

## **Understanding the use of the PanMPO in 10GBASE-SR and 40GBASE-SR4 Channels**

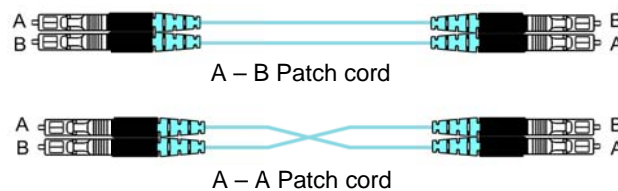
### **Purpose**

The purpose of this document is to describe the usage and reasoning behind the development and characteristics of the PanMPO to be utilized in 10GBASE-SR and 40GBASE-SR4 channels.

### **Background**

MPO connectivity has become widely used throughout the industry, not only to increase cable density, but also to prepare the cable plant for the migration from 10GBASE-SR (10G) to 40GBASE-SR4 (40G).

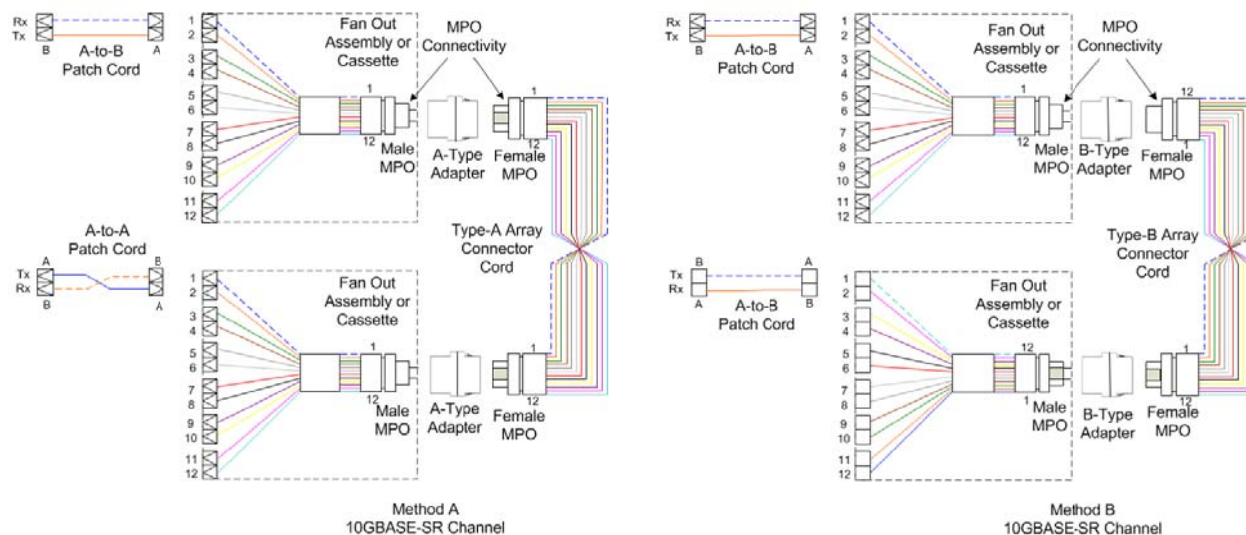
10G transmission utilizes a full duplex serial transmission scheme. Two fibers are used in the channel; one fiber for transmit and one fiber for receive. The polarity of the cabling infrastructure supporting these channels (Tx to Rx) is relatively easy to manage from end to end. If polarity correction is required, it is easy to accomplish in the field by re-arranging the fiber position via the connector duplexing clip (see fig. 1 below).



**Figure 1. Polarity of LC Duplex signals**

Today a majority of the 10G links are constructed with array type connectors (MPO) in the horizontal infrastructure connected to fan out assemblies or cassettes to separate the individual duplex channels. TIA-568-C.0 defines methods and discusses maintaining the polarity of the MPO connectors throughout the channels. Two of the methods discussed in TIA-568-C.0 are Method A and Method B.

Shown in Figure 2 are typical 10GBASE-SR Method A and Method B channels as discussed in the standard.



As shown in Figure 2, the Method A channel consists of the following:

- Type A female MPO to female MPO connector cord (Key Up to Key Down)
- Type A MPO adapters (Key Up to Key Down)
- A – B patch cord and an A-A patch cord

One A-A patch cord is needed on one end of the link to ensure the TX signal is transposed to the respective RX port on the other end of the link.

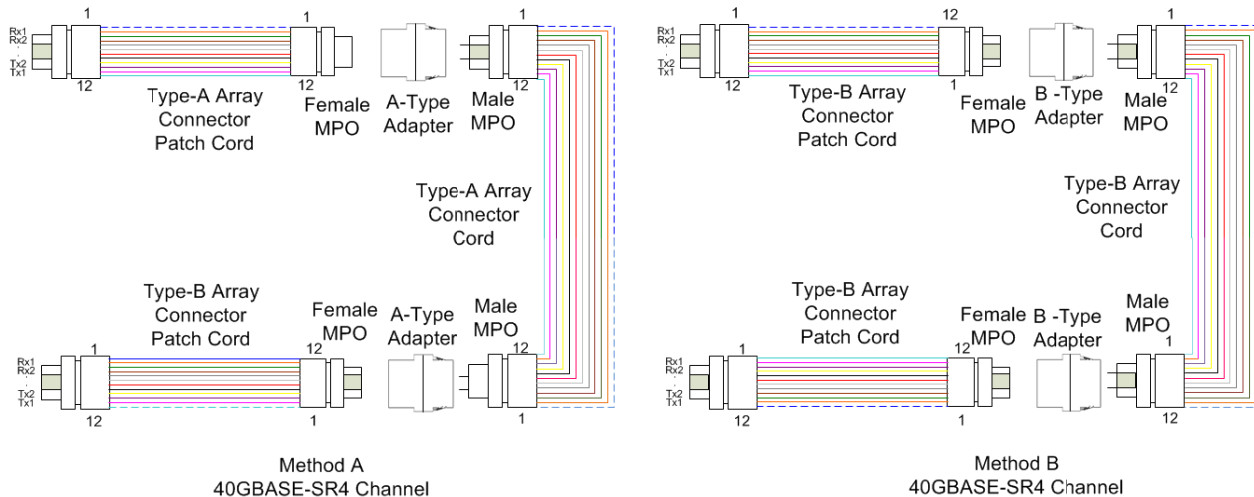
On the other hand, the Method B channel consists of the following:

- Type B female MPO to female MPO connector cord (Key Up to Key Up)
- Type B MPO adapters (Key Up to Key Up)
- A – B patch cords

The two methods contain different cabling solutions and are relatively easy to manage due to the LC duplex connection at the beginning and end of the channel.

In 40G transmission, the Media Device Interface (MDI) for the transceivers is changed to an MPO receptacle from an LC duplex receptacle for 10G. There are eight fibers associated with the SR4 channel; four (4) fibers for the Tx side of the transceiver and four (4) fibers for the Rx side. With multiple fibers being utilized, maintaining polarity of these channels becomes more complex to manage from end to end. Additionally, mating of two MPO connectors is not accomplished with a split sleeve type adapter, but rather with alignment pins that are present on one of the MPO connectors (referred to as a male MPO). The other MPO connector has receiving alignment holes for these pins (referred to as a female MPO).

Shown in Figure 3 are typical 40GBASE-SR4 Method A and Method B channels as discussed in the standard.



**Figure 3. Method A and Method B 40GBASE-SR4 Channels**

As shown in Figure 3, the Method A channel consists of:

- Type A female MPO to female MPO connector cord (Key Up to Key Down)
- Type A MPO adapters (Key Up to Key Down)
- Type A female MPO to female MPO patch cord
- Type B female MPO to female MPO patch cord

One Method B MPO patch cord is needed on one end of the link to ensure the TX signal is transposed to the respective RX port on the other end of the link.

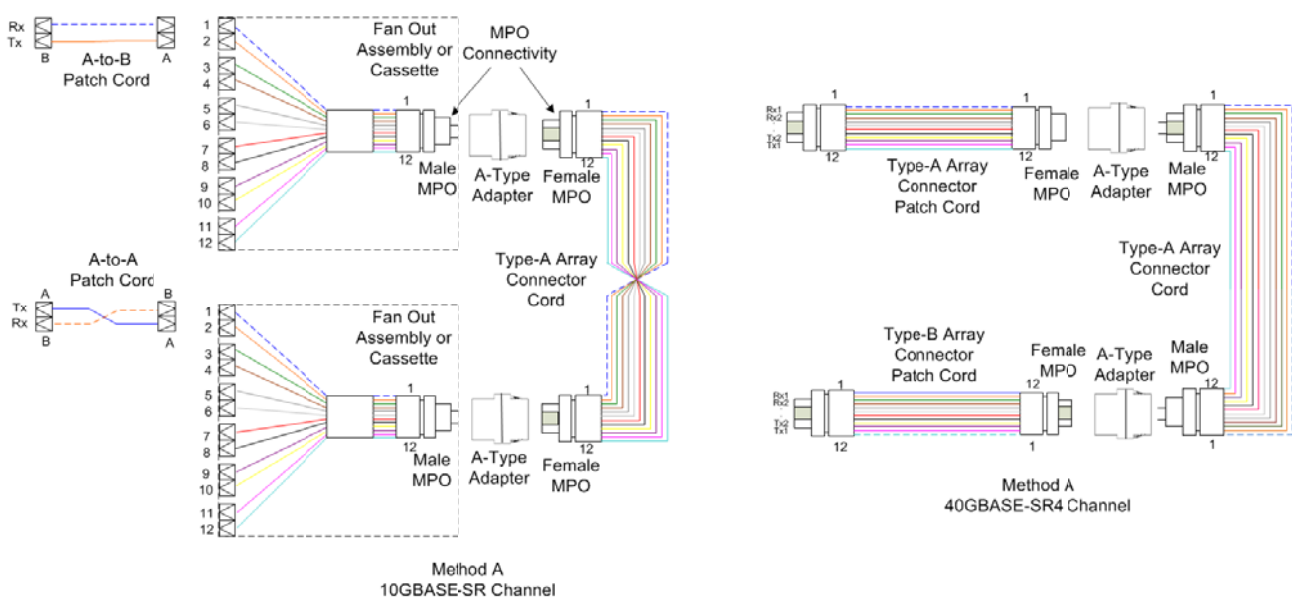
On the other hand, the Method B channel consists of the following:

- Type B female MPO to female MPO connector cord (Key Up to Key Up)
- Type B MPO adapters (Key Up to Key Up)
- Type B female MPO to female MPO patch cords

As shown in Figure 2, when using MPO based connectivity in a 10G channel, the cabling standard, calls for a female MPO horizontal cabling infrastructure and male MPO cassettes or breakout cables. The male MPO is located within the cassette to protect the alignment pins from damage during installation. In a 40G channel configuration cassettes are not used and therefore cannot serve to protect the pins. Consequently, the standard calls for male MPO horizontal cabling (as shown in Figure 3) to protect the alignment pins on the back side of the adapter module rather than have them exposed to possible damage on the end of a patch cord. Further, male connectors on patch cords pose an additional operational risk to QSFP+ ports should a male connector be inserted due to the QSFP+ ports being configured as male to protect the pins within the port.

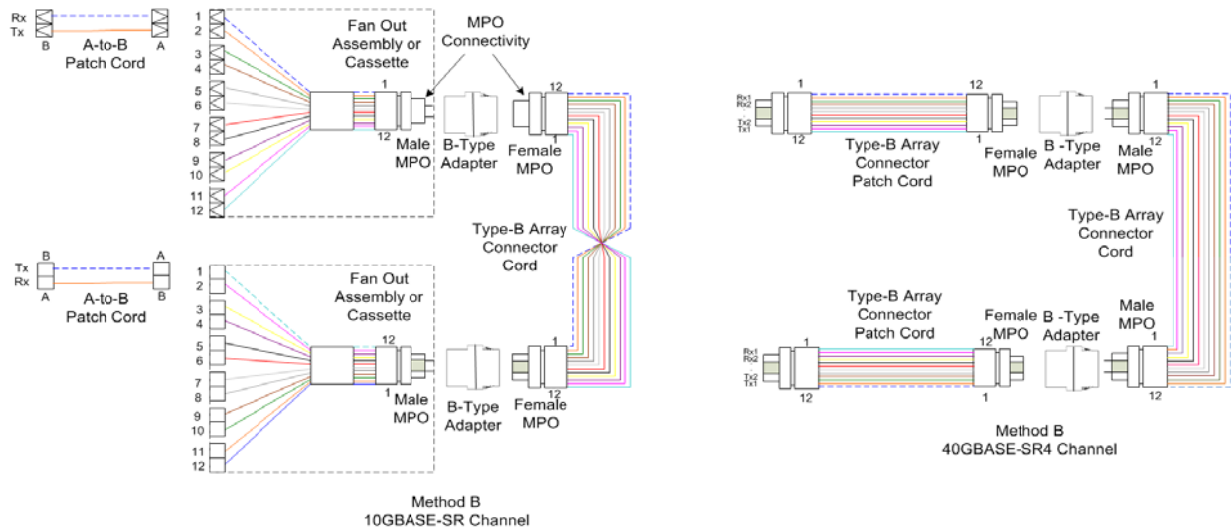
Considering this, in order to comply with the standard cabling guidelines and provide the optimal pin protection when migrating from a 10G to 40G cabling configuration, the MPO connectors associated with the horizontal cabling infrastructure must be changed from female to male. Given that existing MPO connectivity does not allow for this alteration in the field without significant risk of fiber or connector damage, it suggests that the cabling in the horizontal cabling infrastructure would need to be changed out.

In addition, in the Method A configuration, there are also two different MPO patch cords necessary to complete the 40G channel. Not only does the horizontal cabling MPO change from female to male, but a Method A cord and Method B cord are needed at the ends to complete the channel to ensure proper polarity as shown in Figure 4.



**Figure 4. Method A - 10G and 40G channel layouts**

The Method B configuration (shown in Figure 5) holds the same gender issues as Method A when migrating from 10G to 40G, but does not need the two different MPO patch cords to complete the channel. In a greenfield installation, Method B is the preferred polarity method when building out horizontal cabling infrastructure.



**Figure 5. Method B - 10G and 40G channel layouts**

With the complexity of the gender and polarity associated with the migration of the different methods discussed in the standards, Panduit has introduced the “PanMPO” an MPO connector that will alleviate these complexities.

**Solution**

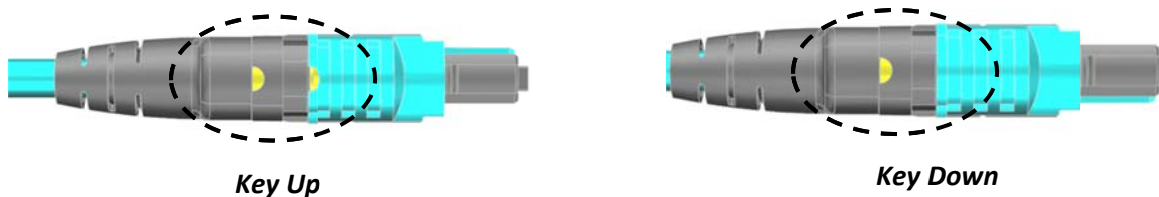
Panduit has introduced the PanMPO, a universal MPO connector that can have the gender and polarity changed in the field with no risk of damage to the internal ribbon fiber or the connectors end face.

The PanMPO is a multiple-fiber push-on/pull-off connector that is IEC-61754-7 and EIA/TIA-604-5 (FOCIS 5) compliant that can be either male or female in gender or key up or key down in housing polarity orientation.



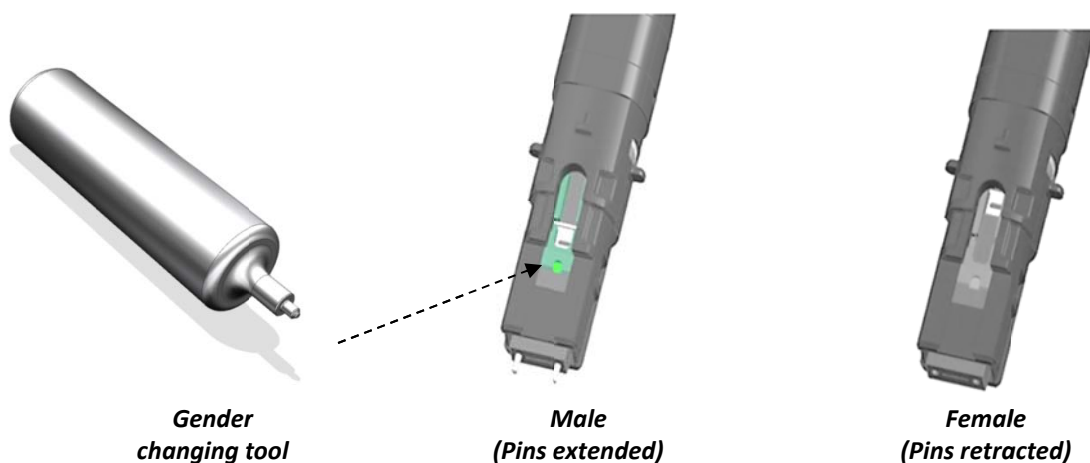
### What are the general characteristics of PanMPO?

The PanMPO has an interchangeable housing that enables the user to change the key position on the connector between key up and key down. With this functionality and depending upon the orientation of the connector on the other end of the cable, this feature can make the cordage either a Method A or Method B MPO cord in accordance with ANSI/TIA-568-B.1-7. The way to identify which way the connector is keyed with respect to fiber one in the MPO ferrule is by observing the semicircles on the side of the connector (one on the inner housing and one on the connector housing). When the two are aligned the connector is key up with fiber one being on the side of the semicircles. When the two are on opposite sides of the connector, the connector is key down with fiber one remaining on the side of the semicircle located on the inner housing. Figure 6 shows the two configurations.



**Figure 6. Key Up and Key Down PanMPO configurations**

The gender of the connector can be changed by removing the housing and using the gender changing tool to either extend or retract the pins. The tool shown below is used to easily slide the tab back (to retract the pins) or forward (to extend) the pins. (The tip of the tool inserts into the guide hole provided in the housing and is used to slide the aluminum pin housing forward or back).



Diagrams in Appendix A show the six possible cable configurations when utilizing the PanMPO.

### *What type of performance can I expect from the PanMPO?*

The PanMPO is both IEC-61754-7 and EIA/TIA-604-5 (FOCIS 5) compliant. It is offered as with a standard maximum insertion loss (0.50dB maximum) or optimized maximum insertion loss (0.35dB maximum) with a minimum return loss of 26dB for the multimode fiber solution and standard insertion loss (0.75dB) with a minimum return loss of 55dB for the singlemode solution.

### *Where can I use PanMPO?*

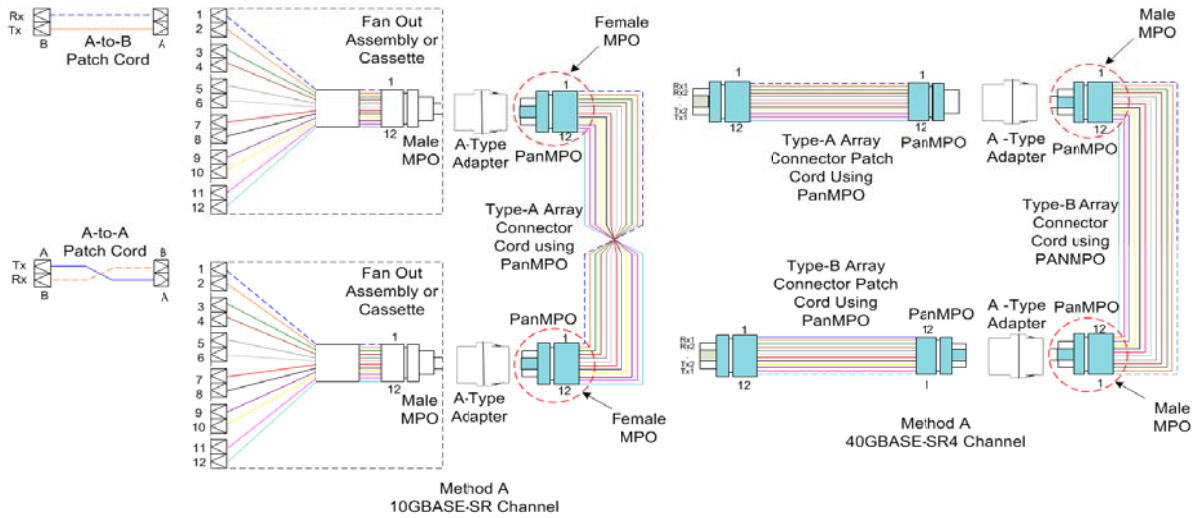
The PanMPO can be utilized in any 10G or 40G based greenfield or brownfield MPO infrastructure containing trunk assemblies, interconnect cords, fan out and MPO patch cords. It will minimize MPO cord configurations to keep in stock and to keep track of on the datacenter floor. It will also prevent installation, adds/move/changes or new turn up delays because an MPO cord or harness was ordered with the incorrect gender or polarity.

In the following paragraphs, we will discuss the advantages of the PanMPO in “greenfield and brownfield” installations.

### *Greenfield Infrastructure*

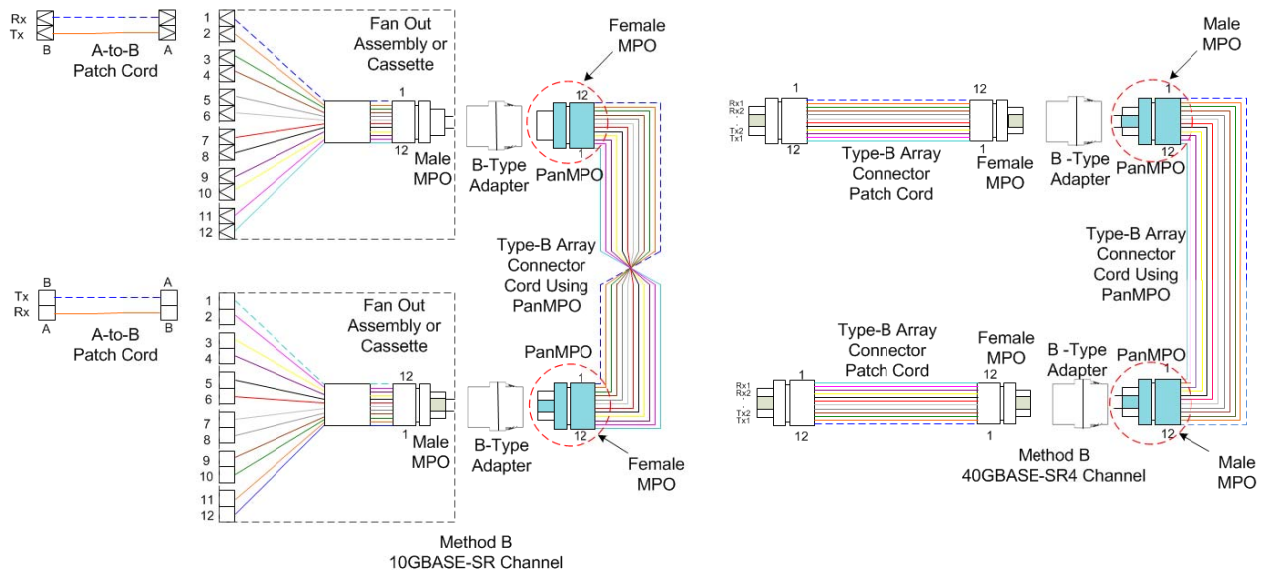
In a greenfield application where the horizontal cabling infrastructure is being designed and installed, the PanMPO can be utilized on the trunks or interconnect assemblies to ensure that both the 10G and 40G infrastructures are standards compliant.

Figure 7 shows how the PanMPO can easily enable a Method A standards based 10G female horizontal cabling solution to be changed to a Method A standards based 40G male horizontal cabling solution and provide for a unique MPO patch cable at the equipment ends that allows the end user to only order one part number and configure the polarity of the cabling as needed.



**Figure 7. Method A greenfield migration from 10G to 40G**

Figure 8 shows how the PanMPO can easily enable a Method B standards based 10G female horizontal cabling solution to be transformed to a Method B standard based 40G male horizontal cabling solution.



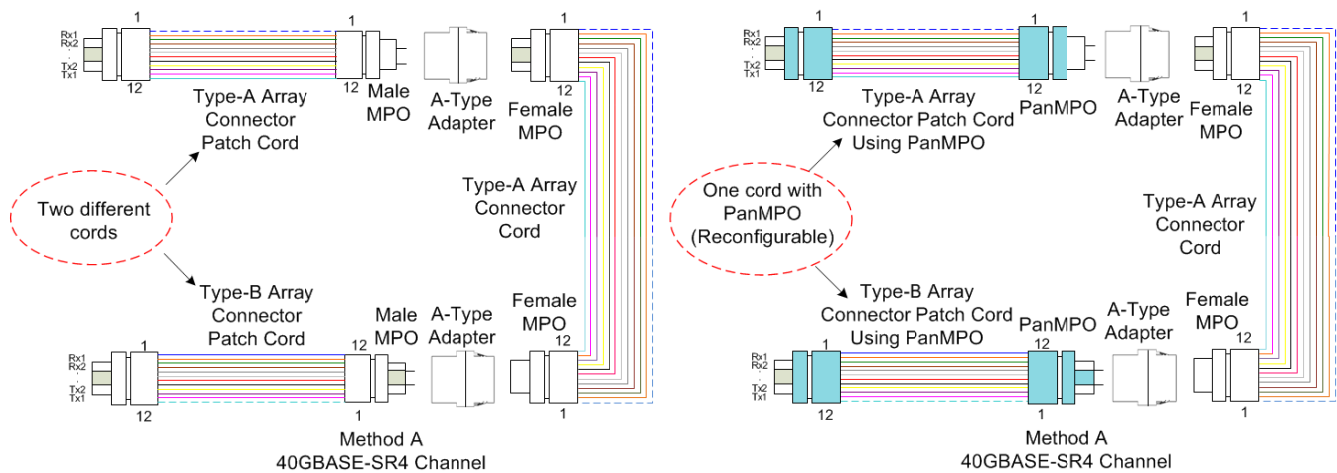
**Figure 8. Method B greenfield migration from 10G to 40G**



**Brownfield Infrastructure**

In a brownfield application where the horizontal cabling infrastructure is already installed, the PanMPO can be utilized on the MPO equipment cords to ensure that the correct polarity is present to transmit the 40G signal from one end of the channel to the other.

Figure 9 shows a 10G to 40G migrated Method A brownfield cabling infrastructure. The diagram on the left shows the cordage necessary when utilizing standard MPO connectors and the diagram on the right shows the cordage necessary when utilizing the PanMPO connector. The PanMPO connector will allow the same cord to be utilized on both ends of the channel due to its ability to be reconfigured. This results in only having to have one cord type in inventory.



**Figure 9. Method A brownfield migrated from 10G to 40G**

**Summary**

Polarity and gender have always been an issue when designing, installing or troubleshooting an MPO based infrastructure in a 10G or 40G environment. To further complicate things, the 10G standards call for a female horizontal cabling infrastructure while the 40G standards call for a male horizontal cabling infrastructure. Panduit has developed the PanMPO to easily solve the gender, polarity, and standards compliancy questions that surround the MPO cabling infrastructure by removing the operational risks involved with changing the gender or polarity of the existing MPO connectivity solution.

Appendix A

*Male Key Up to Male Key Up*



*Male Key Up to Male Key Down*



*Female Key Up to Male Key Up*



*Female Key Up to Male Key Down*



*Female Key Up to Female Key Up*



*Female Key Up to Female Key Down*

