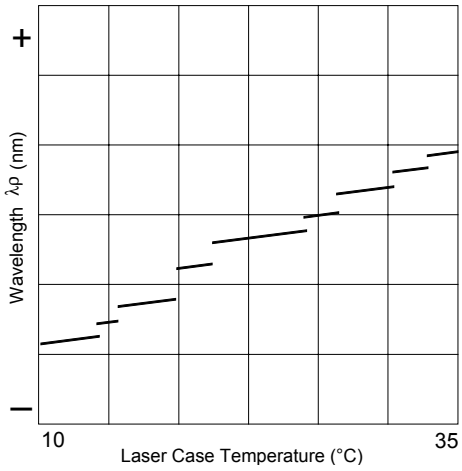
Operating instruction for PPM laser diode module

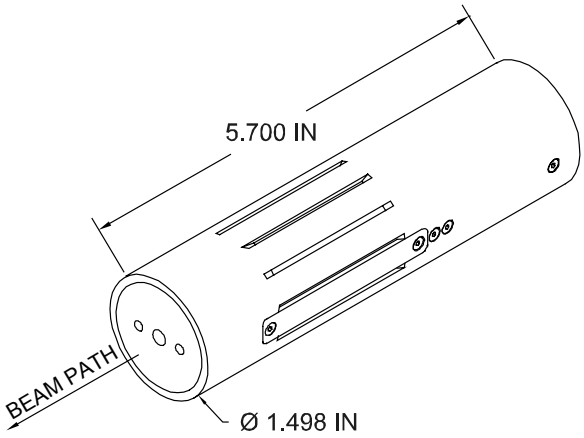
Introduction

Temperature is a crucial consideration when it comes to laser diode technology. In fact, temperature can have a profound effect on wavelength, output power, beam amplitude, noise, modal structure, coherence length, and laser lifetime. The PPM module incorporates a built-in Peltier junction and fan to compensate for temperature change and to actively control it. The Peltier is bi-polar and can, therefore, be used to heat or cool the laser. The ability to control temperature enables users to manipulate, stabilize, and maintain the total operating and spectral characteristics of the laser.

As you can see in Figure 1, wavelength (as well as spectral quality of the laser) will change dramatically as temperature changes. The blank areas between each step indicate areas during the mode change in which the system produces unstable lasing and minimal coherence. There are no values or lasers identified in this graph because each laser will have individual and distinct lasing parameters. Also, the position and size of each step will vary with drive current and will differ from diode to diode.

Fig. 1 Wavelength vs. Temperature





Installation

Do not mount the laser in a thermal insulating material, such as foam plastic. Heat can have adverse effects on laser diodes. Such effects include decreased output power and large shifts in wavelengths. Lasers below 5mW may not need a heat sink. For best heat dissipation use a metal mounting fixture such as PTI's MB6 mounting bracket. A heat sink is always recommended for operating temperatures above 25°C.

The operating voltage for the PPM laser module is 12VDC.

If the label attached to the laser module reads, "Complies with 21CFR 1040.10 and 1040.11," a permanently installed switch at the power source will be required to retain the modules certification as a laser system. This certification is void if the unit is enclosed or otherwise inaccessible, if the labels are modified or removed, or if the system is permanently connected (i.e. soldered, etc.) directly to the power source without the required switch. Modifying the laser will void the CDRH certification. If the distance between the laser head and the power source switch exceeds two meters, an emissions indicator must be mounted near the switch.

Operating Procedure & Control Description

The PPM can operate in either a constant current or automatic power control mode. The control circuitry automatically switches modes as necessary so that neither the current nor the power ever exceeds the set values. If the current and power controls have been previously set for the laser diode, then the current and power will ramp up to the set values when power is connected.

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Caution: If the power and current controls have not been previously set, then they should be set to zero (12 turns counterclockwise) before connecting power

The controls for these two modes can be either mechanical or digital (if module incorporates special digital control option). The optical power of the PPM is monitored and adjusted using the signal current feedback from the laser's back facet monitor diode. The PPM can only operate in one mode at a time. The control that is closest to minimum (counterclockwise) is the mode that is in operation.

You can operate the laser at a constant temperature between 5°C to 30°C[1], or you can vary the temperature anywhere in this range. Protection circuitry in the module will safeguard the laser diode from turn-on and turn-off transients.

Caution: If you are operating the PPM in constant current mode, you need to understand the implications of the temperature and laser power correlation. As temperature decreases, laser power increases. Therefore, the laser's current rating decreases, and the current rating (which was set for 25°C) is no longer true for the required output power. The laser gets more than the required current. If it goes beyond a certain limit, there is a chance for laser burn-out. To avoid this outcome when you are operating the laser below 25°C, start with the current setting at its minimum (12 turns counterclockwise), set the temperature, and then increase the current (while monitoring optical power) up to the maximum power output rating of the system.

There are five 12-turn potentiometers built into the PPM to adjust or change the control parameters. The 7-pin connector provides the analog outputs for monitoring the laser diode current, photodiode current, and laser case temperature. These pins also allow the user to set the low and high temperature points at which the laser shuts off. The pins can either be connected individually to a DVM or they can be connected to an A/D converter. You must remove the plate on the side of the system for access to these controls. See Fig. 2 for identification and location of the controls and the connector pins. The description of the controls is given below.

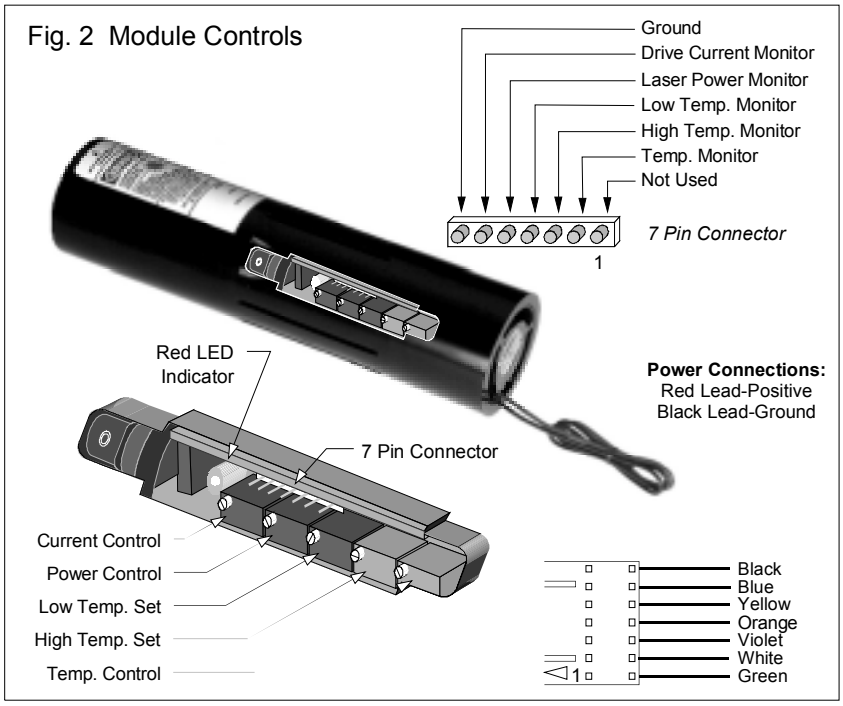

Figure. 2: Behind the cover plate on the side of the system, you will find five potentiometers for adjustment of the controls described below. A wired female connector is supplied for use with the 7-pin connector to monitor these control adjustments.

NOTE: Not all models will include all of the potentiometers shown above. If module is ordered with digital control options or with beam modulation, some potentiometers will not be included.

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Constant Current Mode: Starting with both the power and current controls from zero (counterclockwise, 12 turns), set the power control to maximum (clockwise, 12 turns) and slowly increase the current control until the laser diode current reaches the desired setting. The user can set this current by connecting a voltmeter across the current monitor (blue wire) and the ground (black wire). The voltmeter correlation is 1mV/mA of laser diode current.

Automatic Power Control Mode: Starting with both the power and current controls from zero (counterclockwise, 12 turns), set the current control to maximum (clockwise, 12 turns) and slowly increase the power control until the laser output power reaches the desired setting. The laser power is determined indirectly by measuring the current feedback from the photodiode. Place a voltmeter across pin 7 (ground0, of the 7-pin connector (black wire on the supplied cable) and the laser power monitor (yellow wire). The voltmeter correlation is 1mV/µA of photodiode current. To correlate the photodiode current to the laser power, you will need to develop a correlation table for your system utilizing an optical power meter.

Note: The laser power monitor connections can also be used as a "modal monitor". To do this, use a DVM that blocks the DC. This allows the small AC variations, or modal noise, to be seen on the low-end AC scale. Large AC variations indicate continuous modal changing or "hopping". See Figure1 for a description of this condition.

Low Temperature Set: This control can be adjusted for the desired low temperature setting, below which the laser turns off and the red LED turns on. The desired temperature set value[2] can be obtained by adjusting the control until the voltage on the low temperature monitor pins (orange and black wires) reaches the appropriate setting identified in Table 1.

High Temperature Set: This control can be adjusted for the desired high temperature setting, above which the laser turns off and the red LED turns on. The desired temperature set value[2] can be obtained by adjusting the control until the voltage on the high temperature monitor pins (violet and black wires) reaches the appropriate setting identified in Table 1.

Temperature Control: This control can be adjusted to set the desired temperature for operating the laser. Once the temperature is set, the laser case temperature automatically reaches the set value when the power is connected[3]. This control is normally factory set to run the laser at 25°C. To run the laser below this temperature, turn the temperature control counterclockwise. To go above 25°C, turn it clockwise. Set the temperature by matching the voltage on the temperature monitor pins (white and black wires) to the appropriate setting identified in Table 1.

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Table 1

Laser Case Temperature (°C)	Temperature Monitor (V)
-10	0.383
-9	0.401
-8	0.419
-7	0.438
-6	0.458
-5	0.478
-4	0.499
-3	0.52
-2	0.542
-1	0.564
0	0.586
1	0.61
2	0.633
3	0.657
4	0.682
5	0.707
6	0.732
7	0.758
8	0.783
9	0.81
10	0.836
11	0.863
12	0.89
13	0.917
14	0.945
15	0.972
16	1
17	1.028
18	1.056
19	1.084
20	1.112
21	1.139
22	1.167
23	1.195
24	1.223
25	1.25
26	1.277
27	1.304
28	1.331
29	1.358
30	1.385
31	1.411
32	1.437
33	1.462
34	1.487
35	1.512
36	1.537
37	1.561
38	1.585
39	1.608
40	1.631
41	1.654
42	1.676
43	1.698
44	1.719
45	1.74
46	1.76
47	1.78
48	1.8
49	1.819
50	1.838

Table 1: This table identifies the corresponding laser case temperature for the measured voltage on the temperature monitor pins.

Notes:

1. To maintain a laser case temperature of 5°C (cold side), the outside system temperature (hot side) needs to be no more than 30°C. In other words,

$\Delta T = T_h - T_c = 25°C$

where T_h = Hot side temperature
T_c = Cold side temperature

2. The tolerance of the temperature value is ± 0.5°C for each measured voltage in Table 1.

3. Depending on the temperature settings and the ambient temperature, the steady state will be reached in less than five minutes.

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Maintenance & Service

This laser module contains no user serviceable parts. Depending on environmental conditions, the optics may require occasional cleaning. Clean, compressed air is recommended to blow the optics clean. If compressed air fails, clean lens carefully with alcohol and a lint free rag or cotton swab.

Warranty and Repair Return Policy

No return of merchandise will be accepted by PTI without an RMA (Return Material Authorization) number, issued by the factory and prominently displayed on the return package. No return shipments will be accepted "Collect" or "COD". On warranty returns, PTI will pay for shipping charges on the return of merchandise to the customer.

When contacting the factory for an RMA number, please have the following information available: model number, serial number(s), and a description of the problem.

Laser Safety

Class 3b and 4 lasers are not intended for use in surveying, leveling, alignment, or medical applications.

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution: The use of optical instruments with this product will increase eye hazard.

Do not shine laser in the direction of other people or at reflective surfaces that might cause exposure to the human eye. Do not mount the laser at eye level.

Modifications, that affect any aspect of the product's performance or intended functions will require re-certification and re-identification of the product in accordance with the provisions of 21CFR 1040.10 and 1040.11. A copy of 21CFR 1040.10 and 1040.11 can be downloaded from www.powertechnology.com.

The product labels shown below can typically be found near the output optics.

Class 1 Laser: Class 1 Laser Product	**Class 1M Laser:** Laser Radiation, Do not view directly with optical instruments	**Class 2 Laser:** Laser Radiation, Do not stare into beam
☐ **Component** 	☐ **Component** 	☐ **Component** 
☐ **System** 	☐ **System** 	☐ **System** 
One of the above labels is attached to the laser head.	One of the above labels is attached to the laser head.	One of the above labels is attached to the laser head.

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Class 2M Laser:
Laser Radiation, Do not stare into the beam or view directly with optical instruments

☐ **Component**

☐ **System**

One of the above labels is attached to the laser head.

Class 3R Laser:
Laser Radiation,
Avoid direct eye exposure

☐ **Component**

☐ **System**

One of the above labels is attached to the laser head.

Class 3B Laser:
Laser Radiation,
Avoid exposure to beam

☐ **Component**

☐ **System**

One of the above labels is attached to the laser head.

Class 4 Laser:
Laser radiation, Avoid eye or skin exposure to direct or scattered radiation

☐ **Component**

☐ **System**

One of the above labels is attached to the laser head.

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