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MCLS Series Multi Channel Fiber Coupled Laser Source

Operating Manual



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Part 1. Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

SHOCK WARNING

High voltage inside. To avoid electrical shock, before powering unit, make sure that the protective conductor of the 3-conductor power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without cover installed.

WARNING

This unit must not be operated in explosive environment.

WARNING

Avoid Exposure – Laser Radiation Emitted from apertures.

The unit is supplied with a 115 V parallel blade line cord for North American use only. For all other applications use an IEC 320 compatible line cord fitted with a plug appropriate for your particular AC wall socket.

Make sure that the line voltage rating marked on the rear panel agrees with your local supply and that the appropriate fuses are installed. Changing of the mains fuse can be done by the user (see Setting the AC Line Voltage and Installing Fuses). With the exception of the mains fuses, there are no user serviceable parts in this product.

Do not operate in wet or damp conditions. Do not obstruct the air-ventilation slots in the housing!

This device can only be returned when packed into the complete original packaging, including all foam packing inserts. If necessary, ask for a replacement package.

Mobile telephones, cellular phones or other radio transmitters should not to be used within the range of three meters of this unit since the electromagnetic field intensity may exceed the maximum allowed disturbance values according to EN50082-1.



LASER RADIATION
AVOID EXPOSURE TO THE BEAM
CLASS 3B LASER PRODUCT
405 – 1550 nm <50 mW

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Part 2. Description

The Thorlabs 4-Channel Fiber Coupled Laser Sources provide easy coupling and simple control of laser diode driven fiber optics. Each system is equipped with four fiber output light sources with wavelength available from 406 to 1550 nm. The laser source is configured to accept a wide range of fiber pigtailed laser diodes, and each system can be made with single mode fiber or PM fiber and any combination of 4 laser wavelengths. Below is a sample list of available wavelengths; please visit our website for a full list of currently available options. Please contact Tech Support to configure your laser system.

Item #	λ	Minimum Power	Laser Type	Fiber
LPS-406-FC-LS	406 nm	3.0 mW	Fabry-Perot	S405
LPS-473-FC-LS	473 nm	4.0 mW	Fabry-Perot	S460
LPS-488-FC-LS	488 nm	4.5 mW	Fabry-Perot	S460
LPS-635-FC-LS	635 nm	2.5 mW	Fabry-Perot	SM600
LPS-658-FC-LS	658 nm	6.0 mW	Fabry-Perot	SM600
LPS-670-FC-LS	670 nm	1.5 mW	Fabry-Perot	SM600
LPS-785-FC-LS	785 nm	4.0 mW	Fabry-Perot	SM800-5.6-125
LPS-808-FC-LS	808 nm	4.5 mW	Fabry-Perot	SM800-5.6-125
LPS-850-FC-LS	850 nm	4.5 mW	Fabry-Perot	SM800-5.6-125
LPS-904-FC-LS	904 nm	4.5 mW	Fabry-Perot	SM800-5.6-125
LPS-980-FC-LS	980 nm	4.5 mW	Fabry-Perot	980HP
LPS-1310-FC-LS	1310 nm	1.5 mW	Fabry-Perot	SMF28
LPS-1550-FC-LS	1550 nm	1.0 mW	Fabry-Perot	SMF28
LPS-1550DFB-FC-LS	1550 nm	1.5 mW	DFB	CF126-900

Each laser diode operates from an independent, high-precision, low-noise, constant-current source and temperature control unit. An intuitive LCD interface allows the user to view and set the parameters for each laser. The user can adjust the laser current and temperature control independently for each output. The display indicates the channel number selected, the output wavelength of the source, the operating power calculated from the laser diode monitor diode, and the actual temperature the laser is set to.

This device includes a microcontroller to fully control the laser's optical power, temperature, and monitor the system for fault conditions. The laser source includes a USB connection that allows remote adjustment of power, temperature, and enabling. On the rear panel, analog inputs are available to modulate the lasers with an external signal. This is added to the internal set points. To prevent damage, the microcontroller will disable the output if the analog input plus the internal set point exceeds the laser limits.

While most output sources fall within the class 3R laser rating, the system was fully designed to meet 3B laser class requirements. There is an interlock located on the rear panel that must be shorted in order for any laser output to be enabled. This can easily be configured to be triggered by doors to disable the

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lasers in unsafe conditions. The power switch is a keylock system to prevent accidental or unwanted use. Each source has its own enable button allowing the user to choose the light source or sources they wish to be active as well as a master enable which must also be set. Each channel includes a green LED indicator to easily determine its current state. There is a 3 second delay before the lasers turns on, and the user is warned by the LED rapidly blinking.

The MCLS includes a universal power supply allowing operation over 100-240 VAC without the need for selecting the line voltage. The fuse access is conveniently located on the rear panel. This unit is supplied with a US line cord as well as a standard European line cord.

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Part 3. Setup

3.1. Setting the AC Line Voltage and Installing Fuses

Your MCLS Series Laser Source has been shipped from Thorlabs configured for 100 to 240 VAC operation. There is no line switch adjustment to be made. However it may be necessary to replace an open fuse. To do this you must perform the following procedure.

- Remove the AC power cord if it is connected to the unit.
- Locate the fuse tray directly below the AC power cord connection on the rear panel of the unit.
- Carefully use a flat blade screwdriver to open the fuse tray.
- Remove the existing fuse and install the appropriate 250 mA fuse. The replacement fuse must be a 5 mm x 20 mm, 250 VAC Type T Fuses (IEC 60127-2/III, low breaking capacity, slow blow)
- Push the fuse tray back into place making sure that it snaps and seats correctly.
- Connect the appropriate power cord into the AC receptacle and plug the unit in.

3.2. Initial Set-up

- Locate the unit on a dry, level working surface.
- Make sure the POWER key switch on the front of the unit is in the OFF position (key perpendicular to working surface).
- Plug the female end of the AC line cord provided into the AC Input Receptacle on the rear of the unit. Plug the male end into a properly grounded AC socket.
- Install the interlock “key” into the interlock connector located on the rear panel. See page 12 for details.
- Connect a Fiber Optic cable to the LASER APERTURE on the front panel of the unit and verify that the dust caps are installed onto all unused fiber connections.

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Part 4. Operation

4.1. Front and Back Panel Overview

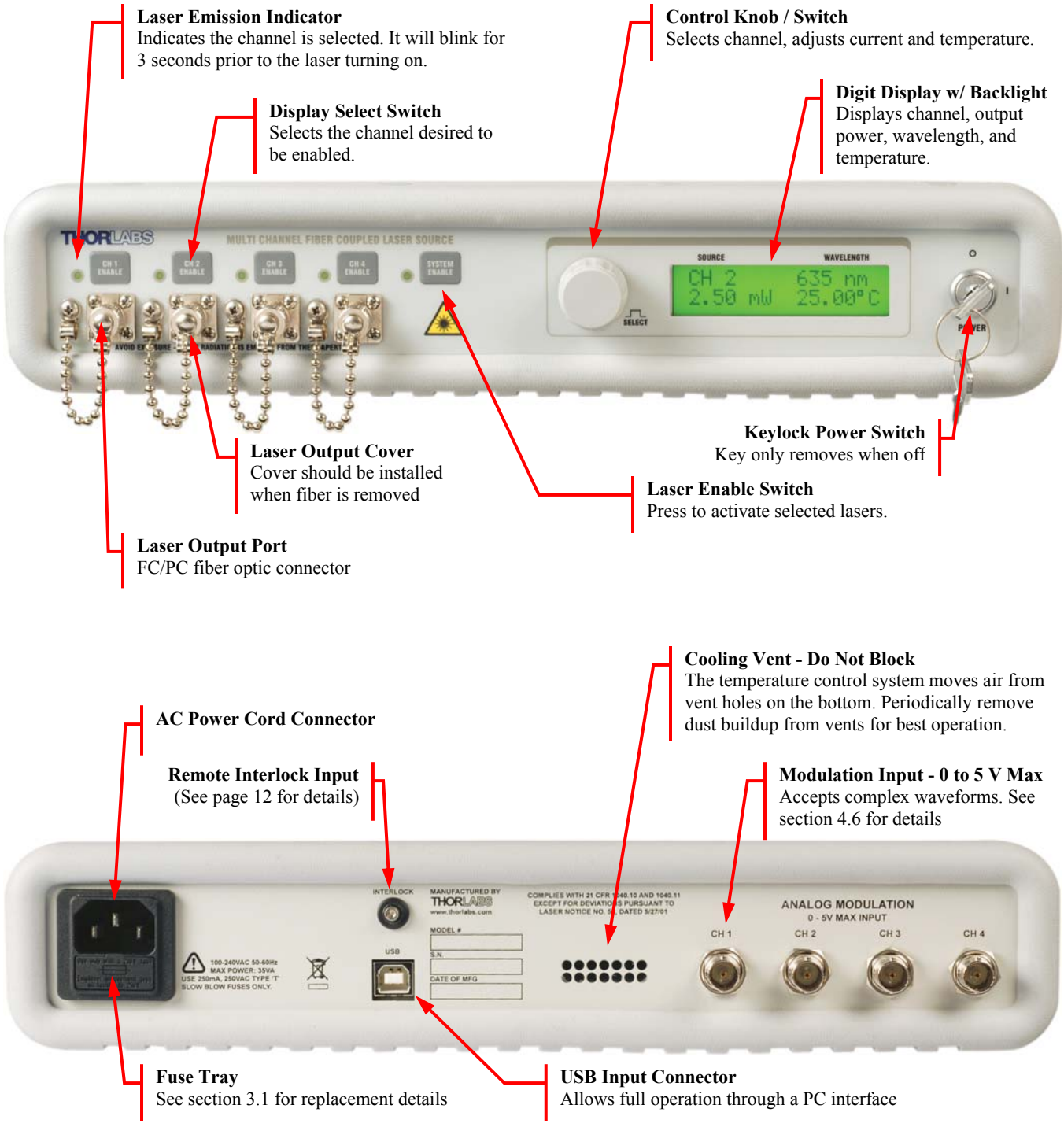


Figure 1: Front and Rear Panels of Laser Source

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4.2. Turning On the Source

- Turn the POWER key switch clockwise. The LCD display will scroll "Thorlabs MCLS" across the screen, followed by the Ch1 information.
- Make sure the Interlock Input is short-circuited; see page 12 for detailed instructions.
- Select the desired output channels by pressing and releasing the ENABLE switch located above the desired fiber output sources. An indicator located next to the switch will light up.
- Press and release the SYSTEM ENABLE switch to activate the lasers. There will be an approximately 3 second delay before the lasers power up. During this time the SYSTEM ENABLE indicator will light up and the selected channel indicator lights will blink rapidly.
- The default display mode is laser power (mW), however the thermo-electric cooler is activated when the unit turns on.

4.3. Viewing Channel Information

The MCLS uses a single LCD display to access the information for each output channel. At any time the display can be adjusted to view another channel by simply rotating the control knob located to the left of the display. The display will scroll through the channels until the desired channel is selected. The following information will be available:

- Top left – Indicates the channel selected. As an additional indicator, the channel enable indicator selected will periodically blink on if disabled and off if enabled.
- Top Right – Indicates the wavelength of the selected channel. This is set at the factory when the lasers are installed.
- Bottom Left – Indicates the power level of the laser diode. If it is disabled this will read "0.00mW" and if the selected laser diode does not include a monitor diode this will read "No PD". When enabled the current power level determined from the monitor photodiode will indicate the approximate power level of the output.

Note: The power shown on the display is the optical power at the laser aperture calibrated to the monitor photodiode. The actual power at the end of your fiber optic cable may be less, depending on the quality of the connection. All fiber optic cables installed should be cleaned first since dust and dirt particles in the connector will effect coupling efficiency and possibly damage the fiber connectors.

- Bottom Right – Indicates the actual temperature the laser is stabilized to and is displayed in °C. The system defaults to a temperature of 25.00 °C until changed by the user. The temperature control is always active and requires 5 to 10 minutes to properly stabilize.

4.4. Adjusting the Laser Output Power and Temperature

- Rotate the control knob to select the appropriate channel. Clockwise rotation increases the channel while counterclockwise decreases the channel. The selected channel is indicated on the display as well as with a periodic blink of the channel indicator light.

Note: The adjustment knob utilizes an intelligent speed control. Adjusting the knob slowly will increment values at the maximum resolution while adjusting fast will make larger movements. This allows both a fine and course control.

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- When the appropriate channel is selected, press the control knob in. The bottom left location will start blinking and will change to current. Ex: xx.xxmA. Adjust the control knob until the desired current is achieved. The power will adjust real-time. The first time default setting will be power full off. Adjusting the knob clockwise will immediately set the power to the laser threshold and then incrementally to the max operating current. Adjusting the knob counter clockwise will incrementally decrease the signal until it hits the threshold, and then immediately to laser off. On power down, the current setting will be remembered.

Note that there is a timeout on the display, after which the display will revert back to the viewing mode. This is to prevent accidental adjustment of the power.

- Press the knob again to switch to temperature adjustment. The set point temperature will be displayed and will be blinking; for example, 25.00 °C. Adjust the control knob to increase or decrease the temperature set point. The temperature default is 25.00 °C but can be adjusted over a range of 20.00 to 30.00 °C with a resolution of 0.01 °C.

Note, as above there is a timeout where the display will revert to the viewing display and lock out adjustment to the temperature.

- Pressing the control knob again will exit the adjustment mode and revert back to the viewing mode, locking in the selected parameters. This can also be achieved by allowing the display to time out at any point in the process. Depending on the magnitude of the change in temperature set point, it will take anywhere from a few seconds to a few minutes for the system to settle into the new operating temperature.

4.5. Turning the Laser Off

- **Standby Mode** – By adjusting the control knob fully counter clockwise the power will adjust down to the threshold current and then to off, or standby mode. The threshold current is the point at which the internal laser diode starts lasing. Below this it operates in a LED mode. For convenience the system is set up to adjust from the threshold to the max current. In addition, when adjusting below the threshold, the current will be set to almost 0 mA. Since the system utilizes a constant current control, there will always be a minimum current to maintain the current control loop. The output emission is typically very low, or nonexistent. The laser is still enabled and operating at the minimum possible current. This can be useful while using the external modulation. The full 5 V can be applied without compensating for the internal set point. However, the external signal will need to provide a DC offset to bias the laser above the threshold current for best results. Input signals will see clipping on there lower edges below threshold. Pulse response time may also be effected since there is typically a time delay during the LED to laser emission change.

- **Disable/Enable Mode** - The Laser output should be turned off by pressing and releasing the SYSTEM ENABLE switch. Outputs can be individually turned off at any time by pressing their ENABLE button. The laser temperature will be maintained even when the laser is disabled.

- **Power Down** - When completely powering down an enabled unit, first press and release the SYSTEM ENABLE switch and then turn the POWER key switch counterclockwise, which will turn OFF the entire unit. Anytime the unit is turned OFF and then turned back ON, the Laser will be disabled until the SYSTEM ENABLE switch is pressed and the desired channels are enabled.

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4.6. Modulating the Laser Output

The MOD IN input can be used to modulate the laser output, or set the laser output remotely using a 5 V power source. The 5 V maximum inputs correspond to the maximum calibrated power of each channel, which operate using a constant current drive technique. The resulting actual output power is dependent on the set current and operating temperature. In addition, in order to eliminate a dead zone in the power control knob, the output of the unit is offset to the threshold current of the coupled laser diode. Adjusting the knob below threshold will immediately set the current to almost 0 mA, or Standby mode as described in section 4.5. Therefore, there are two modes of modulation available. First setting the control to "Standby" allows the analog modulation to utilize the full 0 to 5 V input range. The drawback is that a minimum voltage will be required to operate above the threshold current but allows more flexibility by the user. The second mode is to adjusting the control knob so that the laser is at threshold or above. The analog modulation voltage will be limited to less than 5 V, but a DC offset will not be required. This should be kept in mind when using the modulation input since it will limit the actual input voltage range.

- Connect a signal generator or 0 to 5 V power source to the unit using a BNC type connector.
- Set the PWR ADJ knot on the front panel to its full counter clockwise setting for standby mode, or increase slightly to the threshold current mode.
- Press the ENABLE switch to turn on the laser, wait for the safety delay to time out.
- **For Threshold Offset** - Apply the appropriate signal to the MOD IN input. If too much voltage is applied internal current limiting will prevent damage to the laser diode and the laser diodes will be immediately disabled. If an internal threshold is set the acceptable drive voltage range will be less than 5V. To calibrate your input apply a DC voltage to the MOD IN and slowly increase until the system disables. This will be the max voltage allowable for that channel.
- **For Standby Operation** – Apply and appropriate signal between 0 and 5V to the MOD IN for the desired channel. Determine the DC offset by increasing the voltage slowly until a large power jump is seen on the output. An easier method it to apply a 1Vpp sinusoid and adjust the DC offset until the sinusoid appears and then the bottom edge is no longer clipping. This method requires applying the laser output to a photodetector and monitoring with an oscilloscope. Next maximize the amplitude so that the peak is 5V or less as desired.

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Part 5. Making the Safety Interlock Connections

The MCLS series laser sources are equipped with a remote interlock connector located on the rear panel, see Figure 2. All units have this feature regardless of their FDA and IEC classifications. In order to enable the laser source, a short circuit must be applied across the terminals of the Remote Interlock connector. In practice this connection is made available to allow the user to connect a remote actuated switch to the connector (i.e. an open door indicator). The switch (which must be normally open) has to be closed in order for the unit to be enabled. Once the switch is in an open state the laser source will automatically shutdown. If the switch returns to a closed condition the laser source must be re-enabled at the unit by pressing the SYSTEM ENABLE switch.

All units shipped from Thorlabs are configured with a shorting device installed in the Interlock connector. If you are not going to use this feature then you can leave the shorting device installed and the unit will operate normally as described in the procedures above.

If you wish to make use of the Interlock feature you will need to acquire the appropriate connector mate and wire it to your remote interlock switch. Next, remove the shorting device by pulling it out with a pair of needle nose pliers and install the connector into the interlock input.

The interlock input only accepts a 2.5 mm mono phono jack. This connector is readily available at most electronics stores.

The electrical specifications for the interlock input are shown in the following table.

Specification	Value
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	+5 VDC with Respect to Chassis Ground
Short Circuit Current	~8 mA DC
Connector Polarity	Tip is +5 V, Barrel is Ground
Interlock Switch Requirements	Must be N.O. Dry Contacts Under no circumstances should any external voltages be applied to the Interlock input

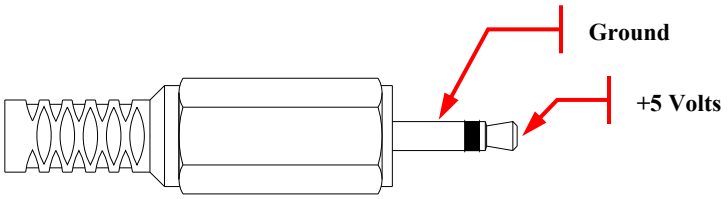


Figure 2: Remote Interlock Connector

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Part 6. Remote Communications

6.1. Installing the USB Drivers

Prior to running the command line interface, the USB drivers must be installed. The MCLS must not be connected to the PC while installing the drivers. Insert the CD that was supplied with your unit into your PC. From the dialog box that is displayed, select the Install Drivers button. If the dialog box is not displayed, browse to the CD and run CD_Started.exe. Follow the onscreen prompts to install the driver. After the driver is installed, attach the MCLS to the PC and power it on. Your PC will then detect the new hardware and will prompt you when the installation is complete.

6.2. Command Line Interface

Once the USB drivers have been installed, the unit connected to the PC, and the power turned on, configure the terminal emulator as follows:

- Baud Rate = 115.2K Bits Per Second
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None

If the connection is correct you will see the following after pressing the “Enter” key.

Command error CMD_NOT_DEFINED

Followed immediately by the prompt:

>

The basic structure of the interface is a keyword followed by either an equals sign “=” or a question mark “?”. The “=” or “?” will determine if the string is a command or a query. All strings (commands and queries) must be terminated by a carriage return (CR) or pressing the ENTER key on the computer.

The command structure is as follows:

Keyword = argument (CR)

Where “keyword” defines the function and “argument” is a numerical value followed by a carriage return (CR). See listing below.

The query structure is a follows:

Keyword? (CR)

The “keyword” defines the function and the question mark (?) indicates a query. The string is terminated with a carriage return (CR). See listing below.

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There are a few exceptions to this which are noted below, also noted are unique shortcut keys.

The prompt symbol ">" will appear on power up and after a command is accepted by the system indicating it is ready to receive another command line.

6.3. Keywords (Commands and Queries)

The following list shows all of the available commands and queries, and summarizes their functions:

Command	Syntax*	Description
Get Commands	?	List the available commands
Get ID	id?	Returns the model number and firmware version.
Get Channel	channel?	Returns the active channel.
Set Channel	channel=*n*	Select the channel specified by *n*.
Get Target Temp	target?	Returns the set temperature for the active channel (C).
Set Target Temp	target=*n*	Sets the set temperature (*n*) for the active channel (C).
Get Temp	temp?	Returns the actual temperature for the active channel (C).
Get Current	current?	Returns the current for the active channel (mA).
Set Current	current=*n*	Sets the current (*n*) for the active channel (mA).
Get Power	power?	Returns the power for the active channel (mW).
Get Enable	enable?	Returns the current state of the active channels Enable button.
Set Enable	enable=*n*	Sets the state of the active channels Enable button (0: disabled, 1: enabled).
Get System	system?	Returns the current state of the System Enable button.
Set System	system=*n*	Sets the state of the System Enable button (0: disabled, 1: enabled).
Get Specs	specs?	Returns the Laser Diode Specifications for the active channel.
Get Step	step?	Returns the increment used to adjust the temperature and current when the arrow keys are pressed.
Set Step	step=*n*	Sets the increment (*n*) used to adjust the temperature and current when the arrow keys are pressed.
Save	save	Saves the current settings.
Get Status	statword	Returns a status word that indicates the state of all enable buttons.

* *All commands and queries are in lower case letters.*

If the keyword, format, or argument is incorrect or out of range, the unit will return an error string. The function is determined by the value set with the mode command in the above table.

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In addition to the above commands there is also special functionality added to the arrow keys of the computer's keyboard.

- Up Arrow Key – Increments the current for the active channel by n.
- Down Arrow Key – Decrements the current for the active channel by n.
- Right Arrow Key – Increments the temperature for the active channel by n.
- Left Arrow Key – Decrements the Temperature for the active channel by n.

Where n is set by the command "Set Step".

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Part 7. General Maintenance

Aside from the AC Input fuse there are no user serviceable parts in this product. If you suspect something has failed on the unit, please contact Thorlabs for advice on returning the unit for evaluation. Always clean fiber optic connectors that will be inserted into the system and install the dust cap whenever the source is not being used. Allowing dust and dirt into the fiber ports will degrade coupling efficiency and possibly damage the fiber patch cords, both inside and outside. If you suspect this to be true, Thorlabs can clean and inspect the fiber connections, and repair if necessary.

7.1. Cleaning

The unit can be cleaned using a soft, slightly damp cloth. Avoid using any solvents on or near the unit. Keep the vent holes located on the bottom of the unit and on the rear panel free of dust buildup. Restricted airflow will cause the temperature controls to operate inefficiently and in extreme cases, lose temperature control.

Always clean the ferrule end of your fiber patch cable prior to inserting it into the output FC Adapter. Allowing dust and dirt into the fiber ports will degrade coupling efficiency and possibly damage the fiber patch cords, both inside and outside. If you suspect this to be true, Thorlabs can clean and inspect the fiber connections, and repair if necessary.

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Part 8. Specifications

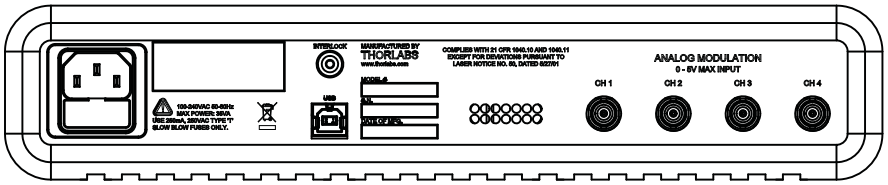
General Specifications	
AC Input	100-240 VAC, 50 - 60 Hz
Input Power	35 VA Max
Fuse Ratings	250 mA
Fuse Type	IEC60127-2/III (250V, Slow Blow Type 'T')
Fuse Size	5 mm x 20 mm
Dimensions (W x H x D)	12.6" x 2.5" x 10.6" (320 mm x 64 mm x 269 mm)
Weight	8.5 lbs
Operating Temperature	15 to 35 °C
Storage Temperature	0 to 50 °C
Connections and Controls	
Interface Control	Optical Encoder with Pushbutton
Enable and Laser Select	Keypad Switch Enable with LED indication
Power On	Key Switch
Fiber Ports	FC/PC
Display	LCD, 16x2 Alphanumeric Characters
Input Power Connection	IEC Connector
Modulation Input Connector	BNC (Referenced to Chassis)
Interlock	2.5 mm Mono Phono Jack (see Part 5,)
Communications	
Communications Port	USB 2.0
Com Connection	USB Type B connector
Required Cable	2 m USB Type A to Type B Cable (Replacement Part Number USB-A-79)

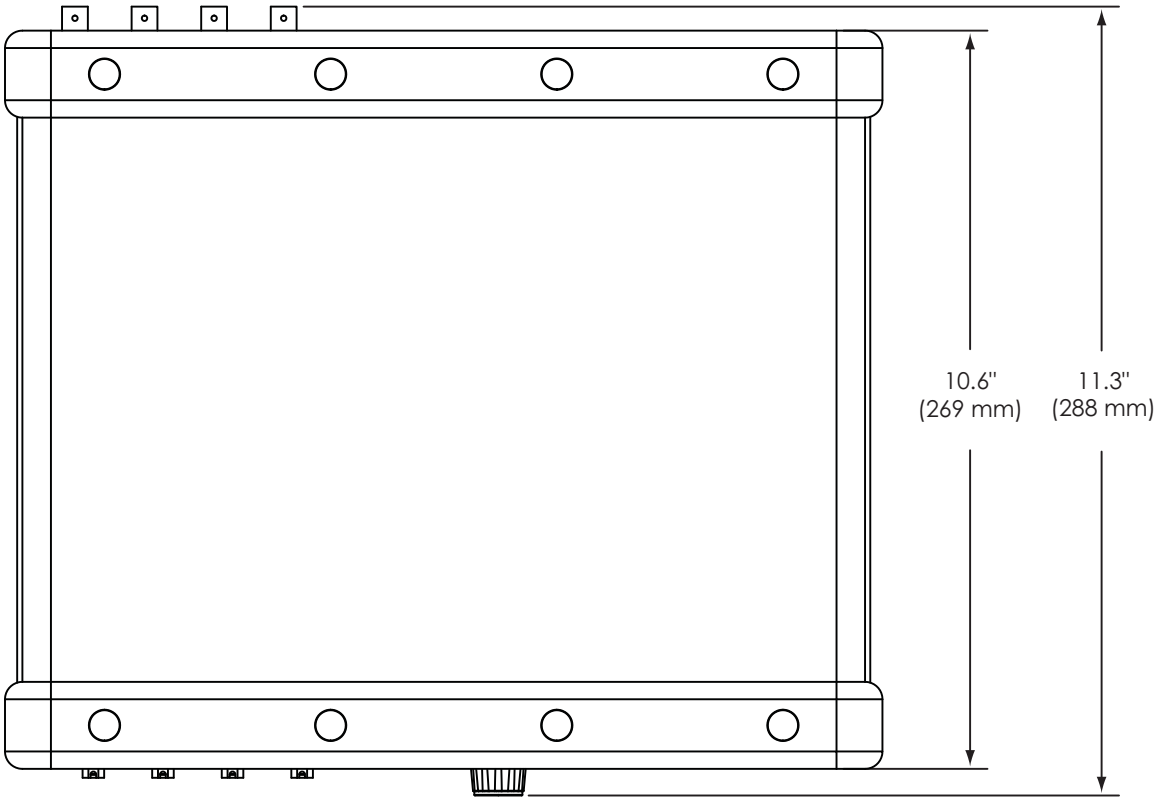
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Performance Specifications	
Display Power Accuracy	±10%
Current Set Point Resolution	0.01 mA
Temperature Adjust Range	20.00 to 30.00 °C
Temp Set Point Resolution	±0.01 °C
Noise	<0.5% Typical (Source Dependent)
Rise Time / Fall Time	<5 µsec
Modulation Input	0 - 5 V = 0 - Full Power
Modulation Bandwidth	80 kHz Full Depth of Modulation

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Part 9. Mechanical Drawing





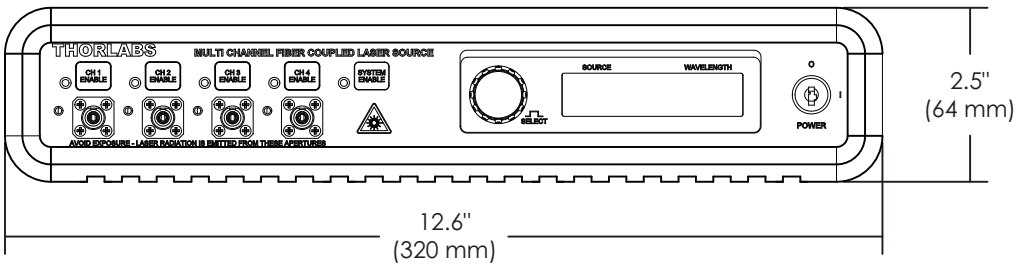


Figure 3: Mechanical Drawing

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Part 10. Declaration of Conformity

Konformitätserklärung
Declaration of Conformity
Déclaration de Conformité

Thorlabs Inc
435 Rt 206
Newton, NJ
USA

erklärt in alleiniger Verantwortung, dass das Produkt:
declares under it's own responsibility, that the product:
declare sous notre seule responsabilité, que le produit:

MCLS1

mit den Anforderungen der Normen
fulfills the requirements of the standard
satisfait aux exigences des normes

2006/95 EC	Low Voltage Directive 12.Dec. 2006
EMC 2004/108/EC	Electromagnetic Compatibility Directive
EN 61010-1:2001	Safety of Test and Measurement Equipment
EN 61326-1:2006	EMC of Test and Measurement Equipment
CISPR 11 Edition 4:2003	Conducted Emissions
CISPR 11 Edition 4:2003	Radiated Emissions
IEC 61000-3-2,	Harmonics
IEC 61000-3-3	Voltage Fluctuation and Flicker
IEC 61000-4-2	Electrostatic Discharge
IEC 61000-4-3	Radiated Immunity
IEC 61000-4-4	Electrical Fast Transient/Burst, Power Leads
IEC 61000-4-4	Electrical Fast Transient/Burst, I/O Leads
IEC 61000-4-5	Surge Immunity, Power Leads
IEC 61000-4-6	Conducted Immunity, Power Leads
IEC 61000-4-6	Conducted Immunity, I/O Leads
IEC 61000-4-11	Voltage Dips, Interrupts and Variations

übereinstimmt und damit den Bedingungen entspricht.
and therefore corresponds to the regulations of the directive.
et répond ainsi aux dispositions de la directive.

Dachau, 8. Juni 2011 ..... D. Jemmich .....

Ort und Datum der Ausstellung	Name und Unterschrift des Befugten
Place and date of issue	Name and signature of authorized person
Lieu et date d'établissement	Nom et signature de la personne autorisée

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Part 11. Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out "wheelie bin" logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

11.1. Waste Treatment is Your Own Responsibility

If you do not return an "end of life" unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

11.2. Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.

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Part 12. Thorlabs Worldwide Contacts

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