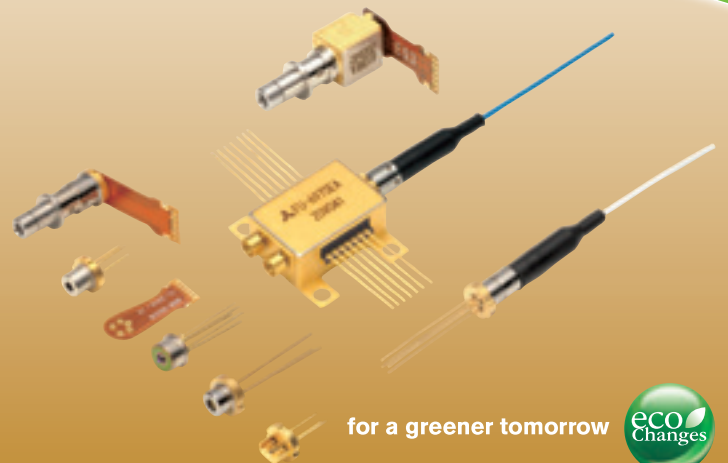


OPTICAL DEVICES



# Optical Devices



for a greener tomorrow





## Mitsubishi Electric Optical Devices: The Key to Connecting Information Networks in the Future.

The amount of information in society today that travels over high-speed Internet, video distribution channels and IP telephones is further increasing at a tremendous rate. This increase seems to know no bounds, as information spreads from subscribers, through access networks and onto backbone networks.

Mitsubishi Electric is playing a leading role in developing the information infrastructure through the use of optical fiber modules, laser diodes and photo diodes.



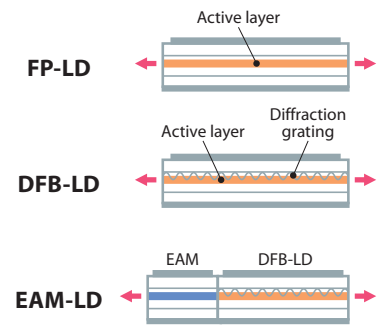
## DFB-LD: Distributed Feedback Laser Diode

DFB-LDs are semiconductor lasers that enable further and faster signal transmission than conventional FP-LDs\* through maintaining the oscillation spectrum in a single longitudinal mode (a single wavelength component). This is achieved by installing a minute periodic structure (diffraction grating) within the internal elements of the laser diode.

EAM-LDs\* are also available, featuring an electro-absorption modulator (EAM) integrated in front of the DFB-LD, for even further transmission.

\* FP-LD: Fabry-Perot Laser Diode

\* EAM-LD: Electro-Absorption Modulator integrated Laser Diode



## Laser Diodes and Photo Diodes for Fiber to the Home (FTTH)

Faster PON technology has led to the development of B-PON\*, G-PON\* and GE-PON\* in response to demands for increased speed and capacity in optical communication systems. Backed by the leading photo diode for FTTH in the B-PON field, DFB-LDs and APDs\* are designed for different types of access network optical fiber grids, providing a flexible approach to changes in customer specifications and packages. These parts are used extensively in G-PON, which has rapidly become increasingly popular around the world.

\* B-PON: Broadband Passive Optical Network

\* G-PON: Gigabit Passive Optical Network

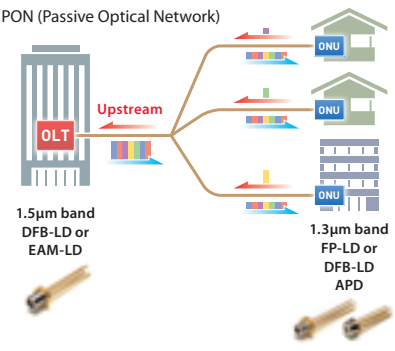
\* GE-PON: Gigabit Ethernet Passive Optical Network

\* APD: Avalanche Photo Diode

\* OLT: Optical Line Terminal

\* ONU: Optical Network Unit

PON (Passive Optical Network)



## 43Gbps Modulator-integrated Laser Diode and Photo Diode Modules

Compliant with industry standards (XLMD-MSA\*), both the laser diode module with built-in driver modulator and the large, dynamic range PD-TIA\* module deliver exceptional performance using Mitsubishi Electric's own optical elements (EAM-LDs, PDs) and an original high-frequency circuit design. As transponders over VSR\* (short communications up to 2 km), they provide faster optical communications between routers, SONET/SDH\* devices and DWDM\* devices, and contribute to more compact devices that use less power and less cost.

\* XLMD-MSA: 40 Gbps Miniature Device Multi Source Agreement

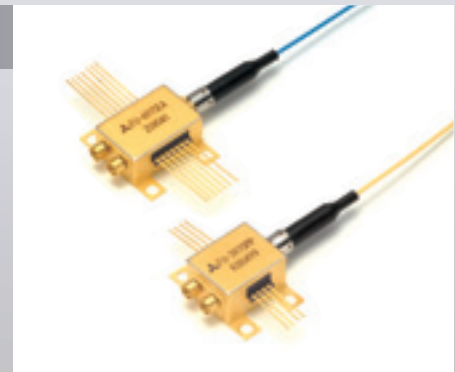
\* PD-TIA: Photo Diode with Trans-Impedance Amplifier

\* VSR: Very Short Reach

\* SONET: Synchronous Optical Network

\* SDH: Synchronous Digital Hierarchy

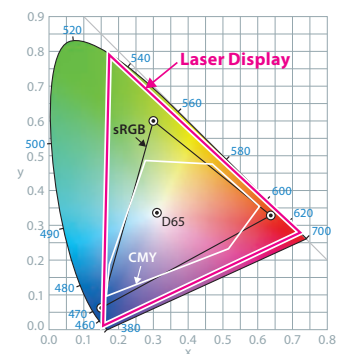
\* DWDM: Dense Wavelength Division Multiplexing



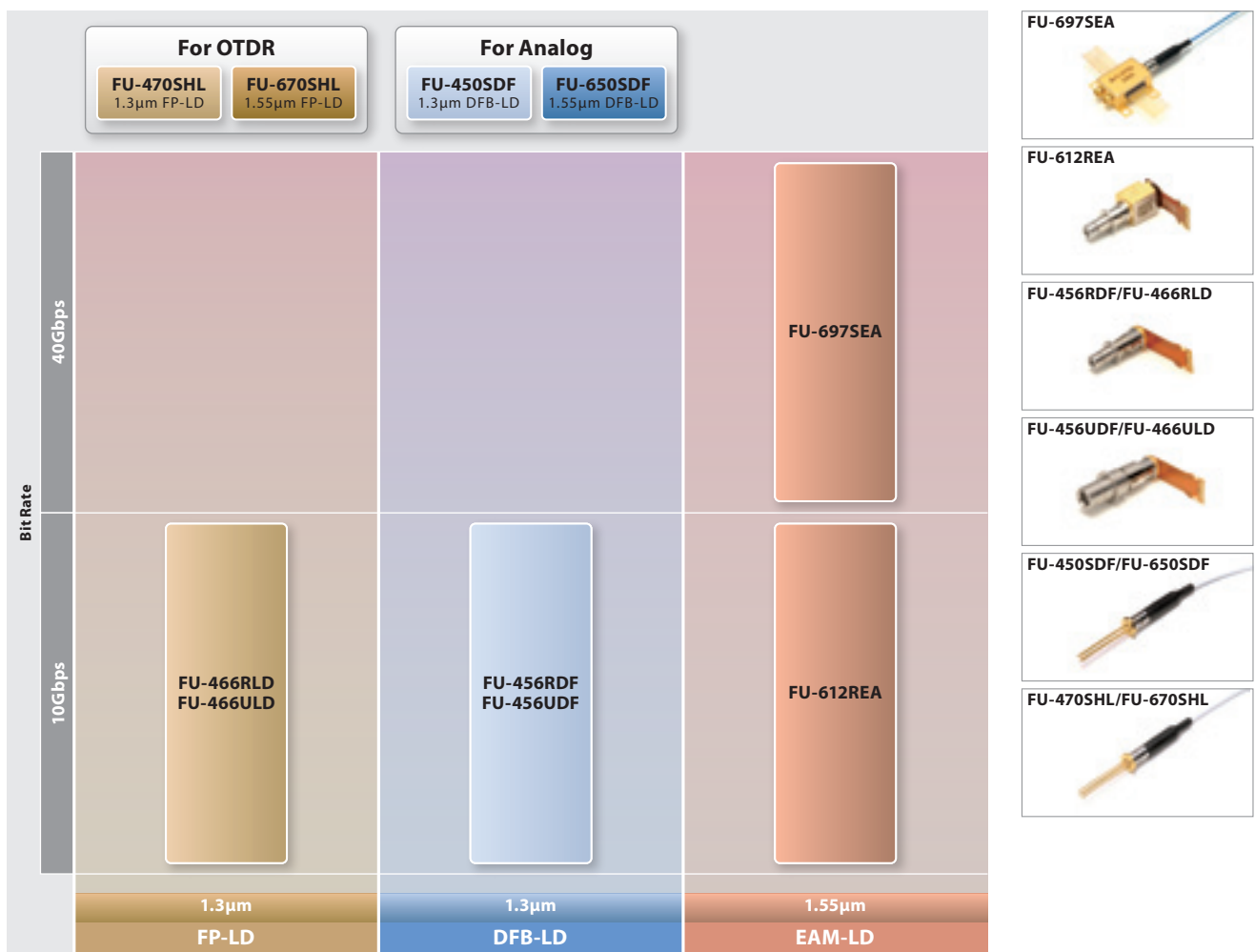
## 638nm High-output Laser Diode for Industry and Displays

Compared to LED\*s, semiconductor lasers have lower power consumption, higher output and can be used with optical systems having a higher maximum aperture. These considerable advantages mean that they can be used for projectors that do not require focal adjustment. Mitsubishi Electric has a range of lasers available, including a multi-mode semiconductor laser with a 638nm wavelength and 1W output (when pulse-driven) that provides highly visible, vibrant red colors for compact color projectors, single-mode lasers and laser arrays.

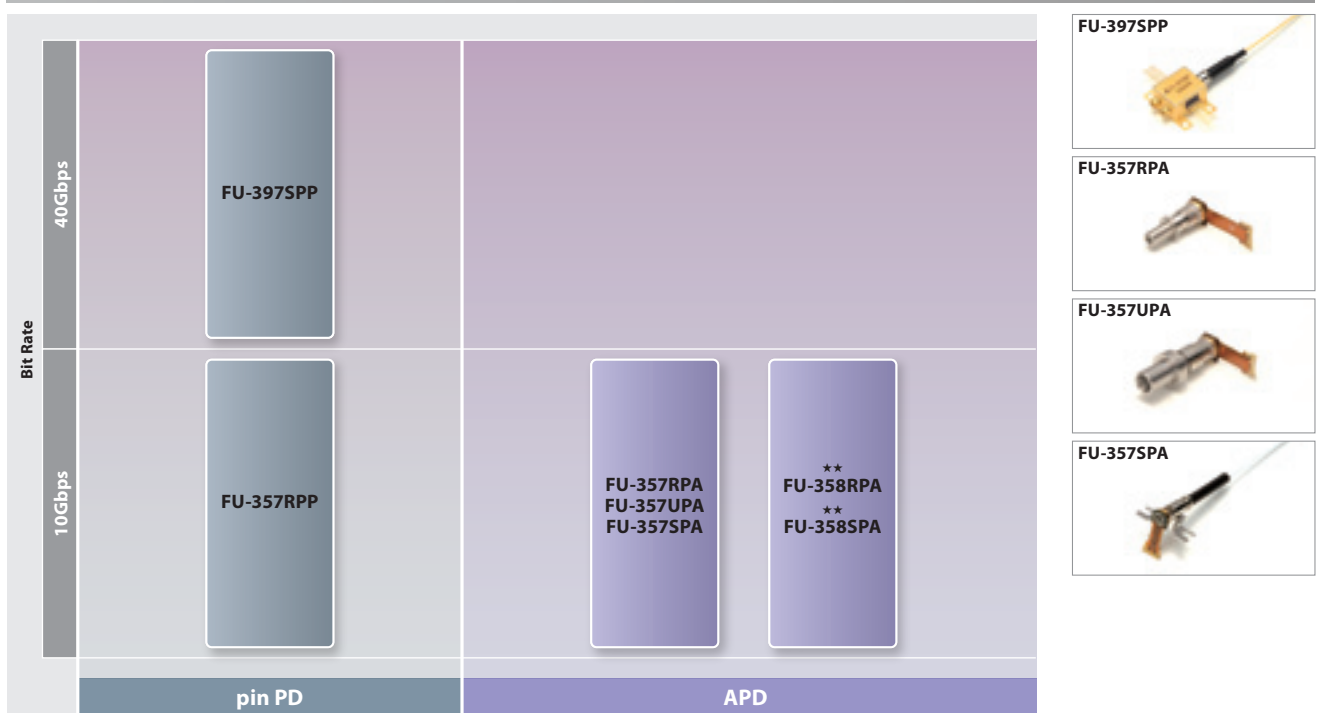
\* LED: Light-Emitting Diode



## Overview of Laser Diode Modules

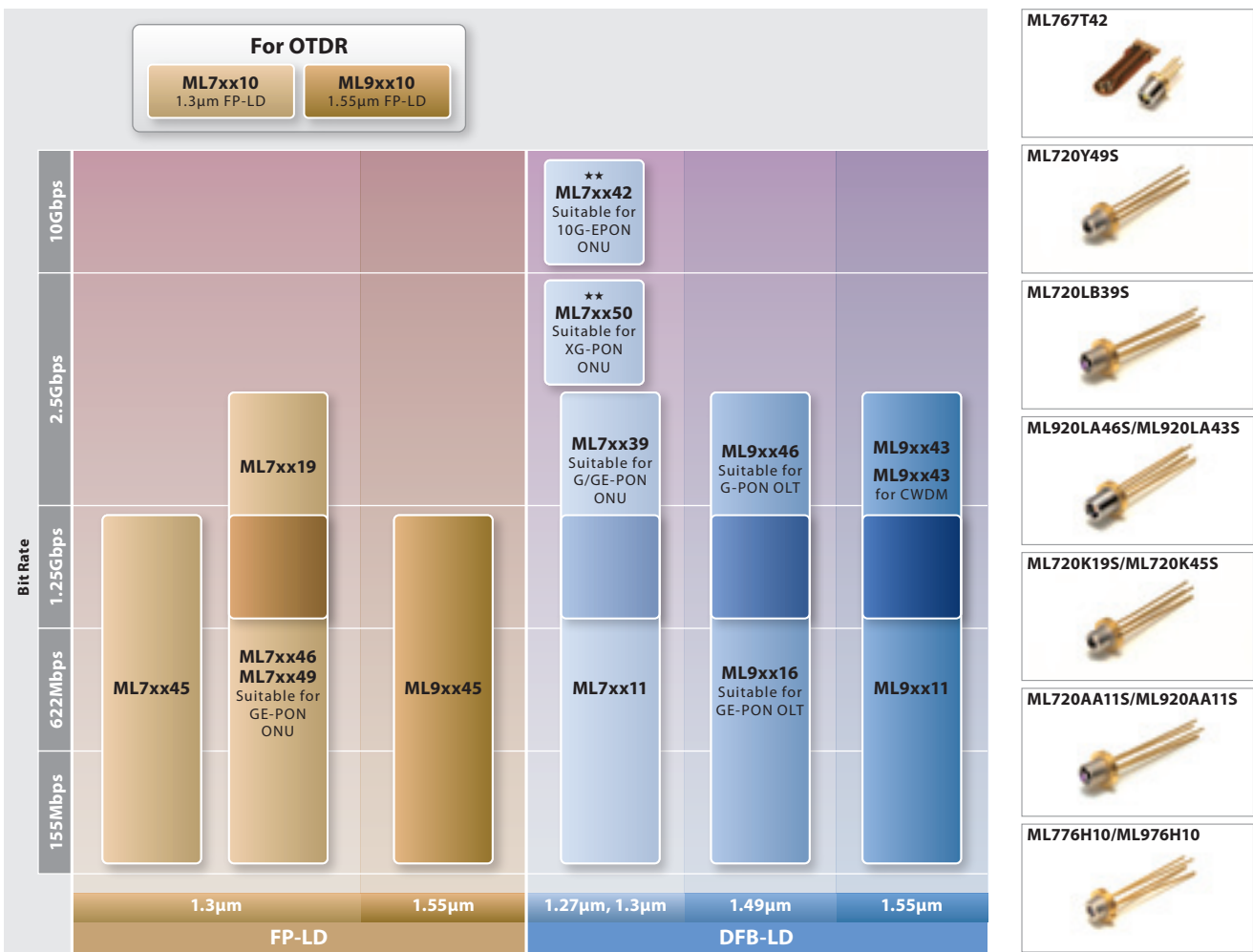


## Overview of Photo Diode Modules



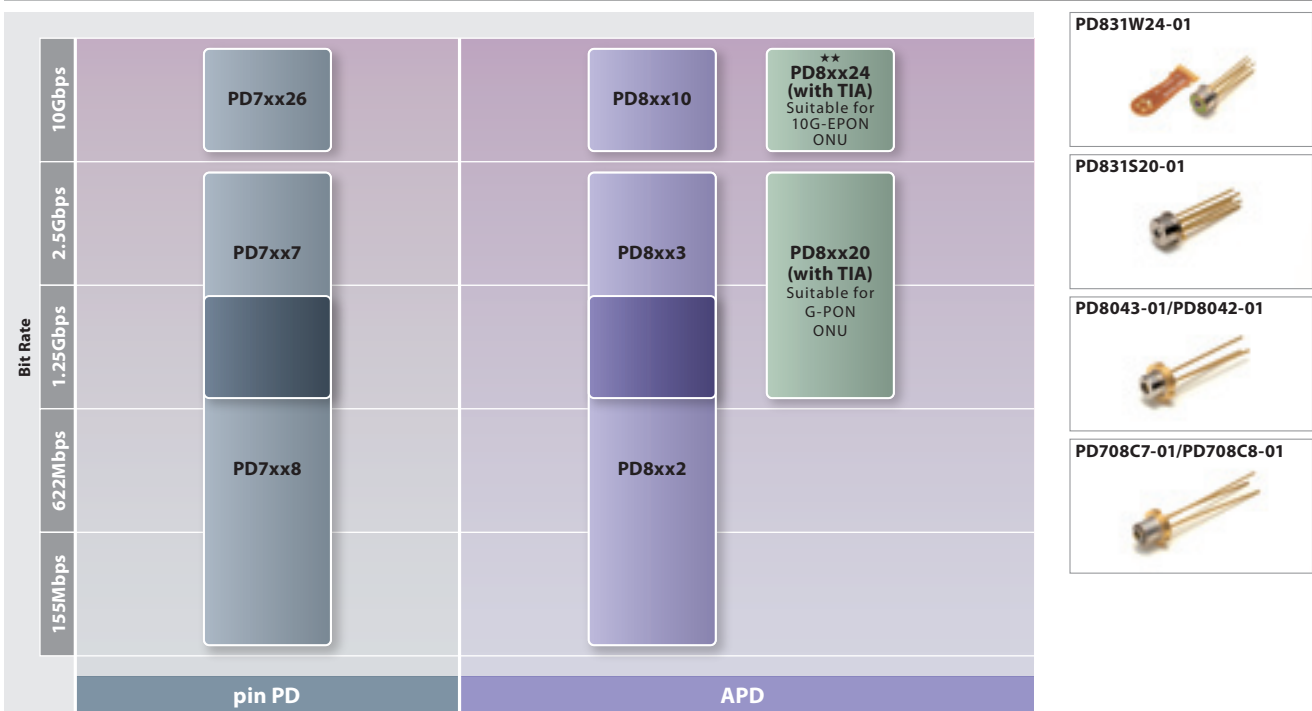
\*\* : Under Development

## Overview of Laser Diodes



★★: Under Development

## Overview of Photo Diodes



★★: Under Development

## Line-up of Laser Diode Modules

	Type Number	Chip Type	Package	Wavelength [nm]	Output Power	Features
for OTDR	FU-470SHL	FP-LD	Coaxial Pigtail	1310	~ 120mW(Pulse)	Pulse width=10us, Duty=1%
	FU-670SHL	FP-LD	Coaxial Pigtail	1550	~ 90mW(Pulse)	Pulse width=10us, Duty=1%
for Analog	FU-450SDF	DFB-LD	Coaxial Pigtail	1310	4mW	CATV Return path, RoF
	FU-650SDF	DFB-LD	Coaxial Pigtail	1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610	4mW	CATV Return path, RoF
for 10G	FU-466RLD	FP-LD	TOSA, LC Receptacle	1310	0.59mW	XFP LRM, XMD-MSA Compliant
	FU-466ULD	FP-LD	TOSA, SC Receptacle	1310	0.59mW	XEMPAK/X2 LRM, XMD-MSA Compliant
	FU-456RDF	DFB-LD	TOSA, LC Receptacle	1310	0.56mW	XFP 2km, XMD-MSA Compliant
	FU-456UDF	DFB-LD	TOSA, SC Receptacle	1310	0.63mW	XEMPAK/X2 LR 10km, XMD-MSA Compliant
	FU-612REA	EAM-LD	TOSA, LC Receptacle	1550	1.0dBm	XFP ER 40km TDM, XMD-MSA Compliant
for 40G	FU-697SEA	EAM-LD	LC/SC Pigtail	1550	1.5dBm	43Gbps VSR, XLMD-MSA Compliant

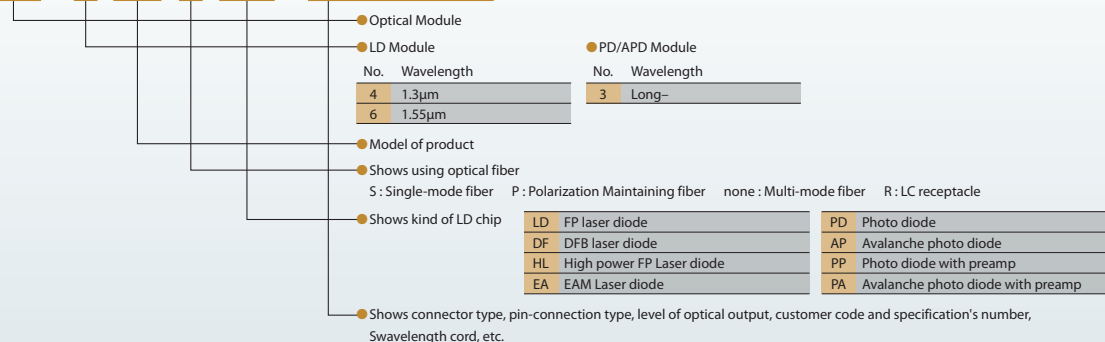
## Line-up of Photo Diode Modules

	Type Number	Chip Type	Package	Wavelength [nm]	Application	Features
for 10G	FU-357RPP	pin PD	ROSA, LC Receptacle	-	XFP ~ 40km	PD TIA, XMD-MSA Compliant
	FU-357RPA	APD	ROSA, LC Receptacle	-	XFP 80km	APD TIA, XMD-MSA Compliant
	FU-357UPA	APD	ROSA, SC Receptacle	-	XFP 80km	APD TIA, XMD-MSA Compliant
	FU-357SPA	APD	LC/SC Pigtail	-	300pin 80km	APD TIA
	FU-358RPA**	APD	ROSA, LC Receptacle	-	XFP 80km	APD TIA, XMD-MSA Compliant
	FU-358SPA**	APD	LC/SC Pigtail	-	300pin 80km	APD TIA
for 40G	FU-397SPP	pin PD	LC/SC Pigtail	-	43Gbps VSR	XLMD-MSA Compliant

\*\* : Under Development

## Type Name Definition of Optical Devices for Optical Communication System

### FU- 6 50 S DF- FW1M15



## Line-up of Laser Diodes

	Type Number	Wavelength [nm]	Output Power@CW [mW]	Case Temperature [°C]	Features
FP-LD	ML7xx45	1310	5	-40 ~ +85	155M, 622M, 1.25Gbps
	ML7xx46	1310	13	-40 ~ +85	GE-PON ONU, 1.25Gbps
	ML7xx49	1310	11	-40 ~ +85	GE-PON ONU, 1.25Gbps, High coupling efficiency
	ML7xx19	1310	5	-40 ~ +85	2.5Gbps
	ML9xx45	1550	5	-40 ~ +85	155M, 622M, 1.25Gbps
DFB-LD	ML7xx11	1310	5	-40 ~ +85	155M, 622M, 1.25Gbps
	ML7xx39	1310	5	-40 ~ +95	G/GE-PON, 1.25Gbps, 2.5Gbps
	ML7xx42**	1270	10	-5 ~ +75	10G-EPON, CPRI, 10Gbps
	ML7xx50**	1270	8	-40 ~ +85	XG-PON ONU, 2.5Gbps
	ML9xx11	1550	5	-40 ~ +85	155M, 622M, 1.25Gbps
	ML9xx16	1490	10	-40 ~ +85	GE-PON OLT, 1.25Gbps
	ML9xx43	1550	5	-20 ~ +95	2.5Gbps
	ML9xx43	1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610	5	-10 ~ +85	1.25Gbps, 2.5Gbps, 8 wavelength for CWDM,
ML9xx46	1490	15	-40 ~ +85	G-PON OLT, 2.5Gbps	
FP-LD for OTDR	ML7xx10	1310	300(Pulse)	-40 ~ +50	OTDR
	ML9xx10	1550	200(Pulse)	-40 ~ +50	OTDR

\*\* : Under Development

## Line-up of Photo Diodes

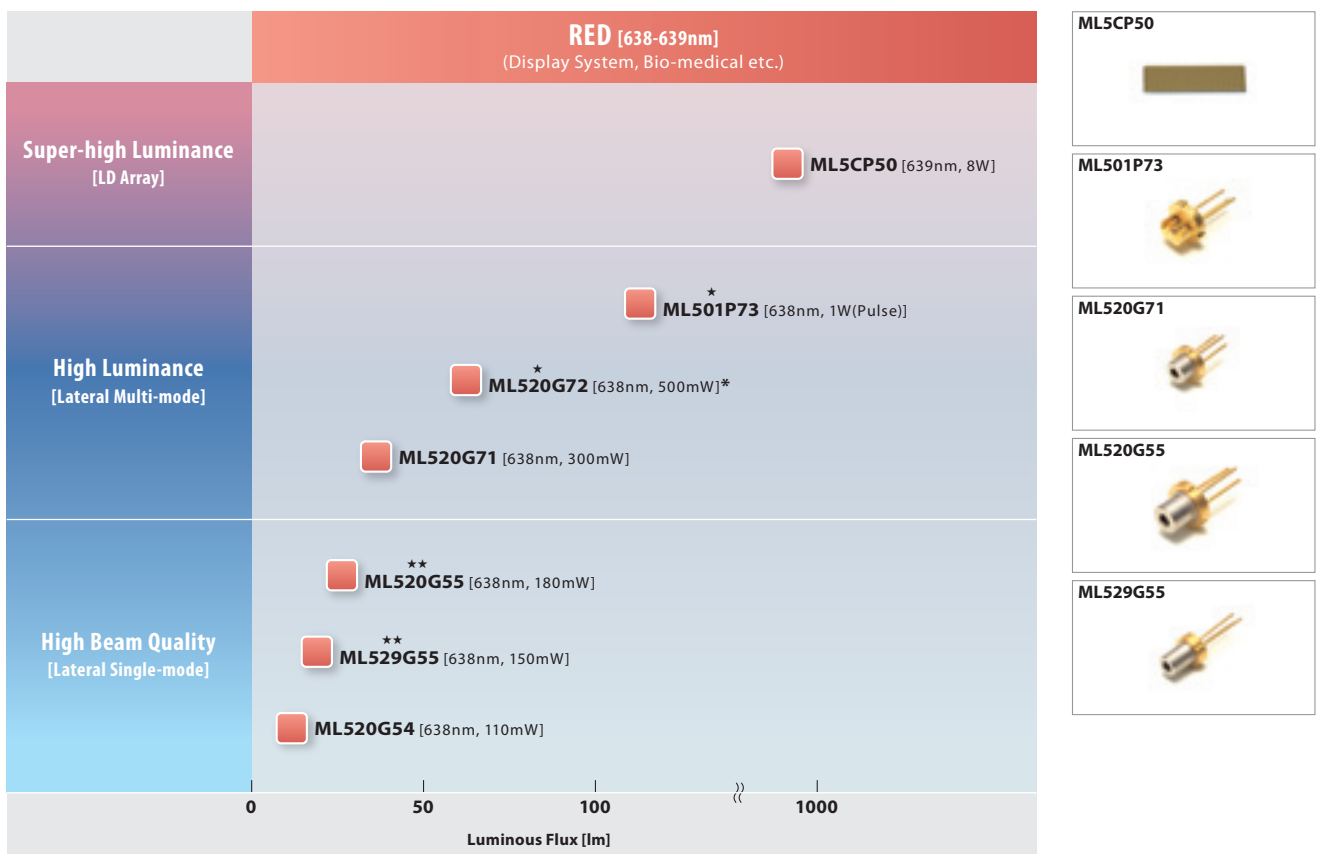
	Type Number	Structure	Detective Range [nm]	Active Diameter [μm]	Features
pin PD	PD7xx8	pin PD	1260 ~ 1620	80	155M, 622M, 1.25Gbps
	PD7xx7	pin PD	1260 ~1620	40	1.25G, 2.5Gbps
	PD7xx26	pin PD	1260 ~1620	20	10Gbps
APD	PD8xx2	APD	1260 ~1620	50	155M, 622M, 1.25Gbps
	PD8xx3	APD	1260 ~1620	35	1.25G, 2.5Gbps
	PD8xx10	APD	1260 ~1620	20	10Gbps
	PD8xx20	APD + TIA	1490	50	G-PON ONU, 2.5Gbps
	PD8xx24**	APD + TIA	1577	40	10G-EPON, 10Gbps

\*\* : Under Development

## Terminology

<b>TOSA</b> .....	Transmitter Optical Sub-Assembly	<b>CWDM</b> .....	Coarse Wavelength Division Multiplexing
<b>ROSA</b> .....	Receiver Optical Sub-Assembly	<b>OTDR</b> .....	Optical Time Domain Reflectometer
<b>LC</b> .....	Lucent Connector	<b>XLMD-MSA</b> .....	40 Gbps Miniature Device Multi Source Agreement
<b>SC</b> .....	Single fiber Connector	<b>XMD-MSA</b> .....	10 Gbps Miniature Device Multi Source Agreement
<b>PC</b> .....	Physical Contact	<b>XENPAK</b> .....	10 Gigabit Ethernet Transceiver Package
<b>APC</b> .....	Angled Physical Contact	<b>X2</b> .....	2nd Generation XENPAK
<b>XG-PON</b> .....	10 Gigabit Passive Optical Network	<b>XFP</b> .....	10 Gigabit small Form-factor Pluggable
<b>GE-PON</b> .....	Gigabit Ethernet-Passive Optical Network	<b>LR</b> .....	Long Reach
<b>RoF</b> .....	Radio over Fiber	<b>LRM</b> .....	Long Reach Multimode
<b>CPRI</b> .....	Common Public Radio Interface	<b>ER</b> .....	Extended Reach

## Overview of Red Laser Diodes



## Overview of High Power Short Wavelength Laser Diodes (Except Red LD)



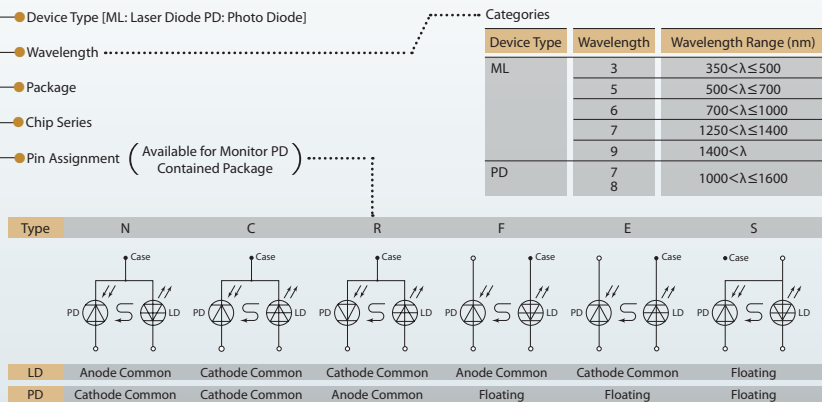
## Line-up of Laser Diodes

Type Number	Application	Wavelength [nm]	Output Power@CW [mW]	Output Power @Pulse [mW]	Case Temperature [°C]	Package
ML520G54	Display	638	110	-	50	φ5.6mm TO-CAN
ML529G55**	Display	638	150	-	40	φ5.6mm TO-CAN
ML520G55**	Display	638	180	-	40	φ5.6mm TO-CAN
ML520G71	Display	638	300	-	45	φ5.6mm TO-CAN
ML520G72*	Display	638	500	600	40	φ5.6mm TO-CAN
ML501P73*	Display	638	500	1000	40	φ5.6mm Capless
ML5CP50	Display	639	8000	-	-	Bare Bar
ML620G40*	Pumping	805	500	1200	60	φ5.6mm TO-CAN
ML629R40*	Pumping	805	500	1200	60	φ3.8mm Capless
ML60171C**	Sensor, Printing	830	260	-	60	φ5.6mm TO-CAN

\*: New Product \*\*\*: Under Development

## Type Name Definition of Laser and Photo Diodes

ML 7 20K 45 S



## SAFETY CAUTIONS FOR USE OR DISPOSAL OF LISTED PRODUCTS

The warnings below apply to all products listed in this pamphlet.

WARNING	
Laser Beam	While the laser diode is on, it gives a laser beam. Even if we can't see a laser beam by its wavelength, penetration into the eye by a laser beam or its reflected light may cause eye injury. Prevent the irradiating part or its reflected light from entering the eyes.
Injury	Fiber fragments may cause injury. In cases of fiber bending or breakage, never touch the fragment.
GaAs	Gallium arsenide (GaAs) is used in these products. To avoid danger, strictly observe the following cautions. <ul style="list-style-type: none"> <li>• Never place the products in your mouth.</li> <li>• Never burn or break the products, or use any type of chemical treatment to reduce them to gas or powder.</li> <li>• When disposing of the products, always follow the laws which apply, as well as your own company's internal waste treatment regulations.</li> </ul>
Disposal of Flame-Retarded Fiber Core Wire	Flame retardant resin must be disposed of according to law of industrial waste in disposal place. This product is a bromine type flame-retarded resin, containing bromine compounds and antimony trioxide. All disposal operations should be conducted with full consideration of this content.





**for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.



Please see here in detail.

<http://www.mitsubishielectric.com/>

#### Keep safety first in your circuit designs!

- Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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