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LASER COMMUNICATION SYSTEM

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ABSTRACT

Laser communication is one of the key area in wireless Communications. This paper includes analysis, optimization, design and system level development of signal transformation between satellites or any two sources. Which work similarly to fiber optic links, except the beam is transmitted through free space. While the transmitter and receiver must require line-of-sight conditions, they have the benefit of eliminating the need for broadcast rights and buried cables. Laser communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies.

KEYWORDS: Wireless Communication System, Laser Communication, Audio Amplifier LM386

INTRODUCTION

Laser Communication is one of the emerging areas of wireless communication system. Due to its low noise ratio makes its one of the well suited communication medium for exchange of information. Currently laser commutation is adopted in satellite communication for space research activities and due to its efficiency on low noise ratio, inexpensive, low power and its flexibility and its resistance to the radio interferences makes laser communication as one of research area in wireless communication. In this process, this paper comprises the one such application of laser communication for information exchange between any two devices.

In Laser Communication the transmitter and receiver must require a line-of-sight conditions and Laser communications systems have the benefit of eliminating the need for broadcast rights and buried cables. The carrier used for the transmission signal is typically generated by a laser diode. Two parallel beams are needed, one for transmission and one for reception.

Laser communications systems are wireless connection through the atmosphere. Which is focused on decreasing the noise ratio in optical communication system Laser communications systems work similarly to fiber optic links, except the beam is transmitted through free space. In Laser Communication the transmitter and receiver must require a line-of-sight conditions and Laser communications systems have the benefit of eliminating the need for broadcast rights and buried cables. Laser Communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode. Two parallel beams are needed, one for transmission and one for reception.

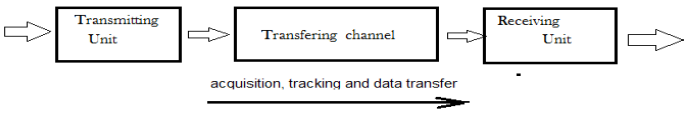

Figure 1

Laser communications plays a key role, as solutions for satisfy ever increasing high demand of bandwidth. In Laser communications systems bandwidth could be distributed in neighborhoods by putting systems on top of homes and pointing them towards a common transceiver with a fast link to the Internet. It supports possible transmit speeds of up to a gigabit per second, Other applications of Laser communications systems technology include temporary connectivity needs (e.g. sporting events, disaster scenes, or conventions), or space based communications.

Space Based Communication

Figure 2

Laser communication system can be used to transmit sound and data signals through the laser beam of the system. The intensity of the carrier beam changes with the change in amplitude of the sound signal. Variation in the intensity of the laser beam is converted in to a variation in the voltage level by using solar panel. In this mode of communication the transmitter and receiver requires to satisfy the line of sight conditions. The carrier required for transmission of signal in laser communication System is generated by laser diodes.

METHODOLOGY

Circuit Diagram - Transmitter

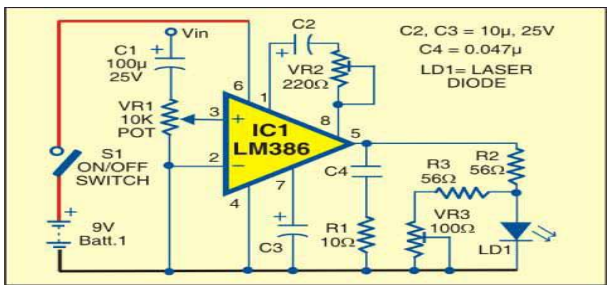

Figure 3

Circuit Diagram - Receiver

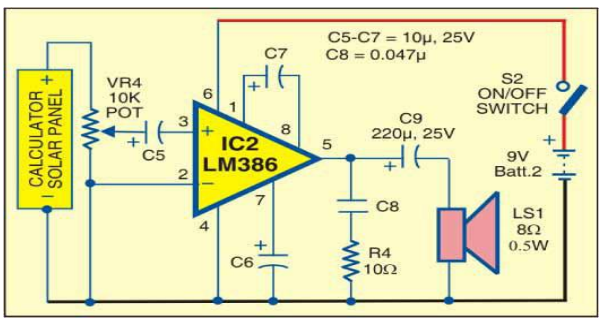

Figure 4

IMPLEMENTATION

The voltage variation on the solar panel is amplified by a low-voltage audio power amplifier LM386 and reproduced by a speaker. The maximum output of audio amplifier LM386 is 1 watt, while its voltage gain is 20 to 200. The circuit consists of a transmitter and a receiver. Both the transmitter and the receiver are built around IC LM386, powered by a 9V battery. Figure 1 shows the transmitter circuit here a laser diode (LD1) with maximum operating voltage of around 2.6V DC and maximum operating current of 45 m A is used to transmit the audio signal. The voltage divider network formed by R2, R3 and VR3 keeps the voltage as well as the current for the laser diode in the safe region. In place of the laser diode, you can also use a laser pointer. Remove the battery from the laser pointer. Extend two wires from terminals of LD1 and connect them to the battery terminals of laser pointer.

The spring inside the laser pointer is the negative terminal. The output power of the laser pointer is 5 m W. Take care while working with laser, as direct exposure to the laser beam can be hazardous to your eyes. Point the laser beam to the solar panel. Potmeter VR1 (10-kilo-ohm) is used to change the level of the input audio signal. The audio input (V in) is taken from the preamplifier output of the music system (CD player, DVD player, etc). Capacitor C2 and preset VR2 are used to vary the gain of the LM386. Figure 2 shows the receiver circuit. The audio signal transmitted by the laser diode (LD1) is received by the calculator's solar panel and amplified by IC2. The gain of the amplifier is fixed by capacitor C7. Preset VR4 is used to change the signal level from the solar panel. This signal is fed to input pin 3 of IC2 through coupling capacitor C5 so that the DC value from the solar panel can be eliminated. The amplified output from IC2 is fed to the speaker, which plays the music from the CD player connected at the input (V in) of IC1. Assemble the transmitter and receiver circuits on separate PCBs and enclose in suitable cabinets. In the transmitter cabinet, fix two terminals for connecting the audio signal. Fix switch S1 on the front panel and the laser diode (LD1 or laser pointer) to the rear side of the cabinet. Keep the 9V battery inside the cabinet. In the receiver cabinet, fix the calculator's solar panel to the rear side such that the transmitted beam directly falls on it. Fix switch S2 on the front panel and the speaker to the rear side. Keep the 9V battery inside the Cabinet.

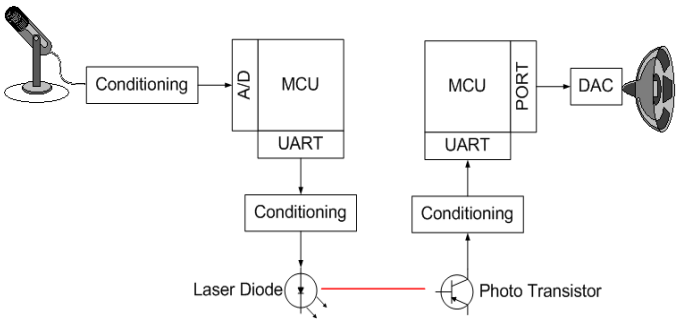

Figure 5: Block Diagram of Laser Communication System

The above diagram shows the block diagram of Laser Communication System, which mainly comprise of 2 sections such as Transmitter section and Receiver section. Transmitter section is used to transmit the data and sound signals, which comprised by microphone, Conditioning ckt, analog to digital converter and laser diode to generate medium for transmission of signals. The receiver section is used to receive the laser beam, using photo transmitter, which incorporated with the data or sound signals from the transmitter comprised of Conditioning, MCR and Digital to Analog converter to extract the data signals from the received laser beam and given as a input to the speaker.

WORKING

Microphone Amplifier: The first step in transmitting sound is to digitize sound waves. For this we used an electric microphone. The microphone he sold us had three leads, which after considerable angst we decided were for power, ground, and signal. The signal coming off the mic was far too low to be read (with any degree of precision) by the analog to digital converter. For that we are using the LM386 op-amp to increase the power and signal. Before the signal is put through the amplifier, first put the signal through a capacitor to remove DC, and then through a voltage divider to appropriately bias the signal. The gain is adjusted by the resistors and for the microphone the gain is around 50-100 (depending on how much popping and how much quality you want).

UART (Universal Asynchronous Receiver/Transmitter): It is a piece of computer hardware that translates data between paralle land serial forms. Serial Communication must first be converted back into parallel form by a universal asynchronous receiver/transmitter for increases the speed of the signals. The *universal* designation indicates that the data format and transmission speeds are configurable and that the actual electric signaling levels and methods typically are handled by a special driver circuit external to the UART.

A UART is usually part of an integrated circuit used for serial communications over a Computer or peripheral device serial port. As soon as data is deposited in the shift register after completion of the previous character, the UART hardware generates a start bit, shifts the required number of data bits out to the line, generates and appends the parity bit (if used), and appends the stop bits. . A dual UART, or DUART, combines two UARTs into a single chip.

Laser Driver: After the A/D converter translates the mic signal into 8 bits, the

MCU generates the appropriate bits to send (including start and stop bits) and applies them to the laser driver circuit a 5V and 0V signals. The BJT in this circuit turns on at 5V and provides the proper current according to the diode.

Receiver: A photo diode detects the laser pulses in a different (distant) location. This signal is put through a comparator in order to generate solid 5V and 0V values which are applied to the receive pin on the microcontroller.

Laser Driver: Once the signal is put through the DAC, it is boosted and low pass filtered (to improve sound quality).

APPLICATIONS

- In the Laser communications systems bandwidth could be distributed in neighborhoods by putting laser communication systems on top of homes and pointing them towards a common transceiver with a fast link to the Internet.
- With possible transmit speeds of up to a gigabit per second,
- With the powerful laser, it would even be possible to communicate using satellites to reflect the signals.
- It can be used to reproduce sound in large public meetings on open grounds or for communication between tall buildings. Direct communication between high-rise buildings in a crowded city would become easy.

ADVANTAGES

- The advantages of laser communication is that it allows very fast communication service between two or more devices than other modes of communications
- It can provide speed more than 1GBps.So it overtakes the LAN or wireless LAN comprehensively.
- Laser communications systems have the benefit of eliminating the need for broadcast rights and buried cables.
- Laser communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode. Two parallel beams are needed, one for transmission and one for reception.
- The transmitting and receiving station are smaller and lighter for given range. Less overall power is required for the given distance and data rate. Higher data rate may be achieved for given distance and power output.
- A tiny light detector may allow for superfast broadband communication over interplanetary distances. This technology advance offers the space laser communication system designer the flexibility to design very lightweight, high bandwidth, low-cost communication payloads for satellites whose launch costs are a very strong function of launch weigh.
- Signals can be reproduced without distortion, even long distances. So the system could be use for communication and cable television transmission.
- A one way laser communications system that is capable of ẋ the transmission of both text and sound.
- Even by a minute fraction of a degree, the laser will miss by thousands of miles. Instead of better and faster pictures, there could be no pictures.

The noise in photodiodes the main sources of noise are dark current noise, shot noise and thermal noise in a photodiode. There is one more source of noise due to random nature of the avalanche in an APD. The dark current noise arises due to dark current which flows in the circuit when the photodiode is in un illuminated environment under bias condition. It is equal to the reverse saturation current of the photodiode. The magnitude of this current is strongly dependent on the operating temperature, the bias voltage and the type of detector. In an optical receiver, dark current sets a noise floor for the detectable signal power level. Therefore, it should be minimized by careful device design and fabrication. Dark current in optical telecommunication grade Si PIN photodiodes is typically 100pA, while in Si APDs it is typically 10 pA. In InGaAs based PIN-photodiodes and APDs, the dark current is of the order of 100nA and it could pose a serious problem unless the device is cooled an appropriate temperature.

CONCLUSIONS

This is new wireless technology to transmit the data or sound signal from one section to other section through the laser beam of the system. This system is safety and without radiation. so it is not harm to living beings. The system can likely transmit data and sound much faster than the other system (like 1GB/s). because of this laser communication system became more popular system than the other system. The paper firstly analyzed the components of maritime laser communication system, the paper made some explanations on the components and functions of the servo system,

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