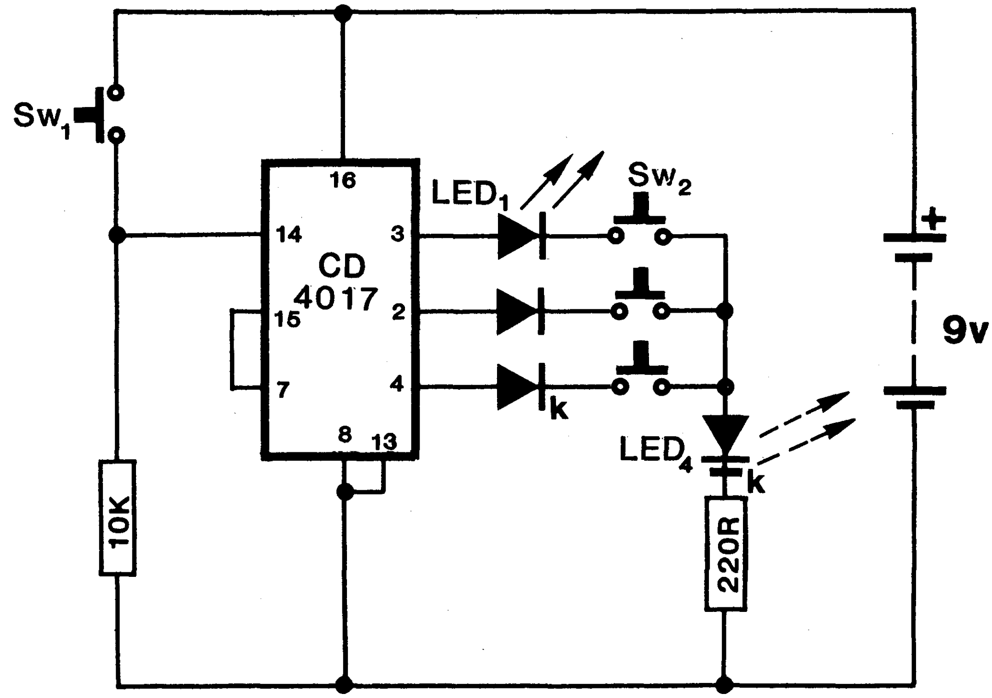
We tested 3 flashing LEDs on a 15v supply with a suitable dropping resistor and found them all to flash at 3Hz without damaging the chip.



12 TO 15v OPERATION

SHELL GAME

P. Jones



SHELL GAME

THE SHELL GAME

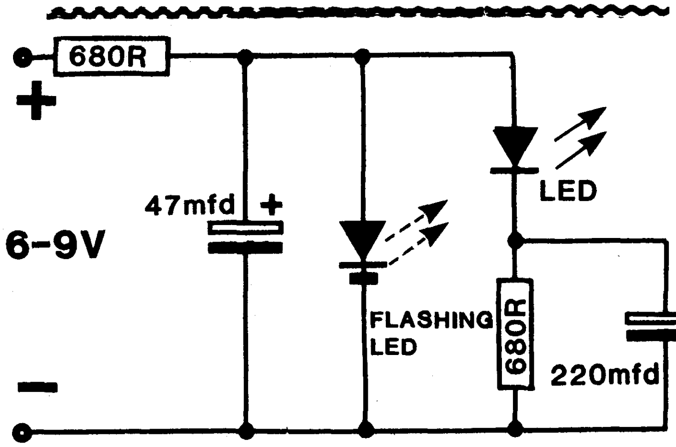
The Shell Game is a centuries old con game. It originally used 3 half walnut shells and a dried pea. The pea was placed under one of the shells and they were shuffled past one another. A bystander was lulled into watching the shells and asked to choose which shell contained the pea. He was invariably wrong.

We have produced a simple electronic version. The three walnuts are replaced by 3 push switches, the shuffling motion performed by the IC, and the pea by the 3 LEDs.

The clocking of the decade counter IC is obtained by the noise content of the push switch. Since it has no debounce network, the IC will clock a number of times according to the amount of noise it receives from the switch. This will give a completely random readout. The first three outputs of the CD 4017 connect to red LEDs and three push buttons. The cathodes are connected together and pass to a flashing LED and dropper resistor. This circuit is designed for 9v operation, it will not work on voltages below 6v as the voltage drop across the components is at least 6v.

By pushing Sw1, the decade counter will clock several times as a result of noise pulses from the push switch. By pressing one of the three switches Sw2 to Sw4 you will detect which LED is activated.

The arrangements for circuit construction will be left to you. One section of an Experimenter board could be used to mount all the components. Two readers fitted their designs onto the top of a small Zippy box, in place of the aluminium lid, the flashing LED itself is not visible to the players. It is intended purely as an activating medium to flash the ordinary LEDs.



LEDS FLASH ALTERNATELY

FLASHING SPEED DEPENDS ON APPLIED VOLTAGE

A flashing LED can be made to flash alternately with an ordinary LED to give a result similar to railway boom-lights. The secret of this operation is the top 680 ohm resistor. When the voltage is applied to the circuit the electrolytic is uncharged and provides a low pass for the ordinary LED. As the electrolytic charges, the LED gradually fades and draws less current. The voltage across the flashing LED increases and it turns on. After a short time it turns off. This allows the other LED to light again. The flash rate for this circuit is fixed at about 3Hz. If you wish to have a lower flash rate, use our next circuit.

Life is so short - the faster we work the more behind we get.

MAKING YOUR OWN FLASHING LED

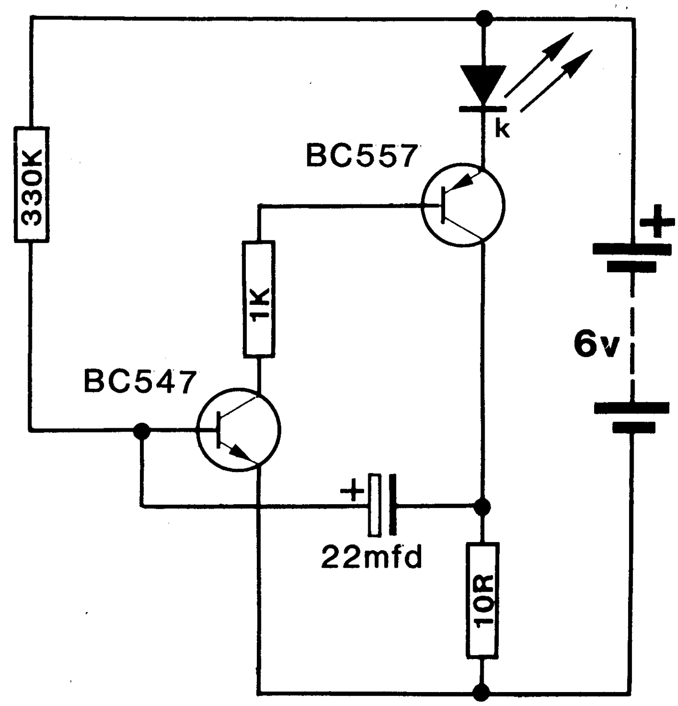
You can make your own flashing LED with the help of a couple of transistors, 3 resistors and an electrolytic. This circuit has a couple of advantages over the intergated flashing LED unit. It pulses the LED with a higher peak current to give a brighter illumination and by adjusting the on/off ratio, it will consume about 1mA average current. This means it will work for a very long time from an almost exhausted battery and will effectively cost you nothing to run. A couple of ideal arrangements for this unit involves deterrent alarms around the house or in the car. They can be left on indefinitely as a warning to possible intruders. Place the LED in an obvious position near the front door or under the dash with a sign saying "alarm activated when flashing". It could also be used as an indicator for battery powered equipment due to its small current consumption.

The operation of the circuit is as follows:-

When the battery is connected, both transistors are turned off and the electrolytic charges via the 330k resistor. The 10 ohm resistor completes the circuit. When the base voltage rises to about .6v (this is the same as saying the electrolytic charges to .6v) the BC 547 turns on and its collector-emitter voltage drops to turn on the BC 557 via the 1k resistor. This illuminates the LED and produces a voltage drop of 2v across the 10 ohm resistor. The electrolytic now sees 2v on its negative lead. This is, in effect, a reverse-voltage to the electrolytic. The .6v charge on it is added to the 2v from the negative lead and this tries to put 2.6v onto the base of the BC 547 transistor. But since the base cannot rise to more than about .6v, the energy in the electrolytic is used up in trying to provide this turn-on voltage. There comes a point when it can no longer supply sufficient current and the transistor "turn-on" is reduced. This action is passed to the BC 557 where the current through the collector circuit is reduced and the voltage across the 10 ohm resistor is reduced slightly. This lower voltage is passed to the base of the first transistor to have a dramatic effect in turning it off. Very soon the chain reaction turns both transistors hard off. The voltage remaining on the electrolytic is about .3v and this is slowly increased via the 330k resistor to begin the cycle over again.

Use a small piece of veroboard or plain matrix board to mount the components. The circuit is guaranteed to work using almost any value electrolytic from 2.2 mfd to 470mfd. The charging resistor must be higher than 100k to allow for an off cycle, and should be in the range 100k to 470k.

The selection of capacitor and resistor will determine the "off" time and to some extent the "on" time. The 10 ohm resistor can be increased to 47 ohms to alter the off period quite considerably as this will alter the value of the reverse voltage on the electrolytic. Obviously this voltage must be overcome before the first transistor will turn on and thus the off cycle will be lengthened. Any LED will operate in this circuit and almost any transistors can be used. In fact it is an ideal circuit for your "junk box" parts as nothing is critical.

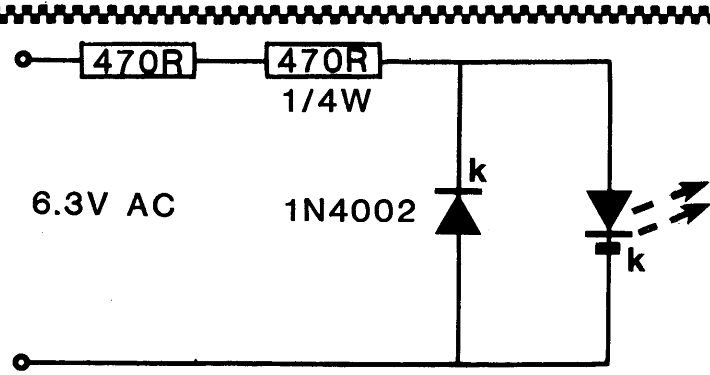


LED FLASHER

AC PILOT LED

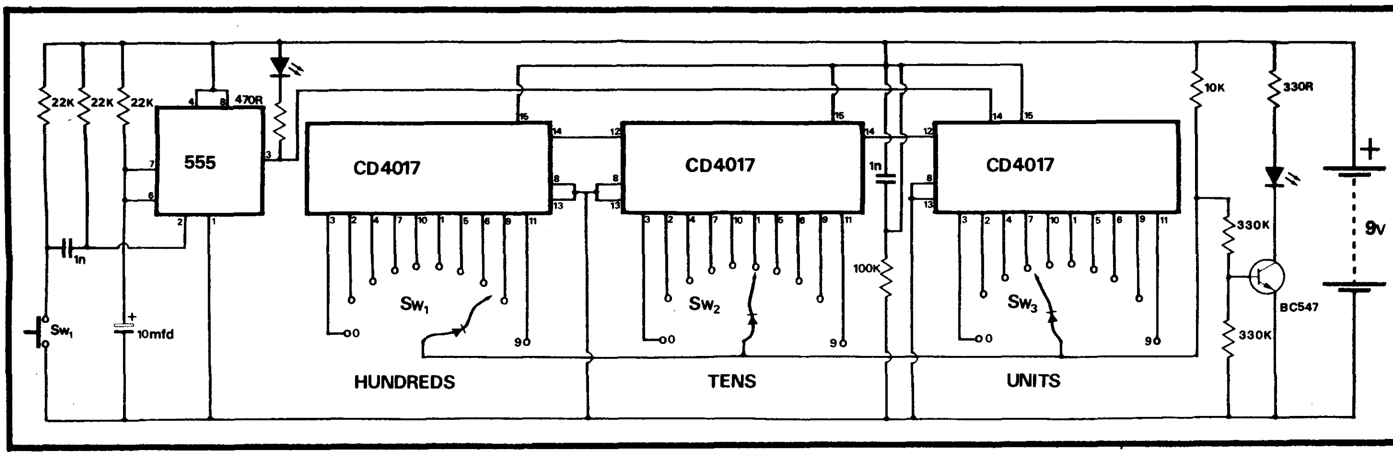
CONNECTING A FLASHING LED TO AC

A flashing LED can be connected across the output of a 6.3v transformer providing a diode is placed across the LED to "short out" the reverse voltages. The dropping resistors will need to be up-rated to handle the extra current if they get too hot.



PROGRAMMABLE COUNTER *Cost:* $10^{50}

This project is a BUILDING BLOCK build it now and keep it for future experimenting



PROGRAMMABLE COUNTER CIRCUIT

Our programmable counter was originally designed for our printed circuit board production. The operator required a simple counter to inform him when the total number of holes had been drilled on each board. Lets look at how this came about. Our PC boards are hand drilled on a 4-head high-speed drill. The blank boards are stacked 4-high making a total of 16 boards completed in the one operation. Since the copper-clad board is drilled BEFORE etching (this is the very opposite to prototype production) it is not possible to pick up the boards and locate any missing holes. This leaves the nagging possibility that a hole or two may be left undrilled.

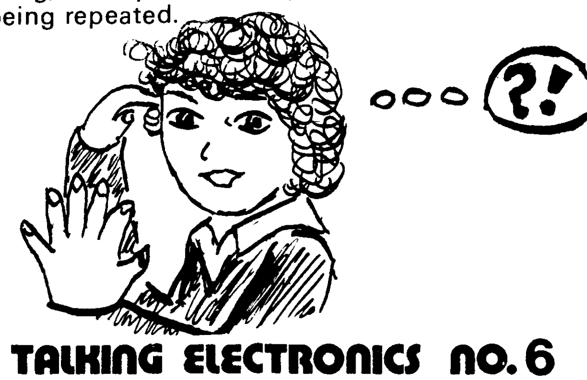
Our programmable counter removes this anguish since the complete number of holes for each board is known and is set on the counter before the run. For instance we set 101 holes for the Led Zeppelin and 202 for the Experimenter Deck. Each time a hole is drilled the counter is advanced one digit. A small piezo beeper was fitted to the output to indicate the end of each board. Maybe you don't need to count PC holes but if you work, (or a member of your family works) in a production line situation, you will be able to find at least half a dozen uses for a unit counter. It can be installed either as a primary counter, piece-rate-work-counter or as a back-up counter to check on individual work-flow. Or even one of a miriad of other situations. Even though it has been designed to count to only 1,000, two modules can be cascaded together to count to 1 million!!

An electronic pre-settable counter such as this is almost un-obtainable commercially. The few units we saw were in the $100 region. The two mechanical units needed to be pre-set after each count-down and were severely limited to the number of counts they could handle per second. In addition, the pre-setting was very slow and required a fairly high current to operate the solenoid.

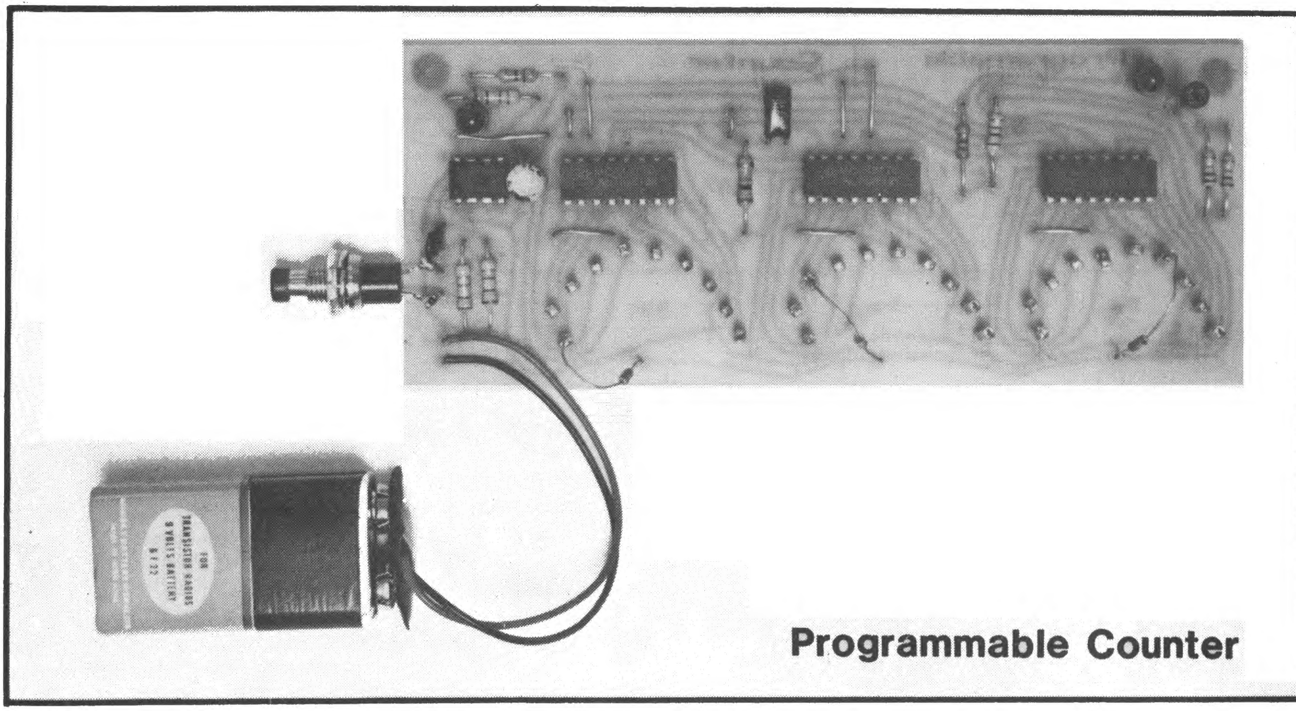
We have overcome all these limitations: Instant start - even half-way through a count - high count speeds and a variety of pick-ups

With an endless number of uses you will be very glad to have it around

make this counter very versatile. By using a CMOS 7555 the counter can be operated from a 6v lantern battery for many months so that complete portability is assured. You could even use it for counting sheep although it is primarily intended as an aid to production-line manufacturing, or anywhere a high number of items is being repeated.



He makes no friend who makes no foe.



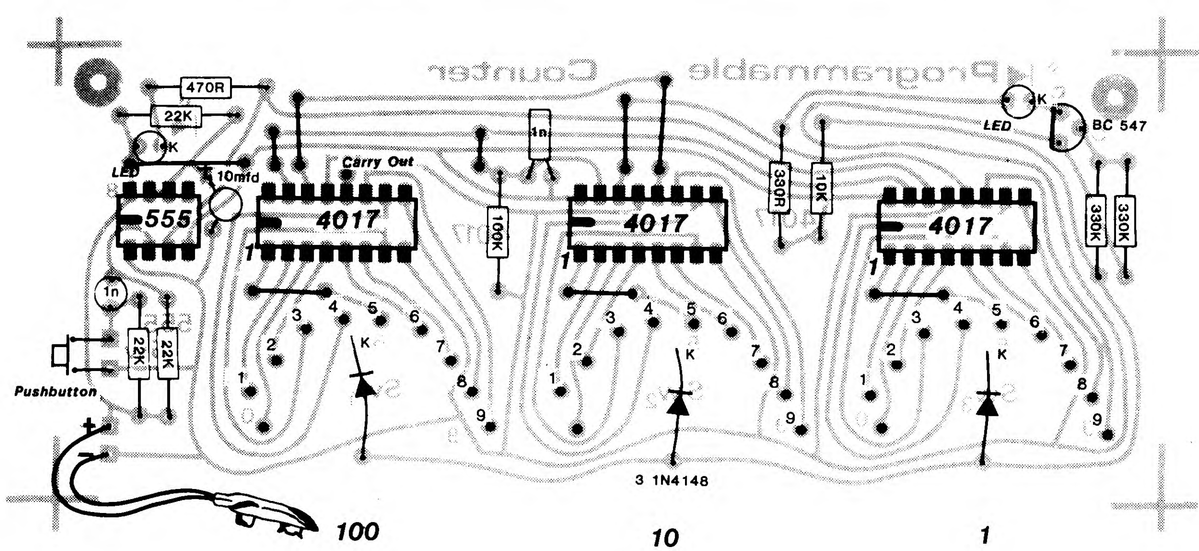
The molex pins can be replaced by a rotary switch.

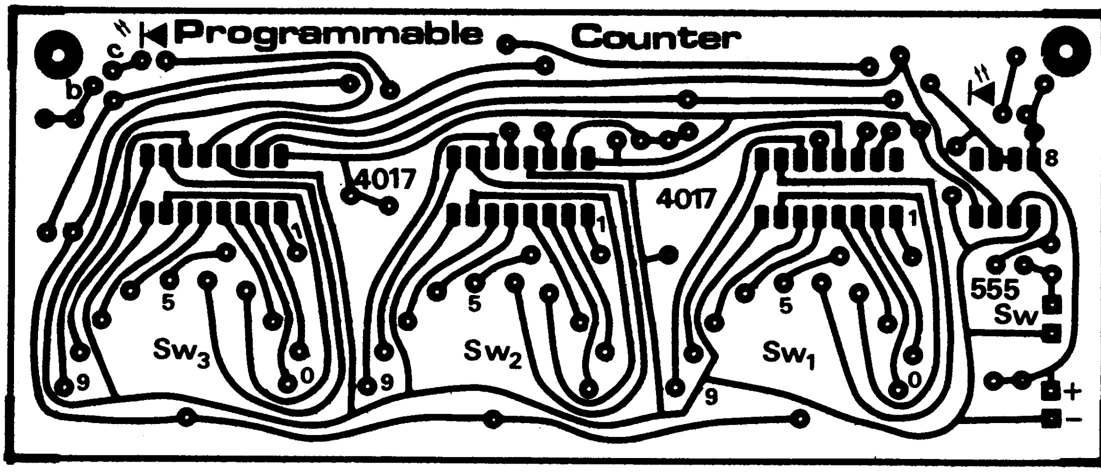
PARTS LIST

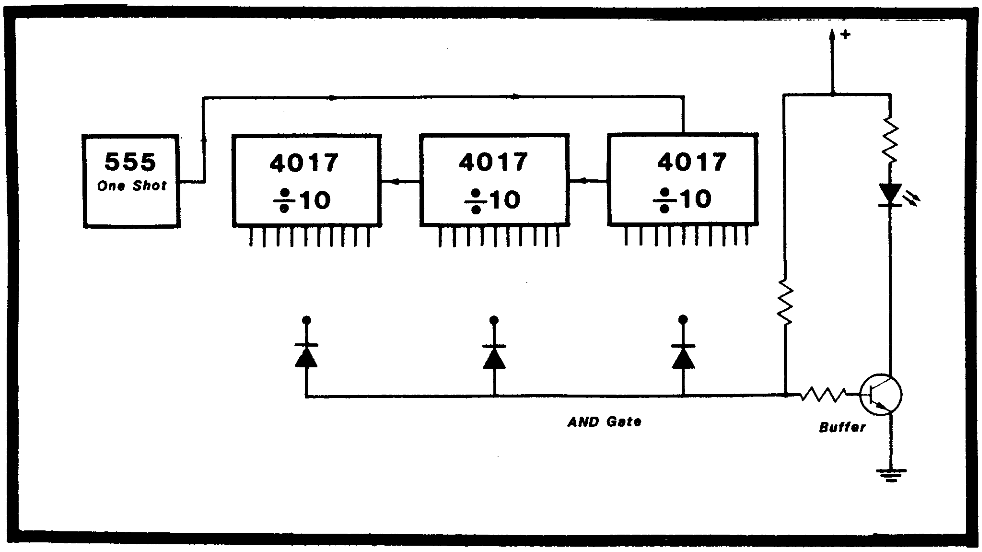
R1	resistor	22k	¼ watt
R2	"	22k	"
R3	"	22k	"
R4	"	470R	"
R5	"	100k	"
R6	"	10k	"
R7	"	330k	"
R8	"	330k	"
R9	"	330R	"
C1	capacitor	1n	100v
C2	electrolytic	10mfd	16v
C3	capacitor	1n	100v

IC1	timer IC	NE 555
IC2	decade counter	CD 4017
IC3	" "	CD 4017
IC4	" "	CD 4017
Q1	transistor	BC 547
D_1 D_2 D_3	diodes	IN 4148

LED_1 LED_2 5mm red LED
Sw_1 Push-to-make switch
30 Molex pins
Battery Snap
PROGRAMMABLE COUNTER PC BOARD



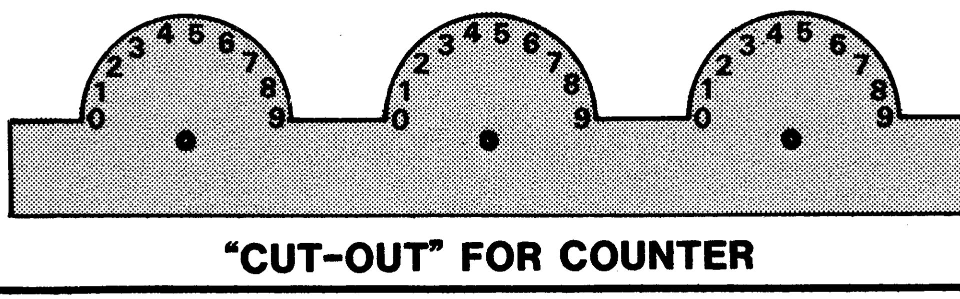




PROGRAMMABLE COUNTER BLOCK DIAGRAM

HOW THE CIRCUIT WORKS

The 555 is wired as a monostable multivibrator and its output is fed to the first CD 4017 decade counter. The "carry out" of this IC is connected to the next CD 4017 and likewise the third CD 4017 is connected to the second to enable the circuit to count to 1,000. Any number from one to 1,000 can be pre-set via the three jumper leads and Molex pins. When the three decade counters count up to the pre-determined number, they present three HIGHs to the buffer transistor via the three gating diodes. This will turn on the LED. Any signalling device can be substituted for the LED such as a relay, buzzer or piezo siren, making this unit suitable for operation in noisy surroundings or even remote from the counting source. A miniature LED registers each count as the 555 clocks the first 4017 IC.



"CUT-OUT" FOR COUNTER

Being as smart as a steel trap is knowing when to shut up.

SENSORS

As the input circuit is fully de-bounced, it will accept a variety of sensors. Even a "rubishy" push button switch will clock the counter providing it does actually make contact. Other suitable switches include reed switches and Hall effect sensors.

Fitting these switches to hand operated tools such as drills and presses should present no problem as a reed switch and magnet can always be attached to the moving arm of the drill with silicone glue and the limit of travel adjusted so that the reed switch contacts only during the final portion of travel.

For other assembly line or piece-work the movement of your hand can be detected via a long piece of spring steel wire connected to a micro-switch. As you brush past this wire during the course of your assembly, it registers as a count. The most logical place to position these detectors is above the completed parts bin. As you drop the component or pack the component, you will trigger the pulse.

MOUNTING THE COMPONENTS

The layout of the board is almost identical to the circuit diagram. This will make parts locating very easy.

The first components to be fitted are the Molex pins. They are very fiddly and need to be inserted one-at-a-time. If you cannot bear to hold them while soldering, insert a piece of wire into their opening and use this as an "extension".

Next fit the jumpers as shown in the lay-out diagram and the 9 resistors.

Next solder the two LEDs, 2 green caps and the electrolytic followed by the transistor, switch and battery snap.

The 4 IC's can be mounted on IC sockets although the cost of the 555 is not much more than a socket. However a saving will be made by fitting sockets for the CD 4017's as they account for about half the cost of the project.

Carefully solder the 4 IC's and note they all go into the board around the same way.

Lastly solder the three diodes making sure that their three leads are left full length as they become flying leads to connect to the semi-circle of Molex pins.

Note the first Molex pin has been off-set from the semi-circle because it is not counted as "1" but "0" when working out the pre-set number. You can see the "5" printed on the underside of the PC board shining through the board to give you an indication of the correct pin numbering.

CONSTRUCTION AND TESTING

As most of the expense lies in the three CD 4017's, we suggest using sockets so that they may be re-employed if necessary. I hope this won't be needed, but you never know what the future holds.

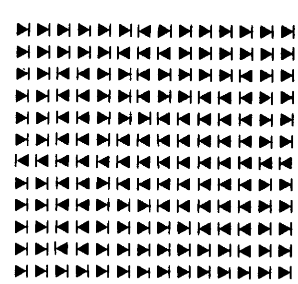
The assembly is very simple if you follow the layout diagram. As with most of our projects, the components form an orderly fashion and generally follow the positions on the circuit diagram. This is especially necessary when the PC board forms part of the programming panel and the three semi-circles of Molex pins are designed to directly correspond to the pre-programmed number. An overlay is provided in this article as a "cut out" to stick onto the board. This will make it easier to identify each Molex pin when setting a number as the first Molex pin corresponds to "0" and the second pin to "1" with the third equal to "2" etc.

The counter provides automatic reset on "turn-on" via the 1n capacitor and 100k resistor. The 555 has a delay of about one quarter of a second making it capable of accepting about two counts per second. For higher frequencies the delay is shortened and the value of the capacitor required can be obtained by experimentation. For a simple adjustment, you can reduce the capacitor by a factor of 10 to increase the count rate 10 times.

To set up the counter for testing, choose a low number and correctly position the three diodes. Trigger the 555 with a simple push-button switch and count the number of pushes. The LED should light. Next, choose a higher number involving the three 4017's and check its accuracy a number of times. Once you are assured that it is operating correctly, it can be used to count the items you assemble at home through to counting your collection of gold coins.

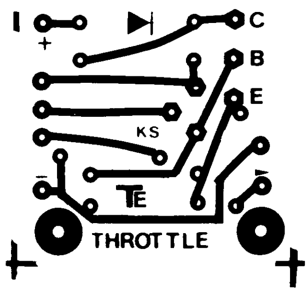
2 OPTICAL PUZZLES

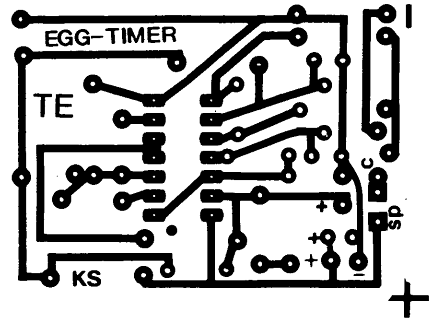
Hold the illustration 30 cm from your eyes. Stare at the 3 dots on the nose for 90 seconds without moving your eyes. Then look at a blank wall about 1 metre away and in a few seconds, the drawing will appear as a positive.

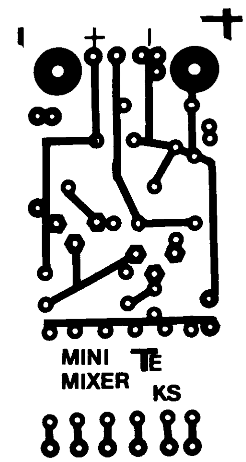


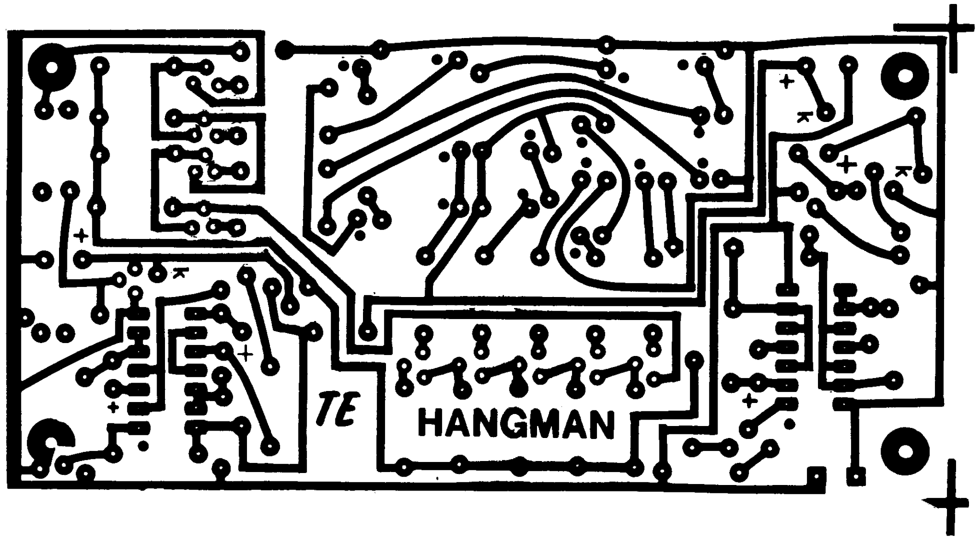
Can you find the LED?

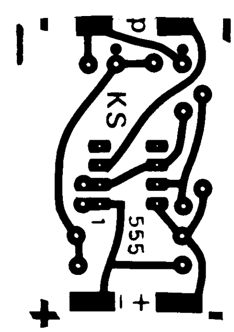
PRINTED CIRCUIT BOARD ARTWORK

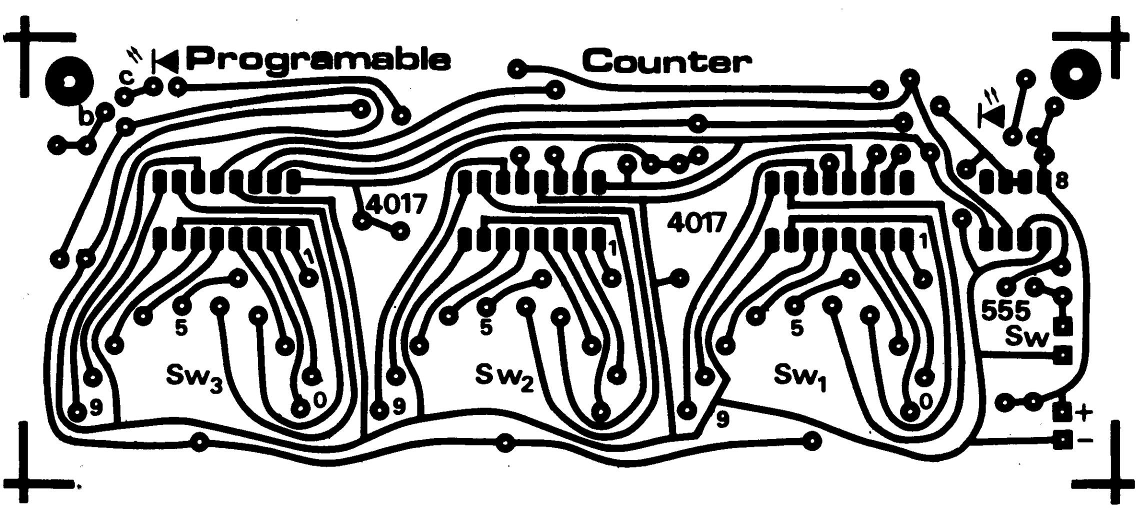






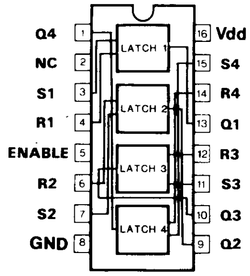






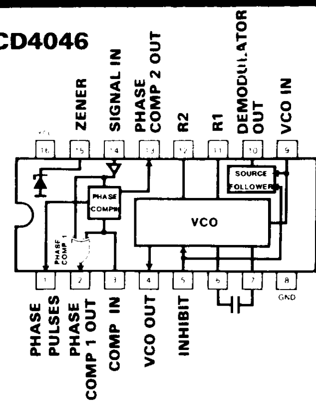
DATA Sheet No.6.

CD4044



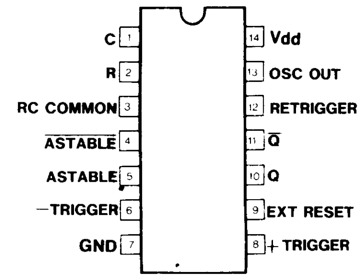
QUAD TRI-STATE NAND R/S LATCHES

CD4046



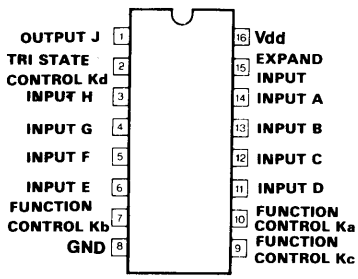
MICRO POWER PHASE-LOCKED LOOP

CD4047



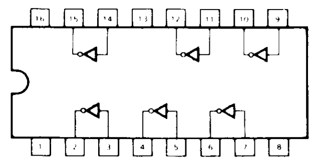
MONOSTABLE/ASTABLE MULTIVIBRATOR

CD4048



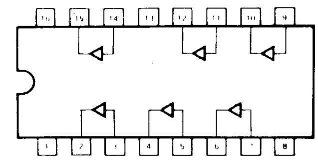
EXPANDABLE 8 FUNCTION 8 INPUT GATE

CD4049



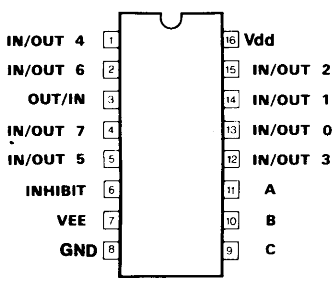
HEX INVERTING BUFFER

CD4050



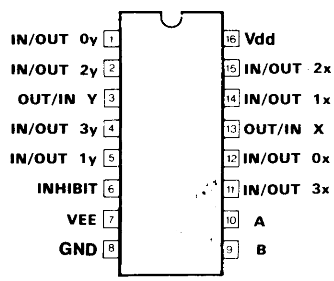
HEX NON INVERTING BUFFER

CD4051



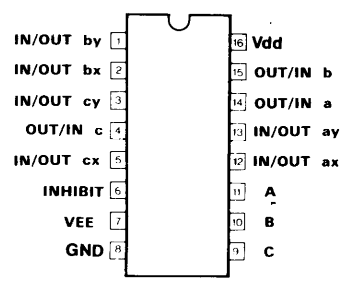
SINGLE 8 CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

CD4052



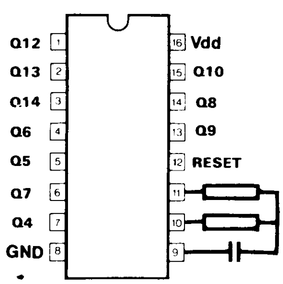
DUAL 4 CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

CD4053



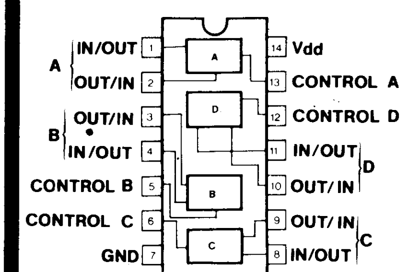
TRIPLE 2 CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

CD4060



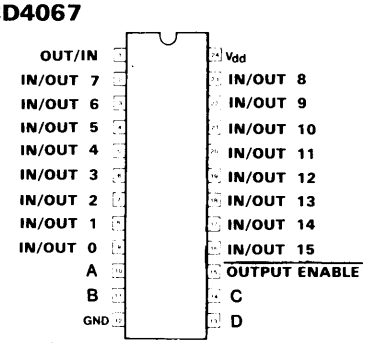
14 STAGE RIPPLE CARRY BINARY COUNTER WITH OSCILLATOR

CD4066



QUAD BILATERAL SWITCH

CD4067



16 CHANNEL ANALOG MULTIPLEXER/ DEMULTIPLEXER

CPW