

NLED Pixel Controller Micro

This pixel controller from NLED is the most effective solution yet for control of addressable LED pixels over DMX-512 or TTL serial. It is a small form factor that is easy to use and setup, but still has many features packed in. It supports all the common chipsets from WS2811, WS2812, WS2801, APA102, SK6812, and numerous others, with a platform that is easily updated additional chipset support can be implemented. The controller allows the chipset to be easily selected on the fly, in circuit with no removal, and no complicated charts to reference. Over DMX-512 a full universe of RGB(170) or RGBW(128) pixels can be controlled, at fast packet rates and update speeds. Using TTL serial for control allows a minimum of 256 RGB pixels to be controlled from any serial device, such as an Arduino, FTDI, Xbee, ESP or similar serial devices, even 3.3 volt types without level translation. Depending on the serial baud rate and pixel chipset up to 2048 pixels could be controlled.

Features:

- Supports Multiple Pixel Chipsets - WS2801, WS2811, WS2812, WS2812B, WS2813, LPD8806, LPD6803, TM1803, APA102, SK9822, SK6812, and more. With ability to add more in future.
- Chipset is easily selectable using input switches. The selected chipset is saved to memory. Easily select which chipset you want to control.
- Features DMX Decoder Mode, decodes DMX-512 data then sends out the data bytes converted to TTL serial and/or standard SPI(no flow control)
- Small form factor, 2" x 1.25" x 0.5" tall. Unpopulated connector option is less than 0.25" tall.
- Supports Color Order / Color Swap. Makes non-RGB order chipsets accept RGB ordered data.
- Supports full DMX-512 universes. With color order settings.
- Supports TTL Serial at all baud rates, control from an Arduino or other serial devices. Up to 2048 pixels. Baud rate selected via the DIP switch.
- Supports WiFi via an ESP8266, Xbee, or similar products. Or Bluetooth via various modules.
- Supports wide voltage ranges, 3.3v to 12 volt support. Supports single cell lithium battery voltages.
- Bootloader Support, easily apply any future upgrades and bug fixes, using only a serial adapter and software.
- Designed and Manufactured in The United States. Includes 3 Year Warranty and Lifetime Support.

Specification:

Input Voltage(VIN)	3.3v - 12v
Logic Current Draw	< 50mA
Standard Outputs	512 channels(170 RGB)
Extended Outputs	2048 channels*
Connectors	Various**
Output Connector Spacing	0.1"/2.54mm
Overall Dimensions	1.25" x 2" x ~0.5"

*Using certain chipsets with serial reception.

This device supports multiple chipsets. You may be required to follow the steps on TEST mode (pg 6) and the setup instructions on page 12 before the controller will correctly control your pixels

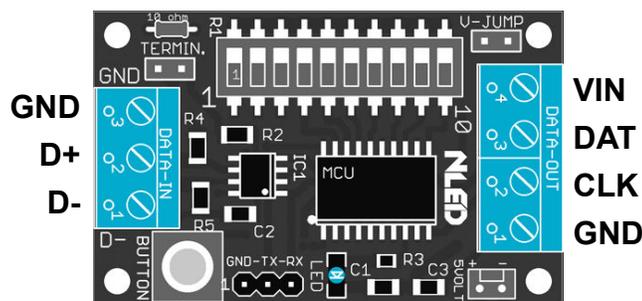


Fig. 1a

See Pg. 6 - 8 For Detailed Layout Information

Supported Pixel Chipsets

Fig. 2a	Name	Color Bits*	Data Speed	PWM Frequency	Wires	Available Color Order	Default Color Order	Max Pixels DMX	Max Pixels Serial
	WS2811, WS2812/B, WS2813	8-bit	800Khz	400Hz	3	RGB, GRB	GRB	170	768**
	SK6812	8-bit	800Khz	400Hz	3	GRBW	GRBW	128	512**
	TM1803	8-bit	800Khz	400Hz	3	RGB, GRB	RGB	170	768**
	APA102	8-bit	2Mhz	20Khz	4	BRG	BRG	170	2048+
	WS2801	8-bit	2.66MHz	2.5kHz	4	RGB,GRB,BGR,BRG	RGB	170	2048+
	WS2803	8-bit	2.66MHz	2.5kHz	4	RGB,GRB,BGR,BRG	RGB	170	2048+
	LPD6803	5-bit	8MHz	N/A	4	RGB	RGB	170	1024
	LPD8806	7-bit	2MHz	4kHz	4	RGB,GRB,BGR,BRG	RGB	170	2048+
	SK9822	8-bit	2MHz	4.7KHz(?)	4	BRG	BRG	170	2048+

Visit www.NLEDshop.com/pixelchipsets for the most updated list of supported chipsets.

*Same as PWM Resolution.

**Actual amount depends on baud rate and whether color order is being utilized. Color order is not available on these chipsets over 256 pixels.

Note: Many pixel chipsets use the same protocols, if you do not see yours on the list try an online search to see if it is compatible with one of the listed chipsets. Or visit the pixel chipsets page.

Many of the most popular pixel chipsets are compatible with this controller. Each chipset has an unique control protocol, hardware specifications, voltage requirements, and color order. To properly configure and control the pixels, the user must select the correct pixel chipset and make any adjustments to the color order if required. See pg. 7 for details on the configuration settings.

Color Order / Color Swap: Some chipsets expect data in non-RGB order, such as BRG or GRB. The chipsets that are inside a LED such as APA102 or WS2812 have a static color order and the controller automatically selects during chipset selection. If you require a different color order, it has to be selected through the configurations and software.

Note: WS2811/WS2812B will automatically load GRB color order when selected through TEST mode. If a different color order is required, use the configuration software to select it.

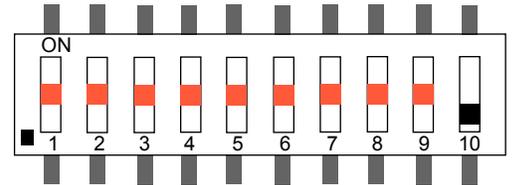
Note: APA102 and SK9822(same protocol, interchangeable) will automatically load BRG color order when selected through TEST mode

Want Another Pixel Chipset Supported? Contact Support@NLEDshop.com for To Request It

User Inputs and Mode Selection

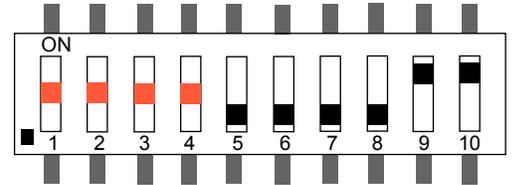
DMX-512 Mode: Standard DMX reception mode, DIP10 low indicates, DIP1-DIP9 set the starting address. The activity LED will blink everytime it receives a DMX packet.

Fig. 3a



Serial Reception Mode: Serial reception at the indicated baud rate, DIP10 and DIP9 high indicates, DIP1-DIP4 set the baud rate, in binary, as per the table on page. The activity LED blinks everytime a packet is sent to the pixel strand.

Fig. 3b



Test Mode: Enters controller into Test Mode at power up. Which allows the pixel strand to be tested and the user to select the desired pixel chipset by cycling through them using the PCB mounted button. See page 6 for details on Test Mode. Setting DIP10 high and holding the button pressed during power up starts this mode. The button can be released once the activity LED lights up.

TEST mode allows the pixel chipset to be selected and saved to memory. Your pixels may not work correctly until the chipset is selected. See page 6 & 11 for details.

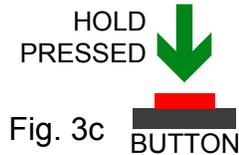
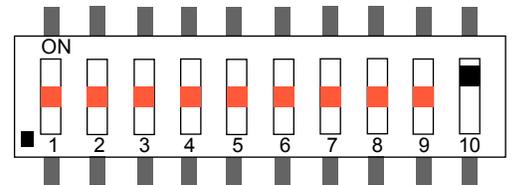


Fig. 3c



Command Mode: Enters the controller into Command Mode at power up. This mode allows the configuration settings to be adjusted over the serial reception hardware. Setting DIP1-DIP10 low and holding the button at power up indicates the mode. The button can be released once the activity LED lights up.

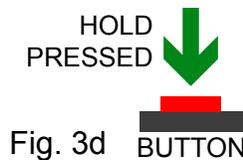
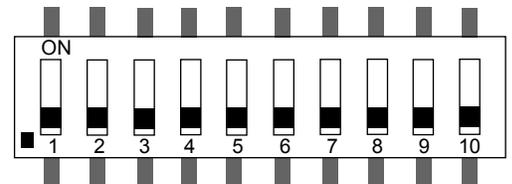
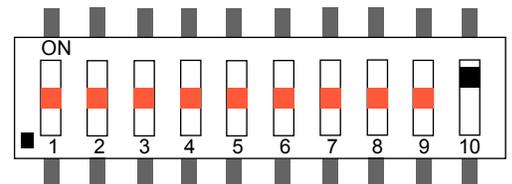


Fig. 3d



DMX Decoder Mode: Enter device into Adapter Mode at power up. Decodes DMX-512 data and outputs easier to read TTL serial at 250k baud, or over SPI(with no flow control). DIP10 high indicates usage. The activity LED will blink everytime it receives a DMX packet.

Fig. 3e



Bootloader Mode: Forces controller into bootloader mode at power up. The button can be released once the activity LED lights up. See page 6 for details.

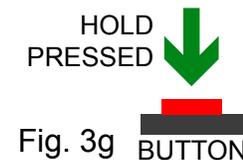
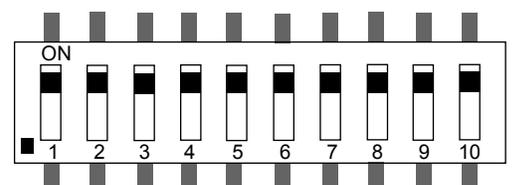


Fig. 3g



DMX Decoder Mode

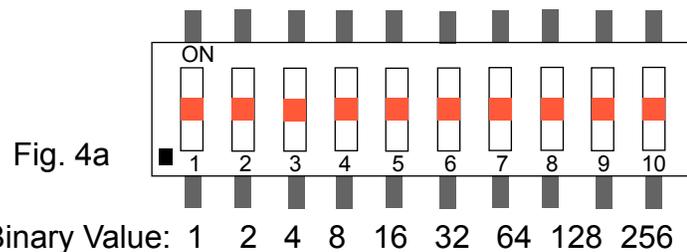
This mode allows a DMX-512 universe to be decoded into a standard serial data or SPI data, suitable for other devices, such as Arduinos, FTDI etc. The amount of channels it decodes and sends out can be set in the configurations. The starting address of collection is indicated by DIP1-DIP8(DIP9 with configuration). To indicate to the controller to enter into this mode DIP10 and DIP 9 are set high. But due to the entry method using DIP9, the starting address can not utilize DIP9 unless the configuration “Force Decoder Mode” is set through software. Once that configuration is enabled, it disables Serial Mode, and will enter DMX Decoder Mode when DIP10 is set high and the button is not pressed at power up. This allows DIP9 to be used for addressing.

The User Pixel Amount configuration is used to set how many channels of data the controller should send out, from 1 - 255 bytes. If decoding full DMX-512 universe is required the configuration “Force Full Packets” can be enabled, the controller will then send all channels available, starting at the indicated start address. Note: If starting at address 1, 512 bytes would be transmitted, if starting address is 400, 112 bytes would be collected and transmitted.

Binary Notes

All numbers such as the DMX starting address and serial baud rate ID, are indicated using the DIP switches and binary numbers. The DIP switches indicate a binary place, doubling each position it goes up. The places are added together to make the final number. Note: Places are LSB on the left, MSB on the right. Which is how humans read it, but not computers, some binary converters will output right to left. Online there are many “DMX DIP Switch Calculators” to help in converting the numbers.

Example #83: 1100-1010-0
 Example #318: 0111-1100-1



DMX-512 Usage

512 Channel Mode, 8-bit: Standard Direct Control

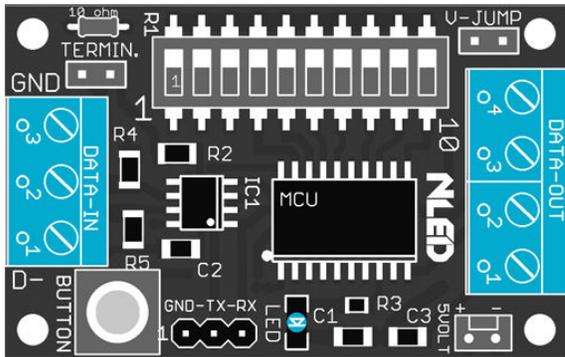
Channel	Value	Description
1	0 - 255	0 is 0%, 255 is 100%
.....		
512	0 - 255	0 is 0%, 255 is 100%

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

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. The device receives data in packets, the size(in bytes) of the packet corresponds to how many channels will be controlled. Example: Sending a packet of 90 bytes will control 30 RGB pixels, sending 510 bytes would control 170 RGB pixels. There is a maximum of 1mS between bytes and a minimum of 1mS between packets(end-of-frame), to allow the data to latch. A delay between received data bytes of more than 1mS will reset the buffer pointer, framing the data. Partial packets will latch after the 1mS delay, or latching will occur immediately after receiving the last byte(if configured).

The baud rate is selected at power up via the DIP switches, when serial mode is indicated(DIP10 and DIP9 set).The byte formatting is the standard 8-N-1(8-bits, no parity, 1 stop bit) Depending on the chipset and any user selected color orders, the controller may expect data in non-RGB orders. See Page 2 regarding color order and see page 7 for information on selecting a color order. By default, serial reception will not do any color re-ordering, and should be done before transmitting. Enabling color order will slow down reception and may limit the maximum number of pixels that can be controlled.



3 2 1

Fig. 4c

Controller RX supports both 3.3 volt and 5 volt logic levels, TX outputs at 5 volt logic level. Level translation is not required.

Additional details and graphics can be found at:

<http://www.nledshop.com/downloads/manuals/nled-serial-reception-manual.pdf>

Command Mode

Command mode allows the configurations to be adjusted via a USB to serial adapter over the TTL serial header GND-TX-RX. See user inputs in how to enter the device into Command Mode.

For configuring not through the software, the protocol is simple. The baud rate is 19,200 at 8-N-1. Once entered into command mode, send the data as numbers, the LED will toggle states with each byte. Do as follows:
Send as numbers: 123 -> 253 -> 82 -> 7

That unlocks locks the function and frames the data.

Then Send the configuration bytes, as numbers: Chipset ID# -> User Pixel Amount -> ConfigFlags
Once it has received those 7 bytes, it will start to blink steadily, power off the controller, set your DIP switches, and power the controller back up. Note: See configurations page for byte info.

DIP Sw. (LSB...MSB)	ID#	Actual Device Baud	Closest Common Baud Rate	Error %
000000011	0	9,615	9,600	0.16%
100000011	1	19,230	19,200	0.16%
010000011	2	38,461	38,400	0.16%
110000011	3	57,142	57,600	0.64%
001000011	4	117,647	115,200	-0.79%
101000011	5	222,222	230,400	2.12%*
011000011	6	250,000		
111000011	7	444,444	460,800	-3.55%*
000100011	8	500,000		
100100011	9	1,000,000	921,600	8.51%

Fig. 5a

8-N-1

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

“Actual Device Baud” is the exact rate the controller is expecting, match it for a 0% error value.

RX-TX-GND Header Connection

Device:

1 RX ← TX
2 TX → RX
3 GND ↔ GND

Fig. 5b

Firmware Updates Using The Bootloader

This device includes a bootloader feature. It allows the firmware on the device to be upgraded with new features and bug fixes using only a common serial adapter and a small computer program.

After the device is connected, please follow the instructions found at www.NLEDshop.com/bootloader. That is also where the software download links can be found. Note: This device uses the Serial Bootloader not the USB/HID Bootloader. And requires a serial adapter such as an FTDI, 5v or 3.3v types work.

Find the latest firmware update at www.nledshop.com/deviceupdates

To Identify a controller's firmware version: v1a has no sticker on the MCU. v1b has a sticker that says 'v1b'. v1c has a sticker with a blue dot, or a sticker with 'v1c'.

Firmware updates are encrypted and protected with special code that prevents other devices from being programmed with the update firmware images. And prevents non-NLED firmwares from being programmed onto the devices. 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 outputs will be off. Contact Us for help restoring your device to original condition if your microcontroller was damaged, erased, 'bricked', or otherwise not working correctly.

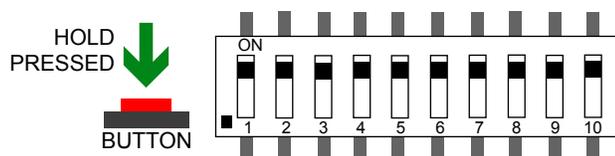


Fig. 6a

The bootloader entry method is:

- With the device powered off, set all DIP switches high.
- Connect your serial adapter to the controller's GND-TX-RX header. Ensure RX->TX, TX->RX
- Power up the device while holding the button pressed.
- Wait a second or two and release the button. The device's notification LED should start blinking.
- Start the software and set it up using the instructions.
- Load the correct HEX file, and follow the instructions to start the upload.
- Wait til the upload is finished and the software notifies that it is done.
- Power off the controller.
- Set the DIP switches to desired mode.
- Bootloader procedure complete.

Test Mode Details

Test mode allows the pixel strand to be tested and to select the pixel chipset. In Test Mode it will attempt to control 1024 RGB pixels or 768 RGBW pixels. The Test Mode pattern is as follows: Off->Red->Yellow->Green->Teal->Blue->Purple-> Repeat

While in Test Mode, pressing the button cycles through the available pixel chipsets. With pixels connected, the user can cycle through the chipsets and once the correct one is selected, the LEDs will respond correctly. When the wrong chipset is selected the LEDs will do nothing, act erratically or otherwise not respond correctly.

Once the chipset is selected, the user pushes and holds the button until the activity LED turns on. When the LED turns on it indicates that the chipset ID has been saved to memory and the controller will use load it next time it powers up. Releasing the button will continue the test pattern.

Device Configurations Settings

Some of the configuration settings on this controller can only be accessed through software, and/or through Command Mode(detailed on page 5)

Please visit the controller's webpage to find the link to the current version of the configuration software or use the Command Mode information here to send the configuration settings from a serial terminal.

The NLED Configuration Software can be used to configure this controller. www.nledshop.com/nledconfig

Select Correct RGB Order for Pixels: The different pixel chipsets require data to be received in various orders. Not all pixels will expect data in RGB order. It may expect GRB, BRG, or any combination, it varies chipset to chipset. This configuration setting allows the user to select the correct color order for their pixels. Note on this controller not all color order options are available.

Select The Pixel Chipset Being Used: The most important configuration setting, this option must be the same as the pixels you expect to utilize. See pg. 2 for compatibility list.

Activity LED Mode: Enables or disables the notification LED usage. If disabled the LED will not turn on.

DMX Decoder Mode, Force Full Packets: This setting allows up to a full universe of data to be converted from DMX-512 to TTL serial. When disabled, the controller will collect and send only the an amount of bytes equal to the User Pixel Amount configuration.

Force Decoder Mode: Forces Decoder Mode when DIP10 is set, ignoring serial mode. When enabled it allows the starting address for Decoder Mode to use DIP9 for addressing. Otherwise if DIP10 and DIP9 are set it would enter Serial mode when powered up. With this configuration enabled, it can not enter serial mode.

Enable Serial Color Swap: When disabled, and in serial mode all data is received and transmitted in RGB order, it is fastest to have it disabled but any color ordering has to be done on transmitter side. When enabled it will try and use the color order as selected in the configurations. Not all chipsets have the function available.

User Pixel Amount: Configures how many pixels the DMX routine should collect data for, default is 170 RGB pixels, which equates to 510 DMX channels. If a RGBW chipset is selected, it would instead collect data for 128 pixels which would be 512 channels. Most users can leave this at 170. But for better performance with fast packet rates or partial packets, this value could be lowered to match the amount of pixels that will be controlled. ONLY USED FOR DMX RECEPTION

See Page 5, for details on using Command Mode

Chipset ID#:

0 - WS2811/WS2812/SK6812

2 - WS2801

4 - LPD8806

6 - LPD6803

8 - APA102

User Pixel Amount: 1 - 255

Visit www.nledshop.com/nledconfig for software.

Configuration Byte Bit Order(ConfigFlags):

LSB - Bit0 - Indicator LED Enable

Bit1 - DMX Decoder, Force Full Packets

Bit2 - Enable Serial Color Swap

Bit3 - GRB Color Order

Bit4 - GRBW Color Order

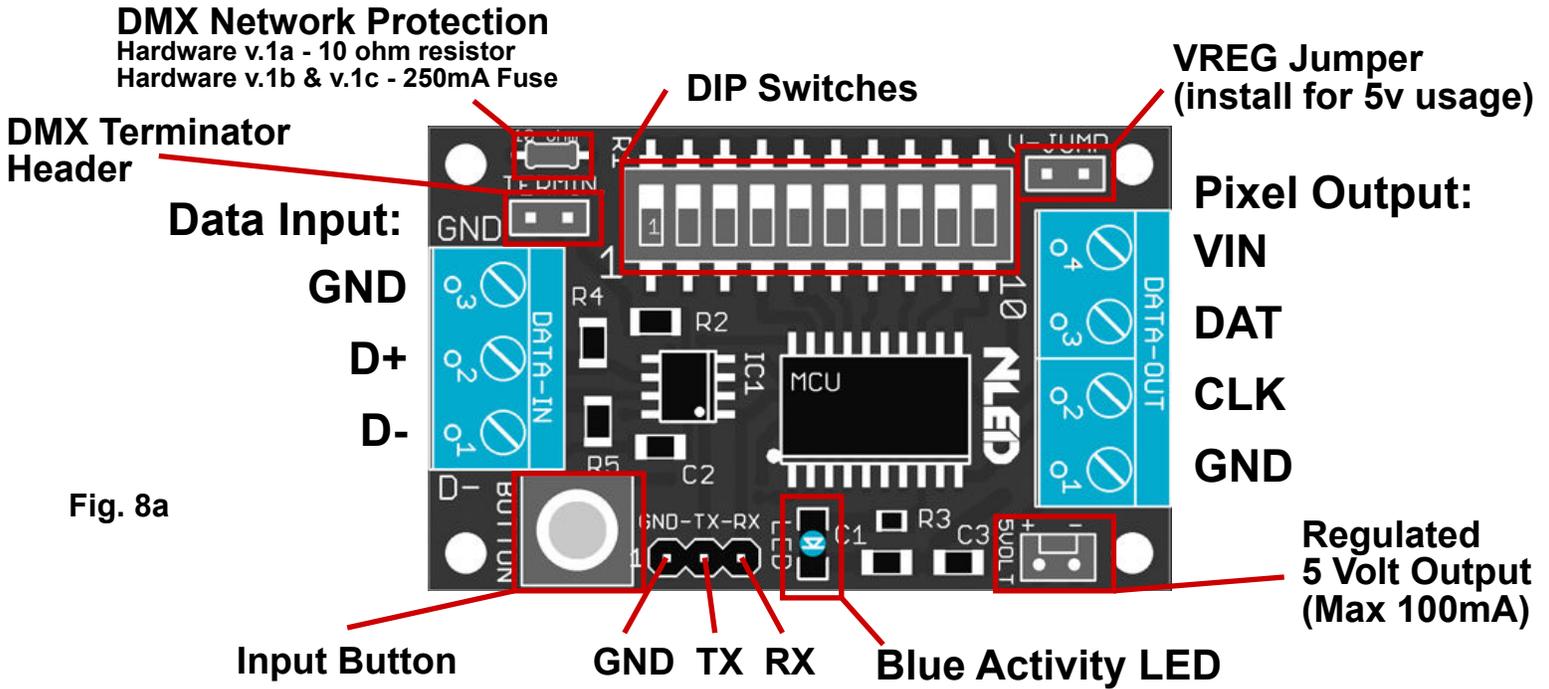
Bit5 - BGR Color Order

Bit6 - BRG Color Order

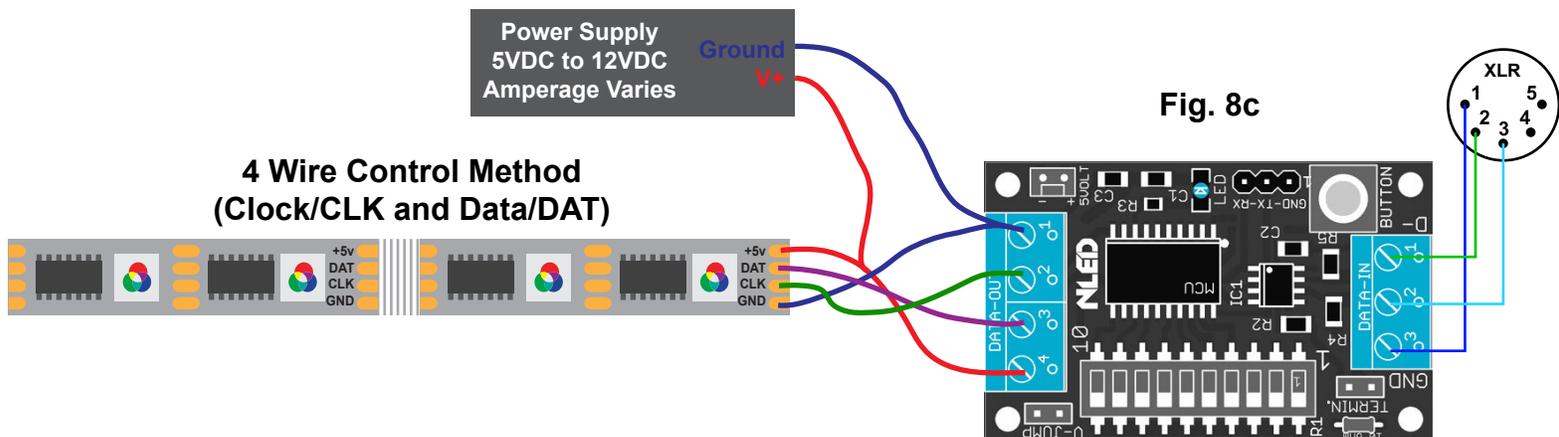
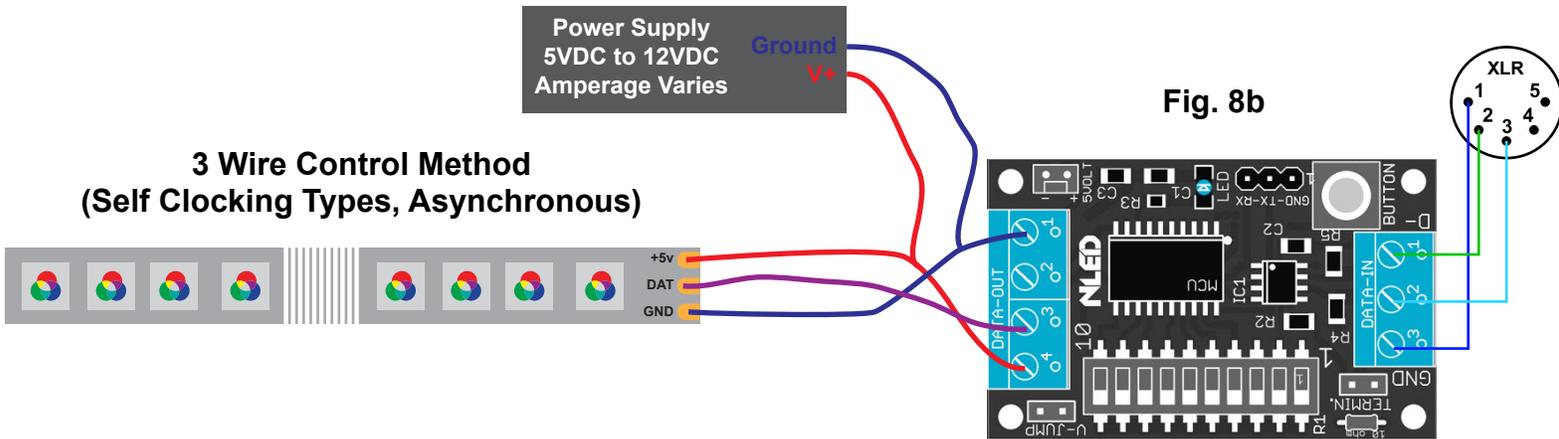
MSB - Bit7 - Force Decoder Mode

Note: Do not set more than one color order at a time.
Default ConfigFlags is 0x01, 00000001

Controller Pinout



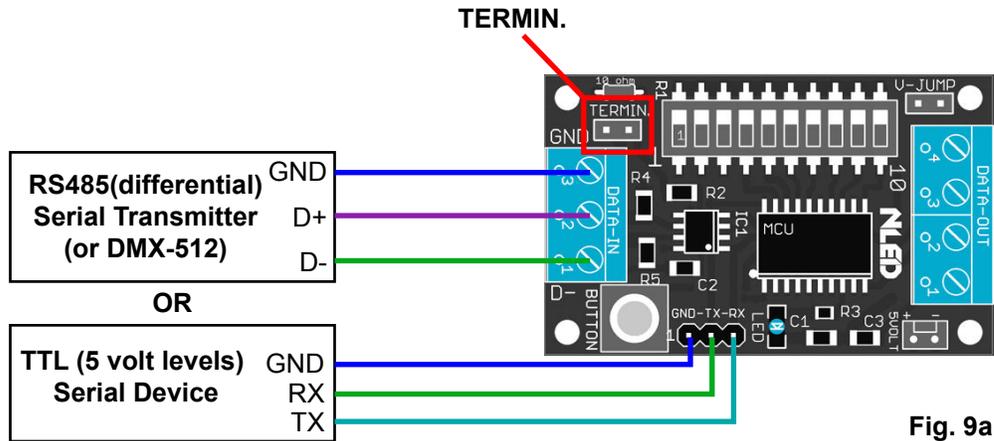
LED Pixel Connections



Serial Data Connections

TERMIN: Header for DMX terminator, only install the jumper if the controller is the *only* or *last* device on the DMX network. Terminating is a technical consideration, specific information can be found online.

The controller is a 5 volt device, but can receive(RX) from 3.3 volt signals, but transmits(TX) at 5 volts levels. Either TTL serial or RS485 serial can be used to transmit data to the controller, connect your transmitter to the one you would like to use.



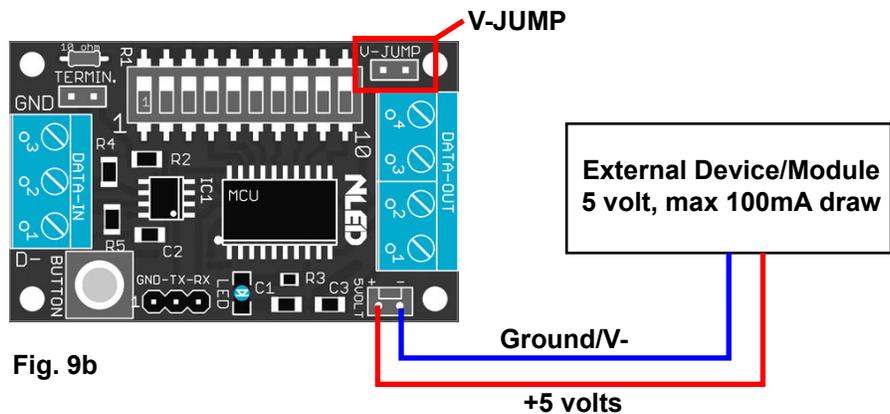
Power Considerations

The controller only draws less than 100mA, the bulk of the current is consumed by the LED pixels. Each pixel can draw up to 60mA each at full intensity.

Example:

170 pixels at 60mA each: $170 \times 0.06 = 10.2$ Amps potential maximum draw.

The standard voltage for LED pixels is 5 volts, but 12 volt types are also available. The V-JUMP position on the controller is used for setting up either 5 volt use, which requires installing a jumper wire in the V-JUMP position. Or if the controller will operate on an input voltage larger than 5 volts, the V-JUMP position is left open.



Connector Options

Standard/Populated: Screw down terminals mounted for both DATA-IN and DATA-OUT

Bare/Solder Pad/Unpopulated: The output positions(VIN, CLK, DAT, GND) are left unpopulated, user solders on their own connector, such as a 3 or 4 pin JST-SM wire harness.

Pluggable Screw Terminal: Screw terminals that can be disconnected easily. Makes the board longer.

See device store listing for details and photos of the different options. www.nledshop.com/pixelmicro

Dimensions and Mounting

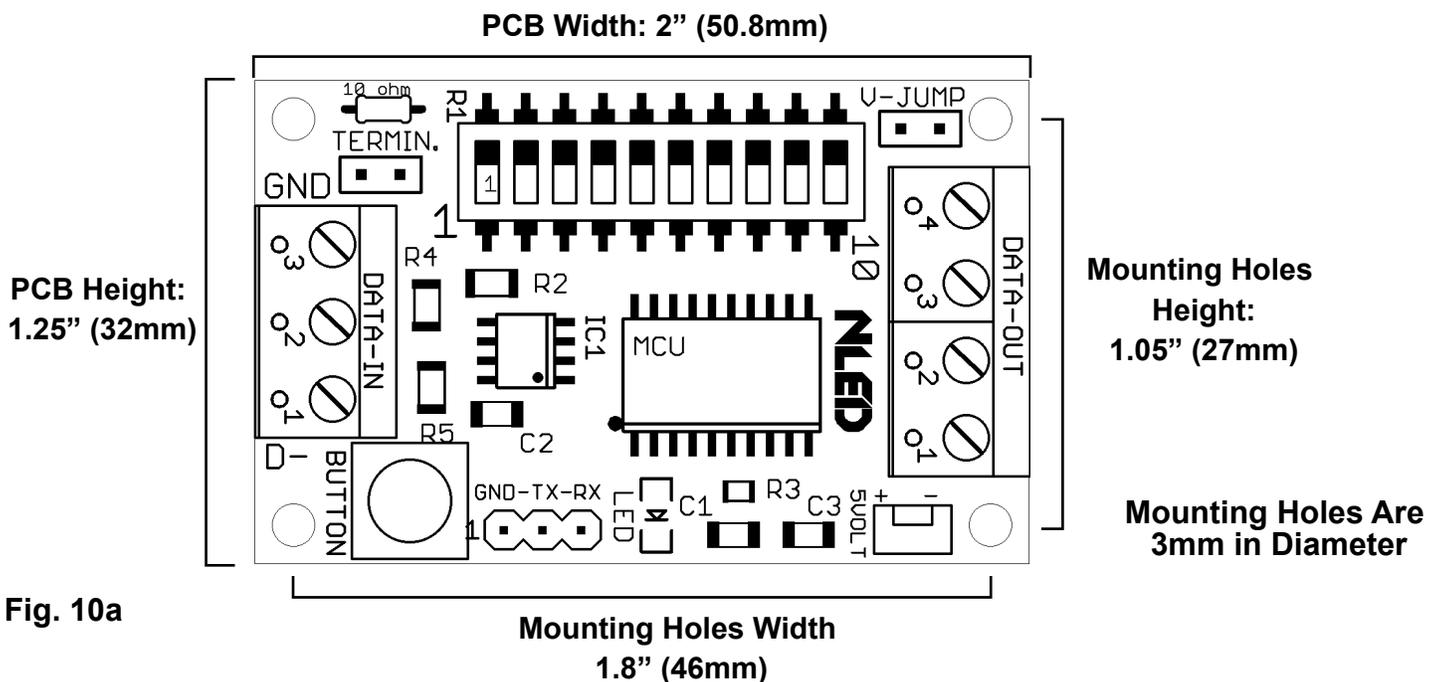


Fig. 10a

Pluggable Screw Terminal Option

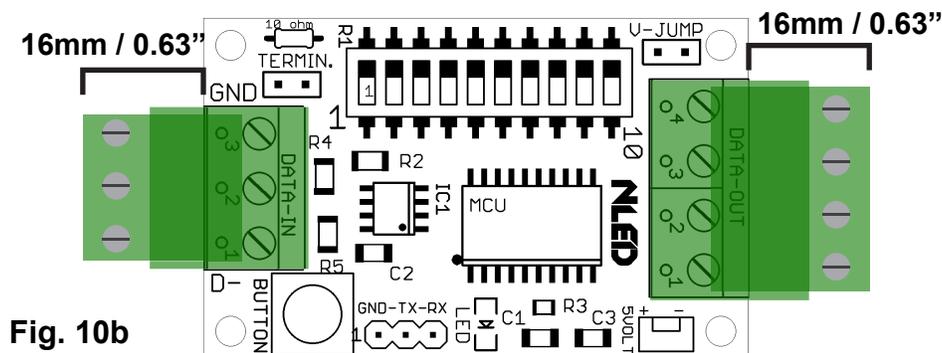


Fig. 10b

Mounting Notes:

Do not allow the PCB to touch anything conductive.

Do not allow foreign material to fall onto or accumulate on the device.

The device should be kept dry and clean. If the device becomes wet or dirty, do not use until it is cleaned and dried. Contact Us for assistance.

Controller Setup(Continued)

Setup:

1. Decide if you will need to install the V-JUMP. If your pixel voltage is 5 volts, install a jumper in V-JUMP. If your pixels/power supply is greater than 12 volts DO NOT INSTALL V-JUMP, leave open.
2. If the pixel chipset and/or any other configurations need to be configured, follow the instructions on page 2 and 3 for details on connecting to software.
3. For testing purposes, it is recommended that Test Mode be ran first as described below before attempting data control to ensure your pixels are connected properly.

DMX Usage:

1. With the power off, set DIP10 low, and set DIP1-DIP9 with the starting DMX address.
2. If the controller will be the only device on the network, install the jumper on the pin header TERMIN. This terminates the DMX signal preventing interference(reflections)
3. Connect to the DMX network using the 3-position terminal, GND, D+, D- . A 3-pin or 5-pin XLR is commonly used.
4. Power up the controller.
5. The controller should start receiving the DMX data starting at the configured DMX Address. The activity LED will flash indicating the controller is receiving valid DMX data. The flash speed indicates packet rate.

Serial Control Usage:

1. With the power off. Set DIP10 high, and set DIP1-DIP5 to the baud rate ID number in binary.
2. If using TTL serial, connect your serial adapter to GND and RX(that is TX from the adapter to RX on the controller.) Note TX on the controller side is only used for DMX Adapter Mode.
2. If using differential(RS485) connect the transmitter to the controller's DATA-IN terminal via GND, D-, D+
3. Power up the controller.
4. Start transmission from transmitting serial device, at the configured baud rate.
5. The activity LED will blink indicating it has latched a data packet Once data has been sent.

Selecting The Chipset and Testing The Pixels:

1. Disconnect Power.
2. Set DIP10 to high. Other DIP switches can be in any state. See Page 3 under TEST mode.
3. Power up the controller while holding down the button.
4. After it powers up the activity LED will turn on. and start to blink slowly. At about 2hz.
5. If it does not ensure the controller is getting suitable power as and V-JUMP has been configured.
6. Connect the pixel strand and power it up.
7. Press the button and release to change to the next pixel chipset, if it blinks/strobes/erratic, keep pressing til the pattern is Off-Red-Yellow-Green-Teal-Blue-Purple-White->repeat
 - a. If it blinks/strobes erratically it may either DAT and CLK are swapped, or the chipset is not configured does not match the chipset that is connected.
8. Once the correct chipset has been selected using the button, and the color order is correct. Press and hold the button until the activity LED turns on, that indicates it has saved the chipset to memory.
9. The controller is now ready to use. Power down the controller and set it up for whatever data mode is going to be used.

Controller Setup(Continued)

DMX Decoder Mode:

SETUP: By default it outputs 170 bytes/channels of DMX data when collected, using the software and configurations this number can be set from 1 - 255. If a whole universe is required, a configuration can be set through software to send out the whole universe(or up to). And if a starting address that requires DIP9 is needed there is another configuration setting that needs to be set through software.

1. With the power off, set DIP10 and DIP9 high.(DIP9 may not need to be set, see configurations)
2. Connect the receiving serial device to GND-TX-RX header, making sure to cross TX and RX. See page 5. Or if using SPI, connect your receiving SPI device to the DATA-OUT terminal. Via CLK and DAT.
3. Set DIP1-DIP8 to the DMX starting address. If the configuration is set, DIP9 can also be used.
4. Power up the controller and apply a DMX signal to be decoded.
5. The controller should then start sending out the decoded DMX data over serial and SPI, the activity LED blinks to indicate a packet has been collected.

Common Issues and Troubleshooting

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. Try to cycle through the Sequences or modes using the button. And ensure you have selected the correct pixel chipset.

Problem: Device connected, LEDs are strobing or not working

Ensure you have selected then uploaded the correct Pixel Chipset configuration setting. Double check CLK and DAT aren't switched(if applicable)

Problem: Device appears to be "bricked", unresponsive to user inputs and/or communication

Attempt to upload a new firmware image via the Bootloader, see page xx for details.

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

Have Any Ideas for Future Updates

Northern Lights Electronic Design, LLC is constantly looking to make our products better and improve upon our designs. If you have any ideas for future products, updates to current products, or features that you would find useful, please Contact Us at Sales@NLEDshop.com. There is a good chance your ideas could be utilized, you could also receive coupons or free items for your feedback.

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