LPA
MOTORISED LASER
POWER ATTENUATOR

LPA series
Table of contents

Table of contents .........................................................................................................................................................2
1. Safety requirements ..................................................................................................................................................4
2. Operation principle ................................................................................................................................................5
   2.1. Features and advantages......................................................................................................................................5
   2.2. Optical design ....................................................................................................................................................5
   2.3. Contrast improvement. Angle adjustment ........................................................................................................5
3. Product description ..................................................................................................................................................6
   3.1. Optical specifications ........................................................................................................................................6
   3.2. Mechanical specifications ..................................................................................................................................6
   3.3. Electronic specifications .....................................................................................................................................6
   3.4. Conditions ..........................................................................................................................................................6
   3.5. Controller ..........................................................................................................................................................7
      3.5.1. Interfaces, pinout .......................................................................................................................................7
      3.5.2. LEDs, Buttons functions ..............................................................................................................................7
      3.5.3. Mounting ......................................................................................................................................................8
   3.6. Voltage levels .....................................................................................................................................................8
   3.7. What’s in the box? ..............................................................................................................................................8
4. Software ..................................................................................................................................................................8
   4.1. Minimum Hardware requirements (recommended) ..............................................................................................8
   4.2. System requirements .........................................................................................................................................8
   4.3. Supported client operating systems ..................................................................................................................8
   4.4. Installing the software ......................................................................................................................................8
   4.5. Using the software ..........................................................................................................................................10
      4.5.1. Connection ...............................................................................................................................................10
      4.5.2. Settings, calibration ................................................................................................................................10
      4.5.3. Main window .............................................................................................................................................11
   4.6. Ethernet connection .........................................................................................................................................12
      4.6.1. About TCP/IP protocol ...............................................................................................................................12
      4.6.2. Client and Server Connection .....................................................................................................................12
      4.6.3. Ethernet configuration using LPA software ...............................................................................................13
      4.6.4. Ethernet connection using LPA software .................................................................................................13
      4.6.5. Ethernet configuration using commands .................................................................................................14
   4.7. Updating the firmware ...................................................................................................................................15
5. Commands ............................................................................................................................................................16
   5.1. Interface ...........................................................................................................................................................16
   5.2. Description ........................................................................................................................................................16
   5.3. Serial communication example in Python .......................................................................................................19
6. Technical drawings ................................................................................................................................................20
LPA

Motorised laser power attenuator

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

March 2019

Copyright UAB Optogama. All rights reserved.

No part of this manual may be reproduced, transmitted in any form without the permission of Optogama.

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.
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
- 175,542 µsteps in full rotation
- ±10 µsteps 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 10J/cm² (10 ns @ 1064 nm)
- Adjustable polariser angle

*repeatability after 10,000 random positions without homing

2.2. Optical design

LPA optical elements are coated for high LIDT (10 J/cm²) (10 ns @ 1064 nm) and can be applied for high power lasers.

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

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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear input aperture</td>
<td>ø18 mm - LPA</td>
</tr>
<tr>
<td>Clear output aperture</td>
<td>ø18 mm - LPA</td>
</tr>
<tr>
<td>Power attenuation range</td>
<td>&lt;0.1 % to &gt;98 % - LPA</td>
</tr>
<tr>
<td>LIDT coating</td>
<td>&gt;10 [J/cm²] (10 ns @ 1064 nm)</td>
</tr>
<tr>
<td>Close to open time</td>
<td>&lt; 0.2 sec</td>
</tr>
<tr>
<td>Resolution</td>
<td>175,542 µsteps in full rotation (0.002 deg, 7.2 arcsec, 0.035 mrad)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±10 µsteps (±0.02 deg, less than ±0.035 %)</td>
</tr>
<tr>
<td>Motor</td>
<td>2 phase stepper motor, 200 steps with 256 µstepping</td>
</tr>
</tbody>
</table>

3.2. Mechanical specifications

<table>
<thead>
<tr>
<th></th>
<th>LPA</th>
<th>LPA with beam dump</th>
<th>Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>76 mm</td>
<td>76 mm</td>
<td>125 mm</td>
</tr>
<tr>
<td>Width</td>
<td>36 mm</td>
<td>52 mm</td>
<td>53 mm</td>
</tr>
<tr>
<td>Height</td>
<td>58 mm</td>
<td>58 mm</td>
<td>31 mm</td>
</tr>
</tbody>
</table>

3.3. Electronic specifications

<table>
<thead>
<tr>
<th>Interface options:</th>
<th>LPA</th>
<th>LPA with beam dump</th>
<th>Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal</td>
<td>Using commands described in p. 12 “Commands”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Using LPA software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>DC 12 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission speed</td>
<td>up to 115,200 bits/s (RS-232) full speed USB 2.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4. Conditions

| Operating temperature | 10 °C to 40 °C |
| Storage temperature   | -15 °C to 50 °C |

A. Standard wavelengths, nm

<table>
<thead>
<tr>
<th></th>
<th>1st harm</th>
<th>2nd harm</th>
<th>3rd harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1064</td>
<td>532</td>
<td>355</td>
<td></td>
</tr>
<tr>
<td>1020-1040</td>
<td>510 - 520</td>
<td>343</td>
<td></td>
</tr>
<tr>
<td>760-840</td>
<td>390 - 410</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

C. Custom wavelengths

Custom coating available
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).

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

RS232 (DB9) Pinout

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

Fig 3. Front view of LPA controller.

Fig 4. Back view of LPA controller.

3.5.2. LEDs, Buttons functions

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 / Reset (Hold 2 to 6 s) | Hold both “+” & “-” buttons from 2 to 6 seconds to define (calibrate) current position as minimum power position (0%) or reset it. “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 |
| Ignore (Hold more than 10s) | Hold both “+” & “-” buttons longer than 10 seconds to ignore commands. “Homed”, “Status” and “Error” LED’s will stop blinking when it is right time to release buttons to ignore commands |

Fig 5. Top view of LPA controller.
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 (GST60A12-P1J)
5. USB cable (1.5 m)

**NOTE:** Other accessories must be purchased separately.

4. Software

4.1. Minimum Hardware requirements (recommended)

<table>
<thead>
<tr>
<th>Processor</th>
<th>1 Ghz</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM</td>
<td>512 Mb</td>
</tr>
<tr>
<td>Disk space</td>
<td></td>
</tr>
<tr>
<td>32-bit</td>
<td>4,5 Gb</td>
</tr>
<tr>
<td>64-bit</td>
<td>4,5 Gb</td>
</tr>
</tbody>
</table>

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](http://www.optogama.com), [www.4lasers.com](http://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

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:

   ![Warning](image)

   **Device is not calibrated! Please go to settings and execute calibration routine.**

   ![OK button](image)

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:

   ![Settings menu](image)

   1. Set default settings
   2. Home device
   3. Rotate device to position where minimum power is:
   4. Set current position as minimum power
   5. Write measurement units and min./max. measured power:
   6. Select procedure after each homing. Go to:
   7. Select if auto homing after power ON is required:
   8. Controller physical buttons state:

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.
4.6. Ethernet connection

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

**NOTE:** LPA 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 dialling 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 LPA 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 LPA controller will never send any data through TCP/IP port unless asked by the TCP/IP Server sending commands (see in command description Pg. 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 LPA software

1. Connect LPA to PC via USB or RS232.
2. Open LPA software. After connecting the LPA 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 LPA 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 LPA network settings from the available interface.

3. Configure Ethernet settings for LPA:
   3.1. Input Network (TCP) Server (your PC) IP address. (It is filled automatically if only one network interface is available)
   3.2. Input Network client (LPA) IP address. Choose any, but it has to be unique IP address in your local network.
   3.3. Input Router/Default Gateway address. (It is filled automatically if only one network interface is available)
   3.4. Input Subnet Mask address. (It is filled automatically if only one network interface is available)
   3.5. 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 LPA software

1. Connect LPA controller via Ethernet cable (RJ45 plug).
2. Open LPA software.
3. Open “Ethernet Connection” and select your Network (TCP) Server IP from the drop-down menu (usually it is only one available address)
4. Input communication port (555 by default) and press “Start Server”.

   **NOTE:** Port must be the same for both Network (TCP) server and Network client (LPA).
5. If everything is configured correctly your LPA device should appear in the connected devices list.
You will see LPA 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 LPA 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 LPA and device communicate on the same network.
- Second case when LPA and other device communicate from different networks over internet. The latter is like the first case but has more steps included.

1. LPA and other device communication on the same network:

   As shown in the picture device that wants to communicate with LPA has to be TCP Server, while LPA is TCP Client by default. Both Server and LPA are connected to the router. The server may be connected via Ethernet cable or Wi-Fi. According to this setup LPA network settings have to be set as follows:
   - “LPA>NIP!_192.168.30.140” – Client (LPA) IP address in the local network.
   - “LPA>NSIP!_192.168.30.153” – Server IP address in the local network.
   - “LPA>GWIP!_192.168.30.100” – 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, LPA 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 LPA device.

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

   LPA 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 LPA settings have to be as following:
   - “LPA>NIP!_192.168.0.3” – Client (LPA) 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, LPA 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 LPA 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 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

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Comments</th>
<th>Example usage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motion</strong></td>
<td>Power - PWR, Angle - ANG, Target - TGT, Stop - STP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPA&gt;PWR?</td>
<td>LPA&gt;PWR_X.XXX</td>
<td>Command used to get the current power value in percentages.</td>
<td>LPA&gt;PWR?</td>
</tr>
<tr>
<td>LPA&gt;PWR!_X.XXX</td>
<td>LPA&gt;PWR!_X.XXX</td>
<td>Command used to set a new power value in percentages.</td>
<td>LPA&gt;PWR!_10</td>
</tr>
<tr>
<td>LPA&gt;PWR!_X.XXX</td>
<td>LPA&gt;PWR!_X.XXX</td>
<td>Command used to set a new power value in percentages.</td>
<td>LPA&gt;PWR!_45.1</td>
</tr>
<tr>
<td>LPA&gt;PWR!_X.XXX</td>
<td>LPA&gt;PWR!_X.XXX</td>
<td>Command used to set a new power value in percentages.</td>
<td>LPA&gt;PWR!_0.07</td>
</tr>
<tr>
<td>LPA&gt;ANG?</td>
<td>LPA&gt;ANG_X.XXX</td>
<td>Command used to get the current angle value in degrees.</td>
<td>LPA&gt;ANG?</td>
</tr>
<tr>
<td>LPA&gt;ANG!_X.XXX</td>
<td>LPA&gt;ANG!_X.XXX</td>
<td>Command used to set the angle value in degrees.</td>
<td>LPA&gt;ANG!_22.5</td>
</tr>
<tr>
<td>LPA&gt;TGT!_X.XXX</td>
<td>LPA&gt;TGT!_X.XXX</td>
<td>Command used to set the target in micro-steps.</td>
<td>LPA&gt;TGT!_44521</td>
</tr>
<tr>
<td>LPA&gt;TGT?</td>
<td>LPA&gt;TGT_X.XXX</td>
<td>Command used to get the current position in micro-steps.</td>
<td>LPA&gt;TGT?</td>
</tr>
<tr>
<td>LPA&gt;STP!</td>
<td>LPA&gt;STP</td>
<td>Command used to stop motor instantly. Device could be used normally, homing is not require.</td>
<td>LPA&gt;STP!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Homing, Calibration &amp; Auto-go</strong></th>
<th>Homing - HOME, Auto-homing - AHOME, Calibration - DEF, Auto-go - AUTOGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPA&gt;HOME!</td>
<td>LPA&gt;HOME</td>
</tr>
<tr>
<td>LPA&gt;AHOME!</td>
<td>LPA&gt;AHOME_1</td>
</tr>
<tr>
<td>LPA&gt;NOAHOME!</td>
<td>LPA&gt;AHOME_0</td>
</tr>
<tr>
<td>LPA&gt;AHOME?</td>
<td>LPA&gt;AHOME_0</td>
</tr>
<tr>
<td>Command</td>
<td>Response</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>LPA&gt;DEF!</td>
<td>LPA&gt;DEF_offset</td>
</tr>
<tr>
<td>LPA&gt;DEF?</td>
<td>LPA&gt;DEF_offset</td>
</tr>
<tr>
<td>LPA&gt;AUTOGO!_X</td>
<td>LPA&gt;AHOME_X</td>
</tr>
<tr>
<td>LPA&gt;AUTO G?</td>
<td>LPA&gt;AHOME_X</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>LPA&gt;BAUD?</td>
<td>LPA&gt;BAUD_baud rate</td>
</tr>
<tr>
<td>LPA&gt;BAUD_baud rate</td>
<td>LPA&gt;BAUD_baud rate</td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK!</td>
<td>LPA&gt;KEYLOCK_X</td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK?</td>
<td>LPA&gt;KEYLOCK_X</td>
</tr>
<tr>
<td>LPA&gt;LDF!</td>
<td>LPA&gt;LDF</td>
</tr>
</tbody>
</table>

**Settings |** Baud rate - BAUD, Buttons lock - KEYLOCK, Default settings - LDF

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Comments</th>
<th>Example usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPA&gt;BAUD?</td>
<td>LPA&gt;BAUD_baud rate</td>
<td>Command used to get baud rate.</td>
<td>LPA&gt;BAUD?</td>
</tr>
<tr>
<td>LPA&gt;BAUD_baud rate</td>
<td>LPA&gt;BAUD_baud rate</td>
<td>Command used to set baud rate. Available speeds:</td>
<td>LPA&gt;BAUD_57600</td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK!</td>
<td>LPA&gt;KEYLOCK_X</td>
<td>Command used to ENABLE / DISABLE controller physical buttons:</td>
<td></td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK?</td>
<td>LPA&gt;KEYLOCK_X</td>
<td>1 - disabled, 0 - enabled.</td>
<td></td>
</tr>
<tr>
<td>LPA&gt;LDF!</td>
<td>LPA&gt;LDF</td>
<td>Command used to load default settings. Device after this command must be:</td>
<td></td>
</tr>
</tbody>
</table>

**Ethernet settings**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Comments</th>
<th>Example usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPA&gt;NIP_x,x,x,x</td>
<td>x.x.x.x</td>
<td>Command used to set Client (LPA) IP address in local network.</td>
<td>LPA&gt;NIP_192.168.30.140</td>
</tr>
<tr>
<td>LPA&gt;NISI_x,x,x,x</td>
<td>x.x.x.x</td>
<td>Command used to get Client (LPA) IP address in local network.</td>
<td>LPA&gt;NISI_192.168.30.153</td>
</tr>
<tr>
<td>LPA&gt;NMSK_x,x,x,x</td>
<td>x.x.x.x</td>
<td>Command used to set Server (PC) IP address in local or public network.</td>
<td>LPA&gt;NMSK_255.255.255.0</td>
</tr>
<tr>
<td>LPA&gt;NPRT_x</td>
<td>NPRT_x</td>
<td>Command used to set Port over which both devices communicate (555 by default)</td>
<td>LPA&gt;NPRT_555</td>
</tr>
<tr>
<td>LPA&gt;NMSK?</td>
<td>LPA&gt;NMSK_x,x,x,x</td>
<td>Command used to get Local network subnet mask.</td>
<td>LPA&gt;NMSK_255.255.255.0</td>
</tr>
<tr>
<td>LPA&gt;NPRT?</td>
<td>LPA&gt;NPRT_x</td>
<td>Command used to set Port over which both devices communicate (555 by default)</td>
<td>LPA&gt;NPRT_555</td>
</tr>
<tr>
<td>LPA&gt;GWP!_x,x,x</td>
<td>GWP!_x,x,x</td>
<td>Command used to set Default Gateway IP address.</td>
<td>LPA&gt;GWP!_192.168.30.100</td>
</tr>
<tr>
<td>LPA&gt;GWP?</td>
<td>LPA&gt;GWP_x,x,x</td>
<td>Command used to get Default Gateway IP address.</td>
<td>LPA&gt;GWP_192.168.30.100</td>
</tr>
<tr>
<td>LPA&gt;NMSK!_x,x,x</td>
<td>NMSK!_x,x,x</td>
<td>Command used to set Local network subnet mask.</td>
<td>LPA&gt;NMSK!_255.255.255.0</td>
</tr>
<tr>
<td>LPA&gt;NMSK?</td>
<td>LPA&gt;NMSK_x,x,x,x</td>
<td>Command used to get Local network subnet mask.</td>
<td>LPA&gt;NMSK_255.255.255.0</td>
</tr>
<tr>
<td>LPA&gt;GWP!</td>
<td>LPA&gt;GWP_x,x,x</td>
<td>Command used to set Default Gateway IP address.</td>
<td>LPA&gt;GWP!_192.168.30.100</td>
</tr>
<tr>
<td>LPA&gt;GWP?</td>
<td>LPA&gt;GWP_x,x,x</td>
<td>Command used to get Default Gateway IP address.</td>
<td>LPA&gt;GWP_192.168.30.100</td>
</tr>
</tbody>
</table>

Settings: Baud rate - BAUD, Buttons lock - KEYLOCK, Default settings - LDF

**User command**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Comments</th>
<th>Example usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPA&gt;BAUD?</td>
<td>LPA&gt;BAUD_baud rate</td>
<td>Command used to get baud rate.</td>
<td>LPA&gt;BAUD?</td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK!</td>
<td>LPA&gt;KEYLOCK_X</td>
<td>Command used to ENABLE / DISABLE controller physical buttons:</td>
<td></td>
</tr>
<tr>
<td>LPA&gt;KEYLOCK?</td>
<td>LPA&gt;KEYLOCK_X</td>
<td>1 - disabled, 0 - enabled.</td>
<td></td>
</tr>
<tr>
<td>LPA&gt;LDF!</td>
<td>LPA&gt;LDF</td>
<td>Command used to load default settings. Device after this command must be:</td>
<td></td>
</tr>
</tbody>
</table>

**Example usage**

1. LPA>DEF! LPA>DEF_offset
2. LPA>DEF? LPA>DEF_offset
3. LPA>AUTOGO!_X LPA>AHOME_X
4. LPA>AUTO G? LPA>AHOME_X
5. LPA>BAUD? LPA>BAUD_baud rate
6. LPA>BAUD!_57600
7. LPA>KEYLOCK! LPA>KEYLOCK_X
8. LPA>KEYLOCK? LPA>KEYLOCK_X
9. LPA>LDF! LPA>LDF
<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Comments</th>
<th>Example usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPA&gt;NPRT?</td>
<td>LPA&gt;NPRT_x</td>
<td>Command used to get Port over which both devices communicate (555 by default)</td>
<td>LPA&gt;NPRT? LPA&gt;NPRT_555</td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td><strong>Device state</strong> - STATUS, <strong>Wavelength</strong> - WL, <strong>Firmware v.</strong> - FW, <strong>Serial number</strong> - ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPA&gt;STATUS?</td>
<td>LPA&gt;X_Y</td>
<td>Command used to get the current state of the device. X signifies if motor is ON. Y signifies the error byte. X=&quot;1&quot; motor is ON (enabled) X=&quot;0&quot; motor is OFF (disabled) Y = 16 bits digit with following bits: bit0 -&gt; driver error bit1 -&gt; driver high temperature warning bit2 -&gt; driver over temperature bit3 -&gt; some type of error in the driver load bit4 -&gt; load warning – open load on phase A or B bit5 -&gt; under voltage error bit6 -&gt; external memory error, working/calibration data may be corrupted bit7 -&gt; reset has occurred bit8 -&gt; left limit switch is pressed bit9 -&gt; right limit switch is pressed bit10 -&gt; stall guard flag is active bit11 -&gt; motor is stand still bit12 -&gt; motor target velocity reached bit13 -&gt; target position reached bit14 -&gt; homing procedure was run after the reset bit15 -&gt; device calibration is done</td>
<td>LPA&gt;STATUS? LPA&gt;1_0 LPA&gt;STATUS? LPA&gt;0_0 LPA&gt;STATUS? LPA&gt;1_2</td>
</tr>
<tr>
<td>LPA&gt;WL?</td>
<td>LPA&gt;WL_XXX</td>
<td>Command used to get the design wavelength.</td>
<td>LPA&gt;WL? LPA&gt;WL_355</td>
</tr>
<tr>
<td>LPA&gt;FW?</td>
<td>LPA&gt;_Firmware version</td>
<td>Command used to get firmware version.</td>
<td>LPA&gt;FW? LPA&gt;_1.0.0.1</td>
</tr>
<tr>
<td>LPA&gt;ID?</td>
<td>LPA&gt;_LPAXXXXXXX</td>
<td>Command used to get serial number.</td>
<td>LPA&gt;ID? LPA&gt;_LPA1901001</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td><strong>Echo, Reset, Motor ON/OFF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPA&gt;ECHO!</td>
<td>LPA&gt;ECHO</td>
<td>Command used for troubleshooting. The device echoes sent command before sending the response.</td>
<td>LPA&gt;ECHO! LPA&gt;TGT? LPA&gt;ECHO LPA&gt;TGT? LPA&gt;TGT_45602</td>
</tr>
<tr>
<td>LPA&gt;NOECHO!</td>
<td>LPA&gt;NOECHO</td>
<td>Command used to disable ECHO command.</td>
<td></td>
</tr>
<tr>
<td>LPA&gt;RESET!</td>
<td>LPA&gt;RESET</td>
<td>Command used to reinitialise device.</td>
<td>LPA&gt;RESET! LPA&gt;RESET</td>
</tr>
<tr>
<td>LPA&gt;OFF!</td>
<td>LPA&gt;OFF</td>
<td>Command used to turn motor OFF.</td>
<td>LPA&gt;OFF! LPA&gt;OFF</td>
</tr>
<tr>
<td>LPA&gt;ON!</td>
<td>LPA&gt;ON</td>
<td>Command used to turn motor ON.</td>
<td>LPA&gt;ON! LPA&gt;ON</td>
</tr>
</tbody>
</table>
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 terminalsof /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 differ on the device you are connecting to)
    ser = serial.Serial(
        port=port,
        baudrate=115200,
        parity=serial.PARITY_NONE,
        stopbits=serial.STOPBITS_TWO,
        bytesize=serial.EIGHTBITS,
        timeout=1  # second
    )
    ser.isOpen()

    print('Enter your commands below. Press Ctrl-D 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 happen 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
# Mechanical Specification

**GST60A12-P1J**

- **AC Inlet**: IEC320-C14
- **Power LED**
- **UL1185 16AWG 1000±50 mm for 12V**
- **70±10mm**

# DC output plug

- **Standard plug**: P1J

<table>
<thead>
<tr>
<th>P1J</th>
<th>Pin Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="P1J" /></td>
<td><img src="image" alt="Pin Assignment" /></td>
</tr>
</tbody>
</table>

- **Outside**: ![Outside](image)  
- **Inside**: ![Inside](image)  
- -V not connected to AC FG