XA Motion Control Software

User Guide

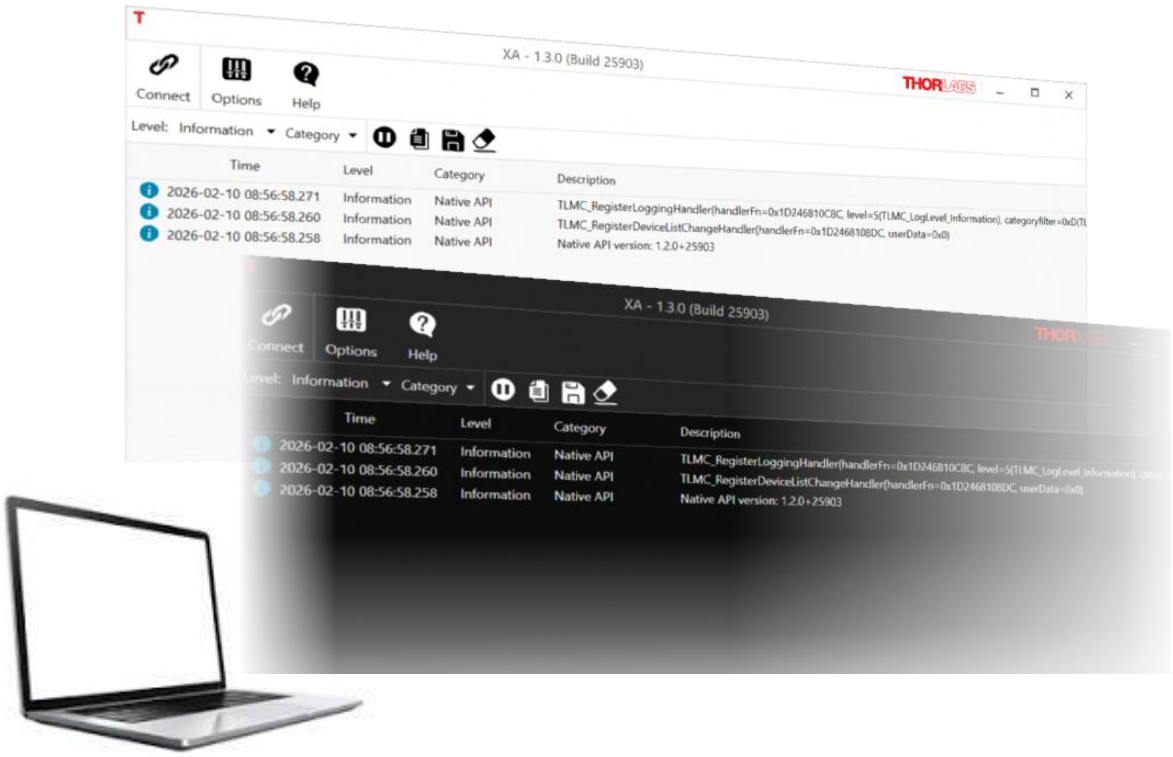


Table of Contents

Chapter 1 Introduction 1
1.1 Intended Use 1
1.2 What is XA? 1
1.3 Supported Motion Control Devices 2
Chapter 2 Display and Navigation Controls 3
Chapter 3 Basic Operation 8
3.1 Connecting to a Device 8
3.1.1 USB Connection 9
3.1.2 Ethernet Connection 9
3.2 Controlling the Device 10
3.2.1 Homing 11
3.2.2 Moving to a Position 12
3.2.3 Jogging 13
3.2.4 Solenoid Control 14
3.2.5 Nanotrack Control 14
3.3 Changing Parameters 17
Chapter 4 Software Reference 18
4.1 Welcome Window Elements 18
4.1.1 Welcome Window Element Descriptions 18
4.1.2 Select devices to connect Window 21
4.1.3 Path Movement Window 21
4.1.4 Options Window 23
4.1.5 Help Window 23
4.2 Controller Menu 24
4.3 Settings Menu 26
4.3.1 DC Brushed Devices 27
4.3.2 Stepper Devices 33
4.3.3 Piezo Devices 38
4.3.4 Brushless Devices 40
4.3.5 Piezo Inertia Stages 53
4.3.6 Solenoid Settings 60
4.3.7 Nanotrack Settings 61
Chapter 5 Thorlabs Worldwide Contacts 65

Chapter 1 Introduction

1.1 Intended Use

The purpose of this document is to provide:

- An overview of the XA Graphical User Interface (GUI).
- The initial steps to get started using XA.
- A full description of the XA software GUI elements and functionality.

NOTICE For clarity and consistency, all screen images shown in this manual are displayed in dark mode.

1.2 What is XA?

XA is a motion control software application that allows both programmed and live control of the Thorlabs range of motion controllers for driving stages and actuators based on different motor types, including brushless, stepper, brushed, and piezo technologies.

Software developers can use the C library or its associated language bindings included in the installation package and should refer to the developer documentation therein.

The XA library is designed to run under 32-bit and 64-bit Windows® operating systems and requires approximately 15 MB of disk space and around 250 MB of RAM.

The XA GUI application is built on the .NET language bindings that are supplied in the Software Development Kit (SDK). Therefore, any functionality that it provides can be recreated in a custom application using the library. The SDK itself consists of a single Dynamic Link Library (DLL) packaged within the installer. The .NET library contains the native (C/C++) library internally.

The XA application will eventually replace Thorlabs' Kinesis® software for existing and newly developed products. Thorlabs is committed to supporting the XA platform until at least 2040.

Examples demonstrating the use of the SDK are available in the Thorlabs GitHub repository here: **https://github.com/Thorlabs/Motion_Control_Examples**.

Along with standard USB connectivity, XA supports control of devices using TCP/IP over Ethernet connections with certain controllers including the BBD30x and UMCx families. This transport allows for HCCP messages to be sent to a device's IP address and port number (see the product manuals for specific details).

Not all devices support all connection modes, however the XA SDK and GUI can connect to specific IPv4 addresses, hostnames, or perform an exploratory scan of an address range if the address is not known initially. To do this programmatically through the API functions, see the installed SDK documentation.

1.3 Supported Motion Control Devices

Below is a list of the different types of products that are currently supported by the XA software. Controllers and actuators/stages grouped under the same heading are compatible with one another within XA. Controllers are denoted with a parenthetical (controller):

Stepper Motor Stages and Actuators:

BSC201 (controller), BSC202 (controller), BSC203 (controller), KST201 (controller), UMC1 (controller), UMC2 (controller), UMC3 (controller), DRV208, DRV225, DRV250, FW6(/M), FW12(/M), FW103(/M), HDR50(/M), LNR502(/M), LNR502E(/M), LPXY1, LTS150C(/M), LTS300C(/M), LTS450C(/M), LTS600C(/M), MAX381(/M), MAX383(/M), MAX681(/M), MAX682(/M), MAX683(/M), MVSN1(/M), NRT100(/M), NRT150(/M), ZFS06, ZFS13, ZFS13B, ZFS25B, ZST206, ZST213 [a], ZST213B [a], ZST225B [a].

DC Brushed Stages and Actuators:

KDC101 (controller), CR1-Z6, CR1-Z7, MTS25-Z8, MTS25/M-Z8, MTS50/M-Z8, MTS50-Z8, MTS100-Z8, MTS100/M-Z8, PRM1Z8, PRM1/MZ8, Z606[a], Z606V[a], Z612[a], Z612B[a], Z612BV[a], Z612V[a], Z625B[a], Z625BV[a], Z806[a], Z806V[a], Z812[a], Z812B[a], Z812BV[a], Z812V[a], Z825[a], Z825B[a], Z825BV[a], Z906, Z906V, Z912, Z912B, Z912BV, Z912V, Z925B, Z925BV.

Brushless Stages and Actuators:

BBD301 (controller), BBD302 (controller), BBD303 (controller), KBD101 (controller), TBD001[a] (controller), UMC1 (controller), UMC2 (controller), UMC3 (controller), DDR25(/M), DDR100(/M), DDS050(/M), DDS100(/M), DDS220(/M), DDS300(/M), DDS600(/M), DDS800(/M), DDS1000(/M), M150XY(/M), MLS203-1, MLS203-2.

Piezo Actuators and Stages:

BPC303 (controller), KPC101 (controller), APF503, APF705, APF710, APFH720, DRV120, DRV517, MAX301(/M), MAX302(/M), MAX311D(/M), MAX312D(/M), MAX381(/M), MAX602D(/M), MAX603D(/M), MAX608(/M), MAX608L(/M), MAX609(/M), MAX609L(/M), MAX682(/M), MAX683(/M), NF15AP25(/M), NFL5D(/M), NFL5DP20(/M), NFL5DP20S(/M), PAS009, PAZ005, PAZ009, PK2FSF1, PK2FVF1.

Closed Loop Piezo Inertia Stages:

PDXC2 (controller), PDXC3 (controller), PDX1(/M), PDX1A(/M), PDX1AV(/M), PDX2(/M), PDX3(/M), PDX3V(/M), PDX4(/M), PDXR1(/M), PDXZ1(/M).

Piezo Inertia Stages:

KIM001 (controller), KIM101 (controller), PDXC2 (controller), PDXC3 (controller), PD1(/M), PD1D(/M), PD1(/M), PD1V(/M), PD2(/M), PD3(/M), PDR1(/M), PDR1C(/M), PDR1V(/M).

Piezo Inertia Actuators:

KIM001 (controller), KIM101 (controller), MPIA10, MPIA10VF, PIA13, PIA13VF, PIA25, PIA25VF, PIA50, PIA50VF, PIAK10, PIAK10VF.

Auto-Alignment Compatible Piezo Stages:

KNA-IR (controller), KNA-VIS (controller), MAX301(/M), MAX302(/M), MAX311D(/M), MAX312D(/M), MAX381(/M), MAX602D(/M), MAX603D(/M), MAX608(/M), MAX608L(/M), MAX609(/M), MAX609L(/M), MAX682(/M), MAX683(/M).

Kinematic Mirror Mounts with Piezo Inertia Adjusters:

KIM001 (controller), KIM101 (controller), PIM05(/M), PIM1(/M).

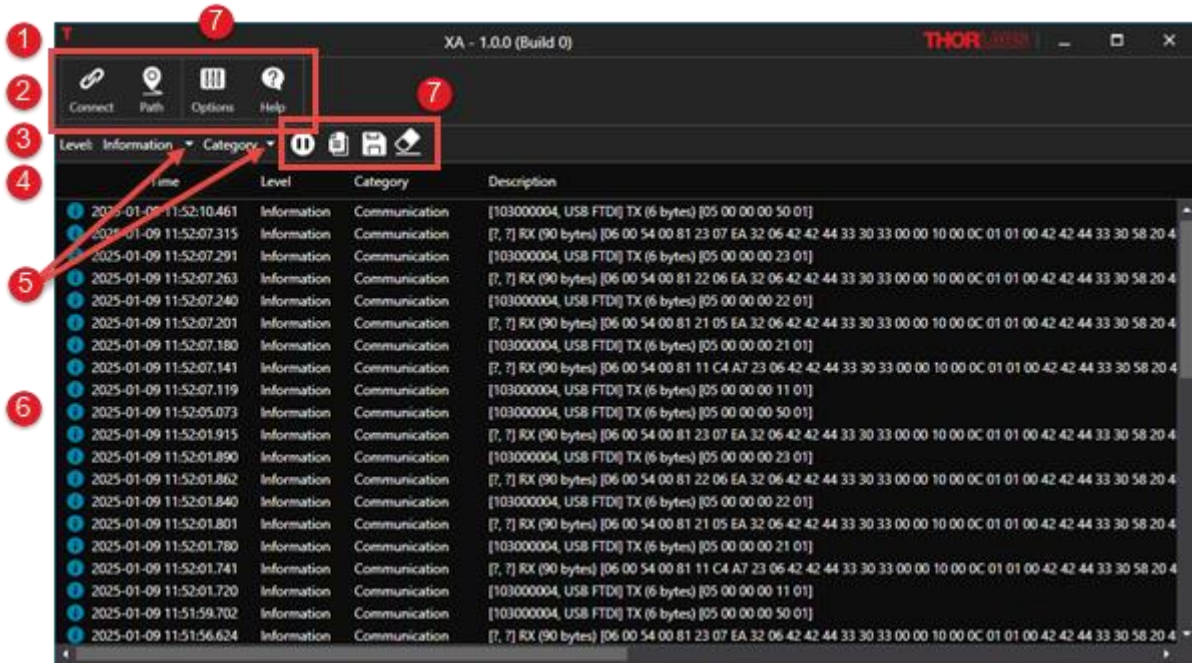
Solenoid Shutters

KSC101 (controller), SH05R(/M), SH1(/M).

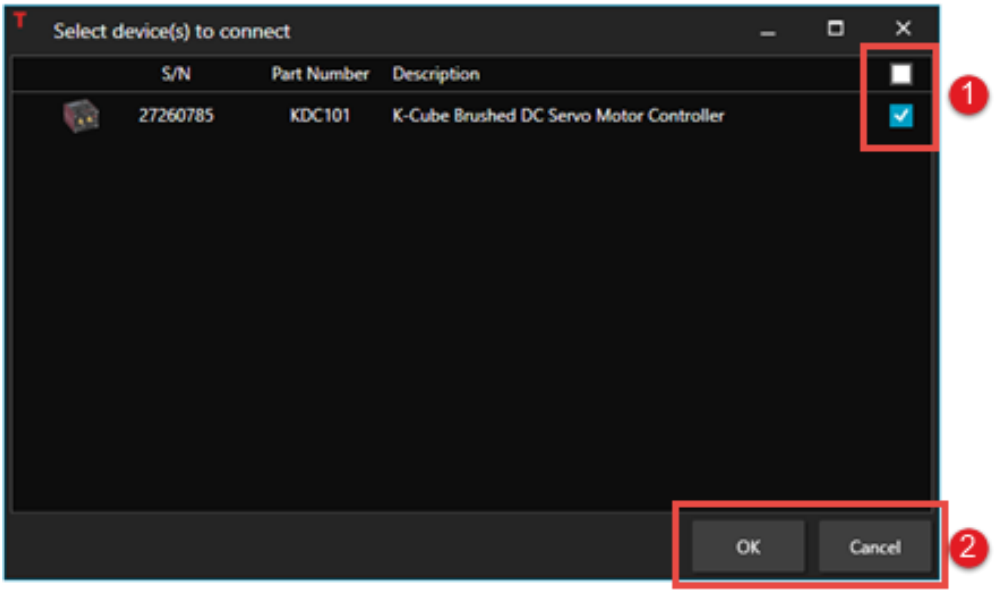
a. This is a previous-generation item.

Chapter 2 Display and Navigation Controls

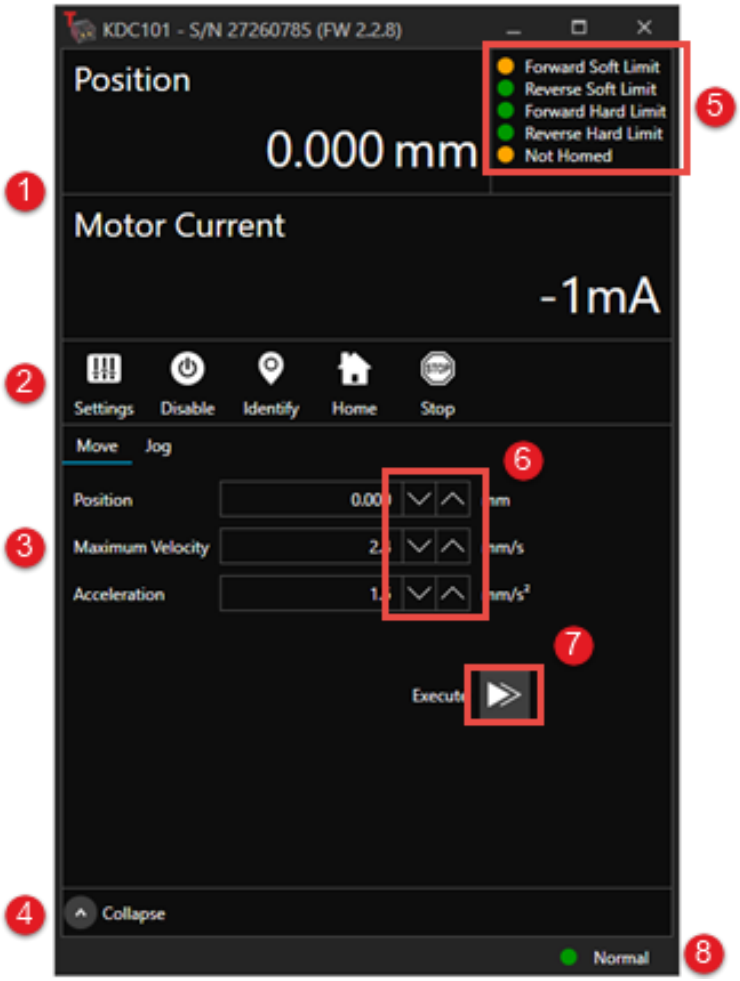
The XA GUI is intuitive, however, the figures below describe the nomenclature used throughout this document.



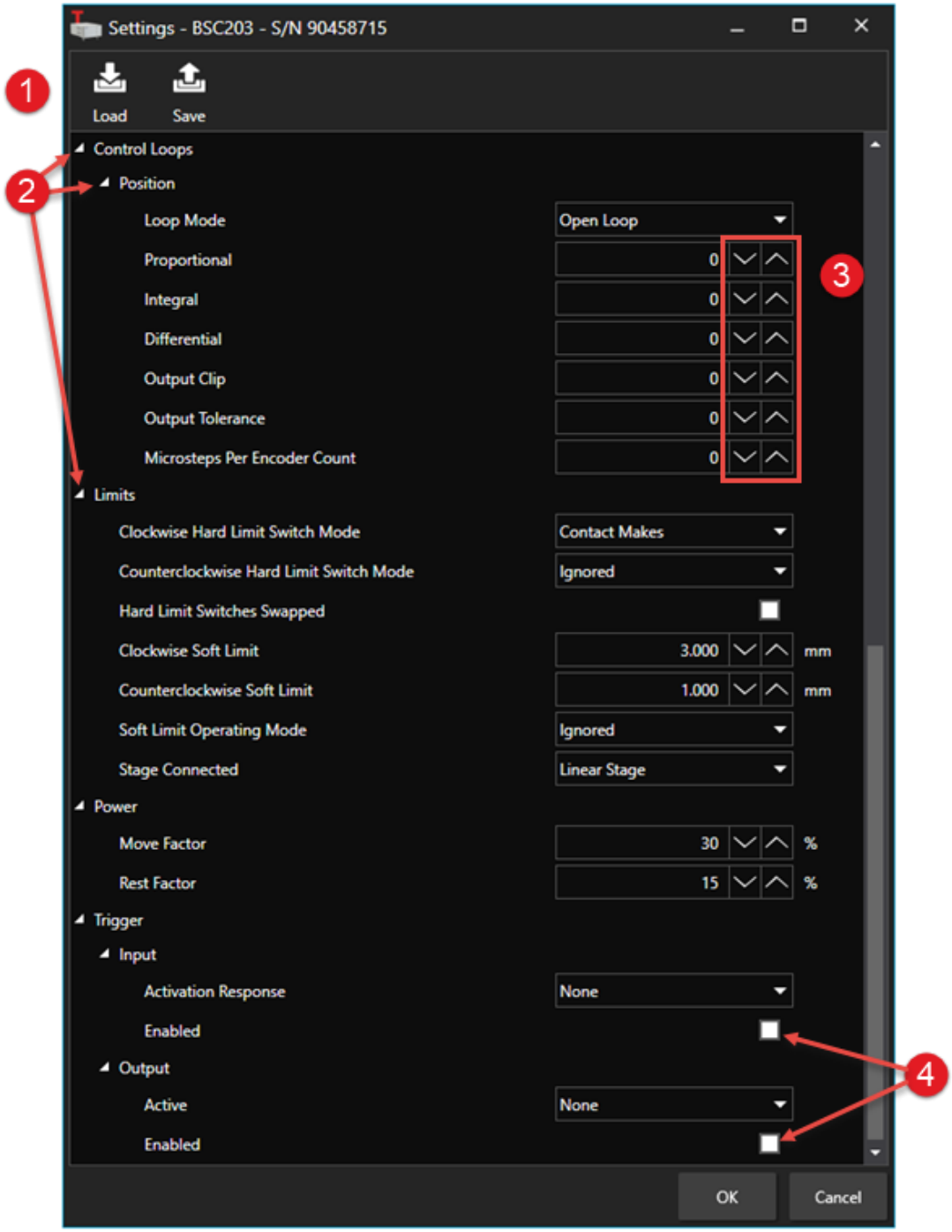
Callout	Description
1	Title Bar used to display software build information, company logo, window minimization, resizing and closing buttons.
2	Toolbar to give access to device connection functions, path designers for synchronized moves, display options and help information.
3	Display and Function Bar to give access to log display options.
4	Log Description Bar to state the column titles for the log data shown in the Main Window
5	Pull-down menus to allow selection of display options.
6	Main Window to display log data.
7	The play, pause, save, and erase icons are used exclusively for logging functionality. These controls allow users to start logging, pause logging, save logged data, and erase logged data respectively, and do not affect any other system functionality.



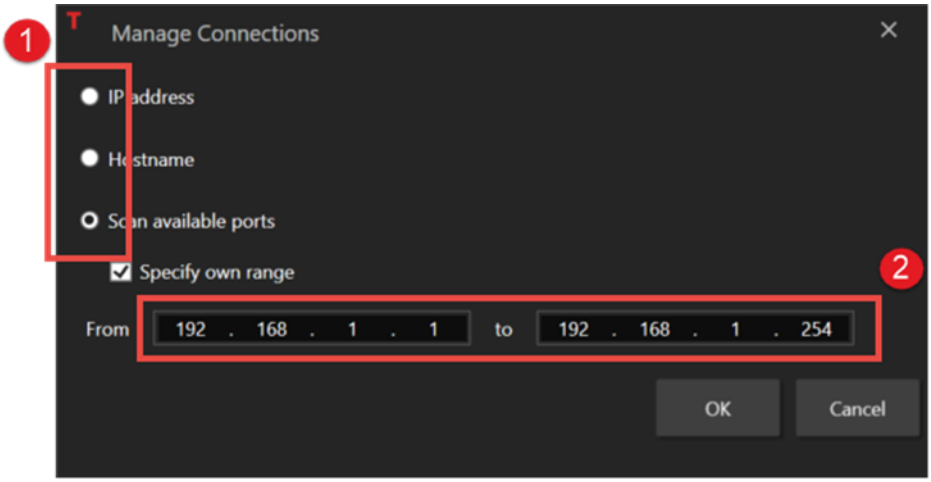
Callout	Description
1	Selectable checkboxes are used to enable or disable functions or select items to perform further function on.
2	Confirmation buttons are used to either initiate a connection attempt or cancel and close the dialog.



Callout	Description
1	Data Display Window used to display device parameter measurements.
2	Toolbar to give access to device settings and operating functions.
3	Main Window to give access to device positioning functions.
4	Window expand / collapse button.
5	Device positioning status indicators used to indicate positioning issues.
6	Buttons used to increase or decrease parameter values.
7	Initiate Move button.
8	Status indicator used to indicate the health or status of a device. The indications are as follows: Error Warning Normal No device



Callout	Description
1	Buttons that allow settings to be saved to a file or loaded from a file.
2	Expand and collapse arrows.
3	Buttons used to increase or decrease parameter values.
4	Selectable checkboxes used to enable or disable functions or select items to perform further function on.



Callout	Description
1	Radio buttons to select options and enable text fields.
2	Text fields used to enter settings or data.

Chapter 3 Basic Operation

The XA application and library is installed using the Windows Install Shield installer, downloaded from the Thorlabs website (Thorlabs · Motion Control Software).

Follow the on-screen instructions to install XA.

Once installed, XA can be used straight away to perform the following basic operations:

- Connecting to a device (see Section 3.1)
- Homing (see Section 3.2.1)
- Moving to a Position (see Section 3.2.2)
- Jogging (see Section 3.2.3)
- Solenoid Control (see Section 3.2.4)
- Changing parameters (see Section 3.3)

3.1 Connecting to a Device

Do the following:

1. Make sure the controller being used is connected and powered up.
2. Run the XA application from the start menu. The XA main window opens and XA automatically scans for USB motion controllers connected to the PC. A live, time-stamped set of logs indicating various software actions is displayed.
3. From the Toolbar, select **Connect**.

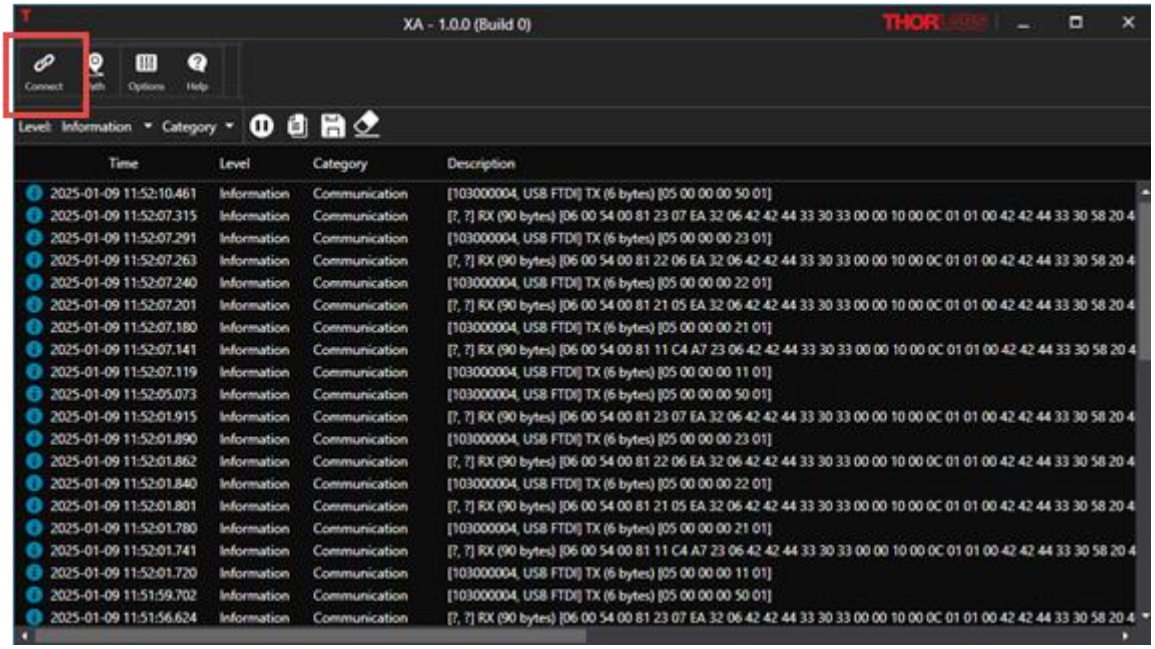


Figure 1 Connecting to Devices

The Select device(s) to connect window is displayed and this lists the devices detected by the software.

If an Ethernet connection is present, there will be an additional button available to select the method of remote connection.

To connect when using a USB connection, see Section 3.1.1.

To connect when using an Ethernet connection, see Section 3.1.2.

3.1.1 USB Connection

In the example in Figure 2, the **Select device(s) to connect** window displays the detected controller(s). In this case, it is a USB-connected KDC101 controller.

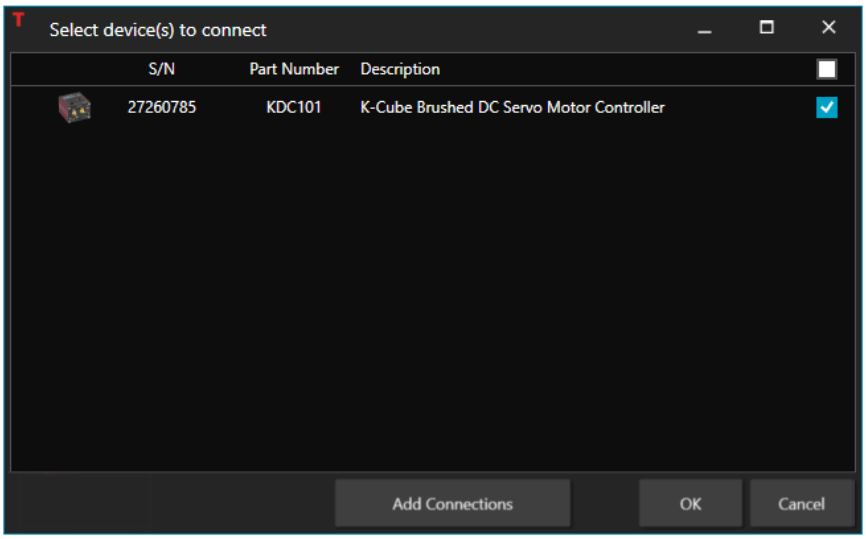


Figure 2 USB Connection

To connect to the device, from the **Select device(s) to connect** window, select the controller and select **OK**. The connection is initiated.

3.1.2 Ethernet Connection

In the example in Figure 3, the **Select device(s) to connect** window displays the detected controller(s). In this case, it is an Ethernet-connected BBD302 controller.

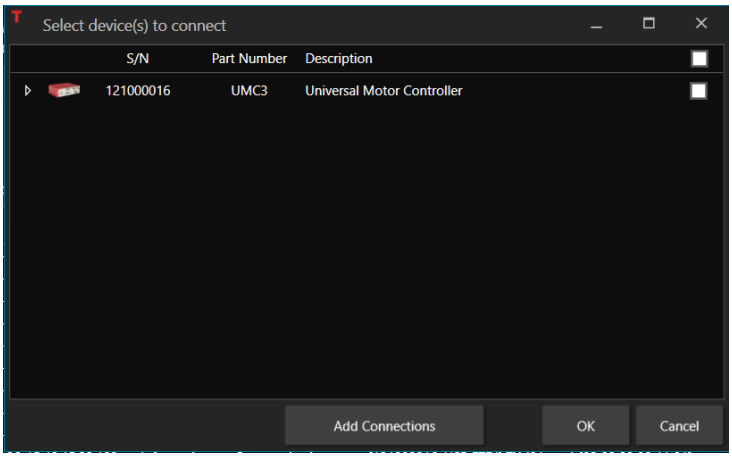


Figure 3 Ethernet Connection

It is, however, possible from here to select a method of remote connection before initiating it. The options are:

- Direct connection to a known IP address.
- Direct connection to a known hostname.
- A scan for all devices in a known range of IP addresses.

To choose one of these methods, do the following:

1. Select **Add Connections**.

2. From the displayed **Manage Connections** window, do one of the following:
   - Select the **IP address** radio button and enter the IP address of the device in the displayed text field.
   - Select the **Hostname** radio button and enter the hostname of the device in the displayed text field.
   - Select the **Scan available ports** radio button and either:
     - Leave the **Specify own range** checkbox unchecked to scan the entire subnet of the host machine's network connection.
     - Check the **Specify own range** checkbox and enter the range to be scanned in the displayed **From** and **to** text fields.
3. Select **OK**.

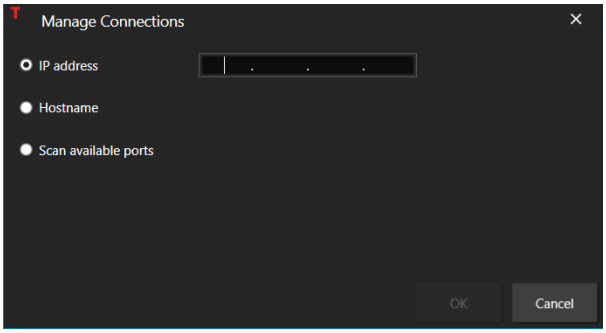


Figure 4 Manage Connections

3.2 Controlling the Device

After connecting to each controller, a device control window will appear for each channel (on multi-channel controllers) or a single window on single-channel controllers. Figure 5 shows information about the controller and stage, such as position and status, and the controls the user can use to home, change settings, move, and perform other operations on the connected controller and stage.

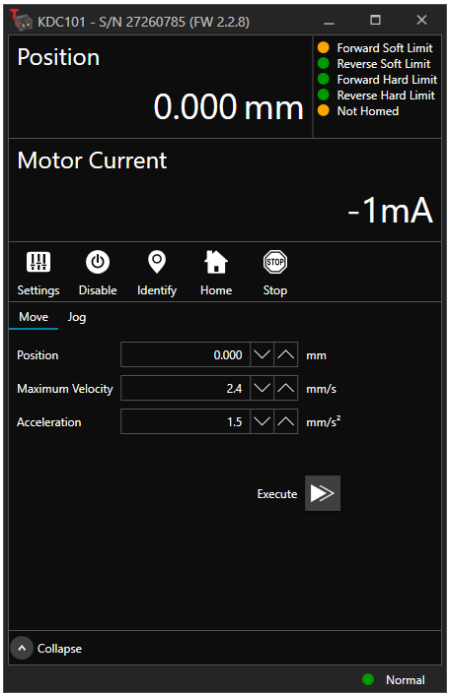


Figure 5 KDC101 GUI

NOTE: multiple devices will be identifiable by their channel number shown in the title bar.

3.2.1 Homing

Some devices require a homing procedure so that all subsequent moves can be started from a known position. Prior to homing, the status is indicated by an amber color Not Homed.

To home a device, select **Home**

The device moves toward its homed position.

When homing is complete, the status indicator is green.

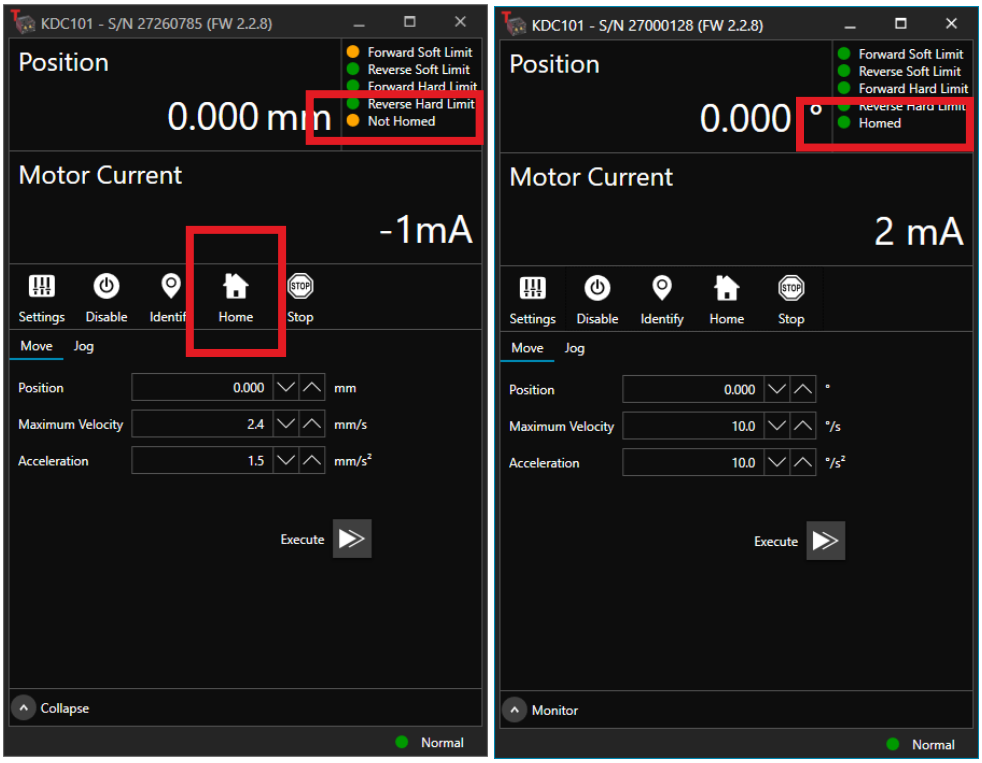


Figure 6 Homing

3.2.2 Moving to a Position

A device can be moved to a given position along its travel by using the Move function.

In the device control window, select the **Move** tab and enter the desired position.

Select **Execute** to begin the move operation. The position dynamically updates as the device moves to the requested position.

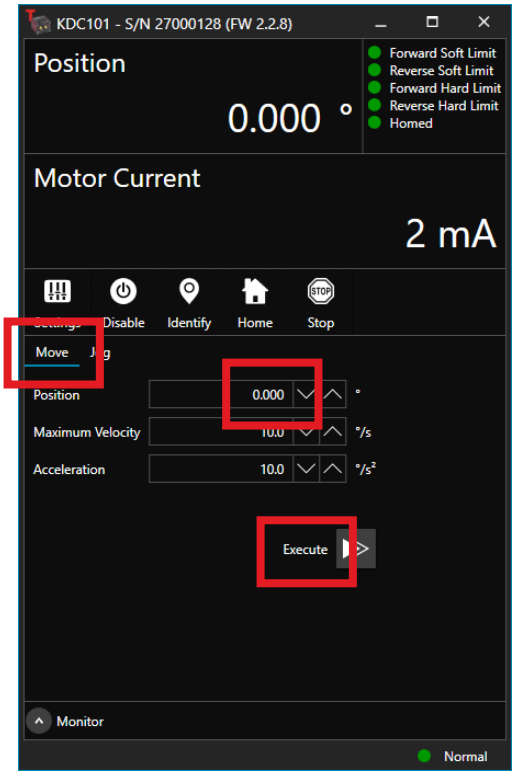


Figure 7 Moving to a Position

3.2.3 Jogging

Jogs are incremental movements made by a specified distance. They are initiated by selecting the **Jog**.

Jogs can also be executed manually using Jog buttons on devices themselves if they are available.

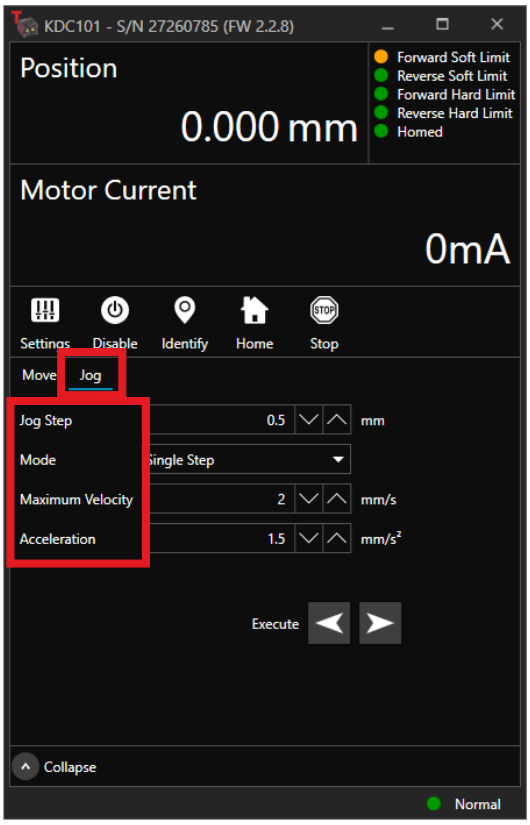


Figure 8 Jog Modes

The Jog options are as follows:

Jog Step The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).

Mode The way in which the device moves when a jog command is received (that is, front panel button pressed, or GUI panel button selected).

There are two jogging modes available:

Single Step
The device moves by the distance specified in the **Jog Step** field. If the jog key is held down, single step jogging is repeated until the button is released (see Figure 8).

Continuous
The device continues to move until the jog signal is removed (that is, the jog button is released). The motor actuator accelerates and moves at the jog velocity while the button is held down.

Maximum Velocity The maximum velocity at which to perform a move.

Acceleration The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.

3.2.4 Solenoid Control

The KSC101 Control Window provides four operating modes:

- Manual Mode- It allows the user to open or close the solenoid manually with a single button click.
- Single Mode – It is initiated manually, but the shutter automatically reopens after a user-defined time interval.
- Automatic Mode – It operates the solenoid in a repeating pattern using a configurable duty cycle. The operation can continue indefinitely or run for a specified number of cycles.
- Triggered Mode – It enables remote control of the solenoid through an I/O port trigger signal.

For additional information about each operating mode, refer to the product manual.

3.2.5 Nanotrack Control

Main Control

NanoTrak® devices provide a range of controls for configuring the search patterns and parameters used for automatic fibre alignment based on photodetector feedback. The NanoTrak® system operates by scanning a defined search path to locate the position with the highest detected signal level. Once the optimum position is identified, the detector gain is reduced and the search process is repeated to refine and maintain alignment accuracy. The control window for these products consists of four main sections:

- PIN detector Trans-Impedance Amplifier (TIA) gain range
- TIA output reading
- NanoTrak® mode controls and readings
- Circle position graphical display

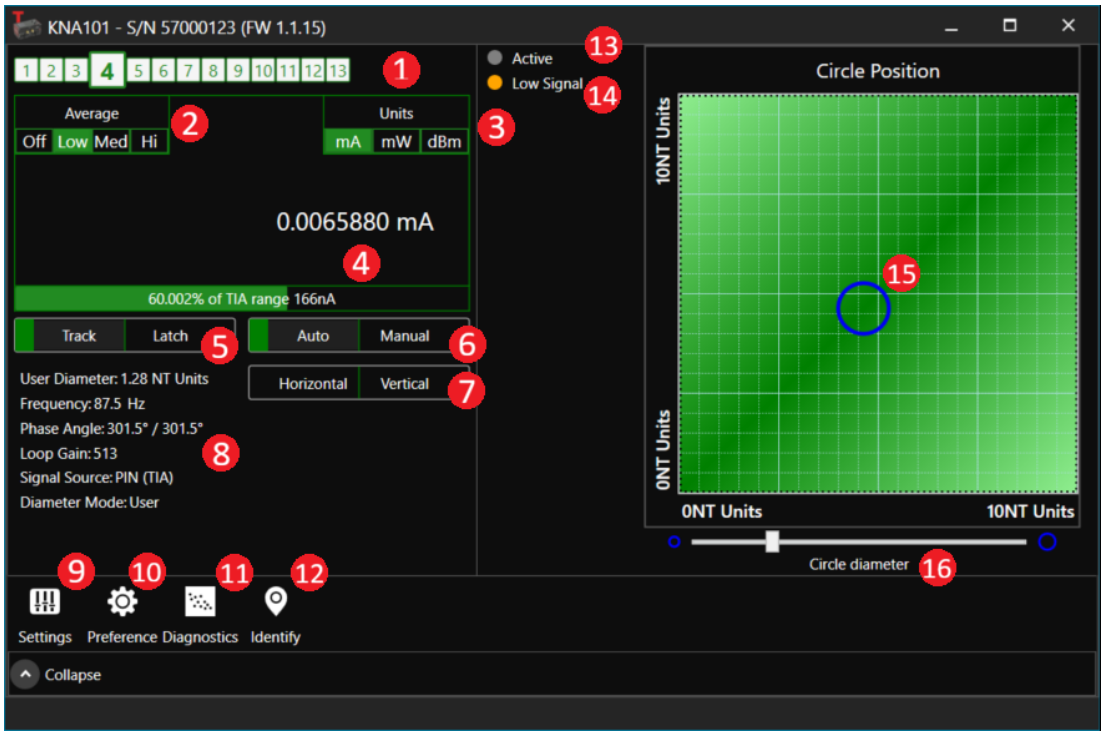


Figure 9 Main Control

Callout	Description
1	TIA Gain Range
2	TIA reading average size
3	TIA display units
4	TIA reading
5	Track or Latch mode selector and indicator
6	TIA gain automatic or manual control selection
7	Active scan axes selector
8	NanoTrak® configuration display
9	Opens the device settings window
10	Opens the NanoTrak® display preferences window
11	Opens the X-Y scan heat map display
12	Instructs the device to identify itself visually on the unit
13	Indicates that the Piezo drive is active
14	Indicates that the TIA output is below the configured threshold
15	Draggable control of the search path circle origin
16	Search circle diameter control

Preferences

The Preferences dialog allows users to customize the appearance of the control window, including display units and grid settings.

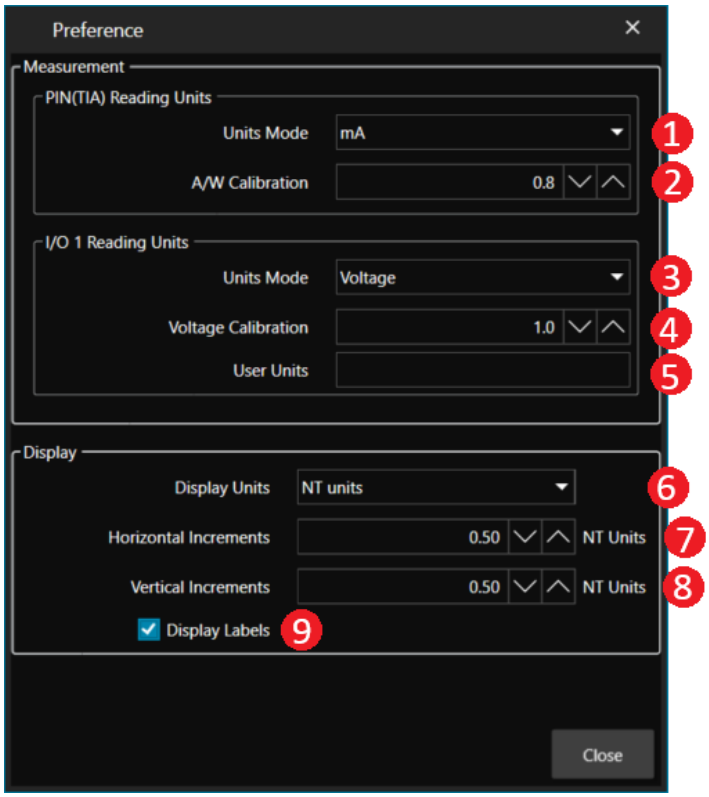


Figure 10 Preferences

Callout	Description
1	Detector reading units for the PIN TIA internal detector
2	Amp-to-watt calibration factor used when power units are selected.
3	I/O 1 external detector units
4	Calibration factor to use when **User Defined** is selected for the **Units Mode**
5	Unit label to display when **User Defined** is selected for the **Units Mode**
6	Units used to display the search circle diameter.
7	Distance between horizontal divisions on the grid
8	Distance between vertical divisions on the grid
9	Selects whether the grid axis labels and chart title are displayed.

Diagnostics

To find the maxima, the KNA can perform a raster scan and generate a heat map showing the detector signal level at each scanned position.

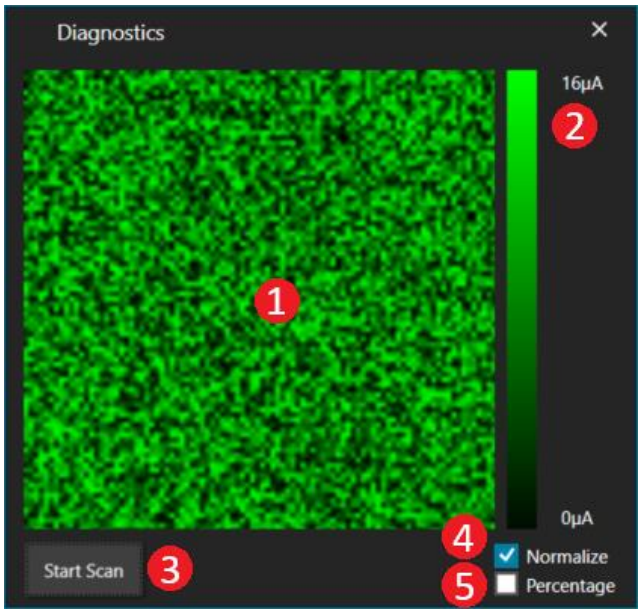


Figure 11 Diagnostics

Callout	Description
1	The heatmap display made up of 96 x 96 detector readings
2	The heatmap scale and maximum value
3	Initiates the X-Y scan
4	Normalizes the heatmap display to provide better contrast between the readings
5	Displays the values as a percentage instead of signal reading

3.3 Changing Parameters

Certain performance parameters may require optimization based on equipment and application. These can be accessed in the **Settings** window for each device. All settings can be saved and loaded to allow subsequent configurations of the device to be accessed quickly and bring it back to its current state.

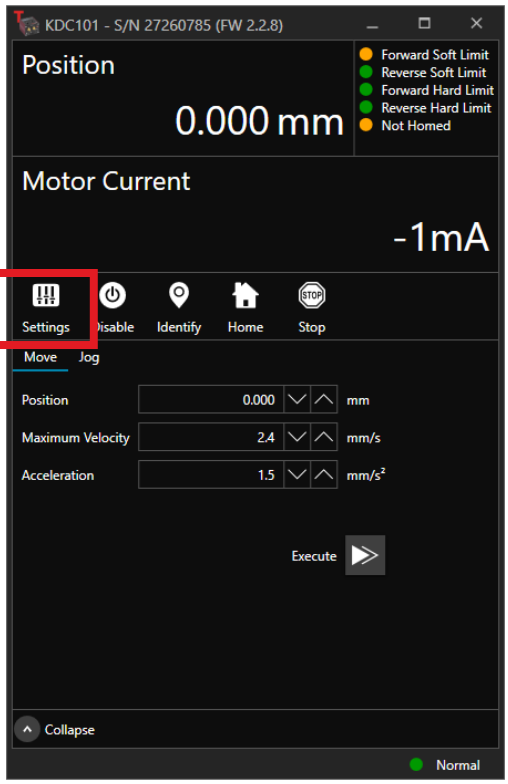


Figure 12 Changing Parameters

Chapter 4 Software Reference

This provides a full description of the XA software GUI elements and functionality:

These include elements and functionality found in:

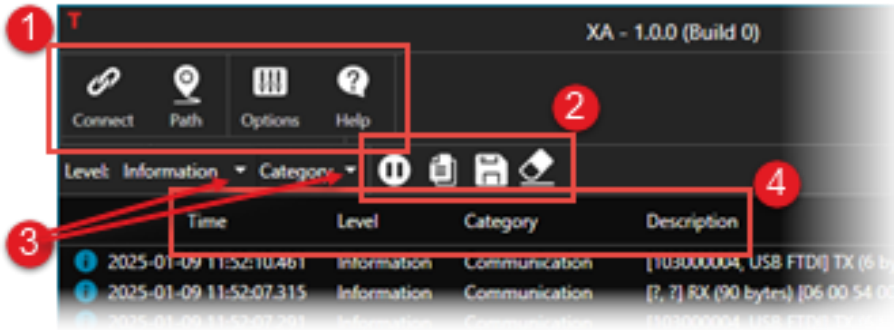
- The welcome window (Section 4.1).
- The controller menu (Section 4.2).
- The settings menus (Section 4.3).

4.1 Welcome Window Elements

Upon launch, the Welcome Window GUI shows a live, time-stamped set of logs indicating the various actions of the software together with buttons and pull-down menus to perform functions and change settings.

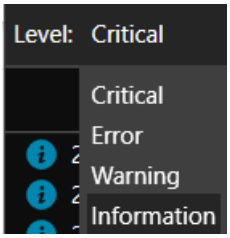
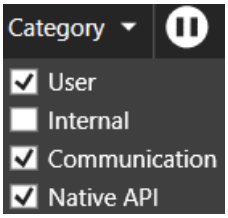
4.1.1 Welcome Window Element Descriptions

The elements of the Welcome Window are described below, with more detailed descriptions in Table 1.



XA Welcome Window Control Button Groups	
Callout	**Description**
1	Toolbar to give access to device connection functions, path designers for synchronized moves, display options and help information.
2	Play/pause, copy, save and erase functions. These belong to the logging functionality.
3	Pull-down menus to filter the logs displayed.
4	Label titles for the data displayed in the columns underneath.

Table 1 is a full description of the Welcome Window elements.

Item	Graphic	Description
Connect		Launches the **Select devices to connect** window. The purpose of this button is to select which devices connected to the PC are to be controlled by the XA software
Path		Launches the **Path Movement** window to access synchronized movement functionality.
Options		Displays various application-related options. Device-specific settings are accessed through the device control window that appears once a connection is made.
Help		Displays the software build, version and copyright information.
Level pull-down		Allows the selection of which log severity level to be recorded. There are four different levels: • **Critical** • **Error** • **Warning** • **Information** The levels range from Critical, the most severe level, to Information, the least severe. Selecting a particular level allows log messages of that level and all more severe levels to be displayed. Changing the level controls the filtering of all subsequent messages. For example, if the level changes from Warning to Error, subsequent log messages will include only Error and Critical messages.
Category pull-down		This relates to the source of the log message. These can be turned on or off depending on the requirements of the log lists. There are four categories that can be selected: • **Internal** The core of XA and its various subsystems. • **Native API** The layer that exposes the core through the API surface. • **User** The logging system contains a user-accessible API so that customer applications can inject log messages into the system logs. • **Communication** Protocol messages between XA and the device.

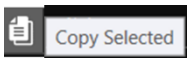
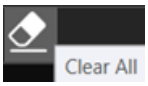
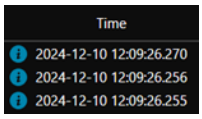
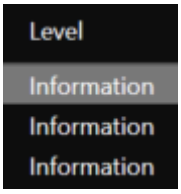
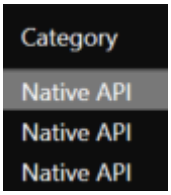
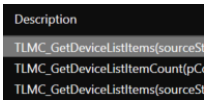
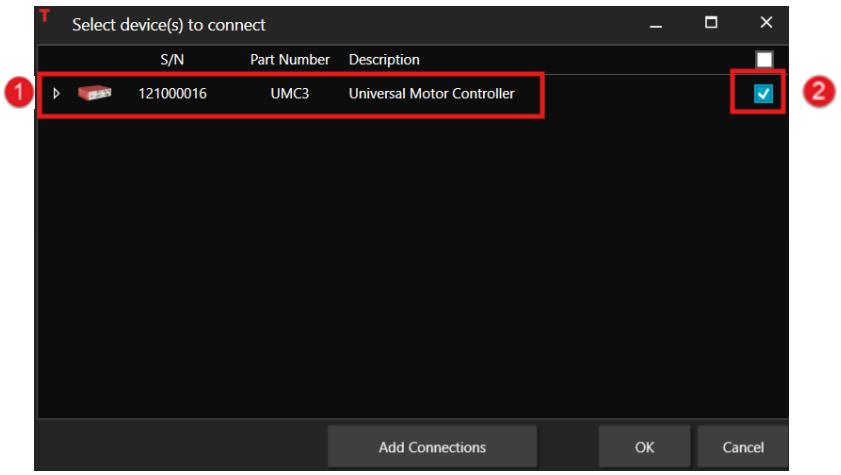
Item	Graphic	Description
Play/Pause		Stop and resumes the display of information logs.
Copy Selected		All log entries are selectable from the main window and can be copied into the Windows clipboard as plain text for further editing, such as inserting into emails or a text editor. This is particularly useful for reporting issues discovered within the software to technical support.
Save		
Clear All		Removes the currently recorded logs.
Time Column		Records the time and date of the log message.
Level Column		Displays the log level being displayed. There are four different levels: • **Critical** • **Error** • **Warning** • **Information** The levels range from Critical, the most severe level, to Information, the least severe.
Category Column		The source of the log message. There are four categories that can be selected: • **Internal** The core of XA and its various subsystems. • **Native API** The layer that exposes the core through the API surface. • **User** The logging system contains a user-accessible API so that customer applications can inject log messages into the system logs. • **Communication** Protocol messages between XA and the device.
Description Column		The log message itself.

Table 1 Welcome Window Element Descriptions

4.1.2 Select devices to connect Window

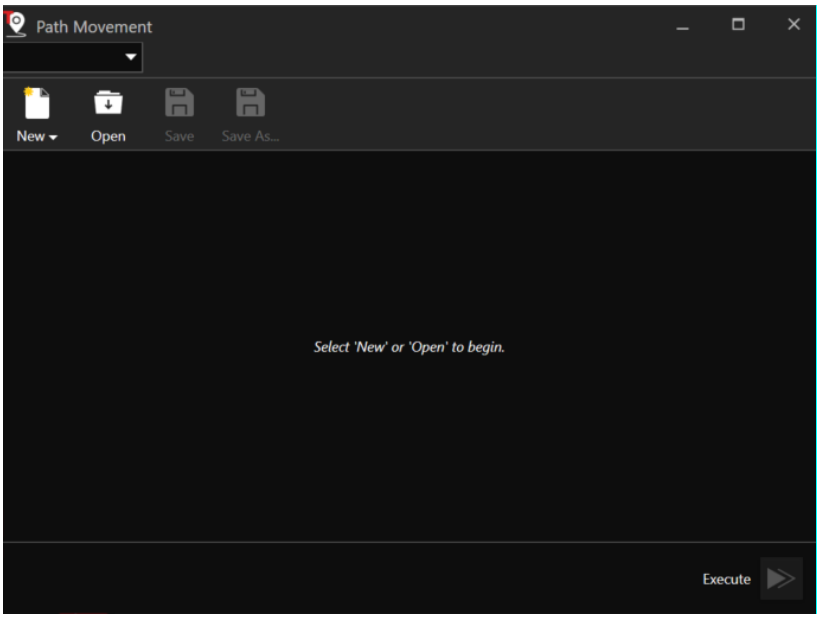
The **Select devices to connect** window is displayed on selection of the **Connect** button. The purpose of this button is to select which devices connected to the PC are to be controlled by the XA software.



Item	Description
1	List of device(s) detected by the software.
2	Checkboxes to select individual devices or all devices listed.

4.1.3 Path Movement Window

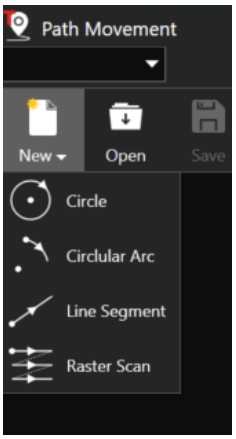
Selecting the Path icon  launches the Path Movement window. This window provides functionality to create, load, and save .kbd path files containing two-dimensional move sequences. Users can modify these files to assemble more complex shapes. The Execute button loads and runs the selected or created path file.

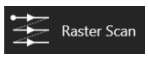


The **New** pull-down menu provides access to the following options:

- Circle
- Circular Arc
- Line

- Raster Scan

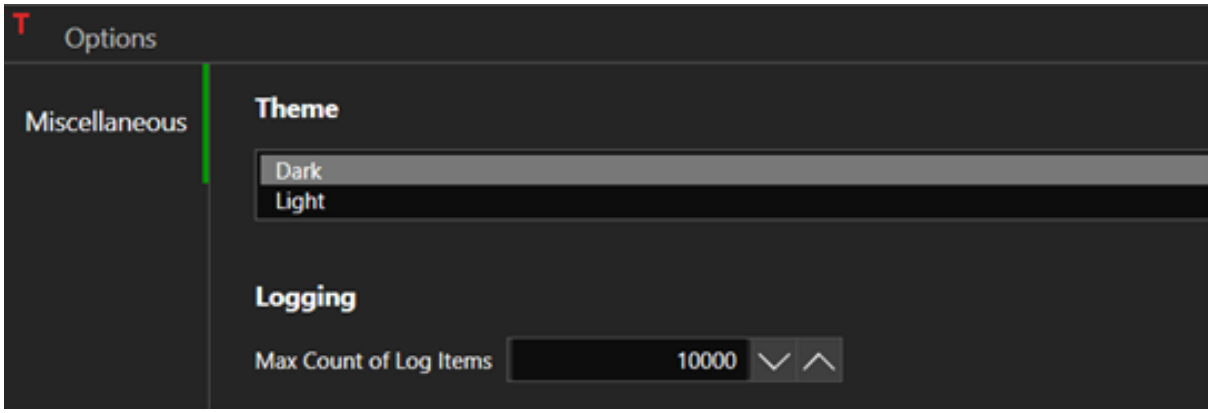


Item	Graphic	Description
Circle		Produces a synchronized circular motion on 2 axes of the same controller.
Circular Arc		Produces a synchronized circular arc motion on 2 axes of the same controller.
Line Segment		Produces a synchronized line segment motion on 2 axes of the same controller.
Raster Scan		Produces a synchronized raster scan motion on 2 axes of the same controller

More details about these can be found in the BBD Manual.

4.1.4 Options Window

The **Options** window is displayed on selection of the **Options** button. The purpose of this button is to choose how the XA GUI looks and set the maximum number of log events displayed in the welcome window.



Item	Description
Theme	Choose between **Dark** and **Light** themed display.
Logging	Set the maximum number of log items using the increase or decrease buttons or typing in a value.

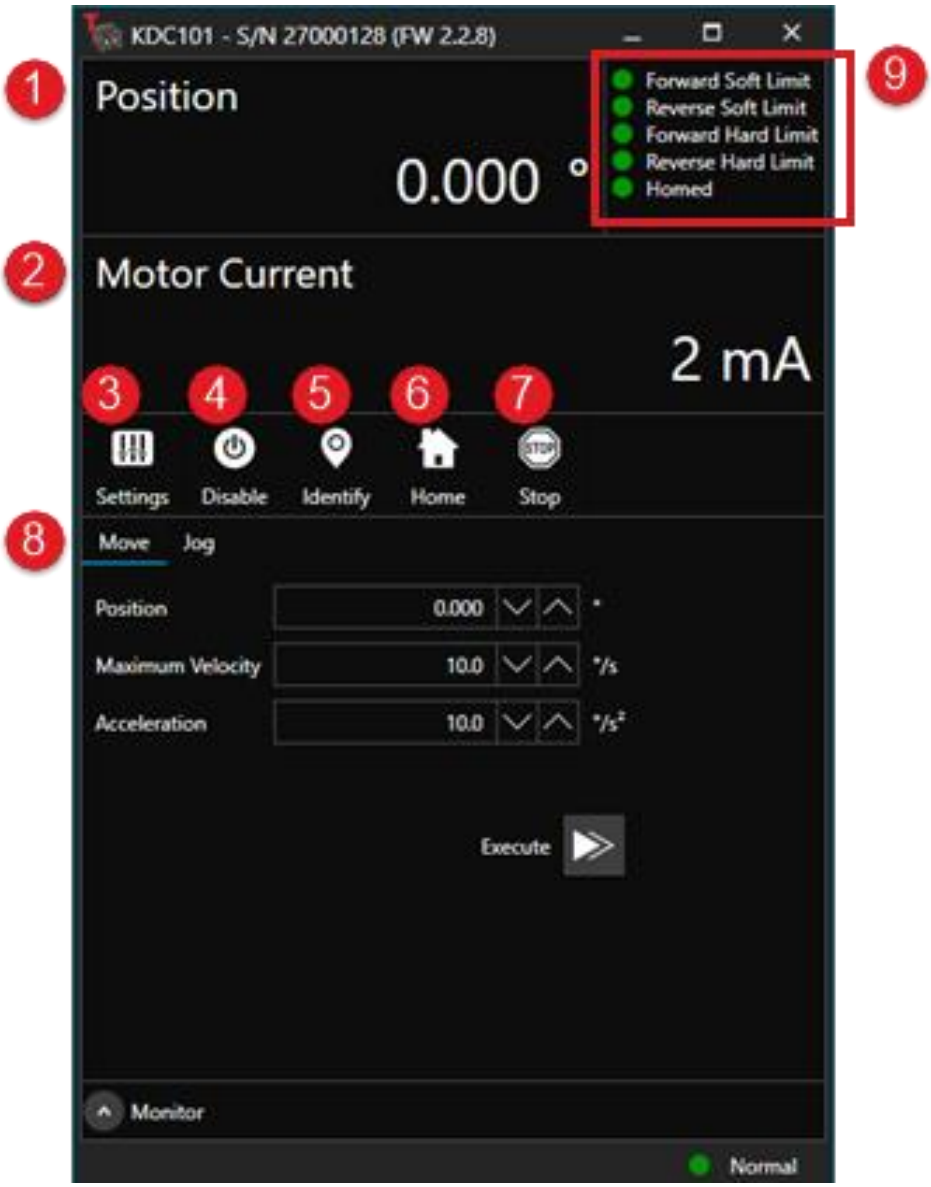
4.1.5 Help Window

The **Help** window is displayed on selection of the **Help** button. The purpose of this button is to give the user build version and copyright information about the XA software.



4.2 Controller Menu

Once the XA software has connected to a controller, various parameters are displayed in the Controller GUI. The KDC101 controller is used as an example in the GUI shown below. Other controllers may have different displays.



Item	Description
1	**Position** Shows the position (in millimeters or degrees) of the device. The device must be 'Homed' before the display shows a meaningful value, (that is, the displayed position is relative to a physical datum, the limit switch). For Piezo devices, voltage is displayed.
2	**Motor Current** Displays the current being used by the motor.
3	**Settings** Displays the **Settings** window, which allows operating parameters to be

Item	Description
	entered for the device. Refer to section 4.3 for details on the available parameters.
4	**Enable/Disable** Toggle button to apply and remove power to the device. When the device is enabled, the **Disable** button is visible; with the device disabled, the **Enable** button is visible.
5	**Identify** Select to identify the active device: Some include LED indicators that provide visual status feedback by pulsing or flashing. On K-Cube devices, the display backlight pulses instead of using a separate LED indicator.
6	**Home** Select to set a physical datum for all other measurements to be set against.
7	**Stop** Halts the movement of the device.
8	**Move**/**Jog** tabs The **Move** tab provides the parameters to change the absolute position of a device and the rate at which this is done. The **Jog** tab provides the parameters to moves the device at discrete distances in the specified direction as described in section 3.3.
9	Indicators showing the status of the following parameters: **Forward Soft Limit** For linear devices, a physical limit switch is activated at the forward travel limit. Forward hard limit switches are often not installed on rotational devices; however, some filter wheels may have them, and they may activate at each filter position. **Reverse Soft Limit** Physical limit switches are used to indicate the home, or zero distance, position to which all other distances are relative. In the case of linear devices, these switches are activated at the end of the travel range. When this switch is turned on, rotational devices will normally use this for homing but won't stop rotation after this point. **Forward Hard Limit** A user definable limit switch position in the forward travel direction settable on some controllers. **Reverse Hard Limit** A user definable limit switch position in the reverse travel direction settable on some controllers. **Not Homed/Homing/Homed** An indication of whether the motor has not been 'Homed' since power up or not. When the **Home** button is selected, the indicator states **Homing**, and the indiactor flashes while the home move is being performed. The LED is lit green once the move is complete. The indicators are colored Amber and green.
10	Indicator showing the health of the device:

Item	Description
	Error Warning Normal No device

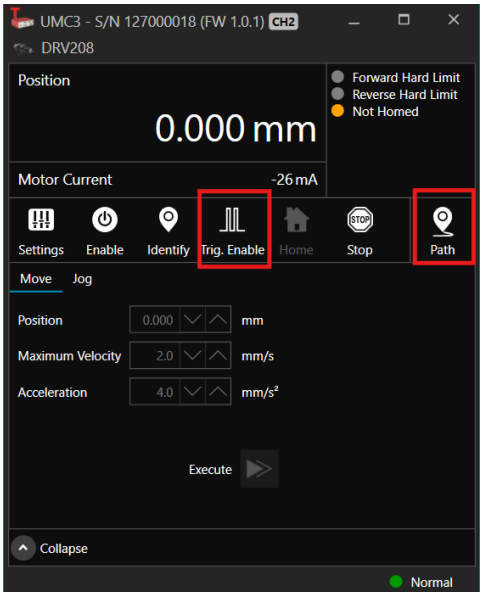


Figure 13 Trig Enable and Path Option

Trig Enable and Path Option are applicable only for BBD, UMC and PDXC3.

Item	Description
1	**Trig Enable** Trig Enable is applicable only for BBD. Enables or disables the position trigger function. The illuminated LED indicates that the position trigger is enabled.
2	**Path** Launches the Path Movement window to access synchronized movement functionality. It is discussed in detail in Section 4.1.3.

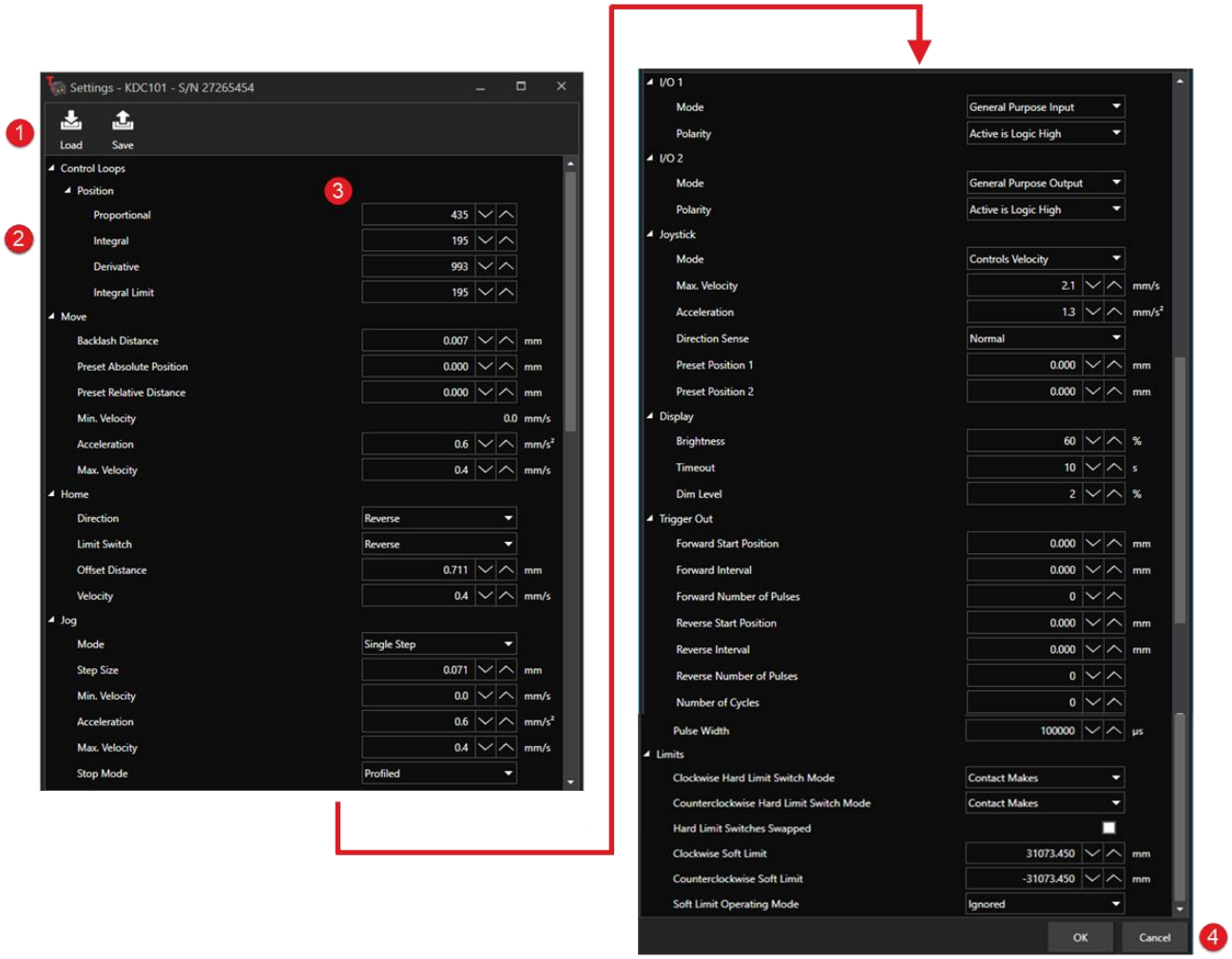
4.3 Settings Menu

The parameters in the **Settings** windows depend on which controller is being used. The common parameters available for the motion controllers are described:

- DC Brushed (see Section 4.3.1).
- Stepper (see Section 4.3.2).
- Piezo (see Section 4.3.3).
- Brushless (see Section 4.3.4).

4.3.1 DC Brushed Devices

This section details the settings available for the KDC101 Brushed DC Motor Controller. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save.
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Control Loops Options	Description
Position	The DC Driver K-Cube® implements a full servo control loop for motor velocity and position control. The loop response to demanded position moves is determined via the sub-item settings. These settings can be altered using the 'Servo Loop (PID) Control Settings' parameters.
Proportional	Makes a change to the output which is proportional to the positional error value. A high proportional gain results in a large change in the output for a given error. Accepted values are in the range 0 to 32767.
Integral	Accelerates the process towards the demanded position, ensuring that the positional error is eventually reduced to zero. If set too high, the output can overshoot the demand value. Under a constant torque loading, the static position error is zero. Accepted values are in the range 0 to 32767.
Derivative	Provides the 'damping' force proportional to the rate of change of the position error, thereby decreasing the overshoot which may be caused by the integral term. However, the differential term also slows down system response. Accepted values are in the range 0 to 32767.
Integral Limit	Sets a maximum limit for the integration term to prevent an excessive build up over time of the restoring force. Accepted values are in the range 0 to 32767.

Move Options	Description
Backlash Distance	The system compensates for lead screw backlash during reverse direction moves by moving past the demanded position by a specified amount and then reversing. This ensures that positions are always approached in a forward direction. **Backlash Distance** is specified in real world units (millimeters or degrees). To remove backlash correction, this value should be set to zero.
Preset Absolute Position	The absolute position to move to when a trigger is configured.
Preset Relative Distance	The relative distance to move by when a trigger is configured.
Min. Velocity	Starting velocity of the motion profile.
Acceleration	The rate at which the velocity increases from zero to maximum and decreases from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.

Home Options	Description
Direction	The direction to move when homing. Options: **Forward** / **Reverse**.
Limit Switch	The hardware limit switch associated with the home position. Options: **Forward** / **Reverse**.
Offset Distance	The distance offset (in mm or degrees) from the limit switch to the Home position.
Velocity	The maximum velocity at which the motors move when homing.

Jog Options	Description
Mode	The way in which the motor moves when a jog command is received. Options: **Single Step** / **Continuous**. **Single Step**: The motor moves by the distance specified in the Step Size parameter. If the jog key is held down, single-step jogging is repeated until the button is released. **Continuous**: The motor actuator accelerates and moves at the jog velocity while the button is held down.
Step Size	The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).
Min. Velocity	Starting velocity of the motion profile.
Acceleration	The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.
Stop Mode	The way in which the jog motion stops when the demand is removed. Options: **Immediate** / **Profiled** **Immediate**: The motor stops quickly, in a non-profiled manner. **Profiled**: The motor stops in a profiled manner using the jog velocity parameters.

I/O 1 and I/O 2 Options	Description
Mode	I/O ports on both first and second ports can be configured for several uses. If enabled as digital inputs, then they can be configured to trigger either relative or absolute movements when activated or they could initiate a homing procedure. Alternatively, when configured as outputs, they can activate to indicate motion in progress or that maximum velocity has been reached during movement. They may also produce a pulsed output where they activate recurrently at pre-defined positions. Finally, the I/O ports can be configured for software control so that the client can read or set them arbitrarily.
Polarity	The voltage level at which the I/O port is considered active. This could be nominally 0 V or 5 V.

Joystick Options	Description
Mode	Deflecting the joystick wheel starts a move with the velocity proportional to the deflection.
Max. Velocity	The velocity corresponding to the full deflection of the joystick wheel.
Acceleration	The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.
Direction Sense	The direction of a move initiated by the velocity wheel. Options: **Forwards** / **Backwards** **Forwards**: Upwards rotation of the wheel results in a positive motion (that is, increased position count). **Backwards**: Upwards rotation of the wheel results in a negative motion (that is, decreased position count). Note: This applies only when **Mode** is set to **Control Velocity**. If set to **Position Jogging** or **Go to Position Mode**, it is ignored.
Preset Position 1	The motor moves to position 1 when the jog wheel is moved down.
Preset Position 2	The motor moves to position 1 when the wheel is moved up.

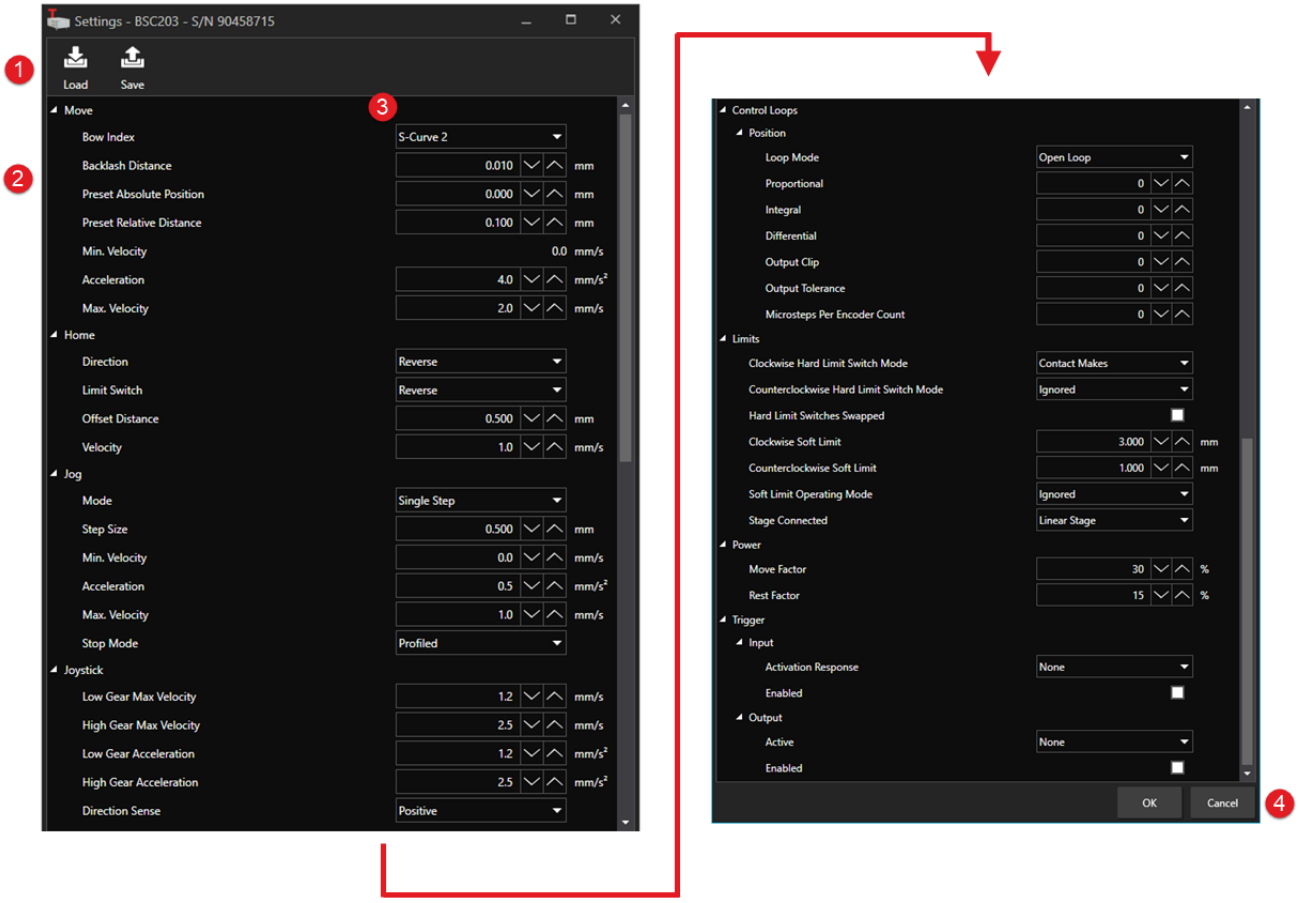
Display Options	Description
Brightness	It is necessary to adjust the brightness of the LED display on the top of the unit. The brightness is set in the **Display Intensity** parameter, as a value from 0 (Off) to 100 (brightest). The display is turned off completely by entering a setting of zero, however, press the **MENU** button on the top panel to temporarily illuminate the display at its lowest brightness setting to allow adjustments. When the display returns to its default position display mode, it turns off again.
Timeout	The display is automatically dimmed after the time interval specified to prevent 'burn in' of the display.
Dim Level	The time interval is specified in minutes in the range 1 to 480. The dim level is set in the Dimmed Intensity parameter, as a percentage of full brightness from 0 (Off) to 10 (brightest) but is also limited by the Display Intensity parameter if this is lower.

Trigger Out Options	Description
Forward Start Position	Trigger output active (pulsed) at pre-defined positions moving forward. Only one Trigger port at a time can be set to this mode.
Forward Interval	The distance between the start of pulses in the forward direction when a pulsed I/O mode is selected.
Forward Number of Pulses	The number of pulses that can be created in the forward direction when a pulsed I/O mode is selected.
Reverse Start Position	Trigger output active (pulsed) at pre-defined positions moving backwards. Only one Trigger port at a time can be set to this mode.
Reverse Interval	The distance between the start of pulses in the reverse direction when a pulsed I/O mode is selected.
Reverse Number of Pulses	The number of pulses that can be created in the reverse direction when a pulsed I/O mode is selected.
Number of Cycles	The number forward/reverse move cycles when a pulsed I/O mode is selected.
Pulse Width	The trigger output pulse width.

Limits Options	Description
Clockwise Hard Limit Switch Mode	Configures the hardware limit switch behavior in the forward (clockwise) direction of travel.
Counterclockwise Hard Limit Switch Mode	Configures the hardware limit switch behavior in the reverse (counterclockwise) direction of travel.
Hard Limit Switches Swapped	Defines whether the clockwise and counterclockwise limit switches have been physically swapped.
Clockwise Soft Limit	Software defined limit switch in the forward (clockwise) direction of travel.
Counterclockwise Soft Limit	Software defined limit switch in the reverse (counterclockwise) direction of travel.
Soft Limit Operating Mode	The operation of the stage or actuator when the software defined limit switch is triggered.

4.3.2 Stepper Devices

This section details the settings available for the BSC203 Stepper Motor Controller. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Move Options	Description
Bow Index	Selects between trapezoidal or S-Curve motion profiles when executing a movement.
Backlash Distance	The system compensates for lead screw backlash during reverse direction moves by moving past the demanded position by a specified amount and then reversing. This ensures that positions are always approached in a forward direction. **Backlash Distance** is specified in real world units (millimeters or degrees). To remove backlash correction, this value should be set to zero.
Preset Absolute Position	The absolute position to move to when a trigger is configured.
Preset Relative Distance	The relative distance to move by when a trigger is configured.
Min. Velocity	The starting velocity when initiating a move.
Acceleration	The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.

Home Options	Description
Direction	The direction to move when homing. Options: **Forward** / **Reverse**.
Limit Switch	The hardware limit switch associated with the home position. Options: **Forward** / **Reverse**.
Offset Distance	The distance offset (in mm or degrees) from the limit switch to the home position.
Velocity	The maximum velocity at which the motors move when homing.

Jog Options	Description
Mode	The way in which the motor moves when a jog command is received. Options: **Single Step** / **Continuous**. **Single Step**: The motor moves by the distance specified in the Step Size parameter. If the jog key is held down, single-step jogging is repeated until the button is released. **Continuous**: The motor actuator accelerates and moves at the jog velocity while the button is held down.
Step Size	The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).
Min. Velocity	The starting velocity when initiating a jog.
Acceleration	The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.
Stop Mode	The way in which the jog motion stops when the demand is removed. Options: **Immediate** / **Profiled** **Immediate**: The motor stops quickly, in a non-profiled manner. **Profiled**: The motor stops in a profiled manner using the jog velocity parameters.

Joystick Options	Description
Low Gear Max Velocity	The maximum velocity of a move when low gear mode is selected.
High Gear Max Velocity	The maximum velocity of a move when high gear mode is selected.
Low Gear Acceleration	The acceleration of a move when low gear mode is selected.
High Gear Acceleration	The acceleration of a move when high gear mode is selected.
Direction Sense	The actual direction sense of any joystick-initiated moves. It depends upon the application. This parameter can be used to reverse the sense of direction for a particular application and is useful when matching joystick direction sense to actual stage direction sense.

Control Loops Position Options	Description
Loop Mode	The mode the movement is being performed in. Options: **Open Loop** / **Closed Loop** Note: These are only possible whilst an encoder is connected.
Proportional	Makes a change to the output which is proportional to the positional error value. A high proportional gain results in a large change in the output for a given error. Accepted values are in the range 0 to 32767.
Integral	Accelerates the process towards the demanded position, ensuring that the positional error is eventually reduced to zero. If set too high, the output can overshoot the demand value. Under a constant torque loading, the static position error is zero. Accepted values are in the range 0 to 32767.
Differential	The differential term in a PID loop has the effect of damping acceleration.
Output Clip	Clips the value of the PID loop to ensure that the value does not run away.
Output Tolerance	A dead-band value below which the output of PID generator is effectively deemed to be zero to avoid continual cycling about the set point.
Microsteps Per Encoder Count	The size of the microstep depends on the resolution of the driver electronics. When used with the Thorlabs BSC203 Stepper Motor Controller, the smallest angular adjustment is 0.000879° (that is, 1.8/0.000879 = 2048 microsteps per full step).

Limits Options	Description
Clockwise Hard Limit Switch Mode	Configures the hardware limit switch behavior in the forward (clockwise) direction of travel.
Counterclockwise Hard Limit Switch Mode	Configures the hardware limit switch behavior in the reverse (counterclockwise) direction of travel.
Hard Limit Switches Swapped	Defines whether the clockwise and counterclockwise limit switches have been physically swapped.
Clockwise Soft Limit	Software defined limit switch in the forward (clockwise) direction of travel.
Counterclockwise Soft Limit	Software defined limit switch in the reverse (counterclockwise) direction of travel.
Soft Limit Operating Mode	The operation of the stage or actuator when the software defined limit switch is triggered.
Stage Connected	The type of movement that the connected stage performs.

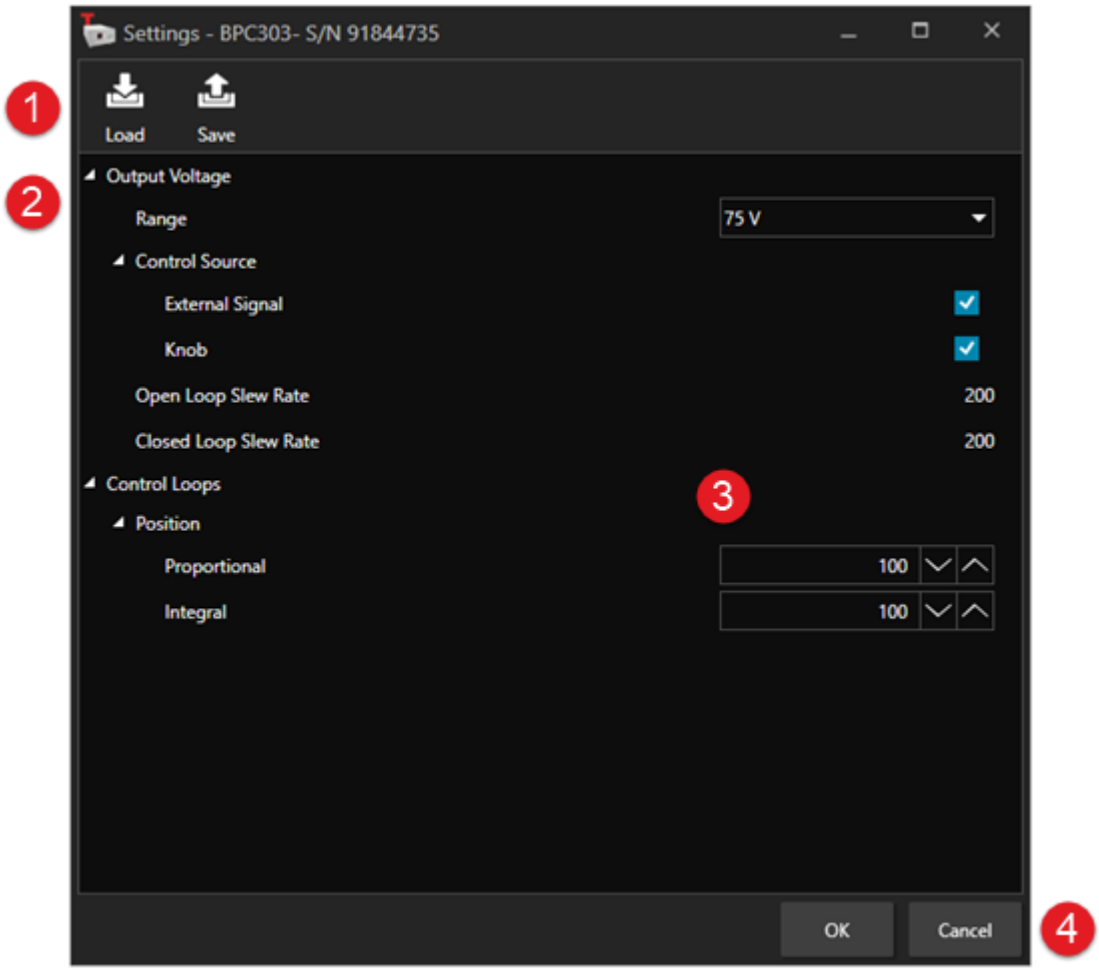
Power Options	Description
Move Factor	Percentage of maximum power to drive the motor during a movement.
Rest Factor	Percentage of maximum power to drive the motor when holding its position.

Trigger Input Options	Description
Activation Response	Determines the effect of an input trigger. This could initiate a homing procedure or a relative or absolute move.
Enabled	Whether the trigger is enabled or not.

Trigger Output Options	Description
Active	Outputs can be activated in the event of an input trigger and can either mirror the input trigger signal exactly or remain active for the period of the move.
Enabled	Whether the output is active or not.

4.3.3 Piezo Devices

This section details the settings available for the BPC303 Piezo Controller. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



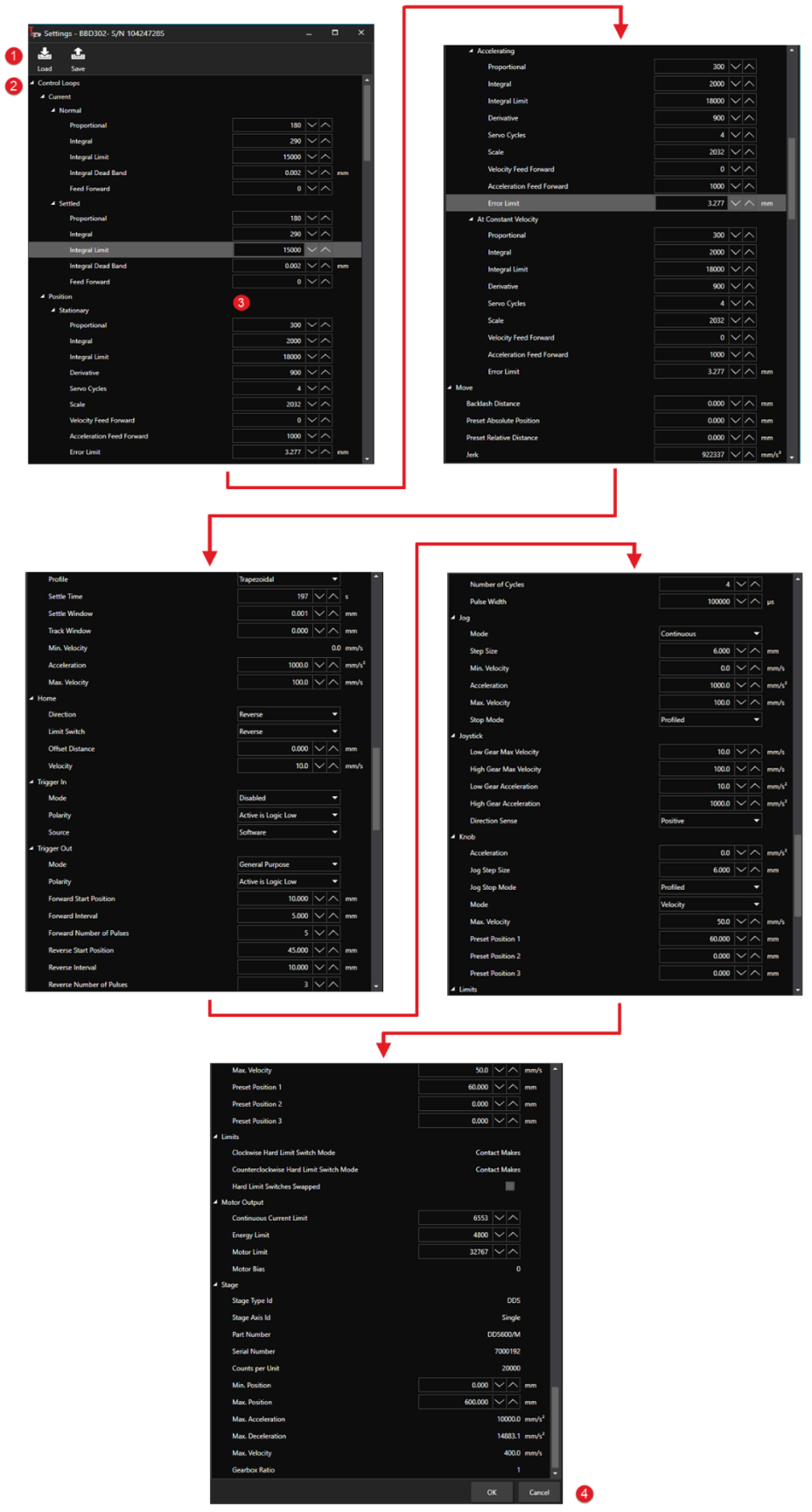
Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Output Voltage Options	Description
Range	Maximum Voltage used to set the maximum output voltage of the piezo controller. This must be set up to suit the maximum specified operating voltage of the piezo actuator connected to the unit. Most Thorlabs piezo actuators are specified for either 75 V or 150 V maximum operation. In general, the maximum voltage should not be exceeded because it can cause damage to the piezo actuator.
Control Source > External Signal	Allows the output voltage to be controlled proportionally to the differential voltage applied to the EXT IN - and EXT IN + connectors.
Control Source > Knob	Allows control of the output voltage by either the front panel knob or a potentiometer connected to the User I/O D-Type connector.
Open Loop Slew Rate	The maximum slew rate when operating in open loop mode. Slew Rate = Value x Max Voltage / 19000, where Max Voltage is 75, 100, or 150 V.
Closed Loop Slew Rate	The maximum slew rate when operating in closed loop mode. Calculated as for Open Loop Slew Rate.

Control Loops Position Options	Description
Proportional	Proportional term of the PID control loop. This value is proportional to error between the current and set point.
Integral	Integral term of the PID control loop.

4.3.4 Brushless Devices

This section details the settings available for the BBD302 Brushless Motor Controller. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Control Loops

The current loop parameters provide digital control of the alternating current (AC) sent to the stage's electric motor. The current drives the motor, and the current loop parameters can be used to improve response times and increase motor efficiency as the stage moves to the target position. The current is supplied to several different coils of wire within the motor. These coils are often called phase windings, since the phase of the AC in each coil differs by a controlled amount

Control Loops Current Normal Options	Description
Proportional	Drives the motor current to the demand value, reducing the current error. Accepted values are in the range 0 to 2,147,483,647.
Integral	Provides the 'restoring force' that grows with time, ensuring that the current error is zero under a constant torque loading. Accepted values are in the range 0 to 32767.
Integral Limit	Caps the value of the integrator to prevent an excessive build up over time of the 'restoring force', thereby causing run away of the integral sum at the output. Accepted values are in the range 0 to 32767. Note: If set to 0 then the integration term in the PI loop is ignored.
Integral Dead Band	Allows an integral dead band to be set, such that when the error is within this dead band, the integral action stops, and the move is completed using the proportional term only.
Feed Forward	A feed-forward term added to the output of the PI filter. Accepted values are in the range 0 to 32767.

Control Loops Current Settled Options	Description
Proportional	Drives the motor current to the demand value, reducing the current error. Accepted values are in the range 0 to 2,147,483,647.
Integral	Provides the 'restoring force' that grows with time, ensuring that the current error is zero under a constant torque loading. Accepted values are in the range 0 to 32767.
Integral Limit	Caps the value of the integrator to prevent an excessive build up over time of the 'restoring force', thereby causing run away of the integral sum at the output. Accepted values are in the range 0 to 32767. Note: If set to 0 then the integration term in the PI loop is ignored.
Integral Dead Band	Allows an integral dead band to be set, such that when the error is within this dead band, the integral action stops, and the move is completed using the proportional term only.
Feed Forward	A feed-forward term added to the output of the PI filter. Accepted values are in the range 0 to 32767.

Control Loops Position Stationary Options	Description
Proportional	Increasing this value increases the amount of effective torque used to correct a given position error. Typically, this is used to minimize the amount of position error when an impulse event affects current target position during motion (that is, stiction, vibration, and so on). If the proportional term is too high this can lead to overshoot and general instability. If this is too low, it can result in a sloppy response. Accepted values are in the range 0 to 32767.
Integral	Increasing this value minimizes following error and final position error. If the value is too high this will typically lead to motion overshoot during and at end of move. If the value is too low final position may take a long time to reach, if at all. Accepted values are in the range 0 to 32767.
Integral Limit	Limits the wind-up limit for the **Integral** value such that excessive overshoots are prevented. Typically used to prevent runaway integral calculations due to stiction and other such physical forms of random forces. Normally it is set as low as possible, but high enough that with the given **Integral** value, the final position can be reached. Accepted values are in the range 0 to 2,147,483,647. Note: If set to 0 then the integration term in the PI loop is ignored.
Derivative	Increasing this value decreases the rate of change of driver output. Typically, this is used to reduce the overshoot from a given motion. If the value is too high, it can become sensitive to noise from the measured position error; if the value is too low, velocity fluctuations may arise during motion. Accepted values are in the range 0 to 32767.
Servo Cycles	The number of servo cycles to wait between calculating the derivative term.
Scale	It is a scaling factor applied to the output of the PID loop. It accepts values in the range 0 to 65535, where 0 is 0% and 65535 is 100%.
Velocity Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Acceleration Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Error Limit	Under certain circumstances, the actual encoder position may differ from the demanded position by an excessive amount. Such a large position error is often indicative of a potentially dangerous condition such as motor failure, encoder failure, or excessive mechanical friction. To warn of and guard against this condition, a maximum position error can be set in the Position Error Limit parameter. Accepted values are in the range 0 to 2,147,483,647. The actual position error is continuously compared against the limit entered, and if exceeded the associated axis is stopped.

Control Loops Position Accelerating Options	Description
Proportional	Increasing this value increases the amount of effective torque used to correct a given position error. Typically, this is used to minimize the amount of position error when an impulse event affects current target position during motion (that is, stiction, vibration, and so on). If the proportional term is too high this can lead to overshoot and general instability. If this is too low, it can result in a sloppy response. Accepted values are in the range 0 to 32767.
Integral	Increasing this value minimizes following error and final position error. If the value is too high this will typically lead to motion overshoot during and at end of move. If the value is too low final position may take a long time to reach, if at all. Accepted values are in the range 0 to 32767.
Integral Limit	Limits the wind-up limit for the **Integral** value such that excessive overshoots are prevented. Typically used to prevent runaway integral calculations due to stiction and other such physical forms of random forces. Normally it is set as low as possible, but high enough that with the given **Integral** value, the final position can be reached. Accepted values are in the range 0 to 2,147,483,647. Note: If set to 0 then the integration term in the PI loop is ignored.
Derivative	Increasing this value decreases the rate of change of driver output. Typically, this is used to reduce the overshoot from a given motion. If the value is too high, it can become sensitive to noise from the measured position error; if the value is too low, velocity fluctuations may arise during motion. Accepted values are in the range 0 to 32767.
Servo Cycles	The number of servo cycles to wait between calculating the derivative term.
Scale	It is a scaling factor applied to the output of the PID loop. It accepts values in the range 0 to 65535, where 0 is 0% and 65535 is 100%.
Velocity Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Acceleration Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Error Limit	Under certain circumstances, the actual encoder position may differ from the demanded position by an excessive amount. Such a large position error is often indicative of a potentially dangerous condition such as motor failure, encoder failure, or excessive mechanical friction. To warn of and guard against this condition, a maximum position error can be set in the Position Error Limit parameter. Accepted values are in the range 0 to 2,147,483,647. The actual position error is continuously compared against the limit entered, and if exceeded the associated axis is stopped.

Control Loops Position At Constant Velocity Options	Description
Proportional	Increasing this value increases the amount of effective torque used to correct a given position error. Typically, this is used to minimize the amount of position error when an impulse event affects current target position during motion (that is, stiction, vibration, and so on). If the proportional term is too high this can lead to overshoot and general instability. If this is too low, it can result in a sloppy response. Accepted values are in the range 0 to 32767.
Integral	Increasing this value minimizes following error and final position error. If the value is too high this will typically lead to motion overshoot during and at end of move. If the value is too low final position may take a long time to reach, if at all. Accepted values are in the range 0 to 32767.
Integral Limit	Limits the wind-up limit for the **Integral** value such that excessive overshoots are prevented. Typically used to prevent runaway integral calculations due to stiction and other such physical forms of random forces. Normally it is set as low as possible, but high enough that with the given **Integral** value, the final position can be reached. Accepted values are in the range 0 to 2,147,483,647. Note: If set to 0 then the integration term in the PI loop is ignored.
Derivative	Increasing this value decreases the rate of change of driver output. Typically, this is used to reduce the overshoot from a given motion. If the value is too high, it can become sensitive to noise from the measured position error; if the value is too low, velocity fluctuations may arise during motion. Accepted values are in the range 0 to 32767.
Servo Cycles	The number of servo cycles to wait between calculating the derivative term.
Scale	It is a scaling factor applied to the output of the PID loop. It accepts values in the range 0 to 65535, where 0 is 0% and 65535 is 100%.
Velocity Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Acceleration Feed Forward	A feed-forward term added to the output of the PI filter to assist in tuning the motor drive signal. Accepted values are in the range 0 to 32767.
Error Limit	Under certain circumstances, the actual encoder position may differ from the demanded position by an excessive amount. Such a large position error is often indicative of a potentially dangerous condition such as motor failure, encoder failure, or excessive mechanical friction. To warn of and guard against this condition, a maximum position error can be set in the Position Error Limit parameter. Accepted values are in the range 0 to 2,147,483,647.

Control Loops Position At Constant Velocity Options	Description
	The actual position error is continuously compared against the limit entered, and if exceeded the associated axis is stopped.

Move Options	Description
Backlash Distance	The system compensates for lead screw backlash during reverse direction moves by moving past the demanded position by a specified amount and then reversing. This ensures that positions are always approached in a forward direction. **Backlash Distance** is specified in real world units (millimeters or degrees). To remove backlash correction, this value should be set to zero.
Preset Absolute Position	The absolute position to move to when a trigger is configured.
Preset Relative Distance	The relative distance to move by when a trigger is configured.
Jerk	Specifies the maximum rate of change in acceleration. **Jerk** is specified in mm/s$^{3.}$ Accepted values are in the range 0 to 46566139.
Profile	Used to set the profile mode. Option: **Trapezoidal** / **S-curve**. In either case, the velocity and acceleration of the profile are specified using parameters on the **Move** or **Jog** tab.
Settle Time	The time that the associated axis must be settled before the settled status is sent.
Settle Window	Specifies the maximum allowed positional error between the target and actual motor positions.
Track Window	Specifies the maximum allowed positional error between the target and actual motor trajectory.
Min. Velocity	The starting velocity when initiating a move.
Acceleration	The rate at which the jog velocity climbs from zero to maximum and slows from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.

Home Options	Description
Direction	The direction to move when homing. Options: **Forward** / **Reverse**.
Limit Switch	The hardware limit switch associated with the home position. Options: **Forward** / **Reverse** .
Offset Distance	The distance offset (in mm or degrees) from the limit switch to the home position.
Velocity	The maximum velocity at which the motors move when homing.

Trigger In Options	Description
Mode	I/O ports on both first and second ports can be configured for several uses. If enabled as digital inputs, then they can be configured to trigger either relative or absolute movements when activated or they could initiate a homing procedure. Alternatively, when configured as outputs, they can activate to indicate motion in progress or that maximum velocity has been reached during movement. They may also produce a pulsed output where they activate recurrently at pre-defined positions. Finally, the I/O ports can be configured for software control so that the client can read or set them arbitrarily.
Polarity	The polarity of the trigger pulse is specified in the Trigger 1 Polarity and Trigger 2 Polarity.
Source	The source that activates the trigger. Options are **Software** if activated using the SDK, or one of the electronic hardware inputs on the AUX I/O connector.

Trigger Out Options	Description
Mode	The trigger output can be set either for the complete period that the device is in motion, after motion has completed or after the stage has reached its target velocity.
Polarity	The voltage level at which the I/O port is considered active. This could be nominally 0 V or 5 V.
Forward Start Position	Trigger output active (pulsed) at pre-defined positions moving forward. Only one Trigger port at a time can be set to this mode.
Forward Interval	The distance between the start of pulses in the forward direction when a pulsed I/O mode is selected.
Forward Number of Pulses	The number of pulses that can be created in the forward direction when a pulsed I/O mode is selected.
Reverse Start Position	Trigger output active (pulsed) at pre-defined positions moving backwards. Only one Trigger port at a time can be set to this mode.
Reverse Interval	The distance between the start of pulses in the reverse direction when a pulsed I/O mode is selected.
Reverse Number of Pulses	The number of pulses that can be created in the reverse direction when a pulsed I/O mode is selected.
Number of Cycles	The number forward/reverse move cycles when a pulsed I/O mode is selected.
Pulse Width	The trigger output pulse width.

Jog Options	Description
Mode	The way in which the motor moves when a jog command is received. Options: **Jog** / **Continuous**. **Jog**: The motor moves by the distance specified in the Step Size parameter. If the jog key is held down, single-step jogging is repeated until the button is released. **Continuous**: The motor actuator accelerates and moves at the jog velocity while the button is held down.
Step Size	The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).
Min. Velocity	Starting velocity of the motion profile.
Acceleration	The rate at which the velocity climbs from zero to maximum and slows from maximum to zero.
Max. Velocity	The maximum velocity at which to perform a move.
Stop Mode	The way in which the jog motion stops when the demand is removed. Options: **Immediate** / **Profiled** **Immediate**: The motor stops quickly, in a non-profiled manner. **Profiled**: The motor stops in a profiled manner using the jog velocity parameters.

Joystick Options	Description
Low Gear Max Velocity	The maximum velocity of a move when low gear mode is selected.
High Gear Max Velocity	The maximum velocity of a move when high gear mode is selected.
Low Gear Acceleration	The acceleration of a move when low gear mode is selected.
High Gear Acceleration	The acceleration of a move when high gear mode is selected.
Direction Sense	The actual direction sense of any joystick-initiated moves. It depends upon the application. This parameter can be used to reverse the sense of direction for a particular application and is useful when matching joystick direction sense to actual stage direction sense.

Knob Options	Description
Acceleration	The maximum acceleration of a move initiated by the control wheel.
Jog Step Size	The size of the step initiated by the control wheel when configured to jog.
Jog Stop Mode	The behavior of the control wheel. It can be: • Moving with a velocity proportional to the deflection of the wheel. • A jog motion when the wheel is deflected. • Moving between preset positions.
Mode	The way in which the motor moves when a jog command is received.
Max. Velocity	The maximum velocity is achievable under manual control using the wheel.
Preset Position 1	The first of three preset positions that can be cycled through using the control wheel.
Preset Position 2	The second of three preset positions that can be cycled through using the control wheel.
Preset Position 3	The third of three preset positions that can be cycled through using the control wheel.

Limits Options	Description
Clockwise Hard Limit Switch Mode	The hardware limit switch associated with the home position. Options are: **Ignore** / **Forward (Hard)**.
Counterclockwise Hard Limit Switch Mode	The hardware limit switch associated with the home position. Options are: **Ignore** / **Reverse (Hard)**.
Hard Limit Switches Stopped	Whether the clockwise (or forward) and counterclockwise (or reverse) limit switches have been physically swapped.

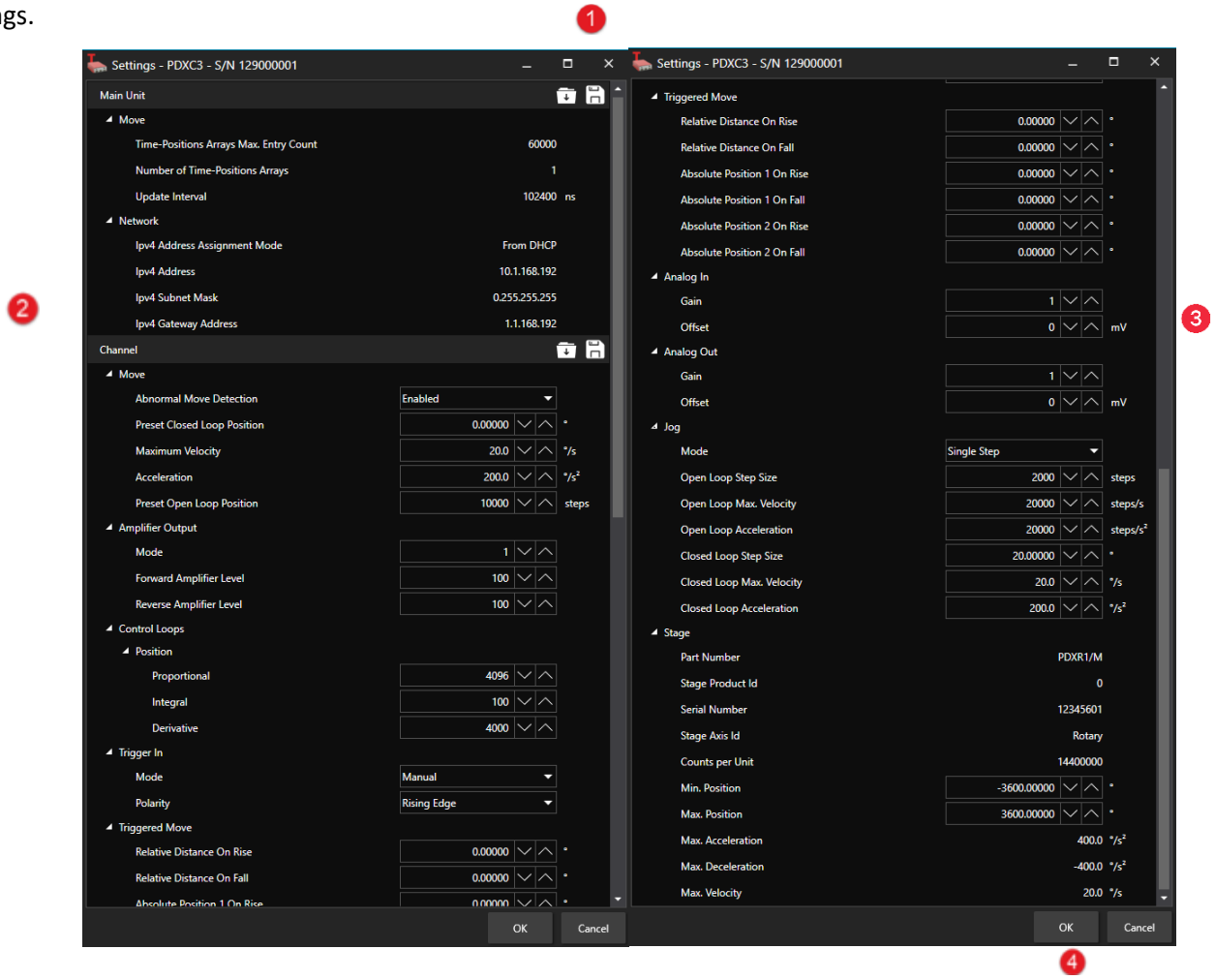
Motor Output Options	Description
Continuous Current Limit	A current 'foldback' facility, whereby the continuous current level can be capped. Accepted values are as a percentage of maximum peak current, in the range 0% to 100%, which is the factory-set default maximum setting (note: this maximum value cannot be altered).
Energy Limit	When the current output of the drive exceeds the limit set in the **Continuous Current Limit** parameter, accumulation of excess current energy begins. The **Energy Limit** parameter specifies a limit for this accumulated energy, as a percentage of the factory-set default maximum, in the range 0% to 100%. When the accumulated energy exceeds this value, a 'current foldback' condition is said to exist, and the commanded current is limited to the value specified in the **Continuous Current Limit** parameter. When this occurs, the Current Foldback status bit (bit 25) is set in the Status Register and the **Current Limit** indicator on the GUI panel is lit. When the accumulated energy above the **Continuous Current Limit** value falls to 0, the limit is removed and the status bit is cleared.
Motor Limit	Sets a limit for the motor drive signal. Accepts values are in the range 0 to 100% (32767). If the system produces a value greater than the limit set, the motor command takes the limiting value. For example, if **Motor Limit** is set to 30000 (91.6%), then signals greater than 30000 will be output as 30000 and values less than -30000 will be output as -30000.
Motor Bias	Not currently implemented.

Stage Options	Description
Stage Type Id	The ID number of the device connected. This number is used by the server to assign stage specific parameter values at start up.
Stage Axis Id	Identifies the axis on a multi-axis device.
Part Number	The part number of the connected device.
Serial Number	The serial number of the connected device.
Counts per Unit	The number of encoder counts per millimeter of travel of the DC servo motor.
Min. Position	The minimum allowable travel of the device.
Max. Position	The maximum allowable travel of the device.
Max. Acceleration	The maximum allowable acceleration of the device.
Max. Deceleration	The maximum allowable deceleration of the device.
Max. Velocity	The maximum allowable velocity of the device.
Gearbox Ration	The number of encoder counts per real-world units.

4.3.5 Piezo Inertia Stages

PDXC3

This section details the settings available for the PDXC3 Piezo Inertia Stage controllers. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Main Unit Move Options	Description
Time-Positions Arrays Max. Entry Count	The maximum number of time-position pairs that can be sent to the device for multi-axis synchronized path moves.
Number of Time-Positions Arrays	The number of paths that can be stored.
Update Interval	The time interval between position entries.

Main Unit Network Options	Description
IPv4 Address Assignment Mode	Whether the displayed IP address has been allocated automatically by a Dynamic Host Configuration Protocol (DHCP) server, or whether it has been set statically on the controller.
IPv4 Address	The Internet Protocol (IPV4) address of the device.
IPv4 Subnet Mask	The subnet mask for the current network.
IPv4 Gateway Address	The gateway address of the switch or router that allows communication outside of the subnet.

Channel Move Options	Description
Abnormal Move Detection	Configure whether abnormal move detection is enabled or disabled.
Preset Closed Loop Position	The position to move to once a move to the preset position is commanded when operating in closed-loop mode.
Maximum Velocity	The maximum velocity at which to move the stage.
Acceleration	The maximum acceleration at which to move the stage.
Preset Open Loop Position	The position to move to once a move to the preset position is commanded when operating in open-loop mode.

Channel Amplifier Output Options	Description
Mode	The operating mode of the amplifier; this value is reserved and should be left at 1.
Forward Amplifier Level	The percentage of maximum drive signal output level to use in the forward direction of travel.
Reverse Amplifier Level	The percentage of maximum drive signal output level to use in the reverse direction of travel.

Channel Control Loops Position Options	Description
Proportional	The proportional term coefficient for the position error control loop.
Integral	The integral term coefficient for the position error control loop.
Derivative	The derivative term coefficient for the position error control loop.

Channel Trigger In Options	Description
Mode	The action to be performed when a trigger condition is detected on the input. Please refer to the product manual for more information.
Polarity	Whether the trigger is asserted on a rising or falling voltage transition.

Channel Triggered Move Options	Description
Relative Distance On Rise	The relative distance to move when a rising trigger edge is encountered.
Relative Distance On Fall	The relative distance to move when a falling trigger edge is encountered.
Absolute Position 1 On Rise	The first absolute position to move to when a rising trigger edge is encountered.
Absolute Position 1 On Fall	The first absolute position to move to when a falling trigger edge is encountered.
Absolute Position 2 On Rise	The second absolute position to move to when a rising trigger edge is encountered.
Absolute Position 2 On Fall	The second absolute position to move to when a falling trigger edge is encountered.

Channel Analog In Options	Description
Gain	The gain applied to the analog input signal.
Offset	A DC offset applied to the analog input signal.

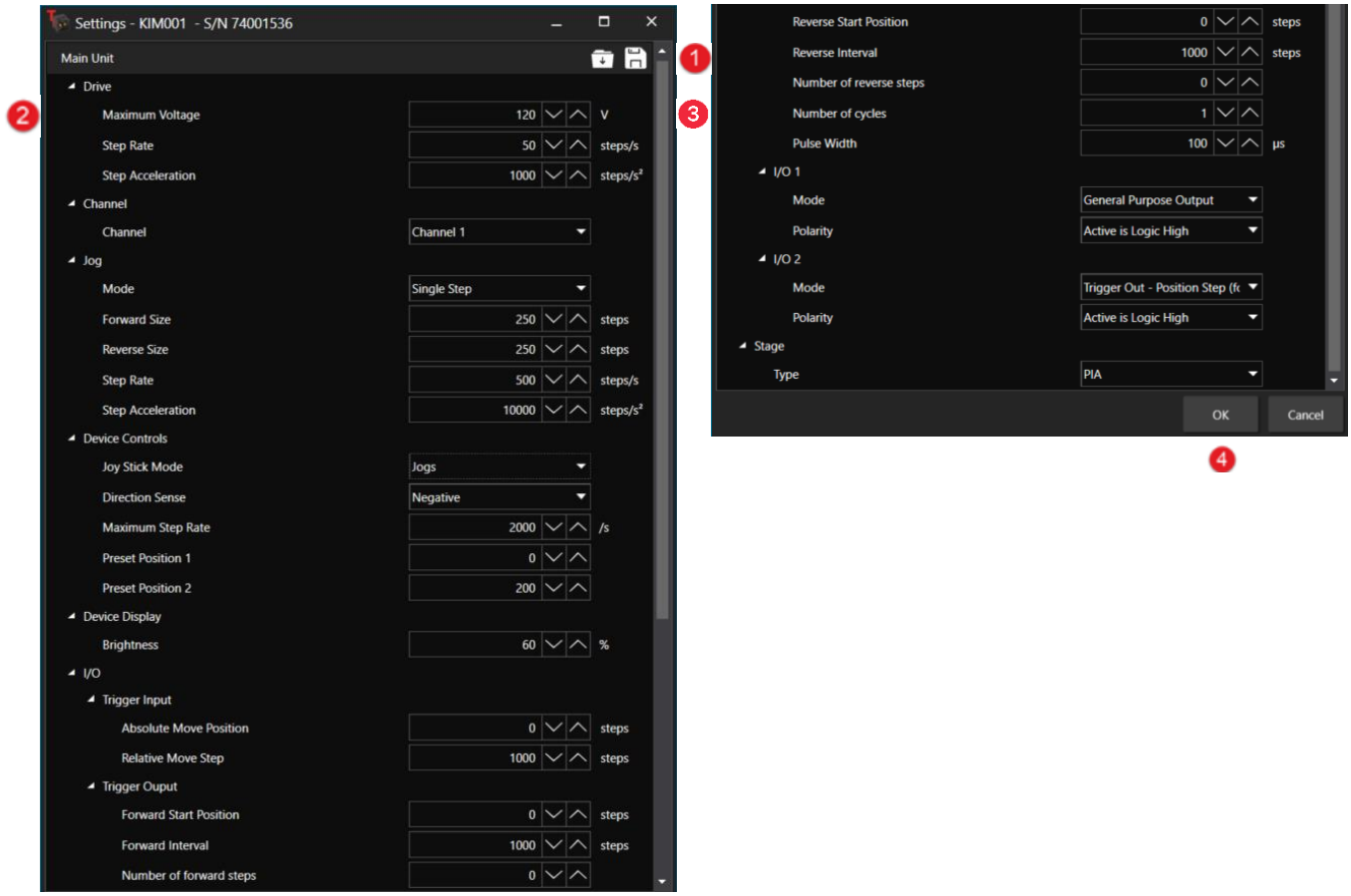
Channel Analog Out Options	Description
Gain	The gain applied to the analog output signal.
Offset	A DC offset applied to the analog output signal.

Channel Jog Options	Description
Mode	Select between continuous movement or single steps when jogging.
Open Loop Step Size	The number of steps to jog when in open-loop control mode.
Open Loop Max. Velocity	The maximum velocity to reach whilst jogging in open-loop mode.
Open Loop Acceleration	The maximum acceleration to reach whilst jogging in open-loop mode.
Closed Loop Step Size	The distance to jog when in closed-loop control mode.
Closed Loop Max. Velocity	The maximum velocity to reach whilst jogging in closed-loop mode.
Closed Loop Acceleration	The maximum acceleration to reach whilst jogging in closed-loop mode.

Channel Stage Options	Description
Part Number	The name of the connected stage.
Stage Product Id	An internal numerical identifier representing the connected stage.
Serial Number	The serial number of the connected stage.
Stage Axis Id	The type of movement provided by the stage.
Counts per Unit	The number of steps per mm or degree.
Min. Position	The minimum achievable position of the connected stage.
Max. Position	The maximum achievable position of the connected stage.
Max. Acceleration	The maximum attainable acceleration under zero load of the connected stage.
Max. Deceleration	The maximum attainable deceleration under zero load of the connected stage.
Max. Velocity	The maximum attainable velocity under zero load of the connected stage.

KIM001

The KIM K-Cube Piezo Inertia Controllers use a reduced set of parameters that differ slightly from those of the PDXC family. This example is intended to familiarize users with the available settings. As an open-loop controller, the kinetic parameters are directly related to the number of steps performed by the actuator. For additional details, refer to the relevant KIM controller user manual.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Main Unit Drive Options	Description
Maximum Voltage	The maximum voltage to drive the actuator.
Step Rate	The number of steps per second that the actuator will reach at maximum travel whilst performing a non-jogging move.
Step Acceleration	The acceleration in steps per-second, per-second, of the actuator when being moved.

Main Unit Channel Options	Description
Channel	The channel to which the actuator is connected.

Main Unit Jog Options	Description
Mode	**Single Step**: The Jog button will instruct a single movement of fixed distance at the given jog parameters once the button is released. **Continuous:** The Jog button will begin jogging as soon as the given jog button is pressed and held and jogs will be issued continuously until the button is released.
Forward Size	The number of steps to jog in the forward (positive) direction.
Reverse Size	The number of steps to jog in the reverse (negative) direction.
Step Rate	The maximum number of steps per second that the actuator will reach at maximum travel whilst jogging.
Step Acceleration	The acceleration in steps per-second, per-second, of the actuator whilst jogging.

Main Unit Device Controls Options	Description
Joystick Mode	Determines the behavior of the integrated jog wheel. **Controls Velocity:** Moves continuously at *Maximum Step Rate* in either direction. **Jogs:** Jogs the actuator using the given jog parameters, in the direction determined by *Direction Sense*. **Goes to Position:** Jogs between the positions set in *Preset Position 1* and *Preset Position 2.*
Direction Sense	Inverts the direction jogged by the wheel. **Positive:** Default operation. **Negative:** Inverted operation.
Maximum Step Rate	Step rate to move at when **Joy Stick Mode** is set to *Controls Velocity.*
Preset Position 1	The first preset position that the actuator will move to when **Joy Stick Mode** is set to **Goes to Position**.
Preset Position 2	The second preset position that the actuator will move to when **Joy Stick Mode** is set to **Goes to Position**.

Main Unit Device Display Options	Description
Brightness	The brightness of the device screen backlight as a percentage.

Main Unit Device Trigger Input	Description
Absolute Move Position	The position to move to when *I/O Mode* is set to *Trigger In – Absolute Move.*
Relative Move Step	The distance, in steps, to move by when *I/O Mode* is set to **Trigger In – Relative Move.**

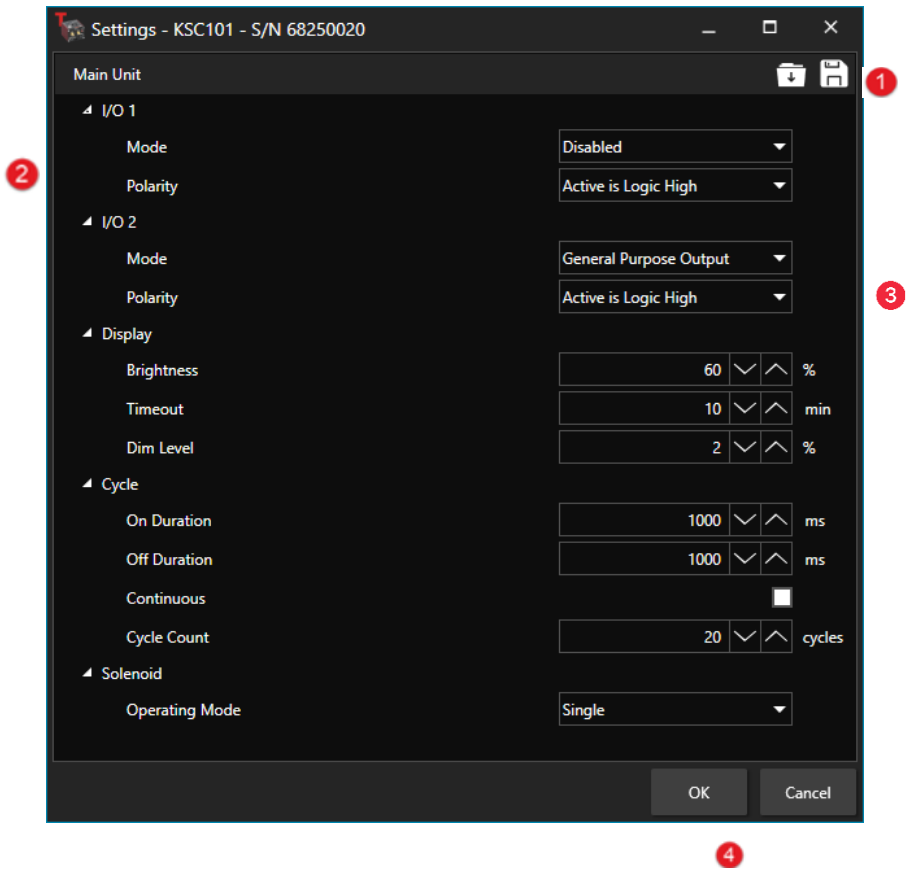
Main Unit Device Trigger Output	Description These settings are only applicable to *Trigger Out – Position Steps* trigger modes
Forward Start Position	The position, in the forward direction, that the position triggering sequence starts from.
Forward Interval	The number of steps between trigger pulses being asserted.
Number of forward steps	The maximum number of pulses to trigger in the forward direction.
Reverse Start Position	The position, in the reverse direction, that the position triggering sequence starts from.
Reverse Interval	The number of steps between trigger pulses being asserted.
Number of reverse steps	The maximum number of pulses to trigger in the forward direction.
Number of cycles	Number of times to repeat the complete trigger sequence.
Pulse Width	The width of the trigger pulse in microseconds.

Main Unit Device I/O 1 and 2 Options	Description
Mode	Trigger or I/O mode of the specified SMA connector. Refer to the product manual for available modes of operation.
Polarity	Whether the SMA connector detects, or outputs, a TTL voltage level high or low when an input or output is asserted.

Main Unit Device Stage Options	Description
Type	The connected actuator or stage.

4.3.6 Solenoid Settings

This section details the settings available for the KSC101 Solenoid Controller. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Main Unit I/O 1 and I/O 2 Options	Description
Mode	**Disabled:** The I/O port is disabled. **General Purpose Input:** A 5 V TTL signal on the port is reported through its status, the Polarity setting determining whether it's active high or active low. This mode also allows for remote operation of the solenoid. **General Purpose Output:** A 5 V TTL signal on the port is set using the Polarity setting.
Polarity	**Active is Logic High:** A TTL level high is determined to be asserted. **Active is Logic Low:** A TTL level low is determined to be asserted.

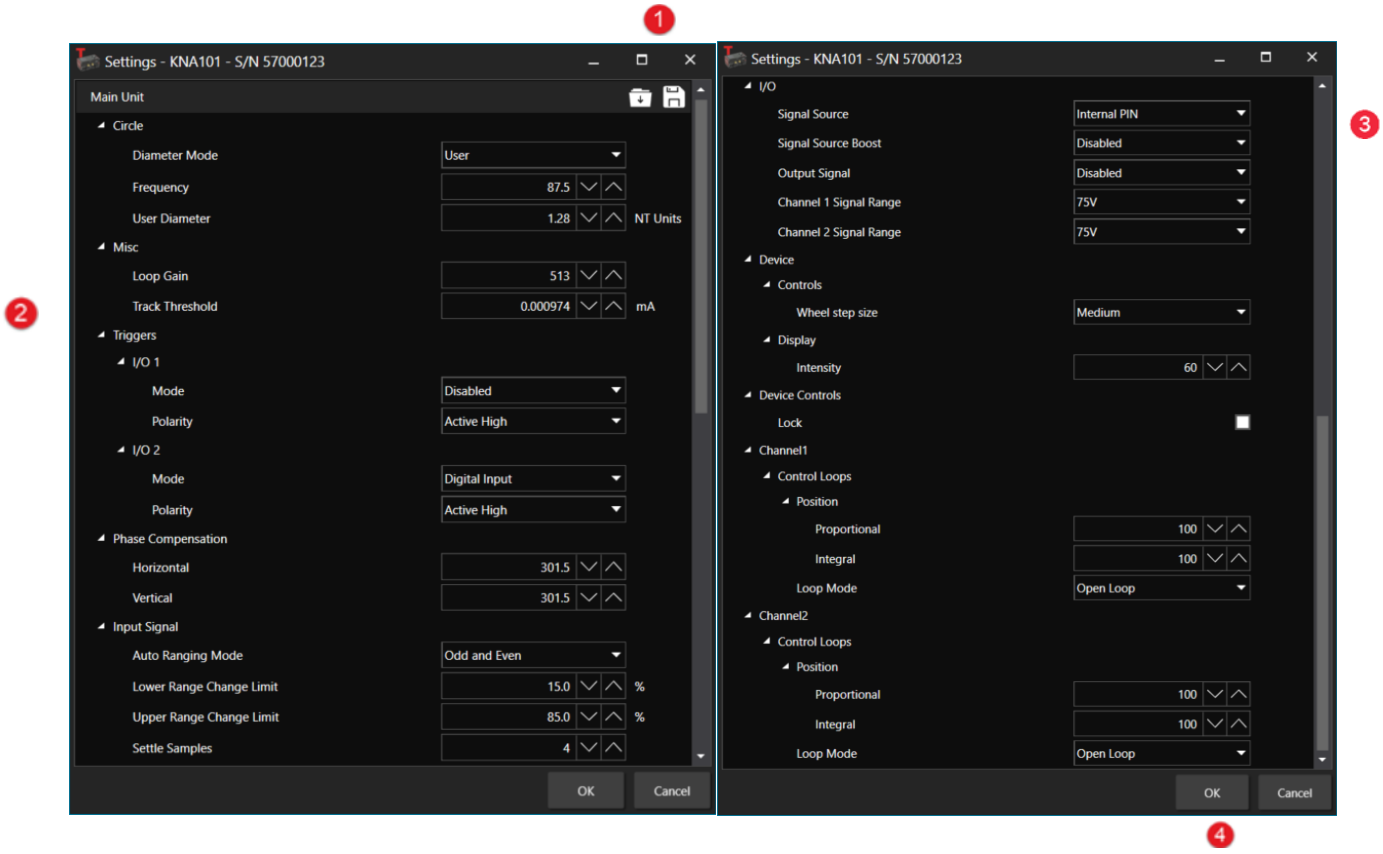
Main Unit Display Options	Description
Brightness	The brightness of the device's LCD screen, expressed as a percentage of the maximum brightness level.
Timeout	The delay, in minutes, between the last solenoid state change and the dimming of the display.
Dim Level	The percentage to which the display brightness is dimmed.

Main Unit Cycle Options	Description
On Duration	In Automatic mode, specifies the duration, in seconds, for which the solenoid is activated during each cycle.
Off Duration	In Automatic mode, specifies the duration, in seconds, for which the solenoid remains deactivated before it is reactivated in the next cycle.
Continuous	Repeats indefinitely.
Cycle Count	Specifies the number of cycles to perform when Continuous mode is disabled.

Main Unit Solenoid Options	Description
Manual	It allows the user to open or close the solenoid manually with a single button click.
Automatic	It operates the solenoid in a repeating pattern using a configurable duty cycle. The operation can continue indefinitely or run for a specified number of cycles
Single	It is initiated manually, but the shutter automatically reopens after a user-defined time interval.
Triggered	It enables remote control of the solenoid through an I/O port trigger signal.

4.3.7 Nanotrack Settings

This section details the settings available for the KNA family of Piezo NanoTrak® Active Auto-Alignment Fiber Controllers. This example is provided to familiarize the user with the expected settings. Other hardware configurations will have similar settings.



Item	Description
1	Load / Save
2	Parameter setting titles. Each parameter is described in the following tables.
3	Parameter setting configurable values.
4	Confirmation or cancellation buttons.

Main Unit Circle Options	Description
Diameter Mode	**User-** Manually Set **LUT-** Defined values for each detector amplifier gain setting
Frequency	Frequency of search circle scanning (Hz)
User Diameter	Specifies the diameter of the search circle in NT units when **Diameter Mode** is set to **User**.

Main Unit Misc. Options	Description
Loop Gain	Gain setting for the NanoTrak® control loop.
Track Threshold	The detector current threshold below which the Low Signal indicator is activated in the control window.

Main Unit Trigger I/O and I/O 2 Options	Description
Mode	**Disabled:** The port is disabled. **Digital Input:** A 5 V TTL signal on the port is reported through its status, the I/O Polarity setting determining whether it's active high or active low. **Digital Output:** A 5 V TTL signal on the port is set using the I/O Polarity setting. **Tracking:** When the port is asserted, the device will begin tracking. **Home:** When the port is asserted, the device will move to the circle home position. **Tracking Active:** The port is asserted whilst the device is tracking.
Polarity	**Active High:** A TTL level high is determined to be asserted. **Active Low:** A TTL level low is determined to be asserted.

Main Unit Phase Compensation Options	Description
Horizontal	The compensation in degrees to be added to the horizontal position.
Vertical	The compensation in degrees to be added to the vertical position.

Main Unit Input Signal Options	Description
Auto Ranging Mode	**Odd and Even:** All detector gain ranges are iterated through. **Odd:** Only the odd detector gain ranges are iterated through. **Even:** Only the even detector gain ranges are iterated through.
Lower Range Change Limit	Threshold at which the detector gain range reverts to the previous (or higher) gain level.
Higher Range Change Limit	Threshold at which the detector gain range proceeds to the next (or lower) gain level.
Settle Samples	The number of consecutive detector readings that are averaged to calculate the input signal.

Main Unit I/O Options	Description
Signal Source	**Internal PIN:** Uses the internal PIN detector diode for signal input. **External I/O 1:** Uses a 2 V input signal from an external voltage-source detector, such as the output of an external power meter.
Signal Source Boost	The signal source boost at low powers can be enabled or disabled.
Output Signal	The KNA piezo output channel may not provide sufficient current to drive certain stages. In such cases, a voltage output can be routed to I/O 2 for controlling an external piezo driver.
Channel 1 and 2 Signal Range	The maximum Piezo drive voltage that will be produced on the output channels.

Main Unit Device Options	Description
Control Wheel step size	The sensitivity of the control wheel (Slow, Medium or Fast).
Display Intensity	The display brightness, expressed as a percentage.

Main Unit Device Controls Options	Description
Lock	When selected, the manual controls on the unit are disabled

Main Unit Channel 1 and Channel 2 Options	Description
Position Control Loops Proportional	The proportional coefficient of the position control.
Position Control Loops Integral	The integral coefficient of the position control.
Loop Mode	**Open Loop:** The Piezo stage is controlled by voltage and without external position sensor feedback. **Closed Loop:** An external position feedback sensor on the stage is used as the input to the control loop.

Chapter 5 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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