Motion Sensing
LED Dimmer/Driver

AL-WS-DR1-PIR

- Vacancy / Occupancy mode
- Ambient Light Sensor
- Night-Light
- LED driver (30 watts)
- FAN driver (12 watts)
- Push Button Switch
- Fan Timer mode
- 3-Way supported
- Gang Operation
- DALI option

Product Description - AL-WS-DR1 wall switch with Vacancy/Occupancy

This switch operates just like any standard residential light switch – however it takes 24-51v DC instead of 120VAC, and directly drives up to 30 watts of LED bulbs or a 12 watt fan. This Decorator style switch in a standard residential style outline fits into any home, looks like any switch yet meets NEC article 411 for Low Voltage lighting. It also meets Title 24 vacancy code requirements for lighting controls.

When used as a LED switch - the built in Ambient Light sensor, and presence sensor, exceeds Title 24 requirements. The switch can operate in:

- Vacancy mode (manual on, automatic off)
- Occupancy mode (automatic on and off)
- Occupancy with Ambient (automatic on if the room is dark, automatic off)

When used as a FAN controller – the push button starts the fan and it runs for a user defined time. Vacancy will turn the fan off after a programmable delay. Occupancy will turn the fan ON if presence is detected for a settable duration. Fans are automatically detected.

Unlike conventional On/Off vacancy switches – the dimming feature of this device means that the light does not go off all at once, instead, it dims slowly down to zero. Should someone be in the room and undetected – the room does not go dark – allowing the occupant to create sufficient motion to maintain light.

Stand alone it operates as a simple switch for 30 watts of LED's. For example, 5x 6 Watt LEDs can connect in series to this switch / dimmer device. Use AWG 16 or 18 to bring 48v (or 24 to 52 volts) from a central power supply over to the switches, then use AWG 20 to connect to your LEDs – no crimping tools are required to wire this device.

For 3-way operation – a simple 2 wire link with AWG24 or better allows 2, 3, or an unlimited numbers of switches to control one set of LED's. Any single pole switch found at Home Depot can be used to add a 3-Way remote switch, or the AL-WS-M momentary switch can be used for unlimited 3-Way connections. Multiple AL-WS-DR1 devices can communicate without any Hub using this interface.

To enable Home / Business automation – the AL-WS-DR1-PIR includes a DALI serial bidirectional port for remote and voice control and central management. Use the AL-DALI-Pi Hub to connect to Alexa or Google home voice control. The DALI protocol is supported, with automatic addressing. Use low cost wire in uncomplicated topology to implement remote management. Power and DALI have in and out connectors to avoid wire nuts.

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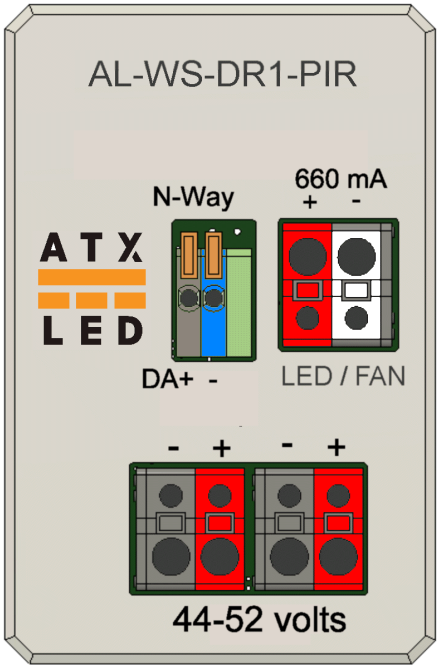
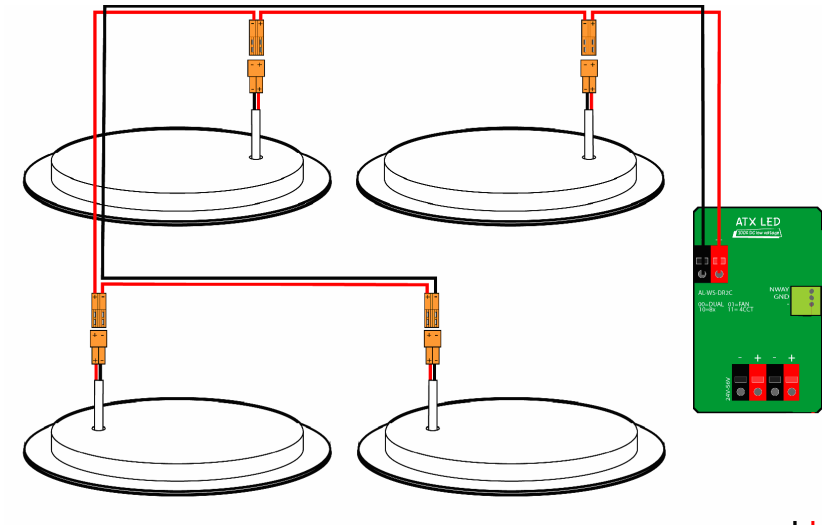
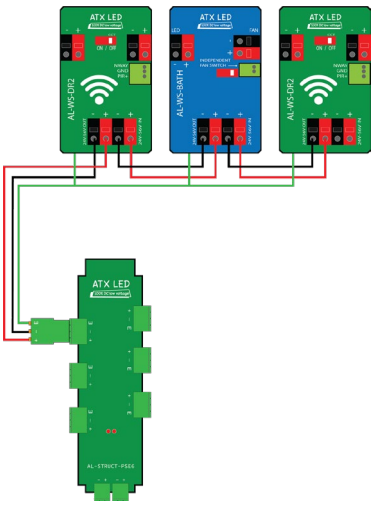
Specifications

Power source and load	Spring loaded connectors (2 pairs) for AWG 16-20 wire
LED constant current output	660 mA with 0 to 100% dimming
	Spring loaded connectors (1 pair)
Input voltage range	24v to 52 volts (power for LEDs)
Standby power consumption	<50 milliwatts
Conversion efficiency	Over 95%
Protection	Reverse protection and static protection
Operating Temperature	0°C ~ 50°C
Size	115 x 46 x 50 mm
Dimming	100% to 1%
	Current control with temperature tracking
FCC and interference	All outputs are RF filtered for minimal interference
Maximum output voltage	Input minus 4 volts
Minimum output voltage	6 volts, minimum current self calibrating*
Hot Swap	Yes – can unplug and connect LEDs with power applied.
DALI interface	AWG 18-24 gauge wire spring fit
Individual, group and scene support	short and long addresses 16 to 24 volts 2 mA
User Programming	Limited user programming supported by a round button
N-Way input	see features list
FAN output	12 volts, 1 amp with speed control
FAN Timer	0 to 90 minutes – using DALI commands



Wiring the AL-WS-DR1-PIR





Powering the AL-WS-DR1-PIR

Power the switch via the Power input connectors, 48 to 52v is recommended. No DALI connection is required. You can feed from the input to the output up to 2 amps. After power up – you might see a flicker while it learns the capability of the attached LED. After that phase – the result is stored in on-board EEprom and will be updated for temperature and aging changes or each time the slider is moved to low dim.

Default Operation – stand alone

By default – the AL-WS-DR1-PIR operates stand alone – no controller or master is required. Connect the LED output to your LED's. See https://atxled.com/How2 for wiring suggestions. No other wires are required. Press the button and the light will turn on. Occupancy, Vacancy modes can be selected from the front panel. The light can be turned off from the switch as well.

Presence Sensing

The AL-WS-DR1-PIR detects the presence of people by infrared passive sensing. The sensitivity is learned over time. Each time the On button is pressed when the switch has inferred that no person is present, the minimum sensitivity will be increased. Each time the light is manually turned off, after the expected vacancy timeout period, and we can infer that sensitivity needs to be reduced.

Daylight Harvesting for Motion sensing

When the AL-WS-DR1-PIR has turned the attached LEDs off – it can measure the light in the room. If there is enough light in the room – then detection of presence will not automatically turn the lights on, the user would have to press the switch to turn the lights on.

Vacancy Sensing and learning

When the AL-WS-DR1-PIR has detected no presence for 120 seconds, the slow fade dimming to off begins. This will slowly turn the lights off to allow anyone in the room to reach the switch or trigger detection before the room is dark. A button press during fading indicates that the vacancy sensing was not sensitive enough and the device will increase sensitivity.

Built in or remote Night Light

If enabled, the AL-WS-DR1-PIR will turn on a light to guide people in the room without turning the lights on. This is most useful in Vacancy mode. The night light brightness is controlled by DALI settings or user selection.

Fan operation

If a fan is detected, then the device will drive a Fan. The user can turn the fan on manually, or it will turn itself on if motion is maintained for 3 minutes. In this mode, fan will stay on for 10 minutes after the last motion is detected.

On / Off Operation

Press the button once to toggle the light on or off. If the light is turned on by the switch during fade out, then the On Time is doubled

Local and Remote Dimming

Press and hold the switch to dim the LED down. To dim up – hold the switch down until it fades to low, and continue to hold so it will brighten back up again. If you reach to high a dim level – then release and press again – the level will decrease.

Auto Gang Operation

If no DALI address is assigned, the AL-WS-DR1-PIR assumes that the device is in autonomous mode, and not connected to a DALI bus. In this mode, each time there is an On/Off event locally – the device will transmit via DALI the dimming level using the reserved command 0xDD. This will be recognized by other AL-WS-DR1-PIR as an ARC level command and ignored by regular DALI devices. This allows multiple devices to be connected as one large, multi motion sensing network controlling a large number of LEDs.

Daylight Harvesting Modes

If daylight harvesting is enabled, the device will increase and decrease the ceiling LED brightness to match the target “Harvesting” brightness set by the user. Every 10 minutes, the system will compare the light in the room with the requested level, and adjust up and down as needed. The level will be sent on the DALI bus, allowing a large number of LEDs to be automatically controlled.

User Programming

The round programming button is used for setting user options. It is used together with the main switch. Press the two switches as shown below, the Night-Light will flash each time the second button is pressed. Repeat until the operation mode requested is active as confirmed by the flashes of the Night-Light. In Title 24 states, the Occupancy mode is disabled. This mode will be exited 15 seconds after no action is performed.

Round button pressed and held Large button is tapped			Large button pressed and held round button is tapped	
Option	Function	Number of flashes	Option	Function
Manual	Manual Control Only	1	Fan - manual	No Automation
LED Occupancy*	Automatic on, Automatic off	2	Fan – 90 second Delay to ON	Automatic On Automatic Delay Off
LED Vacancy	Manual On Automatic Off	3	Fan – Vacancy	Manual On Automatic Delay Off
LED Ambient	Automatic On if dark, Automatic Off	4	Night-Light	Enter Night-Light Brightness Mode

Night-Light Brightness Mode

If the device is placed into Night-Light Brightness mode, then the brightness of the Night-Light will be controlled by the large button for the next 15 seconds. Toggle the Night-Light on/off or dim it by pressing and holding the main switch. Once the level is set, don't do anything for 15 seconds.

Hub Controlled Operation

Default DALI Operation

After a factory reset – the AL-WS-DR1-PIR only responds to DALI broadcast commands. There is no group or short address assignment yet. Since the device accepts DALI broadcast commands – any DALI switch or master that sends broadcast commands can connect to this device remotely for on/off/dimming – the LED outputs are controlled by the switch or DALI broadcast packets. In Default mode – no standard DALI ARC level transmissions occur. DALI received commands are treated like 3-way switch controls.

Auto Virtual 3-Way Operation

If no DALI address is assigned, the AL-WS-DR1-VAC assumes that the device is in autonomous mode, and not connected to a DALI bus. In this mode, each time there is an On/Off event locally – the device will transmit via DALI the dimming level using the reserved command 171 in broadcast mode - this will be recognized by other AL-WS-DR1-VAC as an ARC level command and ignored by regular DALI devices. This allows multiple devices to be connected as one large, multi motion sensing network controlling a large number of LEDs.

Full DALI Operation

For full DALI operation - connect your powered DALI bus to the DA+ connections of the AL-WS-DR1-PIR. The device responds to the provisioning commands from a DALI master. In order for addressable functions to work, a 'short' address [0 thru 63] needs to be assigned. This can be done by a DALI Master with configuration features. Once a short address is assigned – the device can be understood to operate as two devices in one.

1) LED driver with DALI control – the LED outputs will have a unique DALI short address after provisioning. The LED driver outputs are connected to LED's and each switch can now be individually controlled by DALI commands from the bus. All DALI 60929-2006 commands are supported. The actual address and group is defined and can be changed by the DALI master. See below.

2) Dimmer / Switch with DALI outputs – after provisioning – the mechanical front switch in this device is placed into either short address or Group mode – see below – flipping the switch, or the 3-way remote switches, or the slider dimming value will cause a DALI command to be sent internally to the LED outputs as well as externally to the DALI bus.

3) A DALI Short Address Reset command will return the device to broadcast receive mode and disable all On/Off/Dim transmissions.

Use an AL-DALI-PI or DALI-100 or similar provisioning tool to assign short and group addresses.

DALI command set

See the AL-WS-DR2 spec for the full set of DALI commands.

DALI Address Assignment - Auto - Grouping

The switch from the factory has no DALI Short address by default. When a DALI master assigns a short address to the switch, one built-in feature rule has been implemented in all DALI ATX-LED devices.

- If the short address assigned is from 0-15, then the built-in switch will send a Group On/Off/Dim command to the DALI bus each time the local status changes – On, Off, Dim – from the switch, slider or N-Way. This method allows multiple DR1-PIR to be configured as a gang – to all operate as one switch. After assigning each DR1-PIR a short address less than 16, add to each DR1-PIR the group address of the others to be ganged together. An AL-WS-010v can also be assigned to the same group.

  An Al-WS-010v can thus be used as a 3-Way switch with full slider dimming. Use the dip switches in the AL-WS-010v to set it to a fixed Group address 0-15 for remote On/Off/Dim. Set the AL-WS-010v via dip switch to a Group (say starting at 15 downward) and use the DALI Master to assign the DR1-PIR target to the same numeric short address as that Group (say 15)

- If the short address is from address 16-63, then the switch will output these state changes using its short address, not a group address: An AL-WS-010v can be assigned the same short address to implement 3-way control with dimming.

DALI commands also are used to determine the 3-Way state. Therefore, a DALI command with the matching Group or Individual address will set the light on or off – and all local switches – physical or virtual – will reflect that change – so that the next flip of any switch will turn the light off or on as intended. This may result in UP and DOWN being reversed – like any conventional 3-way mechanical switch.

Software 3-Way Operation

DALI commands also are used to determine the 3-Way state. Therefore, an Alexa to DALI interface will set the light on or off – and all local switches – physical or virtual – will reflect that change – so that the next flip of any switch will turn the light off or on as intended.

The Virtual 3-Way method uses 2 or more AL-WS-010v devices with the same short or group address which communicate via the DALI bus. Using the Virtual method just means that each AL-WS-010v will XOR it's physical switch state with the data it receives to its address from the DALI bus. The result allows unlimited numbers of switches to dim and control a common light. Since each DR1-PIR or 010v device supports the N-Way input – the number of control points is limitless.

Note: DALI commands from other devices – such as AL-DALI-Wiz or AL-DALI-Pi receive commands from the Cloud (Alexa, Google, etc) and output those on the DALI bus. These commands (on, off, dim) override the local switch setting – operating as 3-Way switches. Therefore, rocker UP or DOWN will be inverted if a command has arrived from the cloud.

DALI wiring / N-Way operation

Unlike all other ATX LED dimmers, this device only has 2 connectors for DALI and N-Way, this DALI is not isolated, and the polarity must be assured. The Gray / Blue connector is the DALI I/O connector, Gray is DA+ and Blue is DA- .

Connect 2 PIR together via the DALI/Nway pins for stand alone peer operation.

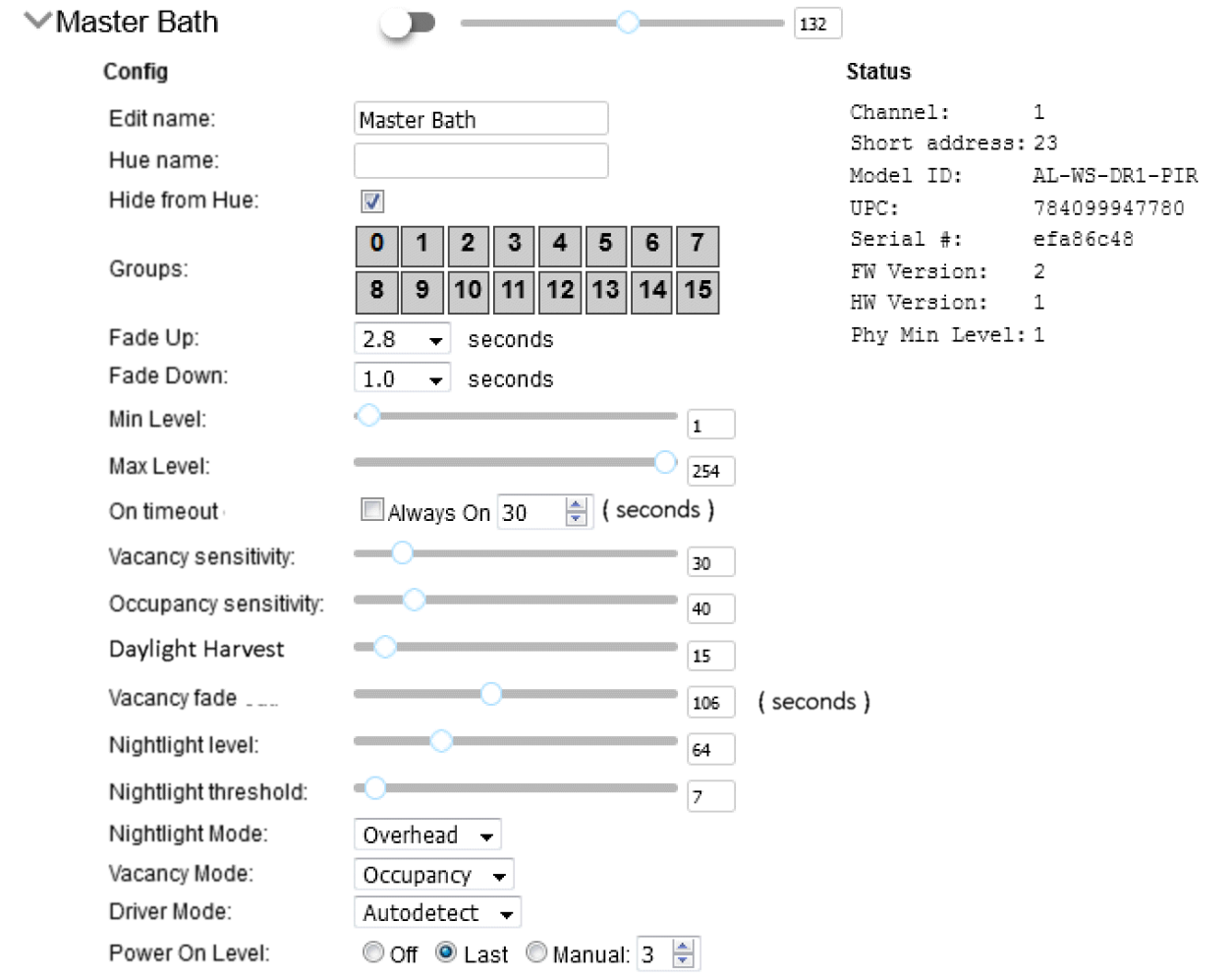
Connect an AL-WS-M switch to the DALI/Nway connector for simple remote on/off/dim operation. The device will automatically detect the difference between DALI and N-Way.

Motion Sensing DALI configuration

Unique to this device are the DALI memory bank 0 contents. They are read / writable

On Time 16	Seconds of On Time renewed each time moment motion is detected The 8 bit value is multiplied by 30 for the number of seconds
Maintain Sensitivity 17	Sensitivity for keep alive. Typically 10 to 15 should be used. Higher values are less sensitive. If no motion in at this sensitivity is detected, the light will turn off automatically in either vacancy or occupancy mode
Detect Sensitivity 18	Sensitivity for new motion. Typically 40 to 80 should be used, higher values are less sensitive. In occupancy mode, this level will cause the light to turn on
Brightness 19	Night-Light Brightness a value from 0 (off) to 255 (full power)
Harvesting 20	if there is ample light in the room – the motion sensor will not turn on the LED lighting – the ceiling light can be dimmed to this level 255 = always turn on the LED lighting
Fade Out 21	this is the number of seconds it will take to fully turn the light off when no motion is detected
Dark Level 22	Night-light Threshold The Ambient light setting that will turn the night-light off if the light exceeds this value
NightLight 23	<table><tr><th>mode</th><th>value</th><th>Onboard Light</th><th>Ceiling Light</th><th>DALI bus</th></tr><tr><td>Off</td><td>0</td><td>Off</td><td>No update</td><td>No update</td></tr><tr><td>Built In</td><td>1</td><td>Active</td><td>No update</td><td>No update</td></tr><tr><td>Overhead</td><td>2</td><td>Off</td><td>Active</td><td>Update</td></tr><tr><td>Both</td><td>3</td><td>Low level</td><td>Active</td><td>Update</td></tr></table>
Motion 24	<table><tr><th>mode</th><th>Value</th><th>On Rule</th><th>Off Rule</th><th>Brightness</th></tr><tr><td>Occupancy</td><td>0</td><td>Auto</td><td>Auto</td><td>Memory</td></tr><tr><td>Vacancy</td><td>1</td><td>Manual</td><td>Auto</td><td>Memory</td></tr><tr><td>Manual</td><td>2</td><td>Manual</td><td>Manual</td><td>Memory</td></tr><tr><td>Occupancy Harvest</td><td>3</td><td>Auto</td><td>Auto</td><td>Automatic</td></tr><tr><td>Vacancy Harvest</td><td>4</td><td>Manual</td><td>Auto</td><td>Automatic</td></tr><tr><td>Manual Harvest</td><td>5</td><td>Manual</td><td>Manual</td><td>Automatic</td></tr></table>

ZWD management



Sensitivity Settings

The motion sensor can be adjusted from requiring a large amount of energy to activate or requiring little energy. 40 is a typical value, 0 is too sensitive for all applications, and 255 will disable the sensor.

Brightness Settings

The sensor can be adjusted to turn on the lights only when the room is not fully lighted already. The main light threshold is adjusted by the Daylight Harvesting slider to only turn the LED on when needed. The Night-Light threshold is adjustable to be on when the room is dark enough to need a guide light. In addition, the brightness of the Night-Light can be adjusted.

Timing Settings

The motion sensor will keep the light on for the time you define, from 30 to 7200 seconds. After this time, the light will start to fade off. During this fade out time, the occupant will have ample light to be able to trigger an extension should the sensitivity be set too high.

N-Way signal options set via DALI command 35

Using the Dali command 35 – several modes are available. A DALI command 35 with the following values will select these advanced features. These settings override and disable the round programming button

0	THREE WAY	Default
2	Full Automatic	Turn on when presence is detected and the room is dark
3	Occupancy	Turn on when presence is detected
4	Vacancy	Manual turn on, turn off after a delay with no presence detected.
5	Ambient	Same as Occupancy, but only on if Ambient light is low
6	FAN	Force fan mode (CV 12 volts)

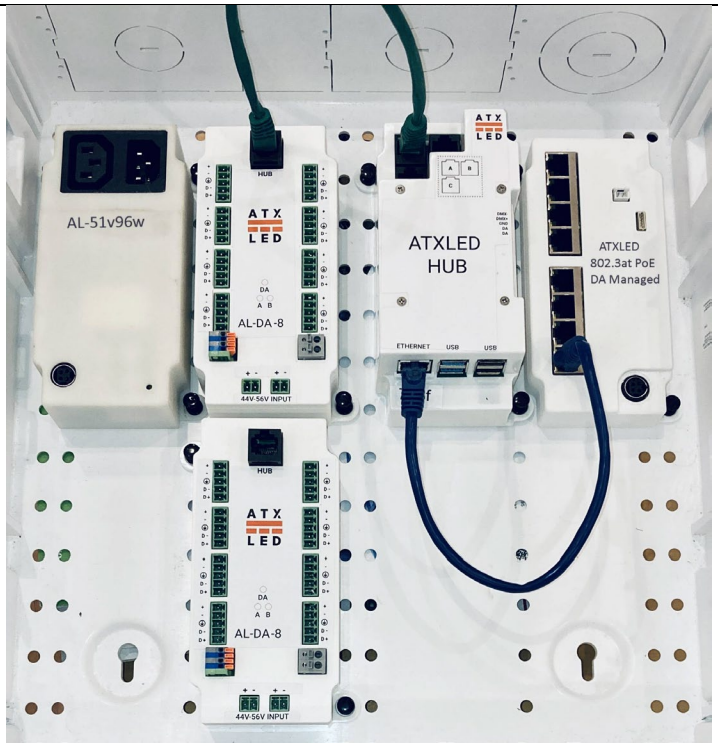
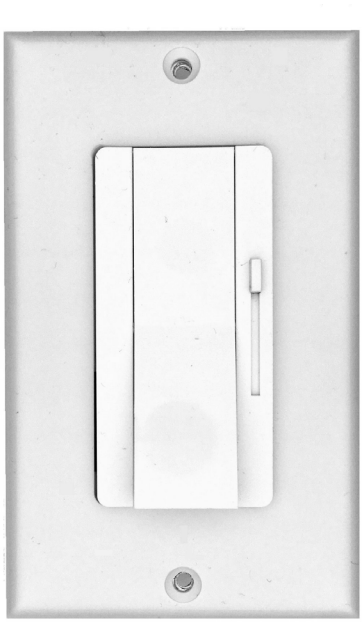
Fan control

Intended for bathroom fans, if the B output is a light, and the light switch is turned on locally and stays on, then the A output will be turned on for the Hold-ON duration. The delay before turn on is set by the DALI command 51, then once on, the on time is set by the DALI command 52. If the light stays on, the fan stays on past the Hold-On time

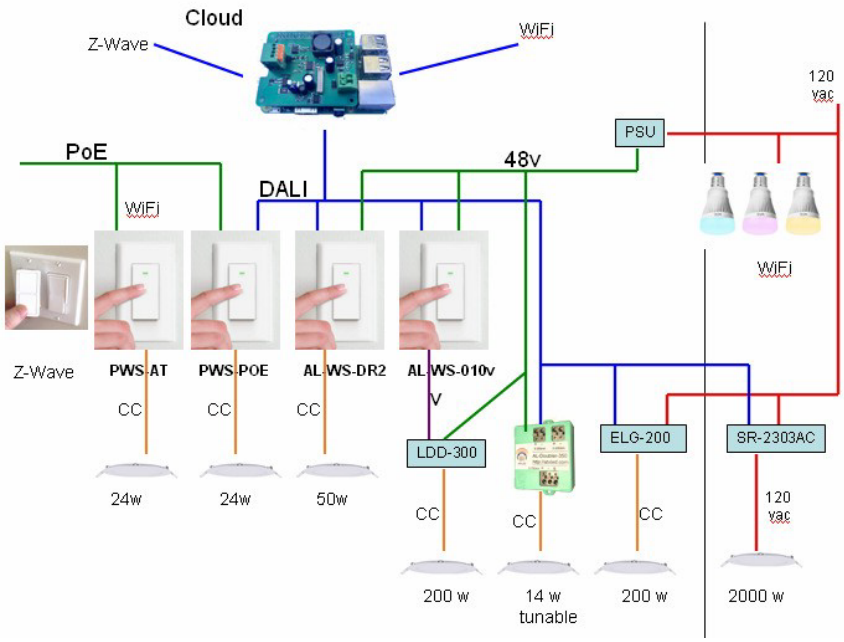
DALI	Function	Set DTR value before these commands	Scale
50	Fan Idle	Sets the speed of the fan when it is 'off' – can set a low level	20-200
51	Delay before ON	∞, 7, 10, 14, 20, 28, 40, 56, 80, 113, 160, 226, 320, 452, 640, 900 Seconds	0 = ∞ 15=900
52	Hold-ON	∞, ½ , ¾, 1, 1 ½ , 2, 3, 4, 5, 8, 10, 15, 20, 30, 40, 60 Minutes	0 = ∞ 15=60
53	Fan Operate	Sets the speed of the fan when it is 'on'	50-254

∞ means never. The A output can also be controlled by a simple contact switch connected to the N-Way input. The N-Way switch overrides the timers. Note: Set mode 35 to FAN to set Delay and Hold. Set mode 35 to 0 to set lamp fade rates – then change to Fan mode to set Delay and Hold

DALI bus products from ATX LED Consultants

	
Structured Wiring DALI power supply with easy wiring	Wall Switch + LED Driver with tunable white

ATX LED Product family



Memory Bank 0 (DTR1 = 0)

DTR register	Bank 0 Name	Bank 0 Value
0	Bytes per Bank (minus 1)	63
1	Checksum	Calculated
2	Number of Banks (minus 1)	3
3	UPC code – msb	
4	UPC code	
5	UPC code	
6	UPC code	
7	UPC code	
8	UPC code – lsb	
9	FW Version	
10	HW Version	
11	Serial Number – msb	Assigned by Master
12	Serial Number	
13	Serial Number	
14	Serial Number – lsb	
15	N-Way Mode	See details
16	On time with Motion detected	Value*30 = Seconds
17	Vacancy Sensitivity (keep alive)	6-255
18	Occupancy Sensitivity (detect)	6-255
19	Night-Light Brightness	0-255
20	Daylight Harvesting	0-254, 255
21	Fade out time if no Motion	Seconds
22	Night-Light on below this ambient	0-255
23	Night-Light Mode	0 = off, 1 = built in, 2= overhead 3 = both
24	Occupancy or Vacancy	0 = Occupancy 1 = Vacancy 2 = Manual
25	Debug Mode if > 0	Send motion sense data and more
26-63	Storage	User Defined

Memory Bank 4 (DTR1 = 4)

DTR register	Name	Value
3, 4	Up Time lsb (3) msb (4)	Hours
5, 6	On Time lsb (5) msb (6)	Hours
12	Wh/10	99 = 990 Wh add to kWh below
7, 8	kWh lsb (7) msb (b)	kWh
9	Average Watts since boot	Watts
10	Peak Watts	Peak when LEDs at 100% Watts
11	UPS mode	Power limited output level 20-254
13	Present Watts – rough	Watts Total
14, 15	Input Voltage lsb (14) msb (15)	Milli Volts
16, 17	Present Wattage detail lsb (16) msb (17)	milli Watts
18, 19	n/a	
20	Ambient Light level now	0 - 255
21	Ambient with Night-Light off	0 – 255
22	Last Motion detected level	Last max level since light turned off