Photonic Power Module

The PPM includes one diode laser, a driver control board and a TEC cooler, with one 10-pin connector. The PPM provides up to 3.5 W of optical power output, which is launched into a 2 meter multimode fiber (62.5/125 µm, NA 0.27) with FC connector at nominally 976 nm wavelength. An extra heat sink for the PPM module is required to provide sufficient cooling when operating under different environmental conditions. This unit is designed only for use when connected to a photovoltaic power converter (PPC), purchased separately.

Assembly Drawing

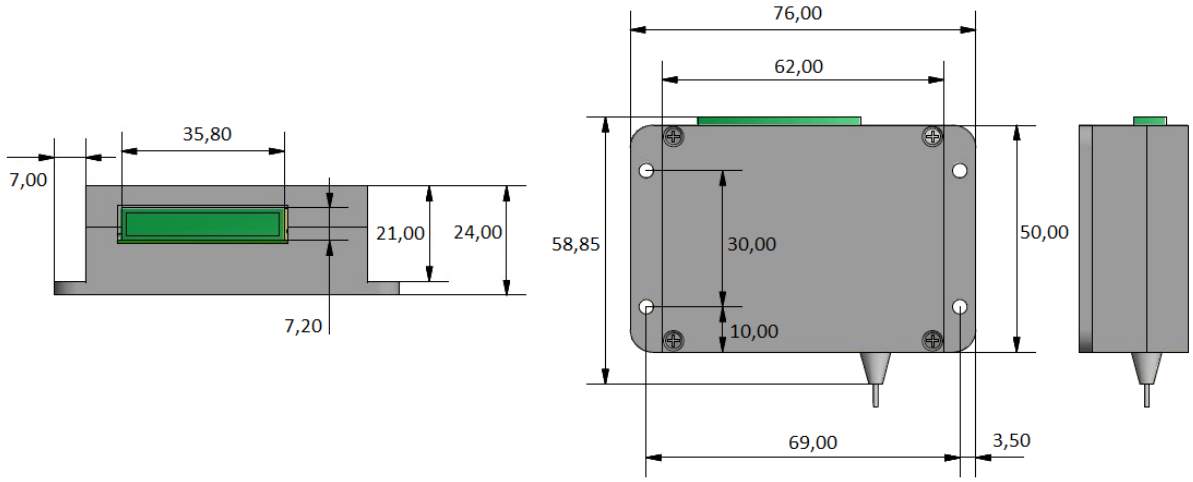


Figure 1. PPM Mechanical Drawing (unit: mm)

Operation Principle

External power and TEC Power must be applied to the module in accordance with Table 1 for proper operation of PPM. The PPM accepts a supply voltage in the range of 3.0 V to 5.5 V.

A voltage applied on **SDN** pin enables the PPM when the voltage is higher than 1.4 V, and disables the PPM when the voltage is lower than 0.95 V. The output optical power can be adjusted through **LIS** pin with a voltage ranging from 0V to 2.0 V. The drive current increases linearly with the voltage applied on **LIS** pin until the voltage reaches 2.0 V. The drive current of the laser diode can be monitored by the voltage level on Pin **LIO**.

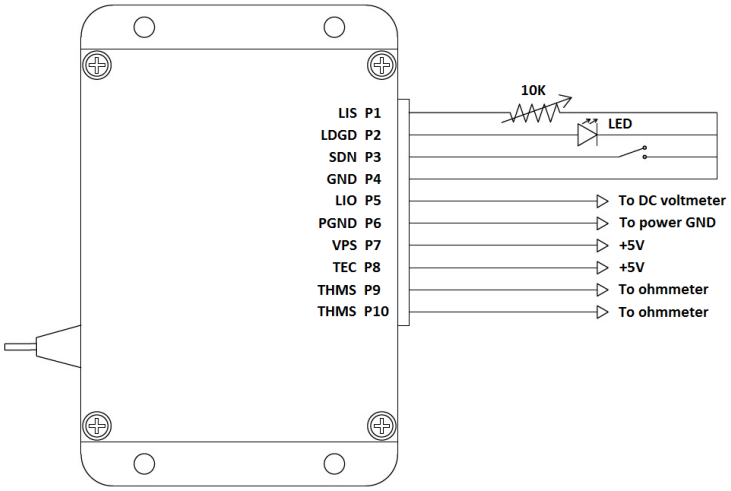


Figure 2. Stand-alone Application Schematic for PPM-003C

Table 1. Pin Function Descriptions

Pin #	Name	Type	Description
1	LIS	Analog Input	Laser current set-point voltage. There is an input variable resistor of 10K tied to GND. Setting it from 0V to 2V will set the output laser power from 0A to 4.8A linearly.
2	LDGD	Digital Output	Laser diode good indicator. When this pin is high, >2V, the control loop is working properly. When this pin is low, <0.3V, the laser diode is bad, or there is a short or open circuit at the laser diode.
3	SDN	Digital Input	Shut down control. When the shutdown control is open (by default), this pin is 5V and the laser will be on. To turn off the laser, short this pin to GND by switching shut down control to close.
4	GND	Signal Ground	Signal ground pin.
5	LIO	Analog Output	Laser current output indicator. The LIO can be used to monitor the output current when the LIS is adjusted. 0V to 2.0V indicates the laser current of from 0A to 4.8A linearly. I_output = 4.8 *V_{LIO} / 2.0 (A).
6	PGND	Power Ground	Power ground pin. Connect this pin directly to power supply return pass.
7	VPS	Power Input	Power supply voltage. The driver will work from VPS = 3.0V to 5.5V.
8	TEC	Power Input	Thermal electrical cooling. The TEC will work from TEC = 3.0V to 5.5V.
9	THMS1	Analog Output	Thermistor. The THMS is used to monitor laser temperature based on the lookup table in Figure 4. Please keep laser temperature below 35℃.

10	THMS2	Analog Output	Same as above.

Turning Laser On and Off

The PPM can be turned on and off by setting the **SDN** pin high and low respectively. It is recommended to turn the PPM on by the following sequence:

Turning on: turn on the PPM by providing the voltage supply on the **VPS** pin, turn on the PPM by raising the voltage of **SDN** pin.

Turning off: turn off the PPM by lowering the voltage of **SDN** pin, turn off the PPM by stopping the voltage supply on the **VPS** pin.

Adjusting the Laser Power

The output laser power can be adjusted by setting the laser driving current through **LIS** pin. The driving current is set by adjusting the 10K variable resistor between **LIS** and **GND**, which sets input voltages of **LIS**. The output current will be I_output = 4.8 × V_{LIS} / 2.0 (A). The voltage settings to generate specific laser power output levels are illustrated in Table 2. Actual voltage settings may vary per PPM, and exact settings will be included with the PPM.

Table 2. Laser Power and Voltage Setting Chart

Laser Power(W)	Setting Voltage(V)	Driving Current(A)	Resistivity(KΩ)
0.25	0.31	0.74	0.31
0.50	0.45	1.08	0.47
1.00	0.67	1.61	0.79
2.00	1.15	2.76	1.82
3.00	1.71	4.10	4.52
3.50	2.00	4.80	8.23

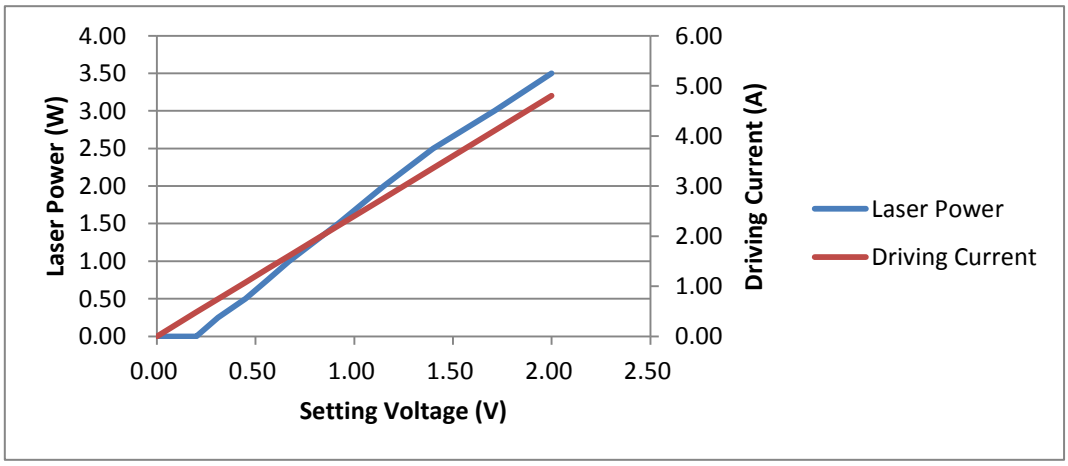


Figure 3. Laser Power & Driving Current under Different Voltage Settings

Monitoring the Laser Power

The PPM output power can be monitored by measuring the voltage on the LIO pin, which

indicates the laser driving current level. This feature is very useful for micro-driver based system where the ADC is available and monitoring the current in real time is required. This pin provides a very low noise voltage signal which is proportional to the output current:
LIO (V) = 2.2 × I_out / 3.52 (V).
For example, when the output signal equals to 1 V, the output current is 1.6 A. **LIO** pin can be used to drive an ADC directly, and also be measured by a multimeter during debugging process.

Monitoring the Laser Temperature

The laser temperature can be monitored using the resistivity between **THMS1** and **THMS2**. The resistivity of the thermistor is 10kΩ at 25℃. Based on the R/T characteristics table in Figure 4, the resistivity will go up as the temperature drops, and the resistivity will go down as the temperature increases.

For example, when the resistivity reading (R2) is 29,200Ω, the laser temperature will be between 0℃ ~ 5℃, determined by looking up values in the table below. Using 0℃ (T1) as the reference point, we know that R1 = 23,650Ω and $\alpha 1$ = 0.051. Putting the values into the following formula, the laser temperature = 2.37℃.

$$\text{Laser temperature} = T1 - \frac{\ln(\frac{R2}{R1})}{\ln(1+\alpha 1)} = 0 - \frac{\ln(\frac{29200}{23650})}{\ln(1+0.051)} = 2.37℃$$

Please keep the laser below 35℃, which is needed to keep the resistivity above 6531Ω. The maximum power that can be applied to this thermistor is 150 mW; exceeding this power level could cause damage to the thermistor.

T (°C)	$B_{25/100}$ = 3988 K		T (°C)	$B_{25/100}$ = 3988 K	
	R_T/R_{25}	α (%/K)		R_T/R_{25}	α (%/K)
−55.0	96.3	7.4	45.0	0.4369	3.9
−50.0	67.01	7.2	50.0	0.3603	3.8
−45.0	47.17	6.9	55.0	0.2986	3.7
−40.0	33.65	6.7	60.0	0.2488	3.6
−35.0	24.26	6.4	65.0	0.2083	3.5
−30.0	17.7	6.2	70.0	0.1752	3.4
−25.0	13.04	6.0	75.0	0.1481	3.3
−20.0	9.707	5.8	80.0	0.1258	3.2
−15.0	7.293	5.6	85.0	0.1072	3.2
−10.0	5.533	5.5	90.0	0.09177	3.1
−5.0	4.232	5.3	95.0	0.07885	3.0
0.0	3.265	5.1	100.0	0.068	2.9
5.0	2.539	5.0	105.0	0.05886	2.9
10.0	1.99	4.8	110.0	0.05112	2.8
15.0	1.571	4.7	115.0	0.04454	2.7
20.0	1.249	4.5	120.0	0.03893	2.6
25.0	1.0000	4.4	125.0	0.03417	2.6
30.0	0.8057	4.3	130.0	0.03009	2.5
35.0	0.6531	4.1	135.0	0.02654	2.5
40.0	0.5327	4.0	140.0	0.02348	2.4

Figure 4. R/T Characteristics of Thermistor

Module Connector

The manufacturer of the 10-pin connector is Phoenix Contact; P/N: MC 1,5/10-ST-3,5; Order number: 1840447. Refer to https://www.phoenixcontact.com/ for detailed schematics

and drawings.

Fiber Handling

Follow proper fiber-handling procedures to avoid catastrophic damage in high-power lasers:

- Do not expose fiber to temperatures higher than 85°C
- Always wear gloves or finger cots when handling the fiber to avoid fiber contamination
- Whenever possible, handle fiber in loops to prevent fiber damage
- Do not drag fiber over equipment, edges or sharp objects
- Never use the fiber to pick up or support the weight of the PPM. Always handle the PPM with two hands, one holding the PPM and the other handling the fiber coil to avoid fiber damage or breakage.
- Do not allow kinks or knots to develop in the fiber. Carefully work out any tangles without pulling on the fiber as this can cause any kinks or curls to tighten and exceed the minimum bend radius.
- Do not bend a fiber with a radius smaller than specified as minimum bending radius 30 mm

Fiber Contamination and Cleaning

Fiber contamination is a key consideration for high-power laser modules. Dirt or contamination will cause a local temperature increase as it absorbs the dissipated cladding modes.

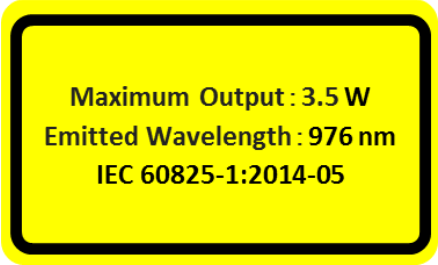
- Wear gloves when handling fiber
- Avoid any contamination of fiber tip

Fiber cleaning materials and procedures shown here are for informational purposes only and are not meant to recommend, endorse, or discredit any existing procedures. It is recommended that users evaluate any procedure or product before using it in applications where damage or failure could result. As always, safety precautions must be exercised at all times when using glass, chemicals, and lasers.

Safety Precaution

PPM-003C can provide up to 3.5 W optical power in the infrared region. Please follow the standard safety protocol for eye and skin for Class 4 IR lasers. Proper electrical interlocks should also be included as required for Class 4 laser systems.

This product is sold in component form and does not conform to **CDRH 21, CFR 1040.1 or 21 CFR 1040.11** or **IEC 60825-1** as applicable to complete laser systems.



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