

# 1,550nm DFB DWDM Direct Modulation Laser

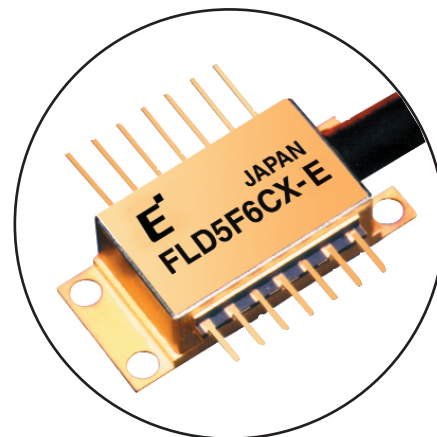
FLD5F6CX-E

## FEATURES

- Direct Modulation DFB Laser
- Built-in TEC, Thermistor and Monitor PD
- 14-Pin Butterfly Type Module
- Low Residual Chirp
- Optimized for 2.5 Gb/s Modulation Rates
- Selected wavelengths according to ITU-T grid available

## APPLICATIONS

This laser is intended for application in 2.5 Gb/s long haul Dense Wavelength Division Multiplexing (DWDM) systems. Transmission spans of 100 km (1800ps/nm) are possible.



## DESCRIPTION

The FLD5FCX-E is capable of 2.5 Gb/s transmission. It is packaged in a “butterfly” type module. The module employs a highly stable optical coupling system, coupling the laser output through a built-in optical isolator into a single mode fiber pigtail. The module also includes a monitor photodiode, a thermoelectric cooler (TEC) and thermistor. This device is optimally designed for use in DWDM direct modulation transmission systems. Selected wavelengths are available to the specified ITU-T grid.

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

| Parameter                        | Symbol            | Condition     | Rating |      | Unit |
|----------------------------------|-------------------|---------------|--------|------|------|
|                                  |                   |               | Min.   | Max. |      |
| Storage Temperature              | T <sub>stg</sub>  | -             | -40    | +70  | °C   |
| Operating Case Temperature       | T <sub>op</sub>   | -             | -20    | +65  | °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    |
| Photodiode Forward Current       | -                 | -             | -      | 10   | mA   |
| Photodiode Reverse Voltage       | V <sub>DR</sub>   | -             | -      | 20   | V    |
| TEC Voltage                      | V <sub>C</sub>    | Cooling       | -      | +2.5 | V    |
|                                  |                   | Heating       | -2.5   | -    |      |
| TEC Current                      | I <sub>C</sub>    | Cooling       | -      | +1.4 | A    |
|                                  |                   | Heating       | -0.9   | -    |      |
| Thermistor Temperature           | T <sub>th</sub>   | ATC Operation | -20    | +65  | °C   |
| Lead Soldering Time              | T <sub>sold</sub> | 260°C         | -      | 10   | sec  |
| Environmental Operating Humidity | X <sub>op</sub>   | Top<30°C      | -      | 95   | %    |
| Environmental Storage Humidity   | X <sub>st</sub>   | Tstg<30°C     | -      | 95   | %    |

## OPTICAL AND ELECTRICAL CHARACTERISTICS (T<sub>L</sub>=T<sub>set</sub>, T<sub>C</sub>=25°C, BOL, unless otherwise specified)

| Parameter                                  | Symbol             | Test Conditions                                    | Limits   |      |       | Unit  |
|--------------------------------------------|--------------------|----------------------------------------------------|----------|------|-------|-------|
|                                            |                    |                                                    | Min.     | Typ. | Max.  |       |
| Laser Set Temperature                      | T <sub>set</sub>   | -                                                  | 15       | -    | 35    | °C    |
| Threshold Current                          | I <sub>th</sub>    | CW                                                 | 3        | -    | 40    | mA    |
| Forward Voltage                            | V <sub>FDC</sub>   | CW, I <sub>F</sub> =30 mA, pin 12-13               | -        | 1.6  | 1.75  | V     |
| Series Resistance                          | R <sub>S</sub>     | CW, pin 12-13                                      | 22       | 25   | 28    | Ω     |
| Optical Output Power                       | P <sub>f</sub>     | CW                                                 | 2.0      | -    | -     | mW    |
| Slope Efficiency                           | η                  | CW, P <sub>f</sub> =2.0mW                          | 0.035    | -    | -     | mW/mA |
| Threshold Power                            | P <sub>th</sub>    | I <sub>F</sub> =I <sub>th</sub> , CW               | -        | -    | 50    | μW    |
| Tracking Error (Note 1)                    | TE                 | P <sub>f</sub> =2.0mW, T <sub>C</sub> =-20 to 65°C | -0.5     | -    | +0.5  | dB    |
| Monitor Current                            | I <sub>m</sub>     | CW, P <sub>f</sub> =2.0mW, V <sub>DR</sub> =5V     | 0.10     | -    | 1.0   | mA    |
| Photodiode Dark Current                    | I <sub>D</sub>     | V <sub>DR</sub> =5V                                | -        | 2    | 100   | nA    |
| Photodiode Capacitance                     | C <sub>t</sub>     | V <sub>DR</sub> =5V, f=1 MHz                       | -        | -    | 10    | pF    |
| Photodiode Cutoff Frequency                | f <sub>cm</sub>    | V <sub>DR</sub> =5V, 50Ω load                      | 100      | -    | -     | MHz   |
| Peak Wavelength                            | λ <sub>p</sub>     | Note (2)                                           | Note (4) |      |       | nm    |
| Wavelength Drift                           | -                  | after 20 years                                     | -200     | -    | +200  | pm    |
| Wavelength Stability with Case Temperature | dλ/dT <sub>C</sub> | T <sub>C</sub> =-20 to 65°C                        | -1       | -    | +1    | pm/°C |
| Side Mode Suppression                      | S <sub>r</sub>     | Note (2)                                           | 33       | 35   | -     | dB    |
| Spectral Width (-20dB)                     | -                  | Note (2)                                           | -        | -    | 0.5   | nm    |
| Rise Time (10%-90%)                        | t <sub>r</sub>     | Note (2)                                           | -        | 0.1  | 0.125 | nsec  |
| Fall Time (10%-90%)                        | t <sub>f</sub>     | Note (2)                                           | -        | 0.1  | 0.125 | nsec  |
| Cutoff Frequency                           | f <sub>c</sub>     | P <sub>f</sub> =2.0mW, -3 dB                       | 4.0      | -    | -     | GHz   |
| In-Band Ripple (Window)                    | S <sub>21</sub>    | f=50 MHz~3 GHz                                     | -1.5     | -    | +1.5  | dB    |
| RF Return Loss                             | S <sub>11</sub>    | f=50 MHz~2 GHz                                     | 8        | -    | -     | dB    |
|                                            |                    | f=2 GHz~3 GHz                                      | 6        | -    | -     | dB    |
|                                            |                    | f=3 GHz~5 GHz                                      | 3        | -    | -     | dB    |
| Optical Isolation                          | I <sub>S</sub>     | T <sub>C</sub> =-20 to 65°C                        | 25       | 35   | -     | dB    |
| Relative Intensity Noise                   | RIN                | f=2.5 GHz<br>P <sub>f</sub> =2.0 mW, ORL=24 dB     | -        | -    | -140  | dB/Hz |
| Kinks                                      | Kns                | up to 2.4 mW                                       | None     |      |       |       |
| Pulsation                                  | -                  | -                                                  | None     |      |       |       |
| BER Performance                            | ER                 | Note (3)                                           | No Floor |      |       |       |
| Power Penalty                              | PP                 | Note (3)                                           | -        | -    | 1.5   | dB    |

Note 1. TE=10\*log(pf(Tcase)/Pf(Tc=25°C))dB, APC

Note 2. 2.5 Gb/s NRZ, pseudo-random, Pb=0.2mW, Ppeak=2.0mW

Note 3. Bit rate=2.48832 Gb/s, PRBS=2<sup>23</sup>-1, Dispersion=1,800 ps/nm, Ppeak=2.0mW,

Pbias=0.2mW (Extinction ratio=10dB), B.E.R.=1x10<sup>-10</sup>

Decision point: Center of Back-to-Back at 10<sup>-9</sup>, Receiver: Eudyna Standard Receiver

Note 4. The selected wavelengths available are listed in Fig. 8

**TEC AND THERMISTOR CHARACTERISTICS ( $T_L=T_{set}$ ,  $T_C=25^\circ\text{C}$ , BOL, unless otherwise specified)**

| Parameter             | Symbol   | Test Conditions                                              | Limit |       |       | Unit       |
|-----------------------|----------|--------------------------------------------------------------|-------|-------|-------|------------|
|                       |          |                                                              | Min.  | Typ.  | Max.  |            |
| TEC Current           | $I_C$    | $T_L=T_{set}$ ,<br>$P_f=2\text{mW}$ , $T_C=65^\circ\text{C}$ | -     | -     | 1.0   | A          |
| TEC Voltage           | $V_C$    | $T_L=T_{set}$ ,<br>$P_f=2\text{mW}$ , $T_C=65^\circ\text{C}$ | -     | -     | 2.4   | V          |
| Cooler Power          | $P_C$    | $T_L=T_{set}$ ,<br>$P_f=2\text{mW}$ , $T_C=65^\circ\text{C}$ | -     | -     | 2.4   | W          |
| TEC Resistance        | $R_C$    | $T_L=T_{set}$ ,<br>$P_f=2\text{mW}$ , $T_C=65^\circ\text{C}$ | 2.0   | 2.4   | 3.2   | $\Omega$   |
| Thermistor Resistance | $R_{tr}$ | $T_L=25^\circ\text{C}$                                       | 9.5   | 10.0  | 10.5  | k $\Omega$ |
| Thermistor B Constant | B        | -                                                            | 3,270 | 3,450 | 3,630 | K          |

Fig. 1 Forward Current vs Output Power

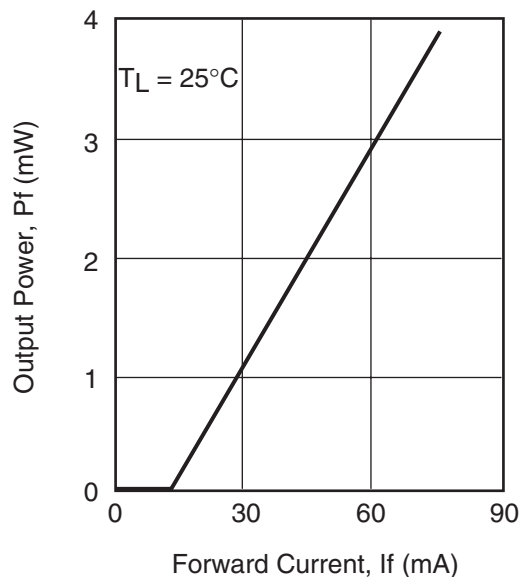


Fig. 2 Frequency Response

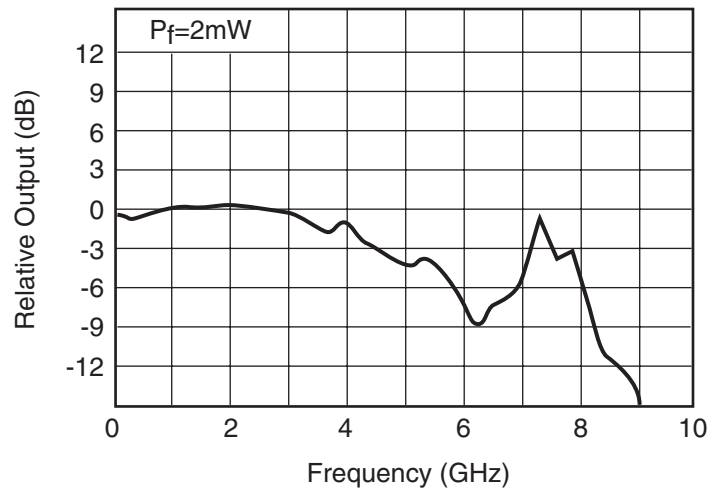


Fig. 3 RF Return Loss

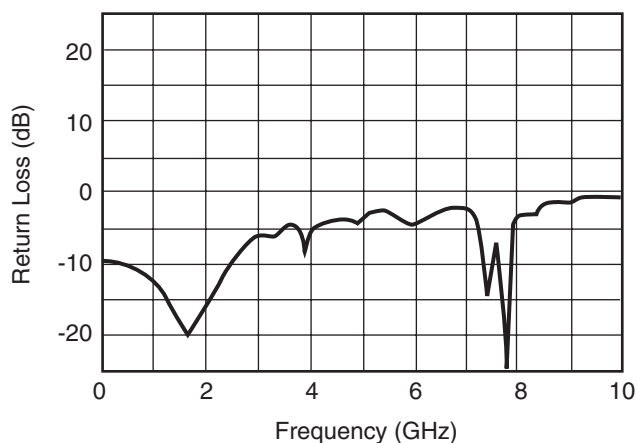


Fig. 4 Cooler Voltage -Current

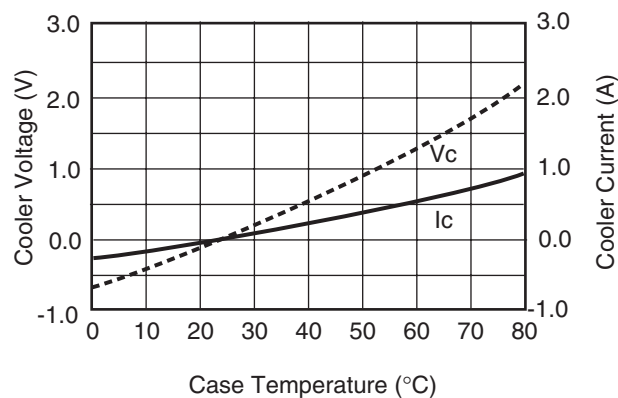


Fig. 5 Spectrum

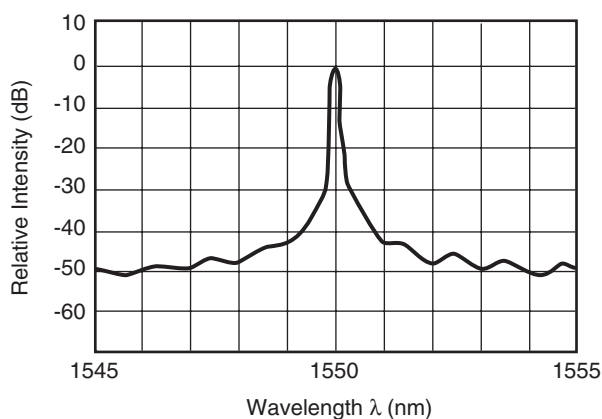
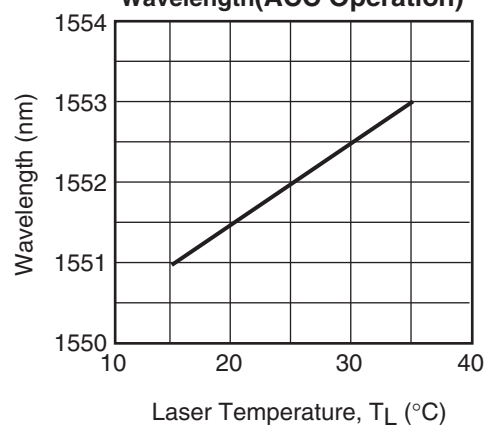
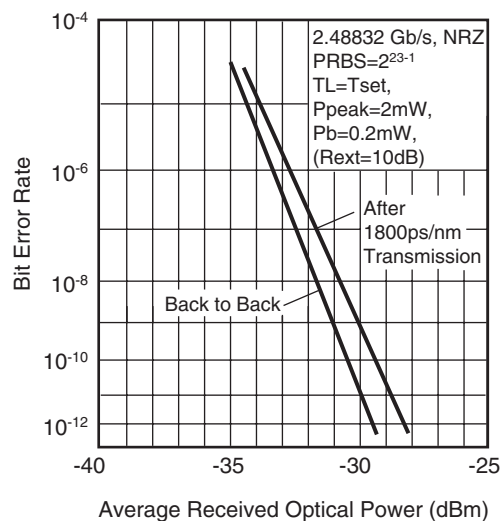


Fig. 6 Temperature Dependence of  
Wavelength(ACC Operation)



**Fig. 7 Transmission Characteristics**



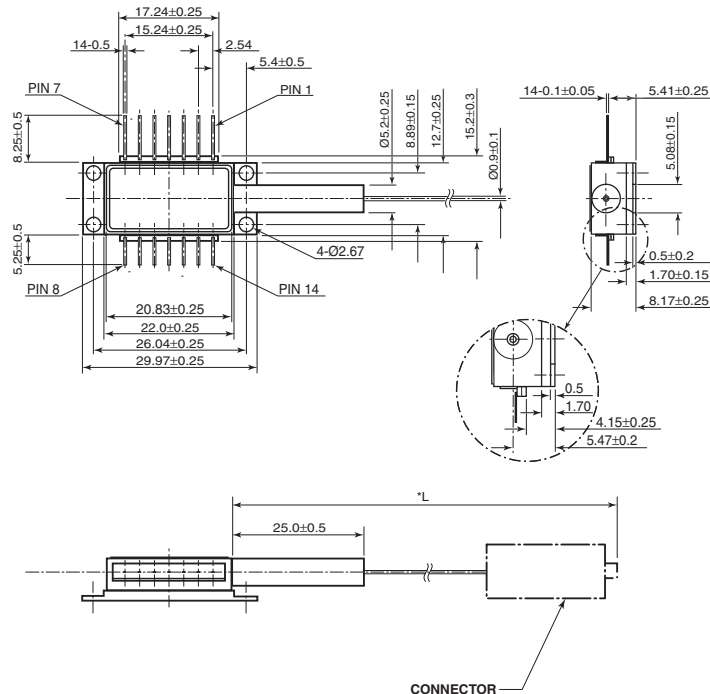
**Fig. 8 Wavelength Table**

| Part Number  | Wavelength (nm)<br>(TL=Tset)<br>(in vacuum) | Tolerance (nm) |
|--------------|---------------------------------------------|----------------|
| FLD5F6CX-E62 | 1527.99                                     | ±0.1           |
| -E61         | 1528.77                                     | ±0.1           |
| -E60         | 1529.55                                     | ±0.1           |
| -E59         | 1530.33                                     | ±0.1           |
| -E58         | 1531.12                                     | ±0.1           |
| -E57         | 1531.90                                     | ±0.1           |
| -E56         | 1532.68                                     | ±0.1           |
| -E55         | 1533.47                                     | ±0.1           |
| -E54         | 1534.25                                     | ±0.1           |
| -E53         | 1535.04                                     | ±0.1           |
| -E52         | 1535.82                                     | ±0.1           |
| -E51         | 1536.61                                     | ±0.1           |
| -E50         | 1537.40                                     | ±0.1           |
| -E49         | 1538.19                                     | ±0.1           |
| -E48         | 1538.98                                     | ±0.1           |
| -E47         | 1539.77                                     | ±0.1           |
| -E46         | 1540.56                                     | ±0.1           |
| -E45         | 1541.35                                     | ±0.1           |
| -E44         | 1542.14                                     | ±0.1           |
| -E43         | 1542.94                                     | ±0.1           |
| -E42         | 1543.73                                     | ±0.1           |

|      |         |      |
|------|---------|------|
| -E41 | 1544.53 | ±0.1 |
| -E40 | 1545.32 | ±0.1 |
| -E39 | 1546.12 | ±0.1 |
| -E38 | 1546.92 | ±0.1 |
| -E37 | 1547.72 | ±0.1 |
| -E36 | 1548.51 | ±0.1 |
| -E35 | 1549.32 | ±0.1 |
| -E34 | 1550.12 | ±0.1 |
| -E33 | 1550.92 | ±0.1 |
| -E32 | 1551.72 | ±0.1 |
| -E31 | 1552.52 | ±0.1 |
| -E30 | 1553.33 | ±0.1 |
| -E29 | 1554.13 | ±0.1 |
| -E28 | 1554.94 | ±0.1 |
| -E27 | 1555.75 | ±0.1 |
| -E26 | 1556.55 | ±0.1 |
| -E25 | 1557.36 | ±0.1 |
| -E24 | 1558.17 | ±0.1 |
| -E23 | 1558.98 | ±0.1 |
| -E22 | 1559.79 | ±0.1 |
| -E21 | 1560.61 | ±0.1 |
| -E20 | 1561.42 | ±0.1 |
| -E19 | 1562.23 | ±0.1 |
| -E18 | 1563.05 | ±0.1 |

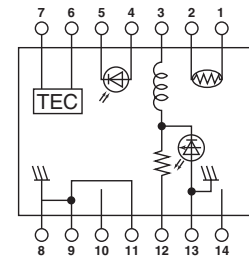
## "CX" PACKAGE

UNIT: mm



### Grounded Type

| PIN # | FUNCTION                  |
|-------|---------------------------|
| 1.    | Thermistor                |
| 2.    | Thermistor                |
| 3.    | Laser DC Bias (-)         |
| 4.    | Monitor (Anode)           |
| 5.    | Monitor (Cathode)         |
| 6.    | Thermoelectric Cooler (+) |
| 7.    | Thermoelectric Cooler (-) |
| 8.    | Case Ground               |
| 9.    | Case Ground               |
| 10.   | N.C.                      |
| 11.   | Case Ground               |
| 12.   | Laser Modulation (-)      |
| 13.   | Case Ground               |
| 14.   | N.C.                      |



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