



# **OA5 Optical Programmable Attenuators**

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## **User Manual**

All information contained herein is believed to be accurate and is subject to change without notice. No responsibility is assumed for its use.

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# 1

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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 Electro technical 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 over voltages 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 CE certified 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.

# 2

## GENERAL INFORMATION

### OA5 Optical Programmable Attenuators Overview

This User Manual for the OA5 attenuators contains complete operating instructions.

OA5 Programmable Optical Attenuators enable precise optical power control and feature high accuracy and superior repeatability. They are ideal for lab and production applications including power level adjustment in automated test systems, BER testing of transmitters and receivers, and channel equalization in WDM systems.

The OA5 Optical Attenuators are available for single-mode and multimode fibers and can be configured for various wavelength ranges and input power levels.



Figure 1: OA5 Optical Programmable Attenuator

### Key Features

- Attenuation range as high as 100 dB with a Long range single mode model
- Wide wavelength range model to cover 750 to 1700 nm
- Compatible with new Flexcore (5/125 um) fiber
- RS-232, IEEE 488 GPIB and USB (via USB-DB9 adapter) interfaces



## **Applications**

- Bit-error-rate (BER) testing
- Link loss simulation
- WDM channel equalization

## **Accessories**

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



# 3

## 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. Observe all safety instructions that are associated with a symbol.

**Table 1: Safety Symbols**


	<p>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.</p>
	<p>Frame or chassis terminal for electrical grounding within the unit.</p>
	<p>Protective conductor terminal for electrical grounding to the earth.</p>
<p>WARNING</p>	<p>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.</p>
<p>CAUTION</p>	<p>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.</p>

## Classification


OA5 Optical Programmable Attenuators consist of an exposed metal chassis that are connected directly to earth via a power cord and, therefore, are classified as Class 1 instruments.

## Important Safety Information

### Laser Hazards

	<p><b>Warning</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>
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### Electrical Shock Hazards

	<p><b>Warning</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.</li> <li>• 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.</li> </ul>
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	<ul style="list-style-type: none"><li>• Do not operate the unit when its cover or panels have been removed.</li><li>• To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.</li><li>• Do not use the unit outdoor.</li><li>• Operating the unit in the presence of flammable gases or fumes is extremely hazardous.</li><li>• 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.</li><li>• Some of the unit's capacitors can be charged even when the unit is not connected to the power source.</li><li>• Do not perform any operating or maintenance procedure that is not described in the User Manual.</li></ul>
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# 4

## GETTING STARTED

**Caution**

To avoid injury or death, always observe the precautions listed in “SAFETY INFORMATION” section on page **Error!**  
**Bookmark not defined..**

This manual contains complete operating instructions for safe and effective operation of the OA5 Programmable Optical Attenuator. It is recommended that users of the OA5 Attenuator 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:
  - OA5 Programmable Optical Attenuator
  - 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 (for more information, see *Front Panel*, on page 14) to initialize the OA5 attenuator, and observe the power-up sequence:
    - Model number and firmware version of the attenuator are displayed.
    - The message “Initializing” should follow momentarily.
    - Set the power switch to OFF and disconnect the attenuator.
- ☑ 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

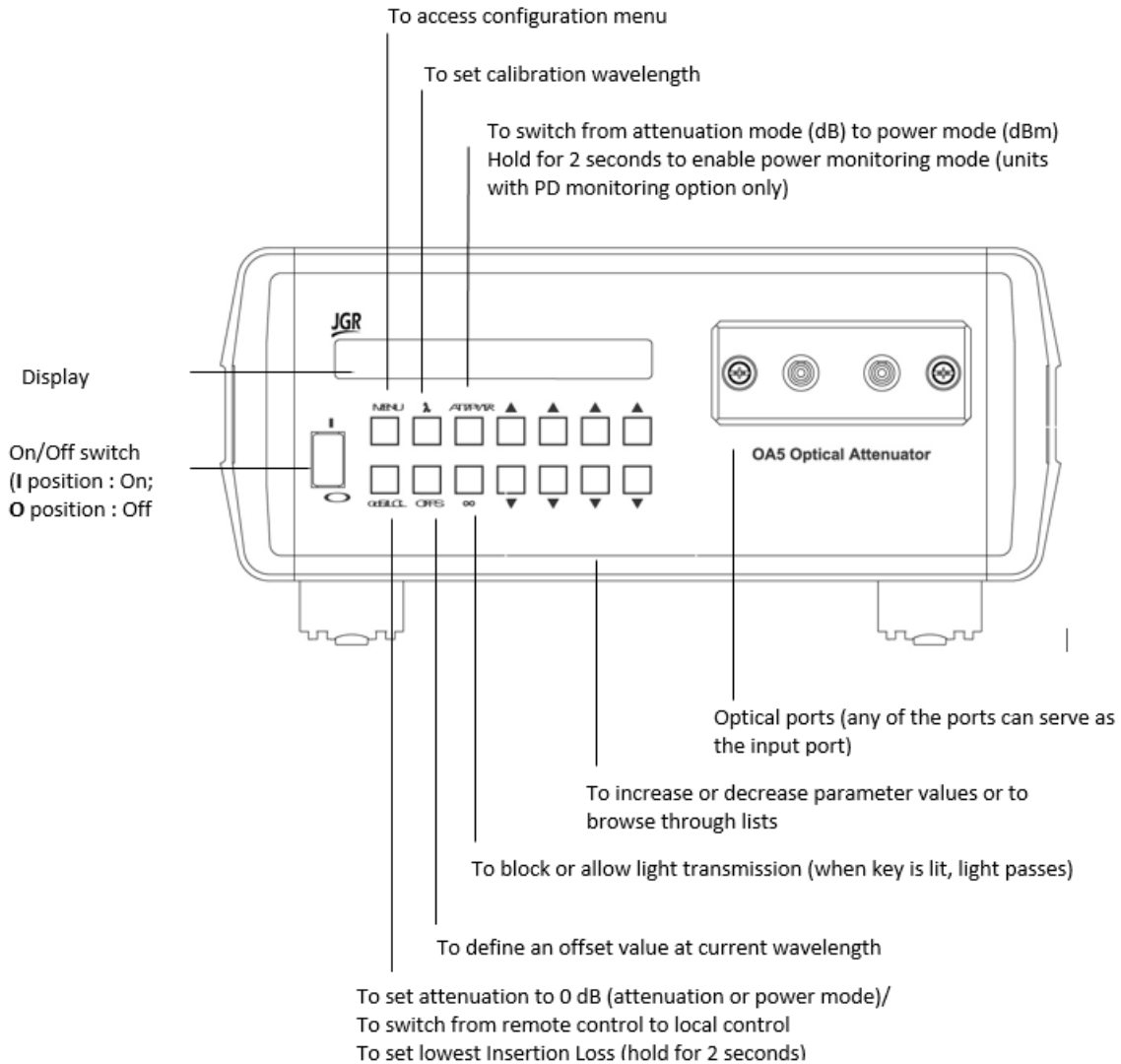
In order for the unit to meet the warranted specifications, the operating environment must meet the following conditions for altitude, temperature, humidity, and voltage.

**Table 2: Environmental Requirements**

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

## Product Overview

### Front Panel



Note: Except for the On/Off switch and the arrow keys, the main keys light up when the associated features are in use.

Figure 2: Front of the attenuator

Back Panel

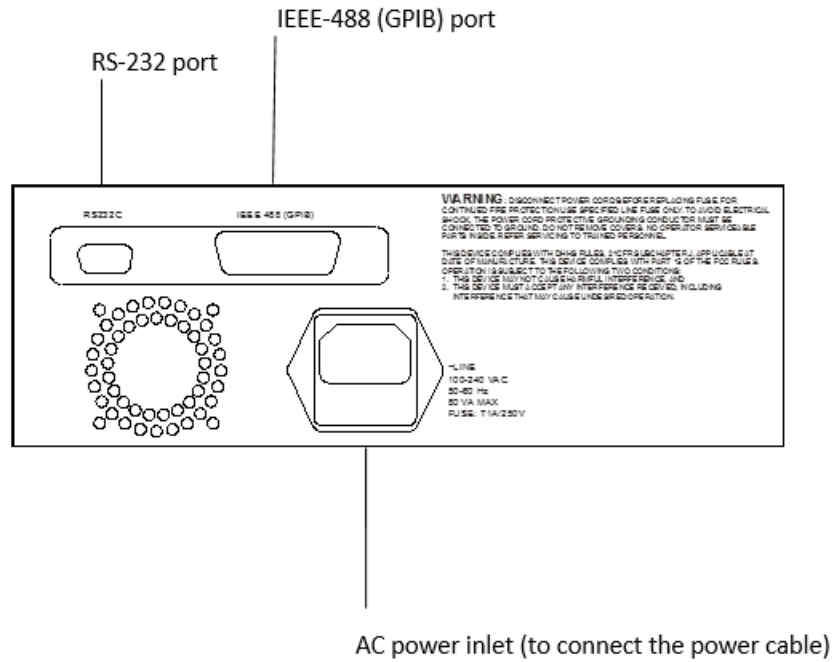



Figure 3: Back of the attenuator

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## OPERATION

### Turning the Unit On and Off

When you turn on your unit, the various parameters such as the state of the beam block and the operation mode will correspond either to the factory values or to those that you have set to better suit your needs.

	<p><b>Warning</b></p> <p>To avoid damaging your unit if it is equipped with the high-power attenuator option, proceed as follows:</p> <p>Ensure that the unit is at room temperature before turning it on.</p> <p>Allow the unit to warm up for a period of 30 minutes before connecting a laser output at full-rated power.</p> <p>Initially, the unit is set to about 10 dB to 40 dB of attenuation. Avoid setting the unit to values close to 0 dB for the first few minutes of use with the beam block in Off position (light coming out of the port).</p> <p>To further reduce the risk of damage, if the source you are using allows it, increase the source power gradually over a period of several minutes until the unit's maximum rated power is reached.</p>
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**To turn the unit on:**

- Connect the unit to a power source using the provided power cord.
- Flip the On/Off switch to the On position (for more information, see *Front Panel*, on page 14).

The model number and firmware version of the attenuator are displayed. The message “Initializing” should follow momentarily.

**To turn the unit off:**

Flip the On/Off switch to the Off position (for more information, see *Front Panel*, on page 14).



## Modifying Settings with the User Menu

The user menu gives you access to additional settings for unit:

- Baud rate (for the RS-232 communication)
- GPIB address
- State of the beam block (shutter) at startup of the unit
- Behavior of the attenuation value (fixed or variable) when wavelength varies

The access to these settings is sequential, which means that you have to view all settings, in turn, until you reach the one that you want to modify.

### To modify settings with the user menu:

1. From the unit's front panel, press the MENU key.

The key will light up and the word "--Menu--" will be displayed to indicate that you have now access to the settings.

2. Press the MENU key as many times as necessary to view the setting that you want to modify.
3. Use the rightmost ▲ and ▼ keys to select the desired value.

Note: Even though there are four sets of ▲ and ▼ keys on the front panel of your unit, only the rightmost keys can be used in the user menu.

4. Repeat steps 2 and 3 with all the settings that need changes.
5. Press the MENU key as many times as necessary to reach the end of the menu.
6. If you are prompted to confirm the changes, proceed as follows:
  - a. Use the rightmost ▲ and ▼ keys until **Yes** or **No** is displayed, depending on if you want to keep the changes or discard them.
  - b. Press the MENU key one last time to confirm or discard the changes.

## Selecting the Operation Mode

Your unit supports two operation modes:

- Attenuation: Values are expressed in dB. By default, the displayed attenuation value is relative to the unit's internal reference attenuation value of 0 dB.
- Output power: Values are expressed in dBm. This could be useful to easily enter the power of the source used for the test.

### To select the operation mode:

From the unit's front panel, press the ATT/PWR key until **dB** or **dBm** appears on the display.

## Operating the Beam Block (Optical Shutter)

Your unit is equipped with a beam block which is an internal device that completely blocks the transmission of light when it is activated.

By default, at startup of the unit, the beam block is activated (no light is transmitted) for safety reasons. However, it is possible to configure your unit so that the next time you start it, the beam block remains in the same state it was the last time you worked with your unit.

### To block or allow light transmission:

From the unit's front panel, press the  $\infty$  key.

When the light transmission is blocked, the  $\infty$  key is lit and the letters "**BLK**" appear on the display.

### To change the default state of the beam block:

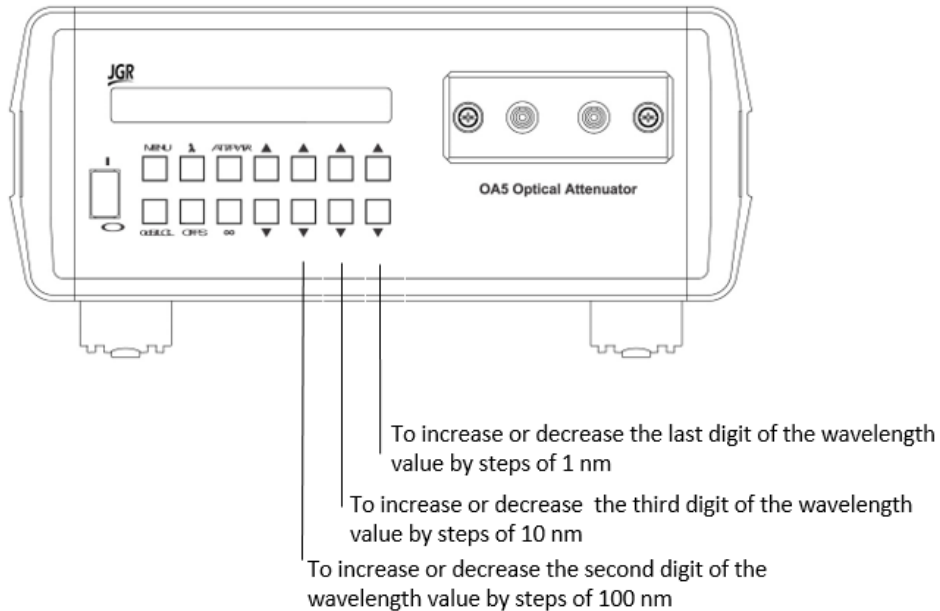
1. From the unit's front panel, press the MENU key to access the user menu. For more information on how to work with the user menu, see *Modifying Settings with the User Menu*, on page 17.
2. Go to the **BBLOCK PWON** setting.
3. Select **ON** to prevent light transmission when the unit is started, or **LST** to keep the last state of the beam block.
4. Save your changes.

## Adjusting the Calibration Wavelength

You can adjust the calibration wavelength of your unit to the corresponding wavelength of your light source for optimum accuracy.

### To adjust the calibration wavelength:

1. From the unit's front panel, press the  $\lambda$  key. The current attenuation or power value is displayed next to the calibration wavelength.
2. Using the desired  $\blacktriangle$  and  $\blacktriangledown$  keys, set the calibration wavelength. The displayed attenuation or power value is adjusted automatically according to the new calibration wavelength.



3. Confirm the new setting by pressing the ATT/PWR key.

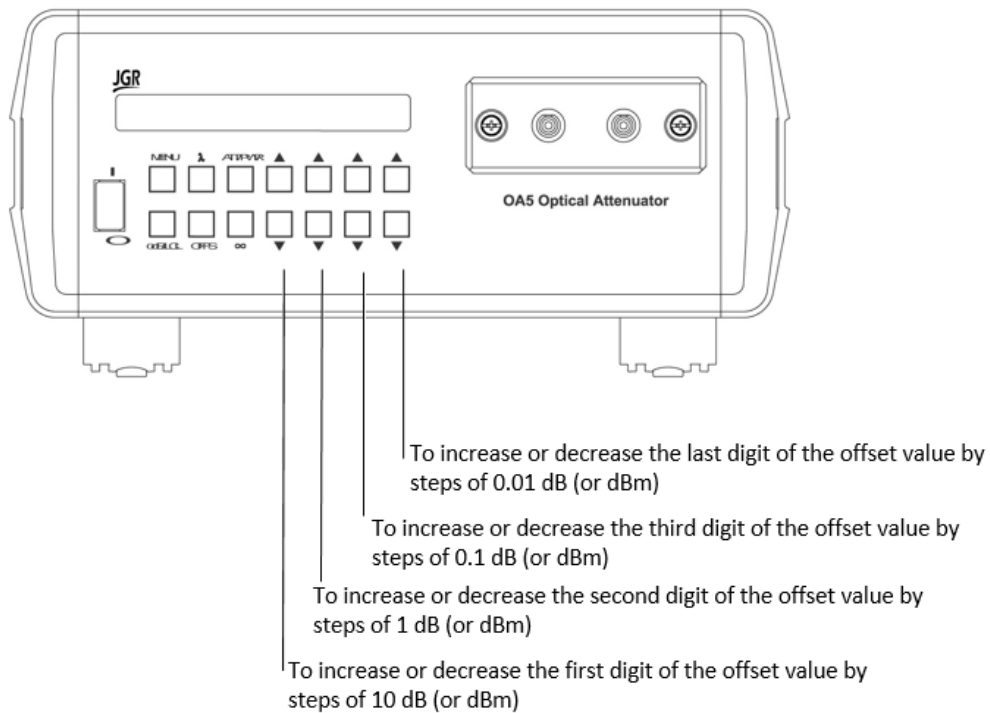
## Defining Offset Values

You may want to define an offset value to take into account any losses in the connected fibers (attenuation mode), or to ensure that the displayed power (power mode) reflects the readings of an actual power meter.

Your unit can store one offset value for the attenuation mode, and one for the power mode.

### To define offset values:

1. Ensure that the unit is in attenuation or power mode, depending on the offset that you want to define. If necessary, press the ATT/PWR key until **dB** or **dBm** appears on the display.
2. From the unit's front panel, press the OFFS key.
3. If you want to quickly set the offset to 0 dB, press the 0 dB/LCL key or use the desired **▲** and **▼** keys, set the offset value.



4. Confirm the new setting by pressing the ATT/PWR key.

## Defining the Attenuation Behavior as a Function of Wavelength (LC Mode)

The total attenuation can be presented in two ways.

- Normal (default behavior): The total attenuation value varies with the selected wavelength.
- LCM On: The total attenuation value remains the same even when you change the wavelength (the unit's internal components are repositioned to take into account the new wavelength). In this case, a caret ("^") sign is displayed at the right of the wavelength to indicate that the unit is in LC mode and that the attenuation value remains the same regardless of the selected wavelength.

### To define the attenuation behavior:

1. From the unit's front panel, press the MENU key to access the user menu. For more information on how to work with the user menu, see *Modifying Settings with the User Menu*, on page 17.
2. Go to the **WL MODE** setting.
3. Select **NORMAL** if you want the attenuation value to vary with the wavelength, or **LCM ON** to keep the same attenuation value regard.
4. The Wavelength Mode is reset to Normal on Power On.

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## PROGRAMMING GUIDE

### Setting up for RS-232, USB or GPIB communication

The OA5 Optical Programmable Attenuators may be remotely controlled via GPIB (IEEE-488) and RS-232 interface. The GPIB interface of the attenuator 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.

In order to establish communication between the computer and the meter, the RS-232 bus or the GPIB bus must be configured properly as explained below.

### JDSU Compatibility

The OA5 command set is compatible with JDSU's HA9 Extended Range Programmable Optical Attenuator. Refer to the HA9 Manual for the list of available commands.

### Programming over GPIB

The OA5 Optical Programmable Attenuators support the IEEE-488.1(1978) interface standard. They also support the mandated common commands of IEEE-488.2(1987) standard. Before attempting to communicate with an OA5 attenuator via the GPIB interface, the device address must be set. This address can be set from the user menu. For more information, see *Modifying Settings with the User Menu*, on page 17.

### Programming over RS-232

In order to establish a serial communication between the computer and the OA5, the computer's COM port must be configured as described in Table 9. The baud rate can be set from the user menu. For more information, see *Modifying Settings with the User Menu*, on page 17.

To connect the OA5 Attenuator 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 OA5 Optical Programmable Attenuator via USB by using a USB to DB9 adapter cable. The same RS-232 commands are used for USB communication.

**Table 3: Serial Communication Settings**

Transmission Rate	Selectable in the "User Menu". Available options are 300, 1200, 2400, 9600, 19200 and 38400 Baud
Data bit	8
Parity	N
Stop bits	1
Flow Control	None

### Switching Back to Local Mode

When the unit is controlled remotely, you can switch back to local mode at any time. To switch back to local mode, from the unit's front panel, press the 0 dB/LCL key.

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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 21.
  2. Loosen the retaining screws of the connector panel, and remove the panel carefully to access the internal connectors (Figure 4).
  3. Remove the connector from the mating sleeve in the panel.
  4. Clean the connector end faces and mating sleeve in accordance with the “CLEANING CONNECTORS” Section on page 21.
  5. Reinstall the connector onto the panel.
  6. 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.
- 1.
  - 2.
  - 3.



4.



5.

**Figure 4: Removing Connector Panel**

6.

### 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.

- Using the dusting gas or compressed air, blow the areas cleaned.

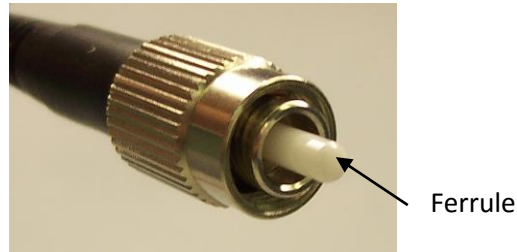


Figure 5: Connector (Connector Type May Vary)

## Replacing Fuses

OA5 Optical Programmable Attenuators are protected with a fuse which is located at the back of the unit near the power inlet. The fuse type used is 5 x 20 mm, 1 A/250 V (slow blow/time delay).



### Warning

Use only the type of fuse specified by JGR Optics as appropriate for this unit. Do not use “repaired” fuses, and avoid any situations that can short-circuit the fuse.

To avoid electrical fire or damaging the unit, only replace the fuse with one of the same size and rating.

Always turn off the unit before replacing the fuse.

There are no user-serviceable parts inside the OA5 Attenuators. Never open the unit: this could seriously compromise your safety as well as cause irreparable damage to your unit. Opening the unit yourself will automatically void the warranty.

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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 could 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@jgropitics.com](mailto:sales@jgropitics.com)  
[www.jgropitics.com](http://www.jgropitics.com)

# A

## SPECIFICATIONS

OPTICAL / ELECTRICAL SPECIFICATIONS					
Parameter	Specification				
	Single-mode		Multimode	High Power	Flexcore
	Long 1200-1700nm	Short 1200-1700nm	750-1700nm	1200-1700nm	980-1100nm
Attenuation Range (dB)	100	60	60	60	90
Insertion Loss (dB) <sup>1</sup> HI1060 (5 / 125μm) <sup>2</sup> SM (9 / 125μm) <sup>3</sup> MM (50 or 62.5 / 125μm) <sup>3</sup>	1.5	1.2	1.8	2.0 <sup>4</sup>	1.8
Return Loss (dB) HI1060 (5 / 125μm) SM (9 / 125μm) MM (50 or 62.5 / 125μm) <sup>5</sup>	60		35	55	55
PDL (dB)	< 0.1				
Repeatability (dB)	± 0.01				
Resolution (dB)	± 0.01				
Absolute Accuracy (dB) <sup>7</sup>	± 0.1				
Max. Optical Input Power (dBm)	23 (200mW)			30 (1W)	23 (200mW)
Beam Block (dB)	> 100				
Input Voltage	110 - 220 V AC, 50 - 60 Hz				
Interface	Front Panel / GPIB / RS232 / USB <sup>8</sup>				

<sup>1</sup> Excluding connectors and couplers.

<sup>2</sup> At 980nm and 1060nm.

<sup>3</sup> At 1550nm. 0.3 dB higher at 1310nm.

<sup>4</sup> At 1550nm 1.0dB higher at 1310nm.

<sup>5</sup> At 850nm. 0.3dB lower at 1310nm.

<sup>6</sup> At 800-1350nm.

<sup>7</sup> At calibration wavelength.

<sup>8</sup> USB interface via-USB-DB9 adapter.

MECHANICAL / ENVIRONMENTAL SPECIFICATIONS	
Parameter	Specification
Unit Dimensions W x H x D (cm)	26 x 11 x 26
Shipping Box Dimensions W x H x D (cm)	37 x 25 x 38
Unit Weight (kg)	3
Total Shipment Weight (kg)	4
Operating Temperature (°C)	0 to 40
Storage Temperature (°C)	-40 to 70
Humidity (Non-condensing) (°C)	Maximum 95% RH from 0 to 40

# 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> or <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:

:INPut:ATTenuation 10

:INP:ATT 10

: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.

```
[:INPut]
    :ATTenuation <Attenuation level in dB>
```

The following program messages are valid:

```
:INPut:ATTenuation 10;ATTenuation?
:INPut:ATTenuation 10;:INPut:ATTenuation?
:STAT:OPER:ENAB 255;ENAB?
```

The following program messages are **NOT** valid:

```
INPut:ATTenuation 10;INPut:ATTenuation?
(no colon before second command)
STAT:OPER:ENAB 5;OPER?
(ENAB command at different level than OPER?)
```

### 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.

```
[:INPut]
    :ATTenuation <Attenuation level in dB>
```

The following program messages are valid:

```
INPut:ATTenuation 10
ATTenuation 20
```

### Implemented Status Structures

There are three distinct status data structures implemented in the OA5 attenuator:

- IEEE 488.2 defined standard registers (standard status structure)
- SCPI defined operation registers (operation status structure)
- SCPI defined questionable registers (questionable 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

The operation and questionable status structures are identical except for the use of their individual bits. These status structures are each composed of five registers:

- condition register
- positive transition register (PTRansition)
- negative transition register (NTRansition)
- event register
- event enable register

The bits in the operation status structure reflect a specific condition within the attenuator. The OA5 attenuator only uses bit 2 of the condition register. Bit 2, the “Settle” bit, is set when the OA5 attenuator is in the process of adjusting the attenuation.

The bits in the questionable registers give an indication of the quality of the output of the OA5 attenuator. None of the bits in the questionable register are currently used by the attenuator.

All three status structures are connected by the status byte register. Refer to IEEE488.2 and SCPI1999 documents for the details.

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.

**Status Byte Register**

The status byte register contains the summary bits for each of the structures implemented in the attenuator, 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
operation summary (OSB)	request for service or master summary	event summary (ESB)	message available (MAV)	questionable summary (QSB)	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 is not used.
- Bit 1 is not used.
- Bit 2 is not used.
- Bit 3 (questionable summary) is the summary bit for questionable status structure. It is set if any bit in the questionable event status register is set while the corresponding bit in the questionable event enable register is set.
- 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 attenuator 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 the summary bit for the operation status register. It is set if any bit in the operation event register is set while the corresponding bit in the operation event enable register is set.



**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 attenuator. 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 attenuator 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 attenuator, for example, if a command parameter is out of the range of the attenuator or a valid program message cannot be executed due to some condition in the attenuator.
- Bit 5 (command error) is set when a command error is detected by the attenuator, 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 attenuator.

**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

**Operation and Questionable Condition Registers**

Each bit in these condition registers reflects a specific condition or state within the attenuator. A bit is set when the attenuator enters the state associated with that bit and remains set while the device is in that state.

Operation Condition Register	
Read with	STATus:OPEReration:CONDition? query
Written to with	Cannot be written to
Cleared by	Power-on

Questionable Condition Register	
Read with	STATus:QUESTionable:CONDition? query
Written to with	Cannot be written to
Cleared by	Power-on

**Operation and Questionable Event Registers**

Event registers reflect changes in the conditions of the attenuator. Each bit in the operation event register and the questionable event register is associated with a bit in the corresponding condition register. Depending on the values of the positive transition register and the negative transition register, a bit in the event register can be set when the associated bit in the condition register changes from 0 to 1, from 1 to 0, or both. If both the positive transition and negative transition bits are set to 0, the event register bit is not set on either transition.

Operation Event Register	
Read with	STATUS:OPERation:EVENT? query
Written to with	Cannot be written to
Cleared by	*CLS common command

Questionable Event Register	
Read with	STATUS:QUESTIONable:EVENT? query
Written to with	Cannot be written to
Cleared by	Power-on *CLS common command

**Operation and Questionable Event Enable Registers**

The event enable registers determine which event bits in the associated event register causes the summary message bit in the status byte register to be set. If any event bit in the event register is set while its associated bit in the event enable register is also set, the summary message bit is set to true.

Operation Event Enable Register	
Read with	STATUS:OPERation:ENABLE? query
Written to with	STATUS:OPERation:ENABLE command
Cleared by	Power-on

Questionable Event Enable Register	
Read with	STATUS:QUESTIONable:ENABLE? query
Written to with	STATUS:QUESTIONable:ENABLE command
Cleared by	Power-on

**Operation and Condition Positive Transition Register**

If a bit in the positive transition register is set, then a positive transition (a transition from 0 to 1) in the associated bit in the condition register sets the associated bit in the event register.

Operation Positive Transition Register	
Read with	STATus:OPERation:PTRansition? query
Written to with	STATus:OPERation:PTRansition command
Cleared by	Power-on

Condition Positive Transition Register	
Read with	STATus:QUEStionable:PTRansition? query
Written to with	STATus:QUEStionable:PTRansition command
Cleared by	Power-on

**Operation and Condition Negative Transition Register**

If a bit in the negative transition register is set, then a negative transition (a transition from 1 to 0) in the associated bit in the condition register causes the associated bit in the event register to be set.

Operation Negative Transition Register	
Read with	STATus:OPERation:NTRansition? query
Written to with	STATus:OPERation:NTRansition command
Cleared by	Power-on

Questionable Negative Transition Register	
Read with	STATus:QUEStionable:NTRansition? query
Written to with	STATus:QUEStionable:NTRansition command
Cleared by	Power-on



## Queues

### Input Queue

The input queue in the attenuator 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 unit 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 OA5 attenuator 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 un-terminated 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
*OPT?	N/A	String	N/A	N/A
*RCL	Integer	N/A	0	9
*RST	N/A	N/A	N/A	N/A
*SAV	Integer	N/A	1	9
*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 Status	Parameters	Response	Minimum	Maximum	Default
:INPut					
:ATTenuation	Decimal   MIN   MAX		0.00		0.00
:ATTenuation?	MAX   MIN   DEF	Decimal	0.00		0.00
:LCMode	Boolean				
:LCMode?		Decimal			
:OFFSet	Decimal   MIN   MAX		-90	90	0
:OFFSet?		Decimal	-90	90	0
:OFFSet:DISPlay					
:WAVelength	Decimal   MIN   MAX		750/1200 nm	1700 nm	1310 nm
:WAVelength?	MAX   MIN   DEF	Decimal	750/1200 nm	1700 nm	1310 nm
:ILMin					
:OUTPut					
[:STATe]	Boolean				
[:STATe]?		Boolean			
:APOWeron	Boolean				
:APOWeron?		Boolean			
:APMode	Boolean				
:APMode?		Boolean			
:POWER	Decimal   MIN   MAX		0.00		0.00
:POWER?	MAX   MIN   DEF	Decimal	0.00		0.00
:OFFSet	Decimal   MIN   MAX		-90	90	0
:OFFSet?	MAX   MIN   DEF	Decimal	-90	90	0
:UCALibration					
:USRMode	Boolean				
:USRMode?		Boolean			
:SLOPe	Decimal   MIN   MAX		0.0	2.0	1.0
:SLOPe?		Decimal			
:STATus					
:OPERation					
[:EVENT]?		Integer			
:CONDition?		Integer			
:ENABle	Integer		0	32,768	
:ENABle?		Integer			
:NTRansition	Integer		0	32,768	
:NTRansition?		Integer			
:PTRansition	Integer		0	32,768	
:PTRansition?		Integer			
:QUESTionable					



[ :EVENT ]?		Integer			
:CONDition?		Integer			
:ENABLE	Integer		0	32,768	
:ENABLE?		Integer			
:NTRansition	Integer		0	32,768	
:NTRansition?		Integer			
:PTRansition	Integer		0	32,768	
:PTRansition?		Integer			
:PRESet					
:SYSTem					
:ERRor?		Integer, String			
:VERSion?		String			
:CAPability?		String			
:COMMunicate					
:GPIB[:SELF]:ADDRess	Integer		1	30	
:GPIB[:SELF]:ADDRess?		Integer			
Power Monitoring Commands (for units with Power Monitoring PD option only)					
:OUTPut:PMON					
:POWer	Decimal   MIN   MAX		-70	15	-10
:POWer?	MIN   MAX	Decimal	-70	15	-10
:LVLing	Boolean				
:LVLing?		Boolean			
:PD:PMON:DARK		Boolean			

## 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><Integer > where $0 \leq \text{Integer} \leq 255$
Function	Sets the bits in the standard event status enable register. The Integer 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 a 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 a 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	<b>*IDN?</b> Returns "JGR Optics Inc., OA5, XXXXX, YYY" <b>Where:</b> <XXXXX> = device serial number <YYY> = firmware revision number

**Operation Complete Command**

Syntax	*OPC
Function	Causes the attenuator to set the OPC bit in the standard event status register when all pending operations have been completed.
Example	<b>*OPC</b>

**Operation Complete Query**

Syntax	*OPC?
Function	Places a "1" in the output queue of the attenuator 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	<b>*OPC?</b>

**Option Identification Query**

Syntax	*OPT?
Function	Reports on options installed or included with the attenuator.
Example	<b>*OPT?</b>

**Recall Command**

Syntax	*RCL<space>< Integer > where $0 \leq \text{Integer} \leq 9$
Function	Restores the attenuator to a state that has been stored in local memory. Restoring to state 0 ( <b>*RCL 0</b> ) is equivalent to sending the <b>*RST</b> command. See the <b>Save Command</b> for a list of settings that are stored for each state.
Example	<b>*RCL 4</b>

**Reset Command**

Syntax	*RST
--------	------

Function	Restores the attenuator to the following settings: <ul style="list-style-type: none"> <li>• Total attenuation = 0 dB</li> <li>• Display offset = 0 dB</li> <li>• Wavelength = 1310 nm</li> <li>• LCM state = OFF</li> <li>• Absolute power mode state = OFF</li> <li>• Beam block state at power on = ON</li> <li>• Beam block state = ON</li> </ul>
Example	<b>*RST</b>

**Save Command**

Syntax	<b>*SAV</b> <space><Integer > where $1 \leq \text{Integer} \leq 9$
Function	Stores the current state of the attenuator in local memory; as many as nine states can be stored. For each state, the following settings are stored: Total attenuation Display offset Wavelength LCM state (ON or OFF) Absolute power mode (ON or OFF) Beam block state at power-on (OFF or LAST) Beam block state (ON or OFF)
Example	<b>*SAV 3</b>

**Service Request Enable Command**

Syntax	<b>*SRE</b> <space>< Integer > where $0 \leq \text{Integer} \leq 63$ and $128 \leq \text{Integer} \leq 191$
Function	Sets the bits in the service request enable register. The Integer value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	<b>*SRE 154</b> sets the service request enable register bits to 10011010.

**Service Request Enable Query**

Syntax	<b>*SRE?</b>
Function	Returns the contents of the service request enable register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>*SRE?</b> 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 a Integer value 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 attenuator and returns 0 if the attenuator passes the self-test or 1 if it fails.
Example	*TST?

**\*WAI Command**

Syntax	*WAI
Function	Prevents the attenuator 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

**Status Commands**

**:STATus:OPERation:CONDition?**

Syntax	:STATus:OPERation:CONDition?
Function	Returns the contents of the operation condition register as an Integer value that, when converted to a binary number, represents the bit values of the register. The attenuator only uses bit 1 of the operation condition register. Bit 1, the Settle bit, is set when the attenuator is in the process of adjusting to the requested attenuation level.
Example	:STAT:OPER:COND?

**:STATus:OPERation:ENABle**

Syntax	STATus:OPERation:ENABle<space><Integer>
--------	---

Function	Sets the bits in the operation enable register. The Decimal value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	<b>:STATUS:OPERATION:ENABLE 33</b> sets bit 0 and bit 5 of the operation enable register to 1.

**:STATus:OPERation:ENABLE?**

Syntax	:STATus:OPERation:ENABLE?
Function	Returns the contents of the operation event enable register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:OPER:ENAB 23;ENAB?</b> returns 23.

**:STATus:OPERation[:EVENT]?**

Syntax	:STATus:OPERation[:EVENT]?
Function	Returns the contents of the operation event register as an Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:OPER:EVENT?</b>

**:STATus:OPERation:NTRansition**

Syntax	:STATus:OPERation:NTRansition<space>< Integer >
Function	Sets the bits of the operation negative transition register. The Decimal value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	<b>:STAT:OPER:NTR 256</b> sets the bits of the operation negative transition register to 0000000011111111.

**:STATus:OPERation:NTRansition?**

Syntax	:STATus:OPERation:NTRansition?
Function	Returns the contents of the operation negative transition register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>STAT:OPER:NTR 12;NTR?</b> returns 12.

**:STATus:OPERation:PTRansition**

Syntax	:STATus:OPERation:PTRansition<space><Integer>
--------	---

Function	Sets the bits of the operation positive transition register. The Decimal value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	<b>STAT:OPER:PTR 255</b> sets the bits of the operation positive transition register to 0000000011111110.

**:STATus:OPERation:PTRansition?**

Syntax	:STATus:OPERation:PTRansition?
Function	Returns the contents of the operation positive transition register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>STAT:OPER:PTR 12;PTR?</b> returns 12.

**:STATus:QUEStionable:CONDition?**

Syntax	:STATus:QUEStionable:CONDition?
Function	Returns the contents of the questionable condition register as a Integer value that, when converted to a binary number, represents the bit values of the register. The attenuator only uses bit 1 of the register. Bit 1, the Settle bit, is set when the attenuator mechanism is in the process of adjusting attenuation level.
Example	<b>:STAT:QUES:COND?</b>

**:STATus:QUEStionable:ENABle**

Syntax	:STATus:QUEStionable:ENABle<space>< Integer >
Function	Sets the bits in the questionable enable register. The Decimal value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	<b>:STATUS:QUESTIONABLE:ENABLE 33</b> sets bit 0 and bit 5 of the questionable enable register to 1.

**:STATus:QUEStionable:ENABle?**

Syntax	:STATus:QUEStionable:ENABle?
Function	Returns the contents of the questionable event enable register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:QUES:ENAB 23;ENAB?</b> returns 23.



**:STATus:QUEStionable[:EVENT]?**

Syntax	:STATus:QUEStionable[:EVENT]?
Function	Returns the contents of the questionable event register as a Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:QUES:EVENT?</b>

**:STATus:QUEStionable:NTRansition**

Syntax	:STATus:QUEStionable:NTRansition<space>< Integer >
Function	Sets the bits of the questionable negative transition register. The Decimal value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	<b>:STAT:QUES:NTR 256</b> sets the bits of the questionable negative transition register to 0000000011111111.

**:STATus:QUEStionable:NTRansition?**

Syntax	:STATus:QUEStionable:NTRansition?
Function	Returns the contents of the questionable negative transition register as an Integer value that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:QUES:NTR 12;NTR?</b> returns 12.

**:STATus:QUEStionable:PTRansition**

Syntax	:STATus:QUEStionable:PTRansition<space>< Integer >
Function	Sets the bits of the questionable positive transition register. The Decimal value is converted to a binary number. The bits of the questionable positive transition register are set to match the bits of the binary number.
Example	<b>:STAT:QUES:PTR 255</b> sets the bits of the questionable positive transition register to 0000000011111110.

**:STATus:QUEStionable:PTRansition?**

Syntax	:STATus:QUEStionable:PTRansition?
Function	Returns the contents of the questionable positive transition register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	<b>:STAT:QUES:PTR 12;PTR?</b> returns 12.

**:STATus:PRESet**

Syntax	:STATus:PRESet
Function	Presets all the enable and transition registers in the questionable and operation structures to the following settings. All bits in the ENABLE registers are set to 1 except the most significant bit (MSB). All bits in the positive transition registers are set to 1 except the MSB. All bits in the negative transition registers are set to 0.
Example	:STAT:PRES

**:SYSTEM:ERROR?**

Syntax	:SYSTEM:ERRor?
Function	Returns the error number and an error message from the error queue. See the <b>Error Queue</b> 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 Decimal value the of the SCPI version number.
Example	:SYST:VERS? returns: 1999.0.

**:SYSTEM:CAPability?**

Syntax	:SYSTEM:CAPability?
Function	To be completed
Example	:SYST:CAP? returns: OPTICAL INSTRUMENT

**:SYSTEM:COMMunicate:GPIB[:SELF]:ADDRess**

Syntax	:SYSTEM:COMMunicate:GPIB[:SELF]:ADDRess<space>< Integer >
Function	Sets the GPIB address. The factory-set GPIB address is 18. 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.

**User Commands**

**:INPut:ATTenuation**

Syntax	:INPut:ATTenuation <space> <Decimal MIN MAX> [dB]
Function	<p>Sets the total attenuation to the parameter value by changing the actual attenuation. Because the total attenuation includes the offset, the actual attenuation of the attenuator is set according to the following formula:</p> $Att_{actual} = Att_{total} - Offset$ <p>This command also accepts the parameters MIN, MAX, and DEF. The minimum total attenuation is the total attenuation at which the actual attenuation is 0 dB. The maximum total attenuation is the total attenuation at which the actual attenuation is 30 dB. The default total attenuation is the same as the minimum attenuation.</p>
Example	:INP:OFFS 30;INP:ATT 40 sets the total attenuation to 40 dB and the actual attenuation to 10 dB (for example, 40 dB - 30 dB = 10 dB).

**:INPut:ATTenuation?**

Syntax	:INPut:ATTenuation? [<space>MAX MIN DEF]
Function	<p>Returns the current total attenuation in dB. The total attenuation is the total of the actual attenuation and the offset:</p> $Att_{actual} = Att_{total} - Offset$ <p>This query also accepts the parameters MIN, MAX, and DEF. The minimum, maximum, or default value for the total attenuation at the current offset setting is returned.</p>
Example	:INP:ATT? MAX returns the current offset plus 100 dB (the maximum actual attenuation of the long range OA5 unit) or 60 dB (the maximum actual attenuation of the OA5 short range unit).

**:INPut:LCMode**

Syntax	:INPut:LCMode <space> <boolean>
Function	<p>Sets the process by which the wavelength calibration is implemented when the wavelength is changed.</p> <p>A boolean value of 1 or ON activates LCM mode. In LCM mode, the total attenuation remains fixed when the wavelength is changed, for example, the attenuator prism is moved to give the same attenuation at the new wavelength.</p> <p>A boolean value of 0 or OFF deactivates LCM mode. When LCM mode is turned off, the actual attenuation changes (as well as the total attenuation) when the wavelength is changed, for example, the attenuator prism does not move when the wavelength is changed.</p>
Example	<p><b>:INP:WAV 1300 NM;ATT 10;LCMode ON;WAV 1550 NM</b> sets the total attenuation to 10 dB, and the total attenuation remains at 10 dB when the wavelength is changed from 1300 nm to 1550 nm.</p> <p><b>:INP:WAV 1550 NM;ATT 10;LCMode OFF;WAV 1300 NM</b> sets the total attenuation to 10 dB, but the total attenuation changes slightly when the wavelength is changed from 1550 nm to 1300 nm.</p>

**:INPut:LCMode?**

Syntax	:INPut:LCMode?
Function	Returns the current state of LCM mode, for example, returns 1 if LCM mode is ON and 0 if LCM mode is OFF.
Example	<b>:INP:LCM ON;LCM?</b> returns 1.

**:INPut:OFFSet**

Syntax	:INPut:OFFSet <space> <Decimal MIN MAX DEF>
Function	<p>Sets the display offset of the attenuator. The value of the offset has no effect on the actual attenuation, but it does affect the total attenuation, for example,</p> $Att_{total} = Att_{actual} + Offset$ <p>This command also accepts the parameters MIN, MAX, and DEF.</p>
Example	<b>:INP:OFFS 10</b> sets the offset to 10 dB. If the actual attenuation is 14 dB, the total attenuation is 24 dB.

**:INPut:OFFSet?**

Syntax	:INPut:OFFSet? [<space> <MIN MAX DEF>]
Function	Returns the current setting of the display offset. The query accepts the parameters MIN, MAX, and DEF to return the minimum, maximum, or default value (respectively) for the display attenuation at the current offset setting.
Example	<b>:INP:OFFS 16;OFF?</b> returns 16. <b>:INP:OFFS? DEF</b> returns 0.

**:INPut:OFFSet:DISPlay**

Syntax	:INPut:OFFSet:DISPlay
Function	Sets the display offset so that the total attenuation is 0 dB: $Offset_{new} = Att_{total} - Offset_{old} = -Att_{act}$
Example	<b>:INP:OFFS:DISP</b> sets the offset to -20 dB if the previous total attenuation was 30 dB and the previous offset was 10 dB.

**:INPut:WAVeLength**

Syntax	:INPut:WAVeLength <space> <Decimal MIN MAX> [<suffix>]
Function	Sets the calibration wavelength of the attenuator. Because the calibration wavelength is used to account for the wavelength dependence of the attenuation, set the calibration wavelength as close as possible to the source wavelength. This command also accepts the parameters MIN, MAX and DEF. The minimum wavelength is 1200 nm, the maximum wavelength is 1700 nm, and the default wavelength is 1310 nm.
Example	<b>:INP:WAV 1550 nm</b>

**:INPut:WAVeLength?**

Syntax	:INPut:WAVeLength? [<space> <MAX MIN DEF>]
Function	Returns the current setting of the calibration wavelength in meters. This query also accepts the parameters MIN, MAX, and DEF, returning the minimum, maximum, or default value (respectively) for the calibration wavelength.
Example	<b>:INP:WAV 1300 nm;WAV?</b> returns 1.3e-06.

**:INPut:ILMin**

Syntax	:INPut:ILMin
Function	Sets the attenuation of the instrument to the minimum value to produce the lowest insertion loss. Depending on the configuration of the instrument, the attenuation in this mode may be identical to the one obtained by setting the attenuation to 0.00 dB.
Example	:INPut:ILMin

**:OUTPut:APMode**

Syntax	:OUTPut:APMode <space> <boolean>
Function	<p>Sets whether the actual attenuation of the attenuator is set by changing the total attenuation or by changing the through power. When absolute power mode is set to ON, the actual attenuation is set by setting the through power rather than the total attenuation. The base through power, otherwise referred to as the power mode offset, is automatically set to the total attenuation when absolute power mode is activated:</p> $\text{ThroughPower}_{\text{base}} = \text{ATT}_{\text{total at apmode on}} = \text{ATT}_{\text{actual}} + \text{PwrOffset}$ <p>This value differs from setting the power mode offset manually (using the keypad) because the attenuator is not set to power mode before the power mode offset is adjusted.</p> <p>To match the display of the attenuator to that of a power meter, adjust the offset until the attenuator display matches the power meter display, then turn on the absolute power mode and set the through power as required.</p> <p>The absolute power mode is turned off automatically when any of the following commands or their associated queries are received by the attenuator:</p> <pre>:INP:ATT :INP:OFFS :INP:OFFS:DISP</pre>
Example	<b>:OUTP:APM ON</b> sets absolute power mode to ON.

**:OUTPut:APMode?**

Syntax	:OUTPut:APMode?
Function	Returns the current absolute power mode state, for example, returns 1 if absolute power mode is ON (the actual attenuation is set by throughput) and 0 if absolute power mode is OFF (the actual attenuation is set by the total attenuation).
Example	<b>:OUTP:APM 1;APM?</b> returns 1.



**:OUTPut:POWer**

Syntax	:OUTPut:POWer <space> <Decimal   MIN   MAX> [dBm]
Function	<p>Sets the through power of the attenuator. The through power is used to set the actual attenuation of the attenuator. Because the total power includes the offset, the actual power of the attenuator is set according to the following formula:</p> $Pwr_{actual} = Pwr_{total} - PwrOffset$ <p>This command also accepts the parameters MIN, MAX, and DEF. The minimum through power is the through power for which the actual attenuation is about 100 dB for the long range OA5 model and about 60 dB for the short range OA5 model. The maximum through power is the through power for which the actual attenuation is 0 dB. The default through power is the same as the maximum through power.</p>
Example	<b>:OUTP:POW -34.55</b>

**:OUTPut:POWer?**

Syntax	:OUTPut:POWer? [<space> <MIN   MAX   DEF>]
Function	Returns the current through power of the attenuator in dBm. This query also accepts the parameters MIN, MAX, and DEF. The minimum, maximum, or default value (respectively) for the through power at the current base through power is returned.
Example	<b>:OUTP:POW?</b>

**:OUTPut:OFFSet**

Syntax	:OUTPut:OFFSet <space> <Decimal   MIN   MAX   DEF>
Function	Sets the offset value for the power mode.
Example	:OUTPut:OFFSet 10.

**:OUTPut:OFFSet?**

Syntax	:OUTPut:OFFSet? [ <space> < MIN   MAX   DEF>]
Function	Returns the value of the offset using in the power mode.
Example	:OUTPut:OFFSet? returns 10



**:OUTPut[:STATe]**

Syntax	:OUTPut[:STATe] <space> <boolean>
Function	Sets the state of the beam block. A boolean value of 0 or OFF leaves the beam block in the beam (the default position) thereby turning off the optical power from the attenuator. When the beam block is in the beam, the attenuation of the attenuator is >110 dB. A boolean value of 1 or ON moves the beam block out of the beam, thereby turning on the optical power out of the attenuator. The attenuation setting of the attenuator is not affected by the beam block state.
Example	<b>:OUTP OFF</b> leaves the beam block in the beam. <b>:OUTP:STAT ON</b> removes the beam block from the beam.

**:OUTPut[:STATe]?**

Syntax	:OUTPut[:STATe]?
Function	Returns the state of the beam block: 1 if the beam block is out of the beam and 0 if the beam block is in the beam.
Example	<b>:OUTP ON;STAT?</b> returns 1. <b>:OUTP OFF;STAT?</b> returns 0.

**:OUTPut[:STATe]:APOWeron**

Syntax	:OUTPut[:STATe]:APOWeron <space> <boolean >
Function	Sets the state of the beam block at power-on: OFF or 0 leaves the beam block in the beam, and ON or 1 sets the beam block state at power-on to the same state that the beam block was in at power-off.
Example	<b>:OUTP:APOW ON</b> when the attenuator is powered on, restores the beam block state to the same state it was in when the attenuator was powered off. <b>:OUTP:STAT:APOW OFF</b> leaves the beam block in the beam at power-on.

**:OUTPut[:STATe]:APOWeron?**

Syntax	:OUTPut[:STATe]:APOWeron?
Function	Returns the state of the beam block at power-on: 1 if the beam block is set to the same state that it was in at power-off and 0 if the beam block state is in the beam.
Example	<b>:OUTP:APOW 1;:OUTP:APOW?</b> returns 1.



**:UCALibration:USRMMode**

Syntax	:UCALibration:USRMMode <space> <boolean>
Function	Sets user mode on or off. A boolean value of 1 or ON turns user mode on and the OA5 uses the current user slope instead of the factory-set slope. A boolean value of 0 or OFF turns user mode off and the OA5 uses the factory-set slope.
Example	<b>:UCAL:USRM ON</b> sets user mode to ON.

**:UCALibration:USRMMode?**

Syntax	:UCALibration:USRMMode?
Function	Returns the current setting of user mode, that is, returns 1 if user mode is on and 0 if user mode is off.
Example	<b>:UCAL:USRM OFF;USRM?</b> returns 0.

**:UCALibration:SLOPe**

Syntax	:UCALibration:SLOPe <space> <Decimal MIN MAX DEF>
Function	Sets the user slope. The slope of the attenuator can be matched to a power meter for a given source by adjusting the user slope. This command also accepts the parameters MIN, MAX, and DEF. The minimum value for the slope is 0.5, the maximum value is 2.0, and the default value is 1.0.
Example	<b>:UCAL:SLOP 1.75</b>

**:UCALibration:SLOPe?**

Syntax	:UCALibration:SLOPe? [<space> <MAX MIN DEF>]
Function	Returns the current user slope setting. This query also accepts the parameters MIN, MAX and DEF, returning the corresponding minimum, maximum, or default value for the user slope.
Example	<b>:UCAL:SLOP MAX;SLOP?</b> returns 2.0.

Power Monitoring Commands (units with Power Monitoring PD option only)

**:OUTPut:PMON:POWer**

Syntax	<b>:OUTPut:PMON:POWer&lt;space&gt; &lt; MIN MAX&gt; dBm</b>
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Function	Sets the output power of the attenuator . If LVling is enabled, the attenuator will correct for fluctuations in input power. This command also accepts the parameters MIN, MAX, and DEF.
Example	<b>:OUTPut:PMON:POWer -10 sets the attenuation so that the output power is -10 dBm.</b>

**:OUTPut:PMON:POWer?**

Syntax	<b>:OUTPut:PMON:POWer?&lt;space&gt; &lt; MIN MAX &gt;</b>
Function	Returns the power at the output of the attenuator based on the power measured on the internal PD. This command also accepts the parameters MIN and MAX.
Example	<b>:OUTPut:PMON:POWer?</b> returns -9.99, the power that is at the output port of the attenuator.

**:OUTPut:PMON:LVling**

Syntax	<b>:OUTPut:PMON:LVling&lt;space&gt; &lt;boolean&gt;</b>
Function	Enables or disables continuous power leveling. A boolean value of 1 or ON turns the leveling on. The :OUTPut:PMON:POWer command has to be issued for the function to be activated. The attenuator sets and keeps the power at the specified power level. A boolean value of 0 or OFF turns the leveling off. The attenuator sets but does not keep the power at the power level specified with the :OUTPut:PMON:POWer command.
Example	<b>:OUTPut:PMON:LVling 1</b> enables the continuous power leveling.

**:OUTPut:PMON:LVling?**

Syntax	<b>:OUTPut:PMON:LVling?</b>
Function	Returns the current setting of the power leveling. Returns 1 if leveling is enabled and 0 if leveling is disabled.
Example	<b>:OUTPut:PMON:LVling?</b> returns 1.

**:PD:PMON:DARK**

Syntax	<b>:PD:PMON:DARK</b>
Function	Measures and stores user dark current on the PD. The beam block will automatically activate if needed. The command returns 1 if successful, 0 if not successful.
Example	<b>PD:PMON:DARK</b> returns 1