



# White Paper | opticalCON MTP®

**Polarity of  
Multichannel Fiber  
Connectors**

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**White Paper – opticalCON MTP®**

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## 1 SCOPE

As demand grows for fiber optics, multi fiber push-on (MPO) and MTP® connectors along with related quad small form factor pluggable (QSFP) transceivers have become more important in the professional broadcast market.

To avoid polarity failures due to intricate multi-fiber installations, a standardized wiring structure is essential.

This paper explains the primary differences between generic MPO and MTP® connectors. The paper also shows and discusses standardized wiring methods. Further sections explain a suitable wiring suggestion for Neutrik's rugged multi-fiber connector system – opticalCON ADVANCED & LITE MTP®.

## 2 MULTI-FIBER CONNECTOR

Resulting on high fiber density the ferrule design steps away from conventional cylindrical dimensions as used on generic LC, ST, SC, etc. connectors, instead using cubical mechanical transfer (MT) ferrules (figure 1) made of plastic materials\*. The fibers are aligned in a V-groove and positioned in a row.



Figure 1



Figure 2

\*...exact material composite depends on ferrule manufacturer

As opposed to common 1.25 mm and 2.5 mm ferrules, the MT-ferrule is usually terminated with a fiber band of, for instance, 12x 250µm fibers in a row called "ribbon fiber" (figure 2) which improves the efficiency of the termination procedure.

### 2.1 MPO connector

The MPO is an MT-ferrule based multi-fiber connector defined by the International Electro technical Commission (IEC 61754-7) and Telecommunications Industry Association & Electronic Industries Alliance (TIA / EIA 604-5). A male / female ferrule system ensures appropriate fiber alignment and low return loss values.

#### Advantages:

- Low insertion loss
- Small form factor
- High fiber density

### 2.2 MTP® Connector

The registered trademark MTP® is an improved fiber optic connector from the company US Conec based on a generic MPO design.

MTP® connectors are fully intermateable with conventional MPO connectors due to similar dimensions from the MT-ferrule.

#### Advantages of the MTP® connector:

- Re-polish of MTP® ferrules possible
- High mating cycles possible due to tight tolerance on guide pins and MT-ferrule

### 3 TRANSCEIVER

Common transceiver modules contain a transmitting port (TX) and a receiving port (RX). On the transmission side, the electric signal is converted to an optical signal and transmitted via a light source such as a vertical-cavity surface-emitting laser (VCSEL) or a light-emitting diode (LED).

The receiving side uses photo detectors to receive the optical signal before converting it back to an electrical signal for further processing.

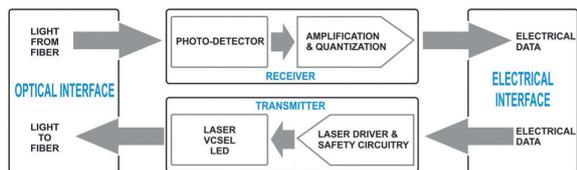


Figure 3

#### 3.1 SFP Transceivers

Small form factor pluggable (SFP) transceivers (figure 4) are lightweight and hot pluggable modules which can be plugged in to an appropriate SFP-cage (figure 5). The cage is typically pre-soldered on a printed circuit board (PCB).



Figure 4



Figure 5

#### 3.2 QSFP Transceiver

QSFP transceivers contain a multi-fiber interface to connect MPO or MTP® cables directly, thereby eliminating breakout cables. This enhances the connection and reduces the risk of polarity-based failures. Using QSFP modules, it is possible to transmit more than 40 Gb/s over a single 12-channel MPO / MTP® cable (figure 6), in a send / return setup.

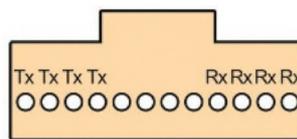


Figure 6

### 4 POLARITY

In general it should be guaranteed that the transmitter (TX) is always connected to a receiver (RX). In a bi-directional fiber setup including a transceiver (TX / RX) on both sides of the cable, a defined wiring setup is essential to ensure that a signal from the transmitter reaches the appropriate receiver port on the other end (figure 7). The TIA / EIA 568-D.0 standard defines three different wiring methods in order to avoid polarity failures and guarantee correct fiber cabling.

To maintain the polarity different methods are available:

- Adapter keying (section 4.1)
- "polarity flip" on the patch cable (section 4.2-4.4)
- "polarity flip" on the breakout cables

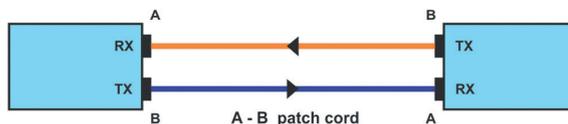


Figure 7

#### 4.1 MPO / MTP® – Adapter keying

Multi-fiber connectors contain “keys” which maintain defined fiber polarity when the connectors are mated together. MPO / MTP® adapters contain an asymmetrical housing including an inverted key to achieve the appropriate fiber polarity.

On Type A adapters (figure 8), the keys are inverted to ensure that the fiber at position 1 is connected to position 1 in the MPO / MTP® cable connector at the opposing end (in case of 12 fiber connectors).

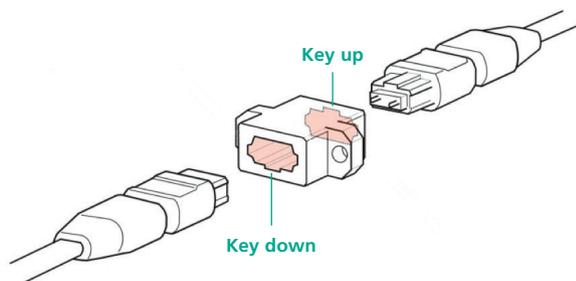


Figure 8: Type A adapter

On Type B adapters (figure 9) both keys are oriented facing up in order that both MPO / MTP® cable connectors are mated “key up” wise. The fiber at position 1 is connected to position 12 in the MPO / MTP® connector at the opposing end.

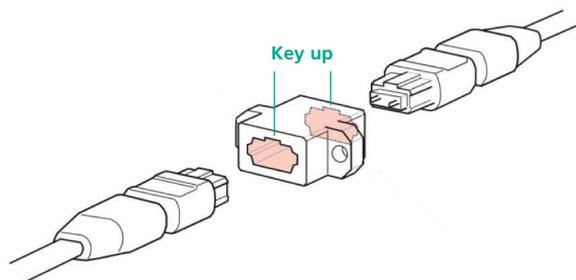


Figure 9: Type B adapter

#### 4.2 Wiring Method A

Wiring Method A uses Type-A “straight through” MPO / MTP® cables which are mated using Type-A MTP® adapters. All components in the link are mated key-up to key-down (figure 10). The polarity flip is executed pairwise on the fan-out side of just one MPO / MTP® breakout cable at the end.

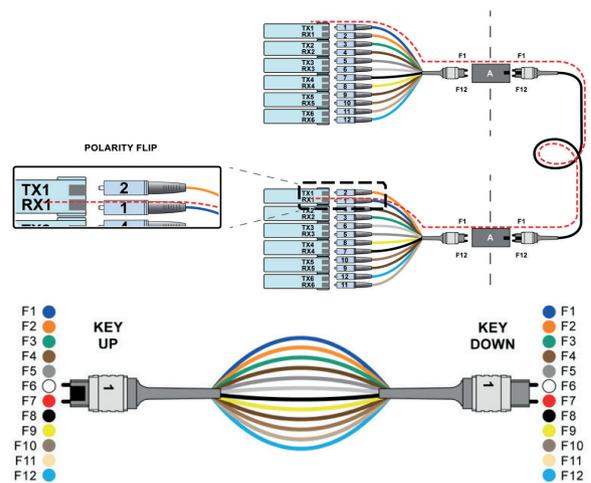


Figure 10

#### Advantage:

- Easy to implement
- Widely used method

### 4.3 Wiring Method B

Wiring Method B uses Type-B “straight through” MPO / MTP® - cables (figure 11) which are mated using Type-B MPO / MTP® adapters. All components in the link are mated key-down to key-down. As a result, transmitting port TX1 on fiber position 1 is connected to receive port RX1 on fiber position 12 at the other end.

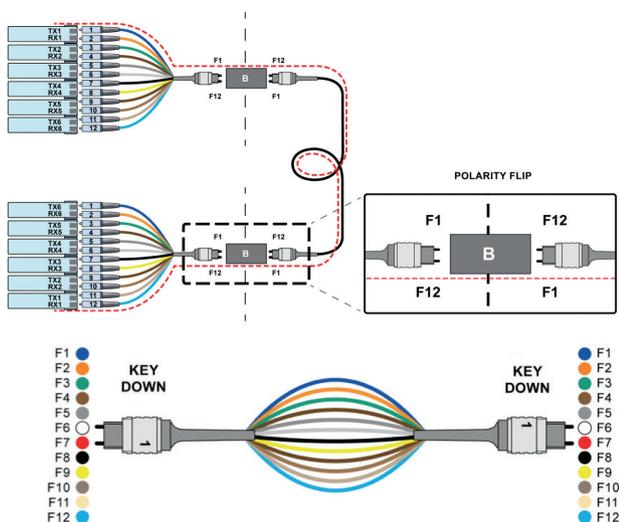


Figure 11

#### Disadvantage

- Not widely implemented
- Not suitable for single-mode APC applications

### 4.4 Wiring Method C

Method C uses Type-C “pair-flipped” MPO / MTP®-cables (figure 12) which are mated using Type-A MPO / MTP® adapters. All components in the link are mated key-up to key-down. In this connectivity method, the polarity flip is done inside the MPO / MTP®-cable.

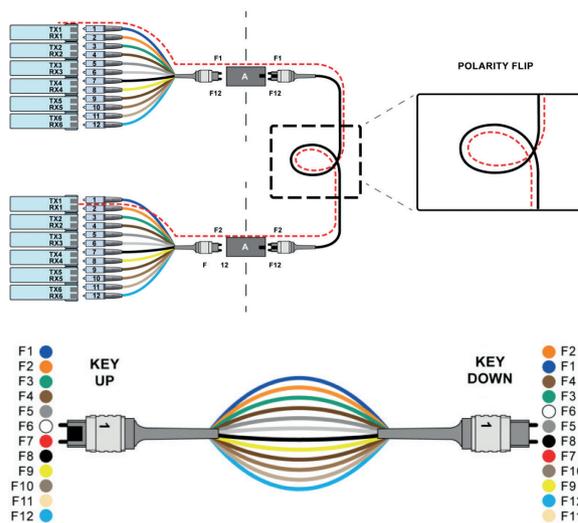


Figure 12

## 5 NEUTRIK'S WIRING METHOD

The opticalCON MTP® chassis connector NO12FDW-A represents a Type A adapter (section 4.1) using a key-up to key-down configuration (figure 13).

The opticalCON ADVANCED MTP® cable contains a “straight through” configuration to ensure fiber wiring in accordance with wiring method A, according section 4.2.



Figure 13

## 5.1 opticalCON ADVANCED & LITE MTP® wiring with SFP (LC) transceivers

When connecting pairs of opticalCON chassis connectors with SFP transceivers modules, both chassis connectors are used as Type A adapter with key up to key-down configurations. The opticalCON MTP® cable contains a “straight through” configuration. The polarity flip is executed pairwise on one MPO / MTP breakout cable (figure 14).

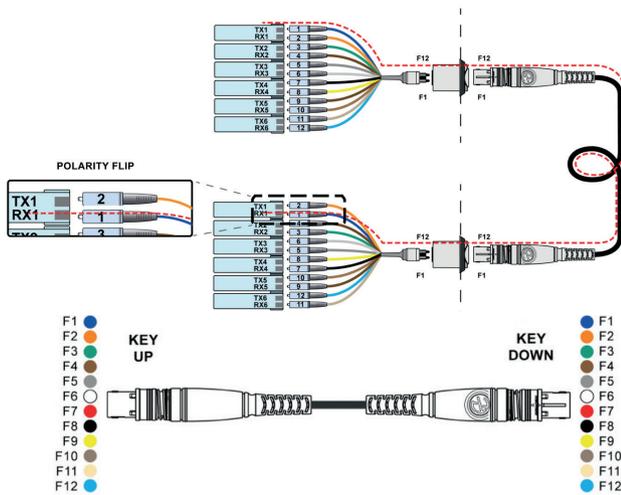


Figure 14

## 5.2 opticalCON ADVANCED & LITE MTP® wiring with QSFP Transceiver

By using QSFP transceivers (figure 15), the requirement for multiple SFP modules is eliminated. MPO / MTP® patch cables replace conventional breakout cables, streamlining cabling and connector requirements. The only consideration required is the fiber polarity of the MPO / MTP® patch cable just one patch cable per link needs to be of Type B.

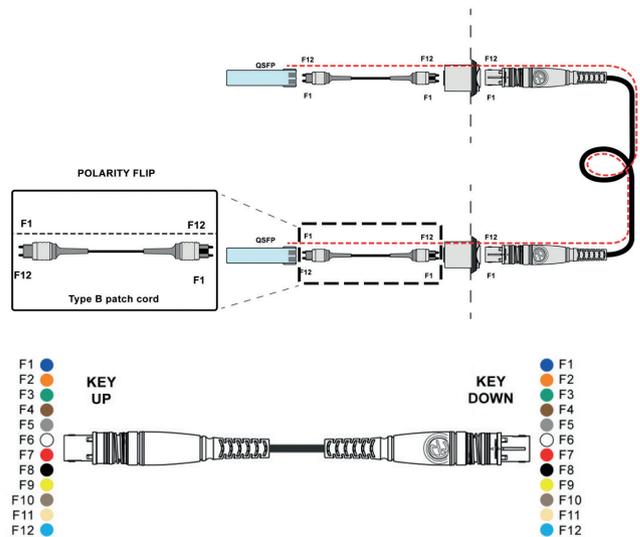


Figure 15

## 5.3 Conclusion

On multi-fiber installations, it is in the interest of both the installer and end-user to choose a wiring method that adheres to the TIA / EIA 568-C.0 standard in order to avoid failures related to incorrect fiber polarity and minimize costly troubleshooting. Further, it is highly favorable not combine the wiring methods within a single installation as the TIA / EIA 568-D.0 standards states: “it is recommended that a method be selected in advance and maintained consistently throughout an installation.” Due to its enhanced cable manageability as well as its compatibility with angled polished connectors, Neutrik has chosen wiring Method A including “straight through” cable wiring along with type A adapters for opticalCON MTP®.

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