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GOOD WRITE
A Mark of Quality

EXPERIMENT-1

AIM- To study different types of transmission media

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# EXPERIMENT-1

**AIM:-** To study different types of transmission media.

**THEORY:-**

Computer and other telecommunication devices use signals to represent data. These signals are transmitted from one device to another in the form of electromagnetic energy. Electromagnetic signal can travel through a vaccum, air or other transmission media.

Transmission media can be divided into two broad categories:

- Guided
- Unguided.

## Guided Media

guided media, which are those that provide a conduit from one device to another. A signal travelling along guided media is directed and contained by the physical limits of the medium. Twisted pair and coaxial cable accept and transport signal in the form of electrical current. Optical fiber accepts and transport signal in the form of light.

Categories of guided media.

- Twisted-pair cable
- Coaxial cable
- Fiber-optic cable.

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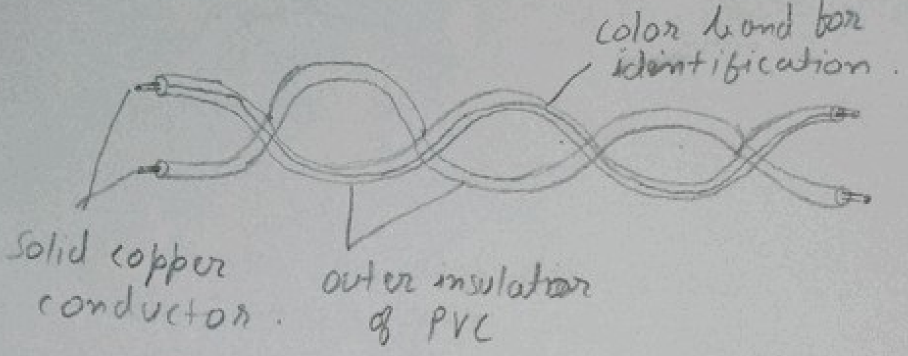


Fig : Unshielded Twisted Pair cable

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## Twisted-Pair Cable.

Types of twisted pair cables.

- Unshielded Twisted Pair (UTP)
- Sheelded Twisted Pair (STP)

## Unshielded Twisted Pair (UTP) cable.

UTP is the most common type of telecommunication medium in use today. A twisted pair consist of two conductors, each with its own colored plastic insulation. The plastic insulation is color banded for identification.



The Electronic Industries Association (EIA) has developed standard to grade UTP cables by quality.

- Category 1: The basic twisted pair cabling used in telephone. Used for voice and low-speed data commⁿ.
- Category 2:- Suitable for voice and data transmission of upto 4 Mbps
- Category 3:- Required atleast 3 twist per foot, can be used for data transmission of upto 10 Mbps.
- Category 4:- Used for data transmission of upto 16 Mbps
- Category 5:- Used for data transmission upto 100 Mbps.

## Advantage

- Low cost
- Ease of use.

## Disadvantage

- Twisting does not always eliminated noise.

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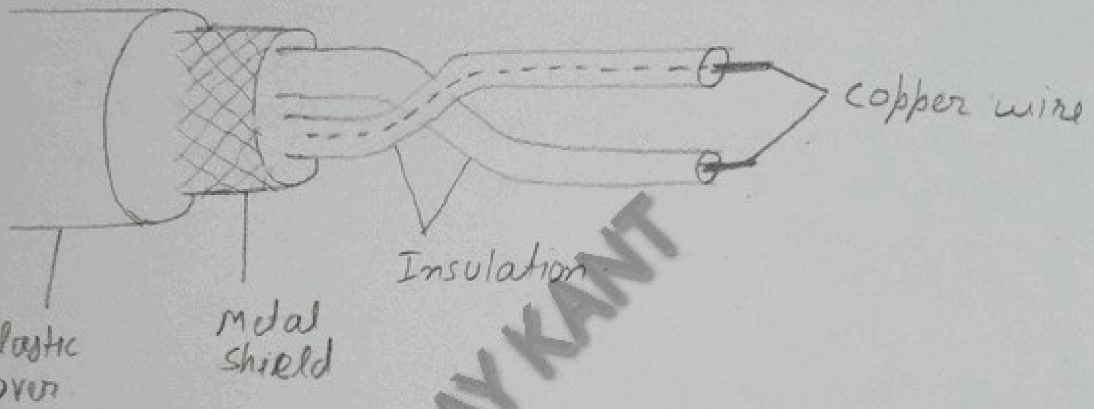


fig: Shielded twisted pair cable

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## Shielded Twisted Pair (STP) cable

STP cable has a metal foil or braided-mesh covering that encases each pair of insulated conductors. The metal casing prevents the penetration of e.m. noise. It can also eliminate a phenomenon called crosstalk. This effect can be experienced during telephone conversations when one can hear other conversations in the background. Shielding each pair of twisted cable can eliminate most cross talk. The shield must be connected to a ground.

Advantages:-

- Shielding eliminate noise

Disadvantage

- Materials and manufacturing requirement makes STP more expensive than UTP

## Coaxial Cable

Coax has a central core conductor of solid or stranded wire enclosed in an insulating sheath, which is, in turn encased in an outer conductor of metal foil, braid or a combination of the two. The outer metallic wrapping serves both as a shield against noise and as second conductor which completes the circuit. This outer conductor is also enclosed in an insulating sheath and the whole cable is protected by a plastic cover.

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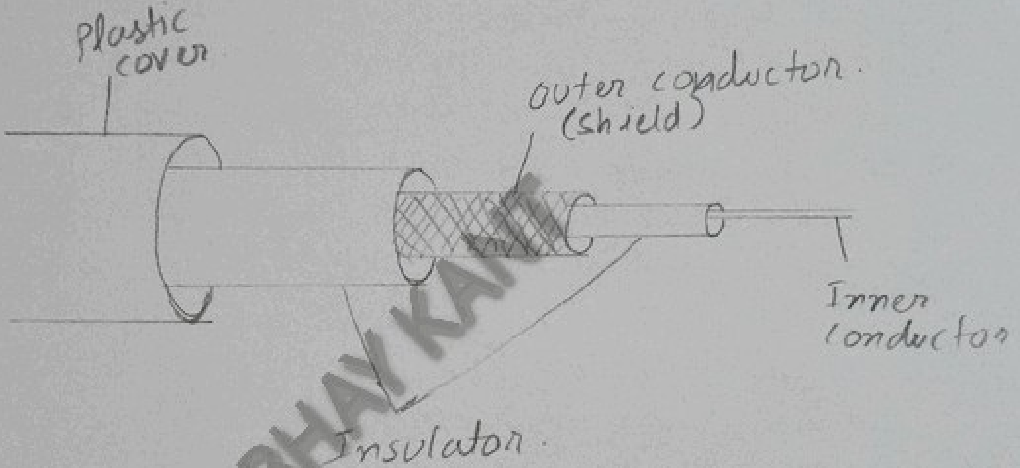


fig : coaxial cable

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## Coaxial Cable standards.

Different coaxial cable designs are categorized by their radio government (RG) rating.

Following are a few of the common ones.

- RG-8, Used in thick ethernet
- RG-9, Used in thick ethernet
- RG-11, Used in thick ethernet
- RG-58, Used in thin ethernet
- RG-59, Used for TV

## Coaxial Cable Connector.

All coaxial connector have a single pin protruding from the center of the male connector that slides into a ferrule in the female connector.

The most common connector is barrel connector. Of the barrel connector most popular is the bayonet network connector (BNC)

Two other commonly used types of connectors are.

- T - connector
- terminators.

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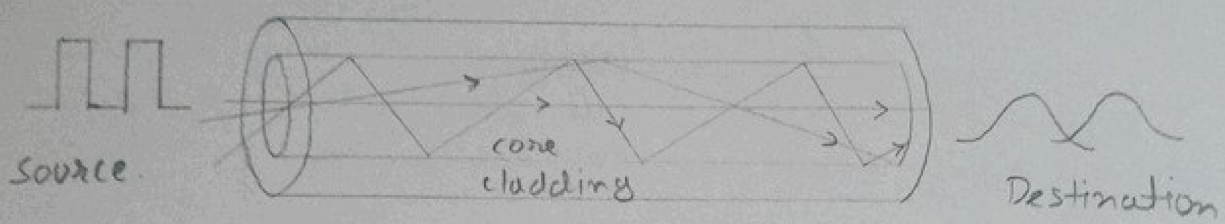


fig : Multimode step-index fiber

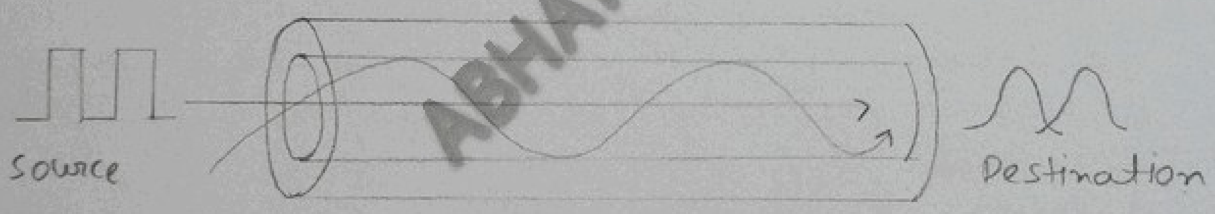


fig : Multimode graded-index fiber

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## OPTICAL FIBER CABLE

Optical fiber is made of glass or plastic and transmit signals in the form of light. It consist of an inner glass core surrounded by a glass cladding which has a lower refractive index. Digital signals are transmitted in the form of intensity-modulated light signal which is trapped in the glass core. Light is launched into the fiber using a light source such as light emitting diode (LED) or laser. It is detected on the other side using a photo detector such as photo transistor. The light is kept in the core by the phenomenon of total internal reflection which causes the fiber to act as a waveguide.

Propogation Modes

- Single Mode
- Multi Mode
  - a) Step-index
  - b) Graded-index

In multimode step-index fiber, the density of the core remains constant from the center to the edges. A beam of light moves through this constant density in a straight line until it reaches the interface of the core and the cladding. At the interface, there is an abrupt change to a lower density that alters the angle of the beam's motion.

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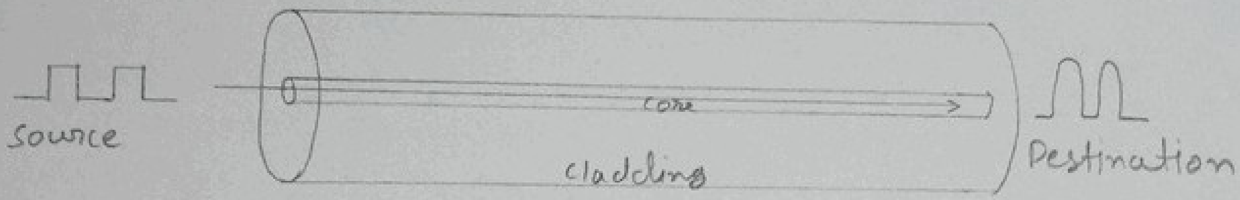


fig: single mode fiber

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A second type of fiber, called multimode graded-index fiber, decreases this distortion of the signal through the cable. A graded index fiber has varying densities. Density is highest at the center of the core and decreases gradually to its lowest at the edge.

## Single Mode.

Single mode uses step-index fiber and a highly focused source of light that limits beams to a small range of angles, all close to the horizontal.

## Characteristics of optical fiber cable.

1) Extremly high bandwidth in the range of 100Mbps to 2Gbps.
2. Low attenation.
3. Not affected by EMI
4. Cost of fiber optic cable is more compared to twisted pair and co-axial.
5. Installation is costly and difficult.

## Advantage of optical fiber

1. Small size and light weight
2. Easy availability and low cost
3. No electromagnetic interference
4. Less signal attenuation.
5. Higher bandwidth.

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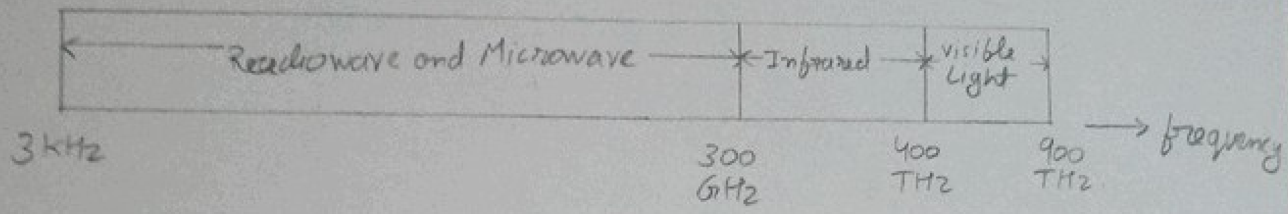


fig:- Electromagnetic spectrum for wireless communication

Disadvantages
1. Cost is high.
2. Difficult installation and maintenance.
3. Fragility.

UNGUIDED MEDIA

Unguided media or wireless comm^n transport em waves without using a physical conductor. Instead, signals are broadcast through air and thus are available to anyone who has a device capable of receiving them.

Propogation Methods

Few propogation methods are.
1. Ground wave propogation.
2. Sky propogation.
3. Space propogation or line of sight propogation.

Types of wireless media.

1. Radio wave.
2. Microwave
3. Infrared.

Radio wave transmission system.

The range of em spectrum between 10 KHz and 1 GHz is called Radio Frequency (RF)

Radio waves include the following types.
1) short wave used in AM radio
2) VHF
3) UHF

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The radio frequency bands are regulated and require a licences to operate.

Microwave transmission system.

~~It makes~~

These frequencies are higher than the RF & they produce better throughput and performance.

There are two types of microwave commⁿ

1. Terrestrial
2. Satellitie

Terrestrial Microwave

Microwaves do not follow the curvature of the earth and therefore require line-of-sight transmission and reception equipment. The distance coverable by a line-of sight signal depends to a large extent on the height of the antenna; the taller the antenna, the longer the sight distance. Height allows the signal to travel farther without being stopped by the curvature of the planet and raises the signal above many surface obstacles such as low hills and tall buildings that would otherwise block transmission.

Microwave system use directional parabolic antennas to transmit and receive signals in the 4-6 and 21 to 23 GHz. Microwaves are unidirectional.

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## Infrared

The em waves having freq. from 300 GHz to 400 THz (wavelength from 1mm to 770 mm) are known as infrared waves.
IR uses line of sight propogation.
IR light is a commⁿ medium whose properties are significantly different from those of the radio freq. A very important property of IR is that it cannot penetrate walls.

# EXPERIMENT - 2

**AIM:** To study Quadrature Phase shift Keying Modulation


fig A: QPSK constellation where the carrier phases are $0, \pi/2, \pi, 3\pi/2$

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# EXPERIMENT - 2

AIM: To study Quadrature Phase Shift Keying Modulation

THEORY:-

QPSK has twice the bandwidth efficiency of BPSK since two bits are transmitted in a single modulation symbol. The phase of the carrier takes on one of four equally spaced values, such as $0, \pi/2, \pi$ and $3\pi/2$, where each value of phase corresponds to a unique pair of message bits. The QPSK signal for this set of symbol states may be defined as

$$S_{QPSK}(t) = \sqrt{\frac{2E_s}{T_s}} \cos\left[2\pi f_c t + (i-1)\frac{\pi}{2}\right]; \quad 0 \le t < T_c, \quad i = 1,2,3,4$$

where $T_s$ is the symbol duration and is equal to twice the bit period.

$E_s$ is Energy per symbol.

Using trigonometric identities rewriting above eqⁿ

$$S_{QPSK}(t) = \sqrt{\frac{2E_s}{T_s}}\left[\cos\left[(i-1)\frac{\pi}{2}\right]\cos(2\pi f_c t) - \sin\left[(i-1)\frac{\pi}{2}\right]\sin 2\pi f_c t\right]$$

Based on this representation, a QPSK signal can be depicted using a two dimensional constellation diagram with four points as shown.

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From the constellation diagram, the distance between adjacent points in the constellation is $\sqrt{2E_s}$. Since each symbol corresponds to two bits, then $E_s = 2E_b$, thus the distance between two neighbouring points in the QPSK constellation is equal to $2\sqrt{E_b}$.

A striking result is that the bit error probability of QPSK is identical to BPSK, but twice as much data can be sent in the same bandwidth. Thus when compared to BPSK, QPSK provides twice the spectral efficiency with exactly the same energy efficiency.

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EXPERIMENT-3

AIM- To study Quadrature Amplitude Modulation.

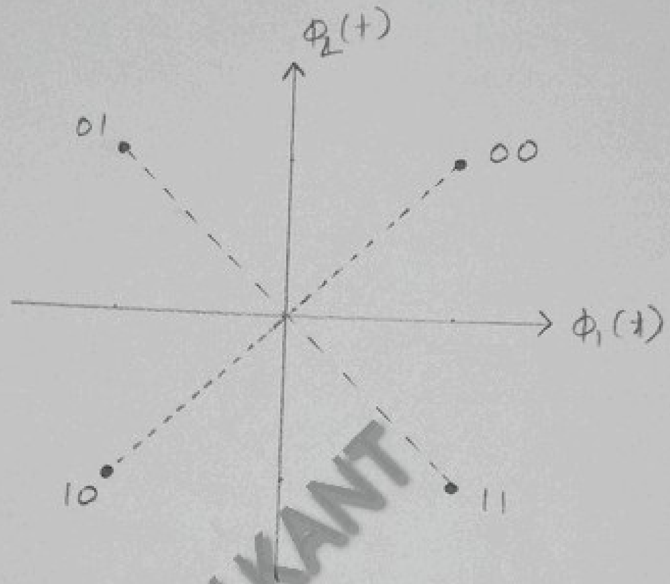


fig A 4-QAM
1 amplitude, 4 phases.

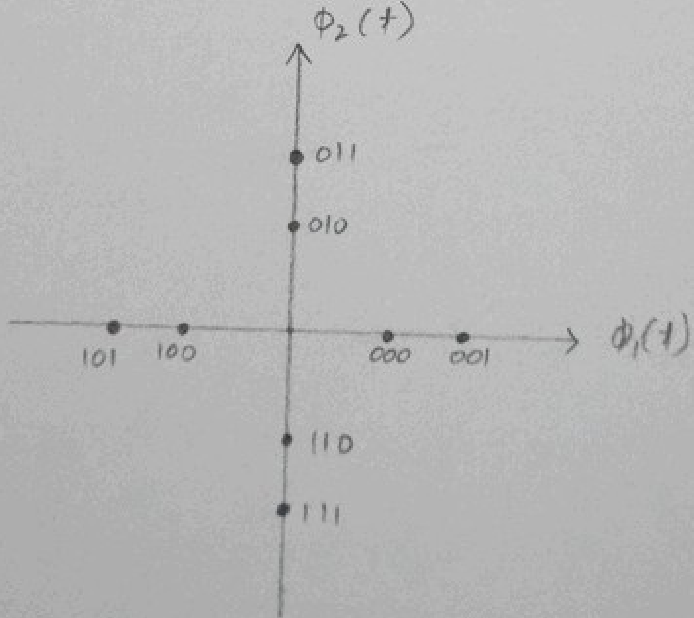


fig B 8-QAM
2 amplitudes, 4 phases

# EXPERIMENT - 3

AIM:- TO study Quadrature Amplitude Modulation

THEORY:-

Quadrature amplitude modulation (QAM) means combining ASK and PSK in such a way that we have maximum contrast between each bit, dibit, tribit, quadbit and so on.

Possible variations of QAM are numerous. Theoretically, any measurable no. of changes in amplitude can be combined with any measurable no. of changes in phase.
Fig A shows two possible configurations, 4-QAM and 8-QAM. In both cases, the no. of ampl shifts is fewer than the no. of phase shifts. Because amplitude changes are susceptible to noise and require greater shift differences than do phase changes the no of phase shifts used by a QAM system is always greater than the no. of amplitude shifts.

General form of M-ary QAM signal

$$S_i(t) = \sqrt{\frac{2E_{min}}{T_s}}\, a_i \cos(2\pi f_c t) + \sqrt{\frac{2E_{min}}{T_s}}\, b_i \sin(2\pi f_c t)$$

$$0 \leq t \leq T \qquad i = 1, 2, \cdots M$$

where $E_{min}$ is the energy of the signal with the lowest amplitude and $a_i$ and $b_i$ are a pair of independent integers chosen according to the location of the particular signal point.

The signal $s_i(t)$ may be expanded in terms of a pair of basis functions defined as.

$$\phi_1(t) = \sqrt{\frac{2}{T_s}} \cos(2\pi f_c t) \qquad 0 \le t \le T_s.$$

$$\phi_2(t) = \sqrt{\frac{2}{T_s}} \sin(2\pi f_c t) \qquad 0 \le t \le T_s.$$

EXPERIMENT - 4

**AIM:-** To study 16 Quadrature Amplitude Multiplexing

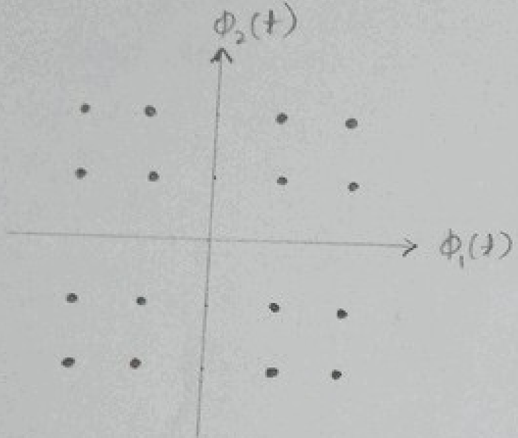


fig A: 16 - QAM
3 Amplitudes
12 - phases

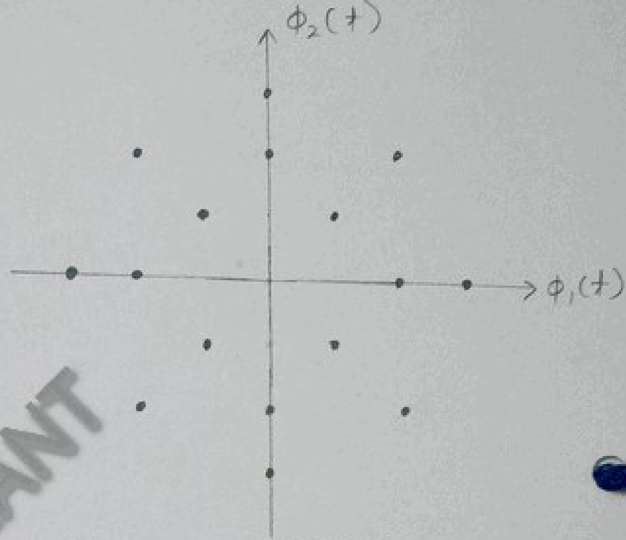


fig B: 16 - QAM
4 - amplitude
8 - phases

# EXPERIMENT - 4

AIM:- To study 16 Quadrature Amplitude Multiplexing

THEORY:-

Possible variations of QAM are numerous. Theoretically, any measurable number of changes in amplitude can be combined with any measurable number of changes in phase.

Three popular 16-QAM configuration are shown in fig. The fig A. three amplitudes and 12 phases handles noise best because of a greater ratio of phase shift to amplitude. It is the ITU-T recommendation. The second fig. B four amplitudes and eight phases is the OSI recommendation. If you examine closely, you will notice that although it is based on concentric circles not every interaction of phase and amp<sup></sup>is utilized. By using few possibilities, the measurable differences between shifts are increased and greater signal readability is ensured.
Several QAM designs link specific amp<sup></sup>with specific phases. This means that even with the noise problems associated with amplitude shifting the meaning of a shift can be recovered from phase information.

Advantage of QAM over ASK is its lower susceptibility to noise.

EXPERIMENT-5

AIM: To study serial Interface RS-232 and its application

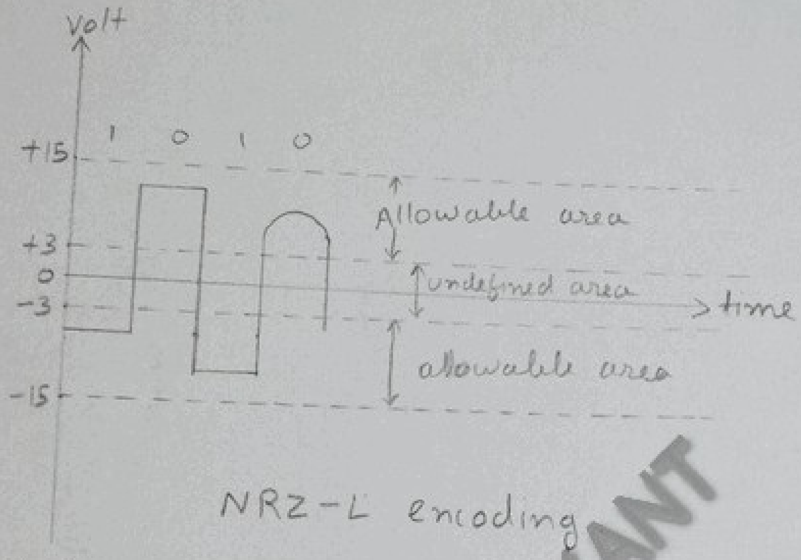


fig A: Electrical specification for sending data in EIA 232

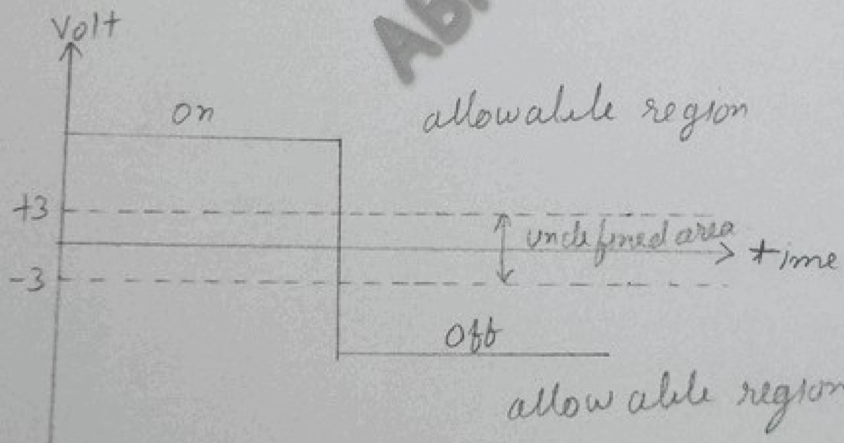


fig B: Electrical specification for control signal in EIA 232

# EXPERIMENT - 5

AIM:- To study Serial Interface RS-232 and its application

APPARATUS REQUIRED:-

THEORY:-

EIA-232 (previously called RS-232) defines the mechanical, electrical and functional characteristics of the interface between a DTE and a DCE.

Mechanical Specification

The mechanical specification of the EIA-232 std defines the interface as a 25-wire cable with a male and a female DB-25 pin connector attached to either end. The length of the cable may not be exceeded 15 meters.

Electrical specification

In RS-232, a 1 is represented by -3 to -25V while a 0 bit is +3 to +25V, making -3 to +3 undefined.

EIA-232 states that all data must be transmitted as logical 1's and 0's using NRZ-L encoding.

Control and Timing

Only 4 wires out of these 25 signal wire are used for data functions. The remaining 21 are reserved for functions like control, timing, grounding and testing.

Teacher Sign. ....................

A


DB-25

| Pin NO. | Pin function of DB-25 |
|---|---|
| 1 | Shield |
| 2 | Transmitted data |
| 3 | Received data |
| 4 | Request to send |
| 5 | Clear to send |
| 6 | DCE ready |
| 7 | Signal ground common return |
| 8 | Received line signal detector |
| 9 | Reserved (testing) |
| 10 | Reserved (testing) |
| 11 | Unassigned. |
| 12 | Secondary received line signal detector. |
| 13 | Secondary clear to send |
| 14 | Secondary transmitted data |
| 15 | Transmitter signal element timing (DCE - DTE) |
| 16 | Secondary received data |
| 17 | Received signal element timing (DCE - DTE) |
| 18 | Local loopback |
| 19 | Secondary request to send |
| 20 | DTE ready |
| 21 | Remote loopback and signal quality detector. |
| 22 | Ring detector |
| 23 | Data signal rate select |
| 24 | Transmitter signal element timing (DTE - DCE) |
| 25 | Test mode. |

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EIA-232 defines that signals other than data must be sent using OFF → less than -3 volts and ON → greater than +3 volts.

Functional specifications
Two different implementations of EIA-232 are DB-25 and DB-9

DB-25 implementation:-
EIA-232 defines the functions assigned to each of the 25 pins in the DB25 connector.

DB-9 implementation.
Many of the pins on the DB-25 implementation are not necessary in a single asynchronous connection. A simple 9 pin version of EIA-232 known as DB-9 was developed.

Applications of RS-232
- Receipt printer, POS
- Sensor Data com
- Communication interface on PC

Teacher Sign. ............

EXPERIMENT- 6

AIM:- To study the parallel interface centronics and its application

A

Pin description for centronics type parallel interface to PC Printer

| Signal Pin No. | Return Pin No. | SIGNAL | DIRECTION |
|---|---|---|---|
| 1 | 19 | $\overline{STROBE}$ | IN |
| 2 | 20 | DATA 1 | IN |
| 3 | 21 | DATA 2 | IN |
| 4 | 22 | DATA 3 | IN |
| 5 | 23 | DATA 4 | IN |
| 6 | 24 | DATA 5 | IN |
| 7 | 25 | DATA 6 | IN |
| 8 | 26 | DATA 7 | IN |
| 9 | 27 | DATA 8 | IN |
| 10 | 28 | $\overline{ACKNLG}$ | OUT |
| 11 | 29 | BUSY | OUT |
| 12 | 30 | PE | OUT |
| 13 | – | SLCT | OUT |
| 14 | – | $\overline{AUTO}$ $\overline{FEED\ XT}$ | IN |
| 15 | – | NC | |
| 16 | – | 0V | |
| 17 | – | CHASIS GND | |
| 18 | – | NC | |
| 19-30 | – | GND | |
| 31 | – | $\overline{INIT}$ | IN |
| 32 | – | $\overline{ERROR}$ | OUT |
| 33 | – | GND | |
| 34 | – | NC | |
| 35 | | | |
| 36 | | $\overline{SLCT\ IN}$ | IN |

# EXPERIMENT - 6

AIM:- To study the parallel interface Centronics and its application

THEORY:-

A common standard for interfacing with parallel printers is the centronics parallel Interface Standard, named after the company that developed it.

Transfer of the ASCII codes from a microcomputer to a printer must be done on a handshake basis because the microcomputer can send characters much faster than the printer can print them. The printer must in some way let the microprocessor know that its buffer is full and that it cannot accept any more characters until it prints some out.

Centronics - type printers usually have a 36-pin interface Connector. Fig A. shows the pin assignments and descriptions for this connector as it is used in the IBM PC printer and the EPSON printers.

The reason for the large number of lines is that each data and signal line has it's own individual ground return line. Individual ground return Reduce the change of picking up electrical noise in the line.

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The rest of the pins on the 36 pin connector fall into two categories: signals sent to the printer to tell it what operation to do; and signals from the printer that indicate its status.
The major control signals to the printer are $\overline{INIT}$ on pin 31, which tells the printer to perform its internal initialization sequence and $\overline{STROBE}$ on pin 1 which tells the printer, "Here is a character for you".

The major status signals output from the printer are:

1. ACKNLG signal on pin 10, which when low, indicates that the data character has been accepted and the printer is ready for the next character.
2. BUSY signal on pin 11, which is high, if for some reason such as being out of paper, the printer is not ready to receive a character.
3. PE signal on pin 12 which goes high if the out-of-paper switch in the printer is activated.
4. SLCT signal on pin 13 which goes high if the printer is selected for receiving data.
5. $\overline{ERROR}$ signal on pin 32 which goes low for a variety of problem conditions in the printer.

EXPERIMENT - 7

AIM- To make inter-connection in cables for data communication in LAN.

T-568A Straight through Ethernet cable

| At end A | | At end B |
|---|---|---|
| Pin NO. | Cable Color. | Pin No. |
| 1 | White / Green | 1 |
| 2 | Green | 2 |
| 3 | white / orange | 3 |
| 4 | Blue | 4 |
| 5 | white / Blue | 5 |
| 6 | Orange | 6 |
| 7 | white / Brown | 7 |
| 8 | Brown. | 8 |

T-568B straight through Ethernet cable

| At end A | | At end B |
|---|---|---|
| Pin NO. | cable color | Pin NO. |
| 1 | White / orange | 1 |
| 2 | orange | 2 |
| 3 | white / Green | 3 |
| 4 | Blue | 4 |
| 5 | white / Blue | 5 |
| 6 | Green | 6 |
| 7 | white / Brown | 7 |
| 8 | Brown | 8 |

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EXPERIMENT 7

AIM:- To make inter-connections in cables for data Communication in LAN.

APPARATUS REQUIRED:- RJ-45 connector, Crimping tool CAT 5 cable.

THEORY:-

In the context of the 100-ohm UTP type of cable used for Ethernet wiring the only categories of interest are Cat3, Cat4, Cat5, Cat5e and Cat6. CATx is an abbreviation for the category number that defines the performance of building telecomm" cabling as outlined by the Electronic Industries Association (EIA) standards.

The TIA/EIA 568-A standard which was ratified in 1995 was replaced by the TIA/EIA 568-B standard in 2002. Both standards define the T-568A and T-568 B pinout for UTP cable and RJ-45 connector for Ethernet connectivity. The standards and pinout spec appear to be related, but are not the same and should not be used interchangeably.

T-568A and T-568 B standard are straight Through cables are used most often as patch cords for your ethernet connection

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RJ 45 Cross over cable Ethernet cable

| Pin No. | wire arrangement end A using T-568 A | wire arrangement at end B using T-568B |
|---|---|---|
| 1 | white / Green | white / orange |
| 2 | Green | orange |
| 3 | white / orange | white / Green |
| 4 | Blue | Blue |
| 5 | white / Blue | white / Blue |
| 6 | orange | Green |
| 7 | white / Brown | white / Brown |
| 8 | Brown | Brown |

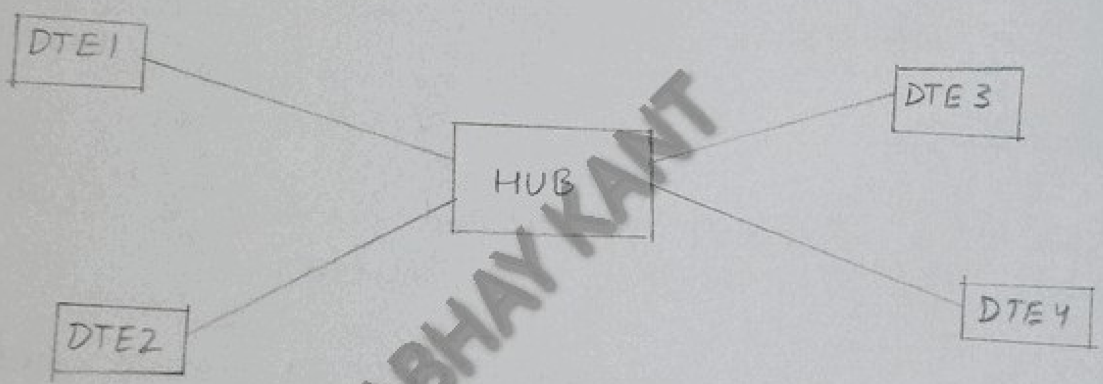
If you require a cable to connect two Ethernet devices directly together without a hub or when you connect two hubs together, you will need to use a crossover cable instead.

PROCEDURE

1. Start by stripping off about 2 inches of plastic Jacket off the end of the cable.
2. Spread the wires apart, but be sure to hold onto the base of the Jacket with your other hand.
3. Insert the wires into RJ-45 connector keeping the metal wire arrangement.
4. Set the RJ45 connector (with the cable) on the plier and squeeze it tightly.
5. Make the other side by repeating steps 1 to 4.

EXPERIMENT - 8

AIM:- To install LAN using STAR topology



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# EXPERIMENT - 8

AIM:- To install LAN using STAR topology.

THEORY:-

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub.
The controller acts as an exchange. If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.



Advantages

- Robustness - If one link fails, only that link is affected. All other link remain active.
- Easy to install and reconfigure.
- Less expensive than mesh topology.

Disadvantages

- If hub goes down complete ntw stops.
- Cabling increased.

GOOD WRITE A Mark of Quality

Teacher Sign. ..............................

EXPERIMENT - 9

~~AI~~ AIM- To install LAN using TREE topology

Topic: .................. Date: .............. Page No: ............

# EXPERIMENT 9

AIM:- To install LAN using Tree topology.

THEORY:-

A tree topology is a variation of a star. As in a star, nodes in a tree are linked to a central hub that controls the traffic to the n/w. However, not every device plugs directly into the central hub. The majority of devices connect to a secondary hub that in turn is connected to the central hub.

The central hub in the tree is an active hub. An active hub contains a repeater, which is a hardware device that regenerates the received bit patterns before sending them out. Repeating strengthens transmissions and increases the distances a signal can travel.

The secondary hubs may be active or passive hubs. A passive hub provide a simple physical connection between the attached devices.

Advantage

1. The addition of secondary hub has two advantages
   a) it allows more devices to be attached to a single central hub and increase the distance a signal can travel.

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ii) it allows n/w to isolate and prioritize commⁿ from different computers.

Disadvantages

1. If the central hub fails, the whole n/w fails
2. Many star n/w require a device at the central point to rebroadcast or switch the n/w traffic.
3. The cabling cost is more since cables must be pulled from all computers to the central hub.

EXPERIMENT-10

A) AIM:- To install LAN using BUS topology.

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EXPERIMENT - 10

AIM:- To install LAN using Bus topology

THEORY:-

A bus topology is multipoint. One long cable acts as a backbone to link all the devices in the network.

Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable. A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core. As a signal travel along the backbone, some of its energy is transforme into heat. Therefore it becomes weaker and weaker the farther it has to travel. For this reason there is a limit on the number of taps a bus can support and on the distance between those taps.

Advantage

1. Ease of installation
2. Less cabling than mesh, star or tree topologies.

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Disadvantages

1. Difficult reconfiguration and fault isolation.
2. Fault or break in the bus cable stops all transmission, even between devices on the same side of the problem.