KEY for DISCOVERIES

LPA-A

ADVANCED and INTEGRATED MOTORISED LASER POWER ATTENUATOR

LPA-A v2 series

Table of contents

LPA-A v2

Advanced & Integrated

Motorised laser power attenuator

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

***

September 2019

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-authorised 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.
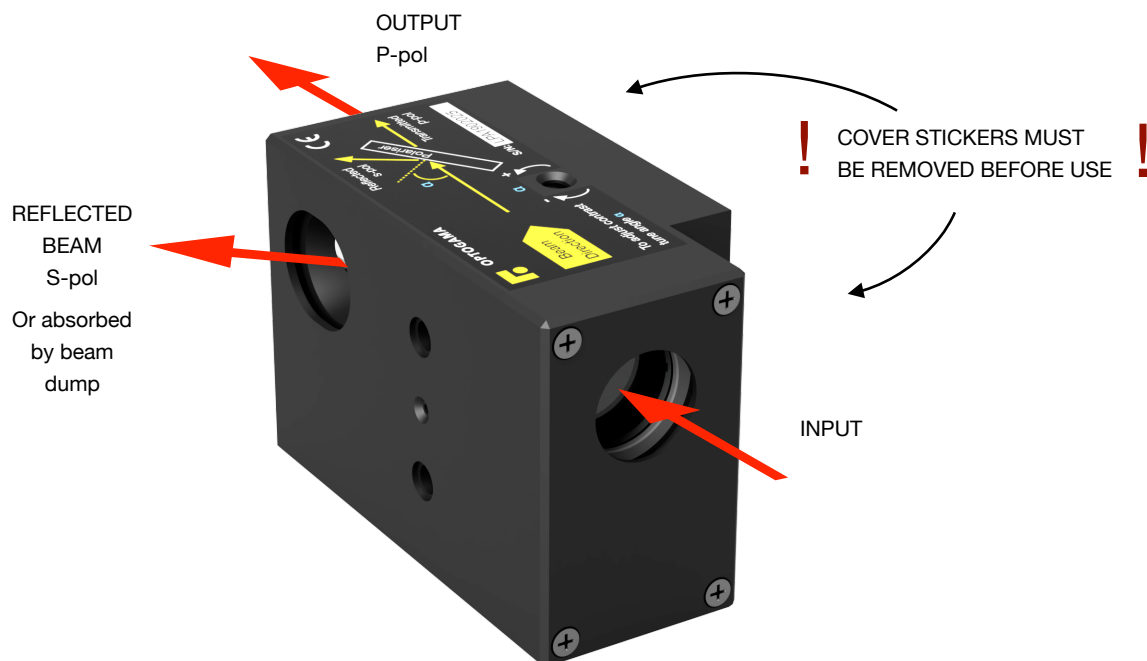
1. Safety requirements

- 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.

OUTPUT
P-pol

REFLECTED
BEAM
S-pol

Or absorbed
by beam
dump

COVER STICKERS MUST
BE REMOVED BEFORE USE

INPUT

2. Operation principle

LPA-A consists of zero-order half-waveplate and High contrast 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 0.1-98% range.

NOTE: Before use calibration 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. 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
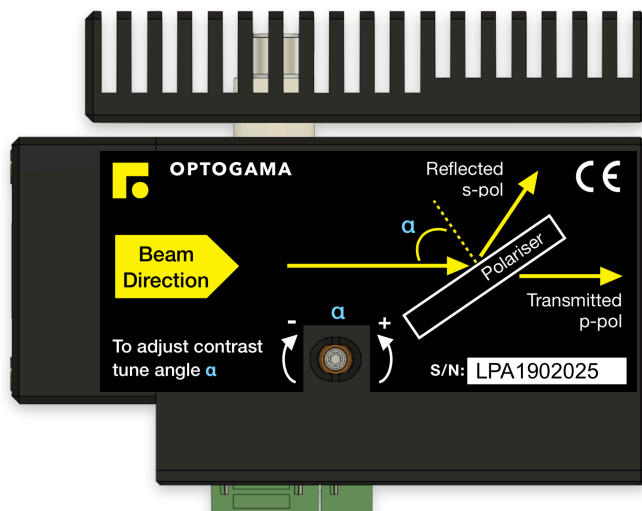- Counter clock-wise to increase angle

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

2.2. Features and advantages

- Integrated controller
- Absolute position encoder - no homing required
- High accuracy - ±0.005 deg
  (less than ±0.01% of laser power)
- Resolution - 0.002 deg, 7.2 arcsec, 0.035 mrad
- Robust design
- Clear aperture - ø15 mm
- Fast adjustment - less than 0.2 sec (min to max)
- High damage threshold:
  up to 10J/cm^2 (10 ns @ 1064 nm)
- Adjustable polariser angle

2.3. Optical design

LPA-A optical elements are coated for high LIDT (10 (J/cm^2) (10 ns @ 1064 nm) and can be applied for high power lasers. There are Reflection and Transmission configurations:
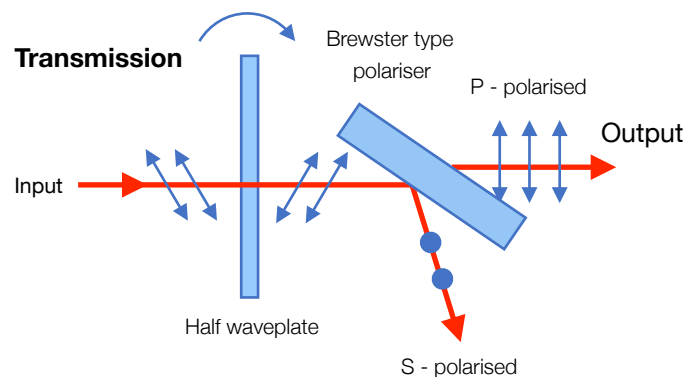

Fig 1. Schematic explanations of optical design of transmission (LPA-A) type laser power attenuator.

3. Product description

Advanced laser power attenuator LPA-A is a compact motorised device for laser power control with integrated controller and absolute position encoder.

The LPA-A 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-A 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-A device.

3.1. Optical specifications

Clear input aperture	ø15 mm
Clear output aperture	ø15 mm
Power attenuation range	<0.1 % to >98 %
LIDT coating	>10 [J/cm^2] (10 ns @ 1064 nm)
Adjustment time	< 0.2 sec (min to max)
Aboslute pos. encoder	Yes
Resolution	175,542 µsteps in full rotation (0.002 deg, 7.2 arcsec, 0.035 mrad)
Accuracy	± 0.005 deg, (±18 arcsec, 0.087 mrad, less than ±0.01 %)
Motor	2 phase stepper motor, 200 steps with 256 µstepping

Available coatings

A. Standard wavelenghts, nm

1st harm	2nd harm	3rd harm
1064	532	355
1020 - 1040	510 - 520	343
760-840	390 - 410	-

C. Custom wavelenghts

Custom coating available

3.2. Mechanical specifications

	LPA-A	LPA-A with beam dump
Lenght	86 mm	86 mm
Width	47 mm	64 mm
Height	58 mm	58 mm

3.3. Electronic specifications

Interface options:

Terminal	Using commands described in p. 12 "Commands"
Software	Using LPA-A 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 ^{0}C to +40 ^{0}C
Storage temperature	-15 ^{0}C to +50 ^{0}C

3.5. Controller

3.5.1. Interfaces, pinout

1. There are two contacts:
   691382000005 for communication;
   691382000002 for Power supply - DC 12 V

Type	Contact	Connector
Communication	691382000005	691381000005
Power supply	691382000002	691381000002
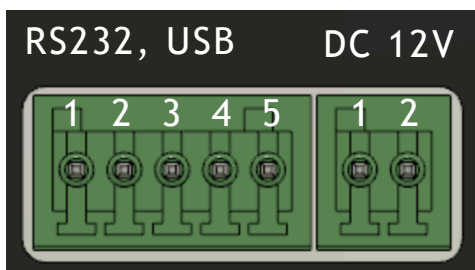
Fig 3. Side view of LPA-A.

PINOUT

DC 12 V	RS232	USB
1. +12 V DC	3. GND	1. USB D-
2. GND	4. RS232 RX	2. USB D+
	5. RS232 TX	3. GND

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-A 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. Integrated motorised laser power attenuator

2. Software

3. Power supply DC 12V

4. USB (1.5 m) cable

NOTE: Other accessories must be purchased separately.

3.8. Available accessories

Beam dump (<6W): (with AR/AR coated window) for all standard wavelengths	• 1064, 1030 • 532, 515 • 343, 355 • 247, 266
RS232 cable:	• 1.8 m • 5 m • 10 m • 15 m

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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:
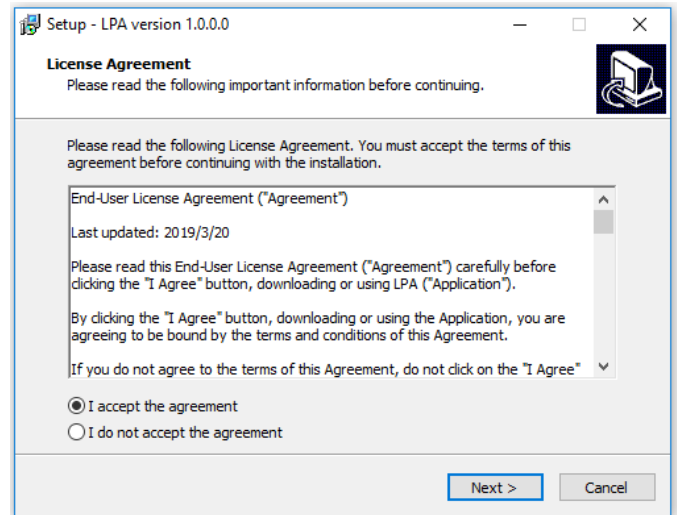
3. Select "Create a desktop shortcut" if it is necessary and click "Next":
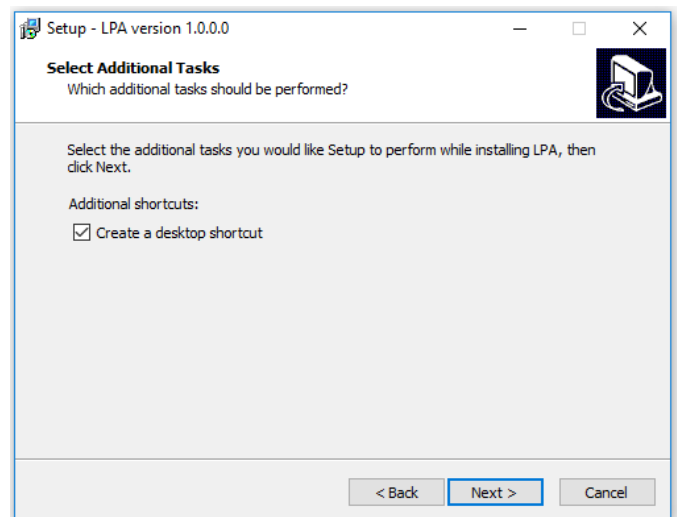
Review setup information and proceed the installation. To continue click "Install":
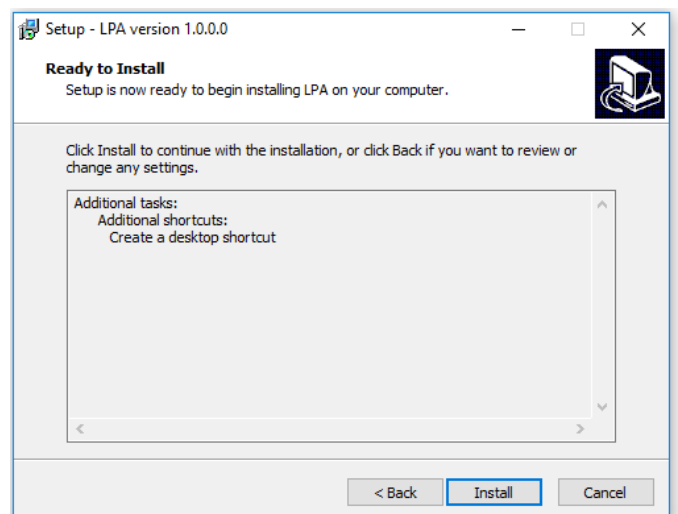
4. Setup will finish the installation:

8
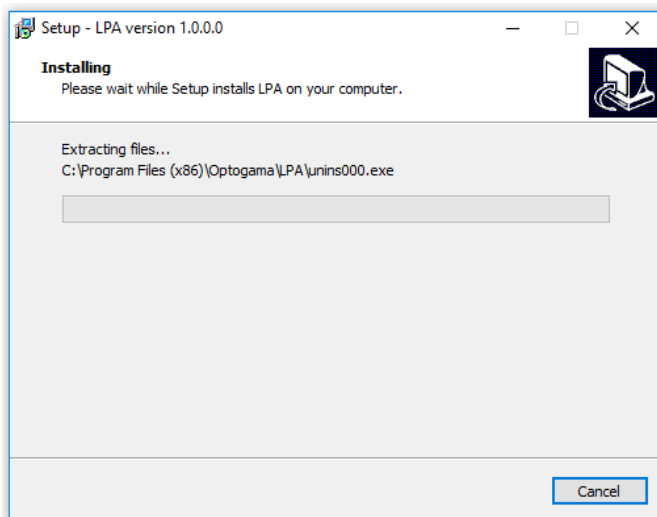
5. Press "Finish" to end the installation:
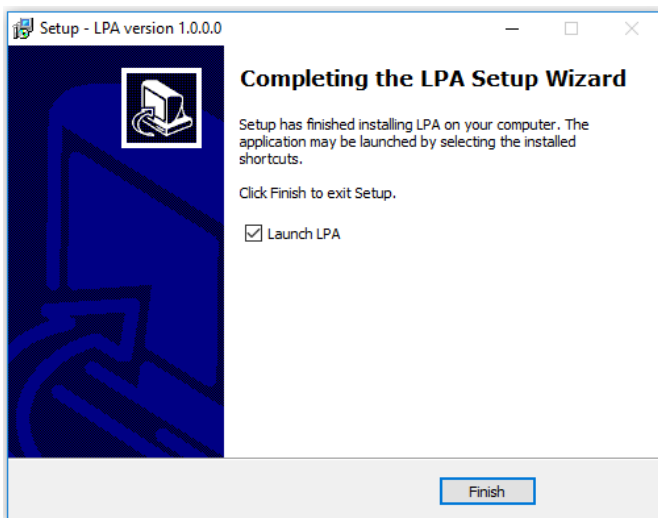
Connect the device and controller via HD-15 cable.

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.

LPA

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.
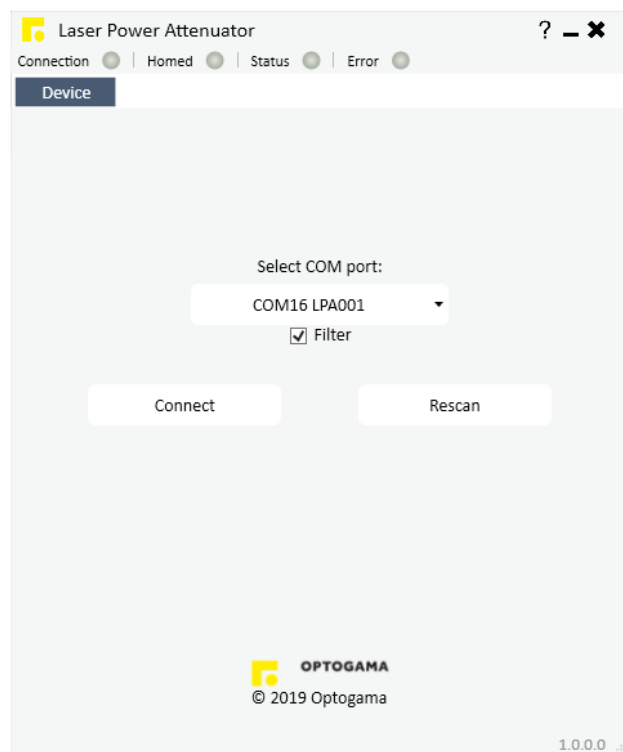Select "**Filter**" when device is connected via USB cable. All other COM ports will be hidden except our device.

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:
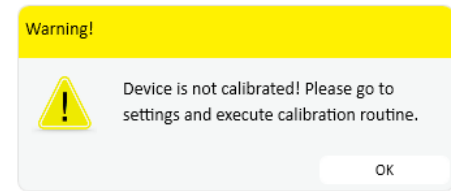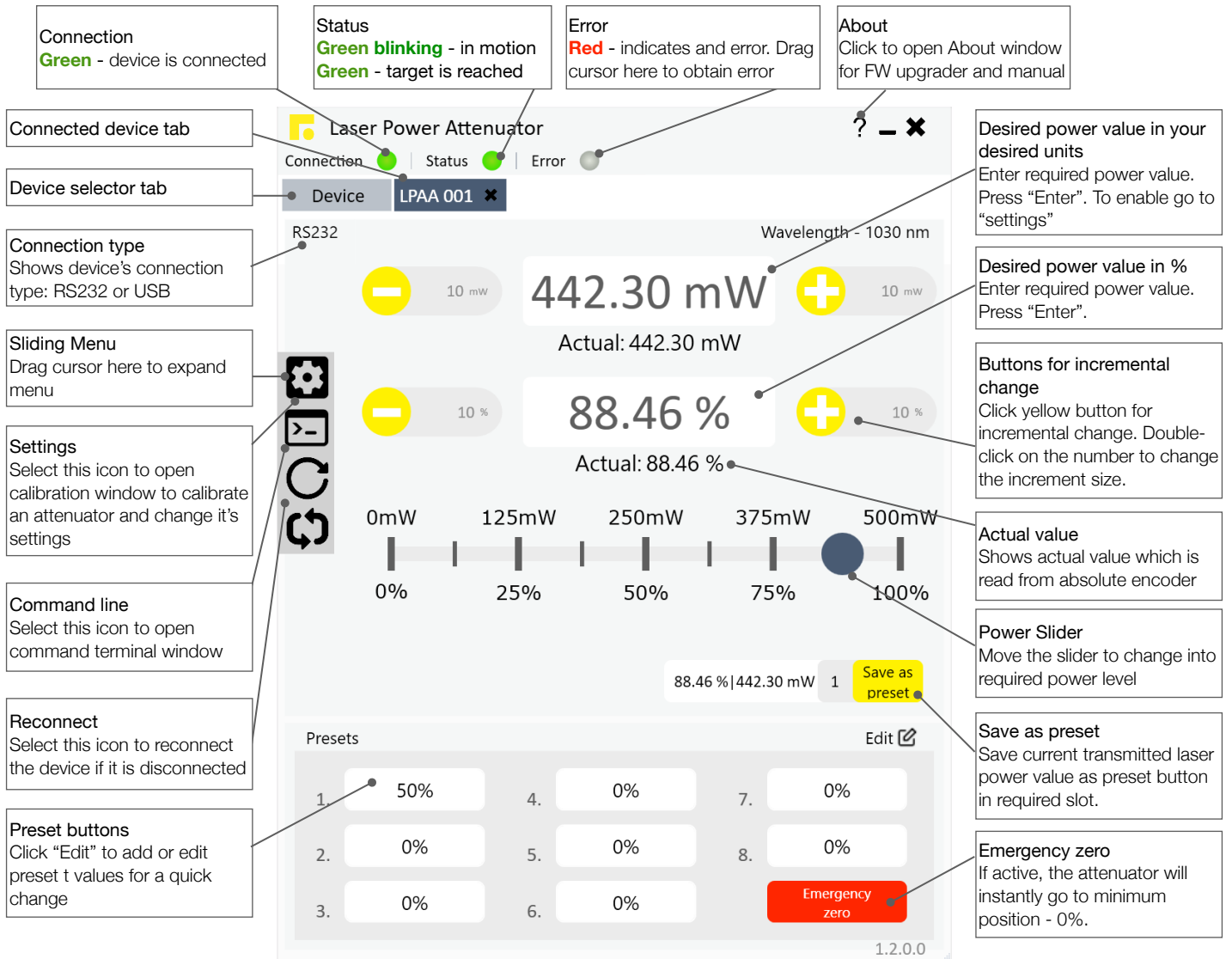
12. For LPA-A calibration, move your mouse to the left side of the window on a gear symbol from the sliding menu and select "Settings". Settings menu will appear:
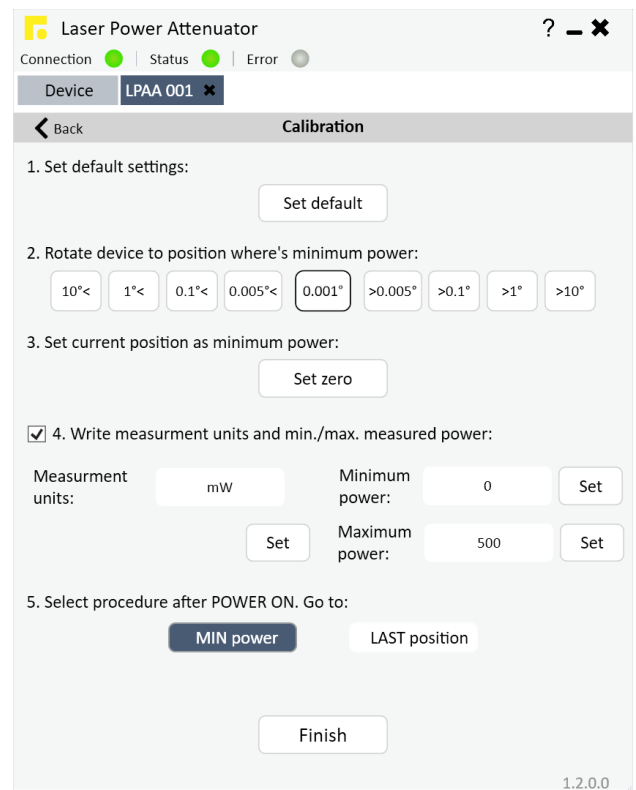
13. To succeed calibration please follow calibration steps:

1. Set default settings.

2. Find minimum laser power position.

3. Set current position as minimum power "Set zero".

4. Choose additional measurement units if necessary

5. Select procedure after turning the device ON. By default the device will reach last desired value

6. Calibration is done and device is ready to use. Press "Finish" and you will be greeted into MAIN window.

4.5.3. Main window

Connection
Green - device is connected

Status
Green blinking - in motion
Green - target is reached

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 selector tab

Connection type
Shows device's connection type: RS232 or USB

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

Desired power value in your desired units
Enter required power value. Press "Enter". To enable go to "settings"

Desired 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.

Actual value
Shows actual value which is read from absolute encoder

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%.

Laser Power Attenuator

Connection | Status | Error

Device — LPAA 001 ✖

RS232   Wavelength - 1030 nm

⊖ 10 mW   **442.30 mW**   ⊕ 10 mW

Actual: 442.30 mW

⊖ 10 %   **88.46 %**   ⊕ 10 %

Actual: 88.46 %

0mW   125mW   250mW   375mW   500mW

0%   25%   50%   75%   100%

88.46 % | 442.30 mW   1   Save as preset

Presets   Edit ✎

1. 50%   4. 0%   7. 0%

2. 0%   5. 0%   8. 0%

3. 0%   6. 0%   **Emergency zero**

1.2.0.0

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:
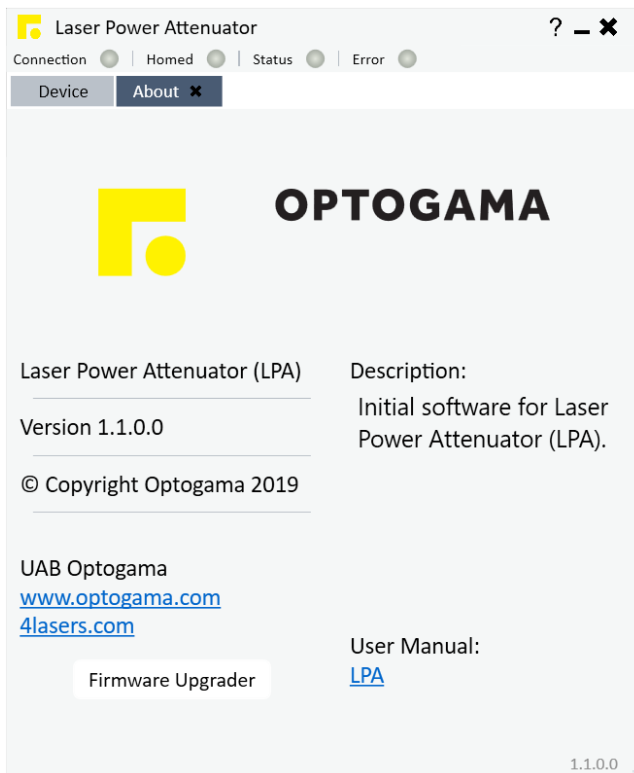
2. In the opened window press "**Update**" button. You will be asked if you really want to update device:
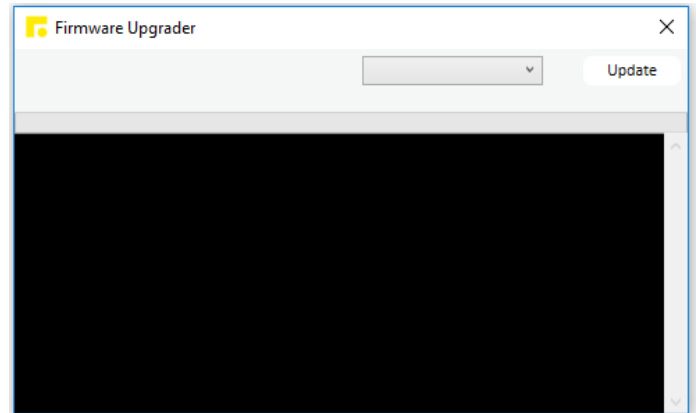
After a warning device **motors will be shut down** and update will start:
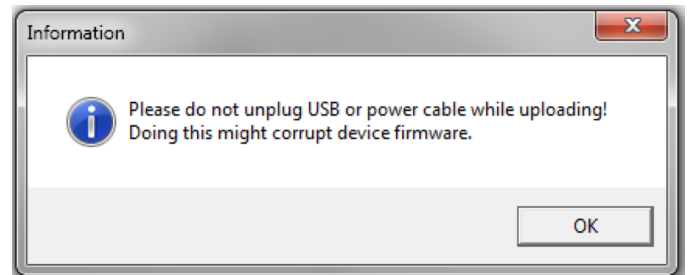
3. Update should be done in about a minute. If everything went successfully message box like this should pop-up:
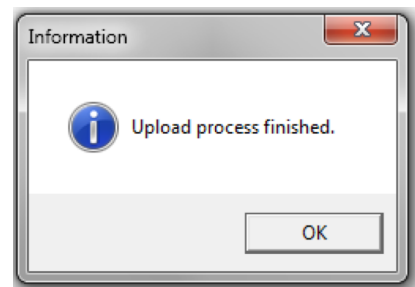
Now you're ready to go.

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, Stop - STP				
LPA>PWR?	LPA>PWR_X.XXX	Command used to get the current power value in percentages. (Read and calculated from absolute encoder)	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. (Read from absolute encoder, 0-360 deg)	LPA>ANG?	LPA>ANG_22.143
LPA>ANG!_X.XXX	LPA>ANG_X.XXX	Command used to set the angle value in degrees (0-360)	LPA>ANG!_22.5	LPA>ANG_22.500
LPA>STP!	LPA>STP	Command used to stop motor instantly. Device could be used normally, homing is not require.	LPA>STP!	LPA>STP
Calibration| Calibration - DEF				
LPA>DEF!	LPA>DEF_offset	Command used to define current waveplate position as minimum power position. Used for calibration.	LPA>DEF!	LPA>DEF_34.067
LPA>DEF?	LPA>DEF_offset	Command used to get an offset value from zero to minimum power. Used for calibration.	LPA>DEF?	LPA>DEF_34.067
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. **115200** by default. Available speeds: 115200, 57600, 38400, 19200, 9600, 4800. Other values are ignored.	LPA>BAUD!_57600	LPA>BAUD_57600
LPA>LDF!	LPA>LDF	Command used to load default settings. Device after this command **must be recalibrated**.		

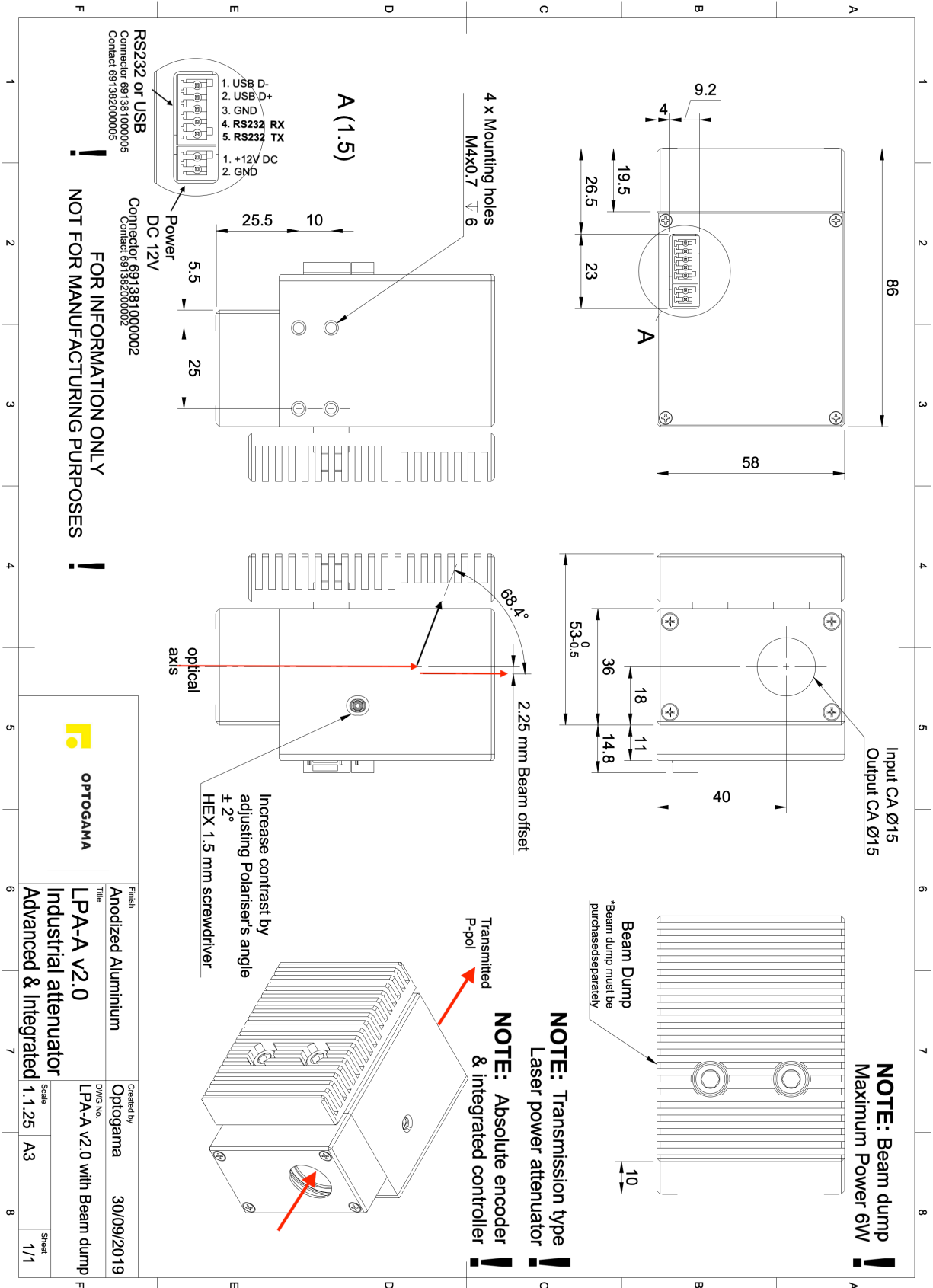| Command	Response	Comments	Example usage	
			User command	**Device response**
Information | Device state - STATUS, Wavelength - WL, Firmware v. - FW, Serial number - ID				
LPA>STATUS?	LPA>X_Y	Command used to get the current state of the device. X signifies if motor is ON. Y signifies the error byte. 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 -> - bit9 -> - bit10 -> target position is reached bit11 -> - bit12 -> motor is stand still bit13 -> - bit14 -> - bit15 -> device calibration is done	LPA>STATUS? LPA>STATUS? LPA>STATUS?	LPA>1_0 LPA>0_0 LPA>1_2
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>_LPAAXXXXXX	Command used to get serial number.	LPA>ID?	LPA>_LPAA190001
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

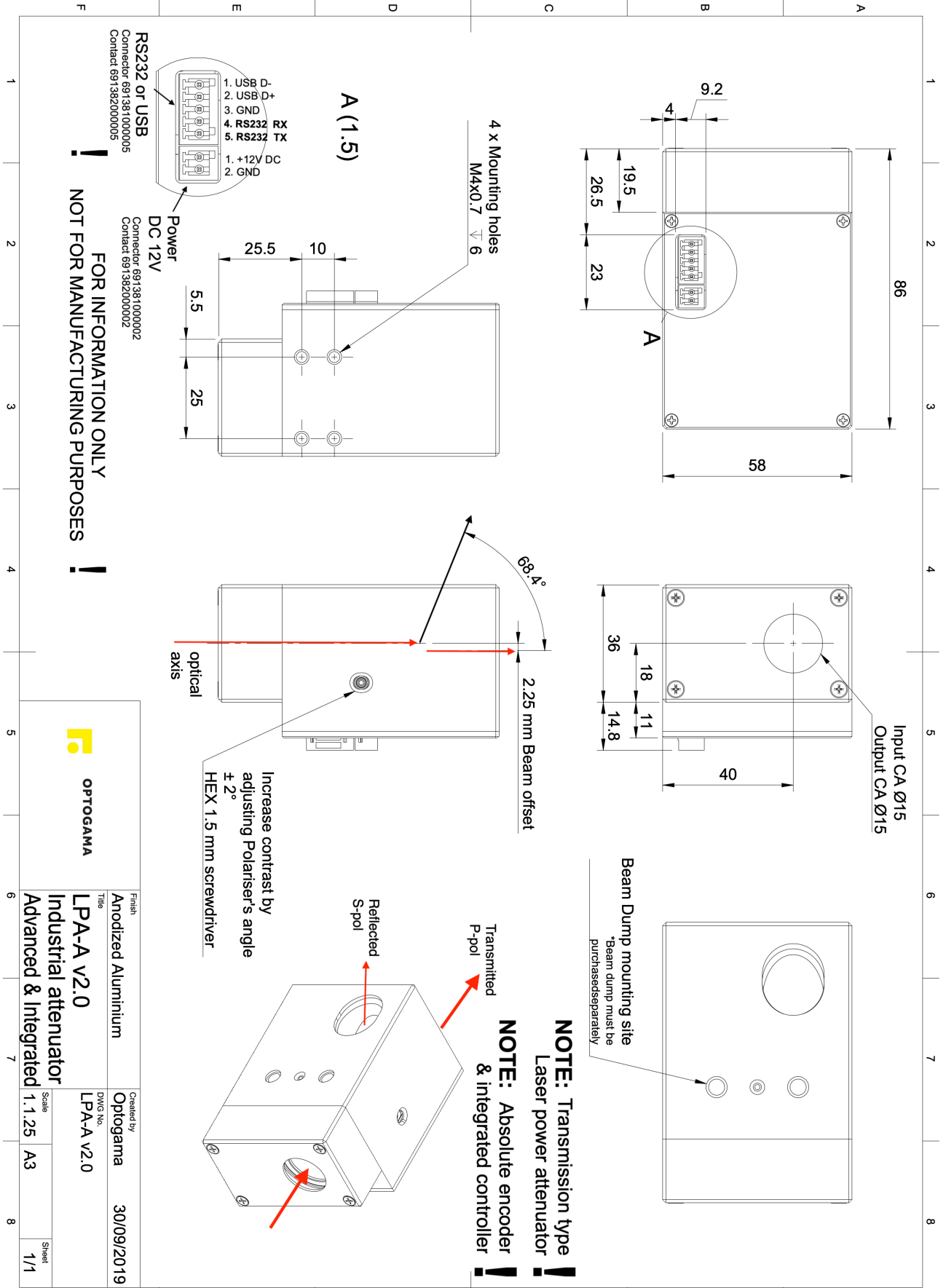## 4.3. Serial communication example in Python

```python
import serial
import glob
import sys
import time

def serial_ports():
    """ Lists serial port names

        :raises EnvironmentError:
            On unsupported or unknown platforms
        :returns:
            A list of the serial ports available on the system
    """
    if sys.platform.startswith('win'):
        ports = ['COM%s' % (i + 1) for i in range(256)]
    elif sys.platform.startswith('linux') or sys.platform.startswith('cygwin'):
        # this excludes your current terminal "/dev/tty"
        ports = glob.glob('/dev/tty[A-Za-z]*')
    elif sys.platform.startswith('darwin'):
        ports = glob.glob('/dev/tty.*')
    else:
        raise EnvironmentError('Unsupported platform')

    result = []
    for port in ports:
        try:
            s = serial.Serial(port)
            s.close()
            result.append(port)
        except (OSError, serial.SerialException):
            pass
    return result

if __name__ == "__main__":
    ports = serial_ports()
    print("Select port number ( starting from 0, 1, 2 etc.):")
    print(ports)
    port = ports[int(input())]
    print(port)

    # configure the serial connections (the parameters differs on the device you are connecting to)
    ser = serial.Serial(
    port=port,
    baudrate=57600,
    parity=serial.PARITY_ODD,
    stopbits=serial.STOPBITS_TWO,
    bytesize=serial.EIGHTBITS,
    timeout=1 #second
    )
    ser.isOpen()

    print('Enter your commands below.\r\nInsert "exit" to leave the application.')
    cmd=1
    while 1 :
        # get keyboard input
        cmd = input(">> ")
            # Python 2 users
            # input = raw_input(">> ")
        if cmd == 'exit':
            ser.close()
            break
        else:
            # send the string to the device
            # (note that I happend a \n line feed to the characters - this is requested by device)
            cmdBytes = (cmd + '\n').encode()
            ser.write(cmdBytes)
            out = ''
            out = str(ser.readline())
            if out != '':
                print(">>" + out)
```

5. Technical drawings

RS232 or USB
Connector 691381000005
Contact 691382000005

1. USB D-
2. USB D+
3. GND
4. RS232 RX
5. RS232 TX

1. +12V DC
2. GND

Power
DC 12V
Connector 691381000002
Contact 691382000002

FOR INFORMATION ONLY
NOT FOR MANUFACTURING PURPOSES

A (1.5)

4 x Mounting holes
M4x0.7 � 6

25.5   10
5.5
25

9.2
4
19.5
26.5
23
86
58

A

optical
axis

68.4°
2.25 mm Beam offset

Increase contrast by
adjusting Polariser's angle
± 2°
HEX 1.5 mm screwdriver

53-0.5
36
18
11
14.8
40

Input CA Ø15
Output CA Ø15

Transmitted
P-pol

NOTE: Transmission type
Laser power attenuator

NOTE: Absolute encoder
& integrated controller

Beam Dump
*Beam dump must be
purchased separately

NOTE: Beam dump
Maximum Power 6W

10

OPTOGAMA

Finish
Anodized Aluminium

Title
LPA-A v2.0
Industrial attenuator
Advanced & Integrated

Created by
Optogama   30/09/2019

DWG No.
LPA-A v2.0 with Beam dump

Scale
1:1.25   A3

Sheet
1/1

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FOR INFORMATION ONLY
NOT FOR MANUFACTURING PURPOSES

RS232 or USB
Connector 6913810000005
Contact 691382000005

Power
DC 12V
Connector 6913810000002
Contact 691382000002

1. USB D-
2. USB D+
3. GND
4. RS232 RX
5. RS232 TX

1. +12V DC
2. GND

A (1.5)

4 x Mounting holes
M4x0.7 ⤵ 6

25.5
10
5.5
25

9.2
4
19.5
26.5
23
86
58
A

36
18
14.8
11
40

68.4°
optical axis
2.25 mm Beam offset

Increase contrast by
adjusting Polariser's angle
± 2°
HEX 1.5 mm screwdriver

Reflected
S-pol

Transmitted
P-pol

NOTE: Transmission type
Laser power attenuator

NOTE: Absolute encoder
& integrated controller

Beam Dump mounting site
*Beam dump must be
purchasedseparately

Input CA Ø15
Output CA Ø15

OPTOGAMA

Finish	Created by	
Anodized Aluminium	Optogama	30/09/2019
Title	DWG No.	
LPA-A v2.0	LPA-A v2.0	
Industrial attenuator		
Advanced & Integrated	Scale 1.1.25	A3	Sheet 1/1

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