

# HOW to WIRE

## WIRING GUIDE FOR THE ATX LED SYSTEM



AL-CBOX4 Rough-in Junction Box for easy code-compliant installation

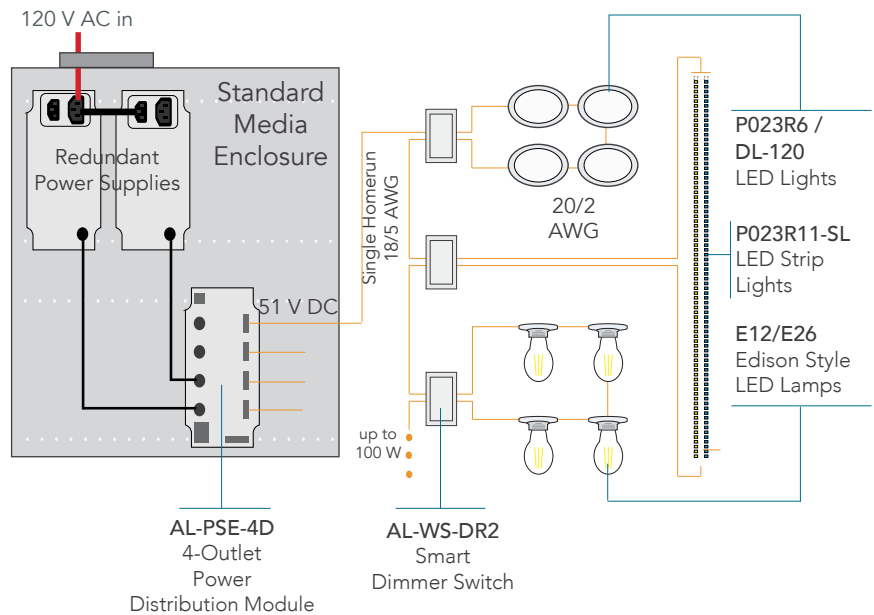
### Overview

ATX LED offers home builders a lower-cost, flicker-free, perfectly-dimmable LED lighting system using low-voltage DC power without changing the look and feel of traditional fixtures or switches. ATX LED's solution converts 120 V AC to DC just once per house to provide DC power to lights, fans, and chargers and reduce labor cost, save copper, and improve the end-user experience with higher reliability. ATX LED's innovative technology eliminates the need to run high-voltage ROMEX™ throughout the home and instead uses 18/5 or 18/3 for home runs and 20/2 between switches and lights.

The end product can be value priced with simple on/off standard wall switches, or smart and full-featured without significant additional cost. Designed for volume builders, the labor and schedule savings allow projects to be completed more quickly and at lower costs.

### Complete System Solution

ATX LED's innovative system features redundant power conversion hardware to insure continuous operation even in the case of unexpected failure. The system includes a selection of LED lighting, switches, power management hardware, and accessories. All ATX LED products are UL listed and compliant with California Title 24 standards, as well as compatible with common smart home controls. The ATX LED DABus provides smart home connectivity and control.



Typical ATX LED System Example

### Flexibility to Choose

ATX LED gives builders the ability to offer home buyers a simple and seamless upgrade path at any stage of the build process because no changes to wiring or other buildout are required. Simply choose lights and switches from the same line to create the optimal lighting experience.

#### V Value Line

The entry-level products in the Value Line offer a starting point for installing energy-efficient DC lighting, with a selection of fixed true white light colors and standard switches.

#### S Signature Line

The Signature Line is for customers who want a fully programmable system that integrates with common wireless smart home controls. Lights in the Signature Line can be color tuned to a wide range of colors and programmed to adjust throughout the day.


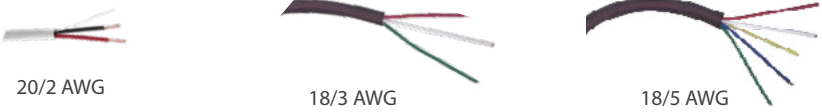
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## Wiring Overview

Conventional wiring for 120 V AC lighting systems relies on heavy gauge ROMEX. This wire is designed to carry heavy loads; it is not required for low-power LEDs. The ATX LED system saves copper and simplifies installation by using right-sized 18/5 skinny wire for home runs and daisy-chaining switches and 20/2 for wiring between switches and lights. This wiring delivers the appropriate amount of power to each fixture without the need for conversion circuitry in each fixture.

The ATX LED system is wired with 18/5 throughout, though our Value Line products require only three wires. This allows for easy upgrade to a full-featured Signature Line system with the simple swap of switches and fixtures; no wiring changes are required. The diagrams in this manual are simplified for clarity when appropriate, showing only the three wires connected on Value Line examples. For extreme cost savings, 18/3 home runs might be used, but this is not recommended since it precludes future upgrades.

ROMEX	ATX LED
 <p><b>14AWG @ 15A = 1800 Watts/LED</b></p>	 <p>20/2 AWG      18/3 AWG      18/5 AWG</p> <p>The ATX LED system utilizes skinny wire for all DC circuits:</p> <ul style="list-style-type: none"> <li>- 18/5 for all home runs and for daisy-chaining switches.</li> <li>- 20/2 from switches to LEDs and between LEDs</li> <li>- For the special case of DALI installations, use 18/5 for home runs.</li> </ul>

## Comparison of Wiring Types

As shown in the example below, using lower-gauge wiring results in significant cost savings in addition to simplifying installation, saving copper, and allowing the LEDs to run cooler and more efficiently. The below tables compare costs in a typical 1800 ft<sup>2</sup> home.

### Low Voltage Example

Application	Gauge	Price per ft (June 2021)	Feet of wiring	Total cost home
Home Run (standard)	18/5	\$0.28	300	\$84.00
Home Run (not recommended)	18/3	\$0.16	300	\$48.00
Switch to Light	18/2	\$0.12	660	\$79.20
	20/2	\$0.064	660	\$42.24
3-Way simple	CAT5e	\$0.10	120	\$12.00
Low Voltage Total				<b>\$186.24 - \$223.20</b>

### 120 V Example

Application	Gauge	Price per ft (June 2021)	Feet of wiring	Total cost home
Home Run	14/2	\$0.48	660 lights 220 switches	\$422.40
3-Way	14/3	\$0.64	120	\$76.80
120 V Total				<b>\$499.20</b>

18/5 Wiring Color Chart

Color	Function	Comment
Red	Power to the Wall switches (48 to 52 V)	Up to 100 Watts
Blue	Return power	
Green	Earth ground for static discharge	Detours static electricity from people to earth
White	DALI bus (-)	Polarity not significant
Yellow	DALI bus (+)	Polarity not significant

48 V VALUE Trim Connections

Color	Wire Marking	Function	Comment
Red	UP	+ voltage to the first LED in a string	
White	UP	- voltage to the first LED in a string	
Red	DOWN	+ voltage to the last LED in a string	Reserved for future use
White	DOWN	- voltage to the last LED in a string	Reserved for future use

SIGNATURE Trim Connections

Color	Wire Marking	Function	Comment	
Red	UP	+ voltage to the first LED in a string	Warm White +	
White	UP	- voltage to the first LED in a string	Cool White -	
Red	DOWN	- voltage to the last LED in a string	Warm White -	
White	DOWN	+ voltage to the last LED in a string	Cool White +	

Use blue tape to mark UP. DOWN is not marked.

## Meet the DR2

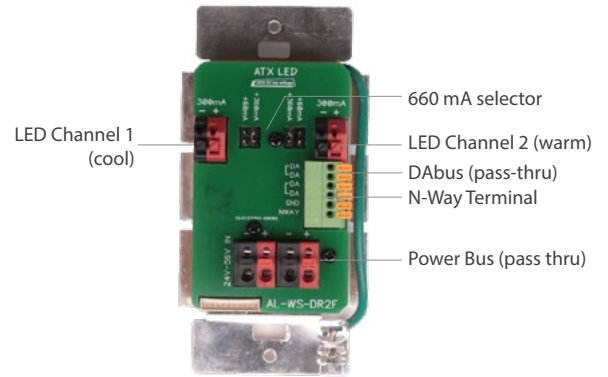
The DR2 is the heart of the entire system. From the front it looks like a typical style wall switch with a slide dimmer. This is where the driver for the LEDs is located. The DR2 uses current control technology to provide perfect dimming to each of its corresponding LEDs. There are several different types of DR2 available, depending on application, as shown starting on page 10 .



RECOMMENDED  
Slider on the left  
Press bottom



NOT RECOMMENDED  
Slider on the right  
Press top



LED Channel 1  
(cool)

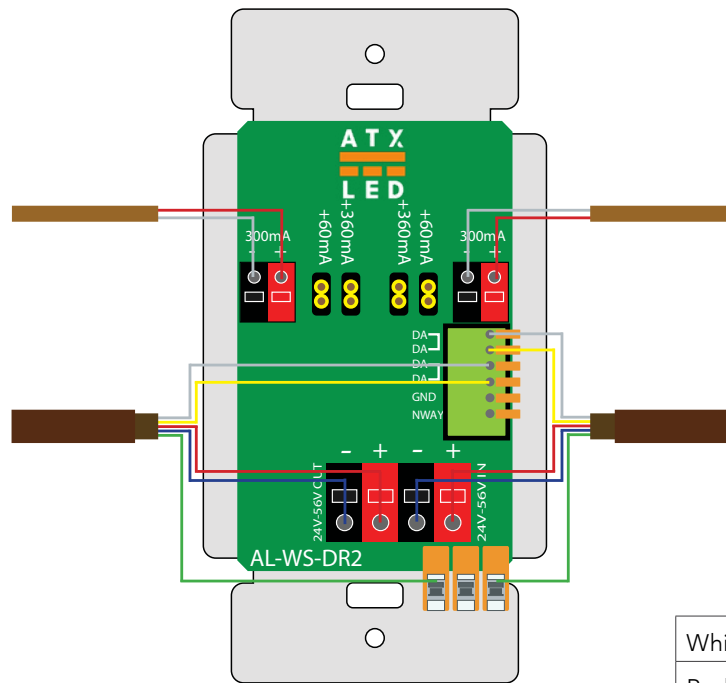
660 mA selector

LED Channel 2 (warm)

DABus (pass-thru)

N-Way Terminal

Power Bus (pass thru)



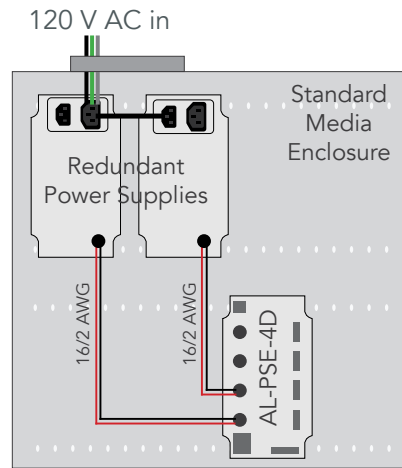
Typical DR2 Wiring

### Color Chart

White/Yellow	DABus
Red/Blue	Power
Green	Earth

## Power Architecture

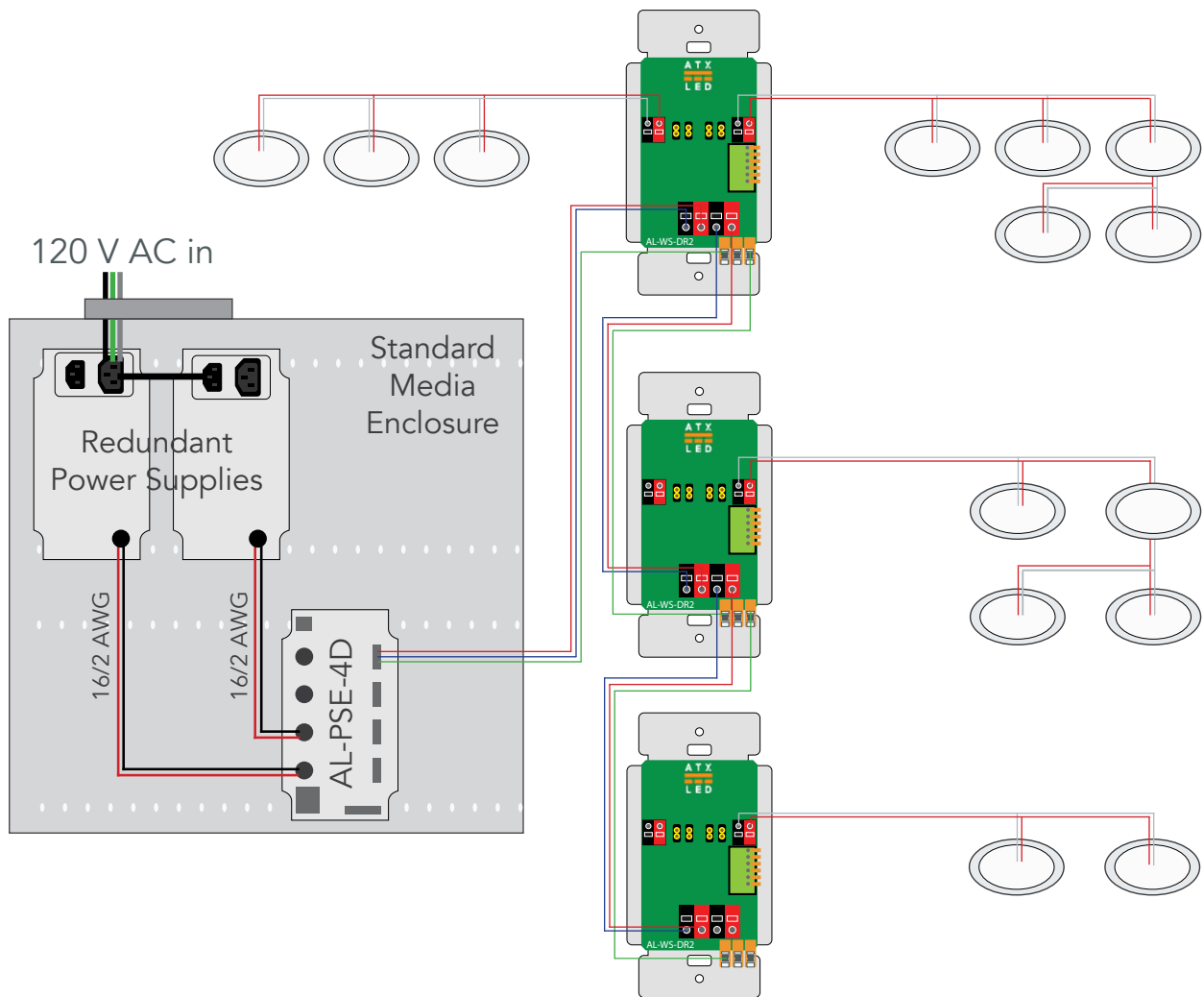
The system is powered by one or more 51 V AC/DC converters. There are two or more contained in the network panel. Only one is needed for each 100 Watts of load, but two are recommended for redundancy. The AL-PSE-4D power distribution board is equipped with automatic fail-over, meaning that if a power supply fails, the AL-PSE-4D will automatically go to backup. Backup can also be a battery system. For houses over 3000 ft<sup>2</sup>, 350 and 500 Watt supplies are recommended. See the AL-DF10 or use multiple PSE-4Ds.



## Power to Room LEDs

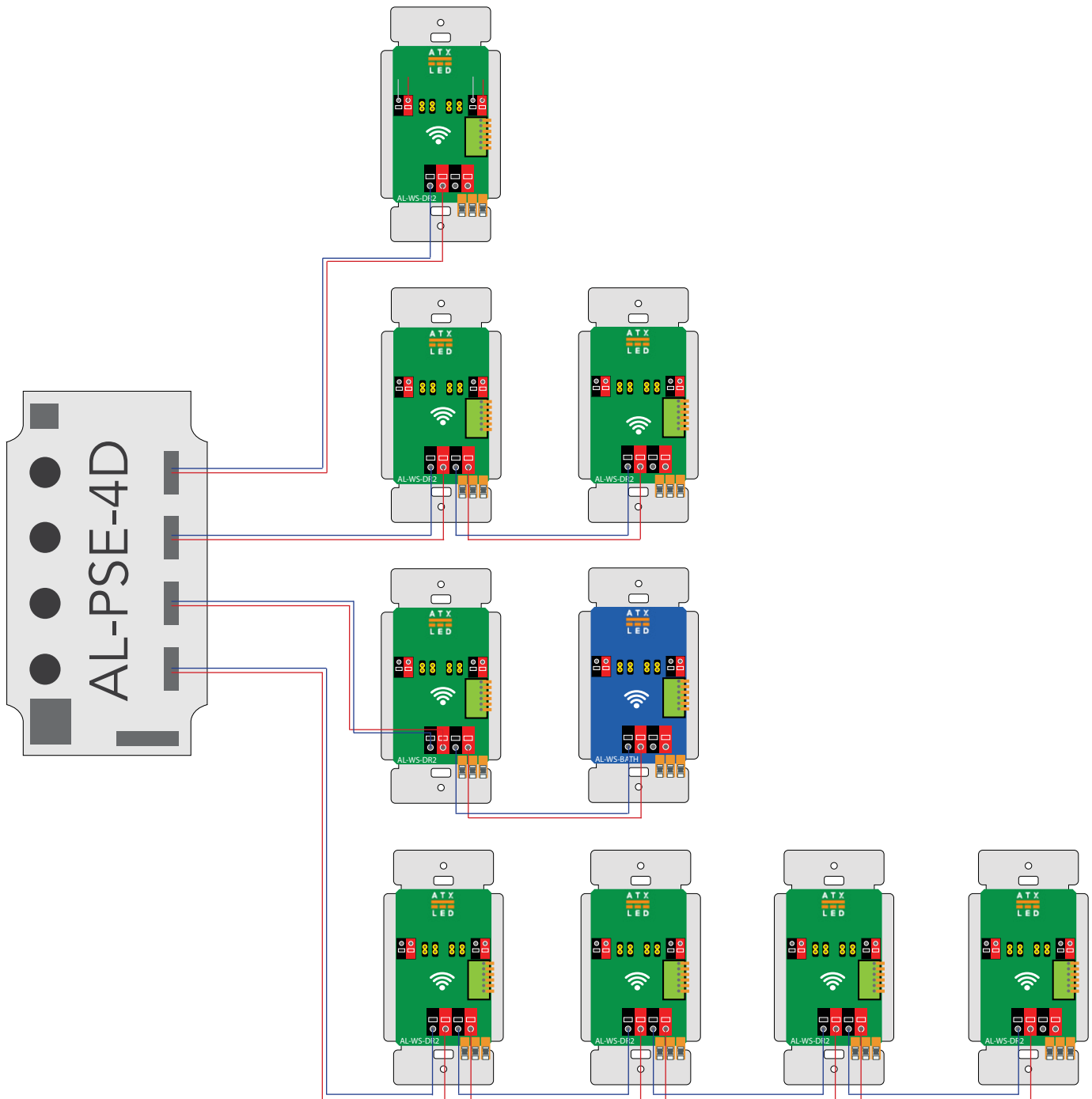
This diagram shows an example arrangement of three wall switches controlling three separate zones of LEDs, all powered from the same home run. Each home run of the AL-PSE-4D (power distribution board) may carry up to 100 Watts. Due to DC line losses, however, it is recommended that only 15 of the 6 Watt LEDs be used in this manner.

Wall switch power may be daisy-chained, as long as the total power demand does not exceed 100 Watts. Again, it is important to consider line losses. Though the max DC power is 100 Watts per home run, 90 Watts of load is recommended. Please see "Typical DR2 Wiring" on page 5 for more detail on complete wiring.



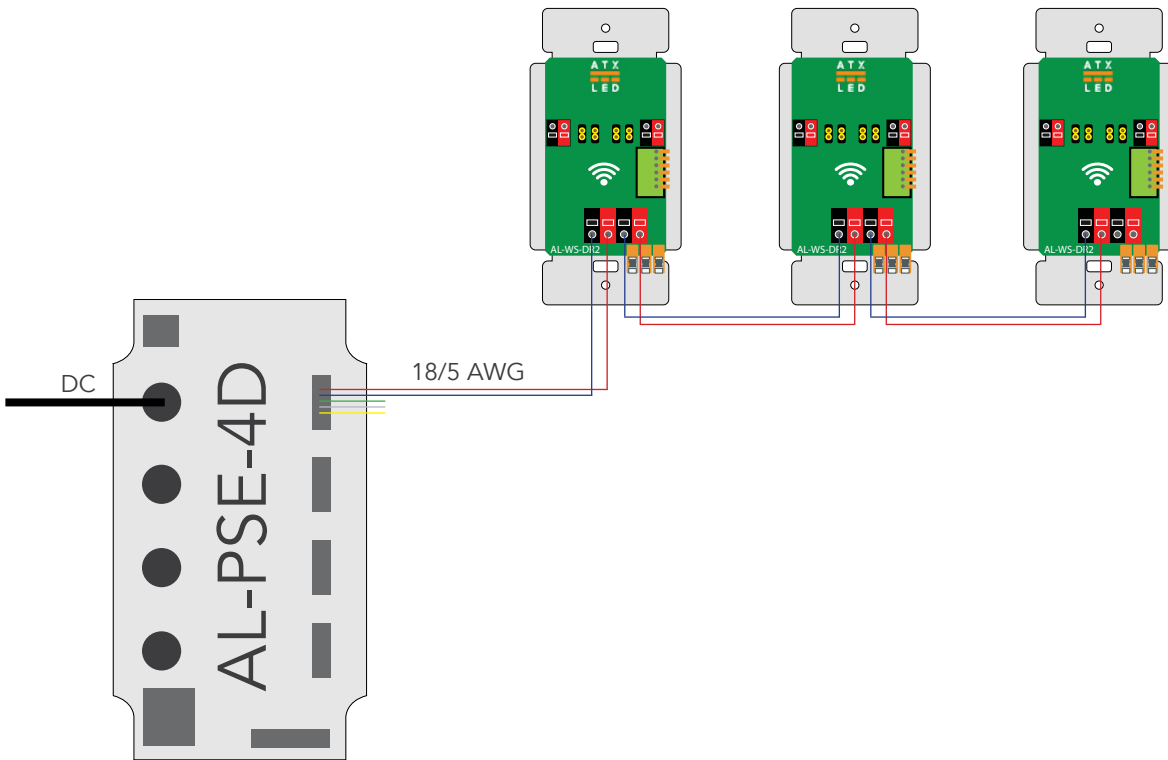
An Example of Power Distribution Architecture

All wires shown in this diagram are 18/5. Earth ground and control lines are omitted for clarity. Please see "Typical DR2 Wiring" on page 5 for more detail on complete wiring.



Switch-to-Switch Power

ATX LED switches can be daisy-chained as shown below. Control and ground are omitted for simplicity; please see "Typical DR2 Wiring" on page 5 for more detail on complete wiring.

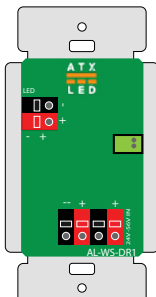





## Control Devices

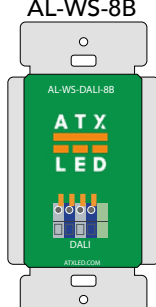
### VALUE LINE Switches

The following switches provide simple on/off control and smooth dimming and can be used with fixed-color true white LEDs from the Value Line.

	Lighting Wattage	Dimming	N-way Capable	Fan	Tunable White
<p><b>AL-WS-DR2C</b></p> 	<p>60 Watts Fixed</p> <p>30 Watts Tunable</p>	1%	Yes	Yes	Yes
<p><b>AL-WS-DR1</b></p> 	30 Watts	10%	Yes	No	No
<p><b>Simple Switch</b></p> 	96 Watts	None	Yes	No	No

**SIGNATURE LINE** Smart Control Devices

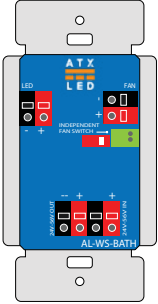
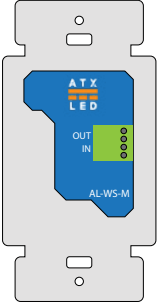
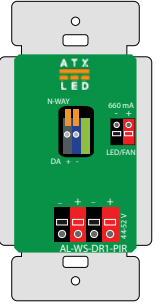
The switches in the following table are designed to be used with tunable white LEDs and provide WiFi connectivity, programmability, and can be used with common smart home controls. They also can be used with Value Line fixed-color LEDs, though their added control capabilities would be be functional.

	Control Method	Lighting Wattage	Dimming	N-way Capable	Fan	Tunable White
 <p><b>AL-WS-DR2</b></p>	DABus	60 Watts Fixed 30 Watts Tunable	0.5%	Yes	V3	Yes
 <p><b>AL-WS-DR2W</b></p>	WiFi	60 Watts Fixed 30 Watts Tunable	1%	Yes	No	Yes
 <p><b>AL-WS-8B</b></p>	DABus	No Limit	--	Yes	Via DALI	Yes
 <p><b>AL-WS-010V</b></p>	DABus	No Limit Controls 120 V AC	0.5%	Yes	No	Yes



Other Components

ATX LED offers the following switches to complete a full home lighting system, serving the need for bath/fan switches, occupancy, and momentary switches.

	Lighting Wattage	Dimming	N-way Capable	Fan
<p><b>AL-WS-BATH</b></p>  <p>Used to drive 24 W of LEDs and 1 DC bathroom fan</p>	<p>24 Watts Fixed</p> <p>12 Watts Fan</p>	<p>5%</p>	<p>No</p>	<p>Yes</p>
<p><b>AL-WS-M</b></p>  <p>Can be used as a remote 3-way or as a bathroom fan timer switch</p>	<p>N/A</p>	<p>Yes</p>	<p>Yes</p>	
<p><b>AL-WS-DR1-PIR</b></p> 	<p>30 Watts</p>	<p>Yes</p>	<p>Yes</p>	<p>Yes</p>

## Installation Accessories

### AL-CBOX-4 Ceiling Mount Receptacle

All of our 4" LED wafers come packaged with optional hanger springs that mount perfectly with our orange rough-in box. The low voltage AL-CBOX4 quickly attaches to the home ceiling flat truss or vertical beams at rough using either standard nails and hanger bars. LEDs such as the P023R6- (wafer) and DL-120- (recessed), R@R temp lighting fixtures, WiFi access points, smoke detectors, and cameras, can be mounted into the CBOX4.



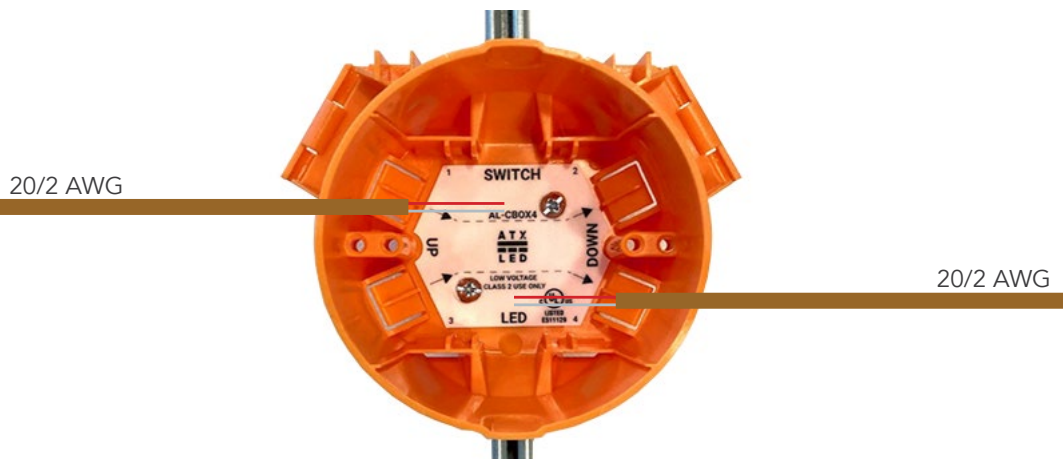
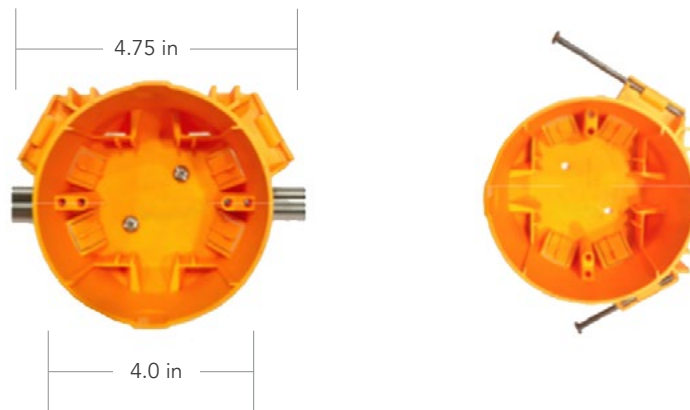
This device solves three requirements for code compliant installation of low voltage devices in ceilings:

- all junctions inside a junction box
- mechanical support by the rafters not the sheetrock
- fire-rated UL94V-0 polycarbonate material

The AL-CBOX4 also simplifies installation by allowing:

- built in depth guide eliminates vertical measurements
- X-Y alignment of the position before sheetrock
- positions low-voltage wire above sheetrock to avoid damage
- holds the R@R temporary light sources for jobsite lighting prior to final electrical inspection
- hole cutting, tape, float, paint to be done by the sheetrock team before installing the lights
- super fast trim installation

Please note: The AL-CBOX4 does not come with a mounting bar.

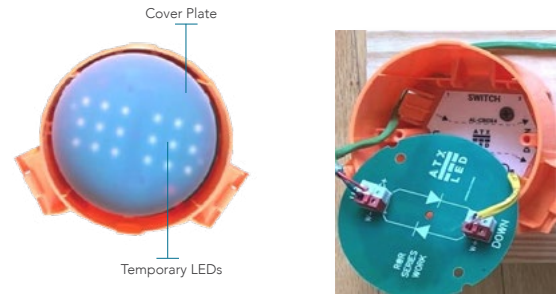


## Ready-at-Rough Kit

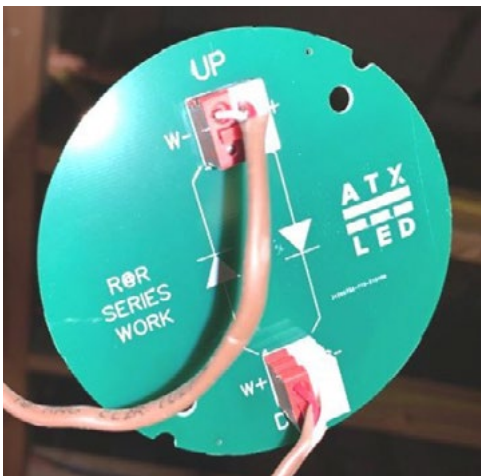
ATX LED's Ready@Rough kit allows lighting installers to validate proper function of the lighting system prior to drywall installation and to cover and protect wiring during the rest of the buildout process. After the CBOX4 and electrical boxes for the switches are installed, lighting installers can use the corresponding components of the R@R "Work" and "Wall" kits to verify the lighting system and protect from accidental cuts during the rest of the buildout process.

Additionally, the included LED lighting works from the moment the wiring is installed and provides lighting for the jobsite during the weeks of finishing work. If a wire is cut during finishing work, the temporary R@R light goes out immediately, making it easy to identify and remedy problems as they arise.

- Protects wires from Rotozip tools, sheetrock mud, and paint
- Provides light during construction before sheetrock
- Verifies all wiring prior to sheetrock
- Saves time at trim
- Optional washable clear lens to allow reuse
- No deformation of the wires



Ceiling Ready-at-Rough Kit



AL-R@R Work - Temporary LED



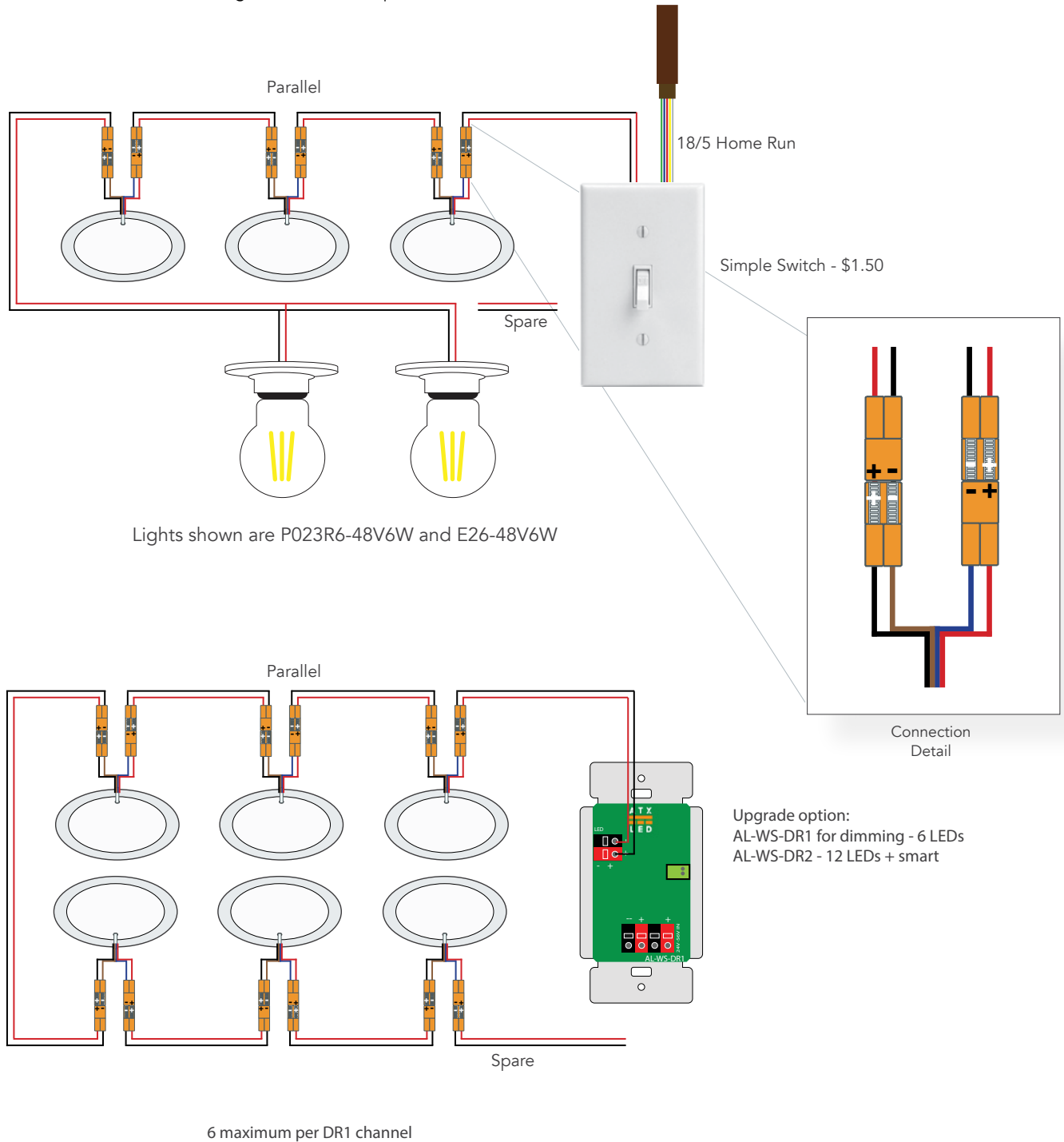
AL-R@R Wall - Temporary Switch

## Wiring Examples

### Lowest-Cost Option: No Dimming - Up to 16 LEDs

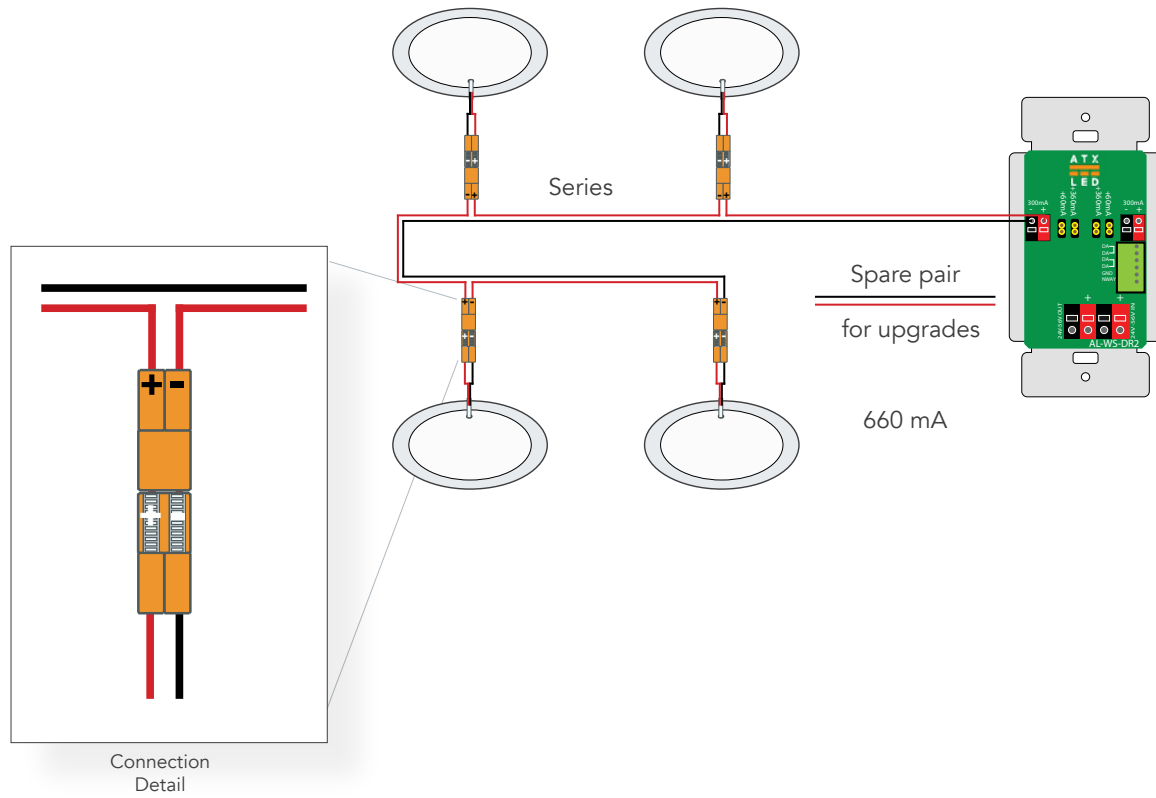
The simple switch architecture allows for up to 16 lamps (96 Watts) of lighting from a single switch and single home run. As with all ATX LED systems, it is recommended to run 18/5 home runs. The example shown here does not support dimming or smart controls, but the use of the 18/5 home run will make future upgrades easy. It is possible to upgrade this circuit to dimming by replacing the simple switch with an AL-WS-DR1 or an AL-WS-DR2 with 6 (or 12) LEDs.

Please note that the 48 V series of lights are wired in parallel.



1 to 5 LED Upgradable Fixed White with Dimming - Model P023R6

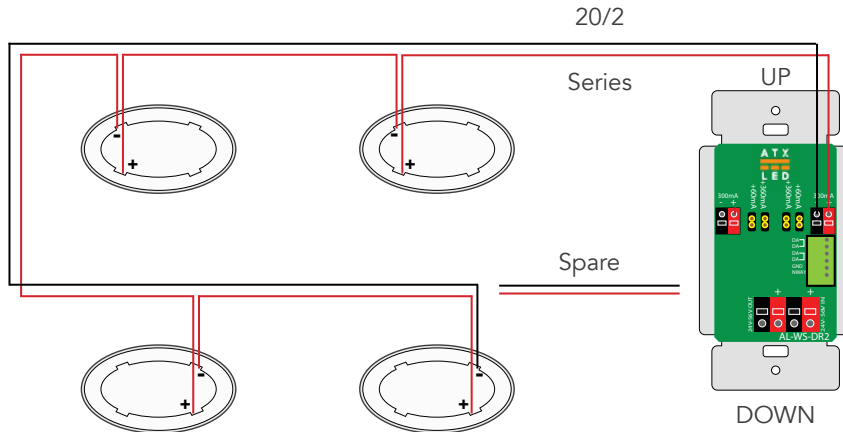
If you might be interested in upgrading to Tunable White LEDs in your system in the future, wire it using this method. Run an additional (unconnected) 18/2 leg from the location of the last LED in the circuit to the available channel on the DR2.



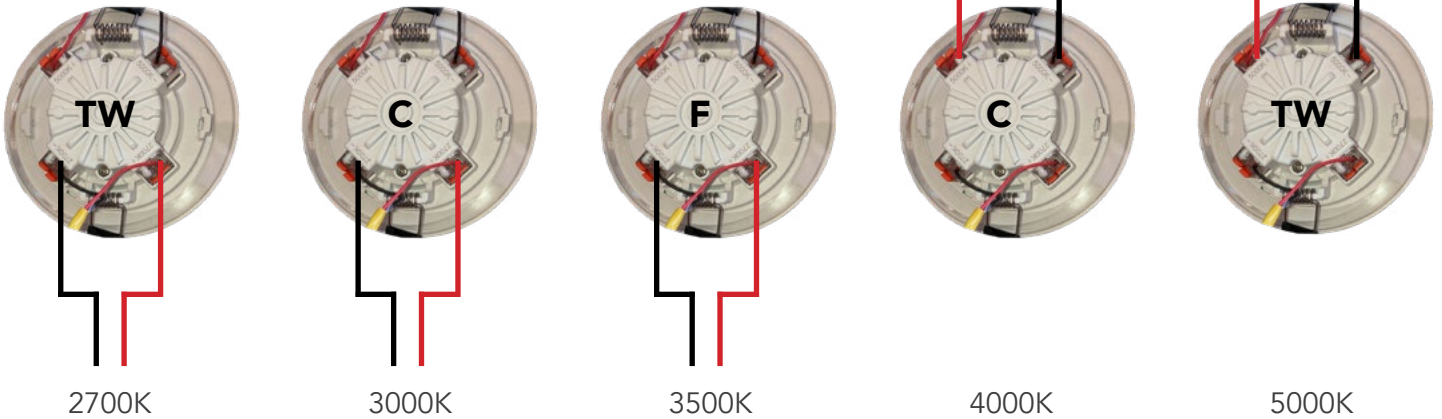
- Color Options
- 2700K
  - 3000K
  - 3500
  - 4000K
  - 5000K

1 to 5 LED Upgradable Fixed White with Dimming - Model DL-120 (Fixed)

If you might be interested in upgrading to Tunable White LEDs in your system in the future, wire it using this method. Run an additional (unconnected) 18/2 leg from the location of the last LED in the circuit to the available channel on the DR2.



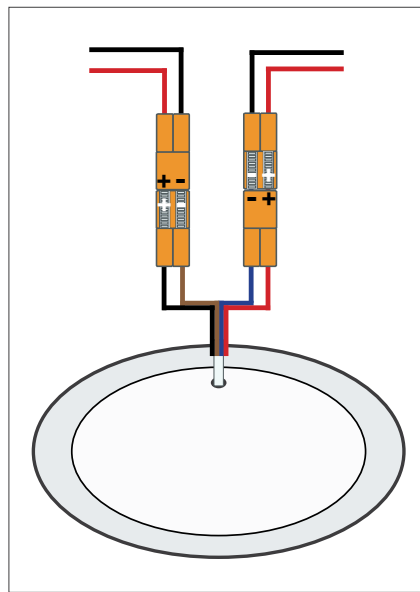
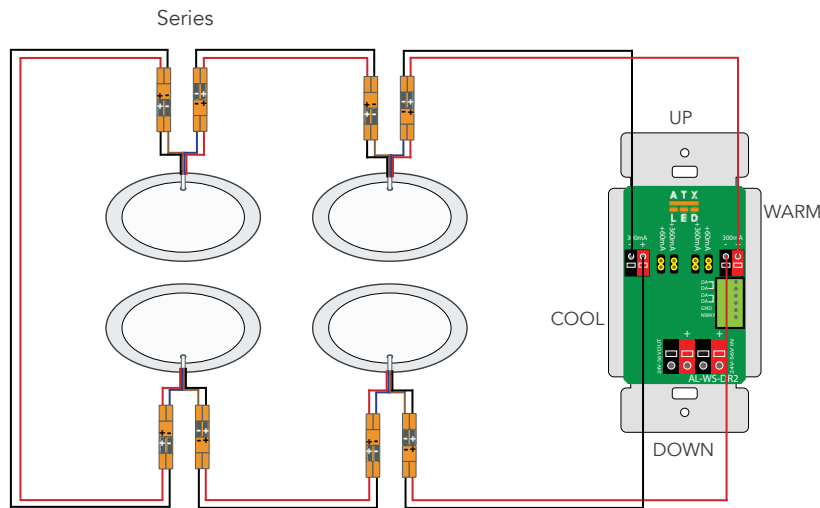
Color Options





1 to 5 LED Tunable White Circuit - Model P023R6

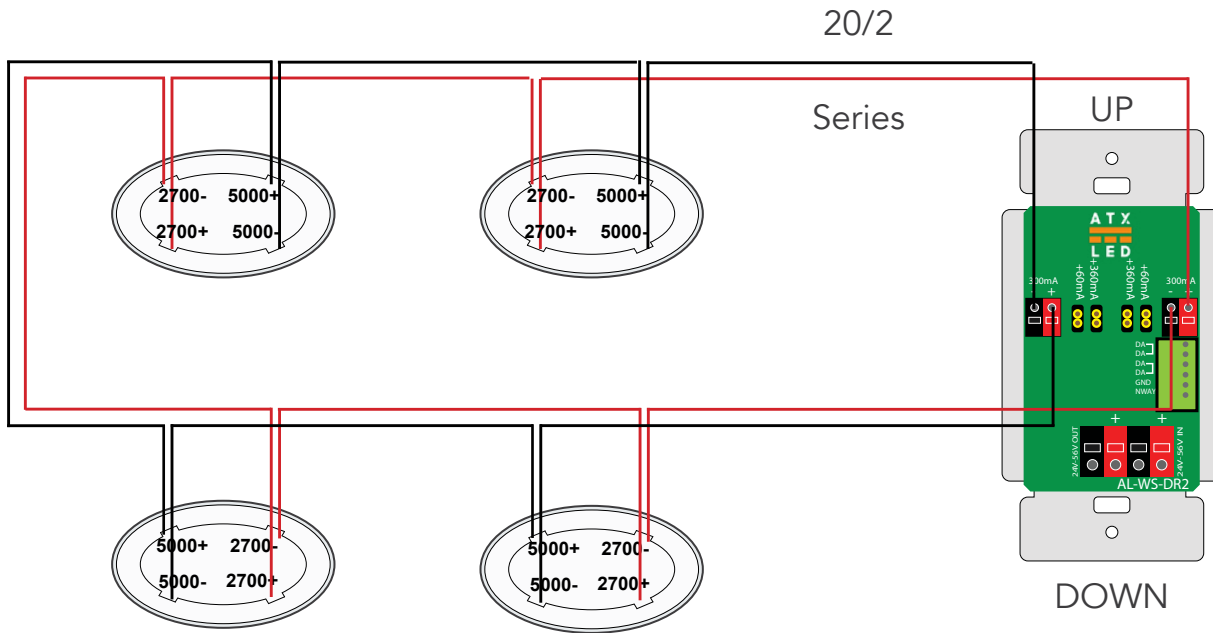
One to five tunable white fixtures per wall switch. Multiple DALI AL-WS-DR2 for larger rooms can be configured in tandem.



Connection Detail

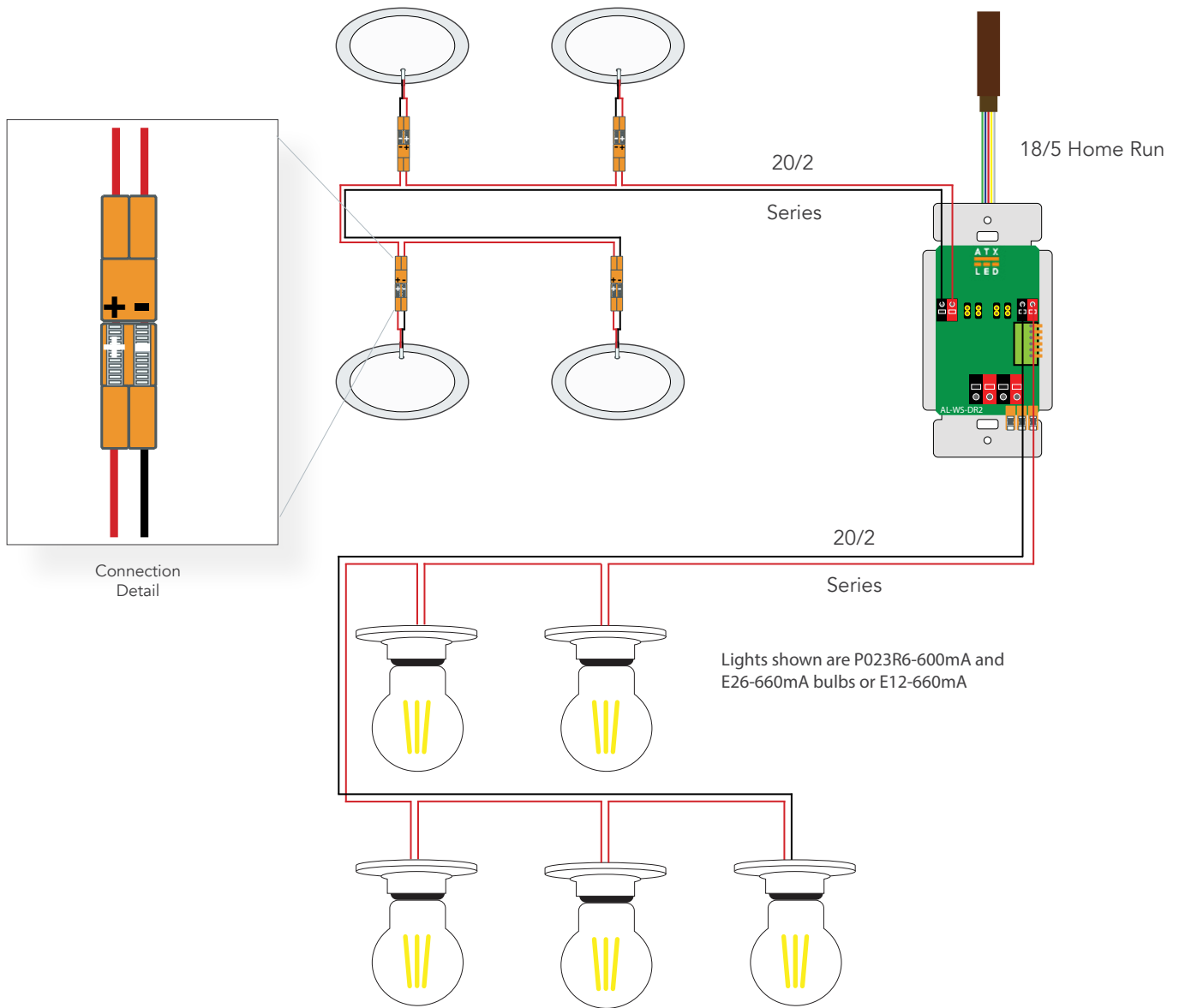
1 to 5 LED Tunable White Circuit - Model DL-120

One to five tunable white fixtures per wall switch. Multiple DALI AL-WS-DR2 for larger rooms can be configured in tandem.



Dimmable 1 to 10 LED Fixed White

The example below includes two separate channels of 1 to 5 LEDs each. Each group of five is connected in series. The red (+) wire first connects to the positive connection of the first LED, then leaves from the negative connector and goes to the positive connector of the next. The idea is that you are making a single series circuit for each channel of LEDs.

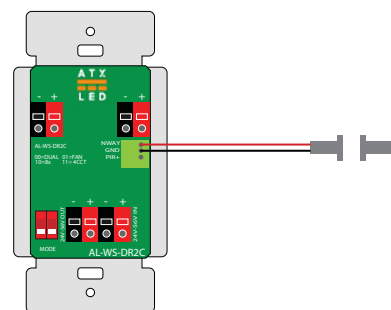
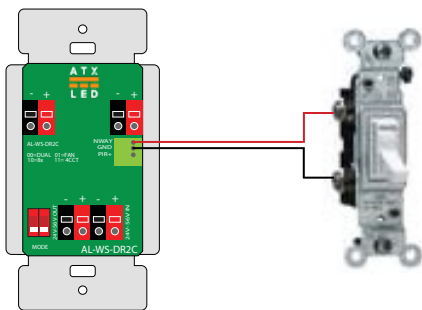
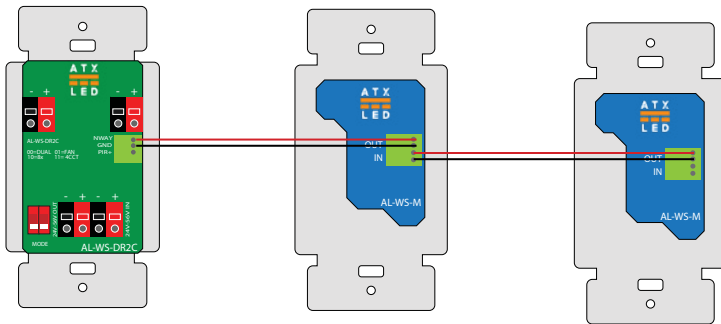
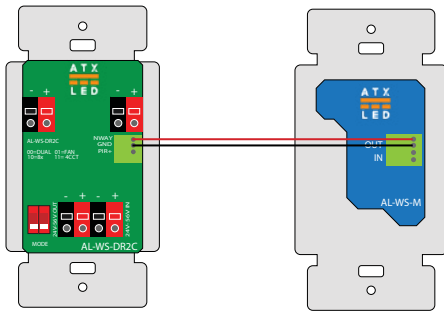


Physical 3-Way

Here are few examples of 3-way configuration.

When a 3-way switch is connected, the driver switch automatically detects whether it is a rocker type or momentary type.

Momentary switches can dim the lighting circuit locally, just hold down the switch and the dim level will cycle, release when desired level is achieved.

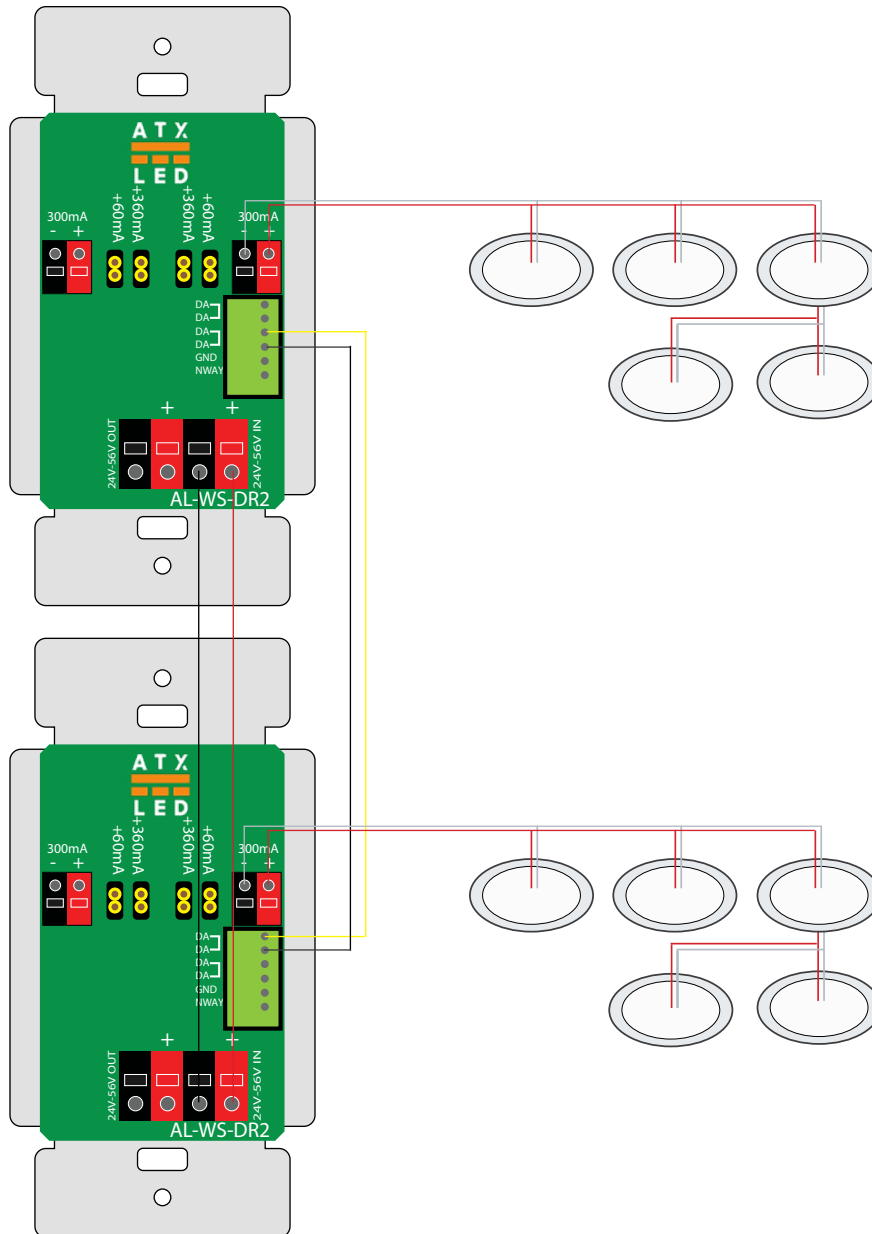


Door jamb switches can be used in the same way. The driver switch will automatically detect it and operate in the appropriate mode.

Tandem Mode

Large rooms typically have more than one entry point. A 3-way switch is typically used to allow the lights at each entry point, or door in a hallway, or level in a stairway, to control all the lights. The physical 3-Way switch documented in the previous section handles this very well and at low cost.

In situations where the lighting requirement exceeds the Watts available from one AL-WS-DR2, then Tandem mode is useful. In this mode, two or more DR2 switches operate in unison. The lights can be turned on and off, dimmed or the color changed as one. This mode requires a powered DABus. The AL-WS-DR2 switches are configured either on-site or off-site for Tandem mode, also known as virtual 3-Way. Once configured, the tandem set of AL-WS-DR2 operate together as long as the DABus has power - no internet or hub is required. Thus - any large space can be fully operate by DC lighting, in a low cost and simple setup.



## Other Installation Types

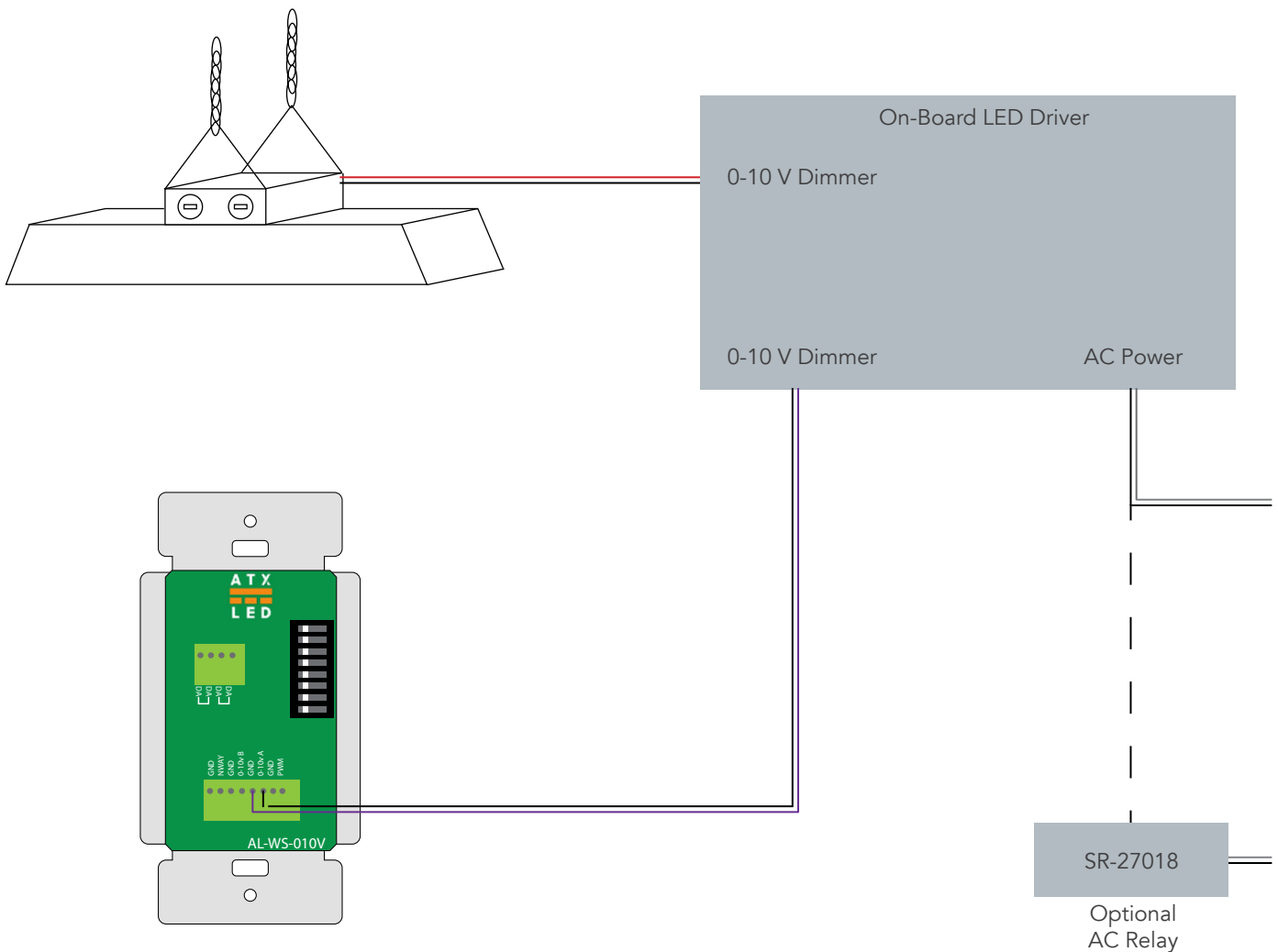
### Commercial Applications: 0-10 V Controls

Our DR2 delivers 50 Watts per switch. Some cases, however, call for much more lighting power per switch.

High power lighting products are powered by AC. Manufacturers offer control by 0-10v violet and grey wire pair. This pair is used to control the on/off/dim functions of the lamp.

To interface this type of fixture with the ATX-LED system, simply wire the 120v power as with conventional, but run the violet/grey pair to our AL-WS-010v switch.

Please note that "0-10v" is a classification of dimming method. There are actually two sub-types of "0-10v." One being the "0-10v" and the other being "1-10v." The difference is that with 0-10v fixtures, the switch can only dim the lamp, whereas with a 1-10v fixture the switch can completely shut off the lamp. If 0-10v fixtures are being used, there will have to be a 120v switch to completely shut off the lighting. Therefore, use 1-10v only.



## Commercial Applications: DALI Controls

Our DR2 delivers 60 W per switch, 100 W per home run.

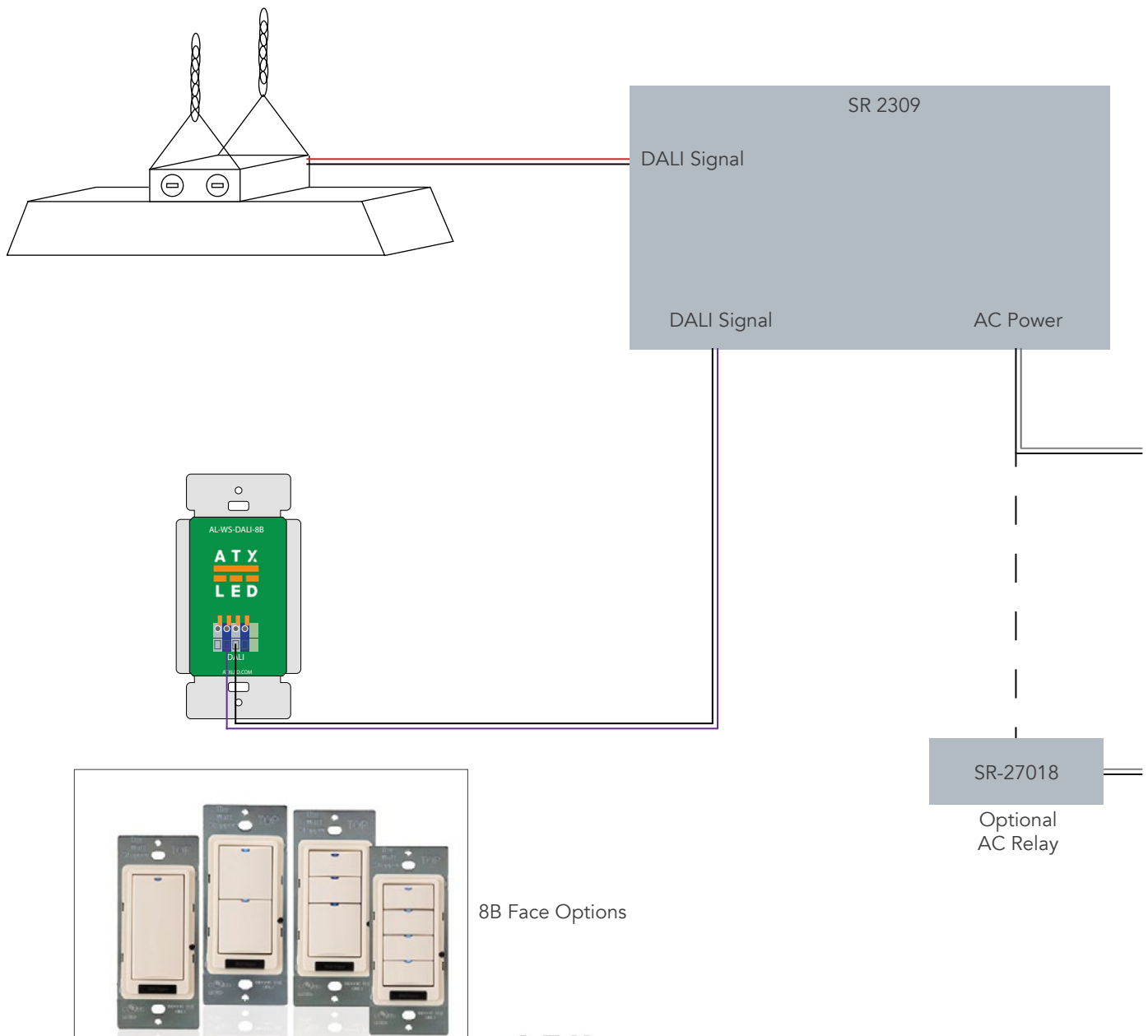
Some cases, however, call for much more lighting power per switch.

High power lighting products are powered with 120 or 240 V AC.

Manufacturers offer control by a DALI wire pair. This pair is used to control the on/off/dim functions of the lamp, and one pair can connect to many fixtures, greatly simplifying the installation.

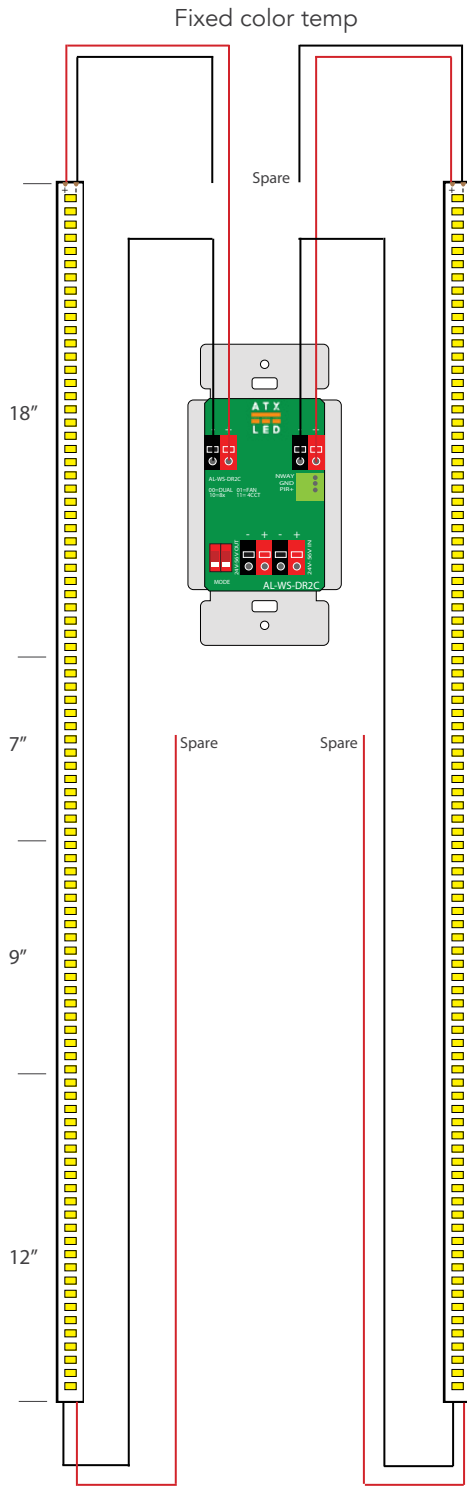
To interface this type of fixture with the ATX-LED system, simply wire the AC power as with conventional, but run the violet/grey DALI pair to the ATX LED DABus and to any of our DABus products, including the AL-WS-8B.

This will enable all smart features like remote dimming, schedule, max and min brightness, scenes and groups.



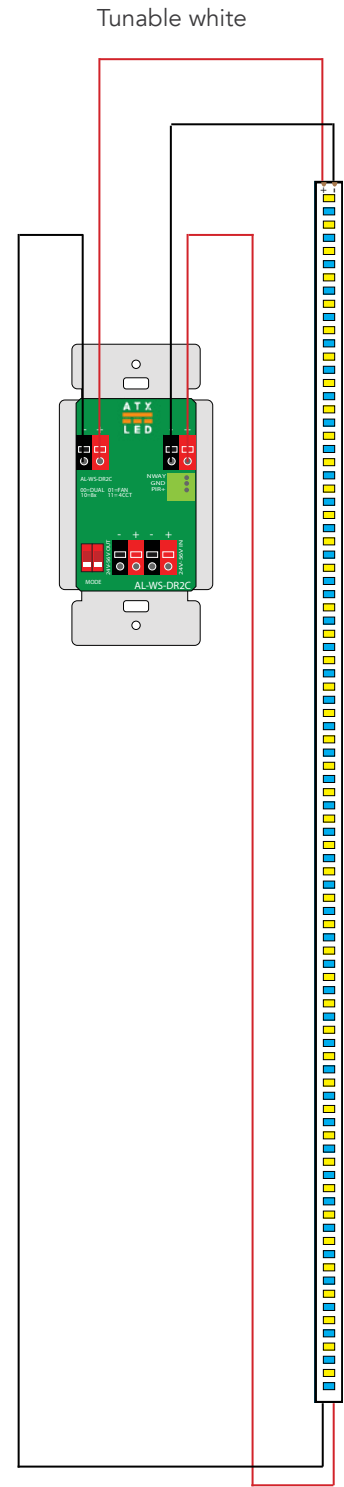
LED Light Strips

Wire strip lights to any of our DR2 switches in a similar manner to our other LEDs. 24v strip lights are the most common on the market and they work well with DR2s. Take care to follow the wattage rules - 24watts per channel. For fixed color, used up to 8ft or 24 watts on each channel. For Tunable White, use 2 different color temperature strips of your choice and wire it the same way, but with the selector on the switch set to "CCT".



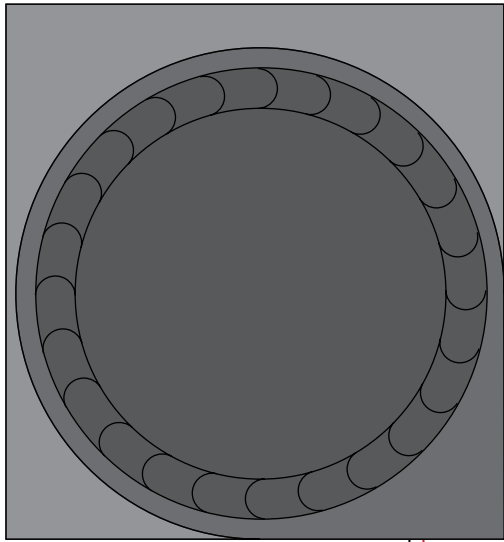
Strip Light Options

- A) 2 W/ft, up to 30 ft fixed or 15 ft tunable
- B) 4 W/ft, up to 15 ft fixed or 7.5 ft tunable
- C) Use tandem mode for longer runs
- D) 1.5 W/ft, 24 V - See Application Note
- E) 3 W/ft, up to 20 ft fixed or 10 ft tunable



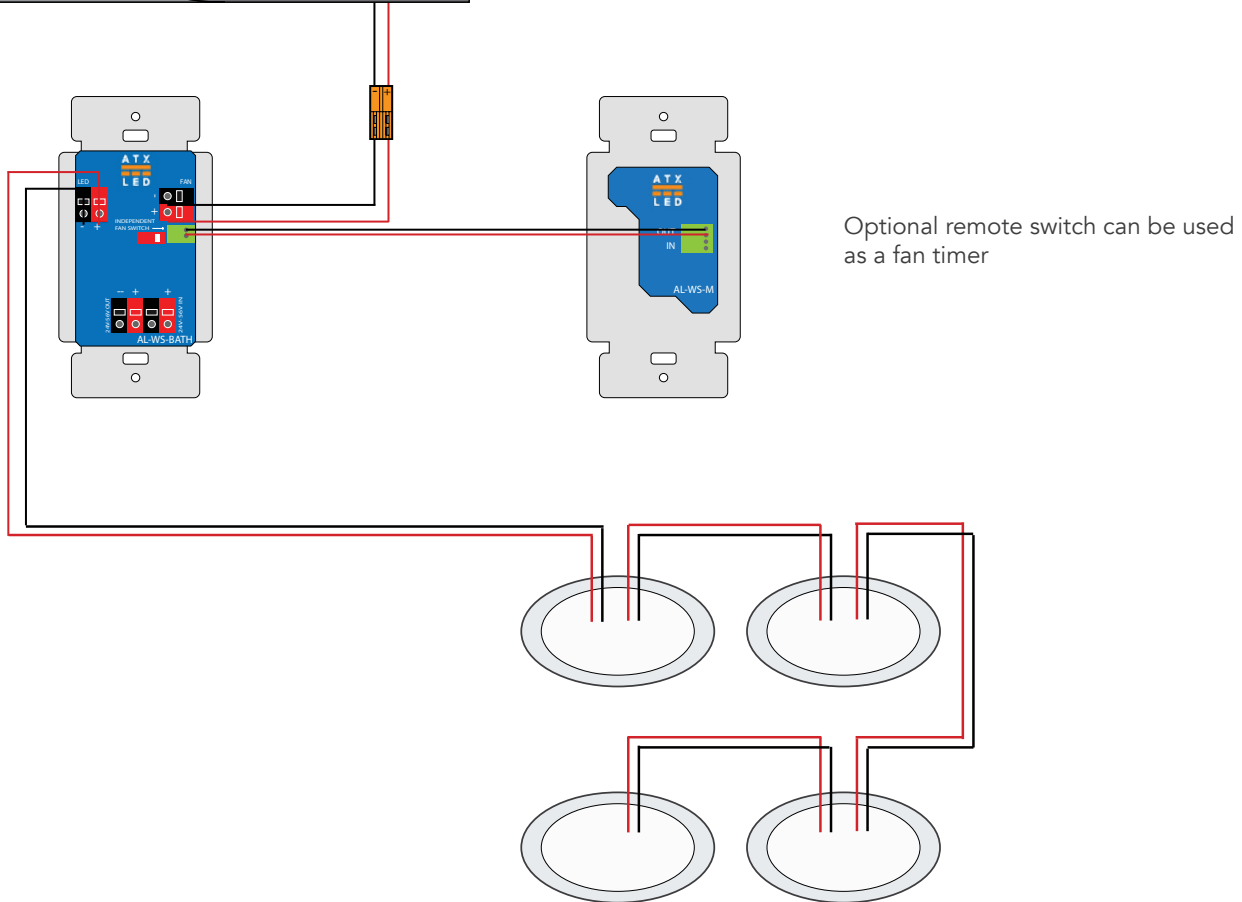


Bathroom Lights Plus Fan



Either the AL-WS-DR2 or AL-WS-Bath are used for bathrooms. They have the capability of running a 12 V DC bathroom fan and up to 24 Watts of LEDs. The switch may be used standalone or with a AL-WS-M remote switch.

When the remote switch is used, every time the momentary switch is engaged, the bath fan will run for 5 minutes and an additional 5 minutes will be added for each button press. Press and hold the switch for 10 seconds to cancel the timer and shut off the fan.

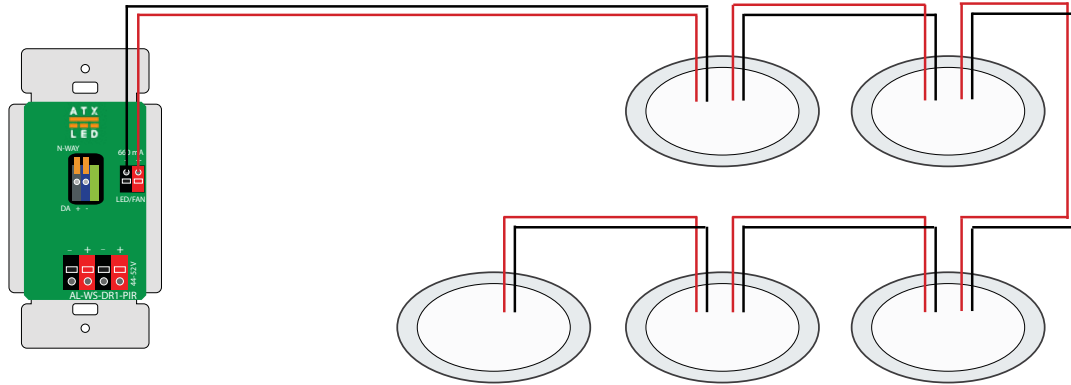


Vacancy/Occupancy for Bathrooms, Utility, Stairs

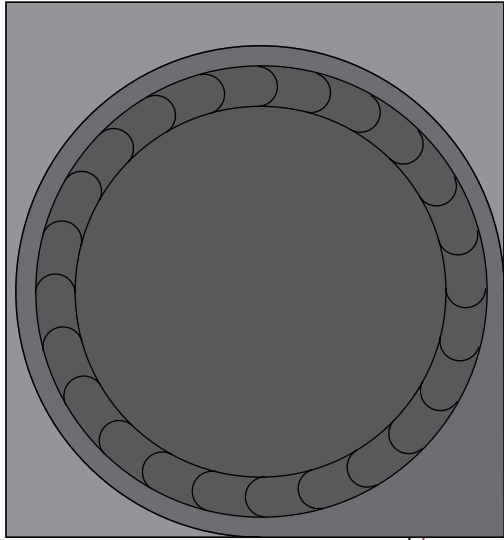
The AL-WS-DR1-PIR device is used for bathrooms and other rooms where automatic turn off is a requirement.

It will turn a fixture on with the dimming level desired, and will dim up softly to allow the eyes to adjust. At the end of the occupancy detection, the light will dim down again. The timing and sensitivity can be adjusted. A manual override switch is provided.

The device drives 30 Watts of LEDs of fixed color LEDs directly, and may be used standalone or with a AL-WS-M remote switch for 3-Way controls. It can also be used to control tunable white drivers such as the AL-WS-DR2, and is a fully managed switch within the ATX LED DAbus and controlled by ZWD if desired.

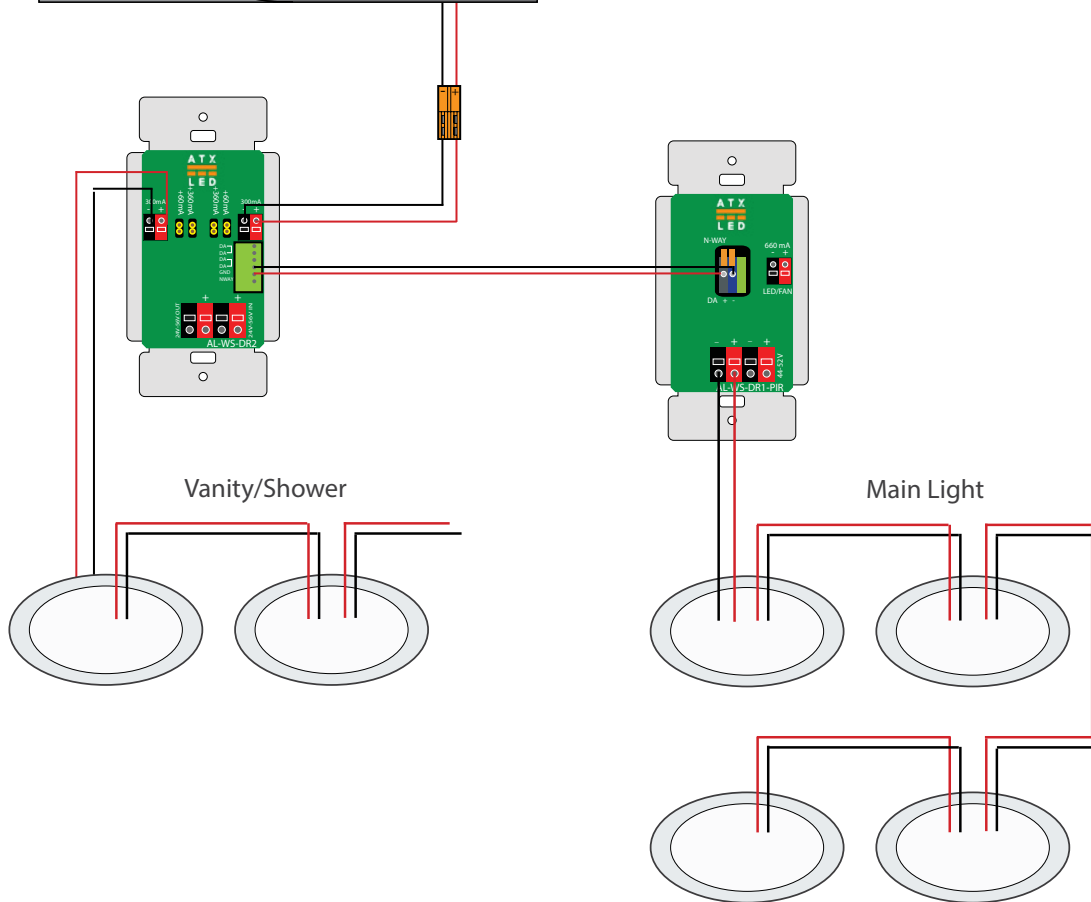


DALI - Fan Plus Motion



Either the AL-WS-DR2 or AL-WS-Bath are used for bathrooms. They have the capability of running a 12 V DC bathroom fan and up to 24 Watts of LEDs. The switch may be used standalone or with a AL-WS-M remote switch.

When the remote switch is used, every time the momentary switch is engaged, the bath fan will run for 5 minutes and an additional 5 minutes will be added for each button press. Press and hold the switch for 10 seconds to cancel the timer and shut off the fan.



DALI™

# Digital Addressable Lighting Interface

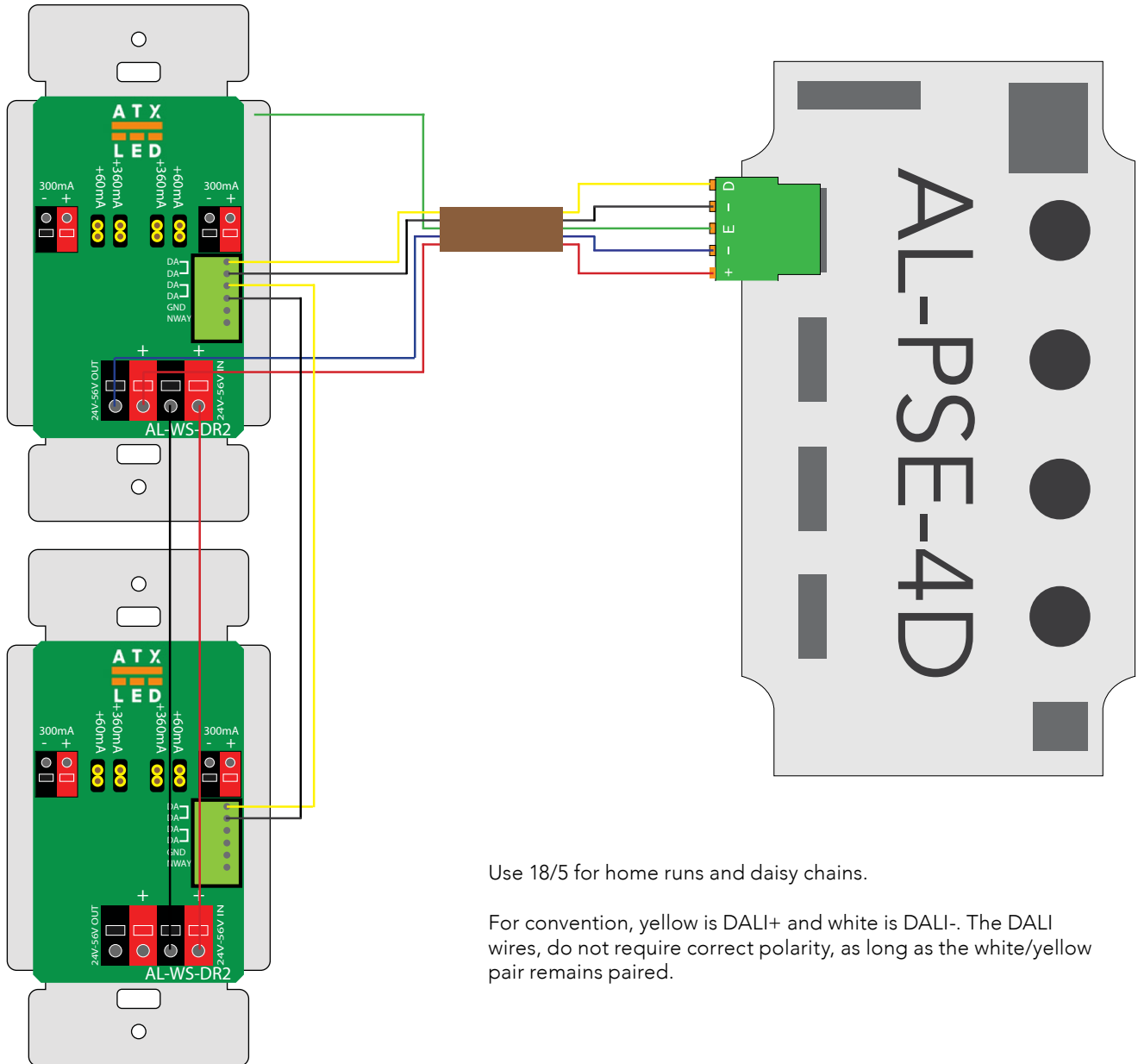
Where the WIFI option allows control of select switches, the DALI™ system allows for whole-home control.

This is the highest-end option for new homes.

The ATX-LED DALI™ system can be compared to Control 4, but much more cost effective.

At the high end, DALI™ works with Crestron and Control 4.

Easier to install than other options because our DALI™ system does not require multiple cat5 terminations.



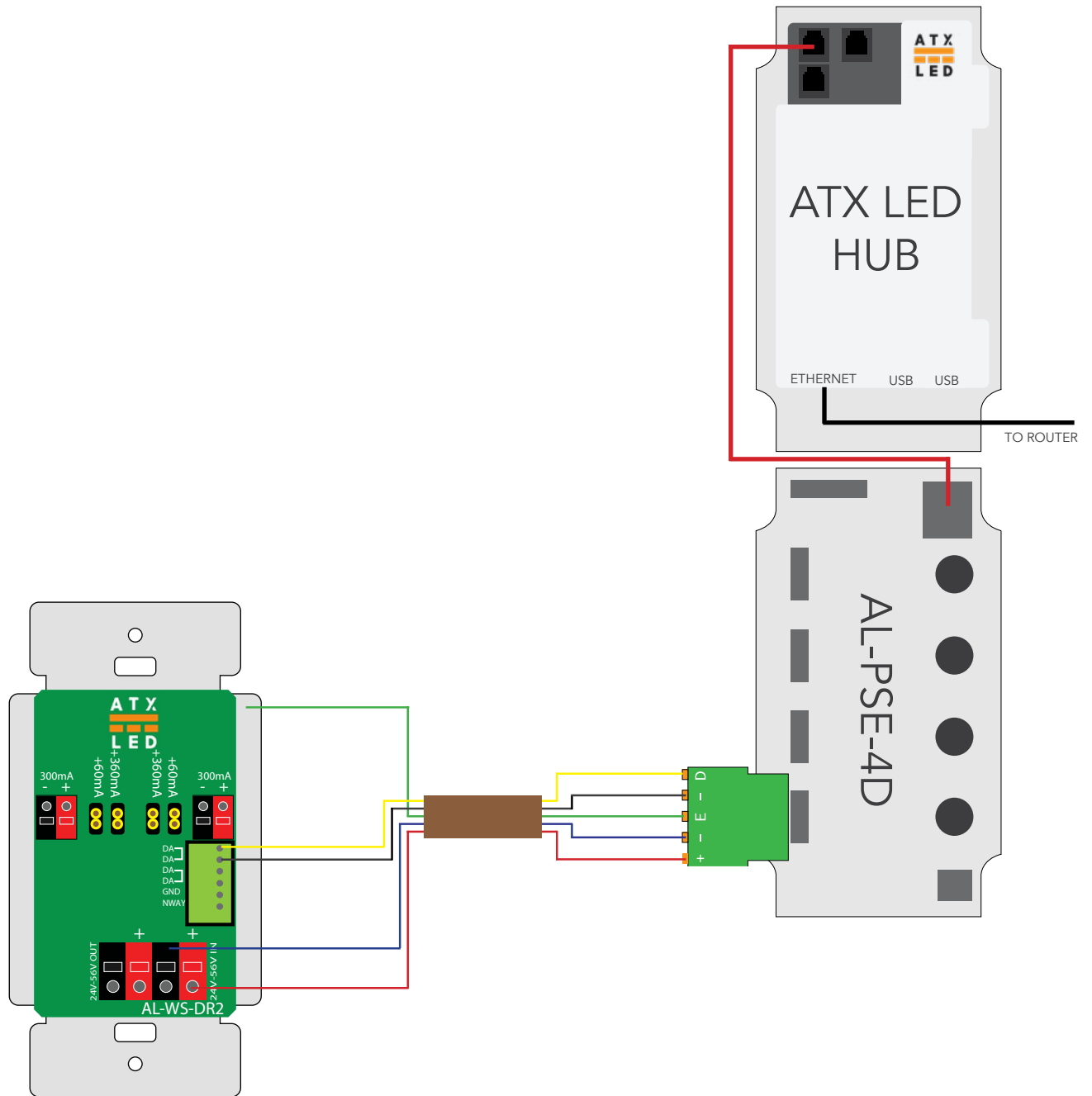
Use 18/5 for home runs and daisy chains.

For convention, yellow is DALI+ and white is DALI-. The DALI wires, do not require correct polarity, as long as the white/yellow pair remains paired.

### DALI for App Control

DALI power architecture is similar to that of the standard system, with just a few differences. In this case, we use the AL-PSE-4D as our power distribution board. The “brain” of the system, the AL-DALI-Pi, is connected directly to the AL-PSE-4D via a non-Ethernet RJ-45 jumper connection.

DALI as a DIIA trademark for the IEC62386 standard. For more information, please visit <https://atxled.wiki.zoho.com/public/ZWD-Control-Suite.html>.



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