

PowerXP Compact Motorized Attenuator

User Manual



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Altechna

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PowerXP

January 2018

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1. Introduction

This user manual is designed to help to install and operate PowerXP. Before installing and operating PowerXP please read installation and operation instructions carefully. Safety instructions must be read carefully. If there are any questions about contents of this manual please contact info@altechna.com. *Altechna* reserves the right to update contents of this manual without any notification.

1.1. PowerXP short description

Compact motorized attenuator - PowerXP is a computer controlled laser beam attenuation device. It attenuates a free space laser beam/pulse continuously without introducing additional energy fluctuations. PowerXP is controlled by a computer via USB.

1.2. General safety requirements

Compact motorized attenuator is designed to operate in conjunction with laser systems. All applicable rules and regulations for safe operation of lasers must be known and applied while installing and operating PowerXP. The customer is solely responsible for laser safety while using PowerXP as a standalone device or integrated into system. The customer must consider protective measures.

While assembling or operating PowerXP, do not stare at the direct or scattered laser light even with safety goggles. All parts of the body must be kept away from the laser radiation. While adjusting laser beam through PowerXP, laser power must be kept as low as possible. Hazardous laser radiation can increase while optical components or instruments are used in combination with PowerXP. Appropriate eye protection must be worn at

all times. Electrical safety requirements must be complied while assembling and operating PowerXP.

1.3. Symbols

Warning!

Sections marked with this symbol explain dangerous situations that can result as personal injury or death. Always read the associated information carefully, before performing indicated procedure.

Attention!

Paragraphs preceded by this symbol explain hazards that could damage the instrument and connected equipment or may cause loss of data.

Note

This manual also contains “NOTES” and “HINTS” written in this form.

1.4. Regulation

Attention!

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation.

These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can create radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by

→ Read further

turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Altechna is not responsible for any radio or television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by *Altechna*. The correction of interference caused by unauthorized modification, substitution or attachment will be treated as responsibility of the user.

Attention!

Cellular phones or other radio transmitters are not recommended to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

1.5. Operating and storage conditions

For proper PowerXP functioning please use the assigned controller (found in the same package). Using unassigned controllers might be harmful to the device.

Environmental conditions that must be hold while storing, servicing and operating are:

- Storage temperature should be between -25 °C and +60 °C

- Operating temperature is $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$
- PowerXP must be protected from humidity, dust and corrosive vapors to avoid damaging optical components and electronics
- Avoid strong static electricity and electromagnetic fields

2. Operation Principle

PowerXP incorporates a rotating quartz $\lambda/2$ phase waveplate and one polarizer which separates s-polarized and p-polarized beams (fig. 1). The intensity ratio of the two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. Proper functioning of PowerXP requires optimal configuration of optical elements considering the polarization contrast of the incident laser beam. Higher incident laser beam polarization contrast leads to higher PowerXP output polarization contrast.

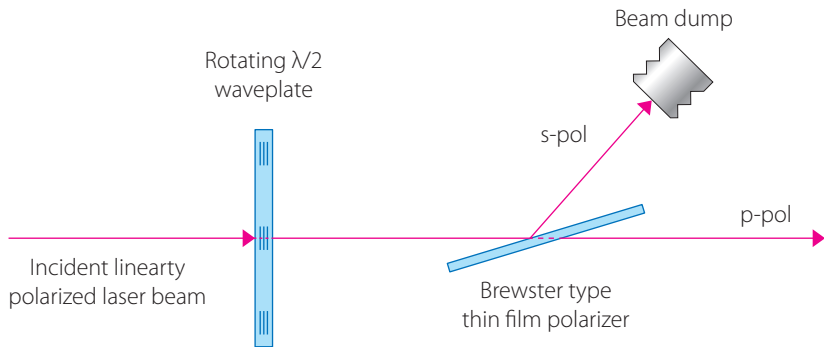


Figure 1. PowerXP operation principle. The intensity of the incident beam is varied by means of a $\lambda/2$ phase waveplate and a polarizer.

3. Package contents

- Compact motorized attenuator - PowerXP
- Controller
- USB cable (2m length recommended but no longer than 3m)
- 12V power supply
- Software, installation instructions in USB flash
- Polarizer – (already in the attenuator)
- Waveplate – (already in the attenuator)

3.1. Optics (dis)assembling

In order to get maximum possible attenuation polarizer adjustment is necessary. The back cover with beam dump can be removed by untightening two screws showed in fig. 2. After removing the closure, 3 microscrews will be uncovered (circled in red). Adjusting them while measuring laser power output, will allow to reach maximum attenuation.

If necessary, the waveplate and polarizer holder can be removed for example for cleaning purposes. To remove the waveplate just untighten the retaining ring and take out the waveplate. For removing the polarizer holder please remove 3 steel screws and carefully pull it from the main PowerXP body.

→ Read further

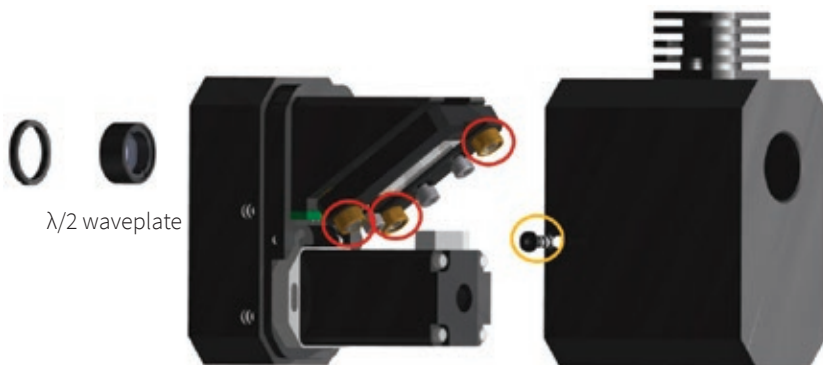


Figure 2. Disassembly of PowerXP. Adjustment microscrews circled in red. To remove the cover loosen two screws on each side of PowerXP (marked with yellow circle)

4. PowerXP Software Description

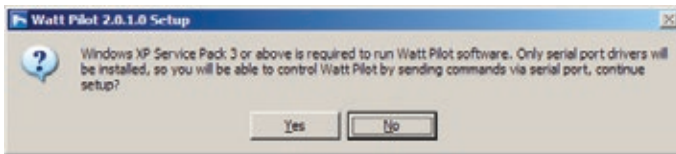
4.1. Computer requirements

- Free USB port. PowerXP is compatible with USB 1.1, USB 2.0 and USB 3.0
Computer administrator rights (only for installation)
- Windows XP sp3 (32-bit)
- Windows Server 2003 sp2 (32-bit)
- Windows Vista sp1 (32/64-bit)
- Windows Server 2008 (32/64-bit)
- Windows 7(32/64-bit)
- Windows 8(32/64-bit)
- Microsoft.Net framework 4.0 redistributable (installs automatically)

→ Read further

4.2. Software installation

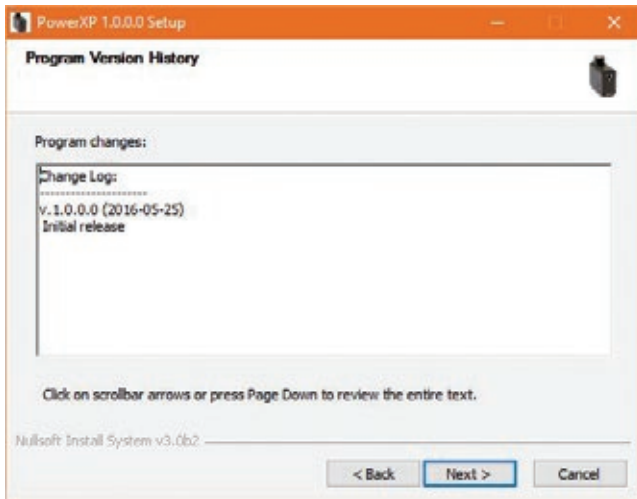
1. Check for and download the latest “PowerXP” software installer package from http://www.altechna.com/product_details.php?id=1224&product_name=PowerXP+Compact+Motorized+Attenuator.
2. Run the downloaded “PowerXP-Setup.exe” installation file. In case the software is installed on an operating system that does not meet requirements, only USB drivers will be installed. Click “Yes” to continue.



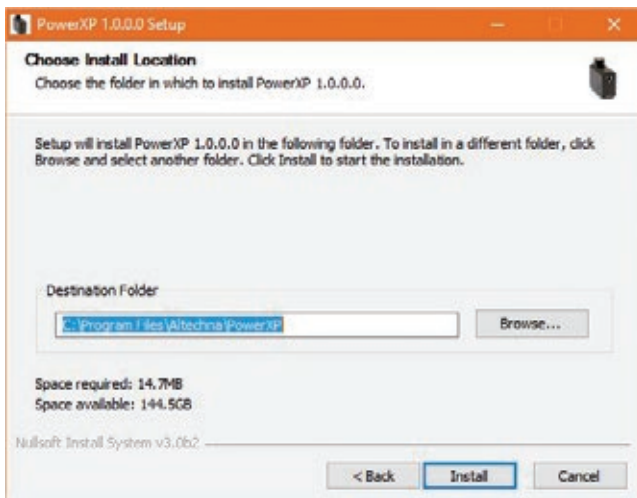
3. Installation window will appear, click “Next” to continue:



4. Click “Next”:

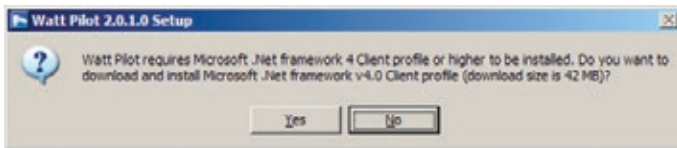


5. Select installation directory and click “Next” to begin installation:

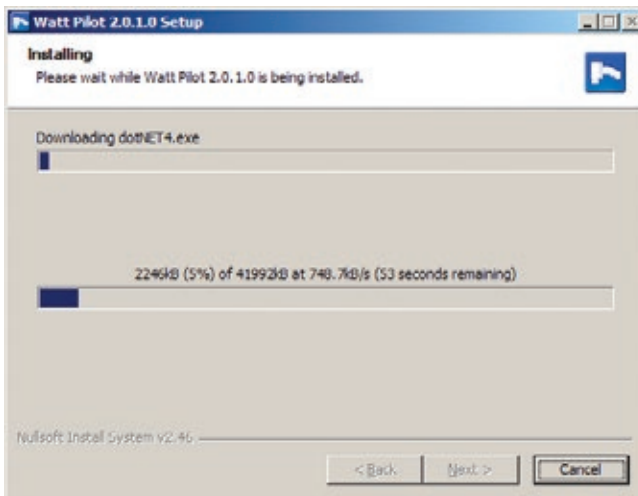


→ Read further

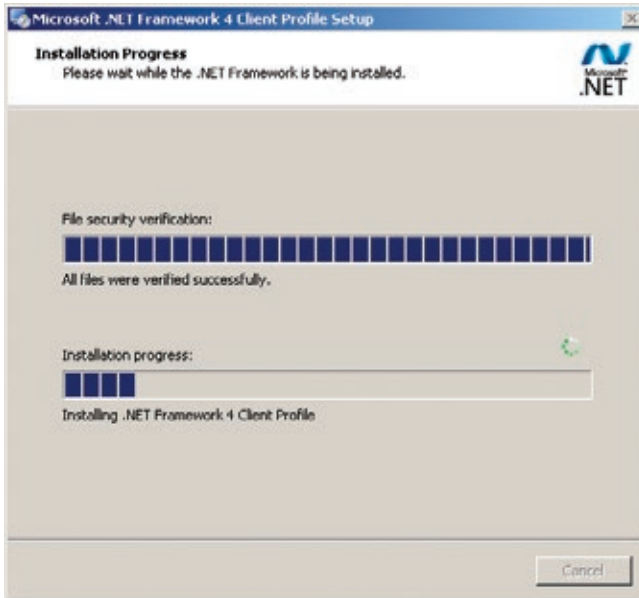
6. “PowerXP” software requires “Microsoft.NET Framework 4 Client Profile” or higher version to be installed. Setup will offer to download it, choose “Yes” if active internet connection is available. Choose “No” to download it from www.microsoft.com/enus/download/details.aspx?id=17113 and install it manually. One should choose “No” if newer version of Microsoft.NET framework is unwanted, or working internet connection is not available. This dialog will not appear if framework is already installed. Download size is 42 Mbytes.



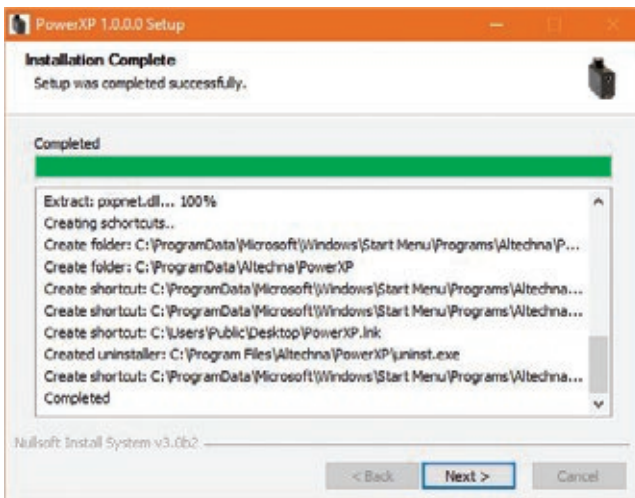
7. Setup will download “Microsoft .NET Framework 4 Client Profile”.



8. After download is finished, “Microsoft .NET Framework 4 Client Profile” will be installed, wait for it to complete. This can take more than 10 minutes on slower machine.

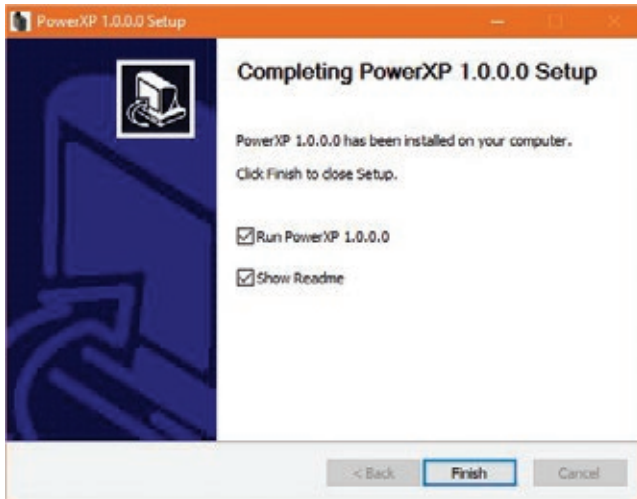


9. Setup will finish by installing drivers. Click “Next” to continue:



→ Read further

10. Click “Finish” to end installation. The program cannot be opened if only drivers were installed (see step 2 for details).

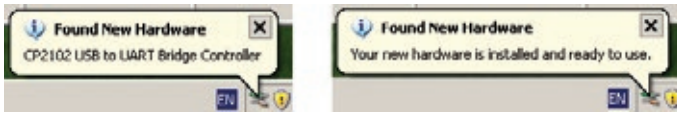


11. “PowerXP” software icon will appear on “All Users” desktop and “All Users” start menu.



12. Connect PowerXP to it's controller.
13. Connect PowerXP controller and PC via USB cable.
14. Plug in PowerXP power supply jack.

15. Windows will detect new hardware. Wait until windows configures new device.



4.3. Program first run

Launch "PowerXP" program using "PowerXP" icon on desktop or from "Start Menu → All Programs → *Altechna* → PowerXP → PowerXP". PowerXP "Selector" window will appear. At least one device must be displayed on the list. If the list is empty, please check USB cable, power connection. Blue LED must be active if power is OK. Click "File → Search For Devices" to refresh. For more information about PowerXP "Selector" window see section

PowerXP "Selector" window".

Select PowerXP from a list and click "File → Connect Once connected to PowerXP, dialog will pop up informing that no calibration file is found for new attenuator:



Figure 3. Dialog box, shown if PowerXP calibration file is not found.

→ Read further

Select “OK”, calibration window will appear. Use instructions in section “Calibration” to setup calibration. After calibration is done, “PowerXP control” window will appear. Use slider to select and set required power. See section “PowerXP “Control” window” window if more information is needed.

4.4. PowerXP “Selector” window

PowerXP “Selector” window contains a list of currently connected and powered attenuators. This window is used to choose device to work with if there are several controllers connected to a single computer. Functions of this window are described in the picture below.

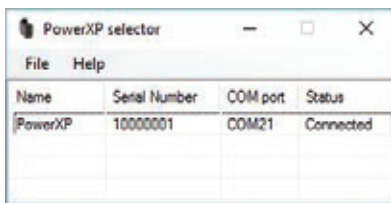


Figure 4. PowerXP “Selector” window. It is displayed every time program is started. There is one device attached to PC in shown screenshot. Double click listed attenuator to open control window for it.

Column description:

- **Name**

It is useful to give meaningful titles for each PowerXP, if more than one is used in the same system. For example, name can be set to “1st Harmonic WP”, and another attenuator can be named as “2nd Harmonic WP”. New name is saved into controller’s internal memory, so new name will be maintained on any computer. Name length is restricted to 20 characters maximum. PowerXP can be renamed from “PowerXP control” window “Options->PowerXP Name...” menu option.

- **Serial Number**

This column shows unique PowerXP controller hardware serial number. It is used to identify hardware at low level. Serial number must be used for hardware identification when contacting the developers.

- **COM port**

Each PowerXP gets unique serial port name after first enumeration with computer. This column shows USB serial port name assigned by Windows. COM port name is necessary to know for advanced users who want to use serial commands in their applications.

- **Status**

This column shows “Connected” if attenuator control window is active. Otherwise it is blank.

“File” menu description:

- **Connect**

Opens control window for selected PowerXP, (the same effect as double-click on the device in the list. If only one device is connected during program startup, control window will be opened automatically. See chapter “PowerXP “Control” window” on page 24 for information.

- **Search For Devices**

Starts searching for PowerXP devices attached to computer. It can help if not all devices are detected and listed automatically.

- **Close**

Closes PowerXP “Selector” window, but leaves control windows opened.

- **Exit**

Closes PowerXP “Selector” and all control windows.

→ Read further

“Help” menu description:

- **User Manual**

Opens user manual

- **About**

Shows software version and contact information.

4.5. Calibration

In order to correctly change the output power, the software needs to know the angle of the $\lambda/2$ waveplate’s fast axis. It can be fixed in any angle with respect to the rotator. The purpose of calibration is to fix angular offset between the $\lambda/2$ waveplate and the rotator hardware zero position. Calibration window is opened automatically on first use of PowerXP, or can be found in menu “Options → Calibration...” in “PowerXP control” window. Make sure that the attenuator is correctly aligned before calibrating.

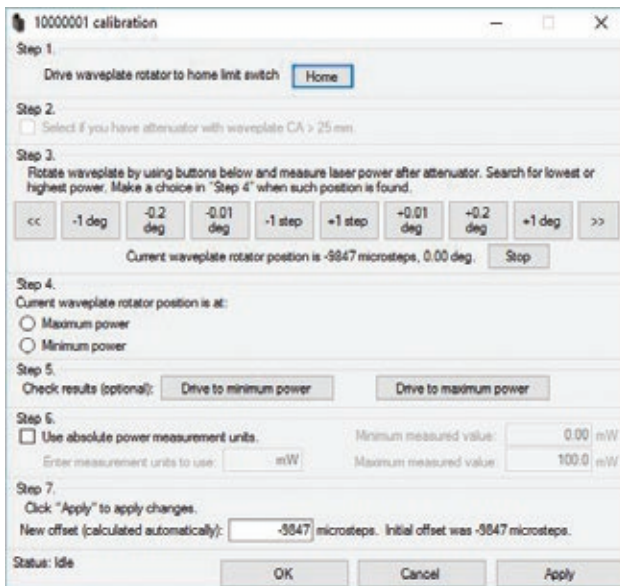


Figure 5. Calibration window.

Calibration procedure:

1. Homing. Click “Home” button in section “Step 1” and wait till motor stops. This will drive the waveplate holder to hardware limit switch (zero position). Step 1 must be performed every time the device is turned on or after extensive period of usage to eliminate any accumulated position error.
2. Rotate waveplate by using buttons in section “Step 3”, and measure laser power after the attenuator. Numbers on the buttons represent motor moving distance (expressed in stepper motor steps) and rotation direction. One step equals 0.003125.

Note

It is advised to search for lowest power (max attenuation) position, because usually it can be spotted more easily and accurately.

3. Find minimum or maximum signal power and select the appropriate option in “Step 4”. It will be called “Home position” in the control window. Angular offset is recalculated and shown in “Step 7” field every time “Step 4” selection is clicked. At this moment, main calibration goal is completed and “Apply” button can be clicked to apply changes. Further steps are not mandatory, but should be considered for convenience.
4. Calibration result can be verified by using buttons in “Step 5” panel. Usage example: click “Drive to minimum power” button and wait till the rotator stops. Use buttons “-0,01” and “0,01” (located in “Step 2”) to ensure if current position is really of lowest power. If it is, click “Apply”, else select “Minimum power” in “Step 4” again, to redefine offset. The same can be done with maximum power point.

→ Read further

5. Alignment of the polarizer and waveplate is critical for ensuring optimal performance, thus during the calibration PowerXP should be aligned to reach maximum performance. Real maximal and minimal transmitted power should be obtained by adjusting the polarizer with adjustment microscrews in the motorized attenuator (figure 2). Once measured, these extreme values should be entered in relevant fields of “Step 6”. Usage example: one uses 1 W laser, and 20 mW is measured as minimal power, and 0.99 W as maximal power. In such case firstly “Use absolute power measurement units” should be checked, then value “0.02” should be entered into field “Minimum measured value:”, and “0.99” – into “Maximum measured value:”, and “W” should be entered into “Enter measurement units to use:” textbox, because measurement units are “Watts”.
6. Click “OK” button to accept calibration or “Cancel” to discard. If dialog, window-request go to zero position will appear, click “Yes” for correct device operation.

4.6. PowerXP “Control” window

PowerXP “Control” window is used to change laser power after PowerXP attenuator. Main components of this window are described below.

- **PowerXP name and serial number** is shown on each attenuator control window caption. Serial number is unique for each PowerXP controller and cannot be changed as it is used to identify hardware at low level.
- **Power meter panel** always shows existing power after the attenuator. Percentage range is from 0 % to 100 % of transmission. Zero percent means that waveplate occurs at 45 degrees angle, beam polarization is rotated by 90 degrees and is maximally attenuated. Display reading “100%” means that waveplate is rotated at minimum attenuation – maximum transmission angle.



Figure 6. Power meter panel: right - “Use absolute power measurement units” checkbox is set in “Options → Preferences”, left - checkbox is unset.

If “Use absolute power measurement units” checkbox is set in “Options → Preferences” or during calibrating, numeric display, showing “mW” becomes active. Absolute power reading is converted from percentage value with respect to minimal and maximal measured power using power meter. Correct min and max power values must be set in program preferences or calibration windows.

- **Lower slider** changes power from 0 % to 100 % with resolution of 0.25%. Values in lower numeric fields will alter according to slider position. There is a triangle-shaped marker above lower slider which shows current power setting, which serves as convenient reference for slider usage.
- **Enter required value (%) field** is used to manually enter percentage of PowerXP transmission. Decimal point symbol is “.” (dot), two decimal places can be used. Valid range is 0.00 % .. 100.00 %.
- **Absolute required power field** is available if “Use absolute power measurement units” option is set in “Options → Preferences...” or “Options → Calibration...”. Decimal point symbol is “.” (dot). Valid range is from “Minimum measured value” to “Maximum measured value” set in program preferences.

→ Read further

- **Preset buttons** can be used to quickly set discreet values of output power if absolute value was predefined in calibration stage. Left click on any of them and appropriate value will appear in (4) or (5) text boxes.

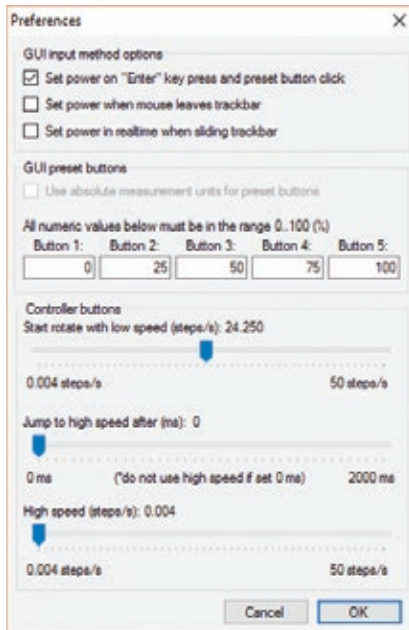


Figure 7. “Edit Preset Buttons at Preferences” window. Currently preset values are 0%, 25%, 50%, 75%, 100% of transmission, because checkbox is unchecked. Otherwise all values would represent absolute power in user selected units.

- **“GO” button.** Click to set power (rotate waveplate).

Note

If “Automatically execute “GO” after required power change” is selected in “Options → Preferences” waveplate would rotate automatically after any of aforescribed power control option is used (button pressed, slide moved, power value enters, etc. Otherwise click “GO” button to actually set power.

- **“STOP” button** cancels rotation.

- **Buttons “<<” and “>>”** will continuously decrease/increase power. Controller firmware must be up to date for these buttons to appear.
- **“Home” button** will drive waveplate rotator to home limit switch and back to “Home position”, set in “Options → Preferences...”. Usually this should be executed every time when device is turned on.

The screenshot shows the PowerXP Control window with the following callouts:

- 1. Watt Pilot name and serial number
- 2. “Power meter panel” Shows output power value, at which attenuator is currently set to
- 3. Move lower slider to change required power level. Click “GO” button to apply it
- 4. Enter required power level here in percent. Click “GO” to set
- 5. Absolute required power field is used to set power level using known units if correctly set in program preferences
- 6. Preset buttons instantly change required power
- 7. Click “GO” to apply power level which is shown in text boxes
- 8. Immediately stops Watt Pilot rotation
- 9. Hold this button to constantly increase power
- 9. Hold this button to constantly decrease power
- 10. This will drive waveplate to “Home” position, set by calibration process and preferences

Figure 8. PowerXP “Control” window. Currently laser power is set to 375 mW or 75 % of full calibrated range. Measurement units are available because absolute minimal and maximal power values are set in program preferences during calibration process.

“File” menu description:

- **Save Calibration**

Current program settings can be saved to file. Configuration file includes all options in “Options → Preferences”, preset values and calibration offset. Run time program configuration files are saved in folder “Application data for all users\Altechna\PowerXP\ Settings”.

- **Load Calibration**

Program settings can be restored from file. Configuration file includes all options in “Options → Preferences”, preset values and calibration offset. Current configuration will be overwritten.

- **Show Device Selector**

Opens PowerXP “Selector” window.

- **Close This Window**

Disconnects from PowerXP and closes active “Control” window.

“Options” menu description:

- **Calibration**

Opens PowerXP calibration window. See chapter “Calibration” on page 22 for details.

- **Preferences**

Opens program configuration window. See chapter “Program preferences description” on page page 30 for details.

- **PowerXP Name**

Opens “Rename Device” window. Use up to 20 characters for name. Enter new name and click “OK” to accept.

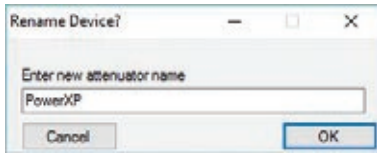


Figure 9. “Rename Device” window.

“Help” menu description:

- **User Manual**

Opens user manual.

- **About**

Shows software version and contact information. Please include software version and controller serial number when contacting manufacturer.

4.7. Program preferences

Preferences window can be accessed by “Options → Preferences” menu item in PowerXP control window.

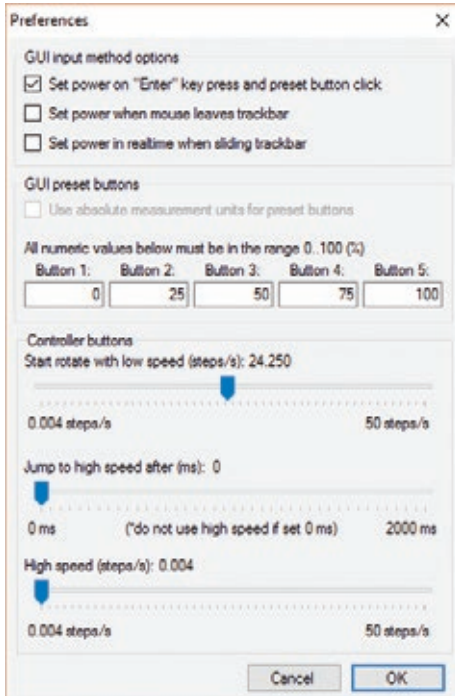


Figure 10. Program preferences window. Can be found under menu “Options → Preferences”.

4.7.1. GUI input method options

- **Set power on "Enter" key press and preset button click.** If checked, the power value will change by clicking "Enter" key after entering a required value.
- **Set power when mouse leaves trackbar.** If checked, the power value will change when mouse leaves the trackbar.

- **Set power in realtime when sliding trackbar.** If checked, the power value will change while sliding the trackbar.

4.7.2. Controller buttons. Speed of attenuation

Start rotate with low speed

In this section rotation speed of attenuator could be easily changed by using a slider “...” (see Figure 10). Speed:

- Minimum speed is 0,004 steps/s
- Maximum speed is 50 steps/s

Jump to high speed after

You can set a time delay in ms for controller to change the speed to fast motion. Time before speed gets higher:

- Minimum time 0 ms
- Maximum time 2000 ms

If using a value >0ms it is necessary to set the speed value using a slider of **High speed.**

While using this option (value is >0ms) it is more accurate and easier to set the right value of attenuation when using buttons on a controller Left/Right or Min/Max (Figure 13). The rotator firstly will move with speed of “Start rotate with low speed” value, after set time it will start to move faster with set “High speed” value.

→ Read further

Note:

“Automatically execute “GO” after required power change” must be checked for this options to be enabled.

- Use absolute measurement units for preset buttons. If this is set, preset button values are shown as absolute power values, otherwise, preset button values mean percentage (%) of transmitted power. Option “Use absolute power measurement units” must be set for this option to be enabled (see in calibration). Preset button values are recalculated automatically with respect to min and max measured power.

4.8. Red error signs in control window

Red error signs are displayed in control window:

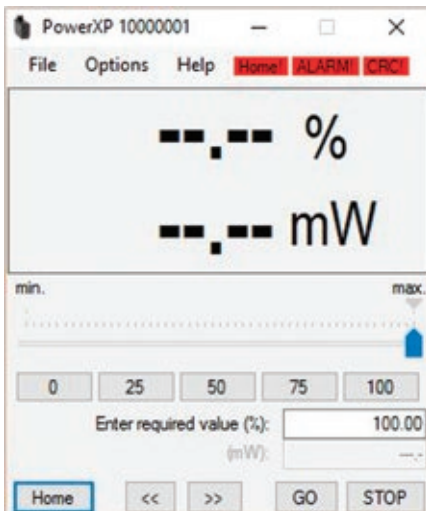


Figure 11. PowerXP “Control” window with error signs (Home Alarm, Crc).

- **HOME!**

Device is not homed after power on, so there is no accurate position reference point for the waveplate. Ratio readings are inaccurate, so ratio change is prohibited. Execute homing first (hold MIN/MAX buttons for 5sec or push home button in control window).

- **ALARM!**

Impossible to move motor - hardware error. Please check wiring, overheating, power supply.

- **CRC!**

Controllers calibration/settings are corrupt. Data corruption can occur due to power supply loss during calibration process. Please run calibration process.

4.9. Writing Software for PowerXP

You can write your own software for PowerXP. For this purpose a development kit is included for each PowerXP. This kit consists of: libraries for x32 and x64 architectures and header file; visual studio c example project with precompiled executables; LabView x32 & x64 2015 example project, which can read several parameters from controller; MATLAB example for x64 architecture, which is tested with MATLAB R2015a x64 on Win10 x64. The kit includes wider descriptions and screenshots of how to use library files and provided examples.

5. PowerXP Controller Hardware

5.1. Controller specifications

PowerXP controller is bipolar stepper motor driver with specifications listed in Table 1 below.

Table 1. Controller specifications

Max output voltage	+12 V
Max output current	2 A
Current regulation type	Pulse Width Modulation
Microstepping capability	Steps 1/256
Position feedback	Open loop operation (no external position feedback encoder)
Controller protection	Driver have overheating and over current (2A) protection
Device can be operated by	Computer software via USB port
Limit switch	One limit switch can be connected and used only for homing
Connector	7 pin circular connector, 712 series

5.2. Controller usage

Operation with buttons

- **(-)** – while holding turns the waveplate to a minimum attenuation
- **(+)** – while holding turns the waveplate to a maximum attenuation
- **HOME** – holding both (-/+) buttons for 5sec. moves attenuator to home position

→ Read further

LED indicators - designation:

- **Power** – indicates power from USB connection with PC
- **Status:**
 - If blinking slowly (1 blink in 1 sec.) – need homing
 - If blinking fast (3 blinks in 1 sec.) – the waveplate is rotating
 - If illuminating continuously – PowerXP is homed, the movement is stopped
- **(Min)** – the PowerXP is at it's minimum attenuation
- **(Max)** – the PowerXP is at it's maximum attenuation

5.3. PowerXP connector pin out

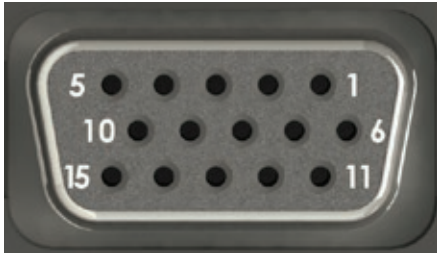


Figure 12. PowerXP VGA connector pin out.

MOTOR WIRES:

1. B\ Blue

2. B Red

3. A\ Green

4. A Black

OPTICAL SENSOR WIRES:

5. +5V Yellow

6. GND/Shiel

7. Signal/OUT White

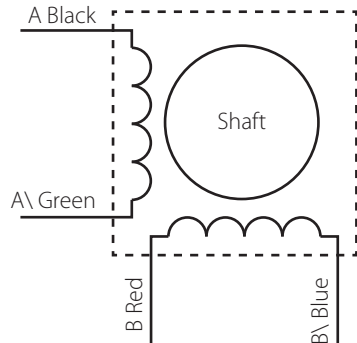


Figure 13. Bipolar stepper motor.

6. Main dimensions

6.1. PowerXP

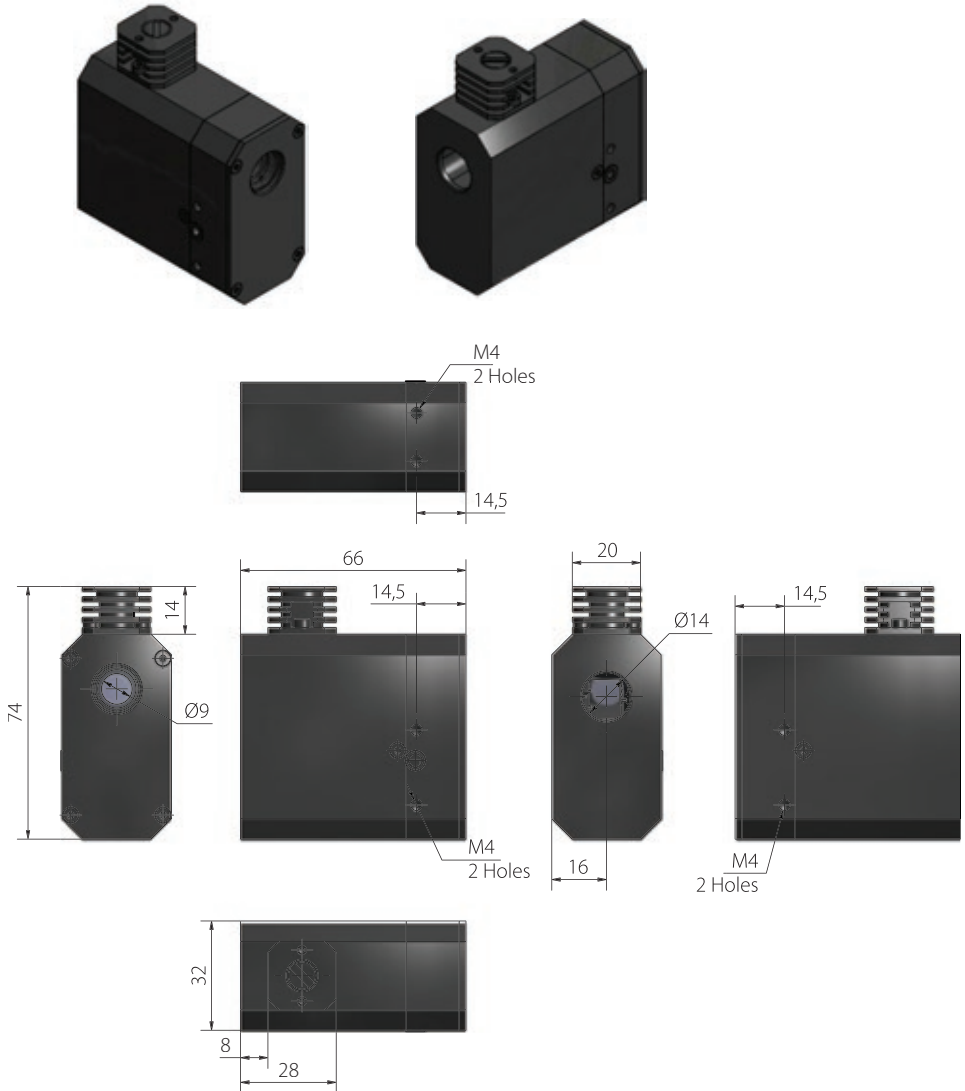


Figure 14. Main dimensions and mounting options of PowerXP.

6.2. PowerXP Controller

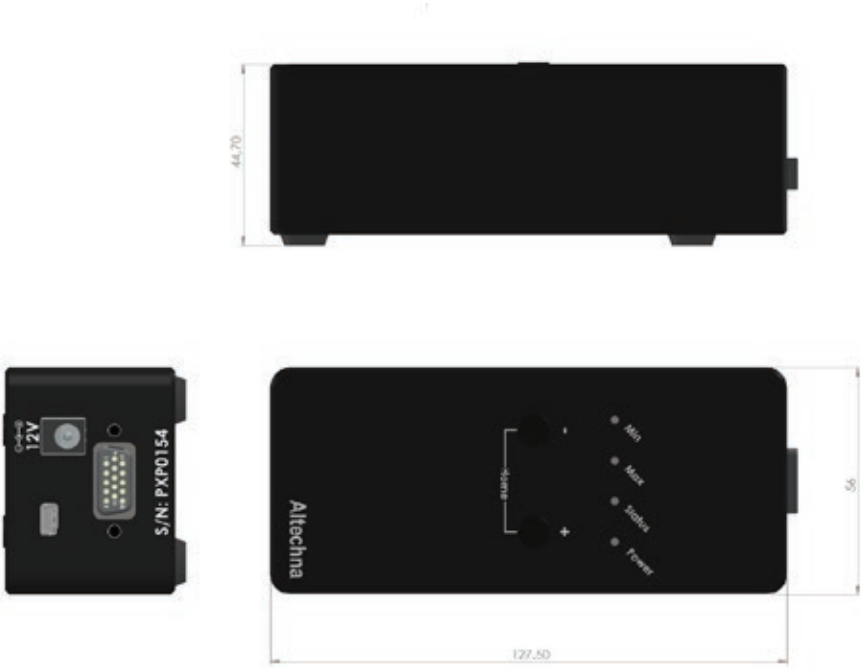


Figure 15. Main dimensions and mounting options of PowerXP Controller.

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