Fiber Board HOWTO

rev 5

The Fiber Duplex Board is for Communication between the Control Computer ("CC") and the Embedded Computer ("EC"). It converts RS232 signals to fiber optic.

The Fiber Simplex Board is for an optical Emergency Stop between the Control Station ("CS")and the Embedded Computer ("EC"). It is primarily for use in hydraulic E-stop circuits, but can be used for any CMOS/TTL switching application. It can be used for either simplex data communications, but as an optical switch.

The same PCB is used for duplex and simplex purposes, but requires conversion. Normally the board will be manufactured for one purpose or the other (Conversion details below).

Optical fiber is used in the system for immunity to electrical noise on the communications line. It also provides isolation between Control Station and the EC, so grounding problems are eliminated. Plastic fiber is used for its ease of use and high durability in the presence of mechanical shock and bending. Note that cold temperature can contribute to limits of the maximum transmission length of a piece of such fiber. Fiber lengths of over 160ft/49m have been used succesfully. See the Agilent datasheet included with this documentation. Fiber boards can also be used as repeaters to increase the transmission length.

Fiber Duplex Boards :

These connect to the serial port of the CC and the EC. The same board can be used on either type of computer.

It is OK to change the length of the serial port wiring, but keep serial line length as short as possible (definitely below 10ft/3m). The serial connector has jumpers installed in it, so be sure to retain these connections if the wiring or connectors are changed.
To make your own :
Use a DB9 (female) connector, inside the shell :
Connect pins 1,4,6 together, touching no other pins.
Also jumper pins 7,8 together, touching no other pins. This allows the serial port to "hardware handshake" itself.
Connect the following PCB pads to the DB9 serial connector :
"RX" - pin 2
"TX" - pin 3
"G" - pin 5

The board requires 5V power. When transmitting, is consumes under 70mA, so it can be powered off of computer USB port power if desired. This is a switching digital circuit, which generates noise, so it should not share power with Input Devices or other "clean

power". Its wiring should be kept several inches away from input device wiring.

Fiber Simplex boards :

The Transmit board has a Transceiver with a "T" on it. It gets mounted on the Control Station. The Transmit board requires 5V power. It consumes under 70 mA so it can be powered off of computer USB power.

The actual Emergency-stop button is a SPST which grounds the signal of the Transmit board to DGND (board common).

The signal wire "ETX" does not require any other external components. The signal is pulled up on the board, so if the wires break, the light goes out and you go into "safe mode".

The Receiver board has a Transceiver with a "R" on it. It gets mounted near the EC and Estop Relay board. The Receiver board requires 5V power. Its output, "EO" goes directly to the Estop Relay board's connector "EIN", pad "E". The two boards must share a common DGND.

The Simplex receiver can pick up a false signal if light containing enough of the correct wavelength is present. Strong sunlight, or close proximity Fluorescent light (less than 2ft/50cm) can cause this. This is only an issue when the fiber becomes unplugged. This is fairly easy to avoid in practice, when mounting the transceivers, point them away from such light sources, or keep them inside/near an enclosure which keeps them in shadow, in case the fiber is unplugged at the wrong moment.

Duplex board Broadcast Configuration :

The Duplex communications boards can be wired together so the CC broadcasts to multiple fibers, ie: multiple ECs. Each fiber carries the same data from the CC. The EC's take turns sending data back to the CC.

At present, software only permits this to work with Chip-EC's. Depending on the CEC ID, it takes its 12 channels out of the incoming 64. So CEC 1 gets channels 1-12, CEC 2 gets channels 13-24, CEC 3 gets channels 25-36.

To wire Fiber Duplex boards together for broadcast :
. You will mount a stack of boards near the CC (with standoffs). One board will be the Primary board, the others Secondaries.
. All boards get common 5V power.
. Wire the Primary CN1 serial connector to the CC serial port as usual.
. Connect the TX wire to all CN1 TX pads of all secondaries also.
. Don't solder anything into the RX pads of the secondaries.
. If powering these boards from a USB port, power is limited, so remove R1 from each board or replace it with a 3.3K. This reduces the power consumption of the LEDs.
. Use an AND gate input (74HC11) for every board's receive logic. Do this by soldering

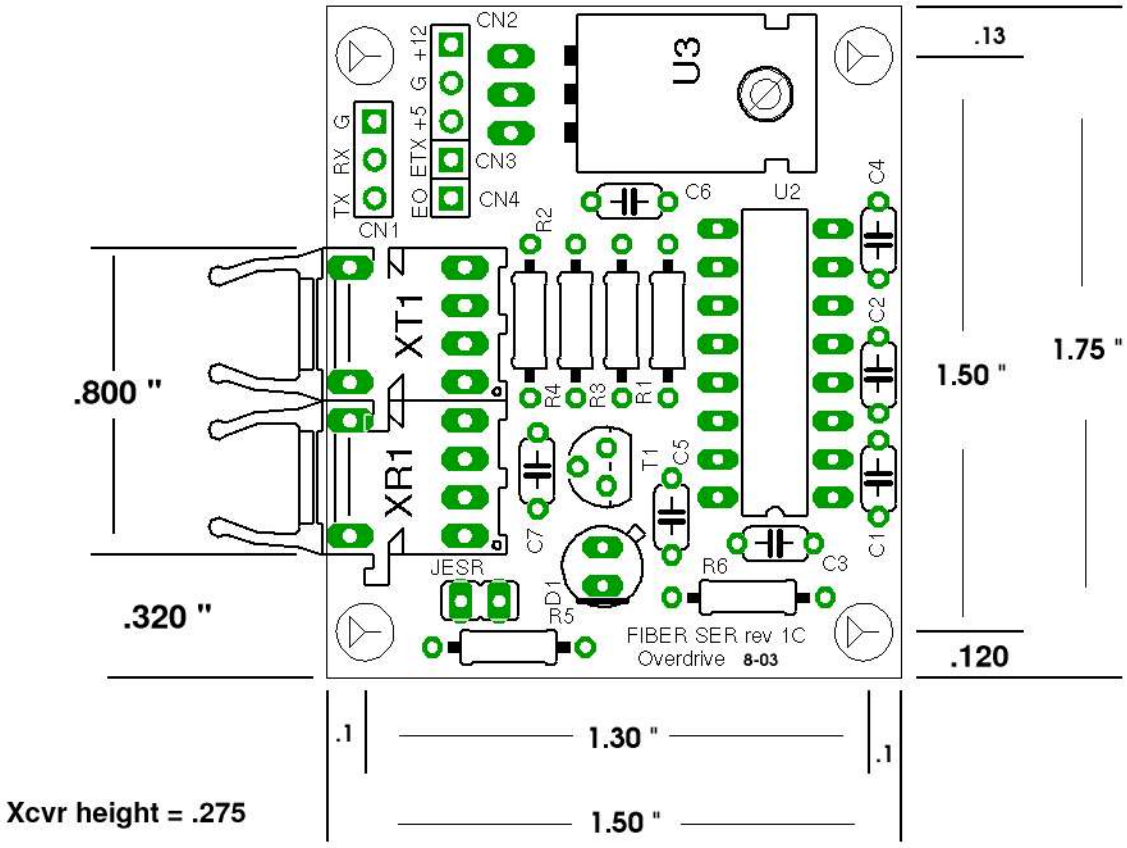
a wire from JESR pin 1 (pin 1 is closest to the fiber Xcvr side of board) to an available AND gate input.
. On the Primary board: cut the trace on the top of the PCB between U2 pin 11 and R5. Solder a wire from pin 11 to the output of the AND gate. Now your primary board will act as a gateway for all the RX signals.
. Put a .01uf cap near the AND chip power pins, and ground any floating inputs to any unused gates. (Note that you can cascade AND gates for more Secondaries).
. Put a 100uf cap on the power line.

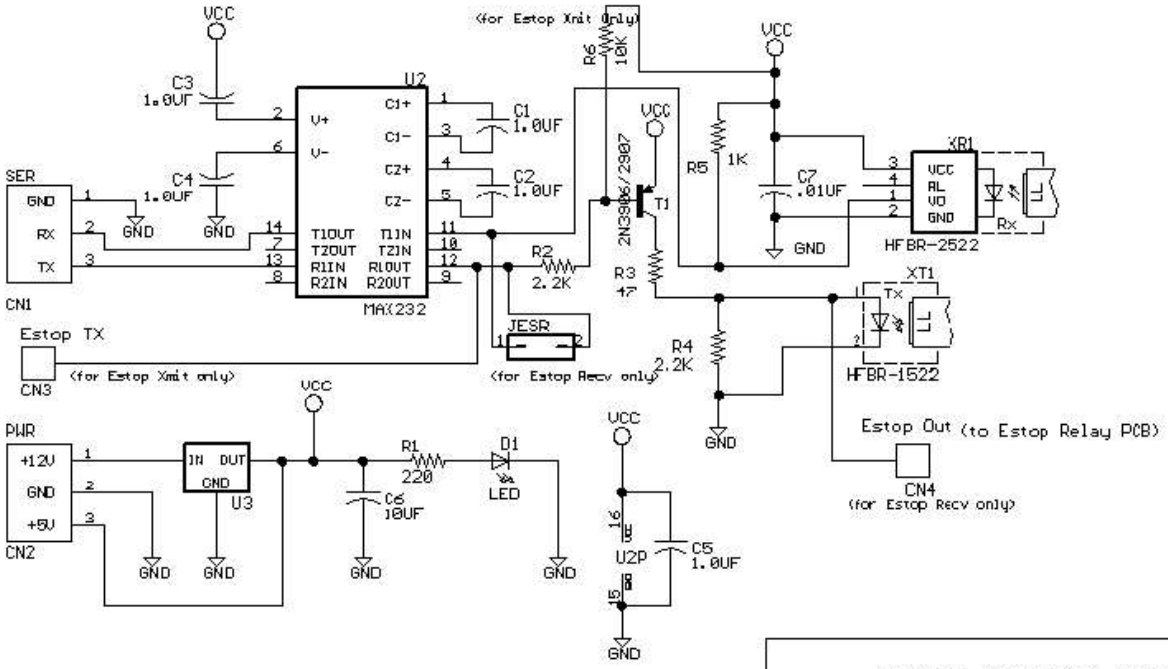
PCB manufacturing configuration for Simplex operation:
Transmitter:
. U2 (MAX232) remains unpopulated
. The fiber transmitter (HFBR-1522) is populated, but not the receiver
. "ETX" is the input
Receiver:
. U2 (MAX232) remains unpopulated
. Jumper "JESR" is installed
. The fiber receiver (HFBR-2522) is populated, but not the transmitter
. Pad "EO" is the output

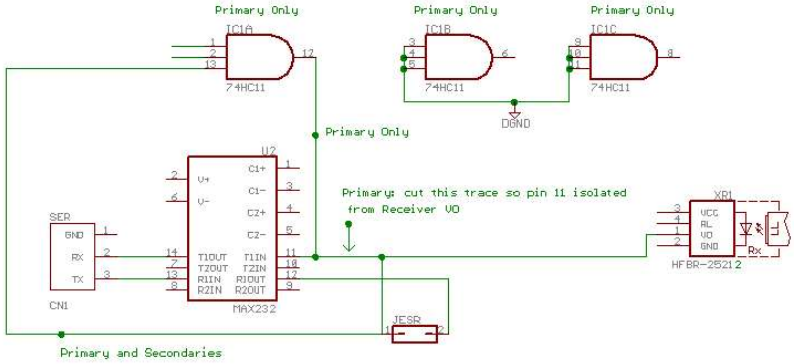
PCB manufacturing configuration for Duplex (communications) operation:

. Populate all parts, <u>except</u> :
. Don't populate "JESR"
. U3: The boards will typically be manufactured with 5V power wires directly to pads "+5" and "G". But note that a 7805 voltage regulator (U3) can be installed on the board, if 5V power is not available. If the regulator is used, power 6.7-15 volts can be applied to pads "G" and "+12".

Fiber Serial Board




VCC
C3
1.0UF
U2
V+
V-
C1+
C1-
C2+
C2-
T1OUT
T2OUT
R1IN
R2IN
T1IN
T2IN
R1OUT
R2OUT
MAX232
C1
1.0UF
C2
1.0UF
C4
1.0UF
SER
GND
RX
TX
CN1
GND
GND
(for Estop Xmit Only)
R6
10K
VCC
R5
1K
C7
.01UF
GND
XR1
VCC
RL
VD
GND
Rx
HFBR-2522
2N3906/2907
T1
R2
2.2K
R3
47
XT1
Tx
HFBR-1522
R4
2.2K
JESR
(for Estop Recv only)
Estop TX
CN3
(for Estop Xmit only)
GND
Estop Out (to Estop Relay PCB)
CN4
(for Estop Recv only)
PWR
+12V
GND
+5V
CN2
IN
OUT
GND
U3
R1
220
D1
LED
C6
10UF
VCC
U2P
C5
1.0UF
RS-232 TO FIBER OPTIC TRANSCEIVER
TITLE: fiber_serial_12c
Document Number:
SR, DS
REV:
1C
Date: 12/12/2003 10:44:06
Sheet: 1/1



* This simplified schematic shows only modifications
* See Fiber Board Howto for further instructions

Fiber Broadcast Modifications	
TITLE: fiber_serial_broadcast	
Document Number: SR	REV: 1
Date: 3/02/2004 22:57:35	Sheet: 1/1