LED CTRL PX24 User Manual

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1 Introduction

This is the user manual for the LED CTRL PX24 pixel controller. The PX24 is a powerful pixel LED controller which converts sACN, Art-Net and DMX512 protocols from lighting consoles, media servers or computer lighting software such as LED CTRL into various pixel LED protocols. The PX24 integration to the LED CTRL software provides a seemless and accurate method to configure jobs quickly.

LED CTRL allows for discovery and management of multiple devices in the one interface. By configuring the devices via LED CTRL using drag and drop patching of fixtures you can be assured that the software and hardware align without needing to open the web management interface. For information on configuration from within LED CTRL please refer to the LED CTRL User Guide available here: https://ledctrl-user-guide.document360.io/.

1.1 Management and Configuration

This manual covers physical aspects of the PX24 controller and its essential setup steps only. Detailed information about its configuration options can be found in the PX24/MX96PRO Configuration Guide here: https://ledctrl.sg/downloads/

Configuration, management, and monitoring of this device can be performed via the web-based Management Interface. To access the interface, either open any web browser and navigate to the IP address of the device, or use LED CTRL's Hardware Configuration feature to access directly.
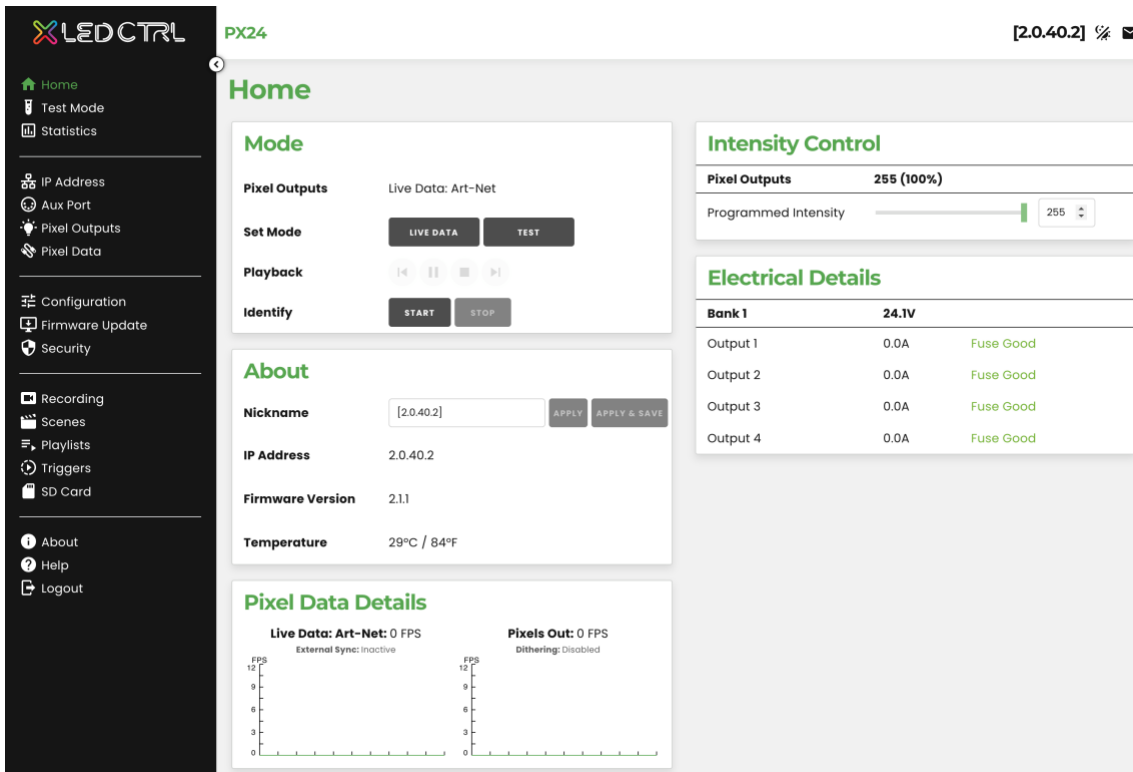

Figure 1 – PX24 Web Management Interface

2 Safety Notes

- This LED pixel controller should be installed by someone with proper technical knowledge only. Installation of the device should not be attempted without such knowledge.

- The pixel output connectors shall be used for pixel output connection only.
- Completely disconnect the supply source during abnormal operation and before making any other connections to the device.
- Specification and certification markings are located on the side of the device.
- The bottom of the enclosure is a heat sink which can become hot.

3   Physical Installation

The device warranty applies only when installed and operated in accordance with these Installation Instructions and when operated in accordance with the limits defined in the specifications.

This LED pixel controller should be installed by someone with proper technical knowledge only. Installation of the device should not be attempted without such knowledge.

3.1   Installation Requirements

- The unit MUST be installed according to the Wall / DIN Rail Mounting methods described below.
- DO NOT block the flow of air through and around the heat sink
- DO NOT fasten to objects that generate heat, such as a power supply.
- DO NOT install or store the device exposed to direct sunlight.
- This device is suitable for indoor installation only.
- The device may be installed outdoors inside a weatherproof enclosure.
- Ensure device ambient temperatures do not exceed the limits detailed in the specifications section.

3.2   Wall Mount

Assemble the unit onto the wall / ceiling using screws of a type suitable for the mounting surface (not supplied). The screws should be a pan head type, 3mm in thread diameter and at least 15mm long, as shown in Figure 2 below
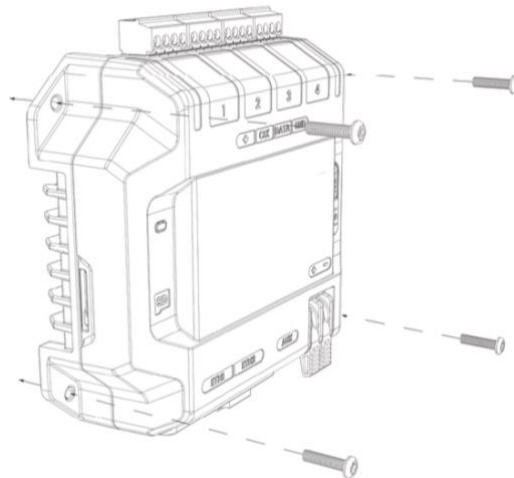
Figure 2 - PX24 wall mounting

3.3   DIN Rail Mount

The controller can be mounted to a DIN rail using the optional mounting kit.

1. Align the controller's mounting holes with the outermost mounting holes on each bracket. Using the four supplied M3, 12mm long screws, assemble the controller to the mounting brackets, as shown in Figure 3 below.
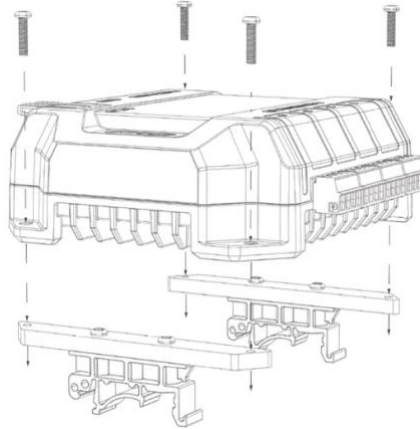
Figure 3 - PX24 DIN Rail bracket

2. Align the lower edge of the bracket with the lower edge of the DIN rail (1), and push the controller down so it clicks onto the DIN rail (2), as shown in Figure 4 below.
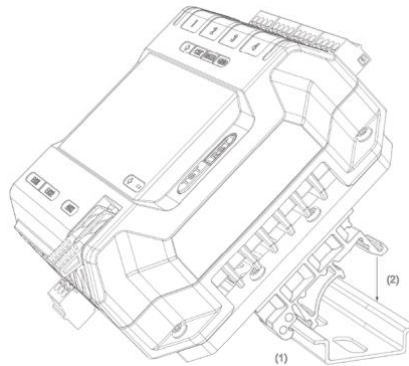
Figure 4 - PX24 Assembled to DIN Rail

3. To remove the controller from the DIN rail, pull the controller horizontally, toward its power connector (1) and rotate the controller up and off the rail (2), as shown in Figure 5 below
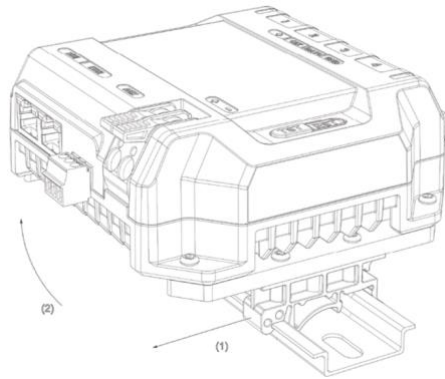
Figure 5 - PX24 Removal from DIN Rail

4   Electrical Connections

4.1   Supplying Power

Power is applied to the PX24 via the large lever clamp connector. The levers should be lifted up for wire insertion and then clamped back down, providing a highly robust and secure connection. Ensure the wire's insulation is stripped back 12mm, so that the clamp does not rest on the insulation when closing the connector. Polarity for the connector is clearly marked on the top surface, as shown below. The type of wire required for supply connection is 4.0mm^2, 10AWG, VW-1.

Figure 6 - PX24 Location of Power Input

Refer to Section 8.2 for operating specifications for powering this device.

Note: It is the user's responsibility to ensure that the power supply used matches the voltage of the pixel fixture they are using and that it can supply the correct amount of power/current.

LED CTRL recommends fusing each positive line that is used to power the pixels using an in-line fast blow fuse.

4.2   Smart Electronic Fuses and Power Injection

Each of the 4 pixel outputs are protected by a Smart Electronic Fuse. The functionality of this fuse type is similar to a physical fuse, where the fuse will trip if the current goes above a specified value, however with smart electronic fusing, the fuse does not require a physical replacement when it is tripped. Instead, the internal circuitry and processor is able to automatically re-enable the output power.

The status of these fuses can be read via the PX24 Web Management Interface, as well as live measurements of the current that is being drawn from each pixel output.

If any of the fuses trip, the user might need to resolve any physical faults with the connected load, and the smart electronic fuses will automatically re-enable power output.

Each of the fuses on the PX24 have a tripping point of 7A.

The number of pixels that can be physically powered through this device may not be as high as the amount of pixel control data that is being output. There is no definitive rule as to how many pixels can be powered from the controller, as it depends on the type of pixel. You need to consider if your pixel load will draw more than 7A of current and whether there will be too much voltage drop in the pixel load for it to only be powered from one end. If you need to "inject power" we recommend bypassing the controller's power output pins entirely.

4.3   Control Data

Ethernet data is connected via a standard network cable into either of the RJ45 Ethernet ports located on the front side of the unit, as shown in Figure 7 below.
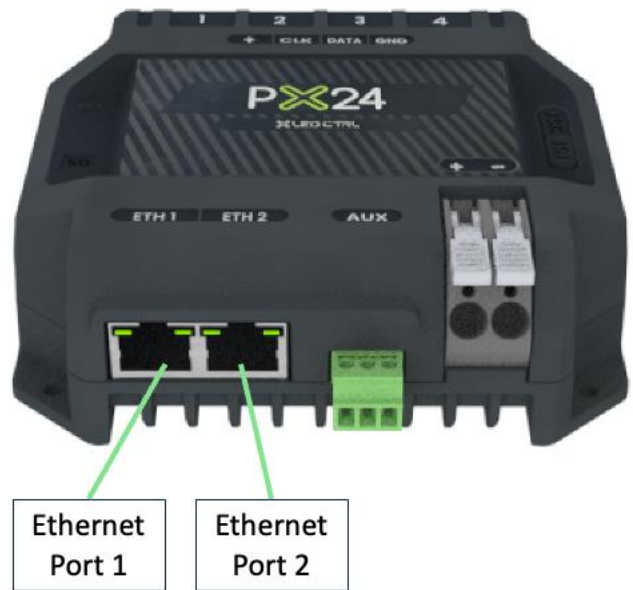
Figure 7 - PX24 Location of Ethernet Ports

4.4   Connecting Pixel LEDs

A high-level wiring diagram for connecting pixel LEDs to a PX24 is shown in Figure 8 below. Refer to Section 6.3 for the specific capacity of a pixel output.

The pixel lights are connected directly via the 4 pluggable screw terminal connectors on the rear of the unit. Each connector is labelled with its output channel number which is clearly marked on the top surface. Simply wire your lights into each screw terminal and then plug them into the mating sockets.
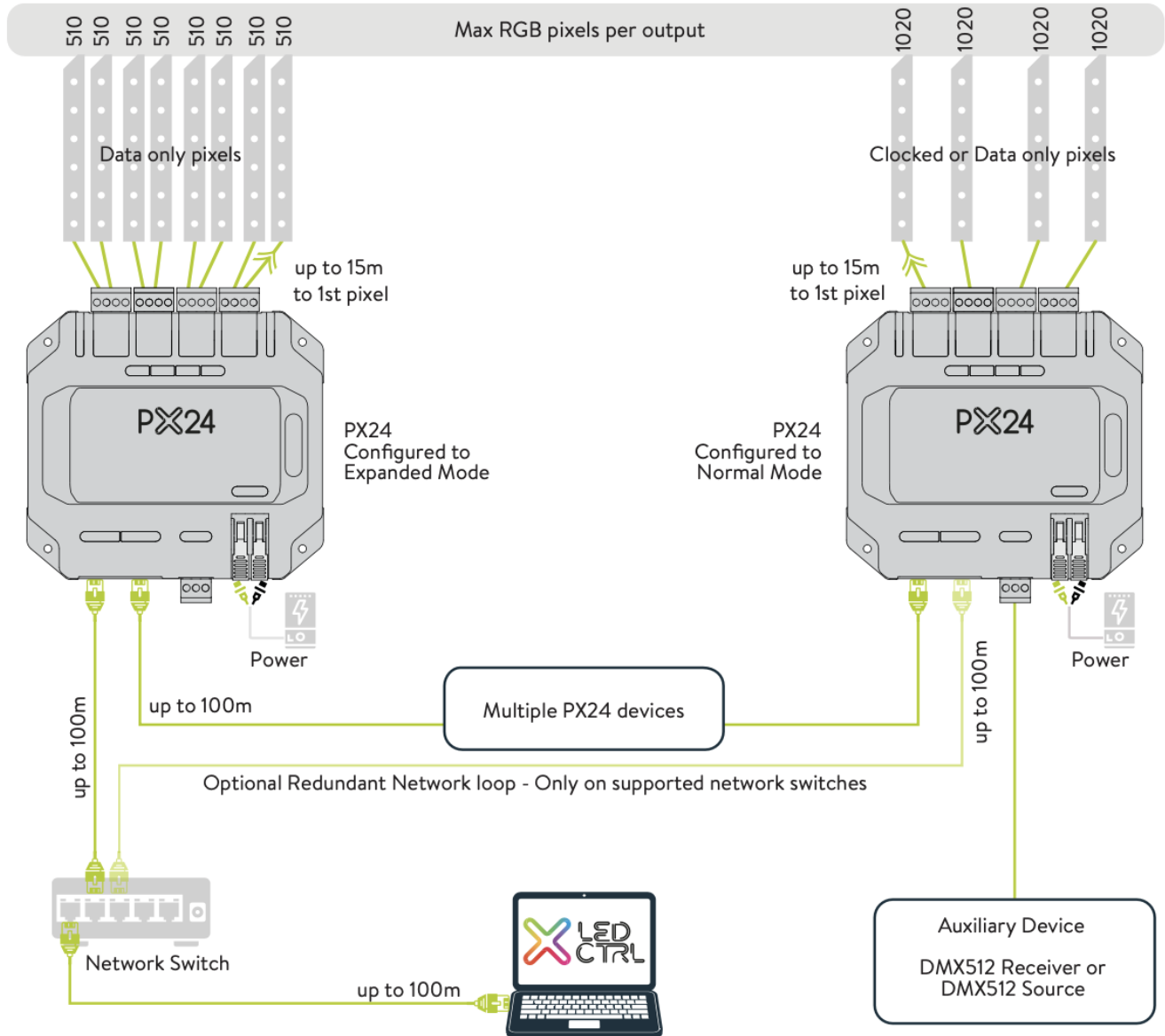
Figure 8 - Typical wiring diagram

The cable length between the output and the first pixel should typically not exceed 15m (although some pixel products may allow more, or demand less).

Figure 9 shows the pin-out of the pixel output connectors for Expanded and Normal modes.
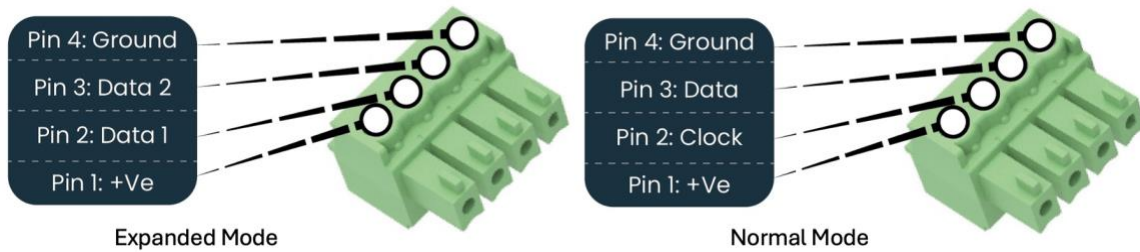
Figure 9 - Expanded v Normal Mode pin-outs

4.5   Differential DMX512 Pixels

The PX24 can connect to differential DMX512 pixels, as well as single-wire serial DMX512 pixels. Single wired DMX512 pixels can connect as per the Normal mode pinout above. Differential DMX512 pixels require connection of an additional data wire. This pinout can be seen in Figure 10 below.

Notes:

When driving differential DMX512 pixels, you should ensure that the data transmission speed is set appropriately, based on the specification of your pixels. The standard speed for DMX512 transmission is 250kHz, however many DMX pixel protocols can accept faster speeds.

With DMX pixels, the outgoing data stream is not limited to a single universe, as a standard DMX universe would be.

When connected to a PX24, the maximum number of DMX512-D pixels that can be configured is the same as if expanded mode were enabled, which is 510 RGB pixels per output.
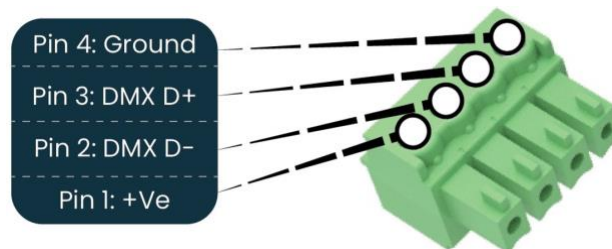
Figure 10 - Pin-out for Differential DMX512 Pixels

4.6   Expanded Mode

If your pixels do not have a clock line, you may optionally activate expanded mode on the controller, via the LED CTRL or the PX24 Web Management Interface. In expanded mode, the clock lines are used as data lines instead. This means the controller effectively has twice as many pixel outputs (8), but half as many pixels per output can be run.

Compared to pixels with a clock line, pixels that only use a data line have the potential to lower the maximum achievable refresh rate in a pixel system. If a pixel system is using data-only pixels, then the refresh rates will typically be improved by using expanded mode. Enabling expanded mode allows for twice as many data outputs, so the same

number of pixels can be spread out over these outputs, resulting in a large improvement to refresh rate. This becomes more important as the number of pixels per output increases.

Mapping of the pixel outputs to their physical port/pins for each mode is as follows:

Mode	Pixel Output	Port	Pin
Expanded	1	1	Clock
Expanded	2	1	Data
Expanded	3	2	Clock
Expanded	4	2	Data
Expanded	5	3	Clock
Expanded	6	3	Data
Expanded	7	4	Clock
Expanded	8	4	Data
Normal	1	1	Data
Normal	2	2	Data
Normal	3	3	Data
Normal	4	4	Data

4.7   AUX Port

The PX24 has 1 multipurpose auxiliary (Aux) port that can be used for DMX512 communication using RS485 electrical signals. It is capable of outputting DMX512 to other devices or receiving DMX512 from another source.

Configure the Aux port to DMX512 Output to allow conversion of a single universe of incoming sACN or Art-Net data to the DMX512 protocol. This then allows any DMX512 device(s) to be connected to this port and effectively be controllable over Ethernet.

Configure the Aux port to DMX512 Input to allow the PX24 to be driven by an external source of DMX512 control. Whilst this is limited to only a single universe of data, the PX24 can use DMX512 as its source of pixel data for situations where a DMX512 control system is required to be used instead of Ethernet-based data.

The Aux port connector is located on the front side of the unit as shown in Figure 11 below.

Figure 11 – Location and Pinout of the Aux port

5 Network Configuration

5.1 Network Layout Options

Figure 8 - Typical wiring diagram shows a typical network topology for the PX24. Daisy-chaining PX24 devices and redundant network loops are both explained in Section 5.3.

The lighting control system can be LED CTRL or any source of Ethernet data - e.g. desktop PC, laptop, lighting console, or media server.

Having a router on the network is not mandatory but is useful for IP address management with DHCP (see Section 5.4.1). A network switch is also not mandatory, so the PX24 devices can be plugged directly into the LED CTRL network port. The controller(s) can be integrated straight into any pre-existing LAN such as your media, home or office network.

5.2 IGMP Snooping

Traditionally when multicasting a large number of universes, IGMP Snooping is required to ensure that the pixel controller is not overwhelmed with irrelevant data. However, the PX24 is equipped with a Universe Data Hardware Firewall, which filters out irrelevant incoming data, removing the need for IGMP Snooping.

5.3 Dual Gigabit Ports

The two Ethernet ports are industry standard gigabit switching ports, so any network device can be connected to either port. A common purpose for the two is to daisy-chain PX24 devices from the one network source, simplifying cable runs. The combination of the speed of these ports and the included Universe Data Hardware Firewall means that latency caused by daisy-chaining is practically negligible. For any practical installation, an unlimited number of PX24 devices can be daisy-chained together.

A redundant network cable can be connected between the final Ethernet port in a chain of PX24 devices and a network switch. Since this will create a network loop, it is important that the network switches being used support Spanning Tree Protocol (STP), or one of its variants such as RSTP. STP will then allow this redundant loop to be automatically managed by the network switch. Most high-quality network switches have a version of STP built in

and the configuration required is either none or minimal. Consult the vendor or documentation of your network switches for further information.

5.4   IP Addressing

5.4.1 DHCP

Routers typically have an internal DHCP server, which means they can assign an IP address to a connected device, if requested.

DHCP is always enabled by default on this device, so it can immediately connect to any existing network with a router / DHCP Server. If the controller is in DHCP mode and is not assigned an IP address by a DHCP server, it will assign itself an IP address with Automatic IP Addressing, as explained in Section 5.4.2 below.

5.4.2 AutoIP

When this device has DHCP enabled (factory default), there is also functionality for it to be operational on networks without a DHCP server, via the AutoIP mechanism.

When no DHCP address is being offered to this device it will generate a random IP address in the range of 169.254.X.Y that does not conflict with any other devices on the network. The benefit of AutoIP is that communication can happen between the device and any other compatible network device, without the need for a DHCP server or pre-configured Static IP addressing.

This then means that connecting a PX24 directly to a PC typically does not require any IP address configuration - communication will be possible because both devices would generate their own valid AutoIP.

While the device has an AutoIP address in use, it continues searching for a DHCP address in the background. If one becomes available, it will switch to the DHCP address instead of the AutoIP.

5.4.3 Static IP

In many typical lighting networks that this device would operate in, it's common for the installer to manually manage a set of IP addresses, instead of relying on DHCP or AutoIP. This is referred to as static network addressing.

When allocating a static address, the IP address and the subnet mask both define the subnet that the device is operating on. You need to ensure that other devices that need to communicate with this device are on the same subnet. Therefore, they should have the same subnet mask and a similar but unique IP address.

When setting static network settings, the Gateway address can be set to 0.0.0.0 if it is not required. If communication between the device and other VLANs is required, the Gateway address should be configured and will typically be the IP address of the router.

5.4.4 Factory IP Address

When you are not sure what IP address the device is using, you can force it to use a known IP address (referred to as the Factory IP).

To activate the Factory IP and establish communication with the device:

1.   While the controller is running, hold down the "Reset" button for 3 seconds.

2.   Release the button.
3.   The controller will immediately restart its application with the following factory default network settings:
  - IP Address: 192.168.0.50
  - Subnet Mask: 255.255.255.0
  - Gateway Address: 0.0.0.0
4.   Configure your PC with compatible network settings. If you are not sure, you can try the following example settings:
  - IP Address: 192.168.0.49
  - Subnet Mask: 255.255.255.0
  - Gateway Address: 0.0.0.0
5.   You should now be able to access the device's web Interface by manually browsing to 192.168.0.50 in your web browser, or by using LED CTRL.

After establishing a connection to the device, make sure to configure the IP address settings for future communication and save the configuration.

Note: The Factory IP is only a temporary setting used to regain connectivity to the device. When the device is reset (powered off and on again), the IP address settings will revert to what is configured in the device.

6   Operation
6.1   Start-up
Upon applying power, the controller will quickly begin outputting data to the pixels. If no data is being sent to the controller, then the pixels will remain turned off until valid data is received. During live mode, the multi colour status LED will be flashing green to indicate the controller is running and outputting any received data to the pixels.

6.2   Sending ethernet Data
Input data is sent from the LED CTRL (or another control PC/server/lighting console) to the controller via Ethernet using a "DMX over IP" protocol such as sACN (E1.31) or Art-Net. This device will accept Art-Net or sACN data on either Ethernet port. Details of incoming and outgoing packets can be viewed in the PX24 Web Management Interface.

Sync modes are supported by the PX24 for both Art-Net and sACN.

6.3   Pixel Outputs
Each of the 4 pixel outputs on the PX24 can drive up to 6 universes of data. This allows for a total of up to 24 universes of pixel data to be driven out of the one controller. The number of pixels that can be driven per pixel output will depend on the configuration, as shown in the table below.

Mode	Normal		Expanded	
Channels	RGB	RGBW	RGB	RGBW
Max pixels per Pixel Output	1020	768	510	384
Max total Pixels	4080	3072	4080	3072

The PX24 must be configured before it can correctly output pixel data. Refer to the LED CTRL User Guide for how to configure and patch your pixel outputs.

6.4   Button Actions

The 'Test' and 'Reset' buttons can be used to perform various operations, as listed below.

Action	Test Button	Reset Button
Toggle Test Mode On/Off	Press for >3 seconds while the application is running	-
Cycle the Test Modes	Press whilst in test mode	-
Hardware Reset	-	Press momentarily
Factory Reset	-	Press for >10 seconds
Factory IP	-	Press for 3 seconds

6.5   Hardware Test Pattern

The controller features a built-in test pattern to assist in troubleshooting during an installation. To put the controller into this mode, press and hold the 'TEST' button for 3 seconds (after the controller is already running) or turn it on remotely using either LED CTRL or the PX24 Web Management Interface.

The controller will then enter the test pattern mode, where different test patterns are available as described in the table below. The controller will display the test pattern on all pixels on each of the pixel outputs and the Aux DMX512 output (if enabled) simultaneously. Pressing the 'TEST' button while in test mode will move through each of the patterns successively in one continuous loop.

To exit the test mode, press and hold the 'TEST' button for 3 seconds and then release.

The hardware test requires that the pixel driver chip type and number of pixels per output are set correctly in the Management Interface. Using Test mode, you can test if this part of your configuration is correct and isolate other possible problems with the incoming Ethernet data side.

Test	Operation
Colour Cycle	Outputs will cycle automatically through the red, green, blue and white colours at fixed intervals. Pressing the TEST button moves to the next mode.
Red	Solid Red
Green	Solid Green
Blue	Solid Blue
White	Solid White
Colour Fade	Outputs will slowly move through a continuous colour fade. Pressing the TEST button will loop back to the original colour cycle test mode.

6.6   Operating Refresh Rates

The overall refresh rate of an installed pixel system will depend on many factors. For monitoring purposes, graphical and numerical information on incoming and outgoing frame rates can be viewed in the Management Interface. This information gives insight as to what refresh rate a system can achieve, and where any limiting factors may exist.

Refresh rates are available in the PX24 Web Management Interface for each of the following elements:

- Incoming sACN
- Incoming Art-Net
- Incoming DMX512 (Aux Port)
- Outgoing Pixels
- Outgoing DMX512 (Aux Port)

6.7   sACN Priorities

It is possible to have multiple sources of the same sACN universe received by the one PX24. The source with the higher priority will be actively streaming to the pixels, and this can be seen on the Statistics page. This is useful for situations where a backup data source is needed.

For this to take place, the PX24 still needs to receive and process each universe, including universes that will be dropped due to a lower priority.

Low priority sACN handling with the PX24 will require that the total number of universes being streamed to the controller from all sources combined, for any purpose, should not exceed 100 universes.

6.8   PX24 Dashboard

The Dashboard built into PX24 Web Management Interface allows PX24s to independently drive light shows without a computer or any source of live data.

The Dashboard allows users to record and play back pixel shows from the PX24 using the inbuilt microSD slot. Design your own breathtaking pixel shows, record them directly onto the microSD card and play them back as many times as you wish.

The Dashboard also unlocks the ability to create up to 25 powerful triggers and use advanced intensity controls to enable true standalone behaviour and enhance live environments.

Experience a new level of control with the dual-user login feature and a dedicated Operator Dashboard. Now, operators can access real-time playback and device control through the Dashboard, amplifying the flexibility of PX24.

For more information, download the PX24/MX96PRO Configuration Guide available from here: https://ledctrl.sg/downloads/

7   Firmware Updates

The controller is capable of having its firmware updated (new software). An update is typically performed to fix problems or to add new features.

To perform a firmware update, ensure that you have your PX24 controller connected to the LAN network as per Figure 8 - Typical wiring diagram.

The latest firmware is available from the LED CTRL website at the following link: https://ledctrl.sg/downloads/.

The downloaded file will be archived in a ".zip" format, which should be extracted. The ".fw" file is the file that the controller needs.

7.1   Updating via the Web Management Interface

Firmware can only be updated using the PX24 Web Management interface as follow:

1. Open the Web Management Interface, and navigate to the "Maintenance" page.
2. Load the firmware ".fw" file with the file browser.
3. Click "Update", the controller will temporarily disconnect.
4. Once the update is complete, the controller will restart its application with the new firmware, maintaining its previous configuration.

8   Specifications

8.1   Derating

The maximum output current that the PX24 can provide to pixels is 28A, which it can do over a wide temperature range. To prevent this high current from causing excessive heat during operation, the PX24 has been equipped with a heat sink on the underside of the unit.

As the ambient temperature increases, the maximum output current the device is rated to handle will become limited, known as derating. Derating is simply a reduction in the rated specification of the controller as the temperature changes. As shown by the graph in Figure 12 - PX24 Derating Curve below, the current maximum output capacity is only impacted when the ambient temperature reaches 60°C. At 60°C, the maximum output capacity drops linearly until the ambient temperature reaches 70°C, at which point the device is not specified for operation.

Installations in hot environments (typically enclosed areas with power supplies) should take note of this derating behaviour. A fan blowing air over the device's heatsink will improve its thermal performance. The amount to which this will improve thermal performance will depend on the specific installation.
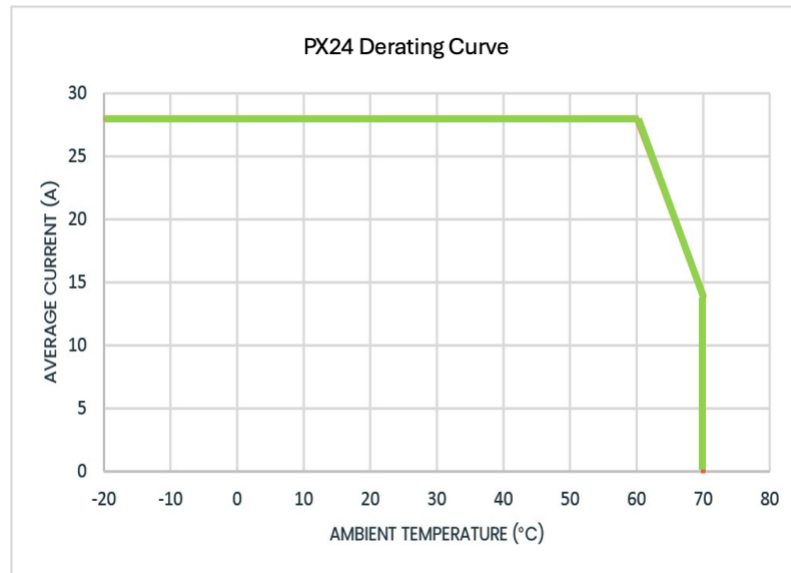
Figure 12 - PX24 Derating Curve

8.2   Operating Specifications

The table below specifies the operating conditions for a PX24 controller. For a full list of specifications, refer to the product datasheet.

8.2.1 Power

Parameter	Value/Range	Units
Input Power	5-24	V DC
Per Output Current Limit	7	A
Total Current Limit	28	A

8.2.2 Thermal

Parameter	Value/Range	Units
Ambient Operating Temperature Refer to Section 8.1 for information on thermal derating	-20 to +70	°C
Storage Temperature	-20 to +70	°C

8.3 Physical Specifications

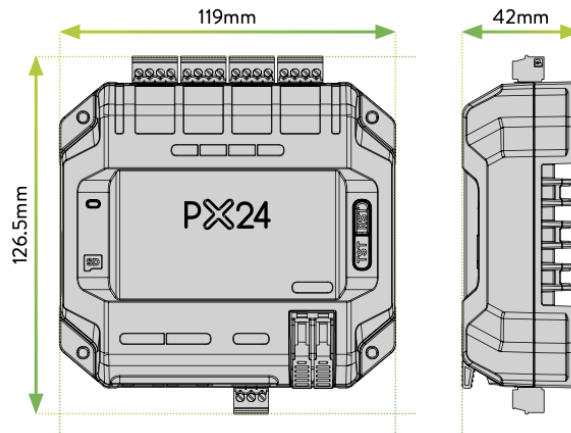| Dimension	Metric	Imperial
Length	119mm	4.69"
Width	126.5mm	4.98"
Height	42mm	1.65"
Weight	0.3kg	0.7lbs

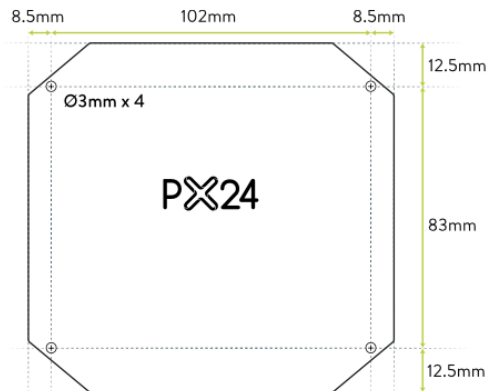*Figure 13 - PX24 Overall Dimensions*

Figure 14 - PX24 Mounting Dimensions

8.4 Electrical Fault Protection

The PX24 features notable protection from potential damage due to various types of faults. This makes the device robust and reliably able to operate in the suitable installation environment, specified in Section 10.

ESD protection is present on all ports.

All pixel output lines are protected against direct shorts of up to +/- 36V DC. This means that even if your pixels or wiring have a fault that causes a direct short between DC power lines and data or clock lines on any output, it will not damage the device.

The Aux Port is also protected against direct shorts of up to +/- 48V DC.

The PX24 is protected against damage from reversed polarity power input. In addition, any pixels that you connect to the pixel outputs are also protected against reverse polarity power input, as long as they are only connected to power through the PX24 controller itself.

9 Troubleshooting

9.1   LED Codes

There are multiple LEDs on the PX24 that are useful for troubleshooting. The location of each is shown in Figure 15 - PX24 below.
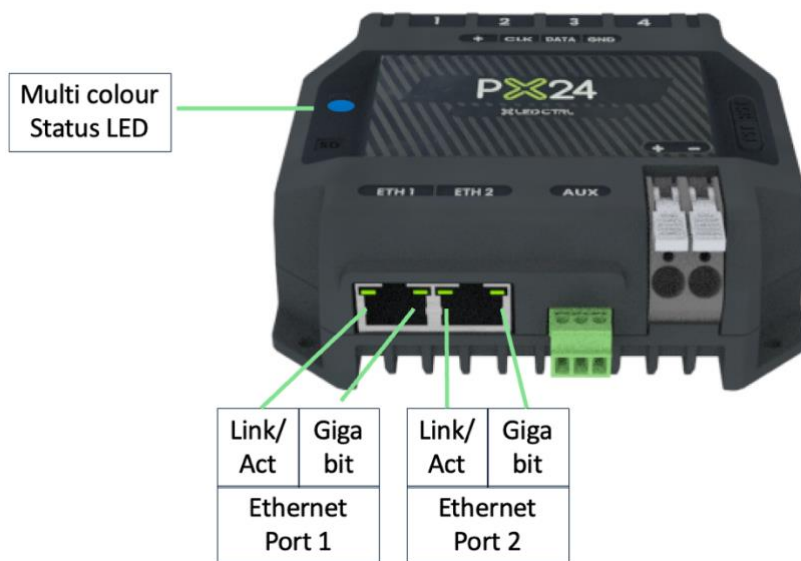
Figure 15 - PX24 Location of LEDs

Please refer to the tables below for condition codes for the Ethernet port LEDs and the multi-color status LED.

Link/Activity LED	Gigabit LED	Condition
Any	Solid	Connected okay at full speed (Gigabit)
Any	Off	Connected okay at limited speed (10/100 Mbit/s)
On	Any	Connected okay, no data
Flashing	Any	Receiving / transmitting data
Off	Off	No link established

Colour(s)	Behaviour	Description
Green	Flashing	Normal Operation
Red	Flashing	Record in Progress
Blue	Flashing	Playback in Progress
Yellow	Flashing (3 per second)	Identify Function (used to visually locate a device)
Red/Green/Blue/White	Cycling	Test Mode - RGBW Cycle
Color Wheel	Cycling	Test Mode - Color Fade
Various	Solid	Test Mode - Set Color
Blue/Yellow	Alternating	Impaired Mode (Current mode cannot function)
Green	Solid	Booting Up or Installing Firmware
White	Flashing	Factory Reset
Green/Red	Alternating	Emergency Recovery Mode
Off	Off	No Power / Hardware Fault
White	Flashing (3 per 5 sec)	Power Supply Stability Error Detected (power device off and on again)
Red/White	Various	Critical Error (Contact your distributor for support)

9.2   Statistical Monitoring

Many issues that may occur are often due to complications in the network, configuration, or wiring. For this reason, the Management Interface features a statistics page for statistical monitoring and diagnostics. Refer to the PX24/MX96PRO Configuration Guide for more information.

9.3   Solutions for Common Issues

Issue	Suggested Solution
Status LED off	- Ensure that your power supply is supplying correct voltage as per Section 4.1. - Disconnect all cables from the device, except for the power input, to see if the device turns on.
No pixel control	- Ensure the device has been configured correctly, with the correct Pixel Type and number of Pixels set. - Activate a test pattern as per Section 6.5 to see if your pixels turn on. - Check that the physical wiring and pinout of the pixels are correctly connected and are in the correct positions, as per Section 4.4. - The status of the smart electronic output fuses should also be checked to ensure that the output load is within specifications, and that there are no direct shorts. See Section 4.2

9.4   Other Issues

Check the LED codes as per Section 10.1. If the device still fails to perform as expected, perform a factory default reset on the device as per Section 10.5 below. For the latest information, more specific troubleshooting guides and other help, you should refer to your local distributor.

9.5   Reset to Factory Defaults

To reset the controller to its factory default settings, do the following:

1.   Ensure the controller is powered up.

2.   Hold down the 'Reset' button for 10 seconds.

3.   Wait for the Multi-Color Status LED to alternate Green/White.

4.   Release the 'Reset' button. The controller will now have factory default configuration.

5.   Alternatively, reset to factory defaults via the PX24 Web Management Interface, in the "Configuration" page.

Note: This process will reset all configuration parameters to Factory Defaults, including IP Address settings (listed in Section 5.4.4), as well as Security settings.

10 Standards and Certifications

This device is only suitable for use in accordance with the specifications. This device is only suitable for use in an environment which is protected from the weather. The device can be used outdoors, provided it is protected from the weather using an enclosure suitable for the environment that prevents moisture getting to the device components.

The PX24 controller is supplied with a 5-year limited warranty and a repair/replacement guarantee.

The PX24 has been tested against and independently certified as compliant with the Standards listed in the table below.

Audio/Video and ICTE - Safety Requirements		UL 62368-1
Radiated Emissions		EN 55032 & FCC Part 15
Multimedia Immunity EN 55035	Electrostatic Discharge	EN 61000-4-2
	Radiated Immunity	EN 61000-4-3
	Electrical Fast Transients/ Burst	EN 61000-4-4
	Conducted Immunity	EN 61000-4-6
Restriction of Hazardous Substances		RoHS 2 + DD (EU) 2015/863 (RoHS 3)

Through testing to the above standards, the PX24 has the certifications and marks listed in the table below.

Certification	Relevant Country
ETL Listing	North America and Canada. Equivalent to UL Listing.
CE	Europe
FCC	North America

ICES3	Canada
RCM	Australia and New Zealand
UKCA	United Kingdom

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

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