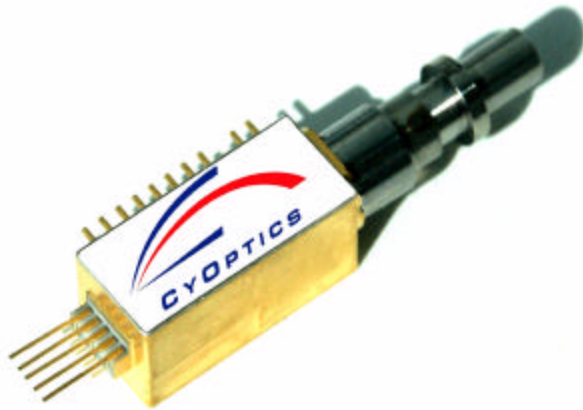


## 1635/36 - Series 10 Gb/s Cooled EML TOSA with integral driver IC



CyOptics' 1635/6-series 10Gb/s TOSA with integrated driver IC

### Features

- Ultra small form-factor TOSA with driver
- Data rates up to 10.7Gb/s
- For use up to 80km (1600 ps/nm) at 10 Gb/s
- Up to +2 dBm typical optical output power
- Wavelength selectable to ITU-T standards covering the full C-band
- Suitable for use in 100GHz channel spacing in DWDM systems
- Temperature stabilized
- Low TEC power consumption
- Operating case temperature range -5 to +75C

### Description

The 1635 (40km) and 1636 (80km) Series 10 Gb/s transmitter optical subassembly (TOSA) with driver integrates a high-speed electroabsorptive (EML) laser, a monitor photodiode, micro-TEC and EA driver IC in a small form-factor package. It is designed for use in small form-factor pluggable (XFP) transceivers and other types of optical modules for high-speed telecommunication and data applications including WDM SONET OC-192, SDH STM-64 and 10 Gigabit Ethernet.

The 1635/36 -Series is available in the full range of C-band ITU-T wavelengths operating at 10 Gb/s per channel. The device exhibits excellent wavelength stability, supporting operation at 100 GHz channel spacing over 20 years (assuming an end-of-life aging condition of  $<\pm 90$  pm), with low hazard rates ( $\sim 100$  FIT wearout over 20 yrs.).

### Applications

- XFP, X2, XENPAK and other Transceivers, 300 pin Transponders for DWDM and SONET/SDH, 10 GbE interfaces
- Line cards

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

| Parameter   | Conditions | Min        | Max          | Unit |
|---|------------|------------|--------------|------|
| Laser Diode Reverse Voltage   | CW         | —          | 2            | V    |
| Laser Diode Forward Current   | CW         | —          | 150          | mA   |
| Optical Output Power  | CW         | —          | 10           | mW   |
| Modulator Voltage   |            | -5         | 1            | V    |
| Driver Power Supply   | $V_{DD}$   | -0.3       | 6.5          | V    |
| Driver Input Data Voltage (DC coupled)                              |            | $V_{DD}-2$ | $V_{DD}+0.6$ | V    |
| Driver Input Data Amplitude (DC coupled)                            |            |            | 1.2          | V    |
| Driver Output Amplitude Control Voltage                             | $V_{ER}$   | -0.3       | 1.6          | V    |
| Modulator Offset Control Voltage                                    | $V_{EAO}$  | -3         | 0.5          | V    |
| Duty Cycle Control Voltage  | $V_{DUT}$  | 0          | 3            | V    |
| Monitor Diode Reverse Voltage                                       | —          | —          | 10           | V    |
| Monitor Diode Forward Current                                       | —          | —          | 2            | mA   |
| Storage Temperature Range   | —          | -40        | 85           | °C   |
| Operating Case Temperature Range                                    | —          | -5         | 75           | °C   |
| TEC Supply Voltage  | —          | —          | 2            | V    |
| TEC Supply Current  | —          | —          | 1.2          | A    |
| Lead Soldering Temperature (10 seconds maximum, local heating only) | —          | —          | 260          | °C   |

## Electrostatic Discharge

**CAUTION: This device is susceptible to damage as a result of electrostatic discharge. Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A (Dec. 1988).**

CyOptics employs a human-body model (HBM) for ESD-susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 k $\Omega$ , capacitance = 100pF) is widely used and can be used for comparison purposes.

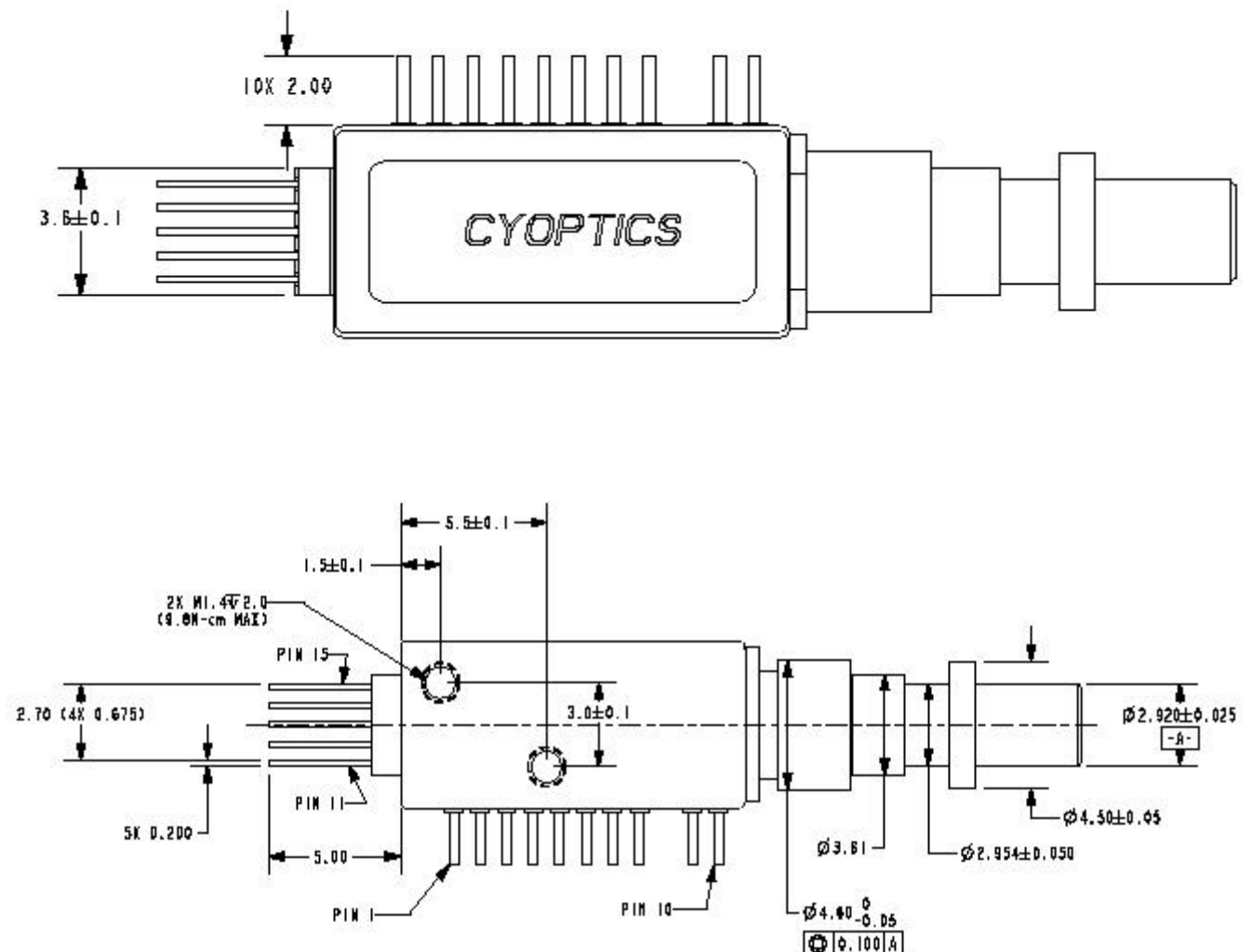
## Electrical/Optical Characteristics

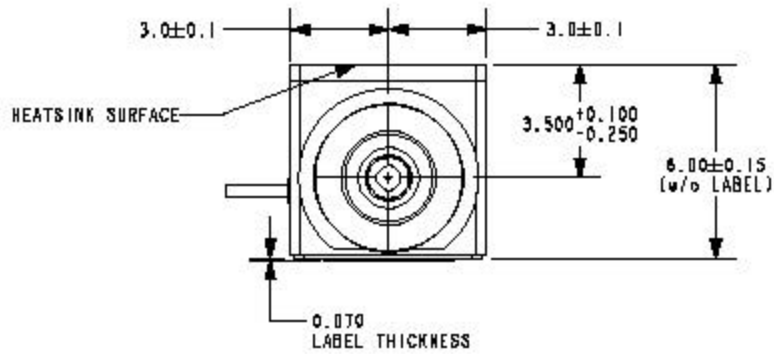
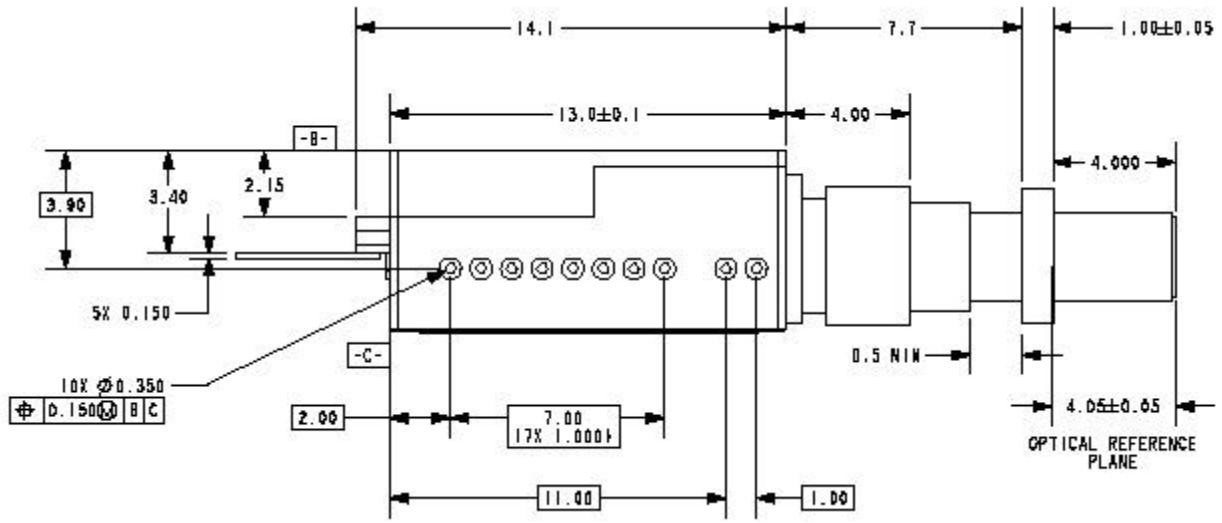
**Table 1. Optical and Electrical Specifications** (Chip operating temp. = 30 to 40C, except where noted. Nominal 50% duty cycle data signal, except where noted.). All parameters are end of life (EOL) unless stated otherwise.

| Parameter   | Symbol                | Conditions   | Min                   | Max              | Unit                     |
|---|-----------------------|--|-----------------------|------------------|--------------------------|
| Laser Operating Temperature   | $T_{OP}$              | $T_{case} = -5$ to $+75C$  | 30                    | 40               | C                        |
| Threshold Current (BOL)   | $I_{TH}$              | —  | —                     | 35               | mA                       |
| Laser Forward Voltage   | $V_F$                 | $I_F = I_{OP}$ @ $T_{OP}$  | —                     | 2                | V                        |
| Operating Current (BOL)   | $I_{OP}$              | $P_F = 0.5dBm$ min.  | —                     | 100              | mA                       |
| Threshold Power   | $P_{TH}$              | $I_F = I_{TH}$   | —                     | 100              | $\mu W$                  |
| Relative Intensity Noise  | RIN                   | 0-10GHz  | —                     | -130             | dB/Hz                    |
| Fiber Output Power (average):<br>40km (1635) (BOL)<br>40km (1635) (EOL)<br>80km (1636) (BOL)<br>80km (1636) (EOL) | $P_{AVG}$             | $I_F = I_{OP}$ @ $T_{OP}$<br>$V_{ON}, V_{PP}$                      | 0<br>-0.5<br>1<br>0.5 | 2<br>2<br>4<br>4 | dBm<br>dBm<br>dBm<br>dBm |
| Data Input Amplitude  | $V_{in, PP}$          | AC coupled, differential   | 0.35                  | 1.2              | V                        |
| Extinction ratio control voltage  | $V_{ER}$              |  | 0                     | 1.2              | V                        |
| Current into $V_{ER}$ pin   | $I_{ER}$              |  | —                     | 0.5              | mA                       |
| Modulator Offset Control Voltage  | $V_{EAO}$             |  | -2.5                  | 0                | V                        |
| Current into $V_{EAO}$ pin  | $I_{EAO}$             |  | —                     | 30               | mA                       |
| Duty Control Voltage  | $V_{DUT}$             | 35%-80% crossing   | 0.4                   | 1.8              | V                        |
| Current into $V_{DUT}$ pin  | $I_{DUT}$             |  | —                     | 1.5              | mA                       |
| Driver IC Supply Voltage  | $V_{DD}$              |  | 4.75                  | 5.25             | V                        |
| Driver IC Supply Current  | $I_{DD}$              |  | —                     | 0.25             | A                        |
| Center Wavelength (DWDM versions)   | $\lambda_c$           | CW, $T_{LASER} = 30-40C$   | 1528.7                | 1563.9           | nm                       |
| Center Wavelength (TDM versions)  |                       |  | 1528                  | 1565             | nm                       |
| Center Wavelength tuning coefficient  | —                     | —  | —                     | 0.13             | nm/C                     |
| Linewidth (3 dB FWHM)   | $\Delta\lambda_{3dB}$ | CW, $I_{bias} = I_{OP}$  | —                     | 15               | MHz                      |
| Side-mode Suppression Ratio   | SMSR                  | CW, $I_{bias} = I_{OP}$  | 35                    | —                | dB                       |
| Extinction Ratio (40km codes) (BOL)   | ER                    | $V_{ON}, V_{PP}$   | 9.2                   | —                | dB                       |
| Extinction Ratio (80km codes) (BOL)   |                       |  | 10                    | —                | dB                       |
| Rise/ fall time   | $T_r, T_f$            | 20-80%, unfiltered eye   | —                     | 30               | ps                       |
| Center wavelength stability   | $\Delta\lambda_D$     | $T_{case} = -5$ to $+75C$  | -90                   | 90               | pm                       |
| Dispersion Penalty<br>1635 (800 ps/nm)<br>1636 (1600 ps/nm)   | DP                    | 10Gb/s, ER, $I_F = I_{OP}$ @ $T_{OP}$<br>BER = $1 \times 10^{-12}$ | —<br>—                | 2.0<br>2.0       | dB<br>dB                 |
| <b>RF Characteristics</b>   |                       |  |                       |                  |                          |
| Input Impedance   | $Z_{IN}$              | —  | 48                    | 55               | $\Omega$                 |
| <b>Monitor Diode</b>  |                       |  |                       |                  |                          |
| Monitor Bias Voltage  | $V_{rmon}$            | —  | 3                     | 10               | V                        |
| Monitor Current   | $I_{BD}$              | $I_{op}, T_{op}$   | 0.2                   | 2                | mA                       |
| Dark Current  | $I_D$                 | $I_F = 0, V_{rmon} = 5V$   | —                     | 0.1              | $\mu A$                  |
| Tracking Error  | TE                    |  | -0.5                  | 0.5              | dB                       |
| <b>Thermistor</b>   |                       |  |                       |                  |                          |
| Resistance (standard 10k $\Omega$ @25C thermistor)  | $R_{THERM}$           | $T = 35C$  | 6.4                   | 6.6              | k $\Omega$               |
| Thermistor B-constant   | B                     |  | 3800                  | 4000             | K                        |
| Thermistor Current  | $I_{TC}$              | —  | 10                    | 100              | $\mu A$                  |

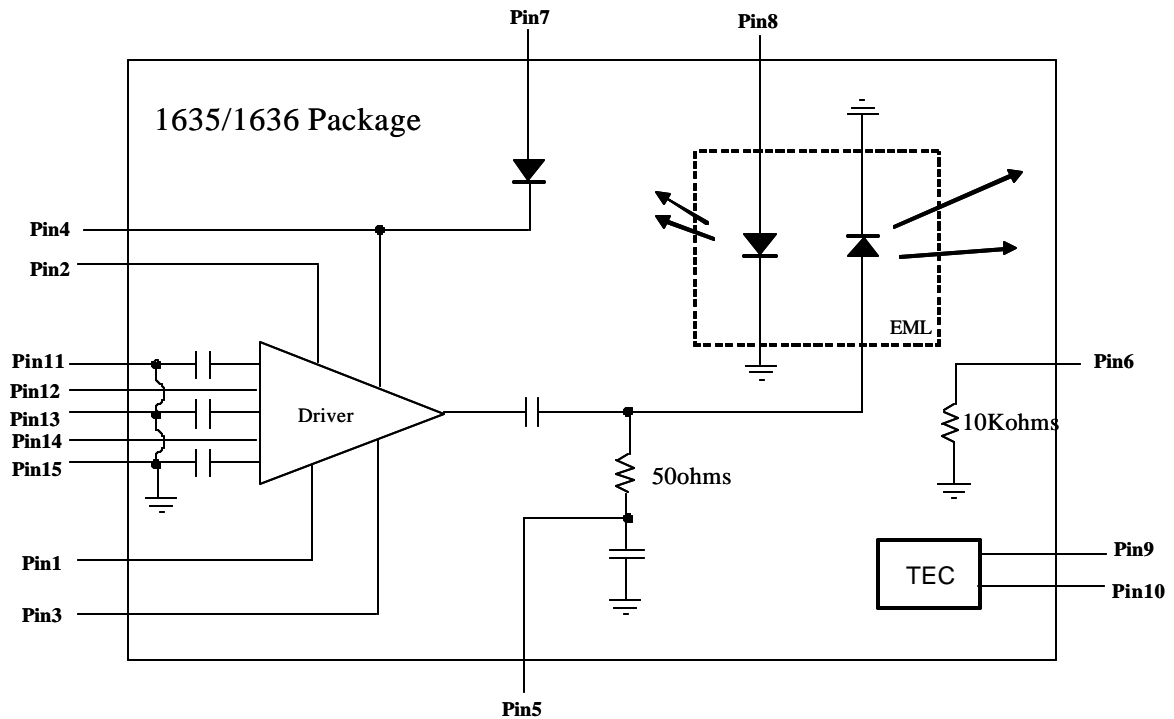
| Parameter                                    | Symbol                       | Conditions   | Min | Max  | Unit |
|--|------------------------------|--|-----|------|------|
| <b>Thermoelectric Cooler (TEC)</b>           |                              |  |     |      |      |
| TEC Current                                  | $I_{TEC}$                    | $T_{CASE} = -5$ to $+75C$<br>$T_{LASER} = 30-40C$ (DWDM)<br>$I_{LASER} = 100mA$<br>$V_{EAO} = -2.2V$ | —   | 1    | A    |
| TEC Voltage                                  | $V_{TEC}$                    |  | —   | 2    | V    |
| TEC Power (TDM versions)                     | $P_{TEC}$                    |  | —   | 0.7  | W    |
| TEC Power (DWDM versions)                    | $P_{TEC}$                    |  |     | 0.75 | W    |
| TEC Capacity                                 | $\Delta T$                   |  | -50 | 45   | C    |
| <b>Optical Isolation</b>                     |                              |  |     |      |      |
| Optical Isolation                            | —                            | $T_{CASE} = 75C$   | 30  | —    | dB   |
| <b>Package</b>                               |                              |  |     |      |      |
| Center Wavelength Drift vs. Case Temperature | $\Delta\lambda_c/\Delta T_c$ | $T_{CASE} = -5C$ to $+75C$   | —   | 0.4  | pm/C |

### Outline Drawing





## Electrical Schematic and Pin Information



| Pin# | Assignment                        |
|------|-----------------------------------|
| 1    | PWC, Pulse Width Control          |
| 2    | Vee, 0V                           |
| 3    | Ver, Modulation Amplitude Control |
| 4    | Vcc, +5V                          |
| 5    | Veao, Modulator On Voltage        |
| 6    | Rth, Thermistor                   |
| 7    | Ibd, Backface Monitor Anode       |
| 8    | Ibias, Laser Diode Anode          |
| 9    | TEC+                              |
| 10   | TEC-                              |
| 11   | RF GND, Floating from Case        |
| 12   | DataN                             |
| 13   | RF GND, Floating from Case        |
| 14   | Data                              |
| 15   | RF GND, Floating from Case        |

**Ordering Information (LC Receptacle versions)**

| 40km Version | 80km Version | ITU-T Frequency (THz) | Center Wavelength (nm) |
|--------------|--------------|-----------------------|------------------------|
| 1635L0       | 1636L0       | (TDM)                 | (TDM)                  |
| 1635L061     | 1636L061     | 196.1                 | 1528.77                |
| 1635L060     | 1636L060     | 196.0                 | 1529.55                |
| 1635L059     | 1636L059     | 195.9                 | 1530.33                |
| 1635L058     | 1636L058     | 195.8                 | 1531.12                |
| 1635L057     | 1636L057     | 195.7                 | 1531.90                |
| 1635L056     | 1636L056     | 195.6                 | 1532.68                |
| 1635L055     | 1636L055     | 195.5                 | 1533.47                |
| 1635L054     | 1636L054     | 195.4                 | 1534.25                |
| 1635L053     | 1636L053     | 195.3                 | 1535.04                |
| 1635L052     | 1636L052     | 195.2                 | 1535.82                |
| 1635L051     | 1636L051     | 195.1                 | 1536.61                |
| 1635L050     | 1636L050     | 195.0                 | 1537.40                |
| 1635L049     | 1636L049     | 194.9                 | 1538.19                |
| 1635L048     | 1636L048     | 194.8                 | 1538.98                |
| 1635L047     | 1636L047     | 194.7                 | 1539.77                |
| 1635L046     | 1636L046     | 194.6                 | 1540.56                |
| 1635L045     | 1636L045     | 194.5                 | 1541.35                |
| 1635L044     | 1636L044     | 194.4                 | 1542.14                |
| 1635L043     | 1636L043     | 194.3                 | 1542.94                |
| 1635L042     | 1636L042     | 194.2                 | 1543.73                |
| 1635L041     | 1636L041     | 194.1                 | 1544.53                |
| 1635L040     | 1636L040     | 194.0                 | 1545.32                |
| 1635L039     | 1636L039     | 193.9                 | 1546.12                |
| 1635L038     | 1636L038     | 193.8                 | 1546.92                |
| 1635L037     | 1636L037     | 193.7                 | 1547.72                |
| 1635L036     | 1636L036     | 193.6                 | 1548.51                |
| 1635L035     | 1636L035     | 193.5                 | 1549.32                |
| 1635L034     | 1636L034     | 193.4                 | 1550.12                |
| 1635L033     | 1636L033     | 193.3                 | 1550.92                |
| 1635L032     | 1636L032     | 193.2                 | 1551.72                |
| 1635L031     | 1636L031     | 193.1                 | 1552.52                |
| 1635L030     | 1636L030     | 193.0                 | 1553.33                |
| 1635L029     | 1636L029     | 192.9                 | 1554.13                |
| 1635L028     | 1636L028     | 192.8                 | 1554.94                |
| 1635L027     | 1636L027     | 192.7                 | 1555.75                |
| 1635L026     | 1636L026     | 192.6                 | 1556.56                |
| 1635L025     | 1636L025     | 192.5                 | 1557.36                |
| 1635L024     | 1636L024     | 192.4                 | 1558.17                |
| 1635L023     | 1636L023     | 192.3                 | 1558.98                |
| 1635L022     | 1636L022     | 192.2                 | 1559.79                |
| 1635L021     | 1636L021     | 192.1                 | 1560.61                |
| 1635L020     | 1636L020     | 192.0                 | 1561.42                |
| 1635L019     | 1636L019     | 191.9                 | 1562.23                |
| 1635L018     | 1636L018     | 191.8                 | 1563.05                |
| 1635L017     | 1636L017     | 191.7                 | 1563.86                |
| TBD          | TBD          | 191.6                 | 1564.68                |
| TBD          | TBD          | 191.5                 | 1565.50                |

**Ordering Information (SC Receptacle versions)**

| 40km Version | 80km Version | ITU-T Frequency (THz) | Center Wavelength (nm) |
|--------------|--------------|-----------------------|------------------------|
| 1635S0       | 1636S0       | (TDM)                 | (TDM)                  |
| 1635S061     | 1636S061     | 196.1                 | 1528.77                |
| 1635S060     | 1636S060     | 196.0                 | 1529.55                |
| 1635S059     | 1636S059     | 195.9                 | 1530.33                |
| 1635S058     | 1636S058     | 195.8                 | 1531.12                |
| 1635S057     | 1636S057     | 195.7                 | 1531.90                |
| 1635S056     | 1636S056     | 195.6                 | 1532.68                |
| 1635S055     | 1636S055     | 195.5                 | 1533.47                |
| 1635S054     | 1636S054     | 195.4                 | 1534.25                |
| 1635S053     | 1636S053     | 195.3                 | 1535.04                |
| 1635S052     | 1636S052     | 195.2                 | 1535.82                |
| 1635S051     | 1636S051     | 195.1                 | 1536.61                |
| 1635S050     | 1636S050     | 195.0                 | 1537.40                |
| 1635S049     | 1636S049     | 194.9                 | 1538.19                |
| 1635S048     | 1636S048     | 194.8                 | 1538.98                |
| 1635S047     | 1636S047     | 194.7                 | 1539.77                |
| 1635S046     | 1636S046     | 194.6                 | 1540.56                |
| 1635S045     | 1636S045     | 194.5                 | 1541.35                |
| 1635S044     | 1636S044     | 194.4                 | 1542.14                |
| 1635S043     | 1636S043     | 194.3                 | 1542.94                |
| 1635S042     | 1636S042     | 194.2                 | 1543.73                |
| 1635S041     | 1636S041     | 194.1                 | 1544.53                |
| 1635S040     | 1636S040     | 194.0                 | 1545.32                |
| 1635S039     | 1636S039     | 193.9                 | 1546.12                |
| 1635S038     | 1636S038     | 193.8                 | 1546.92                |
| 1635S037     | 1636S037     | 193.7                 | 1547.72                |
| 1635S036     | 1636S036     | 193.6                 | 1548.51                |
| 1635S035     | 1636S035     | 193.5                 | 1549.32                |
| 1635S034     | 1636S034     | 193.4                 | 1550.12                |
| 1635S033     | 1636S033     | 193.3                 | 1550.92                |
| 1635S032     | 1636S032     | 193.2                 | 1551.72                |
| 1635S031     | 1636S031     | 193.1                 | 1552.52                |
| 1635S030     | 1636S030     | 193.0                 | 1553.33                |
| 1635S029     | 1636S029     | 192.9                 | 1554.13                |
| 1635S028     | 1636S028     | 192.8                 | 1554.94                |
| 1635S027     | 1636S027     | 192.7                 | 1555.75                |
| 1635S026     | 1636S026     | 192.6                 | 1556.56                |
| 1635S025     | 1636S025     | 192.5                 | 1557.36                |
| 1635S024     | 1636S024     | 192.4                 | 1558.17                |
| 1635S023     | 1636S023     | 192.3                 | 1558.98                |
| 1635S022     | 1636S022     | 192.2                 | 1559.79                |
| 1635S021     | 1636S021     | 192.1                 | 1560.61                |
| 1635S020     | 1636S020     | 192.0                 | 1561.42                |
| 1635S019     | 1636S019     | 191.9                 | 1562.23                |
| 1635S018     | 1636S018     | 191.8                 | 1563.05                |
| 1635S017     | 1636S017     | 191.7                 | 1563.86                |
| TBD          | TBD          | 191.6                 | 1564.68                |
| TBD          | TBD          | 191.5                 | 1565.50                |

**Ordering Information (Fiber Pigtail versions with FC/PC connector)**

| 40km Version | 80km Version | ITU-T Frequency (THz) | Center Wavelength (nm) |
|--------------|--------------|-----------------------|------------------------|
| 1635F0       | 1636F0       | (TDM)                 | (TDM)                  |
| 1635F061     | 1636F061     | 196.1                 | 1528.77                |
| 1635F060     | 1636F060     | 196.0                 | 1529.55                |
| 1635F059     | 1636F059     | 195.9                 | 1530.33                |
| 1635F058     | 1636F058     | 195.8                 | 1531.12                |
| 1635F057     | 1636F057     | 195.7                 | 1531.90                |
| 1635F056     | 1636F056     | 195.6                 | 1532.68                |
| 1635F055     | 1636F055     | 195.5                 | 1533.47                |
| 1635F054     | 1636F054     | 195.4                 | 1534.25                |
| 1635F053     | 1636F053     | 195.3                 | 1535.04                |
| 1635F052     | 1636F052     | 195.2                 | 1535.82                |
| 1635F051     | 1636F051     | 195.1                 | 1536.61                |
| 1635F050     | 1636F050     | 195.0                 | 1537.40                |
| 1635F049     | 1636F049     | 194.9                 | 1538.19                |
| 1635F048     | 1636F048     | 194.8                 | 1538.98                |
| 1635F047     | 1636F047     | 194.7                 | 1539.77                |
| 1635F046     | 1636F046     | 194.6                 | 1540.56                |
| 1635F045     | 1636F045     | 194.5                 | 1541.35                |
| 1635F044     | 1636F044     | 194.4                 | 1542.14                |
| 1635F043     | 1636F043     | 194.3                 | 1542.94                |
| 1635F042     | 1636F042     | 194.2                 | 1543.73                |
| 1635F041     | 1636F041     | 194.1                 | 1544.53                |
| 1635F040     | 1636F040     | 194.0                 | 1545.32                |
| 1635F039     | 1636F039     | 193.9                 | 1546.12                |
| 1635F038     | 1636F038     | 193.8                 | 1546.92                |
| 1635F037     | 1636F037     | 193.7                 | 1547.72                |
| 1635F036     | 1636F036     | 193.6                 | 1548.51                |
| 1635F035     | 1636F035     | 193.5                 | 1549.32                |
| 1635F034     | 1636F034     | 193.4                 | 1550.12                |
| 1635F033     | 1636F033     | 193.3                 | 1550.92                |
| 1635F032     | 1636F032     | 193.2                 | 1551.72                |
| 1635F031     | 1636F031     | 193.1                 | 1552.52                |
| 1635F030     | 1636F030     | 193.0                 | 1553.33                |
| 1635F029     | 1636F029     | 192.9                 | 1554.13                |
| 1635F028     | 1636F028     | 192.8                 | 1554.94                |
| 1635F027     | 1636F027     | 192.7                 | 1555.75                |
| 1635F026     | 1636F026     | 192.6                 | 1556.56                |
| 1635F025     | 1636F025     | 192.5                 | 1557.36                |
| 1635F024     | 1636F024     | 192.4                 | 1558.17                |
| 1635F023     | 1636F023     | 192.3                 | 1558.98                |
| 1635F022     | 1636F022     | 192.2                 | 1559.79                |
| 1635F021     | 1636F021     | 192.1                 | 1560.61                |
| 1635F020     | 1636F020     | 192.0                 | 1561.42                |
| 1635F019     | 1636F019     | 191.9                 | 1562.23                |
| 1635F018     | 1636F018     | 191.8                 | 1563.05                |
| 1635F017     | 1636F017     | 191.7                 | 1563.86                |
| TBD          | TBD          | 191.6                 | 1564.68                |
| TBD          | TBD          | 191.5                 | 1565.50                |

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