



**Department of Electronics & Telecommunication
Engineering
Jnan Chandra Ghosh Polytechnic**

Semester – 4

UNIT -6

BASIC TELEPHONY

(Telephone transmitter – Receiver – Dial tone, side tone and antisidetone circuits –
Handset – Ringer – Switch hook – Hybrid – Local loop – Tone dialling – DTMF)

Smt. Kaberi Chatterjee Polley (Lecturer)

ECE- Class-4

In this class we will cover the following topic:

- Telephone Transmitter , Receiver
- Dial tone, side tone and antisidetone circuits
- Handset , Ringer , Switch hook , Hybrid
- Local loop
- Tone dialling , DTMF



BASIC TELEPHONY



What is Basic Telephony :

A **telephone** or **phone**, is a telecommunications device that permits two or more users to conduct a conversation when they are too far apart to be heard directly. A telephone converts sound , typically and most efficiently the human voice , into electronic signals that are transmitted via cables and other communication channels to another telephone which reproduces the sound to the receiving user.

In 1876, Alexander Graham Bell was the first to invent a device that produced clearly intelligible replication of the human voice. The telephone was the first device in history that enabled people to talk directly with each other across large distances.

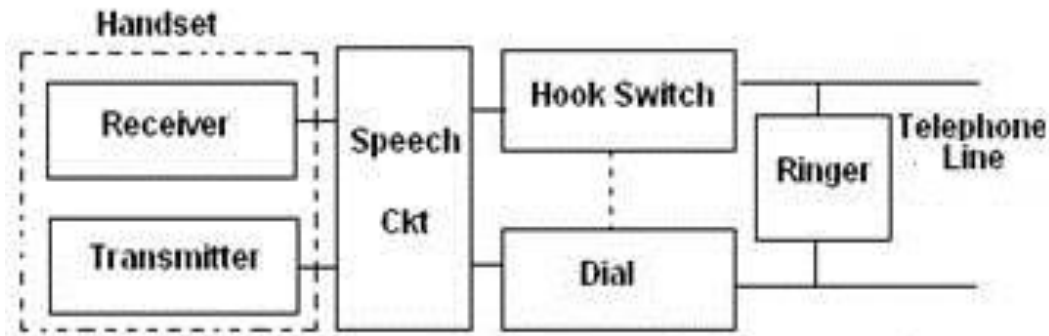
Basic Principle:

The Subscriber Telephone set/hand set consists of the , Transmitter /Microphone, Receiver, Switch connections to the Telephone Systems, Ringing Circuitry . The Handset is placed on the cradle when the telephone is not in use. In this condition it is open the switches and disconnects the handset from the system.

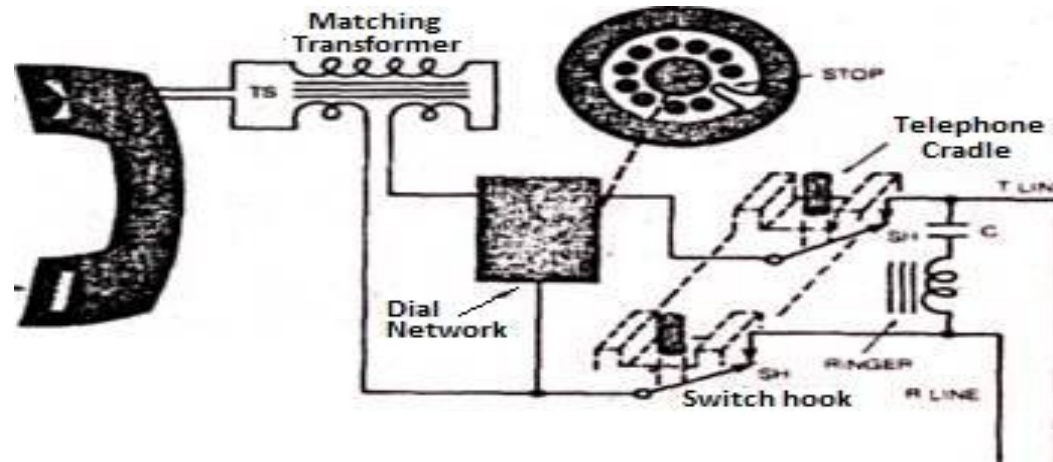
An electromagnet, called the ringer is connected on the telephone line on the exchange side, so that a ring can be received form the exchange when it is called. The exchange determines about the condition whether the telephone is busy, idle or initiating a call by monitoring the DC line level.

BASIC TELEPHONY

Basic Telephony : Block Diagram, Circuit Diagram



Block Diagram of Telephone Set



Circuit Diagram of Telephone Set

Telephone Transmitter

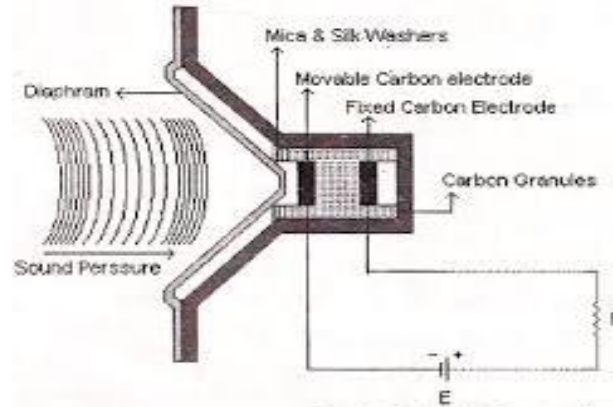
- ❑ The function of the telephone transmitter is to convert waves of sound into waves of electric current of corresponding waveform and frequency.
- ❑ The energy of the waves of electric current so generated must travel over wires for relatively long distances, and arrive at the receiver at a level providing normal listening.
- ❑ The energy is lost in transmission over wires. Because of this loss, the initial energy of the electrical waves must be made greater than the original energy of the sound waves.
- ❑ The circuit of the transmitter therefore must provide a means of supplying this extra energy to the electric waves which it generates.

- In a Telephone set , Microphone acts as a Transmitter.
- It's a Transducer which converts Sound Energy into Electrical Energy.
- There are different type Telephone Transmitters but **Carbon Granules Transmitter** is the most widely used in the handset of modern s of telephony.



Carbon Granules Transmitter

Carbon Granules Transmitter : Carbon granules transmitter works on the basis of principle that the resistance of the carbon granules is inversely proportional to the pressure.



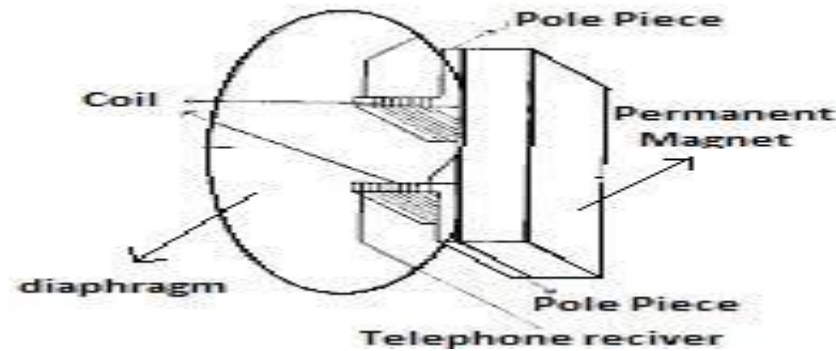
Carbon granules transmitter



- Carbon granules are placed between two electrodes in an insulated chamber.
- One electrode is fixed with the back of the chamber whereas the other electrode is attached with the moveable diaphragm.
- Two electrodes are connected with the battery.
- The transmitter offers an electrical resistance to the flow of the current, which is the resistance of the carbon granules.
- Pressure on the carbon granules changes due to the movement of diaphragm when the voice/audio is made.
- Current flow between two electrodes varies with the changes of the carbon granules pressure.

Telephone Receiver

The Sound reproducer in a Telephone set is called Receiver



Constructional details of Telephone Receiver

- The receiver is the reverse function of transmitter in a telephone set.
- It is a device which converts electrical energy into sound energy.
- It consists of a Diaphragm, Permanent Magnet and Windings.
- Due to flow of incoming current signal through windings magnetic flux is produced.
- The magnetic flux flows the magnetic path which consists of the iron path of permanent magnet, diaphragms, pole pieces and the two air gaps between the diaphragm and two pole pieces.
- A varying magnetic pull is produced which causes the diaphragm to vibrate in accordance with the signal current received and hence produce the sound.
- Permanent magnet is used to polarize the receiver.

Dial tone

- ❑ A **dial tone** is a **telephony** signal sent by a **telephone** exchange or private branch exchange (PBX) to a terminating device, such as a **telephone**, when an off-hook condition is detected.
- ❑ It indicates that the exchange is working and is ready to initiate a **telephone** call.
- ❑ The **dial tone sound** is simply a combination of 350-hertz **tone** and a 440-hertz **tone**.
- ❑ The purpose of a dial tone is to indicate that the phone is functional and ready to make a call.
The dial tone, of course, stops when the call begins.



Side Tone

Side tone : Side tone is defined as the reproduction of a sound in the receiver picked up from the associated transmitter.

- This is when you hear a little bit of your own voice in your ear as you are talking on a traditional **phone / handset**. For most of us it
- makes it more comfortable to talk on the **phone**.
- Side tone gives an indication that **Microphone** in transmitter is working, and how loud you are speaking and that your call is connected.
- The side tone is reduced by adjusting both noise and signal levels and/or by improving the signal-to-noise ratio of such signals.
- Side tone is valuable for the hearing impaired. The amount of side tone on land-lines is typically 8%.
- Side tone can be, and often is, amplified for land-line phones for the hearing impaired.



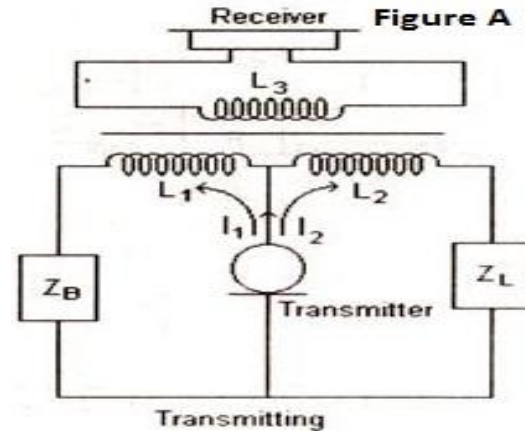
Anti side Tone

The **anti-side tone** circuit is an assemblage of transformers, resistors, and capacitors that perform a number of functions. The primary function is to reduce **side tone**, which is the distracting sound of the speaker's own voice coming through the receiver from the transmitter.

- ❑ The anti-side tone circuit accomplishes this reduction by interposing a transformer between the transmitter circuit and the receiver circuit and by splitting the transmitter signals along two paths.
- ❑ When the divided signals having opposite polarities, meet at the transformer, they almost entirely cancel each other in crossing to the receiver circuit.
- ❑ The speech signal coming from the other end of the line, on the other hand, arrives at the transformer along a single, undivided path and crosses the transformer unimpeded.
- ❑ The anti-side tone circuit also matches the low electrical impedance of the telephone instrument's circuits to the higher electrical impedance of the telephone line.
- ❑ Impedance matching allows a more efficient flow of current through the system.



Anti side Tone Circuit

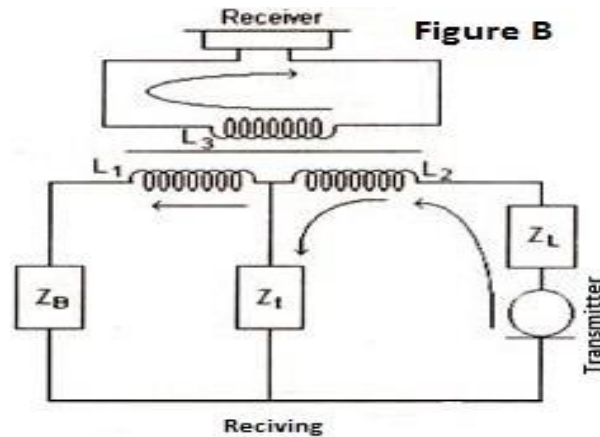


To control the level of the side tone to the desirable amount Anti side tone induction coli circuit is used in the Telephone set.

The principle of the arrangement of the circuit can be explained as follows:

- Consider the fig.-A . Here transmitter is transmitting if - $Z_B = Z_L$ & $L_1 = L_2$
- Transmitter current divides equally in L_1 & L_2 , as a result magnetic field produced in these two windings are equal and opposite to each other , hence cancel each others effect and no emf is induced in L_3 and the side tone is completely eliminated.

Anti side Tone Circuit



- In fig.-B , the receiving current passes through L1 & L2 . The magnetic field produced are in the same direction and reinforced each others effect.
- An emf is induced in the receiver circuit and current flows through the receiver.
- The Anti side tone circuit is modified into more practical-
 - The three windings are magnetically coupled.
 - L1 and L2 are not equal , hence an emf is induced in L3 from the transmitter
 - The value of R across which the receiver is connected , is such that the voltage drop across it is equal and opposite to the emf induced in L3.
 - This results in a much reduced in side tone in the receiver.

Telephone Handset

Telephone handset or instrument is made up of the following functional **components**:

1. A power source,
2. A switch hook,
3. A dialer,
4. A ringer,
5. A transmitter,
6. A receiver,
7. An anti-side tone circuit.

Power source : The first sources were batteries located in the telephone instruments themselves, but since the 1890s current has been generated at the local switching office. The current is supplied through a two-wire circuit called the local loop. The standard voltage is 48 volts.

Switch hook : The switch hook connects the telephone instrument to the direct current supplied through the local loop. Nowadays the hook has been replaced by a cradle to hold the combined handset, enclosing both receiver and transmitter. In some modern electronic instruments, the mechanical operation of metal contacts has been replaced by a system of transistor relays.

When the telephone is “on hook,” contact with the local loop is broken. When it is “off hook” (i.e., when the handset is lifted from the cradle), contact is restored, and current flows through the loop. The switching office signals restoration of contact by transmitting a low-frequency “dial tone”—actually two simultaneous tones of 350 and 440 hertz.



Telephone Handset

Dialer: The dialer is used to enter the number of the party that the user wishes to call. Signals generated by the dialer activate switches in the local office, which establish a transmission path to the called party. Dialers are of the rotary and push-button types.

Ringer: The ringer alerts the user to an incoming call by emitting an audible tone or ring. Ringers are of two types, mechanical or electronic. Both types are activated by a 20-hertz, 75-volt alternating current generated by the switching office. The ringer is commonly activated in two-second pulses, with each pulse separated by a pause of four seconds.

The ringer circuit remains connected to the local loop even when the telephone is on hook. A larger voltage is necessary to activate the ringer because the ringer circuit is made with a high electrical impedance in order to avoid draining power from the transmitter-receiver circuit when the telephone is in use. A capacitor prevents direct current from passing through the ringer once the handset has been lifted off the switch hook.

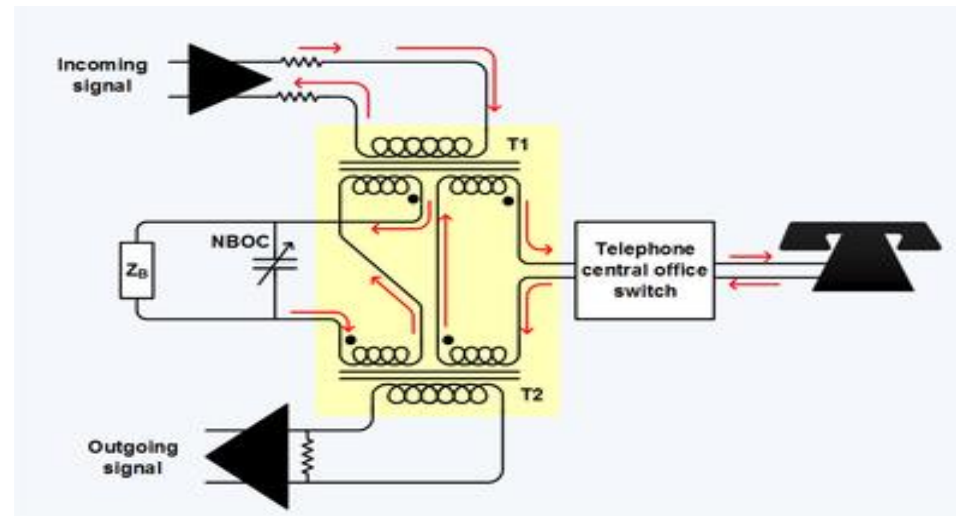
Transmitter , Receiver & Anti side-tone: Already explained earlier



Telephone Hybrid

A **Telephone Hybrid** is the component at the ends of a subscriber line of the public switched telephone network (PSTN) that converts between two-wire and four-wire forms of bidirectional audio paths. When used in broadcast facilities to enable the airing of telephone callers, the broadcast-quality telephone hybrid is known as a **broadcast telephone hybrid** or **telephone balance unit**.

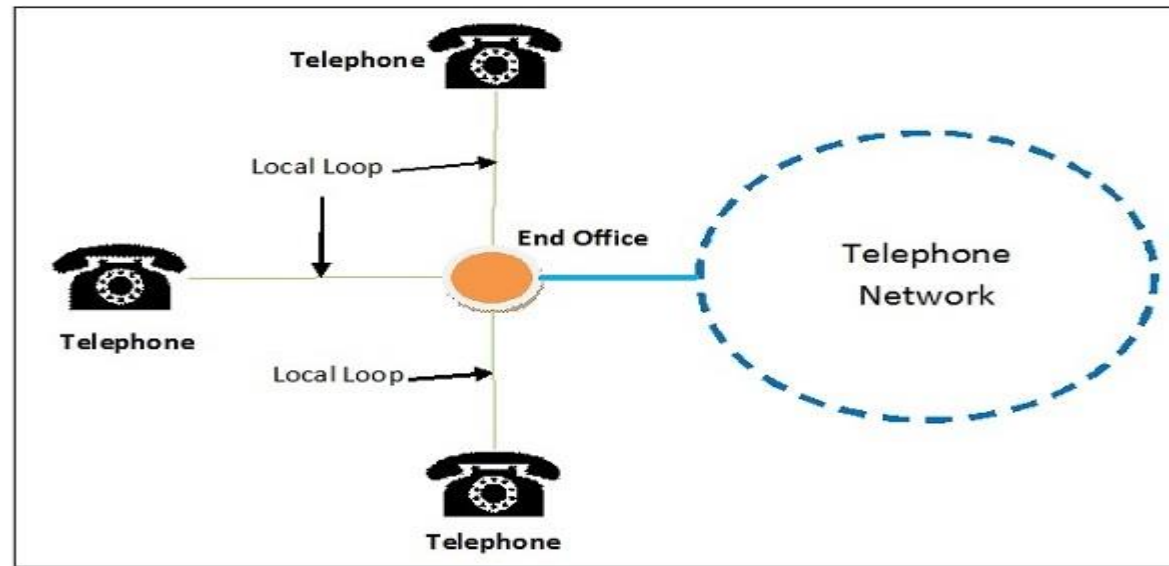
The need for hybrids comes from the nature of analog plain old telephone service (POTS) home or small business telephone lines, where the two audio directions are combined on a single two-wire pair. Within the telephone network, switching and transmission are almost always four-wire circuits with the two signals being separated. Hybrids perform the necessary conversion.



Conversion of 4 wires to 2 wires

Local Loop in Telephone System

In a telephone system, the local loop is a two-wire connection between the subscriber's house and the end office of the telephone company. It is commonly referred to as the "last mile" of the telephone network. The loop may run from 1km to as far as 10 km.



Traditionally, local loops are composed of twisted pair copper cables. The old local loops have several limitations – narrow bandwidth, high attenuation, distortion of symbols, crosstalk's etc.

In recent times, copper wires are being replaced by fiber optic cables for faster and more accurate performance. Installation of fiber cables is popularly known as FTTH (Fiber to the Home).

DTMF Dialling in Telephone



TONE also known as “touch tone” dialling is the name given to phones that make a distinct beep when a keypad button is pressed.

DTMF is a signaling system for identifying the keys or better say the number dialled on a pushbutton or DTMF keypad. The early telephone systems used pulse dialling or loop disconnect signalling. This was replaced by multi frequency (MF) dialling. DTMF is a multi frequency tone dialling system used by the push button keypads in telephone and mobile sets to convey the number or key dialled by the caller. DTMF has enabled the long distance signalling of dialled numbers in voice frequency range over telephone lines. This has eliminated the need of telecom operator between the caller and the callee and evolved automated dialling in the telephone switching centres.

DTMF (Dual tone multi frequency) as the name suggests uses a combination of two sine wave tones to represent a key. These tones are called row and column frequencies as they correspond to the layout of a telephone keypad.

DTMF Dialling in Telephone

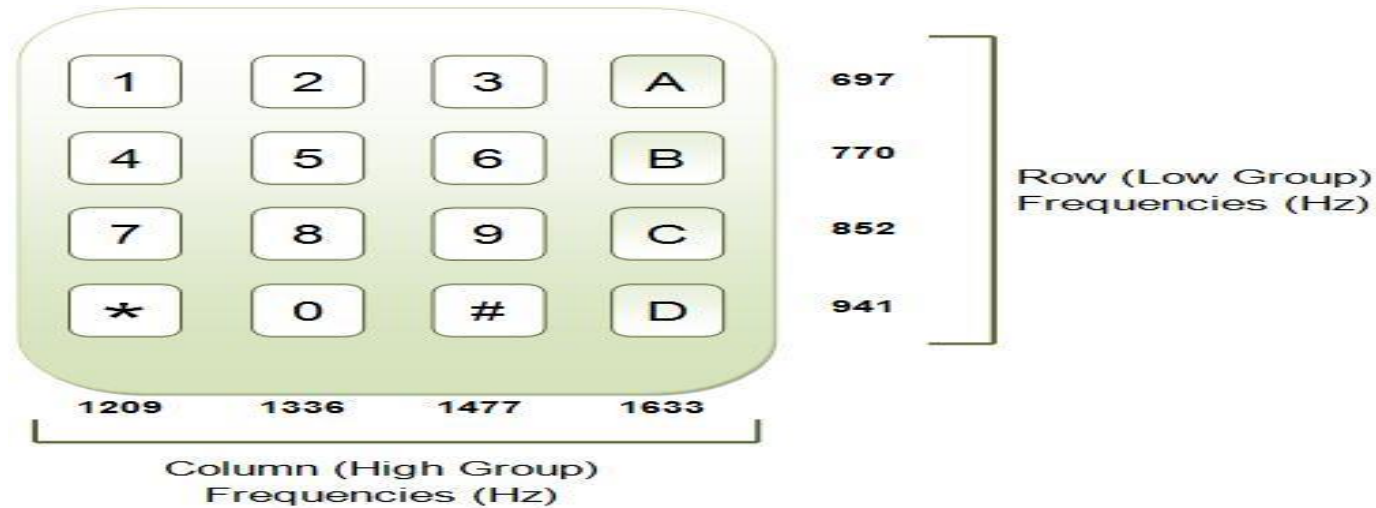


Image Showing DTMF Tone Frequencies

A **DTMF keypad** (generator or encoder) generates a sinusoidal tone which is **mixture of the row and column frequencies**. The row frequencies are low group frequencies. The column frequencies belong to high group frequencies. This prevents misinterpretation of the harmonics. Also the frequencies for **DTMF** are so chosen that none have a harmonic relationship with the others and that mixing the frequencies would not produce sum or product frequencies that could mimic another valid tone. The high-group frequencies (the column tones) are slightly louder than the low-group to compensate for the high-frequency roll off of voice audio systems.

The row and column frequencies corresponding to a **DTMF keypad** have been indicated in the above figure.

Thank You