

## *POWERLINE COMMUNICATED LOAD CONTROL*

### Features and Benefits

PCLC technology enables cost effective, reliable lighting control systems. It was developed to eliminate lighting control wiring for retrofit or new construction in commercial building offices that must meet modern energy codes. These codes typically demand occupancy, daylighting, dimming and demand response. PCLC's emphasis is simplicity of installation and low cost to the end customer. This technology is not intended to replace Wi-Fi or enable every conceivable feature, just enable a lighting control system that is adequate for demonstrated customer needs. And PCLC is hack-proof.

Easy to install and maintain, PCLC requires no new wires for control. PCLC sends commands over the power wiring from a lighting panel or wall switch to the luminaires. If a load is connected to the power line, it can be controlled by PCLC, there is no limit on the distance. The building is equipped with PCLC signal transmitters and PCLC enabled luminaires that are installed just like non-dimmable wall switches and luminaires. Once installed, the system is complete and ready to test. Contractors will save cost, installation manpower and control wiring. The PCLC system is commissioning-free, reducing acceptance testing and other startup costs.

Easy to use, if you can flip a toggle switch, you can dim or switch lights on or off. The PCLC room controller switches look and act similarly to ordinary light switches so users immediately understand how to control their lights.

Occupancy/Vacancy and daylight harvesting sensors can be embedded in PCLC enabled luminaires. This achieves maximum efficiency while eliminating sensor installation time and reducing problems with occupancy sensor shadowing and uneven distribution of daylight.

No commissioning is necessary for the basic code compliant room lighting controller. The daylighting automatically commissions its self on installation.

There is no RF noise or interference generated, no batteries needed and no maintenance is required. There is no network to set up or maintain; signals propagate only from the control switch to the controlled load just like control in conventional lighting has been done since Edison. As more devices use RF or competing high frequency power line communications, the problems of noise susceptibility and mutual interference increase. PCLC has eliminated those problems while requiring no new wires and without the need for sensor and switch batteries that will die and unexpectedly disable the lighting control system over time.

PCLC is hack proof. Wireless/RF can be accessed from outside your building and competing bi-directional power line communication systems can be accessible from outdoor wiring or the wiring of other tenants in a shared tenancy building. This creates a potential for hacking even when not connected to a network or the internet. Some competing systems connect your lighting to your network and make it accessible over the internet. That opens the door to hacking both the lighting system which knows the network password and the building's network if the lighting control system is compromised. PCLC does not hook to your network or the internet and can only be accessed from inside your building on the power wiring between the switch or demand response transmitter and the luminaire.

Demand Response (DR) and Automatic Demand Response (ADR) can be easily implemented for lighting using PCLC.

Beginning July 1, 2014, California's new Title 24-2013 requires all lighting (except HID and very low wattage compact fluorescent lamps) to be dimmable. It also requires that all new buildings and major renovations be equipped to receive a demand response signal from the utility company. For all buildings over 10,000 square feet, the code now requires that the total lighting power of the building must be

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reduced by 15% or more upon receiving a demand response signal. The power level reduction must be uniform which generally means all luminaires must dim 15%. Note that a renovation changing any floor plan in an existing building of 10,000 sf or more can trigger this requirement for the whole building.

The traditional way to meet these new requirements was to employ a centralized lighting control system or a lighting control network. The cost of these networks and systems can increase the cost of a building by over \$1.50 per square foot, and much more if retrofitted. But other than demand response, very little benefit is gained by employing a complete control system, especially for basic lighting in offices, stores, and other commercial buildings. Without a full system, all other control requirements can be met with a switch/dimmer and motion and daylight sensors in the room.

PCLC enables meeting the demand response requirement at low cost without needing to employ a full lighting control system. Install a PCLC demand response transmitter at each lighting panel and the PCLC transmitters encodes the power to all the PCLC enabled luminaires. The demand response transmitters are compatible with, and over ride, the PCLC room lighting controller systems.

All PCLC components can be stand alone devices and interface with existing industry control standards such as 0-10V, but the system and installation costs are reduced by integrating PCLC into the lighting products. For lighting control device and driver manufacturers, PCLC transmitters and receivers are a low cost circuit addition to current switches and sensors and drivers. The PCLC decoders can share some of the existing circuitry in LED drivers or dimming ballasts. Much of the 0-10V or DALI receiver circuitry is eliminated from the light source and the corresponding driver circuitry is eliminated from the PCLC device. The occupancy and daylight sensors can be installed separately, plugged into the PCLC receivers and hung from the T-Bars next to the fixture. But integration of the sensors into the luminaire lowers the installed cost and eliminates installation problems.