DC Controllers

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This presentation can be downloaded from www.HolidayCoro.com

What can I use a DC controller for?

- Controlling relays
  - Solenoids
  - Motors
- Controlling LEDs
  - LED Flood lights
  - LED Strip lighting
  - Tape/module LED lights
- Servos (d-light only)
- Low voltage incandescent lights (regular mini lights)

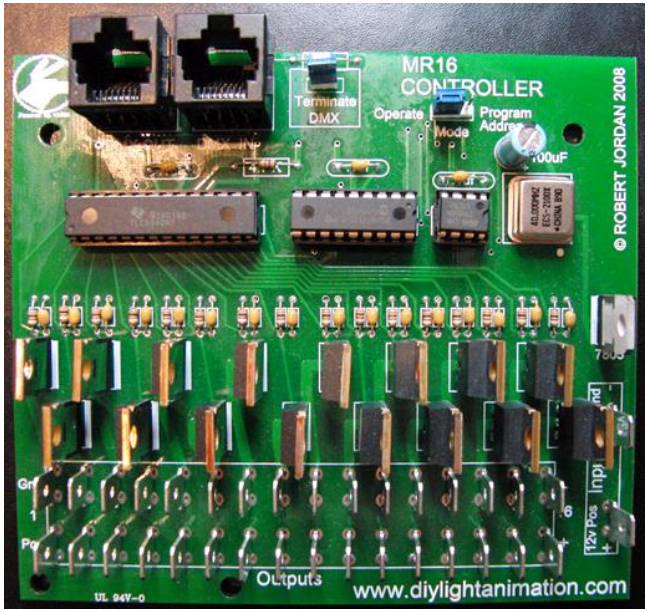
Light-O-Rama CMB16D

- $120 for 16 channels
- 4 amps per channel / 40 amps total (dual banks)
- Stand alone sequence operation with external triggers
- LOR II and DMX protocol compatibility
- Address can be set without programming from PC
- Requires 12v or greater to operate controller
- Common + or anode / All positive outputs are tied together
- Can control 5v to 60v DC
- Size – 4”w x 5”t x 1”h
- www.LightORama.com

d-Light DCx16

- $99 for 16 channels
- 4 amps per channel / 30 amps total (dual banks)
- LOR I protocol compatibility (majority of commands) + additional d-light specific commands
- Address set with PC based hardware application
- Requires 5v or greater to operate controller
- Common + or anode / All positive outputs are tied together
- Can be modified to control servos
- Can control 5v to 60v DC
- Size – 4”w x 5”t x 1”h
- www.d-light.us

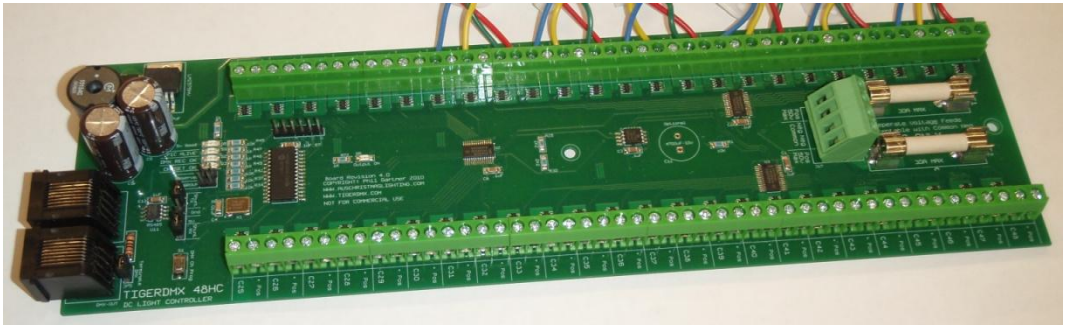
Lynx MR16



- About $40 for 16 channels (DIY build only)
- 2.5 amps per channel / 35 amps total (single bank)
- DMX protocol
- Address set with DMX application from PC
- Requires 5v or greater to operate controller
- Common + or anode / All positive outputs are tied together
- Can control 12v DC (higher voltages with modification)
- Size – 4”w x 4.25”t x .8”h
- www.DIYLightAnimation.com

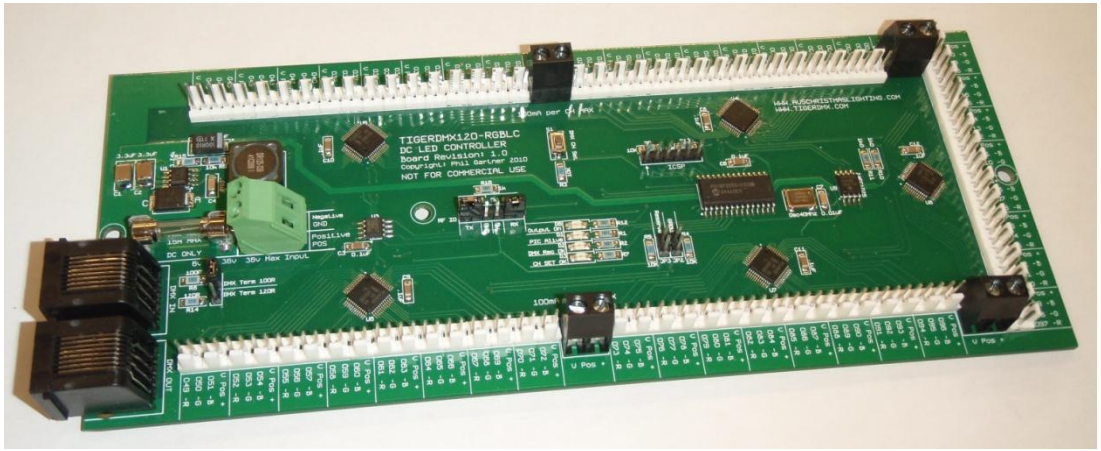
TigerDMX 48 Channel

- About $145 for 48 channels (built and tested)
- $16.50 PCB + $97.71 Parts DIY
- DMX protocol
- Split power input



- 2.5 amps per channel / 30 amps total (both sides)
- Address set with DMX application from PC
- Designed for driving complete strings of LEDs, incandescent lights and other DC items
- Common + or anode / All positive outputs are tied together
- 12v to 55v DC voltages
- Size – 11 ¾”w x 3 ¼”t x 1”h
- www. auschristmaslighting.com / www.tigerdmx.com

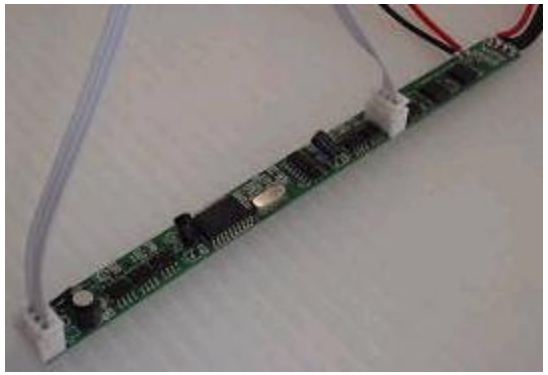
TigerDMX 120 Channel

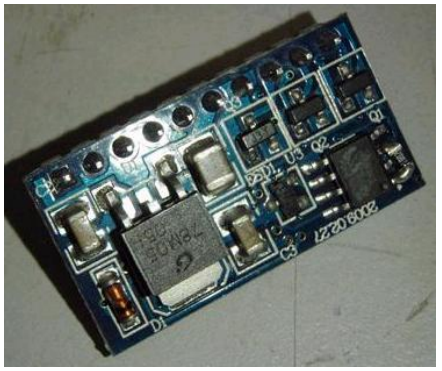


- About $120 for 120 channels (built and tested)
- $11.00 PCB + $54.30 Parts DIY
- DMX protocol
- Address set with DMX application from PC
- 100 milliamps per channel / 12 amps total (single bank)
- Designed for driving RGB light strings/modules
- Requires 6v or greater to operate controller
- Common + or anode / All positive outputs are tied together
- 6v to 36v voltages
- Size – 9”w x 3 ½”t x 1”h
- www. auschristmaslighting.com / www.tigerdmx.com

Cheap Chinese DMX DC Controllers

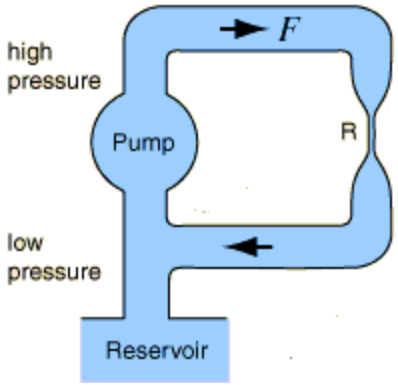
- About $6 to $7 for 3 channels in strip, boxed or controller-on-a-chip formats
- 500ma to 3 amps per channel
- DMX protocol
- Address set with standalone hardware programmer ($15-$45)
- Designed for driving RGB light strings/modules
- Common + or anode / All positive outputs are tied together
- Available in 5/12/24v versions
- http://www.aliexpress.com/fm-store/701799

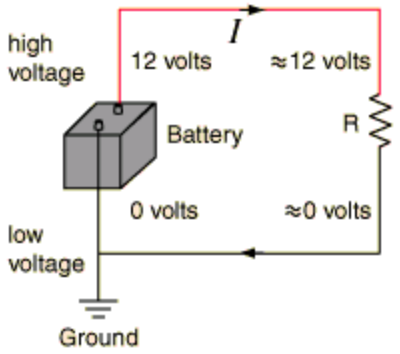




How does electricity work?

Water	Electricity
Volume/Flow Rate (gallons per minute)	Current (Amps)
Pressure (50 PSI)	Voltage (12 volts)
Nozzle/Shower Head	Resistance/Resistor (Ohms)
Pump	Battery
Faucet	Switch (mostly)
Bucket of Water	Capacitor





DC & A/C Controller Differences

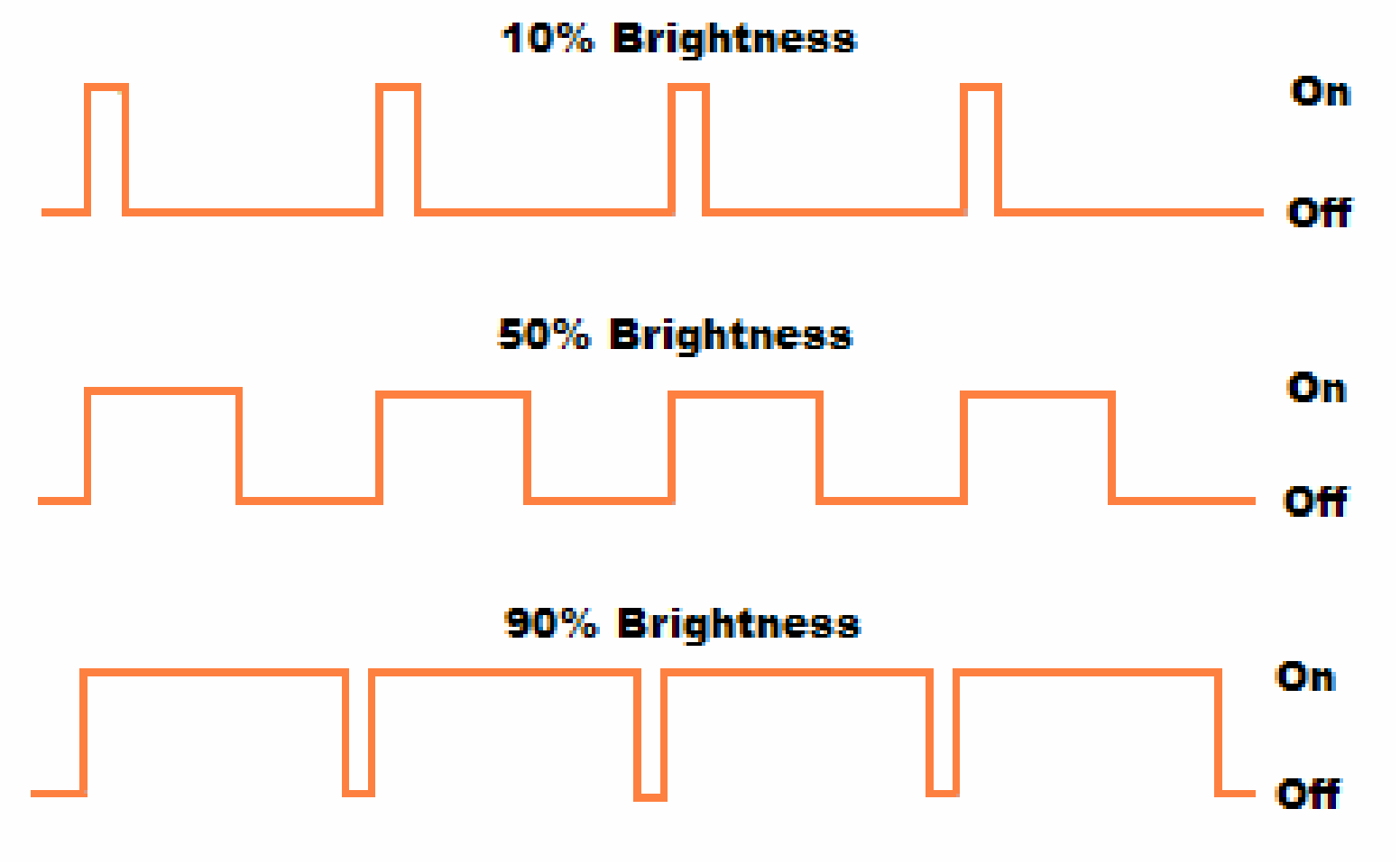
- DC Controllers
  - Requires an external power source
  - Required for items that work only with DC
  - Usually 30-40 amps of power over 16 channels
- A/C Controllers
  - No external power supply required (120volts)
  - Works excellent with incandescent lights
  - Usually up to 40 amps of power over 16 channels

How A/C and DC Controllers Work

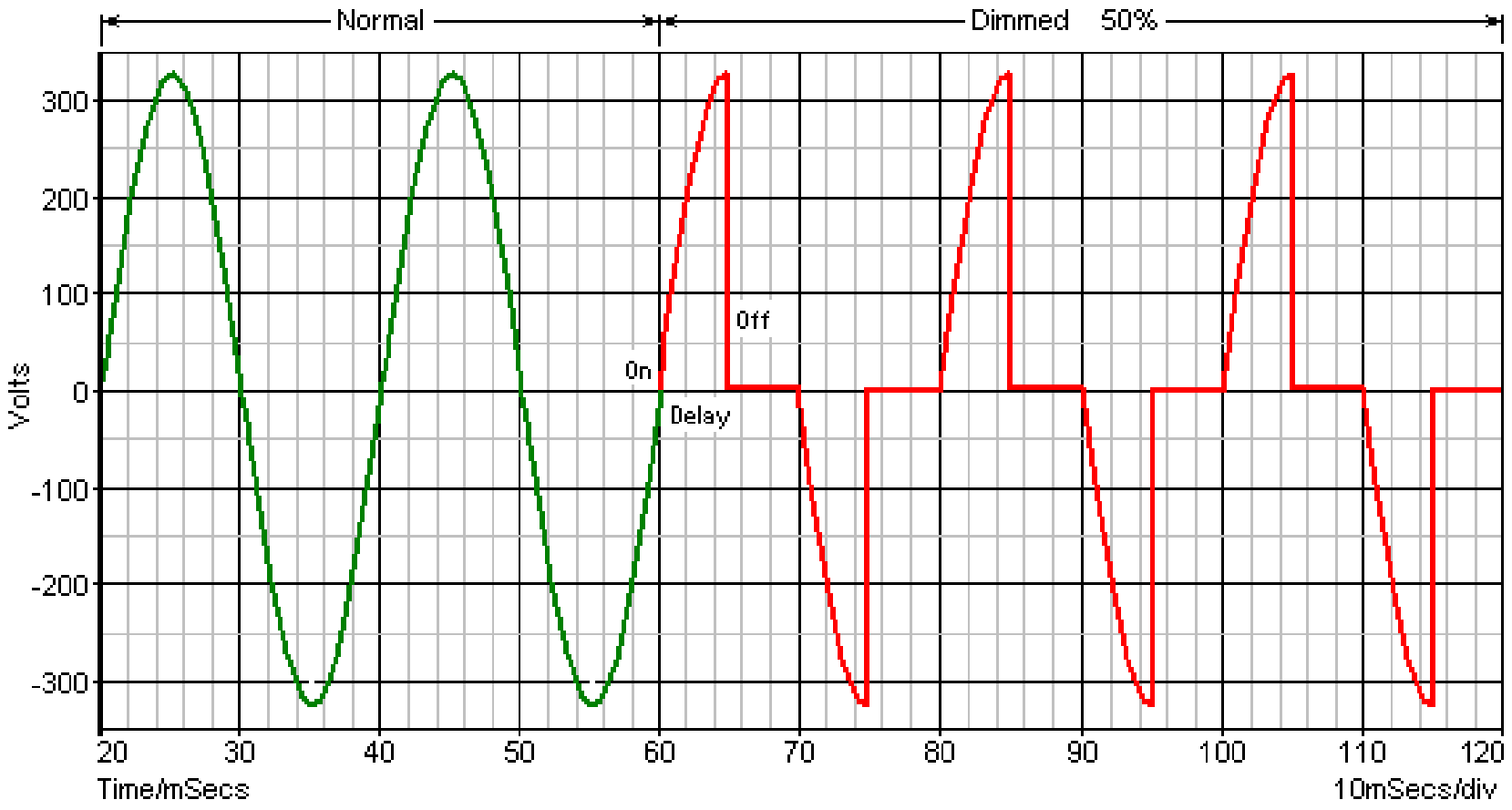
- DC Controllers
  - Use Pulse Width Modulation (PWM)
  - Controlled by MOSFETS

- A/C Controllers
  - Use Phase Angle Dimming
  - Controlled by Triacs

DC - Pulse Width Modulation



A/C - Phase Angle Dimming

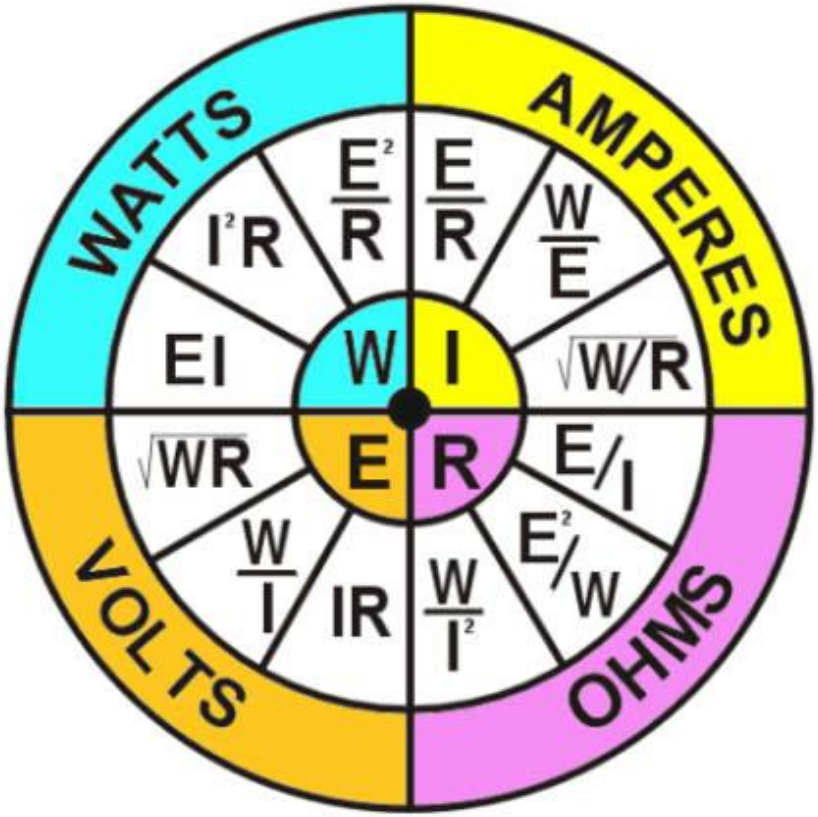


Power Supplies

- An external power supply is required with all DC controllers to run the device and the controller
- Some controller boards have two separate banks allowing two different voltages on the same controller
- Sourcing power supplies
  - e-Bay
  - Computer power supplies (5v & 12v - some issues)
  - AliExpress.com
- Common power supply issues
  - Mounting
  - Weather proofing
  - Heat dissipation
  - Selecting the correct power supply

Determining Power Supply Requirements

- First, determine power requirements by measuring power consumption of DC devices using a amp/multi meter.
- Second, using Ohms Law determine total required watts or add up all the amperage draws measured on the devices. Make sure the power consumption is within the controllers specifications.
- Third, purchase a power supply that meets the power and voltage requirements of the devices and the controller.
- Example – Fifty, 20ma LED modules that use 12v:
  .02 amps x 50 = 1 amp
  12 volts x 1 amp = 12 watts



10ma = .01 amp
100ma = .1 amp
1000ma = 1 amp

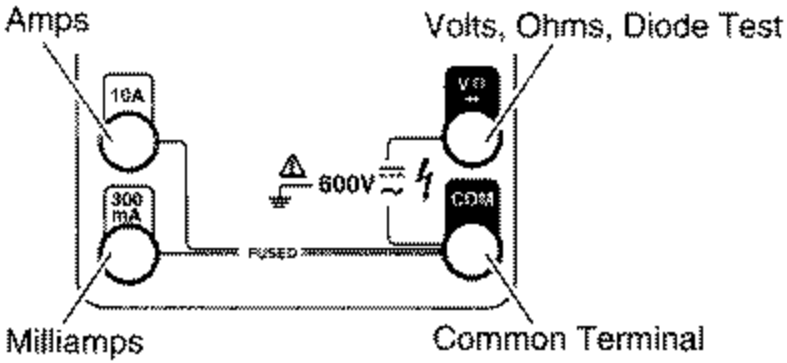
Selecting Proper Wiring

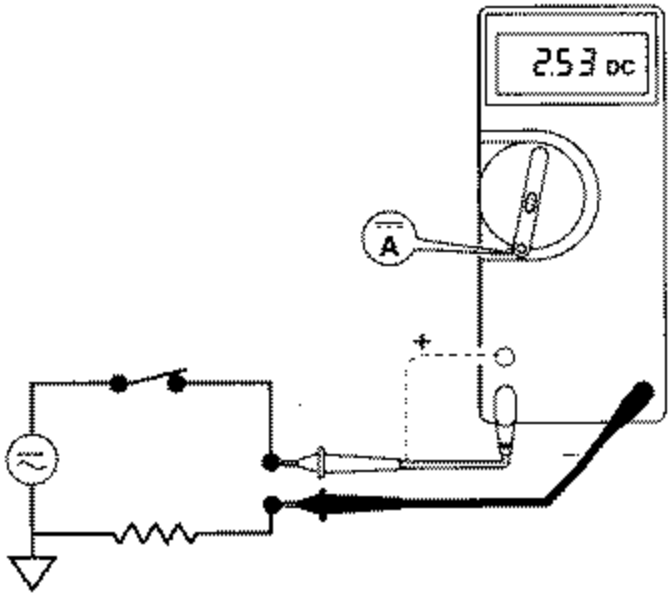
- Input wiring – Add up the maximum possible current consumption per side to determine the proper input size wire

- Output wiring – Determine the current consumption for all devices on a single channel. Also determine the intended length of cable to be used.
- The voltage in wire drops as it's length increases.
- Use an online calculator to determine current carrying capacity and the voltage drop of selected wire: http://www.powerstream.com/Wire_Size.htm

Measuring Current with a Multimeter

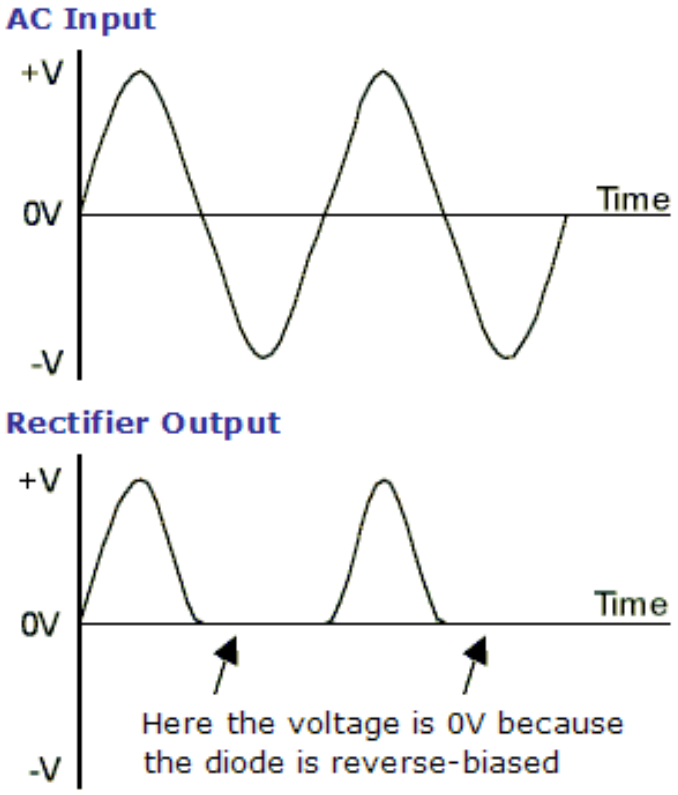
- Insert leads into the COMmon and mA/amps jack depending on the current draw
- Set the meter to mA or Amps scale
- “Break” the circuit and insert the leads on each side of the break to flow power through the meter
- Adjust the scale as needed (some meters)





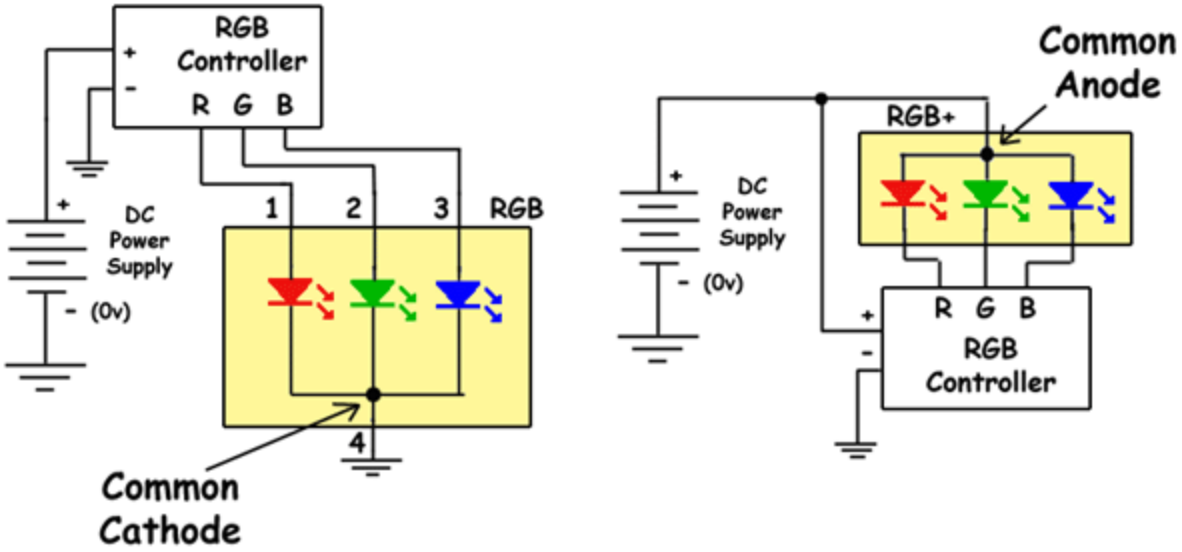
LEDs + DC Controllers = Nirvana

- The current generation of A/C controllers for holiday lighting were designed ten years ago for controlling incandescent lights, not LED lights
- LEDs are inherently designed for DC but “forced” to work with A/C and as a result, suffer the following issues:
  - Non-linear fading
  - Flickering (half-wave A/C strings)
  - Capacitance issues / glowing LED strings after being turned off
  - No tripped GFCI breakers!



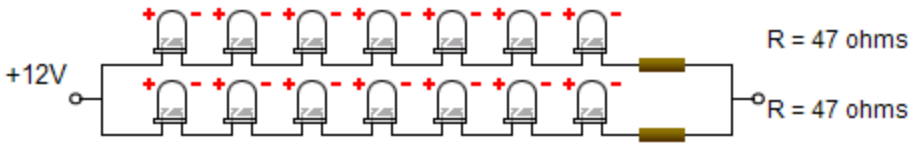
Anode and Cathode

- Anode = Positive +
- Cathode = Negative –
- Most lighting controllers are “Common Anode”



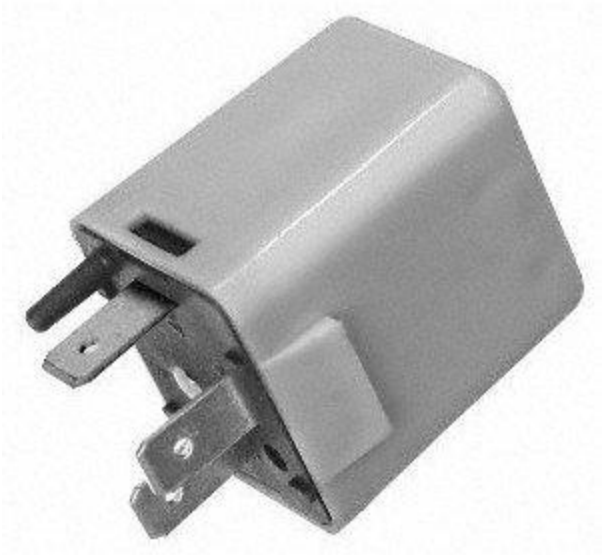
Using LEDs with DC Controllers

- In most cases, LEDs cannot be hooked directly to power. LEDs must have their current limited to the LED's specs.
- Limiting current can be performed with resistors (simple) or a constant current circuit (more complex)
- Most modules/strings/strips come with resistors built-in for use at a predetermined voltage
- When designing your own array of LEDs you need to know:
  - Voltage input
  - LED forward voltage (V) – usually around 1.5-3v
  - LED forward current (mA) – usually around 20-100mA (depends on color)
  - Number of LEDs in the string or array
- Online design wizard can be found here: http://led.linear1.org/led.wiz



Using Relays with DC Controllers

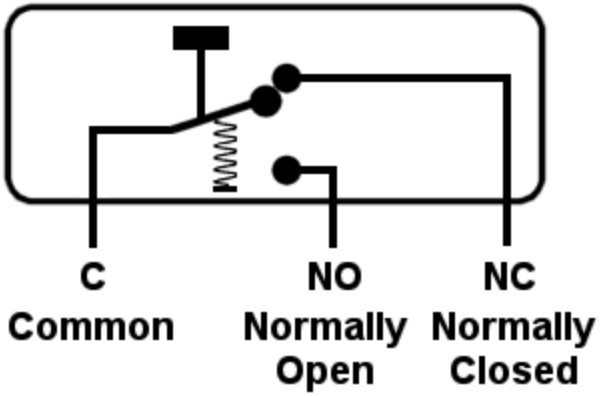
- Use a relay for high current items such as motors and solenoids
- Use a relay for controlling high voltage items – even AC voltages with a DC controller



- Use a relay for controlling lighting above the current capabilities of the controller channel
- **No** dimming when using relays – on/off only

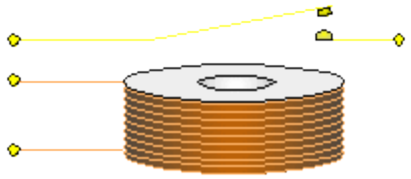
States of a Relay

- Normally Open – when the connection is **not** made with the power off
- Normally Closed – the connection **is** made with the power off

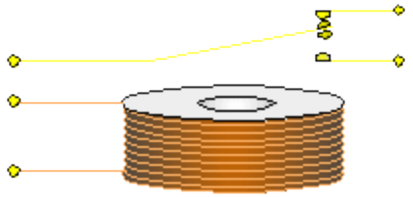


Types of Relays

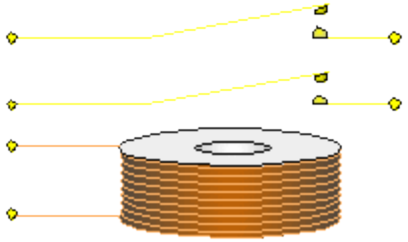
- SPST = Single Pole/Single Throw



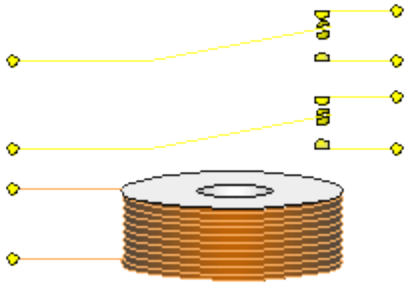
- SPDT = Single Pole Double Throw



- DPST = Double Pole/Single Throw



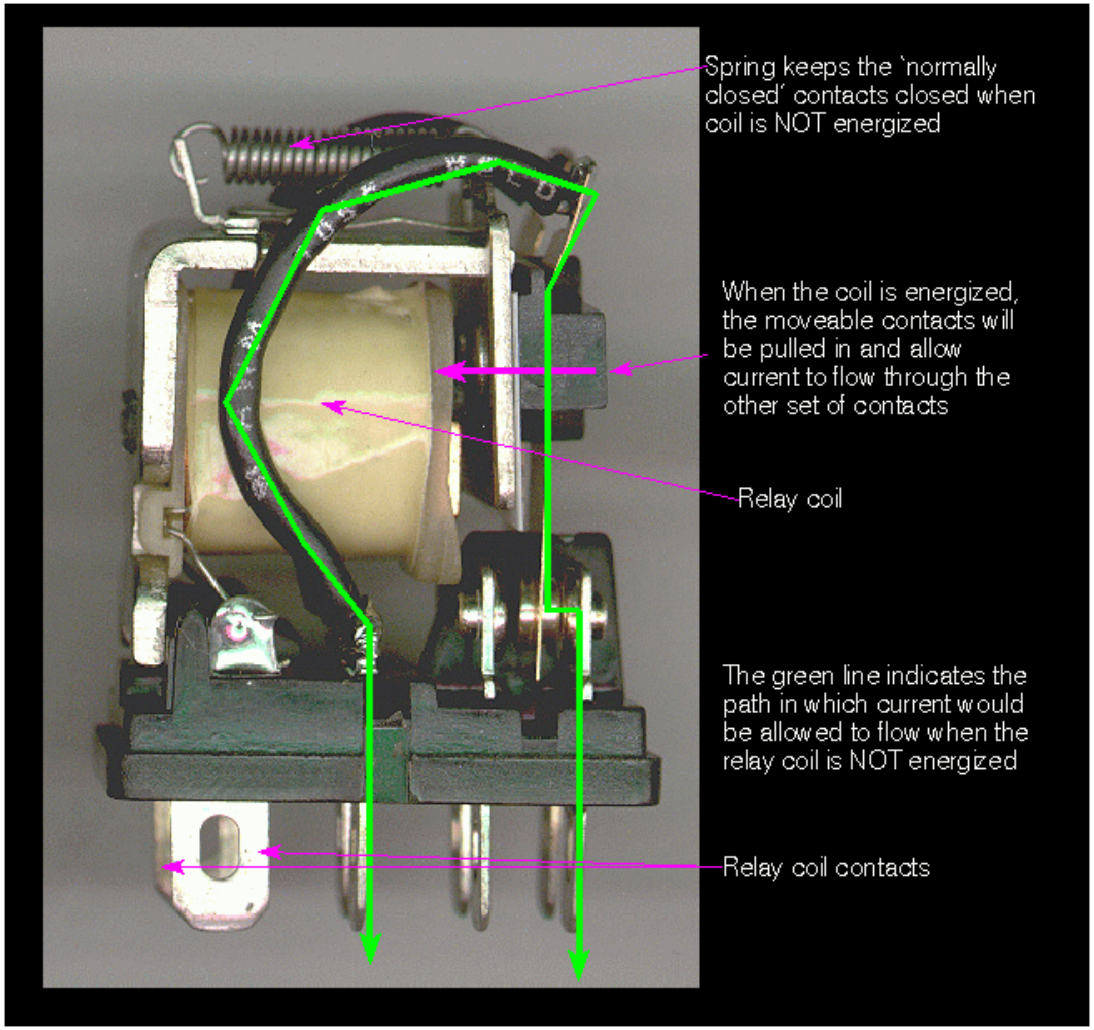
- DPDT = Double Pole/Double Throw



Selecting The Right Relay

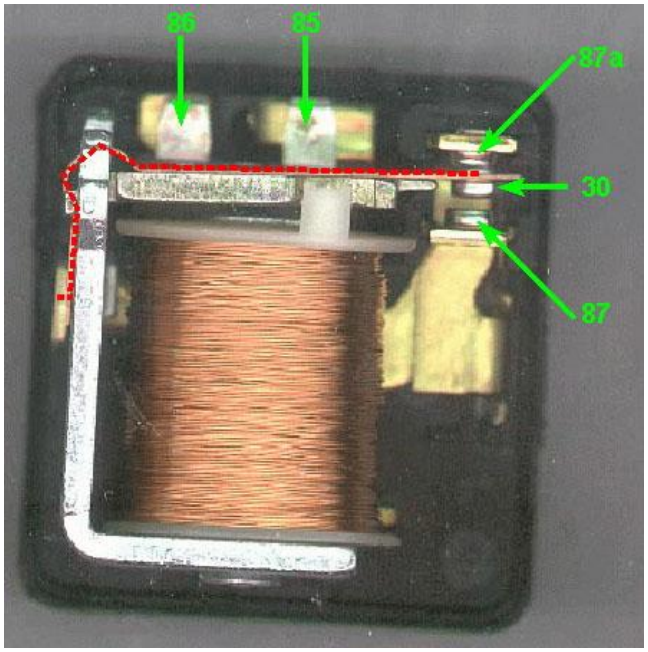
- Make sure the supply voltage for the relay coil matches what is output from the DC card
- The current draw of the relay coil should not exceed the current carrying capacity of the controller channel
- The relay contacts can handle the required amperage and voltage range
- Be aware that there are A/C and DC relays that usually can not be interchanged

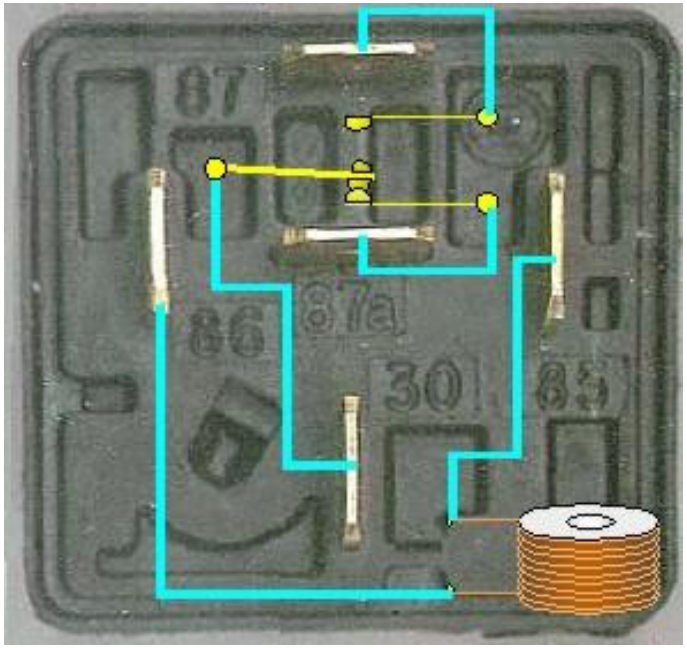
Relay Power Path



The Common “Bosch” Relay

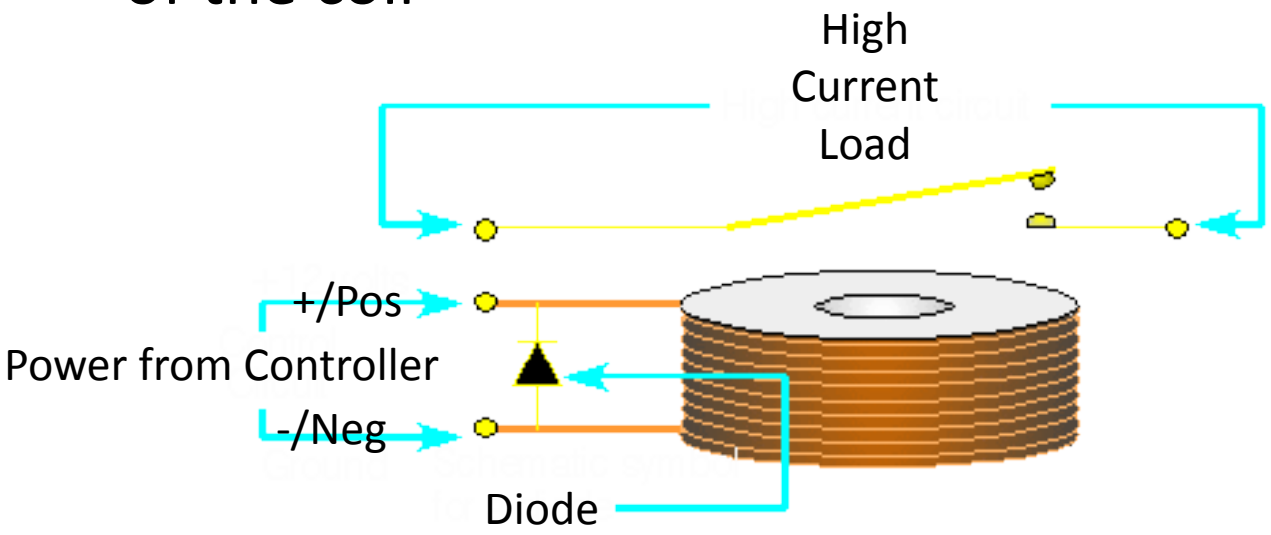
- 85 & 86 = Power to the coil
- 30 = Moveable contact (center pole)
- 87a = Normally closed contact
- 87 = Normally open contact





Inductive Kickback in Relays

- A huge spike in power when the relay coil is de-energized that can damage transistors in your controller card
- Solved with the simple addition of a common diode (1N400x) from Radio Shack or other
- The line on the diode goes to the positive voltage side of the coil

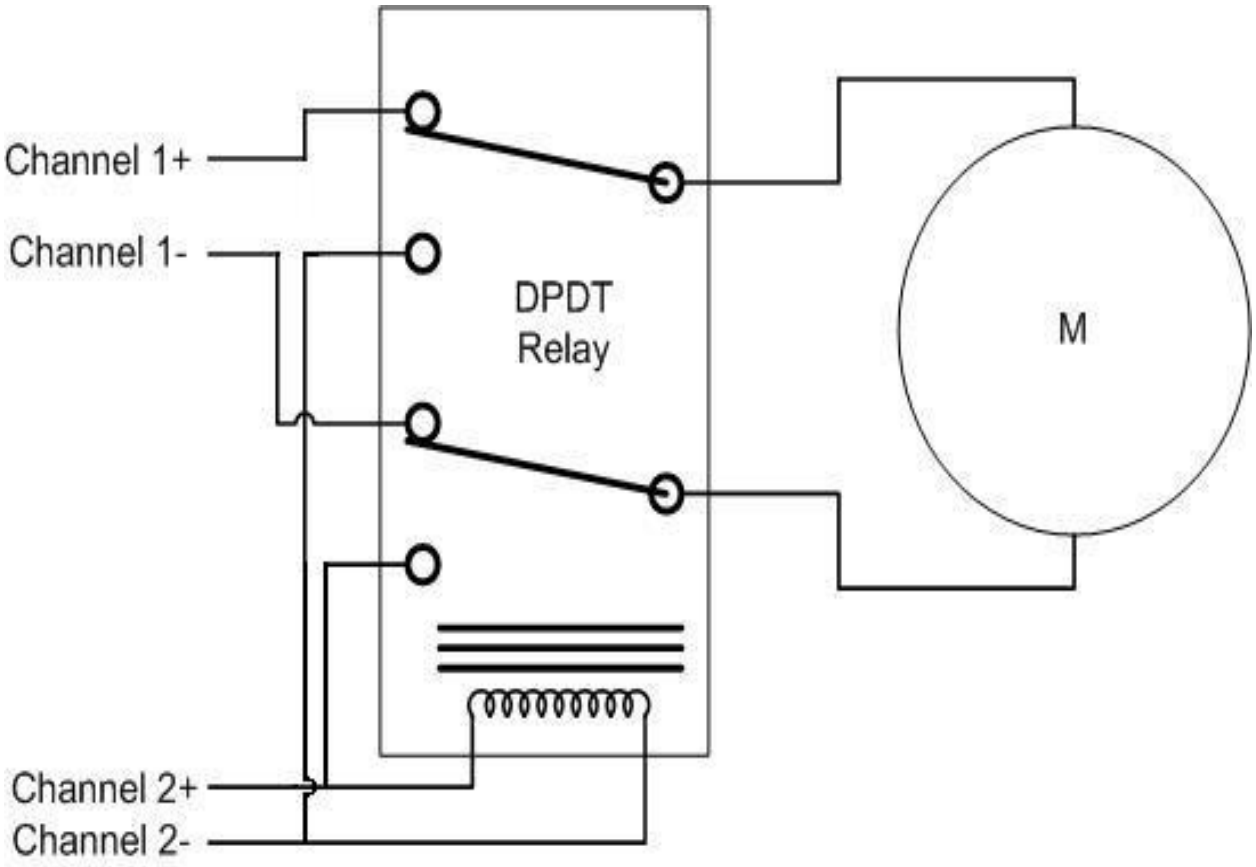


Using Motors with DC Controllers

- Motors require two different current inputs – starting or inrush and running current. The power to start the motor (inrush) can often be much more than the running current. Check the specs or measure peak loads prior to using. When in doubt – use a relay instead.
- Most motors are designed to work with specific voltages and either with DC or A/C

Reversing Motor Polarity

- Positive voltage moves the motor one way (channel 1)
- Negative voltage moves the motor the other way (channel 2)
- When channel 1 & 2 are off, the motor doesn't turn



Non-Holiday Lighting Uses

- Deck lighting
- Landscape lighting
- Art car / parade vehicles
- Signs

External Resources

- LOR Controller for fountain pumps (not currently on the market):
  - www.lightorama.com/Documents/MLC-100.pdf
- Designing LED arrays:
  - http://led.linear1.org/led.wiz

- This presentation can be downloaded from: www.HolidayCoro.com