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LPA

Motorised laser power attenuator

Congratulations on your purchase of the motorised laser power attenuator from Optogama, UAB.

March 2019

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Claims will not be accepted and warranty repair will not be carried out in case of improper use, incorrect service and maintenance not according to product instructions. Warranty claim shall not be accepted if there are any signs of:

- Non-authorized alteration
- Disassembling of the device
- Mechanical or any external damage
- If warranty term has expired
- Serial number of the product is missing

Symbols

CAUTION!

Sections marked with this symbol indicate dangerous situations that can result in damage to the device, components connected to it or operator.

NOTE:

Sections marked with this symbol indicate important information on laser power attenuator or about this manual.

Due to constant development of our products we reserve the right to make changes in the production line without further notice. Up-to-date information is available at our website www.optogama.com. If there are any further questions, please contact us.

Optogama is not liable for damage or injury resulting directly or indirectly from use of this product for anything other than its intended purpose.

The motorised laser power attenuator is intended for industrial and scientific use only. If there are any other electrical devices connected to or used in conjunction with the laser power attenuator, all legal regulations and technical standards that are applied to those devices must be observed as well.

For any technical assistance and consultation please contact your local dealer or directly sales@optogama.com.

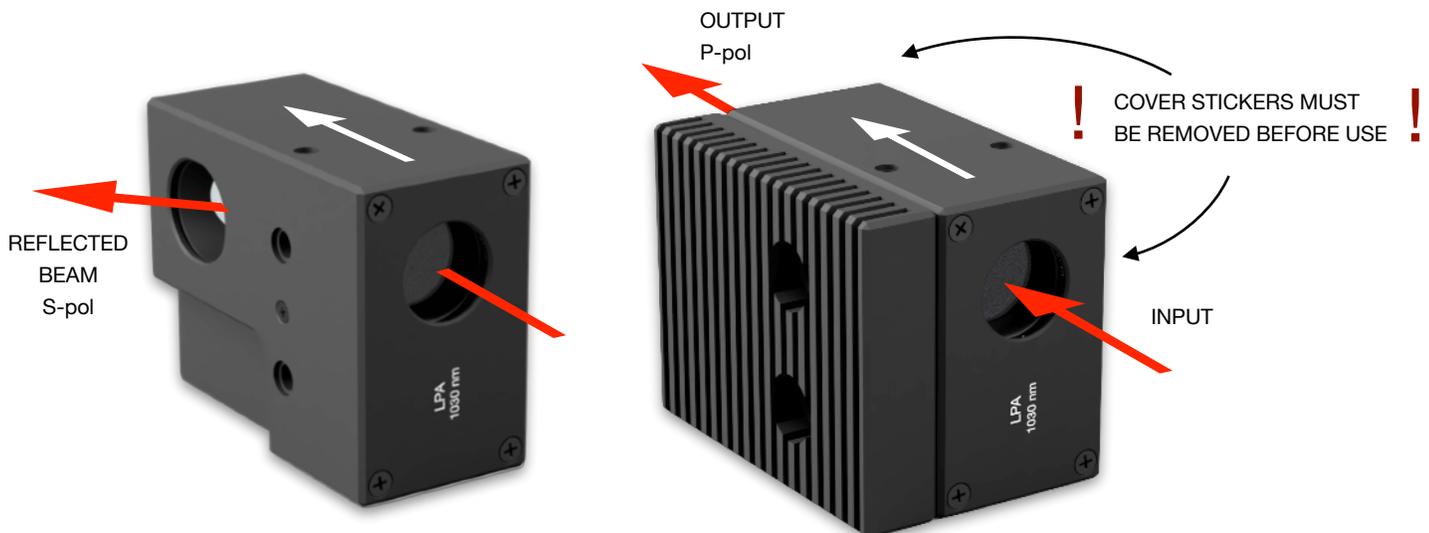
1. Safety requirements

- All safety instructions must be followed.
- All rules and regulations concerning the safe operation of lasers must be known and applied while installing and operating motorised laser power attenuator.
- Even when wearing safety glasses avoid eye contact with direct or scattered laser light while assembling, installing and operating the device.
- The device should never be exposed to dirt, dust or moisture.
- Before any operation make sure the device is installed correctly and well adjusted and all cover stickers are removed.
- Protective measures should be considered if necessary.
- Electrical safety requirements must be complied while operating this device.

CAUTION! High laser output power may damage or destroy optical elements.

CAUTION! The device is meant to be used with a collimated beam. Users take full responsibility when using the device with a highly converging beam.

CAUTION! Before increasing laser power make sure the device is aligned and there is no beam cut. It may damage optical elements.



2. Operation principle

LPA consists of zero-order half-waveplate and Brewster type thin film polariser. Zero-order half-waveplate rotates the polarisation. Brewster type thin polariser passes P-polarised and reflects the S-polarised laser beam. Waveplate and polariser are coated for the desired wavelength. The attenuation adjustment is achieved by motorised rotating of the waveplate, which is located in the incident of the laser beam. The attenuation level is controlled by the software in 0,1-97% range.

NOTE: Before use calibration is required

NOTE: Homing is required.

CAUTION! Before increasing laser power make sure the device is aligned and there is no beam cut. It may damage optical elements.

2.1. Features and advantages

- Robust design
- 175,500 μ steps in full rotation
- $\pm 10 \mu$ steps *accuracy (± 0.02 deg, less than ± 0.05 % of laser power)
- Clear aperture - 18 mm
- Fast adjustment - less than 0.2 sec (min to max)
- High damage threshold up to $10\text{J}/\text{cm}^2$ (10 ns @ 1064 nm)
- Adjustable polariser angle

2.2. Optical design

LPA optical elements are coated for high LIDT ($10 \text{ J}/\text{cm}^2$) (10 ns @ 1064 nm) and can be applied for high power lasers.

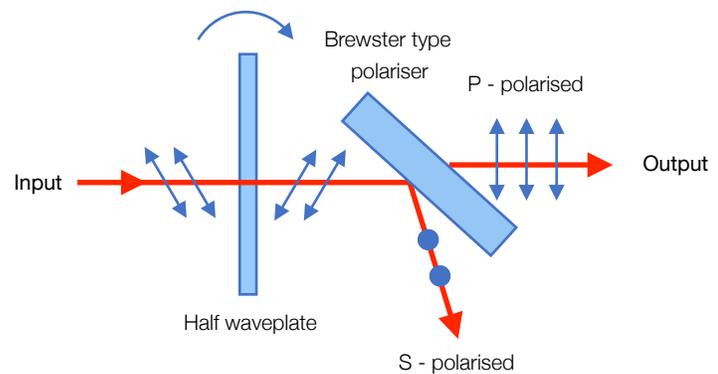


Fig 1. Schematic explanation of optical design of laser power attenuator (LPA)

2.3. Contrast improvement. Angle adjustment

Incident light's angle α should be adjusted to improve device contrast (± 2 deg maximum). Use HEX 1,5 key.

- Clock-wise to decrease angle
- Counter clock-wise to increase angle

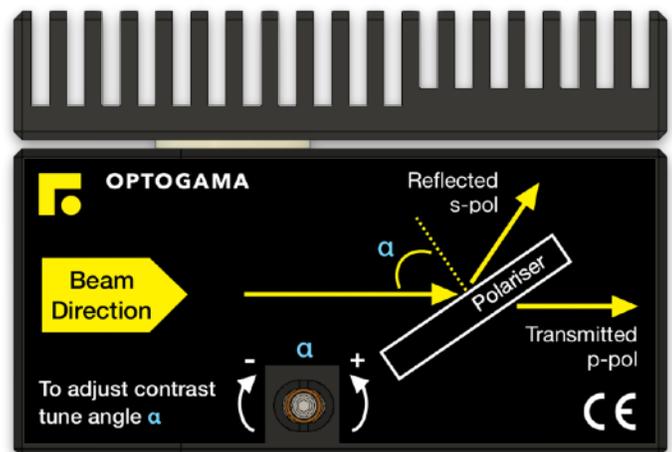


Fig 2. Schematic explanation of optical design of laser power attenuator (LPA)

*repeatability after 10,000 random positions without homing

3. Product description

Laser power attenuator (LPA) is a compact motorised device for laser power control.

The LPA is produced in the UV, visible and NIR spectral ranges, from 250 nm to 2000 nm. This device is combined with the unique mechanical design which ensures repeatability and high stability of performance.

All optical components of the LPA are made for high LIDT and provide stable and reliable performance even using them with high power lasers in industrial applications.

A secondary laser beam from laser power attenuator unit can be rejected to an external beam dump. The beam dump is used for avoiding any thermal effects or stress in the housing of the LPA device.

3.1. Optical specifications

Clear input aperture	18 mm
Clear output aperture	18 mm
Power attenuation range	0.1 - 98%
LIDT coating	>10 [J/cm ²] (10 ns @ 1064 nm)
Close to open time	< 0.2 sec
Resolution	175,500 μ steps in full rotation (0.002 deg, 7.4 arcsec, 0.035 mrad)
Repeatability (after 10,000 positions without homing)	$\pm 10 \mu$ steps (± 0.02 deg, less than ± 0.05 %)
Available coatings	
A. Standard wavelenghts, nm	
	1 st harm 2 nd harm 3 rd harm
	1064 532 355
	1020 - 1040 510 - 520 343
	760-840 390 - 410 -
C. Custom wavelenghts	
Custom coating available	

3.2. Mechanical specifications

	LPA	LPA with beam dump	Controller
Lenght	76 mm	76 mm	125 mm
Width	36 mm	52 mm	53 mm
Height	58 mm	58 mm	31 mm

3.3. Electronic specifications

Interface options:

Terminal	Using commands described in p. 12 "Commands"
Software	Using LPA software
Input voltage	DC 12 V
Transmission speed	up to 115,200 bits/s (RS-232) full speed USB 2.0

3.4. Conditions

Operating temperature	10 °C to 35 °C
Storage temperature	-15 °C to 50 °C

3.5. Controller

3.5.1. Interfaces, pinout

1. RS-232 (DB9), USB 2.0 type B, and power plug for DC 12 V (standard plug 5.5x2.1 mm).

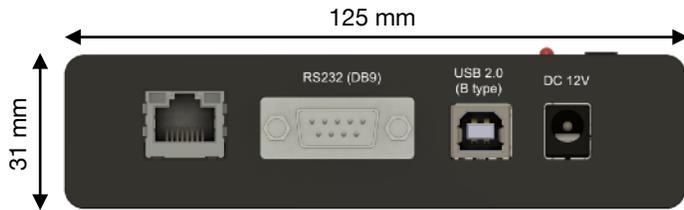


Fig 3. Front view of LPA controller.

RS232 (DB9) Pinout

- 2 - D+ (RS-232: Tx)
- 3 - D- (RS-232: Rx)
- 5 - GND



2. HD-15 connector (for laser power attenuator connection to controller).



Fig 4. Back view of LPA controller.

3.5.2. LEDs, Buttons functions

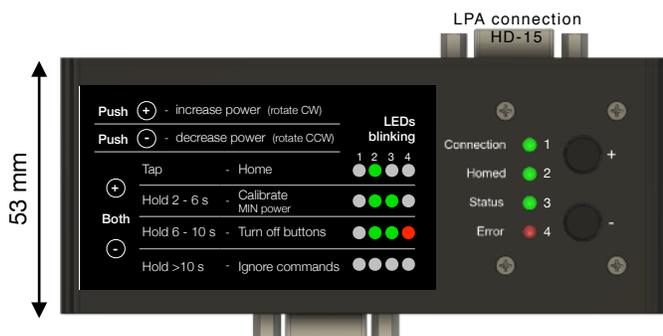


Fig 5. Top view of LPA controller.

LED explanation

Connection	Green - Power ON
Homed	Green - Device is homed and ready to use
Status	Green blinking - Device is in motion
Error	Red - there is an error, please connect PC for further troubleshooting

BUTTONS functions

CW rotation (+)	Push "+" button to rotate clock-wise
CCW rotation (-)	Push "-" button to rotate counter clock-wise
Home (Tap)	Tap both "+" & "-" buttons to home the device

Calibrate (Hold 2 to 6 s)	Hold both "+" & "-" buttons from 2 to 6 seconds to define (calibrate) current position as minimum power position (0%). "Homed" and "Status" LED's will start blinking when it is right time to release buttons to calibrate the device
---------------------------	---

Button lock (Hold 6 to 10 s)	Hold both "+" & "-" buttons longer than 6 seconds to turn off buttons. You will be able to turn buttons ON again only via LPA software (Settings > Buttons ON) or using command.
------------------------------	--

	"Homed", "Status" and "Error" LED's will start blinking when it is right time to release buttons to lock them.
--	--

	Hold both "+" & "-" buttons longer than 10 seconds to ignore commands.
--	--

Ignore (Hold more than 10s)	"Homed", "Status" and "Error" LED's will stop blinking when it is right time to release buttons to ignore commands.
-----------------------------	---

3.5.3. Mounting

LPA controller is suitable for standard *DIN35 rail mounting. You simply attach DIN35 Rail adapter with provided screws. *(DIN35 rail mount is optional)



3.6. Voltage levels

The RS-232 standard defines the voltage levels that correspond to logical one and logical zero levels for the data transmission and the control signal lines. Valid signals are either in the range of +3 to +15 volts or the range -3 to -15 volts with respect to the "Common Ground" (GND) pin; consequently, the range between -3 to +3 volts is not a valid RS-232 level. For data transmission lines (TxD, RxD), logic one is defined as a negative voltage, the signal condition is called "mark". Logic zero is positive and the signal condition is termed "space".

LPA operates on signal levels of ± 5 V and can accept signal levels of up to ± 15 V. Because the voltage levels are higher than logic levels typically used by integrated circuits, special intervening driver circuits are required to translate logic levels. These also protect the device's internal circuitry from short circuits or transients that may appear on the RS-232 interface and provide sufficient current to comply with the slew rate requirements for data transmission.

3.7. What's in the box?

Standard kit includes:

1. Motorised laser power attenuator
2. Controller
3. Software
4. Power supply (DC 12V - 5.5x2.1 mm)
5. USB (type B) and RS-232 (DB9) cables

NOTE: Other accessories must be purchased separately.

4. Software

4.1. Minimum Hardware requirements (recommended)

Processor	1 Ghz
RAM	512 Mb
Disk space	
32-bit	4,5 Gb
64-bit	4,5 Gb

4.2. System requirements

To install the application you must have administrator rights on your computer.

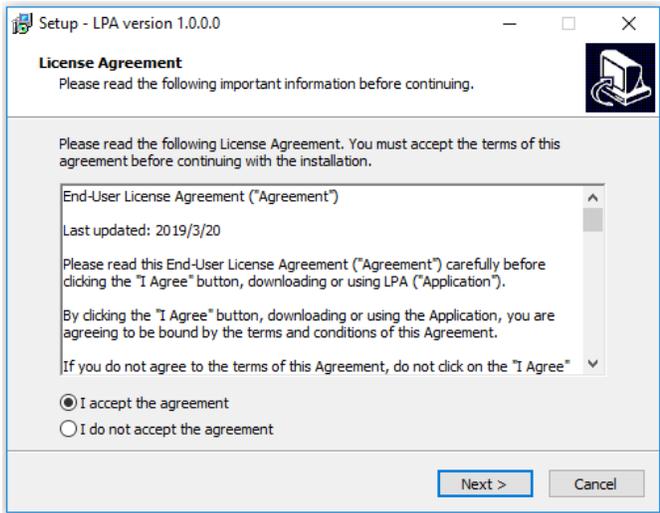
To run LPA application Microsoft .NET 4.5.2 Framework or later must be installed. The installer detects Microsoft .NET Framework and installs it. Administrator privileges are required for installation. Contact your network administrator if you do not have administrator rights on the computer.

4.3. Supported client operating systems

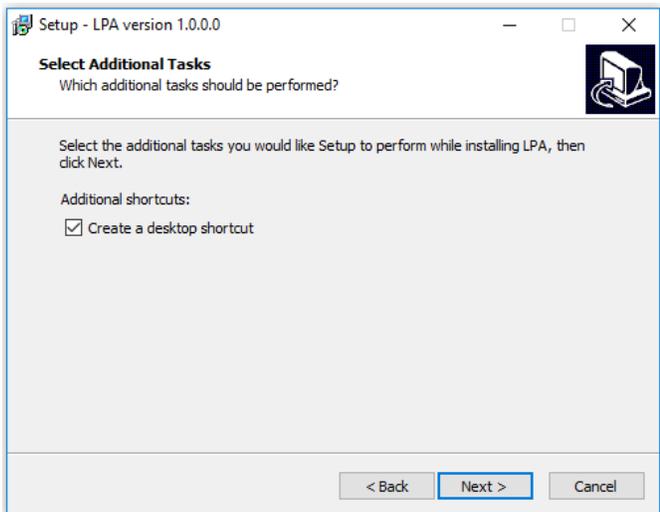
- Windows Vista SP2
- Windows 7 SP1
- Windows 8
- Windows 8.1 (.NET included with OS)
- Windows 10 (.NET 4.6 included with OS)
- Windows Server 2008 SP2/R2
- Windows Server 2012 (.NET included with OS)

4.4. Installing the software

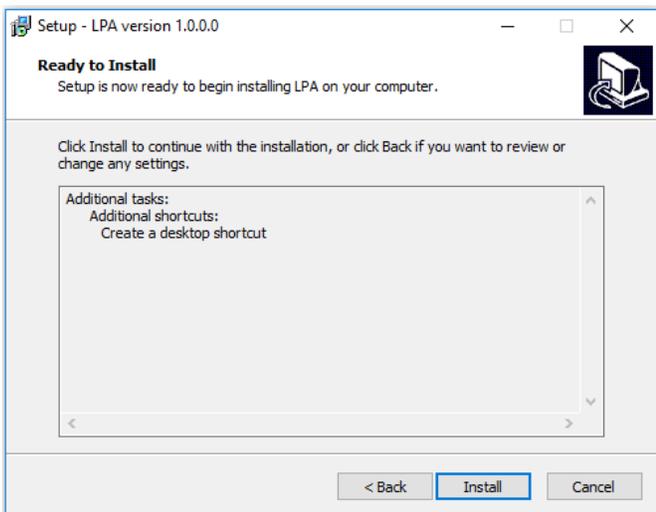
1. Check and download the latest LPA software from our website (www.optogama.com, www.4lasers.com) or contact us directly at sales@optogama.com.
2. Run the downloaded software installation file. Installation window will appear, click "Next" to continue:



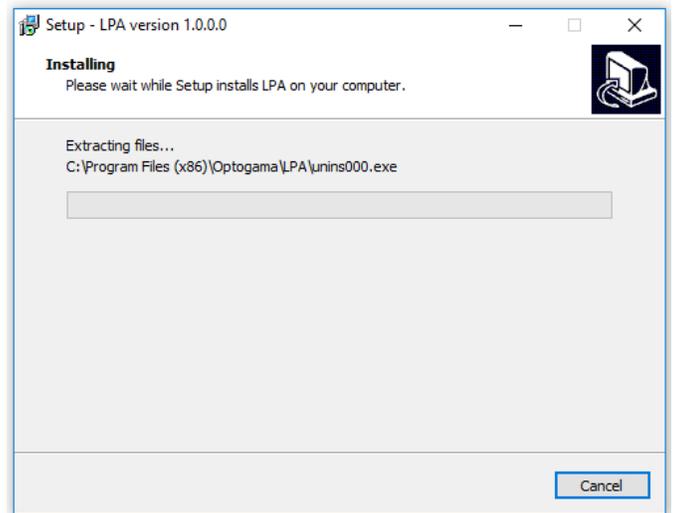
3. Select “Create a desktop shortcut” if it is necessary and click “Next”:



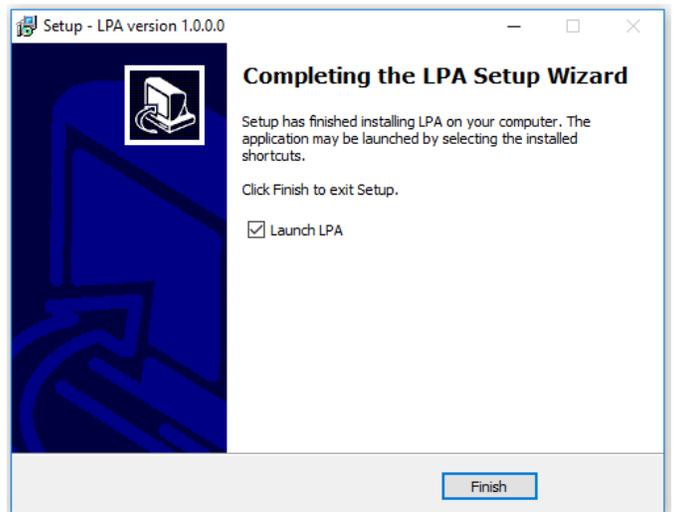
Review setup information and proceed the installation. To continue click “Install”:



4. Setup will finish the installation:



5. Press “Finish” to end the installation:



Connect the device and controller via HD-15 cable.

6. Connect the PC and controller via USB or RS232 cable.
7. Plug in power supply to controller and AC adaptor to wall outlet.
8. The device will be detected and configured.
9. The device installation is complete.

4.5. Using the software

CAUTION! Do not switch the laser ON if the device is not adjusted properly, it may damage or destroy optical elements.

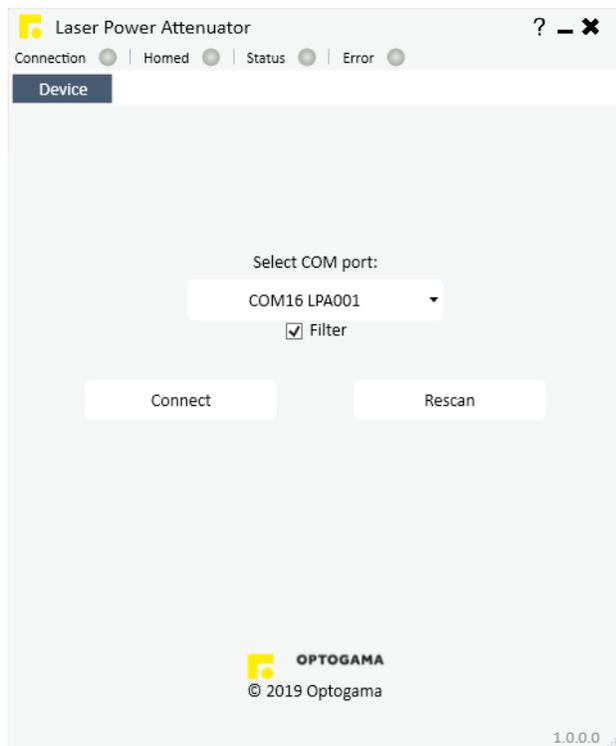
Launch LPA program using LPA icon on the desktop.



4.5.1. Connection, device selector

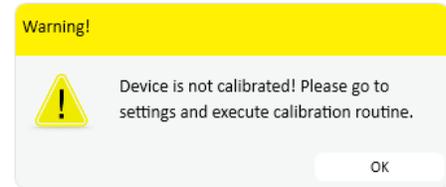
10. Device selector window will appear. Select COM port (to which the laser power attenuator is connected) from the drop down menu. Press **“Connect”** to connect the device or **“Rescan”** if your device is not visible. Select **“Filter”** when device is connected via USB cable. All other COM ports will be hidden except our device.

NOTE: When connecting via RS232 cable “Filter” must be deselected, otherwise device will not be visible.

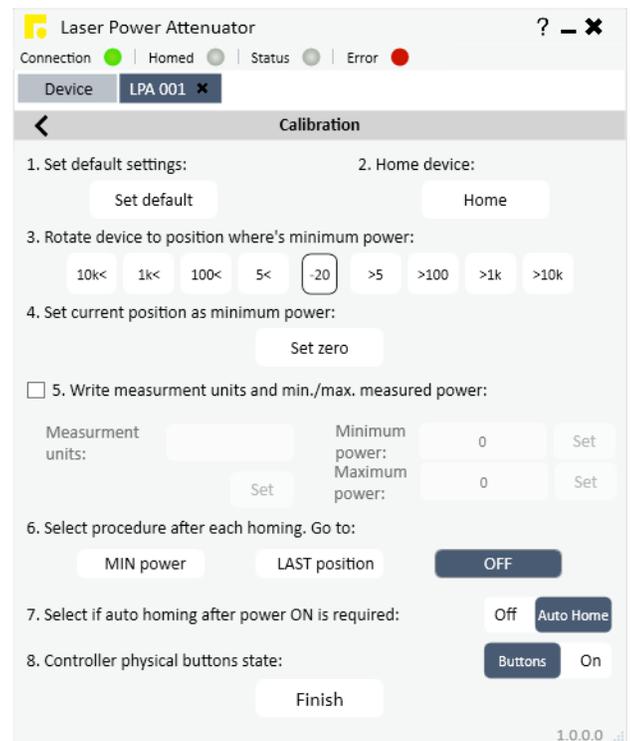


4.5.2. Settings, calibration

11. Using laser power attenuator for the first time the calibration is required. The information window will appear:



12. For LPA calibration, move your mouse to the left side of the window on a gear symbol from the sliding menu and select “Settings”. Settings menu will appear:

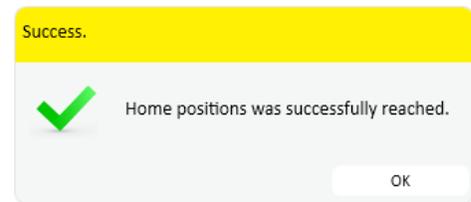


13. To succeed calibration please follow calibration steps:

1. Set default settings
2. Home device
3. Find minimum power position
4. Set current position as minimum power
5. Choose additional measurement units if necessary
6. Select procedure after each homing:

1. Min power - each time after homing the device, the attenuator instantly will go to minimum power position.
 2. Last position - each time after homing the device, the attenuator will go to last position before .
 3. OFF - each time after homing the device, the attenuator will remain in home position.
7. Select if automatic homing is required after turning the device ON.

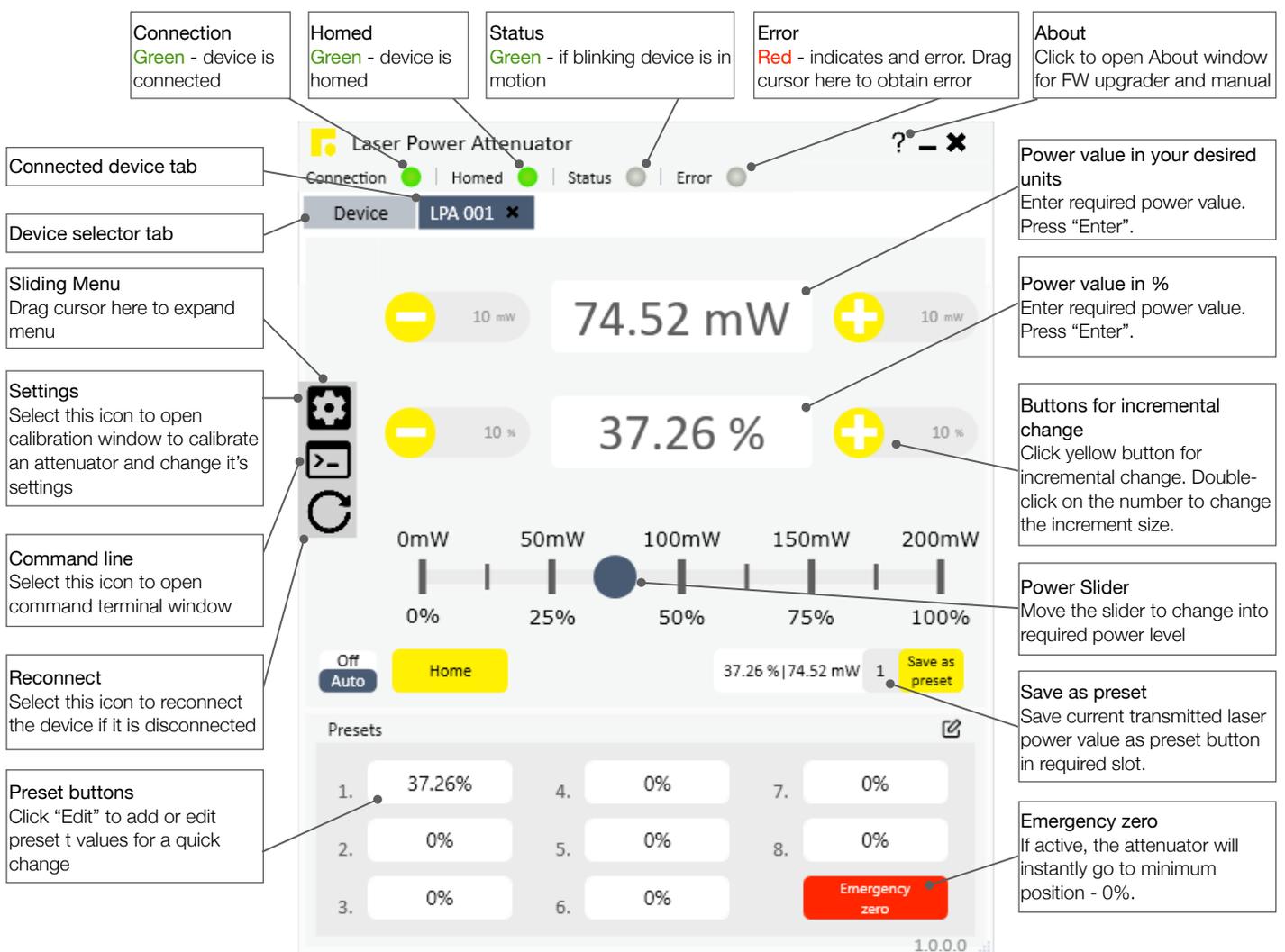
8. Choose if physical buttons are required, if no, you can lock them by choosing "Buttons OFF".
9. After finishing the calibration routine you will be greeted into MAIN window



NOTE: After homing the device message box will appear

4.5.3. Main window

The calibration procedure is done successfully if there is no error, device is connected and homed. The device is ready to use.



Connection
Green - device is connected

Homed
Green - device is homed

Status
Green - if blinking device is in motion

Error
Red - indicates and error. Drag cursor here to obtain error

About
Click to open About window for FW upgrader and manual

Connected device tab
Device LPA 001

Device selector tab

Sliding Menu
Drag cursor here to expand menu

Settings
Select this icon to open calibration window to calibrate an attenuator and change it's settings

Command line
Select this icon to open command terminal window

Reconnect
Select this icon to reconnect the device if it is disconnected

Preset buttons
Click "Edit" to add or edit preset t values for a quick change

Power value in your desired units
Enter required power value. Press "Enter".

Power value in %
Enter required power value. Press "Enter".

Buttons for incremental change
Click yellow button for incremental change. Double-click on the number to change the increment size.

Power Slider
Move the slider to change into required power level

Save as preset
Save current transmitted laser power value as preset button in required slot.

Emergency zero
If active, the attenuator will instantly go to minimum position - 0%.

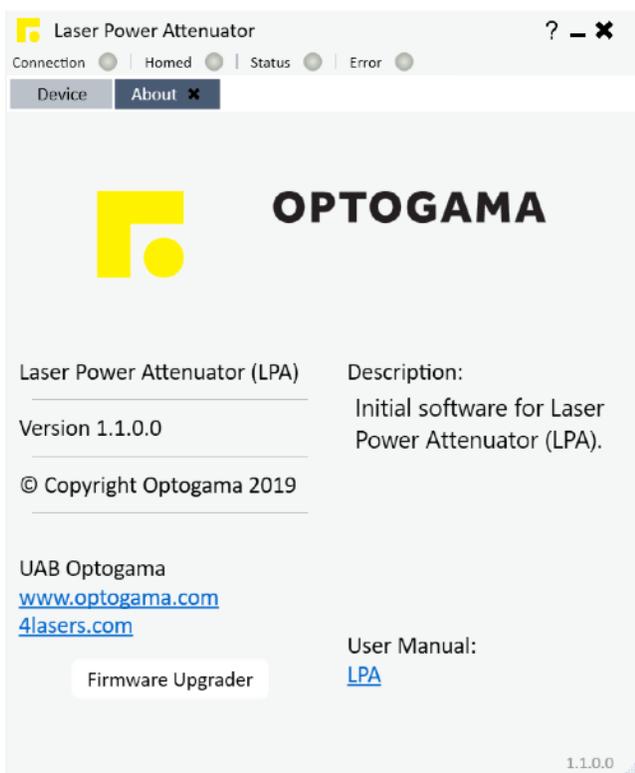
4.6. Updating the firmware

If your device firmware version doesn't match to software's firmware version while connecting to device via LPA software you'll be asked to update your device. If update request pops-up, but you want to keep current firmware and use LPA software, you must use software compatible with that firmware version.

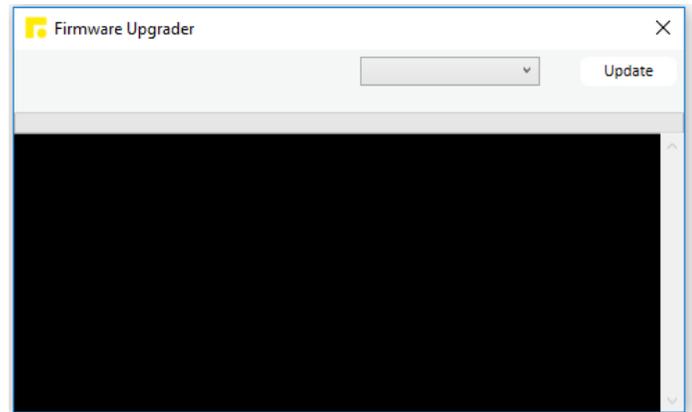
NOTE: Compatible software had been delivered with device.

In order to update your device or rewrite device firmware - **USB cable** must be used (update through RS232 cable is not available).

1. Click button **"Firmware Upgrader"** in the About tab of LPA software:



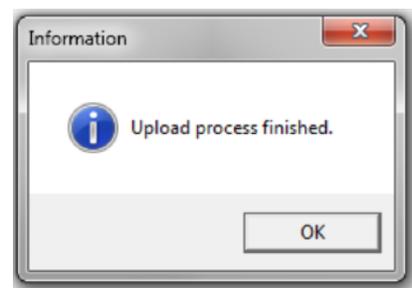
2. In the opened window press **"Update"** button. You will be asked if you really want to update device:



After a warning device **motors will be shut down** and update will start:



3. Update should be done in about a minute. If everything went successfully message box like this should pop-up:



Now you're ready to go.

4. Commands

The device can be controlled using either **USB 2.0** or **RS-232** interface. The device will switch to the required interface upon connection of the appropriate cable.

When using the RS-232 interface, the controller communicates on the **configured baud rate** (see Command descriptions), using **8 data bits, no parity and 1 stop bit**.

4.1. Interface

When the device is connected to the PC through the USB interface, it will appear as a **Virtual Serial COM port**, so all PC side communications are interchangeable between the two interfaces.

All communications with the device are conducted by sending **literal ASCII string commands terminated with the newline character \n**. For example, the power can be set to 10% by issuing a “**LPA>PWR!_10\n**” command to which the device will respond with “**LPA>PWR_10\n**”.

4.2. Description

Command	Response	Comments	Example usage	
			User command	Device response
Motion Power - PWR, Angle - ANG, Target - TGT, Stop - STP				
LPA>PWR?	LPA>PWR_X.XXX	Command used to get the current power value in percentages.	LPA>PWR?	LPA>PWR!_45.125
LPA>PWR!_X.XXX	LPA>PWR!_X.XXX	Command used to set a new power value in percentages.	LPA>PWR!_10	LPA>PWR_10.000
			LPA>PWR!_45.1	LPA>PWR_45.100
			LPA>PWR!_0.07	LPA>PWR_0.070
LPA>ANG?	LPA>ANG_X.XXX	Command used to get the current angle value in degrees.	LPA>ANG?	LPA>ANG_22.143
LPA>ANG!_X.XXX	LPA>ANG_X.XXX	Command used to set the angle value in degrees.	LPA>ANG!_22.5	LPA>ANG_22.500
LPA>TGT!_X.XXX	LPA>TGT_X.XXX	Command used to set the target in micro-steps.	LPA>TGT!_44521	LPA>TGT_44521
LPA>TGT?	LPA>TGT_X.XXX	Command used to get the current position in micro-steps.	LPA>TGT?	LPA>TGT_44521
LPA>STP!	LPA>STP	Command used to stop motor instantly. Device could be used normally, homing is not require.	LPA>STP!	LPA>STP
Homing, Calibration & Auto-go Homing - HOME, Auto-homing - AHOME, Calibration - DEF, Auto-go - AUTOGO				
LPA>HOME!	LPA>HOME	Command used to home the device (motor goes to home position - TGT_0).	LPA>HOME!	LPA>HOME
LPA>AHOME!	LPA>AHOME_1	Command used to turn ON auto homing after power ON.		
LPA>NOAHOME!	LPA>AHOME_0	Command used to turn OFF auto homing after power ON.		
LPA>AHOME?	LPA>AHOME_0	Command used to get auto homing state. If 1 - Auto homing is enabled, 0 - disabled.		
LPA>DEF!	LPA>DEF_offset	Command used to define current waveplate position as minimum power position. Used for calibration.	LPA>DEF!	LPA>DEF_-25432

Command	Response	Comments	Example usage	
			User command	Device response
LPA>DEF?	LPA>DEF_offset	Command used to get an offset value from zero to minimum power. Used for calibration.	LPA>DEF?	LPA>DEF_-25432
LPA>AUTOGO!_X	LPA>AHOME_X	Command used to set procedure after each homing: 0 - device remains in home position (TGT_0); 1 - device goes to MIN power position (calibrated position for minimum power); 2 - device goes to LAST position it was before homing.		
LPA>AUTOGO?	LPA>AHOME_X	Command used to get which procedure after each homing is selected: 0 - device remains in home position (TGT_0); 1 - device goes to MIN power position (calibrated position for minimum power); 2 - device goes to LAST position it was before homing.		
Settings Baud rate - BAUD, Buttons lock - KEYLOCK, Default settings - LDF				
LPA>BAUD?	LPA>BAUD_baud rate	Command used to get baud rate.	LPA>BAUD?	LPA>BAUD_115200
LPA>BAUD!_baud rate	LPA>BAUD_baud rate	Command used to set baud rate. Available speeds: 115200, 57600, 38400, 19200, 9600, 4800. Other values are ignored.	LPA>BAUD!_57600	LPA>BAUD_57600
LPA>KEYLOCK!	LPA>KEYLOCK_X	Command used to ENABLE / DISABLE controller physical buttons: 1 - disabled, 0 - enabled.		
LPA>KEYLOCK?	LPA>KEYLOCK_X	Command used to get controller physical buttons state: 1 - disabled, 0 - enabled.		
LPA>LDF!	LPA>LDF	Command used to load default settings. Device after this command must be: 1. Homed; 2. Recalibrated.		
Information Device state - STATUS, Wavelength - WL, Firmware v. - FW, Serial number - ID				
LPA>STATUS?	LPA>X_Y	Command used to get the current state of the device. X signifies if motor is ON. Y signifies the error byte. X="1" motor is ON (enabled) X="0" motor is OFF (disabled) Y = 16 bits digit with following bits: bit0 -> driver error bit1 -> driver high temperature warning bit2 -> driver over temperature bit3 -> some type of error in the driver load bit4 -> load warning – open load on phase A or B bit5 -> under voltage error bit6 -> external memory error, working/ calibration data may be corrupted bit7 -> reset has occurred bit8 -> left limit switch is pressed bit9 -> right limit switch is pressed bit10 -> stall guard flag is active bit11 -> motor is stand still bit12 -> motor target velocity reached bit13 -> target position reached bit14 -> homing procedure was run after the reset bit15 -> device calibration is done	LPA>STATUS?	LPA>1_0
			LPA>STATUS?	LPA>0_0
			LPA>STATUS?	LPA>1_2

Command	Response	Comments	Example usage	
			User command	Device response
LPA>WL?	LPA>WL_XXX	Command used to get the design wavelength.	LPA>WL?	LPA>WL_355
LPA>FW?	LPA>_Firmware version	Command used to get firmware version.	LPA>FW?	LPA>_1.0.0.1
LPA>ID?	LPA>_LPAXXXXXXX	Command used to get serial number.	LPA>ID?	LPA>_LPA1901001
Other Echo, Reset, Motor ON/OFF				
LPA>ECHO!	LPA>ECHO	Command used for troubleshooting. The device echoes sent command before sending the response.	LPA>ECHO! LPA>TGT?	LPA>ECHO LPA>TGT? LPA>TGT_45602
LPA>NOECHO!	LPA>NOECHO	Command used to disable ECHO command.		
LPA>RESET!	LPA>RESET	Command used to reinitialise device.	LPA>RESET!	LPA>RESET
LPA>OFF!	LPA>OFF	Command used to turn motor OFF.	LPA>OFF!	LPA>OFF
LPA>ON!	LPA>ON	Command used to turn motor ON.	LPA>ON!	LPA>ON

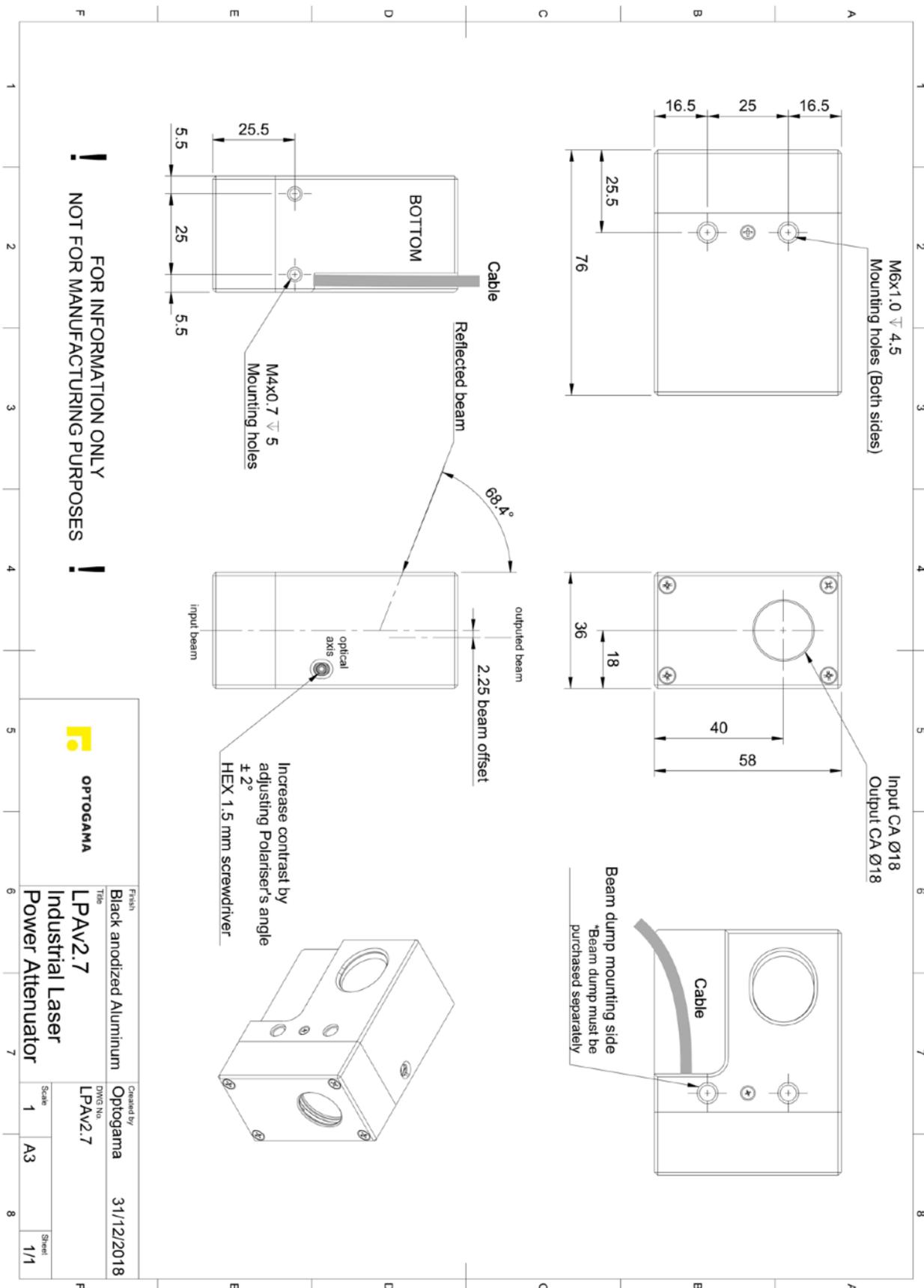
4.3. Serial communication example in Python

```

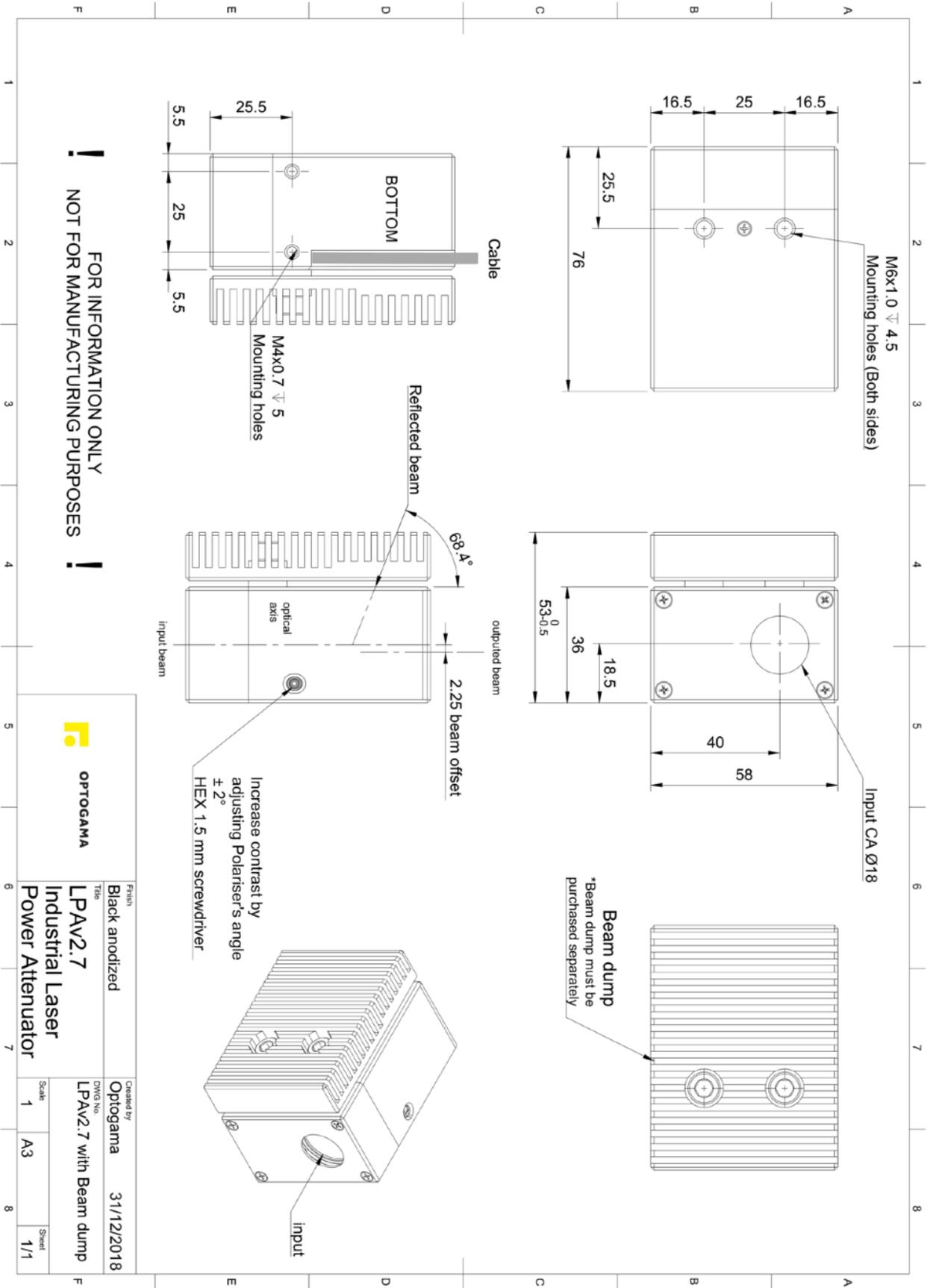
1  import serial
2  import glob
3  import sys
4  import time
5
6  def serial_ports():
7      """ Lists serial port names
8
9          :raises EnvironmentError:
10             On unsupported or unknown platforms
11          :returns:
12             A list of the serial ports available on the system
13      """
14      if sys.platform.startswith('win'):
15          ports = ['COM%s' % (i + 1) for i in range(256)]
16      elif sys.platform.startswith('linux') or sys.platform.startswith('cygwin'):
17          # this excludes your current terminal "/dev/tty"
18          ports = glob.glob('/dev/tty[A-Za-z]*')
19      elif sys.platform.startswith('darwin'):
20          ports = glob.glob('/dev/tty.*')
21      else:
22          raise EnvironmentError('Unsupported platform')
23
24      result = []
25      for port in ports:
26          try:
27              s = serial.Serial(port)
28              s.close()
29              result.append(port)
30          except (OSError, serial.SerialException):
31              pass
32      return result
33
34  if __name__ == "__main__":
35      ports = serial_ports()
36      print("Select port number ( starting from 0, 1, 2 etc.):")
37      print(ports)
38      port = ports[int(input())]
39      print(port)
40
41      # configure the serial connections (the parameters differs on the device you are connecting to)
42      ser = serial.Serial(
43          port=port,
44          baudrate=57600,
45          parity=serial.PARITY_ODD,
46          stopbits=serial.STOPBITS_TWO,
47          bytesize=serial.EIGHTBITS,
48          timeout=1 #second
49      )
50      ser.isOpen()
51
52      print('Enter your commands below.\r\nInsert "exit" to leave the application.')
53      cmd=1
54      while 1 :
55          # get keyboard input
56          cmd = input(">>> ")
57          # Python 2 users
58          # input = raw_input(">>> ")
59          if cmd == 'exit':
60              ser.close()
61              break
62          else:
63              # send the string to the device
64              # (note that I happend a \n line feed to the characters - this is requested by device)
65              cmdBytes = (cmd + '\n').encode()
66              ser.write(cmdBytes)
67              out = ''
68              out = str(ser.readline())
69              if out != '':
70                  print(">>>" + out)

```

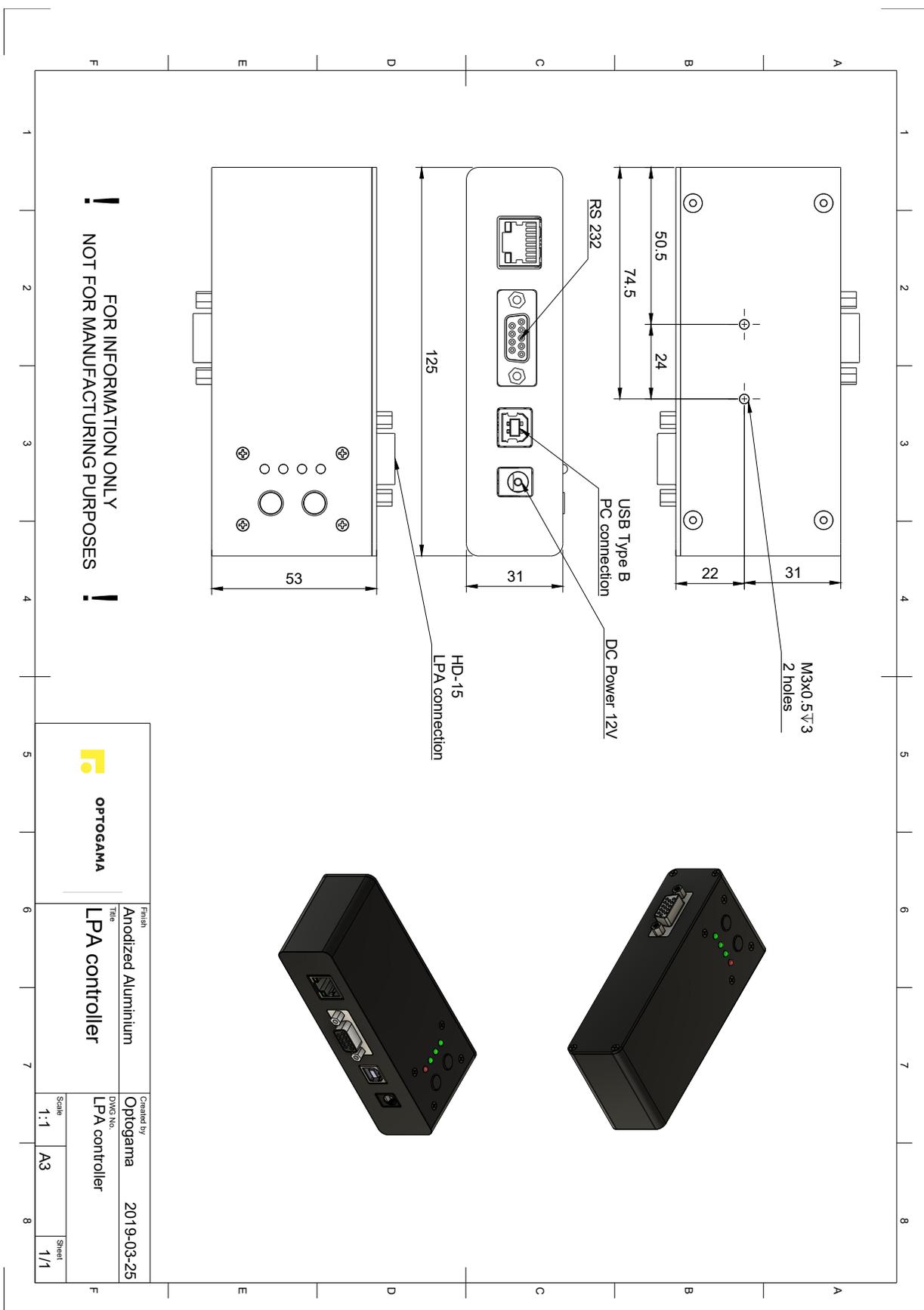
5. Technical drawings



		Finish	Created by	31/12/2018
		Black anodized Aluminum	Optogama	
LPav2.7 Industrial Laser Power Attenuator		DWG No.	LPav2.7	
Scale	1	A3	Sheet	1/1



	Title LP AV2.7 Industrial Laser Power Attenuator	Created by Optogama	Date 31/12/2018
	Finish Black anodized	DWG No. LP AV2.7 with Beam dump	Scale 1
Sheet 1/1		Scale A3	



	Finish	Created by
	Anodized Aluminium	Optogama
LPA controller	Title	DWG No.
	LPA controller	LPA controller
Scale	A3	Sheet
1:1		1/1
LPA controller		2019-03-25

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