

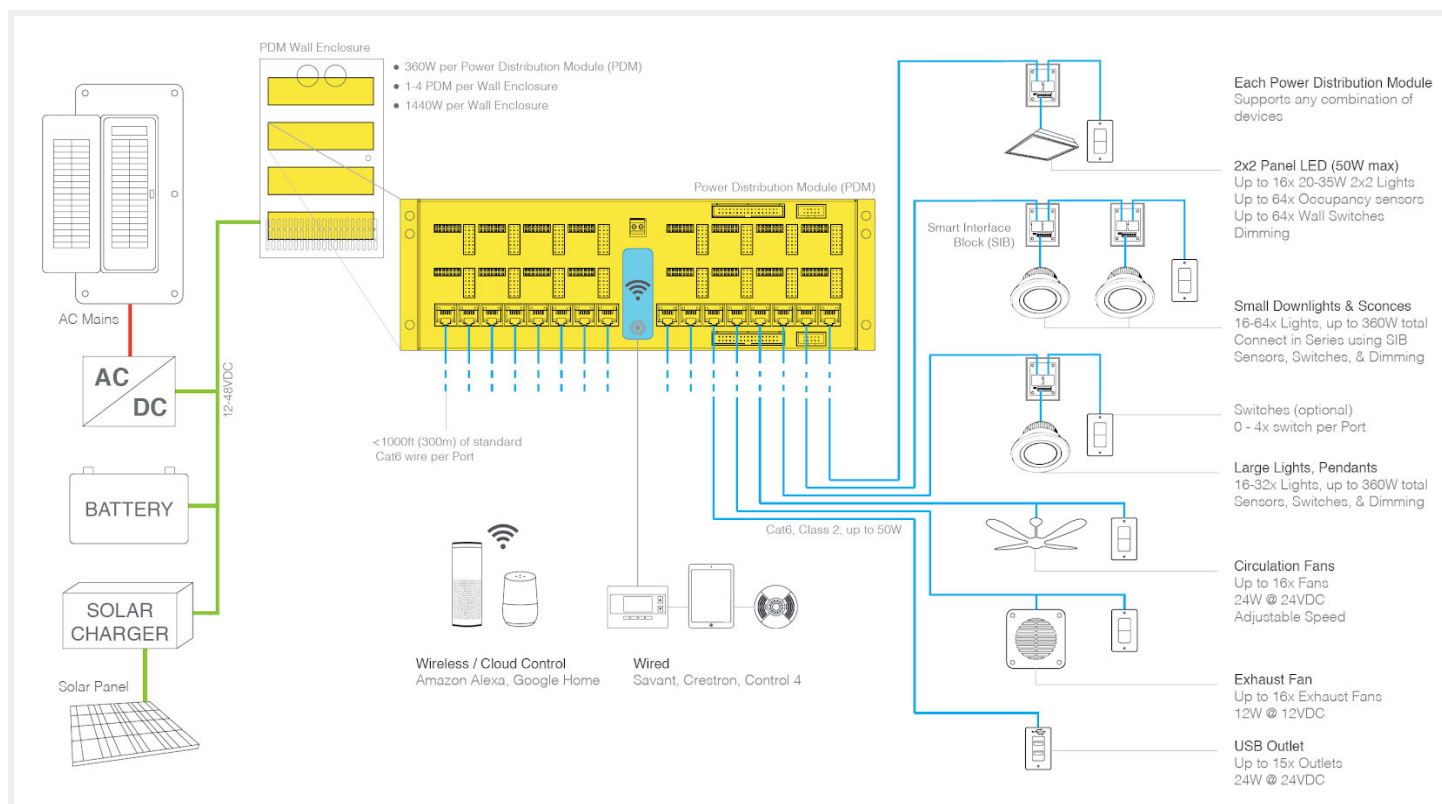


LumenCache LibRE System Introduction

Flexible Power and Control Platform for Buildings

The energy savings and convenience benefits of smart home products are widely accepted, so why do less than 5% of new homes constructed include smart systems from the builder? Builders tend to install the most widely accepted standard: AC wiring and light switches, then leave it to the homeowner to convert their switches and lights to a controllable platform after construction. These systems use many wireless protocols and all struggle with the same technical and reliability challenges that wireless presents: coverage, battery changes, complex commissioning by skilled systems integrators, and service contracts or monthly online charges.

If we are ever to make smart platforms desirable for every new home being built, we have to give the builders what they want: a simple, reliable, low-cost, open, and flexible solution.

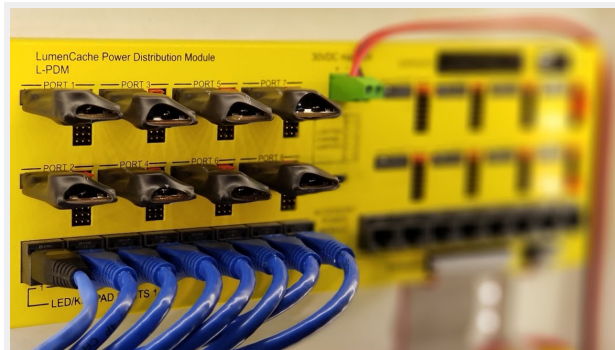


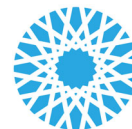
LumenCache is an open hardware platform for new homes and buildings that distributes DC power, control signals, and standby/accessory power to connected devices using Cat5/6 wires. It adapts diverse power supplies including AC, DC, solar, or batteries providing a resilient and efficient power source for all installed lights and electronic devices. The open hardware platform merges control signals and power through modular distribution panels to ensure compatibility of all devices over the life of the building. It currently provides up to 60W per port, which is sufficient to power nearly all devices in a smart ceiling.

With LumenCache installed in every new home, hotel, school, apartment, dormitory, or office building, activating smart connected features is as easy as plugging in one device: an Ethernet Gateway module. **No other solution can transform like this.**

Learn how each component of the system works to accomplish the same basic functions of traditional lights and wall switches, but in a better and modern way that creates a new and higher standard of building performance.

Visit www.LumenCache.com/learn

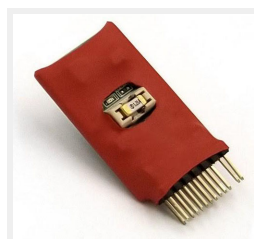
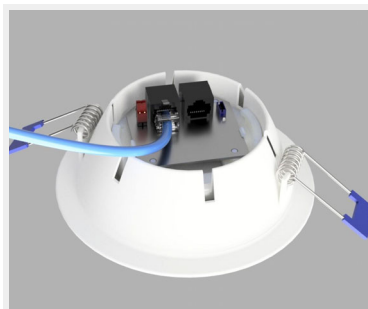




LumenCache SYSTEM COMPONENTS

FIELD DEVICES: LIGHTS, SWITCHES, KEYPADS, & MORE...

Lights, wall switches, keypads, exhaust fans, ceiling fans, charging outlets, sensors, and actuators are attached to the ends of Cat5/6 low-voltage wires. Standard RJ45 (Ethernet style) tips terminate each end of the wires. Each powered device has 1-2 RJ45 jacks either built into the device or attached externally to a Smart Interface Block (SIB). These wires are grouped together at the power panel Enclosures and connected to the Power Distribution Modules (PDMs) by plugging the wires into the RJ45 jacks. Often, devices may be chained together on a single home-run wire from the PDM panel.



OUTPUT DRIVERS:

Drivers form a bridge from the power entering the Power Distribution Modules and the field devices at the other end of the Cat5/6. They plug into PDM sockets to regulate or convert the electricity for safety and efficiency. They also control the flow on/off/dim level by following a control channel signal so groups of lights or devices can be commanded together into zones. There are three categories of drivers: **Constant Voltage**, **Constant Current**, and **Protocol**.

Adapter Module	Room Devices	Description
Constant Current LED Drivers L2-CC	LED Lights without internal drivers or regulators	LEDs require constant current drivers. Traditionally, drivers are mounted inside or at the fixture. LumenCache allows the drivers to be separated from the fixture. This innovation allows drivers to be serviced or upgraded in the wall enclosure without the need to climb a ladder or risk damaging ceiling drywall to change a failed fixture. Constant Current Lights can be connected in Series and will all have identical intensity. Constant current LED lights will have the same intensity regardless of wire length. Their combined voltage must be less than the driver maximum output voltage.
Switched Voltage drivers L2-SV	Bulbs, Strip LEDs, anything with a regulator built into the fixture	SV room devices have their own driver or regulators, like LED screw-in bulbs (regulator is in the base), LED strips (the little black regulator chips on the strip), motor controllers, or USB outlets. Sum the current consumed by all SV devices attached to an L2-SV and stay below 1.2A. A typical 48V system can supply 50W from each PDM port with an L2-SV inserted in its associated socket. Unlike constant current, SV loads are familiar to electricians because it is similar to AC wiring networks. USB wall outlets are powered through an L2-SV and can optionally be turned off at the PDM to eliminate "vampire loads".
Protocol Driven Regulators	PoE Security Camera, Fingerprint Panel, Control Touchscreen, Desk phones	Power Over Ethernet "PoE" is a set of standard protocols and wiring configurations that enable the Power Sourcing Equipment (PSE) device to talk with the Powered Device (PD) to negotiate a suitable delivery of power the PD requires. L2-PDM ports do not support PoE internally, however Midspan Modules allow PoE power to be injected onto the wire from a nearby network switch or router and power is provided and controlled by the socket device.

INPUT & CONTROL MODULES:

Wall switches, motion sensors, and other stimuli from the rooms can be read, measured, and acted upon by Input and Control Modules. The L2-DM "Dimming Module" is a multi-function input and control module that can read wall switch or keypad button presses, and turn a zone of lights on, off, or dimmed, or a scene commanding any or all lights to specific levels. The L2-DM can read switches attached to the same Cat5/6 wire as a light because the input and output signals are separated in the wire. To combine both functions over the same Cat5/6 Port, plug the LED Driver on top of the L2-DM.



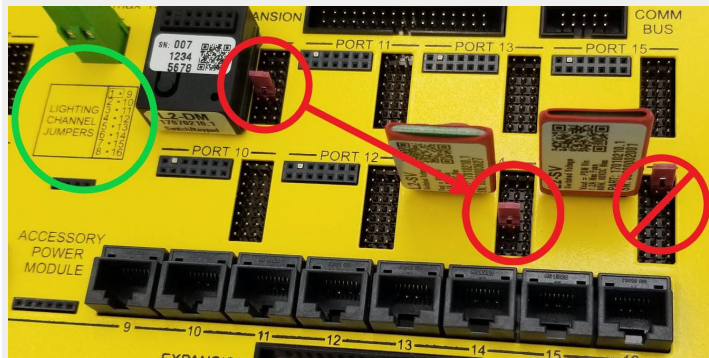


ACCESSORY POWER REGULATOR:

Motion sensors and other smart devices require a small amount of power for their microcontrollers, backlights, wireless radios, and sensors. 12V power is supplied to all the PDM sockets by the L2-APR Accessory Power Regulator. Now each device does not need to adapt the relatively high voltage PDM power source to the tiny voltages the sensitive microcontrollers natively require. If no drivers require 12V, you can omit the L2-APR or only insert one when you add a device that requires it, saving installation costs.

CHANNELS: CONTROLLING ZONES OR GROUPS OF LIGHTS

Channels connect input modules to drivers. Easily select which light drivers are grouped into zones by setting the jumper next to each driver socket on the PDM to match the channel of the input/control module you want to command the driver(s). Each PDM has 16 channels to choose from, so each enclosure of 4 PDMs supports up to 64 lighting zones, and an 8 PDM panel supports up to 128 channels. Share the 16 zones from one PDM to the next adjacent PDMs using the wide expansion jumper cables. Each channel can support up to 128 drivers listening to an L2-DM, L2-SW, or L2-CH16 module. The channel header is a 3x8 pin array and a small shunt jumper. To select channel 1-8, place the jumper from the left side to the center, or the right side to center for channels 9-16. The module plugged into the associated socket next to the channel header will broadcast to, or listen to, the selected channel. Like Television channels, only one device can broadcast but many can listen. L2-DM, L2-SW, L2-CH16, and L2-ONF16 are broadcast modules while L2-CC, L2-SV listen to a channel. Channels make re-assigning lights to switches as simple as going to the closet panel and moving a driver jumper position. No re-wiring or complex software programming required. No more tearing up drywall to change lighting zones.

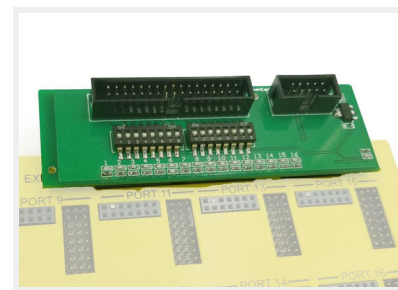


GATEWAYS:

What would a smart infrastructure be without an internet connected gateway? The L2-EGW Ethernet Gateway allows wired and wireless connection, control, and monitoring of up to 240 LumenCache modules per L2-EGW. 120 CH16s x 128 ports x 5 lights x endless repeaters = whoa... big number (76,000 controlled lights before we even add a repeater). The L2-EGW does not need an Internet connection nor a monthly service fee to operate. When attached it will query the smart devices on the communication bus and automatically build it's browser-based interface. Comm bus adapters allow panel-to-panel communication over a simple Cat5/6.

CHANNEL EXPANSION MODULES:

PDMs can be chained together to control the zoning and grouping of control signals 16 channels at a time. The Channel Expansion Modules plug into the top channel and comm bus ports on the PDM. The L2-CH16 can command up to 16 channels from a single device. It does not have a Socket or Port connection, so it can't listen to wall switch button presses directly, but it does respond to communication protocol commands from 3rd party control systems or the Gateway. This means a single L2-DM with keypad buttons can recall scenes to control all 16 channels on a PDM. With a full enclosure of 4 PDMs and 4 L2-CH16s you can command 64 individually addressable lights and connect more enclosures of PDMs to expand further.



SMART INTERFACE BLOCKS: SIBs

When a room device does not have a LumenCache RJ45 jack built-in, connect a Smart Interface Block (SIB) to the end of the Cat5/6 wire and connect the SIB terminals to the device. LumenCache multi-purpose SIBs come in several sizes and shapes to support any device needing power, accessory power, and input signals. Each SIB includes 2-4 screw terminals for LED power, and a 4-pin connector for Accessory 12V power, and sensor input.



WIRING:

It is recommended to run Cat6 (Cat6A not required) wires to any and every device you feel may someday be DC powered and/or controlled. This includes Thermostats, Blinds, Leak detectors, and more. Consult with a system design expert to help design the wiring and select compatible powered and controlled devices. Loads that must exceed the current rating of Cat6 wires can have #16/2c wire in parallel with the Cat5. This combination provides the control and accessory power via the Cat5, and the bulk power over the large gauge wire. Generally, you can conservatively send 50W over a Cat5, and new driver technologies will enable much higher power. While LumenCache drivers can use wire lengths far exceeding Power over Ethernet (PoE) devices, it is recommended to stay within the PoE wiring specification in case you want to use PoE modules in the future. Use only low-oxygen solid copper Cat5/6/7. The speed rating is not important, but the copper quality is important for a lifetime of reliable operation. LumenCache brand wires are optimized for LumenCache power and communication capability.

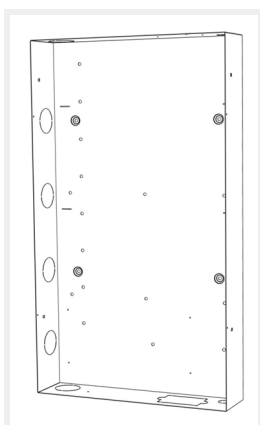
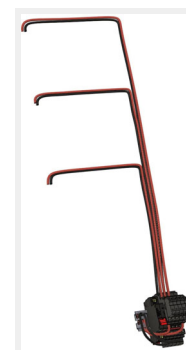


POWER INPUT:

The enclosure power supplies will adapt utility grid AC power to DC and can optionally charge batteries if needed. All supply power must be converted to a safe level voltage input to the PDMs, 48VDC or 24VDC. LumenCache is isolated from mains power to at least 4000V at this device. It also performs Power Factor Correction (PFC) producing up to 30% energy bill savings and improving power quality. 24V is the most compatible with field devices like LED strip lights and 48V offers the highest performance. Order UL Listed Panels in factory-built standard configurations including silent AC/DC power adapter or battery chargers at 600W or 1000W each unit. Some electricity sources can be combined, for example an AC battery charger and a DC Solar Charger may be set to coordinate their supply voltage setpoints so the solar automatically charges during sunshine and the AC charger only starts if the battery becomes low.

PANEL WIRE HARNESS:

To speed installation, use factory pre-assembled panel wiring harnesses. They are ready to install complete with pre-cut DIN rail, wire lugs, tinned wires, and fuse block assemblies. Three harness combinations meet the needs of every common configuration and simplify ordering, parts management, and installation. Fuse blocks safely disconnect individual PDM power and allow the remaining PDMs to remain powered during servicing. The optional battery harness includes a resettable DC breaker and an extra jumper wire to allow 24V and 48V battery configurations. The expansion harness simplifies connecting other DC powered devices and high power LED strips while protecting the wire safety and keeping the entire panel clean and organized.



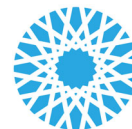
ENCLOSURE PANEL:

The wall enclosure is installed pre-construction between studs or on a wall surface. It provides protection of the wires and modules as well as easy access for servicing. The enclosure back box, door, and fan kits are provided separately to match the installation phase of typical construction. Install the L2-ENC28 during pre-wire phase and protect the wires inside from dust and paint with the included dust cover. Metal knockouts on the sides, and top/bottom left side provide sufficient access for clean and trouble-free installation in wood, metal, and concrete construction. AC or DC power can enter the enclosure at the bottom/top right side in addition to a square knockout for a standard junction box at the bottom. The L2-ENC28 allows many configurations of components including: Power Distribution Modules (PDMs), Battery Shelves, AC/DC and DC/DC Power Supplies, and DIN rail mounted accessories. LumenCache enclosures are required for UL Certification. Do not install the enclosure in confined spaces without adequate ventilation to dissipate the maximum heat produced in the enclosures. The L2-ENC28 is slightly wider than a standard 16"-on-center wall stud spacing.

ACCESSORIES:

LumenCache requires very few accessories to complete installations. For convenience and availability at the job sites, most accessories are already included in the devices that may require them. The most common accessory is a simple RJ45 splitter/combiner.





RECOMMENDED INSTALLATION TOOLS

LumenCache installs quickly and with only a few tools. No special programming or commissioning software is required.

RJ45 TERMINATION TOOLS:

A good crimp tool and cutter should result in perfect Cat5e terminations in under 60 seconds each by a trained technician. Cat6/7 wires require extra care due to the spacers required for high bandwidth data. The “EZ” style tools are recommended for fast and reliable installation.



DIGITAL NETWORK TESTER:

This is a must-have tool for fast and reliable LumenCache installations. Wire errors during installation cause 99% of all issues. A digital network tester measures the distance of each wire pair, confirms there are no crosses, shorts, or opens, and can even help locate lost or hidden wires behind the walls. This tool is so important, LumenCache requires that every certified dealer has at least one (we even include one free in every Dealer demonstration package) and passes a training exam on its use. Network mapper/test tools allow fast and efficient “one trip up the ladder” installation of lights and room devices using this simple technique:



1. Tip the enclosure panel end of the wire and place a numbered mapper device on up to 8 tipped ends.
2. Bring the other tip, tester, and light fixture up the ladder. Tip the cable and test. Jot the ID number and confirm the fixture ID from your plans while you're here. Then click the tipped wire into the light and confidently install in the ceiling. Repeat for up to 8 lights at a time.
3. Back at the enclosure panel, unplug the mapper end, mark/label the wire, and plug into the PDM.

DIGITAL MULTIMETER:

Multi-meters will give you quick confidence the system is wired correctly before you even power it up. Continuity testing and voltage are the two most important features and reasons to always have one in your tool kit.

L2-ONF16:

The L2-ONF16 has the ability to turn ON any of the 16 channels, thereby forcing the drivers on and the lights attached to the drivers. This is handy as a mid-construction tool. Tip and test some wires and install the L2-ONF16 with a “construction PDM” (a PDM you move from job to job during construction). You'll have construction lighting without risking damage to the customer purchased equipment. Add a battery and you'll have reliable jobsite lighting to help reduce the risk of injury or lost work from lighting outages.

L2-EGW1:

The wireless Ethernet gateway is not required for installation, however it allows advanced settings in the smart modules for a more custom system configuration. New homes rarely have an internet connection installed before completion. The EGW creates a wireless hotspot you can connect to from your smartphone, so no internet connection is required to perform walk-around control of the system. When you're finished with installation, remove it and bring it to your next project.

Your Smartphone:

LumenCache products have a QR code label that will take you to the product information pages for each item scanned with your phone camera. Most phones automatically detect the codes. LumenCache design tools let you create fast service links, BIM catalogs, and warranty turnover packages for your clients. Go ahead...try it!

