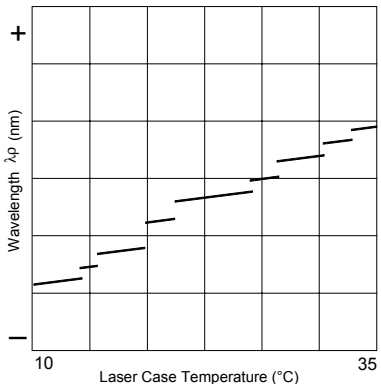
Operating instruction for PPMT laser diode module

For applications requiring active temperature control and TTL modulation from CW to 20MHz

Introduction

The PPMT laser diode module is designed for external TTL compatible modulation from CW up to 20MHz. Because changes in temperature can result in changes in wavelength, power, beam amplitude, noise, modal structure, coherence length, and laser lifetime, the module features active temperature control via a built-in Peltier Junction and fan. The Peltier is bi-polar and can, therefore, be used to heat or cool the laser. The ability to control temperature allows users to manipulate, stabilize, and maintain the total operating and spectral characteristics of the laser.

Fig. 1 Wavelength vs. Temperature



As may be seen in Fig. 1, wavelength and spectral quality change dramatically as temperature changes. The blank areas between each step indicate areas during the mode change where the laser produces unstable output and minimal coherence. There are no values or lasers identified in this graph because each laser will have individual and distinct lasing parameters, and the position and size of each step will vary with drive current and will differ from diode to diode.

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 like PTI's MB6 mounting bracket. A heat sink is always recommended for operating temperatures above 25°C.

The operating voltage for the PPMT laser module is 12 ± 1.8VDC.

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 PPMT operates on 12 ± 1.8VDC input. In operation, the system provides a constant current to the laser, which means that it does not monitor the back-facet photodiode and automatically adjust to maintain a constant optical laser output power. The current control has a current limit that prevents the current from exceeding the maximum rating of the laser at 25°C. If the current control has been previously set for the laser diode, then the current will ramp up to the set value when power is connected.

Caution: If the current control has not been previously set, then it should be set to its minimum setting (12 turns counterclockwise) before connecting power.

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

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Mailing: P. O. Box 191117, Little Rock, AR 72219-1117 • Shipping: 16302 Alexander Road, Alexander, AR 72002
Tel: 501.407.0712 • Fax: 501.407.0036 • Email: sales@powertechnology.com • Web: www.powertechnology.com

Caution: Because the system drives the laser at a constant current, users must understand the implications of the temperature and laser power correlation. As temperature decreases, laser power increases. Therefore, the laser's current rating decreases. The current rating that was set for 25°C is no longer true for the required output power. The laser gets more than the required current and is at risk for laser burnout. To avoid this risk when 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 four 12-turn potentiometers built into the module to adjust or change the control parameters. The seven-pin connector provides the analog outputs for monitoring the laser diode current and the laser case temperature. These pins also allow the user to set the low and high temperature point 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. Users must remove the plate on the side of the module for access to these controls. See Fig. 2 for identification and location of the controls and connector pins.

TTL Modulation

The modulation signal is transmitted to the module via the single coaxial cable. Because the modulation is TTL, the external pulse generator must toggle between 0VDC and +5VDC. The system can be operated CW (with 0VDC on the data input) or pulsed up to 20MHz.

The module will not operate until driven by a pulse generator via the coaxial cable, or until the termination is shorted (which allows the system to operate CW).

Use of Power Meter

Check the operating range of your power meter before setting the power. Most photodiode-based meters will saturate at 2mW (without an external attenuation). Although some digital meters will indicate power greater than 2mW, this reading is usually in error with the meter always giving a reading below the actual power. Also, because the system is modulated, the meter will not give a true reading. For the true laser power, you must factor in the pulse width and the pulse frequency.

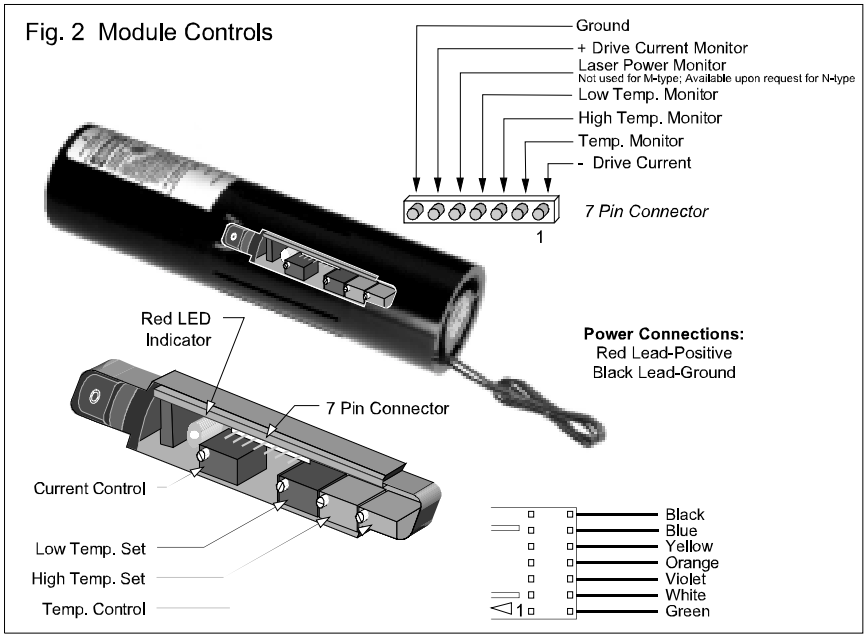

Fig. 2: Behind the cover plate on the side of the module, you will find four potentiometers for adjustment of the controls described below. A wired female connector is supplied for use with the 7-Pin Connector to monitor these control adjustments.

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Controls

Current Control: Starting with the current control at its minimum setting (12 turns counterclockwise), slowly increase the current control (clockwise) 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 -current monitor (green wire). The voltmeter correlation is 1mV/mA of laser diode current.

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[2] value 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[2] by matching the voltage on the temperature monitor pins (white and black wires) to the appropriate setting identified in Table 1.

Laser Power Monitor: The laser power is determined directly by measuring the current feedback from the photodiode. Place a voltmeter across the gray wire exiting the end of the module and Pin 1 of the 7-pin connector (green wire on the supplied cable). 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 *(see Use of Power Meter above)*.

Note: The Laser Power Monitor (Option J) 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 Fig.1 for a description of this condition.

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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.

Maintenance & Service

This laser module contains no user serviceable parts. Depending on environmental conditions, the optics may require occasional cleaning. The use of 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.

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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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