

**SpectraDrive16™ Three-Channel LED
Controller**

With Serial Interface

I Product Safety



The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of un-insulated dangerous voltage within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

CAUTION: NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

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1 Introduction

Congratulations on your purchase of the NuLEDs SPECTRADRIVE16 LED Controller. The SPECTRADRIVE16 was designed to provide intensity control of LED lighting in architectural spaces. The SPECTRADRIVE16 can control 3 separate single color, constant voltage, LED lighting zones (e.g. LumiFlex™ or MiniCans™) simultaneously. It will also control all NuLEDs RGB LED (SpectraFlex™, SpectraChips™) lighting components and many other common anode RGB components with regulated input voltages between 6 and 24 volts.

The SPECTRADRIVE16 is specifically designed to control constant-voltage LED. This document covers constant voltage usage. With some modification at the factory, the SPECTRADRIVE16 can also be supplied as a logic level PFM controller to control power supplies and drivers with a PWM input. Results will vary with the ability of the supply or driver to respond to the signal.

The SPECTRADRIVE16 will **not** work on integrated lamp replacements with built-in AC to DC power conversion.

1.1 Technology

The SPECTRADRIVE16 has smooth, flicker free, scene fades and a special logarithmic algorithm for more accurate color matching of eight-bit (256 level) RGB values. Scene definition and control are easily accomplished by interfacing with any computer or automation system that can generate ASCII code packets at 9600 baud through an RS232 serial port. Up to 15 SPECTRADRIVE16 controllers can be daisy-chained on a single RS232 line. The SPECTRADRIVE16 is a receive-only device. There is no feedback to the computer or automation system.

The technology of the SPECTRADRIVE16 represents a departure from the LED lighting controls systems such as DMX where large volumes of streaming data at very high baud rates are used. Instead, much of the processing power is delegated to the SPECTRADRIVE16 and simple, unitary command strings from an automation system can create complex lighting scenes over stable, low-baud-rate networks.

1.2 Features

Each SPECTRADRIVE16 comes with a predefined looping color sequence that is invoked and operated manually by buttons or by serial string. The SPECTRADRIVE16 has a series of 8 dipswitches. The first 4 determine the address of the controller, 5 and 6 determine the mode (standard color changing, all white, sunrise/sunset, or color morphing) switch 7 determines if the lights come on when powered up, and switch 8 is the terminator for the end device on a bank of controllers. The looping color sequence is installed at the factory and cannot be changed in the field. Note: Colors defined in the table have been tested with NuLEDs SpectraFlex and SpectraChip RGB components. Other RGB components may have unexpected color response due to differences in their LEDs and construction.

The SPECTRADRIVE16 is intended to be wall mounted and can be installed in a standard single-gang low-voltage electrical box (separate from any AC line voltage wiring) and is operated with only two buttons or serial connection. The power supply is separate and should be specifically matched to the LED system it is driving. NuLEDs can provide the proper power supply and control for just about any non-integral LED system.

2 Overview

The following documentation will guide an installer through simple setup, operation, and control of the SPECTRADRIVE16 LED Controller.

Please read through the entire document prior to connecting, installing, or programming the SPECTRADRIVE16.

Should any questions arise during the installation or programming, please contact NuLEDs technical support.

2.1 Contacting Technical Support

Website	http://www.nuleds.com	
Phone	760.931.2550/760.707.5611	9am to 5pm PST Monday thru Friday
Fax	760.931.2574	Please allow 24hrs for Reply
Email	support@nuleds.com	Please allow 24hrs for Reply

2.2 Before you Begin

Before installing or connecting the SPECTRADRIVE16 controller, please make sure that the system is properly designed. This will ensure that all proper connections are made and the controller is ready for use once the system is installed. The following steps will act as a guideline in creating a robust LED lighting system. NuLEDs support can help with planning and implementation. The possibilities are endless.

- Determine the lighting requirements for the space. Determine the locations and types of LED components to be used. Are there specific colors or multi-zone scenes envisioned?
- Determine power, cabling and control requirements to achieve the desired lighting effects. Power draw and distance between supply and load will determine gage and length of power cable. Distance from the automation system to the SPECTRADRIVE16 will affect how the data cabling will be specified. Some additional components may be necessary.
- Determine the user interface for the automation system. Refer to the automation system's documentation for connection as well as an understanding of the programming protocol.

2.3 Items to Have Available:

- SPECTRADRIVE16 Controller(s)
- LED Lighting components
- Power Supplies, Cabling (power and data), Connections, etc.
- Automation System or PC (optional)
- Operations Manual for the Automation System
- Programming Document for the Automation System (if used)
- Tools such a control screw driver and wire strippers

2.4 Firmware Revision

The information contained in this document is intended for SPECTRADRIVE16 controllers with the latest version of firmware. Please verify that you have the latest version of firmware for each SPECTRADRIVE16 controller in the system. Firmware revisions must be made at NuLEDs. Contact technical support.



Improper connection of electronic components can cause permanent damage and/or create a safety risk. Please read this document carefully.. In the event that you are still unsure, STOP and contact nuLEDS technical support.



Electrical currents can cause serious injury; AC connection to the power supply should ONLY be performed by a qualified electrician.

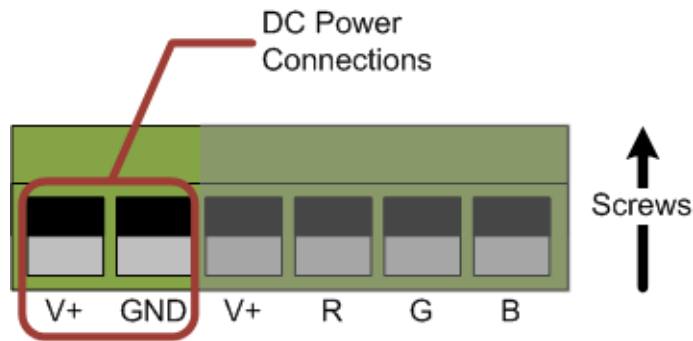
3.1 Mounting the SPECTRADRIVE16

The SPECTRADRIVE16 is intended to be wall mounted and can be installed in a standard single-gang low-voltage electrical box (separate from any AC line voltage wiring) and is operated with only two buttons or serial connection. Power supply is separate and should be specifically matched to the LED system it is driving. NuLEDs can provide the proper power supply and control for just about any non-integral LED system.

3.2 Connecting the SPECTRADRIVE16

3.2.1 Power Connection

Power for the SPECTRADRIVE16 controller is supplied via a 6-24 volt DC power supply to V+ and GND connections on the 6 position screw terminal. This supply is typically the same constant-voltage supply as the LED system. When more than one power supply is used for the LED system (see later sections) only one connection needs to be made to power the controller.



V+ Positive Voltage NuLEDs LED Standard: Red Wire from Power Supply

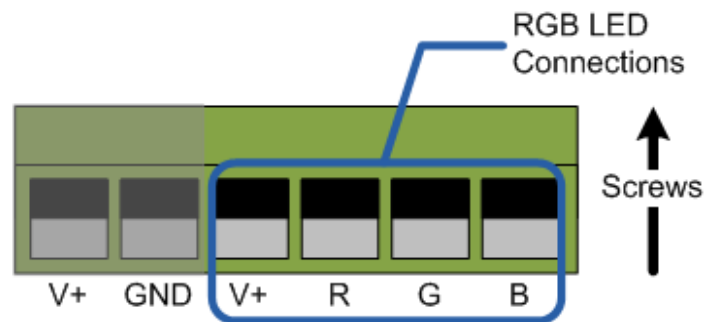
GND Negative Ground NuLEDs LED Standard: Black Wire from Power Supply

3.2.2 Simple LED Connections

This section covers smaller systems with an LED load under 5 amps. This is the simplest and most widely used configuration as all connections are made on the controller circuit board. In this configuration, V+ from the constant-voltage power supply connects through the controller circuit board to the V+ out to the LED system anode via a copper trace thus limiting the amount of current in the system. See later section or contact NuLEDs support for systems larger than 5 amps. Common-anode RGB LED systems like the NuLEDs SpectraFlex and SpectraChips or iFlex30 utilize a 4 wire connection. This consists of an anode connection (V+) and cathode connections (R,G,B) for the individual color channels. NuLEDs supplied wiring will conform to the standard wire insulation colors listed in the tables. Other manufacturers may have different color standards.

Alternatively, three separate single-color “zones” can be connected by connecting all of their anodes to V+ and the cathodes of the modules connected to R, G, or B zones as required for control of lighting scenes. In this case the R,G and B terminals are the three single color channels.

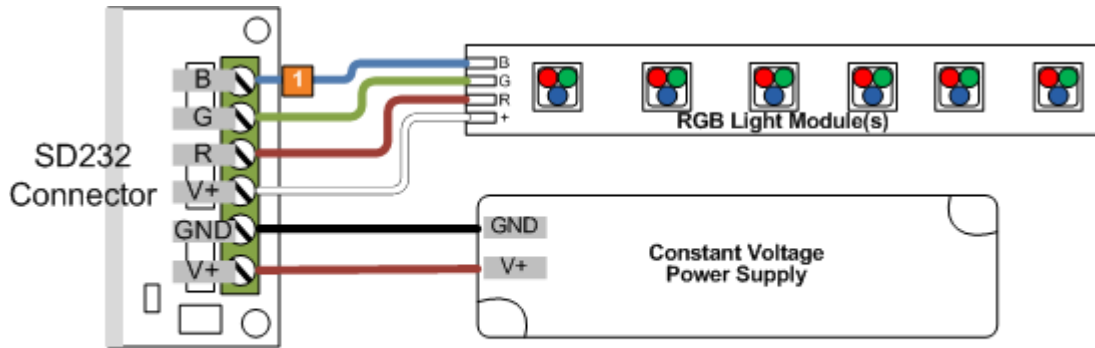
Please note that the following diagrams are but a small sampling of the possible configurations.



V+	Positive Voltage	NuLEDs LED Standard: White Wire
R	Red Channel	NuLEDs LED Standard: Red Wire
G	Green Channel	NuLEDs LED Standard: Green Wire
B	Blue Channel	NuLEDs LED Standard: Black Wire

3.3 System Configurations

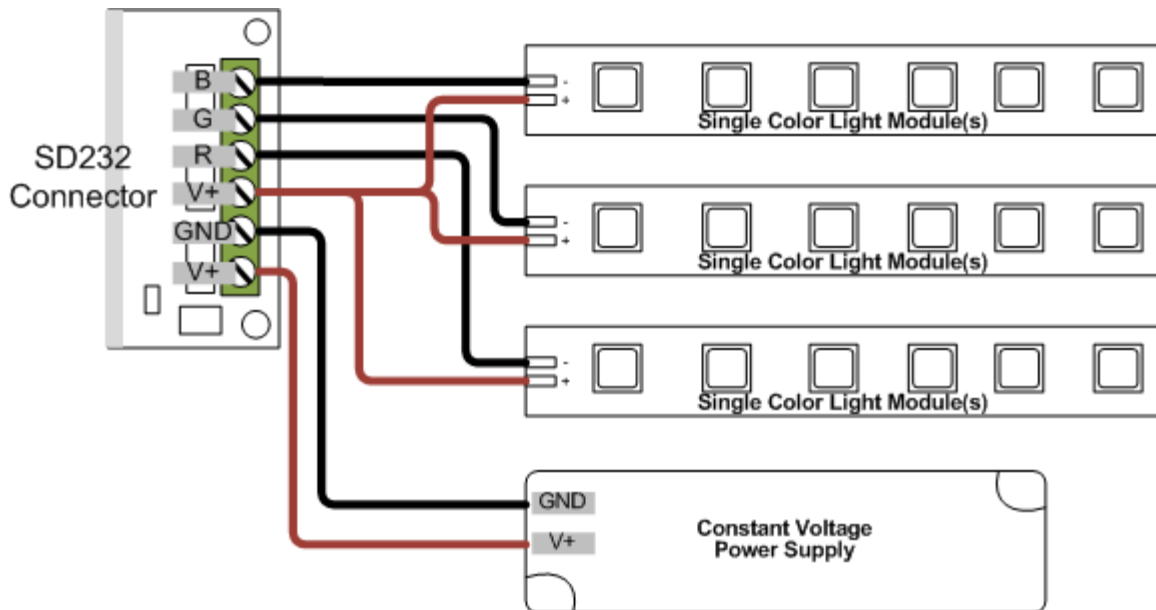
3.3.1 RGB – Single Power Supply



1 Blue connection wire is BLACK on NuLEDs RGB Light Module(s)

V+	Positive Voltage	NuLEDs LED Standard: White Wire
R	Red Channel	NuLEDs LED Standard: Red Wire
G	Green Channel	NuLEDs LED Standard: Green Wire
B	Blue Channel	NuLEDs LED Standard: Black Wire

3.3.2 Single- Color 3 Zone – Single Power Supply



V+	Positive Voltage (anode)	NuLEDs Standard: Red or White Wire
R	R Channel (cathode)	NuLEDs Standard: Black Wire
G	G Channel (cathode)	NuLEDs Standard: Black Wire
B	B Channel (cathode)	NuLEDs Standard: Black Wire

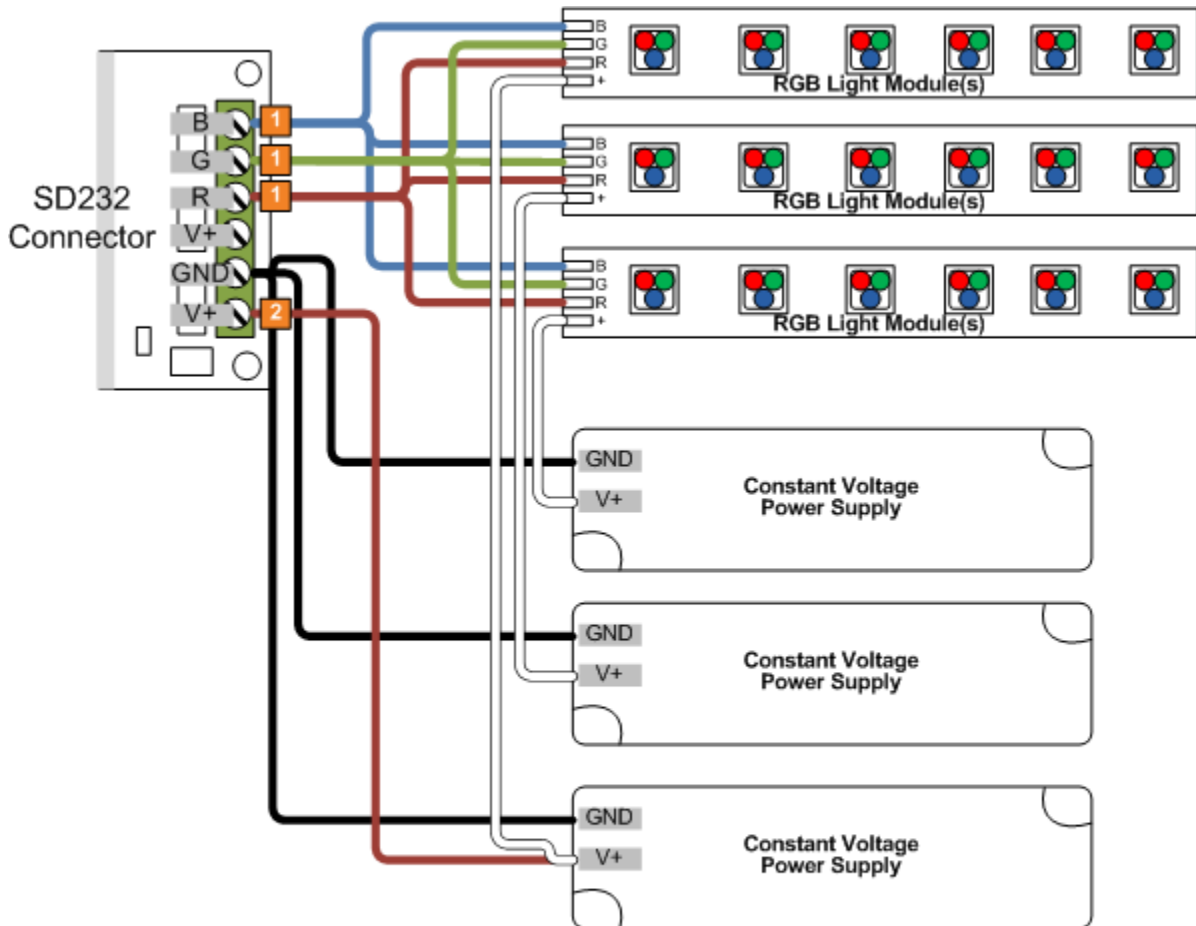
3.3.3 Multiple Configurations

Power Supplies can be used in multiple configurations with the SPECTRADRIVE16 module. Each configuration is based on the requirements of the installation. As noted earlier, having the installation planned out in advance is advised in order to avoid damage to components or injury. Call NuLEDs support with questions.

The maximum current for the SPECTRADRIVE16 module is 15Amps (5 amps per channel) please keep this in mind when designing a system with the SPECTRADRIVE16. If more power is required, additional controllers can be used.

3.3.4 RGB – Multiple Power Supplies

Multiple configurations are possible. The following schematic is just an example.

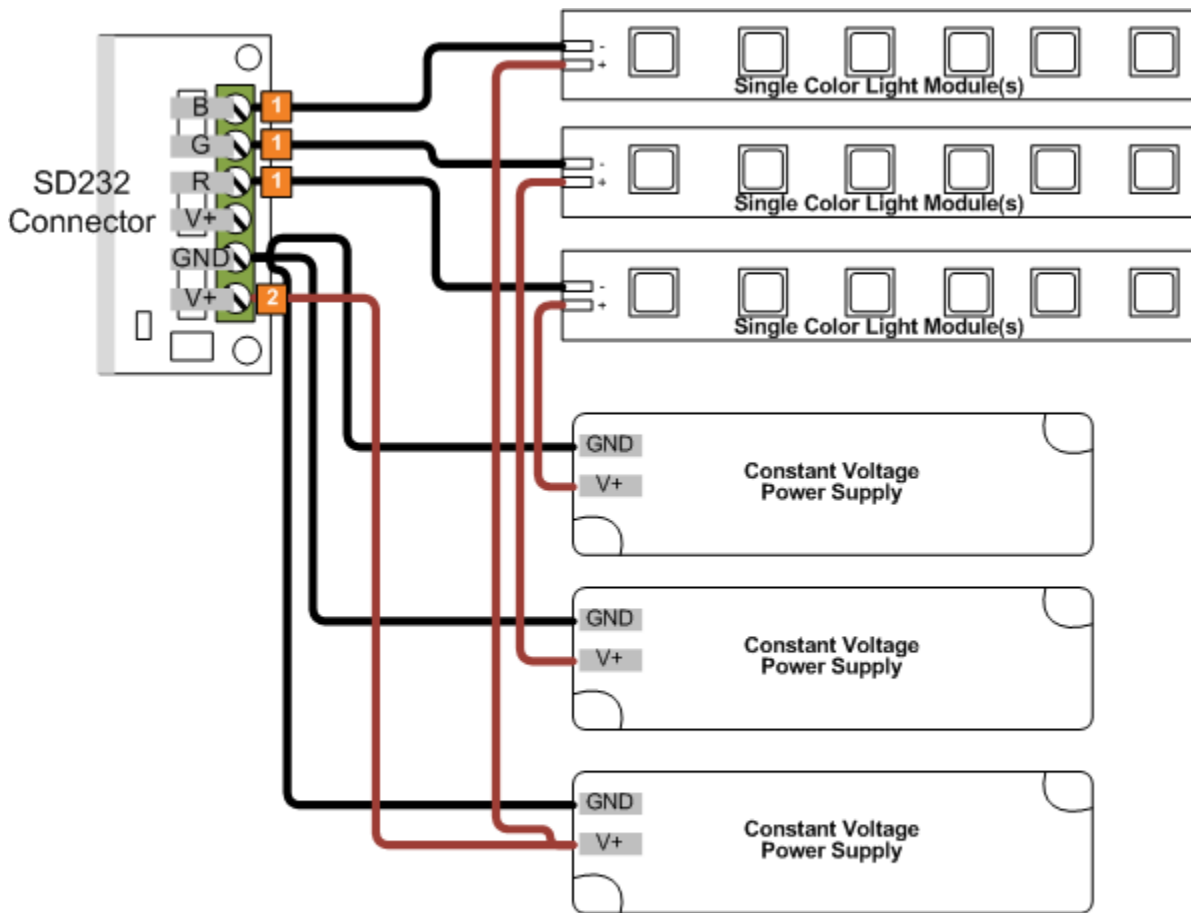


1 Max 5 amps per channel

2 SD232 is powered by only 1 of the multiple supplies

V+	Positive Voltage	NuLEDs LED Standard: White Wire
R	Red Channel	NuLEDs LED Standard: Red Wire
G	Green Channel	NuLEDs LED Standard: Green Wire
B	Blue Channel	NuLEDs LED Standard: Black Wire

3.3.5 Single-Color 3 Zone – Multiple Power Supplies



1 Max 5 amps per channel

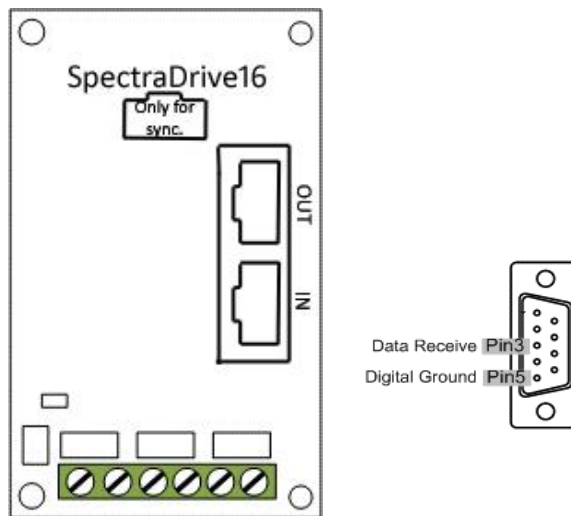
2 SD232 is powered by only 1 of the multiple supplies

V+	Positive Voltage (anode)	NuLEDs Standard: Red or White Wire
R	R Channel (cathode)	NuLEDs Standard: Black Wire
G	G Channel (cathode)	NuLEDs Standard: Black Wire
B	B Channel (cathode)	NuLEDs Standard: Black Wire

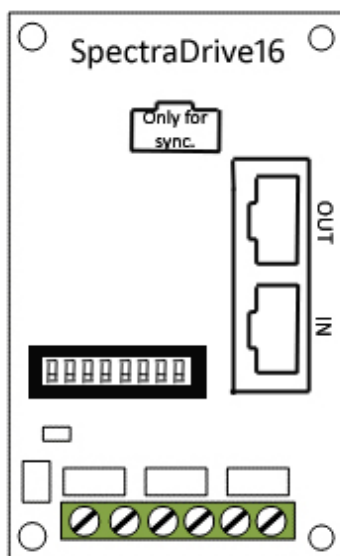
3.4 SPECTRADRIVE16 Automation System Connections

Serial control of the SPECTRADRIVE16 is via RS232 serial connection with a female RJ45 to socket marked 'in'. This allows a PC or automation system to send simple commands to the SPECTRADRIVE16 to create complex lighting scenes. Up to 15 individual addresses (individual SPECTRADRIVE16 controllers) can be controlled with one RS232 serial line. Simply daisy chain Cat5 jumpers out-to-in, and turn on dip switch 8 on the last switch in the series.

Connection from the automation system may vary so please consult your automation systems manual for information on connection type and pin configuration. Cabling and signal integrity are the responsibility of the installer.



For Serial outputs



3.5 SPECTRADRIVE16 Dipswitch Settings

1-4

Address

When multiple addresses are used, a four position dip switch assigns a unique address to each SPECTRADRIVE16. Addresses are binary. When a switch is "On", its bit is 0 (zero). "Off" is 1 (one). Switch 1 is the least significant bit

5-6

Designate program (see spread sheet)

7

Power-on state

8

Terminator



ON

This Represents the DipSwitch in the On Position.

Address	Binary	DipSwitch Setting
A0	0000	
A1	0001	
A2	0010	
A3	0011	
A4	0100	
A5	0101	
A6	0110	
A7	0111	

Address	Binary	DipSwitch Setting
A8	1000	
A9	1001	
A10	1010	
A11	1011	
A12	1100	
A13	1101	
A14	1110	
A15	1111	

4 Operation

4.1 Manual Operation

Manual operation of the SPECTRADRIVE16 has been simplified to two buttons. The unit will come loaded with a predefined sequence of

4.1.1 Button Operation

Button 1 is the top button (when the text on the controller circuit board is readable with the cover removed).
Button 2 is the bottom button.

4.1.2 Loop Mode/Freeze Mode

See spread sheet

4.1.3 Standard Loop Color Sequence (for NuLEDs RGB Components)

Red Level	Green Level	Blue Level	Fade Time (sec)	Hold Time (sec)	Description
255	255	255	1	2	Ice Cool white
255	255	150	1	2	White
255	255	110	1	2	Warm White
255	255	70	1	2	Ultra Warm White
255	255	0	3	3	Yellow
127	255	0	3	3	Yellowish Green
0	255	0	3	3	Green
0	255	127	3	3	Bluish Green
0	255	255	3	3	Cyan
0	127	255	3	3	Greenish Blue
0	0	255	3	3	Blue
127	0	255	3	3	Purple
255	0	255	3	3	Fuscia
255	0	127	3	3	Hot Pink
255	0	0	3	3	Red
255	127	0	3	3	Orange

4.2 Serial Operation

4.2.1 SPECTRADRIVE16 Communication Format

The SPECTRADRIVE16 Module receives commands from many automation systems and PCs via a female RJ45 RS232 connection. This section outlines the requirements for control of the SPECTRADRIVE16 module.

Format: ASCII string

Baud rate: 9600

Data bits:8

Parity: None

Stop bit: 1

The controller requires a 1ms delay between each byte, setting the stop bit to 2 may help to facilitate the 1ms delay should an issue occur when set to 1ms.

4.2.2 Command Structure

The technology of the SPECTRADRIVE16 represents a departure from the LED lighting controls systems such as DMX where large volumes of streaming data at very high baud rates are used. Instead, the processing power is delegated to the SPECTRADRIVE16 and simple, unitary command strings from an automation system can create complex lighting scenes over stable, low-baud-rate networks.

The ASCII strings consist of parameters that are parsed and stored in registers (memory locations) in the SPECTRADRIVE16 and then acted upon independently when a carriage return is detected. The address parameter is not stored in a register but is assigned by the user by setting a four-position DIP switch. Up to 15 different addresses are possible on a single RS232 line.

When a command string is sent, the SPECTRADRIVE16 “listens” for its address and only loads parameters that follow its own address. It will continue loading allowable parameters until a different address is sent, in which case, it will ignore data and continue listening. Address zero (A0) is special in that all SPECTRADRIVE16 controllers receiving a zero (A0) address will load parameters that follow. If the DIP switches on an SPECTRADRIVE16 are set to A0, it will load all parameters intended for all other addresses. Once a parameter is loaded, it stays in the register until it is changed or power is lost.

The following tables list allowable parameters and their ranges. The extended parameters are typically single-action parameters and will be sent separately in their own string.

Note: Most automation systems have their own unique ways of sending a carriage return. Some systems have multiple types of carriage returns. It is up to the installer to discover the correct carriage return that will work with the SPECTRADRIVE16.

4.2.2.1 Allowable parameters and their ranges

Identifier	Description	Min	Max
A	Address of SPECTRADRIVE16 Controller to receive	0	15
R	Intensity of R Channel (red)	0	255
G	Intensity of G Channel (green)	0	255
B	Intensity of B Channel (blue)	0	255
F	Sets fade time in tenths of seconds (0.1s)	1	255
M	Sets the fade multiplier	1	255
P	Plays the internal color loop	1	1
S	Sets the Dimscale (scales all channels)	0	255
X	See Extended Commands	1	15
<CR>	Carriage Return – Activates Command		

4.2.2.2 Extended Commands

Identifier	Description
X1	Increment the Dimscale (all channels) by 5% of full scale
X2	Decrement the Dimscale (all channels) by 5% of full scale
X3	Increment the R channel by 5% of full scale
X4	Decrement the R channel by 5% of full scale
X5	Increment the G channel by 5% of full scale
X6	Decrement the G channel by 5% of full scale
X7	Increment the B channel by 5% of full scale
X8	Decrement the B channel by 5% of full scale
X9	Activate Freeze Mode (If looping, freeze. Same as pressing button1)
X10	Deactivate Freeze Mode (If frozen, continue loop. Same as pressing button1)
X11	Increment Multiplier (Button2 in loop mode)
X12	Decrement Multiplier
X13	Step to next color in loop
X14	Set “no-break” Dimscale (set Dimscale without stopping fade)
X15	Set “no-break” multiplier (set multiplier without stopping fade)

Sample Strings

All parameters are stored and remain in memory of the controller until changed or power is removed. This includes F (fade time), M (fade multiplier), and S (dimscale) so the user must be cognizant of what parameters are sent. Not resetting the parameters on subsequent commands may lead to unexpected results.

The following is a small sample of command strings for the SPECTRADRIVE16. These are but a few of the many possibilities to create virtually any lighting scene imaginable. With an automation system strings can be invoked by touchpads, sensors, scheduled events, etc.. And by combining sequences of strings in a macro, dynamic lightshows can be realized. The extended (X) commands are especially helpful in allowing the end user to make adjustment to scenes. Please call NuLEDs with any questions.

A0 R255 G255 B255 F30

<CR>

Set the intensity level of the R, G, and B channels to 255 (full on) over 3 seconds.

A0 R0 G0 B0 F20 A1 R210 F40 A2 G65 F60

A0<CR>

Set all intensities of all channels on all addresses to zero (all off) over 2 seconds while simultaneously setting the R channel of Address 1 to 210 over 4 seconds and the G channel of Address 2 to 65 over 6 seconds. The A0 at the end tells all SPECTRADRIVE16s to accept the carriage return (otherwise, only A2 would receive the carriage return).

A3 R255 G125 B62 F100

<CR>

On Address 3, set the R channel to 255, the G channel to 125, and the B channel to 62 over 10 seconds. All other channels of all other addresses remain unchanged.

A0 R0 G0 B0 F255 M255

<CR>

Fade all channels on all addresses to zero in 6502.5 seconds (108 minutes, 22.5 seconds). Don't forget to reset the M value to 1 afterward in a new command line: A0 M1 <CR>.

A0 X3

<CR>

Reduce the intensity level of the R channel on all addresses by 5% of full scale (5% of 255 ~ 13). Use the last fade time stored in each controller.

A0 S217 X14

<CR>

Set the dimscale of all addresses to 85% without stopping the fade or loop (no break).

A1 S255

<CR>

Sets the dimscale of address 1 to 100%. Looping or fading will stop.

Dip Switch Settings

Dip Switch Settings:(wait for buttons released)	Setpoint = 100% M=1								Wait for button push
	DS5 off	DS6 off	DS5 off	DS6 on	DS5 on	DS6 off	DS5 on	DS6 on	D7 on
STATES	ColorLoop (Defined loop)		SunsetLoop (Defined loop)		WhiteState (All Channels simultaneously)		MorphState (Randomized Target Color Selection)		(off- auto on when powered)
pb1 singleclick	If OFF Start ColorLoop with slow rise to setpoint. If ON Toggle loop/freeze		If OFF Start SunsetLoop with slow rise to setpoint. If ON Toggle loop/freeze		If OFF Start Whitestate with slow rise to setpoint If ON slow rise to 100%		If OFF Start MorphState with slow rise to setpoint. If ON Toggle loop/freeze		
pb1 singleclick while pb2	If ON then Loopmode: next multiplier. Freezemode: next color		If ON then Loopmode: next multiplier. Freezemode: next color		No function		If ON then Loopmode: next multiplier. Freezemode: next color		
pb1 doubleclick	If OFF Start ColorLoop Fast rise to 100% not affecting setpoint		If OFF Start SunsetLoop Fast rise to 100% not affecting setpoint		If OFF Start Whitestate Fast rise to 100% not affecting setpoint		If OFF Start MorphState Fast rise to 100% not affecting setpoint		
pb1 doubleclick while pb2	Unassigned buttonevent		Unassigned buttonevent		Unassigned buttonevent		Unassigned buttonevent		
pb1 hold	If OFF Start Colorloop Increase Brightness Release sets setpoint		If OFF Start Sunsetloop Increase Brightness Release sets setpoint		If OFF Start Whitestate Increase brightness. Release sets setpoint		If OFF Start Morphstate Increase Brightness Release sets setpoint		
pb1 hold while pb2	Reset module. Enter Power-Up								
pb1 stophold	Stop Increase brightness Set setpoint		Stop Increase brightness Set setpoint		Stop increase brightness Set setpoint		Stop Increase brightness Set setpoint		

pb2 singleclick Turn off slow				
pb2 singleclick while pb1				
	Unassigned buttonevent	Unassigned buttonevent	Unassigned buttonevent	
pb2 doubleclick Turn off fast				
pb2 doubleclick while pb1 If ON Reset M to 1				
	If ON Reset M to 1	If ON Reset M to 1	If ON Reset M to 1	
pb2 hold Decrease brightness release to stop				
	Decrease brightness. When 0% turn OFF Release sets setpoint	Decrease brightness. When 0% turn OFF Release sets setpoint	Decrease brightness. When 0% turn OFF Release sets setpoint	
pb2 hold while pb1 - Reset module. Enter Power up				

Pin-Out Config:

SpectraDrive(tm) 16

Data Connections (NuLEDs COMBUS)

Dual RJ45 connector (combus_in, combus_out)

pin 1 = combus_out TR- (RS485 wire TxD-/RxD- on all chained boards)

pin 2 = combus_out TR+ (RS485 wire TxD+/RxD+ on all chained boards)

pin 3 = combus_out TTL_TX (TTL output on all chained boards)

pin 4 = combus_out NC

pin 5 = combus_out NC

pin 6 = combus_out TTL_RX (TTL input on all chained boards)

pin 7 = combus_out GND (GND on all chained boards)

pin 8 = combus_out NC

pin 1 = combus_in TR- (RS485 wire TxD-/RxD- on all chained boards)

pin 2 = combus_in TR+ (RS485 wire TxD+/RxD+ on all chained boards)

pin 3 = combus_in TTL_TX (TTL output on all chained boards)

pin 4 = combus_in 232_TX (RS232 output on first board of chain)

pin 5 = combus_in 232_RX (RS232 input on first board of chain)

pin 6 = combus_in TTL_RX (TTL input on all chained boards)

pin 7 = combus_in GND (GND on all chained boards)

pin 8 = combus_in VCC (3.3V output on first board of chain)

Note: Combus_in should not be connected to another combus_in. Vcc on pin8 may be slightly different and create a power conflict. Rule of thumb: OUT connects to IN.

RJ45 to DB9F adapter

(RJ45 side connects to combus_in RJ45 using straight patch cable)

(DB9F side connects to pc comport using straight DB9F/DB9M cable)

wire blue = RJ45 pin 1

wire orange = RJ45 pin 2

wire black = RJ45 pin 3

wire red = RJ45 pin 4 ----> 232_TX (RS232 output) connects to pin 2 of DB9F (red wire)

wire green = RJ45 pin 5 ----> 232_RX (RS232 input) connects to pin 3 of DB9F (green wire)

wire yellow = RJ45 pin 6

wire brown = RJ45 pin 7 ----> GND connects to pin 5 of DB9F (brown wire)

wire white = RJ45 pin 8

nuLEDs

Simplified LED Solutions

NuLEDs SPECTRADRIVE16 Operations Manual

Rev: 1.1

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