A745E

EDH0259En1040 – 01/26

User's Manual

XPS-DRVP1

Driver Board for XPS Controller and Piezoelectric Stages

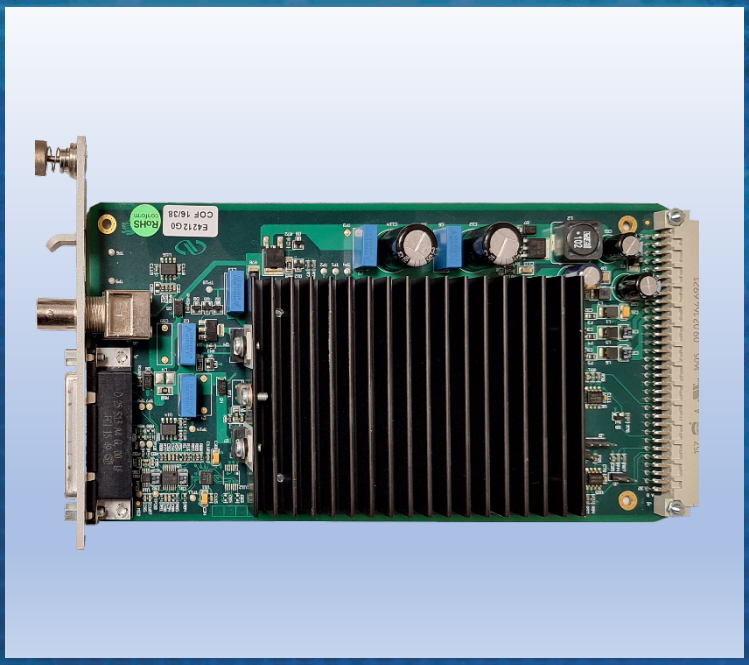

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Table of Contents

1 Warranty

MKS Instruments, Inc. warrants that this product will be free from defects in material and workmanship and will comply with MKS published specifications at the time of sale for a period of one year from date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at MKS option.

To exercise this warranty, write or call your local MKS office or representative. You will be given prompt assistance and return instructions. Send the product, freight prepaid, to the indicated service facility. Repairs will be made, and the instrument returned freight prepaid. Repaired products are warranted for the remainder of the original warranty period or 90 days, whichever occurs last.

LIMITATION OF WARRANTY

The above warranties do not apply to products which have been repaired or modified without MKS written approval, or products subjected to unusual physical, thermal or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling.

CAUTION

Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - **With a non-Newport XPS controller.**
  - **Improper connection and grounding.**
    - **Connectors must be properly secured.**
    - **Use of extension cables.**
    - **When the load on the stage presents an electrical risk, it must be connected to ground.**
- **Modification of the board or any part therein.**

CAUTION

Please return equipment in the original (or equivalent) packaging.
You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR USE. MKS INSTRUMENTS, Inc. SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM THE PURCHASE OR USE OF ITS PRODUCTS.

2 Preface

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MKS shall retain full ownership of Intellectual Property Rights in and to all development, process, align or assembly technologies developed and other derivative work that may be developed by MKS. Customer shall not challenge, or cause any third party to challenge, the rights of MKS.

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Customer shall protect the MKS Instruments, Inc. Programs and Related Materials as trade secrets of MKS and shall devote its best efforts to ensure that all its personnel protect the MKS Programs as trade secrets of MKS. Customer shall not at any time disclose MKS trade secrets to any other person, firm, organization, or employee that does not need (consistent with Customer's right of use hereunder) to obtain access to the MKS Programs and Related Materials. These restrictions shall not apply to information (1) generally known to the public or obtainable from public sources; (2) readily apparent from the keyboard operations, visual display, or output reports of the Programs; (3) previously in the possession of Customer or subsequently developed or acquired without reliance on the MKS Programs; or (4) approved by MKS for release without restriction.

SERVICE INFORMATION

The user should not attempt any maintenance or service of the present product and its accessories beyond the procedures outlined in this manual. Any problem that cannot be resolved should be referred to MKS I Newport. When calling MKS I Newport regarding a problem, please provide the Tech Support representative with the following information:

- Your contact information.
- System serial number or original order number.
- Description of problem.
- Environment in which the system is used.
- State of the system before the problem.
- Frequency and repeatability of problems.
- Can the product continue to operate with this problem?
- Can you identify anything that may have caused the problem?

MKS | NEWPORT RMA PROCEDURES

Any product being returned to MKS I Newport must have been assigned an RMA number by Newport. Assignment of the RMA requires the item serial number.

PACKAGING

Materials being returned under an RMA must be securely packaged for shipment. If possible, reuse the original factory packaging.

3 Safety Information

3.1 Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety related issues occur.

3.1.1 General Warning or Caution

The Exclamation Symbol may appear in Warning and Caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

3.1.2 Electric Shock

The Electrical Shock Symbol may appear on labels affixed to the product.

This symbol indicates a hazard arising from dangerous voltage. Any mishandling could result in irreparable damage to the equipment, in personal injury, or death.

3.1.3 European Union CE Mark

The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

3.1.1 United Kingdom Conformity Assessed Mark

The presence of the UKCA Mark on Newport equipment means that it has been designed, tested and certified as complying with all applicable United Kingdom's regulations and recommendations.

CAUTION

This board is designed to be used ONLY inside a Newport XPS controller.
Proper installation procedure must be followed to ensure CE Mark compliance.

3.2 General Warnings and Cautions

Definitions of, **NOTE**, **CAUTION**, **WARNING** and **DANGER** messages used throughout the manual.

NOTE	**The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.**
CAUTION	**The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.**
WARNING	**The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition, on the like, which, if not correctly performed or adhered to, could result in injury to personnel.**
DANGER	**The DANGER sign Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**

3.3 Warnings

WARNING

Do not attempt to modify this board; this may cause an electrical shock or downgrade its performance.

WARNING

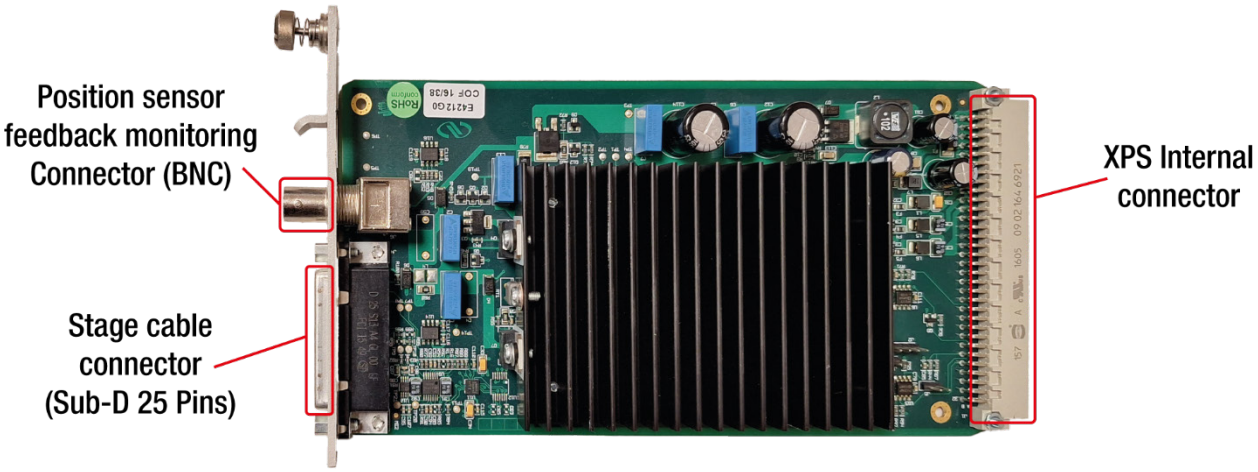
This product, like all microcontroller products, uses semiconductors that can be damaged by electrostatic discharge (ESD).
When handling, care must be taken so that the devices are not damaged.
Damage due to inappropriate handling is not covered by the warranty.

3.4 Cautions

CAUTION	**As Newport piezoelectric stages might include flexure mechanisms with limited load capacity, do not move the moving part of the stage manually.**
CAUTION	**Do not disconnect the stage cable when the XPS controller is powered ON.**

4 Introduction

This manual describes the operating instructions for the XPS-DRVP1driver board.



XPS-DRVP1 Driver board.

Newport "XPS-DRVP1" driver board has been specially designed to provide POWERFUL and SIMPLE CONTROL, through XPS controller, of Newport stages motorized by piezoelectric actuators from the following series:

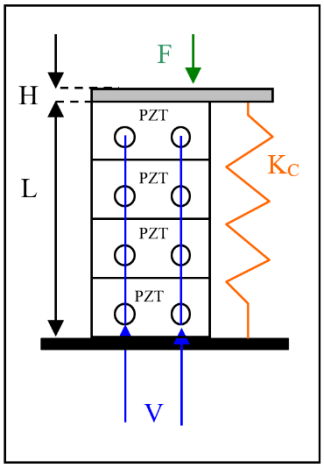
NPA, NPM, NPO, NPX, NPXY, NPXY and PSM.

NOTE	**You must read the section "Installing the XPS-DRVP1 in the XPS controller" carefully before attempting to use the XPS-DRVP1 driver board.**

5 Overview of piezoelectric technology

5.1 Actuator principle

A piezoelectric actuator is made of crystals (PZT: Lead Zirconate Titanate) having three properties:



- It expands whenever a voltage is applied at the ends.
  The crystal expands linearly to the voltage applied, which can be up to ~100V:
  $\Delta L = KE * V$ (K_E = crystal expansion coefficient in µm/V).
- It shrinks whenever a force is applied on it.
  The compression of the crystal also follows a linear law depending on the applied force:
  $\Delta L = F / K_C$ (K_C = crystal stiffness in N/µm represented by the springing the figure beside).
- It has hysteresis (H)
  Under the same conditions of input voltage and force applied, an actuator does not go back to the exact same size.
  Consequently, the length of the crystal depends on the voltage and on the force applied.
  This expansion being relatively small (ΔL = ~ 0.1% L), several crystals can be stacked and wired in parallel to obtain longer travel ranges.

NOTE **The piezoelectric principle is reversible by applying a force to this crystal; it creates a voltage difference between the ends.**

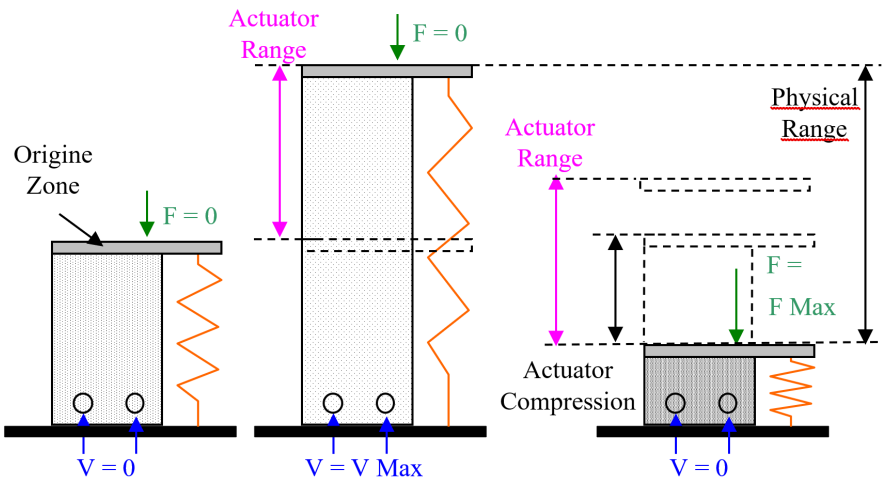
5.2 Actuator travel range

Without being powered, and without any force applied, a piezoelectric actuator rests in an equilibrium region called **Origin zone**.

When applying the maximum voltage, the actuator reaches its maximum expansion called the **Actuator Range**

Without being powered and applying the maximum force permissible, the actuator reaches its maximum compression called the **Actuator Compression**

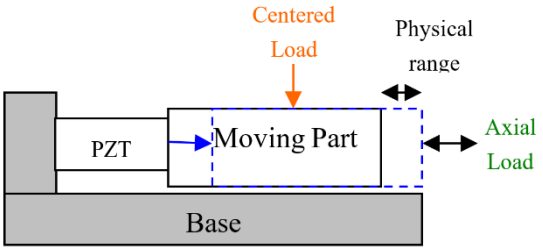
The sum of **Actuator range** and **Actuator compression** is called the **Physical Range**



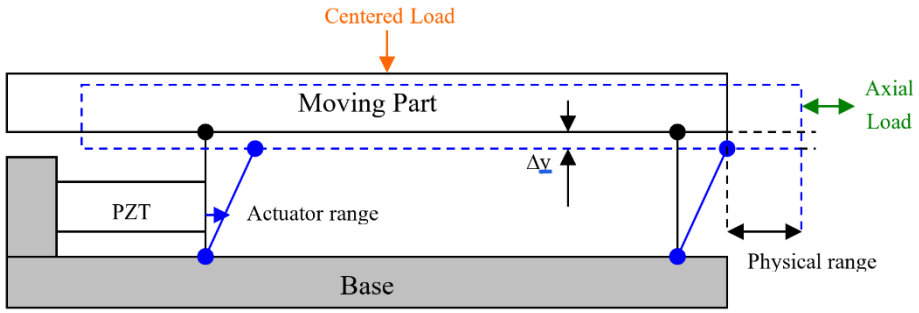
5.3 Piezoelectric Stages

Two types of stages use piezoelectric actuators:

- **Direct**: No mechanism is added, the crystal directly "pushes" the moving part (i.e.: actuator)



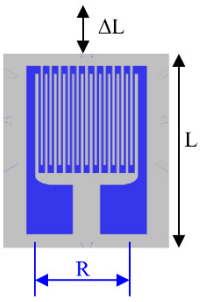
- **Amplified**: the crystal pushes the mobile part decoupled from the base by flexures. The motion can be amplified by lever arms shown below (i.e.: NPX stages)



NOTE **The design of the stage mechanism is important to minimize the motion in the orthogonal dimension (Δy) which can be neglected.**

5.4 Position sensors

Stages can be equipped with position sensors of the "strain gauge" type which is made of thin metallic conductors (few µm thick) placed on a non-conductive material.

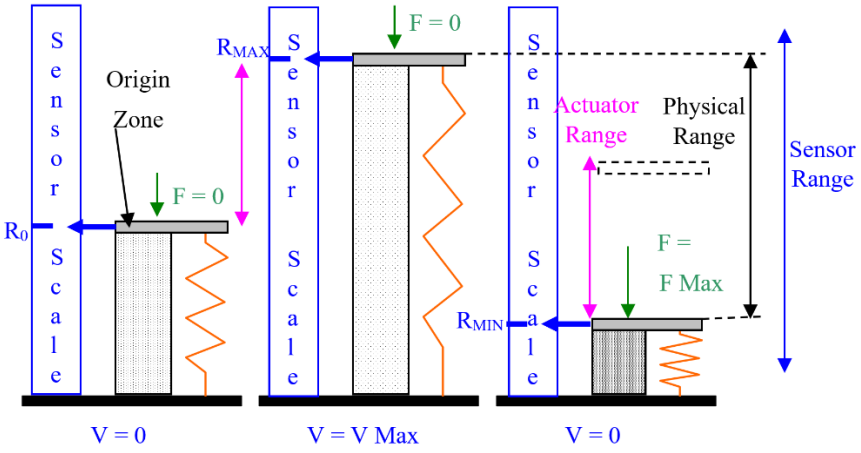


Expansion of the conductors changes electrical resistance following a linear law:

($\Delta R / R = K_j * \Delta L / L$)

The relative displacement measured at the strain gauge is directly proportional to the stage mobile part displacement and so provides position information.

The sensor's range is greater than the full physical range of the stage.



5.5 Piezoelectric technology pros and cons

Stages using piezoelectric technology usually have a relatively **small footprint** and offer **high sensitivity** (nanometer level) combined with **fast motion** (frequency of several hundred Hertz for actuators).

Position can be controlled simply in **open loop** by providing a voltage to the actuator (~0 to 100V), but **hysteresis** can reach up to 10% of the range.

"**Direct**" type of stages offers a **short range** (few hundred microns) with **high axial load capacity** (several tens of kilograms) and good axial stiffness (several tens of N/µm)

"**Amplified**" type of stages offers longer range but drastically reduced axial load capacity (kilogram level) and axial stiffness (N/µm level).

Stages equipped with **position sensors** allow **hysteresis compensation** but **require close loop control** mode.

Higher **absolute accuracy** can be obtained but requires **stage calibration** using an external device.

6 Newport solution advantages

Newport piezoelectric actuators and stages controlled through the XPS controller and the XPS-DRVP1 driver board provide simple efficient solutions for a wide variety of applications from fast positioning with high resolution to fast signal tracking and to true high resolution/accuracy absolute positioning.

All Newport piezoelectric stages are tested and calibrated in the factory. Calibration parameters like piezoelectric actuator input voltage range, stage range, sensor (if present) position and resolution, etc. are stored into the stage's EEPROM.

During initialization, the XPS controller and the XPS-DRVP1 driver boards read these parameters and automatically configure the axis for optimum control (open / close loop, resolution, range, etc.)

The stage can then be used like any motorized stage with origin position, software limits, relative and absolute moves, etc.

XPS-DRVP1 driver board also features position sensor feedback analog signal output providing precise stage real position information. See section Description/Use of "BNC" output

Newport solution also allows sensor calibration to improve the stage absolute accuracy. See section Accuracy linear correction procedure

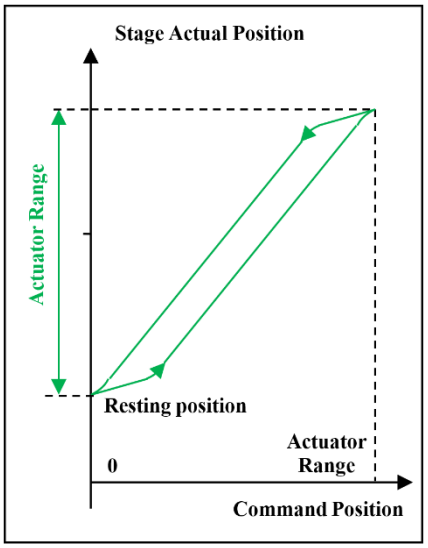
6.1 Control loops

After power-on and during initialization, the XPS controller through the XPS-DRVP1 driver board reads the parameters from the connected stage and sets the corresponding control loop type:

- Without sensor (i.e. NPX400-D, NPXY200-D, etc.): **Open loop** control
- With sensor (i.e. NPX400SG-D, NPXY200SG-D, etc.): **Close loop** control

6.1.1 Open loop

In the case of stages without sensors, an open loop control is used and the XPS-DRVP1 board generates a voltage to control the actuator proportional to the theoretically desired position.



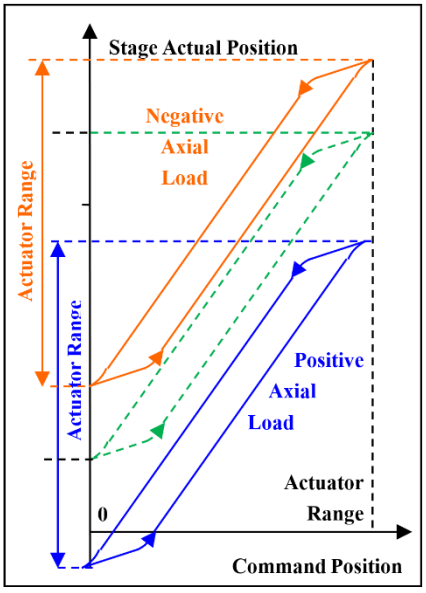
Operators can use the XPS control range set from **0 to Actuator range**.

The actuator moves between positions:
"**Resting position**" (V=0) and
"**Resting position + actuator range**" (=V_{Max})".

However, the stage's actual position will be affected by the intrinsic hysteresis shown in Figure 1.

Figure 1 : Open loop, without axial load

If an axial load is initially applied to the stage, the actuator shrinks (or expands accordingly).



The actuator's resting position is shifted (up or down).

The operator still issues a command via the XPS to a position between **0 and the Actuator range**.

The actuator moves between positions:
"**New resting position**" (V=0) and
"**New resting position + actuator range**"
(V=V_{Max}), (Figure 2).

Figure 2 : Boucle ouverte avec charge

WARNING

DO NOT OVERLOAD THE STAGE. If the axial load exceeds the maximal permissible load of the actuator, the available travel range will be reduced, and the stage might even be damaged.

6.1.2 Close loop control

For stages equipped with a strain gauge sensor, the XPS controller and XPS-DRVP1 board allow true absolute positioning by generating the necessary voltage to the actuator to maintain the desired absolute position based on the sensor scale.

At power-on and during initialization, the **stage usable range**, corresponding control voltage, sensor origin and current positions are read from the stage EEPROM and are used to set the necessary driver board closed loop parameters and also the **XPS control range** at 80% of the open loop **actuator range.**

As described in the Actuator travel range section, modifying the stage axial load will shift the actual stage travel range within its physical range. Three cases can be considered:

- **Without any axial load** a Newport piezoelectric stage resting position is very close to its sensor origin position and the Default configuration can be used.
- **With a small variation of the axial load** the resting position is slightly shifted causing a stage Usable range limitation.
- **In the case of a high axial load**, although the actuator range is shifted along the sensor absolute scale and the usable range is reduced, the XPS controller allows Full range recovery and maintains the same origin. This is done by setting the "**DriverStagePositionOffset" (DSPO) parameter**.

Default configuration

By default, the "DriverStagePositionOffset" (D_{SPO}) parameter is set to 0.

The XPS command "0" position is set to correspond to the stage origin position

The XPS control range is set to 80% of the actuator range and **software limits are placed at:**

"0" and "control range" values.

Operators can use the XPS control range set from **"0"** to **"Control range".**

The actuator moves between positions: **"Origin"** and **"Origin + Usable range"**.

The actual position of the stage will not be affected by the hysteresis of the actuator (Figure 3).

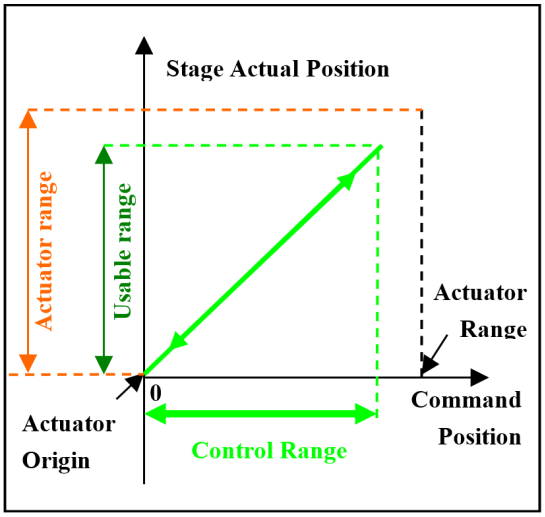


Figure 3 : Close loop default configuration

NOTE

Relatively small axial load variations will not affect the actual position as the close loop control will compensate for actuator shrinking.
However, after an axial load variation, when disabling the control loop, the stage may drift to its new resting position and "jump" back to the command position when the loop is re-enabled.
A larger axial load variation may also reduce the usable range (see below)

Usable range limitation

In case of axial load variation, the piezoelectric actuator will shrink (or expand). The stage resting position is shifted along the sensor scale (i.e. to position -X). The actuator range is now from "-X" to "Actuator range-X"

The control command range remains from "**0**" to "**Control range**" (limited by software limits).

Operator can only control the stage from "**0**" to "**Actuator range -X**". Trying to move above "actuator range -X" will generate an error.

So, the usable range is limited (figure 4)

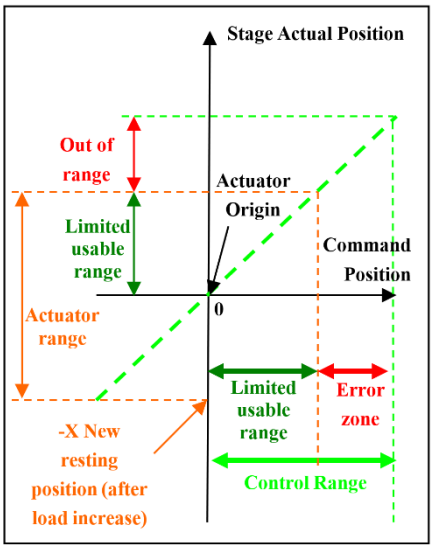


Figure 4 : Close loop with limited range

NOTE **When disabling the control loop, the stage drifts to its new resting position and "jump" back to the command position when the loop is re-enabled.**

Full range recovery

During initialization, the XPS software limits are in fact placed at "D_{SPO}" ("DriverStagePositionOffset") and "D_{SPO} + control range" values. Giving the D_{SPO} parameter the value corresponding to the resting position under axial load allows full range recovery as described below:

Under some axial load, the stage resting position is shifted along the sensor scale (i.e. to position "-X").

The **actuator range** is now from "**-X**" to "**Actuator range-X**"

With "D_{SPO}" set at "-X", the control **command range** is now set from "**–X**" to "**Control range -X**" (software limits).

Operators can control the stage on its full **usable range** again from "**–X**" to "**Control range -X**"

The XPS "0" position still corresponds to the same stage physical origin position. (Figure 5)

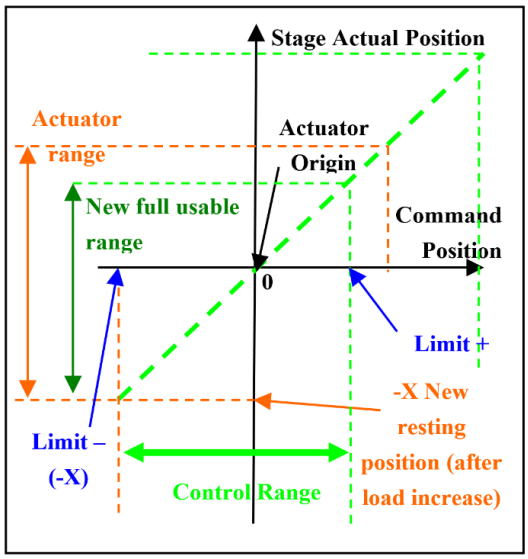


Figure 5 : Close loop after full range recovery

To modify D_{SPO} parameter, refer to the section Offset adjustment procedure.

CAUTION

DO NOT OVERLOAD THE STAGE. If the axial load exceeds the maximal permissible load of the actuator, the available travel range will be reduced and the stage might even be damaged.

7 Specifications

7.1 XPS-DRVP1 Compatibility and Functional Description

Newport "XPS-DRVP1" driver board has been specially designed to drive the following Newport piezoelectric actuators and stages:

Stage Series	Without Position Sensor	With Position Sensor
NPA	NPA25-D	NPA25SG-D
	NPA50-D	NPA50SG-D
	NPA100-D	NPA100SG-D
NPM	NPM140-D	NPM140SG-D
NPO	NPO140-D NPO250-D	NPO140SG-D NPO250SG-D
NPX	NPX200-D NPX400-D	NPX200SG-D NPX400SG-D
NPXY	NPXY100-D NPXY200-D	NPXY100SG-D NPXY200SG-D
NPXYZ	NPXYZ100-D	NPXYZ100SG-D
PSM	PSM2-D	PSM2SG-D

Figure 6 : XPS-DRVP1 compatibility list

NOTE **Check the Newport website for any updates to this list.**

After installation in the XPS controller, the XPS-DRVP1 board allows:

- Automatic reading of stages parameters (stored during final testing in the factory)
- Automatic setting of control loop type (open or closed loop)
- Ensuring absolute positioning of the stage under different axial loads due to its Range shifting function
- Providing voltage information relative to the sensor position (if present in the stage) through "BNC" connector

7.2 XPS-DRVP1 Specifications

Parameters	Specifications
Output Voltage	-10V, + 130 V
Resolution	< 10 mV
Max. Output Current	60mA
BNC Output voltage	0 – 10V
Internal Frequency	2 kHz

Figure 7 : XPS-DRVP1 Specifications

8 Starting up

8.1 Installing the XPS-DRVP1 in the XPS controller

WARNING

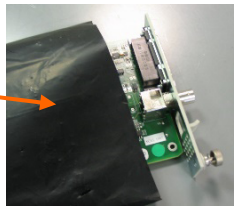
Do not open the protective conductive packaging until you have read the following and are at an approved anti-static workstation.
Use a conductive wrist strap attached to a good earth ground.
Always turn the controller's power OFF before installing a board.
Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD - sensitive electronic component.
Use an approved anti-static mat to cover your work surface.

To install XPS-DRVP1 driver board in XPS controller, proceed as follows:

- Select an available slot and remove the corresponding plate (1 screw)

NOTE **When used with XPS-D or XPS-RLD, plug XPS-DRVP1 into slots other than slot 1.**

- Remove the board from its package by holding it by the rear plate (avoid touching the printed circuit)



- Insert the board in the slot and tighten the blocking screw

8.2 Stage connection

WARNING

Always turn the controller's power OFF before connecting to a stage.

Connect the 25-pin, male Sub-D connector to the XPS-DRVP1 driver board terminal.

WARNING **All Newport products are provided with standard cable length. The use of extension cable is not recommended as it might result in the degradation of your product performance.**

8.3 Powering up

After installing the XPS-DRVP1 board, the XPS controller can now be powered on. However, the presence of this new board requires updating the XPS controller initialization file "system.ini" and requires to be logged to the XPS website as an "Administrator".

Then, after the correct parameter setting, the axis (driver board + stage without axial load) can be initialized.

Finally, in case of a stage equipped with position sensor, verify the behavior of the axis depending on the axial load place on the stage.

8.3.1 XPS Controller

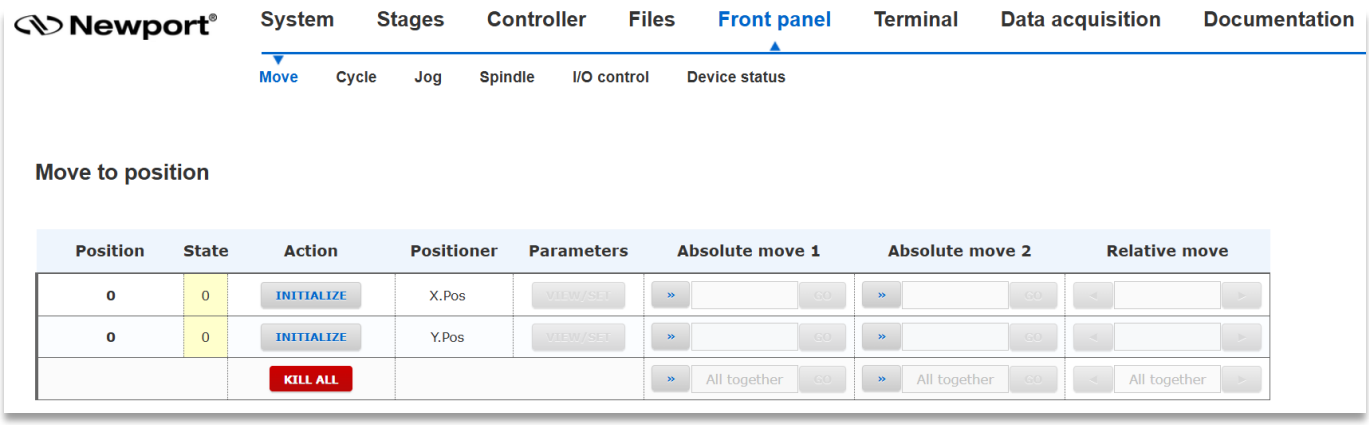
For instructions on how to update "system.ini" initialization file, refers to XPS Configuration Manual. (See also the File <<System.ini>> section for "system.ini" file example)

NOTE

If the new driver board and/or the stage are not automatically detected, the XPS firmware might need to be updated manually. Refer to section «Controller – Firmware Update» of the XPS "User Interface Manual".
Latest XPS firmware package can be downloaded from https://www.newport.com/

At the end of start up procedure, the XPS controller has recognized the driver board and the stage.

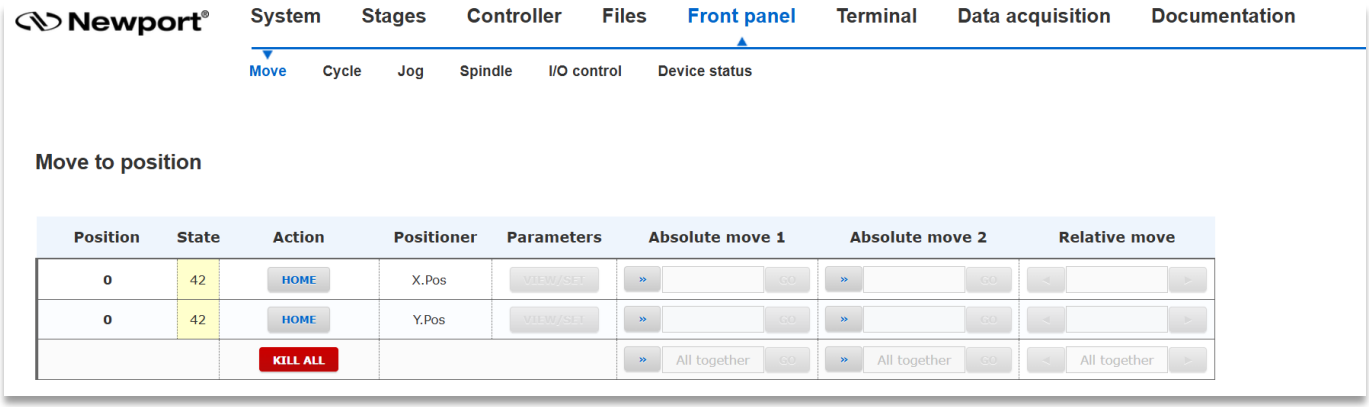
Example of the XPS **Front panel / Move** page



8.3.1 Axis initialization

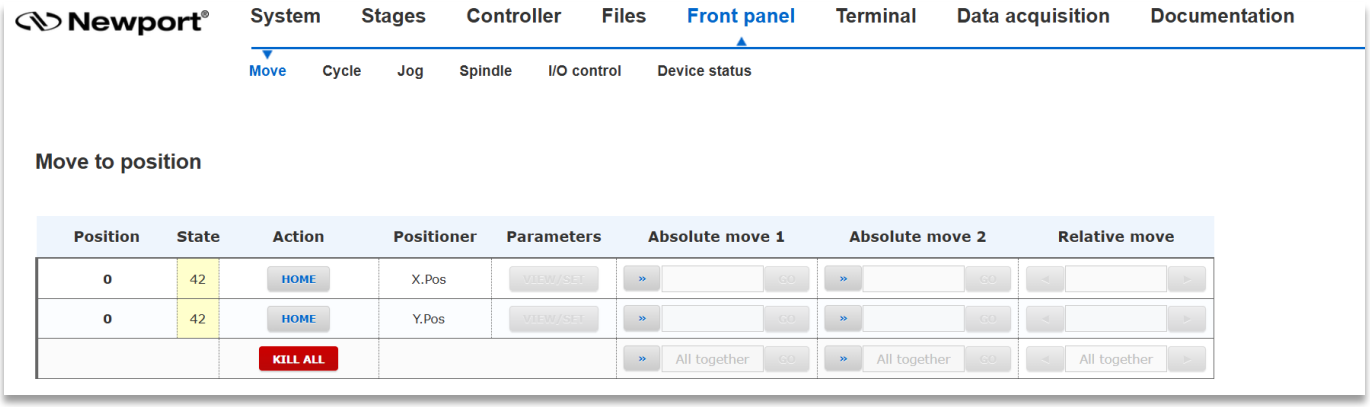
NOTE **When using the stage for the first time, initialize the axis without load on the stage.**

The XPS-DRVP1 driver board must be initialized to set all axis parameters (loop type, range and software limits). This can be done by clicking on "**INITIALIZE**" button:



NOTE **At the end of initialization, the axis control loop is activated and so the stage might slightly move to reach the actual command position.**

The axis must now be referenced by clicking on "**HOME**" button:



The axis is now ready to be used.

NOTE **A preset value can be set to the current position.**
See section: Offset adjustment procedure

8.3.1 Axial Load verification

For stages equipped with a position sensor, the following tests can be performed to verify axis behavior based on an axial load.

No axial Load

All Newport piezoelectric stages are tested and calibrated in the factory. Calibration parameters (saved in the stage's EEPROM) allow the driver board to set the XPS controller scale Zero position at the stage origin.

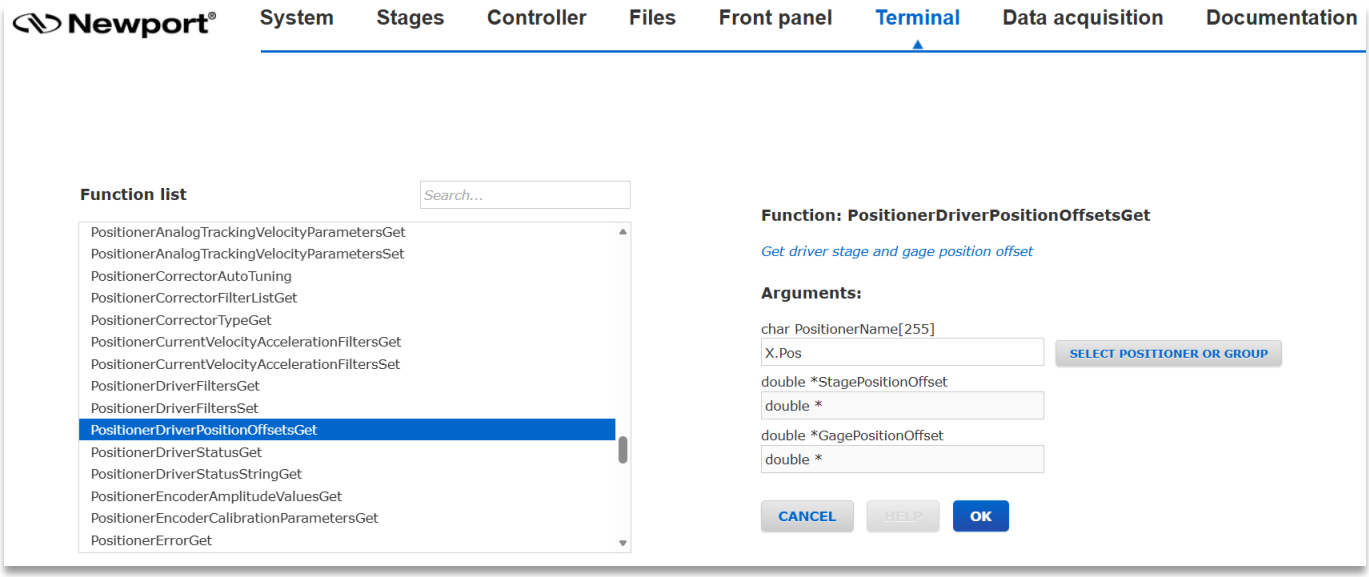
With no applied power, any Newport piezoelectric stage rests in an equilibrium or rest position based on actuator's hysteresis. Although very close, this position is always slightly different from the stage origin (within 5% of the total travel range).

The value at this rest position can be obtained using XPS Website "**Terminal**" page.

NOTE **Axis must be disabled prior to using this command.**

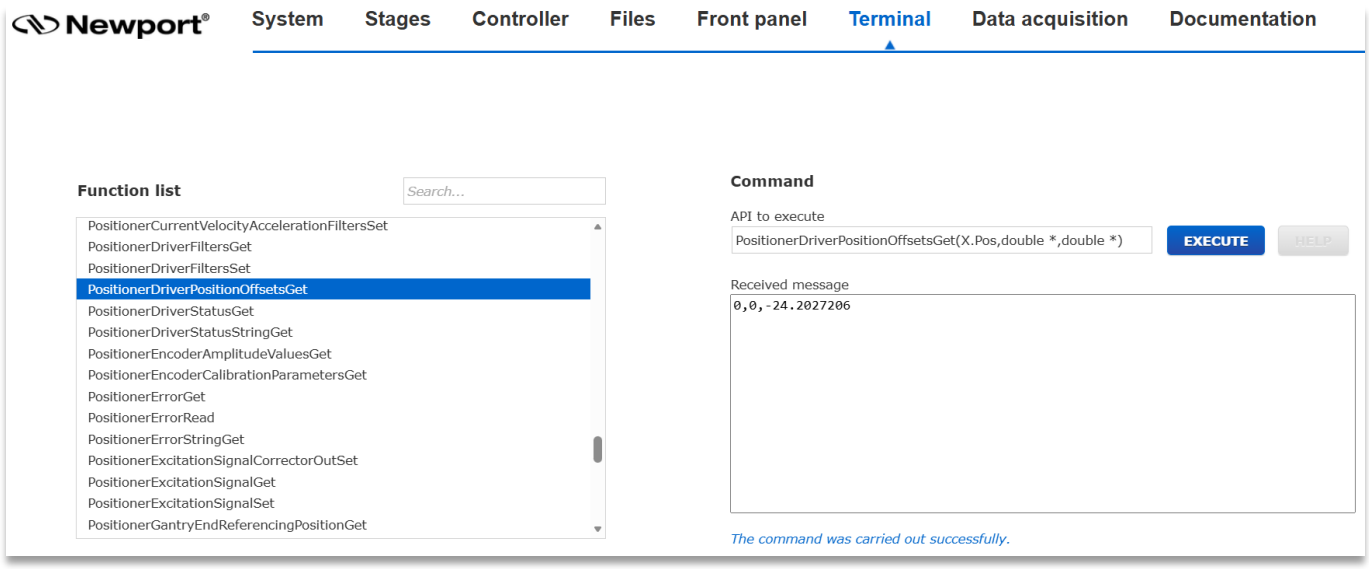
In the **Function list**, select the command: "**PositionerDriverPositionOffsetsGet**".

Using **c** button, select the positioner to be adjusted then click on "**OK**" and finally "**EXECUTE**"



The command returns 3 numbers separated by commas:

- The first "0" indicates the correct execution of the command.
- The second number indicates the current value (in microns) of the "DriverStagePositionOffset" parameter of the "stages.ini" file. See section Offset adjustment procedure. (Default value: "0")
- The third number indicates the current position (in microns) of the stage compared to the stage origin. Verify that this value is less than 5% of the stage travel range.



CAUTION

If the resting position value of a non-energized piezoelectric stage and without any axial load is greater than ± 15% of its total range, the stage is probably damaged. Contact Newport for service.

NOTE

If the axis is not disabled, the command will return an error (Error -118: Function is only allowed in DISABLE group state).

With intended axial Load

The intended axial load can now be applied. The resting position will change.

NOTE

Consult stage documentation to ensure intended maximal axial load is within specification.

Proceeding the same way as above, verify that the current position is less than 80% of the stage travel range.

WARNING

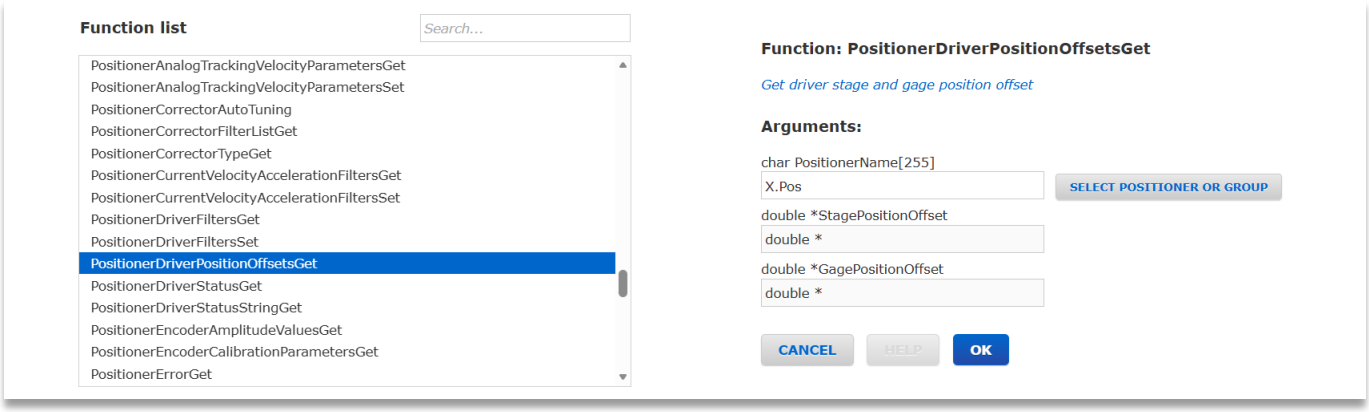
If the resting position value of a non-energized piezoelectric stage and with its intended axial load is greater than ± 80% of its total range, the stage is overloaded. Using it this way might damage it!
DO NOT USE THIS CONFIGURATION.
Contact Newport for service

9 Offset adjustment procedure

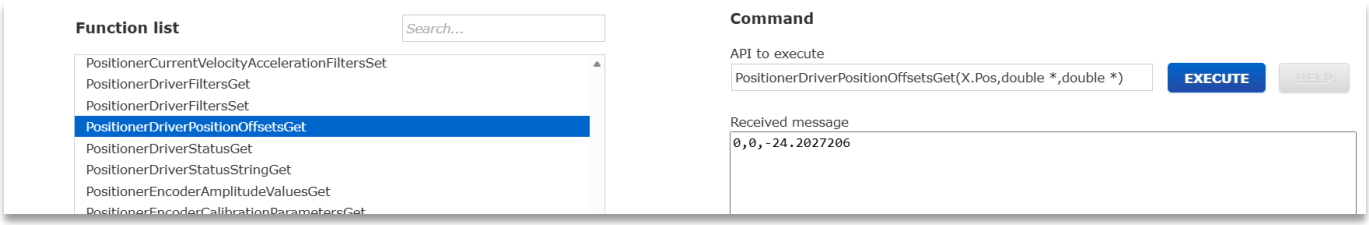
To modify the offset parameter and therefore shift the command range, proceed as follows:

NOTE **Axis must be initialized prior to proceed otherwise the command will return an error (Error -117: Positioner must be initialized).**

- Logon to the XPS website as an "Administrator"
- In the "**Terminal**" menu, select the command : "**PositionnerDriverPositionOffsetsGet**"

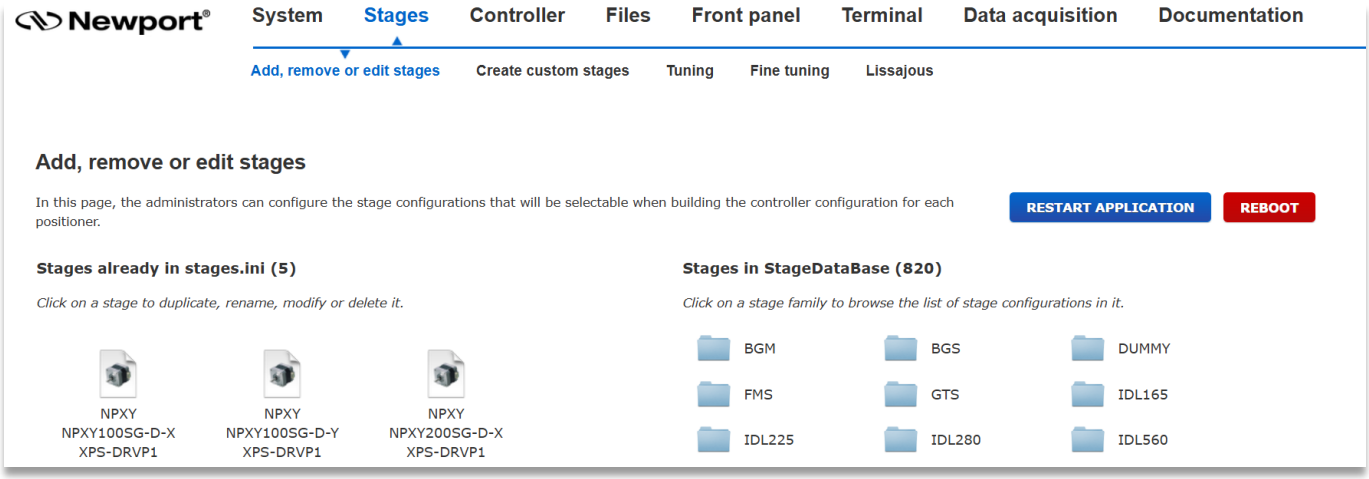


- Select the Positioner name, then click on "**OK**", then on "**EXECUTE**"

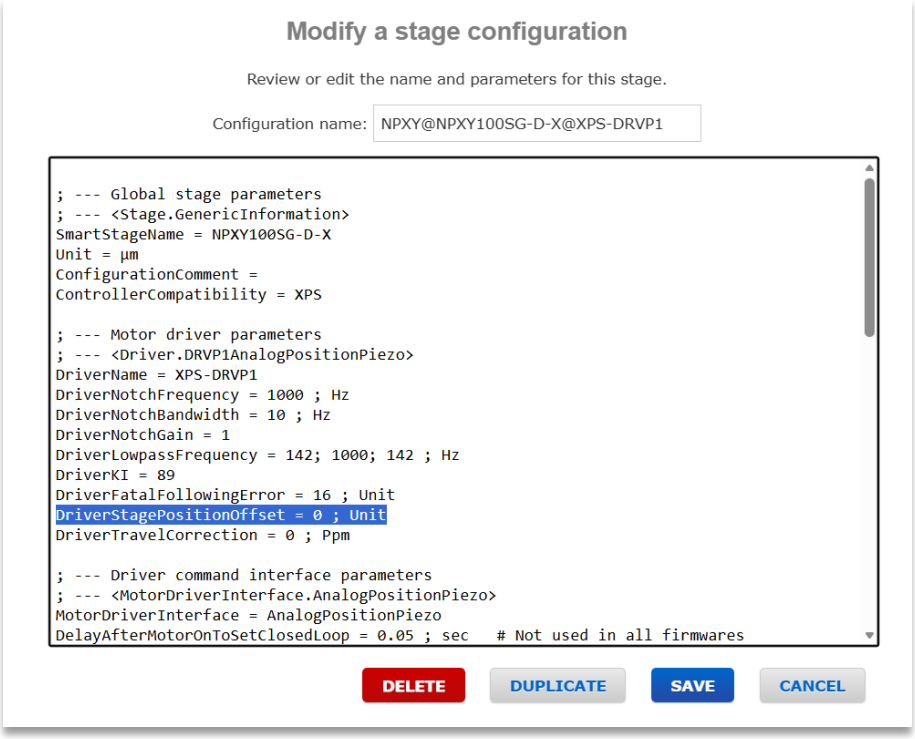


- This command returns: "0, Offset1, Offset2" with:
  - The first "0" indicating the correct execution of the command
  - Offset1, corresponding to the parameter "DriverStagePositionOffset" current value
  - Offset2, corresponding to the stage current position

- In the list proposed by the "**Stages / Add, remove or edit stages**" menu, select the corresponding stage to open its configuration file.

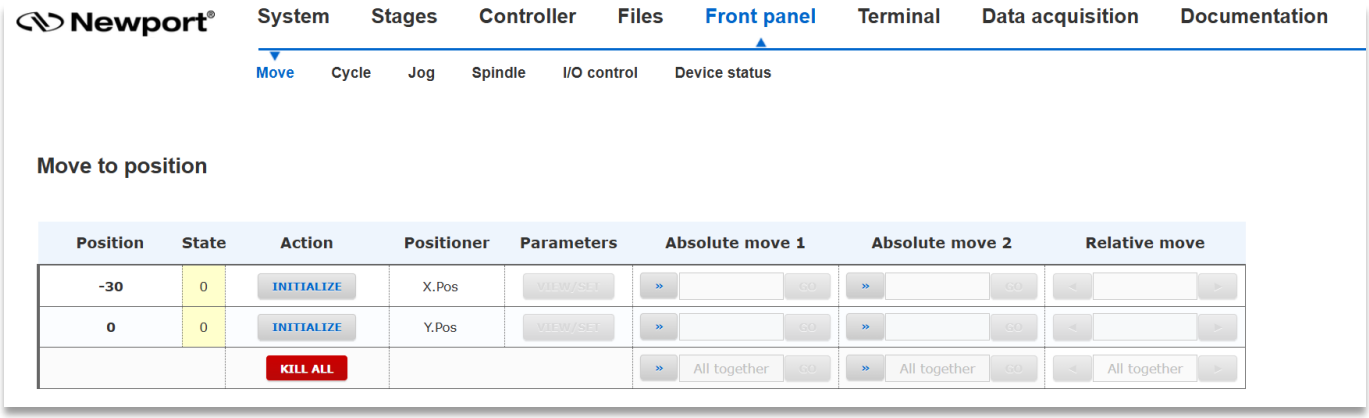


- Then, in the **Motor driver parameters** list, find the line starting with "DriverStagePositionOffset"



- Replace the current parameter value by "Offset2" rounded up to the nearest tens of microns.
- Click on "**SAVE**". The previous page is displayed again.
- Click on **REBOOT** and wait for XPS controller initialization completion.
- Re-logon to the XPS controller "WEB" as User
- In the "**Front Panel / Move**" menu, verify that the corresponding axis position is equal to Offset 2.

- Click "**INITIALIZE**" and then "**HOME**" buttons. The axis is now ready to be used between positions "Offset2" and "Offset2 + usable range".



10 Accuracy linear correction procedure

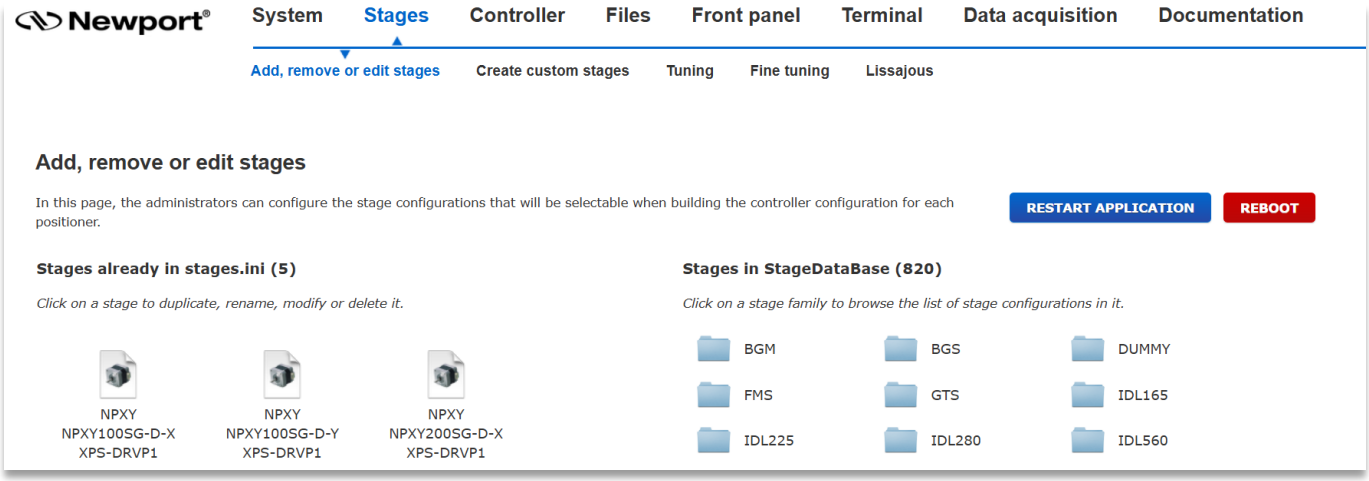
Absolute accuracy of piezoelectric stages equipped with a position sensor and controlled in close loop is directly related to its sensor quality.

As described in the Position sensors section, strain gauge type position sensors have a typical accuracy linearity of 0.1%.

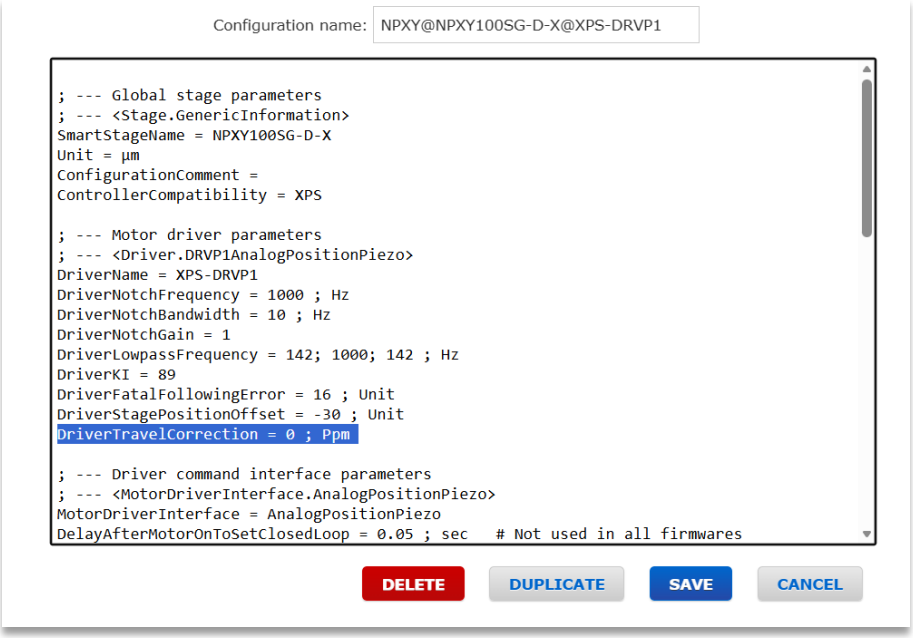
The XPS controller and the XPS-DRVP1 driver board allow compensation for this linear error by modifying the "DriverTravelCorrection" parameter of the "Stages.ini" file.

To modify this parameter, proceed as follows:

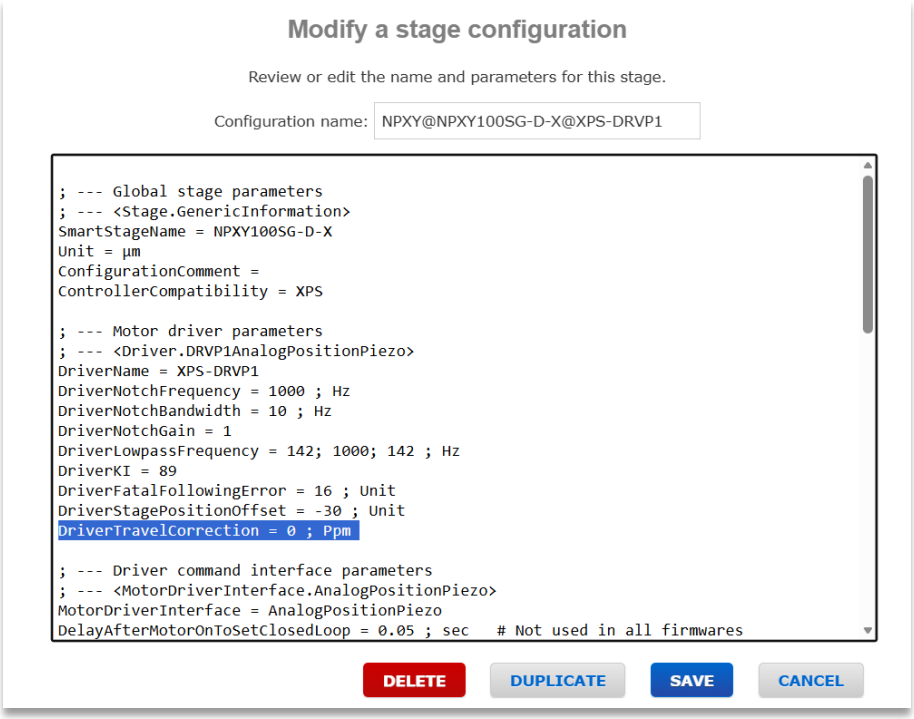
- Install an external position measuring device (I.E. interferometer) on the moving part of the piezoelectric stage to acquire the actual stage position variation.
- In the list proposed by the "**Stages/Add, remove or edit stages**» menu, select the corresponding stage to open its configuration file.



- Then, in the **Motor drive parameters** list, find the line starting with: DriverTravelCorrection"



- Verify the current parameter value:
- If it is different from 0 (default value), replace it with 0, and then click on "**SAVE**" then "**REBOOT**", and finally restart this procedure
- If it is already equal to 0, continue this procedure
- In the "**Front Panel/Move**" menu:
  - Click on "**INITIALIZE**" then "**HOME**" buttons of the desired axis.
  - Launch an absolute move to position "0"
- Reset to "0" your external sensor display.
- In the "**Front Panel/Move**" menu, launch an absolute move to the stage maximum position and note this value as: C_{TH}
- Note your external sensor position value as: C_R
- Calculate the correction coefficient: $K_R=10^6*(C_{TH} - C_R)/ C_{TH}$
- Return into "**Stages/Add, remove or edit stages**" menu to display "DriverTravelCorrection" parameter value.



- Set the parameter "DriverTravelCorrection" value to K_R.
- Click on "**SAVE**" and then "**REBOOT**" buttons and wait for XPS controller initialization completion.

The stage is now ready to be used with improved absolute accuracy.

NOTE **Linear compensation does not affect "BNC" voltage output**

11 Description/Use of "BNC" output

NOTE **This output can be used only if the driver board controls a piezoelectric stage equipped with a position sensor.**

The XPS-DRVP1 driver board features a "BNC" connector that provides an analog voltage image of the stage current position.

Output voltage ranges from 0 to 10V with:

- ~5V: when the stage is not initialized, not energized without external force or load applied.
- ~0V: when the stage is at its lower limit (not energized and maximum axial load or external force)
- ~10V: when the stage is at its upper limit (energized at its maximum voltage and without axial load or external force)

This output can be monitored by an oscilloscope, a multi-meter, a data logger or one of the controller's GPIO Analog Input.

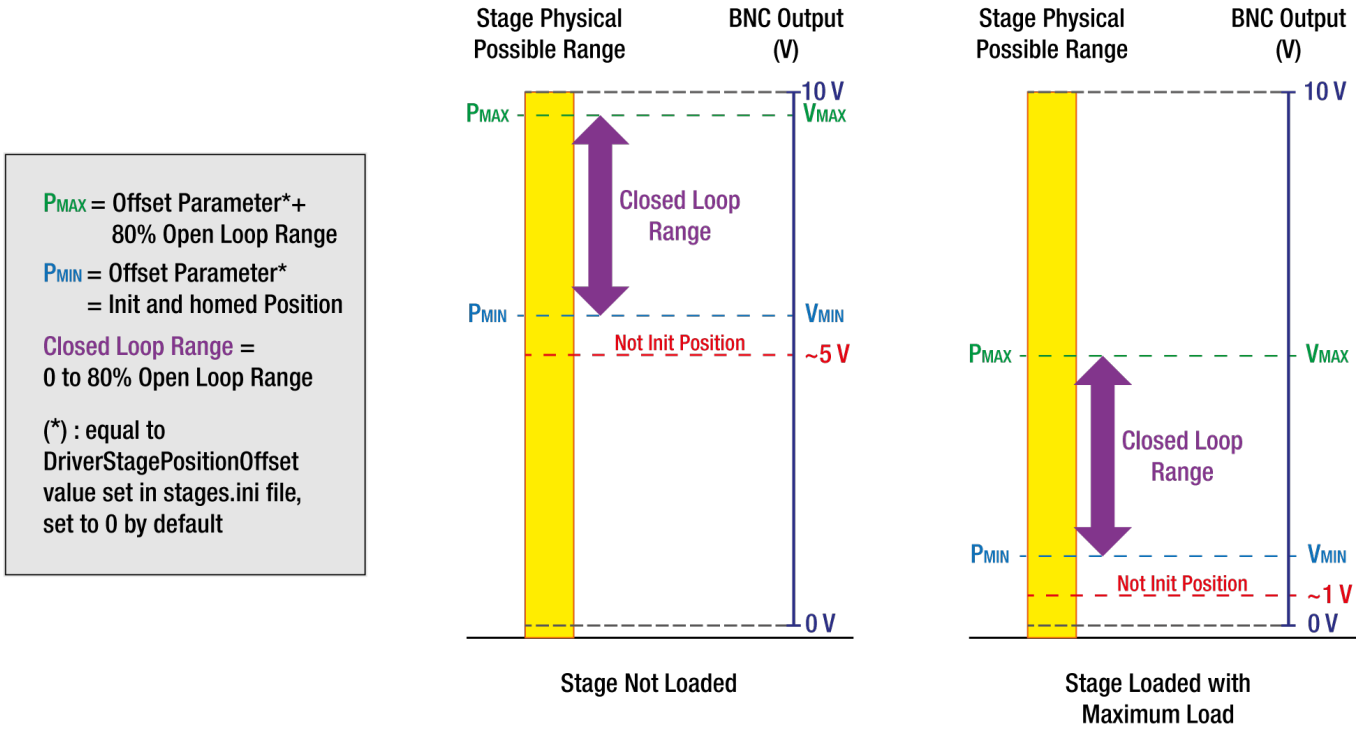


Figure 8 : BNC output voltage during displacement vs loading conditions

NOTE **"BNC" output voltage does not depend on Offset nor Linearity parameter values**

"BNC" output voltage varies from one stage to another.

A calibration of this voltage output can be done. To do so, proceed as follows:

- Memorize output voltage values (V_{MAX} et V_{MIN}) for stages maximal and minimal positions (P_{MAX} et P_{MIN}) in closed loop mode.
- Calculated resolution = (V_{MAX} - V_{MIN}) ÷ (P_{MAX} - P_{MIN}) in V/Unit

WARNING

In case of a stage placed in "disable" mode and without any axial load, if BNC output value is lower than 4 Volts or higher than 6 Volts, the stage has probably been damaged. Contact Newport for service

12 Specific APIs

In addition to the standard XPS commands, the following XPS-DRVP1 board specific APIs are available:

- "PositionerDriverFiltersGet": to get axis current close loop control parameters:
  - KI (close loop integral coefficient),
  - Notch filter frequency,
  - Notch filter bandwidth,
  - Notch filter gain,
  - Low Pass filter frequency.
- "PositionerDriverFiltersSet": to set axis closed loop control parameters
- "PositionerDriverStatusGet": to get driver board current status number
- "PositionerDriverStatusStringGet": to get driver board detailed status
- "PositionnerDriverPositionOffsetsGet": to get offset parameters
  (see Offset adjustment procedure section)

13 Parameters description

Parameters required to drive piezoelectric stages are preset in the factory within the system.ini and stages.ini files and some of these can be modified by the user.

Examples of piezoelectric stage parameters:

13.1 "System.ini» File

Parameter	Description / Remark
[GROUPS] SingleAxisInUse = NPX400SG-D SingleAxisThetaInUse = SpindleInUse = XYInUse = XYZInUse = MultipleAxesInUse = SingleAxisWithClampingInUse = TZInUse = InterlockedGroups=	Group definition section. Piezoelectric stages can be used only in the following groups: - SingleAxisInUse - XYInUse - XYZInUse - MultipleAxesInUse
[NPX400SG-D] PositionerInUse = Pos	Positioner definition section
[NPX400SG-D.Pos]	Positioner name. Must correspond to the name defined in the 2 previous sections
PlugNumber = 2	Board physical address (XPS slot number)
StageName = NPX400SG-D	Name of the section of the "stages.ini" file containing the stage parameters.
EncoderIndexOffset = 0	General parameters. Not used by XPS-DRVP1
TimeFlasherBaseFrequency = 40e6	
MovingMass = 0	
StaticMass = 0	
Viscosity = 0	
Stiffness = 0	

Figure 9 : XPS file: "System.ini"

13.2 "Stages.ini" File

Parameter	Description / Remark
[NPX400SG-D]	Section name. Must correspond to the name defined in the "System.ini" file
SmartStageName=NPX400SG-D	Stage name. Must correspond to the name memorized in the stage EEPROM.
; Position servo loop type CorrectorType=NoEncoderPosition MotionDoneMode=Theoretical	Control loop parameters DO NOT MODIFY
; Driver command interface MotorDriverInterface=AnalogPositionPiezo	
; Motor driver model DriverName=XPS-DRVP1	Driver board name DO NOT MODIFY
; Driver parameters DriverNotchFrequency=1000.0 DriverNotchBandwidth=50.0 DriverNotchGain=1.0 DriverLowpassFrequency=50 DriverKI=31 DriverFatalFollowingError=1.0	Control loop parameters depending on the stage type. DO NOT MODIFY
DriverStagePositionOffset=0	Offset parameter. See section : Offset adjustment procedure
DriverTravelCorrection=0	Accuracy parameter. See section : Offset adjustment procedure
; Position encoder interface Backlash=0 CurrentVelocityCutOffFrequency=100 CurrentAccelerationCutOffFrequency=100 PositionerMappingFileName=	Control loop parameters DO NOT MODIFY
; Limit sensors input plug ServitudesType=Piezo MaximumVelocity=4000 MaximumAcceleration=100000 EmergencyDecelerationMultiplier=4 MinimumJerkTime=0.04 MaximumJerkTime=0.04 TrackingCutOffFrequency=25	Control loop parameters DO NOT MODIFY
; Home search process HomeSearchSequenceType=CurrentPositionAsHome HomeSearchMaximumVelocity=4 HomeSearchMaximumAcceleration=100 HomeSearchTimeOut=60	General parameters. Not used by XPS-DRVP1

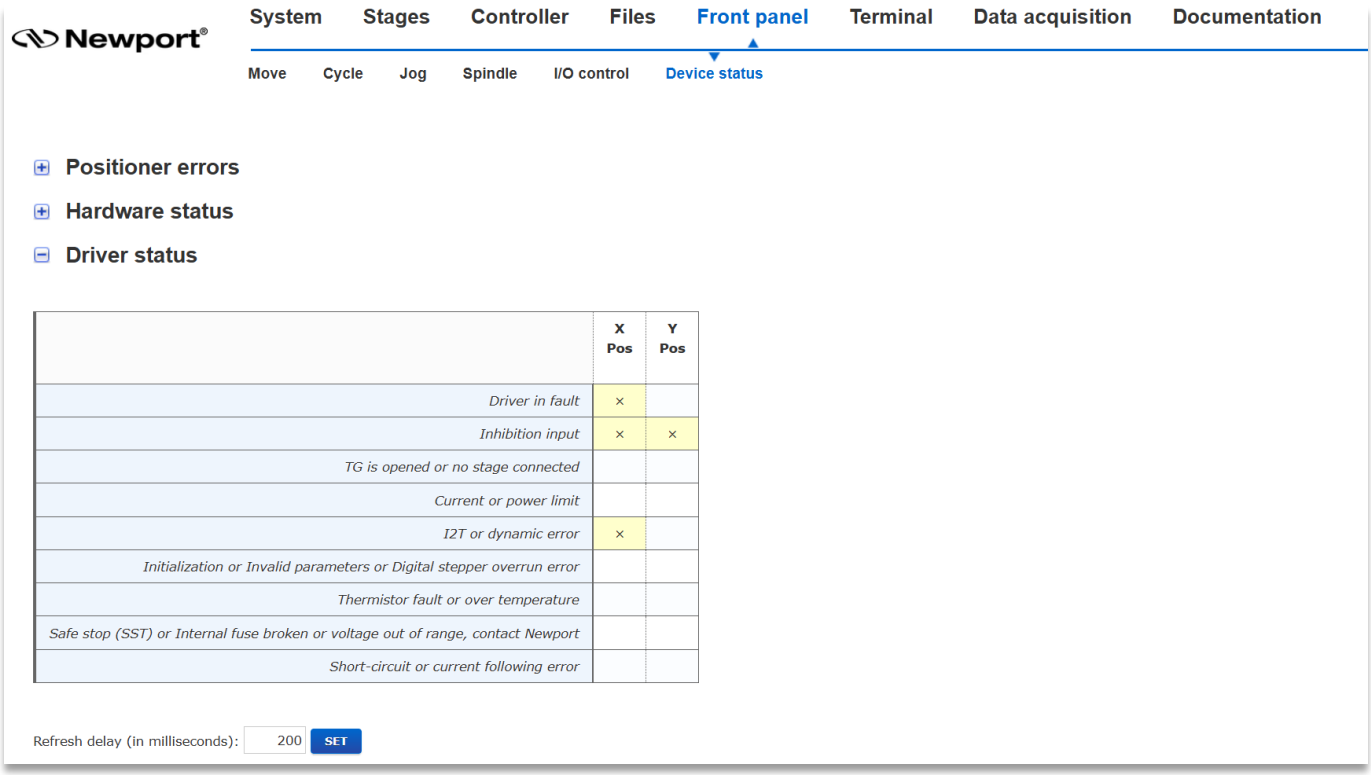
Figure 10 : XPS file "Stages.ini"

14 Maintenance

14.1 Driver errors

In case of malfunction, the XPS-DRVP1 driver board returns errors and the XPS controller will automatically "kill" the axis. XPS website allows checking the type of error(s).

Select **Front panel / Device status** to display the current XPS-DRVP1 driver board status.



This table is automatically refreshed.

Once errors are corrected the concerned axes must be re-initialized using **Front panel / Move** menu.

14.2 Maintenance

The XPS-DRVP1 Driver board requires no particular maintenance.

Nevertheless, this is an electronic board that must be kept and handled with precaution.

WARNING

Do not extract the board from the controller until you have read the following, and are at an approved anti-static workstation.
Use a conductive wrist strap attached to a good earth ground.
Always turn the controller's power OFF before installing a board.
Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD - sensitive electronic component.
Use an approved anti-static mat to cover your work surface.
The XPS-DRVP1 board must be kept in its protective packaging when not in an XPS controller

14.3 Repair

CAUTION

Never attempt to disassemble an element of the driver board.
To disassemble an element can cause a malfunction of the board.

If you observe a malfunction in your board, please contact us immediately to make arrangements for a repair.

CAUTION

Any attempt to disassemble or repair a stage without authorization will void your warranty.

Service Form

Your Local Representative

Tel.: _____

Fax: _____

Name: _____

Company: _____

Address: _____

Country: _____

P.O. Number: _____

Item(s) Being Returned: _____

Model#: _____

Return authorization #: _____

(Please obtain prior to return of item)

Date: _____

Phone Number: _____

Fax Number: _____

Serial #: _____

Description: _____

Reasons of return of goods (please list any specific problems): _____

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