THORLABS

Thorlabs Instrumentation

LDC8000
Laser Diode Current Modules
Operation Manual

2016

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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 LDC8000 Modules are Laser Diode Current Controllers that are capable to drive laser diodes with different connection schemes - CG (cathode grounded) and AG (anode grounded) - as well as with or without monitor diodes.

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 LDC8000, 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 LDC8000 Series are allowed to be operated only a mainframe of the PRO8000 series.

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 LDC8000 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
LDC8001ULN	Laser Current Controller Module ± 100 mA, Ultra Low Noise
LDC8002	Laser Current Controller Module ± 200 mA
LDC8005	Laser Current Controller Module ± 500 mA
LDC8010	Laser Current Controller Module ± 1 A
LDC8020	Laser Current Controller Module ± 2 A
LDC8040	Laser Current Controller Module ± 4 A
LDC8080	Laser Current Controller Module ± 8 A
CAB400	Cable for LDC8001ULN to LDC8040 (9 pin Connector), 1.5 m, to connect Thorlabs Laser Diode Mounts

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 LDC8000 mechanically and electrically.

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

1. LDC8000 Series Module
2. Operating Manual

2.2 Operating Principle

The LDC8000 current modules are bipolar current sources for laser diodes. The different module types operate in the same way, the differences are in maximum current, resolution and accuracy (see Technical Data 45)

The current modules LDC8000 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.

The output can operate either in constant current or constant power mode.

The laser diode current (constant current mode) or the monitor diode current (constant power mode) of the LDC8000 modules are set with 16 bit resolution.

Limit values for the laser diode current (software limit) and the monitor diode current (limiting the optical output power) are set with a resolution of 12 bit.

The monitor diode current is read back with 16 bit, the laser diode current, laser diode voltage and the limit for the laser diode current (hardware limit) with 15 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.

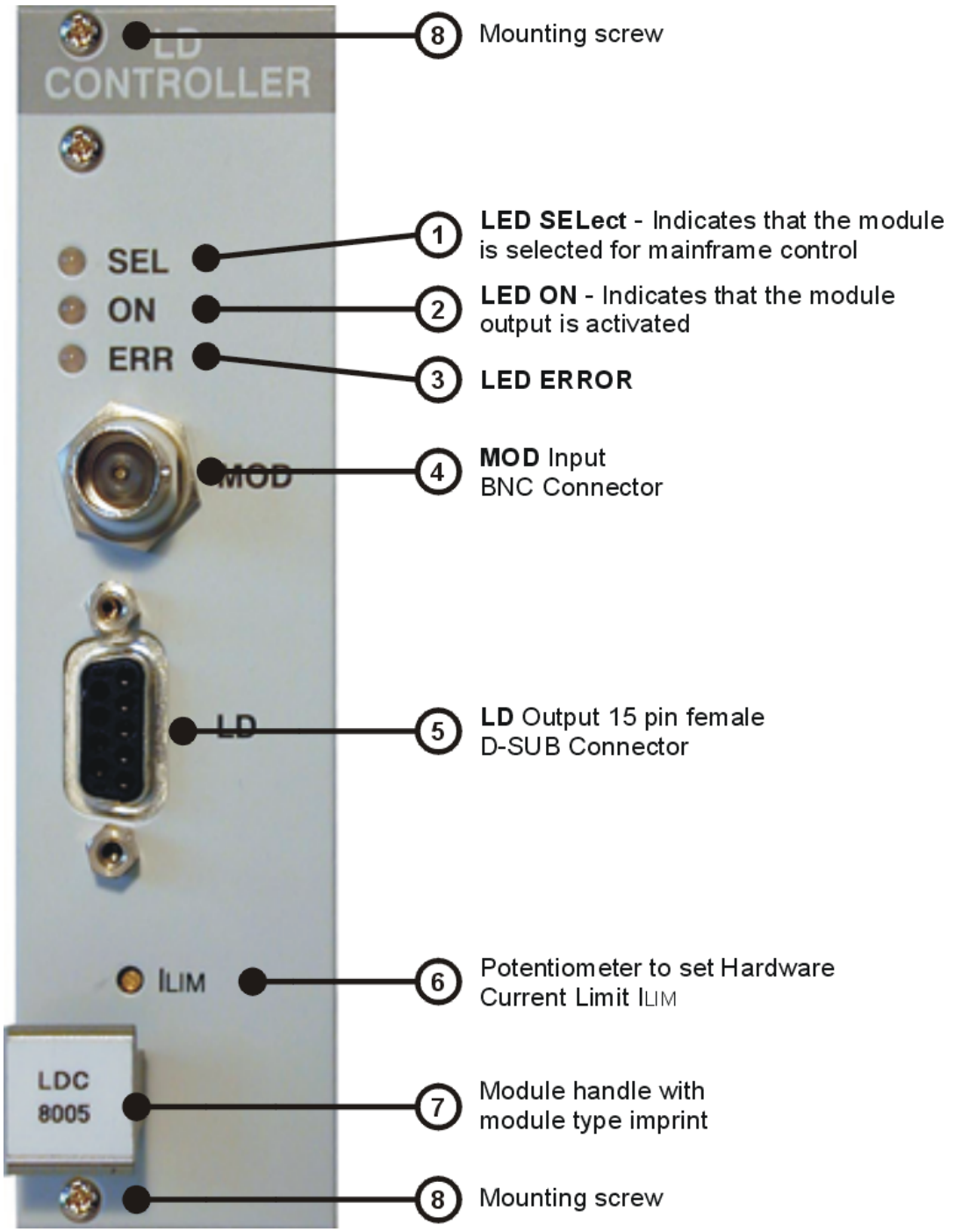
Laser Diode Protection Features

To protect the connected laser diodes the LDC8000 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.

- **Open-Circuit Protection of the connection cable to the laser diode**
  Protection against cable damage or bad contact.
- **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



Note

This figure is valid for all LDC8000 modules with the exception of the LDC8080 which is of double width and has a 15-pin HD D-SUB jack instead of the 9-pin D-SUB jack shown above.

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

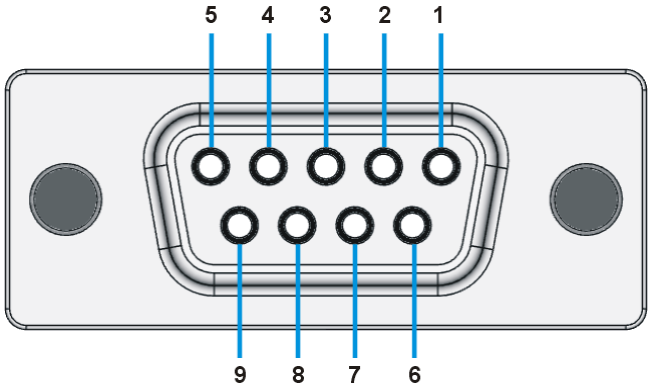
The laser diode is always sourced against ground by the current controller. This is of a considerable advantage with respect to laser protection and to the laser diode current stability.

The 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.

The LDC8000 modules come with separate inputs for laser forward voltage measurement. This allows a 4-wire connecting scheme that eliminates measurement errors due to the voltage drop caused by the injection current.

3.1.1 LDC8010 to LDC8040

Pin Assignment of the Output Connector



Female 9 pin D-SUB Connector

Pin	Connector
	Interlock, Status Display
1	Output for Interlock and Status LASER ON/OFF
5	Ground (return) for pin 1
	Laser Diode
7	Laser Diode Cathode with Polarity AG
8	Laser Diode Anode with Polarity CG
3	Laser Diode Ground
	Monitor Diode
4	Monitor Diode Input
2	Monitor Diode Ground
	Measurement Input for Laser Diode Forward Voltage
9	Laser Diode Anode
6	Laser Diode Cathode

We recommend to use separate wires drilled in pairs (twisted pair) in a common shield for laser diode current, monitor diode current and laser voltage measurement, respectively. The shield must be connected to ground potential (pin 3).

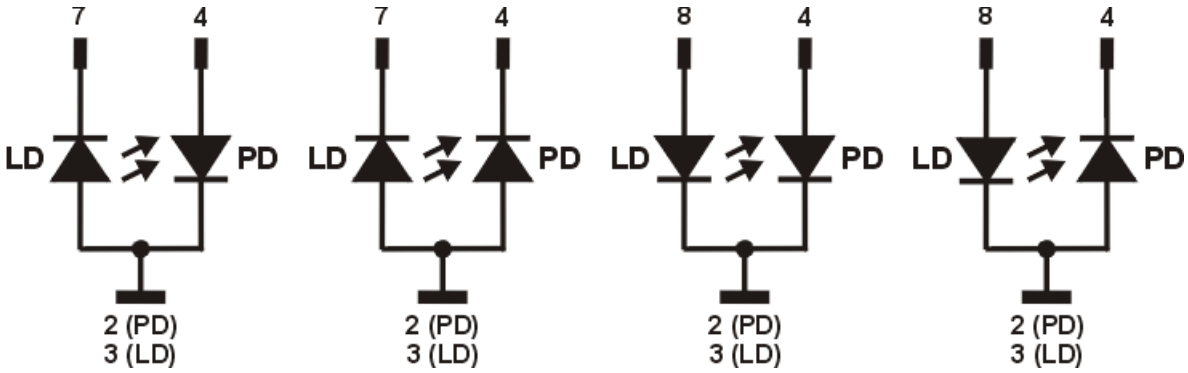
If an external monitor diode is used, it must be connected via coaxial cable with the shield to pin 2 and the inner conductor to pin 4.

Connect laser and monitor diode to the connector jack of the LDC8000 module.

The lines for voltage measurement of the laser diode (pin 6 and pin 9) must be connected as closely as possible to the laser diode to avoid measurement errors.

The ground conductor of the monitor diode (pin 2) can be connected to the ground conductor of the laser diode (pin 3). If this is necessary (e.g. laser diodes with integrated monitor diode and common ground), connect the ground conductors as closely as possible to the laser diode to avoid measurement errors when measuring the monitor diode current.

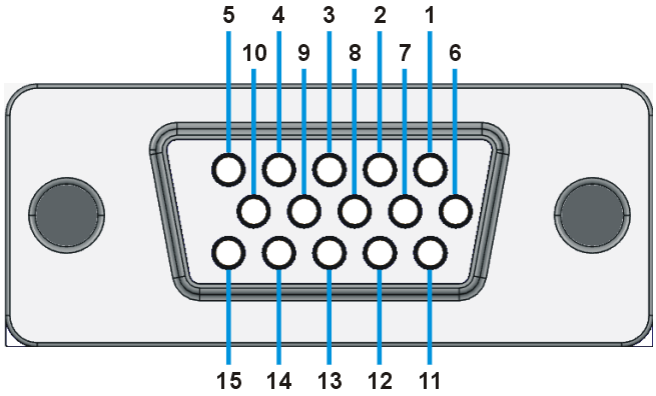
In this case the following pin assignments of the output jack are possible (shown without voltage measurement):



LD - Laser Diode; PD - Photo (Monitor) Diode

3.1.2 LDC8080

Pin Assignment of the Output Connector



Female 15 pin D-SUB HD Connector

Pin	Connector
	Interlock, Status Display
6	Output for Interlock and Status LASER ON/OFF
15	Ground (return) for pin 1
	Laser Diode
1, 2, 7	Laser Diode Cathode with Polarity AG
4, 5, 10	Laser Diode Anode with Polarity CG
3, 8, 9	Laser Diode Ground
	Monitor Diode
13	Monitor Diode Input
12	Monitor Diode Ground
	Measurement Input for Laser Diode Forward Voltage
14	Laser Diode Anode
11	Laser Diode Cathode

Note

When connecting the laser, all 3 respective pins 1, 2, 7 and 3, 8, 9 (AG) or 4, 5, 10 and 3, 8, 9 (CG) must be used!

We recommend to use separate wires drilled in pairs (twisted pair) in a common shield for laser diode current (3x), monitor diode current and laser voltage measurement, respectively. The shield must be connected to ground potential (pin 3, 8, 9).

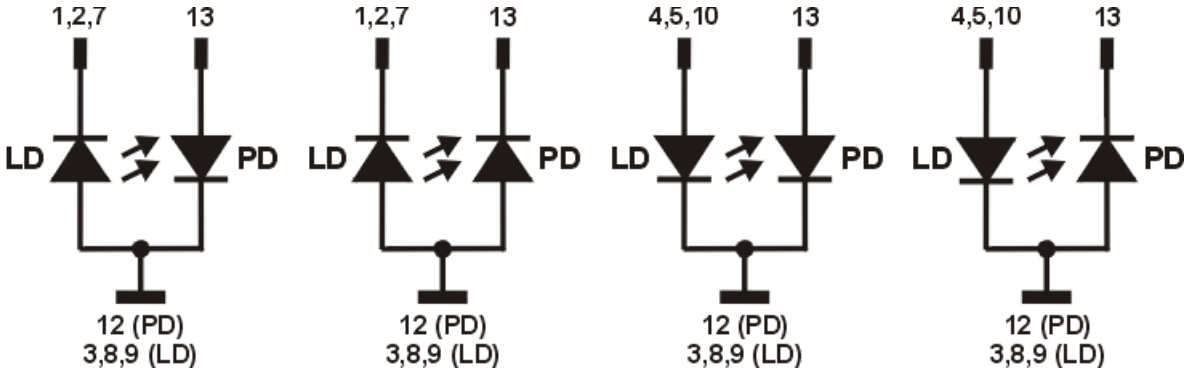
If an external monitor diode is used, it must be connected via coaxial cable with the shield to pin 12 and the inner conductor to pin 13.

Connect laser and monitor diode to the connector jack of the LDC8000 module.

The lines for voltage measurement of the laser diode (pin 11 and pin 14) must be connected as closely as possible to the laser diode to avoid measurement errors.

The ground conductor of the monitor diode (pin 12) can be connected to the ground conductor of the laser diode (pin 3, 8, 9). If this is necessary (e.g. laser diodes with integrated monitor diode and common ground), connect the ground conductors as closely as possible to the laser diode to avoid measurement errors when measuring the monitor diode current.

In this case the following pin assignments of the output jack are possible (shown without voltage measurement):



LD - Laser Diode; PD - Photo (Monitor) Diode

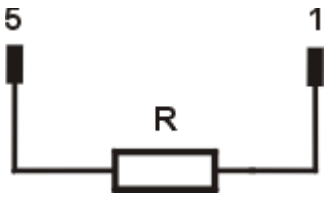
3.2 Connecting Interlock and Status Display

Interlock and cable damage monitoring

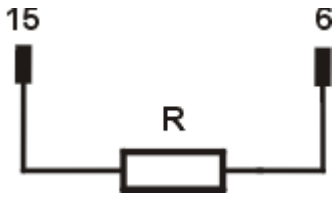
The interlock function provides a safety feature in order to switch off instantly the laser.

Therefore, the connection between pin 1 and pin 5 (LDC8001ULN to LDC8040) or pin 6 and pin 15 (LDC8080) of the connector jack serves as safety circuit:

- If the resistance between above mentioned pins is less than 430 Ω (short circuit allowed), the laser current is enabled and can be switched on.



LDC8001ULN to LDC8040
R = 0 to 430 Ω



LDC8080
R = 0 to 430 Ω

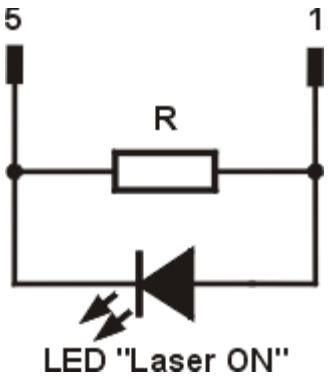
Note

Using a resistor > 430 Ω may lead to a malfunction as the status of the interlock is then in an undefined range.

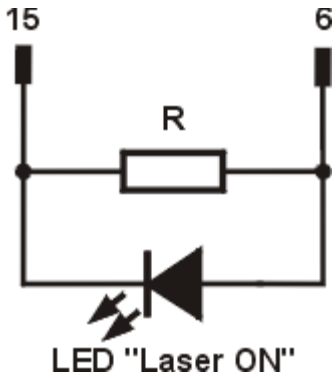
- In the case that the current between the interlock pins is interrupted, the laser controller module cannot be switched on. If this interruption happens during operation, the output will be switched off immediately and remains switched off until the interlock circuit is closed again and the LDC8000 is switched on again.

Status display

For Laser On/Off status indication, a LED with a 470 Ω resistor in parallel can be connected between the two interlock pins. The LED will light up when the laser output is switched on.



LDC8001ULN to LDC8040
R = 470 Ω



LDC8080
R = 470 Ω

Note

Mispoling the LED may lead to a malfunction as the status of the interlock is then in an undefined range.

3.3 Using the Modulation Input

Depending on the mode of operation (constant current or constant power), the laser diode current or the optical power of the LDC8000 can be modulated by an external voltage signal.

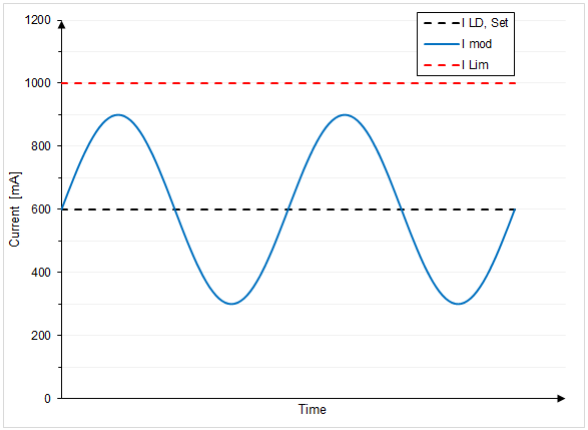
Note

The specified modulation bandwidth is given as "Small signal 3 dB bandwidth", whereas "small signal" means, that the modulation current amplitude does not exceed 10% of the maximum current that can be delivered by the given LDC8000 module. "3 dB" stands for the -3 dB drop of the modulation amplitude at the upper modulation frequency, which is equivalent to a drop for about 29%.

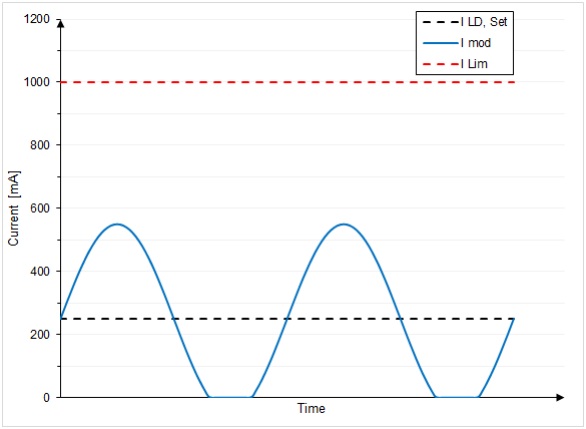
The modulation current is proportional to the applied external modulation voltage; the "modulation coefficient" is module specific, see Technical Data 45. The resulting modulating current is superposed to the laser set current. This is advantageous as all protective functions will remain active and the laser will run safely. In order to avoid clipping of the modulated laser current, it is important to adjust the set current and the modulation amplitude in such way, that the resulting current

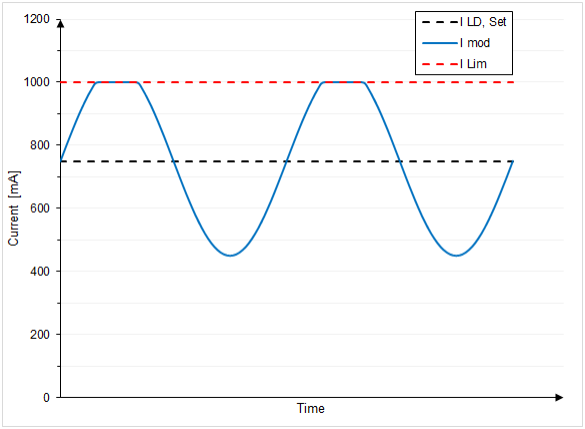
- does not exceed the laser maximum current, defined by the hardware or the software limit 17 - whichever is lower.
- does not underrun a zero current.

The diagram below shows an example of correct settings:



The diagrams below show settings that lead to laser current clipping:





Expressed mathematically, the settings are:

$$I_{LD,Set} - m * U_{Mod,max} > 0 \quad \text{and} \quad I_{LD,Set} + m * U_{Mod,max} < I_{LD,Lim}$$

with: $I_{LD,Set}$ - Laser current setpoint

$I_{LD,Lim}$ - Laser limit current

m - Modulation coefficient

$U_{Mod,max}$ - Amplitude of the applied external modulation voltage

Note

The modulation coefficient is module dependent!

4 Operating Instruction

Note

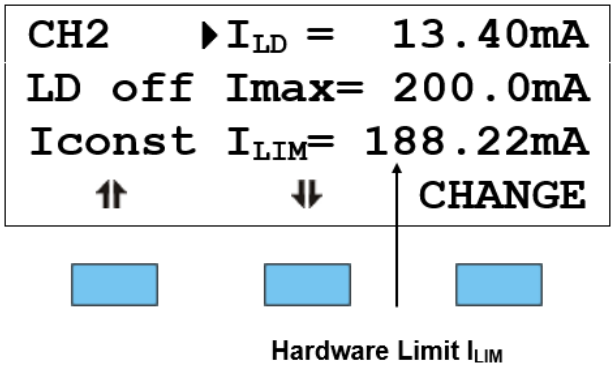
All settings that are made to the LDC8000 modules via the Control Panel of the PRO8000 mainframe are applied immediately; no need to confirm settings.

4.1 Pre-Settings

The maximum Laser Diode Current can be limited in order to protect the laser. There are three different limits:

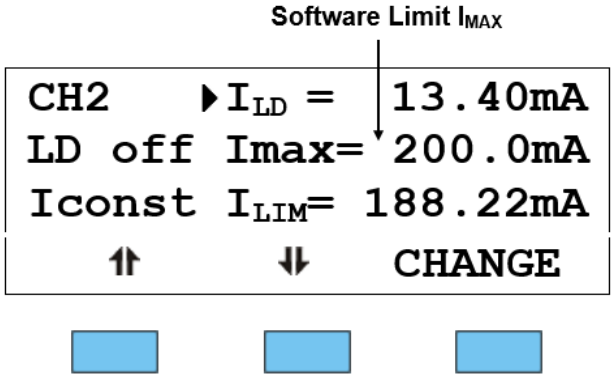
Setting the Hardware Current Limit I_{LIM}

The hardware limit I_{LIM} is set with the potentiometer 6 8 marked **I_{LIM}** 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:



Software Limit I_{MAX}

The software limit I_{MAX} affects the current control of the LDC8000 module via the D/A converter and yields exactly the same protective function as the hardware limit. See section Functions in the Channel Menu 19.



Note

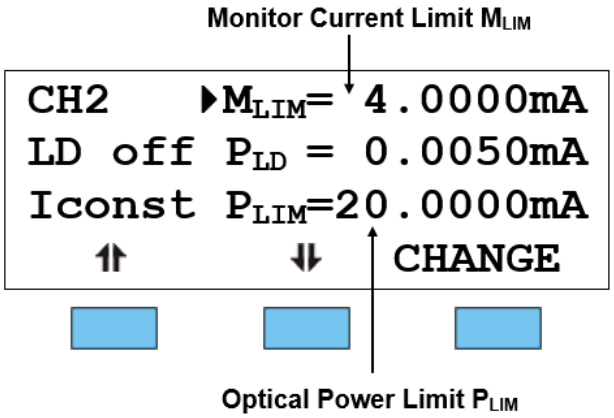
The laser current limitation is enabled at the lower value of the two limits I_{MAX} or I_{LIM}.

Limit value for the optical power P_{LIM} (monitor diode current M_{LIM})

Beside injection current limitation, the LDC8000 modules are capable to limit the optical power as well in “Constant Power” mode. In this case, the photodiode current is the control criteria. The limits for the monitor diode current M_{LIM} or the optical power P_{LIM} can be set manually in

the channel menu of the module or remotely via the control computer.

The monitor diode current limit affects directly the current control of the LDC8000 module via the A/D converter and reacts practically immediately, without delay.



Note

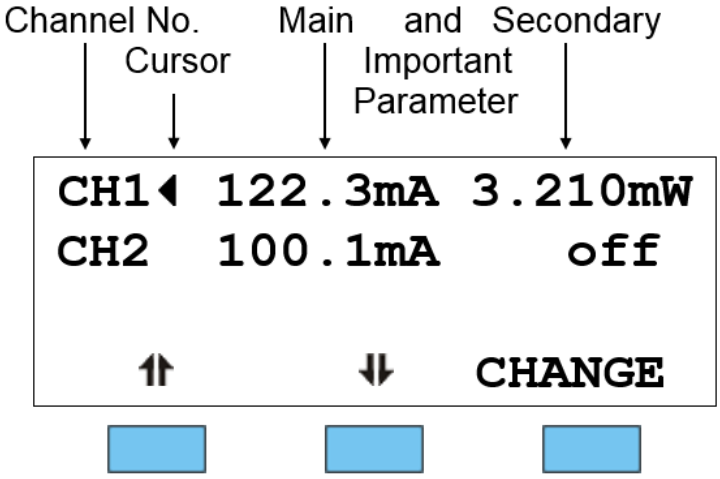
The two values MLIM and PLIM are related to each other by the efficiency coefficient η of the monitor diode. This value is named "CAL" and has the unit A/W. It can be changed in the channel menu of the current module.

Changing PLIM will automatically change MLIM and vice versa. The factory default CAL value is 0.2000 A/W. Please refer to section Calibrating the Monitor Diode 21.

4.2 Functions in the Main Menu

Display

The main menu shows the channel number, mode, range and status of the LDC8000 module.



Main and Secondary Parameter

In constant current mode, the main parameter is the laser current ILD in mA or A, while the secondary value - the optical power PLD in mW.

In constant power mode, the main parameter is the optical power PLD in mW, while the secondary value - the laser current ILD in mA or A.

If the module is switched off, the second parameter is replaced by the characters "off".

Selecting a Module

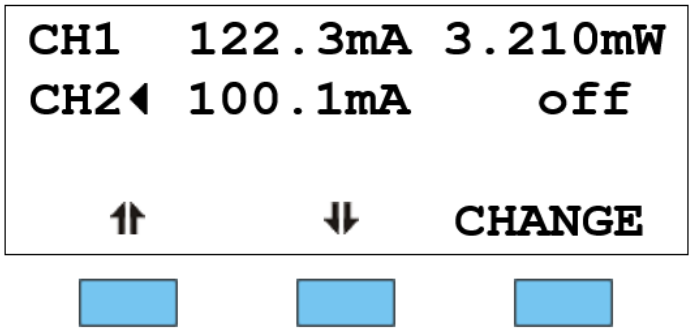
Select a module for further input by setting the cursor to the channel number of the desired module using the soft keys ↑ and ↓.

CH4◂

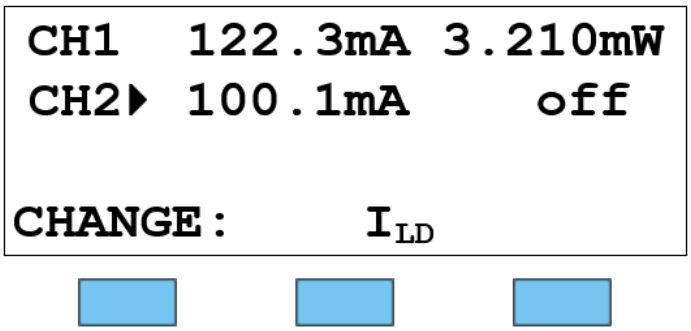
Pressing ESC will lead to the channel menu 19.

Changing the Main Parameter

To set the main parameter in the main menu, select the corresponding module (here CH2) with the cursor:



Pressing the key (**CHANGE**) will turn the cursor pointing now to the right:



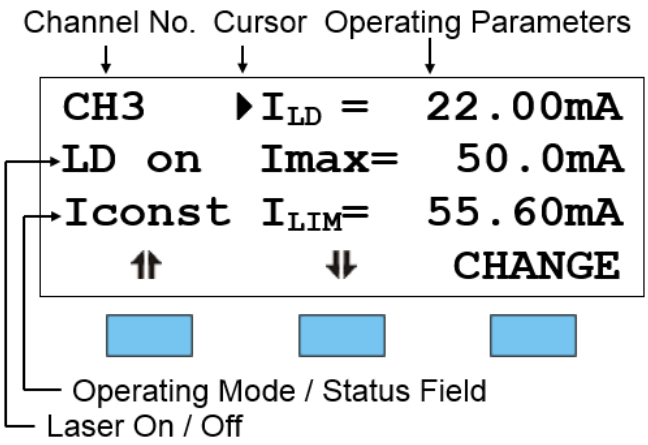
Now, the main parameter (here I_{LD} in mA) can be adjusted by means of the tuning knob. Pressing the ESC keys completes the procedure.

4.3 Functions in the Channel Menu

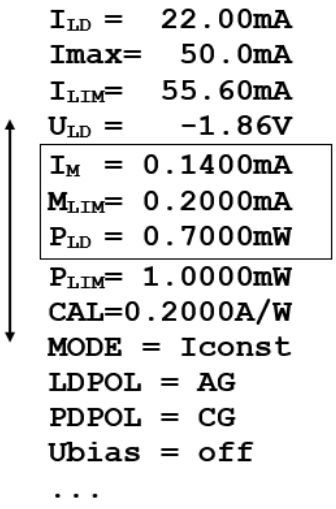
The channel menu is opened from the main menu by pressing the key CHANNEL. Hit again CHANNEL or ESC to return to the main menu.

4.3.1 Display

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



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:



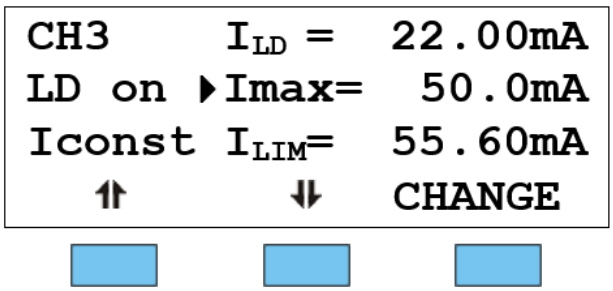
The Operating Mode / Status Field shows the actual status:

ON	Laser is on
OFF	Laser is off
Iconst	Constant current mode
Pconst	Constant power mode
■ILIM■	Current limit reached during operation
■PLIM■	Optical power limit 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 **IMAX**:



Pressing the soft key **CHANGE** activates the tuning knob to change the selected parameter. If the parameter is only to toggle (e.g., polarity of the laser diode), the function of the soft keys will change:

Pressing the soft key **TOGGLE** changes the polarity; 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 Polarity of the Laser and the Monitor Diode

If the polarity of the **laser diode** should be changed, the parameter

LDPOL =

must be selected in the channel menu. It can then be changed to the desired polarity.

To change the polarity of the **monitor diode** be changed, select the parameter

PDPOL =

in the channel menu.

4.3.4 Calibrating the Monitor Diode

In order to display the correct optical power based on the monitor current, the actual efficiency coefficient η of the monitor diode must be entered.

If, for example, η is 0.5 A/W this can be entered in the channel menu by changing the default value

CAL=0.2000A/W

If this parameter is not given in the specification of the laser, it can be calculated from the

measured actual optical power out of the laser and the monitor current:

$$\eta = I_M / P_{opt} \quad [A/W]$$

4.3.5 Selecting CC or CP mode

The LDC8000 laser current 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 monitor diode is required. Changing the operating mode is possible only when the laser current is switched off.

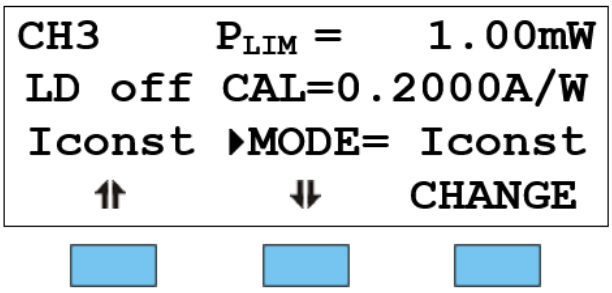
In order to change the operating mode of the laser diodes, the parameter

MODE =

can be set to:

I CONST = Constant current mode

P CONST = Constant power mode



4.3.6 Selecting a TED8000 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 TED8000 module can be used. For details, please see the TED8000 manual.

Therefore this TED8000 must be assigned to the LDC8000 module. Two steps are necessary:

1) Assign the desired TED8000 module to the LDC8000 by setting the parameter

   Twin slot =

   to the desired slot number of the TED8000. If there is only one TED8000 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

4.3.7 Bias Voltage for the Monitor Diode

If required, the monitor diode can be operated with a bias voltage of 5V.

Attention

Prior to switching on the bias voltage make sure that the photodiode polarity is set correctly (inverse direction). If the photodiode is biased forward, the current flow through the PD can damage it.

The bias voltage is switched on by setting:

`Ubias = on`

in the channel menu of the module.

4.4 Switching ON and OFF

Attention

LDC8000 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 17 are made prior to switching on the module!

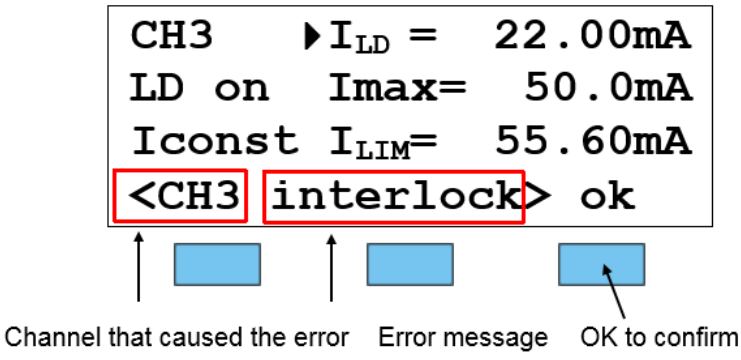
Select the module to be switched on or off in the main menu 19. The LED “SEL” of the selected module lights up.

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 LDC8000 module are:

`interlock`	Laser was switched off or cannot be switched on due to interlock circuit interruption.
`open ckt`	Laser was switched off due to interrupted connection, or the voltage across the LD output exceeds the LDC8000 compliance voltage.
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 59.

Not if LD on Certain parameters are not allowed to be changed while laser is ON.

Not if BIAS The photodiode polarity cannot be changed as long as bias voltage is applied (danger of damage!)

In case a TED8000 module is linked to the LDC8000 module:

TWIN Temperature is out of window (when window is activated). Laser cannot be switched on.

If an error occurs during operation, it is displayed in brackets:

<CH1 INTERLOCK>

If the error occurs when trying to switch on, it is displaye 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 LDC8000 module are described here. See also section Operating Instruction 17.

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 LDC8000 module the limit value of the laser diode current ILIM (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 8 of the LDC8000# module.

The value ILIM is constantly measured by the PRO8000 Series mainframe and can be checked in the channel menu 17 of the LDC8000 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 53, 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 53, 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 53, 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 53, 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 Calibrating a Photodiode (CALPD)

Command	Explanation Response Example
Programming	
":CALPD:SET <NR3>"	Programs the sensitivity calibration factor (η) of the monitor diode in [A/W]
Reading	
":CALPD:SET?"	Reads the sensitivity (η) of the monitor diode in [A/W] **[:CALPD:SET <NR3><LF>]**
":CALPD:MIN?"	Reads the minimum allowed sensitivity (η) of the module **[:CALPD:MIN <NR3><LF>]**
":CALPD:MAX?"	Reads the maximum allowed sensitivity (η) of the module **[:CALPD:MAX <NR3><LF>]**

5.3.3 Setting the Laser Diode Current (ILD)

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} - ADC = 0000 **[:ILD:MIN_R <NR3><LF>]**
":ILD:MAX_R?"	Reads the maximum laser diode current for I_{LD} - ADC = 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)

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>]**
":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

Command	Explanation Response Example
	[: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} - ADC = 0000 **[:IMD:MIN_R <NR3><LF>]**
":IMD:MAX_R?"	Reads maximum monitor diode current for I_{PD} - ADC = 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 Selecting the Laser Diode Polarity (LDPOL)

Command	Explanation Response Example
Programming	
":LDPOL AG"	Selects Anode Grounded
":LDPOL CG"	Selects Cathode Grounded
Reading	
":LDPOL?"	Reads status of the laser output **[:LDPOL AG<LF>]** **[:LDPOL CG<LF>]**

5.3.7 Programming the Laser Diode Software Limit (LIMC)

Command	Explanation Response Example
Programming	
":LIMC:SET <NR3>"	Programs the laser diode current limit
Reading	
":LIMC:SET?"	Reads the laser diode current limit **[:LIMC:SET <NR3><LF>]**
":LIMC:MIN?"	Reads the minimum possible laser diode current limit **[:LIMC:MIN <NR3><LF>]**
":LIMC:MAX?"	Reads the maximum possible laser diode current limit **[:LIMC:MAX <NR3><LF>]**
":LIMC:MIN_W?"	Reads the laser diode current limit for I_{LIM} - DAC = 0000 **[:LIMC:MIN_W <NR3><LF>]**
":LIMC:MAX_W?"	Reads the laser diode current limit for I_{LIM} - DAC = FFFF **[:LIMC:MAX_W <NR3><LF>]**

See also section Pre-Settings 17.

5.3.8 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>]**

5.3.9 Programming the Monitor Diode Current Limit (LIMM)

Command	Explanation Response Example
Programming	
":LIMM:SET <NR3>"	Programs the monitor diode current limit
Reading	
":LIMM:SET?"	Reads the monitor diode current limit **[:LIMM:SET <NR3><LF>]**
":LIMM:MIN?"	Reads the minimum possible monitor diode current limit **[:LIMM:MIN <NR3><LF>]**
":LIMM:MAX?"	Reads the maximum possible monitor diode current limit **[:LIMM:MAX <NR3><LF>]**
":LIMM:MIN_W?"	Reads the monitor diode current limit for I_{LIM} - ADC = 0000 **[:LIMM:MIN_W <NR3><LF>]**
":LIMM:MAX_W?"	Reads the monitor diode current limit for I_{LIM} - ADC = FFFF **[:LIMM:MAX_W <NR3><LF>]**

5.3.10 Programming the Optical Power Limit (LIMP)

Command	Explanation Response Example
Programming	
":LIMP:SET <NR3>"	Programs the optical power limit
Reading	
":LIMP:SET?"	Reads the optical power limit **[:LIMP:SET <NR3><LF>]**
":LIMP:MIN?"	Reads the minimum possible optical power limit **[:LIMP:MIN <NR3><LF>]**
":LIMP:MAX?"	Reads the maximum possible optical power limit **[:LIMP:MAX <NR3><LF>]**
":LIMP:MIN_W?"	Reads the optical power limit for I_{LIM} - DAC = 0000 **[:LIMP:MIN_W <NR3><LF>]**
":LIMP:MAX_W?"	Reads the optical power limit for I_{LIM} - DAC = FFFF **[:LIMP:MAX_W <NR3><LF>]**

5.3.11 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>]**

5.3.12 Switching the Bias Voltage On and Off (PDBIA)

Command	Explanation Response Example
Programming	
":PDBIA ON"	Switch ON bias voltage
":PDBIA OFF"	Switch OFF bias voltage
Reading	
":PDBIA?"	Reads the bias voltage state **[:PDBIA ON<LF>]** **[:PDBIA OFF<LF>]**

5.3.13 Selecting the Photo Diode Polarity (PDPOL)

Command	Explanation Response Example
Programming	
":PDPOL AG"	Selects Anode Grounded
":PDPOL CG"	Selects Cathode Grounded
Reading	
":PDPOL?"	Reads the monitor diode polarity: **[:PDPOL AG<LF>]** **[:PDPOL CG<LF>]**

5.3.14 Programming the Optical Power (POPT)

Command	Explanation Response Example
Programming	
":POPT:SET <NR3>"	Programs the laser diode set current
Reading	
":POPT:SET?"	Reads the optical power **[:POPT:SET <NR3><LF>]**
":POPT:ACT?"	Reads the actual optical power **[:POPT:ACT <NR3><LF>]**
":POPT:MIN?"	Reads the minimum possible optical power **[:POPT:MIN <NR3><LF>]**
":POPT:MAX?"	Reads the maximum possible optical power **[:POPT:MAX <NR3><LF>]**
":POPT:MIN_W?"	Reads the optical power for P_{LD} - DAC = 0000 **[:POPT:MIN_W <NR3><LF>]**
":POPT:MAX_W?"	Reads the optical power for P_{LD} - DAC = FFFF **[:POPT:MAX_W <NR3><LF>]**
":POPT:MIN_R?"	Reads the optical power for P_{LD} - ADC = 0000 **[:POPT:MIN_R <NR3><LF>]**
":POPT:MAX_R?"	Reads the optical power for P_{LD} - ADC = FFFF **[:POPT:MAX_R <NR3><LF>"]**

5.3.15 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>]**

5.3.16 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>]**

5.3.17 Reading the Type of Module (TYPE)

Command	**Explanation** **Response Example**
Reading	
":TYPE:ID? "	Reads the module ID (here 191 for LDC8000) **[:TYPE: 191<LF>]**

5.3.18 Reading the Laser Diode Voltage (VLD)

Command	**Explanation** **Response Example**
Programming	
":VLD:MEAS <NR1>"	Programs the laser diode voltage as measurement value in the "ELCH" *) output string on position <NR1> (1....8)
Reading	
":VLD:ACT?"	Reads the actual laser diode voltage **[:VLD:ACT <NR3><LF>]**
":VLD:MIN_R?"	Reads U_{LD} - ADC = 0000 **[:VLD:MIN_R <NR3><LF>]**
":VLD:MAX_R?"	Reads U_{LD} - ADC = FFFF **[:VLD:MAX_R <NR3><LF>]**
":VLD:MEAS?"	Reads the position of U_{LD} in the "ELCH" output string (**1....8**, **0** if not selected) **[:VLD:MEAS <NR1><LF>]**

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

5.4 IEEE Error Messages

[1001, "Interlock is open"]

Possible reason: Attempt to switch on laser while interlock loop 14 is open.

[1002, "Open Circuit"]

Possible reason: Interrupted connection to the laser diode; laser forward voltage higher than compliance voltage of the LDC8000 module.

[1003, "Over temperature"]

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

[1004, "Internal power failure"]

Reason: Severe hardware error. Please contact Thorlabs 59.

[1005, "No LD polarity change during laser on"]

Reason: Attempt to change LD polarity while laser was switched on.

[1006, "No PD polarity change during laser on"]

Reason: Attempt to change PD polarity while laser was switched on.

[1007, "No setting of ILD during constant power mode"]

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

[1008, "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.

[1009, "Attempt to activate Twin during laser on"]

Reason: Attempt to activate temperature protection while laser was switched on.

[1010, "Attempt to switch on laser while temperature is out of window"]

Reason: The actual temperature of the TED8000 that is assigned to the LDC8000 module is exceeds the range (Tset ± Twin). See sections Activating the Temperature Protection (TP) 32 and Assigning a TEC for Temperature Protection (TPSLOT) 33.

[1011, "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.

[1013, "No PD polarity change during bias on"]

Reason: Attempt to change PD polarity while bias was switched on.

[1014, "No calibrating of PD during laser on in CP mode"]

Reason: Attempt to change PD sensitivity (CAL) while laser in Constant Power mode and switched on.

[1015, "No TEC in this slot"]

Reason: In the assigned for temperature protection slot no TED8000 is recognized.

[1016, "No mode change during laser on"]

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

[1019, "No bias change during laser on CP mode"]

Reason: The photodiode bias cannot be switched on or off while laser in Constant Power mode and switched on.

[P1084]

Reason: This error message may appear if the laser current is set to ZERO, the LDC8000 is switched to “Laser On” and then the laser set current is increased.

Resolution: Set the laser current to a value > 0 prior to switch it on. If error persists, please contact Thorlabs 59.

5.5 Status Reporting

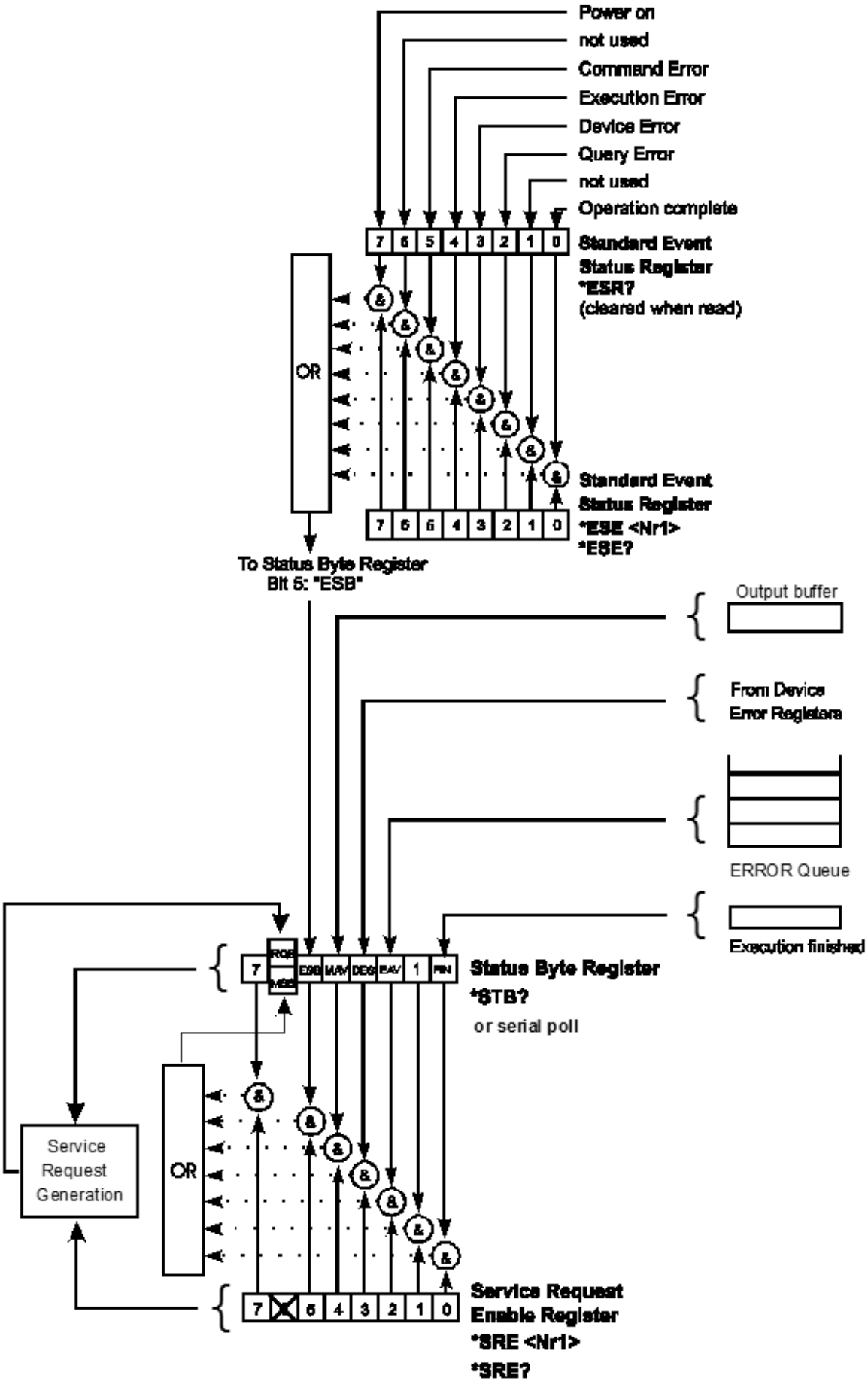
The LDC8000 module provides four 8 bit registers 37

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

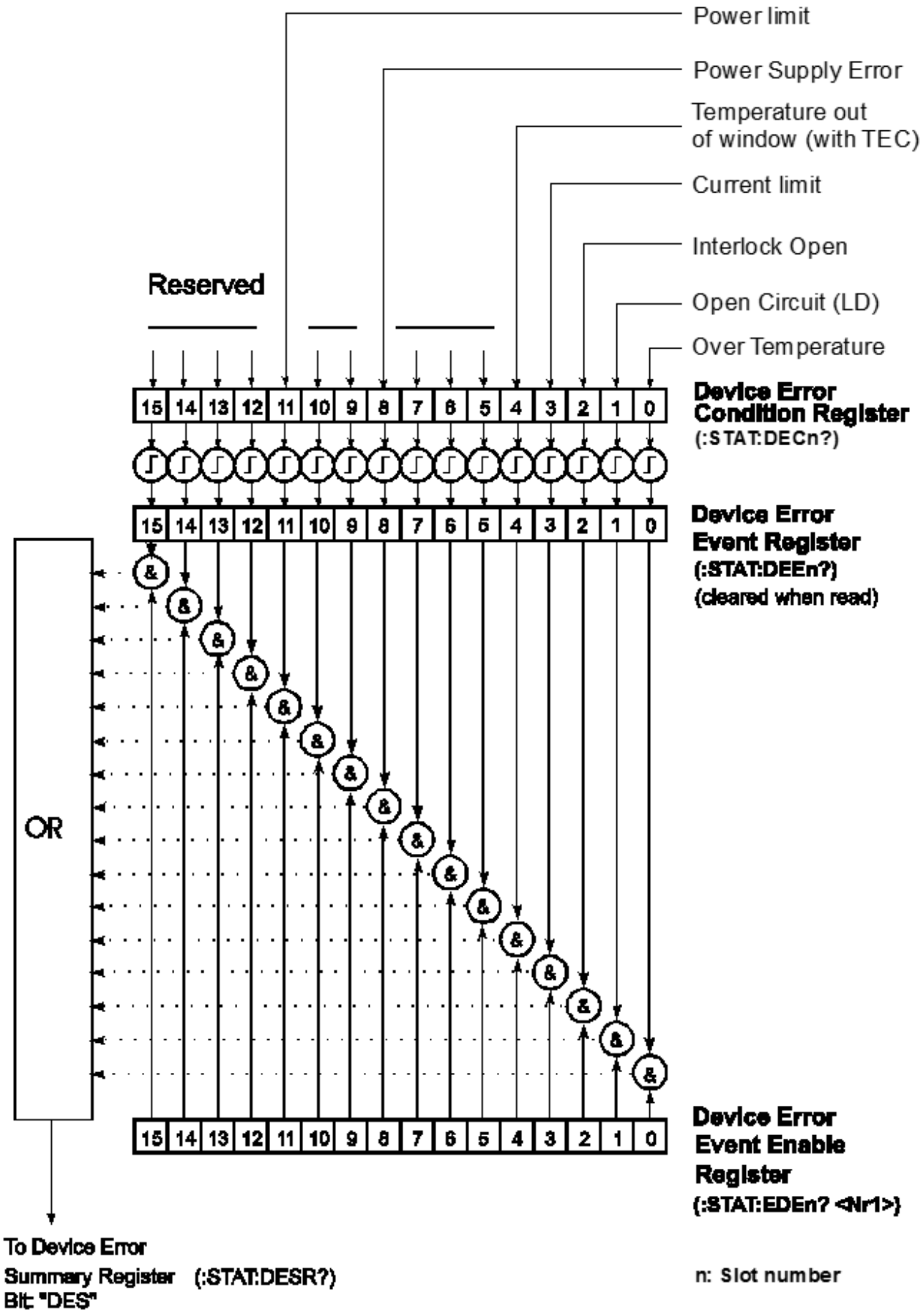
and three 16 bit registers 38

- 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 53, 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 40). Alternatively the SRQ can be recognized using the command "*STB? 40 or by serial poll 40.

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 40 is asserted, bit 6 of the STB is set to logical 1, so that the controller can detect by auto 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 LDC8000 modules the bits 0 to 4, 8 and 11 are used

Bit 0 - Over temperature
LDC8000 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 hardware 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 LDC8000 from adverse weather conditions. The LDC8000 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 59 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 LDC8000 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 14.
- ➢ 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 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} or the software limit I_{MAX} set correctly?
  - Adjust the hardware limit I_{LIM} by means of the potentiometer on the LDC8000# front panel and the software limit I_{LIM} in the channel menu to appropriate values.

- Is the software limit P_{LIM} set to zero?
  - Correct the value in the channel menu to the desired limit.
- 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 LDC8000 module (AG or CG)
- Is the photo diode connected properly?
  - Check the connecting cable.
- Is the photo diode poled correctly?
  - If not, change the polarity with the **":PDPOL:SET"** command or in the channel menu.
- Are you using a bias voltage with the photo diode in photocurrent mode?
  - Turn off bias voltage in the channel menu, with the **":PDBIA OFF"** command or change the polarity of the diode for photo element mode.
- Is the correct photo diode efficiency set (A/W)?
  - Enter the coefficient in the channel menu or with the command **":CAL:SET"**
- Is the desired output power programmed correctly?
  - Adjust the desired output power P_{LD} in the channel display
- 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 Thorlabs 59 for technical support and/or return instructions.

7 Appendix

7.1 Technical Data

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

Common Specifications	
Resolution	16 bit
Power Control	
Range of Monitor Current IPDS	10 µA to 5 mA [1])
Resolution	0.1 mA
Setting Accuracy (f.s.)	± 0.05 %
Drift (30 min, Constant Ambient Temperature)	≤ 1 µA
Photodiode bias voltage	0 V / 5 V
Power Control Limit	
Setting Range	0 to 5 mA [1])
Resolution	1.25 µA
Setting Accuracy (f.s.)	± 50 µA
Laser Voltage	
Measurement Principle	4-Wire
Measurement Range	0 to 5 V
Resolution	0.2 mV
Accuracy (f.s.)	± 5 mV
Analog Modulation	
Input Impedance	10 kΩ
Connector	BNC
Input Voltage	-10 V to +10 V
General	
Warm-up Time for Rated Accuracy	≤15 min
Operating Temperature Range [2])	0 - 40 °C
Storage Temperature Range	-40 to 70 °C
Weight	< 500 g

[1]) Other Ranges on Request
[2]) non-condensing

LDC8001ULN	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 100 mA
Compliance Voltage	> 2.5 V
Setting Resolution	1.5 µA
Setting Accuracy (f.s.)	± 0.05%
Measurement Resolution	3 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 1 µA
Ripple (50/60 Hz, rms, typ.)	< 0.8 µA
Transients (Processor, typ.)	≤ 10 µA
Transients (Other, typ.))	< 100 µA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 1 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 0.5 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 1.5 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 100 mA
Setting Range Software IMAX	0 ... ≥ 100 mA
Setting Resolution	3 µA
Setting Accuracy	± 100 µA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 2.5 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	10 mA/V± 5%
Rise and Fall Time, typ.	< 100 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8002	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 200 mA
Compliance Voltage	> 5 V
Setting Resolution	3 µA
Setting Accuracy (f.s.)	± 0.05%
Measurement Resolution	6 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 3 µA
Ripple (50/60 Hz, rms, typ.)	< 1 µA
Transients (Processor, typ.)	≤ 15 µA
Transients (Other, typ.))	< 200 µA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 1.5 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 0.5 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 1.5 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 200 mA
Setting Range Software IMAX	0 ... ≥ 200 mA
Setting Resolution	6 µA
Setting Accuracy	± 200 µA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 200 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	20 mA/V± 5%
Rise and Fall Time, typ.	< 2 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8005	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 500 mA
Compliance Voltage	> 5 V
Setting Resolution	7.5 µA
Setting Accuracy (f.s.)	± 0.05%
Measurement Resolution	15 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 5 µA
Ripple (50/60 Hz, rms, typ.)	< 1 µA
Transients (Processor, typ.)	≤ 30 µA
Transients (Other, typ.))	< 500 µA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 4 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 2 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 4 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 500 mA
Setting Range Software IMAX	0 ... ≥ 500 mA
Setting Resolution	15 µA
Setting Accuracy	± 500 µA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 100 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	50 mA/V± 5%
Rise and Fall Time, typ.	< 4 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8010	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 1 A
Compliance Voltage	> 5 V
Setting Resolution	15 µA
Setting Accuracy (f.s.)	± 0.1%
Measurement Resolution	30 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 10 µA
Ripple (50/60 Hz, rms, typ.)	< 1.5 µA
Transients (Processor, typ.)	≤ 50 µA
Transients (Other, typ.))	< 1 mA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 10 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 5 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 20 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 1 A
Setting Range Software IMAX	0 ... ≥ 1 A
Setting Resolution	30 µA
Setting Accuracy	± 2 mA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 50 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	100 mA/V± 5%
Rise and Fall Time, typ.	< 5 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8020	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 2 A
Compliance Voltage	> 5 V
Setting Resolution	30 µA
Setting Accuracy (f.s.)	± 0.1%
Measurement Resolution	60 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 20 µA
Ripple (50/60 Hz, rms, typ.)	< 3 µA
Transients (Processor, typ.)	≤ 80 µA
Transients (Other, typ.))	< 2 mA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 30 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 15 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 100 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 2 A
Setting Range Software IMAX	0 ... ≥ 2 A
Setting Resolution	60 µA
Setting Accuracy	± 4 mA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 30 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	200 mA/V± 5%
Rise and Fall Time, typ.	< 6 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8040	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 4 A
Compliance Voltage	> 5 V
Setting Resolution	70 µA
Setting Accuracy (f.s.)	± 0.1%
Measurement Resolution	130 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 50 µA
Ripple (50/60 Hz, rms, typ.)	< 4 µA
Transients (Processor, typ.)	≤ 120 µA
Transients (Other, typ.))	< 4 mA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 50 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 25 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 150 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 4 A
Setting Range Software IMAX	0 ... ≥ 4 A
Setting Resolution	130 µA
Setting Accuracy	± 8 mA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 20 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	0.4 A/V± 5%
Rise and Fall Time, typ.	< 9 µs
Other Data	
Module Width	1 Slot
Output Connector	9 pin DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

LDC8080	
Current Control	
Range of Laser Current I_{LD}	0 ... ± 8 A
Compliance Voltage	> 5 V
Setting Resolution	130 µA
Setting Accuracy (f.s.)	± 0.3%
Measurement Resolution	250 µA
Noise w/o Ripple (10 Hz ... 10 MHz, rms, typ.)	< 100 µA
Ripple (50/60 Hz, rms, typ.)	< 8 µA
Transients (Processor, typ.)	≤ 200 µA
Transients (Other, typ.))	< 8 mA
Short-term Fluctuations (15 s, 0 ... 10 Hz)	≤ 125 µA
Drift (60 min, Constant Ambient Temperature, typ.)	≤ 100 µA
Drift (24 h, Constant Ambient Temperature, typ.)	≤ 200 µA
Temperature Coefficient	≤ 50 ppm/°C
Current Limit	
Setting Range Potentiometer ILIM	0 ... ≥ 8 A
Setting Range Software IMAX	0 ... ≥ 8 A
Setting Resolution	250 µA
Setting Accuracy	± 50 mA
Analog Modulation	
Small Signal 3 dB Bandwidth (CC Mode)	DC to 10 kHz
Modulation Coefficient (CP)	0.5 mA/V± 5%
Modulation Coefficient (CC)	0.8 A/V± 5%
Rise and Fall Time, typ.	< 15 µs
Other Data	
Module Width	2 Slots
Output Connector	15 pin HD DSUB

[1]) Maximum Transients at the output, e.g., when switching the unit On or Off.

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) [6]
	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 LDC8000 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] MOD IN port capped.

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 LDC8000 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 Protection
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

7.8 Thorlabs Worldwide Contacts

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