Taking the mystery out of power injection

Les Willis
WillisChristmasShow.com

ChristmasExpo

My background

- Electrical Engineer
- Programmer
- Many years experience with
  - Computers
  - Networking
  - DIY

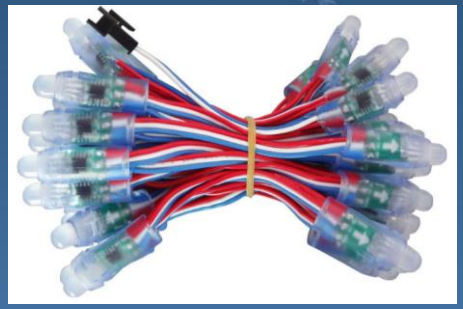
My lighting background

- Always have had a simple static light display
- 2015 Season I did my first light animation to music (using dumb RGB and incandescent)
  - GCLF
    - Great Christmas Light Fight
  - 2016 took the full plunge into smart RGB pixels

ChristmasExpo

Feliz Navidad

Smart pixel examples



ChristmasExpo

Power injection

- Let's understand the problem, why do we need to power inject at all
- Cover 10% theory and 90% "rules of thumb"
  - Real examples of how to do power injection
  - Summary

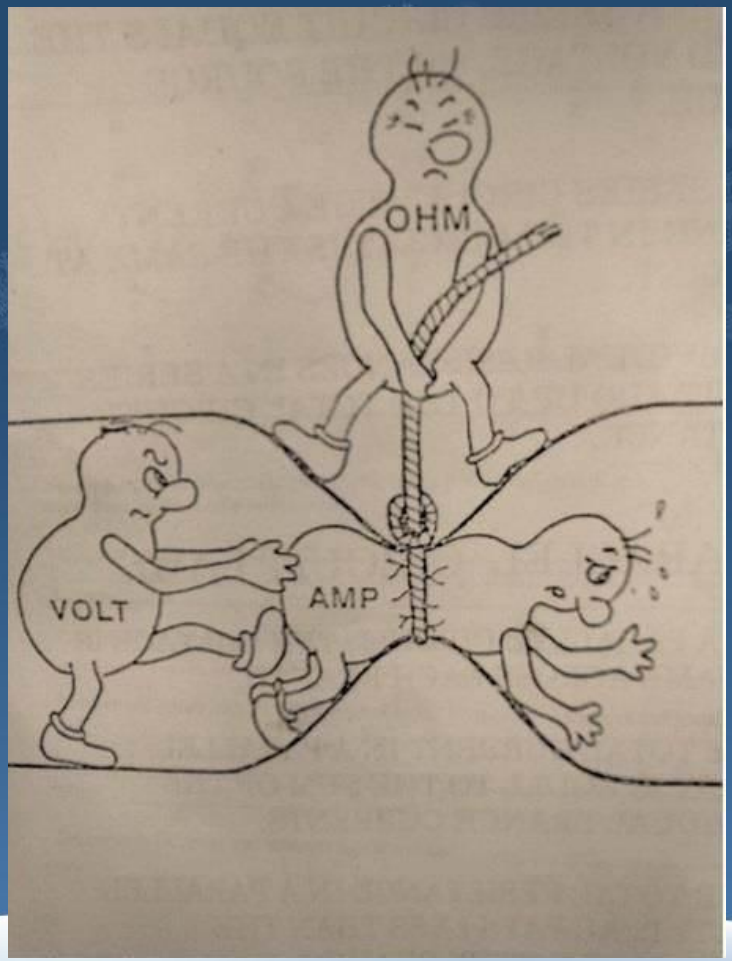
Why do we have to power inject?

Why Power Inject?

1. The LEDs (lights) we use are “low voltage” devices
2. Voltage decreases along the length of any wire. This is based on many factors (size, resistance, type, etc.)
3. Increasing current (Amps) down a wire increases the voltage drop

ChristmasExpo

Volts = Amps x Resistance

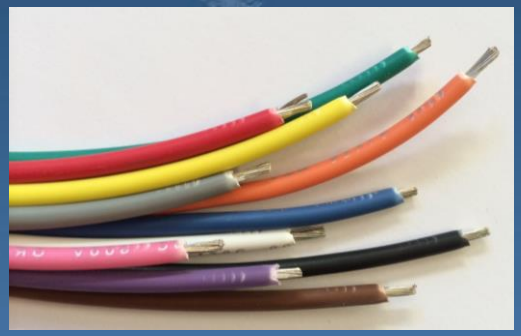


The why??

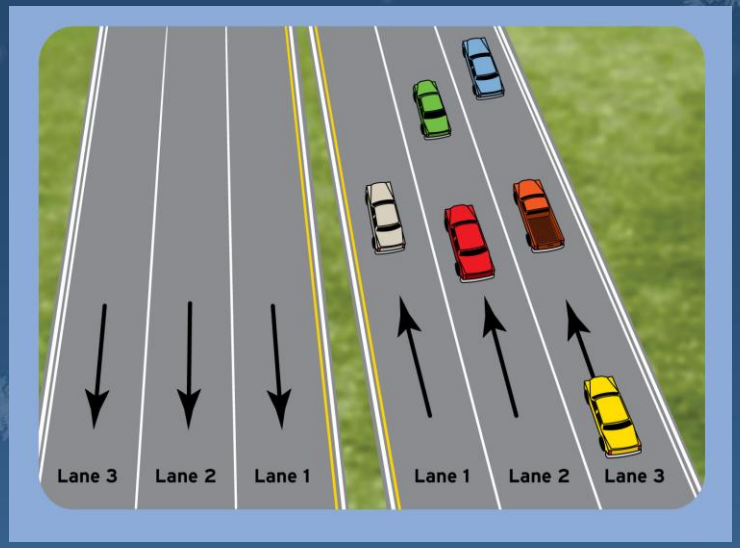
We are battling voltage drop. And the lower the voltage the tougher the battle.

Wire gauge and resistance

- Gauge is a measure of wire size (lower gauge is larger diameter)
- Every wires has resistance



Current flow is analogous to traffic flow

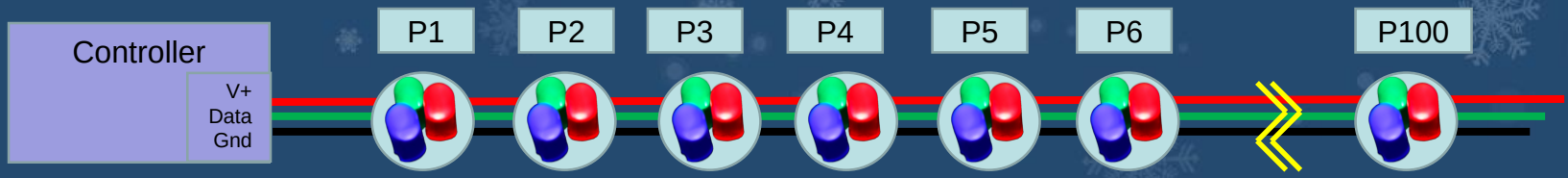


ChristmasExpo

What does this look like in your display?

ChristmasExpo

Voltage Drop Symptoms



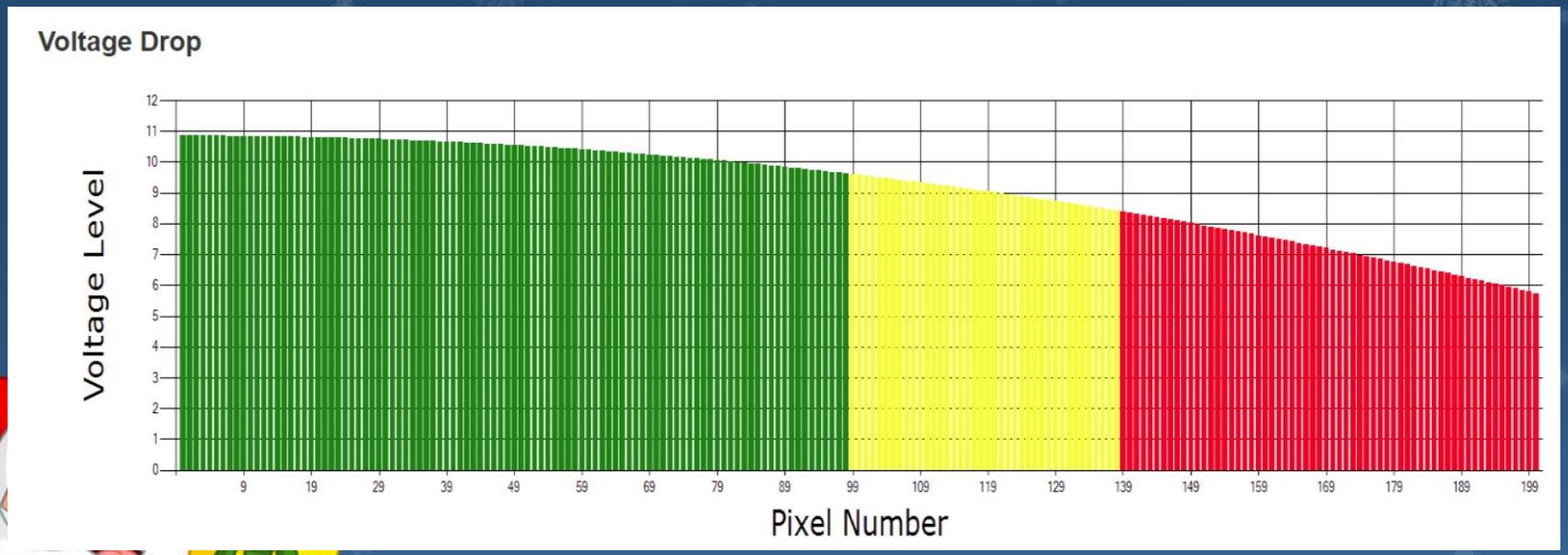
1. LED color
2. Data integrity

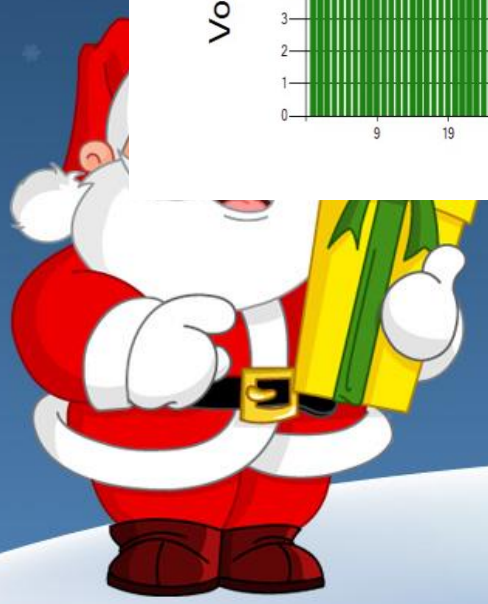
Why power inject?

- The problem: Voltage decreases along the length of any wire that current is flowing through
  - As the voltage drops
    - LED colors change (especially white)
    - The circuitry passing the color data will start to fail

ChristmasExpo

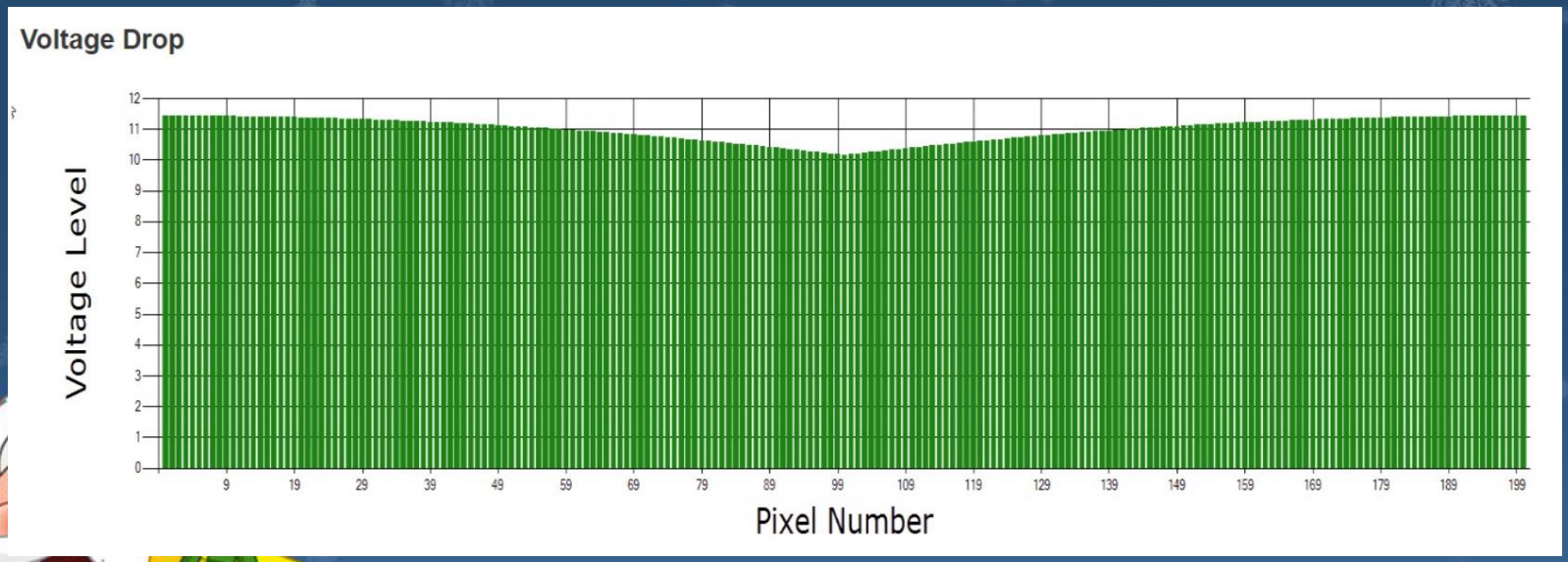
Voltage drop without power injection





ChristmasExpo

Voltage graph with power injection



ChristmasExpo

A small amount of theory

.06 Amps
100%

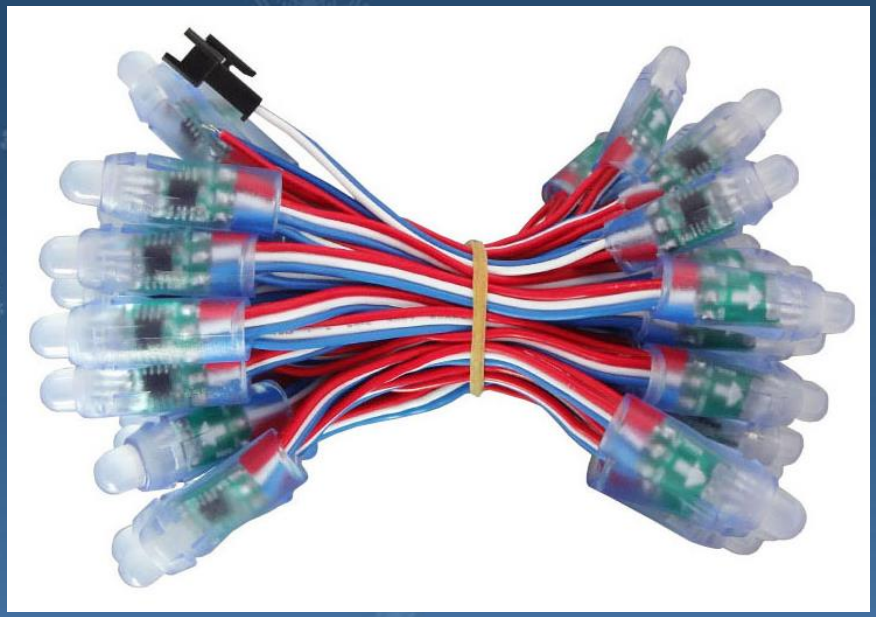
Smart RGB Pixels

- Watts (P) = E*I

36 Watts

- 36W = 12V * I

3 Amps



ChristmasExpo

Voltage, Resistance, Current

Volts (E) = R*I

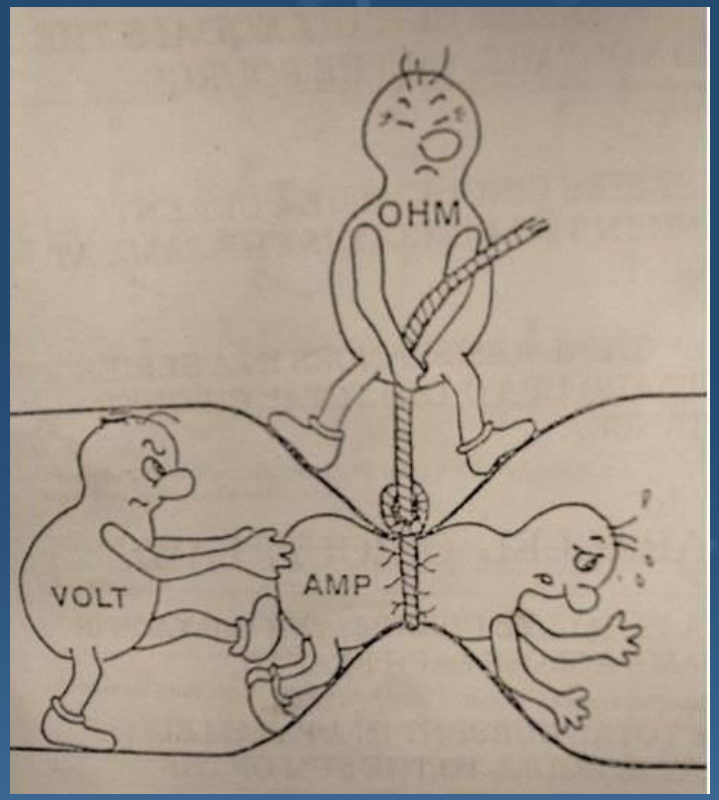
Example:

1 Ohm resistance

20 ft wire

12V lights

3.0 Volt drop



Power Supplies

Power = Voltage x Current

360W/120V = 3 Amps

360W/12V = 30 Amps

360W/5V = 72 Amps

ChristmasExpo

.06 Amps
100%

12 Volt vs. 5 Volt

Power = Voltage x Current

Each pixel requires .06 Amps at 100% brightness

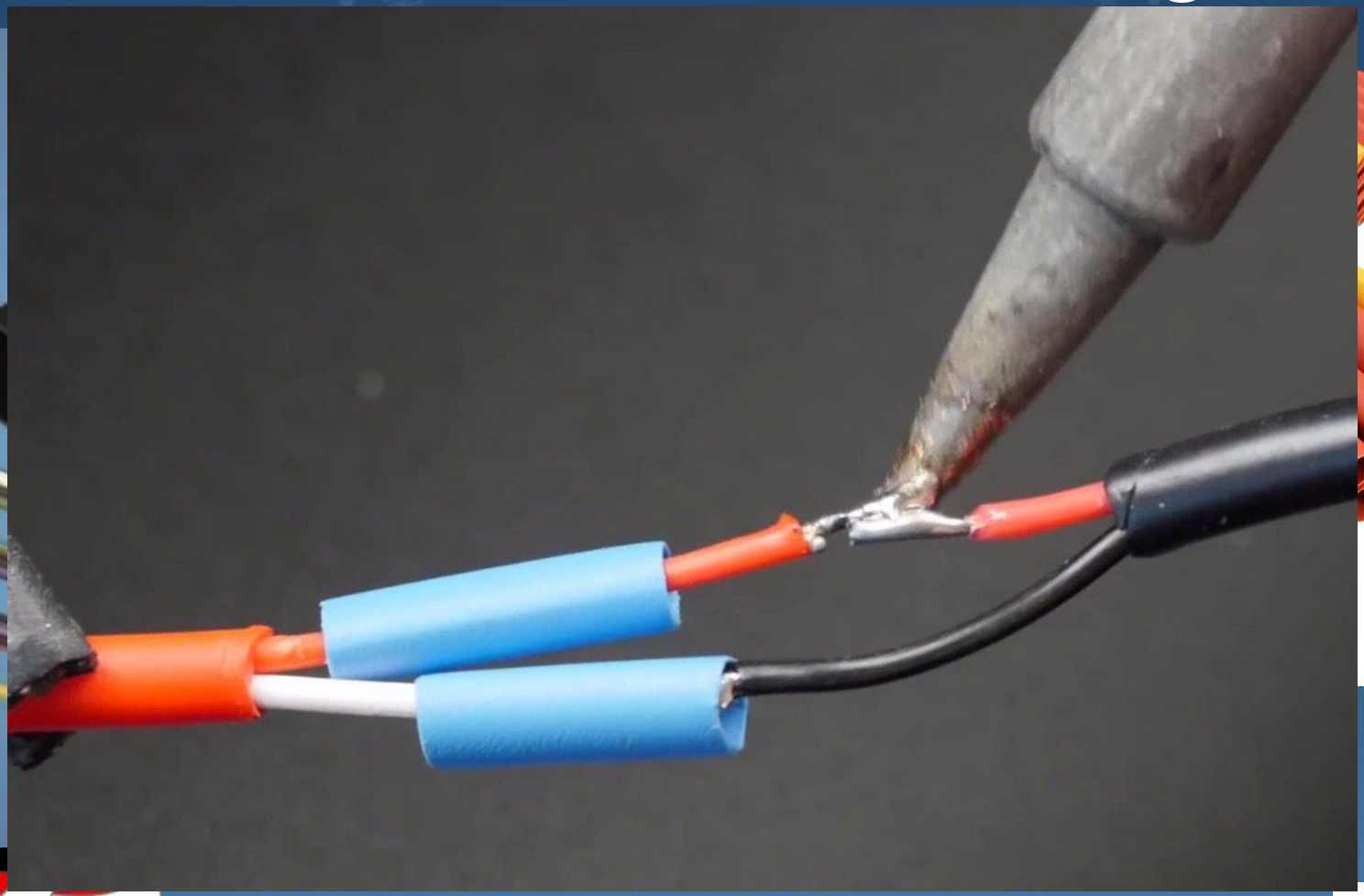
- 360/12 = 30 Amps
  30/.06 = 500 Pixels

- 360/5 = 72 Amps
  72/.06 = 1200 Pixels

ChristmasExpo

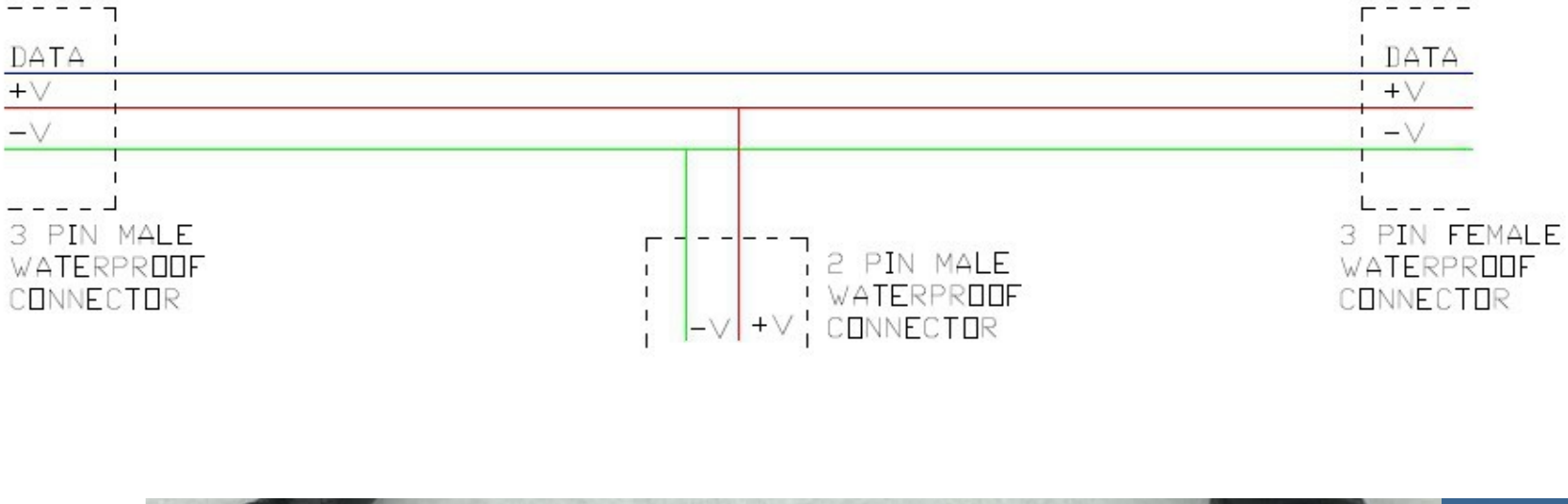
How to power inject

Solder + Shrink Tubing



Solder Seal Connectors

Power Injection T's



ChristmasExpo

Rules to go by

.06 Amps

100%

Power Injection guidelines

1. Furthest distance

For 5V pixels

No more than 50 pixels from then nearest injection point

For 12 V pixels

No more than 100 pixels from the nearest injection point

.06 Amps
100%

Power Injection Guidelines

2. Max pixels per power supply run

- A good rule of thumb is to use 14 gauge minimum wire for power injection runs
- 14 gauge wire is rated to 20 Amps
- Don’t exceed more than 333 pixels per power injection run (20/.06 = 333)

ChristmasExpo

.06 Amps
100%

Power Injection Guidelines

3. Keep track of total power consumption

- Each power supply has a max wattage rating.
- Determine what percentage brightness you want to design for your show

ChristmasExpo

.06 Amps
100%

3 rules of Power injection

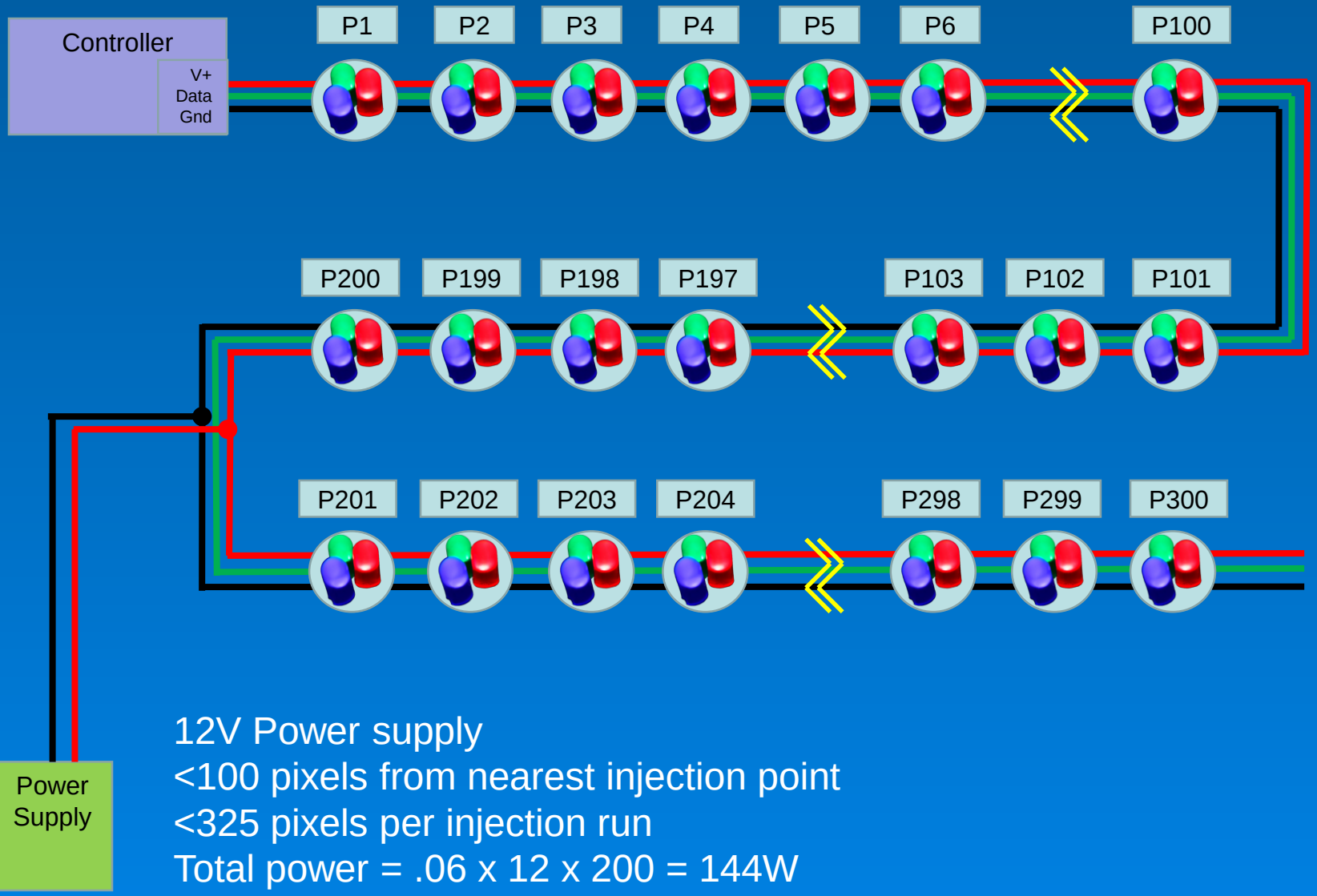
1. Stay within furthest power injection point (100 for 12V, 50 for 5V)
2. For each run inject a maximum of 325 pixels (assuming 14 gauge wire)
3. Monitor your total Wattage per power supply

ChristmasExpo

Real case examples

.06 Amps
100%

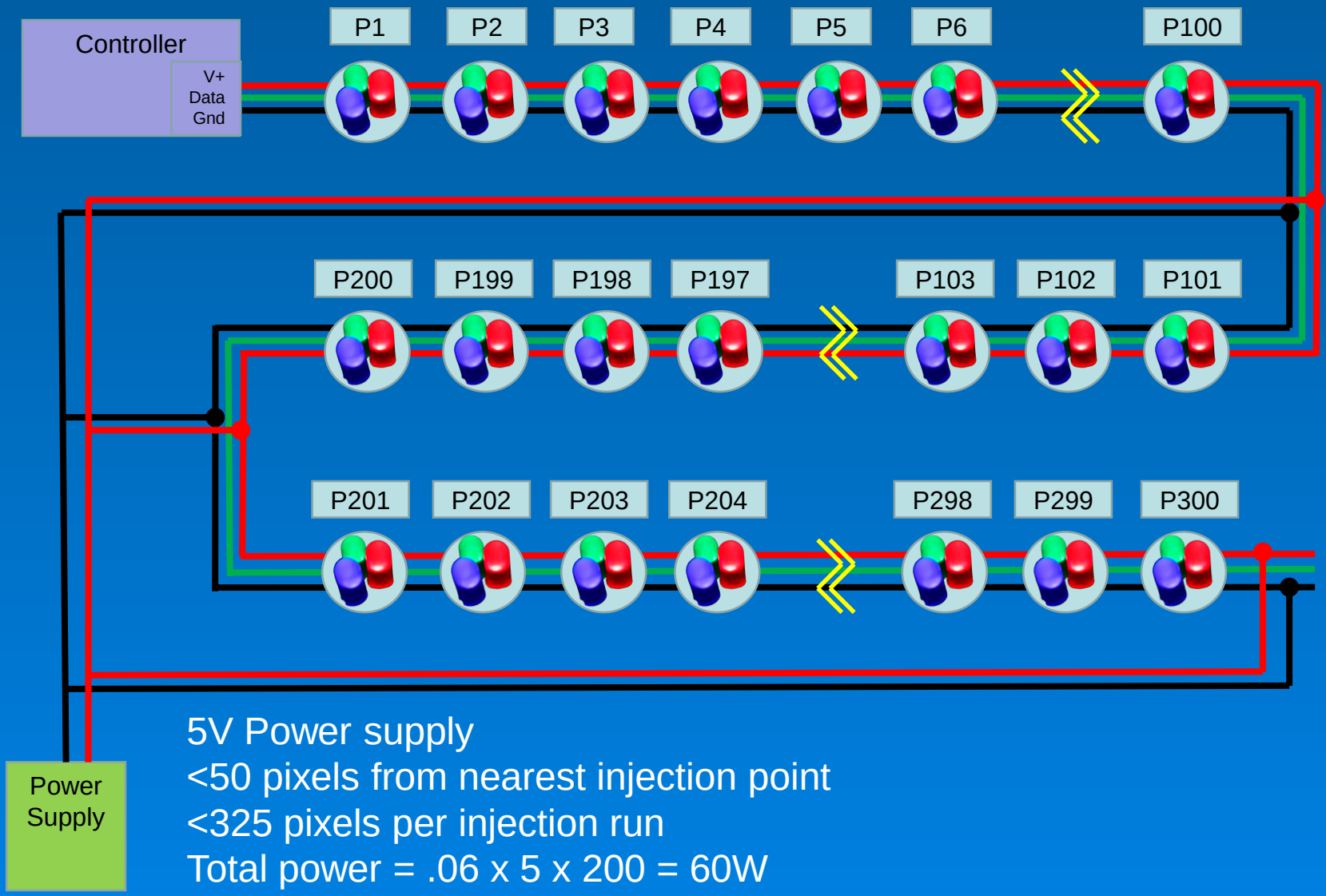
Pixel Strings/Ribbons 12V example



12V Power supply
<100 pixels from nearest injection point
<325 pixels per injection run
Total power = .06 x 12 x 200 = 144W

.06 Amps
100%

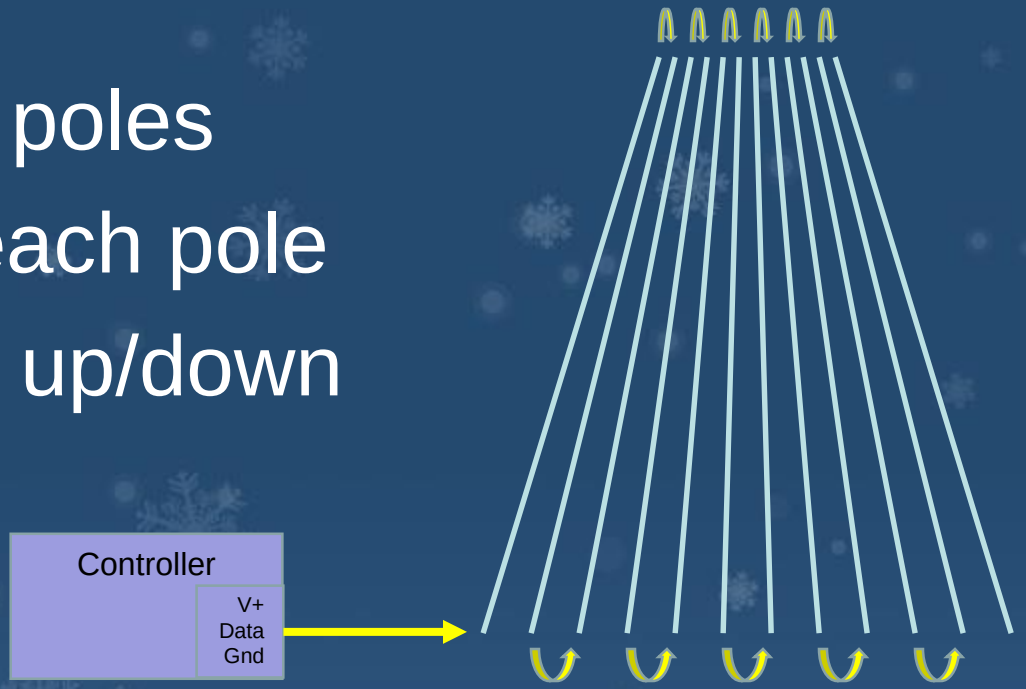
Pixel Strings/Ribbons 5V example



5V Power supply
<50 pixels from nearest injection point
<325 pixels per injection run
Total power = .06 x 5 x 200 = 60W

Props – Mega tree

- 12 vertical poles
- 90 pixels each pole
- Data flows up/down

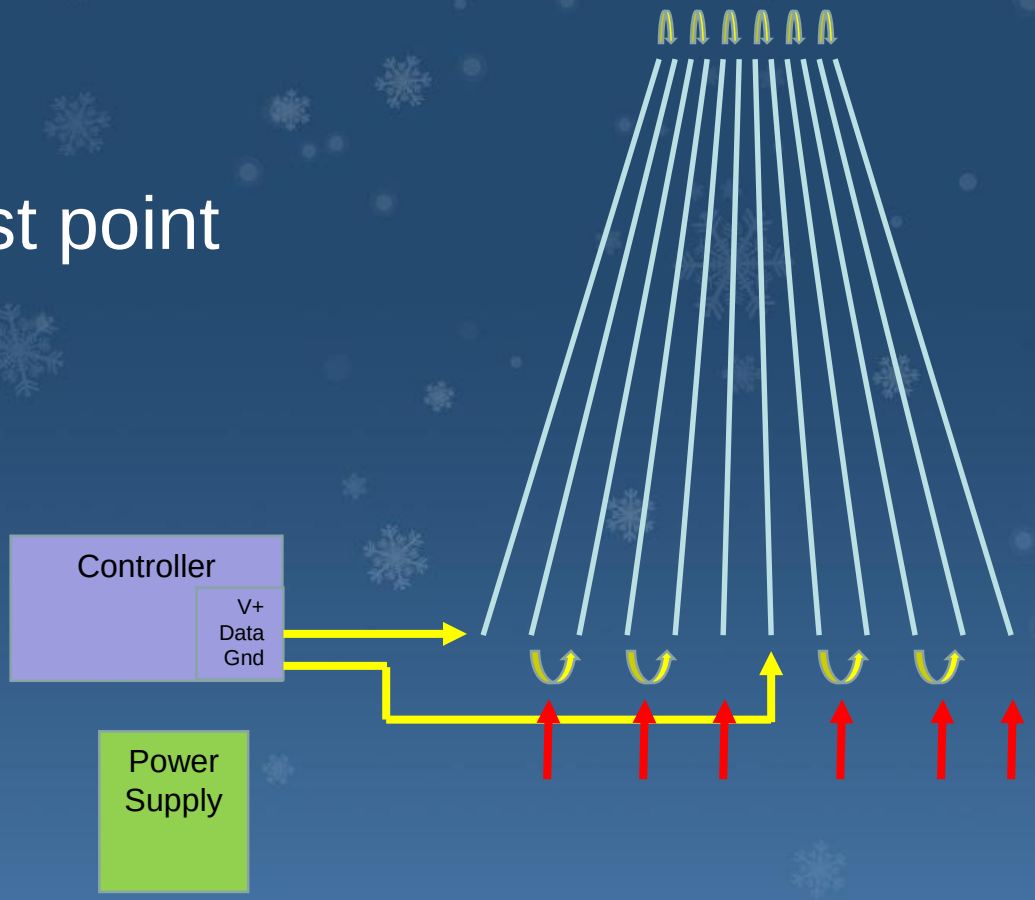


ChristmasExpo

.06 Amps
100%

Props – Mega tree

- 12V Power
- <100 furthest point

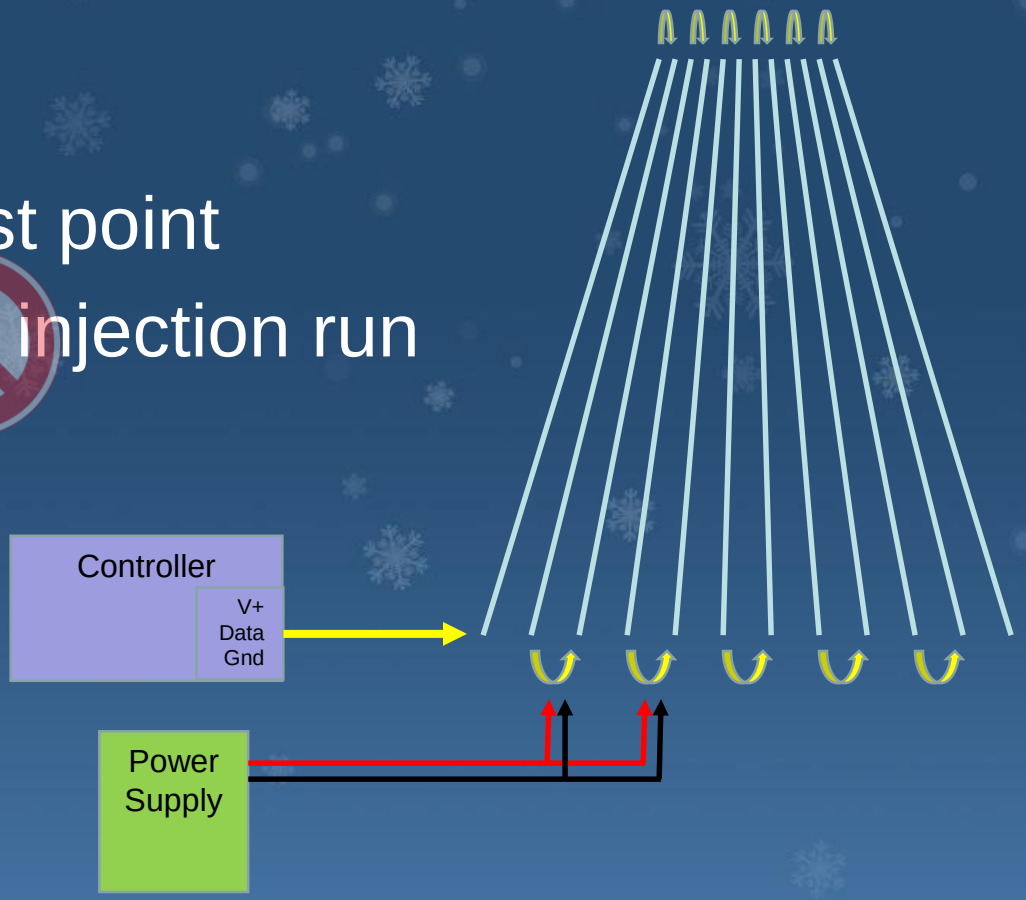


ChristmasExpo

.06 Amps
100%

Props – Mega tree

- 12V Power
- <100 furthest point
- <333 Single injection run

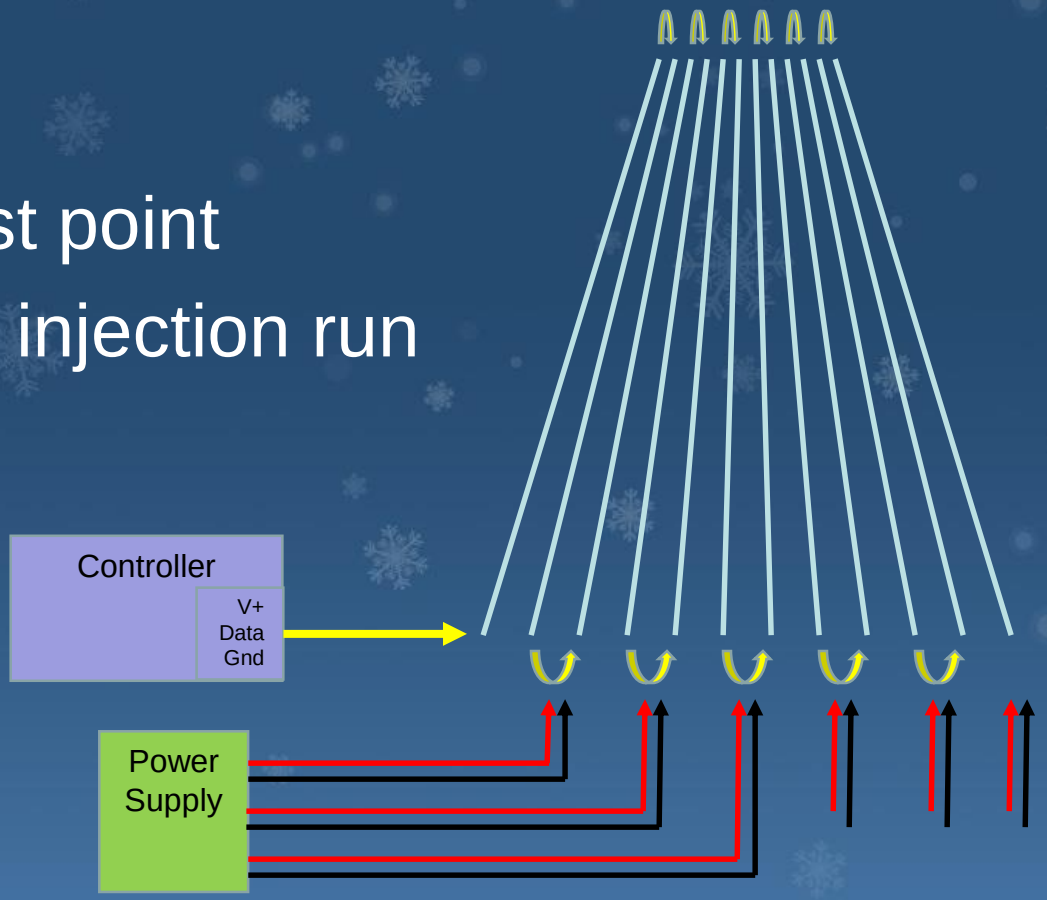


ChristmasExpo

.06 Amps
100%

Props – Mega tree

- 12V Power
- <100 furthest point
- <333 Single injection run

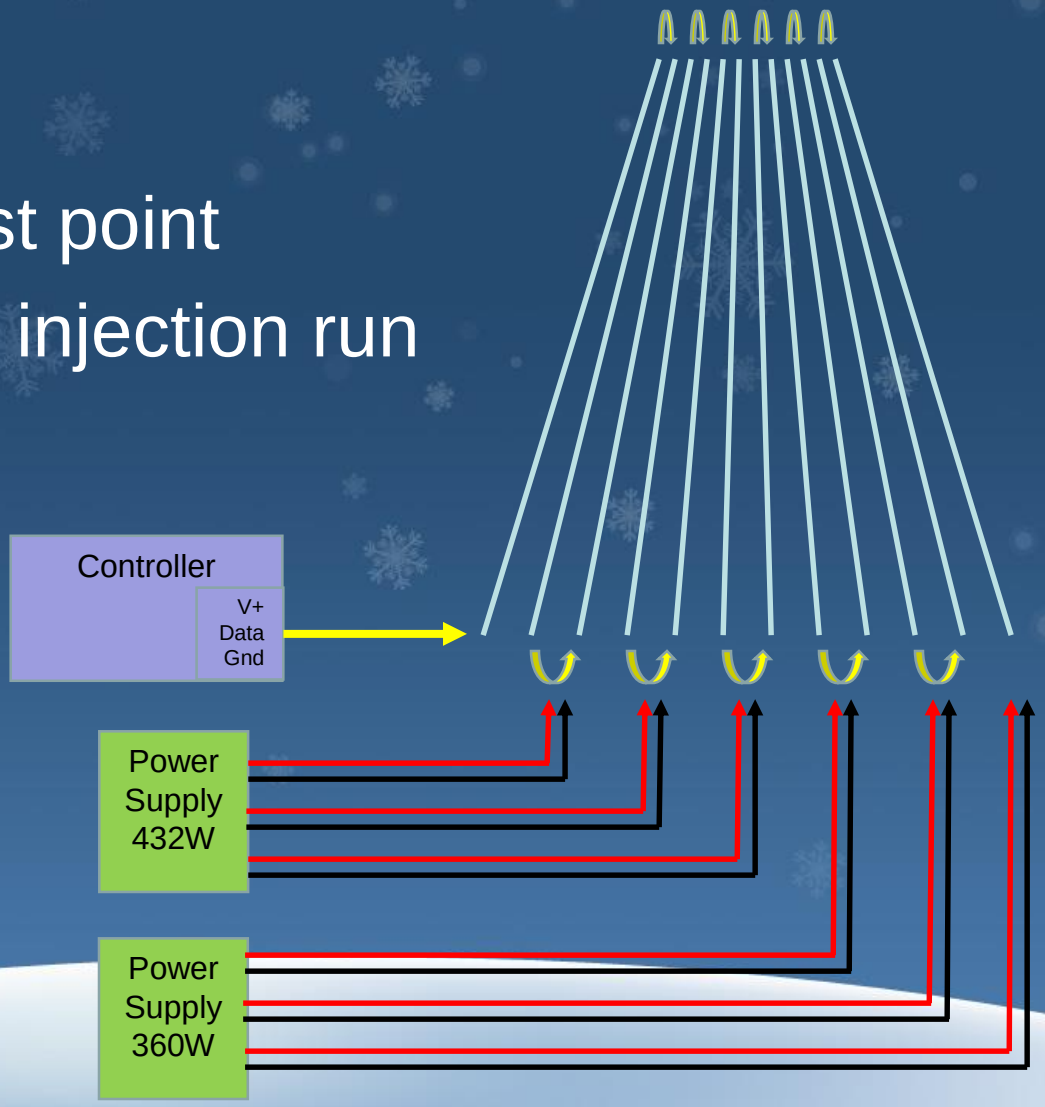


ChristmasExpo

.06 Amps
100%

Props – Mega tree

- 12V Power
- <100 furthest point
- <333 Single injection run

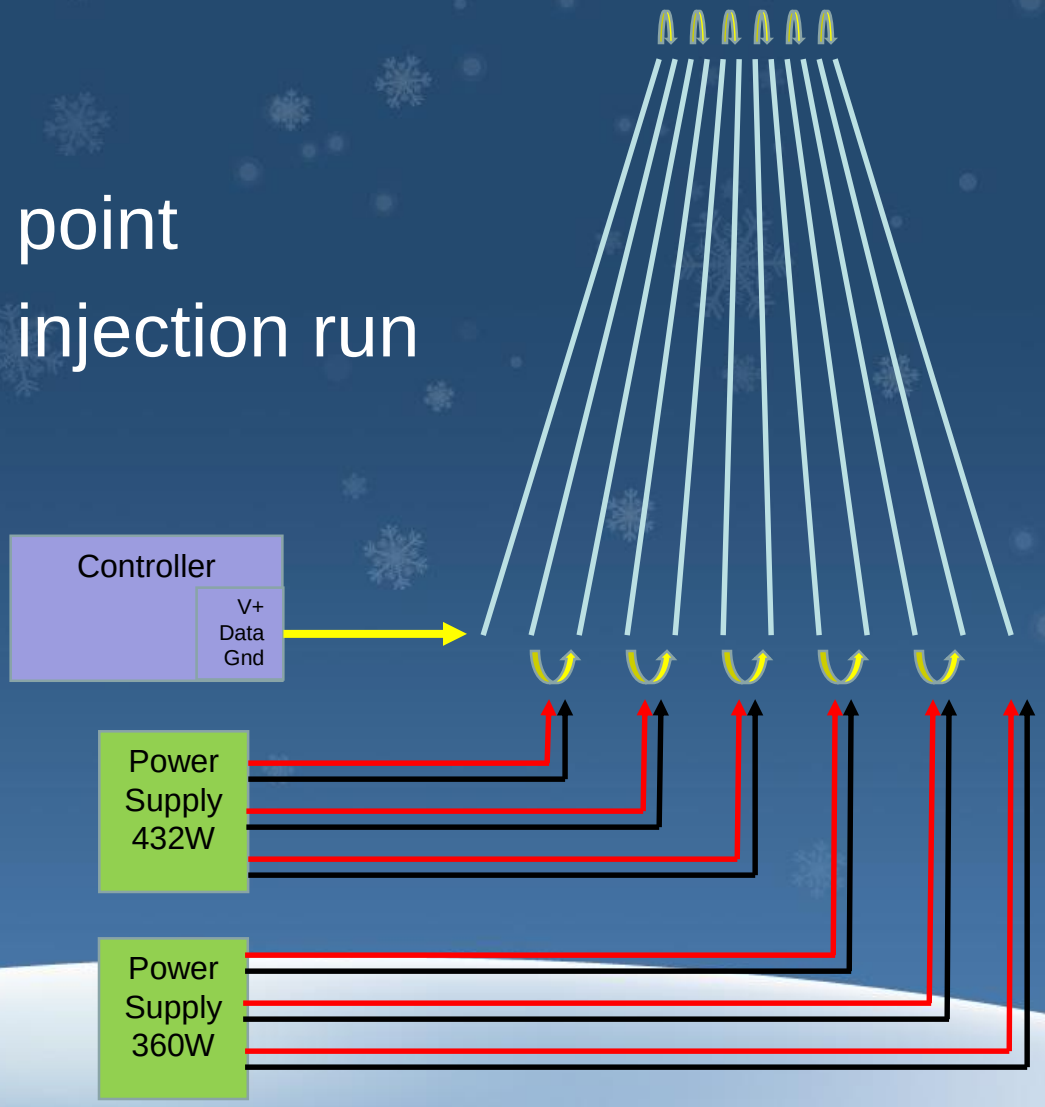


ChristmasExpo

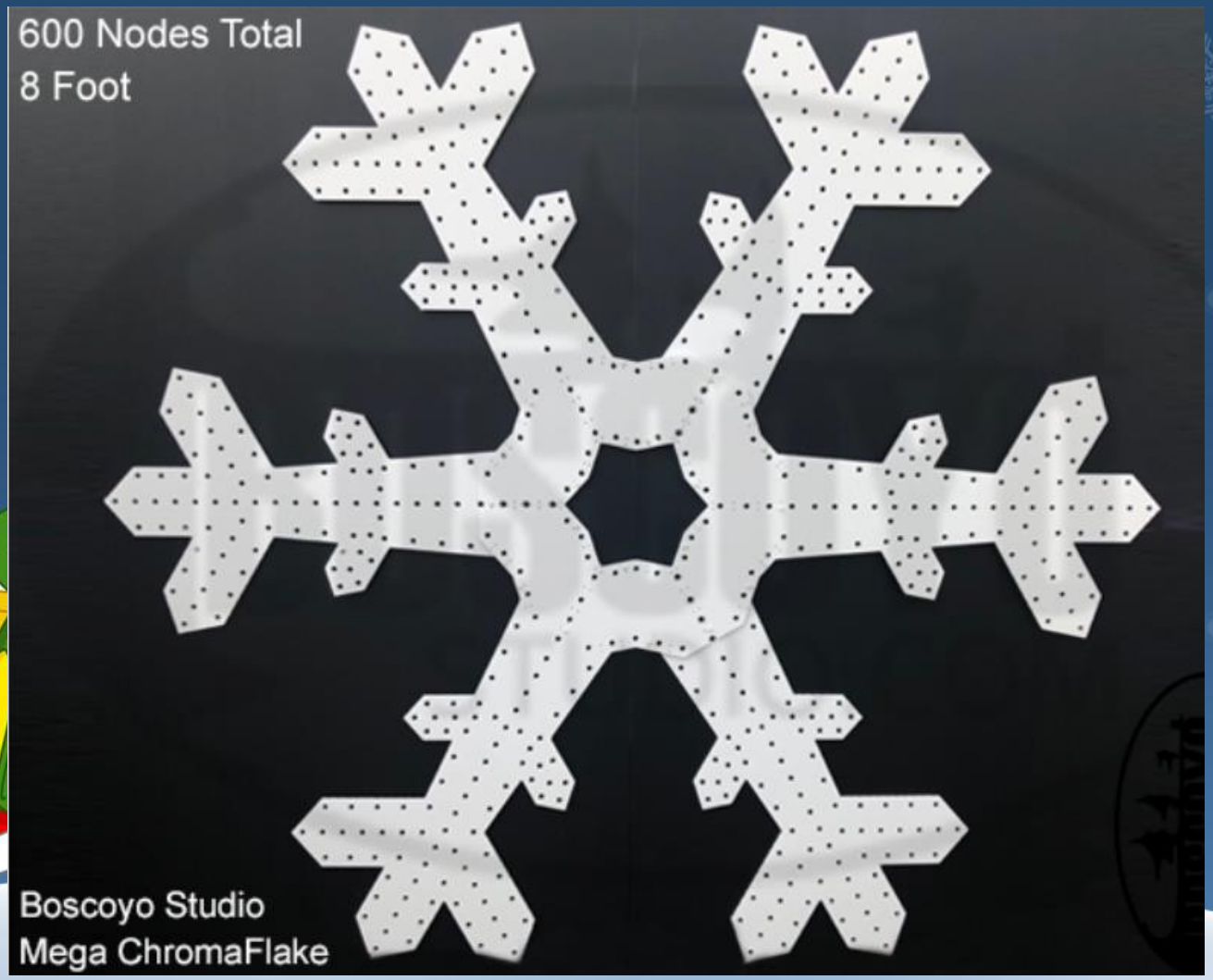
.06 Amps
100%

Props – Mega tree

- 5V Power
- <50 furthest point
- <333 Single injection run

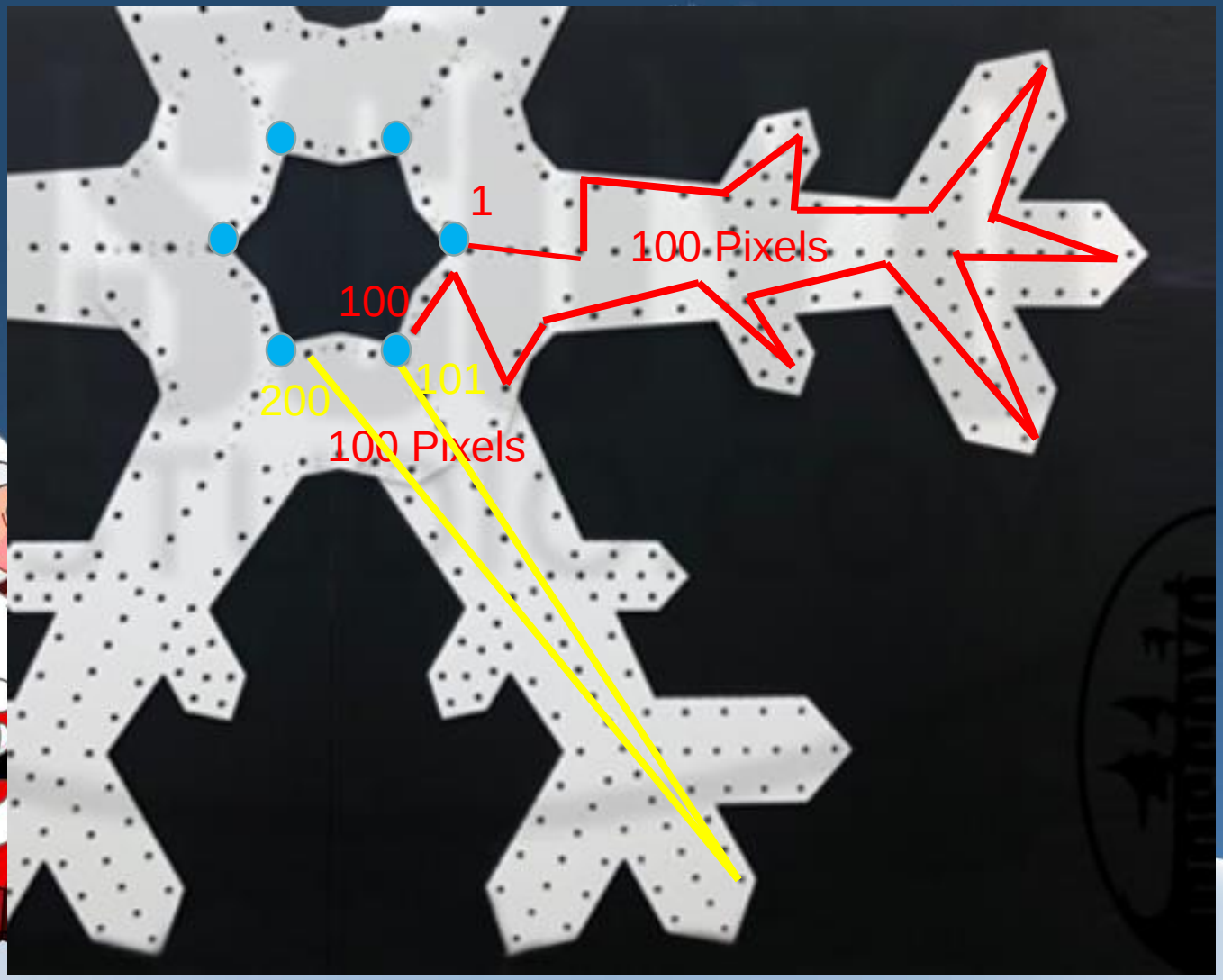


ChristmasExpo



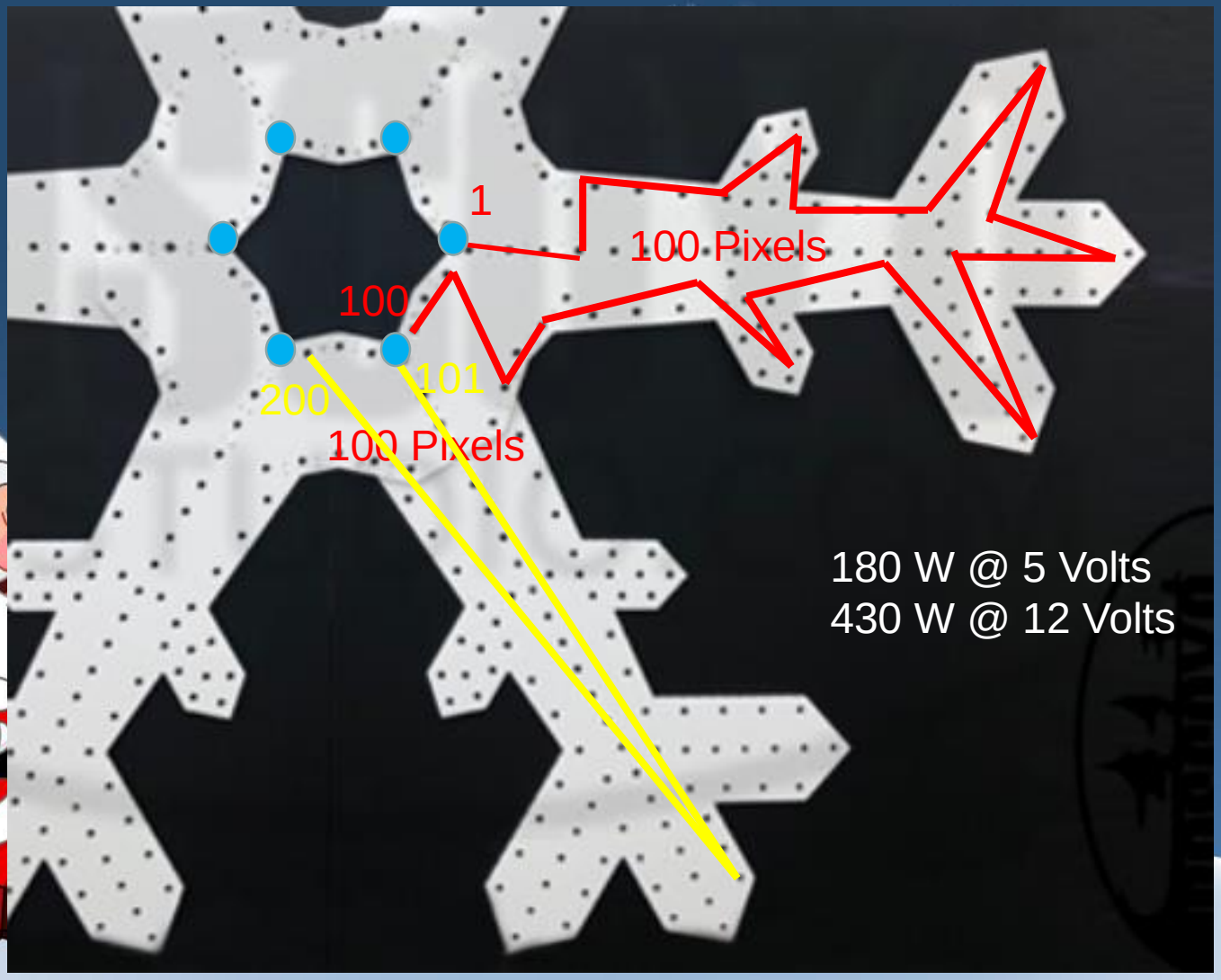
ChristmasExpo

100 Pixels per arm



ChristmasExpo

600 x .06 = 36 Amps



ChristmasExpo

.06 Amps
100%

Summary

1. Stay within furthest power injection point (100 for 12V, 50 for 5V)
2. For each run inject a maximum of 325 pixels (assuming 14 gauge wire)
3. Monitor your total Wattage per power supply

ChristmasExpo

Questions?

WillisChristmasShow.com