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Model 6000

Laser Diode Controller

Key Features

- *Comprehensive laser diode protection features*
- *Advanced 16-bit control technology*
- *Complete laser diode characterization (L,V,I)*
- *Complete TE cooler characterization (I_{TE}, V_{TE}) and sensor*
- *Intuitive front panel controls*
- *Standard GPIB/IEEE-488.2 and RS-232C interfaces*
- *LabVIEW drivers are provided*
- *Integrated 32 W temperature controller*
- *Modular concept accepts various laser diode drivers*



The **Model 6000 Laser Diode Controller** follows in the footsteps of the Model 8000 Modular Controller providing flexible solutions to a variety of laser diode control applications. It has an integral 32 W temperature controller and one bay that accepts a variety of laser diode driver modules.

A LCD supertwist, 4-line display provides crisp viewing of the complete system setup and status. Ease of operation results from on-screen instructions and simplified front panel controls. Multiple system configurations are easily stored and retrieved allowing you to quickly configure and perform different test and control functions for various applications.

Unsurpassed resolution and accuracy resulting from advanced 16-bit technology gives you ultimate control of your laser diodes. As with all Newport laser diode drivers a complete set of safety features protects your laser diode. These features include special transient detection and filtering circuits, intermittent contact protection, an independent current limit and power limit feature, and a slow turn-on sequence. All these provide the superior protection you expect from your laser diode instrumentation.

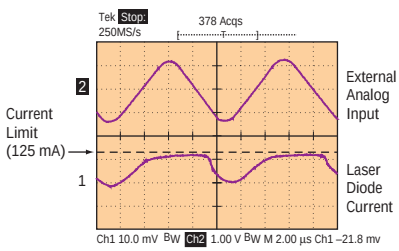
GPIB/IEEE-488.2 and RS-232C interfaces are included with the Model 6000 giving complete remote control capability. All control and measurement functions are accessible and the command set is the most comprehensive found on the market today. LabVIEW drivers are supplied free of charge with all Model 6000 Laser Diode Controllers.

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Laser Diode Driver Modules

Advanced circuit designs and careful layout of the **6500 Series** modules result in an extremely low noise, highly stable output current source. This coupled with a low bandwidth mode, results in the lowest noise output of any modular laser diode system. Output currents range from below 500 mA up to 6 A.

The LDD modules are designed for use in communication applications and have an internal function generator for testing systems. The user only needs to program the frequency, I_{max}, and I_{min} to modulate the laser diode output. Both sinewave or squarewave (50% duty cycle) waveforms are available from 200 Hz–300 kHz. This range of



Limiting circuitry unconditionally prevents laser diode current from exceeding limit setting independent of operating mode even during external analog modulation.

frequencies meets today's low frequency singletone and high data rate test requirements for datacom and telecom.

An external analog modulation input allows precision control of the laser output for a variety of applications. Modulation is available in both constant current (ACC) and constant power (APC) modes.

A monitor photodiode may be zero biased for CW low noise applications or reversed biased up to 5 V for high frequency modulation.

All laser diode parameters are accessible with 16-bit resolution including the laser diode's forward voltage. Full characterization of laser diode parameters is available with every current source module offered with the Model 6000 mainframe.

Temperature Controller

A 32 W **Temperature Controller** is built into the Model 6000 mainframe to meet all your TE cooling requirements. Three operating modes are available:

a. constant temperature,

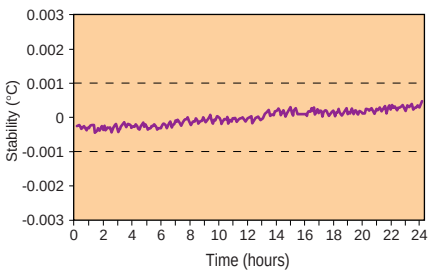
b. constant resistance (thermistor and RTD), LM335 voltage, or AD590/92 current,

c. constant TE Current.

Short-term stability is better than 0.0005°C while long-term stability is better than 0.001°C.

Measurement of the TE cooler (I_{TE}, V_{TE}) as well as the sensor output makes the Model 6000 ideal for completely characterizing telecom laser diodes.

The temperature controller can be linked to the LDD module so that if the laser diode temperature exceeds a user-defined operating range, the output of the LDD turns off and an error message is displayed. Both T_{HI} and T_{LO} are set when configuring the temperature controller.



Newport's temperature controllers have unparalleled long-term stability of better than 0.001°C.



Model 6560A Laser Diode Driver Module

LDD Module Specifications

	6505	6510	6530	6560A
Laser Output				
Output Current Range (mA)	0–500	0–1000	0–3000	0–6000
Output Current Resolution (mA)	0.0076	0.0153	0.0458	0.0916
Output Current Accuracy[1]	±(0.03% + 15 µA)	±(0.03% + 30 µA)	±(0.03% + 90 µA)	±(0.03% + 180 µA)
Compliance Voltage (V)	7	5	5	5
Temperature Coefficient (ppm FS/°C)	<50			
Short-Term Stability (1 h) (ppm FS)	<10			
Long-Term Stability (24 h) (ppm FS)	<50			
Noise/Ripple (rms) (µA)[2]				
Hi BW	<8.0	<10	<15	<25
Lo BW	<4.0	<8.0	<10	<25
Current Limit				
Range (mA)	0–500	0–1000	0–3000	0–6000
Resolution (mA)	1			
Accuracy (mA)	±2	±2	±4	±6
Internal Function Generator				
Waveforms	Sinewave, Squarewave			
Frequency Range[3]	200 Hz–300 kHz			
Squarewave Duty Cycle	50 ±5%			
Independent Output Set Points	I_{max}, I_{min}			
Analog Modulation				
Input Range, Input Impedance	0–10 V, 10 kΩ			
Transfer Function (mA/V)	50	100	300	600
Bandwidth (3dB ±10%), Hi (APC mode only) (kHz)	DC to 350	DC to 250	DC to 100	DC to 100
Bandwidth (3dB ±10%), Lo (APC mode) (kHz)	DC to 10			
Bandwidth (3dB ±10%) (APC mode) (Hz)	DC to 20			
Photodiode Input				
Monitor Current Range (mA)	0–5	0–5	0–20	0–20
Monitor Current Stability (24 h)	±0.02% FS			
Monitor Current Accuracy[1]	±(0.004% + 0.5 µA)	±(0.004% + 0.5 µA)	±(0.004% + 1 µA)	±(0.004% + 1 µA)
Temperature Coefficient	<0.02% FS/°C			
Photodiode Reverse Bias	0–5 V ±10%			
Measurement Display				
Output Current Range (mA)	0–500.00	0–1000.0	0–3000.0	0–6000.0
Output Current Resolution (mA)	0.01	0.1	0.1	0.1
Output Current Accuracy[1]	±(0.02% + 20 µA)	±(0.02% + 200 µA)	±(0.02% + 200 µA)	±(0.02% + 200 µA)
Forward Voltage Range (V)	0.000–7.000	0.000–5.000	0.000–5.000	0.000–5.000
Forward Voltage Resolution (mV)	1			
Forward Voltage Accuracy[1]	±(0.005% + 1 mV)			
Photodiode Current Range (µA)	5–5000	5–5000	15–20,000	15–20,000
Photodiode Current Resolution (µA)	0.1			
Photodiode Current Accuracy[1]	±(0.01% + 0.5 µA)	±(0.01% + 0.5 µA)	±(0.01% + 1 µA)	±(0.01% + 1 µA)
PD Response Range (µA/mW)	0.00–600.00			
PD Response Resolution (µA/mW)	0.01			
Optical Power Range (mW)	0.00–500.00	0.00–1000.00	0.00–3000.00	0.00–6000.00
Optical Power Resolution (mW)	0.01	0.1	0.1	0.1

1) ± (x% Reading + Fixed Error)
2) True rms, 3 Hz–300 kHz, 1/2 FS, resistive load
3) Output current may begin to roll-off at higher frequencies

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Mainframe Specifications

TEC Output	
Type	Bipolar, Low Noise
Maximum Current (A)	4
Compliance Voltage (V)	>8
Typical Power (W)	32
I_{TE} Current Resolution (mA)	0.122
I_{TE} Current Accuracy[3]	±(0.02% + 4 mA)
Current Limit	
Range (A)	0–4
Accuracy (mA)	±20
Ripple/Noise (rms) (mA)	<1
Short-Term Stability (1 h)	<0.0005°C
Long-Term Stability (24 h)	<0.001°C
Temperature Coefficient	<0.05°C/°C
TEC Measurement Display	
Temperature	-100.00 to +240.00 °C
Resistance (10 µA) (kΩ)	0.01–495
Resistance (100 µA) (kΩ)	0.001–49.5
Range Resistance (RTD) (kΩ)	20–192
TE Current (A)	-4.000 to +4.000
Range AD590 Current (µA)	248–378
Range LM335 Voltage (mV)	2331–3731
Range TE Voltage (V)	0.0–8.0
Temperature	0.01°C
Resistance (10 µA) (Ω)	10
Resistance (100 µA) (Ω)	1
Resolution Resistance (RTD) (Ω)	0.01
TE Current (mA)	1
Resolution AD590 Current (µA)	0.01
Resolution LM335 Voltage (mV)	0.1
Resolution TE Voltage (V)	0.1
Temperature[4]	Typical ±0.1°C
Resistance (10 µA)[3]	±(0.04% + 16Ω)
Resistance (100 µA)[3]	±(0.05% + 8Ω)
Accuracy Resistance (RTD)[3]	±(0.03% + 50 mΩ)
TE Current[3]	±(0.09% + 2 mA)
Accuracy AD590 Current[3]	±(0.005% +0.5 µA)
Accuracy LM335 Voltage[3]	±(0.09% + 1 mV)
Accuracy TE Voltage[3]	±(0.005% +100 mV)

Mainframe Temperature Controller Specifications

Temperature Sensors	Thermistor (NTC 2-wire)	AD590	LM335	RTD (100Ω)[1]
Temp. Sensor Control Resolution	0.01°C			
Temp. Sensor Control Accuracy	±0.05°C[2]	±0.05°C	±0.05°C	±0.05°C
Sensor Bias	10/100 µA	+5 V	1 mA	1 mA
Temperature Computation and Calibration				
Thermistor (NTC 2-wire)	$1/T = (C1 \times 10^{-3}) + (C2 \times 10^{-4})(\ln R) + (C3 \times 10^{-7})(\ln R)^3$			
AD590	$T = C1 + C2 \times (I_{AD590}/1\ \mu A/K - 273.15)$			
LM335	$T = C1 + C2 \times (V_{LM335}/10\ mV/K - 273.15)$			
RTD (100Ω)	$R_T = Ro\ [1 + C1T + C2T^2]$; T ≥0°C, Ro = resistance at 0°C where Ro = 100Ω for a 100Ω Pt RTD. $R_T = Ro\ [1 + C1T + C2T^2 + C3T^3(T - 100)]$; T < 0°C			

1) Accuracy is with lead wire resistance calibrated out
2) Thermistor accuracy will degrade at temperatures above 25°C
3) ± (x% Reading + Fixed Error)
4) Temperature is a value derived from the sensor's parameter (resistance, voltage or current) using the above temperature computation equations. Accuracy can be computed by applying the sensor's parameter to the above equations at the temperature in question.

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Specifications

Display Type	4-line by 20 character alphanumerical
Display Backlighting	Green LED
Display Controls	Brightness, contrast
Laser Diode On Indicator	Green LASER ACTIVE LED indicates at least one laser diode is on
Output Connectors TEC	15-pin female D-sub
Output Connectors LDD	9-pin female D-sub, BNC (external modulation), BNC (auxiliary photodiode input)
Chassis Ground	4 mm banana jack
GPIB	24-pin IEEE-488
RS-232C	9-pin male D-sub
Power Requirements	90–132 V (max. 2.25 A), 198–250 V (max. 1.0 A), 50–60 Hz
Size [in. (mm)]	3.5 (86) x 14 (356) x 14 (356)
Mainframe Weight [lb (kg)]	21 (9.5)
Module Weight [lb (kg)]	2.5 (1.1) typical
Operating Temperature	0°C to 40°C (<70% relative humidity non-condensing)
Storage Temperature	-20°C to + 60°C (<90% relative humidity non-condensing)
Laser Safety Features	Laser enable keyswitch, interlock, output delay (meets CDRH US21 CFR 1040.10)
Isolation/Crosstalk	All modules electrically isolated with respect to each other and from earth ground

Ordering Information

Model	Description	Option Code
6000 Series	Laser Diode Controller Mainframe (includes 4A/8V Temperature Controller)	
Model 6000 Laser Diode Driver (LDD) Modules		
6505	LDD Module (500 mA)	11
6510	LDD Module (1000 mA)	12
6530	LDD Module (3000 mA)	13
6560A	LDD Module (6000 mA)	14
Accessories		
300-02[1]	Temperature Controller Cable	
300-04[1]	TEC/Mount Cable	
300-16	10.0 kΩ Thermistor (±0.2°C)	
300-22	AD592CN IC Sensor (-45°C to +125°C Range)	
500-02[1]	Laser Diode Driver Cable	
500-04[1]	LDD/Mount Cable	
LD1-RACK	Rack Mount Kit, Single	

1) Please see page 64 for cable diagrams.

Ordering Instructions

When ordering your customized system configuration, specify the following Model number:

6000-OPT-☐☐

Indicate the Option Code number for the specific module you would like us to install in the Model 6000 bay.

Example: 6000-OPT-11

Model 6000 Laser Diode Controller with Model 6505, 500 mA LDD Module.

Related Products

Newport offers a full line of Temperature-Controlled and Telecommunication laser diode mounts for use with the Model 6000 Temperature Controller and Laser Diode Driver Modules.



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