Gulf Power®

Building Controls

Whether simple or complex, building controls are an effective way to save energy for a wide range of equipment. This Tech Brief will help you choose the proper controls and control settings to maintain occupant comfort while reducing energy use and identify energy-efficiency measures that can reduce electricity costs.

This Building Controls Tech Brief outlines the pros and cons of various energy-efficiency measures and is designed to serve as a comprehensive, quick reference guide for everyday use.

Timers

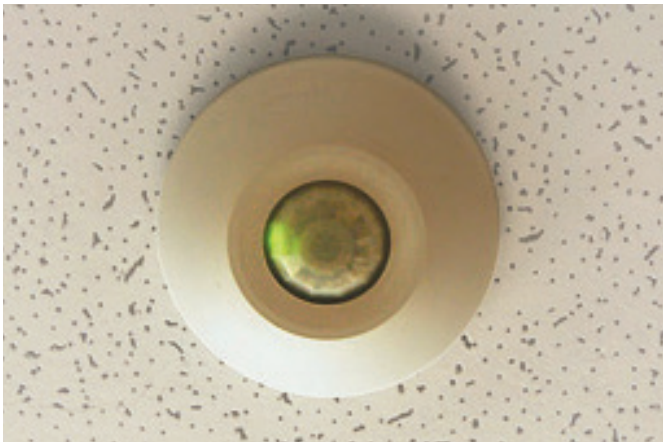
Time-based controls can effectively manage HVAC systems, lighting circuits, water heaters, office equipment, battery rechargers, and other types of equipment. These controls feature a variety of capabilities and range from simple twist timers costing around $30 to smart manual switches and automatic timers costing up to $200.

- **Twist timers** are bypass timers that allow manual operation of electrically operated dampers, air handlers, exhaust fans, pumps, or lighting circuits for a selected amount of time.
- **Smart light switches** can be locked to prevent tampering during normal work hours; later in the evening, the cleaning crew can use the same switch to turn on lighting for a programmed period of time.
- **Programmable switches** with automatic timers can be set to turn lights on in the morning and, after a warning blink, automatically turn lighting back off at the end of the workday.

Occupancy Sensors

Occupancy sensors adjust lighting levels based on room activity. Although most occupancy sensors just turn lights on and off, some can be combined with dimmable fixtures to take advantage of the energy-saving potential of both devices. New smart sensors can also use microprocessors to provide automatic sensitivity or time adjustment, enabling a smart sensor to learn the changing activity levels and habits of building occupants and to adapt its time delay to improve performance.

Wall-mounted occupancy sensors—the most common type—typically replace an existing wall switch and cost between $30 and $90 uninstalled. Ceiling-mounted sensors can provide greater coverage area for large rooms and cost between $40 and $120 uninstalled. Depending on the application, occupancy sensors can reduce lighting energy consumption anywhere from 10 to 80 percent and typically yield short, simple payback periods.



- **Passive infrared (PIR)** is the most common type of occupancy sensor. PIR sensors are able to “see” radiated heat and thus require a line of sight to the occupant. They are most reliable within a 15-foot range and are generally best suited to small enclosed spaces such as hallways.
- **Ultrasonic (US)** sensors emit an inaudible high-frequency sound to detect motion. They have a typical effective range of about 25 feet and can be prone to false triggering. US sensors are most suitable for open spaces, spaces with obstacles, restrooms, and spaces with hard surfaces.
- **Hybrid sensors** combine PIR and US technologies into a single unit to virtually eliminate false triggers.

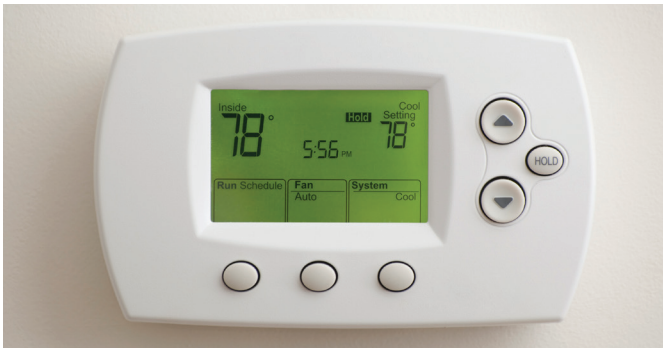
Daylighting Controls

Daylighting controls are essential for realizing savings from daylighting systems (which use natural lighting to supplement electric lighting). When properly implemented, daylighting systems can actually reduce cooling loads in addition to lighting loads because sunlight provides more light per watt of added heat than a typical lighting system does. Control capabilities may include simple on/off functionality, stepped reduction of light output (lowering light levels in discrete steps), and continuous dimming. Daylighting systems work best if they are incorporated into the original building design. The incremental additional cost is minimal, and there are a number of strategies for ensuring that these controls work effectively.

- **Keep it simple.** Although simple daylighting systems may sacrifice some potential energy savings, they are also much more likely to work properly. Typically, "simple" implies using fewer sensors, choosing open-loop rather than closed-loop controls, and sometimes using on/off switches rather than dimmers. Simple on/off controls can often be used effectively (and they are less expensive than dimming controls), though changes in light levels may be more noticeable to occupants. Turning individual lamps off in multilamp fixtures can make on/off switching less noticeable than switching entire fixtures at once. Indirect lighting fixtures can also help to make changes in lighting levels less obvious. Though they may seem simple, be wary of units that combine occupancy sensors and photosensors in a single package—the two types of sensors often have different positioning requirements.
- **Coordinate the efforts of all design professionals**. To implement a good daylighting system, all members of the design team—architects, interior designers, mechanical engineers, and commissioning agents—need to coordinate their efforts. For example, if the interior designer isn't on the team, you may wind up with interior furnishings that are too dark for the planned daylighting system. If mechanical and electrical specialists aren't aware of the benefits of a planned daylighting system, the HVAC equipment may not be sized to take advantage of the reduced cooling loads—and the controls may then be less likely to work properly.
- **Supplement daylighting with task lighting.** Strategic use of task lighting can enable further dimming of ambient lighting.
- **Conduct commissioning.** Daylighting system commissioning consists of adjusting photosensors and ensuring proper sensor placement so that the electric lighting system responds properly to the presence of daylight. Unfortunately, with today's analog sensor technology, calibration is more art than science. Typically, a technician simply adjusts the system until it works (even though it may not be optimally calibrated), and will keep coming back until there are no more complaints. New products are now entering the market that can be calibrated remotely or have self-calibrating capabilities that should help to make commissioning easier.

Programmable Thermostats

- **Programmable thermostats** can help reduce energy consumption by adjusting cooling or heating system setpoints when a space is unoccupied. The energy savings that can be achieved depends on the local climate, how well a building is insulated and sealed, the utility rate structure, the temperature setpoints, and how effectively the thermostat is used, but can be as high as 50 percent of cooling and heating costs. Typical prices range from $30 to $200, depending on the complexity and features offered.



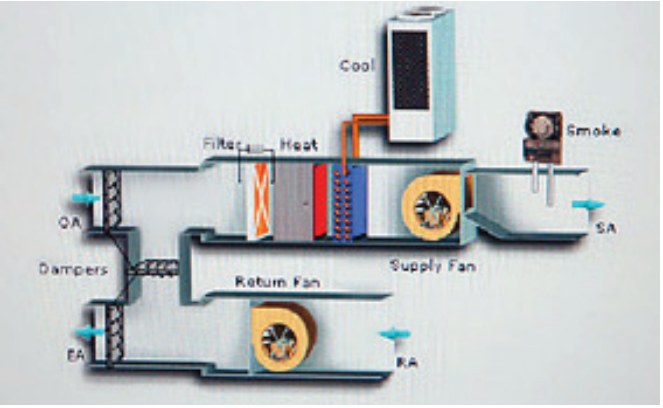
- **Digital thermostats** offer varying degrees of programmability and can be used with any type of heating or cooling equipment. The simplest are only capable of maintaining a single program that repeats each day, whereas more complex units offer the ability to set multiple start/stop times and temperature setpoints for each day of the week. Some units can also adjust furnace or air-conditioner run time based on outside temperatures, and nearly all digital thermostats include a manual override capability.
- **Occupancy-based thermostats** don't base temperature settings on the time of day, but rather keep the space at a specific setback temperature in "unoccupied" mode until the occupancy sensor is tripped and the "occupied" mode setpoints are activated. The thermostat will remain in occupied mode for a predetermined period—typically between 30 minutes and 12 hours. These devices are simple to use but not very flexible, and they work best in areas that remain unoccupied for long periods.
- **Light-sensor thermostats** are also designed to adjust temperature setpoints based on occupancy, but they do so by tracking whether lights are turned on or off. They can be particularly useful for retail stores and other places where closing times may vary because they don't need to be reprogrammed on a regular basis.

Building Automation Systems

Building automation systems (BASs), also called energy management and control systems (EMCSs), can reduce overall building operating costs by controlling energy-consuming building equipment so that it operates more efficiently while maintaining comfortable conditions for building occupants. Direct digital control (DDC) systems use solid-state sensors to measure critical HVAC system operating parameters and send electronic signals via computer to directly control valves, dampers, and actuators. When properly designed, set up, and calibrated, BASs can lower total building energy consumption by 5 to 15 percent (up to 30 percent in retrofit installations), while simultaneously reducing maintenance costs, at a cost ranging from $1.50 to $7.00 per building square foot. Data centers and hospitals typically cost more per square foot, whereas K–12 facilities and hotels are generally at the lower end of this range.

» **What to look for.** Although BASs can be highly customized, there are some general characteristics to look for:
  – A distributed control system network will help to ensure that the failure of a single controller will not affect more than one mechanical system on a BAS network.
  – The use of an open standard communication protocol, such as BACnet or LonWorks, will ensure that the BAS will be compatible with field controls and equipment from different manufacturers and will create a competitive bidding environment for future system additions and renovations.
  – An uninterruptible power supply (UPS) backup system is essential for maintaining controller memory in the event of a power outage.
  – A BAS that includes alarms, trending capabilities, web interfaces, and remote controllability as standard features rather than expensive add-ons will be more cost-effective.

» **What can be done with a BAS.** The complexity of a BAS can range from controlling a single digital thermostat to managing dozens of network-connected controllers that are systematically configured to minimize building energy costs Here are some strategies to consider:
  – Start/stop turns equipment on and off according to an operator-defined schedule.
  – Setpoint reset adjusts room heating and cooling temperature setpoints according to an operator-defined (seasonal) schedule or a software algorithm that looks at the real-time outside air temperature.
  – Unoccupied variable-air-volume (VAV) box airflow reset sets the VAV box to an operator-selected minimum when the occupancy sensor switches to unoccupied mode.
  – Optimal start/stop time uses a software algorithm that views the previous day's operating conditions and then uses that information to start the cooling or heating system at the optimal time before scheduled occupancy. It also stops the system at the optimal time before the space becomes unoccupied to save energy while maintaining occupant comfort.
  – Air-handling unit (AHU) temperature and discharge static pressure reset uses a software algorithm to adjust these setpoints when operating conditions are different from the design conditions.
  – Secondary chilled water pump pressure reset uses a software algorithm to adjust the setpoint so that the farthest coil receives just enough pressure to achieve rated flow when operating conditions are different from design conditions.
  – Chiller supply water temperature reset uses a software algorithm to adjust the setpoint upward as the building cooling load decreases.
  – Chiller staging facilitates the efficient operation of cooling plants that have multiple chillers.



» **Staff training.** Start training operators and maintenance staff early in the installation process, rather than waiting until the BAS has been installed, and don't skimp on training quality. If possible, use only one brand of equipment and software in your BAS to maintain uniformity and limit the additional knowledge required by operators and maintenance staff. To overcome resistance to using advanced BAS features, you can select a particular building system or area and establish a demonstration program highlighting a selected feature before implementing it throughout the entire facility.

» **Commissioning.** To improve the likelihood that your BAS will achieve the expected benefits, you should adopt a comprehensive approach to quality control known as "commissioning" (for new systems) or "retrocommissioning" (for existing systems). Commissioning and retrocommissioning involve a series of reviews and inspections as well as rigorous performance tests that move the system through its intended sequences of operation to ensure that it is operating properly. The commissioning process is complete when all of the building's systems are working as designed and the operations team is thoroughly trained in using all of the system's features.Commissioning and retrocommissioning are among the most cost-effective efficiency measures you can perform— a 2009 study by Lawrence Berkeley National Laboratory found median overall energy savings of 13 and 16 percent for commissioning and retrocommissioning, respectively, with median costs per square foot of $1.16 and $0.30. In addition to energy savings, the process also yields a number of nonenergy benefits, including improved thermal comfort, extended equipment lifetimes, and improved indoor air quality. If your building was previously commissioned, consider investing in recommissioning every three to five years to ensure that your building systems continue to work as effectively as possible.