Base-16 Fiber Cabling System

APPLICATION GUIDE

Delivering High Performance, Reliability, and Scalability while Future Proofing your Data Center up to 1.6 Terabits per second

PANDUIT®

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Introduction

Delivering high performance, reliability, and scalability, the Base-16 Fiber Cabling System from Panduit allows users to future proof their Data Center up to a blazing 1.6 terabits per second.

Base-16 fiber cabling offers high bandwidth and breakout lane capabilities and is used for applications with multiple fibers/channels for both Transmit and Receive.

What is Base-16 Fiber?

This groundbreaking product is available globally and ideal for large enterprise, hyperscale, and artificial intelligence (AI) deployments.

Base-16 optical trunks consist of 16 fibers per jacket, that are either discrete/loose tube or ribbonized in nature and can terminate with MPO or multiple duplex LC connectors. These Base-16 cables, either in trunk, interconnect, or harness format consist of 16 fiber lanes with eight lanes dedicated for Transmit (Tx) and eight lanes for Receive (Rx). This differs from a Base-8 trunk in which the middle four fiber lanes are either “dark”, missing, or stubbed from the trunk cable. This 16-fiber lane count aligns 400GbE and 800GbE parallel optics data transmission methods. The Base-16 MPO-16 connector is TIA-604-18 (FOCIS18) compliant.

The Base-16 offering will encompass 50 µm OM4, OM4+ (Signature Core), and OM5 for multimode, and 9 µm OS2 for single-mode. Fiber trunk jacket colors will match those of Base-12 fiber applications (Yellow = OS2, Aqua = OM4/OM4+, Lime = OM5). The main distinction for the MPO-16 is that the connector key is offset, which will ensure it can only be mated with other Base-16 components. Base-16 components are not directly compatible with Base-8 or Base-12 components without some form of conversion media.

How do Base-8, Base-12, and Base-16 Fiber Applications Differ?

Base-12 structured cable has been the widely deployed standard for fiber backbone installations over the past 30 years, but as applications change, so has the need for additional connectivity methods. With the high cost of transceiver optics and with the cost-per-port of high radix switches growing, it quickly became evident that high bandwidth, multi-lane applications are the main use case for Base-16 fiber. Base-16 applications make full use of the large lane count of a 16F MPO, ensuring no dark fibers in data transmission.

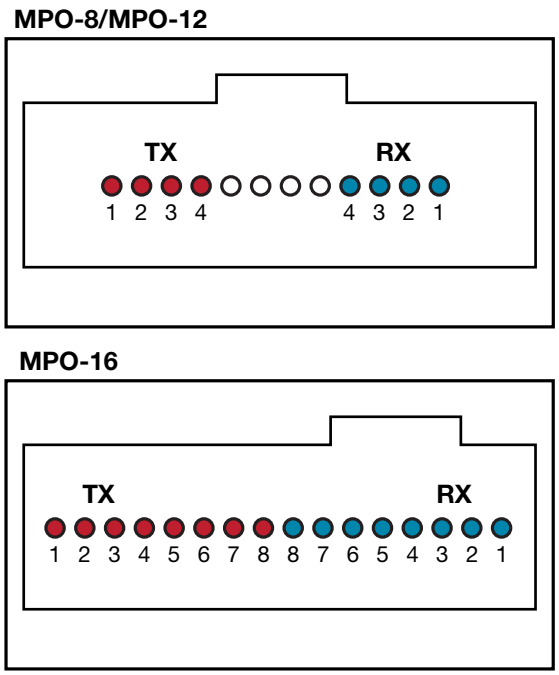
The main physical difference between Base-8, Base-12, and Base-16 fiber is the count of fibers in the trunk or application. In addition to the per-jacketed fiber count, the Base-16 connector offset key and alignment pin spacing is the largest difference than that of Base-8 or Base-12 connectors, in addition to having an Angled Physical Contact connector (APC) for both multimode (MMF) and single-mode (SMF) connectors, which minimizes back reflection or optical return loss. Because of the APC connector, only key-up to key-down (Type A) MPO adapters can be used in Base-16 applications to ensure the MPO-16 APC connectors are oriented correctly. While Ultra-Physical Contact (UPC) connectors are available in the market, air gaps in connector mating could produce enough reflection to degrade system performance.

Also, there are currently few Base-16 applications, with 400GBASE-SR8 being the most popular, which currently requires this APC connector. The MPO-16 APC connector is quickly becoming the common connector even though a flat polish connector is the FOCIS-18 standard for Multimode fiber.

As mentioned previously, Base-16 components have no direct compatibility with Base-12 applications; however, Base-16 can be converted to Base-8 or Base-12 using conversion cables or components.

Base-16 fiber trunks can be identified easily from a Base-12 trunk by the key-offset MPO. Additionally Base-16 and Base-12 components are unable to be directly interconnected due to this key-offset. Base-16 applications easily allow for switch port replication with 16, 32, or 48 port switches, while Base-12 does not break out as cleanly once applications reached 40GB in speed, which is a reason for the uptick in Base-16 implementations. While all three technologies (Base-8/Base-12/Base-16) are suitable for Base-2 MPO/LC breakout scenarios, Base-16 allows higher bandwidth applications such as 400G-SR8 and 800G-DR8 as well as provides greater fiber utilization and reduced attenuation values.

Additional physical differences in Base-12 vs. Base-16 are transmission modes. Base-12/Base-8 connections will have Tx/Rx physically separated on each side of the MPO connector with four dark fibers, whereas Base-16 MPO connectors will have Tx/Rx on continuous ports using full jacketed fiber density, which is represented on the graphic to the right.



MPO-8/MPO-12 vs MPO-16 MDI Tx/Rx

What Transceiver Technologies Does Base-16 Encompass?

While there are only currently a few Base-16 applications in the market, they are popular due to their high bandwidth and breakout lane capabilities.

Base-16 Parallel Optics (Either MPO/MPO or MPO/LC Breakout)				
Transceiver Model	**Media Type**	**Transmission Speed**	**Reach**	**Connector Type**
QSFPDD-SR8-400G	MMF	400G	100m*	MPO-16
QSFPDD-DR8-800G	SMF	800G	500m	
QSFPDD-XDR8-800G			2km	
QSFPDD-FR8-800G				
QSFPDD-PLR8-800G			10km	
OSFP-SR8-400G	MMF	400G	100m*	
OSFP-DR8-800G	SMF	800G	500m	
OSFP-XDR8-800G			2km	
OSFP-PLR8-800G			10km	

*Reach for SR8 applications using Panduit Signature Core is 130m

Table 1: Example Parallel Optics Applications

(These can also be connected with 16F MPO to 8xLC harnesses, 16F trunks or interconnects.)

Parallel and Duplex Link Paths

Base-16 fiber is used for parallel links, meaning for applications that use multiple fibers/channels for both Transmit and Receive using a FOCIS-18 MPO (multi-fiber push on) based connector. Base-16 also allows for quick conversion to Base-2 duplex links since its 16 fibers are easily divisible for 2-fiber Tx/Rx breakout transmission. With Base-16 fiber, Tx1, or fiber position one, should be received on Rx1, or fiber position 16. If traffic enters on Tx8, it should be received on Rx8, or fiber position 9. This Tx/Rx scenario is achieved by using Type B or 'Method B' MPO-16 to MPO-16 trunk or interconnect assemblies.

MPO-16 Connector Tx/Rx

Fiber Infrastructure Form Factor Options

Panduit offers Base-16 fiber connectivity components in multiple form factor and density options as well. Base-8 components are available in SFQ QuickNet™, OptiCom®, and HD Flex™ component form factors, as shown below.

QuickNet Base-16 | Opticom Base-16 | HD Flex Base-16

Base-16 fiber assemblies are also available Configure to Order for Trunks, Interconnects (jumpers), and Harnesses. Options such as fiber type, flame rating, connector type, performance, polarity, and length are configurable.

Base-16 Applications

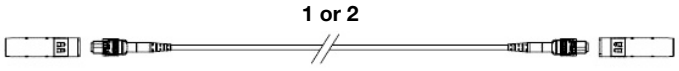
For all applications, please use these channel drawings to help with part selection. For part number specifics, please review the intended application. Application scenarios shown using HD Flex components for simplicity but SFQ QuickNet™, OptiCom®, and HD Flex™ component part numbers are available in most applications.

> ***Note:*** *There may be additional applications possible using Base-16, but these are the most common deployment options. Jacket Flame Rating shown in Plenum, for LSZH or Euroclass, please visit* ***CPQ****. Additionally, any applications using trunks/interconnects terminating in MPO-8 connectors are using PanMPO™ connectors. For more information on Panduit's PanMPO™ connector visit here.*

Direct Connect Applications

1 – High Bandwidth Direct Connect

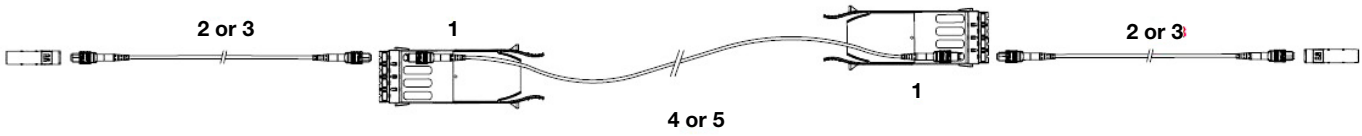
Supports easy 1:1 connection for in-cabinet scenarios



Description		OS2			OS4		
#	High Bandwidth Direct Connect	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
2	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCPOOY025F***		

2 – High Bandwidth Cross Connect

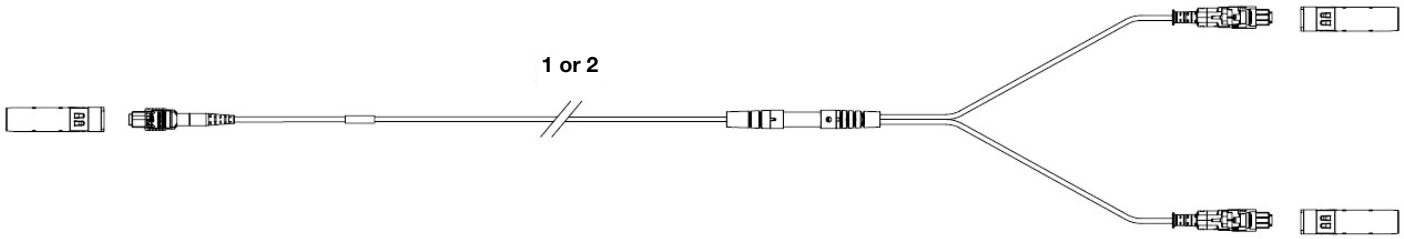
Supports 1:1 connections via horizontal cable runs



Description		OS2			OS4		
#	High Bandwidth Cross Connect	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F FAP	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL
2	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
3	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCPOOY025F***		
4	16F Interconnect (Male to Male)	FR9CPMMB021F***			FRZCPMMY021F***		
5	16F Trunk (Male to male)	FY9CPMMB025F***			FYZCPMMY025F***		

3 – High Bandwidth Switch to Switch

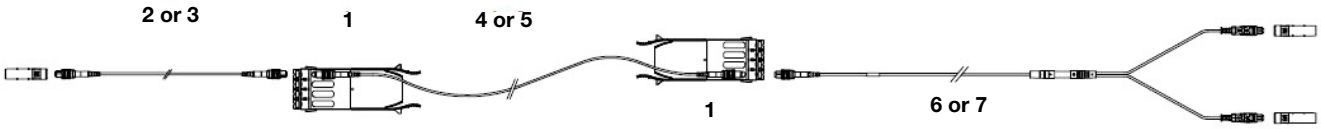
Supports high-bandwidth connections to upstream or downstream switches



Description		OS2			OS4		
#	High Bandwidth Switch to Switch	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F MPO to (2) 8F PanMPO Assembly (Female to Female) Trunk Interconnect	FY9CPOJB025F***			FRZCPOJY025F***		
2	16F MPO to (2) 8F PanMPO Assembly (Female to Female)	FR9CPOJB023F***			FRZCPOJY023F***		

4 – Switch to Switch Cross Connect

Supports high-bandwidth connections to upstream switches where there is distance between devices with horizontal cabling involved

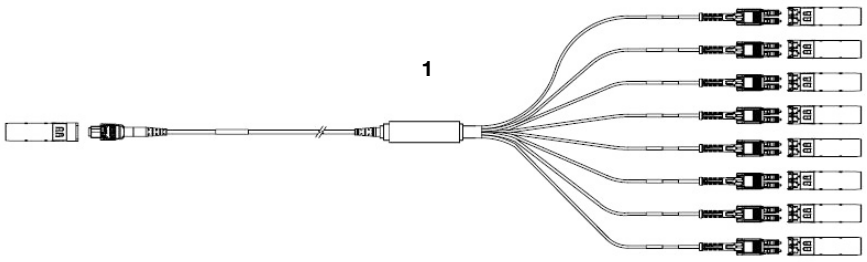


Description		OS2			OS4		
#	Switch to Switch Cross Connect	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F FAP	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL
2	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
3	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCPOOY025F***		
4	16F Interconnect (Male to Male)	FR9CPMMB021F***			FRZCPMMY021F***		
5	16F Trunk (Male to Male)	FY9CPMMB025F***			FYZCPMMY025F***		
6	16F MPO to (2) 8F PanMPO Assembly (Female to Female) Trunk	FY9CPOJB025F***			FRZCPOJY025F***		
7	16F MPO to (2) 8F PanMPO Assembly (Female to Female) Interconnect	FR9CPOJB023F***			FRZCPOJY023F***		

Breakout Applications

5 – 8:1 Breakout Harness

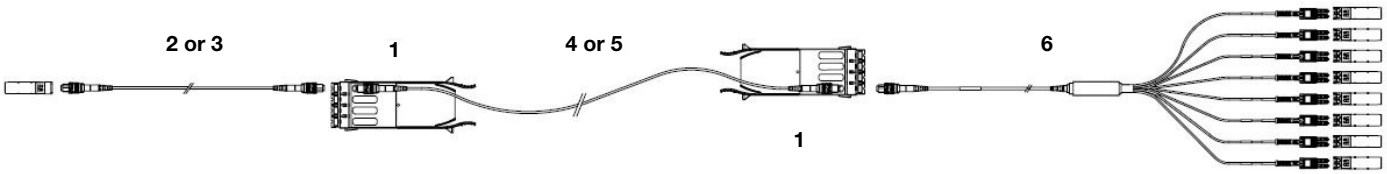
Support for QSFP-DD SR8 to 8x SFP56 50G for switch-to-server applications



Description		OS2			OS4		
#	8:1 Breakout Harness	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F to (8) Duplex LC Harness (U2 Polarity)	FH9CPOP4026F***			FHZCPOP5026F***		

6 – Cross-Connect to 8:1 Breakout

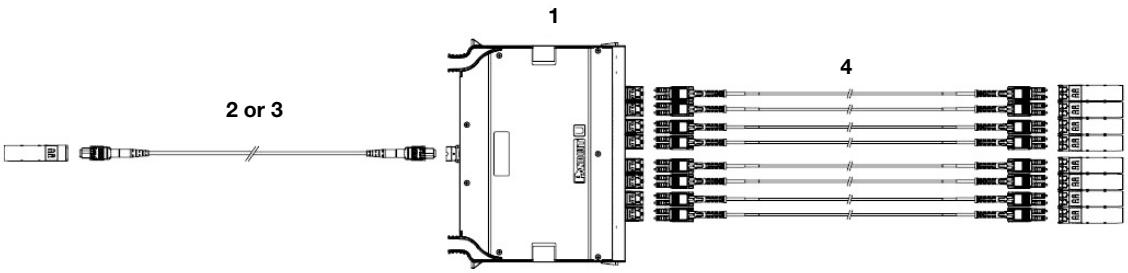
Support for QSFP-DD SR8 to 8x SFP56 50G for switch-to-server applications out of cabinet



Description		OS2			OS4		
#	Cross Connect to 8:1 Breakout	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F FAP	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL	FHMP-6M-ABL	FAPH12MBLMPO	FQMAP6MBL
2	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
3	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCPOOY025F***		
4	16F Interconnect (Male to Male)	FR9CPMMB021F***			FRZCPMMY021F***		
5	16F Trunk (Male to Male)	FY9CPMMB025F***			FYZCPMMY025F***		
6	16F to (8) Duplex LC Harness (U2 Polarity)	FR9CPOJB023F***			FRZCPOJY023F***		

7 – Cassette Based 8:1 Breakout

QSFP-DD 400G to 8 x 50G SFP56 breakout. Using cassettes/patch cords allows for differences in installation locations/elevations not easily completed with a breakout harness. Supports 96F per RU

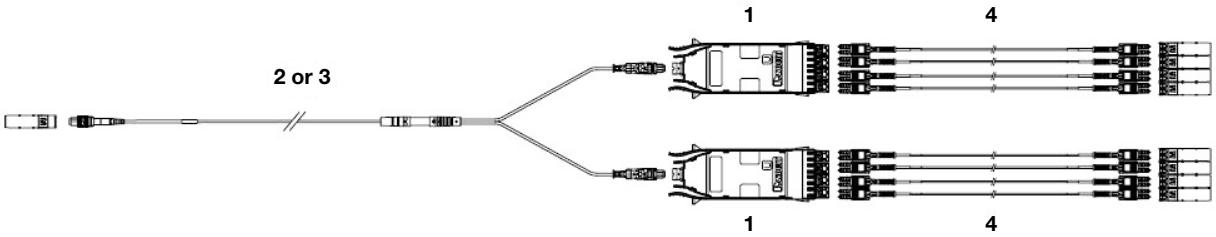


Description		OS2			OS4		
#	Cassette Based 8:1 Breakout	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	16F 8:1 Cassette (U2 Polarity)	FHC39N-16M-10U2	FC39N-16M-10U2	N/A	FHC3ZO-16M-10U2	FC3ZO-16M-10U2	N/A
2	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
3	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCPOOY025F***		
4	LC/LC Uniboot Patch Cord-Standard	F92RPU1U1ONM***			FZ2RPU1U1ONM***		

*Note: For additional Base-16 part numbers, please visit **www.panduit.com**.*

8 – High Density Cassette Based 8:1 Breakout

Supports a high density 144F per RU application

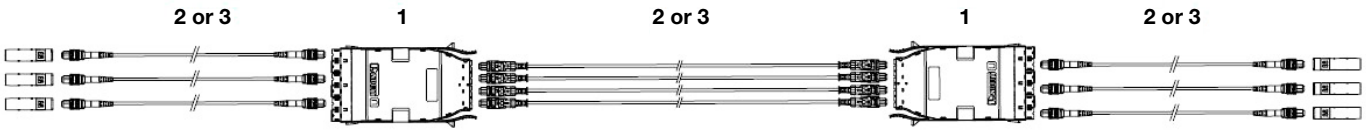


Description		OS2			OS4		
#	High Density Cassette Based 8:1 Breakout	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	4-Port, 8-Fiber Cassette - University Polarity	FHC39N-08H-10U2	FC39N-16-10U2	FQ39N-08-10U2	FHC3ZO-08H-10U2	FC3ZO-16-10U2	FQ3ZO-08-10U2
2	16F MPO to (2) 8F PanMPO Assembly (Female to Female) Trunk	FY9CPOJB025F***			FRZCPOJY025F***		
3	16F MPO to (2) 8F PanMPO Assembly (Female to Female) Interconnect	FR9CPOJ023F***			FRZCPOJY023F***		
4	LC/LC Uniboot Patch Cord - Standard	F92RPU1U1ONM***			FZ2RPU1U1ONM***		

Dark Fiber/Conversion Applications

9 – Dark Fiber Conversion

Re-using existing 12F horizonal links to suit Base-16 applications



Description		OS2			OS4		
#	Dark Fiber Conversion	HD Flex	Opticom	SFQ QuickNet	HD Flex	Opticom	SFQ QuickNet
1	Dark Fiber Conversion Cassette (3) 16F MPO to (4) 12F MPO	FH49N-48-463MU	FC49N-48-463MU	N/A	FH4ZO-48-463MU	FC4ZO-48-463MU	N/A
2	16F Interconnect (Female to Female)	FR9CPOOB021F***			FRZCPOOY021F***		
3	16F Trunk (Female to Female)	FY9CPOOB025F***			FYZCP00Y025F***		

*Note: For additional Base-16 part numbers, please visit **www.panduit.com**.*

MPO-16 APC Trunk Cable Assemblies

Part Number Configurator

FYZCPOJY025F030 = OM4 16-Fiber, Indoor Small Diameter Trunk, Plenum, 1× MPO-16 Female APC with 1m breakout to 2× PanMPO-8 Female with 1m breakout, Polarity B, Optimized IL, Pulling Eye End A, 30 feet

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	F	Y	Z	C	P	O	J	Y	0	2	5	F	0	3	0

1 – Fiber
F = Fiber

2 – Cable Type
Y = Indoor small diameter trunk cable

3 – Fiber Type
9 = OS2 Singlemode 9/125µm
Z = OM4 50/125µm
S = OM4+ 50/125µm
W = OM5 50/125µm

4 – Fiber Count
C = 16-Fibers

5 – Jacket Type
P = Plenum
L = LSZH
C = LSZH EuroClass Cca

6 – Connector Type (End A)
O = MPO-16 APC Female
M = MPO-16 APC Male

7 – Connector Type (End B)
G = MPO-8 Female
H = MPO-8 Male
J = PanMPO-8 Female
K = PanMPO-8 Male
O = MPO-16 Female APC (SM & MM)
M = MPO-16 Male APC (SM & MM)
X = MPO-8 Female APC (SM)
Y = MPO-8 Male APC (SM)
V = PanMPO-8 Female APC (SM)
W = PanMPO-8 Male APC (SM)
L = Duplex LC (SM & MM)
P = LC Uniboot Push Pull (SM & MM)
B = Duplex LC APC (SM)
9 = LC Uniboot Push Pull APC (SM)
U = Pigtail

8 – Construction/Perfomance
A = Method A, Standard IL (SM)
B = Method B, Standard IL (SM)
X = Method A, Optimized IL
Y = Method B, Optimized IL
4 = 8 to 1 U2 Polarity Standard IL (MPO to LC only)
5 = 8 to 1 U2 Polarity Optimized IL (MPO to LC only)
7 = 8 to 1 U (Pair Flipped) Polarity Standard IL (MPO to LC only)
8 = 8 to 1 U (Pair Flipped) Polarity Standard IL (MPO to LC only)

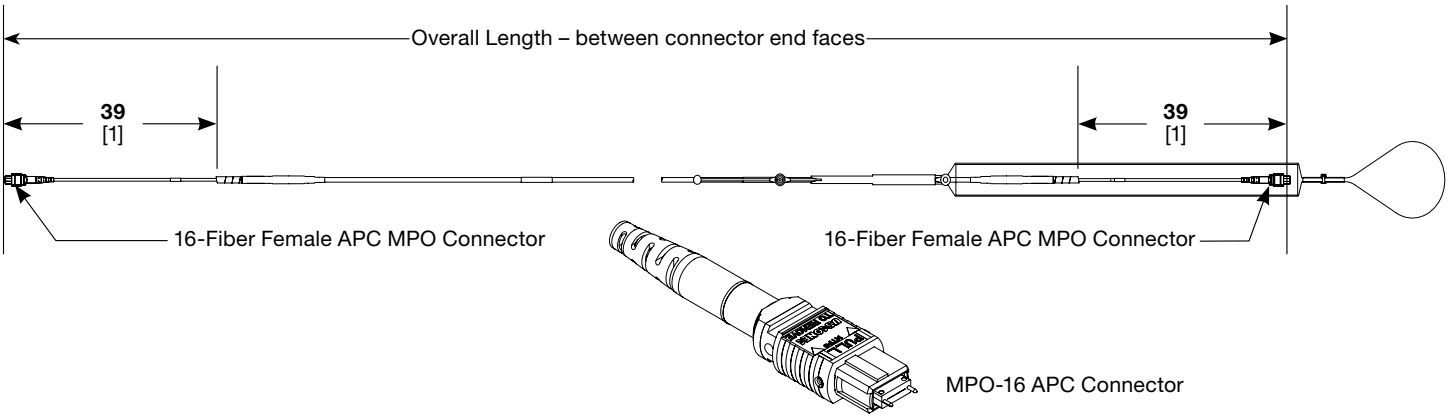
9-11 – Serial

12 – Unit of Measure
F = Feet
M = Meters

13, 14, 15 – Cable Asembly Length
015 – 999 Feet
005 – 999 Meters

Serial	Transition	Pulling Eye
021	HD Flex	Yes
022	HD Flex	No
023	HD Flex to pigtail	Yes
024	HD Flex to pigtail	No
025	Standard	Yes
026	Standard	No
027	Standard to pigtail	Yes
028	Standard to pigtail	No

Small Diameter Trunk Cable Assembly Detail



MPO-16 APC Interconnect Cable Assemblies

Part Number Configurator

Example: FRZCPOJY023F030 - OM4 16-Fiber Interconnect, Plenum, MPO-16 Female APC to PanMPO-8 Female, with 24" (60cm) Breakout Polarity B, Optimized IL, 30 feet.

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	F	R	Z	C	P	O	J	Y	0	2	3	F	0	3	0

1 – Fiber

F = Fiber

2 – Cable Type

R = Indoor, round

3 – Fiber Type

9 = OS2 Singlemode 9/125µm
Z = OM4 50/125µm
S = OM4+ 50/125µm
W = OM5 50/125µm

4 – Fiber Count

C = 16 fibers

5 – Jacket Type

P = Plenum (OFNP)
L = LSZH
B = LSZH, Euroclass B2ca

6 – Connector Type (End A)

O = MPO-16 APC Female (SM & MM)
M = MPO-16 APC Male (SM & MM)

7 – Connector Type (End B)

G = MPO-8 Female (MM)
H = MPO-8 Male (MM)
J = PanMPO-8 Female (MM)
K = PanMPO-8 Male (MM)
O = MPO-16 Female APC (SM & MM)
M = MPO-16 Male APC (SM & MM)
X = MPO-8 Female APC (SM)
Y = MPO-8 Male APC (SM)
V = PanMPO-8 Female APC (SM)
W = PanMPO-8 Male APC (SM)

8 – Construction/Performance

A = Method A, Standard IL (SM)
B = Method B, Standard IL
X = Method A, Optimized IL (SM)
Y = Method B, Optimized IL

9 – 11 – Serial

See Table Below

12 – Unit of Measure

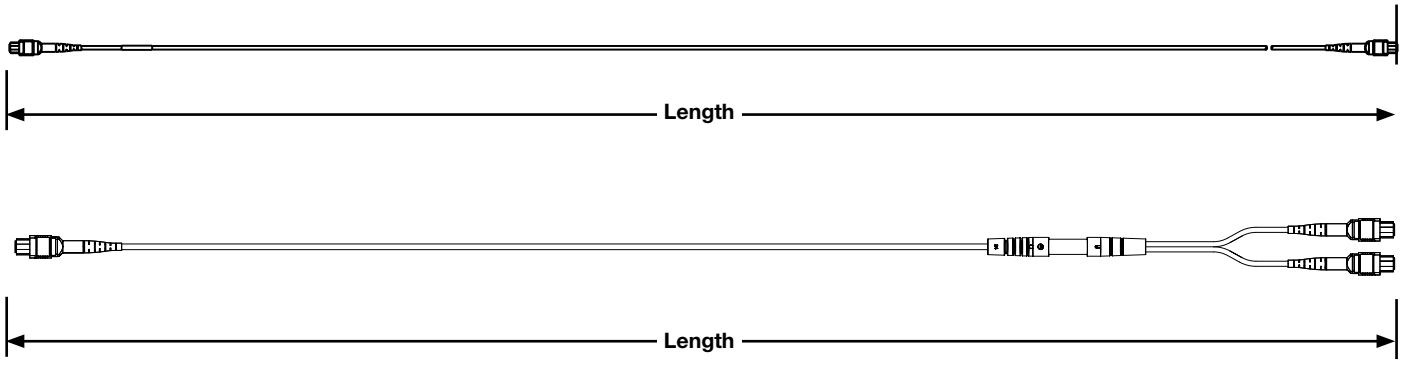
F = Feet
M = Meters

13, 14, 15 – Cable Assembly Length

1 – 300 Feet
0.5 – 100 Meters

Serial	Breakout – End A	Breakout – End A
021	None	None
022	24-inch (60 cm)	24-inch (60 cm)
023	None	24-inch (60 cm)

QuickNet™ MPO Interconnect Round Cable Assembly Detail



MPO-16 MPO Breakout Harness Cable Assemblies

Part Number Configurator

Example: FHZCPOL5026F015 = OM4 Harness, 16-Fiber, round, plenum, MPO-16 female APC to LC duplex with 24in (60cm) equal breakout, 8 to 1 Polarity (U2), Optimized IL - 15 Feet

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	F	H	Z	C	P	O	L	5	0	2	6	F	0	1	5

1 – Fiber
F = Fiber

2 – Cable Type
H = Indoor, Round Harness

3 – Fiber Type
9 = OS2 Singlemode 9/125µm
Z = OM4 50/125µm
W = OM5 50/125µm
S = OM4+ 50/125µm

4 – Fiber Count
C = 16 fibers

5 – Jacket Type
P = Plenum (OFNP)
L = LSZH
B = LSZH Euroclass B2ca

6 – Connector Type (End A)
O = MPO-16 APC Female (SM & MM)
M = MPO-16 APC Male (SM & MM)

7 – Connector Type (End B)
L = LC Duplex
P = LC Uniboot Push Pull
B = LC/APC Duplex (SM)
9 = LC/APC Uniboot Push Pull (SM)

8 – Construction/Performance
4 = 8 to 1 / U2 - Std. IL
5 = 8 to 1 / U2 - Opt. IL (MM)
7 = 8 to 1 / U - Std. IL
8 = 8 to 1 / U - Opt. IL (MM)

9 – 11 – Serial
See Table Below

12 – Unit of Measure
F = Feet
M = Meters

13, 14, 15 – Cable Assembly Length
1 – 300 Feet
0.5 – 100 Meters

Serial	Breakout Length	Stagger	Serial	Breakout Length	Stagger
021	18" (45cm)	Equal Breakout	02B	30" (76cm)	Equal Breakout
022	18" (45cm)	LC Pair 1 Longest	02C	30" (76cm)	LC Pair 1 Longest
023	18" (45cm)	LC Pair 1 Shortest	02D	30" (76cm)	LC Pair 1 Shortest
024	18" (45cm)	LC Pair 1 and 2 Longest	02E	30" (76cm)	LC Pair 1 and 2 Longest
025	18" (45cm)	Pair 1 and 2 Shortest	02F	30" (76cm)	Pair 1 and 2 Shortest
026	24" (60cm)	Equal Breakout	02M	39" (1m)	Equal Breakout
027	24" (60cm)	LC Pair 1 Longest	02N	39" (1m)	LC Pair 1 Longest
028	24" (60cm)	LC Pair 1 Shortest	02P	39" (1m)	LC Pair 1 Shortest
029	24" (60cm)	LC Pair 1 and 2 Longest	02Q	39" (1m)	LC Pair 1 and 2 Longest
02A	24" (60cm)	Pair 1 and 2 Shortest	02R	39" (1m)	Pair 1 and 2 Shortest

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