TLS5 Tunable Laser Source

User Manual

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COMPLIANCE

FDA-CDRH Compliance

Under the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH), the unit complies with the Code of Federal Regulations (CFR), Title 21, Subchapter J, which pertains to laser safety and labeling. See the link below for more information.

- *http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPartFrom=1000&CFRPartTo=1050*

CSA / IEC Compliance

The unit complies with certain standards of the Canadian Standards Association (CSA) and the International Electrotechnical Commission (IEC).

The unit falls in the Installation Category (Overvoltage Category) II under IEC 664. IEC 664 relates to impulse voltage levels and insulation coordination. The particular category is defined as: local level, appliances, portable equipment, etc, with smaller transient overvoltages than Installation Category (Overvoltage Category) III.

The unit falls in the Pollution Degree 2 category under IEC 1010-1 and CAN/CSA-C22.2 No. 1010.1. The IEC standard on Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use relates to insulation coordination. The CSA standard is on Safety Requirements for Electrical Equipment for Measurement Control, and Laboratory Use, Part I: General Requirements. The Pollution Degree 2 category is defined as follows: “Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.”

CE Compliance

Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has undergone extensive testing according to the European Union Directive and Standards.

FCC Certification

15.19(a)(3) All devices

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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GENERAL INFORMATION

TLS5 Tunable Laser Source Overview

The TLS5 is a Tunable Laser Source that offers an ultra-wide continuous wavelength range of 1260 to 1650 nm, all in one bench-top chassis.

Figure 1: TLS5 Tunable Laser Source

The TLS5 enables customers to span the entire CWDM spectral range at a relatively low cost, enabling affordable testing of CWDM as well as broadband optical components. To accomplish such wide wavelength coverage, the TLS5 uses several optical amplifiers and an external cavity. The output wavelength of each amplifier is aligned within the cavity to achieve seamless and continuous wavelength coverage at the unit's output.

The output spectrum features low coherence length, an accuracy of ±50 pm, stability of ±8 pm, and high repeatability of better than ±80 pm. The source also offers a very good side mode suppression ratio of over 60 dB. The tuning speed of the TLS5 is over 25 nm/s allowing users to access their desired wavelength quickly and efficiently.

The TLS5 offers a user friendly LED display that can be controlled manually with the use of the front panel buttons, but also offers the possibility of remote control through GPIB and RS232.

Output Port

The output port of the TLS5 tunable laser source is equipped with an ultra-low backreflection APC connector.

> Extreme care must be taken to avoid damaging the connector when plugging and unplugging output jumper. Connection must be kept clean and should be inspected before every mating. Please refer to the Cleaning Connectors section on page 20 for more information.

Key Features

- Ultra wide 1260 nm to 1650 nm continuous wavelength coverage
- Tuning resolution of 0.1 nm
- Side mode suppression ratio of 60 dB at 0.1 nm resolution bandwidth
- Tuning speed of over 25 nm / second
- RS-232 serial and IEEE 488 GPIB parallel interfaces

Applications

- CWDM and PON component testing
- General lab instrument

Accessories

- AC power cord
- User Manual
- NIST traceable Calibration Certificate

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SAFETY INFORMATION

To avoid situations that could result in serious injuries or death, always observe the following precautions.

The safety instructions must be observed whenever the unit is operated, serviced, or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the User Manual is in direct violation of the standards of design, manufacturing, and intended use of the unit. JGR Optics assumes no liability for the customer's failure to comply with any of these safety requirements.

Safety Markings on the Unit

The following symbols and messages can be marked on the unit (see Table 1 below). Observe all safety instructions that are associated with a symbol.

Table 1: Safety Symbols

	Laser radiation may be present. Refer to the User Manual for instructions on handling and operating the unit safely. Avoid looking into any ports near which this symbol appears.
	Frame or chassis terminal for electrical grounding within the unit.
	Protective conductor terminal for electrical grounding to the earth.
WARNING	Procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.
CAUTION	Procedure can result in serious damage to or destruction of the unit if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding.

Classification

The TLS5 Tunable Laser Source consists of an exposed metal chassis that is connected directly to earth via a power cord and, therefore, is classified as a Class 1 instrument.

Laser Specifications

The laser contained in the TLS5 source is Class 1 laser as specified under the laser classification of the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH). Laser specifications are provided in Table 2 below.

Table 2: Specifications

Parameter	*Single-mode (SM)*
Wavelength	1260 to 1650 nm
Class	1
Fiber Type	Panda PM fiber
Maximum Accessible Emission Level	-15 dBm
Maximum Output Power	+5 dBm
Numerical Aperture	0.13
Effective Numerical Aperture	0.20

Important Safety Information

Laser Hazards

Warning
Never look into the end of an optical cable connected to an optical output device that is operating. Laser radiation is invisible, and direct exposure can severely injure the human eye.

Electrical Shock Hazards

Warning

- Some of the circuits are powered whenever the unit is connected to the AC power source (line power). To ensure that all circuits are powered off, disconnect the power cord from either the power inlet on the unit's rear panel or from the AC line-power source (receptacle). The power cord must always be accessible from one of these points. If the unit is installed in a cabinet, the operator must be able to disconnect the unit from the line power by the system's line-power switch.
- Use only the type of power cord supplied with the unit. If you need to replace a lost or damaged cord, make sure to replace with a power cord of the same type.
- Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord or any receptacle that is not equipped with this feature.
- If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.
- Do not interrupt the protective earth grounding. Such action can lead to a potential shock hazard that can result in serious personal injury. Do not operate the unit if an interruption to the protective grounding is suspected.
- Do not operate the unit when its cover or panels have been removed.
- To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.
- Do not use the unit outdoor.
- Operating the unit in the presence of flammable gases or fumes is extremely hazardous.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Only technicians authorized by JGR Optics should carry out the repairs. In addition to voiding the warranty, opening the unit (even when unplugged) can expose you to potential shock hazards.
- Some of the unit's capacitors can be charged even when the unit is not connected to the power source.
- Do not perform any operating or maintenance procedure that is not described in the User Manual.

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GETTING STARTED

Caution

To avoid injury or death, always observe the precautions listed in “SAFETY INFORMATION” section on page 5.

This manual contains complete operating instructions for safe and effective operation of the TLS5 Tunable Laser Source. It is recommended that users of the TLS5 familiarize themselves with contents of this manual before using the instrument.

The inspection report and a description of any customer-requested information may be found in the calibration document envelope included with the instrument.

Initial Inspection

Warning

To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage. Ensure that the unit and any devices or cords connected to it are properly grounded.

☑ Inspect the package and contents for signs of damage.

☑ Ensure all contents are included:

- TLS5 Tunable Laser Source
- 1 AC power cord
- User Manual
- NIST traceable Calibration Certificate

☑ Read the User Manual thoroughly, and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely.

☑ Ensure the unit is operational:

- Connect the unit to a power source using the provided power cord
- Set the power switch to ON to initialize the TLS5 Tunable Laser Source, and observe the power-up sequence:
  - Model number and firmware version of the meter are displayed
  - The message “Initializing” is displayed as the light source stabilizes
  - WL = xxxx.x nm and LASER OFF messages are then displayed
- Set the power switch to OFF and disconnect the source.

☑ Keep the packaging.

☑ Immediately notify JGR Optics and, if necessary, the carrier if the content of the shipment is incomplete, if the unit or any of its components are damaged or defective, or if the unit does not pass the initial inspection.

Operational Requirements

In order for the unit to meet the warranted specifications, the operating environment must meet the following conditions for altitude, temperature, humidity, and voltage.

Table 3: Environmental Requirements

Parameter	***Specification***
Altitude	Up to 2000 m
Temperature	Range of 0 to 40 °C
Humidity	Up to 95% humidity (0 to 40 °C)
Voltage	Main supply voltage fluctuations must not exceed ±10% of the nominal voltage

Product Overview

Front Panel and Key Description

A front view of the TLS5 Tunable Laser Source is shown on Figure 2 and a detailed description of keys and LEDs is provided in Table 5 on next page.

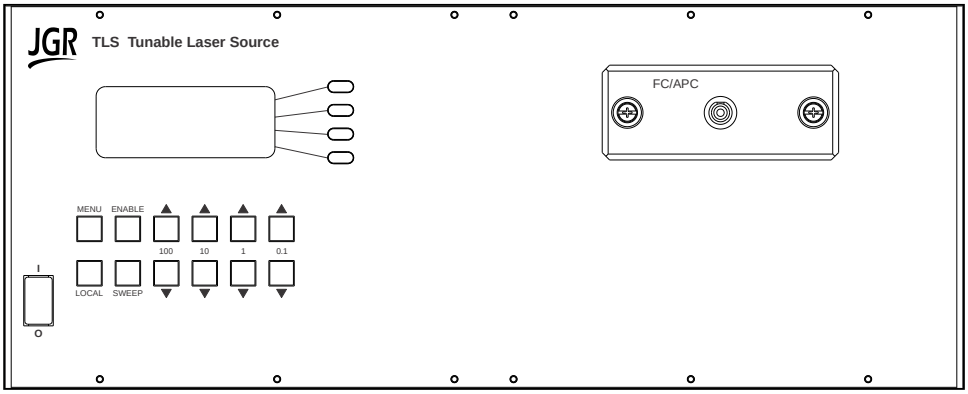

Figure 2: Front of Laser Source

Rear Panel

The back of the laser source is shown in Figure 3 and the rear-panel features are described in Table 4.

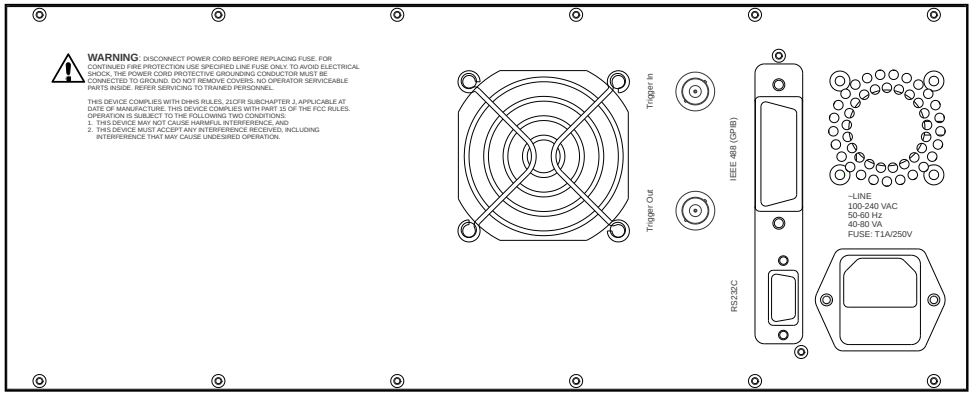

Figure 3: Back of the Laser Source

Table 4: Rear Panel Components

Component	*Function*
RS-232C	RS-232C serial interface port
IEEE 488 (GPIB)	GPIB (IEEE 488.1) interface port
~LINE	Power Input (also contains the user-replaceable fuse)
TRIG IN	BNC connector used to receive a TTL trigger signal from an external device to make the TLS5 Tunable laser source to move one (1) wavelength step.
TRIG OUT	BNC connector used to send a TTL trigger function to an external devide to indicate that the TLS5 tunable laser source has stabilized on the required wavelength. Always enabled.

Table 5: Operating Keys and Status LEDs

Key/LED	*Description*
I/O	ON / OFF Power switch.
MENU	Press to access the Menu or to come back one level up in the Menu
ENABLE	Press and hold to turn laser ON or OFF. When turning ON the laser, 3 hyphens will appear in a sequence to the right of the LASER ON message to indicate that the laser is now active.
LOCAL	Press once to exit the Sweep mode
SWEEP	Press once to access the first page of the sweep mode allowing configuration of start wavelength, stop wavelength and step and also stard the sweep mode. Press a second time to toggle to the second page to configure the Delay, Trigger In and Ramp settings.
↑ 100, 10, 1, 0.1 ↓	Use the up and down arrows to manually tune the laser wavelength by steps of 100 nm, 10 nm, 1 nm or 0.1 nm depending on which set of arrow is used.

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OPERATION

Before using the TLS5 Laser Source, make sure to allow a warm-up time of at least 30 minutes for laser stabilization.

Powering Up the Tunable Laser Source

To power up the laser source:

1. Connect the meter to an AC power source using the power cord provided. If the meter has been running, ensure that the meter is powered off and restarted.
2. Set the power switch to I (ON), and wait for the "Initialization" process to finish.
3. Press the ENABLE button to turn-on the laser. Note that pushing the ENABLE button a second time will allow turning-off the laser without powering down the TLS5 completely.

Manual Tuning

The TLS5 Laser Source can be manually tuned to any wavelength within the operation range by using the set of "arrow" keys on the front panel indicated on figure 4 below.

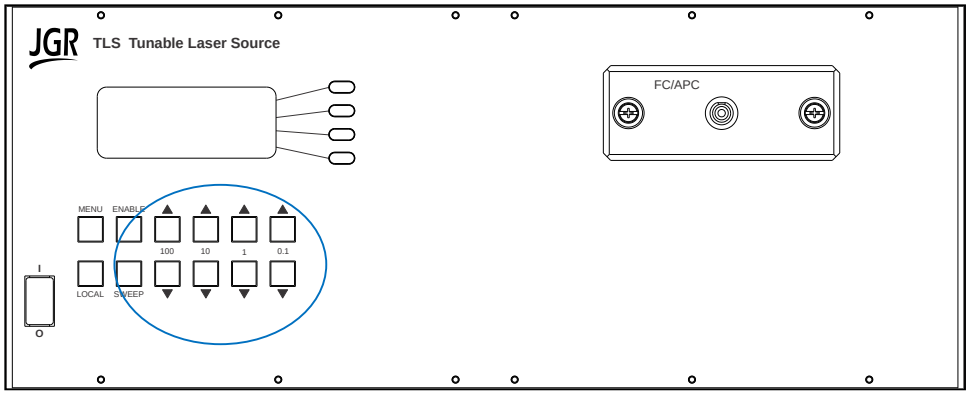


Figure 4: Tuning keys on TLS5 front panel

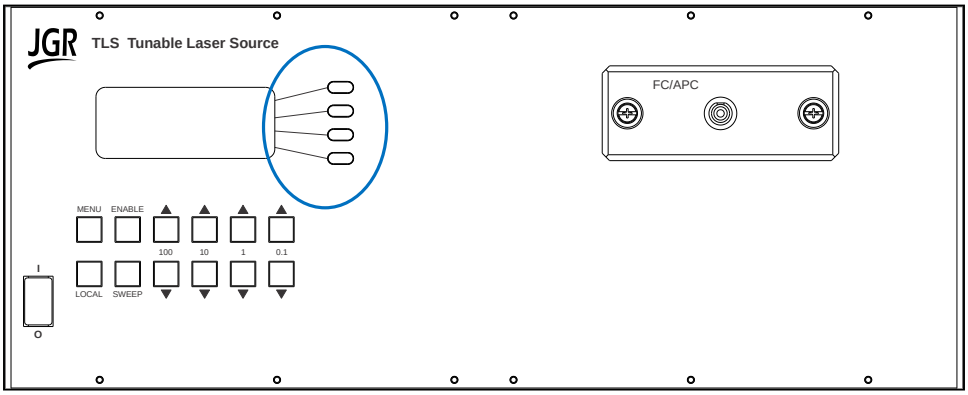
For example, to change the TLS5 laser source wavelength from 1308.0 nm to 1550.1 nm, follow these steps:

- Press the 100 up key twice to go from 1308.xx to 1508.xx
- Press the 10 up key five times to go from 1508.xx to 1558.xx
- Press the 1 down key 8 times to go from 1558.xx to 1550.xx
- Press the 0.1 up key once to go to 1550.1

Sweep Mode

TLS5 Tunable Laser Source can also be configured to continuously sweep the entire wavelength range or a specific user-defined wavelength range. Press the Sweep button once to access the first page of the Sweep mode configuration menu.

Using the four (4) soft keys on the right of the display, it is possible to Begin the sweep or define the start and stop wavelengths as well as the tuning step. For example, pressing the START key allows modification of the START wavelength by using the Up and Down arrow keys below the display in a similar way as described in the Manual Tuning section above.



Once all is set properly, then pressing the BEGIN SWEEP key will start the sweep sequence which will automatically stop once the STOP wavelength is reached.

Pressing the SWEEP key a second time, will toggle to the second page of the SWEEP menu where the Delay, Trigger and Ramp functions can be enabled and configured.

The DELAY, in milliseconds, programmed from this page, will be added between wavelength steps no matter if the Trigger In detailed below has been enabled or not.

There are two (2) BNC connectors at the back of the unit used to send and receive trigger signals to synchronize the TLS5 Tunable Laser Source with an external device like a power meter. The Trigger In function can be enabled by pressing the TRGIN softkey in the menu. When enabled, the TLS5 will advance one (1) wavelength step.

The Trigger Out is always enabled and a 5 Vdc TTL, 10 µs wide pulse will be sent on this output after each step.

The RAMP function can be enabled to make the source accelerate (ramp) and decelerate when possible whiletraversing each wavelength step.

User Menu Operation

Accessing the User Menu

To access the User Menu, press the MENU key on the front panel.

User Menu Options

The first menu level reached by pressing the MENU key once shows two (2) selections: Remote Options and Option Menu. Only the first slection can be used by users. The Option menu is for internal use only. User Menu Remote Options are shown In Table 6. They can be accessed by using the soft keys on the right of the display.

To come back to the previous menu level, simply press MENU again.

Table 6: User Menu Remote Options

Option	*Selection*	*Note*
JGR Command Sets	None	The TLS5 only supports JGR commands
RS232 Transmission Rate	300-34800 baud	Choose a transmission rate between 300 and 38400 Baud by using the Up and Down 0.1 arrow keys.
GPIB Address	01-30	Select GPIB address between 01 and 30 by using the Up and Down 0.1 arrow keys.

Messages and Symbols

The messages/symbols displayed by the TLS5 Tunable Laser Source are shown in Table 7.

Table 7: TLS5 Tunable Laser Source Display Messages and Symbols

Display	*Description*
TLS5 VER *X.XX*	Displayed momentarily during the power-up sequence and indicates the firmware version
INITIALIZING	Displayed momentarily during the power-up sequence as the initial internal reference measurements are made
WL= xxx.x nm	Indicates the wavelength on which TLS5 is currently tuned
LASER OFF	Laser is currently turned OFF
LASER ON ---	Tunable laser is ON and transmitting at indicated wavelength
SWEEPING …	Laser is currently sweeping over the user defined wavelength range
BEGIN SWEEP START: xxxx.x nm STOP : yyyy.y nm STEP : zzzz.z nm	First Sweep mode menu showing the Start and Stop wavelength as well as the sweep increment. Refer to Sweep Mode section on page 13 for more information.
BEGIN SWEEP DELAY: xxx.x ms TRGIN: OFF RAMP: ON	Second Sweep mode menu showing the Trigger and Ramp controls. Refer to Sweep Mode section on page 13 for more information.

Calibration

Caution

Devices with malfunctioning lasers must be returned to the manufacturer for repair.

Calibration should be performed by a qualified Calibration Laboratory. Wavelength accuracy of the TLS5 Tunable Laser Source are factory-set and must be periodically adjusted to maintain performance.

Calibration Period

JGR Optics recommends a 1 year calibration period for the TLS5 Tunable Laser Source.

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PROGRAMMING GUIDE

Setting up for RS-232, USB or GPIB communication

The TLS5 Tunable Laser Source may be remotely controlled via GPIB (IEEE-488) and RS-232 interface. The GPIB interface of the meter conforms to the ANSI/IEEE standards 488.1-1987 and 488.2-1987. The RS232C interface conforms to ANSI/IEEE standard 488.2-1987 where applicable.

The common command set conforms to ANSI/IEEE 488.2 standard syntax. All other commands conform to the Standard Commands for Programmable Instruments (SCPI) command language, version 1999.0.

Accessing the "User Menu" mode

In order to establish communication between the computer and the meter, the RS-232 bus or the GPIB bus must be configured properly. The different options for the communication are contained in the User Menu. Refer to the "USER MENU OPERATION" section on page 14 for further details.

Programming over GPIB

The TLS5 supports the IEEE-488.1(1978) interface standard. It also supports the mandated common commands of IEEE-488.2(1987) standard. Before attempting to communicate with the TLS5 via the GPIB interface, the device address must be set. The address is set by accessing the User Menu function from the front panel. Use the Up and Down 0.1 arrow keys to set the address to the required value.

Programming Over RS-232

In order to establish a serial communication between a computer and the TLS5, the computer's COM port must be configured as described in Table 8.

To connect the TLS5 to the computer, a standard 9 pins straight RS-232 cable is required. Only three pins, Txd, Rxd and GND are needed.

Programming Over USB

It is also possible to remote control the TLS5 Tunable Laser Source via USB by using a USB to DB9 adapter cable. The same RS-232 commands are used for USB communication.

Table 8: Serial Communication Settings

Transmission Rate	Selectable in the “User Menu”. Available options are 300, 1200, 2400, 9600, 19200 and 38400 Baud. Use the Up and Down 0.1 arrow keys from the front panel to select required rate.
Data bit	8
Parity	N
Stop bits	1
Flow Control	None

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MAINTENANCE AND TROUBLESHOOTING

Maintenance

	**Warning** Devices with malfunctioning lasers must be returned to the manufacturer for repair.

Cleaning the Unit

1. Unplug the unit from the line power.
2. Clean the enclosure with a damp cloth.
3. Do not plug the unit back until it is completely dry.

Cleaning the Connector Ends

1. Clean all connector ends with a lint-free tissue and alcohol before every mating. See the “CLEANING CONNECTORS” section on page 20.
2. Loosen the retaining screws of the connector panel, and remove the panel carefully to access the internal connectors (
3.
4.

5. Figure 5).
6. Remove the connector from the mating sleeve in the panel.
7. Clean the connector end faces and mating sleeve in accordance with the “CLEANING CONNECTORS” Section on page 20.

8. Reinstall the connector onto the panel.
9. Reinstall the connector panel. To avoid damaging the input and output port fibers, make one or two large loops in the fibers when reinstalling the panel.

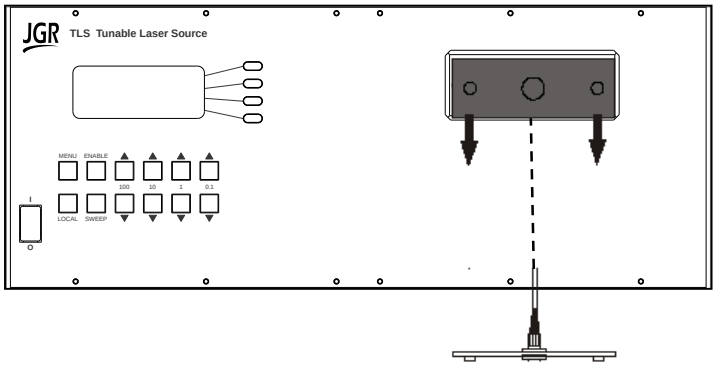

Figure 5: Removing Connector Panel

Cleaning Jumper Connectors

	Warning Connecting damaged or dirty fibers to the unit can damage the front-panel connectors of the unit. Never force an optical connector. Some connectors have a ceramic ferrule that can easily be broken.

Optical cable ends need to be cleaned before using them with the unit. The following items are required for cleaning the connector:

- Filtered compressed air or dusting gas
- Lint-free swab and lint-free towels
- Optical grade isopropyl alcohol or optical grade 200° ethanol **(do not use rubbing alcohol, which contains 30% water)**

To clean the connectors:

1. Blow the sleeve with filtered compressed air.

2. Apply optical grade isopropyl alcohol or optical grade ethanol to a small area of a lint-free towel and rub the end of the ferrule over the wet area.
3. Wipe the ferrule on a dry area of the lint-free towel.
4. Using the dusting gas or compressed air, blow the end of the ferrule.
5. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.
6. With the other end of the pipe cleaner or swab, dry the areas cleaned.
7. Using the dusting gas or compressed air, blow the areas cleaned.

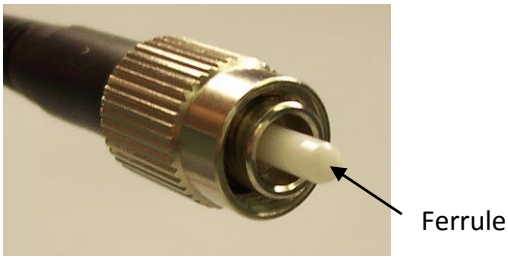

Figure 6: Connector (Connector Type May Vary)

Troubleshooting

If any problem described in this section persists, contact JGR Optics or your local representative.

Connector Issues

Front Panel Connectors

Follow the maintenance procedure described in the section: “CLEANING THE CONNECTOR ENDS” section on page 19, to ensure that the internal pigtail connectors are clean and properly connected to the front panel mating sleeve.

If cleaning is not sufficient, the FC/APC connector can be polished.

Other potential Issues

There are very few things that can go wrong with the TLS5 Tunable Source that could be solved by the user. Refer to Table 9 on next page for a list of potential problems and solutions. If problem persist, please contact JGR Optics for support.

Table 9: Front Panel Display Function

Display	*Problem*	*Solution*
	Source does not turn on	Turn OFF the unit. Connect the TLS5 Tunable laser source to a reliable power source, and wait a few minutes. Turn the unit ON.
INITIALIZING	Message is displayed for a long time	Turn OFF the unit. Connect the TLS5 Tunable Laser Source to a reliable power source, and wait a few minutes. Turn the unit ON.
SYSTEM ERROR	Internal communications error	Try to restart the TLS5 Tunable Laser Source; if the problem remains, contact JGR Optics.
END LIMIT ERROR	Source motor overrun the end limit.	The step motor may have lost reference position due to vibration or impact. Try to restart the TLS5 Tunable Laser Source; if the problem remains, contact JGR Optics.

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STORAGE AND SHIPPING

Damage can occur from improper handling during storage or shipping. Make sure to maintain the unit within the specified temperature range during storage or shipping. Please follow the recommendations below to minimize the possibility of damage:

If possible, pack the unit in its original packing material when shipping;

Avoid high humidity or large temperature fluctuations that cold generate condensation within the unit.

Avoid unnecessary shocks and vibrations.

Returning Instruments to JGR Optics

As indicated above, please ship the returned material in the original shipping box and packing material. If these are not available, follow the guidelines below:

1. Contact JGR Optics to obtain a RMA number;
2. Cover the front panel with foam to prevent damage;
3. Wrap the unit in anti-static packaging. Use anti-static connector covers;
4. Pack the unit in a strong enough shipping box considering the unit's weight;
5. Use enough shock-absorbing material (10 to 15 cm) to cushion the unit and prevent it from moving inside the box. Pink poly anti-static foam is recommended;
6. Seal the shipping box securely;
7. Clearly mark FRAGILE on at least 3 of the 4 sides of the box;
8. Always provide the model and serial number of the unit and, if necessary, the RMA number on any accompanying documentation. If possible, indicate the RMA number on the box itself to facilitate identification.

Contact Information

JGR Optics Inc.
160 Michael Cowpland Drive
Ottawa, Ontario, Canada
K2M 1P6

Phone: 613-599-1000
Fax: 613-599-1099
sales@jgroptics.com
www.jgroptics.com

A

SPECIFICATIONS

Specifications are provided here as a reference only and may be changed without notice. Please refer to JGR Optics's website for the most recent specifications.

OPTICAL / ELECTRICAL SPECIFICATIONS		
Parameter	Specification	
	CL	W
Wavelength Range (nm)	1520-1650	1260-1650
Power Stability (dB)[1]	±0.01	±0.07
FWHM (pm)	0.1	
Power Repeatability (dB)[2]	± 0.02	± 0.02
Output Power (dBm)	-5 to +5	
SMSR @ 0.1nm BW (dB)	>60	
Wavelength Stability (pm)[3]	±8	
Wavlength Accuracy (pm)	±50	
Wavelength Repeatbility (pm)	±80	
Resolution (nm)	0.1	
Tuning Speed (nm/s)[4]	25	
High Frequency Modulation (kHz)	75	
Output Type	Panda PM fiber	
Output Connector	FC / APC	
PER, PM output (dB)	18	
Communication Interfaces[5]	RS-232C, GPIB (IEEE-488.1) and BNC	
Laser Safety Classification	Class 1M	

Footnotes:

[1]over 15 minutes

[2]At constant temperature, over 100 sweeps

[3]Over 1 h at constant temperature

[4]100 nm/s available

[5]BNC for modulated Trig IN/OUT

B

REMOTE CONTROL COMMANDS

Command Syntax and Style

Program Message Formats

A program message consists of a command header, followed by its required parameters. The parameters must be separated from the command header by a space, for example, ***ESE 10**. Multiple parameters must be separated by a comma (,).

Each program message can contain one or more message units. The message units in a program message must be separated by a semicolon (;), for example, ***CLS;*ESE 10**.

Terminating a Program Message

The command terminator should be a linefeed <LF> plus EOI for GPIB, and a carriage return <CR> plus a linefeed <LF> for RS-232. No command processing occurs until a command terminator is received.

Command Header Variations

Each command header in the command tree has a long form and a short form. Both forms are acceptable and each form gives an identical response.

Examples:

:SOURCE:WAVELENGTH 1310

:SOUR:WAV 1310

:STATUS:OPERATION:ENABLE 255

:STAT:OPER:ENAB 255

The query form of a command must end with a question mark (?). A command can be entered in either uppercase characters or lowercase characters.

Specifying the Command Path

In order to use a command in the command tree, the meter must know the full path to the command. If the command is the first command in the program message, the command header must contain the full path to the command. Subsequent commands in the same program message are automatically referenced in the same path as the previous command, unless a colon (:) precedes the command's command header, in which case the full path to the command must be included in the command header.

[:SOURce]
:WAVelength <wavelength>

The following program messages are valid:

SOUR:WAV 1310;WAV?
SOUR:WAV 1310;:SOUR:WAV?
STAT:OPER:ENAB 5;ENAB?

The following program message is **NOT** valid:

SOUR:WAV 1310;SOUR:WAV?
(no colon before second command)

Default Commands

Default commands are commands that do not need to be explicitly included in the command path. If a default command for a path exists, it is enclosed by square brackets ([ ]) in the command tree. If a default command is implied in the first command of a program message, the command path for subsequent commands is determined as if the default command had been explicitly included in the first command header.

[:SOURce]
:WAVelength <wavelength>

The following program messages are valid:

SOUR:WAV 1310
WAV 1310

Implemented Status Structures

TLS5 Tunable Laser Source has the following status data structures implemented:

- IEEE 488.2 defined standard registers (standard status structure)

The 488.2 standard status structure consists of four registers:

- status byte register
- service request enable register
- standard event status register
- standard event status enable register

Note that the standard event status register and the event register are both "sticky" (i.e. once their bits are set to 1 they remain set until they are cleared by appropriate commands). The status byte register and the condition register are both dynamic and get updated when the state of the instrument or the underlying status structures change. Refer to IEEE488.2 and SCPI1999 documents for further details.

Status Byte Register

The status byte register contains the summary bits for each of the structures implemented in the meter, the master summary bit (MSB) and the request for service bit (RQS).

Status Register							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
(OSB) not used	request for service *or* master summary	event summary (ESB)	message available (MAV)	(QSB) not used	not used	not used	not used
Read with		By serial polling ***STB?**					
Written to with		Cannot be written to					
Cleared by		***CLS** common command					

- Bit 0 to Bit 3 are not used.

- Bit 4 (message available) is set to 1 when a response message is available in the output queue.

- Bit 5 (event summary bit) is the summary bit for the standard event status structure. The ESB summary message bit is set if any bit in the standard event status register is set while its corresponding value in the standard event status enable register is set.

- Bit 6, as the service request bit, is set to 1 if a service request has been generated.

  Bit 6, as the master summary bit, is set when there is at least one reason for the laser source to request service from the controller. That is, the master summary bit is set if any summary bit in the status byte register is set and if the corresponding bit in the service request enable register is also set.

- Bit 7 (operation summary bit) is not used.

Service Request Enable Register

The service request enable register determines which summary bits in the status byte register can generate service requests. If a summary bit in the status register is set to 1 and the corresponding bit in the service request enable register is set to 1, a service request is generated by the laser source. A new service request is not generated for this condition unless the bit in the status register or the bit in the service request enable register is cleared and the condition reoccurs.

Service Request Enable Register	
Read with	***SRE?** common query (the value of bit 6 is always 0)
Written to with	***SRE** common command (the value of bit 6 is always zero, regardless of the value sent with the command)
Cleared by	***SRE** common command with a parameter value of 0 Power-on

Standard Event Status Register

Standard Event Status Register							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
power on (PON)	user request (URQ)	command error (CME)	execution error (EXE)	device dependent error (DDE)	query error (QYE)	request control (RQC)	operation complete (OPC)
Read with		***ESR?** common query					
Written to with		Cannot be written to					
Cleared by		***ESR?** common query ***CLS** common command Power-on					

- Bit 0 (operation complete) is set in response to the ***OPC** common command. This bit is set when all operations are complete.
- Bit 1 (request control) is always set to 0.

- Bit 2 (query error) is set when a query error occurs, for example, an attempt is made to read the output queue when the output queue is empty or when the data in the output queue is lost.
- Bit 3 (device dependent error) is set by the laser source to indicate that an error has occurred that is not a command error, an execution error, or a query error.
- Bit 4 (execution error) is set when an execution error is detected by the laser source, for example, if a command parameter is out of the range of the meter or a valid program message cannot be executed due to some condition in the laser source.
- Bit 5 (command error) is set when a command error is detected by the laser source, for example, if a syntax error is detected in a program message, an incorrect command header is received, or if an IEEE GET message is received in the middle of a program message.
- Bit 6 (user request) is always set to 0.
- Bit 7 (power on) is set when an off-to-on transition occurs in the power supply of the laser source.

Standard Event Status Enable Register

The contents of the standard event status enable register determine which events in the standard event status register are reflected in the event summary bit (ESB) of the status byte register.

Standard Event Status Enable Register	
Read with	***ESE?** common query
Written to with	***ESE** common command
Cleared by	Power-on ***ESE** common command with a parameter 0

Queues

Input Queue

The input queue in the TLS5 Tunable Laser Source is a first-in-first-out (FIFO) queue and is 128 characters in length. Data bytes received from the controller are placed in the input queue in the order received. When a full message is received, it is transferred to the parser.

If the input queue becomes full while the GPIB is being used, the data acknowledge signal (DAQ) is not sent to the GPIB controller until a character is transferred from the input buffer to the parser. This ensures that no bytes in the program message are lost. However, the RS232C interface has no DAQ signal and

cannot be signaled when the input queue becomes full. Therefore, characters sent to the TLS5 Source are lost.

If a new program message is received before the response to a query in a previous message is read, the output queue is cleared, MAV is set to false, and the query error bit is set. This error is also referred to as an unterminated error.

Output Queue

Responses to query messages are placed in the output queue. This queue is 128 characters in length. When a response is placed in the output queue, the MAV bit in the status register is set. The MAV bit is cleared when the response is sent.

Response messages are always terminated with the sequence <LF> and, if the response is being sent through the GPIB, the EOI signal is set to true when the last character in a response is sent.

If an attempt is made to read the output queue when it is empty and the current program message does not contain a query, a query error bit is set.

Error Queue

The error queue is where errors are placed and it can contain up to 10 error messages. Because it is a FIFO queue, the error returned when the error queue is read is always the first error that occurred.

If more than 10 errors are put in the error queue, an overflow error occurs and the last error in the queue is overwritten with error number -350 (Queue Overflow). Each error in the queue consists of an error number and a brief error message.

Description of Error Numbers

0	No error

No error has occurred.

-100	Command error

A command error was detected, but the parser cannot be more specific.

-130	Suffix error

An error was detected in the suffix sent with the command, but the parser cannot be more specific.

-220	Parameter error

An error was detected in a parameter, but the control block cannot be more specific.

-240	Hardware error

A hardware error was detected, but the control block cannot be more specific.

-330	Self-Test error

The device failed a self-test.

-350	Queue overflow

The error queue has overflowed, and an error has occurred that cannot be recorded.

-400	Query error

A query error was detected, but the parser cannot be more specific.

IEEE 488.2 Common Commands and the SCPI Command Tree

IEEE 488.2 Common Commands

Command	Parameter	Response	Minimum	Maximum
*CLS	N/A	N/A	N/A	N/A
*ESE	Integer	N/A	0	255
*ESE?	N/A	Integer	0	255
*ESR?	N/A	Integer	0	255
*IDN?	N/A	String	N/A	N/A
*OPC	N/A	N/A	N/A	N/A
*OPC?	N/A	Integer	1	1
*RST	N/A	N/A	N/A	N/A
*SRE	Integer	N/A	0	255
*SRE?	N/A	Integer	0	255
*STB?	N/A	Integer	0	255
*TST?	N/A	Integer	0	1
*WAI	N/A	N/A	N/A	N/A

SCPI Command Tree

All commands other than the IEEE 488.2 common commands are listed in the following table.

Command	Parameters	Response
[:SOURce]		
:ENABle	Boolean	
:ENABle?		Boolean
:WAVelength	Num Val| MIN|MAX	
:WAVelength?	None|MIN|MAX	Num Val
:SWEEP		
:START		
:WAV	Num Val| MIN|MAX	
:WAV?	None|MIN|MAX	Num Val
:STOP		
:WAV	Num Val| MIN|MAX	
:WAV?	None|MIN|MAX	Num Val
:STEP	Num Val	
:STEP?		Num Val
:DELAY	Num Val	
:DELAY?		Num Val
:TRIGIN	Boolean	
:TRIGIN?		Boolean
:RAMP	Boolean	
:RAMP?		Boolean
:STATus		
:OPERation		
[:EVENt]?		Num Val
:CONDition?		Num Val
:ENABle	Num Val	
:ENABle?		Num Val
:NTRansition	Num Val	
:NTRansition?		Num Val
:PTRansition	Num Val	

:PTRansition?		Num Val
:QUEStionable		
[:EVENt]?		Num Val
:CONDition?		Num Val
:ENABle	Num Val	
:ENABle?		Num Val
:NTRansition	Num Val	
:NTRansition?		Num Val
:PTRansition	Num Val	
:PTRansition?		Num Val
:PRESet		
:SYSTem		
:ERRor[:NEXT]?		Num Val, String
:VERSion?		String
:CAPability?		String
:COMMunicate :GPIB [:SELF] :ADDRess	Num Val	
:COMMunicate :GPIB [:SELF] :ADDRess?		Num Val
SPECial:REBoot		
ABORt		
INITiate [:IMMediate][:ALL]		

Description of Individual Commands

IEEE-488.2 Common Commands

Clear Status Command

Syntax	***CLS**
Function	Clears the following queues and registers: • Error queue • Standard event status register • Status byte register • Operation event register • Questionable event register If ***CLS** is sent immediately after a message terminating sequence, both the output queue and the MAV bit in the status byte register are cleared.
Example	***CLS**

Standard Event Status Enable Register Command

Syntax	***ESE**<space><numeric value> where 0 ≤ <numeric value> ≤ 255
Function	Sets the bits in the standard event status enable register. The numeric value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	***ESE 97** sets the standard event status enable register bits to 01100001.

Standard Event Status Enable Register Query

Syntax	***ESE?**
Function	Returns the contents of the standard event status enable register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	***ESE?** returns 97 if the standard event status enable register is set to 01100001.

Standard Event Status Register Query

Syntax	***ESR?**
Function	Returns the contents of the standard event status register as an integer that, when converted to a binary number, represents the bit values of the register. The standard event status register is cleared after ***ESR?** command.
Example	***ESR?** returns 195 if the standard event status register is set to 11000011.

Identification Query

Syntax	***IDN?**
Function	The ***IDN** query returns a string value which identifies the manufacturer, instrument type and firmware version.
Example	***IDN?** Returns "JGR Optics Inc., BR5, XXXXXXX, Y.YY" **Where:** <XXXXXXX> = device serial number <Y.YY> = firmware revision number

Operation Complete Command

Syntax	***OPC**
Function	Causes the source to set the OPC bit in the standard event status register when all pending operations have been completed.
Example	***OPC**

Operation Complete Query

Syntax	***OPC?**
Function	Places a "1" in the output queue of the source when all pending operations have been completed. Because the "1" is not always placed in the output queue immediately, the status byte register should be polled and the MAV bit checked to determine if there is a message available in the output queue.
Example	***OPC?**

Reset Command

Syntax	***RST**
Function	Source is reset to the power-on condition.
Example	***RST**

Service Request Enable Command

Syntax	***SRE**<space><numeric value> where 0 ≤ <numeric value> ≤ 63 and 128 ≤ <numberic value> ≤ 191.
Function	Sets the bits in the service request enable register. The numeric value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	***SRE 154** sets the service request enable register bits to 10011010.

Service Request Enable Query

Syntax	***SRE?**
Function	Returns the contents of the service request enable register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	***SRE?** returns 154 if the service request enable register is set to 10011010.

Read Status Byte Query

Syntax	***STB?**
Function	Returns the contents of the status byte register as an integer that, when converted to a binary number, represents the bit values of the register. The bit value for bit 6 of the register is the MSS bit value, not the RQS bit value.
Example	***STB?** returns 170 if the status byte register is set to 10101010.

Self-Test Query

Syntax	***TST?**
Function	Initiates a self-test of the source and returns 0 if the source passes the self-test or 1 if it fails.
Example	***TST?**

*WAI Command

Syntax	***WAI**
Function	Prevents the source from executing any further commands or queries until all previously pending operations have been completed. There are no consequences to this command because all commands are executed sequentially; therefore, any subsequent commands are completed by the time this command is parsed.
Example	***WAI**

SCPI Commands

[:SOURce]:ENABle

Syntax	[:SOURce]:ENABle<space>[0|1] OR [OFF|ON]
Function	This command sets the state of the laser. • **False or OFF:** Turns OFF the laser • **True or ON:** Turns ON the laser
Example	**ENAB ON** turns ON the laser.

[:SOURce]:ENABle?

Syntax	[:SOURce]:ENABle?
Function	Returns the current status of the laser. • **False or OFF:** Laser is OFF • **True or ON:** Laser is ON
Example	**ENAB?** returns ON or True if the laser is ON.

[:SOURce]:WAVelength

Syntax	[:SOURce]:WAVelength<space>[wavelength|MIN|MAX]
Function	Switches to a specified or next available wavelength. • **wavelength:** switches to the specified wavelength in nm. Other units can be specified • **MIN or MAX:** switches to the first or last wavelength respectively.
Example	**WAV 1550** switches the meter's output to 1550 nm.

[:SOURce]:WAVelength?

Syntax	[:SOURce]:WAVelength?<space>[MIN|MAX]
Function	Returns the current or specified output source wavelength in nm • **No parameter:** returns the current wavelength • **MIN or MAX:** returns the first or last wavelength respectively.
Example	**WAV? MIN** returns: 1310.

[:SOURce]:SWEEP:START

Syntax	[:SOURce]:SWEEP:START
Function	Starts the wavelength sweep
Example	SWEEP:START

[:SOURce]:SWEEP:START:WAV

Syntax	[:SOURce]:SWEEP:START:WAV<space>[wavelength|MIN|MAX]
Function	Sets the start wavelength of the sweep mode. • **wavelength:** set the start wavelength of the sweep mode to the wavelength specified • **MIN or MAX:** sets the start wavelength of the sweep mode to the first or last wavelength
Example	**SWEEP:START:WAV 1310** sets the sweep start wavelength to 1310 nm.

[:SOURce]:SWEEP:START:WAV?

Syntax	[:SOURce]:SWEEP:START:WAV?
Function	Returns the current start wavelength of the sweep mode.
Example	**SWEEP:START:WAV?** Returns 1260 for example which could be the minimum wavelength of the laser, 1260 nm.

[:SOURce]:SWEEP:STOP

Syntax	[:SOURce]:SWEEP:STOP
Function	Stops the wavelength sweep
Example	SWEEP:STOP

[:SOURce]:SWEEP:STOP:WAV

Syntax	[:SOURce]:SWEEP:STOP:WAV<space>[wavelength|MIN|MAX]
Function	Sets the stop wavelength of the sweep mode. • **wavelength:** sets the stop wavelength of the sweep mode to the wavelength specified • **MIN or MAX:** sets the stop wavelength of the sweep mode to the first or last wavelength
Example	**SWEEP:STOP:WAV 1570** sets the sweep stop wavelength to 1570 nm.

[:SOURce]:SWEEP:STOP:WAV?

Syntax	[:SOURce]:SWEEP:STOP:WAV?
Function	Returns the current stop wavelength of the sweep mode.
Example	**SWEEP:STOP:WAV?** Returns 1619 for example which could be the maximum wavelength of the laser, 1619 nm.

[:SOURce]:SWEEP:STEP

Syntax	[:SOURce]:SWEEP:STEP<space>[step]
Function	Sets the sweep wavelength step of the sweep mode in nm
Example	**SWEEP:STEP 10** Sets the wavelength step of the sweep mode to 10 nm

[:SOURce]:SWEEP:STEP?

Syntax	[:SOURce]:SWEEP:STEP?
Function	Returns the current or specified sweep wavelength step of the sweep mode in nm
Example	**SWEEP:STEP?** Returns the wavelength step of the sweep mode, for example 10 nm

[:SOURce]:SWEEP:DELAY

Syntax	[:SOURce]:SWEEP:DELAY<space>[delay]
Function	Sets the delay between each wavelength step, in ms. This delay will be added to each wavelength step no matter if the TRIGIN function is activated or not.
Example	**SWEEP:DELAY 500** Sets a delay of 500 ms between each wavelength step

[:SOURce]:SWEEP:DELAY?

Syntax	[:SOURce]:SWEEP:DELAY?
Function	Returns the current or specified delay between each wavelength step in ms
Example	**SWEEP:DELAY?** returns: 500 for a 500 ms delay between each wavelength step

[:SOURce]:SWEEP:TRIGIN

Syntax	[:SOURce]:SWEEP:TRIGIN
Function	This command is used to enable the TRIG IN mode. Refer to the Sweep mode section in the manual for more information. • **False or OFF:** Disables the TRIG IN mode • **True or ON:** Enables the TRIG IN mode
Example	**SWEEP:TRIGIN ON** enables the TRIG IN mode

[:SOURce]:SWEEP:TRIGIN?

Syntax	[:SOURce]:SWEEP:TRIGIN?
Function	This command returns the status of the TRIG IN mode. Refer to the Sweep mode section in the manual for more information. • **False or OFF:** TRIG IN mode is Disabled • **True or ON:** TRIG IN mode is Enabled
Example	**SWEEP:TRIGIN?** Returns True or ON if TRIGIN mode is enabled

[:SOURce]:SWEEP:RAMP

Syntax	[:SOURce]:SWEEP:RAMP
Function	This command is used to enable the RAMP mode. Refer to the Sweep mode section in the manual for more information. • **False or OFF:** Disables the RAMP mode • **True or ON:** Enables the RAMP mode
Example	**SWEEP:RAMP ON** enables the RAMP mode.

[:SOURce]:SWEEP:RAMP?

Syntax	[:SOURce]:SWEEP:RAMP?
Function	This command returns the status of the RAMP mode. Refer to the Sweep mode section in the manual for more information. • **False or OFF:** RAMP mode is Disabled • **True or ON:** RAMP mode is Enabled
Example	**SWEEP:RAMP?** Returns True or ON if RAMP mode is enabled.

:STATus:OPERation[:EVENt]?

Syntax	:STATus:OPERation[:EVENt]?
Function	This command reads the value of the Operation Status Event Register. Only Bit 1 is used in TLS5.
Example	**:STATus:OPERation[:EVENt]?** returns 2 if an event was detected

:STATus:OPERation:CONDition?

Syntax	:STATus:OPERation:CONDition?
Function	This command reads the value of the Operation Status Condition Register. Only Bit 1 is used.
Example	**:STATus:OPERation:CONDition?** returns 2 if sweep motor has not settled

:STATus:OPERation:ENABle

Syntax	:STATus:OPERation:ENABle
Function	This command determines which bits in the Standard Operation Event Register will set the Standard Operation Status Summary bit in the Status Byte Register.
Example	**:STATus:OPERation:ENABle 32767** sets the summary bit to 15

:STATus:OPERation:ENABle?

Syntax	:STATus:OPERation:ENABle?
Function	This command gets which bits in the Standard Operation Event Register will set the Standard Operation Status Summary bit in the Status Byte Register
Example	**:STATus:OPERation:ENABle?** Returns 32767

:STATus:OPERation:NTRansition

Syntax	:STATus:OPERation:NTRansition
Function	This command determines which bits in the Status Operation Condition Register will set the corresponding bit in the Standard Operation Event Register when that bit has a negative transition
Example	**:STATus:OPERation:NTRansition 2** sets bit 1 as the corresponding bit

:STATus:OPERation:NTRansition?

Syntax	:STATus:OPERation:NTRansition?
Function	This command gets which bits in the Status Operation Condition Register will set the corresponding bit in the Standard Operation Event Register when that bit has a negative transition
Example	**:STATus:OPERation:NTRansition?** Returns 2

:STATus:OPERation:PTRansition

Syntax	:STATus:OPERation:PTRansition
Function	This command determines which bits in the Standard Operation Condition Register will set the corresponding bit in the Standard Operation Event Register when that bit has a positive transition (0 to 1).
Example	**:STATus:OPERation:PTRansition 2** sets bit 1 as the corresponding bit

:STATus:OPERation:PTRansition?

Syntax	:STATus:OPERation:PTRansition?
Function	This command gets which bits in the Standard Operation Condition Register will set the corresponding bit in the Standard Operation Event Register when that bit has a positive transition (0 to 1).
Example	**:STATus:OPERation:PTRansition?** Returns 2

:STATus:QUEStionable[:EVENt]?

Syntax	:STATus:QUEStionable[:EVENt]?
Function	Returns the decimal sum of the bits in the Data Questionable Event Register.
Example	**:STATus:QUEStionable[:EVENt]?** Returns 2 if only bit 1 is set to 1

:STATus:QUEStionable:CONDition?

Syntax	:STATus:QUEStionable:CONDition?
Function	Returns the decimal sum of the bits in the Data Questionable Condition Register.
Example	**:STATus:QUEStionable:CONDition?** Returns 2 if only bit 1 is set to 1

:STATus:QUEStionable:ENABle

Syntax	:STATus:QUEStionable:ENABle
Function	This command determines which bits in the Data Questionable Event Register will set the Data Questionable Status Group Summary bit in the Status Byte Register.
Example	**:STATus:QUEStionable:ENABle 2** Sets bit 1

:STATus:QUEStionable:ENABle?

Syntax	:STATus:QUEStionable:ENABle?
Function	This command gets which bits in the Data Questionable Event Register will set the Data Questionable Status Group Summary bit in the Status Byte Register.
Example	**:STATus:QUEStionable:ENABle?** Returns 2 if only bit 1 was selected

:STATus:QUEStionable:NTRansition

Syntax	:STATus:QUEStionable:NTRansition
Function	This command determines which bits in the Data Questionable Condition Register will set the corresponding bit in the Data Questionable Event Register when that bit has a negative transition (1 to 0).
Example	**:STATus:QUEStionable:NTRansition 2** Sets bit 1 as corresponding bit

:STATus:QUEStionable:NTRansition?

Syntax	:STATus:QUEStionable:NTRansition?
Function	This command gets which bits in the Data Questionable Condition Register will set the corresponding bit in the Data Questionable Event Register when that bit has a negative transition (1 to 0).
Example	**:STATus:QUEStionable:NTRansition?** Returns 2 if only bit 1 was selected

:STATus:QUEStionable:PTRansition

Syntax	:STATus:QUEStionable:PTRansition
Function	This command determines which bits in the Data Questionable Condition Register will set the corresponding bit in the Data Questionable Event Register when that bit has a positive transition (0 to 1).
Example	**:STATus:QUEStionable:PTRansition 2** Sets bit 1 as corresponding bit

:STATus:QUEStionable:PTRansition?

Syntax	:STATus:QUEStionable:PTRansition?
Function	This command gets which bits in the Data Questionable Condition Register will set the corresponding bit in the Data

	Questionable Event Register when that bit has a positive transition (0 to 1).
Example	**:STATus:QUEStionable:PTRansition?** Returns 2 if only bit 1 was selected

:STATus:PRESet

Syntax	:STATus:PRESet
Function	This command initializes all the status registers: OPERation_ENABle = 0x7fff (32767); QUEStionable_ENABle = 0x7fff (32767); OPERation_PTRansition = 0x7fff (32767); QUEStionable_PTRansition = 0x7fff (32767); OPERation_NTRansition = 0; QUEStionable_NTRansition = 0;
Example	**:STATus:PRESet**

:SYSTem:ERRor?

Syntax	:SYSTem:ERRor?
Function	Returns the error number and an error message from the error queue. See the **Error Queue** section, for a list of error numbers and their associated messages.
Example	**:SYST:ERR?** returns: 0, “No error”.

:SYSTem:VERSion?

Syntax	:SYSTem:VERSion?
Function	Returns the formatted numeric value the of the SCPI version number.
Example	**:SYST:VERS?** returns: 1999.0**.**

:SYSTem:CAPability?

Syntax	:SYSTem:CAPability?
Function	Returns the string specifying the capability of the device.

Example	**:SYSTem:CAPability?** returns: OPTICAL INSTRUMENT

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess

Syntax	:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess<space><numeric_value>
Function	Sets the GPIB address. The factory-set GPIB address is 21. When the address is changed, the interface immediately responds to the new address.
Example	:SYST:COMM:GPIB:ADDR 7

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess?

Syntax	:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess?
Function	Returns the GPIB address.
Example	:SYST:COMM:GPIB:ADDR? returns 7.

:SPECial:REBoot

Syntax	:SPECial:REBoot
Function	Automatically reboots the unit
Example	**:SPECial:REBoot**

:ABORt

Syntax	:ABORt
Function	This command aborts the sweep sequence and changes the trigger to idle state.
Example	**:ABORt**

:INITiate[IMMediate][:ALL]

Syntax	:INITiate[IMMediate][:ALL]
Function	Initiates the Trigger mode, when the sweep sequence is completed after in trig signal, the Trigger mode goes back to idle
Example	**:INITiate[IMMediate][:ALL]**