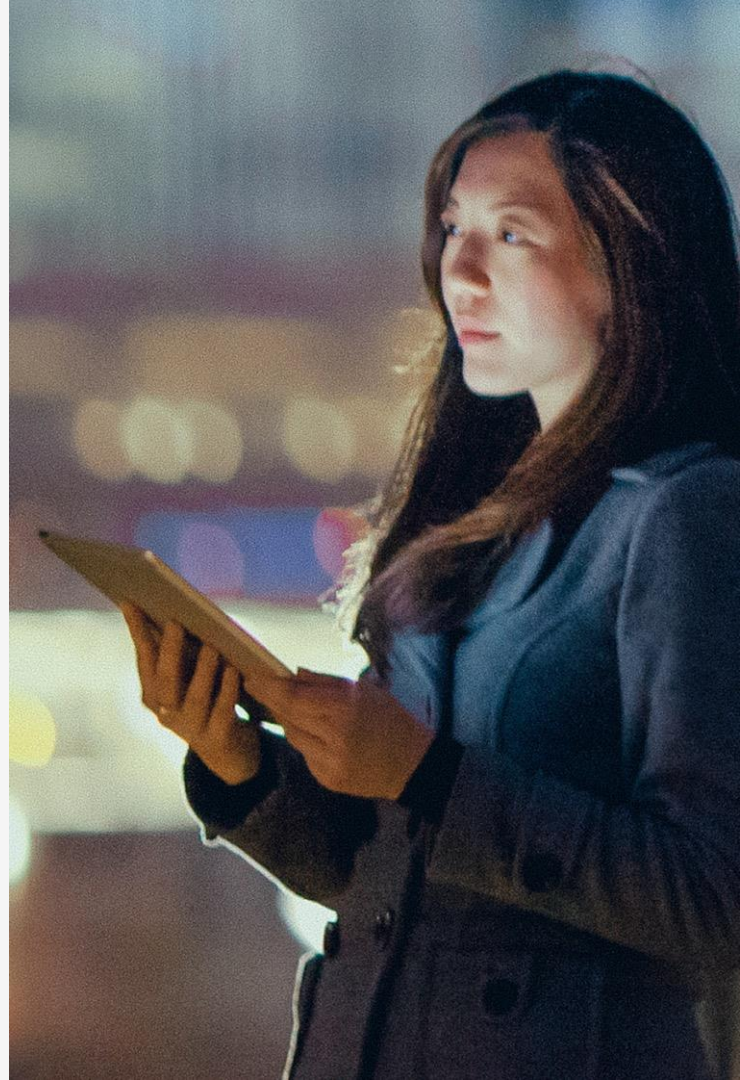




Molex Optical Connectivity

11/05/2024

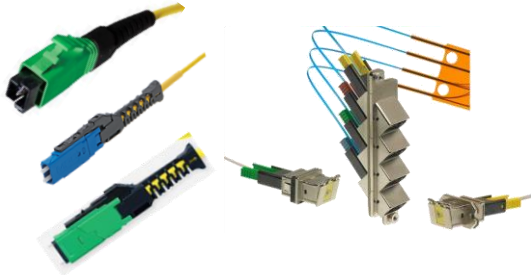
© Molex, LLC



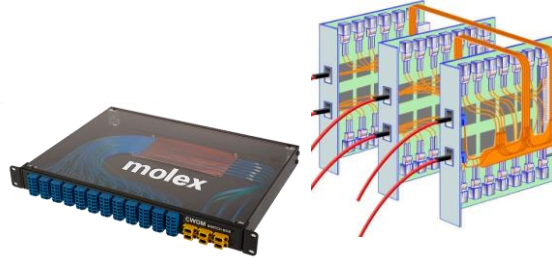
Optical Connectivity Solutions

Expand our value proposition with unique, innovative, disruptive solutions

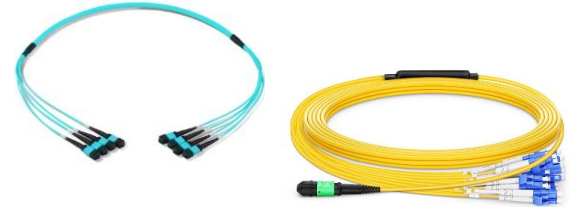
New Connector Technology



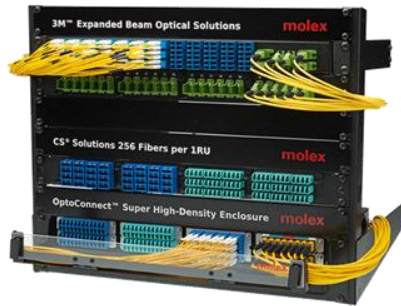
Fiber Shuffle Solutions



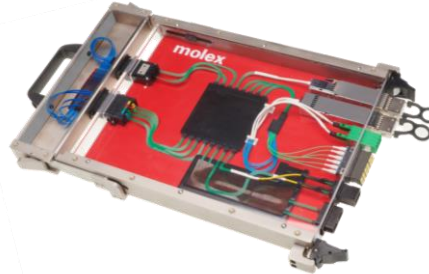
Patch Cables & Trunks for Data Centers



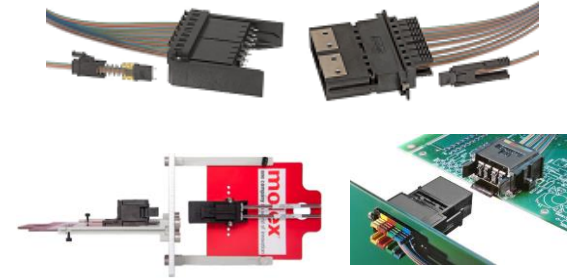
Pre-terminated Solutions



Architectural Innovations



Backplane/Ortho Blindmate

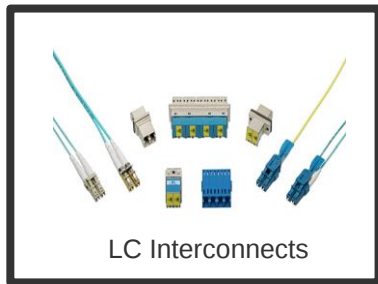


Design and Manufacturing Locations

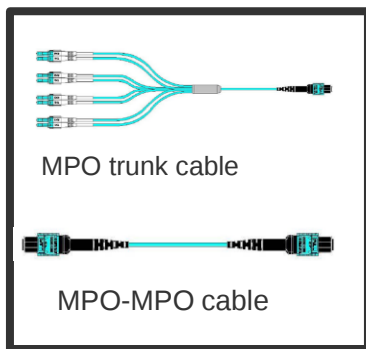
Engineering/Design
Manufacturing



LC assembly, MPO assembly, 200G/400G Assemblies

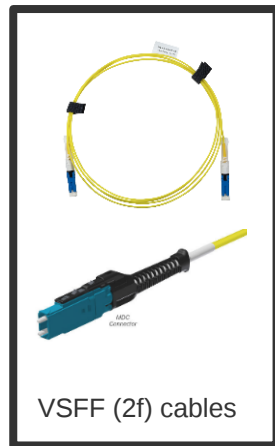


LC Interconnects

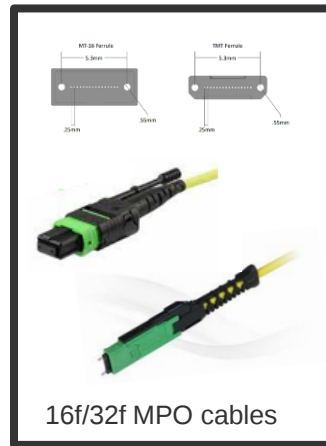


MPO trunk cable

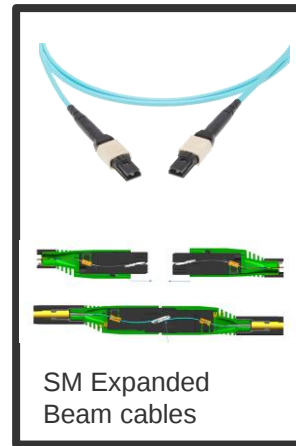
MPO-MPO cable



VSFF (2f) cables



16f/32f MPO cables



SM Expanded Beam cables

■ 2000 to Present

- Telecom
- Datacom
- LTE/4G Base Station

■ 2012 to Present

- Telecom
- Datacom
- Datacenter
- Server

■ 2020 and emerging

- MSO
- Datacenter
- Networking
- Cloud
- HPC
- 200G/400G/800G
- SR4 / DR4
- SR8 / DR8

From 10G to 800G cable solution in datacenter application

2000

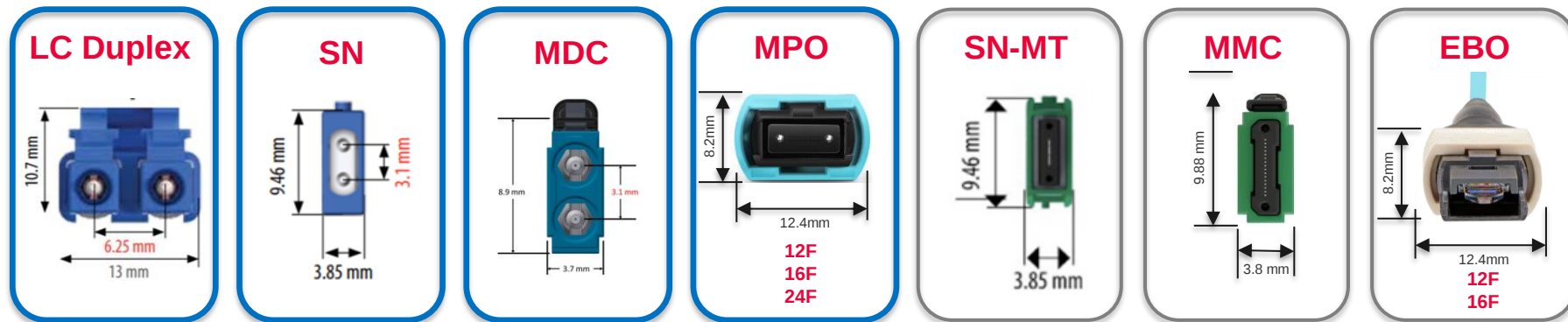
2012

2020

2024

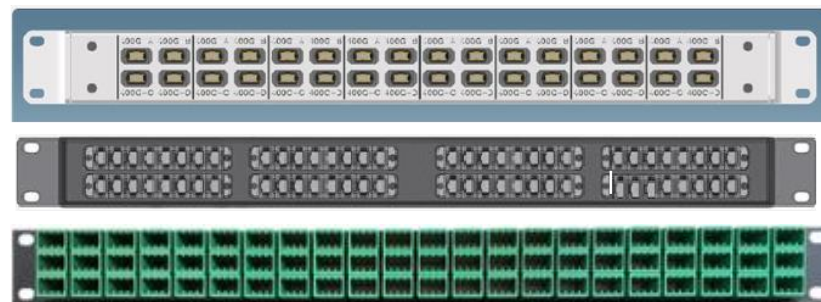
molex

CONNECTOR FORM FACTOR – PITCH/DENSITY 1RU



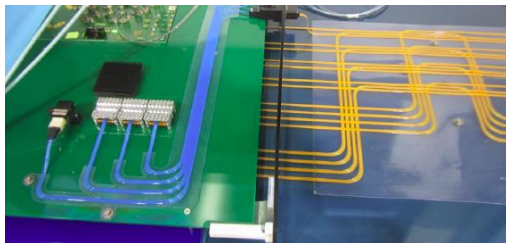
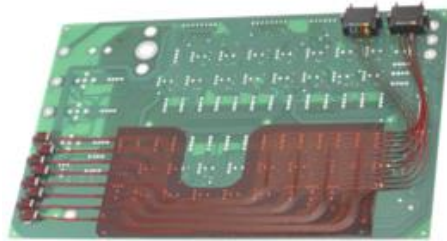
Connector Type	1RU Patch Panel	Mating Transceivers
LC	144-Fiber	SFP, FRx
SN/MDC	384-Fiber	QSFP-DD
MTP/MPO	Up to 2,048 Fibers	QSFP, QSFP-DD, OSFP
SN-MT/MMC	Up to 6,336 Fibers	Future Products

MPO/MTP to MMC Port Comparison

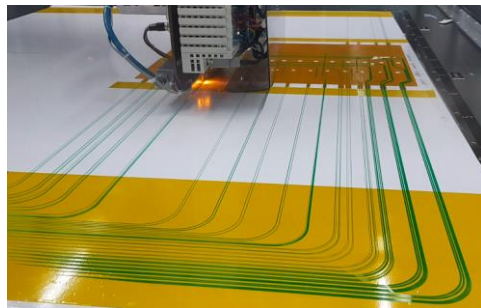
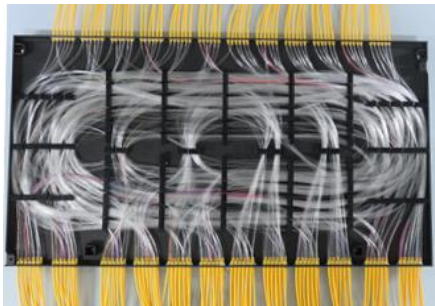
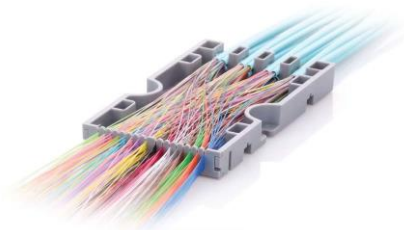


Molex Fiber Circuit Support

- Simplify fiber routing upon PCB and aggregates channels

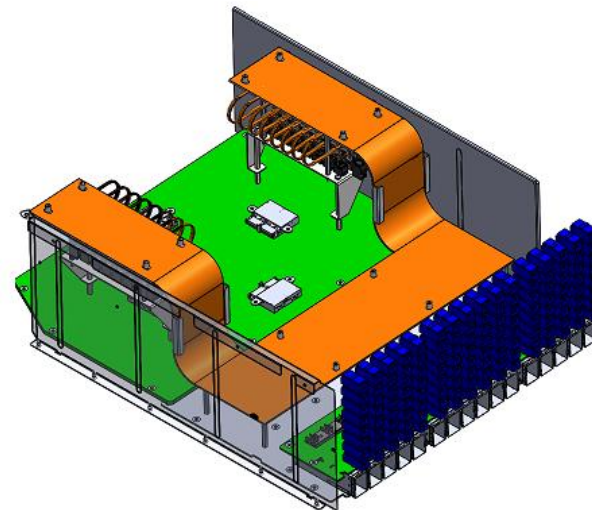
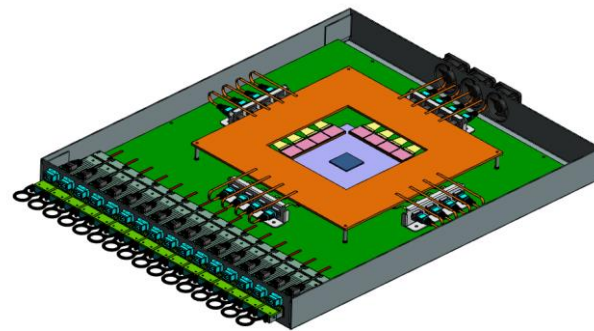
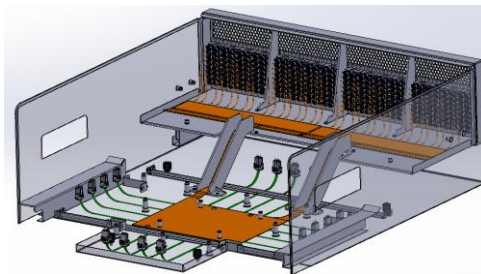
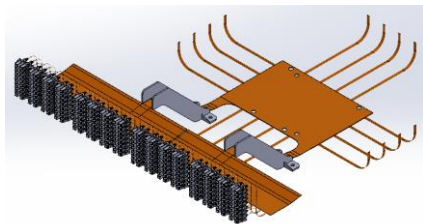


- Developed high density stackable Flexes assembly to support high fiber counts shuffle with under low stack height (Reference : $\cong$ 1,000 ports, manual shuffle : 200mm x110 x 28mm, Fiber circuit : 420mm x 100mm x 5mm)



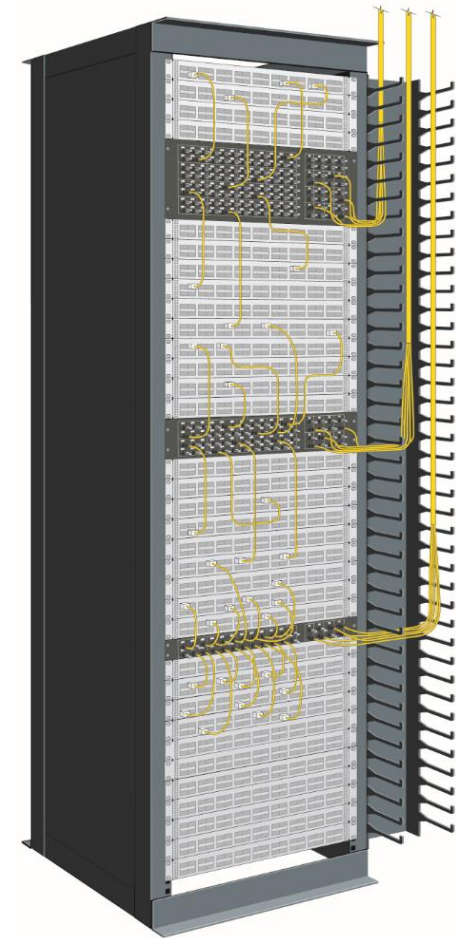
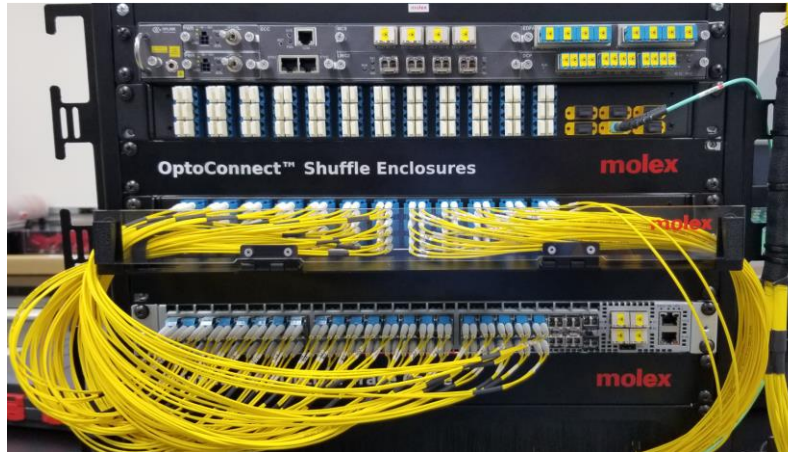
Molex Fiber Circuit Support

- › Solve thermal issue in the box
- › Ability to co-design and develop reliable prototypes
- › Establish long-term partnership for fiber laying technology



Aggregation Concepts

- Sheet Metal Boxes
 - Any RU size, single fiber or multi-fiber interconnects and combinations
 - Can maximize 1Ru sizes with front and rear connectivity
 - Custom Silkscreen for port ID
 - Pin-outs for SFP (CWDM Patching), QSFP, and Next Gen Data Rate (QSFP-DD, SFP-DD, OSFP, etc.....)



Fiber Enclosure Classification

4-Ports Flush Mount



- **4 Adapter Panel**
 - Best fit with MPO/LC/CS/SN bulkhead adapter panel
 - Support 144 LC ports and 256 CS ports
- **Cable Management and Distribution**
 - Build splice tray, cable management hub and spool inside

HD Blindmate



- **Blindmate mechanism**
 - Support 12 sets slim 12F MPO-LC cassette capacity
 - Guide PIN mechanism and easy installation
 - Support inner shutter LC option compete Corning EDGE solution

SHD Flush Mount



- **192 SHD Revision**
 - Support 8 sets SHD 24 LC ports cassette
 - Simplify LC adapter design
 - Support 4 sets CS cassette and maximum 256 ports capacity
 - Support MPO output shuffle module platform

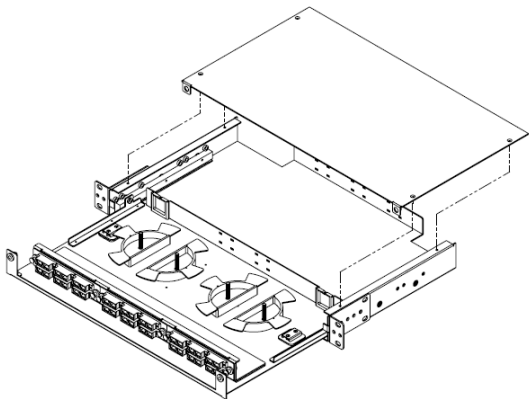
4-Ports Patch Panel



- **Low cost easy installation**
 - Best fit with MPO/LC/CS/SN bulkhead adapter panel
 - 19" open bracket design and low cost

1RU Slidable STD Fiber Enclosure

Main Body

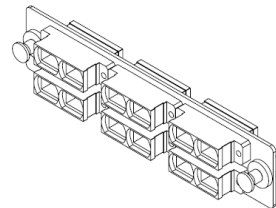


- › 1RU enclosure supports 72 LC ports or 3 LGX cassettes capacity
- › The idea choice for data center, storage area network (SAN), local area network (LAN)
- › Cable spool, splicing tray options for different operation

Parts Options



- › SM/MM LGX cassette
- › SC/LC/MPO/VSF/MPO adapter panel



2RU/3RU STD Fiber Enclosure

2RU Main Body

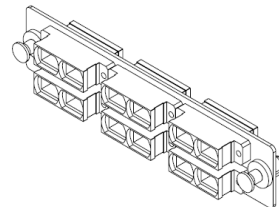


- › 2RU enclosure supports 144 LC ports or 6 LGX cassettes capacity
- › 3RU enclosure supports 288 LC ports or 12 LGX cassettes capacity
- › The idea choice for data center, storage area network (SAN), local area network (LAN)
- › Cable spool, splicing tray options for different operation

3RU Main Body



Parts Options



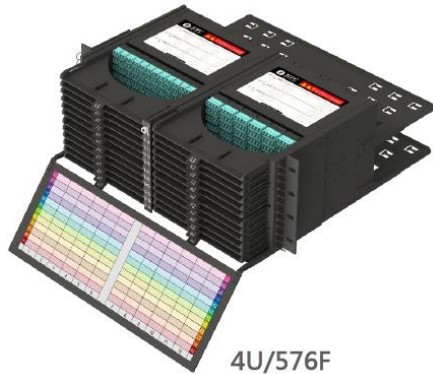
- › SM/MM LGX cassette
- › SC/LC/MPO/VSFF/MPO adapter panel

1RU/4RU Individual Slidable Fiber Enclosure

Main Body

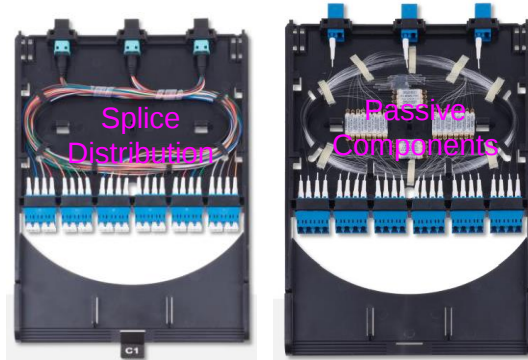


1U/144F



4U/576F

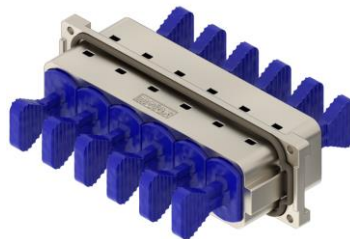
- › 1RU enclosure supports 144 LC ports cassettes capacity
- › 4RU enclosure supports 576 LC ports cassettes capacity
- › Individual slidable cassette supports maximum 3 MPO input and 24 LC output
- › The idea choice for data center, storage area network (SAN), local area network (LAN)
- › Cable spool, splicing tray options for different operation
- › Tap/WDM cassette assembly for network monitor or add/drop application



Optical EMI Shielding Adapters

EMI Adapter Benefits

- With different types for interconnect technology (MPO/LC/MMC)
- Provides electro-magnetic interference (EMI) protection
- Provides dust protection and reduces EMI
- Enhances safety for operators
- Enables greater design flexibility
- Eases space constraints on the panel
- Improves functionality and minimizes system design requirements
- Offers mounting flexibility
- Improves airflow and simplifies assembly operations
- Reduces EMI at the mounting surface



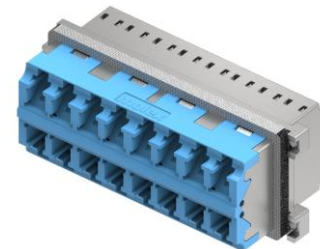
1x6 EMI Vertical MPO Adapter



1x4 EMI Horizontal MPO Adapter



Duplex EMI LC Adapter

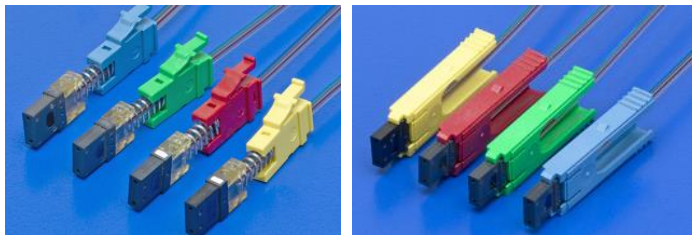


2x8 EMI LC Adapter with Inner Shutter



1x4 EMI MMC Adapter(Sr-Sr)

Optical Blind Mate Backplane & HBM

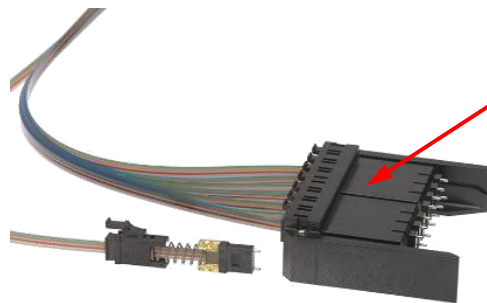


Versatile Format Interconnect - HBM

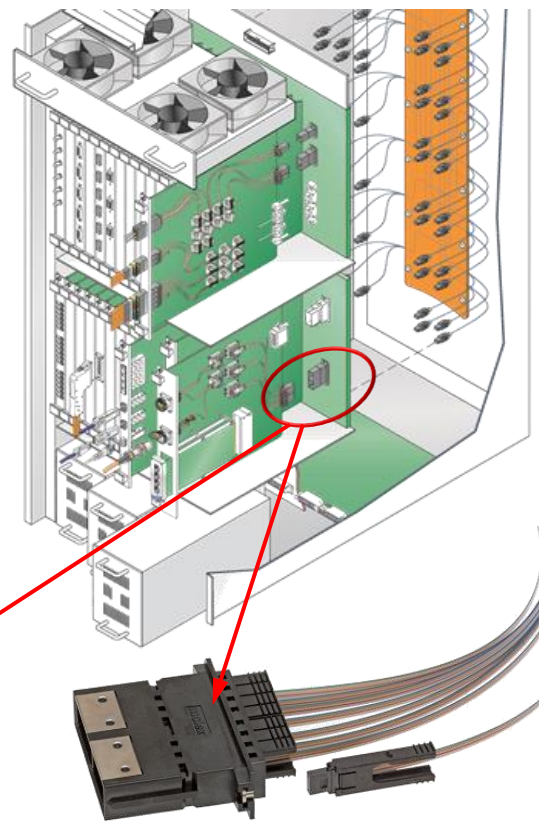
- Patented dual shutter design for dust and eye safety protection
- Single mode and multimode compatible
- Telcordia GR-1435-core compliant
- X,Y,Z Float Alignment
- Compatible with optical flex circuit technology Utilizes standard MT ferrule as the optical interface
- Easily cleaned Mother Board connector with optional clean clip system

Blindmated Benefits

- Mature (20+ Years) field proven interconnect technology
- Excellent for organization of high-density fiber systems
- Simplify card installation
- Designed with float alignment for proper connector mating
- Offering many density options
- Compliment to Flexplane products



VFI Backplane Connector

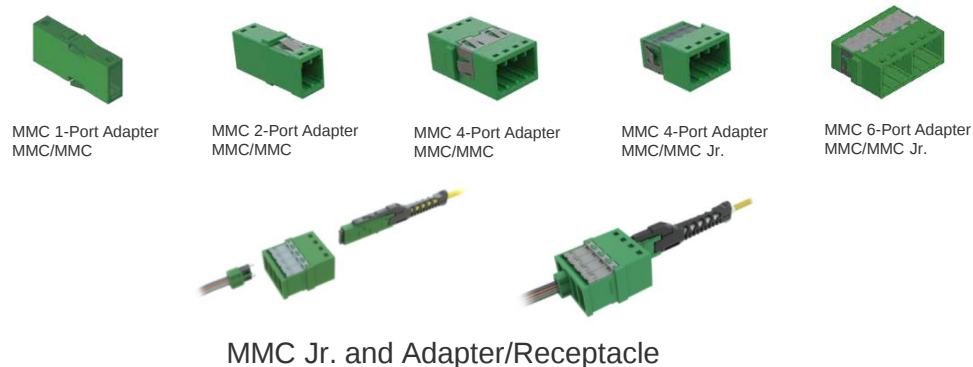
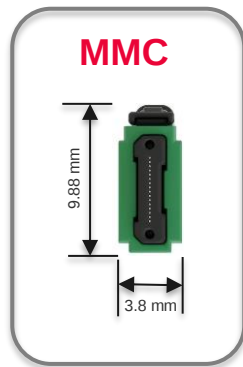


Mother Board Backplane Adapter

Very Small Form Factor Connectors – Multi Fiber

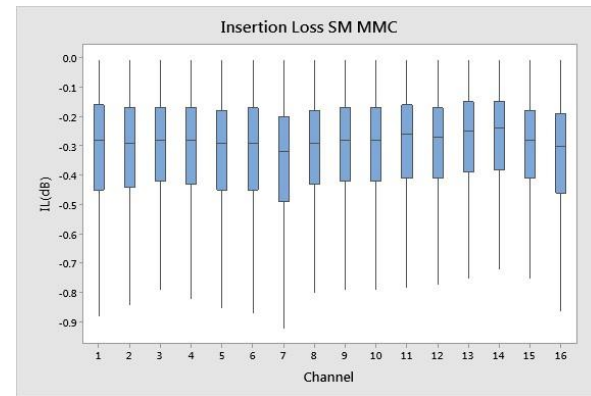
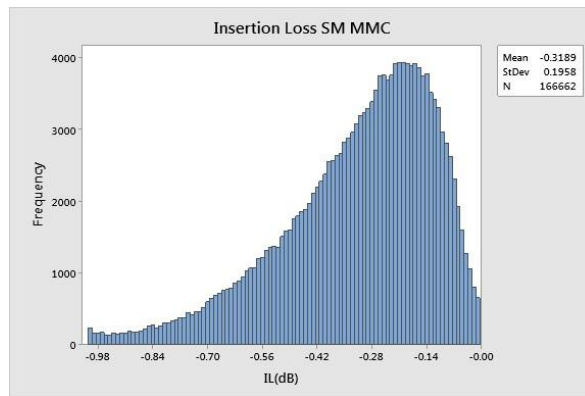
■ MMC

- Similar footprint to MDC
- MMC can accommodate up to 16 Fibers per connector
- Compared to MPO, MMC is a 4x increase in density
- Highest density multi-fiber connector available



■ MMC technologies

- Molex can support form factors
- MMC assemblies available now
- Full suite of EMI Adapters & Cable Assemblies in development



Data represents cable assembly loss (2x connectors)

molex

Expanded Beam Ferrule Technology

■ Product Features and Advantages

Provides the ability to develop novel connector designs that are not limited by spring forces

Low mating/un-mating forces, even with high fiber counts

Delivers high performance and reliability while providing stability under multiple re-mating cycles

Low insertion and high return loss

Offers flexible, scalable designs

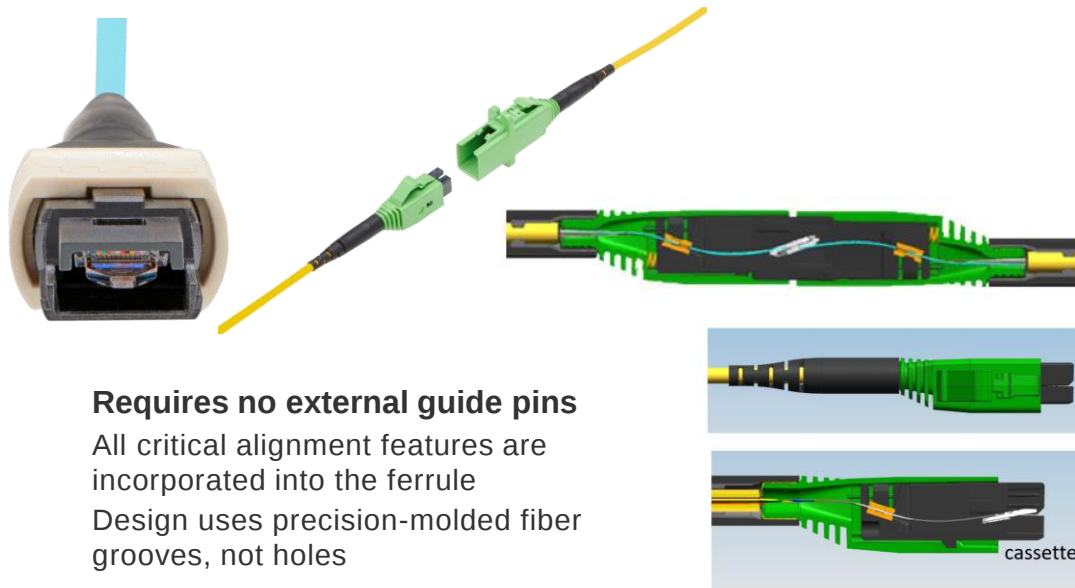
Single- and multi-mode solutions

Delivers a plug-and-play solution for data center

Low dust sensitivity for easy deployment

Allows for faster, more scalable terminations

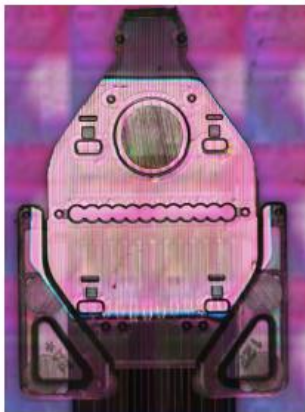
No fiber/ferrule polishing



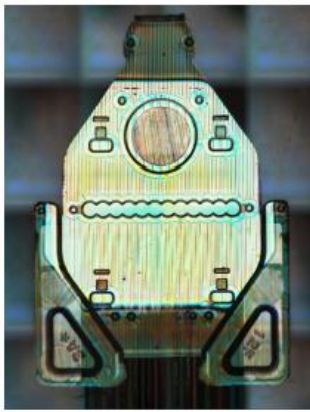
EBO Mechanical Mate / Demate Performance

■ Mated / De-mated Performance

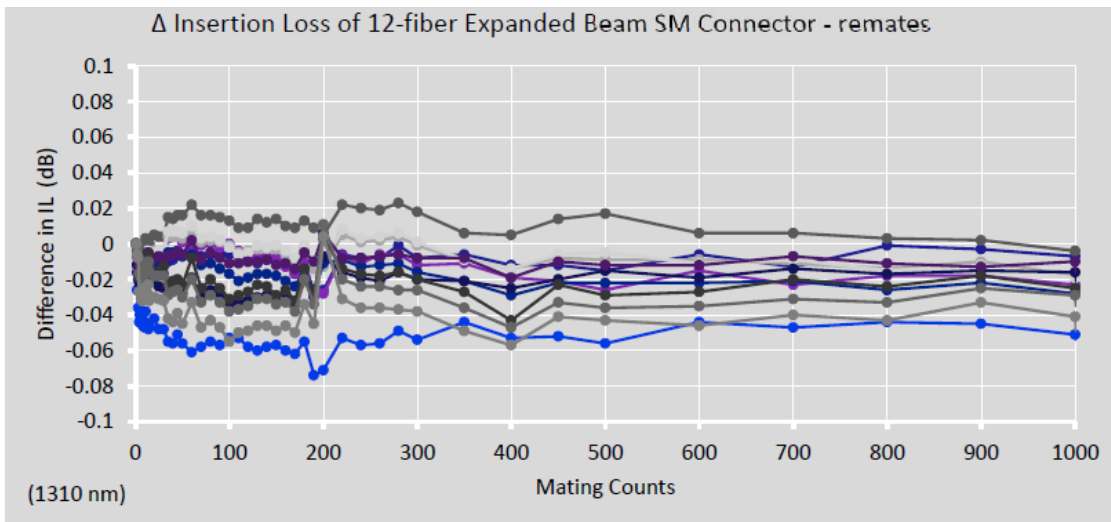
- Δ Insertion Loss at 1310nm
- 1550 nm data performance is similar
- Typical IL $\sim$ 0.39dB (<15K channels)



Ferrule Before Testing



Ferrule after 1,000
re-mates

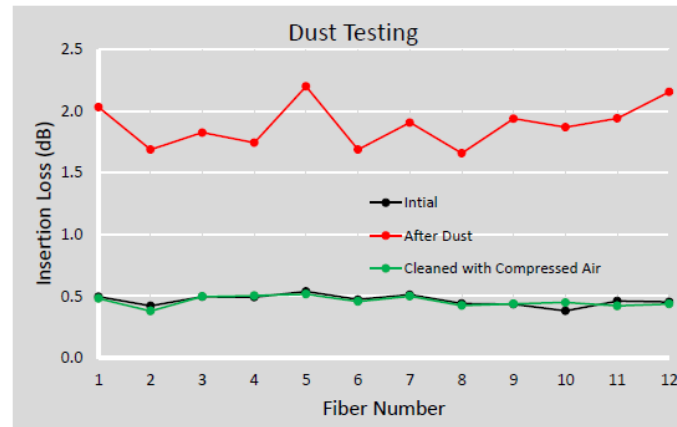
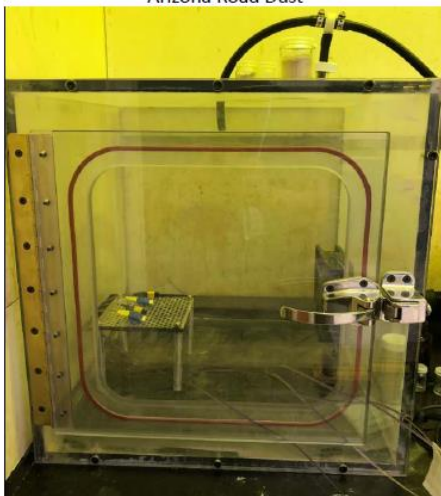


Dust Resilience & Cleaning

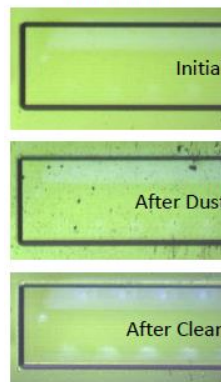
■ Dust Test

- › EIA-364-91 Using A2 Arizona Road Dust
- › Drying at 50°C for one hour, 9g/ft³ of a A2 fine Arizona road dust was placed in the chamber with the samples
- › The dust was agitated with a continuous airflow for one hour, and then allowed to settle for one hour

Dust Chamber with Connectors
Arizona Road Dust



Images of Ferrule
Optical Surface



Initial Test



Dust



After Dust



Clean

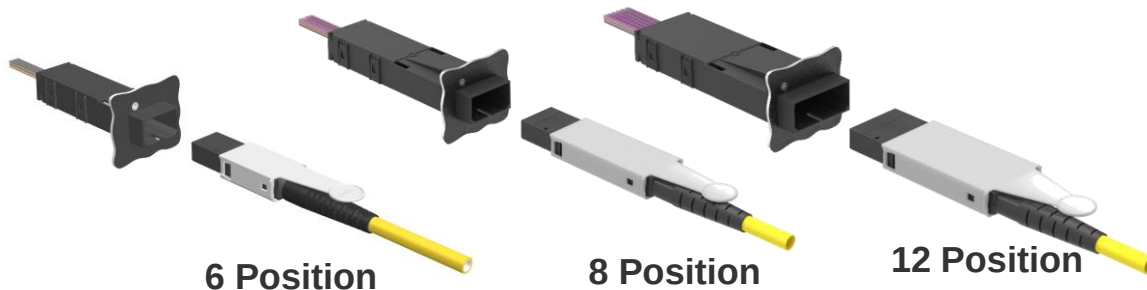
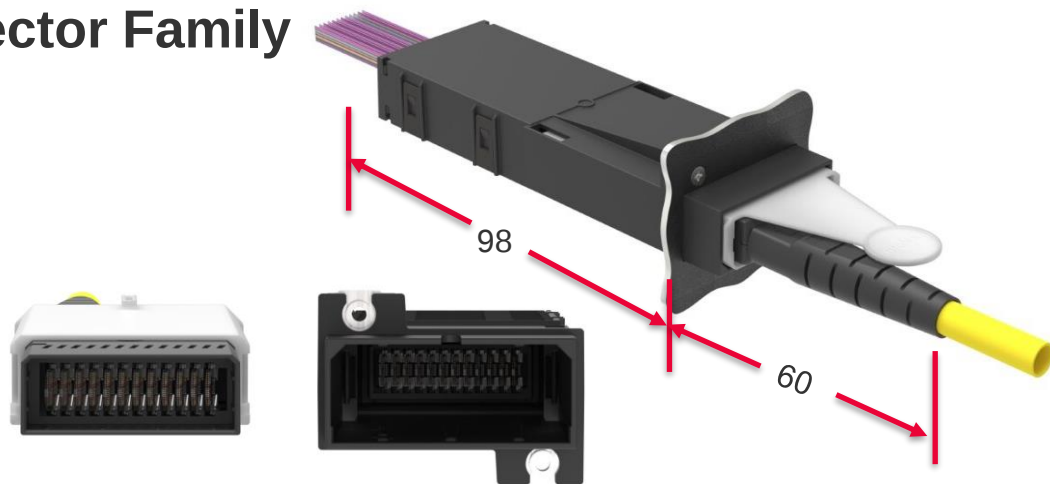


After Clean



VersaBeam EBO Trunk Connector Family

- Multiple port count options
 - 12, 9, 8, 6, 4
- Support for both 12 & 16F EBO Ferrules
 - 48 to 192 Fibers per connector
- Compatible with both SM and MM fiber
- Mated Length = ~158mm
 - ~60mm protrudes from panel
 - Designed for furcation tube OD = 6-7mm
- 9x16F EBO 144F Connector
 - Protos Avail Now
 - Release Q1 2025



molex

creating connections for life