

**SUPERLUM**

Master Oscillator Power Amplifier SLD System  
MOPA-SLD-850 *Operator's Guide*

# Master Oscillator Power Amplifier SLD System

## MOPA-SLD-850



## Operation Manual

The contents of this manual may be changed without prior notice.

## Document Information

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# Table of Contents

Page

Warranty and Limitations .....	4
Safety Symbols and Terms .....	5
General Safety Information.....	6
Laser Safety Information .....	7
1. Description.....	9
2. Purposes and Scope .....	11
3. Unpacking and Inspection .....	11
4. Features and Functions.....	12
5. Power ON .....	14
6. Getting Started .....	15
7. Modulation Mode .....	16
8. Power OFF .....	17
9. Routine Maintenance and Recommendations.....	17
10. Computer Control .....	18
10.1. Introduction to Remote Operation.....	18
10.2. Data Communication Protocol .....	20
10.3. Remote Command Set .....	20
10.3.1. Identification Query .....	20
10.3.2. Local/Remote Enable Command .....	21
10.3.3. Local/Remote Check Query .....	22
10.3.4. Optical Output Enable Command .....	22
10.3.5. SLD/SOA Driver Check Query .....	22
10.3.6. Operating Parameters Check Query .....	23
11. Troubleshooting Information .....	25
12. Preparing the Instrument for Shipment.....	27
13. Customer Service & Contact .....	27
14. Technical Data.....	28

# Warranty and Limitations

## Warranty

Superlum warrants the MOPA-SLD-850 Master Oscillator Power Amplifier SLD System for a period of 12 months from the date of shipment. During this warranty period Superlum will repair or exchange any unit proven to be defective. Repairs are warranted for the balance of the original warranty period or at least 90 days.

For warranty repairs or service the unit must be returned to Superlum at the customer's expense.

## Limitation of Warranty

Superlum will not accept liability for any incidental damage caused by the failure of this product.

This warranty **does not** cover:

- Any defect or damage caused by improper operation: incorrect connections, improper handling of the device etc.
- Accompanying accessories: optical patch cables, AC power cords, RS-232 cables etc.

Disassembly of the instrument or any part of the device without prior approval from Superlum will void the warranty.

## Statement of Calibration

Superlum certifies that this product has been inspected, tested and calibrated to meet its published specifications.

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## Safety Symbols and Terms

This section includes information on the safety symbols used on the product and in the manual, and gives explanations about what they stand for. These symbols and terms indicate precautions you must strictly follow for safe operation of the device.



This symbol indicates the field-wiring terminal that must be connected to earth ground before operating the equipment. It is intended for protection against electrical shock, in case of a fault.



This warning sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.



This caution sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of the entire product or part thereof. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.



This sign denotes important information. It calls attention to procedures, practice, condition or the like, which is essential to highlight.



The CE mark shows that the product complies with all relevant European Legal Directives.



This warning label denotes laser radiation.



This label means the compliance with the requirement of the RoHS Directive (Directive 2002/95/EC).

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# General Safety Information

## General Notes and Warnings

This operation manual must be read completely before using the device. Incorrect use or handling and any consequences arising from this may damage the device or endanger personnel. The manufacturer declines all liability resulting from incorrect use and handling.

## Safety Notes

Before you switch the device on, make sure that all protective earth terminals, extension cords and autotransformers are connected to a protective earth-grounded receptacle. Any interruptions of the protective grounding conductor or disconnections of the protective earth terminal can make the device dangerous. *Do not* perform an intentional interruption of the protective grounding conductor.

For continued protection against fire hazard, replace the line fuse only with a fuse of the same rating (current, time delay etc.). *Do not* use repaired fuses or short-circuited fuse holders.

Before you switch the device on, verify that the product is set to your power line voltage and the correct fuse is installed.

Use this equipment only with either the supplied AC power cord or with an equal replacement.

*Do not* use this device with AC power source which is different from that specified on the rear panel of the device. Failure to obey this rule may result in personal injury and can cause permanent damage to the device.

*Do not* open the device as you may damage it. Disassembly of the device will lead to voiding of the warranty.

Never operate the instrument at condensing conditions.

Have you instrument recalibrated once a year.



## Laser Safety Information

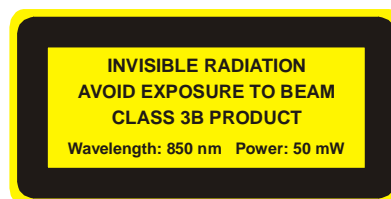
The light source in this equipment is classified as a **Class 3B** laser product according to IEC 60825-1 Ed.2.0 2007-03 standard.

**Table 1:** Laser Safety Classification Based on IEC 60825-1 Ed.2.0 2007-03

Model	Class	Optical Power (max)	Operational Mode	Emitted Wavelength	Beam Radiation Angle	Output Aperture
MOPA-SLD-850	3B	50 mW	CW	850 nm	11.5 deg.	Fig. 3

Information about the class of the product can be found on the yellow label on the front panel of the device above the **Optical Aperture** (see Fig. 3).

### CLASS 3B LASER PRODUCT – Avoid Exposure To Beam!



Light sources assigned to this class are always hazardous for the intra-beam ocular viewing even if an accidental short-time exposure occurs. Viewing them through optical elements with diffuse-reflecting properties is usually safe for the user.



**Using controls, adjustments or operating procedures that are different from those described in this manual may result in radiation exposure hazardous to the user.**

When the instrument is used with certain optical elements (optical amplifiers, lenses, collimators etc.) that are not supplied with the product as original accessories or the product is integrated into a high-level system, it is strictly recommended to reclassify the final optical system in order to determine the total degree of optical radiation hazard. The reason for this is that the class of laser hazard may higher under these conditions. It is the responsibility of the end-user who performs such integration to provide correct reclassification for the optical system at the final stage.

It is the end-user who is responsible for being aware of possible risk associated with using class 3B laser products as well as being adequately trained for working with such light sources. Superlum is not liable for any personal injury, property damage or other (direct or indirect) damage of any nature caused by personal faults, improper and/or inadequate using of the instrument coming from disregarding the necessary aspects of laser safety.

Incorporated into this equipment are the following laser safety features:

- Key-operated master control
- Remote interlock connector
- Enable button with a built-in LED indicator
- Three-second time delay before the optical output activation
- Audible and visible warning signals for the optical output activation
- Protective metal cap for the optical output
- Laser safety marking



**Before you start working with the device, please read thoroughly this manual to acquaint yourself with all features for laser safety implemented in this equipment.**

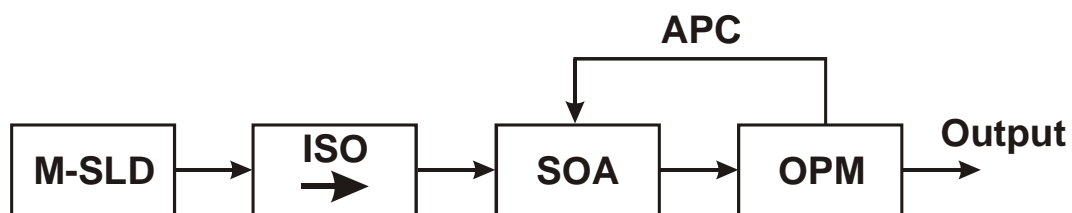


# 1. Description

This manual is an operator's guide for the model MOPA-SLD-850 Master Oscillator Power Amplifier SLD System, a laboratory ultra-high power SLD-based light source, designed and manufactured by Superlum.

This light source is a bench top optoelectronic instrument designed to generate incoherent light in 850-nm spectral range with optical power of up to 50 mW from fiber. It is particularly designed to OCT (Optical Coherent Tomography) applications where high levels of optical power are frequently needed. The system is built on the optical scheme known as MOPA – *Master Oscillator Power Amplifier*. This is a combination of a weak power master-source (called *oscillator*) with a high-power output booster (called *amplifier*). This configuration is widely and successfully used in various laser applications in order to boost optical power of a master laser. For the device in question, an SLD-master source is used instead of a laser.

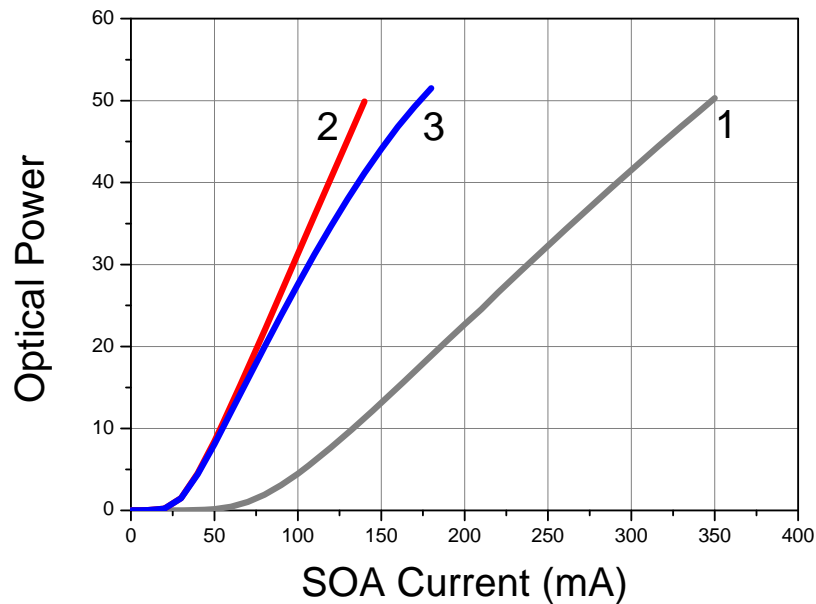
A simplified block diagram of the optical scheme of the device is shown in Fig. 1.



**Fig. 1:** Block Diagram of MOPA Configuration (Simplified)

**M-SLD** – Master SLD  
**ISO** – Isolator  
**SOA** – Semiconductor Optical Amplifier  
**OPM** – Optical Power Monitor  
**APC** – Automatic Power Control

A medium-power SLD used as a master source provides optical power of 6 – 10 mW with a relatively broad spectrum of 10-20 nm centered at 850 nm. After passing through the appropriate optical isolator with isolation of better than –25 dB, this power is raised to a high level of 50 mW by a spectrally matched SOA. The key advantage of such an approach is that the SOA becomes weakly sensitive to optical feedback. This is because the input power of 6-10 mW is high enough to provide SOA operation in deep saturation mode. In this mode, the SOA remains rather insensitive to optical feedback up to –14 dB that corresponds to typical back reflections of 4%, naturally imposed by a normal cleaved fiber tip (Fig. 2). Further increase of this value (to –10 dB) will cause significant reduction of the SOA performance, but without any fatal damage to the SOA emitter. Due to low sensitivity to optical feedback, there is no need to use an optical isolator (as a protective measure) at the output of the SOA. In this situation, substantially lower operating currents are realized. Obviously, the SOA lifetime, thereby, could be prolonged.



**Fig. 2:** Power-Current Characteristics of SOA

- 1: SOA without input optical power – "free-running" mode; angle-cleaved fibers
- 2: 10 mW power of master SLD applied; angle-cleaved output fiber
- 3: 10 mW power of master SLD applied; normal-cleaved output fiber

As well as the mentioned advantages, the other important one is all-PM-fiber design which gives perfect stability of the PER (Polarization Extinction Ratio) under varying conditions of temperature, humidity and long-term usage than conventional SM-based realizations.

The device uses Superlum driving electronics that features high stability and reliability for SLD applications. To ensure safe driving, the following protective measures are implemented: the "soft" start of drive current at activation, turn-on transient suppression, protection against overheating and disconnection, and pumping current clamping at a limit level. Both the master SLD and the SOA are operated in constant power mode, which provides better stability of optical power than operation in constant current mode.

The device can be operated in pulse modulation mode. With TTL pulses applied to the **MOD IN** connector on the rear panel, the instrument toggles between activation and deactivation states. The maximum frequency of modulation is 50 kHz.

Each instrument is carefully tested at the final stage (including calibration, measurements, short-term running etc.), and an individual acceptance test report is provided with the device.

Detailed information on the MOPA design for SLD applications, including physical estimations and practical results, is available at: <http://www.superlumdiodes.com/pdf/Ultra-High-Power-MOPA-SLD-Sources.pdf>

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## 2. Purposes and Scope

This guide has been designed to provide you with basic information on how to set up, run and successfully use your MOPA-SLD-850 Master Oscillator Power Amplifier SLD System. Information on the device maintenance and repair (except routine procedures and common recommendations) lies beyond the scope of this document and is not intended for the end-user.

This document covers: 1) installation, 2) manual control from the front panel, 3) computer control, 4) routine maintenance and recommendations. Troubleshooting information is also given here. If our documentation does not satisfy your query, further support is available. Please use the following information to contact:



**Phone:** +353 21 4533666

**Fax:** +353 21 4533026

**E-mail:** [support@superlum.ie](mailto:support@superlum.ie)

## 3. Unpacking and Inspection

In addition to this manual, the MOPA-SLD-850 includes the following items:

- One AC power cord
- One optical patch cable
- Two keys for the device's master control
- Remote interlock connector (comes inserted into the rear-panel jack)
- RS-232 null-modem cable
- Connectivity software and user manual on the disc
- Acceptance Test Report (ATR)

Make sure that all the above items are present and are in good condition. If any of the items is missing or damaged, please contact Superlum. Keep the shipping materials for the carrier's inspection if any damage is found.



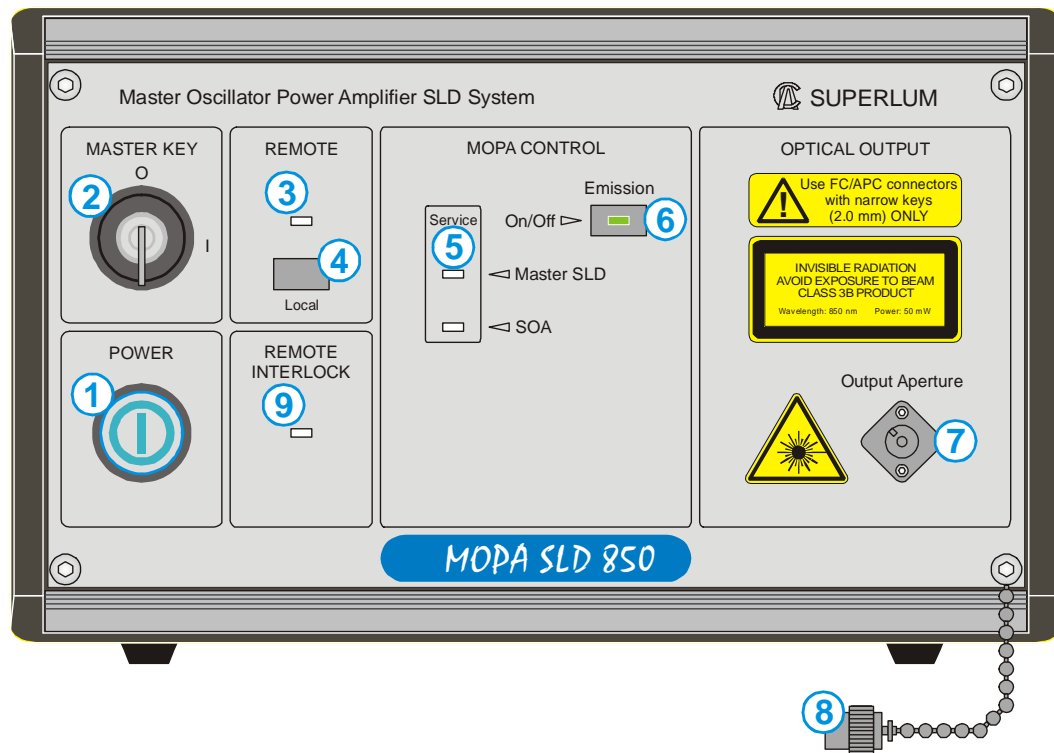
**After transportation in cool weather, store the container at room temperature for about two hours before opening. Avoid sharp changes in temperature – they can cause water condensation on the internal parts of the instrument, most of them are delicate optical components. Any amount of water condensation may affect their performance.**



Retain the original container for possible future use.

If the device is to be sent to Superlum for repair and the original container is not available, use an equal replacement.

## 4. Features and Functions



**Fig. 3:** Front-Panel Features and Controls

**1 – POWER.** This button turns the device on and off. When engaged, the blue LED indicator lights up.

**2 – MASTER KEY** (Laser Safety Measure). This key-operated master control is used as a laser safety measure specified in IEC 60825-1. Turning the key to position I allows for output emission activation. With the key in position O, the output emission of the device cannot be enabled.

**3 – REMOTE.** This green LED lights up only when the device is controlled remotely from a computer.

**4 – LOCAL.** This button terminates remote access and returns the device to local operation.

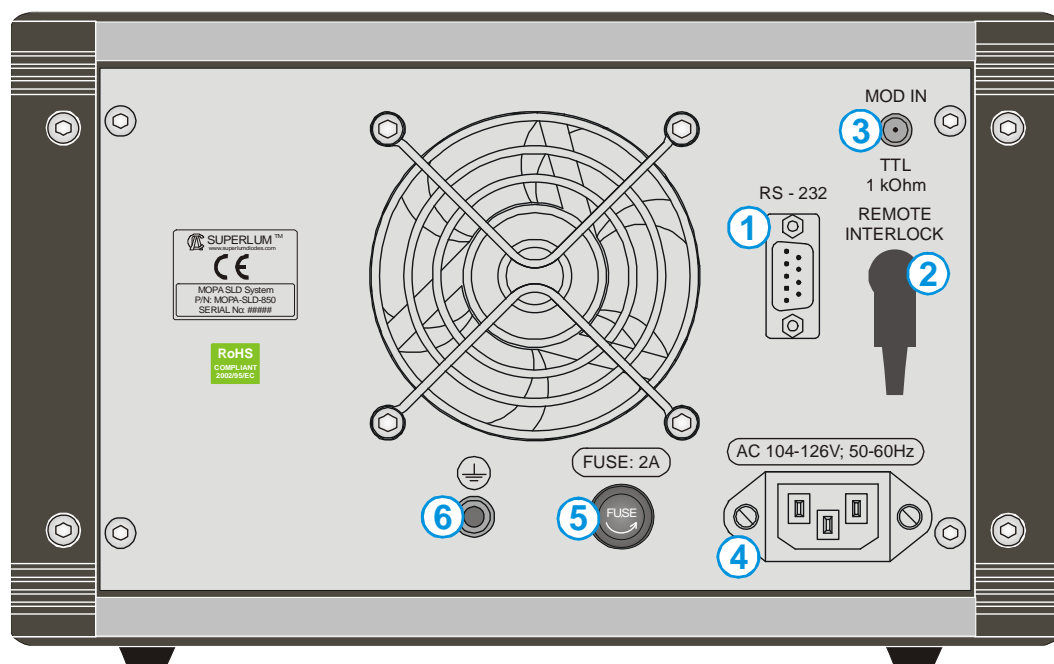
**5 – SERVICE.** This light indicates that the device needs servicing.

**6 – EMISSION ON/OFF.** This button toggles between activation and deactivation of the output emission. When the light is green, emission is activated.

**7 – OUTPUT APERTURE.** This socket is the optical output of the device. The optical patch cable supplied with the device is connected here.

**8 – PROTECTIVE CAP.** This cap is used to protect the optical output from dust and dirt. Always reattach this cap when the device is not in use.

**9 – REMOTE INTERLOCK (Laser Safety Measure).** This is used to inform the operator that the terminals of the remote interlock connector are open-circuited. When this happens, the LED illuminates red.



**Fig. 4:** Rear-Panel Features and Controls

**1 – RS-232 CONNECTOR.** This adapter is used to connect the device to a computer for remote access.

**2 – REMOTE INTERLOCK (Laser Safety Measure).** This is an audio monophonic jack through which the device can be connected to your local external controls for laser safety. The device is inoperable unless the interlock connection is made. If there are no external controls in your local laser safety system or if the use of these controls is not essential for you, the appropriate short-circuited connector (supplied) must be installed to the rear-panel remote interlock jack. With this connector installed, you will be able to use the device independently of your local laser safety system.

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**3 – MOD IN.** This SMA connector is used to connect the device to an external pulse generator for operation in modulation mode. TTL pulses are applied here.

**4 – AC POWER INPUT RECEPTACLE.** This connector accepts a 3-conductor power cord (supplied) used to connect the device to your local AC power line.

**5 – AC LINE FUSE HOLDER.** This holder is used to hold the line fuse.

**6 – GROUNDING TERMINAL.** This terminal is used to ground the device. It accepts a male banana plug.

## 5. Power ON



**Before you start working with your MOPA-SLD-850, please check that you have already read and clearly understood the Safety Information on page 6. Make sure that the required precautions have been taken.**

1. Place the device on a flat surface close to your measuring equipment in a location with sufficient ventilation. Make sure the ventilation openings are not obstructed and the optical patch cable can be easily connected.
2. Check that the **POWER** button is set to the off position. If it is not in the off position, press to release.
3. Connect the AC power cord (supplied) to the rear-panel power receptacle.
4. Insert either one of the supplied keys into the **MASTER KEY** lock and leave it in the **O** position.
5. Plug in the device and press the **POWER** button. The blue LED in the button will light up.
6. The device is now ready to use.

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## 6. Getting Started

1. Connect the device to your local external controls for laser safety. Use the **REMOTE INTERLOCK** jack on the rear panel of the device for this connection. If you do not have the external controls for laser, use the short-circuited connector supplied with the device.
2. Connect one end of the optical patch cable to the front-panel **Output Aperture**; the other, to your measuring equipment (e.g. an optical power meter). To ensure low insertion optical loss at the device output, follow the direction on the optical cable label.
3. Press the **POWER** button to turn the device on. The Thermo-Electric Cooler (TEC) controllers are activated automatically at power-on. They remain active until the device is turned off.
4. Turn the **MASTER KEY** clockwise to position **I**. The device will run an internal test to verify whether or not the remote interlock connection has been made. If the test passes, you can activate the optical output of the device (continue to step 5 to do this). If the test fails, the **REMOTE INTERLOCK** LED will light up steady red and the device will produce a continuous tone. The alarm signifies that the remote interlock connection is open-circuited. Any attempt to activate the output emission will fail until the remote interlock connection has been made and the alarm is reset. To reset, turn the key to position **O** and back to position **I** again.
5. Enable the optical output power by pressing the **Emission On/Off** button. There will be a three-second delay during which the button will blink and the device will beep. Once the delay has elapsed, the button displays a steady green light and the audible signal is turned off. At this point, the output emission begins.
6. Verify that the output power of the device corresponds to the value listed in the ATR.



To keep the end faces of the optical patch cable clean and protected, we strongly recommend that you avoid unnecessary disconnections. Whenever possible, leave the optical cable connected to the device.

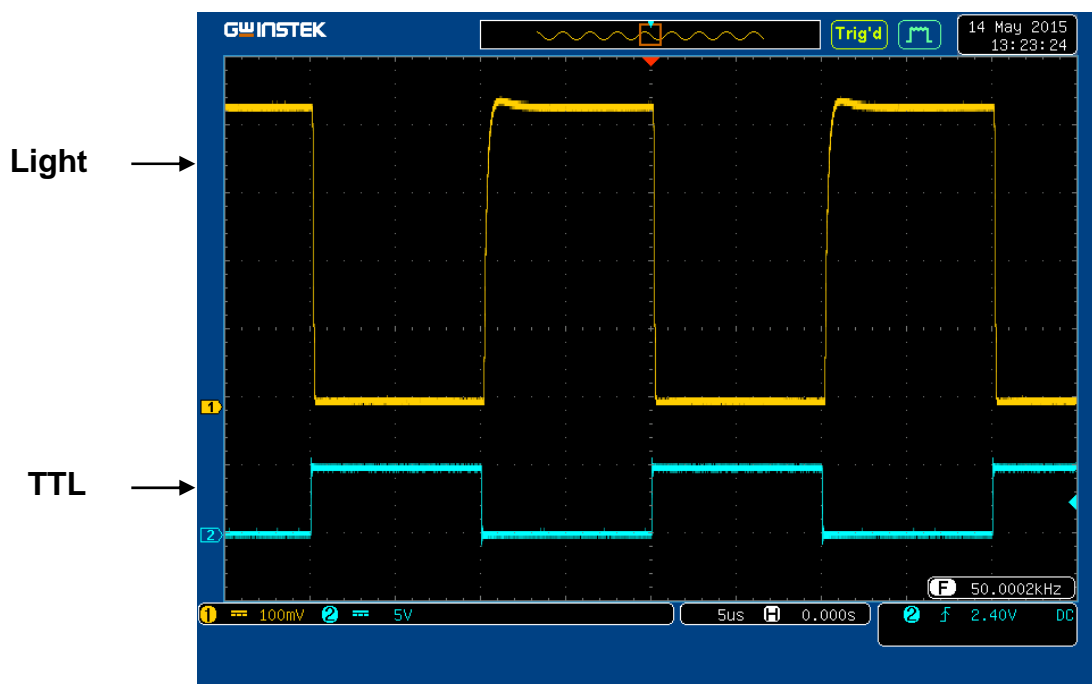
Never use optical connectors different from those specified for the device – they are not designed to use with the device and can seriously damage its optical output.



This equipment contains analog circuits of driving electronics that are sensible to temperature changes. Therefore, after turning the device on, the optical power of the device can slightly drift over time. For improved stability, a 30-minute warm-up period is recommended.

## 7. Modulation Mode

1. Install an interconnection cable (not supplied) between the **MOD IN** connector located on the front panel of the device and the output of your external pulse generator. Note that the **MOD IN** connector is a female SMA type.
2. Prepare the instrument for operation as described in Section 6 (on page 15).
3. Pre-set your pulse generator to the following parameters: Pulse Amplitude: 5 V (TTL), Pulse Repetition Frequency: 50 kHz, Duty Cycle: 50%.
4. Activate the optical output of the MOPA-SLD-850 by pressing the **Emission On/Off** button.
5. Enable the output of your pulse generator.
6. Observe the waveform of optical power on an oscilloscope using a high-speed fiber-coupled photodetector. Compare the obtained results with those depicted in Fig. 5.



**Fig. 5:** Operation in Pulse Modulation Mode  
(Generator Settings: Pulse Amplitude: 5 V (TTL),  
Pulse Repetition Frequency: 50 kHz, Duty Cycle: 50%.)



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## 8. Power OFF

1. If the optical output is active, press the **Emission On/Off** button to disable.
2. Turn the **MASTER KEY** control counterclockwise to position **O**.
3. Depress the **POWER** button.



**Always disable the optical output before turning the device off. Never unplug the device if the optical output is active.**

## 9. Routine Maintenance and Recommendations

In order to ensure accurate and reliable operation of the device, it is very important to clean ferrules of the output optical fiber. Dirt, dust and oil inside the connector ports may scratch the surface of the ferrules, thereby producing erroneous results. Never store the device with the uncovered optical output. Always recap the connectors of the optical patch cable.



We recommend that you clean the fiber ferrules before each insertion. Use 99% (or better) isopropyl alcohol and a lint-free cloth for this procedure. Use a can of compressed air to dry off the connectors after wiping and to blow out dust from bulkheads.

If optical patch cables not supplied with the instrument are to be used, pay close attention to the connector type. It must be compatible with the optical output of the device. Any attempt to use connectors other than specified can cause permanent damage to the device.

## 10. Computer Control

### 10.1. Introduction to Remote Operation

This instrument is equipped with the RS-232 interface to provide communication between the device and a PC. By sending the appropriate commands from a computer, it is possible to do the following:

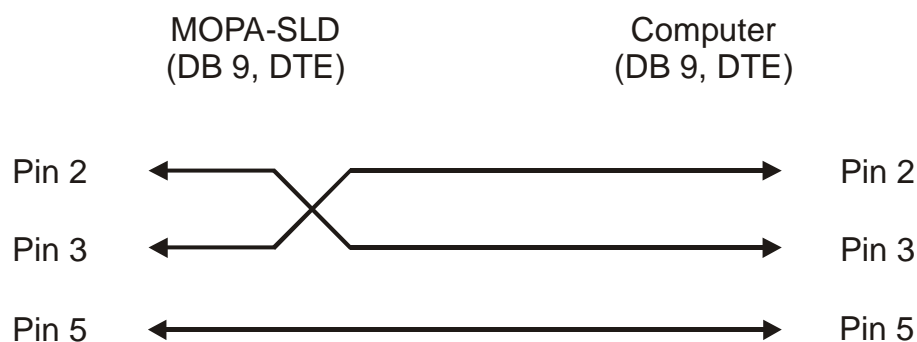
- Monitor performance parameters of the device: the driving current, operating temperature etc.
- Activate or deactivate the optical output of the device.

The device responds to the following actions from a PC:

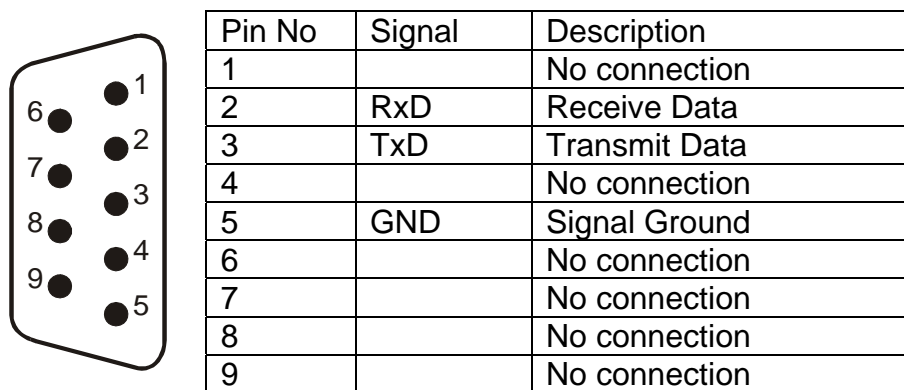
- Commands – they change the current state of the instrument.
- Queries – they query numerical values of operational parameters.

The instrument goes to remote operation immediately as soon as addressing to it is executed. The green light of the **REMOTE** LED indicates that the device is under remote control. In this state, the front-panel features are locked out. Press the **Local** button on the front panel to return to local operation or send the necessary command from a computer.

Configuration the cable wires and a pinout for the RS-232 connector are shown in Fig. 6 and Fig. 7, respectively.



**Fig. 6:** RS-232 Cable Configuration



**Fig. 7: RS-232 Connector Pinout**

Use the following settings on your computer to communicate with the device:

- Baud rate (bits per second): 57600
- Data bits: 8
- Parity: none
- Start bit: 1
- Stop bit: 1
- Flow control: none
- Galvanic isolation: 1 kV
- Data type: ASCII string



**Before connecting or disconnecting the RS-232 cable between the instrument and your computer, always unplug both devices – the instrument and your computer.**



**For connection to a PC, always use a null-modem cable (supplied).**

**For the first running of the device from a computer, the use of the Superlum connectivity software is recommended.**

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## 10.2. Data Communication Protocol

The instrument responds to commands or queries only if they are placed in the correct order and use the correct mnemonic. The following Data Communication Protocol describes the structure of a command and a query. The response structure of the device is also given below.

### Command/Query Structure

[command][data][CR][LF]

where,

[command] – command code (always begins with "S")

[data] – data (if required)

[CR][LF] – line termination sequence ([CR] – ASCII13, [LF] – ASCII10)

### Response Structure

[command][data][CR][LF]

where,

[command] – response code (always begins with "A")

[data] – data

[CR][LF] – line termination sequence ([CR] – ASCII13, [LF] – ASCII10)



The square brackets are used as a punctuation mark to mark off elements in a command or query.

In Windows OS, the line termination sequence is equal to pressing the Enter button.

## 10.3. Remote Command Set

### 10.3.1. Identification Query

**Syntax:** [S0]

**Remarks:** the device responds an identification string containing numeric information about the instrument.

**Response:** [A][0][data#1][data#2][data#3][data#4][CR][LF]

where,

[data#1] – 1-byte integer indicating the type of the instrument. The value ranges from 0 to 9.

[data#2] – 1-byte integer indicating the number of active channels for the instrument being used. The value ranges from 1 to 4.

[data#3] – 1-byte integer indicating the current number of the firmware version used in this instrument. The value ranges from 0 to 9.

[data#4] – 5-byte serial number of the instrument being used.

In case of error, the instrument sends the following response:

[A][E][CR][LF]

**Example****Query:** [S0][CR][LF]**Response:** [A][0][5][2][0][12345][CR][LF]

Here,

[A][0] – response code

[5] – this type of the instrument is 5

[2] – this instrument is a two-channel device

[0] – this version of the firmware is 0

[12345] – the serial number of the instrument is 12345

[CR][LF] – line termination sequence ([CR] – ASCII13, [LF] – ASCII10)

**For the MOPA-SLD-850, the ID number is 5.****10.3.2. Local/Remote Enable Command****Syntax:** [S1][data][CR][LF]**Remarks:** this command activates or deactivates remote control.

The [data] is 1-byte integer indicating the mode to be activated. Two possible values for the [data] are tabulated below.

Data	Description
1	Returns the device to local operation.
2	Activates remote control.



**Local operation is a factory-default setting that is activated each time at power up.**  
**The device ignores any command except the Remote Enable command when it is under front-panel control.**

### 10.3.3. Local/Remote Check Query

**Syntax:** [S1][0][CR][LF]

**Remarks:** the device responds an integer indicating the current mode of operation.

**Response:** [A][1][data][CR][LF]

Two possible values for the [data] are listed in the following table:

Data	Description
1	The instrument is under local control.
2	The instrument is under remote control.

In case of error, the instrument sends the following response:

[A][E][CR][LF]

#### Example

**Command:** [S1][2][CR][LF]

**Remarks:** after receiving this command, the instrument goes to remote operation.

**Query:** [S1][0][CR][LF]

**Response:** [A][1][2][CR][LF]

Here,

[A][1] – response code

[2] – this number means that the instrument is under remote control

[CR][LF] – line termination sequence ([CR] – ASCII13, [LF] – ASCII10)

### 10.3.4. Optical Output Enable Command

**Syntax:** [S2][data][CR][LF]

**Remarks:** this command activates or deactivates the optical output of the device.

Data	Description
1	Toggles the optical output of the device between activation and deactivation states.

### 10.3.5. SLD/SOA Driver Check Query

**Syntax:** [S2][0][CR][LF]

**Remarks:** the device responds numerical code containing information on the current state of the SLD current and temperature controllers.

**Response:** [A][2][data#1][data#2][CR][LF]

where,

[data#1] – This decimal number ranges from 000 to 255. It describes the current state of the current and temperature controller for the master SLD.

[data#2] - This decimal number ranges from 000 to 255. It describes the current state of the current and temperature controller for the SOA.

Signal	Bit	Description of the states of the logical signals
TEC_GOOD	0	Level <b>1</b> : the current temperature of SLD is within the required T-window. Level <b>0</b> : the current temperature of SLD is beyond the required T-window (faulty operation)
SLD_GOOD	1	Level <b>1</b> : SLD module is enabled. Level <b>0</b> : SLD module is disabled or faulty.
LIMIT	2	Level <b>1</b> : the limit current of SLD module has been reached.
SLD_ERROR	3	Level <b>1</b> : SLD module is faulty. Level <b>0</b> : SLD is operational.
MASTER KEY	5	Level <b>1</b> : the <b>MASTER KEY</b> control is in position ON. Level <b>0</b> : the <b>MASTER KEY</b> control is in position OFF.
INTERLOCK	6	Level <b>1</b> : the <b>Remote Interlock</b> connection is open-circuited. Level <b>0</b> : the <b>Remote Interlock</b> connection is closed.
SLD_WAIT	7	Level <b>1</b> : always active during 3-sec delay at the output enable.

In case of error, the instrument responds either of the following:

Response	Error Description
[A][E][CR][LF]	Common error.
[A][L][CR][LF]	This means that the required command cannot be executed as the instrument is under local control.

### 10.3.6. Operating Parameters Check Query

**Syntax:** [S3][data#1][data#2][CR][LF]

Where,

[data#1] – 1-byte integer indicating a channel number ([1] – for the master SLD, [2] – for the SOA).

[data#2] – 1-byte integer indicating parameter number [1-6] (see the table below).

**Remarks:** the device responds numerical code containing information on the queried operating parameter.

**Response:** [A][3][data#1][data#2][data#3...data#6][data#7][CR][LF]

where,

[data#1] – 1-byte integer indicating a channel number ([1] – for the master SLD, [2] – for SOA).

[data#2] – 1-byte integer indicating parameter number [1-6] (see the table below).

[data#3...data#6] – 3-byte variable containing information about the current state of the SLD driver.

[data#7] – 5-byte variable containing information about the real value of the queried parameter.

Data	Parameter	Description
[1]	PD	Setting value of photodiode current.
[2]	I_SLD_REAL	Real value of SLD driving current.
[3]	LIMIT	Maximum allowable value of SLD driving current.
[4]	T_SET	Setting value of SLD operating temperature.
[5]	I_SLD_SET	Setting value of SLD driving current.
[6]	T_REAL	Real value of SLD operating temperature.

In case of error, the instrument responds one of the following:

Response	Error Description
[A][E][CR][LF]	Common error.
[A][L][CR][LF]	This means that the required command cannot be executed as the instrument is under local control.
[A][W][CR][LF]	This means that the required command cannot be executed because SLD is being activated.

Values of the operating parameters can be measured with the following resolution:

- Setting and real value of SLD operating temperature – 1  $\Omega$  of the internal thermistor ( $R_t = 10 \text{ k}\Omega @ +25 \text{ }^\circ\text{C}$ ).
- Setting value of photodiode current – 1  $\mu\text{A}$ .
- Setting and real value of SLD driving current – 0.1 mA.
- Maximum allowable value of SLD driving current – 0.1 mA.



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## 11. Troubleshooting Information

The following table gives an overview over the most possible problems and on what to do to solve them.

**Problem 1:** After turning the device on, the **POWER** button remains blank and the device does not work.

**Possible Reason:**

1. The AC power cord is disconnected.
2. The line fuse is blown.

**Remedy:**

1. Check the power cord connection.
2. Disconnect the AC power and replace the fuse with a new one of the same rating.

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**Problem 2:** After turning the **MASTER KEY** to position **I**, the instrument activates the alarm and the **REMOTE INTERLOCK** LED turns red.

**Possible Reason:**

1. The device has not been connected to your laser safety system or the cable responsible for this connection is faulty.
2. Your local laser safety system has been triggered that cause the device to alarm.

**Remedy:**

1. Turn the **MASTER KEY** to position **O** and verify that the remote interlock connection is made properly and no disconnections persist. Then try to run the device again.
2. Turn the **MASTER KEY** to position **O** and reset your laser safety system. Then start the device again.
3. If you use the device independently of your laser safety system, check that the appropriate short-circuited connector has been installed into the rear-panel jack and the connection is not lost.

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**Problem 3:** The **Service** indicator blinks or lights steadily.

**Possible Reason:** The SLD driving current has reached the maximum allowable level. The reason is SLD performance degradation.

**Remedy:** The device needs servicing. Please notify Superlum about this problem and send the instrument for repair.

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**Problem 4:** After activation of the optical power, the LED of the **Emission** button momentary switches to red and the optical output is disabled.

**Possible Reason:** The SLD driving electronics operates improperly.

**Remedy:** The device needs servicing. Please notify Superlum about this problem and send the instrument for repair.

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**Problem 5:** The current value of optical power is lower than the specified one, but the **Service** indicators do not illuminate.

**Possible Reason:** Fiber tips of the optical patch cable are dirty.

**Remedy:** Disconnect the patch cable and clean the end-faces of the connectors. Then re-attach the cable and measure the output power again. If the problem persists, consult Superlum.

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## 12. Preparing the Instrument for Shipment

If the instrument is to be sent to Superlum for repair or calibration, prepare the device using the instructions below.

1. Write a description of the failure that should include the following information:
  - Type of service required: repair or calibration.
  - Date of the failure.
  - Description of the problem: the mode of operation, how often it happens, whether problem is constant or intermittent, device settings to reproduce the problem, any photo or screenshot of the problem.
  - Company name and return address.
  - Name and phone number of a technical contact person.
  - Model number and serial number of the returned instrument.
  - List of accessories returned with the instrument.
2. Attach a protective cap on the optical output of the device. Use the original one or an equal replacement.
3. Pack the instrument in the original shipping container or use an adequate replacement, if the original container is not available.
4. Retain copies of all shipping papers.



**To prevent the optical output of the device from dust and dirty, we strongly recommend that you reattach the protective cap to the device's optical output as well as other protective caps to the optical patch cable to be sent with the instrument.**

## 13. Customer Service & Contact

Superlum, Unit B3, Fota Point Enterprise Park, Carrigtwohill, Co. Cork, Ireland.

**Phone:** +353 21 4533666

**Fax:** +353 21 4533026

**E-mail:** [support@superlum.ie](mailto:support@superlum.ie)

## 14. Technical Data

Optical Specifications <sup>1</sup>	
Center Wavelength	850 ± 2 nm
Optical Bandwidth (FWHM)	10-20 nm
Spectral Ripple	< 2%
Output Power	50 mW (45 mW min.)
Maximum Allowed Feedback <sup>2</sup>	-10 dB (corresponds to 10%-feedback)
Output Power Stability <sup>3</sup>	< 0.5%
Polarization Extinction Ratio	> 18 dB (20 dB typ.)
Optical Fiber Type	Corning PANDA PM 850
Polarization Orientation in the Output Fiber	Slow axis, Aligned with the connector key
Output Optical Connector	FC/APC type with narrow key (2.0 mm)

Electrical Specifications	
Operating Mode, for SLD / SOA	Constant Power
Enable Control	1) Manual: from the front panel 2) Electrical via: a) TTL pulses, b) RS-232 port
Modulation Input <sup>4</sup>	TTL, 0 – 5 V => Full Power – 0, R <sub>IN</sub> =1 kOhm
Rise Time / Fall Time	2 μs / 0.5 μs
Modulation Input Connector	SMA-female (Referenced to Chassis)
I/O Interface <sup>5</sup>	RS-232

General Specifications	
Power Requirements	110 VAC, 50-60 Hz
Power Consumption	20 VA Max
Warm-up Time	10 min
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Continuous Operation	16 hrs/day
Outline Dimensions (W x H x D)	257 x 170 x 325 mm
Approximate Weight	7 kg
Warranty	12 months

### NOTES:

<sup>1</sup> ALL SPECIFICATIONS ARE QUOTED AFTER 1HR WARM-UP AND CALIBRATION AT 25 °C.

<sup>2</sup> THIS FEEDBACK APPLIED CAN CAUSE TEMPORAL DECREASE OF SOA PERFORMANCE WITH NO RISK FOR THE SOA TO BE FATALY DAMAGED.

<sup>3</sup> DURING 3 HOURS.

<sup>4</sup> DEPENDING ON THE SOA INSTALLED, IN THE "OFF" POSITION THE OUTPUT POWER MAY RISE UP TO 0.1 mW.

<sup>5</sup> MALE CONNECTOR WITH DTE PIN FUNCTIONS.



