

# USB Cable using Optical Fiber

Rimi Chauhan<sup>1</sup>, Pagare R. A.<sup>2</sup>

<sup>1</sup>ME (Digital Systems), Trinity College of Engineering & Research,, Pune (MS), India

<sup>2</sup>Professor, Department of Electronics and Telecommunication, Trinity College of Engineering & Research, Pune (MS) , India

**Abstract:** *Wide bandwidth signal transmission with low delay is a key requirement in present day applications. The position of an optical fibers is controlled so that the fiber is not bent at a radius below its minimum bend radius. Fiber optic systems are important telecommunication infrastructure for world-wide broadband networks systems. We are going to implement and demonstrate prototype of Optical USB (2.0) system for long distances by using PIC microcontroller to a PC via the USB port using fiber.*

**Keywords:** Serial Communication, PIC Microcontroller, Power supply, Drivers ckt, USB port, Networking

## 1. Introduction

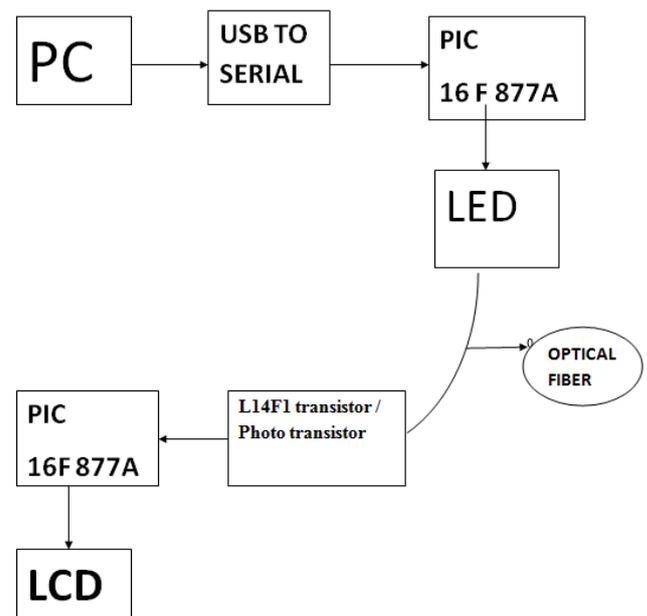
Today, the most widely used optical technology is optical fiber for high-speed interconnections, such as in server racks, connecting offices, buildings, metropolitan networks, and even continents via submarine cables. The term “photonics” is taken to cover all applications of light technology, from the ultraviolet part of the spectrum, through the visible, to the near-, mid- and far-infrared. Photonics is increasingly being used in data communication because it provides more ultra-high-capacity and speed in storage, communication and computation[1]. The purpose of this project is to explain how to interface a PIC microcontroller to a PC via the USB port and the concepts are universal. USB is a system for connecting a wide range of peripherals to a computer, including pointing devices, displays, and data storage and communications products. USB 2.0 with a data rate of 480 Mbit/s is commonly used. In this system, an USB host and an USB device are connected via a cable. USB is a system for connecting a wide range of peripherals to a computer, including pointing devices, displays, and data storage and communications products.

In this project, PC is used as data generator. PC contains software like terminal. in which baud rate is set to be 9600bps. If user enters character on PC it will be sent to USB to serial converter. Usb to serial converter is interfaced to PIC microcontroller's serial port. Data received serially in microcontroller will be sent out in the form of 1 0 bits to transmitting LED. Transmitting LED converts data 1 0 bits to ON OFF of light which is transmitted along optical fiber.

At receiver end photo-transistor will convert light into voltage and its sent to signal conditioning ckt. After signal conditioning signal becomes suitable to 0-5V TTL logic and then it can be interfaced to microcontroller. Microcontroller received that data serially and its displays character on LCD. USB protocol provides communication between computer and peripheral device. Its construction is based on 3 layers:(a)functional, which covers high-level relations between a computer program and a peripheral device,(b)logic, responsible for the flow of data stream, (c)physical, including wires, connections, analog devices.[2] Physical connection consists of 4 wires – 2 for power and 2 for bi-directional differential data transmission. The same set of wires may be shared by up to 127 peripheral devices.

## 2. Implementation

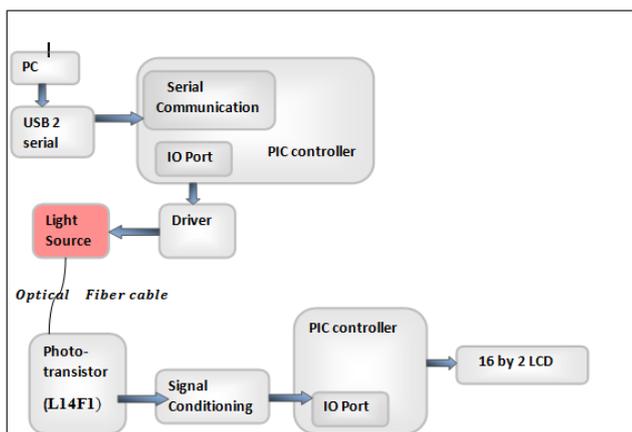
Fig.1 The project has two units in it. 1<sup>st</sup> unit is transmitter unit, which consists of microcontroller, driver circuit, LED, optical transmitter cable, LCD and PC. 2<sup>nd</sup> unit is receiver unit. It has microcontroller, driver circuit, optical receiver cable, LCD. PC is the important unit at the transmitter section. Through terminal or flash magic on PC, data is passed to the transmitter section through max232. For this transmission, RS232 cable or BAFO cable can be used. The microcontroller at the transmitter section is programmed in such a way that, data received is transmitted serially to LED through driver circuit and then to optical transmitter cable end. Now, through this optical fiber cable, data is transmitted to other end at receiver section. Receiver section has optical receiver L14F1 transistor. This received data is then given to signal conditioning circuit. Received data is first go through the waveform shaping using comparator IC LM358 and then to hex inverter IC 74LS04. This signal is then serially received by microcontroller at receiver section. This received data is displayed on LCD interfaced with the microcontroller PIC16F877A.



**Figure 1:** Block Diagram of Usb to serial converter is interfaced to PIC microcontroller' serial port

### 3. Hardware Design of Optical USB

A. **Serial Communication:** In general, there are three communication methods used in modern data acquisition systems between computer and peripherals: traditional RS232 serial port, parallel port, and universal high-speed data acquisition card. But not all these methods are ideal. Here are some examples, the transmission speed of RS232 serial port is too low to meet the requirements of real-time, the connection of parallel port is complicated, and high-speed data acquisition card based on ISA or PCI is complex and expensive. As a standard universal serial interface, the best advantages of USB interface is its high speed, feasibility, support for Plug and Play, and automatic. The USB (Universal Serial Bus) is a fast and flexible interface which can be used to connect electrical devices to a PC, and, as such, has become one of the most popular device interfaces. [3] Its merits are its ease of connection, fast data rate and the fact that most personal computers support it. [3]. A serial communications interface (SCI) is a device that enables the serial (one bit at a time) exchange of data between a microprocessor and peripherals such as printers, external drives, scanners, or mic. Serial communication is a communication technique used in telecommunications wherein data transfer occurs by transmitting data one bit at a time in a sequential order over a computer bus or a communication channel. It is the simplest form of communication between a sender and a receiver. Because of the synchronization difficulties involved in parallel communication, along with cable cost, serial communication is considered best for long-distance communication. The SCI contains a parallel-to-serial converter that serves as a data transmitter, and a serial-to-parallel converter that serves as a data receiver.



**Figure 2:** Block Diagram of Optical USB Communication

#### 1. PIC16F877 Microcontroller:

8-bit microcontrollers with 40-pins flash microcontrollers that operate in a range 2.0 to 5.5 V at 20 MHz with internal oscillator. It has high performance RISC CPU, interrupt capability, direct, indirect and relative addressing modes, 8K flash Program Memory, 368 bytes of data Memory (RAM), 256 EEPROM data Memory, Programmable code protection, power saving sleep mode, 8-bit analog to digital

converters (ADC), serial peripheral interface modules, USRT, 3 timers & 5 ports. The microcontroller is well suited for this remote application, because of its low-power consumption, high speed, power on reset facility, in circuit programming & debugging.

#### 2. RS-232 Specifications

RS 232 is a serial communication cable used in the system. Here, the RS 232 provides the serial communication between the microcontroller and the outside world such as display, PC or Mobile etc. So it is a media used to communicate between microcontroller and the PC. RS-232 is a “complete” standard. This means that the standard sets out to ensure compatibility between the host and peripheral systems by specifying 1) common voltage and signal levels, 2) common pin wiring configurations, and 3) a minimal amount of control information between the host and peripheral systems. Unlike many standards which simply specify the electrical characteristics of a given interface, RS-232 specifies electrical, functional, and mechanical characteristics in order to meet the above three criteria. In our project the RS232 serves the function to transfer the edited notice (or data) from PC (VB software) to the microcontroller, for the further operation of the system.

#### 3. MAX232

MAX232 is compatible with RS-232 standard, and consists of dual transceiver. Each receiver converts TIA/EIA-232-E levels into 5V TTL/CMOS levels. Each driver converts TTL/ COMS levels into TIA/EIA-232-E levels. The MAX232 is characterized for operation from - 40°C to +85°C for all packages. MAX232 is purposed for application in high-performance information processing systems and control devices of wide application.

#### 4. Power Supply

Microcontroller required 5v dc power supply, We are using is lead acid 12v 1.2Ah battery to achieve this 12VDC is applied to bridge rectifier and filter circuit, then by using fixed regulator IC7805, continuous 5Vdc supply is provided to microcontroller.

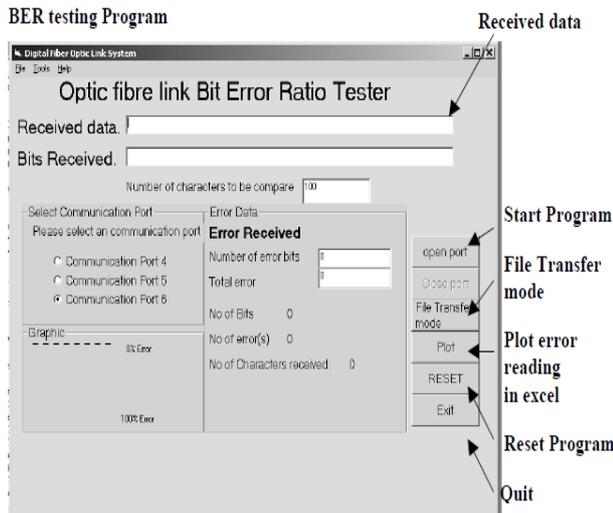
#### 5. IC7805

The 7805 three-terminal positive regulator is available in the TO-220/D-PAK package and 5V fixed output voltage, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents

### 4. Software Design and Implementation

A. BER (Bit-Error-Ratio): Receiver can be determines the logic state of each transmitted bit, where BER is the bit error ratio, E(t) is the number of bits received in error over time t, and N(t) is the total number of bits transmitted in time t. Bit error ratio is a statistical parameter. The measured value depends on the gating

time,  $t$ , over which the data is collected and on the processes causing the errors.[4,5]



**Figure 3:** BER tester screen shot.

- 1) Mikro ICD(In-circuit Debugger):  
 mikro ICD is highly effective tool for **Real-Time debugging** on hardware level. ICD debugger enables you to execute a mikroC program on a host PIC microcontroller and view variable values, Special Function Registers (SFR), memory and EEPROM as the program is running
- 2) USART:  
 USART hardware module is available with a number of PICmicros. mikroC USART Library provides comfortable work with the Asynchronous (full duplex) mode. It can easily communicate with other devices via RS232 protocol (for example with PC). We need a PIC MCU with hardware integrated USART, for example PIC16F877.
- 3) Flash Magic  
 Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the device. Flash Magic provides a clear and simple user interface.

## 5. Conclusion

By using Optical USB Protocol, we can communicate two devices for upto long distances. For its future scope we can use USB hub for the connections of multiple number of computers with each other in star topology so that we can communicate for large distances even upto 10m to 1km.

## 6. Acknowledgments

The goal of this paper is to design "Optical USB cable using Controlled Fiber Positioning". The function has been realized successfully. I wish to place on record my sincere thanks and whole hearted thanks to my guide Prof. Pagare R. A. under whose supervision this dissertation work has been carried out. It was his keen interest encouraging disposition and full co-operation that has made it possible for me to complete this work. I wish to place on record my sincere thanks and also acknowledge my indebtedness to Prof.

Hendre V. S., Head of Electronics & Telecommunication Department, whose critical analysis, careful comments and valuable suggestions have been immense help in completing this work. Lastly, I am thankful to all those persons, who have contributed directly or indirectly in the completion of this project.

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