

**ZABER**



## **ZABER TECHNOLOGIES**

Getting Started Guide

## Contents

|   |          |   |           |
|---|----------|---|-----------|
| <b>PRECAUTIONS</b> .....                    | <b>1</b> | <b>CONTROL</b> .....                      | <b>14</b> |
| <b>MAINTENANCE</b> .....                    | <b>2</b> | Software.....                             | 14        |
| <b>RETURNS, WARRANTY, AND REPAIRS</b> ..... | <b>2</b> | Zaber Console.....                        | 14        |
| <b>COMMON TERMINOLOGY</b> .....             | <b>3</b> | LabVIEW.....                              | 15        |
| <b>QUICK SET-UP CHECKLIST</b> .....         | <b>4</b> | Programming Libraries.....                | 15        |
| <b>CONNECT</b> .....                        | <b>5</b> | Resolution - Stepper & Servo Motors ..... | 15        |
| Daisy-chaining.....                         | 5        | I/O's & Triggers.....                     | 17        |
| Computer Connection: Serial Port.....       | 6        | Servo Device Tuning.....                  | 17        |
| Computer Connection: USB.....               | 6        | Manual Knobs.....                         | 23        |
| Power Connection.....                       | 7        | Joystick.....                             | 24        |
| Peripherals.....                            | 8        | <b>TROUBLESHOOTING</b> .....              | <b>26</b> |
| Vacuum Devices.....                         | 8        | Firmware Update.....                      | 26        |
| <b>CONFIGURE</b> .....                      | <b>9</b> | Slipping and Stalling.....                | 26        |
| Zaber Console.....                          | 9        | Resetting to Factory Default.....         | 26        |
| COM Ports.....                              | 9        | Front Panel Indicators.....               | 27        |
| Find Devices.....                           | 10       |   |           |
| Protocol.....                               | 11       |   |           |
| Default Configurations.....                 | 12       |   |           |
| Peripheral IDs.....                         | 12       |   |           |

## Precautions

1. Zaber's devices may produce enough force to cause personal injury. Be careful to keep hair, body parts, jewelry, and clothing from being caught in moving components. Pinch labels are used on our devices to indicate areas of particular concern.
2. During continuous operation, a device's motor may feel hot to the touch. Although this is normal, care should be taken when handling the device. If the device emits a burnt smell, it may be damaged. Cease operation and contact Zaber Customer Support.
3. For positioners without integrated controllers, set the peripheral ID on the controller (as described on page 12) before connecting the motor to the controller.
4. To reduce the risk of electrostatic damage, avoid touching the electrical contacts of the data cables included with your device(s).
5. Before storing your device(s), retract any extended components in order to keep them clean and to protect them from damage.
6. Do not expose device(s) to vibration or shock.
7. Do not expose device(s) to extreme conditions, such as temperatures exceeding device ratings, radiation, and dusty or humid environments.
8. Do not submerge device(s) in liquid.
9. Do not disassemble. Zaber devices do not contain user-serviceable parts. Please contact Customer Support for service and/or repairs.
10. Check the device manual online for any additional precautions and warnings related to your devices.

## Maintenance

Most of our positioners do not require regular maintenance. Lead screws and rails do not need to be greased (unless otherwise specified in the device user manual). If a component is exposed to dust or dirt, it should be gently wiped with isopropyl alcohol. We do not recommend using stronger solvents, as they can damage non-metal components. Please refer to our online product manuals at [www.zaber.com/support](http://www.zaber.com/support) for maintenance information on your specific device(s).

## Returns, Warranty, and Repairs

All of Zaber's standard products (those that appear on our website) are backed by a 30-day satisfaction guarantee. If you are not satisfied with your purchase for any reason, you may return the item(s) in saleable and unmarked condition within 30 days of the purchase date for a refund, less applicable shipping costs.

High vacuum ( $10^{-6}$  torr) devices cannot be returned for refund once they have been removed from their sealed packaging.

All standard products are warrantied against defects in manufacture and design for one full year from the purchase date. This warranty excludes products that have been misused, modified, or disassembled by the customer.

Misuse includes operating the devices in abnormal conditions, such as in extreme temperatures, in proximity of radiation or strong magnets, or in wet environments. If you are not sure whether the conditions in which you plan to use your device(s) are acceptable under our warranty, please contact Customer Support.

Aside from issues covered under warranty, we are also happy to inspect any other problems that may arise, and we offer reasonably priced repairs. Simply email [contact@zaber.com](mailto:contact@zaber.com) for assistance.

Please refer to [www.zaber.com/policies](http://www.zaber.com/policies) for more information about our policies.

## Common Terminology

### Positioner

A motorized product with moving mechanics, such as a linear stage, a rotational stage, or a stepper motor.

### Peripheral

A positioner that includes a motor and mechanics but does not include an integrated controller. Peripherals are designed for use with Zaber's motor controllers, but they can also be used with compatible third-party motor drivers and controllers.

### Device

A stand-alone controller or a positioner with an integrated controller. Stand-alone controllers are designed for use with Zaber's peripherals, but they can also be used with compatible third-party motors.

### Joystick

A product that allows multi-axis manual input and push-button input for positioners. Joysticks do not function as controllers; instead, they are designed to communicate with Zaber's motor controllers when connected in series.

### T-Series, A-Series, X-Series

Devices that share common features, such as connectors, protocols, and power. The series is indicated by the first letter of the device's name. For example, the X-LSM025A model belongs to the X-Series family. Please refer to our Series Reference Table for more information: [www.zaber.com/SeriesReferenceTable.pdf](http://www.zaber.com/SeriesReferenceTable.pdf)

### Closed-Loop and Servo Devices

For Zaber devices, closed-loop refers to any device where encoder feedback is used to inform the trajectory of the controller. Servo devices refer to a sub-set of these where encoder feedback is also required for the driver. Servo devices include linear motor and direct-drive stages.

Stepper motor devices with encoders use closed-loop control but are not servo devices, as the driver controls stepping directly without encoder feedback. Encoder feedback is still used to inform the trajectory of the controller on these.

Servo devices require tuning of their control loop to get the best performance (more on page 17). They also use encoder counts as their unit of resolution, as opposed to stepper motors, which use microsteps (more on page 15).

## Quick Set-up Checklist

| Checklist Item   | Page |
|--|------|
| <input type="checkbox"/> Check for and remove shipping guards or fasteners (select devices)          | 4    |
| <input type="checkbox"/> Connect daisy-chain   | 5    |
| <input type="checkbox"/> Connect to computer   | 6    |
| <input type="checkbox"/> Connect power   | 7    |
| <input type="checkbox"/> Install USB drivers (if using USB)  | 6    |
| <input type="checkbox"/> Install Zaber Console   | 9    |
| <input type="checkbox"/> Configure communication (optional)  | 9    |
| <input type="checkbox"/> Configure peripheral ID (if using a peripheral)                             | 12   |
| <input type="checkbox"/> Connect to peripheral (if using a peripheral)                               | 8    |
| <input type="checkbox"/> Move device to home position with knob to confirm set-up                    | 23   |
| <input type="checkbox"/> Fine tune the servo control loop after mounting a load (servo devices only) | 17   |

### Shipping Guards

Some devices include guards, such as plates, inserts, covers, or fasteners, which prevent movement of devices during shipping and limit potential damage from shock loads. If they are present for a device, they will be either be clearly visible and intuitive to remove or clearly marked with labels and instructions. Following those instructions, remove any such components before powering the device. Read the device manual online for more details on shipping security features.

## Connect

All Zaber controllers can connect to a computer through a DSUB9 serial port or USB port. Accessories for making these connections are included when an accessory kit is ordered with a device. For devices that can also connect with RS-485, please refer to the online product manuals for configuring these connections: [www.zaber.com/support](http://www.zaber.com/support)

Our Quick Set-up Tool also provides instructions for connecting and daisy-chaining your positioners, which you can find here: [www.zaber.com/QuickSetupTool](http://www.zaber.com/QuickSetupTool)

### Daisy-chaining

Daisy-chaining is used to connect and control multiple devices in a series with one computer connection.



T-Series and A-Series devices can be daisy-chained using a Mini-DIN connection.



T-Series and A-Series devices can be daisy-chained to X-Series devices with a T-XDC adaptor cable.\*†



X-Series devices can be daisy-chained using an M8 cable, such as the X-DC02.†

\*X-Series devices are designed to be connected at the beginning of a daisy-chain (closest to the computer) when different product series are connected together.

† Peripherals are not shown connected to the stand-alone controllers. See page 8 for information on peripherals.

## Computer Connection: Serial Port



T-Series devices can connect to a computer's serial port with a T-DSUB9 adaptor and a T-DC06 cable.



A-Series devices can connect to a computer's serial port with a T-DSUB9 adaptor and a T-DC06 cable.



X-Series devices can connect to a computer's serial port with an X-SDC cable.

## Computer Connection: USB



T-Series devices can connect to a computer's USB port with a T-USBDC\* cable.



A-Series devices can connect to a computer's USB port with a T-USBDC\* cable.



X-Series devices can connect to a computer's USB port with an X-USBDC\* cable.



Stand-alone controllers also have the option to connect directly to a computer's USB port with a U-DC06† cable.

\*Drivers may be required if COM port does not appear. Download and installation instructions here: [www.zaber.com/software](http://www.zaber.com/software)

†Drivers are required. Download link and installation instructions can be found here: [www.zaber.com/USB](http://www.zaber.com/USB)

## Power Connection



T-Series devices connect to a 15 V power supply\* with a 2.1 mm centre positive power plug.



A-Series devices connect to a 24-48 V power supply with a Molex Mini-Fit Jr.™ 3-pin power connector.



X-Series devices connect to a 24-48 V power supply\* with a 2-pin, 5 mm pitch screw terminal block.

\*These power supplies connect to devices that can share power with similar devices along the daisy-chained data cables. The number of devices you can power will depend on the combined current draw of the devices and the current capacity of the power supply.

## Peripherals

**CAUTION:** To avoid damaging the peripheral, it is important to configure its controller **before** you connect them together. Please see the section on setting the Peripheral ID in the **Configure** section (page 12) of this guide for more information.

### Vacuum Devices

While some of the information covered in this guide applies to our vacuum compatible devices, please refer to the online product manuals for detailed connection recommendations or read our technical article on “Considerations for Vacuum Applications”:  
[www.zaber.com/VacuumTechnicalArticle](http://www.zaber.com/VacuumTechnicalArticle)



The MC03 motor cable connects a controller to a peripheral with a panel-mount connector.



The MC04 motor cable connects a controller to a peripheral with an in-line connector. The MC04 can also be used to extend any motor connection.

## Configure

### Zaber Console

Zaber Console is our free open-source software. For initial configuration of your device(s), we strongly suggest using Zaber Console for its ease of use.

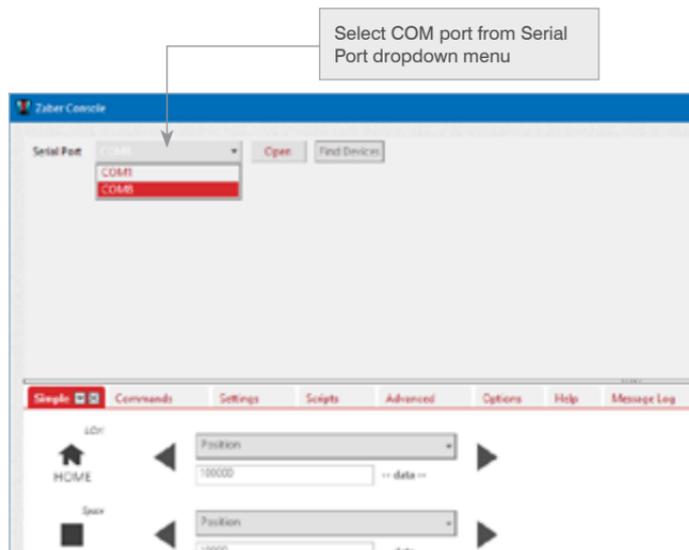
A download link and installation instructions are available online: [www.zaber.com/software/ZaberConsole](http://www.zaber.com/software/ZaberConsole)

The following configuration sections are based on Zaber Console. Please contact Customer Support if you would like to use any other software. More information about Zaber Console and other software options is included in the **Control** section (page 14) of this guide.

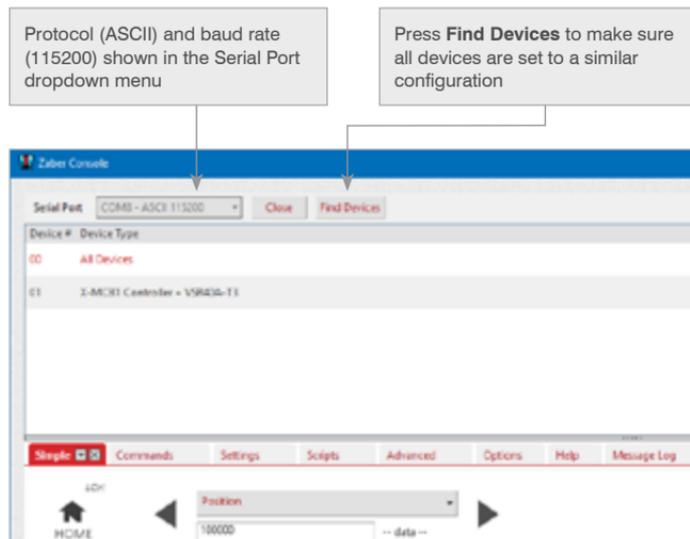
### COM Ports

A COM port is a specific serial connection on a computer, such as COM1 or COM3. When connected via USB, your computer should create a virtual COM port that will be available only when the device is connected. To start communication between computer and device, select the appropriate COM port. If you are not sure which to choose, please contact Customer Support.

With Zaber Console open, select the COM port to which the devices are connected from the Serial Port dropdown in Zaber Console and press **Open**.



Zaber Console will detect which devices are connected to that port, and those devices will be displayed in the Device List if they all share the same communication protocol and baud rate. The protocol and baud rate of the found devices are shown in the Serial Port menu. The next section will explain what to do if they don't share the same configuration, if they don't all appear, or if you would like to change the protocol the devices are using.



## Find Devices

Once a port has been opened, the **Find Devices** feature is available. This button allows you to do a thorough search to find devices without common baud rates or protocols, and set them all to a shared baud rate and protocol.

When you select this option, you'll be able to select a preference for all of the devices to use either the Zaber Binary protocol or Zaber ASCII protocol.

For more information on protocols, please refer to the following section.

The Zaber ASCII protocol is not available on T-Series devices. Almost all Zaber devices can use the Zaber Binary protocol; if a T-Series device is included in the chain, all devices will be set to Zaber Binary.



## Protocol

Communication protocols dictate the way in which commands are formatted to send to a device. Zaber's devices use two protocol options: **Zaber Binary** and **Zaber ASCII**. The protocols of different devices in a daisy-chain must match for them to work together.

The first table below lists some of the benefits of each protocol option, and the second table shows where you can access the online user manuals.

| Zaber Binary* Protocol  | Zaber ASCII Protocol   |
|---|--|
| <ul style="list-style-type: none"> <li>• Commands and responses in compact 6-byte packages.</li> <li>• Address devices in a daisy-chain.</li> <li>• Fast processing speed.</li> </ul> | <ul style="list-style-type: none"> <li>• Commands and responses in readable ASCII strings.</li> <li>• Address devices and axes in a daisy-chain.</li> <li>• Advanced commands and settings available.</li> <li>• Additional information available in responses.</li> </ul> |

|                |  |
|----------------|--|
| Binary* Manual | <a href="http://www.zaber.com/manuals/BinaryProtocol">www.zaber.com/manuals/BinaryProtocol</a> |
| ASCII Manual   | <a href="http://www.zaber.com/manuals/ASCIIProtocol">www.zaber.com/manuals/ASCIIProtocol</a>   |

\*T-Series product manuals ([www.zaber.com/support](http://www.zaber.com/support)) provide device-specific information to the Binary protocol.

## Default Configurations

You can use the table below to confirm the default baud rate and protocol of your devices, as well as which they are capable of using.

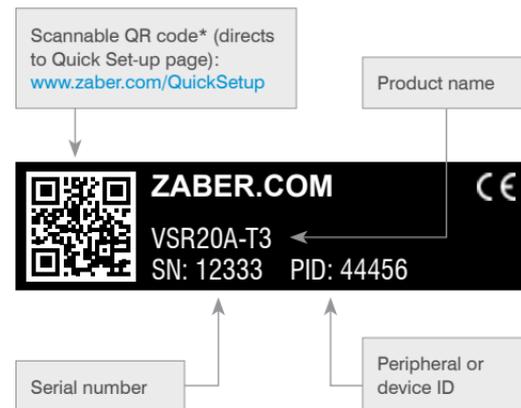
|                      | T-Series | A-Series                                  | X-Series                                  |
|----------------------|----------|---|---|
| Default Protocol     | Binary   | Binary                                    | ASCII                                     |
| Default Baud Rate    | 9600     | 9600                                      | 115200                                    |
| Available Protocols  | Binary   | Binary<br>ASCII                           | Binary*<br>ASCII                          |
| Available Baud Rates | 9600     | 9600<br>19200<br>38400<br>57600<br>115200 | 9600<br>19200<br>38400<br>57600<br>115200 |

\*Some Firmware 7 devices do not fully support Binary. See product manual online for more details.

## Peripheral IDs

Zaber's controllers and peripherals are designed for ease of use when used together. Optimal settings such as the default current, speed, acceleration, and limit settings can be easily entered for peripherals.

Controllers can use the same optimal settings by setting the peripheral ID. The peripheral ID is listed as the ID on the peripheral's label (see image below). A list of IDs is also available online: [www.zaber.com/support/IDMapping](http://www.zaber.com/support/IDMapping)



\*On calibrated devices, the QR code will take you to the calibration report for that specific device.

To set the peripheral ID for a controller using the Binary protocol in Zaber Console, select the **Settings** tab, enter the ID into the **Peripheral ID** setting, and press **Write**. When connecting a peripheral with a linear encoder, also ensure that the **Peripheral Serial Number** setting is set to match the peripheral's serial number.

Enter the ID into the Peripheral ID setting, then press **Write**



To set the peripheral ID for a controller using the ASCII protocol with Zaber Console, select the **Settings** tab, enter the ID as the data for the **peripheralid** setting, and press **Write**. For peripherals with linear encoders, also enter the Serial number in the **peripheral.serial** setting. When connecting a peripheral with a linear encoder, also ensure that the **peripheral.serial** setting is set to match the peripheral's serial number.

Zaber's controllers and peripherals can also be used with third-party controllers and peripherals, in which case care should be taken when selecting optimal settings. Peripheral IDs are not used for these cases, please contact Zaber if you have any questions or need assistance with setting up the configuration.

Enter the ID into the peripheralid setting, then press **Write**



## Control

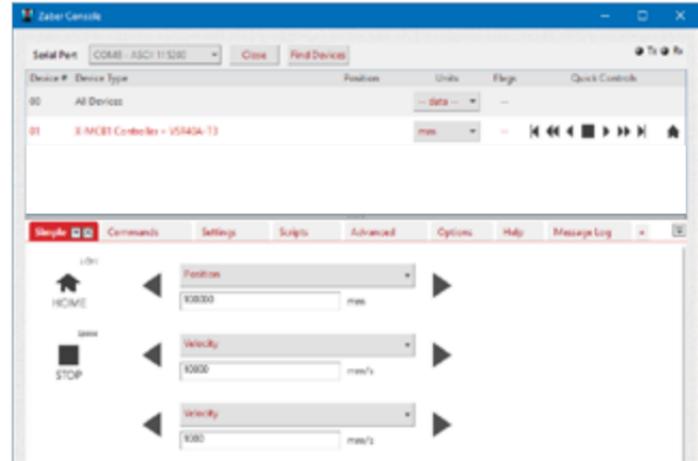
### Software

Once your Zaber device is powered and connected to a computer, you are ready to start controlling it. To begin communicating with your device, you will need to select a software interface. The sections below outline some of the software options available to you.

### Zaber Console

Zaber Console is free, open-source software that is designed for ease of use. Zaber Console allows you to manage port communication, identify devices, send commands to devices, and set the units of measure. The application also makes it easy for you to create and run your own scripts using several .NET programming languages, such as Python, C#, or JavaScript. We strongly recommend using Zaber Console for the initial set-up and troubleshooting of your device. Source code for Zaber Console and a user manual is available online at:

[www.zaber.com/software/ZaberConsole](http://www.zaber.com/software/ZaberConsole)



## LabVIEW

Zaber's devices can be used with LabVIEW's graphical programming environment. We provide certified drivers and examples online:

|        |  |
|--------|--|
| Binary | <a href="http://www.zaber.com/software/LabVIEWBinary">www.zaber.com/software/LabVIEWBinary</a> |
| ASCII  | <a href="http://www.zaber.com/software/LabVIEWASCII">www.zaber.com/software/LabVIEWASCII</a>   |

Our Customer Support team is also available for additional support, advice, and troubleshooting.

## Programming Libraries

Libraries with APIs are available in several programming languages. For a complete list of supported languages and features, please see our Software page: [www.zaber.com/software](http://www.zaber.com/software). Other examples, drivers, and some customer-submitted code samples are also available on that page.

## Resolution - Stepper & Servo Motors

The resolution of a device is the smallest increment you can command it to move. For example, sending the ASCII protocol command '/move rel 1' instructs a device to move forward by 1 increment. The physical distance corresponding to this increment depends on the type of motor that drives the device. For devices driven by stepper motors, an increment is a microstep of the motor, and the size of an increment is the device's Microstep Size specification. For servo devices, an increment is an encoder count, and the size of an increment is the device's Encoder Resolution specification.

### Microstepping

Stepper motors are designed for position control. In a motor revolution, they have a number of equally-spaced full-step positions. Most stepper motors in Zaber devices have 200 steps per revolution.

Zaber's drivers sub-divide each motor step into a number of smaller increments called microsteps. By default, most devices use a resolution of 64 microsteps per step (although this is adjustable), so by default they can move to 12800 microstep positions for every motor revolution.

Many devices use lead screws or gearing to move the actuators or stages, so a motor revolution will move the device a certain distance. That distance can be divided by the number of microsteps per revolution to get the distance moved per microstep. This is the Microstep Size. The Microstep Size will vary from device to device; the value for your device is available on our website under the 'Series Specs' tab for each product.

### Encoder Counts

Unlike stepper motors, servo motors are designed with force control in mind; they can be driven using position control, but the resolution is very coarse. To achieve fine-resolution positioning, they require position feedback, as such Zaber's servo devices feature a variety of digital and analog position encoders. An encoder count is the smallest movement of the encoder that will be registered by the controller.

### Speed and Acceleration

While microsteps (for stepper motor devices) or encoder counts (for direct drives devices) are the increments of position on Zaber devices, there are conversion factors required to calculate the increments of speed and acceleration. The conversion factors differ depending on the Series of the device:

#### A-Series and X-Series

$$\text{speed (in microsteps or encoder counts/second)} = \text{Data} / 1.6384$$

$$\text{acceleration (in microsteps or encoder counts/second}^2) = \text{Data} / 1638.4$$

#### T-Series (stepper motor only)

$$\text{speed (in microsteps/second)} = \text{Data} * 9.375$$

$$\text{acceleration (in microsteps/second}^2) = \text{Data} * 11250$$

A spreadsheet is available for easy conversion: [www.zaber.com/ZaberSpeedSettings.xls](http://www.zaber.com/ZaberSpeedSettings.xls). Make sure you are using the correct tab; T-Series devices use Speed fw5.xx; A-Series and X-Series devices use Speed fw6.xx. Enter the microstep size or encoder resolution of your device into the spreadsheet to easily convert from data to speed or acceleration, and vice versa, in mm/s or mm/s<sup>2</sup>.

## I/O's & Triggers

Some Zaber controllers have configurable digital and analog inputs and digital outputs. While these controllers can be used to interact with a variety of devices, care should be taken when setting up the circuit to which they are connected. The product manuals for these controllers on our Support page will include usage instructions and sample circuit diagrams:

[www.zaber.com/support](http://www.zaber.com/support)

The inputs and outputs can be configured to either trigger actions on the controller or to be triggered by certain conditions. These triggers can also be configured on devices without I/O's available. More information on how to set up these triggers are available in our ASCII protocol manual: [www.zaber.com/manuals/ASCIITriggers](http://www.zaber.com/manuals/ASCIITriggers)

Please contact Customer Support if you have any questions about setting up your circuit.

## Servo Device Tuning

Servo devices use a control loop in order to drive their motors and use encoder feedback to inform the control loop. The default parameters used in the control loop (which the device uses when it's powered on for the first time) are optimized for good performance with no load added to the stage. These parameters should also work with some load mounted to the stage. You can tune the parameters of the control loop to adjust the smoothness, accuracy, and responsiveness of the performance.

In order to make tuning as easy and simple as possible, Zaber provides a tool within Zaber Console called the Servo Tuning tab. Complete documentation on the tool is available at [www.zaber.com/ServoTuning](http://www.zaber.com/ServoTuning).

To use the tool, first make sure Zaber Console is installed and the device is powered and connected. If a servo device is detected when you open the port in Zaber Console, you will be asked if you want to add the Servo Tuning tab to the Tab Dock (if it's not already present).

Use caution when adjusting parameters; it's possible to enter values that will cause the device to become unstable and move erratically. If this occurs, press the 'Disable Driver' button to stop current to the motor and stop driven motion. The parameters can then be adjusted to be more stable or be returned to default values. Press 'Enable Driver' to resume driven motion.

## Tuning Methods

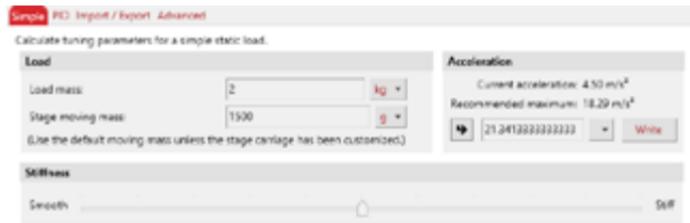
The servo tuning tab includes 4 modes for tuning:

### Simple

The inertia of the moving load is the minimum information about an application required to choose reasonable tuning parameters. For linear motion this is the moving mass; for rotary motion it is the mass moment of inertia. The simple tab allows you to set parameters using only this information.

The inertia has two components: the inertia of the carriage of the device, and the inertia of the load added to the stage. Using the Simple tuning method in Zaber Console, the carriage inertia is automatically set, and the user can enter the contribution from their load.

A slider allows optional adjustment between smoother (less position overshoot) and stiffer (faster and more forceful response to position errors) motion.



As the mass is changed, the largest reasonable acceleration of the axis also changes. While this is not one of the servo tuning parameters, setting the acceleration too high can also create overshoot or instability in the system. The Simple tuning control also indicates the maximum recommended acceleration you should set based on the load, and allows you to adjust it within the tab.

### PID

If you have experience tuning a proportional-integral-derivative (PID) controller, this tuning method will allow you to adjust the parameters using familiar gain and time constant values.



### Import/Export

Use Import/Export to save sets of parameters to a file on your computer. These parameter sets can be named and will be displayed as long as that file is selected. Use this tool to move parameter sets from computer to computer, or to easily apply parameter sets to multiple devices.

## Advanced

Servo devices may have different control loops and parameters. Zaber Console's servo tuning tab translates these control loops to the easier Simple and PID tuning methods, and Zaber recommends using these to adjust the performance. The low-level control loop parameters can be adjusted directly using the Advanced tuning method though. Contact Zaber's customer support if you need a description of these low-level parameters or a block diagram of the control loop.



## Save and Apply Tuning

The parameters that govern the control loop on a servo device are known as the 'live' parameter set. Devices also store multiple sets of saved parameters that are not active, called 'presets'. These presets could represent sets of optimal tuning under different conditions (for example different loads). Use the Servo Tuning tab to quickly and easily save tuning sets to presets, apply tuning as the live set, or set one of the presets as the live set. Additionally, live or stored presets can be read in PID, Import/Export, or Advanced modes (the inertia input when using Simple tuning cannot be re-calculated based on low-level parameters). In addition to the writable presets, there is also a 'default' preset, which contains the factory tuning values. The default preset can be read or applied, but cannot be overwritten. Restore the defaults at any time to apply safe (but not necessarily optimized) parameters.

Step 1: Choose a tuning method.

Step 2: Enter values.

Step 3: Select a Preset to save the values to, and press **Write**.

Step 4: Select the Preset to make Live, and press **Activate**.

The screenshot shows the Zaber software interface for Servo Tuning. The top menu bar includes 'Simple', 'Options', 'Terminal', 'Commands', 'Settings', 'Scripts', 'Oscilloscope', 'Servo Tuning', and 'Help'. The 'Servo Tuning' menu is open, showing 'Simple' as the selected tuning method. Below this, a warning message is displayed. The 'Simple' method section includes instructions to calculate tuning parameters for a simple static load. The 'Load' section has input fields for 'Load mass' (2 kg) and 'Stage moving mass' (1500 g). The 'Acceleration' section shows 'Current acceleration: 4.50 m/s<sup>2</sup>' and 'Recommended maximum: 18.29 m/s<sup>2</sup>', with a 'Write' button. The 'Stiffness' section has a slider from 'Smooth' to 'Stiff'. The 'Device management' section on the right shows 'Live parameter set: Preset 1' with 'Preset 1' and 'Activate' buttons, and 'Power-on preset: Preset 1' with 'Preset 1' and 'Change' buttons. At the bottom, there is a 'Device parameter set to read/write:' section with 'Preset 1' and 'Write' buttons, and a 'Write defaults' button.

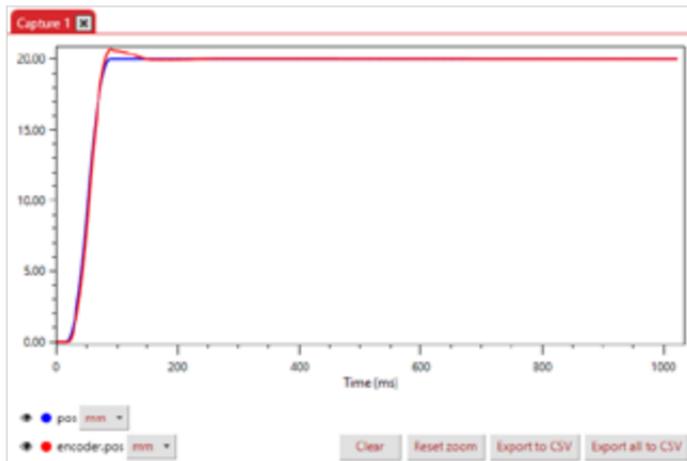
## Initial Parameter Set on Power-On

When a servo device is powered on, one of the presets is loaded as the active parameters. This preset is shown as the Power-on Preset. To change which preset is used as the initial parameter set, select from the dropdown, and press Change.

## Oscilloscope Tab

The Oscilloscope tab in Zaber Console is a tool for reading and displaying information from devices over time. A variety of information can be read, such as the expected position based on the trajectory planner, the actual position based on encoder feedback, and the temperature of the motor or driver. Plotting the first two (the expected and measured positions) during a movement can be useful in assessing the effectiveness of different servo tuning parameters; it can show performance such as rise time, overshoot, settling time, and steady-state error.

You can access the Oscilloscope tab by selecting it from Zaber Console's Tab Dock or by pressing the Open Scope button in the Servo Tuning Tab.



While complete information on general usage of the Oscilloscope tab can be found at [www.zaber.com/Oscilloscope](http://www.zaber.com/Oscilloscope), here are some recommended settings to use for plotting the step response of a servo device:

**Trigger** – Select Manual mode to capture high resolution information over a limited time period. Automatic mode will capture lower resolution information indefinitely.

**Channels** – Select the Trajectory Position (pos setting) and Measured Position (encoder.pos setting) to compare the expected and actual trajectories. Choose ‘mm’ from the Unit selector.

**Sample Rate** –The maximum sample rate depends on the Trigger type. For Manual mode, selecting a higher frequency will give a smaller sample period. Enter 1 kHz for a reasonable mix of resolution and period for capturing a movement.

**Signal Generator** – Enable this to create a movement during the data capture. We recommend a relative movement with a step of 20 mm as a sample movement, and resetting after the capture is complete.

The screenshot shows the Oscilloscope settings window with the following configuration:

- Start Capture** button (red)
- Trigger**: Manual (dropdown)
- Channels** (expanded):
 

| Color                                    | Setting                 | Unit |
|--|-------------------------|------|
| <input checked="" type="checkbox"/> Blue | Trajectory Position (p) | mm   |
| <input checked="" type="checkbox"/> Red  | Measured Position (e)   | mm   |
- Delay**: 0 (input field), s (unit dropdown)
- Sample rate**: 1 (input field), kHz (unit dropdown)
- Signal Generator** (checked):
  - Movement**: Move relative (dropdown)
  - Step size**: 20 (input field), mm (unit dropdown)
  - Return to start?**:
- Settings** (collapsed)

Press Start Capture to begin reading the information. The device will move, and once all of the data has been collected and transmitted, a plot of the information will be displayed.

After generating a plot, you can evaluate whether the motion is in line with your application requirements. If not, you can adjust the servo tuning and generate a new plot for comparison. Repeat this process until you're content with the performance.

Because performance also relates to the motion trajectory, there are some adjustable trajectory settings. In particular, you may want to try adjusting the maximum trajectory speed (maxspeed setting), the trajectory's acceleration (accel setting), and how accurate and stable the final position must be at the end of the movement (cloop.settle.tolerance and cloop.settle.period settings). See the online product manual for more information on these settings.

## Manual Knobs

Most Zaber devices include a manual knob for moving the unit without a computer connection. Devices still need to be connected to a power source for the manual knob to work. The following tables summarize the functionality offered by manual knobs for each device series.

### Potentiometer Knob (T-Series) Functionality

|                                  |   |
|----------------------------------|---|
| Turning the knob                 | Moves the device based on the direction the knob is turned (clockwise moves in the positive direction) at a speed proportional to the amount that the knob is turned. |
| Returning the knob to the detent | Stops the device from moving.   |

| Indexed Knob (A-Series and X-Series) Functionality |   |
|--|---|
| Turning the knob                                   | Moves the device based on the direction the knob is turned (clockwise moves in the positive direction).   |
| Pressing the knob                                  | Decelerates and stops the device (identical to a <b>Stop</b> command). Pressing the knob also instantly stops the device if the device is already decelerating. |
| Pressing and holding the knob for 1 second         | Toggles between <b>Velocity Mode</b> * and <b>Displacement Mode</b> †.  |

\***Velocity Mode**: each knob turn increments the speed of the axis in a continuous movement.

†**Displacement Mode**: each knob turn moves the axis a specific distance, as indicated by the *knob.distance* setting.

## Joystick

Zaber's joystick can be used to control up to 3 Zaber devices manually; the joystick's programmable buttons can also save commands for ease of use.

The joystick is designed to connect at the start of a daisy-chain, where it can send instructions to all of the other devices over the chain. However, these joysticks are not intended to act as controllers, so each axis will still require an integrated controller or a stand-alone controller.

### Default Key Configuration for X-JOY3

| Key | Short Press            | Long Press           |
|-----|------------------------|----------------------|
| 1   | Stop                   | Home                 |
| 2   | Send alerts* 1, 2      | Send alerts* 1, 3, 4 |
| 3   | Move to saved position | Save position        |
| 4   | Move to saved position | Save position        |
| 5   | Move to saved position | Save position        |
| 6   | Axis 1 low speed       | Axis 1 high speed    |
| 7   | Axis 2 low speed       | Axis 2 high speed    |
| 8   | Axis 3 low speed       | Axis 3 high speed    |

\*When comm.alert is set to 1.

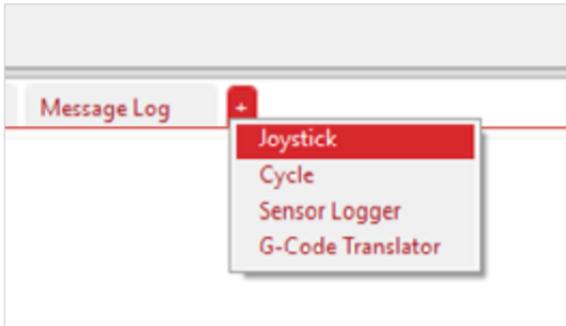
## Joystick Start-up Instructions

### Connect

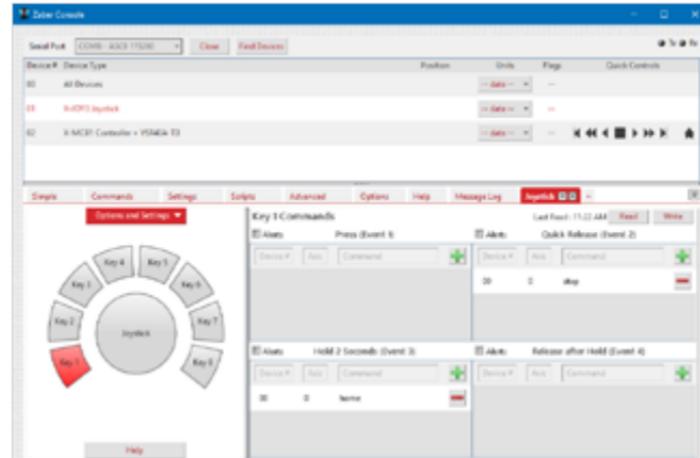
The joystick must be connected to a computer to configure it. Once it is configured, you can operate it with or without a computer connection. The joystick should be the first device in the daisy-chain. Once all devices are connected to the chain, send the Renumbr command to all devices (Device 0). The joystick will be device 1, and the joystick will control devices 2, 3, and 4 (the three devices daisy-chained after it).

### Configure

Zaber Console has a useful tool for configuring the joystick settings and the button functions. In order to use this tool, press the + tab (shown below) and add the **Joystick** tab.



Highlight the joystick, and go to this tab. Select any of the buttons in the bottom left to view or change the button functions. Highlight the centre button to adjust joystick settings. Additionally, the tool allows you to save and load joystick configurations.



Visit the online manual at [www.zaber.com/JoystickTab](http://www.zaber.com/JoystickTab) for complete information on the tools and features available.

## Troubleshooting

Some general troubleshooting information is included here. See the online product manual for additional information.

### Firmware Update

In order to allow access to new features and bug fixes, Zaber devices (with Firmware Version 6.18 or higher) are able to be updated remotely through Zaber Console. Follow instructions here to update: [www.zaber.com/FirmwareUpdate](http://www.zaber.com/FirmwareUpdate)

Devices can only be updated within their major version. Firmware 6 devices only accept 6.xx versions and Firmware 7 devices only accept 7.xx versions.

### Slipping and Stalling

If the positioner is making unusual noises when in motion, and/or it is not traveling the expected distance or not traveling at all, then the positioner is likely slipping or stalling.

If the positioner is slipping or stalling, and it has encoders, the blue LED on the controller will also flash. To correct the problem, try the following steps:

#### All Devices

1. Lower the *maximum speed setting*.
2. Lower the *maximum acceleration setting*.
3. Reduce the load on the positioner.

If the positioner continues to stall with no external load at default speed and acceleration settings, or if the steps above cannot be performed given your application requirements, please contact Customer Support for assistance.

### Resetting to Factory Default

If the device is unable to communicate, operating erratically, or performing in unexpected ways, a manual factory reset can be performed through the following steps:

#### T-Series

Send the **Restore Settings** command (command number 36). If the controller is integrated on the positioner, the data value should be 0. If the controller is connected to a peripheral, the peripheral ID should be the data value.

#### A-Series and X-Series

1. **Power Off** the device.
2. Push and hold the knob.
3. **Power On** the device.
4. Continue to hold the knob in until the blue LED is lit (about 5 seconds), then release the knob.

## Front Panel Indicators

|                             | T-Series                                     | A-Series and X-Series  |
|-----------------------------|--|--|
| Green LED on                | Device is powered on and operating normally. | Device is powered on and operating normally.   |
| Green LED flashing          | Power supply voltage is out of range.        | Operating conditions of the device are outside of the recommended range. This will occur if the supply voltage is either over or under the recommended range, if the internal temperature has exceeded the set limit or the driver has disabled. |
| Green LED fading in and out |  | Device is parked.  |
| Red LED on or flashing      |  | A critical error has occurred. Please contact Customer Support.  |
| Blue LED on or flashing     |  | Device has slipped or stalled.   |
| Amber or red LED on         | Device is in motion.                         |  |
| Amber or red LED flashing   | Traffic packet on the RS-232 line.           |  |
| Amber or red LED blinking   | Manual movement potentiometer is turned.     |  |

**Customer Support**

1-888-276-8033 (Toll Free Canada/USA)

1-604-569-3780 (Direct)

contact@zaber.com