Taking the mystery out of power injection

Les Willis
WillisChristmasShow.com

I Heard the Bells on Christmas Day

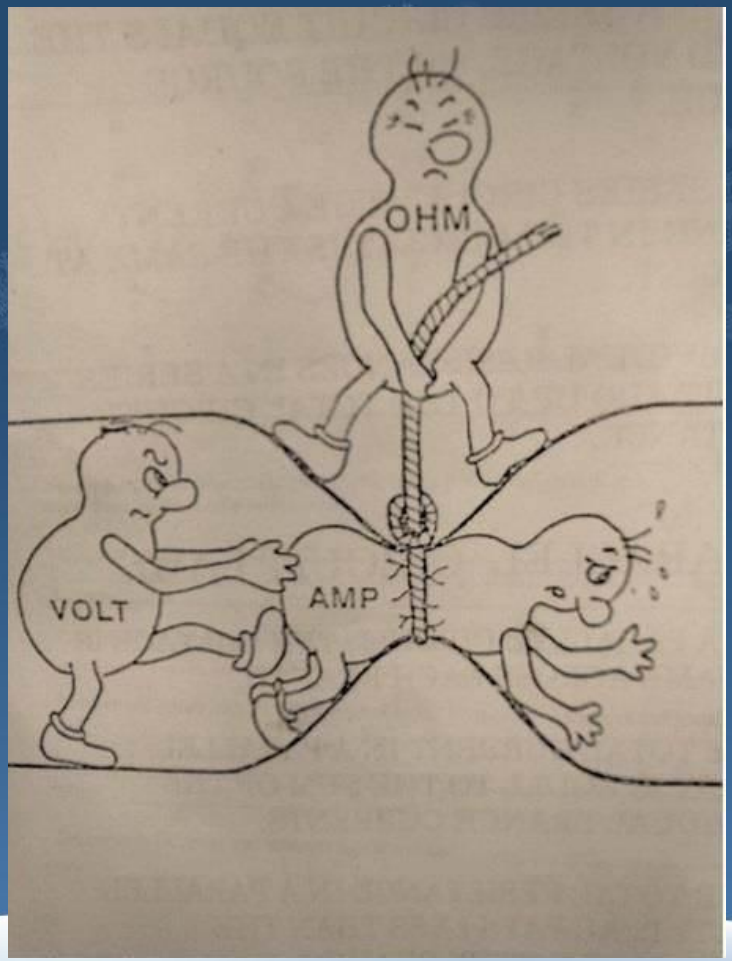
Power injection

- 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 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.)

Volts = Amps x Resistance

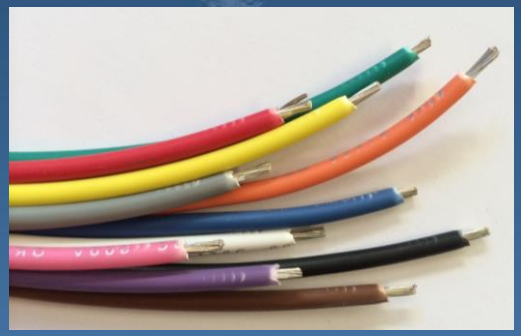


The why??

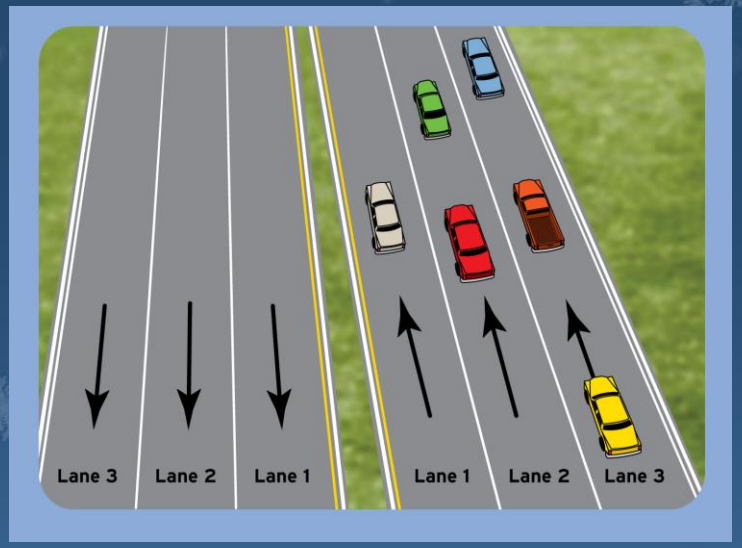
We are battling voltage drop. And the lower the voltage the tougher the battle.

Wire gauge and resistance

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

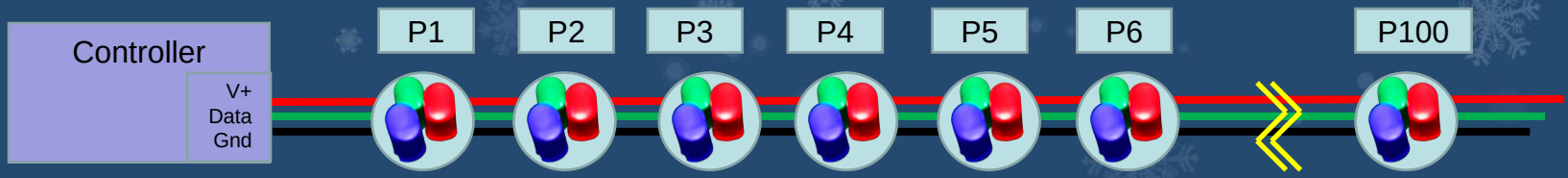


Current flow is analogous to traffic flow



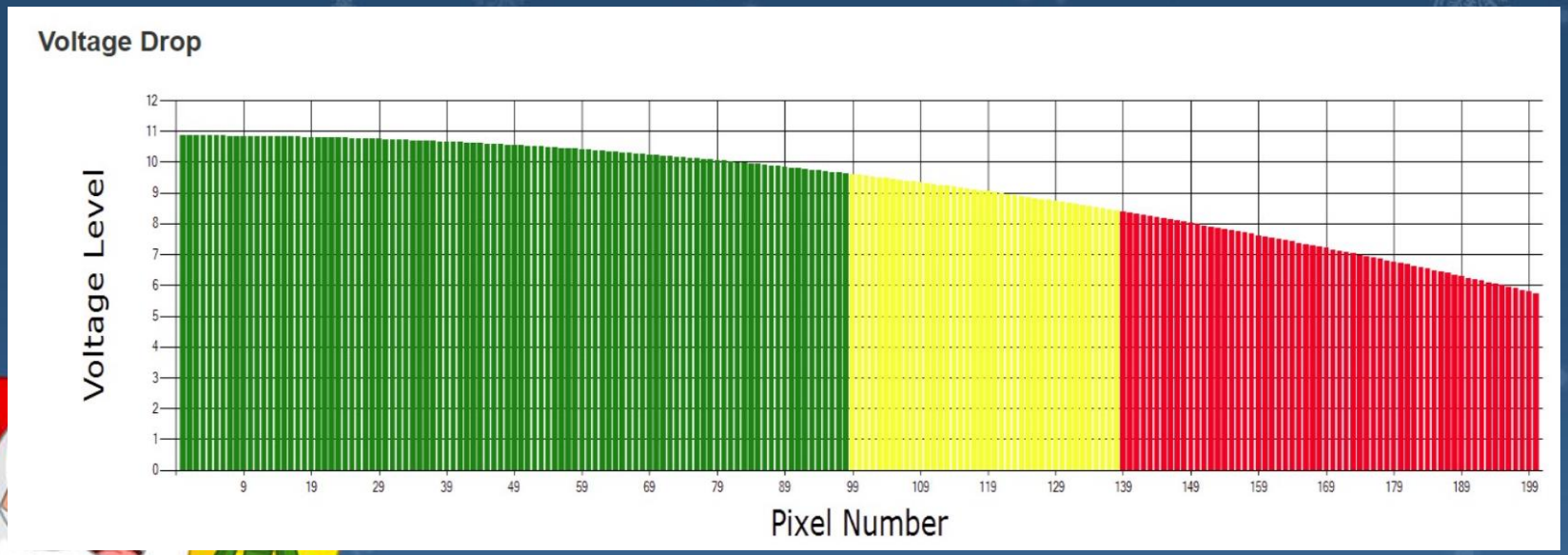
How does this impact your display?

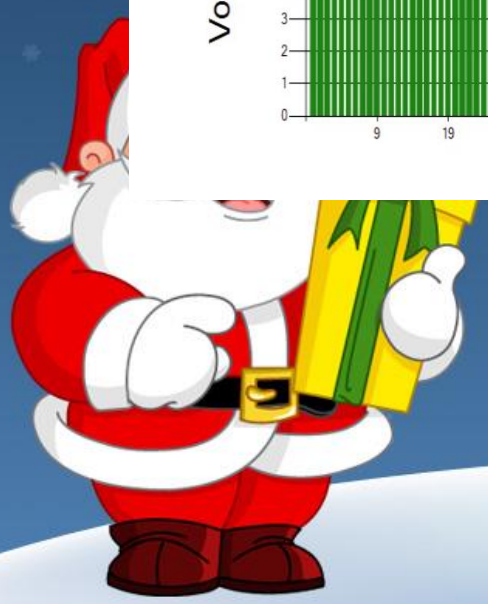
Voltage Drop Symptoms



1. LED color (whites will become pink)
2. Data integrity (The TTL logic can’t distinguish the 1’s and 0’s)

Voltage drop without power injection





Based on 12V pixels!

A small amount of theory

Typical pixel electrical specifications

Product Specifications

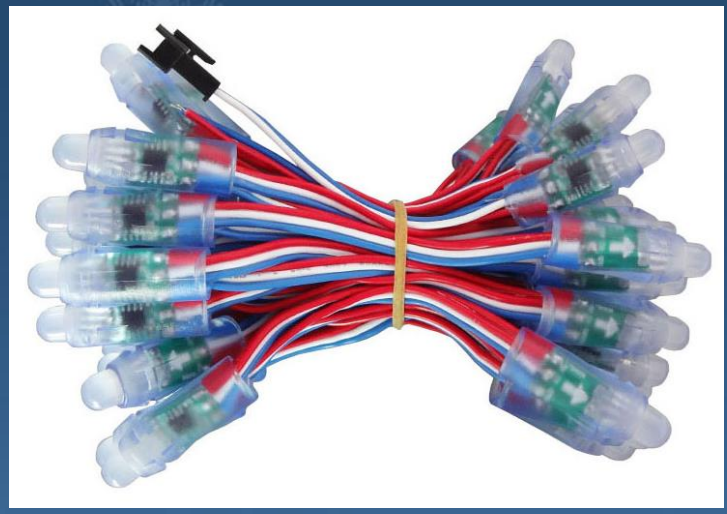
- **Node Voltage**: 12V DC
  - Regulator
- **Node Color**: RGB
- **Node Protocol**: WS2811
- **Node Spacing**: 10cm / ~4"
- **Lead Length**: 150mm / ~6"
- **Node Type**: Smart Bullet
- **Nodes Per. String**: 50
- **Compatible Pigtail**: xConnect / Scott LED / Holiday Coro
- **Power Consumption Based On 100% White**:
  - **Max Node Current Draw**: 60mA
  - **Max Node Wattage**: 0.72W
  - **Max String Current Draw**: 3A
  - **Max String Wattage**: 36W
  - **Max Nodes Before Power Injection**: 120
- **DMX Channels**:
  - **Per Node**: 3
  - **Per String**: 150
- **Required Controller**: Smart Pixel
- **Viewing Angle**: 150 - 180°
- **Weather Protection**: IP65
- **Width**: 12mm
- **Wire Color**: Black
- **Wire Gauge**: Stamped 18AWG, Closer to 20AWG

.06 Amps
100%

Smart RGB Pixels

- Watts (P) = E*I
- 36W = 12V * 3 Amps

50 Count String



36 Watts

Power Supplies

Power = Voltage x Current

360W/120V = 3 Amps

360W/12V = 30 Amps

360W/5V = 72 Amps

.06 Amps
100%

12 Volt vs. 5 Volt

Power = Voltage x Current

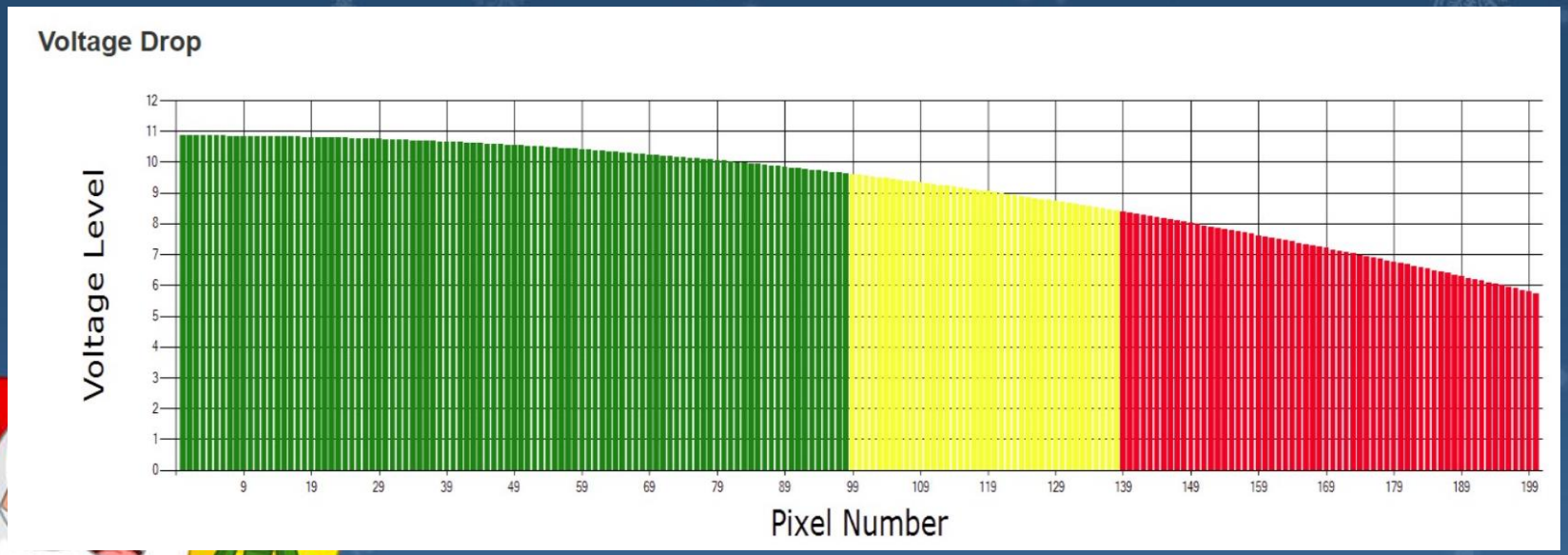
Each pixel requires .06 Amps at 100% brightness

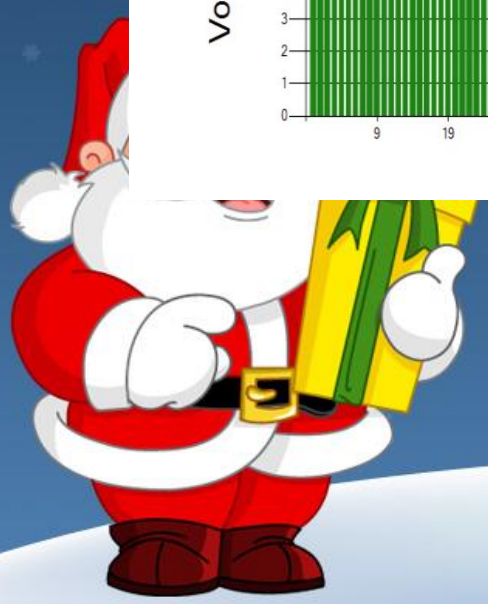
- 360/12 = 30 Amps
  30/.06 = 500 Pixels

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

How to power inject

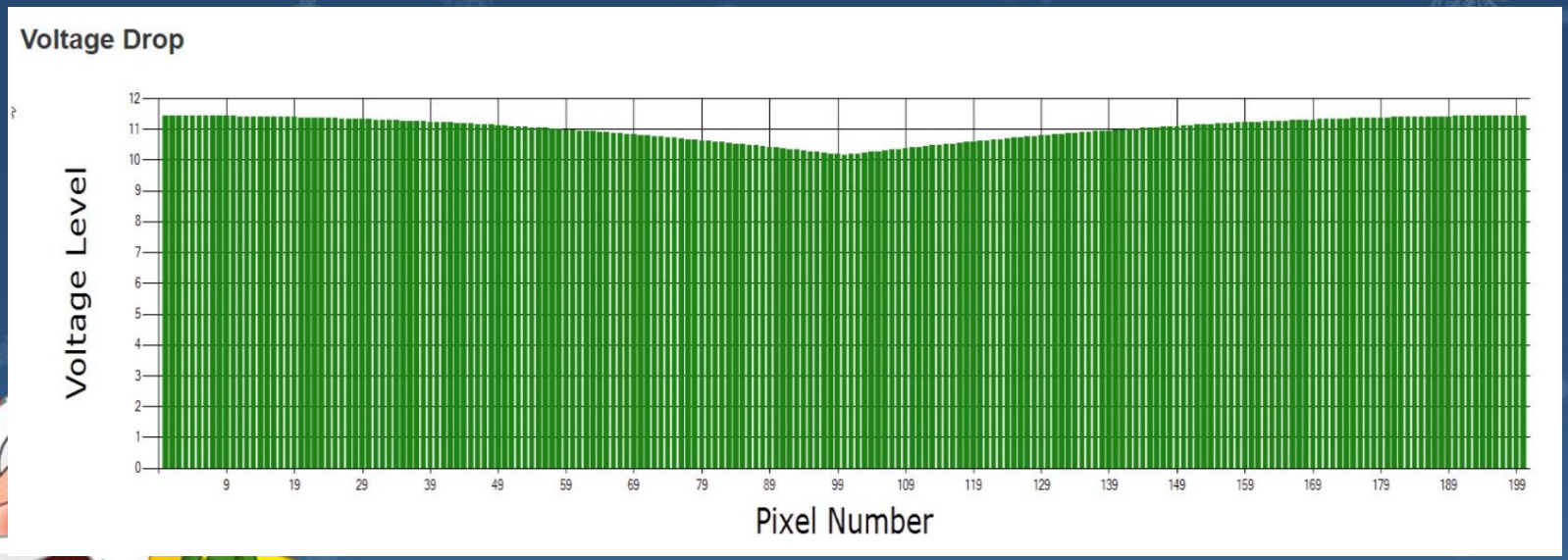
Voltage drop without power injection



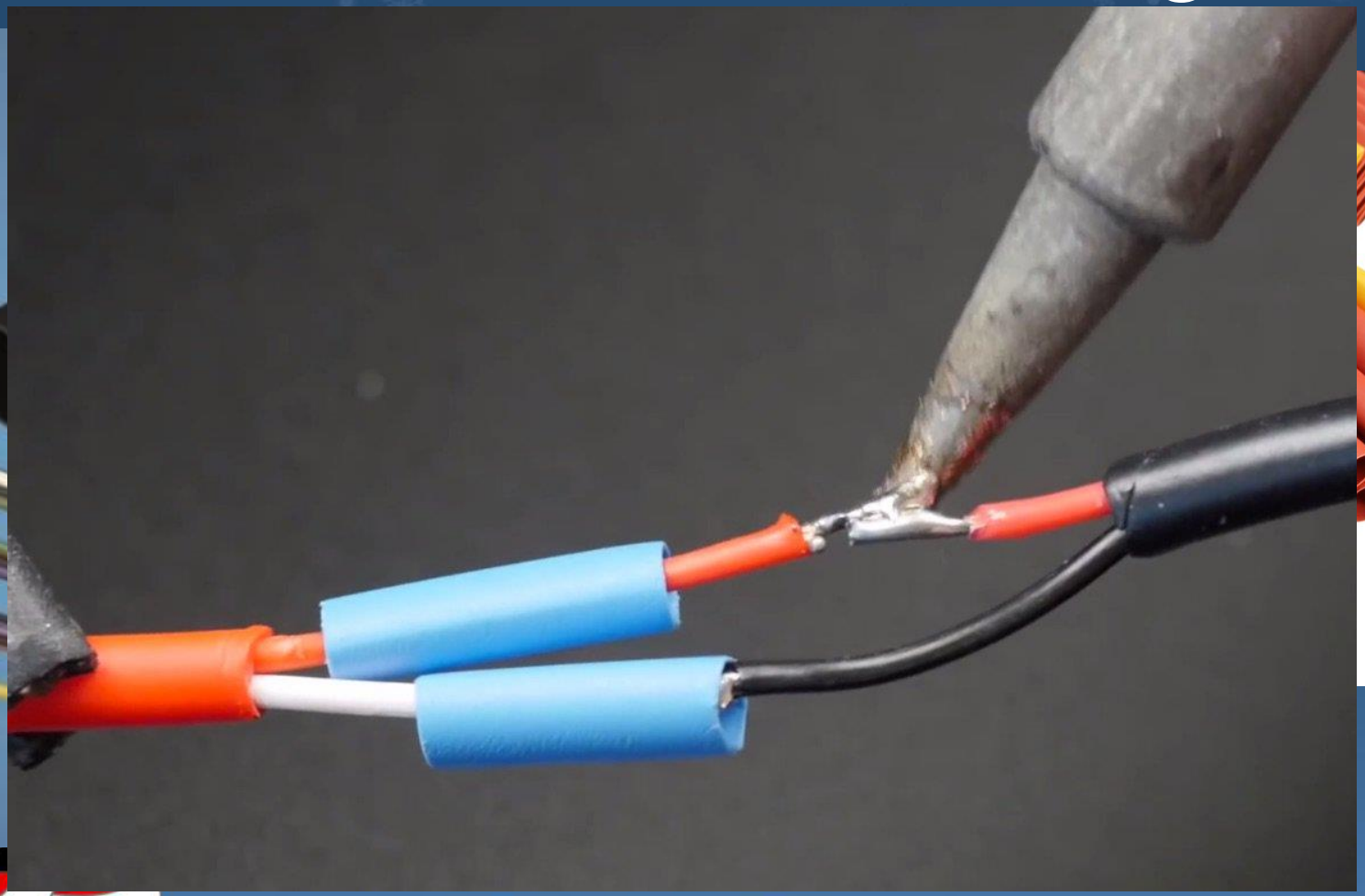


Based on 12V pixels!

Voltage graph with power injection



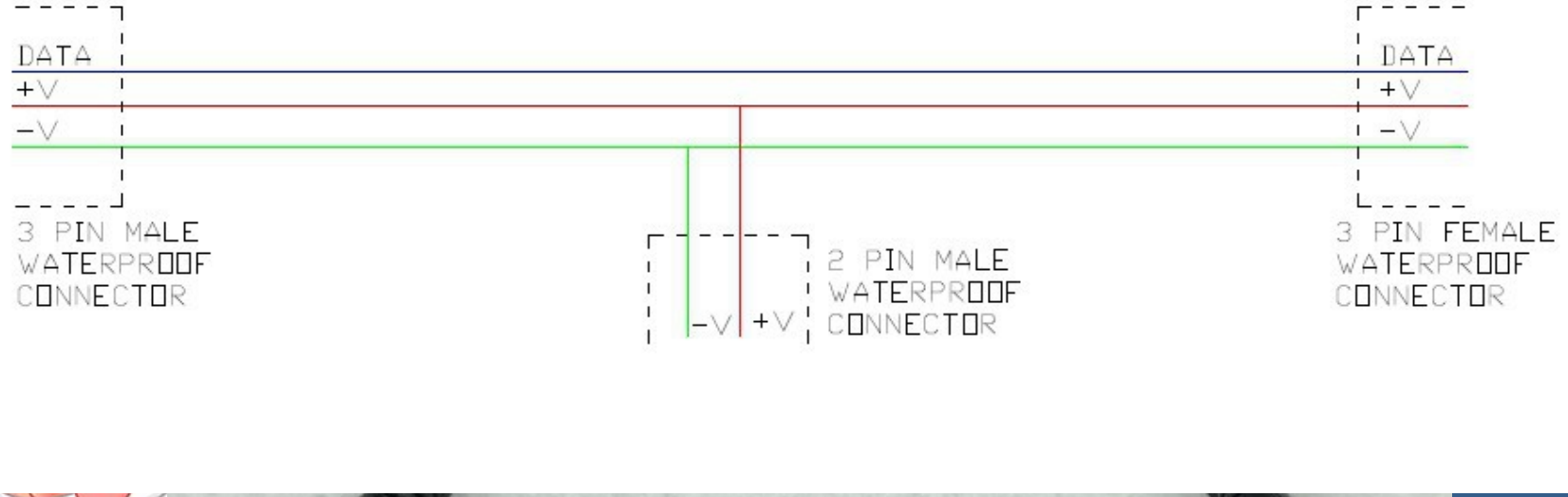
Solder + Shrink Tubing

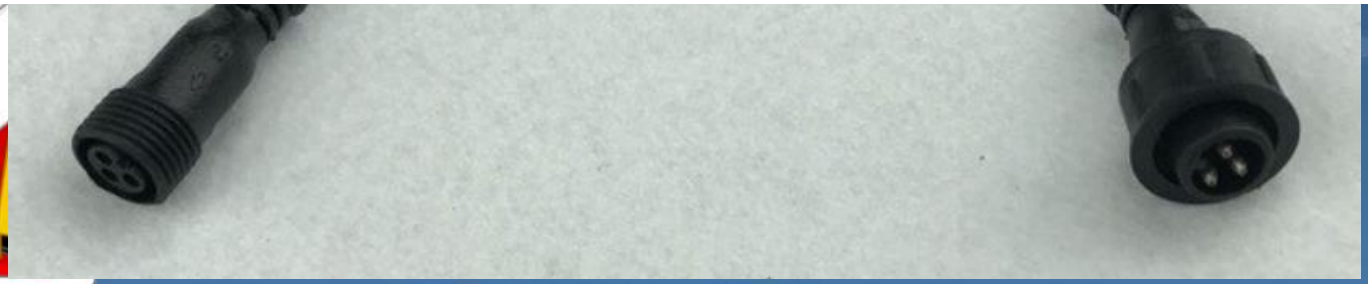


Solder Seal Connectors

Power Injection T's

Power Injection T's





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. Plan for your power injection runs

- A good rule of thumb is to use 18 gauge minimum wire for power injection runs
- Longer runs could require a larger wire

Gage No.	Ohms per 1000 Feet			Gage No.	Ohms per 1000 Feet			Gage No.	Ohms per 1000 Feet			Gage No.	Ohms per 1000 Feet		
0	0.1			10	1			20	10			30	100		
1		.125		11		1.25		21		12.5		31		125	
2			.16	12			1.6	22			16	32			160
3	.2			13	2			23	20			33	200		
4		.25		14		2.5		24		25		34		250	
5			.32	15			3.2	25			32	35			320
6	.4			16	4			26	40			36	400		
7		.5		17		5		27		50		37		500	
8			.64	18			6.4	28			64	38			640
9	.8			19	8			29	80			39	800		

Wire gauge standard vs Resistance

.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

.06 Amps
100%

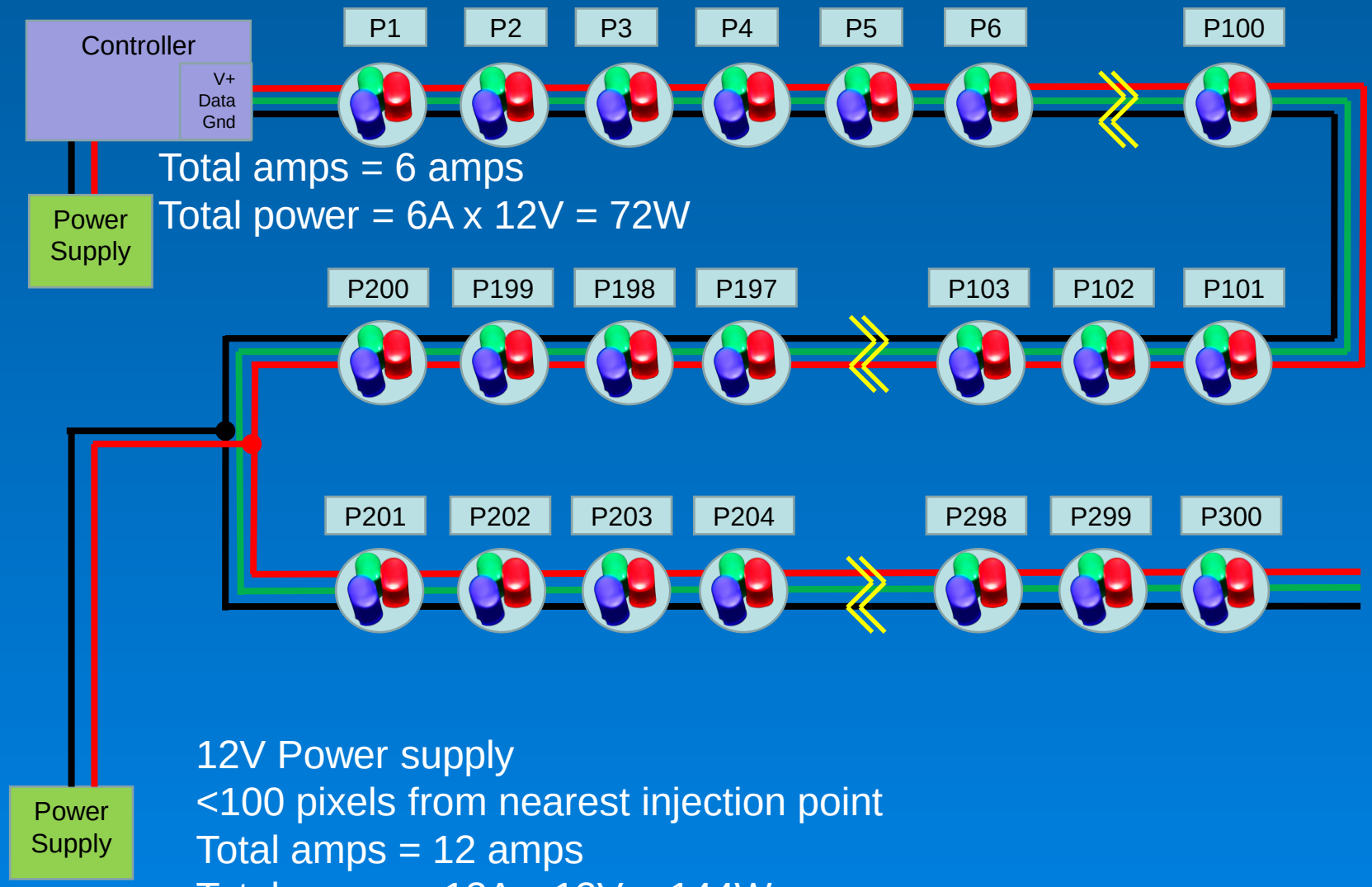
3 rules of Power injection

1. Furthest pixel from power injection point (100 for 12V, 50 for 5V)
2. For each run inject a maximum of 325 pixels (assuming 18 gauge wire)
3. Monitor your total Wattage per power supply

Real case examples

.06 Amps
100%

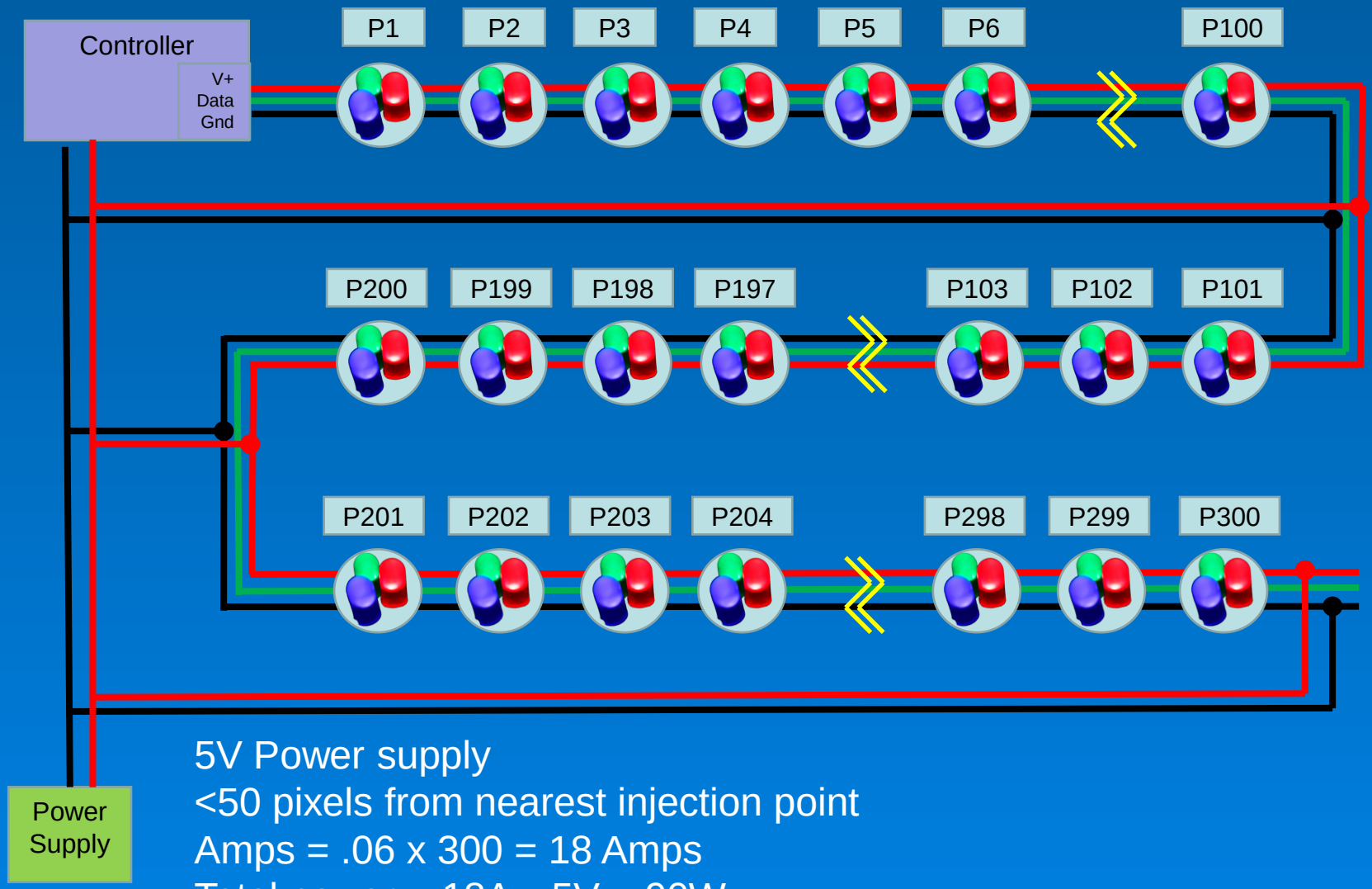
Pixel Strings/Ribbons 12V example



12V Power supply
<100 pixels from nearest injection point
Total amps = 12 amps
Total power = 12A x 12V = 144W

.06 Amps
100%

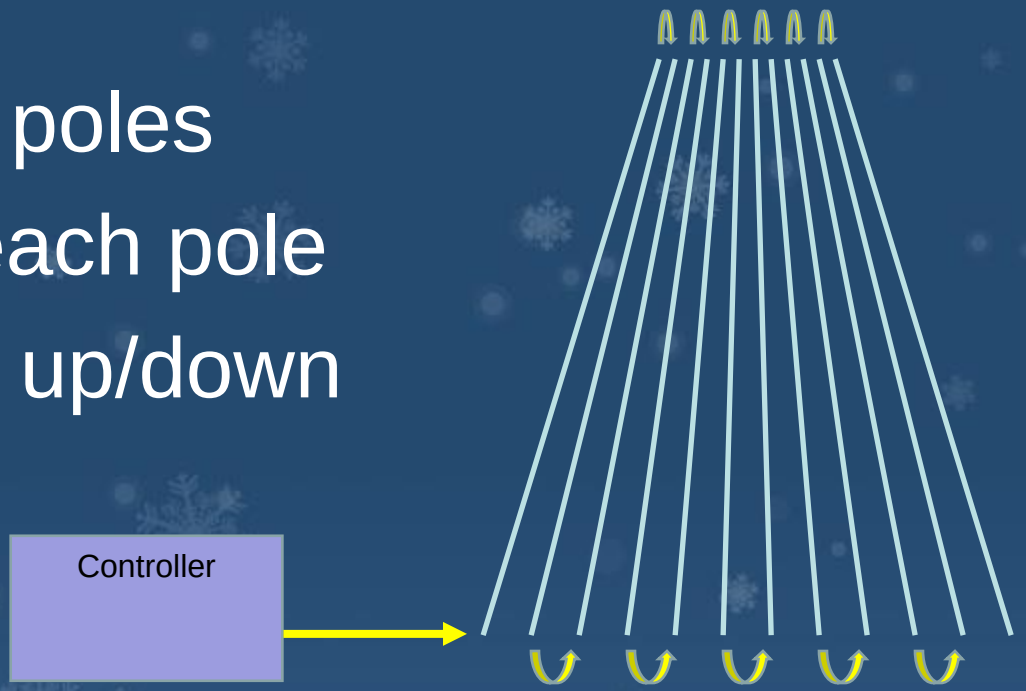
Pixel Strings/Ribbons 5V example



5V Power supply
<50 pixels from nearest injection point
Amps = .06 x 300 = 18 Amps
Total power = 18A x 5V = 90W

Props – Mega tree

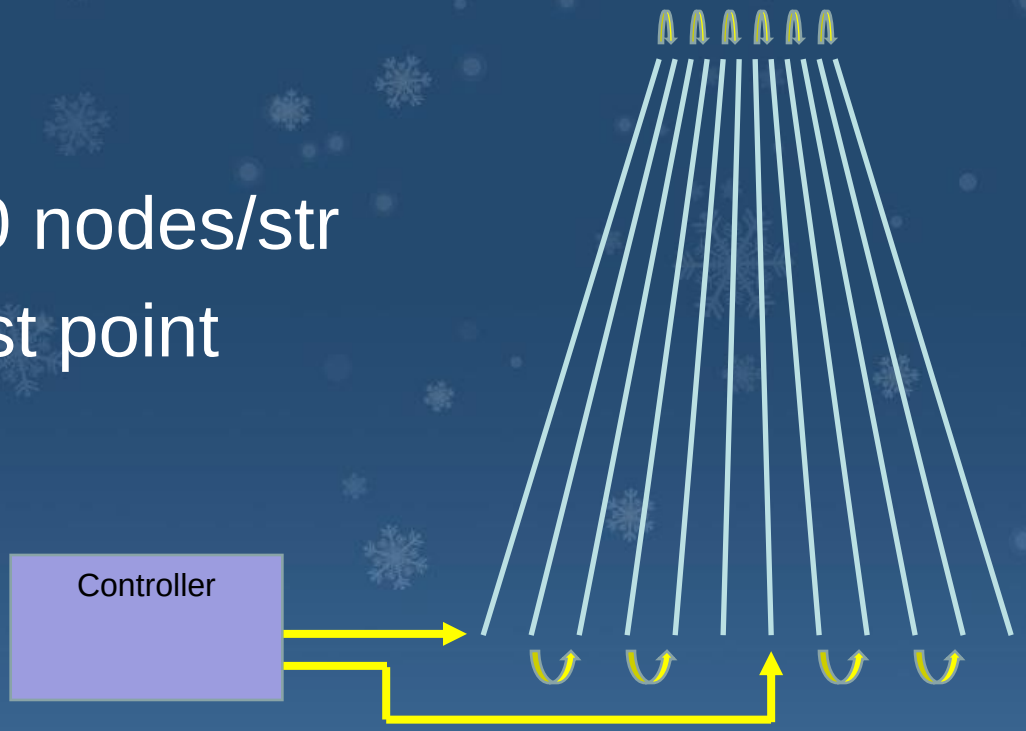
- 12 vertical poles
- 90 pixels each pole
- Data flows up/down



.06 Amps
100%

Props – Mega tree

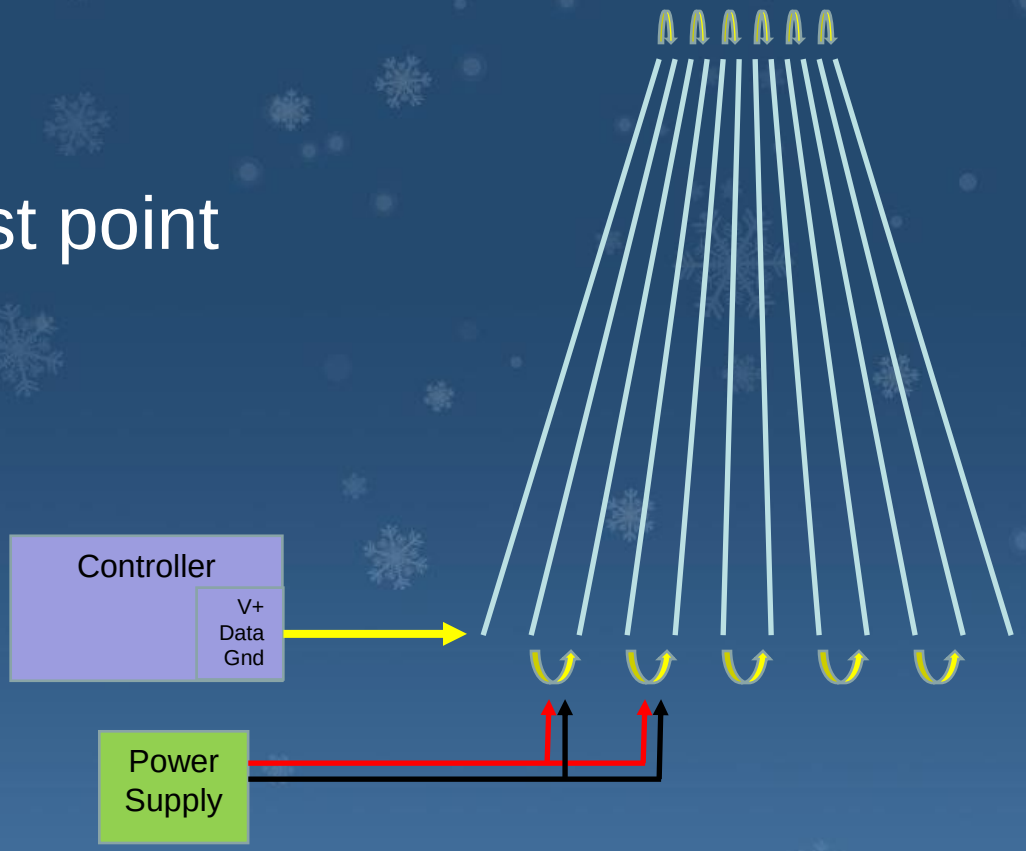
- 12V Power
- 6 x 90 = 540 nodes/str
- <100 furthest point



.06 Amps
100%

Props – Mega tree

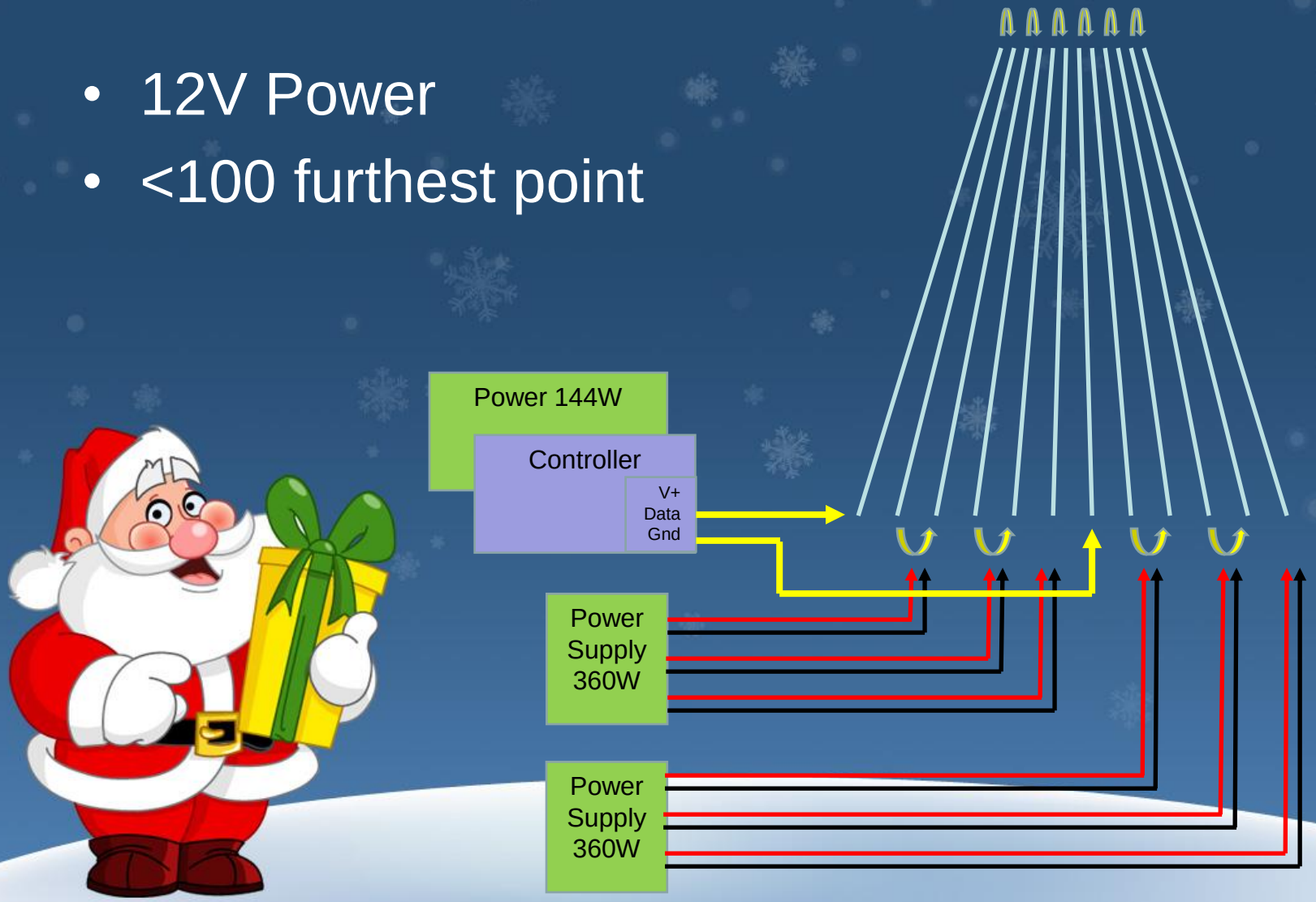
- 12V Power
- <100 furthest point

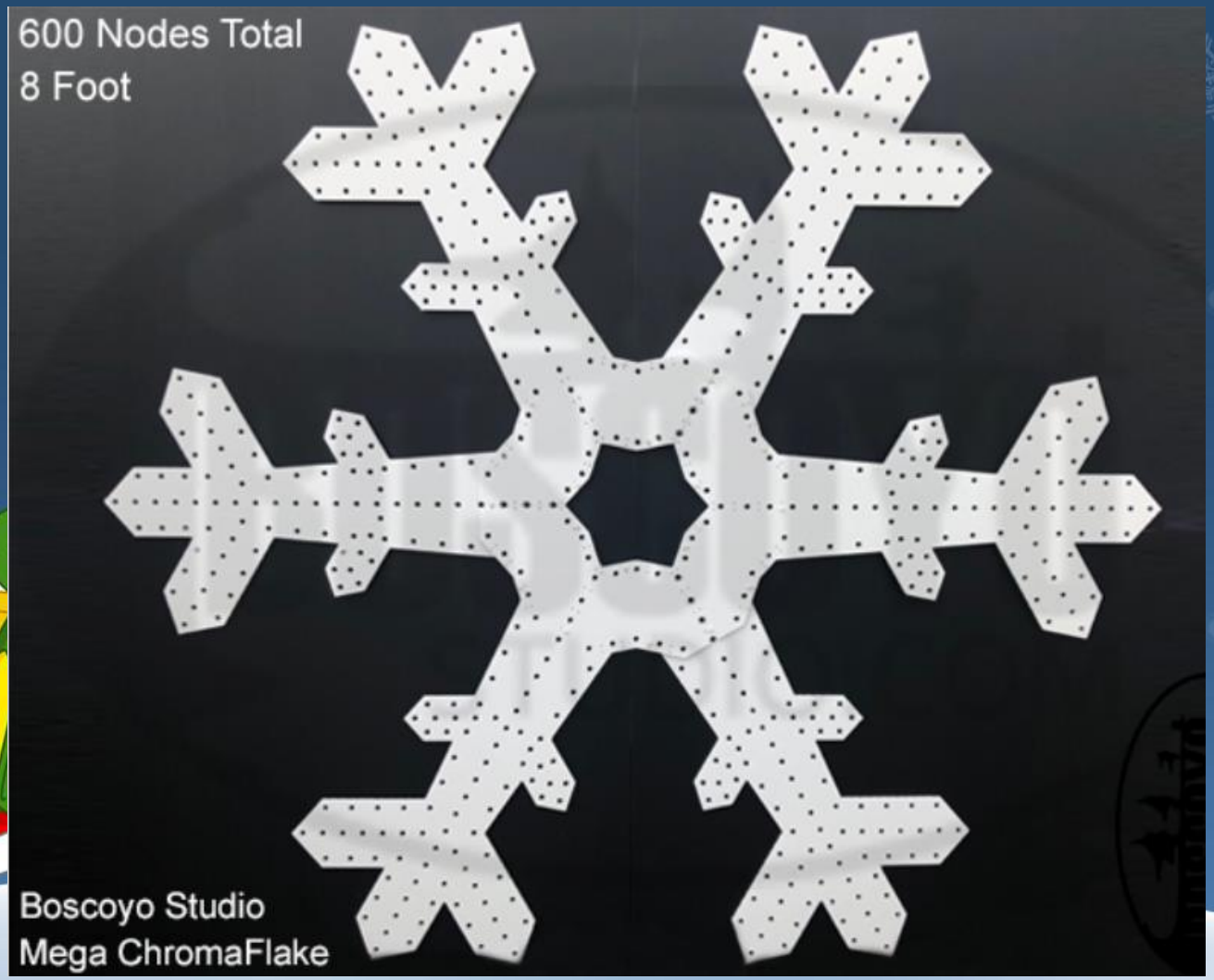


.06 Amps
100%

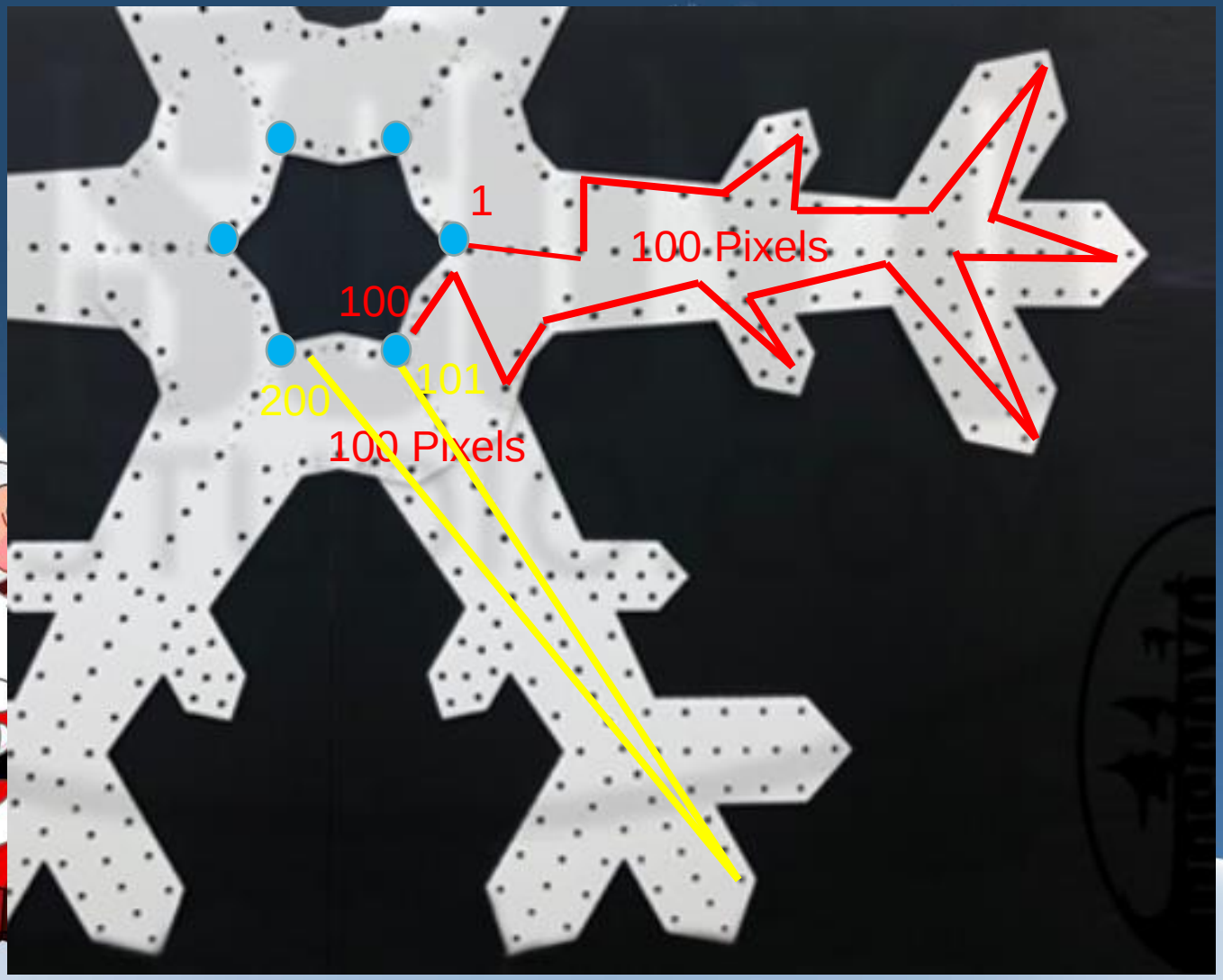
Props – Mega tree

- 12V Power
- <100 furthest point

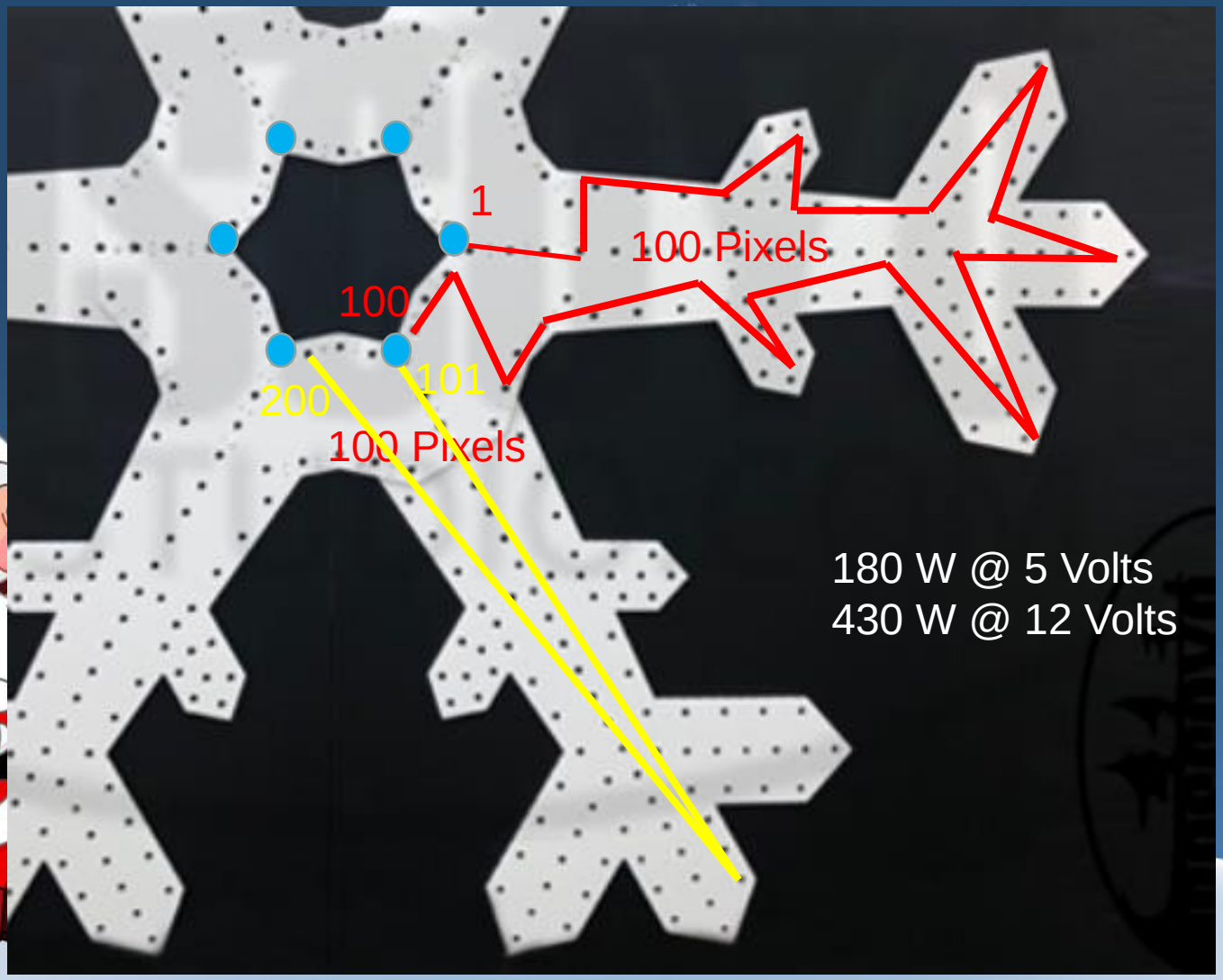



600 Nodes Total
8 Foot
Boscoyo Studio
Mega ChromaFlake

100 Pixels per arm

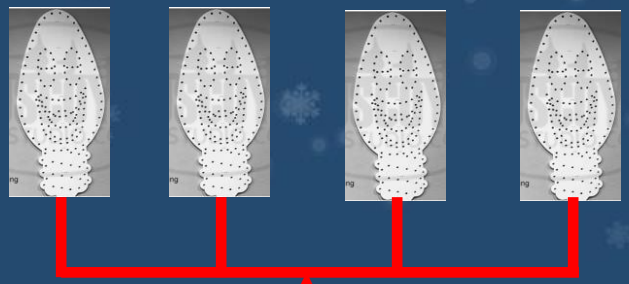


600 x .06 = 36 Amps



170 pixels x .06 =
10.2 A

18 ga stranded



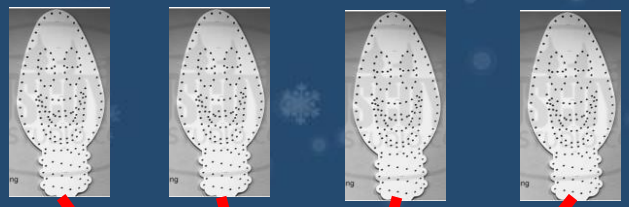
10 ft
.064 ohms x 40A = 2.56V

40A x 12V = 480W

Power Supply

170 pixels x .06 =
10.2 A

18 ga stranded



10 ft
.064 ohms x 10A = .64V

40A x 12V = 480W

Power Supply

4A x 120V = 480W

.06 Amps
100%

Summary

1. Stay within furthest power injection point (100 for 12V, 50 for 5V)
2. Consider Power injection runs and resistance
3. Monitor your total Wattage per power supply

Questions?

WillisChristmasShow.com

Voltage, Resistance, Current

Volts (E) = R*I

Example:

1 Ohm resistance

20 ft wire

12V lights

3.0 Volt drop