Low Noise Tunable Laser

Clean Light portfolio – PPCL200 - Datasheet

The **Pure Photonics** full-band tunable laser solution provides a very narrow linewidth (~10 kHz), significantly reduced low-frequency AM and FM noise and a range of operating modes in this low-noise setting. The product can access any desired frequency set-point in either the C-band or L-band. Output power can be set as low as 7dBm and as high as 18dBm.

The laser and its features are designed for high SNR (Signal-to-Noise-Ratio) applications, such as sensing and T&M (Test and Measurement).

In its low-noise mode, the laser disables its control loops and is essentially frozen. To enable tunability and flexibility, **Pure Photonics** is developing optimized control schemes for this operating mode, enabling:

Snapshot
Full Band Tunable (C or L) Power up to 18dBm (60mW) 15kHz narrow linewidth Reduced AM/FM low freq. noise Advanced operation modes

- Clean Sweep: a (repeating) frequency sweep of 50GHz up to 300GHz
- Clean Modulation: an external function generator allows up to 3GHz of frequency modulation at drive frequencies of up to 75kHz.
- Clean Jump: jump to any frequency within 2 seconds
- Clean Scan: scan the full frequency range as fast as within 10 seconds
- Clean Measurement: integrated DAQ functionality with the other functions

The different features are currently still in different states of development. Updates to the firmware and the GUI will be regularly available on the **Pure Photonics** website (www.pure-photonics.com) and if possible are backwards compatible with the PPCL200 product.

1. Table of Contents

1. Table of Contents 2
2. Operating Principle 3
3. Specifications 4
Absolute Maximum Ratings 4
Performance Specifications 4
Digital Interface Specifications 5
Clean Sweep Specifications 5
Clean Modulation Specifications 6
Clean Jump Specifications 6
Clean Scan Specifications 6
4. Technical Drawing 8
Topview 8
Sideviews 8
5. Compliance 9
Electromagnetic compatibility 9
Safety compliance 9
European Union RoHS Compliance 10
Product certification and compliance marking 10
Hazardous Substance Statement (China RoHS) 11
6. Ordering and Technical Support 12

2. Operating Principle

The PPCL200 is the highest performance ITLA on-the-market (MSA form-factor, www.oiforum.com/public/documents/OIF-ITLA-MSA-01.2.pdf), controlled through a digital interface. The user can operate the product without having to control or understand the underlying technology.

The PPCL200 has an External Cavity Laser design (see figure), with tunable filters embedded in the cavity for frequency control. The Cavity consists out of an InP front-facet coated gain chip with back-facet AR coating and a high-reflection end-mirror, mounted on a PZT element. By changing the injection current into the gain-chip and the built-in photo-diode tap, the product accurately controls the operating power to the user-defined power target.

Within the cavity two Silicon etalon filters, with slightly different Free Spectral Range (FSR), utilize the Vernier effect to select one dominant cavity mode. The frequency is controlled through micro-temperature sensing and heating elements on the filters. The dominant cavity mode is aligned with the etalon transmission peaks through adjustment of the cavity temperature.

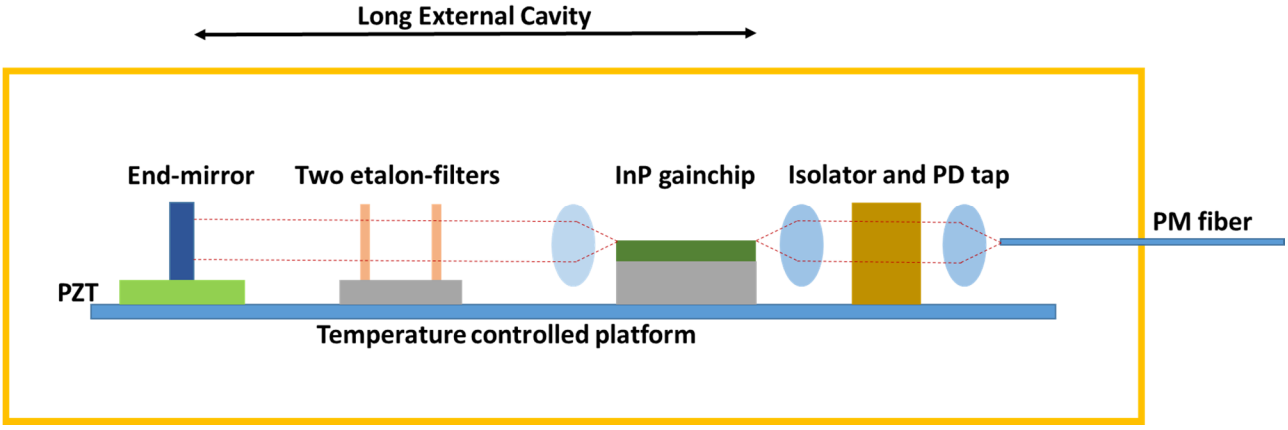


Figure 1: illustration of optics engine

3. Specifications

Absolute Maximum Ratings

In Table 1 the absolute maximum ratings for the product are listed. These settings are never to be exceeded and may result in critical damage to the product if applied.

Parameter	Unit	Min	Max
Operating temperature	ºC	-5	75
Storage temperature	ºC	-40	85
Humidity	%DH	5	85
Voltage +3.3V	V	0	3.6
Voltage -5.2V	V	-5.5	0.3
Fiber bend radius	Mm	20	
Current Source Slew rate	V/msec		20
Mounting surface flatness	micron		25
Installation torque	Inch-lb	0.9	1.1

Table 1: Absolute maximum ratings

Performance Specifications

In Table 2 the more general performance specifications of the product are listed

Parameter	Unit	Min	Typ	Max
Operating Temperature	ºC	0		50
Power				
Max set-power ***Configuration dependent***	dBm	7		18
Power accuracy	dB	-1		+1
Power resolution	dB			0.01
Short term power variation	dB	-0.05		0.05
Frequency				
Frequency range C-band L-band ***Custom configurations available***	THz	191.5 186.35		196.25 190.95
Frequency accuracy	GHz	-1.5		1.5
Frequency resolution (set-point)	GHz			0.1
Fine Tune Frequency Range	GHz	-30		30
Fine Tune Frequency resolution	GHz			0.001
Optical characteristics				
SMSR	dB	40	55	
OSNR	dB	40	60	
Intrinsic linewidth	kHz		15	100

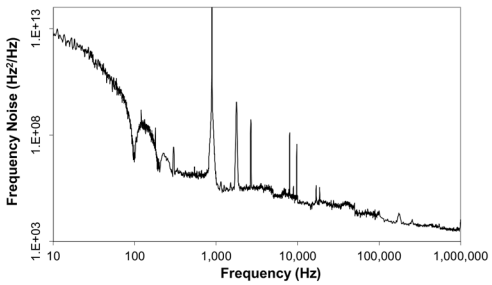
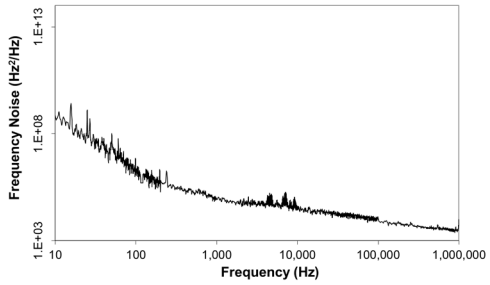
FM noise spectrum (standard mode)	Typ.			
FM noise spectrum (low noise mode)	Typ.			
AM noise (RIN) 7dBm 13dBm	dB/Hz			-140 -145
Back-reflection	dB			-14
Polarization Extinction Ratio	dB	18		
Timing characteristics				
Warm-start time	sec			30
Cold-start time	sec			60
Electrical characteristics				
Supply voltage +3.3V	V	3.15	3.3	3.45
Supply current +3.3V	mA		400	1200
Supply voltage -5.2V	V	-5.45	-5.2	-4.95
Supply current -5.2V	mA			1500

Table 2: performance specifications

Digital Interface Specifications

The digital interface to the product is compliant to the ITLA MSA (http://www.oiforum.com/public/documents/OIF-ITLA-MSA-01.2.pdf). Most functions of this MSA are supported.

Clean Sweep Specifications

This feature is under development. The basic functionality is available and further enhancements are being worked. Expect improvement in future firmware versions

In Table 3 the performance targets for the clean sweep feature are listed.

Parameter	Unit	Min	Typ	Max
Modehop free range	GHz			300

• Ambient temperature limitations may apply dependent on magnitude				
Power stability	dB	-1		1
Typical cycle time	s/GHz			0.1
Slew rate (of one slope)	GHz/s	20		

Table 3: clean sweep specifications

Clean Modulation Specifications

This feature requires an additional hardware interface that needs to be agreed upon. A revised version is in development that would require MAX 5V.

In Table 4 the performance targets for the clean modulation feature are listed.

Parameter	Unit	Min	Typ	Max
Modehop free range	GHz			3
Cut-off frequency	kHz			75
Applied voltage	V/GHz		150	

Table 4: clean modulation specifications

Clean Jump Specifications

The basic functionality is available and further enhancements are being worked. Expect improvement in future firmware versions

In Table 5 the performance targets for the clean jump feature are listed.

Parameter	Unit	Min	Typ	Max
Time to correct optical mode	sec			1
Power error to target	dB	-3	-0.5	0.5
Frequency error to target	GHz	-3	0	3
Time to specification	sec			2
Power error to target	dB	-0.5	0	0.25
Frequency error to target	GHz	-0.5	0	0.5

Table 5: clean jump specifications

Clean Scan Specifications

.

In Table 6 the performance targets for the clean scan feature are listed.

Parameter	Unit	Min	Typ	Max
Minimum scan time	GHz/s	20		
Power error from average	dB	-0.5	0	0.5
Frequency error from linear scan	GHz	-5		5

Table 6: clean scan specifications

Clean Measurement Specifications

This feature is under development. This will require a hardware implementation that is not backwards compatible. An initial implementation is expected by mid 2014.

In Table 7 the performance targets for the clean measurement feature are listed.

Parameter	Unit	Min	Typ	Max
Measurement DAQ #bits	-	12		
Input voltage	V	0		3
Sample-rate	Hz	1000		
#points	-	10,000		

Table 7: clean scan specifications

4. Technical Drawing

Parameter	Unit	Min	Typ	Max
Fibertype		Polarization Maintaining, PANDA		
Fiberlength (from edge of board)	cm	50		

Table 8: dimensional information

Topview

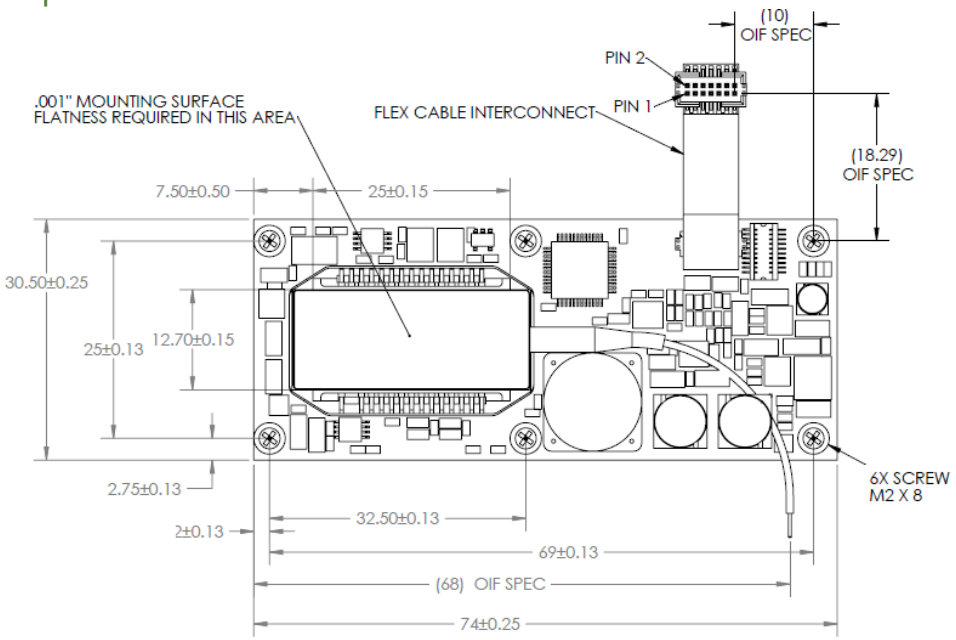


Figure 2: top view of the PPCL200

Sideviews

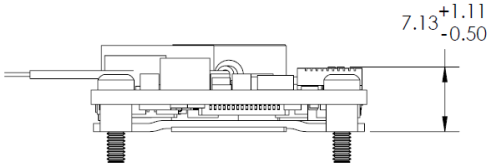


Figure 3: front-side-view of the PPCL200

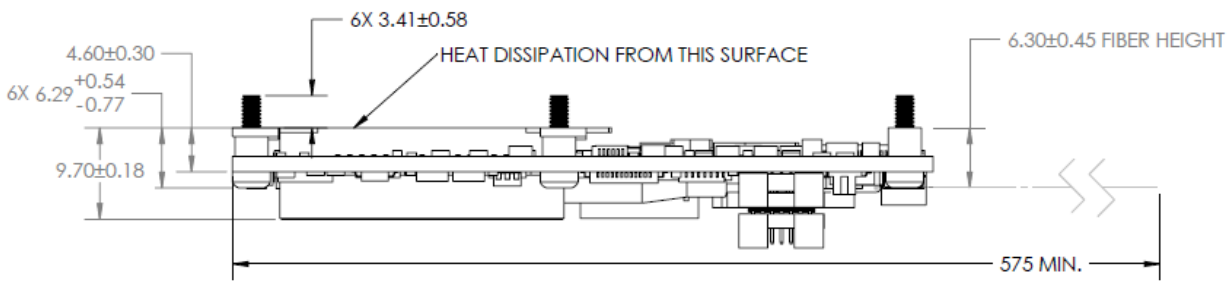


Figure 4: side view of the PPCL200

5. Compliance

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
	IEC 60825-2	Safety of Laser Products - Part 2: Safety of Optical Fiber Communication Systems

The PPCL200 product complies 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.

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.

6. Ordering and Technical Support

Please contact the **Pure Photonics** team for further information and support, as well as quotations.

This datasheet refers as a reference to the product capabilities and features. The exact performance and the features included are listed on the quote and purchase order.

The part number PPCL200 refers to a generic, customized to individual needs product. For higher volume products Pure Photonics may assign a different part number that is specifically assigned to the user and is under change control.

Our contact information:

Tel: (510) 497 0815
Email: support@pure-photonics.com
Web: www.pure-photonics.com