DLC pro - Digital Laser Controller

Remote Command Reference

for TCP/IP and USB

Firmware 3.5.4

TOPTICA Photonics SE

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1 Introduction

DLC pro devices can be completely controlled by remote commands sent via USB (virtual serial RS232C line) or via a TCP/IP network. The instruction set, the instruction syntax, as well as the responses, are identical in both cases. Instructions and responses consist of printable ASCII characters only. Any standard terminal or TELNET software can be used to operate the device. See appendix 4.3 and 4.4 for explanations on how to establish connections between a PC and a DLC pro.

2 Control Language

The device's control language is based on the *Scheme*[1] programming language.

Scheme instructions always have the same simple syntax. The instructions are enclosed by parentheses and use prefix notation. The function/instruction name is always the first text within the parentheses. If the instruction requires arguments, these are separated by whitespaces (spaces, tab, or linefeed):

```
(cmd arg1 arg2)
```

Instructions are terminated by a linefeed character (ASCII code 10 decimal, 0xA hexdecimal). Execution is finished when a *prompt* is received. The prompt consists of the "> " (larger than and space)characters at the beginning of a new line.

Each instruction returns a value of some type that can be used by other instructions, or, for example, can be assigned to a variable. The return value always is the last item before the prompt. Example:

```
> (+ 13 7 5)
25
>
```

Instructions can be nested, i.e. each element of an instruction can be the result of another instruction:

```
> (+ 13 (/ 21 3) (* 2.5 2))
25
>
```

Errors are indicated by the "Error: " string at the beginning of a new line:

```
> (/ 1 0)
Error: /: division by zero
>
```

Some instructions print out additional text preceding the return value:

[1] There is plenty of information about Scheme in the Internet, as well as some tutorials.

```
> (display "Hello World\n")
Hello World
#t
>
```

Here, the boolean value #t is the return value which could be used, for example, in nested instructions, while the"Hello World" string is printed out only.

All details of a DLC pro are controlled by *parameters* and *commands*. Parameters represent certain properties of the device like a laser power level, the serial number, or an enable/disable flag etc. Commands are used to execute specific tasks like a recalibration or a firmware update.

2.1 Parameters

Each parameter is characterized by a specific name, a specific type, and a specific mode. For each available parameter, the following chapters provide all parameter information in detail.

Parameter names start with a letter and can contain letters, numerical digits, and special characters like hyphens, underscores, or alike.

The following parameter types are used:

integer - integer numbers, e.g. -10, 0, or 1998

real - floating point numbers, using decimal points, e.g. 3.1415 or 6.625e-34

string - text enclosed in quotation marks, e.g. "TOPTICA Photonics". The string content is stored as a bytestream[2].

boolean - true/false values, #t = true, #f = false

tuples - a set set of several values of the parameter types listed above in a fixed order, enclosed by parentheses, e.g. a pair of XY coordinates: (100 200).

The mode of a parameter provides information about accessing the parameter:

read-only - these parameters can not be modified but can only be read out.

read-write - these parameters can be modified. The new value immediately takes effect and is returned when the parameter is read out.

There are three different Scheme instructions for accessing parameters:

- param-ref
- param-set!
- param-disp

[2] https://en.wikipedia.org/wiki/Bytestream

2.1.1 param-ref

The value of a parameter can be retrieved with the *param-ref* instruction. Its return value is the value of the parameter being queried.

The following examples show queries for different parameter types:

```
> (param-ref 'int-param)
8375309
> (param-ref 'str-param)
"this is a string"
> (param-ref 'bool-param)
#t
> (param-ref 'real-param)
3.141592
> (param-ref 'tuple-param)
(0.8 15)
>
```

Note that parameter names must be quoted with the single, straight quotation mark (').

Reading the parameter value is possible for all parameters modes.

2.1.2 param-set!

To change a parameter value, use the *param-set!* instruction. Its return value is zero or a positive integer in case of success and an error message in case of an error.

Here are a few examples for parameters of different type:

```
> (param-set! 'label "Example Device")
0
> (param-set! 'int-param 50)
0
> (param-set! 'bool-param #f)
0
> (param-set! 'tuple-param '(15 0.8))
0
>
```

Modifying a parameter value is only possible for parameters of *read-write* mode. Tuple-type arguments have to be quoted with the single, straight quotation mark. Please remember that nesting of instructions is possible. The following example shows a way to toggle a boolean parameter:

```
> (param-set! 'bool-param (not (param-ref 'bool-param)))
0
>
```

2.1.3 param-disp

While the *param-ref* instruction is the way to choose for software implemented parameter queries, there is a more human readable alternative for manual queries on the command console: the *param-disp* instruction.

In contrast to the *param-ref* instruction it *displays* the parameters values together with their names while its return value always is zero[3].

While *param-disp* can be used with single parameters, it is most useful when used with parameter sections:

```
> (param-disp 'laser1)
laser1
  :serial-number = "11092"
  :model = "DLCpro"
...
0
>
```

To get a complete list of all parameters, you can use the `(param-disp)` instruction without a parameter name .

2.2 Commands

Commands are used differently than parameters. They are called by the *exec* instruction as in the following example:

```
> (exec 'dummy-command)
()
>
```

Please note that command names, like parameter names, must be quoted by a single, straight quotation mark ('). As in the example, commands often don't return a specific return value but an empty tuple instead[4].

Some commands require one or more additional arguments, which are included in the parentheses and separated by whitespaces.

```
> (exec 'buzzer:play "A   A A   A A   A E   E H   E H   E AAAA")
()
> (exec 'net-conf:set-ip "192.168.1.1" "255.255.255.0")
()
```

Other commands return a result value. For all commands, the type of the return value is provided in this manual.

[3] i.e. it cannot be used reasonably in nested instructions or variable assignments

[4] Since all Scheme instructions must return a result value, these commands return an empty tuple `()`.

2.3 Errors and Warnings

When a parameter value is changed using the *param-set!* instruction, an error message with a negative number is returned in case of an error. A positive number returned indicates a warning condition.
For error indications, "Error:" is displayed at the beginning of a line, followed by a specific, negative-number error code and a brief error description.
Examples of indicated errors:

```
> (param-set! 'laser1:dl:lock:spectrum-input-signal 555)
Error: -3 no such parameter
> (param-set! 'laser1:dl:lock:spectrum-input-channel 555)
Error: -1 invalid argument
> (param-set! 'laser1:dl:cc:current-act 5000)
Error: -11 parameter not settable
>
```

A positive number returned at the beginning of a line indicates a warning condition.
For numerical parameters, a return value of *2* indicates *"parameter value clipped"*. That is, the specified value has exceeded the valid data range limit and the parameter was set to the minimum or maximum allowed value, respectively.
Use the *param-ref* instruction to retrieve the actually set value. Example:

```
> (param-set! 'laser1:dl:cc:current-set 5000)
2
> (param-ref 'laser1:dl:cc:current-set)
234
>
```

2.4 Remote Monitoring

The Monitoring line enables automatic remote monitoring of device parameters. This feature can be especially valuable for GUI programming. It drastically reduces the traffic between PC and device.

The idea is to *subscribe* for certain parameter updates, rather than polling them frequently. After submitting a subscription, the monitoring line will automatically send a telegram with the newest value of that parameter whenever it has changed. Subscriptions are per connection. For opening a monitoring line, a dedicated telnet connection on the reserved monitoring line port 1999 is necessary.

The syntax for the monitoring line is similar to scheme commands, see Sec. 2. The structure for a monitoring command is:

```
(cmd_name ['{param_name}|userlevel] [period|stringvalue] [threshold])
```

cmd_name Possible commands are:

add Adds a param for monitoring, e.g.
"`(add 'laser1:dl:cc:current-act 100 0.1)`"

remove Removes the parameter from monitoring, e.g.
"`(remove 'laser1:dl:cc:current-act)`

remove-all Removes all parameters from monitoring line, e.g. "`(remove-all)`"

change-ul Changes the userlevel of the monitoring line. For more information, please read the acccording section about the use level in this manual. Syntax example: "`(change-ul 0 "secret")`"

param_name The name of the parameter to be monitored.

userlevel Integer value representing the userlevel.

period Update interval in ms. Every "period" ms, an update value is sent if the parameter is changed. The change must be above the "threshold" value. This allows to reduce traffic for parameters that change too often.

stringvalue Password that is needed for changing the userlevel.

threshold A threshold value for sending updates. If a parameter changes and the change does not exceed the threshold, no update will be sent. This allows to reduce traffic for floating point parameters where too small changes are not of interest.

If an error occurs, an empty list, `()`, is returned. Otherwise the current values of the registered parameter is returned. A value looks like:

```
(timestamp 'param_name value)
```

Example:

```
(2013-07-15T13:58:59.123Z 'laser1:dl:cc:current-act 98.354201)
(2013-07-15T13:59:00.842Z 'laser1:dl:cc:enabled #t)
```

timestamp A timestamp for the value in ISO 8601 format.

param_name The name of the monitored parameter

value The current value of the parameter.

3 List of all Parameters and Commands

3.1 General Operation

Commands and parameters for general device operation
emission-button-enabled

(BOOLEAN parameter, read-write)

Parameter indicating the state of the laser emission button.
#t - the emission button is enabled, laser emission is allowed
#f - the laser emission button is switched off
This parameter is writable only if the controller is qualified for system-integration. For DLC pros with "SI" module at the back side of the DLCpro this means the SI2 switch must be switched on. If no SI module is present, only DLCpros with "SI" type on their identification label are qualified if a single DFB pro laser heads is connected.

interlock-open

(BOOLEAN parameter, read-only)

Parameter indicating whether the interlock circuit is open.
#t - interlock circuit open, no laser emission possible.
#f - interlock circuit closed

frontkey-locked

(BOOLEAN parameter, read-only)

Parameter indicating whether the key switch on the DLCpro front panel is locked.
#t - key switch locked, no laser emission possible
#f - key switch unlocked

emission

(BOOLEAN parameter, read-only)

Parameter indicating whether laser emission is switched on.
#t - at least one laser diode (in any of the attached laser heads) is switched on.
#f - all laser heads are switched off.
This parameter reflects the state of the white laser emission LEDs at the DLCpro front panel and laser head.

system-health

(INTEGER parameter, read-only)

Parameter indicating system health problems.
Returns *0* if the system has no problems. If a non-zero value is returned, each bit represents a specific failure.

bit 0 - main FPGA fault

bit 1 - power supply fault

bit 2 - laser 1 problem

bit 3 - laser 2 problem

bit 4 - laser 3 problem

bit 5 - laser 4 problem
bit 8 - problem with module in M-slot 1
bit 9 - problem with module in M-slot 2
bit 10 - problem with module in M-slot 3
bit 11 - problem with module in M-slot 4
bit 12 - problem with module in S-slot 1
bit 13 - problem with module in S-slot 2
bit 14 - problem with module in S-slot 3
bit 15 - problem with module in S-slot 4
bit 16 - problem with IO board
bit 20 - CAN bus problem
bit 21 - problem with a Motor pro
bit 22 - problem with a servo board
bit 23 - problem with a FALC pro

system-health-txt

(STRING parameter, read-only)

Parameter providing a text representation of the system's health problem(s).

laser1:

(parameter section)

This section provides controls for the first laser head attached to the DLCpro. It provides many commands and parameters, for example:

- switching on and off
- controlling laser diode temperature
- reading back status information
- etc.

laser1:type

(STRING parameter, read-only)

Parameter indicating the type of connected laser, e.g. "DLpro", "TApro".
Possible values are:
- BoosTApro
- BoosTAproXP
- TA-SHGproXP
- CTL
- CTL+BoosTApro

- CTL+BoosTAproXP
- DFB-FHGpro
- DFB-MOPA
- DFB-TA-TOPOsmart
- DFB-TA-TOPOsmartXP
- DFB-OPOpro
- DFB-SHGpro
- DFB-TA-FHGpro
- DFB-TA-SHGpro
- DFB-TA-SHGproXP
- DFB-TApro
- DFB-TAproXP
- DFB
- DFBpro
- DFBpro+BoosTApro
- DFBpro+BoosTAproXP
- DL-FHGpro
- DL-SHG
- DL-SHGpro
- DLpro
- DLproBFY
- DLpro+BoosTApro
- DLproBFY+BoosTApro
- DLpro+BoosTAproXP
- DLproBFY+BoosTAproXP
- DPSS-SHGpro
- ECDL-MOPA
- ECDL
- OPOpro
- TA-FHGpro
- TA-SHGpro
- TApro
- TAproXP
- TopWave405
- TopWaveXP
- TopWaveUV

laser1:product-name

(STRING parameter, read-only)

Parameter indicating the model name of the laser head hardware.
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"legacy ECDL"*. Basically, the value of this parameter is the type of the laser head followed by its serial number.

laser1:label

(STRING parameter, read-write)

Parameter providing a user-configurable string that can be used to easily identify the laser.

laser1:emission

(BOOLEAN parameter, read-only)

Parameter indicating the laser head emission status.
#t - laser is switched on
#f - laser is switched off

laser1:enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable all CCs for the laser.
#t - at least one CC is enabled
#f - all CCs is disabled

laser1:enabled-valid

(BOOLEAN parameter, read-only)

Parameter indicating all CCs have the same state.
#t - all CCs are enabled or disabled
#f - CCs have different state

laser1:health

(INTEGER parameter, read-only)

Parameter indicating laser health problems.
Returns *0* if the system has no problems. If a non-zero value is returned, each bit represents a specific failure.

bit 0 - diode laser TC problem

bit 1 - diode laser CC problem

bit 2 - ECDL PC problem

bit 3 - CTL communication problem

bit 4 - CTL PC problem

bit 5 - CTL problem

bit 6 - DPSS problem

bit 7 - master replacement problem

bit 8 - Motor pro problem

bit 12 - amplifier TC problem
bit 13 - amplifier CC problem
bit 14 - amplifier seed problem
bit 15 - amplifier power problem
bit 16 - amplifier replacement problem
bit 20 - NLO communication problem
bit 21 - SHG crystal TC problem
bit 22 - SHG cavity PC problem
bit 23 - FHG crystal TC problem
bit 24 - FHG cavity PC problem
bit 25 - SHG cavity TC problem
bit 26 - OPO crystal TC problem
bit 27 - OPO cavity TC problem
bit 28 - OPO PC problem

laser1:health-txt

(STRING parameter, read-only)

Parameter providing a text representation of the system's health problem(s).

laser1:busy

(BOOLEAN parameter, read-only)

Parameter indicating whether the laser is busy with procedures like optimizations or diagnosis.
#t - laser is busy with optimization or diagnosis
#f - laser can be regularly operated

laser1:override-safety-checks

(BOOLEAN parameter, read-only)

Parameter to disable laser safety checks for seed and output.

laser1:dl:

(parameter section)

Parameters of the laser head.

laser1:dl:legacy

(BOOLEAN parameter, read-only)

Parameter indicating whether a legacy laser head - without factory settings stored in EEPROM - is connected to the DLCpro.
#t - legacy laser head connected; factory settings cannot be identified
#f - TOPTICA laser head factory settings identified in EEPROM

laser1:dl:type

(STRING parameter, read-only)

Parameter indicating the type of laser head, e.g. "DLpro".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"legacy laser"*. Possible values are:
- CTL
- DFB-FHGpro/master
- DFB-TA-TOPOsmart/master
- DFB-OPOpro/master
- DFB-SHGpro/master
- DFB-TA-FHGpro/master
- DFB-TA-SHGpro/master
- DFB-TA-SHGproXP/master
- DFB-TApro/master
- DFB-TAproXP/master
- DFBpro
- DL-FHGpro/master
- DL-SHGpro/master
- DLpro
- DLproBFY
- TA-FHGpro/master
- TA-SHGpro/master
- TA-SHGproXP/master
- TApro/master
- TAproXP/master
- TopWave405/master
- TopWaveXP/master
- TopWaveUV/master
- legacy laser

laser1:dl:version

(STRING parameter, read-only)

Parameter indicating the version of the laser head hardware, e.g. "3V1".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"unknown"*.

laser1:dl:model

(STRING parameter, read-only)

Parameter indicating the model of the laser head hardware, e.g. "DFB pro BFY".
May return an empty string for some laser heads.

laser1:dl:serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the laser head, e.g. "020000".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"unknown"*.

laser1:dl:fru-serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the laser-diode unit.

laser1:dl:ontime

(INTEGER parameter, read-only)

Parameter indicating the accumulated time (in seconds) the laser has been emitting.
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *0*.

laser1:dl:ontime-txt

(STRING parameter, read-only)

Formatted string for the accumulated laser emission time:
hours:minutes:seconds
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"0:00:00"*.

laser1:dl:cc:

(parameter section)

Current driver for laser 1

laser1:dl:cc:path

(STRING parameter, read-only)

Parameter describing the hardware location of the current control (CC) channel.
Example: "cc1:channel1" indicates the first channel of the first current controller

laser1:dl:cc:variant

(STRING parameter, read-only)

Parameter describing the hardware variant of the current control (CC) channel. For example, "250 mA" or "500 mA"

laser1:dl:cc:enabled

(BOOLEAN parameter, read-write)

Parameter to switch the laser emission on/off:
#t - laser emission on
#f - laser emission off

laser1:dl:cc:emission

(BOOLEAN parameter, read-only)

Parameter indicating the laser emission status.
#t - all criteria for laser emission are fulfilled. Laser radiation should be emitted from this channel's laser.
#f - if laser emission is not possible for one of the following reasons:
- interlock circuit is open.
- the front panel key swicth is "off".
- the laser emission push button on the frontpanel is not pressed.
- laser emission is disabled by the software.

laser1:dl:cc:current-set

(REAL parameter, read-write)

Parameter to set the desired laser diode current in mA.
If **laser1:dl:cc:feedforward-enabled** is #t, **laser1:dl:cc:current-set** is determined as follows:

laser1:dl:cc:current-set = **laser1:dl:cc:current-offset** + **laser1:dl:cc:feedforward-factor** * (**laser1:dl:pc:voltage-set** - *voltage-pivot*)
where *voltage-pivot* is the value of **laser1:dl:pc:voltage-set** at the time the feedforward gets enabled.
The **laser1:dl:cc:current-set** parameter setting affects the **laser1:dl:cc:current-offset** value.

laser1:dl:cc:current-offset

(REAL parameter, read-write)

Parameter to specify the laser diode current without Feed Forward contribution (in mA).
This parameter setting affects the **laser1:dl:cc:current-set** value.

laser1:dl:cc:current-set-dithering

(BOOLEAN parameter, read-write)

Parameter to enable/disable resolution enhancement for the laser diode current.
#t - resolution enhancement enabled
#f - resolution enhancement disabled

laser1:dl:cc:external-input:

(parameter section)

Parameters to configure the current control by an external, analog voltage input.

laser1:dl:cc:external-input:signal

(INTEGER parameter, read-write)

ID for the input signal to be routed to this laser channel.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:dl:cc:external-input:factor

(REAL parameter, read-write)

Factor to be applied to the input signal.

laser1:dl:cc:external-input:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the control by external analog input.
#t - channel controlled by external analog input specified in **:external-input:signal**
#f - channel control by external analog input disabled

laser1:dl:cc:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

laser1:dl:cc:output-filter:slew-rate

(REAL parameter, read-write)

Parameter to configure the maximum rate of change of the output channel in physical unit per second.

laser1:dl:cc:output-filter:slew-rate-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable rate of change limit
#t - rate of change limited #f - output not limited

laser1:dl:cc:output-filter:slew-rate-limited

(BOOLEAN parameter, read-only)

Parameter indicating whether the signal change of the output channel is currently limited by the slew rate.
#t - output channel is modulated too fast. Modulation is limited by slew rate filter
#f - no limitation by slew rate filter

laser1:dl:cc:current-act

(REAL parameter, read-only)

Parameter indicating the measured value of the laser diode current in mA. Usually, this is the current flowing through the laser diode. However, if the safety circuitry shorts the current output, this is not true.

laser1:dl:cc:current-out

(REAL parameter, read-only)

Parameter indicating the current value in mA, as applied to the digital-to-analog converter. The value should be close to the **current-act** value, but with higher resolution and without measurement noise.

laser1:dl:cc:positive-polarity

(BOOLEAN parameter, read-only)

Parameter to specify the laser diode polarity setting
IMPORTANT:
To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t).
To be modified only if the channel is disabled (**:enabled** = #f).
#t - positive laser diode polarity
#f - negative laser diode polarity

laser1:dl:cc:current-clip

(REAL parameter, read-write)

Parameter to specify the maximum allowed current (in mA) for this channel's laser diode.

laser1:dl:cc:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the maximum allowed tuning current (in mA) for this channel's laser diode.

laser1:dl:cc:use-current-clip-tuning

(BOOLEAN parameter, read-write)

Parameter to specify if the maximum tuning current **:current-clip-tuning** should be taken into account for limiting the laser diode current. If set to #t the current gets limited to the maximum tuning current **:current-clip-tuning** or the maximum current **:current-clip**, depending on which one is smaller.

laser1:dl:cc:current-clip-limit

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA).
IMPORTANT: To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t).
.

laser1:dl:cc:voltage-act

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage applied to the laser diode (in V).

laser1:dl:cc:voltage-clip

(REAL parameter, read-only)

Parameter to specify the maximum allowed voltage (in V) for this channel's laser diode. Can be changed only for legacy laser heads (without factory settings stored in EEPROM).

laser1:dl:cc:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this current control channel.
#t - Feed Forward enabled
#f - Feed Forward disabled
If enabled, a current proportional to another channel's output is added to this channel. The other channel is defined by the **laser1:feedforward-master** parameter.

laser1:dl:cc:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the piezo channel's output is to be added to the current channel (in mA/V).

laser1:dl:cc:pd

(REAL parameter, read-only)

Parameter indicating the measured monitor diode current in μA.
Please note that not every laser diode features an internal monitor photodiode.

laser1:dl:cc:aux

(REAL parameter, read-only)

Parameter indicating the measured voltage at the AUX input (in V).

laser1:dl:cc:snubber

(BOOLEAN parameter, read-only)

Snubber setting depending on the connected laser head
#t - Mandatory snubber setting if a legacy TOPTICA diode laser head - without EEPROM-stored factory settings - is connected.
#f - Snubber setting indication only if a new TOPTICA diode laser head - with factory settings stored in EEPROM - is connected.

laser1:dl:cc:status

(INTEGER parameter, read-only)

Parameter providing channel status information. Each bit of the integer value provides specific channel status information.

bit 0 - emission
bit 1 - enabled
bit 2 - positive polarity
bit 3 - snubber enabled (frequency low pass)
bit 4 - crowbar enabled (protective short circuit)
bit 5 - DAC enabled
bit 6 - current clip
bit 7 - voltage clip
bit 8 - command error
bit 12 - DAC not initialized
bit 13 - channel forced to be off by health monitoring
bit 15 - laser diode current at lower limit
bit 16 - laser diode current at upper limit
bit 17 - laser diode current limited by slew rate

laser1:dl:cc:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

laser1:dl:tc:

(parameter section)

This section provides parameters related to the temperature controller for **laser1**.

laser1:dl:tc:path

(STRING parameter, read-only)

Parameter describing the hardware location of the TEC channel.

laser1:dl:tc:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable temperature stabilization.
#t - enable temperature stabilization
#f - disable temperature stabilization

laser1:dl:tc:temp-act

(REAL parameter, read-only)

Parameter indicating the temperature of the laser diode in °C.

laser1:dl:tc:temp-set

(REAL parameter, read-write)

Parameter indicating the laser diode target temperature in °C.

laser1:dl:tc:external-input:

(parameter section)

Parameters to configure the temperature control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

laser1:dl:tc:ready

(BOOLEAN parameter, read-only)

Parameter indicating whether the temperature of the laser diode is settled at the target temperature.
#t - laser diode temperature settled at the target temperature
#f - laser diode temperature not settled

laser1:dl:tc:fault

(BOOLEAN parameter, read-only)

Parameter indicating whether the temperature controller reports a problem.
#t - problem reported by the temperature controller
#f - no temperature controller problem report

laser1:dl:tc:status

(INTEGER parameter, read-only)

Parameter providing a flag register with status information. Each bit in the register represents a specific information:

bit 0 - temperature regulation enabled

bit 1 - ready (same as **:ready** parameter)

bit 2 - TEC or heater is cooling (i.e. not heating)

bit 3 - TEC or heater is heating

bit 4 - output driver operating at maximum output

bit 5 - TEC or heater missing (i.e. too high resistance)

bit 6 - TEC or heater short circuit (i.e. too low resistance)

bit 7 - leakage current deteted

bit 8 - output driver overcurrent

bit 9 - output driver overtemperature

bit 10 - output driver missing

bit 11 - temperature probe missing

bit 12 - temperature probe short circuit

bit 13 - regulation timed out

bit 14 - output current operating at minimum or maximum limit

bit 15 - *unused*

bit 16 - measured temperature outside allowed temperate range

bit 17 - timeout, output driver or current were operating at limit for too long

bit 18 - cable detached (i.e. found no probe, no TEC/heater, no EEPROM and no GPIOs)

laser1:dl:tc:status-txt

(STRING parameter, read-only)

Parameter providing a brief description of the status register.

laser1:dl:tc:t-loop:

(parameter section)

Parameters for configuring the temperature controller performance.
Temperature control loop access.

laser1:dl:tc:t-loop:p-gain

(REAL parameter, read-write)

Proportional gain in dB.

laser1:dl:tc:t-loop:i-gain

(REAL parameter, read-write)

Integral gain in dB.

laser1:dl:tc:t-loop:d-gain

(REAL parameter, read-write)

Differential gain in dB.

laser1:dl:tc:t-loop:ok-tolerance

(REAL parameter, read-write)

Temperature tolerance for "ready" status in Kelvin.

laser1:dl:tc:t-loop:ok-time

(REAL parameter, read-write)

Minimum time (in seconds) the temperature must be within the **:ok-tolerance** temperature range before the "ready" status is confirmed.

laser1:dl:tc:limits:

(parameter section)

Parameter handling temperature conditions for monitoring.

laser1:dl:tc:limits:temp-min

(REAL parameter, read-only)

Parameter to specify/indicate the minimum laser diode temperature in °C. You cannot operate the laser if the laser diode temperature is below **:temp-min**.
Note: **:temp-min** can be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t) and the TCs for nonlinear crystals in frequency-converted diode laser systems.

laser1:dl:tc:limits:temp-max

(REAL parameter, read-only)

Parameter to specify/indicate the maximum laser diode temperature. You cannot operate the laser if the laser diode temperature is higher than **:temp-max**.
Note: **:temp-max** can be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t) and the TCs for nonlinear crystals in frequency-converted diode laser systems.

laser1:dl:tc:limits:timeout

(INTEGER parameter, read-write)

Parameter to specify/indicate the time the system accepts the non-settled laser diode temperature (in seconds). If it takes longer than the **:timeout** time for the laser diode temperature to settle, or if the TEC current is at its limit for longer than the **:timeout** time, the laser and TEC are switched off.
Note: **:timeout** can be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t)) and the TCs for nonlinear crystals in frequency-converted diode laser systems.

laser1:dl:tc:limits:timed-out

(BOOLEAN parameter, read-only)

Parameter indicating whether a timeout has occurred.
#t - timeout has occurred
#f - no timeout
To reset the laser after a timeout, switch the temperature control loop (**:t-loop**) off and on.

laser1:dl:tc:limits:out-of-range

(BOOLEAN parameter, read-only)

Parameter indicating whether the laser diode temperature is out of range.
#t - laser diode temperature out of range
#t - laser diode temperature within range

laser1:dl:tc:current-set

(REAL parameter, read-only)

Parameter to read the TEC current (in A). In open loop operation, you can use the parameter to manually set a specific current.
Note: During closed loop operation the **:current-set** value indicated can exceed the limits given by **:current-min** and **current-max**. The actual current whoever will not exceed the limts.

laser1:dl:tc:current-act

(REAL parameter, read-only)

Parameter to read the TEC current (in A).

laser1:dl:tc:temp-set-min

(REAL parameter, read-only)

Parameter to specify the minimum limit for the target temperature (in °C).

laser1:dl:tc:temp-set-max

(REAL parameter, read-only)

Parameter to specify the maximum limit for the target temperature (in °C).

laser1:dl:tc:temp-roc-enabled

(BOOLEAN parameter, read-only)

Parameter to enabled/disable the rate-of-change limitation.

laser1:dl:tc:temp-roc-limit

(REAL parameter, read-only)

Parameter to limit the temperature rate of change (in °C per second).
IMPORTANT: To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t) and the TCs for nonlinear crystals in frequency-converted diode laser systems.

laser1:dl:pc:

(parameter section)

Piezo driver for laser 1

laser1:dl:pc:path

(STRING parameter, read-only)

Parameter indicating the hardware location of the piezo channel.

laser1:dl:pc:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable piezo HV output:
#t - enable HV output
#f - disable HV output

laser1:dl:pc:voltage-set

(REAL parameter, read-write)

Parameter to set the desired piezo voltage in V.

laser1:dl:pc:voltage-min

(REAL parameter, read-only)

Parameter to specify the minimum piezo voltage in V.

laser1:dl:pc:voltage-max

(REAL parameter, read-only)

Parameter to specify the maximum piezo voltage in V.

laser1:dl:pc:voltage-set-dithering

(BOOLEAN parameter, read-write)

Parameter to enable/disable resolution enhancement for the piezo voltage
#t - resolution enhancement enabled
#f - resolution enhancement disabled

laser1:dl:pc:external-input:

(parameter section)

Parameters to configure the piezo voltage control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

laser1:dl:pc:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

For usage see **laser1:dl:cc:output-filter:** on page 57.

laser1:dl:pc:voltage-act

(REAL parameter, read-only)

Parameter indicating the measured voltage of **:channel1** in V.

laser1:dl:pc:voltage-out

(REAL parameter, read-only)

Parameter indicating the calculated output voltage of **:channel1** in V, as it is handed to the digital to analog converter, i.e. including all PID, feedforward, scan and ARC contributions.

laser1:dl:pc:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this channel
#t - enable Feed Forward
#f - disable Feed Forward
If Feed Forward is enabled, a voltage proportional to another channel's output is added to this channel's piezo voltage. The other channel is defined by the **laser1:feedforward-master** parameter.

laser1:dl:pc:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the **laser1:feedforward-master** channel's output is to be added to this channel's piezo voltage (in V/X, where X is the unit of ther feedforward master channel).

laser1:dl:pc:heatsink-temp

(REAL parameter, read-only)

Parameter indicating the PC-channel's heat sink temperature in °C.

laser1:dl:pc:status

(INTEGER parameter, read-only)

Parameter indicating channel status information. Each bit of the integer value provides specific channel status information.

bit 0 - enabled

bit 3 - HV fault

bit 4 - current fault

bit 5 - current limit

bit 7 - voltage at lower limit

bit 8 - voltage at upper limit

bit 9 - voltage slew-rate limited

laser1:dl:pc:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

laser1:dl:lock:

(parameter section)

Access to the DLCpro's lock module. The lock module provides the following features:

- two PID regulators for controlling two independent output channels.
- Lock-In detection
- automatic ReLock and reset.
- easy-to-use click-and-lock functionality

Access to the lock module is available only if the TOPTICA Lock License option is installed.

laser1:dl:lock:type

(INTEGER parameter, read-write)

Parameter to determine the lock type:
1 - "Top of Fringe" - lock to an extremum; requires a reasonable Lock-In parameter configuration.
2 - "Side of Fringe" - lock to an edge (slope).
3 - "Top of Fringe PDH" - lock to an edge (slope) with PDH module.

laser1:dl:lock:lock-without-lockpoint

(BOOLEAN parameter, read-write)

Parameter to specify the mode for activating the lock.
#t - lockpoint and lockpoint candidates are not used. When the lock gets activated, the scan will stop in its center (at scan-offset) and the PIDs get enabled. Use the PIDs **:sign** parameter to select which slope of the Signal is to be used.
#f - the lock can only be enabled if a lockpoint is selected. If the lock gets activated, the scan will stop and PIDs will be enabled when the lockpoints X and Y conditions are met. The PIDs **:sign** parameter should be set to #t and the slope is configured automatically.

laser1:dl:lock:state

(INTEGER parameter, read-only)

Parameter indicating the current operational mode of the lock module. Possible values are:

0 - "Idle": no scan, no lock

1 - "Scanning": scan controller enabled

2 - "Selecting": "Scanning" plus an additional evaluating signal to find the lockpoint candidates

3 - "Selected": "selecting" plus one lockpoint candidate selected as actual lockpoint

4 - "Locking": start of locking procedure; scanning to the lockpoint and activating the PID controller(s).
The scope engine is paused for a moment to show the start process of the lock. The background-data contains the last trace before the start of the lock.

5 - "Locked": scan controller deactivated and PID lock(s) closed

6 - "On Hold": PIDs on hold, waiting for being activated again

7 - "Resetting": PIDs are being reset

8 - "Reset": PIDs reset and on hold, waiting for being actived again

9 - "Relocking": relock engine is scanning, trying to relock the PIDs

laser1:dl:lock:state-txt

(STRING parameter, read-only)

Parameter indicating the current operational mode of the lock module as a short text. Possible values are: "Idle", "Scanning", "Selecting", "Selected", "Locking", "Locked", "On Hold", "Resetting", "Reset", and "Relocking".

laser1:dl:lock:lock-enabled

(BOOLEAN parameter, read-write)

Parameter to specify the lock module's operational mode (**:state**).
Read mode:
#t - operational mode is "Locking", "Locked", "On Hold", "Resetting", "Reset" or "Relocking".
#f - operational mode is "Idle", "Scanning", "Selecting" or "Selected".
Write mode:
#t - same effect as submitting the **:close** command.
#f - same effect as submitting the **:open** command.

laser1:dl:lock:hold

(BOOLEAN parameter, read-write)

Parameter for pausing the PID controller(s).
#t - pause the PID controller(s)
#f - do not pause the PID controller(s)

laser1:dl:lock:di-hold-enabled

(BOOLEAN parameter, read-write)

Parameter to enable pausing/holding the PID controller(s) by the digital input.
#t - link PID controller(s) to digital input and hold on high signal
#f - let PID(s) ignore digital input
Laser 1 uses digital input 0, laser 2 uses digital input 1 etc.

laser1:dl:lock:spectrum-input-channel

(INTEGER parameter, read-write)

Parameter to select the channel of the lock input signal.
For possible values, see the "Signal Channel IDs" section in appendix 4.1 on page 286.
This parameter will automatically set:
the input channels for the PIDs
the input channel for Lock-In demodulation
the first channel for the scope engine

laser1:dl:lock:error-channel

(INTEGER parameter, read-write)

Parameter to indicate the channel fed into the PIDs for locking.
For possible values see the "Signal Channel IDs" section in appendix 4.1 on page 286.
For "Side of Fringe" locks this parameter returns the same value as the **:spectrum-input-channel**.
For "Top of Fringe" locks this parameter returns 30, i.e. "Lock-In Out" signal.
If a "Top of Fringe PDH" lock is selected and the **:spectrum-input-channel** is 41 ("PDH In 1") or 43 ("PDH In 2"), this parameter returns 40 ("PDH Error 1") or 42 ("PDH Error 2"), respectively.
If a "Top of Fringe PDH" lock is selected and the **:spectrum-input-channel** is not a PDH signal, this parameter needs to be set manually to either "PDH Error 1" or "PDH Error 2".

laser1:dl:lock:error-channel-inverted

(BOOLEAN parameter, read-write)

Parameter to specify whether the **:error-channel** signal is inverted compared to the **:spectrum-input-channel** signal.
The value is always #f for "Side of Fringe" locks and "Top of Fringe" locks. It can only be set to #t for "Top of Fringe PDH" locks.
The DLC pro click-and-lock feature assumes that the error-signal for "Top of Fringe PDH" locks is the derivative of the spectrum input signal, meaning that a peak in the spectrum comes with a falling edge in the error signal and a trough in the spectrum comes with a rising edge in the error signal. Furthermore the auto-PDH feature optimizes the PDH phase for this assumption. If this relation is inverted in your setup, this parameter needs to be set manually to #t.

laser1:dl:lock:pdh-selection

(INTEGER parameter, read-write)

Parameter to select the PDH channel to be used by the lock engine:
0 - no PDH
1 - PDH 1 Channel 1
2 - PDH 1 Channel 2
3 - PDH 2 Channel 1
4 - PDH 2 Channel 2
This parameter will be automatically set to 1 or 2, if **:error-channel** is set to 40 ("PDH Error 1") or 42 ("PDH Error 2"), respectively. It will be 0 if no PDH module is available.

laser1:dl:lock:pid-selection

(INTEGER parameter, read-write)

Parameter to select the PID controllers to be used by the lock engine:
0 - no PID controller
1 - PID1
2 - PID2
3 - PID1 and PID2

laser1:dl:lock:falc-selection

(INTEGER parameter, read-write)

Parameter to select the FALC module to be used by the lock engine:
0 - no FALC
1 - FALC 1
2 - FALC 2
3 - FALC 3
4 - FALC 4

laser1:dl:lock:setpoint

(REAL parameter, read-write)

Parameter indicating the setpoint for the PID controllers. Typically, the **:setpoint** is automatically set by the **laser1:dl:lock:select-lockpoint** command, depending on the settings of **:lock:type**, **:lock:candidate-filter**, and so on.

laser1:dl:lock:relock:

(parameter section)

Settings for automatic ReLock.

laser1:dl:lock:relock:enabled

(BOOLEAN parameter, read-write)

Set this parameter to #t to enable the ReLock engine.

laser1:dl:lock:relock:output-channel

(INTEGER parameter, read-write)

Parameter to select the output channel for the ReLock scan to return to the in-lock state (described by the **:lock:window** parameters).
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:dl:lock:relock:frequency

(REAL parameter, read-write)

Parameter to control the frequency of the ReLock scan (in Hz).

laser1:dl:lock:relock:amplitude

(REAL parameter, read-write)

Parameter to control the amplitude of the ReLock waveform (in V).

laser1:dl:lock:relock:delay

(REAL parameter, read-write)

Parameter to determine the waiting time before the ReLock procedure starts after the out-of-lock condition is signaled by **:lock:window**.

laser1:dl:lock:reset:

(parameter section)

Settings for automatic PID reset.

laser1:dl:lock:reset:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the PID reset engine
#t - PID reset engine enabled
#f - PID reset engine disabled.

laser1:dl:lock:window:

(parameter section)

Settings for out-of-lock detection for ReLock and triggering the PID controller reset.

laser1:dl:lock:window:enabled

(BOOLEAN parameter, read-write)

Set this parameter to #t to enable the ReLock window supervision engine.

laser1:dl:lock:window:input-channel

(INTEGER parameter, read-write)

Parameter to select the signal that monitors the ReLock window.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:dl:lock:window:level-high

(REAL parameter, read-write)

Parameter to determine the upper limit of the outer ReLock window (in V).

laser1:dl:lock:window:level-low

(REAL parameter, read-write)

Parameter to determine the lower limit of the outer ReLock window (in V).

laser1:dl:lock:window:level-hysteresis

(REAL parameter, read-write)

Parameter to determine the inner ReLock window by a voltage difference to the outer ReLock window limits (in V).

laser1:dl:lock:pid1:

(parameter section)

Parameters for the PID1 controller.

laser1:dl:lock:pid1:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the PID controller.
#t - PID controller enabled
#f - PID controller disabled

laser1:dl:lock:pid1:gain:

(parameter section)

Gain parameters for PID controller(s).

laser1:dl:lock:pid1:gain:all

(REAL parameter, read-write)

Parameter to control the overall gain. This parameter has no physical unit.

laser1:dl:lock:pid1:gain:p

(REAL parameter, read-write)

Parameter to control the proportional gain.
The unit of **:gain:p** is A/B.

A - unit of the **laser1:dl:lock:pid1:output-channel** parameter

B - unit of the **laser1:dl:lock:spectrum-input-channel** parameter

Example: The unit of the **:gain:p** parameter for a typical lock of the laser current to the *Fine In 1* input is mA/V.

laser1:dl:lock:pid1:gain:i

(REAL parameter, read-write)

Parameter to control the integral gain.
The unit of **:gain:i** is $\frac{A}{B \cdot ms}$.

A - unit of the **laser1:dl:lock:pid1:output-channel** parameter

B - unit of the **laser1:dl:lock:spectrum-input-channel** parameter

Example: The unit of the **:gain:i** parameter for a typical lock of the laser current to the *Fine In 1* input is $\frac{mA}{V \cdot ms}$.

laser1:dl:lock:pid1:gain:d

(REAL parameter, read-write)

Parameter to control the differential gain.
The unit of **:gain:d** is $\frac{A \cdot \mu s}{B}$.

A - unit of the **laser1:dl:lock:pid1:output-channel** parameter

B - unit of the **laser1:dl:lock:spectrum-input-channel** parameter

Example: The unit of the **:gain:d** parameter for a typical lock of the laser current to the *Fine In 1* input is $\frac{mA \cdot \mu s}{V}$.

laser1:dl:lock:pid1:gain:i-cutoff

(REAL parameter, read-write)

Parameter to determine the frequency limit (*I-cutoff*) for the integral PID gain (in Hz).

laser1:dl:lock:pid1:gain:i-cutoff-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable a frequency limit (*I-cutoff*) for the integral PID gain (**:lock:pid1:gain:i-cutoff**).
#t - I-cutoff enabled
#f - I-cutoff disabled

laser1:dl:lock:pid1:gain:fc-ip

(REAL parameter, read-only)

Parameter indicating the transition frequency where the integral behavior of a PID controller changes to proportional behavior for lower frequencies (in Hz).

laser1:dl:lock:pid1:gain:fc-pd

(REAL parameter, read-only)

Parameter indicating the transition frequency where the proportional behavior of a PID controller changes to differential behavior (in Hz).

laser1:dl:lock:pid1:sign

(BOOLEAN parameter, read-write)

Sign of PID controller action. Usually set automatically when using the **laser1:dl:lock:select-lockpoint** command.

laser1:dl:lock:pid1:slope

(BOOLEAN parameter, read-write)

Slope of the signal to lock to. Usually set automatically when using the **laser1:dl:lock:select-lockpoint** command.

laser1:dl:lock:pid1:output-channel

(INTEGER parameter, read-write)

Parameter to select the signal channel to be controlled by the PID controller.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:dl:lock:pid1:outputlimit:

(parameter section)

Parameters to specify limits for the PID output.

laser1:dl:lock:pid1:outputlimit:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable PID output limits
#t - PID output limits enabled
#f - PID output limits disabled

laser1:dl:lock:pid1:outputlimit:max

(REAL parameter, read-write)

Parameter to control the maximum PID output value,
in units of the selected PID output channel (**laser1:dl:lock:pid[1/2]:output-channel**).
The output limit is symmetrical, ie, the PID output is limited to a range $-max \ldots + max$.

laser1:dl:lock:pid1:hold

(BOOLEAN parameter, read-write)

Parameter for pausing/holding the PID controller(s).
#t - hold the PID controller
#f - do not hold the PID controller

laser1:dl:lock:pid1:lock-state

(BOOLEAN parameter, read-only)

Parameter indicating whether the PID controller is in In-Lock state.
#t - The PID controller is enabled and the selected window signal is within the specified range.
#f - The PID controller is enabled and the selected window signal is out of the specified range.
Note: The parameter is set to *#f* if the PID controller is disabled.

laser1:dl:lock:pid1:hold-state

(BOOLEAN parameter, read-only)

Parameter indicating whether the PID controller is on hold.
#t - The PID controller is enabled but is set on hold. The PID controller can be set on hold via a software parameter or via the corresponding hardware line.
#f - The PID controller is enabled and no hold criterion (software parameter or hardware line) is set.
Note: The parameter is set to *#f* if the PID controller is disabled.

laser1:dl:lock:pid1:regulating-state

(BOOLEAN parameter, read-only)

Parameter indicating whether the PID controller is actually regulating.
#t - The PID controller algorithm is currently executed (**:lock-state**=#t; **:hold-state**=#f).
#f - The PID controller algorithm is not executed.
Note: The parameter is set to *#f* if the PID controller is disabled.

laser1:dl:lock:pid2:

(parameter section)

Parameters for the PID2 controller.

For usage see **laser1:dl:lock:pid1:** on page 72.

laser1:dl:lock:lockin:

(parameter section)

Parameters for the Lock-In detection engine.

laser1:dl:lock:lockin:modulation-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable modulation of the output channel signal (**:output-channel**).
#t - apply modulation to the channel selected by **:output-channel**
#f - no modulation of the output channel signal

laser1:dl:lock:lockin:modulation-output-channel

(INTEGER parameter, read-write)

Parameter to specify the output channel the modulation is applied to.
For possible values, see the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:dl:lock:lockin:frequency

(REAL parameter, read-write)

Parameter to control the modulation/demodulation frequency (in Hz).

laser1:dl:lock:lockin:amplitude

(REAL parameter, read-write)

Parameter to control the modulation amplitude.
Unit according to the **:modulation-output-channel** setting

laser1:dl:lock:lockin:phase-shift

(REAL parameter, read-write)

Parameter to control the phase difference between modulation and demodulation (in °). Used to optimize the demodulated Lock-In signal.

laser1:dl:lock:lockin:lock-level

(REAL parameter, read-write)

Parameter to control the setpoint level for top-of-fringe locks to compensate for an eventual DC offset in lock-in output signal.

laser1:dl:lock:lockin:auto-lir:

(parameter section)

Parameters for the automatic adjustment of the LIR phase-shift.

laser1:dl:lock:lockin:auto-lir:state

(INTEGER parameter, read-only)

Parameter indicating the state of the auto-lir algorithm.

0 - idle

1 - active

2 - aborting

laser1:dl:lock:lockin:auto-lir:progress

(INTEGER parameter, read-only)

Parameter indicating the auto-lir progress in %.

laser1:dl:lock:lockin:auto-lir:start

(command, no arguments, returns empty tuple)

Command to automatically set the phase difference between the modulation and the error signal for the master lock-in.

laser1:dl:lock:lockin:auto-lir:abort

(command, no arguments, returns empty tuple)

Command to abort the automatic phase optimization and to return to the previous phase value.

laser1:dl:lock:lockpoint:

(parameter section)

Parameter indicating the selected lock point.

laser1:dl:lock:lockpoint:position

(COORDINATE parameter, read-only)
Type COORDINATE is defined as a tuple (x y) of types (REAL REAL).

Parameter indicating the X/Y position of the currently selected lock point.
X value: unit of the scan output channel (**:scan:output-channel**).
Y value: unit of the lock input channel (**:lock:spectrum-input-channel**).

laser1:dl:lock:lockpoint:type

(STRING parameter, read-only)

Parameter indicating the lock point position on the lock input signal:

none - no lock point selected

top - selected lock point is a peak

bottom - selected lock point is a trough

positive-edge - selected lock point is on a rising edge

negative-edge - selected lock point is on a falling edge

laser1:dl:lock:candidate-filter:

(parameter section)

Filter settings for searching for lock point candidates. The settings are changed automatically if the **:lock:type** setting is changed.

laser1:dl:lock:candidate-filter:top

(BOOLEAN parameter, read-write)

#t - Search for lock point candidates shall find peaks.

laser1:dl:lock:candidate-filter:bottom

(BOOLEAN parameter, read-write)

#t - Search for lock point candidates shall find troughs.

laser1:dl:lock:candidate-filter:positive-edge

(BOOLEAN parameter, read-write)

#t - search for lock point candidates shall find rising edges.

laser1:dl:lock:candidate-filter:negative-edge

(BOOLEAN parameter, read-write)

#t - search for lock point candidates shall find falling edges.

laser1:dl:lock:candidate-filter:edge-level

(REAL parameter, read-write)

Parameter to specify the level for edge detection.
Value range according to the lock input channel (**:lock:spectrum-input-channel**) in V.

laser1:dl:lock:candidate-filter:peak-noise-tolerance

(REAL parameter, read-write)

Parameter to control the noise tolerance for peak detection.
Specify the maximimum expected signal modulation caused by noise in the lock input signal (in V).
Lock input signal modulation below the **:peak-noise-tolerance** threshold is ignored for peak detection.
0 - enables automatic noise detection.

laser1:dl:lock:candidate-filter:edge-min-distance

(INTEGER parameter, read-write)

Parameter to specify the minimum distance of adjacent signal cross-overs of the lock input signal and the edge detection level.
Signal cross-overs within the **:edge-min-distance** are considered a single lockpoint.
Unit: number of signal sampling points

laser1:dl:lock:candidate-filter:top-of-fringe-low-pass

(BOOLEAN parameter, read-write)

Parameter to specify whether a low-pass filter should be applied to the "Lock Input" signal (Signal Channel ID 100) in Top-of-Fringe mode. If this parameter is set to #t, the low-pass filter will automatically be enabled and disabled together with the lock-in modulation and the filter's cut-off frequency will be tuned to 10% of the lock-in modulation frequency. If the **:top-of-fringe-low-pass** parameter is set to #f, the filter will stay disabled.
Note: The filter gets applied only to the "Lock Input" signal for Signal Display an alike, in order to reduce the influence of the lock-in modulation on the lock-candidate detection. It will not influence the signals used by PIDs, ARC etc.

laser1:dl:lock:candidates

(BINARY parameter, read-only)

Parameter indicating lock point candidate data for display in the DLCpro GUI (in binary format).
The parameter value is provided in the format decribed in Appendix 4.2. It contains data blocks with IDs *'s'*, *'l'*, *'c'* and *'t'*.

laser1:dl:lock:locking-delay

(INTEGER parameter, read-write)

Parameter to set the locking delay time (in ms). After a **:lock:close** command, the lock module stays in the LOCKING state for the specified time. During the locking delay time, the scope engine is paused and shows the signal trace at the locking time.

laser1:dl:lock:background-trace

(BINARY parameter, read-only)

Parameter indicating the X/Y coordinate data for the background trace in the DLCpro GUIs. The parameter provides the last scan trace before the lock was closed. The parameter value is provided in the format decribed in Appendix 4.2. It contains data blocks with IDs *'x'* and *'y'*.
If the lock is not closed, **:background-trace** is empty.

laser1:dl:lock:lock-tracking

(COORDINATE parameter, read-only)
Type COORDINATE is defined as a tuple (x y) of types (REAL REAL).

Parameter indicating the X/Y position of the center-of-mass of the acquired X and Y trace.
X value: unit of the scan output channel (**:scan:output-channel**).
Y value: unit of the lock input channel (**:lock:spectrum-input-channel**).
The center-of-mass is only available while the lock is closed and while the scope is working in XY mode. In all other cases this parameter returns (0 0).

laser1:dl:lock:show-candidates

(command, no arguments, returns INTEGER)

Command to print a list of lock point candidates to the console and display the number of lock point candidates.

laser1:dl:lock:find-candidates

(command, no arguments, returns empty tuple)

Command to put the autolock module into *Selecting* mode. For each scan, the lock point candidates are determined according to the settings in **:lock:candidate-filter**.

laser1:dl:lock:select-lockpoint

(command, 3 arguments, returns empty tuple)

Arguments:
1. *x* of type REAL
2. *y* of type REAL
3. *type* of type INTEGER

Command to put the lock module into *Selected* mode. The given x/y coordinates and the given lock type are set as lock point settings.
The x-coordinate is in units of the signal selected by **laser1:scan:output-channel**.
The y-coordinate is in units of the signal selected by **laser1:dl:lock:spectrum-input-channel**.
The lock type must comply with the lock mode selected in **laser1:dl:lock:type**.
For the "Top of Fringe" lock mode, the following lock types can be specified:

0 - candidate (set lockpoint to the closest extremum, according to candidate filter)

1 - top (set lockpoint to the closest peak)

2 - bottom (set lockpoint to the closest trough)

For the "Side of-Fringe" lock mode, the following lock types can be specified:

0 - candidate (set lockpoint to the closest edge, according to candidate filter)

3 - positive-edge (set lockpoint to the closest rising edge)

4 - negative-edge (set lockpoint to the closest falling edge)

The point of the specified lock type, that is closest to the given x-coordinate in the spectrum input trace, is selected as lockpoint.
For "Side of Fringe" lockpoints, the y-coordinate provides the new setpoint for the PID controllers and the new **:edge-level** for the candidate filter.
For "Top of Fringe" lockpoints, the y-coordinate is ignored.

laser1:dl:lock:close

(command, no arguments, returns empty tuple)

Command to close the lock. The command can be successfully executed only if one of the following conditions is fullfilled:
1. **:lock-without-lockpoint** is #f and the lock module is in *Selected* state.
2. **:lock-without-lockpoint** is #t and the lock module is in *Scanning* state.

If :lock-without-lockpoint is #f, the command initiates the following steps:

1. The PID controllers are configured (slope, setpoint) according to the currently selected lockpoint.
2. A trace of the spectrum input signal is acquired and stored as **:background-trace** for the signal display.
3. A trigger mechanism is configured: When the scan reaches the lockpoint position (scan generator and input signal) during the next scan period, the PID controllers are automatically enabled.
4. The lock module is set to the *"Locking"* state.
5. The trigger is activated and shortly later, the PID controllers lock to the desired lockpoint. The scan is disabled automatically.
6. Another trace of the spectrum input signal is acquired, showing how the scan module scans up to the desired lockpoint and how the PID controllers subsequently lock the laser.
7. The command finishes.

If **:lock-without-lockpoint** is #t, PID setpoint and sign must have been configured reasonably before. The **:close** command initiates the following steps:

1. If the scope is in XY mode, a trace of the spectrum input signal is acquired and stored as **:background-trace** for the signal display.
2. A trigger mechanism is configured: When the scan generator reaches the center position (**laser1:scan:offset**) during the next scan period, the PID controllers are automatically enabled.
3. The lock module is set to the *"Locking"* state.

4. The trigger is activated and shortly later, the PID controllers are enabled and the scan is disabled automatically.
5. Another trace of the spectrum input signal is acquired, showing how the scan module scans up to the scan center and how the PID controllers subsequently lock the laser.
6. The command finishes.

To better visualize the brief interval when the lock is closed, the scope engine is paused and the last trace is returned in **laser1:scope:data** for a time period specified in **laser1:dl:lock:locking-delay**. After the locking delay time has expired, the lock module is automatically set to the *"Locked"* state.

laser1:dl:lock:open

(command, no arguments, returns empty tuple)

Command to open the lock. The command is ignored if the lock module is not in *locked* state.
Otherwise, the command disables the PID controllerss and sets the lock module back to the state before the **:close** command was executed.
Also, the command re-enables the scan generator.

laser1:dl:pressure-compensation:

(parameter section)

Linear air pressure compensation.
The pressure compensation allows to adapt the geometrical ECDL cavity length to changes in the laser wavelength, resulting from pressure change induced variation of the refractive index of the air. For this the voltage of the cavity piezo is changed (dU) linearly with air pressure changes (dp) according to $dU = \frac{dU}{dp} \cdot dp$. The factor $\frac{dU}{dp}$ must be given by the parameter **laser1:dl:pressure-compensation:factor**.

laser1:dl:pressure-compensation:enabled

(BOOLEAN parameter, read-write)

Parameter to enabled/disable automatic pressure compensation.
#t - enable pressure compensation
#f - disable pressure compensation.

laser1:dl:pressure-compensation:air-pressure

(REAL parameter, read-only)

Parameter indicating the averaged air pressure measured by the pressure sensor (in hPa).

laser1:dl:pressure-compensation:factor

(REAL parameter, read-write)

Parameter to specify the factor for linear air pressure compensation in units of $\frac{V}{hPa}$.

laser1:dl:pressure-compensation:compensation-voltage

(REAL parameter, read-only)

Parameter indicating the overall voltage difference in V applied to the PC channel by the pressure compensation.

laser1:dl:pd:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

laser1:dl:pd:seed:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

laser1:dl:pd:seed:input-channel

(INTEGER parameter, read-write)

Parameter to specify the input channel the photodiode is connected to.

laser1:dl:pd:seed:power

(REAL parameter, read-only)

Parameter indicating the power level in mW.

laser1:dl:pd:seed:cal-offset

(REAL parameter, read-only)

Parameter to specify the calibration offset for the photodiode in V.

laser1:dl:pd:seed:cal-factor

(REAL parameter, read-only)

Parameter to specify the calibration factor for the photodiode in mW/V.

laser1:dl:pd:seed-probe:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

laser1:dl:pd:seed-probe:power

(REAL parameter, read-only)

Parameter indicating the power level in mW.

laser1:dl:pd:seed-probe:cal-offset

(REAL parameter, read-only)

Parameter to specify the calibration offset for the photodiode in V.

laser1:dl:pd:seed-probe:cal-factor

(REAL parameter, read-only)

Parameter to specify the calibration factor for the photodiode in mW/V.

laser1:dl:pd:fiber:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

For usage see **laser1:dl:pd:seed-probe:** on page 83.

laser1:dl:power-optimization:

(parameter section)

Parameters for the power optimization routine of frequency-converted diode laser systems (use with AutoAlign option only).

laser1:dl:power-optimization:ongoing

(BOOLEAN parameter, read-only)

Parameter indicating the status of the power optimization routine:
#t: An optimization routine is in progress.
#f: No optimization routine is in progress.

laser1:dl:power-optimization:progress

(INTEGER parameter, read-only)

Parameter indicating the overall progress of the power optimization routines depending on the selected stages:

0 : Optimization routine is starting.

100 : Optimization routine has finished.

laser1:dl:power-optimization:status

(INTEGER parameter, read-only)

Status of the optimization for internal purposes.

laser1:dl:power-optimization:status-string

(STRING parameter, read-only)

Parameter indicating the status of the power optimization routine as a status string as displayed in the TOPAS DLC PC-GUI.

laser1:dl:power-optimization:fiber-advanced

(BOOLEAN parameter, read-write)

Parameter to select the Advanced mode of the power optimization routine:
#t: Advanced mode selected.
#f: Advanced mode deselected.

laser1:dl:power-optimization:stage1:

(parameter section)

Parameters for the seed-probe power optimization routine of diode laser systems.

laser1:dl:power-optimization:stage1:input:

(parameter section)

Parameters concerning the photo diode input of the power optimization routine.

laser1:dl:power-optimization:stage1:input:value-calibrated

(REAL parameter, read-only)

Parameter indicating the calibrated photo diode voltage used in the power optimization routine.

laser1:dl:power-optimization:stage1:progress

(INTEGER parameter, read-only)

Parameter indicating the progress of the power optimization routine as a percentage:

0 : Optimization routine is starting.

100 : Optimization routine has finished.

laser1:dl:power-optimization:stage1:optimization-in-progress

(BOOLEAN parameter, read-only)

Parameter indicating the status of the power optimization routine:
#t: The optimization routine is in progress.
#f: The optimization routine is not in progress.

laser1:dl:power-optimization:stage1:restore-on-abort

(BOOLEAN parameter, read-write)

Parameter to enable/disable the return of the servo motors to their previous positions after the power optimization routine is aborted.

laser1:dl:power-optimization:stage1:restore-on-regress

(BOOLEAN parameter, read-write)

Parameter to enable/disable the return of the servo motors to their previous positions after the power optimization routine has decreased the stage power. This may happen for an already optimized system.

laser1:dl:power-optimization:stage1:regress-tolerance

(INTEGER parameter, read-write)

Parameter to specify the failure margin (as a percentage) that is tolerated if the power optimization routine leads to a power decrease. This may happen for an already optimized system.

laser1:dl:power-optimization:stage1:start-optimization

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the stage.

laser1:dl:power-optimization:stage2:

(parameter section)

Parameters for the amplifier power optimization routine of diode laser systems (use with amplifier only).

For usage see **laser1:dl:power-optimization:stage1:** on page 85.

laser1:dl:power-optimization:stage3:

(parameter section)

Parameters for the fiber power optimization routine of diode laser systems using the amplifier servo motors.

For usage see **laser1:dl:power-optimization:stage1:** on page 85.

laser1:dl:power-optimization:stage4:

(parameter section)

Parameters for the advanced fiber power optimization routine of diode laser systems (use with amplifier only).

For usage see **laser1:dl:power-optimization:stage1:** on page 85.

laser1:dl:power-optimization:progress-data-seed-probe

(BINARY parameter, read-only)

Parameter array indicating the amplifier power after the various iteration steps of the amplifier power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor (use with amplifier only). The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:dl:power-optimization:progress-data-amp

(BINARY parameter, read-only)

Parameter array indicating the amplifier power after the various iteration steps of the amplifier power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor. The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:dl:power-optimization:progress-data-fiber

(BINARY parameter, read-only)

Parameter array indicating the fiber monitor power after the various iteration steps of the fiber power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor (use with external photodiode only). The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:dl:power-optimization:abort

(BOOLEAN parameter, read-write)

Parameter specifying whether to abort the power optimization routine.

laser1:dl:power-optimization:low-power-threshold

(REAL parameter, read-only)

Threshold for low power detection at seed-probe and fiber power inputs (in V). If the photo diode voltage is below this threshold, power-optimization gets refused to be started.

laser1:dl:power-optimization:start-optimization-all

(command, no arguments, returns INTEGER)

Command to start the power optimization routine for all stages. This command returns 0 if the power optimization routine could be successfully started or an error message otherwise.

laser1:dl:power-optimization:start-optimization-seed-probe

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the seed-probe stage. This command returns 0 if the power optimization routine could be successfully started or an error message otherwise.

laser1:dl:power-optimization:start-optimization-amp

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the amplifier stage. This command returns 0 if the power optimization routine could be successfully started or an error message otherwise.

laser1:dl:power-optimization:start-optimization-fiber

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the fiber stage. This command returns 0 if the power optimization routine could be successfully started or an error message otherwise.

laser1:dl:servo:

(parameter section)

Parameters of the servo motors for systems with servo control.

laser1:dl:servo:probe1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the probe stage.

laser1:dl:servo:probe1-hor:display-name

(STRING parameter, read-only)

Parameter indicating the name of the servo motor, used in error messages.

laser1:dl:servo:probe1-hor:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the servo motor.

laser1:dl:servo:probe1-hor:value

(INTEGER parameter, read-write)

Parameter indicating the position of the servo motor.

laser1:dl:servo:probe1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the probe stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:ta1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the amplifier stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:ta1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the amplifier stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:ta2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the amplifier stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:ta2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the amplifier stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:fiber1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the fiber stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:servo:fiber1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the fiber stage.

For usage see **laser1:dl:servo:probe1-hor:** on page 88.

laser1:dl:eom:

(parameter section)

Parameters of the intra cavity EOM.

For usage see **laser1:dl:pc:** on page 64.

laser1:dl:motor:

(parameter section)

Parameters of the dl-motor.

laser1:dl:motor:state

(INTEGER parameter, read-only)

Parameter indicating the status of the motor.

-100 Error: Motor is stuc, no calibration available, ...

-5 Motor is referencing

0 Ready to move or scan

1 Moving to new wevelength

2 Moving to start position

3 Motor is scanning

4 Returnig to previous position

5 Scan paused

laser1:dl:motor:state-txt

(STRING parameter, read-only)

Parameter indicating the status of the motor.

laser1:dl:motor:wavelength-set

(REAL parameter, read-write)

Parameter to specify the wavelength of the laser in nanometers.

laser1:dl:motor:wavelength-act

(REAL parameter, read-only)

Parameter indicating the actual wavelength of the laser in nanometers.

laser1:dl:motor:scan:

(parameter section)

Parameters to control the scan of the motor.

laser1:dl:motor:scan:speed

(REAL parameter, read-write)

Parameter to specify the speed for the scan.

laser1:dl:motor:scan:speed-max

(REAL parameter, read-only)

Parameter indicating the maximum set-speed for the scan.

laser1:dl:motor:scan:shape

(INTEGER parameter, read-write)

Paramter for setting the shape for the scan:

0 - Triangle.

1 - Sawtooth.

laser1:dl:motor:scan:scan-begin

(REAL parameter, read-write)

Parameter to specify the wavelength for the scan at the beginning.

laser1:dl:motor:scan:scan-end

(REAL parameter, read-write)

Parameter to specify the wavelength for the scan at the end.

laser1:dl:motor:scan:progress

(INTEGER parameter, read-only)

Parameter indicating the progress of the scan in

laser1:dl:motor:scan:remaining-time

(INTEGER parameter, read-only)

Paramter indicating the remaining time of the scan in seconds.

laser1:dl:motor:scan:continuous-mode

(BOOLEAN parameter, read-write)

Parameter to specify the scan to continuous mode.

laser1:dl:motor:scan:restore-on-end

(BOOLEAN parameter, read-write)

Parameter to specify, if at the end of the scan the motor position should be restored to the set value it had before the scan.

laser1:dl:motor:scan:threshold-trigger:

(parameter section)

Parameters to control the threshold trigger of the scan.

laser1:dl:motor:scan:threshold-trigger:threshold

(REAL parameter, read-write)

Parameter to specify the threshold wavelength for setting the trigger output.

laser1:dl:motor:scan:start

(command, no arguments, returns empty tuple)

Command to start the scan.

laser1:dl:motor:scan:stop

(command, no arguments, returns empty tuple)

Command to stop the scan.

laser1:dl:motor:scan:pause

(command, no arguments, returns empty tuple)

Command to pause the scan.

laser1:dl:motor:scan:continue

(command, no arguments, returns empty tuple)

Command to continue a paused scan.

laser1:dl:motor:cycle-count

(INTEGER parameter, read-only)

Parameter indicating the count of motor rotations.

laser1:dl:motor:perform-referencing

(command, no arguments, returns empty tuple)

Command to start the referencing for the motor.

laser1:dl:smc:

(parameter section)

Parameters controlling the smc module.

laser1:dl:smc:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the SMC mode.

laser1:dl:smc:discover

(BOOLEAN parameter, read-write)

Parameter to enable/disable the SMC plateau discovery.

laser1:dl:smc:state

(INTEGER parameter, read-only)

Parameter indicating the state of the SMC unit:

0 - disabled
1 - preparing
2 - busy
3 - locked
4 - locked, but mode-hop likely (actuator close to limit)
5 - locked, but mode-hop occurred
6 - lock lost (actuator at limit)
7 - failed (no single-mode plateau found)
8 - internal error

laser1:dl:smc:state-txt

(STRING parameter, read-only)

Parameter indicating a short text representation of the SMC state.

laser1:dl:smc:pc-setpoint

(REAL parameter, read-only)

Parameter indicating the voltage setpoint for the single mode control.

laser1:dl:smc:mode-hop-occurred

(BOOLEAN parameter, read-only)

Parameter indicating whether a mode-hop occurred since last reset.

laser1:dl:smc:mode-hop-likely

(BOOLEAN parameter, read-only)

Parameter indicating whether a mode-hop is likely to occur due to actuator limitations.

laser1:dl:smc:bandwidth-selection

(INTEGER parameter, read-write)

Parameter to select the bandwidth for smc.

0 0.01 Hz - very slow
1 0.1 Hz - slow
2 1 Hz - medium
3 10 Hz - fast

Note: The higher the bandwidth, the higher the laser's SMC induced relative intensity noise (RIN).

laser1:dl:smc:tuning:

(parameter section)

Parameters for the SMC current tuning.

laser1:dl:smc:tuning:current-min

(REAL parameter, read-only)

Parameter indicating the minimum current of SMC current tuning range.

laser1:dl:smc:tuning:current-max

(REAL parameter, read-only)

Parameter indicating the maximum current of SMC current tuning range.

laser1:dl:smc:rescan

(command, no arguments, returns empty tuple)

Command to start a new scan, if smc is active.

laser1:dl:smc:reset-mode-hop

(command, no arguments, returns empty tuple)

Command to reset the mode-hop indicator.

laser1:dl:factory-settings:

(parameter section)

Factory settings for the most important laser parameters.
These settings are only available for non-legacy laser heads with an EEPROM (**laser1:dl:legacy** = #f)

laser1:dl:factory-settings:wavelength

(REAL parameter, read-only)

Parameter indicating the specified laser wavelength (in nanometer).

laser1:dl:factory-settings:threshold-current

(REAL parameter, read-only)

Parameter indicating the threshold current as determined during production (in mA).

laser1:dl:factory-settings:power

(REAL parameter, read-only)

Parameter indicating the output power measured under factory settings during production (in mW).

laser1:dl:factory-settings:cc:

(parameter section)

Factory settings for the current controller (CC).

laser1:dl:factory-settings:cc:feedforward-factor

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:dl:cc:feedforward-factor** used for measurements during production.

laser1:dl:factory-settings:cc:current-set

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:dl:cc:current-set** used for measurements during production.

laser1:dl:factory-settings:cc:current-clip

(REAL parameter, read-only)

Parameter indicating the factory setting for the parameters **laser1:dl:cc:current-clip** and **laser1:dl:cc:current-clip-limit**.

laser1:dl:factory-settings:cc:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the factory setting for the maximum allowed current used for tuning.

laser1:dl:factory-settings:cc:voltage-clip

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:cc:voltage-clip**.

laser1:dl:factory-settings:cc:positive-polarity

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:cc:positive-polarity**.

laser1:dl:factory-settings:cc:snubber

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:cc:snubber**.

laser1:dl:factory-settings:tc:

(parameter section)

Factory settings for the temperature controller (TC).

laser1:dl:factory-settings:tc:temp-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set-min**.
The parameter **tc:limits:temp-min** is set to 2K below this value if this result is below 15°C. Otherwise **tc:limits:temp-min** is set to 15°C.

laser1:dl:factory-settings:tc:temp-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set-max**.
The parameter **tc:limits:temp-max** is set to 2K above this value if this result is above 30°C.Otherwise **tc:limits:temp-max** is set to 30°C.

laser1:dl:factory-settings:tc:temp-set

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set**.

laser1:dl:factory-settings:tc:temp-roc-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-roc-enabled**.

laser1:dl:factory-settings:tc:temp-roc-limit

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-roc-limit**.

laser1:dl:factory-settings:tc:current-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:current-set-max**.

laser1:dl:factory-settings:tc:current-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:current-set-min**.

laser1:dl:factory-settings:tc:p-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:p-gain**.

laser1:dl:factory-settings:tc:i-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:i-gain**.

laser1:dl:factory-settings:tc:d-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:d-gain**.

laser1:dl:factory-settings:tc:c-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:c-loop:i-gain**.

laser1:dl:factory-settings:tc:ok-tolerance

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:ok-tolerance**.

laser1:dl:factory-settings:tc:ok-time

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:ok-time**.

laser1:dl:factory-settings:tc:timeout

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **tc:limits:timeout**.

laser1:dl:factory-settings:tc:power-source

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **tc:power-source**.

laser1:dl:factory-settings:tc:ntc-series-resistance

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:ntc-series-resistance**.

laser1:dl:factory-settings:tc:ntc-parallel-resistance

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:ntc-parallel-resistance**.

laser1:dl:factory-settings:tc:output-inverted

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **tc:output-inverted**.

laser1:dl:factory-settings:pc:

(parameter section)

Factory settings for the piezo controller (PC).

laser1:dl:factory-settings:pc:voltage-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:pc:voltage-min**.

laser1:dl:factory-settings:pc:voltage-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:pc:voltage-max**.

laser1:dl:factory-settings:pc:feedforward-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for **laser1:dl:pc:feedforward-enabled**.

laser1:dl:factory-settings:pc:feedforward-factor

(REAL parameter, read-only)

Parameter indicating the factory setting for **laser1:dl:pc:feedforward-factor**.

laser1:dl:factory-settings:pc:capacitance

(REAL parameter, read-only)

Parameter indicating the piezo capacitance, measured during production (in μF).

laser1:dl:factory-settings:pc:scan-offset

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:scan:offset** used for measurements during production.

laser1:dl:factory-settings:pc:scan-amplitude

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:scan:amplitude** used for measurements during production.

laser1:dl:factory-settings:pc:slew-rate

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:dl:pc:output-filter:slew-rate** recommended by TOPTICA.

laser1:dl:factory-settings:pc:slew-rate-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the setting for parameter **laser1:dl:pc:output-filter:slew-rate-enabled**.

laser1:dl:factory-settings:pc:pressure-compensation-factor

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:dl:pressure-compensation:factor**.

laser1:dl:factory-settings:eom:

(parameter section)

Factory settings for the eom controller (PC).

laser1:dl:factory-settings:eom:voltage-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:pc:voltage-min**.

laser1:dl:factory-settings:eom:voltage-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:dl:pc:voltage-max**.

laser1:dl:factory-settings:eom:feedforward-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for **laser1:dl:pc:feedforward-enabled**.

laser1:dl:factory-settings:eom:feedforward-factor

(REAL parameter, read-only)

Parameter indicating the factory setting for **laser1:dl:pc:feedforward-factor**.

laser1:dl:factory-settings:eom:capacitance

(REAL parameter, read-only)

Parameter indicating the piezo capacitance, measured during production (in μF).

laser1:dl:factory-settings:eom:scan-offset

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:scan:offset** used for measurements during production.

laser1:dl:factory-settings:pd:

(parameter section)

Factory settings for the laser power calibration. (Only available for certain laser heads)

laser1:dl:factory-settings:pd:seed:

(parameter section)

Factory settings for the laser power calibration. (Only available for certain laser heads)

laser1:dl:factory-settings:pd:seed:cal-offset

(REAL parameter, read-only)

Parameter to specify the factory setting for the photodiode's calibration offset in V.

laser1:dl:factory-settings:pd:seed:cal-factor

(REAL parameter, read-only)

Parameter to specify the factory setting for the photodiode's calibration factor in mW/V.

laser1:dl:factory-settings:motor:

(parameter section)

Factory settings for the dl-motor. (Only available for certain laser heads)

laser1:dl:factory-settings:motor:position-min

(INTEGER parameter, read-only)

Parameter to specify the minimum position.

laser1:dl:factory-settings:motor:position-max

(INTEGER parameter, read-only)

Parameter to specify the maximum position.

laser1:dl:factory-settings:motor:wavelength-set

(REAL parameter, read-only)

Parameter to specify the wavelength of the laser in nanometers.

laser1:dl:factory-settings:motor:speed-max-raw

(INTEGER parameter, read-only)

Parameter indicating the maximum set-speed for the scan.

laser1:dl:factory-settings:motor:calibration:

(parameter section)

Parameters for the factory-settings of the calibration of position-wavelength dependency.

laser1:dl:factory-settings:motor:calibration:fit-a

(REAL parameter, read-only)

Coefficient for quadratic component of fit.

laser1:dl:factory-settings:motor:calibration:fit-b

(REAL parameter, read-only)

Coefficient for linear component of fit.

laser1:dl:factory-settings:motor:calibration:fit-c

(REAL parameter, read-only)

Coefficient for constant component of fit.

laser1:dl:factory-settings:motor:calibration:backlash

(INTEGER parameter, read-only)

Parameter defining the backlash of motor on direction change.

laser1:dl:factory-settings:motor:calibration:inaccuracy

(REAL parameter, read-only)

Parameter defining the maximum error of the calibration fit against the wavemeter data.

laser1:dl:factory-settings:motor:calibration:wavelength-min

(REAL parameter, read-only)

Parameter indicating the minimum settable wavelength.

laser1:dl:factory-settings:motor:calibration:wavelength-max

(REAL parameter, read-only)

Parameter indicating the maximum settable wavelength.

laser1:dl:factory-settings:servo-control:

(parameter section)

Factory settings for the servo control board.

The parameters are used to connect a servo-motor or photodiode to a specific item on a servo control board. The item is a servo for the parameters **probe1-hor, probe1-vert, ta1-hor, ta1-vert, ta2-hor, ta2-vert, fiber1-hor, fiber1-vert** and a photodiode for **probe-pd, ta-pd, fiber-pd**.
The format is *servo-board-serialnumber:item-number*. Item-number can be 1-8 for servos and 1-3 for photodiodes. For ta-photodiode item-number 3 is used.
The serialnumber can be replaced by a servo control board parameter name, if no serialnumber is available.

Examples:

Parameter	Value	Result
probe1-hor	test1:1	probe1-hor servo is connected to servo number 1 of servo control board with serialnumber *test1*
probe1-hor	servo-control2:1	probe1-hor servo is connected to servo number 1 of servo control board connected to the DeCoF parameter **:servo-control2**
prode-pd	test1:1	probe-pd photodiode is connected to photodiode number 1 of servo control board with serialnumber *test1*

laser1:dl:factory-settings:servo-control:probe1-hor

(STRING parameter, read-write)

Parameter to specify the horizontal servo for the probe component.

laser1:dl:factory-settings:servo-control:probe1-vert

(STRING parameter, read-write)

Parameter to specify the vertical servo for the probe component.

laser1:dl:factory-settings:servo-control:ta1-hor

(STRING parameter, read-write)

Parameter to specify the first horizontal servo for the ta component.

laser1:dl:factory-settings:servo-control:ta1-vert

(STRING parameter, read-write)

Parameter to specify the first vertical servo for the ta component.

laser1:dl:factory-settings:servo-control:ta2-hor

(STRING parameter, read-write)

Parameter to specify the second horizontal servo for the ta component.

laser1:dl:factory-settings:servo-control:ta2-vert

(STRING parameter, read-write)

Parameter to specify the second vertical servo for the ta component.

laser1:dl:factory-settings:servo-control:fiber1-hor

(STRING parameter, read-write)

Parameter to specify the horizontal servo for the fiber component.

laser1:dl:factory-settings:servo-control:fiber1-vert

(STRING parameter, read-write)

Parameter to specify the vertical servo for the fiber component.

laser1:dl:factory-settings:servo-control:probe-pd

(STRING parameter, read-write)

Parameter to specify the photodiode for the probe component.

laser1:dl:factory-settings:servo-control:ta-pd

(STRING parameter, read-write)

Parameter to specify the photodiode for the for the ta component.

laser1:dl:factory-settings:servo-control:fiber-pd

(STRING parameter, read-write)

Parameter to specify the photodiode for the fiber component.

laser1:dl:factory-settings:apply

(command, no arguments, returns empty tuple)

This command applies to all factory settings for the respecive CC, PC, TC channels etc.

laser1:ctl:

(parameter section)

Parameters of the CTL head.

laser1:ctl:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the CTL head FPGA.

laser1:ctl:model

(STRING parameter, read-only)

Parameter indicating the model of the CTL hardware.
May return an empty string for some laser heads.

laser1:ctl:wavelength-set

(REAL parameter, read-write)

Parameter to set the desired wavelength in nm.
Changing the value of this parameter will start the motor. The motor will then move with maximum velocity to the posititon attributed to the desired wavelength, according to the internal calibration.

laser1:ctl:wavelength-act

(REAL parameter, read-only)

Parameter indicating the actual wavelength in nm.
The value indicated here is calculated from the motor position, according to the internal calibration.

laser1:ctl:wavelength-min

(REAL parameter, read-only)

Parameter indicating the minimum wavelength in nm.

laser1:ctl:wavelength-max

(REAL parameter, read-only)

Parameter indicating the maximum wavelength in nm.

laser1:ctl:tuning-current-min

(REAL parameter, read-only)

Parameter indicating the minimum current in mA, required for proper mode-hope free operation of the CTL.
The value is only informative. It's still possible to choose lower laser currents.

laser1:ctl:tuning-power-min

(REAL parameter, read-only)

Parameter indicating the minimum power in mW, required for proper mode-hope free operation of the CTL. It is also the lower limit for the setvalue of the power stabilization.

laser1:ctl:state

(INTEGER parameter, read-only)

Parameter indicating the current state of the CTL scan engine:

-100 - ERROR
-90 - Standby
-8 - Motor referencing and FLOW initialization in progress
-7 - FLOW initialization in progress
-6 - Motor not referenced, yet
-5 - Motor referencing in progress
-4 - Motor referenced
-3 - Drift compensation in progress
-2 - FLOW optimization in progress
-1 - SMILE optimization in progress
0 - Ready
1 - Remotely controlled

laser1:ctl:state-txt

(STRING parameter, read-only)

Parameter indicating the state of the CTL scan engine as a text.

laser1:ctl:head-temperature

(REAL parameter, read-only)

Parameter indicating the temperature inside the CTL laser head in $°C$.

laser1:ctl:optimization:

(parameter section)

CTL SMILE (Single Mode Intelligent Loop Engine) and FLOW (Feedback Light Optimization Wizard) optimization control.

laser1:ctl:optimization:progress

(INTEGER parameter, read-only)

Parameter indicating the progress of the SMILE or FLOW optimization in percent.

laser1:ctl:optimization:smile

(command, no arguments, returns empty tuple)

Command to start optimization of SMILE parameters. Updates CTL state in **:ctl:state**. Abort with **:ctl:optimization:abort**.

laser1:ctl:optimization:flow

(command, no arguments, returns empty tuple)

Command to start FLOW optimization followed by an optimization of SMILE parameters. Updates CTL state in **:ctl:state**. Abort with **:ctl:optimization:abort**.

laser1:ctl:optimization:abort

(command, no arguments, returns empty tuple)

Command to abort currently running SMILE or FLOW optimization procedure.

laser1:ctl:remote-control:

(parameter section)

Parameter to configure CTL analog remote control.
With analog remote control it's possible to control the wavelength of the laser with a voltage applied to one of the DLC pro's frontpanel inputs.

laser1:ctl:remote-control:signal

(INTEGER parameter, read-write)

Parameter to specify the input signal to be used for CTL analog remote control.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:ctl:remote-control:factor

(REAL parameter, read-write)

Parameter specifying the factor to be applied to the input signal in nm/V.
The factor specified with parameter is only valid around the currently set wavelength.

laser1:ctl:remote-control:enabled

(BOOLEAN parameter, read-write)

Parameter to enabled/disabled analog remote control.

laser1:ctl:mode-control:

(parameter section)

Parameters and commands related to SMILE.

laser1:ctl:mode-control:loop-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable SMILE.

laser1:ctl:motor:

(parameter section)

CTL motor control parameters.

laser1:ctl:motor:position-accuracy-fullstep

(INTEGER parameter, read-only)

Parameter for setting the motor position accuracy (in arbitrary units) for full-step operation. Default value is 8. When approaching its set wavelength, the motor stops when the measured position differs from the set position by less than the accuracy in arbitrary units. If this value is too small, the motor might jump back and forth between two positions instead of stopping.

laser1:ctl:motor:position-hysteresis-fullstep

(INTEGER parameter, read-only)

Parameter for setting the motor position hysteresis (in arbitrary units)for full-step operation. Once the motor stopped, it will not start moving again before the measured position differs from the set position by more than position-accuracy+position-hysteresis. In unsteady environment, the laser might show small drifts. This is compensated by changing the motor position until the configured accuracy is again reached. By increasing this value, unwanted motor steps can be prevented.

laser1:ctl:motor:position-accuracy-microstep

(INTEGER parameter, read-only)

Parameter for setting the motor position accuracy (in arbitrary units) for micro-step operation. Default value is 2. See **:position-accuracy-fullstep** for details.

laser1:ctl:motor:position-hysteresis-microstep

(INTEGER parameter, read-only)

Parameter for setting the motor position hysteresis (in arbitrary units) for micro-step operation. See **:position-hysteresis-fullstep** for details.

laser1:ctl:motor:microsteps

(BOOLEAN parameter, read-write)

Paramter to specify whether microstepping should be used when possible.
Microstepping leads to smoother scans for low scan speeds. If this parameter is set to #t, microstepping will be used for speeds up to about 50% of the maximum speed specified by **:speed-max**. If this parameter is set to #f microstepping will not be used.

laser1:ctl:motor:power-save-disabled

(BOOLEAN parameter, read-only)

Parameter for enabling/disabling a "dead zone" around the target position inside which the motor is automatically disabled to save power and avoid heat generation.
#t - dead zone is deactivated, motor is always on

#f - dead zone is activated, motor is switched off after having reached the target position
Note: When **:power-save-disabled** is set to #f motor microsteps are disabled automatically and can not be activated unless power-save-disabled is set to #t.

laser1:ctl:motor:status

(INTEGER parameter, read-only)

Parameter indicating status information about the CTL motor.
Each bit of the integer value provides specific status information.

bit 0 - arrived at set wavelength (distance to static set wavelength below tolerance value)

bit 1 - on track (distance to dynamic wavelength target below tolerance value)

bit 2 - motor switched off (for debugging only)

bit 3 - motor got stuck

bit 4 - dynamic wavelength target at lower limit

bit 5 - dynamic wavelength target at upper limit

NOTE: The tolerance for the "arrived" and "on track" bits is calculated from the hysteresis and accuracy parameters.

laser1:ctl:motor:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

laser1:ctl:power:

(parameter section)

Parameters related to the output power level of the CTL as measured by an CTL head internal photodiode.

laser1:ctl:power:power-act

(REAL parameter, read-only)

Parameter indicating the approximate output power level of the CTL in mW.

laser1:ctl:factory-settings:

(parameter section)

Factory settings for CTL operation.

laser1:ctl:factory-settings:wavelength-min

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:ctl:wavelength-min**.

laser1:ctl:factory-settings:wavelength-max

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:ctl:wavelength-max**.

laser1:ctl:factory-settings:tuning-current-min

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:ctl:tuning-current-min**.

laser1:ctl:factory-settings:tuning-power-min

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:ctl:tuning-power-min**.

laser1:ctl:factory-settings:apply

(command, no arguments, returns empty tuple)

Command to apply factory settings (originally read from EEPROM) to active CTL parameters in DLC pro.

laser1:amp:

(parameter section)

Parameters of the laser power amplifier stage.

laser1:amp:legacy

(BOOLEAN parameter, read-only)

Parameter indicating whether a legacy laser head - without factory settings stored in EEPROM - is connected to the DLCpro.
#t - legacy laser head connected; factory settings cannot be identified
#f - TOPTICA laser head factory settings stored in EEPROM

laser1:amp:type

(STRING parameter, read-only)

Parameter indicating the type of amplifier head, e.g. "TApro".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"legacy amplifier"*. Possible values are:
- BoosTApro
- BoosTAproXP
- TA-SHGproXP
- DFB-TA-SHGproXP

- DFB-TA-FHGpro/amplifier
- DFB-TA-SHGpro/amplifier
- DFB-TApro/amplifier
- TA-FHGpro/amplifier
- TA-SHGpro/amplifier
- TApro/amplifier
- TAproXP/amplifier
- TopWave405/amplifier
- TopWaveXP/amplifier
- TopWaveUV/amplifier
- legacy amplifier

laser1:amp:version

(STRING parameter, read-only)

Parameter indicating the version of the laser head hardware, e.g. "3V1".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"unknown"*.

laser1:amp:model

(STRING parameter, read-only)

Parameter indicating the model of the amplifier hardware.
May return an empty string for some laser heads.

laser1:amp:serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the laser head, e.g. "020000".
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"unknown"*.

laser1:amp:fru-serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the laser-diode unit.

laser1:amp:ontime

(INTEGER parameter, read-only)

Parameter indicating the accumulated time (in seconds) the laser has been emitting.
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *0*.

laser1:amp:ontime-txt

(STRING parameter, read-only)

Formatted string for the accumulated laser emission time:
hours:minutes:seconds
For a legacy laser head - without factory settings stored in EEPROM - this parameter returns *"0:00:00"*.

laser1:amp:cc:

(parameter section)

Current control channel of power amplifier.

laser1:amp:cc:path

(STRING parameter, read-only)

Parameter describing the hardware location of the current control channel.
Example: "ampcc1:channel1" indicates the current channel of the first CC-5000 current controller.

laser1:amp:cc:variant

(STRING parameter, read-only)

Parameter describing the hardware variant of the current control channel channel. For example, it returns "5000 mA" or "10000 mA" for CC5000 or CC10000 channel, respectively.

laser1:amp:cc:enabled

(BOOLEAN parameter, read-write)

Parameter to switch the amplifier current on/off:
#t - laser emission on
#f - laser emission off

laser1:amp:cc:emission

(BOOLEAN parameter, read-only)

Parameter indicating the amplifier emission status.
#t - all criteria for laser emission are fulfilled. Laser radiation should be emitted from this channel's amplifier.
#f - if laser emission is not possible for one of the following reasons:
- interlock circuit is open.
- the front panel key swicth is "off".
- the laser emission push button on the frontpanel is not pressed.
- laser emission is disabled by the software.

laser1:amp:cc:current-set

(REAL parameter, read-write)

Parameter to set the desired amplifier current in mA.
If **laser1:amp:cc:feedforward-enabled** is #t, **laser1:amp:cc:current-set** is determined as follows:

laser1:amp:cc:current-set = **laser1:amp:cc:current-offset** + **laser1:amp:cc:feedforward-factor** * (**laser1:dl:pc:voltage-set** - *voltage-pivot*) where *voltage-pivot* is the value of **laser1:dl:pc:voltage-set** at the time the feedforward gets enabled.
The **laser1:amp:cc:current-set** parameter setting affects the **laser1:amp:cc:current-offset** value.

laser1:amp:cc:current-offset

(REAL parameter, read-write)

Parameter to specify the amplifier current without Feed Forward contribution (in mA). This parameter setting affects the **laser1:amp:cc:current-set** value.

laser1:amp:cc:external-input:

(parameter section)

Parameters to configure the current control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

laser1:amp:cc:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

For usage see **laser1:dl:cc:output-filter:** on page 57.

laser1:amp:cc:current-act

(REAL parameter, read-only)

Parameter indicating the measured value of the amplifier chip current in mA. Usually, this is the current flowing through the amplifier chip. However, if the safety circuitry shorts the current output, this is not true.

laser1:amp:cc:current-out

(REAL parameter, read-only)

Parameter indicating the current value in mA, as applied to the digital-to-analog converter. The value should be close to the **current-act** value, but with higher resolution and without measurement noise.

laser1:amp:cc:current-clip

(REAL parameter, read-write)

Parameter to specify the maximum allowed current (in mA) for this channel's amplifier chip.

laser1:amp:cc:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the maximum allowed tuning current (in mA) for this channel's amplifier chip.

laser1:amp:cc:use-current-clip-tuning

(BOOLEAN parameter, read-write)

Parameter to specify if the maximum tuning current **:current-clip-tuning** should be taken into account for limiting the amplifier current. If set to #t the current gets limited to the maximum tuning current **:current-clip-tuning** or the maximum current **:current-clip**, depending on which one is smaller.

laser1:amp:cc:current-clip-limit

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA).
IMPORTANT: To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t).
.

laser1:amp:cc:current-clip-free-run

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA) in case of seedless operation.
The maximum parameter value is limited with **:current-clip**.

laser1:amp:cc:using-current-clip-free-run

(BOOLEAN parameter, read-only)

Parameter indicating if current of amplifier was changed due to amplifier's seedless operation.

laser1:amp:cc:voltage-act

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage applied to the amplifier chip (in V).

laser1:amp:cc:voltage-out

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage at the voltage fuse (in V).

laser1:amp:cc:voltage-clip

(REAL parameter, read-only)

Parameter to specify the maximum allowed voltage (in V) for this channel's amplifier chip.
Can be changed only for legacy laser heads (without factory settings stored in EEPROM).

laser1:amp:cc:potential-load

(REAL parameter, read-only)

Parameter indicating the approximate electrical load in W this current channel can potentially exert on the power supply if the maximum diode current is used. The sum of all amplifier channel loads must not exceed 40W.

laser1:amp:cc:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this current control channel.
#t - Feed Forward enabled
#f - Feed Forward disabled
If enabled, a current proportional to another channel's output is added to this channel. The other channel is defined by the **laser1:feedforward-master** parameter.

laser1:amp:cc:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the piezo channel's output is to be added to the current channel (in mA/V).

laser1:amp:cc:status

(INTEGER parameter, read-only)

Parameter providing channel status information. Each bit of the integer value provides specific channel status information. The meaning of the individual bits depends on the type of amplifier current channel.
For CC-5000 type channels please refer to **ampcc1:channel1:status** for more details.
For HCC type channels please refer to **hcc1:channel1:status** for more details.
For CBC type channels please refer to **cbc:cc:status** for more details.

laser1:amp:cc:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

laser1:amp:tc:

(parameter section)

The **laser1:amp:tc** section provides parameters related to the temperature controller for laser's power amplifier.

For usage see **laser1:dl:tc:** on page 60.

laser1:amp:pd:

(parameter section)

Amplifier monitoring photodiodes.

laser1:amp:pd:seed:

(parameter section)

Access to the calibration of the amplifier's seed power monitoring photodiode (only available for certain laser heads.)

For usage see **laser1:dl:pd:seed:** on page 83.

laser1:amp:pd:seed-probe:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

For usage see **laser1:dl:pd:seed-probe:** on page 83.

laser1:amp:pd:amp:

(parameter section)

Access to the calibration of the amplifier's output power monitoring photodiode (only available for certain laser heads.)

For usage see **laser1:dl:pd:seed:** on page 83.

laser1:amp:pd:fiber:

(parameter section)

Access to the calibration of the internal master laser power. (Only available for certain laser heads.)

For usage see **laser1:dl:pd:seed-probe:** on page 83.

laser1:amp:power-optimization:

(parameter section)

Parameters for the power optimization routine of frequency-converted diode laser systems (use with AutoAlign option only).

For usage see **laser1:dl:power-optimization:** on page 84.

laser1:amp:servo:

(parameter section)

Parameters of the servo motors for systems with servo control.

For usage see **laser1:dl:servo:** on page 88.

laser1:amp:seed-limits:

(parameter section)

The amplifier's seed power is measured with a photodiode inside the TApro and the ADC of the CC-500 SMB input ch1. The seed power must be within a certain range of power levels to ensure proper operation and long lifetime for the amplifier.

laser1:amp:seed-limits:power

(REAL parameter, read-only)

Parameter indicating the power level in mW.

laser1:amp:seed-limits:power-min

(REAL parameter, read-only)

Parameter to specify the minimum required seed power in mW.

laser1:amp:seed-limits:power-min-warning-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed power is tolerated to be below **:power-min** before a warning message is issued.

laser1:amp:seed-limits:power-min-shutdown-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed power is tolerated to be below **:power-min** before a warning the amplifier is switched off.

laser1:amp:seed-limits:power-max

(REAL parameter, read-only)

Parameter to specify the minimum required power in mW.

laser1:amp:seed-limits:power-max-warning-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed power is tolerated to be above **:power-max** before a warning message is issued.

laser1:amp:seed-limits:power-max-shutdown-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed power is tolerated to be above **:power-max** before a warning the amplifier is switched off.

laser1:amp:seed-limits:status

(INTEGER parameter, read-only)

Parameter indicating status information about the power monitoring. Each bit provides specific information.

bit 0 - actual power below minimum

bit 1 - minimum power warning

bit 2 - minimum power shutdown

bit 3 - actual power exceeds maximum

bit 4 - maximum power warning

bit 5 - maximum power shutdown

bit 6 - photodiode detached

laser1:amp:seed-limits:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

laser1:amp:output-limits:

(parameter section)

The amplifier's output power is measured with a photodiode inside the TApro and the ADC of the CC-5000 SMB input ch1. The output power must be within a certain range of power levels to ensure proper operation and long lifetime for the amplifier.

For usage see **laser1:amp:seed-limits:** on page 116.

laser1:amp:seedonly-check:

(parameter section)

The amplifier must not be seeded while it is switched off (*seed without pump*). The parameters in this section configure when the seed is switched off in such a case.

laser1:amp:seedonly-check:warning-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed laser is tolerated to be on with the amplifier being off before a warning message is issued.

laser1:amp:seedonly-check:shutdown-delay

(REAL parameter, read-only)

Parameter to specify the time in seconds, the seed laser is tolerated to be on with the amplifier being off before a warning the seed laser is switched off.

laser1:amp:seedonly-check:status

(INTEGER parameter, read-only)

Parameter indicating status information about the power monitoring. Each bit provides specific information.

bit 0 - emission conflict

bit 1 - emission conflict warning

bit 2 - emission conflict shutdown

laser1:amp:seedonly-check:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

laser1:amp:factory-settings:

(parameter section)

Factory settings for the most important amplifier parameters.
These settings are only available for non-legacy amplifier heads with an EEPROM (**laser1:amp:legacy** = #f)

laser1:amp:factory-settings:wavelength

(REAL parameter, read-only)

Parameter indicating the specified laser wavelength of the amplifier (in nanometer).

laser1:amp:factory-settings:power

(REAL parameter, read-only)

Parameter indicating the amplifier output power measured under factory settings during production (in mW).

laser1:amp:factory-settings:cc:

(parameter section)

Factory settings for the amplifier current controller (CC).

laser1:amp:factory-settings:cc:feedforward-factor

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:amp:cc:feedforward-factor** used for measurements during production.

laser1:amp:factory-settings:cc:current-set

(REAL parameter, read-only)

Parameter indicating the setting for parameter **laser1:amp:cc:current-set** used for measurements during production.

laser1:amp:factory-settings:cc:current-clip

(REAL parameter, read-only)

Parameter indicating the factory setting for the parameters **laser1:amp:cc:current-clip** and **laser1:amp:cc:current-clip-limit**.

laser1:amp:factory-settings:cc:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the factory setting for the maximum allowed current used for tuning.

laser1:amp:factory-settings:cc:current-clip-free-run

(REAL parameter, read-only)

Parameter indicating the factory setting for the maximum allowed current used during amplifier's seedless operation. The maximum allowed value that can be set is capped to the value of **:current-clip**

laser1:amp:factory-settings:cc:voltage-clip

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:cc:voltage-clip**.

laser1:amp:factory-settings:tc:

(parameter section)

Factory settings for the amplifier temperature controller (TC).

For usage see **laser1:dl:factory-settings:tc:** on page 96.

laser1:amp:factory-settings:pd:

(parameter section)

Factory settings for the Amplifier monitoring photodiodes.

laser1:amp:factory-settings:pd:seed:

(parameter section)

Factory settings for the calibration of the amplifier's seed power monitoring photodiode (only available for certain laser heads.)

For usage see **laser1:dl:factory-settings:pd:seed:** on page 100.

laser1:amp:factory-settings:pd:amp:

(parameter section)

Factory settings for the calibration of the amplifier's output power monitoring photodiode (only available for certain laser heads.)

For usage see **laser1:dl:factory-settings:pd:seed:** on page 100.

laser1:amp:factory-settings:seed-limits:

(parameter section)

Factory settings for the seed laser power monitoring.

laser1:amp:factory-settings:seed-limits:power-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-min**.

laser1:amp:factory-settings:seed-limits:power-min-warning-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-min-warning-delay**.

laser1:amp:factory-settings:seed-limits:power-min-shutdown-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-min-shutdown-delay**.

laser1:amp:factory-settings:seed-limits:power-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-max**.

laser1:amp:factory-settings:seed-limits:power-max-warning-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-max-warning-delay**.

laser1:amp:factory-settings:seed-limits:power-max-shutdown-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seed-limits:power-max-shutdown-delay**.

laser1:amp:factory-settings:output-limits:

(parameter section)

Factory settings for the amplifier output power monitoring.

For usage see **laser1:amp:factory-settings:seed-limits:** on page 120.

laser1:amp:factory-settings:seedonly-check:

(parameter section)

Factory settings for the amplifier *seed-without-pump* check.

laser1:amp:factory-settings:seedonly-check:warning-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seedonly-check:warning-delay**.

laser1:amp:factory-settings:seedonly-check:shutdown-delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:amp:seedonly-check:shutdown-delay**.

laser1:amp:factory-settings:servo-control:

(parameter section)

Factory settings for the servo control board.

The parameters are used to connect a servo-motor or photodiode to a specific item on a servo control board. The item is a servo for the parameters **probe1-hor, probe1-vert, ta1-hor, ta1-vert, ta2-hor, ta2-vert, fiber1-hor, fiber1-vert** and a photodiode for **probe-pd, ta-pd, fiber-pd**.
The format is *servo-board-serialnumber:item-number*. Item-number can be 1-8 for servos and 1-3 for photodiodes. For ta-photodiode item-number 3 is used.
The serialnumber can be replaced by a servo control board parameter name, if no serialnumber is available.

Examples:

Parameter	Value	Result
probe1-hor	test1:1	probe1-hor servo is connected to servo number 1 of servo control board with serialnumber *test1*
probe1-hor	servo-control2:1	probe1-hor servo is connected to servo number 1 of servo control board connected to the DeCoF parameter **:servo-control2**
prode-pd	test1:1	probe-pd photodiode is connected to photodiode number 1 of servo control board with serialnumber *test1*

For usage see **laser1:dl:factory-settings:servo-control:** on page 101.

laser1:amp:factory-settings:apply

(command, no arguments, returns empty tuple)

Command to apply all factory settings for the respective CC, PC, TC channels etc.

laser1:dpss:

(parameter section)

Parameters for the diode-pumped solid state (DPSS) laser.

laser1:dpss:enabled

(BOOLEAN parameter, read-write)

Parameter to specify the DPSS laser on/off state.

laser1:dpss:status

(INTEGER parameter, read-only)

Parameter indicating the DPSS laser status.

laser1:dpss:status-txt

(STRING parameter, read-only)

Parameter indicating the Cobolt LED status in a textual form.

laser1:dpss:tc-status

(INTEGER parameter, read-only)

Parameter indicating the status of the DPSS' TECs.

1 - TECs have reached the set temperature
0 - TECs are regulating and have reached the set temperature yet
-1 - Temperature error

laser1:dpss:tc-status-txt

(STRING parameter, read-only)

Parameter indicating the status of the DPSS' TECs in a textual form.

laser1:dpss:error-code

(INTEGER parameter, read-only)

Parameter indicating the DPSS laser fault status.

laser1:dpss:error-txt

(STRING parameter, read-only)

Parameter indicating the DPSS laser fault status in a textual form.

laser1:dpss:operation-time

(REAL parameter, read-only)

Parameter indicating the DPSS laser operation time (in hours).

laser1:dpss:power-set

(REAL parameter, read-write)

Parameter to specify the output power of the DPSS laser (in mW).

laser1:dpss:power-act

(REAL parameter, read-only)

Parameter indicating the actual output power of the DPSS laser (in mW).

laser1:dpss:power-max

(REAL parameter, read-only)

Parameter indicating the maximum power output of the DPSS laser (in mW).

laser1:dpss:power-margin

(REAL parameter, read-only)

Parameter indicating the fractional power-margin for the DPSS laser.

laser1:dpss:current-act

(REAL parameter, read-only)

Parameter indicating the actual drive current of the DPSS laser (in mA).

laser1:dpss:current-max

(REAL parameter, read-only)

Parameter indicating the maximal drive current of the DPSS laser (in mA).

laser1:dpss:temperature-control:

(parameter section)

Parameters for controlling the temperatures of the dpss

laser1:dpss:temperature-control:t1:

(parameter section)

Parameters controlling the temperature t1

laser1:dpss:temperature-control:t1:temp-act

(REAL parameter, read-only)

Parametern indicating the actual temperature

laser1:dpss:temperature-control:t1:temp-set

(REAL parameter, read-write)

Parametern to specify the set temperature

laser1:dpss:temperature-control:t1:temp-set-min

(REAL parameter, read-write)

Parametern to specify the minimum set temperature

laser1:dpss:temperature-control:t1:temp-set-max

(REAL parameter, read-write)

Parametern to specify the maximum set temperature

laser1:dpss:temperature-control:t1:temp-roc-limit

(REAL parameter, read-write)

Parametern to specify the maximum change rate of the temperature

laser1:dpss:temperature-control:t2:

(parameter section)

Parameters controlling the temperature t2

For usage see **laser1:dpss:temperature-control:t1:** on page 123.

laser1:dpss:temperature-control:t3:

(parameter section)

Parameters controlling the temperature t3

For usage see **laser1:dpss:temperature-control:t1:** on page 123.

laser1:dpss:temperature-control:t4:

(parameter section)

Parameters controlling the temperature t4

For usage see **laser1:dpss:temperature-control:t1:** on page 123.

laser1:dpss:temperature-control:t5:

(parameter section)

Parameters controlling the temperature t5

For usage see **laser1:dpss:temperature-control:t1:** on page 123.

laser1:scan:

(parameter section)

Access to the laser's main scan signal generator. It is closely coupled to the laser's scope and locking features.

laser1:scan:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the signal generator
#t - signal generator enabled
#f - signal generator disabled

laser1:scan:hold

(BOOLEAN parameter, read-write)

Parameter to hold the signal generator
#t - signal generator held
#f - signal generator not held

laser1:scan:signal-type

(INTEGER parameter, read-write)

Parameter to specify the waveform of the scan signal.
0: sine
1: triangle
2: triangle rounded

laser1:scan:frequency

(REAL parameter, read-write)

Parameter to control the scan frequency (in Hz).

laser1:scan:phase-shift

(REAL parameter, read-write)

Phase difference in degrees with respect to the trigger output

laser1:scan:output-channel

(INTEGER parameter, read-write)

This parameter controls the output channel for applying the modulation. For possible values, see the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:scan:unit

(STRING parameter, read-only)

Parameter indicating the physical unit for **:offset** and **:amplitude**.
Please note that string values might contain UTF-8 encoded characters like the small circle in $°C$.

laser1:scan:amplitude

(REAL parameter, read-write)

Parameter to control the peak-to-peak amplitude of the scan. Provided in physical units of the signal selected by the **:output-channel**.

laser1:scan:offset

(REAL parameter, read-write)

Parameter to control the offset/center of the scan. Provided in physical units of the signal selected by the **:output-channel**.

laser1:scan:start

(REAL parameter, read-write)

Parameter to control the start value of the scan period. Provided in physical units of the signal selected by the **:output-channel**.

laser1:scan:end

(REAL parameter, read-write)

Parameter to control the end value of the scan. Provided in physical units of the signal selected by the **:output-channel**.

laser1:wide-scan:

(parameter section)

Access to the single-shot wide-scan.

laser1:wide-scan:state

(INTEGER parameter, read-only)

Parameter indicating the current state of the wide-scan:

0 - disabled

1 - waiting for start condition to be reached

2 - scan active

3 - waiting for stop condition to be reached

laser1:wide-scan:state-txt

(STRING parameter, read-only)

Parameter indicating the current state of the wide-scan as string.

laser1:wide-scan:output-channel

(INTEGER parameter, read-write)

Parameter to specify the output channel for the scan. For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:wide-scan:scan-begin

(REAL parameter, read-write)

Parameter to specify the start value for the scan in $°C$.

laser1:wide-scan:scan-end

(REAL parameter, read-write)

Parameter to specify the stop value for the scan in $°C$.

laser1:wide-scan:continuous-mode

(BOOLEAN parameter, read-write)

Parameter to enable/disable wide-scan repeat mode.
#t - repeat mode on, scan runs continuously until **:stop** command is executed.
#f - repeat mode off, scan stops when **:scan-end** is reached.

laser1:wide-scan:restore-on-end

(BOOLEAN parameter, read-write)

Parameter to specify, if at the end of the scan the output channel should be restored to the set value it had before the scan.

laser1:wide-scan:shape

(INTEGER parameter, read-write)

Parameter defining the scan type.
0 = Sawtooth, 1 = Triangle

laser1:wide-scan:offset

(REAL parameter, read-write)

Parameter to specify the center value of the scan in $°C$.

laser1:wide-scan:amplitude

(REAL parameter, read-write)

Parameter to specify the peak-to-peak amplitude of the scan in $°C$.

laser1:wide-scan:speed

(REAL parameter, read-write)

Parameter to specify the scan speed in K/s.

laser1:wide-scan:speed-min

(REAL parameter, read-only)

Parameter indicating the minimum possible scan speed in K/s.

laser1:wide-scan:speed-max

(REAL parameter, read-only)

Parameter indicating the maximum possible scan speed in K/s.

laser1:wide-scan:duration

(REAL parameter, read-write)

Parameter to specify the scan duration in s.

laser1:wide-scan:value-set

(REAL parameter, read-write)

Parameter to specify the value of the parameter for the wide-scan x-axis.

laser1:wide-scan:value-act

(REAL parameter, read-only)

Parameter indicating the value of the parameter for the wide-scan x-axis.

laser1:wide-scan:value-unit

(STRING parameter, read-only)

Parameter indicating the unit of the parameter for the wide-scan x-axis.

laser1:wide-scan:recorder-stepsize-set

(REAL parameter, read-write)

Parameter to specify step size for x-axis.
If set to 0, **laser1:recorder:sample-count-limit** is used, to calculate **:recorder-stepsize**.

laser1:wide-scan:recorder-stepsize

(REAL parameter, read-only)

Parameter indicating the next possible step size for x-axis.

laser1:wide-scan:recorder-sample-count

(INTEGER parameter, read-only)

Parameter indicating the expected number of recorded samples.

laser1:wide-scan:recorder-sampling-rate

(REAL parameter, read-only)

Parameter indicating the expected sampling rate.

laser1:wide-scan:recorder-sampling-interval

(REAL parameter, read-only)

Parameter indicating the expected sampling interval.

laser1:wide-scan:memory-size

(INTEGER parameter, read-only)

Parameter indicating the memory size in bytes needed to record all enabled channels.

laser1:wide-scan:progress

(INTEGER parameter, read-only)

Parameter indicating the wide-scan progress in %.

laser1:wide-scan:remaining-time

(INTEGER parameter, read-only)

Parameter indicating the approximate remaining time of the wide-scan in s.

laser1:wide-scan:trigger:

(parameter section)

Parameters to configure the wide-scan's input and output trigger.

laser1:wide-scan:trigger:input-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the wide-scan input trigger. Use **:input-channel** for input channel configuration.

laser1:wide-scan:trigger:input-channel

(INTEGER parameter, read-write)

Parameter to specify the wide-scan trigger input channel on the Digital I/O Connector:

2 - Digital Input 2

3 - Digital Input 3

laser1:wide-scan:trigger:output-threshold

(REAL parameter, read-write)

Parameter to specify the trigger threshold in physical units of the selected output-channel. Trigger output level on the selected Digital Output pin is high if the actual value of the output channel is higher than this parameter and low otherwise.

laser1:wide-scan:start

(command, no arguments, returns empty tuple)

Command to start the wide scan. It has an effect only if **laser1:scan:enabled** is #f.

laser1:wide-scan:stop

(command, no arguments, returns empty tuple)

Command to stop the wide scan.

laser1:wide-scan:set-output-to-zoom-offset

(command, no arguments, returns empty tuple)

Command to set the value for the x-axis-parameter to the center of the zoom window.

laser1:wide-scan:set-scan-range-to-zoom-range

(command, no arguments, returns empty tuple)

Command to set the range for the next scan to the current zoom range.

laser1:wide-scan:set-zoom-range-to-scan-range

(command, no arguments, returns empty tuple)

Command to set the zoom range to the full scan range.

laser1:scope:

(parameter section)

Access to the data traces for the DLCpro diagram.

laser1:scope:variant

(INTEGER parameter, read-write)

Parameter to control which kind of data is exported to the **:data** parameter:

0 - *xy* - This variant is typically used to find the lock point. The input signals are shown as function of the scan output-channel. Use the **:scope:channelx:xy-signal** parameter to define the signal for the x-axis.
The acquisition time for the scope engine is automatically set to half the scan period.

1 - *scope* - This variant shows the input signals as function of the time.
Use the **:scope:channelx:scope-timescale** parameter to define the total acquisition time for the traces (in ms). The acquisition time for the scope engine is set to the **:scope:channelx:scope-timescale** value.

2 - *spectrum* - This variant shows a Fast Fourier Transform of the signals as function of the frequency.
Use the **:scope:channelx:spectrum-range** parameter to define the maximum frequency you want to resolve.
The acquisition time for the scope engine is set to the $500/f_{max}$, with f_{max} = **:channelx:spectrum-range**.

laser1:scope:update-rate

(INTEGER parameter, read-write)

Sets the diagram update rate (in Hz).
Please note that, the trace acquisition time may influence the real diagram update-rate.

laser1:scope:channel1:

(parameter section)

Settings for channel1 of the scope engine. For most lock applications, this channel's **:input-signal** is set to [100], that is, to the **:lock:spectrum-input-channel**.

laser1:scope:channel1:signal

(INTEGER parameter, read-write)

Parameter to specify the signal channel to be acquired by the scope engine.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:scope:channel1:unit

(STRING parameter, read-only)

Parameter indicating the physical unit of the selected signal.
Please note that string values might contain UTF-8 encoded characters like the small circle in $°C$.

laser1:scope:channel1:name

(STRING parameter, read-only)

Parameter indicating the name of the signal.

laser1:scope:channel2:

(parameter section)

Settings for channel2 of the scope engine. You can freely configure this channel.

For usage see **laser1:scope:channel1:** on page 131.

laser1:scope:channelx:

(parameter section)

Settings for the x-axis of the scope engine.
The x-axis is treated differently, depending on the **:scope:variant** setting.

laser1:scope:channelx:xy-signal

(INTEGER parameter, read-write)

Parameter to define the signal channel to be acquired for the x-axis values.
Applied if the **:scope:variant** parameter is set to "0" (xy) .
In most cases, this parameter is set to "101" - the scope acquiring signals from the **:scan:output-channel** channel.

laser1:scope:channelx:scope-timescale

(REAL parameter, read-write)

Parameter to define the timescale (in ms).
Applied if the **:scope:variant** parameter is set to "1" (scope).

laser1:scope:channelx:spectrum-range

(REAL parameter, read-write)

Parameter to define the full frequency range (in kHz).
Applied if the **:scope:variant** parameter is set to "2" (spectrum).

laser1:scope:channelx:spectrum-omit-dc

(BOOLEAN parameter, read-write)

To help with autoscaling in the diagrams, the DC-components of the Fast Fourier Transform traces can be omitted.
Applied if the **:scope:variant** parameter is set to "2" (spectrum).
#t - the DC-components of the Fast Fourier Transform traces (that is, the 3 lowermost frequency components) are omitted.
#f - The DC-components of the Fast Fourier Transform traces can be seen.

laser1:scope:channelx:unit

(STRING parameter, read-only)

Parameter indicating the physical unit of the signal.
"scope": ms
"spectrum": kHz
"xy": unit of the signal defined by **:channelx:xy-signal**
Please note that string values might contain UTF-8 encoded characters like the small circle in $°C$.

laser1:scope:channelx:name

(STRING parameter, read-only)

Parameter indicating the name of the signal.

laser1:scope:timescale

(REAL parameter, read-only)

Parameter indicating the data trace acquisition time in ms.

laser1:scope:data

(BINARY parameter, read-only)

Parameter indicating trace data for all enabled channels. The parameter value is provided in the format decribed in Appendix 4.2.
It always contains a block of IDs *'x'* and, depending on which scope channels are enabled, contains IDs *'y'* and/or *'Y'*.

laser1:recorder:

(parameter section)

Access to the real-time data acquisition.
The recorder allows to simultaneously acquire 3 traces of data, with up to about 200 kHz sampling rate and up to 5 Mio. data points per trace.

laser1:recorder:state

(INTEGER parameter, read-only)

Parameter indicating the current state of the single-shot data acquisition:

0 - disabled

1 - armed, waiting for trigger

2 - recording

laser1:recorder:state-txt

(STRING parameter, read-only)

Parameter indicating the current state of the data acquisition as string.

laser1:recorder:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the data acquisition.
Set this parameter to #t to arm the data acquisition. Set the parameter to #f in order to stop running data acquisition.

laser1:recorder:trigger-mode

(INTEGER parameter, read-write)

Parameter to specify the trigger mode for the data acquisition:

- 0 - immediate, data acquisition will start immediately when the **:enabled** Parameter is set from #f to #t
- 2 - wide-scan/scan-aux triggered, data acquisition will start when the wide-scan is started, or with the next period of the scan-aux signal generator
- 4 - digital input 0, rising edge
- 5 - digital input 0, falling edge
- 6 - digital input 1, rising edge
- 7 - digital input 1, falling edge

laser1:recorder:inputs:

(parameter section)

Parameters to configure the channels to be recorded.

laser1:recorder:inputs:channel1:

(parameter section)

Parameter to configure the signal for channel1.

laser1:recorder:inputs:channel1:signal

(INTEGER parameter, read-write)

Parameter to specify the signal channel to be acquired for this channel of the single-shot scope engine.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:recorder:inputs:channel1:low-pass-filter:

(parameter section)

Parameter to configure the input low-pass filter for this channel.

laser1:recorder:inputs:channel1:low-pass-filter:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the low-pass filter for this signal.

laser1:recorder:inputs:channel1:low-pass-filter:cut-off-frequency

(REAL parameter, read-write)

Parameter to specify the cut off frequency for the low-pass filter in Hz.

laser1:recorder:inputs:channel2:

(parameter section)

Parameter to configure the signal for channel2.

For usage see **laser1:recorder:inputs:channel1:** on page 134.

laser1:recorder:inputs:channelx:

(parameter section)

Parameter to configure the signal for channelx.

laser1:recorder:inputs:channelx:signal

(INTEGER parameter, read-write)

Parameter to specify the signal channel to be acquired for this channel of the single-shot scope engine.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:recorder:recording-mode

(INTEGER parameter, read-write)

Parameter to specify the recording mode:

0 - reset: resets all data on start.

1 - overwrite: overwrites old data.

2 - continuous: overwrites old data periodically.

In *reset mode* the data acquisition automatically stops when the configured amount of samples (see **:sample-count**) was recorded. In *continuous mode* data acquisition does not stop automatically. It uses a buffer of size **:sample-count** and starts overwriting it from the beginning, every time the end of the buffer was reached. Set **:enabled** to #f in order to stop data acquisition.
The *overwrite mode* is only used for internal purposes.

laser1:recorder:recording-time

(REAL parameter, read-write)

Parameter to specify the recording time in ms.

laser1:recorder:sample-count-limit

(INTEGER parameter, read-write)

Parameter to specify the maximum total number of samples to be set.
This value is also used to calculate **laser1:wide-scan:recorder-stepsize**, if **laser1:wide-scan:recorder-stepsize-set** is set to 0.

laser1:recorder:sample-count-set

(INTEGER parameter, read-write)

Parameter to specify the desired, minimum total number of samples to be recorded. From this value and the given **:recording-time**, the required sampling interval is calculated. This calculated interval has to be rounded to the next smaller possible value, supported by the digital sampling electronics. If this supported sampling interval is smaller than the original one, more sampling points are needed to cover the specified **recording-time**. If there is no supported smaller sampling interval, the targeted sample count cannot be reached. The number of actually required sampling points is returned by the **:sample-count** parameter.

laser1:recorder:sample-count

(INTEGER parameter, read-only)

Parameter indicating the total number of samples to be recorded.
See **:sample-count-set** for a description.
When recording is started this number will be used to allocate internal memory for the data to be recorded.

laser1:recorder:sampling-interval

(REAL parameter, read-only)

Parameter indicating the sampling interval in ms.

laser1:recorder:sampling-rate

(REAL parameter, read-only)

Parameter indicating the sampling rate in Hz.

laser1:recorder:memory-size

(INTEGER parameter, read-only)

Parameter indicating the memory size in bytes needed to record all enabled channels.

laser1:recorder:data:

(parameter section)

Parameters to retrieve the recorded data.

laser1:recorder:data:channel1:

(parameter section)

Properties of channel1 of the recorded data.

laser1:recorder:data:channel1:signal

(INTEGER parameter, read-only)

Parameter indicating the signal channel acquired by the single-shot scope engine.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:recorder:data:channel1:unit

(STRING parameter, read-only)

Parameter indicating the physical unit of the selected signal.
Please note that string values might contain UTF-8 encoded characters like the small circle in $°C$.

laser1:recorder:data:channel1:name

(STRING parameter, read-only)

Parameter indicating the name of the signal.

laser1:recorder:data:channel2:

(parameter section)

Properties of channel2 of the recorded data.

For usage see **laser1:recorder:data:channel1:** on page 136.

laser1:recorder:data:channelx:

(parameter section)

Properties of the x channel of the recorded data.

For usage see **laser1:recorder:data:channel1:** on page 136.

laser1:recorder:data:zoom-data

(BINARY parameter, read-only)

Parameter indicating trace data for all enabled channels. The parameter value is provided in the format described in appendix 4.2.
It always contains a block of IDs *'x'* and, depending on which scope channels are enabled, additionally *'a'* and *'A'* and/or *'b'* and *'B'*.

laser1:recorder:data:zoom-offset

(REAL parameter, read-write)

Parameter to specify the center of the data range to be zoomed into, in units of the x-axis signal.

laser1:recorder:data:zoom-amplitude

(REAL parameter, read-write)

Parameter to specify the full length of the data range to be zoomed into, in units of the x-axis signal. The amplitude must be positive.

laser1:recorder:data:recorded-sampling-interval

(REAL parameter, read-only)

Parameter indicating the sampling interval in the traces for being retrieved with the `:get-data` and `:show-data` commands.

laser1:recorder:data:recorded-sample-count

(INTEGER parameter, read-only)

Parameter indicating the number of recorded samples per channel, i.e. the number of samples available in the traces for being retrieved with the `:get-data` and `:show-data` commands.

laser1:recorder:data:last-recorded-sample

(INTEGER parameter, read-only)

Parameter indicating the last recorded sample count.
This is useful when using the **:recording-mode** continuous. All samples beyond last-recorded-samples are recorded at the previous scan.

laser1:recorder:data:last-valid-sample

(INTEGER parameter, read-only)

Parameter indicating if data acquisition was corrupted, eg, due to too high sampling rate.
If no corruption was detected this parameter returns **:recorded-sample-count** - 1.
If data corruption was detected this parameter returns index of the last sample that has been recorded before the first corruption was detected.
Please note that sometimes data corruption may occur without being detected.

laser1:recorder:data:memory-size

(INTEGER parameter, read-only)

Parameter indicating the memory size in bytes currently used.

laser1:recorder:data:zoom-out

(command, no arguments, returns empty tuple)

Command to adjust **:zoom-offset** and **:zoom-amplitude** to the full width of the x-axis data range.

laser1:recorder:data:get-data

(command, 2 arguments, returns BINARY)

Arguments:

1. *start-index* of type INTEGER
2. *count* of type INTEGER

Command to get part of the recorded data.
Argument *start-index* specifies the index of the first sampling point to be returned. Argument *count* specifies the number of sampling points to be returned. If *start-index* is greater than or equal to **:recorded-sample-count**, no sampling points will be returned. If *count* is greater than 1024 it will be clipped to 1024. If *start-index*+*count* is greater than **:recorded-sample-count** only **:recorded-sample-count** − *start-index* samples will be returned.
The binary return value is provided in the format described in Appendix 4.2.
It always contains a block of ID *i*, consisting of two 32bit integer values. The first integer value is the value of *start-index* and the second one is the number of sampling points returned (may be less than specified by *count*). Depending on which recorder channels are enabled, the data furthermore contains IDs *'x'*, *'y'* and/or *'Y'* with arrays of floating point values.

laser1:recorder:data:show-data

(command, 2 arguments, returns empty tuple)

Arguments:

1. *start-index* of type INTEGER
2. *count* of type INTEGER

Command to print of the recorded data to the console.
Argument *start-index* specifies the index of the first sampling point to be returned. Argument *count* specifies the number of sampling points to be returned. If *start-index* is greater than or equal to **:recorded-sample-count**, no sampling points will be returned. If *count* is greater than 1024 it will be clipped to 1024. If *start-index*+ *count* is greater than **:recorder-sample-count** only **:recorder-sample-count**−*start-index* samples will be returned.
The data will be printed to the console as comma separated table of decimal numbers. The table always has 4 columns: *index*, *channel-x value*, *channel 1 value* and *channel 2 value*. It is recommended to use the `:get-data` for obtaining recorded data as there are no precision loses and the data is collected faster.

laser1:recorder:data:clear-data

(command, no arguments, returns empty tuple)

Command to clear the recorded data.

laser1:scan-aux:

(parameter section)

Access to the laser's auxilliary scan signal generator. It can be used independently of scan-and-lock and is not synchronous to the laser's scope."

For usage see **laser1:scan:** on page 125.

laser1:daq-connected

(BOOLEAN parameter, read-write)

Parameter to connect one of the DLCpros data acquisition (DAQ) engines (aka scope engine) to this laser. The data acquisition engine is necessary for viewing scope traces or using recorder and wide-scan etc. However, there are only two DAQ engines available in the DLCpros hardware. If more than two lasers are in use, this parameter must therefore be used to specify which lasers can make use of the DAQ engines at a time. Set this parameter to #t if this lasers scope traces are to be used. If set to #f the scope still can be configured, but the **:scope:data** parameter will not return any result. If the DLCpro's two DAQ engines are in use by other lasers, setting this parameter to #t will result in an error. It's then necessary to disconnect one of the other lasers from their DAQ engine.

laser1:nlo:

(parameter section)

Parameters relevant for the operation of frequency-converted diode laser systems.

laser1:nlo:servo:

(parameter section)

Parameters of the servo motors in frequency-converted diode laser systems.

laser1:nlo:servo:ta1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the amplifier stage.

laser1:nlo:servo:ta1-hor:display-name

(STRING parameter, read-only)

Parameter indicating the name of the servo motor, used in error messages.

laser1:nlo:servo:ta1-hor:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the servo motor.

laser1:nlo:servo:ta1-hor:value

(INTEGER parameter, read-write)

Parameter indicating the position of the servo motor.

laser1:nlo:servo:ta1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the amplifier stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:ta2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the amplifier stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:ta2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the amplifier stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:shg1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:shg1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:shg2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:shg2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fhg1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the FHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fhg1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the FHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fhg2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the FHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fhg2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the FHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fiber1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the fiber stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fiber1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the fiber stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fiber2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the fiber stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:fiber2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the fiber stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:uv-outcpl:

(parameter section)

Parameters of the servo of the UV cavity's output coupling mirror.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:uv-cryst:

(parameter section)

Parameters of the servo of the UV cavity's crystal.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:uv-lens:

(parameter section)

Parameters of the servo of the UV cavity's.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:comp-hor:

(parameter section)

Parameters of the horizontal axis of the compensation mirror.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:comp-vert:

(parameter section)

Parameters of the vertical axis of the compensation mirror.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:servo:etalon:

(parameter section)

Parameters of the servo of the OPO intra-cavity etalon.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:nlo:pd:

(parameter section)

Parameters for values and calibration of the photo diodes within frequency-converted diode laser systems.

laser1:nlo:pd:dl:

(parameter section)

Parameters for value and calibration of the seed photo diode within frequency-converted diode laser systems.

For usage see **laser1:dl:pd:seed:** on page 83.

laser1:nlo:pd:amp:

(parameter section)

Parameters for value and calibration of the amplifier photo diode within frequency-converted diode laser systems.

For usage see **laser1:dl:pd:seed:** on page 83.

laser1:nlo:pd:fiber:

(parameter section)

Parameters for value and calibration of the fiber photo diode within frequency-converted diode laser systems (use with FiberMon option only).

laser1:nlo:pd:fiber:power

(REAL parameter, read-only)

Parameter indicating the power level in mW.

laser1:nlo:pd:fiber:cal-offset

(REAL parameter, read-only)

Parameter to specify the calibration offset for the photodiode in mW.

laser1:nlo:pd:fiber:cal-factor

(REAL parameter, read-only)

Parameter to specify the calibration factor for the photodiode in mW/V.

laser1:nlo:pd:shg:

(parameter section)

Parameters for value and calibration of the SHG photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:nlo:pd:shg-input:

(parameter section)

Parameters for value and calibration of the SHG input photo diode within frequency-converted diode laser systems.

For usage see **laser1:dl:pd:seed:** on page 83.

laser1:nlo:pd:shg-int:

(parameter section)

Parameters for value and calibration of the SHG intra-cavity photo diode within frequency-converted diode laser systems.

laser1:nlo:pd:shg-int:photodiode

(REAL parameter, read-only)

Parameter indicating the photo diode voltage in V.

laser1:nlo:pd:shg-int:cal-offset

(REAL parameter, read-only)

Parameter to specify the calibration offset for the photodiode in V.

laser1:nlo:pd:shg-pdh-dc:

(parameter section)

Parameters for value and calibration of the SHG cavity-rejection photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:shg-int:** on page 145.

laser1:nlo:pd:shg-pdh-rf:

(parameter section)

Parameters for value and gain of the SHG PDH photo diode within frequency-converted diode laser systems.

laser1:nlo:pd:shg-pdh-rf:photodiode

(REAL parameter, read-only)

Parameter indicating the photo diode voltage in V.

laser1:nlo:pd:shg-pdh-rf:gain

(REAL parameter, read-write)

Parameter to specify the gain factor for the photodiode in V/V.

laser1:nlo:pd:fhg:

(parameter section)

Parameters for value and calibration of the SHG photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:nlo:pd:fhg-int:

(parameter section)

Parameters for value and calibration of the FHG intra-cavity photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:shg-int:** on page 145.

laser1:nlo:pd:fhg-pdh-dc:

(parameter section)

Parameters for value and calibration of the FHG cavity-rejection photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:shg-int:** on page 145.

laser1:nlo:pd:fhg-pdh-rf:

(parameter section)

Parameters for value and gain of the FHG PDH photo diode within frequency-converted diode laser systems.

For usage see **laser1:nlo:pd:shg-pdh-rf:** on page 145.

laser1:nlo:pd:pump:

(parameter section)

Parameters for value and calibration of the pump output power photo diode in an OPO system.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:nlo:pd:pump-dep:

(parameter section)

Parameters for value and calibration of the pump depleted output power photo diode in an OPO system.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:nlo:pd:sig:

(parameter section)

Parameters for value and calibration of the *signal* output power photo diode in an OPO system.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:nlo:power-optimization:

(parameter section)

Parameters for the power optimization routine of frequency-converted diode laser systems (use with AutoAlign option only).

laser1:nlo:power-optimization:ongoing

(BOOLEAN parameter, read-only)

Parameter indicating the status of the power optimization routine:
#t: An optimization routine is in progress.
#f: No optimization routine is in progress.

laser1:nlo:power-optimization:progress

(INTEGER parameter, read-only)

Parameter indicating the overall progress of the power optimization routines depending on the selected stages:

0 : Optimization routine is starting.

100 : Optimization routine has finished.

laser1:nlo:power-optimization:status

(INTEGER parameter, read-only)

Status of the optimization for internal purposes.

laser1:nlo:power-optimization:status-string

(STRING parameter, read-only)

Parameter indicating the status of the power optimization routine as a status string as displayed in the TOPAS DLC PC-GUI.

laser1:nlo:power-optimization:last-time-optimized

(STRING parameter, read-only)

Parameter indicating when the latest power optimization took place.

laser1:nlo:power-optimization:shg-advanced

(BOOLEAN parameter, read-write)

Parameter to select the Advanced mode of the power optimization routine for the SHG stage:
#t: Advanced mode selected.
#f: Advanced mode deselected.

laser1:nlo:power-optimization:stage1:

(parameter section)

Parameters for the amplifier power optimization routine of frequency-converted diode laser systems (use with amplifier only).

laser1:nlo:power-optimization:stage1:input:

(parameter section)

Parameters concerning the photo diode input of the power optimization routine.

laser1:nlo:power-optimization:stage1:input:value-calibrated

(REAL parameter, read-only)

Parameter indicating the calibrated photo diode voltage used in the amplifier power optimization routine.

laser1:nlo:power-optimization:stage1:progress

(INTEGER parameter, read-only)

Parameter indicating the progress of the power optimization routine as a percentage:

0 : Optimization routine is starting.

100 : Optimization routine has finished.

laser1:nlo:power-optimization:stage1:optimization-allowed

(BOOLEAN parameter, read-only)

Parameter to enable/disable the optimization for this servo motors.

laser1:nlo:power-optimization:stage1:optimization-in-progress

(BOOLEAN parameter, read-only)

Parameter indicating the status of the power optimization routine:
#t: The optimization routine is in progress.
#f: The optimization routine is not in progress.

laser1:nlo:power-optimization:stage1:restore-on-abort

(BOOLEAN parameter, read-write)

Parameter to enable/disable the return of the servo motors to their previous positions after the power optimization routine is aborted.

laser1:nlo:power-optimization:stage1:restore-on-regress

(BOOLEAN parameter, read-write)

Parameter to enable/disable the return of the servo motors to their previous positions after the power optimization routine has decreased the stage power. This may happen for an already optimized system.

laser1:nlo:power-optimization:stage1:regress-tolerance

(INTEGER parameter, read-write)

Parameter to specify the failure margin (as a percentage) that is tolerated if the power optimization routine leads to a power decrease. This may happen for an already optimized system.

laser1:nlo:power-optimization:stage1:start-optimization

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the stage.

laser1:nlo:power-optimization:stage2:

(parameter section)

Parameters for the SHG power optimization routine of frequency-converted diode laser systems.

For usage see **laser1:nlo:power-optimization:stage1:** on page 147.

laser1:nlo:power-optimization:stage3:

(parameter section)

Parameters for the SHG power optimization routine of frequency-converted diode laser systems using the amplifier servo motors (use with amplifier only).

For usage see **laser1:nlo:power-optimization:stage1:** on page 147.

laser1:nlo:power-optimization:stage4:

(parameter section)

Parameters for the fiber power optimization routine of frequency-converted diode laser systems.

For usage see **laser1:nlo:power-optimization:stage1:** on page 147.

laser1:nlo:power-optimization:stage5:

(parameter section)

Parameters for the FHG power optimization routine of frequency-converted diode laser systems.

For usage see **laser1:nlo:power-optimization:stage1:** on page 147.

laser1:nlo:power-optimization:low-power-threshold

(REAL parameter, read-only)

Threshold for low power detection at the fiber power input (in V). If the photo diode voltage is below this threshold, power-optimization gets refused to be started.

laser1:nlo:power-optimization:progress-data-amp

(BINARY parameter, read-only)

Parameter array indicating the amplifier power after the various iteration steps of the amplifier power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor (use with amplifier only). The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:nlo:power-optimization:progress-data-shg

(BINARY parameter, read-only)

Parameter array indicating the SHG power after the various iteration steps of the SHG power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor. The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:nlo:power-optimization:progress-data-fiber

(BINARY parameter, read-only)

Parameter array indicating the fiber monitor power after the various iteration steps of the fiber power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor (use with FiberMon option only). The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:nlo:power-optimization:progress-data-fhg

(BINARY parameter, read-only)

Parameter array indicating the FHG power after the various iteration steps of the FHG power optimization routine, as displayed in the TOPAS DLC PC-GUI Power Optimization Monitor. The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:nlo:power-optimization:abort

(BOOLEAN parameter, read-write)

Parameter specifying whether to abort the power optimization routine.

laser1:nlo:power-optimization:start-optimization-all

(command, no arguments, returns INTEGER)

Command to start the power optimization routine for all stages. This command returns 0 if the power optimization routine could be successfully started or a negative error code otherwise.

laser1:nlo:power-optimization:start-optimization-amp

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the amplifier stage. This command returns 0 if the power optimization routine could be successfully started or a negative error code otherwise.

laser1:nlo:power-optimization:start-optimization-shg

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the SHG stage. This command returns 0 if the power optimization routine could be successfully started or a negative error code otherwise.

laser1:nlo:power-optimization:start-optimization-fiber

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the fiber stage (use with FiberMon option only). This command returns 0 if the power optimization routine could be successfully started or a negative error code otherwise.

laser1:nlo:power-optimization:start-optimization-fhg

(command, no arguments, returns INTEGER)

Command to start the power optimization routine of the FHG stage. This command returns 0 if the power optimization routine could be successfully started or a negative error code otherwise.

laser1:nlo:auto-nlo:

(parameter section)

Parameters for controlling the AutoNLO feature of frequency-converted diode laser systems.

laser1:nlo:auto-nlo:automatic-mode

(BOOLEAN parameter, read-only)

Parameter to enable the Auto-Pilot feature.

laser1:nlo:auto-nlo:laser-on

(BOOLEAN parameter, read-write)

Parameter to enable the NLO laser head.

laser1:nlo:auto-nlo:emission

(BOOLEAN parameter, read-only)

Parameter indicating the emission status for the NLO laser head.
#t - laser emits light
#f - laser emission is switched off

laser1:nlo:auto-nlo:operation-time-master

(REAL parameter, read-only)

Parameter indicating the operation time of the master laser in hours.

laser1:nlo:auto-nlo:operation-time-amplifier

(REAL parameter, read-only)

Parameter indicating the operation time of the amplifier in hours.

laser1:nlo:auto-nlo:operation-time-cavity

(REAL parameter, read-only)

Parameter indicating the operation time of the SHG resonator in hours.

laser1:nlo:auto-nlo:operation-time-cavity-fhg

(REAL parameter, read-only)

Parameter indicating the operation time of the FHG resonator in hours.

laser1:nlo:auto-nlo:amplifier-current-margin

(REAL parameter, read-only)

Parameter indicating the fractional current-margin for the amplifier.

laser1:nlo:auto-nlo:amplifier-current-margin-alo

(REAL parameter, read-only)

Parameter indicating the fractional current-margin after last optimize for the amplifier.

laser1:nlo:auto-nlo:conversion-efficiency

(REAL parameter, read-only)

Parameter indicating the conversion efficiency of the SHG resonator.

laser1:nlo:auto-nlo:conversion-efficiency-fhg

(REAL parameter, read-only)

Parameter indicating the conversion efficiency of the FHG resonator.

laser1:nlo:auto-nlo:wavelength

(REAL parameter, read-only)

Parameter indicating the wavelength (in vacuum) in nanometer.

laser1:nlo:auto-nlo:temp-act-baseplate

(REAL parameter, read-only)

Parameter indicating the current temperature of the baseplate on a TopWave405 system.

laser1:nlo:auto-nlo:perform-single-mode-optimization

(command, no arguments, returns empty tuple)

Command to optimize the single-mode performance of the NLO system.

laser1:nlo:auto-nlo:perform-auto-align

(command, no arguments, returns empty tuple)

Command to start the AutoAlign optimization routine.

laser1:nlo:shg:

(parameter section)

Parameters for the control of the SHG cavity.

laser1:nlo:shg:tc:

(parameter section)

The **laser1:nlo:shg:tc** section provides parameters related to the temperature controller for the nonlinear crystals in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:shg:cavity-tc:

(parameter section)

The **laser1:nlo:shg:cavity-tc** section provides parameters related to the temperature controller for the cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:shg:pc:

(parameter section)

Parameters the Temperature Control (TC) board.

For usage see **laser1:dl:pc:** on page 64.

laser1:nlo:shg:scan:

(parameter section)

This section provides access to the SHG cavity scan signal generator.

laser1:nlo:shg:scan:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the SHG cavity signal generator
#t - signal generator enabled
#f - signal generator disabled

laser1:nlo:shg:scan:frequency

(REAL parameter, read-write)

Parameter to control the SHG cavity scan frequency (in Hz).

laser1:nlo:shg:scan:amplitude

(REAL parameter, read-write)

Parameter to control the peak-to-peak amplitude of the SHG cavity scan generator (in Vpp).

laser1:nlo:shg:scan:offset

(REAL parameter, read-write)

Parameter to control the offset/center of the SHG cavity scan generator (in V).

laser1:nlo:shg:scope:

(parameter section)

This section provides access to the data traces for the SHG signal display.

laser1:nlo:shg:scope:variant

(INTEGER parameter, read-write)

This parameter controls which kind of data should be exported in the **:data** parameter:

0 - *xy* - This variant will typically be used for finding the lock point. The input signals are then shown as a function of the scan output-channel. Use the **:scope:channelx:xy-signal** to define the signal for the x-axis. The acquisition time for the scope engine is automatically set to half the scan period.

1 - *scope* - This variant shows the signals as a function of time.
Use the **:scope:channelx:scope-timescale** parameter to define the total acquisition time for the traces in ms. The acquisition time for the scope engine is set to the **:scope:channelx:scope-timescale** value.

2 - *spectrum* - This variant shows a Fast Fourier Transform of the signals as a function of frequency.
Use the **:scope:channelx:spectrum-range** parameter to define the maximum frequency you want to resolve. The acquisition time for the scope engine is set to the $500/f_{max}$, with f_{max} = **:channelx:spectrum-range**.

laser1:nlo:shg:scope:update-rate

(INTEGER parameter, read-write)

Sets the diagram update-rate (in Hz).
Please note that, the trace acquisition time may influence the real diagram update-rate.

laser1:nlo:shg:scope:channel1:

(parameter section)

Settings for channel1 of the scope engine. For most lock applications you may want to set this channel's **:input-signal** to 100, meaning the **:lock:spectrum-input-channel**.

laser1:nlo:shg:scope:channel1:signal

(INTEGER parameter, read-write)

Use this parameter to set the signal channel you want to be acquired by the scope engine.

laser1:nlo:shg:scope:channel1:unit

(STRING parameter, read-only)

Returns the physical unit of the selected signal.

laser1:nlo:shg:scope:channel1:name

(STRING parameter, read-only)

Returns the name of the signal.

laser1:nlo:shg:scope:channel2:

(parameter section)

Settings for channel2 of the scope engine. You can freely configure this channel.

For usage see **laser1:nlo:shg:scope:channel1:** on page 155.

laser1:nlo:shg:scope:channelx:

(parameter section)

Settings for the x-axis of the scope engine. Depending on the **:scope:variant** setting the x-axis is treated differently and different parameters of this sections apply.

laser1:nlo:shg:scope:channelx:xy-signal

(INTEGER parameter, read-write)

This parameter is only used if the **:scope:variant** is set to "XY mode". It then defines the signal channel to be acquired for the x-axis values. In most cases this parameter should be set to 101 will make the scope acquiring the signals from the channel defined as **:scan:output-channel**.

laser1:nlo:shg:scope:channelx:scope-timescale

(REAL parameter, read-write)

This parameter is only used if the **:scope:variant** is set to "scope". It then defines the timescale (in ms).

laser1:nlo:shg:scope:channelx:spectrum-range

(REAL parameter, read-write)

This parameter is only used if the **:scope:variant** is set to "spectrum". It then defines the full frequency range (in kHz).

laser1:nlo:shg:scope:channelx:spectrum-omit-dc

(BOOLEAN parameter, read-write)

If this parameter is set to #t, the lowest 3 frequency components (i.e. the DC components) of the Fast Fourier Transform traces will be omitted. This is intended to help with autoscaling in the diagrams. Set this parameter to #f if you need to see the DC components.

laser1:nlo:shg:scope:channelx:unit

(STRING parameter, read-only)

Returns the physical unit of the signal. For the "scope" case it will return "ms", for the spectrum case "kHz" and for the "xy" case it will return the unit of the signal defined by **:channelx:xy-signal**.

laser1:nlo:shg:scope:channelx:name

(STRING parameter, read-only)

Returns the name of the signal.

laser1:nlo:shg:scope:timescale

(REAL parameter, read-only)

Returns the data trace acquisition time (in ms).

laser1:nlo:shg:scope:data

(BINARY parameter, read-only)

Returns trace data for all enabled channels. The data format is described in the appendix (to be done).

laser1:nlo:shg:lock:

(parameter section)

This section provides access to the SHG cavity's lock engine. It has two PID regulators for controlling two independent output channels. Furthermore it provides modules for lock-in detection, automatic relock or reset, as well as for easy to use click-and-lock functionality.

laser1:nlo:shg:lock:state

(INTEGER parameter, read-only)

Parameter indicating the current operational mode of the lock module. Possible values are:
0 - lock off
1 - locking
2 - locked

laser1:nlo:shg:lock:state-txt

(STRING parameter, read-only)

Parameter indicating the current operational mode of the lock module as a short text. Possible values are: "idle", "locking" and "locked".

laser1:nlo:shg:lock:lock-enabled

(BOOLEAN parameter, read-write)

This parameter returns #t if the lock engine's **:state** is "locking" or "locked".
Setting this parameter to #t has the same effect as submitting the command **:close** and setting this parameter to #f has the same effect as submitting the command **:open**.

laser1:nlo:shg:lock:pid-selection

(INTEGER parameter, read-write)

Parameter to select the PID controllers to be used by the SHG cavity lock engine:
0 - no PID controller active.
1 - "PID Slow" (PID2) on, "PID Fast" (PID1) off, analog PID off.
2 - "PID Slow" (PID2) on, "PID Fast" (PID1) off, analog PID on.
3 - "PID Slow" (PID2) on, "PID Fast" (PID1) on, analog PID off.
4 - All PID controllers on.

laser1:nlo:shg:lock:setpoint

(REAL parameter, read-write)

Parameter to specify the setpoint for the PID Slow controller (in V).

laser1:nlo:shg:lock:continuous-calc-pid

(BOOLEAN parameter, read-write)

Parameter to enable continuous calculation of PIDs for SHG lock.

laser1:nlo:shg:lock:relock:

(parameter section)

Settings for automatic SHG cavity ReLock.

laser1:nlo:shg:lock:relock:enabled

(BOOLEAN parameter, read-write)

Set this parameter to #t to enable the ReLock engine.

laser1:nlo:shg:lock:relock:frequency

(REAL parameter, read-write)

Parameter to control the frequency of the ReLock scan (in Hz).

laser1:nlo:shg:lock:relock:amplitude

(REAL parameter, read-write)

Parameter to control the amplitude of the ReLock waveform (in V).

laser1:nlo:shg:lock:relock:delay

(REAL parameter, read-write)

Parameter to determine the waiting time before the ReLock procedure starts after the out-of-lock condition is signaled by **:lock:window**.

laser1:nlo:shg:lock:window:

(parameter section)

Settings for out-of-lock detection for SHG cavity ReLock and triggering the PID controller reset.

laser1:nlo:shg:lock:window:input-channel

(INTEGER parameter, read-write)

Parameter to select the input signal for the lock detection window.

laser1:nlo:shg:lock:window:threshold

(REAL parameter, read-write)

Parameter to determine the threshold of the ReLock window (in V).

laser1:nlo:shg:lock:window:level-hysteresis

(REAL parameter, read-write)

Parameter to determine the inner ReLock window by a voltage difference to the outer ReLock window limits (in V or mW).

laser1:nlo:shg:lock:calibration:

(parameter section)

Settings for continuous calculation of PIDs for SHG lock.

laser1:nlo:shg:lock:calibration:power-min

(REAL parameter, read-write)

Parameter specifying minimum power of amplifier

laser1:nlo:shg:lock:calibration:power-max

(REAL parameter, read-write)

Parameter specifying maximum power of amplifier

laser1:nlo:shg:lock:calibration:power-hysteresis

(REAL parameter, read-write)

Parameter specifying hysteresis value in percent for power. Setting 0 disables hysteresis.

laser1:nlo:shg:lock:calibration:pid2-all-min

(REAL parameter, read-write)

Parameter to control minimum of the overall gain. This parameter has no physical unit.

laser1:nlo:shg:lock:calibration:pid2-all-max

(REAL parameter, read-write)

Parameter to control maximum of the overall gain. This parameter has no physical unit.

laser1:nlo:shg:lock:calibration:pid2-p-min

(REAL parameter, read-write)

Parameter to control minimum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:pid2-p-max

(REAL parameter, read-write)

Parameter to control maximum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:pid1-all-min

(REAL parameter, read-write)

Parameter to control minimum of the overall gain. This parameter has no physical unit.

laser1:nlo:shg:lock:calibration:pid1-all-max

(REAL parameter, read-write)

Parameter to control maximmum of the overall gain. This parameter has no physical unit.

laser1:nlo:shg:lock:calibration:pid1-p-min

(REAL parameter, read-write)

Parameter to control minimum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:pid1-p-max

(REAL parameter, read-write)

Parameter to control maximum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:analog-p-min

(REAL parameter, read-write)

Parameter to control minimum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:analog-p-max

(REAL parameter, read-write)

Parameter to control maximum of the proportional gain (in V/V).

laser1:nlo:shg:lock:calibration:shg-pdh-rf-gain-min

(REAL parameter, read-write)

Parameter to control minimum of the gain for SHG PDH photo diode.

laser1:nlo:shg:lock:calibration:shg-pdh-rf-gain-max

(REAL parameter, read-write)

Parameter to control maximum of the gain for SHG PDH photo diode.

laser1:nlo:shg:lock:calibration:lo-amplitude-min

(REAL parameter, read-write)

Parameter to control minimum of the gain for peak-to-peak local oscillator amplitude for the cavity lock (in V).

laser1:nlo:shg:lock:calibration:lo-amplitude-max

(REAL parameter, read-write)

Parameter to control maximum of the gain for peak-to-peak local oscillator amplitude for the cavity lock (in V).

laser1:nlo:shg:lock:calibration:threshold-min

(REAL parameter, read-write)

Lower limit (in V) for **the threshold of the ReLock window**.

laser1:nlo:shg:lock:calibration:threshold-max

(REAL parameter, read-write)

Upper limit (in V) for **the threshold of the ReLock window**.

laser1:nlo:shg:lock:pid1:

(parameter section)

Parameters for the PID Fast controller.

laser1:nlo:shg:lock:pid1:gain:

(parameter section)

Gain parameters for the PID controller.

laser1:nlo:shg:lock:pid1:gain:all

(REAL parameter, read-write)

Parameter to control the overall gain. This parameter has no physical unit.

laser1:nlo:shg:lock:pid1:gain:p

(REAL parameter, read-write)

Parameter to control the proportional gain (in V/V).

laser1:nlo:shg:lock:pid1:gain:i

(REAL parameter, read-write)

Parameter to control the integral gain (in V/V/ms).

laser1:nlo:shg:lock:pid1:gain:d

(REAL parameter, read-write)

Parameter to control the differential gain (in V/V*μs).

laser1:nlo:shg:lock:pid1:gain:i-cutoff

(REAL parameter, read-write)

Parameter to determine the frequency limit (I-cutoff) for the integral PID gain (in Hz).

laser1:nlo:shg:lock:pid1:gain:i-cutoff-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable a frequency limit (I-cutoff) for the integral PID Fast gain (**:lock:pid1:gain:i-cutoff**). Possible values are:
#t - I-cutoff enabled
#f - I-cutoff disabled

laser1:nlo:shg:lock:pid2:

(parameter section)

Parameters for the PID Slow controller.

For usage see **laser1:nlo:shg:lock:pid1:** on page 161.

laser1:nlo:shg:lock:analog-dl-gain:

(parameter section)

Access to the parameters of the analog lock path.

laser1:nlo:shg:lock:analog-dl-gain:p-gain

(REAL parameter, read-write)

Parameter to specify the proportional gain of the analog lock path (in V/V).

laser1:nlo:shg:lock:local-oscillator:

(parameter section)

Access to the parameters of the local oscillator for the SHG cavity lock.

laser1:nlo:shg:lock:local-oscillator:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the local oscillator for the SHG cavity lock.
#t - Local oscillator is enabled.
#f - Local oscillator is disabled.

laser1:nlo:shg:lock:local-oscillator:use-external-oscillator

(BOOLEAN parameter, read-write)

Parameter to specify if the internal local oscillator tries to phase-lock onto an external signal at the "extLO" plug.
#t - Phase-lock to external signal is enabled.
#f - Phase-lock to external signal is disabled.
This parameter is necessary in the context of PDH locks of the master oscillator to an external reference. For details, see the TA/DL-SHG pro manual.

laser1:nlo:shg:lock:local-oscillator:amplitude

(REAL parameter, read-write)

Parameter to specify the peak-to-peak local oscillator amplitude for the cavity lock (in V). Only discrete values are possible, and the user is recommended to set the local oscillator amplitude via the parameter **laser1:nlo:shg:lock:local-oscillator:attentuation-raw**.

laser1:nlo:shg:lock:local-oscillator:attenuation-raw

(INTEGER parameter, read-write)

Parameter to select the peak-to-peak amplitude of the cavity local oscillator. Possible values are:
0 - 0.65 Vpp
2 - 0.58 Vpp
4 - 0.52 Vpp
6 - 0.46 Vpp
9 - 0.39 Vpp
12 - 0.33 Vpp
16 - 0.26 Vpp
21 - 0.19 Vpp
28 - 0.13 Vpp
40 - 0.065 Vpp
63 - 0.017 Vpp

laser1:nlo:shg:lock:local-oscillator:phase-shift

(REAL parameter, read-write)

Parameter to select the phase difference between the local oscillator for the cavity lock and the PDH RF photo diode signal of the SHG cavity (in °).

laser1:nlo:shg:lock:local-oscillator:auto-pdh-state

(INTEGER parameter, read-only)

Parameter indicating the state of the auto-pdh algorithm.

0 - idle

1 - active

2 - aborting

laser1:nlo:shg:lock:local-oscillator:auto-pdh

(command, no arguments, returns empty tuple)

Command to automatically set the phase difference between the local oscillator for the cavity lock and the PDH RF photo diode signal of the SHG cavity for an optimized SHG cavity error signal.

laser1:nlo:shg:lock:local-oscillator:auto-pdh-abort

(command, no arguments, returns empty tuple)

Command to abort auto-PDH.

laser1:nlo:shg:lock:cavity-fast-pzt-voltage

(REAL parameter, read-write)

Alias for single-value-main-out.

laser1:nlo:shg:lock:cavity-slow-pzt-voltage

(REAL parameter, read-write)

Alias for single-value-aux-out.

laser1:nlo:shg:lock:background-trace

(BINARY parameter, read-only)

Parameter indicating the X/Y coordinate data for the background trace in the DLCpro GUIs. The parameter provides the last scan trace before the lock was closed. The parameter value is provided in the format decribed in Appendix 4.2. It contains data blocks with IDs *'x'* and *'y'*.
If the lock is not closed, **:background-trace** is empty.

laser1:nlo:shg:lock:candidates

(BINARY parameter, read-only)

Parameter indicating lock point tracking data for display in the DLCpro GUI (in binary format).
The parameter value is provided in the format decribed in Appendix 4.2. It contains a single data block with IDs *'t'*.

laser1:nlo:shg:factory-settings:

(parameter section)

Factory settings for the most important parameters related to the SHG cavity and power optimization.

laser1:nlo:shg:factory-settings:tc:

(parameter section)

Factory settings for the temperature controller (TC) of the SHG nonlinear crystal.

laser1:nlo:shg:factory-settings:tc:temp-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set-min**.
The parameter **tc:limits:temp-min** is set to 2K below this value if this result is below 15°C. Otherwise **tc:limits:temp-min** is set to 15°C.

laser1:nlo:shg:factory-settings:tc:temp-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set-max**.
The parameter **tc:limits:temp-max** is set to 2K above this value if this result is above 30°C.Otherwise **tc:limits:temp-max** is set to 30°C.

laser1:nlo:shg:factory-settings:tc:temp-set

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-set**.

laser1:nlo:shg:factory-settings:tc:temp-roc-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-roc-enabled**.

laser1:nlo:shg:factory-settings:tc:temp-roc-limit

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:temp-roc-limit**.

laser1:nlo:shg:factory-settings:tc:current-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:current-set-max**.

laser1:nlo:shg:factory-settings:tc:current-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:current-set-min**.

laser1:nlo:shg:factory-settings:tc:p-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:p-gain**.

laser1:nlo:shg:factory-settings:tc:i-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:i-gain**.

laser1:nlo:shg:factory-settings:tc:d-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:d-gain**.

laser1:nlo:shg:factory-settings:tc:c-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:c-loop:i-gain**.

laser1:nlo:shg:factory-settings:tc:ok-tolerance

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:ok-tolerance**.

laser1:nlo:shg:factory-settings:tc:ok-time

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:t-loop:ok-time**.

laser1:nlo:shg:factory-settings:tc:timeout

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **tc:limits:timeout**.

laser1:nlo:shg:factory-settings:tc:power-source

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **tc:power-source**.

laser1:nlo:shg:factory-settings:tc:ntc-series-resistance

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **tc:ntc-series-resistance**.

laser1:nlo:shg:factory-settings:cavity-tc:

(parameter section)

Factory settings for the temperature controller (TC) of the SHG cavity.

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:nlo:shg:factory-settings:pc:

(parameter section)

Factory settings for the piezo controller (PC) of the slow SHG cavity piezo element.

laser1:nlo:shg:factory-settings:pc:voltage-min

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:pc:voltage-min**.

laser1:nlo:shg:factory-settings:pc:voltage-max

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:pc:voltage-max**.

laser1:nlo:shg:factory-settings:pc:feedforward-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:pc:feedforward-enabled**.

laser1:nlo:shg:factory-settings:pc:feedforward-factor

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:pc:feedforward-factor**.

laser1:nlo:shg:factory-settings:pc:capacitance

(REAL parameter, read-only)

Parameter indicating the piezo capacitance, measured during production (in μF).

laser1:nlo:shg:factory-settings:pc:scan-offset

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:scan:offset** used for measurements during production.

laser1:nlo:shg:factory-settings:pc:scan-amplitude

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:scan:amplitude** used for measurements during production.

laser1:nlo:shg:factory-settings:pc:scan-frequency

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:scan:frequency** used for measurements during production.

laser1:nlo:shg:factory-settings:pd:

(parameter section)

Factory settings for the SHG photodiodes.

laser1:nlo:shg:factory-settings:pd:shg:

(parameter section)

Factory settings for the SHG photo diode.

laser1:nlo:shg:factory-settings:pd:shg:cal-offset

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:pd:dl:cal-offset**.

laser1:nlo:shg:factory-settings:pd:shg:cal-factor

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:pd:dl:cal-factor**.

laser1:nlo:shg:factory-settings:pd:shg-input:

(parameter section)

Factory settings for the SHG input photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:shg:factory-settings:pd:fiber:

(parameter section)

Factory settings for the fiber monitor photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:shg:factory-settings:pd:int:

(parameter section)

Factory settings for the SHG's intra-cavity photo diode.

laser1:nlo:shg:factory-settings:pd:int:cal-offset

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:pd:int:cal-offset**.

laser1:nlo:shg:factory-settings:pd:pdh-dc:

(parameter section)

Factory settings for the SHG cavity-rejection photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:int:** on page 168.

laser1:nlo:shg:factory-settings:pd:pdh-rf:

(parameter section)

Factory settings for the SHG PDH photo diode.

laser1:nlo:shg:factory-settings:pd:pdh-rf:gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:pd:shg-pdh-rf:gain**.

laser1:nlo:shg:factory-settings:lock:

(parameter section)

Factory settings for the lock engine.

laser1:nlo:shg:factory-settings:lock:pid-selection

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid-selection**.

laser1:nlo:shg:factory-settings:lock:setpoint

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:setpoint**.

laser1:nlo:shg:factory-settings:lock:calibration:

(parameter section)

Factory settings for continuous calculation of PIDs for SHG lock.

For usage see **laser1:nlo:shg:lock:calibration:** on page 159.

laser1:nlo:shg:factory-settings:lock:relock:

(parameter section)

Factory settings for the automatic SHG cavity ReLock.

laser1:nlo:shg:factory-settings:lock:relock:enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:relock:enabled**.

laser1:nlo:shg:factory-settings:lock:relock:frequency

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:relock:frequency**.

laser1:nlo:shg:factory-settings:lock:relock:amplitude

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:relock:amplitude**.

laser1:nlo:shg:factory-settings:lock:relock:delay

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:relock:delay**.

laser1:nlo:shg:factory-settings:lock:window:

(parameter section)

Factory settings for out-of-lock detection for SHG cavity ReLock and triggering the PID controller reset.

laser1:nlo:shg:factory-settings:lock:window:input-channel

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:window:input-channel**.

laser1:nlo:shg:factory-settings:lock:window:threshold

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:window:threshold**.

laser1:nlo:shg:factory-settings:lock:window:level-hysteresis

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:window:level-hysteresis**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:

(parameter section)

Factory Settings for the PID Fast controller.

laser1:nlo:shg:factory-settings:lock:pid1-gain:all

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:all**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:p

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:p**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:i

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:i**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:d

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:d**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:i-cutoff

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:i-cutoff**.

laser1:nlo:shg:factory-settings:lock:pid1-gain:i-cutoff-enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:pid1:gain:i-cutoff**.

laser1:nlo:shg:factory-settings:lock:pid2-gain:

(parameter section)

Factory Settings for the PID Slow controller.

For usage see **laser1:nlo:shg:factory-settings:lock:pid1-gain:** on page 170.

laser1:nlo:shg:factory-settings:lock:analog-p-gain

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:analog-dl-gain:p-gain**.

laser1:nlo:shg:factory-settings:lock:local-oscillator:

(parameter section)

Factory settings for the local oscillator of the cavity lock.

laser1:nlo:shg:factory-settings:lock:local-oscillator:enabled

(BOOLEAN parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:local-oscillator:enabled**.

laser1:nlo:shg:factory-settings:lock:local-oscillator:attenuation-shg-raw

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:local-oscillator:attenuation-raw**.

laser1:nlo:shg:factory-settings:lock:local-oscillator:attenuation-fhg-raw

(INTEGER parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:local-oscillator:attenuation-raw**.

laser1:nlo:shg:factory-settings:lock:local-oscillator:phase-shift-shg

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:local-oscillator:phase-shift**.

laser1:nlo:shg:factory-settings:lock:local-oscillator:phase-shift-fhg

(REAL parameter, read-only)

Parameter indicating the factory setting for parameter **laser1:nlo:shg:lock:local-oscillator:phase-shift**.

laser1:nlo:shg:factory-settings:apply

(command, no arguments, returns empty tuple)

This command applies all factory settings for the SHG cavity and power optimization.

laser1:nlo:fhg:

(parameter section)

Parameters for the control of the FHG cavity.

laser1:nlo:fhg:tc:

(parameter section)

The **laser1:nlo:fhg:tc** section provides parameters related to the temperature controller for the nonlinear crystals in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:fhg:cavity-tc:

(parameter section)

The **laser1:nlo:fhg:cavity-tc** section provides parameters related to the temperature controller for the cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:fhg:pc:

(parameter section)

Parameters the Temperature Control (TC) board.

For usage see **laser1:dl:pc:** on page 64.

laser1:nlo:fhg:scan:

(parameter section)

This section provides access to the scan signal generator.

For usage see **laser1:nlo:shg:scan:** on page 153.

laser1:nlo:fhg:scope:

(parameter section)

This section provides access to the data traces for the DLCpro diagram.

For usage see **laser1:nlo:shg:scope:** on page 154.

laser1:nlo:fhg:lock:

(parameter section)

This section provides access to the DLCpro's lock engine. It has two PID regulators for controlling two independent output channels. Furthermore it provides modules for lock-in detection, automatic relock or reset, as well as for easy to use click-and-lock functionality.

laser1:nlo:fhg:lock:state

(INTEGER parameter, read-only)

Parameter indicating the current operational mode of the lock module. Possible values are:
0 - lock off
1 - locking
2 - locked

laser1:nlo:fhg:lock:state-txt

(STRING parameter, read-only)

Parameter indicating the current operational mode of the lock module as a short text. Possible values are: "idle", "locking" and "locked".

laser1:nlo:fhg:lock:lock-enabled

(BOOLEAN parameter, read-write)

This parameter returns #t if the lock engine's **:state** is "locking" or "locked".
Setting this parameter to #t has the same effect as submitting the command **:close** and setting this parameter to #f has the same effect as submitting the command **:open**.

laser1:nlo:fhg:lock:pid-selection

(INTEGER parameter, read-write)

Parameter to select the PID controllers to be used by the FHG cavity lock engine:
0 - no PID controller active.
1 - "PID Slow" (PID2) on, "PID Fast" (PID1) off, analog PID off.
2 - "PID Slow" (PID2) on, "PID Fast" (PID1) off, analog PID on.
3 - "PID Slow" (PID2) on, "PID Fast" (PID1) on, analog PID off.
4 - All PID controllers on.

laser1:nlo:fhg:lock:setpoint

(REAL parameter, read-write)

Parameter to specify the setpoint for the PID Slow controller (in V).

laser1:nlo:fhg:lock:relock:

(parameter section)

Settings for automatic FHG cavity ReLock.

For usage see **laser1:nlo:shg:lock:relock:** on page 158.

laser1:nlo:fhg:lock:window:

(parameter section)

Settings for out-of-lock detection for FHG cavity ReLock and triggering the PID controller reset.

For usage see **laser1:nlo:shg:lock:window:** on page 158.

laser1:nlo:fhg:lock:pid1:

(parameter section)

Parameters for the PID Fast controller.

For usage see **laser1:nlo:shg:lock:pid1:** on page 161.

laser1:nlo:fhg:lock:pid2:

(parameter section)

Parameters for the PID Slow controller.

For usage see **laser1:nlo:shg:lock:pid1:** on page 161.

laser1:nlo:fhg:lock:local-oscillator:

(parameter section)

Access to the parameters of the local oscillator for the FHG cavity lock.

laser1:nlo:fhg:lock:local-oscillator:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the local oscillator for the FHG cavity lock.
#t - Local oscillator is enabled.
#f - Local oscillator is disabled.

laser1:nlo:fhg:lock:local-oscillator:amplitude

(REAL parameter, read-write)

Parameter to specify the peak-to-peak local oscillator amplitude for the cavity lock (in V). Only discrete values are possible, and the user is recommended to set the local oscillator amplitude via the parameter **laser1:nlo:fhg:lock:local-oscillator:attenuation-raw**.

laser1:nlo:fhg:lock:local-oscillator:attenuation-raw

(INTEGER parameter, read-write)

Parameter to select the peak-to-peak amplitude of the cavity local oscillator. Possible values are:
0 - 0.65 Vpp
2 - 0.58 Vpp
4 - 0.52 Vpp
6 - 0.46 Vpp
9 - 0.39 Vpp
12 - 0.33 Vpp
16 - 0.26 Vpp
21 - 0.19 Vpp
28 - 0.13 Vpp
40 - 0.065 Vpp
63 - 0.017 Vpp

laser1:nlo:fhg:lock:local-oscillator:phase-shift

(REAL parameter, read-write)

Parameter to select the phase difference between the local oscillator for the cavity lock and the PDH RF photo diode signal of the FHG cavity (in °).

laser1:nlo:fhg:lock:local-oscillator:auto-pdh-state

(INTEGER parameter, read-only)

Parameter indicating the state of the auto-pdh algorithm.

0 - idle

1 - active

2 - aborting

laser1:nlo:fhg:lock:local-oscillator:auto-pdh

(command, no arguments, returns empty tuple)

Command to automatically set the phase difference between the local oscillator for the cavity lock and the PDH RF photo diode signal of the FHG cavity for an optimized FHG cavity error signal.

laser1:nlo:fhg:lock:local-oscillator:auto-pdh-abort

(command, no arguments, returns empty tuple)

Command to abort auto-PDH.

laser1:nlo:fhg:lock:cavity-fast-pzt-voltage

(REAL parameter, read-write)

Alias for single-value-main-out.

laser1:nlo:fhg:lock:cavity-slow-pzt-voltage

(REAL parameter, read-write)

Alias for single-value-aux-out.

laser1:nlo:fhg:lock:background-trace

(BINARY parameter, read-only)

Parameter indicating the X/Y coordinate data for the background trace in the DLCpro GUIs. The parameter provides the last scan trace before the lock was closed. The parameter value is provided in the format decribed in Appendix 4.2. It contains data blocks with IDs *'x'* and *'y'*.
If the lock is not closed, **:background-trace** is empty.

laser1:nlo:fhg:lock:candidates

(BINARY parameter, read-only)

Parameter indicating lock point tracking data for display in the DLCpro GUI (in binary format).
The parameter value is provided in the format decribed in Appendix 4.2. It contains a single data block with IDs *'t'*.

laser1:nlo:fhg:factory-settings:

(parameter section)

Factory settings for the most important parameters related to the FHG cavity, power optimization.

laser1:nlo:fhg:factory-settings:tc:

(parameter section)

Factory settings for the temperature controller (TC) of the FHG nonlinear crystal.

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:nlo:fhg:factory-settings:cavity-tc:

(parameter section)

Factory settings for the temperature controller (TC) of the FHG cavity.

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:nlo:fhg:factory-settings:pc:

(parameter section)

Factory settings for the piezo controller (PC) of the slow FHG cavity piezo element.

For usage see **laser1:nlo:shg:factory-settings:pc:** on page 166.

laser1:nlo:fhg:factory-settings:pd:

(parameter section)

Factory settings for the FHG photodiodes.

laser1:nlo:fhg:factory-settings:pd:fhg:

(parameter section)

Factory settings for the FHG photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:fhg:factory-settings:pd:int:

(parameter section)

Factory settings for the FHG's intra-cavity photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:int:** on page 168.

laser1:nlo:fhg:factory-settings:pd:pdh-dc:

(parameter section)

Factory settings for the FHG cavity-rejection photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:int:** on page 168.

laser1:nlo:fhg:factory-settings:pd:pdh-rf:

(parameter section)

Factory settings for the FHG PDH photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:pdh-rf:** on page 168.

laser1:nlo:fhg:factory-settings:lock:

(parameter section)

Factory settings for the lock engine.

For usage see **laser1:nlo:shg:factory-settings:lock:** on page 169.

laser1:nlo:fhg:factory-settings:apply

(command, no arguments, returns empty tuple)

This command applies all factory settings for the FHG cavity.

laser1:nlo:opo:

(parameter section)

Parameters for the control of the OPO cavity.

laser1:nlo:opo:crystal:

(parameter section)

Parameters related to the OPO crystal in frequency-converted diode laser systems.

laser1:nlo:opo:crystal:tc:

(parameter section)

Parameters related to the temperature controller (TC) board for the OPO crystal in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:opo:cavity:

(parameter section)

Parameters related to the OPO cavity in frequency-converted diode laser systems.

laser1:nlo:opo:cavity:tc:

(parameter section)

Parameters related to the temperature controller (TC) board for the OPO cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:nlo:opo:cavity:pc:

(parameter section)

Parameters for the Piezo Control (PC) board for the OPO cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:pc:** on page 64.

laser1:nlo:opo:cavity:pc-fast:

(parameter section)

Parameters for the fast piezo of the OPO cavity in frequency-converted diode laser systems.

laser1:nlo:opo:cavity:pc-fast:voltage-set

(REAL parameter, read-write)

Parameter to set the desired piezo voltage in V.

laser1:nlo:opo:cavity:pc-fast:voltage-min

(REAL parameter, read-only)

Parameter indicating the minimum piezo voltage in V.

laser1:nlo:opo:cavity:pc-fast:voltage-max

(REAL parameter, read-only)

Parameter indicating the maximum piezo voltage in V.

laser1:nlo:opo:cavity:pc-fast:external-input:

(parameter section)

Parameters to configure the piezo voltage control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

laser1:nlo:opo:cavity:pc-fast:voltage-act

(REAL parameter, read-only)

Parameter indicating the calculated voltage in V, including contributions of external input, feedforward etc.

laser1:nlo:opo:cavity:pc-fast:status

(INTEGER parameter, read-only)

Parameter indicating channel status information. Each bit of the integer value provides specific channel status information.

bit 7 - voltage at lower limit

bit 8 - voltage at upper limit

bit 9 - voltage slew-rate limited

laser1:nlo:opo:cavity:pc-fast:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

laser1:nlo:opo:cavity:fast-pzt-voltage-set

(REAL parameter, read-write)

Parameter indicating the voltage of the fast OPO cavity piezo (in V).

laser1:nlo:opo:cavity:slow-pzt-voltage-set

(REAL parameter, read-write)

Parameter indicating the voltage of the slow OPO cavity piezo (in V).

laser1:nlo:opo:cavity:motor:

(parameter section)

Parameters for controlling the OPO intra-cavity motor.

laser1:nlo:opo:cavity:motor:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the motor driver.

laser1:nlo:opo:cavity:motor:position-set

(REAL parameter, read-write)

Parameter to set the motor position in millimeters.

laser1:nlo:opo:cavity:motor:position-act

(REAL parameter, read-only)

Parameter indicating the actual motor position in millimeters.

laser1:nlo:opo:cavity:motor:position-min

(REAL parameter, read-only)

Parameter to set the minimum motor position in millimeters.

laser1:nlo:opo:cavity:motor:position-max

(REAL parameter, read-only)

Parameter to set the minimum motor position in millimeters.

laser1:nlo:opo:cavity:motor:recalibrate

(command, no arguments, returns empty tuple)

Command to re-calibrate the absolute position of the motor. The motor will move in negative direction to the mechanical limit of its travel range and then set its zero position a certain distance away from this limit. At the end it will move back to its previous position.

laser1:nlo:opo:factory-settings:

(parameter section)

Factory settings for the most important parameters related to OPO systems.

laser1:nlo:opo:factory-settings:crystal-tc:

(parameter section)

Factory settings for the temperature controller (TC) of the OPO nonlinear crystal.

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:nlo:opo:factory-settings:cavity-tc:

(parameter section)

Factory settings for the temperature controller (TC) of the OPO nonlinear crystal.

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:nlo:opo:factory-settings:cavity-pc:

(parameter section)

Factory settings for the piezo controller (PC) of the slow OPO cavity piezo element.

For usage see **laser1:nlo:shg:factory-settings:pc:** on page 166.

laser1:nlo:opo:factory-settings:pd:

(parameter section)

Factory settings for the OPO photodiodes.

laser1:nlo:opo:factory-settings:pd:pump:

(parameter section)

Factory settings for the pump output power photo diode in an OPO system.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:opo:factory-settings:pd:pump-dep:

(parameter section)

Factory settings for the pump depleted output power photo diode in an OPO system.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:opo:factory-settings:pd:sig:

(parameter section)

Factory settings for the *signal* output power photo diode in an OPO system.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:opo:factory-settings:pd:fiber:

(parameter section)

Factory settings for the fiber monitor photo diode in an OPO system.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:nlo:opo:factory-settings:apply

(command, no arguments, returns empty tuple)

This command applies all factory settings for the OPO cavity.

laser1:nlo:ssw-ver

(STRING parameter, read-only)

Parameter indicating the version of the currently installed SHG system software.

laser1:uv:

(parameter section)

Parameters relevant for the operation of UV frequency-converted diode laser systems.

laser1:uv:pump:

(parameter section)

Parameters for the diode-pumped solid state (DPSS) laser.

For usage see **laser1:dpss:** on page 122.

laser1:uv:eom:

(parameter section)

Parameters concerning the electro-optic modulator in UV-SHG systems.

laser1:uv:eom:tc:

(parameter section)

The **laser1:uv:eom:tc** section provides parameters related to the temperature controller for the EOM in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:uv:cavity:

(parameter section)

Parameters describing the doubling cavity in UV-SHG systems.

laser1:uv:cavity:tc:

(parameter section)

The **laser1:uv:cavity:tc** section provides parameters related to the temperature controller for the doubling cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:uv:cavity:pc:

(parameter section)

Parameters for the Piezo Control (PC) board in the doubling cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:pc:** on page 64.

laser1:uv:crystal:

(parameter section)

Parameters describing the NLO-crystal in UV-SHG systems.

laser1:uv:crystal:tc:

(parameter section)

The **laser1:uv:cavity:tc** section provides parameters related to the temperature controller for the doubling cavity in frequency-converted diode laser systems.

For usage see **laser1:dl:tc:** on page 60.

laser1:uv:crystal:optics-shifters:

(parameter section)

Parameter describing for the crystal spots an UV-SHG system.

laser1:uv:crystal:optics-shifters:current-spot

(INTEGER parameter, read-only)

Parameter indicating the current spot position, beginning at 1.

laser1:uv:crystal:optics-shifters:remaining-spots

(INTEGER parameter, read-only)

Parameter indicating the number of remaining spot positions.

laser1:uv:servo:

(parameter section)

This section provides access to the servo motors in UV-SHG systems.

laser1:uv:servo:shg1-hor:

(parameter section)

Parameters of the first mirror/horizontal axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:shg1-vert:

(parameter section)

Parameters of the first mirror/vertical axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:shg2-hor:

(parameter section)

Parameters of the second mirror/horizontal axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:shg2-vert:

(parameter section)

Parameters of the second mirror/vertical axis servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:hwp:

(parameter section)

Parameters of the servo of the half-wave plate.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:lens:

(parameter section)

Parameters of the servo of the beamforming lens.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:outcpl:

(parameter section)

Parameters of the servo of the out-coupler in the UV cavity.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:cryst:

(parameter section)

Parameters of the servo of the crystal in the UV cavity.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:comp-hor:

(parameter section)

Parameters of the horizontal compensation servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:servo:comp-vert:

(parameter section)

Parameters of the vertical compensation servo of the SHG stage.

For usage see **laser1:nlo:servo:ta1-hor:** on page 140.

laser1:uv:pd:

(parameter section)

This section provides access to the photodiodes in UV-SHG systems.

laser1:uv:pd:shg:

(parameter section)

Parameters for value and calibration of the SHG photo diode in an UV-SHG system.

For usage see **laser1:nlo:pd:fiber:** on page 144.

laser1:uv:pd:pdh-rf:

(parameter section)

Parameters for value and gain of the SHG PDH photo diode in an UV-SHG system.

For usage see **laser1:nlo:pd:shg-pdh-rf:** on page 145.

laser1:uv:pd:pdh-dc:

(parameter section)

Parameters for value and calibration of the SHG cavity-rejection photo diode in an UV-SHG system.

For usage see **laser1:nlo:pd:shg-int:** on page 145.

laser1:uv:power-optimization:

(parameter section)

This section provides access to the power optimization routine in UV-SHG systems.

laser1:uv:power-optimization:ongoing

(BOOLEAN parameter, read-only)

Parameter indicating the status of the power optimization routine:
#t: An optimization routine is in progress.
#f: No optimization routine is in progress.

laser1:uv:power-optimization:status

(INTEGER parameter, read-only)

Parameter indicating the status of the optimization for internal purposes.

laser1:uv:power-optimization:status-string

(STRING parameter, read-only)

Parameter indicating the status of the power optimization routine in textual form.

laser1:uv:power-optimization:cavity:

(parameter section)

Parameters for the SHG power optimization routine of frequency-converted diode laser systems.

For usage see **laser1:nlo:power-optimization:stage1:** on page 147.

laser1:uv:power-optimization:progress-data

(BINARY parameter, read-only)

Parameter array indicating the SHG power after the various iteration steps of the SHG power optimization routine. The values are represented as a BASE64-encoded sequence of 4-byte long floating point numbers in *little endian* byte order.

laser1:uv:power-optimization:abort

(BOOLEAN parameter, read-only)

Parameter specifying whether to abort the power optimization routine.

laser1:uv:power-stabilization:

(parameter section)

This section provides access to the power stabilization routine in UV-SHG systems.

laser1:uv:power-stabilization:enabled

(BOOLEAN parameter, read-only)

Parameter to enable/disable the power stabilization.

laser1:uv:power-stabilization:gain:

(parameter section)

Gain parameters for the power stabilization.

laser1:uv:power-stabilization:gain:all

(REAL parameter, read-only)

Parameter to control the overall gain. This parameter has no physical unit.

laser1:uv:power-stabilization:gain:p

(REAL parameter, read-only)

Parameter to control the proportional gain.
The unit of **:gain:p** is mA/mW.

laser1:uv:power-stabilization:gain:i

(REAL parameter, read-only)

Parameter to control the integral gain.
The unit of **:gain:i** is $\frac{mA}{mW \cdot ms}$.

laser1:uv:power-stabilization:gain:d

(REAL parameter, read-only)

Parameter to control the differential gain.
The unit of **:gain:d** is $\frac{mA \cdot \mu s}{mW}$.

laser1:uv:power-stabilization:power-set

(REAL parameter, read-only)

Parameter to specify the target power in mW.

laser1:uv:power-stabilization:power-act

(REAL parameter, read-only)

Parameter indicating the current power level (in mW).

laser1:uv:power-stabilization:power-min

(REAL parameter, read-only)

Parameter to specify the minimal target power in mW.

laser1:uv:power-stabilization:power-max

(REAL parameter, read-only)

Parameter to specify the maximum target power in mW.

laser1:uv:power-stabilization:state

(INTEGER parameter, read-only)

Parameter indicating the state of the power stabilization PID controller.

0: off

1: in lock

2: on hold

3: suspended

laser1:uv:power-stabilization:update-strategy

(INTEGER parameter, read-only)

Parameter to specify the strategy used for updating the output power during power-stabilization:

0 - change the pump laser power output only.

1 - change the position of the half-wave plate only.

2 - change both the pump laser power output and the position of the half-wave plate as necessary.

laser1:uv:scan:

(parameter section)

This section provides access to the UV-SHG cavity scan signal generator.

For usage see **laser1:nlo:shg:scan:** on page 153.

laser1:uv:scope:

(parameter section)

This section provides access to the data traces for the UV-SHG signal display.

For usage see **laser1:nlo:shg:scope:** on page 154.

laser1:uv:lock:

(parameter section)

This section provides access to the UV-SHG cavity's lock engine. It has two PID regulators for controlling two independed output channels. Furthermore it provides modules for lock-in detection, automatic relock or reset, as well as for easy to use click-and-lock functionality.

For usage see **laser1:nlo:shg:lock:** on page 156.

laser1:uv:factory-settings:

(parameter section)

Factory settings for UV-SHG systems.

laser1:uv:factory-settings:eom-tc:

(parameter section)

Factory settings for the EOM temperature controller (TC).

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:uv:factory-settings:crystal-tc:

(parameter section)

Factory settings for the crystal temperature controller (TC).

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:uv:factory-settings:cavity-tc:

(parameter section)

Factory settings for the cavity temperature controller (TC).

For usage see **laser1:nlo:shg:factory-settings:tc:** on page 164.

laser1:uv:factory-settings:pc:

(parameter section)

Factory settings for the piezo controller (PC) of the slow SHG cavity piezo element.

For usage see **laser1:nlo:shg:factory-settings:pc:** on page 166.

laser1:uv:factory-settings:pd:

(parameter section)

Factory settings for the SHG photodiodes.

laser1:uv:factory-settings:pd:shg:

(parameter section)

Factory settings for the SHG photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:shg:** on page 167.

laser1:uv:factory-settings:pd:pdh-rf:

(parameter section)

Factory settings for the SHG PDH photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:pdh-rf:** on page 168.

laser1:uv:factory-settings:pd:pdh-dc:

(parameter section)

Factory settings for the SHG cavity-rejection photo diode.

For usage see **laser1:nlo:shg:factory-settings:pd:int:** on page 168.

laser1:uv:factory-settings:lock:

(parameter section)

Factory settings for the lock engine.

For usage see **laser1:nlo:shg:factory-settings:lock:** on page 169.

laser1:uv:factory-settings:apply

(command, no arguments, returns empty tuple)

Command to apply all factory settings.

laser1:uv:status-parameters:

(parameter section)

Parameters for configuring the UV-SHG state machine.

laser1:uv:status-parameters:baseplate-temperature-limit

(REAL parameter, read-only)

Parameter to specify the limit for temperature of the baseplate (in °C) on an UV-SHG system before reporting an error.

laser1:uv:status-parameters:temperature-settle-time

(INTEGER parameter, read-only)

Parameter to specify the time limit (in seconds) for which the temperature loop is allowed to be out of lock.

laser1:uv:status-parameters:pump-lock-settle-time

(INTEGER parameter, read-only)

Parameter to specify the time limit (in seconds) for which the pump laser is allowed to be out of lock.

laser1:uv:status-parameters:settle-down-delay

(INTEGER parameter, read-only)

Parameter to specify a delay (in seconds) to allow the system to settle down after an optimization.

laser1:uv:status-parameters:power-margin-tolerance-time

(INTEGER parameter, read-only)

Parameter to specify the time limit (in seconds) for which the power margin is allowed to be under the threshold.

laser1:uv:status-parameters:power-margin-threshold

(REAL parameter, read-only)

Parameter to specify the minimum recommended value of the power-margin for the pump laser.

laser1:uv:status-parameters:cavity-lock-settle-time

(INTEGER parameter, read-only)

Parameter to specify the time limit (in seconds) for the cavity lock-in mechanism to get into a locked state.

laser1:uv:status-parameters:cavity-lock-tolerance-factor

(INTEGER parameter, read-only)

Parameter to specify the time limit for which the cavity is allowed to be out of lock, as multiple of **lock:relock:delay**.

laser1:uv:status-parameters:power-lock-settle-time

(INTEGER parameter, read-only)

Parameter to specify the time limit (in seconds) for which the power-stabilization is allowed to be out of lock.

laser1:uv:status-parameters:cavity-scan-duration

(INTEGER parameter, read-only)

Parameter to specify the duration of the cavity scan (in seconds) before attempting a lock in case of power-warning.

laser1:uv:status-parameters:power-stabilization-strategy

(INTEGER parameter, read-only)

Parameter to specify the strategy used for updating the output power during power-stabilization:

0 - change the pump laser power output only.

1 - change the position of the half-wave plate only.

2 - change both the pump laser power output and the position of the half-wave plate as necessary.

laser1:uv:status-parameters:power-stabilization-level-low-factor

(REAL parameter, read-only)

Parameter to specify the power-stabilization level threshold, as a multiple of **laser1:uv:power-stabilization:power-min**.

laser1:uv:status-parameters:power-output-relative-error-max

(REAL parameter, read-only)

Parameter to specify the maximum tolerated error for the power output relative to its set value.

laser1:uv:status-parameters:power-output-relative-deviation-max

(REAL parameter, read-only)

Parameter to specify the maximum tolerated value for the standard deviation of the power output relative to its set value.

laser1:uv:status-parameters:operational-pump-power

(REAL parameter, read-only)

Parameter to specify the value for pump power used for the power-stabilization.

laser1:uv:status-parameters:degradation-detection-slope-threshold

(REAL parameter, read-only)

Parameter to specify the limit for a variation in pump power indicating optics degradation (in mW/h).

laser1:uv:status-parameters:degradation-detection-measurement-interval

(INTEGER parameter, read-only)

Parameter to specify the delay between measurements of the pump power to detect optics degradation (in seconds).

laser1:uv:status-parameters:degradation-detection-number-of-measurements

(INTEGER parameter, read-only)

Parameter to specify the number of measurements of the pump power to detect optics degradation.

laser1:uv:status-parameters:idle-alignment-option

(BOOLEAN parameter, read-only)

Parameter to specify whether the HWP should be set to minimum transmission during idle state. Set to #t if the HWP should *NOT* be set to minimum transmission.

laser1:uv:power-margin

(REAL parameter, read-only)

Parameter indicating the overall fractional power-margin for the pump laser/HWP system.

laser1:uv:hwp-transmittance

(REAL parameter, read-only)

Parameter indicating the transmittance of the half-wave plate.

laser1:uv:status

(INTEGER parameter, read-only)

Parameter indicating the status of the UV-SHG system corresponding to the following states:

0 - *power off*

10 - *preparing*

20 - *standby*
30 - *pre-emission*
35 - *idle*
40 - *ready*
50 - *power warning*
60 - *optimizing*
-1 - *error*
99 - *service mode*

laser1:uv:status-txt

(STRING parameter, read-only)
Parameter indicating the status of the UV-SHG system in textual form.

laser1:uv:specs-fulfilled

(BOOLEAN parameter, read-only)
Parameter indicating whether the laser specifications are currently met.

laser1:uv:error

(INTEGER parameter, read-only)
Parameter indicating the error status of the UV-SHG system.

laser1:uv:error-txt

(STRING parameter, read-only)
Parameter indicating the error status of the UV-SHG system.

laser1:uv:operation-time

(REAL parameter, read-only)
Parameter indicating the operation time of the UV-SHG system in hours.

laser1:uv:remaining-optics-spots

(INTEGER parameter, read-only)
Parameter indicating the number of remaining optics spot positions.

laser1:uv:baseplate-temperature

(REAL parameter, read-only)
Parameter indicating the current temperature of the baseplate on an UV-SHG system.

laser1:uv:ssw-ver

(STRING parameter, read-only)

Parameter indicating the version of the currently installed SHG system software.

laser1:uv:perform-optimization

(command, no arguments, returns empty tuple)

Command to optimize the power level of the UV-SHG system.

laser1:uv:perform-optics-shift

(command, no arguments, returns empty tuple)

Command to shift the optics of the UV-SHG system to the next spot position.

laser1:uv:clear-errors

(command, no arguments, returns empty tuple)

Command to reset all error flags.

laser1:pd-ext:

(parameter section)

Parameters for using an external photodiode at one of the BNC inputs as user-calibrated power meter.

laser1:pd-ext:input-channel

(INTEGER parameter, read-write)

Parameter to specify the input channel, the photodiode is connected to. Allowed values are 0, 1, 2, 4.

laser1:pd-ext:photodiode

(REAL parameter, read-only)

Parameter showing the voltage measured at the input specified by **:input-channel**.

laser1:pd-ext:power

(REAL parameter, read-only)

Parameter for reading the laser power. The signal measured at the input specified by **:input-channel** in Volts is converted into power by use of the calibration parameters **:cal-offset** and **:cal-factor**.

laser1:pd-ext:cal-offset

(REAL parameter, read-write)

Parameter to specify the calibration offset for the photodiode in V.

laser1:pd-ext:cal-factor

(REAL parameter, read-write)

Parameter to specify the calibration factor for the photodiode in mW/V.

laser1:power-stabilization:

(parameter section)

Power Stabilization

laser1:power-stabilization:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the power stabilization.

laser1:power-stabilization:gain:

(parameter section)

Gain parameters for the power stabilization.

For usage see **laser1:uv:power-stabilization:gain:** on page 186.

laser1:power-stabilization:sign

(BOOLEAN parameter, read-write)

Sign of the power stabilization action. Typically this parameter should be #f.
#f - to increase the power level the output current needs to be increased
#t - to increase the power level the output current needs to be decreased.

laser1:power-stabilization:input-channel

(INTEGER parameter, read-write)

Parameter to select the signal channel to be stabilized.
Depending on the laser head connected, different choices are possible here. The possible values are a subset of the signals listed in the "Signal Channel IDs" section in appendix 4.1 on page 286.

laser1:power-stabilization:setpoint

(REAL parameter, read-write)

Parameter to specify the target power in mW.

laser1:power-stabilization:window:

(parameter section)

Parameters for power supervision.

laser1:power-stabilization:window:enabled

(BOOLEAN parameter, read-write)

Set this parameter to #t to enable the power supervision engine.

laser1:power-stabilization:window:level-low

(REAL parameter, read-write)

Parameter to specify a lower limit (in mW) for power stabilization.
If the power level drops below this limit, the power stabilization loop with be set to hold state, waiting for the power level to return to higher levels.

laser1:power-stabilization:window:level-hysteresis

(REAL parameter, read-write)

Parameter to specify the hysteresis (in mW) for the supervision engine.
If the power stabilization was set to hold state because the power level dropped below **:level-low**, the requirement for the stabilization loop to continue is that the power level returns to values higher than **:level-low + :level-hysteresis**.

laser1:power-stabilization:hold-output-on-unlock

(BOOLEAN parameter, read-write)

Parameter to determine the behaviour when power stabilization is disabled.
#t - upon disabling the power stabilization the, the PID output is transferred to the current set-value, keeping the current power level.
#f - upon disabling the power stabilization the, the PID output is reset to zero. The current will return to the value it had before enabling power stabilization.

laser1:power-stabilization:output-channel

(INTEGER parameter, read-write)

Parameter indicating the PID output channel for the power-stabilization. For amplified laser heads (TA pro and alike) this will be the amplifier current (63). For all other lasers it will be the laser diode current (51). (See the "Signal Channel IDs" section in appendix 4.1 on page 286.)

laser1:power-stabilization:input-channel-value-act

(REAL parameter, read-only)

Parameter indicating the current power level (in mW) as measured by the input specified with **:input-channel**.

laser1:power-stabilization:state

(INTEGER parameter, read-only)

Parameter indicating the state of the power stabilization PID controller.

0: off

1: in lock

2: on hold

3: suspended

4: limited

5: unstable

laser1:power-stabilization:feedforward-enabled

(BOOLEAN parameter, read-write)

Only for CTL laser heads: Parameter for enabling/disabling the feedforward for the cavity piezo. The feedforward is used to compensating current change induced wavelength changes by adapting the cavity.

laser1:power-stabilization:feedforward-factor

(REAL parameter, read-write)

Only for CTL laser heads: Parameter to specify the feedforward factor between piezo voltage and laser current (in V/mA).

laser1:hf-cavity:

(parameter section)

Parameter relevant for using the external high-finess-cavity.

laser1:hf-cavity:tc1:

(parameter section)

The **laser1:hf-cavity:tc1** section provides parameters related to the first temperature controller for laser first external high-finess-cavity.

For usage see **laser1:dl:tc:** on page 60.

laser1:hf-cavity:tc2:

(parameter section)

The **laser1:hf-cavity:tc2** section provides parameters related to the second temperature controller for laser second external high-finess-cavity.

For usage see **laser1:dl:tc:** on page 60.

laser1:hf-cavity:factory-settings:

(parameter section)

Factory settings for the most important high-finess-cavity parameters.
These settings are only available for non-legacy heads with an EEPROM.

laser1:hf-cavity:factory-settings:tc1:

(parameter section)

Factory settings for the first temperature controller (TC).

For usage see **laser1:dl:factory-settings:tc:** on page 96.

laser1:hf-cavity:factory-settings:tc2:

(parameter section)

Factory settings for the second temperature controller (TC).

For usage see **laser1:dl:factory-settings:tc:** on page 96.

laser1:config:

(parameter section)

Parameters and commands to load, save, modify and inspect a configurations file.

Up to four configurations can be stored on the controller, addressed by the labels "dlc:config1" through "dlc:config4". More configurations can be stored on an attached USB stick. They are stored in a folder named "toptica", get the file extensions ".laserconf" and are addressed by the labels "usb:*filename*". Furthermore, configurations can be imported from and exported to a remote PC via command line.

Working with a configuration always consists of two steps: First, the content of the configuration must be set with one of the commands **:retrieve**, **:load** or **:import**. Then, second, the content can be either applied to the laser parameters or stored into a file or transferred to a remote PC with the commands **:apply**, **:save** or **:export**, respectively.

Examples:

Activate configuration #4, stored on the device
First execute `(exec 'laser1:config:load "dlc:config4")` to load the content of the configuration file into memory. Then execute `(exec 'laser1:config:apply)` to set all laser parameters according to the configuration values.

Copy configuration #1 from the device to a file on a remote PC
First execute `(exec 'laser1:config:load "dlc:config1")` to load the content of the configuration file into memory. Then execute `(exec 'laser1:config:export)` to read out the configuration content in BASE64 format. Decode the data and store the result in a file on the PC.

Save current parameter values to configuration file "laser-settings.laserconf" on the USB stick
First execute `(exec 'laser1:config:retrieve)` to get a snapshot of the current parameter values. If desired use `(param-set! 'laser1:config:caption "...")` to add a descriptive text to the configuration. Then execute `(exec 'laser1:config:save "usb:laser-settings.laserconf")` to store the values onto the USB stick.

Replace configuration #3 on the device by a file from a remote PC
First encode your file content to BASE64 format. Then start the command `(exec 'laser1:config:import)`. When prompted for data transfer, send the BASE64 data, followed by a '#' character. Now the file content is in memory. Execute `(exec 'laser1:config:save "dlc:config3")` to write the content into configuration #3.

laser1:config:source

(STRING parameter, read-only)

Parameter indicating the source of the configuration.
The label has the form "dlc:configX" for configurations stored on the controller, "usb:filename" for configurations stored on an USB-stick, "imported" for contents imported from remote or "retrieved" for values retrieved from the current parameters.

laser1:config:product-name

(STRING parameter, read-only)

Parameter indicating type and serial number of the laser head, the configuration was generated for.
This value is automatically set when the **:retrieve** command is used.
Note: The configuration can only be applied to a laser head with the exactly same product name.

laser1:config:date

(STRING parameter, read-only)

Parameter indicating date and time when the configuration was generated.
This value is automatically set when the **:retrieve** command is used.

laser1:config:caption

(STRING parameter, read-write)

Parameter to specify a short description of the purpose of the configuration.

laser1:config:pristine

(BOOLEAN parameter, read-only)

Parameter indicating whether the configuration is in an 'original' state, i.e. whether it was not manually modified outside the device.

laser1:config:load

(command, 1 argument, returns empty tuple)

Arguments:

1. *source* of type STRING

Command to load the content of the configuration file specified by the *source* argument. The *source* argument accepts values "dlc:config1" to "dlc:config4" for configurations stored inside the controller or "usb:filename" for a configuration stored on a USB-Stick.

laser1:config:save

(command, 1 argument, returns empty tuple)

Arguments:

1. *destination* of type STRING

Command to save the configuration content to a configuration file specified by the *destination* argument.
The *destination* argument accepts the same values as the *source* argument of the **:load** command. If the USB stick is used as destination, the file will be stored in a folder named "toptica". If the folder does not exist it will be created.

laser1:config:import

(command, no arguments, returns empty tuple)

Command to import a configuration content via command line.
Start the command with `(exec 'laser1:config:import)`.
The device then prompts for the content file:
`waiting for input (send # for end-of-file) ...`
Send the entire configuration content BASE64 encoded. The end-of-file signal (# character) tells the firmware to process the data which then gets acknowledge by `transfer complete.`.

laser1:config:export

(command, no arguments, returns empty tuple)

Command to export the content of the configuration via command line.
The content gets printed to the command line in BASE64 format.

laser1:config:retrieve

(command, no arguments, returns empty tuple)

Command to retrieve the configuration content from the current parameter values.
The parameter **:date** will automatically be set to the current system-time and the parameter **:product-name** will be set to the product name of the laser head. The parameter **:caption** will be set to an empty string.

laser1:config:apply

(command, no arguments, returns BOOLEAN)

Command to apply the content of the configuration to the parameters. Note: Only parameters accessible in the current userlevel will be applied. If all parameters from the configuration are used, the command returns #t. If, due to userlevel restrictions, parameter values need to be omitted, the return value is #f. If the product name of the laser head **laser1:product-name** differs from that in the **laser1:config:product-name** parameter, the command refuses to apply the parameters and exits with an error message.

laser1:config:show

(command, no arguments, returns empty tuple)

Command to print the content of the configuration to the console.

laser1:config:list

(command, no arguments, returns STRING)

Command to list the configuration files available on the device and the attached USB stick.
The return value consists of a multi-line string, listing informations for one file per line. Each line contains the configuration name in the format needed for the **:load** and **:save** commands, the product-name, the date when the configuration was saved and the optional caption, separated by semicolons. Files on the USB stick are listed if their file extension is ".laserconf" and if they reside in a folder named "toptica".

laser1:save

(command, no arguments, returns empty tuple)

Command to save laser parameters to the DLC pro flash memory.
This includes all relevant parameters related of **:dl:cc**, **:dl:pc**, **:dl:tc**, **:dl:scan**, **:scope**, **:dl:lock**, **:amp:cc**, and **:amp:tc**.

laser1:load

(command, no arguments, returns empty tuple)

Command to load laser parameters from the DLC pro flash memory.

laser1:load-head

(command, no arguments, returns empty tuple)

Command to load laser head parameters from the DLC pro flash memory.

laser2:

(parameter section)

This section provides controls for the second laser head attached to the DLC pro controller.

For usage see **laser1:** on page 50.

laser3:

(parameter section)

This section provides controls for the third laser head attached to the DLC pro controller.

For usage see **laser1:** on page 50.

laser4:

(parameter section)

This section provides controls for the fourth laser head attached to the DLC pro controller.

For usage see **laser1:** on page 50.

laser-common:

(parameter section)

Parmeters and commands related to more than one laser.

laser-common:scan:

(parameter section)

Parameters and command to synchronize the scan generators of multiple lasers.

laser-common:scan:sync-laser1

(BOOLEAN parameter, read-write)

Parameter to specify if the **laser1:scan** should be considered when the command **:sync** is executed.

laser-common:scan:sync-laser2

(BOOLEAN parameter, read-write)

Parameter to specify if **laser2:scan** should be considered when the command **:sync** is executed.

laser-common:scan:sync-laser3

(BOOLEAN parameter, read-write)

Parameter to specify if **laser3:scan** should be considered when the command **:sync** is executed.

laser-common:scan:sync-laser4

(BOOLEAN parameter, read-write)

Parameter to specify if **laser4:scan** should be considered when the command **:sync** is executed.

laser-common:scan:frequency

(REAL parameter, read-write)

Parameter to specify the common frequency the scan generators should use when they get synchronized with the **:sync** command.

laser-common:scan:sync

(command, no arguments, returns empty tuple)

Command to synchronize the scan generators of all connected lasers.
When the command is executed, the scan generators of all configured lasers get set to the same frequency **:frequency**. They then get restarted simultaneously and will continue to oscillate synchronously with zero relative phase-shift.
Note: During the process of synchronization the digital output 3 will be toggled.

laser-common:scan:save

(command, no arguments, returns empty tuple)

Command to save scan-synchronization settings.

laser-common:scan:load

(command, no arguments, returns empty tuple)

Command to load scan-synchronization settings.

laser-common:ampcc-load:

(parameter section)

Parameters indicating information about electrical power consumption of amplifier current channels.
In systems with several amplifier current channels, the total electrical load of all channels must not exceed a limit of 40W. Therefore each amplifier current channel can only be enabled, if its contribution to the total load will not make the total load exceed this limit. The potential load contribution of a single channel is calculated by **:voltage-clip** * **:current-clip**.

laser-common:ampcc-load:potential-load-total

(REAL parameter, read-only)

Parameter indicating the maximum total electrical load (in W) of all amplifier current channels, if they would all be enabled with their maximum currents.

laser-common:ampcc-load:potential-load-enabled

(REAL parameter, read-only)

Parameter indicating the total potential electrical load (in W) of all amplifier current channels, currently being enabled, if they would be operated with their maximum current.

laser-common:ampcc-load:load-max

(REAL parameter, read-only)

Parameter indicating the maximum allowed total electrical load (in W) of all amplifier current channels.

laser-common:ampcc-load:load-ok

(BOOLEAN parameter, read-only)

Parameter indicating whether all amplifier current channels can be enabled at the same time, without exceeding the limit for maximum electrical load.

laser-common:save-all

(command, no arguments, returns empty tuple)

Command to save all user-settings, including global settings and settings of all connected lasers.

laser-common:load-all

(command, no arguments, returns empty tuple)

Command to load all user-settings, including global settings and settings of all connected lasers.

laser-common:store-all

(command, no arguments, returns empty tuple)

Command to store all laser-settings, including global settings and settings of all connected lasers.

laser-common:restore-all

(command, no arguments, returns empty tuple)

Command to restore all laser-settings, including global settings and settings of all connected lasers.

laser-common:apply-all

(command, no arguments, returns empty tuple)

Command to apply all factory-settings, including global settings and settings of all connected lasers.

laser-common:retrieve-all

(command, no arguments, returns empty tuple)

Command to retrieve all factory-settings, including global settings and settings of all connected lasers.

uv:

(parameter section)

This section provides controls for a UV-SHG laser head attached to the DLC pro controller.

uv:laser-on

(BOOLEAN parameter, read-write)

Parameter to enable the UV-SHG laser head.

uv:emission

(BOOLEAN parameter, read-only)

Parameter indicating the emission status for the UV-SHG laser head.
#t - laser emits light
#f - laser emission is switched off

uv:status

(INTEGER parameter, read-only)

Parameter indicating the status of the UV-SHG system corresponding to the following states:

0 - *power off*
10 - *preparing*
20 - *standby*
30 - *pre-emission*
35 - *idle*
40 - *ready*
50 - *power warning*
60 - *optimizing*
-1 - *error*
99 - *service mode*

uv:status-txt

(STRING parameter, read-only)

Parameter indicating the status of the UV-SHG system in textual form.

uv:specs-fulfilled

(BOOLEAN parameter, read-only)

Parameter indicating whether the laser specifications are currently met.

uv:error

(INTEGER parameter, read-only)

Parameter indicating the error status of the UV-SHG system.

uv:error-txt

(STRING parameter, read-only)

Parameter indicating the error status of the UV-SHG system in textual form.

uv:operation-time-pump

(REAL parameter, read-only)

Parameter indicating the operation time of the pump laser in hours.

uv:operation-time-uv

(REAL parameter, read-only)

Parameter indicating the operation time of the UV-SHG system in hours.

uv:pump-power-margin

(REAL parameter, read-only)

Parameter indicating the fractional power-margin for the pump laser.

uv:remaining-optics-spots

(INTEGER parameter, read-only)

Parameter indicating the number of remaining optics spot positions.

uv:power-set

(REAL parameter, read-write)

Parameter to specify the target power in mW.

uv:power-act

(REAL parameter, read-only)

Parameter indicating the current power level (in mW).

uv:baseplate-temperature

(REAL parameter, read-only)

Parameter indicating the current temperature of the baseplate on an UV-SHG system.

uv:idle-mode

(BOOLEAN parameter, read-write)

Parameter to enable the idle mode in the UV-SHG system.

uv:idle-alignment-option

(BOOLEAN parameter, read-write)

Parameter to specify whether laser power should be minimized in idle-mode (#f) or should should keep a certain level to allow for optical alignment procedures (#t).

uv:perform-optimization

(command, no arguments, returns empty tuple)

Command to optimize the power level of the UV-SHG system.

uv:perform-optics-shift

(command, no arguments, returns empty tuple)

Command to shift the optics of the UV-SHG system to the next spot position.

uv:clear-errors

(command, no arguments, returns empty tuple)

Command to optimize the power level of the UV-SHG system.

auto-nlo:

(parameter section)

Parameters for controlling the AutoNLO feature of frequency-converted diode laser systems.

auto-nlo:automatic-mode

(BOOLEAN parameter, read-only)

Parameter to enable the Auto-Pilot feature.

auto-nlo:serial-number

(STRING parameter, read-only)

Parameter indicating the serial-number of the laser head.

auto-nlo:fw-ver

(STRING parameter, read-only)

Parameter indicating the firmware version of the laser head.

auto-nlo:fw-ver-valid

(BOOLEAN parameter, read-only)

Parameter indicating the validity of the firmware version of the laser head.

auto-nlo:customer

(STRING parameter, read-only)

Parameter indicating the customer of the laser head.

auto-nlo:laser-on

(BOOLEAN parameter, read-write)

Parameter to enable the NLO laser head.

auto-nlo:emission

(BOOLEAN parameter, read-only)

Parameter indicating the emission status for the NLO laser head.
#t - laser emits light
#f - laser emission is switched off

auto-nlo:status

(INTEGER parameter, read-only)

Parameter indicating the status of the NLO system corresponding to the following states:

0 - *power off*
10 - *preparing*
20 - *standby*
30 - *pre-emission*
35 - *idle*
40 - *ready*
50 - *power warning*
60 - *optimizing*
-1 - *error*
99 - *service mode*
999 - *disabled*

auto-nlo:status-txt

(STRING parameter, read-only)

Parameter indicating the status of the NLO system in textual form.

auto-nlo:error

(INTEGER parameter, read-only)

Parameter indicating the error status of the NLO system.

auto-nlo:error-txt

(STRING parameter, read-only)

Parameter indicating the error status of the NLO system in textual form.

auto-nlo:locked-cavity

(BOOLEAN parameter, read-only)

Parameter indicating the SHG cavity status.
#t - cavity locked
#f - cavity unlocked

auto-nlo:locked-cavity-fhg

(BOOLEAN parameter, read-only)

Parameter indicating the FHG cavity status.
#t - cavity locked
#f - cavity unlocked

auto-nlo:operation-time-master

(REAL parameter, read-only)

Parameter indicating the operation time of the master laser in hours.

auto-nlo:operation-time-amplifier

(REAL parameter, read-only)

Parameter indicating the operation time of the amplifier in hours.

auto-nlo:operation-time-cavity

(REAL parameter, read-only)

Parameter indicating the operation time of the SHG resonator in hours.

auto-nlo:operation-time-cavity-fhg

(REAL parameter, read-only)

Parameter indicating the operation time of the FHG resonator in hours.

auto-nlo:current-set-master

(REAL parameter, read-only)

Parameter indicating the setpoint value for the master laser diode current in mA.

auto-nlo:current-act-master

(REAL parameter, read-only)

Parameter indicating the actual master laser diode current in mA.

auto-nlo:current-set-amplifier

(REAL parameter, read-only)

Parameter indicating the setpoint value for the amplifier diode current in mA.

auto-nlo:current-act-amplifier

(REAL parameter, read-only)

Parameter indicating the actual amplifier diode current in mA.

auto-nlo:power-act-master

(REAL parameter, read-only)

Parameter indicating the master laser output power in mW.

auto-nlo:power-act-amplifier

(REAL parameter, read-only)

Parameter indicating the actual amplifier output power in mW.

auto-nlo:power-act-shg

(REAL parameter, read-only)

Parameter indicating the current power level (in mW) of SHG cavity.

auto-nlo:power-act-fhg

(REAL parameter, read-only)

Parameter indicating the current power level (in mW) of FHG cavity.

auto-nlo:temp-set-master

(REAL parameter, read-only)

Parameter indicating the setpoint value for the master laser diode temperature in °C.

auto-nlo:temp-act-master

(REAL parameter, read-only)

Parameter indicating the actual master laser diode temperature in °C.

auto-nlo:temp-set-amplifier

(REAL parameter, read-only)

Parameter indicating the setpoint value for the amplifier diode temperature in °C.

auto-nlo:temp-act-amplifier

(REAL parameter, read-only)

Parameter indicating the actual amplifier diode temperature in °C.

auto-nlo:temp-set-crystal

(REAL parameter, read-only)

Parameter indicating the setpoint value for the SHG crystal temperature in °C.

auto-nlo:temp-act-crystal

(REAL parameter, read-only)

Parameter indicating the actual SHG crystal temperature in °C.

auto-nlo:temp-set-cavity

(REAL parameter, read-only)

Parameter indicating the setpoint value for the SHG cavity temperature in °C.

auto-nlo:temp-act-cavity

(REAL parameter, read-only)

Parameter indicating the actual SHG cavity temperature in °C.

auto-nlo:temp-set-crystal-fhg

(REAL parameter, read-only)

Parameter indicating the setpoint value for the FHG crystal temperature in °C.

auto-nlo:temp-act-crystal-fhg

(REAL parameter, read-only)

Parameter indicating the actual FHG crystal temperature in °C.

auto-nlo:temp-set-cavity-fhg

(REAL parameter, read-only)

Parameter indicating the setpoint value for the FHG cavity temperature in °C.

auto-nlo:temp-act-cavity-fhg

(REAL parameter, read-only)

Parameter indicating the actual FHG cavity temperature in °C.

auto-nlo:temp-act-baseplate

(REAL parameter, read-only)

Parameter indicating the actual baseplate temperature in °C. (Available on TopWave 405 laser-heads only).

auto-nlo:voltage-set-master

(REAL parameter, read-only)

Parameter indicating the setpoint value for the master cavity piezo voltage in V.

auto-nlo:voltage-act-master

(REAL parameter, read-only)

Parameter indicating the actual master cavity piezo voltage in V.

auto-nlo:voltage-act-shg

(REAL parameter, read-only)

Parameter indicating the actual SHG cavity piezo voltage in V.

auto-nlo:air-pressure

(REAL parameter, read-only)

Parameter indicating the air pressure measured inside the DLC pro in hPa.

auto-nlo:amplifier-current-margin

(REAL parameter, read-only)

Parameter indicating the fractional current-margin for the amplifier.

auto-nlo:amplifier-current-margin-alo

(REAL parameter, read-only)

Parameter indicating the fractional current-margin after last optimize for the amplifier.

auto-nlo:conversion-efficiency

(REAL parameter, read-only)

Parameter indicating the conversion efficiency of the SHG resonator.

auto-nlo:conversion-efficiency-fhg

(REAL parameter, read-only)

Parameter indicating the conversion efficiency of the FHG resonator.

auto-nlo:master-noise

(REAL parameter, read-only)

Parameter indicating the relative RMS-noise in the master power output.

auto-nlo:power-set

(REAL parameter, read-write)

Parameter to specify the target power in mW.

auto-nlo:power-act

(REAL parameter, read-only)

Parameter indicating the current power level (in mW).

auto-nlo:wavelength

(REAL parameter, read-only)

Parameter indicating the wavelength (in vacuum) in nanometer.

auto-nlo:idle-mode

(BOOLEAN parameter, read-write)

Parameter to enable the idle mode in the NLO system.

auto-nlo:optimization-progress

(INTEGER parameter, read-only)

Parameter indicating the progress of the power optimization routine as a percentage:

0 : Optimization routine is starting.

100 : Optimization routine has finished.

auto-nlo:last-time-auto-align

(STRING parameter, read-only)

Parameter indicating when the latest power optimization took place.

auto-nlo:last-time-single-mode-optimization

(STRING parameter, read-only)

Parameter indicating when the latest single mode optimization took place.

auto-nlo:single-mode-optimization-valid

(INTEGER parameter, read-only)

Parameter indicating whether the last single-mode optimization is still valid.

0: Last optimization is invalid.

1: Last optimization is valid.

The optimization becomes valid after a successful optimization run and invalid, whenever the master laser emission gets switched off or the master laser temperature gets unstable.

auto-nlo:perform-optimization

(command, no arguments, returns empty tuple)

Command to optimize the power level of the NLO system.

auto-nlo:perform-warm-up

(command, no arguments, returns empty tuple)

Command to perform warm-up routine of the NLO system.

auto-nlo:abort-warm-up

(command, no arguments, returns empty tuple)

Command to abort ongoing warm-up routine of the NLO system.

auto-nlo:clear-errors

(command, no arguments, returns empty tuple)

Command to reset all the AutoNLO related error flags.

cc1:

(parameter section)

This section provides controls for the first Current Controller (CC) board. CC controls the laser current and provides checks for the laser system's health.

cc1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the CC-board is mounted in.

cc1:serial-number

(STRING parameter, read-only)

Parameter indicating the CC-board's serial number.

cc1:revision

(STRING parameter, read-only)

Parameter indicating the CC-board's hardware revision number.

cc1:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

cc1:board-temp

(REAL parameter, read-only)

Parameter indicating the CC-board temperature (in °C).

cc1:variant

(STRING parameter, read-only)

Parameter describing the hardware configuration of the CC-channel. For example, "2x 250 mA" or "1x 500 mA"

cc1:parallel-mode

(BOOLEAN parameter, read-only)

Parameter indicating whether both CC channels are combined into a single high-power channel.
#t - both 250mA CC channels are combined into a single 500mA channel.
#f - the two 250mA CC channels are not combined and can be used separately.

cc2:

(parameter section)

This section provides controls for the optional 2nd Current Controller (CC) board.

For usage see **cc1:** on page 214.

cc3:

(parameter section)

This section provides controls for the optional 3rd Current Controller (CC) board.

For usage see **cc1:** on page 214.

cc4:

(parameter section)

This section provides controls for the optional 4th Current Controller (CC) board.

For usage see **cc1:** on page 214.

ampcc1:

(parameter section)

This section provides controls for the Amplifier Current Controller (CC) board. CC controls the amplifier current and provides checks for the laser system's health.

ampcc1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the CC-5000 board is mounted in.

ampcc1:serial-number

(STRING parameter, read-only)

Parameter indicating the CC-5000 board's serial number.

ampcc1:revision

(STRING parameter, read-only)

Parameter indicating the CC-5000 board's hardware revision number.

ampcc1:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

ampcc1:board-temp

(REAL parameter, read-only)

Parameter indicating the CC-board temperature (in °C).

ampcc1:variant

(STRING parameter, read-only)

Parameter describing the hardware configuration of the CC-5000 channel. For example, "1x 5000mA"

ampcc1:parallel-mode

(BOOLEAN parameter, read-only)

Parameter describing the hardware configuration of the CC-5000 channel.
#t - this board's channel is combined with a second CC-5000 board's channels into a single 10000mA channel.
#f - this board is provigin a single 5000mA channel

ampcc1:power-15v

(BOOLEAN parameter, read-only)

Parameter to specify power supply to use for the CC5000 board.
#t - use 15V line
#f - use 5V line.

ampcc1:channel1:

(parameter section)

This section provides controls for the current channel of the current controller (CC-5000) board. The controls include setting the amplifier chip current, configuring the clips of the chip protection circuitry, reading status information, etc.

ampcc1:channel1:path

(STRING parameter, read-only)

Parameter describing the hardware location of the current control channel.
Example: "ampcc1:channel1" indicates the current channel of the first CC-5000 current controller.

ampcc1:channel1:variant

(STRING parameter, read-only)

Parameter describing the hardware variant of the current control channel channel. For example, it returns "5000 mA" or "10000 mA" for CC5000 or CC10000 channel, respectively.

ampcc1:channel1:enabled

(BOOLEAN parameter, read-write)

Parameter to switch the amplifier current on/off:
#t - laser emission on
#f - laser emission off

ampcc1:channel1:emission

(BOOLEAN parameter, read-only)

Parameter indicating the amplifier emission status.
#t - all criteria for laser emission are fulfilled. Laser radiation should be emitted from this channel's amplifier.
#f - if laser emission is not possible for one of the following reasons:
- interlock circuit is open.
- the front panel key swicth is "off".
- the laser emission push button on the frontpanel is not pressed.
- laser emission is disabled by the software.

ampcc1:channel1:current-set

(REAL parameter, read-write)

Parameter to set the desired amplifier current in mA.
If **laser1:amp:cc:feedforward-enabled** is #t, **laser1:amp:cc:current-set** is determined as follows:

laser1:amp:cc:current-set = **laser1:amp:cc:current-offset** + **laser1:amp:cc:feedforward-factor** * (**laser1:dl:pc:voltage-set** - *voltage-pivot*)

where *voltage-pivot* is the value of **laser1:dl:pc:voltage-set** at the time the feedforward gets enabled.
The **laser1:amp:cc:current-set** parameter setting affects the **laser1:amp:cc:current-offset** value.

ampcc1:channel1:current-offset

(REAL parameter, read-write)

Parameter to specify the amplifier current without Feed Forward contribution (in mA). This parameter setting affects the **laser1:amp:cc:current-set** value.

ampcc1:channel1:external-input:

(parameter section)

Parameters to configure the current control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

ampcc1:channel1:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

For usage see **laser1:dl:cc:output-filter:** on page 57.

ampcc1:channel1:current-act

(REAL parameter, read-only)

Parameter indicating the measured value of the amplifier chip current in mA. Usually, this is the current flowing through the amplifier chip. However, if the safety circuitry shorts the current output, this is not true.

ampcc1:channel1:current-out

(REAL parameter, read-only)

Parameter indicating the current value in mA, as applied to the digital-to-analog converter. The value should be close to the **current-act** value, but with higher resolution and without measurement noise.

ampcc1:channel1:current-clip

(REAL parameter, read-write)

Parameter to specify the maximum allowed current (in mA) for this channel's amplifier chip.

ampcc1:channel1:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the maximum allowed tuning current (in mA) for this channel's amplifier chip.

ampcc1:channel1:use-current-clip-tuning

(BOOLEAN parameter, read-write)

Parameter to specify if the maximum tuning current **:current-clip-tuning** should be taken into account for limiting the amplifier current. If set to #t the current gets limited to the maximum tuning current **:current-clip-tuning** or the maximum current **:current-clip**, depending on which one is smaller.

ampcc1:channel1:current-clip-free-run

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA) in case of seedless operation.
The maximum parameter value is limited with **:current-clip**.

ampcc1:channel1:using-current-clip-free-run

(BOOLEAN parameter, read-only)

Parameter indicating if current of amplifier was changed due to amplifier's seedless operation.

ampcc1:channel1:current-clip-limit

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA).
IMPORTANT: To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t).
.

ampcc1:channel1:voltage-act

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage applied to the amplifier chip (in V).

ampcc1:channel1:voltage-out

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage at the voltage fuse (in V).

ampcc1:channel1:voltage-clip

(REAL parameter, read-only)

Parameter to specify the maximum allowed voltage (in V) for this channel's amplifier chip.
Can be changed only for legacy laser heads (without factory settings stored in EEPROM).

ampcc1:channel1:potential-load

(REAL parameter, read-only)

Parameter indicating the approximate electrical load in W, this current channel can potentially exert on the power supply if the maximum diode current is used. The sum of all amplifier channel loads must not exceed 40W.

ampcc1:channel1:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this current control channel.
#t - Feed Forward enabled
#f - Feed Forward disabled
If enabled, a current proportional to another channel's output is added to this channel. The other channel is defined by the **laser1:feedforward-master** parameter.

ampcc1:channel1:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the piezo channel's output is to be added to the current channel (in mA/V).

ampcc1:channel1:aux

(REAL parameter, read-only)

Parameter indicating the measured voltage in V at the AUX input.

ampcc1:channel1:status

(INTEGER parameter, read-only)

Parameter providing channel status information. Each bit of the integer value provides specific channel status information. For CC-5000 type channels, the bits provide the following information:

bit 0 - emission

bit 1 - enabled

bit 2 - inverter in constant-current mode

bit 3 - inverter dummyload enabled

bit 4 - crowbar enabled (protective short circuit)

bit 5 - DAC enabled

bit 6 - current clip

bit 7 - voltage clip

bit 12 - DAC not initialized

bit 11 - shortcircuit detected

bit 12 - channel forced to be off bei health monitoring

bit 14 - laser diode current at lower limit

bit 15 - laser diode current at upper limit

bit 16 - laser diode current limited by slew rate

ampcc1:channel1:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

ampcc2:

(parameter section)

This section provides controls for an optional 2nd Amplifier Current Controller (CC) board.

For usage see **ampcc1:** on page 215.

hcc1:

(parameter section)

This section provides controls for the High Current Controller (HCC) board. HCC controls the amplifier current and provides checks for the laser system's health.

hcc1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the HCC board is mounted in.

hcc1:serial-number

(STRING parameter, read-only)

Parameter indicating the HCC board's serial number.

hcc1:revision

(STRING parameter, read-only)

Parameter indicating the HCC board's hardware revision number.

hcc1:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

hcc1:board-temp

(REAL parameter, read-only)

Parameter indicating the HCC-board temperature (in °C).

hcc1:variant

(STRING parameter, read-only)

Parameter describing the hardware configuration of the HCC channel. Returns "HCC".

hcc1:channel1:

(parameter section)

This section provides controls for the current channel of the high current controller (HCC) board. The controls include setting the amplifier chip current, configuring the clips of the chip protection circuitry, reading status information, etc.

hcc1:channel1:path

(STRING parameter, read-only)

Parameter describing the hardware location of the current control channel.
Example: "hcc1:channel1" indicates the current channel of the first HCC current controller.

hcc1:channel1:variant

(STRING parameter, read-only)

Parameter describing the hardware variant of the current control channel channel. Returns "HCC" for all HCC channels.

hcc1:channel1:enabled

(BOOLEAN parameter, read-write)

Parameter to switch the amplifier current on/off:
#t - laser emission on
#f - laser emission off

hcc1:channel1:emission

(BOOLEAN parameter, read-only)

Parameter indicating the amplifier emission status.
#t - all criteria for laser emission are fulfilled. Laser radiation should be emitted from this channel's amplifier.
#f - if laser emission is not possible for one of the following reasons:

- interlock circuit is open.
- the front panel key swicth is "off".
- the laser emission push button on the frontpanel is not pressed.
- laser emission is disabled by the software.

hcc1:channel1:current-set

(REAL parameter, read-write)

Parameter to set the desired amplifier current in mA.
If **laser1:amp:cc:feedforward-enabled** is #t, **laser1:amp:cc:current-set** is determined as follows:

laser1:amp:cc:current-set = **laser1:amp:cc:current-offset** + **laser1:amp:cc:feedforward-factor** * (**laser1:dl:pc:voltage-set** - *voltage-pivot*) where *voltage-pivot* is the value of **laser1:dl:pc:voltage-set** at the time the feedforward gets enabled.
The **laser1:amp:cc:current-set** parameter setting affects the **laser1:amp:cc:current-offset** value.

hcc1:channel1:current-offset

(REAL parameter, read-write)

Parameter to specify the amplifier current without Feed Forward contribution (in mA). This parameter setting affects the **laser1:amp:cc:current-set** value.

hcc1:channel1:external-input:

(parameter section)

Parameters to configure the current control by an external, analog voltage input.

For usage see **laser1:dl:cc:external-input:** on page 56.

hcc1:channel1:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

For usage see **laser1:dl:cc:output-filter:** on page 57.

hcc1:channel1:polarity-txt

(STRING parameter, read-only)

Parameter indicating the polarity of the current driver. Possible values are "anode-grounded", "cathode-grounded" and "floating".

hcc1:channel1:current-act

(REAL parameter, read-only)

Parameter indicating the measured value of the amplifier chip current in mA. Usually, this is the current flowing through the amplifier chip. However, if the safety circuitry shorts the current output, this is not true.

hcc1:channel1:current-out

(REAL parameter, read-only)

Parameter indicating the current value in mA, as applied to the digital-to-analog converter. The value should be close to the **current-act** value, but with higher resolution and without measurement noise.

hcc1:channel1:current-clip

(REAL parameter, read-write)

Parameter to specify the maximum allowed current (in mA) for this channel's amplifier chip.

hcc1:channel1:current-clip-tuning

(REAL parameter, read-only)

Parameter indicating the maximum allowed tuning current (in mA) for this channel's amplifier chip.

hcc1:channel1:use-current-clip-tuning

(BOOLEAN parameter, read-write)

Parameter to specify if the maximum tuning current **:current-clip-tuning** should be taken into account for limiting the amplifier current. If set to #t the current gets limited to the maximum tuning current **:current-clip-tuning** or the maximum current **:current-clip**, depending on which one is smaller.

hcc1:channel1:current-clip-free-run

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA) in case of seedless operation.
The maximum parameter value is limited with **:current-clip**.

hcc1:channel1:using-current-clip-free-run

(BOOLEAN parameter, read-only)

Parameter indicating if current of amplifier was changed due to amplifier's seedless operation.

hcc1:channel1:current-clip-limit

(REAL parameter, read-only)

Parameter to specify the maximum value for the **:current-clip** parameter (in mA). IMPORTANT: To be specified only for legacy laser heads (without factory settings stored in EEPROM; **:legacy** = #t).
.

hcc1:channel1:voltage-act

(REAL parameter, read-only)

Parameter indicating the measured value of the voltage applied to the amplifier chip (in V).

hcc1:channel1:voltage-out

(REAL parameter, read-only)

Parameter indicating the measured value on the board, used for detection voltage-clip (V).

hcc1:channel1:voltage-clip

(REAL parameter, read-only)

Parameter to specify the maximum allowed voltage (in V) for this channel's amplifier chip.
Can be changed only for legacy laser heads (without factory settings stored in EEPROM).

hcc1:channel1:potential-load

(REAL parameter, read-only)

Parameter indicating the approximate electrical load in W this current channel can potentially exert on the power supply if the maximum diode current is used. The sum of all amplifier channel loads must not exceed 40W.

hcc1:channel1:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this current control channel.
#t - Feed Forward enabled
#f - Feed Forward disabled
If enabled, a current proportional to another channel's output is added to this channel. The other channel is defined by the **laser1:feedforward-master** parameter.

hcc1:channel1:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the piezo channel's output is to be added to the current channel (in mA/V).

hcc1:channel1:status

(INTEGER parameter, read-only)

Parameter providing channel status information. Each bit of the integer value provides specific channel status information. For HCC type channels, the bits provide the following information:

bit 0 - emission
bit 1 - enabled
bit 6 - current-clip
bit 7 - voltage clip
bit 11 - short circuit detected
bit 12 - channel forced to be off by health monitoring
bit 13 - driver fault
bit 14 - laser diode current at lower limit
bit 15 - laser diode current at upper limit
bit 16 - laser diode current limited by slew rate
bit 18 - ground offset voltage exceeds limit

hcc1:channel1:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

hcc2:

(parameter section)

This section provides controls for an optional 2nd High Current Controller (HCC) board.

For usage see **hcc1:** on page 221.

pc1:

(parameter section)

This section provides controls for the Piezo Controller (PC) board. The PC controls the piezo voltage applied to the laser head.

pc1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the PC-board is mounted in.

pc1:serial-number

(STRING parameter, read-only)

Parameter indicating the PC-board's serial number.

pc1:revision

(STRING parameter, read-only)

Parameter indicating the PC-board's hardware revision number.

pc1:variant

(STRING parameter, read-only)

Parameter indicating the board variant of the PC module.

pc1:channel-count

(INTEGER parameter, read-only)

Parameter indicating the number of available voltage channels.

pc1:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

pc2:

(parameter section)

This section gives access to the piezo control board. It provide means for controlling the piezo voltage.

For usage see **pc1:** on page 226.

pc3:

(parameter section)

This section gives access to the piezo control board. It provide means for controlling the piezo voltage.

For usage see **pc1:** on page 226.

tc1:

(parameter section)

This section provides controls for the Temperature Control (TC) board.

tc1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the TC-board is mounted in.

tc1:serial-number

(STRING parameter, read-only)

Parameter indicating the TC-board's serial number.

tc1:revision

(STRING parameter, read-only)

Parameter indicating the TC-board's hardware revision number.

tc1:fpga-fw-ver

(STRING parameter, read-only)

Parameter indicating the firmware version of the FPGA.

tc1:channel-count

(INTEGER parameter, read-only)

Parameter indicating the number of available channels.
The standard version of TC board features 2 channels. For certain laser heads 4-channel versions are available. Only 4-channel boards support **channel1b** and **channel2b**. The additional channels share the electrical connectors with **channel1** and **channel2**, respectively.

tc1:board-temp

(REAL parameter, read-only)

Parameter indicating the TC-board temperature in °C.

tc1:channel1:

(parameter section)

Parameters for controlling channel1 of the TC board.

For usage see **laser1:dl:tc:** on page 60.

tc1:channel1b:

(parameter section)

Parameters for controlling channel1b of the TC board.
Channel1b is only available on 4-channel versions of the TC board (see parameter **:channel-count**). It shares the electrical connector with channel1. Please note that the maximum available current is only 50% of that of channel1.

For usage see **laser1:dl:tc:** on page 60.

tc1:channel2:

(parameter section)

Parameters for controlling channel2 of the TC board.

For usage see **laser1:dl:tc:** on page 60.

tc1:channel2b:

(parameter section)

Parameters for controlling channel2b of the TC board.
Channel1b is only available on 4-channel versions of the TC board (see parameter **:channel-count**). It shares the electrical connector with channel2. Please note that the maximum available current is only 50% of that of channel2.

For usage see **laser1:dl:tc:** on page 60.

tc2:

(parameter section)

This section provides controls for the Temperature Control (TC) board.

For usage see **tc1:** on page 227.

mc:

(parameter section)

This section provides controls for the Main Controller (MC) board.

mc:serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the MC-board.

mc:revision

(STRING parameter, read-only)

Parameter indicating the MC-board's hardware revision number.

mc:fpga-type

(INTEGER parameter, read-only)

Parameter indicating the type of FPGA hardware.
1 = generation 1 hardware, 2 = generation 2 hardware.

mc:fpga-fw-ver

(STRING parameter, read-only)

Parameter indicating the firmware version of the FPGA.

mc:board-temp

(REAL parameter, read-only)

Parameter indicating the temperature measured on the MC-board (in °C).

mc:relative-humidity

(REAL parameter, read-only)

Parameter indicating the relative humidity measured by the humidity sensor (in %).

mc:air-pressure

(REAL parameter, read-only)

Parameter indicating the air pressure measured by the pressure sensor (in hPa).

io:

(parameter section)

This section provides controls for the Input/Output (I/O) board.

io:serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the I/O-board.

io:revision

(STRING parameter, read-only)

Parameter indicating the I/O-board's hardware revision number.

io:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

io:fine-1:

(parameter section)

Parameters for the Fine 1 analog frontpanel input.

io:fine-1:value-act

(REAL parameter, read-only)

Parameter indicating the voltage in V, measured at the analog input connector.

io:fine-2:

(parameter section)

Parameters for the Fine 2 analog frontpanel input.

For usage see **io:fine-1:** on page 230.

io:fast-3:

(parameter section)

Parameters for the Fast 3 analog frontpanel input.

For usage see **io:fine-1:** on page 230.

io:fast-4:

(parameter section)

Parameters for the Fast 4 analog frontpanel input.

For usage see **io:fine-1:** on page 230.

io:out-a:

(parameter section)

Settings for the Out A analog frontpanel output.

io:out-a:voltage-set

(REAL parameter, read-write)

Parameter to specify the static output voltage in V.
In contrast to the **:voltage-offset** parameter, this value includes the static contribution of the feedforward (See **laser1:dl:cc:current-set**). With feedforward disabled **:voltage-offset** and **:voltage-set** are identical.

io:out-a:voltage-act

(REAL parameter, read-only)

Parameter indicating the output voltage (in V) including all contributions like static offset, feed forward, analog remote control, PIDs and signal generators.
Please note that this is not a measured value and that the actual voltage can differ due to component tolerances.

io:out-a:voltage-offset

(REAL parameter, read-write)

Parameter to specify the static output voltage offset in V.

io:out-a:voltage-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the static output voltage offset.

io:out-a:voltage-min

(REAL parameter, read-write)

Parameter to specify the minimum output voltage in V.

io:out-a:voltage-max

(REAL parameter, read-write)

Parameter to specify the maximum output voltage in V.

io:out-a:signal-monitor:

(parameter section)

Parameters to configure analog signal monitoring.

io:out-a:signal-monitor:signal

(INTEGER parameter, read-write)

ID for the input signal to be routed to this laser channel.
For possible values, refer to the "Signal Channel IDs" section in appendix 4.1 on page 286.

io:out-a:signal-monitor:operating-point

(REAL parameter, read-write)

Parameter to specify the operating point within the input signal, that is to be mapped to 0V at the monitor output.

io:out-a:signal-monitor:factor

(REAL parameter, read-write)

Factor to be applied to the input signal.

io:out-a:signal-monitor:enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable the monitoring signal on the analog output channel.
#t - the monitoring signal is added to the output channel
#f - monitoring is disabled

io:out-a:output-filter:

(parameter section)

Parameters to configure output filters such as slew rate.

For usage see **laser1:dl:cc:output-filter:** on page 57.

io:out-a:linked-laser

(INTEGER parameter, read-write)

Parameter to specify which laser's channels are to be used if, eg, the **:feedforward-master** is specified. Use 1 for **laser1** and 2 for **laser2**.

io:out-a:feedforward-master

(INTEGER parameter, read-write)

Parameter to specify the master channel for the Feed Forward.

io:out-a:feedforward-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable Feed Forward for this voltage output channel.
#t - Feed Forward enabled
#f - Feed Forward disabled
If enabled, a voltage proportional to another channel's output is added to this channel. The other channel is defined by the **:feedforward-master** parameter.

io:out-a:feedforward-factor

(REAL parameter, read-write)

Parameter to control how much of the master channel's output is to be added to this voltage channel.

io:out-a:status

(INTEGER parameter, read-only)

Parameter providing channel status information. Each bit of the integer value provides specific channel status information.

bit 0 - voltage output enabled

bit 1 - voltage at lower limit

bit 2 - voltage at upper limit

bit 3 - voltage limited by slew rate

io:out-a:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

io:out-b:

(parameter section)

Settings for the Out B analog frontpanel output.

For usage see **io:out-a:** on page 231.

io:digital-in0:

(parameter section)

Parameters related to the digital input 0.

io:digital-in0:value-act

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin.
#t - high signal (5V)
#f - low signal (0V)

io:digital-in1:

(parameter section)

Parameters related to the digital input 1.

For usage see **io:digital-in0:** on page 233.

io:digital-in2:

(parameter section)

Parameters related to the digital input 2.

For usage see **io:digital-in0:** on page 233.

io:digital-in3:

(parameter section)

Parameters related to the digital input 3.

For usage see **io:digital-in0:** on page 233.

io:digital-out0:

(parameter section)

Parameters related to the digital output 0.

io:digital-out0:value-act

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital output pin.
#t - high signal (5V)
#f - low signal (0V)

io:digital-out0:value-set

(BOOLEAN parameter, read-write)

Parameter specifying the electrical state of the digital output pin in case of software control.
#t - high signal (5V)
#f - low signal (0V)
If the **:invert** parameter is #t, the signal will be inverted. To use software control set the **:mode** parameter to 3.

io:digital-out0:mode

(INTEGER parameter, read-write)

Parameter to specify the signal source for digital output.

0 - trigger output of signal generator **laserX:scan** of the linked laser

1 - *out-of-lock* signal of lock engine **laserX:dl:lock** of the linked laser

2 - trigger output of the wide-scan **laserX:wide-scan** of the linked laser

3 - software control via parameter **:value-set**

io:digital-out0:linked-laser

(INTEGER parameter, read-write)

Parameter to specify which laser's trigger signals are to be used on this digital output channel. Use 1 for **laser1** and 2 for **laser2** etc.

io:digital-out0:invert

(BOOLEAN parameter, read-write)

Parameter to specify if the digital output logic should be inverted.

io:digital-out1:

(parameter section)

Parameters related to the digital output 1.

For usage see **io:digital-out0:** on page 234.

io:digital-out2:

(parameter section)

Parameters related to the digital output 2.

For usage see **io:digital-out0:** on page 234.

io:digital-out3:

(parameter section)

Parameters related to the digital output 3.

For usage see **io:digital-out0:** on page 234.

io:save

(command, no arguments, returns empty tuple)

Command to save user settings for the analog output channels.

io:load

(command, no arguments, returns empty tuple)

Command to load user settings for the analog output channels.

power-supply:

(parameter section)

This section provides information about power supply lines.

power-supply:type

(STRING parameter, read-only)

Parameter indicating the type of power supply installed.

power-supply:serial-number

(STRING parameter, read-only)

Parameter indicating the serial number of the power supply.

power-supply:revision

(STRING parameter, read-only)

Parameter indicating the power supply's hardware revision number.

power-supply:board-temp

(REAL parameter, read-only)

Parameter indicating the temperature of the power filter PCB (in °C).

power-supply:heatsink-temp

(REAL parameter, read-only)

Parameter indicating the temperature of the power supply heatsink (in °C). This parameter is only available if the power supply hardware supports it.

power-supply:current-5V

(REAL parameter, read-only)

Parameter indicating the current on the +5V line (in A).

power-supply:current-15V

(REAL parameter, read-only)

Parameter indicating the current on the +15V line (in A).

power-supply:current-15Vn

(REAL parameter, read-only)

Parameter indicating the current on the -15V line (in A).

power-supply:voltage-5V

(REAL parameter, read-only)

Parameter indicating the voltage of the +5V line (in V).

power-supply:voltage-15V

(REAL parameter, read-only)

Parameter indicating the voltage of the +15V line (in V).

power-supply:voltage-15Vn

(REAL parameter, read-only)

Parameter indicating the voltage of the -15V line (in V).

power-supply:voltage-3V3

(REAL parameter, read-only)

Parameter indicating the voltage of the +3.3V line (in V).

power-supply:load

(REAL parameter, read-only)

Parameter indicating total power consumption of 5V, +15V and -15V line in W.

power-supply:status

(INTEGER parameter, read-only)

Parameter providing status information about the power-supply health. Each bit of the integer value provides specific channel status information.

bit 0 - high temperature (temperature above limit T_1)

bit 1 - critical temperature (temperature above limit T_2)

bit 2 - legacy powersupply without temperature sensor

bit 3 - problem with reading one of the sensors

bit 4 - very high current at DC/DC converter

The temperature limits T_1 and T_2 depend on type and revision of the power-supply installed. At temperatures above T_2 all modules with be switched off.

power-supply:status-txt

(STRING parameter, read-only)

Parameter providing a brief text version of the **:status** parameter.

buzzer:

(parameter section)

Parameters to access the buzzer.

buzzer:welcome

(STRING parameter, read-write)

Parameter to determine the welcome melody that is played by the buzzer at boot time when the firmware is started.
Set an empty string if no melody is to be played.

buzzer:play-welcome

(command, no arguments, returns empty tuple)

Command to play the **:welcome** melody.

buzzer:play

(command, 1 argument, returns empty tuple)

Arguments:
1. *melody* of type STRING

Command to play the melody specified in the command argument.

display:

(parameter section)

Parameters to specify the behaviour of the DLCpro touch screen illumination.

display:brightness

(REAL parameter, read-write)

Parameter to specify the brightness of the touch screen illumination. The minimum value for darkest illumination is 0.5. The maximum value of 100 means maximum brightness. The scale is not linear.

display:auto-dark

(BOOLEAN parameter, read-write)

Parameter to enable/disable *screen save* mode.
#t - If the touchscreen on DLC pro frontpanel is not used for a time specified by the **:idle-timeout**, the display illumination is automatically switched off. It is automatically switched on again as soon as the screen is touched again.
#f - The display stays illuminated.

display:idle-timeout

(INTEGER parameter, read-write)

Parameter specifying the time in seconds after which the display illumination is switched off, if the touchscreen on the frontpanel has not been used.

display:state

(INTEGER parameter, read-only)

Parameter indicating the display state.

0 - display is off
1 - display is about to be turned off (semi dark)
2 - display is on, **:auto-dark** is enabled
3 - display is on, **:auto-dark** just got enabled,
4 - display is on, **:auto-dark** is disabled

display:save

(command, no arguments, returns empty tuple)

Command to save display user-settings.

display:load

(command, no arguments, returns empty tuple)

Command to load display user-settings.

display:update-state

(command, 1 argument, returns empty tuple)

Arguments:
1. *active* of type BOOLEAN

Command for the touch UI to report frontpanel activity to the device control.

standby:

(parameter section)

Parameters to modify the settings of the standby mode. The standby mode is toggled with the power/standby button on the DLCpro frontpanel.

standby:enabled

(BOOLEAN parameter, read-write)

Parameter indicating whetheher the system is in standby mode.
#t - system in standby mode
#f - system not in standby mode

standby:state

(INTEGER parameter, read-only)

Parameter indicating standby state of the system.

0 - standby disabled, system is in *power mode*

1 - standby enabled, system is in *standby mode*

2 - transition from *standby mode* to *power mode*, system is waiting for confirmation

standby:laser1:

(parameter section)

Settings for the standby mode of laser1.

standby:laser1:dl:

(parameter section)

Settings for the standby mode of the laser-head's diode laser.

standby:laser1:dl:disable-pc

(BOOLEAN parameter, read-write)

Parameter to disable the piezo voltage in laser standby mode.
#t - piezo voltage disabled in laser standby mode

standby:laser1:dl:disable-cc

(BOOLEAN parameter, read-write)

Parameter to disable the diode current in laser standby mode.
#t - diode current disabled in laser standby mode

standby:laser1:dl:disable-tc

(BOOLEAN parameter, read-write)

Parameter to disable the temperature control in laser standby mode.
#t - temperature control disabled in laser standby mode

standby:laser1:dl:disable-eom

(BOOLEAN parameter, read-write)

Parameter to disable the intra-cavity EOM voltage in laser standby mode.
#t - intra-cavity EOM voltage disabled in laser standby mode

standby:laser1:amp:

(parameter section)

Settings for the standby mode of the laser-head's amplifier.

standby:laser1:amp:disable-cc

(BOOLEAN parameter, read-write)

Parameter to disable the amplifier current in laser standby mode.
#t - amplifier current disabled in laser standby mode

standby:laser1:amp:disable-tc

(BOOLEAN parameter, read-write)

Parameter to disable the amplifier temperature control in laser standby mode.
#t - amplififer temperature control disabled in laser standby mode

standby:laser1:ctl:

(parameter section)

Settings for the standby mode of laser-head's CTL.

standby:laser1:ctl:disable

(BOOLEAN parameter, read-write)

Disable the CTL laser-head in standby mode.

standby:laser1:nlo:

(parameter section)

Settings for the SHG (and FHG) standby mode.

standby:laser1:nlo:disable-pc

(BOOLEAN parameter, read-write)

Disable the SHG (and FHG) piezo control in standby mode.

standby:laser1:nlo:disable-tc

(BOOLEAN parameter, read-write)

Disable the temperature control of the SHG-cavity (and of the FHG-cavity) in standby mode.

standby:laser2:

(parameter section)

Settings for the standby mode of laser2.

standby:laser2:dl:

(parameter section)

Settings for the standby mode of the laser-head's diode laser.

For usage see **standby:laser1:dl:** on page 240.

standby:laser2:amp:

(parameter section)

Settings for the standby mode of the laser-head's amplifier.

For usage see **standby:laser1:amp:** on page 240.

standby:laser3:

(parameter section)

Settings for the standby mode of laser3.

standby:laser3:dl:

(parameter section)

Settings for the standby mode of the laser-head's diode laser.

For usage see **standby:laser1:dl:** on page 240.

standby:laser4:

(parameter section)

Settings for the standby mode of laser4.

For usage see **standby:laser3:** on page 242.

pdh1:

(parameter section)

This section provides controls for the first Pound-Drever-Hall (PDH) board.

pdh1:slot

(STRING parameter, read-only)

Parameter indicating the slot, the PDH board is mounted in.

pdh1:serial-number

(STRING parameter, read-only)

Parameter indicating the PDH board's serial number.

pdh1:revision

(STRING parameter, read-only)

Parameter indicating the PDH board's hardware revision number.

pdh1:fpga-fw-ver

(INTEGER parameter, read-only)

Parameter indicating the firmware version of the FPGA.

pdh1:board-temp

(REAL parameter, read-only)

Parameter indicating the PDH board temperature (in °C).

pdh1:channel1:

(parameter section)

Channel1 of PDH board.

pdh1:channel1:label

(STRING parameter, read-write)

Parameter indicating the PDH channel's label.

pdh1:channel1:modulation-enabled

(BOOLEAN parameter, read-write)

Parameter to enable/disable modulation of the output channel signal (**:output-channel**).
#t - apply modulation to the channel selected by **:output-channel**.
#f - no modulation of the output channel signal.

pdh1:channel1:use-fast-oscillator

(BOOLEAN parameter, read-write)

Parameter to control the modulation/demodulation frequency.
#t - select 25MHz.
#f - select 5MHz.

pdh1:channel1:modulation-amplitude-dbm

(REAL parameter, read-write)

Parameter to control the modulation amplitude in dBm.

pdh1:channel1:modulation-amplitude-vpp

(REAL parameter, read-only)

Parameter to view the modulation amplitude (in V peak to peak).

pdh1:channel1:lo-output-amplitude-dbm

(REAL parameter, read-write)

Parameter to control the lo output amplitude in dBm.

pdh1:channel1:lo-output-amplitude-vpp

(REAL parameter, read-only)

Parameter to view the lo output amplitude in volts.

pdh1:channel1:lo-output-enabled

(BOOLEAN parameter, read-write)

Parameters for enabling the output of the pdh lo signal.

pdh1:channel1:phase-shift

(REAL parameter, read-write)

Parameter to control the phase difference between modulation and demodulation (in °). Used to optimize the demodulated Lock-In signal.

pdh1:channel1:input-level-max

(INTEGER parameter, read-write)

Parameter to specify the maximal input level for the signal.
Possible values:

0: -10dBm

1: 0dBm

2: +10dBm

pdh1:channel1:lock-level

(REAL parameter, read-write)

Parameter to control the setpoint level for top-of-fringe locks to compensate for an eventual DC offset in lock-in output signal.

pdh1:channel1:auto-pdh:

(parameter section)

Parameters for the automatic adjustment of the PDH phase-shift.
This feature is only available if a valid lock license is installed.

For usage see **laser1:dl:lock:lockin:auto-lir:** on page 76.

pdh1:channel2:

(parameter section)

Channel2 of PDH board.

For usage see **pdh1:channel1:** on page 243.

pdh1:save

(command, no arguments, returns empty tuple)

Command to save PDH parameters to the DLC pro flash memory.

pdh1:load

(command, no arguments, returns empty tuple)

Command to load PDH parameters from the DLC pro flash memory.

pdh2:

(parameter section)

This section provides controls for the second Pound-Drever-Hall (PDH) board.

For usage see **pdh1:** on page 242.

falc1:

(parameter section)

This section provides controls for the first FALC pro device with CANopen node-id 91.

falc1:node-id

(INTEGER parameter, read-only)

Parameter indicating the CANopen node ID of the FALC device.

falc1:serial-number

(STRING parameter, read-only)

Parameter indicating the FALC device's serial number.

falc1:label

(STRING parameter, read-only)

Parameter indicating the FALC device's label.

falc1:model

(INTEGER parameter, read-only)

Parameter indicating the hardware model of the FALC device.

0 - FALC

1 - mFALC

falc1:revision

(STRING parameter, read-only)

Parameter indicating the FALC device's hardware revision number.

falc1:fw-ver

(STRING parameter, read-only)

Parameter indicating the version of firmware on the FALC device.

falc1:mcu-temp

(REAL parameter, read-only)

Parameter indicating the FALC MCU temperature (in °C).

falc1:status

(INTEGER parameter, read-only)

Parameter to specify FALC device status information. Each bit provides specific information.

bit 0 - mainboard over-temperature

bit 1 - main output at lower internal limit

bit 2 - main output at upper internal limit

bit 3 - unlim output at lower limit

bit 4 - unlim output at upper limit

bit 5 - main locked

bit 6 - unlim locked

bit 7 - unlim on hold

bit 31 - device is missing / not answering

falc1:status-txt

(STRING parameter, read-only)

Parameter to specify a brief text version of the **:status** parameter.

falc1:input:

(parameter section)

FALC input parameters.

falc1:input:gain

(INTEGER parameter, read-write)

Parameter to specify the gain of FALC's input.

0 - 1x

1 - 5x

falc1:input:offset

(REAL parameter, read-write)

Parameter to specify the offset of FALC's input (in V).

falc1:mon:

(parameter section)

Falc monitor parameters.

falc1:mon:config

(INTEGER parameter, read-write)

Parameter to specify the configuration of FALC's monitor output. Possible values include:

0 - Error output

1 - Main output

2 - Main input RMS

falc1:unlim:

(parameter section)

Falc unlim parameters.

falc1:unlim:enabled

(BOOLEAN parameter, read-write)

Parameter to specify the lock-ON/OFF state of FALC's unlim path.

falc1:unlim:hold

(BOOLEAN parameter, read-write)

Parameter to specify the hold state of FALC's unlim path.

falc1:unlim:sign

(BOOLEAN parameter, read-write)

Parameter to specify the sign of the action of FALC's unlim path.

falc1:unlim:slew-rate

(INTEGER parameter, read-write)

Parameter to specify the slew rate of FALC's unlim path. The discrete slew rate values are represented by integer indices 1 ... 12. The resulting gain of the unlim path is available from the **:unlim:gain** parameter.

falc1:unlim:gain

(REAL parameter, read-only)

Parameter indicating the gain of the FALC's unlim path (in $\frac{V}{s \cdot V}$). It depends on parameters **:unlim:slew-rate**, **:unlim:output-range** and **:input:gain**.

falc1:unlim:output-range

(REAL parameter, read-write)

Parameter to specify the output range of FALC's unlim path (in Vpp).
NOTE: only certain discrete voltage values in the range 0.018 V ... 4.10V are available. When setting the parameter, the given target value is rounded to the nearest valid value. When reading, the discrete value is returned.

falc1:unlim:input-offset

(REAL parameter, read-write)

Parameter to specify the input offset of FALC's unlim path (in mV).

falc1:unlim:lock-state

(BOOLEAN parameter, read-only)

Parameter indicating the lock state of FALC's unlim path.

falc1:unlim:hold-state

(BOOLEAN parameter, read-only)

Parameter indicating the hold state of FALC's unlim path.

falc1:unlim:regulating-state

(BOOLEAN parameter, read-only)

Parameter indicating the regulating state of FALC's unlim path.

falc1:main:

(parameter section)

FALC main parameters.

falc1:main:enabled

(BOOLEAN parameter, read-write)

Parameter to specify Lock-ON/OFF for FALC's main path.

falc1:main:gain:

(parameter section)

FALC's Main gain parameters.

falc1:main:gain:all

(REAL parameter, read-write)

Parameter to specify the gain of FALC's main path.

falc1:main:gain:use-external-input

(BOOLEAN parameter, read-write)

Parameter to specify whether the gain of FALC's main path should be set internally or through an external input.

falc1:main:gain:i1-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the main path's I1 is enabled.

falc1:main:gain:i1

(INTEGER parameter, read-write)

Parameter to specify the corner frequency of the main path's I1. The discrete frequency values are represented by integer indices 1 ... 10, with the following meaning:

1 = 1.5 kHz

2 = 3.0 kHz

3 = 7.0 kHz

4 = 15 kHz

5 = 31 kHz

6 = 70 kHz

7 = 130 kHz

8 = 290 kHz

9 = 620 kHz

10 = 7.0 MHz

falc1:main:gain:i2-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the main path's I2 is enabled.

falc1:main:gain:i2

(INTEGER parameter, read-write)

Parameter to specify the corner frequency of the main path's I2. The discrete frequency values are represented by integer indices 1 ... 9, with the following meaning:

1 = 25 Hz

2 = 50 Hz

3 = 100 Hz

4 = 220 Hz

5 = 470 Hz

6 = 1.0 kHz

7 = 2.2 kHz

8 = 5.0 kHz

9 = 10 kHz

falc1:main:gain:i3-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the main path's I3 is enabled.

falc1:main:gain:i3

(INTEGER parameter, read-write)

Parameter to specify the corner frequency of the main path's I3. The discrete frequency values are represented by integer indices 1 ... 7, with the following meaning:

1 = 0.6 Hz

2 = 1.8 Hz

3 = 6.0 Hz

4 = 18 Hz

5 = 60 Hz

6 = 180 Hz

7 = 600 Hz

falc1:main:gain:d1-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the main path's D1 is enabled.

falc1:main:gain:d1

(INTEGER parameter, read-write)

Parameter to specify the corner frequency of the main path's D1. The discrete frequency values are represented by integer indices 1 ... 10, with the following meaning:

1 = 10 kHz

2 = 20 kHz

3 = 40 kHz

4 = 90 kHz

5 = 190 kHz

6 = 400 kHz

7 = 760 kHz

8 = 1.5 MHz

9 = 3.5 MHz

10 = 7.2 MHz

falc1:main:gain:d2-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the main path's D2 is enabled.

falc1:main:gain:d2

(INTEGER parameter, read-write)

Parameter to specify the corner frequency of the main path's D2. The discrete frequency values are represented by integer indices 1 ... 10, with the following meaning:

1 = 10 kHz

2 = 20 kHz

3 = 45 kHz

4 = 100 kHz

5 = 200 kHz

6 = 420 kHz

7 = 700 kHz

8 = 1.2 MHz

9 = 3.5 MHz

10 = 6.0 MHz

falc1:main:gain:ramp-up-rate

(INTEGER parameter, read-write)

Parameter to specify the maximal ramp-up rate for the main gain. The discrete ramp-up rates are represented by integer indices 1 ... 7.

falc1:main:lock-state

(BOOLEAN parameter, read-only)

Parameter indicating FALC's lock state.

falc1:path-selection

(INTEGER parameter, read-write)

Parameter indicating the FALC controller paths for "lock-enabled" and "hold" of the DLC pro lock machine. Possible values include:

0 - None of the controller paths selected.

1 - unlim path only selected.

2 - Main path only selected.

3 - Both unlim and main paths selected.

falc1:hold-state

(BOOLEAN parameter, read-only)

Parameter indicating FALC's hold state.

falc1:save

(command, no arguments, returns empty tuple)

Command to save FALC parameters to the DLC pro flash memory.

falc1:load

(command, no arguments, returns empty tuple)

Command to load FALC parameters from the DLC pro flash memory.

falc2:

(parameter section)

This section provides controls for the second FALC pro device with CANopen node-id 92.

For usage see **falc1:** on page 245.

falc3:

(parameter section)

This section provides controls for the third FALC pro device with CANopen node-id 93.

For usage see **falc1:** on page 245.

falc4:

(parameter section)

This section provides controls for the fourth FALC pro device with CANopen node-id 94.

For usage see **falc1:** on page 245.

servo-control1:

(parameter section)

This section provides controls for the first ServoControl device with CANopen node-id 95.

servo-control1:node-id

(INTEGER parameter, read-only)

Parameter indicating the CANopen node ID of the Servo-Control device.

servo-control1:serial-number

(STRING parameter, read-only)

Parameter indicating the Servo-Control device's serial number.

servo-control1:revision

(STRING parameter, read-only)

Parameter indicating the Servo-Control device's hardware revision number.

servo-control1:fw-ver

(STRING parameter, read-only)

Parameter indicating the version of firmware on the Servo-Control device.

servo-control1:mcu-temp

(REAL parameter, read-only)

Parameter indicating the Servo-Control MCU temperature (in °C).

servo-control1:status

(INTEGER parameter, read-only)

Parameter indicating Servo-Control device status. Each bit provides specific information:

bit 0 - Over-temperature of the Servo-Control board.

bit 1 - Over-current in one of the servo connections.

bit 15 - Device is missing or not answering.

servo-control1:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

servo-control2:

(parameter section)

This section provides controls for the second ServoControl device with CANopen node-id 96.

For usage see **servo-control1:** on page 252.

servo-control3:

(parameter section)

This section provides controls for the third ServoControl device with CANopen node-id 97.

For usage see **servo-control1:** on page 252.

servo-control4:

(parameter section)

This section provides controls for the fourth ServoControl device with CANopen node-id 98.

For usage see **servo-control1:** on page 252.

mot1:

(parameter section)

This section provides controls for the first Motor pro device with CANopen node-id 90.

mot1:node-id

(INTEGER parameter, read-only)

Parameter indicating the CANopen node ID of the Motor pro.

mot1:serial-number

(STRING parameter, read-only)

Parameter indicating the Motor pro's serial number.

mot1:revision

(STRING parameter, read-only)

Parameter indicating the Motor pro's hardware revision number.

mot1:fw-ver

(STRING parameter, read-only)

Parameter indicating the version of firmware on the Motor pro.

mot1:board-temp

(REAL parameter, read-only)

Parameter indicating the Motor pro board temperature (in °C).

mot1:status

(INTEGER parameter, read-only)

Parameter indicating Motor pro device status. Each bit provides specific information:

bit 0 - Over-temperature of the Motor pro board.

bit 1 - Over-current in one of the stepper connections.

bit 15 - Device is missing or not answering.

mot1:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

mot1:channel1:

(parameter section)

Parameters of the first stepper motor.

For usage see **laser1:dl:motor:** on page 90.

mot1:channel2:

(parameter section)

Parameters of the second stepper motor.

For usage see **laser1:dl:motor:** on page 90.

mot1:io:

(parameter section)

Parameters for the digital IOs of the board.

mot1:io:digital-in0:

(parameter section)

Parameters related to the digital input 0 of the Motor pro board.

mot1:io:digital-in0:value-act

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin.
#t - high signal (5V)
#f - low signal (0V)

mot1:io:digital-in1:

(parameter section)

Parameters related to the digital input 1 of the Motor pro board.

For usage see **mot1:io:digital-in0:** on page 255.

mot1:io:digital-in2:

(parameter section)

Parameters related to the digital input 2 of the Motor pro board.

For usage see **mot1:io:digital-in0:** on page 255.

mot1:io:digital-in3:

(parameter section)

Parameters related to the digital input 3 of the Motor pro board.

For usage see **mot1:io:digital-in0:** on page 255.

mot1:io:digital-out0:

(parameter section)

Parameters related to the digital output 0 of the Motor pro board.

mot1:io:digital-out0:value-act

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital output pin.
#t - high signal (5V)
#f - low signal (0V)

mot1:io:digital-out0:value-set

(BOOLEAN parameter, read-write)

Parameter specifying the electrical state of the digital output pin in case of software control.
#t - high signal (5V)
#f - low signal (0V)
If the **:invert** parameter is #t, the signal will be inverted. To use software control set the **:mode** parameter to 3.

mot1:io:digital-out0:mode

(INTEGER parameter, read-write)

Parameter to specify the signal source for digital output.
Following modes are supported:

0 - trigger output for threshold of motor 1

1 - trigger output for threshold of motor 2

2 - unused

3 - software control via parameters **:value-set** and **:invert**

mot1:io:digital-out0:invert

(BOOLEAN parameter, read-write)

Parameter to specify if the digital output logic should be inverted.

mot1:io:digital-out1:

(parameter section)

Parameters related to the digital output 1 of the Motor pro board.

For usage see **mot1:io:digital-out0:** on page 256.

mot1:io:digital-out2:

(parameter section)

Parameters related to the digital output 2 of the Motor pro board.

For usage see **mot1:io:digital-out0:** on page 256.

mot1:io:digital-out3:

(parameter section)

Parameters related to the digital output 3 of the Motor pro board.

For usage see **mot1:io:digital-out0:** on page 256.

mot2:

(parameter section)

This section provides controls for the second Motor pro device with CANopen node-id 99.

For usage see **mot1:** on page 254.

pfd1:

(parameter section)

This section provides controls for the first PFD pro device with CANopen node-id 86.

pfd1:node-id

(INTEGER parameter, read-only)

Parameter indicating the CANopen node ID of the PFD pro.

pfd1:serial-number

(STRING parameter, read-only)

Parameter indicating the PFD pro's serial number.

pfd1:label

(STRING parameter, read-write)

Parameter indicating the PFD pro's device's label.

pfd1:revision

(STRING parameter, read-only)

Parameter indicating the PFD pro's hardware revision number.

pfd1:fw-ver

(STRING parameter, read-only)

Parameter indicating the version of firmware on the PFD pro.

pfd1:status

(INTEGER parameter, read-only)

Parameter indicating device's status. Each bit provides specific information:

bit 0 - signal level at "RF LF" input out of range

bit 1 - cycle slip occurred

bit 15 - device is missing or not answering.

pfd1:status-txt

(STRING parameter, read-only)

Parameter indicating a brief text version of the **:status** parameter.

pfd1:external-clock-detected

(BOOLEAN parameter, read-only)

Parameter to indicate that the external clock source is detected.

pfd1:external-clock-locked

(BOOLEAN parameter, read-only)

Parameter to indicate that the external clock source is locked.

pfd1:rf-path

(INTEGER parameter, read-write)

Parameter to specify the signal path:

0 - LF.

1 - LF with tunable filter.

2 - HF.

pfd1:reference-path

(INTEGER parameter, read-write)

Parameter to specify the signal used for the reference frequency:

0 - Internal reference.

1 - External reference.

pfd1:dds-output-enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable the DDS output.

pfd1:phase-out-filter-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the PFD output filter should be enabled.

pfd1:aux-out1-signal

(INTEGER parameter, read-write)

Parameter to specify the signal on the first auxiliary output (Aux Out 1):

0 - Internal signal.

1 - Internal signal.

2 - LF counter monitor.

3 - LF frequency monitor.

4 - Internal signal.

pfd1:aux-out2-signal

(INTEGER parameter, read-write)

Parameter to specify the signal on the second auxiliary output (Aux Out 2):

0 - Reference frequency.

1 - Frequency error.

2 - Feed-forward for frequency switch.

pfd1:frequency-counters:

(parameter section)

Parameters controlling the PFD pro's frequency counters.

pfd1:frequency-counters:gating-time

(INTEGER parameter, read-write)

Parameter specifying the gating time for the frequency counters (in μs).

pfd1:frequency-counters:reference-frequency

(INTEGER parameter, read-only)

Parameter indicating the value of the frequency counter for the reference frequency (in Hz).

pfd1:frequency-counters:lf-frequency

(INTEGER parameter, read-only)

Parameter indicating the value of the frequency counter for the LF frequency (in Hz).

pfd1:frequency-counters:counter-output-frequency

(INTEGER parameter, read-only)

Parameter indicating the value of the frequency counter for the counter output (in Hz).

pfd1:frequency-counters:phase-output-frequency

(INTEGER parameter, read-only)

Parameter indicating the value of the frequency counter for the phase output (in Hz).

pfd1:frequency-plan:

(parameter section)

Parameters controlling the reference frequency scan.

pfd1:frequency-plan:mode

(INTEGER parameter, read-write)

Parameter to specify the reference frequency's operation mode:

0 - Single frequency.

1 - Adjustable frequency.

2 - Scan internal.

3 - Scan external.

4 - Hopping external.

pfd1:frequency-plan:center-frequency

(REAL parameter, read-write)

Parameter to specify the frequency at the RF HF or RF LF input, respectively (in MHz).

pfd1:frequency-plan:scan:

(parameter section)

Parameters controlling the frequency scan.

pfd1:frequency-plan:scan:amplitude

(REAL parameter, read-write)

Parameter to specify the amplitude of frequency scan (in MHz).

pfd1:frequency-plan:scan:frequency

(INTEGER parameter, read-write)

Parameter to specify the frequency for *internal* scans (in Hz).

pfd1:frequency-plan:scan:ramp-rate

(REAL parameter, read-write)

Parameter to specify the ramp-rate for *external* scans (in MHz/s).

pfd1:frequency-plan:hopping:

(parameter section)

Parameters controlling the frequency switch.

pfd1:frequency-plan:hopping:frequency1

(REAL parameter, read-write)

Frequency value 1 for the frequency switch (in MHz).

pfd1:frequency-plan:hopping:frequency2

(REAL parameter, read-write)

Frequency value 2 for the frequency switch (in MHz).

pfd1:frequency-plan:hopping:frequency3

(REAL parameter, read-write)

Frequency value 3 for the frequency switch (in MHz).

pfd1:frequency-plan:hopping:frequency4

(REAL parameter, read-write)

Frequency value 4 for the frequency switch (in MHz).

pfd1:frequency-plan:hopping:feed-forward-offset

(REAL parameter, read-write)

Frequency offset used for the feed-forward analog output signal (in MHz).

pfd1:frequency-plan:hopping:feed-forward-factor

(REAL parameter, read-write)

Feed-forward factor for the analog output signal (in V/MHz).

pfd1:reference-frequency:

(parameter section)

Parameters controlling the reference frequency scan.

pfd1:reference-frequency:center-frequency

(REAL parameter, read-only)

Parameter indicating the reference frequency in single-tone mode (in MHz).

pfd1:reference-frequency:scan:

(parameter section)

Parameters indicating the reference frequency scan.

pfd1:reference-frequency:scan:amplitude

(REAL parameter, read-only)

Parameter to specify the amplitude of frequency scan (in MHz).

pfd1:reference-frequency:scan:ramp-rate

(REAL parameter, read-only)

Parameter to specify the ramp-rate for *external* scans (in MHz/s).

pfd1:reference-frequency:hopping:

(parameter section)

Parameters indicating the reference frequency switch.

pfd1:reference-frequency:hopping:frequency1

(REAL parameter, read-only)

Frequency value 1 for the frequency switch (in MHz).

pfd1:reference-frequency:hopping:frequency2

(REAL parameter, read-only)

Frequency value 2 for the frequency switch (in MHz).

pfd1:reference-frequency:hopping:frequency3

(REAL parameter, read-only)

Frequency value 3 for the frequency switch (in MHz).

pfd1:reference-frequency:hopping:frequency4

(REAL parameter, read-only)

Frequency value 4 for the frequency switch (in MHz).

pfd1:reference-frequency:hopping:feed-forward-offset

(REAL parameter, read-only)

Frequency offset used for the feed-forward analog output signal (in MHz).

pfd1:reference-frequency:hopping:feed-forward-factor

(REAL parameter, read-only)

Feed-forward factor for the analog output signal (in V/MHz).

pfd1:cavity-bridge:

(parameter section)

Parameters controlling the cavity bridge scan functionality.

pfd1:cavity-bridge:output-enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable the output signal.

pfd1:cavity-bridge:external-trigger-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the trigger control using the digital input should be enabled.

pfd1:cavity-bridge:output-frequency

(REAL parameter, read-write)

Parameter indicating the current output frequency of the bridge scan (in MHz).

pfd1:cavity-bridge:scan-enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable the bridge scan.

pfd1:cavity-bridge:end-frequency

(REAL parameter, read-write)

Parameter to specify the final frequency for the bridge scan (in MHz).

pfd1:cavity-bridge:step-size

(REAL parameter, read-write)

Parameter to specify the step-size for the bridge scan frequency (in Hz). Only used for scans using the external trigger.

pfd1:cavity-bridge:ramp-rate

(REAL parameter, read-write)

Parameter to specify the ramp-rate for the bridge scan frequency (in Hz/s). Only used for scans using the internal timer.

pfd1:lf:

(parameter section)

Parameters controlling the low-frequency phase-frequency detector.

pfd1:lf:r-divider

(INTEGER parameter, read-write)

Parameter to specify the value of the divider for the reference counter in the range [1, 1000].

pfd1:lf:n-divider

(INTEGER parameter, read-write)

Parameter to specify the value of the divider for the input counter in the range [1, 1000].

pfd1:lf:input-filter-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the band-pass input filter should be enabled.

pfd1:lf:input-level

(REAL parameter, read-only)

Parameter indicating the absolute input signal level (in dBm).

pfd1:lf:input-gain

(REAL parameter, read-write)

Parameter to specify the manual gain factor for the LF input signal when automatic gain control is disabled.

pfd1:lf:signal-level

(REAL parameter, read-only)

Parameter indicating the PFD signal level (in dBm).

pfd1:lf:current-gain

(INTEGER parameter, read-write)

Parameter to specify the current gain for the charge pump in the range [0, 7].

pfd1:lf:polarity

(BOOLEAN parameter, read-write)

Parameter to specify the polarity of the phase detector, "true" meaning positive and "false" negative polarity.

pfd1:lf:tunable-filter-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether the tunable filter for the PFD LF branch should be enabled.

pfd1:lf:tunable-filter-center-frequency

(REAL parameter, read-write)

Parameter to specify the center frequency for the tunable filter, in MHz.

pfd1:lf:agc:

(parameter section)

Parameters controlling the automatic gain control for low-frequency inputs.

pfd1:lf:agc:enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable the automatic gain control.

pfd1:lf:agc:set-level

(REAL parameter, read-write)

Parameter to specify the set-value for the control loop (in dBm).

pfd1:lf:agc:p-gain

(REAL parameter, read-write)

Parameter to specify the proportional gain for the PID controller (in dBm/dB).

pfd1:lf:agc:i-gain

(REAL parameter, read-write)

Parameter to specify the integer gain for the PID controller (in dBm/dB/s).

pfd1:lf:agc:d-gain

(REAL parameter, read-write)

Parameter to specify the differential gain for the PID controller (in s·dBm/dB).

pfd1:lf:frequency-deviation:

(parameter section)

Parameters controlling the frequency deviation analog output.

pfd1:lf:frequency-deviation:value

(INTEGER parameter, read-only)

Parameter indicating the value of the frequency deviation (in Hz).

pfd1:lf:frequency-deviation:analog-output-scaling

(REAL parameter, read-write)

Parameter to specify the scaling factor for the analog output signal on Aux Out 2 (in V/MHz).

pfd1:hf:

(parameter section)

Parameters controlling the high-frequency phase-frequency detector.

pfd1:hf:r-divider

(INTEGER parameter, read-write)

Parameter to specify the value of the divider for the reference counter in the range [1, 1000].

pfd1:hf:n-divider

(INTEGER parameter, read-write)

Parameter to specify the value of the input divider for the N counter. If the value of **:rfdiv2-enabled** is #f, the **:n-divider** must be in the rage [16, 1000]. If the value of **:rfdiv2-enabled** is #t, the **:n-divider** must be in the rage [32, 1000].

pfd1:hf:rfdiv2-enabled

(BOOLEAN parameter, read-write)

Parameter to enable or disable the RF divide-by-2 divider.

pfd1:hf:current-gain

(INTEGER parameter, read-write)

Parameter to specify the current gain for the charge pump in the range [0, 7].

pfd1:hf:polarity

(BOOLEAN parameter, read-write)

Parameter to specify the polarity of the phase detector, "true" meaning positive and "false" negative polarity.

pfd1:event-detector:

(parameter section)

Parameters for the event monitoring.

pfd1:event-detector:phase-error

(REAL parameter, read-only)

Parameter indicating the magnitude of the phase error.

pfd1:event-detector:counter

(INTEGER parameter, read-only)

Parameter indicating the value of the event counter.

pfd1:event-detector:indicator

(BOOLEAN parameter, read-only)

Parameter indicating the value of the digital event monitor.

pfd1:event-detector:indicator-auto-reset-enabled

(BOOLEAN parameter, read-write)

Parameter to specify whether auto-reset of the digital event monitor is enabled:

#t - Enabled, digital event monitor is in "single-shot" mode (latched).

#f - Auto-reset after **indicator-auto-reset-time** milliseconds.

pfd1:event-detector:indicator-auto-reset-time

(INTEGER parameter, read-write)

Parameter to specify the time before resetting the digital event monitor (in ms). Only considered if **indicator-auto-reset-enabled** is set to *#t*.

pfd1:event-detector:reset-counter

(command, no arguments, returns empty tuple)

Reset the event counter.

pfd1:event-detector:reset-indicator

(command, no arguments, returns empty tuple)

Reset the event indicator.

pfd1:digital-io:

(parameter section)

Parameters related to the digital IOs of the board.

pfd1:digital-io:in0

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin 0.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:in1

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin 1.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:in2

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin 2.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:in3

(BOOLEAN parameter, read-only)

Parameter indicating the electrical state of the digital input pin 3.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:out0

(BOOLEAN parameter, read-write)

Parameter indicating the electrical state of the digital input pin 0.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:out1

(BOOLEAN parameter, read-write)

Parameter indicating the electrical state of the digital input pin 1.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:out2

(BOOLEAN parameter, read-write)

Parameter indicating the electrical state of the digital input pin 2.
#t - high signal (5V)
#f - low signal (0V)

pfd1:digital-io:out3

(BOOLEAN parameter, read-write)

Parameter indicating the electrical state of the digital input pin 3.
#t - high signal (5V)
#f - low signal (0V)

pfd1:user-led-mode

(INTEGER parameter, read-write)

Parameter to specify the function of the user LED.
Possible values:

0 - Off (default).

1 - Indicator for the event detector.

2 - Out-of-lock indicator.

3 - RF LF Frequency deviation > 1.0 % indication.

pfd1:save

(command, no arguments, returns empty tuple)

Command to store PFD pro device-specific data to the DLC pro.

pfd1:load

(command, no arguments, returns empty tuple)

Command to restore PFD pro device-specific data from the DLC pro.

pfd2:

(parameter section)

This section provides controls for the second PFD pro device with CANopen node-id 87.

For usage see **pfd1:** on page 257.

pfd3:

(parameter section)

This section provides controls for the third PFD pro device with CANopen node-id 88.

For usage see **pfd1:** on page 257.

pfd4:

(parameter section)

This section provides controls for the fourth PFD pro device with CANopen node-id 89.

For usage see **pfd1:** on page 257.

3.2 Maintenance

Commands and parameters for device maintenance

time

(STRING parameter, read-only)

Parameter indicating the system time of the device.
Format: YYYY-MM-DD hh:mm:ss

time-iso

(STRING parameter, read-only)

Parameter indicating the time of the device with millisecond precision in ISO 8601 format.
Format: YYYY-MM-DDThh:mm:ss.uuuZ

tan

(INTEGER parameter, read-only)

Parameter indicating the *transaction number* for specific service tasks.

system-messages:

(parameter section)

Parameters providing access to system messages.
The information of system messages is provided in the following component structure:

- timestamp in ISO 8601 format
- status character
- priority indicator
- status/message ID (negative value for *Error* and *Alert*-priority messages)
- message text

The priority of a system message reflects the importance of the event that triggered the message.
Priority indicators of system messages:

0 Information: information only; no action required. Example:

```
laser1: new laser head detected
```

1 Warning: The system is operating within the limits of regular operating conditions. However, check for incorrect parameter settings. Example:

```
laser1: laser diode current at upper limit
```

2 Error: System error; action is required to return the system to regular operating conditions. Example:

```
laser1: diode current safety clip (Imax), current switched off
```

3 Alert: Indication of a system defect. Example:

```
TC board not found
```

Note:
In the PC-GUI, system messages are indicated by a lit-up error indicator in the header of the PC-GUI screen. The system messages and the related code are displayed in the footer of the PC-GUI screen. System messages can also be displayed by clicking the error indicator in the header of the PC-GUI screen.
On the touchscreen, system messages are displayed in the bottom right area. Tapping the bell symbol opens the system messages window where all current system messages are displayed. The system messages window is also accessible from the home screen.

system-messages:count

(INTEGER parameter, read-only)

Parameter indicating the number of system messges.
Number of messages in the *show-all* list

system-messages:count-new

(INTEGER parameter, read-only)

Parameter indicating the number of unread system messages.
Number of messages in the *show-new* list

system-messages:latest-message

(STRING parameter, read-only)

Parameter indicating the latest, unread system message.

system-messages:mark-as-read

(command, 1 argument, returns empty tuple)

Arguments:
1. *ID* of type INTEGER

Command to mark a message, identified by a specific ID, as read and remove it from the *show-new* list of new system messages.
The message ID can be retrieved with the *show-all* command.

system-messages:show-all

(command, no arguments, returns empty tuple)

Command to print the list of system messages to the console. Example:

```
> (exec 'system-messages:show-all)
2014-04-02T10:45:19.915Z * 1 (   1002) emission disabled
()
>
```

Each printed line provides a system message in the structure described in **system-messages:**
The status character displayed after the timestamp indicates the "message read" status:

'*' : message unread

' ' : message read

system-messages:show-new

(command, no arguments, returns empty tuple)

Command to print the list of unread system messages to the console.
Each printed line provides a system message in the structure described in **system-messages:**
The * status character displayed after the timestamp indicates the "message unread" status.

system-messages:show-log

(command, no arguments, returns empty tuple)

Command to print the system message log file to the console. Example:

```
> (exec 'system-messages:show-log)
2014-04-01T16:02:52.818Z + 1 (   1002) emission disabled
2014-04-01T16:02:53.600Z + 1 (   3016) laser1: temperature not settled
2014-04-01T16:04:19.922Z - 1 (   3016)
2014-04-01T16:17:25.954Z - 1 (   1002)
2014-04-02T10:45:19.915Z + 1 (   1002) emission disabled
()
>
```

Each printed line provides a system message in the structure described in **system-messages:**
The status character displayed after the timestamp indicates the chronological sequence of messages in the *show-all* list:

'+' : message is added to the *show-all* list

'-' : message is removed from the *show-all* list

system-messages:show-persistent

(command, no arguments, returns empty tuple)

Command to print the persistent log to the console.
The persistent log collects critical system messages, that is, all messages with *Alert* priority, in the DLCpro's flash memory. Example:

```
> (exec 'system-messages:show-persistent)
2013-11-14T10:08:39.257Z + 3 (  -3003) laser1: no peltier connected
2013-11-14T10:08:39.260Z + 3 (  -3005) laser1: temperature sensor missing
()
>
```

Each printed line provides a system message in the structure described in **system-messages:**
The + status character displayed after the timestamp indicates that the message was added to the *show-all* list.

licenses:

(parameter section)

Parameter providing access to the installed license options and license-related commands.

licenses:options:

(parameter section)

Parameter providung a list of TOPTICA license options.

licenses:options:lock:

(parameter section)

Parameter for the TOPTICA Lock License option.

licenses:options:lock:enabled

(BOOLEAN parameter, read-only)

Parameter indicating whether the license option is enabled.
#t - license option enabled
#f - license option disabled.

licenses:options:lock:valid-until

(STRING parameter, read-only)

Parameter indicating the validity of the license option:
- a specific date in ISO8601-format
- 'forever'

licenses:options:dual-laser-operation:

(parameter section)

Parameter for the TOPTICA Dual-Laser-Operation License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:quad-laser-operation:

(parameter section)

Parameter for the TOPTICA Quad-Laser-Operation License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:automatic-nlo-operation:

(parameter section)

Parameter for the TOPTICA Automatic-NLO-Operation License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:pfd1-hf-port:

(parameter section)

Parameter for the TOPTICA PFD1 pro HF port License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:pfd2-hf-port:

(parameter section)

Parameter for the TOPTICA PFD2 pro HF port License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:pfd3-hf-port:

(parameter section)

Parameter for the TOPTICA PFD3 pro HF port License option.

For usage see **licenses:options:lock:** on page 274.

licenses:options:pfd4-hf-port:

(parameter section)

Parameter for the TOPTICA PFD4 pro HF port License option.

For usage see **licenses:options:lock:** on page 274.

licenses:install

(command, 1 argument, returns BOOLEAN)

Arguments:

1. *licensekey* of type STRING

Command to install a license option with a specific license key.

fw-update:

(parameter section)

Commands for applying and diagnosing firmware updates.

fw-update:upload

(command, 1 argument, returns empty tuple)

Arguments:

1. *filename* of type STRING

Command to upload firmware updates of the DLCpro control firmware. Firmware updates are provided by TOPTICA as single ASCII files, containing BASE64-coded binary data.
Start the command with `(exec 'fw-update:upload "filename")`.
The device prompts for the update file:
`waiting for input (terminate with # ) ...`
Send the entire update file. When the file transfer is complete, a message acknowledges:
`transfer complete.`
The end-of-file signal (# character) tells the firmware to process the data.
Multiple firmware updates can be uploaded consecutively. The updates are installed when the device is booted next time.

fw-update:show-log

(command, no arguments, returns empty tuple)

Command to print the firmware update log to the console.

fw-update:show-history

(command, no arguments, returns empty tuple)

Command to print the firmware update history to the console.

system-service-report:

(parameter section)

Parameters to control the service report functionality.

system-service-report:ready

(BOOLEAN parameter, read-only)

Parameter indicating whether a service report request (cf. **:request**) is ready to be printed using **:print**.

system-service-report:service-report

(command, no arguments, returns empty tuple)

Command to print a (base64-encoded) data stream containing detailed information about the system status to the console.
It combines **:request** and **:print** in a single step.

system-service-report:request

(command, no arguments, returns empty tuple)

Command to request the generation of a system summary suitable for the service report.

system-service-report:add-info

(command, 1 argument, returns empty tuple)

Arguments:

1. *text* of type STRING

Command to add informations to service report.

system-service-report:print

(command, no arguments, returns empty tuple)

Command to print a previously requested (cf. **:request**) service report as a data stream to the console.

system-service-report:save-to-usb

(command, no arguments, returns empty tuple)

Command to save a previously requested (cf. **:request**) service report to a USB storage device. The USB device must be available at the DLC pro front. The file will be saved into a folder "toptica".

error-log

(command, no arguments, returns empty tuple)

Command to print the firmware error log file to the console.

service-script

(command, no arguments, returns empty tuple)

Command to execute DeCoF command scripts, provided by TOPTICA service staff.

service-script-from-usb

(command, no arguments, returns empty tuple)

Command to execute DeCoF command scripts, provided by TOPTICA service staff. Note: The scripts must be stored in **toptica** directory and have **.base64** extension. In case when multiple service scripts are provided, they are alphanumeric sorted and the first on the list is executed.

service-report

(command, no arguments, returns empty tuple)

Prints a summary of the most important system components to the console.

3.3 Device Information

Parameters to provide general device information.

uptime

(INTEGER parameter, read-only)

Parameter indicating the accumulated system uptime in seconds. The uptime counter records whenever the device is switched on.

uptime-txt

(STRING parameter, read-only)

Parameter indicating the accumulated system uptime **uptime** as string.
Format: hours:minutes:seconds

fw-ver

(STRING parameter, read-only)

Parameter indicating the version of the currently active firmware.
Note: After a firmware update, the system has to be rebooted to activate the new firmware.

ssw-ver

(STRING parameter, read-only)

Parameter indicating the version of the currently installed system software.

echo

(BOOLEAN parameter, read-write)

Parameter to control the echo behavior of the command console.
#t - each character sent to the device is echoed
#f - no echo
For USB connections the default setting is #t, because this is usually required for use with serial terminal programs (like eg Hyperterminal). For TCP/IP connections the default setting is #f.

serial-number

(STRING parameter, read-only)

Parameter indicating the DLCpro's serial number.

revision

(STRING parameter, read-only)

Parameter indicating the DLCpro's hardware revision number.

system-type

(STRING parameter, read-only)

Parameter indicating the device type. Currently always returns "DLCpro".

system-model

(STRING parameter, read-only)

Parameter indicating the laser hardware composition. The string is built in the following way:
[0:modules]1:laser1[2:laser2[3:laser3 [4:laser4]]]

The module string consists of one or more of the following substrings with an index added, separated by dashes:

- PDH
- FALC
- PFD

The laser1-4 strings consist of one or more of the following substrings, separated by dashes:

- DFB or DFB* (for a DFB laser)
- DL or DL* (for an external cavity laser)
- CBC (for a CBC/XP amplifier)
- CTL (for CTL laser)
- TA or TA* (for a tapered amplifier)
- SHG (for a TOPTICA second harmonic generation)
- FHG (for a TOPTICA fourth harmonic generation)
- servo (for NLO AutoAlign option)
- fiber (for FiberMon option)
- uv (for TOPTICA UV cavity)
- eom (for intra-cavity EOM)
- motor (for motorized diode-lasers)
- opt_probe (for MTA AutoAlign seed probe optimization)
- opt_amp (for MTA AutoAlign amplifier optimization)
- opt_fiber (for MTA AutoAlign fiber coupling optimization)
- shgtc (for temperature stabilized SHG cavity)
- fhgtc (for temperature stabilized FHG cavity)

- hfc (for temperature stabilized high-finesse cavity)

Examples:
"0:PDH1-PDH2-FALC1 1:DL 2:DFB" for a TOPTICA "DL" and a "DFB" laser head with two PDH and one FALC modules.
"1:DL*-TA*-SHG-servo-fiber" for a TOPTICA "TA-SHG pro" laser head with or AutoAlign and FiberMon option.
Asterisks mark modern TOPTICA versions of the respective laser heads, featuring non-volatile memory with factory settings for the most important operation parameters for easy installation.

system-label

(STRING parameter, read-write)

Parameter providing a user-configurable string that can be used to easily identify the device, for example, "pump laser for flux compensator".
On delivery, the **system-label** string is empty.

vcs-id

(STRING parameter, read-only)

Parameter providing an unique identifier for the current firmware in the version control system.

ssw-vcs-id

(STRING parameter, read-only)

Parameter providing an unique identifier for the current system software in the version control system.

build-information:

(parameter section)

Parameters providing the build information.

build-information:build-number

(INTEGER parameter, read-only)

Parameter indicating the internal build number.

build-information:build-id

(STRING parameter, read-only)

Parameter indicating the date of the build.

build-information:build-tag

(STRING parameter, read-only)

Parameter providing a string description of the build.
Format: jenkins-{JOB_NAME}-{BUILD_NUMBER}

system-summary

(command, no arguments, returns empty tuple)

Command to print a summary list of the most important system components to the console.

system-summary-ontimes

(command, no arguments, returns empty tuple)

Command to print a summary of the most importent ontimes of the system.

component-list

(command, no arguments, returns empty tuple)

Command to print a summary list of the most important system components in XML format.

3.4 Network Configuration

Parameters related to the network configuration module
net-conf:

(parameter section)

Parameters providing information about the current network configuration.
Commands for changing the network configuration.
Your device can be controlled via Ethernet. You can either connect it to a local area network (LAN) or directly to your computer. In both cases, the device's TCP/IP network address has to be configured correctly.
In many LANs, the configuration can or must be done automatically by a DHCP server. For a direct PC-to-device connection, the device usually needs a fixed network address assigned.

net-conf:ip-addr

(STRING parameter, read-only)

Parameter indicating the current IP address of the device[5]. To change the IP address, use the **net-conf:set-dhcp** command for automatic address retrieval in a LAN with a DHCP server, or the **net-conf:set-ip** for manual configuration.

[5]If you want to access your device via TCP/IP but don't know the current IP address (e.g. in case of DHCP configuration), you can use the "Identification Server" in Appendix 4.4.2 on page 295 to find out.

net-conf:net-mask

(STRING parameter, read-only)

Parameter indicating the current netmask of the device. To change the netmask, use the **net-conf:dhcp** command for automatic address retrieval in a LAN with a DHCP server, or the **net-conf:set-ip** for manual configuration.

net-conf:gateway

(STRING parameter, read-only)

Parameter indicating the current gateway of the device. To change the gateway, use the **net-conf:dhcp** command for automatic address retrieval in a LAN with a DHCP server, or the **net-conf:set-ip** for manual configuration.

net-conf:hostname

(STRING parameter, read-write)

Parameter to set the hostname of the device.

net-conf:mac-addr

(STRING parameter, read-only)

Parameter indicating the device's MAC[6] address.

net-conf:dhcp

(BOOLEAN parameter, read-only)

Parameter indicating whether the device is configured for automatic IP configuration by a DHCP server.
#t - automatic IP configuration by a DHCP server #f - static IP configuration

net-conf:cmd-port

(INTEGER parameter, read-only)

Parameter indicating the TCP/IP port to access the device's command line console.

net-conf:mon-port

(INTEGER parameter, read-only)

Parameter indicating the TCP/IP port to access the device's monitoring line.
0 - monitoring lines are not supported on this system.

net-conf:set-dhcp

[6]Media Access Control

(command, no arguments, returns empty tuple)

Command to change the device's network adapter configuration for automatic setup by a DHCP server.
After executing the command, the **net-conf:dhcp** parameter will return #t. However, IP address, netmask and gateway did not yet change accordingly. The new network adapter configuration will take effect with the next adapter restart.
To use the DHCP mechanism, reboot the system or use the **net-conf:apply** command.

net-conf:set-ip

(command, 2 arguments, returns empty tuple)

Arguments:

1. *ip-addr* of type STRING
2. *net-mask* of type STRING

Command to change the device's network adapter configuration to a static IP configuration. The desired IP address and netmask must be provided as IPv4 addresses in the following format:
xxx.xxx.xxx.xxx, for example,

```
(exec 'net-conf:set-ip "192.168.1.1" "255.255.255.0")
```

After executing the command, the **net-conf:dhcp** parameter will return #f. However, IP address and netmask did not yet change accordingly. The new network adapter configuration will take effect with the next adapter restart.
. To use the new address, reboot the system or use the **net-conf:apply** command.

net-conf:set-ip-gateway

(command, 3 arguments, returns empty tuple)

Arguments:

1. *ip-addr* of type STRING
2. *net-mask* of type STRING
3. *gateway* of type STRING

Command to change the device's network adapter configuration to a static IP configuration. The desired IP address, netmask and gateway must be provided as IPv4 addresses in the following format:
xxx.xxx.xxx.xxx, for example,

```
(exec 'net-conf:set-ip "192.168.1.1" "255.255.255.0" "192.168.50.100")
```

The gateway may also be empty.
After executing the command, the **net-conf:dhcp** parameter will return #f. However, IP address, netmask and gateway did not yet change accordingly. The new network adapter configuration will take effect with the next adapter restart.
. To use the new address, reboot the system or use the **net-conf:apply** command.

net-conf:apply

(command, no arguments, returns empty tuple)

Command to restart the network adapter with the current network configuration. newline Note: Your current TCP/IP connections can get lost if you execute the **net-conf:apply** command. Be careful when executing the **net-conf:apply** command from within a TCP/IP command console.

3.5 Userlevel

Parameters and commands for user level control.

ul

(INTEGER parameter, read-write)

Parameter indicating the currently active user level.

Some parameters and commands are not made available to all users, either because they are not required for regular operation, or because they can adversely affect the system performance. The following user levels are implemented:

4 - read-only level, lowest priority

3 - normal operation

2 - maintenance level

1 - service level

0 - TOPTICA internal

The lower the user level the more parameters and commands are accessible. It is always possible to change the **ul** parameter to a higher value, but setting it to a lower value requires the **change-ul** command.

change-ul

(command, 2 arguments, returns INTEGER)

Arguments:

1. *ul* of type INTEGER
2. *passwd* of type STRING

Command to change the active user level.

All user levels except for the read-only level (4) are password protected. The password for normal operation (user level 3) can be configured with the **change-password** command. By default, it is an empty string. The higher-priority user-level passwords are predefined.

In order to change the user level, enter the desired level as first argument, and the corresponding password as second argument. Passwords of higher-priority levels are valid for all lower-priority levels as well.

If you provide an empty string instead of the correct password as second argument, the system prints `password:` to prompt you for input. You may then enter the password without any letters being displayed.

The return value is the new user level.

change-password

(command, 1 argument, returns empty tuple)

Arguments:

1. *password* of type STRING

Command to change the password for the NORMAL user level. If the password is not empty, each subsequent remote connection starts in READONLY mode. The user level has to be explicitly changed to NORMAL.
Please note that there is no way to read out the password. Changing the password to empty, resets to default behavior.

4 Appendix

4.1 Signal Channel IDs

The following lists provide the numeric ID values to be entered if a specific signal input or output channel is to be configured, for example, the output channel of a PID controller for lock settings.

ID	signal name	type	remark
special			
-3	none		
-2	Time	x-axis	for display only
-1	Frequency	x-axis	for display only
external signals (BNC connector)			
0	Fine In 1	input channel	
1	Fine In 2		
2	Fast In 3		
4	Fast In 4		
20	Output A	output channel	available for Lock-In modulation
21	Output B		
internal signals (FPGA)			
30	Lock-In Out	input channel	
31	PID 1 Out	internal signal	for display only
32	PID 2 Out		
34	Scan Output		
35	Aux Scan Output		
PDH signals (only available with PDH plugin boards)			
40	PDH Error 1	input channel	
41	PDH In 1		
42	PDH Error 2		
43	PDH In 2		
diode laser related signals (only available with ECDL/DFB/DBR lasers)			

50	Piezo Voltage	output channel	not available for DFB/DBR lasers, available for Lock-In modulation
51	CC Current, Laser Current		available for Lock-In modulation
52	CC AIn A	input channel	
53	CC AIn B		
54	Laser PD, Monitor Photo Diode		available for power stabilization
55	PD EXT, user calibrated laser power		available for power stabilization
56	Laser Set Temperature	output channel	available for Lock-In modulation
57	Laser Actual Temperature	input channel	
58	EOM Voltage	output channel	only available for DL pro FL
tapered amplifier related signals (only for TA laser heads)*			
60	AMPCC AIn	input channel	
61	Seed Power	input channel	not available for *SHG/FHG* laser heads (see 85)
62	Amplifier Power		not available for *SHG/FHG* laser heads (see 84), available for power stabilization
63	Amplifier Current	output channel	
CTL related signals (only for CTL laser heads)			
69	CTL Laser Photodiode	input channel	
70	CTL Laser Power		available for power stabilization
78	CTL Set Wavelength	output channel	
79	CTL Actual Wavelength	input channel	
SHG related signals (only for SHG and FHG laser heads)			
80	SHG Cavity Error Signal	input channel	
81	SHG Cavity Rejection Signal		
82	SHG Intra-Cavity Signal		

83	SHG Power		available for power stabilization
84	Amplifier Power		available for power stabilization
85	Seed Power		
86	Fiber Power		with *FiberMon* option only, available for power stabilization
87	SHG Input Power		
90	SHG Cavity Piezo Voltage Slow	output channel	
91	SHG Cavity Piezo Voltage Fast		
	FHG related signals (only for FHG laser heads)		
110	FHG Cavity Error Signal	input channel	
111	FHG Cavity Rejection Signal		
112	FHG Intra-Cavity Signal		
113	FHG Power		available for power stabilization
120	FHG Cavity Piezo Voltage Slow	output channel	
121	FHG Cavity Piezo Voltage Fast		
	OPO related signals (only for TOPO laser heads)		
144	OPO Pump Power	input channel	
145	OPO Pump Depleted Power		
146	OPO Signal Power		
147	OPO Idler Power		
150	OPO Cavity Piezo Voltage Slow	output channel	available for Lock-In modulation
151	OPO Cavity Piezo Voltage Fast		
	aliases		
100	Lock Input	input channel	for display only

101	Scan Output Channel	output channel	
102	PowerLock Input	input channel	
103	Aux Scan Output Channel	output channel	
Laser independent signals			
1000	CC1 AIn 1	input channel	
1001	CC2 AIn 1		
1002	CC3 AIn 1		
1003	CC4 AIn 1		
1004	CC1 AIn 2		
1005	CC2 AIn 2		
1006	CC3 AIn 2		
1007	CC4 AIn 2		
1010	AMPCC1 AIn		
1011	AMPCC2 AIn		
1014	HCC1 AIn 1		
1015	HCC2 AIn 1		
1016	HCC1 AIn 2		
1017	HCC2 AIn 2		

For the so-called 'alias'-settings [100], [101], [102] and [103], the actually used signal channel is determined by the signal channel setting for the following parameters:

100	Spectrum Input Channel: **laser1:dl:lock:spectrum-input-channel**
101	Scan Output Channel: **laser1:scan:output-channel**
102	Laser Output Power: **laser1:power-stabilization:input-channel**
103	Aux Scan Output Channel: **laser1:scan-aux:output-channel**

Example: If [100] is selected for the Input Trace Signal (laser1:scope:channel:signal), the actual channel of the Input Trace Signal is
Fast In 3 if **laser1:dl:lock:spectrum-input-channel** is set to *2*
Fine In 1 if **laser1:dl:lock:spectrum-input-channel** is set to *0*

If not noted otherwise in the above table, the following rules apply for the usage of the signals:

- All signals can be used for display, i.e. for data acquisition by the laser's scope and

recorder features.

- All **input channels** can be used as "external inputs" (aka *ARC - Analog Remote Control*) and, if a Lock option is installed, as inputs for PIDs or Lock-In detection. Certain input channels can also be used for power stabilization.
- All **output channels** can be used as "feedforward master" for other output channels, as output for signal generators (e.g. scan or wide-scan) or PIDs (if a Lock option is installed). Certain output channels can also be used for Lock-In modulation.

4.2 Scope, Lock and Recorder Binary Data

Most signal display-relevant data is transferred coded as BASE64 binary blobs[7] in parameters like **laser1:scope:data**, **laser1:dl:lock:candidates**, **laser1:dl:lock:background-trace** and **laser1:recorder:data:zoom-data**. Also the return value of the command **laser1:recorder:data:get-data** is formatted in the same way. These blobs consist of multiple blocks of different type. Each block starts with a header, containing an identifier byte and a blocklength value. The block-length is provided as a null-terminated string in decimal format. After the block-length, the payload data is provided. The format of the payload data depends on the type of data.

4.2.1 Data Blocks

The following table illustrates the layout of a single block:

ID	block-length value	'\0'	payload data
(1 byte)	*(multiple bytes)*	*(1 byte)*	*(many bytes)*

1. Example[8]: a signal trace (array of 1000 single precision floating point values) as in **laser1:scope:data**:

ID	block-length value				'\0'	payload data
(1 byte)	*(4 bytes)*				*(1 byte)*	*(4000 bytes)*
'y'	'4'	'0'	'0'	'0'	'\0'	4000 bytes, containing 1000 floating point values

2. Example: state of the lock module (single byte) as in **laser1:dl:lock:candidates**:

ID	block-length value	'\0'	payload data
(1 byte)	*(1 byte)*	*(1 byte)*	*(1 byte)*
's'	'1'	'\0'	2

[7] blob = binary large object

[8] In the following examples, values of single bytes are either given as decimal numbers or as ASCII characters. For example, ASCII character *'y'* is the same as the decimal value *121*.
In some cases, *backslash escaped* characters are used to stress the difference between character and number. For example, *'\0'* means decimal number *0* and not the ASCII character '0' (or decimal 48).

Usually, mutliple blocks are concatenated inside one blob.

The following types of blocks are used:

ID	description
'x'	x-axis values for signal display or wide-scan array of single precision floating point values (see 4.2.2)
'y'	y-axis values of first trace for signal display array of single precision floating point values (see 4.2.2)
'Y'	y-axis values of second trace for signal display array of single precision floating point values (see 4.2.2)
'l'	selected lockpoint single *candidate type* of data (see 4.2.4)
'c'	list of lockpoint candidates array of *candidate type* of data (see 4.2.4)
's'	ID of the lock module's state single byte
't'	lock tracking position, ie center of mass of the x and y data during lock single *candidate type* of data (see 4.2.4). The *type* reflects the type of the lockpoint at the time the lock got closed. If **lock-without-lockpoint** is set, the type will always be *positive-edge*
'a'	y-axis values with of the lower envelope (minimum values) of the first trace for wide-scan display array of single precision floating point values (see 4.2.2)
'A'	y-axis values with of the upper envelope (maximum values) of the first trace for wide-scan display array of single precision floating point values (see 4.2.2)
'b'	y-axis values with of the lower envelope (minimum values) of the second trace for wide-scan display array of single precision floating point values (see 4.2.2)
'B'	y-axis values with of the upper envelope (maximum values) of the second trace for wide-scan display array of single precision floating point values (see 4.2.2)
'i'	index range of the data returned by **laser1:recorder:data:get-data** two 32 bit integer values (see 4.2.3)

4.2.2 Floating Point Format

Non-integer numerical values are represented as single precision floating point values with 32 bit, according to IEEE 754 standard. The most significat bit 31 contains the sign, bits 23 to 30 contain the exponent, and bits 0 to 22 contain the mantissa.

31	30 23	22 0
+-	8 bit exponent	23 bit mantissa

These 32 bits are transferred in little endian manner, starting with the least significant bytes.

first byte		second byte		third byte		fourth byte	
7	0	15	8	23	9	31	24

This is in accordance with the native way of storing single precision floating point numbers on x86-based computers and, for example, the *float* data type in C on such computers.

For arrays of floating point numbers, the length of array must be calculated from the length of the payload block divided by 4 (size of floating point numbers).

Please note that LabVIEW, in contrast to most other programming languages, uses big endian format, independent of the computer hardware.
To use the "unflatten from string" VI to convert DLCpro floating point data into a LabVIEW SGL value, you first need to reverse the byte order of the 4-byte package.

4.2.3 Integer Format

Integer numerical values are, if not noted differently, given as signed 32 bits values in two's complement representation. Like the floating point values they are transferred in little endian manner, starting with the least significant bytes.

first byte		second byte		third byte		fourth byte	
7	0	15	8	23	9	31	24

Again, for LabVIEW the order of the bytes needs to be reversed before converting them into a LabVIEW I32 value.

4.2.4 Candidate Type

Lockpoint candidates are represented by their x and y position and their type.
The x and y postions are provided as single precision floating point values. The type is given as a single byte.

x value	y value	type
(4 byte, floating point)	*(4 byte, floating point)*	*(1 byte)*

The lockpoint candidate type is coded as follows[9]:

0 - none (not a valid candidate/lockpoint)

1 - top (candidate/lockpoint is a peak)

2 - bottom (candidate/lockpoint is a trough)

3 - positive-edge (candidate/lockpoint is on a rising edge)

4 - negative-edge (candidate/lockpoint is on a falling edge)

4.2.5 BASE64

The DLC pro's remote control protocol is a pure ASCII protocol. Binary data is not transmitted as is, but BASE64-coded. BASE64 data uses only 6 bit per byte. A binary blob of n bytes therefore results in $n * 8/6$ bytes of BASE64 code. The following alphabet is used for BASE64 coding and decoding:

```
"ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789+/"
```

4.2.6 Processing Binary Data

Interpreting these binary parameter values requires the following steps:

1. Decode the BASE64 data into a binary data buffer.
2. Read the first byte of the buffer to get the type of the first block.
3. Interpret the buffer contents as string - from the second byte up to the next zero byte. Parse the number from the string in variable n. This gives the number of bytes to read for the first block's payload.
4. Starting from the first byte behind the zero, read the next n bytes. This is the payload data. Now, interpret the data according to the block type read in step 2.
5. If there is more data available behind this block, repeat steps 2-4 at the buffer position behind the last byte of the previous block.

[9] Compare **laser1:dl:lock:lockpoint:type**.

4.3 USB Connection

When connecting your DLC pro to a USB port of your PC, it will be identified as *"DLCpro"* Device and registered as a *virtual COM port* (Windows) or *ttyACMx* serial interface (Linux). You can use this virtual COM port exactly the same way as a real RS232C interface. The communication is much faster than with normal serial interfaces, though. Settings like baud rate, number of data and stop bits, as well a parity, and handshake settings are ignored.

Please note the following hints:

- Send your commands, terminated by a linefeed character (ASCII code 10 decimal, 0x0A hexadecimal).
- The DLC pro's answer is terminated by the prompt which consists of the two characters "> " (greater-than and space) at the beginning of a new line (i.e. after a linefeed character).
- Any terminal emulator like PuTTY on Windows or Minicom or Kermit on Linux can be used to access the command console.

4.4 Ethernet Connection

The fastest and most flexible way of controlling the DLC pro is via the Ethernet interface. The DLC pro's firmware provides several servers that allow different ways of communicating with it. The device has to be connected to a local area network (LAN) or directly to a PC (e.g. with a cross link cable). Further, the DLC pro and the PC must have IP addresses of the same subnet. Upon delivery, the DLC pro is configured to retrieve its IP address automatically via DHCP. To change these settings, use the **net-conf:** commands on a USB console (for details, see chapter 3.4 above).

4.4.1 Telnet Server: Command Console and Monitoring Line

A Telnet server on standard port 1998 provides access to the Command Console. This connection is intended for automated remote control via Ethernet. The full set of control commands, as discussed in this reference manual, can be used on this console. For manual control, you can use any standard Telnet client. A popular choice on Windows is PuTTY or the "telnet" command at the MS-DOS command console. Alternatively, you can try entering

`telnet://xxx.xxx.xxx.xxx:1998`

in the address bar of your web browser, to let Windows choose its favorite Telnet client. The Telnet command also belongs to every standard Linux distribution. For programmatic control proceed as follows::

1. Open TCP/IP connection to port 1998 at the DLC pro's IP address.

2. Set the socket option TCP_NODELAY[10].
3. Receive the incoming welcome text. The DLC pro then sends a specific welcome text which is terminated by the prompt "> " consisting of the two characters (greater-than and space) at the beginning of a new line (that is, after a linefeed character).
4. Send your commands, terminated by a linefeed character (ASCII code 10 decimal, 0x0A hexadecimal).
5. The DLC pro's answer is again terminated by the prompt.
6. At the end close the TCP/IP connection or send a `(quit)`.

The DLC pro will accept up to eight command line connections at the same time. For example, while the DLC pro is controlled by the software of your automated experiment on one connection, the second connection can be used manually for debugging purposes.

In addition to a Command Console, a second telnet connection may be used to establish a Monitoring Line, which uses port 1999. To establish the connection for the Monitoring Line use telnet as described above for the Command Console but using port 1999. For example:

`telnet://xxx.xxx.xxx.xxx:1999`

Please note that no welcome message will be displayed on the Monitoring Line. Depending on the used telnet program and its settings, the input typed in may be not displayed due to the lack of an echo setting.

Section 2.4 describes how to use the Monitoring Line, e.g. how to subscribe for notifications of changes of selected parameters.

4.4.2 Identification Server

To find the DLC pro's IP address (e.g. in a DHCP-based IP configuration), the firmware provides an UDP-based identification service on port 60010.

For programmatically finding a DLC pro in the LAN proceed as follows:

1. Broadcast a short string like "laserfinder" on port 60010 to the whole LAN (address 255.255.255.255) or to the broadcast address of you network adapter (e.g. 192.168.1.255).
2. On the same port, listen for an answer. The DLC pro will answer the broadcast with an UDP message containing information like its serial number and its firmware version as the payload. The IP address of the DLC pro is contained in the header of the UDP packet.
3. Repeat step 2 until no answer is received within a second. If, within a second, no message is received at all, no device is available.

If more than one DLC pro is connected to the LAN, this procedure should return the list of all devices.

[10] This option is not mandatory. However, it usually helps speeding up communication since typically many very short telegrams are exchanged between PC and DLC pro.

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