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Conversion of RF Signal to Optical Domain Using MZM

Yakin Y. Malekar
Dayananda Sagar College of Engineering
y.yakin39@gmail.com

Dr. A. R Aswatha
Dayananda Sagar College of Engineering
aswath.ar@gmail.com

Abstract: In the previously proposed system, Radio frequency signal was transmitted through RF system. But the system had some disadvantages like non-coherence and system was not efficient. Hence to overcome these drawbacks, RF over Fiber system is proposed. In the proposed system, RF signal is the message signal which is used to modulate the optical signal that has to be transmitted over the optical cable. Mach–Zhender Modulators (MZMs) is used to convert the RF signal to optical signal when the light cannot directly modulate for higher speed, the Lithium Niobate, Mach-Zhender Modulator (LN-MZM) is used, Continuous Wave Laser diode is used as the source and PIN diode is used as an optical detector. To transmit the optical signal Polarization-Maintaining Optical fiber (PMF or PM fiber) is used, this transmitted signal is detected at the receiver by the optical detector.Hence in RF over fiber system are small in size, these are flexible and is a very low loss technology using intensity modulation to transmit RF signal.

Keyword: RFoF, MZM, OPTICAL, RF, PSoC, LASER.

1. INTRODUCTION

From few decade, utilizing the FO cable replace the old coaxial cables and because of advancements in technology of fiber optic, there are several applications. It has specific advice to accomplish for building (DAS) designed a system which is common in terms of FO, there spec and the components that can be applied to design a Radio Frequency (RF) system. There is some generalization used that help in the introduction to the Fiber optics. The particular details that are utilized here depend on producers distributed determinations. (1)

1.1 RF APPLICATIONS OF FO SYSTEM

The Radio Frequency scheme designers mostly worried by two noteworthy restricting qualities of coaxial links those are the loss of RF increments with recurrence and length. Normally the coaxial link is restricted in the length so they can be utilized without extra intensification. In the event that length of the coaxial link is long, at that point it may be required in passages or working to building and quickly increment the cost, particularly when in-line RF speakers are required. (2)

FO links are the one which is having little misfortune contrasted with coaxial links. With RFoF separations of numerous miles being handy, on the grounds that the new instruments that are produced to tackle troublesome RF circulation challenges that would regularly be unfeasible utilizing coaxial links. FO links, as a rule, don't "break" making perfect system while directing towards loud Radio Frequency conditions. FO links may be significantly littler and weight is lighter relating Radio Frequency links that are generally not metallic, providing establishment also directing substantially less complex. (2)

1.2 LINK BUDGET

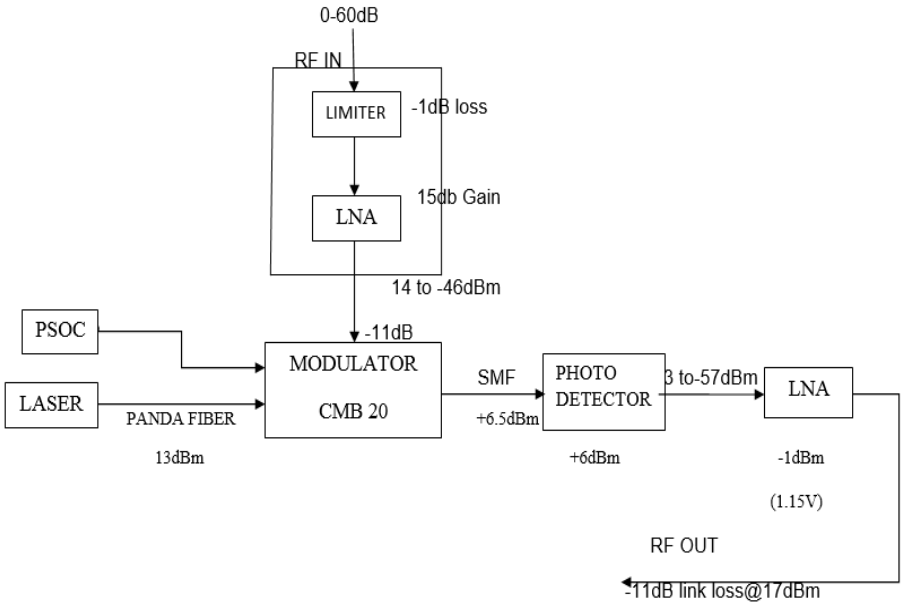

Fig 1: Link Budget Calculation

The below figure 1.2 shows the calculation of link budget proposed system. Link budget means calculating the behavior of the whole system based on specifications mentioned. 0dB-60dB is the input to the RF front end. The limiter will usually use to provide a 1dB of loss. Low noise amplifier (LNA) provide a Gain up to 15dB.Laser output will be of 13dB this output of Laser is given to the Modulator and output up to +6.5dB at Modulator is obtained. Usually, detector will vary from 3dB to -57dB. Hence the link loss will be of -11dB at 17dB.

2. SOFTWARE TOOLS

2.1 OrCAD TOOL

OrCAD is one kind of exclusive programming apparatus suite utilized principally for electronic outline mechanization (EDA). This product is likewise utilized by outline engineers and professionals to make schematics of electronic and give prints electronically for assembling circuit of printed sheets. The name OrCAD and its product's starting points: Oregon + CAD. Established by John, Keith, and Ken in 1985, as "OrCAD Systems Corporation", the organization turned into the provider of electronic development plan robotization (EDA) programming. One of the item for EDA is OrCAD, and it incorporates a schematic editorial manager (Capture), a circuit test system and a PCB creator.

2.2 MATLAB

The MATLAB (matrix laboratory) is a numerical computing environment and new generation programming language. An exclusive language for programming use was developed by the Math-Works at MATLAB which allows matrix changes, plotting of the functions and information, algorithm implementation, providing user interfaces, and programmers written in other languages are also interfaced, which is include languages like C, Java, Fortran, C++, C# , and Python. Although MATLAB is mainly used for numerical data computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package like Simulink, adds a graphical multi-domain simulation and model-based design for dynamic and embedded systems, MATLAB was being developed since 1970.

3. SYSTEM DESIGN

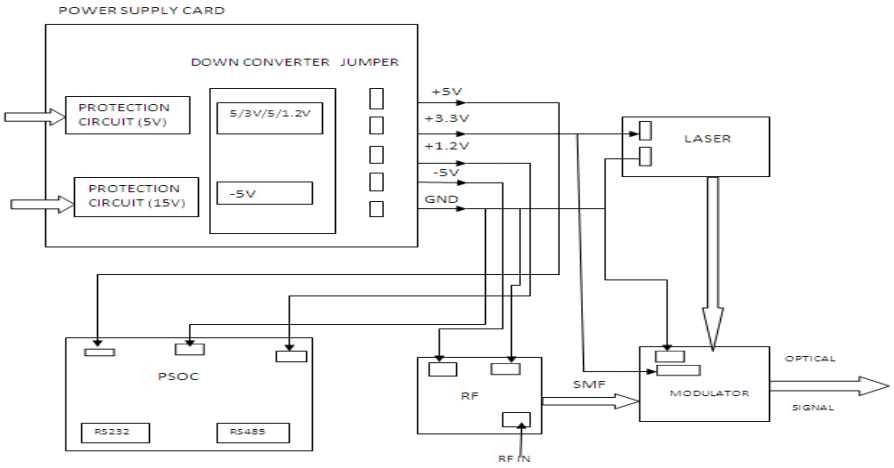

Fig 3.1: Chassis

The above fig 3.1 shows chassis of proposed system. It contains power supply unit (PSU), PSoC, Modulator, RF front end and laser source. Power supply unit (PSU) is used for providing a regulated power output. This power supply unit will provide the power required to the system. The modulator is fed by the output of Laser and another input to Modulator is fed from RF front end.

3.1 PROTECTION CIRCUIT

Figure 3.2 shows the power supply of 5Vcircuit used for the proposed system.

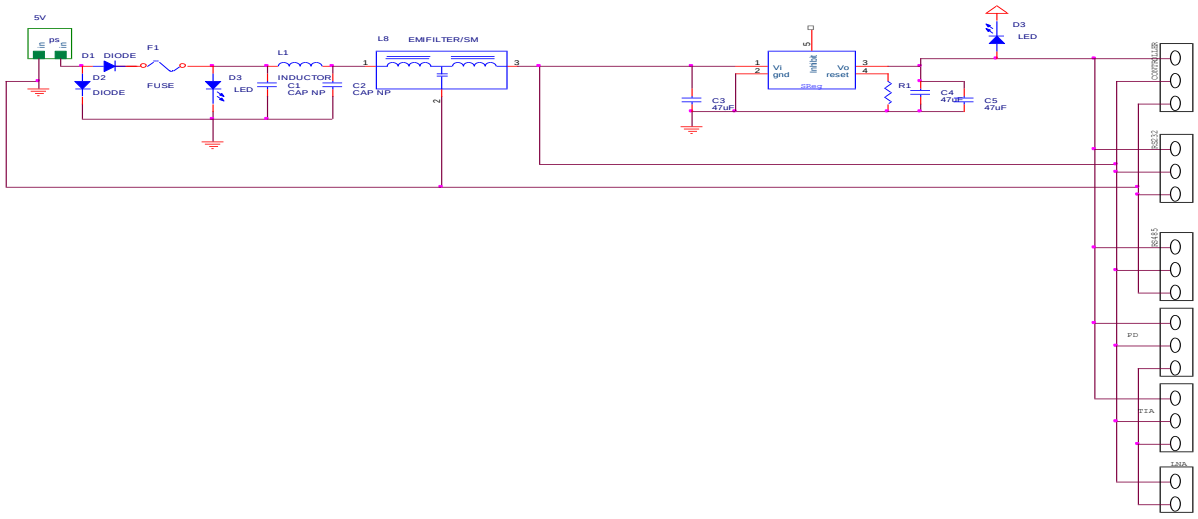

Fig 3.2: Protection circuit for 5V

The above figure has following components

- BAT54 SERIES DIODE
- FUSE
- PI FILTER
- EMI FILTER
- FERRITE BEAD
- SWITCHING REGULATOR

3.2. A 3 V to 5.5 V Low-Powers, RS-232 Transceivers

Electronic Industries Association (EIA) presented RS-232 as a Recommended Standard. These were the current DTEs which were electromechanical teletypewriters, and the current DCEs which were modems. The client data is transmitted as a periodic arrangement of bits in RS-232. Here the Asynchronous and Synchronous transmissions that are bolstered by the standard. Alongside this information circuits utilized, this standard characterizes a many numbers of control circuits that can be utilized to deal with the required association between the DTE and DCE.

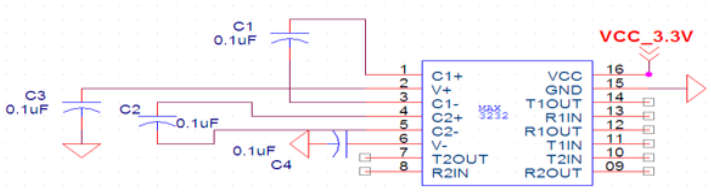

Fig 3.3:schematic of RS232

3.3. A 3.3V, High-Speed, RS-485/RS-422 Transceiver

RS 485 is additionally called as TIA-485, EIA-485, is a standard which is characterizing the electrical qualities of drivers and collectors for use in serial interchanges frameworks. Electrical flag adjusting and multipoint frameworks are bolstered. The principles are normally distributed by the TIA/EIA. These DC (digital correspondence) arranges that are executing the standard which can be utilized viably over long separations and in electrically loud conditions. Various beneficiaries can be associated with such a direct system, multi-drop setup. The RS-485 standard is superseded by TIA-485, yet frequently specialists and applications guides keep on using the RS-485 assignment. It is, for the most part, acknowledged that RS-485 can be utilized with the information rates up to 10 Mbit/s and separations around 1,200 m (4,000ft), yet not in the meantime. Because of a few conditions, it can be utilized something like information transmission paces of 64 Mbit/s. RS-422 has a solitary driver circuit which can't be turned off, though RS-485 drivers utilize three-state rationale enabling individual transmitters to deactivate. This permits RS-485 to execute straight transport topologies utilizing just two wires. (6)

SCHEMATIC

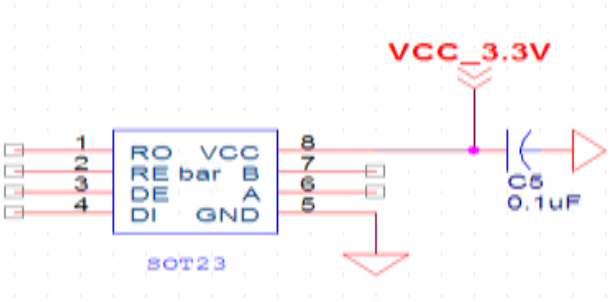

Fig 3.4: Schematic of RS232

3.4 PSoC

PSoC, (Programmable System on Chip) is a class of microcontroller (MC) integrated circuits by Cypress SC. The chips consist of CPU and array of mixed-signal which can be configured with analog or digital components. A PSoC circuit includes configurable digital and analog blocks, core, interconnect and code routing. This device has blocks which can be assembled differently when compared with the other type of MC. The PSoC contains three separate memory spaces: paged SRAM for data, for instructions and fixed data memory Flash is used, and configurable logic blocks for controlling and accessing and functions I/O Registers are used [4].

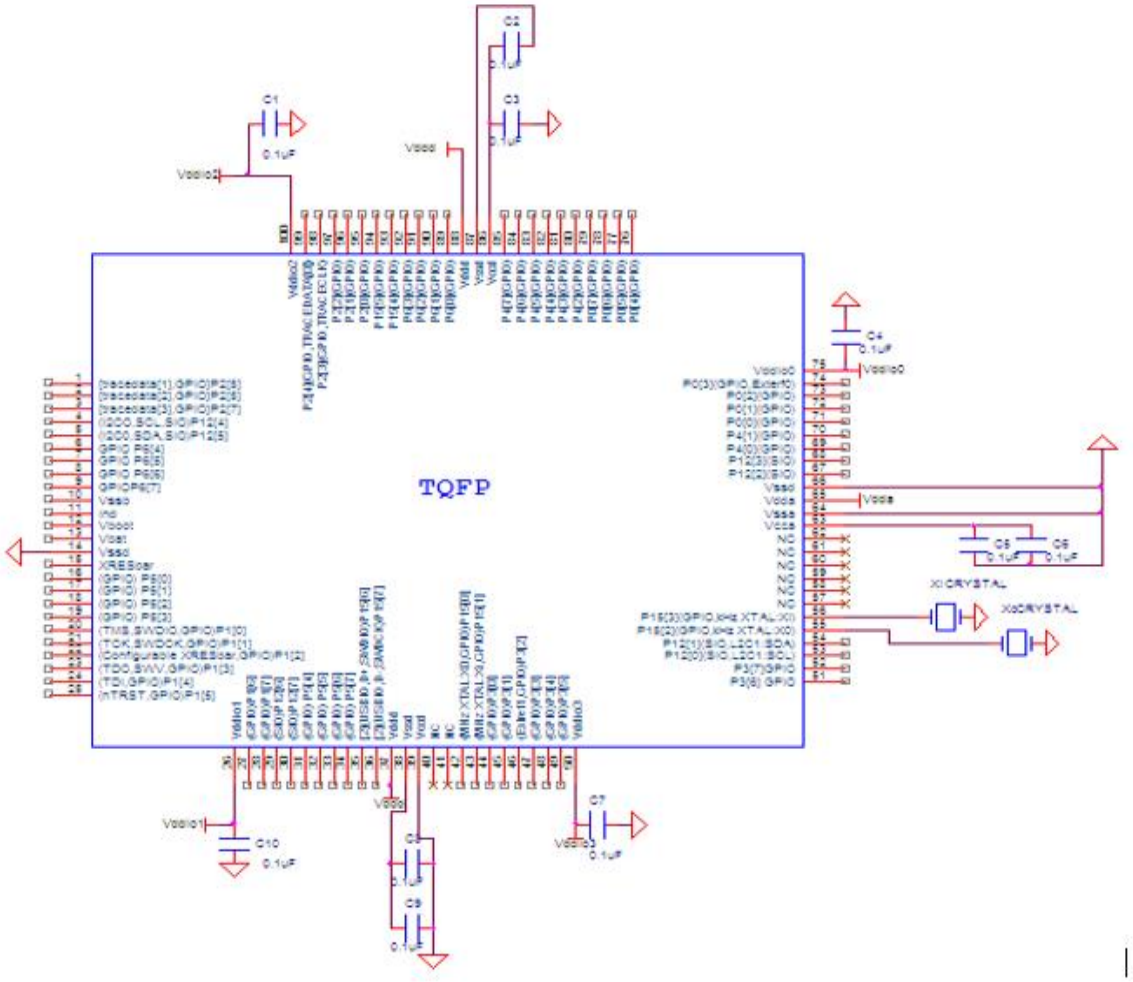

Fig 3.5: Schematic of PSoc

4 .HARDWARE COMPONENTS

4.1 MODULATOR

The modulator is a type of device that is used to perform modulation. Modulation is a method of translating at least one feature of a periodic waveform that is carrier wave in accordance with the message signal that typically has information to be transmitted. (8)

Types of Modulation

- Direct Modulation
- External Modulation

SCHEMATIC

The below figure 4.1 shows the schematic of the modulator.

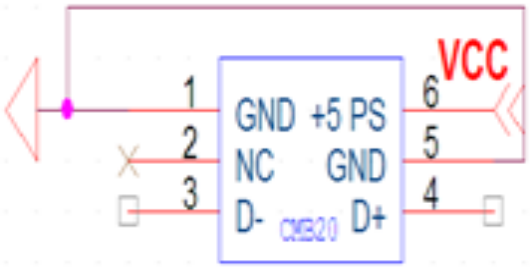

Fig 4.1: Schematic of modulator

4.2 LASER

The laser source module utilized is DFB-C-PM-M which is expounded as Compact Distributed Feedback (DFB) Polarization Maintaining (PM), intended to frame high data transmission simple or computerized photonics connect when incorporated with an optical modulator. To guarantee steady wavelength strength and power security, DFB laser's yield control and working temperature are absolutely controlled. It might be adjusted with all DFB laser that is standard. The DFB-C-PM-M is

intended to work with Compact Modulator w/Bias Control (CMB) for RFoF application. The client can control the wavelength and laser drive current by means of PC interface, utilizing its USB interface. (9)

5. IMPACTS ON DEVICE DESIGN

5.1 LASER

Modulation done by an external link will be having a Gain that will be equal to two times of the output power supplied by CW. Optical sources which will be having narrow output spectra like SC, -state, and fiber lasers doped, are correct choices of CW optical source in the modulation link which is external, because of their power output and RIN behavior. No solid-state sources are commercially available, at 1550nm wavelength, making external modulation stronger. (9)

5.2 MODULATOR

In an analog link of external modulation type, the dominant factor is the modulator which helps in finding the link performance. There are many other characteristics of a modulator that are most useful those are voltage sense, represented by $V\pi$, the impedance(Z), the optical loss, the capability of optical power-handling, the linearity, and the stability of environment. Lithium-niobate, SC, and polymers are the three important parameters useful in designing the system. The performance of a modulator is always found by the material type, design of modulator and overall amount of time spent on designing this material [6].

6. SCHEMATIC

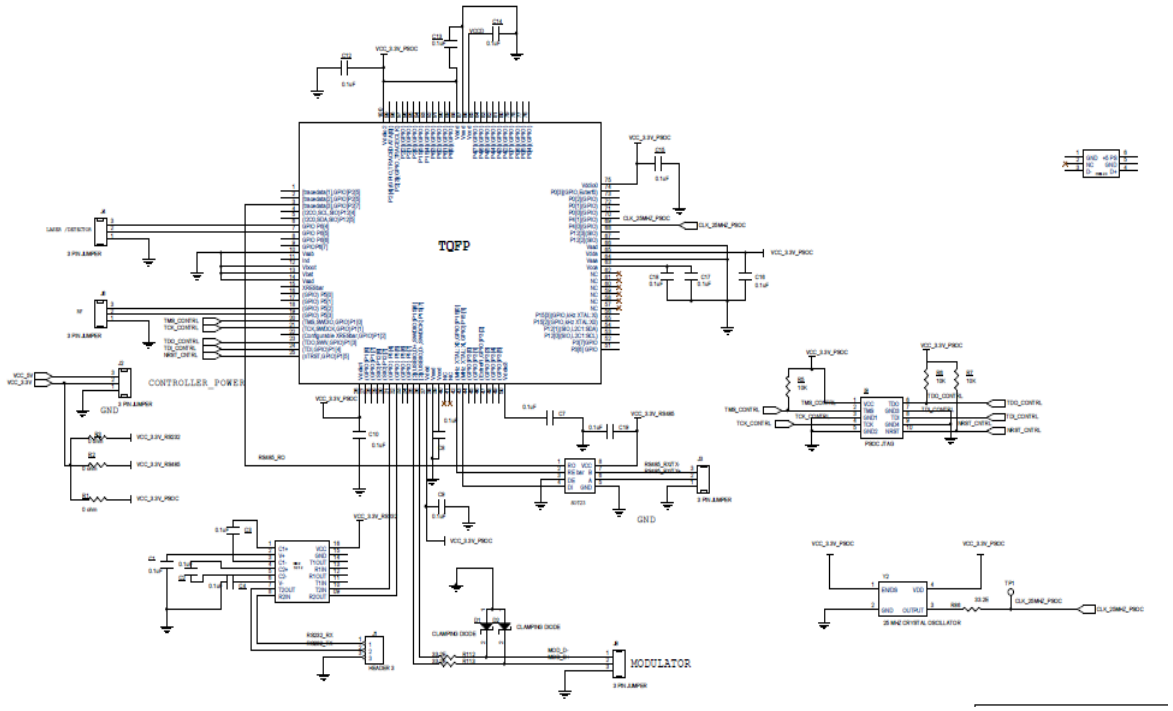

Fig 6.1:Schematic of system

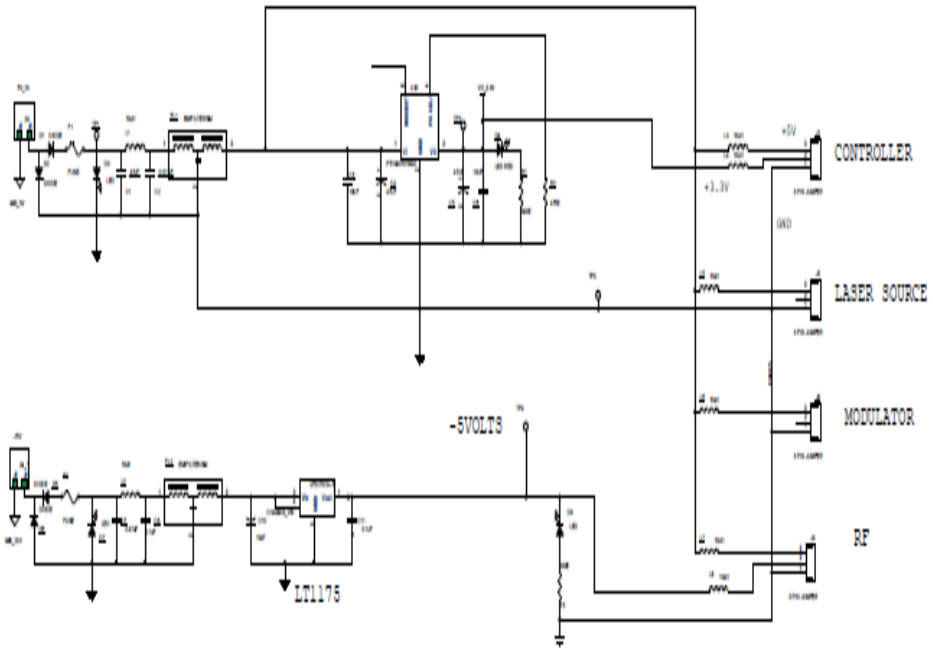

Fig 6.2: Schematic power supply.

7. SIMULATION RESULTS

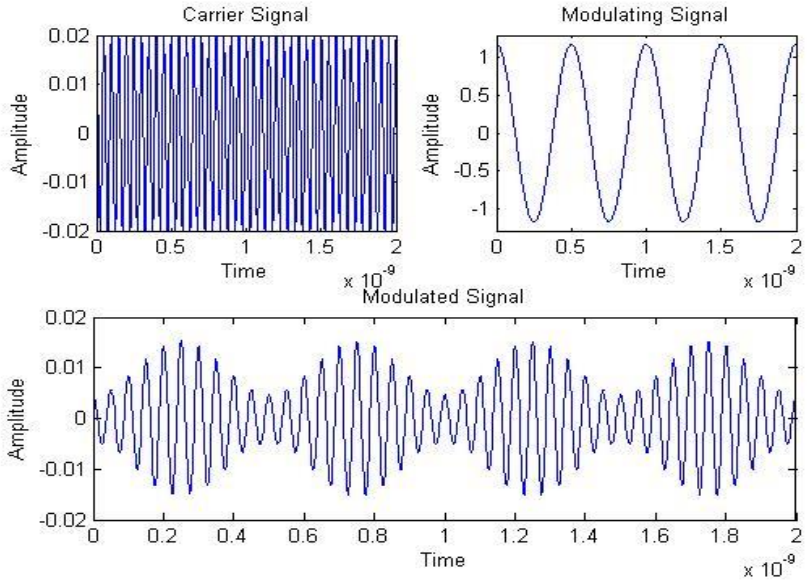

Fig 7.1: simulation.

8. CONCLUSION AND FUTURE SCOPE

By using this system a high speed optical to RF conversion is done. Many hazardous caused by the RF can be overcome using optical transmission system. By implementing this system it is helpful for high-speed optical data transmission. In the proposed system MZM (Mach-Zehnder Modulator) is used for high-speed optical conversion. The RF signal is given to one input of MZM to modulate the light signal produced by Laser Diode. Here in the proposed system, the ADC (Analog to Digital conversion) is not done, the only analog signal is used. Hence our system is used for high-speed optical conversion. Hence the advantage of using this system is that attenuation is been reduced, bandwidth is increased; installation will become easy and easy maintenance.

Wireless networking is the most trending topic in past few decades, owing to its higher mobility rate. People will be able to connect their devices to cell phone, computer, and printers to the network by using radio signal without using wire connection.

By using wireless cost can be reduced and can be used in the mobile environment. The use of mobile subscribers is increased in comparison with the wired ones. Hence this system can be used for wireless transmission and reception by the mean of the antenna.

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