ZABER

ZABER TECHNOLOGIES
Getting Started Guide

Simplifying Motion Control   www.zaber.com

Contents

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, in which case, you should cease operation, and contact Customer Support for assistance.

3. For positioners without integrated controllers, set the peripheral ID on the controller (as described in this guide) 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 submerse device(s) in liquid.

9. Do not disassemble. Zaber's device(s) do not contain user-serviceable parts. Please contact Customer Support for service and/or repairs.

Maintenance

Most of our positioners do not require regular maintenance. Lead screws and rails do not need to be greased. 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 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 (-SV2) devices cannot be returned 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 for assistance.

Please refer to 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 stepper motor and mechanics but does not include an integrated controller. Peripherals are designed for use with Zaber's stepper motor controllers, but they can also be used with third-party stepper 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 third-party two-phase stepper 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 stepper 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 T-LSM025A model belongs to the T-Series family. Please refer to our Series Reference Table for more information: www.zaber.com/SeriesReferenceTable.pdf

Quick Set-up Checklist

Checklist Item	Page
❑ Connect power	5
❑ Connect daisy-chain	6
❑ Connect to computer	7
❑ Install USB drivers (if using USB)	7
❑ Install Zaber Console	9
❑ Configure communication (optional)	9
❑ Configure peripheral ID (if using a peripheral)	12
❑ Connect to peripheral (if using a peripheral)	8
❑ Move device with knob to confirm set-up	16

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

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

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.

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 p.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 a 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 a 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
[†]**Drivers are required.** Download link and installation instructions can be found here: www.zaber.com/software

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:
www.zaber.com/manuals/VacuumDevices

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

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**.

Select COM port from Serial Port dropdown menu
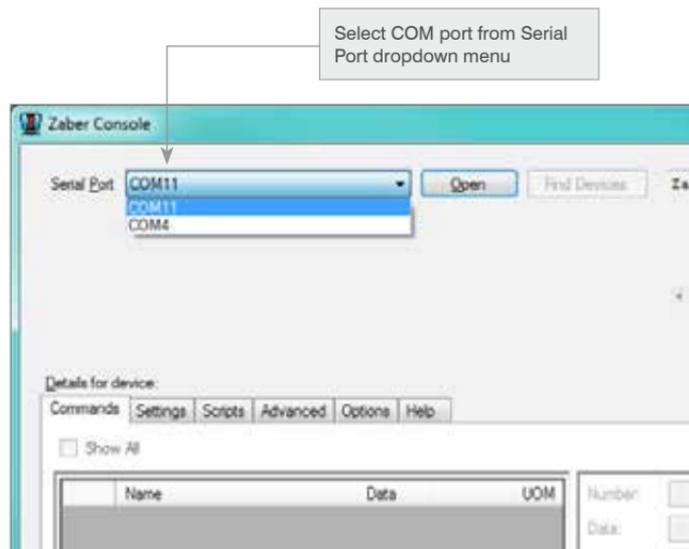
Zaber Console will detect which devices are connected to that port, and those devices will be displayed in the Device List if they all share the same communication protocol and baud rate. The protocol and baud rate of the found devices are shown in the Serial Port menu. The next section will explain 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.

Protocol (ASCII) and baud rate (115200) shown in the Serial Port dropdown menu

Press **Find Devices** to make sure all devices are set to a similar configuration

The Zaber ASCII protocol is not available on T-Series devices. 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.
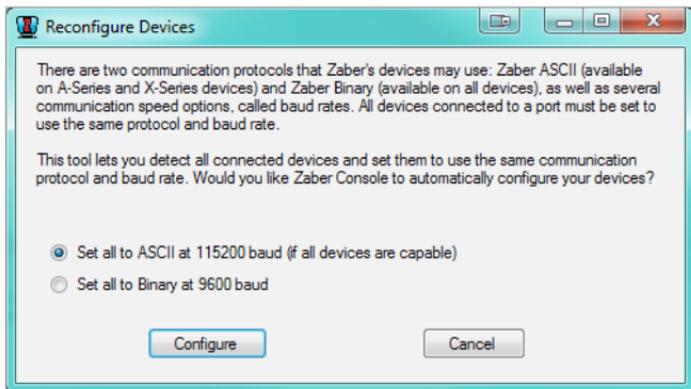
Protocol

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
• Commands and responses in compact 6-byte packages. • Address devices in a daisy-chain. • Fast processing speed.	• Commands and responses in readable ASCII strings. • Address devices and axes in a daisy-chain. • Advanced commands and settings available. • Additional information available in responses.

Binary* Manual	www.zaber.com/manuals/BinaryProtocol
ASCII Manual	www.zaber.com/manuals/ASCIIProtocol

*T-Series product manuals (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 ASCII	Binary ASCII
Available Baud Rates	9600	9600 19200 38400 57600 115200	9600 19200 38400 57600 115200

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

Scannable QR code (directs to Quick Set-up page): www.zaber.com/QuickSetup

Product name

ZABER.COM

VSR20A-T3
SN: 12333   PID: 44456

Serial number

Peripheral or device ID
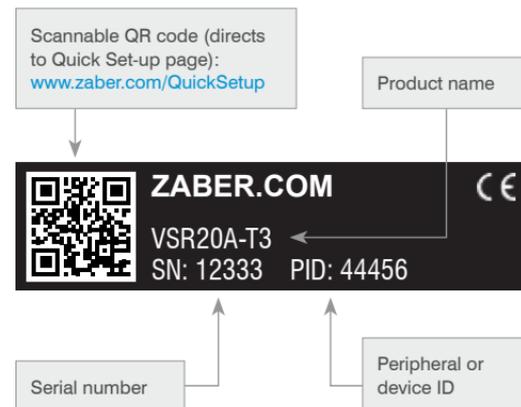
To set the peripheral ID for a controller using the Binary protocol in Zaber Console, select the **Settings** tab, enter the ID into the **Peripheral ID** setting, and press **Write**.

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**.

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 Peripheral ID setting, then press **Write**

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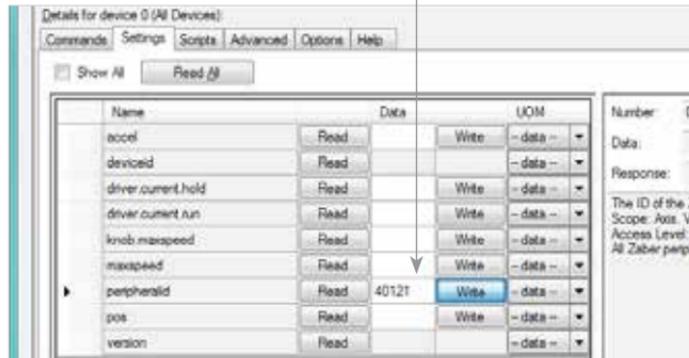
Control

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

LabVIEW

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

Binary	www.zaber.com/software/LabVIEWBinary
ASCII	www.zaber.com/software/LabVIEWASCII

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. Other examples, drivers, and some customer-submitted code samples are also available on that page.

Stepper Motors, Microstepping, and Resolution

Zaber's devices use stepper motors with microstepping drivers. To get the most out of your Zaber device, it is useful to have a basic idea of how these motors work. One revolution of a stepper motor is divided into a number of steps. Most of our devices use stepper motors with 200 steps per revolution.

Our controllers divide each step into a number of smaller microsteps, typically 64 microsteps per step, although this can be adjusted.

Therefore, by default, most of our devices can move to 12800 positions for every motor revolution.

Many devices use lead screws or gearing to move the actuators or stages, and 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 microstep size, or resolution, is the smallest distance that the device can be asked to move. 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.

It is important for you to know the microstep size when you are controlling your device. The number of microsteps is used as the data value in many of the commands and settings. For example, a **Move Relative** command with a data value of 1000 is translated as a move forward by the device of 1000 microsteps. When using Zaber Console, you can choose to use millimeters, inches, or microns instead of microsteps.

Speed and acceleration values are also related to the microstep size, but not as directly. The following table shows formulas that can be used to convert data to meaningful values such as speed and acceleration.

T-Series
speed (microsteps/second) $=$ Data * 9.375   acceleration (microsteps/s^2) $=$ Data * 11250
A-Series and X-Series
speed (microsteps/second) $=$ Data / 1.6384   acceleration (microsteps/s^2) $=$ Data * 10000 / 1.6384

A spreadsheet with built-in formulas for easy conversion is available: 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 of your device into the spreadsheet to easily convert from data to speed or acceleration, and vice versa, in mm/s or mm/s^2.

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

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

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

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 **Stop** 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 **Velocity Mode*** and **Displacement Mode**†.

*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 axes 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, 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.

Our joysticks are intended for use with other Zaber devices. The table on the right includes some basic instructions for getting started with our joysticks.

Joystick Start-up Instructions	
Connect	Although a joystick can be used with or without a computer connection, we recommend that you connect it to a computer for the initial set-up. The joystick should be connected directly to the computer with the devices that it will control daisy-chained to it.
	Once all devices are connected to the chain, the **Renumber** command should be sent to all devices (Device 0). This will set the joystick as device 1, and the joystick will control devices 2, 3, and 4, or, in other words, the next three devices daisy-chained to it.
Configure	You can configure the joystick based on your desired usage. There are a number of settings, such as axis inversion, velocity profile, and velocity range that can be set. You can also program the buttons to send certain commands to the devices. Please refer to the online product manuals for details on changing the settings and programming the buttons on our Support page: www.zaber.com/support
	Once the joystick has been configured, you can either continue to use it while connected to a computer's serial port, or you can disconnect from the computer and only use the joystick for control.

Troubleshooting

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.	

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.

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, than 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.

Customer Support

1-888-276-8033 (Toll Free Canada/USA)
1-604-569-3780 (Direct)
contact@zaber.com