MEMS Variable Optical Attenuator (VOA)
(patents pending)

Product Description
The BM Series VOA is based on a proprietary micro-electro-mechanical mechanism featuring ultra-high reliability, compact design, fiber to fiber directly coupling technology, simple construction, easy drive, and excellent optical performance. The MM series VOA is fully compliant with the Telcordia 1209 and 1221 reliability standards. The MM series VOA is available in either normally-transparent or normally-opaque configurations.

The VOA is driven with an electrical current or voltage; and the attenuation can be continuously adjusted with the applied current or voltage. The MM series can be repackaged with pin-pin compatibility to most VOAs on the market. Standard package contains one or two VOAs in dimensions of 23.2mmx10.1mmx10.7mm.

Performance Specifications

<table>
<thead>
<tr>
<th>MM Series VOA</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1310/1550 nm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>0.6</td>
<td>0.8 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarization Dependent Loss</td>
<td>0.15 @10dB</td>
<td>0.25 @20dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wavelength Dependent Loss</td>
<td>0.2 @10dB</td>
<td>0.4 @20dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Dependent Loss</td>
<td>0.4 @10dB</td>
<td>0.7 @20dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attenuation Range</td>
<td>25</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarization Mode Dispersion</td>
<td>0.01 ps</td>
<td>0.05 ps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return Loss</td>
<td>45 dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attenuation Resolution</td>
<td>Continuous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response Time</td>
<td>3</td>
<td>6 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving Voltage</td>
<td>5 V</td>
<td>6+ V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>130 mW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Power Handling</td>
<td>0.3 W</td>
<td>0.5 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-5 °C</td>
<td>75 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 °C</td>
<td>85 °C</td>
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<tr>
<td>Reliability</td>
<td>Telcordia 1209 and 1221</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package Dimension</td>
<td>23.2(L)x10.1(W)x10.7(H) mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Excluding connectors
2. Reference to room temperature
3. For full dynamic range. Other drive voltages available
4. Over this value will damage the device
MEMS Variable Optical Attenuator (VOA)

Mechanical Footprint Dimensions (mm)

Single VOA
(Reflect, package type 3)

Dual VOA
(Reflect, package type 2)

All Pin diameter = .45mm

Ordering Information

<table>
<thead>
<tr>
<th>BMOA</th>
<th>Type</th>
<th>Wavelength</th>
<th>Off State</th>
<th>Package Type</th>
<th>Fiber Type</th>
<th>Fiber Length</th>
<th>Connector Type</th>
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<tbody>
<tr>
<td>1</td>
<td>1 N/A</td>
<td>1260-1620</td>
<td>Single VOA</td>
<td>SMF 28=1</td>
<td>0.25m=1</td>
<td>None = 1</td>
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<tr>
<td>2</td>
<td>2 Ground</td>
<td>950-1080</td>
<td>Transparent</td>
<td>HI1060=2</td>
<td>0.5m=2</td>
<td>FC/PC = 2</td>
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</tr>
<tr>
<td>3</td>
<td>3 0-5V control signal</td>
<td>740-850</td>
<td>Opaque</td>
<td>HI780=3</td>
<td>1.0 m= 3</td>
<td>FC/APC = 3</td>
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<td>4</td>
<td>Special</td>
<td>N/A</td>
<td>0-5V control signal, VOA1</td>
<td>Special =0</td>
<td>900 µm fiber=3</td>
<td>ST/PC = 5</td>
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<td>5</td>
<td></td>
<td></td>
<td>0-5V control signal, VOA2</td>
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<td>250 µm fiber=1</td>
<td>LC = 7</td>
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<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 m= 3</td>
<td>Special = 0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special =0</td>
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<td></td>
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</tbody>
</table>

View from PIN Side
MEMS VOA Typical Performance Charts (1)

Features
- Compact
- Low Cost
- High Reliability
- Low IL, PDL, WDL & TDL
- Direct Current Drive
- Low Power Consumption

Applications
- Power Control
- Power Regulation
- Channel Balance
- Instrumentation

Typical Performance of MEMS VOAs (open loop)

Typical Attenuation Response vs Drive Voltage

Typical PDL Characteristics vs Attenuation
MEMS VOA Typical Performance Charts (2)

Features
- Compact
- Low Cost
- High Reliability
- Low IL, WDL, PDL & TDL
- Direct Current Drive
- Low Power Consumption

Applications
- Power Control
- Power Regulation
- Channel Balance
- Instrumentation

Typical Performance of MENS VOAs (open loop)

Typical Attenuation Wavelength Dependence of MEMS VOA @ 20 dB

Typical Wavelength-Dependent Loss of MENS VOA vs Attenuation
MEMS VOA Typical Performance Charts (3)

Features
- Compact
- Low Cost
- High Reliability
- Low IL, PDL, WDL & TDL
- Direct Current Drive
- Low Power Consumption

Applications
- Power Control
- Power Regulation
- Channel Balance
- Instrumentation

Typical Insertion loss Variation vs Temperature of MEMS VOAs

Excess Insertion Loss [dB] vs Temperature [°C]
MEMS VOA Typical Performance Charts (4)

Features
- Compact
- Low Cost
- High Reliability
- Low IL, WDL, PDL & TDL
- Direct Current Drive
- Low Power Consumption

Applications
- Power Control
- Power Regulation
- Channel Balance
- Instrumentation

VOA Responses (close-loop)

(a) Falling Response

0.1 ms

Optical Output

Electrical Control

(b) Rising Response

2.5 ms

Optical Output

Electrical Control