3M-Rosenberger COBO Webinar

The Application of Expanded Beam Optics in the Next Generation of Data Centers

July 7, 2021
Key demand drivers for Data Center workloads

- **Internet Of Things (IoT):**
  - 470M connected cars
  - 157M ZB of machine information produced in 2025

- **AI/ML:**
  - 648M smart wearable devices

- **Industrial IOT:**
  - 5.4B NA connections

- **Smart Home Devices:**
  - 13.5B active smart home devices

Source: Mordor Intelligence

- 5G machine information data: [AMAT 2021 Investor Meeting presentation](https://www.intellias.com/big-data-for-connected-car-platforms/)

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More than ever, the data center of the future will demand dense, reliable interconnects necessary to support the growth in optical connectivity.

- Longer fiber links to support increased switching radix
- Significant increase in fiber connections
- Increasing expectations on performance and reliability
Future IO designs will present new connector challenges

As optics move further inside the box, front panel interconnects will grow in number and importance.
Common traditional multifiber approaches

<table>
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<tr>
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<th>Physical contact</th>
<th>Expanded beam</th>
<th>Air Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust resistance</td>
<td>Worse</td>
<td>Good</td>
<td>OK</td>
</tr>
<tr>
<td>IL Performance</td>
<td>Good</td>
<td>OK</td>
<td>Good</td>
</tr>
<tr>
<td>RL Performance</td>
<td>Good</td>
<td>OK</td>
<td>Good</td>
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The limitations of physical contact fiber connectors is well known.

Traditional approaches to expanded beam solutions have made some progress.

Air gap designs address some, but not all the dust and contamination concerns.
A crucial component for the **Performance and Reliability** of optical transmission lines are the corresponding **Fiber Optic Connectors**.

**Two basic principles in the market:**

“Physical Contact” & “Expanded Beam”
Fiber Optic Connectivity - „Physical Contact (PC)“ Principle

FO Connector – Basic Principle

- LC
- SC
- MTP® / MPO
- E2000
- MDC
- ....
PC type Fiber Optic Connectors provide reliable performance already for a lot of years

- Low Insertion Loss (IL)
- High Return Loss (RL)
- Stable & Repeatable Performance for a lot of mating cycles

However, there remains one challenge:

**Potential Contaminations of the connector end-face**

>> Worst case: Total link failure
>> Risk of permanent damage of the polished end-face
PC type Connectors shall be only mated in **absolute clean condition**!

= Time consuming process

Source: VIAVI
Single Fiber Lens Contact – Principle:

- Significant lower impact of dust & dirt particles
- No direct physical contact between fibers
- Relative expensive technology
- Insertion Loss about 1.5 dB
- Mainly for Multimode applications
3M™ Expanded Beam Optical Connectivity

Completely new innovative „Expanded Beam“ principle

- EBO – Expanded Beam Optical Connect
- developed and patented by 3M
- Precision molded Ferrule with groves (instead of holes)
  Allows automated fiber alignment and bonding
- No fiber/ferrule polishing
- Terminates 12 Singlemode or Multimode fibers
  (16 fiber Ferrule in development)
- Hermaphroditic Ferrule Design
Ferrules are mated using **Fiber Suspension**, providing:

- freedom for optimal alignment
- mating retention force
- low mating/de-mating force.
Specifications

<table>
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<tr>
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<th>Singlemode (1310 nm)</th>
<th>Multimode (850 nm)</th>
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</thead>
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<tr>
<td>Insertion Loss (IL) max. [dB]</td>
<td>&lt; 0.70 dB</td>
<td>&lt; 0.30 dB</td>
</tr>
<tr>
<td>Return Loss (RL) min. [dB]</td>
<td>&gt; 55 dB</td>
<td>&gt; 35 dB</td>
</tr>
</tbody>
</table>

**Single Mode**

- Insertion Loss (IL) max. [dB]: < 0.70 dB
- Return Loss (RL) min. [dB]: > 55 dB

**Multimode**

- Insertion Loss (IL) max. [dB]: < 0.30 dB
- Return Loss (RL) min. [dB]: > 35 dB

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3M™ Expanded Beam Optical Connectivity – Performance
Simple cleaning approach, when required

Conducted in Dust Chamber with Arizona Road Dust
Insertion Loss tested at single mode 1310nm
- **Singlemode**- and **Multimode**

- **Reduced Sensitivity to Dust & Dirt particles**
  owing to innovative „Expanded Beam“ Principle
  support easy installation and handling

- **High reliability & good performance**
  - low Insertion Loss (IL)
  - high Return Loss (RL)
  - stable performance over a lot of mating cycles

- **Light turn promotes eye safety**

- **Low mating force**

- **Flexible, scalable Connector options**
Increased serviceability

Dense, precision, reflow compatible, high performance optical interconnect

Providing worry free connections across the data center

Single Mode

Multimode

3M™ EBO-XX
12 – 32 fibers
- 12f or 16f ferrule
- 1 or 2 Ferrules
- Hermaphroditic
- LC-style latch
- SM or MM

3M™ EBO-MPXX
12 – 16 fibers
- 1 ferrule: 12f or 16f
- Hermaphroditic
- Push/Pull style
- MPO footprint compatible
- SM or MM

Under Development

192 fibers
288 fibers
Successful Hyperscale Proof of Connect Install

320 3M™ EBO-12 connectors installed
- 192 connectors on trunks
- 128 connectors on pigtail assemblies

No connector cleaning was performed throughout the install

Completed trunk link testing in one hour with zero failures

Completed switch links the following week with pigtail installs

No errors reported with 90-days of traffic and counting
For more information on 3M™ Expanded Beam Optical

Visit our website at www.3M.com/opticalinterconnect
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