T100S-HP

High Power Tunable Laser

Programming Guide

About This Manual

Subject

This manual specifies the remote interfaces of the T100S-HP and the corresponding remote commands.

Application

Information in this document applies to the T100S-HP version 6.07 and later.

Intended Readers

Users of this manual must be familiar with:

- Fiber optic technology
- The RS-232C and/or IEEE-488.1 interfaces used to operate the T100S-HP in remote mode
- The use of the T100S-HP (see *T100S-HP User Manual*)

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Manual Reference

T100SHP_PG_6.07v1.0

Typographical Conventions

bold	Identifies graphical interface objects such as menu names, labels, buttons and icons.
italic	Identifies references to other sections or other guides.
`monospace`	Identifies portions of program codes, command lines, or messages displayed in command windows.
IMPORTANT	Identifies important information to which you must pay particular attention.

Command Syntax Notation Conventions

Notation	Meaning
[...]	The content between square brackets is optional.
<...>	The content between angled brackets indicates the type of information that you must enter as parameter (command) or that is received (response).
|	Indicates an alternative. Equivalent to "or".

Symbols

Identifies conditions or practices that could result in injury or loss of life.

Identifies conditions or practices that could result in damage to the product or other property.

Abbreviations Used & Definitions

Abbreviation	Meaning
CR	carriage return
EOI	End-Or-Identify
GPIB	General Purpose Interface Bus
LF	line feed
LSB	Least Significant Bit
STB	STatus Byte

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Table of Contents

1. Remotely Controlling the T100S-HP

You can remotely control the T100S-HP through the following ports:

- IEEE-488.1 connector
- RS-232C connector

This section explains how to use these ports to remotely control the T100S-HP.

1.1 Switching Between Remote and Local Mode

Procedures

Entering the Remote Mode

- If the T100S-HP receives data from either the RS-232C or the IEEE-488.1 interfaces, it automatically enters the remote control mode and the LED on the **Remote** key is lit to indicate that remote control is active.

  When the T100S-HP is operating in remote mode, all function keys on the front panel are disabled apart from the **Remote** key.

Switching Back to Local Mode

- To go back to local mode, press the **Remote** key or use the `LOCAL` command (RS-232C only, see *p. 35*).

  In GPIB, if the T100S-HP is set to local lockout condition (see commands in section *IEEE Standard Functions, p. 18*), the "Local lockout" message is displayed. This means that the T100S-HP is locked into GPIB remote control operation: all front panel control are disabled and local operating mode can no longer be restored using the **Remote** key.
  To return to local mode, enter the **`Go to local`** GPIB command.

1.2 Remotely Controlling the T100S-HP via IEEE-488.1

Subject

The GPIB is located on the rear panel and is labeled **IEEE 488** (see *T100S-HP User Manual*). It is compatible with the IEEE-488.1 standard.

The standard configuration is composed of a controller device (which is usually a computer equipped with a GPIB interface board and corresponding IEEE-488.1 terminal emulation software) linked to various instruments. The controller manages the flow of information to, from, and between devices. One "talker" device and one or more "listener" devices may be present at any time on the GPIB link. Data sent on the bus is encoded in ASCII strings.

Each instrument on the bus is identified by its own GPIB address. The default T100S-HP GPIB address is 10 but can take any value between 1 and 30 (see section *Setting the GPIB Address, p. 11*).

For each instrument, you can use different control registers to determine the instrument operation state. This section defines such registers and how they can be used to properly remotely control the T100S-HP via IEEE-488.1.

GPIB Capabilities

The following table lists the T100S-HP GPIB capabilities.

Mnemonic	Function
SH1	Complete source handshake
AH1	Complete acceptor handshake
T5	Complete talker
L3	Complete listener
SR1	Complete service request
RL1	Complete remote/local
PP0	No parallel poll
DC1	Complete device clear
DT0	No device trigger
C0	No controller

Table 1: GPIB Interface Capabilities

1.2.1 Checking System Status with the Status Byte

Definition of the Status Byte

The status byte is an 8-bit value that reflects the status of the T100S-HP. It contains a number of binary indicators, which can be used by the computer for optimal synchronization with the T100S-HP product. They indicate to the computer the nature of the current operations as well as the errors encountered.

The only way to read the status byte is to perform an operation called serial polling.

If a condition is in effect, the corresponding binary indicator takes a bit-value of `1` otherwise, the default bit-value is `0`.

Bit Position	Indicator	Meaning
#7 (MSB)	(Bit not used)	Bit 7 is not used.
#6	SRQ (Service ReQuest)	This line is part of the definition of the IEEE-488.1 standard. It can be triggered by any device on the bus. It alerts the central controller that a particular device requests to perform a specific operation. When the controller detects that the SRQ line is active, it can probe all of the devices present on the bus to determine which device has initiated the service request and for what reason. This operation by which the controller reads the status byte of each device is called "serial polling". The controller then monitors the bit-value of each indicator within the status byte. The IEEE-488.1 standard specifies that when a device sends a service request, bit-value #6 is set to `1`. The other bits of the status byte can reflect the state of different logical indicators of the system. • Set to `1` if a service request has been sent by the product. • Set to `0` cleared when the bus controller reads the status register.
#5	ESB	Reserved for future use.
#4	MAV (Message AVailable)	• Set to `1` if a message is placed in the output buffer. This bit remains set to "1" for as long as the output buffer is not polled. • You can to clear the buffers so that any message is flushed (see section *IEEE Standard Functions, p. 18*, function `Clear`)
#3	LIM (Current LIMitation)	• Set to `1` if the T100S-HP has reached its current limit while in APC mode. The bit is only lifted once the current limit is reached. When sending a Power or Current command, this bit is usually set a short delay after the OPC bit is set back to `1`. This is because the laser actively and continuously monitor its current and as it evolves, the limit can be reached. This can happen after the "Power" or "Current" command is considered "completed". • Set to `0` in all other cases.

Bit Position	Indicator	Meaning
#2	ERRV (ERror in Received parameter Value)	• Set to `1` if the value entered as a parameter could not be read, exhibits an invalid format, or is outside the valid range (e.g.: L=15555.000). For example, a parameter value becomes invalid if the parameter unit is provided. • Set to `0` when a correct instruction is received.
#1	ERRC (ERror in Received Command)	• Set to `1` if an invalid command has been received. • Set to `0` if a valid command is received.
#0	OPC (OPeration Complete)	• Set to `1` (Idle) if the execution of the last command is complete; no task is currently performed by the T100S-HP. The T100S-HP is ready to receive new instructions. • Set to `0` when handling commands (and when shifting the drive to modify the wavelength emission). During a wavelength scan operation, the OPC bit-value is `0` each time the motor is moving and `1` during the pause between two successive steps.

Table 2: GPIB – Bit layout in status byte

Synchronization of Messages

To accelerate and secure the exchange of information between the computer and the T100S-HP, use the value of the status byte obtained by serial polling (see section *Definition of the Status Byte, p. 9*).

This status byte contains the information letting the computer know the status of commands received by the T100S-HP, and therefore decides when a new instruction can be sent or when the requested parameter can be read.

Various flags in the status byte register (STB) indicate the outcome of the command last processed and the type of error event, if any.

Message synchronization is essential in the following two cases:

- To ensure that a pending command has been completely executed before proceeding to perform other operations.
  This can be checked through the OPC flag (bit #0 of STB). This flag is set to `0` as long as a command line has not been completely executed, and is set to `1` afterwards. The computer should test this flag until it becomes true, and only then, proceed with the next instruction. In this case the STB byte must be read through a serial poll.
- When a query statement has been sent, the computer must wait until the response is actually available before reading it.
  This is signaled by the MAV flag (bit #4 of the STB). In this case the STB byte must be read through a serial poll. This flag remains false (its bit value is 0) until a complete message is available for reading. Therefore, the computer should constantly check this flag until it becomes true (bit value equal to 1), and only then, the response message associated with the query becomes available.

1.2.2 Setting the GPIB Address

Subject

The default GPIB address of the T100S-HP is factory-set to 10. This section explains how to modify it (possible values are 1 to 30).

Once changed, the new GPIB address is stored in flash memory, and becomes the new default system setting. The T100S-HP retains the new GBIP address even after system turn-off.

To void address conflicts, you must make sure that your T100S-HP GPIB address is different from the address of any other device already connected to the GPIB port.

Procedure

Setting the GPIB Address from the Front Panel

1. Press the **2nd** + **Remote** keys.

   The current GPIB address is displayed as the display prompts you to enter the new value at the numeric keypad.
2. Enter the new GPIB address, in the range of 1 to 30.
3. Press **Enter** to confirm the change.

   The **DATA** area display prompts you to activate/deactivate the RS-232C remote mode.
4. Press **Esc**.

Setting the GPIB Address in Remote Mode

Use the command: `GPAD=xx` (see section *GPAD, p. 35*).

1.2.3 Connecting the T100S-HP to an IEEE-488.1 Controller

Subject

The GPIB port enables you to connect the T100S-HP to a computer to control it via remote commands.

Before Starting

Make sure you have a GPIB cable to link the T100S-HP to an IEEE-488.1 controller (GPIB PCI card or GPIB-USB-HS from National Instrument) connected to your computer.

Procedure

1. Connect the GPIB port of the T100S-HP to the IEEE-488.1 controller connected to your computer via the GPIB cable.
2. Use the authorized remote GPIB commands detailed in the present guide to remotely control the T100S-HP.

1.3 Remotely Controlling the T100S-HP via RS-232C

1.3.1 Turning On/Off the RS-232C Remote Control Mode

Subject

The following procedure explains how to activate/deactivate the RS-232C remote control mode.

Procedure

1. Press the **2nd** + **Remote** keys.

   The current GPIB address is displayed as the display prompts you to enter a new value at the numeric keypad.

2. Press **Enter** to confirm the GPIB address.

   You reach the status of the RS-232C remote control mode.

3. Specify the mode status on the numeric keypad:

   - To turn off the RS-232C mode: press **0**
     This breaks the cable connection to the remote computer.
   - To turn on the RS-232C mode: press **1**

4. Press **Enter** to confirm the change.

   When the **Remote** key LED is lit, all front panel manual commands are rerouted to the remote computer via the RS-232C interface. In addition, the user interface specific commands are also available in remote mode.

5. To exit the Remote mode without breaking the cable connection to the remote computer, press the **Remote** key.

1.3.2 Connecting a Remote Controller

Before Starting

- Make sure you have the appropriate RS-232C cable (crossover, three-wire RS-232C type):
  The RS-232C cable connection must meet the following pin assignment on the T100S-HP SubD-9 connector:
  - Pin 2: RX (data received by T100S-HP on pin 2)
  - Pin 3: TX (messages sent out by T100S-HP via pin 3)
  - Pin 5: GND (the ground is through pin 5)

  No other connector-pin is used. The following table shows how to connect the T100S-HP system (DCE) to your PC (DTE):

Digital Communications Equipment (DCE)		Digital Terminal Equipment (DTE)
1 o		o 1
(RXD) 2 o		**o 2**
(TXD) 3 o		**o 3**
4 o		o 4
(GND) 5 o		**o 5**
6 o		o 6
7 o		o 7
8 o		o 8
9 o		o 9

- Activate the RS-232C remote control mode (see section *Turning On/Off the RS-232C Remote Control Mode, p. 12*).

Procedure

1. Connect a PC equipped with a terminal emulation program to the RS-232C port on the rear panel of the T100S-HP using the appropriate RS-232C cable.
2. Configure the computer's terminal emulation program with the following parameters:
   - Data transmission rate: 9600 bauds
   - Number of bits: 8
   - Parity: None
   - Stop bits: 1

1.4 Format of Messages

Communication Overview

Command Message Ending

A command message must end with one of the following:

- RS-232C: CR (or ASCII code 13 character)
- IEEE-488.1: LF (or ASCII code 10 character) or EOI message

Response Message

- **RS-232C**

  When the T100S-HP receives an instruction, the character string is decoded and the relevant procedure is carried out.

  After completion, the T100S-HP returns a message to inform the computer that the requested procedure has been performed (`OK` statement) or that an error event has occurred (see section *Error Handling, p. 15*).

  This response message always ends with the same end-of-message group, indicating that the T100S-HP system is ready to receive a new instruction:
  - ↵ (carriage return)
  - > (greater than)
  - " " (space character)

- **IEEE-488.1**

  Each command/query is immediately handled by the T100S-HP microprocessor.

  Upon completion of an instruction, the T100S-HP does not return any response message unless the command string is a query.
  There is no "end-of-message" group at the end of the response message

Message Syntax Rules

Syntax of messages

- Command: MNEMONIC=VALUE or MNEMONIC
- Query: MNEMONIC?

Case

Commands are not case sensitive, you can type messages in upper-case or lower-case characters.

Response messages are always in upper case.

Multiple Commands

To send multiple commands or queries in a single message, you must separate individual instructions from one another by a semicolon (;).

Instructions are processed by the T100S-HP one after another in the order received.

Responses generated by multiple queries are separated by a semicolon (;).

In RS-232C, the command string must end with a carriage return character.
Responses generated by multiple command strings are ended with the carriage return character "↵"". Only the last response is ended with the end-of-message group "↵"", ">" and "space"

White Space

All characters with ASCII codes lower than or equal to 32, except the carriage return character (ASCII code 13) in RS-232C and the line-feed character (LF, ASCII code10) in GPIB are considered as white space characters.

White space characters are allowed in the following places inside the command strings sent to T100S-HP:

- At the beginning of an instruction
- After an instruction
- Before, after, or in place of the "=" sign.

They cannot be inserted in the following places:

- Within an instruction mnemonic
- Within a numeric value
- Between a mnemonic and the "?" mark.

Command Length

In RS-232C, the T100S-HP input buffer is 255 characters long.

If you enter a command string longer than 255 characters, or submit a new command before previous strings have been processed, the buffer is cleared, all received instructions are lost and the message `command error` is sent.

Numeric Values

Some command messages include a value. The format rules for these values are as follows:

- No space (see section *White Space, p. 14)* is allowed within a numerical value.
- Leading zero ("0") characters are allowed at the beginning of a value.
- Digits after the decimal point can be sent or omitted.
- A comma cannot be used in place of a decimal dot.
- Unit notation cannot be used after a numeric value. All values take the default units, factory-set or user-defined (depending on commands).

1.5 Error Handling

T100S-HPThe two following types of errors can occur in the transmission of instructions:

- Command error: the command string received by the T100S-HP is invalid due to a syntax error or to the use of an unknown mnemonic.
  - In RS-232C, the message is `COMMANDERROR`
  - In GPIB, the ERRC indicator in the status byte register is activated.
- Value error: the command is correctly formulated, but the value of the parameter is incorrect, either because it could not be read or because it is outside the valid range. In both cases, the provided command is ignored.
  - In RS-232C, the message is `VALUEERROR`
  - In GPIB, the ERRV indicator in the status byte is activated.

In GPIB, no message contains the error; it is only set in the STB: both ERRC and ERRV indicators are automatically reset when a new valid command is received.

2. Remote Control Commands

The following table gives an overview of all available commands and queries.

	Command/Query	Corresponding Section
Optical Output Control	DISABLE	*DISABLE, p. 20*
	ENABLE	*ENABLE, p. 20*
Output Power Settings	DBM	*DBM, p. 20*
	MW	*MW, p. 21*
	P	*P, p. 21*
	P?	*P?, p. 21*
Diode Current Settings	I	*I, p. 22*
	I?	*I?, p. 22*
	I? MAX	*I? MAX, p. 22*
	LIMIT?	*LIMIT?, p. 23*
Emission Wavelength/ Frequency Settings	L L?	*L, p. 24* *L?, p. 24*
	L? MIN|MAX	*L? MIN|MAX, p. 24*
	F F?	*F, p. 25* *F?, p. 25*
	F? MIN|MAX	*F? MIN|MAX, p. 25*
	MOTOR_SPEED MOTOR_SPEED?	*MOTOR_SPEED, p. 25* *MOTOR_SPEED?, p. 26*
	FSCL FSCF	*Fine Scanning Mode Control, p. 26*
	APCON APCOFF	*Automatic Power Control, p. 27*
	ACTCTRLON ACTCTRLOFF	*Active Cavity Control, p. 27*
	B_SUPPR B_SUPPR?	*Backlash Suppression Control, p. 28*
	CTRLON CTRLOFF	*Coherence Control, p. 29*
Calibration Control	AUTO_CAL	*AUTO_CAL, p. 31*
	PCAL1	*PCAL1, p. 31*
	PCAL2	*PCAL2, p. 31*
	PCAL1?	*PCAL1?, p. 32*
	PCAL2?	*PCAL2?, p. 32*
Active Wavelength Monitoring Control	L_FEEDBACK L_FEEDBACK?	*Active Wavelength Monitoring Control (GPIB only), p. 32*
General System Control	INIT	*INIT, p. 34*
	ECHON	*ECHON, p. 34*
	ECHOFF	*ECHOFF, p. 34*
	*IDN?	**IDN?, p. 35*
Remote Mode Control	GPAD	*GPAD, p. 35*
	LOCAL	*LOCAL, p. 35*

2.1 IEEE Standard Functions

The following IEEE-488.1 interface standard functions can be processed by the T100S-HP.

They correspond to basic programming commands whose syntax varies depending on the particular GPIB driver software you are using. For the exact syntax of those functions, please refer to the user's manual that comes with your GPIB hardware and software.

Function	Description
`Remote change`	Switches from remote to local mode or local to remote mode.
`Local lockout`	Disables all controls from the front panel.
`Status reading`	Conducts a serial poll.
`Write`	Writes data to a device.
`Read`	Reads data from a device.
`Clear`	Resets a specific device.

Table 3: IEEE Standard Functions

2.1.1 *STB?

Applicability GPIB only.

Syntax `*STB?`

Parameter None.

Description Returns the value of the instrument status byte. The value returned is the addition of all decimal values corresponding to the activated individual indicators (see *Table 4, p. 18*).

To know which bit indicators are activated in the status byte, use the following table to translate the value returned into the corresponding activated bits. .

Indicator	Decimal Value	Bit Position #	Binary Value
MAV	16	#4	00010000
LIM	8	#3	00001000
ERRV	4	#2	00000100
ERRC	2	#1	00000010
OPC	1	#0	00000001

Table 4: GPIB – Examples of single-indicator STB values

Response `xxx`: integer that takes a value between 0 and 255.

Response Examples

- `17`: the OPC and MAV indicators are set to `1` (`1`+`16` = `17`)
- `6`: the ERRV and ERRC indicators are set to 1 (`2`+`4`=`6`)

2.1.2 *SRE

Applicability GPIB only.

Syntax `*SRE=xxx`

Parameter

- `xxx`: integer that takes a value between 0 and 255.

Description

Defines the conditions under which the T100S-HP automatically sends a service request (SRQ) to the computer. The computer can instruct the T100S-HP to send a service request whenever certain bit-values are set to `1`.

Therefore, you do not need to repeatedly prompt for the status byte since the T100S-HP automatically notifies the computer when a particular event occurs.

You can configure the `*SRE` instruction to perform a particular service request.

For example, if the instruction `*SRE=16` is received by the T100S-HP, the bit indicator #4 is set to 1 (Bit #4 = MAV = Message Available): the SRQ line will be automatically activated each time a message becomes available.

The following table provides examples of SRE values when individual indicator bit-values are set to `1`.

Indicator	Decimal Value	Bit Position #	Binary Value
MAV	16	#4	00010000
LIM	8	#3	00001000
ERRV	4	#2	00000100
ERRC	2	#1	00000010
OPC	1	#0	00000001

Table 5: GPIB – Examples of single-indicator SRE values

To calculate the parameter value to send with the instruction `*SRE`, add together the decimal values found in *Table 5, p. 19* of each individual indicators you would like to combine.

Once the T100S-HP has activated a service request, the status byte is no longer automatically updated, until the controller performs a new serial poll on the GPIB link.

As the status byte indicators remain unchanged, this allows the status byte to provide reliable system-status information at the time of service request.

IMPORTANT Since the processing of an instruction begins with the deactivation of the OPC indicator, no new instruction can be processed until the computer has performed the serial poll. Therefore, you should perform a serial poll as soon as a service request is received by the computer. Once the status byte is read, the service request is deactivated and the T100S-HP can resume normal operation.

Examples

- `*SRE=6`: the SRQ line will be automatically activated each time an error is made. This is obtained by adding the corresponding values of the two error indicators, which are ERRV(4) and ERRC(2).
- `*SRE=16`: the SRQ line will be automatically activated each time a message becomes available. Bit indicator #4 is set to 1 (Bit #4 = MAV = Message Available)

2.2 Optical Output Control

2.2.1 DISABLE

Syntax `DISABLE`

Parameter None.

Description Disables the laser output.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.2.2 ENABLE

Syntax `ENABLE`

Parameter None.

Description Enables the laser output.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.3 Output Power Settings

2.3.1 DBM

Syntax `DBM`

Parameter None.

Description Sets dBm as the unit for optical power values.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.3.2 MW

Syntax `MW`

Parameter None.

Description Sets mW as the unit for optical power values.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.3.3 P

Syntax `P=[±]xx.xx|xx.xx`

Parameter
- `[±]xx.xx`: optical output power in dBm, if the unit is set to dBm (see section *DBM, p. 20*). Possible values are given in the *Technical Specifications* section in *T100S-HP User Manual*.
- `xx.xx`: optical output power in mW, if the unit is set to mW (see section *MW, p. 21*). Possible values are given in the *Technical Specifications* section in *T100S-HP User Manual*.

Description Sets the optical power (in dBm or mW depending on the selected power unit) and switches to the constant-power mode (see section *APCON, p. 27*).
The units (dB or mW) must be first selected with the appropriate DBM or MW command.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.3.4 P?

Syntax `P?`

Parameter None.

Description Returns the current value of the laser output power, according to the selected power unit. The format of the response depends on the power unit selected (see section *DBM, p. 20* and section *MW, p. 21*).

Response
- `P=xx.xx`: output power value in mW.
- `P=±xx.xx`: output power value in dBm.
- `DISABLED`: the optical output is disabled, the output power value cannot be returned.

2.4 Diode Current Settings

2.4.1 I

Syntax `I=xxx.x`

Parameter
- `xxx.x`: current level in mA. The minimum possible value is 0 and the maximum possible value is available by using the *I? MAX* command (see *p. 22*)

Description Sets the laser current level (in mA) and switches to the "constant-current" mode (see section *APCOFF, p. 27*).

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.4.2 I? MAX

Syntax `I? MAX`

Parameter `MAX`: maximum laser diode current.

Description Returns the maximum operating laser diode current of the T100S-HP in "constant-current" mode, in mA.

Response `xxx`

2.4.3 I?

Syntax `I?`

Parameter None.

Description Returns the value of the diode current in mA.
The module optical output must be enabled (see section *Optical Output Control, p. 20*).

Response
- `I=xxx.x`: diode value in mA.
- `DISABLED`: the optical output is disabled, the current level value cannot be returned.

2.4.4 LIMIT?

Syntax `LIMIT?`

Parameter None.

Description Returns the status of the laser diode current limitation (400 mA).

Response

- `YES`: the current has reached its limit.
- `NO`: the current has not reached its limit.

2.5 Optical Emission Wavelength/Frequency Settings

2.5.1 Emission Wavelength/Frequency Control

2.5.1.1 L

Syntax `L=xxxx.xxx`

Parameter
- `xxxx.xxx`: emission wavelength in nm. The possible wavelength range is available by using the *L? MIN|MAX* command (see *p. 24*).

Description Sets the emission wavelength (in nm) and automatically switches the displayed unit to nm.
The laser is tuned directly to the desired wavelength without step-mode scanning or swept-mode hop-free scanning. The tuning is performed at the `MOTOR SPEED` speed value (see section *MOTOR_SPEED, p. 25*).

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.1.2 L?

Syntax `L?`

Parameter None.

Description Returns the value of the present emission wavelength in nm.

Response `L=xxxx.xxx`

2.5.1.3 L? MIN|MAX

Syntax `L? MIN|MAX`

Parameter
- `MIN`: minimum operating wavelength.
- `MAX`: maximum operating wavelength.

Description Returns the minimum or maximum operating wavelength of the T100S-HP in nm.

Response `xxxx.xxx`

2.5.1.4 F

Syntax `F=xxxxxx.x`

Parameter
- `xxxxxx.x`: optical frequency in GHz. The possible wavelength range is available by using the *F? MIN|MAX* command (see *F? MIN|MAX, p. 25*).

Description Sets the emission wavelength (in GHz) and automatically switches the displayed unit to GHz.
The laser is tuned directly to the desired optical frequency without step-mode scanning or swept-mode hop-free scanning. The tuning is performed at the `MOTOR SPEED` speed value (see section *MOTOR_SPEED, p. 25*).

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.1.5 F?

Syntax `F?`

Parameter None.

Description Returns the value of the present optical frequency value in GHz.

Response `F=xxxxxx.x`

2.5.1.6 F? MIN|MAX

Syntax `F? MIN|MAX`

Parameter
- `MIN`: minimum operating frequency.
- `MAX`: maximum operating frequency

Description Returns the minimum or maximum operating frequency of the T100S-HP in GHz.

Response `F=xxxx.xxx`

2.5.1.7 MOTOR_SPEED

Syntax `MOTOR_SPEED=xxx`

Parameter `xxx`: sweep speed in nm/s, in the range 1 to 100 nm/s. Operational sweep speeds are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17,18, 20, 22, 25, 29, 33, 40, 50, 67, 100 nm/s.

Description Sets the sweep speed (in nm/s) used in swept-mode, hop-free scanning operation and any tuning of laser.
The speed setting provided is automatically rounded to the nearest operational sweep speed.
For example, if you set `MOTOR_SPEED=060`, the actual sweep speed implemented by the system is 67 nm/s. To check the current operational sweep speed, use the *MOTOR_SPEED?* query (see *p. 26*).

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.1.8 MOTOR_SPEED?

Syntax `MOTOR_SPEED?`

Parameter None.

Description Returns the operational sweeping speed in nm/s.

Response `xxx`: sweep speed in nm/s.

2.5.2 Fine Scanning Mode Control

2.5.2.1 FSCL

Syntax `FSCL=xx.x`

Parameter `xx.x`: wavelength change in pm.

Description Switches to the Fine Scanning mode. For more details on this mode, see *T100S-HP User Manual*.
This mode is canceled by any other command.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.2.2 FSCF

Syntax `FSCF=x.xx`

Parameter `x.xx`: optical frequency change in GHz.

Description Switches to the Fine Scanning mode. For more details on this mode, see *T100S-HP User Manual*.
This mode is canceled by any other command.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.3 Automatic Power Control

2.5.3.1 APCON

Syntax `APCON`

Parameter None.

Description Sets the system operation to "constant-power" mode (APC mode enabled). For more details on this mode, see *T100S-HP User Manual*.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.3.2 APCOFF

Syntax `APCOFF`

Parameter None.

Description Sets the system operation to "constant-current" mode (APC mode disabled). For more details on this mode, see *T100S-HP User Manual*.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.4 Active Cavity Control

2.5.4.1 ACTCTRLON

Syntax `ACTCTRLON`

Parameter None.

Description Enables the active cavity control mode. For more details on this mode, see *T100S-HP User Manual*.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.4.2 ACTCTRLOFF

Syntax `ACTCTRLOFF`

Parameter None.

Description Disables the active cavity control mode. For more details on this mode, see *T100S-HP User Manual*.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.5 Backlash Suppression Control

2.5.5.1 B_SUPPR

Syntax `B_SUPPR=0|1`

Parameter
- `0`: the backlash suppression control is disabled.
- `1`: (default) the backlash suppression control is enabled.

Description Sets the state of the backlash suppression control on the micrometer screw.
Bringing the T100S-HP back to local mode automatically activates the backlash suppression control, even if it had previously been set to `0`.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.5.2 B_SUPPR?

Syntax `B_SUPPR?`

Parameter None.

Description Returns the state of the backlash suppression control.
Bringing the T100S-HP back to local mode automatically activates the backlash suppression control, even if it had previously been set to `0`.

Response
- `0`: the backlash suppression control is disabled.
- `1`: the backlash suppression control is enabled.

2.5.6 Coherence Control

2.5.6.1 CTRLON

Syntax `CTRLON`

Parameter None.

Description Enables the coherence control function. For more details on this mode, see *T100S-HP User Manual*.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.6.2 CTRLOFF

Syntax `CTRLOFF`

Parameter None.

Description Disables the coherence control function. For more details on this mode, see *T100S-HP User Manual*.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.5.7 Continuous Wavelength Sweep

Syntax `P=[±]xx.xx;L=xxxx.xxx;MOTOR_SPEED=nnn;ACTCTRLON;L=xxxx.xxx;MOTOR_SPEED=100;ACTCTRLOFF`

Description To perform continuous and mode-hop-free scans in the sweep-mode, you must use a combination of commands and make a remote subroutine, as explained below.

In GPIB you must make sure that the laser has received and fully executed a remote command before sending the next one, by verifying the OPC bit test (see *Checking System Status with the Status Byte, p. 9*).

1. Set the optical power using the `P=` command (see section *P, p. 21*).
2. Tune the laser to the start wavelength using the `L=` command (see section *L, p. 24*). This is the first wavelength of your sweep.
3. Set the tuning speed required for your continuous sweep using the `MOTOR_SPEED=` command (see section *MOTOR_SPEED, p. 25*).
4. Enable the active cavity control using the `ACTCTRLON` command (see section *ACTCTRLON, p. 27*).

5. Tune the laser to the last wavelength using the `L=` command (see section *L, p. 24*). This is your continuous first sweep. This second wavelength must be higher than the first one.
6. Set the tuning speed at 100 nm/s using the `MOTOR_SPEED=` command (see section *MOTOR_SPEED, p. 25*).
   This enables you to return to the first wavelength at the maximum speed.
7. Disable the active cavity control using the `ACTCTRLOFF` command (see section *ACTCTRLOFF, p. 28*).
   This enables you to earn around 100 ms on a full scan. If this is not a concern, you can skip steps 4 and 7. By default, the active cavity control is enabled in the T100S-HP.
8. Repeat steps 2 to 7 to perform a new sweep.

2.6 Calibration Control

2.6.1 AUTO_CAL

Syntax `AUTO_CAL`

Parameter None.

Description Launches the internal wavelength referencing sequence.

Response

- `REFERENCING ERROR`: if auto-calibration has failed, this message is displayed for a few seconds, and the T100S-HP resumes normal operating status. Unlike the **2nd + I** command (in manual mode) that stalls the system when a referencing error occurs, there is no need to press **Enter** to restore the system.
- `OK`: (RS-232C only) the calibration has been successfully performed.

2.6.2 PCAL1

Syntax `PCAL1=xx.xx`

Parameter

- `xx.xx`: the calibration power at first wavelength, in the range 0.3 to 0.6 mW.

Description Sets the first power value (in mW) of the two-point power calibration method.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.6.3 PCAL2

Syntax `PCAL2=xx.xx`

Parameter

- `xx.xx`: the calibration power at second wavelength, in the range 0.3 to 0.6 mW.

Description Sets the second power value (in mW) of the two-point power calibration method.

Response

- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.6.4 PCAL1?

Syntax `PCAL1?`

Parameter None.

Description Returns the first power value (in mW) of the two-point power calibration method.

Response `P=xx.xx`

2.6.5 PCAL2?

Syntax `PCAL2?`

Parameter None.

Description Returns the second power value (in mW) of the two-point power calibration method.

Response `P=xx.xx`

2.7 Active Wavelength Monitoring Control (GPIB only)

2.7.1 L_FEEDBACK

Applicability GPIB only.
To use this function, the T100S-HP must be connected to a wavemeter via the RS-232C interface, so the RS-232C interface cannot be used to receive commands.

Syntax `L_FEEDBACK=1|0`

Parameter
- `1`: the Active Wavelength Monitoring is enabled, while using an external wavemeter.
- `0`: the Active Wavelength Monitoring is disabled.

Description Sets the state of the Active Wavelength Monitoring function. For more details on this function, see *T100S-HP User Manual*.

Response None, see section *Checking System Status with the Status Byte, p. 9*.

2.7.2 L_FEEDBACK?

Applicability GPIB only.
To use this function, the T100S-HP must be connected to a wavemeter via the RS-232C interface, so the RS-232C interface cannot be used to receive commands.

Syntax `L_FEEDBACK?`

Parameter None.

Description Returns the state of the Active Wavelength Monitoring function. For more details on this function, see *T100S-HP User Manual*.

Response

- `1`: the Active Wavelength Monitoring is in use.
- `0`: the Active Wavelength Monitoring is disabled.
- `ERROR`: possible malfunction, make sure a wavemeter is connected to the RS-232C port (see *T100S-HP User Manual* for details).

2.8 General System Control

2.8.1 INIT

Syntax `INIT`

Parameter None.

Description
- In RS-232C, starts the initialization of the optical head (this takes at least 10 s). This procedure includes the auto-calibration sequence (see section *AUTO_CAL, p. 31*).
- In GPIB, cancel all the pending commands stored in the GPIB buffer.

Response
- RS-232C: `OK`
- GPIB: none, see section *Checking System Status with the Status Byte, p. 9*.

2.8.2 ECHON

Applicability RS-232C only.

Syntax `ECHON`

Parameter None.

Description Activates the "echo" mode: the T100S-HP sends an echo of each character received back through the serial cable.
Since some terminals and terminal emulation programs do not feature local echo, this function can be useful for visual monitoring of the characters keyed in at the terminal or for having a secure link.

Response `OK`

2.8.3 ECHOFF

Applicability RS-232C only.

Syntax `ECHOFF`

Parameter None.

Description Cancels the "echo" mode (default setting).
In addition, ECHON mode is restored to ECHOFF if you press the **Remote** key to return to manual-mode operation.

Response `OK`

2.8.4 *IDN?

Syntax `*IDN?`

Parameter None.

Description Returns information about the T100S-HP as follows: company name, product name, software version number (FPGA version).

Response `EXFO,T100S-HP,0,<software version>`

2.9 Remote Mode Control

2.9.1 GPAD

Applicability GPIB only.

Syntax `GPAD=xx`

Parameter `xx`: GPIB address of the T100S-HP, in the range 1-30.

Description Sets the GPIB address of T100S-HP.

Response None, see section *Checking System Status with the Status Byte, p. 9*.

2.9.2 LOCAL

Applicability RS-232C only.

Syntax `LOCAL`

Parameter None.

Description Switches back to local mode.

Response `OK`

3. Program Example and Library

Subject

EXFO provides the following tools to allow you to control the T100S-HP via RS-232C and GPIB:

- LabVIEW Virtual Instrument example *T100S_HP_Example.vi*
- LabVIEW library *T100S_HP.lvlib*

These tools are available on the USB key delivered with the T100S-HP, or you can download them from the EXFO website at www.EXFO.com/software/en/exfo-apps

Compatibility

The Virtual Instrument *T100S_HP_Example* is part of the LabVIEW library *T100S_HP.lvlib*, developed for LabVIEW 2010 or later.

The example and library are compatible with 32- and 64-bits versions of LabVIEW.

3.1 T100S-HP LabVIEW Library

The *T100S_HP.lvlib* LabVIEW library is organized in three sub-folders:

- **Parameter Settings**

  This folder contains sub-Vis that allow the settings of parameters such as Power, Current, Wavelength/Frequency and Motor Speed, as well as enabling/disabling the laser or controlling the Active Cavity Control and Active Power Control.

- **Parameters Queries**

  This folder contains sub-Vis that collect current values of parameters such as Power, Current, Wavelength/Frequency and Motor Speed, the state of the laser or the wavelength limits of the laser in operation.

  The sub-VI **T100S_HP_Get_Laser_Settings** collects the most relevant information about the laser in one single VI.

- **Communication**

  This folder contains sub-Vis that allow basic Write/Read of remote commands in both GPIB and RS 232C. Specific functionalities are available from the GPIB or RS-232C sub-folders.

3.2 T100S-HP LabVIEW Example

3.2.1 Using the Front Panel to Remotely Control the T100S-HP

Front Panel Presentation

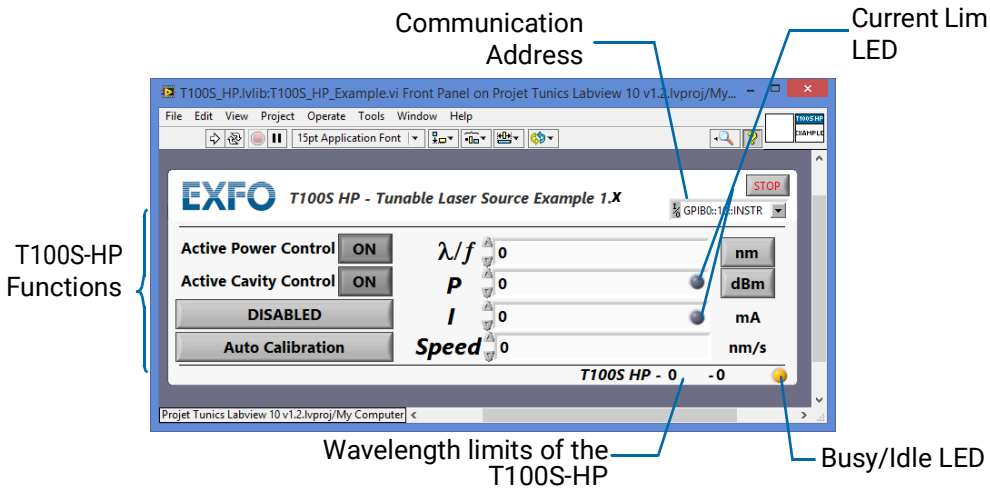


Figure 1: T100S-HP Example – Front Panel

T100S-HP Functions

The VI reproduces most of the functionalities of the T100S-HP by emulating the following functions:

- **λ/f**: Wavelength/Frequency screen
- **P**: Power screen
- **I**: Current screen
- **Speed**: Motor Speed (usually accessed via **2nd+ λf** on the instrument)
- **nm** and **dBm**: unit buttons
- **ON**: APC and Active Cavity Control (usually accessed via **2nd+APC**) buttons
- **DISABLED/ENABLED**: Enable button
- **Auto Calibration**: wavelength referencing (usually accessed via **2nd+I** on the instrument)

Busy/Idle LED

- Orange: remote access is performing a remote command.
- Green: remote access is ready for a new command.

Current Limit LED

The LEDs located within the **P** and **I** controls indicate if the laser has reached its current limit by switching to red if the limit is reached.

Procedures

Opening and Initializing the Application Example

1. To open the remote control example, double-click the *T100S_HP_Example.vi* file.
2. In the **I/O** parameter on the top right of the application, set the correct communication address

3. Run the Vi by pressing the **Run** arrow, or using the shortcut **CTRL+R**.

   The Vi first runs the *T100S_HP_Get_Laser_Setting.vi* and collects the Laser State, the Current, Wavelength/Frequency, Power and Motor Speed and checks whether the laser has reached its current limit or not.

   The application queries and displays the wavelength limits of the laser in operation next to the Busy/Idle LED.

   If the laser is DISABLED, NaN (Not a Number) is displayed in **P** and **I** parameters.

   When the application is ready for remote control, the Busy/Idle LED becomes green.

Controlling the T100S-HP

- **Modifying a Parameter**

  a. Click on the value displayed and type the desired value.

  b. Press the Enter key on the keyboard to confirm the value typed.

     The instrument is set to the new value. If the value is outside of the allowed limits, the application resets the parameter to the previous value.

  The application behavior reproduces the behavior displayed on the front panel of the instrument:
  - When in "Idle", both Current and Power are updated to reflect the display on the instrument.
  - When entering a new Current value, the APC and ACC are automatically turned OFF.
  - When entering a new Power value, the APC is automatically turned ON.
- **Changing Unit**

  To toggle between nm and GHz, or between mW and dBm, click on the unit buttons next to the parameter fields.
- **Enabling/Disabling the laser output**

  To enable or disable the laser, click on the DISABLED/ENABLED button.
- **Running the "Referencing" function**

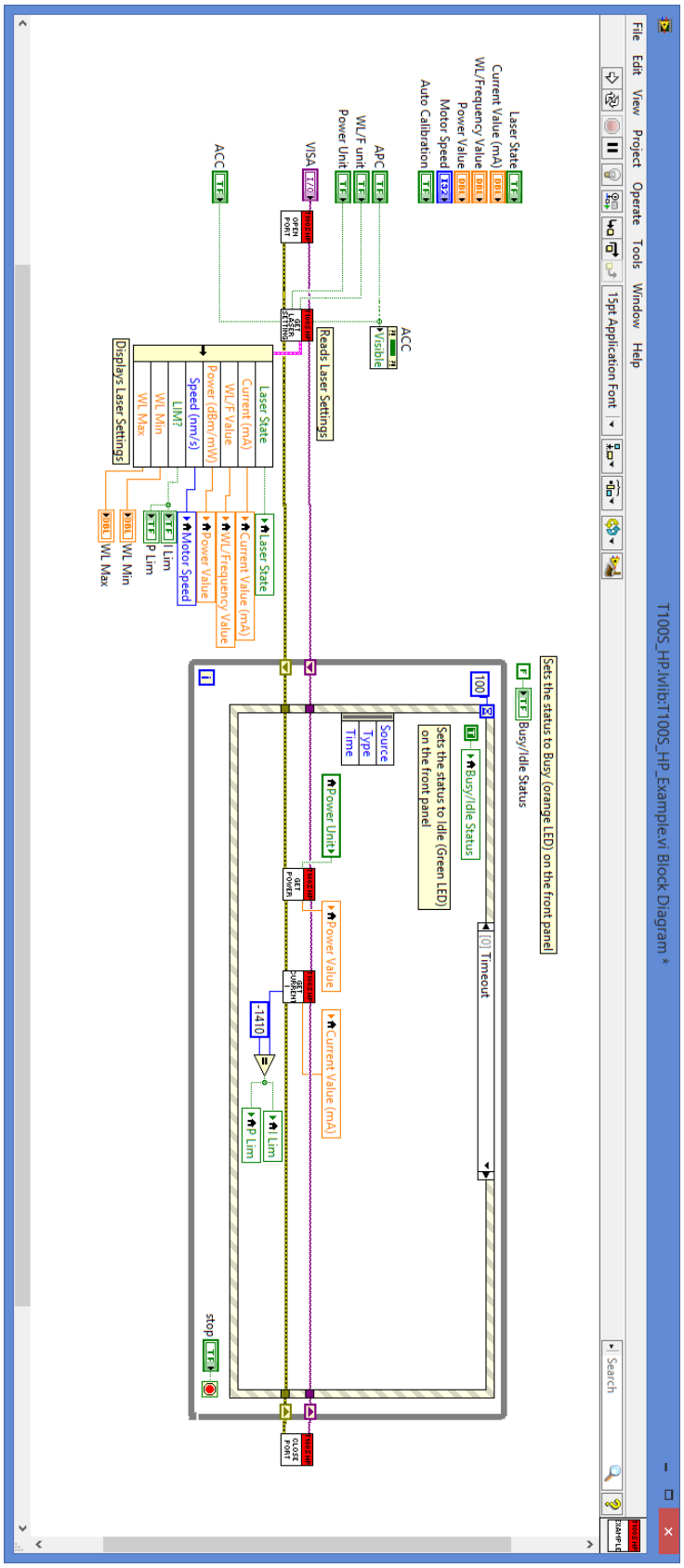
  To run the "Referencing" function, click on the Auto-Calibration button.

See *T100S-HP User Manual* for more information on laser operation.

3.2.2 Example Diagram

The LabVIEW diagram of *T100S_HP_Example.vi* is composed of two parts:
- The first part is the initialization of the communication port using the *T100S_HP_OpenPort.vi* and the *T100S_HP_Get_Laser_Settings.vi* to collect up-to-date values for the lasers parameters.
- The second part consists of on an *Event Handler*. Comments in each relevant Event Case helps understand the structure of the program.

The program has been written to be easily exported or modified by the user in order to suit a particular need.


T100S_HP.vlib:T100S_HP_Example.vi Block Diagram *
File Edit View Project Operate Tools Window Help
Laser State
Current Value (mA)
WL/Frequency Value
Power Value
Motor Speed
Auto Calibration
APC
WL/F unit
Power Unit
VISA
ACC
Reads Laser Settings
Displays Laser Settings
Sets the status to Busy (orange LED) on the front panel
Busy/Idle Status
Sets the status to Idle (Green LED) on the front panel
Timeout
Source
Type
Time
Power Unit
Power Value
Current Value (mA)
-1410
P Lim
stop
WL Max
WL Min
P Lim
I Lim
Motor Speed
Power (dBm mW)
Speed (nm/s)
LIM?
WL Max
WL Min
WL/F Value
Current (mA)
Laser State

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