Operating guide for Pure Photonics tunable laser

Contents

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Introduction

The Pure Photonics tunable laser is a CW (Continuous Wave) Tunable Laser with integrated electronics. The control of the product is through a digital interface. As a user only limited knowledge of the laser operating principle is needed, as the on-board micro-processor takes care of the details. For more details on the operating principle, refer to the datasheet.

The product comes in ITLA (PPCL100/PPCL200), upgraded ITLA (PPCL300) and micro-ITLA formfactor (PPCL600/PPCL700). The product is compliant to the OIF (Optical Internetworking Forum) MSA (Multi-Source Agreement) OIF-ITLA-MSA-1.3, which is publicly available at https://www.oiforum.com/wp-content/uploads/2019/01/OIF-ITLA-MSA-01.3.pdf. And the micro-ITLA products are compliant to OIF-microITLA-01.1 at https://www.oiforum.com/wp-content/uploads/2019/01/OIF-Micro-ITLA-01.1.pdf (which refers back to the ITLA MSA for command interface)

Based on the capabilities of the product, which go well beyond those envisioned in the MSA, Pure Photonics has enabled additional features that can be accessed through the same interface.
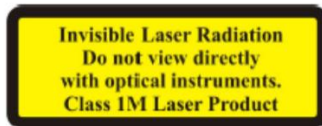
Disclaimer

The products comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50 dated June 24, 2007.

This product is a component laser device and as such, does not include all end product safety controls or design features as required by international laser safety standard, IEC 60825-1, or by the U.S. Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH), regulation CFR 1040.10.

This device is a class 1M laser product for use only under the recommended operating conditions and ratings specified in this document. Use of controls or adjustments or performance of procedures other than these specified in this product datasheet may result in hazardous radiation exposure.

Invisible laser radiation – Do not view the laser output from this device directly with optical instruments (e.g., eye loupes, magnifiers, microscopes). Viewing the laser output with certain optical instruments within a distance of 100mm may pose an eye hazard. Class 1M laser product.

Methods of Operation

A customer has three methods available to him to control the laser:

1. **Graphical User Interfaces provided by Pure Photonics**
   These programs are available for down-load on the Pure Photonics website and allow the user to perform specific functions through a mouse-based interface.
2. **Line Editor interface provided by Pure Photonics**
   The line editor interface allows convenient access to all the OIF and Pure Photonics commands, as well as providing a means to run scripts
3. **RS-2323 communication**
   The user can communicate directly with the unit at the RS-232 protocol level, by interfacing it with a micro-processor

The following sections described these different methods.

Graphical User Interface

The graphical user interfaces for the Pure Photonics tunable laser can be found at www.pure-photonics.com\downloads1. The latest release can be downloaded as a zip-file and extracted to a target directory. Please check regularly for updates with improvements and bug fixes.

The user will need to ensure that there is an RS-232 connection between the PC and the tunable laser. Note that this connection needs to be down-converted from the high-voltage RS-232 output on the PC to a low voltage TTL signal at the tunable laser.

The operation of the different GUIs are intuitive, though manuals are available at the download site.

Line Editor

The line editor is a program that can be downloaded at www.pure-photonics.com\downloads1. It provides an interface where the user can send intuitive commands to the laser that are then converted into the appropriate RS-232 commands. This method provides more flexibility as all the commands are available through this interface. Also, (complex) scripts can be executed through this interface.

The underlying language for the line-editor interface is 'Python'. All the programming features of Python are available for running scripts.

The user will need to ensure that there is an RS-232 connection between the PC and the tunable laser. Note that this connection needs to be down-converted from the high-voltage RS-232 output on the PC to a low voltage TTL signal at the tunable laser.

Getting started

After starting the exe.file, a prompt appears. As a general first demonstration, please type *it.connect(1,9600)* . This will open up the RS-232 port (no communication with the laser yet). Then for example you can type *it.oop()* to get the current output power from the laser. This should return in a numeric response. At the end of the session you can type *it.disconnect()* to release the RS-232 port.

Commands

The below commands are available for communication with the module. Note that some commands may be dependent on the loaded firmware, both in availability and behavior.

Each command can be accessed by typing it.xxxxx, where xxxx is a command in the below list.

Command	Register	arguments	Function
RS-232 management			
connect			Open RS-232 interface at host side (no communication with module)
disconnect			Close RS-232 interface
baudrate			Set baudrate
lstResp			Provide latest response from module
toModulePacket			Provide latest packet to module
High level commands			
register			Gets the laser register send or received
upgrade			firmware upgrade command
reset			Clear the communication
packet			Send a custom packet
Pure Photonic special commands			
cleanMode	0x90		Set Low Noise Mode
cleanSweepAmplitude	0xE4		Clean Sweep Amplitude
cleanSweepEnable	0xE5		Clean Sweep Enable
cleanSweepOffset	0xE6		Clean Sweep Offset
password	0xE0		Password
cleanJumpTHz	0xEA		Set Clean Jump next frequency (THz)
cleanJumpMHz	0xEB		Set Clean Jump next frequency (10*GHz)
cleanJumpSled	0xEC		Set Clean Jump next sled Temperature (100*C)
cleanJumpEnable	0xED		Enable Clean Jump
Standard OIF MSA commands			
nop	0x00	Read Only	NOP / status
devTyp	0x01	Read Only	Device Type
mfgr	0x02	Read Only	Manufacturer
model	0x03	Read Only	Model ID
serNo	0x04	Read Only	Serial Number
mfgDate	0x05	Read Only	Manufacturing Date
release	0x06	Read Only	Release Info
relBack	0x07	Read Only	Backwards Release Compatibility
genCfg	0x08		General Module Configuration
ioCap	0x0D		IO Capabilities

dlConfig	0x14		Download Configuration
dlStatus	0x15	Read Only	Download Status
statusF	0x20		Fatal Status
statusW	0x21		Warning Status
fPowTh	0x22		Fatal Power Threshold
wPowTh	0x23		Warning Power Threshold
fFreqTh	0x24	Read Only	Fatal Frequency Threshold
wFreqTh	0x25	Read Only	Warning Frequency Threshold
fThermTh	0x26	Read Only	Fatal Thermal Threshold
wThermTh	0x27	Read Only	Warning Thermal Threshold
srqT	0x28		SRQ
fatalT	0x29		Fatal
almT	0x2A		Alarm
channel	0x30		Channel Set-point
pwr	0x31		Power Set-point
resena	0x32		Device enable
mcb	0x33		Module Configuration Behaviour
grid	0x34		Grid
fcf	0x35, 0x36		First Channel Frequency
fcf1	0x35		First Channel Frequency (THz part)
fcf2	0x36		First Channel Frequency (GHz part)
lf	0x40, 0x41	Read Only	Laser Frequency
oop	0x42	Read Only	Optical Output Power
ctemp	0x43	Read Only	Laser temperature
opsl	0x50	Read Only	Power Lower Limit Device Capability
opsh	0x51	Read Only	Power Upper Limit Device Capability
lfl	0x52, 0x53	Read Only	Frequency Lower Limit Device Capability
lfh	0x54, 0x55	Read Only	Frequency Upper Limit Device Capability
lgrid	0x56	Read Only	Grid Lower limit Device Capability
currents	0x57	Read Only	Device Currents (gain chip & TEC)
temps	0x58	Read Only	Device Temperatures (gain chip & case)
ditherE	0x59		Dither Enable (SBSS & TxTrace)
ditherR	0x5A		Dither Rate (SBSS)
ditherF	0x5B		Dither Frequency (SBSS)
ditherA	0x5C		Dither Amplitude (SBSS)
fAgeTh	0x5F		Fatal Age Threshold
wAgeTh	0x60		Warning Age Threshold
age	0x61	Read Only	Age
ftf	0x62		Fine Tune Frequency

Running scripts

The user can run scripts by typing *execfile('filename.xx')*. This will execute the commands in filename.xx.

RS-232 communication

Electrical interface

The user interface to the component tunable laser is either a 14 pin connector, with a pin-out displayed below or a 20 pin connector with analog inputs at the additional pins (AM modulation pin 16, Clean Measurement 1 at pin 18, Clean Measurement 2 at pin 19, FM modulation at pin 20). Many more details are available in section 7 of the MSA.
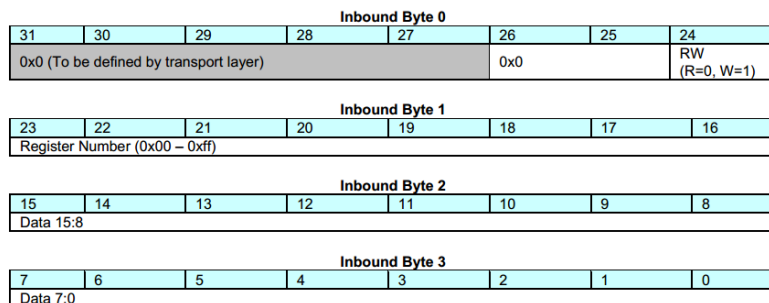
PIN Name	PIN #		PIN #	PIN Name
+3.3V Supply	1		2	DIS*
+3.3V Supply	3		4	SRQ*
Gnd	5		6	MS*
Gnd	7		8	TxD
-5.2 Supply	9		10	RxD
-5.2 Supply	11		12	RST*
OIF Reserved	13		14	DitherAA[11]

The voltage supplies need to be provided at pin 1+3 (3.3V, internally connected) and pin 9+11 (-5.2V, internally connected). Ground needs to be connected at pin 5+7 (internally connected). Pin 13 is not used. Pins 2, 4, 6, 8, 10, 12 use LVTTL logic. The DIS pin (pin 2) provides a means to disable the output from the laser. The RST pin (pin 12) provides a means to keep the laser in reset. A high level will allow the laser to operate. A low level will disable or reset the laser. SRQ pin (pin 4) allows the product to indicate to the user that attention is needed. High level indicates no service request. The user can read-out the status of the laser in the registers (see next section) and clear the SRQ line. MS pin (pin 6) clears the communication buffer and allows to restore communication if, for some reason, communication between host and product lost synchronization. The action is trigger by a transition from low to high state. Pin 8 and 10 are used for the RS-232 communication. Pin 14 is an analog input port for AM modulation.

Communication protocol

The user can communicate with the product through a standard RS-232 interface. Essentially, this is a handshake model with 4 consecutive bytes being sent in either direction before a response (again 4 bytes) is required. Details can be found in section 8 and 9 of the MSA.

The packets sent by the user will need to have the following configuration:

Inbound Byte 0

31	30	29	28	27	26	25	24
0x0 (To be defined by transport layer)					0x0		RW (R=0, W=1)

Inbound Byte 1

23	22	21	20	19	18	17	16
Register Number (0x00 – 0xff)							

Inbound Byte 2

15	14	13	12	11	10	9	8
Data 15:8							

Inbound Byte 3

7	6	5	4	3	2	1	0
Data 7:0							

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Here, byte 2 and 3 contain the data (16 bits, values 0 – 65535). Byte 1 contains the target register (linked to the function that you want to address) and the first byte contains some control information. In bit 24 the user indicates if a read (value = 0) or a write (value = 1) is desired to the register. Bit 27 contains the LstRsp bit, which is useful in case of communication errors. When this bit is set to 1 the rest of the packet is ignored and the product returns the last response. Bits 31-28 contain the checksum, which is calculated to detect errors in the data transmission.
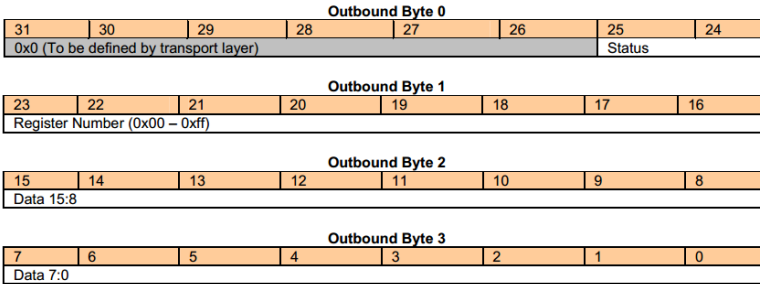
The checksum is calculated as follows:

```
unsigned char calcBIP4( unsigned char* data )    {
    int i;
    unsigned char bip8=(data[0]& 0x0f) ^ data[1] ^ data[2] ^ data[3];
    unsigned char bip4=((bip8 & 0xf0) >>4) ^ (bip8 & 0x0f);
    return bip4;
}
```

The packet send by the product to the user looks like:

Outbound Byte 0

31	30	29	28	27	26	25	24
0x0 (To be defined by transport layer)						Status	

Outbound Byte 1

23	22	21	20	19	18	17	16
Register Number (0x00 – 0xff)							

Outbound Byte 2

15	14	13	12	11	10	9	8
Data 15:8							

Outbound Byte 3

7	6	5	4	3	2	1	0
Data 7:0							

Here, byte 2 and 3 contain data (either the read-out from a register or an echo from the data that was written to a register). Byte contains the register information. The first byte contains control information. Bit 28-31 contains the checksum, which allows the user to check for transmit errors. Bit 27 indicates if the last received packet was consistent (1 if not consistent, 0 if consistent). Bit 26 is not used and should be standard 1. In bit 24 and 25 error messages are returned. See below for definition.

Bits 25:24 Value	Status Field
0x00	OK flag, Normal return status
0x01	XE flag, (execution error)
0x02	AEA flag, (Automatic extended addressing result being returned or ready to write)
0x03	CP flag, Command not complete, pending

In general, the communication protocol allows the user to read and write 16-bit integers to specific registers, which are associated with specific actions. Some registers (e.g. reading out the serial number) are not appropriately represented by a 16-bit integer. For those an Automatic Extended Addressing (AEA) scheme is available. For those situations, bit 24 and 25 contain the error code 0x02 and the data-bytes contain the number of bytes that are available through AEA. These bytes can be downloaded through reads on register 0x0A (EA).

Available MSA registers

The following registers are defined and are generally available. Some may be technology specific and may be slightly different configured on the Pure Photonics product. However, differences should be minimal.

Command	Register Name	Read / Write	AEA	Non-volatile (NV)	Description
General Module Commands					
0x00	NOP	R/W			Provide a way to read a pending response as from an interrupt, to determine if there is pending operation, and/or determine the specific error condition for a failed command.
0x01	DevTyp	R	AEA		Returns device type (tunable laser source, filter, modulator, etc) as a null terminated string.
0x02	MFGR	R	AEA		Returns manufacturer as a null terminated string in AEA mode (vendor specific format)
0x03	Model	R	AEA		Returns a model null terminated string in AEA mode (vendor specific format)
0x04	SerNo	R	AEA		Returns the serial number as null terminated string in AEA mode
0x05	MFGDate	R	AEA		Returns the mfg date as a null terminated string.
0x06	Release	R	AEA		Returns a manufacturer specific firmware release as a null terminated string in AEA mode
0x07	RelBack	R	AEA		Returns manufacturer specific firmware backwards compatibility as a null terminated string
0x08	GenCfg	RW			General module configuration
0x09	AEA-EAC	R			Automatic extended address configuration register
0x0A	AEA-EA	R			Automatic extended address (16 bits)
0x0B	AEA-EAR	RW			Location accessed "thru" AEA-EA and AEA-EAC
0x0C	Reserved				
0x0D	IOCap	RW		NV	Physical interface specific information (such as data rate, etc.)
0x0E	EAC	RW			Extended address configuration register - auto incr/decr flag on read and on write and additional address bits
0x0F	EA	RW			Extended address (16 bits)
0x10	EAR	RW			Location accessed "thru" EA and EAC
0x13[24]	LstResp	R			Returns last response
0x14	DLConfig	RW			Download configuration register
0x15	DLStatus	R			Download status register
0x17 – 0x1F	Reserved	--	--		

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Module Status Commands

0x20	StatusF	RW			Contains reset status, optical faults and alarms, and enable status.
0x21	StatusW	RW			Contains reset status, warning optical faults and alarms, and enable status.
0x22	FPowTh	RW		NV	Returns/Sets the threshold for the output power FATAL condition encoded as ±dB*100
0x23	WPowTh	RW		NV	Returns/Sets the threshold for the power warning encoded as ±dB*100
0x24	FFreqTh	RW		NV	Returns/Sets the threshold for the frequency FATAL condition encoded as ±GHz*10
0x25	WFreqTh	RW		NV	Returns/Sets the threshold for the frequency error warning encoded as ±GHZ*10
0x26	FThermTh	RW		NV	Returns/Sets the threshold for thermal deviations (> ±°C*100) at which FATAL is asserted.
0x27	WThermTh	RW		NV	Returns/Sets the threshold for thermal deviations (> ±°C*100) at which a warning is asserted.
0x28	SRQT	RW		NV	Indicates which bits in the Fatal & Warning status registers, 0x20-0x21, cause a SRQ condition and asserts the SRQ* line.
0x29	FatalT	RW		NV	Indicates which bits in the Fatal & Warning status register, 0x20-0x21, assert a FATAL condition
0x2A	ALMT	RW		NV	Indicates which bits in the status registers. 0x20. 0x21, cause an alarm condition. (Default behavior asserted whether laser is LOCKED on frequency.
0x2B – 0x2F	Reserved				

Module Optical Commands

0x30	Channel	RW		NV	Setting valid channel causes a tuning operation to occur.
0x31	PWR	RW		NV	Sets the optical power set point as encoded as dBm*100
0x32	ResEna	RW			Reset/Enable - Enable output, hard and soft reset
0x33	MCB	RW		NV	Various module configurations
0x34	GRID	RW		NV	Allows the grid spacing to be set for channel numbering.
0x35	FCF1	RW		NV	Allows the first channel's frequency to be defined for channel numbering. (THz)
0x36	FCF2	RW		NV	Allows the first channel's frequency to be defined for channel numbering. (GHz*10)
0x37 – 0x3F	Reserved				Reserved for OIF configuration registers
0x40	LF1	R			Returns channel's frequency as THz
0x41	LF2	R			Returns channel's frequency as GHZ*10
0x42	OOP	R			Returns the optical power encoded as dBm*100
0x43	CTemp	R			Returns the current temperature (monitored by the temperature alarm) encoded as °C*100.
0x44 – 0x4E	Reserved				Reserved for OIF status registers

Module Capabilities							
0x4F	FTFR	R			Returns min/max fine tune frequency range (MHz)		
0x50	OPSL	R			Returns the min possible optical power setting		
0x51	OPSH	R			Returns the max possible optical power setting		
0x52	LFL1	R			Laser's first frequency (THz)		
0x53	LFL2	R			Laser's first frequency (GHz*10)		
0x54	LFH1	R			Laser's last frequency (THz)		
0x55	LFH2	R			Laser's last frequency (GHz*10)		
0x56	LGrid	R			Laser's minimum supported grid spacing (GHz*10)		
MSA Commands							
0x57	Currents	R	AEA		Return module specific currents		
0x58	Temps	R	AEA		Return module specific temperatures		
0x59	DitherE	RW		NV	Digital dither enable	**Optional features**	
0x5A	DitherR	RW		NV	Digital dither rate		
0x5B	DitherF	RW		NV	Digital dither frequency modulation		
0x5C	DitherA	RW		NV	Digital dither amplitude modulation.		
0x5D	TBTFL	RW		NV	Sets the lower boundary for a warning on base of the butterfly temperature		
0x5E	TBTFH	RW		NV	Sets the upper boundary for a warning on base of the butterfly temperature		
0x5F	FAgeTh	RW		NV	Specifies the maximum end of life (EOL) percent aging at which fatal condition for the vendor specific error is asserted		
0x60	WAgeTh	RW		NV	Specifies the maximum end of life (EOL) percent aging at which warning condition for the vendor specific error is asserted		
0x61	Age	R			Returns the laser's age as a percentage		
0x62	FTF	RW			Fine tune frequency adjustment of laser output.	**Optional feature**	
0x63- 0x7F	Reserved						

Non-MSA registers

Pure Photonics has added the following registers to access:

Command	Name	R/W	AEA	NV	Description
0x90	MODE	R/W			Select low-noise mode: 0: standard operation (with dither signal) 1: no-dither operation 2: whisper-mode operation
0xE0	PWORD	R/W			Password to enable laser W: provide password to the laser (all Pure Photonics provided lasers already have the password in the parameter file) R: provide a 16 bit integer that will help Pure Photonics to calculate the password for you
0xE4	CSRANGE	R/W			Range for the Clean Sweep feature in GHz
0xE5	CSSTART	W			Start or Stop the Clean Sweep feature 0: Stop 1: Start
0xE6	CSOFFSET	R			Provide the offset during the Clean Sweep in units of 0.1GHz with an offset of 200GHz. Calculate the offset as: (read-out – 2000) * 0.1 GHz
0xEA	CJTHZ	R/W			Clean Jump target frequency; THz portion
0xEB	CJGHZ	R/W			Clean Jump target frequency; 0.1 GHz portion To set 195.3452 THz as target, write 195 to 0xEA and 3452 to 0xEB
0xEC	CJSLED	R/W			Clean Jump target temperature for the laser in 0.01C
0xED	CJSTART	W			Execute the Clean Jump 1: Start

Different firmware version may have some features disabled. E.g. firmware version 8.0.0 will include both Clean Sweep and Clean Jump. Firmware version 8.0.1 does not include Clean Jump.

Example

The communication with the product will follow the standard handshake model. The user sends a 4 byte command and the product will send back a response. Below is an example of an exchange that executes the Clean Sweep feature.

Note that there are two different versions of the return packet (depends on firmware version). The below example is with the bit 26 (0x04000000) in the response packet set to 0. In some versions it is set to 1 (this is actually the correct implementation following the MSA). This will also impact the checksum.

Action	Packet to the product	Return packet
Ensure that there is communication. Read NOP register	0x00 0x00 0x00 0x00	0x10 0x00 0x00 0x10
Set PWR level to 10dBm (data: 1000 * 0.01dBm)	0x61 0x31 0x03 0xE8 See first byte: 6 is the checksum 1 is for write	0x70 0x31 0x03 0xE8 The power level 03E8 is echo'ed
Set First Channel Frequency to 193.560		
Set 193THz to FCF1	0xA1 0x35 0x00 0xC1	0xB0 0x35 0x00 0xC1
Set 560GHz to FCF2 (data: 5600 * 0.1GHz)	0xE1 0x36 0x15 0xE0	0xF0 0x36 0x15 0xE0
Set channel to 1	0x31 0x30 0x00 0x01	0x20 0x30 0x00 0x01
Turn on the laser (SENA bit is bit 3, i.e. data is 8)	0x81 0x32 0x00 0x08	0xB3 0x32 0x10 0x08
Wait until NOP returns without pending flag	0x00 0x00 0x00 0x00	0x10 0x00 0x00 0x10 Response for pend: 0x00 0x00 0x01 0x10
Turn no-dither mode on	0x90 0x90 0x00 0x02	0xB3 0x90 0x01 0x00 X100 response is bug
Set Clean Sweep range to 60GHz	0x41 0xE4 0x00 0x3C	0x50 0xE4 0x00 0x3C
Start Clean Sweep	0xB1 0xE5 0x00 0x01	0xA0 0xE5 0x00 0x01
Read Clean Sweep offset	0x80 0xE6 0x00 0x00 In the first byte 0 because of the read	0x80 0xE6 0x07 0x07
Stop Clean Sweep mode	0xA1 0xE5 0x00 0x00	0xB0 0xE5 0x00 0x00
Return to standard operating mode	0x81 0x90 0x00 0x00	0xB3 0x90 0x01 0x00 X100 response is bug
Turn laser off	0x01 0x32 0x00 0x00	0x10 0x32 0x00 0x00

Compliance statement

The following information is obtained from the optics vendor.

Electromagnetic compatibility

Requirement	Regulation	Performance Level
Electromagnetic interference (EMI)	• FCC rules, Part 15, subpart B • EN 55022	Meets Class B limits with a minimum 6 dB margin
Electrostatic discharge (ESD)	JEDEC JESD22-A114-B Human Body Model	± 500 kV contact discharge to connector electrical pins with no degradation in performance or loss of function
	EN 61000-4-2	• ±15 kV air discharge • ± 8 kV contact discharge to face plate Meets Level B test criteria (that is, no degradation of performance or loss of function occurs)
Radio frequency electromagnetic field (Radiated immunity)	EN 61000-4-3, level A test criteria	3 V/m from 80 MHz to 1G Hz with no degradation of performance or loss of function

Safety compliance

Requirement	Regulation	Title
Product Safety	UL 60950-1 CSA C22.2 No. 60950-1	Information Technology Equipment – Safety - Part 1: General Requirements (USA and Canada)
	EN 60950-1+A11	Information Technology Equipment – Safety - Part 1: General Requirements (European Union)
	IEC 60950-1	Information Technology Equipment – Safety - Part 1: General Requirements (International)
	GR-63-CORE Section 4.2, Clause 4.2.3.1	Compliant with the fire resistance requirements of Telcordia Technologies Generic Requirements GR-63-CORE document for discrete electronic components.
Laser Safety	21CFR1040.10	Code of Federal Regulations Title 21 Chapter I Subchapter J – Radiological Health Part 1040: Performance Standards for Light-Emitting Products
	EN 60825-1+A1 +A2	Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide
	IEC 60825-1+A1 +A2	Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide
	EN 60825-2	Safety of Laser Products - Part 2: Safety of Optical Fiber Communication Systems
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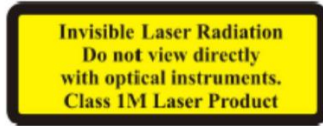
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> **Invisible Laser Radiation**
> **Do not** view directly
> **with optical instruments.**
> **Class 1M Laser Product**

European Union RoHS Compliance

This product complies with the European Union directive for Restrictions of Hazardous Substances (RoHS) – Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, Directive 2002/95/EC plus all amendments.

This product does contain lead in solder and components, but utilizes the applicable exemptions (7b, 7(c)i, 13a).

Product certification and compliance marking

Origin and Description	Markings and Compliance Statements
Markings	
CE mark. The CE (Conformité Européene*) mark indicates compliance to the European Union Low Voltage directive (73/23/EEC).	CE
Lead in second level interconnects.	e0
China Environmental Friendly Use Period (EFUP) mark, where 30 in the marking denotes 30 years. The number provided as the EFUP is provided solely to comply with applicable laws of the People's Republic of China. It does not create any warranties or liabilities on behalf of EMCORE Corporation to customers.	30
Compliance Statements	
USA Food and Drug Administration (FDA), Center for Devices and Radiological Health compliance statement.	Complies with 21CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
USA FDA, Center for Devices and Radiological Health compliance statement – *Alternate*. Use the alternate statement listed, as needed.	Alternate FDA compliance statement: Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

Hazardous Substance Statement (China RoHS)

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
集成光电器件 Integrated optical circuit board assembly	×	○	○	○	○	○
金属盒件 Metal enclosure	○	○	○	○	○	○

○ ： 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T 11363-2006标准规定的限量要求以下。

○ ： Indicates that this hazardous substance contained in all homogeneous materials of this part is below the limit requirement in SJ/T 11363-2006.

× ： 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T 11363-2006标准规定的限量要求。

× ： Indicates that this hazardous substance contained in at least one of the homogeneous materials of this part is above the limit requirement in SJ/T 11363-2006.

对销售之日的所售产品,本表显示我公司供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件。

This table shows where these substances may be found in the supply chain of our electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注,此标志为针对所涉及产品的环保使用期限标志. 此环保使用期限只适用于产品在产品手册中所规定的条件下工作.

The Environment-Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. The Environment-Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.