Operation Manual
Thorlabs Blueline™ Series
PRO8000 (-4) / PRO800

Optical sources

WDM8xxx
C81xxxx
LS8xxxx

2006

THORLABS GmbH

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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 develop 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 GmbH.

Thorlabs GmbH

This part of the instruction manual contains all the specific information on how to operate the optical source modules WDM8xxxx, C81xxxx and LS8xxxx. A general description is followed by explanations of how to operate the unit manually. You will also find complete information about remote control via the IEEE 488 computer interface.

☝Attention☝

This manual contains "WARNINGS" and "ATTENTION" labels in this form, to indicate personal danger or possible damage to equipment.

Please read these advises carefully!

NOTE

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

1 General description of the optical source modules

1.1 Safety

☝ Attention ☝

The modules 'WDM8xxxx' are class 1M laser sources.
Emitted wavelength: 1 single wavelength in the range 1454 nm … 1625 nm, according to ordered wavelength.
Emitted optical power: up to 50 mW, according to ordered output power! Numerical aperture of the beam 0.11.

CAUTION – The use of optical instruments with these products will increase eye hazard!!

☝ Attention ☝

The laser modules supplied by Thorlabs are class 1M laser systems. However, if you collimate or focus the laser beam you will create a class 3R or class 3B laser system!
In that case additional safety measures have to be observed!

For the individual wavelength and output power see the certificate of calibration supplied with the module!

Never switch on the output with no fiber connected and switch off the output before disconnecting the fiber!

NOTE

The products are classified and labeled according to IEC 60825-1/Am2 (2001).
If you need an additional aperture label according to CFR § 1040.10.g (5) please use the adhesive labels delivered with the PRO8000 (-4) / 800 and place them clearly visible for any possible user on your laser set-up!.
Two possible places for laser modules without and with modulation input are shown below.

Without modulation input
(label 30 x 15 mm)

With modulation input
(label 20 x 15 mm)

☝ Attention ☝

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

Before applying power to your PRO8000 (-4) / PRO800 system, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet!
Improper grounding can cause electric shock with damages to your health or even death!

Modules may only be installed or removed with the mainframe switched off.

All modules must be fixed with all screws provided for this purpose.

Modules of the 8000 series must only be operated in the mainframe PRO8000, PRO8000-4 or PRO800.

All modules must only be operated with duly shielded connection cables.

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

This precision device is only dispatchable if duly packed into the complete original packaging including the plastic form parts. If necessary, ask for a replacement package.

☝ 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 EN 50 082-1.

The PRO8000 (-4) / PRO800 must not be operated in explosion endangered environments.

1.2 Warranty

Thorlabs GmbH warrants material and production of the WDM8xxxx, C81xxxx and LS8xxxx modules for a period of 24 months starting with the date of shipment. During this warranty period *Thorlabs GmbH* 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 GmbH (Germany)* or to a place determined by *Thorlabs GmbH*. The customer will carry the shipping costs to *Thorlabs GmbH,* in case of warranty repairs *Thorlabs GmbH* 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 GmbH warrants the hard- and software determined by *Thorlabs GmbH* for this unit to operate fault-free provided that they are handled according to our requirements.
However, *Thorlabs GmbH* does not warrant a fault free and uninterrupted operation of the unit, of the soft- or firmware for special applications nor this instruction manual to be error free. *Thorlabs GmbH* 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 conditions (refer to the PRO8000 (-4) / PRO800 mainframe operation manual) stated by us or unauthorized maintenance.

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

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

1.3 Properties

1.3.1 Protections for the laser diode

To protect the optical sources in the WDM8xxxx, C81xxxx and LS8xxxx modules the PRO8000 (-4) / PRO800 are equipped with the following protection circuits:

- **Fixed current limit**
  A fixed limit set in factory protects the laser diode against operating errors.

- **Electronic short-circuit switch for the laser diode**
  When the PRO8000 (-4) / PRO800 is switched on or off an electronic switch will short-circuit the laser diode.

- **Separate on/off function for each module**
  After turning on the PRO8000 (-4) / PRO800 the WDM and LS modules are in OFF mode.
  They must be switched on individually. Default settings are used.

- **Over-temperature protection for each module**
  Should errors occur (for example the limit set in factory has been reached, the power stage is overheated etc.), the LED “ERR” of the module will light up. Furthermore, in case of certain errors the output is switched off automatically.

- **Mains filter**
  Protection against line disturbances (transients).

- **Mains failure protection**
  In case of line failure/line damage the optical source modules must explicitly be switched on anew since it cannot be taken for granted that all components of the measurement setup are still working faultlessly.

- **Key-operated power switch**

Protection against unauthorized or accidental use.

- **Run-off control**
  The WDM8xxxx, C81xxxx and LS8xxxx modules are in LASER OFF mode after turning on the PRO8000 (-4) / PRO800 mainframe and must be switched on explicitly.

- **LabVIEW® -and LabWindows/CVI® drivers**
  For the PRO8000 (-4) / PRO800 *Thorlabs* supplies LabVIEW® and LabWindows/CVI®-drivers for MS Windows 32.

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

1.3.2 Features

The laser fibers are connected via FC/APC connectors at the front of the module. (Other connectors optional).

Each module is protected against overheating of the output stage by an automatic shutdown. The LED "ERR" indicates that the module is switched off. After a decline in temperature of about 10 °C the LED "ERR" extinguishes and the output can be reactivated

The laser wavelength of the WDM and CWDM modules is directly adjustable, whereas the rated center wavelength of the LS8xxxx module is adjusted by operating the laser diode at a certain user controllable temperature. The user can change the temperature (thus the wavelength) by selecting a positive or negative temperature difference δT.

The PRO8000 (-4) / PRO800 contains a forced air cooling system with built-in fans. Depending on the temperature the air flow of the fans is adapted automatically.

All settings can be changed with the operating elements of the mainframe or via remote control from a PC.

The mains filter installed in the mainframe and the careful shielding of the transformer, the microprocessor as well as the module itself provide an excellent suppression of noise and ripple.

All PRO8000 (-4) / PRO800 modules can be supplied in a variety of versions, e.g. with different modulation options or wavelength.

➔ (refer to chapter 1.4, “Technical data” starting on page 9)

1.4 Technical data

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

1.4.1 Common technical data for the WDM modules

Laser source	DFB laser diode with isolator
Output power	20 mW [1)]
Setting range (attenuation)	10 dB
Resolution	0.01 dB
Optical output connector	PMF, FC/APC [2)]
Operating temperature	0 … + 35 °C (non condensing)
Storage temperature	- 40 … + 35 °C
Warm-up time for rated accuracy	15 min
Mechanical width of module	1 slot
Weight	< 0.5 kg

Wavelength

Channel spacing	ITU grid (50 GHz)
Wavelengths	S, L and C band [3)]
Wavelength accuracy	± 10 pm (typ.) / < ± 25 pm
Stability (typ.)	< 2 pm / 24 h
Setting range	± 1 nm [4)]
Resolution	1 pm
Spectral linewidth	< 10 MHz

Power

Stability (15 s)	< 0.002 dB
Stability (15 min)	< 0.005 dB
Stability (24 h)	< 0.01 dB
SMSR (side mode suppression ratio, at nominal power)	> 40 dB; typ.>45 dB
RIN (Relative intensity noise)	typ.> 145 dB / Hz
Optical isolation	> 35 dB

Modulation (Standard)

Digital DC modulation (TTL, synchronous from mainframe))	0 ... 10 kHz
Internal sinus, mod. depth 0...100%	0 ... 50kHz
Internal square, "	0 ... 50 kHz
Internal ON/OFF	0 ... 50 kHz
Internal noise, mod. depth 0...10%	BW~ 0,2 ... 5 kHz
External analog LF modulation (optional)	DC … 50 kHz

[1] Other nominal power ratings on request

[2] PMF with aligned connector on request. Other connector styles on request

[3] Selected customer specific according to ITU

[4] Corresponds to about ± 10 °C (larger setting range on request)

Coherence Control

via internal modulation (noise, sine, square, triangle[1])

adjustable	optical BW up to 1GHz

1.4.2 Common technical data for the LS8xxxx modules

General data

Optical output connector	FC/APC
Operating temperature	0 … + 35 °C (non condensing)
Storage temperature	- 40 … + 35 °C
Warm-up time for rated accuracy	15 min
Mechanical width	1 slot
Weight	< 0.5 kg

Wavelength

Wavelength / power[2]	1310 nm / 10 mW
	1550 nm / 10, 20, 40 & 50 mW
Center wavelength tolerance	± 20 nm
Stability (typ.)	< 0.01 nm / 24 h
Spectral linewidth (typ.)	< 30 MHz

Power

Stability (24 h)	< 0.01 dB

Setting of temperature

Setting range	± 5 °C
Resolution	0.001 °C

Modulation

TTL (all modules synchronous, BNC from mainframe)	DC … 10 kHz
Analog modulation input (BNC)[3]	DC … 50 kHz
RF modulation (SMA) [2]	0.2 … 500 MHz
Type of modulation	direct modulation with bias T
Input impedance	50 Ω

[1] Triangle on request
[2] Other wavelengths and power on request
[3] Either analog modulation input or RF BIAS-T modulation available

1.4.3 Common technical data for the CWDM modules

Output power	10 mW
Center wavelength tolerance	± 3nm (± 1nm optional)
Optical output connector	FC/APC [1)]
Operating temperature	0 … + 35 °C (non condensing)
Storage temperature	- 40 … + 35 °C
Warm-up time for rated accuracy	15 min
Mechanical width of module	1 slot
Weight	< 0.5 kg

Wavelength

Channel spacing	20 nm
Center Wavelengths	1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610 nm
Stability (typ.)	< 2 pm / 24 h
Setting range	± 0.5 nm [2)]
Resolution	0.01 nm
Spectral linewidth	< 30 MHz

Power

Stability (15 s)	< 0.002 dB
Stability (15 min)	< 0.005 dB
Stability (24 h)	< 0.01 dB
SMSR (side mode suppression ratio, at nominal power)	> 36 dB; typ.>40 dB
Optical isolation	> 35 dB

Modulation (Standard)

Digital DC modulation (TTL, synchronous from mainframe))	0 ... 10 kHz
Internal sinus, mod. depth 0...100%	0 ... 50kHz
Internal square, "	0 ... 50 kHz
Internal ON/OFF	0 ... 50 kHz
Internal noise, mod. depth 0...10%	BW~ 0,2 ... 5 kHz

Coherence Control

via internal modulation (noise, sine, square, triangle[3])	
adjustable	optical BW up to 1GHz

[1] Other standards on request

[2] Corresponds to about ±5 °C (larger setting range on request)

[3] Triangle on request

2 Operating the PRO8000 (-4) / PRO800 optical source modules

2.1 Operating elements on front panel

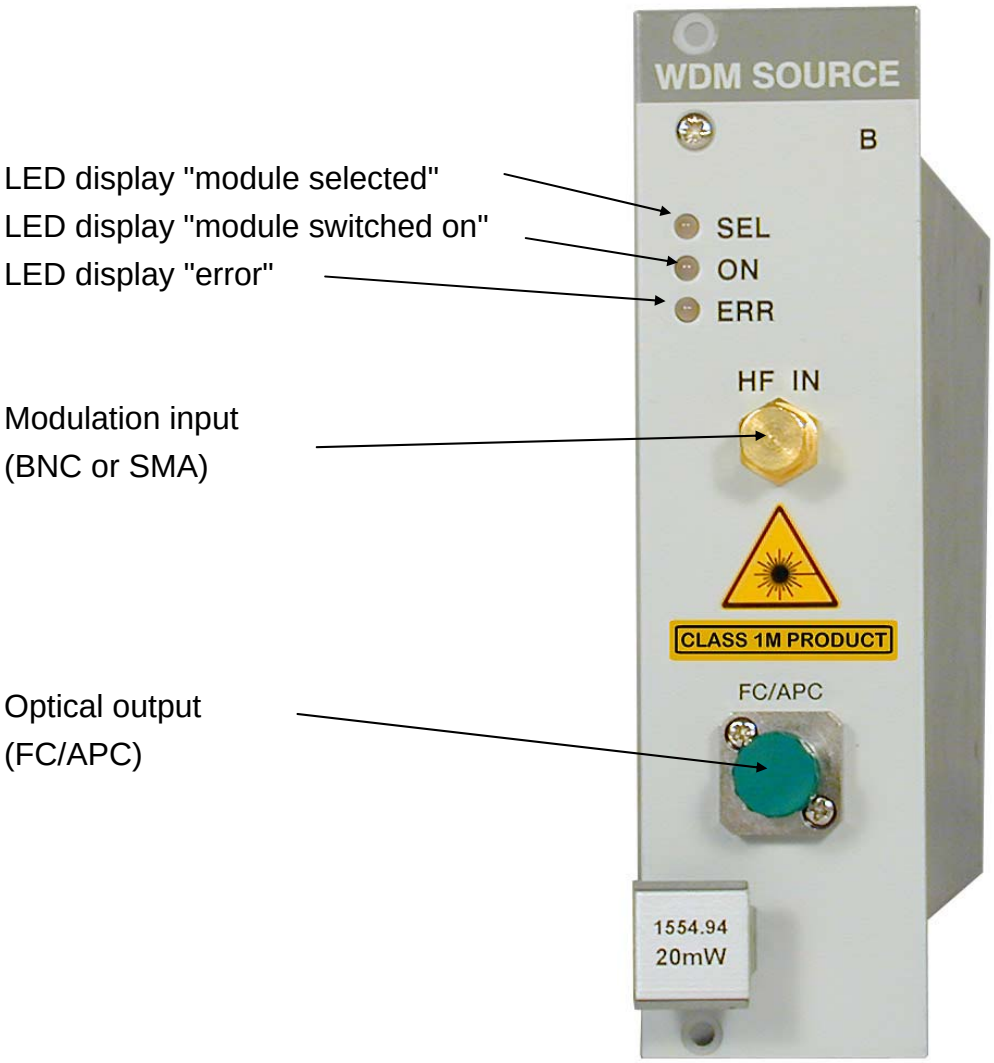


Figure 1 Front view of WDM, CWDM and LS plug-in modules

2.2 Connecting external components

2.2.1 Connecting an optical fiber

Depending on the construction of the optical connector the fiber is to be connected to the optical output by means of a corresponding plug.

NOTE

Do not to confuse the FC/PC with the FC/APC connector.
The corresponding type of connector is marked on the module.
Never switch on the output with no fiber connected!

2.2.2 Connecting an external RF modulation source

External modulation is fed to the device by the SMA- or BNC connector in the middle of the front panel.

Input impedance is 50 Ω.

☝ Attention ☝

To avoid damage to the module do not exceed the following

signal amplitudes: ± 10V DC and RF 1.6 V peak to peak!
For modules with Bias-T see chapter 2.3

2.2.3 Connecting an external DC modulation source

A DC modulation source (DC....10 kHz, TTL) is fed through a BNC connector at the rear panel of your PRO8000 (-4) / PRO800 mainframe.

➔ Please refer to the mainframe operation manual!

2.3 Modulating the optical source modules

The state of the art offers different procedures of modulation. Depending on the type ordered, the following kinds of modulation can be found within the different module types for analog or digital modulation (WDM, CWDM and LS types).

WDM and CWDM types allow for synchronous modulation (on/off), 0...10 kHz, internal low frequency modulation (20 ... 50000 Hz, 0.1 ... 100 % rel. Amplitude, and depending on the type of module additional modulation capabilities.

- **Analog direct modulation of internal set parameters**
- **Analog direct modulation via an internal bias-T**
- **Analog direct modulation via an internal DC bias-T**
- **Digital internal DC modulation (synchronous for all modules)**

2.3.1 Direct modulation via an internal bias-T

The principal set up of a Pro8 optical module with direct modulation via an internal bias-T
is shown here:

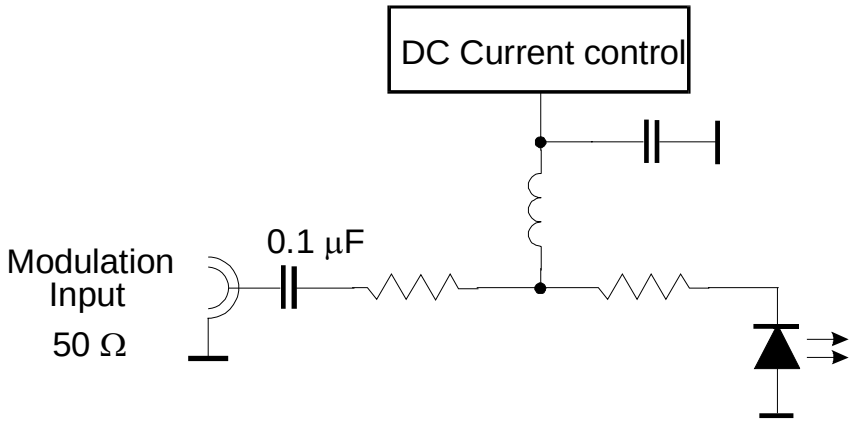


Figure 2 Direct modulation via internal bias-T

The (RF) modulation current is superimposed to the DC laser source current by means of the internal bias-T.

There are no specific parameters to be set.

Input	50 Ω SMA
Signal type	Analog AC coupled
Frequency range	100 kHz ... 0.5 GHz

☝ Attention ☝

You have direct access to the expensive laser diode !

Be sure not to apply any transients

Do not drive the laser diode with more than the rated maximum current!

NOTES

The modulation current is calculated as:

$$I_{mod} = V_{mod} / 50\Omega$$

Where

I_{mod} is the modulation current that is added to the laser diode current

V_{mod} is the applied modulation voltage.

In the datasheet supplied with the laser module you will find:

- The relation between I_{mod} and the optical output of the laser.
- The allowed maximum laser current.

2.3.1.1 Remarks on direct modulation by bias-T

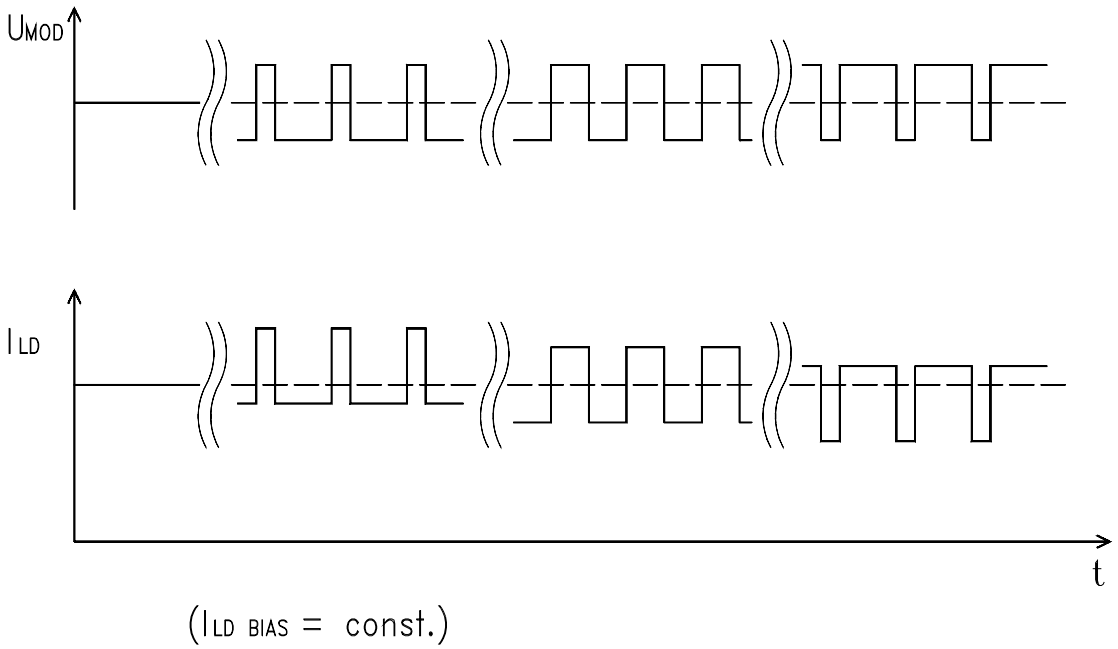


Figure 3 Possible DC-component of digital signals

Laser current with asymmetrical modulation

When modulating via a BIAS-T only the AC component of the modulating signal is fed to the laser diode. The lower frequency limit of the modulation input is at about 100 ... 500 kHz.
If the modulation signal is asymmetric (e.g. logical high and low levels are not evenly distributed) this asymmetry corresponds to a DC component. Since this DC component is not fed to the laser diode, the maximum and minimum value of the laser current may change.

The figure shows the dependency of the laser current from pulse period ratio with square modulation.

2.3.2 Direct modulation via internal DC bias-T

Here the set up of a Pro8 optical module with direct modulation via internal DC bias-T is shown:

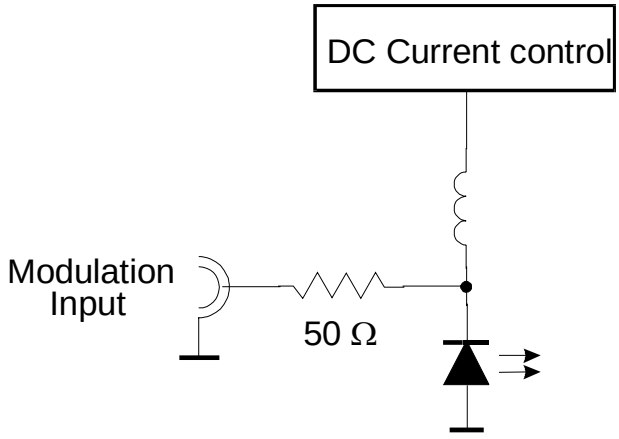


Figure 4 Direct modulation via internal DC bias-T

The injection current is directly modulated via internal bias-T.

There are no specific parameters to be set.

☝ Attention ☝

You have direct access to the expensive laser diode !

Make sure not to apply any transients!!

Do not drive the laser diode with more than the rated maximum current!

Input	50 Ω SMA
Signal type	Analog DC coupled
Frequency range	0 Hz ... 20 MHz

NOTES

The laser is DC-coupled to the input so any input voltage will alter laser current and laser power. We recommend using an external coupling capacitor in cases, where no DC-coupling is required.

The modulated laser diode current is calculated as:

$$I_{LDmod} = I_{LDCW} + (V_{mod} - V_{LD}) / 50\Omega$$

(Definition of polarities of currents and voltages see next page)

Where

I_{LDmod} is the modulated laser diode current

V_{mod} is the applied modulation voltage.

I_{LDCW} is the laser diode CW current generated in the module.

V_{LD} is the laser diode voltage (laser current dependent, typically 0.8 … 1.8V).

In the datasheet supplied with the laser module you will find:

- The relation between I_{mod} and the optical output of the laser.
- The maximum laser current allowed.
- I_{LDCW} at different operating points.

Polarities of currents and voltages:

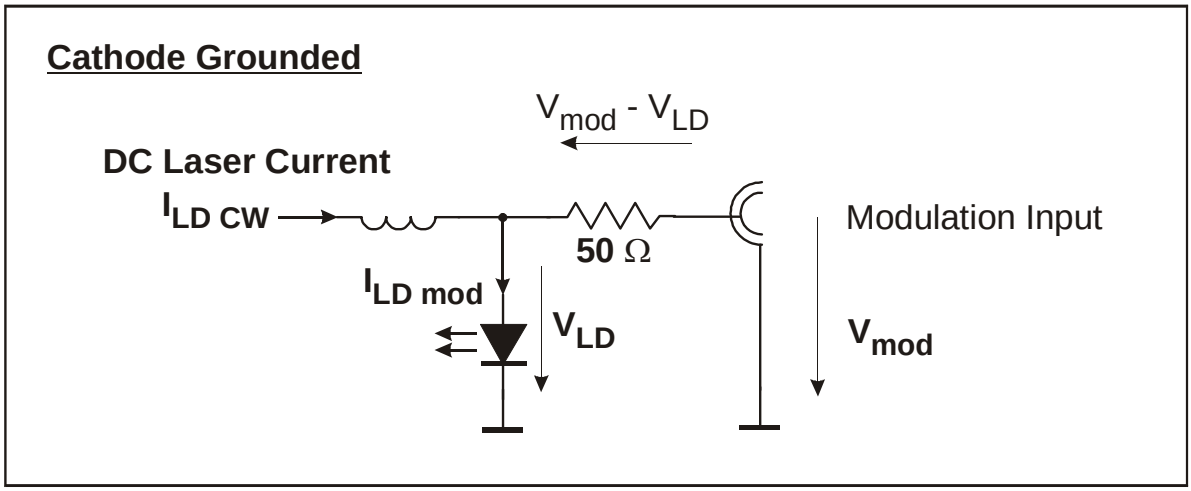


Figure 5 Polarities of currents and voltages with grounded cathode

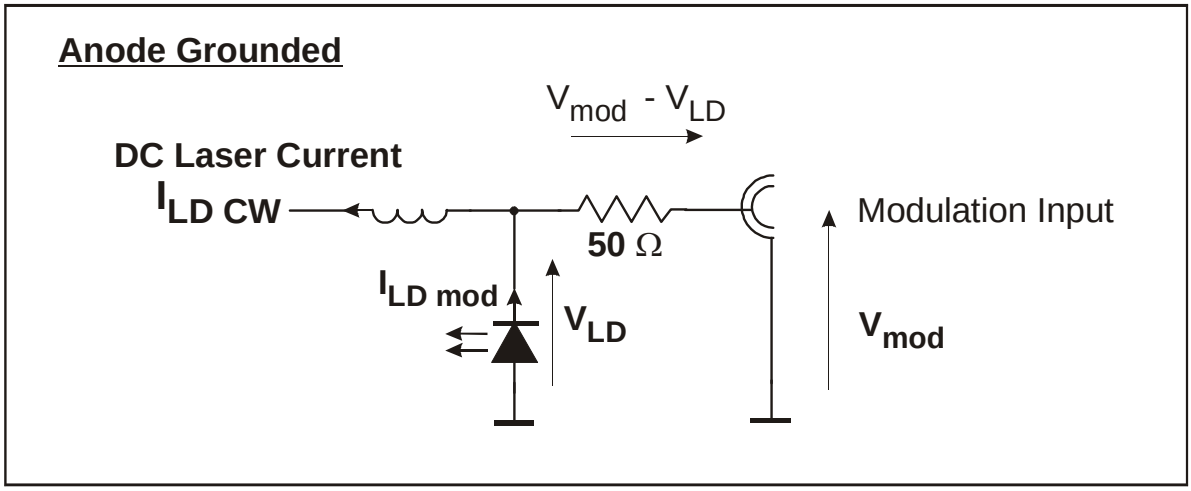


Figure 6 Polarities of currents and voltages with grounded anode

FURTHER NOTES

Please do not shortcut the modulation input, as this is an „input voltage“ of 0V influencing the laser diode current (see formula).

The laser diode is operated in constant current mode, so the output power is dependent on the temperature and thus on the wavelength.
The output power will vary slightly during wavelength tuning.

To avoid any damage to the laser diode the output power will be set to 0 if the deviation between actual and set wavelength is larger than typ. 0.1 nm. To avoid this in manual operation please turn the knob slowly. In remote operation do not change the wavelength in steps wider than 0.05 nm and not faster than 0.1nm/s.

2.3.3 External modulation (PM-output recommended)

If there are still higher requirements regarding the transmission bandwidth at present only external electro-optical modulators are used. Their inner structure mostly resembles a Mach-Zehnder interferometer.

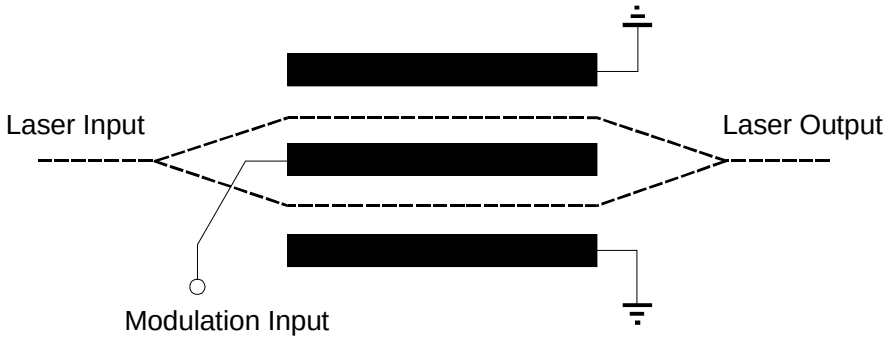


Figure 7 External modulation generation

By means of 3 dB couplers the incoming light is divided into two identical beams and recombined again at the end of the modulator. By applying voltage an electrical field between the electrodes sets up. The applied electrical field causes changes in the refractive index in both wave guides (Pockels effect) which are - due to the circuitry - reversed to each other. Since the propagation speed of light depends on the refractive index of the wave guide this results in propagation time differences and thus in a phase difference. When both beams are recombined, light shares of opposite phase extinguish each other - the result is an intensity modulation.

Electro-optical modulation excels in a negligible chirping and reaches a high extinction ratio (modulation depths). The disadvantage of these modulators is their high attenuation loss (about 4 dB) and the relatively high modulation voltages required.

Wavelength stability with external modulation

When using external modulators a retroaction on the laser module is excluded as far as possible if an optical isolator is used. Nevertheless, the consequent use of angle polished connectors is recommended.

2.4 Coherence control

The PRO8000 (-4) / PRO800 optical source modules (WDM, CWDM) are equipped with an adjustable coherence control, to reduce unwanted stimulated Brillouin or Raman Scattering.

Coherence control is done by an internal amplitude modulation with band limited (1-5 kHz) white noise or with a discrete modulation with a sinusoidal, rectangular or triangular (option) signal in the frequency range 20 Hz … 50 kHz.

A 0% setting in the menu means no noise modulation, a setting of 100% delivers a maximum of 5% amplitude modulation. This results in a maximum gauss-shaped line-broadening of typ. more than 1 GHz.

NOTE

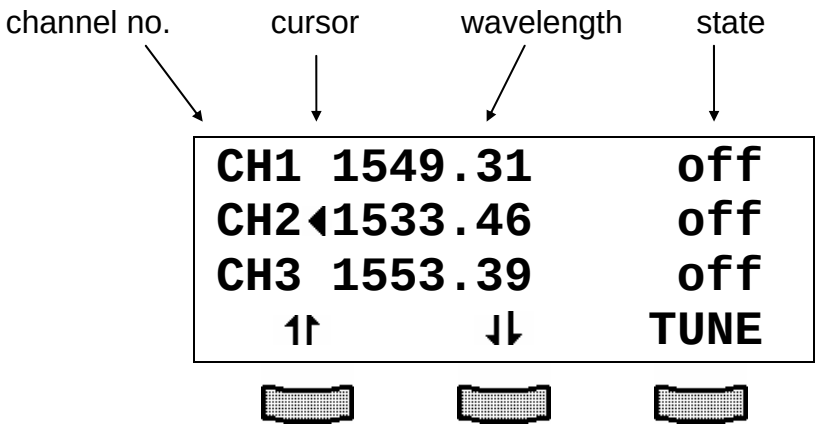
Percentage setting and bandwidth are not in strict linear relationship to each other!

2.5 Operating the WDM and CWDM modules

2.5.1 Functions in the main menu

2.5.1.1 Display

The main menu shows the channel number, the wavelength and the status of the different inserted modules.:



2.5.1.2 Selecting a module

Select a module with the cursor by pressing the softkeys ↑ and ↓ .

e.g.: CH2◀

The display scrolls up and down.

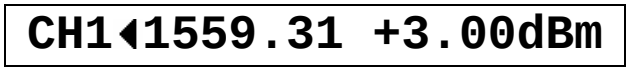
(The LED “SEL” on the corresponding module front panel will light up).

Press CHANNEL to enter the channel menu

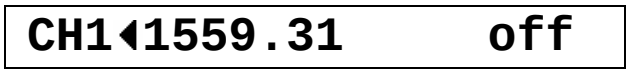
2.5.1.3 Switching modules on and off

Modules can be switched on or off in the main menu or in the channel menu. For this purpose first select the module (see page 24). Press the key ON/OFF to turn on the module. The LED “ON” at the respective module will light up and the display shows the emitted optical power.

Optical power



Press the key ON/OFF again to turn off the module. The LED “ON” at the module extinguishes.

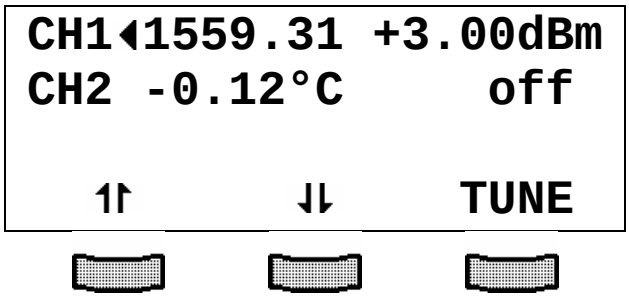


☝ Attention ☝

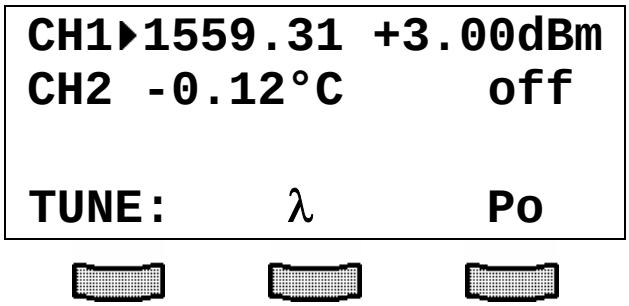
Never switch on the laser output with no fiber installed!

2.5.1.4 Setting of temperature δT and optical power

To set the wavelength or the optical output power in the main menu the corresponding module is selected with the cursor (here: CH1):



Pressing the key **(TUNE)** will turn the cursor to the right. Thus indicating the value to be selected. The softkeys get new functions:

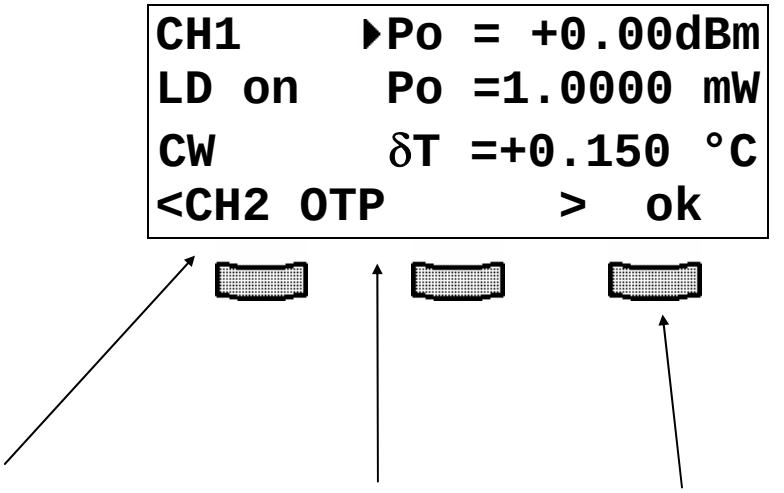


The softkey (λ) selects the wavelength, the softkey (**Po**) selects the optical power.
The selected value can be adjusted by means of the tuning knob. Press ESC to make new settings valid.

2.5.2 Error messages

Error messages are shown in the bottom line of the display regardless of which menu you are in.

If an error occurs, the display shows for example:



Channel causing the error Error message ok to accept

Possible error messages (depending on the type of module) are:

a) Display messages with interrupt:

<CHn Vcc fail > OK	Laser switched off due to an error in the current sourcing.
<CHn OTP > OK	Module is too hot. Operation is possible again after cooling down
<CHn SHUTTER > OK	Shutter is not in the right position or was moved during operation of the laser diode
<CHn ctrl Temp> OK	Operating temperature of the laser not yet reached

b) Display messages while changing parameters:

▶NO PAV TUNE !◀ OK	Attempt to change the set power with modulation on.
▶NOT IF MOD ON◀ OK	Attempt to change the modulation type while modulation is on.
▶AMP TOO HIGH!◀ OK	Attempt to switch on modulation when either the sum of set power and modulation amplitude would exceed 100% nominal power or the difference between set power and modulation amplitude would "extinguish" the laser function.

c) Display messages when trying to switch on the module:

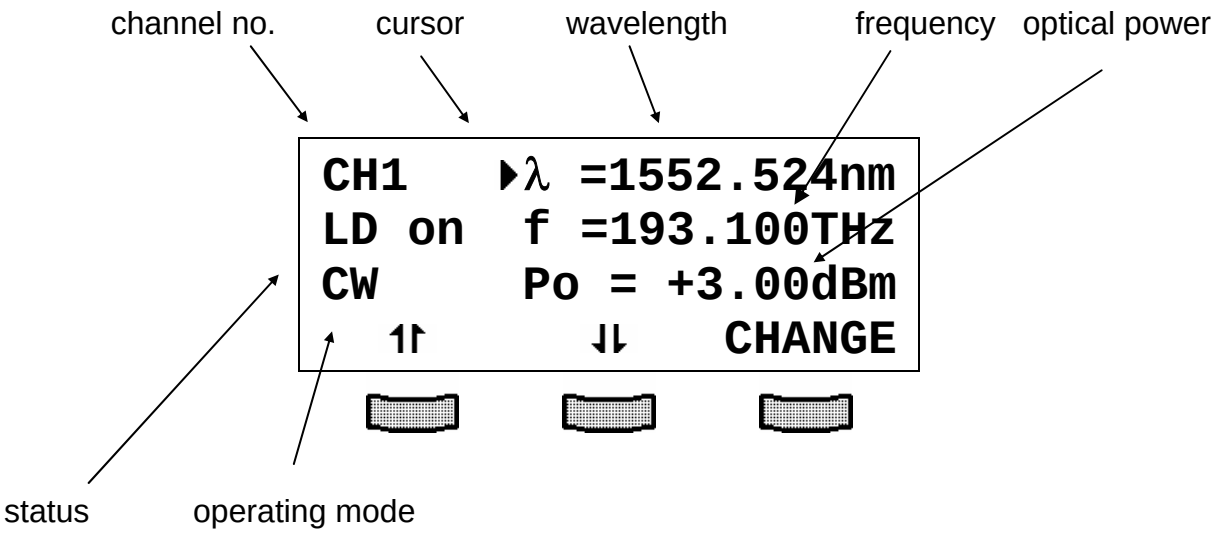
▶CHn OTP !◀ OK	Module is overheated. Wait for cooling down.
▶CHn Vcc fail ◀ OK	Power supply error. (Maybe service needed).
▶CHn ctrl Temp◀ OK	Operating temperature of the laser not yet reached.
▶CHn SHUTTER !◀ OK	Safety shutter (option) not in the right position.

2.5.3 Functions in the channel menu (CW modules)

You can reach the channel menu from the main menu by pressing the key CHANNEL. Pressing again CHANNEL or ESC will lead you back to the main menu.

2.5.3.1 Display

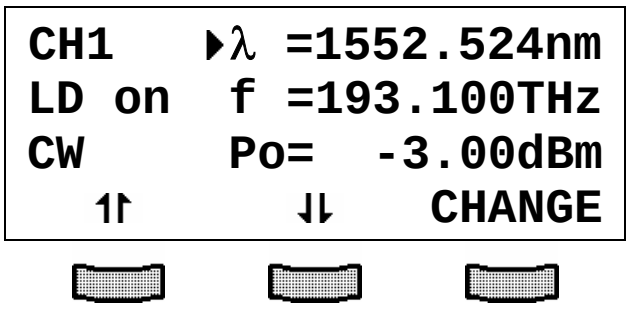
In the channel menu all parameters of the selected module will appear:



The ↑ and ↓ keys moves the cursor up and down and let you scroll through the menu.

2.5.3.2 Setting the wavelength

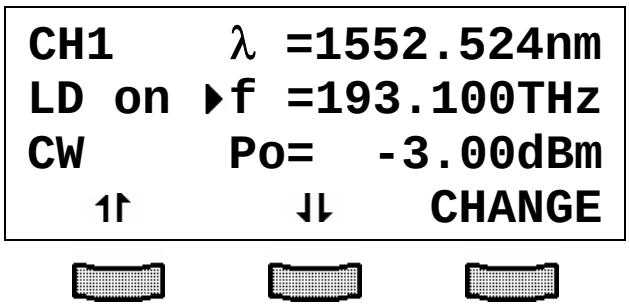
Select the respective line with the cursor:



Press (**CHANGE**) to change the wavelength.
Adjust the wavelength with the tuning knob. The actual wavelength follows your input.
Press ESC to finish the wavelength tuning and saves the data even if the PRO800/PRO8000 (-4) is switched off.

2.5.3.3 Setting the laser frequency

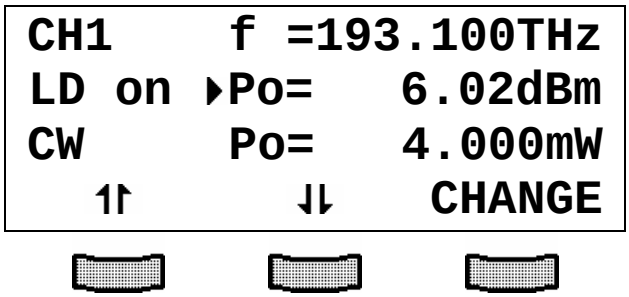
Select the respective line with the cursor:



Press (**CHANGE**) to change the laser frequency.
Adjust the frequency with the tuning knob. The actual frequency follows your input.
Press ESC to make settings valid and store the data in a non-volatile memory.

2.5.3.4 Setting the optical power

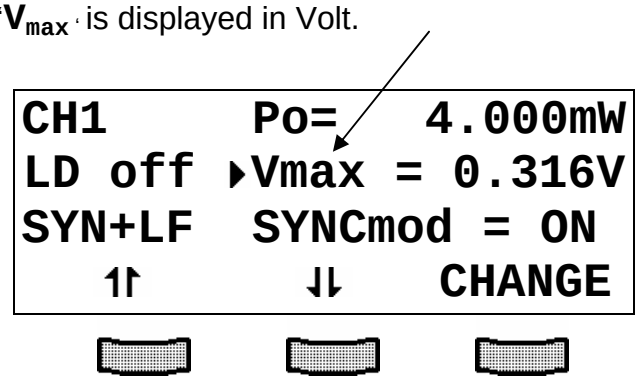
You can set the optical power either in dBm or in mW. Both power values are given in the channel menu. Changing one will also affect the display of the other.
Select the respective line with the cursor:



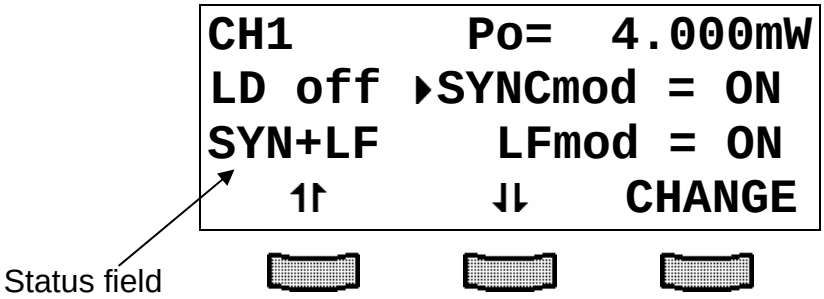
Press (**CHANGE**) to change the optical power.
Adjust the power with the tuning knob.
Press ESC to make settings valid and store the data in a non-volatile memory.

2.5.3.5 Read maximum modulation voltage (opt. Bias-T)

If you are using a CW module with the option Bias-T, the maximum allowed RF modulation voltage 'V_{max}' is displayed in Volt.



2.5.3.6 Switching the modulations on and off



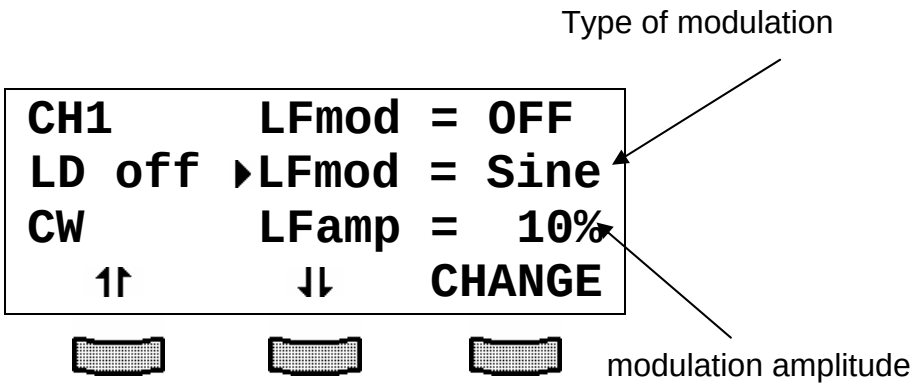
The CW modules can use two type of modulations: external synchronous modulation and internal low frequency modulation. Both can be applied one by one or together. The line: '**SYNCmod**' allows to switch on or off the synchronous modulation for every WDM module, which is applied at the BNC jack on the back panel of the PRO8 (0 ... 10 kHz). This modulation is fed synchronously to all WDM modules in the unit and is a 100% on/off modulation.

The internal low frequency modulation (20Hz ... 50 kHz) is generated separately for every module.
The status field shows which kinds of modulation are active.

2.5.3.7 Changing waveform and amplitude of LF modulation

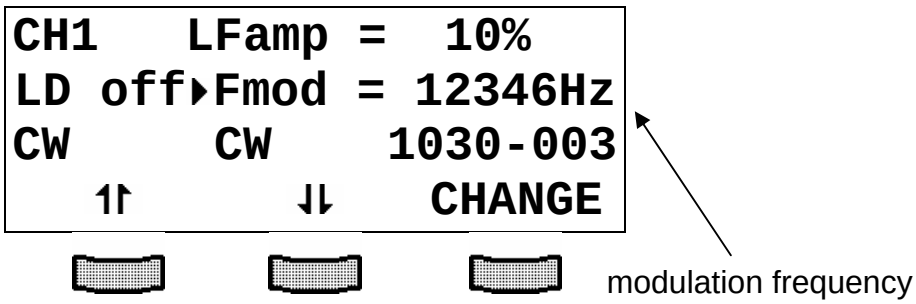
You can select between four different modulation waveforms in the line 'LFmod': **sine** – **square** – **pulse**-- (optional **triang**) and **noise**. (The **Lfmod** must be switched off, in order to change the modulation type).

In case of sine, square, triangle (optional) and noise you can adjust the relative modulation depth from 0,1% ... 100% in the line '**LFamp**'.



In the case of square modulation, the modulation never extinguishes the laser function of the diode, whereas the '**Pulse**' option is a real on/off modulation. Therefore the Modulation amplitude cannot be changed here, the amplitude display shows: '**Pulse**'.

2.5.3.8 Change the modulation frequency



Press (**CHANGE)** to change the modulation frequency.

Adjust the frequency between 20 and 50000 Hz in 1 Hz steps with the tuning knob.

Press ESC to make settings valid and store the data even if the PRO800/PRO8000 (-4) is switched off.

With noise modulation no frequency change is possible. The display only shows '**noise**'.

2.5.3.9 Display the serial number of the unit

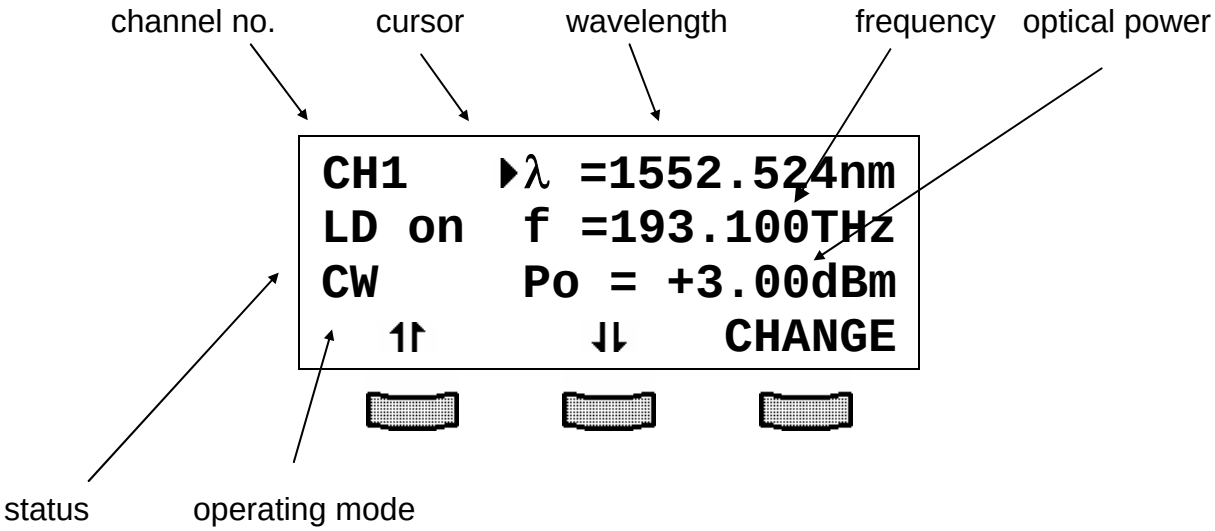
The last line of the menu shows the serial number, here CW module #1030-003.

2.5.4 Functions in the channel menu (modules with direct modulation)

You can reach the channel menu from the main menu by pressing the key CHANNEL. Pressing again CHANNEL or ESC will lead you back to the main menu.

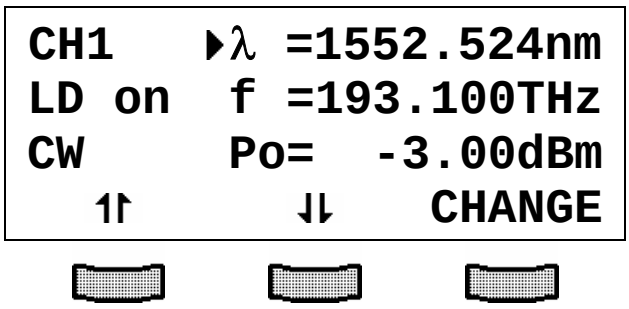
2.5.4.1 Display

In the channel menu all parameters of the selected module will appear:



2.5.4.2 Setting the wavelength

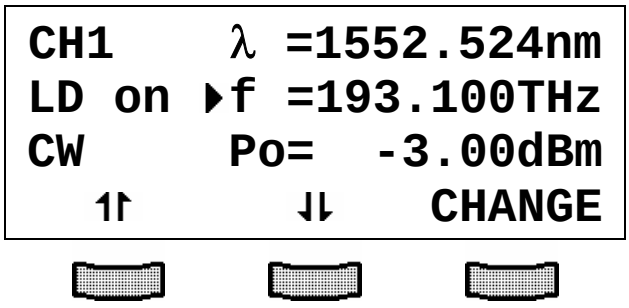
Select the respective line with the cursor:



Press (**CHANGE**) to change the wavelength.
Adjust the wavelength with the tuning knob.
Press ESC to make settings valid.

2.5.4.3 Setting the laser frequency

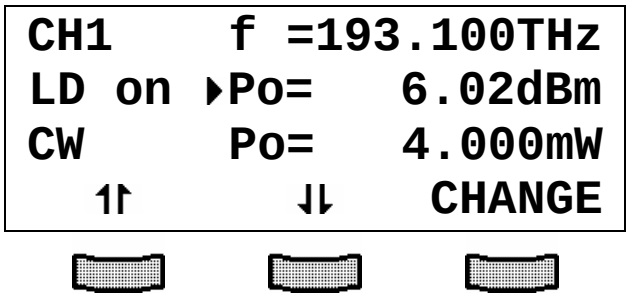
Select the respective line with the cursor:



Press (**CHANGE**) to change the laser frequency.
Adjust the frequency with the tuning knob.
Press ESC to make settings valid.

2.5.4.4 Setting the optical power

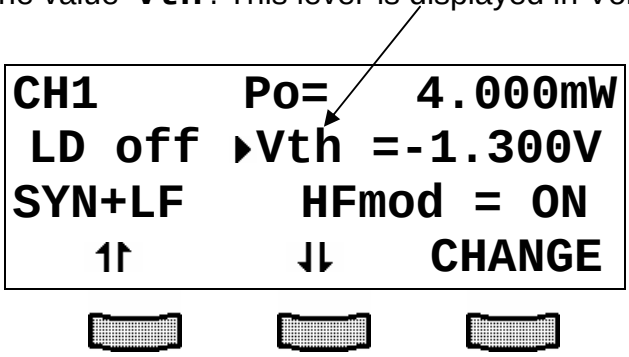
You can set the optical power either in dBm or in mW. Both power values are given in the channel menu. Changing one will also affect the display of the other.
Select the respective line with the cursor:



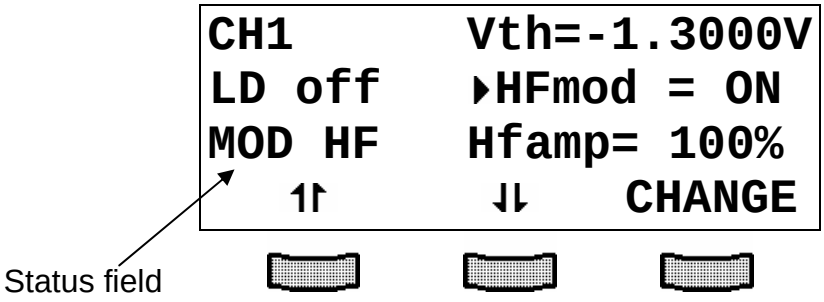
Press (**CHANGE**) to change the optical power.
Adjust the power with the tuning knob.
Press ESC to make settings valid.
If you have switched the RF modulation on, the display shows the average power '**Pav**' instead of the set value '**P0**'

2.5.4.5 Set the lower ECL voltage threshold

You can adapt the lower ECL input threshold voltage of the modulation input to your set-up by changing the value '**Vth**'. This level is displayed in Volt.



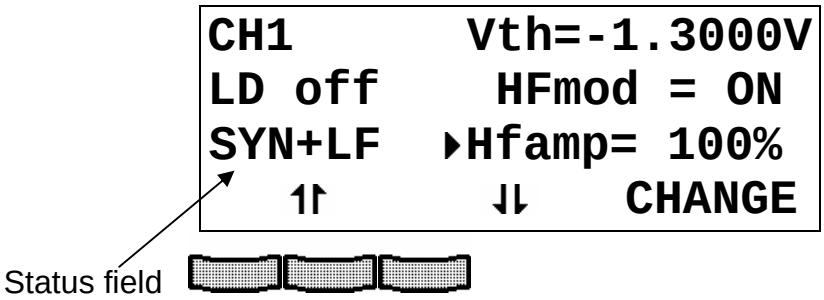
2.5.4.6 Switching the external RF modulation on and off



Pressing (**CHANGE**) toggles the status of the external RF modulation between on and off.

Press ESC to store the status, even when power is switched off.

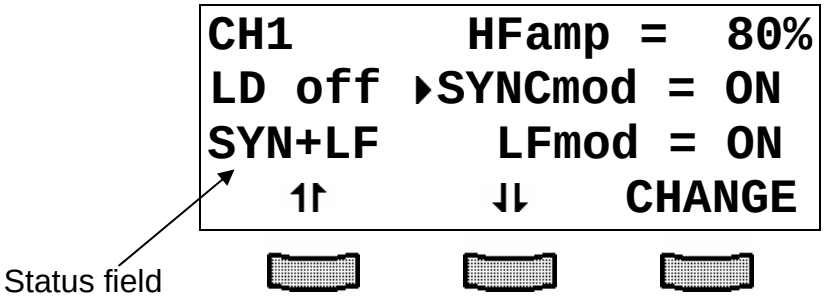
2.5.4.7 Adjusting the external RF modulation amplitude



Pressing (**CHANGE**) to set the relative external RF modulation amplitude with the tuning knob.

Press ESC to store the status, even when power is switched off.

2.5.4.8 Switching the modulations on and off

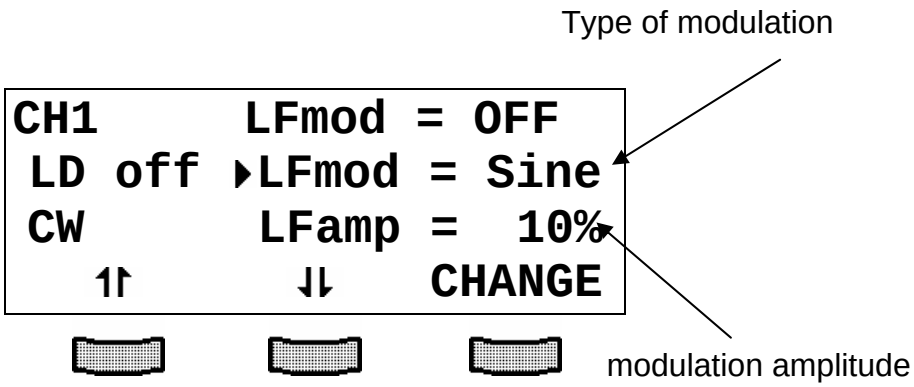


The WDM CW modules can use two kinds of modulations: external synchronous modulation and internal low frequency modulation. Both can be applied one by one or together. The line: '**SYNCmod**' allows to switch on or off the synchronous modulation for every WDM module, which is applied at the BNC jack on the back panel of the PRO8 (0 ... 10 kHz). This modulation is fed synchronously to all WDM modules in the unit and is a 100% on/off modulation.

The internal low frequency modulation (20Hz ... 50 kHz) is generated separately for every WDM module.
The status field shows which kinds of modulation are active.

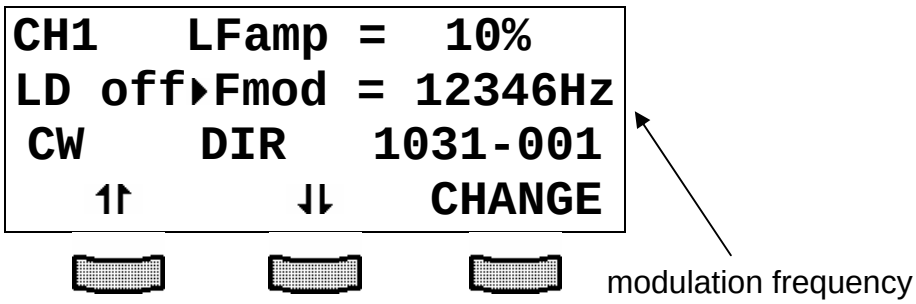
2.5.4.9 Changing waveform and amplitude of LF modulation

You can select between four different modulation waveforms in the line 'LFmod': Sine – Square – Pulse –(triangle, optional) and noise. (The **Lfmod** must be switched off, in order to change the modulation type).
In case of sine, square, triangle (optional) and noise you can adjust the relative modulation depth from 0,1% ... 100% in the line '**LFamp**'.



In the case of square modulation, the modulation never extinguishes the laser function of the diode, whereas the '**Pulse**' option is a real on/off modulation. Therefore the Modulation amplitude cannot be changed here, the amplitude display shows: '**Pulse**'.

2.5.4.10 Change the modulation frequency



The line 'Fmod' allows you to adjust the modulation frequency between 20 and 50000 Hz in 1 Hz steps. Select the line '**Fmod**', press 'change' and adjust the frequency with the tuning knob. With noise modulation no frequency change is possible. The display only shows '**noise**'.

2.5.4.11 Display the serial number of the unit

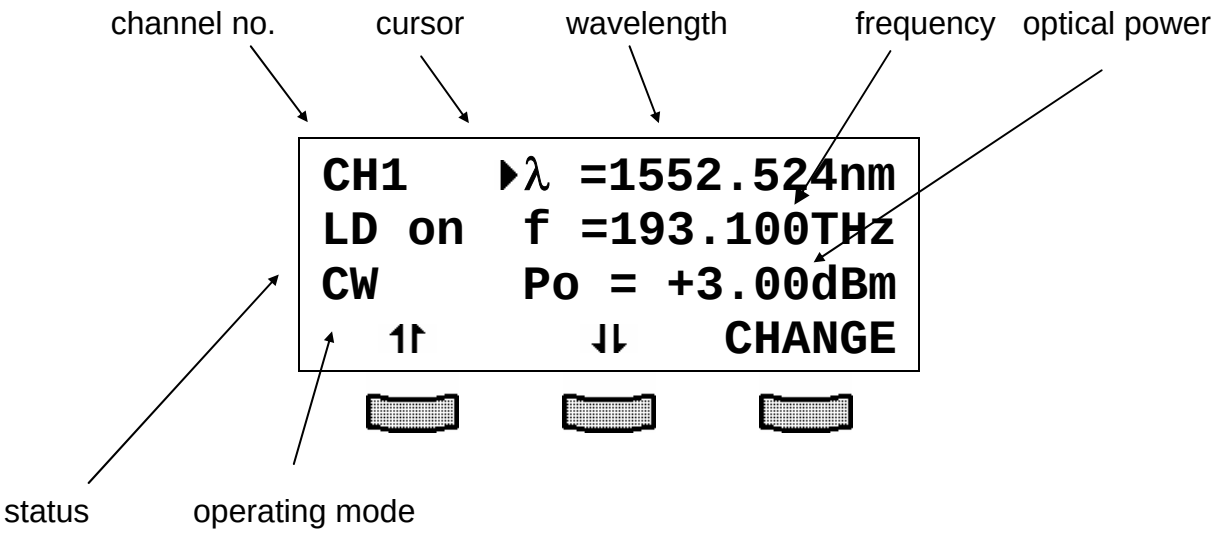
The last line of the menu shows the serial number, here DIR module #1031-001.

2.5.5 Functions in the channel menu (WDMias-T-DC or RF)

You can reach the channel menu from the main menu by pressing the key CHANNEL. Pressing again CHANNEL or ESC will lead you back to the main menu.

2.5.5.1 Display

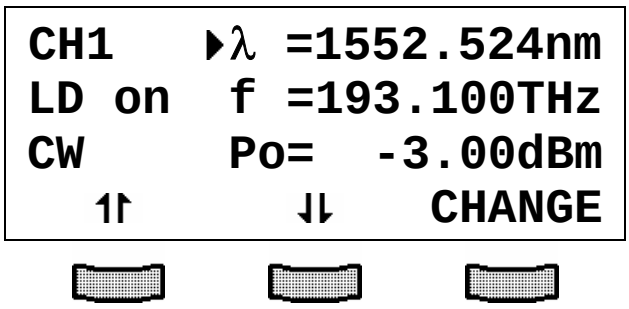
In the channel menu all parameters of the selected module will appear:



The ↑ and ↓ keys moves the cursor up and down and let you scroll through the menu.

2.5.5.2 Setting the wavelength

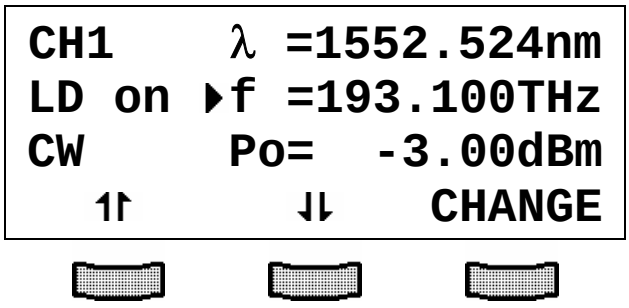
Select the respective line with the cursor:



Press (**CHANGE**) to change the wavelength.
Adjust the wavelength with the tuning knob. The actual wavelength follows your input.
Press ESC to finish the wavelength tuning and saves the data even if the PRO800/PRO8000 (-4) is switched off.

2.5.5.3 Setting the laser frequency

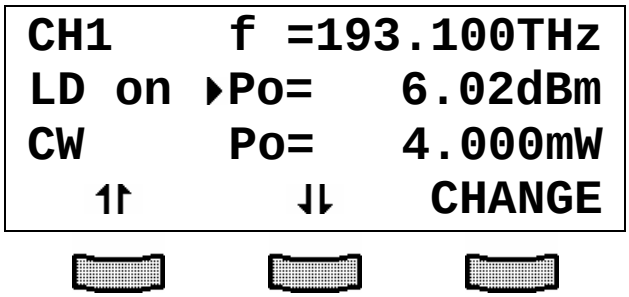
Select the respective line with the cursor:



Press (**CHANGE**) to change the laser frequency.
Adjust the frequency with the tuning knob. The actual frequency follows your input.
Press ESC to make settings valid and store the data even if the PRO800/PRO8000 (-4) is switched off.

2.5.5.4 Setting the optical power

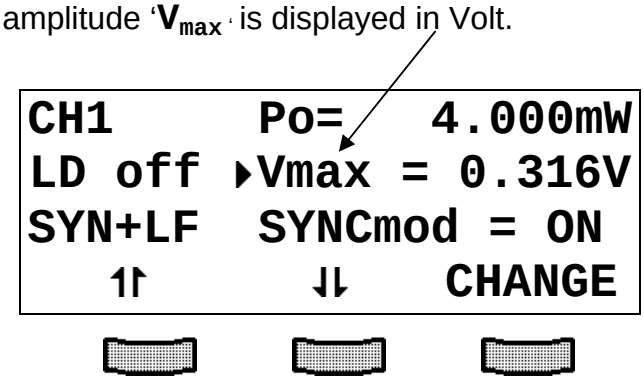
You can set the optical power either in dBm or in mW. Both power values are given in the channel menu. Changing one will also affect the display of the other.
Select the respective line with the cursor:



Press (**CHANGE**) to change the optical power.
Adjust the power with the tuning knob.
Press ESC to make settings valid and store the settings.

2.5.5.5 Read maximum modulation voltage (opt. Bias-T)

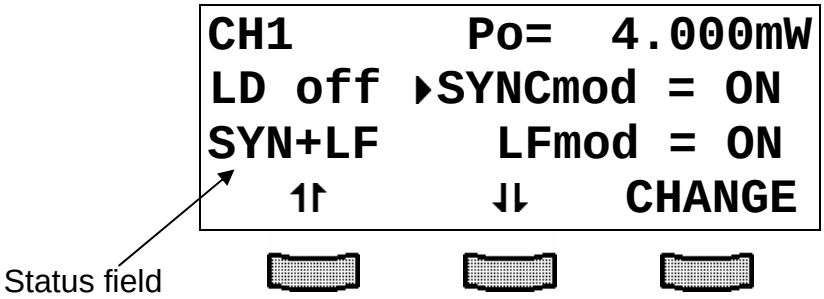
If you are using a module with the option Bias-T installed, the maximum allowed RF modulation voltage amplitude 'V_{max}' is displayed in Volt.



☝ Attention ☝

Modulation voltages higher than the displayed value may lead to destruction of the laser diode!

2.5.5.6 Switching the modulations on and off

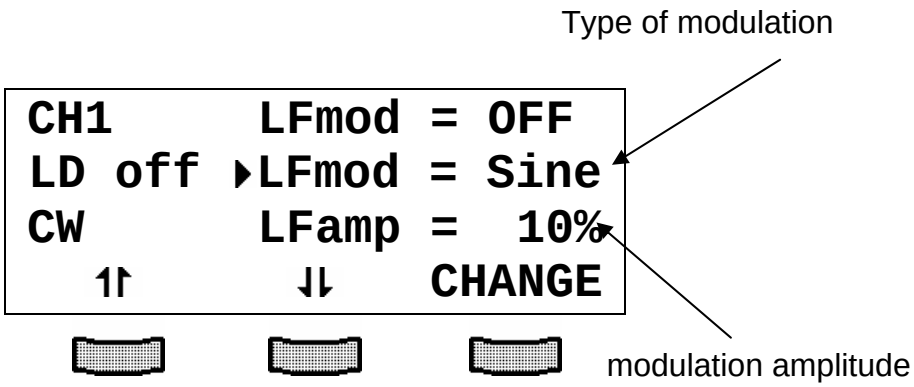


The WDM modules can use two types of modulations: external synchronous modulation and internal low frequency modulation. Both can be applied one by one or together. The line: '**SYNCmod**' allows to switch on or off the synchronous modulation for every optical module, which is applied at the BNC jack on the back panel of the PRO8 (0 ... 10 kHz). This modulation is fed synchronously to all WDM modules in the unit and is a 100% on/off modulation.

The internal low frequency modulation (20 Hz ... 50 kHz) is generated separately for every WDM or CWDM module.
The status field shows which kinds of modulation are active.

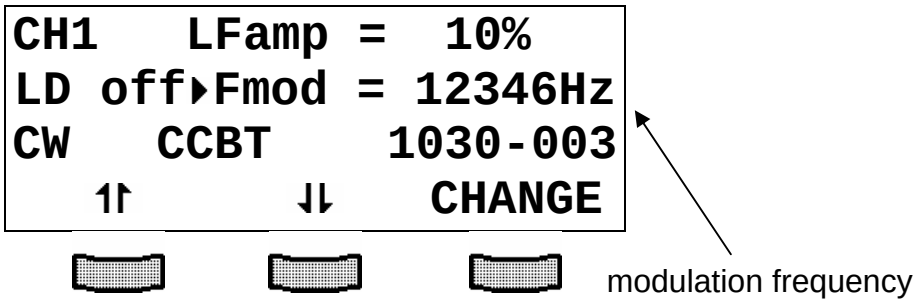
2.5.5.7 Changing waveform and amplitude of LF modulation

You can select between four different modulation waveforms in the line 'LFmod':
Sine – Square – Pulse –(triangle, optional) and noise. (The **Lfmod** must be switched off, in order to change the modulation type).
In case of sine, square, triangle (optional) and noise you can adjust the relative modulation depth from 0,1% ... 100% in the line '**LFamp**'.



In the case of square modulation, the modulation never extinguishes the laser function of the diode, whereas the '**Pulse**' option is a real on/off modulation. Therefore the Modulation amplitude cannot be changed here, the amplitude display shows: '**Pulse**'.

2.5.5.8 Change the modulation frequency



Press (**CHANGE)** to change the modulation frequency.
Adjust the frequency between 20 and 50000 Hz in 1 Hz steps with the tuning knob.
Press ESC to make settings valid and store the data even if the PRO800/PRO8000 (-4) is switched off.
With noise modulation no frequency change is possible. The display only shows '**noise**'.

2.5.5.9 Display the serial number of the unit

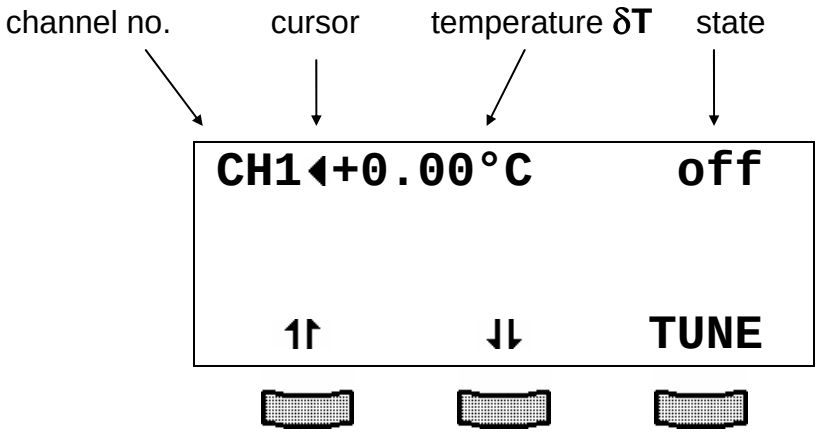
The last line of the menu shows the serial number, here CCDM module #1030-003. with Bias-T option (CCBT).

2.6 Operating the LS modules

2.6.1 Functions in the main menu

2.6.1.1 Display

The main menu shows the channel number, the temperature (difference) δT and the state of the LS module:



2.6.1.2 Selecting a module

Select a module for further input with the cursor using the softkeys ↑ and ↓ :

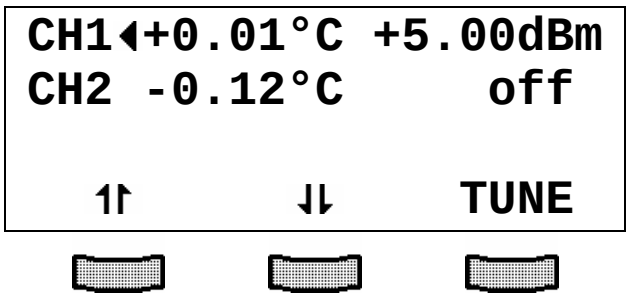
e.g. :CH4

Pressing CHANNEL will lead to the channel menu

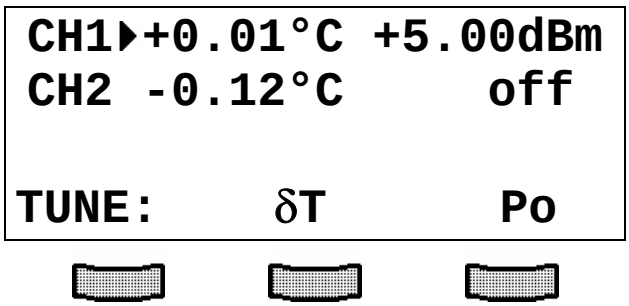
➔ (refer to chapter"2.5.1.2", page 24)

2.6.1.3 Setting of temperature δT and optical power

To set the temperature **δT** in the main menu the corresponding module is selected with the cursor (here: CH1):



Pressing the key **(TUNE)** will turn the cursor to the right. Thus indicating the value to be selected. The softkeys get new functions:



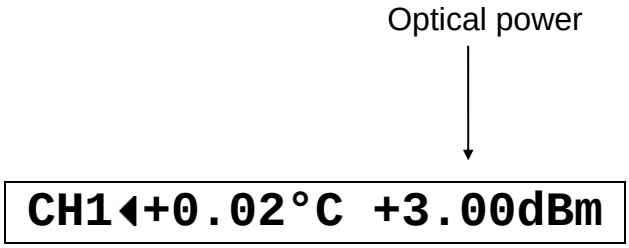
The softkey (**δT**) selects the temperature, the softkey (**Po**) selects the optical power. The selected value can be adjusted by means of the tuning knob. Press ESC to make new settings valid.

NOTE

With the module switched off only the temperature can be selected. For presetting the optical power, enter the channel menu, see 2.6.3

2.6.1.4 Switching on and off

Modules can be switched on or off in the main menu or in the channel menu. First select the module (see previous page). Pressing ON/OFF will switch on the module. The LED “ON” at the respective module will light up and the set optical power is indicated.

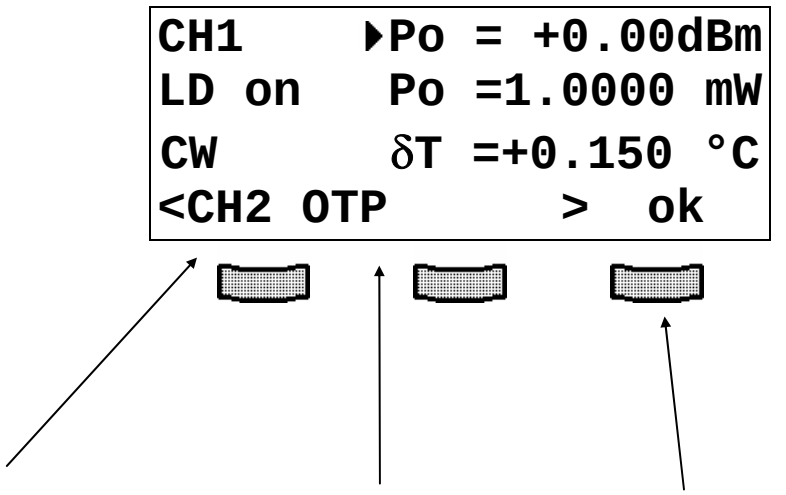


Pressing the key ON/OFF again will switch off the module. The LED ON at the module extinguishes.

2.6.2 Error messages

Error messages are shown in the bottom line of the display regardless of which menu you are in.

If an error occurs, the display shows for example:



Channel causing the error Error message ok to accept

Possible error messages (depending on the type of module) are:

a) Display messages with interrupt:

<CHn Vcc fail > OK	Laser switched off due to an error in the current sourcing.
<CHn OTP > OK	Module is too hot. Operation is possible again after cooling down
<CHn SHUTTER > OK	Shutter is not in the right position or was moved during operation of the laser diode
<CHn ctrl Temp> OK	Operating temperature of the laser not yet reached

b) Display messages while changing parameters:

▶NO PAV TUNE !◀ OK	Attempt to change the set power with modulation on.
▶NOT IF MOD ON◀ OK	Attempt to change the modulation type while modulation is on.
▶AMP TOO HIGH!◀ OK	Attempt to switch on modulation when either the sum of set power and modulation amplitude would exceed 100% nominal power or the difference between set power and modulation amplitude would "extinguish" the laser function.

c) Display messages when trying to switch on the module:

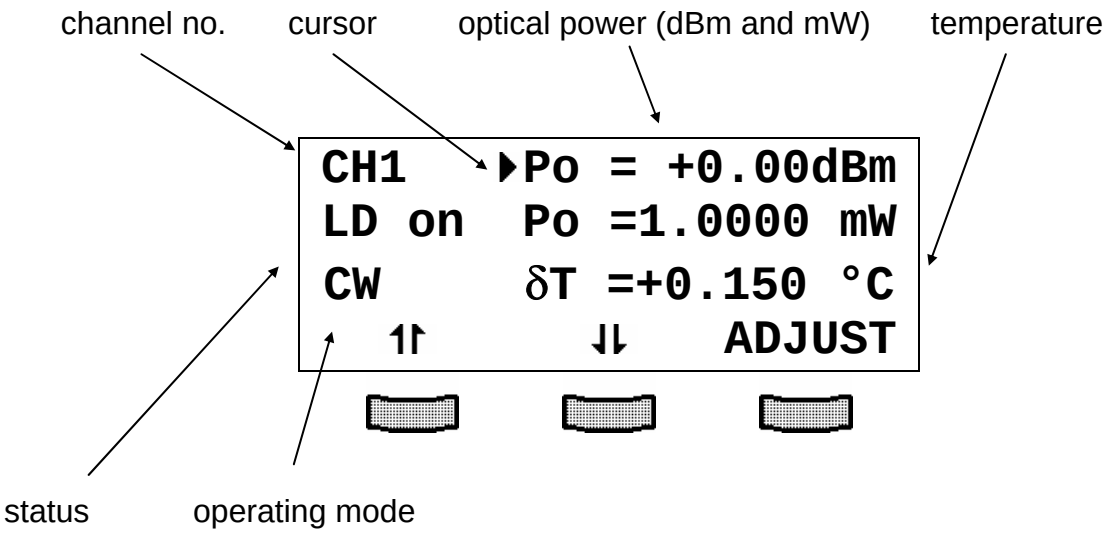
▶CHn OTP !◀ OK	Module is overheated. Wait for cooling down.
▶CHn Vcc fail ◀ OK	Power supply error. (Maybe service needed).
▶CHn ctrl Temp◀ OK	Operating temperature of the laser not yet reached.
▶CHn SHUTTER !◀ OK	Safety shutter (option) not in the right position.

2.6.3 Functions in the channel menu (LS)

The channel menu is reached from the main menu by pressing CHANNEL. Pressing CHANNEL or ESC again will lead you back to the main menu.

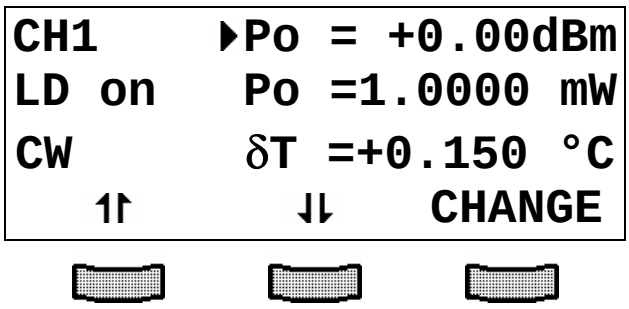
2.6.3.1 Display

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

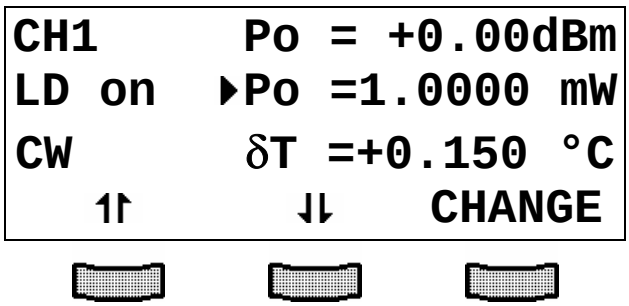


2.6.3.2 Setting the optical power

To set the optical power (either in dBm or in mW) in the channel menu the respective line is selected with the cursor:



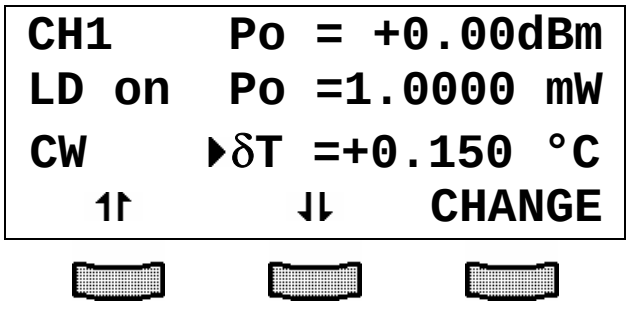
or:



Pressing the key **(CHANGE)**, will activate the tuning knob to change the optical power. Pressing ESC will terminate the procedure.

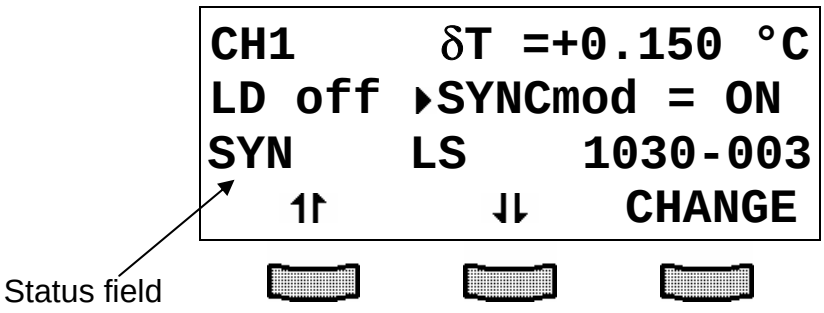
2.6.3.3 Setting the temperature δT

To set the temperature **δT** in the channel menu the respective line is selected with the cursor:



Pressing the key **(CHANGE)**, will activate the tuning knob enabling the temperature **δT** to be changed. Pressing ESC will terminate the procedure.

2.6.3.4 Switching the synchronous modulation on and off



The LS modules can use internal synchronous modulation. The line: '**SYNCmod**' allows to switch on or off the synchronous modulation for every WDM or LS module, which is applied at the BNC jack on the back panel of the PRO8 (0 ... 10 kHz). This modulation is fed synchronously to all WDM and LS modules in the unit and is a 100% on/off modulation

2.6.3.5 Display the serial number of the unit

The last line of the menu shows the serial number, here LS module #1030-003.

3 Communication with a control computer

3.1 General notes on remote control

The description of the mainframe of the PRO8000 (-4) / PRO800 includes all instructions on how to prepare and execute the programming of the system via computer interface.

The fundamental operation of a PRO8000/800 optical source module is found in this instruction manual.

➔ (Refer to chapter 2, “Operating the PRO8000 (-4) / PRO800 optical source modules” page 12

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.

3.1.1 Nomenclature

Program messages (PC ⇒ PRO8000 (-4)) are written in inverted commas:
"*IDN?"

Response messages (PRO8000 (-4) ⇒ PC) are written in brackets:
[:SLOT 1]

There is a decimal point: **1.234**
Parameters are separated with comma: **"PLOT 2,0"**
Commands are separated with semicolon: **"*IDN?;*STB?"**

3.1.2 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

➔ (Refer to IEE488.2 (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

➔ (Refer to IEE488.2 (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
```

➔ (Refer to IEE488.2 (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
```

➔ (Refer to IEE488.2 (8.7.4))

3.2 Commands of the different light source modules

3.2.1 Select the module slot

":SLOT <NR1>"	Selects a slot for further programming <Nr1>=1…8 (PRO8000), 1…2 (PRO800)
":SLOT?"	Queries the selected slot **[:SLOT <NR1><LF>]**

NOTE

There are different commands for the different options implemented in the WDM modules (e.g. EA- or Direct modulation, coherence control etc.)

The commands are listed here in relation to the possible modulation types!

3.2.2 WDM Modules with CW mode

3.2.2.1 Programming the coherence control (in %)

(These command are for compatibility with the old WDM modules. The new commands: see "**:LFMOD**" and "**:LFAMP**")

This command has the same function as:

```
:LFMOD:TYPE NOISE
:LFMOD:ENABLE ON
:LFAMP XX
```

Programming:

":COHERENCE:SET <NR3>"	Program the modulation degree (%) for coherence control

Reading:

":COHERENCE:SET?"	Read the modulation degree (%) for coherence control **[:COHERENCE:SET <NR3><LF>]**
":COHERENCE:MIN?"	Read minimum modulation degree (%) for coherence control **[:COHERENCE:MIN <NR3><LF>]**
":COHERENCE:MAX?"	Read maximum modulation degree (%) for coherence control **[:COHERENCE:MAX <NR3><LF>]**

3.2.2.2 Programming the wavelength (LAMBDA)

Programming:

":LAMBDA:SET <NR3>"	Program the wavelength of module (in nm)

Reading:

":LAMBDA:SET?"	Read the wavelength of the module **[:LAMBDA:SET <NR3><LF>]**
":LAMBDA:MIN?"	Read the minimum wavelength allowed **[:LAMBDA:MIN <NR3><LF>]**
":LAMBDA:MAX?"	Read the maximum wavelength allowed **[:LAMBDA:MAX <NR3><LF>]**

3.2.2.3 Turning the laser on and off

Programming:

":LASER ON"	Turn the laser output on
":LASER OFF"	Turn the laser output off

Reading:

":LASER?"	Read status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

3.2.2.4 Setting the laser frequency [THz]

Programming:

":LASERFREQ:SET <NR3>"	Setting laser frequency in THz

Reading:

":LASERFREQ:SET?"	Read the set laser frequency **[:LASERFREQ:SET <NR3><LF>]**
":LASERFREQ:MIN?"	Read the minimum allowed frequency **[:LASERFREQ:MIN <NR3><LF>]**
":LASERFREQ:MAX?"	Read the maximum allowed frequency **[:LASERFREQ:MAX <NR3><LF>]**

3.2.2.5 Selecting the modulation amplitude

Programming:

":LFAMP:SET <NR3>"	Select modulation amplitude (%)

Reading:

":LFAMP:SET?"	Read selected modulation amplitude (%) **[:LFAMP:SET** **3.939536E+000<LF>]**
":LFAMP:MIN?"	Read minimum modulation amplitude (%) **[:LFAMP:MIN** **1.000000E-001<LF>]**
":LFAMP:MAX?"	Read maximum modulation amplitude (%) **[:LFAMP:MAX** **7.000000E+001<LF>]**

3.2.2.6 Selecting the modulation frequency

Programming:

":LFFREQ:SET<NR3>"	Select the modulation frequency [Hz]

Reading:

":LFFREQ:SET?"	Read selected modulation frequency **[:LFFREQ:SET** **3.939536E+003<LF>]**
":LFFREQ:MIN?"	Read minimum modulation frequency **[:LFFREQ:MIN** **2.000000E+001<LF>]**
":LFFREQ:MAX?"	Read maximum modulation frequency **[:LFFREQ:MAX** **5.000000E+004<LF>]**

3.2.2.7 Selecting the modulation type

Programming:

":LFMOD:ENABLE ON"	Turn on low frequency modulation
":LFMOD:ENABLE OFF"	Turn off low frequency modulation
":LFMOD:TYPE NOISE"	Select noise modulation (coherence control)
":LFMOD:TYPE PULSE"	Select pulse modulation (on/off)
":LFMOD:TYPE SINE"	Select sine wave modulation
":LFMOD:TYPE SQUARE"	Select square wave modulation (adj. depth)
":LFMOD:TYPE TRIANGLE"	Select triangular modulation

Reading:

":LFMOD:ENABLE?"	**[:LFMOD:ENABLE ON<LF>]**
":LFMOD:TYPE?"	**[:LFMOD:TYPE SINE<LF>]**

3.2.2.8 Programming the output power in dBm

Programming:

":P_DBM:SET <NR3>"	Program the output power of the module (in dBm)
":P_DBM:START <NR3>"	Program the start value (in dBm) for ELCH
":P_DBM:STOP <NR3>"	Program the stop value (in dBm) for ELCH

Reading:

":P_DBM:SET?"	Read the output power of the module **[:P_DBM:SET <NR3><LF>]**
":P_DBM:MIN?"	Read the minimum output power allowed **[:P_DBM:MIN <NR3><LF>]**
":P_DBM:MAX?"	Read the maximum output power allowed **[:P_DBM:MAX <NR3><LF>]**
":P_DBM:START?"	Read the start value (in dBm) for ELCH **[:P_DBM:START <NR3><LF>]**
":P_DBM:STOP?"	Read the stop value (in dBm) for ELCH **[:P_DBM:STOP <NR3><LF>]**

3.2.2.9 Programming the output power in Watt

Programming:

":P_W:SET <NR3>"	Program the output power of the module (in W)
":P_W:START <NR3>"	Program the start value (in W) for ELCH[1)]
":P_W:STOP <NR3>"	Program the stop value (in W) for ELCH

Reading:

":P_W:SET?"	Read the set output power of the module **[:P_W:SET <NR3><LF>]**
":P_W:MIN?"	Read the minimum output power allowed of the module **[:P_W:MIN <NR3><LF>]**
":P_W:MAX?"	Read the maximum output power allowed of the module **[:P_W:MAX <NR3><LF>]**
":P_W:START?"	Read the start value (in W) for ELCH **[:P_W:START <NR3><LF>]**
":P_W:STOP?"	Read the stop value (in W) for ELCH **[:P_W:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.2.10 Activating the synchronous modulation

Programming:

":SYNCMOD ON"	Activate the participation of the module in synchronous modulation
":SYNCMOD OFF"	Deactivate the participation of the module in synchronous modulation

Reading:

":SYNCMOD?"	**[:SYNCMOD ON<LF>],** **[:SYNCMOD OFF<LF>]**

3.2.2.11 Reading the module identification

Reading:

":TYPE:ID?"	Read plug-in module ID (here 249) **[:TYPE:ID 249<LF>]**
":TYPE:SUB?"	Read plug in sub-type (here 2) **[:TYPE:SUB 2<LF>]**
":TYPE:TXT?"	Read plug-in module ID as plaintext, e.g. **[:TYPE:TXT WDM81550 CW 20mW<LF>]**
":TYPE:SN?"	Read plug-in module serial number, e.g. **[:TYPE:SN 1030-004<LF>]**

3.2.2.12 Read maximum allowed HF modulation voltage

Reading:

":VHFMAX:ACT?"	Read maximum HF modulation voltage in Volt **[:VHFMAX:ACT** **2.000000E-001<LF>]**

3.2.3 CWDM Modules

3.2.3.1 Turning the laser on and off

Programming:

":LASER ON"	Turn the laser output on
":LASER OFF"	Turn the laser output off

Reading:

":LASER?"	Read status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

3.2.3.2 Querying the laser wavelength [nm]

Reading:

":LAMBDA:SET?"	Read the set laser frequency **[:LAMBDA:SET <NR3><LF>]**

3.2.3.3 Querying the laser frequency [THz]

Reading:

":LASERFREQ:SET?"	Read the set laser frequency **[:LASERFREQ:SET <NR3><LF>]**

3.2.3.4 Setting the temperature difference δT [K]

Programming:

":DTEMP:SET <NR3>"	Set the temperature difference δT

Reading:

":DTEMP:SET?"	Read the set temperature difference **[:DTEMP:SET 10.939E+000<LF>]**
":DTEMP:MIN?"	Read minimum allowed δT **[:DTEMP:MIN 1.000000E-001<LF>]**
":DTEMP:MAX?"	Read maximum allowed δT **[:DTEMP:MAX 3.0000E+001<LF>]**

3.2.3.5 Selecting the modulation amplitude

Programming:

":LFAMP:SET <NR3>"	Select modulation amplitude (%)

Reading:

":LFAMP:SET?"	Read selected modulation amplitude (%) **[:LFAMP:SET 3.939536E+000<LF>]**
":LFAMP:MIN?"	Read minimum modulation amplitude (%) **[:LFAMP:MIN 1.000000E-001<LF>]**
":LFAMP:MAX?"	Read maximum modulation amplitude (%) **[:LFAMP:MAX 7.000000E+001<LF>]**

3.2.3.6 Selecting the modulation frequency

Programming:

":LFFREQ:SET<NR3>"	Select the modulation frequency [Hz]

Reading:

":LFFREQ:SET?"	Read selected modulation frequency **[:LFFREQ:SET** **3.939536E+003<LF>]**
":LFFREQ:MIN?"	Read minimum modulation frequency **[:LFFREQ:MIN** **2.000000E+001<LF>]**
":LFFREQ:MAX?"	Read maximum modulation frequency **[:LFFREQ:MAX** **5.000000E+004<LF>]**

3.2.3.7 Selecting the modulation type

Programming:

":LFMOD:ENABLE ON"	Turn on low frequency modulation
":LFMOD:ENABLE OFF"	Turn off low frequency modulation
":LFMOD:TYPE NOISE"	Select noise modulation (coherence control)
":LFMOD:TYPE PULSE"	Select pulse modulation (on/off)
":LFMOD:TYPE SINE"	Select sine wave modulation
":LFMOD:TYPE SQUARE"	Select square wave modulation (adj. depth)
":LFMOD:TYPE TRIANGLE"	Select triangular modulation

Reading:

":LFMOD:ENABLE?"	**[:LFMOD:ENABLE ON<LF>]**
":LFMOD:TYPE?"	**[:LFMOD:TYPE SINE<LF>]**

3.2.3.8 Programming the output power in dBm

Programming:

":P_DBM:SET <NR3>"	Program the output power of the module (in dBm)
":P_DBM:START <NR3>"	Program the start value (in dBm) for ELCH
":P_DBM:STOP <NR3>"	Program the stop value (in dBm) for ELCH

Reading:

":P_DBM:SET?"	Read the output power of the module **[:P_DBM:SET <NR3><LF>]**
":P_DBM:MIN?"	Read the minimum output power allowed **[:P_DBM:MIN <NR3><LF>]**
":P_DBM:MAX?"	Read the maximum output power allowed **[:P_DBM:MAX <NR3><LF>]**
":P_DBM:START?"	Read the start value (in dBm) for ELCH **[:P_DBM:START <NR3><LF>]**
":P_DBM:STOP?"	Read the stop value (in dBm) for ELCH **[:P_DBM:STOP <NR3><LF>]**

3.2.3.9 Programming the output power in Watt

Programming:

":P_W:SET <NR3>"	Program the output power of the module (in W)
":P_W:START <NR3>"	Program the start value (in W) for ELCH[1)]
":P_W:STOP <NR3>"	Program the stop value (in W) for ELCH

Reading:

":P_W:SET?"	Read the set output power of the module **[:P_W:SET <NR3><LF>]**
":P_W:MIN?"	Read the minimum output power allowed of the module **[:P_W:MIN <NR3><LF>]**
":P_W:MAX?"	Read the maximum output power allowed of the module **[:P_W:MAX <NR3><LF>]**
":P_W:START?"	Read the start value (in W) for ELCH **[:P_W:START <NR3><LF>]**
":P_W:STOP?"	Read the stop value (in W) for ELCH **[:P_W:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.3.10 Activating the synchronous modulation

Programming:

":SYNCMOD ON"	Activate the participation of the module in synchronous modulation
":SYNCMOD OFF"	Deactivate the participation of the module in synchronous modulation

Reading:

":SYNCMOD?"	**[:SYNCMOD ON<LF>], [:SYNCMOD OFF<LF>]**

3.2.3.11 Reading the module identification

Reading:

":TYPE:ID?"	Read plug-in module ID (here 249) **[:TYPE:ID 249<LF>]**
":TYPE:SUB?"	Read plug in sub-type (here 2) **[:TYPE:SUB 2<LF>]**
":TYPE:TXT?"	Read plug-in module ID as plaintext, e.g. **[:TYPE:TXT WDM81550 CW 20mW<LF>]**
":TYPE:SN?"	Read plug-in module serial number, e.g. **[:TYPE:SN 1030-004<LF>]**

3.2.4 WDM Modules with direct modulation mode

3.2.4.1 Programming the modulation current I_{MOD} [%]

Programming:

":CMOD:SET <NR3>"	Program modulation current in %

Reading:

":CMOD:SET?"	Read the modulation current **[:CMOD:SET <NR3><LF>]**
":CMOD:MIN?"	Read the minimum modulation current **[:CMOD:MIN <NR3><LF>]**
":CMOD:MAX?"	Read the maximum modulation current **[:CMOD:MAX <NR3><LF>]**

3.2.4.2 Programming the coherence control

(This command is for compatibility with the old WDM modules. The new commands: see "**:LFMOD**" and "**:LFAMP**")

This command has the same function as:

```
:LFMOD:TYPE NOISE
:LFMOD:ENABLE ON
:LFAMP XX
```

Programming:

":COHCNTL ON"	Turn on coherence control
":COHCNTL OFF"	Turn off coherence control

Reading:

":COHCNTL?"	Read status of coherence control (on/off) **[:COHCNTL ON<LF>]** **[:COHCNTL OFF<LF>]**

3.2.4.3 Programming the RF modulation amplitude [%]

Programming:

":HFAMP:SET <NR3>"	Program modulation amplitude in %

Reading:

":HFAMP:SET?"	Read the modulation amplitude **[:HFAMP:SET <NR3><LF>]**
":HFAMP:MIN?"	Read the minimum modulation amplitude **[:HFAMP:MIN <NR3><LF>]**
":HFAMP:MAX?"	Read the maximum modulation amplitude **[:HFAMP:MAX <NR3><LF>]**

3.2.4.4 Activating the RF modulation

Programming:

":HFMOD ON"	Turn on the RF modulation
":HFMOD OFF"	Turn off the RF modulation

Reading:

":HFMOD?"	Read status of the RF modulation (on/off) **[:HFMOD ON<LF>]** **[:HFMOD OFF<LF>]**

3.2.4.5 Programming the wavelength (LAMBDA)

Programming:

":LAMBDA:SET <NR3>"	Set the wavelength of the module (in nm)

Reading:

":LAMBDA:SET?"	Read the wavelength of the module **[:LAMBDA:SET <NR3><LF>]**
":LAMBDA:MIN?"	Read the minimum wavelength allowed **[:LAMBDA:MIN <NR3><LF>]**
":LAMBDA:MAX?"	Read the maximum wavelength allowed **[:LAMBDA:MAX <NR3><LF>]**

3.2.4.6 Switching the output on and off (LASER)

Programming:

":LASER ON"	Turning the laser output on
":LASER OFF"	Turning the laser output off

Reading:

":LASER?"	Read status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

3.2.4.7 Setting the laser frequency (THz)

Programming:

":LASERFREQ:SET <NR3>"	Setting laser frequency in THz

Reading:

":LASERFREQ:SET?"	Read the set laser frequency **[:LASERFREQ:SET <NR3><LF>]**
":LASERFREQ:MIN?"	Read the minimum allowed frequency **[:LASERFREQ:MIN <NR3><LF>]**
":LASERFREQ:MAX?"	Read the maximum allowed frequency **[:LASERFREQ:MAX <NR3><LF>]**

3.2.4.8 Selecting the modulation amplitude

Programming:

":LFAMP:SET <NR3>"	Select modulation amplitude (%)

Reading:

":LFAMP:SET?"	Read selected modulation amplitude (%) **[:LFAMP:SET** **3.939536E+003<LF>]**
":LFAMP:MIN?"	Read minimum modulation amplitude (%) **[:LFAMP:MIN** **1.000000E-001<LF>]**
":LFAMP:MAX?"	Read maximum modulation amplitude (%) **[:LFAMP:MAX** **7.000000E+001<LF>]**

3.2.4.9 Selecting the modulation frequency

Programming:

":LFFREQ:SET<NR3>"	Select modulation frequency

Reading:

":LFFREQ:SET?"	Read selected modulation frequency **[:LFFREQ:SET** **3.939536E+003<LF>]**
":LFFREQ:MIN?"	Read minimum modulation frequency **[:LFFREQ:MIN** **2.000000E+001<LF>]**
":LFFREQ:MAX?"	Read maximum modulation frequency **[:LFFREQ:MAX** **5.000000E+004<LF>]**

3.2.4.10 Selecting the modulation type

Programming:

":LFMOD:ENABLE ON"	Turn on low frequency modulation
":LFMOD:ENABLE OFF"	Turn off low frequency modulation
":LFMOD:TYPE NOISE"	Select noise modulation (coherence control)
":LFMOD:TYPE PULSE"	Select pulse modulation (on/off)
":LFMOD:TYPE SINE"	Select sine wave modulation
":LFMOD:TYPE SQUARE"	Select square wave modulation (adj. depth)
":LFMOD:TYPE TRIANGLE"	Select triangular modulation

Reading:

":LFMOD:ENABLE?"	**[:LFMOD:ENABLE ON<LF>]**
":LFMOD:TYPE?"	**[:LFMOD:TYPE SINE<LF>]**

3.2.4.11 Programming modulation

Programming:

":MOD ON"	Enable modulation
":MOD OFF"	Disable modulation

Reading:

":MOD?"	Read status of modulation (on / off) **[:MOD ON<LF>]** **[:MOD OFF<LF>]**

3.2.4.12 Reading the actual average laser power (dBm)

Reading

":PAV_DBM:ACT?"	Read the actual average laser power in dBm **[:PAV_DBM:ACT <NR3><LF>]**

3.2.4.13 Reading the actual average laser power (W)

Reading

":PAV_W:ACT?"	Read the actual average laser power in Watt **[:PAV_W:ACT <NR3><LF>]**

3.2.4.14 Programming the output power in dBm

Programming:

":P_DBM:SET <NR3>"	Program the output power (in dBm)
":P_DBM:START <NR3>"	Program the start value (in dBm) for ELCH
":P_DBM:STOP <NR3>"	Program the stop value (in dBm) for ELCH

Reading:

":P_DBM:SET?"	Read the output power of the module **[:P_DBM:SET <NR3><LF>]**
":P_DBM:MIN?"	Read the minimum output power allowed **[:P_DBM:MIN <NR3><LF>]**
":P_DBM:MAX?"	Read the maximum output power allowed **[:P_DBM:MAX <NR3><LF>]**
":P_DBM:START?"	Read the start value (in dBm) for ELCH **[:P_DBM:START <NR3><LF>]**
":P_DBM:STOP?"	Read the stop value (in dBm) for ELCH **[:P_DBM:STOP <NR3><LF>]**

3.2.4.15 Programming the output power in Watt

Programming:

":P_W:SET <NR3>"	Program the output power (in W)
":P_W:START <NR3>"	Program the start value (in W) for ELCH[1]
":P_W:STOP <NR3>"	Program the stop value (in W) for ELCH

Reading:

":P_W:SET?"	Read the set output power of the module **[:P_W:SET <NR3><LF>]**
":P_W:MIN?"	Read the minimum output power allowed of the module **[:P_W:MIN <NR3><LF>]**
":P_W:MAX?"	Read the maximum output power allowed of the module **[:P_W:MAX <NR3><LF>]**
":P_W:START?"	Read the start value (in W) for ELCH **[:P_W:START <NR3><LF>]**
":P_W:STOP?"	Read the stop value (in W) for ELCH **[:P_W:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.4.16 Activating the synchronous modulation

Programming:

":SYNCMOD ON"	Activate the participation of the module in synchronous modulation
":SYNCMOD OFF"	Deactivate the participation of the module in synchronous modulation

Reading:

":SYNCMOD?"	**[:SYNCMOD ON<LF>],** **[:SYNCMOD OFF<LF>]**

3.2.4.17 Reading the module identification

Reading:

":TYPE:ID?"	Read plug-in module ID (should be 243) **[:TYPE:ID 243<LF>]**
":TYPE:SUB?"	Read plug in sub-type (here 6) **[:TYPE:SUB 6<LF>]**
":TYPE:TXT?"	Read plug-in module ID in plaintext, e.g. **[:TYPE:TXT WDM81550 DIR 20mW<LF>]**
":TYPE:SN?"	Read plug-in module serial number, e.g. **[:TYPE:SN 1030-004<LF>]**

3.2.4.18 Programming the ECL logical level Uth (V)

Programming:

":VTH:SET <NR3>"	Program the ECL logical level (in V)

Reading:

":VTH:SET?"	Read the ECL logical level (in V) **[:VTH:SET <NR3><LF>]**
":VTH:MIN?"	Read the minimum level voltage Uth allowed **[:VTH:MIN <NR3><LF>]**
":VTH:MAX?"	Read the maximum level voltage Uth allowed **[:VTH:MAX <NR3><LF>]**

3.2.5 WDM Modules with Bias-T

3.2.5.1 Programming the coherence control (in %)

(This command is for compatibility with the old WDM modules. The new commands: see "**:LFMOD**" and "**:LFAMP**")

This command has the same function as:

```
:LFMOD:TYPE NOISE
:LFMOD:ENABLE ON
:LFAMP XX
```

Programming:

":COHERENCE:SET: <NR3>"	Program the modulation degree (%) for coherence control

Reading:

":COHERENCE:SET?"	Read the modulation degree (%) for coherence control **[:COHERENCE:SET <NR3><LF>]**
":COHERENCE:MIN?"	Read minimum modulation degree (%) for coherence control **[:COHERENCE:MIN <NR3><LF>]**
":COHERENCE:MAX?"	Read of maximum modulation degree (%) for coherence control **[:COHERENCE:MAX <NR3><LF>]**

3.2.5.2 Programming the wavelength (LAMBDA)

Programming:

":LAMBDA:SET <NR3>"	Program the wavelength of the module (in m)

Reading:

":LAMBDA:SET?"	Read the wavelength of the module **[:LAMBDA:SET <NR3><LF>]**
":LAMBDA:MIN?"	Read the minimum wavelength allowed **[:LAMBDA:MIN <NR3><LF>]**
":LAMBDA:MAX?"	Read the maximum wavelength allowed **[:LAMBDA:MAX <NR3><LF>]**

3.2.5.3 Switching the output on and off (LASER)

Programming:

":LASER ON"	Turn the laser output on
":LASER OFF"	Turn the laser output off

Reading:

":LASER?"	Read status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

3.2.5.4 Setting the laser frequency [THz]

Programming:

Programming:

":LASERFREQ:SET <NR3>"	Setting laser frequency in THz

Reading:

":LASERFREQ:SET?"	Read the set laser frequency **[:LASERFREQ:SET <NR3><LF>]**
":LASERFREQ:MIN?"	Read the minimum allowed frequency **[:LASERFREQ:MIN <NR3><LF>]**
":LASERFREQ:MAX?"	Read the maximum allowed frequency **[:LASERFREQ:MAX <NR3><LF>]**

3.2.5.5 Selecting the modulation amplitude

Programming:

":LFAMP:SET <NR3>"	Select modulation amplitude (%)

Reading:

":LFAMP:SET?"	Read selected modulation amplitude (%) **[:LFAMP:SET** **3.939536E+000<LF>]**
":LFAMP:MIN?"	Read minimum modulation amplitude (%) **[:LFAMP:MIN** **1.000000E-001<LF>]**
":LFAMP:MAX?"	Read maximum modulation amplitude (%) **[:LFAMP:MAX** **7.000000E+001<LF>]**

3.2.5.6 Selecting the modulation frequency

Programming:

":LFFREQ:SET<NR3>"	Select modulation frequency

Reading:

":LFFREQ:SET?"	Read selected modulation frequency **[:LFFREQ:SET** **3.539536E+003<LF>]**
":LFFREQ:MIN?"	Read minimum modulation frequency **[:LFFREQ:MIN** **2.000000E+001<LF>]**
":LFFREQ:MAX?"	Read maximum modulation frequency **[:LFFREQ:MAX** **5.000000E+004<LF>]**

3.2.5.7 Selecting the modulation type

Programming:

":LFMOD:ENABLE ON"	Turn on low frequency modulation
":LFMOD:ENABLE OFF"	Turn off low frequency modulation
":LFMOD:TYPE NOISE"	Select noise modulation (coherence control)
":LFMOD:TYPE PULSE"	Select pulse modulation (on/off)
":LFMOD:TYPE SINE"	Select sine wave modulation
":LFMOD:TYPE SQUARE"	Select square wave modulation (adj. depth)
":LFMOD:TYPE TRIANGLE"	Select triangular modulation

Reading:

":LFMOD:ENABLE?"	**[:LFMOD:ENABLE ON<LF>]**
":LFMOD:TYPE?"	**[:LFMOD:TYPE SINE<LF>]**

3.2.5.8 Programming the output power in dBm

Programming:

":P_DBM:SET <NR3>"	Program the output power (in dBm)
":P_DBM:START <NR3>"	Program the start value (in dBm) for ELCH[1]
":P_DBM:STOP <NR3>"	Program the stop value (in dBm) for ELCH

Reading:

":P_DBM:SET?"	Read the set output power of the module **[:P_DBM:SET <NR3><LF>]**
":P_DBM:MIN?"	Read the minimum output power allowed of the module **[:P_DBM:MIN <NR3><LF>]**
":P_DBM:MAX?"	Read the maximum output power allowed of the module **[:P_DBM:MAX <NR3><LF>]**
":P_DBM:START?"	Read the start value (in W) for ELCH **[:P_DBM:START <NR3><LF>]**
":P_DBM:STOP?"	Read the stop value (in W) for ELCH **[:P_DBM:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.5.9 Programming the output power in Watt

Programming:

":P_W:SET <NR3>"	Program the output power (in W)
":P_W:START <NR3>"	Program the start value (in W) for ELCH[1]
":P_W:STOP <NR3>"	Program the stop value (in W) for ELCH

Reading:

":P_W:SET?"	Read the set output power of the module **[:P_W:SET <NR3><LF>]**
":P_W:MIN?"	Read the minimum output power allowed of the module **[:P_W:MIN <NR3><LF>]**
":P_W:MAX?"	Read the maximum output power allowed of the module **[:P_W:MAX <NR3><LF>]**
":P_W:START?"	Read the start value (in W) for ELCH **[:P_W:START <NR3><LF>]**
":P_W:STOP?"	Read the stop value (in W) for ELCH **[:P_W:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.5.10 Activating the synchronous modulation

Programming:

":SYNCMOD ON"	Activate the participation of the module in synchronous modulation
":SYNCMOD OFF"	Deactivate the participation of the module in synchronous modulation

Reading:

":SYNCMOD?"	**[:SYNCMOD ON<LF>],** **[:SYNCMOD OFF<LF>]**

3.2.5.11 Reading the module identification

Reading:

":TYPE:ID?"	Read plug-in module ID (should be 243) **[:TYPE:ID 243<LF>]**
":TYPE:SUB?"	Read plug in sub-type (here 4) **[:TYPE:SUB 4<LF>]**
":TYPE:TXT?"	Read plug-in module ID in text form, e.g. **[:TYPE:TXT WDM81550 CCDM 20mW<LF>]**
":TYPE:SN?"	Read plug-in module serial number, e.g. **[:TYPE:SN 1030-004<LF>]**

3.2.5.12 Query maximum allowed modulation voltage

Reading:

":VHFMAX:ACT "	Read maximum modulation voltage (in V)

3.2.6 LS modules

3.2.6.1 Programming the temperature δT

Programming:

":DTEMP:SET <NR3>"	Program the temperature deviation **δT**

Reading:

":DTEMP:SET?"	Read the temperature deviation **δT** **[:DTEMP:SET <NR3><LF>]**
":DTEMP:MIN?"	Read the minimum allowed temperature deviation **δT** **[:DTEMP:MIN <NR3><LF>]**
":DTEMP:MAX?"	Read the maximum allowed temperature deviation **δT** **[:DTEMP:MAX <NR3><LF>]**

3.2.6.2 Switching the output on and off (OUTP)

Program:

":LASER ON"	Turn the laser output on
":LASER OFF"	Turn the laser output off

Reading:

":LASER?"	Read status of the laser output **[:LASER ON<LF>]** **[:LASER OFF<LF>]**

3.2.6.3 Programming the output power (in dBm)

Programming:

":P_DBM:SET <NR3>"	Program the output power (in dBm)
":P_DBM:START <NR3>"	Program the start value (in dBm) for ELCH
":P_DBM:STOP <NR3>"	Program the stop value (in dBm) for ELCH

Reading:

":P_DBM:SET?"	Read the set output power of the module **[:P_DBM:SET <NR3><LF>]**
":P_DBM:MIN?"	Read the minimum output power allowed of the module **[:P_DBM:MIN <NR3><LF>]**
":P_DBM:MAX?"	Read the maximum output power allowed of the module **[:P_DBM:MAX <NR3><LF>]**
":P_DBM:START?"	Read the start value (in W) for ELCH **[:P_DBM:START <NR3><LF>]**
":P_DBM:STOP?"	Read the stop value (in W) for ELCH **[:P_DBM:STOP <NR3><LF>]**

3.2.6.4 Programming the output power (in W)

Programming:

":P_W:SET <NR3>"	Program the output power (in W)
":P_W:START <NR3>"	Program the start value (in W) for ELCH[1]
":P_W:STOP <NR3>"	Program the stop value (in W) for ELCH

Reading:

":P_W:SET?"	Read the set output power of the module **[:P_W:SET <NR3><LF>]**
":P_W:MIN?"	Read the minimum output power allowed of the module **[:P_W:MIN <NR3><LF>]**
":P_W:MAX?"	Read the maximum output power allowed of the module **[:P_W:MAX <NR3><LF>]**
":P_W:START?"	Read the start value (in W) for ELCH **[:P_W:START <NR3><LF>]**
":P_W:STOP?"	Read the stop value (in W) for ELCH **[:P_W:STOP <NR3><LF>]**

[1] ELCH: Electrical Characterization

3.2.6.5 Activating the synchronous modulation

Programming:

":SYNCMOD ON"	Activate the participation of the module in synchronous modulation
":SYNCMOD OFF"	Deactivate the participation of the module in synchronous modulation

Reading:

":SYNCMOD?"	**[:SYNCMOD ON<LF>],** **[:SYNCMOD OFF<LF>]**

3.2.6.6 Reading the module identification

Reading:

":TYPE:ID?"	Read plug-in module ID (should be 249) **[:TYPE:ID 249<LF>]**
":TYPE:SUB?"	Read plug in sub-type (here 7) **[:TYPE:SUB 7<LF>]**
":TYPE:TXT?"	Read plug-in module ID in plaintext, e.g. **[:TYPE:TXT WDM81300 SLED 2mW <LF>]**
":TYPE:SN?"	Read plug-in module serial number, e.g. **[:TYPE:LSLD 1030-004<LF>]**

3.3 Status reporting

The WDM8xxxx, C81xxx and LS8xxxx modules provide three 16 bit registers DEC, DEE and EDE (see Figure 8) and four 8 bit registers ESR, STB, ESE and SRE (see Figure 9) to program various service request functions and status reporting.

➔ (Please refer to the IEEE488.2-1992 standard chapter 11)

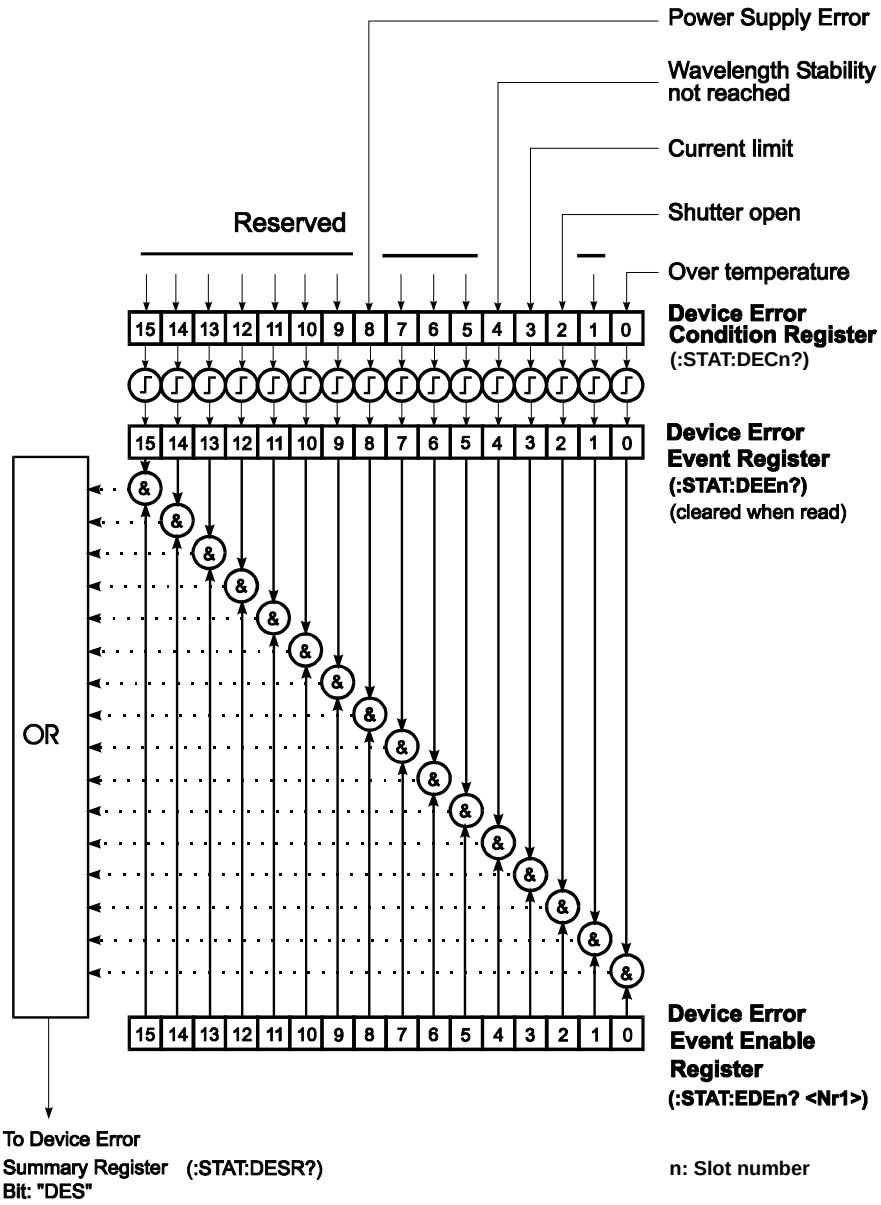


Figure 8 The 16-Bit Device error registers DEC, DEE and EDE

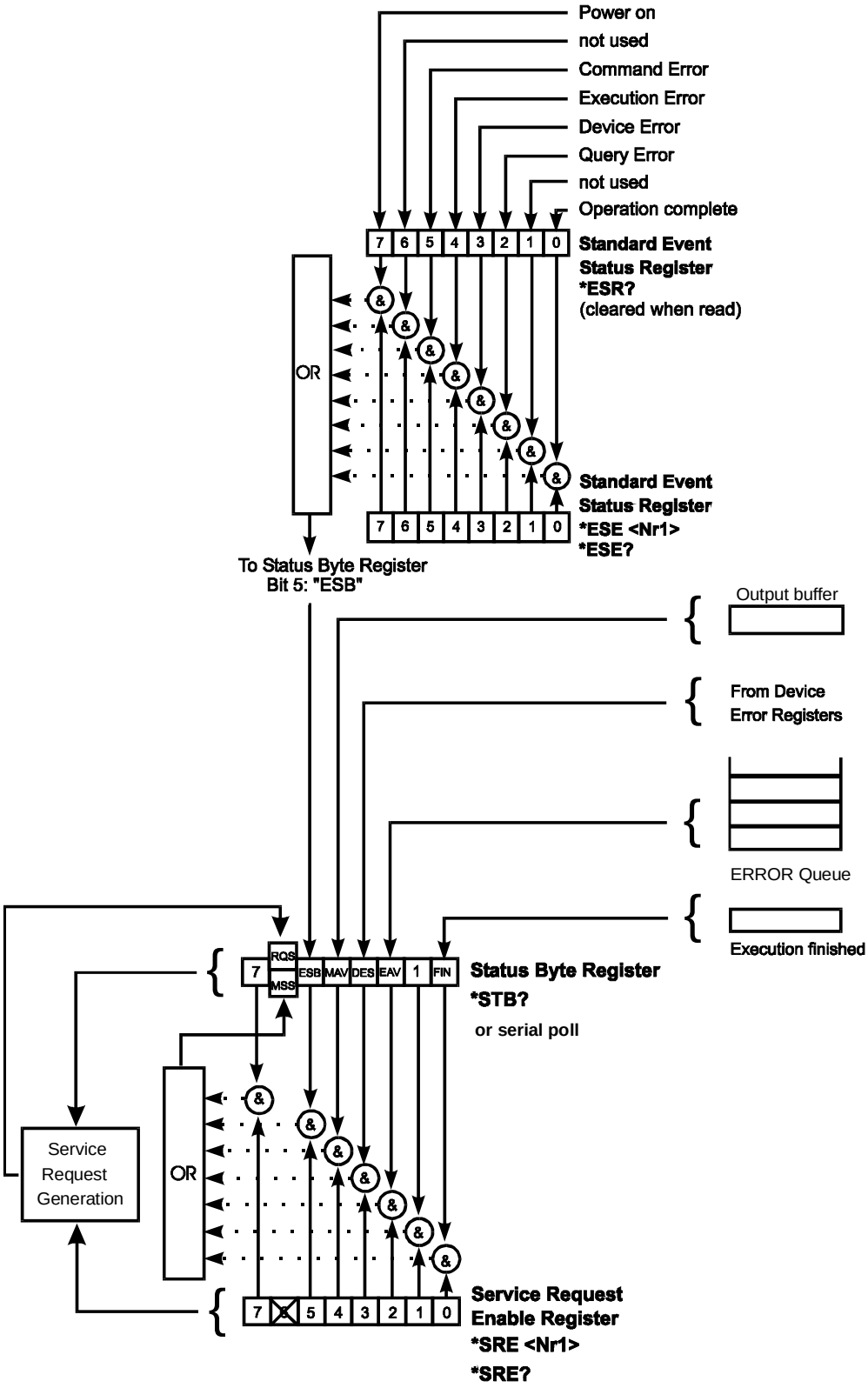


Figure 9 The 8-Bit registers “ESR, STB, ESE and SRE”

3.3.1 Standard event status register (ESR)

The bits of this register represent the following standard events:

Power on	This event bit indicates that an off to on transition has occurred in the power supply. So it is high after turning 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 occurred.
Query error	A query error occurred.
Request control	(Not used)
Operation complete	Can be set with **"*OPC".**

The ESR can be read directly with the command **"*ESR?".** This read command clears the ESR. The content of the ESR cannot be set.

The bits are active high.

3.3.2 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 STB. The 8 bits of the ESE are combined with the according 8 bits of the ESR via a wired “AND”-function These 8 results are combined with a logical “OR”-function, 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.

3.3.3 Status byte register (STB)

The bits of this register are showing the status of the LDC 3065.

RQS	RQS: Request service message: Shows that this device has asserted SRQ (red via serial poll).
MSS	Master summary status: Shows that this device requests a service (read via **"*STB?"**).
MAV	(Message AVailable) This bit is high after a query request, as a result "waits" to be fetched in the output queue. It is low, if the output queue is empty.
DES	(Device Error Status) This bit is high after a device error occurred. Which device errors will set this bit is defined with the EDE.
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.

The STB can be read directly with the command **"*STB?".** The content of the STB cannot be set. The bits are active high.

All bits except bit 6 of the STB can be used to assert a service request (SRQ)
➔ (Please refer to 3.3.5). Alternatively the SRQ can be recognized using the command
➔ **"*STB?"** (Please refer to 3.3.6) or by serial poll (Please refer to 3.3.7).

3.3.4 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 related to the according 7 bits of the SRE by logical “AND”. This 7 results are combined by a logical "OR", so that any "hit" leads to a logical 1 in bit 6 of the STB and asserts an SRQ.

3.3.5 Reading the STB by detecting SRQ

If an SRQ is asserted (see 3.3.4) bit 6 of the STB is set to logical 1, so that the controller can detect which device asserted the SRQ by auto serial polling.

3.3.6 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.

3.3.7 Reading the 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.

3.3.8 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 PRO8000 (-4)/800 optical source modules bits 0, 2 ... 4 and 8 are used:

(0) Over temperature Laser temperature too high. Wait until the module has cooled down. Maintain proper air flow.

(2) Shutter opened Output fiber not properly installed.

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

(4) Wavelength stabilization not yet reached
Appropriate laser temperature and thus the correct wavelength are not yet reached.

(8) Power supply error Internal power supply error.

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

3.3.9 Device error event register (DEE)

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

The DEE can be read but not set. Reading clears the DEE.

3.3.10 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 related to the according 8 bits of the DEE by logical "AND". These 8 results are combined by logical "OR", so that any "hit" leads to a logical 1 of 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.

3.4 Error messages

NOTE

Not all error messages are implemented in all modules

[1201,"Over temperature"]

Possible reason: Module temperature too high. Switch off the output and wait until the module has cooled down. Maintain proper air flow.

[1202,"Internal power failure"]

Possible reason: Severe hardware error. Contact *Thorlabs*.

[1203, "Temperature is out of window"]

Possible reason: The operating temperature of the laser module is not yet reached while attempting to switch on the module.

[1204, "Shutter error- fiber missing"]

Possible reason: The shutter is not in the right position while attempting to switch on the module.

[1230,"Command not valid for this module "]

Possible reason: Attempt to program a command for a optical source module that is not valid for this special module.
e.g. command **":DTEMP:SET <NR3>"** on a WDM8xxxx module.

[1282,"No power change during modulation on allowed "]

Possible reason: Attempt to change the output power with the modulation switched on (only DIR modules)

[1284,"Calibration required "]

Possible reason: Loss of calibration data. Should not occur in normal operation

[1285,"No LF-modulation type change during LF-modulation on allowed "]

Possible reason: Attempt to change the modulation type while the modulation is still switched on

[1286,"No LF-modulation – modulation amplitude too high"]

Possible reason: Attempt to switch on the modulation while the sum of modulation and laser power exceeds 105% nominal output power.

4 Service and Maintenance

4.1 Recalibration of laser wavelength

If the precise laser wavelength is of vital interest to you, you should send your module for recalibration to *Thorlabs (Germany)* once a year!

4.2 Shutter function control

If your module is equipped with a shutter, you should regularly control the correct function of the shutter.
With the laser in operation, lift the shutter a little bit: the laser output has to be interrupted. This is also the case with no fiber installed and the shutter closed.

Otherwise the PRO8000 (-4) / PRO800 optical source modules do not need any further maintenance.

4.3 Troubleshooting

In case that one module of your PRO8000/800 system shows malfunction please check the following items:

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

- ➢ Mainframe PRO8000 (-4)/800 connected properly to the mains?
  - ▪ Connect the PRO8000 (-4)/800 to the power line, take care of the right voltage setting of your mainframe.

- ➢ Mainframe PRO8000 (-4)/800 turned on?
  - ▪ Turn on your PRO8000 (-4)/800 with the key mains-switch.

- ➢ Control the fuse at the rear panel of the PRO8000 (-4)/800 mainframe.
  - ▪ If blown, replace the fuse with the correct type

➔ (refer to your PRO8000 (-4)/800 mainframe operating manual to select the appropriate fuse)

◆ The PRO8000 (-4)/800 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 any laser output power

- ➢ Do you have selected the desired module?
  - ▪ (The LED "SEL" on the front panel of the module must be on)
    Select the desired module on the display by means of the up- and down arrow keys.

- ➢ Do you have turned on the laser output in the main menu or one of the sub-menus?
  - ▪ Change the status setting from "off" to "on".

➔ (refer to chapter 2.5.1.3)

➔ The LED "ON" on the front panel of the module must be on

- Is the fiber installed properly?
  - Make sure the fiber is not broken and tighten the FC/APC connector.

- Do you use the right FC/APC-connector?
  - If not, change the fiber connector to a APC-type.

- Is the shutter in the right position?
  - Make sure the shutter position is neither open nor closed. It must just touch the fiber.
- Is the desired output power programmed correctly?
  - Adjust the desired output power on the display

➔ (refer to chapter 2.6.1.3)

◆ The laser does not emit the correct wavelength (LS-modules)

- Is the operation temperature of the laser reached?
  - Wait for settling of temperature.

If you don't find the error source by means of the trouble shooting list or if more modules work erratic please first connect the *Thorlabs-Hotline (blueline@thorlabs.com)* before sending the whole PRO8000 (-4)/800 system for checkup and repair to *Thorlabs*-Germany.

(refer to section 5.5, "Addresses " on page 112

5 Appendix

5.1 Thorlabs “End of Life” policy (WEEE)

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 10)
- 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.).

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

5.1.1 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.

5.1.2 Ecological background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.
The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.

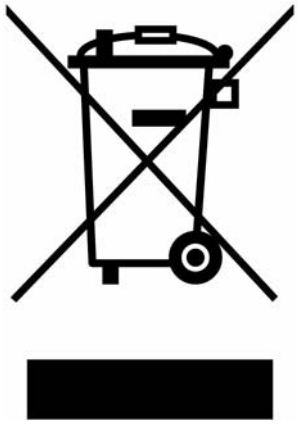


Figure 10 Crossed out “wheelie bin” symbol

5.2 List of acronyms and abbreviations

The following abbreviations are used in this manual:

AC	Alternating Current
AG	Anode Ground
ASE	Amplified Spontaneous Emission
APC	Angled Physical Contact
DC	Direct Current
DEC	Device Error Condition Register
DEE	Device Error Event Register
DES	Device Error Status
DFB	Distributed Feedback
EA	Electro-Absorption
EAV	Error AVailable
ECL	Emitter Coupled Logic
ELCH	ELectrical Characterization
ESE	Standard Event Status Enable register
ESR	Event Status Register
FC	Fiber Connector
FC/APC	Fiber Connector / Angled Physical Contact
FC/PC	Fiber Connector / Physical Contact
FIN	Command FINished
FP	Fabry-Pérot
ITU	International Telephone and Telegraph Union
LDC	Laser Diode Controller
LED	Light Emitting Diode
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
PC	Personal Computer
PC	Physical Contact
PD	Photo Diode
RF	Radio Frequency
RQS	ReQuest Service Message

SLED	Super LED, Super Light Emitting Diode
SRE	Service Request Enable Register
SRQ	Service ReQuest
STB	STatus Byte Register
TEC	ThermoElectric Cooler (Peltier Element)
TTL	Transistor-Transistor Logic
WDM	Wavelength Division Multiplex

5.3 List of figures

5.4 Certifications and compliances

Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC 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[1,2,3] and Immunity.[1,2,4]
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance criterion B)
	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 Zealand Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard[1,2,3]:	
	AS/NZS 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[1,2,3].	

[1] Compliance demonstrated using high-quality shielded interface cables.

[2] Compliance demonstrated with the WDM8x, C81x, and LS8x series modules installed in the Thorlabs GmbH PRO8x series of mainframes. Test configuration included a Thorlabs GmbH POL8000 Polarization Controller.

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

[4] Minimum Immunity Test requirement.

Certifications and compliances

Category	Standards or description	
Complies with	EN60825-1/A2:2001	Safety of laser products Part 1. Equipment classification, requirements and user's guide. Class 1M
	IEC60825-1/A2:2001	Safety of laser products Part 1. Equipment classification, requirements and user's guide. Class 1M
	21CFR 1040.10 Laser Notice No. 50	Code of Federal Regulations, Radiological Health, Part 1040 - Performance Standards for Light-Emitting Products. Class 1M

5.5 Addresses

Our Company is represented by several distributors and sales offices throughout the world.

Europe
Thorlabs GmbH
Gauss-Strasse 11
D-85757 Karlsfeld
Germany

Sales and Support
Phone: +49 (0) 81 31 / 5956-0
Fax: +49 (0) 81 31 / 5956-99
Email: europe@thorlabs.com
Web: www.thorlabs.com

USA
Thorlabs, Inc.
435 Route 206 North
Newton, NJ 07860
USA

Sales and Support
Phone: 1-973-579-7227
Fax: 1-973-300-3600
Email: sales@thorlabs.com
Email: techsupport@thorlabs.com
Web: www.thorlabs.com

Japan
Thorlabs, Inc.
6th Floor, Fujimizaka Building
5-17-1, Ohtsuka
Bunkyo-ku, Tokyo 112-0012
Japan

Sales and Support
Phone: +81-3-5977-8401
Fax: +81-3-5977-8402
Email: sales@thorlabs.jp
Web: www.thorlabs.jp

Please call our hotlines, send an Email to ask for your nearest distributor or just visit our homepage
http://www.thorlabs.com