Volume : 2 | Issue : 12 | December 2013 • ISSN No 2277 - 8179

Research Paper

Engineering

KEYWORDS : Laser diodes, photo-beam, free space optical communication, LOS, AFTS, free space optics.

Laser Based Data Signal Transmission Using Free Space Optics

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ABSTRACT

The setup used is based on free space optical communication. In which communication between two PC's is established using LASER light. IC MAX 232 is used. IR diodes are used for short distance communication be-tween 2-3 m. This dis-tance could be further improved to up to hundred meters, by replacing IR LEDs with laser diodes. Laser pointers available commonly are used as the laser module in this setup which has about 3 mW power as output. Laser beam from one module is made to point towards the photodiode of the other module which is connected with the personal computer and vice-versa. Software module is writ-ten using C language to perform this process. This C codes are used in chatting and data transfer be-tween nodes only when Line of Sight must exists

Introduction

In 1930 transmission of data using modulated laser light was used in televisions for military applications. Invention of laser lights increased the data transfer rate as well as the source detector distance. Primary aspect during the first satellite launch was to have stable transmission of data between ground stations and satellites. "Airborne Flight Test System (AFTS)" was developed by McDonnell Douglas in the year 1970, this system allowed unidirectional data transmission with a data rate up to 1GBit/s a distance of up to 60 miles. To ensure secure data transfer at high data rates, optical data transmission has key benefits than RF technology. Use of stable optical data links with data rates up to 10 G Bits/ sec allows high availability of the used satellite. Carl Zeiss Optronics has a lot of experience in space-based laser communication terminals. Currently, the first demonstrators for eye-safe laser communication in the atmosphere are being prepared in cooperation with the DLR.

Laser – a Brief History

In 1960 'Light Amplification by Stimulated Emission of Radiation' or Laser was developed by Theodore Maiman, at Hughes Laboratory. First people to publish their findings on laser and also to apply for patent were Physicists Charles H. Townes and his brother-in-law Arthur Schawlow. During the year 1968, He-Ne laser (red beam) was commercially used. Recently, wide range of lasers is available to perform various applications. Some of the applications of Lasers include surgery, cutting of metals, distance determination, projection of 3-dimensional holographic images and computer printing, etc.

Free Space Optics

The most important technology used in the field of telecommunication is Free Space Optics (FSO). FSO uses light propagating in free space to transmit data. Free space optical communication is usually requires line-of-sight (LOS), here transmission of visible light or infrared light through the atmosphere to achieve broadband communications. Free space optics makes use of a light emitting diode (LED) or a laser point source for transmission of data. Instead of guiding the energy beam through an optical cable, energy beams are first collimated and later they are transmitted through space in free space optical communication.

Transmitter Module

Data signals are transmitted through Pin 3 of '9' pin 'D' connector of RS-232 COM port are sent to Pin 8 of MAX232 IC which converts these EIA (Electronics Industry Association) RS-232C compatible levels of +/- 9V to 0/5V TTL levels. Output pin line of MA X232 IC drives the PNP transistor SK100 and powers IR LED. Figure 1 represents the basic module of data transfer using Laser.

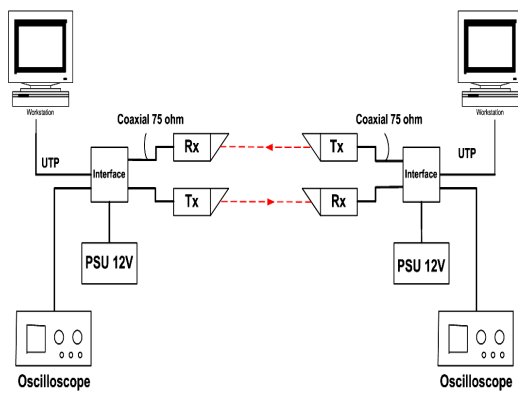

Figure 1. Transmission Setup

Output Pin 9 also drives a LED indicator during positive output. At logic'0' output at Pin 9, LED2 goes 'off', but drives the PNP transistor through a bias resistor of 1 kilo-ohm, to switch 'on' IRLED1 and IRLED2 and also a visible LED3. Due to very low drive current, high- efficiency visible LEDs are used. These LEDs will light up at 1mA. Electrical pulses sent by COM port are now converted into corresponding modulated pulses of IR light. Figure 2 describes the circuit connections involved in the transmitter module of the Laser data transfer setup.

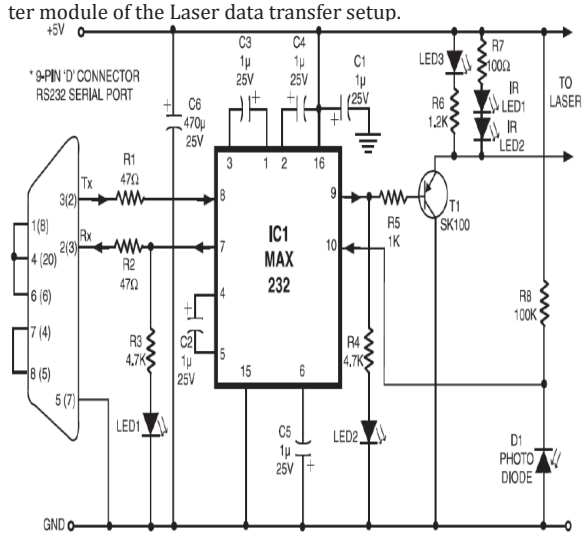

Figure 2. Transceiver Circuit Diagram

Receiver Module

IR signals are detected by the photodiode (D1). The detected TTL level (0/5 V) signals are coupled to pin 10 of MAX232 IC. These TTL levels are converted to +/- 9V levels internally and

output at Pin 7. Visible LED1 at Pin 7 of MAX232 IC indicates that signals are received. Pin 7 is also connected to Pin 2 of '9' pin 'D' connector used for serial port in the PC, so that the data may be read. Optical signals received by the photodiodes are converted to electrical pulses and both the personal computers consider that there is a null modem cable connected between them. In some PCs, serial port is terminated into '9' Pin 'D' connector and in certain personal computers serial port is terminated into a '25' pin 'D' connector.

Conclusion

A full-duplex 10Mbps free-space optical transceiver complying with IEEE802.3 standard for Ethernet networking has been implemented and is successfully tested for a distance of about 300 metres. Employing easy-to-find components and is manufacturing cost makes this system more accessible and applicable for people including hobbyists, experimenters, academics, or serious investors. Future work can also include the development of low-cost transceiver that could handle fast or gigabit Ethernet link (100Mbps and 1Gbps) with longer link range, due to constant demand for high-bandwidth communications.

REFERENCE

[1] H. A. Willebrand et al, "Fiber Optics With-out Fiber," IEEE Spectrum, pp. 40-45, Au-gust 2001. | [2] C. C. Davis et al, "Flexible Optical Wireless Links and Networks," IEEE Communica-tions Magazine, March 2003. | [3] S. Bloom, "The Physics of Free-Space Op tics," Air Fiber, http://www.airfiber.com, | [4] A. Acampora, "Last Mile by Laser," Scien-tific American, July 2002. | [5] http://www.infineon.com, | [6] B. Razavi, Design of Integrated Circuits for Optical Communications, section 4.5, McGraw Hill, March 2003. | [7] http://www.semiconductors.philips.com | [8] http://www.semiconductors.philips.com | |