THORLABS

Thorlabs Instrumentation

MLC8000
Multi Laser Controller Modules
Operation Manual

2016

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Item No.: M0009-510-223

Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

In the displays shown by the PRO8 you may find the name PROFILE. PROFILE was the name of the manufacturer before it was acquired by Thorlabs and renamed to Thorlabs.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceeded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read these advices carefully!

1 General Information

The MLC8000 Modules are Multi Laser Controllers that are capable to drive up to 8 laser diodes simultaneously and independently. They come in 2 versions - CG (cathode grounded) and AG (anode grounded).

Each module supports 2 current ranges, indicated as low or high range. Constant current (CC) and constant power (CP) modes are supported.

A common for all 8 lasers hardware injection current limit is set with a potentiometer located on the front panel of the module.

For the PRO8000 mainframe series Thorlabs supplies LabVIEW®- and LabWindows/CVI®-drivers for Windows 32 bit.

Please refer to http://www.thorlabs.com for latest driver updates.

1.1 Safety

Attention

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

Prior to applying power to the MLC8000, make sure that the protective conductor of the mains power cord is correctly connected to the protective earth ground contact of the socket outlet! Improper grounding can cause electric shock resulting in damage to your health or even death!

Also make sure that your line voltage agrees with the voltage given on the letterplate of the unit and that the right fuse has been inserted!

Modules of the MLC8000 Series must only be operated in a PRO8000, PRO8000-4 or PRO800 mainframe.

To avoid damage to the modules used or to the mainframe, modules must not be installed or removed when the mainframe is switched on.

All modules must be fixed using the screws provided for this purpose.

The MLC8000 must not be operated in explosion endangered environments!

Do not remove covers! Do not obstruct the air ventilation slots in the housing!

Refer servicing to qualified personnel!

Only with written consent from *Thorlabs* may changes to single components be made or components not supplied by *Thorlabs* be used.

This precision device is only serviceable if properly packed into the complete original packaging. If necessary, ask for a replacement package prior to return.

All connections to the load must be made using shielded cables, unless otherwise stated.

Semiconductor lasers can deliver up to several 100mW of possibly invisible laser radiation! Improper operation can cause severe eye and health damage!

Pay strict attention to the safety recommendations of the appropriate laser safety class!

Attention

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial

environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

Attention

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

1.2 Ordering Codes and Accessories

Please refer to the actual catalog or the web for an actual list of available plug in modules and accessories and for the complete ordering codes.

Ordering Code	Short Description
MLC8025-8AG	Multichannel Laser Controller, AG, 5 mA and 25 mA
MLC8025-8CG	Multichannel Laser Controller, CG, 5 mA and 25 mA
MLC8050-8AG	Multichannel Laser Controller, AG, 10 mA and 50 mA
MLC8050-8CG	Multichannel Laser Controller, CG, 10 mA and 50 mA
MLC8100-8AG	Multichannel Laser Controller, AG, 25 mA and 100 mA
MLC8100-8CG	Multichannel Laser Controller, CG, 25 mA and 100 mA
MLC8200-8AG	Multichannel Laser Controller, AG, 50 mA and 200 mA
MLC8200-8CG	Multichannel Laser Controller, CG, 50 mA and 200 mA

Note

The output polarity (AG or CG) is common for all 8 channels and factory fixed; it cannot be changed!

2 Getting Started

2.1 Parts List

Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the MLC8000 mechanically and electrically.

Verify that you have received the following items within the package:

1. MLC8000 Series Module
2. Operating Manual

2.2 Operating Principle

The current modules MLC8000 are unipolar current sources for laser diodes.

They can be ordered for laser diodes with anode grounded or cathode grounded. The MLC offers two current ranges.

The different module types operate the same way, they only differ in maximum current, resolution and accuracy. See section Technical Data 46.

The current modules MLC8000 contain a transimpedance amplifier input for the monitor diode (input impedance 0 Ω). Both polarities of the monitor diode are allowed. The monitor diode may be operated either photovoltaic (without bias voltage) or photoconductive, i.e. with bias voltage (U_{BIAS} = 5V).

All necessary value settings are done by the mainframe operating elements (keypad and rotational encoder) or via remote control by a computer. The only parameter that must be set manually, is the laser diode current limit ("absolute hardware limit").

In an automated test set-up for different laser diodes no manual settings are required.

All outputs can operate either in constant current or constant power mode simultaneously. All outputs are switched on and off together.

The laser diode current (constant current mode) or the monitor diode current (constant power mode) of the MLC8000 modules are set with 12 bit resolution.

The monitor diode current is read back with 12 bit, the laser diode current, the limit for the laser diode current (hardware limit) with 11 bit plus sign.

The built-in mains filter in the mainframe and the careful shielding of the transformer, the micro processor as well as the module itself will provide an excellent suppression of noise and ripple.

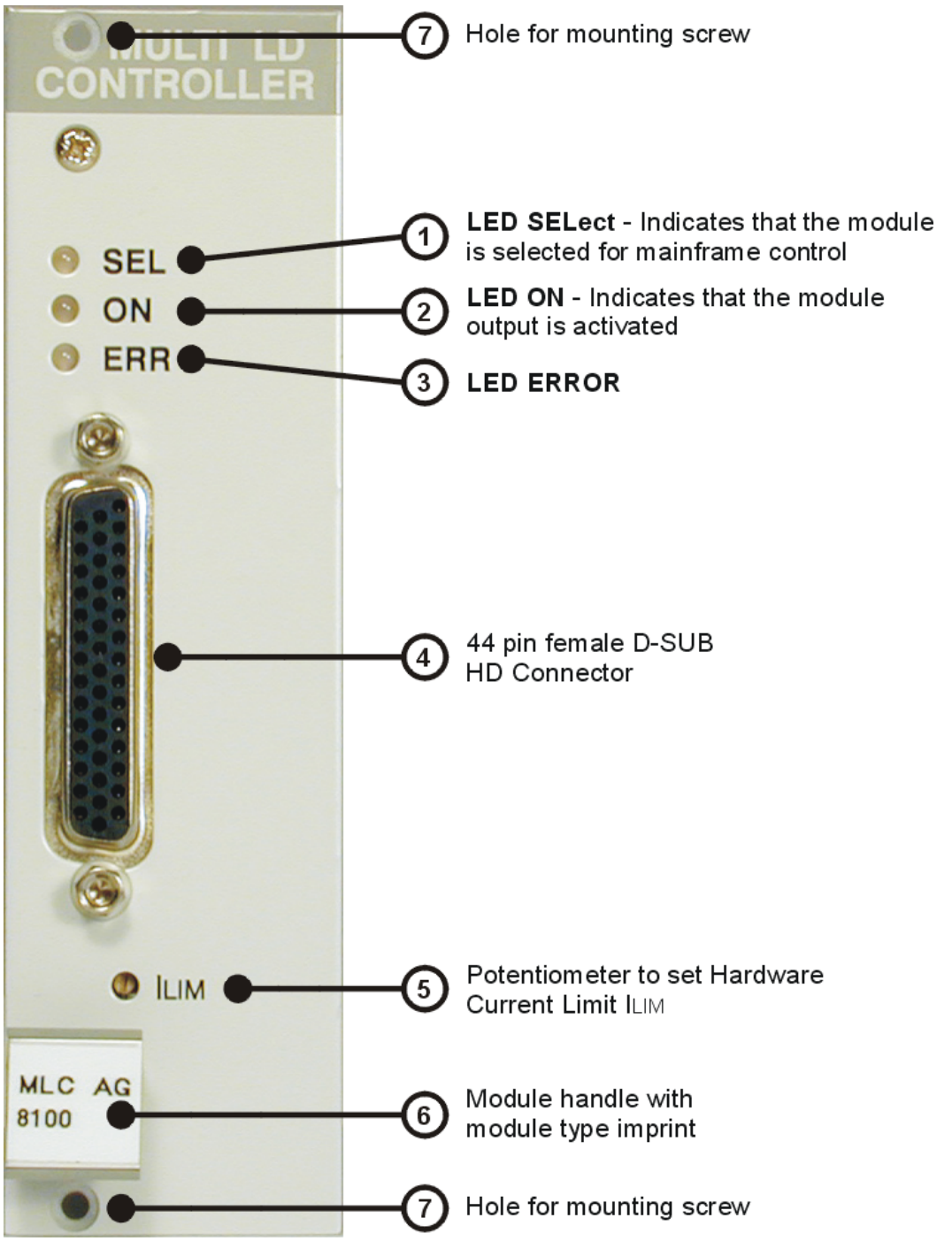
Laser Diode Protection Features

To protect the connected laser diodes the MLC8000 modules contain the following protection circuits:

- **Softstart when switching on the laser diode current**
  Protection against capacitive and inductive parasitic elements (switching peaks).
- **Limit for the injection current in all operating modes**
  Protection against thermal destruction of the laser chip.
- **Limit for the optical power in constant current (!) mode**
  Protection against thermal destruction of the mirrors caused by too high optical power.

- **Interruption control of the connection cable to the laser diode (interlock)**
  Protection against accidental operation.
- **Electronic short-circuit switch for the laser diode**
  Protection against static discharge when touching the switched off laser.
- **Separate on and off function for each module**
  Protection against operating errors.
- **Control LED for activated laser current**
  Laser safety when laser radiation is switched on.
- **Separate over-temperature protection for each module**
  Protection against thermal failure of the module.
- **Laser Protection** can be coupled to a temperature window, if TED8000 modules are present within the same PRO8000 mainframe.

2.3 Operating Elements



3 External Connections

3.1 Connecting Laser and Monitor Diode

Laser diodes are manufactured in many different housings. Normally the following components are installed together in the housing of the laser:

- Laser diode
- Monitor diode
- TEC element for setting the chip temperature
- Temperature sensor

The laser diode is always sourced against ground by the current controller. This is of a considerable advantage regarding the safety of the laser diode and the stability of the laser diode current.

The current modules have a monitor diode input that is set up as a transimpedance amplifier input (input impedance 0 Ω).

The polarity of the photo diode can be freely selected. It can also be floating. Monitor diodes can be operated either photovoltaic (without bias voltage) or photoconductive, i.e. with bias voltage supplied by the MLC8000 (U_{BIAS} = 5V).

Therefore, soldered jumpers can be used to provide biasing depending on the individual configuration shown in the next sections - see Connecting Components - Anode Ground Version 11 or Connecting Components - Cathode Ground Version 18.

3.2 Connecting Interlock and Status Display

Interlock

The interlock function provides a safety feature in order to switch off instantly all lasers simultaneously.

Therefore, the connection between pin 15 and any GND pin of the connector jack will serve as safety circuit:

- If the resistance between pin 15 and GND is less than 430 Ω (short circuit allowed), the laser current is enabled and can be switched on.
- As soon as the current between is being interrupted, the multi laser controller module cannot be switched on.

If this interruption happens during operation, the output (all 8 lasers) will be switched off immediately and remains switched off until the interlock is closed again and the MLC8000 is switched on again.

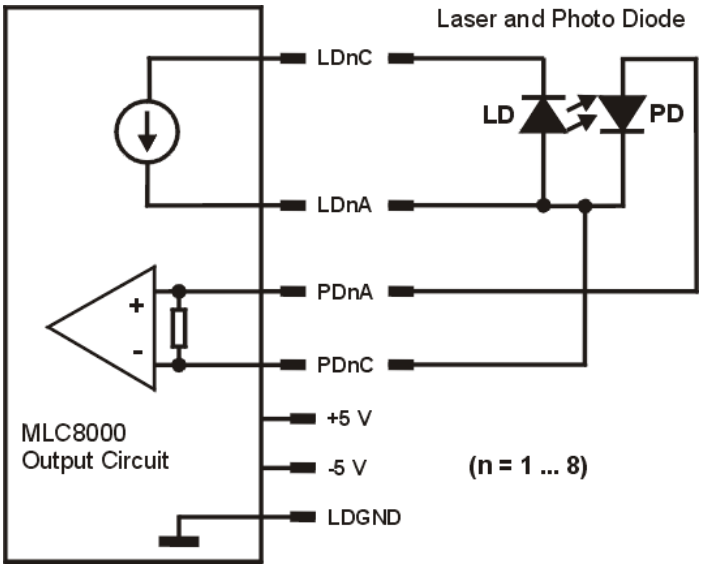
Status display

For laser on/off status indication, a LED with anode to pin 44 and cathode to any GND pin can be used. The LED will light up when the output current is switched on.

3.3 Connecting Components - Anode Ground Version

3.3.1 AG Output Port Connection Scheme

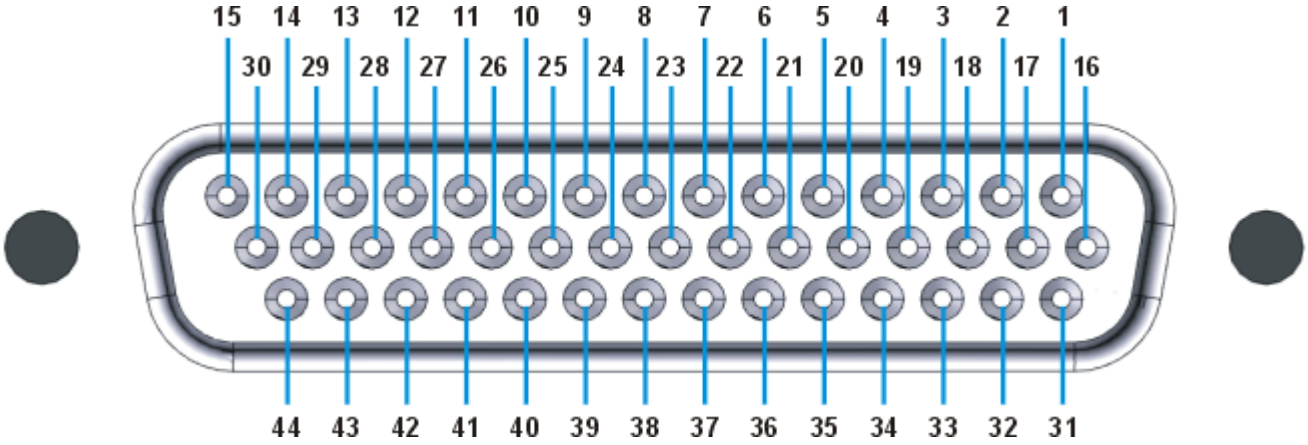
Each laser is connected to an MLC8xxx-8AG output port as shown below:



We recommend to use separate wires drilled in pairs (twisted pair) in a common shield for laser diode current and monitor diode current respectively.

The shield must be connected to ground.

3.3.2 AG MLC8xxx Output Connector Pinning



Pin Assignment Sorted by Function

Pin	Connector
14	LD1C cathode of laser # 1
12	LD2C cathode of laser # 2
11	LD3C cathode of laser # 3
9	LD4C cathode of laser # 4
8	LD5C cathode of laser # 5
6	LD6C cathode of laser # 6
5	LD7C cathode of laser # 7
3	LD8C cathode of laser # 8
29	LD1A anode of laser # 1
27	LD2A anode of laser # 2
26	LD3A anode of laser # 3
24	LD4A anode of laser # 4
23	LD5A anode of laser # 5
21	LD6A anode of laser # 6
20	LD7A anode of laser # 7
18	LD8A anode of laser # 8
13	PD1A anode photo diode # 1
42	PD2A anode photo diode # 2
10	PD3A anode photo diode # 3
39	PD4A anode photo diode # 4
7	PD5A anode photo diode # 5
36	PD6A anode photo diode # 6
4	PD7A anode photo diode # 7
33	PD8A anode photo diode # 8

Pin	Connector
43	PD1C cathode photo diode # 1
41	PD2C cathode photo diode # 2
40	PD3C cathode photo diode # 3
38	PD4C cathode photo diode # 4
37	PD5C cathode photo diode # 5
35	PD6C cathode photo diode # 6
34	PD7C cathode photo diode # 7
32	PD8C cathode photo diode # 8
31	GND ground
16	GND ground
17	GND ground
19	GND ground
22	GND ground
25	GND ground
28	GND ground
30	GND ground
44	LEDA out for a LED to show the on/off status
15	Interlock to be shortened to any GND pin
1	+ 5 V
2	- 5 V

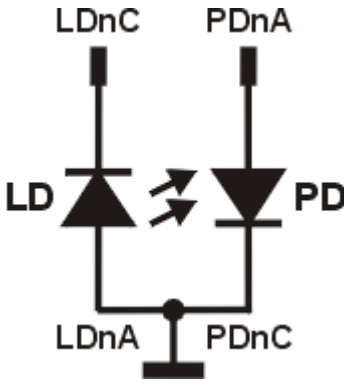
Pin Assignment Sorted by Pin Number

Pin	Connector
1	+ 5 V
2	- 5 V
3	LD8C cathode of laser # 8
4	PD7A anode photo diode # 7
5	LD7C cathode of laser # 7
6	LD6C cathode of laser # 6
7	PD5A anode photo diode # 5
8	LD5C cathode of laser # 5
9	LD4C cathode of laser # 4
10	PD3A anode photo diode # 3
11	LD3C cathode of laser # 3
12	LD2C cathode of laser # 2
13	PD1A anode photo diode # 1
14	LD1C cathode of laser # 1
15	Interlock to be shortened to any GND pin
16	GND ground
17	GND ground
18	LD8A anode of laser # 8
19	GND ground
20	LD7A anode of laser # 7
21	LD6A anode of laser # 6
22	GND ground
23	LD5A anode of laser # 5
24	LD4A anode of laser # 4
25	GND ground
26	LD3A anode of laser # 3
27	LD2A anode of laser # 2
28	GND ground
29	LD1A anode of laser # 1
30	GND ground
31	GND ground
32	PD8C cathode photo diode # 8
33	PD8A anode photo diode # 8
34	PD7C cathode photo diode # 7
35	PD6C cathode photo diode # 6
36	PD6A anode photo diode # 6

Pin	Connector
37	PD5C cathode photo diode # 5
38	PD4C cathode photo diode # 4
39	PD4A anode photo diode # 4
40	PD3C cathode photo diode # 3
41	PD2C cathode photo diode # 2
42	PD2A anode photo diode # 2
43	PD1C cathode photo diode # 1
44	LEDA out for a LED to show the on/off status

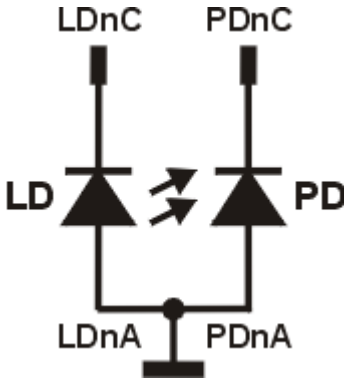
3.3.3 AG Standard Configurations - No Bias Voltage

Laser Diode - AG; Photo Diode - CG



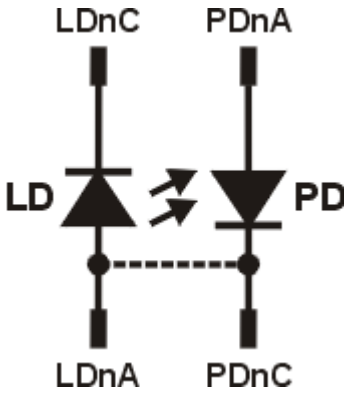
n = Number of Channel (1 to 8)

Laser Diode - AG; Photo Diode - AG



n = Number of Channel (1 to 8)

Laser Diode - AG; Photo Diode - floating



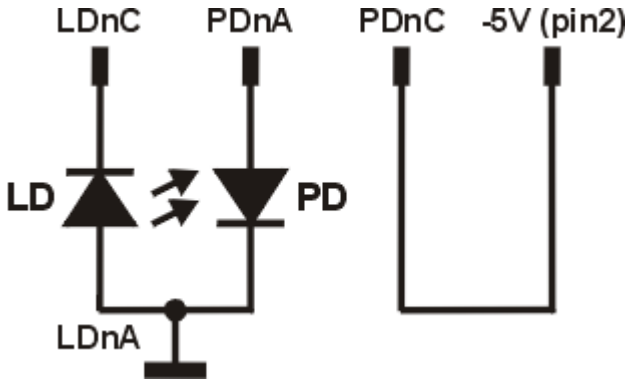
n = Number of Channel (1 to 8)

Note

The connection, marked as dashed line, can be made either at the connector or at the laser diode.

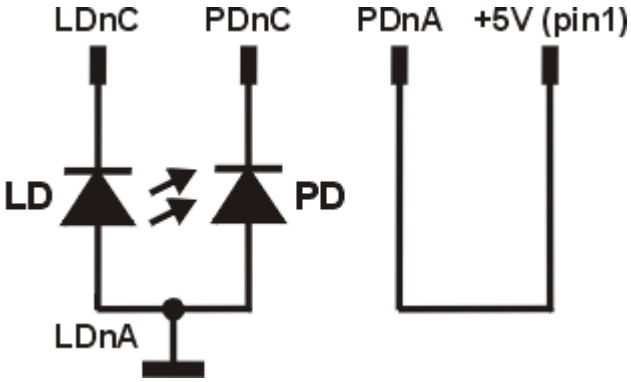
3.3.4 AG Standard Configurations - 5 V Internal Bias Voltage

Laser Diode - AG; Photo Diode - CG



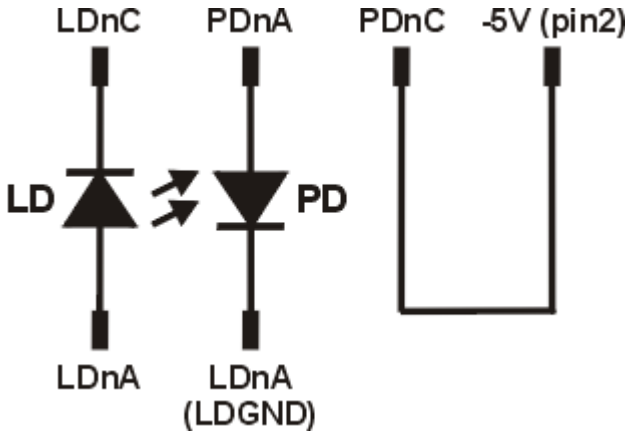
n = Number of Channel (1 to 8)

Laser Diode - AG; Photo Diode - AG



n = Number of Channel (1 to 8)

Laser Diode - AG; Photo Diode - floating



n = Number of Channel (1 to 8)

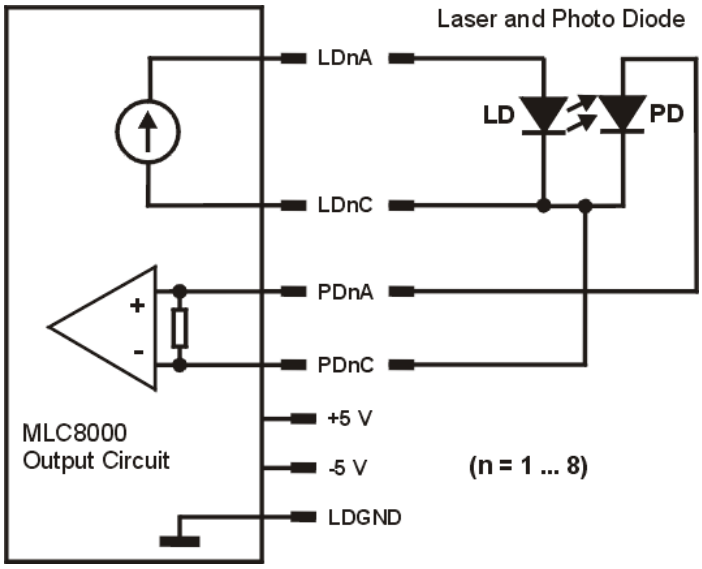
Attention

A reverse connection of the photo diode using a bias voltage can permanently damage the device!

3.4 Connecting Components - Cathode Ground Version

3.4.1 CG Output Port Connection Scheme

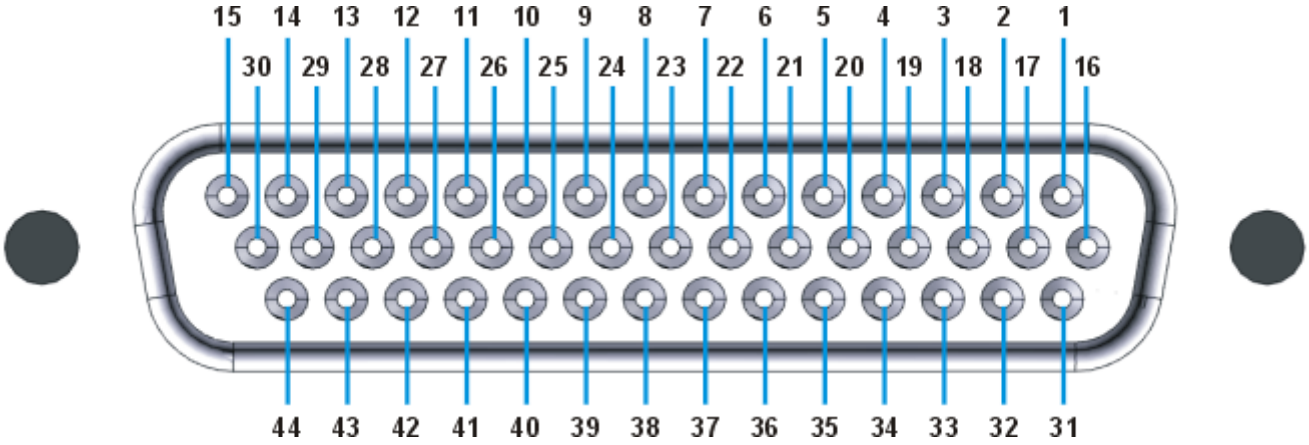
Each laser is connected to an MLC8xxx-8AG output port as shown below:



We recommend to use separate wires drilled in pairs (twisted pair) in a common shield for laser diode current and monitor diode current respectively.

The shield must be connected to ground.

3.4.2 CG MLC8xxx Output Connector Pinning



Pin Assignment Sorted by Function

Pin	Connector
14	LD1A anode of laser # 1
12	LD2A anode of laser # 2
11	LD3A anode of laser # 3
9	LD4A anode of laser # 4
8	LD5A anode of laser # 5
6	LD6A anode of laser # 6
5	LD7A anode of laser # 7
3	LD8A anode of laser # 8
29	LD1C cathode of laser # 1
27	LD2C cathode of laser # 2
26	LD3C cathode of laser # 3
24	LD4C cathode of laser # 4
23	LD5C cathode of laser # 5
21	LD6C cathode of laser # 6
20	LD7C cathode of laser # 7
18	LD8C cathode of laser # 8
13	PD1A anode of the photo diode of laser # 1
42	PD2A anode of the photo diode of laser # 2
10	PD3A anode of the photo diode of laser # 3
39	PD4A anode of the photo diode of laser # 4
7	PD5A anode of the photo diode of laser # 5
36	PD6A anode of the photo diode of laser # 6
4	PD7A anode of the photo diode of laser # 7
33	PD8A anode of the photo diode of laser # 8

Pin	Connector
43	PD1C cathode of the photo diode of laser # 1
41	PD2C cathode of the photo diode of laser # 2
40	PD3C cathode of the photo diode of laser # 3
38	PD4C cathode of the photo diode of laser # 4
37	PD5C cathode of the photo diode of laser # 5
35	PD6C cathode of the photo diode of laser # 6
34	PD7C cathode of the photo diode of laser # 7
32	PD8C cathode of the photo diode of laser # 8
31	GND ground
16	GND ground
17	GND ground
19	GND ground
22	GND ground
25	GND ground
28	GND ground
30	GND ground
44	LEDA out for a LED to show the on/off status
15	Interlock to be shortened to any GND pin
1	+ 5 V
2	- 5 V

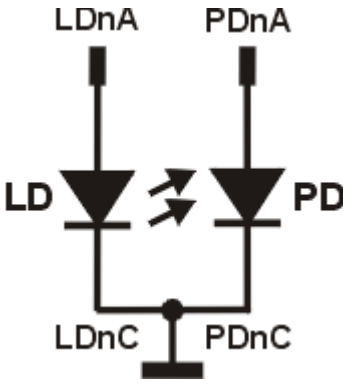
Pin Assignment Sorted by Pin Number

Pin	Connector
1	+ 5 V
2	- 5 V
3	LD8A anode laser # 8
4	PD7A anode photo diode # 7
5	LD7A anode laser # 7
6	LD6A anode laser # 6
7	PD5A anode photo diode # 5
8	LD5A anode laser # 5
9	LD4A anode laser # 4
10	PD3A anode photo diode # 3
11	LD3A anode laser # 3
12	LD2A anode laser # 2
13	PD1A anode photo diode # 1
14	LD1A anode of laser # 1
15	Interlock to be shortened to any GND pin
16	GND ground
17	GND ground
18	LD8C cathode laser # 8
19	GND ground
20	LD7C cathode laser # 7
21	LD6C cathode laser # 6
22	GND ground
23	LD5C cathode laser # 5
24	LD4C cathode laser # 4
25	GND ground
26	LD3C cathode laser # 3
27	LD2C cathode laser # 2
28	GND ground
29	LD1C cathode laser # 1
30	GND ground
31	GND ground
32	PD8C cathode photo diode # 8
33	PD8A anode photo diode # 8
34	PD7C cathode photo diode # 7
35	PD6C cathode photo diode # 6
36	PD6A anode photo diode # 6

Pin	Connector
37	PD5C cathode photo diode # 5
38	PD4C cathode photo diode # 4
39	PD4A anode photo diode # 4
40	PD3C cathode photo diode # 3
41	PD2C cathode photo diode # 2
42	PD2A anode photo diode # 2
43	PD1C cathode photo diode # 1
44	LEDA out for a LED to show the on/off status

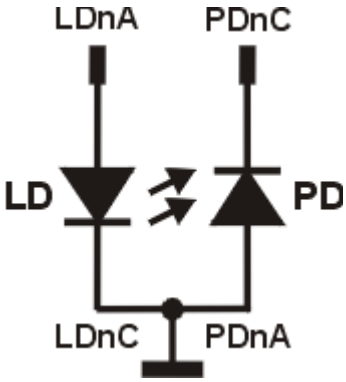
3.4.3 CG Standard Configurations - No Bias Voltage

Laser Diode - CG; Photo Diode - CG



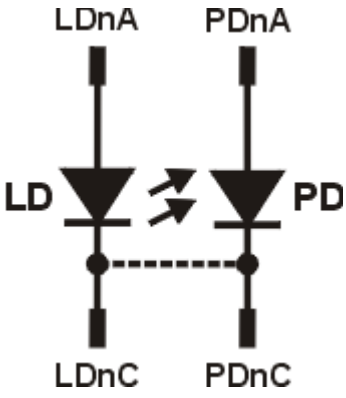
n = Number of Channel (1 to 8)

Laser Diode - CG; Photo Diode - AG



n = Number of Channel (1 to 8)

Laser Diode - CG; Photo Diode - floating



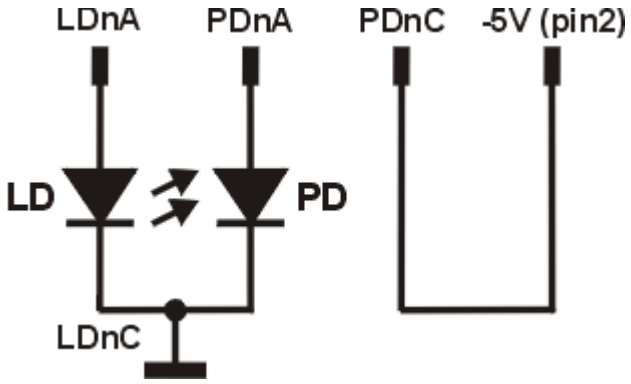
n = Number of Channel (1 to 8)

Note

The connection, marked as dashed line, can be made either at the connector or at the laser diode.

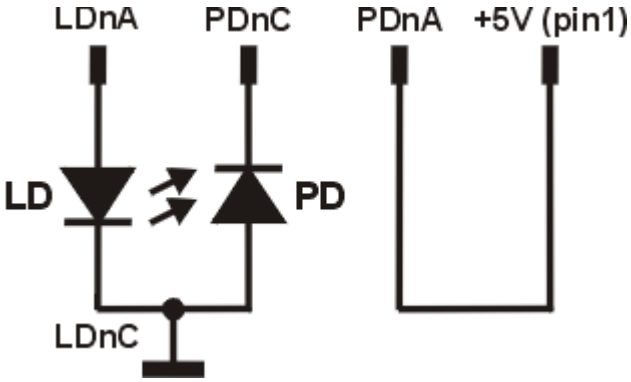
3.4.4 CG Standard Configurations - 5 V Internal Bias Voltage

Laser Diode - CG; Photo Diode - CG



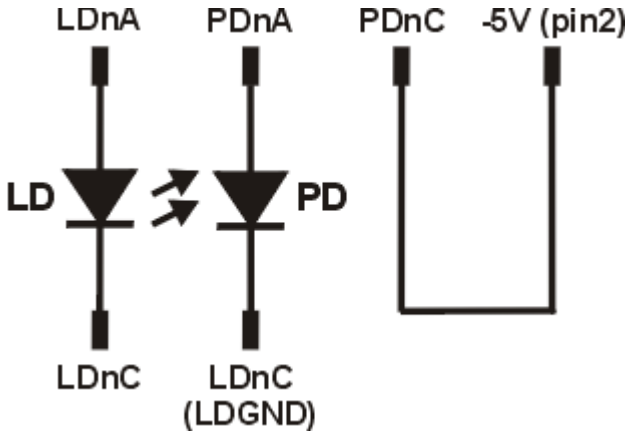
n = Number of Channel (1 to 8)

Laser Diode - CG; Photo Diode - AG



n = Number of Channel (1 to 8)

Laser Diode - CG; Photo Diode - floating



n = Number of Channel (1 to 8)

Attention

A reverse connection of the photo diode using a bias voltage can permanently damage the device!

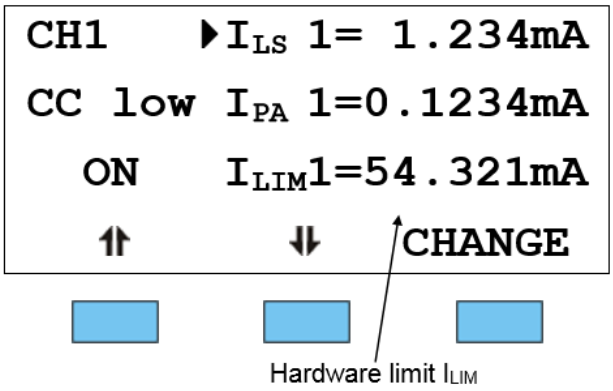
4 Operating Instruction

4.1 Pre-Settings

Setting the Hardware Current Limit I_{LIM}

The maximum Laser Diode Current can be limited by hardware setting in order to protect the laser. This setting affects all output ports simultaneously.

The hardware limit I_{LIM} is set with the potentiometer 5 9 marked ILIM at the front panel of the module. The value is displayed continuously in the channel menu of the module so you can observe it during adjustment:



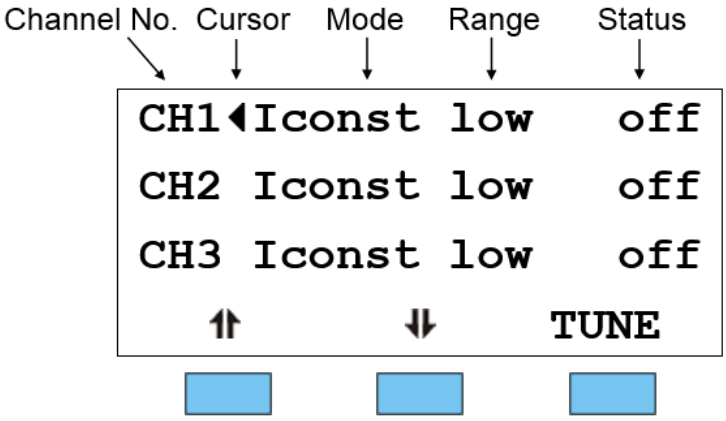
Note

$I_{LIM}1$ to $I_{LIM}8$ always show the same value.

4.2 Functions in the Main Menu

Display

The main menu shows the channel number, mode, range and status of the MLC8000 module.



Selecting a Module

Select a module for further input by setting the cursor to the channel number of the desired module using the soft keys ↑ and ↓.

CH2◂

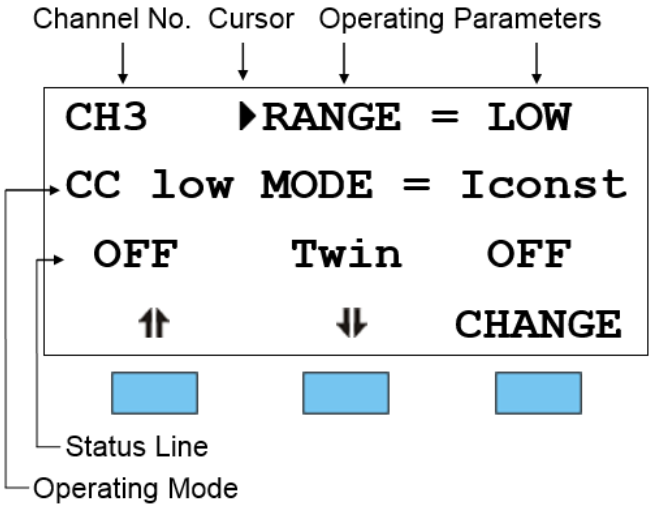
Pressing ESC will lead to the channel menu 26.

4.3 Functions in the Channel Menu

The channel menu is opened from the main menu by pressing the key CHANNEL. Hit again CHANNEL or ESC to return to the main menu.

4.3.1 Display

In the channel menu all parameters of the selected module are shown:



Parameter List

In the channel menu the following abbreviations are used:
In CP (Constant Current) mode:

I_{LS} 1 ... I_{LS} 8 **L**aser diode **s**et current of channel 1... 8
I_{PA} 1 ... I_{PA} 1 **P**hoto diode **a**ctual current of channel 1 ... 8

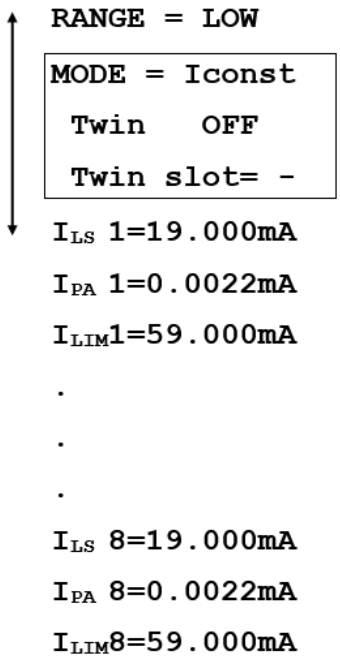
In constant power mode:

I_{PS} 1 ... I_{PS} 8 **P**hoto diode **s**et current of channel 1 ... 8
I_{LA} 1 ... I_{LA} 8 **L**aser diode **a**ctual current of channel 1 ... 8

In both modes

I_{LIM}1 ... I_{LIM}8 **Lim**it current (is the same for channel 1 ... 8)

Only three parameters can be shown at a time, so there is a scroll function. All parameters are sorted in a virtual list, which can be run through with the cursor:



Status Line

The status line shows the actual status:

Normal operation

ON	Laser is on
OFF	Laser is off

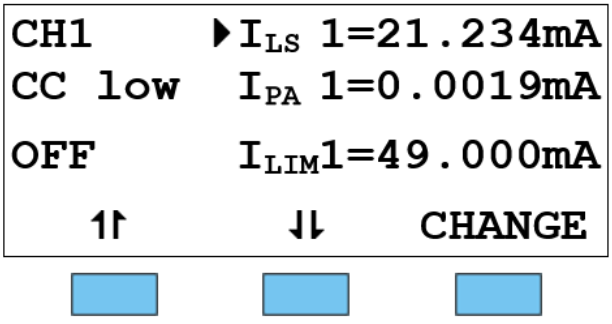
Malfunction

■Vcc ■	Internal power supply failed - maintenance required
■OTP ■	**O**ver **T**emperature **P**rotection - module overheated
■ILCK■	Interlock is open
■ILIM■	Limit Current reached during operation

4.3.2 Changing Parameters

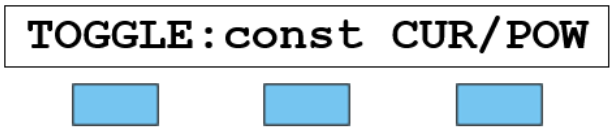
To set or change a numerical parameter in the channel menu select the respective line with the cursor:

Example: Change **ILS 1**:



Pressing the soft key **CHANGE** will activate the tuning knob to change the selected parameter.

If the parameter is only to toggle (e.g. operating mode), the function of the soft keys will change:



Pressing the soft key **TOGGLE** toggles the operating mode between constant current and constant power.

Pressing the 

key terminates the procedure.

Note

Some parameters can not be changed, as they are measurement values (i.e. the laser voltage) or cannot be changed while the laser current output switched on. In these cases the access is denied indicated by a long beep.

4.3.3 Selecting the Laser Diode Current Range

To change the range of the laser diode current, select the parameter

RANGE =

in the channel menu. The right soft key toggles between “high” and “low” range.

4.3.4 Selecting CC or CP mode

The MLC8000 multi laser controller modules offer two operating modes for the laser diodes: constant current and constant power mode.

In ***CC (constant current) mode*** the laser diode current is maintained constant. A temperature change of the laser changes the optical power as well, since the laser efficiency will change.

In ***CP (constant power) mode*** a monitor diode is used to measure the emitted laser power. A constant monitor current is equivalent to a constant optical power. To maintain the monitor current constant, the laser diode current is controlled correspondingly.

Note

For "constant power" mode a separate monitor diode will be necessary for each laser in the set up.

In order to change the operating mode of the laser diodes, the parameter

MODE =

can be set to:

I CONST = Constant current mode

P CONST = Constant power mode

See Changing Parameters 27.

4.3.5 Using a Separate TED8xxx Module for Temperature Protection

If the laser diodes are temperature controlled and shall be operable only within a specific temperature range (window), the temperature window function of a TED8xxx module can be used. For details, please see the TED8xxx manual.

Therefore this TED8xxx must be assigned to the MLC8000 module. Two steps are necessary:

1) Assign the desired TED8xxx module to the MLC8000 by setting the parameter

   `Twin slot =`

   to the desired slot number of the TED8xxx. If there is only one TED8xxx module inserted in the PRO8000 mainframe, the appropriate slot is recognized automatically.

2) Then, the temperature protection needs ton be switched ON:
   `Twin ON`

Disable the temperature protection using the command

`Twin slot =`

`Twin OFF`

4.4 Switching ON and OFF

Attention

MLC8000 modules can be switched on or off at any time, with no regard if any parameters have been set! So make sure that the appropriate Pre-Settings 25 are made prior to switching on the module!

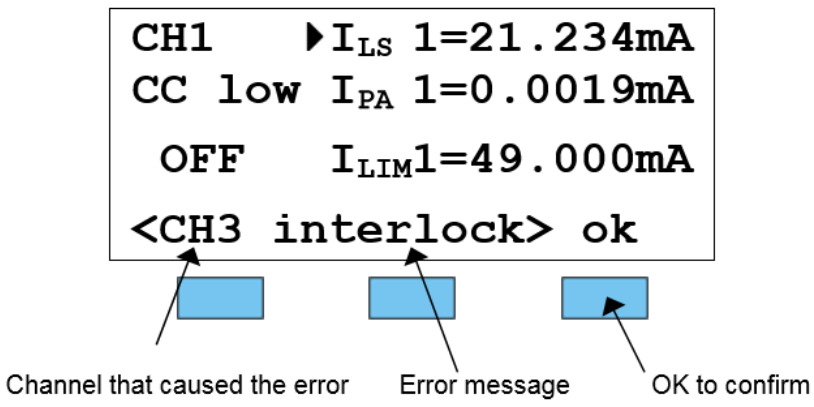
Select the module to be switched on or off in the main menu 25. The LED “SEL” of the selected module lights up.

Press the key CHANNEL to switch on the selected module. The LED “ON” of the selected will lights up, this way indicating that the laser current is enabled.

4.5 Error Messages

Error messages are shown in the bottom line of the display independent of the actual menu (main menu or channel menu).

If an error occurs while the module is switched on, the display shows for example:



Possible error messages for an MLC8000 module are:

INTERLOCK	Laser was switched off or cannot be switched on due to interlock circuit interruption.
OTP	**O**ver **T**emperature **P**rotection. Module has been switched off due to overheating. The module can be switched on only after cooling down.
Vcc fail	Internal supply voltage failure. Please contact Thorlabs 55.
Not if LD on	Certain parameters are not allowed to be changed while laser is ON.

In case a TED80xx module is linked to the MLC8000 module:

TWIN	Temperature is out of window (when window is activated).
ctrl Temp	T_{ACT} exceeded T_{WIN}, the laser was switched off.

If the error occurs during operation it is written in brackets:

<CH1 INTERLOCK>

If the error occurs by trying to switch on it is written in cursor arrows:

◀CH1 interlock▶

Any error must be confirmed by pushing the "**ok**" soft key. Any further operation is locked until "**ok**" soft key is pushed.

5 Communication with a PC

The description of the PRO8000 Series mainframe includes all instructions of how to prepare and execute the programming of the system via a computer interface.

Special operation features of the MLC8000 module are described here. See also section Operating Instruction 25.

Note

All analog values are read and written in SI units, i.e. A (not mA), W (not mW) etc. Letters may be written in small or capital letters.

Attention

Prior to programming a MLC8000 module the limit value of the laser diode current I_{LIM} (hardware limit) for the applied laser diodes must be set using a screwdriver.

The corresponding potentiometer is marked ILIM and is located on the front panel 9 of the MLC8000# module.

The value ILIM is constantly measured by the PRO8000 Series mainframe and can be checked in the channel menu 25 of the MLC8000 during setting.

5.1 Nomenclature

Program messages (PC to PRO8000) are written in inverted commas:	**"*IDN?"**
Response messages (PRO8000 to PC) are written in brackets:	**[:SLOT 1]**
Decimal point:	**1.234**
Subsequent parameters are separated with commas:	**"PLOT 2,0"**
Subsequent commands are separated with semicolons:	**"*IDN?;*STB?"**

5.2 Data Format

According to the IEEE 488.2 specifications all data variables are divided into 4 different data formats:

Character response data (<CRD>) is a single character or a string.
Examples: **A** or **ABGRS** or **A125TG** or **A1.23456A**

(See IEE488.2 49, section 8.7.1)

Numeric response data Type 1 (<NR1>) is a numerical value with sign in integer notation.
Examples: **1** or **+1** or **-22** or **14356789432**

(See IEE488.2 49, section 8.7.2)

Numeric response data Type 2 (<NR2>) is a numerical value with or without sign in floating point notation without exponent.
Examples: **1.1** or **+1.1** or **-22.1** or **14356.789432**

(See IEE488.2 49, section 8.7.3)

Numeric response data Type 3 (<NR3>) is a numerical value with or without sign in floating point notation with exponent with sign.
Examples: **1.1E+1** or **+1.1E-1** or **-22.1E+1** or **143.56789432E+306**

(See IEE488.2 49, section 8.7.4)

5.3 Commands and Queries

5.3.1 Select the Module Slot

Command	Explanation Response Example
":SLOT <NR1>"	Selects a slot for further programming **<NR1>** = 1…8 PRO8000, PRO8000-4 **<NR1>** = 1…2 PRO800
":SLOT?"	Queries the selected slot **[:SLOT <NR1><LF>]**

5.3.2 Selecting the Channel (Port)

Command	Explanation Response Example
Programming	
":PORT 1"	Selects port 1 for further commands
":PORT 2"	Selects port 2 for further commands
Reading	
":PORT?"	Reads the selected port **[:PORT <NR1><LF>]**

5.3.3 Setting the Laser Diode Current (ILD)

Note

These commands control the laser diode current of the laser of a specific channel. Please select first this channel (port) by the command **"PORT <NR1>"**.

Command	Explanation Response Example
Programming	
":ILD:SET <NR3>"	Programs the laser diode set current
":ILD:START <NR3>"	Programs the laser diode start current for “ELCH” *)
":ILD:STOP <NR3>"	Programs the laser diode stop current for “ELCH”
":ILD:MEAS <NR1>"	Programs the laser diode current as measurement value on position <NR1> in the output string for “ELCH” (<NR1> = 1....8)
Reading	
":ILD:SET?"	Reads the laser diode set current **[:ILD:SET <NR3><LF>]**
":ILD:ACT?"	Reads the actual laser diode current **[:ILD:ACT <NR3><LF>]**

Command	Explanation Response Example
":ILD:MIN?"	Reads the allowed minimum laser diode current **[:ILD:MIN <NR3><LF>]**
":ILD:MAX?"	Reads the allowed maximum laser diode current **[:ILD:MAX <NR3><LF>]**
":ILD:MIN_W?"	Reads the minimum laser diode current for I_{LD} – DAC = 0000 **[:ILD:MIN_W <NR3><LF>]**
":ILD:MAX_W?"	Reads the maximum laser diode current for I_{LD} – DAC = FFFF **[:ILD:MAX_W <NR3><LF>]**
":ILD:MIN_R?"	Reads the minimum laser diode current for I_{LD} – DAC = 0000 **[:ILD:MIN_R <NR3><LF>]**
":ILD:MAX_R?"	Reads the maximum laser diode current for I_{LD} – DAC = FFFF **[:ILD:MAX_R <NR3><LF>"]**
":ILD:START?"	Reads the laser diode start current for “ELCH” **[:ILD:START <NR3><LF>]**
":ILD:STOP?"	Reads the laser diode stop current for “ELCH” **[:ILD:STOP <NR3><LF>]**
":ILD:MEAS?"	Reads the position of the laser diode current as measurement value in the output string for “ELCH” (**1....8, 0** if not selected**)** **[:ILD:MEAS <NR1><LF>]**

*) ELCH = **EL**ectrical **CH**aracterization, a PRO8000 Macro Function. Please see the PRO8000 Series Mainframe Manual for details.

5.3.4 Changing the Monitor Diode Current (IMD)

Note

These commands control the monitor diode current of the laser of a specific channel. Please select first this channel (port) by the command **"PORT <NR1>"** (See section Selecting the Channel (Port) 32)

Command	Explanation Response Example
Programming	
":IMD:SET <NR3>"	Programs the monitor diode set current
":IMD:START <NR3>"	Programs the monitor diode start current for “ELCH” *)
":IMD:STOP <NR3>"	Programs the monitor diode stop current for “ELCH”
":IMD:MEAS <NR1>"	Programs the monitor diode current as measurement value in the “ELCH” output string on position <NR1> (1....8)
Reading	
":IMD:SET?"	Reads the monitor diode set current **[:IMD:SET <NR3><LF>]**

Command	Explanation Response Example
":IMD:ACT?"	Reads the actual monitor diode current **[:IMD:ACT <NR3><LF>]**
":IMD:MIN?"	Reads allowed minimum monitor diode set current **[:IMD:MIN <NR3><LF>]**
":IMD:MAX?"	Reads allowed maximum monitor diode set current **[:IMD:MAX <NR3><LF>]**
":IMD:MIN_W?"	Reads minimum monitor diode current for I_{PD} – DAC = 0000 **[:IMD:MIN_W <NR3><LF>]**
":IMD:MAX_W?"	Reads maximum monitor diode current for I_{PD} – DAC = FFFF **[:IMD:MAX_W <NR3><LF>]**
":IMD:MIN_R?"	Reads minimum monitor diode current for I_{PD} – DAC = 0000 **[:IMD:MIN_R <NR3><LF>]**
":IMD:MAX_R?"	Reads maximum monitor diode current for I_{PD} – DAC = FFFF **[:IMD:MAX_R <NR3><LF>]**
":IMD:START?"	Reads the monitor diode start current for “ELCH” **[:IMD:START <NR3><LF>]**
":IMD:STOP?"	Reads the monitor diode stop current for “ELCH” **[:IMD:STOP <NR3><LF>]**
":IMD:MEAS?"	Reads the position of the monitor diode current as measurement value in the “ELCH” output string (**1....8**, **0** if not selected) **[:IMD:MEAS <NR1><LF>]**

*) ELCH = **EL**ectrical **CH**aracterization, a PRO8000 Macro Function. Please see the PRO8000 Series Mainframe Manual for details.

5.3.5 Switching the Output On and Off (LASER)

Command	Explanation Response Example
Programming	
":LASER ON"	Turns the laser output on
":LASER OFF"	Turns the laser output off
Reading	
":LASER?"	Reads status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

5.3.6 Reading the Laser Diode Hardware Limit (LIMCP)

Command	**Explanation** **Response Example**
Reading	
":LIMCP:ACT?"	Reads the actual hardware-limit **[:LIMCP:ACT <NR3><LF>]**
":LIMCP:MIN_R?"	Reads I_{max} – ADC = 0000 **[:LIMCP:MIN_R <NR3><LF>]**
":LIMCP:MAX_R?"	Reads I_{max} – ADC = FFFF **[:LIMCP:MAX_R <NR3><LF>]**

5.3.7 Selecting the Operation Mode (MODE)

Command	**Explanation** **Response Example**
Programming	
":MODE CC"	Constant current mode
":MODE CP"	Constant power mode
Reading	
":MODE?"	Reads the mode of operation **[:MODE CC<LF>]** **[:MODE CP<LF>]**

5.3.8 Setting the Current Range (RANGE)

Command	**Explanation** **Response Example**
Programming	
":RANGE <NR1>"	Setting the current range **0** (low current) or **1** (high current)
Reading	
":RANGE?"	Reads the current range **[:RANGE <NR1><LF>]**

5.3.9 Activating the Temperature Protection (TP)

Command	Explanation Response Example
Programming	
":TP ON"	Switches temperature protection on
":TP OFF"	Switches temperature protection off
Reading	
":TP?"	Reads status of the temperature protection **[:TP ON<LF>]** **[:TP OFF<LF>]**

5.3.10 Assigning a TEC for Temperature Protection (TPSLOT)

Command	Explanation Response Example
Programming	
":TPSLOT <NR1>"	Program assigned slot number (1...8 for PRO8000 and PRO8000-4, 1...2 for PRO800)
Reading	
":TPSLOT?"	Reads assigned slot number **[:TPSLOT <NR1><LF>]**

5.3.11 Reading the Type of Module (TYPE)

Command	Explanation Response Example
Reading	
":TYPE:ID? "	Reads the module ID (here 47) **[:TYPE:ID 47<LF>]**
":TYPE:SUB? "	Reads module subtype: 0: Anode ground version: **[:TYPE:SUB 0<LF>]** 1: Cathode ground version: **[:TYPE:SUB 1<LF>]**

5.4 IEEE Error Messages

[1601, "Interlock is open"]

Possible reason: Attempt to switch on laser while interlock loop 10 is open.

[1603, "Over temperature"]

Reason: **O**ver **T**emperature **P**rotection was tripped. The module is overheated and cannot be switched on.

[1604, "Internal power failure"]

Reason: Severe hardware error. Please contact Thorlabs 55.

[1607, "No setting of ILD during constant power mode"]

Reason: The set value for ILD (laser current) cannot be changed in CP (constant power) mode.

[1608, "No setting of IMD during constant current mode"]

Reason: The set value for IPD (monitor photo diode current) or PLD (laser output power) cannot be changed in CC (constant current) mode.

[1616, "No mode change during laser on"]

Reason: The operating mode CC or CP cannot be changed while laser output is switched on.

[1619, "No changing of current range during laser on"]

Reason: The current range cannot be changed while laser output is switched on.

[1620, "Attempt to switch on laser while temperature is out of window"]

Reason: Attempt to switch on the laser while the laser temperature is outside of the temperature window.

[1621, "Attempt to activate Twin although there is no TEC in the system"]

Reason: The temperature window protection could not be activated because a TEC8xxx module was not recognized in the PRO8000 mainframe.

[1622, "Attempt to activate Twin during laser on"]

Reason: The temperature window cannot be activated while the laser output is switched on.

[1623, "No TEC in this slot"]

Reason: There is no TED8xxx module in the selected slot.

5.5 Status Reporting

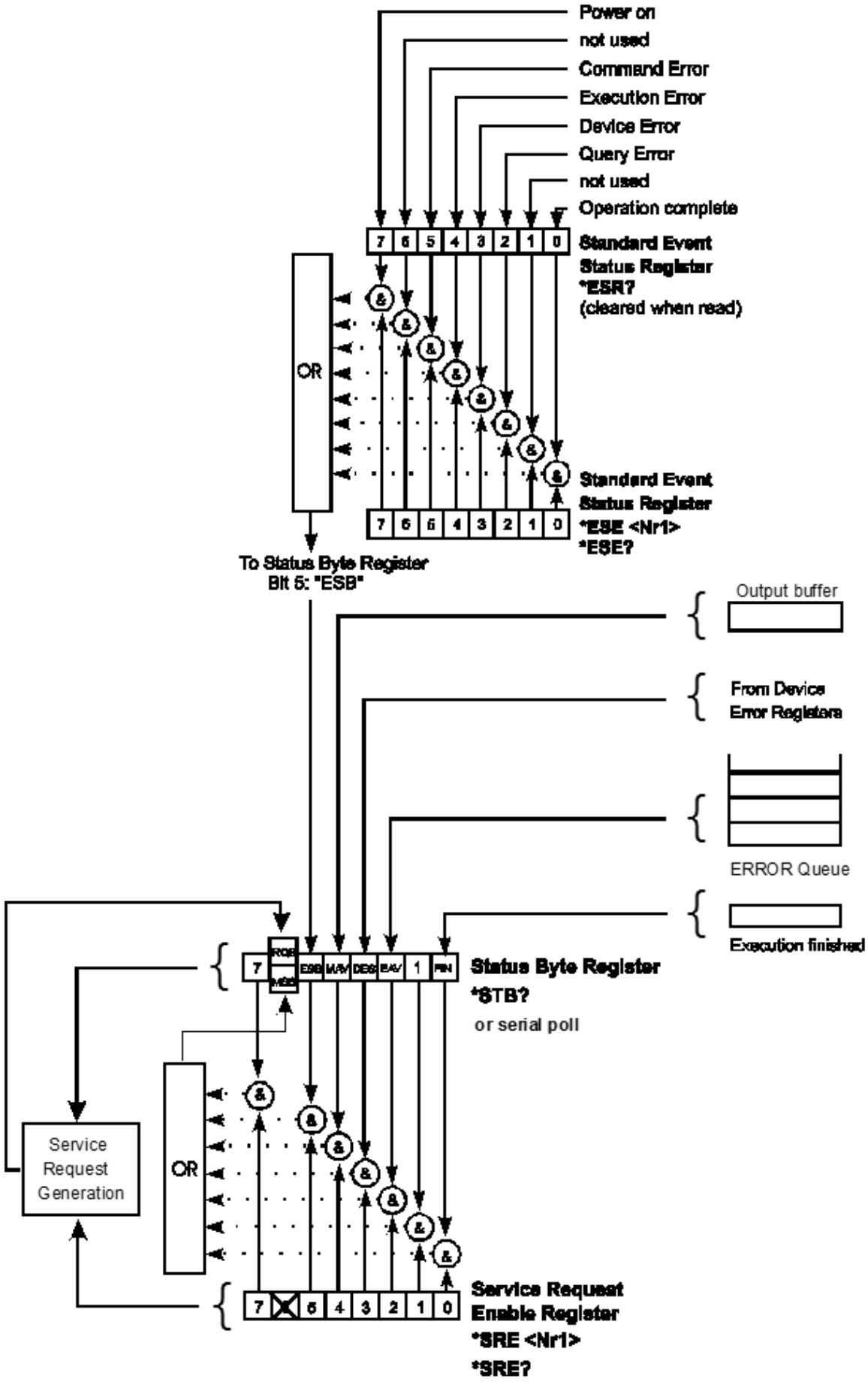
The MLC8000 module provides four 8 bit registers 39

- ESR Standard event status register
- ESE Standard event Status Enable Register
- STB Status Byte Register
- SRE Service Request Enable Register

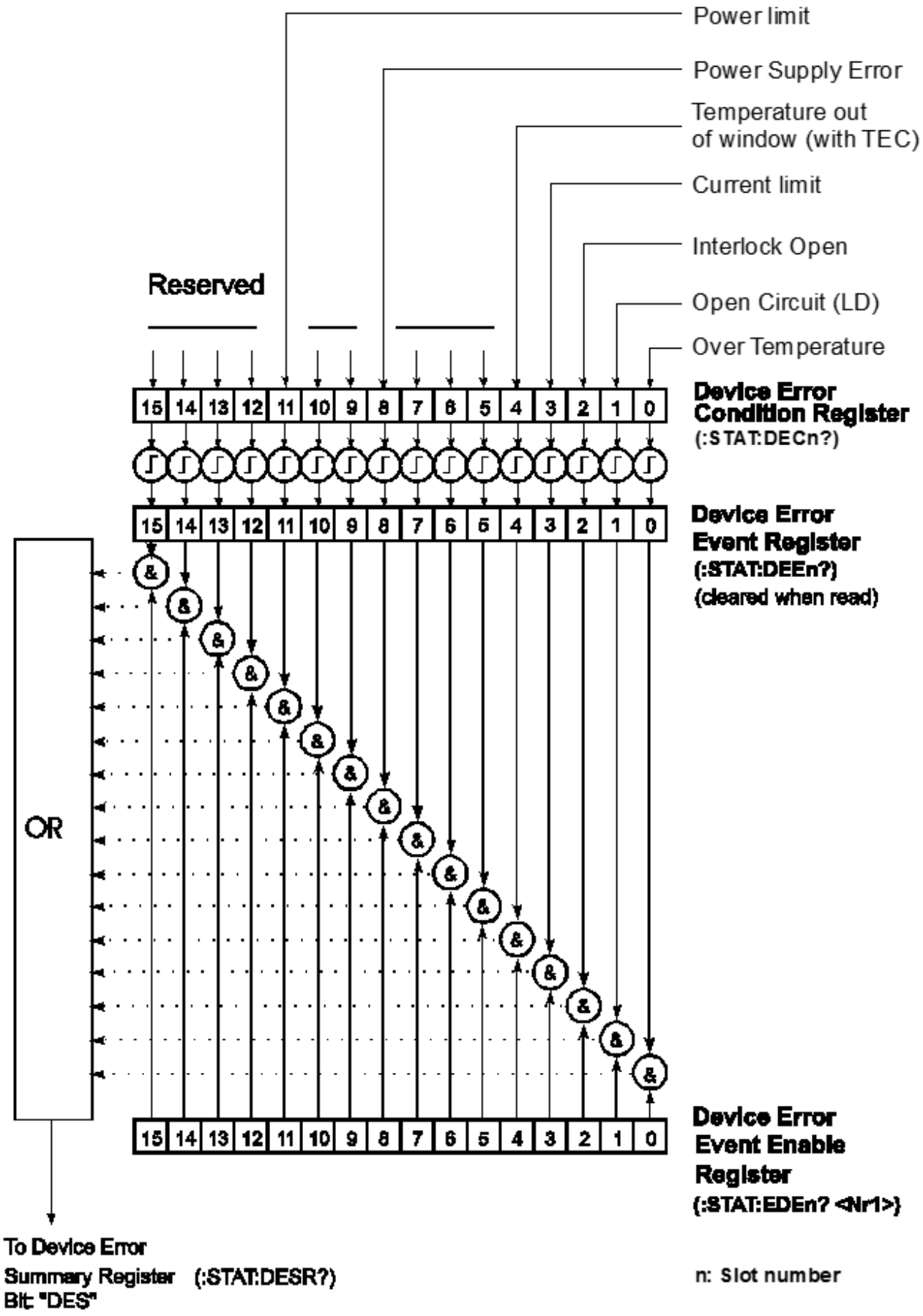
and three 16 bit registers 40

- DEC Device Error Condition Register
- DEE Device Error Event Register
- EDE Device Error Event Enable Register

to program various service request functions and status reporting. See also IEE488.2 Standard 49, section 11.



Structure of the registers ESR, ESE, STB and SRE



Structure of the registers DEC, DEE and EDE

5.5.1 Standard Event Status Register (ESR)

The ESR can be read directly with the command **"*ESR?"**. Reading the ESR clears it at the same time. The content of the ESR can not be set.

The bits are active high and represent the following standard events:

Power on :	This bit indicates the off to on state of the power supply. State = HIGH after switching on the device for the first time.
User request :	(not used)
Command error:	A command error occurred.
Execution error:	An execution error occurred.
Device dependent error:	A device dependent error (module error) occurred.
Query error:	An error occurred trying to query a value.
Request control:	not used
Operation complete:	Can be set with **"*OPC"**. All started operations have been completed. System is in idle mode.

5.5.2 Standard Event Status Enable Register (ESE)

The bits of the ESE are used to select which bits of the ESR shall influence bit 5 (ESB) of the Status Byte Register (STB).

The 8 bits of the ESE are connected by logical "AND" with the according 8 bits of the ESR. These 8 results are connected by logical "OR", so that any "hit" leads to a logical 1 of bit 5 (ESB) of the STB.

As any bit of the STB can assert an SRQ, every event (bit of the ESR) can be used to assert an SRQ.

5.5.3 Status Byte Register (STB)

The bits of this register show the status of the PRO8000 mainframe. The register can be read out using ***STB?**. The content of the STB can not be set. The bits are active high.

RQS	**R**e**Q**uest **S**ervice message: Shows that this device has asserted SRQ (read via serial poll).
MSS	**M**aster **S**ummary **S**tatus: Shows that this device requests a service (read via **"*STB?"**).
MAV (Message AVailable)	This bit is high after a query, as a result "waits" in the output queue to be fetched. It is low, if the output queue is empty.
DES (Device Error Status)	This bit is high after a device error occurred. EDE defines which device errors this bit sets.
EAV (Error AVailable)	This bit is high as long as there are errors in the error queue.
FIN (command FINished)	This bit is high, after a command has finished and all bits of the STB have been set.

All bits except bit 6 of the STB can be used to assert a service request (SRQ 42). Alternatively the SRQ can be recognized using the command "*STB? 42 or by serial poll 42.

5.5.4 Service Request Enable Register (SRE)

The bits of the SRE are used to select which bits of the STB shall assert an SRQ.

Bit 0, 1, 2, 3, 4, 5 and 7 of the STB are combined by logical "AND" with the according 7 bits of the SRE. These 7 results are combined by logical "OR", so that any "hit" leads to a logical 1 in bit 6 of the STB and asserts an SRQ.

5.5.5 Reading the STB by Detecting SRQ

If an SRQ 42 is asserted, bit 6 of the STB is set to logical 1, so that the controller can detect by serial polling, which device asserted the SRQ.

5.5.6 Reading the STB by *STB? Command

If the controller does not "listen" to SRQs at all, the service request can be detected by reading the status byte with the command **"*STB?"**.

If bit 6 is logical 1, a service request was asserted.

5.5.7 Reading STB by Serial Poll

If the controller does not support auto serial poll, the service request can also be detected via manual serial poll.

If bit 6 is logical 1, a service request was asserted.

5.5.8 Device Error Condition Register (DEC)

The bits of this register show the errors, that occur during operation (operation errors). The bits are active high.

If the error disappears, the bits are reset to low.

For MLC8000 modules the bits 0 to 4, 8 and 11 are used

Bit 0 - Over temperature
MLC8000 is overheated. Wait until the module has cooled down. Maintain proper air flow.

Bit 1 - Open circuit
Laser diode circuit is open.

Bit 2 - Interlock open
The interlock has opened or path resistance is >430 Ω.

Bit 3 - Current limit
The current limit is reached and the protection circuit is active now. Noise and drift specs are not valid any more.

Bit 4 - Temperature out of window
Appropriate laser temperature (controlled by an TEC8xxx module) is out of specified window.

Bit 8 - Power supply error
Internal power supply error.

Bit 11 - Power limit
The given hard- or software power limit is reached.

The DEC can be read but not set. Reading does not clear the DEC.

5.5.9 Device Error Event Register (DEE)

The bits of this register hold the errors that occurred during operation (operation errors). So each bits of the DEC sets the according bit of the DEE.

The DEE can be read but not set.

Reading out clears the DEE.

5.5.10 Device Error Event Enable Register (EDE)

The bits of the EDE are used to select, which bits of the DEE shall influence bit 3 (DES) of the STB.

The 8 bits of the EDE are combined by logical "AND" to the according 8 bits of the DEE. These 8 results are combined by logical "OR" so that any "hit" leads to a logical 1 in bit 3 (DES) of the STB.

As any bit of the STB can assert an SRQ, every error (bit of the DEE) can be used to assert an SRQ.

6 Maintenance and Service

Protect the MLC8000 from adverse weather conditions. The MLC8000 is not water resistant.

Attention

To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

The unit does not need a regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs 55 for return instructions.

Do not remove covers!

In order to ensure best performance, accuracy and reliable operation, Thorlabs recommends a **recalibration after 24 months.**

6.1 Troubleshooting

In case that your MLC8000 shows malfunction please check the following items:

◆ **The mainframe does not work at all (no display on the mainframe):**

- ➢ Is the mainframe connected properly to the mains power supply?
  - Connect the mainframe to the power line, take care of the correct voltage setting and grounding of the mainframe.
- ➢ Is the mainframe turned on?
  - Turn on the power key switch.
- ➢ Check the fuse at the rear panel of the mainframe.
  - If blown, replace the fuse with the correct type (one spare fuse is inserted in the fuse holder). Please refer to section Exchanging the Mains Fuse in the PRO8000 Series Manual.

◆ **The display works, but not the module:**

- ➢ Is the module inserted correctly and are all mounting screws tightened?
  - Insert the module in the desired slot and tighten all mounting screws properly.

◆ **You don’t get the desired laser output power**

- ➢ Is the interlock closed?
  - Verify that the resistance between the interlock pins of the connector jack does not exceed 430 Ω. See section Connecting Interlock and Status Display 10.
- ➢ Is the desired module selected?
  - Select the desired module on the display by means of the up- and down arrow keys. (LED “SEL” on the front panel lights up).
- ➢ Is the desired port selected?
  - Select the desired port for input on the display by means of the up and down arrow keys or by the **":PORT <NR1>"** command.
- ➢ Is the laser output turned ON in the main menu or one of the sub menus?
  - Change the status setting from “off” to “on”. The LED “ON” on the front panel of the module must light.

- Is the hardware limit I_{LIM} set correctly?
  - Adjust the hardware limit I_{LIM} by means of the potentiometer on the MLC8000# front panel
- Is the laser current of the corresponding port set correctly?
  - Adjust the laser current in the channel menu to the desired value.
- Is the laser diode installed properly?
  - Control the connection cable.
- Is the laser diode poled correctly?
  - If not, change the polarity of the laser diode corresponding to the type of MLC8000 module (AG or CG)
- Is the photo diode connected properly?
  - Check the connecting cable.
- Do you use a temperature window with inappropriate setting or with no TEC connected?
  - Change settings, install TEC or turn off the window function

If above hints could not resolve the malfunction, please contact Thorlabs55 for technical support and/or return instructions.

7 Appendix

7.1 Technical Data

Common Specifications	
Compliance voltage	≤ 4V
Photo diode current range	5 µA to 2 mA
Photo diode current resolution	0.5 µA
Photo diode current accuracy	± 6 µA
PD reverse BIAS voltage	0V / 5V (wireable)
Laser Diode Polarity	AG or CG (Factory Fixed)

MLC8025-8AG (-8CG)		
Range	LOW	HIGH
Laser Current	5 mA	25 mA
Setting accuracy	± 15 µA	± 75 µA
Setting / Measurement Resolution	1.2 µA	6 µA
Noise w/o (10 Hz to10 MHz)	< 0.5 µA	< 0.5 µA
Ripple (50 Hz, RMS)	< 0.5 µA	< 0.5 µA
Transients (Other, Typ.)	< 25 µA	
Short Term Fluctuations (15 s)	< 0.15 µA	< 0.3 µA
Drift (60 min, 0 to 10 Hz)	< 0.3 µA	< 1 µA
Temperature Coefficient	< 50 ppm / °C	
Setting Range HW Limit	0 to ≥ 5 mA	0 to ≥ 25 mA
Setting Accuracy HW Limit	± 50 µA	± 125 µA
Resolution HW Limit	1.2 µA	6 µA

MLC8050-8AG (-8CG)		
Range	LOW	HIGH
Laser Current	10 mA	50 mA
Setting accuracy	± 30 µA	± 150 µA
Setting / Measurement Resolution	2.5 µA	12 µA
Noise w/o (10 Hz to10 MHz)	< 0.5 µA	< 0.5 µA
Ripple (50 Hz, RMS)	< 0.5 µA	< 0.5 µA
Transients (Other, Typ.)	< 50 µA	
Short Term Fluctuations (15 s)	< 0.25 µA	< 0.6 µA
Drift (60 min, 0 to 10 Hz)	< 0.5 µA	< 1.5 µA
Temperature Coefficient	< 50 ppm / °C	
Setting Range HW Limit	0 to ≥ 10 mA	0 to ≥ 50 mA
Setting Accuracy HW Limit	± 100 µA	± 250 µA
Resolution HW Limit	2.5 µA	12 µA

MLC8100-8AG (-8CG)		
Range	LOW	HIGH
Laser Current	25 mA	100 mA
Setting accuracy	± 75 µA	± 300 µA
Setting / Measurement Resolution	6 µA	25 µA
Noise w/o (10 Hz to10 MHz)	< 0.5 µA	< 1 µA
Ripple (50 Hz, RMS)	< 0.5 µA	< 1 µA
Transients (Other, Typ.)	< 100 µA	
Short Term Fluctuations (15 s)	< 0.25 µA	< 1 µA
Drift (60 min, 0 to 10 Hz)	< 1 µA	< 3 µA
Temperature Coefficient	< 50 ppm / °C	
Setting Range HW Limit	0 to ≥ 25 mA	0 to ≥ 100 mA
Setting Accuracy HW Limit	± 0.25 mA	± 0.5 mA
Resolution HW Limit	6 µA	25 µA

MLC8200-8AG (-8CG)		
Range	LOW	HIGH
Laser Current	50 mA	200mA
Setting accuracy	± 150 µA	± 600 µA
Setting / Measurement Resolution	12 µA	50 µA
Noise w/o (10 Hz to10 MHz)	< 0.5 µA	< 1.5 µA
Ripple (50 Hz, RMS)	< 0.5 µA	< 1 µA
Transients (Other, Typ.)	< 200 µA	
Short Term Fluctuations (15 s)	< 0.5 µA	< 2 µA
Drift (60 min, 0 to 10 Hz)	< 1.5 µA	< 5 µA
Temperature Coefficient	< 50 ppm / °C	
Setting Range HW Limit	0 to ≥ 50 mA	0 to ≥ 200 mA
Setting Accuracy HW Limit	± 0.5 mA	± 1 mA
Resolution HW Limit	12 µA	50 µA

General	
Connector	44-pin HD D-Sub (F) (for laser diode, photodiode and general interlocks etc.)
Card Width	1 Slot
Operating Temperature Range [1])	0 - 40 °C
Storage Temperature Range	-40 to 70 °C
Weight	< 500 g

[1]) non-condensing

All technical data are valid at 23 ± 5°C and 45 ± 15% rel. humidity (non condensing)

7.2 Certifications and Compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 2004/108/EC [1] for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions [2,3,4] and Immunity [2,3,5]
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance Criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance Criterion B) [5]
	IEC 61000-4-4	Electrical Fast Transient / Burst Immunity (Performance Criterion C)
	IEC 61000-4-5	Power line Surge Immunity (Performance criterion C)
	IEC 61000-4-6	Conducted RF Immunity (Performance Criterion B)
	IEC 61000-4-11	Voltage Dips and Interruptions Immunity (Performance Criterion C)
	EN 61000-3-2	AC Power Line Harmonic Emissions
Australia / New Zeeland Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard [2,3,4]	
	AS/NZ 2064	Industrial, Scientific, and Medical Equipment: 1992
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B [2,3,4].	

[1] Replaces 89/336/EEC.

[2] Compliance demonstrated using high-quality shielded interface cables shorter than or equal to 3 meters, including with a custom-made shielded cable installed at the LD OUT port.

[3] Compliance demonstrated with the MLC8000 Series modules installed in the Thorlabs PRO8xxx Series Mainframes.

[4] Emissions, which exceed the levels required by these standards, may occur when this equipment is connected to a test object.

[5] Minimum Immunity Test requirement.

[6] Replaces 73/23/EEC, amended by 93/68/EEC

7.3 Literature

[1] IEEE488.2-1992 - IEEE Standard Codes, Formats, Protocols, and Common Commands for Use With IEEE Std 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation

Available at http://www.ieee.org/publications_standards/index.html .

7.4 Warranty

Thorlabs warrants material and production of the MLC8000 for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to Thorlabs. The customer will carry the shipping costs to Thorlabs, in case of warranty repairs Thorlabs will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and software determined by Thorlabs for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs is not liable for consequential damages.

Restriction of warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

7.5 Copyright and Exclusion of Reliability

Thorlabs has taken every possible care in preparing this Operation Manual. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this manual is regularly updated and adapted to reflect the current status of the software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.

Please note that the content of this User Manual is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of *Thorlabs* result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this User Manual. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the User Manual, please contact your local *Thorlabs* dealer or system installer.

7.6 Thorlabs 'End of Life' Policy

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 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see figure below)
- 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

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.).

Waste treatment on 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.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment 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-life products will thereby avoid negative impacts on the environment.

Crossed out
"Wheelie Bin" symbol

7.7 List of Acronyms

The following abbreviations are used in this manual:

AC	Alternating Current
ADC	Analog to Digital Converter
AG	Anode Ground
CG	Cathode Ground
CLR	CLeaR
CR	Carriage Return
CRD	Character Response Data
DAC	Digital to Analog Converter
DC	Direct Current
DCL	Device Clear
DEC	Device Error Condition Register
DEE	Device Error Event Register
DES	Device Error Status
EAV	Error AVailable
EDE	Enable Device Error Event Register
EDFA	Erbium Doped Fiber Amplifier
ELCH	ELectrical Characterization
EOI	End Of Information
ESE	Standard Event Status Enable register
ESR	Event Status Register
FIN	Command FINished
GET	Group Execute Trigger
GTL	Go To Local
IEEE	Institute for Electrical and Electronic Engineering
LD	Laser Diode
LDC	Laser Diode Controller
LED	Light Emitting Diode
LF	Line Feed
LLO	Local Lockout
LS	Laser Source Module
NR1	Numeric Response data of type 1
NR2	Numeric Response data of type 2
NR3	Numeric Response data of type 3
MAV	Message AVailable)
MSS	Master Summary Status

OTP	Over TemPerature
PC	Personal Computer
PD	Photo Diode
RQS	ReQuest Service Message
SDC	Selected Device Clear
SEL	SELect
SRE	Service Request Enable Register
SRQ	Service ReQuest
STB	STatus Byte Register
SW	Soft Ware
TEC	ThermoElectric Cooler (Peltier Element)
TRG	TRiGger

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