EAR ENHANCEMENT DEVICE

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Introduction to the Project

Motivation of the Project

We have always imagined how it would feel if we could have heightened senses. Would it be beneficial for the current human condition or would it be too much for the brain to process those signals which are beyond our range of hearing or seeing or feeling. With this imagination of feeling what is beyond our grip of understanding we started planning for a human sense enhancement device. Just like the night vision goggles allows us to see in the dark as if it was daytime, our Ear enhancement system focuses on a similar goal but on a different sense of the human being which is hearing. This device would allow us not only to hear very low amplitude sounds that we can’t normally hear but also detect Ultrasonic Sound that will expand our range of hearing. Hence, to achieve this result we have chosen two separate circuits, each having their own functions and uses, one was the Amplifier Stage which is basically an Audio Detector and Amplifier and the second is the Ultrasonic Proximity Detector, which is used by many blind people to detect sounds in a wider range of hearing and react to situations faster. Our main objective is to design these two circuits individually and then couple them together to form the entire circuit.

INTRODUCTION TO AMPLIFIER STAGE

With this sound amplifier, you can now hear things crystal clear that you could never hear before. Amplifier Stage is very easy to use, just put the ear buds in your ears - aim the Amplifier Stage towards what you want to hear and things are heard crystal clear. Amplifier Stage has adjustable volume control, which amplifies sound up to 50 decibels. Amplifier Stage is also great for watching TV late at night; while your family sleeps you can keep the sound on the TV way down and still hear clearly.

SYSTEM OVERVIEW

The Amplifier Stage audio amplifier has a condenser microphone as input device and a 32Ω Earphone as output device. This device will amplify very low amplitude sound and with the variable resister we can adjust the volume of signal that we receive in the earphone. When this circuit will be coupled with the ultrasonic proximity detector then the results will be better than ever. The ultrasonic proximity detector basically detects the sounds at 40 kHz range, converts it into a signal in between 20 to 20000 Hz and then amplifies it. So after the coupling of the two circuits the device will not only detect low amplitude sounds but also ultrasonic sounds.

Amplifier Stage

Circuit Diagram

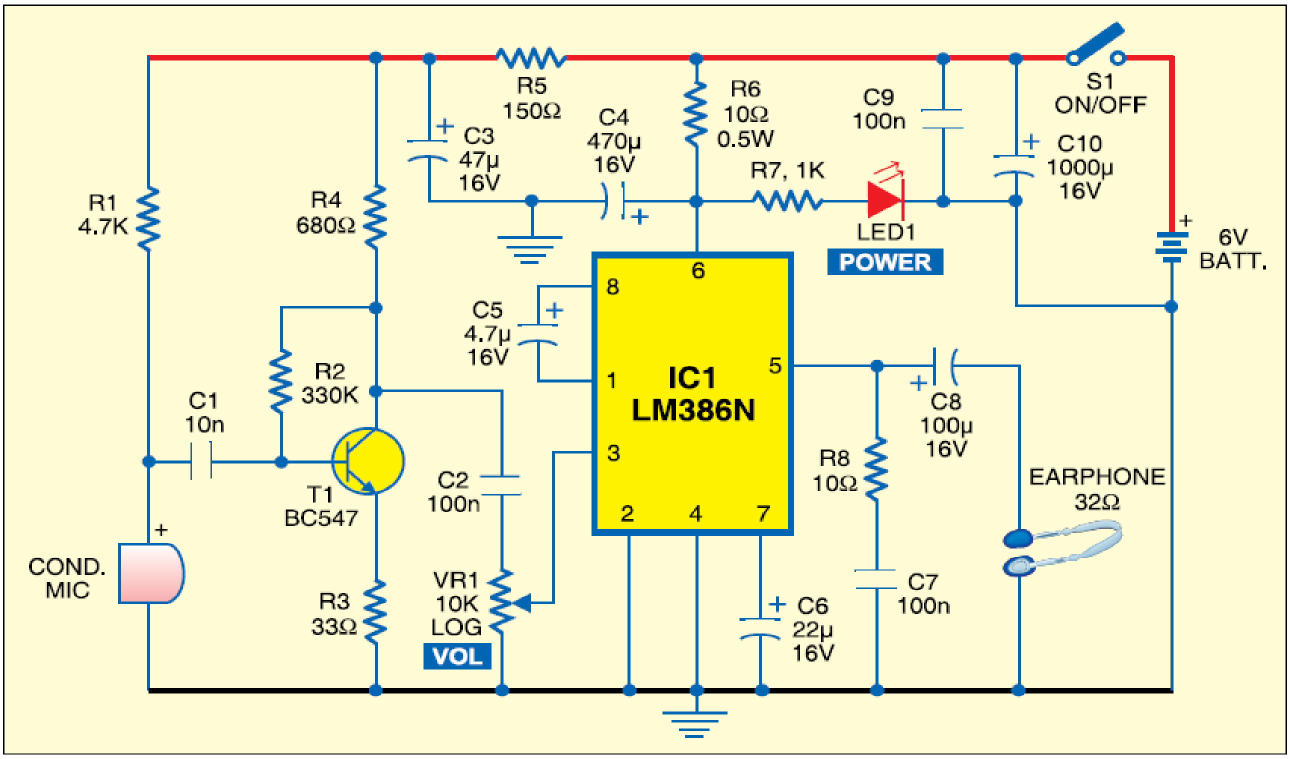


Fig 1 – Circuit diagram of Amplifier StageDevice

Circuit Components

The main components of this device are:-

a) The sound amplifier(LM386)

b) The condenser microphone

c) BC547 Transistor and other circuit components

d) Variable Resister

e) 32Ω Earphone

f) 4 1.5 V batteries

g) Resisters and Capacitors of specifications mentioned in circuit diagram

We will discuss the following in details in this section.

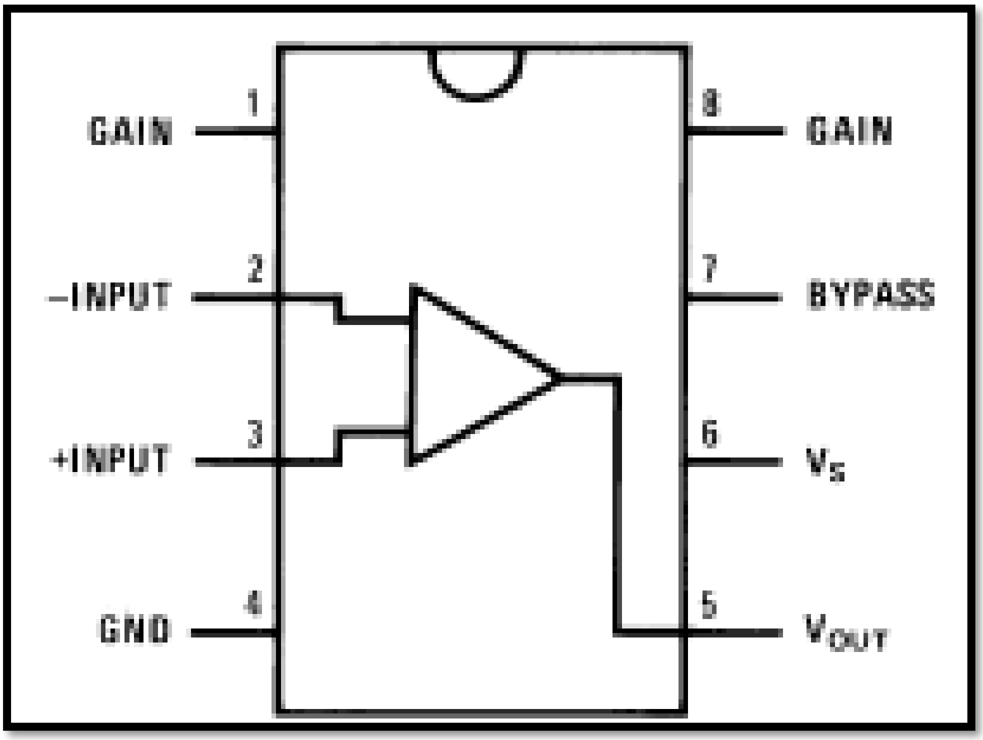
- I) LM386 Amplifiers
- II) Condenser Microphones
- III) BC 547 NPN Transistor

LM386 Amplifiers

The LM386 circuit is an audio amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200.

The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 milliwatts when operating from a 6 volt supply, making the LM386 ideal for battery operation.

The LM386 amp is an affordable, simple to use chip. The chip is nowhere near high power or high end (for a high-end amp, see the LM3886 68W amp), as it only delivers about 250mW (about 1/4 watts). A good use for this chip is for low power computer speakers, audio buffers,etc.



LM386 circuit features

- Battery operation
- Minimum external parts
- Wide supply voltage range: 4V–12V or 5V–18V
- Low quiescent current drain: 4mA
- Voltage gains from 20 to 200
- Ground referenced input
- Self-centering output quiescent voltage
- Low distortion: 0.2% (AV = 20, VS = 6V, RL = 8Ω, PO = 125mW, f = 1kHz)
- Available in 8 pin MSOP package

LM386 circuit applications

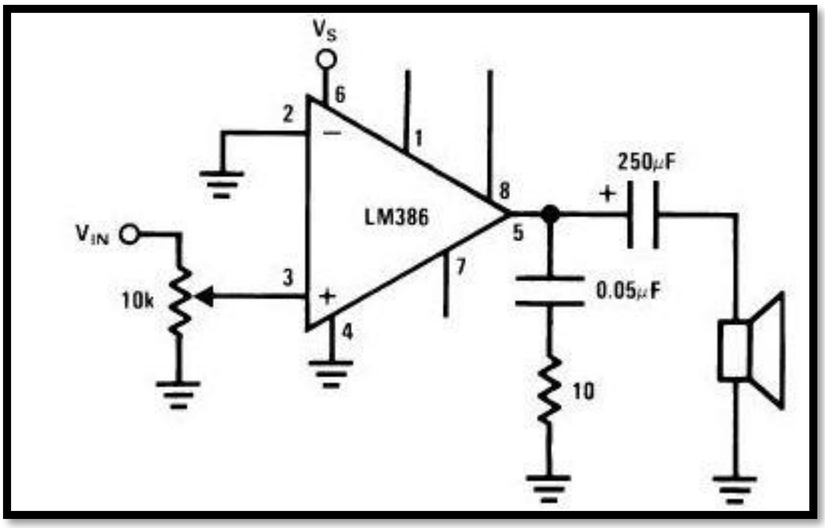
- AM-FM radio amplifiers
- Portable tape player amplifiers
- Intercoms
- TV sound systems
- Line drivers
- Ultrasonic drivers
- Small servo drivers
- Power converters

LM 386 series output power (P_{out})

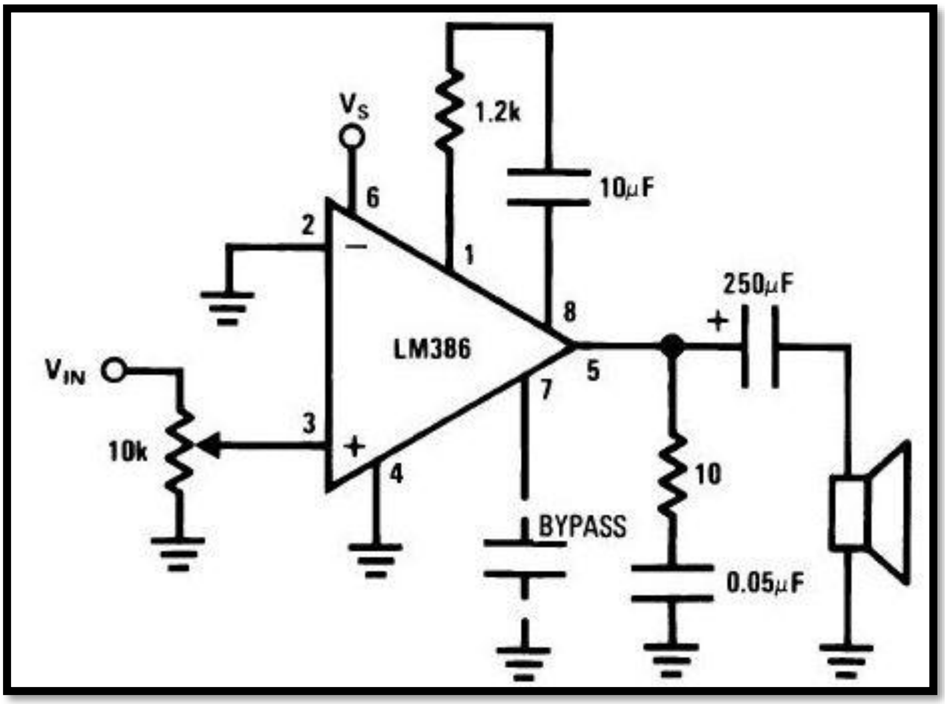
- LM386N-1, LM386M-1 at VS = 6V, RL = 8ohms, THD = 10% is 250-325 mW
- LM386N-3 at VS = 9V, RL = 8ohms, THD = 10% is 500-700 mW

LM38 LM 386 amp circuit 20dB gain

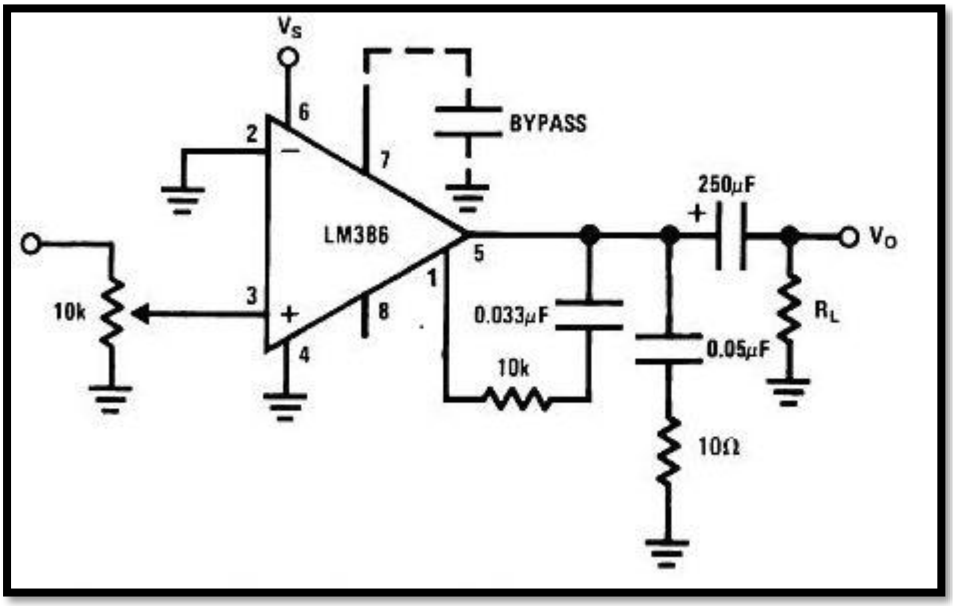
- LM386 Audio Amplifier with Gain = 20 and minimum part count. 6N-4 at VS = 16V, RL = 32ohms, THD = 10% is 700-1000 mW.



LM386 audio amp 50dB gain:



LM386 amplifier 200dB gain



To make the LM 386 a more versatile audio amplifier, 2 pins (pin 1 and 8) are provided for gain control. With pins 1 and 8 open the internal 1.35k resistor sets the gain at 20 (26 dB). If a capacitor is placed between pin 1-8, bypassing the built-in 1.35k resistor, the gain will go up to 200.

If a resistor is placed in series with the capacitor, the gain can be set to any value from 20 to 200. Gain control can also be done by capacitive coupling a resistor or FET transistor from pin 1 to the ground.

Condenser Microphone

Condenser means capacitor, an electronic component which stores energy in the form of an electrostatic field. The term condenser is actually obsolete but has stuck as the name for this type of microphone, which uses a capacitor to convert acoustical energy into electrical energy.

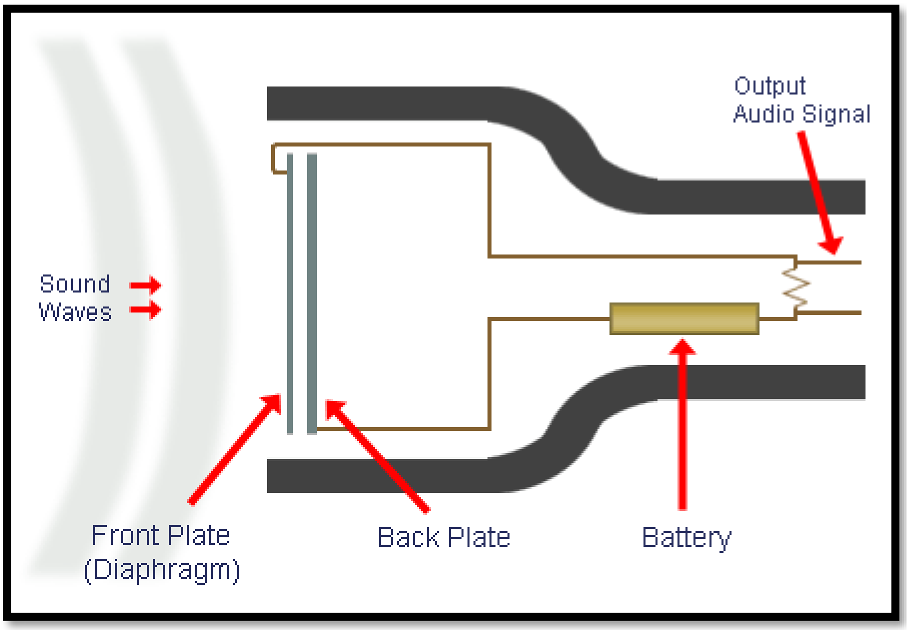
Condenser microphones require power from a battery or external source. The resulting audio signal is stronger signal than that from a dynamic. Condensers also tend to be more sensitive and responsive than dynamics, making them well-suited to capturing subtle nuances in a sound. They are not ideal for high-volume work, as their sensitivity makes them prone to distort.

How Condenser Microphones Work

A capacitor has two plates with a voltage between them. In the condenser mic, one of these plates is made of very light material and acts as the diaphragm. The diaphragm vibrates when struck by sound waves, changing the distance between the two plates and therefore changing the capacitance. Specifically, when the plates are closer together, capacitance increases and a charge current occurs. When the plates are further apart, capacitance decreases and a discharge current occurs.

A voltage is required across the capacitor for this to work. This voltage is supplied either by a battery in the mic or by external phantom power.

Cross-Section of a Typical Condenser Microphone



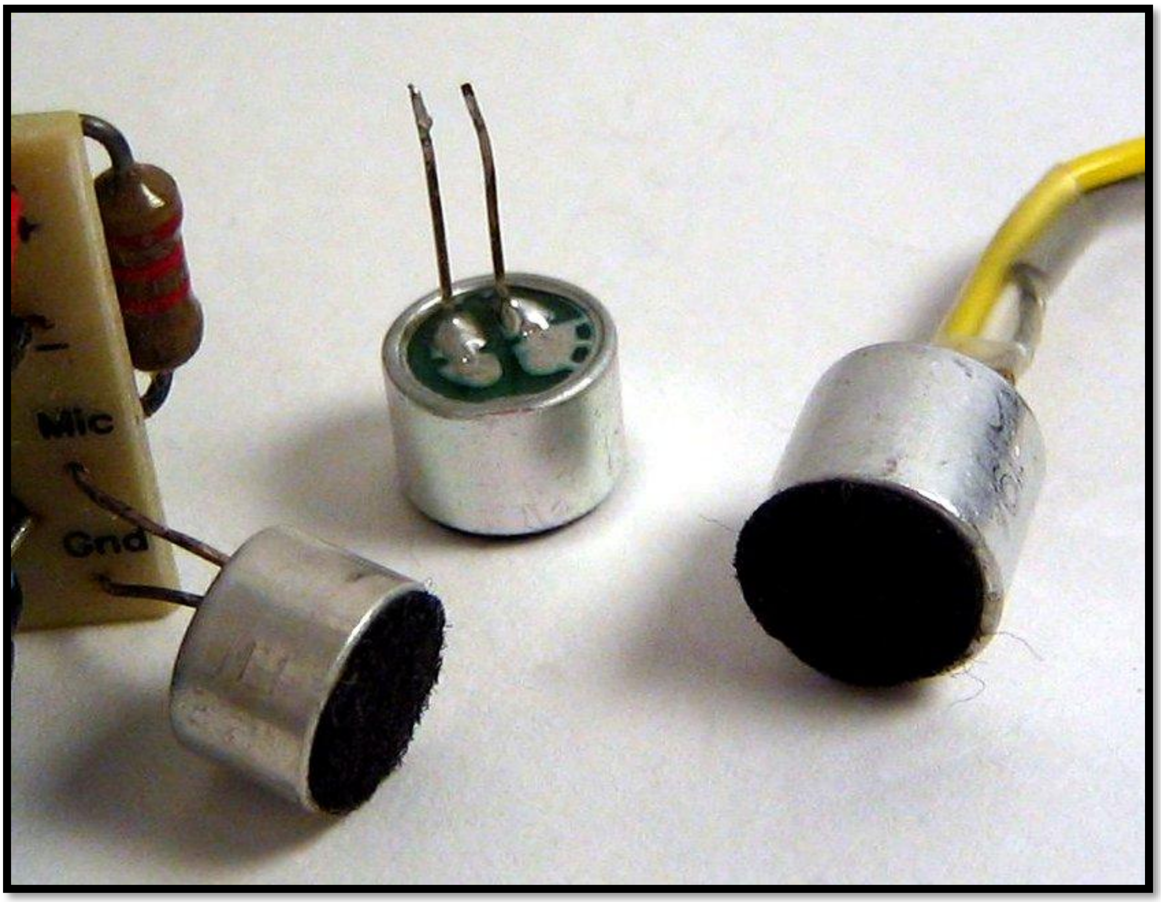
The Electret Condenser Microphone

The electret condenser microphone uses a special type of capacitor which has a permanent voltage built in during manufacture. This is somewhat like a permanent magnet, in that it doesn't require any external power for operation. However, good electret condensers microphones usually include a pre-amplifier which does still require power.

Other than this difference, you can think of an electret condenser microphone as being the same as a normal condenser.

- Condenser microphones have a flatter frequency response than dynamics.
- A condenser mic works in much the same way as an electrostatic tweeter (although obviously in reverse).

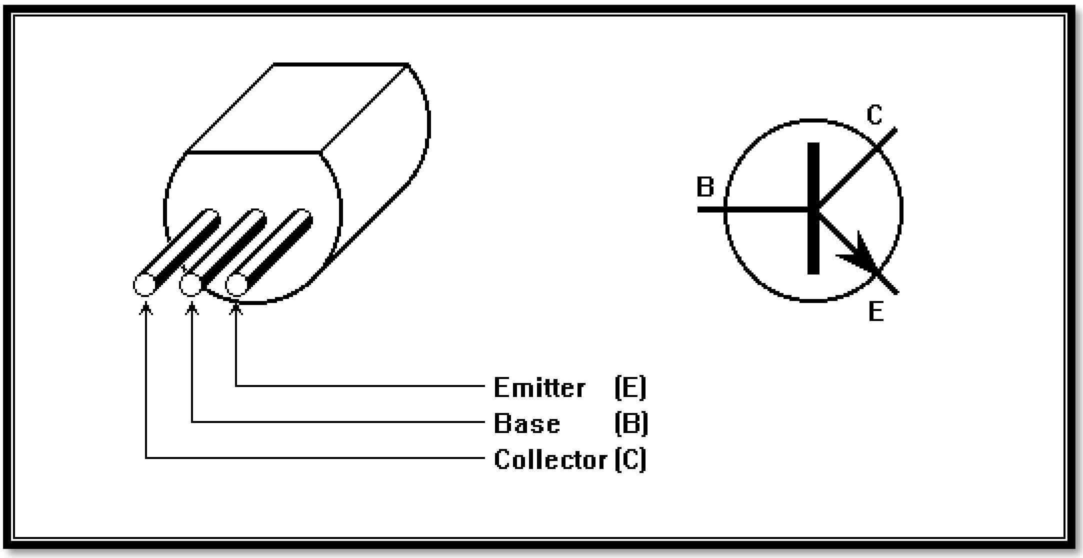
Availability at the market



BC 547 NPN TRANSISTOR

Transistors can be regarded as a type of switch, as can many electronic components. They are used in a variety of circuits and . They are central to electronics and there are two main types; NPN and PNP. Most circuits tend to use NPN. There are hundreds of transistors which work at different voltages but all of them fall into these two categories

Transistors are manufactured in different shapes but they have three leads (legs). The BASE - which is the lead responsible for activating the transistor. The COLLECTOR - which is the positive lead. The EMITTER - which is the negative lead.



B, C means:

B-Silicon

C- Audio frequency device

FEATURES

Low current (max. 100 mA)

Low voltage (max. 65 V).

APPLICATIONS

General purpose switching and amplification.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.

PIN DESCRIPTION

1. emitter
2. base
3. collector

Circuit Operation

- The input is given in the condenser microphone. It changes the sound signal into a electrical signal then the input is fed through capacitor C1 to the npn BJT voltage amplifier.
- BC547 npn transistor is a common emitter transistor. As we all know the function of a common emitter transistor is voltage amplification. It also has a lot of audio frequency application. Its voltage gain is about 500.
- Then it goes to the capacitor C2 (100nf) to the variable resistance (10K LOG). This variable resistance controls the voltage. It also acts as the volume controller of the circuit. This is then fed in the pin 3 of IC LM386N.
- IC LM386N is designed for operation with power supplies in the 4-15V DC range. It is known as the Audio amplifier IC. It is housed in a standard 8-pin DIL package, consumes very small quiescent current and is ideal for battery-powered portable applications.
    - Pin 1:- Gain
    - Pin 2:- Inverting input
    - Pin 3:-Non-inverting input
    - Pin 4:-Ground
    - Pin 5:-V_{out}
    - Pin 6:-Vs.
    - Pin 7:-Bypass.
    - Pin 8:-Gain.
- V_{cc} or the supply voltage is given through the battery (6 V) supply.
- Resistance R3 33Ω is used for connecting the emitter to ground.

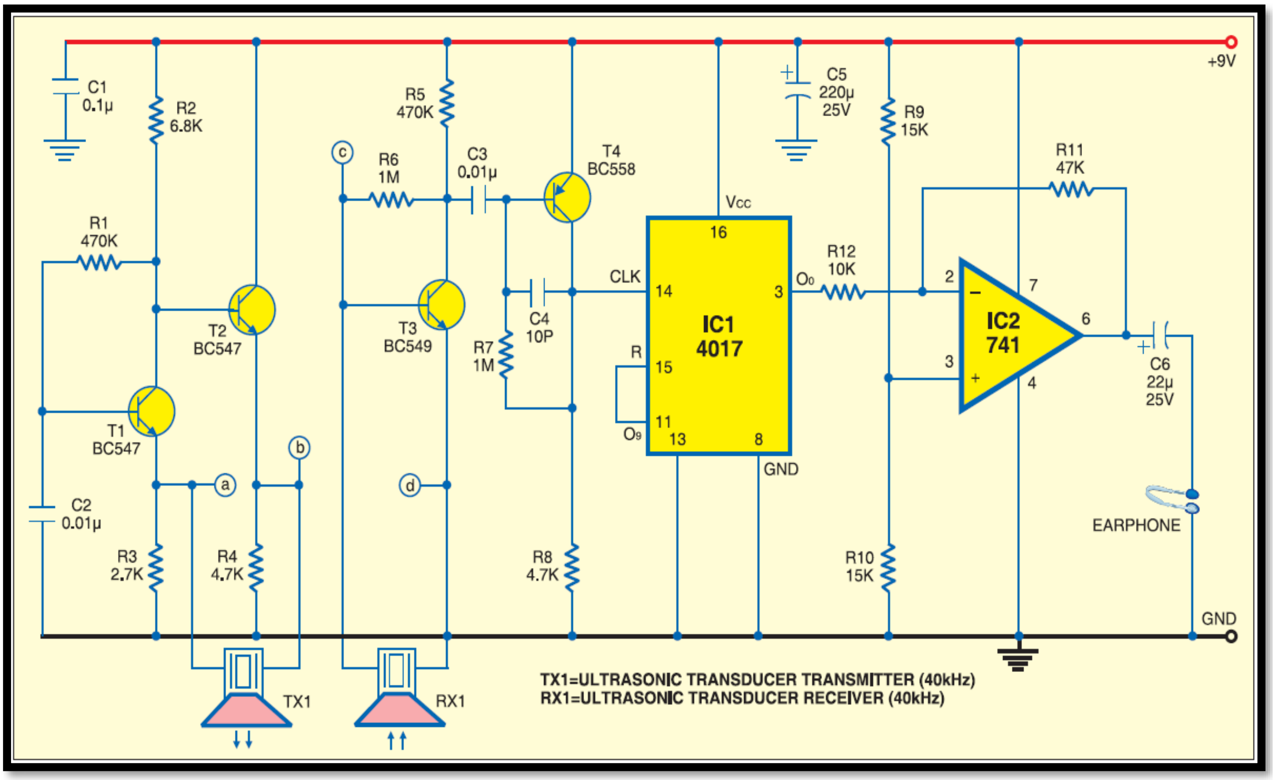
- R4 680Ω through V_{cc} is used to control the voltage of the transistor.
- R2 330kΩ is used here as the feedback transistor for BJT.
- Gain of the IC LM386 pins 1 and 8 is through capacitor C5 4.7µF 16V.
- Switch S1 is closed and the LED will be controlled by the R7 1KΩ voltage C9 100n voltage.
- Port 6 of LM386 source voltage controlled through R6 10Ω, 0.5 W resistor.
- R5 150Ω and C3 47µ 16V forms a decoupling network which provides a pre-amplifier block with a clean supply voltage.
- R6 10Ω 5W and C4 470µF 16V used as RF decouple positive supply to pin 6.
- R8 10Ω -C7 100nF is an optional Zobel network that ensures high frequency stability when feeding an inductive headphone load.
- Capacitor C6 (22µF, 16V) wired between bypass pin port 7 and ground gives additional ripple rejection.
- Port 4 is grounded.

Availability at the market

Normal spy year kits available at the market

Ultrasonic Proximity Detector

Circuit Diagram



Brief introduction to Ultrasonic Proximity Detector

We the humans can hear sound of up to 20kHz frequency only. This proximity detector works at a frequency of 40kHz. It uses two specially made ultrasonic transducers: One transducer emits 40kHz sound, while the other receives 40kHz sound and converts it into electrical variation of the same frequency. Fig. shows the block diagram of the ultrasonic proximity detector and Fig. 2 shows its circuit. Mount the transducers (transmitter as well as receiver) about 5 cm apart on a piece of general-purpose PCB as shown in Fig. 3 and connect to identical points ('a' through'd') of the detector circuit via external wires. The 40kHz oscillator is built around transistors T1 and T2. If there is a solid object in front of the ultrasonic transmitter module (TX1), some signals will be reflected back and sensed by the receiver transducer (RX1). The 40kHz ultrasonic signals are converted into 40kHz electric signals by the receiver and then amplified by transistors T3 and T4. The amplified signals are still in the inaudible range, i.e., these can't be heard. So a frequency-divider stage using CMOS decade counter IC4017 (IC1) is used at the output of the amplifier. IC1 divides the input frequency by '10,' so the 40kHz signal becomes 4 kHz, which is within the audible range. The 4kHz signals are fed to op-amp IC 741 (IC2), which is wired as an earphone amplifier. This circuit can be used as an electronic guard for the blind. Keep it (along with 9V battery) in their pocket with earphone plugged to their ear. The transducer modules should be directed towards the walking path. If any object comes up in front or n e a r b y , they will hear 4kHz sound through the earphone and can change their path accordingly. One thing to be noted here is that while using this device, avoid the company of your pets. The reason is that pets can hear ultrasonic sound, which will irritate them and they will bark unnecessarily.

These are devices that are used to detect the presence of another object using some property such as Doppler Effect, Mutual Capacitance, reflection of signals etc. These devices and its principles are used in parking sensors, burglar alarms, motion sensors, RADAR, SONAR etc.

Possible Applications of the Project

- Ear Enhancement System can be a powerful tool for Intelligence as it is simple and compact.
- With complete development Sonar technology can be introduced for UPD to map close environments.
- This technology can be used for security purpose as it can detect very low amplitude and ultrasonic sounds.
- With setup of large number of condenser mics to a centralized ear enhancement device any room can be made sound secured.

Background of the project

Ultrasound and ultrasonic

Ultrasound is cyclic sound pressure with a frequency greater than the upper limit of human hearing. Although this limit varies from person to person, it is approximately 20 kilohertz (20,000 hertz) in healthy, young adults and thus, 20 KHz serves as a useful lower limit in describing ultrasound. The production of ultrasound is used in many different fields, typically to penetrate a medium and measure the reflection signature or supply focused energy. The reflection signature can reveal details about the inner structure of the medium, a property also used by animals such as bats for hunting. The most well known application of ultrasound is its use in sonography to produce pictures of fetuses in the human womb. There are a vast number of other applications as well.
Although ultrasound behaves in a similar manner to audible sound, it has a much shorter wavelength. This means it can be reflected off very small surfaces.
Ultrasonic vibrations travel in the form of a wave which is similar to the way light travel. However, unlike light waves, which can travel in a vacuum, ultrasound requires an elastic medium.

Proximity Detector

These are devices that are used to detect the presence of another object using some property such as Doppler Effect, Mutual Capacitance, reflection of signals etc. These devices and its principles are used in parking sensors, burglar alarms, motion sensors, RADAR, SONAR etc.

1.2 Field of the project
The present project relates to ultrasonic proximity detector systems. It relates to a collision sensing system for the visually impaired, automotive vehicles, obstruction sensing etc. While the present project deals with the mere detection of obstructions, it is understood that the project potential is not limited thereto. Those of ordinary skill in the art and access to the teachings provided herein will recognize additional modification, applications and embodiments within the scope thereof.
1.3 Description of related art

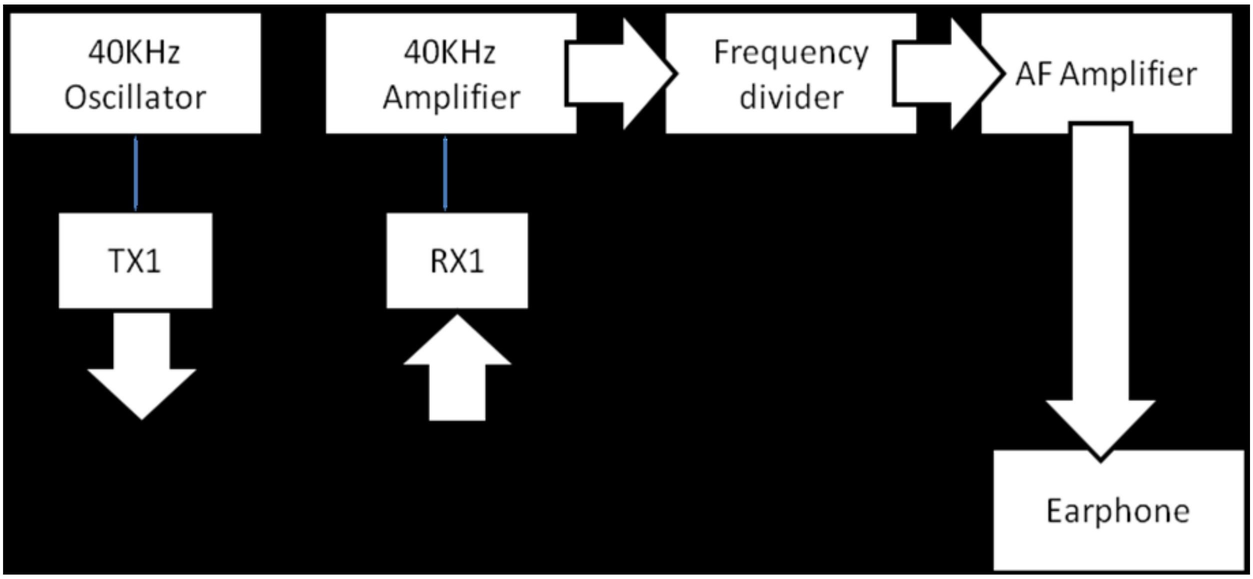
The existing proximity detectors generate an ultrasonic wave and transmit this wave with transducers. The distance to an object is measured based on the time that a pulse of ultrasonic wave leaves the transducer and an echo has been received from the obstacle. The distance is displayed in numbers or LED indicators and an annunciator is activated.
1.4 Market Researches

For visually impaired or blind applications, the project can help a blind person to walk and know the proximity of objects around him. The project specimen can be mounted on a belt around the waist and can save much trouble for the visually impaired. An extensive market research has shown no comparable product in the market.
The market mobility of visual aids is very new. A survey estimates that out of hundred disabled people, eighteen are visually challenged. The need for this kind of a system is on the rise, as people are becoming aware of the technologies and are intending to use them in their day- to-day- life

The same application has been inducted into various automobiles based on the fact that the driver is, essentially, blind to the activities on his/her blind spot of vision. There is a need to have some sort of a warning system to prevent any sort of avoidable mishaps in case of reversing or being in a rather congested area.

As per the World Health Organization's "Global Status Report on Road Safety", more people die in road accidents in India than anywhere else in the world, including the more populous China. Though the project may not directly aid in the prevention of fatalities, there is no doubt that it will surely help in bringing down the minor accidents due to negligence on the part of the driver.

BLOCK DIAGRAM



BLOCK DIAGRAM EXPLANATION

The block diagram of the project circuit contains the following stages:

1. Oscillator

This block comprises the first section of the circuit which produces the required ultrasonic signals. This section is built around transistor action. However, crystal oscillators too can be incorporated to satisfy the condition if precise value of frequency is to be achieved. The primary aim of this block is to produce frequencies above 20 KHz as is required from the circuit.

2. Transducer- Transmitter

This block comprises of a transmitter which can convert electrical signals into required sound signals. The transmitter usually is selected based on the operating frequency as these are sensitive devices which can be easily destroyed if given a value above their normal operating range.

3. Transducer- Receiver

This block comprises of a receiver transducer which receives the reflected signal. This particular section needs to be more sensitive than the former transducer as the signals arriving after reflection maybe weakened slightly due to the various interferences it has to account for and the distance it has to cover.

4. Amplifier

Here the amplifier section amplifies the signals that are being received by the receiver side of the circuit. The transistor action is again being made use of here.

5. Frequency divider

The frequency of the reflected signal may still be in the ultrasound region as it may not have varied with strength. To make an audible sound, this signal needs to b brought down to audible frequency range. This is done by using the frequency divider block.

6. Audio Frequency Amplifier

Now that the signal frequency has been converted to within audible frequency range, the signal is made to undergo the final amplification so as to make it sufficiently audible.

7. Earphones

As the final stage of the circuit, we have the earphones or speakers as the case maybe. The amplified output of the previous stage is being applied to the inputs of the hearing element to make the audible sound so as t warn the bearer of any obstruction.

COMPONENT DESCRIPTION

The circuit consists of the following components:

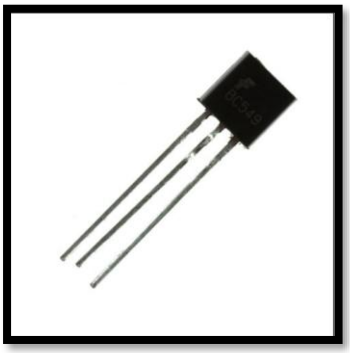
1. RESISTORS

6.8KΩ : 1 NOS
470KΩ: 3 NOS
2.7KΩ : 1 NOS
4.7KΩ : 2 NOS
1MΩ : 2 NOS
10KΩ : 1 NOS
15KΩ : 2 NOS
47KΩ : 1 NOS

2. CAPACITORS

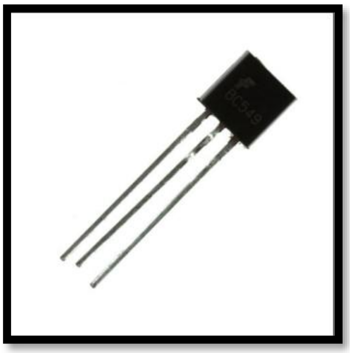
0.1µF : 1 NOS
0.01µF : 1 NOS
10pF : 1 NOS
220µF : 1 NOS
22µF : 1 NOS

3. TRANSISTORS



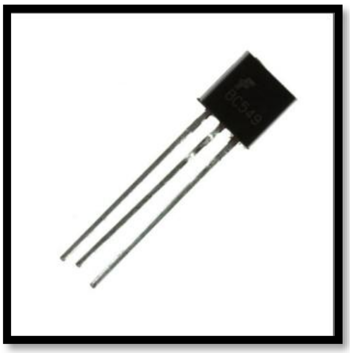
BC547

This is a NPN general purpose transistor which is used for general purpose switching as well as amplifying applications. It has low current (maximum 100mA) as well as low voltage (maximum 65V) values of operation.



BC549

This is a NPN general purpose transistor of low noise type. It is used in the low noise stages of audio frequency equipment. It has low current (maximum 100mA) as well as low voltage (maximum 45V) values of operation.



BC559

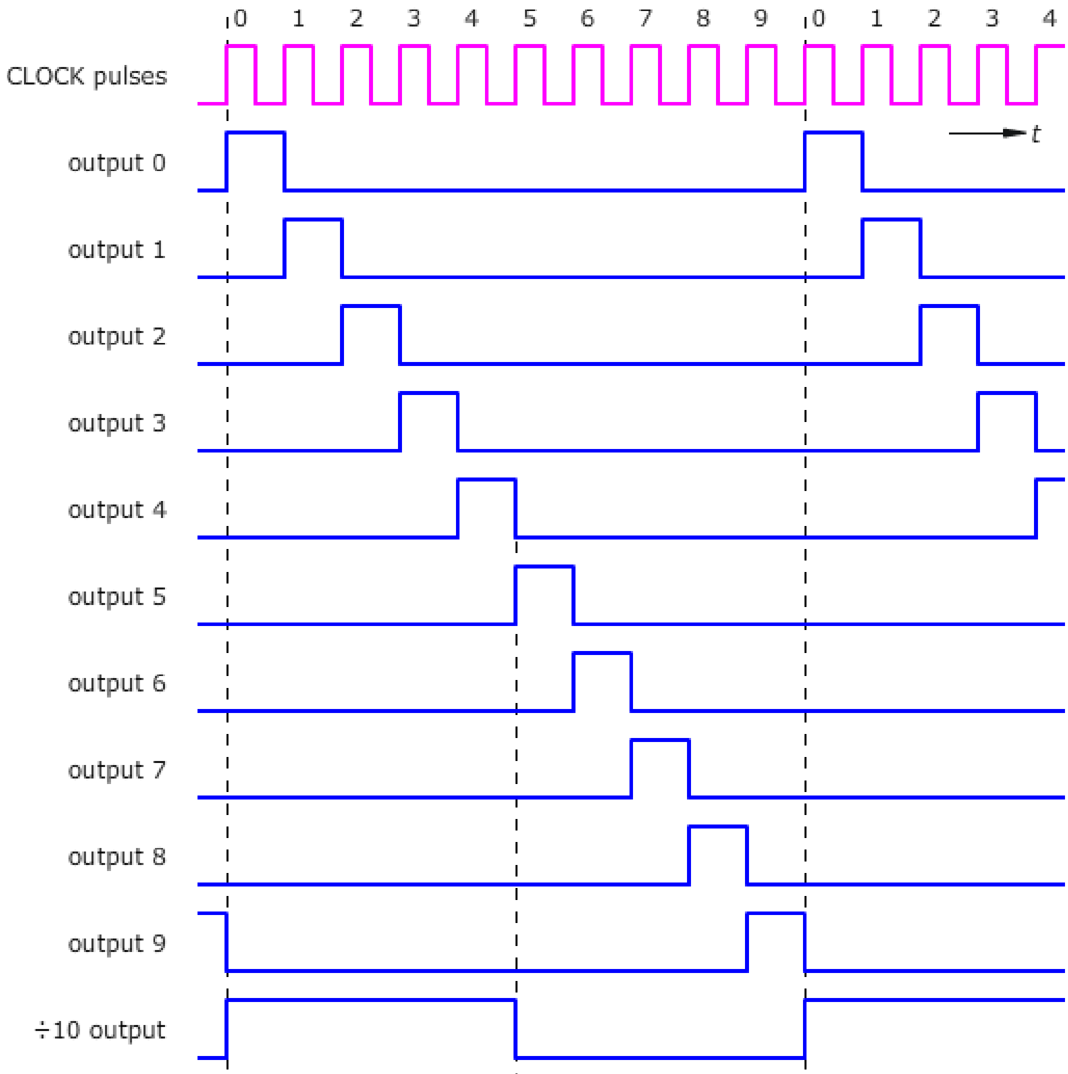
PNP Silicon Epitaxial Planar Transistors for switching and amplifier applications. These transistors are subdivided into three groups A, B and C according to their current gain. The BC559 is a low-noise type available in all three groups.

INTEGRATED CIRCUITS

IC 4017

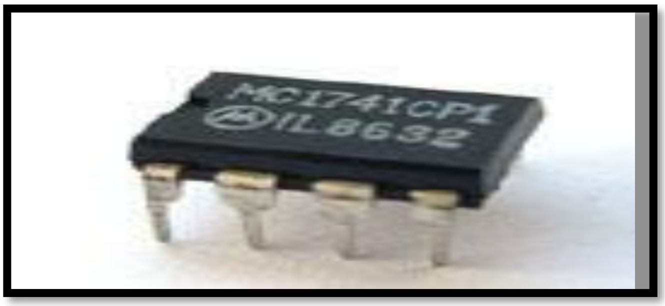
This is a Counter IC that describes the decade counter. It is a 16 pin IC with power input provided at pin number 16.
The count advances as the CLOCK input becomes high (on the rising-edge). Each output Q0-Q9 goes high in turn as counting advances. For some functions (such as flash sequences) outputs may be combined using diodes.
The RESET input should be low (0V) for normal operation (counting 0-9). When high it resets the count to zero (Q0 high). This can be done manually with a switch between reset and +Vs and a 10k resistor between reset and 0V. Counting to less than 9 is achieved by connecting the relevant output (Q0-Q9) to reset, for example to count 0,1,2,3 connect Q4 to reset.
The DISABLE input should be low (0V) for normal operation. When high it disables counting so that clock pulses are ignored and the count is kept constant.
The ÷10 OUTPUT is high for counts 0-4 and low for 5-9, so it provides an output at 1/10 of the clock frequency.

The counting action of the 4017 can be understood from the graph below:



IC 741

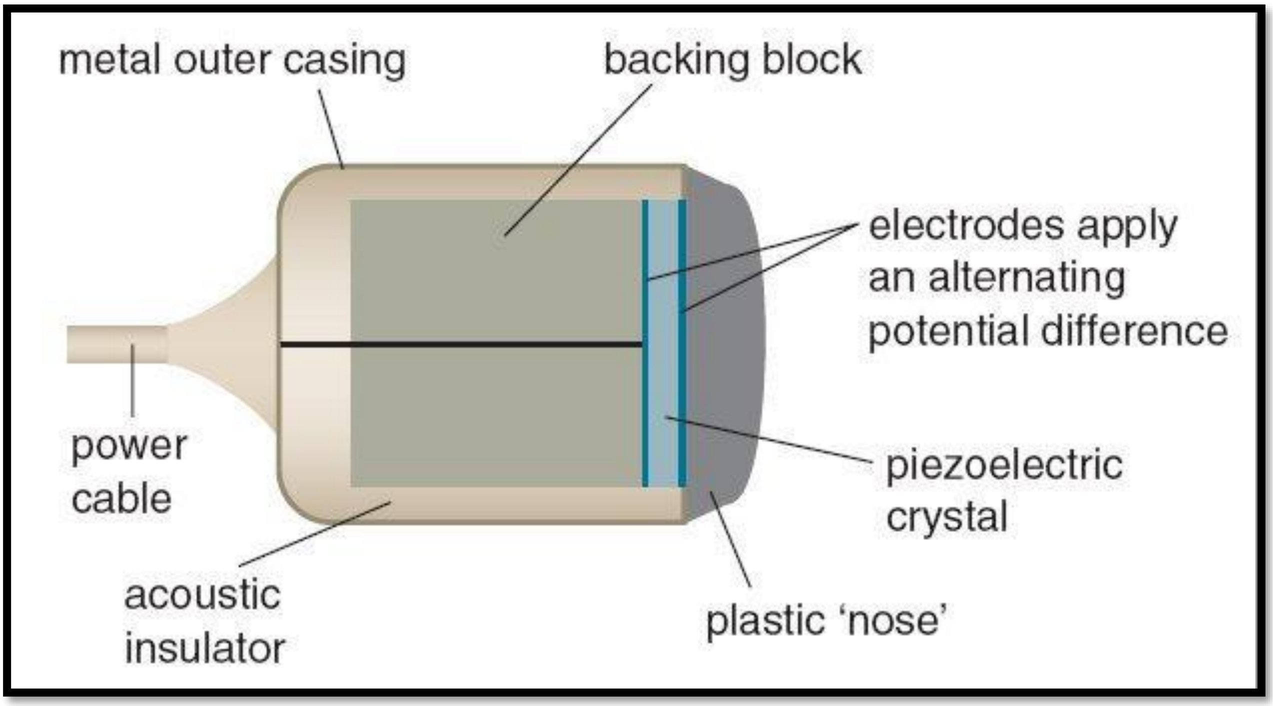
This is the traditional dual supply operational amplifier IC having 8 pins. The positive and negative supplies are provided at the pin numbers seven and four respectively. Pin number two and three performs as inverting and non inverting terminals respectively. This is a commercially grade IC which has a supply range of ±15V although it can work well at ±5V and can withstand temperature ranges of 0^{o}C to 70^{o}C



TRANSDUCERS

Ultrasonic transceivers or transducers work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. The sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor.
This technology can be used for measuring wind speed and direction, fullness of tank and speed through air or water, ultrasonography etc.
Systems typically use a transducer which generates sound waves in the ultrasonic range by turning electrical energy into sound which can be then measured and displayed.
The technology is limited by the shapes of the surface and density or consistency of the material. For example, foam on the surface of the fluid in a tank could distort a reading.
In this project we use transducers to transmit and receive ultrasonic sound signals. The basic demands of the circuit involve the transmission of signals which are greater than 20 KHz.

Though variations are possible, we have chosen transmitter and receiver devices of identical specifications.
It possesses a maximum input voltage of $20V_{rms.}$ The operating temperatures are specified at -20°C to +85°C.The range of the device is 0.2 to 6m. The operating frequency is 40 KHz and having a sensitivity of 67 dB.



The Active Element

The active element, which is piezo or ferroelectric material, converts electrical energy such as an excitation pulse from a flaw detector into ultrasonic energy. The most commonly used materials are polarized ceramics which can be cut in a variety of manners to produce different wave modes. New materials such as piezo polymers and composites are also being employed for applications where they provide benefit to transducer and system performance.

Backing

The backing is usually a highly attenuative, high density material that is used to control the vibration of the transducer by absorbing the energy radiating from the back face of the active element. When the acoustic impedance of the backing matches the acoustic impedance of the active element, transducer that is lower in resolution due to a longer waveform duration, but
may be higher in signal amplitude or greater in sensitivity.

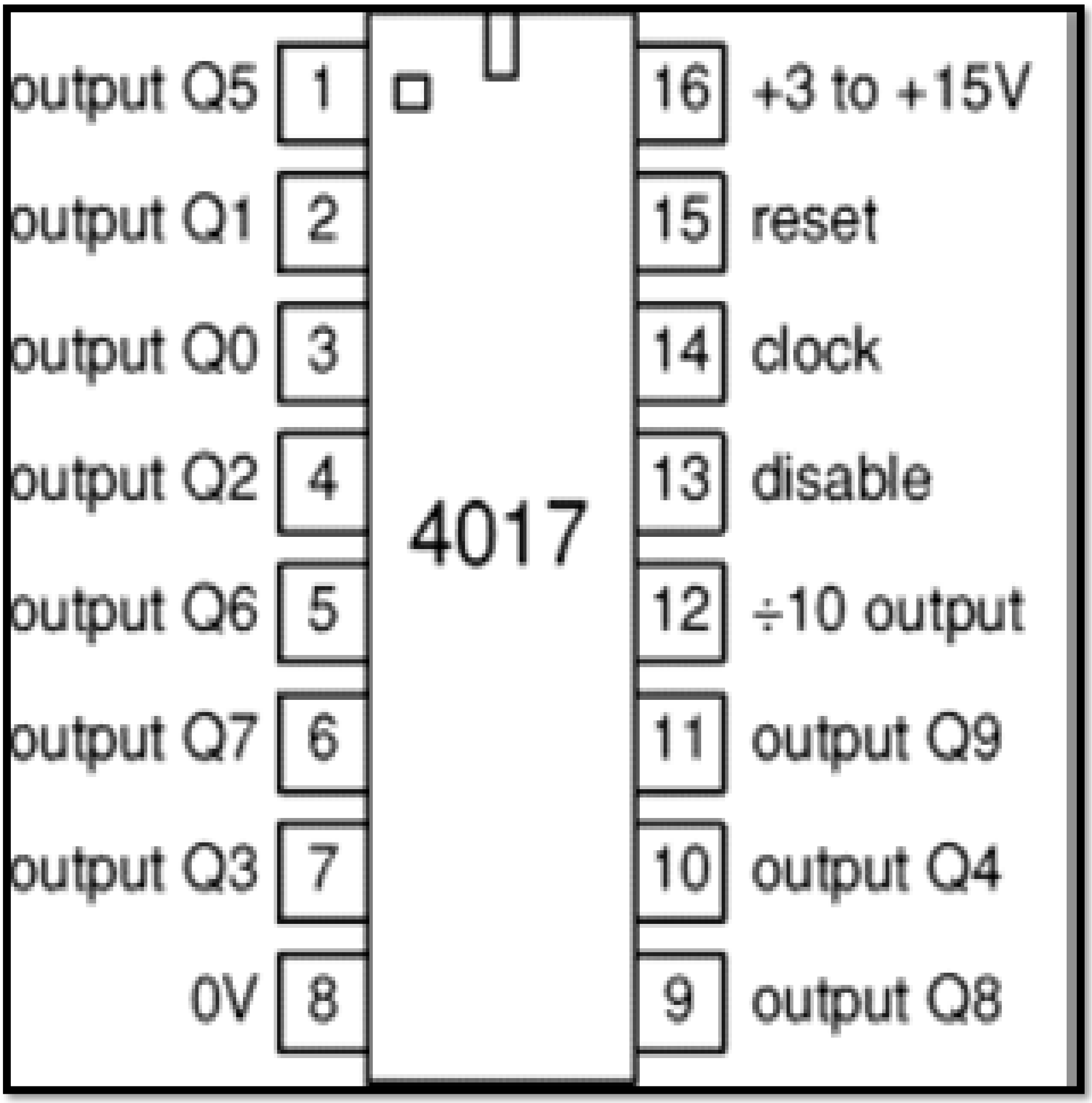
Wear Plate

The basic purpose of the transducer wear plate is to protect the transducer element from the testing environment. In the case of contact transducers, the wear plate must be a durable and corrosion resistant material in order to withstand the wear caused by use on materials such as steel. For immersion, angle beam, and delay line transducers the wear plate has the additional purpose of serving as an acoustic transformer between the high acoustic impedance of the active element and the water, the wedge or the delay line all of which are of lower acoustic impedance. This is accomplished by selecting a matching layer that is 1/4 wavelength thick (l/4) and of the desired acoustic impedance (the active element is nominally ½ wavelength). The choice of the wear surface thickness is based upon the idea of superposition that allows waves generated by the active element to be in phase with the wave reverberating in the matching layer.

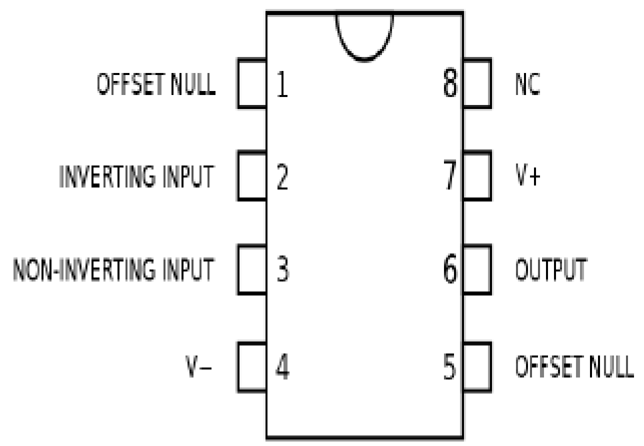
EARPHONES

The Earphone or speakers that are used here are of ordinary ratings and wouldn't require more than the basic earphones available at any basic electronics retailer. These have a frequency range of 20 to 20K Hz.
Speakers too maybe used in case louder and more open audio signals are the need for the application. these are of low power and low impedance in the values of 0.25W and 8Ω respectively.
For the blind, a simple earphone connected from the device to the ear would do whereas for the automobile industry, they use speakers of greater gain to alert the driver of any obstruction.

PIN DIAGRAMS



Pin Diagram of IC 4017

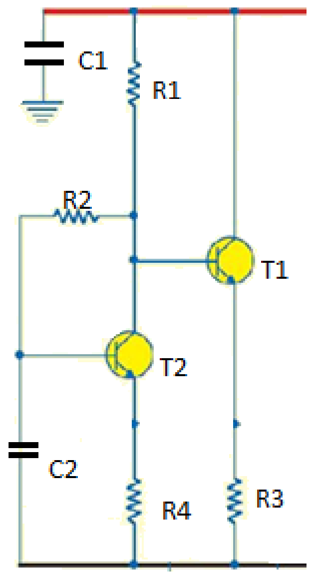


Pin Diagram of IC 741

CIRCUIT DESCRIPTION

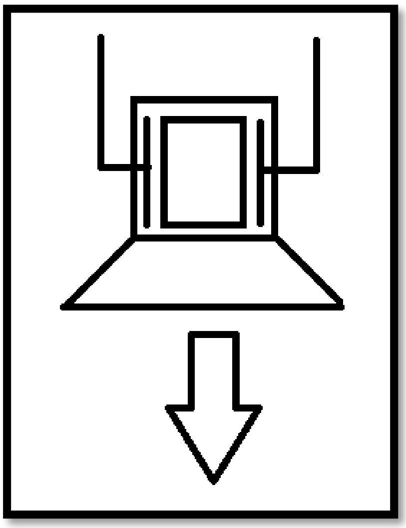
1. Oscillator circuit

The circuit that we have employed to generate the oscillations is that which resembles an astable multivibrator circuit. In the given circuit, when given the supply, one of the transistors is forced into

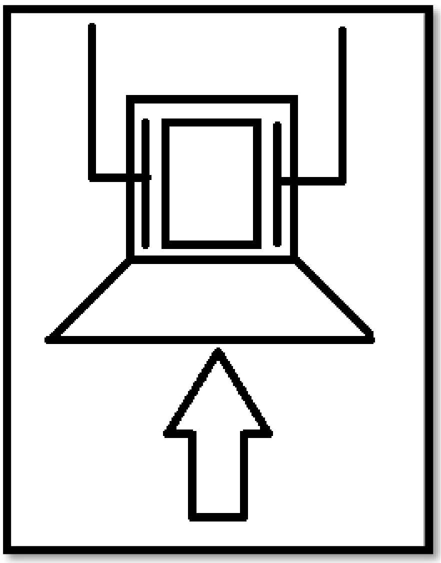


the conduction mode. Here, T1 is forced into conduction. This would result in drop in collector voltage and an increase in emitter current. At the same time, the capacitor, C2 charges through R2. When it reaches a specific value of charge voltage, it turns on T2 by applying this voltage to the base of the transistor. Hence, increasing the base emitter voltage past the required 0.7V. Thus T2 enters the conduction state. As soon as this happens, the collector voltage of T2 drops. This is coupled to the base of T1. Thus, the low voltage at its base, forces it into the off state. Emitter current through T2 now increases substantially and the capacitor too starts discharging through the circuit. This happens until such a level till the capacitor voltage again slips below the required base voltage of T2 and then, T1 starts conduction all over again thus the cycle continues.

2.Transmitter section



The transmitter that we have used in this application is the 40 T/R 16B the working is fairly simple. The input from the emitter section of one of the transistors in the oscillator circuit is fed to the crystal housed in the transducer causing it to vibrate in one direction. Immediately, thereafter, the applied potential is reversed from the emitter section of the second transistor in the oscillator circuit. This is supplied continuously from one end the other thus causing the piezocrystal to vibrate in both directions so as to culminate into ultrasonic signals in its physical form, i.e. ultrasonic sound waves.

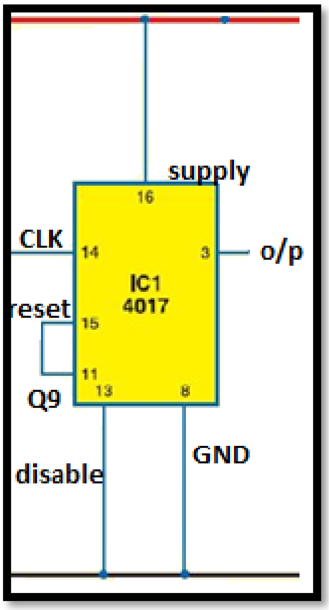


This section utilizes the reverse piezo electric effect in converting the reflected signals from the object, converting them into electrical signals.

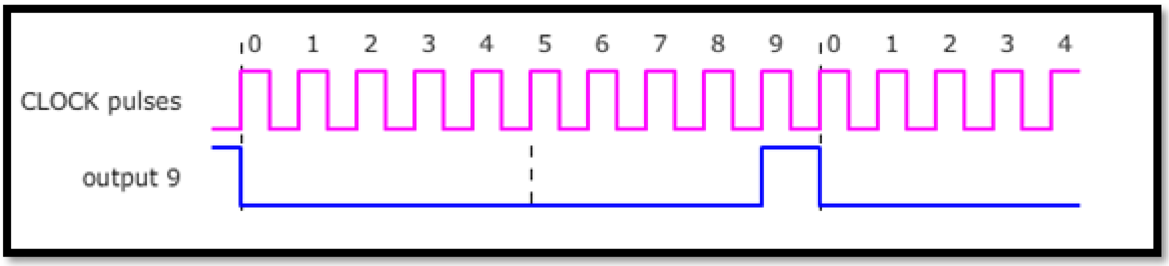
3.Frequency divider

The frequency division of ultrasonic signals into that of audible sound frequency requires a decade counter. Here, we make use of the IC 4017 which houses the Johnson counter to for

this purpose. The circuit works on the principle that for every tenth clock signal, the output goes high.



Thus, a signal frequency of 40 KHz is divided into an audible frequency signal of 4 KHz, which is within the audible range.



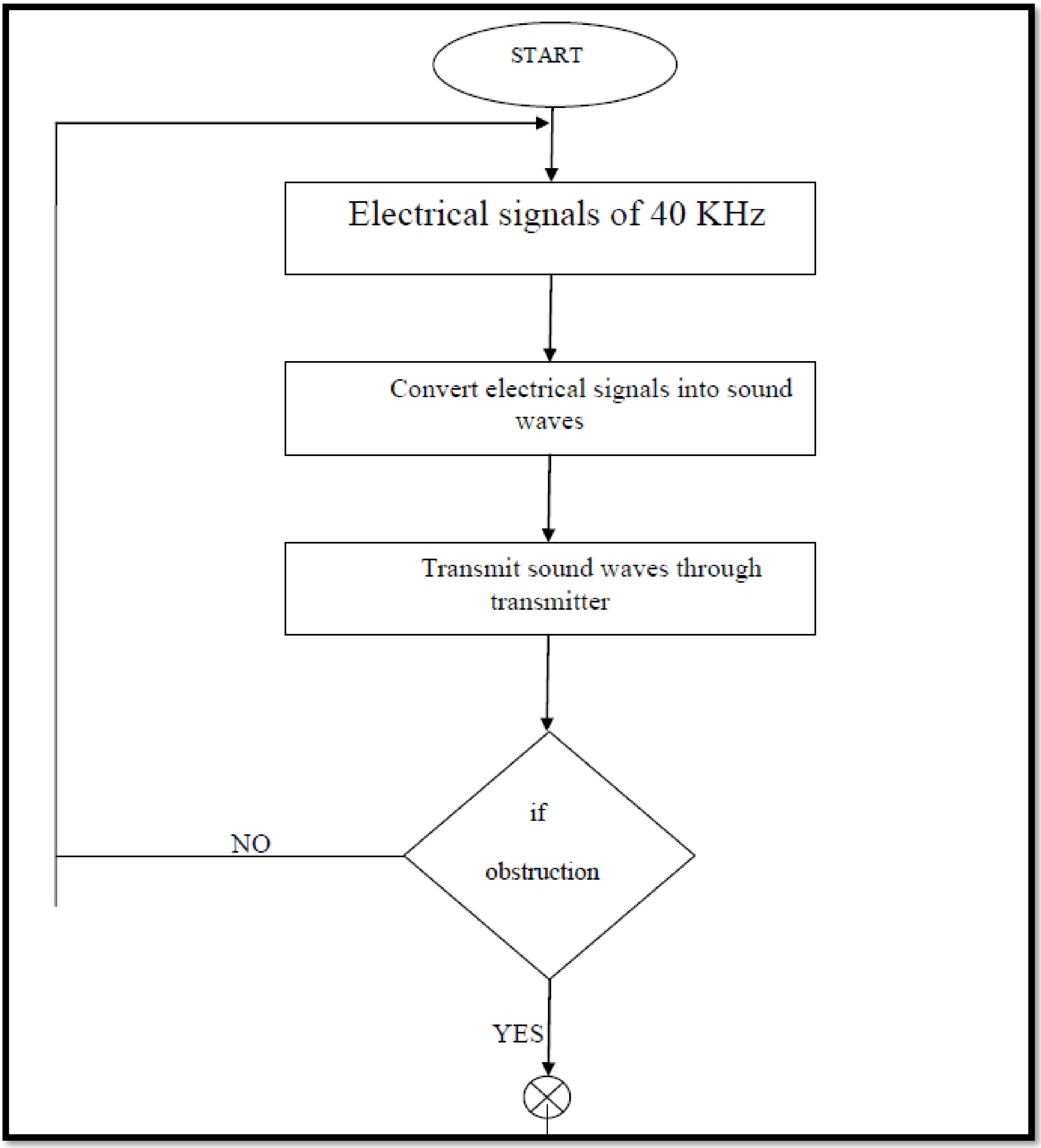
Output of Frequency Divider Section

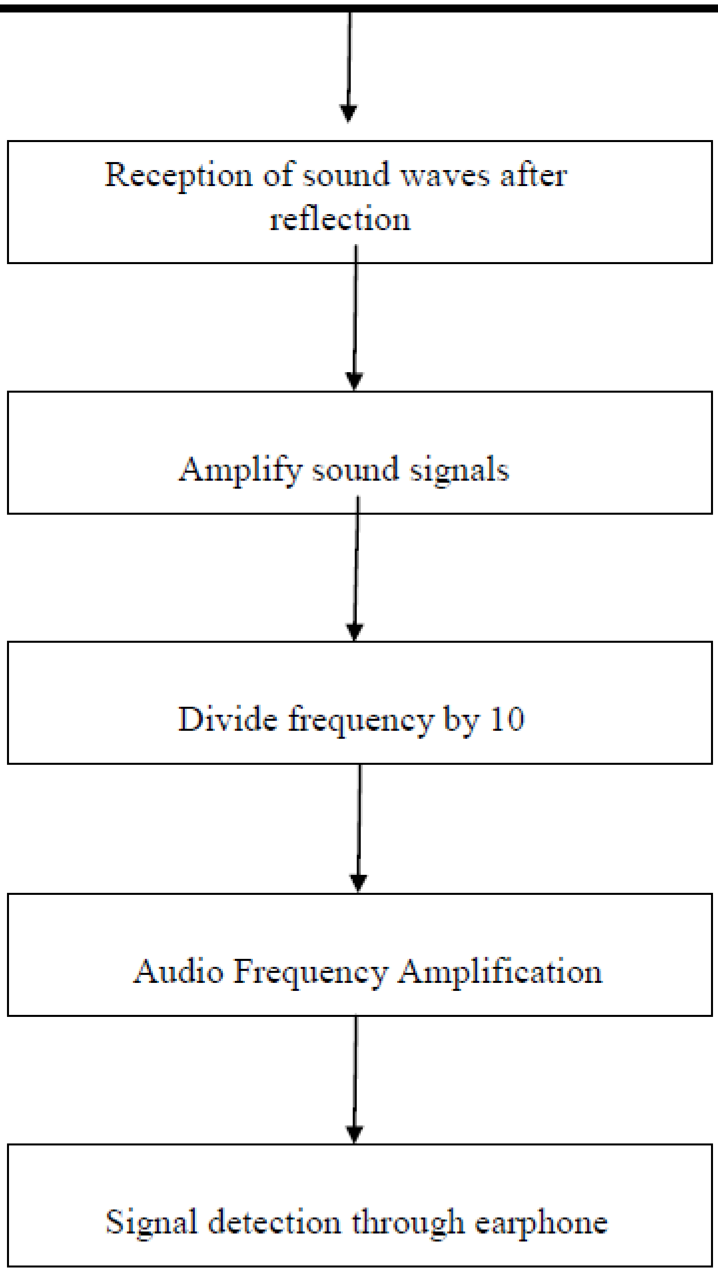
4. Power Supply

The power supply being used here is a simple and potable DC supply of voltage rating 9V.

9V Battery and Connector

FLOW DIAGRAM





Flow diagram of Ultrasonic Proximity Detection

WORKING

The transducers are mounted about 5cm apart on a general PCB board. The connections are given to the two emitter terminal connections of the transistors which form the basis of the oscillator circuit. As soon as the circuit is powered up, the oscillator slips into action. This is built around the action of twin BC 547 (T1 and T2) and capacitor as shown in the circuit. Here, T1 is forced into conduction. This would result in drop in collector voltage and an increase in emitter current. At the same time, the capacitor, C2 charges through R2. When it reaches a specific value of charge voltage, it turns on T2 by applying this voltage to the base of the transistor. Hence, increasing the base emitter voltage past the required 0.7V. Thus T2 enters the conduction state. As soon as this happens, the collector voltage of T2 drops. This is coupled to the base of T1. Thus, the low voltage at its base, forces it into the off state. Emitter current through T2 now increases substantially and the capacitor too starts discharging through the circuit. This happens until such a level till the capacitor voltage again slips below the required base voltage of T2 and then, T1 starts conduction all over again thus the cycle continues. It was found to produce a continuous signal of 40 KHz ± 2 KHz.

The transducer- transmitter section now begins the process of converting these electrical signals into sound waves which can be physically reflected back by any obstruction ahead. This is done by supplying the two emitter terminals of the oscillator circuit to the two connection terminals of the transducer. These are used to excite the piezo crystal within the transducer element. The transducer is so designed so as to work in the 40 KHz range. As signals are supplied to either end of the connections, at a time, as the oscillator circuit swings between the two polarities, this is shown at the transducer end as well with the crystal being forced to oscillate to and fro and thereby causing vibrations which constitute the required sound signal. This is, of course, not heard by man as the it exceeds the audible range of frequency by a considerable margin.

If there were to be an obstacle in front of the transmitter at a distance range of … to …, reflection of the transmitted waves must occur. It is this reflected wave that is picked up by the receiver which works on the principle of reverse piezo electric effect. Herein, the crystal vibrates first due to its sensitivity to the received signal and thereby forms a potential difference across its electric axes. This way, the transducer converts actual physical signals into electrical signals of the same frequency as its parent signal, in this case, the reflected signals.

These signals could have lost much of its strength during the process of transmission and reflection. The impedances it had to suffer through its course from the transmitter to the particular obstruction and then to the receiver, where complete reception is practically impossible, contributes towards this. Moreover, some of the signal must have been lost due to the dispersive nature of sound waves which does not necessarily travel in straight lines as light does. Further, interferences, particularly of the destructive type might have played a role in considerable weakening the transmitted signal. For this purpose, the circuit employs an amplifier section which is used to amplify this received signal for further processing.

These signals which may have incurred some frequency change due to Doppler Effect still may remain in the ultrasonic frequency range. It is necessary, therefore, to cut down the frequency to at least below 20 KHz so as to enable detection by the human ear. Towards this extent, the frequency divider is employed using the IC 4017 which is a Decade Counter. This configuration is used to reduce the incoming frequency through a division of ten. By this, we mean that for every ten clock signals that are fed as input, the decade counter expresses a high output. Thus, a frequency of 40 KHz is reduced to 4 KHz accordingly. This enables the detection of signals.

As a final segment, the processed signal undergoes one more round of amplification, this time using the inverting configuration of the IC 741 operational amplifier. The inverting amplifier is preferred because of its properties of suppressing noise and providing greater bandwidth at the expense of some gain which isn't the case with a non inverting configuration. We have designed the present circuit to provide a gain of nearly 5dB.

The audio signals are now fed into a standard earphone which outputs a disturbance each time an audio signal is received by it. The noise represents the detection of an obstacle while the increasing frequency of the noise conveys the close proximity of the obstacle; the lower frequency denotes a farther obstacle. Hence the obstacle has been detected.

APPLICATIONS

The ultrasonic proximity detector offers the following applications:

- Electronic guard for the blind
- Skoda Laura uses this detector to prevent accidental bumping
- Used for nondestructive testing
- Sensors used for liquid level control
- Sensing clear objects
- Applications not suitable for photoelectric sensors

FUTURE ENHANCEMENTS

The present device can be enhanced to perform a wider range of applications such as non destructive testing, provide distance measurement etc. apart from these present day applications, the future would see this device being utilized among the activities related with deep earth exploration. Here the device is equipped with imaging devices that can withstand the rigors of the unknown underground.

ADVANTAGES

The Ultrasonic Proximity Detector provides the following advantages compared to other proximity detectors

- No physical contact with the object to be detected, therefore, no friction and wear
- Unlimited operating cycles since there is no mechanical contact with the target
- Ultrasonic proximity sensors are not affected by target color or atmospheric dust, snow etc
- Can work in adverse conditions
- Sensing distance is more compared to inductive or capacitive proximity sensors
- The targets to be detected can be in the solid, liquid, granular or powder state.

DISADVANTAGES

The circuit does possess disadvantages which mainly depends upon the properties of ultrasonic signals itself

- Animals are easily distracted by ultrasonic sound signals
- Cannot detect objects in the range of a few millimeters
- Medium dependent.

CONCLUSION

The aim of this project, “EAR ENHANCEMENT DEVICE” to develop a cost effective, affordable and convenient tool to detect the presence of obstruction in the path of the user has been achieved and amplification of signals has also been achieved.

The circuit uses basic components such as transistors, resistors and integrated circuits to function as devices which provide oscillations, amplification and counting.

Further enhancement can be done by incorporating wireless technology.

All necessary tests has been performed and the circuit is found to be working at a optimum level.

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