

There are many factors when deciding on controls/sensors for LED lighting projects. For example, government, military and bank projects require special considerations compared to other projects in order to ensure security. The purpose of this paper is to help explain the differences in technology and the benefits of choosing a RemPhos control system.

Sub-topics covered in this paper:

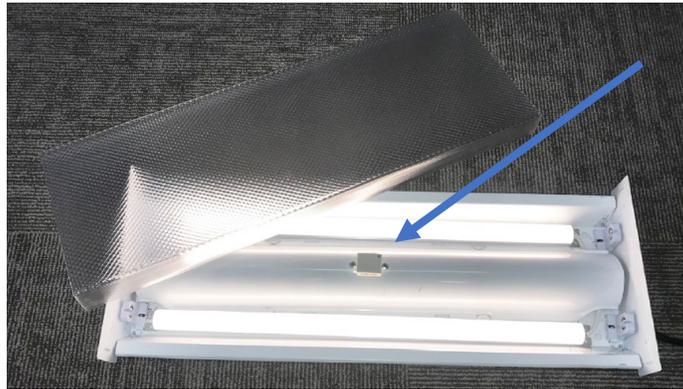
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[Motion sensing technologies](#)

There are 3 major motion sensing technologies that are used by the industry. The purpose of a motion sensor would be to sense occupancy of people or vehicles so that the lights dim down or turn off based on no motion.

- **PIR.** PIR stands for passive infrared. PIR works by sensing the heat signature of an object. PIR works great in just about any environment. The only limitation to PIR is that it must be mounted external to the fixture, in other words, it cannot see through a plastic or glass lens. Therefore, it is challenging to use PIR when retrofitting an existing fixture, because it can be ugly, labor intensive or difficult/impossible to find a place to mount the sensor.
- **Ultrasonic.** The easiest way to think of ultrasonic is to think about it like a microphone listening for sound. When the microphone hears noise, it associates that with motion. Ultrasonic is not commonly used except in restrooms. A limitation of ultrasonic is that it must be mounted external to the fixture, in other words, it cannot see through a plastic or glass lens. Therefore, it is challenging to use ultrasonic when retrofitting an existing fixture, because it can be ugly, labor intensive or difficult/impossible to find a place to mount the sensor.
- **High-frequency radar or microwave.** High-frequency radar works by sending out high frequency (around 5.8ghz) waves of energy and looking for a disruption in those waves. It is often referred to as “microwave”, but typically we choose to use the term “high-frequency radar” since people associate microwave with cooking! You can assure customers that manufacturers that use this motion sensing technology have to be FCC compliant for safety. High-frequency radar sensors are not widely available because it takes a high level of technical engineering to design the sensor. We are one of the few manufactures that have mastered this technology after successfully deploying well over 500,000 high-frequency radar sensors over the last 5 years. The major benefit of this sensor technology vs PIR and ultrasonic is that high-frequency radar is the only motion sensing technology that can be mounted inside of a fixture, behind a lens. It can see through plastic and glass lenses. This makes high-frequency radar great for new fixtures and optimal for retrofit. When we design a new fixture, we can hide the sensor inside the fixture under the lens, which puts the sensor “out of sight, out of mind”. People do not even notice it, so they cannot vandalize it, or modify it and it will not accumulate bugs, gunk, dust etc. When used to retrofit an existing fixture, the sensor can be easily mounted anywhere inside the fixture in the field (so long as its not behind metal). The limitation of high frequency radar is that the waves may see motion even through thin doors and walls. So sometimes this is not a good fit in offices because motion can be sensed through the glass doors (for example).

The following 2 images show RemPhos high-frequency motion sensors in a new fixture as well as a retrofit:



High-frequency radar motion sensor mounted inside an existing wrap fixture, behind lens as a retrofit (along with LEDBARKITs)



High-frequency radar motion sensor mounted inside a new RemPhos LEDCF Canopy/Garage Fixture

Daylight sensing technologies

There are 2 major daylight sensing technologies. The purpose of a daylight sensor is to sense natural sunlight in the space and adjust the LED light fixture to turn off or dim smoothly up and down.

- **Typical photocell.** A photocell is a daylight sensor that has been around for many years and is commonly utilized on exterior lighting. These sensors work fine, but they must be mounted outside of the fixture, and pointed away from the LED light. This is because the photocell could get confused by the LED light and think its sunlight. This is why on exterior parking lot fixtures the photocell is mounted on top of the fixture away from the LED light. It is hard to use this when retrofitting an existing fixture, because it can be ugly, labor intensive or difficult/impossible to find a place to mount the sensor.
- **Smart photocell.** This is a new technology that RemPhos and only a few other manufactures offer. A smart photocell has an intelligent sensing and processing circuit that can distinguish the difference between natural sunlight and artificial LED light. The major benefit of using a RemPhos control with a smart photocell is that it can be installed inside a fixture, under the lens. Even if the lens is diffused, it will still work from inside the fixture. This makes it great for new fixtures, since the sensor will be “out of sight, out of mind” as well as retrofit.

Programming/commissioning technologies

Typically a control/sensor will come factory set to a default program that can be used in typical installations. RemPhos picks a default, based on our experience, that will work for many projects and this saves install time, because they do not require any additional programming unless you want to change the settings. For example, on most RemPhos basic controls (OCC,OC2 for example) the control will dim the fixture down to 20% light level after 5min of no motion, and never turn the fixture completely off or adjust light levels for daylight. If a customer chooses to modify the settings of a control, there are 3 main methods used by the industry:

- **Dipswitches.** Some low-cost manufacturers still rely solely on dipswitches on the control to adjust. We do not recommend this method since its labor intensive and you must physically access the switches to change settings. For example, on a ceiling mounted fixture, you would have to use a ladder and remove the fixture lens.
- **IR remote control.** IR remote controls are identical to the remote used on your home television. These are remotes where the user presses a button to change a setting on the control up in the fixture. The user can stand on the ground under the fixture and simply point it up at the fixture. IR remote controls are easy to use. The only drawbacks of IR remote controls are that to change the settings of multiple fixtures, you must physically stand under each fixture and change the settings of each control. While this sounds daunting, it is in fact fast. For example, to change settings on 100 parking garage fixtures, it typically takes 1 person 30 minutes total. IR remote controls are a great choice for government projects because they offer a direct, secure, non-networked link to the fixture. Typically, IR remote controls are used on “basic controls” (described at a later time in this paper).
- **Wireless RF/Zigbee/Bluetooth/Wi-Fi control.** This technology wirelessly communicates to the control inside the fixture or the ceiling via RF/Zigbee/Bluetooth/Wi-Fi communication. Typically, there would be a mobile phone, tablet or laptop that has software installed to adjust settings. This method is nice because it can allow for remote programming and you can apply changes to multiple fixtures at the same time. RF/Zigbee/Bluetooth/Wi-Fi programming is used on “advanced controls” (described later in this paper). The drawback is usually these methods of programming take a higher skill level to master and some secure government or bank projects will not allow.

Basic (non-networked) controls vs Advanced (networked) controls

We like to help people navigate through so many control methods by dividing them into 2 buckets, “basic (non-networked)” and “advanced (networked)”.

- **Basic (non-networked).** Each fixture has its own control. Controls do not communicate with each other. This means that each light fixture is standalone and does not talk to other fixtures, so it does not allow wireless grouping of fixtures. This is a cost-effective way to get major energy savings. For example, in a hallway, each light fixture would dim up or down based on people being near that fixture. RemPhos has successfully deployed hundreds of thousands of basic controls and customers have been extremely happy. Basic (non-networked) controls should not be used in most office, retail or any other environment where it may be viewed as annoying to have each fixture dimming up and down on its own.
- **Advanced (networked).** These control systems are becoming more and more popular. Some examples are Philips SpaceWise, Lutron Vive, LG SensorConnect, Acuity nLight, Siemens Enlighted, and Avion/Silvair Bluetooth. Each of these advanced wireless controls provides a high level of customization to the program/schedule etc. of the sensors and light fixtures. They also allow you to tie them to wireless wall mounted

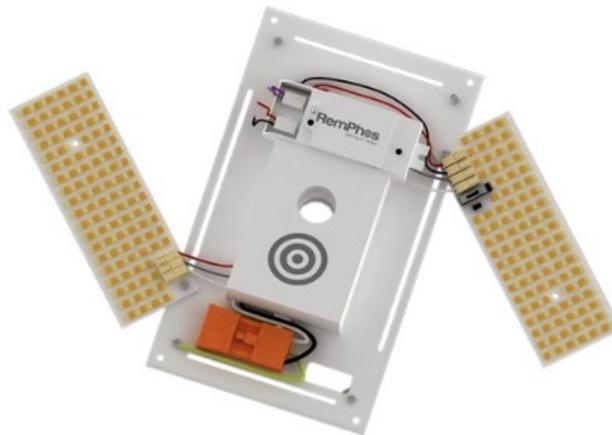
manual dimmer switches. Advanced control systems can often be tied to back end BMS systems to have remote control of the lighting, HVAC etc. of the entire building. More and more Utilities these days are providing higher rebate \$ for advanced controls (compared to basic controls). Advanced controls can make it easy to group multiple fixtures together, so they are great for office, retail and other environments where customers want many fixtures tied together, dimming up and down as a group. These controls use RF, Zigbee, Bluetooth or Wi-Fi to create a network. Advanced controls are more expensive than basic controls and care must be taken on government, military, bank or other projects where security is critical, since often no wireless networks or communications are allowed. There is no clear leader yet in what protocol will become the standard, but our best guess at this time is Bluetooth, since it provides the most secure, easy to set up, versatile and low-cost options.

RemPhos also offers an option between basic and advanced with our high frequency radar control with RF wireless grouping. This option is lower cost compared to advanced networked controls, but it does not provide all the features of more advanced systems.

RemPhos control options

RemPhos by Light Efficient Design has been designing, manufacturing and successfully deploying basic and advanced control options for since 2013 and has the experience necessary to help you decide what the best technology will be for your projects. The majority of our customer's projects end up using our **basic high frequency radar/smart photocell/IR remote programmed controls**. They are low cost, easy to use and provide significant energy savings. We are now seeing more and more customers interested to use advanced controls. We can integrate any of the advanced control offerings (Philips SpaceWise, Lutron Vive, LG SensorConnect, Acuity nLight, Siemens Enlighted, and Avion/Silvair Bluetooth) into our fixtures or retrofits at the factory to make for fast in-field installs!

RemPhos has proprietary in-house designed controls which are low cost, small, reliable and safe. For example, our proprietary controls available on our LEDCR and LEDBARKIT-Internal Driver shown below:



LED SR (sconce retrofit kit) with factory installed OCC basic high frequency radar/smart photocell/IR remote programmed control.



LEDBARKIT-Internal Driver (LBI) with super fast to install, plug & play OC2 basic high frequency radar/smart photocell/IR remote programmed control.

Further information

We have a plethora of detailed information on controls and sensors and would be happy to have an educational discussion over the phone, in person or via webinar with you and your customers. The following video tutorial cover many commonly asked questions in an easy to watch video format:

- Dimming, Controls & Sensors ProClass: <https://youtu.be/ouskWzM81nM>

Conclusion

RemPhos by Light Efficient Design has over 1,000,000 fixtures and retrofits with controls installed and running in projects for many years, trouble free. We are confident that we can provide you with the right guidance to make the most reliable, safe and energy saving decisions for your project.

Thank you,



David Gershaw – Chief Innovation Officer

