

# MOTORIZED LASER POWER ATTENUATOR



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## Motorized laser power attenuator

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

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The motorized 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.

Due to constant development of our products we reserve the right to make changes in production without further notice. Up-to-date information is available at our website [www.eksmaoptics.com](http://www.eksmaoptics.com).

If there are any further questions, please do not hesitate to contact us.

For any technical assistance and consultation please contact your local distributor or directly at [info@eksmaoptics.com](mailto:info@eksmaoptics.com).

## 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 about motorized laser power attenuator, or about this manual.

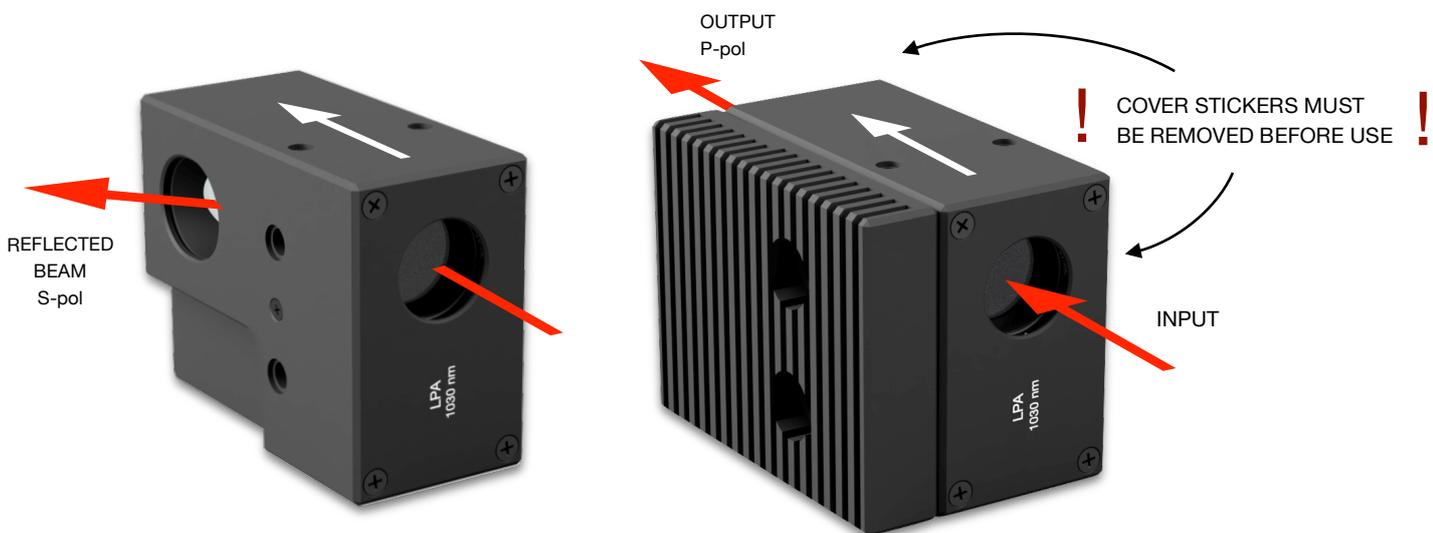
# 1. Safety requirements

- 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 motorized laser power attenuator.
- Even wearing safety goggles, 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. Otherwise, it may damage optical elements.



## 2. Operation principle

Motorized attenuator consists of a zero-order half-waveplate and a Brewster type thin film polarizer. Zero-order half-waveplate rotates the polarization. Brewster type thin film polarizer passes P-polarized and reflects S-polarized laser beam. Attenuation is adjusted while rotating the waveplate, hence changing the intensity ratio of the two beams. The attenuation level is controlled by the software in 0,1-97% range.

**NOTE:** Calibration is required.

**NOTE:** Homing is required.

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

### 2.1 Features and advantages

- Robust design
- 175,542  $\mu$ steps in full rotation
- $\pm 10$   $\mu$ steps accuracy\* ( $\pm 0.02$  deg, less than  $\pm 0.05$  % 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 polarizer angle

\*repeatability after 10,000 random positions without homing

### 2.2 Optical design

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

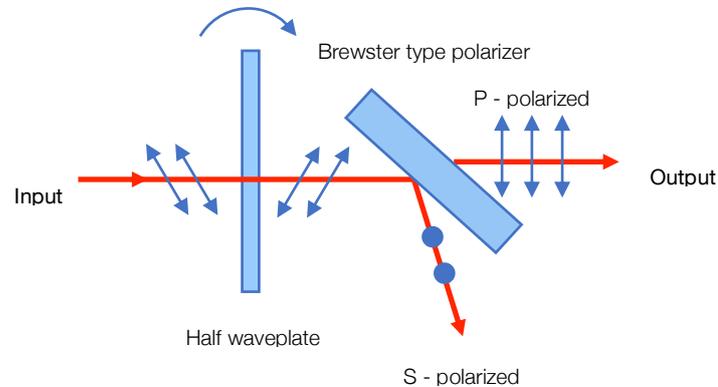


Fig 1. Schematic explanation of optical design of laser power attenuator

### 2.3 Contrast improvement. Angle adjustment

Angle of incidence  $\alpha$  should be adjusted to improve device contrast ( $\pm 2$  deg maximum).

Use HEX 1,5 key:

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

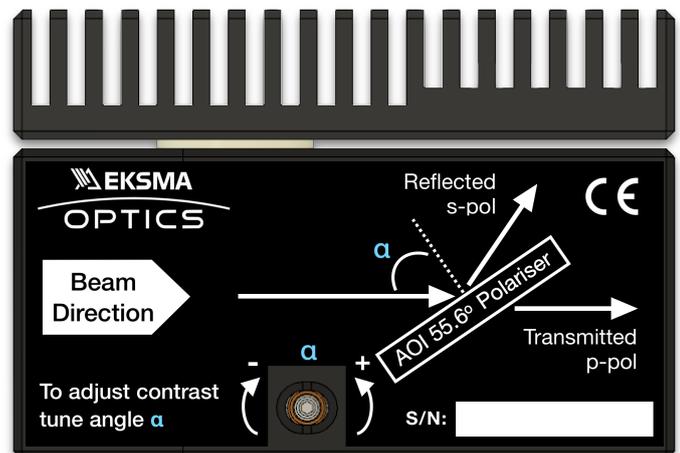


Fig 2. Schematic explanation of optical design of laser power attenuator

### 3. Product description

Laser power attenuator is a compact motorized device for laser power control.

Attenuator 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 are made for high LIDT, and provide stable and reliable performance even using it 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 to avoid any thermal effects or stress in the housing of the device.

#### 3.1 Optical specifications

Clear input aperture	ø18 mm	
Clear output aperture	ø18 mm	
Power attenuation range	from <0.1 % to >98 %	
LIDT coating	>10 J/cm <sup>2</sup> for 10 ns @ 1064 nm	
Close to open time	< 0.2 sec	
Resolution	175,542 μsteps in full rotation (0.002 deg, 7.2 arcsec, 0.035 mrad)	
Accuracy (repeatability after 10,000 positions without homing)	±10 μsteps (±0.02 deg, less than ±0.035 %)	
Motor	2 phase stepper motor, 200 steps with 256 μstepping	
Available coatings		
Standard wavelengths, nm		
1 <sup>st</sup> harm	2 <sup>nd</sup> harm	3 <sup>rd</sup> harm
1064	532	355
1020 - 1040	510 - 520	343
760-840	390 - 410	-
Custom wavelengths		

Custom coating available upon request

#### 3.2 Mechanical specifications

	Attenuator	Attenuator with beam dump	Controller
Length	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 Commands section (p. 16).
Software	Using 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

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

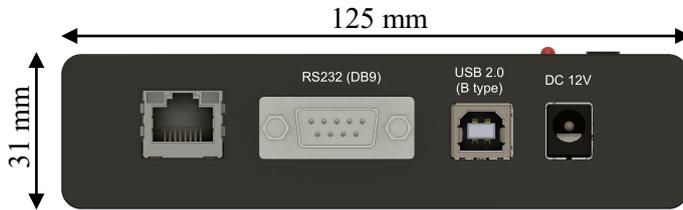


Fig 3. Front view of the controller.

#### RS232 (DB9) Pinout

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



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

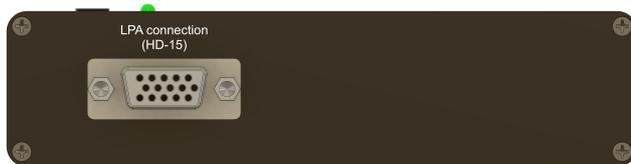


Fig 4. Back view of the controller.

#### 3.5.2 LEDs, Buttons functions

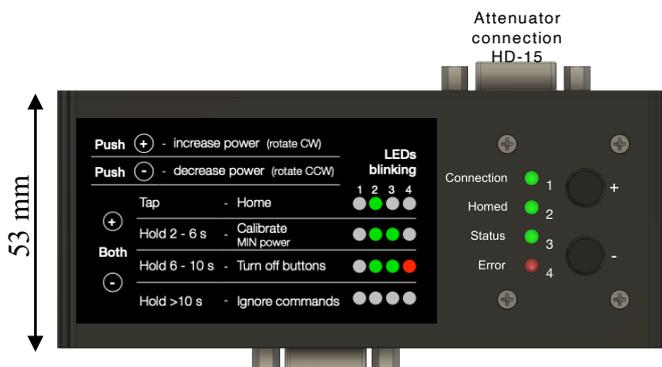


Fig 5. Top view of the controller.

#### 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

Hold both "+" & "-" buttons from 2 to 6 seconds to define (calibrate) current position as minimum power position (0%) or reset it.

Calibrate / Reset (Hold 2 to 6 s)

"Homed" and "Status" LED's will start blinking when it is right time to release buttons to calibrate the device

Hold both "+" & "-" buttons longer than 6 seconds to turn ON/OFF buttons. Also, you will be able to turn buttons ON/OFF again via software (Settings > Buttons ON) or using a command.

Button lock / unlock (Hold 6 to 10 s)

"Homed", "Status" and "Error" LED's will start blinking when it is a 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

Attenuator 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".

Motorized attenuator operates on signal levels of  $\pm 5$  V and can accept signal levels of up to  $\pm 15$  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:

- Motorized laser power attenuator
- Controller
- Software
- Power supply (DC 12V - 5.5x2.1 mm; 1 m + 1.5 m)
- USB cable (1.5 m)

**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/64-bit	4,5 Gb

### 4.2 System requirements

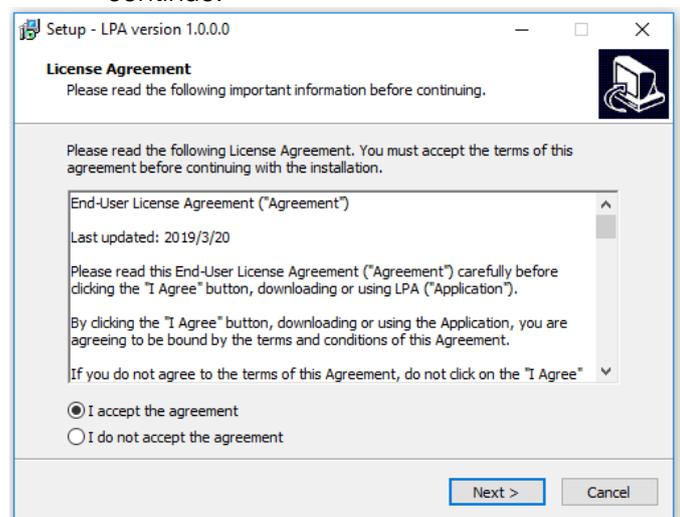
To run the application Microsoft .NET 4.5.2 Framework or later must be installed. The installer detects Microsoft .NET Framework and installs it. Administrator privileges are required for installation. Contact your network administrator if you do not have administrator rights on the computer.

### 4.3 Supported client operating systems

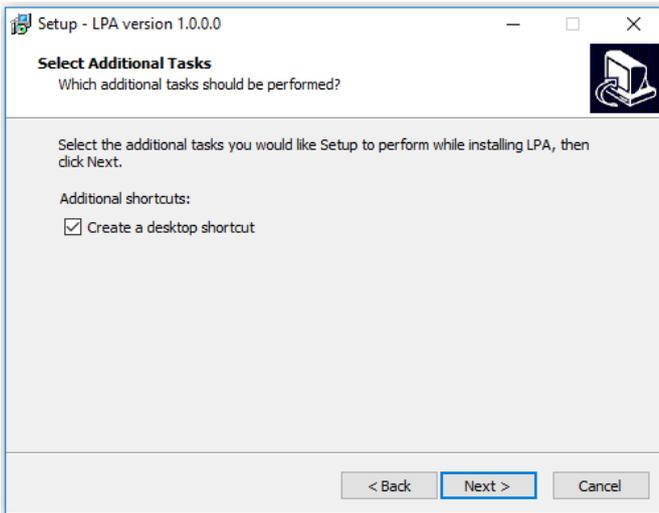
- Windows Vista SP2
- Windows 7 SP1
- Windows 8
- Windows 8.1 (.NET included with OS)
- Windows 10 (.NET 4.6 included with OS)
- Windows Server 2008 SP2/R2
- Windows Server 2012 (.NET included with OS)

### 4.4 Installing the software

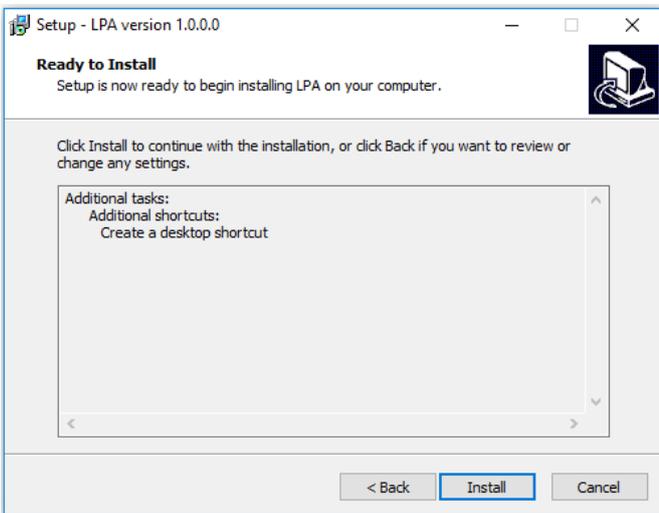
- Check and download the latest software from our website [www.eksmaoptics.com](http://www.eksmaoptics.com) or contact us directly at [info@eksmaoptics.com](mailto:info@eksmaoptics.com).
- Run the downloaded software installation file. Installation window will appear, click "Next" to continue:



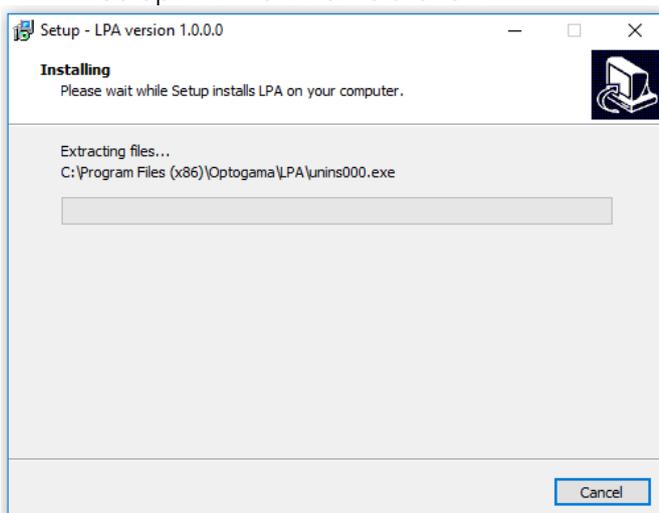
- Select "Create a desktop shortcut" if it is necessary and click "Next":



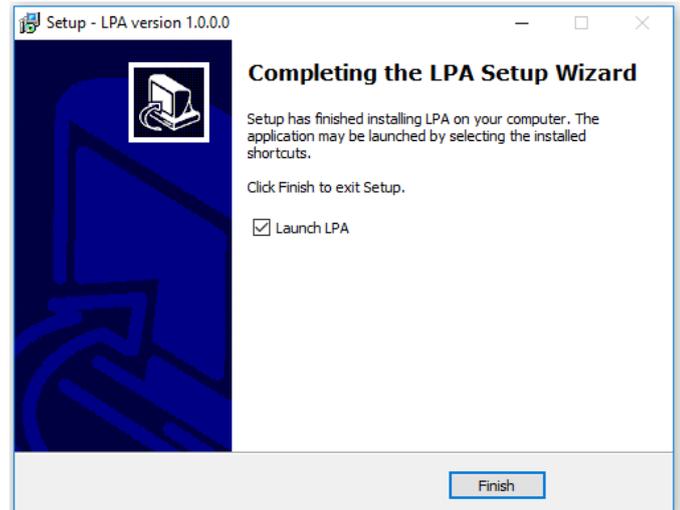
- Review setup information and proceed the installation. To continue click “Install”:



- Setup will finish the installation:



- Press “Finish” to end the installation:



- Connect the device and controller via HD-15 cable.
- Connect the PC and controller via USB or RS232 cable.
- Plug in power supply to controller and AC adapter to wall outlet.
- The device will be detected and configured.
- The device installation is complete.

## 4.5 Using the software

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

Launch software using the icon on the desktop.

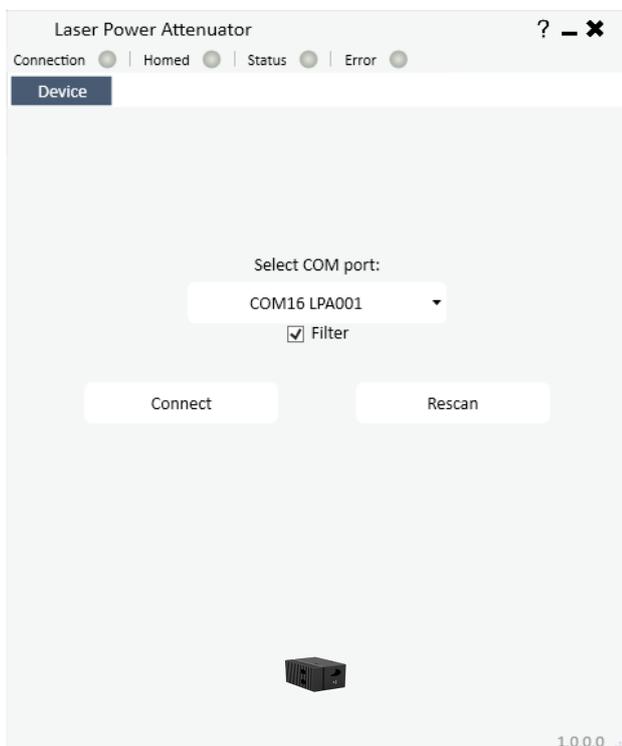


### 4.5.1 Connection

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.

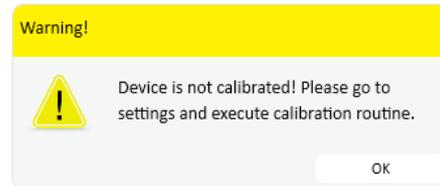
Select “**Filter**” when device is connected via USB cable. All other COM ports will be hidden except our device.

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

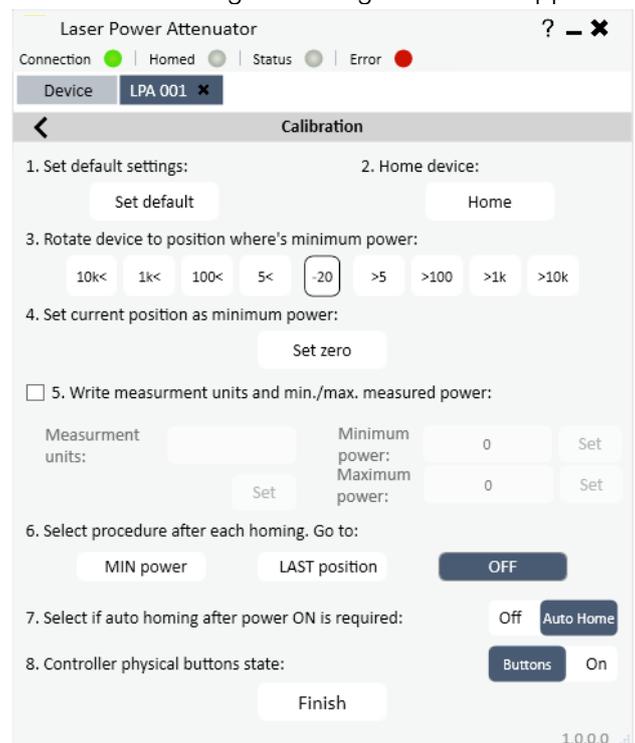


### 4.5.2 Settings, calibration

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



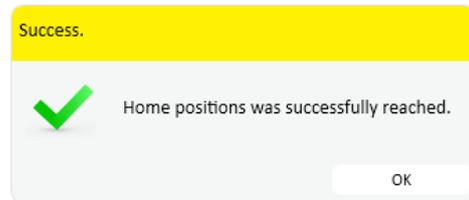
For calibration, move your mouse to the left side of the window on a gear symbol from the sliding menu and select “**Settings**”. Settings menu will appear:



To succeed calibration please follow calibration steps:

- Set default settings
- Home device
- Find minimum power position
- Set current position as minimum power
- Choose additional measurement units if necessary
- Select procedure after each homing:
  - Min power - each time after homing the device, the attenuator instantly will go to minimum power position.
  - Last position - each time after homing the device, the attenuator will go to last position before.
  - OFF - each time after homing the device, the attenuator will remain in home position.
- Select if automatic homing is required after turning the device ON.

- Choose if physical buttons are required, if no, you can lock them by choosing “Buttons OFF”.
- 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 are no errors, device is connected and homed. The device is ready to use.

The screenshot shows the main interface of the Laser Power Attenuator. At the top, there are status indicators for Connection (Green), Homed (Green), Status (Green), and Error (Red). Below these are tabs for 'Device' (LPA 001) and 'About'. The main display area shows two large digital readouts: '74.52 mW' and '37.26 %'. Below these are two sets of yellow '+' and '-' buttons for incremental changes of 10 mW and 10%. A horizontal slider below the readouts allows for power level adjustment from 0% to 100%. At the bottom, there are 'Off', 'Auto', and 'Home' buttons, a 'Save as preset' button, and a grid of 'Presets' (1-8) with values like 37.26% and 0%. A red 'Emergency zero' button is also present.

**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 its 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 Ethernet connection

The software has implemented TCP/IP communication. It is practically plug-and-play usage in the software once network settings of the device are correctly configured for TCP/IP communication. The interface and usage of the software stays the same as for USB or RS-232, only communication protocol is changed.

**NOTE:** Attenuator network settings must be configured using USB or RS-232 connection before use. This can be done using commands from Command description (p. 16) or using software.

### 4.6.1 About TCP/IP protocol

The device can communicate via RJ45 connector using “Transmission Control Protocol/Internet Protocol” (TCP/IP) network protocol. The TCP/IP protocol is designed such that each computer or device in a network has the unique IP address and each IP address can open and communicate over up to 65535 different “ports” for sending and receiving data to or from any other network device. The IP address uniquely identifies the computer or device on the network and a “Port Number” identifies a specific connection between one computer or device and another (between two IP addresses).

A TCP/IP Port can be thought of as a private two-way communications line where the port number is used to identify a unique connection between two devices. The TCP/IP protocol creates a “virtual IP port” and the network hardware and software are responsible for routing data in and out of each virtual IP port.

### 4.6.2 Client and Server Connection

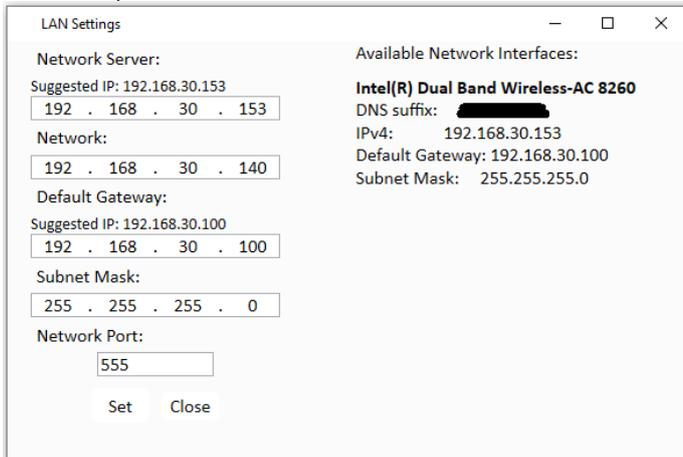
TCP/IP connection works in a manner like a telephone call where someone has to initiate the connection by dialing the phone. At the other end of the connection, someone has to be listening for calls and then pick up the line when a call comes in. **The Client in a TCP/IP connection is the controller** that “dials the phone” and the **“Server” is the computer or another device** that is “listening” for calls to come in. The Client needs to know the IP address of whatever Server it wants to connect to and it also needs to know the port number that it wants to send and receive data through after a connection has been established. The server only has to listen for connections and either accept them or reject when they are initiated by a client.

Once a connection through a TCP/IP port has been established between a TCP/IP Client and a TCP/IP Server, data can be sent in either direction. The controller will never send any data through TCP/IP port unless asked by the TCP/IP Server sending commands (see in command description p. 16). The connection between a Client and a Server remains open until either the client or the server terminates the connection.

The above description is basic and describes a general concept of how TCP/IP communication works. For deeper understanding at least networking basics must be known.

### 4.6.3 Ethernet configuration using software

- Connect attenuator to PC via USB or RS232.
- Open the software. After connecting the attenuator go to “Settings” > “Configure Network”. The LAN Settings window will pop-up:



On the left side of the Network Settings window, current network settings for attenuator will be displayed.

On the right side of the window network interfaces which are available will be listed, usually, there's only one available interface. Furthermore, IP addresses will be suggested for attenuator network settings from the available interface.

- **Configure Ethernet settings for attenuator:**
  - Input Network (TCP) Server (your PC) IP address. (It is filled automatically if only one network interface is available)
  - Input Network client (attenuator) IP address. Choose any, but it has to be unique IP address in your local network.
  - Input Router/Default Gateway address. (It is filled automatically if only one network interface is available)
  - Input Subnet Mask address. (It is filled automatically if only one network interface is available)
  - Input Network Port. By default, it is 555, but you can choose any up to 65535.

**NOTE:** Default “Network port”: 555.

Configuration is complete.

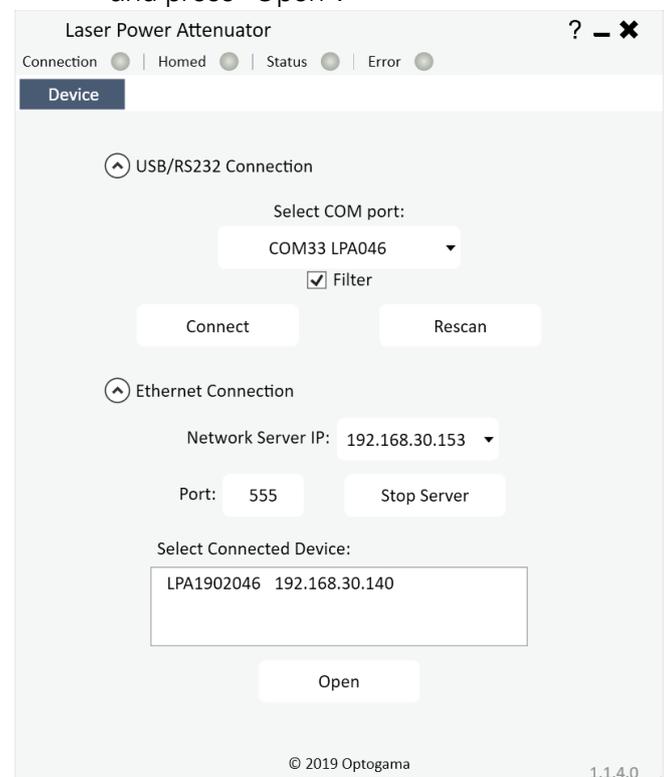
### 4.6.4 Ethernet connection using software

- Connect controller via Ethernet cable (RJ45 plug).
- Open the software.

- Open “Ethernet Connection” and select your Network (TCP) Server IP from the drop-down menu (usually it is only one available address)
- Input communication port (555 by default) and press “Start Server”.

**NOTE:** Port must be the same for both Network (TCP) server and Network client (attenuator).

- **If everything is configured correctly your device should appear in the connected devices list.** You will see attenuator serial number and IP from which it connected (if local network, IP should be the same as configured). Select device you want to use and press “Open”.



For further usage refer to section **4.5 Using the software.**

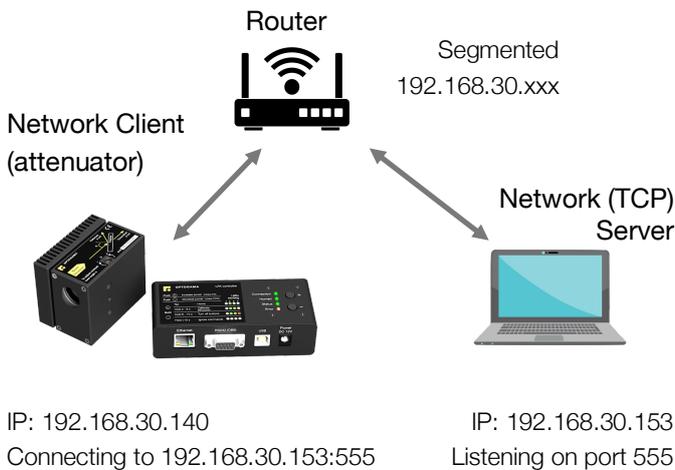
After the TCP server is started it constantly waits only for attenuator devices.

**NOTE:** If any other device or computer tries to connect to the TCP Server, connection is refused.

#### 4.6.5 Ethernet configuration using commands

In this manual two cases of network settings configurations will be reviewed. First case is when attenuator and device communicate on the same network. Second case when attenuator and other device communicate from different networks over internet. The latter is like the first case but has more steps included.

##### 1. Attenuator and other device communication on the same network:



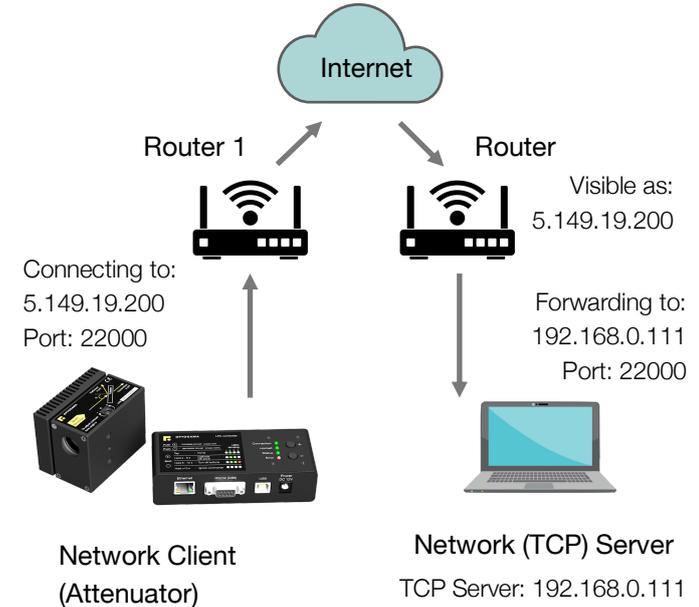
As shown in the picture, device that wants to communicate with attenuator has to be TCP Server, while attenuator is a TCP Client by default. Both Server and attenuator are connected to the router. The server may be connected via Ethernet cable or Wi-Fi. According to this setup attenuator network settings have to be set as follows:

- "LPA>NIP!\_192.168.30.140" – Client (attenuator) IP address in the local network.
- "LPA>NSIP!\_192.168.30.153" – Server IP address in the local network.
- "LPA>GWIP!\_Attenuator192.168.30.100" – Router/Default Gateway IP address.
- "LPA>NMSK!\_255.255.255.0" – Local network subnet mask.
- "LPA>NPRT!\_555" – Port over which both devices communicate.

With these settings, attenuator device which has Network client IP address 192.168.30.140, will try to connect to Network Server (PC) with IP address 192.168.30.153 over Port 555. The connection will be made through Router whose IP address is 192.168.30.100 and both devices are connected to it. If everything is configured correctly, TCP Server during "listening" of Port 555 should get a request of

connection from attenuator.

##### 2. Attenuator and other device communication from different networks over internet:



Attenuator is a Client and another device is a Server. In this case, both devices are on different networks and the only way they can reach each other is through the internet. To do this attenuator settings have to be as following:

"LPA>NIP!\_192.168.0.3" – Client (Attenuator) IP address in the local network.

"LPA>NSIP!\_5.149.19.200" – Server's Public IP Address.

"LPA>GWIP!\_192.168.0.1" – Default Gateway/Router1 IP address.

"LPA>NMSK!\_255.255.255.0" – Local network subnet mask.

"LPA>NPRT!\_22000" – Port over which both devices communicate.

In this case, attenuator will try to connect to a server with port 22000 over the internet which has the Public IP Address 5.149.19.200. Router 2 should accept connection from attenuator and Port Forward to a device in the Local Network with IP address 192.168.0.111.

**NOTE:** Port Forwarding must be configured on Router 2. This procedure varies on different devices and instructions should be available on Router 2 user manual.

#### 4.7 Updating the firmware

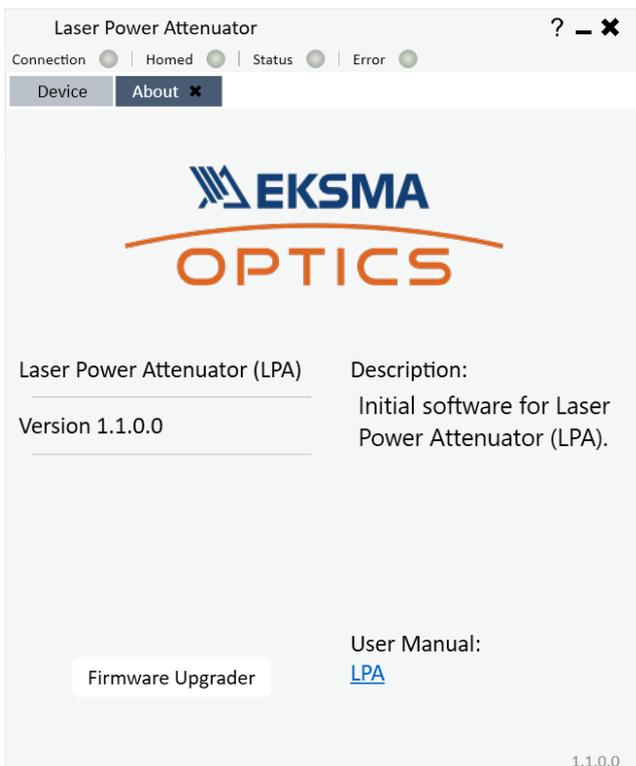
If your device's firmware version does not match the software's firmware version while connecting to device via attenuator software, you will be asked to update your device. If update request pops-up, but

you want to keep current firmware and use attenuator software, you must use software compatible with that firmware version.

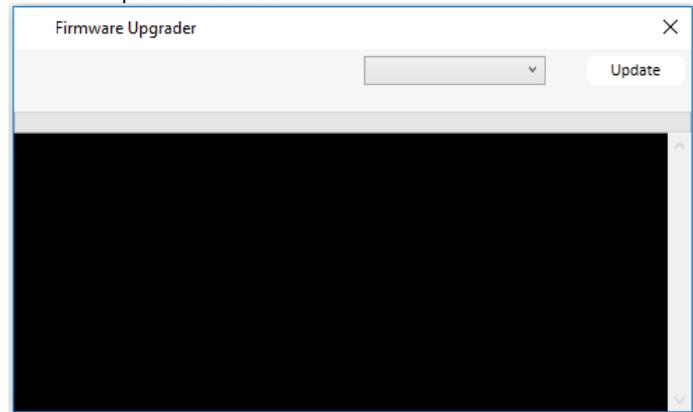
**NOTE:** Compatible software has been delivered with the device.

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

- Click button “**Firmware Upgrader**” in the About tab of attenuator software:



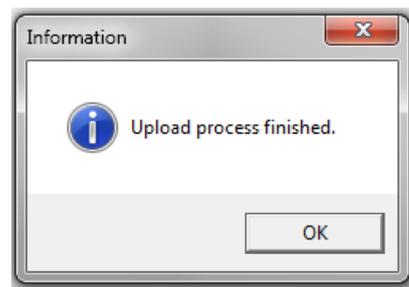
- In the opened window press “**Update**” button. You will be asked if you really want to update device:



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



- 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.

## 5. Commands

### 5.1 Interface

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**.

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**”.

### 5.2 Description

Command	Response	Comments	Example usage	
			User command	Device response
<b>Motion</b>   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! <b>_45.125</b>
LPA>PWR! <b>_X.XXX</b>	LPA>PWR! <b>_X.XXX</b>	Command used to set a new power value in percentages.	LPA>PWR! <b>_10</b>	LPA>PWR_ <b>10.000</b>
			LPA>PWR! <b>_45.1</b>	LPA>PWR_ <b>45.100</b>
			LPA>PWR! <b>_0.07</b>	LPA>PWR_ <b>0.070</b>
LPA>ANG?	LPA>ANG_X.XXX	Command used to get the current angle value in degrees.	LPA>ANG?	LPA>ANG_ <b>22.143</b>
LPA>ANG! <b>_X.XXX</b>	LPA>ANG_ <b>X.XXX</b>	Command used to set the angle value in degrees.	LPA>ANG! <b>_22.5</b>	LPA>ANG_ <b>22.500</b>
LPA>TGT! <b>_X.XXX</b>	LPA>TGT_ <b>X.XXX</b>	Command used to set the target in micro-steps.	LPA>TGT! <b>_44521</b>	LPA>TGT_ <b>44521</b>
LPA>TGT?	LPA>TGT_ <b>X.XXX</b>	Command used to get the current position in micro-steps.	LPA>TGT?	LPA>TGT_ <b>44521</b>
LPA>STP!	LPA>STP	Command used to stop motor instantly. Device could be used normally; homing is not required.	LPA>STP!	LPA>STP
<b>Homing, Calibration &amp; Auto-go</b>   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_ <b>-25432</b>
LPA>DEF?	LPA>DEF_offset	Command used to get an offset value from zero to minimum power. Used for calibration.	LPA>DEF?	LPA>DEF_ <b>-25432</b>

Command	Response	Comments	Example usage	
			User command	Device response
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.		
<b>Settings   Baud rate - BAUD, Buttons lock - KEYLOCK, Default settings - LDF</b>				
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: Homed; Recalibrated.		
<b>Ethernet settings</b>				
LPA>NIP!_x.x.x.x	LPA>NIP_x.x.x.x	Command used to set Client (LPA) IP address in local network.	LPA>NIP!_192.168.30.140	LPA>NIP_192.168.30.140
LPA>NIP?	LPA>NIP_x.x.x.x	Command used to get Client (LPA) IP address in local network.	LPA>NIP?	LPA>NIP_192.168.30.140
LPA>NSIP!_x.x.x.x	LPA>NSIP_x.x.x.x	Command used to set Server (PC) IP address in local or public network.	LPA>NSIP!_192.168.30.153	LPA>NSIP_192.168.30.153
LPA>NSIP?	LPA>NSIP_x.x.x.x	Command used to get Server (PC) IP address in local or public network.	LPA>NSIP?	LPA>NSIP_192.168.30.153
LPA>GWIP!_x.x.x.x	LPA>GWIP_x.x.x.x	Command used to set Default Gateway IP address.	LPA>GWIP!_192.168.30.100	LPA>GWIP_192.168.30.100
LPA>GWIP?	LPA>GWIP_x.x.x.x	Command used to get Default Gateway IP address.	LPA>GWIP?	LPA>GWIP_192.168.30.100
LPA>NMSK!_x.x.x.x	LPA>NMSK_x.x.x.x	Command used to set Local network subnet mask.	LPA>NMSK!_255.255.255.0	LPA>NMSK_255.255.255.0
LPA>NMSK?	LPA>NMSK_x.x.x.x	Command used to get Local network subnet mask.	LPA>NMSK?	LPA>NMSK_255.255.255.0
LPA>NPRT!_x	LPA>NPRT_x	Command used to set Port over which both devices communicate (555 by default)	LPA>NPRT!_555	LPA>NPRT_555
LPA>NPRT?	LPA>NPRT_x	Command used to get Port over which both devices communicate (555 by default)	LPA>NPRT?	LPA>NPRT_555
<b>Information   Device state - STATUS, Wavelength - WL, Firmware v. - FW, Serial number - ID</b>				
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)	LPA>STATUS?	LPA>1_0
			LPA>STATUS?	LPA>0_0

Command	Response	Comments	Example usage	
			User command	Device response
		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_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>_LPAXXXXXXX	Command used to get serial number.	LPA>ID?	LPA>_LPA1901001
<b>Other   Echo, Reset, Motor ON/OFF</b>				
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 reinitialize 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

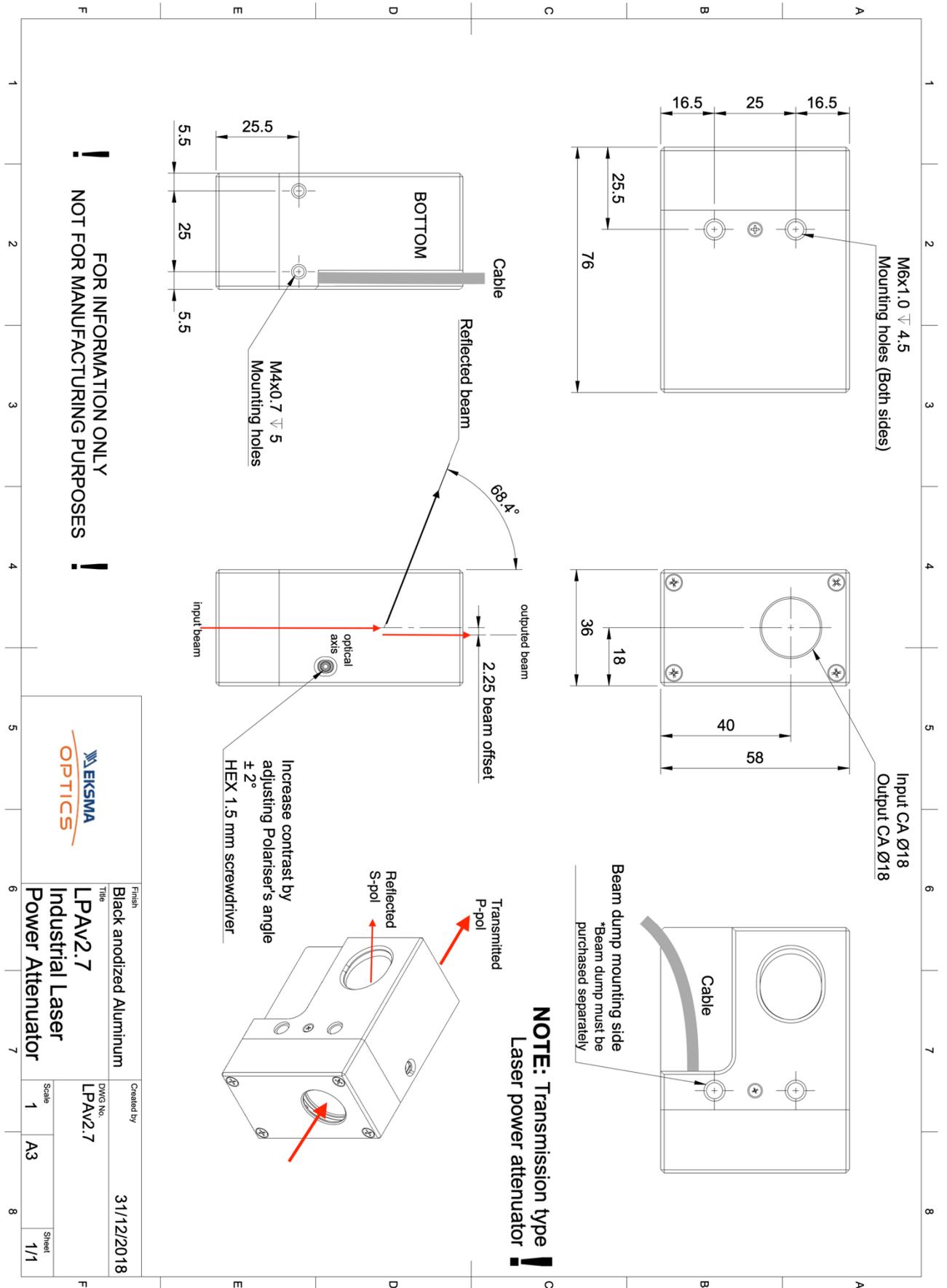
## 5.3 Serial communication example in Python

```

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=115200,
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)

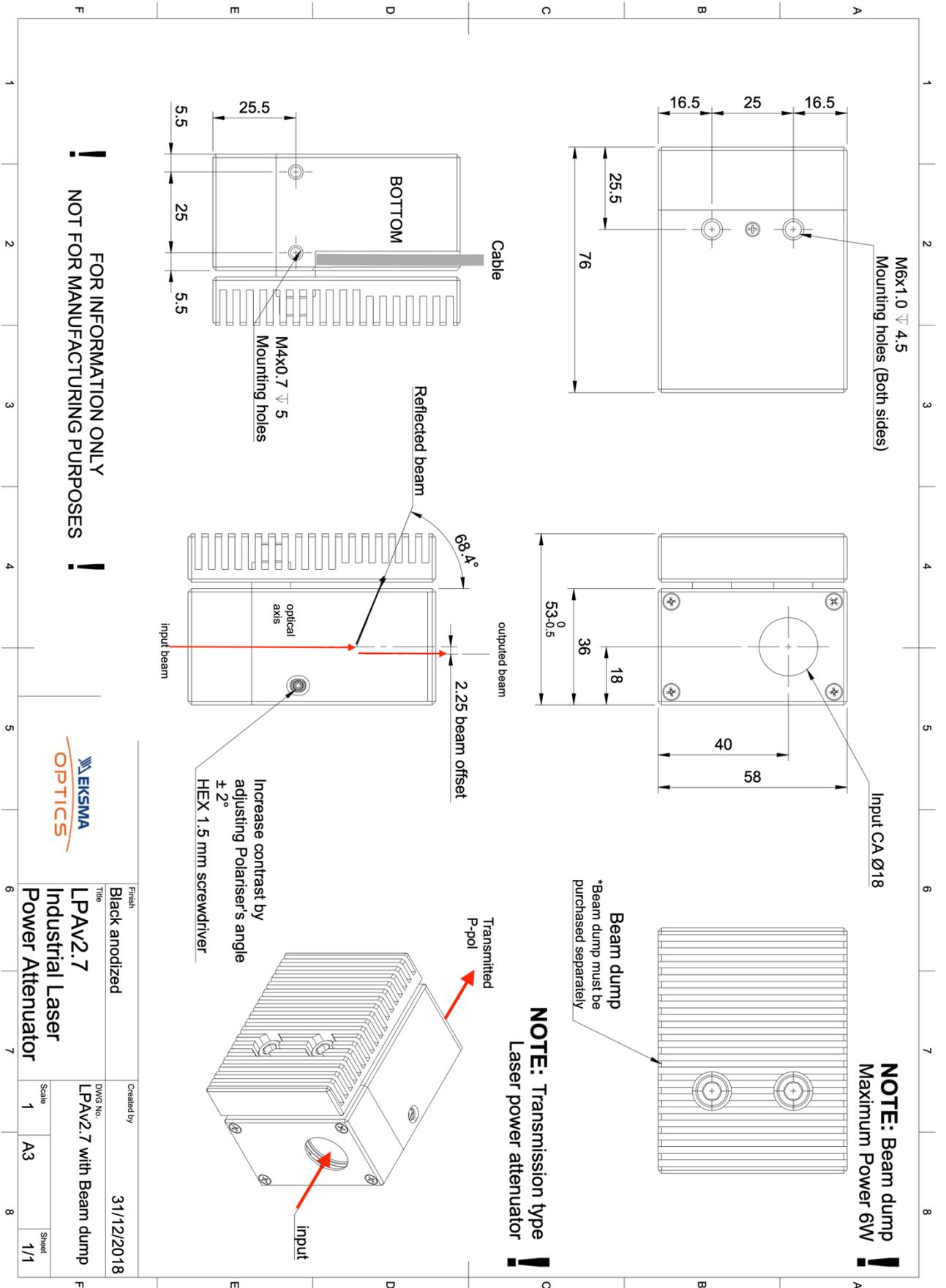
```

# 6. Technical drawings



Finish		Created by	
Black anodized Aluminum		31/12/2018	
Title	DWG No.		
LPAV2.7 Industrial Laser Power Attenuator	LPAV2.7		
Scale	Sheet		
1	A3	1/1	





Finish	Black anodized	Created by	31/12/2018
The	LPAV2.7	DWG No.	LPAV2.7 with Beam dump
	Industrial Laser		
	Power Attenuator	Scale	1
		Sheet	A3
		Sheet	1/1