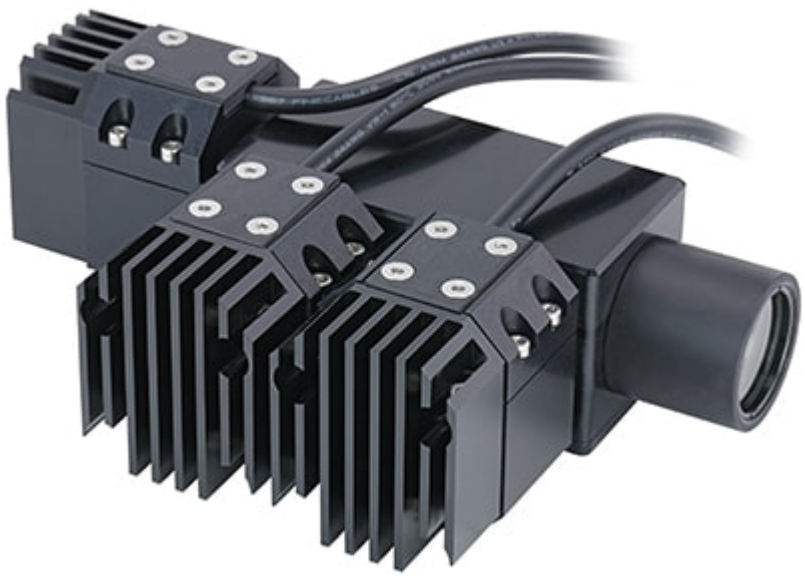
MLR Series User's Manual

Nucleus™ MLR reflected light illluminators



Zaber’s products are not intended for use in any critical medical, aviation, or military applications or situations where a product's use or failure could cause personal injury, death, or damage to property. Zaber disclaims any warranty of fitness for a particular purpose. The user of this product agrees to Zaber's general terms and conditions of sale.

⚠ **UV Light Hazard!** The MLR illuminator contains a high-power UVA LED. Do not look directly into the beam of light or expose skin. Do not attempt to disassemble or service an MLR device, except under the advisement of a Zaber representative.

Connect the MLR illuminator to the epi-illumination port of any Zaber MVR microscope. Connect the 3 LED channels to the X-LCA4 controller using the 5-pin locking M8 connectors.

The MLR LED peripherals are designed to be plug & play with Zaber's X-LCA4 controller. The controller will automatically detect the connected LEDs and apply appropriate driving currents when LEDs are activated. See the X-LCA4 Manual for more information on how to activate LED peripherals.

By default, the LED channels will be set to 0 brightness upon device initialization. To increase brightness, send commands to the X-LCA4 controller, or turn the manual control knobs.

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.

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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). Newsletters typically include a promotional offer worth at least $100.

Contact Zaber Technologies Inc by any of the following methods:

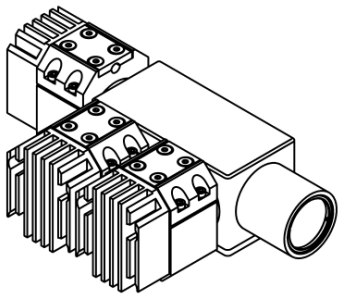
Phone	1-604-569-3780 (direct) 1-888-276-8033 (toll free in North America)
Fax	1-604-648-8033
Mail	#2 - 605 West Kent Ave. N., Vancouver, British Columbia, Canada, V6P 6T7
Web	www.zaber.com
Email	Please visit our website for up to date email contact information.

The original instructions for this product are available at https://www.zaber.com/manuals/MLR.

ZABER

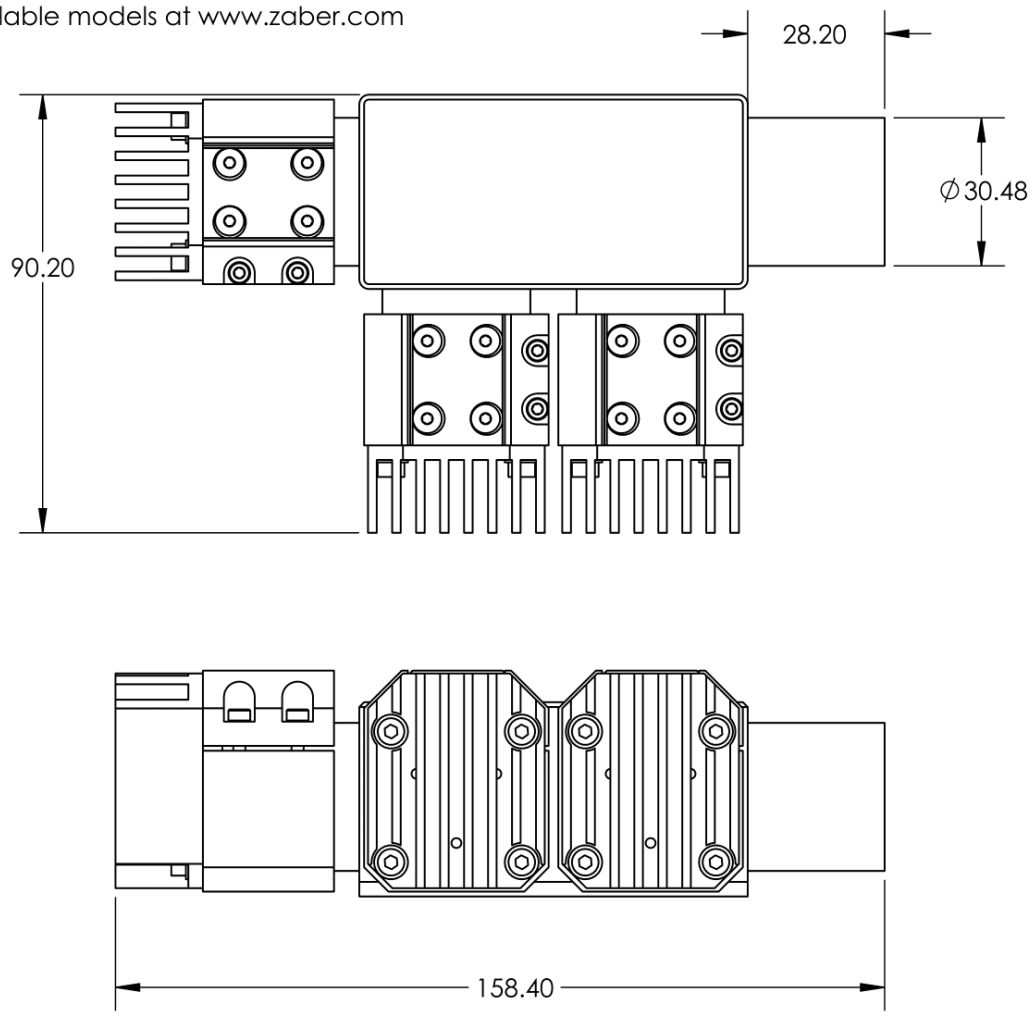
MLR3 - Microscope Reflected Light Illuminator

dimensions in mm



Model Number*	LED Wavelengths
MLR3A	385nm, 473nm, 568nm
MLR3B	385nm, 3000K, 625nm

*See product page for complete list of available models at www.zaber.com



DWG 2792 R03

Specification	Value	Alternate Unit
Built-in Controller	No	
Recommended Controller	X-LCA4 (48 V) Recommended	
Connector Type	3 x 5-pin locking M8	
Operating Temperature Range	0-50 °C	
RoHS Compliant	Yes	
CE Compliant	Yes	
Weight	0.6 kg	1.323 lb

Comparison

Part Number	Maximum Current Draw	Nominal Wavelength	Colour Temperature	FWHM (Full Width at Half Maximum)
MLR3A Channel 1	1000 mA	385 nm	N/A	18 nm
MLR3A Channel 2	1000 mA	473 nm	N/A	25 nm
MLR3A Channel 3	1000 mA	550 nm	N/A	110 nm
MLR3B Channel 1	1000 mA	385 nm	N/A	18 nm
MLR3B Channel 2	3000 mA	N/A	3000 K	N/A
MLR3B Channel 3	1000 mA	625 nm	N/A	20 nm

This product uses the LZ4 compression library. LZ4 is © 2011–2016 Yann Collet and is governed by the following license:

X-LCA4 Series User's Manual

Nucleus™ X-LCA4 4-channel LED controllers

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⚠The X-LCA4 controller is intended to drive up to four channels of LED peripherals, providing a current of up to 3 A per LED. Zaber's MLR and MLT series LED peripherals are automatically detected by the X-LCA4 controller and are configured for appropriate driving currents. Always follow the instructions in Activating Peripherals when switching between LED peripherals.

The X-LCA4 is not recommended for use with third-party illuminators.

UV Light Hazard! Zaber illuminators used with the X-LCA4 may contain a high-power UVA LED. Do not look directly into the beam of light or expose skin.

- `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.

We recommend using Zaber Launcher to communicate with the device(s) on set up. Please refer to the Protocol Manual for more detailed information on the available commands.

In addition to the standard software options available for all Zaber devices, the X-LCA4 is supported by Micro-Manager open-source microscopy software. Micro-manager can be downloaded for free from the Micro-Manager website. For setting up your Zaber illuminators and other devices, see Zaber's Micro-Manager documentation.

Initial Set-up

- Daisy chain all controllers and integrated controller devices 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 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 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.
- Connect the LED peripherals in the order desired. During initial set-up, each channel will automatically be detected by the controller and appropriate settings will be applied to drive the specific LED. When swapping peripheral channels, it may be necessary to activate the new peripheral before it can be used. See the Activating Peripherals section for additional information.

Using the Device

Several commonly used ASCII commands are shown below. For a full list of available commands, please refer to the Protocol Manual.

Command	Description
/1 1 get lamp.flux.max ↵	Query the maximum flux for the lamp connected to channel #1.
/1 1 lamp on ↵	Turn on lamp connected to channel #1.
/1 2 activate ↵	Activate the LED peripheral connected to channel #2.

Modifying Device Settings

Here are some examples if you would like to customize particular device settings. Refer to the Protocol Manual for detailed descriptions of each setting.

Command	Description
/1 1 set lamp.current 0.25 ↵	Configures the driver to provide 250mA of current to the lamp connected to channel #1.

Activating Peripherals

Important: The X-LCA4 should always be powered down before disconnecting or connecting an LED peripheral.

For more information about peripheral types, compatibility, and activation, please refer to the peripheral section of the protocol manual.

- After the X-LCA4 is powered on with an LED peripheral connected to a channel, the peripheral will be activated automatically if the channel is not configured for use with a different peripheral.
- When an autodetect peripheral is connected and the DATA 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 channel, either use the Activate button near the peripheral name in Zaber Launcher or send the activate command to the channel using the Terminal app.
  - If you have swapped channels 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.

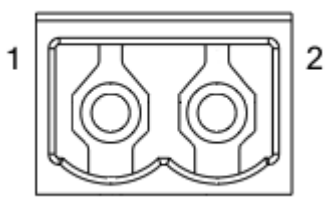
Firmware Upgrades

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

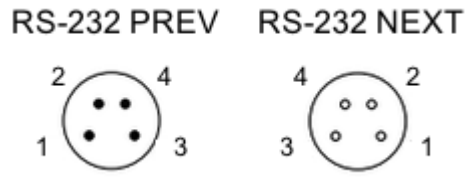


Pin	Description
1	24 - 48 V
2	Device GND

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

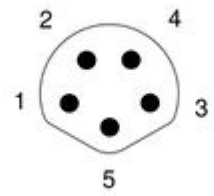
Default Settings

- Baud rate: 115200
- Protocol: Zaber ASCII

Specifications

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

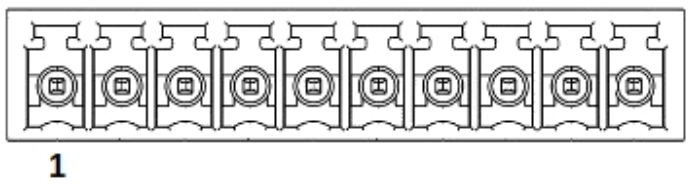
LED Channel Connector



Male B-Coded M8 Connector

Pin	Description
1	LED Temperature
2	LED ID
3	LED-
4	Ground
5	LED+

Digital Inputs/Outputs



Pin	Description
1	Ground
2	Digital In 4
3	Digital In 3
4	Digital In 2
5	Digital In 1
6	Not Connected
7	Digital Out 2
8	Digital Out 1
9	Not Connected
10	Ground

Mating Products

TE Connectivity 284506-5 or 1986692-5

Note: See I/O Usage and Examples for additional information.

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 (Device) - Communication

- On: Data is being transferred.
- Blinking twice per second: Packet corruption has occurred for ASCII commands sent with a checksum.
- Fading in and out every 2 seconds: A connected autodetect peripheral is awaiting activation.

Blue (Device) - Channel Activation Status

- Solid: Any or all of the peripherals are deactivated.

Blue (Channel) - LED Channel Status

- Solid: LED is on

The X-LCA4 can be connected to a computer as follows:

- Plug the M8 to USB adaptor (X-USBDC) into one of your computer's USB ports, then attach the device to the adaptor. 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-LCA4 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.

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 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-LCA4 is designed to mount to 25mm or 2" pitch optical breadboards using M6 or 1/4" screws, respectively, or for use on a desk or table.

Zaber's LED Controllers have an integrated, depressible knob with 20 detents per revolution, allowing LED channels to be controlled without the use of a computer.

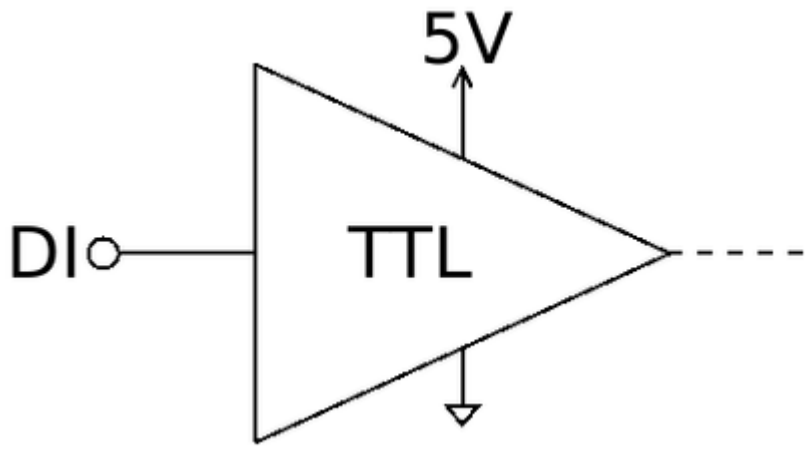
Depress the knob to toggle the LED channel on and off.

By default the LED channels will power up with 0 brightness.
Turn the knob clockwise to increase the brightness, and counter-clockwise to decrease brightness. There are 11 brightness increments on the knob.

The X-LCA4 features four digital inputs and two digital outputs that operate on a +5 V supply and are TTL compatible. The input and output capabilities of the X-LCA4 can also be used with triggers to perform actions based on the current value of the I/O channel.

Digital Inputs

The inputs will draw up to 1 mA during operation.



Reading the input is accomplished by sending the unit an io get di command, as shown below.

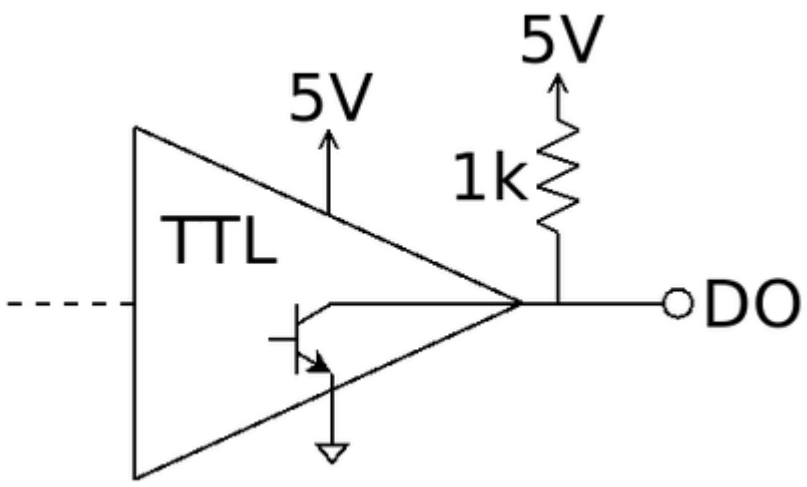
```
/1 io get di 1↵

@01 0 OK IDLE -- 0
```

This command queries the input on the device, in this case input 1, which is low.

Digital Outputs

The digital outputs use an open collector buffer with a pre-installed 1 kΩ pull up resistor to +5 V. Each output can sink up to 20 mA.



The digital outputs are set through the io set do command, as shown below.

```
/1 io set do 2 1↵

@01 0 OK IDLE -- 0
/1 io set do 1 0↵

@01 0 OK IDLE -- 0
```

The first command sets the second digital output high (5 V). The second command sets the first digital output low (0 V).

Controlling Lamps

Some users may find it useful to turn lamps on and off with the digital inputs directly. To link a lamp to a digital input, add a pair of triggers as shown below for each desired lamp.

Set up a trigger to turn a lamp on when a digital input is high:

```
/trigger 1 when io di 1 == 1↵

@01 0 OK IDLE -- 0
/trigger 1 action a 1 lamp on↵

@01 0 OK IDLE -- 0
/trigger 1 enable↵

@01 0 OK IDLE -- 0
```

Set up a trigger to turn a lamp off when a digital input is low:

```
/trigger 2 when io di 1 == 0↵

@01 0 OK IDLE -- 0
/trigger 2 action a 1 lamp off↵

@01 0 OK IDLE -- 0
/trigger 2 enable↵

@01 0 OK IDLE -- 0
```

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 lamp
- 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.

Driven LED Behavior

The LED is not illuminated, although the axis light is blue.
The LED might be set to 0 power. Try turning the knob to increase the brightness.

If the illuminator is installed in a microscope, check that the filter cube is compatible with the LED channel you are attempting to use.

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.

Blue DATA LED is on.
One or more of the channels is deactivated. Plug in any unplugged peripherals. Set peripheral.id to 0 on any channels that are not intended for use.

Yellow DATA LED fades in and out every two seconds.
One or more axes need to be activated. See Activating Peripherals for more information.

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 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 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 command. Make sure that the computer does not transmit anything else while the devices renumber.

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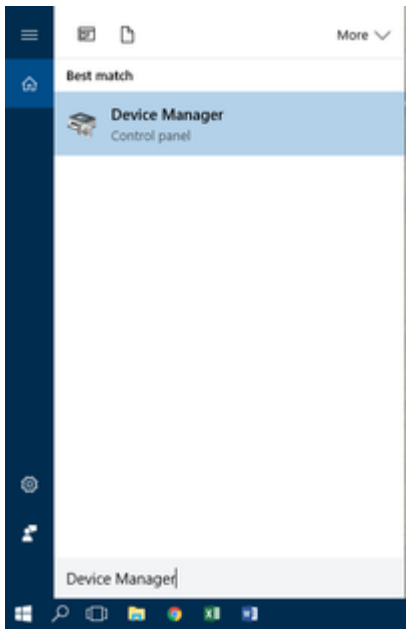
Fax	1-604-648-8033
Mail	#2 - 605 West Kent Ave. N., Vancouver, British Columbia, Canada, V6P 6T7
Web	www.zaber.com
Email	Please visit our website for up to date email contact information.

The original instructions for this product are available at https://www.zaber.com/manuals/X-LCA4.

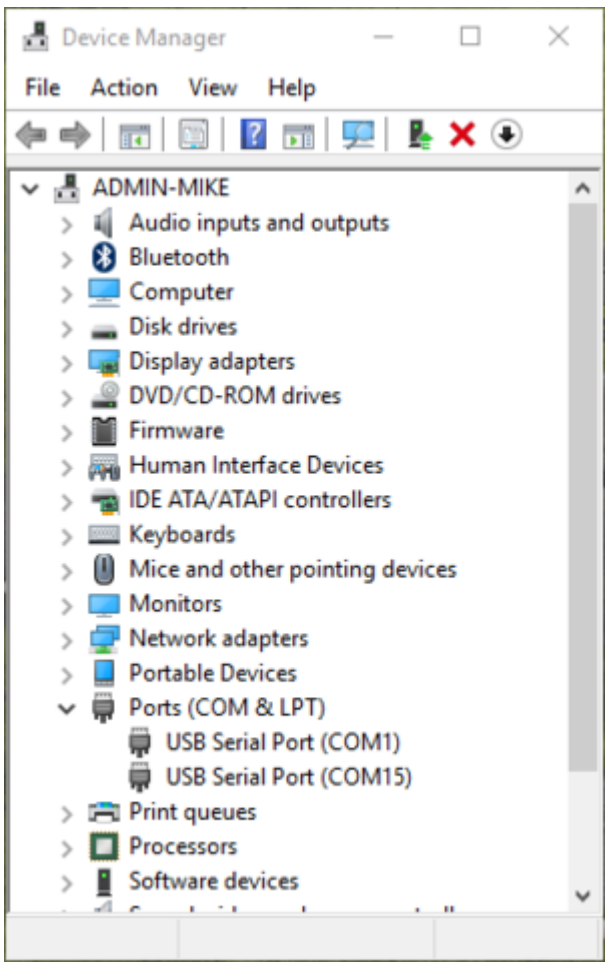
Finding Installed Serial Ports

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 ttyUSB0
```

  - This shows that there are 3 serial ports available: ttyS0, ttyS4 and ttyUSB0 (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 logon.

OSX

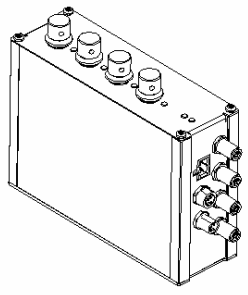
- Finding devices
  - Open a terminal and execute the following command:

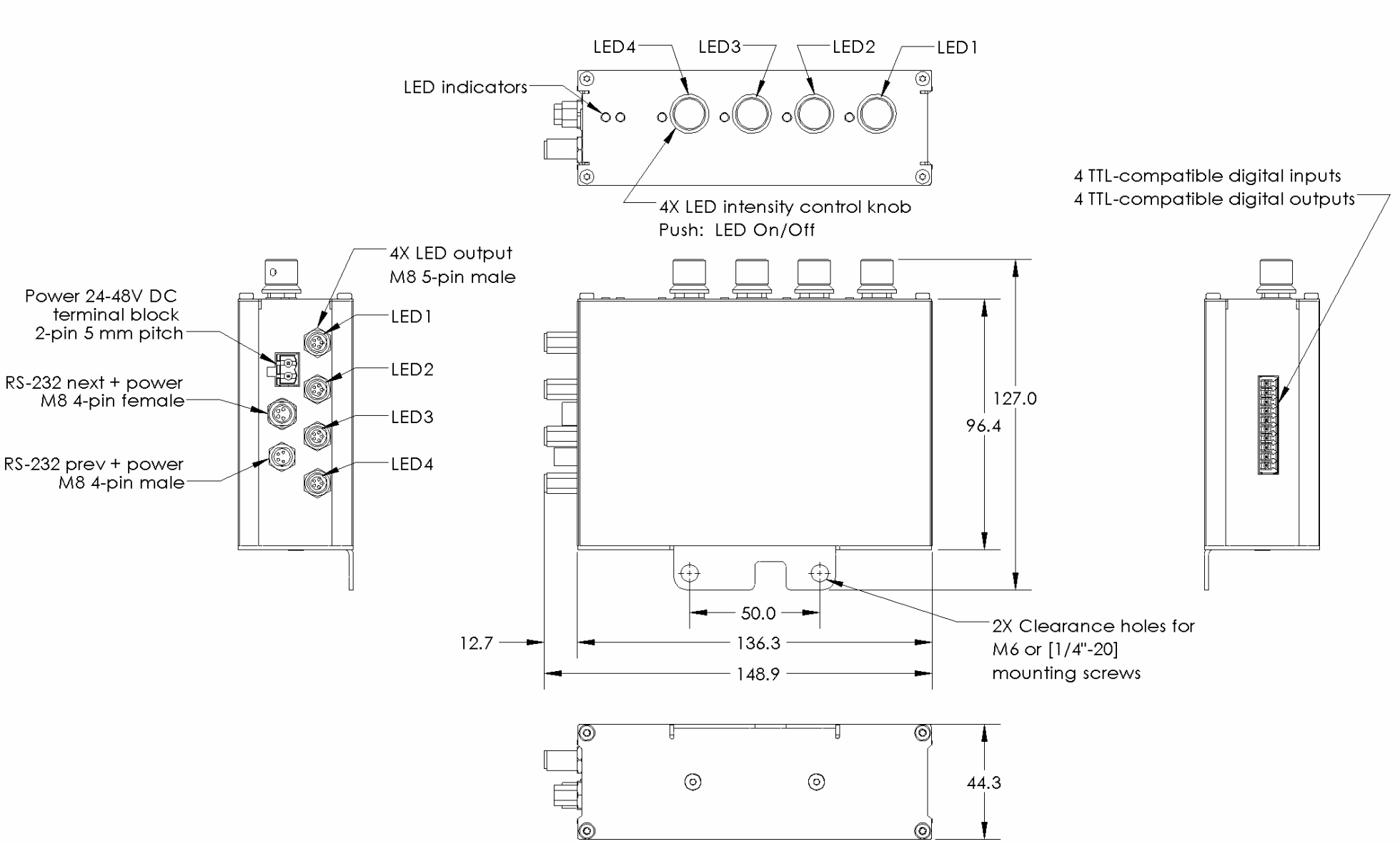
```
ls /dev/cu.*serial*
```

  - 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.





DWG 2764 R03

Specification	Value	Alternate Unit
Communication Interface	RS-232	
Communication Protocol	Zaber ASCII	
Data Cable Connection	Locking 4-pin M8	
Power Supply	24-48 VDC VDC	
Power Plug	Screw Terminal	
Maximum Current Draw	4000 (24V), 2000 (48V) mA	
Maximum Current per LED Channel	3000 mA	
Manual Control	Indexed knobs with push switches	
LED Indicators	Yes	
LED Channel	4	
Digital Input	4	
Digital Output	2	

Specification	Value	Alternate Unit
Operating Temperature Range	0 to 40 °C	
RoHS Compliant	Yes	
CE Compliant	Yes	
Vacuum Compatible	No	
Weight	0.2 kg	0.441 lb

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