THORLABS

Series 4000

LDC40xx
TED4015
ITC40xx

SCPI Programmer's Reference Manual

2015

Version: 3.3
Date: 08-Apr-2015

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Warning

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

Attention

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

Note

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

Please read these advices carefully!

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1 General Information

This part of the programmer's reference manual contains specific information about the SCPI command set of the Series 4000 instruments. A general description is followed by explanations of how to use the SCPI commands. The command set is according to the SCPI 1999.0 standard.

The Series 4000 instruments provide a USB 2.0 Full Speed link according to the USB 2.0 specification, the USBTMC specification and the USBTMC USB488 specification.

The instrument's command buffer accepts commands with a maximum length of 255 characters. The instrument's message output buffer can contain response messages of up to 255 characters.

There are VXIpnp/VISA instrument drivers available for Series 4000 instruments. See www.thorlabs.com for downloads.

Related documents:

- TED4000 Series Operation Manual available at www.thorlabs.com
- LDC4000 Series Operation Manual available at www.thorlabs.com
- ITC4000 Series Operation Manual available at www.thorlabs.com
- USB Test and Measurement Class (USBTMC) Specification, Revision 1.0, available at www.usb.org
- USB Test and Measurement Class, Subclass USB488 Specification (USBTMC USB488), Revision 1.0, available at www.usb.org
- IEEE Std 488.2-1992, IEEE Standard Codes, Formats, Protocols, and Common Commands, available at www.ieee.org
- SCPI Specification, Version 1999.0, May, 1999, available at www.ivifoundation.org

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2 Introduction to the SCPI Language

SCPI (Standard Commands for Programmable Instruments) is an ASCII based instrument command language designed for test and measurement instruments, based on a hierarchical tree structure. It means associated commands are grouped together under a common node. For example:

```
SOURce[1]
  :CURRent
    :LIMit
      [:AMPLitude] {MIN|MAX|<amps>}
```

`SOURce` is the root level keyword of the command, `CURRent` is the second level keyword, `LIMit` is the third level keyword and `AMPLitude` is the fourth level keyword, which can be omitted in this case. A colon (`:`) separates between command levels.

For further information about SCPI please see SCPI Standard available at www.ivifoundation.org.

2.1 Syntax Conventions

The format used in this manual for commands is illustrated below:

`SOURce[1]:CURRent {MINimum|MAXimum|<amps>}`

The command syntax shows most commands (and some parameters) as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. For shorter program lines, you can use the abbreviated form. For better program readability, you can send the long form. In the above example `CURR` and `CURRent` are both acceptable syntax spellings. Other spellings like `CUR` or `CURRe` are not allowed and will generate an error. Commands are not case sensitive.

Curly braces ({}) enclose the parameter choices for a given command string. Braces are not sent with the command string.

A vertical bar (|) separates multiple parameter choices for a given command string. For example, `{MINimum|MAXimum|<amps>}` in the above command indicates that you can specify a numeric current parameter, or `MINimum`, or `MAXimum`. The bar is not sent with the command string.

Triangle brackets (<>) indicate that you must specify a value for the enclosed parameter. For example, the above syntax statement shows the `<amps>` parameter enclosed in triangle brackets. The brackets are not sent with the command string. You must specify a value for the parameter (for example `5.0`) unless you select one of the other options shown in the syntax (for example `MIN`).

Some parameters and even parts of the command itself are enclosed in square brackets (`[]`). This indicates that the part of the command or the parameter is optional and can be omitted. The brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument chooses a default value.

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2.2 Command Separators

A colon (:) is used to separate a command keyword from a lower-level keyword. You must insert a blank space to separate a parameter from a command keyword. If a command requires more than one parameter, you must separate adjacent parameters using a comma (,) as shown below:

```
MEM:STAT:NAME 1,"My setting"
```

A semicolon (;) is used to separate commands within the same subsystem, and can also minimize typing. For example, sending the following command string:

```
DISP:BRIG 1;CONT 0.5
```

... is the same as sending the following two commands:

```
DISP:BRIG 1
DISP:CONT 0.5
```

Use a semicolon and a colon to link commands from different subsystems. The colon resets the command tree to the root level. For example:

```
SOURce:CURRent 0.5;:OUTPut ON
```

2.3 Using the MIN, MAX and DEF Parameters

For many commands, you can substitute `MINimum` or `MAXimum` in place of a parameter. In some cases you may also substitute `DEFault`.

For example, consider the following command:

```
SOURce:TEMPerature:PROTection:WINDow {MIN|MAX|DEF|<temp>}
SOURce[1]
  :CURRent
    :LIMit
      [:AMPLitude] {MIN|MAX|<amps>}
```

Instead of selecting a specific value for the `<temp>` parameter, you can substitute `MIN` or `MINimum` to set the value to its minimum, `MAX` or `MAXimum` to set the value to its maximum, `DEF` or `DEFault` to set the value to the default value.

For reasons of clarity the following parts of commands are written in short form only throughout this manual:

Original Form	Short Form
{MINimum|MAXimum|DEFault|<value>}	{MIN|MAX|DEF|<value>}
{MINimum|MAXimum|DEFault}	{MIN|MAX|DEF}
{MINimum|MAXimum|<value>}	{MIN|MAX|<value>}
{MINimum|MAXimum}	{MIN|MAX}

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2.4 Querying Parameter Settings

You can query the current value of most parameters by adding a question mark (?) to the command. For example, the following command sets the temperature setpoint:

```
SOURce:CURRent 5.0
```

You can then query the value by typing:

```
SOURce:CURRent?
```

You can also query the minimum or maximum and - where specified - the default values as follows:

```
SOURce:CURRent? MINimum
SOURce:CURRent? MAXimum
```

2.5 Command Terminators

A command string sent to the instrument must terminate with a <new line> (<NL>) character. Command string termination will always reset the current SCPI command path to the root level.

2.6 Parameter Types

The SCPI language defines several data formats to be used in program messages and response messages.

2.6.1 Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. Special values for numeric parameters such as `MIN`, `MAX`, and `DEF` may also be accepted. You can also send engineering unit suffixes with numeric parameters (e.g., M, k, m, or u). If a command accepts only certain specific values, the instrument will automatically round the input numeric parameter to the accepted values.

Additionally numeric parameters can be programmed using binary, decimal, hexadecimal or octal data formats for the parameter value (for a detailed description of numeric formats see chapter 7.7.4 <NONDECIMAL NUMERIC PROGRAM DATA> of IEEE488.2-1992).

Example

The four commands program the *Auxiliary Enable Register* to the same value:

→ `STAT:AUX:ENAB 2081`
Program the *Auxiliary Enable Register* with 2018 decimal.

→ `STAT:AUX:ENAB #H821`
Program the *Auxiliary Enable Register* with 821 hexadecimal.

→ `STAT:AUX:ENAB #Q4041`
Program the *Auxiliary Enable Register* with 4041 octal.

→ `STAT:AUX:ENAB #B100000100001`
Program the *Auxiliary Enable Register* with 100000100001 binary.

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2.6.2 Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (like `CELSius`, `FAHRenheit` or `KELVin`). They have a short form and a long form just like command keywords. You can mix upper- and lower-case letters. Query responses will always return the short form in all upper-case letters.

Example

The following command requires a discrete parameter for the temperature unit:

→ `UNIT:TEMPerature {C|CEL|CELSius|F|FAR|FAHRenheit|K|KELVin}`

Discrete parameters may also have a default condition. In this manual the default conditions are underlined.

2.6.3 Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrument will accept `OFF` or `0`. For a true condition, the instrument will accept `ON` or `1`. When you query a boolean setting, the instrument will always return `0` or `1`.

Boolean parameters may also have a default condition. In this manual the default conditions are underlined.

2.6.4 ASCII String Parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote. You can include the quote delimiter as part of the string by typing it twice without any characters in between.

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3 Commands by Subsystem

3.1 IEEE-488.2 Commands

The IEEE-488.2 standard defines a set of common commands that perform functions such as reset, self-test, and status operations. Common commands always begin with an asterisk (*), are three characters in length, and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands. IEEE488.2 commands are device commands that are common to all devices according to the IEEE488.2 standard. Most of the commands are described in detail in this section. The following common commands associated with the status structure are related to the STATus Subsystem Commands 65 section: `*CLS,*ESE,*ESE?,*ESR?,*SRE,*SRE?,*STB?`

See also figure Status Structure 65.

Table <%TABLENO++%>: IEEE-488.2 commands

Mnemonic	Name	Description
*CLS 14	Clear status	Clear all event registers and Error Queue
*ESE 14 <value>	Event enable command	Program the *Standard Event Enable Register*
*ESE? 14	Event enable query	Read the *Standard Event Enable Register*
*ESR? 14	Event status register query	Read and clear the *Standard Event Register*
*IDN? 11	Identification query	Read the unit's identification string
*OPC 12	Operation complete command	Set the Operation Complete bit in the *Standard Event Register*
*OPC? 12	Operation complete query	Place a 1 into the output queue when all device operations have been completed
*RCL 12 <value>	Recall command	Return the unit to the user-saved setup
*RST 11	Reset command	Return the unit to the *RST default condition
*SAV 12 <value>	Save default device setting	Initialize the content of save/recall registers
*SDS 12 <value>	Save default device setting	Initialize the content of save/recall registers
*SRE 13 <value>	Service request enable command	Program the *Service Request Enable Register*
*SRE? 13	Service request enable query	Read the *Service Request Enable Register*
*STB? 13	Status byte query	Read the *Status Byte Register*
*TST? 12	Self-test query	Perform the unit's self-test and return the result.
*WAI 13	Wait-to-continue command	Wait until all previous commands are executed

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3.1.1 *IDN? - Identification Query

Syntax

`*IDN?`

Description

The identification query reads the instrument's identification code which contains four comma-separated fields. The first field is the manufacturer, the second field is the model code, the third filed is the serial number, and the fourth field is the firmware revision code which contains two (LDC4000) or three (TED4000, ITC4000) codes separated by slashes (/).

The query is sent in the following format:

`THORLABS,MMM,SSS,X.X.X/Y.Y.Y/Z.Z.Z`

Where:

`MMM`	is the model code
`SSS`	is the serial number
`X.X.X`	is the instrument firmware revision level
`Y.Y.Y`	is the firmware revision level of the front panel board
`Z.Z.Z`	is the firmware revision level of the temperature controller board (TED4000, ITC4000 only)

Example

→ `*IDN?`
Query the ID code.

← `THORLABS,ITC4020,E12345678,1.4.0/2.0.3/1.6.0`
Typical response.

3.1.2 *RST - Reset

Syntax

`*RST`

Description

When the `*RST` command is sent, the instrument performs the following operations:

- Switches off the instrument's outputs.
- Sets the direction of general purpose I/O1..4 to input.
- Switches photodiode BIAS to OFF

3.1.3 *SAV, *RCL, *SDS - Save/Recall Setup

Syntax

```
*SAV <value>
*RCL <value>
*SDS <value>
```

Description

Value: 0..7 Memory location 1 ... 8

Use the *SAV command to save the present instrument setup configuration in non-volatile (state-) memory for later recall. The *RCL command is used to restore the instrument to the saved setup configuration. Eight setup configurations can be saved and recalled.

Use the *SDS command to initialize the selected (state-) memory with factory default settings. Your settings will be overwritten. See also chapter Memory Subsystem Commands 74 and appendix Instrument Default Settings 86.

Example

→ *SAV 1
Saves the present instrument setup configuration to memory location 2.

3.1.4 *TST? - Self Test

Syntax

```
*TST?
```

Description

Use this query command to perform the instrument self-test routine. The command places the coded result in the output queue. A returned value of zero (0) indicates that the test passed, other values indicate that the test failed and the error code is placed into the instrument's error queue.

3.1.5 *OPC, *OPC? - Operation Complete

Syntax

```
*OPC
*OPC?
```

Description

When *OPC is sent, the OPC bit in the *Standard Event Register* will be set after all pending command operations are complete. When *OPC? is sent, an ASCII 1 is placed in the output queue after all pending command operations are complete.

Typically, either one of these commands is sent after the INITiate command. The INITiate command is used to take the instrument out of idle in order to perform measurements. While operating within the trigger model layers, many sent commands will not execute. After all programmed operations are completed, the instrument returns to the idle state at which time all pending commands (including *OPC and/or *OPC?) are executed. When executing the OPC bit in the status structure is set and/or an ASCII 1 is placed in the output queue.

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3.1.6 *WAI - Wait To Continue

Syntax

`*WAI`

Description

The *WAI command is a no operation command for the instrument and thus, does not need to be used. It is there for conformance to IEEE488.2.

3.1.7 *STB?

Syntax

`*STB?`

Description

The `*STB?` command queries the instrument's *Status Byte Register*. This is a read-only register and the bits are not cleared when you read the register. See also figure Status Structure 65.

Table <%TABLENO++%>: *Status Byte Register*

Bit #	Decimal Value	Mnemonic - Description
0	1	AUX - Auxiliary Status Structure Summary Bit One or more bits are set in the *Auxiliary Event Register* (bits must be enabled, see *Auxiliary Status Register Group* 69).
1	2	MEAS - Measurement Status Structure Summary Bit One or more bits are set in the *Measurement Event Register* (bits must be enabled, see *Measurement Status Register Group* 70).
2	4	EAV - Error Available Bit One or more errors have been stored in the Error Queue. Use the `SYSTem:ERRor?[:NEXT]` 16 command to read and delete errors.
3	8	QUES - Questionable Data Structure Summary Bit One or more bits are set in the *Questionable Event Register* (bits must be enabled, see *Questionable Data Register Group* 71).
4	16	MAV - Message Available Bit Data is available in the instrument's output buffer.
5	32	ESB - Standard Event Status Bit One or more bits are set in the *Standard Event Register* (bits must be enabled, see `*ESE` 14 command).
6	64	RQS/MSS - Request Service / Master Summary Status Bit One or more bits are set in the *Status Byte Register* and may generate a Request for Service (RQS). Bits must be enabled using the `*SRE` 14 command.
7	128	OPER - Standard Operation Status Summary Bit One or more bits are set in the *Standard Operation Register* (bits must be enabled, see `STATus:OPERation:ENABle` 72 command).

3.1.8 *SRE, *SRE?

Syntax

`*SRE <value>`

`*SRE?`

Description

The `*SRE` command enables bits in the enable register (*Service Request Enable Register*) for the *Status Byte Register Group*. See table *Status Byte Register* 13 for a description of the bits. Once enabled, the corresponding bits may generate a Request for Service (RQS) in the status byte. This RQS event may generate a "call back" to your application as a type of asynchronous interrupt.

3.1.9 *CLS

Syntax

`*CLS`

Description

The `*CLS` command clears the event registers in all register groups. This command also clears the error queue.

3.1.10 *ESR?, *ESE, *ESE?

Syntax

`*ESR?`

`*ESE <value>`

`*ESE?`

Description

The `*ESR?` command queries the *Standard Event Register*. In order to be reported to the *Status Byte Register*, the corresponding bits in the event register must be enabled using the `*ESE` command.

The `*ESE` command enables bits in the enable register (*Standard Event Status Enable Register*) for the *Standard Event Register Group*. The selected bits are then reported to bit 5 of the *Status Byte Register*.

See also chapter Status Subsystem 65 and figure Status Structure 65.

The following table lists the bit definitions for the *Standard Event Register Group.*

Table <%TABLENO++%>: *Standard Event Register*

Bit #	Decimal Value	Description
0	1	Operation Complete All commands prior to and including `*OPC` 12 have been executed
1	2	not used
2	4	Query Error The instrument tried to read the output buffer but it was empty or a new command line was received before a previous query has been read or both the input and output buffers are full.
3	8	Device Dependent Error A self-test or calibration error occurred (an error in the -300...-399 range or any positive error has been generated). For a complete listing of error messages, see chapter SCPI Error Messages 81.

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Bit #	Decimal Value	Description
4	16	Execution Error An execution error occurred (an error in the -200...-299 range has been generated).
5	32	Command Error A command syntax error occurred (an error in the -100...-199 range has been generated).
6	64	User Request
7	128	Power On Power has been turned off and on since the last time the event register was read or cleared.

Example

→ *ESE 4

Sets bit 2 of the *Standard Event Status Enable Register* which enables bit 2 of the *Standard Event Register* to be reported to bit 5 of the *Status Byte Register*.

3.2 System Subsystem Commands

Table <%TABLENO++%>: System Subsystem Commands

Command	Description
SYSTem 22	
:BEEPer 16	
[:IMMediate]	Issues an audible signal
:STATE {ON|1|OFF|0}	Activates/deactivates the beeper
:STATe?	Returns the state of the beeper
:ERRor 16	
[:NEXT]?	Returns the latest <error code>, "Message"
:LFRequency 17 {50|60|AUTO}	Sets the line frequency to fixed 50/60Hz or auto detect
:ACTual?	Returns the used line frequency
:LFRequency? 17	Returns the line frequency setting
:VERSion? 17	Returns the level of SCPI standard (1999.0)

3.2.1 Beeper

Syntax

```
SYSTem:BEEPer[:IMMediate]
SYSTem:BEEPer:STATe {ON|1|OFF|0}
SYSTem:BEEPer:STATe?
```

Description

The `SYSTem:BEEPer[:IMMediate]` issues an audible signal.

The `SYSTem:BEEPer:STATe` command activates or deactivates the beeper.

Example

→ `SYST:BEEP`
The instrument will issue an audible signal.

→ `SYST:BEEP:STAT?`
Queries the state of the beeper activation.

← `1`
Response for beeper activated. The response is ASCII `1` if the beeper is activated or an ASCII `0` if the beeper is deactivated.

3.2.2 Error Query

Syntax

```
SYSTem:ERRor[:NEXT]?
```

Description

The `SYSTem:ERRor[:NEXT]?` command queries the instrument's error queue. This is a query-only command. For a detailed list of possible error codes see chapter SCPI Error Messages 81.

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Example

→ `SYST:ERR?`
Query the error queue.

← `+0,"No error"`
Typical response.

3.2.3 Line Frequency

Syntax

`SYSTem:LFRequency {50|60|AUTO}`
`SYSTem:LFRequency:ACTual?`
`SYSTem:LFRequency?`

Description

The `SYSTem:LFRequency` sets the line frequency to use for signal filtering to the given value or to automatic detection.

With the `SYSTem:LFRequency:ACTual?` query the actual used value can be retrieved.

The `SYSTem:LFRequency?` query returns the line frequency setting.

Example

→ `SYST:LFR 50`
Sets the line frequency setting to 50Hz.

→ `SYST:LFR:ACT?`
Queries the actual used line frequency.

← `60`
Typical response.

3.2.4 SCPI Version Query

Syntax

`SYSTem:VERSion?`

Description

The `SYSTem:VERSion?` command queries the level of the SCPI standard implemented. This is a query–only command.

Example

→ `SYST:VERS?`
Query the SCPI version.

← `1999.0`
Typical response.

3.3 Measurement Commands

Table <%TABLENO++%>: Measurement Commands for a TED4000 Series Instrument

Command	Description
ABORt 22	Aborts the current measurement
CONFigure[:SCALar] 22	
[:TEMPerature]	Configures instrument for temperature measurement
:CURRent[1][:DC]	Configures instrument for TEC current measurement
:VOLTage[1][:DC]	Configures instrument for TEC voltage measurement
:POWer[1]	Configures instrument for TEC power measurement
:TSENsor	Configures for sensor signal measurement
CONFigure? 22	Returns the current configuration
INITiate[:IMMediate] 24	Starts measurement
FETCh? 24	Returns the last measurement data. The data returned is the data configured with the last CONFigure[:SCALar] or the last MEASure[:SCALar] command
FETCh 24	
:TEMPerature?	Returns the last measured temperature
:CURRent[1][:DC]?	Returns the last measured TEC current
:VOLTage[1][:DC]?	Returns the last measured TEC voltage
:POWer[1]?	Returns the last measured TEC power
:TSENsor?	Returns the last measured sensor signal
READ? 26	Starts new measurement and returns data
MEASure[:SCALar] 26	
[:TEMPerature]?	Measures temperature
:CURRent[1][:DC]?	Measures TEC current
:VOLTage[1][:DC]?	Measures TEC voltage
:POWer[1]?	Measures TEC power
:TSENsor?	Measures sensor signal

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Table <%TABLENO++%>: Measurement Commands for a LDC4000 Series Instrument

Command	Description
ABORt 22	Aborts the current measurement
CONFigure[:SCALar] 22	
[:CURRent][1][:DC]	Configures instrument for LD current measurement
:VOLTage[1][:DC]	Configures instrument for LD voltage measurement
:CURRent2[:DC]	Configures instrument for PD current measurement
:POWer2	Configures instrument for power measurement via photodiode
:VOLTage2[:DC]	Configures instrument for thermopile/power meter voltage measurement
:POWer3	Configures instrument for power measurement via thermopile/power meter
:POWer[1]	Configures instrument for LD electrical input power measurement
CONFigure? 22	Returns the current configuration
INITiate[:IMMediate] 24	Starts measurement
FETCh? 24	Returns the last measurement data. The data returned is the data configured with the last CONFigure[:SCALar] or the last MEASure[:SCALar] command
FETCh 24	
:CURRent[1][:DC]?	Returns the last measured LD current
:VOLTage[1][:DC]?	Returns the last measured LD voltage
:CURRent2[:DC]?	Returns the last measured PD current
:POWer2?	Returns the last measured optical power (via PD)
:VOLTage2[:DC]?	Returns the last measured thermopile/power meter voltage
:POWer3?	Returns the last measured optical power (via thermopile/power meter)
:POWer[1]?	Returns the last measured LD input electrical power
READ? 26	Starts new measurement and returns data
MEASure[:SCALar] 26	
[:CURRent][1][:DC]?	Measures LD current
:VOLTage[1][:DC]?	Measures LD voltage
:CURRent2[:DC]?	Measures PD current
:POWer2?	Measures LD power via PD
:VOLTage2[:DC]?	Measures thermopile/power meter voltage
:POWer3?	Measures LD power via thermopile/power meter
:POWer[1]?	Measures LD electrical input power

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Table <%TABLENO++%>: Measurement Commands for a ITC4000 Series Instrument

Command	Description
ABORt 22	Aborts the current measurement
CONFigure[:SCALar] 22	
:TEMPerature	Configures instrument for temperature measurement
:CURRent3[:DC]	Configures instrument for TEC current measurement
:VOLTage3[:DC]	Configures instrument for TEC voltage measurement
:POWer4	Configures instrument for TEC power measurement
:TSENsor	Configures instrument for temperature sensor signal measurement
[:CURRent][1][:DC]	Configures instrument for LD current measurement
:VOLTage[1][:DC]	Configures instrument for LD voltage measurement
:CURRent2[:DC]	Configures instrument for PD current measurement
:POWer2	Configures instrument for for power measurement via photodiode
:VOLTage2[:DC]	Configures instrument for thermopile/power meter voltage measurement
:POWer3?	Configures instrument for power measurement via thermopile/power meter
:POWer[1]?	Configures instrument for LD electrical input power measurement
CONFigure? 22	Returns the current configuration
INITiate[:IMMediate] 24	Starts measurement
FETCh? 24	Returns the last measurement data. The data returned is the data configured with the last CONFigure[:SCALar] or the last MEASure[:SCALar] command
FETCh 24	
:TEMPerature?	Returns the last measured temperature
:CURRent3[:DC]?	Returns the last measured TEC current
:VOLTage3[:DC]?	Returns the last measured TEC voltage
:POWer4?	Returns the last measured TEC power
:TSENsor?	Returns the last measured temperature sensor signal
:CURRent[1][:DC]?	Returns the last measured LD current
:VOLTage[1][:DC]?	Returns the last measured LD voltage
:CURRent2[:DC]?	Returns the last measured PD current
:POWer2?	Returns the last measured optical power (via PD)
:VOLTage2[:DC]?	Returns the last measured thermopile/power meter voltage
:POWer3?	Returns the last measured optical power (via thermopile/power meter)
:POWer[1]?	Returns the last measured LD input electrical power
READ? 26	Starts new measurement and returns data
MEASure[:SCALar] 26	
:TEMPerature?	Measures temperature
:CURRent3[:DC]?	Measures TEC current
:VOLTage3[:DC]?	Measures TEC voltage
:POWer4?	Measures TEC power

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Command	Description
:TSENsor?	Measures temperature sensor signal
:CURRent[1][:DC]?	Measures LD current
:VOLTage[1][:DC]?	Measures LD voltage
:CURRent2[:DC]?	Measures PD current
:POWer2?	Measures LD power via PD
:VOLTage2[:DC]?	Measures thermopile/power meter voltage
:POWer3?	Measures LD power via thermopile/power meter
:POWer[1]?	Measures LD electrical input power

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3.3.1 Abort Measurement in Progres

Syntax

```
ABORt
```

Description

This command aborts a measurement in progress.

Remarks

This command aborts a measurement a measurement in progress and stops, returning the instrument to the idle state.

Example

→ `ABOR`
Abort the measurement in progress.

3.3.2 Configuring a Measurement

Syntax

For TED4000 Series instruments:

```
CONFigure[:SCALar][:TEMPerature]
CONFigure[:SCALar]:CURRent[1][:DC]
CONFigure[:SCALar]:VOLTage[1][:DC]
CONFigure[:SCALar]:POWer[1]
CONFigure[:SCALar]:TSENsor
CONFigure?
```

For LDC4000 Series instruments:

```
CONFigure[:SCALar][:CURRent][1][:DC]
CONFigure[:SCALar]:VOLTage[1][:DC]
CONFigure[:SCALar]:CURRent2[:DC]
CONFigure[:SCALar]:POWer2
CONFigure[:SCALar]:VOLTage2[:DC]
CONFigure[:SCALar]:POWer3
CONFigure[:SCALar]:POWer[1]
CONFigure?
```

For ITC4000 Series instruments:

```
CONFigure[:SCALar]:TEMPerature
CONFigure[:SCALar]:CURRent3[:DC]
CONFigure[:SCALar]:VOLTage3[:DC]
CONFigure[:SCALar]:POWer4
CONFigure[:SCALar]:TSENsor
CONFigure[:SCALar][:CURRent][1][:DC]
CONFigure[:SCALar]:VOLTage[1][:DC]
CONFigure[:SCALar]:CURRent2[:DC]
CONFigure[:SCALar]:POWer2
CONFigure[:SCALar]:VOLTage2[:DC]
CONFigure[:SCALar]:POWer3
CONFigure[:SCALar]:POWer[1]
CONFigure?
```


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Description

Configures the instrument to measure the selected value. The `CONFigure` command does not perform the measurement. Use the `INITiate` or `READ?` command to take the configured measurement. The configuration query returns the current measurement configuration.

Example

The following program segment configures a TED4000 Series instrument for temperature measurements and performs one measurement with the `READ?` command.

→ `CONF:TEMP`
Configure the instrument for temperature measurement.

→ `READ?`
Perform a measurement and send the reading to the output buffer.

← `2.500000E+01`
Typical response.

Example

The following program segment configures a TED4000 Series instrument for temperature measurements and performs one measurement with the `INITiate[:IMMediate]` and `FETCh?` command sequence.

→ `CONF:TEMP`
Configure the instrument for temperature measurement.

→ `INIT`
Perform the measurement and store reading in memory.

→ `FETC?`
Transfer reading from memory to instrument's output buffer.

← `2.500000E+01`
Typical response.

Example

→ `CONF?`
Query the current measurement configuration.

← `TEMP`
Typical response.

Example

The following program segment configures a LDC4000 Series instrument for thermopile/power meter voltage measurements and performs one measurement with the `INITiate[:IMMediate]` and `FETCh?` command sequence.

→ `CONF:VOLT2`
Configure the instrument for thermopile/power meter voltage measurement.

→ `INIT`
Perform the measurement and store reading in memory.

→ `FETC?`
Transfer reading from memory to instrument's output buffer.

← `3.770000E-01`
Typical response.

Example

The following program segment configures a ITC4000 Series instrument for TEC current measurement and performs one measurement with the `READ?` command.

→ `CONF:CURR3`
Configure the instrument for TEC current measurement.

→ `READ?`
Perform a measurement and send the reading to the output buffer.

← `6.532000E+00`
Typical response.

3.3.3 Initiating a Measurement

Syntax

```
INITiate[:IMMediate]
```

Description

This command performs a previously configured measurement, and stores the reading in memory.

Example

The following program segment configures a TED4000 / ITC4000 Series Instrument for temperature measurements and performs one measurement.

→ `CONF:TEMP`
Configure the instrument for temperature measurement.

→ `INIT`
Perform the measurement and store reading in memory.

→ `FETC?`
Transfer reading from memory to instrument's output buffer.

← `2.500000E+01`
Typical response.

3.3.4 Fetch a Measurement

Syntax

For TED4000 Series instruments:

```
FETCh?
FETCh:TEMPerature?
FETCh:CURRent[1][:DC]?
FETCh:VOLTage[1][:DC]?
FETCh:POWer[1]?
FETCh:TSENsor?
```

For LDC4000 Series instruments:

```
FETCh?
```

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FETCh:CURRent[1][:DC]?
FETCh:VOLTage[1][:DC]?
FETCh:CURRent2[:DC]?
FETCh:POWer2?
FETCh:VOLTage2[:DC]?
FETCh:POWer3?
FETCh:POWer[1]?

For ITC4000 Series instruments:

FETCh?
FETCh:TEMPerature?
FETCh:CURRent3[:DC]?
FETCh:VOLTage3[:DC]?
FETCh:POWer4?
FETCh:TSENsor?
FETCh:CURRent[1][:DC]?
FETCh:VOLTage[1][:DC]?
FETCh:CURRent2[:DC]?
FETCh:POWer2?
FETCh:VOLTage2[:DC]?
FETCh:POWer3?
FETCh:POWer[1]?

Description

This command transfers readings from memory to the instrument's output buffer where you can read them into your computer. The readings are not erased from memory when you read them. You can send the command multiple times to retrieve the same data. With the FETCh? command the last configured measurement will be transferred to the instruments output buffer. With FETCh:XXX? the value of the last measurement of XXX will be transferred to the instruments output buffer.

Example

→ FETC?
Query last measurement.

← 2.500000E+01
Typical response.

Example

→ FETC:POW2?
Query last measurement of optical power via photodiode of an ITC4000 Series instrument.

← 4.520000E-03
Typical response.

3.3.5 Read Measurement Data

Syntax

`READ?`

Description

The `READ?` command performs a previously configured measurement, and then sends the reading to the instrument output buffer. It has the same effect as `INITiate[:IMMediate]` followed by the `FETCh?` command.

Example

The following program segment configures a TED4000 / ITC4000 Series instrument for temperature measurements and performs one measurement.

→ `CONF:TEMP`
Configure the instrument for temperature measurement.

→ `READ?`
Perform a measurement and send the reading to the output buffer.

← `2.500000E+01`
Typical response.

3.3.6 Simple Measurement

Syntax

For TED4000 Series instruments:

```
MEASure[:SCALar][:TEMPerature]?
MEASure[:SCALar][:CURRent][1][:DC]?
MEASure[:SCALar]:VOLTage[1][:DC]?
MEASure[:SCALar]:POWer[1]?
MEASure[:SCALar]:TSENsor?
```

For LDC4000 Series instruments:

```
MEASure[:SCALar][:CURRent][1][:DC]?
MEASure[:SCALar]:VOLTage[1][:DC]?
MEASure[:SCALar]:CURRent2[:DC]?
MEASure[:SCALar]:POWer2?
MEASure[:SCALar]:VOLTage2[:DC]?
MEASure[:SCALar]:POWer3?
MEASure[:SCALar]:POWer[1]?
```

For ITC4000 Series instruments:

```
MEASure[:SCALar]:TEMPerature?
MEASure[:SCALar]:CURRent3[:DC]?
MEASure[:SCALar]:VOLTage3[:DC]?
MEASure[:SCALar]:POWer4?
MEASure[:SCALar]:TSENsor?
MEASure[:SCALar][:CURRent[1]][:DC]?
MEASure[:SCALar]:VOLTage[1][:DC]?
MEASure[:SCALar]:CURRent2[:DC]?
MEASure[:SCALar]:POWer2?
```


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`MEASure[:SCALar]:VOLTage2[:DC]?`
`MEASure[:SCALar]:POWer3?`
`MEASure[:SCALar]:POWer[1]?`

Description

The `MEASure?` command provides the easiest way to program the instrument for measurements. However, this command does not offer much flexibility. The results are sent directly to the instrument's output buffer. Sending `MEASure?` is functionally the same as sending `CONFigure` followed immediately by a `READ?` command.

Example

→ `MEAS:TEMP?`
Query temperature of a TED4000 / ITC4000 Series instrument.

← `2.500000E+01`
Typical response.

3.4 LD Output Commands

The OUTPut[1] subsystem controls the LD output of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only. For LDC4000 and ITC4000 Series instruments the command suffix is 1 (can be omitted).

Table <%TABLENO++%>: LD Output Commands

Command	Description
OUTPut[1]	Path to LD output
[:STATe] 29 {OFF|ON|0|1}	Set output state
:DELay 29 {MIN|MAX|DEF|<seconds>}	Set switch-on delay
:POLarity 30 {NORMal|CG|INVerted|AG}	Set output polarity
:FILTer 30 [:LPASs]	Path to LD output low pass filter
[:STATe] {ON|1|OFF|0}	Enables/disables LD output low pass filter (since firmware V1.5)
[:STATe]?	Returns output filter state (since firmwareV1.5)
:PROTection	
:VOLTage	
[:LEVel] 31 {MIN|MAX|DEF|<volts>}	Set output protection voltage
[:LEVel]? 31 {MIN|MAX|DEF}	Return output protection voltage
:TRIPped? 33	Return voltage protection tripped
:EXTernal	
[:MODE] 32 {OFF|PROTection|ENABle}	Set external protection mode
:TRIPped? 33	Return external protection tripped
:INTernal	
[:MODE] 31 {OFF|PROTection|ENABle}	Set internal protection mode
:TRIPped? 33	Return internal protection tripped
:INTLock	
:TRIPped? 33	Return interlock protection tripped
:KEYLock	
:TRIPped? 33	Return front panel key switch protection tripped
:OTEMp	
:TRIPped? 33	Return over temperature protection tripped

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3.4.1 Output State

Syntax

```
OUTPut[1][:STATe] {OFF|0|ON|1}
OUTPut[1][:STATe]?
```

Description

The `OUTPut[1][:STATe]` command switches the instrument's LD output on/off.

Example

→ `OUTP ON`
Switches the LD output on.

→ `OUTP?`
Queries the state of the LD output.

← `1`
The response is ASCII `1` if the output is switched on or an ASCII `0` if the output is off.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

Note

The `*RST` 11 command switches the output off.

3.4.2 Switch-On Delay

Syntax

```
OUTPut[1]:DELay {MIN|MAX|DEF|<seconds>}
OUTPut[1]:DELay? [{MIN|MAX|DEF}]
```

Description

The `OUTPut[1]:DELay` sets the output switch-on delay of the LD output.

Example

→ `OUTP:DEL 3`
Sets the LD output switch-on delay to 3 seconds.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.4.3 Polarity

Syntax

`OUTPut[1]:POLarity {NORMal|CG|INVerted|AG}`
`OUTPut[1]:POLarity?`

Description

The `OUTPut[1]:POLarity` command sets the LD output polarity to cathode ground (`NORMal` or `CG`) or anode ground (`INVerted` or `AG`). The parameters `NORMal` and `INVerted` are for SCPI conformance.

Example

→ `OUTP:POL CG`
Sets the LD output polarity to cathode ground.

→ `OUTP:POL?`
Queries the LD output polarity.

← `CG`
The response is either `CG` or `AG`.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.4.4 Noise Reduction Filter

Syntax

`:FILTer[:LPASs]:STATe {ON|1|OFF|0}`
`:FILTer[:LPASs]:STATe?`

Description

The `FILTer[:LPASs]:STATe` command switches the LD output low pass filter on or off.

Example

→ `FILT:STAT ON`
Switches LD output noise reduction filter ON.

→ `FILT:STAT?`
Queries the LD output noise filter status.

← The response is ASCII `1` if the filter is switched on or an ASCII `0` if the output is off.

Note

This command is valid for LDC4005, ITC4001, ITC4002QCL, ITC4005 and ITC4005QCL instruments, FW version 1.5 up, only.

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3.4.5 Protection Voltage

Syntax

`OUTPut[1]:PROTection:VOLTage[:LEVel] {MIN|MAX|DEF|<volts>}`
`OUTPut[1]:PROTection:VOLTage[:LEVel]? [{MIN|MAX|DEF}]`

Description

The `OUTPut[1]:PROTection:VOLTage[:LEVel]` command sets the output voltage protection (compliance voltage) threshold. If this threshold is reached the output switches off.

Example

→ `OUTP:PROT:VOLT 8.0`
Sets the LD output protection voltage to 8V.

→ `OUTP:PROT:VOLT? MAX`
Queries the maximum settable LD output protection voltage.

← `1.000000E+01`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.4.6 Temperature Protection Mode

Syntax

`OUTPut[1]:PROTection:INTernal[:MODE] {OFF|PROTection|ENABle}`
`OUTPut[1]:PROTection:INTernal[:MODE]?`

Description

The `OUTPut[1]:PROTection:INTernal[:MODE]` command sets the function of the internal temperature protection circuit.

Parameter	Description
`OFF`	Temperature protection is disabled and has no effect on the LD output
`PROTection`	Acts as protection. If the temperature is out of bounds the LD output is switched off
`ENABle`	Acts as enable. If the temperature is out of bounds the LD output is disabled temporarily.

Example

→ `OUTP:PROT:INT ENAB`
Sets the temperature protection mode to output-enable mode.

Note

This command is valid for ITC4000 Series instruments only.

See also Temperature Protection 62 for further details.

3.4.7 LD-ENABLE Input Mode

Syntax

`OUTPut[1]:PROTection:EXTernal[:MODE] {OFF|PROTection|ENABle}`
`OUTPut[1]:PROTection:EXTernal[:MODE]?`

Description

The `OUTPut[1]:PROTection:EXTernal[:MODE]` command sets the function of the rear panel LD-ENABLE input.

Parameter	Description
`OFF`	The LD-ENABLE input is ignored and has no effect
`PROTection`	Acts as protection input (inhibit functionality). A TTL low level switches the LD output off.
`ENABle`	Acts as enable input. A TTL low level disables the LD output temporarily.

Example

→ `OUTP:PROT:EXT ENAB`
Sets the LD-ENABLE input mode to output-enable mode.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.4.8 Protection Queries

Syntax

```
OUTPut[1]:PROTection:VOLTage:TRIPped?
OUTPut[1]:PROTection:EXTernal:TRIPped?
OUTPut[1]:PROTection:INTernal:TRIPped?
OUTPut[1]:PROTection:INTLock:TRIPped?
OUTPut[1]:PROTection:KEYLock:TRIPped?
OUTPut[1]:PROTection:OTEMp:TRIPped?
```

Description

The `OUTPut[1]:PROTection:VOLTage:TRIPped?` query command returns 1 if the LD output protection voltage was reached.

The `OUTPut[1]:PROTection:EXTernal:TRIPped?` query command returns 1 if the LD-ENABLE input has a TTL low level.

The `OUTPut[1]:PROTection:INTernal:TRIPped?` query command returns 1 if the temperature window protection is currently active. This command is valid for ITC4000 instruments only.

The `OUTPut[1]:PROTection:INTLock:TRIPped?` query command returns 1 if the interlock circuit is open.

The `OUTPut[1]:PROTection:KEYLock:TRIPped?` query command returns 1 if the front panel key switch is in the lock position.

The `OUTPut[1]:PROTection:OTEMp:TRIPped?` query command returns 1 if the instrument's internal temperature is too high.

Example

→ `OUTP:PROT:KEYL:TRIP?`
Queries the front panel key switch.

← `0`
Typical response.

Note

These commands are valid for LDC4000 and ITC4000 only.

3.5 PD Input Commands

The INPut[1] subsystem controls the PD input of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only. For LDC4000 and ITC4000 Series instruments the command suffix is 1 (can be omitted).

Table <%TABLENO++%>: PD Input Commands

Command	Description
INPut[1]	Path to PD input
:POLarity 34 {NORMal|CG|INVerted|AG}	Set input state
:POLarity? 34	Return input state
:BIAS[:STATe] 35 {OFF|0|ON|1}	Switch PD-Bias on or off
:BIAS[:STATe]? 35	Return PD-Bias state
:BIAS:VOLTage[:DC] 35 {MIN|MAX|DEF|<volts>}	Set PD-Bias voltage level
:BIAS:VOLTage[:DC]? 35 [{MIN|MAX|DEF}]	Return PD-Bias voltage
:ROUTe[:TERMinals] 36 {DSUB|BNC}	Set PD-input routing
:ROUTe[:TERMinals]? 36	Return PD-input routing

See also chapter PD Sense Commands 45.

3.5.1 Polarity

Syntax

INPut[1]:POLarity {NORMal|CG|INVerted|AG}
INPut[1]:POLarity?

Description

The INPut[1]:POLarity command sets the PD input polarity to cathode ground (NORMal or CG) or anode ground (INVerted or AG). The parameters NORMal and INVerted are for SCPI conformance.

Example

→ INP:POL CG
Sets the PD input polarity to cathode ground.

→ INP:POL?
Queries the PD input polarity.

← CG
The response is either CG or AG.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.5.2 BIAS State

Syntax

```
INPut[1]:BIAS[:STATe] {OFF|0|ON|1}
INPut[1]:BIAS[:STATe]?
```

Description

The `INPut[1]:BIAS[:STATe]` command switches the instrument's PD input BIAS on/off.

Example

→ `INP:BIAS ON`
Switches the PD input BIAS on.

→ `INP:BIAS?`
Queries the state of the PD input BIAS.

← `1`
The response is ASCII `1` if the BIAS is switched on or an ASCII `0` if the BIAS is off.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

Note

The `*RST` 11 command switches the BIAS off.

3.5.3 BIAS Voltage

Syntax

```
INPut[1]:BIAS:VOLTage[:DC] {MIN|MAX|DEF|<volts>}
INPut[1]:BIAS:VOLTage[:DC]? [{MIN|MAX|DEF}]
```

Description

The `INPut[1]:BIAS:VOLTage[:DC]` command sets the PD input BIAS voltage.

Example

→ `INP:BIAS:VOLT 800mV`
Sets the PD input BIAS voltage to 0.8V.

→ `INP:BIAS:VOLT? MAX`
Queries the maximum settable PD input BIAS voltage.

← `5.000000E+01`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.5.4 Input Routing

Syntax

`INPut[1]:ROUTe[:TERMinals] {DSUB|BNC}`

`INPut[1]:ROUTe[:TERMinals]?`

Description

The `INPut[1]:ROUTe[:TERMinals]` command sets the path for the PD input routing to either the rear panel LASER OUTPUT D-SUB connector or the rear panel BNC connector.

Example

→ `INP:ROUT BNC`
Sets the path for the PD input to the rear panel BNC connector.

→ `INP:ROUT?`
Queries the path for the PD input routing.

← `BNC`
The answer is either `DSUB` or `BNC`.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.6 Thermopile/Power Meter Input Commands

The INPut2 subsystem controls the thermopile/power meter input of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only.

Table <%TABLENO++%>: Thermopile/Power Meter Input Commands

Command	Description
INPut[2]	Path to PD input
:ROUTe[:TERMinals] 37 {DSUB|BNC}	Set thermopile/power meter input routing
:ROUTe[:TERMinals]? 37	Return thermopile/power meter input routing

See also chapter Thermopile/Power Meter Sense Commands 47.

3.6.1 Input Routing

Syntax

INPut2:ROUTe[:TERMinals] {DSUB|BNC}
INPut2:ROUTe[:TERMinals]?

Description

The INPut2:ROUTe[:TERMinals] command sets the path for the thermopile/power meter input routing either to the rear panel LASER OUTPUT D-SUB connector or to the rear panel BNC connector.

Example

→ INP2:ROUT BNC
Sets the path for the thermopile/power meter input to the rear panel BNC connector.

→ INP2:ROUT?
Queries the path for the thermopile/power meter input routing.

← BNC
The answer is either DSUB or BNC.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7 LD Source Commands

The SOURce[1] subsystem controls the LD source part of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only.

Table <%TABLENO++%>: LD Source Commands

Command	Description
SOURce[1]	Path to LD source function
:FUNCtion 40	
[:MODE] 53 {CURRent|POWer}	Set LD driver source function
[:MODE] 53?	Return LD driver source function
[:SHAPe] {DC|PULSE}	Set CW(DC) or QCW(PULSe) mode
[:SHAPe]?	Return mode
:CURRent	
:LIMit	
[:AMPLitude] {MIN|MAX|<amps>} 40	Set LD limit current value
[:AMPLitude]? [{MIN|MAX}] 40	Return LD limit current value
:TRIPped? 40	Return LD limit current tripped
[:LEVel][:IMMediate][:AMPLitude] 41 {MIN|MAX|<amps>}	Set LD current setpoint
[:LEVel][:IMMediate][:AMPLitude]? 40 [{MIN|MAX}]	Return LD current setpoint
:POWer	
[:LEVel] 41	
[:IMMediate][:AMPLitude] {MIN|MAX|<watts>}	Set LD power setpoint
[:IMMediate][:AMPLitude]? [{MIN|MAX}]	Return LD power setpoint
:DIODe[:CURRent][:IMMediate] [:AMPLitude] {MIN|MAX|<amps>}	Set LD power via setting photodiode current setpoint
:DIODe[:CURRent][:IMMediate] [:AMPLitude]? [{MIN|MAX}]	Return photodiode current setpoint
:PMETer[:VOLTage][:IMMediate] [:AMPLitude] {MIN|MAX|<volts>}	Set LD power via setting thermopile/power meter voltage setpoint
:PMETer[:VOLTage][:IMMediate] [:AMPLitude]? [{MIN|MAX}]	Return thermopile/power meter voltage setpoint
:ALC 43	
:SOURce {DIODe|PMETer|PDIode|THERmopile}	Set the power source feedback loop input

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Command	Description
:SOURce?	Return the power source feedback loop input
:SPEed {MIN|MAX|DEF|<percent>}	Set feedback loop speed setting
:SPEed? [{MIN|MAX|DEF}]	Return feedback loop speed setting
:AM 43	
[:STATe] {OFF|0|ON|1}	Enables (ON) or disables (OFF) modulation
[:STATe]?	Return modulation state
:SOURce {INTernal|EXTernal} [,{INTernal|EXTernal}]	Set modulation source
:SOURce?	Return modulation source
:INTernal	
:SHAPe {SINusoid|SQUare|TRIangle}	Set internal modulation shape
:SHAPe?	Return internal modulation shape
:FREQuency {MIN|MAX|DEF|<hertz>}	Set internal modulation frequency
:FREQuency? [{MIN|MAX|DEF}]	Return internal modulation frequency
[:DEPTh] {MIN|MAX|DEF|<percent>}	Set internal modulation depth
[:DEPTh]? [{MIN|MAX|DEF}]	Return internal modulation depth
:PULSe 44	
:PERiod {MIN|MAX|DEF|<secs>}	Set pulse period
:PERiod? [{MIN|MAX|DEF}]	Return pulse period
:WIDTh {MIN|MAX|DEF|<secs>}	Set pulse width
:WIDTh? [{MIN|MAX|DEFault}]	Return pulse width
:DCYCle {MIN|MAX|DEF|<percent>}	Set pulse duty cycle
:DCYCle? [{MIN|MAX|DEF}]	Return pulse duty cycle
:HOLD {WIDTh|DCYCle}	Set parameter to hold
:HOLD?	Return parameter to hold

3.7.1 LD Source Function

Syntax

`SOURce[1]:FUNCtion:MODE {CURRent|POWer}`
`SOURce[1]:FUNCtion:MODE?`
`SOURce[1]:FUNCtion[:SHAPe] {DC|PULSe}`
`SOURce[1]:FUNCtion[:SHAPe]?`

Description

The `SOURce[1]:FUNCtion:MODE` and `SOURce[1]:FUNCtion[:SHAPe]` commands set the instrument's LD source function to constant current (CW) mode or to pulsed constant current (QCW) mode or to constant power (CW) mode.

Note

The combination `POWer` and `PULSe` is not available.

Example

→ `SOUR:FUNC:MODE CURR;SHAP DC`
Sets the LD source function of a LDC4000 Series or an ITC4000 Series instrument to constant current (CW) mode.

→ `SOUR:FUNC:MODE?;SHAP?`
Queries the LD source function.

← `CURR;DC`
Response for constant current (CW) mode or

← `CURR;PULS`
response for pulsed constant current (QCW) mode or

← `POW;DC`
response for constant power (CW) mode.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7.2 LD Current Limit

Syntax

`SOURce[1]:CURRent:LIMit[:AMPLitude] {MIN|MAX|<amps>}`
`SOURce[1]:CURRent:LIMit[:AMPLitude]? [{MIN|MAX}]`
`SOURce[1]:CURRent:LIMit:TRIPped?`

Description

The `SOURce[1]:CURRent:LIMit[:AMPLitude]` command sets the LD source limit current in amperes.

The `SOURce[1]:CURRent:LIMit:TRIPped?` query command returns an ASCII `1` if the LD source current reached the limit value or an ASCII `0` if it's inactive.

Example

→ `SOUR:CURR:LIM 1.5`
Sets the LD source limit current to 1.5 A on a LDC4000 Series or an ITC4000 Series instrument.

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→ `SOUR:CURR:LIM? MAX`
Queries the maximum settable LD source limit current of a LDC4000 Series or an ITC4000 Series instrument.

← `1.500000E+01`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7.3 LD Current Setpoint

Syntax

```
SOURce[1]:CURRent[:LEVel][:IMMediate][:AMPLitude] {MIN|MAX|<amps>}
SOURce[1]:CURRent[:LEVel][:IMMediate][:AMPLitude]? [{MIN|MAX}]
```

Description

The `SOURce[1]:CURRent[:LEVel][:IMMediate][:AMPLitude]` command sets the LD current setpoint in amperes in current source modes.

Example

→ `SOUR:CURR 1.0`
Sets the LD source current to 1.0 A on a LDC4000 Series or an ITC4000 Series instrument.

→ `SOUR:CURR? MAX`
Queries the maximum settable LD source current setpoint of a LDC4000 Series or an ITC4000 Series instrument.

← `2.000000E+01`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7.4 LD Optical Power

Syntax

```
SOURce[1]:POWer[:LEVel][:IMMediate][:AMPLitude] {MIN|MAX|<watts>}
SOURce[1]:POWer[:LEVel][:IMMediate][:AMPLitude]? [{MIN|MAX}]
SOURce[1]:POWer:ALC:SOURce {DIODe|PMETer}
SOURce[1]:POWer:ALC:SOURce?
SOURce[1]:POWer:ALC:BANDwidth {MIN|MAX|DEF|<hertz>}
SOURce[1]:POWer:ALC:BANDwidth? [{MIN|MAX|DEF}]


SOURce[1]:POWer[:LEVel]:DIODe[:CURRent][:IMMediate]
   [:AMPLitude] {MIN|MAX|<amps>}
SOURce[1]:POWer[:LEVel]:DIODe[:CURRent][:IMMediate]
   [:AMPLitude]? [{MIN|MAX}]
SOURce[1]:POWer[:LEVel]:PMETer[:VOLTage][:IMMediate]
   [:AMPLitude] {MIN|MAX|<volts>}
SOURce[1]:POWer[:LEVel]:PMETer[:VOLTage][:IMMediate]
   [:AMPLitude]? [{MIN|MAX}]
```

Description

The SOURce[1]:POWer[:LEVel][:IMMediate][:AMPLitude] command sets the LD power setpoint in watts for constant power (CW) mode.

The SOURce[1]:POWer:ALC:SOURce command sets the feedback source loop input to current input (DIODe) or to voltage input (PMETer).

The SOURce[1]:POWer:ALC:BANDwidth command sets the bandwidth of the feedback source loop input.

For constant power (CW) mode the feedback source input - photodiode current or thermopile voltage - can additionally be used as parameter to control the LD output power.

The SOURce[1]:POWer[:LEVel]:DIODe[:CURRent][:IMMediate][:AMPLitude] command sets the value for the photodiode current feedback. The LD power will be regulated so that the current through the photodiode caused by the laser light will equal the value set by this command.

The SOURce[1]:POWer[:LEVel]:PMETer[:VOLTage][:IMMediate][:AMPLitude] command sets the value for the thermopile voltage feedback. The LD power will be regulated so that the voltage of the thermopile caused by the laser light will equal the value set by this command.

Example

→ SOUR:POW 0.001
Sets the LD source power to 1.0 mW on a LDC4000 Series or an ITC4000 Series instrument.

→ SOUR:POW:ALC:SOUR PMET
Sets the feedback source loop input to thermopile/power meter input.

→ SOUR:POW? MAX
Queries the maximum settable LD source power setpoint of a LDC4000 Series or an ITC4000 Series instrument.

← 5.111964E-01
Typical response.

Note

The power regulation is actually based on photodiode current or the thermopile/power meter voltage. Setting a new value for the responsivity for the connected photodiode or the connected thermopile/power meter will not cause the instrument to change its output setting. In this case the power set point will be adapted.

Example: The LD power is set to 1.0 mW, the photodiode responsivity is set to 1.0 A/W, the resulting feedback current of the photodiode is 1.0 mA. When you change the responsivity to 2.0 A/W the feedback current remains constant at 1.0 mA but the read back value of the laser power set point will decrease to 0.5 mW.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.7.5 LD Power Feedback

Syntax

```
SOURce[1]:POWer:ALC:SOURce {DIODe|PMETer|PDIode|THERmopile}
SOURce[1]:POWer:ALC:SOURce?
SOURce[1]:POWer:ALC:SPEed {MIN|MAX|DEF|<percent>}
SOURce[1]:POWer:ALC:SPEed? [{MIN|MAX|DEF}]
```

Description

The `SOURce[1]:POWer:ALC:SOURce` command sets the power source feedback loop input to photodiode (`DIODe|PDIode`) or to thermopile/power meter (`PMETer|THERmopile`).

The `SOURce[1]:POWer:ALC:SPEed` command sets the speed of the power source feedback loop. Please refer to the instrument's operation manual for a detailed description of the constant power mode operation.

Example

→ `SOUR:POW:ALC:SOUR PDI`
Sets the power source feedback loop input to photodiode.

→ `SOUR:POW:ALC:BAND 250`
Sets the power source feedback loop bandwidth to 250 Hz.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7.6 LD Amplitude Modulation

Syntax

```
SOURce[1]:AM[:STATe] {OFF|0|ON|1}
SOURce[1]:AM[:STATe]?
SOURce[1]:AM:SOURce {INTernal|EXTernal}[,{INTernal|EXTernal}]
SOURce[1]:AM:SOURce?
SOURce[1]:AM:INTernal:SHAPe {SINusoid|SQUare|TRIangle}
SOURce[1]:AM:INTernal:SHAPe?
SOURce[1]:AM:INTernal:FREQuency {MIN|MAX|DEF|<hertz>}
SOURce[1]:AM:INTernal:FREQuency? [{MIN|MAX|DEF}]
SOURce[1]:AM:INTernal[:DEPTh] {MIN|MAX|DEF|<percent>}
SOURce[1]:AM:INTernal[:DEPTh]? [{MIN|MAX|DEF}]
```

Description

The `SOURce[1]:AM[:STATe]` command enables (`ON|1`) or disables (`OFF|0`) the amplitude modulation of the LD source.

The `SOURce[1]:AM:SOURce` command selects the amplitude modulation source(s) of the LD source. It may specify a single source or two sources. The specified sources, in the `SOURce[1]:AM:SOURce` command, are all selected and turned on. Any sources from a previous selection that are not part of the current selection list are deselected and turned off.

The `SOURce[1]:AM:INTernal:SHAPe` command sets the internal modulation shape.

The `SOURce[1]:AM:INTernal` command sets the internal modulation depth.

Example

→ `SOUR:AM 1`
Enables LD source modulation on a LDC4000 Series or an ITC4000 Series instrument.

→ `SOUR:AM:SOUR EXT`
Selects the external BNC connector as source for modulation.

→ `SOUR:AM:SOUR INT,EXT`
Selects both, internal modulator and external BNC connector as source for modulation.

→ `SOUR:AM:INT:FREQ? DEF`
Queries the default internal modulation frequency.

← `1.000000E+03`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.7.7 QCW Pulse Setting

Syntax

```
SOURce[1]:PULSe:PERiod {MIN|MAX|DEF|<secs>}
SOURce[1]:PULSe:PERiod? [{MIN|MAX|DEF}]
SOURce[1]:PULSe:WIDTh {MIN|MAX|DEF|<secs>}
SOURce[1]:PULSe:WIDTh? [{MIN|MAX|DEFault}]
SOURce[1]:PULSe:DCYCle {MIN|MAX|DEF|<percent>}
SOURce[1]:PULSe:DCYCle? [{MIN|MAX|DEF}]
SOURce[1]:PULSe:HOLD {WIDTh|DCYCle}
SOURce[1]:PULSe:HOLD?
```

Description

The `SOURce[1]:PULSe:PERiod` command sets the period time of the internal modulator.

The `SOURce[1]:PULSe:WIDTh` command sets the pulse width of the internal modulator.

The `SOURce[1]:PULSe:DCYCle` command sets the duty cycle of the internal modulator.

The `SOURce[1]:PULSe:HOLD` command sets, for a pulsed waveform, the parameter to be held constant when the period changes.

Example

→ `SOUR:PULS:PER 0.0001`
Sets the pulse period to 100µs.

`SOUR:PULS:DCYC MIN`
Sets the duty cycle of the internal modulation to its minimum.

`SOUR:PULS:HOLD?`
Queries the parameter to be held constant for a pulsed waveform.

← `WIDT`
The response is either `WIDT` or `DCYC`.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.8 PD Sense Commands

The SENSe[1] subsystem controls the photodiode (PD) sense part of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only. For LDC4000 and ITC4000 Series instruments the command suffix is 1 (can be omitted).

Table <%TABLENO++%>: PD Sense Commands

Command	Description
SENSe[1]	Path to PD sense subsystem
[:CURRent][:DC]	
:RANGe[:UPPer] 45 {MIN|MAX|<amps>}	Set photodiode range
:RANGe[:UPPer]? 45 [{MIN|MAX}]	Return photodiode range
:PROTection 46	
[:LEVel] {MIN|MAX|DEF|<amps>}	Set photodiode current limit value
[:LEVel]? [{MIN|MAX|DEF}]	Return photodiode current limit value
:TRIPed?	Return protection tripped
:CORRECTION	
:POWer[:PDIode][:RESPonse] 46 {MIN|MAX|DEF|<amps>}	Set photodiode responsivity value in $^{A}/_{W}$
:POWer[:PDIode][:RESPonse]? 46 [{MIN|MAX|DEF}]	Return photodiode responsivity value in $^{A}/_{W}$
:POWer[:DC]	
:RANGe[:UPPer] 47 {MIN|MAX|<watts>}	Set photodiode range in units of power
:RANGe[:UPPer]? 47 [{MIN|MAX}]	Return photodiode range setting in units of power
:PROTection 47	
[:LEVel] {MIN|MAX|DEF|<watts>}	Set power limit value (photodiode)
[:LEVel]? [{MIN|MAX|DEF}]	Return power limit value (photodiode)
:TRIPped	Return protection tripped

3.8.1 Photodiode Current Range

Syntax

SENSe[1][:CURRent][:DC]:RANGe[:UPPer] {MIN|MAX|<amps>}
SENSe[1][:CURRent][:DC]:RANGe[:UPPer]? [{MIN|MAX}]

Description

The SENSe[1][:CURRent][:DC]:RANGe[:UPPer] command sets the photodiode current range

to the most appropriate range for the given value.

Example

→ `SENS:RANG 1.7mA`
Sets the photodiode current range to 2 mA (this is valid for 4000 Series instruments with a 2 mA photodiode input range).

→ `SENS:RANG? MAX`
Queries the biggest available photodiode current range.

← `2.000000E-02`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.8.2 Photodiode Current Protection

Syntax

```
SENSe[1][:CURRent][:DC]:PROTection[:LEVel] {MIN|MAX|DEF|<amps>}
SENSe[1][:CURRent][:DC]:PROTection[:LEVel]? [{MIN|MAX|DEF}]
SENSe[1][:CURRent][:DC]:PROTection:TRIPped?
```

Description

The `SENSe[1]:CURRent[:DC]:PROTection[:LEVel]` command sets the photodiode current limit value.

The `SENSe[1][:CURRent][:DC]:PROTection:TRIPped?` query command returns an ASCII `1` if the photodiode current limit value is currently reached or an ASCII `0` if the photodiode current is currently below that limit.

Example

→ `SENS:PROT 0.3mA`
Sets the photodiode current limit to 0.3 mA.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.8.3 Photodiode Responsivity

Syntax

```
SENSe[1][:CURRent][:DC]:CORRection:POWer[:PDIode][:RESPonse]
        {MIN|MAX|DEF|<amps>}
SENSe[1][:CURRent][:DC]:CORRection:POWer[:PDIode][:RESPonse]?
        {MIN|MAX|DEF}
```

Description

The `SENSe[1][:CURRent][:DC]:CORRection:POWer[:PDIode][:RESPonse]` command sets the photodiode responsivity in $^{A}/_{W}$.

Example

→ `SENS:CORR:POW 511mA`
Sets the photodiode responsivity to 511.0 $^{mA}/_{W}$.

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Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.8.4 Photodiode Power Range

Syntax

`SENSe[1]:POWer[:DC]:RANGe[:UPPer] {MIN|MAX|<watts>}`
`SENSe[1]:POWer[:DC]:RANGe[:UPPer]? [{MIN|MAX}]`

Description

The `SENSe[1]:POWer[:DC]:RANGe[:UPPer]` command sets the power range to the most appropriate range for the given value.

Example

→ `SENS:POW:RANG 0.012`
Sets power range to or above 12 mW depending on the set responsivity of the used photodiode.

→ `SENS:POW:RANG? MAX`
Queries the biggest available power range.

← `1.800000E+00`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.8.5 Photodiode Power Protection

Syntax

`SENSe[1]:POWer[:DC]:PROTection[:LEVel] {MIN|MAX|DEF|<watts>}`
`SENSe[1]:POWer[:DC]:PROTection[:LEVel]? [{MIN|MAX|DEF}]`
`SENSe[1]:POWer[:DC]:PROTection:TRIPped?`

Description

The `SENSe[1]:POWer[:DC]:PROTection[:LEVel]` command sets the power limit value.

The `SENSe[1]:POWer[:DC]:PROTection:TRIPped?` query command returns an ASCII `1` if the power limit value is currently reached or an ASCII `0` if the power is currently below that limit.

Example

→ `SENS:POW:PROT 0.035`
Sets the power limit to 35.0 mW.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.9 Thermopile/Power Meter Sense Commands

The `SENSe2` subsystem controls the thermopile/power meter sense part of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only.

Table <%TABLENO++%>: Thermopile/Power Meter Sense Commands

Command	Description
SENSe2	Path to thermopile/power meter sense subsystem
[:VOLTage][:DC]	
:RANGe[:UPPer] 48 {MIN|MAX|<amps>}	Set thermopile/power meter range
:RANGe[:UPPer]? 48 [{MIN|MAX}]	Return thermopile/power meter range
:PROTection 49	
[:LEVel] {MIN|MAX|DEF|<amps>}	Set thermopile/power meter voltage limit value
[:LEVel]? [{MIN|MAX|DEF}]	Return thermopile/power meter voltage limit value
:TRIPed?	Return protection tripped
:CORRECTION 49	
:POWer[:PDIode][:RESPonse] {MIN|MAX|DEF|<amps>}	Set thermopile/power meter responsivity value in $^{V}/_{W}$
:POWer[:PDIode][:RESPonse]? [{MIN|MAX|DEF}]	Return thermopile/power meter responsivity value in $^{V}/_{W}$
:POWer[:DC]	
:RANGe[:UPPer] 50 {MIN|MAX|<watts>}	Set thermopile/power meter range in units of power
:RANGe[:UPPer]? 50 [{MIN|MAX}]	Return thermopile/power meter range setting in units of power
:PROTection 50	
[:LEVel] {MIN|MAX|DEF|<watts>}	Set power limit value (thermopile/power meter)
[:LEVel]? [{MIN|MAX|DEF}]	Return power limit value (thermopile/power meter)
:TRIPped	Return protection tripped

3.9.1 Thermopile/Power Meter Voltage Range

Syntax

```
SENSe2[:VOLTage][:DC]:RANGe[:UPPer] {MIN|MAX|<volts>}
SENSe2[:VOLTage][:DC]:RANGe[:UPPer]? [{MIN|MAX}]
```

Description

The `SENSe2[:VOLTage][:DC]:RANGe[:UPPer]` command sets the thermopile/power meter voltage range to the most appropriate range for the given value.

Example

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→ `SENS2:RANG 0.5`
Sets the thermopile/power meter voltage range to 1.0 V (this is valid for 4000 Series instruments with a 1 V thermopile/power meter input range).

→ `SENS2:RANG? MAX`
Queries the biggest available thermopile/power meter voltage range.

← `1.000000E+01`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.9.2 Thermopile/Power Meter Voltage Protection

Syntax

```
SENSe2[:VOLTage][:DC]:PROTection[:LEVel] {MIN|MAX|DEF|<volts>}
SENSe2[:VOLTage][:DC]:PROTection[:LEVel]? [{MIN|MAX|DEF}]
SENSe2[:VOLTage][:DC]:PROTection:TRIPped?
```

Description

The `SENSe2[:VOLTage][:DC]:PROTection[:LEVel]` command sets the thermopile/power meter voltage limit value.

The `SENSe2[:VOLTage][:DC]:PROTection:TRIPped?` query command returns an ASCII `1` if the thermopile/power meter voltage limit value is currently reached or an ASCII `0` if the thermopile/power meter voltage is currently below that limit.

Example

→ `SENS2:PROT 0.4V`
Sets the thermopile/power meter voltage limit to 400 mV.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.9.3 Thermopile/Power Meter Responsivity

Syntax

```
SENSe2[:VOLTage][:DC]:CORRection:POWer[:THERmopile][:RESPonse]
        {MIN|MAX|DEF|<volts>}
SENSe2[:Voltage][:DC]:CORRection:POWer[:THERmopile][:RESPonse]?
        {MIN|MAX|DEF}
```

Description

The `SENSe2[:VOLTage][:DC]:CORRection:POWer[:THERmopile][:RESPonse]` command sets the thermopile/power meter responsivity in $^{V}/_{W}$.

Example

→ `SENS2:CORR:POW 0.04V`
Sets the thermopile/power meter responsivity to 40.0 $^{mV}/_{W}$.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.9.4 Thermopile/Power Meter Power Range

Syntax

`SENSe2:POWer[:DC]:RANGe[:UPPer] {MIN|MAX|<watts>}`

`SENSe2:POWer[:DC]:RANGe[:UPPer]? [{MIN|MAX}]`

Description

The `SENSe2:POWer[:DC]:RANGe[:UPPer] {MIN|MAX|<watts>}` command sets the thermopile/power meter power range to the most appropriate range for the given value.

Example

→ `SENS2:POW:RANG 0.012`
Sets the power range to or above 12 mW depending on the set responsivity of the used thermopile/power meter.

→ `SENS2:POW:RANG? MAX`
Queries the biggest available power range.

← `1.800000E+00`
Typical response.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.9.5 Thermopile/Power Meter Power Protection

Syntax

`SENSe2:POWer[:DC]:PROTection[:LEVel] {MIN|MAX|DEF|<watts>}`

`SENSe2:POWer[:DC]:PROTection[:LEVel]? [{MIN|MAX|DEF}]`

`SENSe2:POWer[:DC]:PROTection:TRIPped?`

Description

The `SENSe2:POWer[:DC]:PROTection[:LEVel]` command sets the power limit value.

The `SENSe2:POWer[:DC]:PROTection:TRIPped?` query command returns an ASCII `1` if the power limit value is currently reached or an ASCII `0` if the power is currently below that limit.

Example

→ `SENS:POW:PROT 0.511`
Sets the power limit to 511.0 mW.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

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3.10 QCW Pulse Trigger Commands

The `TRIGger[1]` subsystem controls the QCW mode triggering of the instrument.

Note

These commands are valid for LDC4000 and ITC4000 Series instruments only. For LDC4000 and ITC4000 Series instruments the command suffix is 1 (can be omitted).

Table <%TABLENO++%>: QCW Pulse Trigger Commands

Command	Description
`TRIGger`	Path to trigger functions
`[:SEQuence]:SOURce` 51 `{INTernal|EXTernal}`	Set the trigger source
`TRIGger[:SEQuence]:SOURce?` 51	Return the trigger source

3.10.1 QCW Trigger Source

Syntax

`TRIGger[:SEQuence]:SOURce {INTernal|EXTernal}`

`TRIGger[:SEQuence]:SOURce?`

Description

The `TRIGger[:SEQuence]:SOURce` command sets the source for the QCW pulse trigger to either internal pulse generator or external pulse source connected through a rear panel BNC connector.

Example

→ `TRIG:SOUR INT`
Sets the trigger source for QCW pulses to the internal pulse generator.

→ `TRIG:SOUR EXT`
Sets the trigger source for QCW pulses to the rear panel BNC connector.

→ `TRIG:SOUR?`
Queries the trigger source for QCW pulses.

← `INT`
The response is either `INT` or `EXT`.

Note

This command is valid for LDC4000 and ITC4000 Series instruments only.

3.11 TEC Source Commands

The SOURce{[1]|2} subsystem controls the TEC source part of the instrument.

Note

These commands are valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

Table <%TABLENO++%>: TEC Source Commands

Command	Description
SOURce{[1]|2}	Path to TED source function
:FUNCtion 53	
[:MODE] 53 {TEMPerature|CURRent}	Set function
:CURRent	
:LIMit[:AMPLitude] 54 {MIN|MAX|<amps>}	Set limit current value
:LIMit[:AMPLitude] 54 [{MIN|MAX}]	Return limit current value
[:LEVel][:IMMediate][:AMPLitude] 54 {MIN|MAX|<amps>}	Set current setpoint
[:LEVel][:IMMediate][:AMPLitude]? 54 [{MIN|MAX}]	Return current setpoint
:TEMPerature	
[:SPOint] 55 {MIN|MAX|DEF|<temperature>}	Set temperature setpoint
:LIMit 55	
:HIGH 55 {MIN|MAX|<temperature>}	Set settable temperature high limit
:LOW 55 {MIN|MAX|<temperature>}	Set settable temperature low limit
:LCONstants 56	
[:GAIN] 56 {MIN|MAX|DEF|<value>}	Set PID loop P value
:INTegral 56 {MIN|MAX|DEF|<value>}	Set PID loop I value
:DERivative 56 {MIN|MAX|DEF|<value>}	Set PID loop D value
:PERiod 56 {MIN|MAX|DEF|<seconds>}	Set thermal load oscillation period
:ATUNe 56	
[:INITiate] 56	Start AUTO-PID tune
:CANCel 56	Cancel AUTO-PID tune
:STATe? 56	Query AUTO-PID state
:LCONstants 56	
[:GAIN]? 56	Query AUTO-PID P value

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Command	Description
:INTegral? 56	Query AUTO-PID I value
:DERivative? 56	Query AUTO-PID D value
:PERiod? 56	Query AUTO-PID oscillation period
:TRANsfer 56	Transfer AUTO-PID to control loop
:PROTection 62	
:DELay 62 {MIN|MAX|DEF|<seconds>}	Set protection delay
:WINDow[:AMPLitude] 62 {MIN|MAX|DEF|<temperature>}	Set temperature window amplitude
:TRIPped? 62	Query protection tripped

3.11.1 TEC Source Function

Syntax

```
SOURce{[1]|2}:FUNCtion[:MODE] {TEMPerature|CURRent}
SOURce{[1]|2}:FUNCtion[:MODE]?
```

Description

The SOURce{[1]|2}:FUNCtion[:MODE] command sets the instrument's TEC source function to current source mode or temperature control mode.

Example

→ SOUR:FUNC TEMP
Sets the TEC source function of a TED4000 Series instrument to temperature source mode.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.11.2 TEC Current Limit

Syntax

```
SOURce{[1]|2}:CURRent:LIMit[:AMPLitude] {MIN|MAX|<amps>}
SOURce{[1]|2}:CURRent:LIMit[:AMPLitude]? [{MIN|MAX}]
```

Description

The `SOURce{[1]|2}:CURRent:LIMit[:AMPLitude]` command sets the TEC element limit current in amperes.

Example

→ `SOUR:CURR:LIM 1.5`
Sets the TEC element limit current to 1.5A on a TED4000 Series instrument.

`SOUR2:CURR:LIM? MAX`
Queries the maximum settable TEC element limit current of a ITC4000 Series instrument.

← `1.500000E+01`
Typical response.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.11.3 TEC Current Setpoint

Syntax

```
SOURce{[1]|2}:CURRent[:LEVel][:IMMediate][:AMPLitude]
   {MIN|MAX|<amps>}
SOURce{[1]|2}:CURRent[:LEVel][:IMMediate][:AMPLitude]?
   [{MIN|MAX}]
```

Description

The `SOURce{[1]|2}:CURRent[:LEVel][:IMMediate][:AMPLitude]` command sets the TEC current setpoint in amperes in current source mode.

Example

→ `SOUR:CURR 1.0`
Sets the TEC element current to 1.0 A on a TED4000 Series instrument.

→ `SOUR2:CURR? MAX`
Queries the maximum settable TEC element current setpoint of a ITC4000 Series instrument.

← `1.500000E+01`
Typical response.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

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3.11.4 TEC Temperature Setpoint Limit

Syntax

```
SOURce{[1]|2}:TEMPerature:LIMit:HIGH {MIN|MAX|<temperature>}
SOURce{[1]|2}:TEMPerature:LIMit:HIGH? [{MIN|MAX}]
SOURce{[1]|2}:TEMPerature:LIMit:LOW {MIN|MAX|<temperature>}
SOURce{[1]|2}:TEMPerature:LIMit:LOW? [{MIN|MAX}]
```

Description

The `SOURce{[1]|2}:TEMPerature:LIMit` commands set a user defined temperature setpoint range in the selected temperature unit.

Example

→ `SOUR:TEMP:LIM:LOW 0;HIGH 70`
Sets the temperature setpoint range to 0 ... 70 on a TED4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.11.5 TEC Temperature Setpoint

Syntax

```
SOURce{[1]|2}:TEMPerature[:SPOint] {MIN|MAX|DEF|<temperature>}
SOURce{[1]|2}:TEMPerature[:SPOint]? [{MIN|MAX|DEF}]
```

Description

The `SOURce{[1]|2}:TEMPerature[:SPOint]` command sets the temperature setpoint in the selected temperature unit in temperature control mode. The default value is 25.0°C.

Example

→ `SOUR:TEMP 25C`
Sets the temperature setpoint to 25°C on a TED4000 Series instrument.

→ `SOUR2:TEMP?`
Queries the temperature setpoint of a ITC4000 Series instrument.

← `2.500000E+01`
Typical response.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.11.6 PID Loop Constants

Syntax

```
SOURce{[1]|2}:TEMPerature:LCONstants[:GAIN]
   {MIN|MAX|DEF|<value>}
SOURce{[1]|2}:TEMPerature:LCONstants[:GAIN]?
   [{MIN|MAX|DEF}]
SOURce{[1]|2}:TEMPerature:LCONstants:INTegral
   {MIN|MAX|DEF|<value>}
SOURce{[1]|2}:TEMPerature:LCONstants:INTegral?
   [{MIN|MAX|DEF}]
SOURce{[1]|2}:TEMPerature:LCONstants:DERivative
   {MIN|MAX|DEF|<value>}
SOURce{[1]|2}:TEMPerature:LCONstants:DERivative?
   [{MIN|MAX|DEF}]
SOURce{[1]|2}:TEMPerature:LCONstants:PERiod
   {MIN|MAX|DEF|<value>}
SOURce{[1]|2}:TEMPerature:LCONstants:PERiod?
   [{MIN|MAX|DEF}]
```

Description

The `SOURce{[1]|2}:TEMPerature:LCONstants` commands control the instrument PID temperature control loop. The gain value (proportional) is in [$^{A}/_{K}$], its default value is 1.0. The integral value is in [$^{A}/_{K\times s}$], its default value is 0.1. The derivative value is in [$^{A\times s}/_{K}$], its default value is 0. The period value specifies the thermal load oscillation period in seconds [s], its default value is 1s.

Example

→ `SOUR:TEMP:LCON:GAIN 1.0;INT 0.1;DER 0.0;PER 1.0`
Sets the PID control loop constants on a TED4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.11.7 PID Auto Tune

Syntax

```
SOURce{[1]|2}:TEMPerature:ATUNe[:INITiate]
SOURce{[1]|2}:TEMPerature:ATUNe:CANCel
SOURce{[1]|2}:TEMPerature:ATUNe:STATe?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants[:GAIN]?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:INTegral?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:DERivative?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:PERiod?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:TRANsfer
```

Description

The `SOURce{[1]|2}:TEMPerature:ATUNe[:INITiate]` starts the Auto-PID procedure.

The `SOURce{[1]|2}:TEMPerature:ATUNe:CANCel` stops a running Auto-PID procedure.

The `SOURce{[1]|2}:TEMPerature:ATUNe:STATe?` query retrieves information about a

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previously run Auto-PID procedure.

The Auto-PID state query response is: state, phase, loop as numeric values, where state reflects the current state, phase shows the algorithm used and loop indicates the Auto-PID progress.

State	Description
0	Never run for this sensor/configuration
1	Auto-PID currently running
2	Canceled by user
3	Auto-PID failed
4	Auto-PID finished successfully

Phase	Description
0	Full tuning Auto-PID procedure
1	Fine tuning Auto-PID procedure

The query commands

```
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants[:GAIN]?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:INTegral?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:DERivative?
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:PERiod?
```

read back the evaluated Auto-PID loop constants.

You may pass the evaluated values to the PID temperature control loop using the command:

```
SOURce{[1]|2}:TEMPerature:ATUNe:LCONstants:TRANsfer
```

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.12 Temperature Sense Commands

The SENSe{[1]|3} subsystem controls the temperature sensing part of the instrument.

Note

These commands are valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 3.

Table <%TABLENO++%>: Temperature Sense Commands

Command	Description
SENSe{[1]|3}	Path to TEC sense function
:TEMPerature	
:TRANsducer 60[:TYPE] {AD590|THLow|THHigh|PT100|PT1000|LM35|LM335}	Set temperature sensor type
:TRANsducer 60[:TYPE]?	Return temperature sensor
:THERmistor 60	
:METHod {EXPonential|SHH}	Set thermistor calculation method
:METHod?	Return thermistor calculation method
[:SHH]	
:A {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter A
:A? [{MIN|MAX|DEF}]	Return Steinhart-Hart parameter A
:B {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter B
:B? [{MIN|MAX|DEF}]	Return Steinhart-Hart parameter B
:C {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter C
:C? [{MIN|MAX|DEF}]	Return Steinhart-Hart parameter C
:EXPonential	
:R0 {MIN|MAX|DEF|<ohms>}	Set exponential parameter R_0
:R0? [{MIN|MAX|DEF}]	Return exponential parameter R_0
:T0 {MIN|MAX|DEF|<temperature>}	Set exponential parameter T_0
:T0? [{MIN|MAX|DEF}]	Return exponential parameter T_0
:BETA {MIN|MAX|DEF|<value>}	Set exponential parameter beta
:BETA? [{MIN|MAX|DEF}]	Return exponential parameter beta
:OFFSet 61 {MIN|MAX|DEF|<temperature>}	Set transducer temperature offset

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Command	Description
:OFFSet? 61 [{MIN|MAX|DEF}]	Return transducer temperature offset
:PROTection 62	
:DELay 62 {MIN|MAX|DEF|<seconds>}	Set protection reset delay
:DELay 62? {MIN|MAX|DEF}	Return protection reset delay
:WINDow[:AMPLitude] 62 {MIN|MAX|DEF|<temperature>}	Set temperature window amplitude
:WINDow[:AMPLitude] 62? {MIN|MAX|DEF}	Return temperature window amplitude
:TRIPped? 62	Return protection tripped

3.12.1 Sensor Selection

Syntax

```
SENSe{[1]|3}:TEMPerature:TRANsducer[:TYPE]
   {AD590|THLow|THHigh|PT100|PT1000|LM35|LM335}
SENSe{[1]|3}:TEMPerature:TRANsducer[:TYPE]?
```

Description

The `SENSe{[1]|3}:TEMPerature:TRANsducer[:TYPE]` command selects the temperature sensor to be used for future operation. See the operation manual for a more detailed description on temperature sensors for TED4000 and ITC4000 Series instruments.

Example

→ `SENS:TEMP:TRAN AD590`
Sets the temperature sensor to be used to an AD590 for a TED4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 3.

3.12.2 Thermistor Calculations

Syntax

```
SENSe{[1]|3}:TEMPerature:THERmistor:METHod {EXPonential|SHH}
SENSe{[1]|3}:TEMPerature:THERmistor:METHod?


SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:A
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:A?
   [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:B
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:B?
   [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:C
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:C?
   [{MIN|MAX|DEF}]


SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:R0
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:R0?
   [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:T0
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:T0?
   [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:BETA
   {MIN|MAX|DEF|<value>}
SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:BETA?
   [{MIN|MAX|DEF}]
```

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Description

The `SENSe{[1]|3}:TEMPerature:THERmistor:METHod` command selects one of the two temperature to/from resistance calculation methods (Steinhart-Hart or Exponential method).

The `SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:A` command sets the parameter A for the calculation method according to Steinhart-Hart.

The `SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:B` command sets the parameter B for the calculation method according to Steinhart-Hart.

The `SENSe{[1]|3}:TEMPerature:THERmistor[:SHH]:C` command sets the parameter C for the calculation method according to Steinhart-Hart.

The `SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:R0` command sets the parameter R_0 (resistance at nominal temperature T_0) for the exponential calculation method.

The `SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:T0` command sets the parameter T_0 (nominal temperature) for the exponential calculation method.

The `SENSe{[1]|3}:TEMPerature:THERmistor:EXPonential:BETA` command sets the parameter Beta (also known as B-value) for the exponential calculation method.

Example

→ `SENS:TEMP:THER:METH EXP`
Sets the calculation method for a thermistor to exponential for a TED4000 Series instrument.

→ `SENS3:TEMP:THER:EXP:R0 10k;T0 25;BETA 3988`
Sets the three thermistor parameters needed (R_0, T_0, Beta) to calculate the temperature from a given resistance for a ITC4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 3.

3.12.3 Transducer Offset

Syntax

`SENSe{[1]|3}:TEMPerature:OFFSet {MIN|MAX|DEF|<temperature>}`
`SENSe{[1]|3}:TEMPerature:OFFSet? [{MIN|MAX|DEF}]`

Description

The `SENSe{[1]|3}:TEMPerature:OFFSet` command sets a temperature offset for a temperature sensor (usually used to compensate small errors of temperature sensors).

Example

→ `SENS:TEMP:OFFS -0.2`
Sets a temperature offset of -0.2K for a TED4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 3.

3.12.4 Temperature Protection

Syntax

```
SENSe{[1]|3}:TEMPerature:PROTection:WINDow[:AMPLitude]
   {MIN|MAX|DEF|<temperature>}
SENSe{[1]|3}:TEMPerature:PROTection:WINDow[:AMPLitude]?
   [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:PROTection:DELay {MIN|MAX|DEF|<seconds>}
SENSe{[1]|3}:TEMPerature:PROTection:DELay? [{MIN|MAX|DEF}]
SENSe{[1]|3}:TEMPerature:PROTection:TRIPed?
```

Description

The `SENSe{[1]|3}:TEMPerature:PROTection:WINDow[:AMPLitude]` sets the temperature window width.

The `SENSe{[1]|3}:TEMPerature:PROTection:DELay` sets the temperature window protection reset delay.

The `SENSe{[1]|3}:TEMPerature:PROTection:TRIPped?` query command returns an ASCII `1` if the window protection is currently active or an ASCII `0` if it's inactive.

Example

→ `SENS:TEMP:PROT:WIND 1.5K;DEL 5`
Sets the temperature window amplitude to ±1.5 Kelvin and the protection reset delay to 5 seconds for a TED4000 Series instrument.

Note

This command is valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 3.

See also Temperature Protection Mode 31 to protect the LD output of an ITC4000 Series instrument.

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3.13 TEC Output Commands

The OUTPut{[1]|2} subsystem controls the TEC output of the instrument.

Note

These commands are valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

Table <%TABLENO++%>: TEC Output Commands

Command	Description
OUTPut{[1]|2}	Path to TEC output function
[:STATe] 63 {ON|1|OFF|0}	Enable (ON) or disable (OFF) TEC output
[:STATe]? 63	Return output state
:PROTection	Path to TEC output protection
:CABLe 64	Path to cable failure detection
:TRIPped?	Return protection tripped
:TRANsducer 64	Path to temperature sensor protection
:TRIPped?	Return protection tripped
:OTEMp 64	Path to Over Temperature protection circuit
:TRIPped?	Return protection tripped

3.13.1 Output State

Syntax

OUTPut{[1]|2}[:STATe] {OFF|0|ON|1}
OUTPut{[1]|2}[:STATe]?

Description

The OUTPut{[1]|2}[:STATe] command switches the instrument's TEC output on/off.

Example

→ OUTP ON
Switches the TEC output of a TED4000 Series instrument on.

→ OUTP?
Queries the state of the TEC output of a TED4000 Series instrument.

→ OUTP2 ON
Switches the TEC output of an ITC4000 Series instrument on.

→ OUTP2?
Queries the state of the TEC output of an ITC4000 Series instrument.

← 1
The response is ASCII 1 if the output is switched on or an ASCII 0 if the output is off.

Note

The *RST 11 command switches the output off.

Note

These commands are valid for TED4000 and ITC4000 Series instruments only. For TED4000 Series instruments the command suffix is 1 (can be omitted), for ITC4000 Series instruments the suffix is 2.

3.13.2 Protection Queries

Syntax

`OUTPut[1]:PROTection:CABLe:TRIPped?`

`OUTPut[1]:PROTection:TRANsducer:TRIPped?`

`OUTPut[1]:PROTection:OTEMp:TRIPped?`

Description

The `OUTPut[1]:PROTection:CABLe:TRIPped?` query command returns a `1` if the cable connection from pin 1 to pin 15 (interlock) of the TEC-DRIVER 17W2 D-Sub jack is disrupted and returns a `0` if the connection is closed.

The `OUTPut[1]:PROTection:TRANsducer:TRIPped?` query command returns `1` if a sensor failure condition is detected and a `0` if a sensor is detected.

The `OUTPut[1]:PROTection:OTEMp:TRIPped?` query command returns `1` if the internal temperature of the instrument is too hot and a `0` when not.

Example

→ `OUTP:PROT:CABL:TRIP?`
Queries the cable failure protection of the TEC part of the instrument.

← `0`
Typical response.

Note

These commands are valid for TED4000 and ITC4000 only.

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3.14 Status Subsystem Commands

The Status Subsystem of the 4000 Series instruments is implemented based on the SCPI 1999.0 standard chapter 9 'Status Reporting' and the status mechanism described in chapter 11 of IEEE 488.2 (see also IEEE-488.2 commands 10).

Table <%TABLENO++%>: Status Commands

Command	Description
STATus	Path to status subsystem
:AUXiliary 69	Path to control auxiliary event registers
[:EVENt]?	Read the event register
:CONDition?	Read the condition register
:PTRansition <value>	Program the positive transition filter
:PTRansition?	Read the positive transition filter
:NTRansition <value>	Program the negative transition filter
:NTRansition?	Read the negative transition filter
:ENABle <value>	Program the enable register
:ENABle?	Read the enable register
:MEASurement 70	Path to measurement event registers
[:EVENt]?	Read the event register
:CONDition?	Read the condition register
:PTRansition <value>	Program the positive transition filter
:PTRansition?	Read the positive transition filter
:NTRansition <value>	Program the negative transition filter
:NTRansition?	Read the negative transition filter
:ENABle <value>	Program the enable register
:ENABle?	Read the enable register
:QUEStionable 71	Path to control questionable event registers
[:EVENt]?	Read the event register
:CONDition?	Read the condition register
:PTRansition <value>	Program the positive transition filter
:PTRansition?	Read the positive transition filter
:NTRansition <value>	Program the negative transition filter
:NTRansition?	Read the negative transition filter
:ENABle <value>	Program the enable register
:ENABle?	Read the enable register
:OPERation 72	Path to control operation event registers
[:EVENt]?	Read the event register
:CONDition?	Read the condition register
:PTRansition <value>	Program the positive transition filter

Command	Description
:PTRansition?	Read the positive transition filter
:NTRansition <value>	Program the negative transition filter
:NTRansition?	Read the negative transition filter
:ENABle <value>	Program the enable register
:ENABle?	Read the enable register
:PRESet 73	Return status registers to default states

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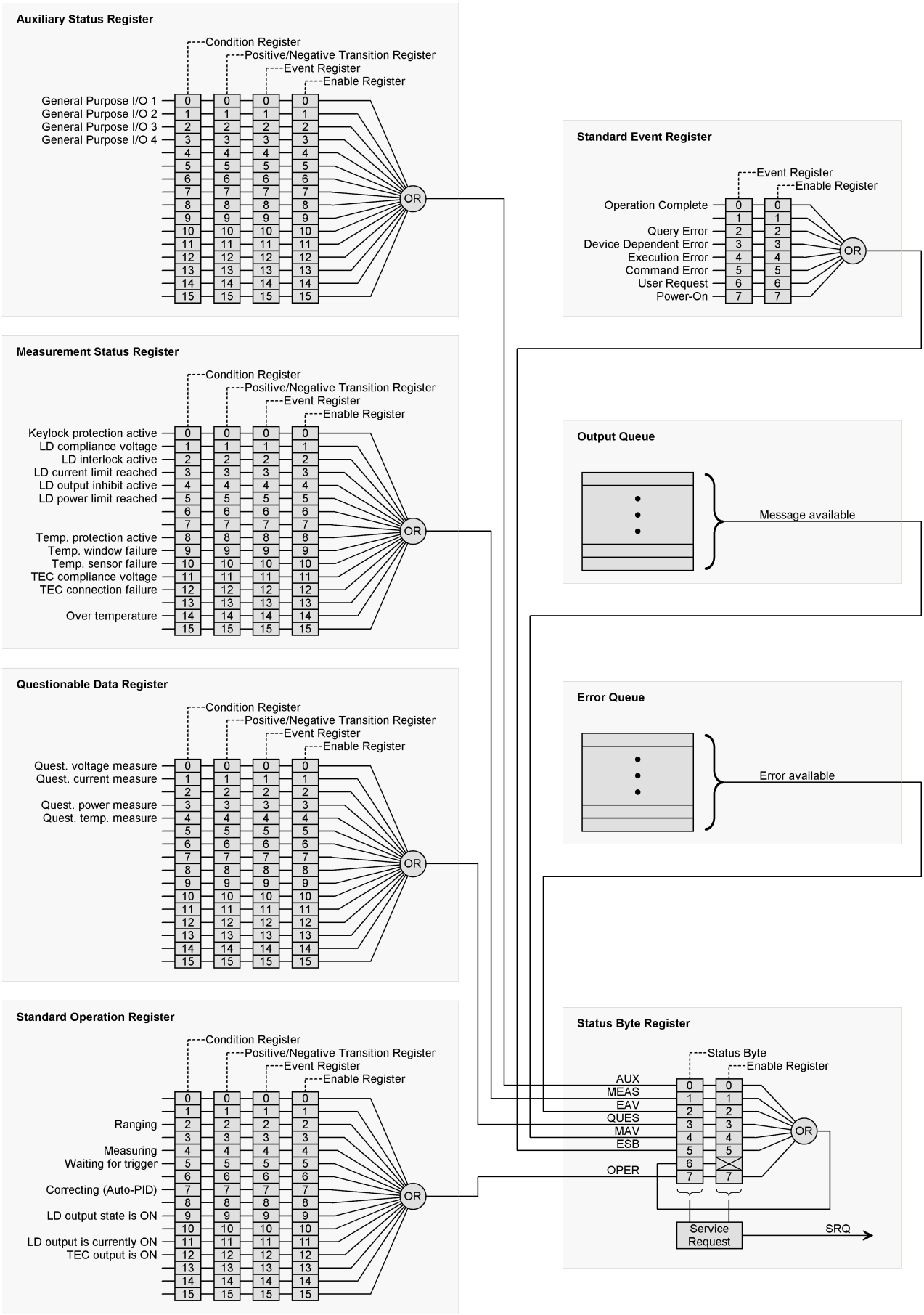

Figure <%FIGURENO++%>: Status Structure

3.14.1 Programming and Reading Registers

The status system records various instrument conditions and states in several register groups. Each register group is made up of several low-level registers called the condition register, event register, filter register and enable register which control the action of specific bits within the register group.

A **condition register** continuously monitors the state of the instrument. The bits in the condition register are updated in real-time and the bits are not latched or buffered. This is a read-only register and the bits are not cleared when you read the register.

An **event register** latches the various events from the changes in the condition register. There is no buffering in this register; while an event bit is set, subsequent events corresponding to that bit are ignored. This is a read- only register. Once a bit is set, it remains set until cleared by a query or clear status (*CLS 14) command.

An **enable register** defines which bits in the event register will be reported to the *Status Byte Register Group*. You can write to or read from an enable register.

A **filter register** (= positive/negative transition register) defines which transition of the condition register will cause an event for the event register. A set bit in the positive (negative) transition register will lead to a set bit in the event register when a low to high (high to low) transition of the corresponding bit in the condition register occurs.

The only registers that can be programmed by the user are the enable and the filter registers. All other registers in the status structure are read-only registers. The following explains how to get the parameter values for the various commands used to program enable registers.

A command to program an event enable register or a filter register is sent with a parameter value that determines the desired state (0 or 1) of each bit in the appropriate register. An enable register or a filter register can be programmed using binary, decimal, hexadecimal or octal data formats for the parameter value (for a detailed description of numeric formats see chapter 7.7.4 <NONDECIMAL NUMERIC PROGRAM DATA> of IEEE488.2-1992).

Example

The four commands program the *Auxiliary Enable Register* to the same value:

→ `STAT:AUX:ENAB 2081`
Program the *Auxiliary Enable Register* with 2018 decimal.

→ `STAT:AUX:ENAB #H821`
Program the *Auxiliary Enable Register* with 821 hexadecimal.

→ `STAT:AUX:ENAB #Q4041`
Program the *Auxiliary Enable Register* with 4041 octal.

→ `STAT:AUX:ENAB #B100000100001`
Program the *Auxiliary Enable Register* with 100000100001 binary.

The bit positions of the register (see table below) indicate the binary parameter value. For example, if you wish to sets bits B11, B5, and B0, the binary value would be 100000100001 (where B11=1, B5=1, B0=1, and all other bits are 0). When you use one of the other formats, convert the binary number to its decimal, hexadecimal, or octal equivalent:

Binary 100000100001 = Decimal 2081 = Hexadecimal 821 = Octal 4041

Note that the table below includes the decimal weight for each register bit. To set bits B11, B5, and B0, the decimal parameter value would be the sum of the decimal weights for those bits (2048 + 32 + 1 = 2081).

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Table <%TABLENO++%>: 16-bit Register Values

bit position	B7	B6	B5	B4	B3	B2	B1	B0
binary value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
decimal weights (as power of 2)	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)
bit position	B15	B14	B13	B12	B11	B10	B9	B8
binary value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
decimal weights (as power of 2)	32768 (2^{15})	16384 (2^{14})	8192 (2^{13})	4096 (2^{12})	2048 (2^{11})	1024 (2^{10})	512 (2^9)	256 (2^8)

3.14.2 Auxiliary Register Group

Syntax

```
STATus:AUXiliary[:EVENt]?
STATus:AUXiliary:CONDition?
STATus:AUXiliary:PTRansition <value>
STATus:AUXiliary:PTRansition?
STATus:AUXiliary:NTRansition <value>
STATus:AUXiliary:NTRansition?
STATus:AUXiliary:ENABle <value>
STATus:AUXiliary:ENABle?
```

Description

The `STATus:AUXiliary` commands and queries handle the registers of the *Auxiliary Register Group*.

Table <%TABLENO++%>: Auxiliary Register Group

Bit Number	Decimal Value	Definition
0	1	General Purpose I/O_1
1	2	General Purpose I/O_2
2	4	General Purpose I/O_3
3	8	General Purpose I/O_4
4-15		reserved

Note

For more information on the SCPI Status System for Thorlabs 4000 Series instruments, see chapter Programming and Reading Registers 68.

3.14.3 Measurement Register Group

Syntax

```
STATus:MEASurement[:EVENt]?
STATus:MEASurement:CONDition?
STATus:MEASurement:PTRansition <value>
STATus:MEASurement:PTRansition?
STATus:MEASurement:NTRansition <value>
STATus:MEASurement:NTRansition?
STATus:MEASurement:ENABle <value>
STATus:MEASurement:ENABle?
```

Description

The `STATus:MEASurement` commands and queries handle the registers of the *Measurement Register Group*.

Table <%TABLENO++%>: Measurement Register Group

Bit Number	Decimal Value	Definition	
0	1	keylock protection active	
1	2	LD compliance voltage	LDC, ITC
2	4	LD interlock active	LDC, ITC
3	8	LD current limit reached	LDC, ITC
4	16	LD output inhibit active	LDC, ITC
5	32	LD power limit reached	LDC, ITC
6	64	not used	
7	128	not used	
8	256	Temperature protection active	TED, ITC
9	512	Temperature window failure	TED, ITC
10	1024	Temperature sensor failure	TED, ITC
11	2048	TEC compliance voltage reached	TED, ITC
12	4096	TEC connection failure	TED, ITC
13	8192	not used	
14	16384	Over temperature	
15	32768	reserved	

Note

For more information on the SCPI Status System for Thorlabs 4000 Series instruments, see chapter Programming and Reading Registers 68.

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3.14.4 Questionable Register Group

Syntax

```
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:PTRansition <value>
STATus:QUEStionable:PTRansition?
STATus:QUEStionable:NTRansition <value>
STATus:QUEStionable:NTRansition?
STATus:QUEStionable:ENABle <value>
STATus:QUEStionable:ENABle?
```

Description

The `STATus:QUEStionable` commands and queries handle the registers of the *Questionable Register Group*.

Table <%TABLENO++%>: Questionable Register Group

Bit Number	Decimal Value	Definition
0	1	Questionable voltage measure
1	2	Questionable current measure
2	4	not used
3	8	Questionable power measure
4	16	Questionable temperature measure
5-15		not used

Note

For more information on the SCPI Status System for Thorlabs 4000 Series instruments, see chapter Programming and Reading Registers 68.

3.14.5 Operation Registers Group

Syntax

```
STATus:OPERation:[:EVENt]?
STATus:OPERation:CONDition?
STATus:OPERation:PTRansition <value>
STATus:OPERation:PTRansition?
STATus:OPERation:NTRansition <value>
STATus:OPERation:NTRansition?
STATus:OPERation:ENABle <value>
STATus:OPERation:ENABle?
```

Description

The `STATus:OPERation` commands and queries handle the registers of the *Operation Register Group*.

Table <%TABLENO++%>: Operation Register Group

Bit Number	Decimal Value	Definition	
0	1	not used	
1	2	not used	
2	4	Ranging	LDC, TED, ITC
3	8	not used	
4	16	Measuring	LDC, TED, ITC
5	32	Waiting for trigger	LDC, ITC
6	64	not used	
7	128	Correcting (Auto-PID)	TED, ITC
8	256	not used	
9	512	LD output state is ON	LDC, ITC
10	1024	not used	
11	2048	LD output is currently ON	LDC, ITC
12	4096	TEC output is ON	TED, ITC
13	8192	not used	
14	16384	not used	
15	32768	reserved	

Note

For more information on the SCPI Status System for Thorlabs 4000 Series instruments, see chapter Programming and Reading Registers 68.

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3.14.6 Status Preset Command

Syntax

`STATus:PRESet`

Description

The `STATus:PRESet` command presets the registers of the *Auxiliary Register Group* 69, the *Measurement Register Group* 70, the *Questionable Register Group* 71 and the *Operation Register Group* 72 to the default values shown in the table below.

Table <%TABLENO++%>: Default Register Values

Register	Default Value
Auxiliary Status Enable Register	all set
Auxiliary Status Positive Transition Register	all set
Auxiliary Status Negative Transition Register	all cleared
Measurement Status Enable Register	all set
Measurement Status Positive Transition Register	all set
Measurement Status Negative Transition Register	all cleared
Questionable Status Enable Register	all cleared
Questionable Status Positive Transition Register	all set
Questionable Status Negative Transition Register	all cleared
Standard Operation Status Enable Register	all cleared
Standard Operation Status Positive Transition Register	all set
Standard Operation Status Negative Transition Register	all cleared

Note

For more information on the SCPI Status System for Thorlabs 4000 Series instruments, see chapter Programming and Reading Registers 68.

3.15 Memory Subsystem Commands

The MEMory subsystem manages instrument memory.

Table <%TABLENO++%>: Memory Commands

Command	Description
MEMory	Path to memory subsystem
:NSTates? 74	Return number of state memories
:STATe	
:NAME 74 <value>,<name>	Assign a name to a state memory
:NAME? 74 <value>	Return the name of a state memory

3.15.1 Number of State Memories

Syntax

MEMory:NSTates?

Description

The MEMory:NSTates? query command returns the number of state memories. For 4000 Series instruments the answer will be 8. See also chapter *SAV, *RCL, *SDS - Save/ Recall Setup 12

Example

→ MEM:NST?
Queries the number of state memories available.

← 8
Typical response.

3.15.2 State Memories Names

Syntax

MEMory:STATe:NAME <value>,<name>
MEMory:STATe:NAME? <value>

Description

The MEMory:STATe:NAME command assigns a name to a state memory. For the parameter <value> remember that the state memories 1 ... 8 are numbered 0 ... 7.

Example

→ MEM:STAT:NAME 0,"Experiment 5"
Sets the name of state memory 1 to 'Experiment 5'.

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3.16 Display Subsystem Commands

The DISPlay subsystem controls the front panel display (LCD) of a Thorlabs Series 4000 instrument.

Table <%TABLENO++%>: Display Commands

Command	Description
DISPlay	Path to display subsystem
:BRIGHTness 75 <value>	Set the display brightness
:BRIGHTness? 75	Return the display brightness
:CONTrast 75 <value>	Set the display contrast
:CONTrast? 75	Return the display contrast

3.16.1 Display Brightness

Syntax

```
DISPlay:BRIGHTness <value>
DISPlay:BRIGHTness?
```

Description

The DISPlay:BRIGHTness command controls the intensity of the display. The range of the parameter is 0 to 1, where 1 is full intensity and 0 is fully blanked.

Example

→ DISP:BRIGHT 0.6
Sets the brightness of the front panel display to 60% of full intensity

3.16.2 Display Contrast

Syntax

```
DISPlay:CONTrast <value>
DISPlay:CONTrast?
```

Description

The DISPlay:CONTrast command determines the relative difference in brightness between “full” intensity and “no” intensity as displayed. The parameter ranges in value from 0 to 1; 0 indicates no difference between data and background, and 1 indicates maximum contrast.

Example

→ DISP:CONT 0.5
Sets the contrast of the front panel display to 50%.

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3.17 Digital I/O Output Commands

The SOURce{2|3} subsystem controls the instrument's digital I/O output.

Note

For LDC4000 and TED4000 Series instruments the command suffix is 2, for ITC4000 Series instruments the suffix is 3.

Table <%TABLENO++%>: Digital I/O Output Commands

Command	Description
SOURce{2|3}	Path to output functions
:DIGital	Path to digital I/O functions
:DATA 76 <value>	Set digital I/O output data
:DATA? 76	Return digital I/O output data
:ENABle 77 <value>	Set digital I/O output enable value
:ENABle? 77	Return digital I/O output enable value

3.17.1 Digital I/O Output

Syntax

SOURce{2|3}:DIGital:DATA <value>

SOURce{2|3}:DIGital:DATA?

Description

The SOURce{2|3}:DIGital:DATA command sets the I/O pins according to value. 'Value' can be calculated as:

$$value = 1\times I/O_1 + 2\times I/O_2 + 4\times I/O_3 + 8\times I/O_4.$$

where:

$I/O_n = 0$ for I/O is low level,
$I/O_n = 1$ for I/O is high level.

In table 'Digital I/O values' 78 all possible I/O values are listed in decoded form.

Example

→ SOUR3:DIG:DATA 8
Sets I/O_4 of the digital I/O port of an ITC4000 to high, I/O_1, I/O_2, I/O_3 to low.

Note

$I/O_{1...4}$ of the digital I/O port can be configured as input or output (see Digital I/O configuration 77). To drive an external load the respective I/O has to be configured as output.

Note

For TED4000 Series instruments and for LDC4000 Series instruments the command suffix is 2, for ITC4000 Series instruments the suffix is 3.

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3.17.2 Digital I/O Configuration

Syntax

`SOURce{2|3}:DIGital:ENABle <value>`
`SOURce{2|3}:DIGital:ENABle?`

Description

The `SOURce{2|3}:DIGital:ENABle` command enables the I/O pins as output according to value. 'Value' can be calculated as:

$$value = 1\times I/O_1 + 2\times I/O_2 + 4\times I/O_3 + 8\times I/O_4.$$

where:

$I/O_n = 0$ for I/O is input,
$I/O_n = 1$ for I/O is output.

In table 'Digital I/O values' 78 all possible I/O values are listed in decoded form.

Example

→ `SOUR3:DIG:ENAB 15`
Sets $I/O_{1...4}$ of the digital I/O port of an ITC4000 to output.

Note

For TED4000 Series instruments and for LDC4000 Series instruments the command suffix is 2, for ITC4000 Series instruments the suffix is 3.

3.18 Digital I/O Input Commands

The `SENSe{2|3|4}` subsystem controls the instrument's digital I/O input.

Note

For LDC4000 Series instruments the command suffix is 3, for TED4000 Series instruments the command suffix is 2 and for ITC4000 Series instruments the command suffix is 4.

Table <%TABLENO++%>: Digital I/O Input Commands

Command	Description
`SENSe{2|3|4}`	Path to input functions
`:DIGital`	Path to digital I/O functions
`:DATA?` 78	Return digital I/O input data

3.18.1 Digital I/O Input

Syntax

`SENSe{2|3|4}:DIGital:DATA?`

Description

The `SENSe{2|3|4}:DIGital:DATA?` command queries the I/O pins of the digital I/O port. The returned value represents the levels of $I/O_{1...4}$ according to:

Table <%TABLENO++%>: Digital I/O Values

I/O_4	I/O_3	I/O_2	I/O_1	value
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	L	L	L	8
H	L	L	H	9
H	L	H	L	10
H	L	H	H	11
H	H	L	L	12
H	H	L	H	13
H	H	H	L	14
H	H	H	H	15

Example

→ `SENS2:DIG:DATA?`
Queries the digital I/O port of a TED4000 Series instrument.

← 9
Typical response.

Note

$I/O_{1...4}$ of the digital I/O port can be configured as input or output (see Digital I/O configuration 77). To be able to read the level of a connected driver the respective I/O has to be configured as input.

Note

For LDC4000 Series instruments the command suffix is 3, for TED4000 Series instruments the command suffix is 2 and for ITC4000 Series instruments the command suffix is 4.

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3.19 Unit Subsystem Commands

For each SCPI command default units are defined, where applicable. The `UNIT` subsystem provides a mechanism to change these default units. The units selected apply to the designated command parameters for both command and response

Table <%TABLENO++%>: Unit Commands

Command	Description
`UNIT`	Path to unit functions
`:TEMPerature` 79 `{C|CEL|CELSius|F|FAR|FAHRenheit|K|KELVin}`	Set the temperature unit
`:TEMPerature?` 79	Return the temperature unit

3.19.1 Temperature Unit Commands

Syntax

`UNIT:TEMPerature {C|CEL|CELSius|F|FAR|FAHRenheit|K|KELVin}`

`UNIT:TEMPerature?`

Description

The `UNIT:TEMPerature` command sets the temperature unit used for further communication with the instrument.

Example

→ `UNIT:TEMP K`
Sets the temperature unit for further communication with the instrument to Kelvin.

Note

This command is valid only for TED4000 and ITC4000 Series instruments.

3.20 Calibration Subsystem Commands

4000 Series instruments do not provide an internal calibration mechanism, they are calibrated at the factory. The `CALibration` subsystem for 4000 Series instruments only provides a means of retrieving the instrument's calibration string. This string is factory set at calibration time.

Table <%TABLENO++%>: Calibration Commands

Command	Description
`CALibration`	Path to calibration functions
`:STRing?` 80	Return the calibration string

3.20.1 Calibration String

Syntax

`CALibration:STRing?`

Description

The `CALibration:STRing?` command returns the calibration string.

Example

→ `CAL:STR?`
Queries the calibration string.

← `CALIBRATED JUNE-30-2009`
Typical response.

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4 SCPI Error Messages

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Device Specific Errors (-300 ... -399) 84
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Instrument Errors (0...) 85

LDC4000, TED4000 and ITC4000 Series instruments return error messages in accord with the SCPI standard.

- A record of up to 10 errors can be stored in the instrument's error queue.
- The front-panel ERROR annunciator turns on when one or more errors are currently stored in the error queue.
- Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was stored.
- Errors are cleared as you read them. When you have read all errors from error queue, the ERROR annunciator turns off.
- If more than 10 errors have occurred, the last error stored in the queue (the most recent error) is replaced with -350,"Error queue overflow". No additional errors are stored until you read from the queue.
- If no errors have occurred when you read the error queue, the instrument responds with +0,"No error".
- Error conditions are also summarized in the Status Byte Register. For more information on the SCPI Status System for the LDC4000, TED4000 and ITC4000 Series instruments, see chapter Status Subsystem Commands 65.
- The error queue is cleared by the *CLS 14 (Clear Status) command and when power is cycled. All errors are cleared when you read the error queue. The error queue is not cleared by the Reset (*RST 11 command) or an status preset command (STATus:PRESet 73 command).
- For reading the error queue refer to chapter Error Query 16.

4.1 Command Errors

Error	Description
-100	*Command error* This is the generic syntax error for devices that cannot detect more specific errors. This code indicates only that a Command Error as defined in IEEE 488.2, 11.5.1.1.4 has occurred.
-101	*Invalid character* A syntactic element contains a character which is invalid for that type; for example, a header containing an ampersand, SETUP&. This error might be used in place of errors -114, -121, -141, and perhaps some others.
-102	*Syntax error* An unrecognized command or data type was encountered; for example, a string was received when the device does not accept strings.

-103	*Invalid separator*
	The parser was expecting a separator and encountered an illegal character; for example, the semicolon was omitted after a program message unit,
	`INP:POL CG*STB?`
	instead of
	`INP:POL CG;*STB?`

-104	*Data type error* The parser recognized a data element different than one allowed; for example, numeric or string data was expected but block data was encountered.
-105	*GET not allowed* A Group Execute Trigger was received within a program message (see IEEE 488.2, 7.7).
-108	*Parameter not allowed* More parameters were received than expected for the header; for example, the `*SRE` common command only accepts one parameter, so receiving `*SRE 0,1` is not allowed.
-109	*Missing parameter* Fewer parameters were received than required for the header; for example, the `*SRE` common command requires one parameter, so receiving `*SRE` is not allowed.
-110	*Command header error* An error was detected in the header. This error message should be used when the device cannot detect the more specific errors described for errors -111 through -119.
-113	*Undefined header (Unknown command)* The header is syntactically correct, but it is undefined for this specific device; for example, `*XYZ` is not defined for any device.
-115	*Unexpected number of parameters* The number of parameters received does not correspond to the number of parameters expected.
-120	*Numeric data error* This error is generated when parsing a data element which appears to be numeric, including the nondecimal numeric types.
-130	*Suffix error* This error, as well as error -131, is generated when parsing a suffix.
-131	*Invalid suffix* The suffix does not follow the syntax described in IEEE 488.2, 7.7.3.2, or the suffix is inappropriate for this device.
-151	*Invalid string data* A string data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.5.2); for example, an END message was received before the terminal quote character.

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4.2 Execution Errors

Error	Description
-220	*Parameter error* Indicates that a program data element related error occurred.
-221	*Settings conflict* Indicates that a legal program data element was parsed but could not be executed due to the current device state (see IEEE 488.2, 6.4.5.3 and 11.5.1.1.5.)
-222	*Data out of range* Indicates that a legal program data element was parsed but could not be executed because the interpreted value was outside the legal range as defined by the device (see IEEE 488.2, 11.5.1.1.5.)
-230	*Data corrupt or stale* Possibly invalid data; new reading started but not completed since last access.
-231	*Data questionable* Indicates that measurement accuracy is suspect.
-240	*Hardware error* Indicates that a legal program command or query could not be executed because of a hardware problem in the device.
-241	*Hardware missing* Indicates that a legal program command or query could not be executed because of missing device hardware; for example, an option was not installed.
-250	*Mass storage error* Indicates that a mass storage error occurred.
-251	*Missing mass storage* Indicates that a legal program command or query could not be executed because of missing mass storage; for example, an option that was not installed.
-252	*Missing media* Indicates that a legal program command or query could not be executed because of a missing media; for example, no SD-card or no USB-stick.
-253	*Corrupt media* Indicates that a legal program command or query could not be executed because of corrupt media; for example, bad SD-card or wrong format.
-254	*Media full* Indicates that a legal program command or query could not be executed because the media was full; for example, there is no room on the SD-card.
-255	*Directory full* Indicates that a legal program command or query could not be executed because the media directory was full.
-256	*File name not found* Indicates that a legal program command or query could not be executed because the file name on the device media was not found; for example, an attempt was made to read or copy a nonexistent file.
-257	*File name error* Indicates that a legal program command or query could not be executed because the file name on the device media was in error; for example, an attempt was made to copy to a duplicate file name.
-258	*Media protected* Indicates that a legal program command or query could not be executed because the media was protected; for example, the write-protect tab on a disk was present.

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4.3 Device Specific Errors

Error	Description
-310	*System error* Indicates that some error, termed “system error” by the device, has occurred.
-311	*Memory error* Indicates some physical fault in the device’s memory, such as parity error.
-313	*Calibration memory lost* Indicates that nonvolatile calibration data used by the *CAL? command has been lost.
-314	*Save/recall memory lost* Indicates that the nonvolatile data saved by the *SAV? command has been lost.
-315	*Configuration memory lost* Indicates that nonvolatile configuration data saved by the device has been lost.
-321	*Out of memory* An internal operation needed more memory than was available.
-330	*Self-test failed* There was an error detected during a self-test. During a self-test the instrument checks the internal hardware for proper function.
-340	*Calibration failed* The instrument is not or improper calibrated.
-350	*Queue overflow* A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.
-363	*Input buffer overrun* Software or hardware USB input port buffer overflows with data caused by improper or nonexistent pacing.

4.4 Query Errors

Error	Description
-400	*Query error* This code indicates that a generic Query Error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.
-410	*Query INTERRUPTED* Indicates that a condition causing an INTERRUPTED Query error occurred (see IEEE 488.2, 6.3.2.3); for example, a query followed by another query before a response was completely sent.

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4.5 Instrument Errors

Error	Description
3	*Instrument is overheated* The device's internal temperature is too high.
20	*Not permitted with LD output on* Operation is not allowed while the LD output is switched on.
22	*Interlock circuit is open* Operation is not allowed while the interlock protection is tripped.
23	*Key switch is in locked position* Operation is not allowed while the front panel key switch protection is tripped.
24	*LD open circuit detected* Operation is not allowed while the LD output voltage protection is tripped.
25	*LD-ENABLE input is de-asserted* Operation is not allowed while the external protection is tripped. This error occurs when the rear panel LD enable input is set to protection mode and has a low level.
26	*LD temperature protection is active* Operation is not allowed while the temperature protection is tripped. ITC 4000 Series instruments only.
27	*Not permitted with photodiode BIAS on* Operation is not allowed while the photodiode BIAS is switched on.
28	*Not permitted with QCW mode on* Operation is not allowed while QCW mode is enabled.
30	*Not permitted with TEC output on* Operation is not allowed while the TEC output is switched on.
31	*Wrong TEC source operating mode* Operation is not allowed for the selected TEC operating mode.
32	*PID Auto-Tune is currently running* Operation not allowed while the PID Auto-Tune procedure is running.
33	*PID Auto-Tune value error* An PID Auto-Tune procedure was not able to detect proper values.
34	*TEC open circuit detected* Operation is not allowed while the TEC output voltage protection is tripped.
35	*Temperature sensor failure* Operation is not allowed while the temperature sensor protection is tripped. E.g. no or wrong sensor connected.
36	*TEC cable connection failure* Operation is not allowed while the TEC cable connection failure protection is tripped.

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5 Appendix

5.1 Instrument Default Settings

The instrument's default settings can be set with the *SDS 12 command. The following table lists the parameters affected by the command.

Table <%TABLENO++%>: Instrument Default Settings

Parameter SCPI command to set parameter	**Default Value *** <value>
LDC operating mode SOURce[1]:FUNCtion:MODE 40	Constant Current CURR
LDC amplitude modulation SOURce[1]:AM[:STATe] 43	OFF OFF
LDC power feedback SOURce[1]:POWer:ALC:SOURce 43	Photodiode DIOD
LDC power feedback bandwidth SOURce[1]:POWer:ALC:BANDwidth 43	100 Hz 100
LDC switch-on delay OUTPut[1]:DELay 29	2 seconds 2
LDC polarity OUTPut[1]:POLarity 30	cathode grounded CG
LDC current limit SOURce[1]:CURRent:LIMit[:AMPLitude] 40	e.g. 20 Amperes (*) 20
LDC photodiode current protection SENSe[1][:CURRent][:DC]:PROTection[:LEVel] 46	e.g. 2 mA (*) 2.0E-03
LDC thermopile/power meter protection SENSe2[:VOLTage][:DC]:PROTection[:LEVel] 49	e.g. 1 Volt (*) 1
LDC output voltage protection (compliance voltage) OUTPut[1]:PROTection:VOLTage[:LEVel] 31	e.g. 1 Volt (*) 1
LDC photodiode polarity INPut[1]:POLarity 34	cathode grounded CG
LDC photodiode current range SENSe[1][:CURRent][:DC]:RANGe[:UPPer] 45	e.g. 20 mA (*) 0.02
LDC path for photodiode input routing INPut[1]:ROUTe[:TERMinals] 36	LASER OUTPUT D-SUB connector DSUB
LDC photodiode BIAS state INPut[1]:BIAS[:STATe] 35	no BIAS voltage OFF

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Parameter SCPI command to set parameter	**Default Value *** <value>
LDC photodiode BIAS voltage INPut[1]:BIAS:VOLTage[:DC] 35	0 Volts 0
LDC photodiode responsivity SENSe[1][:CURRent][:DC]:CORRection:POWer [:PDIode][:RESPonse] 46 46	1 $^{A}/_{W}$ 1
LDC thermopile/power meter voltage range SENSe2[:VOLTage][:DC]:RANGe[:UPPer] 48	10 Volts 10
LDC path for thermopile/power meter routing INPut2:ROUTe[:TERMinals] 37	LASER OUTPUT D-SUB connector DSUB
LDC thermopile/power meter responsivity SENSe2[:VOLTage][:DC]:CORRection:POWer [:THERmopile][:RESPonse] 49 49	1 $^{V}/_{W}$ 1
LDC amplitude modulation state SOURce[1]:AM[:STATe] 43	disabled OFF
LDC amplitude modulation source SOURce[1]:AM:SOURce 43	internal INT
LDC amplitude modulation shape SOURce[1]:AM:INTernal:SHAPe 43	sinusoidal SIN
LDC amplitude modulation frequency SOURce[1]:AM:INTernal:FREQuency 43	10.0 kHz 1.0E+04
LDC amplitude modulation depth SOURce[1]:AM:INTernal[:DEPTh] 43	10 % 10
LDC enable input function OUTPut[1]:PROTection:EXTernal[:MODE] 32	no function OFF
LDC internal temperature protection function OUTPut[1]:PROTection:INTernal[:MODE] 31	no function OFF
LDC pulsed constant current (QCW) trigger source TRIGger[:SEQuence]:SOURce 51	internal INT
LDC pulsed constant current (QCW) mode pulse period SOURce[1]:PULSe:PERiod 44	20 ms 0.02
LDC pulsed constant current (QCW) mode pulse width SOURce[1]:PULSe:WIDTh 44	1 ms 1.0E-03
LDC pulsed constant current (QCW) mode duty cycle SOURce[1]:PULSe:DCYCle 44	5 % 5
LDC pulsed constant current (QCW) mode hold parameter SOURce[1]:PULSe:HOLD 44	pulse width WIDT

Parameter SCPI command to set parameter	**Default Value *** <value>
LDC laser current setpoint SOURce[1]:CURRent[:LEVel][:IMMediate] 41 [:AMPLitude] 41	0 Amperes 0
LDC photodiode current setpoint SOURce[1]:POWer[:LEVel]:DIODe[:CURRent] 41 [:IMMediate] 41	0 Amperes 0
LDC thermopile/power meter voltage setpoint SOURce[1]:POWer[:LEVel]:PMETer[:VOLTage] 41 [:IMMediate] 41	0 Volts 0
LDC power setpoint SOURce[1]:POWer[:LEVel][:IMMediate] 41 [:AMPlitude] 41	0 Watts 0
TED operating mode SOURce{[1]|2}:FUNCtion[:MODE] 53	const. temperature TEMP
TED current limit SOURce{[1]|2}:CURRent:LIMit[:AMPLitude] 54	e.g. 0.1 A (*) 0.1
TED current setpoint SOURce{[1]|2}:CURRent[:LEVel][:IMMediate] 54 [:AMPLitude] 54	0 Amperes 0
TED sensor selection SENSe{[1]|3}:TEMPerature:TRANsducer[:TYPE] 60	AD590 sensor AD590
TED transducer offset SENSe{[1]|3}:TEMPerature:OFFSet 61	0°C / 0K 0
TED temperature protection window SENSe{[1]|3}:TEMPerature:PROTection 62 :WINDow[:AMPLitude] 62	5.0°C 5
TED temperature protection window reset delay SENSe{[1]|3}:TEMPerature:PROTection:DELay 62	1 second 1
TED PID control loop - gain value / P-share SOURce{[1]|2}:TEMPerature:LCONstants[:GAIN] 56	1.0 $^{A}/_{K}$ 1
TED PID control loop - integral value / I-share SOURce{[1]|2}:TEMPerature:LCONstants:INTegral 56	0.1 $^{A \times s}/_{K}$ 0.1
TED PID control loop - derivative value / D-share SOURce{[1]|2}:TEMPerature:LCONstants 56 :DERivative 56	0.0 $^{A}/_{K \times s}$ 0
TED PID control loop - period SOURce{[1]|2}:TEMPerature:LCONstants:PERiod 56	1.0 s 1

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Parameter SCPI command to set parameter	**Default Value *** <value>
TED temperature setpoint limit high SOURce{[1]|2}:TEMPerature:LIMit:HIGH 55	150.0°C 150
TED temperature setpoint limit low SOURce{[1]|2}:TEMPerature:LIMit:LOW 55	-55.0°C -55
TED temperature setpoint SOURce{[1]|2}:TEMPerature[:SPOint] 55	25°C 25
TED thermistor R ↔ T calculation method SENSe{[1]|3}:TEMPerature:THERmistor:METHod 60	exponential meth. EXP
TED thermistor Steinhart Hart parameter A SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod[:SHH]:A 60	1.129241×10^{-3} 1.129241E-03
TED thermistor Steinhart Hart parameter B SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod[:SHH]:B 60	2.341077×10^{-4} 2.341077e-04
TED thermistor Steinhart Hart parameter C SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod[:SHH]:C 60	8.775468×10^{-8} 8.775468E-08
TED thermistor exp. method parameter R_0 SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod:EXPonential:R0 60	10.0 kΩ 1.0E+04
TED thermistor exp. method parameter T_0 SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod:EXPonential:T0 60	25.0°C 25
TED thermistor exp. method parameter B-value SENSe{[1]|3}:TEMPerature:THERmistor: 60 METHod:EXPonential:BETA 60	3575.0 3575
Display brightness DISPlay:BRIGHTness 75	100 % 100
Display contrast DISPlay:CONTrast 75	45 % 45
Acoustic feedback SYSTem:BEEPer[:IMMediate] 16	enabled ON
Temperature unit UNIT:TEMPerature 79	degree Celsius C
Line frequency setting SYSTem:LFRequency 17	autom. detection AUTO

(*) The default values stated here are typical values, they may vary from model to model. For more information on default values please see the user's manual provided with the

instrument.

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