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DESIGN OF A DEVICE FOR OPTICAL COMMUNICATION

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Abstract: Optical communication uses light to carry information. It does not conduct electricity. This prevents problems with ground loops and conduction of lightning. Optical fiber communication is unaffected by neighboring electromagnetic radiation compared to electrical communication. The optical fiber is electrically non-conductive, so it does not act as an antenna to pick up electromagnetic signals. Purpose of this project is to design an optical device between both the equipment's and transmission and reception of signals is done using optical communication. Signals from different protocols will be multiplexed before transmission and demultiplexed after reception of signals through optical fiber.

Keywords: Optical fibre, optical communication, protocols, multiplex, demultiplex.

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INTRODUCTION

In fibre-optic communication, information is transmitted from one place to another by sending pulses of light through an optical fibre. Optical fibre is generally chosen for systems requiring higher bandwidth or spanning longer distances than electrical cabling can accommodate [2]. Optical fibres have largely replaced copper wire communications in core networks in the developed world. Its high bandwidth capabilities and low attenuation characteristics make it ideal for gigabit transmission and beyond [1]. It can function as a waveguide to transmit light between the two ends of the fibre. Fibres are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference.
Main aim of this paper is to develop a device which will transmit the signals between both the equipment's in the laboratory by using more than one protocol namely RS232 and Ethernet. 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.

DESIGN OF DEVICE

A. *Overview Of Design*

Optical interface 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 module. Information is transmitted and received between both the equipment's.

B. *Design Details*

The device is designed to accept the inputs from electrical interfaces like RS232 and Ethernet. Signal through RS232 cable is transmitted to MAX232 interfacing IC. Similarly signal through Ethernet cable is transmitted to MIDCOM 7090-37 10/100 Mbps SMD transformer.Output of MAX232 is then given as one of the inputs to Serializer. These signals will be multiplexed by the Serializer DS90C241. Output from this MIDCOM IC is differential, it has to be converted to single ended. So KSZ8001S Physical Layer Transceiver is used.Si510/511 is used to provide clock frequency to KSZ8001. Output of KSZ8001S is then given as one of the inputs to Serializer. 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 electrical signal by SFP module and fed to Deserializer. Output from Deserializer is then connected to respective interfacing ICs i.e. MAX232 and MIDCOM IC.

Output from MAX232 is transmitted via RS232 cable to the destination. Similarly output from MIDCOM IC is transmitted via Ethernet cable to the destination.

C. Transmitter section

Transmitter section of the device consists of source, DS90C241. Interfacing ICs namely MAX232, MIDCOM IC, are common components for both transmitter and receiver.

DS90C241: This is the serializer which 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. It features 5 MHz-35 MHz clock embedded and DC-Balancing 24:1. It is 48-pin TQFP package. [3]

MAX232: This is the interfacing IC between Serializer and RS232 connector. It is the member of family of line drivers which is used for EIA/TIA-232E and V.24/V.28 communication interfaces. Output obtained is within the range of -0.3V to (VCC +0.3V). Supply voltage required by this IC is within the range of -0.3V to 6V. Its applications are Portable Computers, Low-Power Modems, Interface Translation, Battery-Powered RS-232 Systems, Multidrop RS-232 Networks. [7]

10/100Mbps SMD Transformer: It is the transformer used to accept the input from Ethernet. It meets IEEE 802.3 standard, Supports most 10/100Mbps PHYs requiring 1:1 Turn Ratios. It is Low-profile package. It has high isolation voltage. It has ISO 9002 Certified manufacturing facilities. Operating temperature range is from -40 to+85C. [9]

KSZ8001: It will accept the output from 10/100Mbps SMD Transformer as input and provide single ended output. The KSZ8001 is a 10BASE-T/100BASE-TX/100BASE-FX Physical Layer Transceiver, operating the core at 1.8 volts to meet low voltage and low power requirements. The solution provides interfaces to transmit and receive data. It is 1.8V CMOS design, power consumption 250 mW. It is 48 Pin LQFP, 48 Pin SSOP. [10]

Si510/511: The Si510/511, Crystal Oscillator (XO) 100 kHz TO 250 MHZ, XO utilizes Silicon Laboratories' advanced DSPLL technology to provide any frequency from 100 kHz to 250 MHz . Unlike a traditional XO where a different crystal is required for each output frequency, the Si510/511 uses one fixed crystal and Silicon Labs proprietary DSPLL synthesizer to generate any frequency across this range. This IC-based approach allows the crystal resonator to provide enhanced reliability, improved mechanical robustness, and excellent stability. [6]

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.

DS90C124: The DS90C124 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 extracts the clock/control information from the incoming data stream and deserializes the data. The Deserializer monitors the incoming clock information to determine lock status and will indicate lock by asserting the LOCK output high. [3]

SFP module: The Small Form Factor Pluggable (SFP) module accepts electrical input and converts it into optical signal. This signal is then transmitted through optical cable and SFP module at the other end will convert optical signal into electrical signal. 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. Electrical signal is converted to optical signal. This optical signal is then transmitted to the receiver. At the receiving end photodiode is present. Conversion from optical to electrical signal takes place over here. Output from this is connected to pre amplifier. Its output is then fed to post amplifier. Output of post amplifier is the connected as input to Deserializer. [8]

LP3997: The LP3997 regulator is designed to meet the requirements of portable, battery-powered systems, providing accurate output voltage, low noise, and low quiescent current. 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.When switched in shutdown mode; the power consumption is virtually zero. It is 8-Lead VSSOP Package. Its applications are Portable Consumer Electronics, Cellular Handsets, Laptop and Palm Computers. [5]

TP77601: The TPS775xx and TPS776xx devices are designed (TPS775xx) to have a fast transient response and be stable with a 10F low ESR capacitor. This combination provides high performance at a reasonable cost. It is available in Fixed Output and Adjustable Versions. It has fast Transient Response. TP77601 IC is used to provide 5V supply from 9V supply. Input of this regulator is 9V which is provided by external battery. Its applications are FPGA Power and DSP Core and I/O Voltages. [4]

OPTICAL CABLE

One device is placed near the source and other device is located near destination. When the source transmits data, transmitter near the source end will transmit the data to the receiver located near destination through optical cable. When destination responds to the data, the transmitter near destination will transmit the data to the receiver near source. Optical cable will be of maximum 5 meters.

COMPARISON

The comparison between two interfacing ICs i.e. MAX232 and MIDCOM IC for RS232 and Ethernet is provided in graphical form. It is observed that signal levels through RS232 and Ethernet differs at the input and output of deserialiser, output of serialiser and input of interfacing ICs. 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.

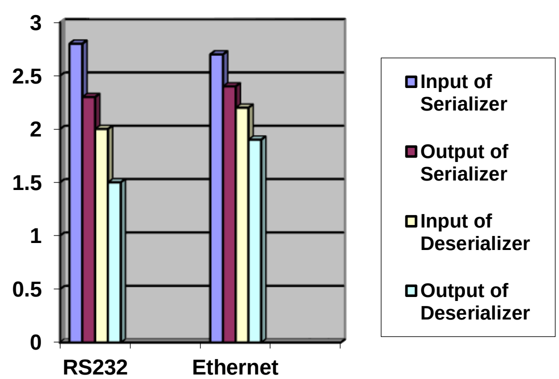

Fig 1. Comparison of signals

CONCLUSION

An optical interface between equipment's which is designed for transmission and reception of signals using above components were verified. At each stage, voltage levels via RS232 and Ethernet were checked which means correct transmission of signal was obtained. 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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