Christmas Lighting Basics

Information compiled from:

Colorado Springs presentation

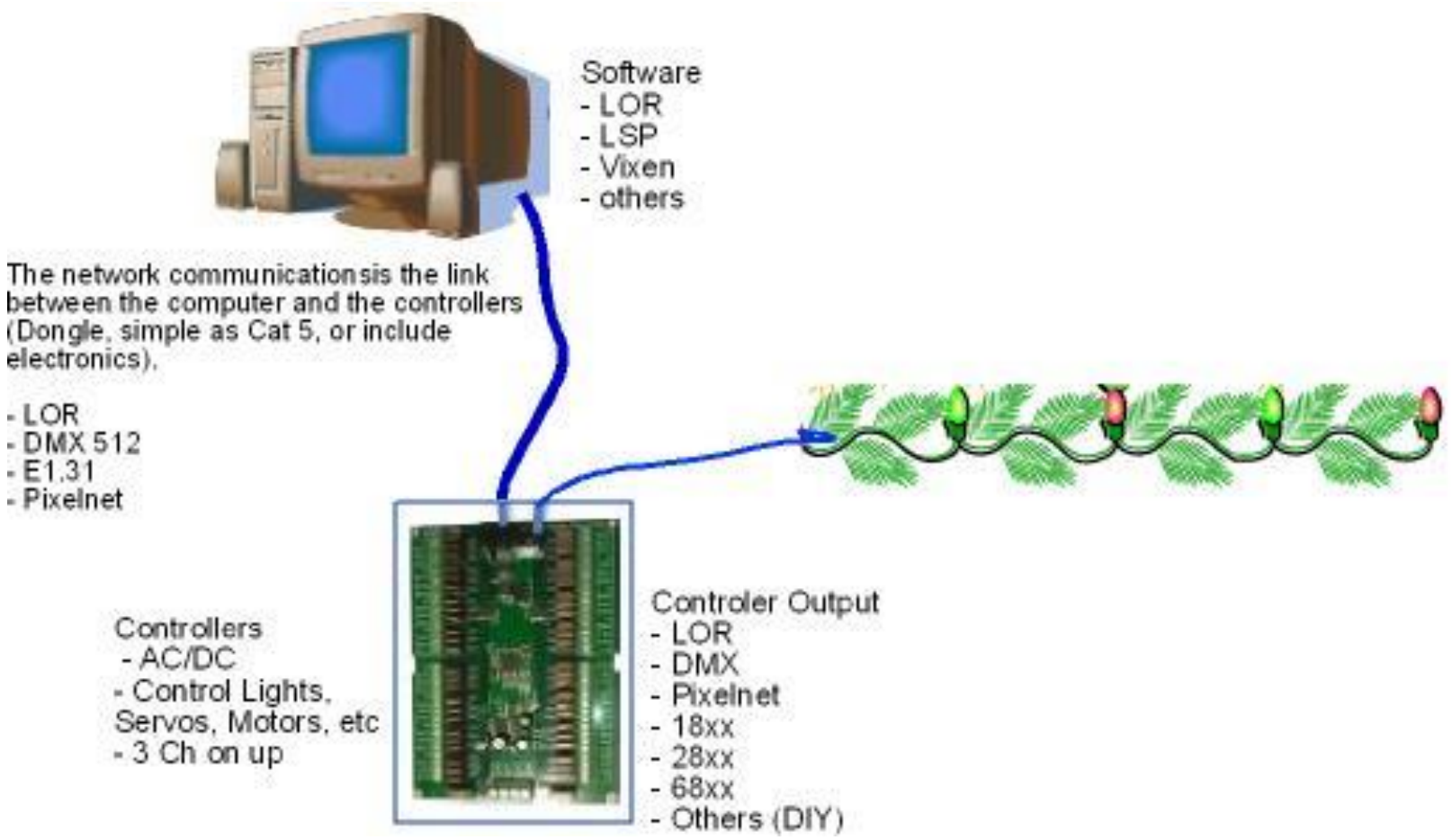
Auschristmaslighting.com

Diylightanimation.com

Building A Christmas Display

- Things have changed…
  - In the way you design with new lighting technology and controllers
  - There is more capability (Ch, Light Count)
  - There is more control
- New Buzz Words
  - Pixels, Nodes, RGB, Smart Pixels, Dumb Pixels, Matrix, SPI, DMX, Universes, E1.31, XML, PoE (Power over Ethernet), Transitions, 3D Projection

Computerized Light Display



Light Choices

- Sizes – mini lights to C9s, flood lights, and beyond
- Color Choices
- Types - Rope, String, Net, Icycles, Flood, etc
- IP Ratings
  - Waterproof Ratings – vary by IP ratings
  - Do your research, as manufactures are the ones giving the ratings
  - Look for lights with a rating of IP65 or higher.

Incandescent

- Mini, C7, C9, Rope, Floods & Spots

Leds

- M5, C6 , C7, C9, Rope, Floods & Spots

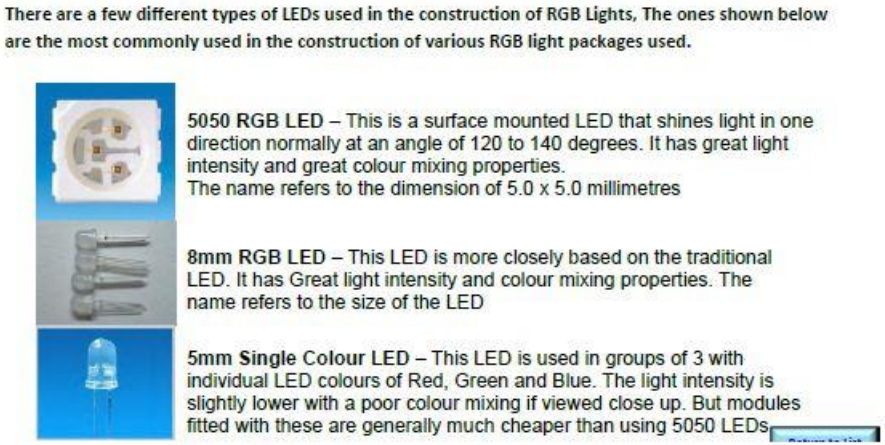
LED Types

LED lights can come in various sizes with different names, generally the larger the number the larger light. The first letter denotes the shape. For example a C6 light would mean that it is candle shaped and 6/8th of an inch in size

5mm M5 C6 C7 C9

LED RGB Lights

- RGB – Red, Green, Blue light used to combine the lights to produce broad array of colors.



Pixel, Nodes, Channels

- Node – is a term that has been used within the hobby to describe an individual light within the string (smart or dumb).
- Pixel is an individual RGB Light/Section that receives both power and data to determine its color and level (as used in light displays)
- RGB is a 3 channels system. For every RGB control you will use 3 channels.

RGB Light Packages

- Strings normally use 8 or 12mm RGB LEDs
- Strips use the 5050 SMD, 3428 SMD
- Floods & Rigid Strips 5mm Single Color (in groups of 3)
-

RGB Light Strings

RGB Strip Light

RGB Modules

RGB Flood/Spot

Strings

RGB Light String Types

There are 2 main types of RGB light packages that are used with RGB light strings that both have advantages and disadvantages.

This is the traditional construction of pixel strings as these were originally designed for the signage industry. Some water ingress issues can happen with the lower IP rated strings if tension is placed on the string as this pulls apart the wires to create a gap. The resin filled IP68 are the best ones to get of these.

This is a newer design but doesn't show the light as well from behind as the traditional string. The advantage to this is that the board is completely encapsulated with resin and the wires come out from the sides, this allows for a very high level of water protection even when the wires have tension as these are rated at IP66 to IP68. They are also easier to mount and face the right direction. It uses the same LED types as well

Modules

RGB Modules

- RGB modules are somewhat like a light string but use multiple LEDs per module in different types of housings.
- RGB modules come in many configurations
- The square and rectangle versions are most the most commonly found and used.
- They are generally 12vdc and come in strings of 20
- Can be used for many things like borders, outlines, matrices, fillers, etc.
- Strong and durable in construction
- Easy to work with and mount
- Modules are directional meaning they only shine light in one direction and give very little wash back light
- Generally IP67

Strips

RGB Strip Light Types

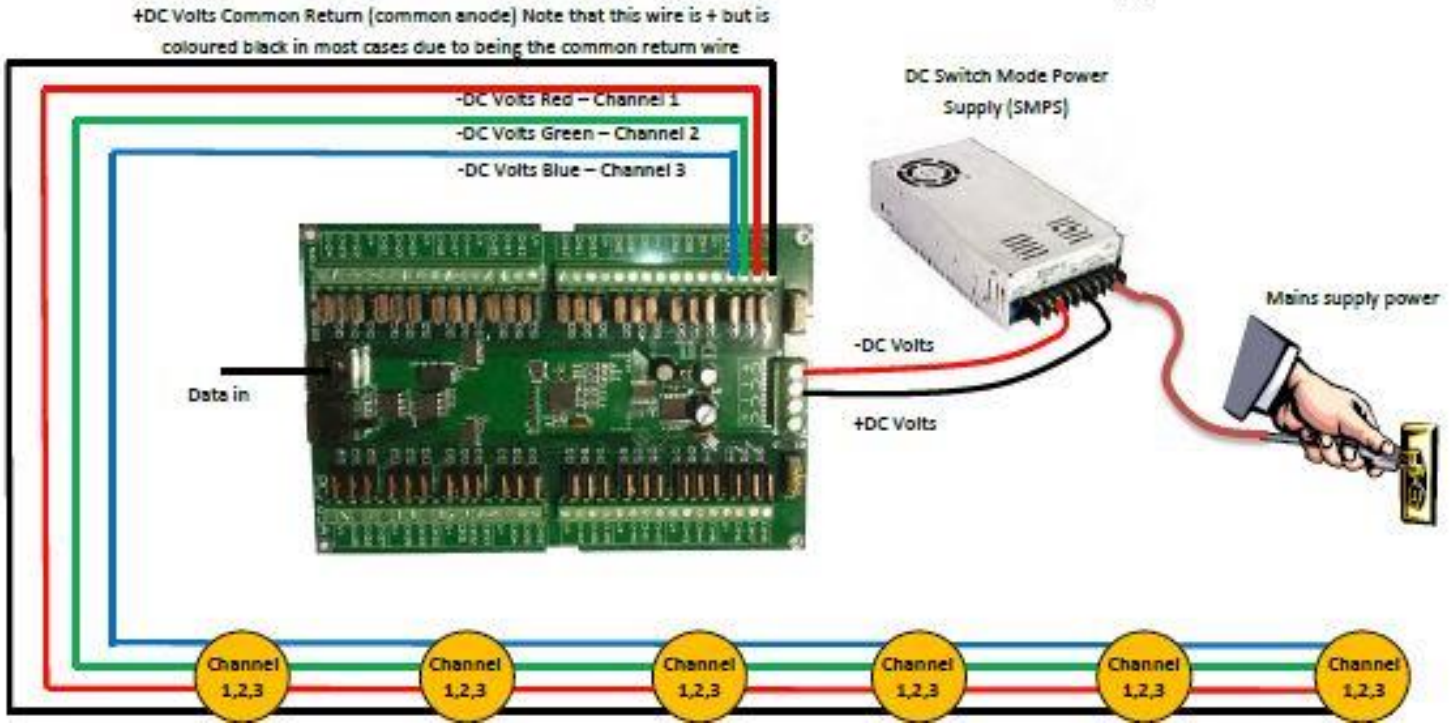
There are a few types of coatings used with strip, with advantages and disadvantages

- No coating
  - Not to be used in outdoor applications
  - Very delicate and easily damaged if bent or handled incorrectly
  - No light diffusion at all
  - Easy to work with and cut
- Silicone tube
  - Generally IP65
  - Delicate and easily damaged if bent or handled incorrectly
  - Moderate light diffusion
  - Easy to work with and cut
- Resin
  - Strong and durable, generally IP65
  - Good light dispersion
  - Easy to moderate to work with and easy to cut
- Solid Silicone
  - Strong and durable, generally IP68
  - Good light dispersion
  - Easy to moderate to work with and easy to cut
- Combination of silicone tube and resin or solid silicone.
  - Has the benefits of both materials

How RGB Works

Dumb RGB lighting is controlled through a low voltage DC controller. It is important to note that only common anode will work with the majority of DC controllers. Common anode is the positive (+) shared return wire with the ground (GND) being switched, this saves on construction costs. Common cathode (-) is not generally used and requires a controller that switches the positive (+) line

The diagram below shows how typical dumb RGB lights are connected up. This is very similar to connecting tradition AC lights but these have 3 wires with a common anode return (+)



Control Standard RGB

- DC Boards
  - Software Specific Protocol using their DC Boards
  - Flavors anywhere from 8 Ch to 48 Ch
  - Use 3 Ch for each RGB color or string.
- DMX Controllers
  - Single 3ch DMX
  - DMX Controllers with multiple channels (up to 512)
  - DMX Universes (groups of DMX512)

DMX Controllers

27 channel DMX LED Controller US$44.21

27 channel, single supply

1 amp per channel, 15 amps total

Single DC input (7V-24VDC)

XLR DMX input, screw terminals

DMX LED Controller US$83.16

24 channel, single supply

1 amps per channel, 24 amps total

Single DC input (8V-24VDC)

Screw terminal DMX input, screw terminals

3 channel DMX LED Controller US$8.95

3 channel, single supply

2 amp per channel, 6 amps total

Single DC input (12V-24VDC)

Screw termial DMX input, screw terminals

DMX512 3 Channel Module US$62.11 for 10

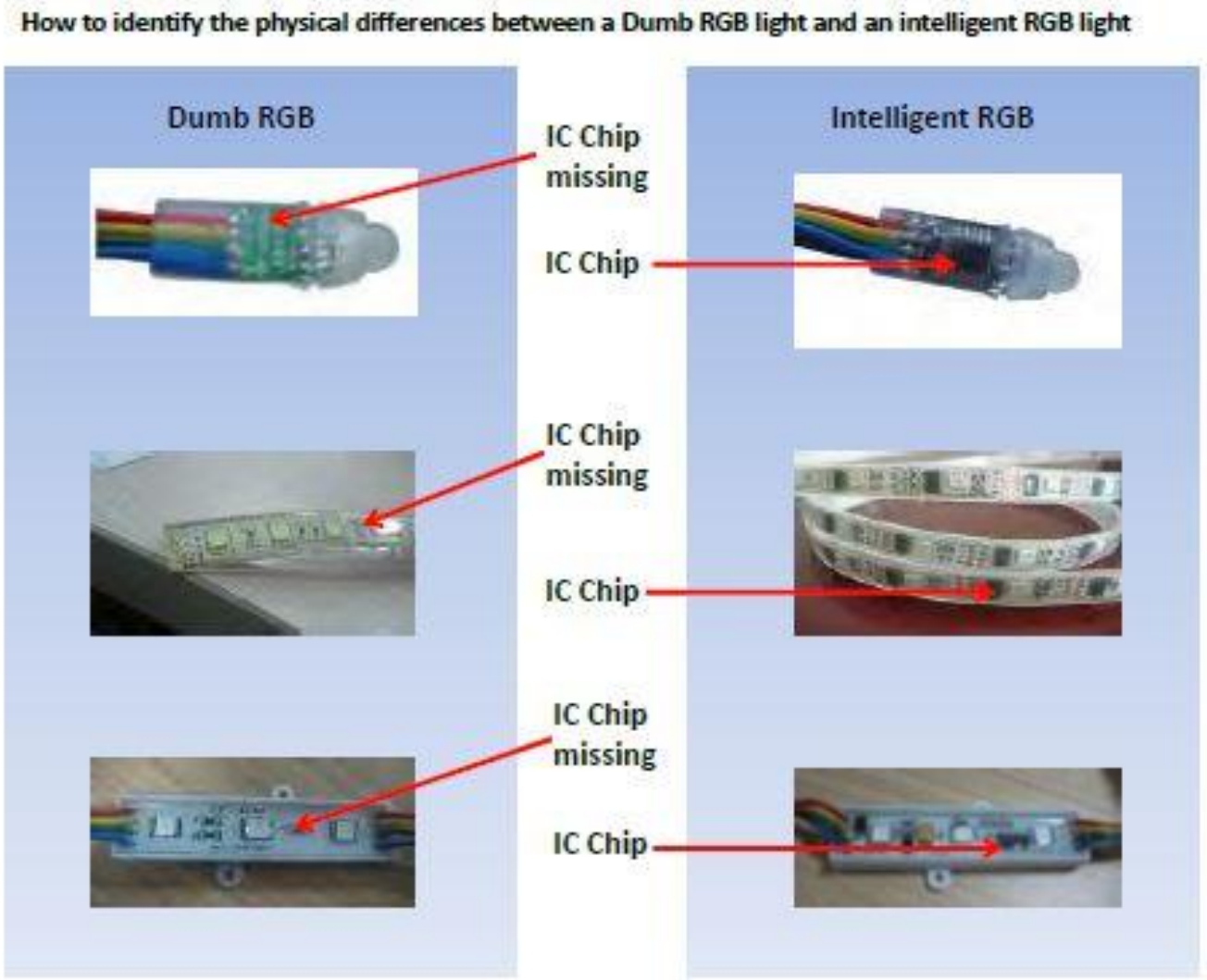
3 channel, single supply

4 amp per channel, 12 amps total

Single DC input (5V or 12V or 24VDC)

Bare wire DMX input, bare wire output.

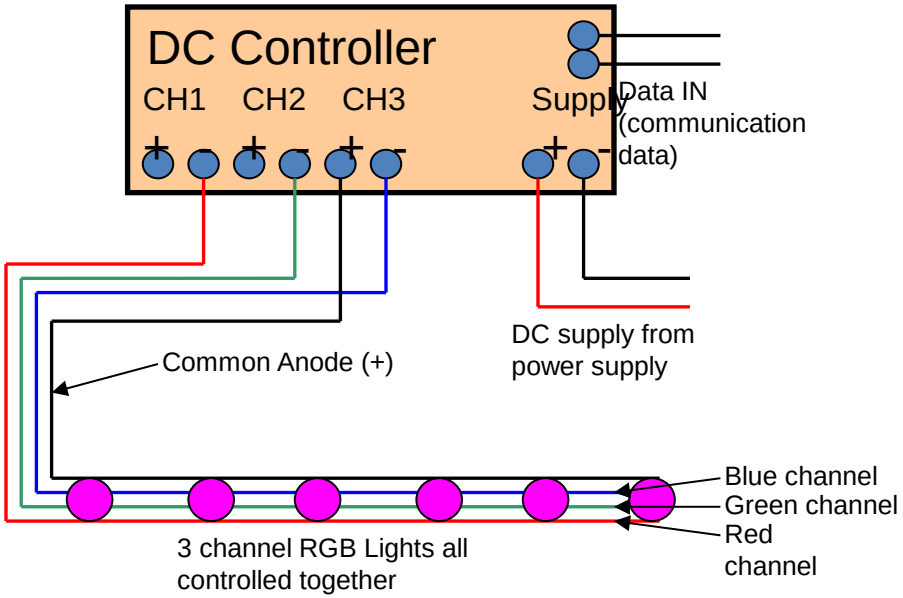
What Makes a Smart RGB Light



Control of RGB

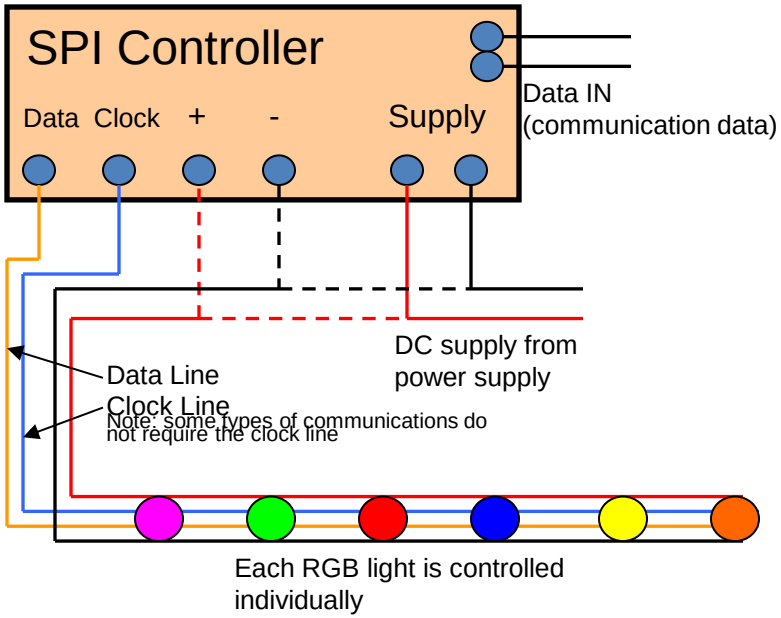
3 Channel DC control

This method of control uses 3 channels to light a length/section of RGB lighting



SPI Data control

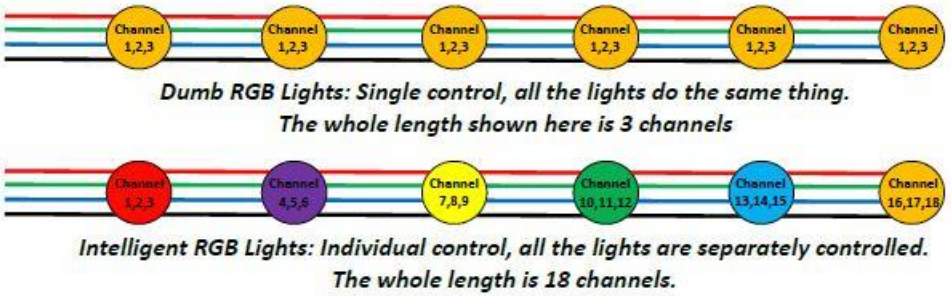
This method of control uses a data stream to communicate to each individual 3 channel RGB light



Std (dumb) vs. Digital (smart)

- Control of lights on the strip, Individual or as a group

The diagram shows below the control difference between the two, dumb RGB light is controlled all together as one and uses only 3 channels for the whole length. The intelligent RGB light is controlled as individual lights/sections.



SPI Digital Light Flavors

- LPD68xx – most popular is 6803 (LOR CCR)
  - 5v, 5bit, 4wire, Constant Current
- TE 1804, 1809 most popular type is US
  - 12v, 8bit, 3 wire Constant Voltage
  - 1812 is a 12bit version
- WS 2801
  - 5v, 8 bit, 4wire Constant Current
  - 2811 is a 12bit version
  - GE Color Effects and TLS 3001 and others
- Others but not as common: 3001IC – 12bit, 3wire, D705, and SD600
- Most have a 12 volt option now

Difference in SPI Bit Count

- Bit count Higher bit count better fading and color control
  - 5 bit: 32 steps per color – total of 4,096 colors
  - 8 bit: 256 steps per color – 16K colors
  - 12 bit: 4,096 steps per color – 68B colors
  - DMX max support is 8 bit so 12 bit sting would work as 8 bit system using DMX. A 12 bit chip will allow for dimming curves to give it better fades.

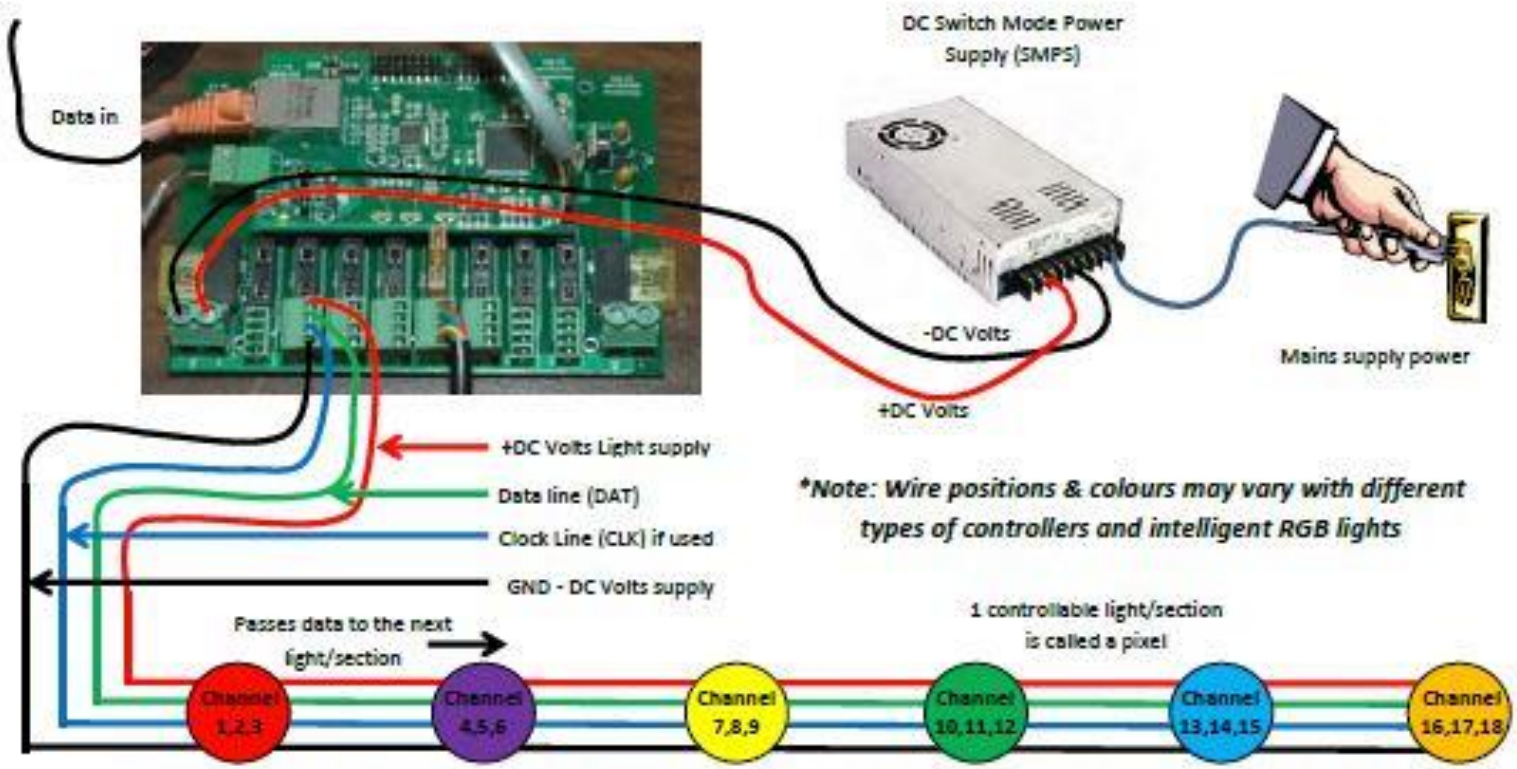
Difference in Voltage

- Constant Current: ensures the correct current is maintained.
- Constant Voltage: ensure the correct voltage is maintained
- 5v vs. 12v: Lower the voltage the better chance for voltage drop. Current requirements are less for 12v as well.

SPI Communications

- Communications must be same on controller as the lights, i.e. can not run 6803 lights with a 2801 controller
- Can not run multiple communications using same wires (most E1.31 and Pixlenet controllers will have a DMX out port)

Typical Digital Light String Setup



Intelligent RGB Lights: Individual control, all the lights are separately controlled. Each light/section is 3 channels. The whole length shown here is 18 channels.

DMX Input Controllers

- Control a few strings at a time. Good for decentralized lighting.

AVD APC718 P-DMX Pixel Controller AU$33.00
75 channel, 25 Pixels
2801, 6801 pixel support
Single DC input (12V-35VDC)
RJ45 DMX input,
screw terminals
Dip switch DMX addressing
Current overload protection
P-DMX enabled
Australian made

LT-DMX 2801 US$38.42
LT-DMX 6803 US$38.95
LT-DMX 3001 US$38.42
512 channel, 170 Pixels
(2801, 2803), (6803), (3001, 3002)
*Pixel support depends on version
Single DC input (5V-24VDC 6803,2801)
Single DC input (12V-24VDC 3001)
XLR DMX input,
screw terminals
Dip switch DMX addressing

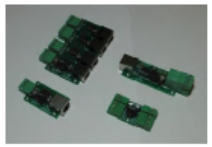
DD-100 6803 DMX US$15.26
DD-100 2801 DMX US$17.89
512, 256, or 128 Channel
(6803), (2801)
*Pixel support depends on version
Single DC input (8V-24VDC)
Bare wire DMX input,
Bare wire output
Non addressable
*These units strip off the DMX channels used and then pass the remaining DMX channels on. 4 x 128 channel controllers can have the DMX stream connected up in series to make up a universe.
These are a cheaply built budget range pixel controller

E 1.31 Controllers

E1.31 Pixel Controller Choice

J1SYS ECG-P12R US$180.00
12 Universes 6144 channels,
2040 Pixels
12 Fused outputs, 6 x 2 banks
2801, 6801, 180x, pixel support
2 x DC input (5V-24VDC, 5VDC)
RJ45 E1.31 input,
Screw terminal plug Outputs
HTML Page hardware setup
Supports Unicast

J1SYS ECG PIXAD8 AU$150.00
8 Universes 4096 channels,
1360 Pixels
8 Fused outputs, 4 x 2 banks
2801, 6801, 180x, pixel support
2 x DC input (5V-24VDC, 5VDC)
RJ45 E1.31 input,
Screw terminal plug Outputs
HTML Page hardware setup
Supports Unicast



J1SYS ECG-PPX Pixel Extender
US$9.00-$25.00
The ECG-PPX is a pixel extender with a driver and receiver board. The PPX will allow the pixel controller to be over 50 metres away from the pixel lights thus allowing many more installation options
There a few pixel extender driver and receiver boards to choose varying in power outputs.

SanDevices E681 Pixel Controller
US$200.00 assembled, US$120.00 Kit
4 Universes 2048 channels , 680 Pixels
16 Fused outputs, 8 x 2 banks
2801, 6801, 880x, 180x, 3001, 3005, 9813, GE Colour effects and 1 wire native DMX pixel support
2 x DC input (7V-24VDC, 5VDC)
RJ45 E1.31 input, Screw terminal plug Outputs
Command based hardware setup
*available as a vendor group buy from time to time at reduced costs from http://www.doityourselfchristmas.com

SanDevices E680 Pixel Controller
US$ N/A assembled, US$ N/A Kit
4 Universes 2048 channels , 680 Pixels
16 non fused outputs, 8 x 2 banks
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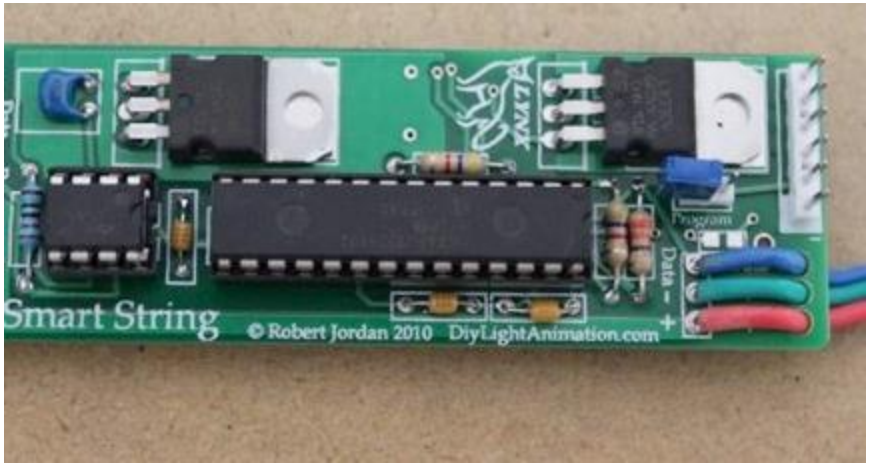
NOTE: The IC of the intelligent RGB lights used must be supported by the pixel controller

Pixelnet Controller

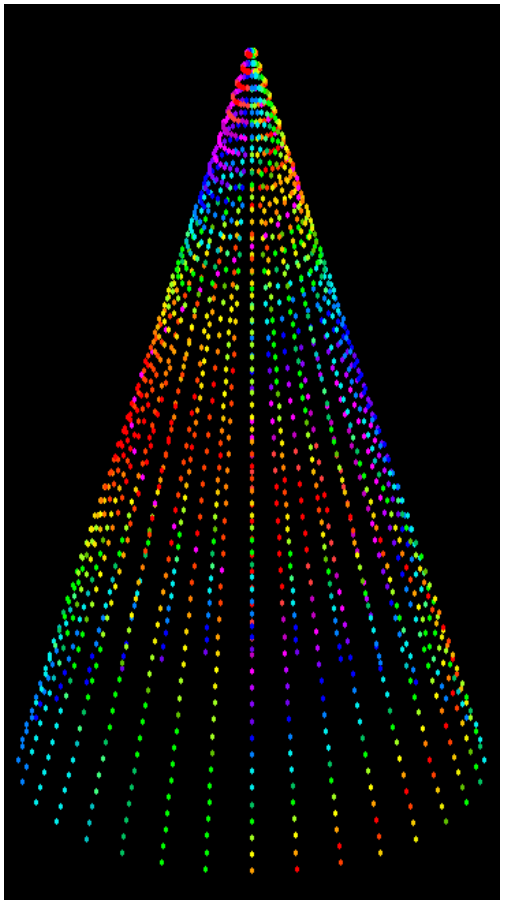


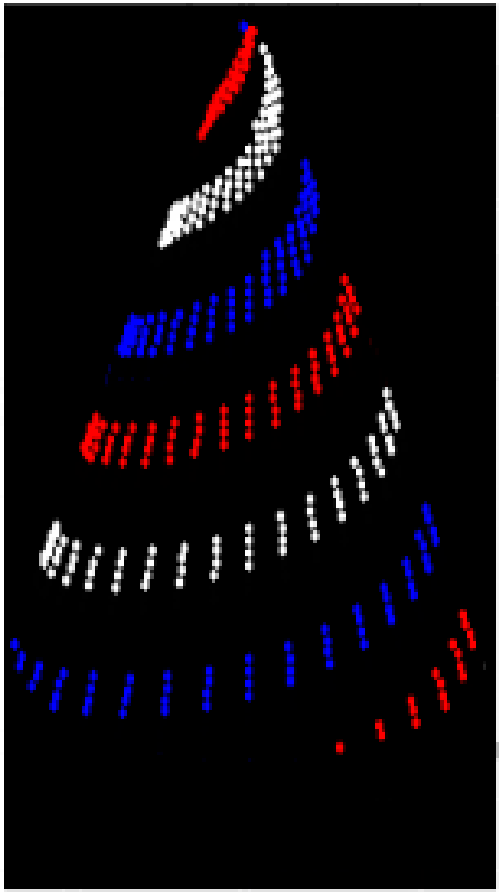
Smart Pixel RGB Chanel Count

- 3 pixels
- 9 Chan (3 pixel x RGB Ch (3)
- String of 20
  - (3 x 20) = 60 Pixels
  - (9 x 20) = 180 channels

- 30 pixel per meter
- 90 Chan (30p x 3 ch) per m
- 5m Length
  - 150 pixels
  - 450 Channels

Sample of Smart Pixels





Connect Lights to Controller

- Standard 4 (or 3) Conductor Wire (Alarm wire, Low Voltage Light Wire, Sprinkler System Wire)
- Stranded vs Solid Core
  - Some only support stranded?
- DMX Cable (3 wire or 5 wire)
- Power Over Ethernet with Cat 5 (Power and Signal)

Controller Location

- AC and DC Wiring
- Centralized or Decentralized
  - Number of Wires or DMX Cables Required
  - Electrical Connections for Power Supplies
  - Length of Cable
    - Voltage Drop, Inject Power
  - Hubs and Passive Hubs

Communicate with Controllers

- Communications interface is the Link between the Computer and the Controllers.
  - LOR (iDMX/CCR Controller take LOR and translates it to DMX/6803)
  - DMX 512 (LOR Cable from RS485 need Blue & Orange Crossed)
  - E1.31 (create separate IP domain for lights)
  - Pixlenet (DoItYourself Christmas JR design) (1.31 to pixlenet via etherdongle)
- Can't mix on Same Wire
- Multiple Dongles

DMX Options

- With Limit of 512 Ch and 32 Controllers, wouldn't take long to outgrow
- DMX Universes Allows multiple 512 groupings
  - Achieved with DMX Splitters (no Y capability)
- E1.31 (E1.33 RDM control)
  - Easier way to create Universes for DMX
  - Supports up to 63,999 Universes (32,767,488 channels)
  - LOR will be releasing 4 and 8 Universe Hubs

Software Choices

- Light-O-Rama (LOR)
- Animated Lighting (AL)
- Light Show Pro (LSP)
- Vixen
- HLS
- Madrix
- XLights

Light-O-Rama

Lightorama S3 software is primarily designed to work with Lightorama controllers, it does also support DMX-512 and X10 when purchasing the Advanced version. For extra features like pixel animation tools and auto sequencing you will require the super star add to be purchased. LOR has also mentioned official support for E1.31 devices to be released

Website: www.lightorama.com

Cost:

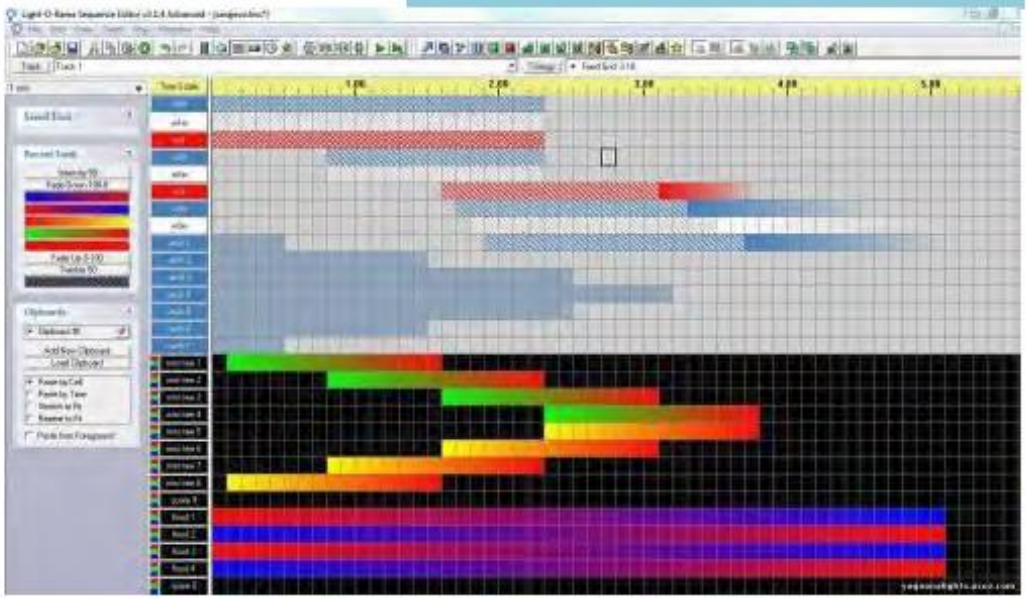
Basic: 2 controller support (32 channels)	- US$49.95
Basic plus: 4 controller support (64 channels)	- US$69.95
Standard: 8 controller support (128 channels)	- US$99.95
Advanced: Unlimited controller support	- US$139.95

Super star add on software for easy sequencing of the Cosmic Color Ribbon (CCR)

2 CCR – 300 channels	- US$45.95
4 CCR – 600 channels	- US$79.95
8 CCR – 1200 channels	- US$149.00
24 CCR – 3600 channels	- US$199.95

Hardware Support:

LOR, DMX-512, X10



LightShow Pro

Lightshow Pro has the most features and support of the 3 software packages, It has many inbuilt tools like a matrix tool, transitions and layers and is the current choice when sequencing large RGB channel sequences.

LSP can even allow you to connect up and control your display using the Wii guitar and drums

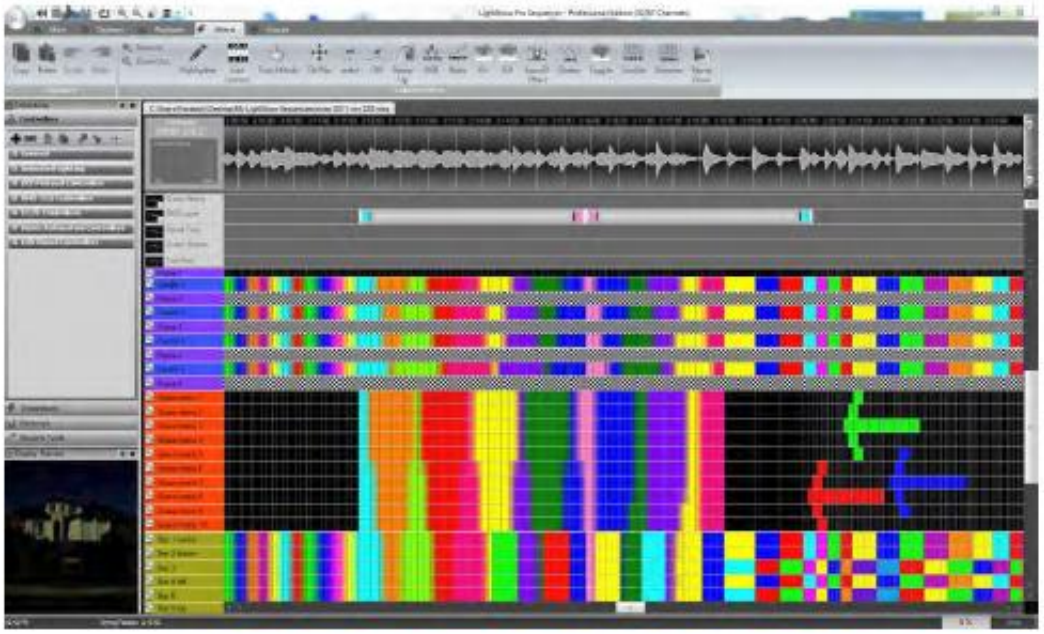
Website: www.lightshowpro.com

Cost:

Basic 512 channel version	- US$99.00
Advanced 8192 channel version	- US$249.00
Professional 32767 channel version	- US$399.00

Hardware Support:

LOR, DMX-512, E1.31, PixelNet, D-Light Enhanced, Active Home, Renard, X10



Vixen

Vixen is a free community based sequencing software package. The current version is not very strong with RGB support compared to LOR and LSP. Vixen is currently going through an upgrade to Vixen 3 that promises to make sequencing of RGB much easier and move away from the traditional sequencing grid.

Website: www.vixenlights.com

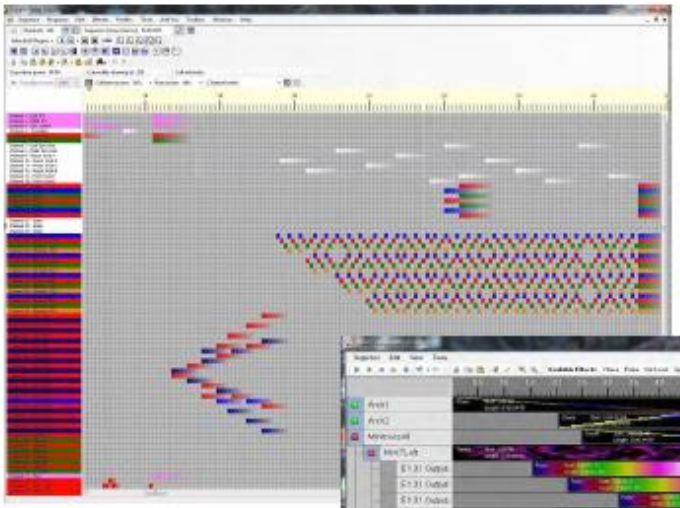
Cost: Free

Hardware Support:

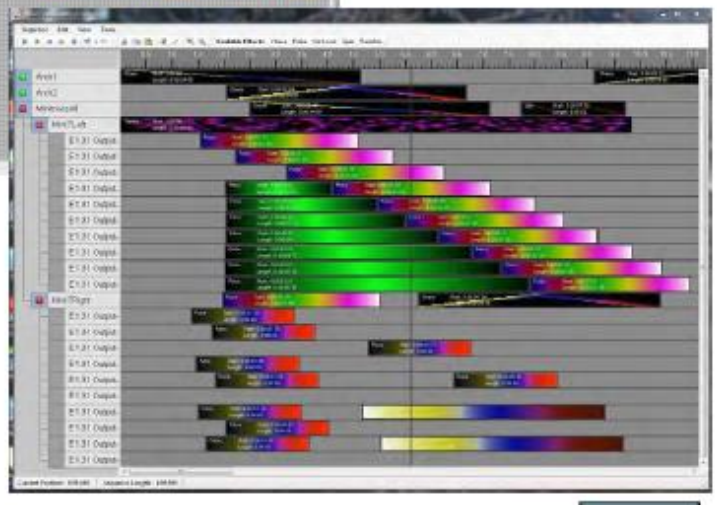
DMX-512, E1.31, Renard,

Versions: Currently there are 2 main versions used with a third version in beta testing

V2.1, V2.5 and V3 which is in beta



Vixen 2.1/2.5 Software Sequencing Screen



Vixen 3 Software Sequencing Screen

Final Words on New Technology

- Lots of new Technology to choose from
- Advice prior to ordering from China
  - Compatibility with controllers
  - Failure rates can be as high as 20%
  - Shipping can get way out of hand, so consider combining orders to save $$
  - Not all product is created equally
- Research before you buy (don't believe everything you read on web sites)