A book to stick your Blinky Flashy Fingers into

AusChristmasLighting

101 A Reference for Everyone

START HERE

auschristmaslighting.com

The Best Animated Lighting Resource Ever.

Created by Fasteddy

Preface

This manual by no means shows all options available but instead shows the most common systems used at **auschristmaslighting.com** This document is current as of the date of the revision release and newer options may become available over time.

AusChristmasLighting (ACL) is an Australian community based lighting forum that caters for anyone around the world wanting to learn how to put on a computer controlled synchronised display. It is a non-profit community providing free information and help to anyone who needs any information regarding computer controlled display setups. The forum has a wealth of information and friendly knowledgeable members always willing to help. There is also a Chat room where members can be social and can help each other in real time. So feel free to pop into the chat room at ACL and say hello.

The Australian Christmas light community have annual get togethers, called minis, where people get to meet and learn from each other with hands on control of sequencers and lights. They are usually held mid-year around May/June/July. This is a highly rated and recommended get together for anyone new to this hobby and you will definitely not leave without seeing and learning lots of great things. For information on dates and times of each states mini please go to the **Australian mini wiki information page.** Members within the US also can attend their regional minis which are also held. Posts on upcoming events appear on the forum with details on the wiki from about April. Videos of past ACL minis from throughout Australia are hosted at **http://www.youtube.com/user/AusChristmasLighting**

The manual has been written with the utmost care to ensure accuracy but if there are any errors, changes or comments then please send them to **feedback@rgbchristmaslighting.com**
Prices listed within the manual change on a regular basis and individual items are upgraded or made redundant by their vendors.
This manual contains 100s of hyperlinks that can be used to direct you to the referenced webpages

AusChristmasLighting 101 - 2nd Revision – 15/06/2014

Table of Contents

Introduction

Definitions

Below is a list of common words used within the hobby and their basic meaning within the hobby. These definitions may have a different meaning outside of this hobby.

VOLTS

Volts (V) is the International System (SI) unit of electric potential and electromotive force, equal to the difference of electric potential between two points on a conducting wire carrying a constant current of one ampere when the power dissipated between the points is one watt.

Volts
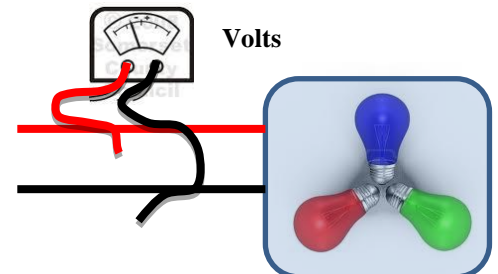
LOW VOLTAGE

Low voltage within this hobby is considered as any AC or DC voltage under 50V. This is not the official IEC definition of Low Voltage. But the term is used loosely within the hobby.

The official IEC Voltage definitions are:

IEC voltage range	AC	DC	defining risk
High voltage (supply system) **HV**	> 1000 V_{rms}	> 1500 V	electrical arcing
Low voltage (supply system) **LV**	50–1000 V_{rms}	120–1500 V	electrical shock
Extra-low voltage (supply system) **ELV**	< 50 V_{rms}	< 120 V	low risk

CURRENT

Electrical current is a flow of electric charge through a medium. This charge is typically carried by moving electrons in a conductor such as wire. The International System (SI) unit of measure for the rate of flow of electric charge is the Ampere (Amp) (A)
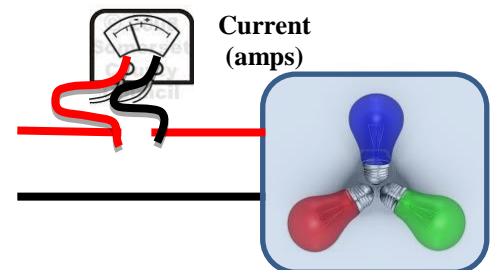
Current (amps)

ALTERNATING CURRENT (AC)

Alternating Current is the movement of electric charge that moves in a sine wave which reverses its direction of flow

DIRECT CURRENT (DC)

Direct current is the unidirectional flow of electric charge. A pulsating current can be defines as having 'ripples' in the DC signal due to rectification from the AC supply

pulsating
direct
variable
alternating
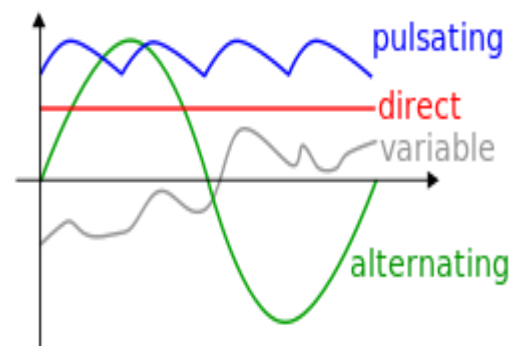
Introduction

RESISTANCE

<u>Electrical resistance</u> of an <u>electrical element</u> is the opposition to the passage of an electric current through that element. The <u>International System (SI) unit</u> of measure for resistance is the <u>Ohm (Ω).</u>

WATT

Watts (W) is the <u>International System (SI) unit</u> of measure for the rate of <u>energy</u> conversion. For us in this hobby the watt refers to the conversion of electrical energy to light and heat energy. A watt is defined as one <u>joule</u> per <u>second</u>.

OHMS LAW

<u>Ohm's Law</u> states that current through a conductor between 2 points is directly <u>proportional</u> to the potential difference across the two points

Ohms Law can be mathematically defined as:

Where I = Current. V = Volts & R = Resistance

$$I = \frac{V}{R}$$
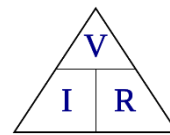
Ohms Law can be used to mathematically work out

$$I = \frac{V}{R} \quad or \quad V = IR \quad or \quad R = \frac{V}{I}.$$

LED

<u>Light Emitting Diode</u> is a <u>semiconductor</u> light source. LEDs are widely used in our hobby for lighting. LEDs are current devices meaning that the current drawn by a LED is critical. LEDs only conduct electricity one way, this means that AC voltage is not ideal for use with LEDs unless it has been <u>rectified</u> to DC Volts
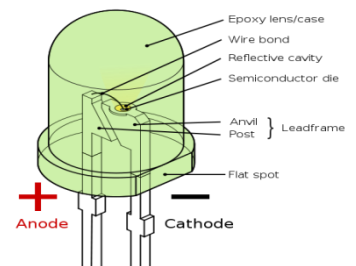
LEDs have an anode and a cathode which can be explained as

     <u>Anode</u> (+) is the inflow of electric current

     <u>Cathode</u> (−) is the outflow of electric current

RGB

<u>RGB</u> stands for Red, Green & Blue and is an <u>additive</u> <u>colour model</u> in which Red, Green & Blue light is added together in various ways to reproduce a broad array of colours.
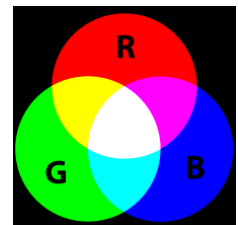
INTEGRATED CIRCUIT

An <u>integrated circuit</u> can be referred to as an IC, chip or microchip. It is an electronic circuit which is made up of layers of a thin <u>substrate</u> of <u>semiconductor</u> material

Introduction

DUMB RGB

Dumb RGB lighting is defined as being a form of lighting that only receives power, there is no on-board control of the lights.
The lights have the integrated circuit external to the light package.

Power only

INTELLIGENT RGB

Intelligent RGB lighting is defined as being a form of lighting that receives both power and data. The actual light control is on-board. The lights have the integrated circuit internal with the light package. This definition is similar to Pixel
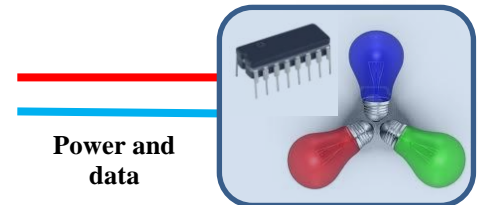
Power and data

NODE

A node is a term that has been used within the hobby to describe an individual light within a string of lights. A node can either be intelligent or dumb.
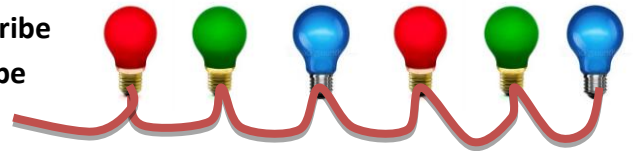
PIXEL

A Pixel is an individual RGB light/section that receives both power and data to determine its colour and level. This definition is different to the [official definition of a Pixel](), but due to some controllers called 'pixel' controllers this definition will save some confusion.

Power and data
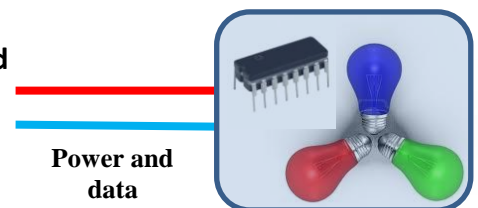
PIXEL CONTROLLER

A pixel controller controls Intelligent RGB lighting (pixels), it sends the data and also in many cases the power to the Integrated circuit (IC) located on the intelligent RGB lights

Pixel Controller

Power and data
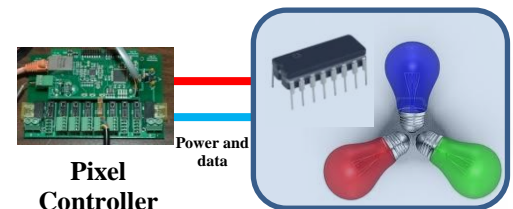
CHANNEL

A channel is a term used in sequencers to indicate a single light or string of lights that all come on at the same time. This could be a single RED LED inside a pixel or 200 multicoloured LEDs as part of a string of fairy lights

UNIVERSE

A universe is a term used as part of the DMX specification that applies to 512 channels. Channels in a DMX universe are referred to as Universe 1 Channel 1, Channel 2 etc through to Channel 512 then on to Universe 2 Channel 1 etc. Pixel controllers typically only use 510 channels in a Universe (170 pixels times 3 colours)

Introduction

Typical System Components Required

This manual is set out in a logical way of setting up a display. Before we can choose what system we want, we need to first look at the lights we will use and based from this we can then follow each section to help design an appropriate system.

There are 6 main components that go into making a display which are Lights, Software, Interfaces, Power supplies/cabling, Controllers and FM transmitters.

LIGHTS		**1**
SEQUENCING SOFTWARE		**2**
COMMUNICATIONS INTERFACES		**3**
POWER SUPPLIES & CABLING		**4**
CONTROLLERS		**5**
RADIO TRANSMITTERS		**6**
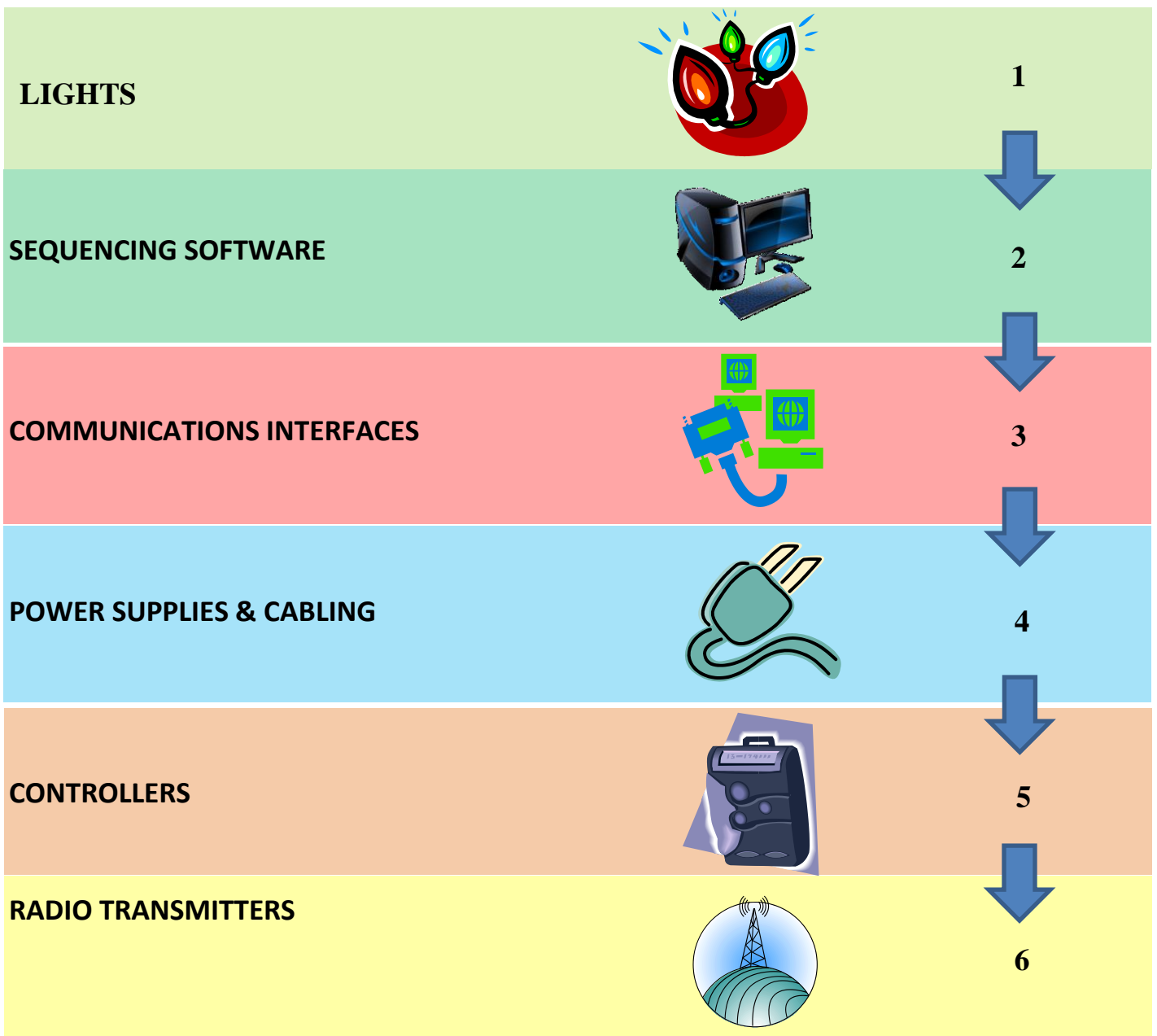
Lights

Christmas Lights

The lights are the face of any great display and will determine what types of controllers and power supplies we use. There are several types of lights available to use and each has its benefits and disadvantages. Lights can vary greatly in cost and quality and it's usually a good idea to talk to other members about their different experiences with different types of lights.

Lights

IP Rating of Lights

Lights are used outside in the weather and come in many forms of construction. The IP rating of the lights can play an important role, the IP rating is based on the 2 numbers below and determines the level of weather protection with IP68 being the highest grade of protection.

Contact Protection

IP0X — No Protection

IP1X — Protected against penetration of solid objects larger than 50mm

IP2X — Protected against penetration of solid objects larger than 12mm
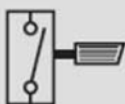
IP3X — Protected against penetration of solid objects larger than 2.5mm
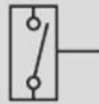
IP4X — Protected against penetration of solid objects larger than 1mm

IP5X — Protected against dust deposits

IP6X — Protected against ingress of dust

IPX
1st digit — Contact Protection
2nd digit — Water Protection

Water Protection

IPX0 — No Protection

IPX1 — Protected against direct dripping water

IPX2 — Protected against indirect dripping water

IPX3 — Protected against spraying water

IPX4 — Protected against splashing water

IPX5 — Protected against water jets

IPX6 — Protected against heavy seas (flooding)

IPX7 — Protected against immersion under defined conditions of pressure and time

IPX8 — Protected against continuous submersion under defined conditions of pressure and time

In addition to IP rating the lights and/or light coatings and wires should be selected so that they are UV stable as no-one want to throw away their lights after a few weeks in the sun. Yellowing of clear coverings is very common and can occur within weeks.

Christmas Light Types

Lights used in the hobby generally fall into 3 categories.

- **Incandescent**
- **LED**
- **RGB LED**

Incandescent Lights

Incandescent lights are the original type of Christmas lighting, these lights come in many types and forms with many names but they are starting to get harder to obtain as LED lights start taking over.

Incandescent lights are not energy efficient and produce a lot of heat energy for the total wattage used. They are constructed with a filament within the globe; this filament slowly burns away over time until the light fails and generally the life of a filament globe is no longer than a few thousand hours total. Switching on and off filaments shortens the life of this sort of light particularly when it is switched on from cold.

Incandescent lights are mainly seen in light strings and rope light and can work with either an AC or DC power source.

Rope Lights

C9 Lights

Lights

LED Lights

Led lights have nearly completely taken over from incandescent lights and offer low energy use with vibrant colours. LED lights can vary greatly and come in different forms.

LED Rope Light

Fairy Lights

Net Lights

Icicles

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

Many of the lights that are bought in Australia use a step down transformer and a multifunction controller that converts the mains voltage to low voltage DC control for the LED lights. This means that we can remove the controller and use an appropriately rated power supply to then control these lights directly through a DC controller. This is commonly done by ACL members using Kmart, Target and Big W strings bought in Australia.

It is not recommended to buy cheap e-bay or Chinese mains voltage lights as these can be dangerous and may not meet state codes as the insulation quality can be an issue. These lights tend to not use step down transformers but instead have 240V on the leds.

Lights

Low Voltage LED Light Control

To control low voltage string lights (fairy lights) it is a matter of removing the controller and connecting the lights through a DC controller with an appropriately rated DC switch mode power supply (SMPS)

110/240 volt mains

DC Switch mode power supply

Low Voltage DC Output

DC Controller

Multifunction controller has been removed

Low Voltage DC computer controlled lights
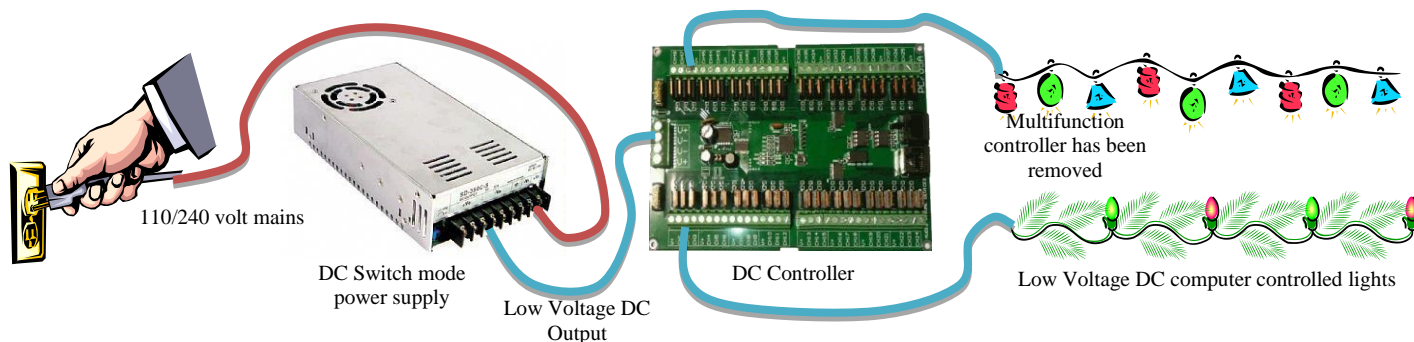
Low voltage LED light strings (fairy lights) have the controllers removed and are directly connected to the outputs of the DC controller

Colour changing effects can be achieved by using different coloured light strings tied together as the lights generally can be obtained in many colours as shown on the previous page.

Mains Voltage LED Light Control

When using mains voltage LED rope lights or strings that have a multifunction controller it may be required to bridge out the controller. The controller actually contains the circuitry that convert the mains 110/240VAC supply to a 110/240VDC supply so the LEDs will function correctly. LEDs only conduct current in one direction and if used without the DC rectifier that is inside the controller, then the LEDs will flicker with the electrical supply frequency as the current flows in a pulsating manner potentially significantly less than 50% of the time. This is why LEDs are better used with DC power.

110/240 volt controller

110/240 volt mains power supply

110/240 volt computer controlled lights

Multi function Controller bridged out for mains voltage AC LED light strings and rope lights
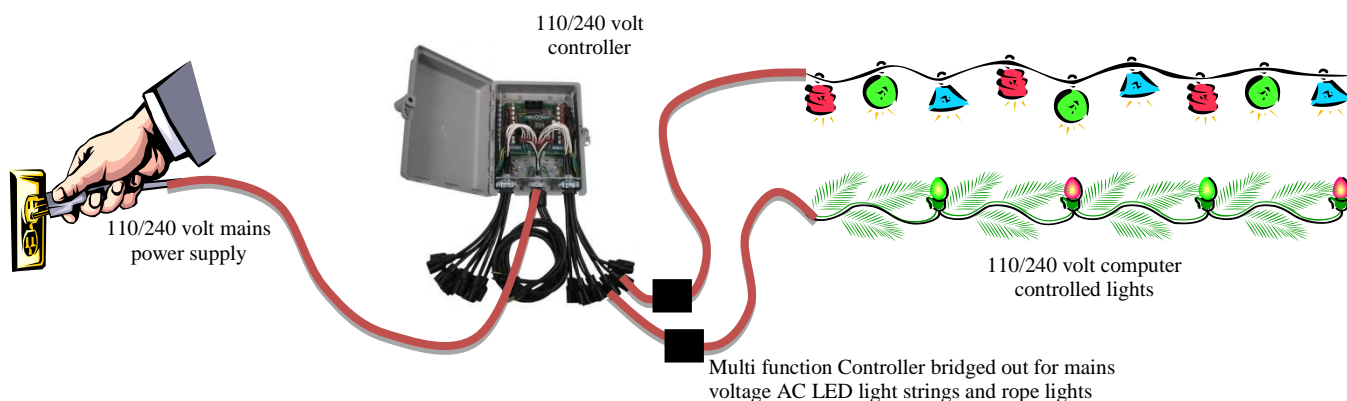
For further information regarding the bypassing of multi-function controllers refer to
http://auschristmaslighting.com/wiki/index.php/Bypassing_Multi_Function_Controllers

Warning 110/240 volt mains supply can cause serious injury or death.

RGB Lights

RGB Lights

RGB Lights are fast becoming the most popular lights to use within the hobby. RGB allows a whole new effect which is colour and control. RGB allows you to use whatever colour you desire as the lights contain a red, green and blue LED light within the same package and special RGB lights that contain a chip to control the RGB light also allow individual lighting control.

- RGB stands for R = Red, G = Green and B = Blue
- RGB lighting is used to create any colour by mixing these colours together.
- RGB lighting uses 3 channels for control by mixing varying percentages of intensities of each colour, which enable us to produce many thousands to millions of colours
- RGB lighting comes in many different forms and packages which are used for lighting up our Christmas displays
- Light is produced in wavelengths for each individual colour
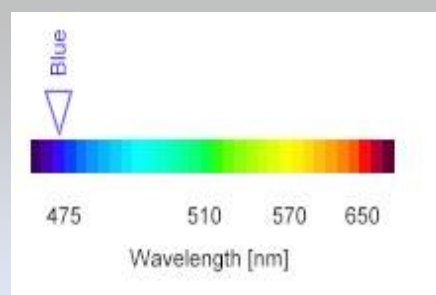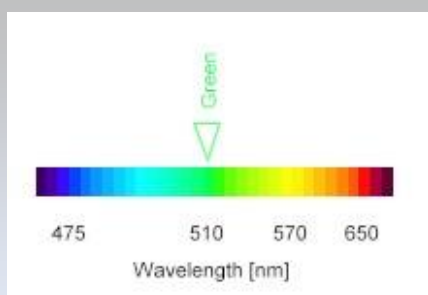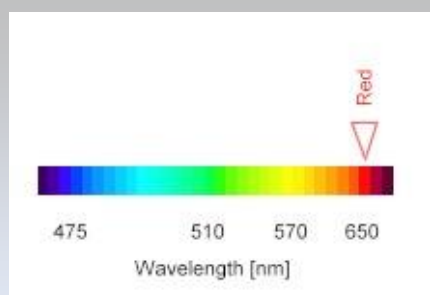
RGB LED TYPES

There are a few different types of LEDs used in the construction of RGB Lights, The ones shown below are the most commonly used in the construction of various RGB light packages used.

5050 RGB LED – This is a surface mounted LED that shines light in one direction normally at an angle of 120 to 140 degrees. It has great light intensity and great colour mixing properties.
The name refers to the dimension of 5.0 x 5.0 millimetres

8mm RGB LED – This LED is more closely based on the traditional LED. It has Great light intensity and colour mixing properties. The name refers to the size of the LED

5mm Single Colour LED – This LED is used in groups of 3 with individual LED colours of Red, Green and Blue. The light intensity is slightly lower with a poor colour mixing if viewed close up. But modules fitted with these are generally much cheaper than using 5050 LEDs

RGB Lights

RGB LED PACKAGES

RGB LEDs can come in several different types of packages that can be used to create different effects within your display. There are 4 main types are:

- Floods & Spot Lights
- Strings
- Strip
- Modules

There are also many other types of RGB lighting arrangements available to suit your requirements

RGB Light Strings

RGB Strip Light

RGB Modules

RGB Flood/Spot Lights

RGB Flood Lights & Spot Lights

Spot Lights

Flood Lights

Wall Wash Strip Light

- RGB flood Lights are used to wash colour onto a wall. These work well when using directional lighting like strips or modules that don't give light wash back. Floods allow you to control the amount and colour of light wash on surfaces
- RGB Spot Lights are used to highlight elements and by focusing light onto an object.
- Floods have a wide angle beam; Spots have a narrow angle beam.
- There are many types of floods and spots available ranging from DIY to DMX packaged units.
- The LEDs used in floods and spots vary greatly with different intensities and light dispersion angles
- Strips and modules can also be used as floods if needed

RGB Lights

RGB Light Strings

RGB strings are somewhat similar to traditional Christmas string lights but these have a much higher light output than traditional LED string lights

They are available in 5vdc or 12vdc, 5vdc being the best voltage for these lights as 12vdc requires a high voltage drop to drive the LED thus making it less efficient. The quality can vary greatly especially with the level of weather protection and UV resistance. Cheaper strings may need additional work to be completely weather resistant as their primary design was for use in billboards and signage.

- **The strings generally come in lengths of 50 (or 100) if ordered from China. If it is critical to ensure that the distance between each light is equal for building things like mega trees then you should clearly specify the required distance between each light.**
- **Strings can be used for almost any purpose like outlines, mega trees, matrices, etc.**
- **Strings will create wash back onto walls and will be brighter when looking directly at the top of the LED.**
- **Strings are the most versatile of all RGB lights as they can be easily positioned in any direction or orientation**
- **The majority of strings are made using a 8mm RGB LED, there are some that use a 5050 LED but their viewing angle is limited.**

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 an RGB Light string 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. Known as a bullet node due to the shape.

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 orientation of the light can be better managed. There are 2 types one is a resin filled (IP68) with the wires coming out the back and the other is silicone covered (IP65) with the wires coming out from the sides. The resin type is much better for water protection but is generally constructed with the wires coming out the back.

RGB Lights

RGB Strip Light

- RGB strip is somewhat similar to rope light, but it is flat and directional meaning they only shine light in one direction. They create little wash back light.
- The strip generally comes in 5 metre lengths and uses 5050 RGB LEDs.
- Strip can be obtained in 5vdc to 24vdc
- Can only be easily bent in one axis as the strip is flat and made from flexible printed circuit board
- The strip can be easily damaged if twisted or bent too much
- Comes in varying numbers of LEDs per metre, the most common are 30 and 60 LEDs per metre.
- Great to use for outlines, borders, arches, matrices, etc.
- It can be cut down to 50mm or 100mm sections depending on the LED count per metre

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

RGB Lights

RGB Strip Light Mounting

Due to the RGB strip being somewhat fragile to twist and sharp bends it is always good practice to mount your strip on something solid that gives support. An easy and cheap method is to attach the strip on lengths of conduit with cable ties. This way it makes it easy to get nice straight lines for roof lines and windows. This also helps with speeding up installation and removal times. Ensure you always support the centre of the conduit when carrying it around as too sharp of a bend of the conduit could stretch and damage the strip. 25mm electrical conduit is best to use as it has a lot more strength than 20mm electrical conduit.

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 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

RGB Lights

RGB Light Control

RGB lights are made up of 3 channels to control the red, green and blue. Changing the ratios of these colours will change the colour shown. RGB lights can either be individually controlled or controlled as a single length. RGB lights can be put into 2 basic control types

- **Dumb RGB control (single colour control)**
- **Intelligent RGB control (individually controlled)**

The difference between dumb 3 channel RGB lights and intelligent RGB light is that there is a little black IC (integrated circuit) on each controllable light/section as shown.
This allows RGB control of each light/section without having additional wires going to each light.
The intelligent RGB light is turned on by receiving the appropriate data that then controls the level of red, green and blue light

How to identify the physical differences between a Dumb RGB light and an intelligent RGB light

Dumb RGB

Intelligent RGB

IC Chip Missing

IC Chip

IC Chip Missing

IC Chip

IC Chip Missing

IC Chip

Note. 2812 based pixels have the chip as part of the LED. They will have 3 wires and markings like –ve, +ve, data. Ink1003 based pixel strips may have an external 12V to 5V regulator on the rear of the strip and will have 4 markings (12V, 5V, 0V and Di (Do on output end)).

RGB Lights

The diagram below shows 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.

Dumb RGB Lights: Single control, all the lights do the same thing. The whole length shown here is 3 channels
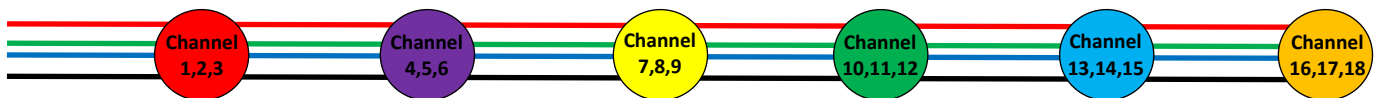
Intelligent RGB Lights: Individual control, all the lights are separately controlled. The whole length is 18 channels.

Dumb RGB Light Control

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 (+)

+DC Volts Common Return (common anode) Note that this wire is + but is coloured black in most cases due to being the common return wire
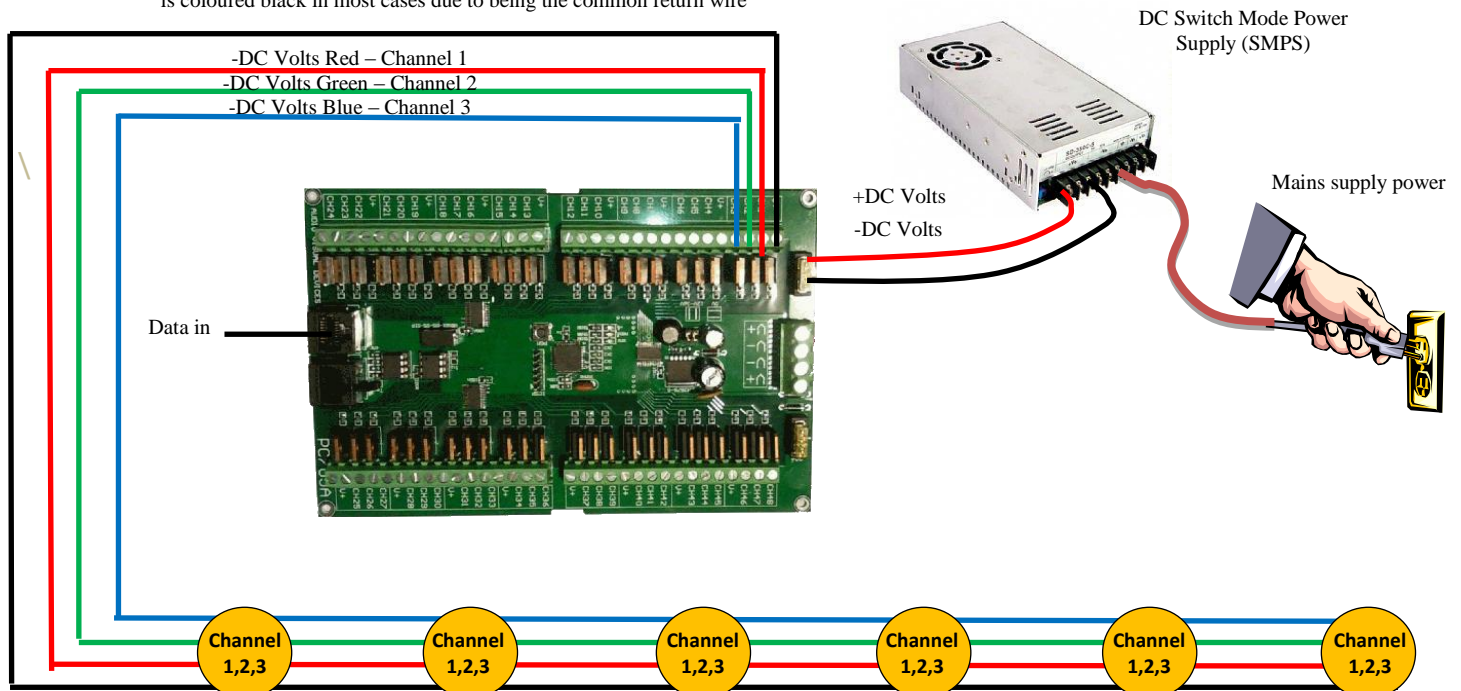
DC Switch Mode Power Supply (SMPS)

-DC Volts Red – Channel 1
-DC Volts Green – Channel 2
-DC Volts Blue – Channel 3

+DC Volts
-DC Volts

Mains supply power

Data in

Dumb RGB Lights: Single control, all the lights do the same thing. The whole length shown here is 3 channels

RGB Lights

Intelligent RGB Light Control

Intelligent RGB lights have several different names that are used, with Pixels being one of the most commonly used.

- **The individual lights/sections are controlled by an IC that processes the data coming in and then converts the data to light control, the data is then passed on to the next light/section**
- **The data used for most applications is called SPI data which stands for Serial Peripheral Interface Bus which is a synchronous serial data link standard created by Motorola**
- **Data is sent along the line, the first light light/section accepts the first piece of data, then removes that data and then regenerates the data signal before passing on the remaining data to the second light and so forth**
- **The lights do not need to be physically individually addressed as they instead cascade the command/data to the next IC so that means you can replace a light/section without worrying about addressing the new light/section.**
- **Intelligent RGB lighting has either 3 or 4 wires, 2 wires are used to supply power to the lighting IC and LEDs the other 2 are for data and clock, some do not use the clock wire.**

Data in

DC Switch Mode Power Supply (SMPS)

-DC Volts

+DC Volts

Mains supply power

+DC Volts Light supply

Data line (DAT)

Clock Line (CLK) if used

GND - DC Volts supply

Note: Wire positions & colours may vary with different types of controllers and intelligent RGB lights

Passes data to the next light/section

1 controllable light/section is called a pixel

Channel 1,2,3

Channel 4,5,6

Channel 7,8,9

Channel 10,11,12

Channel 13,14,15

Channel 16,17,18
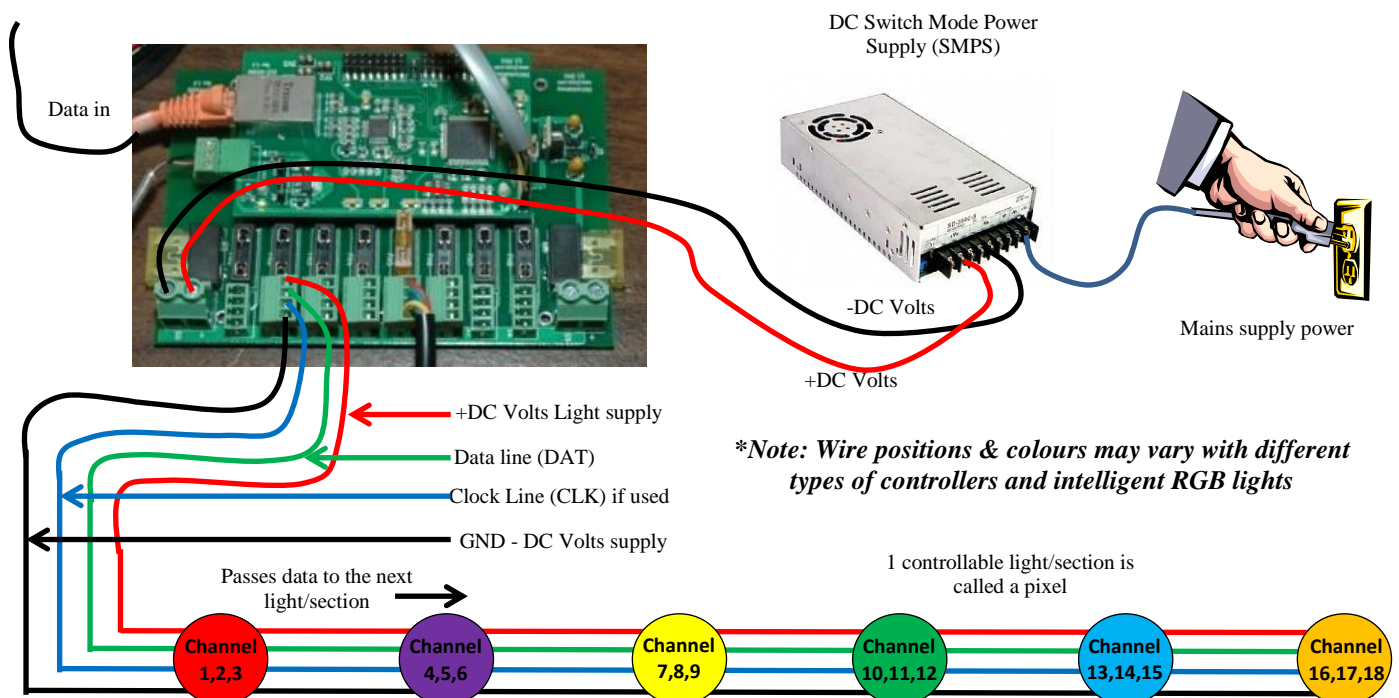
Intelligent RGB Lights: Individual control, all the lights are separately controlled. Each light/section is 3 channels. The whole length shown here is 18 channels.

RGB Lights

Intelligent RGB Light IC Types

There are several different types of data protocols used to communicate between the pixel controller and the IC chips that control the intelligent lights/sections (pixels) which have different features.

- **Bit level:** The higher the control bits the more colour and smoother fading that can be produced
    - **4 bit 16 steps per colour (16x16x16 = 4096 colours)**
    - **5 bit: 32 steps per colour (32x32x32 = 32768 colours)**
    - **8 bit: 256 steps per colour (256x256x256 = 16777216 colours)**
    - **12 bit: 4096 steps per colour (4096x4096x4096 = 68719476736 colours)**

        Note: DMX only supports 8 bit output so a 12 bit chip will only run 256 steps per colour but will allow for dimming curves

IC chip

- **Constant Current: Ensures that the correct current is maintained. LEDs are current devices and are better controlled with constant current. As long as there is sufficient voltage for the current regulation to occur every pixel on a string will be the same brightness.**

- **Constant Voltage: Modulates the full voltage that is on the pixels. Variations in the voltage along a pixel strings will affect the brightness.**

- **12VDC or 5VDC power: The lower the voltage the higher the possibility of voltage drop affecting the lights. 1 volt drop is a much higher percentage of 5 VDC than it is with 12vdc. Depending on pixel style the current requirements are the same regardless of voltage.**

- **1 or 2 wire communication: Generally this should not have an effect on performance.**

4 wire   3 wire

- **There are 7 main types of SPI communications and ICs that are used within the community.**
    - **GE Colour Effects – 4 Bit 3 Wire – constant current control** Available in the US only
    - **LPD6803 IC – 5 Bit 4 wire – constant current control**
    - **WS2801 IC – 8 bit 4 wire – constant current control**
    - **WS2811 IC – 8 bit 3 wire – constant current control**
    - **WS2812 IC – 8 bit 3 wire – constant current control. IC embedded in LED**
    - **TM1804 IC – 8 bit 3 wire – constant voltage control**
    - **TLS3001 IC – 12 bit 3 wire – constant current control**
    - **INK1003 IC – 8 bit 3 wire – constant voltage control. IC embedded in LED. 12V to 5V regulator typically installed on LED strips**

- **Each is available in different packages and voltages. There are also many other types of ICs available, but support for these is either minimal or non-existent.**
- **New protocols are regularly being released.**

RGB Lights

RGB Light Choices

There are several different types RGB lights available and listed below is just some of the more commonly used ones. These choices are only based on the vendor Ray Wu on Aliexpress and there are many more types available then what is listed from many different vendors and it is always recommended to do your own research.

Dumb RGB Lights (no IC)

3 Channel Dumb RGB Strip Lights

RGB 5050 Dumb Strip Light
US$ 14.00
LED Count: 30 Led/metre
Coating: Silicone tube (IP65)
Voltage: 12VDC
Power: 7.2 Watts/metre total
Length: 5 metres
Cost per LED: $0.093

RGB 5050 Dumb Strip Light
US$ 19.00
LED Count: 30 Led/metre
Coating: Solid Silicone + Silicone tube (IP68)
Voltage: 12VDC
Power: 7.2 Watts/metre total
Length: 5 metres
Cost per LED: $0.108

RGB 5050 Dumb Strip Light
US$ 24.00
LED Count: 60 Led/metre
Coating: Solid Silicone + Silicone tube (IP68)
Voltage: 12VDC
Power: 14.4 Watts/metre total
Length: 5 metres
Cost per LED: $0.080

RGB 5050 Dumb Strip Light
US$ 30.00
LED Count: 72 Led/metre
Coating: Solid Silicone (IP65)
Voltage: 12VDC
Power: 17.2 Watts/metre total
Length: 5 metres
Used for wall washing
Cost per LED: $0.082

RGB 5050 Dumb Strip Light
US$ 60.00
LED Count: 144 Led/metre
Coating: Solid Silicone (IP65)
Voltage: 12VDC
Power: 34.5 Watts/metre total
Length: 5 metres
Used for wall washing
Cost per LED: $0.083

RGB 5050 Dumb Strip Light
US$ 19.00
LED Count: 60 Led/metre
Coating: silicone tube (IP65)
Voltage: 24VDC
Power: 14.4 Watts/metre total
Length: 5 metres
Cost per LED: $0.063

RGB Lights

3 Channel Dumb RGB Strings

8mm RGB Dumb String Light
US$ 9.00
LED Count: 50
Coating: IP68 Resin Filled
Voltage: 5VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.18

8mm RGB Dumb String Light
US$ 20.00
LED Count: 100
Coating: IP68 Resin Filled
Voltage: 12VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.20
Less efficient design than 5vdc

3 Channel Dumb RGB Modules

RGB Dumb Module Light
Rectangle US$ 5.00
LED Count: 20 modules
60 5050 LEDs
Coating: IP66 Resin coated
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $0.083

RGB Dumb Module Light
Square US$ 13.68
LED Count: 20 modules
60 5050 LEDs
Coating: IP67 Resin coated
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $0.228

RGB Dumb Module Light
Piranha LED US$ 88.00
LED Count: 100 modules
8 Piranha LEDs per module
Coating: IP68 Resin coated
Voltage: 12VDC
Power: 0.64 watts per module
Length: may vary
Cost per LED: $0.147
Piranha LEDs

RGB Dumb Module Light
Square US$ 5.58
LED Count: 20 modules
20 5050 LEDs
Coating: IP67 Resin coated
Voltage: 12VDC
Power: 0.6 watts per module
Length: may vary
Cost per LED: $0.279

This is just a small sample of the dumb RGB lights available. Dumb RGB lights are also available from other vendors

Intelligent RGB Lights (with IC)

Intelligent RGB Strip

A small sample of the different types of Intelligent RGB strip lights available

Intelligent RGB Strip Light
US$ 41.00
IC Type: LPD6803 4 wire
LED Count: 50 sections (100mm), 150 5050 LEDs
Coating: IP65 Silicone Tube
Voltage: 12VDC
Power: 7.2 watts per metre total
Length: 5 metres
Cost per LED: $0.273

Intelligent RGB Strip Light
US$ 46.00
IC Type: LPD6803 4 wire
LED Count: 50 sections (100mm), 150 5050 LEDs
Coating: IP68 Solid Silicone + Silicone Tube
Voltage: 12VDC
Power: 7.2 watts per metre total
Length: 5 metres
Cost per LED: $0.307

Intelligent RGB Strip Light
US$ 50.00
IC Type: WS2801 4 wire
LED Count: 60 sections (83.3mm), 180 5050 LEDs
Coating: IP65 Solid Silicone or Silicone Tube
Voltage: 12VDC
Power: 10 watts per metre total
Length: 5 metres
Cost per LED: $0.277

Intelligent RGB Strip Light
US$ 51.00
IC Type: WS2801 4 wire
LED Count: 160 sections (31.25mm), 160 5050 LEDs
Coating: IP65 Silicone Tube
Voltage: 5VDC
Power: 10 watts per metre total
Length: 5 metres
Cost per LED: $0.319

Intelligent RGB Strip Light
US$ 19.00
IC Type: WS2811 3wire
LED Count: 160 sections (31.25mm), 300 5050 LEDs
Coating: IP65 Silicone Tube
Voltage: 12VDC
Power: 14.4 watts per metre total
Length: 5 metres
Cost per LED: $0.063

Intelligent RGB Strip Light
US$ 68.00
IC Type: TLS3001 3 wire
LED Count: 160 sections (31.25mm), 160 5050 LEDs
Coating: IP65 Silicone Coating or Silicone Tube
Voltage: 5VDC
Power: 10 watts per metre total
Length: 5 metres
Cost per LED: $0.425

This is just a small sample of the strips available. Most strips are available in different chipsets. Strips are also available from other vendors

RGB Lights

Intelligent RGB Strings
A small sample of the different types of intelligent RGB strings available

Intelligent RGB String Light
US$ 18.00
IC Type: WS2801 4wire
LED Count: 50
Coating: IP67
Voltage: 5VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.360

Intelligent RGB String Light
US$ 46.00
IC Type: 1803 3wire
LED Count: 128
Coating: IP68
Voltage: 12VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.360

Intelligent RGB String Light
US$ 22.50
IC Type: TLS3001 3wire
LED Count: 50
Coating: IP68
Voltage: 5 VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.450

Intelligent RGB String Light
US$ 23.16
IC Type: LPD6803 4 wire
LED Count: 50
Coating: IP66
Voltage: 5VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.463

Intelligent RGB String Light
US$ 18.00
IC Type: WS2801 4 wire
LED Count: 50
Coating: IP68
Voltage: 5VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.360

Intelligent RGB String Light
US$ 23.00
IC Type: TLS3001 3 wire
LED Count: 50
Coating: IP68
Voltage: 5VDC
Power: 0.3 watts per light
Length: may vary
Cost per LED: $0.460

This is just a small sample of the strings available. Most strings are available in other chipsets. Strings are also available from other vendors

Intelligent RGB Modules

A small sample of the different types of intelligent RGB modules available

Intelligent RGB Module Light
US$ 19.47
IC Type: LPD6803 4 wire
LED Count: 20 modules, 60 5050 LEDs
Coating: IP67
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $0.324

Intelligent RGB Module Light
US$ 14.00
IC Type: WS2801 4 wire
LED Count: 20 modules, 60 5050 LEDs
Coating: IP67
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $0.231
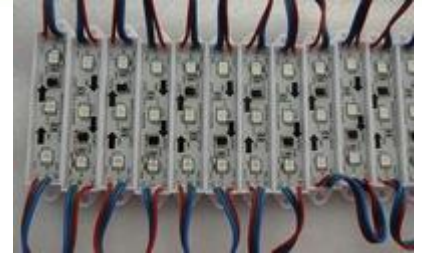
Intelligent RGB Module Light
US$ 12.00
IC Type: WS2811 4 wire
LED Count: 20 modules, 60 5050 LEDs
Coating: IP68
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $0.200

Intelligent RGB Module Light
US$ 17.00 24.21
IC Type: WS2801 4 wire
LED Count: 20 modules, 80 5050 LEDs
Coating: IP67
Voltage: 12VDC
Power: 0.96 watts per module
Length: may vary
Cost per LED: $ 0.213

Intelligent RGB Module Light
US$ 40.00
IC Type: LPD6903 4 wire
LED Count: 20 modules,
Coating: IP66
Voltage: 12VDC
Power: 0.72 watts per module
Length: may vary
Cost per LED: $ 2.00 per module

Intelligent RGB Module Light
US$ 69.47
IC Type: LPD6803 4 wire
LED Count: 10 modules
Coating: IP65
Voltage: 24VDC
Power: 5 watts per module
Length: may vary
Cost per LED: $ 6.95 per module

**This is just a small sample of the modules available. Most modules are available
in other chipsets. Modules are also available from other vendors**

RGB Flood and Spot Lights
A small sample of the different types of RGB flood and spot lights available

3 x 1 watt RGB Spot light
US$ 17.89
DMX512
LED Count: 1xR,1xG,1XB 1 watt LED
IP Rating: IP68
Voltage: 12VDC
Power: 3 watts

36 x 1 watt RGB Flood Light
US$ 100.00
DMX512
LED Count: 12xR,12xG,12XB 1 watt LED
IP Rating: IP65
Voltage: 220VAC or 24VDC
Power: 36 watts

36 x 1 watt RGB Flood Bar Light
US$ 116.84
DMX512
LED Count: 12xR,12xG,12XB 1 watt LED
IP Rating: IP64
Voltage: 220VAC or 24VDC
Power: 36 watts

RGB 5050 Dumb Strip Light
US$ 30.00
LED Count: 72 Led/metre
Coating: Solid Silicone (IP65)
Voltage: 12VDC
Power: 17.2 Watts/metre total
Length: 5 metres
Used for wall washing
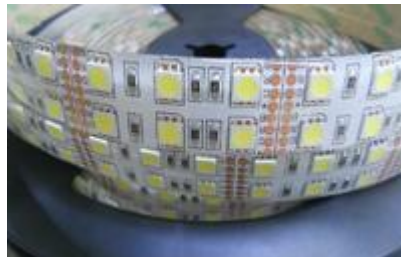
RGB 5050 Dumb Strip Light
US$ 60.00
LED Count: 144 Led/metre
Coating: Solid Silicone (IP65)
Voltage: 12VDC
Power: 34.5 Watts/metre total
Length: 5 metres
Used for wall washing
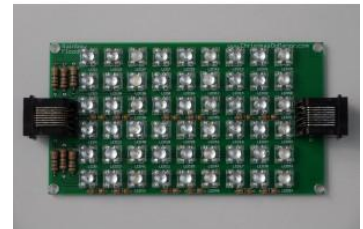
Rainbow RGB Flood Light Kit
US$ 25.75
LED Count: 18xR, 18xG, 18XB superflux LEDs
IP Rating: N/A
Voltage: 12VDC
Power: 26 watts
This is in DIY form

This is just a small sample of the flood and spot lights available.
These are also available from other vendors

Flood lights can also come in DIY Kits from other various vendors and forum group buys.

Sequencing Software Used

Sequencing software is used to control the lights by communicating between the PC and the controllers. The software is what allows you to create different effects like on/off, fade, twinkle, shimmer etc. and synchronise this to the music. The software will also schedule and run your show.

Sequencing can be a time consuming process, but the software is becoming more advanced to help make this an easier task. You basically upload the song you want to use and then setup the controllers and channels within the software and then you upload a picture of your house or premises so you can then draw your display items from your display over this picture. Once you have done this you can start sequencing and watch the simulation of your display on your computer screen. So you can have your whole display planned and sequenced before actually using any hardware.

Sequence Visualizer
in LightShow Pro V2

There are 5 main software packages used by auschristmaslighting members, these have different features and hardware support. All software can be downloaded as a demo to see what will best suit. The 5 software suites that are used by the majority of members are:

- **LightShow Pro V2 (LSP V2)**

- **Vixen**

- **Light-O-Rama S3 (LOR S3)**

- **HLS (Hinkle Lighting Software)**

- **Xlights/nutcracker**

Further information on software can be found at
http://auschristmaslighting.com/wiki/index.php/Software

Sequencing Software

LightShow Pro

Lightshow Pro has the most features and support of the 55 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
Ultimate edition	300000 channel version	- POA

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

Tutorials: http://lightshowpro.com/centralized-training-videos/
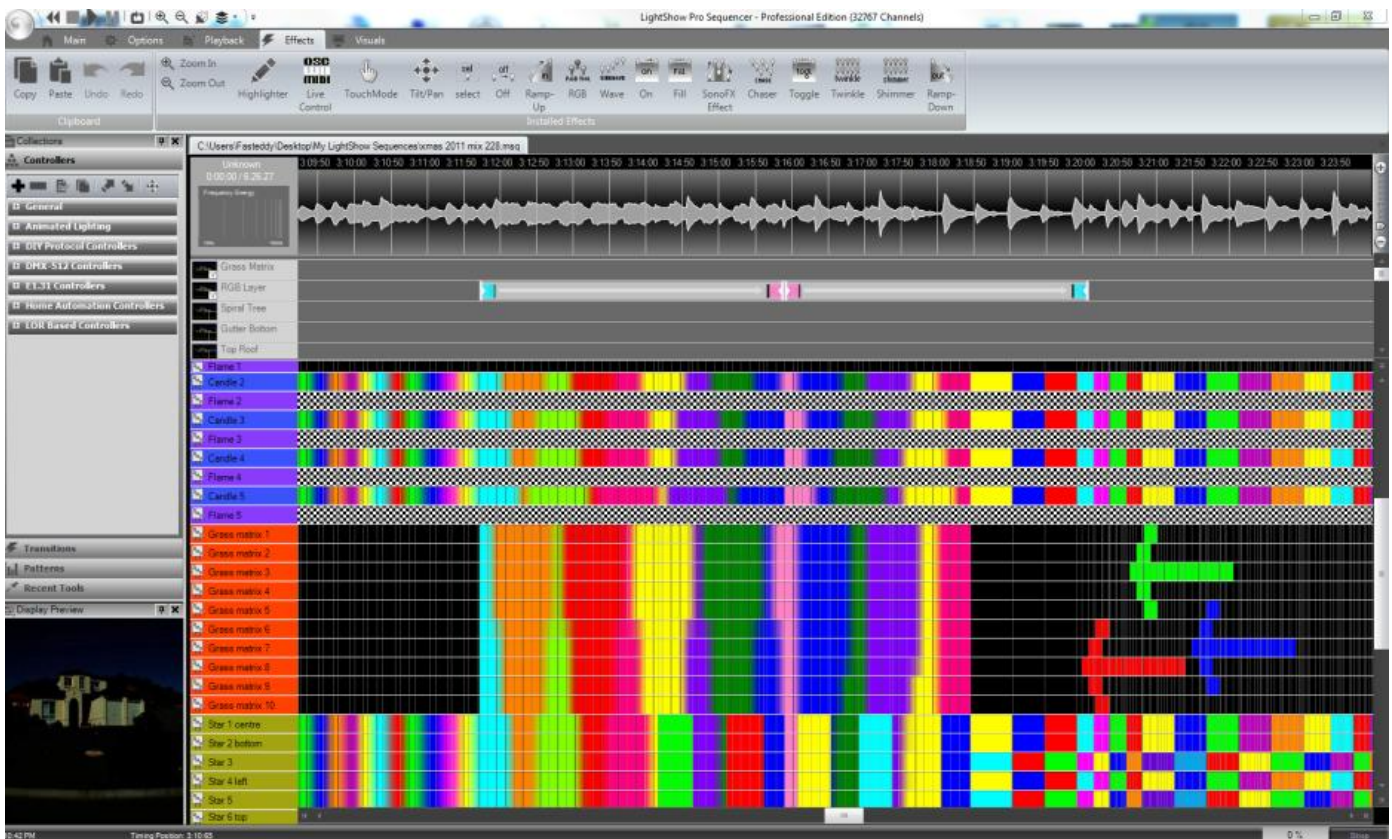
LightShow Pro V2 Software Sequencing Screen

Sequencing Software

Vixen

Vixen is a free community based sequencing software package. RGB support varies depending on the version. Vixen3 is currently going through an upgrade 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 3 main versions used
V2.1, V2.5 and V3

Tutorials: www.vixenlights.com/vixen-3-documentation/video-tutorials/
←

Vixen 2.1/2.5 Software Sequencing Screen
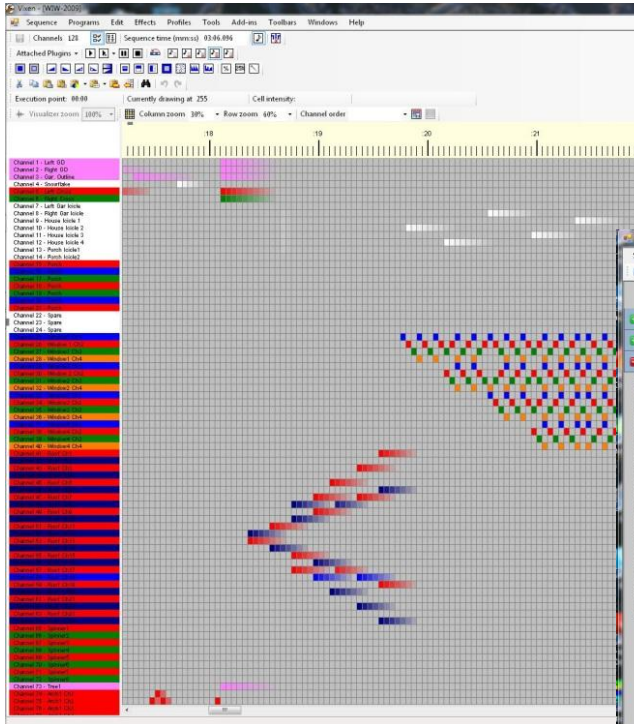
→
Vixen 3 Software Sequencing Screen
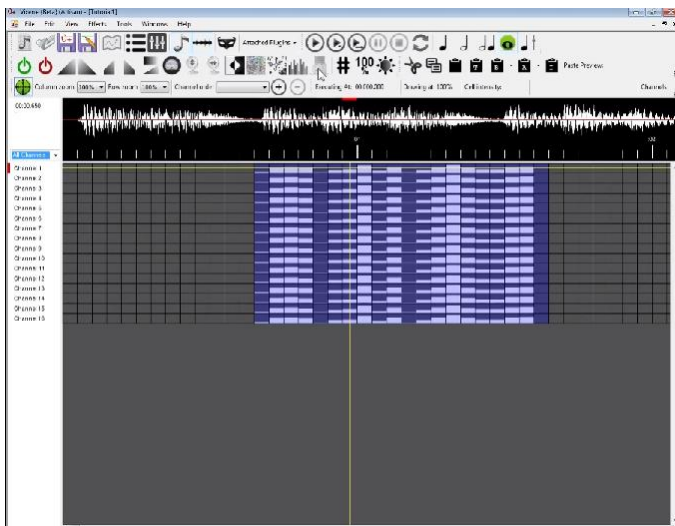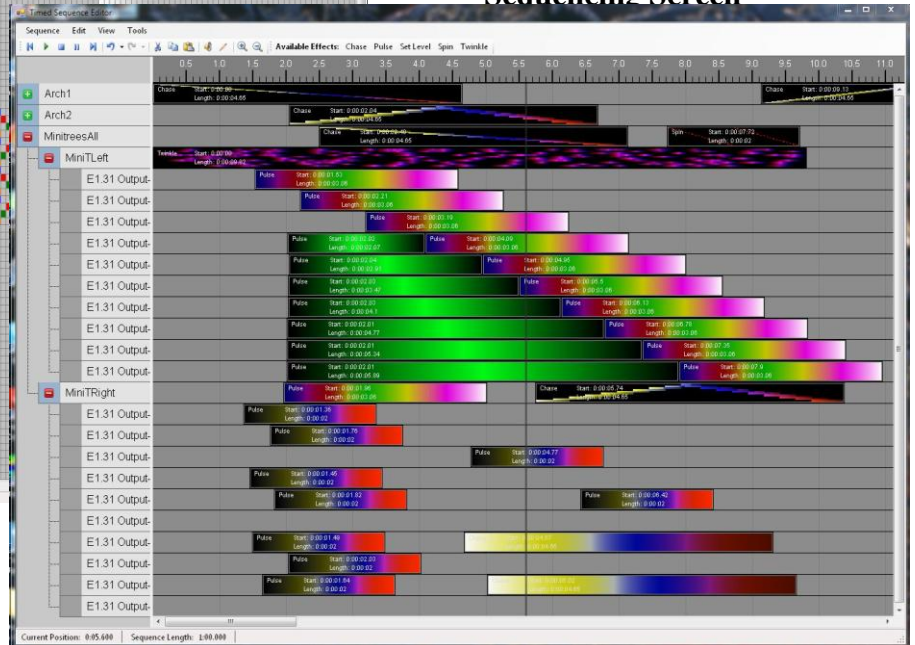
Vixen Plus Software Sequencing Screen

Website: http://vixenplus.com/
Cost: Free

Hardware Support:
DMX-512, E1.31, Renard

Vixen Plus is an alternative to Vixen 2 and Vixen 3

Tutorial: http://www.youtube.com/watch?v=sEyW7S-ge7g

Sequencing Software

Light-O-Rama

Light-O-Rama S3

Lightorama S3 software is primarily designed to work with Lightorama controllers. It also supports DMX-512, E1.31 and X10 with 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

A number of free LOR sequencing, configuration and effects programs have been developed by users.

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

Superstar add on software for easy sequencing of the Cosmic Color Ribbon (CCR) and position based sequencing

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, E1.31, X10

Tutorials: www1.lightorama.com/tutorials/
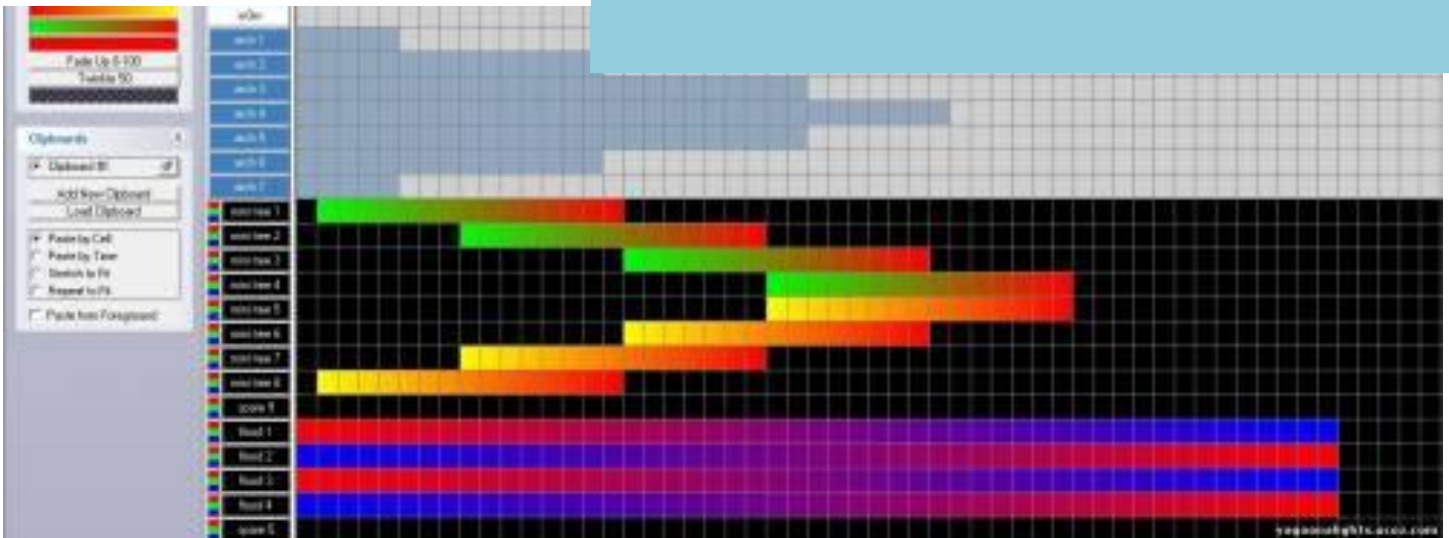
Light-O-Rama (LOR) S3 Software Sequencing Screen

HLS (Hinkle's Lighting Sequencer)

HLS sequencer developed by Joe Hinkle is a free sequencer that is designed for pixel displays and combines grid and position based sequencing.
http://joehinkle.com/HLS/
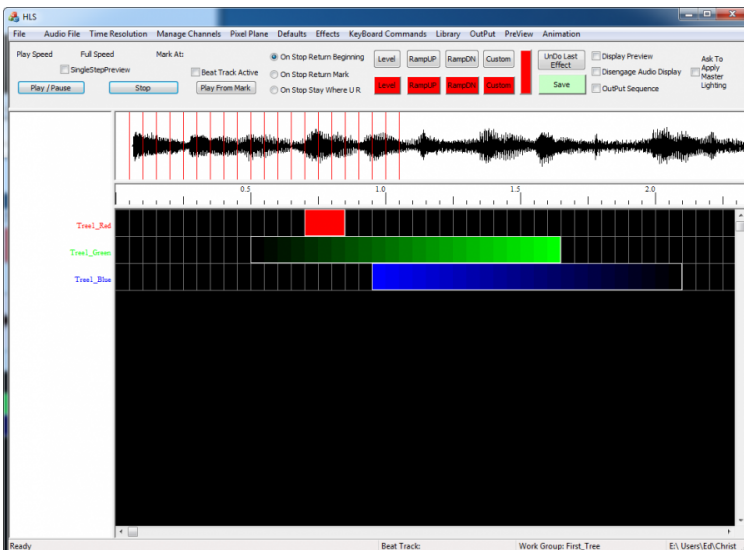
HLS Software Sequencing Screen
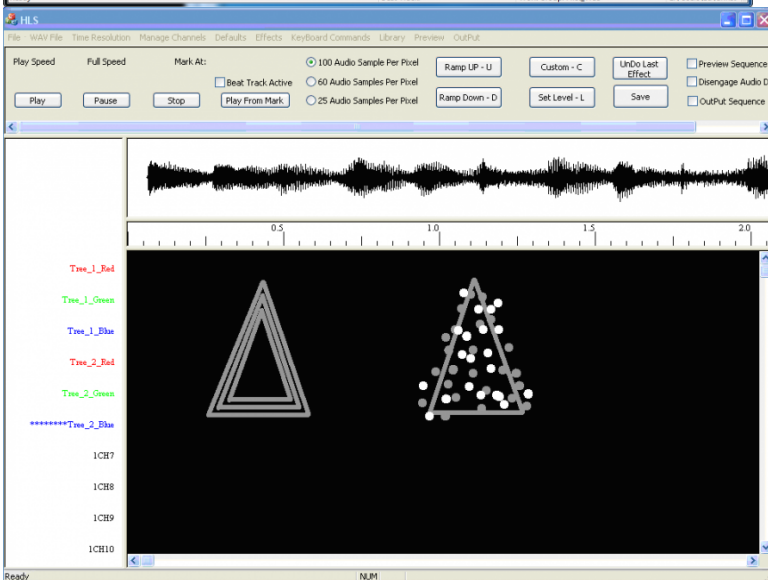
HLS Software Visualiser/Preview Screen

Website (download): http://joehinkle.com/HLS/
Website (information):- http://hinkles-lighting-sequencer.wikia.com/wiki/Hinkle%27s_Lighting_Sequencer_Wiki
Cost: Free

Hardware Support: DMX-512, E1.31

Tutorials: http://hinkles-lighting-sequencer.wikia.com/wiki/Joe_Hinkles_Video_Tutorials

Xlights/Nutcracker

xLights is a scheduling program. xLights has usb and E1.31 drivers. You can create playlists, schedule them, test your hardware, convert between different sequencers. xLights also now has Nutcracker version 3 included as a tab.
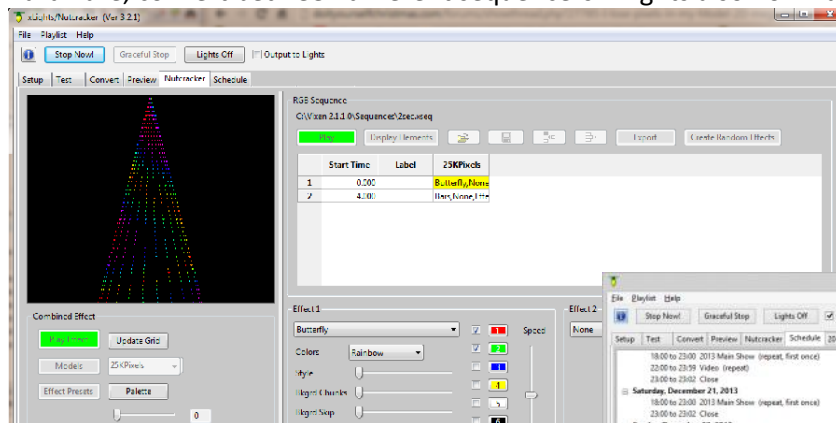
Nutcracker tab of Xlights/Nutcracker
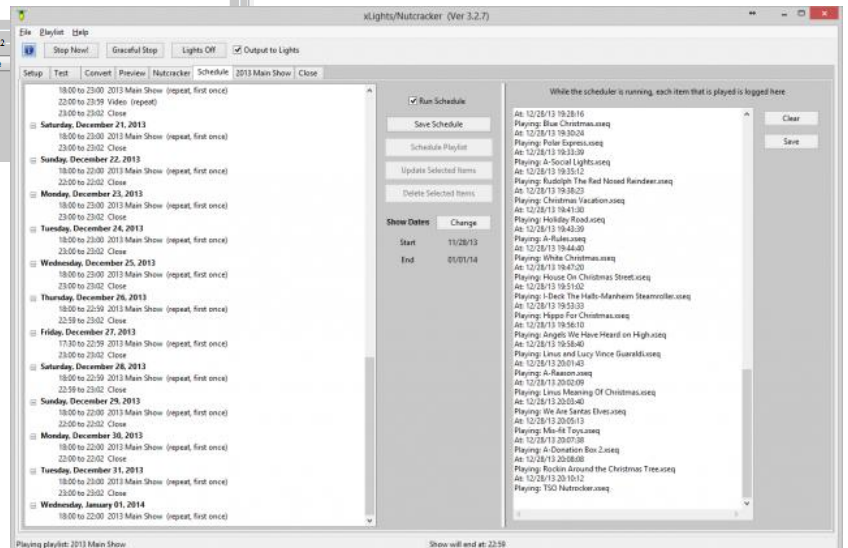
Schedule tab of Xlights/Nutcracker

Xlights/Nutcracker can be used as a sequencer, a scheduler, a test utility and a conversion utility which converts between LSP, LOR, Vixen 2, Falcon Pi Player and other formats. It can also be used as an effects generator for importing effects into LOR, LSP etc.

Website (download): http://nutcracker123.com/nutcracker/releases/

Website (information):- http://nutcracker123.com/forum/

Cost: Free

Hardware Support: DMX-512, E1.31

Tutorials: http://vimeo.com/user10339343/videos

Test Software

David Duffy (David_AVD) of audiovisualdevices (AVD) has written 2 pieces of software for the testing of Christmas light controllers/interfaces. These 2 pieces of software are da_dmx and da_e131.
da_dmx controls a dmx network connected via a usb dongle. Either "Open DMX" or "DMX Pro"
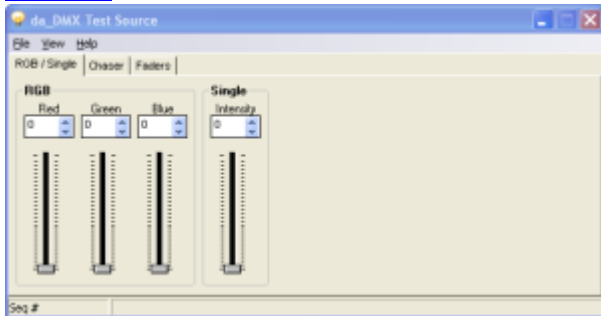
da_dmx main screen
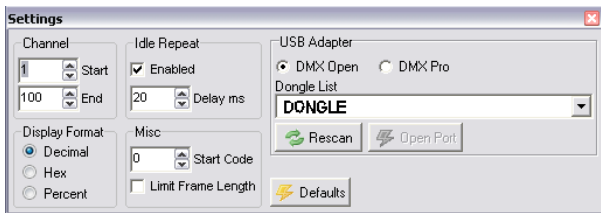
da_dmx settings screen.
Allows the 1st and last channel that the faders and chasers control to be set. When a dongle has been detected simply connect to the dongle with "Open Port"
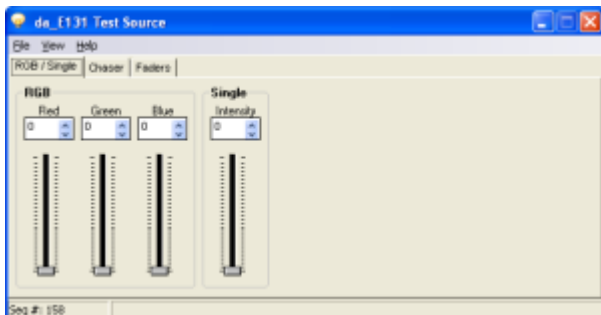
da_e131 controls an Ethernet based E1.31 based network.

da_e131 settings screen.
Allows the 1st and last channel that the faders and chasers control to be set, the universe or universes that are going to be controlled and the IP of the interface that you are going to control.
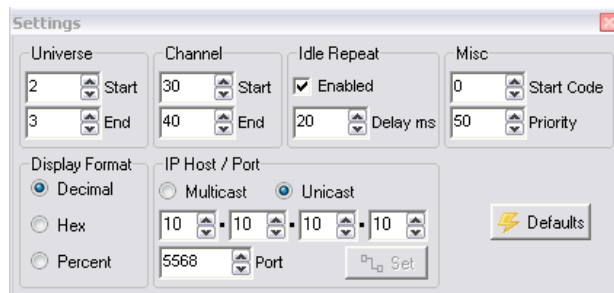
With both pieces of software you can use the R,G,B faders to fade up every 3rd channel or the single fader to fade up all channels in the channel range (white fade). The fader colours may not match the output as that is dependent on the channel range and the configuration of the DMX dimmer or interface.
On the chaser tab the desired intensity, delay between steps and the number of outputs that turn on in a group can be set.
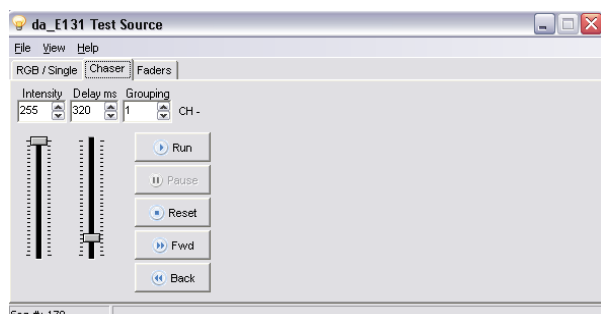
NirCmd is a small command-line utility that allows you to do some useful tasks without displaying any user interface. It can be used for varying volume throughout your show and has various other features that may prove useful.

sACNView is a Windows utility for viewing and controlling Streaming ACN levels on a network. It allows Streaming ACN data to be viewed in real time in a variety of ways, including whole universe views, individual channel displays, and oscilloscope and logging views.
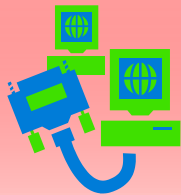
Communications Interfaces

Communication Interfaces Used

The communication interface is the way the computer talks to the controllers, there are different types of communications interfaces used and a decision must be made to decide what communication interface will best suit your needs. A controller must support the correct communication interface type or else it will not work. You can also set up multiple types of communication interfaces.

There are 3 main communication interface systems used by members of auschristmaslighting.com which are:

- **Light-O-Rama**
- **DMX512**
- **E1.31**

The network Interface is the link between the computer and the controllers
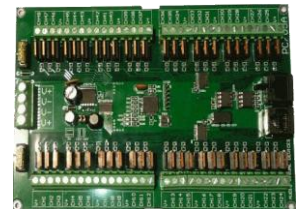
Renard is another communication interface that is currently not within the scope of this manual. For further info see http://doityourselfchristmas.com/wiki/index.php?title=Renard#Protocol

Light-O-Rama

Light-O-Rama (LOR) is a commercial offering that provides a good out of the box experience and is often used by people new to the hobby because of this experience. The LOR hardware can be bought pre-built making it easier for people not wishing to do DIY. The LOR communication will only support LOR hardware and controllers. The great thing about LOR controllers is that they can also be used with DMX which allows you to later take on a DIY approach while still incorporating your LOR controllers and has been a natural progression for many members. Connection is by a USB dongle.

The LOR network is connected to the computer through the USB port which uses controller numbers for seeing the controllers within a network. There is also no general limitations to how many controllers are connected within the same network (bandwidth limitations will apply)

The LOR communication has features like Hardware shimmer and twinkle as well as macros for use in the Colour Cosmic Ribbon (CCR) series which can't be used with any other non LOR hardware.

Light-O-Rama Layout

No limit to number of connected controllers except for bandwidth limitations

Cat5/6 cable

USB

LOR S3 or similar LOR supporting software

Network interface USB to RS485 LOR dongle

LOR ID: Controller 1 16 channels

LOR ID: Controller 2 16 channels

3 LED Section

LOR ID: Controller 3 158 channels
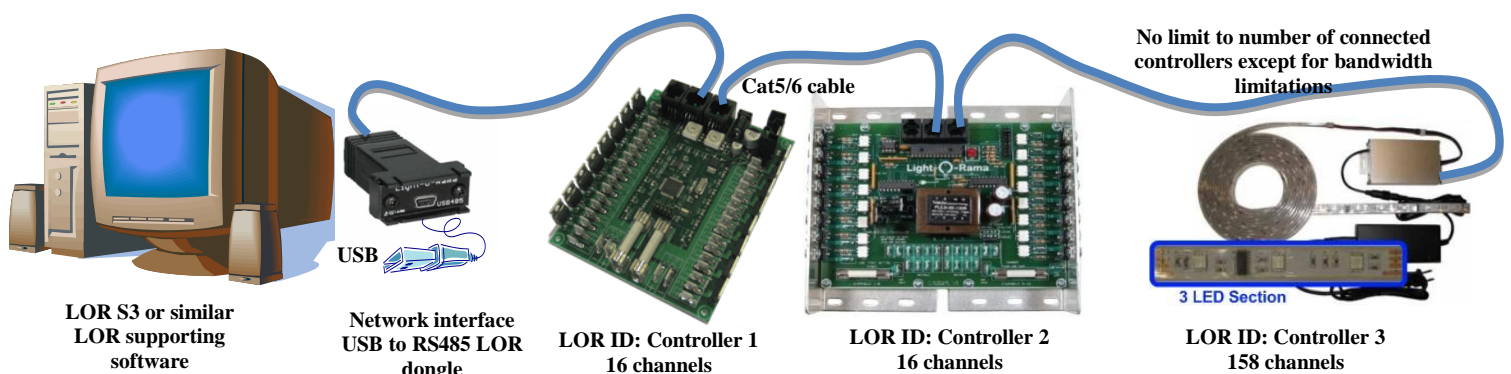
More information on the LOR protocol, connections, topology and technical data can be found at
http://auschristmaslighting.com/wiki/Category:Light-O-Rama
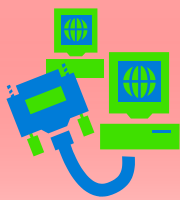
Communications Interfaces

DMX512

The DMX protocol is based on entertainment lighting industry standards, this means that you can use any of the devices that are DMX supported within your network, like laser machines, snow and bubble machines, moving light heads, etc. There is a huge choice of lighting controllers and machines that can be used with the DMX standard.

The DMX protocol is divided into 512 channels that make up a universe; one dongle controls one universe of 512 channels. Controllers are identified within the DMX512 universe by the start channel address unlike LOR which uses controller ID's. Only DMX enabled controllers will work with the DMX512 interface and it is recommended that the last DMX device has the DMX signal terminated

There are 2 types of USB DMX interfaces used, Open DMX and DMX pro, the pro version does the conversion on the dongle thus requiring less CPU overhead. LOR S3 does not support the DMX pro version dongle. It can be cheaper to actually use an E1.31 to DMX Protocol Bridge like the J1-Sys ECG-D4 which gives you 4 DMX512 universe outputs if you plan to have more than one DMX universe.
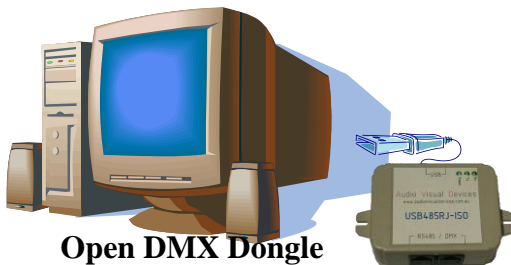
Open DMX Dongle
Processing is done on the CPU and then sent out through the open DMX interface
AVD USB485RJ-ISO Isolated Open DMX Dongle **AU$89.00**
This dongle gives you 2 shared DMX512 outputs and provides electrical isolation
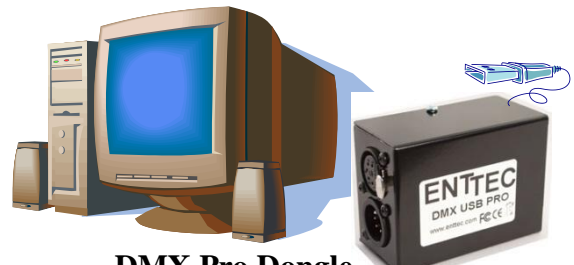
DMX Pro Dongle
Processing is done on the interface dongle itself thus reducing CPU load
Enttec Pro DMX Dongle **AU$180.00**
E1.31 interface using the ECG-DR4 is a much better valued option

DMX512 Layout

Controller numbers are set on the controllers and the controller will recognise the DMX signal for that channel range starting from the first channel

USB

Cat5/6 cable

Terminate the DMX signal on the last DMX device if available.
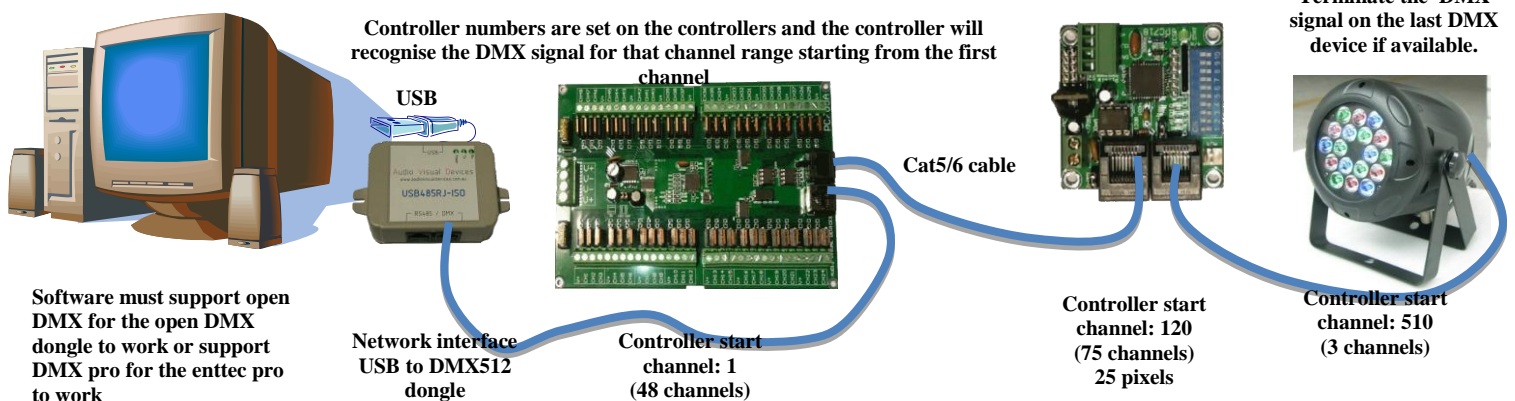
Software must support open DMX for the open DMX dongle to work or support DMX pro for the enttec pro to work

Network interface USB to DMX512 dongle

Controller start channel: 1 (48 channels)

Controller start channel: 120 (75 channels) 25 pixels

Controller start channel: 510 (3 channels)

Hardware does not need to be physically connected in sequential order
Maximum of 512 channels per universe

More information on the DMX protocol, connections, topology and technical data can be found at http://auschristmaslighting.com/wiki/DMX512
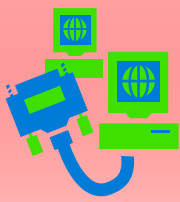
E1.31

E1.31 is the newest form of communications interface used in the hobby mainly designed for high channel count controllers (1000s of channels). The great thing with this is that it works from your RJ45 network output from your computer and connects either through a standard network switch for distribution to multiple controllers or if only using 1 controller will connect directly saving the cost on having a physical interface between the computer and the controller.

The E1.31 system is based on the DMX standard but instead of using USB dongles to connect up to the computer for each group of 512 channels (universe) it instead uses Ethernet, so it connects up to the RJ45 network output of your computer. E1.31 is DMX that has been packaged to run over a TCP/IP network and is primarily used for RGB pixel lights and E1.31 to DMX bridges. E1.31 can allow 200+ controllers hooked up into the same network using IP addresses and standard network switches to distribute

E1.31 allows multiple DMX based universes to transmit over
one communications interface

4 DMX universe E1.31 to
DMX Protocol Bridge

E1.31 Considerations

When using E1.31 there are a few things to take into consideration

- **Use a separate network for E1.31 to reduce any bandwidth sharing with your home network/internet. You can still use E1.31 shared with your home network/internet but you may see performance issues.**
- **If sharing your connection with your home network/internet, then the using a separate subnet address range is recommended.**
- **Use 100 Mb/s or faster switches and network interface controllers (NIC). 10Mb/s can be used but the number of universes used may need to be considered.**
- **Wireless connections can be used, but data packets may be dropped or not arrive in the correct order**
- **When using many universes it may be advantageous to use unicast to limit data swamping the E1.31 controllers**

   More information on the E1.31 protocol, connections, topology and technical data can be found at http://auschristmaslighting.com/wiki/E1.31
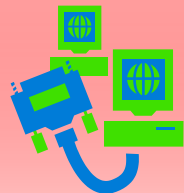
E1.31 Layout

Single E1.31 Device network
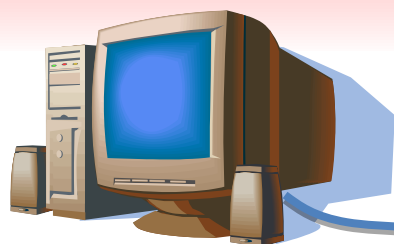
Software that
supports E1.31

Cat5/6 cable

12 Universes (2048 pixels)
IP No. 10.10.10.3

Multi E1.31 Device network

Software that
supports E1.31

4 Universes (2048 channels)
IP No. 10.10.10.5

Cat5/6 cable

**Each E1.31 device is identified
in the network by being
allocated an IP address**

12 Universes (2048 pixels)
IP No. 10.10.10.6

Network Switch used
for distribution

Cat5/6 cable

4 Universes (680 pixels)
IP No. 10.10.10.12

Further information on communication interfaces can be found at
http://auschristmaslighting.com/wiki/index.php/Interfaces

Power Supplies

Electrical Safety

Without power we can't run our lights so it's very important to understand the safety fundamentals with working with certain voltages. There has been a strong trend towards using Low Voltage DC LED lights, this has many safety advantages as shown in the below calculations. LEDS also only conduct electricity in one direction so direct current (DC) is the ideal safe choice.

We can see how the voltage and resistance affects the hazard posed by working with different common voltages use in the hobby.

Current = volts/resistance

An average human body resistance from extremity to extremity when dry (i.e. hand to hand, hand to foot) can be approx. 1500 ohms (this varies from person to person). So below shows how the voltage directly effects the current flowing through the human body

240 Volt supply
current = 240volts/1500ohms **= 0.16amps (160ma)**
current = 240volts/100ohms **= 2.4amps (2400ma)**
current = 240volt/0.1ohms = **2400 amps**

12 Volt supply
current = 12volts/1500ohms = **0.008amps (8ma)**
current = 12volts/100ohms = **0.12amps (120ma)**
current = 12volts/0.1ohms = **120 amps**

110 Volt supply
current = 110volts/1500ohms = **0.073amps (73ma)**
current = 110volts/100ohms **= 1.1amps (1100ma)**
current = 110volt/0.1ohms = **1100 amps**

5 Volt supply
current = 5volts/1500ohms = **0.003 amps (3ma)**
current = 5volts/100ohms = **0.05amps (50ma)**
current = 5volt/0.1ohms = **50 amps**

So its resistance and voltage that determine the current flow, it doesn't matter if you have a 40 amp circuit, it will only draw as much current as the resistance and voltage will allow

Warning 110/240 volt mains supply can cause serious injury or death

Current level (Milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions
5mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6mA - 16mA	Painful shock, begin to lose muscular control. Commonly referred to as the freezing current or "let-go" range.
17mA - 99mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible
100mA - 2000mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death is likely
> 2,000mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable

Power Supplies

Electrical Safety Tips

1: Leave all 110/240v mains voltage electrical connections and repairs to skilled maintenance personnel and licensed electricians

2: Only use plugs that correctly fit the outlet socket

3: Ensure that all terminals are tight

4: Ensure that a Residual Current Device (RCD) are fitted to all 110/240v power circuits. Also known as a Ground Fault Circuit Interrupter (GFCI).

5: All cables must be rated large enough to carry the load with the correct rated circuit protection (CB, Fuse) or this can generate heat and cause a fire.

6: All Steel/aluminium covers, enclosures or equipment that is not double insulated must have an earth wire securely connected

7: Do not work with electricity in the rain

8: Ensure electrical cables and extension cords are regularly inspected during the season to ensure there is no damage or exposed conductors and that they are safely used as to not cause damage.

9: Do not overload circuits or use multiple piggy back adaptors

10: Never work on live equipment or cables. Isolate the supply power before commencing work.

11: Test for any voltages before you touch any electrical wiring or equipment.

12: Do not use aluminium ladders or metal based ladders when working with electricity

13: Wear rubber soled shoes to increase your resistance to earth in the event of an electric shock

Power Supplies

The power supply is needed to power up the controllers and lights. The type of power supply used is determined by the lights you are controlling which then determines what controller you will use.

There are 3 types of power that we use which can be separated into:

- AC mains power
- Low Voltage AC power
- Low Voltage DC power

AC Mains Power Supplies

AC Mains power is generally used for rope lights and strings, especially in the US where most of the light strings are mains voltage. AC mains power is used by connecting mains power to the controller that then supplies computer controlled power to the lights.

110/240 volt controller

110/240 volt mains power supply

110/240 volt computer controlled lights
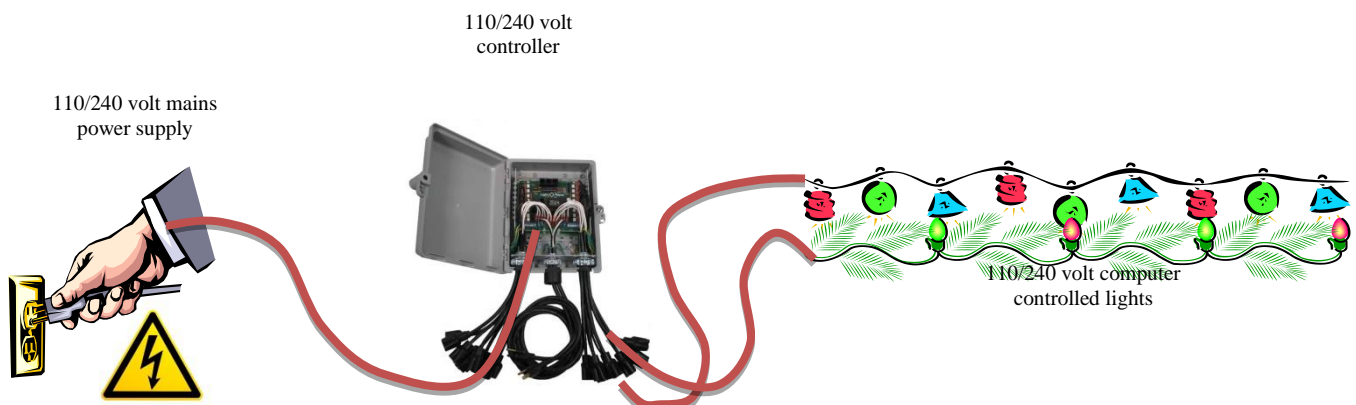
Warning 110/240 volt mains supply can cause serious injury or death

Power Supplies

Low Voltage AC Power

Low Voltage AC power (under 50 volts) is Mains supplied power that is transformed to a lower safer voltage. This is mainly done in Australia due to the danger that 240 volts poses. It is not good practice to connect low voltage transformers into a mains voltage controller as fading, twinkle, shimmer and any quick on/off/on can cause damage to the transformer and the outputs of the controller.

Controlling low voltage AC lights requires a bit more work compared to mains power to connect. A transformer is used to step down the power to a low AC voltage which is connected to the secondary non powered side of an LOR AC controller as the LOR AC controller must have a 110/240 volt supply to run on the primary bank to supply power to the controller CPU.

110/240 volt mains supply to transformer

Low voltage AC supply to left side of the LOR controller

Step down transformer

Low Voltage AC computer controlled lights

110/240 volt computer controlled lights

LOR AC Controller

110/240 volt mains supply to right side of the LOR controller
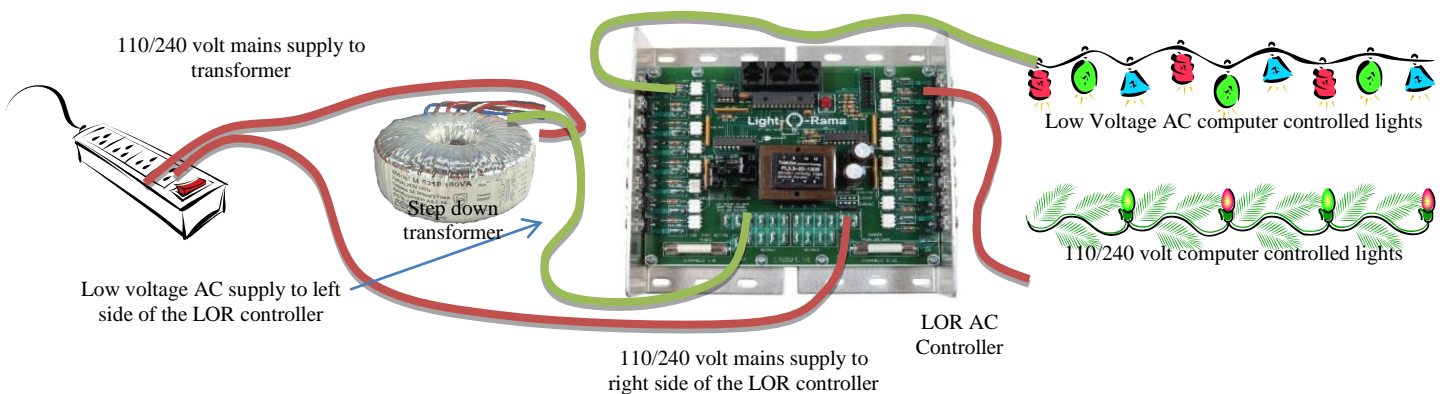
Low Voltage DC Power

Low voltage DC (under 50 volts) is fast becoming the power of choice, there are several reason why this is the case. Low voltage DC is safe to work with; LED lights function better with DC volts as they conduct electricity only in one direction, running LEDs with AC causes them to flicker. Most new RGB lights also use low voltage DC.

To use DC power we need to convert the power from a mains AC voltage to a low DC voltage by using a switch mode power supply (SMPS). The power supply must match the rated voltage of the controller and lights that you are using.

110/240 volt mains

DC Switch mode power supply

Low Voltage DC Output

DC Controller

Low Voltage DC computer controlled lights
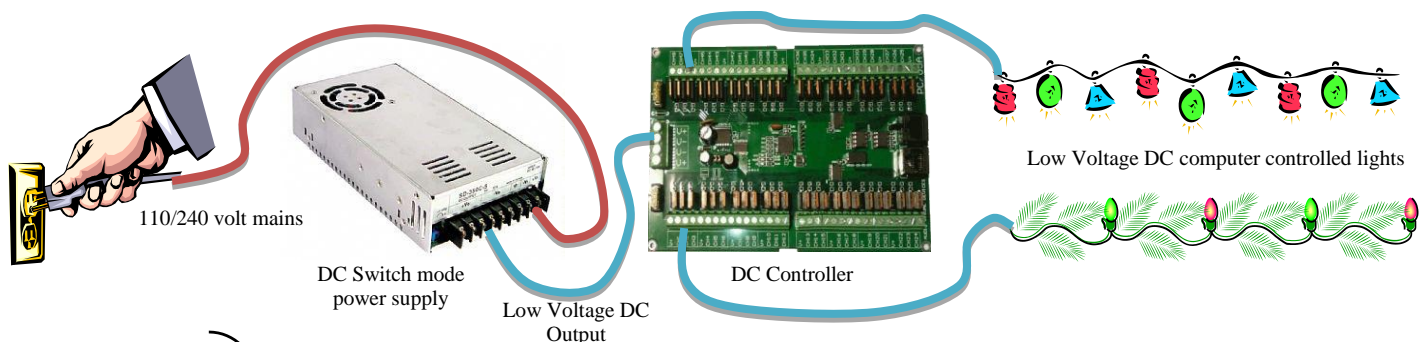
Further information on power supplies can be found at
http://auschristmaslighting.com/wiki/index.php/Power_Supplies

Power Supplies

Selecting the Correct Sized Power Supply

It is important to ensure that you select the correct voltage and output wattage of the power supply to run your lights. Switch mode power supplies (SMPS) should only be loaded to 85% of the power supplies rating to ensure the power supply is not overloaded. Most power supplies can be adjusted +/- 5% of the rated voltage.

The correct power supply can be found by adding the total wattage rating of any lights that will be connected to the power supply ensuring the total does not exceed 85% of the power supplies total wattage rating.

Ensure that the heat from your power supply can get out of your enclosure. Fan forced cooling is often required when you have several hundred Watts of power supplies.

Power Supply Required (Watts) = Total Light Load (Watts) / 0.85

If you do not know the rating of your lights then you can use an amp meter to check the current that your lights are drawing and add up the total current and then convert this into watts using Ohms Law

Power (watts) = Voltage (Volts) x Current (Amps)

If you don't have an amp meter then act on the side of caution, LEDs generally use about 1/8 to 1/10th of the power of incandescent lights

Further information on LED string testing can be found at
http://auschristmaslighting.com/wiki/index.php/LED_String_DC_Testing

The total current drawn by the low voltage lights is much less when measured at mains voltage input of the power supply. This can be shown by using Ohms law to work out the total current drawn by a 350 watt power supply running at 85% load

350 watts x 0.85 = 297.5 watts

Current (Amps) = Power (watts) / Voltage (Volts)

240 Volt supply	12 Volt supply
297.5 watts/240 Volts	297.5 watts/12 Volts
Current drawn = 1.24 amps	*Current drawn = 24.79 amps*
110 Volt supply	**5 Volt supply**
297.5 watts/110 Volts	297.5 watts/5 Volts
Current drawn = 2.70 amps	*Current drawn = 59.5 amps**
	*350 watt 5VDC power supplies are generally limited to 50 amps

Calculating pixel power usage

Pixel wattage can be roughly worked out using the following. Pixels will typically draw *about* 60mA per pixel when on 100% white. The power is Volts times Amps so for 5V pixels they will use about 0.3W/pixel. 12V pixels will use about 0.72W. Refer to supplier data for better info but remember the info isn't always correct and sometimes a single colour is specified.

Power Supplies

DC Power Supply Choices

Common DC Switch Mode Power Supplies generally come in sizes 350 watts (29amps@12VDC& 50amps@5VDC) and below. Higher wattages are available but the cost per watt dramatically increases. Power supplies are generally not designed to be paralleled together unless they are specifically designed for this which makes them very expensive.

Computer switch mode power supplies can be used but these are generally not the best choice as they are designed for less load fluctuations and also designed to draw power from the 5v and 3.3v side. The advantage to using a computer power supply is that there are no mains power leads to connect as the power supply already has a supply lead.

The price of switched mode DC power supplies varies greatly and so does the quality. There are cheap Chinese brands that do the job but it's recommended to keep a spare just in case as we have witnessed these power supplies blowing up. A high quality power supply brand is Meanwell. The construction, filtering and circuitry is far superior to the cheap Chinese brand but that comes at an increased price.

Meanwell Power supplies are high quality and robust and come in a range of voltages and output wattages.
275 watt, 55 amps @ 5vdc
300 watt, 25 amps @ 12vdc
312 watt, 13 amps @ 24vdc
240 watt, 8 amps @ 30vdc
Lower wattages are also available

Search for a local dealer. Prices around AU$120 are typical

Ray Wu sells a range of cheap power supplies ranging in different voltages and output wattages
350 watt, 50 amps @ 5vdc US$20.00
350 watt, 29 amps @ 12vdc US$20.00
350 watt, 14 amps @ 24vdc US$21.05
350 watt, 10.amps @ 27vdc US23.16
350 watt, 10.5amps @ 33vdc US$23.16
350 watt, 9.5 amps @ 36vdc US$23.16
350 watt, 7 amps @ 48vdc US$23.16
Other wattages are also available

The enclosed style of power supply shown above usually has a screwdriver adjustable potentiometer that will allow an adjustment range of plus or minus 10% of the default voltage.

A voltage selector switch is on the side of most of these style power supplies and must be set on the correct setting, 110V or 220V, before connecting to the mains.

A number of Aliexpress vendors supply power supplies as do ebay vendors. Extreme caution should be used with regards to quality especially if a vendor lists their power supplies as being Meanwell ones as clones are very common.

Cables

Cable Characteristics

The selection of cables can be a very important especially with low voltage DC lighting. This is because the wire within a cable has a rated resistance value, this resistance affects the voltage over a distance and the lower the voltage the higher % of voltage loss that is seen over a given distance

The below chart gives a general reference of different sized cables and their resistance

COPPER CABLE CHARACTERISTICS

Number & Size of Strands	Nominal Conductor Area (sq. mm)	Nominal Current Rating (Amps)	Maximum Resistance per metre (ohms @ 35°C)	Nearest Equivalent AWG (B&S)
10 x 0.12	0.11	1.1	0.17	27
7 x 0.16	0.14	1.4	0.13	26
1 x 0.5	0.20	2.0	0.10	24
14 x 0.14	0.22	2.2	0.088	24
7 x 0.2	0.22	2.2	0.086	24
1 x 0.6	0.28	2.8	0.067	23
1 x 0.7	0.38	3.8	0.049	21
14 x 0.2	0.44	4.4	0.043	21
10 x 0.25	0.49	4.9	0.039	20
63 x 0.10	0.49	4.9	0.039	20
50 x 0.12	0.55	5.0	0.035	20
60 x 0.12	0.68	6.8	0.028	19
89 x 0.1	0.70	7.0	0.027	19
24 x 0.2	0.75	7.5	0.025	18
112 x 0.10	0.88	8.8	0.022	18
30 x 0.2	0.94	9.4	0.020	17
1 x 1.13	1.0	10.0	0.019	17
32 x 0.2	1.0	10.0	0.019	17
512 x 0.05	1.0	10.0	0.019	17
168 x 0.1	1.32	13.0	0.014	16
7 x 0.5	1.4	14.0	0.014	16
30 x 0.25	1.5	15.0	0.013	15
26 x 0.3	1.8	17.0	0.010	15
168 x 0.12	1.9	18.0	0.010	14
26 x 0.32	2.1	19.0	0.0091	14
7 x 0.67	2.5	22.0	0.0077	13
1 x 1.78	2.5	22.0	0.0076	13
252 x 0.127	3.2	29.0	0.0059	12
41 x 0.32	3.3	30.0	0.0057	12
315 x 0.12	3.6	30.0	0.0053	12
630 x 0.12	7.13	50	0.0027	9
1666 x 0.12	18.84	120	0.0010	5

Note: The nominal current ratings are intended as guidelines for low power, electronics, communications and control applications only.

Metres to Foot Conversion

1 metre = 3.28084 feet

Divide the maximum resistance per metre by 3.28084 to get resistance per foot

[Wire cross sectionional area calculator](#)   thanks to David_AVD
[Cable voltage drop calculator](#)   thanks to David_AVD
[auschristmaslighting.com/wiki/Wire_Sizes](#)

Cables

Selecting the Correct Sized Cable

Finding the potential voltage drop is a matter of using Ohms law and using the table on the previous page. Using an under rated cable will cause the lights not to function correctly and in some cases can be a fire hazard.

Example: A 10 metre run of cable is 14/020 diameter (approx. 0.44mm2 or 21 gauge) with a 4 amp load

Let's first work out the total resistance of the cable, this value must be doubled because you also have to take into account the return cable as this is the complete circuit
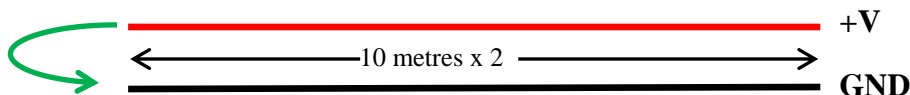
10 metres x 0.043 Ohms = 0.430 Ohms for 10 metres single way

0.430 Ohms x 2 = 0.860 Ohms total return circuit resistance

Now let's look how this affects the end result of different voltages with a 4 amp load

V = I (Current Amps) x R (Resistance Ohms)

240 Volt supply

V = 4 amps x 0.86 = 3.44 volts

Vdrop = 240v – 3.44= 236.56V

Vdrop% = 1.4% drop

12 Volt supply

V = 4 amps x 0.86 = 3.44 volts

Vdrop = 12v – 3.44v = 8.56v

Vdrop% = 28.7% drop

As you can see by these examples shown, the lower the voltage gets the higher the percentage of the volts that are lost. This is the reason electricity is sent long distances at very high voltages.

The same sized cable is unusable for the load when using low voltage, but is acceptable for use with mains voltage

110 Volt supply

V = 4 amps x 0.86 = 3.44 volts

Vdrop = 110v – 3.44v = 106.56V

Vdrop% = 3.1% drop

5 Volt supply

V = 4 amps x 0.86 = 3.44 volts

Vdrop = 5v – 3.44v = 1.56v

Vdrop% = 68.8% drop

Cables

Overcoming Voltage Drop

To overcome this issue with low voltage DC power and voltage drop you can:

- **Use a thicker cable which has lower resistance**
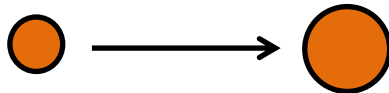
- **Raise the voltage of the power supply to compensate for the voltage drop**

12V — Power supply voltage adjustment → **13V** — Power supply voltage adjustment
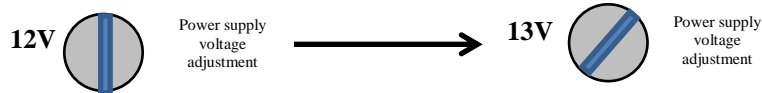
**Extreme caution must be taken when doing this to ensure you do not over power your lights and reduce their life. *Most 5V pixels will be damaged over 5.5V.*

- **Shorten the distance between the power supply and the lights/controller.**

- **Reduce the current load drawn.**
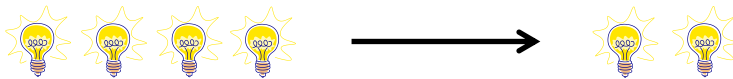
- **Double up the conductors**

From controller/power supply → From same outputs of controller/power supply
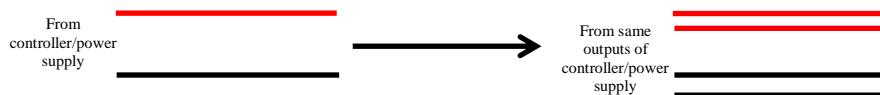
- **Inject additional power along the length of the lights**

From controller/power supply → From same outputs of controller/power supply
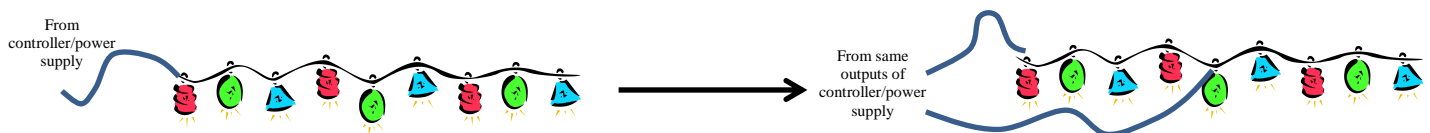
Cables

Cable Choices

Cable choice is dependent on the voltage and the current drawn as was shown in the previous examples. It is best practice when using mains voltage to use double insulated cables and extension leads as we must remember the last thing we want is to electrocute anyone. With low voltage applications the risk is minimal so cable choice can vary more.

4 core 14/020 security cable is commonly used with low voltage DC RGB lights because it is cheap and will carry approx. 4.5 amps. A standard 5 metre 30LED/metre RGB strip will draw 1 amp per colour per core. That means that the common return wire will be carrying 3 amps.
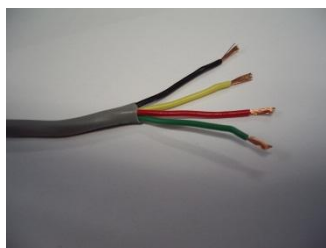
14/020 4 core security cable*
AU$42.00 100 metre roll
4.5 amps approx. 0.5mm2
Not for 240/110V use
*Australian supplier link
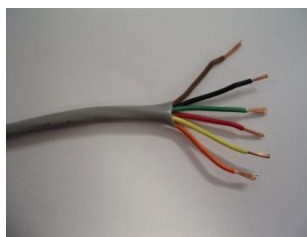
14/020 6 core security cable*
AU$62.00 100 metre roll
4.5 amps approx. 0.5mm2
Not for 240/110V use
*Australian supplier link

Plug Choices

Plugs are used to connect up lights for ease of connecting and disconnecting. For mains voltage plugs ensure that safety precautions are taken and the lights are connected through an RCD or GFCI.

For low voltage usage there is a selection of plugs that can be used.

4 core extension cable 0.75mm
1 metre long: US$ 57.89
2 metre long: US$157.89
3 metre long: US$273.68
Black
50 sets

2 pin male/female plug
$23.16
Black
50 pairs

White male/female plug
2 pin US$30.53
3 pin US$62.11
5 pin US$96.84
Per 100 pairs
4 pin $37.89
Per 50 pairs

*Plugs and leads can also be bought in custom numbers and custom lengths by request. The plug style shown here are available from a number of Aliexpress vendors and are available in black and white with 13.5mm and 15mm diameters and with 0.5mm^2 and 0.75mm^2 wires.

Cables

Pixel Power Injection Cable

This guide for selecting the right cable to use for pixel injection is by no means comprehensive and should only be used as a guide. As a general guide power should be injected into a pixel string at approximately every 50 pixels. If you discount that the pixel string/strip itself will provide a path for the power and use the following basic formula for working out how to inject power you should generally have good results. The following generalisations are made

1) each pixel will draw 50mA (16.5mA per colour per pixel). Different types and styles of pixels have different currents but for the sake of this guide 50mA should provide a good starting point.

2) cable losses are 5% at maximum load. This equates to a drop from 5V to 4.75V or 12V to 11.4V . A voltage drop of up to double that is probably acceptable at 12V and <u>may</u> be okay at 5V.

If the distance from the power supply or fused pixel controller is 2 metres then there will be 4 metres of cable. The 50 pixels that you will be powering before the next injection point will draw 2.5A. Based on the formula and table above calculate V=IxR. V=0.25V. I=2.5A so R needs to be 0.1 ohms or less. For 4 metres you would need a cable size that equates to less than 0.1ohms/4 (metres). This leads to a cable size of 0.75mm^2 or 18AWG.

Distance from power to injection point	Required cable size (5% loss)	Required cable size (10% loss)
2m	0.75mm2 (18AWG)	0.38mm2 (21AWG)
5m	1.9mm2 (14AWG)	0.95mm2 (19AWG)
10m	3.75mm2 (12AWG)	1.9mm2 (14AWG)
15m	5.6mm2 (10AWG)	2.8mm2 (13AWG)
20m	7.5mm2 (9AWG)	3.75mm2 (12AWG)

Ideally power injection should be added at the end of a pixel string as well. This is more critical with 5V pixels. Doubling up conductors will allow the use of smaller cable sizes (higher AWG numbers). If 6 core security cable is used for power as well as data then 3 conductors should be used for 0V, 2 for 5V/12V and 1 for data. If the pixel type requires data and clock then 2 conductors would be used for 0V. Security cable would only really be suitable for short cable runs like at the base of a mega tree. For long cable runs like along rooflines etc heavy duty figure 8 speaker cable is recommended.

Power Supplies

Injecting Power

Due to voltage drop it is important when connecting strips, strings and modules together that you also inject power between them to overcome the voltage drop. This is especially important when dealing with 5VDC and 12VDC

Single Power Supply

Single power supply injection is the most common and easiest way to inject power as this ensures all the lights connected share the same potential.

Wiring colours and orientation may vary

+V   GND   GND   +V   GND   +V

Clock   Data
Clock   Data
Clock   Data

Pixel Controller
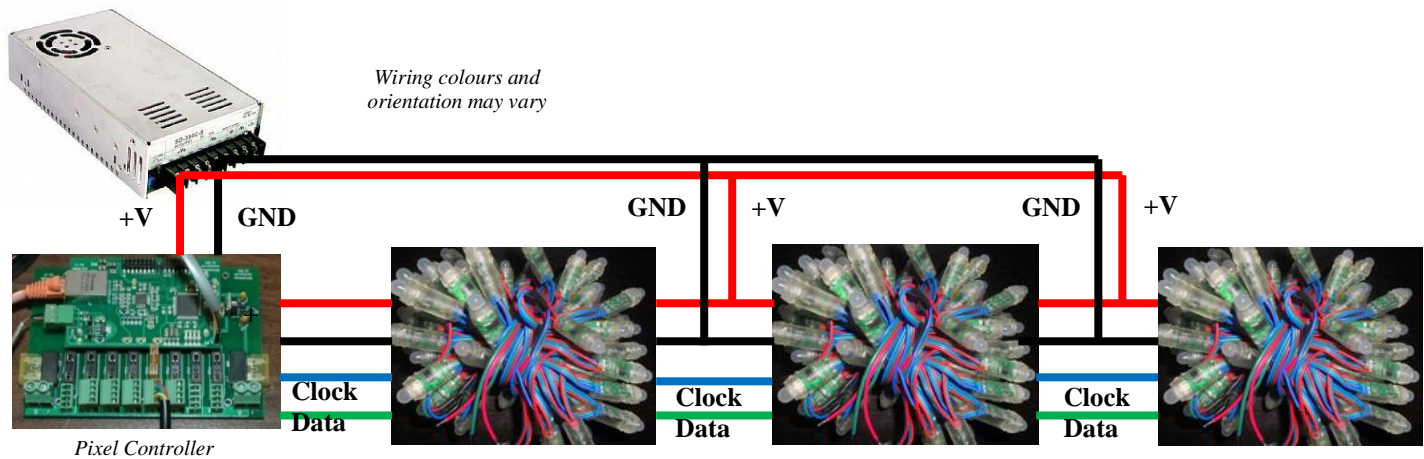
Multiple Power Supplies

You may use multiple power supplies when connecting up multiple intelligent lights together or over long distances. This is OK to do as long as you connect the ground (GND) wire together between the power supplies and controllers. You must ensure you do not connect the positive + wire between different power supplies unless they are designed for this (most are not). This is required to ensure the lights and IC (integrated circuits) has the same potential between each intelligent strip/string and/or module.

Wiring colours and orientation may vary

+V   GND   +V   GND   +V   GND

Clock   Data
Clock   Data
Clock   Data

Pixel Controller
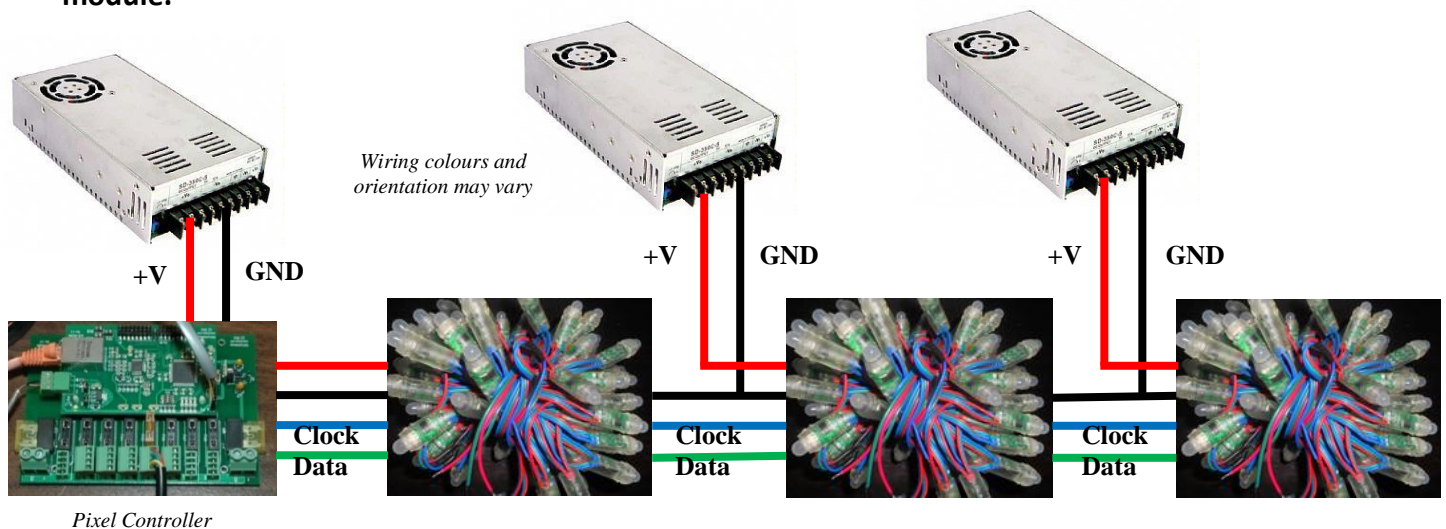
Controllers

Controllers are what take the data sent from the computer and converts that into actual light control or movement control. There are several types of controllers available with varying features, abilities and functions.

Data is sent from the computer using the same communications protocol that the controller supports, Either LOR, DMX512 or E1.31
So the controller and data from the computer must be the same for them to communicate

Light Controller   **Data in**

Controlled power out   **Power in**   **Controlled power out**

Computer controlled lights   Computer controlled lights

A Basic Example of the main connections of a standard controller.
- **Data in**
- **Power in**
- **Controlled power out**

A controller must 'talk' the same language as the data that it is receiving or else the controller will do nothing. The correct pin and plugs arrangement must also be used. The controller will also be rated to run at a certain voltage range and the lights used will determine what controller is used. It is very important that when connecting power to any controller that you have the correct wires connected or else this can cause severe damage to your controller.

Controllers can be separated into five main categories:

1. **AC Controllers**

2. **Low Voltage DC Controllers**

3. **Pixel Controllers**

4. **Protocol Bridges**

5. **Servo controllers**

AC Controllers

These controllers use alternating current (AC) to operate and use electronics (Triacs) that are designed to switch the AC supply. These cannot be used to control anything else other than an AC supply.

AC Controllers are used for things like mains voltage rope lights and strings, There is not a large selection of assembled AC controllers in the market place and there has been a shift away from AC controllers to using low voltage DC controllers instead as this is much safer. Most people start with using a couple of AC controllers to control their current lights before slowly replacing them with low voltage DC controllers.

Light-O-Rama (LOR) AC controllers are usually the best option for an assembled AC board as they have the flexibility to work with either the LOR protocol or the DMX protocol and allow the purchaser to gain confidence by buying from a well-known and established supplier that has solid warranty and support.

Further information regarding LOR Controllers can be found at
http://auschristmaslighting.com/wiki/index.php/Category:Light-O-Rama

Light-O-Rama (LOR) AC boards come mainly in 16 channel format with 2 x 8 separate powered sides. The Right side controls channels 9 to 16 and this side also provides power the electronics that power the controllers electronics. This must be either 110 volts or 240 volts depending on the position of the jumper.

The most common LOR controller used by members is the LOR CTB16PC which is depicted here

Ensure the correct jumper setting is used for the supply voltage used to power the controllers electronics
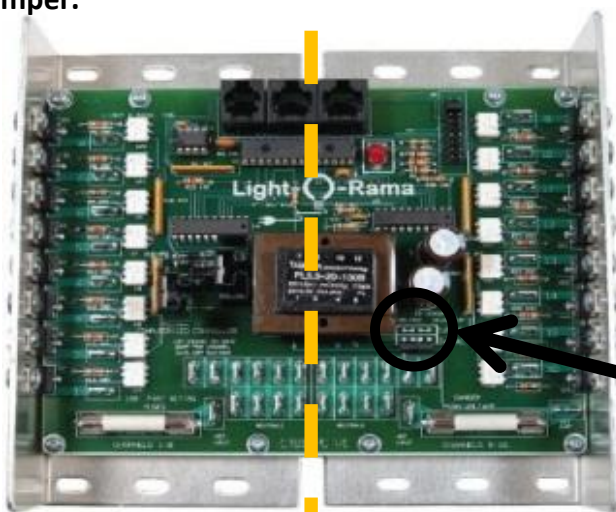
Left Bank Channels 1 to 8 Can be used for other AC voltages if required

Right Bank Channels 9 to 16 Supplies power to controller electronics

The left side controls channels 1 to 8 which can then be used to either control another voltage like 24 volts AC as this is separate from the right side. Or else you can just supply 110/240v to both the left and the right side so you have 16 channels of mains AC lighting control.

AC Controller Choices

AC controller choice is somewhat limited especially for the assembled versions; there are more choices when dealing with AC boards as a kit.

Light-O-Rama (LOR) PC 16 Range of AC controllers US$99.95 - US$249.95

These controllers come with a range of options including kit form.

These are the most commonly used AC board from LOR.

16 channels – 2 x 8 channel banks

8 amps per channel, 15 amps per bank

Spade terminals

Light-O-Rama (LOR) Pro Series Range of AC controllers US$329.95

These controllers come fully assembled with a steel enclosure

16 channels – 2 x 8 channel banks

8 amps per channel, 20 amps per bank

Screw terminals

There are a few AC controller kits available in the Renard range that can be purchased through **Do It Yourself Christmas (DIYC) forums** These boards can also be used with DMX if programmed with the DMX firmware. From time to time DIYC have group buys on the circuit board and components

Further information on Renard controllers can be found at
http://doityourselfchristmas.com/wiki/index.php?title=Renard_Main_Page

Warning 110/240 volt mains supply can cause serious injury or death
Refer to Understanding Electrical Safety before working with mains electricity

More info on AC and DC controllers can be found at **http://auschristmaslighting.com/wiki/Controllers**

DC Light Controllers

Low Voltage DC Controllers

These controllers use low voltage Direct Current (DC) and use electronics (mosfets) that are designed to switch the DC supply. These cannot be used to control anything else other than a low voltage DC supply. Low voltage DC Controllers are used for things like Low Voltage DC LED rope lights, string lights and RGB LED lighting. This is due to the fact that LED lights only conduct electricity in one direction and are Direct Current (DC) devices, so this makes using DC controllers the obvious choice when controlling low voltage LED strings, ropes and RGB LED lighting.

The main difference between an AC mains controller and low voltage DC controllers is the addition of a DC Switch Mode Power Supply (SMPS) which drops the main AC voltage down to a low voltage DC supply to be used with the appropriately rated controller and lights.

110/240 volt mains

DC Switch mode power supply SMPS drops the mains voltage down to a safe low voltage DC output. This is the only real difference physically between running an AC controller and a DC controller.

Low Voltage DC Output

DC Controller

Low Voltage DC computer controlled lights
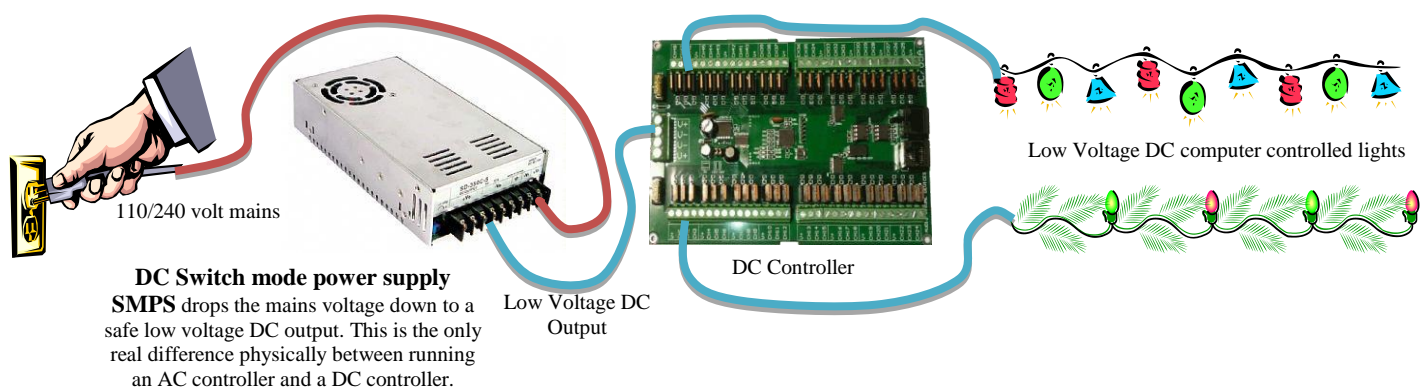
Low Voltage DC is relatively safe to use and work with and is an ideal voltage for our hobby. The difference in the wiring of a DC controller to an AC controller is just the names of the terminals as in both cases you must ensure you have the correct wires connected to the correct terminals or else permanent damage may occur to the controller. So to sum it up in very basic terms

Mains Active Line (A) in the DC world is equivalent to Positive + Line

Mains Neutral Line (N) in the DC world is equivalent to Negative – Line

Remember that DC controllers will only work with a low voltage DC power supply and AC controllers will only work with an AC supply (mains voltage or a lower value via a transformer). Never mix the two.

Further information on connecting to DC controllers can be found at
http://auschristmaslighting.com/wiki/index.php/Controller_Setups_and_Settings

DC Light Controllers

Low Voltage DC Controller Choices

Low voltage DC controllers come in the widest range of all the controller types used, this is mainly due to the explosion of low voltage LED strip, module and string lights coming out of China. There are also DC controllers available in kit form through the community. All the DC controllers are constructed as negative (-) switching so the LEDs used with these controllers must be common anode.

Hanson Electronics DC Controllers
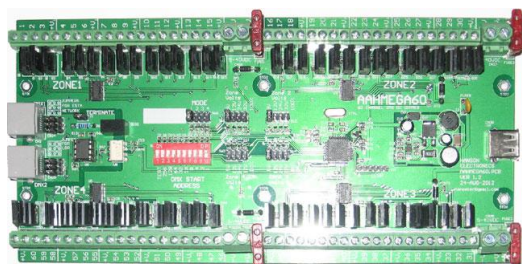
AAHmega60 **AU$250.00**

60 channel 4 x 15 channel banks
2 amps per channel, 30 amps total per bank
Quad DC input (5V-40V)
RJ45 Isolated DMX input, Screw terminals
Dipswitch selectable start address and test mode
Output voltage other than power supply can be selected
Australian made
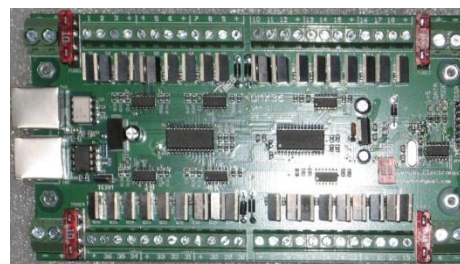
DMX36 **AU$129.00**

36 channel 4 x 9 channel banks
3 amps per channel, 30 amps total per bank
Quad DC input (5V-35V)
RJ45 Isolated DMX input, screw terminals
Dipswitch selectable test mode
Australian made

2801DC15 **AU$43.00**

15 channel 1 x 15 channel banks
2 amps per channel, 30 amps total per bank
DC input (5V-35V)
Isolated pixel input, Screw terminals
Australian made

2801DC30 30 channel available for AU$63

Note:- these controllers are connected as 5(10) pixels in a 2801 pixel network

2811DC15 **AU$40.00**

15 channel 1 x 15 channel banks
2 amps per channel, 30 amps total per bank
DC input (5V-35V)
Isolated pixel input, Screw terminals
Australian made

2811DC30 30 channel available for AU$60

Note:- these controllers are connected as 5(10) pixels in a 2811 pixel network

Refer to **Hanson Electronics** for more information

Light-O-Rama DC Controllers
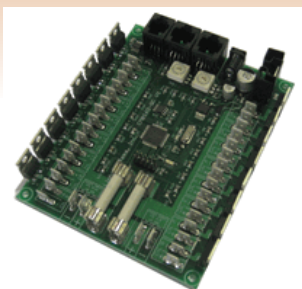
LOR CMB-16D-QC US$99.95

16 channel 2 x 8 channel banks
8 amps per channel, 20 amps total per bank
Dual DC input (12V-60V or 5V)
RJ45 Isolated DMX/LOR input, spade terminals

LOR CMD-16D US$119.95

16 channel 2 x 8 channel banks
8 amps per channel, 20 amps total per bank
Dual DC input (12V-60V or 5V)
RJ45 Isolated DMX/LOR input, screw terminals

Refer to the LOR CMB16D manual for more information at

http://www.lightorama.com/PDF/CMB16D_Man_Web.pdf

Advatek Lights DC Controller

Vortex RGB Control US$149.95

48 channel, dual supply
2 amp per channel (4A per 3ch), 30 amp/bank
Single DC input (5V-30VDC)
RGB DMX input, screw terminals
Australian made
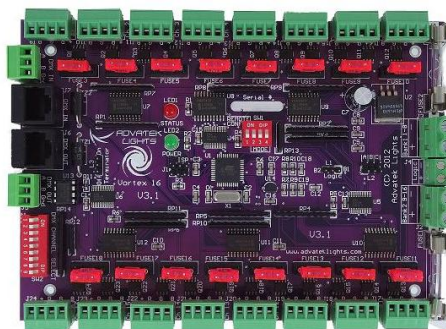
DC Light Controllers

Chinese DC 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 terminal 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.
Start address programmed by programmer or
dedicated software

Renard

There are a few DC controller kits available in the Renard range that can be purchased through Do It Yourself Christmas (DIYC) forums These boards can also be used with DMX if programmed with the DMX firmware. From time to time DIYC have group buys on the circuit board and components

Further information on Renard controllers can be found at

http://doityourselfchristmas.com/wiki/index.php?title=Renard_Main_Page

Many of the Chinese DC controllers are available from a number of Aliexpress vendors and some are available from HolidayCoro in the USA.

Pixel Controllers

Pixel controllers are a new breed of controllers used in our hobby which will only work with low voltage DC RGB Chip controlled pixel lights, these do not work with standard lights. The controller sends out data that communicates to a chip that is embedded into each section so you have control, this allows for great control of lighting without the hassles of having individual wires to control each section. One data circuit can control up to 680 individual lights. The data is transferred using 2 wires, a data and clock wire or with some types this can be a single wire transmission with only the data line which has an embedded clock signal. The data flows from one data controlled section to the next data controlled section, each section strips off the 3 channels that it is using and then passes the remainder to the next section and so on. A DC supply is also needed to supply the lights with power.

In simple terms think of a pixel controller as having the outputs that actually switch the lights at the lights themselves and the data comes out of the controller to then trigger these output switches at the lights.

Data in from computer *DC power supply in from power supply*

DC power supply out

Data & clock signal out

Channel 1,2,3   Channel 4,5,6   Channel 7,8,9   Channel 10,11,12

1 section

Data flows one section to the next section

IC Chip
Integrated circuit

IC Chip turns on light

Pixel Controller sends out both power and data to supply both power and data to the chip controlled sections.

100110001

Data + power is sent to the first LED controlled section

This data is then received by the first chipped section which then removes its 3 channels it has used before passing the remaining data to the next chip and so on

100110001

Data is converted into outputs

The data is then processed through the chip (IC) to then switch the supplied DC power to control the 3 outputs for the colours of the RGB LED

**A pixel controller will support different types of IC chips within the pixel lights, it is essential that you use the correct IC pixel lights with the correct controller or else the controller will not be able to communicate to the IC for the pixel lights.. IC pixel types are covered in the pixel light section

If a Pixel Controller is configured to send 2801 data to the IC pixel lights
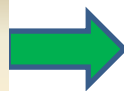
Then the IC chip on the pixel light must be a 2801 type for the lights to work

Pixel Controller Connections and Layout

There is nothing really confusing about connecting up a pixel controller, it is different is some ways from the connection of AC and DC controllers but the reality is the fundamentals are the same. A pixel controller requires power and data like an AC and DC controller to operate.

The output of a pixel controller is different because it has the added data connections. Power still comes out of the controller but this power is for supplying power to all the LED sections, it's the data that does the actual switching of the LED sections via the IC chip on the LED pixel. The distance the controller is away from the first pixel light is important and generally only 3 to 4 metres in distance can be achieved before the data signal is degraded and causes issues. The signal is regenerated between pixels, so by adding an extra pixel in between you can extend your supply range or use the J1SYS ECG-PPX

Pixel Controller Output
with power out and data
out (note some Pixel IC's
support 1 wire data and do
not have the CLK line

+V out
DAT
CLK
GND

+V in
DAT in
CLK in
GND in

Pixel light Input
Supply cable connects to 1st
pixel input, the data then
controls the power for each
section and the data is then
passed from section to section

4 core cable connects from pixel
controller to pixel lights and must be
no longer than 3 to 4 metres

DAT = Data
CLK = Clock

*Note: Wire colours and connection order may vary

Data sent from
network interface
to pixel controller

The physical layout for a pixel controller isn't very different from the physical layouts of AC and DC systems except the distance away your controller is from your lights can be when running pixels

Data sent from the pixel controller to
the pixel lights must be no longer than 3
to 4 metres apart or else use a 'dummy'
pixel to extend the range

Low voltage DC
power supplied to
pixel controller from
the DC power
supply

Data and low
voltage DC power
sent to pixel lights

The main components are similar to an AC or DC circuit
- **Computer**
- **Power supply**
- **Controller**
- **Lights**

Mains power supplied to
DC power supply

Simple pixel layout diagram

The E1.31 pixel controllers can process multiple DMX universes to control multiple different types of pixel IC types through multiple outputs. These controllers come with 2 banks so different voltages can be used as shown. The output types are set through the controllers software

Data sent from network interface to pixel controller

Output configured in pixel controller to send 2801 data out on output and the output is on the 5vdc bank

5vdc 2801 pixels string.

Add a single pixel light or use the ECG-PPX to extend pixel range if data signal becomes weak

Output configured in pixel controller to send 6803 data out on output and the output is on the 12vdc bank

5vdc in   **12vdc in**

12vdc 6803 pixels string.

Mains power supplied to DC power supplies

5vdc power supply

12vdc power supply

Dual voltage, dual pixel layout diagram   6803 @ 12vdc and 2801 @ 5vdc

Pixel Types and Configurations

Pixels come in 2 basic types. Strips or non strips. I'll use nodes (often found as strings) not to indicate the bullet type nodes in particular but as an indication that the pixel is not part of a continuous strip. This could be bullet nodes, modules or any of the other varieties that aren't a "strip". As a further subdivision of pixel types they are usually 5V or 12V. Due to the design of the pixel driver chip regardless of whether the pixel is 5V or 12V they will use approximately 55mA for most common styles when the pixel is lit up to 100% white.

Pixel strip in 5V will typically have 1 LED per IC with the IC sometimes embedded upon the LED as is the case with 2812 and a few other pixel styles. 12V pixel strip will usually have 3 LEDs for each IC. This means that there is 3 times the light output but 1/3 of the resolution. The exception to this rule at this time is the INK1003 pixels which are 5V pixels and as such are 1 pixel per IC but they are powered via a stepdown 12V to 5V regulator.

Pixel nodes that are 5V will always have 1 LED per IC. Each pixel will use 55mA (0.275W).

Pixel nodes that are 12V will be either 1 LED per IC like in bullet nodes or most individual LED string type pixels or they will be 3 LEDs per pixel for modules. Some modules may actually have 9 5mm LEDs as the red, green and blue LEDs are not in the same device like in a 5050 LED. All of the 12V pixels will also use 55mA (0.66W) with the single LED devices using the extra 0.375W purely as heat. The triple led modules etc will also use 55mA but will be putting out 3 times the light.
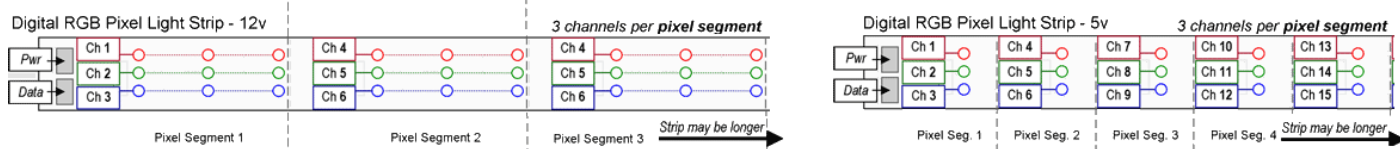
Pixel Light Controllers

Pixel Controller Choices

Pixel controllers come in DMX, LOR and E1.31 data inputs. E1.31 is the preferred method due to its ability to process multiple universes and channels of data with one data line from the computer or network switch. This is advantageous as pixel lights use up channels very quickly and for DMX512 you would only get 170 RGB Pixel lights per DMX512 universe.

DMX512 may be a better option if you only have a few elements in your display that are pixel based or if you need to distribute only a few pixel lights in different areas of your display as they are generally cheaper.

Note:- Most pixel controllers with fused outputs are incapable of supplying all the current that the attached pixel string requires. If there is more the 50 pixels attached then separately fused power injection is required

DMX Pixel Controller Choices

AVD APC718 P-DMX Pixel/Servo 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

NOTE: The IC of the intelligent RGB lights used must be supported by the pixel controller

LOR Pixel Controller Choices

3 LED Section

Light-O-Rama Cosmic Color Ribbon (CCR)
US$250.00
The CCR is a complete product; it has the pixel controller, the CCR strip and the power supply as a complete plug and play package. The controller is designed to run one CCR five metre strip
150 Channels, 50 Pixels
CCR (6801) support only
Single 12vdc supply
DMX and LOR protocol enabled
Standalone operation
1 x Input

E1.31 Pixel Controller Choices

Advatek PixLite 16 Plug and Play **US$449.95**

A Pixlite 16 controller in an enclosure with 320W power supply, splash proof venting and waterproof cable glands for all mains and data connections.
16 Fused outputs, 32 universes, 5440 pixels
TLS3001, SM16716, LPD6803, WS2801, WS2811, WS2812, WS2812B, TM180x, MBI6020, INK1003
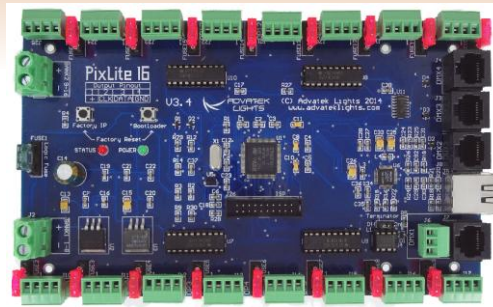
Advatek Pixlite 16 **US$229.95**

16 Fused outputs, 32 universes, 5440 pixels
TLS3001, SM16716, LPD6803, WS2801, WS2811, WS2812, WS2812B, TM180x, MBI6020, INK1003
4 DMX outputs
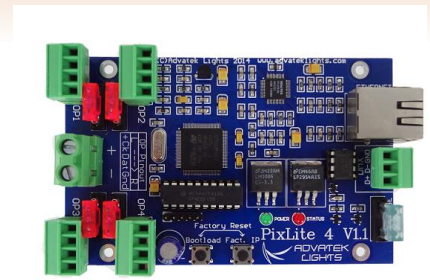
Advatek Pixlite 4 **US$129.95**

4 Fused outputs, 16 universes, 2720 pixels
TLS3001, SM16716, LPD6803, WS2801, WS2811, WS2812, WS2812B, TM180x, MBI6020, INK1003

J1SYS ECG-P12S **US$225.00**

12 Universes, 2040 Pixels
12 Fused outputs, 6 x 2 banks
2801, 6801, 180x,INK1003 pixel support
2 DMX outputs
2 x DC input (5V-24VDC, 5VDC)
RJ45 E1.31 input,
Screw terminal plug Outputs
HTML Page hardware setup
Supports Unicast

J1SYS ECG PIXAD8
US$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
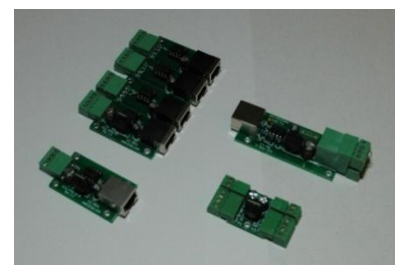
J1SYS ECG-PPX **Pixel Extender US$9.00-$25.00**

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 are a few pixel extender driver and receiver boards to choose varying in power outputs.

A number of J1 Sys Controllers are stocked in Australia at clap-supplies.yagoonalights.com

E1.31 Pixel Controller Choice

San Devices E6804
The E6804 keeps the full E682 feature set, but in a lower-cost and more compact 4-output package. Unicast E1.31 and Art-Net (up to 12 universes) and expands Multicast E1.31 to 7 universes.
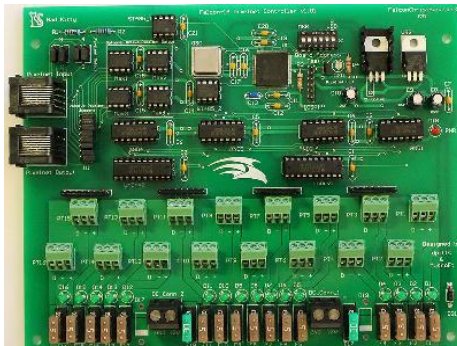
Falcon-16 Pixelnet Controller US$105
Available in fully assembled or kit form.
16 Fused outputs

J1 Sys ECG-P2 US$75 ($85 w/case)
2 Unfused outputs, 2801,2811, 6801, 180x, pixel support
4 universes per output. 1360 pixels

SanDevices E681 Pixel Controller
US$200.00 assembled, US$120.00 Kit
4 Universes 2048 channels , 680 Pixels
16 Fused outputs, 8 x 2 banks
2801, 6801, 880x, 180x, 3001, 3005, 9813, GE Colour effects and 1 wire native DMX pixel support
2 x DC input (7V-24VDC, 5VDC)
RJ45 E1.31 input, Screw terminal plug Outputs
Command based hardware setup
*available as a vendor group buy from time to time at reduced costs from http://www.doityourselfchristmas.com
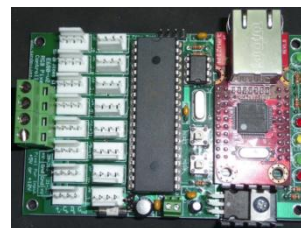
SanDevices E680 Pixel Controller
US$ N/A assembled, US$ N/A Kit
4 Universes 2048 channels , 680 Pixels
16 non fused outputs, 8 x 2 banks
2801, 6801, 880x, 180x, 3001, 3005, 9813, GE Colour effects and 1 wire native DMX pixel support
2 x DC input (7V-24VDC, 5VDC)
RJ45 E1.31 input, Molex plug outputs
Command based hardware setup
*available as a vendor group buy from time to time at reduced costs from http://www.doityourselfchristmas.com

NOTE: The IC of the intelligent RGB lights used must be supported by the pixel controller. Protocols are being added to controllers regularly.

Pi Player

Sequence Playback Device

FPP Player (Falcon Pi Player)

David Pitts in combination with a few other people developed an application for the Raspberry Pi single board computer that allows sequences to be played back and control Christmas lights via E1.31 and also USB dongles.

Features of the software.

* Outputs at least 128 Universes of E131
* Plays music files and outputs audio on 3.5mm jack.
* Embedded web page configuration.
    Setup playlists, schedules, upload sequence and music files. Setup optional RDS feature.
* Uses a user defined NTP server to keep accurate time.
* FTP Server (Optional)
    Can be used to transfer files to player. FTP transfers of 64 MB sequence files are averaging 10 seconds.
* Optional Server and Client operation by using inexpensive USB wireless interface in each.
  Using USB wireless card in both server and clients will allow E131 data to be transmitted on hard wired interface
  and have all sync information sent on wireless interface. Allowing for a small amount of data on the wireless sync network.
    USB network interfaces are about $10.00.
* Optional RTC clock board if internet based NTP is not available for scheduling of shows.
* Optional RDS ASCII output.
*Play video on 1080p HDMI output.
* Client and slave will be same software just a configuration change.
* Output up to 32768 channel for Pixelnet, 6144 channels of DMX. 12 RS-485 circuits. (Optional Falcon Pixelnet/DMX board (FPD) needed)

xlights/nutcracker is used to convert sequence data to FPP file format.
The Rasberry Pi is available from a number of places with and without the plastic protective case
The plastic case is optional but an SD card, 5V power supply and micro USB lead is required. A USB thumbdrive is used to store sequences etc.

Australia - Element 14. Bare Model B Pi	AU$38
USA - Amazon.com Bare Model B	US$37.49
USA- Amazon.com Ultimate-Includes-Essential-Accessories	US62.95

A wifi dongle will allow wireless connection to the Pi and also allows the onboard clock to update if the wifi is connected to the internet. If the Pi is going to be used for scheduled programs then either a wireless connection or a real time clock module should be used. There are a few clock varieties available including this 1.
.

Pi Player
Sequence Playback Device

Information

Tutorials

Computer	Raspberry Pi Model B, 512mb
SD card needed?	Yes,4gb for OS
USB Flash Needed?	Yes,8-32gb for music, sequences, movies
Outputs Music thru 3.5mm jack	Yes. OGG, MP3, MP4 files
Uses a user defined NTP server to keep accurate time	Yes
Optional RTC clock board	Yes
Optional RDS ASCII output	Summer 2014
Play composite NTSC/PAL video output	Yes
Play video on 1080p HDMI output	Yes
Video playback synchronized with sequence data	Yes
Output: E1.31	at least 64 universes
Output: Pixelnet	32768 channels (with fpd)
Output: DMX	6144 channels (with fpd)
Output: Lynx Pixelnet USB dongle	Yes
Output: DMX Pro compatible USB dongles	Yes
Output: DMX Open compatible USB dongles	Yes
Output: Renard	Yes
Output: Output: Pixelnet-Open. It allows you to send one Universe of Pixelnet out via a USB-to-RS485 adapter.	Yes
Output: single strand of WS2801 pixels directly attached to the SPI port on the Pi	Yes
Channel remapping. Remap one or more channels during output to avoid re-sequencing at the last minute	Yes
Master/Slave synchronization between multiple Pi's for supporting higher channel counts.	Yes
Memory mapped channel overlays to allow external scripts to overlay data onto the channel data being output,	Yes
Channel Test Mode, allowing the user to toggle channels on or off to test lights, cables, etc..	Yes

Light-O-Rama and Minleon both also produce sequence playback devices.

Protocol Bridges

A protocol bridge is a device that converts the data signal from one type to another, it isn't actually a light controller but instead it changes the communications data from one protocol to another. This is mainly seen with E1.31 to DMX where the data is converted from an E1.31 protocol to the DMX512 protocol. This then allows you to run DMX512 devices from an E1.31 network and allows multiple DMX universe outputs without having to use a separate DMX512 USB interface dongle for each DMX512 universe.

E1.31 is sent out from the computer RJ45 network interface

E1.31

Protocol Bridge receives the E1.31 data and then converts this data to DMX512

DMX512

DMX Controller receives DMX data and doesn't know the data originated from E1.31
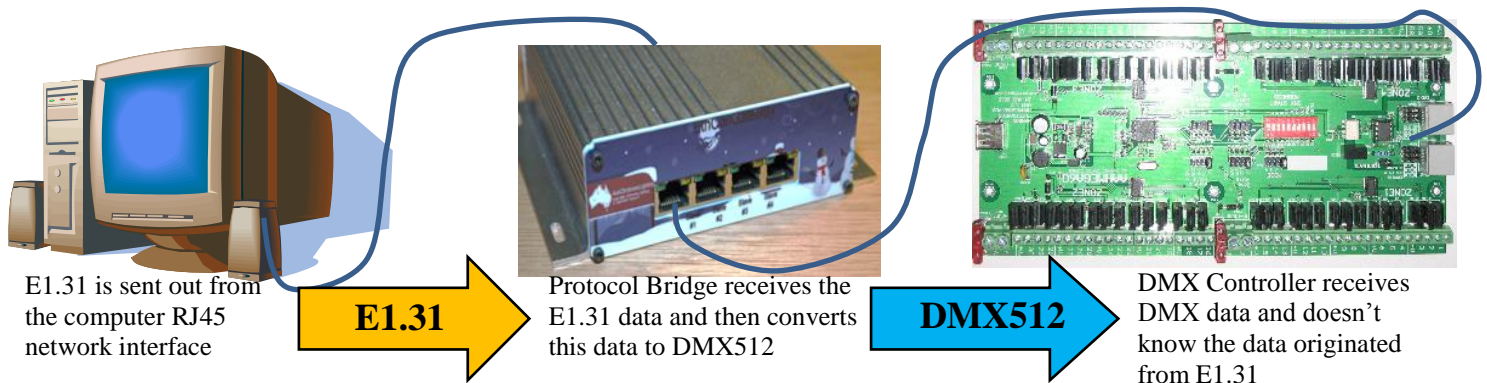
E1.31 to DMX Protocol Bridge Example

Protocol Bridge Choices

J1SYS E1.31 to DMX Bridge
ECG-DMXRen8 US$215.00 PKG8 Kit only
This protocol bridge converts the E1.31 communications protocol to DMX512 or Renard protocol, see link above for more detail on availability
E1.31 to 8 DMX universe outputs
4096 channels (512 x 8)
E1.31 to 8 Renard outputs
5VDC Supply

J1SYS E1.31 to DMX Bridge
ECG-DR4 US$145.00 PKG2 Complete unit + PSU
This protocol bridge converts the E1.31 communications protocol to DMX512 or Renard protocol, The DR4 is fully assembled
E1.31 to 4DMX universe outputs
2048 channels (512 x 4)
E1.31 to 4 Renard outputs
5VDC Supply (supplied)
Also
http://www.j1sys.com/ecg-d4/
http://www.j1sys.com/ecg-d2/

SanDevices LOR to E1.31 Bridge US$ 95.00 kit $125 Assembled
Converts LOR protocol to E1.31 output
2048 channels (4 universe) and one output of DMX512
This is not an official LOR supported device

LOR to E1.31 output (4 Universes)
LOR to DMX (1 universe)
6~24VDC power supply.
1 Amp 5VDC output

Servo Controllers

Servo Controllers

Servo controllers are used to control small DC motors and servos for the use with animatronics; they control physical movement for use in different motion props.
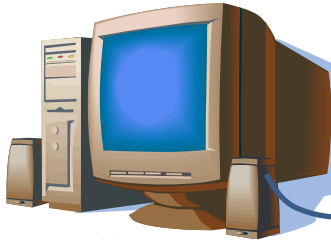
Servo positions are programmed into the sequencing software

Servo controller converts data to an output to control the servo

Servo for creating movement on props

Servo Controller Choices.

LOR ServoDog8   US$95.95
8 channel servo control
6 digital inputs
Can be configured with 2 channels of
pulse width modulation (PWM)
DMX in, LOR in

BOC 16 Channel Servo Controller
US$90.00 Board only
US$190.00 Complete with power supply
16 channel servo control
8 or 16bit output
DMX in

AVD APC718 P-DMX Pixel/Servo Controller
AU$33.00
Single DC input (12V-35VDC)
Five servo outputs (1.5A max load)
RJ45 DMX input,
screw terminals
Dip switch DMX addressing
Current overload protection
P-DMX enabled
Australian made

Basic Layout Examples

The Light-O-Rama Network

The LOR system is a commercial product that provides strong warranty and support but is more expensive than the DIY options. The LOR system can also run a DMX universe by either purchasing the advanced version of LOR S3 software or by purchasing an iDMX1000 DMX interface ($259.00)

There are no limitations to how many controllers are connected to a LOR network, but bandwidth restrictions may reduce this to around 1000 channels

LOR controllers will also run in a native DMX universe.

Refer to Running LOR Controllers in DMX presentation for further info on running LOR controllers in a DMX universe

FM Transmitter and antenna

Cat5/6 network cable

Connect to AC power Supply

Cat5/6 network cable

Connect to DC power Supply

3 LED Section
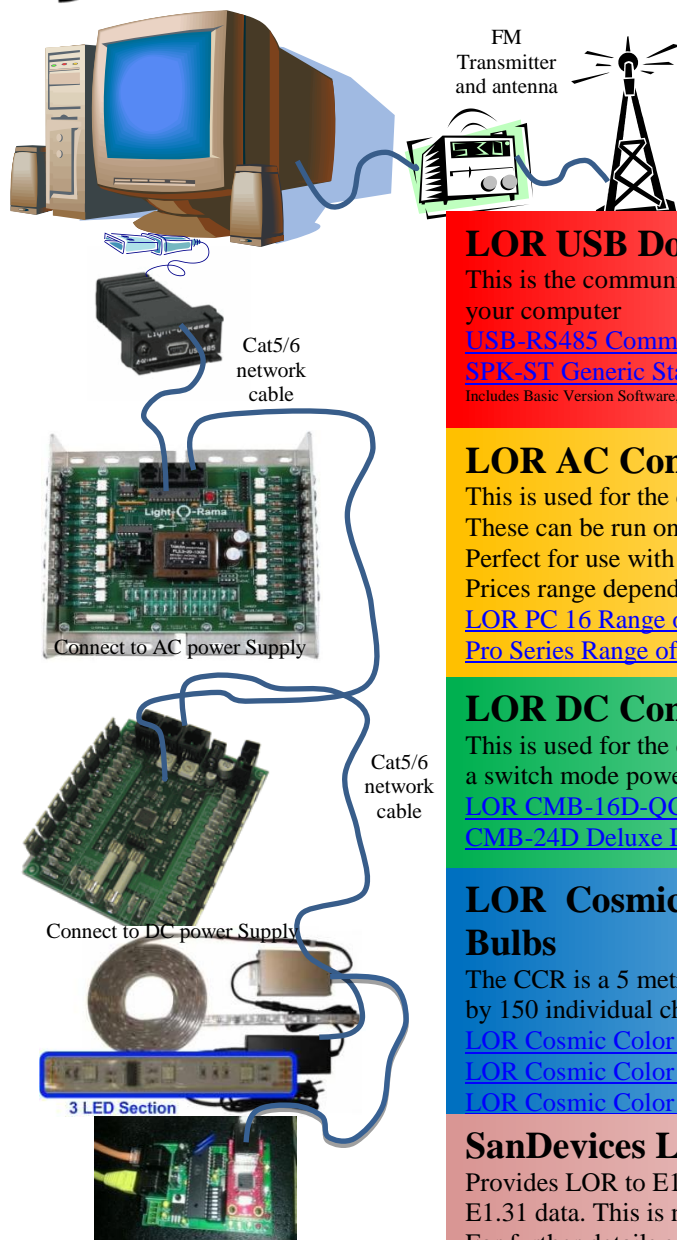
LOR USB Dongle

This is the communications interface that plugs into your USB port of your computer

USB-RS485 Communications Adaptor   US$29.95

SPK-ST Generic Starters Package   US$49.95

Includes Basic Version Software, USB Cable and 10ft Cat 5 cable

LOR AC Controller.

This is used for the control of AC lighting that is connected to your mains

These can be run on either 110v or 240v by jumper selection.

Perfect for use with mains voltage strings and rope lights

Prices range depending on the model and options that are selected

LOR PC 16 Range of AC controllers   US$104.95 - US$259.95

Pro Series Range of AC controllers   US$329.95

LOR DC Controller.

This is used for the control of low voltage DC lighting that is connected to a switch mode power supply. Perfect for use with LEDs and RGB lighting

LOR CMB-16D-QC Deluxe   US$99.95

CMB-24D Deluxe DC Card   US$109.95

LOR Cosmic Color Ribbon (CCR), Pixels and Bulbs

The CCR is a 5 metre RGB Pixel ribbon strip light that can be controlled by 150 individual channels to make up 50 individual sections

LOR Cosmic Color Ribbon   US$249.95

LOR Cosmic Color Pixels US$239.95

LOR Cosmic Color Bulbs US$289.95

SanDevices LOR to E1.31 4 universe Bridge

Provides LOR to E1.31 data to allow LOR users to use 4 universes of E1.31 data. This is not an officially supported LOR device.

For further details see www.sandevices.com

Further information regarding LOR Controllers can be found at

http://auschristmaslighting.com/wiki/index.php/Category:Light-O-Rama

The total length of network cable can be up to 1.2km
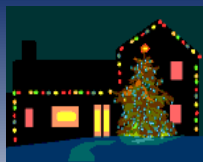
Basic Layout Examples

DMX512

FM Transmitter and antenna
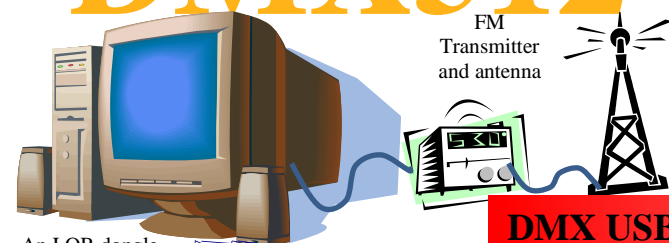
An LOR dongle can also be used as an open DMX dongle but requires the LOR to DMX adaptor to work with DMX devices

Cat5/6 network cable
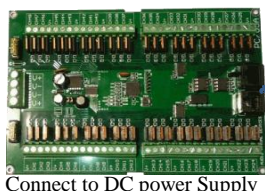
Connect to DC power Supply

LOR to DMX adaptor
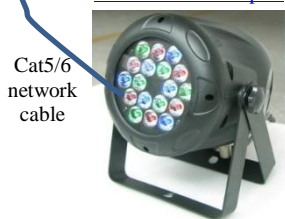
Cat5/6 network cable

DMX Termination on the last DMX device

The DMX512 Network

The DMX512 system is based on industry standards and is physically similar to the LOR layout. The DMX network is 512 channels per universe, for each universe you require another USB communications interface dongle.

Controllers are setup in a network by setting the start channel on each controller instead of using controller numbers which LOR uses.

A DMX network opens up a whole new world of choices as you can use many of the different types of DMX controllers and devices that are available in the market place. LOR controllers can also be used within a DMX network

DMX USB Communication Interface

There are 2 types of DMX dongles available, the open DMX model uses the CPU to process the data whereas the DMX pro uses the onboard DMX chip to process thus having lower over heads.

AVD USB485RJ-ISO Isolated Open DMX Dongle   Au$89.00
Hanson Electronics Open DMX Dongle   Au$22.00
Entec Pro DMX Dongle   Au$180.00

Hanson Electronics DMX DC Controllers

Hanson Electronics sells 2 DMX DC controllers. These boards both have signal isolation

AAHmega60   Au$250.00
DMX36   Au$129.00

Advatek Lights DMX Controllers and Devices

Vortex 16   US$229.95   48 channel. Isolated

Ray Wu Budget Controllers.

These DMX controllers are low cost

27 Channel DMX   US$44.21   Isolated
3 Channel DMX   US$8.95   Not isolated

LOR Controllers Running in DMX.

LOR controllers can be connected into a DMX universe by using a LOR to DMX to LOR adaptor cable. Refer here for more information

LOR Online Store   US$99.95 - US$329.95

Other DMX Controllers and Devices

With DMX you are able to connect a range of different DMX enabled equipment like laser and snow machines. There is a very large selection of available DMX enabled devices   Ray Wu Online store

Further information regarding DMX512 can be found at

http://auschristmaslighting.com/wiki/index.php/Category:DMX

Refer to the comparison chart for more DMX enabled controllers

http://auschristmaslighting.com/wiki/index.php/Controllers

The total length of network cable can be up to 1.2km

Basic Layout Examples

E1.31

Cat5/6 network
cable

FM
Transmitter
and antenna

Cat5/6 network
cable

Connect to DC Power Supply

Connect to DC power Supply

Cat5/6 network
cable

The E1.31 Network

The E1.31 network is the same as a normal TCP/IP network, the computer uses IP addresses to tell the controllers what to do. Distribution is done through a standard computer network switch using standard Cat5/6 cable to connect to each controller and is not daisy chained like DMX or LOR . E1.31 networks are preferred for using with RGB pixel lights as these lights use 3 channels per light and the number of channels and universes used goes up very quickly. The e1.31 network is the newest of the networks and is now gaining very strong support due to its great flexibility, high channel counts, low ownership per channel and performance.

Network Distribution Switch

To distribute the data to your controllers in E1.31 you use a standard computer network switch. Each controller has an IP address that you set and its best to ensure that your controllers are all set up IP addresses in the same range, eg; Controller 1: 10.10.10.5, Controller 2: 10.10.10.6, etc

J1SYS ECG E1.31 Pixel Controllers

J1SYS sell a range of E1.31 controllers with different features.
ECG-PIXAD8: 8 Universe (4096 channels) , 8 Fused outputs: US$135.00
ECG-P12R: 12 Universes (6144 channels), 12 Fused outputs: US$150.00
ECG-P2: 8 Universe (4096 channels) , 8 Fused outputs: US$75.00-$85.00

Advatek Lights Pixel Controller

Pixlite 16 32 Universe (16320 channels), 16 Fused outputs US$229.95
Pixlite 4 16 Universe (8160 channels), 4 Fused outputs US$129.95

SANDEVICES E68x E1.31 Pixel Controllers

SanDevices sell a number of versions of the E68x controllers in both kit form and assembled.
E680: 4 Universes (2048 channels), 16 non fused outputs
E681: 4 Universes (2048 channels), 16 Fused outputs
E6804 4 Fused outputs

J1SYS E1.31 to DMX BRIDGE

J1SYS also supply an E1.31 to DMX Bridge which converts the E1.31 data stream into 4 separate DMX Universe Outputs. This allows you to also use DMX devices and controllers within an E1.31 network.
ECG-DR4: 4 DMX Universe Outputs, fully assembled: Pkg 2 US$145.00
ECG-D4 4 DMX Universe Outputs, fully assembled: US$105.00
ECG-DMXRen8: 8 DMX Universe Outputs in Kit form: Pkg 8 US$215.00

Further information regarding E1.31 can be found reading

Understanding E1.31 Presentation

The maximum length of network cable between any 2 devices is 100m.

FM Radio Transmitters.

A FM radio transmitter is used to broadcast the music from your sequence software on your computer to the audience's car radios. FM Radio transmitters can vary greatly in price, sound quality and output power.

The FM radio transmitter is connected to the audio out of your computer and tuned to an open frequency for the cars to tune into the FM frequency you have chosen to transmit on. You can either use the antenna that comes with the transmitter or else you can build your own antenna

Speakers and Amplifier

Computer audio jack out   **FM Transmitter with clear frequency**   **FM Antenna**   **Car tunes into FM frequency for music**
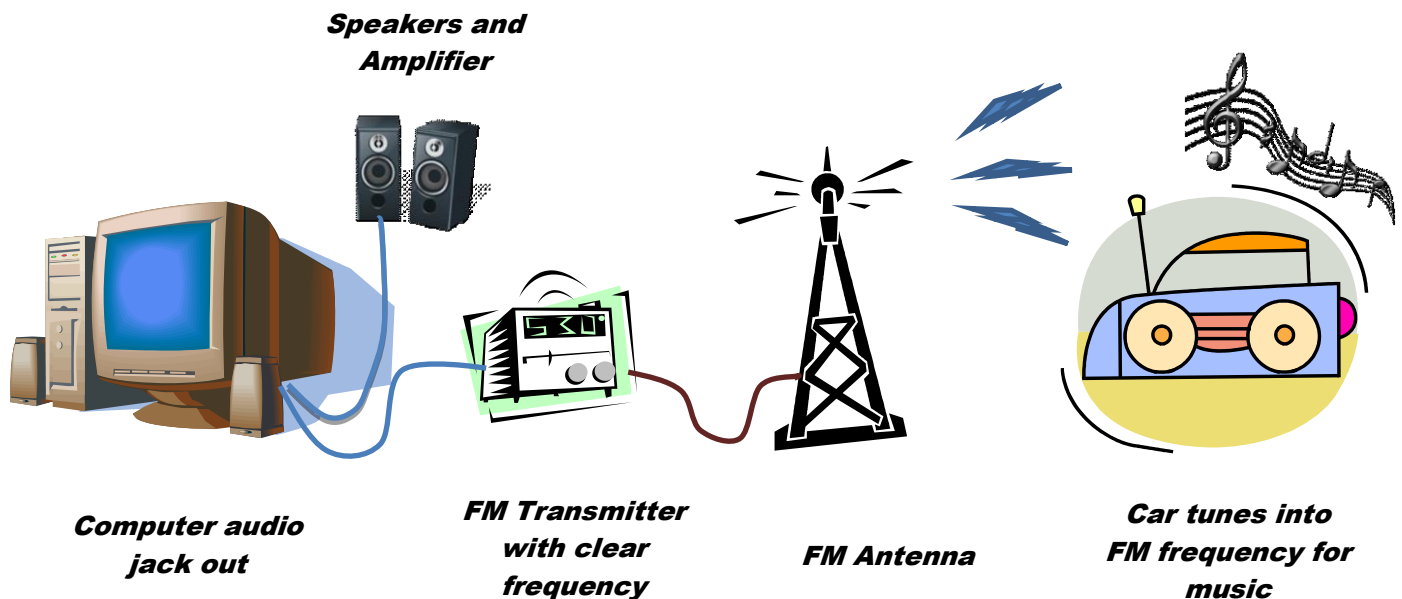
There are a few general rules that must be followed when using a transmitter. Transmissions over the radio bandwidth generally fall under regulations that are managed by legal governing bodies for radio transmissions which vary from country to country. If the below general rules are followed then you should expect to have no issues.

- Do not use a transmitter with a high wattage unit as this will contravene most countries regulations on FM transmission; generally a 10mw transmitter will do the job. There is no need to transmit into the next suburb.
- Ensure you transmit only on a clear frequency, it may be worth while driving around your area to ensure that the radio frequency is clear.
- Do not transmit any advertising material.
- Do not run the transmitter 24 hours a day.
- Do not transmit any vulgar or offensive material.
- Ensure you are not causing any interference.

Further information regarding the use of a transmitter can be found at
http://auschristmaslighting.com/wiki/index.php/FM_Transmitters
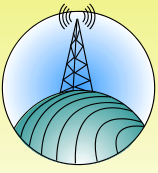
FM Radio Transmitters

FM Radio Antennas

The antenna can make a very big difference in the distance and sound quality of the transmission, As a signal gets weaker the FM radio receiver will start to only pick up a mono signal and the stereo separation will be absent reducing the quality of sound to the receiving radio.

Most FM receivers also come with either a small antennal or a piece of wire for the antenna, generally these do not achieve a far range but if the FM radio transmission is suitable for your needs then there is no need to add or modify the antenna.

The location and height of the antenna are the first things to look at when trying to increase reception range. The higher the transmitting antenna and the fewer obstacles between the transmitting antenna and the receiving radio the further the range and clearer the reception will be.

Another option is to make a simple external antenna, this generally dramatically increases the range and quality in most cases.

Further information on how to build a simple antenna can be found at
http://auschristmaslighting.com/wiki/images/a/a7/How_to_make_a_dipole_antenna.pdf.

Setting Up Audio

Some people choose to not have a FM radio transmitter and prefer to just use speakers set up in the yard instead. Most will use both an FM transmitter and speakers in the yard as this is the best option as it allows both cars and pedestrians to both hear the music, because without the music it is just a bunch of flashing lights,

Setting up the audio for your display can be done in 2 ways; either just connect your speakers or amplifier directly to your computer and play the audio that way or the method I prefer which is tuning your stereo radio to the frequency and using that to run the displays speakers. This way it allows you to monitor your transmission because if the speakers stops playing the music then there could be an issue with the transmitter.

Computer audio jack out

FM Transmitter with clear frequency

FM Antenna

Car and home stereo radio for garden speakers receives the FM frequency for music
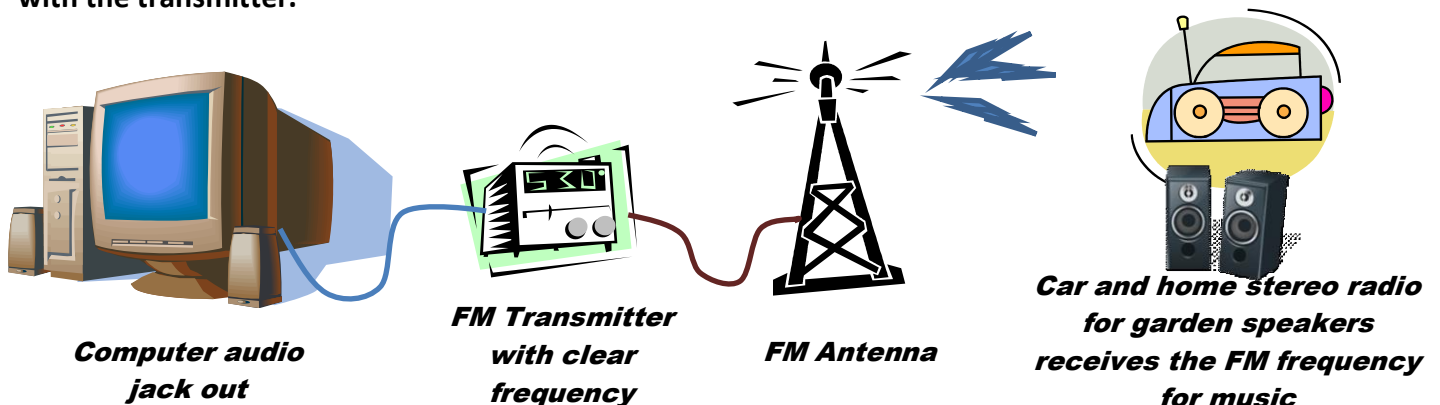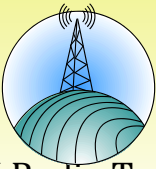
FM Radio Transmitter

FM Radio Transmitter Choices

There are a few different types of FM Radio Transmitters available that vary in output and sound quality, generally output wattage is not the only thing to consider, the sound quality and FM separation are also important factors especially these days with most standard cars equipped with a high quality stereo.

EDM FM Transmitters

www.edmdesign.com

EDM is located in South Africa and have designed high quality FM transmitters for several years, many people swear by these as having the best sound quality of the bunch. The FM transmitters come in a very simple kit that just requires soldering of the power wires to the socket.

Standard Model	High Quality Model
EDM-LCD-CS-EP US$151.00	**EDM-TX-LCD-EP US$199.00**
10/100mW Adjustable RF output	10/100mW Adjustable RF output
1-10mW and 2-100mW	1-10mW and 2-100mW

Ramsey FM Transmitters

http://www.ramseyelectronics.com/hk/

Ramsey Electronics supply a range of FM Transmitters. Some people swear by these.

Standard Model	High Quality Model
FM30-B US$199.00	**FM35BWT US$299.00**
0 -25mW Adjustable RF output.Kit form	0 - 1W Adjustable RF output. Assembled

Hlly FM Transmitters

http://www.hllyfmtransmitter.com/

Hlly are a Chinese manufactured FM transmitter with many different models available. The sound quality isn't as good as an EDM or Ramsey but the entry price is a lot cheaper. These can be usually be bought through EBay.

Budget Model	Standard Model
Hlly 25mw US$45.00	**Hlly 0.5w US$85.00**
25mW output	500mw output
Board Only	Assembled

Ordering From China

Ordering From China

Many members order their lights directly from China as this can save considerable cost and allow for a wider selection. Ordering from China can be a very easy and trouble free task if some precautions are taken.

One of the preferred Chinese dealers that are used by many ACL members is Ray Wu, this dealer runs an Aliexpress online shop that has been used by members for the last 4 years. The benefits of using Aliexpress is the payment protection that is offered which is a 3rd party called Escrow. Escrow holds the money until the goods are received and signed off without any disputes. There is a rating system like Ebay for buyers to leave feedback and a dispute claim can be lodged if there are any issues. The aliexpress shop also offers a chat room to talk to the vendor so you can ask questions in real time and when ordering multiple items it is best to ask for a pro-forma invoice with combined shipping as this can save a considerable amount.

For Australian residents the total value of your order must be below AU$1000 or else you will incur import duties
It is recommended that you check with your state or federal authorities regarding any possible import duties or taxes that may be payable before purchasing.

Paying by means of money gram or Western Union or any other direct deposit method of payment may be risky if you are unsure about the dealer as these methods offer no protection. So only pay by this method if it's a trusted dealer.

One thing that must be taken into consideration is that the quality control is not as high as if these were bought from a reputable commercial dealer but the price is much lower, so it is always wise to factor in a 5-10% failure rate, this way you won't be disappointed but you will still save by buying directly from China

Do not buy 240V lights from China (Aliexpress) or via ebay as the quality and insulation is typically absolutely terrible and you will be putting yourself and others at risk if you use them. The quality is nowhere near the standard that meets Australian Standards. If you are buying icicle, fairy or rope lights there are low voltage alternatives (12V, 24V etc)

General Tools & Equipment

General Tools & Equipment Used

There is a list of general tools, equipment and disposables that are generally used with in the hobby for construction, testing and implementation of lighting, controllers and equipment. The list below is a general list of some of the more commonly used tools and disposables, Tools and disposables needed with vary between person to person and individual budgets.

General Tools

Cable Cutters

Used for cutting and stripping wires. Also used for cutting cable ties

Pliers

Standard bull nose and long nose pliers are sufficient
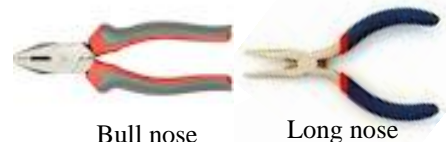
Bull nose   Long nose

Crimping Tool

Used for crimping wires and terminals together

Wire Strippers

Used for stripping bare ends on wires

Screw Drivers

Both slotted and Phillips head screw drivers

Slotted   Phillips

Cutting Knife

Box cutting knife. Do not use household kitchen knifes

Silicone Caulking Gun

Used with a silicone tube to administer silicone for sealing

General Tools & Equipment

Equipment

Multimeter

Used for testing voltage and continuity of circuits and wires. A very important piece of test equipment to have

Soldering Iron

Used for soldering wires, plugs and electronics together

Standard   Temperature Controlled

Heat Gun

Used for shrinking heat shrink

Hair dryer   Hot air gun

Magnifying Lamp

Used for fine work and identification

Head Mounted lamp

Used for working hands free at night and in dark areas

Hands Free Parts Holder

Used for holding parts and electronic boards for soldering and working on

Bootlace Ferrules and Crimper

Used to provide secure ends to wires and better cable clamping.

Reduces the chances of wires shorting to adjacent channels/connections.

Available in single and dual cable style.

Disposables
Cable Ties

Used for attaching wires and lighting

Note that white/clear and many coloured ties aren't UV stabilised and may break down in sunlight within months of exposure.

Electrical Tape

Used for many purposes for sealing and insulating

Heat Shrink

Used for many purposes for sealing and insulating. Comes in

Many colours, sizes and shrink diameters

Coloured   Clear

Silicone Tube

Used for sealing, use only non-corrosive, neutral cure silicone

Acetic cure, the sort that shouldn't be used, smells like vinegar.

Solder

Used for soldering wires and electronics. Use 60/40 SnPb

60% Tin and 40% lead or use 63/37. The quality of the flux varies but

it mainly affects wires/pads etc that are oxidised or aren't clean.

Cable Crimps

Used for connecting wires, various sizes and shapes are available

E1.31 and DMX Typical Layout

The below layout show the differences between E1.31 and DMX and how they are connected into the network. The below layout is by no means a complete list of equipment or configurations that could be used and is intended as giving guidance examples only

Main Show Computer running sequencing software that supports DMX and/or E1.31 Output

FM Transmitter

93.3FM

Transmitter Power supply

Antenna

Audio Cables connected to audio output on computer

50 Ohm Coax cable

Set com port for DMX dongle. Eg; Com 3

E1.31 Out

USB cable

USB DMX Dongle

DMX Universe 5- 512 channels

Standard Cat 5 cable

DMX

E1.31 protocol connected to the network card going through a distribution switch

Standard Cat 5 cable

E1.31 In

Switch

E1.31 Out

E1.31 Out

E1.31

E1.31 protocol can be directly connected to E1.31 controllers or the ECG/DR-4 if only using one E1.31 controller/ECG/DR-4 device

ECG DR-4 Power supply

ECG DR4 DMX

Also available is the ECG DMX/REN 8 with 8 DMX universes/outputs

1
2
3
4

DMX Universe 1- 512 channels
DMX Universe 2- 512 Channels
Standard Cat 5 cable

Standard Cat 5 cable

E1.31 In

Use IP address to set controller Eg; 10.1.1.15

Standard Cat 5 cable

DC POWER SUPPLY
Mains AC Voltage to DC Voltage Switch Mode Power Supply
DC
+DC -DC E Neutral Active
100-250VAC 50/60 Hz Supply

DC POWER SUPPLY
Mains AC Voltage to DC Voltage Switch Mode Power Supply
DC
+DC -DC E Neutral Active
100-250VAC 50/60 Hz Supply

DC POWER SUPPLY
Mains AC Voltage to DC Voltage Switch Mode Power Supply
DC
+DC -DC E Neutral Active
100-250VAC 50/60 Hz Supply

DC Supply 5Vdc to 24Vdc
DC Supply 5Vdc to 24Vdc

DC Supply 5Vdc to 24Vdc
DC Supply 5Vdc to 24Vdc

DC Supply 5vdc to 12vdc
DC Supply 5vdc to 12vdc

E1.31 In

J1SYS ECG-PR12
12 Fused Outputs, 12 Universes
Total 6144 Channels, 2040 Pixels
Supports 2801,6803,D705,180x

E1.31 In

J1SYS ECG-PIXAD8
8 Fused Outputs, 8 Universes
Total 4096 Channels, 1360 Pixels
Supports 2801,6803,D705,180x

E1.31 In

SanDevices E681
16 Fused Output, 4 Universe Total 2048 Channels, 680 Pixels
Supports 6803,D705,2801,180x, 3001,3005, 880x,9813 and GE strings

Separate 5VDC Supply for powering board if only 12vdc is used for outputs

Use IP address to set controller Eg; 10.1.1.5

Use IP address to set controller Eg; 10.1.1.9

Use IP address to set controller Eg; 10.1.1.3

DC Supply 5Vdc to 24Vdc

DC Supply 5Vdc to 12vdc

Digital Pixel based RGB strip, strings and/or modules

Digital Pixel based RGB strip, strings and/or modules

Digital Pixel based RGB strip, strings and/or modules

Inject power between strings, strips and modules

DC Supply 5Vdc to 24Vdc

Digital Pixel based RGB strip, strings and/or modules

Controllers do not need to be physically located in channel order

DMX Universe 2- 512 Channels

DMX Universe 2- 512 Channels

DMX start address = 510
3 channel flood light

DMX Out

Wireless

DMX In

DMX Universe 2- 512 Channels

DMX Universe 1- 512 channels

DC Supply

DMX Out Terminator

DMX In

DC Supply

DC Supply

DMX Out Terminator

DMX In

DC Supply

DMX-LOR converter cable

LOR 12VDC Power Supply

DMX-LOR converter cable

DC Supply

DMX Out Terminator

DMX In

DC Supply

DMX Out

DMX In

DMX Out

DMX In

DMX Out

DMX In

DMX Out

DMX In

DMX Pixel Controller 50 Pixels
DMX Start address = 1
150 Channels, 50 Pixels used

DMX Pixel Controller 119 Pixels
DMX Start address = 151
357 Channels, 119 Pixels used

DMX light,, laser, smoke machine, ect

DC POWER SUPPLY
Mains AC Voltage to DC Voltage Switch Mode Power Supply
DC
+DC -DC E Neutral Active
100-250VAC 50/60 Hz Supply

DMX Pixel Controller 170 Pixels
DMX Start address = 1
Maximum of 510 Channels, 170 pixels can be used

DMX Pixel Controller 95 Pixels
DMX Start address = 225
Maximum of 285 Channels, 95 Pixels remaining in universe

DC POWER SUPPLY
Mains AC Voltage to DC Voltage Switch Mode Power Supply
DC
+DC -DC E Neutral Active
100-250VAC 50/60 Hz Supply

AVD DC48 controller
DMX Start address = 177
48 channels

DC Output

LOR CCR Using DMX
DMX Start address = 17
150 Channels

LOR 16 Channel AC controller Using DMX
DMX Start address = 1
16 Channels

AC Output

220-240VAC AUS
100-120VAC US Mains Supply

To allow LOR controllers to work in a DMX universe you need to make a converter cable by cutting the network cable and rejoining the wires.

DMX pin1 – LOR pin 4
DMX pin 2 – LOR pin 5
DMX pin 7 – LOR pin 6

LOR pin 4 – DMX pin 1
LOR pin 5 – DMX pin 2
LOR pin 6 – DMX pin 7

There is no need to have a converter cable between LOR controllers. Only required between LOR controllers and native DMX devices

DC Supply

Digital Pixel based RGB strip, strings and/or modules

Digital Pixel based RGB strip, strings and/or modules

Inject power between strings, strips and modules

Standard Non digital based RGB strip, strings and/or modules

AC Controller for controlling strings, rope lights and other AC related lighting
Total usable channel output = 16

DMX

Maximum of 512 channels per DMX universe which can be a combination of any DMX compatible controllers. DMX controllers are located in the network by channel start numbers which are set on the controllers

Inject power between strings, strips and modules. Ensure the ground wire is connected between separate power supplies

Each 3 channel dumb RGB light controlled by a DC board will require 3 channels for Red, Green and Blue (RGB)
Total Usable channel output = 16 RGB (48)

The controller address must be set with LOR S2 software when adding LOR controllers to a DMX universe. Refer to LOR users manual for DMX start addresses CCR Total usable channel output = 50 RGB (150)

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E1.31 & DMX Layout attachment Version 1.5 - 19th March 2012
Fasteddy – www.AusChristmasLighting.com

Digital Pixel based RGB strip, strings and/or modules

References and Links

Forums

auschristmaslighting.com   **Australian Based Online Christmas light community forum**

auschristmaslighting.com/wiki   **Auschristmaslighting Wiki information page**

doityourselfchristmas.com   **The home of Renard controllers and Vixen. DIY focussed forum**

www.falconchristmas.com/forum/   **US based home of FPP Pi player and pixel controllers**

Software

www.lightorama.com   **Commercial controller and software vendor**

www.lightshowpro.com   **Software sequencing software vendor**

www.vixenlights.com/   **Free sequencing software. Home of Vixen 2 and Vixen 3**

vixenplus.com   **Free sequencing software. Home of VixenPlus**

joehinkle.com/HLS/   **Free sequencing software. More info at here**

xlights/nutcracker   **Free sequencing/test/effect generation software. More info here**

www.da-share.com/software/   **Home of da_dmx and da_e131 test software**

Hardware

Audio Visual Devices AVD   **Australian based designer and supplier of custom DMX controllers**

Hanson Electronics   **Aust. based designer and supplier of lighting controllers**

Advatek Lights   **Aust. based designer and supplier of lighting controllers and pixels**

J1-Sys Controllers   **US based designer and supplier of E1.31 controllers**

clap-supplies.yagoonalights.com   **Australian distributor of J1-Sys Controllers**

SanDevices Controllers   **US based designer and supplier of E1.31 controllers**

My-T-Brite   **Aust. based distributor of high quality LED strings including 240V**

Christmas Creations   **Aust. based manufacturer of Christmas wireframes**

Mysolarled   **Chinese manufacturer of LED light strings**

www.zazzle.com.au/auschristmaslighting **ACL coffee mugs etc**

Ray Wu Aliexpress Shop   **Chinese RGB light and DMX controller vendor**

Paul Zhang Aliexpress Shop   **Chinese RGB light and DMX controller vendor**

MINLEON Australia and New Zealand **Aust. importer and distributor of Minleon lights and controllers**

Credits

Here is a list of people who need mention for their ongoing assistance to AusCristmasLighting and also for helping with the information within this manual.

Phil – AussiePhil – Owner of auschristmaslighting.com without his vision and hard work ACL would never have existed. Credit goes to him for part creating the front cover and cable resistance chart.

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The manual has been written with the utmost care to ensure accuracy but if there are any errors, changes or comments then please send them to feedback@rgbchristmaslighting.com

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