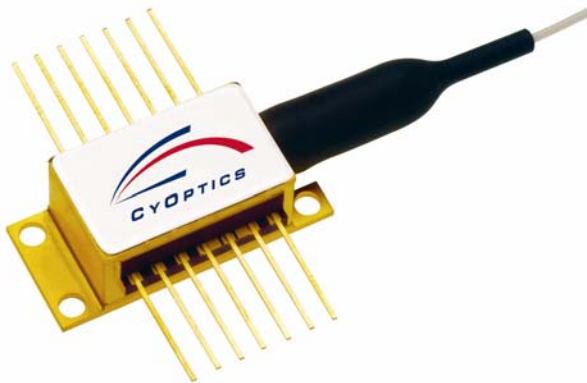


## **Wavelength-Selectable High-Power D2547P-Type CW DFB Laser Module**

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Featuring wavelength selection to the DWDM ITU-T grid, the D2547P Laser Modules are ideally suited for use with external lithium niobate modulators, and in high-power (20 mW) applications.

### **Features**

- High-performance, multiquantum-well (MQW), distributed-feedback (DFB) laser
- D2547P-Type is offered on 100 GHz ITU grid wavelengths ranging from 1528.77 nm—1610.06 nm
- Polarization-maintaining fiber pigtail
- For use with lithium niobate modulators
- High optical power (20 mW, CW)
- Hermetic, 14-pin package

### **Applications**

- Telecommunications:
  - Dense WDM
  - SONET/SDH OC-192/ STM-64
  - Extended and ultra-long reach
  - Undersea systems
- Digital video

### **Description**

The D2547P-Type DFB laser module is designed for use with an external lithium niobate modulator and also in applications where high power (20 mW) is required.

The laser comes packaged in an industry-standard 14-pin butterfly module with a polarization-maintaining fiber pigtail.

Temperature-stabilized with a thermoelectric cooler (TEC) and thermistor, the package is available in C and L band ITU-T grid wavelengths on a 100 GHz spacing plan.

D2547P does not contain a wavelength locker, which is not needed for high-reliability operation in 100GHz-spaced applications. For a 20 mW CW laser butterfly version with integrated wavelength locker and available on a 50 GHz grid, refer to the companion product data sheet for D3587P.

## Description (continued)

### Controlled Feedback

The module contains an internal optical isolator that suppresses optical feedback in laser-based, fiber-optic systems. Light reflected back to the laser is attenuated a minimum of 30 dB.

### Controlled Temperature

An integral TEC provides stable thermal characteristics. The TEC allows for heating and cooling of the laser chip to maintain a temperature constant as the case temperature changes from  $-5^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$ . The laser temperature is monitored by the internal thermistor, which can be used with external circuitry to control the laser chip temperature.

### Controlled Power

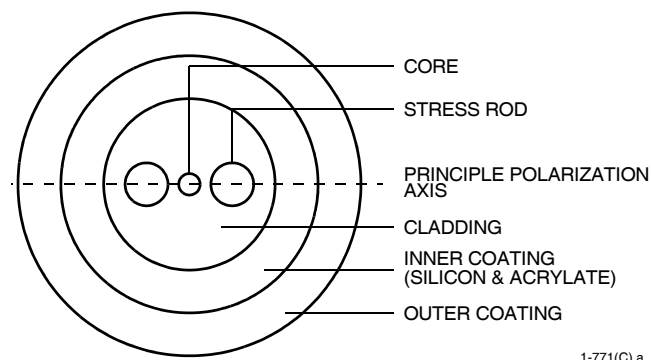
An InGaAs PIN photodiode functions as the back-facet power monitor. The photodiode monitors emission from the rear facet of the laser and, when used in conjunction with control circuitry, can control optical power launched into the fiber. Normally, this configuration is used in a feedback arrangement to maintain consistent laser output power.

### Standard Package

The laser module is fabricated in a 14-pin, hermetic, metal/ceramic butterfly package.

The laser module is equipped with *Fujikura*® polarization-maintaining fiber (PMF). The fiber is PANDA type it has a mode field diameter of  $10.5\text{ }\mu\text{m}$ , a cladding diameter of  $125\text{ }\mu\text{m} \pm 3\text{ }\mu\text{m}$ , and a tight-buffered coating, all within a  $900\text{ }\mu\text{m}$  diameter, loose tube jacket. Figure 1 shows the orientation of polarization in the fiber without the loose tubing.

CyOptics' optoelectronic components are qualified to rigorous internal standards that are consistent with *Telcordia Technologies*™ TR-NWT-000468. All design and manufacturing operations are *ISO*® 9001 certified.



**Figure 1. Polarization-Maintaining Fiber without Jacket**

## Pin Information

**Table 1. Pin Descriptions**

| Pin | D2547P-Type                    |
|-----|--------------------------------|
| 1   | Thermistor                     |
| 2   | Thermistor                     |
| 3   | Laser dc Bias (Cathode) (–)    |
| 4   | Back-facet Monitor Anode (–)   |
| 5   | Back-facet Monitor Cathode (+) |
| 6   | TEC (+) <sup>1</sup>           |
| 7   | TEC (–) <sup>1</sup>           |
| 8   | Case Ground                    |
| 9   | Case Ground                    |
| 10  | Case Ground                    |
| 11  | Laser Anode (+)                |
| 12  | Laser Input Cathode (–)        |
| 13  | Laser Anode (+)                |
| 14  | Case Ground                    |

1. A positive current through the thermoelectric heat pump cools the laser.

## Functional Description

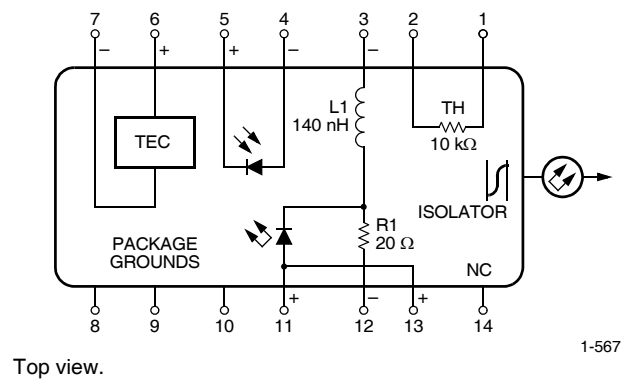


Figure 2. D2547P Circuit Schematic

## 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 operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

| Parameter                                          | Symbol           | Min | Max             | Unit |
|----------------------------------------------------|------------------|-----|-----------------|------|
| Laser DC Reverse Voltage                           | VRLMAX           | —   | 2               | V    |
| Laser DC Forward Current                           | IFLMAX           | —   | 225             | mA   |
| Operating Case Temperature Range                   | T <sub>C</sub>   | –5  | 75              | °C   |
| Storage Case Temperature Range <sup>1</sup>        | T <sub>stg</sub> | –40 | 85 <sup>2</sup> | °C   |
| Photodiode dc Reverse Voltage                      | VRPDMAX          | —   | 10              | V    |
| Photodiode dc Forward Current                      | IFPDMAX          | —   | 2               | mA   |
| Thermistor Temperature <sup>3</sup>                | —                | —   | 100             | °C   |
| Thermoelectric Cooler in Heating Mode <sup>3</sup> | ITEC             | —   | 0.5             | A    |

1. Does not apply to shipping container.

2. Maximum 2000 hrs. at extreme conditions.

3. To prevent package over-temperature conditions.

## Handling Precautions

### Power Sequencing

To avoid the possibility of damage to the laser module from power supply switching transients, follow this turn-on sequence:

1. All ground connections
2. Most negative supply
3. Most positive supply
4. All remaining connections

Reverse the order for the proper turn-off sequence.

## 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).

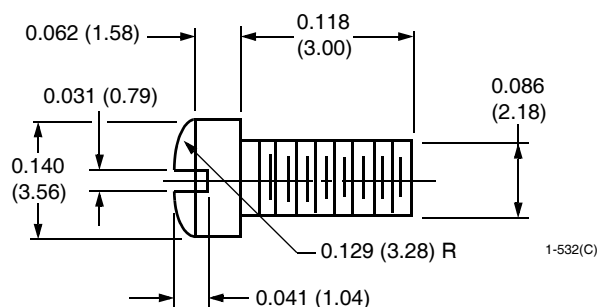
CyOptics employs a human-body model (HBM) for ESD-susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 kΩ, capacitance = 100 pF) is widely used and, therefore, can be used for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

## Mounting Instructions

The minimum fiber bend radius is 1.0 in. (25.4 mm).

To avoid degradation in performance, mount the module on the board as follows:

1. Place the bottom flange of the module on a flat heat sink at least 0.5 in. x 1.180 in. (12.7 mm x 30 mm) in size. The surface finish of the heat sink should be better than 32 μin. (0.8 μm), and the surface flatness must be better than 0.001 in. (25.4 μm). Using thermal conductive grease is optional; however, thermal performance can be improved by up to 5% if conductive grease is applied between the bottom flange and the heat sink.
2. Mount four #2-56 screws with Fillister heads (M2-3 mm) at the four screw hole locations (see Outline Diagram). The Fillister head diameter must not exceed 0.140 in. (3.55 mm). Do not apply more than 1 in.-lb. of torque to the screws.



Note: Dimensions are in inches and (millimeters).

**Figure 3. Fillister Head Screw**

For additional information and latest specifications, see our website: [www.cyoptics.com](http://www.cyoptics.com)

## Characteristics

Minimum and maximum values are testing requirements. Typical values are device characteristics and are results of engineering evaluations; they are for information purposes only and are not part of the testing requirements. All parameters are beginning of life, unless otherwise specified.

**Table 2. D2547P-Type Electrical Characteristics**

| Parameter                                 | Symbol      | Test Conditions                   | Min | Typ  | Max  | Unit             |
|-------------------------------------------|-------------|-----------------------------------|-----|------|------|------------------|
| Threshold Current                         | $I_{TH}$    | —                                 | —   | 15   | 40   | mA               |
| Drive Current                             | —           | $I_F = 20 \text{ mW}$             | —   | —    | 165  | mA               |
| Laser Forward Voltage                     | $V_{LF}$    | $I_F = 20 \text{ mW (CW)}$        | —   | 2    | 2.5  | V                |
| Monitor Reverse-bias Voltage <sup>1</sup> | $V_{RMON}$  | —                                 | 3   | 5    | 10   | V                |
| Back-facet Monitor Current:               | $I_{RMON}$  | $P_O = 20 \text{ mW (CW)}$        | 0.2 | —    | 3.0  | mA               |
| Monitor Dark Current                      | $I_D$       | $I_F = 0, V_{RMON} = 5 \text{ V}$ | —   | 0.01 | 0.1  | $\mu\text{A}$    |
| Input Impedance                           | $Z_{IN}$    | —                                 | —   | 25   | —    | $\Omega$         |
| Thermistor Current                        | $I_{TC}$    | —                                 | 10  | —    | 100  | $\mu\text{A}$    |
| Resistance Ratio <sup>2</sup>             | —           | —                                 | 9.1 | 9.6  | 10.1 | —                |
| Thermistor Resistance                     | $R_{TH}$    | $T_L = 25 \text{ }^\circ\text{C}$ | 9.5 | —    | 10.5 | k $\Omega$       |
| Laser Submount Temperature                | $T_{LASER}$ | —                                 | 20  | —    | 35   | $^\circ\text{C}$ |
| TEC Current                               | $I_{TEC}$   | $T_C = 75 \text{ }^\circ\text{C}$ | —   | —    | 1.2  | A                |
| TEC Voltage                               | $V_{TEC}$   | $T_C = 75 \text{ }^\circ\text{C}$ | —   | —    | 2.5  | V                |
| TEC Capacity                              | $\Delta T$  | $T_C = 75 \text{ }^\circ\text{C}$ | —   | —    | 55   | $^\circ\text{C}$ |

<sup>1</sup> Standard operating condition is 5.0 V reverse bias.

<sup>2</sup> Ratio of thermistor resistance at 0  $^\circ\text{C}$  to thermistor resistance at 50  $^\circ\text{C}$ .

**Table 3. D2547P-Type Optical Characteristics**

| Parameter                                          | Symbol            | Test Conditions                                                     | Min     | Typ | Max       | Unit   |
|----------------------------------------------------|-------------------|---------------------------------------------------------------------|---------|-----|-----------|--------|
| Optical Output Power                               | $P_P$             | —                                                                   | 20.0    | —   | —         | mW     |
| Center Wavelength*<br>(See Ordering Information)   | $\lambda_C$       | $T_L = T_{SET}$<br>$\lambda_C = \lambda_{ITU} \pm 0.1 \text{ nm}$   | 1528.77 | —   | 1610.06   | nm     |
| Line Width (3 dB full width)                       | $\Delta\lambda$   | CW, $P_F = 20.0 \text{ mW}$                                         | —       | 2   | 10        | MHz    |
| Side-mode Suppression Ratio                        | SMSR              | CW                                                                  | 35      | 45  | —         | dB     |
| Relative Intensity Noise                           | RIN               | CW, $P_F = 20 \text{ mW}$<br>$200 \text{ MHz} < f < 10 \text{ GHz}$ | —       | —   | -135      | dB/Hz  |
| Optical Isolation                                  | —                 | $T_C = 0 \text{ }^\circ\text{C}$ to $75 \text{ }^\circ\text{C}$     | 30      | —   | —         | dB     |
| Optical Polarization Extinction Ratio <sup>†</sup> | —                 | $0 \text{ }^\circ\text{C}$ to $75 \text{ }^\circ\text{C}$           | 20      | —   | —         | dB     |
| FM Efficiency                                      | FM                | $P_F = 20 \text{ mW}$                                               | —       | 100 | —         | MHz/mA |
| Wavelength Drift (EOL)                             | $\Delta\lambda_C$ | Tested over<br>25-year lifetime                                     | —       | —   | $\pm 0.1$ | nm     |

\* Custom wavelengths available.

<sup>†</sup> The ST ferrule key is not aligned to slow axis of fiber. Connector is intended for testing purposes only.

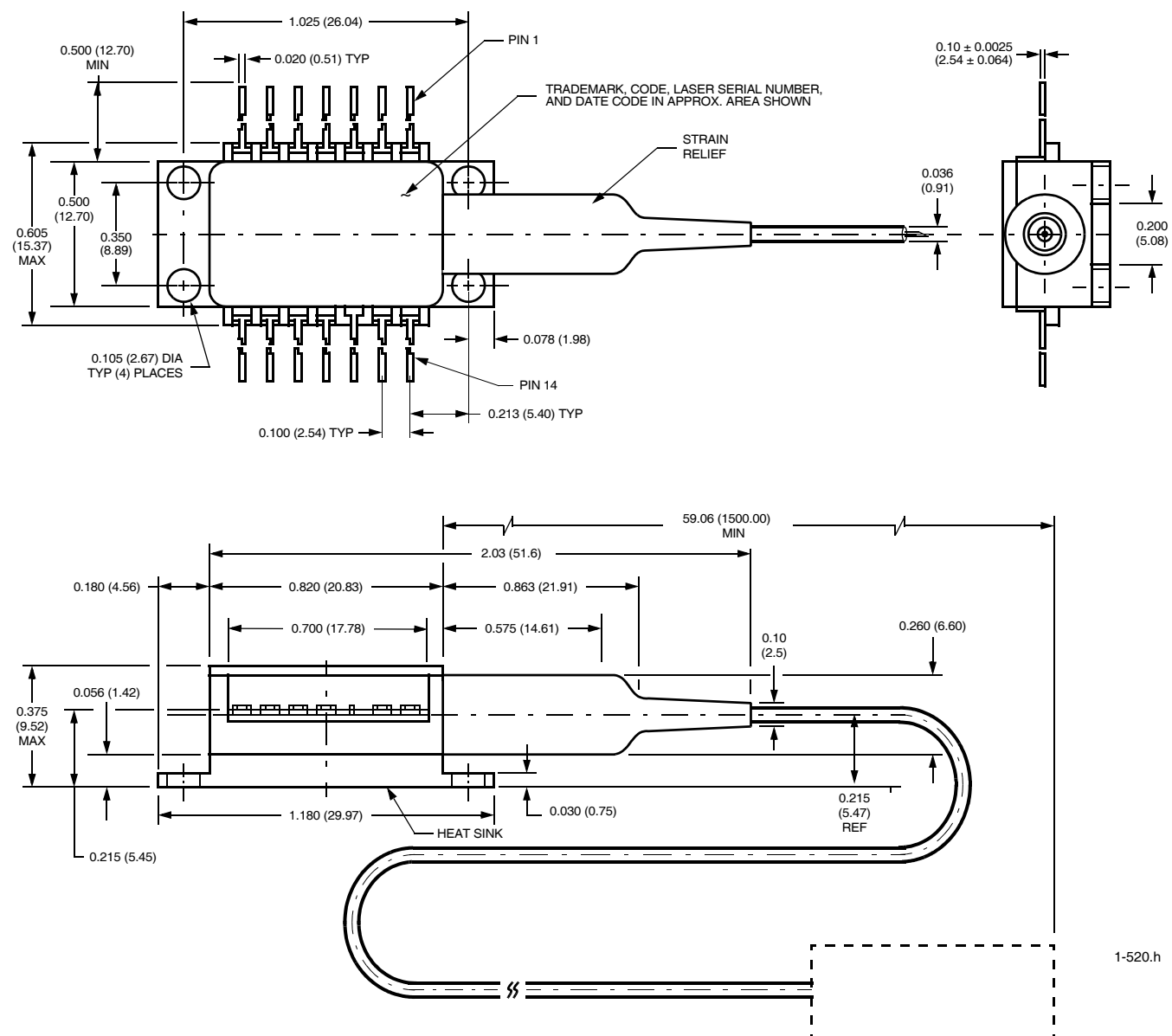
## Characteristics (continued)

Table 4. D2547P Fiber Pigtail and Optical Connector Characteristics

| Parameter       | Symbol | Description                                                 | Min | Typ | Max | Unit |
|-----------------|--------|-------------------------------------------------------------|-----|-----|-----|------|
| Pigtail Length  | L      | Fujikura PANDA or equivalent polarization-maintaining fiber | 1.5 | —   | —   | m    |
| Connector Style | —      | ST plug (FC/PC optional)                                    | —   | —   | —   | —    |

## Outline Diagram

Dimensions are in inches and (millimeters). Tolerances are  $\pm 0.005$  in. ( $\pm 0.127$  mm).



## High-Power Product

### Class IIIb Laser Product

FDA/CDRH Class IIIb laser product. All versions are Class IIIb laser products per CDRH, 21 CFR 1040 Laser Safety requirements. All versions are classified Class 3B laser products consistent with *IEC*® 60825-1: 1993. This device family has been classified with the FDA under accession number 8720010. Measurements were made to classify the product per *IEC* 60825-1: 1993.

This product complies with 21 CFR 1040.10 and 1040.11.

PANDA-type 10.5  $\mu\text{m}$ /125  $\mu\text{m}$   $\pm 3$   $\mu\text{m}$  single-mode fiber with a tight-buffered coating, all within a 900  $\mu\text{m}$  diameter, loose-tube jacket. Connector is included.

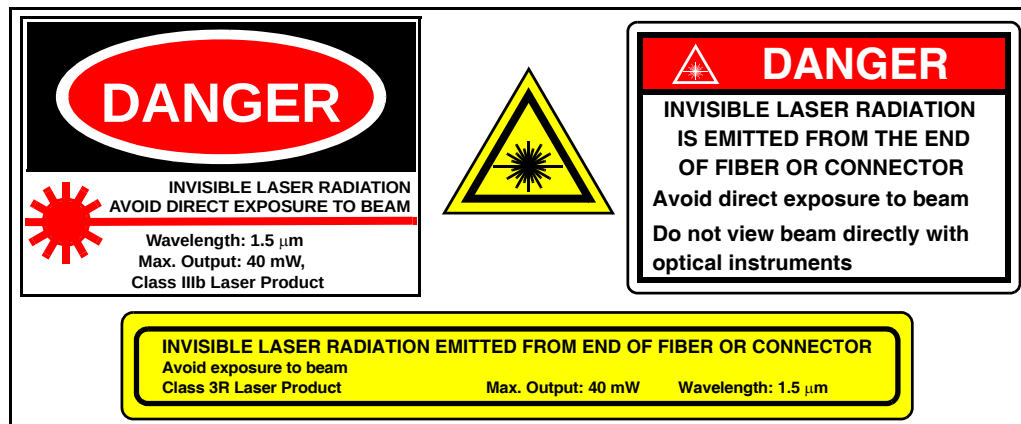
Wavelength = 1.5  $\mu\text{m}$

Maximum power = 40 mW

Because of size constraints, laser safety labeling (including an FDA Class IIIb label) is not affixed to the module but attached to the outside of the shipping carton.

Product is not shipped with power supply.

**Caution: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.**



## Ordering Information (continued)

Table 5. D2547P 20 mW CW Laser Without Locker (C-Band) Ordering Information

| Device Code | ITU-T Frequency (THz) | Center Wavelength (nm) | Device Code | ITU-T Frequency (THz) | Center Wavelength (nm) |
|-------------|-----------------------|------------------------|-------------|-----------------------|------------------------|
| D2547P61    | 196.1                 | 1528.77                | D2547P38    | 193.8                 | 1546.92                |
| D2547P60    | 196.0                 | 1529.55                | D2547P37    | 193.7                 | 1547.72                |
| D2547P59    | 195.9                 | 1530.33                | D2547P36    | 193.6                 | 1548.51                |
| D2547P58    | 195.8                 | 1531.12                | D2547P35    | 193.5                 | 1549.32                |
| D2547P57    | 195.7                 | 1531.90                | D2547P34    | 193.4                 | 1550.12                |
| D2547P56    | 195.6                 | 1532.68                | D2547P33    | 193.3                 | 1550.92                |
| D2547P55    | 195.5                 | 1533.47                | D2547P32    | 193.2                 | 1551.72                |
| D2547P54    | 195.4                 | 1534.25                | D2547P31    | 193.1                 | 1552.52                |
| D2547P53    | 195.3                 | 1535.04                | D2547P30    | 193.0                 | 1553.33                |
| D2547P52    | 195.2                 | 1535.82                | D2547P29    | 192.9                 | 1554.13                |
| D2547P51    | 195.1                 | 1536.61                | D2547P28    | 192.8                 | 1554.94                |
| D2547P50    | 195.0                 | 1537.40                | D2547P27    | 192.7                 | 1555.75                |
| D2547P49    | 194.9                 | 1538.19                | D2547P26    | 192.6                 | 1556.55                |
| D2547P48    | 194.8                 | 1538.98                | D2547P25    | 192.5                 | 1557.36                |
| D2547P47    | 194.7                 | 1539.77                | D2547P24    | 192.4                 | 1558.17                |
| D2547P46    | 194.6                 | 1540.56                | D2547P23    | 192.3                 | 1558.98                |
| D2547P45    | 194.5                 | 1541.35                | D2547P22    | 192.2                 | 1559.79                |
| D2547P44    | 194.4                 | 1542.14                | D2547P21    | 192.1                 | 1560.61                |
| D2547P43    | 194.3                 | 1542.94                | D2547P20    | 192.0                 | 1561.42                |
| D2547P42    | 194.2                 | 1543.73                | D2547P19    | 191.9                 | 1562.23                |
| D2547P41    | 194.1                 | 1544.53                | D2547P18    | 191.8                 | 1563.05                |
| D2547P40    | 194.0                 | 1545.32                | D2547P17    | 191.7                 | 1563.86                |
| D2547P39    | 193.9                 | 1546.12                |             |                       |                        |



**Ordering Information** (continued)

**Table 6. D2547P 20 mW CW Laser Without Locker (L-Band) Ordering Information**

| <b>Device Code</b> | <b>ITU Frequency (THz)</b> | <b>Center Wavelength (nm)</b> | <b>Device Code</b> | <b>ITU Frequency (THz)</b> | <b>Center Wavelength (nm)</b> |
|--------------------|----------------------------|-------------------------------|--------------------|----------------------------|-------------------------------|
| D2547P916          | 191.6                      | 1564.68                       | D2547P888          | 188.8                      | 1587.88                       |
| D2547P915          | 191.5                      | 1565.50                       | D2547P887          | 188.7                      | 1588.73                       |
| D2547P914          | 191.4                      | 1566.31                       | D2547P886          | 188.6                      | 1589.57                       |
| D2547P913          | 191.3                      | 1567.13                       | D2547P885          | 188.5                      | 1590.41                       |
| D2547P912          | 191.2                      | 1567.95                       | D2547P884          | 188.4                      | 1591.26                       |
| D2547P911          | 191.1                      | 1568.77                       | D2547P883          | 188.3                      | 1592.10                       |
| D2547P910          | 191.0                      | 1569.59                       | D2547P882          | 188.2                      | 1592.95                       |
| D2547P909          | 190.9                      | 1570.42                       | D2547P881          | 188.1                      | 1593.79                       |
| D2547P908          | 190.8                      | 1571.24                       | D2547P880          | 188.0                      | 1594.64                       |
| D2547P907          | 190.7                      | 1572.06                       | D2547P879          | 187.9                      | 1595.49                       |
| D2547P906          | 190.6                      | 1572.89                       | D2547P878          | 187.8                      | 1596.34                       |
| D2547P905          | 190.5                      | 1573.71                       | D2547P877          | 187.7                      | 1597.19                       |
| D2547P904          | 190.4                      | 1574.54                       | D2547P876          | 187.6                      | 1598.04                       |
| D2547P903          | 190.3                      | 1575.37                       | D2547P875          | 187.5                      | 1598.89                       |
| D2547P902          | 190.2                      | 1576.20                       | D2547P874          | 187.4                      | 1599.75                       |
| D2547P901          | 190.1                      | 1577.03                       | D2547P873          | 187.3                      | 1600.60                       |
| D2547P900          | 190.0                      | 1577.86                       | D2547P872          | 187.2                      | 1601.46                       |
| D2547P899          | 189.9                      | 1578.69                       | D2547P871          | 187.1                      | 1602.31                       |
| D2547P898          | 189.8                      | 1579.52                       | D2547P870          | 187.0                      | 1603.17                       |
| D2547P897          | 189.7                      | 1580.35                       | D2547P869          | 186.9                      | 1604.03                       |
| D2547P896          | 189.6                      | 1581.18                       | D2547P868          | 186.8                      | 1604.88                       |
| D2547P895          | 189.5                      | 1582.02                       | D2547P867          | 186.7                      | 1605.74                       |
| D2547P894          | 189.4                      | 1582.85                       | D2547P866          | 186.6                      | 1606.60                       |
| D2547P893          | 189.3                      | 1583.69                       | D2547P865          | 186.5                      | 1607.47                       |
| D2547P892          | 189.2                      | 1584.53                       | D2547P864          | 186.4                      | 1608.33                       |
| D2547P891          | 189.1                      | 1585.36                       | D2547P863          | 186.3                      | 1609.19                       |
| D2547P890          | 189.0                      | 1586.20                       | D2547P862          | 186.2                      | 1610.06                       |

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