cBLMD Light Sources

User Manual

GENERAL WARNING

Before using this Light Source ALL users should read this manual and fully understand how to operate this Light Source.

ABSOLUTE MAXIMIM RATINGS WARNING

Failure to comply with the following requirements may result in the catastrophic failure of the Light Source.

Parameter	Min	Typ	Max
DC supply voltage, V	9.0	12.0	15.0
DC supply current, A	–	–	3
Remote Port input voltage, V	0	5	8
Remote Port input current, mA	–	8	15
Remote Port output voltage, V	–	5	20
Remote Port output current, mA	–	–	10

LASER SAFETY WARNING

This Light Source emits invisible light that may have a potential hazard associated with CLASS 3R to 3B of IEC 60825-1. For further information regarding laser safety and laser classification of the Light Source please contact SUPERLUM.

Warranty

Superlum products are guaranteed for a period of one year from date of delivery, against any faults caused by manufacturing errors or proven intrinsic material faults as long as the products have NOT been transformed, incorrectly installed, wrongly used or repaired by the buyer/user. Superlum will conduct analysis of the failures and undertake to repair or replace any product failing under the above mentioned conditions. Notification of any Claim under this warranty must be submitted in writing within 1 week from discovery to Superlum giving specific details of the fault. The product must be returned to Superlum not later than the expiry date of the warranty. Shipping costs incurred, are not covered by this warranty. Failure Root Cause analysis is carried out free-of-charge after warranty expiry date.

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1 Light Source Description

1.1 General Description

The miniature cBLMD is a stable, reliable and low noise, broadband lightsource, based on a combination of up to three Superluminescent Diodes (SLDs) with slightly different center wavelengths and partly overlapping emission spectra to create a broad spectral band. Designed as an OEM solution allowing easy integration, especially in applications where a miniature integral light source with a broad emission spectrum and a very short coherence length is required.

The built-in electronics allows various options of controlling of the optical output: by the pushbutton on the front panel, by logic signals via the Remote Port or from a USB interface (Virtual COM/RS-232 port).

Each Light Source is standardly configured with the USB and the Remote Port interfaces. Depending on the order specification Your Light Source could be configured with a supporting of the following features:

- Output power modulation input;
- Additional TTL-level UART interface;
- Built-in VOA;
- Built-in tap power monitor at the optical output.

1.2 Optical Performance

The optical design is based on SM fiber. Non-isolated Light Source can tolerate no more than -30dB feedback. Lightsources fitted with a built-in optical isolator ensures >15dB isolation within the entire emission band, >20dB isolation within the central FWHM of the emission band, and >30dB isolation in the area of the emission wavelength center.

The optical output can be a 500mm-long FC/APC terminated fiber pigtail in a 3mm reinforced tube, or an FC/APC mating sleeve for external connection of FC/APC patch cables.

NOTE – The miniature cBLMD is customizable. Optical performance options are available at the time of ordering and are listed on our web-site. If your application requires none optically isolated a lightsource or you require non-standard enclosure dimensions or other spec please contact sales@superlum.ie for more information on the optical performance and other spec options available with all our product line.

The quantity of SLDs combined in any given unit is referenced in the part number, as follows:

- cBLMD-S: single-channel lightsource;
- cBLMD-D: double-channel lightsources, based on a combination of two SLD- modules;
- cBLMD-T: triple-channel lightsources, based on a combination of three SLD- modules;

Subsequent letters refer to optical specs. cBLMD-T-850-HP-I for example refers to a device with 3 x SLDs,@850nm- with an isolator fitted).

1.3 Package Contents

This Light Source is supplied with the following accessories as standard (these parts are to be found in the shipping box which should be kept and carefully stored):

- 1 x connector for the DC Power input port;
- 1 x connector for the remote input port;
- 1 x flat cable (0.5 meters length);
- 1 x USB cable;
- 1 x optical patch cable. Specifically matched (applicable for device models with a mating sleeve output);
- 1 x CD containing Superlum Companion Software and a copy of this Manual;
- 1 x Acceptance test report (ATR).
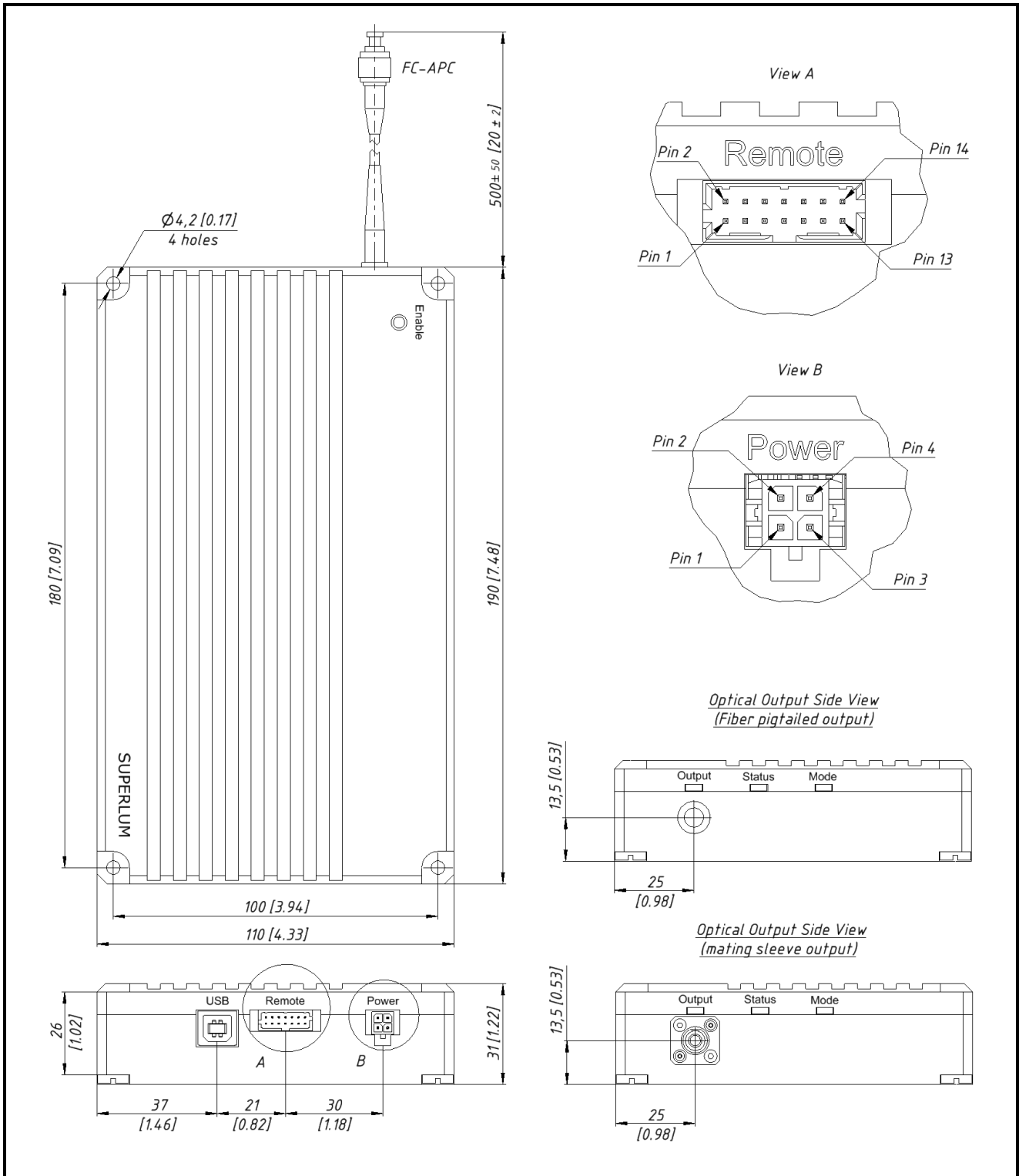

1.4 Outlines and Dimensions

Figure 1. Drawings of Light Source. Dimensions are in millimeters [inches]

1.5 Control LEDs

There are three LEDs on the front panel. These LEDs are a visual indication of the device status as described in the Table 1 below.

Table 1. Statuses of control LEDs

LED Name	LED State	System status
"OUTPUT" *	No light	The optical output is off.
	Flickering green	The optical output is starting (soft start).
	Green	The optical output is on.
	Yellow	SLD current limit reached – SLD degradation; time to service.
"STATUS"	No light	No power. No active SLDs.
	Flickering green	Temperature stabilization is in process.
	Green	SLD temperature is stabilized at the pre-set level on all channels. The optical output can be switched on. No errors detected.
	Flickering red	The optical output and all controls are disabled once the interlock has been actuated (correspondent terminals on the REMOTE port are open circuited). Interlock is only operable, if the correspondent option is computer activated ("*Configuration*" area in the SUPERLUM's companion software – see Sec. 4.3 below).
	Red	Common Error. Failure of the temperature controller.
"MODE"	No light	The unit is in manual operation. Remote control option is not activated
	Green	The unit is in REMOTE port operation (manual operation is disabled)
	Yellow	The unit is in computer remote operation (manual operation is disabled). USB mode.
	Flickering yellow	The unit is in computer remote operation (manual operation is disabled). USB SERVICE mode.

* – LED reflects the status of the combined optical output, i.e. all "active" SLD channels together (those user pre-selected in the companion software, or all channels as factory preset). Failure of, at least, one of the channels will result in the failure status of the combined optical output.

1.6 Remote Control Features

Refer to the companion software for remote control via computer using the USB port. Computer interface fitted to this device is nonstandard USB interface. It provides a virtual COM port for remote control via USB connection.

Short summary of the most relevant remote control features (also those available with SUPERLUM's companion software) are given in the Table 2 below. See Sec. 4.2-4.4 of this document for more information on this topic.

Table 2. Remote control features

USB (virtual COM port)	REMOTE port
- ON/OFF control of the optical output; - Pre-selection of certain SLD-channels for ON/OFF controlling; - Monitoring of relevant driving parameters of SLD-channels; - Self-test option – remote diagnostics feature; - Enabling/disabling the option of analog remote controlling via the REMOTE port (does not apply to the interlock control). Activation of this option disables a manual ON/OFF control of the optical output from the front device panel; - Controlling of optical performance.	*The REMOTE port is operable only if the correspondent option has been computer activated.* - ON/OFF control of the optical output by analog remote signals; - Monitoring of device statuses (e.g. on/off statuses of the optical output, service status); - Remote interlock control: interlock is actuated when correspondent terminals on the REMOTE port are open circuited. - Interlock is only operable, if the correspondent option is activated in the computer control software.

2 Technical Specification

2.1 Electrical Connections

Diagrams of electrical connections of the Light Source are shown in Fig. 2 below. Electrical Inputs/Outputs are described in Table 3 below.

There are three separate connectors (ports): first – for 12V DC power supply, second – for REMOTE control (external switching of SLDs on and off by analog signal triggering, and remote interlock control) and third – for USB interfacing.
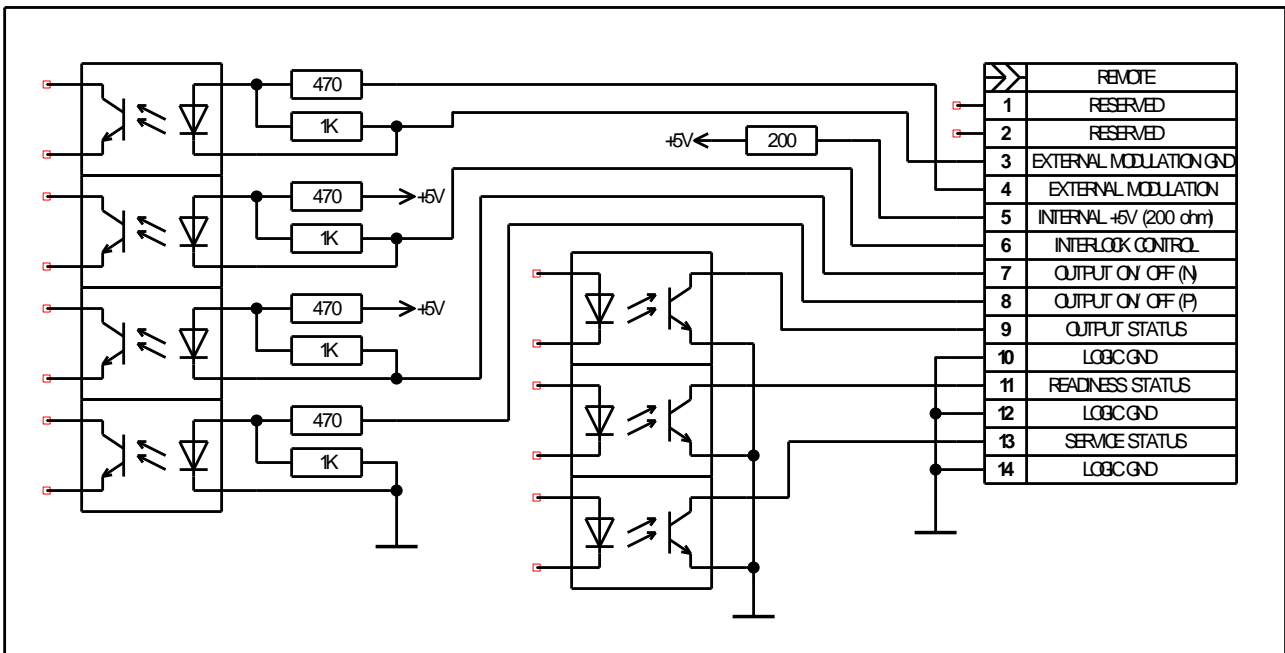

Figure 2**.** The electrical circuit of REMOTE port

Table 3. Description of Light Source control inputs/outputs

Pin number	Name	IN/OUT	Description/structure
POWER port:			
2,4	+12 V INPUT	IN	Input DC supply
1,3	GND	IN	DC supply GND
NOTE – GND terminals and the case of the Light Source are not connected inside.			
REMOTE port:			
1, 2	RESERVED		Reserved for additional TTL-level UART interface
3	EXTERNAL MODULATION GND		External modulation signal common wire
4	EXTERNAL MODULATION	IN	External modulation signal
5	INTERNAL +5V (200Ohm)	OUT	
6	INTERLOCK CONTROL	IN	Interlock is actuated when the control terminals are open circuited – optical output and controls are disabled in this case. 10mA (max) current. To de-actuate the earlier actuated interlock, device power resetting is required. Interlock is operable, only if the correspondent option is activated in remote control software ("*Configuration*" area in SUPERLUM's companion software – see Sec. 4.3 below).
7	OUTPUT ON/OFF (N)	IN	Allows switching the optical output. Connect this pin to any LOGIC GND pin to switching optical output ON.
8	OUTPUT ON/OFF (P)	IN	Allows switching the optical output. Apply +5VDC voltage from external power supply between this pin and any LOGIC GND pin to switching optical output ON
9	OUTPUT STATUS	OUT	Open collector. Goes to low impedance state in case of the optical output is ON. Recommended to load externally by ballast resistor of >=10kΩ
11	READINESS STATUS	OUT	Open collector. Goes to low impedance state in case of the optical output is ON. Recommended to load externally by ballast resistor of >=10kΩ
13	SERVICE STATUS	OUT	Open collector. Goes to low impedance state in case of service is required. Recommended to load externally by ballast resistor of >=10kΩ
10, 12, 14	LOGIC GND		Logic common wire

NOTE – To enable the controls of the REMOTE port, prior activation is required via USB / Ethernet interface (with use of SUPERLUM's companion software). The interlock is the only control option, computer activated separately from other controls of the REMOTE port.

Activation of REMOTE controls (except the interlock control) disables a manual ON/OFF control of the optical output from the front device panel.

Controlling via REMOTE port (except the interlock control) is possible only if the Light Source is not computer controlled in parallel.

Refer to Sec. 4.4 below for more details about controlling via REMOTE port.

2.2 General Specification

Table 4

Parameter	Condition	Min	Typ	Max	Unit
Storage temperature		−20	–	+70	°C
Operating temperature	The Light Source mounted on a heatsink capable for dissipating up to 35W.	+5	–	+45[1]	°C
	The Light Source is not mounted. Free air circulation around the enclosure	+5	–	+35	
Humidity, non-condensing		–	–	90	% RH
Weight [2]	With no shipping package		950		gram
DC supply voltage		10.0	12.0	13.0	V
DC supply current [3]		–	–	3.0	A
DC supply ripples	1 kHz…200 kHz frequency range	–	20	60	mVpp

(1) Refer to Sec. 3.1 for more details.
(2) Weight is typically 950g and depends on the final configuration: number of SLDs, availability of the built-in optical isolator.
(3) This light source is designed for integration and therefore is NOT supplied with a DC power supply unit. The power supply requirements indicated in Table 4 above are critical for the correct operation of the light source and must be strictly complied with. The power supply should ideally be capable of supplying up to 3A current, however a less powerful unit may be used but it will limit the operating temperature range. A power supply with a maximum current of less than 2.0A cannot be used. NOTE: For compliance with the EMC standard EN61000-4-5 it is recommended that the 12V power cable be less than 3m.

2.3 Fiber and Optical Connection Specification

Table 5

	Type	Comments
Fiber type	SM	Corning HI780 fiber for 750-1000nm spectral range; Corning SMF-28 fiber for 1.20-1.65um spectral range
Connector type	FC/APC	Depending on the ordered device configuration, the optical output is a FC/APC terminated fiber pigtail in a 3mm reinforced tube, or a FC/APC mating sleeve for external connection of FC/APC patch cables.

2.4 Other Electro-Optical Characteristics

Table 6

Parameter	Condition	Min	Typ	Max	Unit
Temperature dependent optical drift in the specified operating temperature range	Optically not isolated Light Source	–	100	200	ppm/°C
	Optically isolated Light Source	–	3 000	10 000	ppm/°C
Relative Intensity Noise (RIN)	10 kHz…2 MHz	–	−135	−125	dB/Hz
Long-term optical power stability	8 h after 60 min warming up	–	2 500	10 000	ppm
"Ready-to-work" time	From the moment of DC power application	–	–	7	s
Cold start settling time (system warm-up)		20 [1]	30	90 [2]	min
Rise time of optical signal		30	50	100	ms
Fall time of optical signal		1	–	3	µs

(1) at +25 °C;
(2) at high and low extremes of the operating temperature range.

3 General Information

3.1 Mounting

Temperature control is an important factor when considering where and how you will integrate this lightsouce to your application. Ideally in order to ensure effective heat dissipation the Light Source should be mounted to an appropriate heatsink in any spatial orientation with 25mm of free space around the sides and cover to allow air circulation. The Lightsource should be anchored to a flat plate heatsink large enough to accommodate the entire footprint of the lightsource base, *(see section 1.4 above; Figure 1. Drawing of Light Source)* using the Four (4) anchoring holes. Mounting and using without a heatsink is possible, but this approach will reduce the operating temperature range. Forced air circulation system around the enclosure is in this case strongly recommended.

3.2 Laser Safety Considerations

The Light Source emits invisible light that may have a potential hazard associated with CLASSES 3R-3B of IEC 60825-1, depending on specification of your particular lightsource.

The Light Source is designed for integration into an OEM application and as such, is outside the scope of laser safety standards. The cBLMD Light Source is not supplied with laser safety devices e.g. - key operated master control. However, these features can be implemented at the OEM application level by using the REMOTE port or USB interface.

If in doubt or you require any further information on Laser safety please contact Superlum.

4 Installation and Using he Light Source

4.1 Getting Started

It is recommended that the following procedures are completed prior to using the lightsource for the first time.

4.1.1 Fix the Light Source onto an appropriate heat sink firmly (refer also to Sec. 3.1 of the document for more details).

4.1.2 Apply 12 V DC power. Ensure that the DC power supply unit in use fulfills the requirements of the "Absolute Maximum Ratings" (Table 4) above, including the ripple requirement. Do not make other connections at this stage (USB, etc.).

The "STATUS" LED on the device panel will flicker for a short time on startup (for approximately 15 sec), and will light constant green when startup period is complete.

4.1.3 Push the "ENABLE" button on the front panel to switch the optical output on – the "OUTPUT" LED will then light green (a short delay is acceptable due to the soft start of the optical output). All SLDs installed will be powered on.

Measure output power with a dedicated power-meter, and compare the result with the power value specified in the individual Acceptance Test Report sheet provided (ATR). Make sure that output power you obtain is comparable to that on the datasheet i.e. within ±10%.

4.1.4 Connect the light source to a spectrum analyzer. Compare the spectrum with that depicted in ATR. There should be no perceptible differences between the two spectrums. Polarization insensitive spectrum analyzers (OSAs), e.g. ANDO AQ6317B / Yokogawa AQ6370 OSAs are recommended for this task. Polarization sensitive OSAs, or OSAs with MM fiber optical inputs may disturb the measurement results, i.e. introduce misbalances, distortions and artifacts to measured spectral shapes.

4.1.5 If no abnormality was found on the preceding stages the lightsource is now ready for use also when the Light Source has been run successfully for the first time it can now be controlled via the USB port, or analog signals via the remote port (see Fig. 1, 2, and Sec. 4.4). To prolong the device lifetime it is recommended to switch off the optical output when the lightsource is not in use.

WARNING

Optical output in fibre-coupled light sources is achieved by the use of an FC /APC mating sleeve and FC/APC connectors (optical output port). FC/APC connectors are sensitive to even the slightest contamination. Failure to comply with the following operating requirements may result in contamination entering the optical output port severely reducing the performance of the unit and may result in permanent damage to the optical output port. Any such occurrence is the responsibility of the user and is **NOT covered by the warranty**.

DO NOT: Insert any FC/APC connector into the optical output port without first ensuring it is clean. It is vital that you clean the fiber ferrule before each insertion. *No known cleaning methods are 100% effective therefore it is imperative that inspection is included as part of the cleaning process.*

Cleaning FC/APC   connectors: using a lint free cloth and isopropyl alcohol (Min 99%) and clean compressed air to dry off the connector is recommended.

Cleaning the optical output port: Using an Improper cleaning method may result in permanent damage to the optical output port. ONLY users who have the knowledge, training and equipment should attempt cleaning the optical output port. For further information please contact Superlum.

DO NOT: Remove the optical dust cap until a clean FC/APC connector is immediately ready to insert into the unprotected optical output port.

IMPORTANT!

If discrepancies are found when comparing the observed optical output or spectrum to the ATR please contact SUPERLUM before further using the Light Source. Using the lightsource without identifying the cause of the observed discrepancies may result in a reduction of the expected lifetime of the device.

The user should regularly compare actual device performances to those originally specified in ATR while using the Light Source.

4.2 Establishing Computer Communication

Manual control of the Light Source from the front device panel becomes disabled once the Light Source has established computer communication

4.2.1 Minimum System Requirements for SUPERLUM's Companion Software for remote control of the Light Source:

> **Operating system:** Windows 95, 95 OSR2, 98 or 98 SE, Windows ME, Windows NT Workstation 4.0 Service Pack 3, Windows 2000 Professional, Windows XP, Windows Vista, Windows 7.
> **Memory:** 32 megabytes (MB) for Windows 9x and ME, 64 MB for Windows NT, 128 MB for Windows 2000 and XP, 1 gigabyte (GB) (32-bit) or 2 GB (64-bit) for Windows Vista and Windows 7.
> **Processor:** 100-megahertz (MHz) or faster processor for Windows 9x and ME, 300-MHz or faster processor for Windows 2000 and XP, 1-gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor for Windows Vista and Windows 7.
> **Hard disk space:** 5 MB of free hard disk space (not including disc space required for associated USB drivers – see below).

4.2.2 Communication Interface

This Light Source incorporates an embedded Serial-to-USB converter that allows internal serial interface commands to be transmitted over USB. The converter comes with device drivers that create a virtual COM port on the computer to communicate with the Light Source.

The virtual COM port (VCP) drivers for the Serial-to-USB converter can be found on the FTDI web site: http://www.ftdichip.com/Drivers/VCP.htm

Refer to APPENDIX A at the end of this document for more details about establishing computer communication.

4.3 Computer Control of Light Source with SUPERLUM's Companion Software

Software allows basic remote computer controlling of the Light Source via USB port.
You can create your own control software using the provided command protocol (see APPENDIX B at the end of the document). However, it is recommended that in the first instance to use SUPERLUM's Companion Software.

NOTE – Screenshots shown in this section correspond to the example of dual-channel unit. The "SLD operation", "Configuration" and areas of the software display will be different in case of single- and triple-channel units reflecting the appropriate number of channels involved.
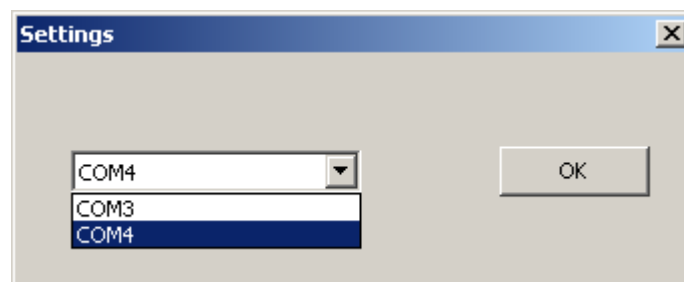
4.3.1 Using the USB cable supplied connect the Light Source to the computer.

4.3.2 Using the CD supplied install the software.

**4.3.3** Switch on the Light Source.

4.3.4 Brief description of software operation

Run the software. When starting the software for the first time, the following window for selecting of COM port # will appear.

If the drop-down list for setting COM port number is not available, or if this list does not contain the COM port number the Light Source is connected to, it may indicate that there is either no DC power applied to the Light Source, or the Light Source is not connected to the computer.

Select COM port # to which the Light Source is connected. The next window will then appear, as shown below. You can change COM port # when required by clicking on the "Connection" display button.
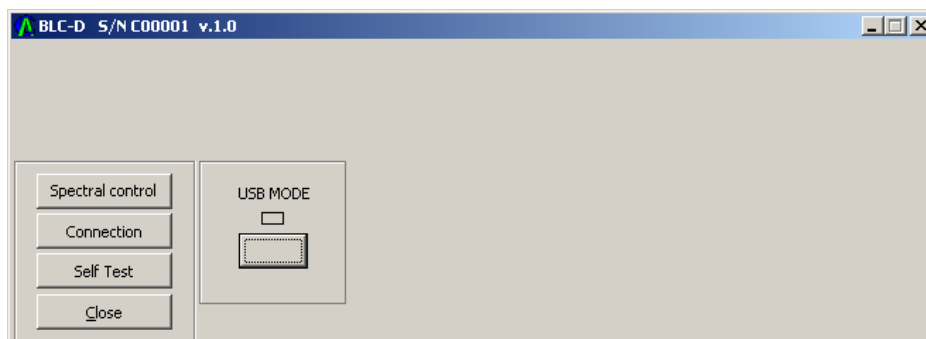
The selected COM port # will be stored. All future times of connecting the Light Source to the same computer and to the same computer communication port, the initial "Settings" window will no more appear at starting the software.

Once the "USB MODE" button has been clicked on the software display, the Light Source turns to remote operation, and the following window appears (indicator turns from blank to green). Manual control of the Light Source from the front device panel becomes disabled once the Light Source has established computer communication.
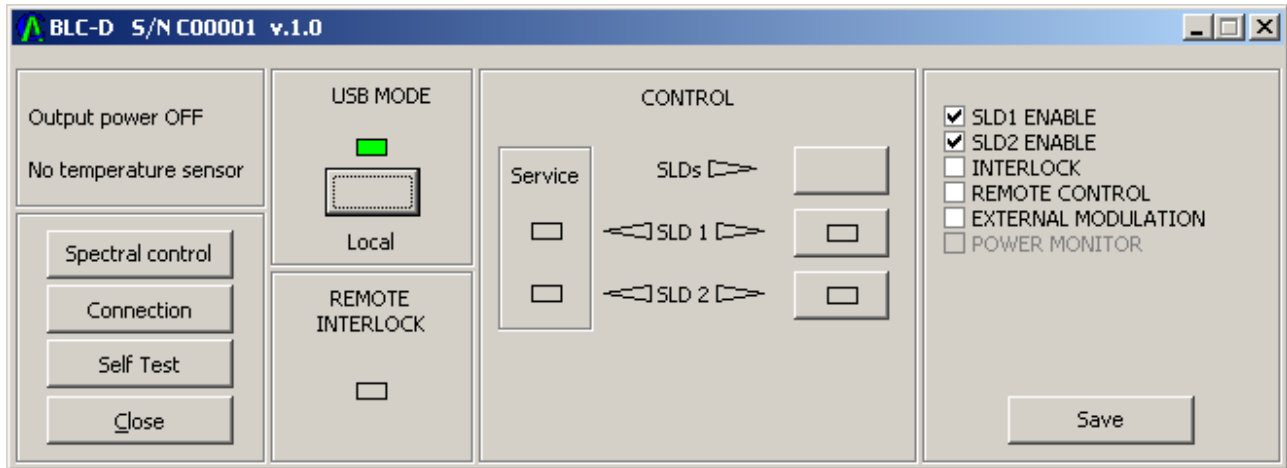
Display indicators - "SLD" and "Service" in the "*SLD Operation*" area - show actual statuses of each of the SLD- channels (TEC and SLD statuses). Optical output can be toggled on and off with the "SLD enable" display button –SLD channels, which are selected (activated) in the "*Configuration*" area, will only be toggled.

"Self Test" option is used for internal self-testing of the Light Source. It is initiated by clicking on the "**Self Test**" display button in the "*Options*" area. This procedure may take a few minutes after being initiated. Upon completion, the program will automatically generate a test file, which should be e-mailed to SUPERLUM for further processing and verification of actual device statuses. You can add your comments before saving and e-mailing the generated self-test file.

The **"***Configuration***"** area of the software display allows the following control features:

- **Activate / deactivate SLD- channels for on/off toggling.** Only those SLD channels, which are selected / checked in the **"***Configuration***"** area, will be triggered ON and OFF remotely ("SLD enable" button of the companion software, and through the REMOTE port if activated) and manually (front panel pushbutton). By default (being factory preset) all SLD channels involved are pre-selected in the "*Configuration*" area, i.e. are ready for controlling.

- **Activate / deactivate the remote interlock.** The interlock is actuated – the optical output and all controls become disabled, and the correspondent indicators ("Remote" LED indicator on the device panel, and "REMOTE INTERLOCK" software display indicator) lit red – when the correspondent control terminals on the REMOTE port are open circuited (see Sec. 2.1 for more details). To de-actuate the earlier actuated interlock, device power reset is required.

- **Activate /deactivate analog controls of the REMOTE** port (does not apply to the remote interlock control, which is computer activated separately). Manual control of the Light Source remains disabled when analog controls of the REMOTE port are activated.

- **Activate / deactivate the external modulation input.**

Any changes to the **"***Configuration***"** area are possible only when the optical output is switched off. Changes are applied immediately once correspondent boxes are ticked in the "*Configuration*" area.

To save changes introduced to the **"***Configuration***"** area, the **"Save"** display button in the "*Configuration*" area must be clicked. In this case the introduced changes are stored even after device power re-setting. Otherwise, the changes introduced are in place only during the current work session.

Yellow indication of "**SLD**" display indicators in the "*SLD Operation*" area show that the correspondent channel(s) have not reached readiness. When SLD is fully ready for operation, the correspondent indicator turns to blank.

"Spectral control" option is used for fine adjustment of Light Source output performance.
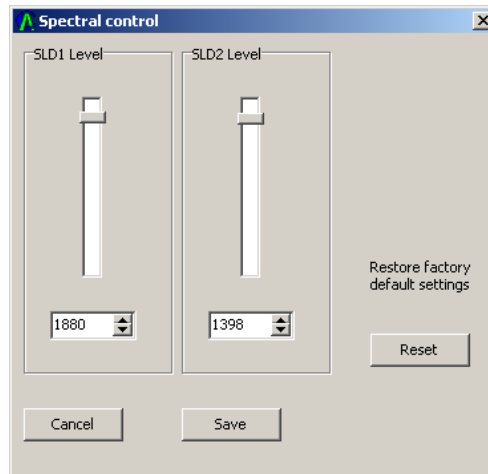
SLD channel level bar. These bars allow you to control the output level of the SLDs. This can be varied between 0 (no output) to a maximum allowed value. By default, these bars are set so the intensities of the spectral peaks forming the output of the Light Source are equalized.

SLD channel level value. These texts fields show you the SLD output level in arbitrary units. For a precise level control, the User can also type in a value or control it with the up arrow and down arrow buttons. These arbitrary units were pre-calibrated at Superlum and the value is unique for each SLD. The User can expect a near linear dependence between the value in arbitrary units and the actual output power. The maximum level value in arbitrary units is unique for each SLD and is hard-preset by Superlum.

Reset button. Resets the SLD output levels to factory settings.

Cancel button. Discard changes made in the spectral control menu.

Save button. Save the changes made in the spectral control menu. The settings will be stored in the Light Source memory.

*By changing the SLD output level **both** the spectral shape and the intensity of SLD output are changed. Be very careful when adjusting the output levels of the SLDs.*

4.4 Controlling the Light Source via Remote port

This section concerns to all control options available with the REMOTE port, except the interlock control. The latter is activated and controlled separately from other controls of the REMOTE port.

4.4.1 Connect the Light Source to a computer via USB.

4.4.2 Power on the Light Source.

4.4.3 Run companion software. Establish communication with the Light Source.

4.4.4 Check the "Remote control" box in the "*Configuration*" area of the software display, and click "Save" display button to apply changes. It activates the option of controlling via the REMOTE port.

Analog control via the REMOTE port will be user-available once the computer session has been interrupted (click "REMOTE" display button to toggle computer control on and off).

Manual control of the Light Source from the front device panel becomes disabled when the "Remote Control" box has been checked on the software display.

4.4.5 Control the Light Source by applying control signals to the terminals of the REMOTE port. Possible example is shown on Figure 3. More details about electrical connections to the REMOTE port can be found in Sec. 2.1 of the document.
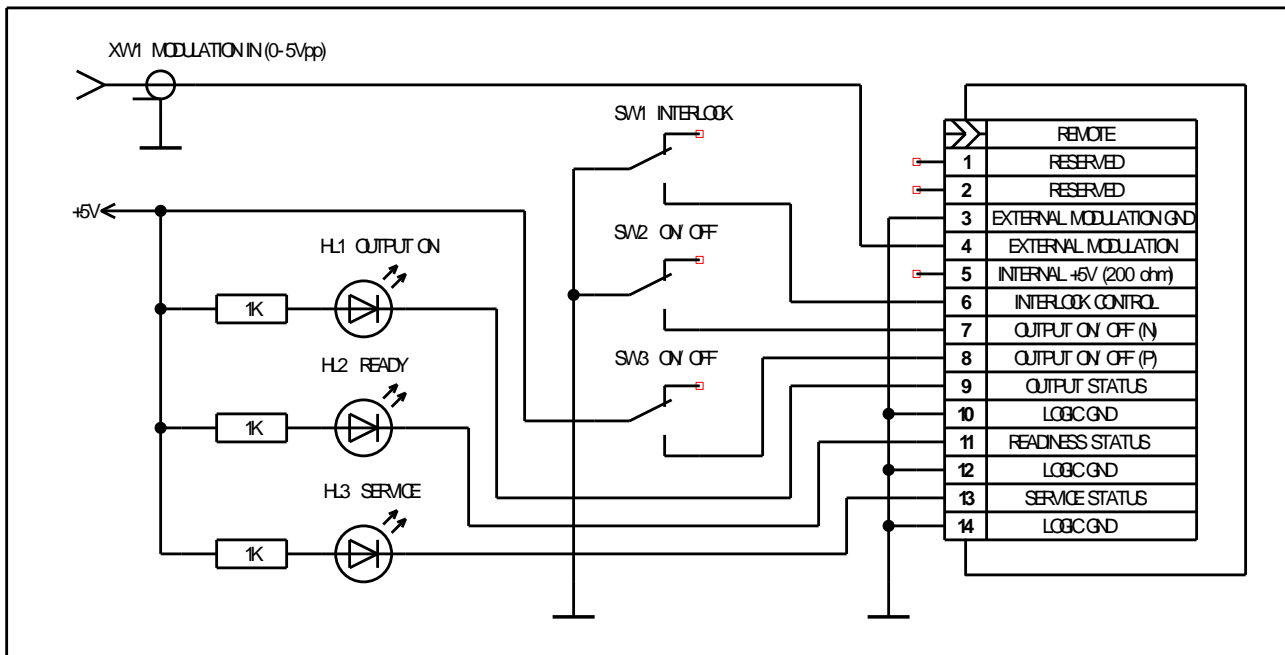

Figure. 3 Example of basic controlling of the Light Source via REMOTE port

4.4.6 Uncheck the "Remote Control" box of the "*Configuration*" area of the software display to disable the REMOTE port, and to return to manual and computer controlling of the Light Source.

APPENDIX A
Downloading and Installing Procedures to Establish
Computer Communication and Control

Connecting to Light Source via USB

When the Light Source is connected via USB for first time, the OS driver installer will automatically run the process of device initialization (assigning COM port). It may take few minutes until the process will be completed. Corresponding icon of the installer must appear in the system tray.

Upon completion of the process COM port number will be automatically assigned to the device. Port number can be checked by clicking on the installer icon on the system tray.

If the automatic initialization process failed on the computer in use, please refer to a manual installing of drivers as recommended by FTDI, the manufacturer of the embedded Serial-to-USB converter (http://www.ftdichip.com/Drivers/VCP.htm).

APPENDIX B
USB Command Protocol

UART configuration:

Baud Rate = 57600;
Start Bits = 1;
Stop Bits = 1;
Parity = None;
Flow Control = None.

1   SYSTEM COMMANDS

1.1   Read Light Source type, firmware version and serial number

Request: [I] [CR] [LF]
Acknowledge: [I] [:] [TYPE] [:] [VH] [VL] [:] [SN] [CR] [LF]
Error message: [!] [E] [CR] – common error message.

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

[TYPE] – Light Source type, five ASCII printable chars:
          "BLC-S" – one channel Light Source;
          "BLC-D" – two channels Light Source;
          "BLC-T" – three channels Light Source;
          "BLC-E" – one channel Light Source with electronic output power control function.
[VH] – Major part of firmware version [0…9], one ASCII chars;
[VL] – Minor part of firmware version [0…9], one ASCII chars;
[SN] – Serial number, six ASCII printable chars.

1.2   Set Light Source operation mode. Read current mode.

Request: [M] [CMD] [CR] [LF]
Acknowledge: [M] [MODE] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message.

[CMD]	DESCRIPTION
[?]	Read current mode
[L]	Set LOCAL mode
[U]	Set USB CTRL mode
[C]	Set USB CTRL mode

[MODE]	DESCRIPTION
[L]	Device operated in LOCAL mode
[U]	Device operated in USB CTRL mode
[E]	FATAL ERROR mode

2 USB CTRL MODE COMMANDS [U]

2.1 Switch SLD ON/OFF. Read Channel status data

Request:	[U] [C] [CH] [CR] [LF]
Acknowledge:	[U] [C] [IL] [ST1] [ST2] [ST3] [CR]
Error message:	[!] [E] [CR] [LF] – common error message;
	[!] [M] [CR] [LF] – wrong mode set message.

[CH]	DESCRIPTION
[?]	Read CH status data
[1]	Switch SLD#1 ON/OFF
[2]	Switch SLD#2 ON/OFF
[3]	Switch SLD#3 ON/OFF
[9]	Switch all SLDs ON/OFF

[IL] – Remote interlock data [0] or [1]:
    [0] – output disabled;
    [1] – output enabled.
[ST1]…[ST3] – Channel [1…3] status, [00…FF], two ASCII chars in hexadecimal code. See table below for signal identification.

SIGNAL	BIT	DESCRIPTION
OME	0	'1' – Optical module enabled '0' – Optical module disabled
TON	1	'1' – TEC ON; '0' – TEC OFF
TGD	2	'1' – Optical module temperature stabilized '0' – Optical module temperature not stabilized
TER	3	'1' – TEC (Thermistor) error
SMD	4	'1' – SLD operated in ACC mode '0' – SLD operated in APC mode
SON	5	'1' – SLD ON; '0' – SLD OFF
SLM	6	'1' – SLD current limit reached
SER	7	'1' – SLD error

2.2 Switch control

Request:	[U] [S] [CMD] [CR] [LF]
Acknowledge:	[U] [S] [SWDATA] [CR] [LF]
Error message:	[!] [E] [CR] [LF] – common error message;
	[!] [M] [CR] [LF] – wrong mode set message.

[CMD]	DESCRIPTION
[?]	Read current Switch Data
[1]	Switch Channel #1 (CH1)
[2]	Switch Channel #2 (CH2)
[3]	Switch Channel #3 (CH3)
[5]	Enabling / Disabling Interlock
[6]	Enabling / Disabling REMOTE port
[7]	Enabling / Disabling External Modulation
[S]	Store current Switch Data to EEPROM

[SWDATA] – Switch status, [00…FF], two ASCII chars in hexadecimal code. See table below for signal identification

[SWDATA]	DESCRIPTION
Bit#0	'1' – Channel #1 (CH1) enabled '0' – Channel #1 (CH1) disabled
Bit#1	'1' – Channel #2 (CH2) enabled '0' – Channel #2 (CH2) disabled
Bit#2	'1' – Channel #3 (CH3) enabled '0' – Channel #3 (CH3) disabled
Bit#3	Reserved, reads as null
Bit#4	'1' – Interlock enabled '0' – Interlock disabled
Bit#5	'1' – REMOTE port enabled '0' – REMOTE port disabled
Bit#6	'1' – External Modulation enabled '0' – External Modulation disabled
Bit#7	'1' – Output Power Monitor enabled '0' – Output Power Monitor disabled

2.3 Measure optical module parameter (read data from ADC)

Request: [U] [M] [CH] [PN] [CR] [LF]
Acknowledge: [U] [M] [CH] [PN] [ADATA] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
                    [!] [M] [CR] [LF] – wrong mode set message.

[CH] – Channel number [1…3], one ASCII character;
[PN] – Parameter number [1…8], one ASCII character;
[ADATA] – Parameter value [0000…FFFF], four ASCII characters in hexadecimal code.

[PN]	DESCRIPTION	ADATA RANGE
1	Real TEC current	[0000] = 0,00A [00FF] = +2,55A [01FF] = -2,55A
2	SLD current (maximum current) set value	[0000]=0,00 mA [FFFE]=655,34mA
3	Optical module photo-diode current (HP) set value	[0000]=0,0µA [FFFE]=6553,4µA
4	Optical module photo-diode current (LP) set value	[0000]=0,0µA [FFFE]=6553,4µA
5	Real Optical module temperature value	[0000]=0Ω [FFFE]=65534Ω
6	Real SLD current value	[0000]=0,00 mA [FFFE]=655,34mA
7	Real PD current value	[0000]=0,0µA [FFFE]=6553,4µA
8	Optical module temperature set point value	[0000]=0Ω [FFFE]=65534Ω

Note - ADATA overload string is [FFFF].

2.4 Read optical module parameter

Request: [U] [P] [MN] [PN] [CR] [LF]
Acknowledge: [U] [P] [MN] [PN] [DATA] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
               [!] [M] [CR] [LF] – wrong mode set message.

[MN] – Optical module number, [1…3] (One ASCII character);
[PN] – Parameter number, [0…9] (One ASCII character);
[DATA] – Parameter data see table below.

[PN]	Description	DATA Range	Comments
0	Optical module serial number	[XXXXXX]	Six ASCII printable characters
1	Optical module operation mode	[0] or [1], one ASCII char	[0] – APC mode [1] – ACC mode
2	Optical module temperature set point value	[0000…FFFE], four ASCII chars	[0000] = 0 ohm [FFFF] = 65534 ohm
3	Optical module maximum current value	[0000…270F], four ASCII chars	[0000] = 0,0 mA [270F] = 999,9 mA
4	Optical module current value	[0000…270F], four ASCII chars	[0000] = 0,0 mA [270F] = 999,9 mA
5	Optical module photo-diode current value (HP)	[0000…270F], four ASCII chars	[0000] = 0 µA [270F] = 9999 µA
6	Optical module photo-diode current value (LP)	[0000…270F], four ASCII chars	[0000] = 0 µA [270F] = 9999 µA
7	Optical module photo-diode current maximum value	[0000…270F], four ASCII chars	[0000] = 0 µA [270F] = 9999 µA
9	Optical module operating time	[00000000]- [FFFFFFFF], Eight ASCII chars	00000000 – 0 s; 0000000A – 10 s; ….

2.5 Read optical module parameter (factory data)

Request: [U] [F] [MN] [PN] [CR] [LF]
Acknowledge: [U] [F] [MN] [PN] [DATA] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
               [!] [M] [CR] [LF] – wrong mode set message.

[MN] – Optical module number, [1…3] (One ASCII character);
[PN] – Parameter number, [0…8] (One ASCII character);
[DATA] – Parameter data. See table 2.4 above for details.

2.6 Adjust optical module parameter

Request: [U] [J] [MN] [PN] [DATA][CR] [LF]
Acknowledge: [U] [J] [MN] [PN] [DATA] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
                [!] [M] [CR] [LF] – wrong mode set message.

[MN] – Optical module number, [1…3] (One ASCII character);
[PN] – Parameter number, [4…6] (One ASCII character);
[DATA] – Parameter data. See table 2.4 above for details.

2.7 Store adjusted optical module parameters in EEPROM

Request: [U] [E] [CR] [LF]
Acknowledge: [U] [E] [Y] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
                [!] [M] [CR] [LF] – wrong mode set message.

[Y] – Result of data storing:
        '1' – all right;
        '0' – data storing error.

2.8 Read temperature and output power

Request: [U] [T] [CR] [LF]
Acknowledge: [U] [T] [TV] [PV] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
                [!] [M] [CR] [LF] – wrong mode set message.

[TV] – Temperature value [00…FF], two ASCII chars in hexadecimal code in two's complement form:
        [7F] = +127 ºC;
        [00] = 0 ºC;
        [FF] = -1 ºC;
        [81] = -127 ºC;

        [80] - no temperature sensor installed or temperature sensor error.

[PV] – Output power value [000…FFF], three ASCII chars in hexadecimal code.
        [000] = 0 mW;
        [FFF] = 409,5 mW.

2.9 Read output power limit value

Request: [U] [L] [CR] [LF]
Acknowledge: [U] [L] [PL] [CR] [LF]
Error message: [!] [E] [CR] [LF] – common error message;
                [!] [M] [CR] [LF] – wrong mode set message

[PL] – Output power LIMIT value, [00…FF], two ACSII characters in hexadecimal code:
[00] = 0 mW, [FF] = 255 mW.