

# Motion Sensors (Occupancy Sensors)

Motion sensors, offer an inexpensive and effective means of reducing energy costs by turning off lights when rooms or areas are unoccupied. Since lighting accounts for an average of 40% of electric usage in commercial buildings, motion sensors can play a key role in reducing energy costs.

Motion sensors for the control of lighting were first adapted from sensors that were developed for use in security systems. Now many different types of sensors are available that are specifically designed to control lighting for a variety of applications. Depending on the space type, the sensor can replace wall-mounted light switches or can be mounted remotely, retaining the normal switching for use as override switches, allowing the lighting to be kept off even when the space is occupied.

## Motion Sensor Technologies

### Passive Infrared (PIR) Occupancy Sensors

Passive infrared sensors monitor the patterns of background heat energy in the space. When the sensor detects a significant change in the background heat energy, it responds by automatically turning the lights on or by allowing the lights to be turned on manually. When the background heat energy returns to a stable condition, the sensor turns the lights off. Passive infrared sensors must have a direct “line of sight” to occupants in order to detect human presence. In order to minimize false sensing, the sensors are designed to respond to the heat energy wavelengths that are emitted by humans.

### Active Ultrasonic Occupancy Sensors

These sensors broadcast sound waves at frequencies much higher than the human ear can detect. The sound waves bounce off of walls, objects and people. When the frequency of the sound waves returning to the sensor changes (the Doppler effect), motion is detected and the sensor goes into the occupied mode. When the sound wave frequencies stabilize, the sensor turns the lights off. Unlike passive infrared sensors, ultrasonic sensors can “see” around objects and surfaces as long as there are hard surfaces in the space.

### Dual-Technology Passive Infrared and Active Ultrasonic Occupancy Sensors

Utilizing both passive infrared and active ultrasonic technologies, these sensors are designed for use in large areas, in spaces that are difficult to cover, and for areas where maximum reliability is important for safety or productivity reasons.

### Dual-Technology Passive Infrared and Microphonic Occupancy Sensors

These differ from the sensors described above in that no sound waves are transmitted by the sensor. The passive infrared technology senses initial movement and continues to monitor the infrared activity. In addition, a microphone monitors the sound waves and keeps the lighting on until sound activity stabilizes.

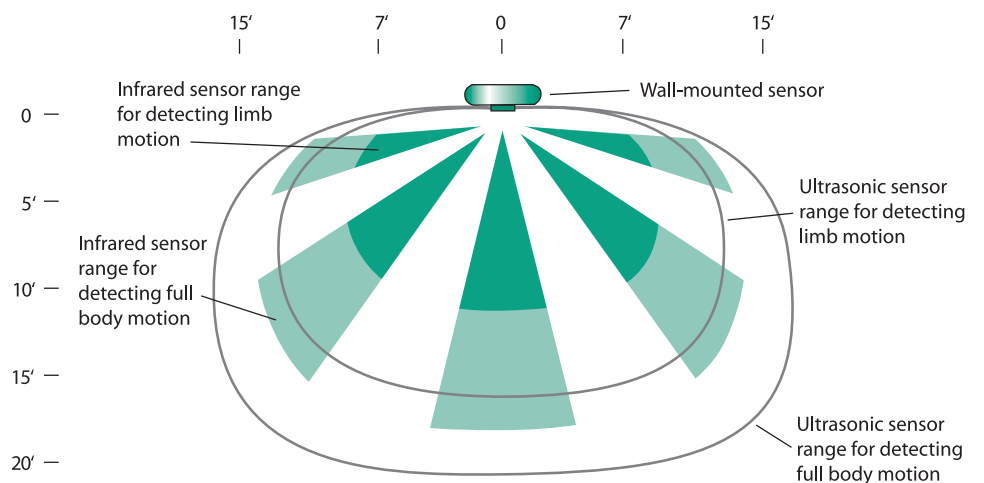
### Occupancy Sensors With Daylight Override

Many manufacturers now offer occupancy sensors with built-in daylight sensors. The daylight sensing can be adjusted to keep lights off when there is sufficient daylight, even when the space is fully occupied. These sensors are a great choice for private offices that receive significant amounts of natural light.

### Vacancy Sensors: Manual-On/Auto-Off

Vacancy sensors are similar to occupancy sensors. However, the only automatic feature they perform is to turn off lights when the space is vacated. Turning on the lights must be done manually. Vacancy sensors offer the maximum energy savings for

Typical Sensor Coverage Ranges



Efficiency Maine is a statewide effort to promote the more efficient use of electricity, help Maine residents and businesses reduce energy costs, and improve Maine’s environment.

spaces such as private offices where occupants may choose to keep lights off when there is enough available ambient light for the tasks being performed.

### Advancing Sensor Technology

The performance of modern motion sensors is exceptionally good and significantly better than the performance of earlier versions. Manufacturers continue to advance the technology with features that improve performance. Many sensors are now available that incorporate automatic adjusting features that adjust both sensitivity and the time that lights stay on following the last movement sensed. Additionally, newer sensor technology has nearly eliminated false triggering due to airflow and heat/humidity changes within the space.

### Adjusting Sensors

Unless the sensors incorporate automatic adjusting features, they will need to be adjusted for both sensitivity and for time-delay. The sensitivity adjustment allows the user to adjust the sensor so that human movement is recognized, while false triggering from other motion is eliminated. Adjusting the time-delay properly prevents the lights from being turned off simply because an occupant has not recently moved, and prevents the lights from being turned on and off frequently if people tend to move in and out of the space during the day.

## Motion Sensor Applications

### Private Offices

Vacancy sensors offer the maximum savings for most private offices, as they do not automatically turn lights on. Wall switch or remote mounted passive infrared sensors work well in private offices. If people will be working out of the sight line of the sensor, dual technology sensors should be used. Motion sensors with daylight overrides should be used if there is significant natural available light.

### Open Office Areas

Remote occupancy sensors mounted high on the walls or on the ceiling work best for these spaces. Ultrasonic or dual technology sensors may be needed to assure that people are “seen” if the space is populated with cubicles.

### Classrooms

Wall-switch mounted sensors can be a vandalism magnet, so remote ceiling-mounted sensors are best here. Manual-On/Auto-Off sensors will allow teachers maximum control over the lighting and prevent false triggering from hallway activity.

### Hallways

In commercial and institutional buildings, hallways are considered to be “means of egress” areas, so occupancy sensors should not control all of the lighting. However, significant savings can be obtained by controlling the light fixtures that are not required for egress. Most sensor manufacturers produce sensors that are designed for hallways and aisles that have a narrow range of view.

### Gymnasiums

With the exception of special high/low stepped dimming systems, High Intensity Discharge (HID) fixtures (metal halide, mercury vapor, high-pressure sodium) should not be controlled by occupancy sensors because these fixtures have long warm-up times. However, high-intensity fluorescent fixtures have become very popular for gymnasiums, and multiple long-range passive infrared sensors work well for controlling individual fixtures or groups of fixtures.

### Warehouses

Warehouses have very similar issues to gymnasiums. Additionally, special sensors designed for aisles should be used to control aisle lighting.

### Outdoors

Specially designed occupancy sensors can be mounted outdoors to control security lighting. Weather issues and false triggering can be especially problematic, so it is important to follow manufacturer guidelines and protect sensors from severe weather.

## For More Information

The Efficiency Maine Business Program offers cash incentives on electric energy efficiency projects including remote mounted occupancy sensors. A list of these incentives, along with contractors and suppliers who are knowledgeable about the Efficiency Maine Program, is available on our website, [efficiencymaine.com](http://efficiencymaine.com), or call toll-free 866-376-2463.