NLED 16-Bit RGBW Lamp Controller

The NLED 16-Bit RGBW Lamp Controller is designed for small LED based mood lamps and color washes. It features a rotary encoder(dial) with a button for user control, adjust the sequence, speed, intensity, and manually select colors. The device is compatible with the NLED Aurora Control software, which allows the user to connect the device to a computer over USB and design custom color sequences that can be uploaded to the controller, for it to run by itself, without a computer. This controller features 4 channels of 16-bit PWM, which can create trillions of unique colors with completetly smooth fade transistions. The multiple channels allow for 4 different groups of LEDs to be controlled, such as RGB, RGB+White/UltraViolet, or multiple single colors. It offers the ability to control the outputs over USB, serial from an Arduino or similar, and DMX-512(model B) with selectable 8-bit and 16-bit reception modes.

Features:

- Small Size 1.9” x 1.5” x 0.5”(tall)
- USB Connectivity for control from a computer(emulated serial) or for uploading user color Sequences.
- 4 Output Channels, current sinking, for RGB, RGB+W, or RGB+U.V. or single color setups.
- 16-Bit PWM Resolution(65,535 Brightness levels per channel) with full reception and Stand-Alone support.
- High Current Sinking Outputs(LED Configuration as Common Anode, see pg. 6)
- Dynamic stand-alone Sequences, in full 16-bit, user customizable via the software and an USB Cable.
- NLED Aurora Control Software compatibility, connection via Mini USB.
  Create and Upload(save) Custom Stand-Alone Color Sequences to the Controller From a Computer.
- Firmware Upgradable, all future firmware revisions and updates will be freely available and easy to apply to the device using an USB cable via the Bootloader(see page 4)
- Serial Reception at a user selected baud rate. With RS-485 or TTL reception and 8-bit or 16-bit options.
- Both models support DMX-512 with various reception modes(pg. 5), including 16-bit reception, but only model B has the DMX(RS-485) hardware populated, but is still capable of receiving, pg. 3 for details.
- DMX Master Transmission(model B, see pg. 3) of stand-alone sequences, in 8-bit or 16-bit mode.
- Serviceable Design, in case of any damage caused by accidents, including a Full Warranty and Guarantee

Specification:

Input Voltage	**5v* or 12v**
Logic Current Draw	**< 100mA**
Output	**4 Channels, Sink**
Max Current Per Output	**6 Amp**
Max Current Total	**15 Amp**
PWM Frequency	**244 Hz**
PWM Resolution	**16-Bit (65,535 levels)**
Connectors	**Screw Terminals, 0.2”(5.08mm)**
Connector Spacing	**0.1“(Headers) 0.2”(Terminal)**
Main PCB Dimension	**1.9” x 1.5”**

***5 Volt Input operation possible with minor hardware modification.**

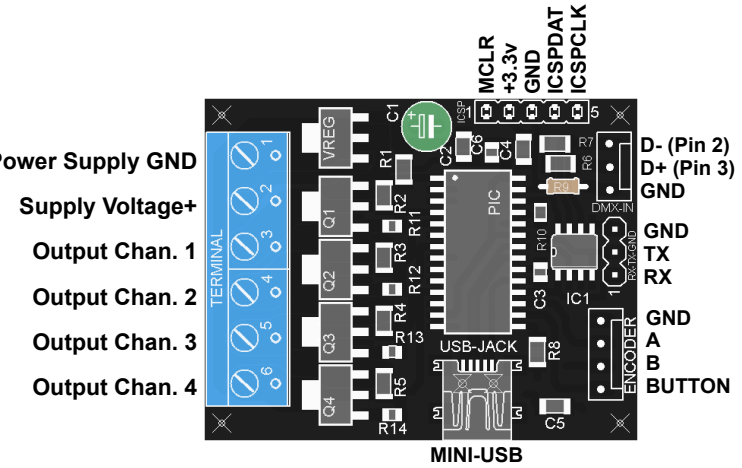


Fig. 1a

Rotary Encoder Usage

Action:	Description:
Short Press	Change Sequence Up
Press and Hold	Turn Off/Put to Sleep
Double Press	Enter Color Select Mode, See Description
Rotate CW	Adjust Overall Intensity Up
Rotate CCW	Adjust Overall Intensity Down
Rotate CW While Pressed	Adjust Sequence Speed Up, Not Saved
Rotate CCW While Pressed	Adjust Sequence Speed Down, Not Saved

CW = Clockwise, CCW = Counter Clockwise

Fig. 2a

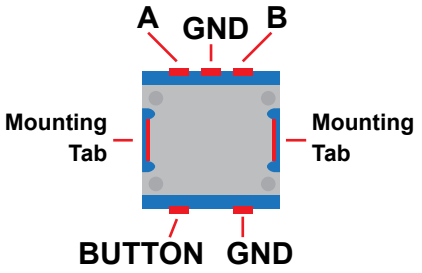


Fig. 2b -
Encoder Viewed From Bottom

Color Select Mode

Quickly pressing the button twice forces the device into Color Select mode. In Color Select mode the rotary encoder can be used to adjust the outputs to a chosen color. Upon entering the mode, rotating rotary encoder will alter the 1st channel(Red) value, pressing and releasing the button again will select the next color channel, and allow its value to altered using the encoder. Continue pressing to wrap back to chanel 1. Color Select mode and the selected values are saved to the device and will restore on power up if it was powered down in Color Select mode or the values will restore when the user re-enters Color Select mode.

Rotary encoder usage in Color Select Mode is as follows in Fig. 2c.

Action:	Description:
Short Press	Changes the selected channel to be altered.
Double Press	Exits Color Select Mode
Rotate CW	Alter the selected channel value upwards, Small.
Rotate CCW	Alter the selected channel value downwards, Small.
Rotate CW While Pressed	Alter the selected channel value upwards, Large.
Rotate CCW While Pressed	Alter the selected channel value downwards, Large.

CW = Clockwise, CCW = Counter Clockwise

Fig. 2c

User Settings and Configuration Saving

The device automatically saves any user settings adjusted using the encoder or button. When the device powers on it loads the previously saved settings so the device starts in the same state it was when it was turned off. After adjusting a setting, allow 3 seconds for the device to save before powering off or making more changes. Speed adjustments and Sleep mode do not get saved.

Model A & Model B

There is a model A and a model B of this device. The model A does not have the integrated circuits to transmit or recieve a standard RS-485 DMX signal. Although a DMX signal in TTL levels could be applied to the RX-TX-GND header. The model B does have all the DMX integerated circuits populated, and all DMX functions are fully usable. If you would like to upgrade your device to a model B, please contact us for details

Daisy Chaining Model A

Multiple model A devices can be chained together. They would function as if using DMX, but using TTL signal levels. All the RX pins on the RX-TX-GND header would be connected in parallel. One device on the chain would be setup up as the DMX Master(as normal) and that device's TX pin connected to the other device's RX pins(which are all in parallel)

Serial Reception Usage

Serial reception can directly control the device's outputs using a common serial transmission device. Such as a standard COM port with level translation, an FTDI adapter, Arduino, PIC UART, wireless XBee, or similar. Data is recieved in packets of 4 bytes for 8-bit reception mode and 8 bytes, MSB first, for 16-bit mode. There is a maximum of 5mS between bytes and a minimum of 5mS between packets, to allow the data to latch. A delay between received data bytes of more than 5mS will reset the buffer pointer, framing the data. Partial packets will latch after the 5mS delay, or latching will occur immediately after receiving the last(4th or 8th) byte. 8-bit or 16-bit reception modes are selected through the configurations, which can be accessed through the software or through commands.

Serial reception can be enabled through the NLED Aurora Control Software. Upload an Index containing a Serial Reception icon, select it on the device via the button. Or on the Hardware Tab, select Auto-Detect Serial option to automatically enter Serial Reception when valid data is recieved, the device can take several packets to detect and validate the data before starting reception. The stock baud rate is 19,200, but the user can set the utilized baud rate using the software through the hardware Tab by selecting the desired baud rate from the drop down. The byte formatting is the standard 8-N-1(8-bits, no parity, 1 stop bit)

For Serial Reception on the model B devices, the RS-485 hardware must be configured. RS-485 is a differential transmission method, that DMX-512 utilizes. The user can select through the software to use the RS-485 hardware for Serial Reception(transmitting device must be RS-485 as well) on the DMXIN header or to disable usage and utilize the RX-TX-GND header for direct TTL (Low=0v, High=5v, 3.3v levels will work as well) control. Model A devices do not have the RS-485 hardware installed and will always use the RX-TX-GND header for serial reception.

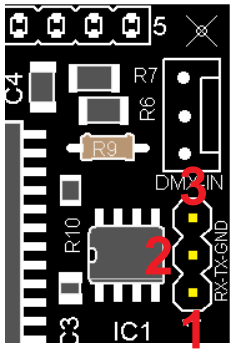


Fig. 3c

RX-TX-GND Header Connection

1 RX ⟵ TX
2 TX ⟶ RX
3 GND ⟷ GND

Fig. 3b

***Percentage of error is within usable limits. And won't affect usage.**

ID#	Actual Device Baud	Closest Common Baud Rate	Error %
0	9,615	9,600	0.16%
1	19,230	19,200	0.16%
2	38,461	38,400	0.16%
3	57,142	57,600	0.64%
4	117,647	115,200	-0.79%
5	222,222	230,400	2.12%*
6	250,000		
7	444,444	460,800	-3.55%*
8	500,000		
9	1,000,000	921,600	8.51%

Fig. 3a

8-N-1

Firmware Updates Using The Bootloader

This device includes a H.I.D. USB bootloader. It allows the firmware on the device to be updated usig a USB cable and a small computer program. To enter the device bootloader: with the device powered off, connect the device using a USB cable to a computer, start the supplied software that is compatible with your O.S., then hold the button down and then power up the device, continue to hold the button and the software will indicate that it is connected. Follow the instructions supplied with the software download to select the correct HEX file and upload it to the device. Once the new firmware is uploaded either hit the reset button in the software or power cycle the device. If it does not work, try again, if still doesn't work Contact Support.

Every microcontroller is sold with special code that prevents other devices from being programmed with the update firmware images. If a firmware image is loaded onto a microcontroller without the special protection code it will respond to commands and USB will work, but the Sequences will NOT run, but display static starting colors. Contact Us for help restoring your device to original condition if your microcontroller was damaged, erased, or bricked.

Auto-Detect, DMX or Serial

One of the configuration options allows the device to detect valid serial data or DMX signal and automatically switch from stand-alone sequences to the selected data signal type. For DMX it will take a few packets of good data for the device to validate the signal and then switch over. Serial auto detection is similar, it must detect several packets of serial data at the correct baud rate for it to validate the signal and switchover from stand-alone sequneces. The configuration can be changed in NLED Aurora Control software or through NLED Aurora USB commands.

DMX-512 Usage

The device supports multiple DMX-512 reception modes, a reception mode can be selected through the software and are detailed on pg. 5. It can also be a setup as a DMX Master device, which will broadcast a DMX universe when running stand-alone color sequences. The data transmitted will be the same the device is outputing to the *Output Channels*. So two or more devices could be daisy chanined together and would be synchronized.

DMX transmission from this device will not be fully compatible with the DMX-512 standard, due to voltage levels, so transmission may not be compatible with all devices.

DMX Master Transmission Modes

When the device is running stand-alone color sequences it can be set to transmit its *Output Channel* value's over DMX. Which allows similar devices to recieve and synchronize with the transmitting device. The data sent varies depending on the sequence, but a Mono/Single sequence will transmit 4 values, RGB sequence will transmit 3 values, and RGBW sequence will transmit 4 values. If 16-bit master transmission is enabled each value would be 2 bytes MSB first, if its disabled, each value is a single byte.

r1 No Master DMX Transmission, device receives normally. As Slave.

r2 Transmits full DMX Universe when in Stand-Alone Mode, transmits the values, repeating, to all DMX channels. ex(1-3, 4-6, etc OR 1-4, 5-9, etc)

r3 Transmits a partial DMX Universe when in Stand-Alone mod. Repeats the values in order 16 times per DMX packet.

Through software 8-bit or 16-bit DMX master transmission can be selected. 16-bit mode transmits MSB first, then LSB. Not compatible with all DMX devices, check recieving device's specifications for details.

DMX Reception Modes

These are selectable through NLED Aurora Control software or through USB commands.

4 Channel Mode: Standard RGBW Usage(od1)

DMX Channel	Function	Value	Description
Channel 1	Red	0 - 255	Red Value, 0 is Off, 255 is Maximum
Channel 2	Green	0 - 255	Green Value, 0 is Off, 255 is Maximum
Channel 3	Blue	0 - 255	Blue Value, 0 is Off, 255 is Maximum
Channel 4	White/UV	0 - 255	Fourth Value, 0 is Off, 255 is Maximum

8 Channel, 16-bit Mode: 16-Bit RGBW(od2)

DMX Channel	Function	Value	Description
Channel 1	Red MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 1st value
Channel 2	Red LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 1st value
Channel 3	Green MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 2nd value
Channel 4	Green LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 2nd value
Channel 5	Blue MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 3rd value
Channel 6	Blue LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 3rd value
Channel 7	White/UV MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 4th value
Channel 8	White/UV LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 4th value

5 Channel Mode: RGBW Control with Intensity - RGBWA(od3)

DMX Channel	Function	Value	Description
Channel 1	Red	0 - 255	Red Value, 0 is Off, 255 is Maximum
Channel 2	Green	0 - 255	Green Value, 0 is Off, 255 is Maximum
Channel 3	Blue	0 - 255	Blue Value, 0 is Off, 255 is Maximum
Channel 4	White/UV	0 - 255	Fourth Value, 0 is Off, 255 is Maximum
Channel 5	Intensity/Alpha	0 - 255	Scales other channel's Intensity, 0 is 0%, 255 is 100%

10 Channel, 16-bit Mode: 16-Bit RGBW Control with Intensity(od4)

DMX Channel	Function	Value	Description
Channel 1	Red MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 1st value
Channel 2	Red LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 1st value
Channel 3	Green MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 2nd value
Channel 4	Green LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 2nd value
Channel 5	Blue MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 3rd value
Channel 6	Blue LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 3rd value
Channel 7	White/UV MSB	0 - 255	Most-Signifcant-Bits of the 16-bit 4th value
Channel 8	White/UV LSB	0 - 255	Least-Signifcant-Bits of the 16-bit 4th value

Need something different? Custom? Contact Support@NLEDshop.com for Help

LEDs Configuration Examples

The controller outputs are current sinking, meaing the cathode of the LED(s) or LED string is connected to the controller *Output Channels* and the anode(s) are connected directly to the positive supply voltage. Either using the *Supply Voltage+* terminal position or directly to the power supply.

Many configurations of LEDs can be controlled. Such as standard 12 volt LED strip or 12 volt RGB(W) LED strip(common anode), series/parallel or single high wattage LEDs (1w, 3w, 5w, 10w, 20w, +more up to max specification) or series/parallel or single 10mm, 5mm LEDs with a current limiting resistors. And multi color LEDs with common anodes.

A few configuration examples are shown below.

Need Help or Have Questions? Contact Support@NLEDshop.com For Help

Standard Loose LEDs

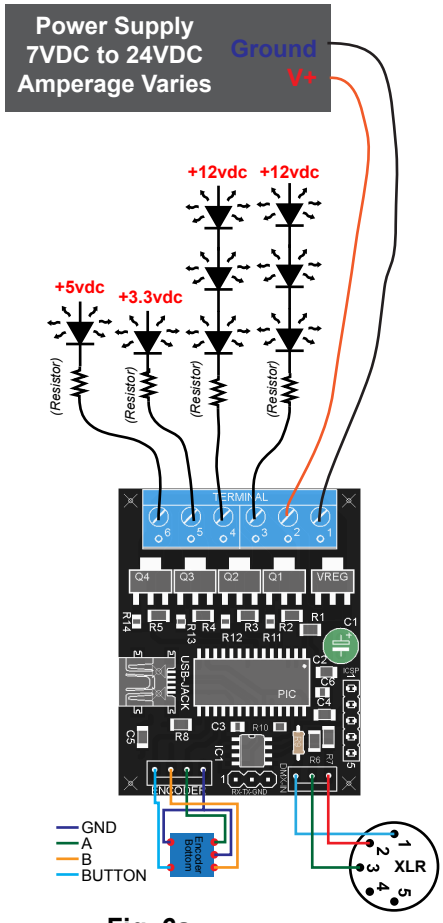


Fig. 6a

Common Anode RGB

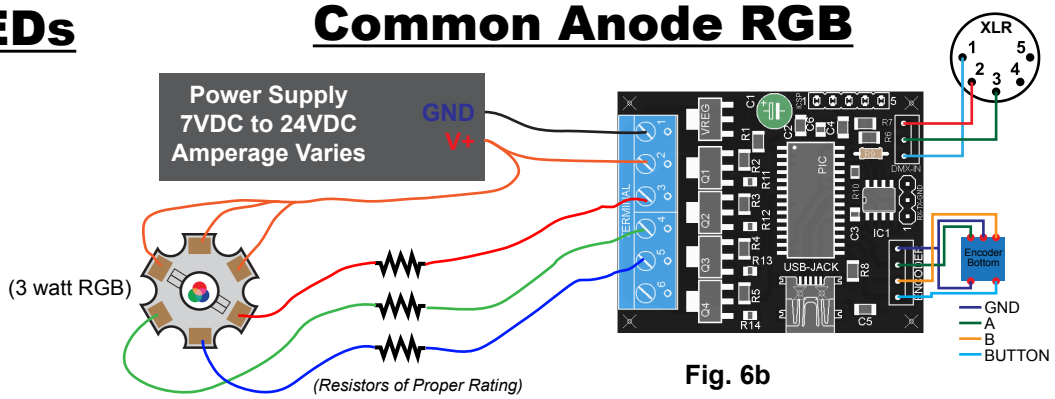


Fig. 6b

Strip LEDs Configuration

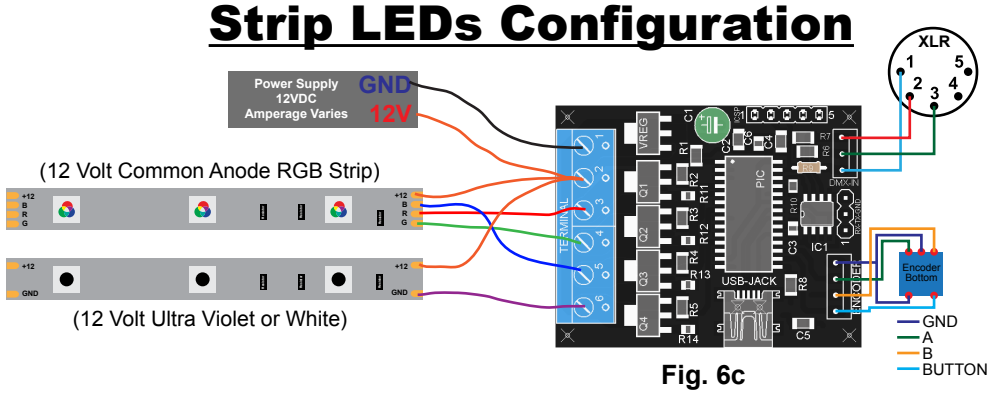


Fig. 6c

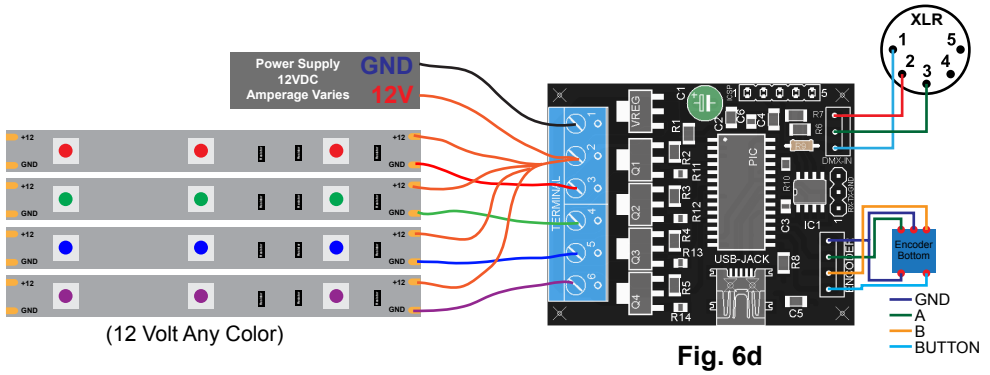
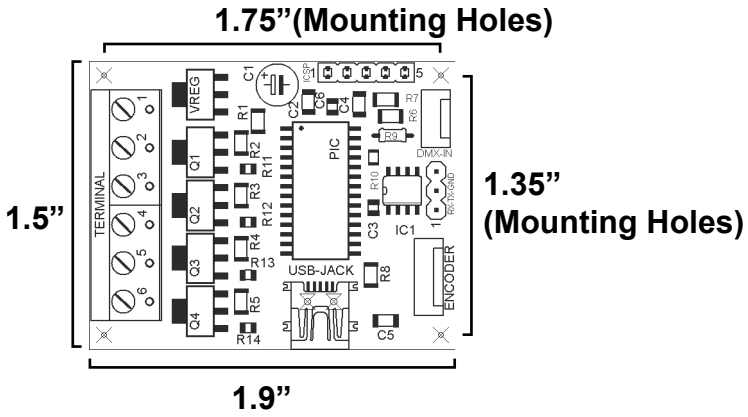
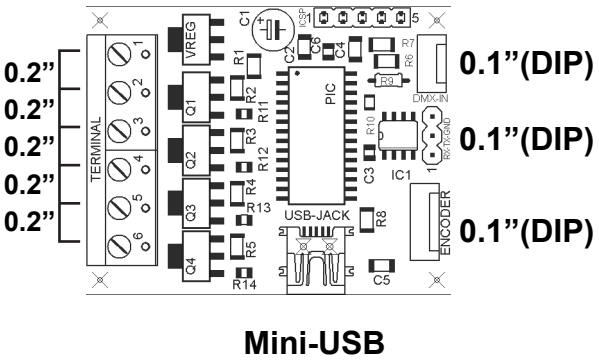


Fig. 6d

Dimensions





Common Issues and Troubleshooting

Please Contact Support@NLEDshop.com with any Questions, Comments, or Bug Reports.

Most issues can be resolved by power off the device, waiting a few seconds, and powering it back up.

Problem: Device with connected LEDs does not produce any light.
First ensure the LEDs are properly powered and wired to the controller and power source. Second ensure the intensity is set to maximum by rotating the encoder.

Problem: DMX-512 control is not working
Ensure you have the model B device that has the DMX circutiry installed. Model A devices do not have those installed and will not work, without some tweaks. Contact for details.

Problem: Device is not as bright as it should be.
Adjust the intensity value using the encoder, see page 2 for details.

Problem: Device appears to be “bricked”, unresponsive to user inputs and/or communication(USB etc)
Attempt to upload a new firmware image via the Bootloader, see page 4 for details.

Problem: USB connection is not being established.
Check to make sure the USB cable is plugged and seated correctly, then power up the device. Check for connection via NLED Control or your operating systems device manager, it should be listed as a COM port. All major operating systems should not require a driver. So the device should plug and play.