SYSTIMAX® Solutions

Duplex Fiber Polarity Guidelines for LC and SC Connectors

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Introduction

Most fiber systems today are based on transmission along fiber pairs, using one fiber for one direction of signal propagation and the other fiber for the opposite direction. When installing and maintaining these systems, it is important to make sure that the signals are kept on the correct fibers, so that the transmit-to-receive polarity is always maintained.

Duplex crossover cords and pair-wise crossover wiring greatly simplify cable administration for this type of optical fiber network. When installed correctly, these systems automatically ensure proper signal polarity, so end users do not need to worry about maintaining transmit and receive signal integrity at connection points.

While the figures in this guideline depict connector hardware (plugs and adapters) resembling the SC connector, the descriptions and guidance apply equally to the LC connector.

General Principles

1. All duplex opto-electronic transceivers within the same application (Ethernet for example) have the same transmit and receive port positions. When looking into the ports of the transceiver with the keyways of the receptacle facing up, typically the transmitter is on left and the receiver on the right, as shown in Figure 1.

2. When connecting transceivers together, the signals must cross over. The crossover connects the transmitter of one device to the receiver of the second device.

3. All individual elements of a channel should provide a crossover. Channel elements include every patch cord, every adapter (coupling), and every cable segment between patch panels.

4. There are always an odd number of elements in a channel, whether the channel is made from a single patch cord or a concatenation of many cables and cords.

5. The net effect of an odd number of crossovers is a single crossover.

![Figure 1](image_url)

**Figure 1**
Typical transceiver polarity
How plugs and adapters work together

Figures 2a and 2b show a duplex connector plug and adapter. When looking at the duplex connector plug head-on (into the fibers) with the raised keys on top, the left position is A and the right position is B, as shown in Figure 2a. The raised keys on the plug, and the keyways in the adapter, allow the plug to be inserted into the adapter in only one orientation so that plug A inserts into adapter position A and plug B into adapter position B.

Note: Shading used in these figures is for illustration clarity only.

The adapter provides a crossover between two mated plugs because the keyways on the front and back halves of the adapter are oriented the same direction (for example, on top) as shown in Figure 2b. When looking into the front of the adapter, this construction causes the right position (labeled A) to mate to the left position (labeled B) as viewed when looking into the back of the adapter. Thus position A on one plug mates to position B on the other plug, and vice versa, which provides the crossover in the adapter. The letters A and B are generally marked on the plug and on the adapter for identification.

How patch cords provide a crossover

Duplex patch cords, as shown in Figure 3, provide a crossover because the fibers are attached to opposite plug positions from one end to the other. To illustrate this more clearly, the same crossover patch cord is shown in three different orientations. In all three views, each of the two fibers is attached to plug position A on one end and position B on the other end. Note the positions of the keys on the connectors.
How cables are terminated to provide crossovers

Permanent cable segments must be installed with a crossover in each fiber pair such that each fiber of a pair is plugged into an adapter position A on one end and an adapter position B on the other end. This is easily accomplished by following one of two methods governing the orientation of the adapters and the ordering of the fibers in the patch panels.

Crossover methods for cable termination

There are two methods available to achieve proper polarity when terminating cables at patch panels. The first method is preferred, as it provides more straightforward administration for applications that operate on other than two fibers, such as surveillance video on one fiber, or high-resolution component video that operates on three fibers (for R, G, B signals). This method is referred to as Symmetrical Positioning and it maintains the same order of the fibers at both ends of the cable. The alternate method, called Reverse-Pair Positioning, is used when the adapter orientation in patch panels is fixed. For example, use Reverse-Pair Positioning when installing cables between two iPatch panels or when splicing to cassettes with preinstalled pigtails.

The Symmetrical Positioning Method

1. Adapters are inserted in the patch panel at one end of the cable with the opposite orientation of the adapters at the other end of the cable. At one end of the cable, adapters are installed such that adapter position A corresponds to odd numbered panel positions (A-B, A-B order), and on the other end of the cable, adapters are installed in the opposite orientation such that adapter position B corresponds to odd numbered panel positions (B-A, B-A order).

2. Fibers are plugged into the adapters with the same number (or color code) sequence on both ends of the cable (that is, 1 (blue), 2 (orange), 3 (green), 4 (brown), etc.) so that the fiber number (or color code) sequence is symmetric with respect to the panel positions.

Figure 4a
Fiber ordering and adapter orientation in patch panel for the Symmetrical Position Method
The Reverse-Pair Positioning Method

1. Adapters are inserted (or are pre-installed, as with iPatch hardware and pigtailed cassettes) in the patch panel at one end of the cable with the same orientation of the adapters at the other end of the cable. They may be installed either in A-B, A-B order or B-A, B-A order. Note: iPatch hardware is preinstalled in B-A, B-A order, that is, with keyways facing up.

2. Fibers are plugged into the adapters with normal number (or color code) sequence on one end of the cable (that is, 1 (blue), 2 (orange), 3 (green), 4 (brown), etc.), and with pair-reversed ordering on the other end (that is, 2 (orange), 1 (blue), 4 (brown), 3 (green), etc.). For cassettes with preinstalled pigtails, the reverse pairing occurs at the splice on one end of the cable, not at the adapters. On one end splice the blue fiber to the orange pigtail, the orange fiber to the blue pigtail, etc.

Following either of these methods ensures that each fiber will be routed from position A on one end to position B on the other end, thus providing the required crossover. Figure 4a illustrates the Symmetrical Positioning Method and Figure 4b illustrates the Reverse-Pair Positioning Method as implemented with wall-mounted hardware where position 1 is at the top of the patch panels.

End-to-end polarity management

Figure 5 illustrates end-to-end connectivity using these methods from the main cross-connect, through the intermediate cross-connect or the horizontal cross-connect, to the telecommunications outlet. Each cable segment and each patch cord in this figure is plugged into an adapter position A on one end and into an adapter position B on the other end.
Installing the cabling system properly at an interconnect may require special attention, since interconnects have no distinct front side or back side for reference. When installing the adapters at an interconnect, it is best to check the origin of the fibers entering the interconnect. Make sure that each fiber is connected to adapter position A on one end and adapter position B on the other end. A sample layout, using centralized cabling architecture with interconnects in both the telecommunications closet and consolidation point, is shown in Figure 6.

Figure 6
Adapter orientation within interconnects

It is important to remember when testing a link comprised of concatenated cable segments, that, for example, a signal originating on an odd fiber will not necessarily remain on an odd fiber. It may switch to the even fiber in the pair. This odd/even transposition occurs when cross connecting two adapters that have the same orientation, as is illustrated in Figure 7. Because this situation can occur, it is best not to think of the signals as traveling on odd or even fibers. Instead, use the A and B positions to provide this distinction. In all cases, when a signal is input at the A position, then at all downstream points along the path, the signal will be output from the B position of the fiber pair.

Figure 7
Signal transposition from odd to even fibers when cross-connecting adapters of the same orientation
Troubleshooting tip

Polarity problems may be encountered when the above methods are not followed. Each violation of the A-to-B rule eliminates a crossover and may create incorrect polarity in the system by causing an even number of crossovers. Sometimes, installers or users try to fix this problem by eliminating another crossover in the link, either by using simplex cords or by using a straight through patch cord instead of a crossover cord. This method may cause problems in cable administration and should be avoided, as those patch cords may later be inadvertently used in correctly routed channels. To fix polarity problems, it is necessary to locate the patch panel(s) in which the methods were not followed and correct it in each instance. Remember that on correctly installed cable segments, signals input into position A will exit position B. Once these systems are properly installed, the polarity will always be maintained.

iPatch System Manager configuration tip

In iPatch installations, **cabling between two iPatch panels must be installed using the Reverse-Pair Positioning method**. Cabling between other panels, or cabling between iPatch panels and other panels or TOs (telecommunications outlets), may be installed using either the Symmetrical Positioning or Reverse-Pair Positioning methods.

iPatch System Manager software allows the user to indicate whether the fibers between adapters are installed with a crossover or direct (non-crossover). Note that both the Symmetrical Positioning method and the Reverse-Pair Positioning method are crossover connections. In order to properly manage fiber polarity in System Manager Software, you must ensure that the correct method is selected. For cabling connections that follow the guidelines of this document, the “Crossover” setting, as shown in Figure 8, is the correct setting, and is the default method in System Manager software. For further information regarding System Manager settings and features, refer to your iPatch System Manager User’s Guide or the System Manager Help buttons.

![Figure 8](image)

*Figure 8*

“Crossover” connectivity is the default setting in iPatch System Manager