

June 20, 2001

|                                                                                   |                                                                                     |               |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------|
| Approved                                                                          | Approved                                                                            | Charged       |
|  |  | <b>M.Sato</b> |

## Specification of wavelength monitor integrated DFB-LD module

Module type: FU-675PDF-V2MxxA

|          |   |          |   |
|----------|---|----------|---|
| A        | B | C        | D |
|          | x |          |   |
| Date     |   | Approved |   |
| 01.06.20 |   | Y.Hozumi |   |

# MITSUBISHI ELECTRIC CORPORATION

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MITSUBISHI (OPTICAL DEVICES)

**FU-675PDF-V2MxxA**

**WAVELENGTH MONITOR INTEGRATED 1.55  $\mu\text{m}$  DFB-LD MODULE  
WITH POLARIZATION MAINTAINING FIBER PIGTAIL  
(WAVELENGTH SELECTED, DIGITAL APPLICATION)**

**DESCRIPTION**

Module type FU-675PDF-V2MxxA is a wavelength monitor integrated 1.55 $\mu\text{m}$  DFB-LD module with polarization maintaining optical fiber.

This module is suitable to a CW light source for external modulator for use in 2.5Gb/s and 10Gb/s digital optical communication systems.

This module can be prepared in accordance with ITU-T recommendation wavelength channel plan for Dense-WDM transmission.

**FEATURES**

- Multi quantum wells (MQW) DFB Laser Diode module
- Emission wavelength is in 1.55 $\mu\text{m}$  band
- Polarization maintaining optical fiber pig-tail
- Built-in optical isolator
- Built-in thermal electric cooler
- Butterfly package
- With 2 photodiodes for wavelength monitor and optical output power monitor

**APPLICATION**

High speed transmission systems ( $\sim 10\text{Gb/s}$ )  
Dense-WDM systems

**ABSOLUTE MAXIMUM RATINGS (T<sub>ld</sub>=T<sub>set</sub>)**

| Parameter                     |                      | Symbol | Conditions | Rating   | Unit |
|-------------------------------|----------------------|--------|------------|----------|------|
| Laser diode                   | Optical output power | Pf     | CW         | 24       | mW   |
|                               | Forward current      | If     | CW         | 150      | mA   |
|                               | Reverse voltage      | Vrl    | -          | 2        | V    |
| Photodiode                    | Reverse voltage      | Vrd    | -          | 20       | V    |
|                               | Forward current      | Ifd    | -          | 2        | mA   |
| Thermo-electric cooler (Note) | Cooler current       | Ipe    | -          | 1.3      | A    |
|                               | Cooler voltage       | Vpe    | -          | 3.1      | V    |
| Operating case temperature    |                      | Tc     | -          | -20 ~ 70 | °C   |
| Storage temperature           |                      | Tstg   | -          | -40 ~ 70 | °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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**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                       |
| Operating current                       | I <sub>op</sub>   | CW, P <sub>f</sub> =20mW                         | -        | -    | 130  | mA                       |
| Operating voltage                       | V <sub>op</sub>   | CW, P <sub>f</sub> =20mW                         | -        | -    | 2    | V                        |
| Light-emission central wavelength       | $\lambda_c$       | CW, P <sub>f</sub> =20mW                         | (Note 1) |      |      | nm                       |
| Wavelength drift after 15 years         | $\Delta\lambda_c$ | CW, P <sub>f</sub> =20mW, APC, ATC, AFC (Note 2) | -30      | -    | 30   | pm                       |
| Laser operating temperature             | T <sub>set</sub>  | -                                                | 15       | -    | 35   | °C                       |
| Spectral line width                     | $\Delta f$        | CW, P <sub>f</sub> =20mW                         | -        | -    | 20   | MHz                      |
| Side mode suppression ratio             | S <sub>r</sub>    | CW, P <sub>f</sub> =20mW                         | 33       | 40   | -    | dB                       |
| Polarization extinction ratio           | E <sub>x</sub>    | CW, P <sub>f</sub> =20mW                         | 20       | 25   | -    | dB                       |
| Relative intensity noise                | N <sub>r</sub>    | CW, P <sub>f</sub> =20mW, 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> =20mW                         | 0.15     | -    | -    | mW/<br>mA                |
| Power monitor current                   | I <sub>pm</sub>   | CW, P <sub>f</sub> =20mW, V <sub>rd</sub> =5V    | 35       | -    | 700  | $\mu\text{A}$            |
| Wavelength monitor current              | I <sub>wm</sub>   | CW, P <sub>f</sub> =20mW, V <sub>rd</sub> =5V    | 25       | -    | 500  | $\mu\text{A}$            |
| Wavelength discriminator slope (Note 4) | D <sub>s</sub>    | CW, P <sub>f</sub> =20mW, V <sub>rd</sub> =5V    | -        | 0.15 | -    | $\mu\text{A}/\text{GHz}$ |
| 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                      | -        | -    | 30   | pF                       |

Note 1) See Table 1.

Note 2) Includes case temperature variation and aging.

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

Note 4) See Figure 1.

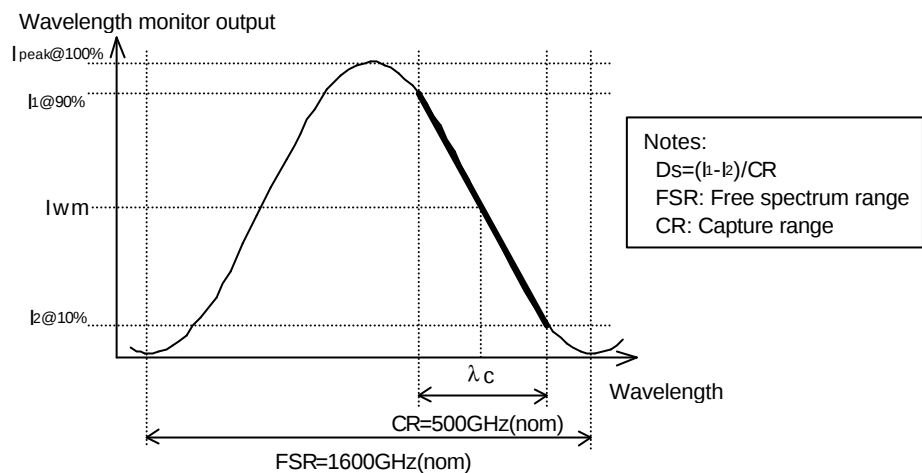


Figure 1. Wavelength discriminator curve

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(WAVELENGTH SELECTED, DIGITAL APPLICATION)**

**THERMAL CHARACTERISTICS** (Tld=Tset, Tc=-20~70°C)

| Parameter             | Symbol     | Test Conditions               | Limits |      |      | Unit       |
|-----------------------|------------|-------------------------------|--------|------|------|------------|
|                       |            |                               | Min.   | Typ. | Max. |            |
| Thermistor resistance | Rth        | Tld=25°C                      | 9.5    | 10   | 10.5 | k $\Omega$ |
| B constant of Rth     | B          | -                             | -      | 3950 | -    | K          |
| Cooling capacity      | $\Delta T$ | Pf=20mW, Tc=70°C              | 55     | -    | -    | °C         |
| Cooler current        | Ipe        | Pf=20mW, Tc=65°C,<br>Tld=Tset | -      | 0.7  | 1    | A          |
|                       |            | Pf=20mW, Tc=70°C,<br>Tld=Tset | -      | 0.9  | 1.2  | A          |
| Cooler voltage        | Vpe        | Pf=20mW, Tc=65°C,<br>Tld=Tset | -      | 1.4  | 2.3  | V          |
|                       |            | Pf=20mW, Tc=70°C,<br>Tld=Tset | -      | 2    | 2.6  | V          |

**FIBER PIGTAIL SPECIFICATIONS**

| Parameter                        | Limits        | Unit          |
|----------------------------------|---------------|---------------|
| Type                             | PM (Note 5)   | -             |
| Mode field diameter              | 10.5 $\pm$ 1  | $\mu\text{m}$ |
| Cladding diameter                | 125 $\pm$ 3   | $\mu\text{m}$ |
| Secondary coating outer diameter | 0.9 $\pm$ 0.1 | mm            |
| Polarization axis                | slow axis     | -             |
| Connector                        | FC/PC         | -             |
| Optical return loss of connector | 40 (min)      | dB            |

Note 5) PMF - Sumitomo Panda fiber (PM-155)

**DOCUMENTATION** (Tld=Tset)

- Fiber output power vs. Laser forward current at Tld=Tset and Tc=-20,25,70°C
- Threshold current (Ith)
- Laser forward current (Iop) at Pf=20mW
- Laser forward voltage (Vop) at Pf=20mW
- Laser operating temperature (Tset) at  $\lambda_c$  (Note 6)
- Power monitor current (Ipm) at Pf=20mW
- Wavelength monitor current (Iwm) at Pf=20mW,  $\lambda_c$
- Thermistor resistance (Rth)
- Cooler current (Ipe) at Pf=20mW and Tc=70°C
- Cooler voltage (Vpe) at Pf=20mW and Tc=70°C

Note 6) Tset is attached as a reference data. Rth should be used in order to tune the wavelength to the specified value accurately.

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**Table 1.**

| Type number      | $\lambda_c$ (nm) | Type number      | $\lambda_c$ (nm) | Type number      | $\lambda_c$ (nm) |
|------------------|------------------|------------------|------------------|------------------|------------------|
| FU-675PDF-V2M3A  | 1527.22          | FU-675PDF-V2M36A | 1540.16          | FU-675PDF-V2M69A | 1553.33          |
| FU-675PDF-V2M4A  | 1527.60          | FU-675PDF-V2M37A | 1540.56          | FU-675PDF-V2M70A | 1553.73          |
| FU-675PDF-V2M5A  | 1527.99          | FU-675PDF-V2M38A | 1540.95          | FU-675PDF-V2M71A | 1554.13          |
| FU-675PDF-V2M6A  | 1528.38          | FU-675PDF-V2M39A | 1541.35          | FU-675PDF-V2M72A | 1554.54          |
| FU-675PDF-V2M7A  | 1528.77          | FU-675PDF-V2M40A | 1541.75          | FU-675PDF-V2M73A | 1554.94          |
| FU-675PDF-V2M8A  | 1529.16          | FU-675PDF-V2M41A | 1542.14          | FU-675PDF-V2M74A | 1555.34          |
| FU-675PDF-V2M9A  | 1529.55          | FU-675PDF-V2M42A | 1542.54          | FU-675PDF-V2M75A | 1555.75          |
| FU-675PDF-V2M10A | 1529.94          | FU-675PDF-V2M43A | 1542.94          | FU-675PDF-V2M76A | 1556.15          |
| FU-675PDF-V2M11A | 1530.33          | FU-675PDF-V2M44A | 1543.33          | FU-675PDF-V2M77A | 1556.55          |
| FU-675PDF-V2M12A | 1530.72          | FU-675PDF-V2M45A | 1543.73          | FU-675PDF-V2M78A | 1556.96          |
| FU-675PDF-V2M13A | 1531.12          | FU-675PDF-V2M46A | 1544.13          | FU-675PDF-V2M79A | 1557.36          |
| FU-675PDF-V2M14A | 1531.51          | FU-675PDF-V2M47A | 1544.53          | FU-675PDF-V2M80A | 1557.77          |
| FU-675PDF-V2M15A | 1531.90          | FU-675PDF-V2M48A | 1544.92          | FU-675PDF-V2M81A | 1558.17          |
| FU-675PDF-V2M16A | 1532.29          | FU-675PDF-V2M49A | 1545.32          | FU-675PDF-V2M82A | 1558.58          |
| FU-675PDF-V2M17A | 1532.68          | FU-675PDF-V2M50A | 1545.72          | FU-675PDF-V2M83A | 1558.98          |
| FU-675PDF-V2M18A | 1533.07          | FU-675PDF-V2M51A | 1546.12          | FU-675PDF-V2M84A | 1559.39          |
| FU-675PDF-V2M19A | 1533.47          | FU-675PDF-V2M52A | 1546.52          | FU-675PDF-V2M85A | 1559.79          |
| FU-675PDF-V2M20A | 1533.86          | FU-675PDF-V2M53A | 1546.92          | FU-675PDF-V2M86A | 1560.20          |
| FU-675PDF-V2M21A | 1534.25          | FU-675PDF-V2M54A | 1547.32          | FU-675PDF-V2M87A | 1560.61          |
| FU-675PDF-V2M22A | 1534.64          | FU-675PDF-V2M55A | 1547.72          | FU-675PDF-V2M88A | 1561.01          |
| FU-675PDF-V2M23A | 1535.04          | FU-675PDF-V2M56A | 1548.11          | FU-675PDF-V2M89A | 1561.42          |
| FU-675PDF-V2M24A | 1535.43          | FU-675PDF-V2M57A | 1548.51          | FU-675PDF-V2M90A | 1561.83          |
| FU-675PDF-V2M25A | 1535.82          | FU-675PDF-V2M58A | 1548.91          | FU-675PDF-V2M91A | 1562.23          |
| FU-675PDF-V2M26A | 1536.22          | FU-675PDF-V2M59A | 1549.32          | FU-675PDF-V2M92A | 1562.64          |
| FU-675PDF-V2M27A | 1536.61          | FU-675PDF-V2M60A | 1549.72          | FU-675PDF-V2M93A | 1563.05          |
| FU-675PDF-V2M28A | 1537.00          | FU-675PDF-V2M61A | 1550.12          | FU-675PDF-V2M94A | 1563.45          |
| FU-675PDF-V2M29A | 1537.40          | FU-675PDF-V2M62A | 1550.52          | FU-675PDF-V2M95A | 1563.86          |
| FU-675PDF-V2M30A | 1537.79          | FU-675PDF-V2M63A | 1550.92          | FU-675PDF-V2M96A | 1564.27          |
| FU-675PDF-V2M31A | 1538.19          | FU-675PDF-V2M64A | 1551.32          | FU-675PDF-V2M97A | 1564.68          |
| FU-675PDF-V2M32A | 1538.58          | FU-675PDF-V2M65A | 1551.72          | FU-675PDF-V2M98A | 1565.09          |
| FU-675PDF-V2M33A | 1538.98          | FU-675PDF-V2M66A | 1552.12          | FU-675PDF-V2M99A | 1565.50          |
| FU-675PDF-V2M34A | 1539.37          | FU-675PDF-V2M67A | 1552.52          |                  |                  |
| FU-675PDF-V2M35A | 1539.77          | FU-675PDF-V2M68A | 1552.93          | FU-675PDF-V2M1A  | (Note 7)         |

All wavelengths are referred to vacuum.

Note 7) Any ITU-T wavelength between 1527.22~1565.50nm.

**mitsubishi (optical devices)**

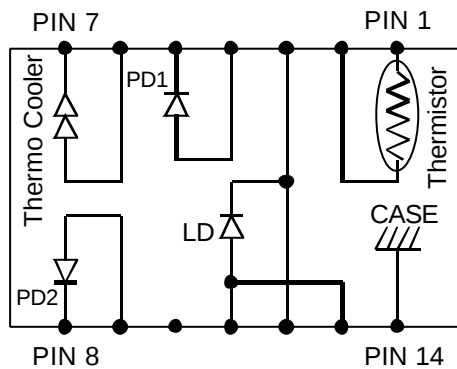
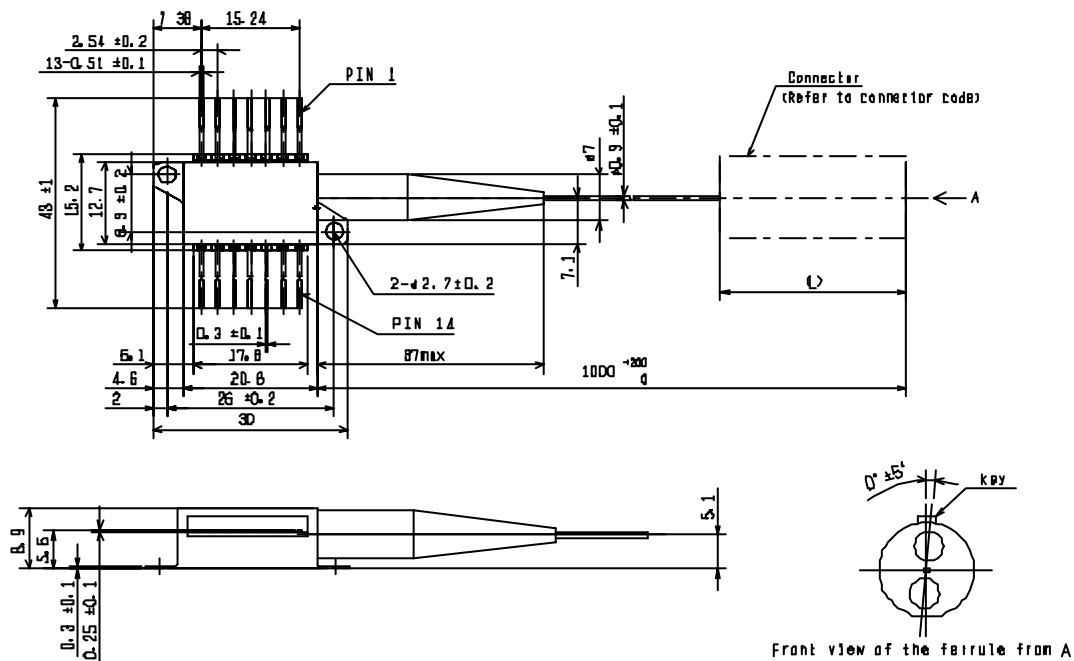
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## OUTLINE DIAGRAM

(Unit : mm)

NOTE. TOLERANCES UNLESS NOTED  $\pm 0.5$  [mm]



| PIN | FUNCTION                          |
|-----|-----------------------------------|
| 1   | THERMISTOR                        |
| 2   | THERMISTOR                        |
| 3   | LD CATHODE                        |
| 4   | POWER MONITOR<br>PD1 ANODE        |
| 5   | POWER MONITOR<br>PD1 CATHODE      |
| 6   | COOLER ANODE                      |
| 7   | COOLER CATHODE                    |
| 8   | WAVELENGTH MONITOR<br>PD2 CATHODE |
| 9   | WAVELENGTH MONITOR<br>PD2 ANODE   |
| 10  | NC                                |
| 11  | LD ANODE                          |
| 12  | LD CATHODE                        |
| 13  | LD ANODE                          |
| 14  | GND                               |

FU-675PDF-V2MxxA