

**ES Product**

**FU-60RDF-S6M1x**

1.55  $\mu\text{m}$  CWDM DFB-LD WITH LC RECEPTACLE FOR LONG HAUL APPLICATIONS

**DESCRIPTION**

FU-60RDF-S6M1x is a 1.55 $\mu\text{m}$  DFB-LD TOSA (Transmitter Optical Subassembly) with a single-mode fiber stub.

This module is designed for use in high-speed, long haul CWDM optical communication systems.

**FEATURES**

- Multi-quantum wells (MQW) DFB laser diode
- 1.55 $\mu\text{m}$  band of optical emission wavelength
- High-speed response
- Built-in optical isolator
- 4-pin coaxial package
- With photodiode for optical output monitor
- LC receptacle with a single-mode fiber stub



**APPLICATION**

2.5Gb/s Long haul coarse WDM (CWDM) optical communication systems (OC-48, STM-16)  
Extended reach datacom applications

**ABSOLUTE MAXIMUM RATINGS** ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Rating	Unit
Laser diode	Optical output power	Pf CW	9	mW
	Forward current	If CW	150	mA
	Reverse voltage	Vrl -	2	V
Photodiode	Reverse voltage	Vrd -	20	V
	Forward current	Ifd -	2	mA
Operating case temperature	Tc	-	-5 ~ +75	$^\circ\text{C}$
Storage temperature	Tstg	-	-40 ~ +85	$^\circ\text{C}$

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**ELECTRICAL/OPTICAL CHARACTERISTICS** (Tc=-5~75°C, unless otherwise noted)

Parameter	Symbol	Test Conditions	Limits			Unit	
			Min.	Typ.	Max.		
Threshold current	Ith	CW, Tc=25°C	-	10	20	mA	
		CW	2	-	45		
Optical output power at threshold current	Pth	CW, I <sub>bias</sub> =Ith	-	-	100	μW	
Operating current	Iop	CW, Pf=3.16mW, Tc=25°C	-	35	55	mA	
		CW, APC (Note 1), Tc=75°C	-	60	110		
Operating voltage	Vop	CW, Pf=3.16mW, Tc=25°C	-	1.2	1.5	V	
		CW, APC, Tc=75°C	-	1.6	1.7		
Modulation Current (Iop-Ith) (Note 2)	I <sub>mod</sub>	CW, Pf=3.16mW, Tc=25°C	14	25	40	mA	
		CW, APC	10	-	65		
Differential impedance	Rs	-	3	6	10		
Optical output power from fiber end	Pf	CW, nominal	3.16			mW	
Light-emission central wavelength	λ <sub>c</sub>	CW, APC	-S6M12	1463	1470	1477	nm
			-S6M13	1483	1490	1497	nm
			-S6M14	1503	1510	1517	nm
			-S6M15	1523	1530	1537	nm
			-S6M16	1543	1550	1557	nm
			-S6M17	1563	1570	1577	nm
			-S6M18	1583	1590	1597	nm
			-S6M19	1603	1610	1617	nm
Wavelength temperature coefficient	λ <sub>ct</sub>	CW, APC	-	0.1	0.11	nm/°C	
Side mode suppression ratio	Sr	CW, APC	30	45	-	dB	
Rise and fall time (20~80%)	tr, tf	(Note 3) (Note 4)	-	125	150	psec	
Relative intensity noise	Nr	CW, APC, f=1GHz	-	-145	-130	dB/Hz	
Tracking error (Note 5)	Er	CW, APC	-	0.5	1.25	dB	
Monitor current	I <sub>mon</sub>	CW, Pf=3.16mW, V <sub>rd</sub> =5V, Tc=25°C	0.1	-	2	mA	
Optical isolation	Iso	-	16	-	-	dB	
Dark current (PD)	I <sub>d</sub>	V <sub>rd</sub> =5V	-	-	0.1	μA	
Capacitance (PD)	Ct	V <sub>rd</sub> =5V, f=1MHz	-	-	10	pF	

Note 1) APC by a constant monitor current for Pf=3.16mW at Tc=25°C.

Note 2) Modulation current for LD driver shall be less than this "I<sub>mod</sub>" when the optical extinction ratio is set around 10dB.

Note 3) 2.48832Gb/s NRZ, 2<sup>23</sup>-1, Pf<sub>ave</sub>=1.58mW, I<sub>bias</sub>=Ith, optical return loss from the line should be greater than 24dB in order to ensure the specified performance.

Note 4) Guaranteed only when the length of LD pins are shorter than 5mm.

Note 5) Er=max|10×log(Pf / Pf@25°C)|

**RECEPTACLE SPECIFICATIONS**

Parameter	Limits	Unit
Type	SM, for LC connector	-
Mode field diameter	10±1	μm
Cladding diameter	125±2	μm

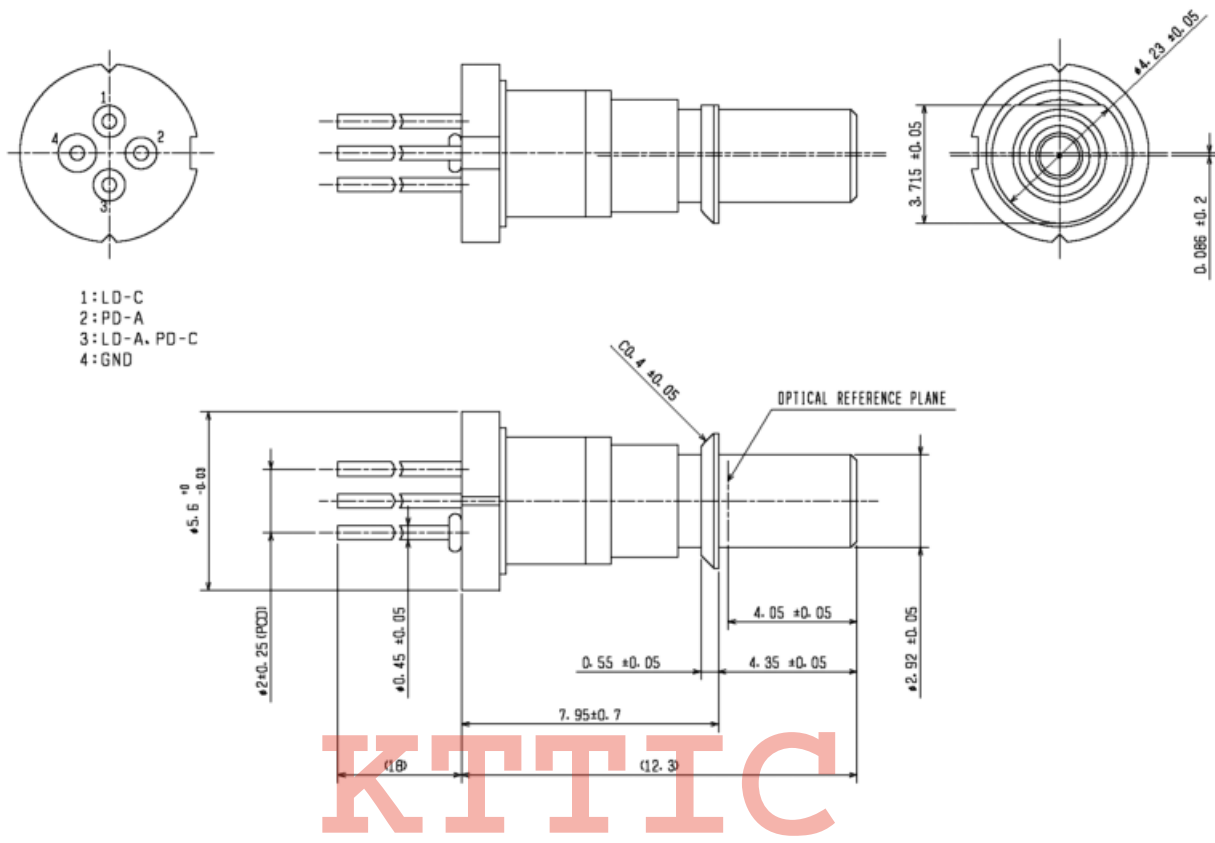
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OUTLINE DIAGRAM (Unit : mm)

Note: Tolerances unless noted ±0.3



ORDERING INFORMATION

**FU-60RDF-S6M1x**

Wavelength: Please see ELECTRICAL/OPTICAL CHARACTERISTICS table.

**ES Product****FU-60RDF-S6M1x****1.55  $\mu\text{m}$  CWDM DFB-LD WITH LC RECEPTACLE FOR LONG HAUL APPLICATIONS****Safety Cautions for Use of Optoelectronic Devices****General:**

Although the manufacturer is always striving to improve the reliability of its product, problems and errors may occur with semiconductor products. Therefore, the user's products are required to be designed with full safety regard to prevent any accidents that results in injury, death, fire or environmental damage even when semiconductor products happen to error. Especially it is recommended to take in consideration about redundancy, fire prevention, error prevention safeguards. And the following requirements must be strictly observed.

**Warning!**

**1. Eye safety :** Semiconductor laser radiates laser light during operation. Laser light is very dangerous when shot directly into human eyes. Don't look at laser light directly, or through optics such as a lens. The laser light should be observed using the ITV camera, IR-viewer, or other appropriate instruments.

**2. Product handling :** The product contains GaAs (gallium arsenide). It is safe for regular use, but harmful to the human body if made into powder or steam. Be sure to avoid dangerous process like smashing, burning, chemical etching. Never put this product in one's mouth or swallow it.

**3. Product disposal :** This product must be disposed of as special industrial waste. It is necessary to separate it from general industrial waste and general garbage.

**Handling Cautions for Optoelectronic Devices****1. General:**

(1) The products described in this specification are designed and manufactured for use in general communication systems or electronic devices, unless their applications or reliability are otherwise specified. Therefore, they are not designed or manufactured for installation in devices or systems that may affect human life or that are used in social infrastructure requiring high reliability.

(2) When the customer is considering to use the products in special applications, such as transportation systems (automobiles, trains, vessels), medical equipments, aerospace, nuclear power control, and submarine repeaters or systems, please contact Mitsubishi Electric or an authorized distributor.

**2. Shipping Conditions:**

(1) During shipment, place the packing boxes in the correct direction, and fix them firmly to keep them immovable. Placing the boxes upside down, tilting, or applying abnormal pressure onto them may cause deformation in the electrode terminals, breaking of optical fiber, or other problems.

(2) Never throw or drop the packing boxes. Hard impact on the boxes may cause break of the devices.

(3) Take strict precautions to keep the devices dry when shipping under rain or snow.

**3. Storage Conditions:**

When storing the products, it is recommended to store them following the conditions described below without opening the packing. Not taking enough care in storing may result in defects in electrical characteristics, soldering quality, visual appearance, and so on. The main points are described below (if special storage conditions are given to the product in the specification sheet, they have priority over the following general cautions):

(1) Appropriate temperature and humidity conditions, i.e., temperature range between 5~30°C, and humidity between 40~60 percent RH, should be maintained in storage locations. Controlling the temperature and humidity within this range is particularly important in case of long-term storage for six months or more.

(2) The atmosphere should be particularly free from toxic gases and dust.

(3) Do not apply any load on the product.

(4) Do not cut or bend the leads of the devices which are to be stored. This is to prevent corrosion in the cut or bent part of the lead causing soldering problems in the customer's assembling process.

(5) Sudden change in temperature may cause condensation in the product or packing, therefore, such locations should be avoided for storing. Temperature in storage locations should be stable.

(6) When storing ceramic package products for extended periods of time, the leads may turn reddish due to reaction with sulfur in the atmosphere.

(7) Storage conditions for bare chip and unsealed products shall be stated separately because bare chip and unsealed products require stricter controls than package sealed products.

**4. Design Conditions and Environment under Use:**

(1) Avoid use in locations where water or organic solvents adhere directly to the product, or where there is any possibility of the generation of corrosive gas, explosive gas, dust, salinity, or other troublesome conditions. Such environments will not only significantly lower the reliability, but also may lead to serious accidents.

(2) Operation in excess of the absolute maximum ratings can cause permanent damage to the device. The customers are requested to design not to exceed those ratings even for a short time.

**5. ESD Safety Cautions:**

The optoelectronic devices are sensitive to static electricity (ESD, electro-static discharge). The product can be broken by ESD. When handling this product, please observe the following countermeasures:

<Countermeasures against Static Electricity and Surge>

To prevent break of devices by static electricity or surge, please adopt the following countermeasures in the assembly line:

(1) Ground all equipments, machinery jigs, and tools in the process line with earth wires installed in them. Take particular care with hot plates, solder irons and other items for which the commercial power supplies are prone to leakage.

(2) Workers should always use earth bands. Use of antistatic clothing, electric conductive shoes, and other safety equipment while at work is highly recommended.

(3) Use conductive materials for this product's container, etc.

(4) It is recommended that grounding mats be placed on the surfaces of assembly line workbench and the surrounding floor in work area, etc.

(5) When mounting this product in parts or materials which can be electrically charged (printed wiring boards, plastic products, etc.), pay close attention to the static electricity in those parts. ESD may damage the product.

(6) Humidity in working environment should be controlled to be 40 percent RH or higher.

These countermeasures are most general, and there is a need to carefully confirm the line before starting mass production using this product (in the trial production, etc.). It is extremely important to prevent surge, eliminate it rapidly, and prevent it from spreading.