International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 04 – Issue 05 || May 2019 || PP. 65-71

An Experimental study on PC to PC Data Transfer

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Abstract: Data transfer is the need of today's world and for this; people using internet through Personal Computers (PCs).The PC to PC communication can be performed either in the electrical domain or in optical domain. The aim of this paper is to understand "PC to PC Laser Communication" through fiber-the requirement of different components and related configuration.

I. Introduction

Communication is the transfer of information from one place to another. Block diagram for communication system is shown in Figure 1.1. The main components of communication are Transmitter, Channel or Medium and Receiver. To establish communication, the signal or message is converted into system's compatible format using transducer, then transmitted by compatible transmitter and then the signal or message received through channel or medium at the receiver point, finally the received signal or message is again converted to its original form using compatible transducer.

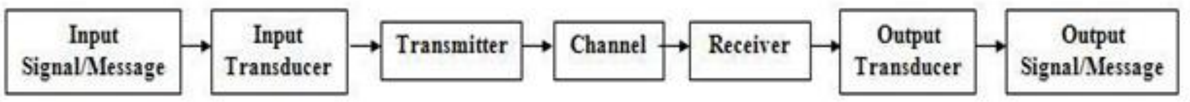

Figure 1.1: Block diagram for Communication system

II. Basics of Optical Communication

Charles Kao & Charles Hockham (Standard Telecommunication Laboratory in England) in 1966 first cited that Optical Fiber communications is possible. They stated that the optical fiber of loss 20 dB/km could replace the then coaxial cable. Nature of optical loss vs. wavelength of light is shown in the figure 2.1.

At that time

- fiber had a loss of 1000 dB/km
- amplifier was needed for 100 dB loss – which was 5 km on coaxial

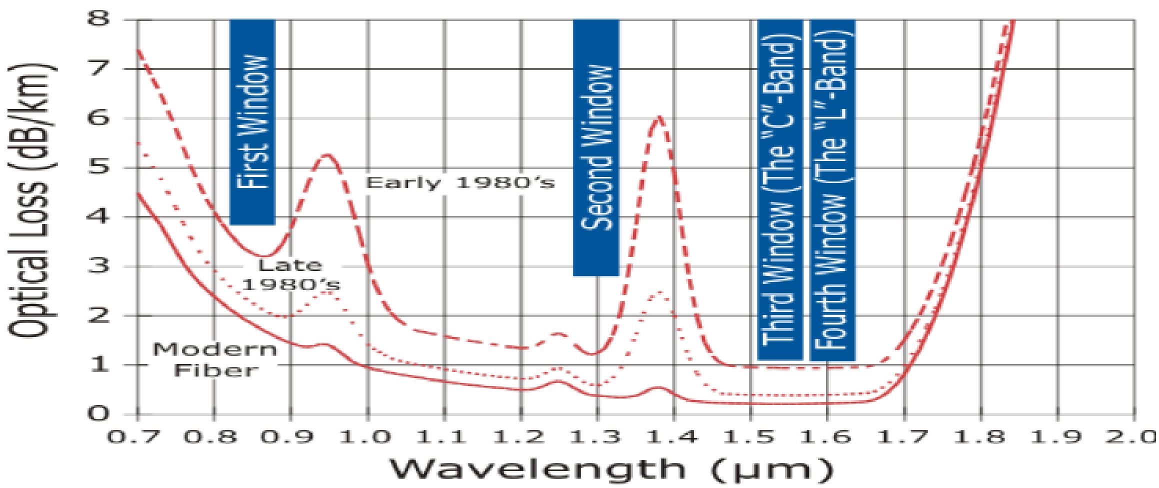

Figure 2.1: Nature of optical loss vs. wavelength of light

- they realized problem was impurity in glass
- in 1970 Maurer, Keck, & Schultz of Corning Glass developed fiber of : 17 dB/km
- first fibers used GaAs lasers at ~850 nm (1st window), having loss 3-4 dB/km

New lasers targeted 1310 nm (2nd window) min absorption band 0.5 dB/km. In 1977 Nippon Telephone & Telegraph went to 1550 nm (3rd window) 0.2 db/km. Now modern fibers is having loss of <<1 db/km, signal travels 500-800 km without amplification and in 1990 Bells labs achieved 7500 km at 2.5 Gb/s without amps.

III. Various Types of Optical Communication

There are two type of optical communication based on signal carrier or the medium

- Optical fiber communication(figure 3.1)
- Free space communication(figure 4.1)

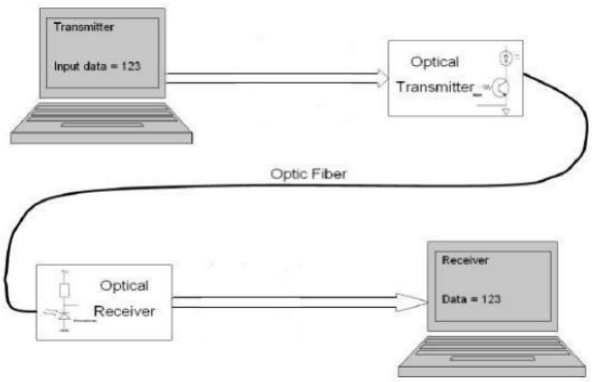

Figure 3.1: PC to PC Fiber Optic Communication

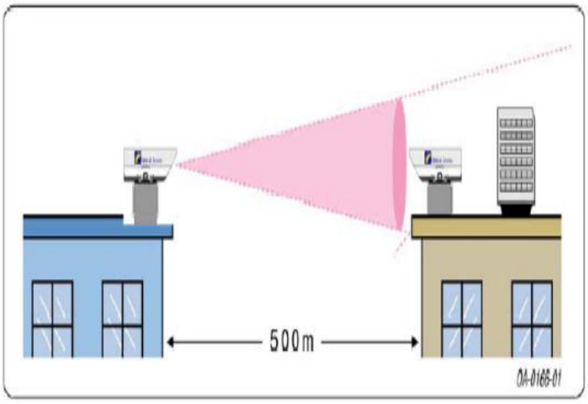

Figure 4.1: Free Space Optical Communication

IV. Optical Vs Electrical transmission

The choice between optical fiber and electrical (or copper) transmission for a particular system is made based on a number of trades-offs. Optical fiber is generally chosen for systems requiring higher bandwidth or spanning longer distances than electrical cabling can accommodate.

- The main benefits of fiber are its exceptionally low loss (allowing long distances between amplifiers/repeaters)
- High data-carrying capacity
- Thousands of electrical links would be required to replace a single high bandwidth fiber cable.
- Fiber cables experience effectively no crosstalk.
- Fiber can be installed in areas with high electromagnetic interference (EMI), such as alongside utility lines, power lines, and railroad tracks.

Single-line, voice-grade copper systems longer than a couple of kilometers require in-line signal repeaters for satisfactory performance; it is not unusual for optical systems to go over 100 kilometers (62 mi), with no active or passive processing. Single-mode fiber cables are commonly available in 12 km lengths, minimizing the number of splices required over a long cable run. Multi-mode fiber is available in lengths up to 4 km, although industrial.

V. Power Losses in Optical Communication

Rough Estimate of Power losses in the system Infrared light (765 nm) in free space communication is indicated in the following table no 1.1

Table 1.1: Free Space Power losses in different environment for free space communication

Clear, still air	-1 dB/km -5 dB/km
Scintillation	0 to -3 dB/km 0
Birds or foliage Impenetrable	0 to -20 dB
Window (double-glazed)	-3 dB -1 dB
Light mist (visibility 400m)	-25 dB/km -1 dB/km

Medium fog (visibility 100m)	-120 dB/km -1 dB/km
Thick fog (visibility 40m)	-300 dB/km -1 dB/km
Light rain (25mm/hour)	-10 dB/km -10 dB/km
Heavy rain (150mm/hour)	-25 dB/km -40 dB/km

VI. Semiconductor Laser

Semiconductor Laser is the source of the transmitter section which is shown in the figure 5.1

- Light Amplification by Stimulated Emission of Radiation.
- Laser light is monochromatic, coherent, and moves in the same direction.
- A semiconductor laser is a laser in which a semiconductor serves as a photon source.
- The most common semiconductor material that has been used in lasers is gallium arsenide.
- Einstein's Photoelectric theory states that light should be understood as discrete lumps of energy (photons) and it takes only a single photon with high enough energy to knock an electron loose from the atom it's bound to. Stimulated, organized photon emission occurs when two electrons with the same energy and phase meet. The two photons leave with the same frequency and direction
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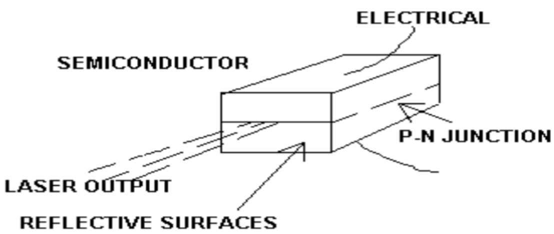

Figure 5.1: Semiconductor Laser Source

VII. Various Experiment on Data Transfer

Following are the experiments performed in the laboratory:

A. Experiment no. 1: To transfer sound over light mode
B. Experiment no. 2: To transfer data over light in Using transmitter and receiver
C. C. Experiment no. 3: Study of RS-232 serial communication between two computers using plastic fiber optic digital link kit
D. Experiment no. 4: Setting up PC-to-PC communication link using Optical glass fiber and optical kit with RS-232 interface
E. Experiment no. 5: Setting up optical link using optical transmitter, optical receiver, Optical fiber and TTL pulse
F. Experiment no. 6: Study of PC to PC communication in electrical domain
G. Experiment no. 7: PC to PC Laser communication

A. Experiment no. 1: To transfer sound over light mode

LED converts electrical energy to light energy and photo diode converts light energy to electrical energy. So by using these two i.e. LED and Photo diode, we can transfer sound over light. Figure 5.1 shows the circuit block diagram of optical communication. Figure 7.1 shows the LAB setup of transfer sound over light and the optical transmitter unit and optical receiver unit are shown in figures 8.1and 9.1 respectively.

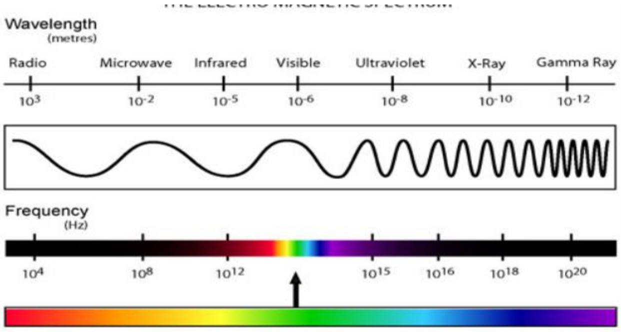

Figure 6.1: The Electromagnetic *Spectrum of laser*

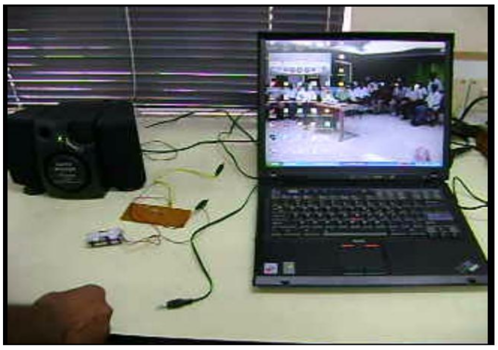

Figure 7.1 Lab setup

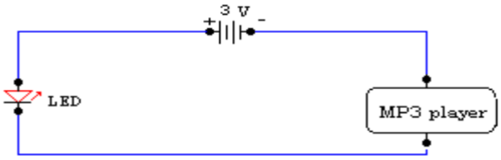

Figure 8.1: Circuit Block Diagram-Optical Transmitter

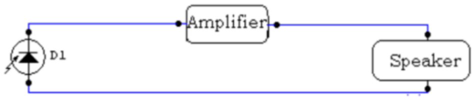

Figure 9.1: Circuit Block Diagram-Optical

- **Connection for transmitter section**
  1. One end of the battery is connected to one leg of LED & other end of the LED is connected to mono audio jacket of MP3 player with the other end of the mono audio jacket is connected to positive end of the battery.
  2. With the help of alligator clips, keeping LED forward biased.
  3. Connect the head of the mono audio jacket to the MP3 player to receive the audio signal.

- **Connection for receiver section**
  1. Connect the two ends of the mono audio jacket (The second one) to both the legs of the photodiode / photo transistor /opto-resistor with the help of alligator clips, keeping photo diode as reversed biased.
  2. Connect the head of the mono audio jacket to the speaker for receiving the sound finally from audio signal (destination).
  3. From audio player the audio output is taken through audio jacket and is connected to LED through the 3V battery. The output of LED is given to photo diode/photo transistor, which is connected with a speaker. If the output of LED is very low energy, then after reception, the weak signal is needed to be amplified. Thus in this way sound is transferred through light in the line of sight range. If we want to transmit it out of line of sight, we can use optical fiber between the LED and photo diode / photo transistor.

B. Experiment no. 2: To transfer data over light in Using transmitter and receiver

Using IED and different resistors, capacitors, transistors and OPAMP the circuit converts electrical energy to light energy and at the receiver side photo diode converts light energy to electrical energy. So by using these two i.e. IED and Photo diode, data transfer over light.

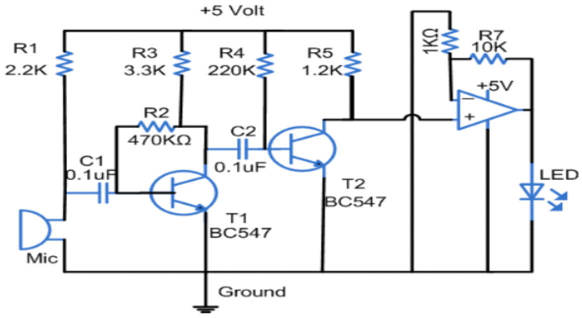

Figure 10.1: Circuit Diagram-Optical Transmitter

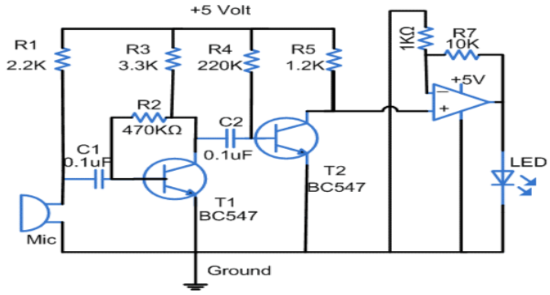

Figure 11.1: Circuit Diagram-Optical

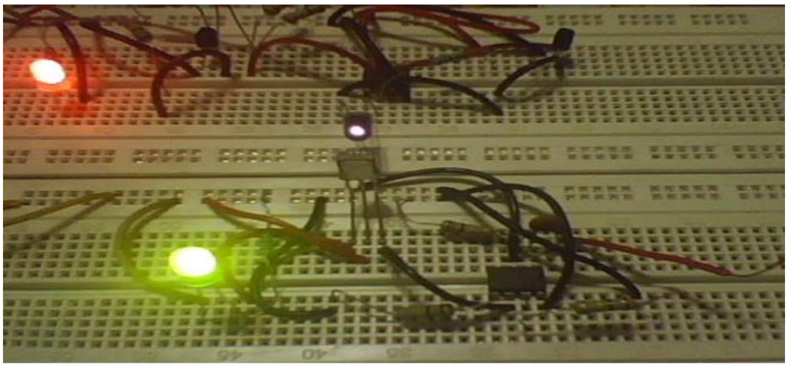

Figure 12.1: Optical Transceiver on Breadboard

C. Experiment no. 3: Study of RS-232 serial communication between Two computers using plastic fiber optic digital link kit

Computers use serial communication with RS232 standards for communicating with other devices like printers, plotters, terminals, etc.

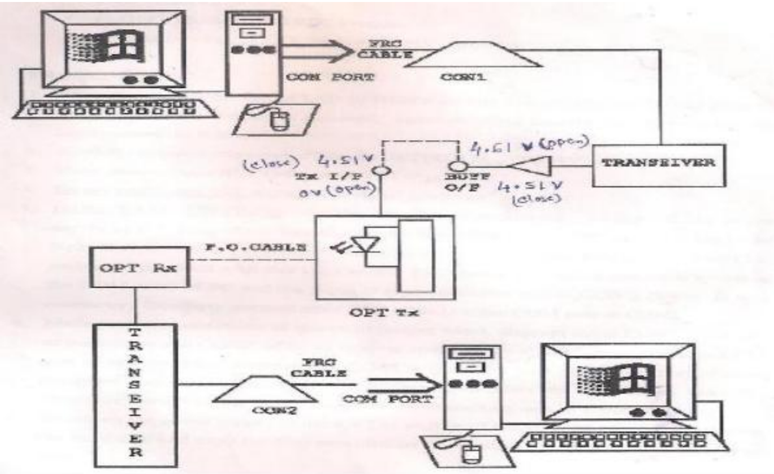

Figure 14.1: Circuit setup in lab

Figure 13.1: Circuit Block Diagram-RS232

D. Experiment no. 4: Setting up PC-to-PC communication link using Optical glass fiber and optical kit with RS-232 interface

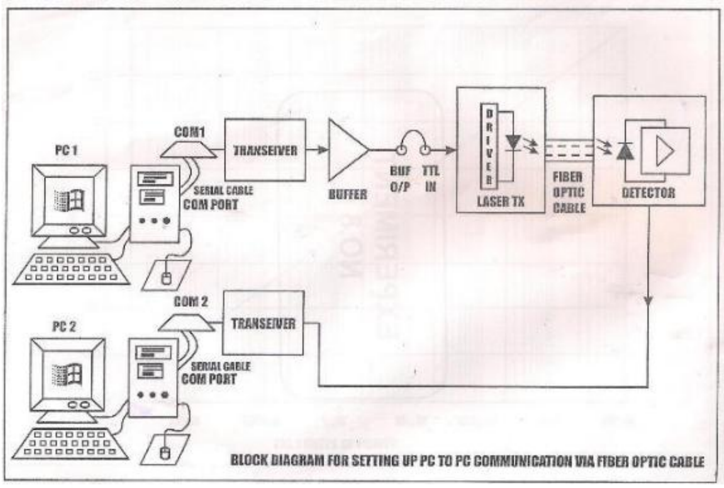

Figure 15.1: Circuit Block Diagram-Optical Transreceiver

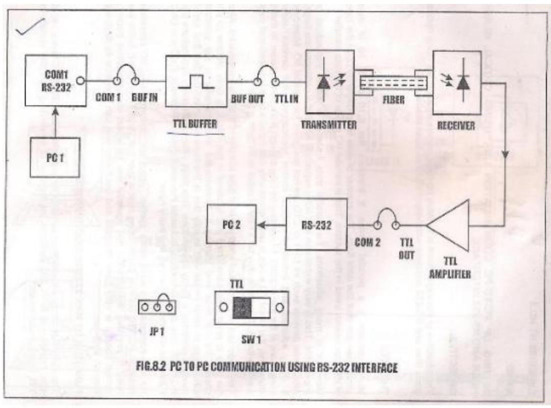

Figure 16.1: Circuit Block Diagram-RS-232 Interface

E. Experiment no. 5: Setting up optical link using optical transmitter, optical Receiver, Optical fiber and TTL pulse

The transmitter section of this block diagram converts the electrical signal into an optical signal. The fiber optic cable carries the modulated light getting from the transmitter to the receiver. The receiver section of the block diagram converts optical signal coming through the fiber cable into an electrical signal and gives an electrical output after amplification and reshaping the signal.

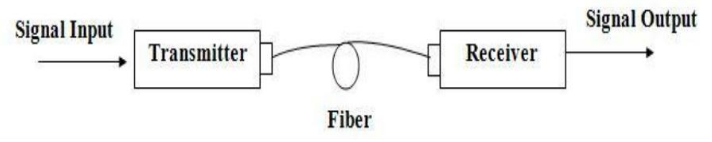

Figure 17.1: Block diagram of TTL enable fiber optic

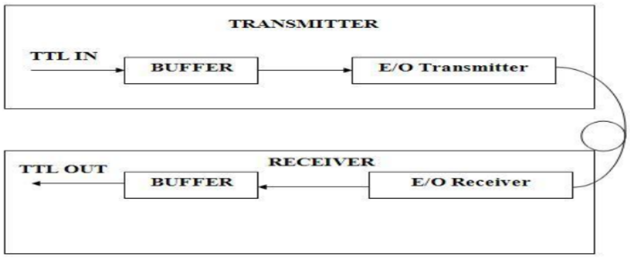

Figure 18.1: Block diagram of TTL enable Transmitter and

Example: IP address: 10.30.14.10, IP mask: 255.255.254.0, Gateway IP: 10.30.14.1.

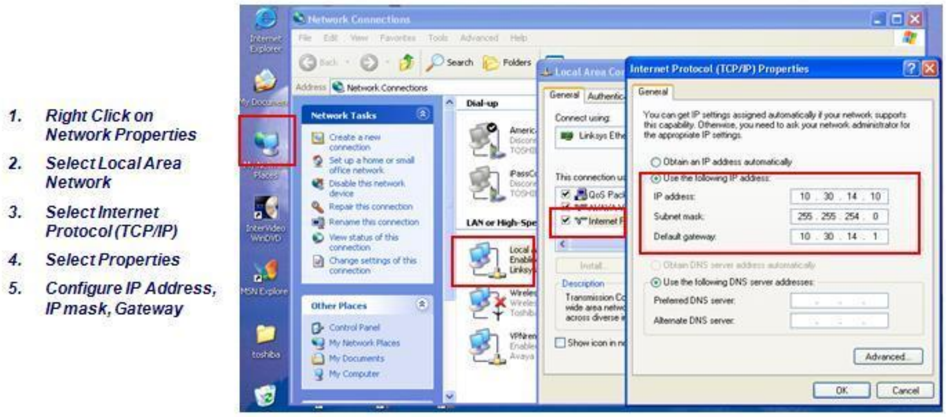

Figure 19.1 : Examples for IP address

F. Experiment no. 6: Study of PC to PC communication in electrical domain

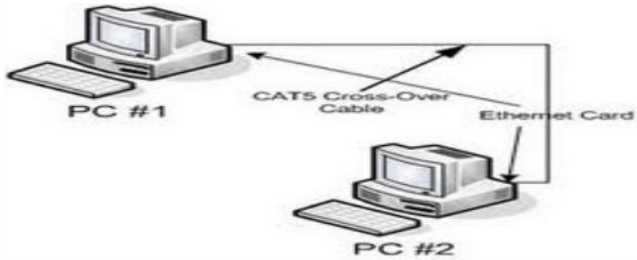

Figure 20.1 PC to PC LAN connection

Steps for LAN connection between 2 computers using crossover cable:

- Plug the cross cable end into the RJ-45 jack of the two computers.
- Go to Windows XP Start menu and then select "My network Places". Now select the "View Network Connections" link.
- Right click on the Local Area Connection icon and click properties link.
- Now select the "Internet Protocol (TCP/IP)", then select the Properties.
- Now enter the following:
- IPaddress:192.168.1.2
  Subnet mask: 255.255.255.0
- Click OK and save these settings.

G. Experiment no. 7: PC to PC Laser communication

Data signals transmitted through pin 2 of RJ-45 LAN port are sent to pin 8 of MAX-232 IC and it converts these EIA (Electronics Industry Association) to compatible levels of 0/5 V TTL levels. The output pin line of MAX-232 IC drives the PNP transistor and powers the IR LED. The output pin 9 also drives an LED indicator during the positive outputs at its pin 9. The electrical pulses sent by the COM/LAN port are now converted into corresponding modulated pulses of IR light. Figure 21.1 shows the model circuit block diagram transmitter unit for PC to PC Laser communication.

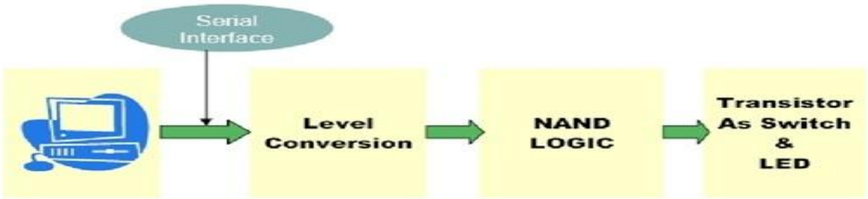

Figure 21.1: Model circuit block diagram for PC to PC laser communication

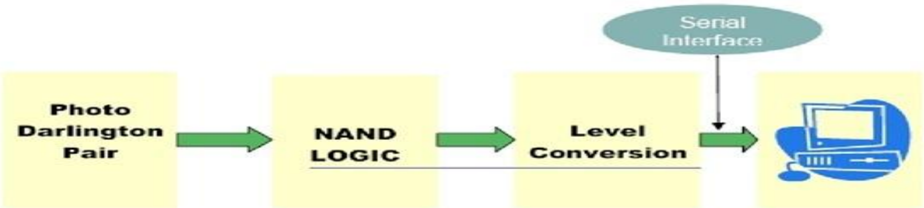

Figure 22.1: Model circuit block diagram for PC to PC laser communication

The IR signals are detected by a photodiode. The detected TTL level (0/5 V) signals are coupled to pin 10 of MAX-232 IC. These TTL levels are converted to RS-232 or LAN compatible levels and output at pin 7. The optical signals received by the photodiodes are converted into electrical pulses and both PC think that there is a null modem cable connected between them. The model circuit diagram of receiver unit is shown in the figure 22.1 for PC to PC Laser communication.

Result and Conclusion

The subject of study in this paper is PC to PC Data transfer to understand PC To PC Data Transfer the following experiments were performed.

1) To transfer sound through light mode using LED source and MP3 player / Laptop.
2) To transfer data between two PCs using standard optical kit and multimode 1m optical plastic fiber.
3) To transfer files between two PCs using standard optical kit and multimode 1m optical glass fiber.
4) To transfer TTL signals using optical transmitter, optical receiver and 20m multimode optical plastic fiber.
5) To set PC to PC communication in electrical domain with proper setting and configuration of the LAN cable.
6) Lastly to set PC to PC communication in optical domain.

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