

X-MCB2 Series User's Manual

Stepper motor controllers, two-axis, 2D linear and circular interpolation



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The X-MCB2 will automatically configure itself for any Zaber autodetect capable peripherals that is plugged into it. **BEFORE CONNECTING ANY OTHER PERIPHERAL to the X-MCB2 controller, it is important to set the correct motor parameters** in the controller, especially [driver.current.run \(T:38\)](#) and [driver.current.hold \(T:39\)](#). For a non-autodetect Zaber peripheral, simply set the [peripheral.id \(T:66\)](#) with the [peripheral's ID number](#). See the detailed usage examples for more information on how to modify the settings, particularly for non-Zaber peripherals. Damage to the peripheral may result if the settings are not correct.

⚠ WARNING: Serious damage can occur to stepper motor products when operated with significantly higher-than-rated current. The X-MCB2 controller can provide up to 2 A of current to a peripheral. Please check the rated current for any peripheral axis before changing the current settings on the X-MCB2 from the default values. If you have any questions, please contact [Zaber Technical Support](#)

- Fixed width type indicates communication to and from a device. The ↵ symbol indicates a carriage return, which can be achieved by pressing enter when using a terminal program.
- An [ASCII command](#) followed by (T:xx) indicates a legacy T-Series [Binary Protocol](#) command that achieves the same result. For example, `move abs 10000 (T:20:10000)` shows that a move abs ASCII command can also be achieved with Binary command number 20.

Not all ASCII commands have an equivalent Binary counterpart.

We recommend using [Zaber Launcher](#) to communicate with the device(s). For other software options, see the [Software](#) page. Please refer to the [Protocol Manual](#) for more detailed information on the available commands.

Initial Set-up



- Connect peripheral(s) to the desired axes of your X-MCB2, while unpowered.
- Daisy chain all integrated devices and controllers together using the RS-232 "Prev" and "Next" connectors (see [Daisy-Chaining Devices](#) for more details).
- Next, supply power to one or more devices. Many products share power through the daisy-chain cables. The green power indicator on each should light up.
- Download and install [Zaber Launcher](#). Start Zaber Launcher.
- Create a New Connection and select the communications port the first controller is connected to. For instructions on how to find the available communication ports on your system, please refer to: [Appendix A - Available Communications Ports](#).
- If multiple devices are detected and there are conflicting device numbers, Zaber Launcher will renumber them or you can [renumber \(T:2\)](#) them as desired. The first device in the chain (closest to the computer) will become Device 1, the next will become Device 2, and so on.
- When the communication port is open, Zaber Launcher's "My Connections" page will indicate the connection status of each axis with a message suggesting what action may be needed. See the [Activating Peripherals](#) section for additional information.
- Once a peripheral has been activated, either press the Home icon in Zaber Launcher's "Basic Movement" app or turn a knob on the X-MCB2 to move the peripheral associated with that axis. Most Zaber positioners will only move at reduced speed in one direction until they reach a home sensor at one limit of travel. Then they will move in both directions over full travel.

Initialization

Always connect peripherals to the controller when the controller is not powered. Peripherals should not be connected or disconnected while the controller is powered on.

Every time the controller is powered up or reset, you should return the motorized peripheral(s) to the home position. This is achieved by sending the [home \(T:1\)](#) command to the individual device or all devices. Until this is done, most positioners will only allow motion in one direction, towards the sensor.

If it is not possible in your application to home the positioner after every power-up, see the [tools_parking \(T:65\)](#) command. Parking allows the device to be turned off and then used at a later time without first having to home the axes.

Using the Device

Several commonly used ASCII commands and their Binary equivalents are shown below. For a full list of available commands, please refer to the [Protocol Manual](#).

Command	Description
/1 1 get pos (T:60)	Query the current position of Device #1 Axis #1.
/1 1 move_abs 10000 (T:20:10000)	Move Device #1, Axis #1 to position 10000 microsteps.
/2 1 move_rel -12800 (T:21:-12800)	Move Device #2, Axis #1 in the negative direction by 12800 microsteps.
/1 stop (T:23)	Decelerate and stop ALL axes on Device 1. An axis number of 0 or no axis number implies all axes on the device, or the device itself.
/ move_vel 153600 (T:22:153600)	Move ALL devices and ALL axes in the positive direction at the speed 153600. A device address of 0 or no device address implies all devices in the chain.

Modifying Device Settings

Here are some examples if you would like to customize particular device or axis settings. Refer to the [Protocol Manual](#) for detailed descriptions of each setting.

Command	Description
/1 set maxspeed 100000 (T:42:100000)	Set the speed of all axes on the device.
/1 get maxspeed (T:53:42)	Query the maximum speed of all axes on the device.
/1 system_restore (T:36)	Restore all the settings of Device 1 to the default.

Activating Peripherals

 **Important:** The X-MCB2 should always be powered down before disconnecting or connecting a peripheral axis.

For more information about peripheral types, compatibility, and activation, please refer to the [peripheral](#) section of the protocol manual.

The X-MCB2 is compatible with many Zaber peripherals, including those with AutoDetect, a feature that enables a controller to automatically configure itself for the connected peripheral. Peripherals with AutoDetect have an “A” at the end of their product name, for example: "LAC10A-T4**A**".

- After the X-MCB2 is powered on with an autodetect peripheral connected to an axis, the peripheral will be activated automatically if the axis is not configured for use with a different peripheral.
- When an autodetect peripheral is connected and the axis status LED is fading yellow, the peripheral has been detected, but needs to be activated.
 - If you are sure that you want to activate a new peripheral on this axis, either use the Activate button near the peripheral name in Zaber Launcher or send the [activate](#) command to the axis.
 - If you have swapped axes unintentionally, remove power, disconnect the current peripheral and then reconnect the desired peripheral instead. Any custom settings for the original peripheral will still be maintained.

The X-MCB2 is also compatible with many peripherals that do not have the AutoDetect feature. These are configured quickly by setting the [peripheral.id](#). Peripherals without the AutoDetect feature do not have an “A” at the end of the product name, for example "LAC10A-T4".

- Once the peripheral ID is configured properly, power off the controller and connect the peripheral.
- After powering on the controller, Zaber Launcher will indicate that the peripheral is connected and activated.

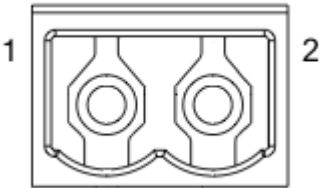
Firmware Upgrades

To allow access to new features and bug fixes, this Zaber device can be upgraded remotely through the Firmware Upgrade app in Zaber Launcher. Click on the “...” menu to the right of the device and select “Click for Updates” for the latest firmware version.

Connectors

All images are shown looking into the device.

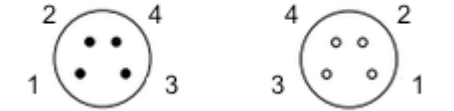
Power

	Pin	Description
	1	24 - 48 V
	2	Device GND

Note: As of February 2022, the power supplies Zaber provides for X-Series devices are isolated and thus the device is not connected to Earth ground. If desired, the chassis may be connected to Earth ground with a screw terminal on the dedicated grounding lugs on X-MCC and X-MCB controllers.

Note: Prior to 2022, most power supplies provided for X-Series devices were non-isolated. Isolated units can be distinguished by the "S" suffix in their Zaber part number (eg. PS14S), which is marked on the label on the bottom of the power supply.

RS-232 Communications

	Pin	Previous	Next
	1	Power (max 4 A)	Power (max 4 A)
	2	Ground	Ground
	3	Receive	Transmit
	4	Transmit	Receive

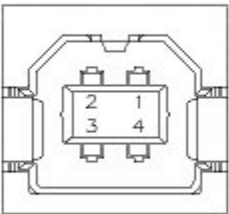
Default Settings

- Baud rate: 115200
- Protocol: Zaber ASCII

Specifications

- Supported Protocols: Zaber ASCII, Zaber Binary
- Supported baud rates: 9600, 19200, 38400, 57600, 115200
- Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

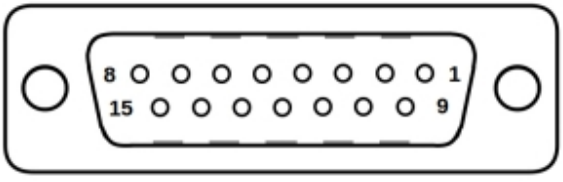
USB Communications



Specifications

- USB 2.0 Full Speed
- Communications Device Class, Abstract Control Model
- Default Protocol: Zaber ASCII
- Supported Protocols: Zaber ASCII, Zaber Binary

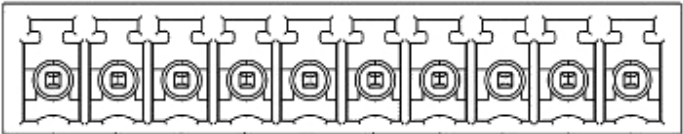
Motor Interface

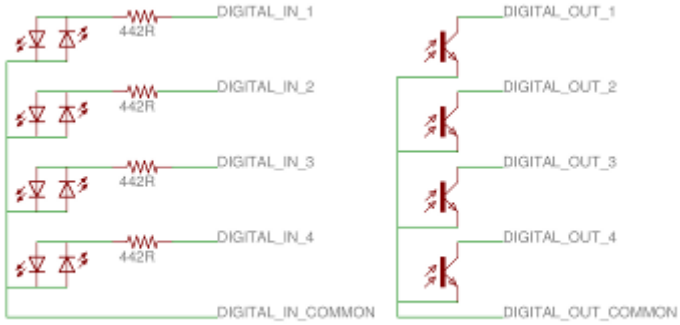
<div></div> <div>Female D-Sub15 Connector</div> <div>Motor and Sensors</div>	Pin	Description
	1	+5 V
	2	AutoDetect Data
	3	C Limit Sensor
	4	Away Limit Sensor
	5	Home Limit Sensor
	6	Ground
	7	Motor B1
	8	Motor A1
	9	AutoDetect Clock
	10	Encoder A
	11	Encoder B
	12	Encoder Index
	13	Ground
	14	Motor B2
	15	Motor A2

NOTE: The limit sensor inputs are pulled up to the internal supply rail and are designed to be pulled low by an open collector.

NOTE: All encoder inputs are non-isolated 5 V TTL lines.

Digital Inputs/Outputs

<div></div> <div>1</div>	Pin	Description
	1	Digital In 1
	2	Digital In 2
	3	Digital In 3
	4	Digital In 4
	5	Digital In Common
	6	Digital Out 1
	7	Digital Out 2
	8	Digital Out 3
	9	Digital Out 4
	10	Digital Out Common

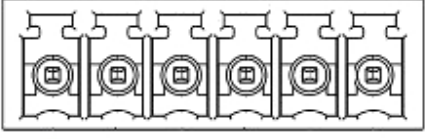
Specifications	Equivalent circuit
Maximum Input Voltage (per pin): 8.0 V [†]	
Minimum Input Logic High Voltage: 1.5 V	
Maximum Output Current (per pin): 3 mA	
Maximum Switchable Voltage (per pin): 50 V	

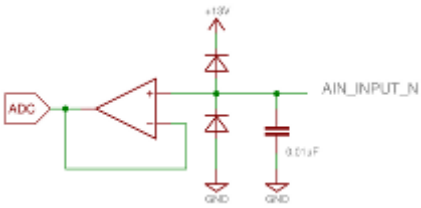
[†]The input voltage range can be extended with additional series resistance, as described in the [I/O Usage and Examples](#) (Digital Inputs) section.

Mating Products

TE Connectivity 284506-5 or 1986692-5

Analog Inputs

	Pin	Description
	1	+5V
	2	GND
	3	Analog In 1
	4	Analog In 2
	5	Analog In 3
	6	Analog In 4

Specifications	Equivalent circuit
Absolute Maximum Input Range (per pin): 0 V - 12.8 V	
Nominal Input Range (per pin): 0 V - 10.0 V	
Resolution: 0.001 V	

+5V Output

The +5V and GND connections can provide power for low-current I/O applications. The pins can source up to 160 mA of current. If additional current is needed, an external power supply is required. Note that this output is not isolated.

Mating Products

TE Connectivity 284506-6 or 1986692-6

Indicators

Green (Device) - Power

- On: Controller is operational.
- Blinking twice per second: The power supply voltage or controller temperature is out of range.

Red (Device) - System Error

- On/blinking: An error has occurred. Please contact [Zaber Technical Support](#).

Yellow (Axis) - Communication/Status

- On: Peripheral positioner is moving, or data is being transferred.
- Blinking twice per second: Packet corruption has occurred for ASCII commands sent with a checksum.
- Blinking: Axis is under manual control via the knob (in Velocity mode). The blinking rate is proportional to movement speed.
- Fading in and out every 2 seconds: A connected autodetect peripheral is awaiting activation.

Blue (Axis) - Axis Warning/Error

- Solid: Peripheral is deactivated.
- Blinking twice per second: Driver is disabled due to over-temperature, out-of-range voltage or other driver fault; or due to user request. See [Fx Warning Flags](#).
Note: This may occur for a few seconds on power-up as device initializes. This will also occur briefly when a peripheral is plugged back into the axis after being unplugged.
- On briefly, during a move: The axis is slipping.
- Blinking once every 2 seconds: The axis has stalled and stopped.
- Flashes: The stationary axis has been forced out of position (2 short flashes every 1 second), or the encoder has encountered a read error and raised the [FQ warning flag](#) (5 short flashes every 2 seconds).
- Fading in and out slowly: The axis is parked. See the [tools parking \(T:65\)](#) command.

Communications

The X-MCB2 supports multiple simultaneous communication interfaces. The device will respond to commands on the communication interface which originally sent the message. It will always send alert messages on all available communication interfaces. When multiple communication interfaces are available, only one interface at a time can communicate with daisy-chained devices connected to the RS-232 Next port. Other communication interfaces may also be used to communicate with the device, but their commands will not be forwarded over the Next port. By default, a fixed priority order is used to determine which communication interface may communicate with daisy-chained devices. Alternatively, a specific communication interface may be selected with the [comm.next.owner](#) setting.

Interface Priority

- USB
- RS-232

Daisy Chaining

Daisy Chaining is supported from USB to RS-232 Next and RS-232 Prev to RS-232 Next.

The X-MCB2 can be connected to a computer as follows:

- Connect the controller to the computer with a USB cable ([U-DC06](#)), and install the appropriate USB driver (see Appendix B for instructions). You may need to use a cable extension to reach your computer. There is no need to power down or reboot the computer.
- Connect one or more peripherals to the X-MCB2 controller using the recommended cables. See the [Quick Tutorial](#) for more information.
- Connect the power plug of your power supply to the power connector of the device. The green LED should light up indicating the device has power.
- Additional devices can simply be daisy-chained to the first. See [Daisy-Chaining Devices](#) below.
- Install software from the [Software](#) page. For the initial setup, using [Zaber Launcher](#) is recommended.



As a simple first test, try entering:

[/renumber](#) ↵ ([T:2](#))

/1 [home](#) ↵ ([T:1](#))

/1 [move rel](#) 10000 ↵ ([T:21:10000](#))

The parameter of 10000 in the move command above specifies 10000 microsteps. To see the microstep size (default resolution) for the peripheral and how it translates to displacement, first go to the [product overview](#) page, find your product, click through to the product's webpage, and click on the "Series Specs" tab. The microstep size (default resolution) will be shown in the list of product specs either in the "Group Specifications" section or the "Comparison" section.

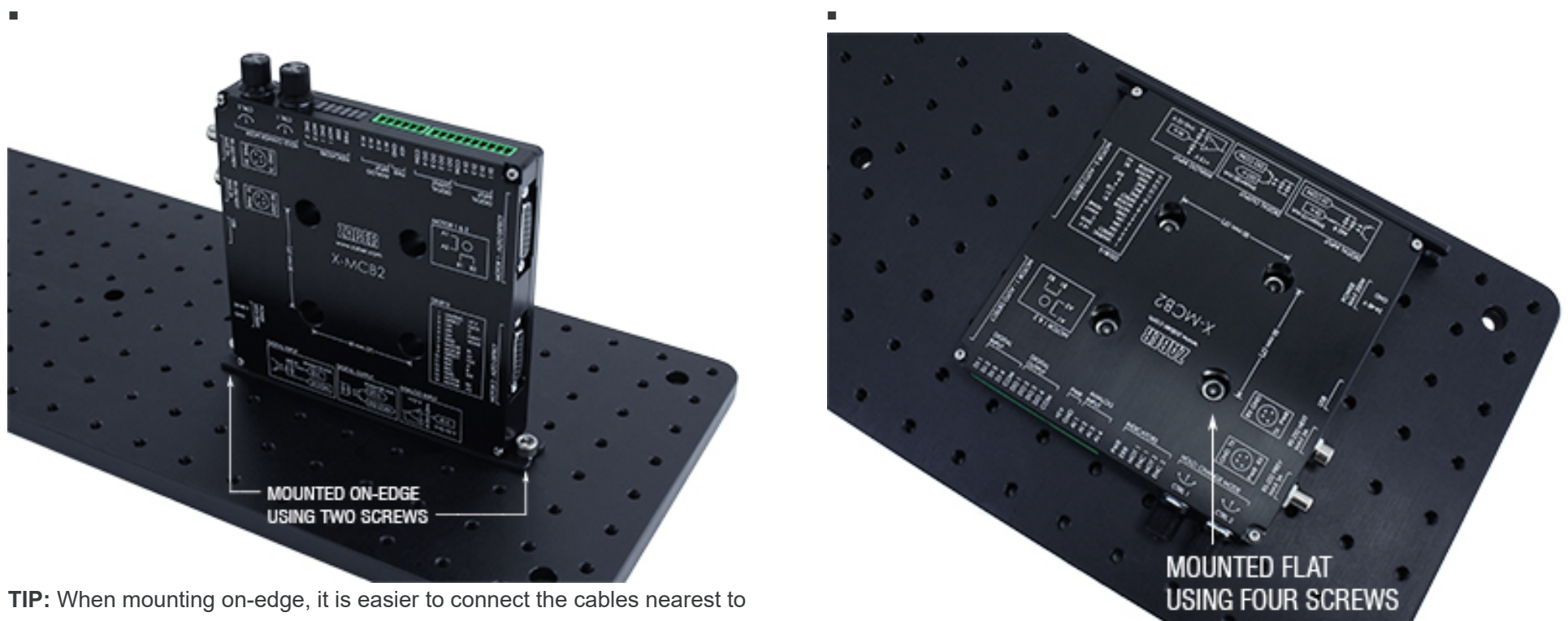
Daisy-Chaining Devices

Multiple devices can be connected together in a chain through the Prev and Next connectors. This allows any number of devices to be controlled from a single connection to a computer, reducing cabling demands. In addition, X-Series devices carry power through the daisy chain, so in most cases a power supply only needs to be connected to one device in the chain. Whenever a device is added or removed from a chain, a [renumber](#) ([T:2](#)) command should be sent to prevent device address conflicts. If there are device address conflicts, Zaber Launcher will renumber automatically the next time you use it to connect to the chain.



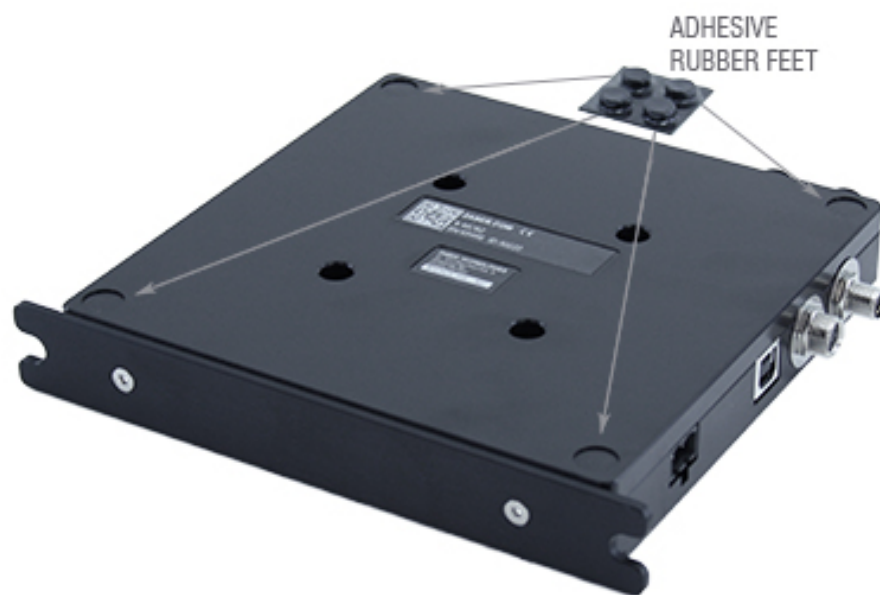
Physical Installation

The X-MCB2 is designed to mount to 25mm or 1" pitch optical breadboards using M6 or 1/4" screws, respectively, or for use on a desk or table. It can be mounted to a breadboard in two configurations:



TIP: When mounting on-edge, it is easier to connect the cables nearest to the adaptor plate after mounting the unit to the optical breadboard.

In situations where mounting is not necessary, 4 adhesive rubber feet are provided which can be applied to the underside of the unit to prevent it from sliding on the surface of a desk or table.



To apply the feet, peel each from the protective backing and place them firmly in the corner recesses on the underside of the unit.

Most X-Series motion control products have an integrated, depressible knob with 20 detents per revolution, allowing axes to be controlled without the use of a computer. There are two manual movement modes available: Velocity and Displacement. Switch between these modes by holding down the knob for 1 second or by configuring the [knob.mode](#) (T:109) setting.

On power-up, many axes will only travel towards the motor from their start-up positions until the home position is reached. Once the axis has been homed, the full range of travel becomes available.

Velocity Mode

Turn the knob clockwise to move the axis in the positive direction (extend) or counter-clockwise for negative direction (retract). Each detent of the knob increases the speed of the carriage.

There are 16 speeds in each direction. The velocity profile and maximum speed can be configured via the [knob.speedprofile](#) (T:112) and [knob.maxspeed](#) (T:111) settings. The axis stops and resets the knob upon arriving at the end of travel.

Displacement Mode

Turn the knob clockwise to move the axis in the positive direction (extend), counter-clockwise for negative direction (retract). Each detent of the knob moves the axis a fixed number of microsteps, specified by the [knob.distance](#) (T:110) setting. If [knob.distance](#) (T:110) is set to 0, each detent of the knob will move to the next index position, similar to [move.index](#) (T:78) movements. The axis moves at the speed specified by the [maxspeed](#) (T:42) setting, or the slower of [maxspeed](#) (T:42) and [limit.approach.maxspeed](#) (T:41) if the axis has not been homed. If there are fewer than [knob.distance](#) (T:110) microsteps to the end of travel and another move is requested, the axis will move to the end of travel and then stop.

Summary of knob functionality

- Turning the knob:

Moves the axis in the direction of knob turn.

- Pressing the knob:

Decelerates and stops the axis (identical to a [stop \(T:23\)](#) command).

Instantly stops the axis, if the axis is already decelerating.

Warning: Stopping instantly may result in damage to the product and reduced lifespan. Use sparingly if the axis is under heavy load.

- Pressing and holding the knob for 1 second:

Toggles between Velocity Mode and Displacement Mode.

This section describes the behaviour of the axis trajectory when a movement command is issued.

Software Position Limits

The travel range of the axis is limited by the Minimum Position and Maximum Position settings. Setting a [peripheral.id \(T:66\)](#) will configure these settings to match the physical travel range. If a customized range is desired, it can be changed by configuring the [limit.min \(T:106\)](#) and [limit.max \(T:44\)](#) settings to appropriate values. For the Current Position, query [pos \(T:60\)](#).

Minimum Position

When the Current Position is less than the Minimum Position value, the axis cannot move in the negative direction(towards the motor).

Maximum Position

When the Current Position is greater than the Maximum Position value, the axis cannot move in the positive direction(away from the motor).

Movement Speed

The movement speed of the axis depends on axis status and various speed settings. If the axis has not been initialized by the [home \(T:1\)](#) command or by moving towards the home end of the axis, movement speed will be constrained to fail-safe values. The home status of the axis can be determined by reading the [limit.home.triggered\(T:53:103\)](#) setting.

Movement speed of the axis is specified below:

[move vel \(T:22\)](#)

The axis will move at the specified speed regardless of home status.

Knob movement in Velocity Mode

The axis will move at the specified speed regardless of home status.

The speed is specified by the [knob.speedprofile \(T:112\)](#) and [knob.maxspeed \(T:111\)](#) settings.

Other movement commands - when the axis has not been homed

The axis will move at the slower of the [maxspeed \(T:42\)](#) and [limit.approach.maxspeed \(T:41\)](#) settings.

Other movement commands - when the axis has been homed

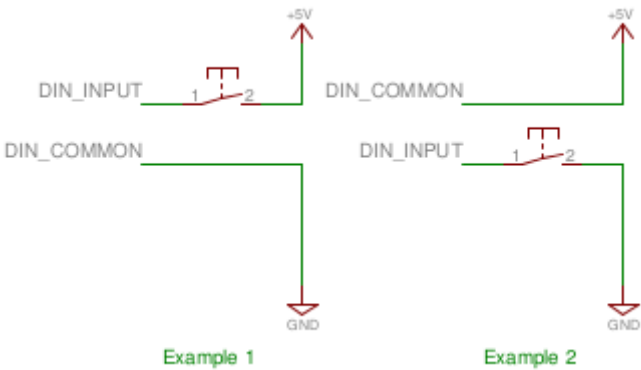
The axis will move at the speed specified by the [maxspeed \(T:42\)](#) setting.

The X-MCB2 features a range of flexible input and output options that can be easily examined and controlled from user software. The input and output capabilities of the X-MCB2 can also be used with [triggers](#) to perform actions based on the current value of the I/O channel.

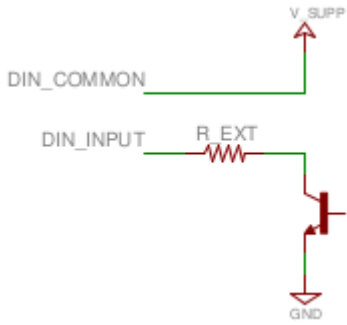
To minimize the number of power supplies needed, the on-board +5 V and GND connections can be used as non-isolated power supplies for I/O circuitry as long as the current draw remains below 200 mA.

Digital Inputs

The digital inputs on the X-MCB2 are fully opto-isolated and bi-directional, giving added flexibility when interfacing to external equipment. The two examples below demonstrate how the common line can be connected to a power rail or to ground, depending on the application.



Each digital input contains an internal current limiting resistor of 442 ohms. While this value is suitable for driving the inputs with 5 V (as shown in the circuit above), higher voltages will require the addition of a series resistor. A list of recommended values for the external resistor and example circuit are shown below.



V_SUPP (V)	R_EXT (Ohms)	Power (mW)
0 - 8	0	n/a
8 - 15	500	125
15 - 24	1500	250

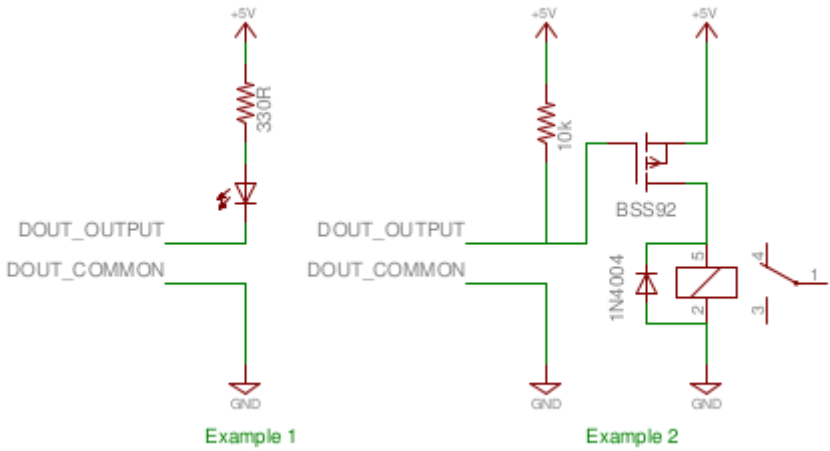
The circuit above also shows how to interface with an open collector output from another device. Reading the inputs is accomplished by sending the unit an [io_get](#) command, as shown below.

```
/1 io get di␣  
  
@01 0 OK IDLE -- 0 0 1 0  
/1 io get di 1␣  
  
@01 0 OK IDLE -- 0
```

The first command queries all inputs on the device and shows that input 3 is "active" (not equal to the common line) and all others are "inactive" (equal to the common line). Depending on whether your common line is connected to ground or a positive voltage, "active" might mean a high or a low voltage level. The second command queries a specific input on the device, in this case input 1, which is "inactive".

Digital Outputs

All digital outputs on the X-MCB2 are fully opto-isolated and capable of sinking a minimum of 3 mA at up to 50 V. The first example circuit below shows how to drive an LED from one of the digital outputs. In order to switch loads with a higher current draw, for example a relay, an external switching transistor is required, as shown in example 2.



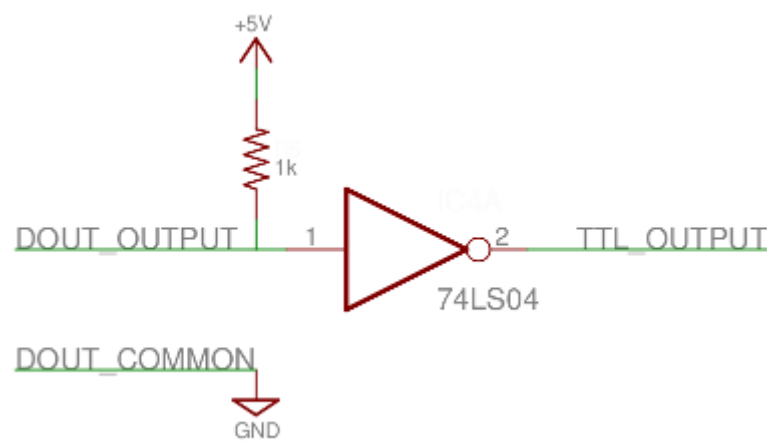
The digital outputs are set through the [io_set](#) command, as shown below.

```
/1 io set do 1 1␣  
  
@01 0 OK IDLE - 0  
/1 io set do 1 0␣  
  
@01 0 OK IDLE - 0
```

The first command sets the first digital output, which would cause the LED in example 1 above to glow. The second command clears the output, turning off the LED.

TTL Outputs

Additional circuitry is required to get TTL signal levels from the X-MCB2, as shown below.

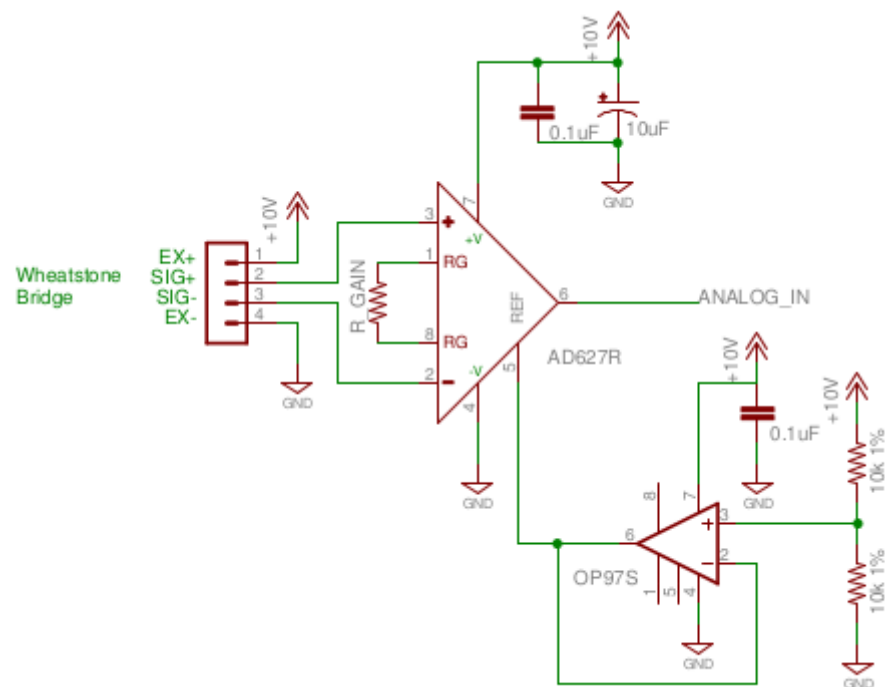


The 74LS04 contains 6 inverters so it is possible to convert all of the digital outputs with one IC. In order to maintain isolation, it is recommended that the 5 V and GND supply connections come from the device requiring the TTL signalling. It is, however, possible to use the 5 V and GND connections from the Analog Output connector on the X-MCB2 to power the external device, as long as the current limits are adhered to.

Analog Inputs

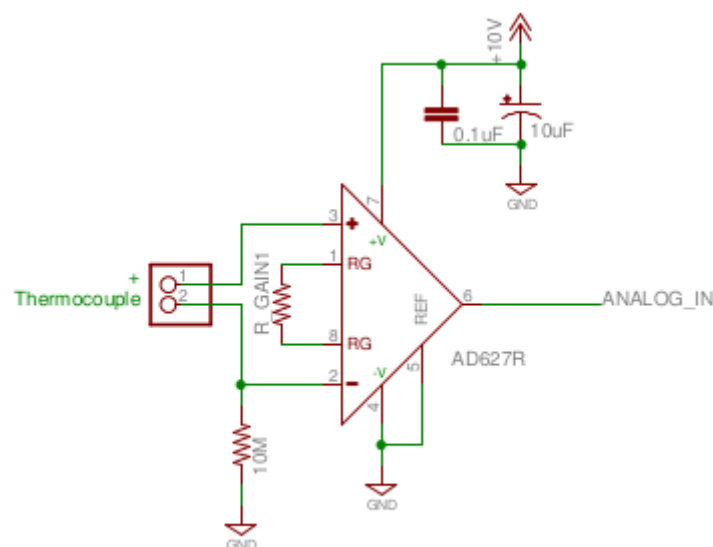
The analog inputs on the X-MCB2 accept and display voltages in the range of 0 – 10 V. In order to measure other analog variables, a transducer or sensor is required that outputs an appropriate voltage range. As transducers typically provide low voltage signals, an amplifier and buffer circuit is required to interface a transducer to the X-MCB2.

The reference circuit below demonstrates how to connect a wheatstone bridge to one of the analog inputs on the X-MCB2. Various instruments are configured in a wheatstone bridge arrangement, including load-cells and strain gauges.



R_GAIN's value should be chosen so that a positive full scale of the instrument produces 10 V at the analog input of the X-MCB2 and a negative full scale produces 0 V. The OP97 op-amp provides an offset of 5 V to the amplified value so that no load on the instrument produces an output of 5 V.

The reference circuit below demonstrates interfacing a thermocouple to the X-MCB2. Depending on the application, an offset voltage may need to be provided.



In firmware versions 7.27 and up, the X-MCB2 can control non-Zaber stepper motor peripherals. It supports a wide range of peripheral hardware, including:

- linear or rotary products
- up to three limit sensors
- up to one position encoder

Use the Advanced Hardware Setup application in [Zaber Launcher](#) to configure a non-Zaber peripheral.

Motors

The bipolar stepper motor driver can drive 2-phase bipolar and unipolar stepper motors at up to 48 V. Unipolar motors are driven in a bipolar configuration with the winding center taps disconnected.

Limit Sensors

Each sensor can be active high or active low but must use either 3.3 - 5 V TTL/CMOS logic, be open collector, or switch to ground.

Encoders

Single-ended, digital signaling position encoders are supported. The encoder must use 3.3 - 5 V logic, and can have up to one index mark.

The following sections contain tips for troubleshooting common problems. If the device is unable to communicate, and it is operating erratically, a manual factory reset can be performed on most devices using the following steps. Note that this will reset most settings.

- Power Off the device
- Push and hold the knob for the first Axis (if applicable)
- Power On the device
- Continue to hold the knob in (for ~5 seconds) until one or more LEDs are fading or the blue LED is lit, then release.
- The device has been returned to its factory defaults and can be configured as per the steps in [Initial Setup](#).

Front Panel Indicators

Green LED on.

The device is powered on and is operating normally.

Green LED flashes slowly.

The operating conditions of the device are outside of the recommended range.

This will occur when the supply voltage is either over or under the recommended range or the controller temperature has exceeded the set limit. Check the following:

- The input voltage is within the operational range of the device. This can be read from the device with the [get system.voltage](#) command.
- The device temperature is within range. This can be read from the device with the [get system.temperature](#) command.

Green LED off.

The device is not powered.

Check the supply connections and power adaptor for correct operation.

Red LED on or flashing.

A critical error has occurred.

Please contact [Zaber Technical Support](#).

Yellow LED always off or flashes but no reply.

There are communication errors.

Please see the [Communication Errors](#) section below.

Yellow LED fading in and out.

A peripheral is awaiting activation.

Please see the [Activating Peripherals](#) section.

Blue (or Green for Firmware versions <7.15) LED Fades In and Out.

The axis is parked.

Issue a [tools parking unpark\(T:65:0\)](#) command, or [home \(T:1\)](#) the axis.

Blue LED flashing during a move or blinking every two seconds.

The axis has slipped or stalled.

Please see the [Slipping and Stalling](#) section below.

Blue LED showing a burst of 2 flashes every 1 second.

A stationary axis has been forced out of position.

Blue LED showing a burst of 5 flashes every 2 seconds.

The encoder has encountered a read error.

Please contact [Zaber Technical Support](#).

Blue LED blinking twice per second. Axis does not move.

Driver may be disabled due to over-temperature, out-of-range voltage or other driver fault; or due to user request.

See [Fx Warning Flags](#).

Once the issue has been resolved, send [driver enable](#).

This will also occur briefly when a peripheral is plugged back into the axis after being unplugged.

Manual Control

Turning the knob either way results in no movement.

The knob may have been disabled.

Check that the [knob.enable](#) ([T:107](#)) setting is correct.

Restore the default parameters through the [system restore](#) ([T:36](#)) command.

The axis won't cover the full range of travel.

The axis hasn't been homed.

Turn the knob anti-clockwise until the axis reaches the fully retracted position. The axis will home and the full range of travel available.

Unexpected Behaviour

The axis doesn't respond to a move command.

The axis may need to be homed before use.

Send the [home](#) ([T:1](#)) command.

A peripheral won't move but commands are not rejected.

If the peripheral had no encoder, verify that it is still plugged in. This controller cannot detect when a peripheral without an encoder has been disconnected. If the peripheral is not plugged in, plug it back in and [activate](#) it.

The axis is moving on its own and running against the ends of travel.

The position encoder has de-synchronized.

Reset the device by power cycling it or sending the [system reset](#) ([T:0](#)) command, then re-initialize it with the [home](#) ([T:1](#)) command.

The axis is moving very slowly. It used to move faster.

The speed settings may have been changed inadvertently.

Send a [system restore](#) ([T:36](#)) command.

The axis makes louder than normal noise during travel and is frequently slipping.

This condition happens if the thrust needed is more than the thrust available from the axis.

Check the following:

- The force on the axis is less than the maximum thrust.
- The voltage matches the specified voltage. Read the voltage using the [get system.voltage](#) command. Voltage less than the specified voltage for the device will reduce the positioner's maximum thrust.

Test the following:

- Try a slower target velocity. Stepper motors produce more thrust when moving slowly.
- Try a lower acceleration and deceleration.
- Clean the screw and lightly re-grease it with a grease that does not degrade plastics.

The axis has repeatability errors smaller than 4 full steps.

If steps aren't being skipped, friction or loose parts may still cause some variation when returning to a position.

Please contact [Zaber Technical Support](#).

The axis doesn't cover the full range of travel, or runs into the end.

A setting might have been inadvertently changed.

- [home](#) ([T:1](#)) the axis to see if this corrects the behaviour.
- Send a [system restore](#) ([T:36](#)) command.
- Ensure that the peripheralID setting of each axis corresponds to the attached positioner. A list of peripheral ids are available at the [Peripheral IDs page](#).

The positioner's motor unexpectedly shuts off. An **Fx warning flag** is present.

The motor over-temperature protection switch has been tripped. This sensor will trip if the positioner's maximum continuous thrust specification is exceeded for too long. To prevent this condition from occurring again, reduce the average force that the motor outputs by reducing acceleration, reducing the load, or lowering the duty cycle.

Send a [driver enable](#) command. The axis does not require homing.

Communication Errors

There is no communication with the device; the Yellow LED does not come on or flash.

There are several things that should be checked:

- Make sure the correct serial port is selected. Try selecting other serial ports in the software.
- Check the baud rate, hand shaking, parity, stop bit, etc. when configuring the serial communications software. The required settings are listed in the [RS-232 Communications](#) section above.
- Make sure there are no bent pins in the ends of all the data cables

- Make sure the device is powered. The Green LED should be on.
- If the computer is a laptop running on batteries, try plugging in the power. Some laptops disable the serial ports when running on batteries.
- Make sure a null modem adaptor or cable is not being used.
- Make sure the correct adaptors (if any) are being used. Refer to the pinouts in the [RS-232 Communications](#) section above.
- If the problem was encountered when trying to control the device with custom software, try using Zaber Launcher or Zaber Console (available from the Zaber website) to verify that the hardware is functioning properly.

Two or more devices both respond to commands sent to device 1.

Most devices are shipped with their device number set as 1. If you connect to the devices with Zaber Launcher, it will automatically renumber them if needed. If you aren't able to install and open Zaber Launcher, send the [renumber \(T:2\)](#) command in the software you are using to set all of the device numbers to different values.

The Yellow LED comes on briefly when sending a command, but the axis does not move and does not reply.

Check baud rate, hand shaking, parity, stop bit, etc. are set as per the [RS-232 Communications](#) defaults.

The device numbers may not be what is expected, issue a [renumber \(T:2\)](#) command. Make sure that the computer does not transmit anything else while the devices renumber.

If using the Binary Protocol, check the following:

- 6 bytes are transmitted and that the device number and command are valid.
- The software does not transmit any control characters such as line feed and spaces.
- That the serial port is not configured with a termination character (it often defaults to linefeed).

If problems are encountered when using custom software, try using the Zaber Console (available from the Zaber website) to verify that the hardware works.

The device does not behave as expected when software sends it a series of commands.

If your computer's language and region settings are other than US English, your software may be sending non-ASCII characters or using commas instead of periods as decimal points. Try setting your computer's language to English and region to United States to see if it fixes the problem.

Check what is being sent out of the serial port. stackoverflow.com has a list of some tools to monitor serial ports.

In Binary mode, the device does not send replies but otherwise works.

Auto-reply might have been disabled via [T:101](#).

Send a [system restore \(T:36\)](#) command.

If the problem is encountered when trying to control the device with custom software:

- Use Zaber Console to verify that the hardware is functioning properly.
- Make sure that the receiving part of the code or commercial package is correct.
- Check the serial port settings are correct.
- Check connectors for bent or broken pins.

In Binary mode, the device sometimes returns fewer than 6 bytes.

This typically indicates a problem with the serial port settings. Some serial ports are set to automatically recognize and remove specific control characters such as carriage returns when they appear in the RS-232 receive buffer.

Check that the settings are correct and are not removing or replacing characters.

Slipping and Stalling

The axis moves smoothly, but only moves for a short time then stops. The Blue LED is flashing but the axis is not actually slipping or stalling.

The internal encoder counter needs to be re-initialized. Reset the device by power cycling it or sending [system reset \(T:0\)](#) command, then re-initialize it with the [home \(T:1\)](#) command.

Ground the device and avoid operating it under statically noisy environment.

The axis makes noise but does not move. The Blue LED is flashing.

The axis is stalling.

Try removing all external loads. If the axis now extends and retracts normally, the problem is excessive load. Try to reduce the load and ensure the load is less than the maximum thrust. A higher thrust or torque can be achieved by lowering the speed of the axis using the [maxspeed \(T:42\)](#) setting.

If an axis is stalling with no external load at default speed and acceleration settings then it requires servicing.

For Zaber's policies on warranty and repair, please refer to the [Ordering Policies](#).

Standard products

Standard products are any part numbers that do not contain the suffix ENG followed by a 4 digit number. Most, but not all, standard products are listed for sale on our website. All standard Zaber products are backed by a one-month satisfaction guarantee. If you are not satisfied with your purchase, we will refund your payment minus any shipping charges. Goods must be in brand new saleable condition with no marks. Zaber products are guaranteed for one year. During this period Zaber will repair any products with faults due to manufacturing defects, free of charge.

Custom products

Custom products are any part numbers containing the suffix ENG followed by a 4 digit number. Each of these products has been designed for a custom application for a particular customer. Custom products are guaranteed for one year, unless explicitly stated otherwise. During this period Zaber will repair any products with faults due to manufacturing defects, free of charge.

How to return products

Customers with devices in need of return or repair should contact Zaber to obtain an RMA form which must be filled out and sent back to us to receive an RMA number. The RMA form contains instructions for packing and returning the device. The specified RMA number must be included on the shipment to ensure timely processing.

If you would like to receive our periodic email newsletter including product updates and promotions, please sign up online at [www.zaber.com \(news section\)](http://www.zaber.com/news-section). Newsletters typically include a promotional offer worth at least \$100.

Contact Zaber Technologies Inc by any of the following methods:

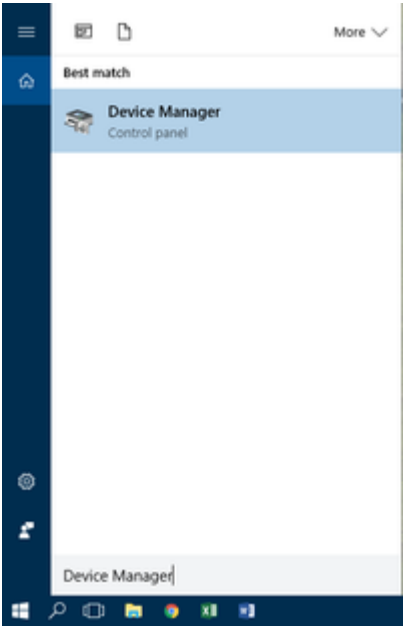
Phone	1-604-569-3780 (direct) 1-888-276-8033 (toll free in North America)
Fax	1-604-648-8033
Mail	#2 - 605 West Kent Ave. N., Vancouver, British Columbia, Canada, V6P 6T7
Web	www.zaber.com
Email	Please visit our website for up to date email contact information.

The original instructions for this product are available at <https://www.zaber.com/manuals/X-MCB2>.

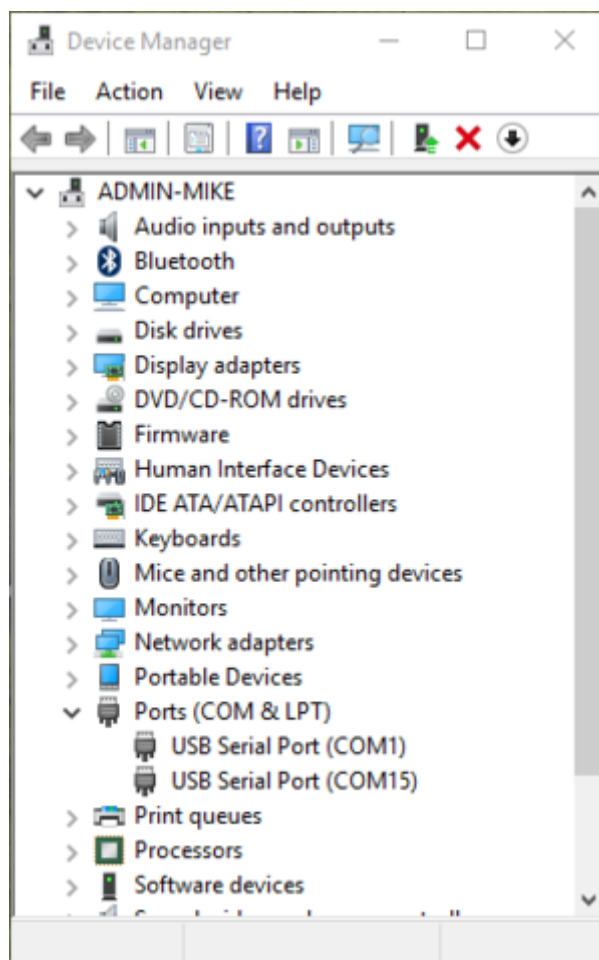
Finding Installed Serial Ports

Windows

- Open Search or Run from the Start Menu or Taskbar, type "Device Manager" and press enter.



- Expand the Ports (COM & LPT) category.



- In this example there are two serial ports available (COM1 and COM15), which are both USB adaptors.

Linux

▪ Finding devices

- Open a terminal and execute the following command:

```
dmesg | grep -E ttyU\?S
```

- The response will be similar to the following:

```
[ 2.029214] serial8250: ttys0 at I/O 0x3f8 (irq = 4) is a 16550A
[ 2.432572] 00:07: ttys0 at I/O 0x3f8 (irq = 4) is a 16550A
[ 2.468149] 0000:00:03.3: ttys4 at I/O 0xec98 (irq = 17) is a 16550A
[ 13.514432] usb 7-2: FTDI USB Serial Device converter now attached to ttys0
```

- This shows that there are 3 serial ports available: `ttys0`, `ttys4` and `ttys0` (a USB adaptor)

▪ Checking port permissions

- Using the ports found above, execute the following command

```
ls -l /dev/tty{S0, S4, USB0}
```

- The permissions, given below, show that a user has to be root or a member of the dialout group to be able to access these devices

```
crw-rw---- 1 root dialout 4, 64 Oct 31 06:44 /dev/ttyS0
crw-rw---- 1 root dialout 4, 68 Oct 31 06:45 /dev/ttyS4
crw-rw---- 1 root dialout 188, 0 Oct 31 07:58 /dev/ttyUSB0
```

▪ Checking group membership

```
groups
```

- The output will be similar to the following:

```
adm cdrom sudo dip plugdev users lpadmin sambashare
Notice that dialout is not in the list
```

- A user can be added to the dialout group with the following command

```
sudo adduser $USER dialout
```

- Group membership will not take effect until the next login.

OSX

▪ Finding devices

- Open a terminal and execute the following command:

```
ls /dev/cu.*serial*
```

- The response will be similar to the following:

```
/dev/cu.usbserial-FTB3QAET
/dev/cu.usbserial-FTEJJ1YW
```

- This shows that there are two serial ports available, both of which happen to be USB adaptors.

- There may be other devices that match this query, such as keyboards or some web cameras. To determine which one corresponds to your USB serial cable, try repeating the command with and without the cable connected to the computer, to see which one appears and disappears.



Integrated USB on a Zaber Controller

Compatible Devices

The following Zaber controllers include a USB 2.0 Type-B port:

- X-MCC1
- X-MCC2
- X-MCC3
- X-MCC4
- X-MCB1
- X-MCB2
- A-MCB2

When connected and configured following the instructions on this page, they will create a virtual serial (COM) port on your computer for communication.

If you are trying to connect one of Zaber's X-USBDC, T-USBDC, or T-USB serial to USB adaptors, go to the [Software](#) page for instructions.

Windows

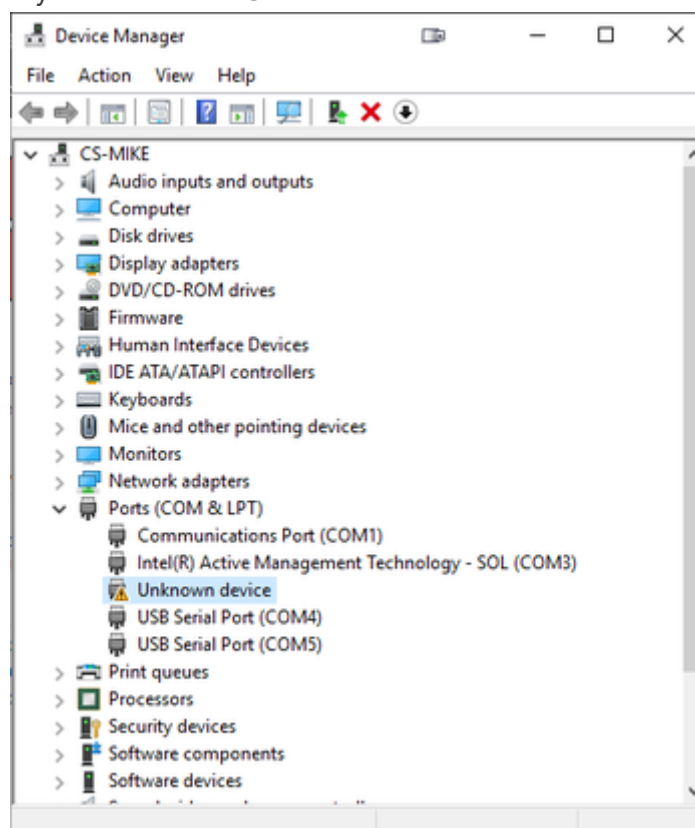
Prior to Windows 10, a driver was required for the USB connection to operate correctly. With Windows 10, installing the driver is not necessary but can be done so that the name of the controller is identified alongside the COM port.

Download

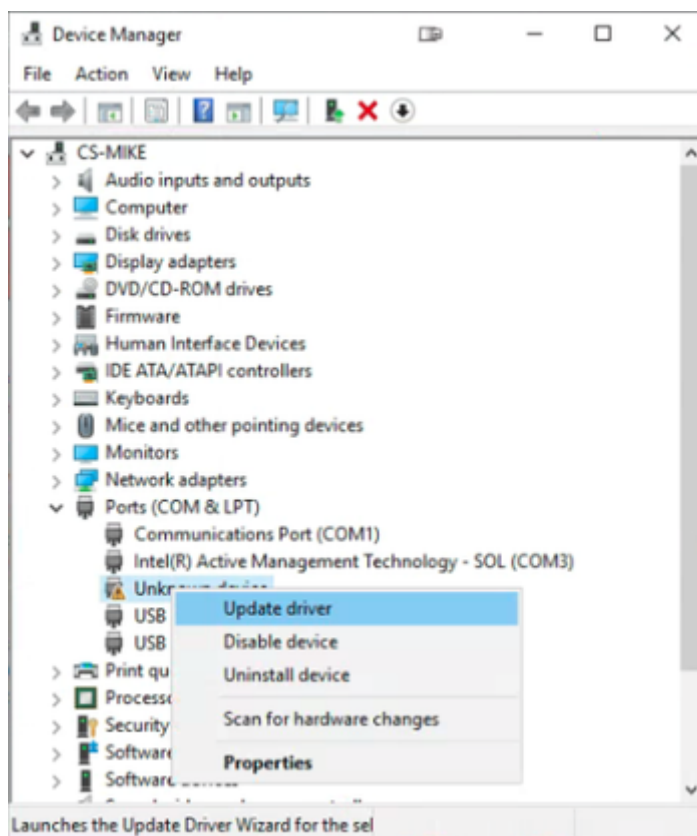
- Download the driver here: [Zaber Integrated USB Driver](#).
- Extract the files to a handy location: Downloads, My Documents or the Desktop are good places.
- Connect power to the controller and connect the USB cable from the controller to the computer.
- Follow the additional steps for your version of Windows.

Windows 10

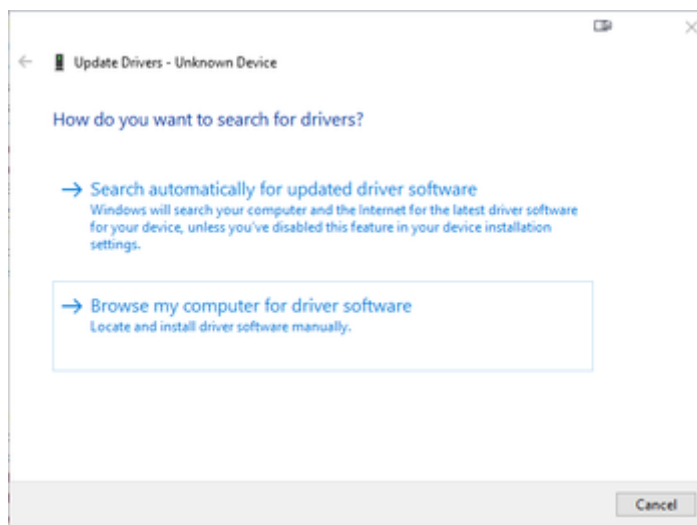
- Right click on the Start button and select Device Manager.
- Under 'Ports (COM & LPT)', you should see an entry with the name 'Unknown device'.



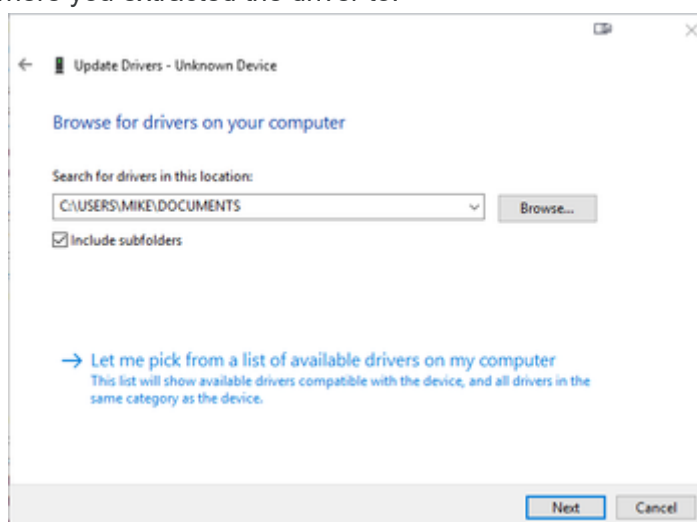
- Right click on this entry and select 'Update Driver'.



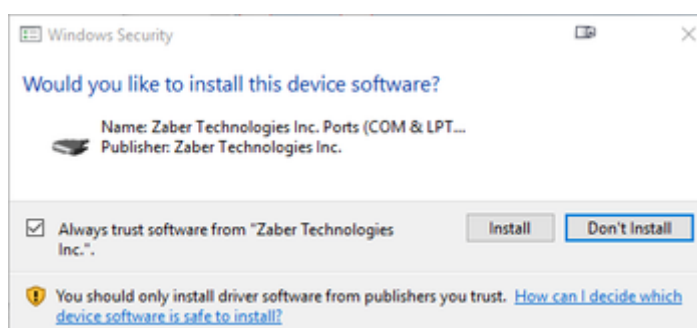
- Choose 'Browse my computer for driver software'.



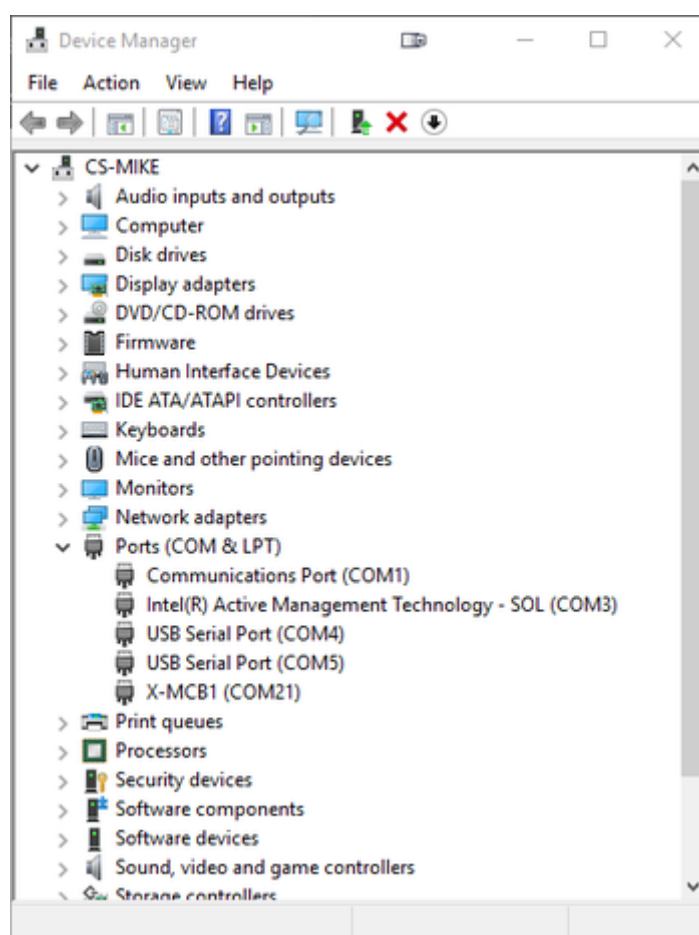
- Click the Browse button and select the location where you extracted the driver to.



- Click Next.
- Click Install.

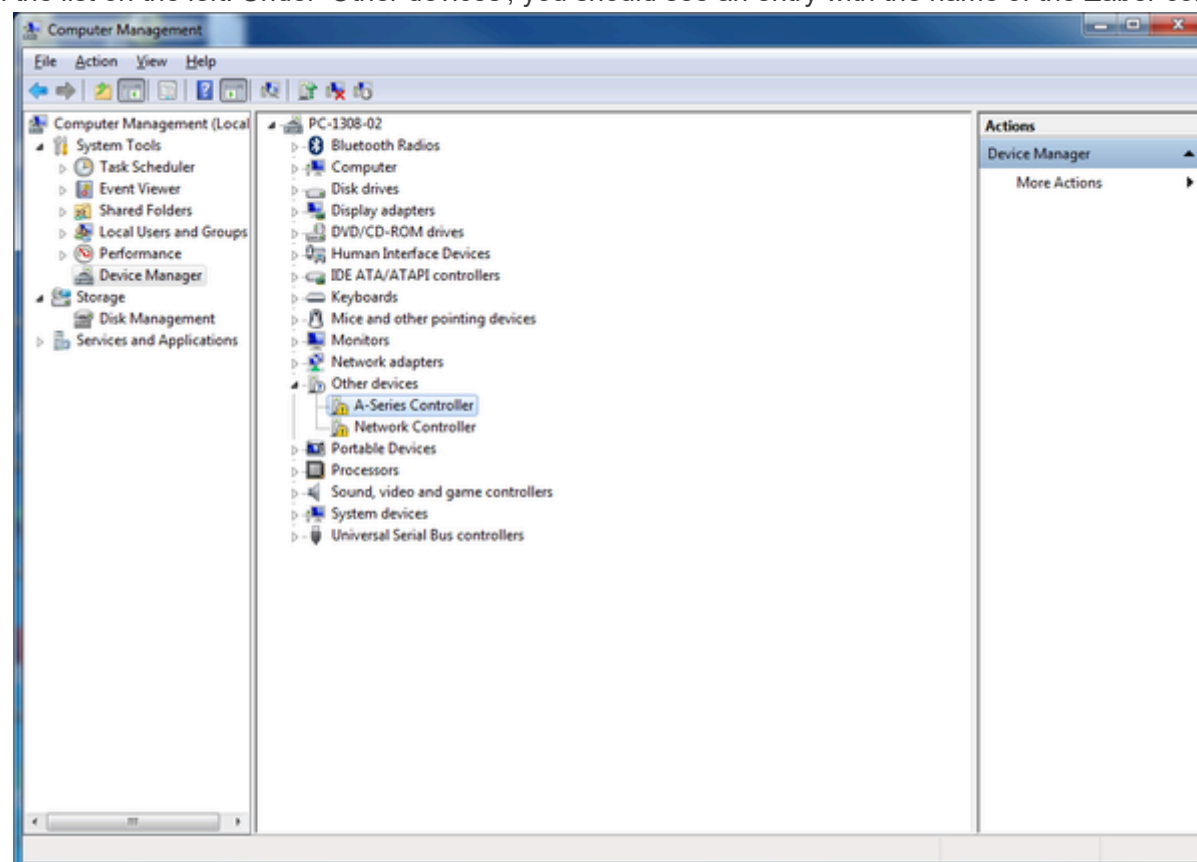


- Click Close. Your controller is now available and should appear in the 'Ports (COM & LPT)' section of the Device Manager.

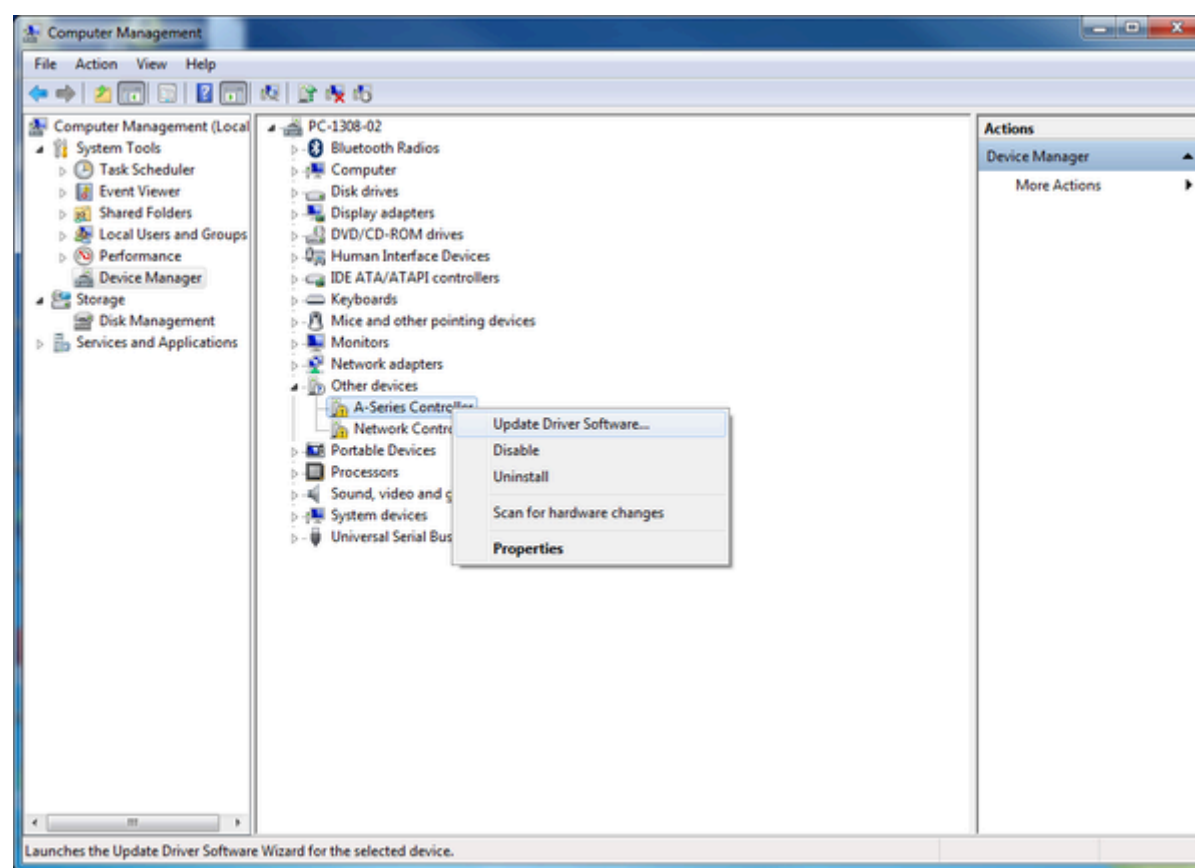


Windows Vista, 7 & 8

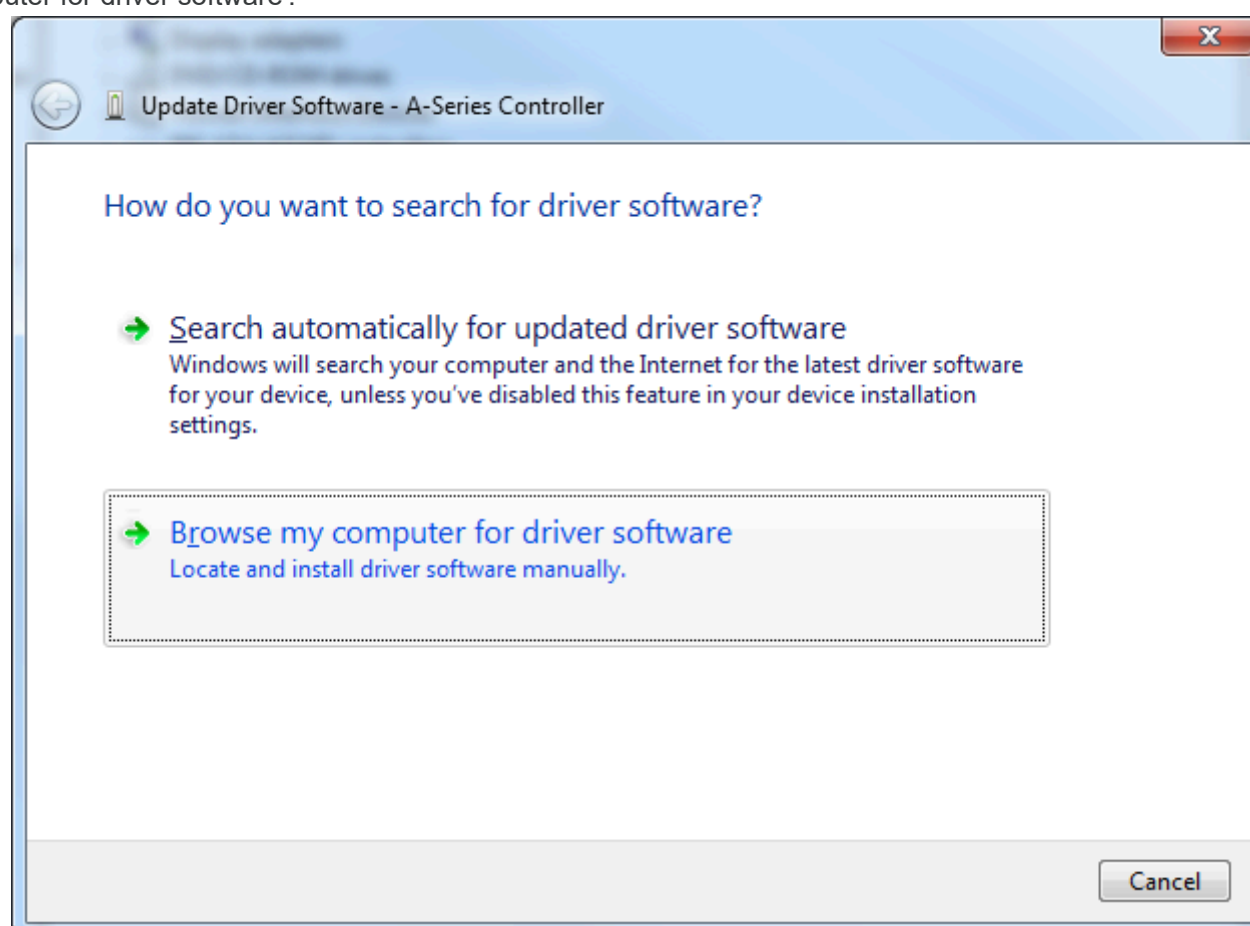
- Windows will detect the device connection and attempt to automatically install drivers. After a minute or so this will fail with a message that the device is not working correctly. Continue on with the steps below.
- Right click on My Computer and select Manage.
- Select Device Manager from the list on the left. Under 'Other devices', you should see an entry with the name of the Zaber controller that is connected.



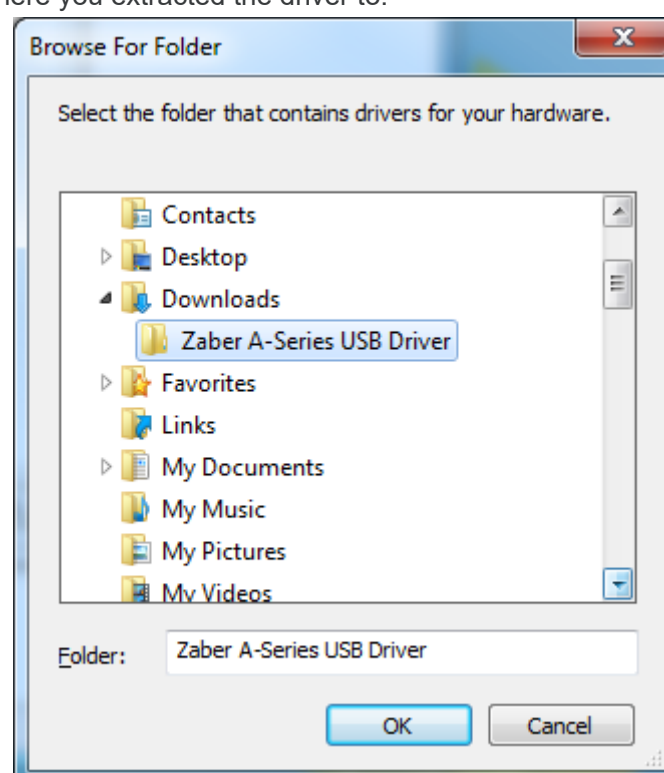
- Right click on this entry and select 'Update Driver Software...'



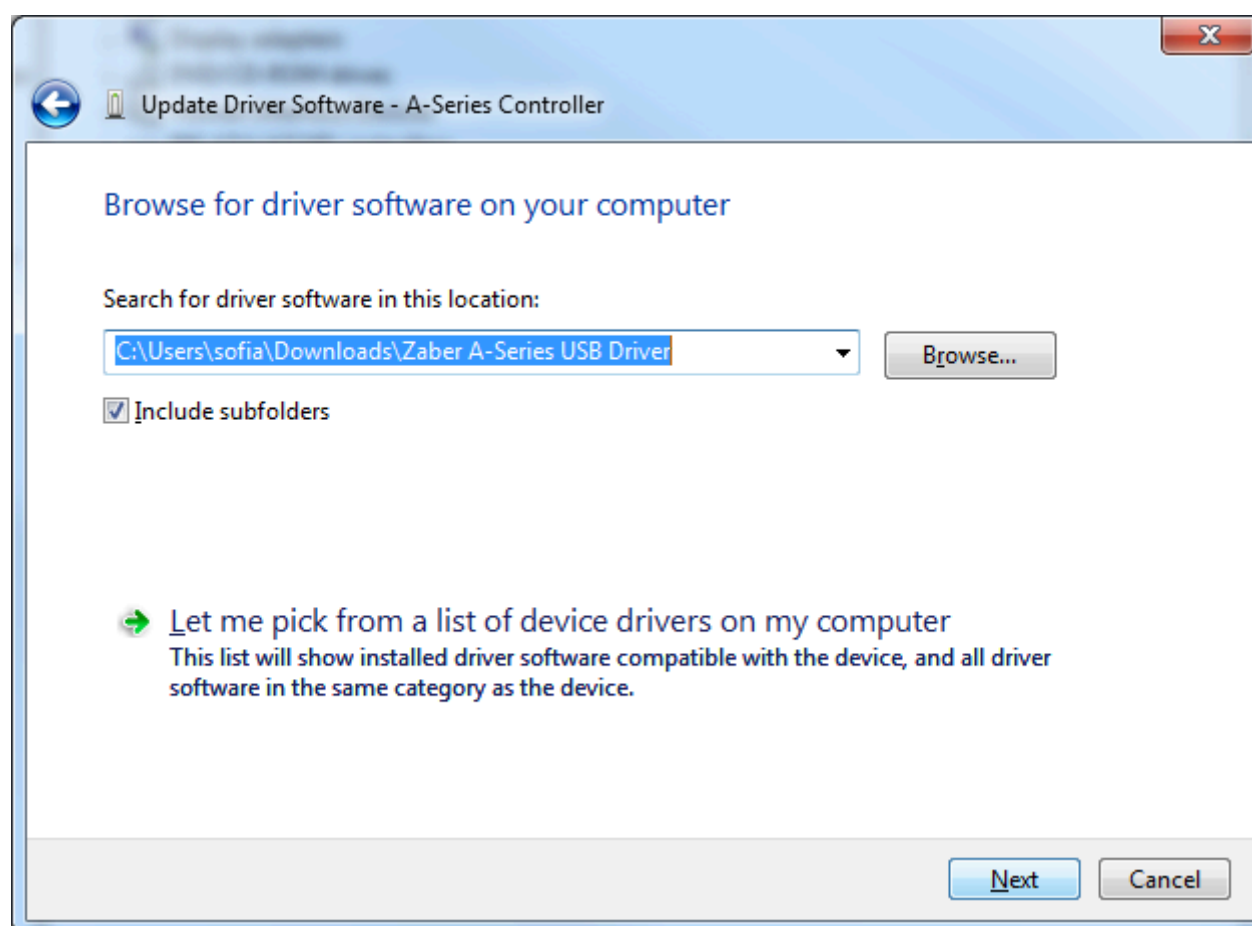
- Choose 'Browse my computer for driver software'.



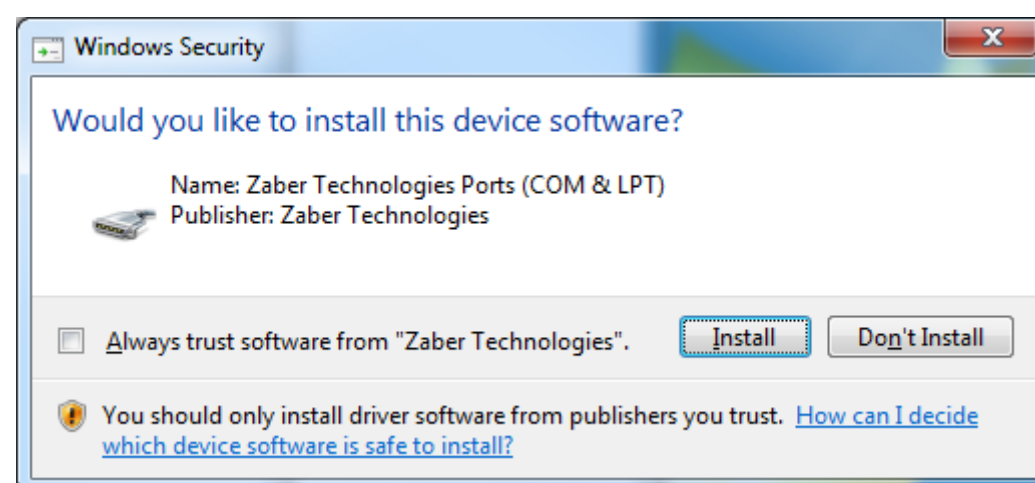
- Click the Browse button and select the location where you extracted the driver to.



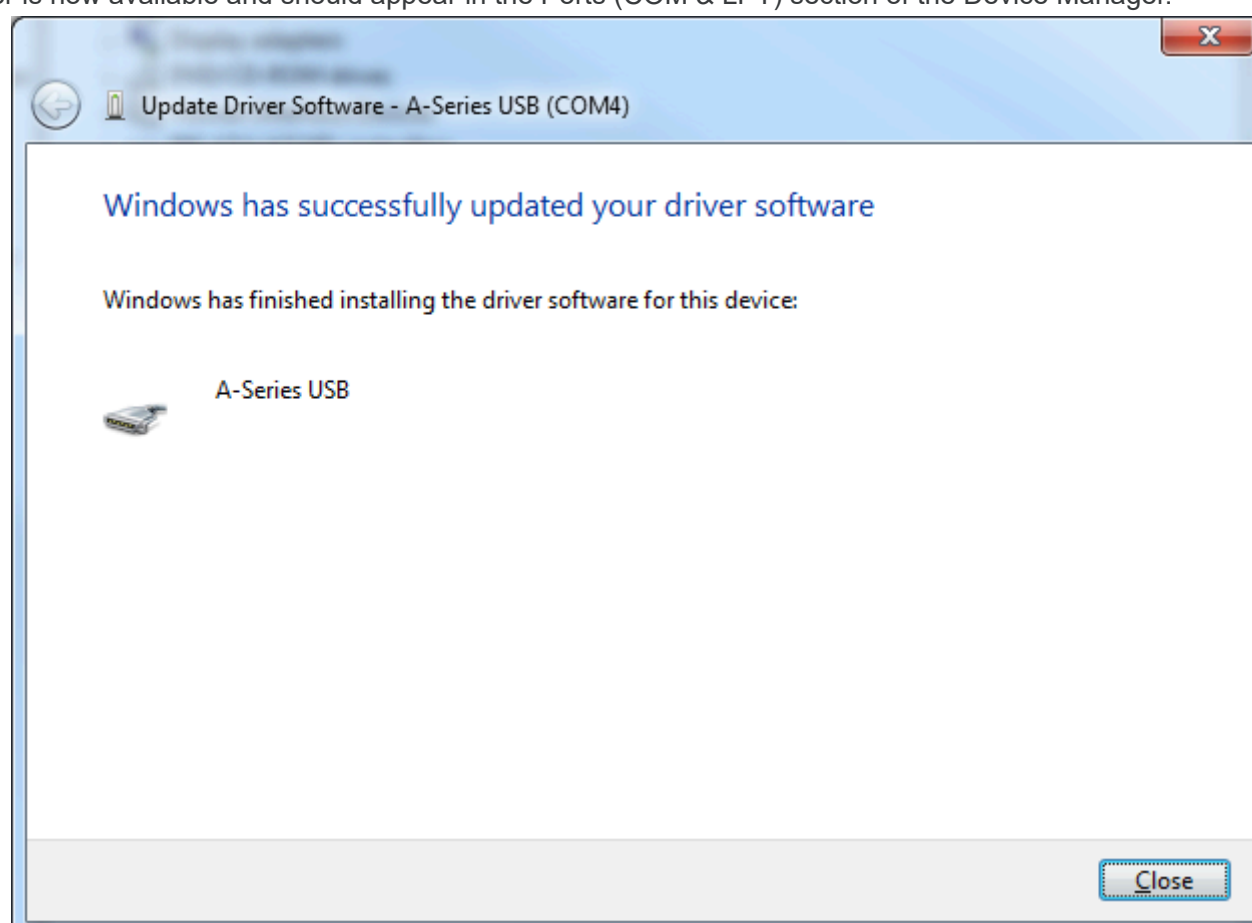
- Click Next.



- Click Install.

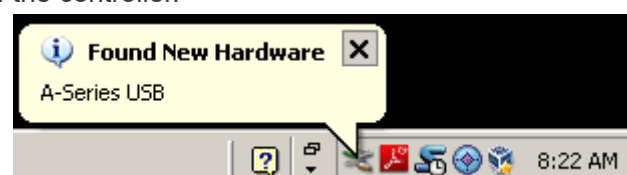


- Click Close. Your controller is now available and should appear in the Ports (COM & LPT) section of the Device Manager.



Windows XP

- Windows will automatically detect the connection of the controller.

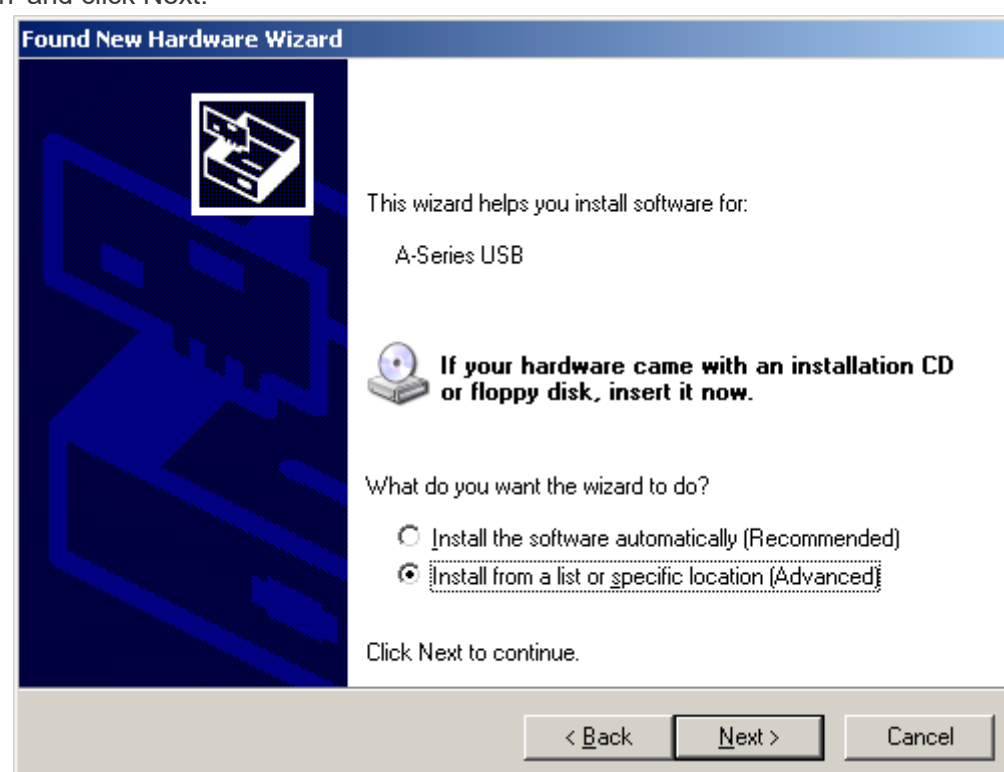


- Once the New Hardware Found wizard starts, select 'No, not this time' and click next.



If the wizard doesn't start:

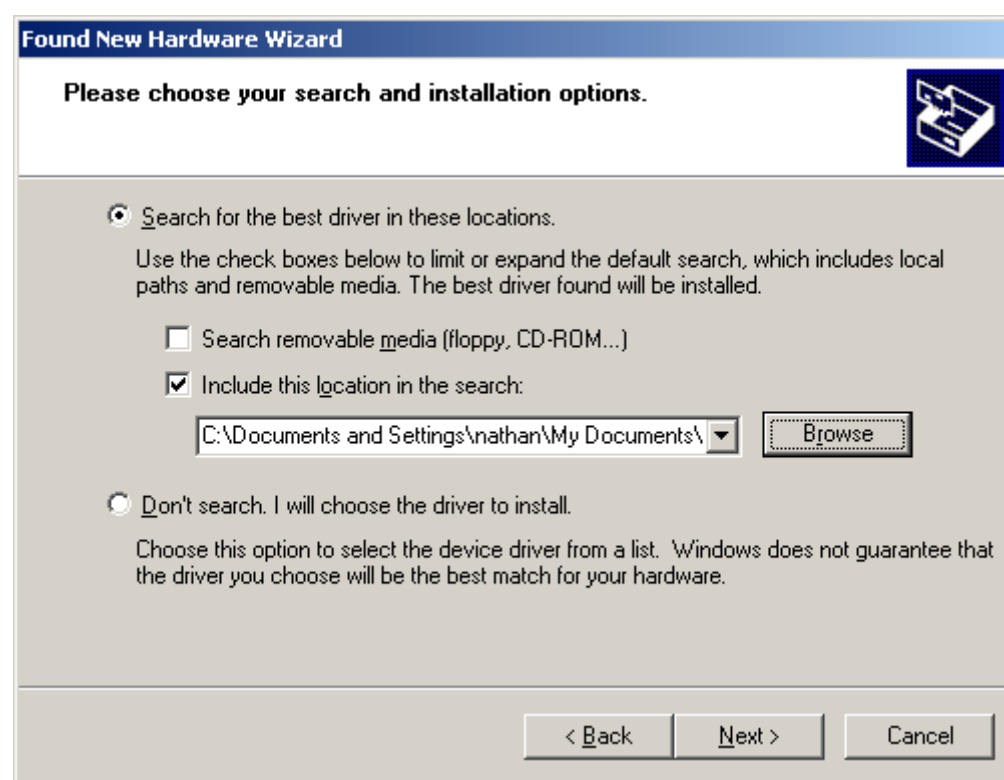
- Right click on My Computer and select Manage.
 - Select Device Manager from the list on the left.
 - Under 'Unknown Devices', you should see an entry with the name of the Zaber controller that is connected.
 - Right click on this entry and select 'Update Driver'.
- Select 'Install from a specific location' and click Next.



- Click the Browse button and select the location where you extracted the driver to.



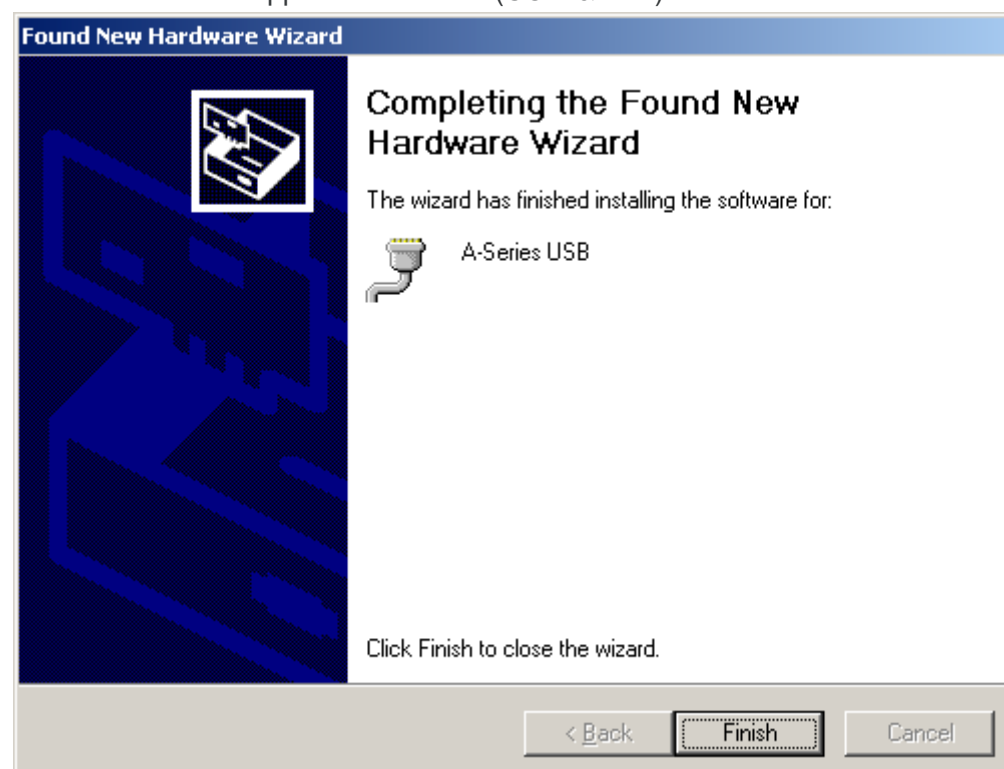
- Click Next.



- Select Continue Anyway.



- Click Finish. Your controller is now available and should appear in the Ports (COM & LPT) section of the Device Manager.



Linux

USB Communications Device Class (CDC) devices are supported in kernel 2.4 and above through the `cdc_acm` module. No special configuration or drivers are needed.

The controller will appear as a `ttyACMx` device. The kernel log (available through `dmesg`) details the device detection and the assigned device, in this case `/dev/ttyACM0`

```
[94929.668171] usb 3-4.1.3: new full-speed USB device number 92 using xhci_hcd

[94929.686563] usb 3-4.1.3: New USB device found, idVendor=2939, idProduct=cafe

[94929.686572] usb 3-4.1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=3

[94929.686577] usb 3-4.1.3: Product: X-MCB2

[94929.686581] usb 3-4.1.3: Manufacturer: Zaber Technologies Inc.

[94929.686585] usb 3-4.1.3: SerialNumber: 1

[94929.687436] cdc_acm 3-4.1.3:1.0: This device cannot do calls on its own. It is not a modem.

[94929.687471] cdc_acm 3-4.1.3:1.0: ttyACM0: USB ACM device
```

If the device does not appear in the /dev directory when connected, the device may need to be manually attached. To do this, enter the commands below corresponding to your controller:

X-MCC4	echo "0x2939 0x49c4" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCC3	echo "0x2939 0x49c3" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCC2	echo "0x2939 0x49c2" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCC1	echo "0x2939 0x49c1" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCB2 (FW7)	echo "0x2939 0x49b2" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCB1 (FW7)	echo "0x2939 0x49b1" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCB2 (FW6)	echo "0x2939 0x495b" > /sys/bus/usb/drivers/cdc_acm/new_id
X-MCB1 (FW6)	echo "0x2939 0x495a" > /sys/bus/usb/drivers/cdc_acm/new_id
A-MCB2	echo "0x2939 0x459" > /sys/bus/usb/drivers/cdc_acm/new_id

Note: In some configurations, modem manager will try to query the device when it is connected. This won't affect device operation but can cause the port to be unavailable for several seconds.

OS X

USB Communications Device Class (CDC) devices are supported in 10.5 and above. No special configuration or drivers are needed.

The controller will appear as a `tty.usbmodem` device. The kernel log (available through `dmesg`) details the device detection and the assigned device, in this case `/dev/tty.usbmodem1421`

```
AppleUSBCDCACMData: Version number - 4.1.23, Input buffers 8, Output buffers 16

AppleUSBCDC: Version number - 4.1.23

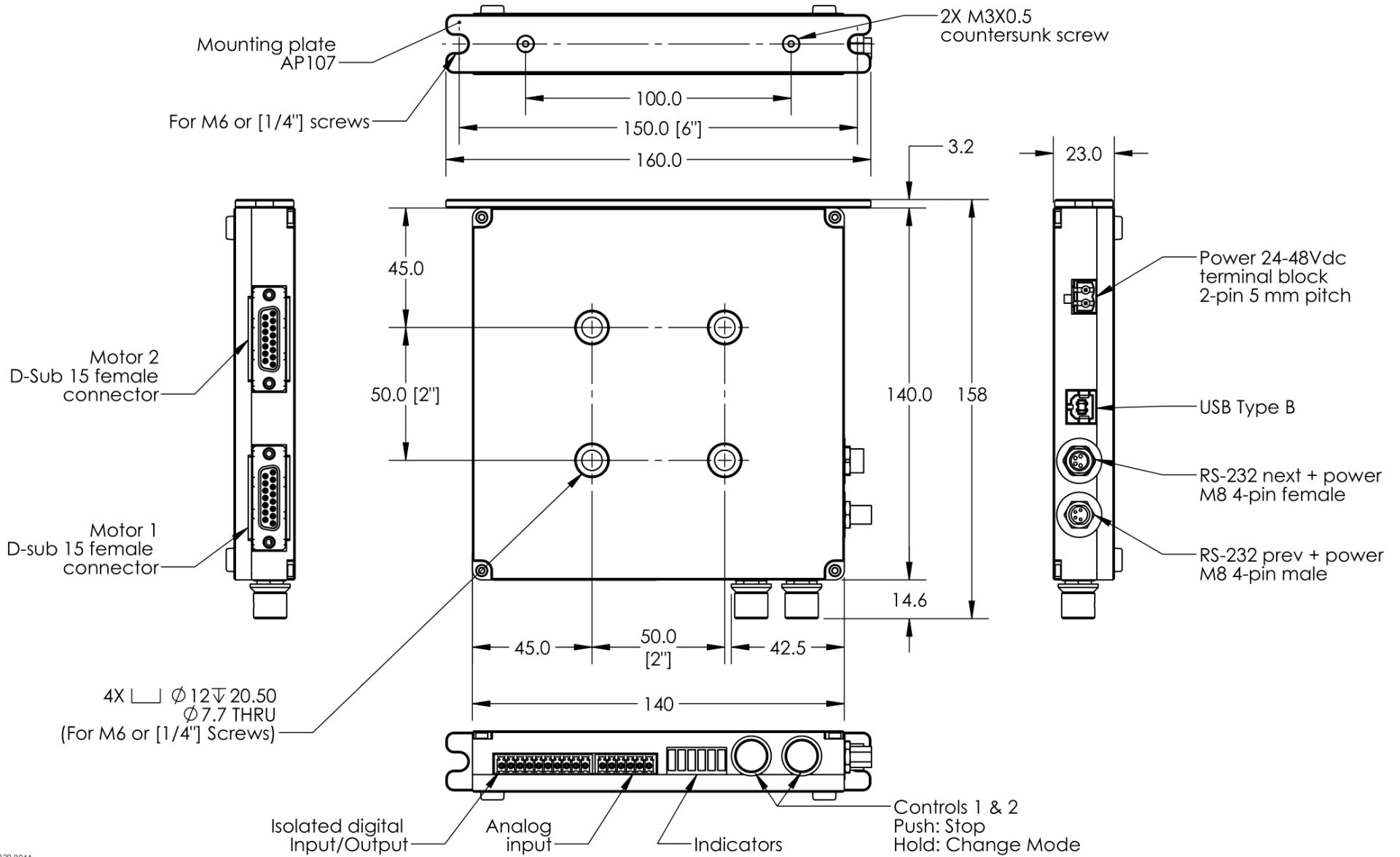
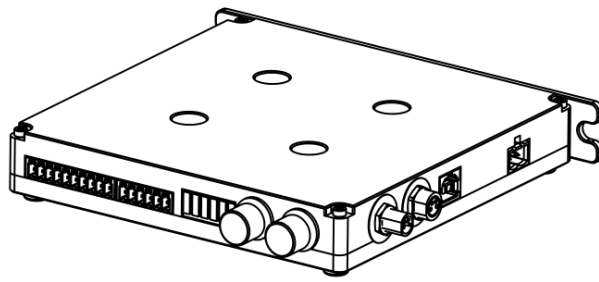
$ ls /dev/tty.usb*

/dev/tty.usbmodem1421
```

ZABER

X-MCB2 Stepper Motor Controller

dimensions in mm



DWG 1120 R04A

Specification	Value	Alternate Unit
AutoDetect	Yes	
Communication Interface	RS-232, USB 2.0	
Communication Protocol	Zaber ASCII (Default), Zaber Binary	
Data Cable Connection	Locking 4-pin M8, USB-B, Buchanan 4-pin 3.5 mm	
Power Supply	24-48 VDC	
Power Plug	Screw Terminal	
Maximum Current Draw	Motor and supply voltage dependent mA	
Controller Maximum Current Per Phase	1410 mA	2000 mA peak
Motor Connection	D-Sub 15 female	
Default Resolution	1/64 of a step	
Manual Control	Indexed knobs with push switches	
Axes of Motion	2	
LED Indicators	Power, System Error, Axis 1 Status, Axis 1 Error, Axis 2 Status, Axis 2 Error	
Limit Sensors per Axis	3	
Isolated Digital Input	4	
Isolated Digital Output	4	
Analog Input	4	
Analog Input Range	0-10 V	
Analog Input Resolution	1 mV	
2D Primitives Supported	Lines, Arcs, Circles	
Operating Temperature Range	0 to 50 °C	
RoHS Compliant	Yes	
CE Compliant	Yes	

Specification	Value	Alternate Unit
Vacuum Compatible	No	
Weight	0.507 kg	1.118 lb

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