



The Zeto Controller Family

Zeto Controller Family Guide Version 1.0

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Zeto Controller Family

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1 Zeto controllers family overview

Zeto controllers family is composed of five different units: Core, CX, CX Plus, VX-4, and VX-16. Core is the brain of the whole system; it serves as an interface between the user and other parts of the system. As such, it must always be present. As for other units, any combination of them can be connected to the Core. The number of connected units to the core can range from 1 to 16; it can be any mix of CX, CX Plus, VX-4, and VX-16. At any time, the system can be expanded with new units. Each unit (CX, CX Plus, VX-4, and VX-16) has a rotary switch at the back that enables setting a unique number between 1 to 16 (more about it can be found in chapter 2). All units, including the core, are designed to be attached to a standard DIN rail (see 4); they connect to each other and communicate with bus connectors at the back, which sit within the DIN rail. The Core will automatically recognize how many and what kind of units are connected to it. Units will be recognized by unique address numbers selected by the aforementioned rotary switches. We briefly described the role of the Core; let's now introduce other family members.



Figure 1.1. 3D Rendering of the Zeto controllers family - Core, CX and VX

CX and CX Plus are two models of Universal Light Controllers. These are precise, high-power, current-controlled LED drivers. They can operate in DC or Strobe mode, with the latter using either internal or external trigger. It is important to note that CX can only be used with the

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light that is designed to use an external LED controller. It won't work or can cause damage to the light or controller if used with the light equipped with a built-in driver. CX is NOT a voltage-regulated power supply and it cannot be used as such. In Metaphase lights family portfolio, products compatible with CX controllers are easily designated in finished good part numbers. These will include 'U' suffix and A-type drive designation for newer products; examples would be: TXISO1A-06-W-M12-U or UB-LL-610-R-NC00-U.

VX-4 and VX-16 are sophisticated, multi-channel, programmable digital dimmers. They allow precise control of light output of lights equipped with internal drivers and 0-10V dimming control lines. In Metaphase (<https://www.metaphase-tech.com>) portfolio, these will be products that have '-24Z' suffix or B/C type drive designation in their finished good part numbers; examples will be: UB-LL-1210-W-CC00-24Z, TXISO1B-12-RGB-3.0M, TXBR3C-24-B-L30-M12.

Both CX and VX units can be connected to the same Core and be used simultaneously. They are intended to be used with different lights, though. It is envisioned that this can be useful in a lab setup or an application that involves multiple illuminators, some of them with built-in drivers and some of them without built-in drivers.

1.1 Core

In this chapter we will describe functions, connections and proper use of the Core unit. 3D model is presented in Figure 1.2.

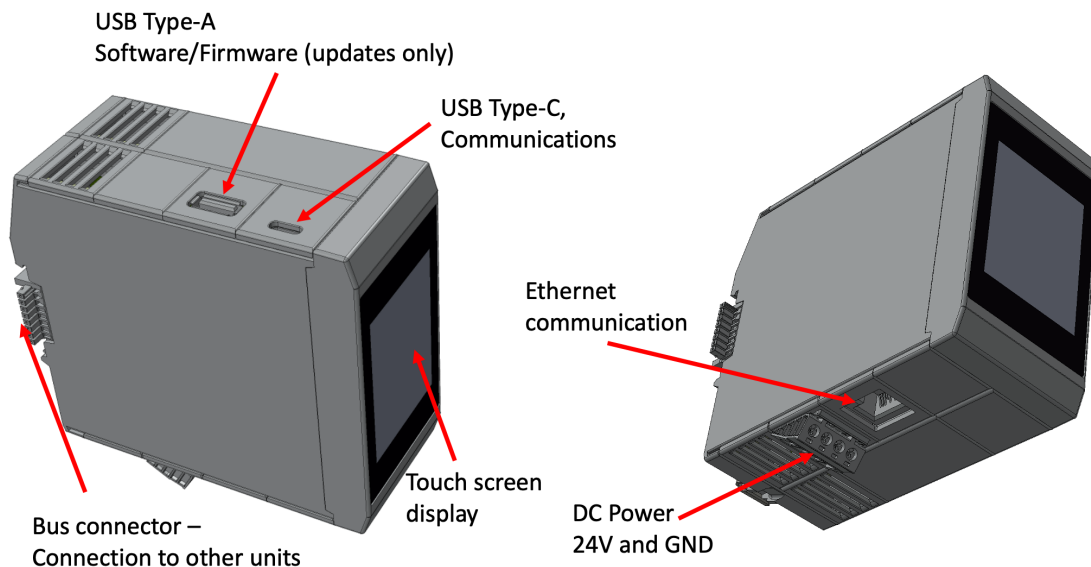


Figure 1.2. 3D model of the Core - shown various connections available

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As mentioned in the introduction, Core is necessary for any ZETO system to function. Regardless how many other units are used (CXs and VXs). Therefore, the customer will have to make sure that at least one Core is being purchased with the new system. Core will act as a gateway to the entire system, providing communication and controls. There are 3 different ways to interact with the system:

- Touch screen display on the front face of the Core
- USB-C, through serial COM port emulation
 - This mode is designed to control the system by sending and receiving binary commands (see 5)
- Ethernet
 - This mode can be used to control the system by sending and receiving binary commands (see 5), similarly to the USB-C port
- WEB
 - Core is equipped with a WEB server that enables the whole system control just with the use of the browser

Ethernet supports both UDP and TCP. Core can utilize the DHCP protocol to obtain an IP address, or it is possible to set a static IP address. The MAC address assigned to the unit is displayed on the sticker at the back.

Each mode of communication is discussed in a separate chapter below.

Additionally to the USB-C port, there is also a USB Type-A port present on the top of the Core (see Figure 1.2). This port is only intended for software/firmware updates – this procedure is described in paragraph 6.

DC power is delivered to the unit with the use of screw-in terminals – they are located at the bottom of the unit (see Figure 1.2 for reference). There are two terminals for 24V and two for GND. Only one pair can be used; another one can be used to daisy-chain 24V to the next unit (CX, VX).

1.1.1 Core – using touchscreen display

After powering up the unit, by delivering 24V DC, and after approximately 9 seconds, this image will greet the user on the touch screen display - Figure 1.3. At the bottom right corner, there will be displayed the current version of the software running currently on the Core. If no other unit is connected (and powered) to the core, the screen won't change, and there will be no way to interact with the core. If, on the other hand, CX or VX are being connected, this will be displayed - Figure 1.4. The screenshot on the left corresponds to a CX, and the

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one on the right to a VX. As it was mentioned before, both can be connected at the same time, as well as multiple CXs and VXs. In order to toggle between them, use the left and right arrows at the bottom of the screen. In the middle of the screen unit id (configured with the rotary switch at the back) and type of unit will be displayed. Always present on the screen is an IP address box – the top left corner of the screen. It is either the IP address assigned by the DHCP server if such is present or a static IP address. In order to switch from DHCP to a static address, please press the box, and this screen will appear – see Figure 1.5.



Figure 1.3. Greeting screen after powering up Core

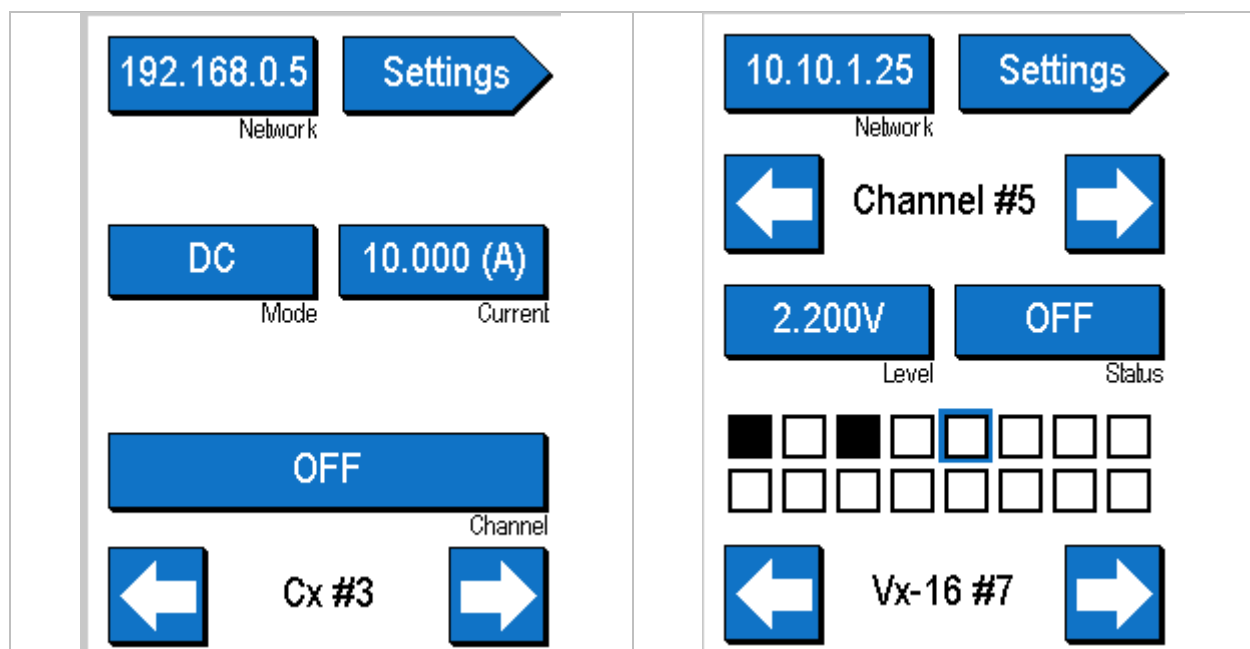


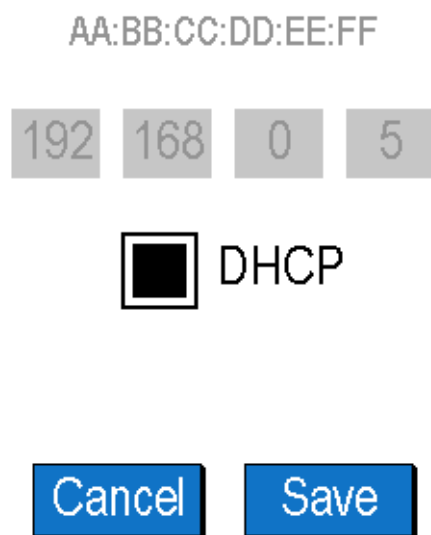
Figure 1.4. Screen display when CX or VX is connected

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If the DHCP box is selected, Core will seek an IP address assignment from the server. If needed, the assigned in factory MAC address is on a sticker at the back of the Core. If DHCP is disabled, one can enter its own IP address. In case DHCP is selected and server fails to assign an IP address, the main screen will display ‘---.---.---.’ in the IP address field, on the main page.

While using CX, there are two basic modes of operation – DC and Strobe modes. The screen for DC is shown in Figure 1.4, whereas the one for Strobe is in Figure 1.6. All settings are quite self-explanatory. To toggle the channel output on and off, press the long button labeled channel. One important thing to understand is that while the channel is on, this setting will be stored in non-volatile memory. Even if CX is power cycled, the channel will come back on. This is intentional, in case of a power failure in the facility, the system will come back live without any intervention.

By tapping the button Settings, we enter additional options for CX – see Figure 1.7. There are three screens to access. They allow us to check the firmware version, set the limits, and tap to more options for the trigger. The latter includes switching between internal and external triggers.



AA:BB:CC:DD:EE:FF

192 168 0 5

☒ DHCP

Cancel Save

Figure 1.5. Settings to set IP address or enable DHCP

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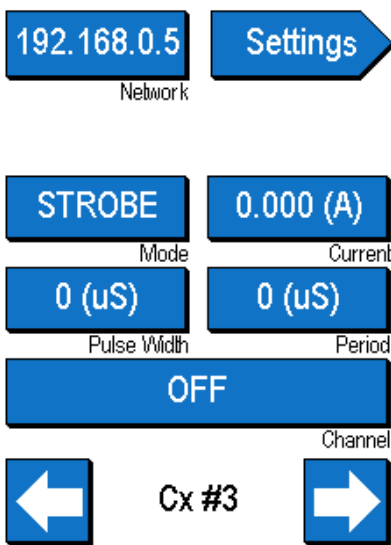


Figure 1.6. Screen displayed when CX is in Strobe mode

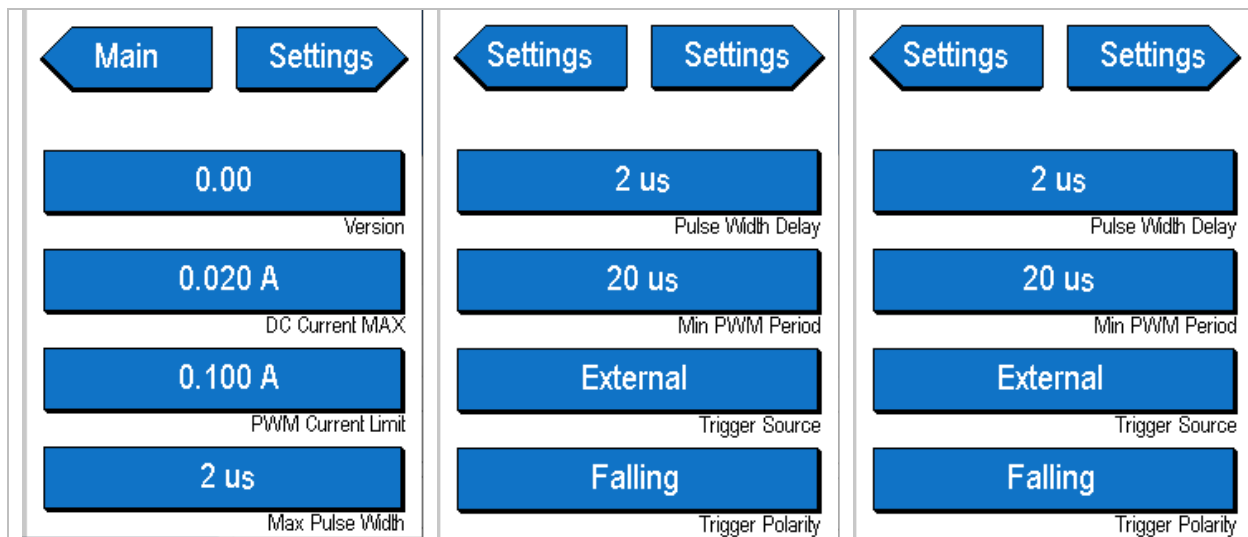


Figure 1.7. Screenshot of Setting screens for CX

When VX has been connected to the Core, this screen will be displayed - Figure 1.8. It allows setting voltage in the range between 0 and 10V for each channel separately. Toggling between channels can be achieved with the use of the left and right arrows at the top of the screen. 16 boxes in the bottom part of the screen are quick indicators of which channels are enabled. Additional options can be found after pressing the Setting button, see - Figure 1.9. It allows checking the firmware version, setting voltage limits for each channel, and assigning trigger inputs to channel outputs; more on that in the chapter designated to VX (see 1.3).

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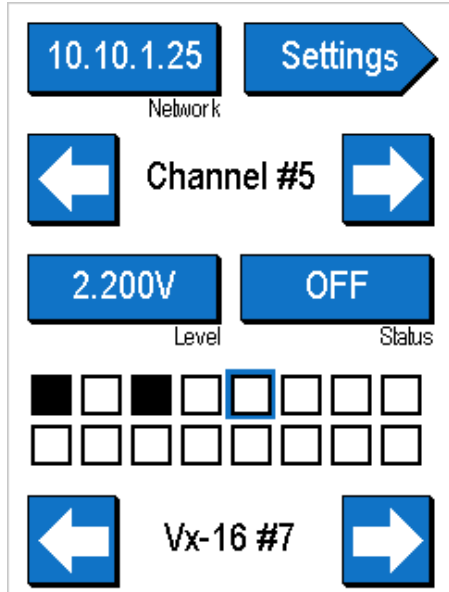


Figure 1.8. Screen shot of the main screen for VX

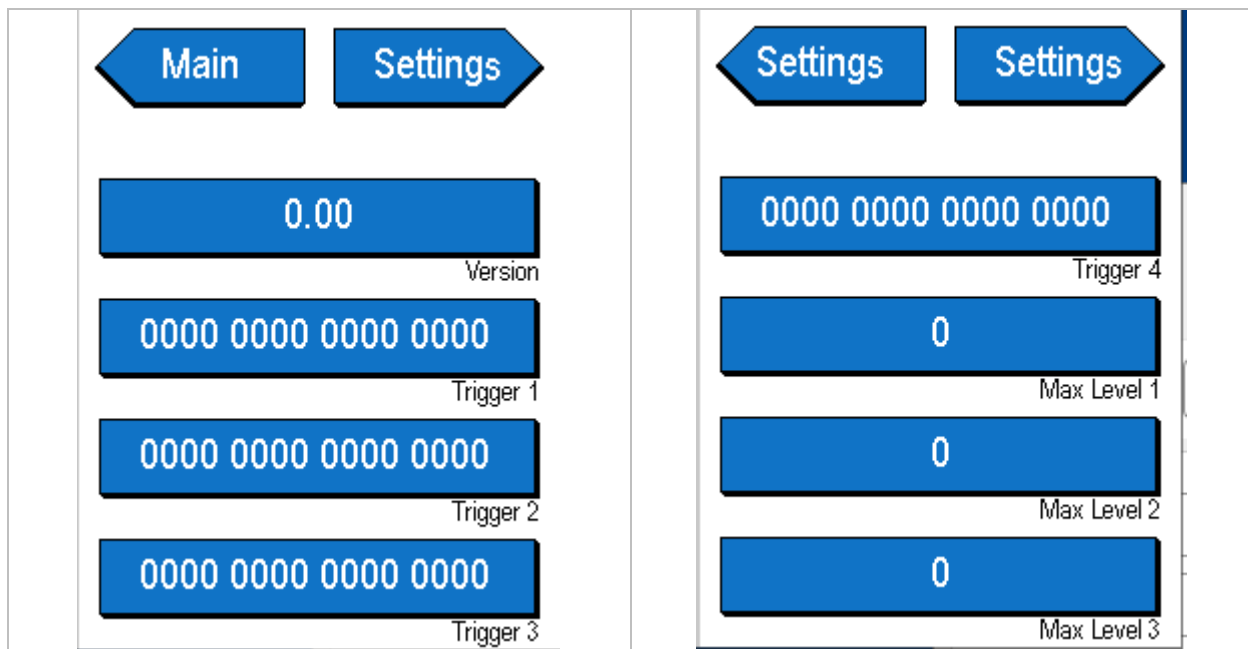


Figure 1.9. Screen shot of VX's Setting screens

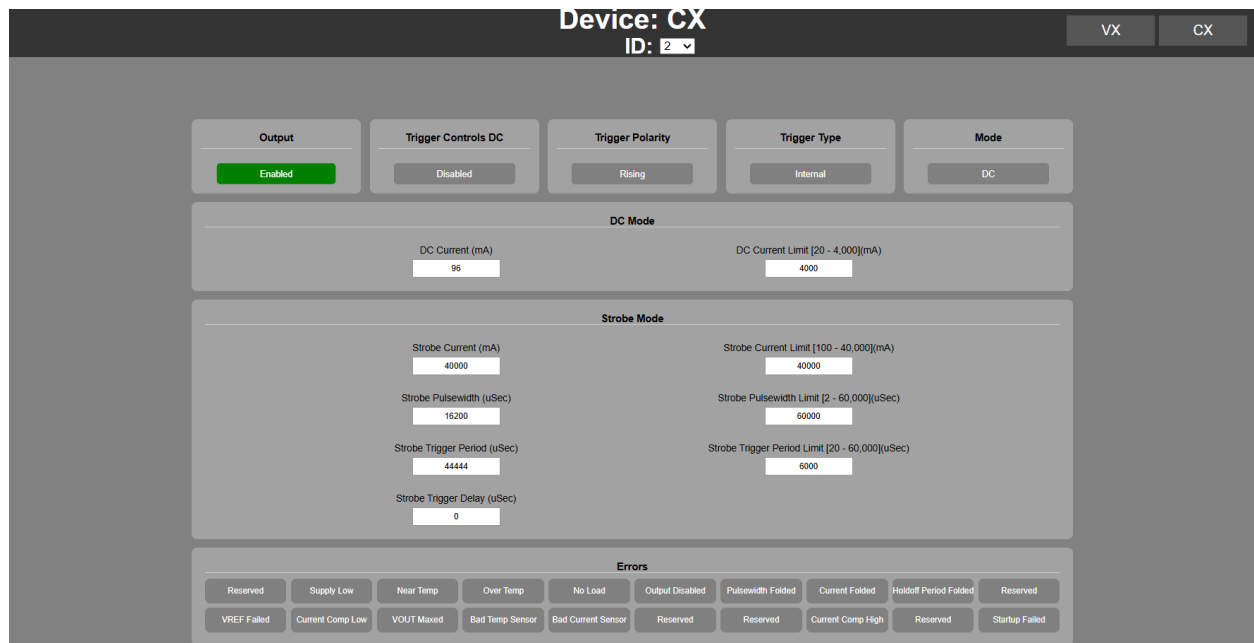
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1.1.2 Core – WEB interface

In this chapter, we will describe the functionality of the WEB interface. The WEB server is running on the Core at all times. It does not need to be initiated in any way. This is how it can be accessed. First, make sure you are on the same network, and the Core is connected to Ethernet. The orange and green LEDs on the side of the Ethernet port should light up, indicating a connection with the network. Make sure the IP address is displayed on the touchscreen display of the Core – for more information, see paragraph 1.1.1.

In a browser of your choice, type the IP address visible on the touch screen display of the Core. A window will open in the browser that has two buttons on the right – VX and CX. Next, please select the ID of the unit you would like to control from the drop-down menu in the middle on top. The appropriate window for either CX or VX will be displayed – see Figure 1.10 and Figure 1.11, respectively.

All the settings are gathered on a single screen and are quite self-explanatory. Additionally, on the screen for CX, there are error flags shown at the bottom. For more explanation on these, we refer to chapter 1.2.2.



The screenshot shows the WEB interface for a CX unit. At the top, it says "Device: CX" and "ID: 2" with a dropdown arrow. There are two tabs: "VX" and "CX", with "CX" selected. The interface is divided into several sections:

- Output:** A green button labeled "Enabled".
- Trigger Controls DC:** A button labeled "Disabled".
- Trigger Polarity:** A button labeled "Rising".
- Trigger Type:** A button labeled "Internal".
- Mode:** A button labeled "DC".

Below these are two main sections:

- DC Mode:**
 - DC Current (mA): 96
 - DC Current Limit [20 - 4,000](mA): 4000
- Strobe Mode:**
 - Strobe Current (mA): 40000
 - Strobe Current Limit [100 - 40,000](mA): 40000
 - Strobe Pulsewidth (uSec): 16200
 - Strobe Pulsewidth Limit [2 - 60,000](uSec): 60000
 - Strobe Trigger Period (uSec): 44444
 - Strobe Trigger Period Limit [20 - 60,000](uSec): 6000
 - Strobe Trigger Delay (uSec): 0

At the bottom is an **Errors** section with a grid of status indicators:

Reserved	Supply Low	Near Temp	Over Temp	No Load	Output Disabled	Pulsewidth Folded	Current Folded	Holdoff Period Folded	Reserved
VREF Failed	Current Comp Low	VOUT Maxed	Bad Temp Sensor	Bad Current Sensor	Reserved	Reserved	Current Comp High	Reserved	Startup Failed

Figure 1.10. WEB interface window for CX unit

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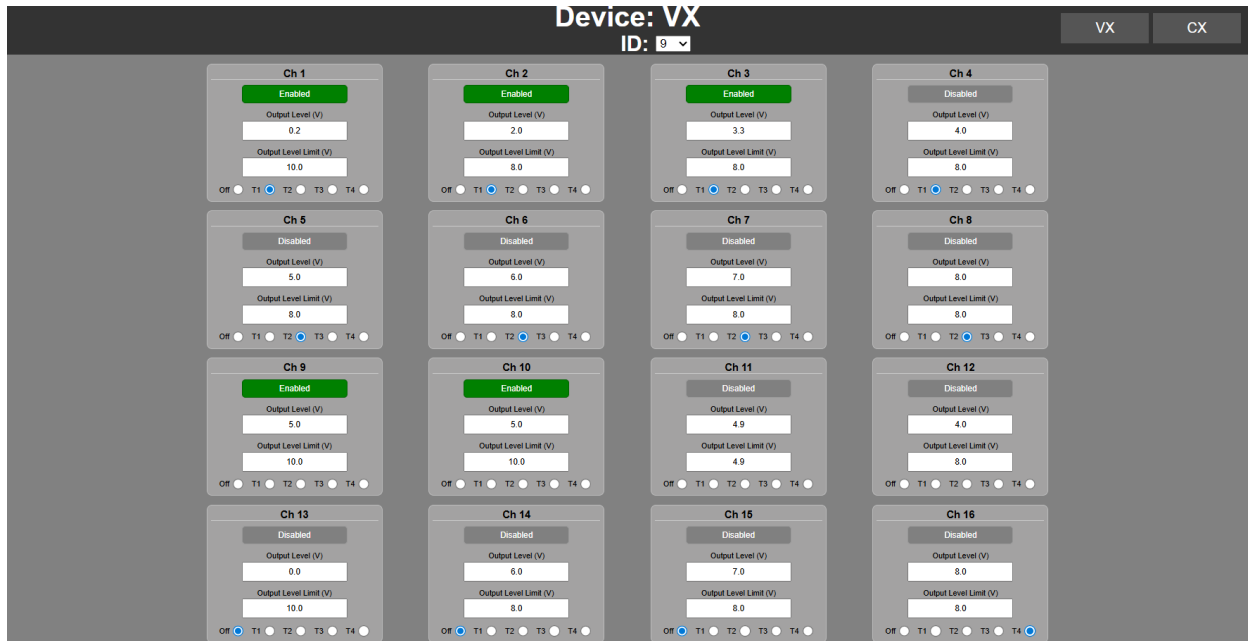


Figure 1.11. WEB interface window for VX unit

Any actions taken with the use of the WEB interface will also be reflected on the touch screen display. For example, if a channel gets enabled with the use of the WEB interface, this will also be shown in the GUI. However, the WEB interface does not refresh automatically. If some action is taken with the GUI, in order to see the change in the WEB interface, the WEB page needs to be refreshed in the browser.

1.2 Universal Light Controllers – CX and CX Plus

CX controllers are precise Current Controlled LED drivers. They can operate in DC or Strobe mode, both with the use of internal or external trigger. Functionality-wise, CX and CX Plus are identical. The difference is in maximum rating (for detailed spec, see 7.3):

- CX
 - DC Current: 4A max
 - Strobe current: 40A max
 - Max output power: 60W
- CX Plus
 - DC Current: 10A max
 - Strobe current: 40A max
 - Max output power: 150W

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3D models of CX/CX Plus, with labeled connections, are presented in Figure 1.12. On the top of the CX, there is a USB-C connector; this is a service port. It is used for software updates and service functions. It cannot be used for controlling the unit. For that function, you have to be connected to the USB-C port on the Core unit – see also 5. On the bottom of the unit, there are screw terminals for DC Power connection. Two of those are labeled +24V, and another two are Grounds (GND). It is important to use an appropriate power supply that is able to deliver sufficient power. See the power supply guide here 3.

The front plate of the CX controller is shown in Figure 1.13. On the front of the controllers, there are two connectors; the top one is a Trigger input. This one is used when an optional external trigger is used. This input has to be enabled, either in the GUI with the use of a touch screen display, through the WEB interface, or by sending appropriate instructions via Ethernet or USB to the controller. It is also important to understand that this trigger input is not required for the controllers' operation. The controller can generate an internal trigger signal where the pulse duration and frequency can be set. The bottom input on the front of the controller is an LED output, and this is where the light should be connected. Attention has to be paid to the polarity; connecting a device with reverse polarity can damage the connected light. A particular light may require more than one channel; in this situation, the customer needs to procure additional CX (or a plurality of them). All CXs can be controlled by one Core unit; it is also possible to mix CX and CX Puls units on the same bus (connected to the same Core unit). It is also important to understand that the controller will recognize faulty conditions, such as: no load, short, excessive power consumption (above the design values of the controller); however, this is the user's responsibility not to overcurrent the light connected to the controller. Setting the current above the design values allowed by a particular light can damage the light. Metaphase-designed lights compatible with external controllers will always have a sticker stating the maximal allowable current both in DC and Strobe operation.

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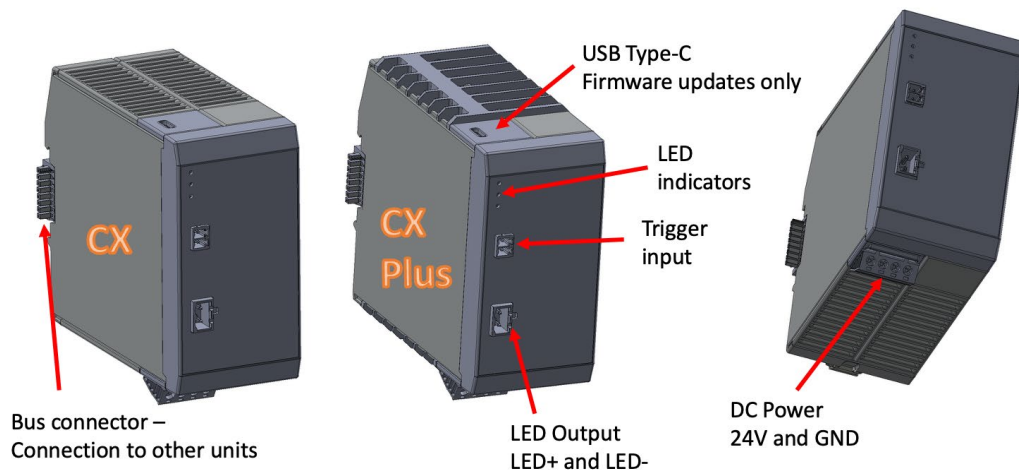


Figure 1.12. 3D model of CX family controllers

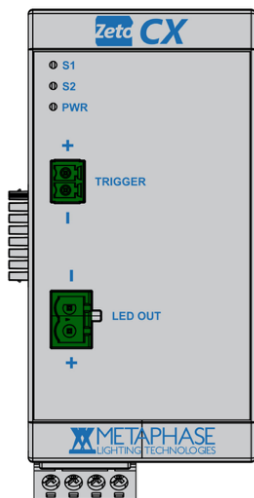


Figure 1.13. Front plate of the CX controller

On the top of the front plate, there is a column of indicator LEDs. The one on the bottom is labeled PWR and it indicates that 24V DC was supplied to the controller. Two other LEDs, labeled S1 and S2, are status indicators. S1 is a heartbeat indicator; in normal operation, it is pulsating all the time – this shows firmware running correctly. S2 is also pulsating, however, only when the unit is idling (output is off). In a situation when output is enabled, S2 will stay constantly on in DC mode and will pulsate quickly in Strobe mode. If either or both S indicators are constantly off, it means that the unit is malfunctioning. Try power cycling the unit; if the problem persists, contact Metaphase for assistance.

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1.2.1 CX startup process

Startup process is an important step in CX operation. Light should be connected to CX always with the power being disconnected from CX. After that, when power is turned on, CX will perform a load testing procedure. If everything is correct, it will be ready to use. If you power CX without light connected, it will return an error message – no load (see next paragraph). It will stay in this mode until it is power cycled. It means you need to connect the light and power cycle the unit for it to recognize the load correctly. If you plan for changing the type of light connected to the unit, this process needs to be repeated. Power down the unit, replace the light, and power it up again. Do not attempt to swap the light during CX being powered.

1.2.2 Errors in CX operation

As mentioned before CX will report a variety of errors. This can be viewed in three ways:

- On the bottom of the WEB interface – see Figure 1.14
- On touch screen display; if error occurs CX label between toggle arrows becomes yellow, when press it will display error type.
- You can also read error messages by sending appropriate binary command to the Core, for more see paragraph 5.

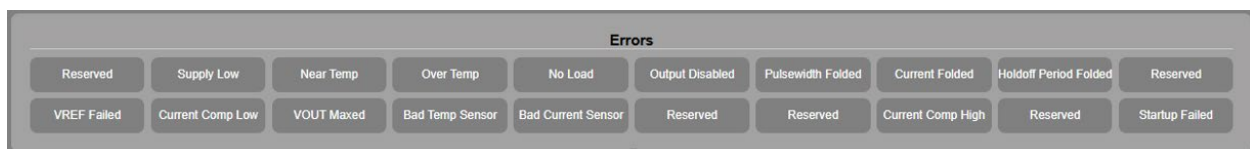


Figure 1.14. Error messages for CX – as displayed on the bottom of WEB interface

1.3 Digital Programmable Dimmers – VX-4 and VX-16

VX controllers are programable digital multichannel dimmers with software-programmable trigger inputs. VX-4 has four individually programmable 0-10V outputs and one trigger input. VX-16 has sixteen 0-10V outputs and 4 trigger inputs. Trigger inputs can be assigned to any output channels; this can be achieved with the use of a touchscreen display on the Core, WEB interface, or writing software. One trigger input can control from 1 to 16 channels; this enables toggling a particular number of channels simultaneously. This concept is shown on the diagram Figure 1.16.

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In Figure 1.15, we can see 3D models of VX controllers with available connections. On the top of the controllers close to the front, there is a USB-C port. Similarly to CX, this port is for service and firmware updates only. Communication can only be achieved by connecting to the Ethernet or USB-C port located on the Core. Behind the Ethernet port, there are channel outputs from no. 1 to 8. Each channel has a pair of connections: V+ (0-10V) and GND. All GNDs are connected internally together and are common ground. On the bottom of the unit, there are channels 9-16, accordingly. All connectors are spring-loaded terminals. At the very far end on the bottom, there is a DC 24V supply input. To distinguish it additionally from outputs, it is equipped with screw terminals. There is a pair of 24V inputs and two GND (grounds) inputs.

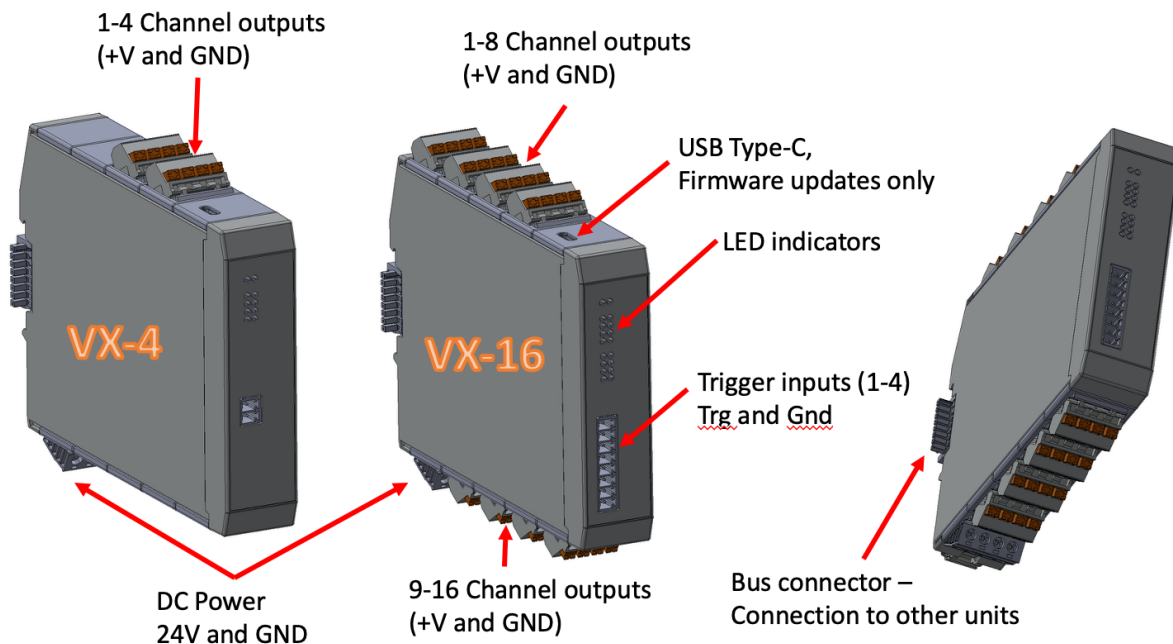


Figure 1.15. 3D models of VX-4 and VX-16 controllers, connectivity

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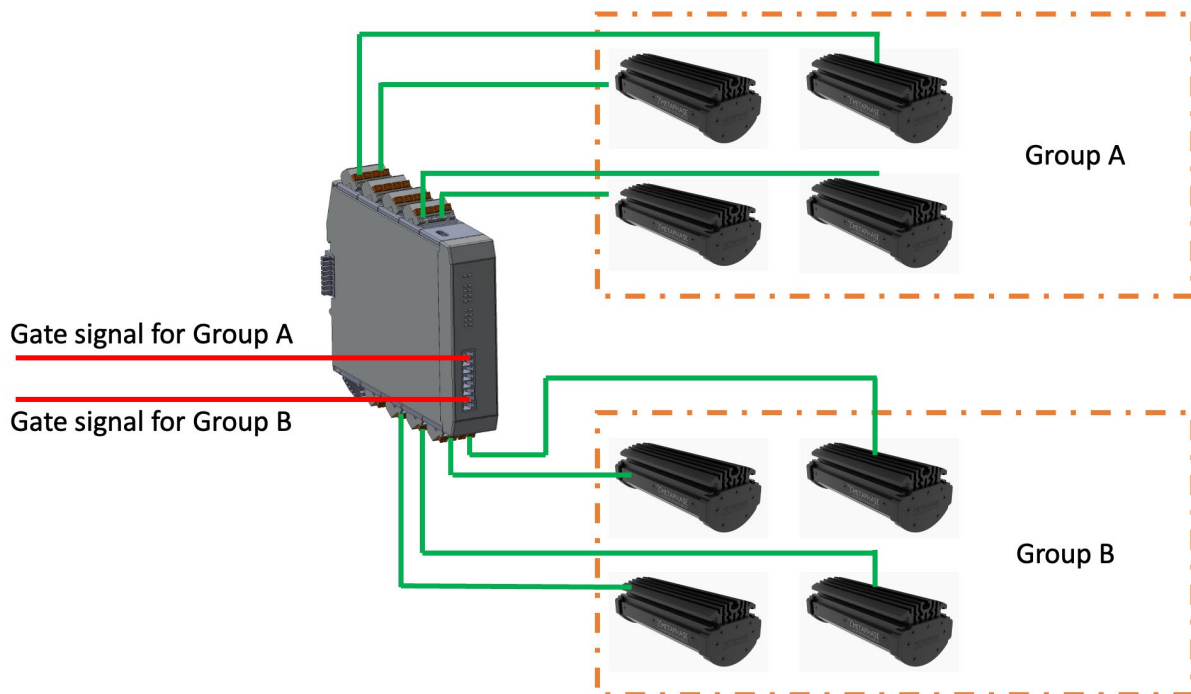


Figure 1.16. Diagram showing how VX can control different group of light simultaneously

In Figure 1.17 there are shown VX's face plates. Starting from the top, there are two LEDs labeled PWR and DIA. The first one is indicating 24V DC power connected to the device, and the second one is a heartbeat indicator. The latter one should pulsate all the time, indicating proper operation of the firmware running on the unit. In case of this indicator going permanently off, try power cycling the unit. If that does not help, this can indicate malfunctioning of the unit, and you should contact Metaphase for assistance.

Next to the two indicator LEDs, there are two columns of channel indicator LEDs. These are showing if the particular channel is being enabled. And finally, at the bottom of the face plate, there are Trigger channel inputs.

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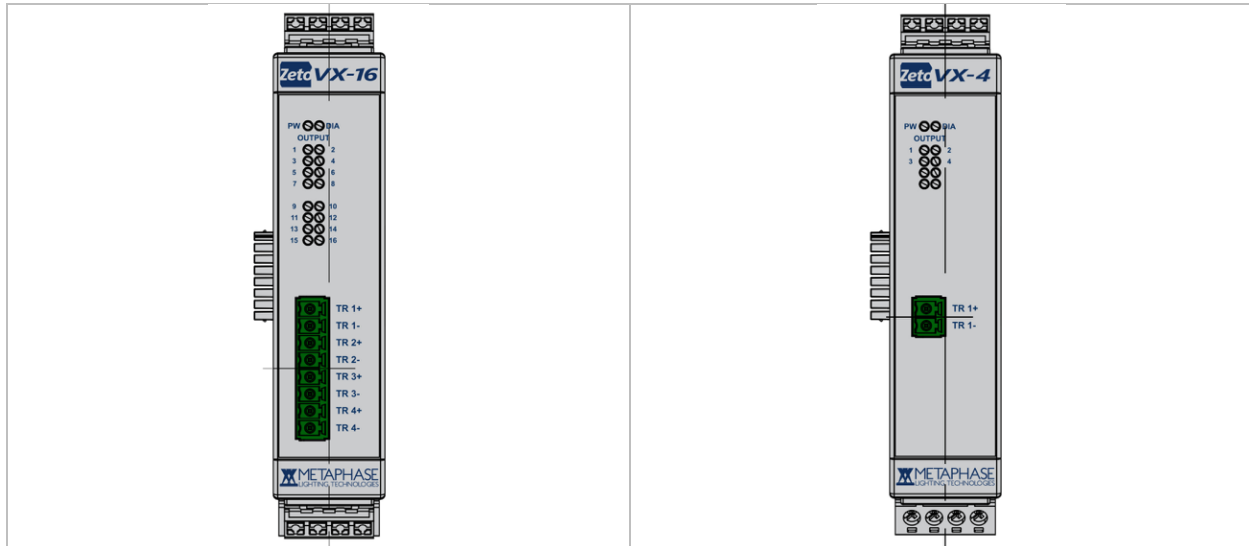


Figure 1.17. Face plates of VX controllers

2 Selecting unit's address

As mentioned before, the Core can support up to 16 units connected to it. It is up to user to manually select unique address 1-16 on each unit. At the back of both CXs and VX there is a rotary switch – see Figure 2.1. Please use the screwdriver and rotate the switch to a desired number. There cannot be two devices having the same address selected on one bus; there is no requirement though that numbers have to be consecutive or units need to be connected on the bus in a particular order.

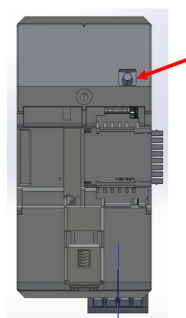


Figure 2.1. Rotary switch at the back of the unit - setting unique address number

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3 Selecting correct power supply

To be added in next revision of this document.

4 Mounting units on a DIN rail

DIN rail 35mm wide and 15mm deep must be used (NS 35/15)! DIN rail of 7.5mm depth is NOT compatible.

5 Programming guide

We refer you to the separate document titled: METAPHASE ZETO - Developer Integration Guide.

6 Firmware/Software upgrades

To be added in next revision of this document.

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7 Specification

7.1 Core

Parameter - CORE	Value (description)
Supply Voltage	24V +/- 10%
Module	Connects up to 16 mixed modules CX-x / VX-xx
Supply Voltage	24V ±10%
Cooling	Passive
Connectivity	USB C (Emulating COM port) or Ethernet
Communication	BUS interface to communicate with CX-x / VX-xx
GUI	Touchscreen Display
ROHS Compliance	Yes

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7.2 VX-4 and VX-16

Parameter - VX-xx	Value (description)
Supply Voltage	24V +/- 10%
Channels (LED out)	4 or 16 Channel
Supply Voltage	24V ±10%
Trigger Input	1 or 4 - Optically isolated inputs, Configurable
Outputs	0-10V
Max Current Sink	50mA per channel
Cooling	Passive
Communication	BUS interface to communicate with Core
ROHS Compliance	Yes

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7.3 CX and CX Plus

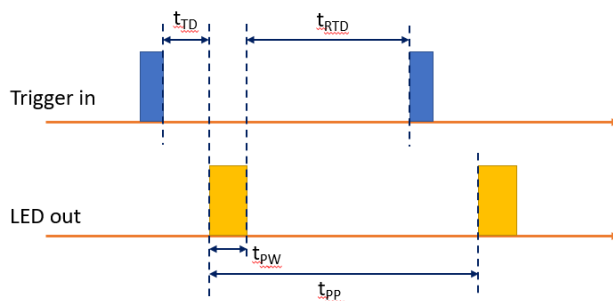
General spec

Parameter	Value (description)
Channels (LED out)	1 Channel
Supply Voltage	24V $\pm$ 10%
Trigger Input	
- Protection	Optically isolated (3.75kV), reverse and overvoltage protected up to 60V
- Voltage	2 to 30V with internal current limit and miswire protection
- Current	3mA max internally limited
- Rate	50kHz max
- Pulsewidth	1 μ s min
- Edge/Polarity	Rising or Falling Edge
Operating Modes	Strobe (Pulse), DC (CC, Constant Current)
ROHS Compliance	Yes
Expected Lifetime	75,000 hours
Mounting	Vertical, DIN Rail
Operating Ambient Temp	40C
Operating Humidity	0% to 90% RH non-condensing

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Strobe Mode Output

Parameter	Value (description)
Voltage	0.5 to 55V (can effectively achieve V_f LED up to 24V)
Current	10mA to 40A
Pulse width	1 μ s to 60ms
Frequency	0 to 50kHz (infinite to 20 μ s period).
Trigger modes	Internal or External
Trigger Delay (delay between trigger event and start of output pulse)	6 μ s (typical) to 60ms
Combined Current, Pulsewidth, and Period Limitations	Strobe limits: $pw \leq 0.03 / i$ $T \geq 75 * pw * i * (pw * (i - 10) + 0.0048)$ (max FET power) $T \geq pw + 15\mu s$ (re-trigger delay or min off time) $T \geq 20\mu s$ (max trigger frequency) $P_{out} \leq 30W$ where: pw = pulsewidth in seconds; i = pulse current in Amps; T = pulse (or trigger) period in seconds; f = pulse (or trigger) frequency in Hz



t_{TD} – Trigger delay $\geq 6\mu s$

t_{RTD} – Re-trigger delay $> 15\mu s$

t_{PW} – Pulse width 1ms – 60ms

t_{PP} – Pulse period (Frequency) $\geq 20ms$ ($\leq 50kHz$)*

*20ms is possible with internal trigger, with external trigger the minimum Period = 1ms + 15ms + 6ms = 22ms

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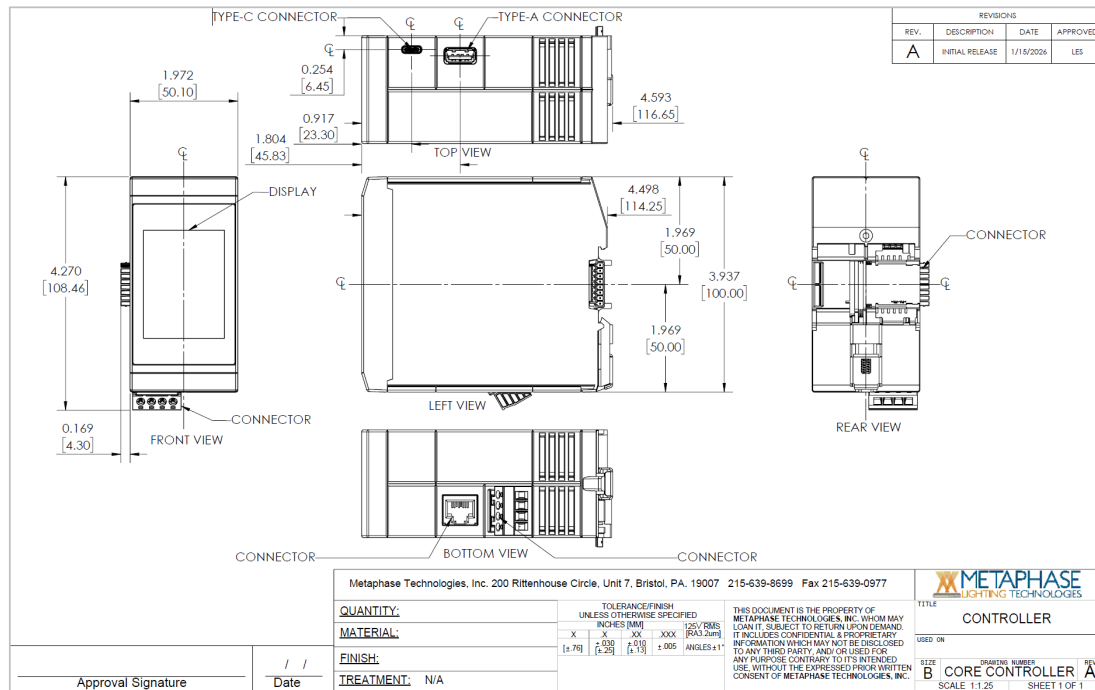
DC Current Mode Output

Parameter	Value (description)
Current	10mA to 4A (CX) or 10A (CX Plus)
Voltage	0.5V to 55V
Continuous Power	60W (CX) or 150 W (CX Plus)

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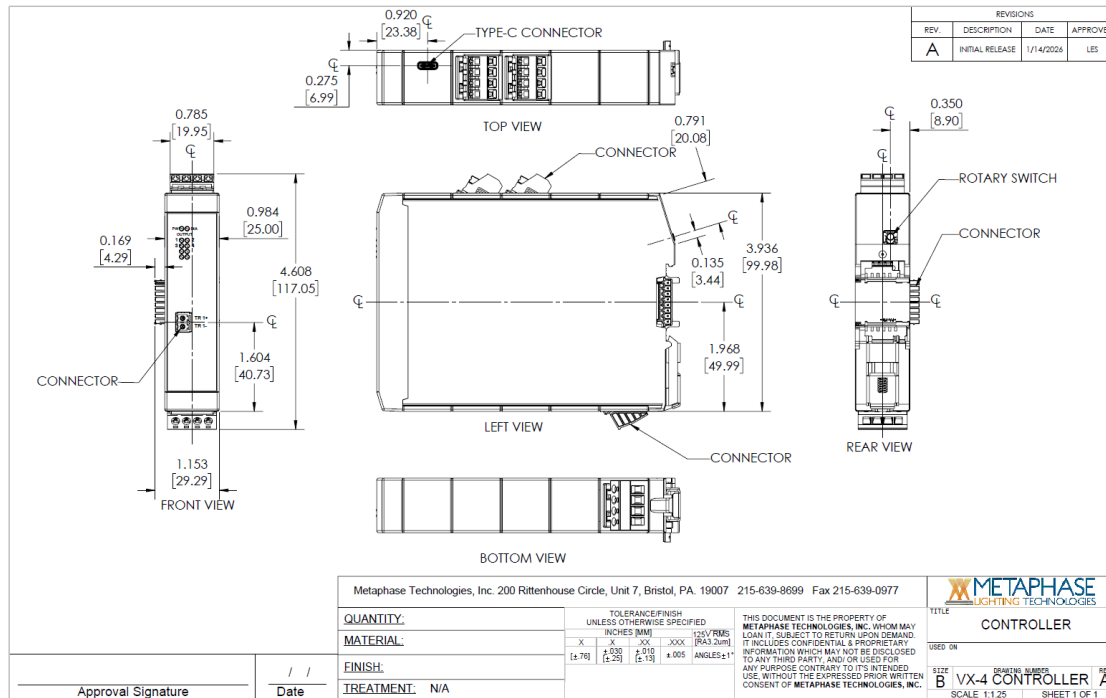
8 Mechanical drawings

8.1 Core

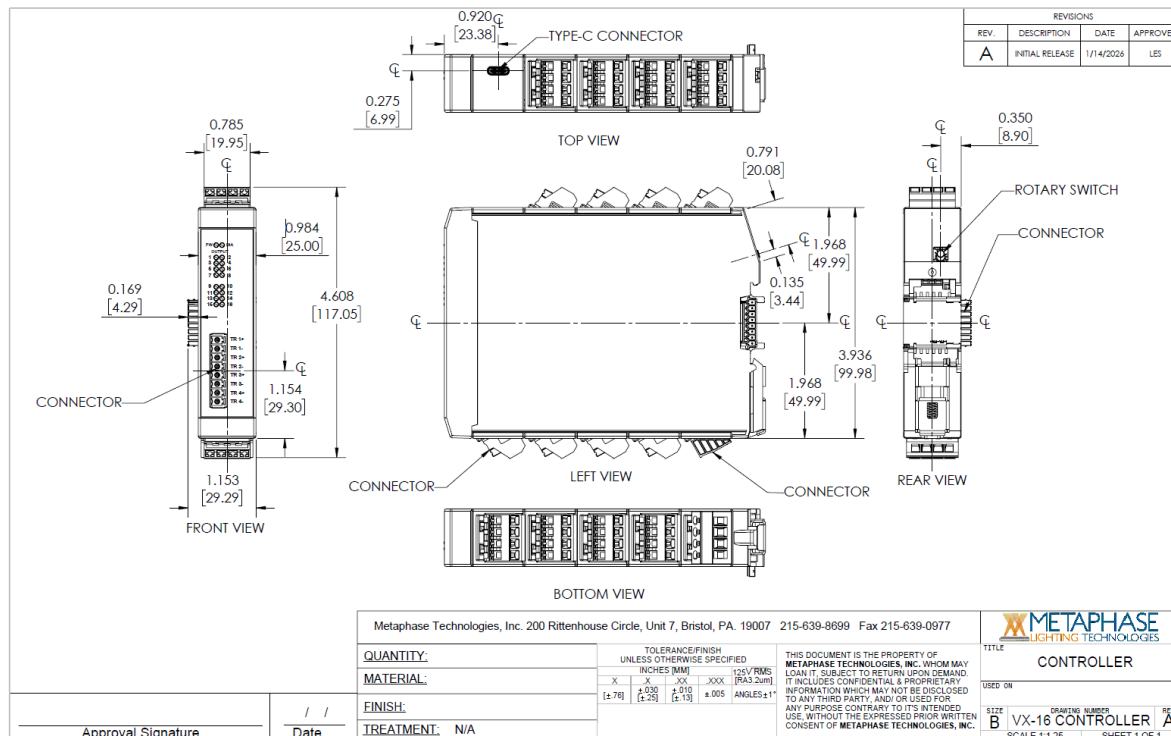


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8.2 VX-4

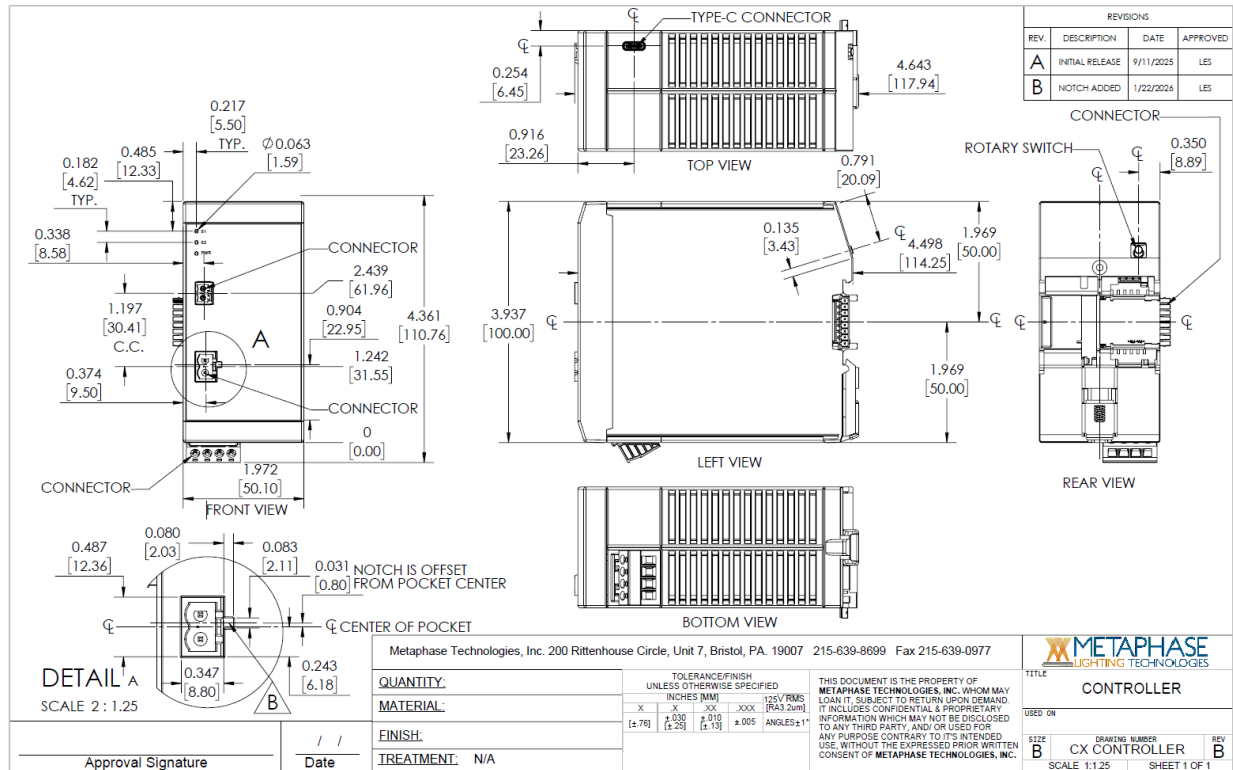


8.3 VX-16



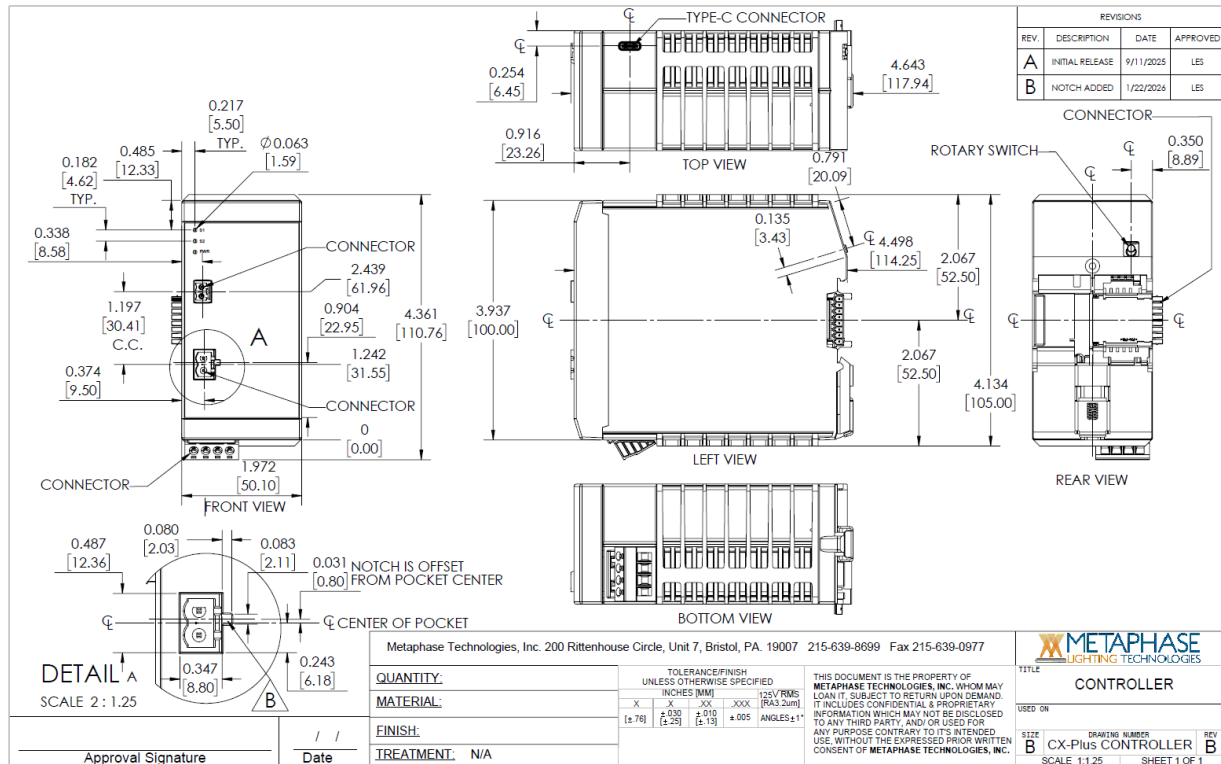
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8.4 CX



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8.5 CX Plus





For over three decades, Metaphase Technologies has been striving

“To bring innovation and inspiration to the global automated vision inspection industry, that improves the health, safety and security of our communities.”

We're proud of our demonstrated expertise in engineering
flexible lighting solutions
that have facilitated integration
into thousands of vision systems designs.

Throughout the world, Metaphase clients enjoy the enhanced automation and image capture benefits of our patent-pending breakthroughs in uniform diffuse high brightness and ultra-brightness LED illumination.

First to implement built-in constant current drivers across multiple product lines, Metaphase continues to synergize cutting-edge LED lighting & control technologies that streamline innovation and increase return on investment.

Made in the USA for over 30 years, our versatile designs are continuously updated to incorporate the latest advances in LEDs, thermal management, optics, and electronic technologies to meet the challenging needs of today's global automation and scientific marketplace.

Contact us to see how Metaphase can help with your cutting-edge lighting needs.



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