FIREFLY™ Optical Half Cables

Application Note

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Patents

Patents: 8588562 and 8588561. Additional Patents pending.

Updated Documentation

Please contact optics@samtec.com to get access to the latest PCIe® documentation including the Optical Cable Assembly User Manual, as well as the PCIe® Over Fiber Guide, and to ensure that you have the latest version of this document.

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Change History

Revision #	Reason	Author	Date
01	Initial Draft	Roger Miller	5/16/2016
02	Corrections to Sec 11	R. Miller	2/19/2018
03	1. Sec 4: Changed reference to “24 Fiber Type A”. 2. Fig 6: Change pinout diagram header to read “24 Fiber Type A”. 3. Fig 10: Corrected so keys are oriented properly. 4. Fig 11, 13, 15: Corrected MTP channel numbering.	R. Miller	3/1/2021

1 FireFly™ Optical Cables

Samtec manufactures FireFly active optical cables (AOCs) which provide a mid-board mounted optical interconnect solution for chip-to-chip, board-to-board or system-to-system applications, at data rates up to 28 Gbps and link distances up to 100 m. FireFly optical modules are currently available in two configurations. The first configuration consists of a separate transmitter (TX) and receiver (RX) optical module, each having 12 unidirectional (half duplex) optical channels. Together, the TX and RX cables form a 12 channel (x12) full duplex optical link. The second configuration is a 4 channel (x4) optical transceiver, which contains 4 bidirectional (full duplex) optical links in a single module.

The active and opto-electronic circuitry in the FireFly optical module is packaged on a printed circuit board (PCB) substrate, which is integrated together with an optical block and heatsink. The ribbon fiber is permanently attached through the optical block to the optical engine. The FireFly module plugs into the user host PCB via a two-part connector system, which isolates the high-speed electrical signals from the low-speed control and DC power.

FireFly optical cables are available in two versions: A full AOC, or a Half Optical Cable (HOC). A full AOC has FireFly optical modules on both ends of the cable, connected together with a 12-channel ribbon fiber. This type of cable is used for chip-to-chip flyover applications on a host PCB. The cables are available in various fiber lengths.

In board-to-board or system-to-system applications, it is usually necessary to route the fiber interconnect through a chassis bulkhead, or pre-installed structured cabling. In this case, a pair of Half Optical Cables (HOC) is typically used, together with a fiber optic patch cable (FOPC), and bulkhead Optical Panel Adapters (OPA). This application note deals specifically with HOCs, and how they should be connected together.

The FireFly HOC consists of an optical module and its ribbon fiber pigtail. The ribbon fiber is normally terminated on the far end with an MPO style multi-channel optical connector. MPO connectors are available in 12 or 24 optical channels, and can be configured as male or female. One common brand of MPO connector is the MTP™, made by US Conec. Other types of optical connectors can be installed upon request. However, MPO is by far the most commonly used.

The MPO end of the HOC is plugged into a bulkhead mounted OPA. The same is done with the HOC at the remote equipment. A long FOPC is usually used to connect between the two systems.

The base part number for a FireFly cable is ECUO-xxx. The last 3 characters of the base part number define the cable configuration. Table 1 lists all the possible half cable configurations.

Half Optical Cable Base Part Number	Description
ECUO-T12	A X12 TX Unidirectional optical module terminated in a 12 fiber MPO connector. 12 half duplex optical TX channels are supported.
ECUO-R12	A X12 RX Unidirectional optical module terminated in a 12 fiber MPO connector. 12 half duplex optical RX channels are supported.
ECUO-B04	A x4 Bidirectional optical module terminated in a 12 fiber MPO connector. 4 full duplex optical channels are supported.
ECUO-Y12	A x12 TX module and a x12 RX module joined in a “Y” configuration, and terminated to a single 24 fiber MPO connector. 12 full duplex optical channels are supported.

Table 1. FireFly Half Optical Cable Configurations

Figure 1 shows a picture of a FireFly half optical cable, which is representative of an ECUO-T12, ECUO-R12 or ECUO-B04 cable. Figure 2 shows a FireFly ECUO-Y12 half optical cable.

Figure 1. FireFly Half Optical Cable (-T12, -R12 or -B04)

Figure 2. FireFly “Y” Half Optical Cable (-Y12)

As will be described in detail in the following sections, the MPO bulkhead adapters and the FOPCs are available in different configurations, which affect how the optical signals are mapped onto the connectors. Furthermore, Samtec uses a specific signal map between the fiber ribbon cable of the HOC and the MPO connector. Because of this, it is necessary to use the proper MPO adapter and FOPC configuration. Otherwise, end-to-end connectivity may not be achieved between the Host and Remote Transmit (Tx) and Receive (Rx) optical channels. The purpose of this application note is to define the proper configurations to be used with Samtec HOCs, based on the intended application.

2 MPO Connectors

MPO connectors are widely used in parallel optical applications. The MPO connector provides a high-density optical connectivity solution, together with a mechanical mechanism to provide positive latching. The MPO connectors used in Samtec half optical cables are configured in either 12 or 24 optical channels. A pair of MPO connectors can be mated through a bulkhead mounted MPO adapter, which occupies very little space on the equipment panel.

Figure 3 shows a 12-channel male MPO connector. The MPO connector consists of a MT ferrule, MPO housing, and a latching mechanism. The male MT ferrule contains the 12 optical channels and the guide pins. A female MT ferrule has holes that accept the guide pins from the male MT ferrule. The 12 optical channels are arranged in a single row on the MT ferrule. In a 24 channel MPO connector, the optical channels are arranged in 2 rows of 12 channels each.

The ferrule is installed into the MPO housing. The MPO housing has a guide key, which ensures that the optical channel numbers are oriented properly with respect to the MPO adapter. The MPO housing is enclosed by a spring-loaded latching mechanism. When two MPO cables are mated through a MPO bulkhead adapter, the spring-loaded latching mechanism keeps the two MT ferrules firmly seated against each other. It is important that the two MT ferrules are firmly seated against each other in order to eliminate any air gap, which minimizes the optical attenuation through the mated connector pair.

Figure 3. 12 Channel Male MPO Connector

3 MPO Bulkhead Adapters as Optical Panel Adapters

The MPO bulkhead optical panel adapters (OPA) are available in 2 different configurations, defined by the relative orientation of the connector keys on each end of the adapter:

- Opposed
- Aligned

Opposed adapters have the connector keys on opposite sides of the adapter (the keys are opposing each other). The result is that the MPO connectors which plug into the adapter will be rotated 180 degrees in relation to each other. Aligned adapters have the connector keys on the same side of the adapter (keys aligned with each other). The result is that the connectors will be aligned in relation to each other. Samtec can supply the MPO adapters, or they can be purchased from other vendors. The MPO adapters will work with either 12 or 24 channel MPO connectors. Figure 4 shows the two types of MPO bulkhead adapters.

Figure 4. MPO Adapters, Opposed (Left) and Aligned (Right)

4 Fiber Optic Patch Cables

In a Half-Cable application, a Fiber Optic Patch Cable (FOPC) is typically used to connect between the host and target PCIe® equipment, at the MPO bulkhead adapters. The FOPCs are available in various lengths. Samtec can supply the FOPCs, or they can be purchased from various suppliers. Like the MPO connectors, they are available with 12 or 24 optical channels.

Patch cables are commonly available in 2 different styles, depending on how the optical fibers are mapped onto the FOPC MPO connector. The map scheme is referred to as the polarity of the optical signals.

Figure 5 shows the optical signal map for 12 channel generic patch cables, of Type A and Type B. A Type A cable maps pin 1 on one end of the cable to pin 1 on the other end, and pin 2 to pin 2, etc. It is sometimes referred to as a “straight through” cable. A Type B cable flips the channels between ends. In other words, pin 1 of one end connects to pin 12 on the other end, pin 2 to pin 11, etc. It is sometimes referred to as an “inverted” cable. Samtec only supplies the Type B FOPC, but it is important to understand the differences between the two cable types.

TYPE A

SIDE A	12 FIBER (A)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	1
2	ORANGE	2
3	GREEN	3
4	BROWN	4
5	SLATE	5
6	WHITE	6
7	RED	7
8	BLACK	8
9	YELLOW	9
10	VIOLET	10
11	ROSE	11
12	AQUA	12

TYPE B

SIDE A	12 FIBER (B)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	12
2	ORANGE	11
3	GREEN	10
4	BROWN	9
5	SLATE	8
6	WHITE	7
7	RED	6
8	BLACK	5
9	YELLOW	4
10	VIOLET	3
11	ROSE	2
12	AQUA	1

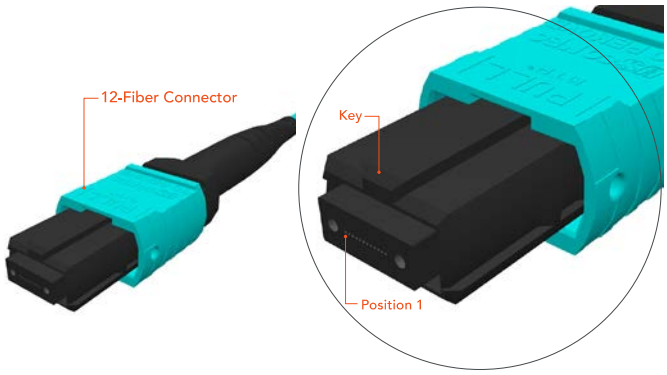


Figure 5. 12 Fiber Optical Patch Cable Signal Map

A 24 fiber FOPC is required for the –Y12 “Y cable” configuration. The 24 fiber FOPC patch cable is available from Samtec with “24 Fiber Type A” polarity, only.

Figure 6 shows the optical signal map for a 24 fiber FOPC. Position 1 on one end of the cable connects to position 13 on the other end, position 2 connects to position 14, etc. The channels are routed to the opposite row on the far end connector, while maintaining position within the same column.

24 Fiber Type A

SIDE A	24 FIBER (C)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	13
2	ORANGE	14
3	GREEN	15
4	BROWN	16
5	SLATE	17
6	WHITE	18
7	RED	19
8	BLACK	20
9	YELLOW	21
10	VIOLET	22
11	ROSE	23
12	AQUA	24
13	BLUE (+)	1
14	ORANGE (+)	2
15	GREEN (+)	3
16	BROWN (+)	4
17	SLATE (+)	5
18	WHITE (+)	6
19	RED (+)	7
20	BLACK (+)	8
21	YELLOW (+)	9
22	VIOLET (+)	10
23	ROSE (+)	11
24	AQUA (+)	12

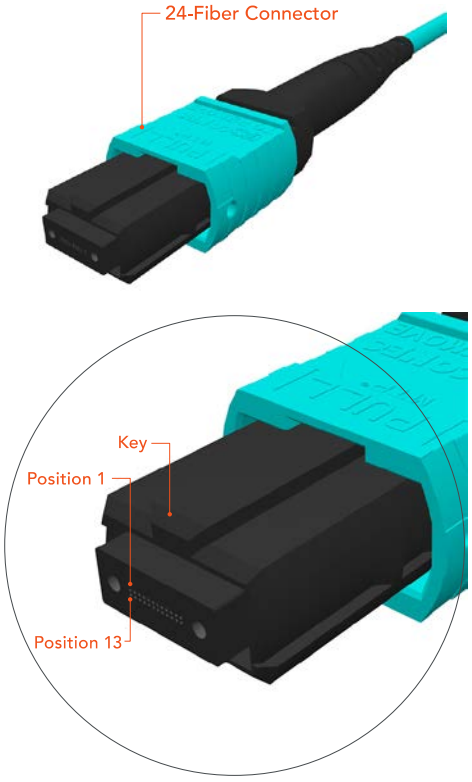


Figure 6. 24 Fiber Optical Patch Cable Signal Map

5 Half Cable Back-to-Back Operation without Patch Cables

In some instances, it may be desirable to operate two FireFly HOCs in a back-to-back configuration. In this application, the MPO ends of the two cables are simply connected together, through an MPO adapter, without using a patch cable.

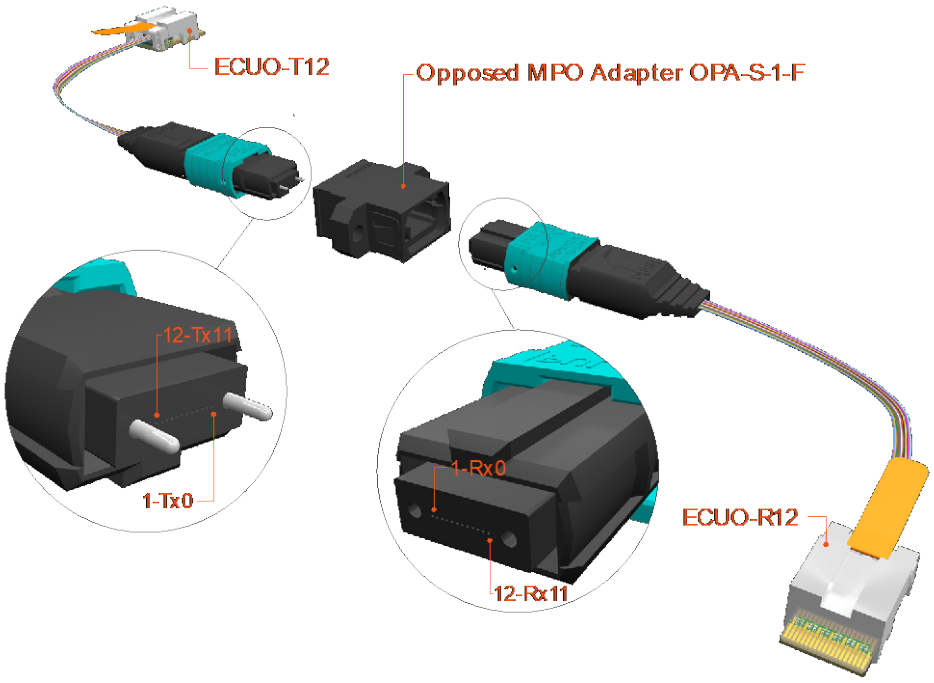
Typical applications are a quick loopback test, or to evaluate half cable connectivity over various lengths or with multiple host/target combinations.

Care must be taken to use the proper polarity MPO adapter, as will be described later for each of the FireFly half cables.

6 ECUO –T12 to ECUO –R12

This section describes the back-to-back configuration for two ECUO 12 channel unidirectional cables, one cable being a 12 channel TX (ECUO-T12) and the other being a 12 channel RX (ECUO-R12).

Figure 7 shows the signal map for back-to-back operation of two HOCs. Both of these half-cables use a 12 channel MPO connector. Note that an opposed MPO adapter is required. Following the signal flow, Tx1 on the left-hand cable connects to Rx1 on the right-hand cable, and so on, with all Tx channels on one cable being connected to the corresponding Rx channel on the other cable, and vice versa.



ECUO-T12
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Tx0	BLUE	1
Tx1	ORANGE	2
Tx2	GREEN	3
Tx3	BROWN	4
Tx4	SLATE	5
Tx5	WHITE	6
Tx6	RED	7
Tx7	BLACK	8
Tx8	YELLOW	9
Tx9	VIOLET	10
Tx10	ROSE	11
Tx11	AQUA	12

ECUO-R12
SIGNAL MAP

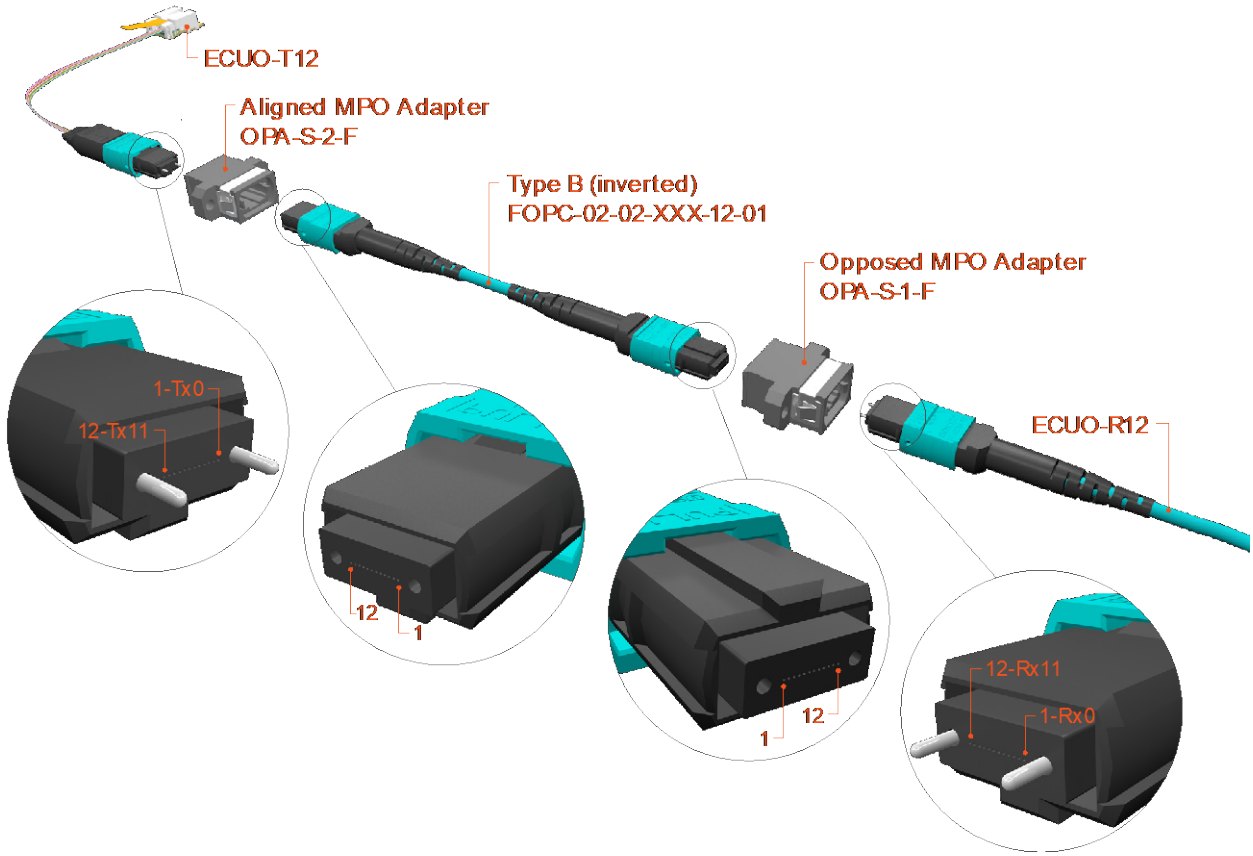
FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Rx4	SLATE	5
Rx5	WHITE	6
Rx6	RED	7
Rx7	BLACK	8
Rx8	YELLOW	9
Rx9	VIOLET	10
Rx10	ROSE	11
Rx11	AQUA	12

Figure 7. ECUO-T12 to ECUO-R12 Signal Map

7 ECUO –T12 to FOPC to ECUO –R12

This section describes the configuration where an ECUO-T12 half cable and an ECUO-R12 half cable are joined using a 12 fiber FOPC. These half cables each have a 12 fiber MPO connector. One cable contains a 12 channel Tx (-T12) and the other contains a 12 channel Rx (-R12). As was mentioned earlier, this is a common application when the optical link must be passed through a bulkhead at each cable end.

Figure 8 shows the signal map for this configuration when a FOPC is used. Note that one aligned and one opposed MPO adapter are required. Tracing the signal flow through the diagram, it is seen that all the Tx channels on one cable connect with the corresponding Rx channel on the other cable, and vice versa.



ECUO-T12
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Tx0	BLUE	1
Tx1	ORANGE	2
Tx2	GREEN	3
Tx3	BROWN	4
Tx4	SLATE	5
Tx5	WHITE	6
Tx6	RED	7
Tx7	BLACK	8
Tx8	YELLOW	9
Tx9	VIOLET	10
Tx10	ROSE	11
Tx11	AQUA	12

ECUO-R12
SIGNAL MAP

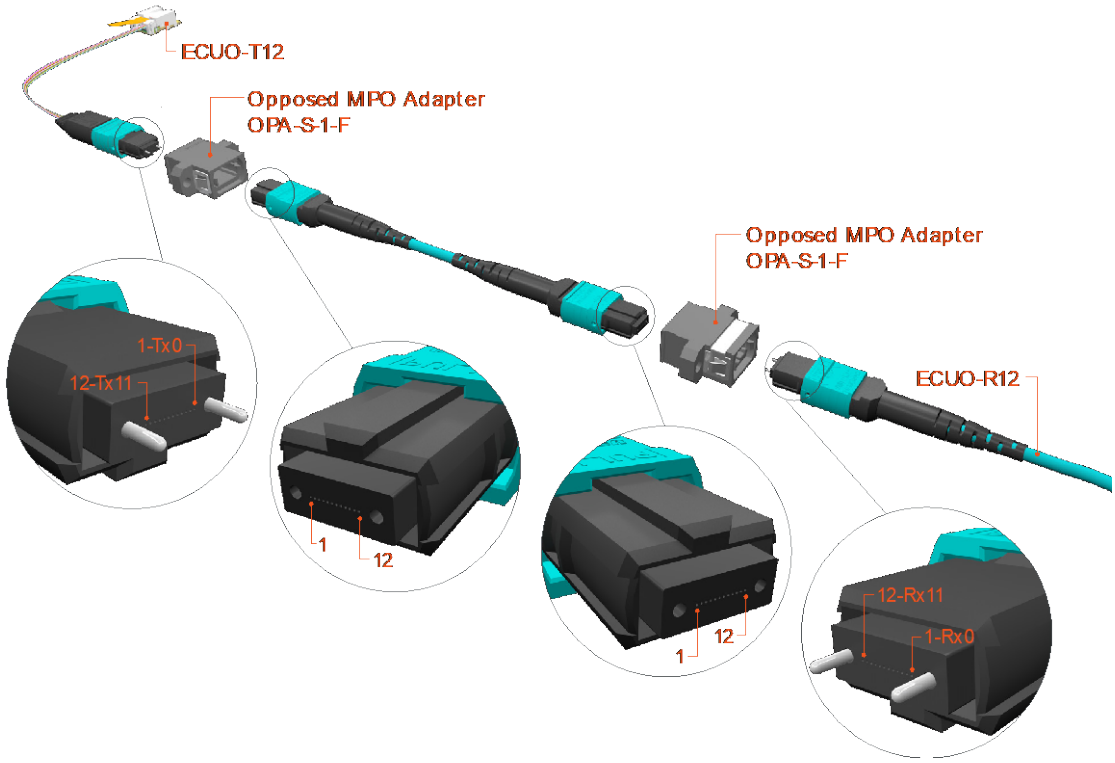
FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Rx4	SLATE	5
Rx5	WHITE	6
Rx6	RED	7
Rx7	BLACK	8
Rx8	YELLOW	9
Rx9	VIOLET	10
Rx10	ROSE	11
Rx11	AQUA	12

FOPC

SIDE A	12 FIBER (B)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	12
2	ORANGE	11
3	GREEN	10
4	BROWN	9
5	SLATE	8
6	WHITE	7
7	RED	6
8	BLACK	5
9	YELLOW	4
10	VIOLET	3
11	ROSE	2
12	AQUA	1

Figure 8. ECUO-T12 to FOPC to ECUO-R12 Signal Map

It is possible to achieve the same connectivity when a Type A (straight through) patch cable is used. This requires the use of two opposed type MPO adapters. Figure 9 shows the details of this configuration. Note that this configuration will also work with two aligned MPO adapters. Note that Samtec does not supply a Type A patch cable.



ECUO-T12
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Tx0	BLUE	1
Tx1	ORANGE	2
Tx2	GREEN	3
Tx3	BROWN	4
Tx4	SLATE	5
Tx5	WHITE	6
Tx6	RED	7
Tx7	BLACK	8
Tx8	YELLOW	9
Tx9	VIOLET	10
Tx10	ROSE	11
Tx11	AQUA	12

ECUO-R12
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Rx4	SLATE	5
Rx5	WHITE	6
Rx6	RED	7
Rx7	BLACK	8
Rx8	YELLOW	9
Rx9	VIOLET	10
Rx10	ROSE	11
Rx11	AQUA	12

TYPE A

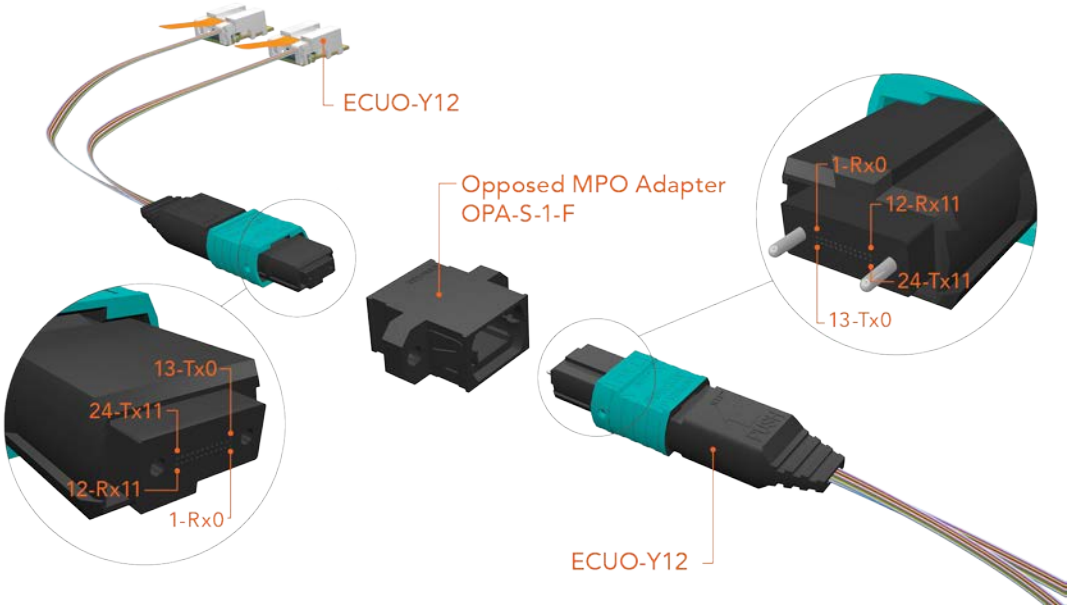
SIDE A	12 FIBER (A)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	1
2	ORANGE	2
3	GREEN	3
4	BROWN	4
5	SLATE	5
6	WHITE	6
7	RED	7
8	BLACK	8
9	YELLOW	9
10	VIOLET	10
11	ROSE	11
12	AQUA	12

Figure 9. ECUO-T12 to FOPC to ECUO-R12 Signal Map

8 ECUO –Y12 to ECUO –Y12

This section describes the back-to-back configuration for two ECUO –Y12 HOCs. Each –Y12 cable contains a 12 channel Tx and a 12 channel Rx joined together in a “Y” cable, and terminated in a 24 fiber MPO connector.

Figure 10 shows the signal map for back-to-back operation of these two HOCs. Note that an opposed MPO adapter is required. Following the signal flow, Tx on the left-hand cable connects to Rx on the right-hand cable, and so on, with all Tx channels on one cable being connected to the corresponding Rx channel on the other cable, and vice versa.



ECUO-Y12
SIGNAL MAP

	FUNCTION	FIBER COLOR	MPO POSITION
Rx	Rx0	BLUE	1
	Rx1	ORANGE	2
	Rx2	GREEN	3
	Rx3	BROWN	4
	Rx4	SLATE	5
	Rx5	WHITE	6
	Rx6	RED	7
	Rx7	BLACK	8
	Rx8	YELLOW	9
	Rx9	VIOLET	10
	Rx10	ROSE	11
	Rx11	AQUA	12
Tx	Tx0	BLUE (+)	13
	Tx1	ORANGE (+)	14
	Tx2	GREEN (+)	15
	Tx3	BROWN (+)	16
	Tx4	SLATE (+)	17
	Tx5	WHITE (+)	18
	Tx6	RED (+)	19
	Tx7	BLACK (+)	20
	Tx8	YELLOW (+)	21
	Tx9	VIOLET (+)	22
	Tx10	ROSE (+)	23
	Tx11	AQUA (+)	24

ECUO-Y12
SIGNAL MAP

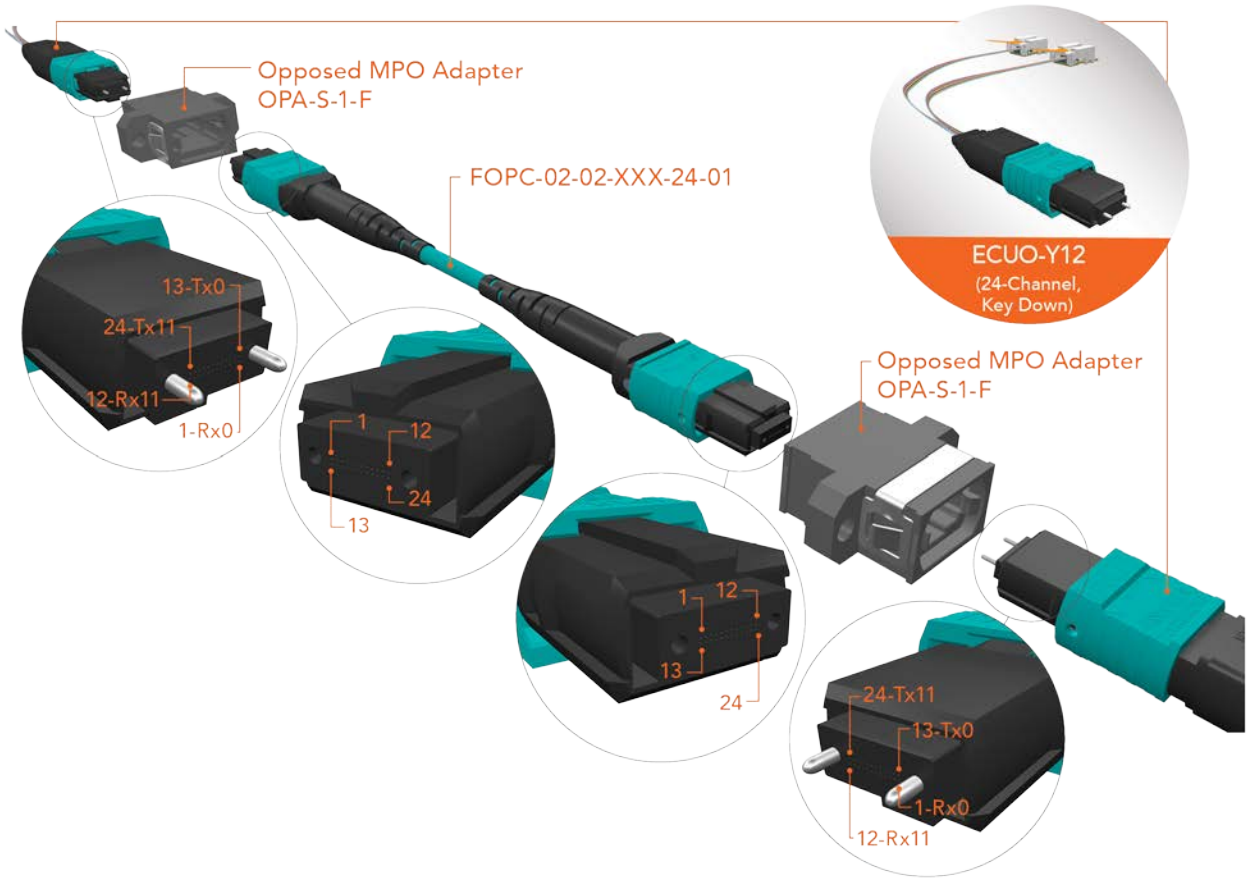
	FUNCTION	FIBER COLOR	MPO POSITION
Rx	Rx0	BLUE (+)	1
	Rx1	ORANGE (+)	2
	Rx2	GREEN (+)	3
	Rx3	BROWN (+)	4
	Rx4	SLATE (+)	5
	Rx5	WHITE (+)	6
	Rx6	RED (+)	7
	Rx7	BLACK (+)	8
	Rx8	YELLOW (+)	9
	Rx9	VIOLET (+)	10
	Rx10	ROSE (+)	11
	Rx11	AQUA (+)	12
Tx	Tx0	BLUE	13
	Tx1	ORANGE	14
	Tx2	GREEN	15
	Tx3	BROWN	16
	Tx4	SLATE	17
	Tx5	WHITE	18
	Tx6	RED	19
	Tx7	BLACK	20
	Tx8	YELLOW	21
	Tx9	VIOLET	22
	Tx10	ROSE	23
	Tx11	AQUA	24

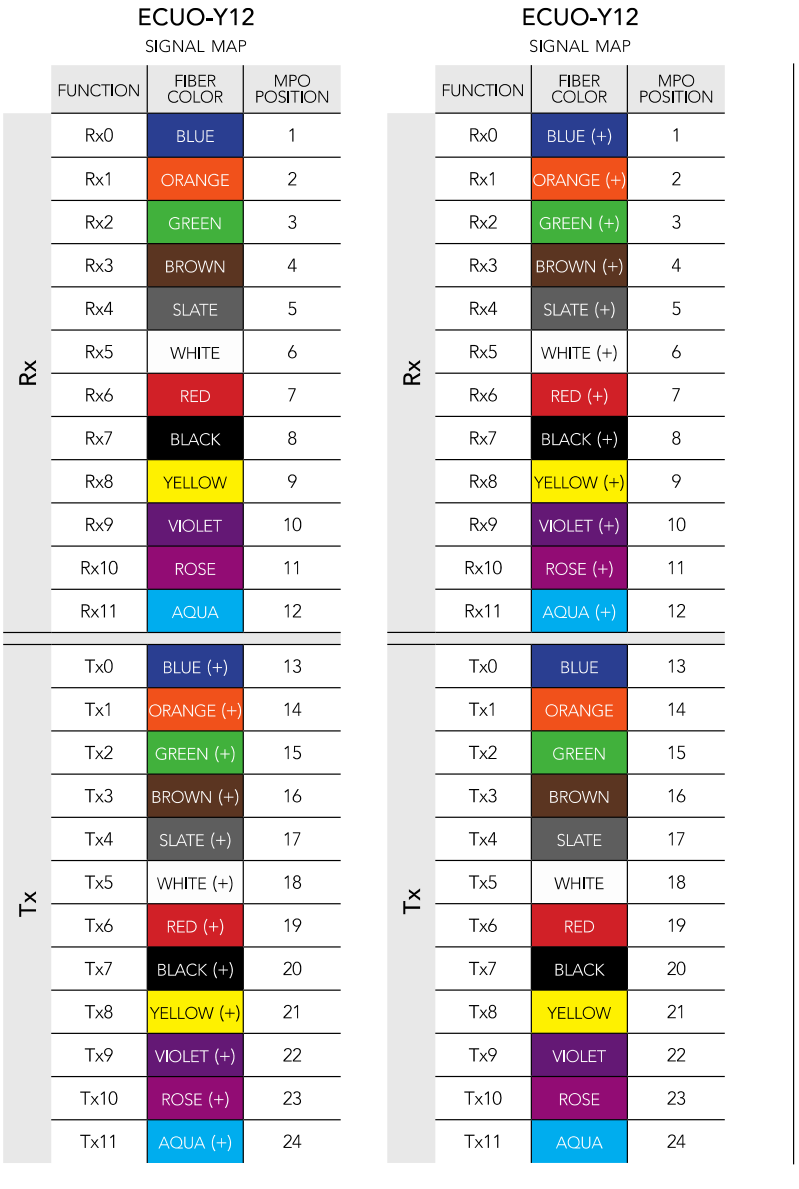
Figure 10. ECUO-Y12 to ECUO-Y12 Signal Map

9 ECUO –Y12 to FOPC to ECUO –Y12

This section describes the configuration when two ECUO –Y12 half-cables are joined using a FOPC. These half cables use 24 fiber MPO connectors. As was mentioned earlier, this is a common application when the optical link must be passed through a bulkhead at each cable end.

Figure 11 shows the signal map for this configuration. Note that two aligned MPO adapters are used. A 24 fiber FOPC is required. Tracing the signal flow through the diagram, it is seen that all the Tx channels on one cable connect with the corresponding Rx channel on the other cable, and vice versa. Please note that this configuration will also work with two opposed MPO adapters.





ECUO-Y12
SIGNAL MAP

	FUNCTION	FIBER COLOR	MPO POSITION
Rx	Rx0	BLUE	1
	Rx1	ORANGE	2
	Rx2	GREEN	3
	Rx3	BROWN	4
	Rx4	SLATE	5
	Rx5	WHITE	6
	Rx6	RED	7
	Rx7	BLACK	8
	Rx8	YELLOW	9
	Rx9	VIOLET	10
	Rx10	ROSE	11
	Rx11	AQUA	12
Tx	Tx0	BLUE (+)	13
	Tx1	ORANGE (+)	14
	Tx2	GREEN (+)	15
	Tx3	BROWN (+)	16
	Tx4	SLATE (+)	17
	Tx5	WHITE (+)	18
	Tx6	RED (+)	19
	Tx7	BLACK (+)	20
	Tx8	YELLOW (+)	21
	Tx9	VIOLET (+)	22
	Tx10	ROSE (+)	23
	Tx11	AQUA (+)	24

ECUO-Y12
SIGNAL MAP

	FUNCTION	FIBER COLOR	MPO POSITION
Rx	Rx0	BLUE (+)	1
	Rx1	ORANGE (+)	2
	Rx2	GREEN (+)	3
	Rx3	BROWN (+)	4
	Rx4	SLATE (+)	5
	Rx5	WHITE (+)	6
	Rx6	RED (+)	7
	Rx7	BLACK (+)	8
	Rx8	YELLOW (+)	9
	Rx9	VIOLET (+)	10
	Rx10	ROSE (+)	11
	Rx11	AQUA (+)	12
Tx	Tx0	BLUE	13
	Tx1	ORANGE	14
	Tx2	GREEN	15
	Tx3	BROWN	16
	Tx4	SLATE	17
	Tx5	WHITE	18
	Tx6	RED	19
	Tx7	BLACK	20
	Tx8	YELLOW	21
	Tx9	VIOLET	22
	Tx10	ROSE	23
	Tx11	AQUA	24

FOPC

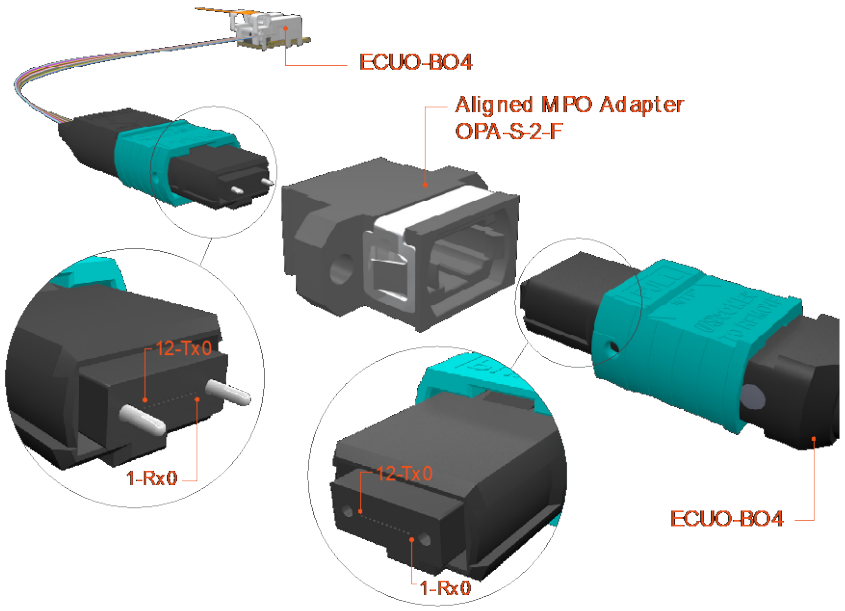
SIDE A	24 FIBER (C)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	13
2	ORANGE	14
3	GREEN	15
4	BROWN	16
5	SLATE	17
6	WHITE	18
7	RED	19
8	BLACK	20
9	YELLOW	21
10	VIOLET	22
11	ROSE	23
12	AQUA	24
13	BLUE (+)	1
14	ORANGE (+)	2
15	GREEN (+)	3
16	BROWN (+)	4
17	SLATE (+)	5
18	WHITE (+)	6
19	RED (+)	7
20	BLACK (+)	8
21	YELLOW (+)	9
22	VIOLET (+)	10
23	ROSE (+)	11
24	AQUA (+)	12

Figure 11. ECUO-Y12 to FOPC to ECUO-Y12 Signal Map

10 ECUO –B04 to ECUO –B04

This section describes the back-to-back configuration for two ECUO –B04 4 channel bidirectional cables. Recall that each –B04 cable consists of a 4-channel full-duplex optical module, terminated in a 12 fiber MPO connector.

Figure 12 shows the signal map for back-to-back operation of the two HOCs. Note that an aligned MPO adapter is required. Following the signal flow, Tx1 on the left-hand cable connects to Rx1 on the right-hand cable, and so on, with all 4 Tx channels on one cable being connected to the corresponding Rx channel on the other cable, and vice versa. Note that only 8 out of 12 channels on the ribbon fiber are used.



ECUO-B04
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

ECUO-B04
SIGNAL MAP

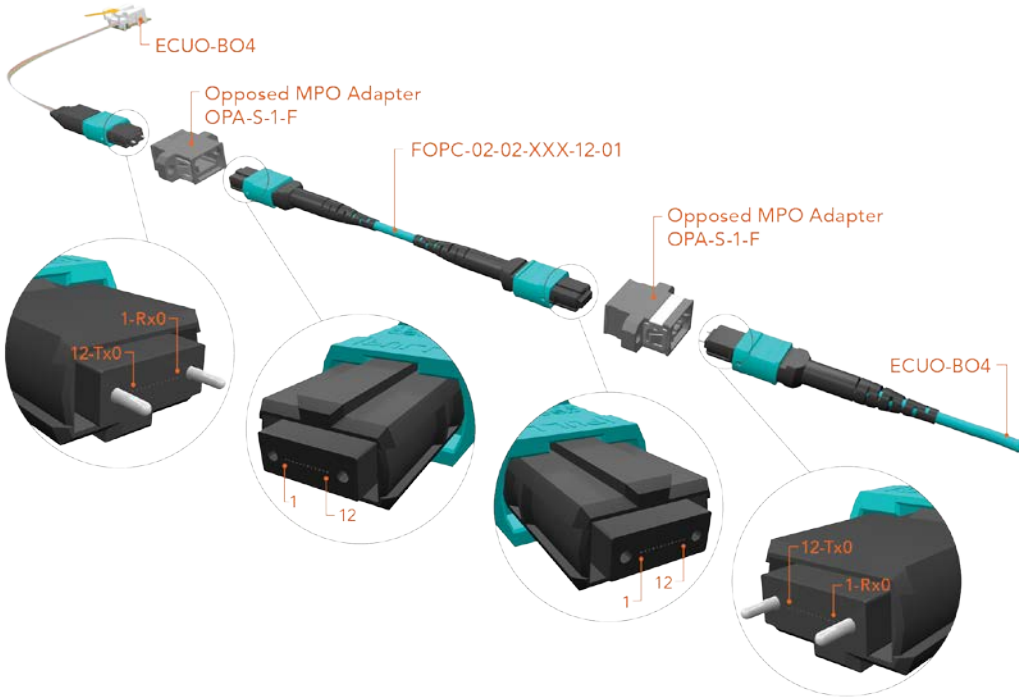
FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

Figure 12. ECUO-B04 to ECUO-B04 Signal Map

11 ECUO-B04 to FOPC to ECUO-B04

This section describes the configuration when two ECUO –B04 half-cables are joined using a FOPC. These half cables use 12 channel MPO connectors. As was mentioned earlier, this is a common application when the optical link must be passed through a bulkhead at each cable end.

Figure 13 shows the signal map for this configuration. Note that two opposed MPO adapters are used. A Type B FOPC is required. Tracing the signal flow through the diagram, it is seen that all the Tx channels on one cable connect with the corresponding Rx channel on the other cable, and vice versa. Please note that this configuration will also work with two aligned MPO adapters.



ECUO-B04
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

ECUO-B04
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

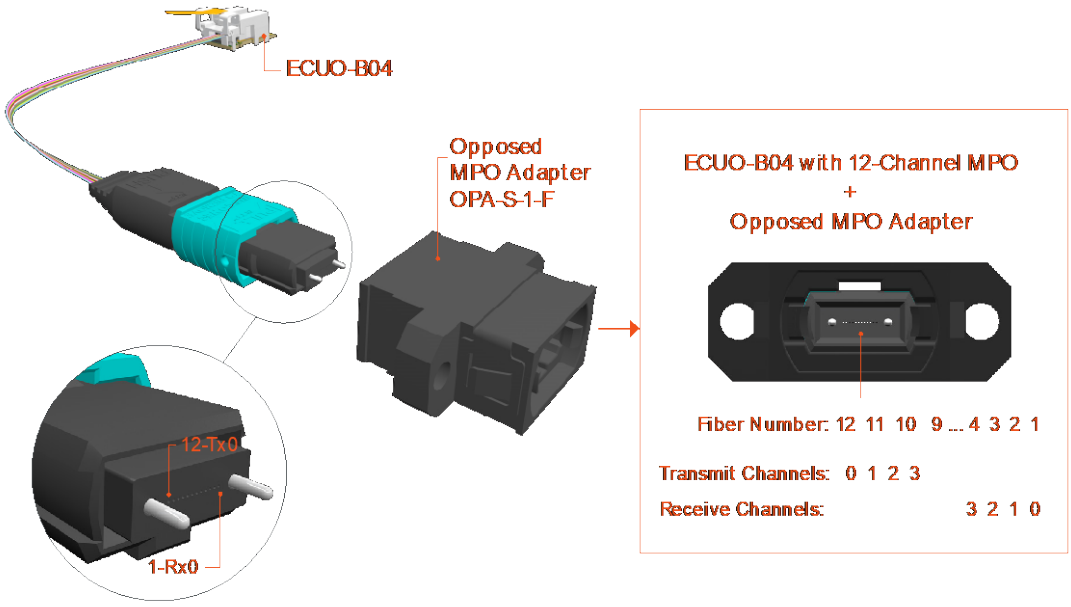
FOPC

SIDE A	12 FIBER (B)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	12
2	ORANGE	11
3	GREEN	10
4	BROWN	9
5	SLATE	8
6	WHITE	7
7	RED	6
8	BLACK	5
9	YELLOW	4
10	VIOLET	3
11	ROSE	2
12	AQUA	1

Figure 13. ECUO-B04 to FOPC to ECUO-B04 Signal Map

12 ECUO-B04 to Mimic a QSFP+ Pluggable Module

Quad Small Form Factor Pluggable (QSFP+) optical modules provide four duplex channels at up to 14 Gbps per channel. The QSFP+ module plugs into a panel mounted cage, which contains a connector that interfaces to the host PCB. Certain applications may require the FireFly ECUO-B04 module to mimic a Quad Small Form Factor (QSFP+) optical module at the panel. For example, the FireFly –B04 module needs to connect to a remote system containing a QSFP+ module. Connecting the FireFly B04 module to an opposed MPO adapter will mimic a QSFP+ module. Figure 14 shows the signal map.



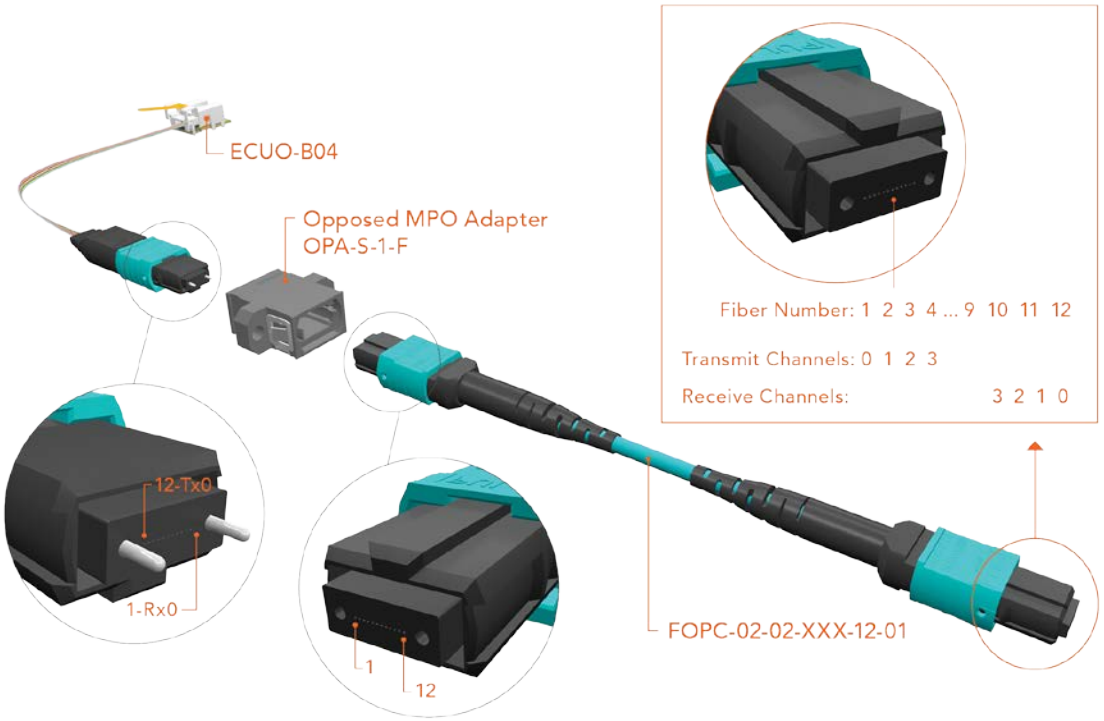
ECUO-B04
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

Figure 14. ECUO-B04 to Mimic a QSFP+ Pluggable Module

13 ECUO-B04 to FOPC to QSFP+ Pluggable Module

The QSFP+ module is described in Section 12. Certain applications may require that the FireFly B04 module be connected to a remote QSFP+ module, through a FOPC. Figure 15 shows the signal map for this configuration.



ECUO-B04
SIGNAL MAP

FUNCTION	FIBER COLOR	MPO POSITION
Rx0	BLUE	1
Rx1	ORANGE	2
Rx2	GREEN	3
Rx3	BROWN	4
Dark	SLATE	5
Dark	WHITE	6
Dark	RED	7
Dark	BLACK	8
Tx3	YELLOW	9
Tx2	VIOLET	10
Tx1	ROSE	11
Tx0	AQUA	12

FOPC

SIDE A	12 FIBER (B)	SIDE B
MPO POSITION	FIBER COLOR	MPO POSITION
1	BLUE	12
2	ORANGE	11
3	GREEN	10
4	BROWN	9
5	SLATE	8
6	WHITE	7
7	RED	6
8	BLACK	5
9	YELLOW	4
10	VIOLET	3
11	ROSE	2
12	AQUA	1

Figure 15. ECUO-B04 to FOPC to QSFP+ Pluggable Module

14 References

[1] https://www.samtec.com/optics/optical-cable/mid-board

[2] Samtec: FireFly™ Optical 14G x12 Data Sheet

[3] Samtec: FireFly™ Optical 14G x4 Data Sheet