DEVICE DESIGNED FOR COMMUNICATION

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Abstract— **In optical communication information is transmitted in the form of light pulses through an optical fiber. The optical fiber is electrically non-conductive. It does not act as an antenna to pick up electromagnetic signals. For any equipment testing in the laboratory, electrical signals have to be transmitted into equipment and received from the equipment. It is therefore required to convert electrical signal into an optical signal during transmission and convert back to electrical signal during reception in order to transmit and receive the optical signal through optical fiber. Purpose of this project is to design an optical device between the equipment's in the laboratory and transmission and reception of signals between the equipments is done using optical communication. Signals from different protocols are multiplexed before transmission through optical fiber and demultiplexed after reception of signals through optical fiber at the destination. Half duplex communication is used. Signal levels at various stages are evaluated for both the protocols.**

Keywords— Equipment's, optical interface, protocols, multiplex, demultiplex.

I. INTRODUCTION

Optical fibre is generally chosen for systems requiring higher bandwidth or spanning longer distances than electrical cabling can accommodate [2]. Fibres are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference. Its high bandwidth capabilities and low attenuation characteristics make it ideal for gigabit transmission and beyond [1].An optical fibre is flexible, transparent fibre made of extruded glass or plastic. It can function as a waveguide to transmit light between the two ends of the fibre. The phenomenon of fibre optic communication is based upon total internal reflection which guides light trajectory to facilitate signal/data transfer. [4].Specially designed fibres are used for a variety of other applications, including sensors and fibre lasers.

Main purpose of designing this device is to develop an optical interface by transmitting the signals between the equipment's in the laboratory by using more than one protocol namely RS485 and USB. Optical interface is developed as replacement for electrical interface which is used in testing environment. Application of this device will reduce the external interference to minimum compared to electrical interface, so that signals transmitted and received between the equipment's will be immune to other interference. This paper focuses on the design of the device and how it functions. It also includes results of verification done at different stages in the design using two protocols.

II. DESIGN OF DEVICE

A. Overview Of Design

This device is a transceiver which consists of transmitter and receiver section. The transceiver consists of Serializer, Deserializer, interfacing ICs (Integrated Circuits), voltage regulators, and SFP (Small Form Factor Pluggable) module. Information is transmitted and received between the equipment's. Therefore the equipment's can act as source or destination depending on the situation of transfer of information.

B. Design Details

The device is designed to accept the inputs from electrical interfaces like RS485 and USB. These are the two electrical interfaces connected to either of the equipment. Signal through RS485 cable is transmitted to MAX485 interfacing IC. Similarly signal through USB cable is transmitted to FT232RL.Output of FT232RL is then given as one of the inputs to Serializer. These signals will be multiplexed by the Serializer DS90C241. Output from the Serializer is then fed to SFP module to convert the electrical signal to optical signal. This optical signal is then transmitted via optical cable to the receiving end. This optical signal is then converted back to

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electrical signal by SFP module and fed to Deserializer. Output from Deserializer is then connected to respective interfacing ICs i.e. MAX485 and FT232RL. Output from MAX485 is transmitted via RS485 cable to the destination. Similarly output from FT232RL is transmitted via USB cable to the destination.

C. Transmitter section

Transmitter section consists of source, DS90C241. Interfacing ICs namely MAX485, FT232RL, are common components for both transmitter and receiver. Source of the device is either of equipment's. When signal is transmitted between both the two equipment's, any equipment can act as source e.g computer or any communicating device in the laboratory. Signal from the source is transmitted through two protocols i.e. RS485 and USB. Device which is designed consists of MAX485 and FT232RL as interfacing ICs. MAX485 is the interfacing IC used for RS485. It is low power transceiver and contains one driver and one receiver. It allows the transmission of data upto2.5 Mbps. FT232RL is a USB to serial UART interface. It is single chip USB to asynchronous serial data transfer interface. Entire USB protocol is handled on the chip. USB specific firmware programming is not required. It is used as an interfacing IC between RS485 and serialiser. Output from these interfacing ICs is given as input to the serialiser. Serialiser used is DS90C241. It is located at the transmitter end. It will accept the inputs from the interfacing ICs and multiplex the signals and then will transmit the output to SFP module. The DS90C241 Chipset translates a 24-bit parallel bus into a fully transparent data/control LVDS serial stream with embedded clock information. This single serial stream simplifies transferring a 24-bit bus over PCB traces and cable by eliminating the skew problems between parallel data and clock paths. In the design only two parallel inputs of DS90C241 are used.

D. Receiver section

Receiver section consists of destination, DS90C124. SFP module, voltage regulators are common components for both transmitter and receiver. Two voltage regulators are used namely LP 3997-3.3V regulator and TPS77601 which is 5V regulator. Destination of the device is either of equipment's. When signal is transmitted between the equipment's, any equipment can act as Destination. Power to the device is provided by the external 9V supply. This 9V is converted to 5V supply by voltage regulator TP77601 so as to provide 5V to all the components which require 5V supply. TP77601 IC is used to provide 5V supply from maximum 12V supply. Its applications are FPGA Power and DSP Core and I/O Voltages. There are some components in the device which require 3.3 V supply. So LP3997 is used. This regulator converts 5V supply to 3.3V supply. The LP3997 provides 3.3V output at up to 250mA load current. The chip architecture is capable of providing output voltages as low as 0.8V. It is 8-Lead VSSOP Package. Its applications are Portable Consumer Electronics, Cellular Handsets, Laptop and Palm Computers. Output from serialiser is fed to SFP (Small Form Factor Pluggable) module. Module consists of PECL. Positive emitter-coupled logic (PECL) is a further development of ECL using a positive 5V supply instead of a negative 5.2V supply. Electrical signal from serializer is connected to PECL. Output from PECL is provided as input to laser driver. At the output of laser driver, a laser is connected. This module is used to convert electrical signal to optical signal. This optical signal is then transmitted via optical cable to the device located near destination. SFP module at the destination end converts optical signal into electrical signal. SFP module offers nominal data rates ranging from 155 Mbit/s to 2.5 Gbit/sec. Supported distances range from 500 m (Gigabit Ethernet and Fiber Channel multimode) to 80 km. Output from the SFP module is then fed to the deserialiser. Deserialiser used is DS90C124. It is 48 pin chipset. The DS90C124 receives the LVDS serial data stream and converts it back into a 24-bit wide parallel data and recovered clock. The Deserializer can attain lock to a data stream without the use of a separate reference clock source; greatly simplifying system complexity and overall cost. The Deserializer monitors the incoming clock information to determine lock status and will indicate lock by asserting the LOCK output high. In the design the number of outputs of DS90C124 utilized are two. The Deserializer synchronizes to the Serializer regardless of data pattern, delivering true automatic plug and lock performance. It will lock to the incoming serial stream without the need of special training patterns or sync characters. The Deserializer recovers the clock and data by extracting the embedded clock information and validating data integrity from the incoming data stream and then deserializes the data. Output from deserialser is then fed to the respective interfacing ICs namely MAX485 and FT232RL. Signal from these ICs are fed to the destination through RS485 and USB. In this process signal is transmitted from source to the destination through optical cable by designing this device. One device is present near the source and another device is located near destination. When the source transmits data, transmitter of the device near the source end will transmit the data to the receiver of the device located near destination through optical cable. When destination responds to the data, the transmitter section of the device near destination will transmit the data to the receiver of the device near source. Optical cable will be of maximum 5 meters. LC connector is used to join the end of optical fibers to the SFP module.

III. SIGNAL TESTING

When the source transmits data via the protocols, interfacing ICs of the device receives the data whose amplitude is 5V. This signal is then fed to serialiser and it was

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found that the amplitude of the signal at the input of serialiser decreases. Similarly the amplitude obtained at the output of deserialiser is decreased. When the signal reaches the destination the signal strength further reduces. Various signal levels were checked through the electrical interfacing ICs i.e. MAX485 and FT232RL.To test any equipment; it is needed to have a device which will verify the correct signal values. This device is used as it includes optical interface which will provide the signal which will be more immune to electrical field than electrical interface.

IV. COMPARISON

The comparison between two interfacing ICs i.e. MAX485 and FT232RL for RS485 and USB is provided in graphical form. The signal communication between source and destination is analyzed using these two protocols. Using both the protocols it is possible to communicate between the devices. It is observed that signal levels through USB and RS485 differs at the output of serialiser and deserialiser. Signal is almost similar at the input of serialiser and deserialiser. Between the output of serialiser and input of deserialiser, conversion of electrical signal to optical and then conversion back to electrical signal was done using SFP module. These two protocols are used in the project so as to evaluate the performance of the signal through these protocols and also user can use the protocol simultaneously without disturbing the setup.

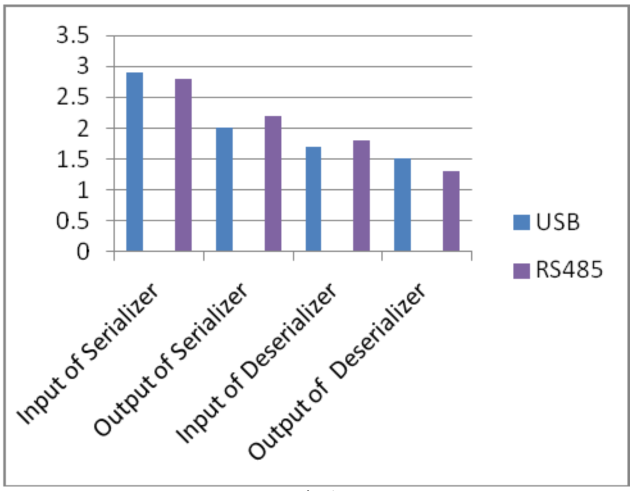

Fig.1

V. CONCLSION

Device designed for communication between equipment's which is designed for transmission and reception of signals using above components were verified. At each stage voltage levels (in volts) via RS485 and USB were checked which means correct transmission of signal was obtained. Data sent from the source was received at the destination using the designed device through optical cable. And the destination responded back to the communication. This device can be used to test equipment in the laboratory. Use of optical interface will result in less attenuation of signal and more immune to noise.

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