

# TENTATIVE

MITSUBISHI (OPTICAL DEVICES)

## FU-68SDF-V810MxxxB

1.58  $\mu\text{m}$  (L-Band) DFB-LD MODULE WITH SINGLEMODE FIBER PIGTAIL  
(WAVELENGTH SELECTED, BIAS CIRCUIT INTEGRATED, DIGITAL APPLICATION)

### DESCRIPTION

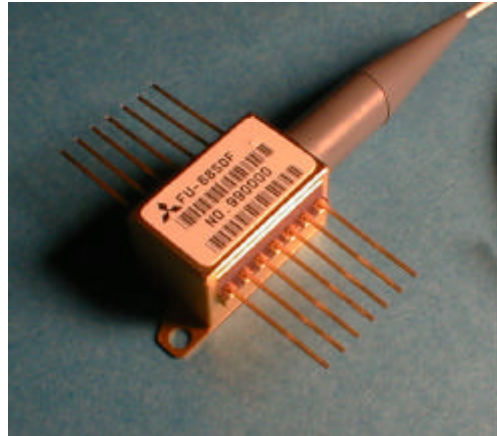
Module type FU-68SDF-V810MxxxB is a 1.58 $\mu\text{m}$  (L-Band) DFB-LD module with single-mode optical fiber.

This module is suitable to a directly modulated light source for use in 2.5Gb/s digital optical communication systems.

This module is prepared to expand the wavelength channels into L-Band for Dense-WDM transmission.

### FEATURES

- Multi quantum wells (MQW) DFB Laser Diode module
- Input impedance is 25 $\Omega$
- Emission wavelength is in 1.58 $\mu\text{m}$  band
- High-speed response
- Built-in optical isolator
- Built-in thermal electric cooler
- Butterfly package
- With photodiode for optical output monitor



### APPLICATION

High speed transmission systems (~2.5Gb/s)  
Dense-WDM systems

### OPTION

- Wavelength option:  
1565nm~1625nm are available

### ABSOLUTE MAXIMUM RATINGS (T<sub>id</sub>=T<sub>set</sub>)

| Parameter                     |                      | Symbol           | Conditions | Rating   | Unit |
|-------------------------------|----------------------|------------------|------------|----------|------|
| Laser diode                   | Optical output power | Pf               | CW         | 15       | mW   |
|                               | Forward current      | I <sub>f</sub>   | CW         | 150      | mA   |
|                               | Reverse voltage      | V <sub>rl</sub>  | -          | 2        | V    |
| Photodiode                    | Reverse voltage      | V <sub>rd</sub>  | -          | 20       | V    |
|                               | Forward current      | I <sub>fd</sub>  | -          | 2        | mA   |
| Thermo-electric cooler (Note) | Cooler current       | I <sub>pe</sub>  | -          | 1.3      | A    |
|                               | Cooler voltage       | V <sub>pe</sub>  | -          | 3.1      | V    |
| Operating case temperature    |                      | T <sub>c</sub>   | -          | -20 ~ 70 | °C   |
| Storage temperature           |                      | T <sub>stg</sub> | -          | -40 ~ 85 | °C   |

Note) Even if the thermo-electric cooler (TEC) is operated within the rated conditions, uncontrolled current loading or operation without heatsink may easily damage the module by exceeding the storage temperature range. Thermistor resistance should be properly monitored by the feedback circuit during TEC operation to avoid the catastrophic damage.

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(WAVELENGTH SELECTED, BIAS CIRCUIT INTEGRATED, DIGITAL APPLICATION)****ELECTRICAL/OPTICAL CHARACTERISTICS** (T<sub>ld</sub>=T<sub>set</sub>, T<sub>c</sub>=25°C unless otherwise noted)

| Parameter                                 | Symbol                          | Test Conditions                                | Limits   |      |      | Unit          |
|---|---------------------------------|--|----------|------|------|---------------|
|   |                                 |  | Min.     | Typ. | Max. |               |
| Threshold current                         | I <sub>th</sub>                 | CW   | -        | 10   | 25   | mA            |
| Optical output power at threshold current | P <sub>th</sub>                 | CW, I <sub>f</sub> =I <sub>th</sub>            | -        | -    | 150  | $\mu\text{W}$ |
| Operating current                         | I <sub>op</sub>                 | CW, P <sub>f</sub> =10mW                       | -        | 50   | 95   | mA            |
| Operating voltage                         | V <sub>op</sub>                 | CW, P <sub>f</sub> =10mW                       | -        | 1.3  | 1.8  | V             |
| Input impedance                           | Z <sub>in</sub>                 | P <sub>f</sub> =10mW                           | -        | 25   | -    | $\Omega$      |
| Light-emission central wavelength         | $\lambda_c$                     | (Note 1)                                       | (Note 2) |      |      | nm            |
| Central wavelength drift with case temp.  | $\Delta\lambda_c/\Delta T_c$    | T <sub>c</sub> =-20~70°C                       | -1       | -    | 0    | pm/°C         |
| Laser operating temperature               | T <sub>set</sub>                | -  | 20       | -    | 35   | °C            |
| Spectral width                            | $\Delta\lambda$                 | (Note 1), -20dB                                | -        | 0.2  | 0.4  | nm            |
| Side mode suppression ratio               | S <sub>r</sub>                  | (Note 1)                                       | 33       | 40   | -    | dB            |
| Dispersion penalty                        | P <sub>p</sub>                  | (Note 1), at 10 <sup>-10</sup> BER, +1800ps/nm | -        | -    | 2    | dB            |
| Cutoff frequency (-1.5dB optical)         | f <sub>c</sub>                  | P <sub>f</sub> =10mW                           | 3.5      | -    | -    | GHz           |
| Rise and fall time (10~90%)               | t <sub>r</sub> , t <sub>f</sub> | (Note 1)                                       | -        | -    | 150  | psec          |
| Relative intensity noise                  | N <sub>r</sub>                  | CW, P <sub>f</sub> =10mW, 0.5~3GHz             | -        | -155 | -145 | dB/Hz         |
| Tracking error (Note 3)                   | E <sub>r</sub>                  | T <sub>c</sub> =-20~70°C, APC, ATC             | -        | -    | 0.5  | dB            |
| Differential efficiency                   | $\eta$                          | CW, P <sub>f</sub> =10mW                       | 0.15     | 0.25 | 0.35 | mW/<br>mA     |
| Linearity                                 | $\Delta\eta$                    | CW, P <sub>f</sub> =1~12mW, (Note 4)           | -20      | -    | 20   | %             |
| Monitor current                           | I <sub>mon</sub>                | CW, P <sub>f</sub> =10mW, V <sub>rd</sub> =5V  | 0.2      | -    | 3    | mA            |
| Optical isolation                         | I <sub>so</sub>                 | T <sub>c</sub> =25°C                           | 35       | -    | -    | dB            |
|   |                                 | T <sub>c</sub> =-20~70°C                       | 23       | -    | -    |               |
| Dark current (PD)                         | I <sub>d</sub>                  | V <sub>rd</sub> =5V, T <sub>c</sub> =-20~70°C  | -        | -    | 0.1  | $\mu\text{A}$ |
| Capacitance (PD)                          | C <sub>t</sub>                  | V <sub>rd</sub> =5V, f=1MHz                    | -        | -    | 10   | pF            |

Note 1) 2.48832Gb/s NRZ, 2<sup>23</sup>-1, P<sub>f\_ave</sub>=5mW, Extinction ratio 10dB, optical return loss of the connectors should be greater than 40dB in order to ensure the specified performance.

Note 2) See Table 1.

Note 3)  $E_r = \max\{10 \times \log(P_f / P_{f@25^\circ\text{C}})\}$

Note 4) Variation of the differential efficiency from the straight line between 1mW and 10mW.

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(WAVELENGTH SELECTED, BIAS CIRCUIT INTEGRATED, DIGITAL APPLICATION)****THERMAL CHARACTERISTICS** (T<sub>ld</sub>=T<sub>set</sub>, T<sub>c</sub>=-20~70°C)

| Parameter                     | Symbol          | Test Conditions  | Limits |      |      | Unit       |
|-------------------------------|-----------------|--|--------|------|------|------------|
|                               |                 |  | Min.   | Typ. | Max. |            |
| Thermistor resistance         | R <sub>th</sub> | T <sub>ld</sub> =25°C  | 9.5    | 10   | 10.5 | k $\Omega$ |
| B constant of R <sub>th</sub> | B               | -  | -      | 3950 | -    | K          |
| Cooling capacity              | $\Delta T$      | P <sub>f</sub> =10mW, T <sub>c</sub> =70°C                                       | 50     | -    | -    | °C         |
| Cooler current                | I <sub>pe</sub> | P <sub>f</sub> =10mW, T <sub>c</sub> =70°C,<br>T <sub>ld</sub> =T <sub>set</sub> | -      | 0.6  | 1    | A          |
| Cooler voltage                | V <sub>pe</sub> | P <sub>f</sub> =10mW, T <sub>c</sub> =70°C,<br>T <sub>ld</sub> =T <sub>set</sub> | -      | 1.2  | 2    | V          |

**FIBER PIGTAIL SPECIFICATIONS**

| Parameter                        | Limits    | Unit          |
|----------------------------------|-----------|---------------|
| Type                             | SM        | -             |
| Mode field diameter              | 9.5+/-1   | $\mu\text{m}$ |
| Cladding diameter                | 125+/-2   | $\mu\text{m}$ |
| Secondary coating outer diameter | 0.9+/-0.1 | mm            |
| Connector                        | FC/PC     | -             |
| Optical return loss of connector | 40 (min)  | dB            |

**DOCUMENTATION** (T<sub>ld</sub>=T<sub>set</sub>)

- Fiber output power vs. Laser forward current at T<sub>ld</sub>=T<sub>set</sub> and T<sub>c</sub>=-20,25,70°C
- BER curves at 2.48832Gb/s modulation
- Threshold current (I<sub>th</sub>)
- Laser forward current (I<sub>op</sub>) at P<sub>f</sub>=10mW
- Laser forward voltage (V<sub>op</sub>) at P<sub>f</sub>=10mW
- Laser operating temperature (T<sub>set</sub>) at  $\lambda_c$  (Note 5)
- Monitor current (I<sub>mon</sub>) at P<sub>f</sub>=10mW
- Thermistor resistance (R<sub>th</sub>)
- Cooler current (I<sub>pe</sub>) at P<sub>f</sub>=10mW and T<sub>c</sub>=70°C
- Cooler voltage (V<sub>pe</sub>) at P<sub>f</sub>=10mW and T<sub>c</sub>=70°C

Note 5) T<sub>set</sub> is attached as a reference data. R<sub>th</sub> should be used in order to tune the wavelength to the specified value accurately.

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| Type number        | $\lambda_c$ (nm) | Type number        | $\lambda_c$ (nm) | Type number        | $\lambda_c$ (nm) |
|--------------------|------------------|--------------------|------------------|--------------------|------------------|
| FU-68SDF-V810M103B | 1567.13          | FU-68SDF-V810M139B | 1582.02          | FU-68SDF-V810M175B | 1597.19          |
| FU-68SDF-V810M104B | 1567.54          | FU-68SDF-V810M140B | 1582.44          | FU-68SDF-V810M176B | 1597.62          |
| FU-68SDF-V810M105B | 1567.95          | FU-68SDF-V810M141B | 1582.85          | FU-68SDF-V810M177B | 1598.04          |
| FU-68SDF-V810M106B | 1568.36          | FU-68SDF-V810M142B | 1583.27          | FU-68SDF-V810M178B | 1598.47          |
| FU-68SDF-V810M107B | 1568.77          | FU-68SDF-V810M143B | 1583.69          | FU-68SDF-V810M179B | 1598.89          |
| FU-68SDF-V810M108B | 1569.18          | FU-68SDF-V810M144B | 1584.11          | FU-68SDF-V810M180B | 1599.32          |
| FU-68SDF-V810M109B | 1569.59          | FU-68SDF-V810M145B | 1584.53          | FU-68SDF-V810M181B | 1599.75          |
| FU-68SDF-V810M110B | 1570.01          | FU-68SDF-V810M146B | 1584.95          | FU-68SDF-V810M182B | 1600.17          |
| FU-68SDF-V810M111B | 1570.42          | FU-68SDF-V810M147B | 1585.36          | FU-68SDF-V810M183B | 1600.60          |
| FU-68SDF-V810M112B | 1570.83          | FU-68SDF-V810M148B | 1585.78          | FU-68SDF-V810M184B | 1601.03          |
| FU-68SDF-V810M113B | 1571.24          | FU-68SDF-V810M149B | 1586.20          | FU-68SDF-V810M185B | 1601.46          |
| FU-68SDF-V810M114B | 1571.65          | FU-68SDF-V810M150B | 1586.62          | FU-68SDF-V810M186B | 1601.88          |
| FU-68SDF-V810M115B | 1572.06          | FU-68SDF-V810M151B | 1587.04          | FU-68SDF-V810M187B | 1602.31          |
| FU-68SDF-V810M116B | 1572.48          | FU-68SDF-V810M152B | 1587.46          | FU-68SDF-V810M188B | 1602.74          |
| FU-68SDF-V810M117B | 1572.89          | FU-68SDF-V810M153B | 1587.88          | FU-68SDF-V810M189B | 1603.17          |
| FU-68SDF-V810M118B | 1573.30          | FU-68SDF-V810M154B | 1588.30          | FU-68SDF-V810M190B | 1603.60          |
| FU-68SDF-V810M119B | 1573.71          | FU-68SDF-V810M155B | 1588.73          | FU-68SDF-V810M191B | 1604.03          |
| FU-68SDF-V810M120B | 1574.13          | FU-68SDF-V810M156B | 1589.15          | FU-68SDF-V810M192B | 1604.46          |
| FU-68SDF-V810M121B | 1574.54          | FU-68SDF-V810M157B | 1589.57          | FU-68SDF-V810M193B | 1604.88          |
| FU-68SDF-V810M122B | 1574.95          | FU-68SDF-V810M158B | 1589.99          | FU-68SDF-V810M194B | 1605.31          |
| FU-68SDF-V810M123B | 1575.37          | FU-68SDF-V810M159B | 1590.41          | FU-68SDF-V810M195B | 1605.74          |
| FU-68SDF-V810M124B | 1575.78          | FU-68SDF-V810M160B | 1590.83          | FU-68SDF-V810M196B | 1606.17          |
| FU-68SDF-V810M125B | 1576.20          | FU-68SDF-V810M161B | 1591.26          | FU-68SDF-V810M197B | 1606.60          |
| FU-68SDF-V810M126B | 1576.61          | FU-68SDF-V810M162B | 1591.68          | FU-68SDF-V810M198B | 1607.04          |
| FU-68SDF-V810M127B | 1577.03          | FU-68SDF-V810M163B | 1592.10          | FU-68SDF-V810M199B | 1607.47          |
| FU-68SDF-V810M128B | 1577.44          | FU-68SDF-V810M164B | 1592.52          | FU-68SDF-V810M200B | 1607.90          |
| FU-68SDF-V810M129B | 1577.86          | FU-68SDF-V810M165B | 1592.95          | FU-68SDF-V810M201B | 1608.33          |
| FU-68SDF-V810M130B | 1578.27          | FU-68SDF-V810M166B | 1593.37          | FU-68SDF-V810M202B | 1608.76          |
| FU-68SDF-V810M131B | 1578.69          | FU-68SDF-V810M167B | 1593.79          | FU-68SDF-V810M203B | 1609.19          |
| FU-68SDF-V810M132B | 1579.10          | FU-68SDF-V810M168B | 1594.22          | FU-68SDF-V810M204B | 1609.62          |
| FU-68SDF-V810M133B | 1579.52          | FU-68SDF-V810M169B | 1594.64          | FU-68SDF-V810M205B | 1610.06          |
| FU-68SDF-V810M134B | 1579.93          | FU-68SDF-V810M170B | 1595.06          | FU-68SDF-V810M206B | 1610.49          |
| FU-68SDF-V810M135B | 1580.35          | FU-68SDF-V810M171B | 1595.49          | FU-68SDF-V810M207B | 1610.92          |
| FU-68SDF-V810M136B | 1580.77          | FU-68SDF-V810M172B | 1595.91          | FU-68SDF-V810M208B | 1611.35          |
| FU-68SDF-V810M137B | 1581.18          | FU-68SDF-V810M173B | 1596.34          | FU-68SDF-V810M209B | 1611.79          |
| FU-68SDF-V810M138B | 1581.60          | FU-68SDF-V810M174B | 1596.76          |                    |                  |

All wavelengths are referred to vacuum.

Tolerance is  $\lambda_c \pm 0.05\text{nm}$ .

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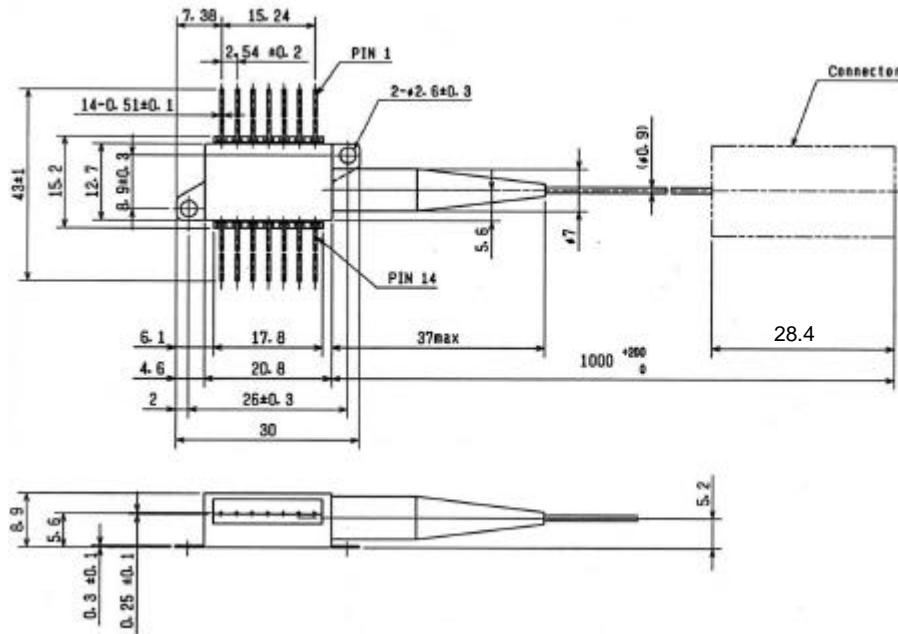
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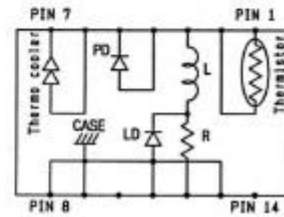
**OUTLINE DIAGRAM**

(Unit : mm)

NOTES 1. TOLERANCES UNLESS NOTED+0.5



| PIN | FUNCTION       |
|-----|----------------|
| 1   | THERMISTOR     |
| 2   | THERMISTOR     |
| 3   | LD BIAS (-)    |
| 4   | PD ANODE       |
| 5   | PD CATHODE     |
| 6   | COOLER ANODE   |
| 7   | COOLER CATHODE |
| 8   | GND            |
| 9   | GND            |
| 10  | NC             |
| 11  | LD ANODE, GND  |
| 12  | LD RF          |
| 13  | LD ANODE, GND  |
| 14  | NC             |



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