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Fiber Optic Polarity Guide for VSFF Connectivity

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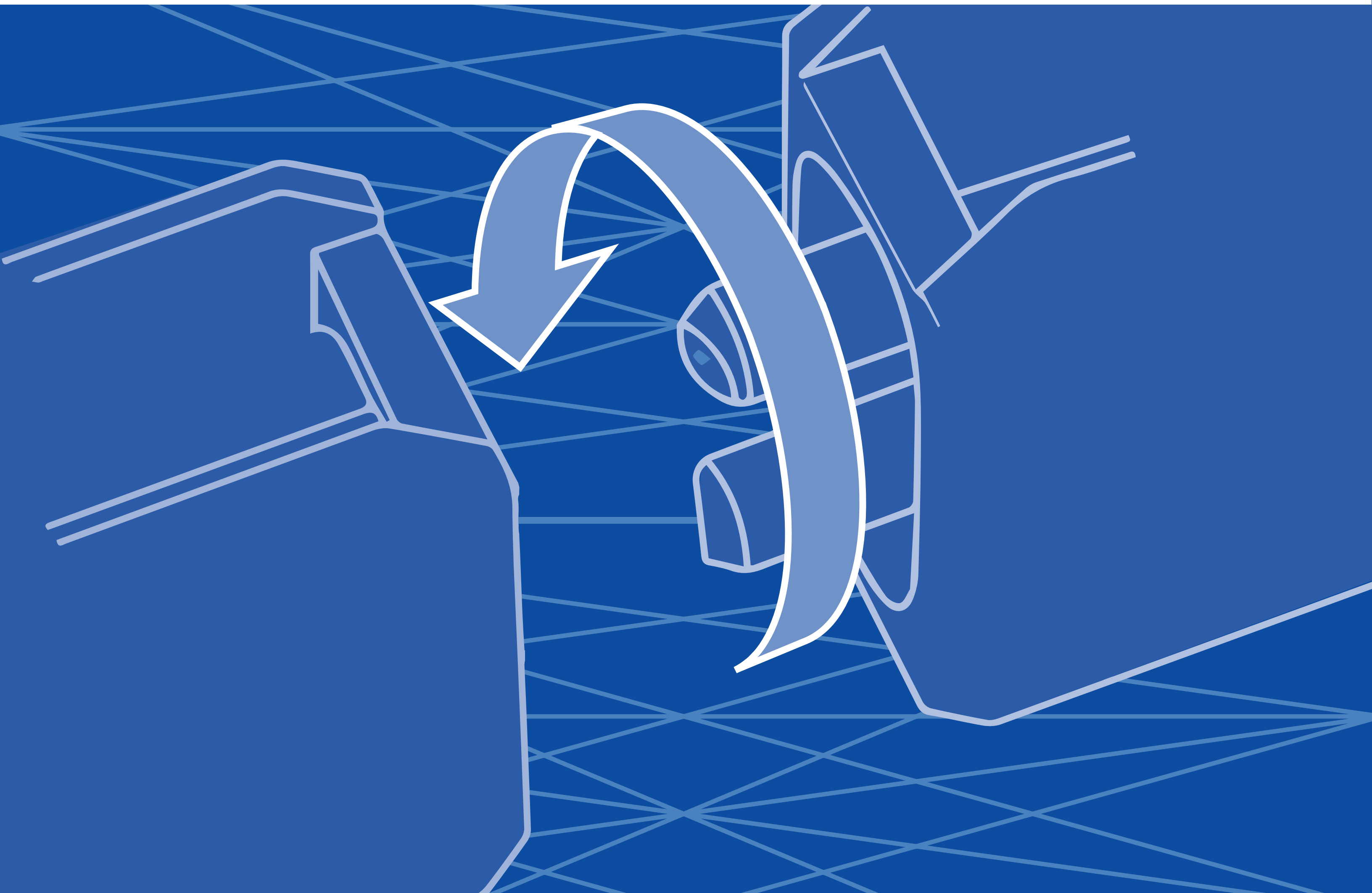

Fiber Optic Polarity Guide for VSFF Connectivity

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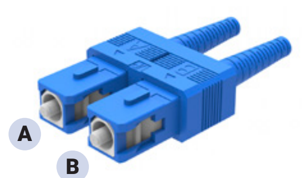
Purpose

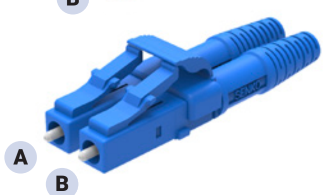
This application note provides guidelines for polarity when creating optical fiber cabling systems using duplex, single-row, and dual-row array connectors. In a fiber optic link, the transmitted signal (Tx) at one end of the cable must match the corresponding receiver (Rx) at the other end. So, how do we define fiber polarity? According to TIA-568.3-E, polarity is a method of positioning optical fibers to ensure connectivity between transmitters and receivers. In other words, fiber polarity specifies the direction in which light travels from one end of the cable to the other. Fiber optics relies on bidirectional transmission, where the transmitter port on one end connects to the receiver port on the other end. A fiber optic link typically requires a duplex connection (Tx and Rx). Incorrect polarity due to routing errors in manufacturing or installation could lead to signal failure, even if the cable is functionally good. It's important to note that this paper does not address new BiDi or bidirectional transceivers that use two different wavelengths to accommodate transmission in both directions in a single fiber.

Overview and Polarity Definitions in Various Connector Types

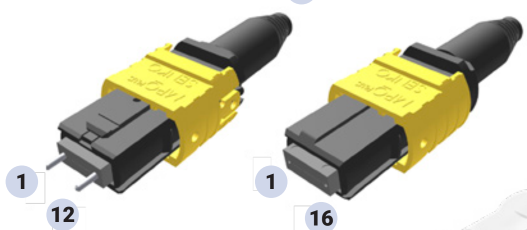
There are four main connector types in the market that are recognized and standardized by the TIA. These connectors have more than one fiber and, therefore, need to be properly interconnected in links to ensure connectivity between transmitters and receivers.



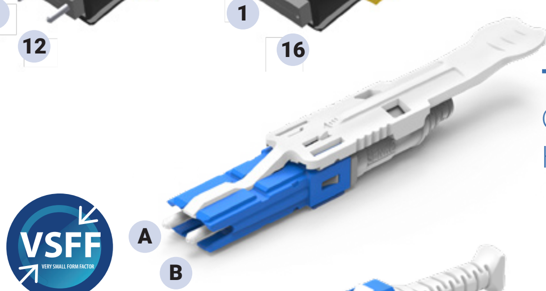
Type 1 ***Duplex SC ANSI/TIA-604-3 (FOCIS-3)***



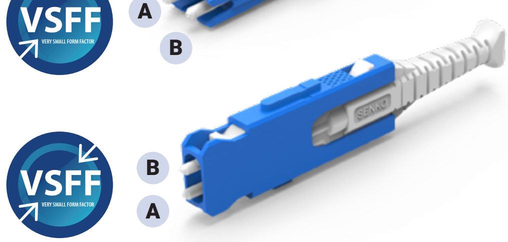
Type 2 ***Duplex LC Small Form Factor (SFF) ANSI/TIA-604-10 (FOCIS-10)***



Type 3 ***Multifiber Array***
MPO 12/24 TIA-604-5 (FOCIS-5)
MPO 16/34 TIA-604-18 (FOCIS-18)



Type 4 ***Duplex Very Small Form Factor (VSFF)***
CS® ANSI/TIA-604-19 (FOCIS-19).
Horizontal polarity scheme similar to LC



Type 5 ***Duplex Very Small Form Factor (VSFF)***
SN® ANSI/TIA-604-TBD (FOCIS-TBD)
Vertical polarity scheme

To address proper fiber routing issues, TIA has published polarity connectivity methods in several documents. One of them is the TIA-568-C standard, called the 'Commercial Building Telecommunications Cabling Standard,' which defines the A-B polarity for discrete duplex patch cords. Additionally, TIA TSB-5069, a paper called 'Optical Fiber Channel Polarity-Duplex-Single and Dual Row Fiber,' provides guidelines for polarity in newer optical fiber cabling systems that use duplex, single-row, and dual-row MPO connector components. This TIA TSB-5069 guide is intended to expand on another TIA document called the ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard. Finally, TIA published a document in 2022, ANSI/TIA-568.3-E, which revises TIA-568.3-D to include the content from TIA-568.3-D-1 Addendum 1: General Updates and additional content deemed appropriate by the formulating subcommittee. In total, TIA has dedicated four active documents that specify and define polarity in the fiber optic world, which continues to evolve. With the emergence of new VSFF connectors QSFP-DD, OSFP and SFP-DD transceivers, TIA is currently (as of 2023) working on a fifth document, ANSI/TIA-568.3-E, that will address new connectors and transceivers that can transmit data at speeds of 100G and 400G by adding U1 and U2 MPO transitions.

In summary:

- ANSI/TIA-568-C.2 focuses on components of balanced copper twisted-pair cable systems
- ANSI/TIA-568.3-E is a first and more generic standard that addresses premises fiber optic fiber cabling and components. The standard specifies requirements for components, connectivity rules, color coding, etc. Test and measurement requirements are also incorporated into this standard
- TIA TSB-5069 provides guidelines for polarity when using duplex, single-row and dual-row array connector components
- TIA-568.3-E specifies types of components to define connectivity methods for multiple duplex and parallel optical signals

All of the above documents view polarity similarly. The official definition is *"Polarity for optical fiber defined as a method of positioning optical fibers to ensure connectivity between transmitter(s) and receiver(s)".*

Furthermore, all duplex connectors have two fibers and keys that secure the interconnect in the adapter. ANSI/TIA-568.3-D refers to two fiber positions in a horizontal duplex connector (such as SC, LC or CS®) and the corresponding adapter as Type A and Type B, and there are 2 polarity types, which are Type A and Type B adapters. The main difference between a Type A and Type B adapters is the way in which the fibers are crossed over. In a Type A polarity adapter, the fibers are not crossed over, ferrules mate A-to-A and B-to-B. The adapter Type A keys are aligned. In a Position B polarity adapter, the Tx and Rx fibers are crossed over at each end and ferrules mate A-to-B and B-to-A. The adapter Type B has opposing keys.

Two types of duplex fiber patch cords are defined in the TIA standard: A-to-A type and A-to-B type shown in Figure 2. Note: A-to-A patch cords are not commonly deployed and should be used only when necessary, as part of a polarity method.

The original standard uses the SC connector as an example to assign positions A and B, but the same concept applies to LC, SC, CS® and other horizontal duplex connectors with exception of vertical duplex connectors such as SN® or MDC®.

Figure 1 shows the locations of Position A and Position B in the SC connector and adapter with aligned key up to key up with respect to the connector's keyways. As figure 1 illustrates, the SC adapter shall perform a pair-wise crossover between connectors. Additionally, figure 1 shows Position A and Position B in the two possible horizontal and two possible vertical orientations.

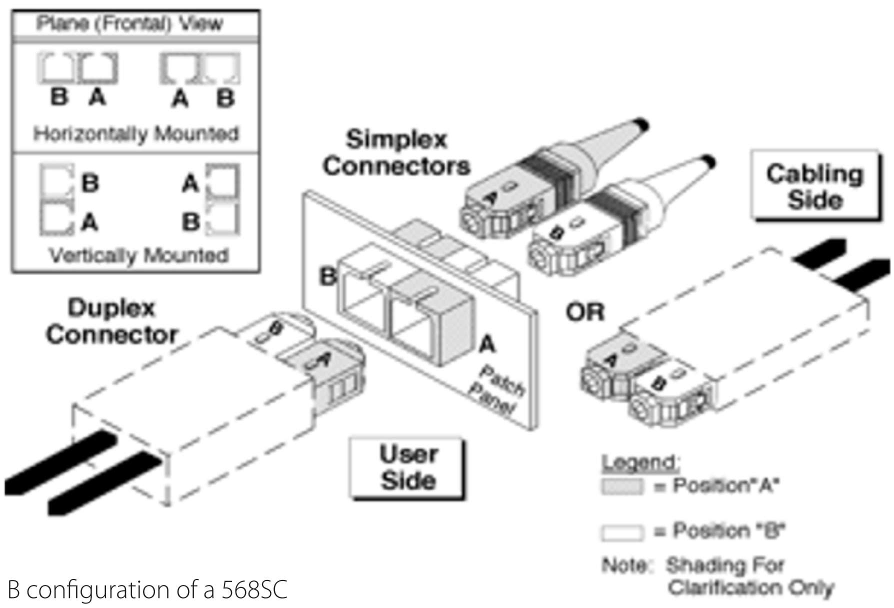


Figure 1 Position A and B configuration of a 568SC

Here's an example to illustrate two ways to achieve proper polarity: if you have a duplex SC, LC or CS® jumper with a standard "A-to-B" polarity, and you want to connect it to another corresponding duplex jumper with a standard "A-to-B" polarity. In this case, you can simply plug the connectors together using Type A adapter, and the Tx fiber from one end will be connected directly to the Rx fiber at the other end. However, if you want to connect the same duplex connector to a connector with a A-to-A" polarity, you will need to use a polarity adapter Type B to cross over the Tx and Rx fibers at one end.

In summary, the main difference between Position A and Position B polarity adapters is the way in which the fibers are crossed over, and they are used to connect different types of connectors with different polarity arrangements.

Once again, the reason for maintaining polarity in fiber optic cables is ensuring that transmit (Tx) signal always goes to receive (Rx). In other words, the connector in the "B" position should always connect to the connector in the "A" position regardless of how many cables are connected, as shown in the diagram below.

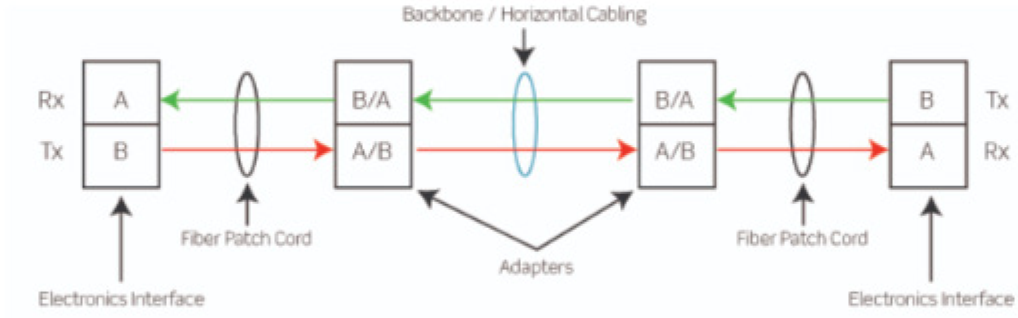


Figure 2 Example of duplex cables interconnection

Per ANSI/TIA-568.3-D standard "A-to-B duplex patch cords shall be of an orientation such that Position A connects to Position B on one fiber, and Position B connects to Position A on the other fiber. Each end of the patch cord shall indicate Position A and Position B if the connector can be separated into its simplex components. For connector designs utilizing latches, the latch defines the positioning in the same manner as the keys".

Figure 3 ANSI/TIA-568.3-D standard "A-to-B"

The ANSI/TIA-568.3-D standard further mentions A-to-A duplex patch cords with the note: A-to-A patch cords are not commonly deployed and should only be used when necessary, as part of a polarity method. The A-to-A duplex patch cords define orientation as "Position A goes to Position A on one fiber, and Position B goes to Position B on the other fiber". It is estimated that the A-to-A configuration accounts for less than 1% of all connections and is used predominantly in the lab environment or to correct field errors.

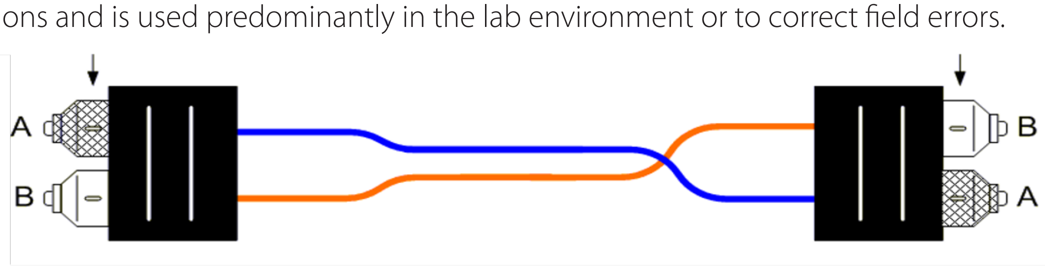


Figure 4 Position A and B configuration of a 568SC

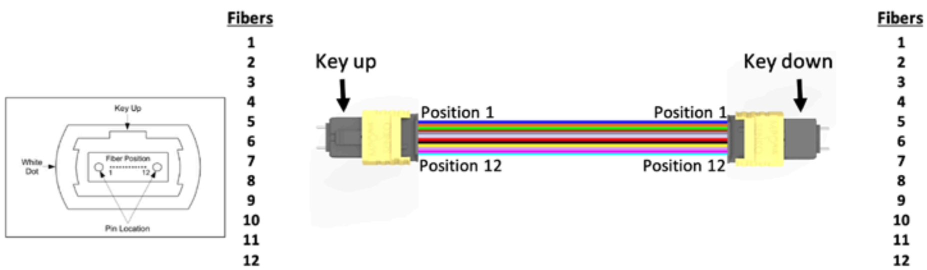
The ANSI/TIA-568.3-D standard not only covers duplex connectors but also addresses array or MPO connector polarity. High-density connectivity typically requires more than two fibers in a link, making it more challenging to maintain correct polarity across a fiber network, especially when using MPO fanouts with duplex interconnects. Despite the complexity, all array connectivity methods share the same goal: to create an optical path from the transmit port of one device to the receive port of another device.

In addition to polarity, MPO gender is also an important consideration. The MPO interfaces on active equipment are male (with pins or "pinned"), and to avoid damaging the transceiver, MPO patch cords that plug into transceivers should be female (without pins or "unpinned"). As a result, many technicians prefer to use pre-terminated MPO interconnects that are designed with defined polarity maintenance to make installation easier.

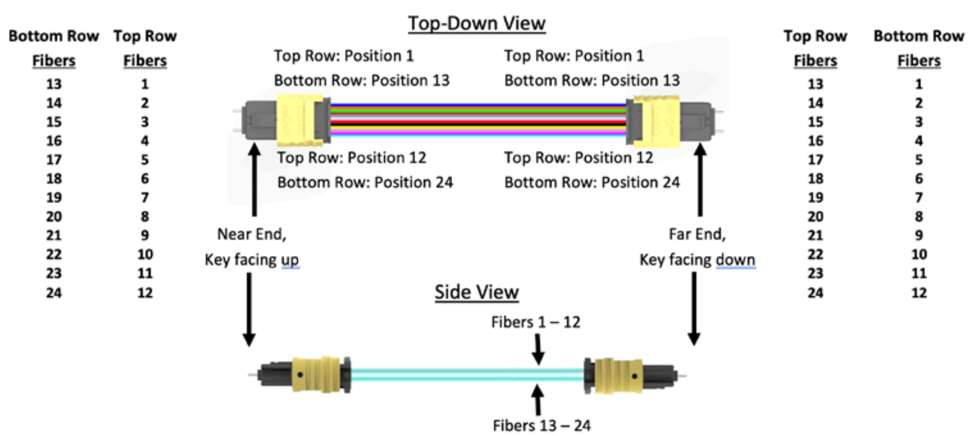
The ANSI/TIA-568.3-E standard addresses three different types of MPO cables – Type A, Type B, and Type C. Type A is a straight-through MPO trunk cable with a key up connector on one end and a key down connector on the other end, resulting in the fiber located in Position 1 arriving at Position 1 at the other end. Type B cables are key up to key up so that the fiber located in Position 1 arrives at Position 12 at the opposite end, the fiber located in Position 2 arrives at Position 11 at the opposite end, and so on. Type C cables flip the pairs so that the fiber in Position 1 arrives at Position 2 at the opposite end and the fiber in Position 2 arrives at Position 1, and so on. Note that MPO polarity configurations are applicable to MM MPOs with a flat polish, and this does not pertain to SM MPOs with angled polish.

Let's review these methods in more details. Type A cables, which are also known as straight cables, consist of straight-through cables with a key-up MPO connector on one end and a key-down MPO connector on the opposite end. This ensures that the fibers at each end of the cable have the same fiber position. For instance, the fiber located at position 1 (P1) of the connector on one side will arrive at P1 on the other connector. It's worth noting that Type A cables require the use of a Type A adapter, which has key-up on one side and key-down on the opposite side. This is defined different from a duplex adapter types and can be confusing. The fiber sequence of a 12-fiber and 24-fiber MPO Type A cable is illustrated below:

Type-A: 1-1 Array Cable *(Straight through 1 to 1…)*



Type-A: 2-2 Array Cable



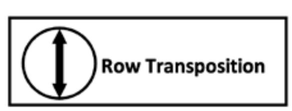


Figure 5 Type A: 1-1 and A: 2-2 array (MPO) cable

Type "A" Adapter Configuration

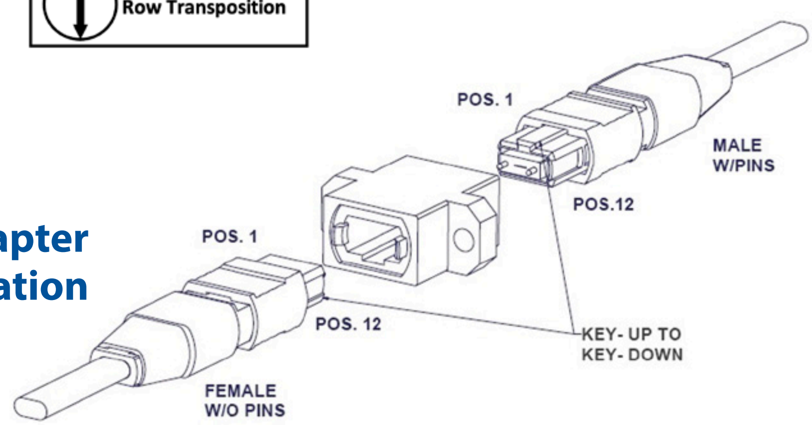
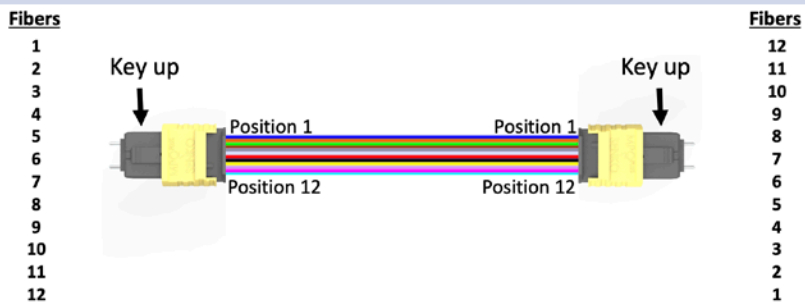


Figure 6 Example of Type A MPO configuration

Type B cables, also referred to as reversed cables, use key-up connectors on both ends of the cable. This results in an inversion of the fiber positions at each end, making it more suitable for parallel optics. Specifically, the fiber at Position 1 on one end is mated with the fiber at Position 13 on the opposing end. It's worth noting that Type B cables require the use of a Type B adapter, which has key-up on both sides. For a summary of connectivity methods for components supporting ribbon (MPO-MPO) cables, please refer to Table 2. Additionally, Figure 7 displays the fiber sequences of a 12-fiber Type B cable.

Type A is the component that does not transpose A and B positions, meaning A will always remain as A.Type B is the component that transposes A and B, so A becomes B and B bacomes A. This distinction applies to both adapters and jumpers. In this section, we can emphasize that using only Type B components in the network guarantees a consistent connection between TX and RX.

Type-B: 1-1 Array Cable *(Cross 1 to 12…)*



Type-B: 2-2 Array Cable

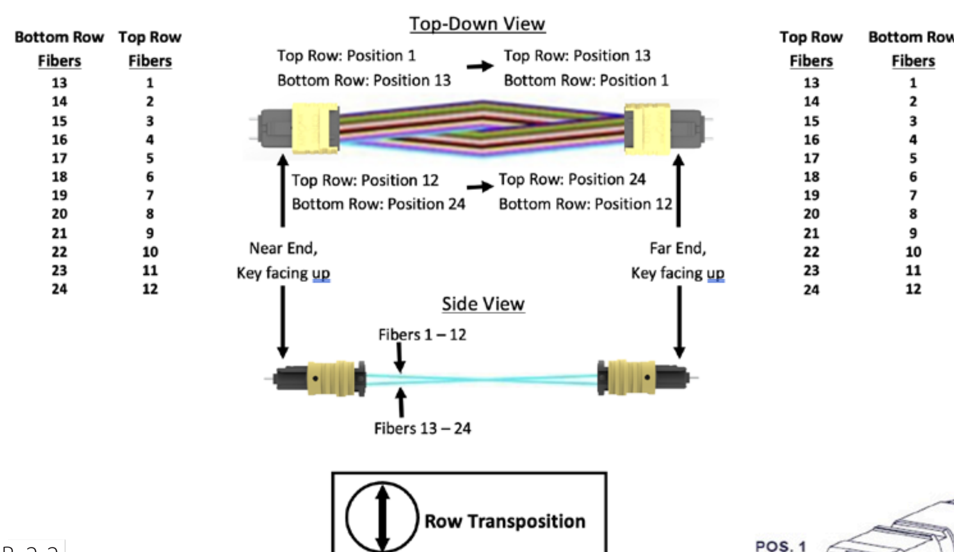


Figure 7 Type B: 1-1 and B: 2-2

Type "B" Adapter Configuration

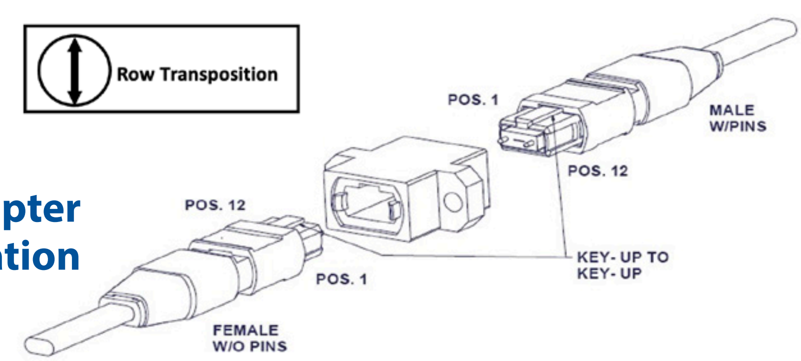
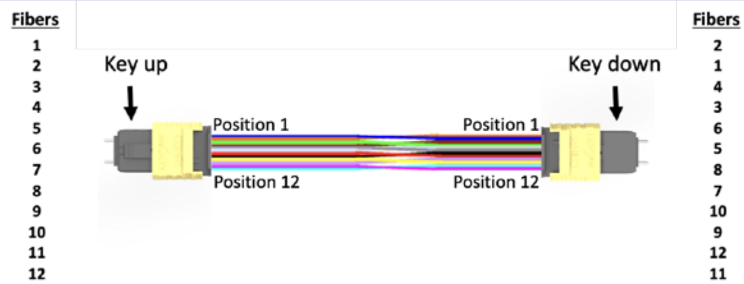


Figure 8 Example of Type B MPO configuration

Type C cable, which has flipped pairs in each cable, looks like a Type A cable with one key-up connector and one key-down connector on each side. However, in Type C, each adjacent pair of fibers at one end is flipped at the other end. For example, the fiber at position 1 on one end is shifted to position 2 at the other end of the cable, and the fiber at position 2 on one end is shifted to position 1 at the opposite end, and so on. The fiber sequence of the Type C cable is demonstrated in Figure 9 for C:1-1 single row and C:2-2 double row configurations.

Type-C: 1-1 Array Cable *(Pair Flipped Type-A 1 to 2, 2 to 1…)*



Type-C: 2-2 Array Cable

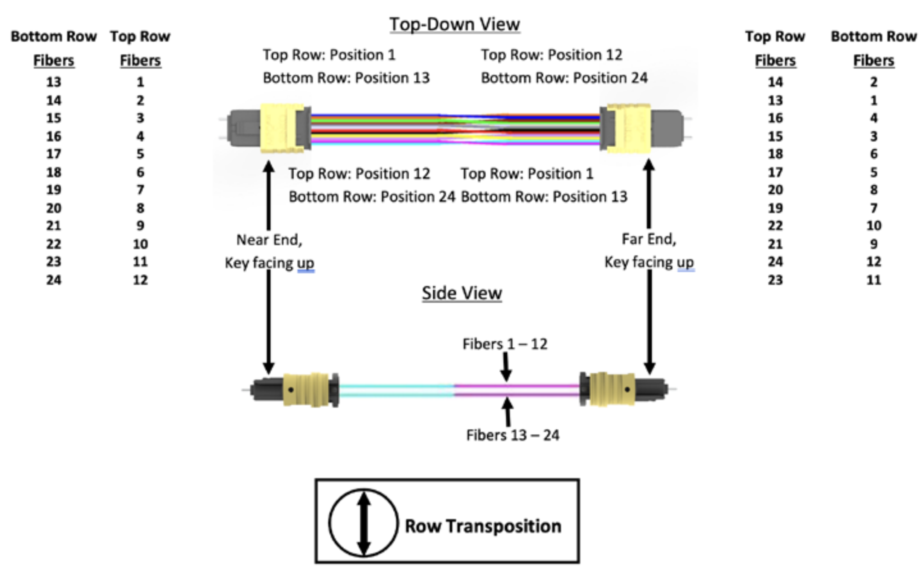


Figure 9 Type C: 1-1 and C: 2-2 array (MPO) cable

Transition Types for Prefabricated MPO to Duplex Connectors Breakouts

MPO connectors often need to be broken out to duplex connectors such as SC, LC, CS®, and SN®. These breakouts, also known as fanouts, are typically packaged within cassettes. The prefabricated cable systems and parallel array transmission systems for 40G/100G/400G often use MPO ferrules with one or more rows of 12 or 16 fibers. Therefore, the LAN and Data Center parallel optics have an additional variation that poses new challenges for polarity management.

Nowadays, LANs using ribbon fiber at speeds of 40 and 100 gigabits/second (Gb/s) are using parallel transmission, with multiple links of 10Gb/s per fiber in each direction. Thus, a 40 Gb/s (4 x 10Gb/s) link requires 8 fibers, while a 100 Gb/s (10 x 10Gb/s) link needs 20 fibers. These parallel links use 12-fiber MPO connectors that are generally not considered field-installable. When a customer needs a network for these systems, a pre-terminated cabling system may be the only logical choice. Several types of prefabricated fanouts are available for cassettes, including A, U1, and U2. Please refer to Figures 10, 11,12 below for more details.

- MPO Position 1 to LC Position 1
- MPO Position 12 to LC Position 12

MPO End Fiber Number	1	2	3	4	5	6	7	8	9	10	11	12
Fiber Color	Blue	Orange	Green	Brown	Silver	White	Red	Black	Yellow	Violet	Rose	Aqua
LC End Connector Number	1	2	3	4	5	6	7	8	9	10	11	12

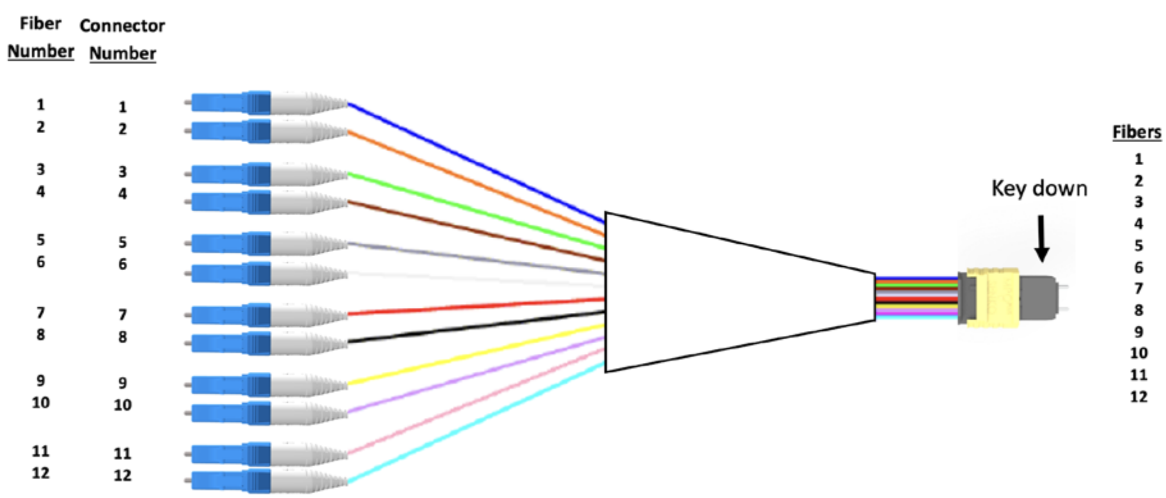


Figure 10 Type A Configuration

- MPO Position 1 to LC Position 1
- MPO Position 12 to LC Position 2

MPO End Fiber Number	1	2	3	4	5	6	7	8	9	10	11	12
Fiber Color	Blue	Orange	Green	Brown	Silver	White	Red	Black	Yellow	Violet	Rose	Aqua
LC End Connector Number	1	3	5	7	9	11	12	10	8	6	4	2

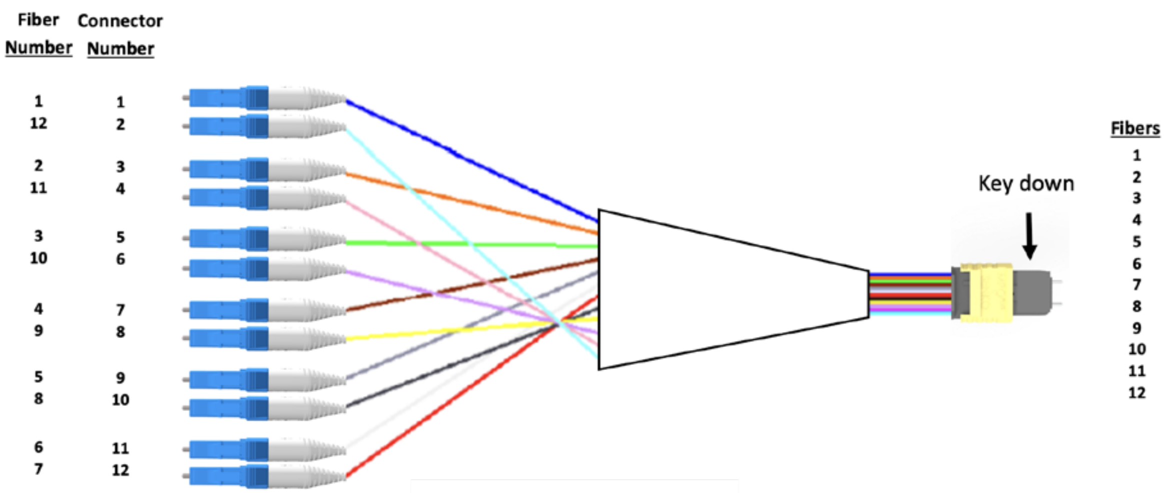


Figure 11 Type U1 Configuration

- MPO Position 1 to LC Position 1
- MPO Position 12 to LC Position 1

MPO End Fiber Number	1	2	3	4	5	6	7	8	9	10	11	12
Fiber Color	Blue	Orange	Green	Brown	Silver	White	Red	Black	Yellow	Violet	Rose	Aqua
LC End Connector Number	1	3	5	7	9	11	12	10	8	6	4	2

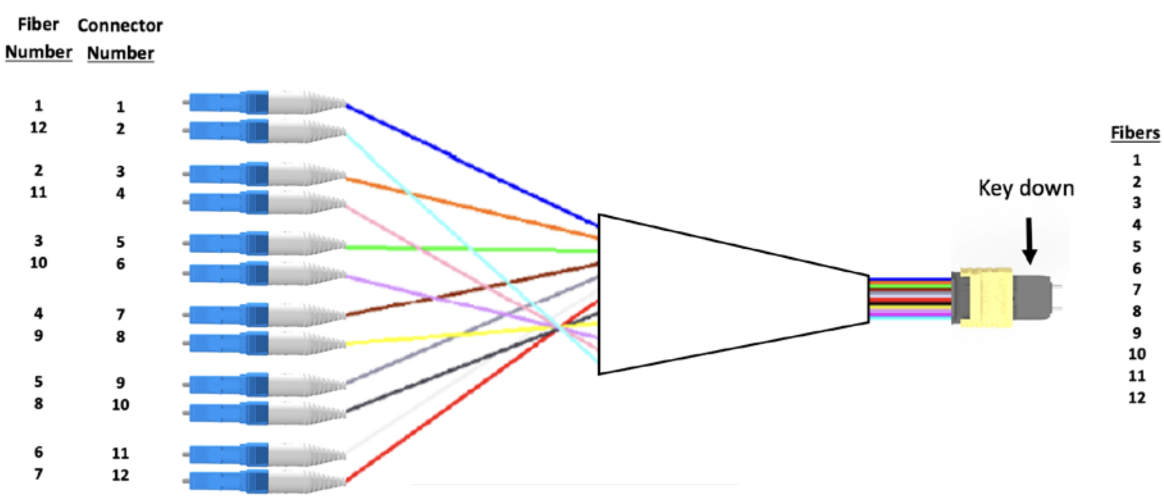


Figure 12 Type U2 Configuration

Connectivity Methods for Combined Duplex Cables, Breakout Cassette and MPO Cables

Each connectivity method requires a specific combination of components to maintain polarity, some of which may be common to other methods. In most networks, it is necessary to use all the cable types mentioned above, including duplex cables, breakout cables on the cassettes, and MPO cables. To summarize the components that support multiple duplex cables, please refer to Table 1. For components that support parallel optics, please refer to Table 2, which is illustrated schematically in figures 13, 14, and 15.

Table 1 Connectivity methods for components supporting multiple duplex signals

Connectivity Method	Array Trunk Cable Type	Array Adapter Type	Fiber Transition Type	Duplex Patch Cord Type
A	Type-A:1-1	Type-A	Type-A	One A-to-B and one A-to-A duplex Channel
B	Type-B:1-1	Type-B	Type-A	A-to-B
C	Type-C:1-1	Type-A	Type-A	A-to-B
U1	Type-B:1-1	Type-A	Type-U1	A-to-B
U2	Type-B:1-1	Type-B	Type-U2	A-to-B

Table 2 Connectivity methods for components supporting parallel signals

Connectivity Method	Array Connector Cable Type	Array Adapter Type	Array Patch Cord Type
A	Type-A:1-1	Type-A	One Type-A:1-1 and one Type-B:1-1 per 12-lane array
B	Type-B:1-1	Type-B	Type-B:1-1
C	Type-C:1-1	Type-A	One Type-B:1-1 and one Type-C:1-1 per 12-lane array

MPO Connectivity Method A

When using this method, the user needs to use different patch cords on each end of the link to ensure the proper Tx to Rx signal routing. This can be confusing, so an alternative method is to use a transition or cassette at one end with connectors that are "pair flipped". See figure 13.

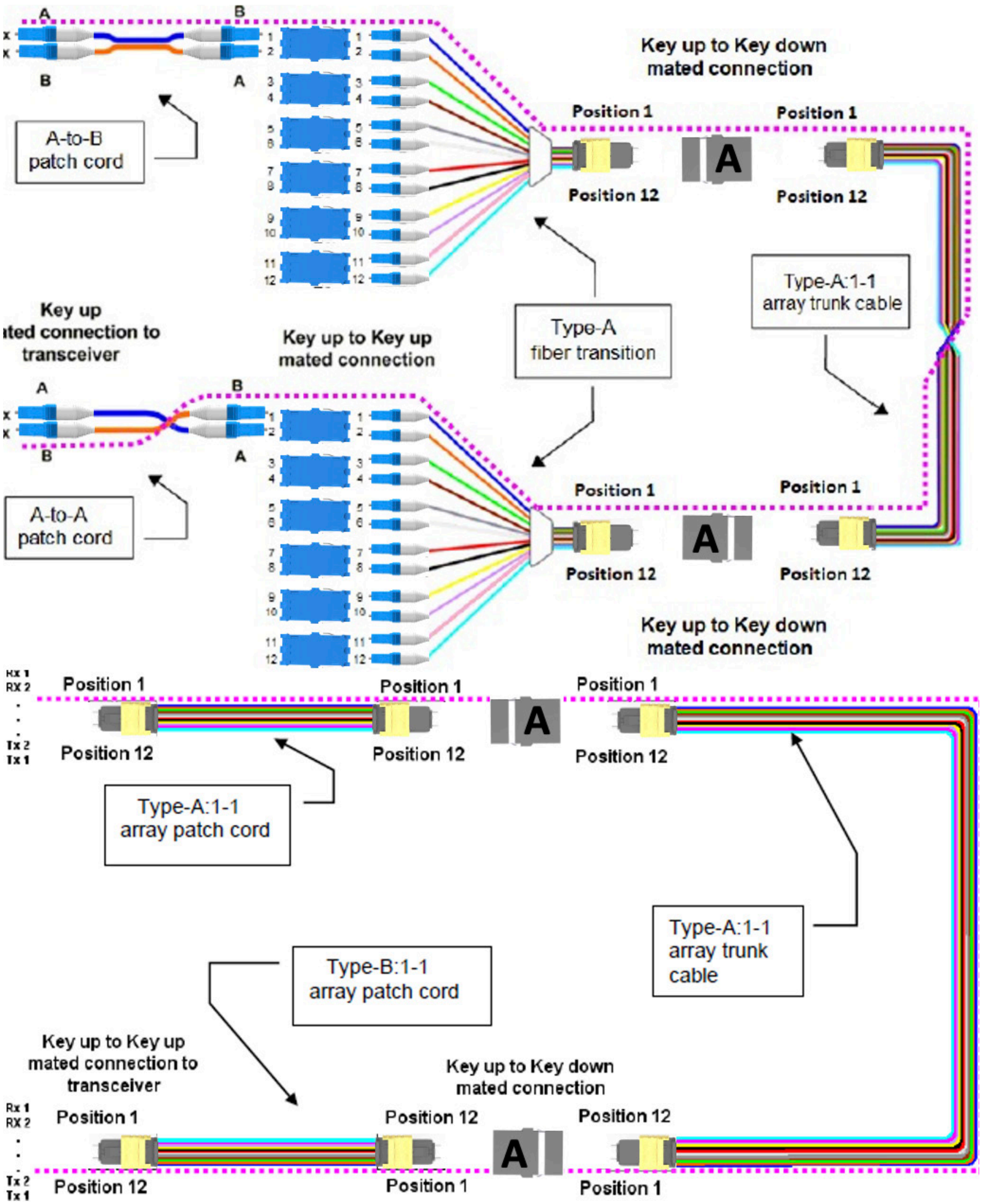


Figure 13 Connectivity method A

MPO Connectivity Method B

By using this method, the user can use the same duplex patch cord at both ends of the link. However, the second transition between the MPO connectors needs to be flipped upside down, which can be accommodated with a special polarity MPO adapter. However, mating MPO/APC connectors with such adapters can be challenging. An alternative option is to use a transition on end 2 with the connectors positioned properly (key up and left to right) on the panel. See figure 14.

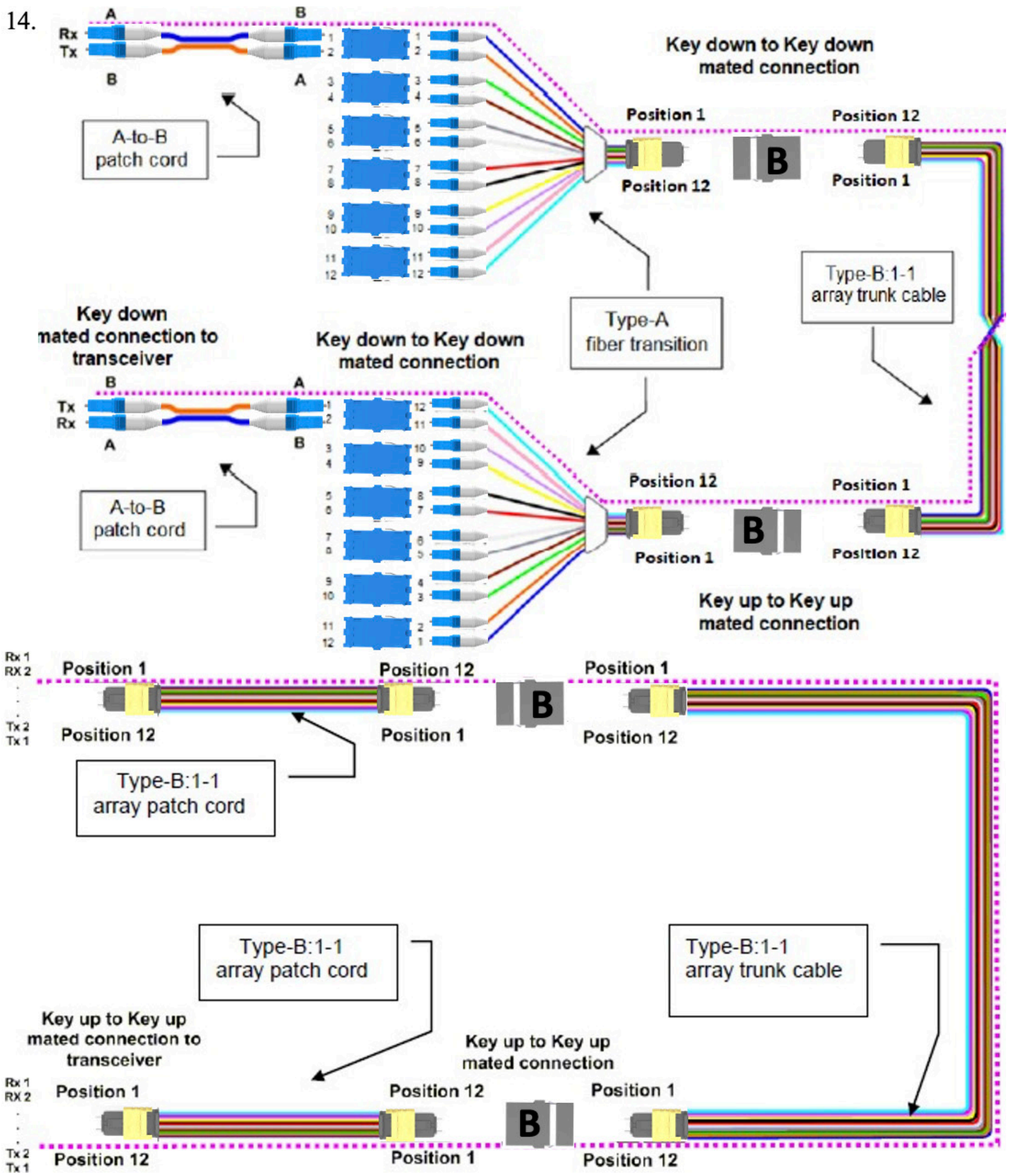


Figure 14 Connectivity method B

MPO Connectivity Method C

This method poses challenges for cable manufacturers in producing ribbon fiber cables due to the need for a pair flip. However, it is well-suited for multiple duplex applications. Migrating this configuration to parallel optics may also pose some challenges. See figure 15.

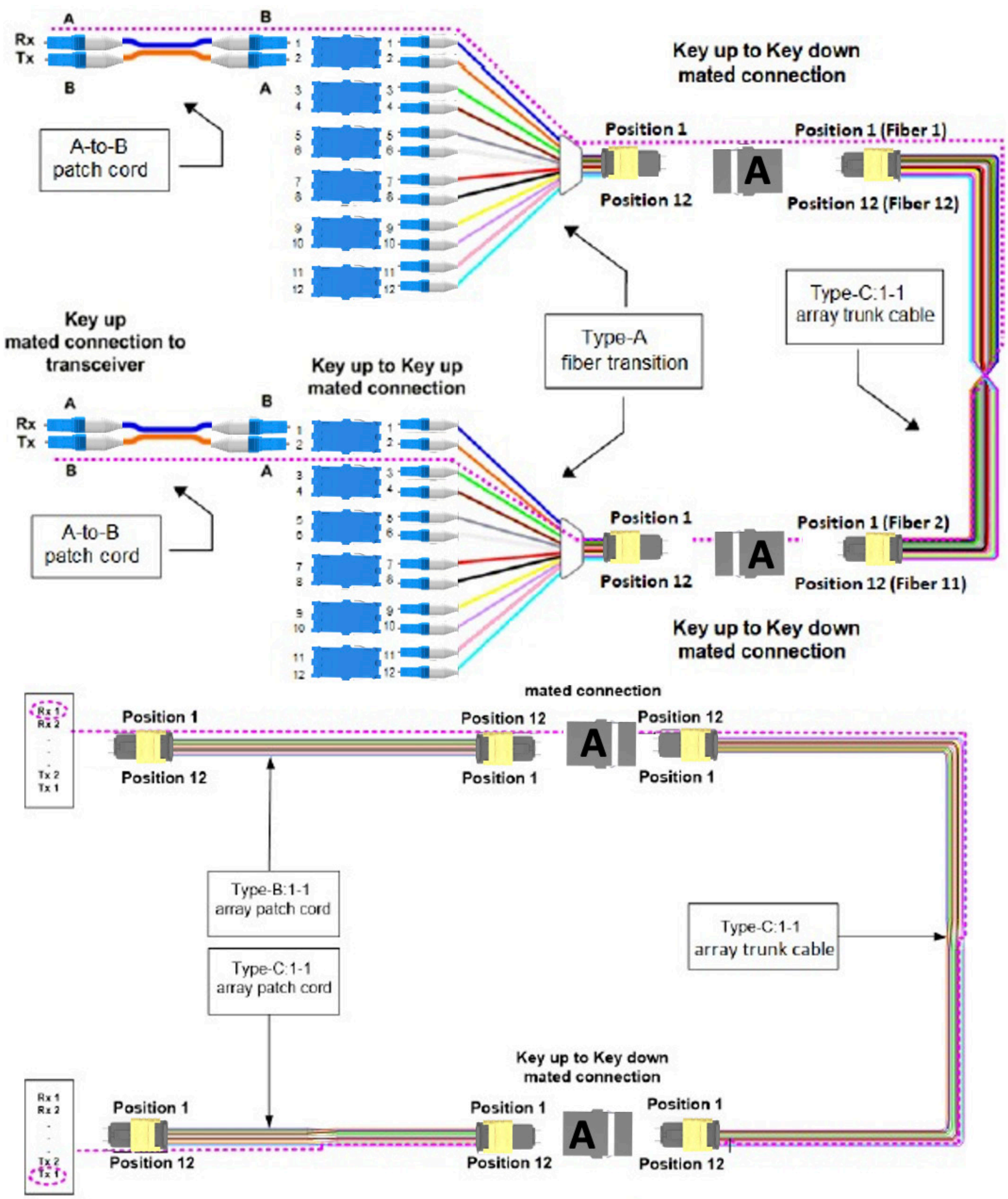


Figure 15 Connectivity method C

MPO Connectivity Methods U1 and U2

This method is likely the most logical as it utilizes the most common duplex patch cord types (A to B and B to A) on both ends. Furthermore, the same U-type transition can be used at each end regardless of whether the cables are MPO-8, MPO-12, or MPO-16. See figure 16.

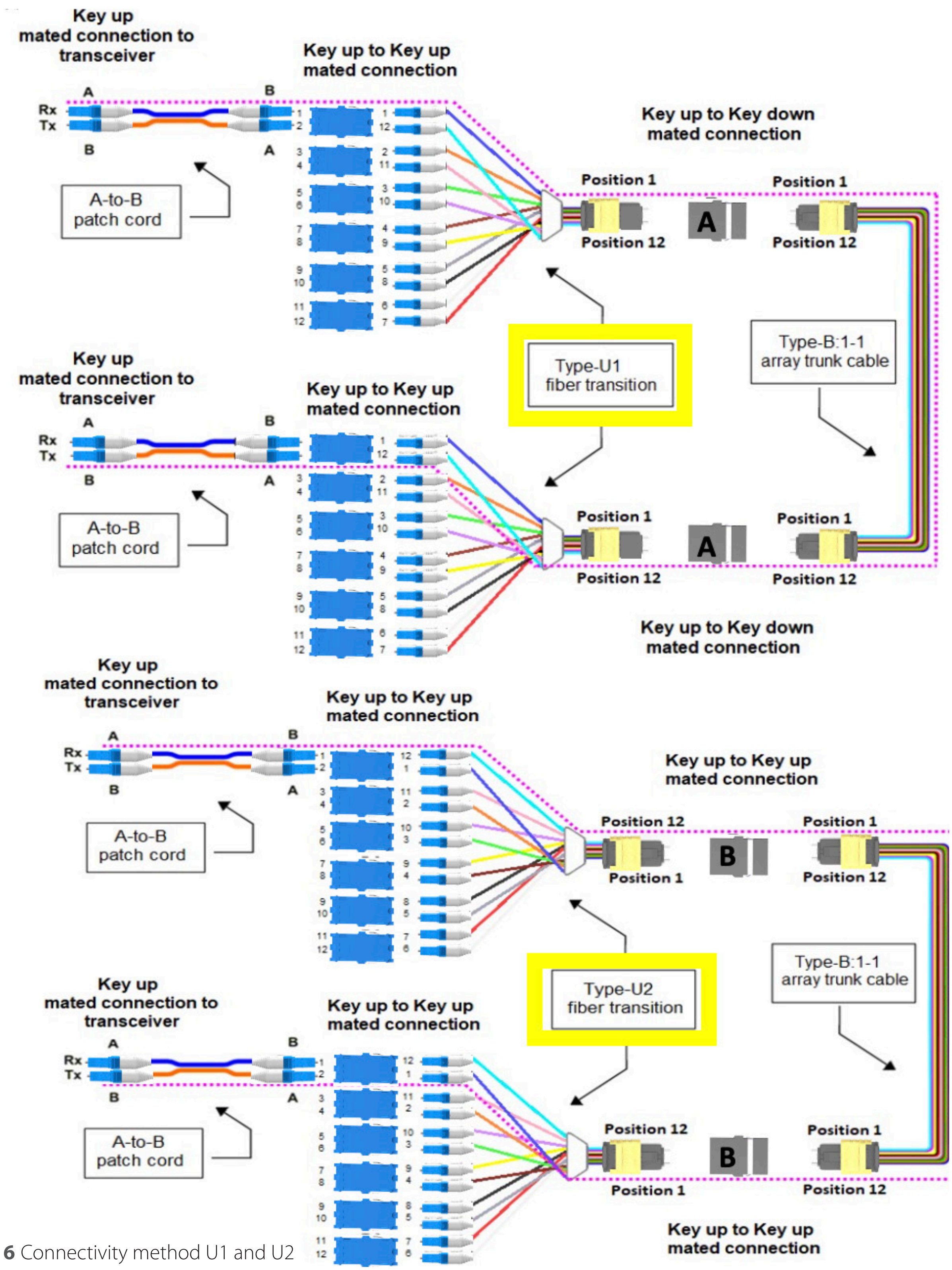
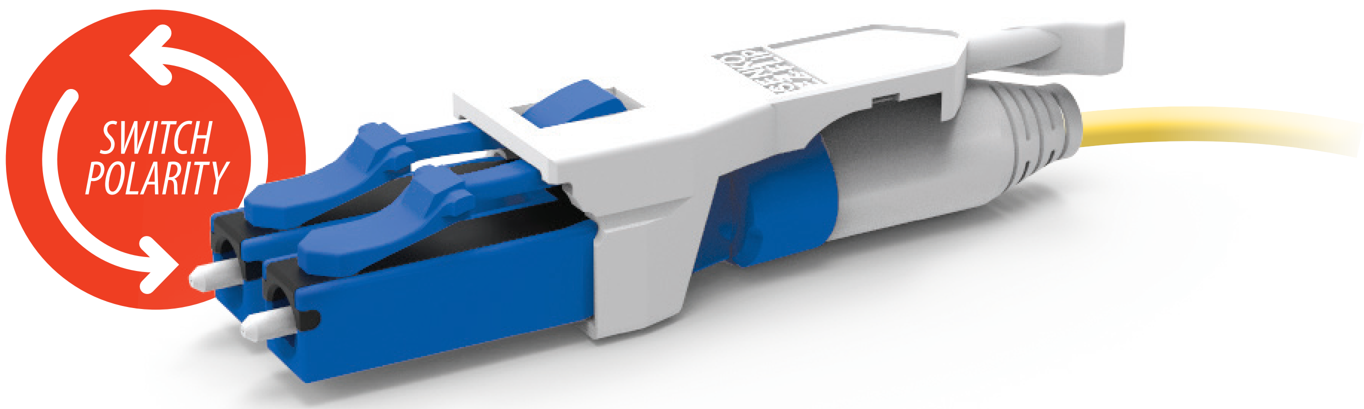


Figure 16 Connectivity method U1 and U2

SENKO LC EZ-Flip® Polarity Connectors

SENKO offers the LC EZ-FLIP® connector, which incorporates a polarity reversing mechanism. This connector simplifies the manufacturing assembly of duplex cables when the fibers are enclosed within a single jacket, as opposed to the traditional zip cable configuration. While the uniboot design saves space in cabinets during cable management when the fibers are inside the jacket, it can pose challenges in tracking fiber colors due to limited visibility. However, termination mistakes resulting from incorrect polarity can be easily rectified during testing by simply flipping the LC duplex clip. Refer to Figure 17.

Similarly, in the case of complex network designs or upgrades, tracking polarity becomes difficult as duplex assemblies are often just a part of intricate breakouts featuring array connectors or array transceivers. In such scenarios, SENKO's LC EZ-FLIP® connector proves to be the perfect choice due to its convenient polarity switch feature. This makes SENKO's LC EZ-FLIP® connector the easiest and fastest duplex uniboot connector with polarity reversing capability available in the market. Moreover, the connector boasts a reduced profile latch mechanism and offers a push-pull tab option, making it ideal for high-density data center and telco central office applications.



The figure below illustrates a step-by-step procedure for polarity reversing.

How to switch:

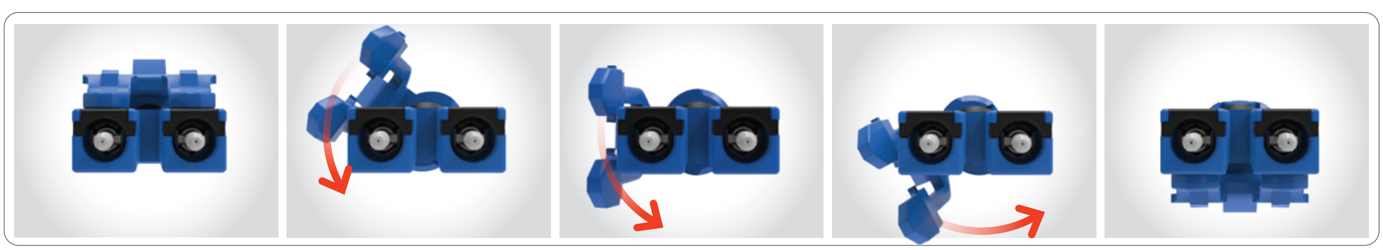
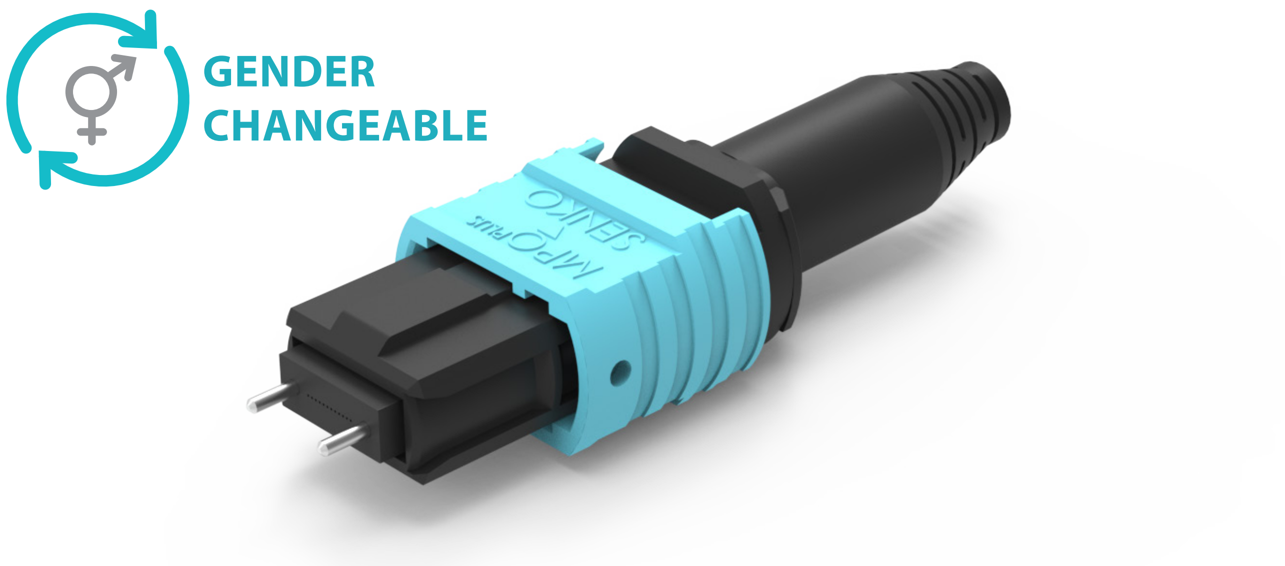


Figure 17 SENKO's LC EZ-FLIP® polarity reversal steps

SENKO MPO Gender Changeable

When manufacturers or network installers utilize MPO connectors, it is crucial to differentiate the connectors based on gender. It is widely known that male MPO connectors with pins cannot be inserted into another male connector. Similarly, achieving proper alignment is not possible when inserting a female MPO connector into another female MPO connector. In such cases, SENKO offers the MPO PLUS Premium Mini connector, which allows for easy gender changing without the need for tools or opening the connector housing. This remarkable feature makes it an exceptionally versatile connector suitable for various applications. The connector is specifically designed for high-density scenarios, boasting a compact size and an optional high-density pull tab that facilitates easier access.



he figures 18 illustrate a step-by-step procedure for gender reversing of MPO connector.

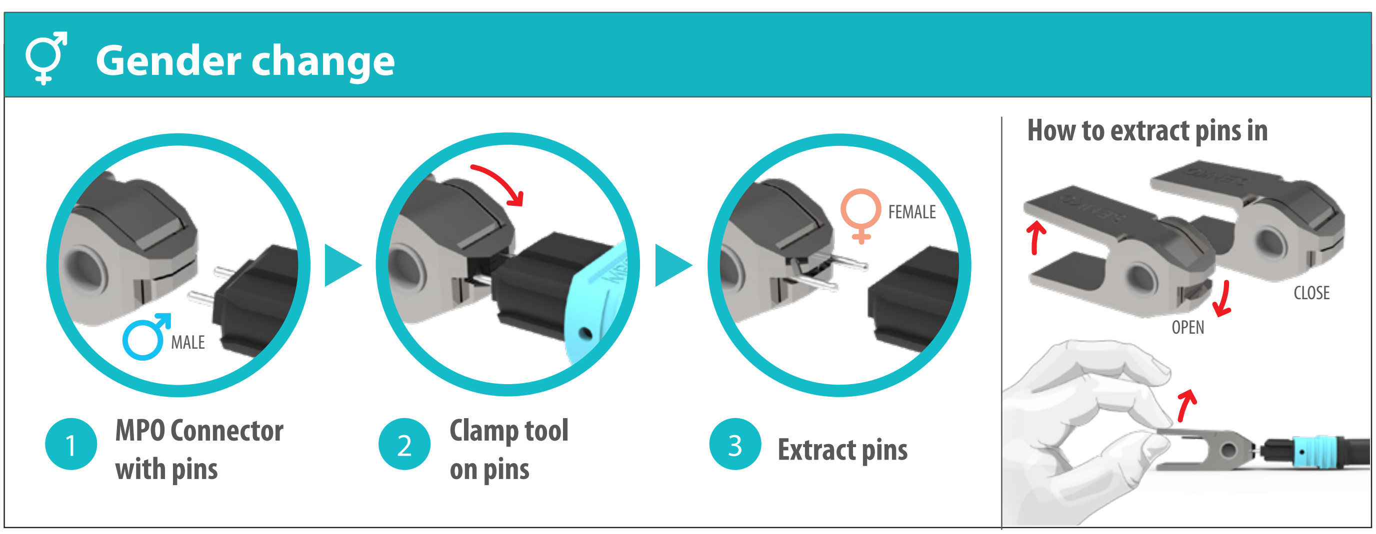
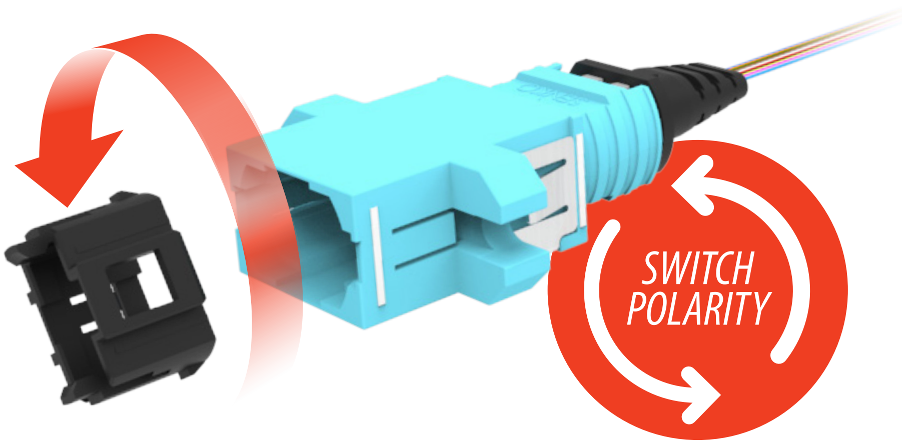


Figure 18 SENKO MPO gender reversal steps

SENKO design team also considered a possibility that in some cases are easier to make a polarity switch not in the connector but in the MPO adapter. With this gender switchable adapter, users can quickly change the gender of their MPO connectors to match their specific needs and requirements in various optical fiber applications by flipping the alignment key in the adapter to 180-degrees. The figure 19 below illustrates a step-by-step procedure for polarity switch in MPO adapter.



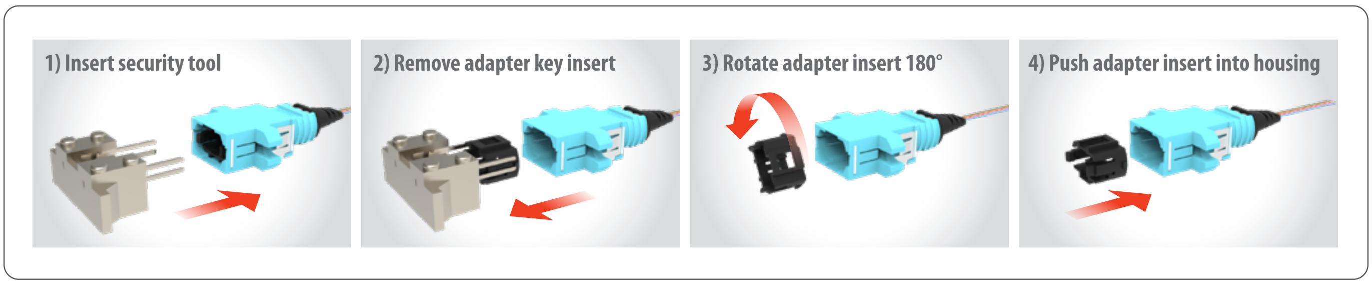


Figure 19 SENKO MPO adapter polarity reversal steps

QSFP-DD Transceivers Connectivity

QSFP-DD is the smallest form factor available for 400G transceivers at the time of writing, offering the industry's highest bandwidth density. This feature, combined with backward compatibility with lower-speed QSFP pluggable modules and cables, has made it popular among fiber optic manufacturers and network designers. These transceivers are the latest type of optical transceivers used in 400G high-speed applications, with MPO connectors plugged into the transceivers and duplex cables playing a crucial role in interconnecting and routing the signals properly. Figure below illustrates the active transceiver ports when used with MPO-12, MPO-16, and MPO-24 cables and duplex connectors.

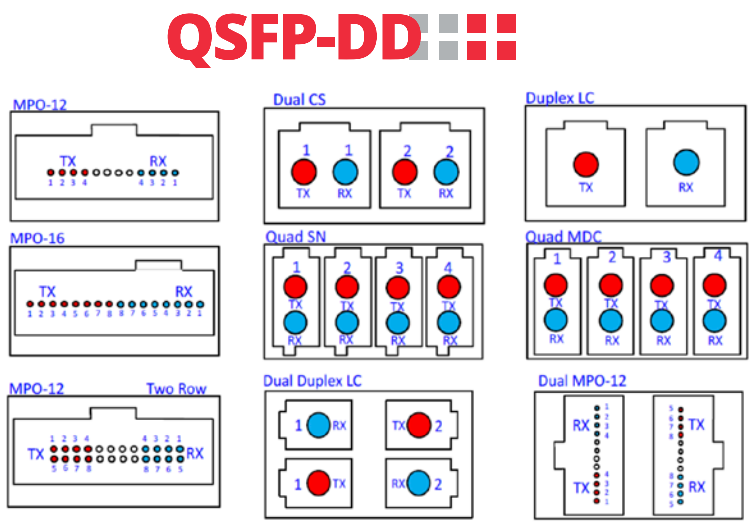


Figure 20 QSFP-DD transceivers active ports configuration

To interconnect this type of combined array and duplex system the network designer needs to follow a rule of thumb: Odd number of Type B components transposes the signal. See figure 21.

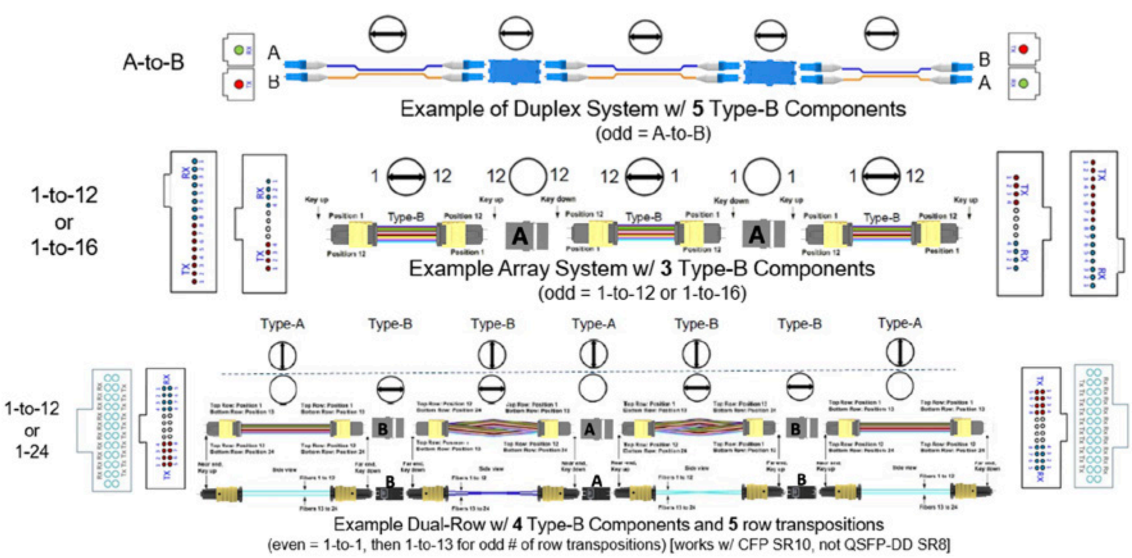
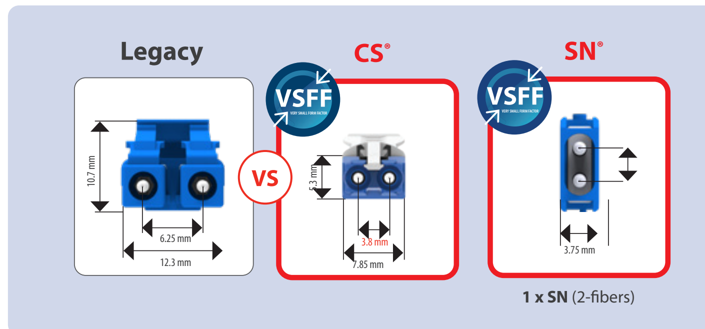


Figure 21 Illustrates how odd number of Type B components transposes the signal

VSFF – Very Small Form Factor Connector Polarity

SENKO offers duplex connectors that are up to 50% smaller than traditional small form factor connectors such as LC. These new connectors are characterized as Very Small Form Factors (VSFF), and they provide significantly higher density compared to LC duplex connector. SENKO CS® and SN® connectors are recognized by the MSA (Multi-Source Agreement) group as optical interfaces. Both interfaces have already been adopted in transceiver specifications of QSFP-DD and OSFP MSAs. These connectors are specifically designed and manufactured for the next generation of pluggable transceivers supporting data center interconnects beyond 200Gbs up to 1.6Tbs. They offer superior optical performance while reducing the number of connection points found in the optical path. Let's review them separately below to highlight the differences between CS® and SN® connectors.



13.0 SENKO CS® Connector

The CS® connector is similar to the LC connector in terms of being a small form factor duplex connector. Both the CS and LC connectors are designed for duplex fiber optic connections, enabling the transmission of data over two fibers. Additionally, both connectors feature a push-pull mechanism for easy insertion and removal. The CS® connector, despite having almost double the density of the LC connector footprint, shares similarities with LC connectors in terms of polarity schematics. Both connectors have a horizontal design, resembling the original SC duplex interconnect where the ferrules are horizontally aligned with respect to the connector key. The polarity rules for these connectors are identical.

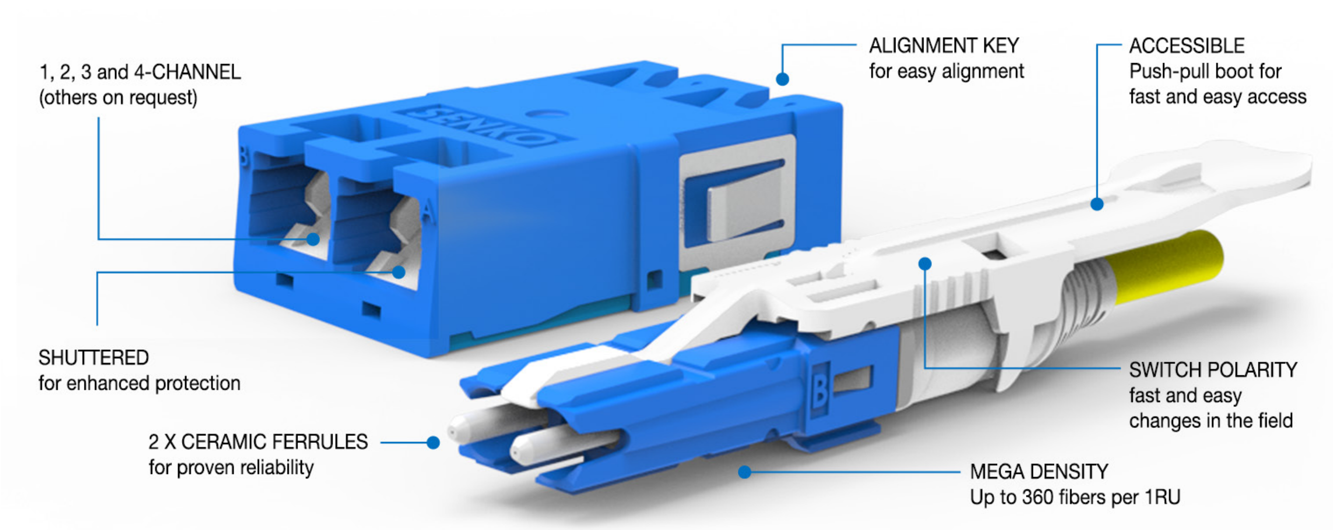


Figure 22 Polarity of SENKO CS® connector is similar to the LC and SC duplex connectors

As mentioned, the CS® connector offers higher density, allowing for more connectors to be packed into limited space. However, having more connections can potentially lead to confusion when maintaining proper polarity throughout the network. To address this, SENKO offers the CS® EZ-Flip Connector, which features a polarity switching mechanism that enables quick reversal of the connector polarity without the need for connector re-termination.

The connector's top and bottom are symmetrical, and by simply removing the push-pull tab from the top and placing it on the bottom, polarity reversal is achieved. This convenient tab also enhances usability in high-density applications. It is important to note that the connector can accept not only small diameter duplex cables like 1.6mm OD but also larger diameter options, such as 2.0/3.0mm duplex cables.

The figure below illustrates a step-by-step procedure for polarity reversing in CS® EZ-Flip Connector.

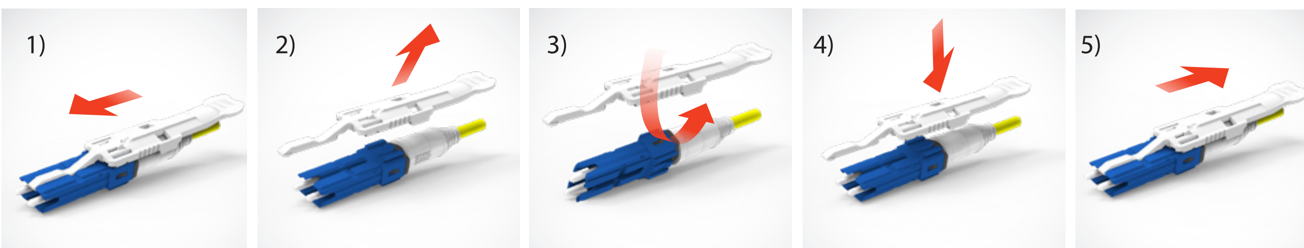


Figure 23 SENKO's CS® EZ-Flip polarity reversal steps

SENKO SN® Connector

At the time of writing, the TIA working group TIA-TR42.11 is actively working on formalizing the polarity configuration for VSFF vertical mount connectors with ferrules vertically aligned with respect to the connector key, and the proposed schematics are depicted in figures below. The following examples showcase SENKO SN® connectors, which currently offer the highest density in networks in terms of duplex interconnects. SN® connectors have a polarity configuration that differs from CS®, LC, and SC connectors due to the vertical adapter mount, as opposed to the horizontal mount of the others.

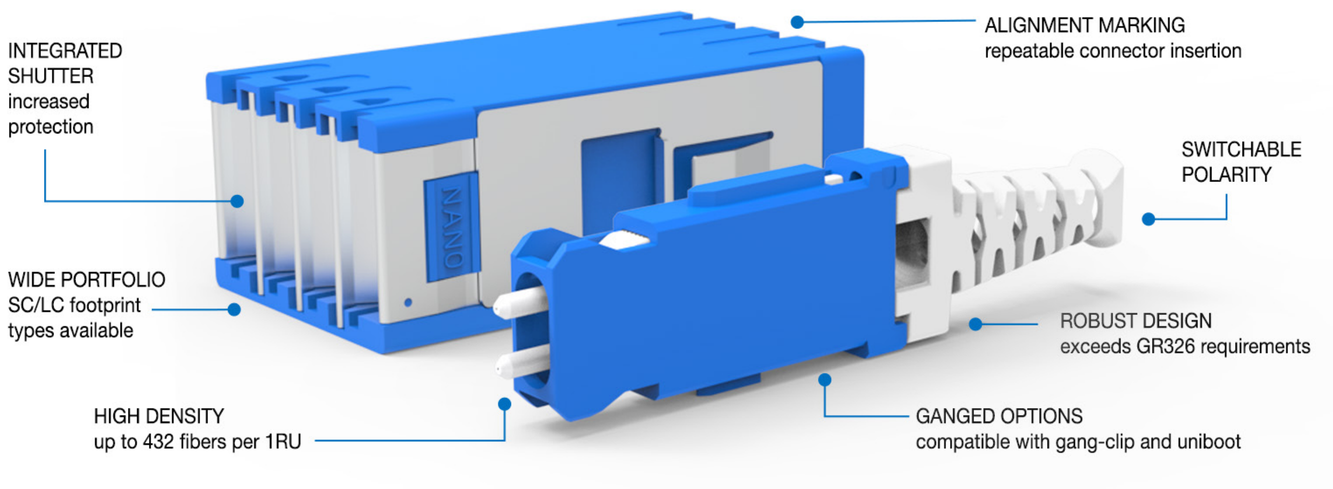


Figure 24 SN® features

Using figure 25 as a base, the cabling for combined parallel optics with vertical based VSFF transceivers could be connected using Method U1. See figure 26. This will indicate the same methodology as currently used with duplex LC.

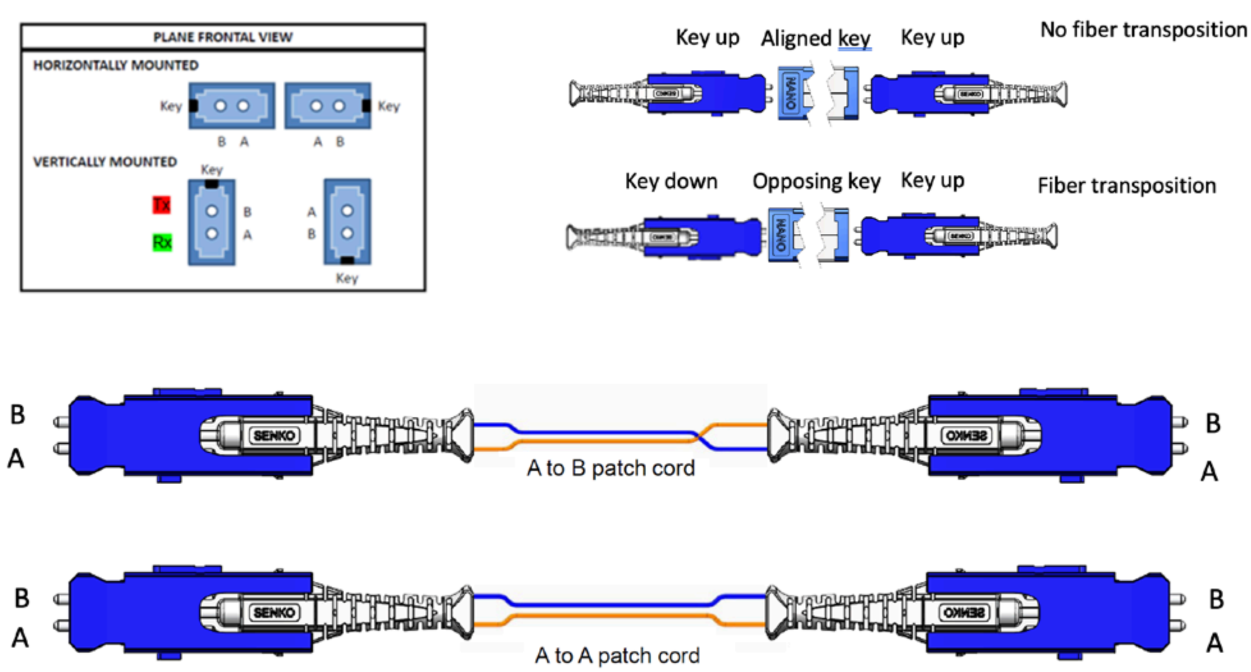


Figure 25 SN® connectors polarity configuration

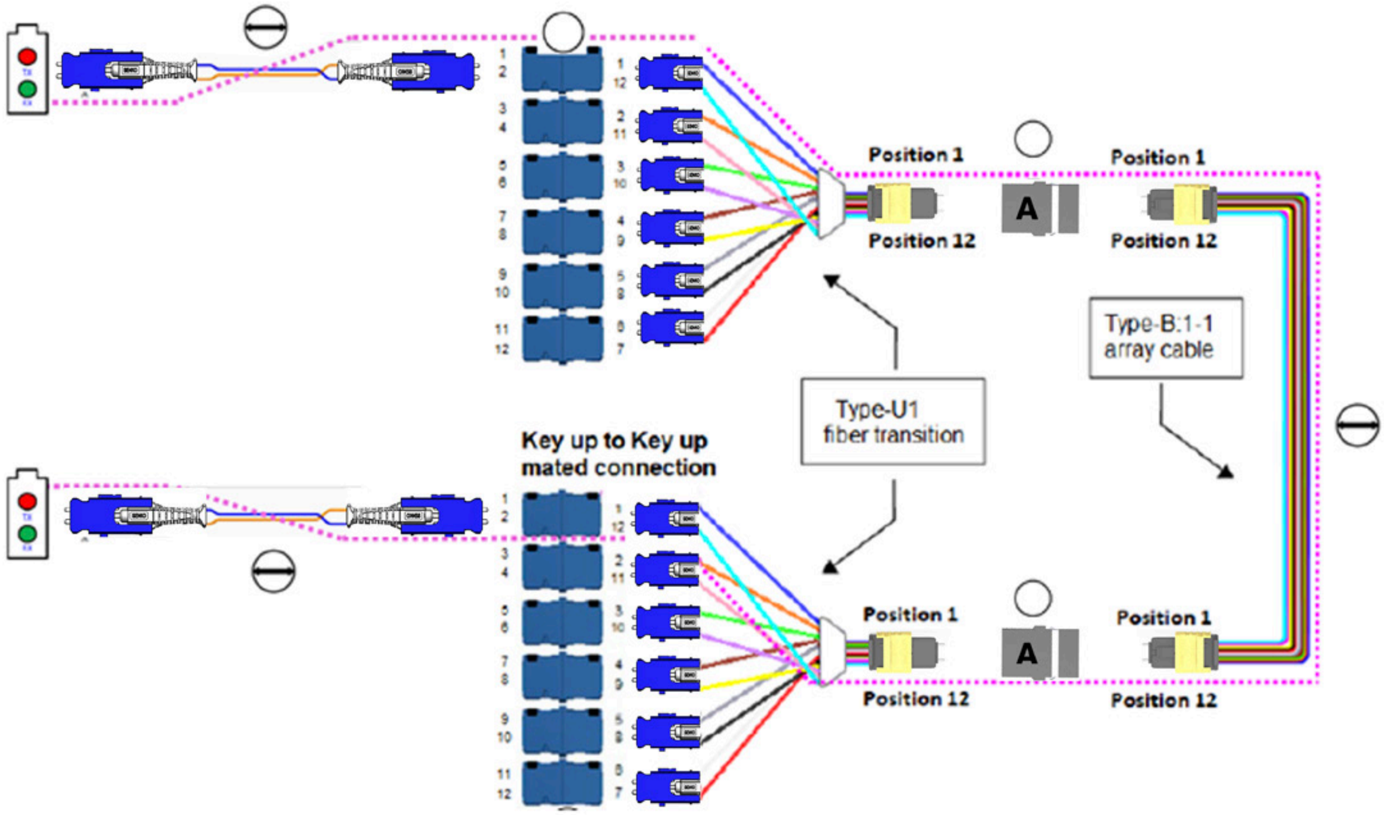
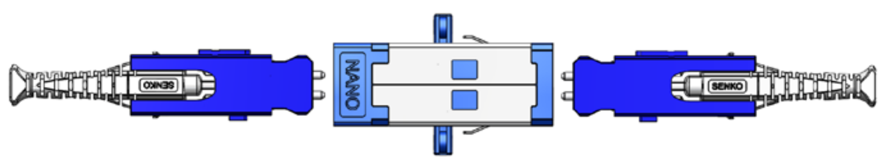


Figure 26 VSFF connectors interconnect with QSFP-DD, cassettes and MPO cables. Method U1 Example.

As mentioned above, the SN® connectors have vertical adapters for vertical (upright) duplex connectors. SN® connectors are typically used in high-density applications, where space is limited, and a vertical adapter is necessary to achieve the desired connectivity or to optimize the use of space on a rack panel. Today most common SN® adapter configuration is Key up to Key up. Refer to figure 28 for achiving polarity methods with such an adapter type.

Figure 27 Most common SN® adapter is Key up to Key up.



With most common SN® adapter availability being Key up to Key up for SN® connectors today a special consideration is needed when laying out a network architecture. In this scenario with Key up to Key up adapters the number of A-B patchcords must be an odd number in order to connect Tx to Rx. See figure 28. This could be confusing because with common SC, LC and CS® adapters that are also Key up to Key up there is any number of A-B patchcords can be used. See figure 29. The polarity is switched in the adapter that connects A to B and B to A fibers due to an aligned keys.

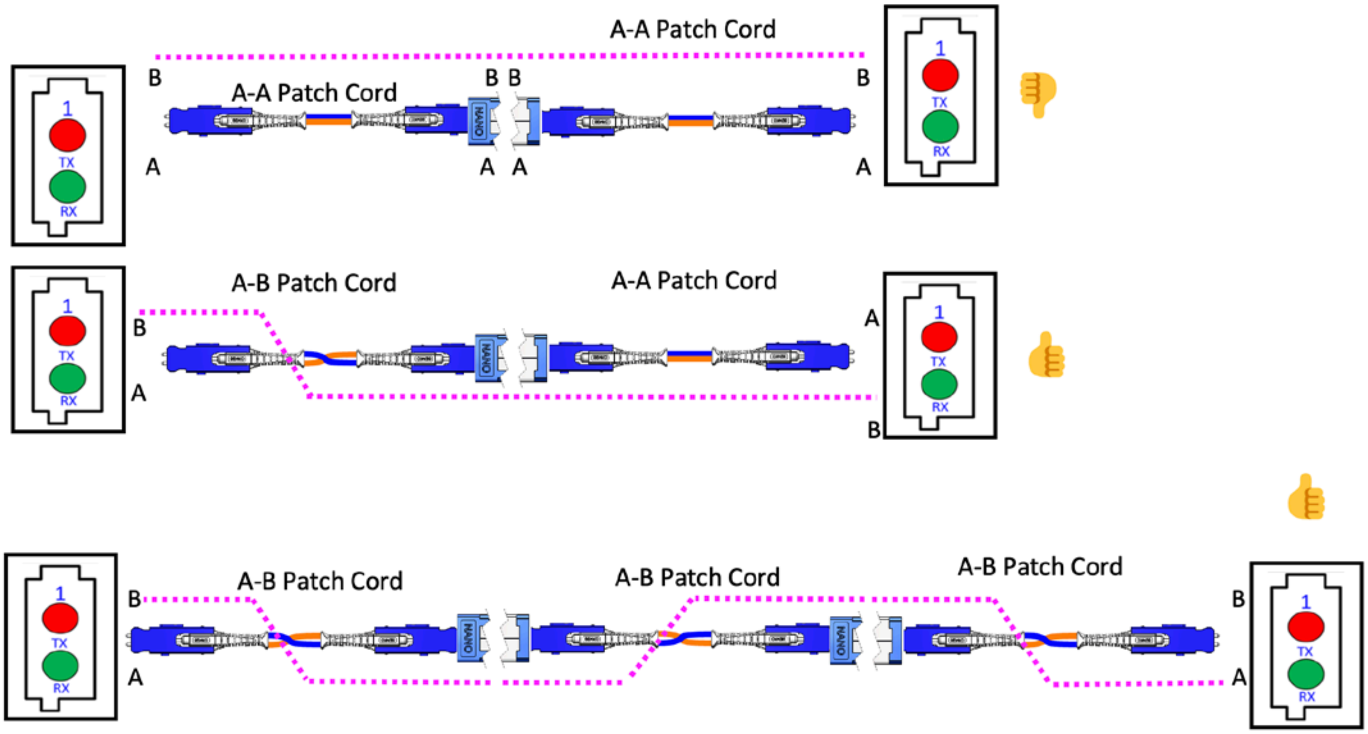


Figure 28 SN® connectors with Key up to Key up adapters must have an odd the number of A-B patchcords

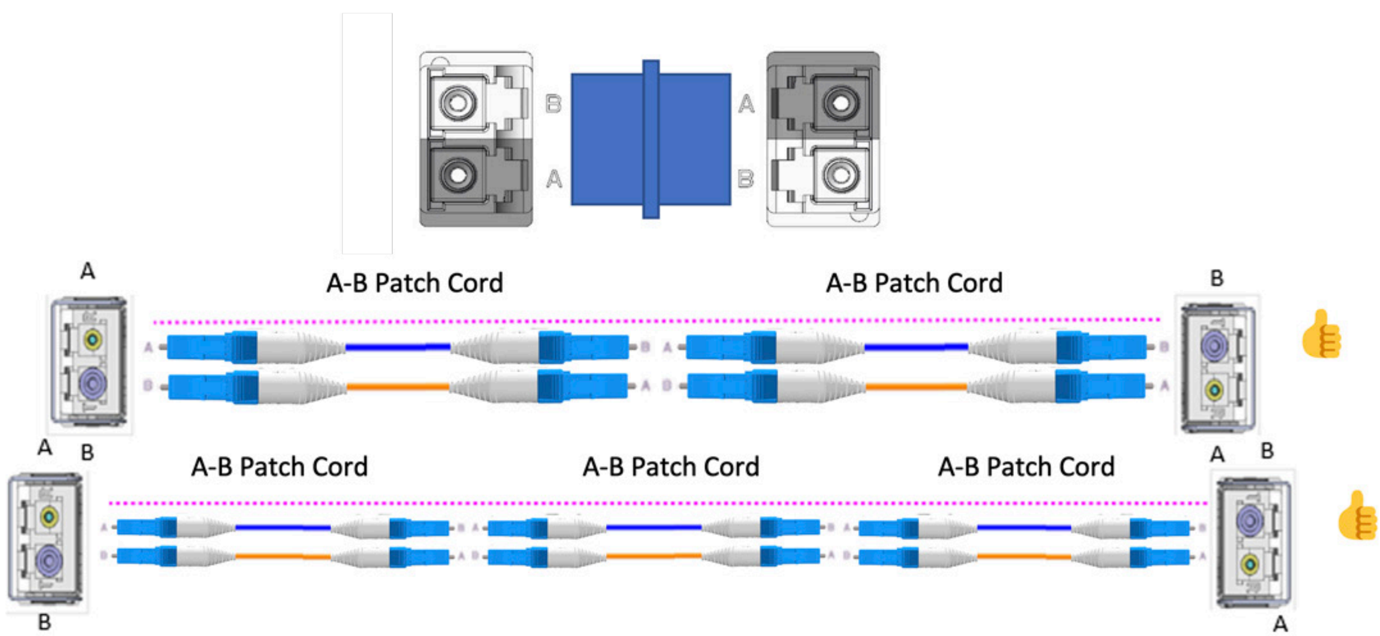


Figure 29 LC Key up to Key up adapter allows any number of A-B patchcords in the system.

Once again, to simplify field installation and network configuration, SENKO offers the SN® EZ-Flip connector. This connector provides the convenience of quick polarity reversal on the fly, if needed. SN® EZ-Flip connector has a unique design that enables it to reverse the polarity of the connector simply by flipping the outerhusing. The ability to change the polarity of a connector without having to re-terminate the fibers can save time and reduce the risk of errors during installation or maintenance. The SENKO SN® polarity changeable connector is one of several types of polarity changeable connectors available in the market, and it is a popular choice due to its ease of use and reliability.

The figure below illustrates a step-by-step procedure for polarity reversing in SN® EZ-Flip Connector.

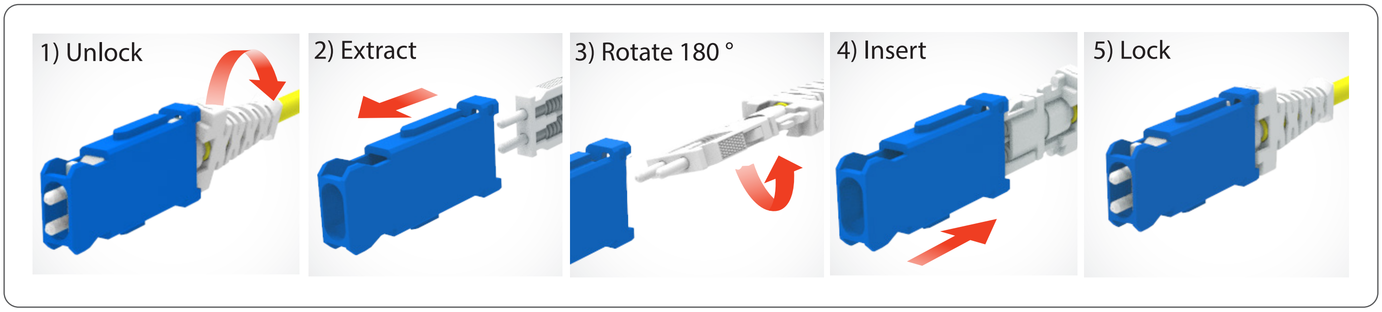


Figure 30 SENKO's SN® EZ-Flip polarity reversal steps

Summary

In summary, to ensure proper polarity, fiber optic multifiber connectors employ two main characteristics: the keying mechanism and fiber arrangement. Keying Mechanism: Fiber optic connectors feature a keying mechanism that ensures they can only be inserted in a specific orientation, aligning the fibers correctly. MPO, SC, LC, and CS® connectors have horizontal style adapters, while SN® connectors have vertical style adapters. Fiber Arrangement: The individual fibers within SC, LC, and CS® connectors are arranged according to the A-B polarity configuration. In SC, LC, and CS® duplex connectors, the Tx fiber of one connector is aligned with the Rx fiber of the other connector. This arrangement guarantees that optical signals are transmitted and received correctly. In addition to polarity and fiber arrangement, the MPO connector has male and female genders. For the MPO to work properly, a male MPO must always be connected to a female MPO.

To make things easier for network designers and installers, SENKO features many duplex connectors, that allows for quick polarity reversal in the field if needed. For example, SN® EZ-Flip connector has a unique design that enables it to reverse the polarity of the connector simply by flipping the outerhusing. The ability to change the polarity of a connector without having to re-terminate the fibers can save time and reduce the risk of errors during installation or maintenance. SENKO offers new high density VSFF connectors such as SN® and CS®. The SENKO SN® EZ-Flip polarity changeable connector is one of several types of VSFF polarity changeable connectors available in the market, and it is a popular choice due to its ease of use and reliability. Similarly, SENKO offers CS® EZ-Flip, in which polarity can also be quickly changed in the field by a technician. As mentioned previously, the CS® EZ-Flip connector allows you to double the density in patch panels compared to an LC duplex. The polarity switching feature allows for the quick reversal of the connector polarity without the need for connector re-termination.

Conclusion

It is important to understand the polarity of your connectors to ensure proper signal transmission and avoid signal loss. The choice of active components and interconnection cables will depend on your network requirements, with the goal being to connect appropriate transceivers and receivers in your network. Manufacturers of these components and cable assemblies may not always know exactly how to make those connections, which is why we have the knowledge and expertise to guide you through the process.

Multiple MSAs have defined duplex optical connectors with a smaller footprint than the LC connector known as VSFF. The reduced size of the SENKO SN® and CS® connector allows a transceiver to accept multiple SN® or CS® patch cables, which are individually accessible directly at the transceiver interface. The increased connector density at the panel minimizes hardware size, leading to reduced capital and operational expenses. For array interconnect options SENKO offers the MPO PLUS Premium MINI connector, which not only provides reverse polarity capabilities but also allows for easy gender changing without the need for tools or opening the connector housing. This remarkable feature makes it an exceptionally versatile connector suitable for various applications. The connector is specifically designed for high-density scenarios, boasting a compact size and an optional high-density pull tab that facilitates easier access.

SENKO has also introduced high-density array-style connectors that provide 16 fibers in a single row, with a smaller footprint than the 16-fiber MPO-style connector. This connector is known as SN®-MT. SENKO's SN®-MT connector is available in 8-fiber and 16-fiber options, occupying the same footprint as the SN® duplex connector. This achieves a 2.7x density increase compared to a 16-fiber MPO connector and a 1.3x density increase compared to a 32-fiber MPO connector. The SN®-MT connector has a vertical orientation, as opposed to the horizontal orientation of the MPO-style connector. The SN®-MT can accommodate up to 3456 fiber connections in one Rack Unit (RU).

As connectors become smaller and density increases, it presents a new challenge for network designers to plan and maintain polarity. That's why SENKO introduced connectors for many available interconnect solutions in which polarity can be changed in the field quickly, reliably, and simply. The advantage of a polarity swappable connector is that it allows for quick and easy changes to the polarity of the connector without the need to re-terminate or replace the connector. This is particularly useful in high-density fiber optic installations where there are a large number of connections. By simply swapping the polarity of the connector, the installer can avoid having to re-run or re-organize the fiber cables, saving time and effort. The ability to quickly and easily swap polarity can also reduce the likelihood of errors or mistakes during installation, which can improve overall network performance and reliability.

SENKO is an active participant in TIA meetings, and our application engineering team is always available to assist in selecting the right components for designing and manufacturing your latest fiber optic network. If you have any further comments or questions, please do not hesitate to contact us.

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The images in figures 1,2,3,4,6 are taken from TIA-568.3-D with permission of the Telecommunications Industry Association

Biography

Andrei Vankov, is an Application Engineer at SENKO Advanced Components. He received his BS from Thomas Edison State College and his MSEE from Pennsylvania State University. He began his career in 1993 at Sumitomo Electric Lightwave Corp as a Fiber Optic Manufacturing Engineer where he worked on active and passive components using Kaizen methods in Yokohama, Japan. As a Senior Optical Design Engineer in Franklin, MA (founded as Advanced Interconnect) Andrei Vankov developed various passive optical components and packaging integration to meet Telcordia industry standards. He designed optical interconnects, including optical backplanes (MTP, HBMT, PHD, OGI), and a fiber optic SMPTE compatible Broadcast Connector for HD applications. In 2013-2020 Andrei worked at Nokia division Radio Frequency Systems (RFS) where he provided leadership for an LTE RAN launch project team. Andrei holds several US and European Patents in fiber optics interconnect technology.

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