XLS-1 series Manual

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1. General notes

Important
Before using the XLS for the first time, please read this manual carefully. This manual contains additional information on handling and care.

Cleaning
Do not use any unsuitable cleaning agents, chemicals, grease/oil or techniques for cleaning. This could damage the surfaces and products could be contaminated by abraded particles. For vacuum and cleanroom applications, gloves are required to avoid contamination of the device during unpacking and installing the device.

Servicing
Repairs may only be carried out by Xeryon's trained service technicians. Only original Xeryon's spare parts may be used.

Authorised personnel
Please ensure that the XLS is installed and operated by authorized and trained personnel. All operators must have read and understood this user manual, and in particular the safety regulations.

Place of use
Avoid large temperature fluctuations, vibrations and shocks. These conditions can distort measurements and can even lead to a damaged stage.

Humidity and dust
Keep relative humidity limited to max. 80%. A higher relative humidity can damage the piezo(s) inside the stage. Keep the stage away from dust. Excessive dust may affect the integrated bearings.

Storage and transport
Use the original packaging for shipping or transporting the XLS. In order to prevent damage from vibrations and shocks, pack and lock all moving parts (according to this manual) in their original packaging and ship it appropriately. Store and transport the XLS in a closed container or plastic bag, free of dust and humidity. Add desiccant bag in closed container. Avoid excessive vibrations during transport. Storage temperature: 0 to +40 °C.

Environment & health
The external surfaces of the device do not contain hazardous materials for human health or the environment. Inside the device however, PZT is present. The electronics are RoHs compatible.

Do not throw in the garbage bin. Dispose of in a responsible matter, according to local legal regulations

2. Introduction

Congratulations on purchasing the XLS linear stage. The XLS is designed for the translation of loads up to 1 kg with high accuracy and repeatability. The XLS is comprised of an ultrasonic piezo motor and an accurate optical encoder. This allows a closed loop control of small samples with high accuracy and a long term stability.

The XLS, shown in Fig. 1, is a high-precision piezo-driven linear stage which can be used in a wide range of applications. The precision bearings guarantee very accurate motion. The integrated encoder provides 78.125 nm (P) or 312.5 nm (S) resolution.

Remark: do not load the stage with a mass or force higher than 1 kg. This can damage the stage. The stage can carefully be moved by hand without harming the device.

Figure 1: XLS-1 – 50.

The XLS is equipped with a male D-sub 15 HD connector. The pin layout of the XLS is described in the table below.

PIN #	SIGNAL	PIN #	SIGNAL
1	/	9	Encoder error
2	Encoder power (5V)	10	Ground piezo 1 & 2
3	Encoder ground	11	I - *
4	Piezo 2	12	A - *
5	Piezo 1	13	B - *
6	Index	14	/
7	A +	15	/
8	B +		

Table 1: Pin layout D-sub 15 HD connector

* The standard encoder is single ended and doesn't use the I- , A-, and B- signal.

Remark:

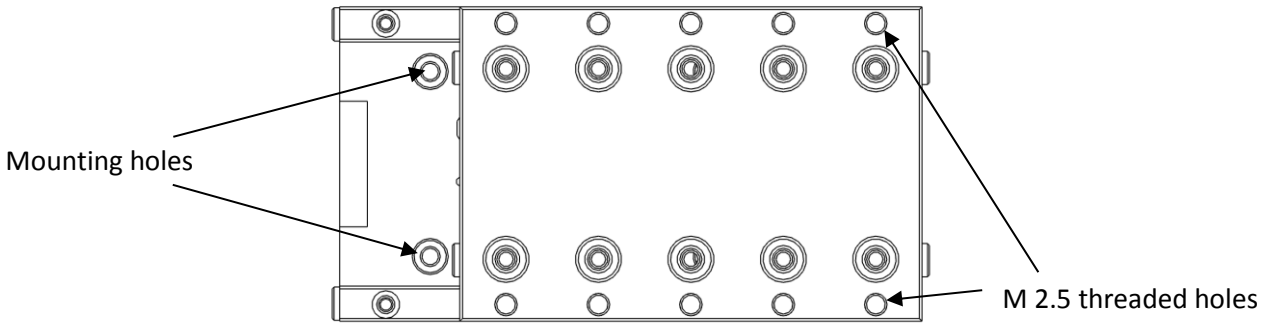
Be careful to avoid that the voltage intended for the piezo is applied to any of the encoder wires as this will almost certainly destroy the encoder. The piezo acts as an electrical capacitor and can hold a substantial charge. Discharge the piezo using a suitable resistor.

3. Installation

1. Unpack the stage carefully.

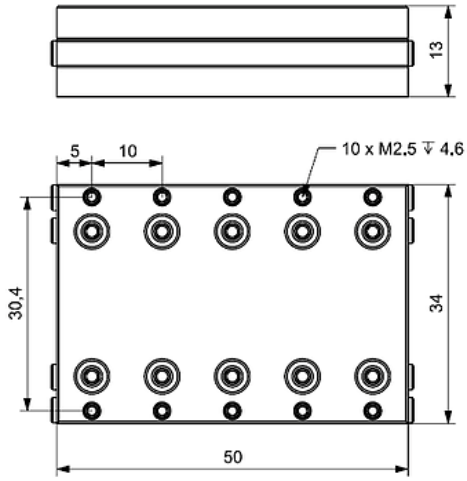
2. Put the stage on a clean and flat surface. Avoid any shock on the stage. The mounting surface must have a flatness ≤ 0.05 mm to ensure a proper functioning and to prevent damage to the stage.

3. Fix the stage via the four mounting holes (M1.6) in the bottom plate. One can reach these mounting holes by moving the top plate to its outer positions (left and right). The stage must be fixed rigidly to ensure proper functioning. The stage cannot be used against gravity force.



4. Mount your sample or object on the top plate via the M2.5 threaded holes. Avoid any shock or load higher than 1 kg on the stage. Overcome excessive forces on the stage while screwing your load on top of the stage.

   <u>Remark:</u> the M2.5 screws may not be screwed deeper than 4 mm into the top plate. Screwing in more deeply may damage the bearings.



5. Connect the D-sub 15 HD connector of the stage to stage connector on the back panel of the XD-U or XD-C piezo driver of Xeryon.

6. To control the XLS, connect a USB cable or RS-232 cable to the corresponding port on the XD-U or XD-C (only USB) piezo driver and the computer.

7. Connect the power cord to a grounded socket and the corresponding port on the piezo driver.

Remark:

It is recommended to use the XD-U or XD-C for driving the XLS. If the XLS is driven with any other driver, Xeryon cannot guarantee a proper functioning and cannot be held responsible for any damage caused to the stage.

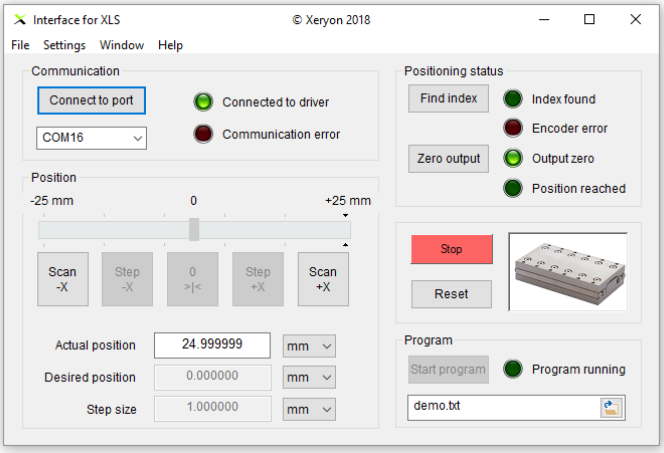
4. Windows interface

1. Switch on the XD-U driver using the on/off button (green button at the front panel). The green LED will blink when the driver is powered. The XD-C has no on/off button. The XD-C is automatically powered when the power plug is connected to the driver.

2. Install the driver installation files and start the windows interface “Xeryon_Dialog.exe”. The windows interface will look like the figure below[1].

3. Select the port number in the drop down box and click on the “Connect to port” button.

4. The green LED “Connected to driver” should light up now. When the LED does not light up it means that the computer is not connected with the driver. In this case, one cannot go to the next step. Please reconnect the computer with the driver and repeat the steps described above until the green LED “Connected to driver” lights up.



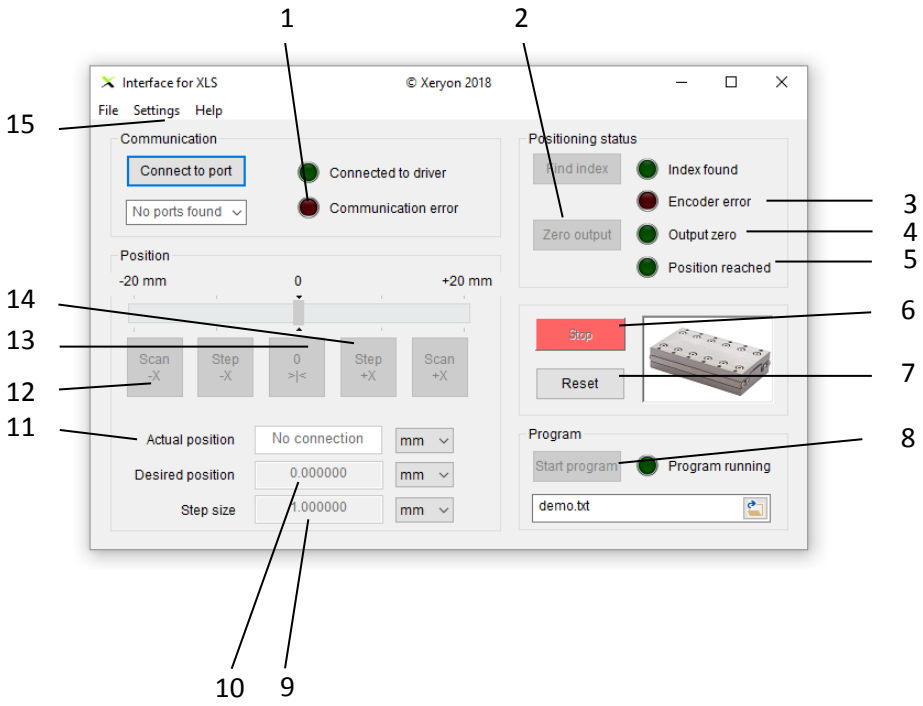
5. Click “Find index”. The stage will automatically search for the index and stop on the index position. The green LED “Index found” will light up when the index is found.

6. The driver and stage are now configured and ready to use.

Remark: the translation speed of the stage can be changed by altering the speed in the Settings menu.

[1] Some of the buttons may be disabled when you start the windows interface. Please follow the next steps to configure the driver. This will enable all buttons.

Function of buttons and status displays:



1 Communication error between the computer and driver.

2 Zero output: the voltage to the piezo motor will be set to zero.

3 Encoder error. Please contact Xeryon's customer service for assistance.

4 The voltage to the piezo motor is zero.

5 The "position reached" LED will light up when the desired position is reached.

6 The stage will stop moving when you click the "Stop" button.

7 Reset the settings and driver.

8 Run automatically the selected program. The green LED "Program running" will light up when the program is running. Via the browse button, one can search and select the program that is being executed (.txt file). Remark: the ASCII commandos to write the program are described in the manual of the driver.

9 Set the step size when you press the "Step -X" and "Step +X" button.

10 Set the desired position.

11 Actual position of the stage.

12 The stage will continuously move in the -X direction.

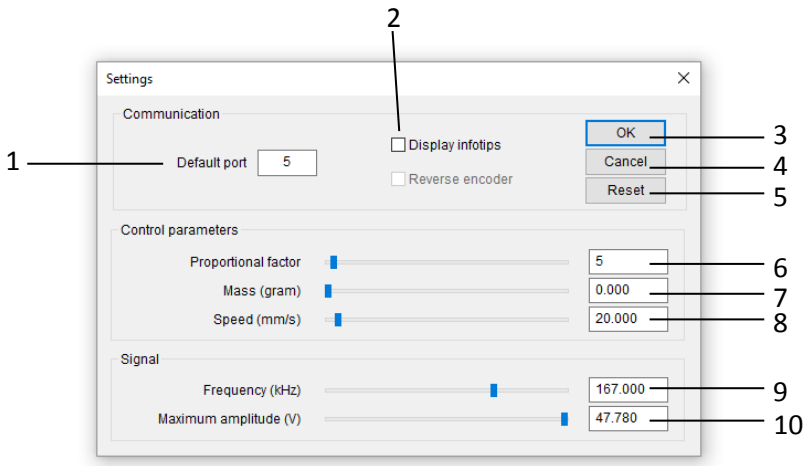
13 Move to the index position.

14 Step in the +X direction with the step size defined in #9.

15 Settings button:

- Load default settings: load the default settings from the "settings_default.txt" file
- Load from file: select a file to load your own user settings
- Edit: open the settings window (see below)
- Save to file: save the settings to a file you select

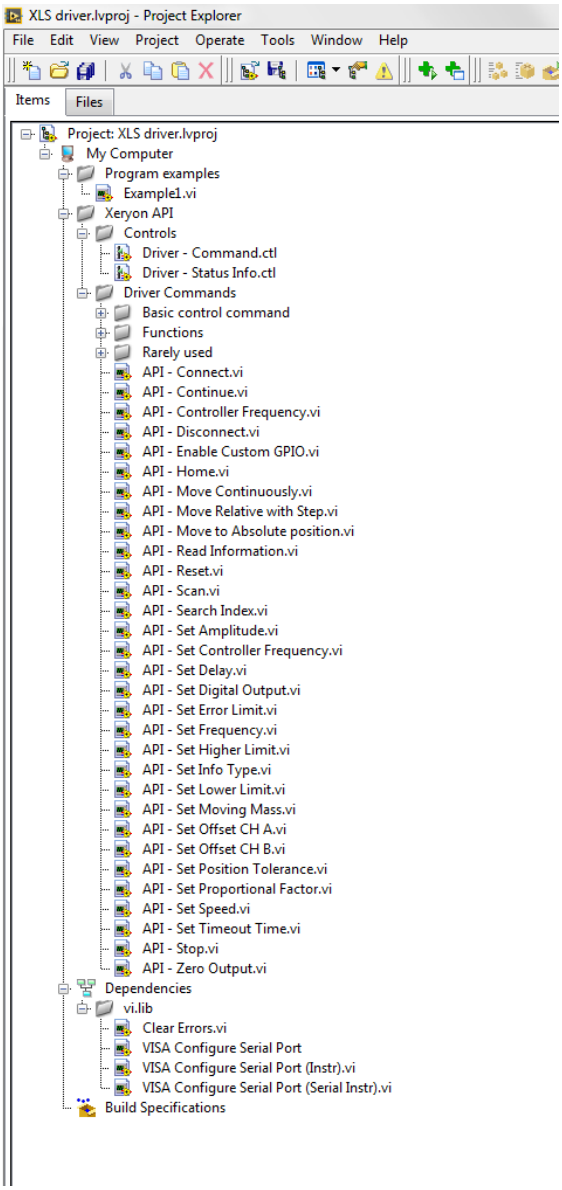
Settings window:



1. Set the default communication port number
2. Display info balloons when you hover over a button or text box
3. Close the settings window and keep the (adapted) settings. The settings will not be saved or overwritten in the settings file.
4. Close the settings windows and reject all changes.
5. Reset to the original settings.
6. Set the proportional control factor.
7. Set the mass of the external load on top of the stage to obtain a stable control.
8. Set the speed.
9. Set the excitation frequency of the piezo motor (typically between 166 en 168 kHz).
10. Set the maximum voltage for excitation of the piezo motor.

5. LabVIEW interface

1. Open LabVIEW project XLS driver.lvproj[2]. The project tree folder contains the following items and sub-folders:



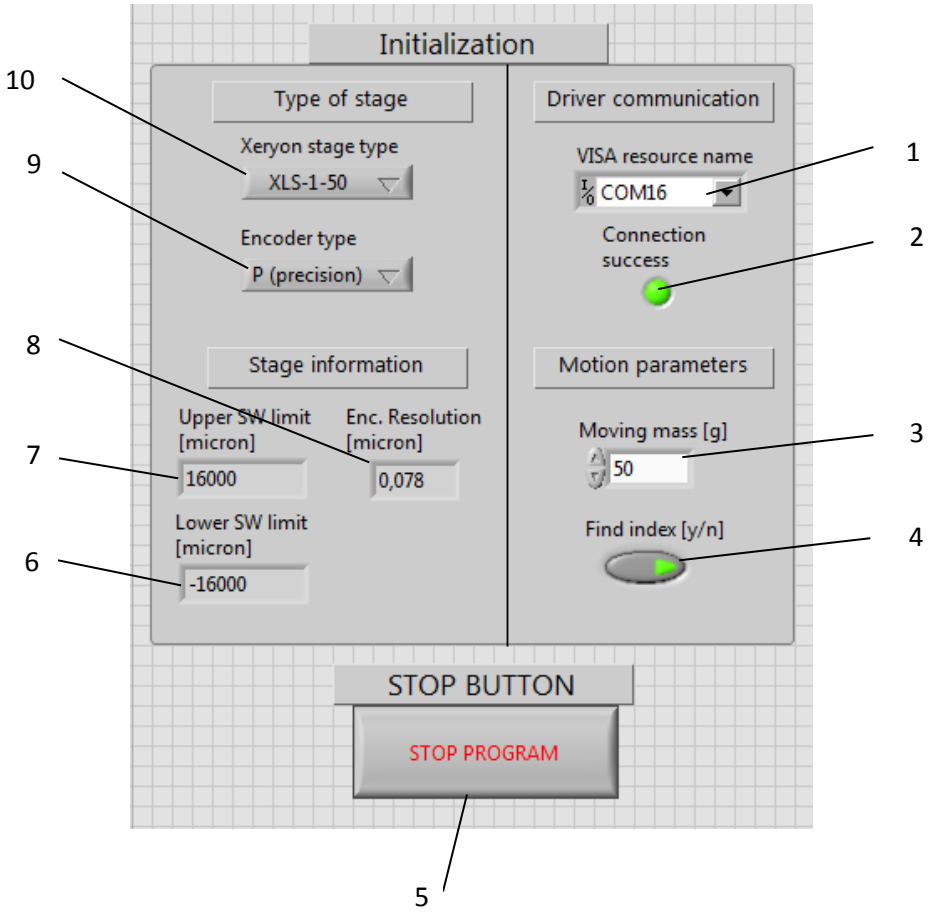
   One can use all the individual .vi's to make your own program. **More information about the individual functions can be found in the manual of the purchased driver.** A useful exemplary program is given in Example1.vi and the use of it is explained below.

2. Switch on the XD-U driver using the on/off button (green button at the front panel). The green LED will blink when the driver is powered. The XD-C driver is automatically switched on when powered.
3. Open Example1.vi to test the driver functionality. The interface can be divided into four different sections.

[2] This requires LabVIEW 2014 or a newer edition of the software.

a. Section 1 is the part about Initialization of the driver

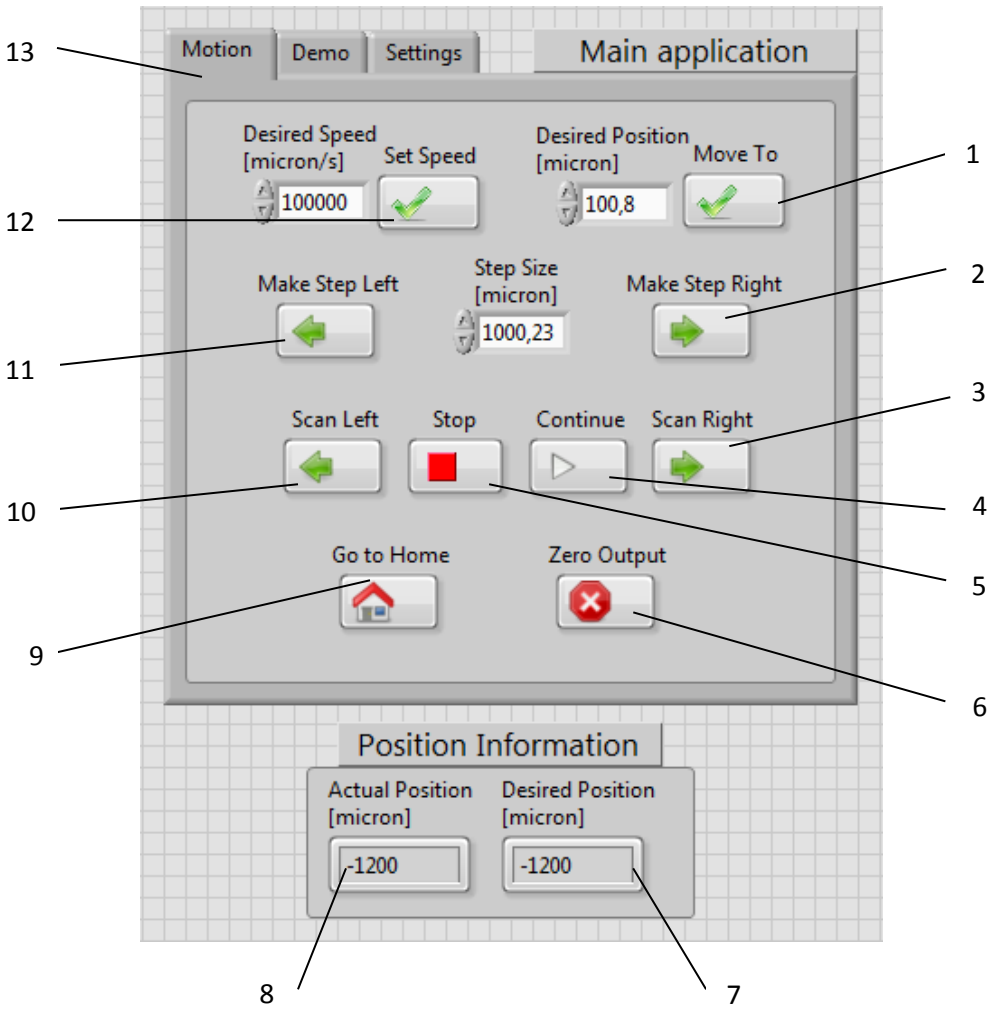
Function of buttons and status displays:



1. Select the correct communication port number (use refresh).
2. Indicates whether connection with communication port is successful.
3. Set the total moving mass, of the external load on the stage, to obtain stable control.
4. Select when you want the stage to search the encoder index of the stage. This is needed when power was shutdown previously.
5. STOP button of LabVIEW program. When using this button, the LabVIEW program will stop running and the driver will be disconnected.
6. Indicating the standard lower limit of the stage (implemented in software). First select the stage type.
7. Indicating the standard upper limit of the stage (implemented in software).
8. Indicating the resolution of the encoder. First select the encoder type.
9. Select the type of encoder
10. Select the type of linear stage

b. Section 2 is the part about the main application of the example.
This part shows three tabs: 'Motion', 'Demo' and 'Settings'.

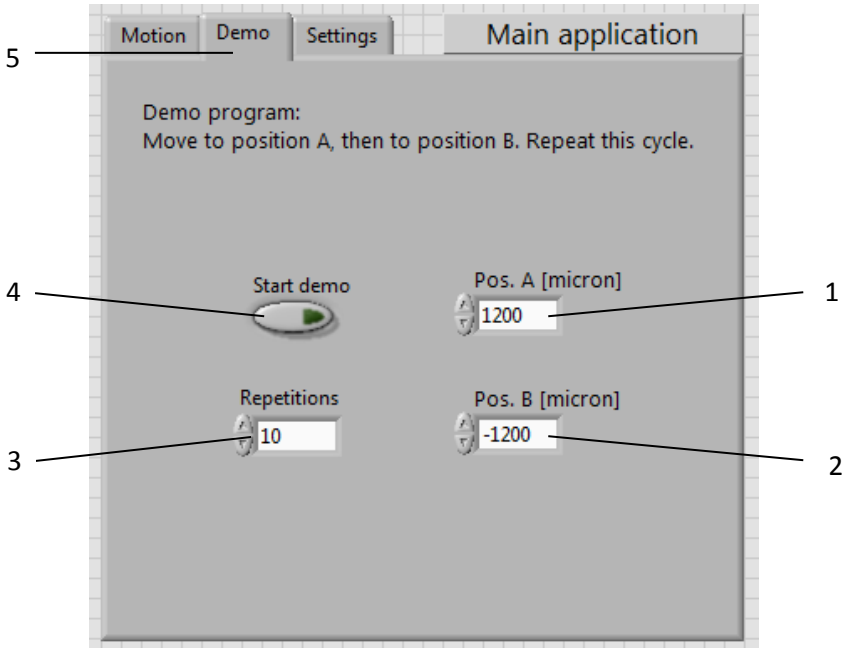
➔ The motion tab shows the following settings:



Function of buttons and status displays:

1. Choose the absolute position to move to and hit the button to start the motion.
2. Perform a step to the right side, with designated step size.
3. Perform scanning motion to the right side.
4. Continue the motion (after being stopped previously).
5. Stop the stage from moving.
6. Zero output: the voltage to the piezo motor will be set to zero.
7. Indicates the desired position.
8. Indicates the actual position of the stage.
9. Move to home (or index) position.
10. Perform scanning motion to the left side.
11. Perform a step to the left side, with designated step size.
12. Set the speed to the chosen value.
13. Motion tab

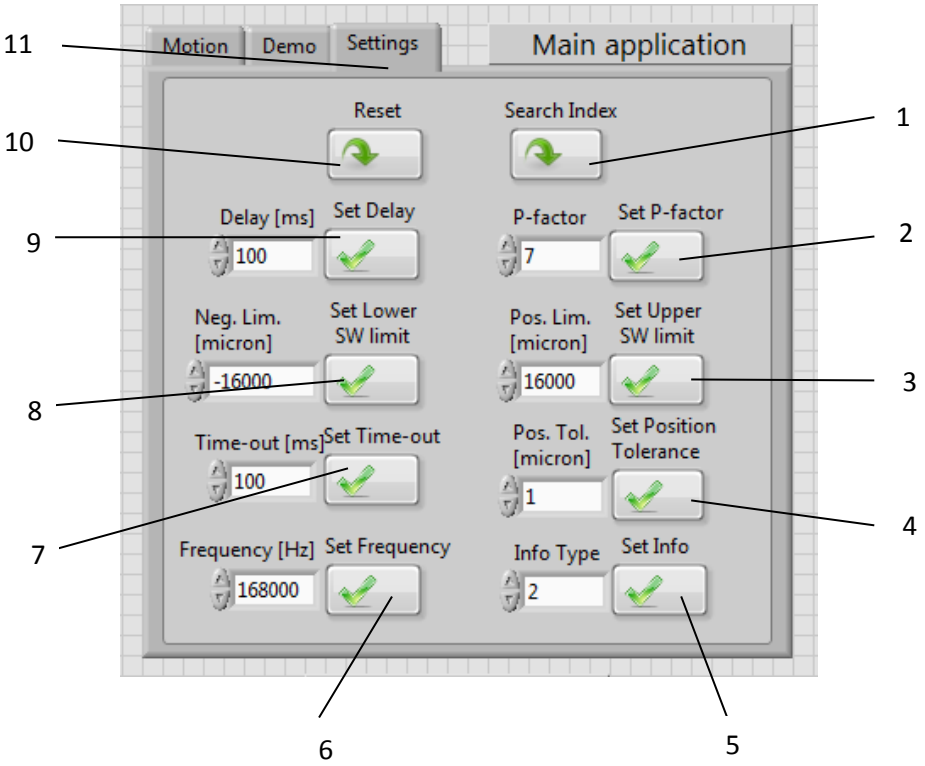
➔ The demo tab shows the parameters of a basic demo program, as explained below: This demo is programmed to perform a back-and-forth movement from position A to position B, which is repeated for several times.



Function of buttons and status displays:

1. Choose position A
2. Choose position B
3. Choose amount of repetitions
4. Hit start to start the demo
5. Demo tab

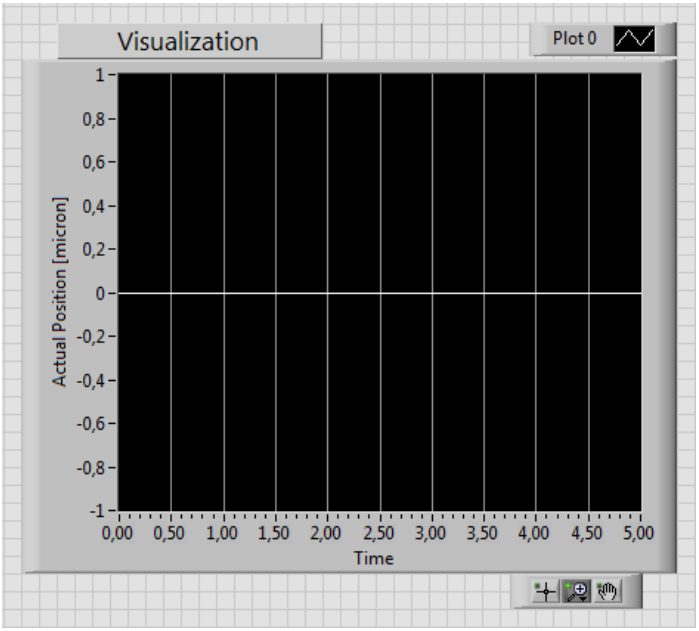
➔ The Settings tab shows all the (advanced) stage and driver settings.



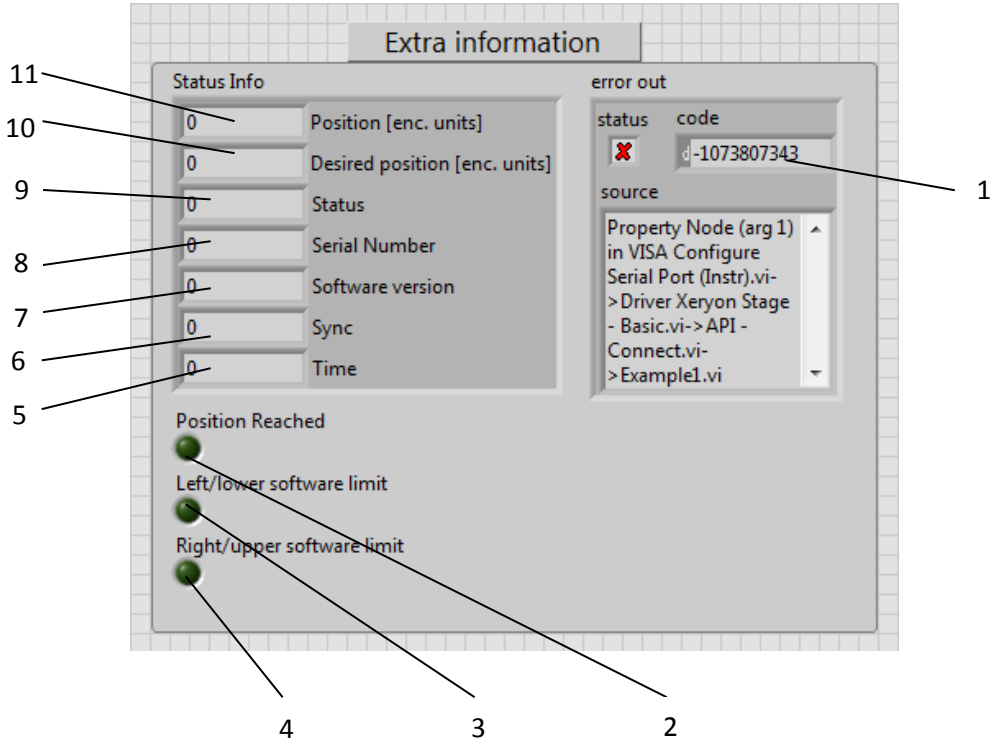
Function of buttons and status displays:

1. Go and find the index of the stage.
2. Set proportional factor for position control.
3. Set upper software limit position.
4. Set position tolerance.
5. Set info type
6. Set piezo motor operation frequency
7. Set time-out time, after which the stage will stop to be controlled to the desired position tolerance
8. Set lower software limit position.
9. Set delay time, this is the delay after which the position reached signal becomes high

c. Section 3 shows the position of the stage over time, shown in a chart.



d. Section 4 shows extra information about the status of the stage and driver



Function of buttons and status displays:

1. Indicator of LabVIEW error.
2. LED indicator that shows if the desired position is reached.
3. LED indicator that shows if the upper software position limit has been passed.
4. LED indicator that shows if the lower software position limit has been passed.
5. Time information, returned from driver, which can be used for position logging purposes
6. Synchronization info (used for communication debugging)
7. Software version installed on the driver
8. Serial number of the driver (hardware)
9. Status word of driver
10. Desired position
11. Actual encoder position

6. Specifications and dimensions

Parameter	Specification
Load capacity	< 10 N (1 kg)
Encoder resolution	78.125 nm (P) or 312.5 nm (S)
Dimensions	30 - 120 x 34 x 13 mm
Stroke	18 – 92 mm
Velocity	Several µm/s up to 100 mm/s
Lift force	~ 1 N
Blocking force	~ 1 N
Operating voltage	0 – 48 V (XD-U) / 30 V (XD-C)
Operating temperature	+10 to +30 °C
Operating pressure	Ambient pressure or vacuum[3] (10-6 mbar)

<u>Remark:</u> the M2.5 screws may not be screwed deeper than 4 mm into the top plate. Screwing in more deeply may damage the bearings.

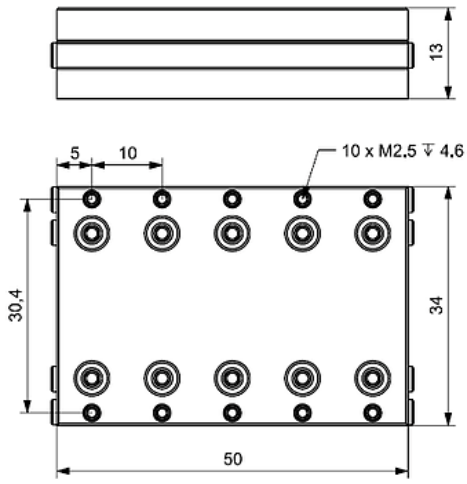


Figure 2: Dimensions of the XLS-1 50.

[3] Only for the HV-version.

7. DON'Ts

- Do not disassemble the stage.
- Do not soak the device in any fluid, not for cleaning, not for lubrication, not for whatever reason.
- Do not lubricate the stage with oil or grease.
- Do not overload the stage.
- Do not move or slide your sample or object over the top plate of the stage without lifting the load. Overcome excessive forces on the stage while screwing bolts in the stage.
- Do not drill holes or mill features in the stage. You would probably damage the device by either touching the internal components or by chips and dust entering the bearing. Instead, take contact with Xeryon's customer service.
- Do not apply negative voltages to the piezo motor.

Contact Xeryon's customer service when you have any question regarding the proper use of the stage.

8. Trouble shooting

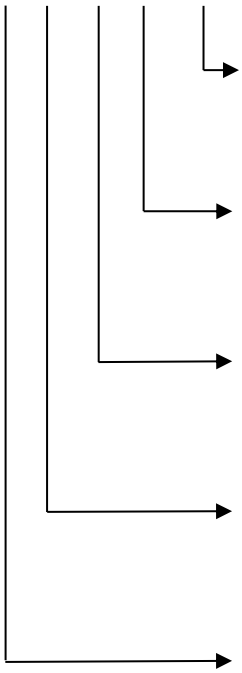
When experiencing problems with the XLS, the following trouble shooting tips may help. If the problem persists, please contact Xeryon's customer service.

- Device makes noise.
  Very low noise is inherent to the operation of this actuator. However, no scratching noises should be heard. In that case, contact Xeryon's customer service.
- Motor does not respond, no motion.
  Check the driver and wiring to the piezo stage.
  Remark: the piezo may still be charged. Discharge the piezo over a resistor prior to the measurement.
- Stage moves but encoder does not produce any output.
  Check wiring to and from encoder. Check presence of A/B encoder signals with a scope (or multimeter).
- Rotor rotates, but encoder does produce unreliable or erratic output.
  Check wiring to and from encoder. Check A/B encoder signals with a scope. In case of noise, shield cable from electromagnetic interference, and/or employ filtering on A/B signals.
- Erratic motion or instable behaviour.
  Change the proportional factor and mass in the settings window until a stable control is achieved.

Tip: To verify the operation of the encoder, the stage can be moved manually.

9. Ordering code

XLS -1 - 30 - S – PB– A – NM (example code)



Material option:
- NM: non-magnetic
- NA: non-anodized

Atmosphere:
- A: normal atmosphere
- HV: high vacuum (10^{-6} mbar)

Bearing accuracy:
- PB: precision bearings
- HPB: high precision bearings

Sensor resolution:
- S: 312.5 nm
- P: 78.125 nm

Stage length:
- 30, 40, 50, 60, 70, 80, 100, 120

10. Customer service

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Website: www.xeryon.com