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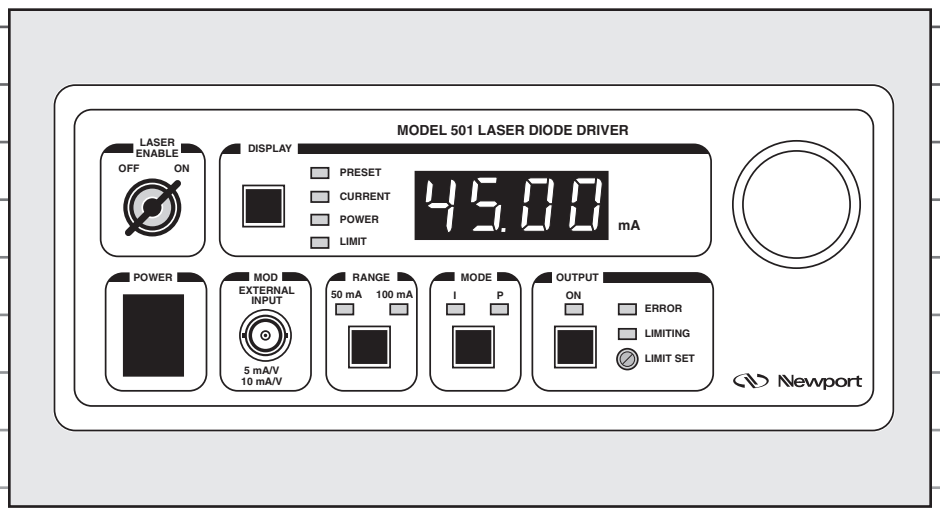
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Model 500 Series
Laser Diode Drivers



OPERATING MANUAL

Newport

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Model 500 Series Laser Diode Drivers Operating Manual

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Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

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EC DECLARATION OF CONFORMITY

Active Isolation Module Set Series

We declare that the accompanying product, identified with the "CE" mark, meets the intent of the Electromagnetic Compatability Directive, 89/336/EEC and Low Voltage Directive 73/23/EEC.

Compliance was demonstrated to the following specifications:

EN50081-1 EMISSIONS:

Radiated and conducted emissions per EN55011, Group 1, Class A

EN50082-1 IMMUNITY:

Electrostatic Discharge per IEC 1000-4-2, severity level 3
Radiated Emission Immunity per IEC 1000-4-3, severity level 2
Fast Burst Transients per IEC 1000-4-4, severity level 3
Surge Immunity per IEC 1000 4-5, severity level 3

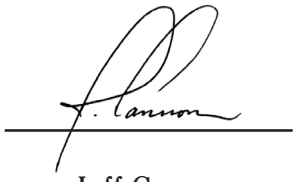
IEC SAFETY:

Safety requirements for electrical equipment specified in IEC 1010-1.



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Safety Precautions

CAUTION

Check that all equipment is unplugged before connecting

Check that the selector is set at the position which corresponds to your mains voltage

All units are factory preset to operate at 180–250 V_{AC}, 50–60 Hz. (See AC Power Inlet, in Section 2.3.7)

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Section 1
General Information

1.1 Introduction

The Model 500 and 500AN Series Laser Diode Drivers are low noise, highly stable current sources for use with laser diodes. Selectable output current ranges allow you to choose the laser current range having the optimum resolution for your application. Two operating modes, constant current and constant laser power are available. A monitor photodiode can be zero biased or reverse biased up to –5 volts without resorting to external power supplies. Redundant FET and relay shorting circuits protect the laser diode during the beginning of a soft-start sequence. After a short delay the output current slowly ramps up to the operating set-point. A current LIMIT setting unconditionally protects the output from exceeding the laser diode's maximum specified operating current independent of operating mode. An external analog modulation input allows voltage control of the output. Model 500AN Series Laser Diode drivers are equipped with an Analog Interface, enabling remote control and monitoring of the laser diode.

1.2 Specifications

	Model 501 Model 501AN		Model 505 Model 505AN		Model 525 Model 525AN		Model 560 Model 560AN	
Output Current								
Output Current Range (mA)	0 to 50	0 to 100	0 to 200	0 to 500	0 to 1000	0 to 2500	0 to 3000	0 to 6000
Set-point Resolution (mA)	0.005	0.010	0.020	0.050	0.100	0.250	0.300	0.600
Set-point Accuracy	±0.1 % FS		±0.1 % FS		±0.1 % FS		±0.1 % FS	
Compliance Voltage (Volts)	7 Volts		7 Volts		7 Volts		5 Volts	
Temp. Coefficient	<50 ppm/°C		<50 ppm/°C		<50 ppm/°C		<100 ppm/°C	
Short Term Stability (30 min.)	<10 ppm		<10 ppm		<10 ppm		<20 ppm	
Long Term Stability (24 hr.)	<25 ppm		<25 ppm		<25 ppm		<50 ppm	
Noise/Ripple (rms)								
Hi Bandwidth	<2 µA	<2 µA	<4 µA	<6 µA	<10 µA	<20 µA	<20 µA	<25 µA
Lo Bandwidth	<1 µA	<1 µA	<2 µA	<2 µA	<4 µA	<10 µA	<10 µA	<20 µA
Current Limit								
Range (mA)	0 to 50.00	0 to 99.99	0 to 200.0	0 to 500.0	0 to 999.9	0 to 2500	0 to 3000	0 to 6000
Resolution (mA)	0.01	0.01	0.1	0.1	0.1	1.0	1.0	1.0
Accuracy (mA)	±0.1	±0.1	±0.5	±0.5	±1	±3	±5	±10

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	Model 501 Model 501AN	Model 505 Model 505AN	Model 525 Model 525AN	Model 560 Model 560AN
External Analog Modulation				
Input	0 to 10V, 10 kΩ	0 to 10V, 10 kΩ	0 to 10V, 10 kΩ	0 to 10V, 10 kΩ
Transfer Function	5 mA/V 10 mA/V	20 mA/V 50 mA/V	100 mA/V 250 mA/V	300 mA/V 600 mA/V
Bandwidth				
Hi BW (kHz)	DC - 800 DC - 600	DC - 500 DC - 350	DC - 300 DC - 150	DC - 100 DC - 50
Lo BW (kHz)	DC - 10 DC - 10	DC - 10 DC - 10	DC - 10 DC - 10	DC - 10 DC - 10
Photodiode Input				
Monitor Current				
Range	0 to 5 mA	0 to 5 mA	0 to 50 mA	0 to 50 mA
Stability	±0.02 %	±0.02%	±0.02 %	±0.02 %
Accuracy	±0.1 %	±0.1 %	±0.1 %	±0.1 %
Photodiode Bias Voltage	0 to 5 Volts	0 to 5 Volts	0 to 5 Volts	0 to 5 Volts
Measurement Display				
Output Current Range (mA)	0 to 50.00 0 to 99.99	0 to 200.0 0 to 500.0	0 to 999.9 0 to 2500	0 to 3000 0 to 6000
Output Current Resol. (mA)	0.01 0.01	0.1 0.1	0.1 1.0	1.0 1.0
Output Current Accuracy	±0.1 % of full scale	±0.1 % of full scale	±0.1 % of full scale	±0.1 % of full scale
Photodiode Current Range (µA)	0 to 5,000	0 to 5,000	0 to 50,000	0 to 50,000
Photodiode Current Resol. (µA)	1.0	1.0	1.0	10
Photodiode Current Acc.	±0.1 % of full scale	±0.1 % of full scale	±0.1 % of full	±0.1 % of full

General

Input Power	90–125, 180–250 V_{AC}, 50–60 Hz
Chassis Ground	4 mm banana jack
Size, H x W x D	88 x 215 x 280 mm (3.5" x 8.5" x 11")
Weight	2.9 kg (6.5 lbs.)
Operating Temperature	0°C to +50°C
Storage Temperature	–40°C to +70°C
Humidity	<90% relative, non-condensing
Laser Safety Features	Output On/Off Keyswitch
(Meets CDRH US21 CFR 1040.10)	Rear Panel Interlock
	Output Delay
Connectors	
Laser Diode & Photodiode	9-pin, D-sub (female)
External Photodiode	BNC
External Analog Modulation	BNC
Analog Interface (Models 501AN, 505AN, 525AN & 560AN)	15-pin, high density D-sub (female)

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1.3 Accessories

The Model 500 Series Laser Diode Drivers come with a line cord for connection to AC power. To order accessories use the following part numbers:

PART #	DESCRIPTION
500-02	Laser Diode Driver Cable
500-04	Laser Diode Driver/Mount Cable
35-RACK	Rack Mount Kit

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Section 2
System Operation

2.1 Introduction

The Model 500 Series Laser Diode Drivers are specifically designed to safely drive all configurations of laser diode/photodiode or LED packages. Carefully read the following sections before operating a laser diode or LED with your unit.

2.2 Front Panel

The front panel of the Model 500 Series Laser Diode Driver is arranged for easy operation. Seven distinct areas, each with a specific set of related functions, and the control knob are located on the front panel, as shown in Figure 1 below.

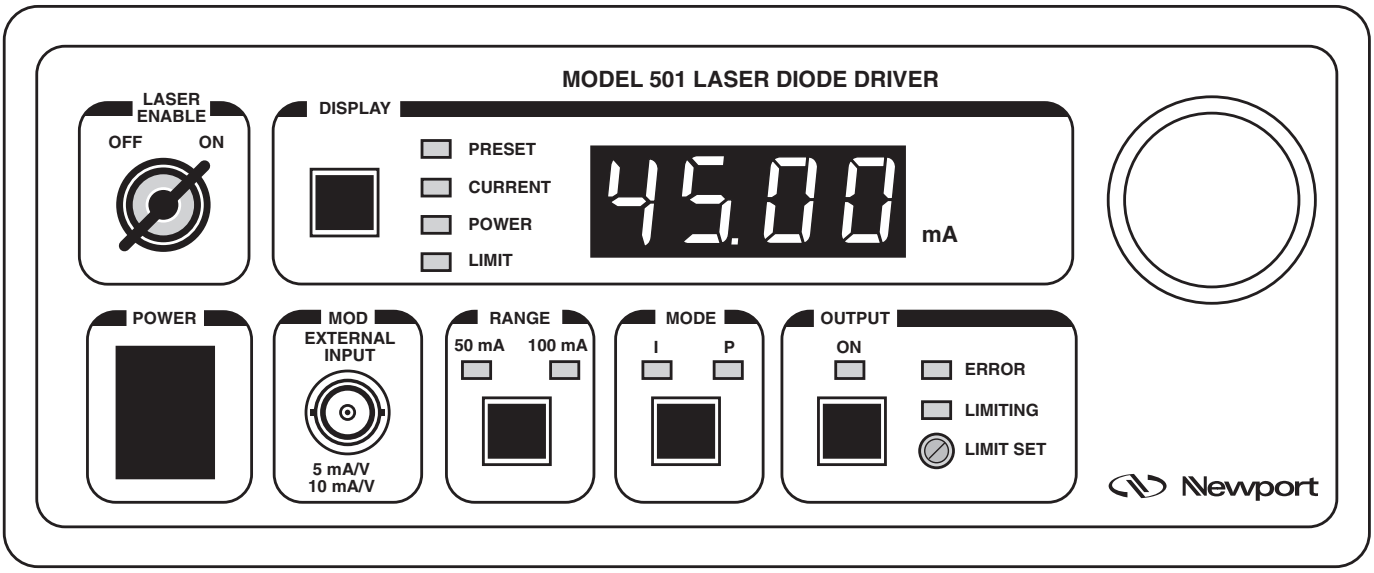


Figure 1: Front panel layout.

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2.2.1 AC Power Switch

When AC power is turned on the unit starts up in a default configuration with the OUTPUT off and the display in the PRESET mode. The power switch is located in the lower left corner of the instrument front panel.

2.2.2 MOD

Modulation of the laser diode by an external signal source through the MOD input BNC can only be performed in the CURRENT mode. The output current level to the laser diode can be set using a constant voltage source or it can be externally modulated with a function generator signal. Any input modulation signal is added to the DC drive current level set by the front panel control knob. The gain ranges noted below the BNC correspond to the low or high RANGE. A bandwidth selection switch on the back panel introduces a dampening filter in the output control loop to reduce output noise when external modulation is not required. If the output drive current does not respond to a modulation frequency above 10 kHz, check the switch to make sure it is not in the LOW bandwidth position.

2.2.3 Range Switch

Each Model 500 series unit has two output current ranges. Before turning the output on, the RANGE must be selected. Once the OUTPUT is turned on, the RANGE switch is inactive.

2.2.4 Mode Switch

The Model 500 Series Laser Diode Drivers have two modes of operation; constant current (I) and constant optical power (P). Mode selection can only be made if the OUTPUT is off. The mode switch is deactivated under output on condition.

In the “I” mode the output drive current to the laser diode is held at a constant level. The output of the laser diode can be modulated in this mode by connecting an external signal source to the MOD input on the front panel.

The Model 500 Series can be used with a monitor photodiode and can be operated in a constant optical power mode. Reverse voltage biasing of the photodiode is a standard feature which improves the dynamic range and frequency response of a laser diode. In the “P” mode the output current to the laser diode is controlled in response to the monitor photodiode current to maintain a constant output optical power. As a laser diode ages or the temperature of the laser diode increases more output drive current is required to maintain a constant optical power level. The output current LIMIT prevents the laser diode from exceeding its maximum current rating. The laser diode cannot be modulated in the POWER mode.

2.2.5 OUTPUT ON Switch and Indicator

The switch will activate the ON LED and allow current flow to the laser diode after a three second delay. Current will not flow unless the laser diode is correctly connected, the “LASER ENABLE” keyswitch is activated, and pin 1 and 2 of the back panel interlock feature are shorted.

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ERROR Indicator LED

The following conditions will cause the red ERROR LED and its protection circuitry to activate, automatically shutting off the output:

A. An open circuit in the laser diode package or cabling.

B. If the forward voltage drop of a laser diode (or series arrangements of multiple diodes) exceeds the compliance voltage specified in the table on page 1.

C. Overmodulating the external voltage input to cause the laser output current to exceed the previously set limit value.

Once the fault is corrected, the OUTPUT ON switch must be pushed once to clear the error indication, and a second time to restore current to the laser diode.

LIMITING Indicator LED

A soft limit occurs when the output current gradually exceeds a preset value, clamping the current flow at that level and causing the LIMIT LED to blink until the threshold is no longer exceeded. A hard limit, indicated by a solid green LED and the ERROR LED will occur if the external input is overmodulated when first attempting to turn on the output. The error must be cleared before normal operation can occur.

Limit Set

A small slotted screwdriver is used to access a recessed trimpot to adjust the unit's output current limiting level. Toggle the DISPLAY section push-button to the LIMIT indicator and adjust the readout with a clockwise rotation to increase the protection level.

2.2.6 Laser Enable

This key switch is a safety feature that prevents the OUTPUT from being turned on. The key may only be removed in the OFF position.

2.2.7 Display Section

The display located in the top center of the front panel is a 3 1/2 digit green LED array. It reads current in mA for all Series 500 models. Pushing the switch repeatedly cycles through display values as described below. Display modes can be toggled with the output on or off.

PRESET Display

This mode allows setting diode current levels with the control knob before actually turning on the output.

CURRENT Display

This readout measures actual current flow in milli-Amps to the laser diode. The current level will drop to zero with the output off. The display shows average output drive current if the laser diode is modulated with a varying external input waveform.

POWER Display

Using the monitor photodiode current (Im) displayed, a conversion table supplied by the diode manufacturer will indicate actual optical power level.

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LIMIT Display

This value is set by the LIMIT set screw adjustment. (See Limit Set). The output drive current will not exceed this LIMIT value regardless of the operating mode.

2.2.8 Control Knob

Located on the right side of the front panel, this knob is used to set the appropriate drive current in PRESET or CURRENT mode, or monitor photodiode current (laser power) in POWER mode.

2.3 Rear Panel

The Model 500 Series rear panel shows the ANALOG INTERFACE and OUTPUT connectors, a REMOTE/LOCAL switch, the photodiode reverse voltage BIAS ADJUST screw, a photodiode BNC input, the BANDWIDTH selection switch, and the AC power inlet.

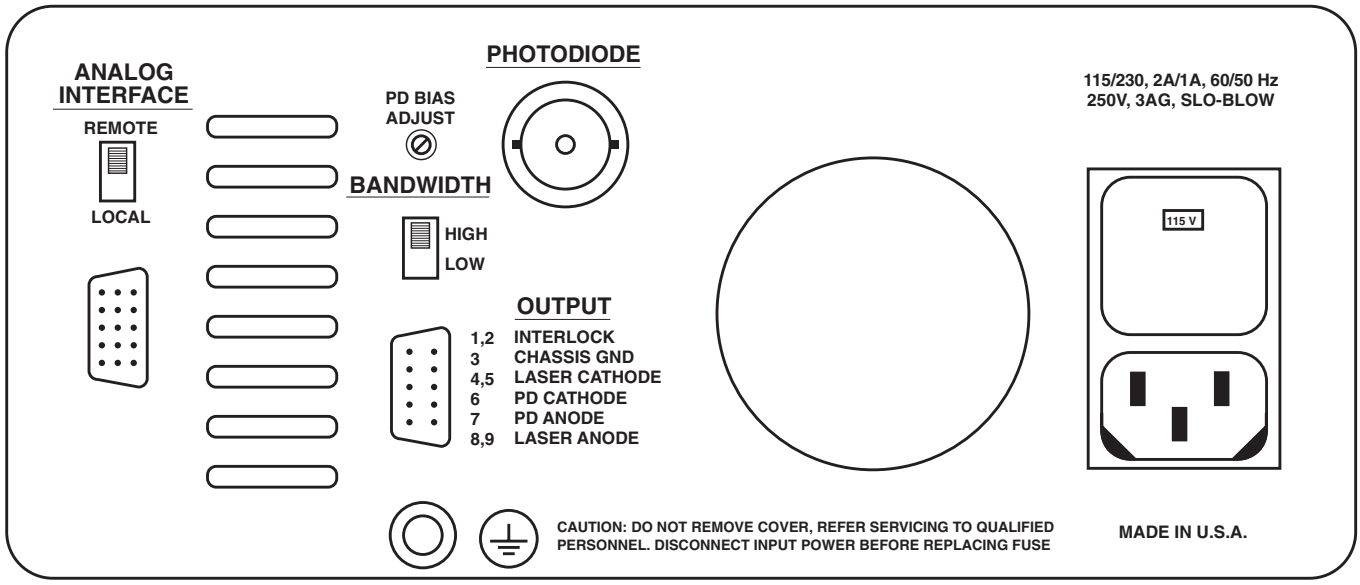


Figure 2: Rear panel layout.

2.3.1 Analog Interface

The Model 500AN Series Laser Diode Drivers include an Analog Interface card, which is located at the far left of the rear panel. A 15-pin, high density, D-sub connector is used for the input and output lines. Above the connector is the REMOTE ON switch used to activate the set-point enable line. The Set-Point line is disabled when this switch is in the off position, all other status lines of the Analog Interface are always active.

How to Use the Analog Interface

The Analog Interface may be used with chart recorders, X-Y recorders or can be operated via a computer. When using a computer a multiple function I/O card, such as a National Instruments LAB-PC data acquisition card

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is required. One data acquisition card will control two Model 500 units or one Model 500 and one Model 300 temperature controller unit. The Output Set-point is set by using one of the analog outputs from the data acquisition card. TTL inputs and outputs of the Analog Interface card are controlled by the digital I/O lines from the data acquisition card. R/T Monitor data, such as the temperature, is then acquired using the analog input line of the data acquisition card.

Analog Interface Connections

Pin #	Description	
1	ON/OFF	TTL or Momentary Low pulse toggles OUTPUT
2	ENABLE	TTL (Low = Remote Enabled)
3	ON/OFF Status	TTL (Low = Output On)
4	LIMIT	TTL (Low = Output Limiting)
5	ERROR	TTL (Low = Output Error)
6	MODE	TTL (Low = Current, High = Power)
7	DGND	Digital ground return for TTL signals
8	EARTH GND	Earth ground for shielding TTL signals
9	LEVEL (+)	0–10 V input signal bypasses front panel control
10	LEVEL (–)	Return signal for external level control
11	CURRENT OUT	0–10 V signal represents 0 to full range selected
12	AGND	Analog ground return for Current Out
13	POWER OUT	0–10 V signal represents 0 to full range selected
14	AGND	Analog ground return for Power Out
15	EARTH GND	Earth ground for shielding Analog signals

2.3.2 PD Bias Adjustment

A monitor photodiode may be reversed biased up to –5 volts using the PD BIAS adjustment screw. In the farthest counter-clockwise position the photodiode is zero biased. Turning the screw clockwise increases the bias voltage.

2.3.3 Bandwidth Select Switch

Setting the bandwidth select switch LOW dampens the output response, thereby reducing noise levels in the 0–10kHz modulation range. Modulation rates above 10kHz require a faster output response requiring the bandwidth selection switch to be set to the HIGH position. The maximum modulation frequency depends on the drive capabilities specified in the table on page 1.

2.3.4 Photodiode BNC Input

The photodiode input connector is used to attach a stand-alone photodiode. The BNC is connected in parallel with pin 6 (cathode) and pin 7 (anode) of the D-Sub 9 output connector. The center terminal of the BNC is the cathode, while the outside shell is the anode and is isolated from the chassis. PD bias adjustments are made with the (+) side of a DC voltmeter to cathode, and (–) side probe to anode (0 to +5 VDC scale).

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2.3.5 Output Connector

Connections to the laser diode and photodiode are made with a 9-pin, D-sub connector.

Output Connections

The pin connections to the laser diode and monitor photodiode are made from the 9-pin, D-sub connector labeled OUTPUT. The connections are printed on the rear panel and should be made as shown in Figure 4 and Figure 5.

Pin #	Description	Wire Color (Part # 500-02)
1,2	Interlock	Shorting jumper or external closure
3	Chassis Gnd	Shield or drain wire
4,5	Laser Cathode	Black
6	Photodiode Cathode	White
7	Photodiode Anode	Green
8,9	Laser Anode	Red

2.3.6 Chassis GND

This 4 mm banana jack, connected to chassis ground, is intended to be used as a common reference ground for the laser diode case. (Pin 3 of the output connector may also be used)

2.3.7 AC Power Inlet

The input voltage setting is indicated in a small window on the face of the power module. A small screwdriver is needed to flip down the panel once the AC line cord is removed. Carefully rotate the plastic tumbler and reinsert it to show the appropriate power grid voltage. The fuse is also located behind this panel and can be pulled out, to be replaced with the appropriate size, as indicated on the back panel.

All units are preset at the factory for operation at 180–250 V_{AC}, 50/60 HZ. The line cord supplied with each unit should be plugged only into a properly grounded three prong outlet to prevent electrical shock in the event of an internal short circuit to the metal cabinet.

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Section 3
Principles of Operation

3.1 Introduction

Operating procedures of the Model 500 Series Laser Diode Drivers include safe handling procedures for laser diodes, various types of laser diode packages, how to make the connections, and how to earth ground a laser diode.

3.2 Laser Diode Handling Precautions

Laser diodes are extremely sensitive to static discharge and guidelines should be followed at all times when handling laser diodes:

a) all operators must have a properly grounded wrist strap before handling any laser diode.

b) all soldering iron tips must be properly grounded.

c) all related test and assembly equipment must be properly grounded

Laser diodes are extremely sensitive to electrostatic discharge since they can only withstand a maximum reverse voltage of 2 to 3 V across their leads and no more than the maximum rated current in the forward direction.

NOTE: Always follow the manufacturer's instructions for removing and handling laser diodes.

Additional precaution must be taken when soldering leads of a laser diode. Excess heat from soldering damages the laser facet. Care must be taken to provide a heat sink between the laser diode and the leads during soldering.

NOTE: Always follow the laser diode manufacturer's specifications for maximum temperatures and soldering times.

3.3 Laser Diode Connections

Laser diodes come in many different types of packages, with and without monitor photodiodes. The following sections will show how to make connections to standard 9mm and 5.6mm packaged laser diodes and also

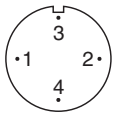
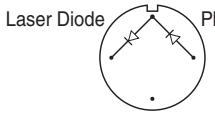
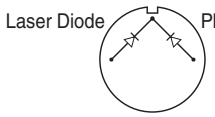
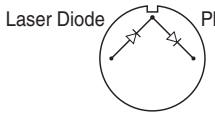
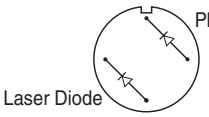
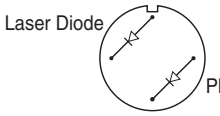
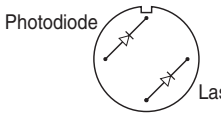
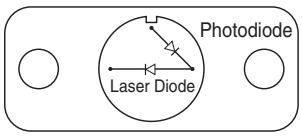
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telecommunication laser diodes in Dual In-Line (DIL) and butterfly packages. Any other packages such as TO-3 packages have laser diode and photodiode connections identical to the types shown below.

3.3.1 9mm and 5.6mm Laser Diode Packages

Almost all CD type packages fall into one of seven configurations as shown in Figure 3. Figure 4 shows how to connect a Model 500 Laser Diode Driver to three of the various laser diode and photodiode configurations.

NOTE: The optional chassis ground (earth ground) should not be connected until reading section 3.4.

Pin assignment from pin side 		9mm & 5.6 mm Laser Diode Pin Connections			
		Pin 1	**Pin 2**	**Pin 3**	**Pin 4**
TYPE A		LD Cathode	PD Anode	LD Anode, PD Cathode, Case Common	
TYPE B		LD Anode	PD Anode	LD Cathode, PD Cathode, Case Common	
TYPE C		LD Anode	PD Cathode	LD Cathode, PD Anode, Case Common	
TYPE D		LD Cathode	PD Anode	PD Cathode	LD Anode, Case Common
TYPE E		LD Cathode	PD Anode	LD Anode, Case Common	PD Cathode
TYPE F		PD Anode	LD Cathode	PD Cathode, Case Common	LD Anode
TYPE G		LD Cathode	LD Anode, PD Cathode, Case Common	PD Anode	

Notes: Pin assignments for some laser diodes may differ from those shown. Please be careful and check for the correct laser diode type before making any connections to a Model 500 Series Laser Diode Driver. If the laser diode is to be earth grounded, the CHASSIS GND from the laser diode driver is used to make this connetion and is connected to the Case Common pin. Make sure that this is the only earth ground connection to the laser diode.

Figure 3: Laser Diode/Photodiode package types with pin assignments.

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NOTE: Pin assignments for some laser diodes may differ from those shown. Please be careful and check for the correct laser diode type before making any connections to a Model 500 Series Laser Diode Driver. If the laser diode is to be earth grounded the CHASSIS GND from the laser diode driver is used to make this connection and is connected to the Case Common pin. Make sure that this is the only earth ground connection to the laser diode.

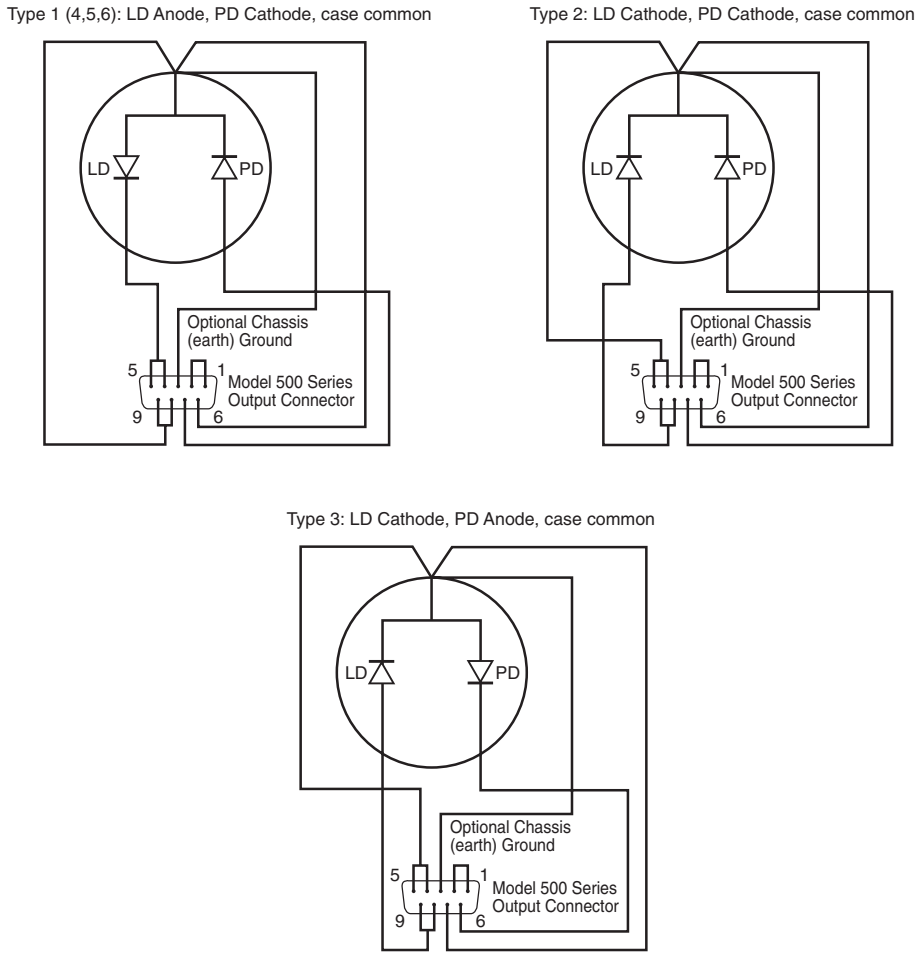
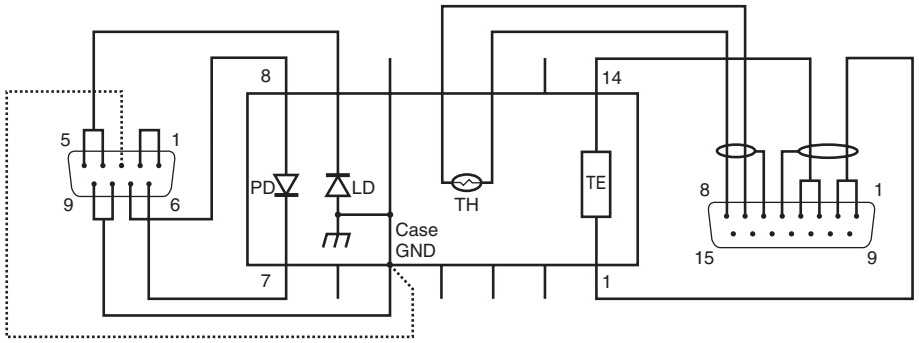


Figure 4: Laser Diode/Photodiode configurations and connections to Model 500 Series Laser Diode Drivers.

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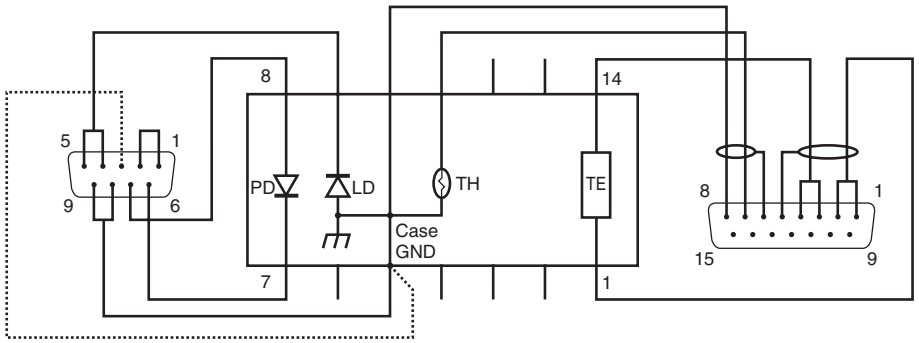
3.3.2 Telecommunication Laser Diode Packages

Most telecommunication laser packages fall into one of the following three configurations. Connections of a Model 500 and Model 300 unit to a telecommunication laser package are shown in Figure 5. Care must be taken when connecting the chassis ground (earth ground) to the package.



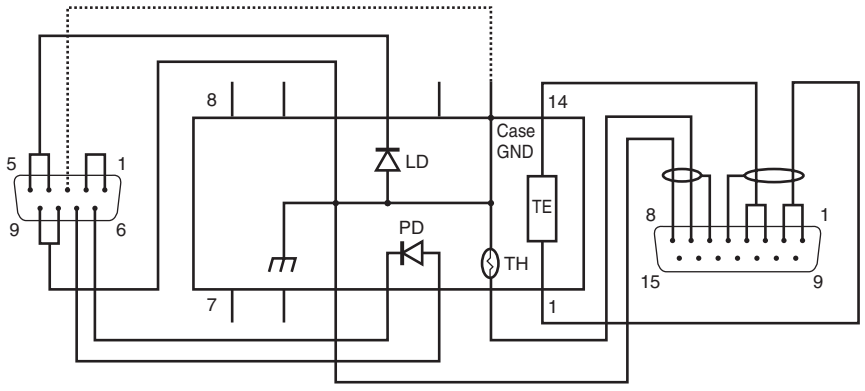
TYPE "A"
Lasertron (DIL)
Mitsubishi (DIL)
BT&D (DIL)

TE: Thermo-Electric Cooler
TH: Thermistor



TYPE "B"
Alcatel (DIL)
Toshiba (Butterfly)
OKI (DIL)

TE: Thermo-Electric Cooler
TH: Thermistor



TYPE "C"
AT&T (Butterfly)
Lasertron (Butterfly)
Mitsubishi (Butterfly)

TE: Thermo-Electric Cooler
TH: Thermistor

Figure 5: Telecommunication laser diode packages and connections to Model 500 Series Laser Diode Drivers.

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3.4 Grounding A Laser Diode

The outputs of the Model 500 Series are isolated from earth (chassis) ground. Isolating the laser diode case avoids damaging the device from multiple ground loop potentials, AC transients or static discharge. Since test equipment probes, signal sources and package mounts are often partially earth grounded, it is often necessary to also bond the device case to earth ground. It is strongly recommended that a single point ground scheme be established, specifically at either pin 3 of the DB-9 connector or the binding post on back of the rear panel. This will help minimize noise, transients, and ground loop hazards.

If you have additional questions about your earth grounding method contact a Newport applications engineer.

3.5 Model 500 Series Setup

3.5.1 Using the Interlock Feature

The interlock feature is an additional contact closure in series with the front panel keyswitch. The loop between pins 1 and 2 can be remoted as a relay contact or safety switch which disables the output drive circuit when opened. When the interlock loop is closed again, pushing the front panel OUTPUT switch will resume current flow after a three second soft-start sequence. The switch or relay contact should be electrically isolated from all other circuits and earth ground.

3.5.2 Rack Mounting Model 500 Series Units

Two units, either Model 300's or Model 500's or one of each, may be mounted side by side in the standard rack mount kit (part #35-RACK). Remove the four feet on the bottom of the instrument. Use the screws supplied with the rack mount kit and secure the bottom of the unit(s) to the bracket using the two original front feet mounting positions. After tightening the screws the unit(s) may be slid into a 19" rack and secured to the side rails.

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3.5.3 Model 500 Series Operationg Checklist

The following step by step procedure should be followed when operating a Model 500 Series Laser Diode Driver:

a) Check the AC voltage selection of the unit to be sure that it is compatible with the outlet to be used. All units are factory preset for operation from 180–250 V_{AC}.

b) Verify that the interlock feature has been enabled. Pins 1 and 2 of the OUTPUT connector must be shorted before the unit will allow the output current to flow to the laser diode.

c) In Model 500AN Series drivers, connect the Analog Interface to a computer and change the ANALOG INTERFACE switch to the REMOTE position.

d) Turn the unit on and allow it to warm up.

e) Select RANGE of operation.

f) Set the LIMIT set point via the recessed limit set screw on the front panel.

g) Connect the laser diode and photodiode as described in Sections 3.2–3.4.

h) Adjust the PD BIAS voltage to the photodiode.

i) Select either CURRENT or POWER mode.

j) Select PRESET display mode and set output current or monitor photodiode (optical power) level using the front panel control knob.

k) Enable KEYSWITCH, push OUTPUT on Switch, then toggle front panel display to the appropriate readout.

NOTE: Newport Corporation is not in any way responsible for any damage to any device used in conjunction with the Model 500 Series products.

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Section 4
Factory Service

4.1 Introduction

This section contains information regarding obtaining factory service for the Model 500 Laser Diode Driver. The user should not attempt any maintenance or service of this instrument and should contact Newport Corporation or a Newport representative for assistance.

The Model 500 Series Laser Diode Driver contains no user serviceable parts. Its calibration accuracy is warranted for a period of 1 year. After 1 year, the unit should be returned to Newport Corporation for recalibration.

4.2 Obtaining Service

To obtain information concerning factory service, contact Newport Corporation or your Newport representative. Please have the following information available:

1. Instrument model number (On front panel)
2. Instrument serial number (On bottom of unit)
3. Description of the problem.

If the instrument is to be returned to Newport Corporation, you will be given a Return Number, which you should reference in your shipping documents.

Please fill out the service form, located on the following page, and have the information ready when contacting Newport Corporation. Return the completed service form with the instrument.

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Service Form

Newport Corporation
U.S.A. Office: 949/863-3144
FAX: 949/253-1800

Name _____ RETURN AUTHORIZATION # _____

Company _____ (Please obtain prior to return of item)

Address _____

Country _____ Date _____

P.O. Number _____ Phone Number _____

Item(s) Being Returned:

Model # _____ Serial # _____

Description _____

Reason for return of goods (please list any specific problems) _____

_____

List all control settings and describe problem _____

_____

_____

_____(Attach additional sheets as necessary).

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not).

Where is the Instrument Being Used?

(factory, controlled laboratory, out-of-doors, etc.) _____

What power line voltage is used? _____ Variation? _____

Frequency? _____ Ambient Temperature? _____

Variation? _____ °F. Rel. Humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe below).

_____

_____

_____

_____

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