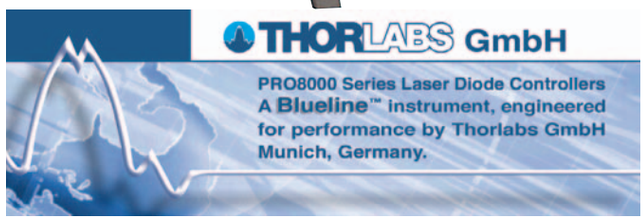
ELECTRONICS 3-364-373.qxd 8/28/03 4:14 PM Page 364

laser controllers, modular chassis... page 1 of 2

High Level Macro Functions for Fast Acquisition of P/I Curves.



Introduction - PRO8000 Series Laser Controllers

The modular design of the PRO8000 series provides a flexible solution to meet many laser diode control requirements. By choosing the appropriate single or multi-channel current and temperature control modules, suitable multi-channel laser diode controllers can be configured to meet the demands of almost any application.

Whether operating a Vertical-Cavity Surface-Emitting Laser (VCSEL) which requires just a few milliamps, or a high power laser diode requiring 8A, the PRO8000 can be configured to meet the needs.

In addition, if an application requires powering just one laser, or hundreds of lasers, the PRO-Series is an appropriate choice. Thorlabs offers the PRO800 that supports two plug-in modules. Or, for the large scale users, we offer single modules that can simultaneously drive eight (8) laser diodes. Populate a PRO8000 with eight (8) of these modules to build a high density 64 channel laser control system, all in a single 19" chassis.

The standard PRO8000 can supply up to 16A; for applications requiring more than 16A, we offer the PRO8000-4, which can supply up to 32A. A wide variety of modules are available for the PRO8000 series, see the insert below for a summary of the compatible modules.

PRO8000 Compatible Modules

Laser Diode Controllers	100mA to 8A
Temperature Controllers	2A to 8A
Combination LD & TEC Controllers	1A Laser / 2A TEC
Multi-Channel Laser Diode Controllers	5mA to 200mA
Optical Switches	1x2, 2x2, 1x4, & 1x8
Photodiode Amplifier	10nA to 10mA
DFB Laser Sources CWDM/WDM	ITU Precision Sources

User-Friendly Controls

The PRO8000 series chassis offer a user-friendly menu driven platform from which a selection of various modules can be driven. For the research laboratory, a 2-slot chassis is available. For optical-telecom as well as other industrial applications, we offer an 8-slot system. Configuring a system is as simple as plugging in the modules; each of the plug-ins are automatically identified upon power-up of the chassis. A brightly lit 4 x 20 fluorescence display allows the user to scroll through and select any of the installed modules. When selected on the display, all control parameters of the individual module are accessible. The controls for a particular module can be set and enabled before scrolling to the next module.

PRO8000 Series Highlights

- Modular controllers with a bright 4 x 20 characters vacuum-fluorescence display.
- Universal platform,interchangeable modules include Laser Diode Controllers, TEC Controllers, WDM Sources and Optical Switches.
- Current modules from 100mA up to 8A (16 bit), temperature modules up to 8A/64W (16 bit), "combi" modules up to 1A current plus 2A/16W temperature.
- Control 8 Lasers from one module, VCSEL, Fabry-Perot, or DFB. Combine 8 modules in one chassis for 64 lasers from a single chassis.
- Ideal Burn-In, and Test Station.
- Macro functions for extremely fast acquisition of P/I curves.
- Fast IEEE 488.2 & RS-232C interfaces.
- Instrument drivers for LabVIEW™ & LabWindows™ CVI free of charge.

Module Interchangeability

All modules can be driven in the compact PRO800 as well as the PRO8000, and PRO8000-4 full size 19" units. Aside from the size difference on the PRO800, and the heavy duty power supply of the PRO8000-4, all the chassis utilize the same operating system and protocols. All chassis models can power any of the plug-in modules that are found in this section as well as our extensive selection of DFB laser modules found on pages 474-475.

Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

ELECTRONICS 3-364-373.qxd 8/28/03 10:48 PM Page 365

PRO800 Bench Top Chassis

The smaller PRO800 chassis offers a menu driven, flexible platform, that supports a multitude of electrical and optical modules to address a wide variety of applications.
This chassis is a bench top system that supports two (2) modules. It is ideal for the lab environment or as a bench top system in crowded manufacturing environments.

This bench top chassis has all the same features as the larger eight slot chassis.

All PRO8000 series controllers are equipped with IEEE 488.2 and RS-232C interfaces as standard features. Each system is delivered with LabVIEW™ and LabWindows™/CVI drivers to support the individual modules, as well as their integration into a comprehensive test and measurement system.

Easy operation

All modules are self-identifying and are operated via menu-driven softkeys, the analog values are set with a rotary knob on the front panel. All values are shown on a 4 x 20 character alphanumeric vacuum fluorescence display. The functions of the softkeys change in accordance with the activated module. A key-operated power switch protects the PRO8000 series against unauthorized use.

Additional Light Source Modules for the PRO8000 series:

- FP & DFB laser sources, page 396.
- DWDM laser sources in the S, C & L-band, page 394.
- Optical switch modules, page 398.

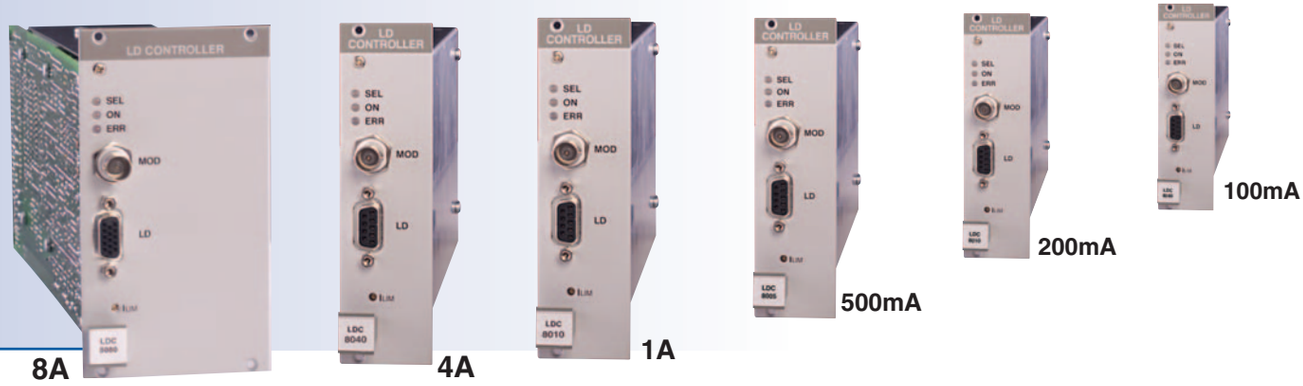
PRO8000 Series Specifications

	PRO800	PRO8000	PRO8000-4
Slots	2	8	8
Maximum Output Current for all modules	8A	16A	32A
Maximum Power Consumption	220VA	500VA	640VA
Display	Alphanumeric Display with 4 x 20 Characters		
Operation	Menu-Driven		
Setting	Function Keys and Rotary Knob		
Protection features	Key-Operated Power Switch		
TTL Modulation Frequency range[1]	DC to 10kHz		
TTL Duty cycle[1]	Selectable		
TTL Modulation Input	BNC		
TTL Trigger Output	BNC		
IEEE 488.2 Interface	24-pin IEEE Jack (Rear Panel)		
RS-232C Interface	9-pin D-sub Plug (Rear Panel)		
Chassis Ground	4mm Banana (Rear Panel)		
Line Voltage	100V, 115V and 230V AC		
Line frequency	50 to 60Hz		
Operating temperature	0 to + 40°C		
Storage temperature	– 40°C to + 70°C		
Relative Humidity	< 90%		
Dimensions (Chassis Only)	232 x 133 x 386mm^3	449 x 133 x 386mm^3	449 x 177 x 456mm^3
Weight (Chassis Only)	7kg	12kg	16kg

[1] external synchronous current modulation for all cards in the chassis

ITEM#	$	£	€	¥	DESCRIPTION
PRO800	$2,587.50	£1,575.00	€2.250,00	¥360,000	2 slot modular bench top chassis
PRO8000	$2,875.00	£1,750.00	€2.500,00	¥400,000	8 slot modular rack chassis
PRO8000-4	$3,737.50	£2,275.00	€3.250,00	¥520,000	8 slot high power modular rack chassis
PRO8000-R32	$ 103.50	£ 63.00	€ 90,00	¥ 14,400	19 inch mounting kit for PRO8000, PAT9000B
PRO8000-R42	$ 138.00	£ 84.00	€ 120,00	¥ 19,200	19 inch mounting kit for PRO8000-4
PRO8000-C	$ 23.00	£ 14.00	€ 20,00	¥ 3,200	PRO8000 front cover plate

laser controller modules... page 1 of 2



Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

Introduction - Laser Diode Controller Modules

The modular laser diode current controllers of the LDC8000 series provide “best in class” performance. All of these current control modules have extremely low noise and drift performance, resulting in exceptional laser stability.

Highlights LDC8000 Modules

- 100mA, 200mA, 500mA, 1A, 4A and 8A Modules.
- Ultra-stable Current Control with 16-bit Resolution.
- Extensive Laser Diode Protection Features.
- Photodiode Bias Provides Improved Sensor Linearity.
- Easily Configured Self-Identifying Modules.
- External Modulation of Laser Output.
- Companion Temperature Control Modules, page 370

Six Current Ranges

Six different current controller modules are available, with maximum output currents ranging from 100mA up to 8A. The drive current can be set precisely with 16 bit resolution - one part in 65,000. All current modules can be operated in either constant current, or constant power mode.

User-Friendly Controls

After installing a new module into the PRO8000 chassis, the front panel control screen is used to configure the plug-in. The soft-keys are used to scroll through the slot location to access the basic settings. The operational settings are easily accessed; displayed mneumonic symbols and simple prompts provide for user-friendly operation. All the settings are retained in memory and automatically recalled upon powering the mainframe.

Built-in Laser Diode Protection Features

The LDC8000 series current modules incorporate proven laser protection features to safeguard sensitive laser diodes. Besides common protection functions, such as current limits, soft start and interrupt protection, an advanced circuit design ensures that AC power-line transients or power outage, as well as RF pickup can not affect the laser diode.

For each current module, three independent limits can be set to safeguard the laser. Two of the limits are programmable, which prevent the laser current and the laser power from exceeding the user defined maximum values.

The third limit is set via a recessed front panel trim-pot that sets a “hard” current limit and protects against programming errors and accidental adjustment of the front panel knob. Even while externally modulating the laser it is not possible to exceed either the hard or soft limits.

After activating the laser diode a soft-start function slowly increases the laser current without voltage overshoots.

LDC8000 Series Protection Features

- Soft Start Slowly Increases Laser Drive Current.
- 3 Independent Current Limits.
- Hard Current Limit, Front Panel Trim-Pot.
- Software Current Limits, Power & Current.
- Meets Applicable CDHR & CE Regulations.
- Temperature Threshold Window Protection.
- Extensive AC Power Filtering Eliminates Transients.

Even in the case of an AC power interruption, the laser current remains transient-free. Voltage peaks on the AC line are effectively suppressed by electronic filters, shielding of the transformer, and careful grounding of the modules and chassis. Our laser diode controllers have all been designed by an engineering team that has a 15 year history of building the high quality, user-friendly instruments. The LDC8000 series meets the international requirements regarding laser protection (e.g. CDRH US21 CFR 1040.10), all models include a key-operated power switch, an interlock, and a delay of the output current, plus many additional features.

Design Note LDC8000 Modules

Our controller design can accommodate all the various laser/photodiode pin configurations, while driving the laser with respect to ground. This ensures maximum protection for the laser diode. This approach offers considerable advantages in comparison with floating operation. By having the drive current tied to ground prevents electro-static disturbances from effecting the laser current.

External Modulation of Laser Output

An analog control input enables the modulation of the laser diode in constant current or constant power mode. The maximum modulation frequency depends on the current module used, see the specifications table on the next page.

ELECTRONICS 3-364-373.qxd 8/28/03 10:51 PM Page 367

Laser Diode Controllers Specifications

... Drive up to 64 Lasers from 1 Chassis, See the Next Page

Specifications	LDC8001	LDC8002	LDC8005	LDC8010	LDC8040	LDC8080
Current control Control range (continuous)	0 to ± 100mA	0 to ± 200mA	0 to ± 500mA	0 to ± 1A	0 to ± 4A	0 to ± 8A
Compliance voltage	> 2.5V	> 5 V				
Resolution	1.5µA	3µA	7.5µA	15µA	70µA	130µA
Accuracy (full scale)	± 0.05 %			± 0.1 %		± 0.3 %
Noise without ripple (10Hz to 10MHz, rms, typ.)	< 1µA	< 3µA	< 5µA	< 10µA	< 50µA	< 100µA
Ripple (50/60Hz, rms, typ.)	< 0.8µA	< 1µA	< 1µA	< 1.5µA	< 4µA	<8µA
Transients (processor, typ.)	< 10µA	< 15µA	< 30µA	< 50µA	< 120µA	< 200µA
Transients (other, typ.)	< 100µA	< 200µA	< 500µA	< 1mA	< 4mA	< 8mA
Drift 30 min / 24 h (typ.,0-10Hz, at constant ambient temperature)	< 5µA / <1.5µA		< 1µA / < 2µA	< 2µA / < 5MA	< 25µA / < 200µA	< 100µA / < 400µA
Temperature coefficient	<50ppm/°C					
Power control Control range of photo current	10µA to 5mA (Other Ranges Available)					
Reverse bias voltage	5V (can be switched off)					
Resolution	100nA					
Accuracy (full scale)	± 0.05 %					
Current limit Setting range (20-turn trim-pot)	0 to ≥100mA	0 to ≥ 200mA	0 to ≥ 500 mA	0 to ≥ 1A	0 to ≥ 4A	0 to ≥ 8A
Resolution	3µA	6µA	15µA	30µA	130µA	250µA
Accuracy	± 100µA	± 200µA	± 500µA	±2mA	± 8mA	± 50mA
Power limit Setting range of photo current limit	0 to 5mA					
Resolution	1.25µA					
Accuracy	>50µA					
Laser-voltage measurement Measurement principle	4-wire					
Measurement range	0 to 5V					
Resolution	0.2mV					
Accuracy	± 5mV					
Analog Modulation Input Input resistance	10kΩ					
3 dB-bandwidth, CC	DC to 2.5kHz	DC to 200kHz	DC to 100kHz	DC to 50kHz	DC to 20kHz	DC to 10kHz
Modulation coefficient, CC	10mA/V±5 %	20mA/V±5 %	50mA/V±5 %	100mA/V±5 %	400mA/V±5 %	800mA/V±5 %
Modulation coefficient, CP	0.5 mA/V ± 5 %					
Rise & fall time, typical	< 100µs	< 2µs	< 4µs	< 5µs	< 9µs	< 15µs
General data Card width	1 slot					2 slots
Connector	9-pin D-Sub (f)					15-pin HD D-Sub (f)
Weight	< 300g		< 500g			< 750g
Operating temperature	0 to +40 °C					
Storage temperature	– 40 to +70 °C					

The technical data are valid at 23 ± 5°C and 45 ±15% relative humidity

ITEM#	$	£	€	¥	DESCRIPTION
LDC8001	$1,092.50	£665.00	€ 950,00	¥152,000	PRO8000 LD control module, 100mA
LDC8002	$1,035.00	£630.00	€ 900,00	¥144,000	PRO8000 LD control module, 200mA
LDC8005	$1,058.00	£644.00	€ 920,00	¥147,200	PRO8000 LD control module, 500mA
LDC8010	$1,115.50	£679.00	€ 970,00	¥155,200	PRO8000 LD control module, 1A
LDC8040	$1,358.50	£833.00	€1.190,00	¥190,400	PRO8000 LD control module, 4A
LDC8080	$1,610.00	£980.00	€1.400,00	¥224,000	PRO8000 LD control module, 8A, 2 slots

Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

ELECTRONICS 3-364-373.qxd 8/28/03 10:45 PM Page 368

high density laser controllers, 8 per module... page 1 of 2

Introduction - MLC8000 Series Multi-Laser Controllers

The MLC8000 series laser diode controllers are designed to control up to eight lasers from a single module. When fully populated, a PRO8000 chassis can simultaneously power up to 64 laser diodes.

Highlights MLC8000 Modules

- Drive 8 Lasers from a Single Module & 64 Lasers from a Single MLC Chassis
- Ranges: 5mA, 10mA, 25mA, 50mA, 100mA, & 200mA
- Ultra-stable Current Control with 12-bit Resolution.
- Extensive Laser Diode Protection Features.
- Photodiode Bias Provides Improved Sensor Linearity.
- Easily Configured Self-identifying Modules.

Designed to support high density laser diode test and burn-in, this series provides eight different maximum drive current ranges. The PRO8000 chassis can support up to a total of 16A of laser diode drive current - the sum of the output drive currents from all the installed cards - and can therefore easily support the demands of driving 64 lasers at 200mA each.

These modules have been field proven in demanding applications for many years. First released in 1998, these instruments have evolved through intensive customer feedback.

Intuitive User-Friendly Controls

Each module provides eight independent outputs in which the laser drive current can be individually set for each output channel. The current range, the current limit and the operating mode (constant current or constant power mode) is set per module; therefore, all eight channels will be operated with the same parameters. The various modules of the MLC series can be mixed and matched, along with modules from other PRO8000 series modules, into any of the three chassis to implement a large variety of systems.

After installing a new module into a PRO8000 chassis, the front panel control screen is used to configure the plug-in. The soft-keys are used to scroll through the slot location to access the settings for the individual modules. The operational parameters are easily accessed using mneumonic symbols and simple prompts provide user-friendly operations. All the settings are retained in memory and automatically recalled upon powering on the mainframe.

The polarity of the laser diodes, either anode or cathode ground, is factory fixed. The eight outputs are switched on together, the current control or power control is independent for each channel.

Built-in Laser Diode Protection

The MLC8000 series modules incorporate proven laser protection features to safeguard sensitive laser diodes. These features include a hardware current limit, a soft start circuit, and an interrupt sensing circuit that can detect a break in the connectors going to the laser diode, and then shut the laser down. Additionally, extensive precautions have been taken to protect the laser diodes during AC power interruptions or outage.

User-Friendly Controls

Configuring a system is as simple as plugging in the modules; each plug-in is automatically identified. A brightly lit 4 x 20 character fluorescence display allows the user to scroll through to select any of the installed modules. When selected, the control parameters can be quickly changed.

The current limit - or power limit, when operating in “constant power mode” - is accessed via a front panel trim-pot. For this industrial driver, the current limit is intentionally adjusted only through the use of this trim-pot to prevent the risk of accidental adjustment. All 8 output channel current limits for an individual card are set in common.

After activating the laser power, a soft-start function slowly increases the laser current, preventing overshoots.

Design Note MLC8000 Modules

The MLC8000 controllers are divided into two groups, one for grounded laser cathodes, and one for grounded anodes - the photodiode polarity can be software selected. Under all conditions, the laser diode is driven with respect to ground, ensuring maximum protection for the laser diode.

Even in the case of an AC power interruption, the laser current remains transient-free. Voltage peaks on the AC line are effectively suppressed by electronic filters, shielding of the transformer, and careful grounding of the modules and chassis. The MLC8000 series meets the international requirements regarding laser protection (e.g. CDRH US21 CFR 1040.10). All models include a key-operated power switch, an interlock, and a delay of the output current, plus many additional features.

Burn-In System Applications

The MLC8000 series modules have been designed for burn-in applications. The high density (64 lasers / chassis) drive capability coupled with the user-friendly advanced control features of the PRO8000 mainframe make this product line an ideal choice for this application.

Our application support engineers are available to work with our customers to ensure appropriate system configurations. Please contact any of the Thorlabs offices listed on the back

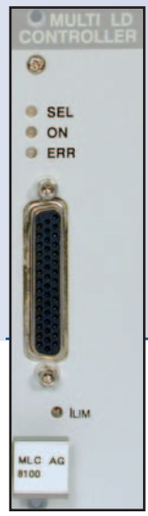
Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

ELECTRONICS 3-364-373.qxd 8/29/03 9:17 AM Page 369

Burn-In Station: Pictured System Powers 512 Lasers

The MLC 8000 Series modules are designed to simultaneously supply drive current to eight laser diodes per module. Therefore, up to 64 laser diodes can be operated by one PRO 8000 chassis.

Utilize the IEEE-488 interface to add PRO8000 chassis to expand and create an automated a test station. High level software macros speed the process of developing automated burn-in, and final test routines.



Specifications

Laser Diode Controllers	MLC8025-8	MLC8050-8	MLC8100-8	MLC8200-8
Current control Control ranges switchable (8X)	0 to ± 5mA 0 to ± 25mA	0 to ± 10mA 0 to ± 50mA	0 to ± 25mA 0 to ± 100mA	0 to ± 50mA 0 to ± 200mA
Laser diode polarity	Fixed, either anode ground (AG) or cathode ground (CG)			
Compliance voltage	> 4 V			
Accuracy	±15µA / ±75µA	±30µA / ±150µA	±75µA / ±300µA	±150µA / ±600µA
Resolution	1.2µA / 6µA	2.5µA /12µA	6µA / 25µA	12µA / 50µA
Noise without ripple (10Hz to 10MHz), typ.	< 0.5µA / < 0.5µA		0.5µA / < 1µA	< 0.5µA /< 1.5µA
Ripple (50/60Hz, rms), typ.	< 0.5µA / < 0.5µA		< 0.5µA / < 1µA	
Transients (other, typ.)	< 25µA	< 50µA	< 100µA	< 200µA
Drift (30 min, 0 to 10Hz), typ.	< 0.3µA / < 1µA	< 0.5µA /< 1.5µA	< 1µA /< 3µA	< 1.5µA / < 5µA
Temperature coefficient	< 50ppm / °C			
Power control Control range of photo current	5µA to 2mA			
Accuracy	± 6µA			
Resolution photo current	0.5µA			
Reverse bias voltage	0V / 5V			
Current limit Setting range (20-turn pot)	0 to 5mA / 0 to 25mA	0 to 10mA / 0 to 50mA	0 to 25mA / 0 to 100mA	0 to 50mA / 0 to 200mA
Resolution	1.2µA / 6µA	2.5µA /12µA	6µA / 25µA	12µA / 50µA
Accuracy	± 50µA/ ±125µA	± 100µA / ±250µA	± 0.25mA /± 0.5mA	± 0.5mA / ±1mA
General data Connector	44-pin HD D-Sub (f) (for laser diode, photodiode and general interlocks etc.)			
Card width	1 slot			
Weight	< 500g			
Operating temperature	0 to +40 °C			
Storage temperature	–40 to +70 °C			

The technical data are valid at 23 ± 5°C and 45 ±15% relative humidity

AG: Laser Anode Grounded
CG: Laser Cathode Grounded

ITEM#	$	£	€	¥	DESCRIPTION
MLC8025-8AG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 25mA, AG
MLC8025-8CG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 25mA, CG
MLC8050-8AG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 50mA, AG
MLC8050-8CG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 50mA, CG
MLC8100-8AG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 100mA, AG
MLC8100-8CG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 100mA, CG
MLC8200-8AG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 200mA, AG
MLC8200-8CG	$1,667.50	£1,015.00	€1.450,00	¥232,000	PRO 8000 multi channel LD controller, 200mA, CG

TED series temperature control cards

The PRO800, chassis accepts two 8000 series modules. Use our LDC8000 and our TED8000 series modules to set up a space saving laser current & temperature controller…

Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

Introduction - TED8000 Series Temperature Controllers

A wide range of thermo-electric temperature control modules are available from ± 2A/16W to ± 8A/64W, with 16 bit resolution. The TED8000 series modules provide excellent temperature stabilization, typically ±0.001°C when using an AD590 thermal sensor, for optimal laser operation and other applications requiring precise thermal control. In general, this facilitates highly stable operation of temperature sensitive components; one example is optical nonlinear birefringent crystal experiments, where phase matching requires sensitive control of the crystal's temperature.

Separate adjustment of the P, I and D settings of the PID servo loop, enable optimal settling times for different thermal loads. If the TED8000 module is used with a laser diode control module in the same chassis, the temperature window protection feature switches the laser diode current off if the temperature of the laser departs from a preset temperature window (high and low thresholds).

The TED8000 series of temperature controllers operate within our PRO8000 series mainframe, and are ideal companions to our LDC8000 laser diode current controller modules shown on page 366.

High Power Laser Systems

With up to 64 Watts of cooling power, the TED8080 is well matched to our LDC8080 laser diode control module that provides 8A laser drive current (shown on page 371). Laser diodes typically operate at approximately 2 to 3 Volts forward bias voltage. At 8A, this results in an overestimated thermal load of 16W to 24W, assuming 0% lasing efficiency and all the electrical energy is converted to thermal energy.

High Channel Count Laser Systems

When using our eight channel laser controller (MLC8000 series), the TED8080 is an ideal choice to temperature stabilize a large number of lasers mounted on a common cold plate. Consider eight MLC modules, each operating eight lasers at 200mA (maximum for the MLC8080 series). Assuming the lasers are operated at 3V, the maximum total thermal load for the system (assuming 100% of the laser current is converted to thermal energy) is 38.4W. This is well within the 64W capacity of the TED8080.

TEC Safeguards

Damage to the TE cooler is prevented by setting an adjustable TEC current limit. This can either be set via a recessed potentiometer on the module front panel (hardware limit), via the front panel softkeys or one of the standard interfaces (software limit).

When used with our laser diode current controllers, an additional laser diode safety feature can be enabled; a temperature window protection can be activated. If the laser temperature departs from the preset window, the laser current will be switched off immediately. The temperature modules of the TED8000 series meet extremely high standards regarding precision and drift performance and provide a low noise, bipolar output. This enables extremely stable wavelength control and safe thermal load management.

Choice of temperature sensors

The temperature modules of the TED 8000 series can be operated with thermistors, AD590/AD592 IC sensors and LM335 transducers. When operated with a thermistor the thermistor calibration constant can be set so that all applicable settings and displays can be done directly in °C, rather than Ω (ohms).

With the modules of the TED8000PT series a Pt100 temperature sensing element can be operated replacing the IC sensor.

For extremely low temperature applications, such as the operation of a lead-salt lasers, a kryo option is offered for all model temperature modules. As a Pt1000 sensor is used for operating temperatures in the range of 20 to 310K, the controller is modified to control a heating element.

Adjustable PID control loop

The P-, I- and D- settings of the temperature control loop can be set via menu-driven softkeys or via one of the remote interfaces. This ensures fast laser temperature settling times. Combination laser current / temperature control modules are also available (ITC8000 series, see page 372 for details). Cable CAB420-15 is delivered with each of the TED8000 modules to connect them with any of our laser diode mounts.

TED8000 Series Temperature Control

	TED8020	TED8040	TED8080
Type of controller	PID with Adjustable Share		
P/I/D-Share	12 bit Control Range		
Card Width	1 slot	1 slot	2 slots
Connector	15-pin D-sub (f)		
Weight	< 500g	< 600g	< 700g
Operating temperature	0 to +40 °C		
Storage temperature	–40 to +70 °C		

ELECTRONICS 3-364-373.qxd 8/28/03 10:00 PM Page 371

Other PRO8000 Modules: WDM laser sources with precise wavelength calibration and 1nm tuning. Optical Switches for automated switching within test setups. Optical detectors for precision optical measurements.

TED8000 Series Specifications

	TED8020	TED8040	TED8080
Control Range	–2A to +2A	–4A to +4A	–8A to +8A
Compliance Voltage		> 8V	
Maximum Output Power	16W	32W	64W
Measurement Resolution I_{TEC}	0.07mA	0.15mA	0.3mA
Measurement Accuracy I_{TEC}	± 5mA	± 10mA	± 25mA
Measurement Resolution U_{TEC}		0.3mV	
Measurement Accuracy U_{TEC}		± 20mV	
Noise & Ripple (typ.)	< 1mA	< 2mA	< 4mA
Temperature Sensors: Thermistor			
Control Range		5Ω to 20kΩ Switchable 50Ω to 200kΩ	
Calibration		Exponential Form, Steinhart-Hart	
Resolution		0.3Ω/3Ω	
Accuracy		±2.5Ω/±25Ω	
Stability, typ.		< 0.5Ω/< 5Ω	
Temperature Sensor: IC-sensors (AD590/AD592/LM335)			
Control Range		–12.375 °C to +90 °C	
Calibration		2-point-linearization	
Resolution		0.0015 °C	
Accuracy		±0.1 °C	
Temperature, stability typ.		< 0.001 °C	
Temperature Sensor: Pt100 Platinum			
Control range		–12.375 °C to + 90 °C	
Resolution		0.0015 °C	
Accuracy		±0.3 °C	
Stability typ.		< 0.005 °C	
Temperature Sensor Pt1000 (KRYO)			
Control range		20 to 310K	
Resolution		(20 to 155K) 2mK	
Accuracy		(20 to 155K) ± 2K	
Temperature Stability typ.		(20 to 155K) 0.005K	
TEC current limit			
Setting range (20-turn pot)	0 to ≥ 2A	0 to ≥ 4A	0 to ≥ 8A
Resolution D/A converter	0.5mA	1mA	2mA
Accuracy	±20mA	±40mA	±80mA

The technical data are valid at 23 ± 5°C and 45 ±15% relative humidity

PID Control Systems

A PID control system combines three different control strategies into one feedback loop. The PID refers to how the error signal (difference between where you are and where you want to be) is processed prior to being fed back to the driving element responsible for changing the system. The purely proportional controller simply scales the error signal by some number prior to feeding it back to the drive element. Normally we talk about the gain of a proportional feedback system. With proportional controllers it is often difficult to prevent them from oscillating around a value slightly offset from the desired value. An older household thermostat is typical of a simple proportional controller.

An integrating controller does a summation of the error signal over some time period and then feeds back this integrated error signal to the system driver. An integrating controller is useful for reducing the offset often found in proportional systems. Integrating controllers are often referred to as reset controllers in that they “reset” the gain of the simplified proportional controllers through the integration of the error signal. As implied, the integrating strategy is often combined with proportional strategy to yield a PI servo control loop that is better more likely to approach the desired set point with minimum offset than a simple P system.

A differential controller, typically not found by itself, is useful for its ability to adjust the response of the servo loop in proportion to the rate of change of the error signal. When combined with the PI to form a full PID system it provides a highly adaptable servo loop that offers both a fast settling time as well as an extremely small offset error.

Polarimeter PMD/PDL
Laser/TEC Controllers
Laser Mounts
WDM Sources & Switches
Optical Sources & Switches
Detectors & Power Meters
Laser Lab Instruments
TXP Systems Measurement & Control

ITEM#	$	£	€	¥	DESCRIPTION
TED8020	$1,173.00	£ 714.00	€1.020,00	¥163,200	PRO 8000 TEC Controller, 16W
TED8040	$1,288.00	£ 784.00	€1.120,00	¥179,200	PRO 8000 TEC Controller, 32W
TED8080	$1,564.00	£ 952.00	€1.360,00	¥217,600	PRO 8000 TEC Controller, 64W
TED8020PT	$1,391.50	£1,266.27	€1.530,65	¥236,555	PRO 8000 TEC Controller, 16W, Pt100
TED8040PT	$1,506.50	£1,370.92	€1.657,15	¥256,105	PRO 8000 TEC Controller, 32W, Pt100
TED8080PT	$1,782.50	£1,622.08	€1.960,75	¥303,025	PRO 8000 TEC Controller, 64W, Pt100 2 slots

ELECTRONICS 3-364-373.qxd 8/28/03 4:17 PM Page 372

ITC8000 series combination control modules

"Combi" Controllers, 3 Models
I_{LD} = ±200mA to ±1A
I_{TEC} = ±2A/16W

Combination Current & Temperature Control Modules

The space-saving "combi" modules of the ITC8000 series incorporate in one module a laser current controller and a TEC temperature controller. Three combi models are available. These modules offer laser drive current ranges of 0 to ±200mA, 0 to ±500mA, and 0 to ±1A. All three models incorporate a TEC controller that provides up to ± 2A/16W.

Each combi module comes in two versions, either with a 9-pin connector for laser current output and a 15-pin connector for TEC current output (series ITC8000) or with a common 15-pin connector for both laser and TEC current output (series ITC8000DS15).

All of the ITC8000 modules offer the same exceptional performance as our separate laser controller, and temperature controller modules. All laser diode, and photodiode pin configurations are supported.

This system can easily be configured for controlling eight (8) butterfly lasers. Populate our PRO8000 chassis (page 390) with eight (8) ITC8000 modules and connect it to our LAB8000 8-channel butterfly laser mount with our shielded cables (CAB450). Simply secure the lasers in the ZIF mounts and the system is ready to operate. Such complete turn-key systems can be specified and quoted by our technical sales team, please call for details.

The LAB8000 8-channel laser diode mount is ideally suited to control 8 butterfly lasers in a 19" rack. The convenient slide-out drawer design allows easy access to the laser sockets. For technical specifications on this product please refer to page 381.

Extremely Low Noise

The "combi" controller modules of the ITC8000 series all feature exceptionally low laser current noise (from 2µA to 10µA depending on the model, see table next page), and exceptional temperature stability of better than 0.002°C, when an AD590 temperature sensor is used. The ITC8000 series offers the same great performance independent of the mode of operation - constant current (CC), or constant power (CP).

User-Friendly Controls

After installing a new module into the PRO8000 chassis, the modules can be configured via the front panel softkey controls or via one of the remote computer interfaces. The softkey-keys on the PRO8000 are used to scroll through the slot locations to access all the module settings. Alternatively, the IEEE-488.2 interface also provides convenient access to the controller settings. Once set, all the settings are retained in memory and automatically recalled upon powering up the mainframe.

Built-in Laser Diode Protection Features

The ITC8000 series modules incorporate proven laser protection features to safeguard sensitive laser diodes. Besides common protection functions, such as current limits, laser current soft start, and interrupt protection, an advanced circuit design ensures that AC power-line transients or power outage, as well as RF pickup can not effect the laser diode.

Additionally, a temperature window can be set that will shut the laser down in the event the high or low thresholds of the window are exceeded.

The PRO8000 meets the international requirements regarding laser protection (e.g. CDRH US21 CFR 1040.10). All modules include a key-operated power switch, an interlock, and a delay of the output current, plus many additional features.

Calibrating the Power Display

The display of the laser power can easily be calibrated with respect to the laser's monitor-photodiode current to provide a read out directly in milliwatts. This is accomplished by adjusting the "CALPD" calibration constant that is accessed via the front panel softkeys or the computer interface, please note an optical power meter is required.

Setting the temperature control loop

The P- (gain), D- and I- settings of the PID control loop can each be set independently to optimize the temperature response of the system to different thermal loads.

ITC8000 Series Temperature Sensors

	ITC8022	ITC8052	ITC8102
Thermistor			
Control Range	200Ω to 40 kΩ		
Resolution	0.7Ω		
Accuracy	± 10Ω		
Stability	< 1Ω		
AD590, AD592, & LM335 IC's (No Pt 100 Sensors)			
Control Range	–12.375 °C to + 90 °C		
Resolution	0.0015 °C		
Accuracy	± 0.1 °C		
Temperature stability typ.	< 0.001 °C		
Pt 100 (No IC Sensors)			
Setting Range	–12.3 °C to + 90 °C		
Resolution	0.0015 °C		
Accuracy	± 0.3 °C		
Temperature stability typ.	< 0.005 °C		

ELECTRONICS 3-364-373.qxd 8/28/03 6:56 PM Page 373

ITC8000 Series Laser Controller

	ITC8022	ITC8052	ITC8102
Laser Controller: Current Control			
Control range of injection current	0 to ± 200mA	0 to ± 500mA	0 to ± 1A
Compliance voltage		> 5V	
Resolution	3µA	7.5µA	15µA
Accuracy (full scale)		± 0.05 %	± 0.1%
Noise without ripple (10Hz to 10MHz, rms, typ.)	< 2 µA	< 5 µA	< 10µA
Ripple (50Hz, rms, typ.)		< 1µA	< 1.5µA
Transients (processor, typ.)	< 15µA	< 30µA	< 50µA
Transients (other, typ.)	< 200µA	< 500µA	< 1mA
Drift (30 min, at constant ambient temperature, typ.)	< 5µA	< 12µA	< 25µA
Temperature coefficient		< 50ppm/ °C	
Laser Controller: Power Control			
Control range of photo current		10µA to 2mA	
Reverse bias voltage		0 to 10V (adjustable)	
Resolution photo current		30nA	
Accuracy (typ.)		± 0.1%	
Laser Controller: Current Limit			
Setting range	0 to ≥ 200mA	0 to ≥ 500mA	0 to ≥ 1A
Resolution	6µA	15µA	30µA
Accuracy	± 200µA	± 500µA	± 2mA
Temperature Controller: Current Limit			
Setting range (20-turn pot)		0 to ≥ 2A	
Resolution		0.5mA	
Setting accuracy		± 20mA	
Temperature Controller: Output			
Control range of TEC current		–2A to + 2A	
Compliance voltage		> 8V	
Maximum output power		16W	
Measurement resolution of TEC current		0.07mA	
Measurement resolution of TEC voltage		0.3mV	
Noise and ripple typ.		< 1mA	
Laser Voltage Measurement			
Measurement principle		4-wire measurement	
Measurement range		0 to 10V	
Resolution		0.3mV	
Accuracy		± 5mV	
General Data			
LD/TEC-connector		9-pin/15-pin D-Sub (ITC8000) : 15-pinDSub(ITC8000DS15)	

ITEM#	$	£	€	¥	DESCRIPTION
ITC8022	$1,909.00	£1,162.00	€1.660,00	¥265,600	PRO 8000 LD & TEC controller, 200mA / 16W, 9-pin / 15-pin D-Sub connector
ITC8022DS15	$1,909.00	£1,162.00	€1.660,00	¥265,600	PRO 8000 LD & TEC controller, 200mA / 16W, 15-pin D-Sub connector
ITC8022PT	$2,127.50	£1,295.00	€1.850,00	¥296,000	PRO 8000 LD & TEC controller, 200mA / 16W, Pt100, 9-pin / 15-pin D-Sub connector
ITC8022PTDS15	$2,127.50	£1,295.00	€1.850,00	¥296,000	PRO 8000 LD & TEC controller, 200mA / 16W, Pt100, 15-pin D-Sub connector
ITC8052	$2,035.50	£1,239.00	€1.770,00	¥283,200	PRO 8000 LD & TEC controller, 500mA / 16W, 9-pin / 15-pin D-Sub connector
ITC8052DS15	$2,035.50	£1,239.00	€1.770,00	¥283,200	PRO 8000 LD & TEC controller, 500mA / 16W, 15-pin D-Sub connector
ITC8052PT	$2,242.50	£1,365.00	€1.950,00	¥312,000	PRO 8000 LD & TEC controller, 500mA / 16W, Pt100, 9-pin / 15-pin D-Sub connector
ITC8052PTDS15	$2,242.50	£1,365.00	€1.950,00	¥312,000	PRO 8000 LD & TEC controller, 500mA / 16W, Pt100, 15-pin D-Sub connector
ITC8102	$2,070.00	£1,260.00	€1.800,00	¥288,000	PRO 8000 LD & TEC controller, 1000mA / 16W, 9-pin / 15-pin D-Sub connector
ITC8102DS15	$2,070.00	£1,260.00	€1.800,00	¥288,000	PRO 8000 LD & TEC controller, 1000mA /16W, 15-pin D-Sub connector
ITC8102PT	$2,288.50	£1,393.00	€1.990,00	¥318,400	PRO 8000 LD & TEC controller, 1000mA / 16W, Pt100, 9-pin / 15-pin D-Sub connector
ITC8102PTDS15	$2,288.50	£1,393.00	€1.990,00	¥318,400	PRO 8000 LD & TEC controller, 1000mA / 16W, Pt100, 15-pin D-Sub connector