



Smart Watering With Soil Moisture-Based Irrigation Controllers



To save water outdoors, many homeowners and businesses with in-ground sprinkler systems install soil moisture-based irrigation controllers, also known as soil moisture sensors (SMSs). SMSs detect the amount of moisture in the ground beneath the landscape and prevent scheduled irrigation when plants don't need water, reducing water waste and promoting plant health. The U.S. Environmental Protection Agency's (EPA's) WaterSense® program labels SMSs that have been independently certified to meet performance criteria detailed in the [WaterSense Specification for Soil Moisture-Based Irrigation Controllers](#). Replacing a clock-based controller with a WaterSense labeled SMS can reduce outdoor water use by 30 percent, saving an average home thousands of gallons of water annually. This document summarizes the benefits of WaterSense labeled SMSs, explains how they work, and provides tips for successful installation and maintenance of these technologies to maximize savings.

Background

At the core of an irrigation system is the controller, or a timer where irrigation schedules are set, determining the frequency and amount of water applied to the landscape. The controller is the key interface between the irrigation system and end user in charge of operating that system. Homeowners, maintenance staff, and irrigation professionals can control when and how much water is applied to the landscape by programming their irrigation controllers.

In addition to water savings, WaterSense labeled SMSs also provide a level of convenience, reducing the need to change irrigation schedules as the seasons change. Furthermore, with the growth of app-based interfaces, some labeled SMSs allow users to control irrigation right from their mobile devices. This added convenience allows consumers to track their irrigation water use, increasing their awareness of how much water they use outdoors. Additionally, some labeled models integrate their app-based software into smart homes' systems, allowing the user to operate all smart devices from one location.

WaterSense Labeled SMS

A properly designed, installed, and maintained irrigation system can provide the right amount of water across a landscape, ensuring water efficiency and curb appeal. The controller is the brain behind any good system. In particular, WaterSense labeled SMSs:

- **Provide a healthy, beautiful landscape:** WaterSense labeled SMSs help landscapes flourish and remain healthy by customizing irrigation to only provide plants the water they need.
- **Save money:** WaterSense labeled SMSs help users reduce overwatering and may lower water expenses, by only watering when the plants need it and bypassing the irrigation cycle when water is sufficient.
- **Reduce water waste and runoff:** WaterSense labeled SMSs avoid unnecessary watering and decrease the amount of water running off the landscape, helping to reduce the amount of pollution flowing to local waterways.



Photo above courtesy of Hunter Industries, Inc.

- **Provide convenience:** Properly programmed SMSs save users the time and effort required to adjust watering schedules. As app-based products enter the market, they will provide the added convenience of monitoring and controlling water use from mobile devices, whether onsite or from afar.

How Do WaterSense Labeled SMSs Work?

WaterSense labeled SMSs prevent normally scheduled irrigation events from occurring when adequate moisture conditions exist in the soil. When the moisture level in the soil is dry enough, irrigation is allowed to occur; if the moisture level in the soil is adequate, then the irrigation event is skipped. An SMS is comprised of a sensor mechanism and an interface device. The sensor mechanism stays in contact with the soil and measures the amount of moisture in the soil. The interface device communicates the reading from the sensor device to the controller, which then either allows or prevents irrigation events.

SMSs come in a variety of models that range in price, complexity, and capacity. Models range from those that are intended for small residential landscapes to those that can control large commercial landscapes' irrigation. **Stand-alone** SMSs can replace an existing controller or be installed in a new irrigation system, as they provide all scheduling capabilities. **Add-on** and **plug-in** SMSs connect to a base controller (typically a clock-based controller, but can also be a weather-based controller). These devices can be installed to upgrade an existing irrigation controller, providing the soil moisture-based watering feature to an existing system. They could also be paired with a new, compatible base controller and installed in a new irrigation system.

One thing to know before purchasing SMSs is whether the sensor mechanism communicates wirelessly with the control system, or via a wire. Some SMS models include sensor mechanisms that are wired to the interface device, while other models include sensor mechanisms that communicate wirelessly with the interface device. Another attribute to note is the number of sensor mechanisms with which an interface device can communicate. For small residential SMS models, the interface device may only communicate with one sensor mechanism.

For models that are intended for use on larger landscapes, such as large residential or commercial sites, the interface device may communicate with multiple sensor mechanisms.

Additional Features Enhance Performance

WaterSense labeled SMSs (i.e., stand-alone controllers or plug-in or add-on devices connected to a compatible base controller) have many capabilities that offer convenience and flexibility, while promoting water efficiency. These features include:

- Irrigation program information and settings are retained in the SMS's memory when the power source is lost and no backup battery is available.
- Irrigation can be customized on landscapes that have multiple zones with various watering requirements.
- Alerts tell the user if the controller is not receiving sensor mechanism input and is not adjusting irrigation based on soil moisture content in the landscape.
- Because multiple states in certain climate regions have mandated rain sensors, the SMS must be able to connect to them.
- To comply with local utility mandates, SMSs must be able to accommodate watering restrictions.
- A water budget feature (also known as "percent adjust") allows users to adjust the amount of water applied to the landscape without changing the detailed settings in the SMS's program.
- If the sensor mechanism signal is lost, the SMS can use the water budget/percent adjust feature.
- If the user runs a manual troubleshooting test cycle, the SMS will automatically return to soil moisture mode within a specified time period as designated by the manufacturer.

A searchable list of WaterSense labeled SMSs, their attributes, and compatible base controllers (where applicable) is available at <https://lookforwatersense.epa.gov/>.

Installing an SMS

Manufacturers include instructions for properly installing SMSs with the product packaging, and

many are also available online. Most manufacturers also provide online training guides and videos on the installation and operation of their SMSs for professionals and homeowners to learn more about installing these products. For help with proper installation, contact an [irrigation professional](#) certified by a program that has earned the WaterSense label, which focuses on information on water-efficient methods and technologies. [Find a professional certifying organization](#) near you for certification options.

While WaterSense recommends that a certified irrigation professional install and program SMSs, many WaterSense labeled SMSs are available at irrigation supply distributors or online, allowing homeowners to purchase labeled SMSs and install them. Installation for these products is typically straightforward, but remember the following tips:

- Always follow the manufacturer's instructions.
- Install the sensor in an area of the landscape that requires the most frequent irrigation (e.g., turf with minimal shade). Place the sensor mechanism in the root zone of the plants. Pay attention to the instructions regarding whether the sensor mechanism should be placed in a certain irrigation zone, as this is product-specific.
- Large landscapes may require more than one sensor mechanism. If so, each one should be placed in a separate irrigation zone.
- Pay special attention to the calibration of the sensor mechanism and follow manufacturer instructions. Calibration may vary across brands and must be conducted properly to realize full water savings.

- If a rain-sensing device is also installed, make sure that the soil moisture sensor and rain sensor are wired in series (as opposed to in parallel). This allows each one to prevent irrigation during conditions with adequate moisture instead of requiring both sensors to prevent irrigation at the same time.
- After initial installation, closely monitor the landscape for a few weeks and adjust the settings if the landscape is too wet or too dry.
- To realize full savings from an efficient irrigation schedule, ensure the system is functioning properly—no overspray onto pavement, broken sprinklers, or leaks.

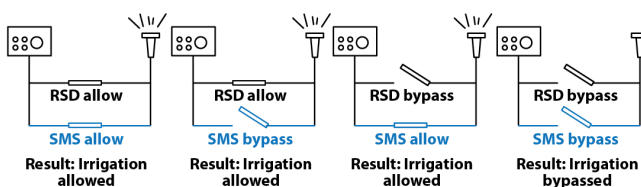
Programming for Water Savings

Correctly programming the SMS is necessary to achieve water savings. As part of the installation process, many SMS models automatically set the threshold at which irrigation is allowed/prevented. The threshold is the point at which the soil holds the maximum or near maximum amount of water before irrigation is prevented. After monitoring closely for several weeks, a user should determine if the threshold is allowing the landscape to be too wet or too dry and adjust accordingly. The base irrigation schedule is equally important. While it may be tempting to set the irrigation schedule to irrigate each day and rely on the sensor mechanism to prevent irrigation if the soil is sufficiently wet, local watering restrictions need to be adhered to and greater water savings will be realized if a more typical schedule is set (e.g., two to three days per week). Note that soil type should also be considered when programming

Wiring Dual Sensors: SMS and a Rain-Sensing Device (RSD)

INCORRECT

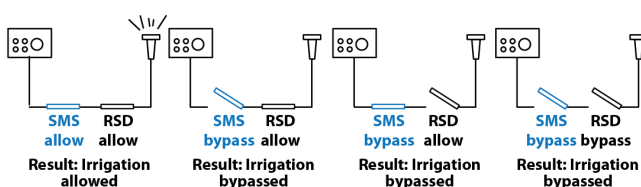
Both sensors are wired in parallel; this does not allow the sensors to work properly because one sensor may say "bypass" while the other may say "allow."



In this case, the signal could still travel a complete loop, and the scheduled irrigation would still occur.

CORRECT

When sensors are wired in series, the signal must travel a single, complete loop through both sensors, allowing either sensor to bypass an irrigation cycle.



In this case, the signal could **not** travel a complete loop, and a scheduled irrigation cycle would be bypassed.

the schedule. For example, irrigation runtimes should be shorter and more frequent in sandy soils to replace water in the soil without causing drainage. Conversely, in heavier soils, less frequent irrigation can occur, since the soil holds more water.

Maintaining Savings

Once a WaterSense labeled SMS is installed and programmed, the controller should effectively deliver irrigation when the landscape needs it (as determined based on soil moisture content). However, no irrigation control system should be installed based on “set it and forget it.” Homeowners, maintenance staff, or a certified irrigation professional will need to periodically inspect the landscape to ensure that the irrigation system is performing properly. This is especially important after installation. If plants are unhealthy due to overwatering, irrigation can be reduced using the water budget feature on the controller or changing the threshold. Users should continue to adjust the threshold until they find a balance that is both water-efficient and healthy for their plants.

Seasonally, users should follow manufacturer instructions for winterizing their irrigation system, including their SMS. Each spring, make sure to consult the instructions for recalibrating or reconditioning the sensor mechanism. This ensures that it is working properly and will allow or prevent irrigation consistently around the threshold. Like other irrigation system components, SMSs need to be replaced as recommended by the manufacturer, typically within five to seven years.

For more information about WaterSense labeled SMSs, visit <https://www.epa.gov/watersense/soil-moisture-based-control-technologies>.

Better Control Is Just One Piece of the Puzzle

While a WaterSense labeled SMS can help reduce unnecessary watering, a holistic approach to landscaping and irrigation is required to achieve the full potential of water savings:

- Many home irrigation systems operate at a water pressure that is too high for sprinkler nozzles and can lead to excessive irrigation flow rates, misting, fogging, and uneven coverage. Install WaterSense labeled spray sprinkler bodies to regulate system pressure at the sprinkler nozzle.
- Utilize microirrigation in flower beds and other non-turf areas to deliver water directly to the root zone of plants, where it is needed most, preventing runoff and reducing evaporation.
- Choose a portion of your yard to be a water-smart landscape. Plants that are adapted to your specific climate can reduce the need for supplemental irrigation.
- Group vegetation with similar watering needs into specific “hydrozones” to reduce water use and ensure plants get the amount of water they need by programming your controller according to each zone’s specific needs.
- Select an irrigation professional certified by a WaterSense labeled program to assist with designing, installing, maintaining, or auditing your system to maximize water efficiency.

For more information about
smart outdoor water use, visit
<https://www.epa.gov/watersense/outdoors>.



Photo above courtesy of Michael Dukes, University of Florida