Test Data Sheet

PM9 - NIR
(EO-T2700M3-VIS)
S/N:

Resonant electro-optic phase modulator with
- tunable resonance frequency
- temperature sensor (NTC)
- thermal crystal mount

<table>
<thead>
<tr>
<th>RF properties</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonance frequency: $f_0$ ¹)</td>
<td>2.38 - 2.78</td>
<td>GHz</td>
</tr>
<tr>
<td>Preset frequency: $f_{set}$ ¹)</td>
<td>2726</td>
<td>MHz</td>
</tr>
<tr>
<td>Bandwidth: $\Delta f$</td>
<td>6.9</td>
<td>MHz</td>
</tr>
<tr>
<td>Quality factor: $Q$</td>
<td>395</td>
<td></td>
</tr>
<tr>
<td>Required RF power for 1 rad @ 780nm ²)</td>
<td>34.0</td>
<td>dBm</td>
</tr>
<tr>
<td>max. RF power (w/ active T-ctrl.): $RF_{max}$ ³)</td>
<td>10</td>
<td>W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optical properties</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EO crystal</td>
<td>MLN</td>
</tr>
<tr>
<td>Aperture</td>
<td>3x3</td>
</tr>
<tr>
<td>Wavefront distortion (633nm)</td>
<td>$\lambda/4$</td>
</tr>
<tr>
<td>recommended max. optical intensity (780nm)</td>
<td>&lt;10</td>
</tr>
<tr>
<td>AR coating (R$_{avg}$&lt;0.5%)</td>
<td>532 - 1064</td>
</tr>
</tbody>
</table>

¹) at 22.3°C  ²) with 50Ω termination  ³) w/o external active cooling
Fig. 1: Oscilloscope trace

![Oscilloscope trace](image)

**Table 1: Expected modulation**

<table>
<thead>
<tr>
<th>$\beta$ = 1 rad</th>
<th>unit</th>
<th>$\lambda_1$</th>
<th>$\lambda_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda$</td>
<td>nm</td>
<td>671</td>
<td>780</td>
</tr>
<tr>
<td>$P$</td>
<td>dBm</td>
<td>32.5</td>
<td>34.</td>
</tr>
<tr>
<td>$P$</td>
<td>W</td>
<td>1.78</td>
<td>2.51</td>
</tr>
<tr>
<td>$U$</td>
<td>$V_p$</td>
<td>13.3</td>
<td>15.8</td>
</tr>
<tr>
<td>$U_\tau$</td>
<td>$V_p$</td>
<td>41.9</td>
<td>49.3</td>
</tr>
<tr>
<td>$\beta / U$</td>
<td>rad / V</td>
<td>0.08</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Fig. 1: Recorded oscilloscope trace retrieved from a test setup as illustrated below.

Fig. 2: Squared absolute values of first-kind Bessel functions vs. modulation depth. Vertical lines reveal the ratio between the carrier $|J_0|^2$ and the $i$th sideband $|J_i|^2$ at a specific $\beta$.

Fig. 3: Dependency between RF amplitude and modulation depth for different wavelengths. Points on the curve allow to retrieve either the required RF amplitude for a specific/desired $\beta$ or the max. achievable modulation depth for a given/available RF power.

Table 1: Expected RF-amplitude/power values and conversion factors for the required wavelength at the reference modulation depth of 1 rad. Note: Experimentally recorded modulation depth displayed in Fig.1 might vary from the respective values ($\beta$=1 rad) provided in the table.
**Resonance characteristics**

![Test setup diagram](image)

**Test setup**

- **MAX resonance frequency** $f_{0\text{max}}$ = 2778 MHz
- **MIN resonance frequency** $f_{0\text{min}}$ = 2383 MHz
- **number of turns** $N_{\text{max}}$ = 5
- **counter clockwise turns** $\uparrow$ higher $f_0$ $\uparrow$
- **clock-wise turns** $\downarrow$ lower $f_0$ $\downarrow$

**Tuning performance**

- **MAX resonance frequency** $f_{0\text{max}}$ = 2778 MHz
- **MIN resonance frequency** $f_{0\text{min}}$ = 2383 MHz
- **number of turns** $N_{\text{max}}$ = 5

Attention:
- No upper stop!!
- Use only supplied tuning tool
- Actuate tuner carefully
- Do not apply too much pressure or torque
- Keep tuning tool coaxial
- Tuner might not be perfectly orthogonal to box

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**Graphs and plots**

- **Line graph** showing the relationship between $f_0$ and $N_{\text{max}}$

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Handling instructions

- Input laser polarization must be aligned with respect to the white markers on the housing
- Please handle device carefully. Avoid shock. Don't drop.
- After turn on the resonance frequency might drift slightly with applied RF power. Please compensate by tuning the RF drive frequency until steady-state (~min).

Package drawing

Note 1: mounting screws (M4x0.7) must not exceed 5mm length.

Note 2: crystal aperture is 3x3mm.

Attention!!

- use only supplied tuning tool
- actuate tuner carefully
- do not apply too much pressure or torque
- keep tuning tool coaxial
- tuner might not be perfectly orthogonal to box
TXC-option information

Delivery contents:
- TEC for active T-ctrl. (additional T-controller required)
- SMD capacitor: 1x 47uF - C1210C476M4PACTU
- Thermally insulating screw: M4, 1pc.
- Thermal pads: 2x, double sided adhesive (50x50mm²)

NTC characteristics

<table>
<thead>
<tr>
<th>TEC part number</th>
<th>Resistance (25°C) (Ω)</th>
<th>B-Constant (25-50°C) (K)</th>
<th>Operating Current for Sensor (25°C) (mA)</th>
<th>Rated Electric Power (25°C) (mW)</th>
<th>Typical Dissipation Constant (25°C) (mW/°C)</th>
<th>Thermal Time Constant (25°C) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXFT15XH03FA28050</td>
<td>10k +/- 1%</td>
<td>3380 +/- 1%</td>
<td>0.12</td>
<td>7.5</td>
<td>1.5</td>
<td>4</td>
</tr>
</tbody>
</table>

- Operating Current for Sensor rises Thermistor's temperature by 0.1°C
- Rated Electric Power shows the required electric power that causes Thermistor's temperature to rise to 30°C by self heating, at ambient temperature of 25°C.

**Graphic:**

- **NTC characteristic graph:**
  - Resistance (kΩ) vs. Temperature (°C)

- **TEC characteristic graph:**
  - Resistance (kΩ) vs. Temperature (°C)

**Table:**

<table>
<thead>
<tr>
<th>TEC part number</th>
<th>Imax (A)</th>
<th>Umax (V)</th>
<th>Qcmax (W)</th>
<th>ΔTmax (K)</th>
<th>Tmax (°C)</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>H (mm)</th>
<th>ID (mm)</th>
<th>Sealing</th>
</tr>
</thead>
<tbody>
<tr>
<td>UEPT-440-127-040M125S</td>
<td>4.0</td>
<td>15.2</td>
<td>40</td>
<td>67.0</td>
<td>125.0</td>
<td>40.0</td>
<td>40.0</td>
<td>4.6</td>
<td>4.5</td>
<td>Silicon</td>
</tr>
</tbody>
</table>

**Tested by:**

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