

## EXPERIMENT #13 PC-TO-PC FIBER OPTIC DATA LINK

### INTRODUCTION:

While it is common to use modems and the occasional "null modem" cable to interconnect computers, it is also possible to use a fiber optic data link. In this experiment, a fiber optic link will be constructed to allow full-duplex communications between two personal computers. Figure 1 shows a block diagram of the experiment.

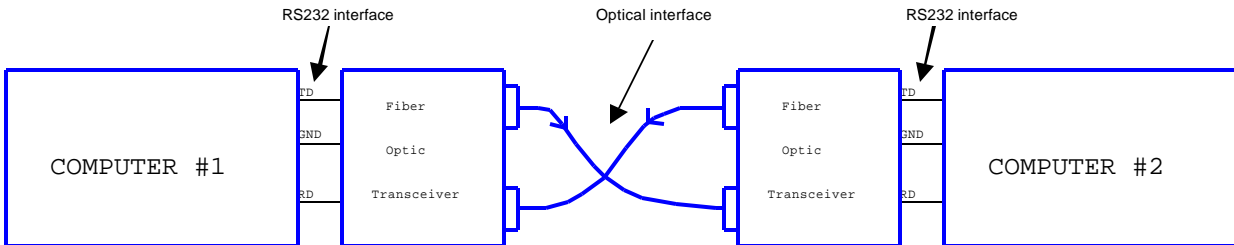


Figure 1: Block Diagram of the Fiber Optic Data Link

### CIRCUIT ANALYSIS:

Figure 2 shows the circuitry for the experiment. In case you're doing a double-take, the answer is *yes*, there are no power supply connections to the transmitter!

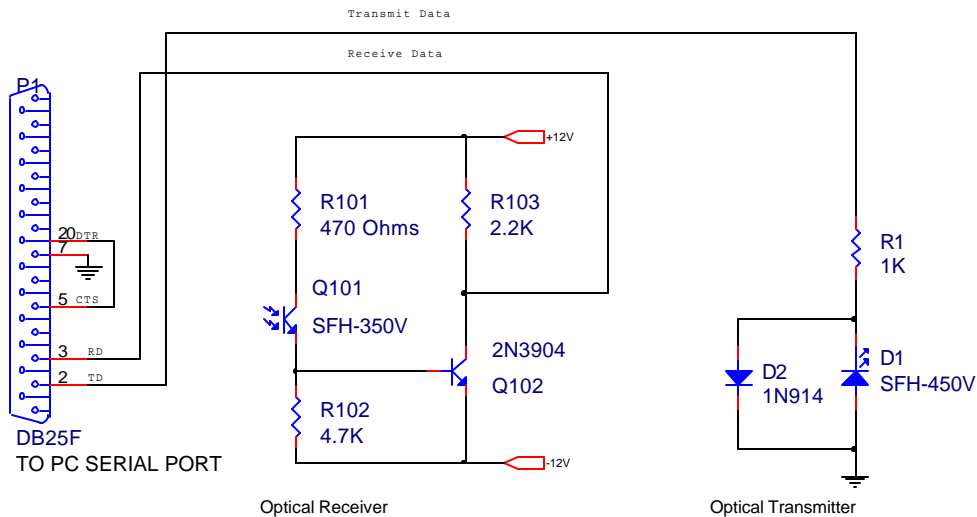


Figure 2: Fiber Optic to PC Interface (DB-25 Serial Ports)

From your study of the RS232 standard, you know that pin 2 of the PC serial port is the transmit data pin, and when idle this pin will be marking. A "mark" in RS232 is really negative voltage. Most PCs will produce about -12V for a mark. *This means that D1, the fiber optic emitter diode, will be on whenever the RS232 data is marking.*

When data is sent, the TD line will go positive (space). When this happens, D1 will be reverse-biased and shut off, turning off the light beam. Because LEDs can't withstand much more than a couple of volts of negative bias, D2 has been added to conduct during the spacing state. D2 protects LED D1 from excessive negative bias, which would rapidly degrade D1 (and eventually make it fail).

The receiver operates similar to the one from experiment 1. When the incoming optical signal is marking, the light beam will be on, turning on Q101. Q101 in turn will turn on Q102, which will pull the received data (RD) pin negative, which is the proper polarity for a mark. Q102 is needed for additional current gain, as Q101 alone can't supply enough current to properly drive an RS232 input. R101 serves as a current limiter to protect Q102's base, and R102 ensures that Q102 turns off fully when Q101 shuts off.

When a key is pressed on the computer the software in the PC will transmit the ASCII equivalent of the character down pin 2 of the RS232 interface, the transmit data pin. D1 will convert this into an optical signal, which will be sent over the fiber optic cable to the receiving computer, where it will be detected by Q101, and converted back into an RS232 signal by Q102. The receiving computer will then be able to display the character that was sent.

## LABORATORY PROCEDURE:

Name \_\_\_\_\_ Sign-off \_\_\_\_\_

1. A laboratory partner is required for this experiment. Two complete circuits and two PCs with terminal software (EZ-TERMINAL) and RS-232 serial ports are necessary. (If your PCs do not have serial ports, use a USB external serial port.)
2. Build the circuit of Figure 2.

### GROUNDING NOTE:

Note: Be sure that the common ground of the +12 and -12 V power supplies is connected to the circuit ground (pin 7 of the RS232 connector). Do not connect your ground to your lab partner's ground.

3. Apply power to your circuit.
4. Boot both PCs and start EZ-TERMINAL. To start EZ-TERMINAL, log onto Windows and double-click the EZ-TERM desktop icon. Check to make sure that the serial port parameters are set as follows:

1200 BPS ; 8,N,1.

### TIP:



You may wish to operate EZ-TERMINAL in its split-screen mode (press the *SPLIT SCREEN* button on the toolbar). In this mode, the screen will be divided into two windows, one for outgoing text (from the keyboard) and the other for incoming text.

5. If everything is working properly, everything typed on one computer should show up on the other. When this works in both directions, you're ready for a sign-off!

### Troubleshooting

The circuitry in this experiment is relatively simple, but you may still run into problems. If you think carefully about the symptoms you and your partner observe, you can work it out! For example:

- If you can type to your partner (and he/she sees what you're typing), but you can't see what your partner is typing, then you know that your transmitter and his or her receiver is working fine. *Either your receiver or his/her transmitter isn't working.* Try optical loopback: Loop the fiber between your own optical input and output points and see if you can type to yourself.

- If neither party can see any output, then its time to get back to basics. Use an oscilloscope to "walk" through the system, starting with the *TD* (transmit data) pin on your own PC. You'll need to transmit a continuous stream of characters to see activity on the scope.
- If you get gibberish...check the parameter settings of both terminals. They should be exactly the same!

### **Questions**

1. Explain how the optical transmitter of Figure 2 works. Where does D1 get its power?

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2. What is the purpose of diode D2 in Figure 2?

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3. What is an optical loopback test? What parts of the system does it test?

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4. What else have you learned in this experiment?

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