Computer Interfacing Manual

Certificate No.: FM 27207

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Irvine, California, USA
Part No. 24595-01
IN-08974
Printed 2-Dec-98
Rev. B

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CHAPTER 1

1. Computer Interfacing

1.1 Introduction

This manual deals with the issues regarding computer interfacing and control of Newport laser diode and temperature controllers, hereafter referred to simply as “controller” or “controllers”. The GPIB/IEEE-488.2 and RS232C interfaces (both not supported on all controllers) allows the computer control of the controller.

In remote operating mode, the controller offers all of the features accessible from the front panel and some advanced features which can only be accessed via the interface bus.

This manual assumes the user is experienced with instrumentation and GPIB or RS-232 control, and is not intended as a tutorial in those practices.

1.2 Specific Controller Support

Because this manual supports multiple controllers, there may be examples used that are not supported on a specific platform, such as TEC commands on a laser controller. In these situations, treat the example as educational and not literal. Where appropriate, a legend of supported platforms will indicate specific platform support. In addition, diagrams, tables, and command definitions include information that may not apply to your specific platform.

1.3 GPIB Interface

1.3.1 Preparation for Bus Control

The talk and listen addresses on the controller are identical and default at 4. This GPIB address is read locally in the GPIB configure window. Turn the ADJUST knob until the desired address value is displayed. The new GPIB address will then be stored in non-volatile memory, independent of the SAVE and RECALL "bin" number. The allowable address range is 0 - 31 for primary GPIB addressing.

1.3.2 Interface Function Subsets

The following table contains the Interface Function Subsets which are supported by the controller.

SHI	Source Handshake - complete compatibility
AH1	Acceptor Handshake - complete capability
T6, TEO	Talker Function
L4, LEO	Listener Function
SR1	Service Request - complete capability
RL2	Remote Local Function - no local lockout
PP1	Remote Configuration Parallel Poll - no local capability
DC1	Device Clear - complete capability
DT0	Device Trigger - no capability
C0	Controller Function - no capability
E1, E2	Three-state bus drivers with automatic switch to open collector during Parallel Poll

1.3.3 Remote Messages

The following table contains GPIB remote messages which are compatible with the controller.

ACG
ATN
DAB
DAC
DAV
DCL
END
GTL
IDY
IFC
LAG
LLO
MLA
MTA
OTA
PCG
PPC
PPE
PPD
PPR1
PPR2
PPR3
PPR4
PPR5
PPR6
PPR7
PPR8
PPU
REN
RFD
RQS
SCG
SDC
SPD
SPE
SRQ
STB
TAG
UCG
UNL
UNT

Non-Supported Remote Interface Messages

The following table contains GPIB interface messages which are unsupported by the controller.

EOS	MSA	NUL
GET	OSA	TCT

1.4 RS-232C Interface

1.4.1 Introduction

The RS-232C interface functions similarly to the GPIB interface, and can accept every command documented above, without the hardware status reporting ability that is inherent in the IEEE bus architecture (serial and parallel poll, serial requests, etc.). However, by polling the controller over the RS-232 interface, a similar level of capability can be achieved.

1.4.2 RS-232C Communication

Before communicating with the controller through the RS-232 port, proper cable connection must be made. Table 1 shows the cable connection for communicating with the RS-232C port on the controller.

Once cable connection are made, the baud rate needs to be set. Valid baud rates are 38400, 19200, 9600, 4800, 2400, 1200, and 300[1], with the default being 9600. The parity, data bits, and stop bits are fixed at no parity, 8 data bits, and 1 stop bit.

Table 1 - RS-232C Cable Connections

Controller DB9 Pin	Code	Description	Computer DB9 Pin	Computer DB25 Pin
2	RXD	Receive Data	3	2
3	TXD	Transmit Data	2	3
5	GND	Signal Ground	5	7

1.4.3 RS-232C Parameters

Baud Rate	38400, 19200, 9600, 4800, 2400, 1200, 300[1]
Parity	None

[1] Not all baud rates may be supported. See the operations manual of the instrument for a list of available baud rates.

Data bits	8
Stop bits	1

1.4.4 Terminal Mode

The controller supports two different modes of operation over the RS-232 interface: terminal mode and normal mode. See the operations manual on how to switch between terminal and normal mode.

In terminal mode, the controller generates a '>' prompt for every new line and all characters sent to the controller are echoed back over the interface until the input buffer is full. As the user is entering commands the line may be edited by using the backspace key (sending an ASCII decimal code 8). A command is not executed until terminated by a new line (ASCII decimal code 10) or a carriage return (ASCII decimal code 13). A zero length command is ignored (but does generate a new ‘>‘ prompt). Each command that generates a response is immediately sent over the port, prefixed with “Response: ”. If there are multiple commands that generate responses from a single command string, each will returned via a separate “Response: ” reply. Terminal mode uses the VT100/ANSI clear-to-end-of-line command during response messages and may use additional VT-100/ANSI commands in future releases, so a terminal supporting the VT100/ANSI command set is suggested but not required.

Normal mode is most useful when the controller is controlled by a computer program. In normal mode, characters are not echoed back to the user, there are no prompts, and command responses are not prefixed with anything. Like terminal mode, a command is not executed until terminated by a new line (ASCII decimal code 10) or a carriage return (ASCII decimal code 13). The line may be edited by using the backspace key (sending an ASCII decimal code 8).

1.4.5 Setting the Baud Rate

See the operation manual of the instrument for a list of available baud rates and how to change them.

1.5 ANSI/IEEE-488.2 Definitions

The following sections contain the relevant definitions for syntax diagrams and syntax elements for the controller commands, as defined by the IEEE-488.2 standard. Note that these definitions apply to both the GPIB interface as well as the RS232C interface, unless otherwise noted.

1.5.1 Power-on Conditions

At power-on, the controller complies with the ANSI/IEEE 488.2-1987 requirements. It will initialize the setup parameters to be the same as when the power was last shut down. However, all outputs will be off at power-up.

1.5.2 White Space

White space is defined as a single ASCII-encoded byte in the range 00-09, 0B-20 Hex (0-9, 11-32 decimal). This range includes the ASCII control characters and the space, but excludes the new line character. In most practical programming situations, the space character would be used. White space is processed by the controller without interpretation. See Figure 1.

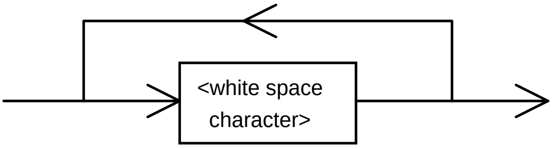


Figure 1 - White Space Diagram

1.5.3 <nrf value>

The symbol <nrf value>, refers to the numeric representation, as defined by the IEEE-488.2 standard. All this means is that numbers may be represented in one of three forms, integer, floating point, or engineering/scientific notation. For example the number "twenty" can be represented by an ASCII string of:

```
20      or   +20
20.0    or   +20.00
2.0E+1  or   +2.0E+1    or    2.0e+1   or   +2.0e+1
```

1.5.4 Message Terminators

When you send a command to the controller, it usually puts a **<CR><LF><EOI>** at the end of the command string. Note that the RS232 interface does not support the **<EOI>** or **END** or **^END** terminators of the GPIB interface. For RS232C interface users, simply ignore future references to **<EOI>** or **END** terminators. In this manner, a **<PROGRAM MESSAGE TERMINATOR>** is sent.

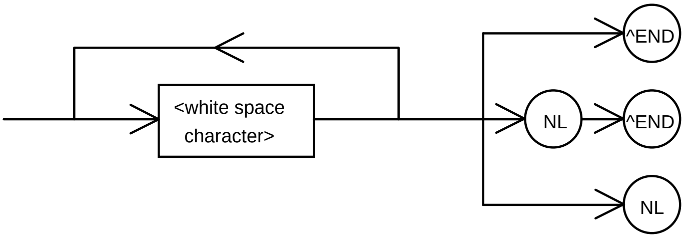


Figure 2 - <PROGRAM MESSAGE TERMINATOR> Syntax Diagram

The controller uses the definition shown in Figure 2 for a **<PROGRAM MESSAGE TERMINATOR>**, where a **<CR>** is defined as white space. Note: **LF** (line feed) is equivalent to **NL** (new line), and **^END** is equivalent to the **EOI** (end or identify) message.

When the controller sends out data, the default value for a response terminator is: **<CR><NL><^END>**. This terminator may not be compatible with existing software. Therefore, the **TERM** command is available to set the controller's response terminator, if needed.

1.6 Status Reporting

Figure 3 shows the status reporting scheme of the controller. Each of the registers which may be accessed by a command or query has the appropriate command or query written above or below the register representation. For example, the Laser Condition Register may be queried via the **LASer:COND?** query, as shown by its register heading.

The condition or event registers are logically ANDed with their respective enable registers. These bits are then logically ORed to form a summary message in the Status Byte Register for that particular register.

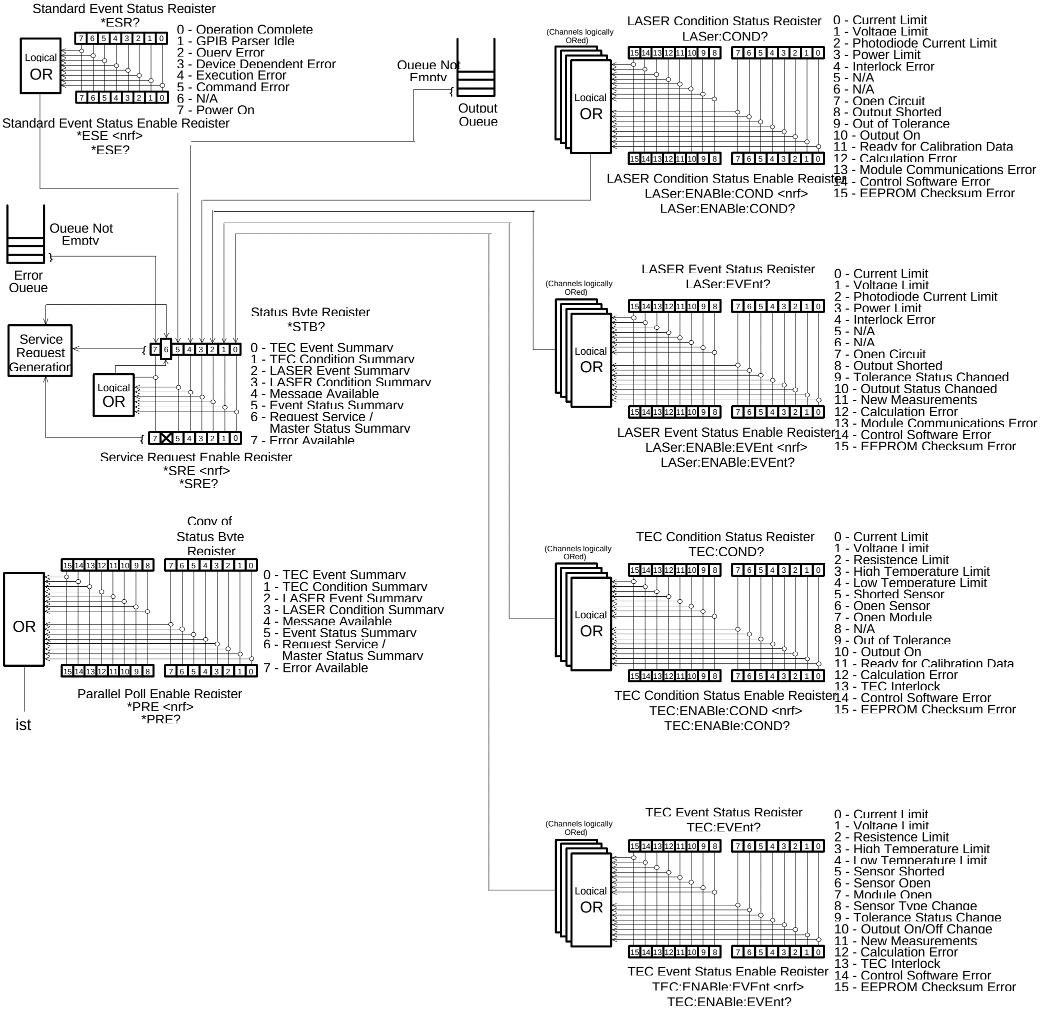


Figure 3 - Status Reporting Diagram

1.6.1 Event and Condition Registers

The Event Registers are used to report events which occur during the operation of the controller. Events differ from conditions in that events signal an occurrence once, and are not reset until the Event Register is queried or the controller is powered off. Conditions reflect the current state of the device, and therefore may change many times during operation. Querying a Condition Register does not change its contents.

The controller contains Event and Condition Registers for TEC and laser controller operations. It also contains the Standard Event Status Register which reports events for general operation of the controller.

1.6.2 Operation Complete Definition

Note that bit 0 of the Standard Event Status Register contains the status of the Operation Complete flag (see ***OPC**). Enabling this bit via the ***ESE** command allows the user to update bits of the Status Byte Register. Then, if the Service Request Enable Register (see ***SRE**) mask has bit 5 set, and the user issues an ***OPC** command, a service request (SRQ) will be issued upon completion of the currently processed commands. This may be used to initiate service request routines which depend on the completion of all previous commands.

For example, the user may set the TEC output to 30°C, enable the SRQ on Operation Complete, and have an SRQ handling routine in the user's software which begins a new measurement after the 30°C value has been reached.

This allows the use of the operation complete features of the controller, such as the **TOLerance** commands, without the need for program looping or polling which can tie up the GPIB.

Operation Complete on the controller is defined as:

1) The laser controller, which is updating the current source hardware, is idle.

2) The TEC controller, which is updating the temperature controller hardware, is idle.

3) No EPROM (non-volatile) memory write cycles are in progress.

4) New laser current and photodiode measurements are available, updated approximately every 500 - 1000 milliseconds.

5) New TEC sensor and ITE measurements are available, updated approximately every 500 - 1000 milliseconds.

6) No delay timeout clocks are running.

7) No calibration routines are running.

8) Laser output is off, or it is on and within tolerance.

9) TEC output is off, or it is on and within tolerance.

1.7 Output Off Registers

The Output Off Enable Registers allow the user to determine which conditions and events in the TEC and laser controllers will cause their outputs to be turned off. These registers are configured in a manner which is similar to the status reporting registers. However, their outputs are not reported in the Status Byte Register. Rather, they go to the hardware which controls the output switching. The events and conditions which may be set to cause the TEC and laser outputs to be turned off are shown in the tables below. Note that each TEC module and each laser module have their own set of registers. The conditions which are enabled by default are shown in **bold**.

Laser Output Off Register

bit 0 - Laser Current Limit
bit 1 - Laser Voltage Limit *(always enabled)*
bit 2 - Photodiode Current Limit
bit 3 - Photodiode Power Limit
bit 4 - Laser Interlock Error *(always enabled)*
bit 5 - N/A
bit 6 - N/A
bit 7 - Laser Open Circuit *(always enabled)*
bit 8 - Laser Output Shorted *(always enabled)*
bit 9 - Laser Output Out of Tolerance
bit 10 - TEC Output Off Event
bit 11 - TEC Temperature Limit Condition
bit 12 - Hardware Error
bit 13 - N/A
bit 14 - N/A
bit 15 - N/A

TEC Output Off Register

bit 0 - TEC Current Limit
bit 1 - TEC Voltage Limit
bit 2 - R Limit
bit 3 - High Temperature Limit
bit 4 - Low Temperature Limit
bit 5 - N/A
bit 6 - Sensor Open
bit 7 - TEC Module Open
bit 8 - Sensor Type Change *(always enabled)*
bit 9 - Out of Tolerance
bit 10 - Sensor Shorted
bit 11 - N/A
bit 12 - Software Error
bit 13 - TEC Interlock[2]
bit 14 - N/A
bit 15 - N/A

1.8 Overview of the Controller Device Dependent Commands

There are two types of device commands; 1) commands which cause the controller to do something, and 2) queries which return stored value or state of the instrument. Queries must end with a question mark (?), while commands may require parameter(s) to follow:

TEC:GAIN 1

For example, the "1" in the command **TEC:GAIN 1**, sets the TEC gain at 1. Generally, a command or query is entered (spelled) as shown in Table 2. Upper or lower case may be used in any combination, but the command/query MUST contain all of the letters which are shown in upper case in Table 2. The lower case letters shown with the commands are optional, and may be used for clarity. For example, the following commands are equal.

TEC:DIS 1
and
tec:DISPLAY 1
and
Tec:Disp 1

[2] Not supported on all TECs.

The syntax of the controller commands follows the rules laid out in the IEEE-488.2 standard. Colons (:) indicate the start of a new command path, while semicolons (;) indicate a separation of commands within a command string. A leading semicolon on a command may be used to return the controller command parser to the command path root.

1.8.1 Active Laser and TEC Channel

The command set of the controller operates on a single channel. However, some controllers operate as a multi-channel devices. For example, there may be a TEC module installed in slots 1 and 2 and a laser module installed in slots 3 and 4. Some commands do not apply to a particular channel, such as **BEEP**. However, many commands do apply to a specific channel, either a TEC or a laser.

When the controller powers up, the active channel for each type of module is the first instance of that module in the system. For example, in an controller with laser modules in slots 1 and 3, and TEC modules in slots 2 and 4, the active laser module would be slot 1, and all laser commands would be directed at that module (unless a **LASer:CHANnel** switched to module 3). Likewise, the active TEC module on power up would be module 2, and all TEC commands would be directed at that module. See the **LASer:CHAN** and **TEC:CHAN** commands for additional details.

1.8.2 Substitute Parameter Names

For clarity in programming, the Boolean values of one and zero may also be represented by the appropriate substitute parameter names, as shown below.

Substitute Name	Value
ON	1
OFF	0
OLD	1
NEW	0
TRUE	1
FALSE	0

The ON parameter name could be used in place of the 1 in the example as follows:

```
TEC:DIS ON
```

1.8.3 Compound Command Structure

Many of the controller remote commands require a compound structure. For example, commands which deal with the controller TEC have the path **TEC:**, as in the command to set the TEC high resistance limit:

```
TEC:LIM:RHI 25.000
```

Table 2 lists all of the controller's device-dependent commands, with the full path shown for each command and a brief explanation of its usage. As shown above, the colon (:) separates commands in a compound command.

Compound queries are also valid, such as: **LASer:DIS?** If multiple parameters are expected, they should be separated with commas. For example, to set the Steinhart-Hart constants on the controller (C1, C2, and C3) the following command could be sent:

```
TEC:CONST 1.111, 2.004, 0.456
```

Spaces or white space may be placed anywhere in a command string (after the command header or query question mark), and must be used to separate the command from the first parameter. The following examples show valid syntax for commands with the controller.

```
TEC:MODE:t; TEC:T 25; TEC:Const 1, 2, 3.5; TEC:OUT 1
:TEC:DIS 1; tec:set:t?
Laser:limit:i 40
LASer:set:ldv?
```

The following are examples of invalid syntax for the controller. These command strings would produce an erroneous result, as explained:

TEC:MODE T	- Missing colon, **MODE?** expected
TEC:MODE:R DEC	- missing semicolon, **DEC** command generates an error
LASer:DIS ?	- Space not allowed before question mark, **DIS** command expected.
Las:LDI33;dis?	- Space missing between LDI command and the parameter value, 33.

1.8.4 Advanced Programming

Once you have become familiar with the command syntax and structure, you may take advantage of some programming shortcuts which are available.

Due to the "tree-walking" capabilities of the controller software, the user may elect to write command strings without constantly repeating the entire command path for each command.

1.8.5 Path Specification

The first command in the string must have its entire path entered. But once a path level is reached, other commands which are at the same level (or higher level) may then be entered without repeating the path. To accomplish this, the semicolon (;) must be used to separate the commands in the string, as usual. However, the command following the semicolon need not specify its full path, if the same path which was previously written out could be used for the new command.

For example, the following legal command string could be used to (1) set the controller TEC display to the measured temperature and (2) set the TEC display for the (temperature) set point value:

TEC:LIMit:THI 50;SET

The path **TEC:LIMit:** is "remembered" by the controller software in this case. If the **SET** command were not found at this level, the software would walk back to the **TEC:** level and search for a **TEC:SET** command. If it is not found there, it will search at the next higher level, and so on until it finds the command or not. If the command is not found, an error message will be generated.

The following is an example of command "tree-walking", where (1) the laser display is set for the current set point, and (2) the laser output is turned on:

Laser:enable:cond?; out on

The command **out** is first searched at the **LASer:ENABle:** level. Since the command **LASer:ENABle:OUT** does not exist, the next higher level **LASer:** is searched. There the command **LASer:OUT** is found, and the parameter **on** is legal, so there is no error.

Care must be taken to avoid errors which are caused by trying to implement commands from the wrong path or level. For example, the following command string was intended to (1) read back the set point resistance and (2) read back the measured resistance:

TEC:SET:R?; R?

Instead, the output would return the set point resistance twice. When the second **R?** is found, the software will first search for that command at its current level. Since it finds it there it will be executed. If this command did not exist at this level, the software would search up to the **TEC:** level and find and execute the intended command, **TEC:R?**.

In order to ensure the proper command is executed for the example above, the following command string should be issued:

TEC:SET:R?; TEC:R?

If you are not sure of the path level of a command, refer to the controller Command Path Structure diagram shown in Figure 4. For this discussion, the root level is the highest level, and moving down the diagram decreases the level. Once the software has "walked" to a lower path level, it remains at that level when it receives the next command. For example, to (1) set the laser display to show the set point, (2) decrement the set point, and (3) set the TEC high temperature limit, the following command string could be used:

LASer:LIM:LDV?; DEC; TEC:LIM:THI 50

When the **DEC** command is reached, the software is at the **LASer:LIMit:** level. Since there is no **DEC** command there, it walks back up to the **LAS** level, and there it finds the **LASer:DEC** command.

The reason that the full path (including **TEC:**) must be specified for the last part (**TEC:LIMit:THI**) is that otherwise it would look for the **LIM:THI** command in the **LASer:** path, not find it, and generate an error.

After the second semicolon is reached (**DEC;**) the software will first look for the next word (**TEC**) at the current path. Since it is not found it will walk back up the tree until it finds it at the root level. Once the search walks up to the root level, it will not walk down any other paths, unless the path is specified.

The only exception to the rule described above is when common commands are used. In that case, the software remembers which level the user was at before the common command was found, and it returns to that same level after finding and executing the common command. Therefore the following command string is legal:

TEC:LIM:THI 50; *WAI;DEC

Here, (1) the high temperature limit is set to 50, (2) the software waits for the previous command to be executed, and (3) the set point is decremented one step.

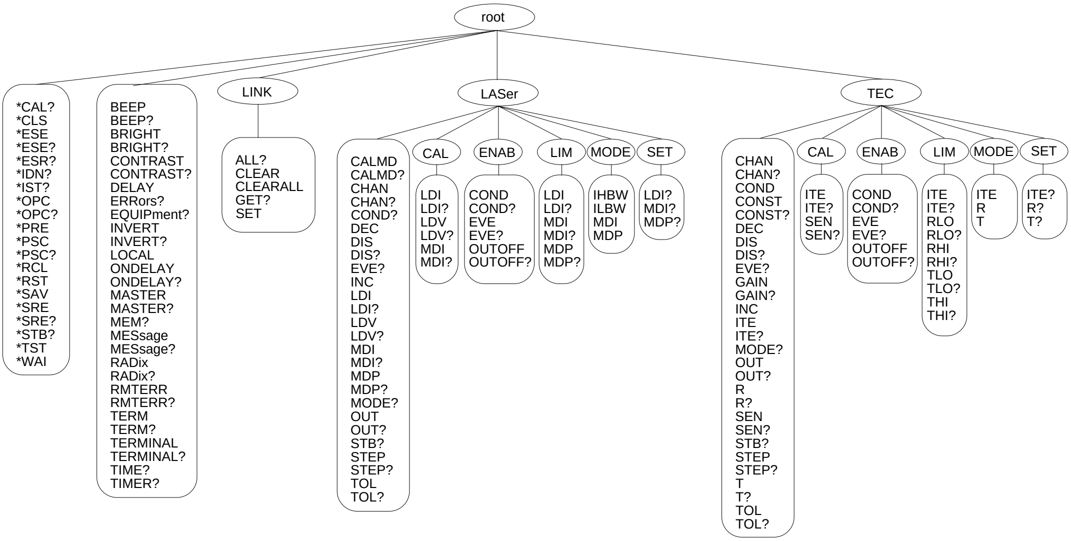


Figure 4 - Command Path Structure

1.8.6 Timing Considerations

Although the shortcuts mentioned above reduce the command length, they may not necessarily optimize the speed of program execution. The following tip may be useful if speed of execution of a command is critical. If a command follows a semicolon (;) in a command string, and it is not at the root level, using the colon (:) will aid the software in locating the command, and time will be saved.

For example, the following command string will execute slightly faster as shown than it would if the first colon (:) after the second semicolon (;) was not included. This would save the time of two binary searches, one at the **LASer:DEC** level and one at the **LASer:** level.

LASer:SET:LDV?;DEC;TEC:SET:T?

In other cases, the hardware may not be able to react as quickly as the commands are executed. For example, if the set point is greatly incremented (i.e. by 10°C) and a measurement is taken before that new set-point temperature has been reached, the measurement could be invalid due to a premature measurement. For cases like this, the ***WAI** command is useful. The ***WAI** command will suspend the execution of the next command until the previous command has been completed.

1.9 ILX Lightwave Corporation LDC-3900 and LDC-3700 Users

The following is a listing of changes that need to be addressed if you are switching from the ILX LDC-3900 or LDC-3700 system to the Newport Corporation controller system or when using both.

1. <u>TEC Sensor Type</u>

The sensor type on the ILX unit is selected by a switch on the rear panel. On the Model controller the **TEC:SENS** command is used to select the sensor in software.

2. <u>TEC Loop Gain</u>

The **TEC:GAIN** command contains two additional settings (5 and 50) that the ILX 3900 does not support.

3. <u>Additional Commands Available</u>

Laser	TEC
LASer:CAL:CANCEL	**TEC:CAL:CANCEL**
LASer:LIMit:MDI	**TEC:LIMit:TLO**
LASer:LIMit:MDI?	**TEC:LIMit:TLO?**
LASer:LIMit:LDV	**TEC:LIMit:RHI**
LASer:LIMit:LDV?	**TEC:LIMit:RHI?**
LASer:MODE:ICW	**TEC:LIMit:RLO**
LASer:MODE:MDI	**TEC:LIMit:RLO?**
	TEC:SENSor

4. <u>Unsupported Commands</u>
These commands are not supported. The controller controller will accept them without error, but will not act on them. All queries will return “0”.

General

***DLF**

***PUD**

***PUD?**

Laser	TEC
LASer:DISplay:xxx commands	**TEC:DISplay:xxx commands**

5. Additional Conditions/Events Available

Laser	TEC
Photodiode Current Limit	R Limit
	Low Temp Limit
	Sensor Shorted
	TEC Interlock[3]

6. TEC Booster and Interlock

The controller's TEC does not support any of the ILX booster or interlock functions. Note also that their respective bits in the event and condition registers have been redefined.

[3] Not supported on all TECs.

CHAPTER 2

2. Commands and Queries

Table 2 summarizes all the commands and queries. Note: For compatibility, some commands have optional entries; such as **LASer:LDI**, which can also be **LASer:I**. Options are shown in Table 2 as parenthesis; such as **LASer:LDI (I)**. After Table 2, each command and query is detailed.

Table 2 - GPIB/RS-232 Command Summary

Name	Number of Parameters	Function
	IEEE 488.2 Commands/Queries	
*CAL?	NONE	Calibration command/query
*CLS	NONE	Clear status command
*ESE	1	Event status register enable command
*ESE?	NONE	Event status register enable query
*ESR?	NONE	Event status register query
*IDN?	NONE	Identification query
*IST?	NONE	Individual status query
*OPC	NONE	Operation complete command
*OPC?	NONE	Operation complete query
*PRE	1	Parallel poll enable register command
*PRE?	NONE	Parallel poll enable register query
*PSC	1	Power-on status clear command
*PSC?	NONE	Power-on status clear query
*RCL	1	Recall saved bin command
*RST	NONE	Reset command
*SAV	1	Save bin command
*SRE	1	Service request enable command
*SRE?	NONE	Service request enable query
*STB?	NONE	Status byte register query
*TST?	NONE	Self test query
*WAI	NONE	Wait for operation complete command
	Device Dependent Commands/Queries	
BEEP	1	Turns the beeper on or off, or beeps once.
BEEP?	NONE	Returns the status of the beeper.
BRIGHT	1	Change display brightness
BRIGHT?	NONE	Get display brightness
CONTRAST	1	Change display contrast
CONTRAST?	NONE	Get display contrast
DELAY	1	Used to create a delay in the execution of further commands.

ERRors?	NONE	Returns errors generated since the last query.
ERRSTR?	NONE	Returns errors and their corresponding error text generated since the last query.
EQUIPment?	NONE	Returns a list of modules installed in the 6000
INVERT	1	Invert the display
INVERT?	NONE	Get display insert setting
LASer:CALMD (CALPD)	1	Used to set the CALPD (Sensitivity) constant.
LASer:CALMD? (CALPD?)	NONE	Returns the CALPD (Sensitivity) constant.
LASer:CAL:CANCEL	NONE	Cancels calibration without updating calibration constants.
LASer:CAL:LDI (I)	1	Used to set the constant I calibration constant.
LASer:CAL:LDI? (I?)	NONE	Returns the ready state for entering the constant I calibration value.
LASer:CAL:LDV	NONE	Used to enter the laser voltage calibration mode.
LASer:CAL:LDV?	NONE	Returns the ready state for entering the laser voltage calibration value.
LASer:CAL:MDI (IPD)	NONE	Used to set the photodiode feedback current calibration constant.
LASer:CAL:MDI? (IPD?)	NONE	Returns the ready state for entering the IPD calibration value.
LASer:CHAN	1 or 2	Used to select the LAS channel , subchannel.
LASer:CHAN?	NONE	Returns the number of the LAS selected channel.
LASer:COND?	NONE	Returns the value of the LAS condition register.
LASer:DEC	0, 1, or 2	Used with LASer:STEP command to decrement the set point value by one step, when no parameters are used. Optional parameters are for number of steps and number of milliseconds between steps.
LASer:DISplay	1	Turns the LAS display on or off.
LASer:DISplay?	NONE	Returns the LAS display value.
LASer:ENABle:COND	1	Sets the enable register for LAS conditions.
LASer:ENABle:COND?	NONE	Returns the value of the LAS conditions enable register.
LASer:ENABle:EVEnt	1	Sets the enable register for LAS events
LASer:ENABle:EVEnt?	NONE	Returns the value of the LAS event enable register.
LASer:ENABle:OUTOFF	1	Sets the enable register for LAS conditions which turn the LAS output off.
LASer:ENABle:OUTOFF?	NONE	Returns the value of the LAS outoff enable register.
LASer:EVEnt?	NONE	Returns the value of the LAS event register.
LASer:LDI (I)	1	Used to set the LAS constant current source set point value.
LASer:LDI? (I?)	NONE	Used to return the constant current source measured value (measured about every 400mS).
LASer:INC	0, 1, or 2	Used with LASer:STEP command to increment the LAS set point value (see LASer:DEC).
LASer:MDI (IPD)	1	Used to set the constant optical power set point if PD sensitivity is 0.
LASer:MDI? (IPD?)	NONE	Used to return the monitor PD current measured value (measured about every 400 milliseconds).
LASer:LDV	1	Used to set the voltage value for calibration.
LASer:LDV?	NONE	Used to return measured laser voltage value (measured about every 400 milliseconds).

LASer:LIMit:LDI (I)	1	Used to set the laser constant current source limit.
LASer:LIMit:LDI? (I?)	NONE	Used to return the laser constant current source limit.
LASer:LIMit:LDV	1	Used to set the laser compliance voltage
LASer:LIMit:LDV?	NONE	Used to return the laser compliance voltage
LASer:LIMit:MDI (IPD)	1	Used to set the laser monitor photodiode current limit.
LASer:LIMit:MDI? (IPD?)	NONE	Used to return the laser monitor photodiode current limit.
LASer:LIMit:MDP (Ppd)	1	Used to set the constant optical power (from monitor PD) limit value.
LASer:LIMit:MDP? (Ppd?)	NONE	Used to return the optical power (from monitor PD) limit value.
LASer:MODE?	NONE	Returns the mode, I (current), IHBW (current, high bandwidth) PPD (optical power) I_{pd} or I_{cw} (cont. wave).
LASer:MODE:ICW	NONE	Sets the Laser to continuous wave mode.
LASer:MODE:ILBW (I)	NONE	Sets the Laser to constant current (low bandwidth) mode.
LASer:MODE:IHBW	NONE	Sets the Laser to constant current, high bandwidth mode.
LASer:MODE:MDI (IPD)	NONE	Sets the Laser to constant photodiode current mode.
LASer:MODE:MDP (Ppd)	NONE	Sets the Laser to constant optical power mode.
LASer:MODULATE	1	Selects the MOPA modulation channel
LASer:MODULATE?	NONE	Returns the MOPA modulation channel
LASer:OUT	1	Same action as setting the LAS OUTPUT on/off.
LASer:OUT?	NONE	Returns the LAS OUTPUT status.
LASer:MDP (Ppd)	1	Used to set the constant optical power set point, if PD sensitivity is non-zero.
LASer:MDP? (Ppd?)	NONE	Returns the actual monitor PD power value (measured about every 400 milliseconds).
LASer:SET:LDI? (I?)	NONE	Returns the constant I (current) set point.
LASer:SET:MDI? (IPD?)	NONE	Returns the constant optical power set point, if the PD sensitivity is 0.
LASer:SET:MDP? (Ppd?)	NONE	Returns the constant P (optical power) set point, if the PD sensitivity is non-zero.
LASer:STB?	NONE	Returns the status summaries for conditions and events.
LASer:STEP	1	Used to set the LAS step value for use with DEC or INC commands. Defaults to a step of 1; 1-step = 0.01 mA (I or IHBW mode), 0.01 mW (P mode), or 1 uA (if CALPD = 0). Range is 1 - 9999 steps.
LASer:STEP?	NONE	Returns the LAS step value.
LASer:TOLerance	2	Used to set the LAS set point tolerance value and time period to determine if a set point has been reached.
LASer:TOLerance?	NONE	Used to return the LAS set point tolerance value and time period used to determine if a set point has been reached within the time period.
LINK:ALL?	NONE	Returns a list of links in the system.
LINK:CLEAR	1	Clears a single link.
LINK:CLEARALL	NONE	Clears all links in the system.
LINK:GET	1	Returns a specific link.
LINK:SET	4	Defines a new link.

LOCAL	NONE	Return to local mode, **RS-232 only**.
ONDELAY	1	Set the laser turn-on delay
ONDELAY?	NONE	Get the laser turn-on delay
MASTER	NONE	Switch to the master display
MASTER?	NONE	Returns 1 if in master display, 0 otherwise.
MESsage	1	Used to enter a string message of up to 16 bytes.
MESsage?	NONE	Returns a previously stored message.
RADix	1	Used to set a radix type for numerical data. Decimal, binary, octal and hexadecimal are allowed.
RADix?	NONE	Used to return the radix type for numerical data.
REMERR	1	Used to enable/disable the display of errors on the unit’s screen when in remote mode.
REMERR?	NONE	Returns 1 if display errors while remote is disabled, 0 otherwise.
TEC:CAL:CANCEL	NONE	Cancels calibration without updating calibration constants.
TEC:CAL:ITE	NONE	Used to set the TEC current source calibration constants.
TEC:CAL:ITE?	NONE	Returns the ready state for entering a current source calibration value.
TEC:CAL:SEN	NONE	Used to set a sensor calibration constant.
TEC:CAL:SEN?	NONE	Returns the ready state for entering a sensor calibration value.
TEC:CHAN	1 or 2	Used to select the TEC channel , subchannel.
TEC:CHAN?	NONE	Returns the number of the selected TEC channel.
TEC:COND?	NONE	Returns the value of the TEC condition register.
TEC:CONST	1 - 3	Used to enter the Steinhart-Hart constants for R-T conversion. Also used to enter constants for AD590, LM335 and RTD.
TEC:CONST?	NONE	Used to read back the Steinhart-Hart constants for R-T conversion. Also used to read back constants for AD590, LM335 and RTD.
TEC:DEC	NONE	Used with TEC:STEP command to decrement the TEC set point value by one step.
TEC:DIS	1	Turns the TEC display on or off.
TEC:DIS?	NONE	Returns the TEC display value.
TEC:ENABle:COND	1	Sets the enable register for TEC conditions.
TEC:ENABle:COND?	NONE	Returns the value of the TEC condition enable register.
TEC:ENABle:EVEnt	1	Sets the enable register for TEC events.
TEC:ENABle:EVEnt?	NONE	Returns the value of the TEC event enable register.
TEC:ENABle:OUTOFF	1	Sets the enable register for TEC conditions which turn the TEC output off.
TEC:ENABle:OUTOFF?	NONE	Returns the value of the TEC outoff enable register.
TEC:EVE?	NONE	Returns the value of the TEC event register.
TEC:GAIN	1	Used to set the TEC control loop gain.
TEC:GAIN?	NONE	Used to return the TEC control loop gain.
TEC:INC	NONE	Used with TEC:STEP command to increment the TEC set point value by one step.
TEC:ITE	1	Used to set the TEC current (ITE) set point.
TEC:ITE?	NONE	Returns the measured TEC current (ITE) value (measured about every 400 milliseconds).

TEC:LIM:ITE	1	Used to set the TEC constant current source limit
TEC:LIM:ITE?	NONE	Used to return the constant current source limit.
TEC:LIM:RHI	1	Used to set the TEC high resistance limit.
TEC:LIM:RHI?	NONE	Returns the TEC high resistance limit.
TEC:LIM:RLO	1	Used to set the TEC low resistance limit.
TEC:LIM:RLO?	NONE	Returns the TEC low resistance limit.
TEC:LIM:THI	1	Used to set the TEC upper temperature limit.
TEC:LIM:THI?	NONE	Returns the TEC upper temperature limit.
TEC:LIM:TLO	1	Used to set the TEC low temperature limit.
TEC:LIM:TLO?	NONE	Returns the TEC low temperature limit.
TEC:MODE?	NONE	Returns the mode, ITE (TEC current), R (resistance/reference) or T (temperature).
TEC:MODE:ITE	NONE	Sets to constant TEC current mode.
TEC:MODE:R	NONE	Sets to constant thermistor resistance/linear sensor reference mode.
TEC:MODE:T	NONE	Sets to constant temperature mode.
TEC:OUT	1	Same action as setting the TEC OUTPUT on/off.
TEC:OUT?	NONE	Returns the TEC OUPUT status.
TEC:R	1	Sets the constant R (resistance/reference) set point.
TEC:R?	NONE	Returns the measured R (resistance/reference) value (measured about every 400 milliseconds).
TEC:SEN	1	Selects the sensor type.
TEC:SEN?	NONE	Returns the sensor type.
TEC:SET:ITE?	NONE	Returns the constant ITE (TEC current) set point.
TEC:SET:R?	NONE	Returns the constant R (resistance/reference) set point.
TEC:SET:T?	NONE	Returns the constant T (temperature) set point.
TEC:STB?	NONE	Returns the status summaries for conditions and events.
TEC:STEP	1	Used to set the TEC step value for use with DEC or INC commands. Defaults to a step of 1. 1 step equals 0.1°C, 1 mA (ITE), 1 Ohm (Therm), 0.1 mV, (LM335) 0.01 µA (AD590) or .01 Ω (RTD). Range is 1 - 9999 steps.
TEC:STEP?	NONE	Returns the value of the TEC step.
TEC:T	1	Used to set the TEC constant T (temperature) set point.
TEC:T?	NONE	Returns the TEC measured temperature value
TEC:TOL	2	Used to set the TEC set point tolerance value and time period used to determine if a set point has been reached.
TEC:TOL?	NONE	Used to return the TEC set point tolerance value and time period used to determine if a set point has been reached.
TEC:V?	NONE	Returns the TEC measured voltage value
TERM	1	Sets the response message terminator.
TERM?	NONE	Returns the value of the response message terminator.
TERMINAL	1	Enabled/disabled terminal mode for RS-232C connection.
TERMINAL?	NONE	Returns 1 if the RS-232C terminal mode is enabled.

TIME?	NONE	Returns the elapsed time since the 6000 was last powered on.
TIMER?	NONE	Returns the elapsed time since the timer was last reset.

2.1 IEEE 488.2 Common Commands and Queries

This section contains a list of the common commands and queries which are supported by the controller. The common commands and queries are distinguished from device dependent types by the * which begins each one. The common commands and queries are listed in alphabetical order, and a brief description of their functions is given. Refer to Figure 3 for commands that deal with status.

*CAL?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Calibration query.

Syntax ***CAL?**

Remarks When this query is sent, the controller performs the TEC and laser controller's ADC and DAC calibration procedure and reports the status.

Response	Description
=0	no calibration errors
≠0	calibration errors detected

*CLS

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Clear status command.

Syntax ***CLS**

Remarks It is used to clear the Status Byte Register and all event registers. It may be used, for example, to clear the Event Status Register, the Standard Event Status Register, and the error queue before enabling SRQ generation from instrument events. The ***CLS** command also cancels any outstanding ***OPC** and ***OPC?** commands.

See Also **ESR?**, **ERR?**, ***IST?**, ***STB?**

*ESE

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Event Status Register Enable command.

Syntax ***ESE *mask***

Remarks This command enables the Standard Event Status Register to update bit 5 of the Status Byte Register.

See the table under the **ESR?** command for a definition of the **ESE** bits.

The parameter value may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

Setting bit 0 allows the user to poll or generate SRQ from any overlapped commands after any previous operations are completed. This may be useful for ensuring that an operation, such as TEC output on and within tolerance, is complete before a measurement is made. Although this could be performed without using service requests, an interrupt-driven program makes more efficient use of the GPIB than polling or waiting (***WAI**) routines.

See Also ***ESE?**, ***ESR?**, ***STB**

*ESE?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Event Status Register Enable query.

Syntax ***ESE?**

Remarks This query will cause the controller to return the value of the Standard Event Enable Register. This allows the user to determine which status bits can set the summary bit (bit 5) in the Status Byte Register.

See the table under the **ESR?** command for a definition of the **ESE?** bits.

The response may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***ESE**, ***ESR?**, ***STB**

*ESR?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Event Status Register query.

Syntax **ESR?**

Remarks This query will cause the controller to return the value of the Standard Event register. This allows the user to determine which type of error has occurred, for example.

Response	Bit	Value	Description
ESR	0	1	Operation Complete: All commands prior to and including an *OPC command have been executed.
	1	2	GPIB Parser Idle: The GPIB parse buffer is empty. However, a *OPC, *OPC?, *WAI, DELAY, or laser/TEC step function may still be running.
	2	4	Query Error: Input or output buffers are full (see error numbers 300 through 399)
	3	8	Device Dependent Error: A self-test, calibration, or other module specific error (see error numbers 400 through 599)
	4	16	Execution Error: An execution error occurred (see error numbers 200 through 299)
	5	32	Command Error: A command error occurred (see error numbers 100 through 199)
	6	64	N/A
	7	128	Power On: Power has been turned off and on since the last time the event register was read or cleared.

The response may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***ESE**, ***STB**

*IDN?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Identification query.

Syntax ***IDN?**

Remarks This query will cause the controller to return an identification string.

Response	Value	Description
IDN String	“Newport *XXXX* v*Y.YY* B*ZZ*”, where *XXXX* is the product platform (3000, 5000, etc.), *X.XX* is the version number and *YY* is the build number.	

*IST?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Individual status query.

Syntax ***IST?**

Remarks The Individual Status query allows the user to read the current state of the IEEE-488.1 'ist' local message.

Response	Description	
ist bit	0	ist false
	1	ist true

See Also ***PRE**, ***STB**

*OPC

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Operation Complete command

Syntax ***OPC**

Remarks This ***OPC** command causes the controller to generate the operation complete message in the Standard Event Status Register when all pending overlapped commands have been completed. The operation of this command is identical to ***WAI**, except ***WAI** does not generate a response.

See Also ***OPC?**, ***ESR?, *WAI**

*OPC?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Operation Complete query.

Syntax ***OPC?**

Remarks This query places an ASCII character into the controller's Output Queue when all pending operations have been finished. The operation of this command is identical to ***WAI**, except ***WAI** does not generate a response.

Response	Description
1	finished

See Also ***OPC, *WAI**

*PRE

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Parallel Poll Enable Register command

Syntax ***PRE** *mask*

Remarks This command sets the Parallel Poll Enable Register bits. These bits are defined the same as the SRE register.

Argument	Bit	Value	Description
mask	0	1	TEC Event Summary
	1	2	TEC Condition Summary
	2	4	Laser Event Summary
	3	8	Laser Condition Summary
	4	16	Message Available
	5	32	Event Status Summary
	6	64	Master Status Summary
	7	128	Error Message Available
	8	256	N/A
	9	512	N/A
	10	1024	N/A
	11	2048	N/A
	12	4096	N/A
	13	8192	N/A
	14	16384	N/A
	15	32768	N/A

The parameter may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***PRE?, *STB, *SRE**

*PRE?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Parallel Poll Enable Register query.

Syntax ***PRE?**

Remarks This query allows the programmer to determine the contents of the Parallel Poll Enable Register. See ***PRE** for a definition of the returned bits.

See Also ***PRE**

*PSC

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Power-On Status Clear command.

Syntax ***PSC** *enable*

Remarks The Power-on Status Clear command controls the automatic power-on clearing of the Service Request Enable Register, the Standard Event Status

Enable Register, the Event Status Enable Register, the Condition Status Enable Register and the Parallel Poll Enable Register.

Argument		Description
enable	0	The power-on-status-clear flag of the controller is set FALSE, therefore allowing SRQ (interrupts) to be asserted after power-on.
	1	The power-on-status-clear flag of the controller is set TRUE, therefore disallowing SRQ (interrupts) to be asserted after power-on.

When the ***PSC 1** command is sent, the controller will clear the above mentioned enable registers (set them all to 0) at power-up. This may be done to avoid any undesirable service requests after a power on/off cycle of the controller.

The factory default value for this bit is 0, Power-on Status Clear is disabled. Therefore, the values of the enable registers are restored from their condition at the last power-down when a power-up occurs.

See Also ***PSC?**

*PSC?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Power-On Status Clear query.

Syntax ***PSC?**

Remarks The Power-on Status Clear Query allows the programmer to query the controller power-on-status-clear flag.

Response		Description
PSC Flag	0	Standard Event Status Enable Register, Service Request Enable Register, the Event Status Enable Register, the Condition Status Enable Register, and the Parallel Poll Enable Register will retain their values when power is restored to the controller.
	1	Registers listed above will be cleared when power is restored to the controller.

See Also ***PSC**

*RCL

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Recall command.

Syntax ***RCL** *bin*

Remarks The recall command restores the controller to the setup state which is in its local memory. The following criteria are restored when the ***RCL** command is given:

1. The controller is in the parameter state which was last stored in that bin.
2. The outputs (laser and TEC) are all off.

Argument	Description	
bin	0	recall reset state
	n	recall state *n*

A value of 0 means the recalled state shall be the same as that of a ***RST** command.

Depending on the platform, up to 11 different stored recall states can be used. These recall states are saved by using the ***SAV** command.

If a different module configuration exists now as compared to when the ***SAV** command was used, ***RCL** will not work and will generate an error code.

Links are not affected by the recall command.

See Also ***RST**, ***SAV**

*RST

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Reset command.

Syntax ***RST**

Remarks The reset command performs a device reset. This has the same effect as ***RCL 0** but with the controller OCIS and OQIS idle states set. The GPIB will remain in remote.

The Operation Complete Command Idle State (OCIS) is the state which the controller is in when it is no longer waiting for any operation to complete, after an ***OPC** command has been executed.

The Operation Complete Query Idle State (OQIS) is the state which the controller is in when it is no longer waiting for any operation to complete, after an ***OPC?** query has been executed.

These idle states allow the controller to complete its reset process (and have no operations pending) before continuing with any other commands after the ***RST** is executed.

Links are cleared by the reset command.

See Also ***RCL**

*SAV

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Save command.

Syntax ***SAV** *bin*

Remarks The save command stores the current state of the controller in non-volatile local memory. A particular state is then recalled by using the ***RCL** recall command. Depending on the platform, up to 10 unique states can be stored.

Argument	Description
bin	Store state *bin*

Links are not stored.

See Also ***RCL**

*SRE

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Service Request Enable command.

Syntax ***SRE** *mask*

Remarks The Service Request Enable command sets the Service Request Enable Register bits to allow the controller to generate the user-selectable service requests.

mask is an integer in the range 0 to 255 inclusive.

Argument	Description	
mask	bit 0	TEC Event Summary[1]
	bit 1	TEC Condition Summary1
	bit 2	Laser Event Summary[2]
	bit 3	Laser Condition Summary2
	bit 4	Message Available
	bit 5	Event Status Summary
	bit 6	Request Service/Master Status Summary
	bit 7	Error Message Available

The parameter value may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***SRE?**

*SRE?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Service Request Enable query.

Syntax ***SRE?**

Remarks The Service Request Enable query allows the user to determine the current contents of the Service Request Enable Register.

Response	Description	
SRE mask	bit 0	TEC Event Summary1
	bit 1	TEC Condition Summary1
	bit 2	Laser Event Summary2
	bit 3	Laser Condition Summary2
	bit 4	Message Available
	bit 5	Event Status Summary
	bit 6	Request Service/Master Status Summary
	bit 7	Error Message Available

The response may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***SRE**

[1] Off for non-TEC units.
[2] Off for non-Laser units.

*STB?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Status Byte Register query.

Syntax ***STB?**

Remarks The Read Status Back query allows the programmer to read the Status Byte Register.

Response	Description	
Status Byte Register	bit 0	TEC Event Summary1
	bit 1	TEC Condition Summary1
	bit 2	Laser Event Summary2
	bit 3	Laser Condition Summary2
	bit 4	Message Available
	bit 5	Event Status Summary
	bit 6	Request Service/Master Status Summary
	bit 7	Error Message Available

Bit 6 represents the MSS (Master Summary Status) bit and not the RQS message. The response may indicate multiple conditions, i.e. 5 is both bit 2 and 0.

See Also ***SRE, *PRE, *IST**

*TST?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Self test query.

Syntax ***TST?**

Remarks The self test query causes an internal self test and returns a response when the self test is complete.

Response	Description
= 0	self test successful
≠ 0	self test failed

*WAI

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Wait to continue command

Syntax ***WAI**

Remarks

The Wait to Continue command prevents the controller from executing any further commands until the Operation Complete flag is true. This allows the programmer to make the controller wait for the completion of an operation before continuing. For example, after a change in temperature is made the ***WAI** command may be used before a measurement is taken. This would allow time for the correct temperature to be reached.

See Also

***OPC, *OPC?**

2.2 Device Dependent Commands and Queries.

BEEP

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Beep command

Syntax **BEEP** *beep set*

Remarks The **BEEP** command controls the controller beeper. The beeper can be used to signal error or warning conditions.

Response	Value	Description
beep set	0	Beeper off
	1	Beeper on
	2	Test beeper

See Also **BEEP?**

BEEP?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Beep query

Syntax **BEEP?**

Remarks The **BEEP?** query returns the enable status of the controller beeper.

Response	Description	
beep set	0	Beeper off
	1	Beeper on

See Also **BEEP**

BRIGHT

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display brightness command

Syntax **BRIGHT** *brightness*

Remarks The **BRIGHT** command controls the brightness of the controller display.

Argument	Description
brightness	Brightness, in percentage, from 0% to 100%

See Also **BRIGHT?, CONTRAST**

BRIGHT?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display brightness query

Syntax **BRIGHT?**

Remarks The **BRIGHT?** query returns the display brightness setting.

Response	Description
brightness	Display brightness, in percentage.

See Also **BRIGHT**

CONTRAST

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display contrast command

Syntax **CONTRAST** *contrast*

Remarks The **CONTRAST** command controls the contrast of the controller display.

Argument	Description
contrast	Contrast, in percentage, from 0% to 100%

See Also **CONTRAST?, BRIGHT**

CONTRAST?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display contrast query

Syntax **CONTRAST?**

Remarks The **CONTRAST?** query returns the display contrast setting.

Response	Description
contrast	Display contrast, in percentage.

See Also **BRIGHT**

DELAY

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Delay command

Syntax **DELAY** *time*

Remarks The **DELAY** command causes the execution of commands to be delayed by a user-defined time.

Response	Description
time	delay in milliseconds

The Operation-Complete flag is held false until the delay period elapses, and the ***OPC?** query will not execute until the delay period has elapsed.

See Also ***OPC, *OPC?**, ***WAI**

EQUIPment?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Installed equipment query.

Syntax **EQUIPment**?

Remarks The **EQUIPment?** query returns a list of modules, separated by commas, installed in the controller. A total of five elements are sent: *main, module1, module2, module3, module4*. If a nothing is installed in a particular module slot, then the corresponding entry is blank.

Response	Description
Equipment list	Comma-delimited list of equipment

Examples An controller with a 8350 in slot 1, a 8560 in slot 3, and a 8325D in slot 4 would respond to an equipment query with the following response:

“controller,8350,,8560,8325D”

ERRors?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Error query.

Syntax **ERRors**?

Remarks The **ERRors?** query returns a list of commands and device errors which have occurred since the last query. These errors are indicated by a number that corresponds to the type of error which occurred.

Response	Description
Error code	Error code number per chapter 5, 0 if no errors

See Also **ERRSTR?**

ERRSTR?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Error string query.

Syntax **ERRSTR**?

Remarks The **ERRSTR?** query returns a list of commands and device error numbers along with the corresponding error text strings which have occurred since the last query.

Response	Description
Error code, "text"	Error code and text for error code as per chapter 5, 0 if no errors

See Also **ERRors?**

INVERT

3150	3040	5000	6000	8000	8008	9000
				✓	✓	

Description Invert the display.

Syntax **INVERT** *invert*

Remarks On graphical units, the pixels can be reversed to create an inverted display.

Argument	Description
invert	0 for normal operation, 1 for inverted operation

INVERT?

3150	3040	5000	6000	8000	8008	9000
				✓	✓	

Description Display invert query.

Syntax **INVERT?**

Remarks The **INVERT?** query returns the current invert state of the display.

Response	Description
invert	0 for normal operation, 1 for inverted operation

LASer:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:** command path is used to get to the controller laser current source commands. The following command paths may be reached from the **LASer:** command path:

LASer:CAL:
LASer:DISplay:
LASer:ENABle:
LASer:LIMit:
LASer:MODE:
LASer:SET:

The following commands may be reached directly from the **LASer:** command path.

LASer:CALMD	**(CALPD)**
LASer:CALMD?	**(CALPD?)**
LASer:CHAN	
LASer:CHAN?	
LASer:COND?	
LASer:DEC	
LASer:DISplay	
LASer:DISplay?	
LASer:EVEnt?	
LASer:LDI	**(I)**
LASer:LDI?	**(I?)**
LASer:INC	
LASer:MDI	**(IPD)**
LASer:MDI?	**(IPD?)**
LASer:LDV	
LASer:LDV?	
LASer:MODE?	
LASer:OUTput	
LASer:OUTput?	
LASer:MDP	**(PPD)**
LASer:MDP?	**(PPD?)**
LASer:STB?	
LASer:STEP	
LASer:STEP?	
LASer:TOLerance	
LASer:TOLerance?	

LASer:CALMD (CALPD)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode feedback sensitivity set command

Syntax **LASer:CALMD** *cal PD*

Remarks The **LASer:CALMD** command sets the laser's photodiode feedback sensitivity (the CAL PD parameter).

Argument	Description
cal PD	sensitivity in µA/mW

If the parameter is set to 0, the controller will only operate in a constant MDI mode. **LASer:MODE:MDP** is treated as **LASer:MODE:MDI** when this parameter is zero.

The value of this parameter is used to convert between MDI and MDP values. The units of this parameter are microamps per milliwatt.

See Also **LASer:CALMD?**

LASer:CALMD? (CALPD?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode feedback sensitivity query

Syntax **LASer:CALMD?**

Remarks The **LASer:CALMD?** query returns the value of the laser's photodiode feedback sensitivity (CAL PD parameter) setting.

Response	Description
cal PD	sensitivity in µA/mW

If this value is 0, the controller will be set to operate in constant MDI mode when MDI or MDP modes are selected, and the MDI set point value will be in effect. If this value is non-zero, the controller will be set to operate in constant MDI or MDP modes depending on the **LASer:MODE** command, and the appropriate set point value will be in effect.

See Also **LASer:CALMD**

LASer:CAL:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:CAL:** command path is used to get to the controller laser calibration commands.

The following commands may be reached directly from the **LASer:CAL:** command path.

LASer:CAL:CANCEL	
LASer:CAL:LDI	**(I)**
LASer:CAL:LDI?	**(I?)**
LASer:CAL:MDI	**(IPD)**
LASer:CAL:MDI?	**(IPD?)**
LASer:CAL:LDV	
LASer:CAL:LDV?	

During calibration, the only commands accepted by the controller are the **LASer:CAL:** path commands, **LASer:LDI**, **LASer:MDI**, **LASer:LDV**, and any query commands. All other commands will generate error E-115, “Identifier Not Valid.”

LASer:CAL:CANCEL

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Exit laser current, measurement, and limit calibration mode.

Syntax **LASer:CAL:CANCEL**

Remarks The **LASer:CAL:CANCEL** command is used to exit a laser calibration mode without changing the calibration constants.

See Also **LASer:CAL:LDI, LASer:CAL:MDI, LASer:CAL:LDV**

LASer:CAL:LDI (I)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter laser current, measurement, and limit calibration mode.

Syntax **LASer:CAL:LDI**

Remarks The **LASer:CAL:LDI** command is used to enter the laser current set point, measurement, and limit calibration mode.

Since the limit circuit is the same for both high and low bandwidth modes, it can be calibrated when either bandwidth mode is selected.

After this command is issued, the controller will allow calibration of the current set point, measurement, and limit.

Calibration is performed at the current set point, wherever it is set. If the laser output is off, the controller will beep each time you try to enter this mode and place an error in the error queue, indicating a calibration procedural error.

See Also **LASer:CAL:LDI?**

LASer:CAL:LDI? (I?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Ready for current calibration value.

Syntax **LASer:CAL:LDI?**

Remarks The **LASer:CAL:LDI?** query is used to determine that the controller is ready for a value to be entered during the calibration cycle of the **LASer:CAL:LDI** mode.

Response	Description
0	not ready
1	ready

After this query is issued and a response of 1 is received, the controller will be ready for the user to enter a current value via the **LASer:LDI** command.

See Also **LASer:CAL:LDI**

LASer:CAL:LDV

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter laser voltage calibration mode.

Syntax **LASer:CAL:LDV**

Remarks The **LASer:CAL:LDV** command is used to enter the voltage calibration mode.

See Also **LASer:CAL:LDV?**

LASer:CAL:LDV?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Ready for voltage calibration value.

Syntax **LASer:CAL:LDV?**

Remarks The **LASer:CAL:LDV?** query is used to determine that the controller is ready for a value to be entered during the calibration cycle of the **LASer:CAL:LDV** mode.

Response	Description
0	not ready
1	ready

See Also **LASer:CAL:LDV**

LASer:CAL:MDI (IPD)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter laser photodiode current calibration mode.

Syntax **LASer:CAL:MDI**

Remarks The **LASer:CAL:MDI** command is used to enter the laser photodiode current calibration mode.

After this command is issued, the controller will automatically enter the laser photodiode current calibration mode for the current laser range. When the controller is ready, the user should enter the true measured value.

If the laser output is off, or the MDI mode is not selected, the controller will beep each time you try to enter this mode and place an error in the error queue, indicating a calibration procedural error.

See Also **LASer:CAL:MDI?**

LASer:CAL:MDI? (IPD?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Ready for photodiode calibration value.

Syntax **LASer:CAL:MDI?**

Remarks The **LASer:CAL:MDI?** query is used to determine that the controller is ready for a value to be entered during the calibration cycle of the **LASer:CAL:MDI** mode.

Response	Description
0	not ready
1	ready

See Also **LASer:CAL:MDI**

LASer:CHAN

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Select laser channel

Syntax **LASer:CHAN** *channel [,subchannel]*

Remarks The **LASer:CHAN** command selects the laser channel for display and control.

Argument	Description
channel	laser channel
subchannel	Selects subchannel, on *channel chosen.*

If the selected slot does not contain a laser module, the selected laser channel will remain unchanged, and an error will be generated.

See Also **LASer:CHAN?**

LASer:CHAN?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser channel query.

Syntax **LASer:CHAN?**

Remarks The **LASer:CHAN?** query returns the laser channel currently selected.

Response	Description
channel	Currently selected laser channel, 0 if no laser drivers are installed.
[subchannel]	Currently selected laser subchannel.

See Also **LASer:CHAN**

LASer:COND?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser condition status register query.

Syntax **LASer:COND?**

Remarks The **LASer:COND?** query returns the value of the condition status register of the laser operation.

Response	Description
1	Current limit
2	Voltage limit
4	Photodiode current limit
8	Photodiode power limit

16	Interlock disabled
32	N/A
64	N/A
124	Open circuit
256	Output is shorted
512	Output is outside tolerance limit
1024	Output on/off state
2048	Ready for calibration data state
4096	Calculation error
8192	Error communicating with laser board
16384	Software error in laser control
32768	laser EPROM checksum error

The response value may indicate multiple conditions, such as "3" would mean both 1 and 2 occurred.

See Also **LASer:ENABle:COND?**

LASer:DEC

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser decrement command.

Syntax **LASer:DEC** *[steps [,time]]*

Remarks The **LASer:DEC** command decrements the selected laser control mode set point by one or more steps. Optional parameters allow multiple steps to be decremented and the time (in milliseconds) between decrements to be set, respectively.

Argument	Description
steps	number of steps to decrement each time
time	time between multiple decrements in milliseconds

The minimum time to complete one decrement is about 10 to 20 milliseconds. Therefore, values for the second optional parameter (time between decrements) have a practical minimum of 20.

The decrement default amount is one step. The step size can be changed via the **LASer:STEP** command, its default value is 0.01 mA, 0.01 mW, or 1 µA, depending on the mode of operation.

If the first optional parameter is used, but not the second, the user may decrement the laser set point by a multiple of the **LASer:STEP** size, without changing the **LASer:STEP** size.

If the both optional parameters are used, the user may create an automated stepping ramp function for the laser output.

If the first optional parameter is entered as zero, **LASer:DEC 0**, the command will do nothing.

See Also **LASer:INC, LASer:STEP**

LASer:DISplay

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enable laser display command.

Syntax **LASer:DISplay** *enable*

Remarks The **LASer:DISplay** command enables or disables the laser display.

Argument	Value	Description
enable	0	display off
	1	display on

A **LASer:DISplay** command will always cause the controller to return to the Master Display screen, regardless of what screen the system was in prior to the command. If the display is turned off, the Master Display will blank out that channel's data, replaced the message "Display Disabled". Access to the channel's single display screen from the Module menu will also be blocked. The display cannot be restored locally except through a power down and power up of the controller.

See Also **LASer:DISplay?**

LASer:DISplay?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enable laser display query.

Syntax **LASer:DISplay?**

Remarks The **LASer:DISplay?** query returns the display state for the channel.

Response	Value	Description

enable	0	display off
	1	display on

See Also **LASer:DISplay**

LASer:DISplay:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

*The **LASer:DISplay:** command path is implemented for ILX-3900 compatibility only.*

All commands will be accepted without error, and all queries will always return “1”.
Commands will have no effect and are ignored by the system.

The following commands may be reached directly from the **LASer:DISplay:** command path.

LASer:DISplay:LDI	**(I)**
LASer:DISplay:LDI?	**(I?)**
LASer:DISplay:MDI	**(IPD)**
LASer:DISplay:MDI?	**(IPD?)**
LASer:DISplay:LDV	
LASer:DISplay:LDV?	
LASer:DISplay:PARAM	
LASer:DISplay:MDP	**(PPD)**
LASer:DISplay:MDP?	**(PPD?)**
LASer:DISplay:SET	
LASer:DISplay:SET?	

LASer:ENABle:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:ENABle**: command path is used to get to the controller laser status enable commands and queries.

The following commands may be reached directly from the **LASer:ENABle:** command path.

LASer:ENABle:COND
LASer:ENABle:COND?
LASer:ENABle:EVEnt
LASer:ENABle:EVEnt?
LASer:ENABle:OUTOFF

LASer:ENABle:COND

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser condition status enable register command.

Syntax **LASer:ENABle:COND** *condition enable*

Remarks The **LASer:ENABle:COND** command sets the condition status enable register of the laser operations for summary (in bit 3 of the Status Byte Register) and generation of service requests.

Argument	Value	Description
condition enable	1	Limit Current
	2	Voltage Limit Error
	4	Photodiode Current Limit
	8	Power Limit
	16	Interlock Disabled
	32	N/A
	64	N/A
	128	Open Circuit
	256	Output is Shorted
	512	Output is Outside Tolerance Limit
	1024	Output On/Off State
	2048	Ready for Calibration Data State
	4096	Calculation Error
	8192	Error Communicating with laser Board
	16384	Software Error in laser Control
	32768	Laser EPROM Checksum Error

The laser condition status can be monitored by the **LASer:COND?** query. If any of the enabled laser conditions are true, bit 3 of the Status Byte Register will be set.

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (see ***PSC**).

To enable multiple conditions, add values together, i.e. 3 enables both 1 and 2.

The factory default for this register is 0.

See Also ***PSC , LASer:COND?, LASer:ENABle:COND?**

LASer:ENABle:COND?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser condition status enable register query.

Syntax **LASer:ENABle:COND?**

Remarks The **LASer:ENABle:COND?** query returns the value of the condition status enable register of the laser operation.

Argument	Description
condition enable	See **LASer:ENABle:COND** for a definition of the condition enable register

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also **LASer:COND?, LASer:ENABle:COND**

LASer:ENABle:EVEnt

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser event status enable register command.

Syntax **LASer:ENABle:EVEnt** *event enable*

Remarks The **LASer:ENABle:EVEnt** command sets the event status enable register of the laser operations. These events are summarized in bit 2 of the Status Byte Register.

Argument		Description
event enable	1	Current Limit
	2	Voltage Limit
	4	Photodiode Current Limit
	8	Power Limit
	16	Interlock State Changed
	32	N/A
	64	N/A
	128	Open Circuit
	256	Output is Shorted
	512	Output Changed to be In/Out of Tolerance
	1024	Output On/Off State Changed
	2048	New Measurements Taken
	4096	Calculation Error
	8192	Communication with laser Board Error

16384	Software Error in laser Control
32768	Laser EPROM Checksum Error

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (see ***PSC**).

The parameter value may indicate multiple conditions; i.e. 3 is both 1 and 2.

The factory default for this register is 0.

See Also ***PSC , LASer:EVEnt?, LASer:ENABle:EVEnt?**

LASer:ENABle:EVEnt?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser event status enable register query.

Syntax **LASer:ENABle:EVEnt?**

Remarks The **LASer:ENABle:EVEnt?** query returns the value of the event status enable register of the laser operation.

Argument	Description
event enable	See **LASer:ENABle:EVEnt** for a definition of the event enable register

See Also **LASer:ENABle:EVEnt, LASer:EVEnt?**

LASer:ENABle:OUTOFF

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser output off enable register command.

Syntax **LASer:ENABle:OUTOFF** *outoff enable*

Remarks The **LASer:ENABle:OUTOFF** command sets the status outoff enable register of the laser operations (occurrences which will turn the laser output off). Conditions which are enabled by default are shown in **bold**.

Argument	Value	Description
outoff enable	1	Current Limit
	2	**Voltage Limit Error *(always enabled)***
	4	**Photodiode Current Limit**
	8	**Photodiode Power Limit**
	16	**Interlock Disabled *(always enabled)***

32	N/A
64	N/A
128	**Open Circuit *(always enabled)***
256	**Short Circuit *(always enabled)***
512	Output is Out of Tolerance Limit
1024	TEC Output is Off
2048	TEC Temperature Limit
4096	**Hardware Error**
8192	N/A
16384	N/A
32768	N/A

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (see ***PSC**).

The factory default value for this register is #H119E, or 4510 decimal.

The parameter value may indicate multiple conditions; i.e. 3 is both 1 and 2.

WARNING: If the "Output is Out of Tolerance Limit" condition is set in this register when the laser output is off, you will not be able to return the laser output on until this bit is reset.

See Also ***PSC, LASer:ENABle:OUTOFF?**

LASer:ENABle:OUTOFF?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser output off enable register query.

Syntax **LASer:ENABle:OUTOFF?**

Remarks The **LASer:ENABle:OUTOFF?** query returns the value of the laser output off enable register of the laser operation.

Response	Description
outoff enable	See **LASer:ENABle:OUTOFF** for a definition *outoff enable*.

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also **LASer:ENABle:OUTOFF**

LASer:EVEnt?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser event register query.

Syntax **LASer:EVEnt?**

Remarks The **LASer:EVEnt?** query returns the value of the event status register of the laser operations.

Response	Value	Description
event	1	Laser Current Limit
	2	Voltage Limit
	4	Photodiode Current Limit
	8	Power Limit
	16	Interlock State Changed
	32	N/A
	64	N/A
	128	Open Circuit
	256	Output is Shorted
	512	Output Changed to be In/Out of Tolerance
	1024	Output On/Off State Changed
	2048	New Measurements Taken
	4096	Calculation Error
	8192	Communicating with laser Board Error
	16384	Software Error in laser Control
	32768	Laser EPROM Checksum Error

The laser event status is only cleared when the event status is read or by the ***CLS** command.

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also ***CLS, LASer:ENABle:EVEnt**

LASer:INC

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser increment command.

Syntax **LASer:INC** *[steps [,time]]*

Remarks The **LASer:INC** command increments the selected laser control mode set point by one or more steps. Optional parameters allow multiple steps to be incremented and the time (in milliseconds) between increments to be set, respectively.

Argument	Description
steps	number of steps to decrement each time
time	time between multiple decrements in milliseconds

The incremental default amount is one step. The step size can be edited via the **LASer:STEP** command, its default value is 0.01 mA, 0.01 mW, or 1 µA (if CALPD = 0), depending on the mode of operation.

If the first optional parameter is used, but not the second, the user may increment the laser set point by a multiple of the **LASer:STEP** size, without changing the **LASer:STEP** size.

If the both optional parameters are used, the user may create an automated stepping ramp function for the laser output.

If the first optional parameter is entered as zero, **LASer:INC 0**, the command will do nothing.

The minimum time to complete one increment is about 10 to 20 milliseconds. Therefore, values for the second optional parameter (time between increments) have a practical minimum of 20.

Examples **LASer:MODE:ILBW; LASer:STEP 30; LASer:INC 3,5000**

Action: The laser source current set point is incremented by 0.3 mA, three times, with 5 seconds between incremental steps. So the laser output is incremented a total of 0.9 mA after 10 seconds.

See Also **LASer:DEC, LASer:STEP**

LASer:LDI (I)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser current set point command.

Syntax **LASer:LDI** *current set point*

Remarks Sets the laser's constant current set point.

Argument	Description
current set point	Laser driver output in mA

This command will not affect the output if the channel is in MDP or MDI modes.

See Also **LASer:LDI?, LASer:SET:LDI?**

LASer:LDI? (I?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Measured laser current query.

Syntax **LASer:LDI?**

Remarks The **LASer:LDI?** query returns the value of the measured laser current.

Response	Description
measured current	Measured laser current in mA

This measurement is updated approximately once every 400 milliseconds.

See Also **LASer:LDI, LASer:SET:LDI?**

LASer:LDV

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Calibrated laser forward voltage command.

Syntax **LASer:LDV** *calibrated voltage*

Remarks The **LASer:LDV** command sets the laser channel's externally measured forward voltage used during calibration.

Argument	Description
calibrated voltage	Forward voltage in volts as externally measured

See Also **LASer:CAL:LDV**

LASer:LDV?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Measured forward voltage query.

Syntax **LASer:LDV?**

Remarks The **LASer:LDV?** query returns the laser channel's measured forward voltage.

Response	Description
measured voltage	Laser diode forward voltage in volts

LASer:LIMit:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:LIMit:** command path is used to get to the controller laser limit commands.

The following commands may be reached directly from the **LASer:LIMit:** command path.

LASer:LIMit:LDI	**(I)**
LASer:LIMit:LDI?	**(I?)**
LASer:LIMit:MDI	**(IPD)**
LASer:LIMit:MDI?	**(IPD?)**
LASer:LIMit:MDP	**(Ppd)**
LASer:LIMit:MDP?	**(Ppd?)**

LASer:LIMit:LDI (I)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser current limit set command.

Syntax **LASer:LIMit:LDI** *current limit*

Remarks The **LASer:LIMit:LDI** command sets the laser current limit value.

Argument	Description
current limit	Current limit in mA

See Also **LASer:LIMit:LDI?**

LASer:LIMit:LDI? (I?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser current limit set query.

Syntax **LASer:LIMit:LDI?**

Remarks The **LASer:LIMit:LDI?** query returns the value of the laser current limit.

Response	Description
current limit	Current limit in mA

See Also **LASer:LIMit:LDI**

LASer:LIMit:LDV

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser voltage limit set command.

Syntax **LASer:LIMit:LDV** *voltage limit*

Remarks The **LASer:LIMit:LDV** command sets the laser voltage limit value.

Argument	Description
voltage limit	Voltage limit in volts

See Also **LASer:LIMit:LDV?**

LASer:LIMit:LDV?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser voltage limit set query.

Syntax **LASer:LIMit:LDV?**

Remarks The **LASer:LIMit:LDV?** query returns the value of the laser voltage limit.

Response	Description
voltage limit	Voltage limit in volts

See Also **LASer:LIMit:LDI**

LASer:LIMit:MDI (IPD)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode current limit set command.

Syntax **LASer:LIMit:MDI** *PD current limit*

Remarks The **LASer:LIMit:MDI** command sets the monitor photodiode current limit.

Argument	Description
PD current limit	Current limit in µA

See Also **LASer:LIMit:MDI?**

LASer:LIMit:MDI? (IPD?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode current limit set query.

Syntax **LASer:LIMit:MDI?**

Remarks The **LASer:LIMit:MDI?** query returns the monitor photodiode current limit.

Response	Description
PD current limit	Current limit in µA

See Also **LASer:LIMit:MDI**

LASer:LIMit:MDP (Ppd)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode power limit set command.

Syntax **LASer:LIMit:MDP** *PD power limit*

Remarks The **LASer:LIMit:MDP** command sets the laser monitor photodiode power limit value.

Argument	Description
PD power limit	Photodiode power limit in mW

When constant power mode is used, the output is current limited in hardware, but power limited in software.

See Also **LASer:LIMit:MDP?**

LASer:LIMit:MDP? (Ppd?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode power limit set query.

Syntax **LASer:LIMit:MDP?**

Remarks The **LASer:LIMit:MDP?** query returns the laser monitor photodiode power limit value.

Response	Description
PD power limit	Photodiode power limit in mW

See Also **LASer:LIMit:MDP**

LASer:MDI (IPD)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode current set point command.

Syntax **LASer:MDI** *photodiode current*

Remarks The **LASer:MDI** command sets the value of the photodiode current set point, in µA.

Argument	Description
photodiode current	Photodiode current set point in µA

See Also **LASer:MDI?, LASer:SET:MDI?**

LASer:MDI? (IPD?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser measured photodiode current query.

Syntax **LASer:MDI?**

Remarks The **LASer:MDI** query returns the value of the measured photodiode current.

Response	Description
measured PD current	Measured photodiode current in µA

This measurement is updated approximately once every 400 milliseconds.

See Also **LASer:MDI, LASer:SET:MDI?**

LASer:MDP (Ppd)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode power set command.

Syntax **LASer:MDP** *PD power*

Remarks The **LASer:MDP** command sets the laser's photodiode power set point, in mW.

Argument	Description
PD Power	Photodiode power set point in mW

See Also **LASer:MDP?, LASer:SET:MDP?**

LASer:MDP? (Ppd?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser photodiode power query.

Syntax **LASer:MDP?**

Remarks The **LASer:MDP?** query returns the measured value of the laser photodiode power.

Response	Description
PD Power	Photodiode power in mW

This measurement is updated approximately once every 400 milliseconds.

See Also **LASer:MDP, LASer:SET:MDP?**

LASer:MODE?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser mode query.

Syntax **LASer:MODE?**

Remarks The **LASer:MODE?** query returns the selected laser control mode.

Response	Value	Description
mode	"Ilbw"	constant current mode, low bandwidth
	"Icw"	constant current mode, continuous wave
	"Ihbw"	constant current mode, high bandwidth
	"Mdi"	constant power mode and CALPD = 0
	"Mdp"	constant power mode and CALPD > 0

See Also **LASer:MODE:ILBW, LASer:MODE:IHBW, LASer:MODE:ICW, LASer:MODE:MDI, LASer:MODE:P**

LASer:MODE:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The LASer:MODE: command path is used to get to the controller's laser mode selection commands.

The following commands may be reached directly from the **LASer:MODE:** command path.

LASer:MODE:ILBW (I)
LASer:MODE:IHBW
LASer:MODE:MDP (Ppd)
LASer:MODE:ICW
LASer:MODE:MDI (IPD)

LASer:MODE:ICW

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter constant current continuous wave mode command.

Syntax **LASer:MODE:ICW**

Remarks The **LASer:MODE:ICW** command selects the laser constant current continuous wave mode.

See Also **LASer:MODE?**

LASer:MODE:IHBW

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter constant current high bandwidth mode command.

Syntax **LASer:MODE:IHBW**

Remarks The **LASer:MODE:IHBW** command selects the laser high bandwidth constant current mode.

See Also **LASer:MODE?**

LASer:MODE:ILBW (I)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter constant current low bandwidth mode command.

Syntax **LASer:MODE:ILBW**

Remarks **The LASer:MODE:ILBW** command selects the laser constant current low bandwidth mode.

See Also **LASer:MODE?**

LASer:MODE:MDI (IPD)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter constant photodiode current mode command.

Syntax **LASer:MODE:MDI**

Remarks The **LASer:MODE:MDI** command selects the photodiode constant current mode.

See Also **LASer:MODE?**

LASer:MODE:MDP (Ppd)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Enter constant photodiode power mode command.

Syntax **LASer:MODE:MDP**

Remarks The **LASer:MODE:MDP** command selects the photodiode constant power mode. If CALPD = 0, this command will be handled as **LASer:MODE:MDI**, placing the controller in MDI mode, *not* MDP mode.

See Also **LASer:MODE?**

LASer:MODULATE

3150	3040	5000	6000	8000	8008	9000
			✓	✓		

Description MOPA laser modulate channel command.

Syntax **LASer:MODULATE** *channel*

Remarks The **LASer:MODULATE** command selects which channel is modulated by the modulation input. The command only works for MOPA laser modules.

Argument	Value	Description
channel	**OSC**	Modulate the oscillator channel (channel A)
	AMP	Modulate the amplifier channel (channel B)

See Also **LASer:MODULATE?**

LASer:MODULATE?

3150	3040	5000	6000	8000	8008	9000
			✓	✓		

Description MOPA laser modulate channel query.

Syntax **LASer:MODULATE?**

Remarks The **LASer:MODULATE?** query returns which channel of the MOPA laser is bring modulated.

Response	Value	Description
channel	**OSC**	Oscillator is modulated.
	AMP	Amplifier is modulated.

See Also **LASer:MODULATE**

LASer:OUTput

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser enable output command.

Syntax **LASer:OUTput** *enable*

Remarks The **LASer:OUTput** command turns the laser output on or off.

Argument	Value	Description
enable	0	off
	1	on

When the laser output is off, an internal short is placed across the output terminals.

See Also **LASer:OUTput?**

LASer:OUTput?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser enable output query.

Syntax **LASer:OUTput?**

Remarks The **LASer:OUTput?** query returns the status of the laser output.

Response	Value	Description
enable	0	off
	1	on

See Also **LASer:OUTput**

LASer:SET:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:SET:** command path is used to get to the controller's laser set point queries.

The following commands may be reached directly from the **LASer:SET:** command path.

LASer:SET:LDI?	**(I?)**
LASer:SET:MDI?	**(IPD?)**
LASer:SET:MDP?	**(Ppd?)**

LASer:SET:LDI? (I?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser constant current set point query.

Syntax **LASer:SET:LDI?**

Remarks The **LASer:SET:LDI?** query returns the constant current set point.

Response	Description
current set point	Current set point in mA

See Also **LASer:LDI**

LASer:SET:MDI? (IPD?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser constant photodiode current set point query.

Syntax **LASer:SET:MDI?**

Remarks The **LASer:SET:MDI?** query returns the laser photodiode current set point value in µA.

Response	Description
PD current set point	Photodiode current set point in µA

See Also **LASer:MDI**

LASer:SET:MDP? (Ppd?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser constant photodiode power set point query.

Syntax **LASer:SET:MDP?**

Remarks The **LASer:SET:MDP?** query returns the laser photodiode power set point value in mW.

Response	Description
PD power set point	Photodiode power set point in mW

See Also **LASer:MDP**

LASer:SIGNAL:

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

The **LASer:SIGNAL:** command path is used to access the controller's laser modulation features[3].

The following commands may be reached directly from the **LASer:SET:** command path.

LASer:SET:LDI?	**(I?)**
LASer:SET:MDI?	**(IPD?)**
LASer:SET:MDP?	**(Ppd?)**

LASer:SIGNAL:AMPlitude

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation level set point command.

Syntax **LASer:SIGNAL:AMPlitude** *amplitude*

Remarks The **LASer:SIGNAL:AMPlitude** command sets the modulation amplitude in mA, uA, or mW, depending on the mode (Io, Im, or Po, respectively).

Argument	Description
amplitude	Photodiode power set point in mW

See Also **LASer:SIGNAL:AMPlitude?**, **LASer:SIGNAL:FREQuency**

LASer:SIGNAL:AMPlitude?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation level set point query.

Syntax **LASer:SIGNAL:AMPlitude?**

[3] Not all lasers support

Remarks The **LASer:SIGNAL:AMPlitude?** query returns the modulation amplitude in mA, uA, or mW, depending on the mode (Io, Im, or Po, respectively).

Response	Description
amplitude	Photodiode power set point in mW

See Also **LASer:SIGNAL:AMPlitude**

LASer:SIGNAL:ENABle

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation enable command.

Syntax **LASer:SIGNAL:ENABle** *enable*

Remarks The **LASer:SIGNAL:ENABle** command enables or disables the modulation circuit.

Argument	Description
enable	0 or OFF to disable, 1 to enable internal modulation circuit, 2 to enable external modulation[4].

See Also **LASer:SIGNAL:AMPlitude?**, **LASer:SIGNAL:FREQuency**

LASer:SIGNAL:ENABle?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation enable query.

Syntax **LASer:SIGNAL:ENABle?**

Remarks The **LASer:SIGNAL: ENABle?** query returns the modulation state.

Response	Description
enable	0 or OFF for disabled, 1 for internal modulation circuit enabled, 2 for external modulation enabled[5].

See Also **LASer:SIGNAL:ENABle**

LASer:SIGNAL:FREQuency

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation frequency level set point command.

Syntax **LASer:SIGNAL:FREQuency** *frequency*

[4] External modulation support not available on all laser modules.

[5] External modulation support not available on all laser modules.

Remarks The **LASer:SIGNAL:FREQuency** command sets the modulation frequency.

Argument	Description
frequency	Modulation frequency in Hz.

See Also **LASer:SIGNAL:AMPlitude?**, **LASer:SIGNAL:FREQuency**

LASer:SIGNAL:FREQuency?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation frequency level set point query.

Syntax **LASer:SIGNAL:FREQuency?**

Remarks The **LASer:SIGNAL:FREQuency?** query returns the modulation frequency.

Response	Description
frequency	Modulation frequency in Hz.

See Also **LASer:SIGNAL:FREQuency**

LASer:SIGNAL:TYPE

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation waveform select command.

Syntax **LASer:SIGNAL:TYPE** *type*

Remarks The **LASer:SIGNAL:TYPE** command sets the modulation waveform.

Argument	Description
type	0 for sine, 1 for square

See Also **LASer:SIGNAL:TYPE?**

LASer:SIGNAL:TYPE?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser modulation waveform type query.

Syntax **LASer:SIGNAL:TYPE?**

Remarks The **LASer:SIGNAL:TYPE?** query returns the modulation frequency.

Response	Description

type	0 for sine, 1 for square

See Also **LASer:SIGNAL:TYPE**

LASer:SET:MDP? (Ppd?)

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser constant photodiode power set point query.

Syntax **LASer:SET:MDP?**

Remarks The **LASer:SET:MDP?** query returns the laser photodiode power set point value in mW.

Response	Description
PD power set point	Photodiode power set point in mW

See Also **LASer:MDP**

LASer:STB?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser status byte register query.

Syntax **LASer:STB?**

Remarks The **LASer:STB?** query is used to return the status summaries for conditions and events. The value is used to determine which laser channels have conditions and/or events which have been reported to the Status Byte Register.

Response	Value	Description
Status Byte Register	1	N/A
	2	N/A
	4	Event Status Register Summary
	8	Condition Status Register Summary

The response value may indicate multiple conditions, i.e. 12 is both 8 and 4.

See Also ***STB, LASer:COND?, LASer:ENABle:COND, LASer:ENABle:EVEnt, LASer:EVEnt?**

LASer:STEP

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser step set command.

Syntax **LASer:STEP** *step value*

Remarks The **LASer:STEP** command is used to increment or decrement the selected laser control mode set point by the given amount, when used with the **LASer:INC** or **LASer:DEC** command.

Argument	Description
step value	Integer from 1 to 9999

The step of 1 corresponds to the smallest incremental change of the mode. For example, a step of 1 means 0.01 mA, 0.01 mW, or 1 µA.

The default step value is 1.

Example **LASer:STEP 1000**

Action: sets the step size to 1000; could mean 10.0 mA, 10.0 mW, or 1000 µA.

See Also **LASer:DEC, LASer:INC**

LASer:STEP?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser step set query.

Syntax **LASer:STEP?**

Remarks The **LASer:STEP?** query is used to return the laser step value.

Response	Description
step value	Integer from 1 to 9999

See Also **LASer:STEP**

LASer:TOLerance

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser tolerance set command.

Syntax **LASer:TOLerance** *tolerance, time*

Remarks The **LASer:TOLerance** command allows the programmer to program the laser current tolerance, and time window for it to occur, in order that the operation complete flag be set after a **LASer:OUTput 1** command is issued, or the laser set point is changed.

Argument	Description
tolerance	Current tolerance in mA from 0.1 to 100.0 mA
time	Time window in seconds from .001 to 50.000 seconds

This command may be used in conjunction with the common query ***OPC?** and common command ***WAI** to delay further program activities until the laser current reaches its set point.

The controller defaults to a tolerance of 10.0 mA for 5 seconds.

For example, if the set point is 40.5 mA, tolerance is 1.0 mA for 5 seconds, and the laser output is turned on, the user may issue the ***WAI** command to ensure this set point is reached before continuing. In this case, the controller will wait until its laser current is within 1.0 mA of 40.5 mA for a period of 5 seconds before the next command is executed.

If the controller is operated in MDI mode, the current tolerance parameter is not used. Instead a fixed value of 50 µA is used for the MDI current, and only the time window parameter may be adjusted. Likewise, in the MDP mode a fixed value of 50 mW is used for the MDP power, and only the time window parameter may be adjusted.

WARNING: If the tolerance is set to tight it may never be achieved. This is due to the calibration of the set point and measurement values.

See Also **LASer:TOLerance?**

LASer:TOLerance?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser tolerance set query.

Syntax **LASer:TOLerance?**

Remarks The **LASer:TOLerance?** query returns laser current tolerance setting.

Response	Description
tolerance	Current tolerance in mA from 0.1 to 100.0 mA
time	Time window in seconds from .001 to 50.000 seconds

A change of the output into or out of tolerance flag sets a flag in the laser event status register, and so entering or exiting laser current tolerance may be used to generate service requests.

See Also **LASer:TOLerance**

LINK:

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

A link is defined as *"source, condition, action, target"*. Each field is described below and is not case sensitive. See the description of linking the product's *Operation and Maintenance Manual* for additional information.

Source, **Target**

The format for source and target parameters are as follows:

channel #[subchannel letter]

Examples include "2", "1a", "1B", etc. The subchannel designator is only valid for multi-channel modules.

Conditions

Each class of module has a set of conditions that are unique to that module. Each condition is evaluated approximately once per second. Links are edge triggered, which means that the action of a link is done the first time the condition goes true, not whenever the condition is true. The action will not be done a second time until the condition first goes false and then returns true.

Laser	Description	TEC	Description
On	On	On	On
Off	Off	Off	Off
Out	Out of tolerance	Out	Out of tolerance
In	In tolerance	In	In tolerance
I_oL	Current limit	I L	Current limit
V_fL	Voltage compliance limit	V L	Voltage limit
I_mL	Photodiode current limit	T L	Temperature limit
P_oL	Photodiode power limit	ThL	Temperature high limit
Lck	Interlock open	TlL	Temperature low limit
Opn	Open circuit	R L	R limit

Laser	Description	TEC	Description
Sho	Short circuit	Opn	Module or sensor open

Actions

The actions parameter determines what happens to the target module when the condition triggers the link.

Actions	Description
Off	Turn off
f#	Turn off in # seconds (allowed values are 1, 3, 5, 10, 20, 30, 60, 90)
On	Turn on
n#	Turn on in # seconds (allowed values are 1, 3, 5, 10, 20, 30, 60, 90)

LINK:ALL?

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

Description Get all links command.

Syntax **LINK:ALL?**

Remarks The **LINK:ALL?** command returns the links defined in the system.

Response	Description
link list	Each link is formatted as follows: *source*, *condition*, *action*, *target* and is seperated by a semicolon (;).Refer to the definitions of these parameters in the **LINK:** command path description above. If there are no links defined in the system, a value of “No Links” is returned.

See Also **LINK:GET, LINK:SET**

LINK:CLEAR

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

Description Clear a specific link command.

Syntax **LINK:CLEAR** *link index*

Remarks The **LINK:CLEAR** command removes a specific link.

Argument	Description
link index	Index of the link to be removed. The first link is considered to be link index 1, the second link link index 2, and so forth.

See Also **LINK:CLEARALL**

LINK:CLEARALL

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

Description Clear all links command.

Syntax **LINK:CLEARALL**

Remarks The **LINK:CLEARALL** command removes all links defined in the system.

See Also **LINK:CLEARALL**

LINK:GET

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

Description Get specific link query.

Syntax **LINK:GET** *link index*

Remarks The **LINK:GET** command retrieves a specific link defined in the system.

Argument	Description
link index	Index of the link to be retrieved. The first link is considered to be link index 1, the second link link index 2, and so forth. The link is formatted as follows: *source, condition, action, target* Refer to the definitions of these parameters in the **LINK:** command path description above. If there are no links defined in the system, a value of “No Link” is returned.

See Also **LINK:ALL?, LINK:SET**

LINK:SET

3150	3040	5000	6000	8000	8008	9000
			✓	✓	✓	✓

Description Set specific link command.

Syntax **LINK:SET** *source, condition, action, target*

Remarks The **LINK:SET** command defines a new link into the system.

Argument	Description
source, condition, action, target	Refer to the definitions of these parameters in the **LINK:** command path description above.

Examples **LINK:SET 2,ThL,Off,1**

This link will shutdown the laser if the TEC exceeds the high temperature limit.

LINK:SET 1,Off,Off,2
LINK:SET 1,On,On,2

These links will tie the laser on/off state to the TEC, so that whenever the laser turns on, the TEC will turn on, and vice versa. However, the TEC can be turned on or off without affecting the laser. To add TEC control over the laser in the same manner, add the following links:

LINK:SET 2,Off,Off,1
LINK:SET 2,On,On,1

These four links will cause the laser and TEC on/off states to mirror each other at all times. In other words, if one is on, both will be on, and if one is off, both will be off.

See Also **LINK:ALL?, LINK:GET**

LOCAL

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Return to local mode (from RS-232 remote)

Syntax **LOCAL**

Remarks Returns the controller to local mode after being placed in remote mode by the RS-232 interface. This command has no effect when issued over the IEEE-488 interface.

MASTER

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Master display command

Syntax **MASTER**

Remarks The **MASTER** command switches the display to the master screen. It is similar to hitting the **MASTER** button on units equipment with both **MASTER** and **MENU** buttons, or **MENU** for units with only a **MENU** button. If errors are being displayed, they will be cleared before switching to the master display.

See Also **MASTER?**

MASTER?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Master display query

Syntax **MASTER?**

Remarks The **MASTER?** query tests if the unit is displaying the master screen.

Response	Description
0	Unit *is not* displaying the master screen.
1	Unit *is* displaying the master screen.

See Also **MASTER**

MESsage

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Store message command.

Syntax **MESsage** *message data*

Remarks The **MESsage** command allows the user to enter an ASCII string of up to 16 characters. This command may be useful for storing messages which relate to a test of configuration.

Argument	Description
message data	Quoted ASCII String 1 to 16 bytes, user defined

The message may contain any ASCII character, but will be terminated when a NULL terminator character is received. If the message has less than 16 bytes, the software will fill the remaining message space with the space character. After 16 bytes have been entered, the software will null-terminate the string.

Example **MES “Hello World”**

Action: sets the stored message to “Hello World   ”. Messages are always padded with spaces to a full 16 characters.

See Also **MESsage?**

MESsage?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Store message query.

Syntax **MESsage?**

Remarks The **MESsage?** query returns the previously stored message. This message will always be 16 bytes long and enclosed in quotes. The message is entered via the **MESsage** command.

Response	Description
message data	ASCII String 1 to 16 bytes, user defined

If there is no previously stored message, the response will be "   ", all spaces.

See Also **MESsage**

ONDELAY

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser turn on delay command

Syntax **ONDELAY** *time*

Remarks The **ONDELAY** command controls the laser turn on delay. This is the amount of time from the point the laser on command is received to the point the output is actually energized.

Argument	Description
time	Time, in milliseconds

See Also **ONDELAY?**

ONDELAY?

3150	3040	5000	6000	8000	8008	9000
		✓	✓	✓	✓	✓

Description Laser turn on delay query

Syntax **ONDELAY?**

Remarks The **ONDELAY?** query returns the laser turn on delay time.

Response	**Description**
time	Time, in milliseconds

See Also **ONDELAY**

RADix

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Set radix command.

Syntax **RADix** *radix*

Remarks The **RADix** command allows the programmer to select the radix type for status, condition, and event query response data. Decimal, binary, hexadecimal, and octal are allowed. Default is decimal.

Argument	**Value**	**Description**
radix	DEC	decimal response <nrf>
	HEX	hexadecimal response (#H)
	BIN	binary response (#B)
	OCT	octal response (#O)

All of the above radixes may be used to enter program data at any time, without the need for issuing the **RADix** command. The proper prefix must also be used with Hex (#H), binary (#B), or octal (#O).

See Also **RADix?, event and condition registers**

RADix?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Set radix query

Syntax **RADix?**

Remarks The **RADix?** query allows the programmer to determine which radix type for status, condition, and even query response data is currently selected.

Response	**Value**	**Description**
radix	DEC	decimal response <nrf>
	HEX	Hexadecimal response (#H)
	BIN	binary response (#B)
	OCT	octal response (#O)

See Also **RADix**

REMERR

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display errors while remote command

Syntax **REMERR** *enabled*

Remarks The **REMERR** command controls the displaying of errors while in remote mode. If enabled, then errors generated while in remote mode will be displayed on the unit's screen.

Argument	Description
0	Disable the display of errors when in remote mode
1	Enable the display of errors when in remote mode

See Also **REMERR?**

REMERR?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Display errors while remote query

Syntax **REMERR?**

Remarks The **REMERR?** query returns the state of display errors while remote.

Response	Description
0	The display of errors when in remote mode is disabled
1	The display of errors when in remote mode is enabled

See Also **REMERR**

TEC:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:** command path is used to get to the controller's thermoelectric cooler (TEC) commands.

The following command paths may be reached from the **TEC:** command path.

TEC:CAL:
TEC:DISplay:
TEC:ENABle:

TEC:LIMit:
TEC:MODE:
TEC:SET:

The following commands may be reached directly from the **TEC:** command path.

TEC:CHAN
TEC:CHAN?
TEC:COND?
TEC:CONST
TEC:CONST?
TEC:DEC
TEC:DISplay
TEC:DISplay?
TEC:EVEnt?
TEC:GAIN
TEC:GAIN?
TEC:INC
TEC:ITE
TEC:ITE?
TEC:MODE?
TEC:OUTput
TEC:OUTput?
TEC:R
TEC:R?
TEC:SENsor
TEC:SENsor?
TEC:STB?
TEC:STEP
TEC:STEP?
TEC:T
TEC:T?
TEC:TOL
TEC:TOL?

TEC:CAL:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:CAL:** command path is used to get to the controller's TEC calibration commands.

The following commands may be reached directly from the **TEC:CAL:** command path.

TEC:CAL:CANCEL
TEC:CAL:ITE
TEC:CAL:ITE?
TEC:CAL:SENsor
TEC:CAL:SENsor?

During calibration, the only commands accepted by the controller are the **TEC:CAL:** path commands, **TEC:ITE**, **TEC:R**, and any query commands. All other commands will generate error E-115, “Identifier Not Valid.”

TEC:CAL:CANCEL

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description Cancel any calibration procedure command

Syntax **TEC:CAL:CANCEL**

Remarks The **TEC:CAL:CANCEL** command terminates any running calibration procedure without updating the calibration constants.

See Also **TEC:CAL:ITE, TEC:CAL:SENsor**

TEC:CAL:ITE

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description Enter current calibration mode command.

Syntax **TEC:CAL:ITE**

Remarks The **TEC:CAL:ITE** command is used to enter the TEC current set point and measurement calibration mode.

Before entering this mode, the TEC should be setup for I_{TE} mode (or T mode if the module does not support I_{TE} mode), the I_{TE} set point should be set to 50% of full scale (**TEC:ITE** command), the I_{TE} limit set to 50% of full scale plus 100 mA (**TEC:LIMit:ITE** command), and the output turned on (**TEC:OUTPUT ON**). The I_{TE} calibration is a 4 point calibration procedure, two points for positive current and two points for negative current. See TEC calibration procedures in the product's *Operation and Maintenance Manual* for complete details on remote I_{TE} calibration.

See Also **TEC:CAL:ITE?, TEC:ITE**

TEC:CAL:ITE?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description Ready for current calibration data query.

Syntax **TEC:CAL:ITE?**

Remarks The **TEC:CAL:ITE?** query is used to determine if the controller is ready for a value to be entered during the calibration cycle of the **TEC:CAL:ITE** mode.

Response	Description
0	not ready
1	ready

This query can be used to poll the controller after the **TEC:CAL:ITE** command to determine if its waiting for a value. If the response is 1, the controller is ready to receive a calibration value via the **TEC:ITE** command. This query may then be repeated for the second half of the calibration cycle. (A query of the TEC condition status register, bit 11, has the same results.)

See Also **TEC:CAL:ITE, TEC:ITE**

TEC:CAL:SENsor

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description Enter sensor calibration mode command.

Syntax **TEC:CAL:SENsor**

Remarks The **TEC:CAL:SENsor** command sets the TEC sensor calibration mode for the selected sensor.

Before entering this mode, the sensor to be calibrated should be selected (**TEC:SENSor** command). The sensor calibration is a single point calibration procedure. See the calibration section in the *Operation and Maintenance Manual* of the product for complete details on remote sensor calibration.

See Also **TEC:CAL:SENsor, TEC:R**

TEC:CAL:SENsor?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description Ready for sensor calibration data query.

Syntax **TEC:CAL:SENsor?**

Remarks The **TEC:CAL:SENsor?** query is used to determine that the controller is ready for a value to be entered during the calibration cycle of the **TEC:CAL:SENsor** mode.

Response	Description
0	not ready
1	ready

This query can be used to poll the controller after the **TEC:CAL:SEN** command to determine if its waiting for a value. If the response is 1, the controller is ready to receive a calibration value via the **TEC:R** command. (A query of the TEC condition status register, bit 11, has the same results.)

See Also **TEC:CAL:SENsor, TEC:R**

TEC:CHAN

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC channel select command.

Syntax **TEC:CHAN** *channel [,subchannel]*

Remarks The **TEC:CHAN** command selects the TEC channel for display and control.

Argument	Description
channel	Selects TEC in *channel*
subchannel	Selects *subchannel* on *channel*. This parameter defaults to 1 for a dual or combo module (i.e., **TEC:CHAN 1** is equivalent to **TEC:CHAN 1,1**).

See Also **TEC:CHAN?**

TEC:CHAN?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC channel select query.

Syntax **TEC:CHAN?**

Remarks The **TEC:CHAN?** query returns the TEC channel currently selected.

Response	Description
channel	Currently selected TEC channel, 0 if no TEC modules
[subchannel]	Currently selected TEC subchannel.

See Also **TEC:CHAN**

TEC:COND?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC condition status register query.

Syntax **TEC:COND?**

Remarks The **TEC:COND?** query returns the value of the condition status register of the TEC operations.

Response	Value	Description
TEC Condition	1	TE Current Limit
	2	Voltage Limit Error
	4	R Limit
	8	High Temperature Limit
	16	Low Temperature Limit
	32	Sensor Shorted
	64	Sensor Open
	128	TE Module Open

256	N/A
512	Output Out of Tolerance
1024	Output On
2048	Ready for Calibration Data
4096	Calculation Error
8192	TEC Interlock[6]
16384	Software Error
32768	TEC EPROM Checksum Error

The TEC condition status is constantly changing, while the event status is only cleared when the event status is read or the ***CLS** command is issued.

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also ***CLS, *STB, TEC:ENABle:COND, TEC:STB**

TEC:CONST

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC sensor constants command.

Syntax **TEC:CONST** *C1[, C2[, C3 [, Ro]]]*

Remarks The **TEC:CONST** command sets the TEC constants for the Steinhart-Hart equation for thermistors, slope and offsets for AD590s and LM335s, or RTD constants.

Argument	Description	
For thermistors		
C1	±9.999 x 10^{-3}	Steinhart-Hart constants
C2	±9.999 x 10^{-4}	
C3	±9.999 x 10^{-7}	
For LM335/AD590		
C1	±9.999 °C	Offset
C2	±9.999	Slope
For RTD		
C1	±9.999 x 10^{-3}	RTD Temperature constants
C2	±9.999 x 10^{-6}	
C3	±9.999 x 10^{-12}	

[6] Not supported on all TECs.

Ro	95.000 to 105.000 Ω

If less than four parameters need to be changed, only the desired change needs to be specified, along with the separating commas (see examples).

When the LM335 or AD590 sensors are selected, only C1 and C2 are used. Therefore, only two parameters are required in those cases.

Examples **TEC:const 1.4**

Action: sets C1 to1.400; C2, C3, and Ro remain unchanged.

TEC:CONST 1.4,2.015

Action: sets C1 to 1.400, C2 to 2.015 for two-point calibration of AD590 or LM335 sensors (C3 and Ro remain unchanged, but are not used).

See Also **TEC:CONST?**

TEC:CONST?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC sensor constants query.

Syntax **TEC:CONST?**

Remarks The **TEC:CONST?** query returns the TEC constants for the Steinhart-Hart equation for thermistors, slope and offsets for AD590s and LM335s, or RTD constants.

Response	Description
C1	See **TEC:CONST** for a description of these
constants.	
C2	
C3	
Ro	

When the LM335 or AD590 sensors are selected, only C1 and C2 are used. Therefore, C3 values may be ignored for these cases.

See Also **TEC:CONST**

TEC:DEC

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC decrement command.

Syntax **TEC:DEC** *[steps]*

Remarks The **TEC:DEC** command decrements the selected control mode set point by *step* steps. If the *steps* parameter is omitted, it defaults to 1 step.

The step size can be edited via the **STEP** command, its default value is 0.1°C, 1 mA (ITE), 1 Ohm (thermistor), 0.01 µA (AD590), 0.1 mV (LM335), or 0.01 Ohm (RTD) depending on the mode of operation.

See Also **TEC:INC, TEC:STEP**

TEC:DISplay

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC display enable command.

Syntax **TEC:DISplay** *enable*

Remarks The **TEC:DISplay** command enables or disables the TEC display.

Argument	Value	Description
enable	0	off
	1	on

A **TEC:DISplay** command will always cause the controller to return to the Master Display screen, regardless of what screen the system was in prior to the command. If the display is turned off, the Master Display will blank out that channel’s data, replaced the message “Display Disabled”. Access to the channel’s single display screen from the Module menu will also be blocked. The display cannot be restored locally except through a power down and power up of the controller.

See Also **TEC:DISplay?**

TEC:DISplay?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC display enable query.

Syntax **TEC:DISplay?**

Remarks The **TEC:DISplay?** query returns the display state for the channel.

Response	Value	Description

enable	0	display off
	1	display on

See Also **TEC:DISplay**

TEC:DISplay:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The ***TEC:DISplay:*** *command path is implemented for ILX-3900 compatibility only.*

All commands will be accepted without error, and all queries will always return “1”.
Commands will have no effect and are ignored by the system.

The following commands may be reached directly from the **TEC:DISplay:** command path.

TEC:DISplay:ITE
TEC:DISplay:ITE?
TEC:DISplay:PARAM
TEC:DISplay:R
TEC:DISplay:R?
TEC:DISplay:SET
TEC:DISplay:SET?
TEC:DISplay:T
TEC:DISplay:T?

TEC:ENABle:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:ENABle:** command path is used to get to the controller's TEC status enable commands and queries.

The following commands may be reached directly from the **TEC:ENABle:** command path.

TEC:ENABle:COND
TEC:ENABle:COND?
TEC:ENABle:EVEnt
TEC:ENABle:EVEnt?
TEC:ENABle:OUTOFF
TEC:ENABle:OUTOFF?

TEC:ENABle:COND

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC condition enable register command.

Syntax **TEC:ENABle:COND** *condition enable*

Remarks The **TEC:ENABle:COND** command sets the condition status enable register of the TEC operation. These conditions are summarized in bit 1 of the Status Byte Register.

Argument	Value	Description
condition enable	1	TE Current Limit
	2	Voltage Limit Error
	4	Resistance Limit
	8	High Temperature Limit
	16	Low Temperature Limit
	32	Sensor Shorted
	64	Sensor Open
	128	TE Module Open
	256	N/A
	512	Output Out of Tolerance
	1024	Output On
	2048	Ready for Calibration Data
	4096	Calculation Error
	8192	TEC Interlock[7]
	16384	Software Error
	32768	TEC EPROM Checksum Error

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (see ***PSC**).

The parameter value may indicate multiple conditions; i.e. 3 is both 1 and 2.

Factory default for this register is 0.

See Also ***PSC**, **TEC:COND?, TEC:ENABle:COND?**

TEC:ENABle:COND?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC condition enable register query.

[7] Not supported on all TECs.

Syntax **TEC:ENABle:COND?**

Remarks The **TEC:ENABle:COND?** query returns the value of the condition status enable register of the TEC operations.

Response	Description
condition enable	See **TEC:ENABle:COND** for a description of *condition enable*

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also **TEC:ENABle:COND**

TEC:ENABle:EVEnt

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC event enable register command.

Syntax **TEC:ENABle:EVEnt** *event enable*

Remarks The **TEC:ENABle:EVEnt** command sets the event status enable register of the TEC operation. These events are summarized in bit 0 of the Status Byte Register.

Argument	Value	Description
event enable	1	TE Current Limit
	2	Voltage Limit
	4	Resistance Limit
	8	High Temperature Limit
	16	Low Temperature Limit
	32	Sensor Shorted
	64	Sensor Open
	128	TE Module Open
	256	Sensor Type Changed
	512	Output Changed to be In or Out of Tolerance
	1024	Output On/Off Changed
	2048	New Measurements Taken
	4096	Calculation Error
	8192	TEC Interlock[8]
	16384	Software Error in TEC Control
	32768	TEC EPROM Checksum Error

[8] Not supported on all TECs.

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (see ***PSC**).

The parameter value may indicate multiple conditions; i.e. 3 is both 1 and 2.

Factory default for this register is 0.

See Also ***PSC, TEC:ENABle:EVEnt?, TEC:EVEnt?**

TEC:ENABle:EVEnt?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC event enable register query.

Syntax **TEC:ENABle:EVEnt?**

Remarks The **TEC:ENABle:EVEnt?** query returns the value of the event status enable register of the TEC operations.

Response	Description
event enable	See **TEC:ENABle:EVEnt?** for a description of *event enable*

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also **TEC:ENABle:EVEnt**

TEC:ENABle:OUTOFF

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC output off enable register command.

Syntax **TEC:ENABle:OUTOFF** *outoff enable*

Remarks The **TEC:ENABle:OUTOFF** command sets the status outoff enable register of the TEC operations (occurrences which will turn the TEC output off). Conditions which are enabled by default are shown in **bold**.

Argument	Value	Description
outoff enable	1	TE Current Limit
	2	Voltage Limit
	4	Resistance Limit
	8	**High Temperature Limit**
	16	**Low Temperature Limit**
	32	N/A

64	**Sensor Open**
128	**Module Open**
256	**Sensor Type Change *(always enabled)***
512	Output Out of Tolerance
1024	**Sensor Shorted**
2048	N/A
4096	Software Error
8192	**TEC Interlock**[9]
16384	N/A
32768	N/A

The value of the TEC outoff enable register is stored in non-volatile memory and is retained at power-up.

The factory default setting for this register is #H25D8, or 9688 decimal.

The parameter value may indicate multiple conditions; i.e. 3 is 1 and 2.

The High Temperature Limit Condition, Sensor Open (While Output On) Condition, and Sensor Type Change (While Output ON) Event bits will not be in effect and will not cause the TEC output to be shut off, if the controller is in TEC mode.

WARNING: If the "Output Out of Tolerance Change" Event bit is set when the output is off, the TEC output will not be able to be turned on until this bit is reset.

See Also ***PSC, TEC:ENABle:OUTOFF?**

TEC:ENABle:OUTOFF?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC output off enable register query.

Syntax **TEC:ENABle:OUTOFF?**

Remarks The **TEC:ENABle:OUTOFF?** query returns the value of the status outoff enable register of the TEC operations (occurrence which will turn the TEC output off).

[9] Not supported on all TECs.

Response	Description
outoff enable	See **TEC:ENABle:OUTOFF** for a definition of *outoff enable*

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also **TEC:ENABle:OUTOFF**

TEC:EVEnt?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC event query.

Syntax **TEC:EVEnt?**

Remarks The **TEC:EVEnt?** query returns the value of the event status register of the TEC operations.

Response	Value	Description
event status register	1	TE Current Limit
	2	Voltage Limit
	4	Resistance Limit
	8	High Temperature Limit
	16	Low Temperature Limit
	32	Sensor Shorted
	64	Sensor Open
	128	TE Module Open
	256	Sensor Type Changed
	512	Output Changed to be In or Out of Tolerance
	1024	Output On/Off Changed
	2048	New Measurements Taken
	4096	Calculation Error
	8192	TEC Interlock[10]
	16384	Software Error in TEC Control
	32768	TEC EPROM Checksum Error

The TEC event status is only cleared when the event status is read or a ***CLS** command is issued.

The response value may indicate multiple conditions; i.e. 3 is both 1 and 2.

See Also ***CLS, TEC:ENABle:EVEnt**

[10] Not supported on all TECs.

TEC:GAIN

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC gain command.

Syntax **TEC:GAIN** *gain*

Remarks The **TEC:GAIN** command sets the TEC control loop gain.

Argument	Value	Description
For TEC's with 8 settings		
gain	1, 3, 5, 10, **30**, 50, 100, or 300	TEC loop gain
For TEC's with 16 settings		
gain	0.2S, 0.6S, 1S, 1, 2S, 3, 5, 6S, 10S, 10, 20S, **30,** 50, 60S, 100, or 300	TEC loop gain

On TEC modules with 16 settings, the slow/fast suffix changes the time constant of the loop. The slow setting allows for larger masses or greater distance between the sensor and the thermo-electric cooler. The numerical value controls the quantity of current that is driven for a given difference between the actual and set temperature. The fast settings correspond to the same gain values of the 8 setting TEC modules.

The default gain setting is 30 (or 30 Fast), and is shown in **bold**.

See Also **TEC:GAIN?**

TEC:GAIN?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC gain query.

Syntax **TEC:GAIN?**

Remarks The **TEC:GAIN?** query returns the value of the control loop gain.

Response	Value	Description
For older TEC's with 8 settings		
gain	1, 3, 5, 10, 30, 50, 100, or 300	TEC loop gain
For newer TEC's with 16 settings		
gain	0.2 Slow, 0.6 Slow, 1 Slow, 1 Fast, 2 Slow, 3 Fast, 5 Fast, 6 Slow, 10 Slow, 10 Fast, 20 Slow, 30 Fast, 50 Fast, 60 Slow, 100 Fast, or 300 Fast	TEC loop gain

See Also **TEC:GAIN**

TEC:INC

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC increment command.

Syntax **TEC:INC** *[steps]*

Remarks The **TEC:INC** command increments the selected control mode set point by *step* steps. If the *steps* parameter is omitted, it defaults to 1 step.

The step size can be edited via the **STEP** command, its default value is 0.1°C, 1 mA (ITE), 1 Ohm (Therm), 0.01 µA (AD590), 0.1 mV (LM335) or 0.01 Ohm (RTD), depending on the mode of operation.

See Also **TEC:DEC, TEC:STEP**

TEC:ITE

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC I_{TE} set point command.

Syntax **TEC:ITE** *set point*

Remarks The **TEC:ITE** command sets the TEC control current set point. It is also used to enter the TEC current calibration value.

Argument	Description
set point	set point in Amps

In ITE current calibration mode, *set point* represents the measured current value in Amps.

See Also **TEC:ITE?, TEC:LIMit:ITE, TEC:SET:ITE?**

TEC:ITE?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC measured output current query.

Syntax **TEC:ITE?**

Remarks The **TEC:ITE?** query returns the value of the measured TEC output current.

Response	Description
measured output	Current in Amps

The TEC current is constantly measured and updated, regardless of the TEC mode of operation.

This measurement is updated approximately once every 400 milliseconds.

See Also **TEC:ITE**

TEC:LIMit:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:LIMit** command path is used to get to the controller's TEC limit commands.

The following commands may be reached directly from the **TEC:LIMit:** command path.

TEC:LIMit:ITE

TEC:LIMit:ITE?
TEC:LIMit:RHI
TEC:LIMit:RHI?
TEC:LIMit:RLO
TEC:LIMit:RLO?
TEC:LIMit:THI
TEC:LIMit:THI?
TEC:LIMit:TLO
TEC:LIMit:TLO?

TEC:LIMit:ITE

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC ITE current limit command

Syntax **TEC:LIMit:ITE** *limit*

Remarks The **TEC:LIMit:ITE** command sets the TEC ITE current limit value.

Argument	Description
limit	Limit in Amps

The factory default current limit is 50% of the maximum current.

See Also **TEC:ITE**

TEC:LIMit:ITE?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC ITE current limit query

Syntax **TEC:LIMit:ITE?**

Remarks The **TEC:LIMit:ITE?** query returns the value of the TEC current limit.

Response	Description
limit	Limit in Amps

See Also **TEC:LIMit:ITE**

TEC:LIMit:RHI

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R_{HI} limit command.

Syntax **TEC:LIMit:RHI** *limit*

Remarks The **TEC:LIMit:RHI** command sets the TEC sensor high resistance limit value.

Argument	Description
limit	Thermistor limit in k Ohms or AD590 limit in µA or LM335 limit in mV or RTD limit in Ohms

See Also **TEC:LIMit:RHI?, TEC:R**

TEC:LIMit:RHI?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R_{HI} limit query.

Syntax **TEC:LIMit:RHI?**

Remarks The **TEC:LIMit:RHI?** query returns the TEC sensor high resistance limit value.

Response	Description
limit	Thermistor limit in k Ohms or AD590 limit in µA or LM335 limit in mV or RTD limit in Ohms

See Also **TEC:LIMit:RHI**

TEC:LIMit:RLO

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R_{LO} limit command.

Syntax **TEC:LIMit:RLO** *limit*

Remarks The **TEC:LIMit:RLO** command sets the TEC sensor low resistance limit value.

Argument	Description
limit	Thermistor limit in k Ohms or AD590 limit in μA or LM335 limit in mV or RTD limit in Ohms

See Also **TEC:LIMit:RLO?, TEC:R**

TEC:LIMit:RLO?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R_{LO} limit query.

Syntax **TEC:LIMit:RLO?**

Remarks The **TEC:LIMit:RLO?** query returns the TEC sensor low resistance limit value.

Response	Description
limit	Thermistor limit in k Ohms or AD590 limit in μA or LM335 limit in mV or RTD limit in Ohms

See Also **TEC:LIMit:RLO**

TEC:LIMit:THI

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC T_{HI} limit command.

Syntax **TEC:LIMit:THI** *limit*

Remarks The **TEC:LIMit:THI** command sets the TEC sensor high temperature limit value.

Argument	Description

limit	Limit in °C, -100 to 240 (200 for LM335 and AD590)

The factory default high temperature limit is 50°C.

See Also **TEC:LIMit:THI, TEC:T**

TEC:LIMit:THI?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC T_{HI} limit query

Syntax **TEC:LIMit:THI?**

Remarks The **TEC:LIMit:THI?** query returns the value of the TEC sensor high temperature limit.

Response	Description
limit	Limit in °C, -100 to 240 (200 for LM335 and AD590)

See Also **TEC:LIMit:THI**

TEC:LIMit:TLO

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC T_{LO} limit command.

Syntax **TEC:LIMit:TLO** *limit*

Remarks The **TEC:LIMit:TLO** command sets the TEC sensor low temperature limit value.

Argument	Description
limit	Limit in °C, -100 to 240 (200 for LM335 and AD590)

The factory default low temperature limit is 10°C.

See Also **TEC:LIMit:TLO?, TEC:T**

TEC:LIMit:TLO?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC T_{LO} limit query

Syntax **TEC:LIMit:TLO?**

Remarks The **TEC:LIMit:TLO?** query returns the value of the TEC sensor low temperature limit.

Response	Description
limit	Limit in °C, -100 to 240 (200 for LM335 and AD590)

See Also **TEC:LIMit:TLO**

TEC:MODE?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC control mode query.

Syntax **TEC:MODE?**

Remarks The **TEC:MODE?** query returns the selected TEC control mode.

Response	Value	Description
mode	ITE	constant current
	R	constant R
	T	constant T

See Also **TEC:MODE:ITE, TEC:MODE:R, TEC:MODE:T**

TEC:MODE:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:MODE:** command path is used to get to the controller's TEC mode selection commands.

The factory default mode is temperature mode.

The following commands may be reached directly from the **TEC:MODE:** command path.

TEC:MODE:ITE
TEC:MODE:R
TEC:MODE:T

TEC:MODE:ITE

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC ITE mode command.

Syntax **TEC:MODE:ITE**

Remarks The **TEC:MODE:ITE** command selects TEC constant current mode.

Changing modes causes the output to be forced off, and the new mode's set point value will be displayed.

See Also **TEC:I, TEC:MODE?**

TEC:MODE:R

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R mode command.

Syntax **TEC:MODE:R**

Remarks The **TEC:MODE:R** command selects TEC constant thermistor resistance/linear sensor reference mode.

Since sensor resistance (or linear sensor reference) is a function of temperature, this mode also controls the TEC output temperature, but it bypasses the use of the conversion constants for set point calculation. This allows finer control of temperature in cases where the sensor's temperature model (and therefore the constants) is not known.

Changing modes causes the output to be forced off, and the new mode's set point value will be displayed.

See Also **TEC:MODE?, TEC:R**

TEC:MODE:T

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC temperature mode command.

Syntax **TEC:MODE:T**

Remarks The **TEC:MODE:T** command selects TEC constant temperature mode.

Since TEC temperature is derived from thermistor or RTD resistance, or, linear sensor current or voltage, constant R and T modes are related. In T mode the set point is converted to resistance voltage or current by using the appropriate constants and conversion model.

Changing modes causes the output to be forced off, and the new mode's set point value will be displayed.

See Also **TEC:MODE?, TEC:T**

TEC:OUTput

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC output enable command.

Syntax **TEC:OUTput** *enable*

Remarks The **TEC:OUTput** command enables or disables the TEC output.

Argument	Value	Description
enable	0	off
	1	on

After the output is turned on, it may be useful to wait until the output is stable (within tolerance) before performing further operations.

See Also **TEC:OUTput?**

TEC:OUTput?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC output enable query.

Syntax **TEC:OUTput?**

Remarks The **TEC:OUTput?** query returns the status of the TEC output.

Response	Value	Description
enable	0	off
	1	on

Although the status of the switch is on, the output may not have reached the set point value.

See Also **TEC:OUTput**

TEC:R

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R set point command.

Syntax **TEC:R** *set point*

Remarks The **TEC:R** command sets the TEC constant thermistor or RTD resistance or linear sensor voltage or current set point.

Argument	Description
set point	Thermistor set point in k Ohms or AD590 set point in µA or LM335 set point in mV or RTD set point in Ohms

See Also **TEC:LIMit:RHI, TEC:LIMit:RLO, TEC:R?**

TEC:R?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC measured R query.

Syntax **TEC:R?**

Remarks The **TEC:R?** query returns the value of the TEC thermistor or RTD resistance, AD590 current, or LM335 voltage measurement.

Response	Description
R value	Measured Thermistor resistance in k Ohms or Measured AD590 current in µA or Measured LM335 voltage in mV or Measured RTD resistance in Ohms

This measurement is updated approximately once every 400 milliseconds.

See Also **TEC:R**

TEC:SENsor

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC sensor select command.

Syntax **TEC:SENsor** *sensor*

Remarks The **TEC:SENsor** command is used to set the sensor type. This value is a coded representation of the sensor type/thermistor current.

Argument	Value	Description
sensor	0	None
	1	Thermistor at 100 µA drive
	2	Thermistor at 10 µA drive
	3	LM335
	4	AD590
	5	RTD

Bit 8 of the TEC event register is set whenever the sensor type is changed.

When changing sensors, the R_{LO} Limit and R_{HI} Limit values are assigned their equivalent temperature limit values.

See Also **TEC:SENsor?**

TEC:SENsor?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC sensor select query.

Syntax **TEC:SENsor?**

Remarks The **TEC:SENsor?** query returns the sensor type. This value is a coded representation of the sensor type/thermistor current.

Response	Description	
sensor	0	None
	1	Thermistor at 100 µA drive
	2	Thermistor at 10 µA drive
	3	LM335
	4	AD590
	5	RTD

Bit 8 of the TEC event register is set whenever the sensor type is changed.

See Also **TEC:SENsor**

TEC:STB?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC status byte register query.

Syntax **TEC:STB?**

Remarks The **TEC:STB?** query returns the status summaries for conditions and events. The value is used to determine which TEC channels have conditions and/or events which have been reported to the Status Byte Register.

Response	Value	Description
Status Byte Register	1	Event Status Register Summary
	2	Condition Status Register Summary

The response value may indicate multiple conditions, i.e. 3 is both 1 and 2.

See Also **TEC:COND?, TEC:ENABle:COND, TEC:ENABle:EVEnt, TEC:EVEnt?**

TEC:SET:

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

The **TEC:SET:** command path is used to get to the controller's TEC set point queries.

The following command may be reached directly from the **TEC:SET:** command path.

TEC:SET:ITE?
TEC:SET:R?
TEC:SET:T?

TEC:SET:ITE?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC ITE set point query.

Syntax **TEC:SET:ITE?**

Remarks The **TEC:SET:ITE?** query returns the TEC constant current set point value.

Response	Description
set point	ITE set point in Amps

See Also **TEC:I**

TEC:SET:R?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC R set point query.

Syntax **TEC:SET:R?**

Remarks The **TEC:SET:R?** query returns the TEC constant thermistor or RTD resistance or linear sensor voltage or current set point value.

Response	Description
set point	Thermistor set point in k Ohms or AD590 set point in μA or LM335 set point in mV or RTD set point in Ohms

See Also **TEC:R**

TEC:SET:T?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC temperature set point query.

Syntax **TEC:SET:T?**

Remarks The **TEC:SET:T?** query returns the TEC constant temperature set point value in °C.

Response	Description
set point	Set point in °C

See Also **TEC:T**

TEC:STEP

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC step size command.

Syntax **TEC:STEP**

Remarks The **TEC:STEP** command is used to increment or decrement the selected TEC control mode set point by the given amount, when used with the **TEC:INC** or **TEC:DEC** command.

Argument	Description
step size	Step size (1-9999)

The step of 1 corresponds to the smallest incremental change of the mode. For example, a step of 1 means 0.1°C, 1 mA (ITE mode) , 1 Ohm (thermistor), 0.01 μA (AD590), 0.1 mV (LM335), or 0.01 Ohm (RTD).

The default step value is 1.

See Also **TEC:DEC, TEC:INC, TEC:STEP?**

TEC:STEP?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC step size query

Syntax **TEC:STEP?**

Remarks The **TEC:STEP?** query returns the TEC STEP value. This value is used to increment or decrement the selected TEC control mode set point by the given amount, when used with the **TEC:INC** or **TEC:DEC** command.

Response	Description
step size	Step size (1-9999)

The step of 1 corresponds to the smallest incremental change of the mode. For example, a step of 1 means 0.1°C, 1 mA (ITE mode), 1 Ohm (thermistor), 0.01 µA (AD590), 0.1 mV (LM335), or 0.01 Ohm (RTD).

See Also **TEC:STEP**

TEC:T

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC temperature set point command.

Syntax **TEC:T**

Remarks The **TEC:T** command sets the TEC constant temperature set point.

Argument	Description
set point	Set point in °C

See Also **TEC:SET:T?, TEC:T**

TEC:T?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC measured temperature query.

Syntax **TEC:T?**

Remarks The **TEC:T?** query returns the value of the TEC temperature measurement.

Response	Description
measured temp	Measured temperature in °C

This measurement is updated approximately once every 400 milliseconds.

See Also **TEC:T**

TEC:TOLerance

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC tolerance command

Syntax **TEC:TOLerance** *tolerance*, *time*

Remarks The **TEC:TOLerance** command allows the programmer to set the TEC temperature tolerance, and time window for it to occur, in order that the operation complete flag be set after a **TEC:OUTput 1** command is issued or the set point is changed.

Argument	Description
tolerance	tolerance in degrees C (0.1 to 10.0)
time	time window in seconds (.001 to 50.000)

This command may be used in conjunction with the common query ***OPC?** and command ***WAI** to delay further program activities until the TEC temperature reaches its set point.

The controller defaults to a tolerance of 0.2°C for 5 seconds.

In ITE mode, the temperature parameter is not used. A fixed value of 10 mA is used instead of the temperature parameter, and only the time window may be adjusted.

WARNING: If the tolerance is set too tight, the output may never reach tolerance, and the Operation-Complete flag (see ***OPC**) may never be set.

Examples **TEC:MODE:ITE; TOLer, 10**

Action: the controller's TEC controller is set for ITE mode, and will be in tolerance when the ITE current is within 10 mA for a period of 10.000 seconds.

TEC:MODE:R; TOLer 0.1,2.5

Action: the controller's TEC controller will be in tolerance when the temperature is within 0.1°C for a period of 2.500 seconds.

See Also **TEC:COND?, TEC:EVEnt?, TEC:STB?, TEC:TOLerance?**

TEC:TOLerance?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC tolerance query

Syntax **TEC:TOLerance?**

Remarks The **TEC:TOLerance?** query returns the TEC temperature tolerance setting.

Response	Description
tolerance	tolerance in degrees C (0.1 to 10.0)
time	time window in seconds (.001 to 50.000)

The TEC tolerance specification is also used in the TEC event status and condition registers, and so entering or exiting TEC temperature tolerance may be used to generate service requests.

See Also **TEC:TOLerance**

TEC:V?

3150	3040	5000	6000	8000	8008	9000
✓	✓		✓	✓	✓	✓

Description TEC voltage query

Syntax **TEC:V?**

Remarks The **TEC:V?** query returns the TEC voltage.

Response	Description
voltage	TEC voltage in volts

This query is not supported on all TECs. See you module or instrument documentation for details.

See Also **TEC:I?**

TERM

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Message terminator command.

Syntax **TERM** *terminator*

Remarks The **TERM** command allows the programmer to select the message terminator type for GPIB and RS-232 messages sent by the controller. <CR> (carriage return), <NL> (new line), and <END> (for GPIB) are allowed.

Argument	Value	GPIB Description	RS232 Description
terminator	0	<CR> <NL> with END	<CR> <NL>
	1	<CR> <NL>	<CR> <NL>
	2	<CR> with END	<CR>
	3	<CR>	<CR>

4	<NL> with END	<NL>
5	<NL>	<NL>
6	END with last byte	no terminator
7	no terminator	no terminator

<CR><NL><^END> (0) is the default type. END means assert EOI line with last byte.

See Also **TERM?**

TERM?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Message terminator query.

Syntax **TERM?**

Remarks The **TERM?** query returns the selected response message terminator.

Response	Value	GPIB Description	RS232 Description
terminator	0	<CR> <NL> with END	<CR> <NL>
	1	<CR> <NL>	<CR> <NL>
	2	<CR> with END	<CR>
	3	<CR>	<CR>
	4	<NL> with END	<NL>
	5	<NL>	<NL>
	6	END with last byte	no terminator
	7	no terminator	no terminator

<CR><NL><^END> (0) is the default type.

See Also **TERM**

TERMINAL

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description RS-232C terminal mode command

Syntax **TERMINAL** *enable*

Remarks The **TERMINAL** command controls whether the RS-232C interface generates prompts and echos characters sent from the computer. See section 1.4.4 for more details.

Argument	Description
0	Disable terminal mode

1	Enable terminal mode

See Also **TERMINAL?**, section 1.4.4

TERMINAL?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description RS-232C terminal mode query

Syntax **TERMINAL?**

Remarks The **TERMINAL?** query returns the enable state of terminal mode.

Response	Description
0	Terminal mode is disabled.
1	Terminal mode is enabled.

See Also **TERMINAL**

TIME?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Time since power on query.

Syntax **TIME?**

Remarks The **TIME?** query returns how much time has passed since the controller was last powered on.

Response	Description
time	In the format of *hh:mm:ss.hh*

See Also **TIMER?**

TIMER?

3150	3040	5000	6000	8000	8008	9000
✓	✓	✓	✓	✓	✓	✓

Description Timer query.

Syntax **TIMER?**

Remarks The **TIMER?** query returns how much time has passed since the last **TIMER?** query was issued.

Response	Description
time	In the format of *hh:mm:ss.hh*

Each time the **TIMER?** query is issued, the timer is reset to 0 and the elapsed time since the last **TIMER?** query is returned.

The timer counter is initially set at power-up, the same as the **TIME?** counter. So the first time the **TIMER?** query is issued its response will be the same as a **TIME?** query's response.

See Also **TIME?**

CHAPTER 3

3. LabVIEW Driver Library

3.1 Introduction

The LabVIEW Driver Library (the Library) contains VISA-compliant sub-VIs for implementing communication with Laser and TEC modules on Newport controllers. The Library also contains Laser and TEC front panel VIs as examples of how to use the Library.

3.1.1 Terms

Library In the context of this document, this refers to the LabVIEW Driver Library

Sub-VI A Sub-VI in the context of the LabVIEW Driver Library is a device driver element that performs usually only a single task such as setting the current set point or reading back a voltage.

Command A Sub-VI that issues a command string to a module such as setting the temperature. The controller does not generate a response.

Query A Sub-VI that issues a command string to a module with a response expected in return, such as getting the current temperature. The sub-VI name for a query always ends with a question mark (?) to indicate it is a query.

3.1.2 Software Requirements

This manual documents version 1.1 of the Library. The Library requires a controller equipped with version 2.0 or later firmware. The firmware version of the controller is displayed during power on initialization.

3.2 Library Overview

The two major groups in the Library are the TEC and Laser sub-VIs. However, there are a few additional sub-VIs that communicate with the controller itself.

3.2.1 Sub-VI Naming Convention

Laser sub-VIs are prefixed with “Laser”, while TEC sub-VIs are prefixed with “TEC”. All VISA-compliant sub-VIs end with the suffix “.visa”. All queries end with a question mark followed by the “.visa” suffix.

3.2.2 Modules and Channels

Some controllers, such as the Model 8000, support multiple removable the TEC controllers, and because of this, TEC controllers are referred to generically as TEC modules throughout this document. On other units, such as the integral TEC controller of the Model 6000, therefore, is referred to as a “module,” although it is not a removable module.

In addition, the concept of “module addressing” does not always apply to the controller, as it has may only have a single laser module and/or a single TEC controller. However, some units can be configured with multi-channel modules, such as when a MOPA laser module is installed in a Model 6000, and therefore do require an understanding of module addressing. If your unit is a single channel controller, you can skip the sections dealing with module addressing.

3.2.3 Module Addressing

When working with multiple modules on modular controllers such as the Model 8000 and 8008, or multi-channel modules on a Model 6000, care must be taken to ensure the correct channel is selected on the controller. The controller maintains a “selected” Laser and TEC channel, and all Laser and TEC commands are directed at this selected channel. On startup, for example, if a system had a single TEC in slot 1 and 2 and a single Laser in slot 3, the selected Laser would be channel 3, while the selected TEC would be channel 1. All commands for the TEC would act on channel 1, likewise channel 3 for the Laser. Therefore, in a control system working with multiple channels simultaneously, care must be taken to ensure that the command issued by the VI is directed at the correct channel.

The **Laser Channel.visa** and **TEC Channel.visa** sub-VIs are used to change the Laser and TEC channels, respectively.

3.3 Using the Library

The first step in using the Library is to construct a VISA instrument handle and an error cluster. As part of your VI setup, a call to **Initialize.visa** is necessary to prepare the unit for LabVIEW control. After this call, any driver element can be called. Each element is a self-contained unit and does not depend on the execution of any other unit to function properly.

3.3.1 GPIB Traffic Reduction

Because LabVIEW variables, such as a current set point, can be updated at any time, the programmer has to choose between two methods of updating instrument values based on these variables changes.

The first is to always send a GPIB command each loop with the current value, even if the value has not changed. This is obviously much easier because no checking needs to be done to test for changes. The drawback with this method is both the GPIB bus and the instrument are saturated with unnecessary communication.

The second method is to maintain a hidden variable for each user changeable variable, and each loop compare the two and send a new value to the instrument is they're different. This approach eliminates the unnecessary communications, but places additional burden on the programmer by requiring additional comparison logic and case structures around all writes to the instrument.

In order to help the programmer in implementing this second approach, Library sub-VIs that write to the controller use "previous" pins, one for each "normal" input to the sub-VI. These previous pins are used by the sub-VI to determine if a new value should be sent to the controller over the GPIB bus. By using these previous value inputs, the comparison logic that would otherwise be placed in the main VI is handled by the sub-VI. However, these pins do not need to be used, and if left unwired then the corresponding value will unconditionally be sent to the controller.

3.3.2 Parallel Tasking Issues Involving Queries

Special care must be taking when using queries. When a query sub-VI executes, it will wait for a response from the controller before returning. Because of the way LabVIEW operates, it is possible for two different loops to generate a query at the same time and get the response data crossed on the return. For example, consider two while loops, separate from each other, one getting the temperature, the other getting the current. If both loops simultaneously generate their queries, when the controller responds, the temperature data could go to the current query and vice-versa. This due to the nature of LabVIEW's parallel processing/data flow architecture. Therefore, it's recommended that all query commands be placed within a single sequence structure, encapsulated by a while loop if repetitive queries are needed. This way, all queries are done sequentially and cannot overlap each other.

3.4 The Sample VIs

The Library comes with two front panel VIs entitled **Laser Front Panel using VISA.vi** and **TEC Front Panel using VISA.vi**. These are located at the open of the Library listing. All sub-VIs are then listed below.

Because of the similarity of the two sample VIs, only the Laser VI will be discussed here.

There are three main loops in the VI: Preliminary Setup, Master Control Loop, and Read back Loop. Below the Read back Loop is another simple loop whose job is merely to return the controller to local control when the VI stops running.

3.4.1 Variables

Here is a brief description of the not so obvious variable definitions used in the VI:

Get Current Values When this value is 0, the master control loop is running normally. When this is set to 1, the master control loop is suspended, and the read back loop kicks in to query the new channel for limits, set points, etc. At the end of this set of queries, **Get Current Values** is set to 2 to indicate the process is finished, and then it is quickly rolled back to 0 to allow the master control loop to resume execution.

Run A Boolean that controls the run state of the VI. The run switch on the front panel is connected to this variable, as is the error status Boolean.

Mode The operating mode of the Laser (Iop CW=0, Iop LoBW=1, Iop HiBW=2, Im=3, Po=4).

3.4.2 Preliminary Setup

The sequence is used to initialize necessary VI variables to a known startup state, get the instrument’s GPIB address, initialize the library, and query for the equipment list. Two important things happen in this case: the instrument is initialized, and the first laser channel is selected. Notice that the VI will stop running if there is no laser modules installed in the system.

3.4.3 Master Control Loop

This is the command control loop for sending updated set point values to the controller. Current, power, limits, etc., are updated inside of this loop. The use of the sequence structure for processing update values is merely to conserve screen space. These frames could have just as easily been placed in a single while loop.

As was discussed in section 3.3.1, the Master Control Loop uses the previous pins in each of the frames of the sequence structure where writes to the controller are performed. Notice the use of while loop structures to maintain the previous value: by leaving the *conditional terminal* unwired, the while loop will execute only once, and the shift register will hold the value until next execution of the while loop, where it can be compared with a “new” value. Note that shift registers are initialized to zero prior to the first execution, so if the value being checked if anything but zero, it will cause an unnecessary write to the 8000, but only on the first loop. Every loop after will have the shift register initialized to the previous value.

The sequence structure is wrapped by a case statement, which is then wrapped by a while loop. The purpose of these wrappings is to update the controller set points once, then check if **Get Channel Values** is zero, which means continue running. **Get Channel Values** is set in the last frame of the sequence structure to allow all set point frames to execute before frame 0 of the Read back Loop (see below) begins executing. Once **Get Channel Values** goes to 1, frame 0 of the Read back Loop starts, and the Master Control Loop and this frame of the Read back Loop cannot overlap.

3.4.4 Read back Loop

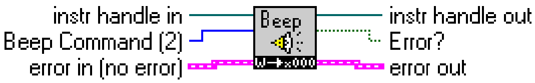
The Read back Loop executes in parallel with the Master Control Loop, except frame 0, which only executes when **Get Channel Values** is 1 (which also pauses execution of the Master Control Loop). This is to stop the reading of set point values interfering with the writing of set point values. Frame 0 is used to read the set point values from the controller. All frames after frame 0 are for reading the dynamic values of the controller such as voltage, current, and temperature.

3.5 VISA Library

Each Sub-VI is documented below. The input and output for most Sub-VIs include a **instr handle in**, **instr handle out**, **error in**, and **error out**. The definition of these elements can be found in the LabVIEW documentation, and are assumed in each Sub-VI description. Most Sub-VIs operate the same are their GPIB Equivalent statement, which is listed for each Sub-VI, and are not documented here. Documentation for those can be found in the main manual under their respective GPIB command. Differences in operation, if any, from the GPIB statement are noted in each description.

See section 3.3.1 for a discussion of the “Previous” inputs.

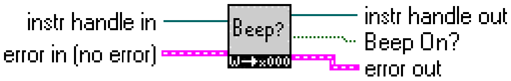
Beep.visa



Description Sets the beep mode.

GPIB Equiv. **BEEP**

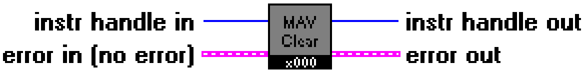
Beep?.visa



Description Queries the current beep mode.

GPIB Equiv. **BEEP?**

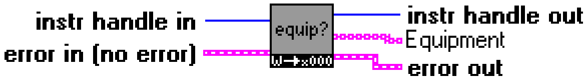
Clear Message Queue.visa



Description Clears the controller output message queue of any pending messages. Used primarily in preparation for a query command.

GPIB Equiv. **None**

Equip?.visa

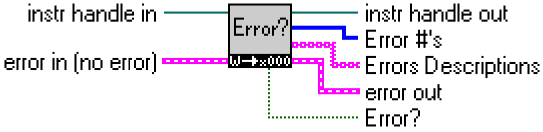


Description Clears the controller output message queue of any pending messages. Used primarily in preparation for a query command.

Outputs **Equipment** An array of 9 strings. Element 0 will be the controller number (i.e. "8000" for the Model 8000 and "6000" for the Model 6000, etc.), while the remaining 8 (Model 8008), or 4 (Model 8000), or 2 (Model 6000) strings are module Ids for each respective module in the controller. If a slot is empty, the corresponding string element will be a zero length string.

GPIB Equiv. **EQUIPment?**

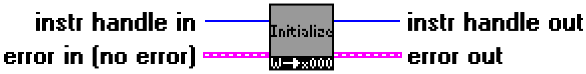
Errors?.visa



Description Returns two arrays, one error numbers and the second error descriptions.

GPIB Equiv. **ERRors?**

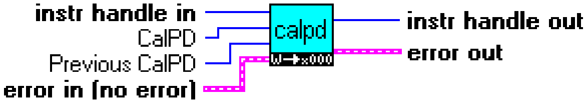
Initialize.visa



Description Prepares the controller for remote control.

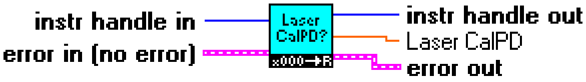
GPIB Equiv. **None**

Laser CalPD.visa



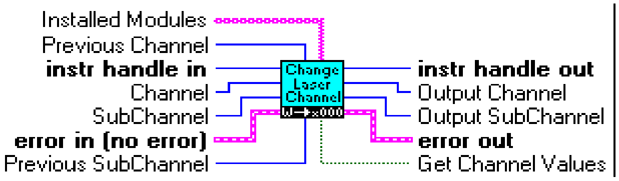
GPIB Equiv. **LASer:CALPD**

Laser CalPD?.visa



GPIB Equiv. **LASer:CALPD?**

Laser Change Channel.visa



Description Similar to **Laser Channel.visa**, but does a verification that the selected channel is a valid laser channel. If the channel is valid, then the outputs will be the new channel, otherwise they will be the previous values.

Inputs

Installed Modules An array of strings describing the installed modules. Same as the array returned from **Equip?.visa**

Channel Channel to change to.

Previous Channel Previous laser channel.

SubChannel SubChannel to change to.

Previous SubChannel Previous SubChannel.

Outputs

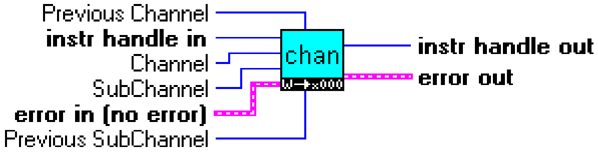
Output Channel Output channel. Will be equal to **Channel** if **Channel** and **SubChannel** is a valid laser channel. Otherwise will be **Previous Channel**.

Output SubChannel Output SubChannel. Will be equal to **SubChannel** if **Channel** and **SubChannel** is a valid laser channel. Otherwise will be **Previous SubChannel**.

Get Channel Values Will be true if **Output Channel** or **Output SubChannel** are different from **Channel** or **SubChannel**.

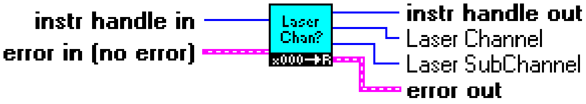
GPIB Equiv. **LASer:CHANnel**

Laser Channel.visa



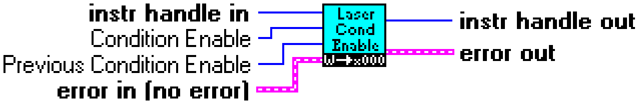
GPIB Equiv. **LASer:CHANnel**

Laser Channel?.visa



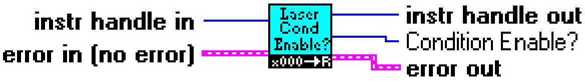
GPIB Equiv. **LASer:CHANnel?**

Laser Condition Enable.visa



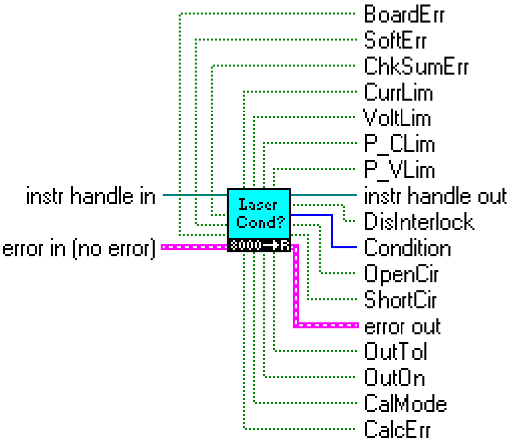
GPIB Equiv. **LASer:ENABle:COND**

Laser Condition Enable?.visa



GPIB Equiv. **LASer:ENABle:COND?**

Laser Condition?.visa

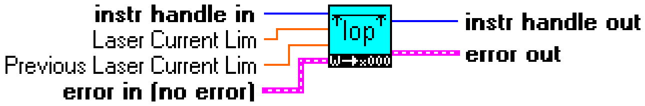


Description Returns the condition register of the controller.

Outputs Condition register, and individual T/F conditions for all the flags in the register.

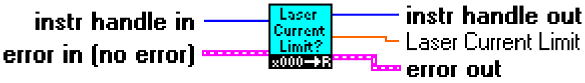
GPIB Equiv. **LASer:COND?**

Laser Current Limit.visa



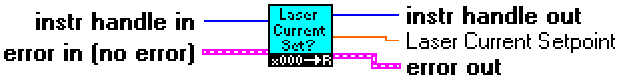
GPIB Equiv. LASer:LIMit:I

Laser Current Limit?.visa



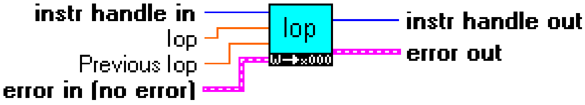
GPIB Equiv. LASer:LIMit:I?

Laser Current Set?.visa



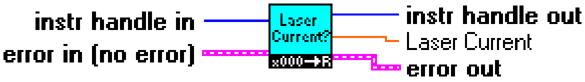
GPIB Equiv. LASer:SET:I?

Laser Current.visa



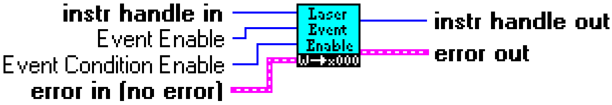
GPIB Equiv. LASer:I

Laser Current?.visa



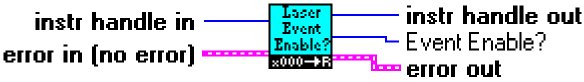
GPIB Equiv. LASer:I?

Laser Event Enable.visa



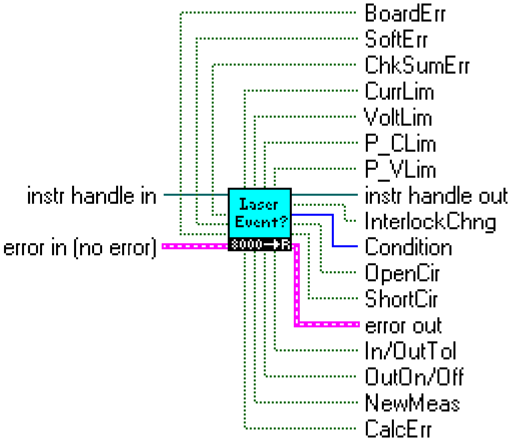
GPIB Equiv. LASer:ENABle:EVEnt

Laser Event Enable?.visa



GPIB Equiv. LASer:ENABle:EVEnt?

Laser Event?.visa

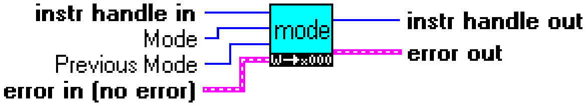


Description Returns the event register of the controller.

Outputs Event register, and individual T/F events for all the flags in the register.

GPIB Equiv. **LASer:EVEnt?**

Laser Mode.visa



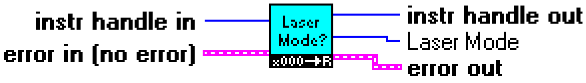
Inputs **Mode, Previous Mode**

Laser mode expressed as a number.

0	Iop CW
1	Iop Low Bandwidth
2	Iop High Bandwidth
3	Photodiode Current (Im)
4	Photodiode Power (Po)

GPIB Equiv. **LASer:MODE:I, LASer:MODE:ILBW, LASer:MODE:IHBW, LASer:MODE:MDI, LASer:MODE:MDP**

Laser Mode?.visa



Outputs **Laser Mode**

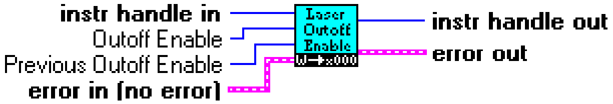
Laser mode expressed as a number.

0	Iop CW
1	Iop Low Bandwidth
2	Iop High Bandwidth

3	Photodiode Current (Im)
4	Photodiode Power (Po)

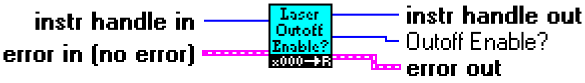
GPIB Equiv. **LASer:MODE?**

Laser Outoff Enable.visa



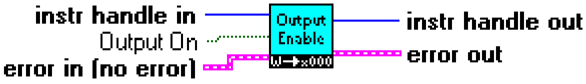
GPIB Equiv. **LASer:ENABle:OUTOFF**

Laser Outoff Enable?.visa



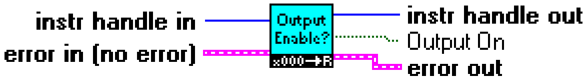
GPIB Equiv. **LASer:ENABle:OUTOFF?**

Laser Output Enable.visa



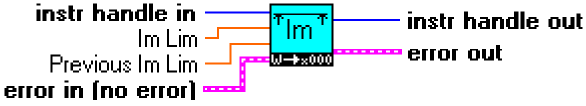
GPIB Equiv. **LASer:OUTPUT**

Laser Output Enable?.visa



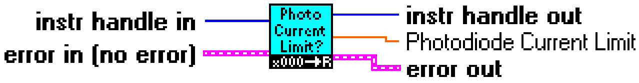
GPIB Equiv. **LASer:OUTPUT?**

Laser Photodiode Current Limit.visa



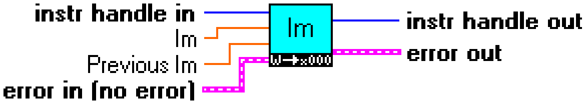
GPIB Equiv. **LASer:LIMit:MDI**

Laser Photodiode Current Limit?.visa



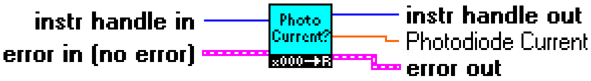
GPIB Equiv. **LASer:LIMit:MDI**

Laser Photodiode Current.visa



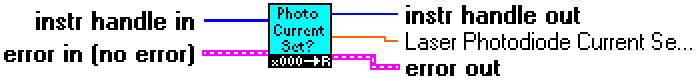
GPIB Equiv. **LASer:MDI**

Laser Photodiode Current?.visa



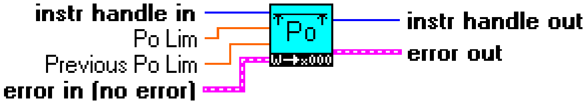
GPIB Equiv. **LASer:MDI?**

Laser Photodiode Current Set?.visa



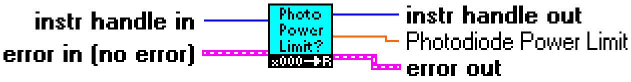
GPIB Equiv. **LASer:SET:MDI?**

Laser Photodiode Power Limit.visa



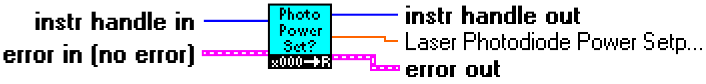
GPIB Equiv. **LASer:LIMit:MDP**

Laser Photodiode Power Limit?.visa



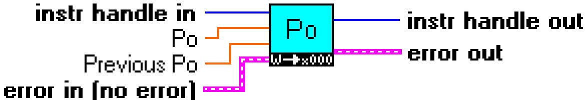
GPIB Equiv. **LASer:LIMit:MDP?**

Laser Photodiode Power Set?.visa



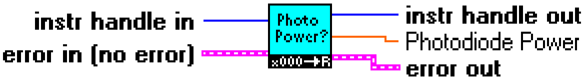
GPIB Equiv. **LASer:SET:MDP?**

Laser Photodiode Power.visa



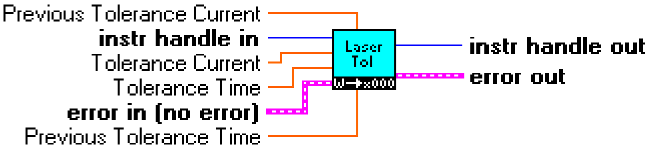
GPIB Equiv. **LASer:MDP**

Laser Photodiode Power?.visa



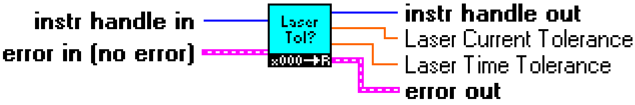
GPIB Equiv. **LASer:MDP?**

Laser Tolerance.visa



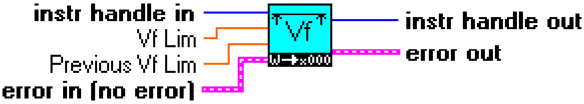
GPIB Equiv. **LASer:TOLerance**

Laser Tolerance?.visa



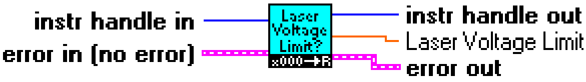
GPIB Equiv. **LASer:TOLerance?**

Laser Voltage Limit.visa



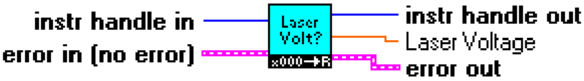
GPIB Equiv. **LASer:LIMit:LDV**

Laser Voltage Limit?.visa



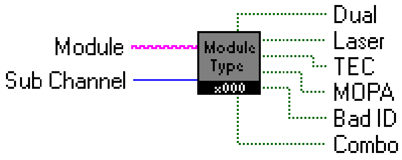
GPIB Equiv. **LASer:LIMit:LDV?**

Laser Voltage?.visa



GPIB Equiv. **LASer:LDV?**

Module Type?.vi



Description When passed in a module ID string and SubChannel specifier, returns the type of module as a boolean value.

Inputs

Module A string like one of those returned by **Equip?.visa**

Sub Channel The SubChannel index.

Outputs

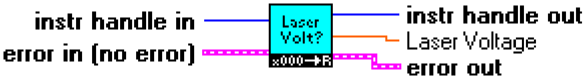
Laser, TEC, MOPA Media type

Dual, Combo Card type

Bad ID TRUE if **Module** is n invalid module ID

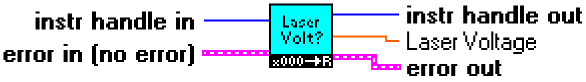
GPIB Equiv. **None**

OnDelay.visa



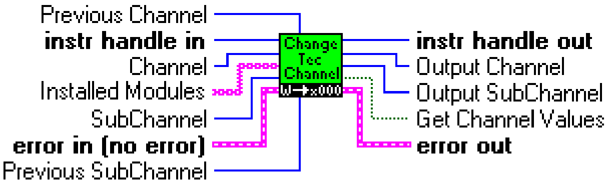
GPIB Equiv. **ONDELAY**

OnDelay?.visa



GPIB Equiv. **ONDELAY?**

TEC Change Channel.visa



Description Similar to **TEC Channel.visa**, but does a verification that the selected channel is a valid TEC channel. If the channel is valid, then the outputs will be the new channel, otherwise they will be the previous values.

Inputs

Installed Modules An array of strings describing the installed modules. Same as the array returned from **Equip?.visa**

Channel Channel to change to.
Previous Channel Previous TEC channel.
SubChannel SubChannel to change to.
Previous SubChannel Previous SubChannel.

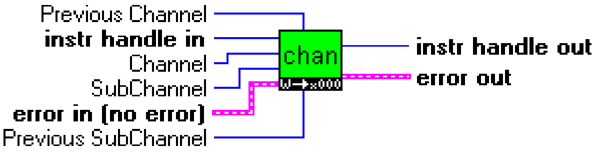
Outputs **Output Channel** Output channel. Will be equal to **Channel** if **Channel** and **SubChannel** is a valid TEC channel. Otherwise will be **Previous Channel**.

Output SubChannel Output SubChannel. Will be equal to **SubChannel** if **Channel** and **SubChannel** is a valid TEC channel. Otherwise will be **Previous SubChannel**.

Get Channel Values Will be true if **Output Channel** or **Output SubChannel** are different from **Channel** or **SubChannel**.

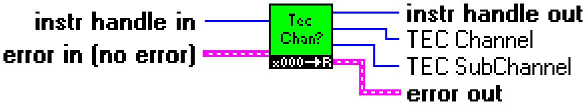
GPIB Equiv. **None**

TEC Channel.visa



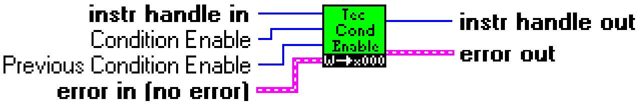
GPIB Equiv. **TEC:CHANnel**

TEC Channel?.visa



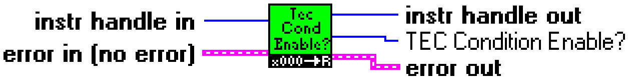
GPIB Equiv. **TEC:CHANnel?**

TEC Condition Enable.visa



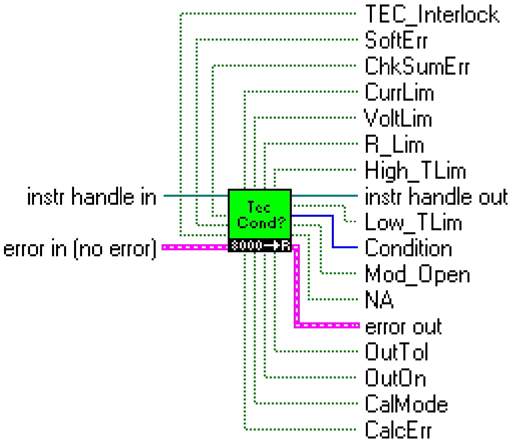
GPIB Equiv. **TEC:ENABle:COND**

TEC Condition Enable?.visa



GPIB Equiv. **TEC:ENABle:COND?**

TEC Condition?.visa

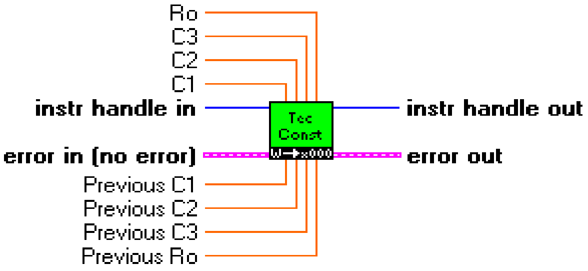


Description Returns the condition register of the controller.

Outputs Condition register, and individual T/F conditions for all the flags in the register.

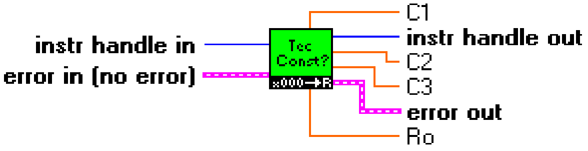
GPIB Equiv. **TEC:COND?**

TEC Const.visa



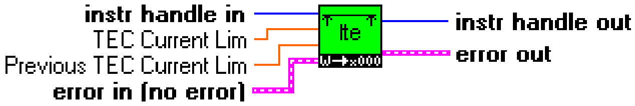
GPIB Equiv. **TEC:CONST**

TEC Const?.visa



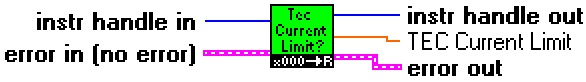
GPIB Equiv. **TEC:CONST?**

TEC Current Limit.visa



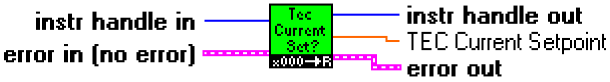
GPIB Equiv. **TEC:LIMit:ITE**

TEC Current Limit?.visa



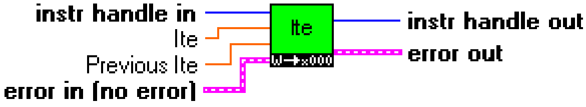
GPIB Equiv. **TEC:LIMit:ITE?**

TEC Current Set?.visa



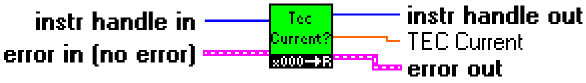
GPIB Equiv. **TEC:SET:ITE?**

TEC Current.visa



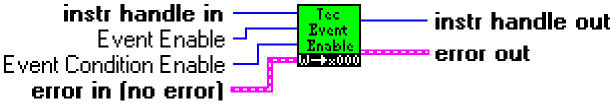
GPIB Equiv. **TEC:ITE**

TEC Current?.visa



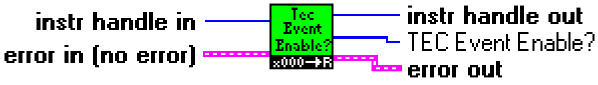
GPIB Equiv. **TEC:ITE?**

TEC Event Enable.visa



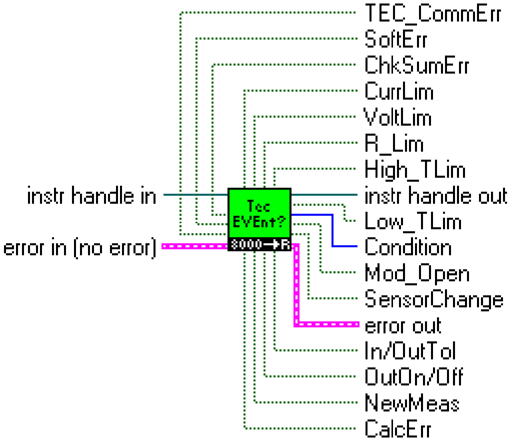
GPIB Equiv. **TEC:ENABle:EVEnt**

TEC Event Enable?.visa



GPIB Equiv. **TEC:ENABle:EVEnt?**

TEC Event?.visa

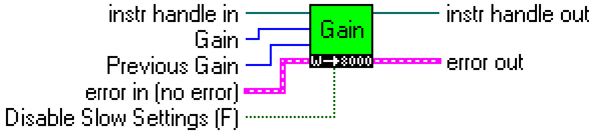


Description Returns the event register of the controller.

Outputs Event register, and individual T/F events for all the flags in the register.

GPIB Equiv. **TEC:EVEnt?**

TEC Gain.visa



Inputs **Gain, Previous Gain, Disable Slow Settings**

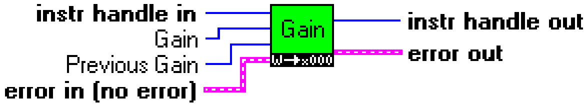
TEC gain expressed as a number.

0	Gain of 0.2 Slow
1	Gain of 0.6 Slow
2	Gain of 1 Slow
3	Gain of 1 Fast
4	Gain of 2 Slow
5	Gain of 3 Fast
6	Gain of 5 Fast
7	Gain of 6 Slow
8	Gain of 10 Slow
9	Gain of 10 Fast
10	Gain of 20 Slow
11	Gain of 30 Fast
12	Gain of 50 Fast
13	Gain of 60 Slow
14	Gain of 100 Fast
15	Gain of 300 Fast

If slow settings are disabled, the vi with round up to the next fast setting. (Not all temperature controllers support slow settings.)

GPIB Equiv. **TEC:GAIN**

TEC Gain?.visa



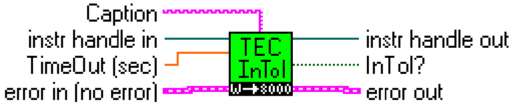
Outputs **TEC Gain**

TEC gain expressed as a number.

0	Gain of 0.2 Slow
1	Gain of 0.6 Slow
2	Gain of 1 Slow
3	Gain of 1 Fast
4	Gain of 2 Slow
5	Gain of 3 Fast
6	Gain of 5 Fast
7	Gain of 6 Slow
8	Gain of 10 Slow
9	Gain of 10 Fast
10	Gain of 20 Slow
11	Gain of 30 Fast
12	Gain of 50 Fast
13	Gain of 60 Slow
14	Gain of 100 Fast
15	Gain of 300 Fast

GPIB Equiv. **TEC:GAIN?**

TEC InTolerance.visa



Inputs **Caption, TimeOut**

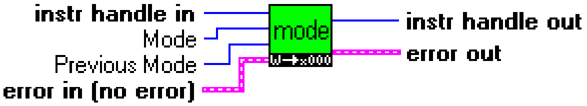
Caption – Shown while settling.

TimeOut – Maximum time allowed to settle.

This vi will display it's front panel and display the current temperature while waiting for the controller to come into tolerance. The caption is displayed as a title for the panel.

GPIB Equiv. **None**

TEC Mode.visa

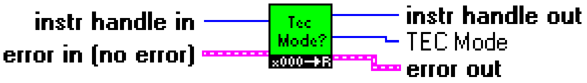


Inputs **Mode, Previous Mode** TEC mode expressed as a number.

0	Constant I_{TE}
1	Constant R
2	Constant T

GPIB Equiv. **TEC:MODE:ITE, TEC:MODE:R, TEC:MODE:T**

TEC Mode?.visa

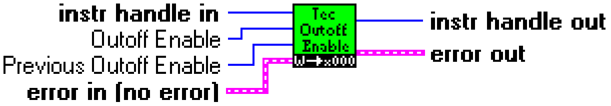


Outputs **TEC Mode** TEC mode expressed as a number.

0	Constant I_{TE}
1	Constant R
2	Constant T

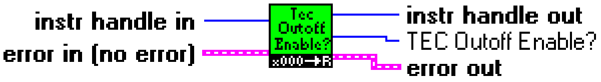
GPIB Equiv. **TEC:MODE?**

TEC Outoff Enable.visa



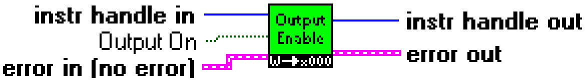
GPIB Equiv. **TEC:ENABle:OUTOFF**

TEC Outoff Enable?.visa



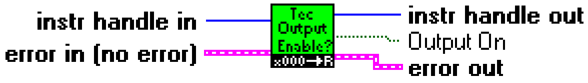
GPIB Equiv. **TEC:ENABle:OUTOFF?**

TEC Output Enable.visa



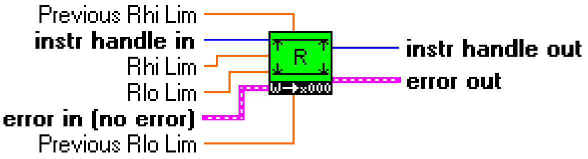
GPIB Equiv. **TEC:OUTput**

TEC Output Enable?.visa



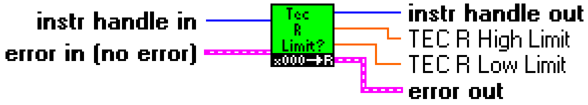
GPIB Equiv. TEC:OUTput?

TEC R Limit.visa



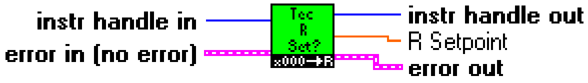
GPIB Equiv. TEC:LIMit:RHI, TEC:LIMit:RLO

TEC R Limit?.visa



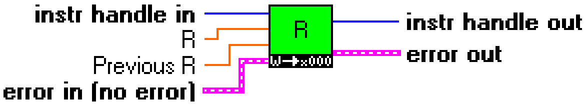
GPIB Equiv. TEC:LIMit:RHI, TEC:LIMit:RLO?

TEC R Set?.visa



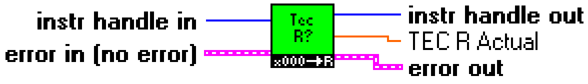
GPIB Equiv. TEC:SET:R?

TEC R.visa



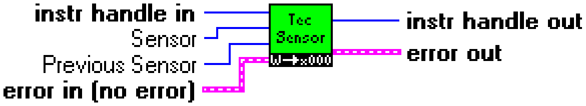
GPIB Equiv. TEC:R

TEC R?.visa



GPIB Equiv. TEC:R?

TEC Sensor.visa

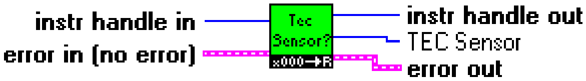


Inputs **Sensor, Previous Sensor** TEC sensor expressed as a number.

1	100 µA Thermistor
2	10 µA Thermistor
3	LM335
4	AD590
5	RTD

GPIB Equiv. **TEC:SENsor**

TEC Sensor?.visa

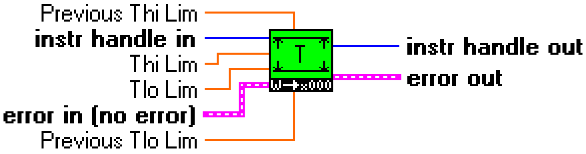


Outputs **TEC Sensor** TEC sensor expressed as a number.

1	100 µA Thermistor
2	10 µA Thermistor
3	LM335
4	AD590
5	RTD

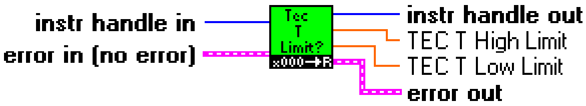
GPIB Equiv. **TEC:SENsor?**

TEC T Limit.visa



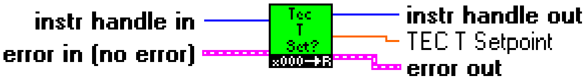
GPIB Equiv. **TEC:LIMit:THI, TEC:LIMit:TLO**

TEC T Limit?.visa



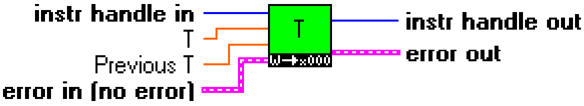
GPIB Equiv. **TEC:LIMit:THI?, TEC:LIMit:TLO?**

TEC T Set?.visa



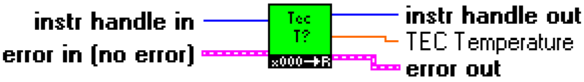
GPIB Equiv. **TEC:SET:T?**

TEC T.visa



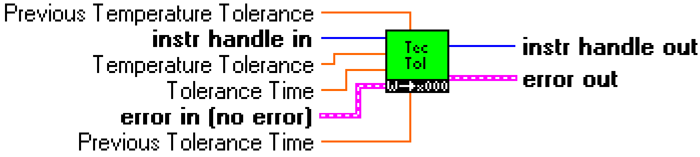
GPIB Equiv. **TEC:T**

TEC T?.visa



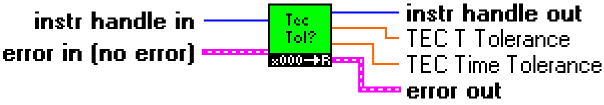
GPIB Equiv. **TEC:T?**

TEC Tolerance.visa



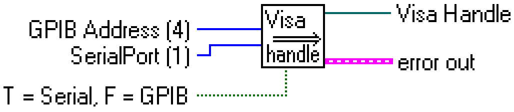
GPIB Equiv. **TEC:TOLerance**

TEC Tolerance?.visa



GPIB Equiv. **TEC:TOLerance?**

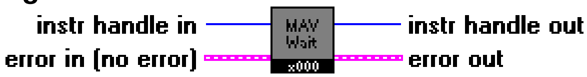
VisaInit.vi



Description Sets up a visa handle for either GPIB or serial.

GPIB Equiv. **None**

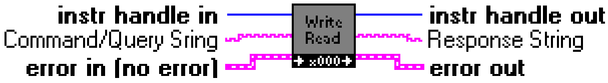
Wait For Message.visa



Description Waits for the message available (MAV) bit on the controller to go true.

GPIB Equiv. **None**

Write then Read.visa



Description A combo VI that handles clearing the controller message queue, writes the query string to the controller then wait for the controller to reply and returns the reply back to the calling VI.

Inputs **Command/Query String** A controller GPIB command/query

Outputs **Response String** The response string returned from the controller.

GPIB Equiv. **None**

CHAPTER 4

4. Tips and Techniques

4.1 GPIB Registers

The GPIB registers offer a significant amount of information in summary fashion. For example, high or low temperature limit conditions can be detected by simply looking at a bit of information without needs to query the instrument for the temperature limits and actual temperature. In addition, conditions can be detected through the event registers that would otherwise be difficult to detect with a polling method. Before reading further into this section, bookmark the status reporting diagram on page 7 for easy reference.

GPIB registers can be grouped into two types of registers: event registers and condition registers.

Condition Registers

Condition registers reflect the state of the instrument at the time the register is read. For example, if the laser condition register is read and indicates the laser is current limiting, then it is current limiting at the point in time that the condition register is read. If the laser stops limiting, then a read of the condition register will no longer indicate a current limit condition.

Condition registers include the laser and TEC condition registers, the Status Byte Register (*STB), and the ist bit (*IST).

Event Registers

Event registers, by comparison, “remember” conditions until they are read, at which point they are reset to zero until the next condition is “remembered”. For example, if the laser event register is read and indicates a current limit, this means the laser was current limiting sometime since the last time the event register was read, but is not necessarily limiting at the time at which the register was read. The event register could be considered a “latched” version on the condition register, where a condition is latched on when the condition first occurs but does not clear when the condition goes away. The register is only cleared when it is read by the user, or the clear command (*CLS) is sent.

Event registers include the laser and TEC event registers and the Standard Event Status Register (*ESR).

Enabling Condition and Event Registers

The information stored these condition and event registers can be summarized in the Status Byte Register and the ist bit for quick detection of conditions or events that should be handled by the controlling program. Each register has corresponding enable register that allows the information summarized in the register to be further summarized and stored in the Status Byte Register as a single summary bit. The Status Byte Register can be further summarized into the ist bit and generate a service request (GPIB interface only).

Enable registers include the laser and TEC event enable registers, the laser and TEC condition enable registers, the Standard Event Status Enable Register, the Service Request Enable Register, and the Parallel Poll Enable Register.

Laser and TEC event and condition registers

The laser and TEC event and condition registers deserve a bit more explaining. As you can see from the status reporting diagram, each of these registers flows into a block that is labeled “Logical OR” with the title above it “(Channels logically ORed)”. What this means is that each channel has an independent enable register, allowing different conditions and events to be monitored for each channel. The result of each channel’s condition and event summary bit is ORed with other channels of the same type to generate a resulting summary bit for all channels. For example, in a system with four laser modules, each laser channel can have a different condition enable register, but the LASER Condition Summary bit in the Status Byte Register is the summary of all four channels, so if any of the four channels results in a true summary for its condition, the LASER Condition Summary bit would be set in the Status Byte Register.

The Standard Event Status Register (ESR)

The ESR is a summary of the non-module specific information, such as summarizing categories of errors, the operation complete bit, and the GPIB parser idle.

The Status Byte Register (STB)

The Status Byte Register is the master summary byte. The summary bits for the various event and condition registers are fed into this register. Because the STB is a condition register, each bit of the STB is only cleared once the respective bit is cleared at it's source. For example, the Error Available bit will only clear after the error queue has been read. The Master Status Summary bit is a summary of all the other bits in the STB.

GPIB Register Example

Consider a system that has a laser in slot 1. The operator wants to be notified by a service request whenever the laser if turned off or turned on. In this example, we will assume that this is the only thing that should generate a SRQ. To implement this, the following commands would be sent to the Model controller:

```
LASER:CHAN 1
LASER:ENABLE:EVENT 256
*SRE 4
```

The first command selects the laser in slot 1. The second command enabled the Output Status Changed in the LASER Event Enable Register. Finally, the last command enables the LASER Event Summary to generate SRQ. When a SRQ is generated, the controlling program must read the laser's event register with a LASER:EVENT? Query to clear the Output Status Changed bit, or further SRQs would not be generated. This is because theGPIB interface will generate a SRQ on a low to high transition on the master summary bit. If the event register is not read, the master summary bit will remain high, masking additional Output Status Changed events.

4.2 RS-232 Control

The Model controller's RS-232 interface is a flexible, inexpensive interface that can allow a surprisingly sophisticated level of control, nearly that of the GPIB interface.

GPIB vs RS-232

RS-232 does not have the dedicated status reporting lines, such as SRQ and parallel poll lines. RS-232 data throughput is much slower than GPIB, and there is no handshaking between the Model controller and the computer on the other end. There is no buffering of outbound messages on RS-232, they are sent immediately (GPIB buffers messages and only sends them when the controller is ready).

Given these limitations, RS-232 can otherwise function nearly identical to the GPIB interface. Every command that can be sent over the GPIB bus can also be sent over RS-232. As for message buffering, as long as the computer can buffer RS-232 data being received, the responsibility of message buffering is merely moved from the controller to the computer. In other words, the controller will send responses immediately, but the computer can buffer the data until the program needs it.

The only significant limitation, besides speed, is the lack of service request generation. Even this, with little additional load on the controller, can be handled by polling the STB or the ist bit. In the controlling program, use a timer to issue a ***STB?** command every second. By reading bit 7 of the STB register, you can quickly tell if the controller is requesting service. The ist bit would be handled in the same way, using the ***IST?** query to read back the ist bit.

Terminal Mode

Terminal mode is a special mode that is intended to make the controller easier to work with when the user is typing in commands via a serial terminal interface. The controller echos characters typed by the user, generates a prompt for input, and prefixes the query responses with “Response:” In addition, by using VT-100/ANSI terminal codes, the controller can maintain a cleaner presentation of data. When controlling the controller from a software program, terminal mode should be turned off to eliminate corruption of the controlling software’s input buffer.

Every response ends with a “K”!

If you are using terminal mode, and your response messages are all ending with a capitol K, you do not have the proper terminal emulation setup. Terminal mode requires an ANSI/VT-52/VT-100 compatible terminal. If your serial terminal cannot support one of these modes, then either turn off terminal mode or ignore the ‘K’.

The terminal is receiving only garbage.

Check your baud rate to be sure the terminal and the controller are using the same baud rate.

CHAPTER 5

5. Error Messages

5.1 Introduction

Error messages may appear on the display when error conditions occur in the respective functions of the controller. For example, a current limit error in the TEC module will be displayed.

In remote operation, the current error list can be read by issuing the "ERR?" query. When this is done, a string will be returned containing all of the error messages which are currently in the error message queue.

The errors codes are numerically divided into areas of operation as shown below.

Error Code Range	Area of Operation
E-001 to E-099	Internal Program Errors
E-100 to E-199	Parser Errors
E-200 to E-299	Execution Control Errors
E-300 to E-399	GPIB/RS232 Errors
E-400 to E-499	TEC Control Errors
E-500 to E-599	Laser Control Errors

Table 3 contains all of the error messages which may be generated by the controller. Not all of these messages may be displayed. Some refer to GPIB activities only, for example.

Table 3 - Error Codes

Error Code	Explanation
E-001	Memory allocation failure.
E-002	Floating point error
E-101	<program mnemonic> is too long.
E-102	<PROGRAM MESSAGE UNIT> is too long.
E-103	<DEFINITE LENGTH ARBITRARY BLOCK PROGRAM DATA> length too long.
E-104	<NON-DECIMAL NUMERIC PROGRAM DATA> type not defined.
E-105	<DECIMAL PROGRAM DATA> exponent not valid.

Error Code	Explanation
E-106	<DECIMAL PROGRAM DATA> digit expected
E-107	<DECIMAL PROGRAM DATA> digit not expected.
E-108	<DECIMAL PROGRAM DATA> more than one decimal point.
E-109	<DECIMAL PROGRAM DATA> more than exponential indicator (E).
E-110	<SUFFIX PROGRAM DATA> must have digit following sign.
E-111	<SUFFIX PROGRAM DATA> must have character following operator.
E-113	<ARBITRARY BLOCK PROGRAM DATA> less than digit count.
E-114	<DEFINITE LENGTH BLOCK PROGRAM DATA> premature end of data.
E-115	<PLACEHOLDER PROGRAM DATA> identifier not valid.
E-116	Parser syntax error, character was not expected.
E-120	<program mnemonic> Lookup, word as part of a header path, has no commands.
E-121	<program mnemonic> Lookup, word as part of a header path, is not found.
E-122	<program mnemonic> Lookup, cannot find a null entry.
E-123	<program mnemonic> Lookup, word within context of current path, is not found.
E-124	<program mnemonic> Lookup, failed because query/command type match failed.
E-125	<program mnemonic> Lookup, word within context of common command path, is not found.
E-126	Too few or too many program data elements.
E-201	<PROGRAM DATA> value out of range.
E-202	<PROGRAM DATA> will not convert to valid type.
E-203	Security violation, command is not available without clearance.
E-204	<PROGRAM DATA> suffix type is not valid.

Error Code	Explanation
E-205	<PROGRAM DATA> is not a Boolean value or word.
E-206	<PROGRAM DATA> will not convert to a signed 16-byte value.
E-207	<PROGRAM DATA> will not convert to an unsigned 16-byte value.
E-208	<PROGRAM DATA> will not convert to a signed 32-byte value.
E-209	<PROGRAM DATA> will not convert to an unsigned 32-byte value.
E-210	<PROGRAM DATA> will not convert to a floating point value.
E-211	<PROGRAM DATA> will not convert to a character value.
E-212	<PROGRAM DATA> will not convert to a byte array pointer.
E-213	<PROGRAM DATA> is incorrect block data length.
E-214	<PROGRAM DATA> length exceeds maximum.
E-216	Present configuration has changed from last stored configuration.
E-217	Attempted to recall a bin from a unsaved position.
E-301	A <RESPONSE MESSAGE> was ready, but controller failed to read it. (Query error).
E-302	6000 is talker, but controller didn't read entire message.
E-303	Input buffer overflow
E-304	Output buffer overflow
E-305	Parser buffer overflow
E-402	Sensor open disabled output.
E-403	TEC module open disabled output.
E-404	TEC Current limit disabled output.
E-405	TEC Voltage limit disabled output.
E-406	TEC resistance/reference limit disabled output
E-407	TEC high temperature limit disabled output.
E-409	Sensor change disabled output.

Error Code	Explanation
E-410	TEC out of tolerance disabled output.
E-411	TEC control error disabled output.
E-412	Analog section status is all 1's or all 0's (power down).
E-413	Serial EPROM checksum error.
E-415	Sensor short disabled output.
E-416	Incorrect Configuration for Calibration Sequence to start.
E-417	TEC output must be on to begin calibration.
E-418	TEC C1, C2, or C3 constants are bad, all set to default values.
E-431	TEC link condition forced output on
E-432	TEC link condition forced output off
E-433	Attempt to select non-TEC channel for TEC mode.
E-501	Laser interlock disabled output.
E-502	Laser hard current limit disabled output
E-503	Laser open circuit disabled output.
E-504	Laser current limit disabled output.
E-505	Laser voltage limit disabled output.
E-506	Laser photodiode current limit disabled output
E-507	Laser photodiode power limit disabled output.
E-508	TEC link disabled laser.
E-509	Laser short circuit disabled output
E-510	Laser out of tolerance disabled output.
E-511	Laser control error disabled output.
E-512	Analog section status is all 1's or 0's (power down).
E-513	Serial EPROM checksum error.
E-514	Laser mode change disabled output
E-515	Laser bandwidth change disabled output
E-516	Incorrect Configuration for Calibration Sequence to start.
E-517	Calibration for Laser Diode current must have the output on to start.
E-518	Calibration for the Monitor Diode must have the output on and the sensitivity set to zero to start.
E-519	Setting a measurement is only valid during the calibration phase for that measurement. User

Error Code	Explanation
	has tried to calibrate a measurement without first entering the required calibration mode.
E-520	User cannot change the Laser Current set point while operating in a calibration mode for another measurement.
E-531	Laser link condition forced output on
E-532	Laser link condition forced output off
E-533	Attempted to select non-laser channel for laser operation.
E-900	Calculation Error shutdown output
E-901	System over temperature shutdown all outputs
E-902	Front laser enable panel key lock in off position, shutdown all laser outputs
E-903	Loading of a saved bin shutdown module output