

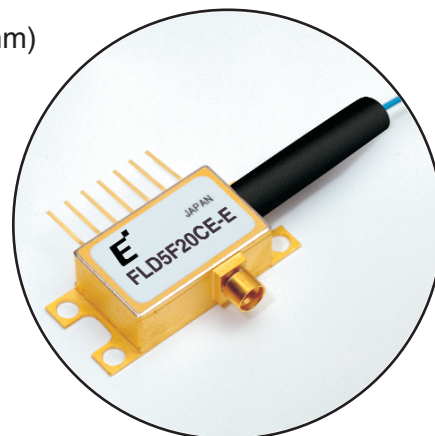
# 1,550nm MI DFB Laser with Integrated Wavelength Locker — FLD5F20CE-E

## FEATURES

- 10Gb/s Modulator Integrated DFB Laser Diode Module
- Wavelength: ITU-T grid W9180 (1563.05nm) thru W9600 (1529.55nm)
- 1600 ps/nm Dispersion
- Compact package with GPO connector
- Built-in Optical Isolator, Ternary PIN-PD for monitor, thermistor and thermoelectric cooler
- Wavelength locker integrated MI-DFB

## APPLICATION

This MI DFB laser is intended for long reach applications (80km) at 10Gb/s.



## DESCRIPTION

The Modulator Integrated DFB Laser (MI DFB Laser) with Wavelength Locker has an electro-absorption modulator monolithically integrated with a conventional Distributed Feed-Back (DFB) laser. The modulation voltage is applied to the modulator section while the laser section operates CW allowing extremely low wavelength chirping. Extinction ratios of more than 10dB can be achieved with 2.6 Vp-p modulation. The MI laser is installed in a butterfly type package. The tuned wavelength can be locked onto the desired ITU-T grid channel via use of the included fabry-perot etalon. The module incorporates a highly stable optical coupling system. The module includes an optical isolator, monitor photodiode, thermistor and a thermo-electric cooler.

## ABSOLUTE MAXIMUM RATINGS (T<sub>op</sub>=25°C, unless otherwise specified)

| Parameter                  | Symbol           | Condition     | Rating |      | Unit |
|----------------------------|------------------|---------------|--------|------|------|
|                            |                  |               | Min.   | Max. |      |
| Operating Case Temperature | T <sub>op</sub>  | -             | -20    | +70  | °C   |
| Storage Temperature        | T <sub>stg</sub> | -             | -40    | +85  | °C   |
| Optical Output Power       | P <sub>f</sub>   | CW            | -      | 5    | mW   |
| Laser Forward Current      | I <sub>F</sub>   | CW            | -      | 150  | mA   |
| Laser Reverse Voltage      | V <sub>R</sub>   | CW            | -      | 2    | V    |
| Modulator Forward Voltage  | V <sub>m</sub>   | CW            | -5     | +1   | V    |
| Photodiode Forward Current | -                | -             | -      | 1    | mA   |
| Photodiode Reverse Voltage | V <sub>DR</sub>  | -             | -      | 10   | V    |
| TEC Voltage                | V <sub>c</sub>   | Cooling       | -      | +5   | V    |
|                            |                  | Heating       | -5     | -    |      |
| TEC Current                | I <sub>c</sub>   | Cooling       | -      | +2.5 | A    |
|                            |                  | Heating       | -0.6   | -    |      |
| Thermistor Temperature     | T <sub>th</sub>  | ATC Operation | -20    | +70  | °C   |
| Lead Soldering Time        | -                | 260°C         | -      | 10   | sec  |

# FLD5F20CE-E ——— 1,550nm MI DFB Laser with Integrated Wavelength Locker

## OPTICAL & ELECTRICAL CHARACTERISTICS

(Laser Temperature  $T_L = T_{set}$ ,  $T_{op} = 25^\circ\text{C}$ , BOL, unless otherwise specified)

| Parameter                                  | Symbol        | Test Condition                                                                                 | Limits       |      |      | Unit                 |
|--------------------------------------------|---------------|------------------------------------------------------------------------------------------------|--------------|------|------|----------------------|
|                                            |               |                                                                                                | Min.         | Type | Max. |                      |
| Laser Set Temperature                      | $T_{set}$     |                                                                                                | 15           | -    | 35   | $^\circ\text{C}$     |
| Peak Wavelength                            | $W_p$         | Note (1)                                                                                       | Note (3)     |      |      | nm                   |
| Wavelength Drift (After 20 Years)          | -             |                                                                                                | -25          | -    | 25   | pm                   |
| Wavelength Stability with Case Temperature | -             |                                                                                                | -0.2         | -    | +0.2 | pm/ $^\circ\text{C}$ |
| Tunability                                 | -             |                                                                                                | -            | 1    | -    | Channel              |
| Threshold Current                          | $I_{th}$      | CW, $V_m = V_o$                                                                                | -            | -    | 30   | mA                   |
| Threshold Power                            | $P_{th}$      | CW, $I_F = I_{th}$ , $V_m = V_o$                                                               | -            | -    | 75   | $\mu\text{W}$        |
| Operating Current                          | $I_{op}$      |                                                                                                | 40           | -    | 100  | mA                   |
| Forward Voltage                            | $V_F$         | CW, $I_F = I_{op}$                                                                             | -            | 1.4  | 2.0  | V                    |
| Output Power                               | $P_f$         | Note (1)                                                                                       | -2.0         | -    | -    | dBm                  |
| Tracking Error                             | TE            | CW, $I_F = I_{op}$ , $V_m = V_{op}$ ,<br>$I_m\text{-APC}$ , $T_c = -20$ to $+70^\circ\text{C}$ | -0.5         | -    | +0.5 | dB                   |
| Sidemode Suppression Ratio                 | SSR           | Note (1)                                                                                       | 35           | -    | -    | dB                   |
| Spectral Width                             | $\Delta W_p$  | Note (1), -3dB, FWHM                                                                           | -            | -    | 0.04 | nm                   |
|                                            |               | Note (1), -20dB, FWHM                                                                          | -            | -    | 0.30 |                      |
| Relative Intensity Noise                   | RIN           | 10MHz to 8.5GHz, $V_m = V_o$ ,<br>$I_F = I_{op}$ , 8% Reflection                               | -            | -    | -120 | dB/Hz                |
| Kink                                       | K             | $I_{th} + 5\text{mA}$ to $1.5 \times I_{op}$                                                   | No Kink      |      |      | -                    |
| Mode Hops                                  | -             | $I_{th} + 5\text{mA}$ to $1.5 \times I_{op}$                                                   | No Mode Hops |      |      | -                    |
| Optical Isolation                          | $I_s$         | $T_c = -20$ to $+70^\circ\text{C}$                                                             | 25           | 35   | -    | dB                   |
| On Level Modulation Voltage                | $V_o$         |                                                                                                | -0.7         | -    | 0    | V                    |
| Modulator Drive Voltage                    | $V_{mod}$     | $(V_o - V_{mod}) > -3.3\text{V}$ , $R_{ext} = 10\text{dB}$                                     | -            | -    | 2.6  | V <sub>pp</sub>      |
| RF Extinction Ratio                        | $R_{ext}$     | $I_F = I_{op}$ , $V_m = V_o$ at On-Level<br>$V_m = V_o - V_{mod}$ at Off-Level                 | 10           | -    | -    | dB                   |
| Transmission Penalty due to Dispersion     | $P_d$         | Note (2)                                                                                       | -            | -    | 2.0  | dB                   |
| Rise/Fall Time                             | $T_r$ , $T_f$ | $I_F = I_{op}$ , $V_m = V_o$ , 20% to 80%                                                      | -            | 20   | 25   | ps                   |
| Cutoff Frequency                           | $f_c$         | -3dB, $I_F = I_{op}$ , $V_m = V_o - 0.5 V_{mod} $                                              | 10           | -    | -    | GHz                  |
| In Band Ripple                             | $\Delta G$    | $I_F = I_{op}$ , 0.1 to 10GHz,<br>$V_m = V_o - 0.5 V_{mod} $                                   | -1.0         | -    | +1.0 | dB                   |

# 1,550nm MI DFB Laser — FLD5F20CE-E with Integrated Wavelength Locker

## OPTICAL & ELECTRICAL CHARACTERISTICS (Continued)

(Laser Temperature  $T_L = T_{set}$ ,  $T_{op} = 25^\circ\text{C}$ , BOL, unless otherwise specified)

| Parameter                                                           | Symbol                    | Test Condition                                              | Limits        |      |      | Unit             |
|---------------------------------------------------------------------|---------------------------|-------------------------------------------------------------|---------------|------|------|------------------|
|                                                                     |                           |                                                             | Min.          | Type | Max. |                  |
| RF Return Loss                                                      | S11                       | DC to 5GHz, $V_m=V_o$ , $I_F=I_{op}$ , 50 $\Omega$ Test Set | 8             | -    | -    | dB               |
|                                                                     |                           | 5 to 10GHz, $V_m=V_o$ , $I_F=I_{op}$ , 50 $\Omega$ Test Set | 5             | -    | -    | dB               |
| Power Monitor Current                                               | $I_{m1}$                  | CW, $I_F=I_{op}$ , $V_m=V_o$ , VDR=5V                       | 0.04          | -    | 1.5  | mA               |
| Power Monitor Dark Current                                          | $I_{d1}$                  | VDR=5V                                                      | -             | 2    | 100  | nA               |
| Power Monitor Diode Capacitance                                     | $C_{t1}$                  | VDR=5V, f=10MHz                                             | -             | 2    | 15   | pF               |
| Wavelength Monitor Current                                          | $I_{m2}$                  | CW, $I_F=I_{op}$ , $V_m=V_o$ , VDR=5V                       | 0.04          | -    | 1.5  | mA               |
| Wavelength Monitor Dark Current                                     | $I_{d2}$                  | VDR=5V                                                      | -             | 2    | 100  | nA               |
| Wavelength Monitor Diode Capacitance                                | $C_{t2}$                  | VDR=5V, f=10MHz                                             | -             | 2    | 15   | pF               |
| Wavelength Difference between Lock Point and $I_{m2}$ peak (Note 4) | $\Delta\lambda$           |                                                             | 6.0           | -    | 44.0 | GHz              |
| $I_{m2}$ Peak-Bottom Ratio                                          | $I_{m2peak}/I_{m2bottom}$ |                                                             | 2.0           | -    | 4.0  | dB               |
| TEC Capacity                                                        | $\Delta T$                | PTEC=5.2W, $I_F=I_{op}$                                     | 70- $T_{set}$ | -    | -    | $^\circ\text{C}$ |
| TEC Current                                                         | $I_{TEC}$                 | $I_F=I_{op}$ , $\Delta T=(70-T_{set})[^\circ\text{C}]$      | -             | -    | 1.3  | A                |
| TEC Voltage                                                         | $V_{TEC}$                 | $I_F=I_{op}$ , $\Delta T=(70-T_{set})[^\circ\text{C}]$      | -             | -    | 4.0  | V                |
| TEC Power Dissipation                                               | PTEC                      | $I_F=I_{op}$                                                | -             | -    | 5.2  | W                |
| Thermistor Resistance                                               | $R_{th}$                  | $T_L=25^\circ\text{C}$                                      | 9.5           | -    | 10.5 | k $\Omega$       |
| Thermistor B Constant                                               | B                         |                                                             | 3270          | 3450 | 3630 | K                |

Note 1. Eudyna Test System, 9.95328Gb/s, PRBS=2<sup>23</sup>-1,  $I_F=I_{op}$ ,  $V_m=V_o$  and ( $V_o-V_{mod}$ )

Note 2. Eudyna Test System, 9.95328Gb/s, PRBS=2<sup>23</sup>-1,  $I_F=I_{op}$ ,  $V_m=V_o$  and ( $V_o-V_{mod}$ ),

Dispersion=1600ps/nm

Dispersion Penalty at Bit-Error-Rate=1.0E-10

Note 3: See Table 1 Wavelength Table

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# FLD5F20CE-E ——— 1,550nm MI DFB Laser with Integrated Wavelength Locker

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Figure 1 Wavelength Table

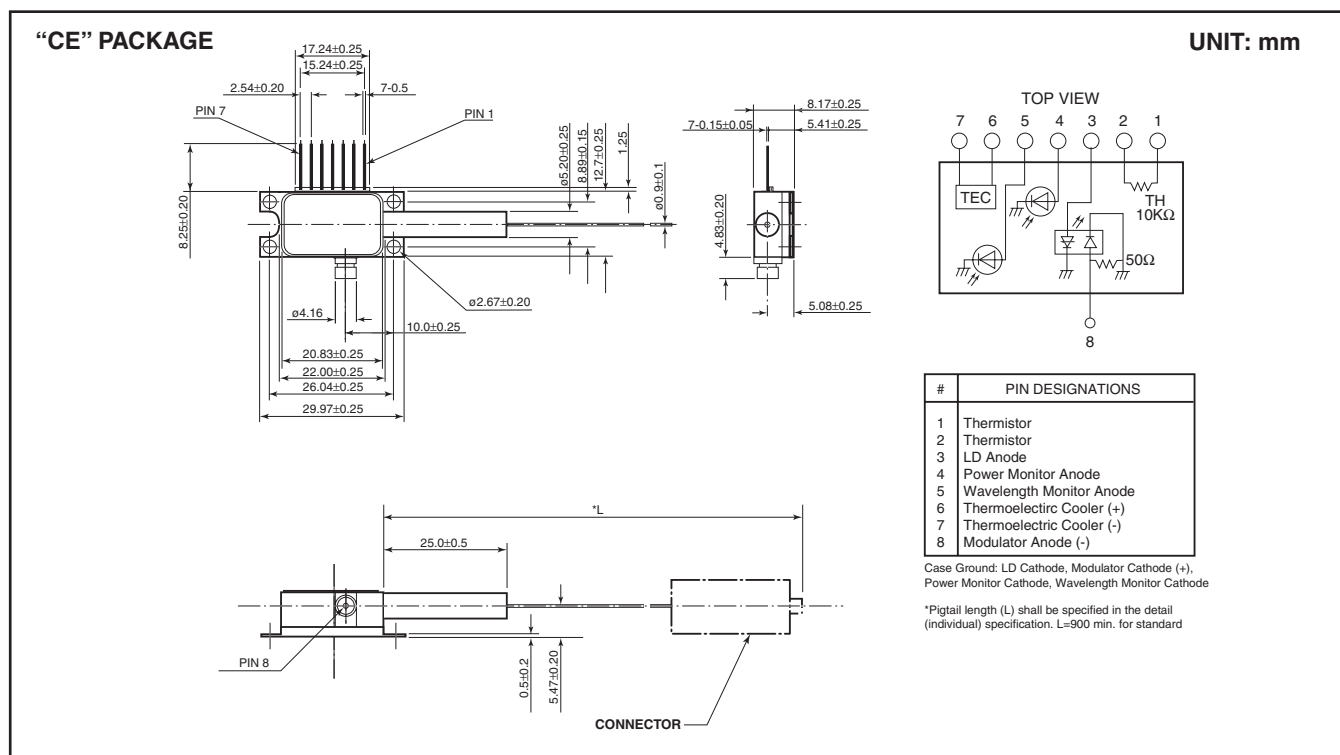
| Part Number     | Wavelength (nm)<br>(TL=Tset)<br>(in vacuum) | Frequency<br>(THz) | Tolerance<br>(nm) |
|-----------------|---------------------------------------------|--------------------|-------------------|
| FLD5F20CE-E9180 | 1563.05                                     | 191.80             | ±0.01             |
| FLD5F20CE-E9185 | 1562.64                                     | 191.85             | ±0.01             |
| FLD5F20CE-E9190 | 1562.23                                     | 191.90             | ±0.01             |
| FLD5F20CE-E9195 | 1561.83                                     | 191.95             | ±0.01             |
| FLD5F20CE-E9200 | 1561.42                                     | 192.00             | ±0.01             |
| FLD5F20CE-E9205 | 1561.01                                     | 192.05             | ±0.01             |
| FLD5F20CE-E9210 | 1560.61                                     | 192.10             | ±0.01             |
| FLD5F20CE-E9215 | 1560.20                                     | 192.15             | ±0.01             |
| FLD5F20CE-E9220 | 1559.79                                     | 192.20             | ±0.01             |
| FLD5F20CE-E9225 | 1559.39                                     | 192.25             | ±0.01             |
| FLD5F20CE-E9230 | 1558.98                                     | 192.30             | ±0.01             |
| FLD5F20CE-E9235 | 1558.58                                     | 192.35             | ±0.01             |
| FLD5F20CE-E9240 | 1558.17                                     | 192.40             | ±0.01             |
| FLD5F20CE-E9245 | 1557.77                                     | 192.45             | ±0.01             |
| FLD5F20CE-E9250 | 1557.36                                     | 192.50             | ±0.01             |
| FLD5F20CE-E9255 | 1556.96                                     | 192.55             | ±0.01             |
| FLD5F20CE-E9260 | 1556.55                                     | 192.60             | ±0.01             |
| FLD5F20CE-E9265 | 1556.15                                     | 192.65             | ±0.01             |
| FLD5F20CE-E9270 | 1555.75                                     | 192.70             | ±0.01             |
| FLD5F20CE-E9275 | 1555.34                                     | 192.75             | ±0.01             |
| FLD5F20CE-E9280 | 1554.94                                     | 192.80             | ±0.01             |
| FLD5F20CE-E9285 | 1554.54                                     | 192.85             | ±0.01             |
| FLD5F20CE-E9290 | 1554.13                                     | 192.90             | ±0.01             |
| FLD5F20CE-E9295 | 1553.73                                     | 192.95             | ±0.01             |
| FLD5F20CE-E9300 | 1553.33                                     | 193.00             | ±0.01             |
| FLD5F20CE-E9305 | 1552.93                                     | 193.05             | ±0.01             |
| FLD5F20CE-E9310 | 1552.52                                     | 193.10             | ±0.01             |
| FLD5F20CE-E9315 | 1552.12                                     | 193.15             | ±0.01             |
| FLD5F20CE-E9320 | 1551.72                                     | 193.20             | ±0.01             |
| FLD5F20CE-E9325 | 1551.32                                     | 193.25             | ±0.01             |
| FLD5F20CE-E9330 | 1550.92                                     | 193.30             | ±0.01             |
| FLD5F20CE-E9335 | 1550.52                                     | 193.35             | ±0.01             |
| FLD5F20CE-E9340 | 1550.12                                     | 193.40             | ±0.01             |
| FLD5F20CE-E9345 | 1549.72                                     | 193.45             | ±0.01             |
| FLD5F20CE-E9350 | 1549.32                                     | 193.50             | ±0.01             |
| FLD5F20CE-E9355 | 1548.91                                     | 193.55             | ±0.01             |
| FLD5F20CE-E9360 | 1548.51                                     | 193.60             | ±0.01             |
| FLD5F20CE-E9365 | 1548.11                                     | 193.65             | ±0.01             |
| FLD5F20CE-E9370 | 1547.72                                     | 193.70             | ±0.01             |
| FLD5F20CE-E9375 | 1547.32                                     | 193.75             | ±0.01             |
| FLD5F20CE-E9380 | 1546.92                                     | 193.80             | ±0.01             |
| FLD5F20CE-E9385 | 1546.52                                     | 193.85             | ±0.01             |
| FLD5F20CE-E9390 | 1546.12                                     | 193.90             | ±0.01             |

# 1,550nm MI DFB Laser with Integrated Wavelength Locker — FLD5F20CE-E

Figure 1 Wavelength Table (Con't)

| Part Number     | Wavelength (nm)<br>(TL=Tset)<br>(in vacuum) | Frequency<br>(THz) | Tolerance<br>(nm) |
|-----------------|---------------------------------------------|--------------------|-------------------|
| FLD5F20CE-E9395 | 1545.72                                     | 193.95             | ±0.01             |
| FLD5F20CE-E9400 | 1545.32                                     | 194.00             | ±0.01             |
| FLD5F20CE-E9405 | 1544.92                                     | 194.05             | ±0.01             |
| FLD5F20CE-E9410 | 1544.53                                     | 194.10             | ±0.01             |
| FLD5F20CE-E9415 | 1544.13                                     | 194.15             | ±0.01             |
| FLD5F20CE-E9420 | 1543.73                                     | 194.20             | ±0.01             |
| FLD5F20CE-E9425 | 1543.33                                     | 194.25             | ±0.01             |
| FLD5F20CE-E9430 | 1542.94                                     | 194.30             | ±0.01             |
| FLD5F20CE-E9435 | 1542.54                                     | 194.35             | ±0.01             |
| FLD5F20CE-E9440 | 1542.14                                     | 194.40             | ±0.01             |
| FLD5F20CE-E9445 | 1541.75                                     | 194.45             | ±0.01             |
| FLD5F20CE-E9450 | 1541.35                                     | 194.50             | ±0.01             |
| FLD5F20CE-E9455 | 1540.95                                     | 194.55             | ±0.01             |
| FLD5F20CE-E9460 | 1540.56                                     | 194.60             | ±0.01             |
| FLD5F20CE-E9465 | 1540.16                                     | 194.65             | ±0.01             |
| FLD5F20CE-E9470 | 1539.77                                     | 194.70             | ±0.01             |
| FLD5F20CE-E9475 | 1539.37                                     | 194.75             | ±0.01             |
| FLD5F20CE-E9480 | 1538.98                                     | 194.80             | ±0.01             |
| FLD5F20CE-E9485 | 1538.58                                     | 194.85             | ±0.01             |
| FLD5F20CE-E9490 | 1538.19                                     | 194.90             | ±0.01             |
| FLD5F20CE-E9495 | 1537.79                                     | 194.95             | ±0.01             |
| FLD5F20CE-E9500 | 1537.40                                     | 195.00             | ±0.01             |
| FLD5F20CE-E9505 | 1537.00                                     | 195.05             | ±0.01             |
| FLD5F20CE-E9510 | 1536.61                                     | 195.10             | ±0.01             |
| FLD5F20CE-E9515 | 1536.22                                     | 195.15             | ±0.01             |
| FLD5F20CE-E9520 | 1535.82                                     | 195.20             | ±0.01             |
| FLD5F20CE-E9525 | 1535.43                                     | 195.25             | ±0.01             |
| FLD5F20CE-E9530 | 1535.04                                     | 195.30             | ±0.01             |
| FLD5F20CE-E9535 | 1534.64                                     | 195.35             | ±0.01             |
| FLD5F20CE-E9540 | 1534.25                                     | 195.40             | ±0.01             |
| FLD5F20CE-E9545 | 1533.86                                     | 195.45             | ±0.01             |
| FLD5F20CE-E9550 | 1533.47                                     | 195.50             | ±0.01             |
| FLD5F20CE-E9555 | 1533.07                                     | 195.55             | ±0.01             |
| FLD5F20CE-E9560 | 1532.68                                     | 195.60             | ±0.01             |
| FLD5F20CE-E9565 | 1532.29                                     | 195.65             | ±0.01             |
| FLD5F20CE-E9570 | 1531.90                                     | 195.70             | ±0.01             |
| FLD5F20CE-E9575 | 1531.51                                     | 195.75             | ±0.01             |
| FLD5F20CE-E9580 | 1531.12                                     | 195.80             | ±0.01             |
| FLD5F20CE-E9585 | 1530.72                                     | 195.85             | ±0.01             |
| FLD5F20CE-E9590 | 1530.33                                     | 195.90             | ±0.01             |
| FLD5F20CE-E9595 | 1529.94                                     | 195.95             | ±0.01             |
| FLD5F20CE-E9600 | 1529.55                                     | 196.00             | ±0.01             |

# FLD5F20CE-E ——— 1,550nm MI DFB Laser with Integrated Wavelength Locker



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