Frequently Asked Questions about HOTLink™ Evaluation Boards

The following questions are frequently asked by customers who are using HOTLink™ Evaluation Boards. These cursory answers will serve as an introduction for each topic. Separate application notes cover these topics in more complete detail.

1. How can I convert a CY9266-C (75Ω) Evaluation Board to use 50Ω cables? How can I convert a CY9266-C (75Ω) board to use 93Ω coax? How can I convert a CY9266-T (150Ω) STP (shielded twisted-pair) board to use 100Ω STP cables?

Conversions of the CY9266-C and CY9266-T boards to use transmission lines other than those shipped in the standard configurations is as simple as changing the transmission line termination resistors (R40 and R41) on the back side of the board. Carefully remove the ones currently on the board (presently 37.4Ω on a -C) and replace them with resistors with a value equal to half the transmission line characteristic impedance (i.e., 25Ω for a 50Ω cable). See *Table 1* for the values used for some common cable impedances. Extreme care must be used to avoid delamination of the board and damage to the traces by excessive heat during desoldering and resoldering.

The change from higher to lower impedance transmission lines (e.g., 75Ω to 50Ω coax or 150Ω to 100Ω STP) may also require that the user change the transformer at T1. Changes from lower to higher impedance transmission lines usually do not require transformer changes. Alternatively, it may be desirable to add resistors at R54 and R55. (If these resistors are added, cut the built-in wire-traces that currently short the previously unused solder pads.) The higher currents involved in driving lower impedance transmission lines require either a higher inductance transformer or series current limiting resistors.

As the impedance of the external cable changes, the drive level must vary to compensate. Part of the drive circuit, R61 & R62, needs to change as well in order to vary the drive current available. See *Table 1* for the values required for various cable impedances. Changes in drive current will change the spectral characteristics of the source signal and therefore the usable distance with a specific media type.

Table 1. Cable Impedance vs. R Values

Cable Impedance	R40 & R41	R61 & R62
150Ω	75Ω	392Ω
100Ω	50Ω	261Ω
93Ω	46.4Ω	243Ω
75Ω	37.4Ω	196Ω
50Ω	24.9Ω	130Ω

2. How can I convert a CY9266-C (75Ω) Evaluation Board to use 150Ω STP cables (like CY9266-T)? How can I convert a CY9266-T (150Ω) STP board to use 75Ω cables (like CY9266-C)?

Conversion of the CY9266-C and CY9266-T boards to use transmission lines other than those shipped in the standard configurations is as simple as changing the transmission line connectors and the transmission line termination resistors (see the answer to question 1).

For the CY9266-C: Carefully desolder and remove the BNC and TNC connectors installed at J1 and J2. Replace them with the connector of choice using the mounting and solder terminal holes provided. WARNING: the CY9266-C board grounds the shield of the coax, and therefore one side of the transformer secondaries. Cut the traces leading to J1 and J2 on the solder side of the board (Under P1) to convert to balanced operation.

For the CY9266-T: Carefully desolder and remove the Sub-D installed at P1. Replace it with the connector of choice using the mounting and solder terminal holes provided. The three traces running on the solder side from P1 to J1 and J2 were cut to unground the cable and allow balanced operation. Reconnect these wires for unbalanced cable connections.

Changing connectors often also involves changing the impedance of the cable used. See question 1 above about changing the resistor values for different values of cable impedance.

Cypress Semiconductor Corporation • 3901 North First Street • San Jose • CA 95134 • 408-943-2600
March 11, 1999

3. What types of Optical Modules are compatible with the CY9266-FX Evaluation Board?

We have tested and are shipping the CY9266-F Evaluation Board with Siemens, HP, and AT&T Optical Modules.

Table 2. Vendors for Optical Modules

Vendor	Part Number	Features
CTS (formerly AT&T)	1408N	Duplex SC, 9-pin Module, LED
HP	HFBR-5302 HFBR-1119T/2119T	Duplex SC, 9-pin Module, LED Separate TX/RX
Siemens	V23806-A7-C2	Optical Data Link FC266 Transceiver
OCP	FCLE-266-TX/RX FCLL-266-TX/RX DTR-266	Separate TX & RX modules, LED and LASER Duplex SC, 9-pin Module, LED
AMP/Lytel	269063-1	AMP SC Duplex Transceiver 270 Mb/s 269063-1

These modules may be purchased from the following vendors. Although this is not a complete list of Optical Module vendors, it will serve as a starting point for finding a module that may suit your needs:

AMP/Lytel Division
61 Chubb Way
P.O. Box 1300
Somerville, NJ 08876
(908) 685-2000

Hewlett-Packard
Components Division
370 West Trimble Road
San Jose, CA 95131
(800) 535-7449 or (408) 435-6342

Sumitomo Electric
Fiber Optics Corporation
777 Old Sawmill River Road
Tarrytown, NY 10591-6725
(914) 347-3770

CTS Corp
1201 Cumberland Ave
West Lafayette, IN 47906-1388
(317) 463-2565

Siemens Fiber Optic Components
19000 Homestead Road
Cupertino, CA 95014
(408) 725-3436

Optical Communications Product
9736 Eton Avenue
Chatsworth, CA 91311
(818) 701-0164

4. Is this board compatible with (i.e., how do I use it with …) the IBM/HP OLC card?

The HOTLink Evaluation Board is intended to allow easy evaluation of Cypress HOTLink parts and is not intended to replace the IBM® OLC card as a system interface (although it is capable of performing this function). The OLC compatibility offered with these boards allows a familiar interface for those systems already compatible with the IBM cards.

OLC system interface signals in JP4 have the same timing and logical levels as the OLC card. Drive and loading are similar, but not identical. The function of the CY9266 Byte-Sync output differs from that of the OLC card when Sync-Enable is LOW. The OLC card will hold Byte-Sync LOW if Sync-Enable is LOW, while the CY9266 will set Byte-Sync HIGH for each byte containing a K28.5. When Sync-Enable is HIGH both boards will behave as the CY9266 does. The CY9266 behavior is convenient for implementing a simple “out of lock” indicator using timers that detect the interval between K28.5s (when Sync-Enable is LOW, a misframed K28.5 does not cause a Byte-Sync indication).

The CY9266 serial interface is incompatible with the IBM OLC card serial interface. The IBM OLC interface uses an 850-nm shortwave laser and detector. The HOTLink Evaluation board uses off-the-shelf 1300-nm LED transmitters and detectors or copper transmission line interfaces. These various types are not compatible. For an operational link, use two compatible serial interfaces (i.e., two CY9266 boards of the same type, either -C, -T, or -F) for the two ends of the transmission link.

Note: The active signal level of the LOOPBACK signal, as implemented on the CY9266, is opposite that of an actual OLC-266 card. If this signal is under software control, it should be programmed to allow signal loopback when the signal is active LOW. For hardware controlled systems an external signal inversion is necessary, or the signal may be jumpered at JP1 for operation from the S1-7 DIP switch.

The physical size of the HOTLink Evaluation Board was chosen to be compatible with the two-channel version of the IBM OLC card. The X-Y dimensions are identical to those of the IBM product, but the thickness and the protrusion of the serial interface hardware is different from the IBM product.

The IBM OLC card includes plastic card guides and attachment clips that facilitate its use in production systems. The HOTLink Evaluation Board has none of these components since it is not intended for the same function.

5. Where can I get additional fiber-optic cables and accessories? Where can I get additional coaxial cables or STP cables?

We have located the following vendors of fiber-optic cables and accessories. You may contact them to receive further information about their offerings. The lists below represent only some of the available sources.

Fiber Instrument Sales Inc. 315-736-2206 315-736-2285 Fax	Nu-Power Optics 619-471-7131	Fibertron 714-871-3344 714-871-5616 Fax	Belden Wire and Cable 800-BELDEN-1 order 317-983-5200

Additional coaxial and STP cables and other accessories may be found through:

Pasternack Enterprises 714-261-1920	First Source 408-371-1470	Newark 312-784-5100	Digi-Key 800-DIGI-KEY

6. How do I use this board to do bit-error-rate (BER) tests?

- Connect the board(s) with a suitable length of transmission line or fiber from the TX port of one board to the RX Port on another (or itself).
- Place the receiving board's Receiver in BIST mode by setting the RCV_BISTEN signal LOW. Ground the external pin marked RCV_BISTEN or set switch S1-5 to ON.
- Place the transmitting board's Transmitter in BIST Transmit mode by setting the XMIT_BISTEN signal LOW. Ground the external pin marked XMIT_BISTEN or set switch S1-1 to ON.
- Press the white reset button on the receiving board. The display should initially show a **.0.** . As the receiver finds an error in the data stream, it will show this with an increasing count. As the count exceeds 100, the overflow indicator will light up.
- The BER may be approximated by: 1 error/hour $\approx$ a BER of 1.1×10^{-12} using the 25.0-MHz oscillator shipped with the board.

7. How do I use this board to do transmitter jitter tests?

To achieve the best possible and most accurate transmit jitter measurements, the external environment of the HOTLink chips needs to have the lowest possible jitter to start. Common oscilloscopes and sources have so much jitter as to obscure the contribution of the transmitter. Additional sources of jitter on this board include:

- For the -C and -T versions: the transformer's frequency characteristics. For the -F version: the optical module.
- Layout of these boards has not been optimized for this testing, and does not have specific test connections built in.

With these items understood, a set-up to do an adequate test requires a quiet clock source and a digital oscilloscope such as the Tek 11801 or the HP 54720. The -F version without an optical module has the most convenient connections. Making connections to the -F board at location U4, all differential PECL signals, will allow the best measurements possible. (See the "HOTLink Jitter Characteristics" application note for information on how to measure jitter.)

Note: Transmit Jitter measured out of a -C or -T board includes significant crosstalk from the receive channel, coupled through the transformer. Ideally, measure Transmit Jitter with a quiet receive channel.

8. How do I use this board to do receiver jitter tolerance tests?

The ultimate performance of any serial link is determined by the performance of the receiver. The function of the receiver is to recover data from a (seemingly arbitrary) serial data stream. This data stream is translated several times, coupled to and though several non-linear devices, and subjected to all manner of distortion. The receiver must accept this serial pulse train and recover a high-speed bit-synchronous clock, de-jitter it, and then separate the DATA from the CLOCK. Jitter tolerance is the typical term for the ability of the receiver to correctly recover the DATA and CLOCK in the presence of these many distortions. HOTLink Receiver jitter tolerance can be measured by connecting a suitable transmission media between the transmitter and receiver, and inserting a jitter generation source similar to that shown in the "HOTLink Jitter Characteristics" application note. By inserting measured jitter amplitudes and watching the RVS output of the receiver, jitter tolerance can be measured. Further details on the fabrication of the jitter generator and the measurement techniques required for accurate measurement of this injected jitter is beyond the scope of this note, but are covered in detail in the "HOTLink Jitter Characteristics" and "HOTLink Built-In Self-Test (BIST)" application notes.

9. How do I use this board to do HOTLink power supply noise immunity tests?

The layout and design of this board makes it difficult to test the power supply immunity of these parts. Power supply noise immunity testing requires injecting a signal into the power supply pins and observing the effect of this injected signal on the link. This requires a different layout to allow access to the power supply pins of the HOTLink chips without affecting the operation of the other parts on the board.

10. How do I use this board to do transmission-line tests?

To check for the maximum transmission-line length over which the HOTLink Evaluation Board can communicate, it is only necessary to connect the selected transmission line between the TX and RX ports of the HOTLink Evaluation Board. Using one board with the cable returning to its own RX port or two boards and cables for simultaneous testing in both/either directions of the transmission line will work quite well. The HOTLink Transmitter and Receiver BIST function serves the purpose of generating and testing the data so the user can check for an acceptable error rate without extra test equipment. Transmission lines can be extended or modified until the BIST error count indicates an unacceptable error rate. An error rate of approximately 1 error/hour ≈ a BER of 1.1×10^{-12} when operated with the 25.0-MHz oscillator shipped with the board.

11. How do I use this board to do receiver-PLL acquisition-time tests?

Two kinds of receiver acquisition are measurable using this board. One kind shows how fast the receiver can recover from a phase hop, and the other shows how fast the receiver can acquire a datastream once the device is powered up with a stable REFCLK.

To measure the receiver recovery from a phase hop, connect a loopback cable with a delay just large enough to delay the data by almost one half a bit time (≈2 ns for the shipped oscillator) with respect to the OUTC+ line that goes between the CY7B923 and the CY7B933. Then arrange a delayed synchronous switch signal into the $A/\overline{B}$ Select input of the receiver. Trigger this delay from $\overline{RP}$ and delay this pulse to a point in the data stream where the data stays HIGH for several bit times. By switching between the delayed and fast signal path, a phase hop can be created at the input to the receiver. Increase the delay until the receiver shows an RVS pulse during BIST testing. The receiver will properly recover data with a phase hop as large as ±170°. Invert the $A/\overline{B}$ select signal to get the other polarity of phase hop.

To observe the receiver recovery from a “lost” data stream, arrange the evaluation board to have an external REFCLOCK 0.1% faster or slower than the on-board oscillator. Configure the transmitter to only send K28.5s by either deasserting both the $\overline{ENN}$ and $\overline{ENA}$ signals, or constantly transmitting a C5.0 character in Encoded mode. With a clean pulse, switch the $A/\overline{B}$ select line to the B input. This will cause the receiver to see a lost and then found data stream. Using a delayed trigger, watch the CKR output with respect to the transmit clock. The two clocks will match frequency and stabilize in phase difference in less than 60 µs.

12. How do I use this board to do min/max frequency tests?

- Arrange the jumpers on the board so that the CKW and REFCLK use the same external clock input. Do this by removing the jumpers across pins IX-IY and GY-HY, then jumpering pins GX-GY and HX-IX. Apply an external reference clock to the XMITCLOCK pin on any of the interface connectors. Loopback the board either externally or by closing S1-7, which loops the board back on itself.
- Now enable the both the XMIT and RCVR BIST functions and the transmitter. The LED display should now show a stable number. Clear the count by pressing the RESET button S2.
- With the board set up as above, vary the frequency of the external reference clock from a nominal 20 MHz downward. As you approach the limits of operation, the board will start to indicate errors on the display. Clear the errors after setting a new frequency by pressing S2 again. The point in frequency where you do not see any BIST errors marks the edge of the frequency range. Change your frequency source upward toward 33 MHz and again clear the error indications until you achieve stable operation just below the high frequency limit.

Typical boards will operate as high as 40 MHz and as low as 12.5 MHz.

HOTLink is a trademark of Cypress Semiconductor.
IBM is a registered trademark of International Business Machines Corporation.