DWDM 40km SFP+ Transceivers

TPD1XGJERxx

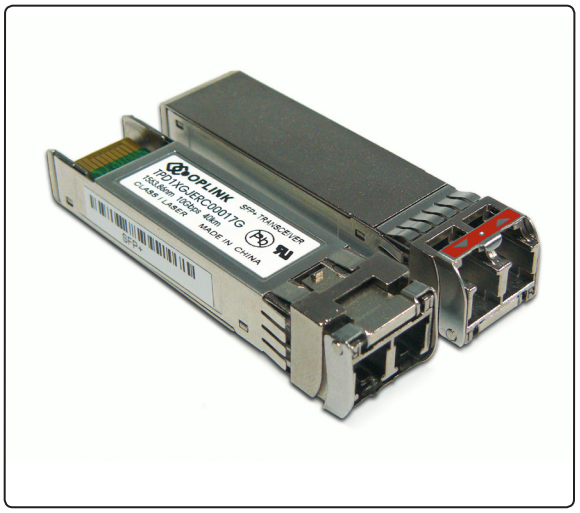
Product Description

The TPD1XGJERxx is an enhanced small form factor pluggable (SFP+) fiber optic transceiver with digital diagnostics monitoring functionality (DDM). Supporting Ethernet and Fiber Channel standards with dense wavelength division multiplexing (DWDM) wavelength makes it ideally suited for high capacity data-com and storage area network applications. DDM functionality (alarm and warning features) is integrated into the design via an I^2C serial interface per the Multi-Source Agreement (MSA) SFF-8472, Rev. 10.4.

Each transceiver utilizes an electro absorption modulator integrated laser (EML) with an operating wavelength with 100GHz (0.8nm) spacing per the ITU-grid. The transceiver supports data rates ranging from 11.3Gbps down to 8Gbps. It provides an excellent solution for data transmission at DWDM wavelength over up to 40km single mode fiber. The low power consumption and excellent EMI performance enable system design with high port density. The product is RoHS compliant and is designed and tested in accordance with industry safety standards. The transceiver is Class I Laser product per U.S. FDA/CDRH and international IEC-60825 standards.

The TPD1XGJERxx transceiver connects to standard 20-pad SFP+ connectors for hot plug capability. This allows the system designer to make configuration changes or maintenance by simply plugging in different transceivers without removing the power supply from the host system. The transmitter and receiver DATA interfaces are internally AC-coupled. LV-TTL Transmitter Disable control input and Loss of Signal (LOS) output interfaces are also provided. The transceiver has bail-type latch, which offers an easy and convenient way to release the modules.

The transceiver operates from a single +3.3V power supply over an operating case temperature range of -5°C to +70°C (Commercial), or -5°C to +85°C (Extended) or -40°C to +85°C (Industrial).



Features

- ☑ Temperature-stablized DWDM EML transmitter
- ☑ Multi-rate for Ethernet & Fiber Channel
- ☑ Transmission distance up to 40km (SM Fiber)
- ☑ Low power consumption
- ☑ Wide case operating temperature range
- ☑ Compliant to SFP+ Electrical MSA SFF-8431
- ☑ Compliant to SFP+ Mechanical MSA SFF-8432
- ☑ Compliant to 10GBASE-E specifications
- ☑ Digital Diagnostics Monitoring (DDM) through Serial Interface comply with SFF-8472, Rev. 10.4
- ☑ RoHS 6/6 Compliant
- ☑ Laser Class 1 IEC/CDRH compliant

Absolute Maximum Ratings

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature Range		T_{ST}	- 40	+ 85	°C
Operating Case Temperature [1]	"Commercial"	T_{OP}	- 5	+ 70	°C
	"Extended"		- 5	+ 85	
	"Industrial"		- 40	+ 85	
Operating Relative Humidity [2]		RH	0	85	%
Supply Voltage Range		V_{CC}	- 0.5	+ 3.6	V

[1] Measured on top side of SFP+ module at the front center vent hole of the cage.
[2] Non condensing

Transmitter Performance Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Data Rate	B	8.0	-	11.3	Gb/s
Center Wavelength [1]	λ_C	See Ordering Information Table			nm
Spectral Width (-20dB)	$\Delta\lambda_{20}$	-	-	1.0	nm
Average Optical Output Power [2]	P_{Avg}	0	-	+ 4	dBm
Optical Modulation Amplitude	P_{OMA}	0	-	-	dBm
Extinction Ratio	ER	4.5	-	-	dB
Relative Intensity Noise in OMA	$RIN_{21}OMA$	-	-	- 128	dB/Hz
Side Mode Suppression Ratio	$SMSR$	30	-	-	dB
Optical Return Loss Tolerance	-	-	-	- 21	dB
Transmitter and Dispersion Penalty @ 10.3125Gb/s	TDP	-	-	3	dB
Optical Output Eye	*Compliant with IEEE 802.3ae*				

[1] BOL : ±0.05nm from ITU grid; EOL: ±0.1nm from ITU grid.
[2] Average power figures are informative only, per IEEE 802.3ae.

Receiver Performance Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Data Rate		B	8.0	-	11.3	Gb/s
Wavelength of Operation		λ	1530	-	1565	nm
Receiver Sensitivity	OMA @ 10.3125Gb/s [1]	P_{min}	-	-	- 14.1	dBm
Stressed Receiver Sensitivity in OMA (@ 10.3125Gb/s) [2]		-	-	-	- 11.3	dBm
Maximum Input Optical Power (10 $^{-12}$ BER)		P_{max}	- 1	-	-	dBm
Receiver Reflectance		-	-	-	- 26	dB
LOS Hysteresis		-	0.5	-	-	dB
LOS Thresholds	Increasing Light Input	P_{los+}	-	-	- 16	dBm
	Decreasing Light Input	P_{los-}	- 30	-	-	

[1] Specified with BER <1x10^{-12} and PRBS 2^{31}-1.
[2] Comply with IEEE 802.3ae

Note: The specified characteristics are met within the recommended range of operation. Unless otherwise noted typical data are quoted at nominal voltage and +25°C ambient temperature.

Laser Safety:
All transceivers are Class 1 Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.

TÜVRheinland CERTIFIED
Type Approved
Safety
Regular Production
Surveillance
www.tuv.com
ID 2000000000

c US

Oplink Communications, Inc.

This product complies with
21 CFR 1040.10 and 1040.11
Meets Class 1 Laser Safety Requirements

Transmitter Electrical Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Differential Input Impedance	Z_d	-	100	-	Ω
Differential Input Voltage Swing	$V_{PP-DIFF}$	180	-	700	mV
Input HIGH Voltage (TX Disable) [1]	V_{IH}	2.0	-	V_{CC}	V
Input LOW Voltage (TX Disable) [1]	V_{IL}	0	-	0.8	V
Output HIGH Voltage (TX Fault) [2]	V_{OH}	2.0	-	V_{CC} + 0.3	V
Output LOW Voltage (TX Fault) [2]	V_{OL}	0	-	0.8	V

[1] There is an internal 4.7kΩ to 10kΩ pull-up resistor to VccT.
[2] Open collector compatible, 4.7kΩ to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

Receiver Electrical Interface (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Differential Output Impedance	Z_d	-	100	-	Ω
Differential Output Swing	$V_{PP-DIFF}$	300	-	850	mV
Output Rise and Fall time (20% to 80%)	t_{RH}, t_{FH}	28	-	-	ps
Output HIGH Voltage (LOS) [1]	V_{OH}	V_{CC} - 1.3	-	V_{CC} + 0.3	V
Output LOW Voltage (LOS) [1]	V_{OL}	0	-	0.8	V

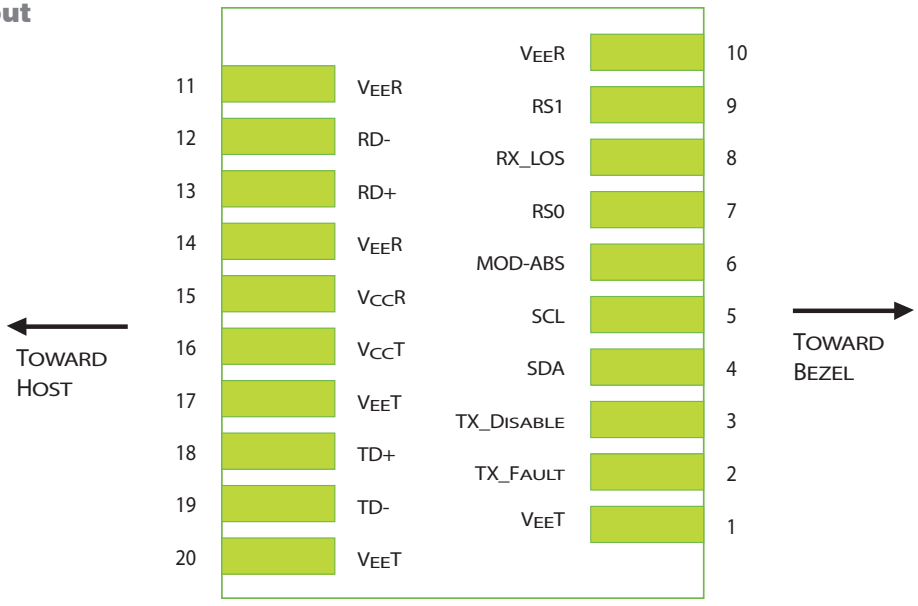
[1] Open collector compatible, 4.7kΩ to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

Electrical Power Supply Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Power Supply Voltage	V_{CC}	3.13	3.30	3.47	V
DC Common Mode Voltage	V_{CM}	0	-	3.6	V
Supply Current	I_{VCC}	-	310	-	mA
Power Consumption	P_W	-	1.0	-	W

Note: The specified characteristics are met within the recommended range of operation. Unless otherwise noted typical data are quoted at nominal voltage and +25°C ambient temperature.

Connector Pin-out



Module Pin Description

Pin	Logic	Symbol	Description
1	-	*VeeT*	Module Transmitter Ground
2	*LVTTL-O*	*TX_Fault*	Module Transmitter Fault
3	*LVTTL-I*	*TX_Disable*	Transmitter Disable; Turns off transmitter laser output
4	*LVTTL-I/O*	*SDA*	2-Wire Serial Interface Data Line
5	*LVTTL-I/O*	*SCL*	2-Wire Serial Interface Clock
6	-	*MOD-ABS*	Module Definition, Grounded in the module
7	*LVTTL-I*	*RS0*	No function implemented
8	*LVTTL-O*	*RX_LOS*	Receiver Loss of Signal Indication
9	*LVTTL-I*	*RS1*	No function implemented
10	-	*VeeR*	Module Receiver Ground
11	-	*VeeR*	Module Receiver Ground
12	*CML-O*	*RD-*	Receiver Inverted Data Output
13	*CML-O*	*RD+*	Receiver Data Output
14	-	*VeeR*	Module Receiver Ground
15	-	*VccR*	Module Receiver 3.3V Supply
16	-	*VccT*	Module Transmitter 3.3V Supply
17	-	*VeeT*	Module Transmitter Ground
18	*CML-I*	*TD+*	Transmitter Non-Inverted Data Input
19	*CML-I*	*TD-*	Transmitter Inverted Data Input
20	-	*VeeT*	Module Transmitter Ground

Application Notes

Electrical Interface: All signal interfaces are compliant with the SFP+ MSA specification. The high speed DATA interface is differential AC-coupled internally and can be directly connected to a 3.3V SERDES IC. All low speed control and sense output signals are open collector TTL compatible and should be pulled up with a 4.7kΩ - 10kΩ resistor on the host board.

Loss of Signal (LOS): The Loss of Signal circuit monitors the level of the incoming optical signal and generates logic HIGH when an insufficient photocurrent is produced.

TX_Fault: The output indicates LOW when the transmitter is operating normally and HIGH with a laser fault including laser end-of-life. TX Fault is an open collector/drain output and should be pulled up with a 4.7kΩ - 10kΩ resistor on the host board.

TX_Disable: When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled. The laser is also disabled if this line is left floating, as it is pulled high inside the transceiver.

Serial Identification and Monitoring: The module definition of SFP is indicated by the MOD_ABS pin and the 2-wrie serial interface. Upon power up, the 2-wrie interface appears as NC (no connection), and MOD_ABS is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I^2C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments of the device that are not write protected, and the negative edge clocks data from the device. The serial data signal (SDA) is for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The supported monitoring functions are temperature, voltage, bias current, transmitter power, average receiver signal, all alarms and warnings, and software monitoring of TX Fault/LOS. The device is internally calibrated.

The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in the SFP MSA, and SFF-8472, Rev. 10.4.

Power Supply and Grounding: The power supply line should be well-filtered. All power supply bypass capacitors should be as close to the transceiver module as possible.

Interfacing the Transceivers

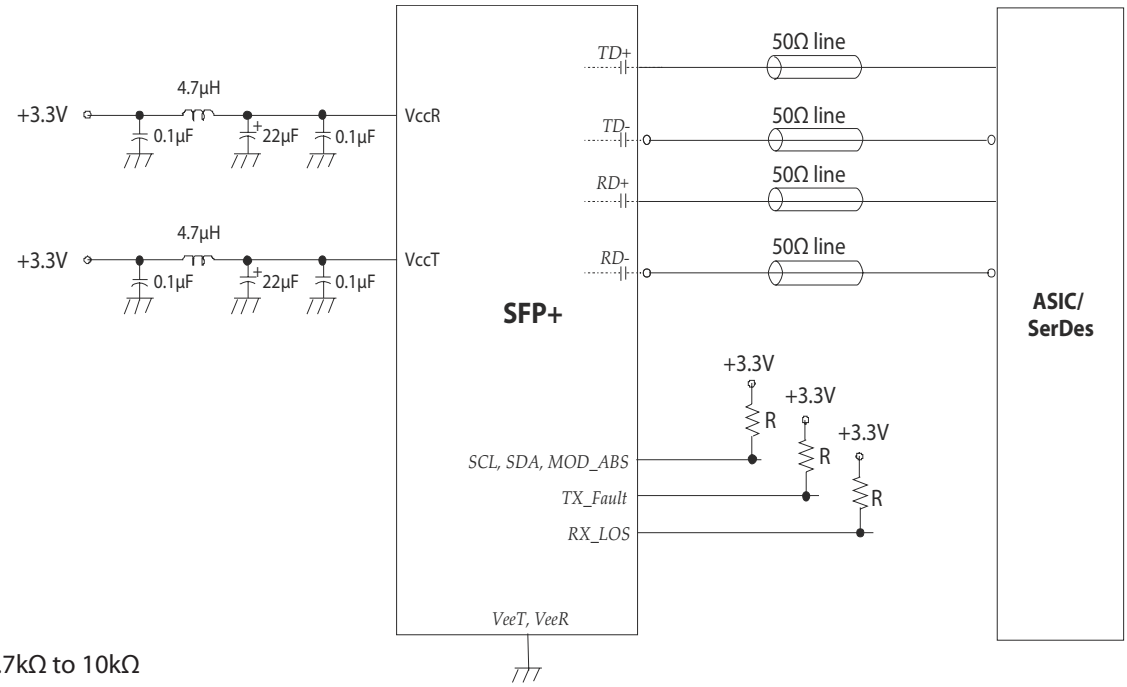
Communication is via a serial 2-wire serial interface. As described in the document SFF-8472 (REV. 10.4) there are two distinct address spaces:

Base Address A0(hex)	
Byte Address	**Content**
0 – 95	Serial Transceiver ID as defined in SFP MSA
96 – 127	OPLINK Specific
128 – 255	Reserved

Base Address A2(hex)	
Byte Address	**Content**
0 - 55	Alarm & Warnings thresholds & limits
56 - 95	External calibration constants (not used)
96 – 119	Values from real time diagnostic monitoring
120 – 127	Not used
128 – 247	Customer specific, writable area
248 - 255	Not used

Application Schematics

Recommended electrical connections to transceiver are shown below.

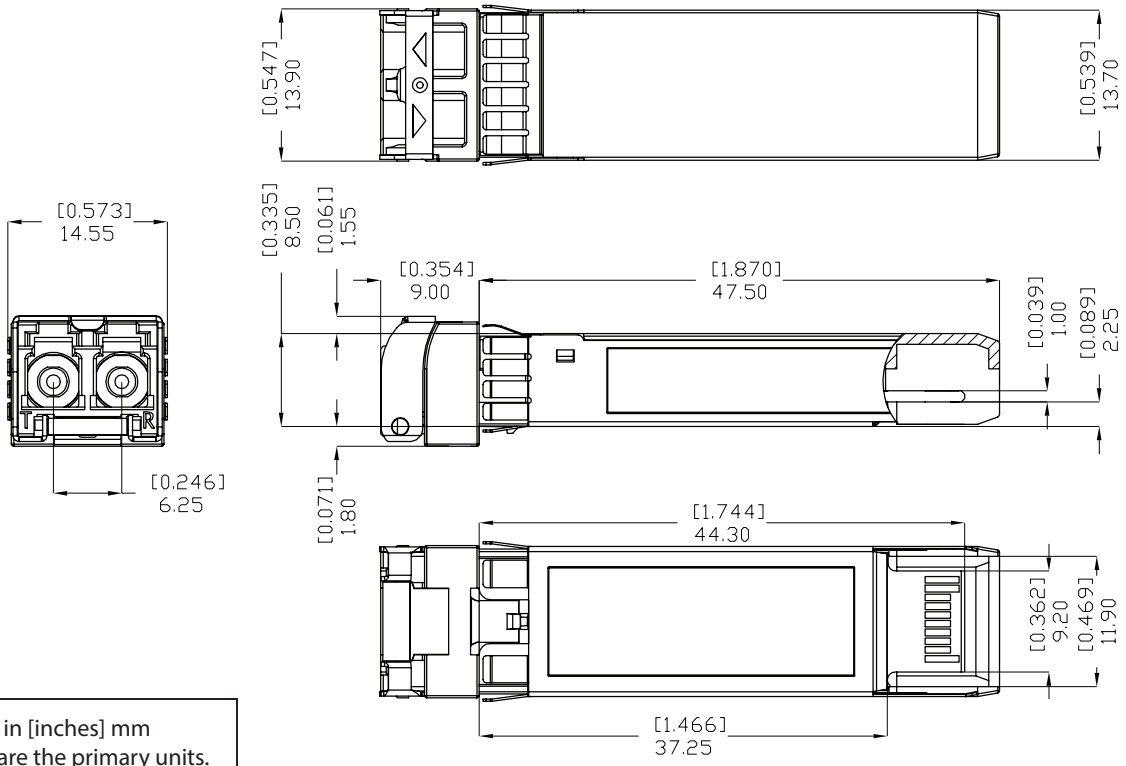


R: 4.7kΩ to 10kΩ

ESD & Electromagnetic Compatibility

Requirements	Standard	Status
Electro Static Discharge to the Electrical Pins (ESD)	EIA/JESD22-A114-B MIL-STD 883C Method 3015.7	Exceeds requirements Class 1B (>1000V)
Immunity to ESD (housing, receptacle)	IEN 61000-4-2	Exceeds requirements Discharges ranging from 2kV to 15kV without damages to the transceiver
Electromagnetic Emission (EMI)	FCC Part 15, Class B EN 55022 Class B CISPR 22	Exceeds requirements Class B

Package Outline



Dimensions in [inches] mm
Millimeters are the primary units.
Tolerances are in accordance with SFF-8432 Rev.5

Ordering Information

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERC00061G	- 5°C to +70°C	Commercial	1528.77	196.1	61	40km
TPD1XGJERC00060G	- 5°C to +70°C	Commercial	1529.55	196.0	60	40km
TPD1XGJERC00059G	- 5°C to +70°C	Commercial	1530.33	195.9	59	40km
TPD1XGJERC00058G	- 5°C to +70°C	Commercial	1531.12	195.8	58	40km
TPD1XGJERC00057G	- 5°C to +70°C	Commercial	1531.90	195.7	57	40km
TPD1XGJERC00056G	- 5°C to +70°C	Commercial	1532.68	195.6	56	40km
TPD1XGJERC00055G	- 5°C to +70°C	Commercial	1533.47	195.5	55	40km
TPD1XGJERC00054G	- 5°C to +70°C	Commercial	1534.25	195.4	54	40km
TPD1XGJERC00053G	- 5°C to +70°C	Commercial	1535.04	195.3	53	40km
TPD1XGJERC00052G	- 5°C to +70°C	Commercial	1535.82	195.2	52	40km
TPD1XGJERC00051G	- 5°C to +70°C	Commercial	1536.61	195.1	51	40km
TPD1XGJERC00050G	- 5°C to +70°C	Commercial	1537.40	195.0	50	40km
TPD1XGJERC00049G	- 5°C to +70°C	Commercial	1538.19	194.9	49	40km
TPD1XGJERC00048G	- 5°C to +70°C	Commercial	1538.98	194.8	48	40km
TPD1XGJERC00047G	- 5°C to +70°C	Commercial	1539.77	194.7	47	40km
TPD1XGJERC00046G	- 5°C to +70°C	Commercial	1540.56	194.6	46	40km
TPD1XGJERC00045G	- 5°C to +70°C	Commercial	1541.35	194.5	45	40km

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERC00044G	- 5°C to +70°C	Commercial	1542.14	194.4	44	40km
TPD1XGJERC00043G	- 5°C to +70°C	Commercial	1542.94	194.3	43	40km
TPD1XGJERC00042G	- 5°C to +70°C	Commercial	1543.73	194.2	42	40km
TPD1XGJERC00041G	- 5°C to +70°C	Commercial	1544.53	194.1	41	40km
TPD1XGJERC00040G	- 5°C to +70°C	Commercial	1545.32	194.0	40	40km
TPD1XGJERC00039G	- 5°C to +70°C	Commercial	1546.12	193.9	39	40km
TPD1XGJERC00038G	- 5°C to +70°C	Commercial	1546.92	193.8	38	40km
TPD1XGJERC00037G	- 5°C to +70°C	Commercial	1547.72	193.7	37	40km
TPD1XGJERC00036G	- 5°C to +70°C	Commercial	1548.51	193.6	36	40km
TPD1XGJERC00035G	- 5°C to +70°C	Commercial	1549.32	193.5	35	40km
TPD1XGJERC00034G	- 5°C to +70°C	Commercial	1550.12	193.4	34	40km
TPD1XGJERC00033G	- 5°C to +70°C	Commercial	1550.92	193.3	33	40km
TPD1XGJERC00032G	- 5°C to +70°C	Commercial	1551.72	193.2	32	40km
TPD1XGJERC00031G	- 5°C to +70°C	Commercial	1552.52	193.1	31	40km
TPD1XGJERC00030G	- 5°C to +70°C	Commercial	1553.33	193.0	30	40km
TPD1XGJERC00029G	- 5°C to +70°C	Commercial	1554.13	192.9	29	40km
TPD1XGJERC00028G	- 5°C to +70°C	Commercial	1554.94	192.8	28	40km
TPD1XGJERC00027G	- 5°C to +70°C	Commercial	1555.75	192.7	27	40km
TPD1XGJERC00026G	- 5°C to +70°C	Commercial	1556.55	192.6	26	40km
TPD1XGJERC00025G	- 5°C to +70°C	Commercial	1557.36	192.5	25	40km
TPD1XGJERC00024G	- 5°C to +70°C	Commercial	1558.17	192.4	24	40km
TPD1XGJERC00023G	- 5°C to +70°C	Commercial	1558.98	192.3	23	40km
TPD1XGJERC00022G	- 5°C to +70°C	Commercial	1559.79	192.2	22	40km
TPD1XGJERC00021G	- 5°C to +70°C	Commercial	1560.61	192.1	21	40km
TPD1XGJERC00020G	- 5°C to +70°C	Commercial	1561.42	192.0	20	40km
TPD1XGJERC00019G	- 5°C to +70°C	Commercial	1562.23	191.9	19	40km
TPD1XGJERC00018G	- 5°C to +70°C	Commercial	1563.05	191.8	18	40km
TPD1XGJERC00017G	- 5°C to +70°C	Commercial	1563.86	191.7	17	40km

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERE00061G	- 5°C to +85°C	Extended	1528.77	196.1	61	40km
TPD1XGJERE00060G	- 5°C to +85°C	Extended	1529.55	196.0	60	40km
TPD1XGJERE00059G	- 5°C to +85°C	Extended	1530.33	195.9	59	40km
TPD1XGJERE00058G	- 5°C to +85°C	Extended	1531.12	195.8	58	40km
TPD1XGJERE00057G	- 5°C to +85°C	Extended	1531.90	195.7	57	40km
TPD1XGJERE00056G	- 5°C to +85°C	Extended	1532.68	195.6	56	40km
TPD1XGJERE00055G	- 5°C to +85°C	Extended	1533.47	195.5	55	40km
TPD1XGJERE00054G	- 5°C to +85°C	Extended	1534.25	195.4	54	40km
TPD1XGJERE00053G	- 5°C to +85°C	Extended	1535.04	195.3	53	40km
TPD1XGJERE00052G	- 5°C to +85°C	Extended	1535.82	195.2	52	40km
TPD1XGJERE00051G	- 5°C to +85°C	Extended	1536.61	195.1	51	40km
TPD1XGJERE00050G	- 5°C to +85°C	Extended	1537.40	195.0	50	40km

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERE00049G	- 5°C to +85°C	Extended	1538.19	194.9	49	40km
TPD1XGJERE00048G	- 5°C to +85°C	Extended	1538.98	194.8	48	40km
TPD1XGJERE00047G	- 5°C to +85°C	Extended	1539.77	194.7	47	40km
TPD1XGJERE00046G	- 5°C to +85°C	Extended	1540.56	194.6	46	40km
TPD1XGJERE00045G	- 5°C to +85°C	Extended	1541.35	194.5	45	40km
TPD1XGJERE00044G	- 5°C to +85°C	Extended	1542.14	194.4	44	40km
TPD1XGJERE00043G	- 5°C to +85°C	Extended	1542.94	194.3	43	40km
TPD1XGJERE00042G	- 5°C to +85°C	Extended	1543.73	194.2	42	40km
TPD1XGJERE00041G	- 5°C to +85°C	Extended	1544.53	194.1	41	40km
TPD1XGJERE00040G	- 5°C to +85°C	Extended	1545.32	194.0	40	40km
TPD1XGJERE00039G	- 5°C to +85°C	Extended	1546.12	193.9	39	40km
TPD1XGJERE00038G	- 5°C to +85°C	Extended	1546.92	193.8	38	40km
TPD1XGJERE00037G	- 5°C to +85°C	Extended	1547.72	193.7	37	40km
TPD1XGJERE00036G	- 5°C to +85°C	Extended	1548.51	193.6	36	40km
TPD1XGJERE00035G	- 5°C to +85°C	Extended	1549.32	193.5	35	40km
TPD1XGJERE00034G	- 5°C to +85°C	Extended	1550.12	193.4	34	40km
TPD1XGJERE00033G	- 5°C to +85°C	Extended	1550.92	193.3	33	40km
TPD1XGJERE00032G	- 5°C to +85°C	Extended	1551.72	193.2	32	40km
TPD1XGJERE00031G	- 5°C to +85°C	Extended	1552.52	193.1	31	40km
TPD1XGJERE00030G	- 5°C to +85°C	Extended	1553.33	193.0	30	40km
TPD1XGJERE00029G	- 5°C to +85°C	Extended	1554.13	192.9	29	40km
TPD1XGJERE00028G	- 5°C to +85°C	Extended	1554.94	192.8	28	40km
TPD1XGJERE00027G	- 5°C to +85°C	Extended	1555.75	192.7	27	40km
TPD1XGJERE00026G	- 5°C to +85°C	Extended	1556.55	192.6	26	40km
TPD1XGJERE00025G	- 5°C to +85°C	Extended	1557.36	192.5	25	40km
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TPD1XGJERE00022G	- 5°C to +85°C	Extended	1559.79	192.2	22	40km
TPD1XGJERE00021G	- 5°C to +85°C	Extended	1560.61	192.1	21	40km
TPD1XGJERE00020G	- 5°C to +85°C	Extended	1561.42	192.0	20	40km
TPD1XGJERE00019G	- 5°C to +85°C	Extended	1562.23	191.9	19	40km
TPD1XGJERE00018G	- 5°C to +85°C	Extended	1563.05	191.8	18	40km
TPD1XGJERE00017G	- 5°C to +85°C	Extended	1563.86	191.7	17	40km

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERI00061G	-40°C to +85°C	Industrial	1528.77	196.1	61	40km
TPD1XGJERI00060G	-40°C to +85°C	Industrial	1529.55	196.0	60	40km
TPD1XGJERI00059G	-40°C to +85°C	Industrial	1530.33	195.9	59	40km
TPD1XGJERI00058G	-40°C to +85°C	Industrial	1531.12	195.8	58	40km
TPD1XGJERI00057G	-40°C to +85°C	Industrial	1531.90	195.7	57	40km
TPD1XGJERI00056G	-40°C to +85°C	Industrial	1532.68	195.6	56	40km
TPD1XGJERI00055G	-40°C to +85°C	Industrial	1533.47	195.5	55	40km

Model Name	Operating Temperature		Center Wavelength (nm)	ITU Frequency (THz)	Wavelength Reference	Distance
TPD1XGJERI00054G	-40°C to +85°C	Industrial	1534.25	195.4	54	40km
TPD1XGJERI00053G	-40°C to +85°C	Industrial	1535.04	195.3	53	40km
TPD1XGJERI00052G	-40°C to +85°C	Industrial	1535.82	195.2	52	40km
TPD1XGJERI00051G	-40°C to +85°C	Industrial	1536.61	195.1	51	40km
TPD1XGJERI00050G	-40°C to +85°C	Industrial	1537.40	195.0	50	40km
TPD1XGJERI00049G	-40°C to +85°C	Industrial	1538.19	194.9	49	40km
TPD1XGJERI00048G	-40°C to +85°C	Industrial	1538.98	194.8	48	40km
TPD1XGJERI00047G	-40°C to +85°C	Industrial	1539.77	194.7	47	40km
TPD1XGJERI00046G	-40°C to +85°C	Industrial	1540.56	194.6	46	40km
TPD1XGJERI00045G	-40°C to +85°C	Industrial	1541.35	194.5	45	40km
TPD1XGJERI00044G	-40°C to +85°C	Industrial	1542.14	194.4	44	40km
TPD1XGJERI00043G	-40°C to +85°C	Industrial	1542.94	194.3	43	40km
TPD1XGJERI00042G	-40°C to +85°C	Industrial	1543.73	194.2	42	40km
TPD1XGJERI00041G	-40°C to +85°C	Industrial	1544.53	194.1	41	40km
TPD1XGJERI00040G	-40°C to +85°C	Industrial	1545.32	194.0	40	40km
TPD1XGJERI00039G	-40°C to +85°C	Industrial	1546.12	193.9	39	40km
TPD1XGJERI00038G	-40°C to +85°C	Industrial	1546.92	193.8	38	40km
TPD1XGJERI00037G	-40°C to +85°C	Industrial	1547.72	193.7	37	40km
TPD1XGJERI00036G	-40°C to +85°C	Industrial	1548.51	193.6	36	40km
TPD1XGJERI00035G	-40°C to +85°C	Industrial	1549.32	193.5	35	40km
TPD1XGJERI00034G	-40°C to +85°C	Industrial	1550.12	193.4	34	40km
TPD1XGJERI00033G	-40°C to +85°C	Industrial	1550.92	193.3	33	40km
TPD1XGJERI00032G	-40°C to +85°C	Industrial	1551.72	193.2	32	40km
TPD1XGJERI00031G	-40°C to +85°C	Industrial	1552.52	193.1	31	40km
TPD1XGJERI00030G	-40°C to +85°C	Industrial	1553.33	193.0	30	40km
TPD1XGJERI00029G	-40°C to +85°C	Industrial	1554.13	192.9	29	40km
TPD1XGJERI00028G	-40°C to +85°C	Industrial	1554.94	192.8	28	40km
TPD1XGJERI00027G	-40°C to +85°C	Industrial	1555.75	192.7	27	40km
TPD1XGJERI00026G	-40°C to +85°C	Industrial	1556.55	192.6	26	40km
TPD1XGJERI00025G	-40°C to +85°C	Industrial	1557.36	192.5	25	40km
TPD1XGJERI00024G	-40°C to +85°C	Industrial	1558.17	192.4	24	40km
TPD1XGJERI00023G	-40°C to +85°C	Industrial	1558.98	192.3	23	40km
TPD1XGJERI00022G	-40°C to +85°C	Industrial	1559.79	192.2	22	40km
TPD1XGJERI00021G	-40°C to +85°C	Industrial	1560.61	192.1	21	40km
TPD1XGJERI00020G	-40°C to +85°C	Industrial	1561.42	192.0	20	40km
TPD1XGJERI00019G	-40°C to +85°C	Industrial	1562.23	191.9	19	40km
TPD1XGJERI00018G	-40°C to +85°C	Industrial	1563.05	191.8	18	40km
TPD1XGJERI00017G	-40°C to +85°C	Industrial	1563.86	191.7	17	40km

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