PGSOFTW

PgSoftw Software Description

Pgsoftw is end-level user interface for designing and debugging firmware for OPG driver board, setting and adjusting parameters for controllers of optical elements.

OPG driver (NPAR7)

OPG driver is designed to control positions (linear positions, rotation angles, also temperatures) of optical elements, such as diffraction gratings, optical crystals, etc., also temperature controllers.

Optical elements can be controlled through:

- step motors, rotation tables, translation tables, temperature controllers, etc., directly connected to the driver board;
- specialized distant drivers, connected to main OPG driver through CAN or RS232 buses.

OPG driver also can be used to control up to 4 energy output meters. Meters can be connected to the driver directly, or through CAN bus.

Driver has direct connections for following controllers:

- up to 6 micro-step motors with zero seek (step is divided by 256) at M1…M6
- up to 3 small-step motors with zero seek (step is divided by 1-64) at L1…L3
- up to 2 step motors without zero seek (step is divided by 2), power supply 5/12 V, at S1…S2
- up to 3 step motors without zero seek (step is divided by 2), power supply 12 V, at F1…F3
- up to 2 shutters, power supply 12 V, at St1…St2
- up to 3 energy meters, one of them synchronized.

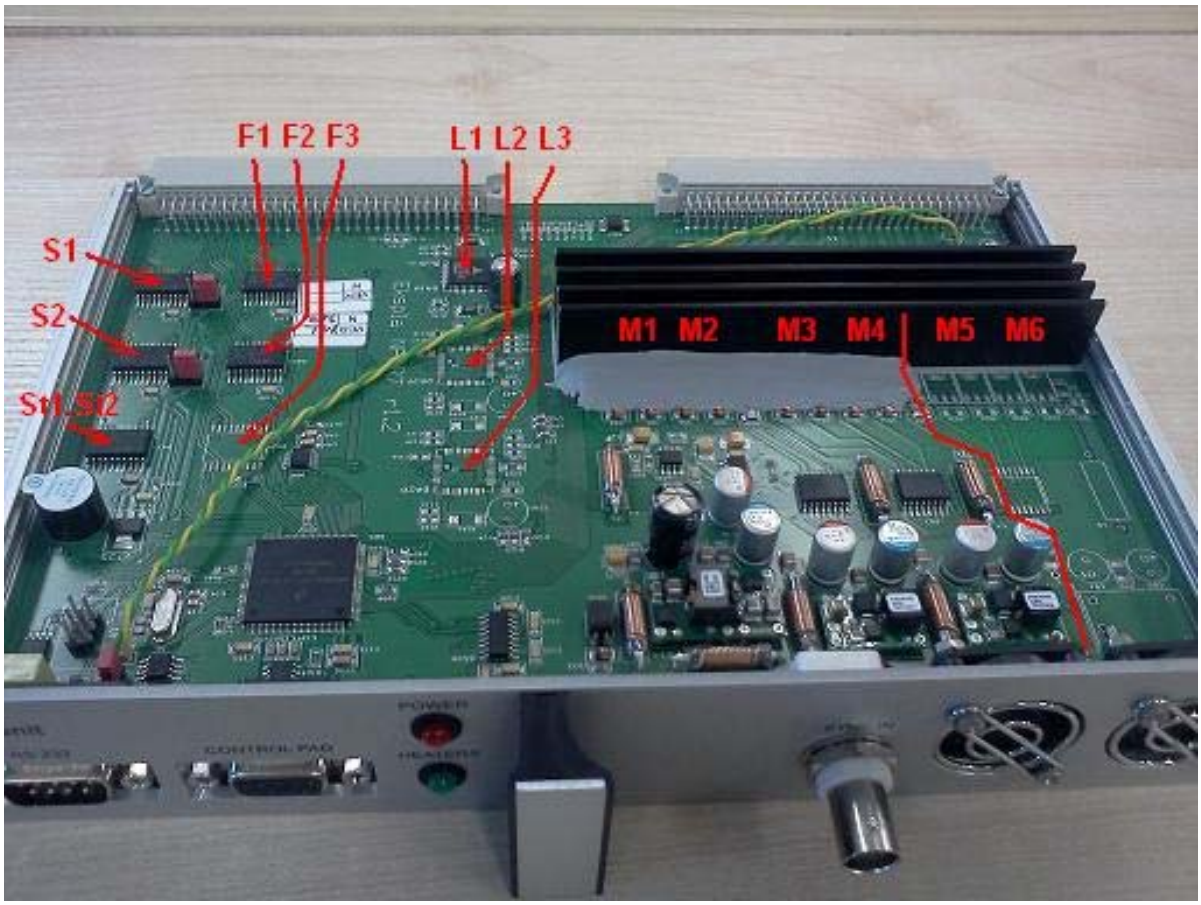


Figure 1 OPG driver board. Depending on a number of controllers in specific OPG's, some PCB components shown above may be not included.

Remote control pad serves as a user interface with OPG driver for routine operations. Control pad can be connected directly to the driver board or through the CAN bus. More advanced operations, as well as routine ones, can be performed from PC using specialized software. PC is connected through CAN bus or RS232 link.

OPG firmware

Boot loader software is written into OPG driver using a hardware programmer. Boot loader is identical for any NPAR7 type driver. Using boot loader, *NPar7loader.exe* on PC and RS232 link the remaining software can be loaded and/or edited.

This firmware package may be unique, intended for use on a specific device only, or universal kernel *UniPG*.

Unique firmware for specific device contains all the code, data and user interface to control all motors. Universal kernel *UniPG* has more open architecture. This manual further describes *UniPG* only.

UniPG

UniPG firmware controls NPAR7 driver and can be used for most EKSPLA produced OPG's.

It includes several layers:

1. Firmware kernel, loaded through RS232 using *Npar7loader.exe*.
2. Settings for a driver, loaded through CAN bus using *PgHardw.exe*.

3. Code to implement control logic, theoretical curves for optical crystals and other parameters, loaded through CAN bus using *PgSoftw.exe*.
4. OPG adjustment parameters, loaded using *PgSoftw.exe*.

Only the last layer is accessible for the end user.

Access levels

Different access levels are implemented in *PgSoftw* software. Developer (a name ‘constructor’ is used within the software) access level of *PgSoftw* software is used to design and debug firmware for the optical parametric generator system board. This task is performed by a manufacturer and is inaccessible for a user.

At a user (a name ‘adjuster’ is used within the software) level *PgSoftw* allows to perform adjustments and corrections within the ranges set at developer level.

This manual further describes using of *PgSoftw* software at a user level.

Storing the Data

All data used by firmware is stored in two locations – on a system board and on a PC in an associated file with *.OPG* extension. All changes are automatically stored in both locations. The name of a file and a path to it are stored on a system board, thus ensuring data safety in case one of the locations becomes inaccessible.

PgSoftw settings may be loaded either from the on-board storage (see **Get program from controller** below), or from the associated file (see **Open OPG** below). When settings are loaded from on-board storage, software looks for an associated file; if the file is not found, software asks for a new file name and/or path.

When settings are loaded from the file, after loading software checks all devices present in a CAN network for an associated OPG driver and then links that driver with settings.

It is recommended to always have at least one associated file in an easily accessible location on a PC.

Main window

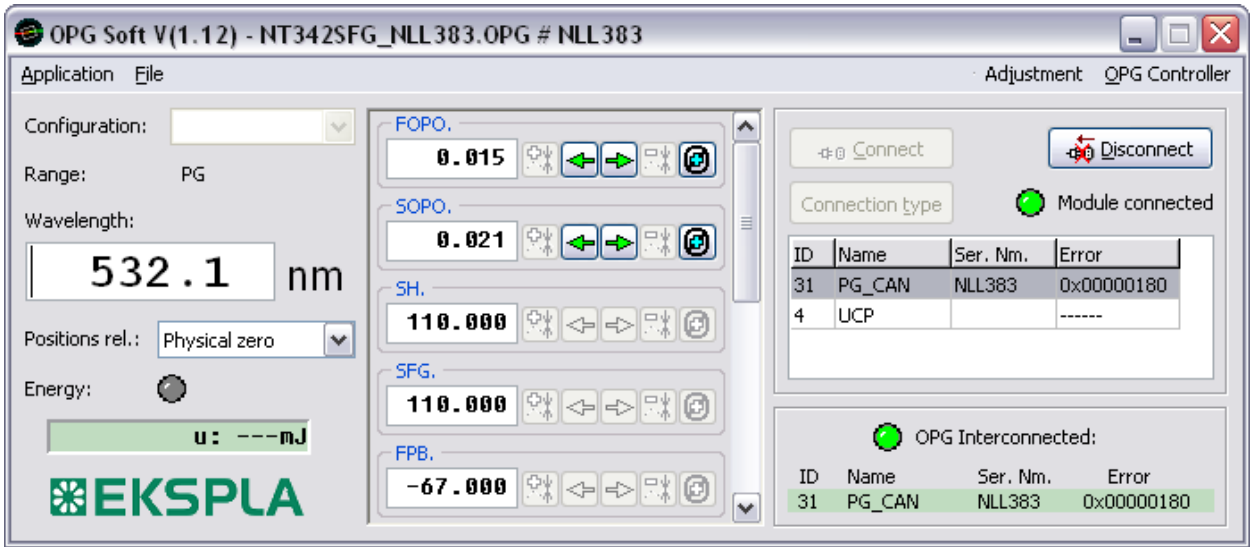


Figure 2 Main window. Names and number of controlled modules will vary depending on a specific device.

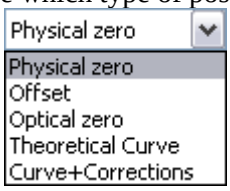
Controls in the main window:

Configuration. Some OPG's may have two or more possible configurations (different setups to generate parametric radiation at the same wavelength). As an example, PG401-DFG model has two configurations: GaSe and $AgGaS_2$.

Range. Indicates in what range OPG is operating at the moment. Ranges are named after a generating module and usually will have different combinations of steering optics, filters, etc. activated to allow different beam paths, etc.

Wavelength. A field to enter the desired wavelength.

Positions rel. A drop-down list to define which type of position will be entered.



Glossary

All components are positioned according to the table containing the wavelengths and corresponding positions of all stepper motors. Each motor has a certain pre-set calibration point called 'Optical "0" (zero)'.

The motors are positioned relative to a fixed 'physical zero'. Usually 'physical zero' (which is a characteristic of a motor) does not match the 'optical zero' (which is a characteristic of an optical element), as it is problematic to mount an element for both zero positions to match. Because of this, optical zero is defined as an offset from physical zero position.

Following variables and constants are used:

abs	Absolute position (relative to motor's Physical zero).
tab	Offset of the element relative to the optical zero when turning from optical zero wavelength to another. Values for various elements are determined by theoretical curve and stored during manufacturing.
cor	Correction value.
Opt'0'	Position of Optical zero (Offset from physical zero). Corresponds to pre-determined wavelength.
ofs	An additional offset.

Position relative to Physical zero, Optical zero, Theoretical Curve or Curve + Corrections may be chosen. Please note that a user can use positions relative to all possible reference points, but is able to edit optical zero position and corrections only. Other offsets and curves are set by a developer.

Physical zero	Absolute crystals positions relative to physical zero.
Offset	An additional offset, if needed. Usually used when two crystals are moved by the same motor.
Optical zero	Position relative to the Optical zero. Position = *abs – Opt'0'- ofs*
Theoretical Curve	Position for currently set wavelength relative to the value logged into table during manufacturing. Positions between logged points are extrapolated. Position = *abs – tab – Opt'0'- ofs*
Curve+Corrections	Position for currently set wavelength relative to the value logged into table during manufacturing with added corrections. Positions between corrections are extrapolated. Position = *abs – tab – Opt'0' – cor- ofs*

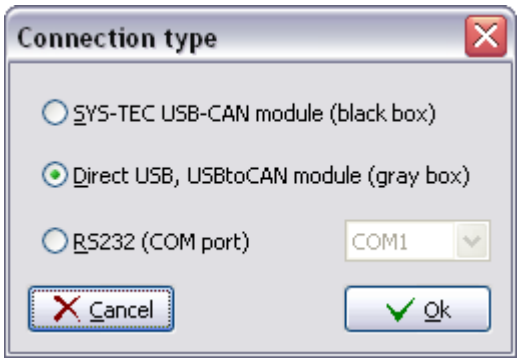
Energy. Energy level displayed in the same way as on a control pad. See laser system manual for a point at which the energy is measured.

Meanings of a color indicator: grey – no output, yellow – laser is operating, red – energy above the pre-set limit.

Connect. After pressing this button software will attempt to connect to OPG driver.

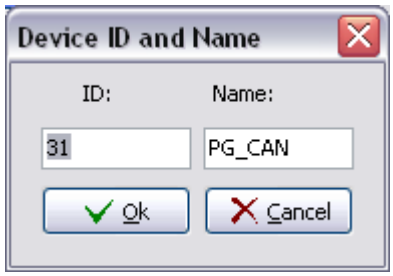
Disconnect. Disconnects the OPG driver.

Connection type. A window with radio buttons will appear, allowing setting the connection type.



Module connected. Green light indicates that module is successfully connected.

Device table. Table shows all connected units and their IDs. If the unit is an OPG driver, serial number and error code (if applicable) is shown in addition.



Select the specific unit by a single click. Activate it by pressing ENTER or double click to open a window with fields for Device ID and a name. ID and name can be changed. Changes for OPG driver are shown instantly; to see changes for some other devices may require their restart.

By selecting a unit and then using SPACE on a keyboard or right mouse click the device menu will be invoked:

Compatibility. See **Compatibility** below.

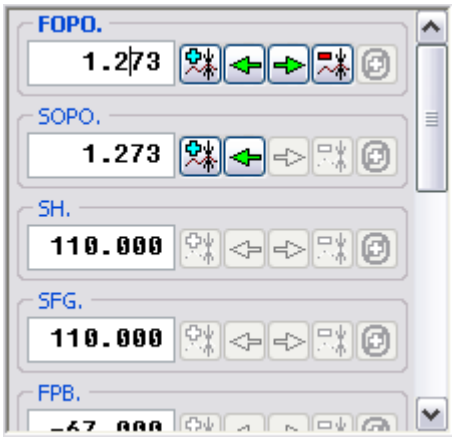
Interconnect. Driver is linked to software if possible.

Get program from controller. Loads program form on-board controller memory and looks for associated file. If associated file is not found, software asks for new path and/or name for a file.

OPG kernel version. Shows OPG kernel version number and amount of assigned flash memory. Also see **OPG Kernel version** below.

When OPG driver is successfully connected, the colored indicator is green and driver information is shown beneath.

In the middle of a window a motor information pane is shown. Various control devices are assumed as 'motors' in *PgSoftw*. For rotation stepper motors position is measured in degrees of arc; for linear motors – in millimeters. For temperature controllers a 'position' is measured in degrees Celsius.



Input Fields

Values can be entered into input fields in two ways – 'calculated' and 'incremental'. Input method is switched using SPACE on a keyboard or mouse middle button.

Maximum values for motor position are hard limited at ±500. Limits for wavelength values may vary from device to device. Button combination Ctrl+Tab provides a shortcut to move cursor from position input field to wavelength input field and vice versa.

Input field can be inactive when it is either in '*Idle*' or '*Disabled*' mode. Field is idle, when associated parameter has no meaning in current wavelength range; disabled fields are used for planned upgrades, when associated motor is planned but not implemented yet. Both modes are set by developer and cannot be changed by a user.

'Calculated' field input

Using this method values are entered directly numerically or by writing arithmetic expressions. The letter 'v' is used to indicate an old value in expression.

Examples:

Old value	Input line	Result
10.5	+1.5 or v+1.5	12
-4	v-3	-7
Anything	1+2*(10-8)	5

1	2^2/2-v*2	0
Anything	5+2*25^(1/2)	15

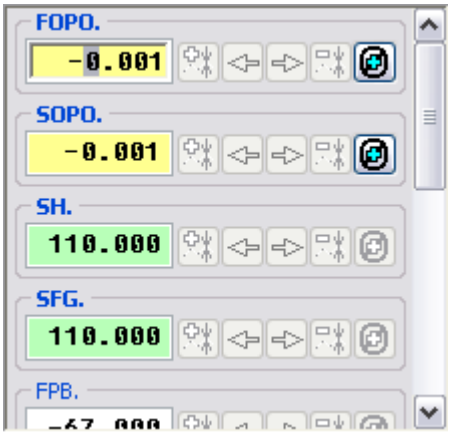
‘Incremental’ field input

In this mode an active digit may be incremented/decremented using up/down arrow keys on a keyboard or a mouse wheel. Active digit is selected using right/left arrow keys or a mouse left click. This mode is indicated by embossed look of an input field.

Linked motors

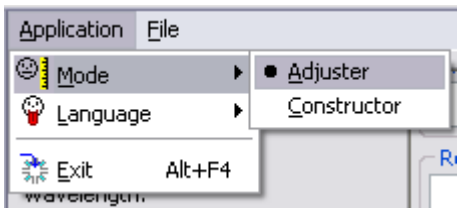
Some motors are intended to be controlled simultaneously, using the same curve. To ease input in this case their input fields may be linked, forming linked motor groups. Linking is done at developer level; user may activate linked input mode by pressing and holding Ctrl key or mouse right button. In this mode different linked groups are represented by input fields of different colours.

Only incremental entry method may be used in linked input mode. The active digit in selected field and corresponding digits in linked fields will be incremented/decremented simultaneously.



Main Menu

Application

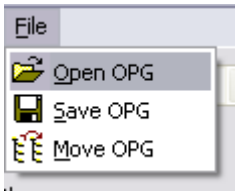


Mode. Switches between different access levels. A password is required to switch to developer (‘constructor’) level.

Language. Changes language of the user interface. Currently English or Lithuanian is supported.

Exit. Closes the program.

File

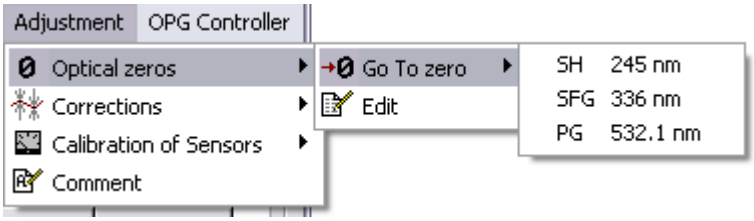


Open OPG. Open *.OPG* file.

Save OPG. Save *.OPG* file in emergency, when OPG driver is inaccessible. Under normal circumstances data is saved in on-board memory and *.OPG* file is created automatically.

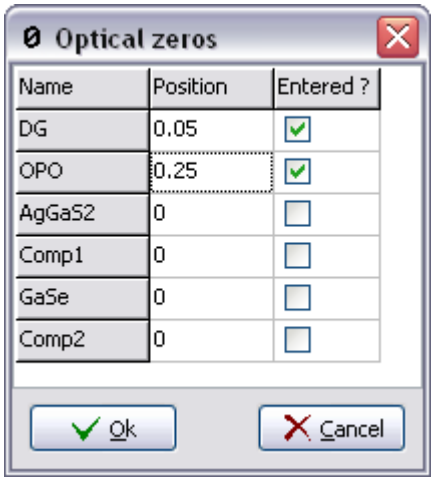
Move OPG. Move *.OPG* file to a new location and/or change its name. In this case it is necessary to program the driver afterwards to save the new location/name there as well.

Adjustment



Optical zeros

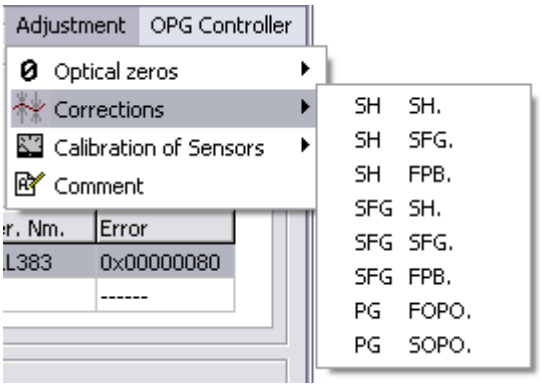
- **Go To zero**. Moves optic elements to positions designated as their optical zero for selected range. The wavelength corresponding to optical zero is set at developer level and cannot be changed by a user. Resulting position change is reflected in motor information pane.
- **Edit**. Opens a window to edit optical zero positions for various elements.



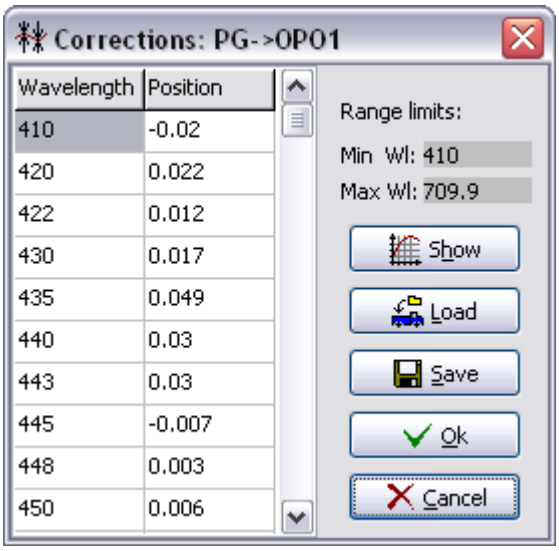
Checkbox *Entered ?* indicates that a position is stored and used. Another way to edit and store optical zero position is to use  button in a motor information pane.

Corrections

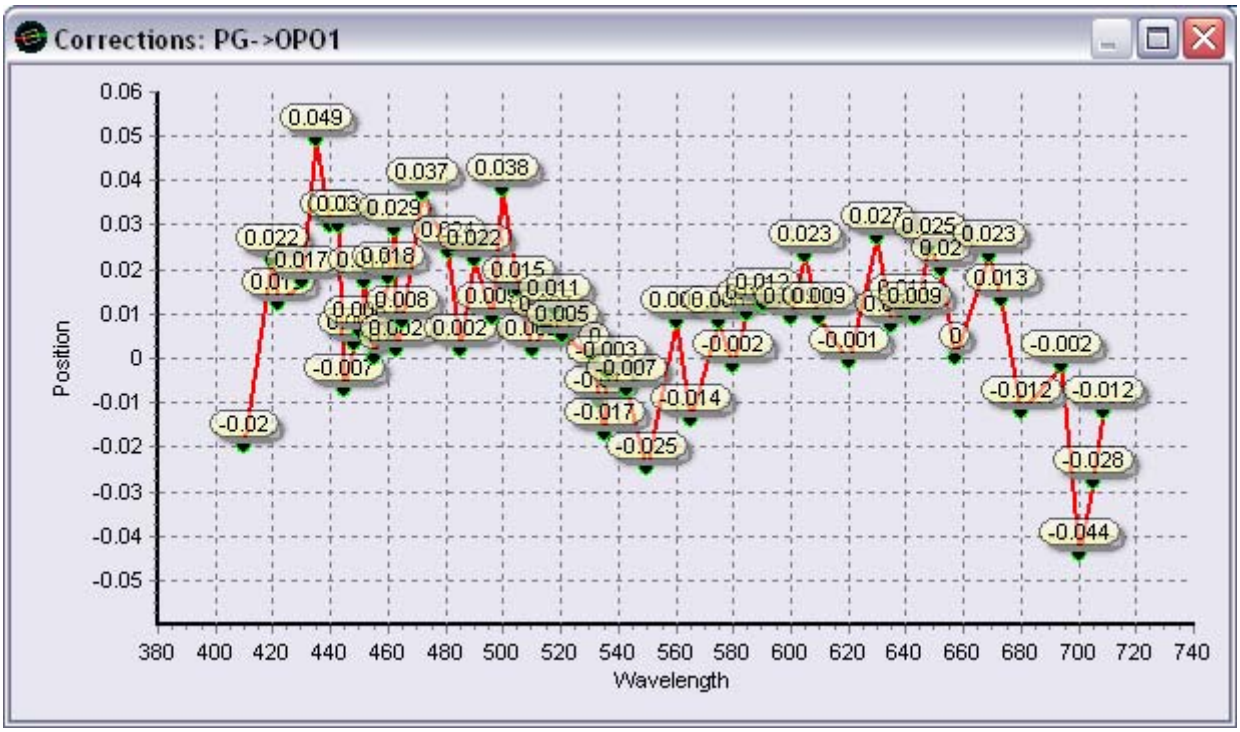
Opens a submenu to pick up combination of range and motor.



Combinations, as well as the names for ranges and their definitions in terms of wavelengths are set by developer and cannot be changed by a user. Pick the combination to open a *Corrections* window:



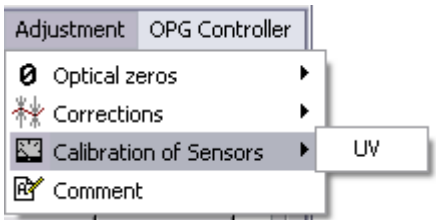
This window is used to edit correction values, to *Save* them as .csv file, to *Load* from .csv file. Pressing *Show* opens a separate graph window.



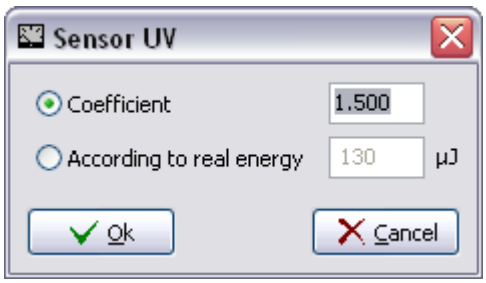
Numerical values are shown by pressing Alt+Ctrl. A region in a graph can be zoomed by selecting it with a mouse.

Calibration of Sensors

Pick the sensor from the submenu:



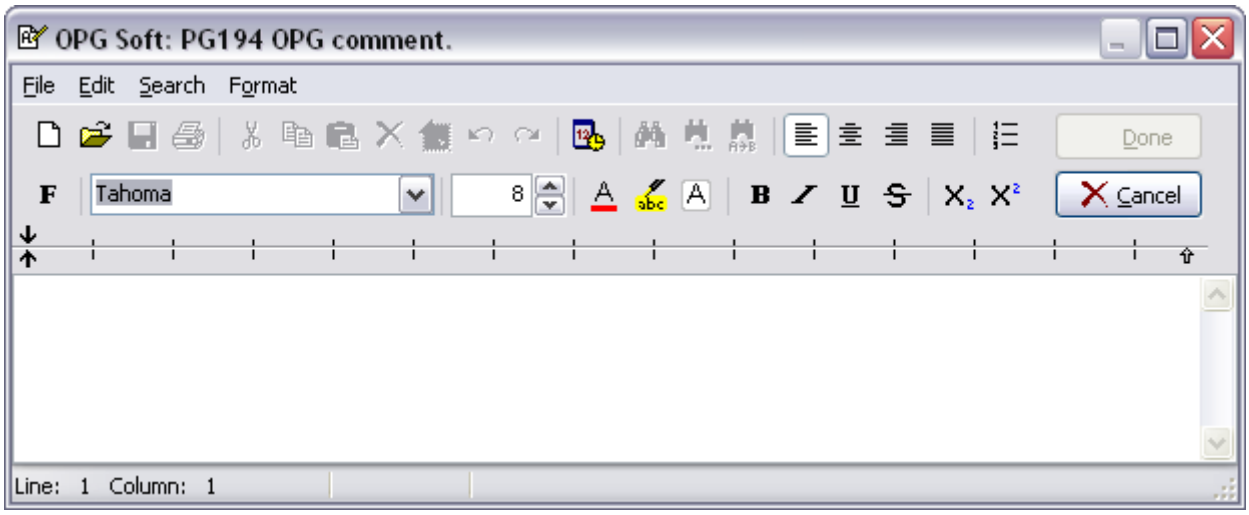
With the sensor chosen energy calibration window opens:



Energy calibration coefficient can be changed within a 1…2 range.

Another way to adjust calibration is using a real energy value, if it is known by other means. Activate *According to real energy* radio button to activate the corresponding input field and enter the energy. Calibration coefficient will be calculated and set automatically.

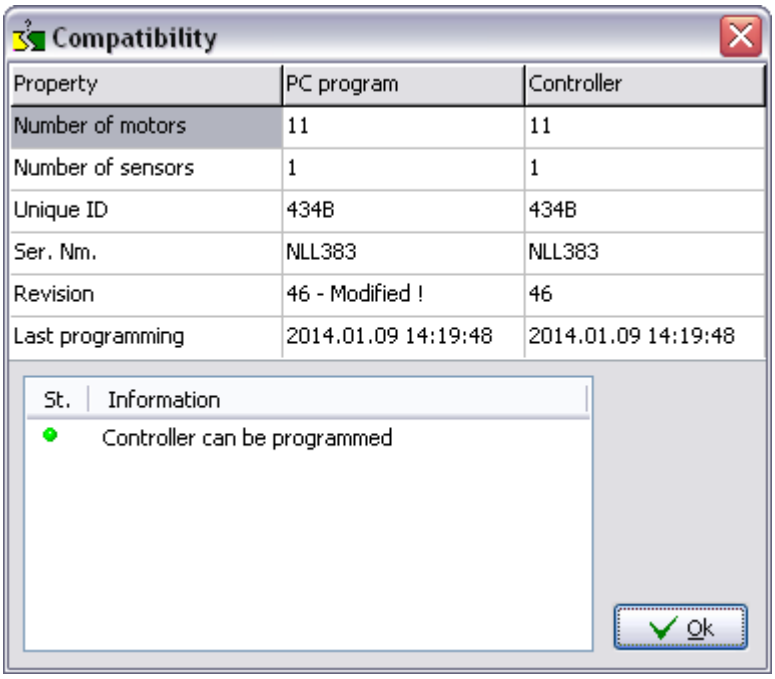
Comments



Comments window is used to edit and save comments (for example, notes about adjustments and changes).

OPG Controller

Compatibility

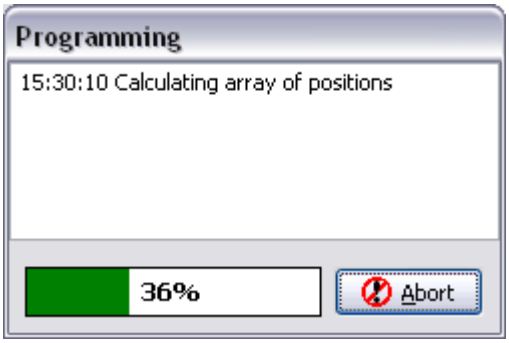


Opens a *Compatibility* window.

Main parameters of OPG driver and OPG software and their compatibility are shown in this window. Compatibility is indicated by green color indicator, warnings - by yellow, incompatibility – by red.

Program

If full compatibility exists and no warnings are shown, programming starts.



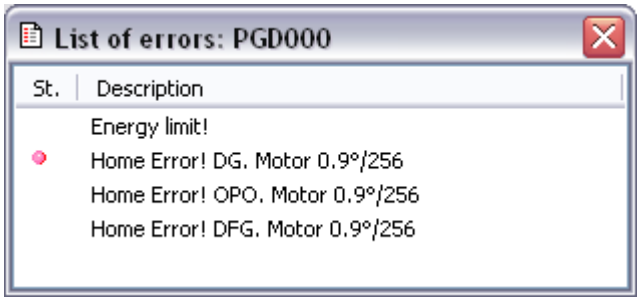
If warnings are discovered, *Compatibility* window opens to show them and for a user to confirm start of programming. In case there is no compatibility, *Compatibility* window opens to show incompatible parameters and programming is denied.

OPG Kernel version

Shows device serial number, OPG kernel version and amount of installed memory. OPG kernel is loaded through RS232 interface using *NPAR7Loader.exe* application. The name of OPG kernel software file is 'UniPG kernel V*X*.phy' where X stands for a version.

Error list

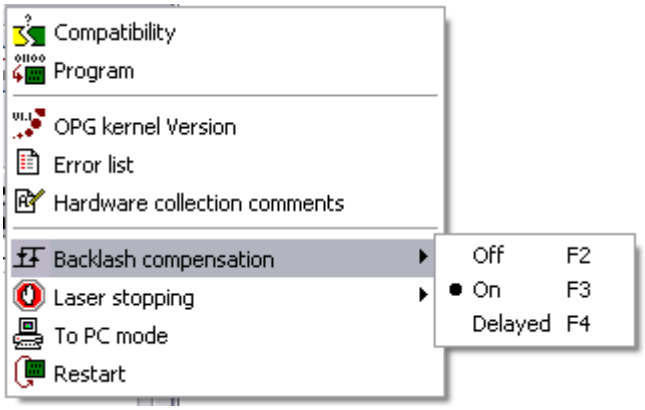
Shows window with a list of all possible errors. Red bullet indicates that the particular error is currently active.



Hardware collection comments

Comments about motor connecting, loaded from the driver. Read-only for a user.

Backlash compensation



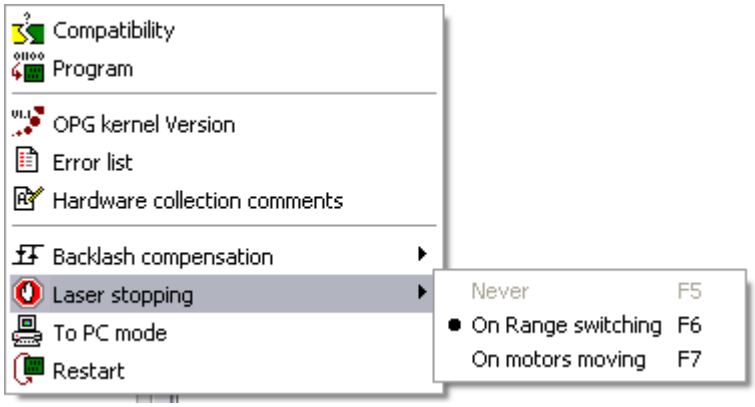
Sets backlash compensation mode. Backlash compensation may have different implementation for different motor types.

- **Off**. No backlash compensation.
- **On**. Backlash compensation is active and performed immediately for every move.

- **Delayed**. Backlash compensation is performed when motors have been idle for 0.8 s. Recommended when modifying motor positions using 'incremental' input to avoid excess motor movements.

Default mode is *On*.

Laser stopping



Sets mode for automatic stopping of a laser operation during motor movements. Possible options are to stop the laser only when changing range, or to stop during any motor movement (for example when changing the wavelength within the same range). Third mode, to never stop the laser, is unavailable for a user.

To PC mode

When in normal mode, OPG driver is controlled from control pad, using data stored in on-board controller. Making adjustments through PC at the same time may cause potential hardware conflicts. It is recommended to switch to *PC mode* while making adjustments through *PgSoftw* software. Switching back to normal mode is done by restart.

Restart

Resets the OPG driver software. Driver motors perform a fresh repositioning to find their zero positions; if the driver was in *PC mode*, it will switch to normal mode. Backslash compensation will be set to *On*.

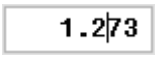
Routine operation

Start operation by loading OPG settings and connecting the driver. It is advised to calibrate the sensors first (see **Calibration of Sensors**).

While designated input windows exist for editing of optical zeroes (see **Optical zeros**) and corrections (see **Corrections**), another convenient way is to perform these operations in motor information pane of the main window.

A single motor information pane consists of:

Name of the motor.



Position input field.


Optical zero input button.


Correction input button.


Correction delete button.


Move to the previous correction point(at shorter wavelength).


Move to the next correction point (at longer wavelength).

Note:

Some or all control elements for selected optical elements may be inactive, dimmed and unavailable for a user; their status is set at developer level.

Adjusting starts from editing optical zeroes. Perform *Go to Zero*, then enter correction(s), if needed, and press the  button(s).

Start adjusting corrections. Set the desired wavelength, enter adjusted positions for motor(s) and press the  button(s). Repeat for other wavelengths as needed.

Changing corrections:

- Check and adjust optical zeroes (if needed).
- First adjust already existing correction points, or remove them, when needed.
- Insert new corrections only when neighboring corrections are already verified.

It is recommended to make notes about changes in the *Comments* window.

Do not forget to save the changes to board by performing *OPG Controller – Program*.

Attention:

All changes and adjustments should be attempted by a personnel with experience and understanding of principles of OPG functioning. In case of problems with PgSoftw software or with OPG in general, please contact EKSPLA service: service@ekspla.com