OpenSprinkler v2.x User Manual
Firmware 2.1.7 (*Nov 6, 2016*)
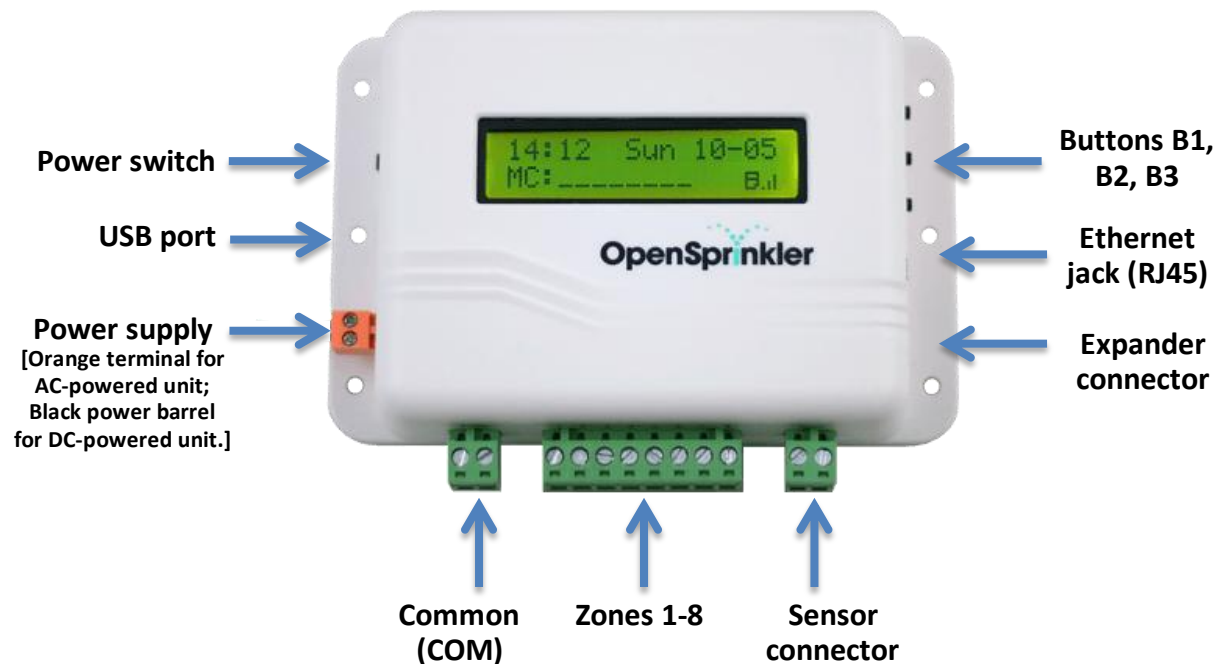
Contents

OpenSprinkler

Introduction

OpenSprinkler is an open-source, web-based sprinkler/irrigation controller. It's a drop-in replacement for conventional sprinkler controllers that do not have web connectivity. OpenSprinkler's advantages include an intuitive user interface, remote access, and smart weather-based watering control. It is ideal for homeowners as well as business owners with applications in lawn and garden watering, plant irrigation, drip irrigation, hydroponics etc.

The package includes the OpenSprinkler controller (8 zones) with screw terminal blocks. The DC-powered version comes with a DC power adapter (and can be alternatively powered by USB adapter or solar panel at 12VDC). The optional add-ons include 24VAC adapter (for AC-powered version only), WiFi or Power-line adapter, and zone expanders (16 additional zones each).

Hardware Interface

Power switch

USB port

Power supply
[Orange terminal for AC-powered unit; Black power barrel for DC-powered unit.]

Buttons B1, B2, B3

Ethernet jack (RJ45)

Expander connector

Common (COM)

Zones 1-8

Sensor connector

Installation

Important Notes

- OpenSprinkler is **NOT waterproof**. For outdoor use, please use a waterproof enclosure.
- **International customers**: for OpenSprinkler AC, please use a 24V AC transformer compatible with your country's powerline voltage standard. Failure to observe the powerline voltage standard can result in damage to your controller. For OpenSprinkler DC, the package includes a universal 7.5V DC power adapter (however, you may need a plug converter).

Watch Installation Tutorial Video

Instructions

Step 1: Label wires and remove your existing sprinkler controller.

- Carefully label and remove the wires from your existing sprinkler controller, then remove it from the wall. Typically you will see the **power supply wires**, the **COM (common) wire**, one or more **Zone wires**. Depending on your setup, you may also find a **Master Zone** (or Pump Start Relay) wire, and **Rain Sensor wires**, and **Flow sensor wires** (if using any such sensor).

### Step 2: Attach OpenSprinkler to the wall, and re-insert the wires:

- Refer to the **Hardware Interface** diagram above. All terminal blocks on OpenSprinkler can be unplugged for easy wiring. To unplug, firmly grab both ends of the terminal block, wiggle, and pull it out.
- For OpenSprinkler AC, insert and tighten the **24V AC wires** into the **Orange** terminal (AC has no polarity so the two wires have no distinction); for OpenSprinkler DC, insert the included power adapter into the power barrel. Then insert the other wires into the corresponding terminals on OpenSprinkler. The COM terminal has two ports: you can use either of them.
- If you have a **Master Zone** (or Pump Start Relay) wire, insert it to any of the zone ports – OpenSprinkler uses software-defined Master Zones, any zone can be assigned as a Master. This firmware supports up to 2 independent Master Zones.
- For instructions on how to connect and use sensor such as rain sensor or flow sensor, refer to **Section 5 - Sensors**.

Step 3: Attach an Ethernet cable to the Ethernet (RJ45) jack:

- Plug the other end of the Ethernet cable into an available port on your router.
- Alternatively, when using a powerline Ethernet adapter, or WiFi adapter, insert the other end of the cable into the adapter. For details, refer to the **Wireless Connection** section on the next page.

Step 4: Link OpenSprinkler Zone Expanders (optional):

- Plug one end of the zone extension cable (which comes with each expander) into OpenSprinkler's **Exp Out connector**: the connector is polarized so there is only one way to plug it in. Plug the other end to the Zone Expansion Board's **IN** connector.
- If you have multiple expansion boards, you can daisy chain them by following the **OUT ⇨ IN** links.
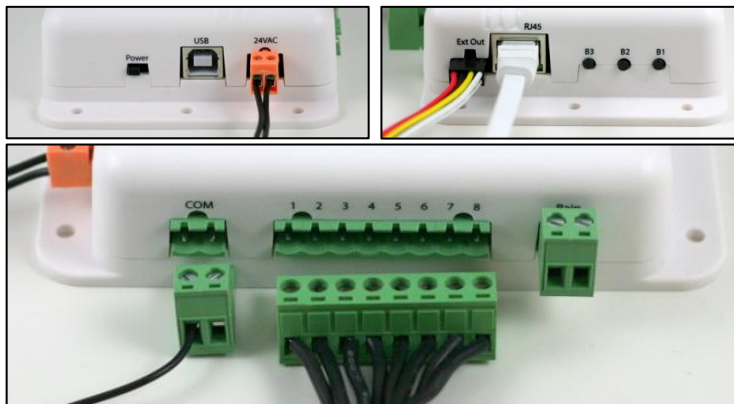
Wireless Connection

If there is no available Ethernet cable between OpenSprinkler and your router, use either of the following wireless options:

Option 1: Powerline Ethernet Adapter

- This option is the easiest as no software configuration is required. Recommended part: **TP-LINK TL-PA2010**.

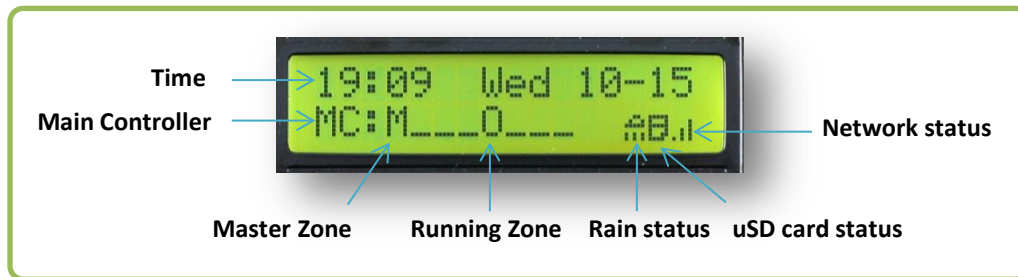## Option 2: WiFi range extender or Pocket-size WiFi adapter

- This option requires some software configuration. Recommended part: **TP-LINK TL-WR850RE**, or **TP-LINK TL-WR702N**.

Watch Wireless Connection Tutorial Video

LCD and Button Functions

LCD

Time — `19:09   Wed 10-15`
Main Controller — `MC:M__O___      ⌨B.⏸` — Network status

Master Zone   Running Zone   Rain status   uSD card status

- Master Zone 1 (if defined) is marked by **M;** and Master Zone 2 (if defined) is marked by **N**.
- Each **running** zone is displayed with a three-letter animation: **. o O**
- The rain icon is displayed if rain is detected (through rain sensor), or a manual rain delay time is in effect.
- If a flow sensor is installed to the sensor terminal and selected, a flow icon (**FL**) will be displayed.
- If a program switch is installed to the sensor terminal and selected, a program icon (**P1**) will be displayed.
- The microSD card icon is displayed when the controller detects a microSD card.

Buttons:

After the controller is powered on, the buttons are assigned the following functions:

	Click	Press and Hold
B1:	Display OpenSprinkler's IP address	Stop all zones immediately
B2:	Display OpenSprinkler' MAC address	Restart the controller
B3:	Toggle between the main controller (MC) and each expansion board (E1, E2, etc).	Manually start an existing program or a test program.
B1 + B2	Display gateway (router) IP (i.e. press B1, and while holding B1, press B2, similar to Ctrl+C etc.)	
B2 + B1	Display external (WAN) IP	
B2 + B3	Display last successful weather call timestamp	

Before the controller is powered on:

- If **B1** is pressed while turning on the controller: enter **Reset All Settings** (factory reset).
- If **B2** is pressed while turning on the controller: enter **Bootloader** (this is applicable to hardware v2.1 only).
- If **B3** is pressed while turning on the controller: enter **Setup Options**.

Note: in the following the terms 'zone' and 'station' are used interchangeably without distinction.

Firmware 2.1.7 User Manual

1. Overview

OpenSprinkler's built-in web interface works with both desktop and mobile browsers. It allows you to change settings and modify programs at any time using **either a standard web browser or the free OpenSprinkler mobile app**. To install the mobile app, just search *opensprinkler* in your app store.

Supported devices and browsers:

- **Desktop** browsers / apps: Google Chrome, Firefox, IE 9+, Apple OS X app, Google Chrome app, etc.
- **Mobile**   browsers / apps: Apple iOS, Google Android, Amazon Kindle, Windows Phone 8, Blackberry 10.

Watch Firmware 2.1.0+ Tutorial

2. Accessing the controller

Once the controller is powered on and establishes a valid connection, you can find out its IP address and HTTP port number on the LCD by clicking button B1. In the following we will refer to the IP address as **os-ip** (for example: *192.168.1.122*).

Next, open a browser and type in the URL **http://os-ip** (e.g. *http://192.168.1.122*). In case you have set a custom HTTP port number (other than the default 80), include the port number in the URL as well. For example, if you have changed OpenSprinkler's port number to 8080, type in **http://os-ip:8080**.

Device Password: the factory default password is **opendoor**. For security reasons, please change the password upon first use.

OpenSprinkler

Enter Device Password

Submit

TIP: the OpenSprinkler mobile app has an additional feature that **automatically scans** your local network for available OpenSprinkler devices.

3. Home Page

Sidebar Button

Notifications

Station Cards

Menu Button

Device Status
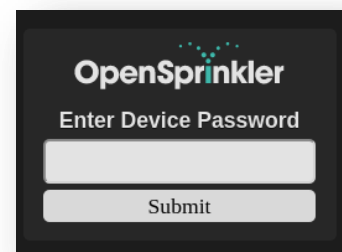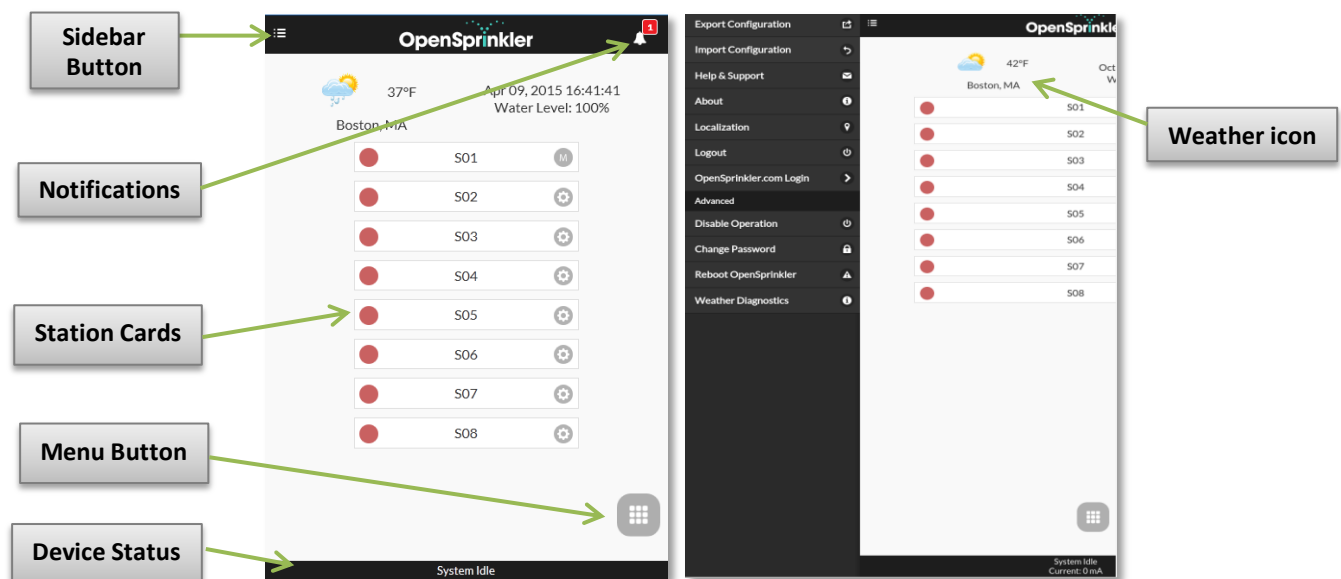
Weather icon

At the home page you will find a weather icon and list of all stations and their status. The bell button in the upper-right corner (when visible) indicates notifications are present and opens a sidebar with all notifications. The button on the upper-left corner activates the left sidebar, which shows additional menu items such as:

- **Export/Import Configuration:** save/restore programs and settings. This is useful for firmware upgrade.
- **About:** display the app version, firmware version, and the language localization website.
- **Localization**: change display language (currently supporting 25 languages). Please check the **About** page to see how you can contribute to additional languages.
- **OpenSprinkler.com Login**: log in with your opensprinkler.com account name and password. This allows cloud synced data such as station photos, notes, site configurations etc.
- **Disable Operation:** disables zone operations. This is useful if OpenSprinkler will not be used for an extended period of time.
- **Weather Diagnostics:** display weather data (requires a valid Wunderground API key).

TIP: at any time, you can **activate the sidebar** by dragging your mouse pointer from left to right (on desktop browses) or swiping your finger from left to right (on mobile browsers).

3.1 Device Status

The footer shows the device's current status. It shows information in the following priority: system enable status, currently running stations, or active rain delay status. If no active events are detected the system will display information of the last run station and if not available will read 'System Idle'. If a flow sensor is installed and enables, the status bar also shows the real-time flow rate (updated every 30 seconds). For controllers that have current sensing capability, the status bar also shows the total current draw of all solenoid valves.

3.2 Station Attributes

Clicking the gear icon to the right of each station card will show a station attribute popup with the following options:

- **Station Name**: you can give each station a **custom name** (up to 24 characters).
- **Use Master**: when checked, the associated Master station(s) will turn on whenever this station is activated. This attribute is only visible if a Master Station has been defined.
- **Ignore Rain**: when checked, this station will bypass rain delay and rain sensor settings. This is useful for zones not to be affected by rain. Default is off.
- **Disable**: when checked, this station will not run and is hidden from the user interface.
- **Sequential**: when checked, this station will be serialized with other stations that also have the Sequential attribute turned on. In other words, at most one sequential station will be running at any given time. Default is on.
- **Station Type (Advanced tab)**: the default type is Standard. Several types of **special/virtual stations** are supported:
  - **RF station**: by installing a RF (radio frequency) transmitter (see **Advanced Topics** section), OpenSprinkler can switch many common RF remote power sockets. To set a station as RF station, you need to purchase an **RFtoy** and use it to decode RF signal code. Once the code is set, whenever this station is turned on/off, OpenSprinkler will send the code through the transmitter to remotely switch on/off the power socket. This allows using OpenSprinkler to switch powerline devices, such as Christmas lights, heaters, pumps, etc.
  - **Remote station**: a remote station is a physical station on another OpenSprinkler controller. This allows one master controller to send commands to remote controllers in order to turn on their valves. Each remote station is specified by the IP address, port number, and station index on the remote controller. The master and remote controllers must share the same password.
  - **GPIO station**: allows the station to directly switch a spare GPIO pin available on the controller. Only pins that are available are listed. You can also define the active state (i.e. Active High or Active Low).
  - **HTTP station**: allows the station to trigger a generic HTTP GET command. To define an HTTP station, you need to provide a server name (either domain name or IP address), port number, on command (without the starting slash /), and off

command. When the station is turned on, it automatically sends a HTTP GET command **server:port/on_command**; similarly, when it's turned off, it sends a HTTP GET command in the form of **server:port/off_command**.

o Note that special stations are logical / virtual – you do not need to have the physical stations to use them. In other words, even if you don't have expansion boards, you can still use special stations that exceed the number of physical stations.

- **Cloud Synced Attributes**: once you log in to opensprinkler.com in the UI/app (through sidebar menu), cloud-synced attributes will become available, including station photos and notes. You can take a custom photo for each station by using the OpenSprinkler mobile app.

4. Menu Button

The menu button is on the bottom right corner of all pages and allows quick navigation between pages relevant to the controller. This menu has the following options:

- Preview Programs (refer to Section 7), or use keyboard shortcut ALT+V
- View Logs (Section 8), or ALT+L
- Change Rain Delay (Section 4.1), or ALT+D
- Run-Once program (Section 6), or ALT+R
- Edit Programs (Section 7), or ALT+P
- Edit Options (Section 5), or ALT+O
- Stop All Stations (Section 4.2).
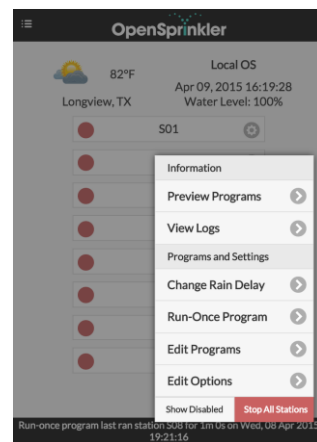
Additionally, when you are at the home page, the menu has a button labeled **Show Disabled**. This allows the user to toggle between showing and hiding disabled stations.

TIP: at any time, you can activate the menu by pressing the **M** key on your keyboard (if available).

4.1 Rain Delay

To manually set a rain delay time, click on the menu button, and select **Change Rain Delay** to set a custom rain delay time (in hours). The controller will immediately stop all stations, and programs will not run until the rain delay time is over. To cancel rain delay, use 0 as rain delay time.

4.2 Stop All Stations or an Individual Station

Click **Stop All Stations** to stop all stations immediately, including those in the queue. To stop (or de-queue) an individual station (either running or in the queue waiting), tap/click the station card on the homepage, and select Yes to confirm.

5. Edit Options

At the home page, click **Edit Options** (or use keyboard shortcut ALT+O) to configure the basic settings.
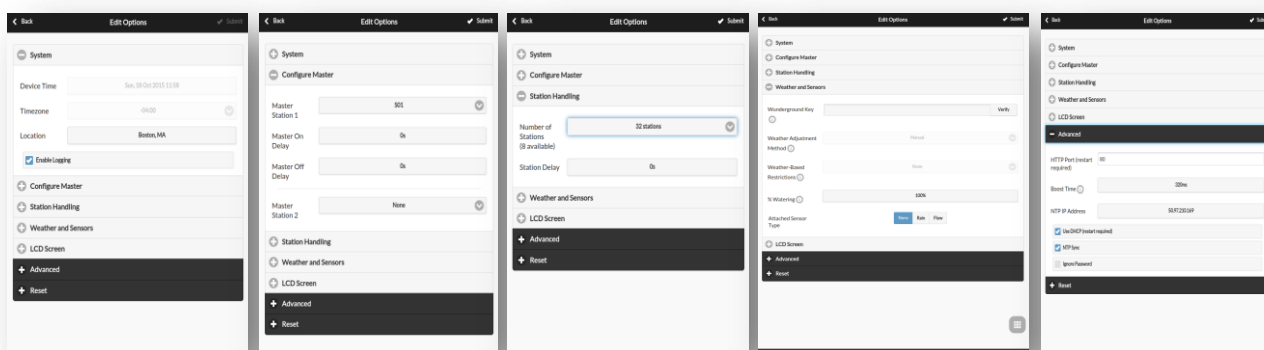
System Settings

- **Location:** click on Location to open a map, where you can locate, search, and select your address.
  - o When a Wunderground API key is provided (see Weather and Sensors section below), the map also shows blue icons which represent your nearby Wunderground weather stations. You can select any of those weather stations as location. The location is used to automatically detect your time zone, DST setting, and obtain weather data online.
- **Enable Logging:** enable logging (data will be stored in the internal microSD card). Default is on.

Configure Master

This firmware supports up to two independent Master Stations, each with their own settings as listed below.

- **Master Station:** define a master station/zone, also known as pump station. Master is a station that turns on together with other stations. Any station can be set as a master. Default is none (i.e. not using master station).
- **Master On Adjustment:** fine tune the exact time at which the master turns on. The acceptable range is 0 to 600 seconds, in steps of 5 seconds. For example, when set to 15, the master station will turn on 15 seconds **after** a station opens.
- **Master Off Adjustment:** fine tune the exact time at which the master turns off. The acceptable range is -600 to 0 seconds, in steps of 5 seconds. For example, when set to -15, the master station will turn off 15 seconds **before** a station closes.

Station Handling

- **Number of Stations:** although OpenSprinkler can automatically detect the number of available expansion boards, the user still needs to manually set the number of stations, because it is allowed to exceed the number of physical stations. This is particularly useful when using virtual stations feature (e.g. remote or RF stations). Default is 8.
- **Station Delay:** the delay time between two consecutive stations. The acceptable range is -600 to 600 seconds, in steps of 5 seconds. For example, when set to 60, the second station will open 1 minute after the first station closes. When set to -15 seconds, the second station will open 15 seconds prior to the closing of the first. A negative station delay is sometimes useful to solve water pipe throttling issues. Default is 0 (i.e. the next station will run immediately after the previous).

Weather and Sensors

- **Wunderground Key:** weather API key. This is required for automatic weather-based water time adjustment. Click on the information icon ⓘ for instructions. Please use the **Verify** button to check if the key is correct.
- **Weather Adjustment Method:** select weather-based adjustment method. If **Manual** method is selected, the *% Watering* is set manually. Otherwise the *% Watering* is set automatically by the selected method.
- **Adjustment Method Options:** tap to configure options for the selected adjustment method.
- **Weather-Based Restriction:** select weather-based restriction. If **None** is selected, no restriction will take effect. If **California Restriction** is selected, no watering will occur if more than 0.1" of rain has accumulated in the past 48 hours.
- **% Watering:** global scaling factor applied to station water times. For example, if set to 150%, all station water times will be multiplied by 150% (except in programs that do not use weather adjustment). Default is 100%. This option is disabled if automatic adjustment method has been selected
- **Attached Sensor Type:** this firmware supports several types of sensors: Rain Sensor, Flow Sensor (dry contact), or Program Switch. Because OpenSprinkler has only one sensor port, you can only select one and **cannot use multiple at the same time**. If you need both sensors, a work-around is to connect rain sensor in series on the COM (common) wire. An alternative is to rely on weather algorithm to automatically reduce water time upon raining, thus removing the need for rain sensor.

  - o **Rain Sensor:** when using a rain sensor, the controller will automatically stop stations from running if rain is detected (except for stations that are set to ignore rain). You can additionally select the rain sensor type: *normally open* or *normally closed*. A rain sensor is essentially a rain-activated switch. Typical sensors are normally closed switches; when rain is detected, the switch opens. *Normally open* sensors are the reverse.
  - o **Program Switch:** if this is selected, you can connect a switch / button to the sensor port. When the switch / button is pressed for at least 1 second, the controller will automatically start Program 1 (the first program).

o **Flow Sensor:** when using a flow sensor, the controller will detect flow sensor pulses, display real-time flow rate at the footer, and log the flow volume at the end of each station run and program run. By default **Dry-contact, 2-wire flow sensors are supported**: these sensors are essentially flow-activated reed switches which close and open repeatedly as water flows through the meter. They do not need power, and typically come with 2 wires. Insert the two wires to the sensor terminal on OpenSprinkler (there is no polarity). Then set the flow pulse rate, which you can find out in your flow sensor's datasheet, and is used to convert the pulse count to actual volume.

o Flow sensors with 3 wires and runs on 5V can also be used with OpenSprinkler. In this case, insert the black wire (ground) to the right pin of the sensor terminal, data wire to the left pin of the sensor terminal, and solder the red wire (5V) to the VIN pin on the circuit board.

Integrations (IFTTT notifications)

This firmware supports push notifications through IFTTT (ifttt.com). To do so, you need to obtain an IFTTT Maker channel key, set up an applet (previously called recipe), and select IFTTT events that you want to receive notifications for.

- **Obtain IFTTT Key:** go to ifttt.com, sign up for an account. At the top click on 'Search' to find 'Maker', and then click 'Connect' to create a Maker channel. Click on the gears icon on the top-right of the Maker channel to view your key. Copy this key to OpenSprinkler's IFTTT key setting. **Note**: clicking on 'Edit connection' will cause the key to be replaced. Once replaced, the previous key will be invalid and cannot be recovered!

Account Info

Connected as:
URL: https://maker.ifttt.com/use/bWs5lMeYu4KFBakuDxGKzW
Status: active   **This is your key**
Edit connection

- **Create IFTTT Applet:** at the time of this writing, it seems IFTTT has disabled creating new applets using the web interface, and instead requires using their app. To do so, **install the IFTTT mobile app** on your smartphone, log in, and go to the My Applets tab, click on the '+' icon at the top-right to create a new Applet.
  o For *trigger* service (this), search and select 'Maker'. Set **sprinkler** as the 'Event Name' of the web request.
  o For *action* (that), search and select a desired notification method, such as 'SMS', or 'email'. You can shorten the message body suitably, but keep **Value1** in the content as the firmware uses this variable to pass notification content. You can modify the message body later to suit your need.
- **Select Events:** go back to the OpenSprinkler app / UI, click 'Configure Events'. The following events are supported:
  o **Program Start:** triggered when a program is scheduled.
  o **Rain Sensor Update:** triggered when rain sensor is enabled and the status changes (or rain delay status changes).
  o **Flow Sensor Update:** triggered when flow sensor is enabled and upon the completion of a program.
  o **Weather Update:** triggered when there is weather update (i.e. water level has changed) or external IP changes.
  o **Controller Reboot:** triggered when the controller is rebooted.
  o **Station Run:** triggered when a station finishes running. **NOTE**: this is likely to generate a large number of notifications, so enable this at your own discretion.
- Technically, IFTTT is implemented by sending a HTTP POST request to IFTTT whenever a selected event is triggered. The request carries the IFTTT key, event name 'sprinkler' (matches the event name set in the recipe), and notification content in the 'Value1' POST variable.
- **Note**: notifications that are sent too close in time may be dropped. For example, if multiple notifications were sent within a couple of seconds, it's likely that only the last one will appear while the other messages will be dropped.

Advanced Settings

- **HTTP Port:** customize the device's HTTP port. Default is 80. **There is typically no need to change this parameter**.
- **Boost Time:** this option is **only applicable to OpenSprinkler DC**. It sets the DC voltage boosting time (from 0 to 1000ms). Default is 320ms. When using a low voltage power adapter, such as USB, to drive 24V AC sprinkler valves, you may want to suitably increase the boosting time to allow valves to be successfully energized.
- **Special Station Auto-Refresh:** whether to periodically auto-refresh special stations (e.g. RF, remote, HTTP stations etc.)
- **NTP Sync:** automatic time sync based on your location. When off, you can set the device time manually. Default is on.
- **NTP IP Address:** set a custom NTP time sync server.
- **Use DHCP:** when on, OpenSprinkler's IP is dynamically assigned by the router. When off, the IP is statically assigned, in which case you will need to manually set a Static IP address, Gateway IP (i.e. your router's IP), and DNS IP . Default is on.
  Note: instead of turning off DHCP, it's highly recommended that you use the router's DHCP reservation, or Bind IP to MAC feature to manage static IP assignment.

Reset

- **Reset All Options:** Restore all options back to factory settings.
- **Reset All Station Data:** Restore all station names and settings to factory settings.

6. Run-Once Program

To manually start a program, go to the home page, and click **Run-Once Program** (or use keyboard shortcut ALT+R). You can load preset water times from any of the existing programs, or a test program (1 minute each station). You can also manually edit the water time for each station.

- A water time of 0 value means the stations will not run.
- If the controller is already running an existing program, you will be prompted to stop it in order to continue.
- Station attributes are observed, such as *Use Master Station*, *Activate Relay*.
- Controller settings, such as *Sequential Mode*, *Station Delay Time*, *Master On / Off Time*, are observed.

NOTE: *Rain Delay* and *Rain Sensor* settings are ignored, and *% Watering Adjustment* is ignored, because run-once program is treated as a type of manual override program.

TIP: you can start a run-once program on the controller using buttons. This is useful for landscapers/gardeners to perform routine checks without having to give them WiFi access. To do so, press and hold button B3 until the LCD displays 'Run a Program'. Then click B3 to navigate through the list of available programs. Once you have found the program, press and hold B3 until the controller starts to run that program.

If you'd like to set a test program which is not intended to run normally, but for the purpose of routine checks: you can create a new program, and set it as 'disabled' (refer to the next section). This way the program will not run normally, but will appear in the list of available programs that you can load as a run-once program.

7. Programs

At the home page, click **Edit Programs** to see the list of existing programs. Here you can:

- **Create** a program by either adding a new program or copying an existing program.
- **Modify** or **Delete** an existing program.
- **Re-order** existing programs by using the arrow keys.

> This firmware supports up to **17** programs.

Program Data

Click on the **+ Add** button at the upper-right corner to create a new program. Each program contains the following data:

Basic Settings
- **Program Name**: a custom program name, up to 20 characters.
- **Enabled**: program enable flag. Default is enabled.
- **Use Weather Adjustment**: when checked, the *% Watering* applies to all station water times in this program. Default is on.
- **Start Time**: the first start time of the program (e.g. 8:00 AM). Also supports using sunrise or sunset time +/- offset as start time.

Program Type
- **Weekday**: program will run on the selected weekdays.
- **Interval Day**: program will run every N days, where N is between 2 to 128. You will also need to set the **Starting in** days. For example, a program that repeats every 5 days starting in 0 day will run today, and every 5th day from today. A program that repeats every 3 days starting in 1 day will run tomorrow, and every 3 days from then.
- **Restrictions**: odd/even day restrictions. **Odd** day means the program will run only if it's an odd day of the month (except the 31st, or Feb 29th). Similarly for even days. Default is no restrictions.

Station Water Times
- Set the water time for each station. A value of 0 means the station will not run. The range of water time is 0 to 64800 seconds (18 hours). Unlike previous firmware, this firmware does not use compression of water time anymore, so it allows full precision in units of seconds.
- Also supports sunrise-to-sunset and sunset-to-sunrise durations.

Additional Start Times
There are two choices of additional start times:
- **Fixed**: up to 3 given additional start times. Any time of a day.
- **Repeating**: regularly repeating start times. For example, repeat every one and half hours for six times. This is useful for breaking down long water times into shorter cycles. Unlike previous firmwares, this firmware allows repeating start times to go overnight to the next day.
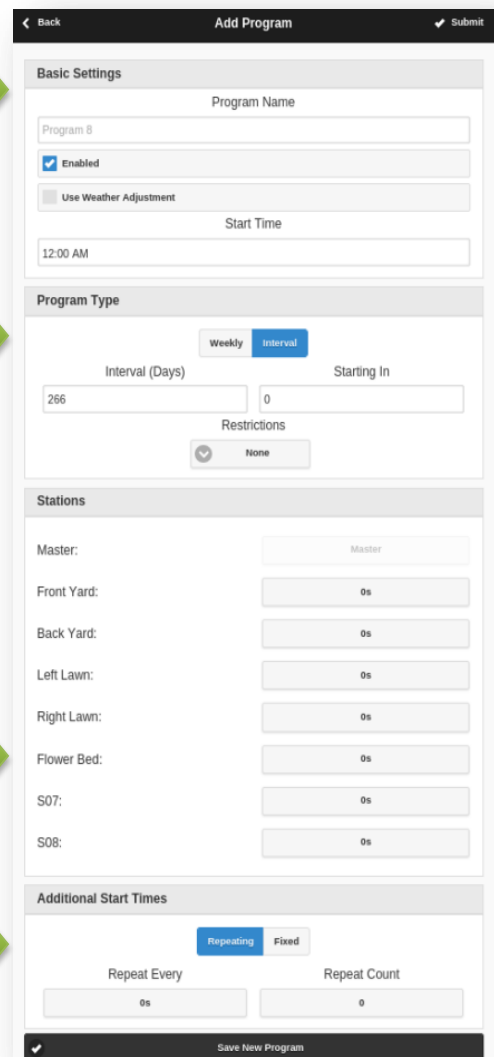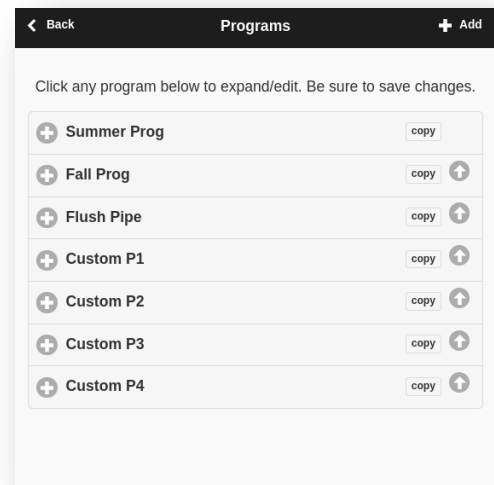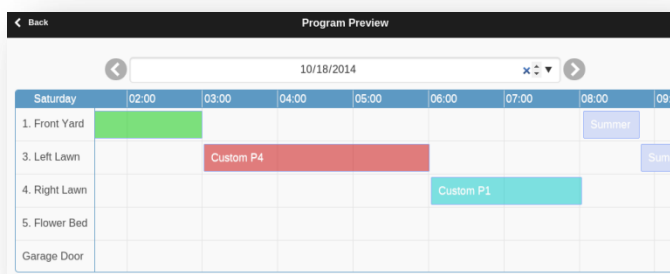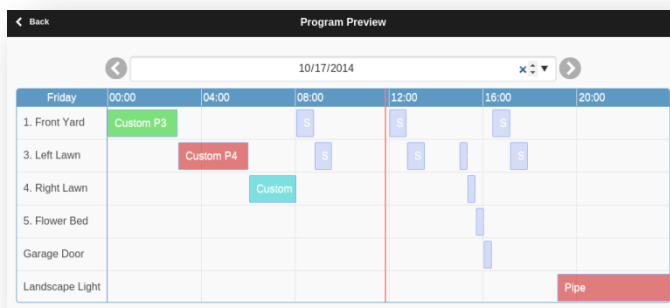
7.1 Program Preview

To verify that all programs are set correctly, go to the home page and click **Preview Programs** to visualize how the programs are scheduled to run each day.

- **Today's schedule** is shown by default. Click on the left and right arrows at the top to change to a different day.
- **Current time** is indicated by the pink line. You can zoom in/out or drag the plot left/right to check the schedule in details.
- **Colored bars** show the program name and time span of each station run. Clicking on each bar directs you to the specific program editing page.

The program preview is implemented using a software simulation of the scheduling algorithm:

- What you see accurately reflects how the programs are scheduled to run.
- All controller settings, such as *Sequential Mode*, *Station Delay Time*, *Master On / Off Time*, are observed; and all station attributes such as *Use Master Station*, *Activate Relay* are observed.

Notes:
- *Rain Delay* and *Rain Sensor* **are ignored** because these dynamic events cannot be predicted therefore cannot be previewed.
- Programs that are set to *Use Weather Adjustment* will be scaled by the current *% Watering* parameter.
  - When using *Manual Adjustment* method, the same *% Watering* is applied to every day.
  - When using the *Zimmerman Adjustment* method, the current *% Watering* (dynamically calculated on a day-to-day basis) is only applied on today's schedule, while 100% is applied to all other days.
  - When the watering level is less than 20%, any station with a resulting water time less than 10 seconds will be skipped (due to the water time being too short).

7.2 Station's Sequential Attribute

OpenSprinkler supports **running multiple stations in sequence (one after another) or parallel (concurrently)**. This can be set using each station's Sequential attribute. Stations that have the Sequential attribute turned on will be automatically serialized. For example, if stations 1, 2, 3 are sequential, the controller will make sure only one is running at any given time. If their scheduled times overlap, for example, station 2 is scheduled to open while station 1 is still running, the controller will automatically push station 2 behind station 1. This is the most common way as it helps conserve the water pressure by ensuring only one station is open at a time.
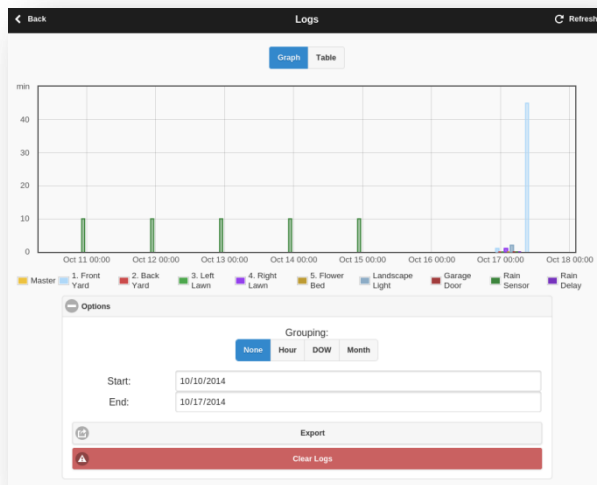
If a station's Sequential attribute is turned off, the controller will open that station whenever it's scheduled to run, therefore allowing multiple stations to run simultaneously. This is useful if you are using OpenSprinkler to switch non-sprinkler devices, such as lights, pump, and heater. Either way, the program preview correctly accounts for the Sequential attribute settings.

8. Logging

OpenSprinkler supports logging by using a microSD card. It logs station runs as well as rain delay and rain sensor status.

At the home page, click **View Logs** to see a graphical plot of the logging data.

- In the **Options** tab, select the start and end dates of the query. The default is the past 7 days.
- Several **Grouping** methods are provided: *None*, *Hour*, *DOW*, or *Month*.
- Select **Table** at the top of the page to switch to a table view of the data.

Firmware Upgrade

> **Warning:** uploading a new firmware will **ERASE** your existing programs and settings. If you don't want to lose them, please use the web interface's **Export Configuration** to save a backup copy and import them later.

To upgrade the OpenSprinkler firmware, you need a standard USB cable, and the firmware updater program. Follow the instructions below or watch the Firmware Update Tutorial Video.

- **OpenSprinkler Firmware Updater Guide**

Watch Firmware Upgrade Tutorial Video

Advanced Topics (technical skills required)

Note: to open the device enclosure, just loosen the four screws at the back of the device.

1. Installing a microSD Card (OS 2.0, 2.1, 2.2 only)

- **NOTE**: from OpenSprinkler 2.3, microSD cards are installed by default. This section is only relevant to prior versions of OpenSprinkler that do not come with built-in SD card.
- OpenSprinkler can use an internal microSD card to store logging data. This is optional. If your OpenSprinkler does not already have one, you can install one yourself. Take a microSD card of any capacity, and insert it to the microSD card slot (which is located close to the top edge of the circuit board, partially under the LCD). Then reassemble the enclosure.
- If the card is correctly installed, upon power-on you should see a microSD card icon on the LCD screen:
- If you want to disable logging, you can turn the **Enable Logging** option off.

2. Installing a Radio Frequency (RF) Transmitter

> **Warning:** the step below requires soldering. **PROCEED WITH CARE AND USE YOUR OWN DISCRETION**!

OpenSprinkler has on-board pins that match a standard 434MHz or 315MHz radio frequency (RF) transmitter. This can be used to send signals to remote power sockets for switching powerline devices, such as lights, heaters, fans, pumps.

- Solder a 17cm long wire antenna to the **ANT** pin on the transmitter.
- Locate the RF pinouts: **A3, VIN, GND.** Solder the RF transmitter to the matching pins: **DATA->A3, VIN->VIN, GND->GND**. Then carefully reassemble the enclosure.
- Firmware 2.1.3 supports radio frequency (RF) stations. This feature allows OpenSprinkler to switch not only sprinkler valves, but also remote power sockets, and therefore control powerline devices. To use this feature, it's best to have an **RFToy** which can easily decode signals of many common remote power sockets.
- Please refer to the instructions in **this blog post**.

Frequently Asked Questions (FAQ)

- **How many zones does OpenSprinkler support?**

  The main controller supports 8 zones. Each expansion board adds 16 zones. Firmware 2.1.7 supports a maximum of 56 zones.

- **How many programs does it support? What about program schedule dates and start times?**

  This firmware supports up to 17 programs. Each program allows: 1) an individual water time for every station; 2) either weekday schedule or interval day schedule; 3) optional odd/even day flags; 4) two types of start times: either up to 4 given start times, or repeating start times (e.g. start at 8:30 am, repeat every 45 minutes for 8 times).

- **Does OpenSprinkler have built-in wireless?**

  OpenSprinkler currently only supports wired Ethernet connection. However, wireless is possible by using a powerline Ethernet adapter, or a WiFi adapter. Please refer to the **Wireless Connection** section.

- **How do I check the IP address assigned to OpenSprinkler?**

  Click button B1, and the IP address will be displayed onto the LCD screen.

- **What types of sprinkler valves does it work with?**

  OpenSprinkler AC works with standard **24V AC sprinkler valves**. If you are not sure what type of valves you have, use a multi-meter to measure the resistance on the two wires of the valve: the resistance should be between 22 to 50 ohm. If it's very low (<10 ohm), that means your valve is probably of DC latching type, which is not compatible with OpenSprinkler. OpenSprinkler DC works with standard 24V AC sprinkler valves as well as 12V DC (non-latching) valves. It's powered by a universal low-voltage DC adapter and is particularly suitable for international markets where AC adapters are difficult to find.

- **I am new to sprinkler system setup. How do I wire sprinkler valves?**

  Each sprinkler valve has two wires. Connect one wire to the COM terminal, and the other wire to a zone port (1 to 8). For multiple valves, one wire from each valve is combined together and goes to the COM terminal; the other wire goes to an individual zone port. If you are not sure, ask a landscaper or go to a home improvement store for help.

- **How do I connect a Master Zone or Pump Station?**

  If you have a **Master Zone** or **Pump Start Relay**, insert that wire into any of the ports. OpenSprinkler uses a software-defined Master Zone, and any zone on OpenSprinkler can be assigned as a Master Zone. Also, this firmware supports up to two independent Master Zones.

- **What's the maximum distance allowed between the controller and the valves?**

  This depends on the wire gauge (AWG). In general, you can run up to 700 ft (200 m) with 20 AWG wires, 1000 ft (300 m) with 18 AWG wires, and 1500 ft (150 m) with 16 AWG wires. Thicker wires allow longer distances.

- **What's the maximum distance allowed between the main controller and expansion boards?**

  Again, this depends on the wire gauge (AWG) of the extension cable. The default cable shipped with expansion boards is a 24 AWG 15-inch long cable. You can extend the length by using a custom cable, such as one made using an Ethernet cable.

- **Can I insert two zone wires to the same terminal port?**

  Yes. But keep in mind that if you do this the two zones will always open or close at the same time.

- **Can I connect sprinkler valves to a garden hose?**

  Sure. Most sprinkler valves use the NPT (National Pipe Thread) standard, while garden hoses use the GHT (Garden Hose Thread) standard. So you need a 'NPT to GHT adapter', which you can find either online or at home improvement stores.

- **What happens if power is lost?**

  OpenSprinkler stores all programs and settings in non-volatile memory, so the data is preserved during power outage.

- **Can OpenSprinkler run offline without a web connection?**

  Once programmed, OpenSprinkler can run offline without network connection at all. The controller has a built-in real-time clock and battery for time keeping. You can also manually start an existing or test program on the controller by using buttons.

- **How do I start a program manually on the controller using buttons?**

  Press and hold button B3 until you see the *Start a Program* message. Then follow the instructions on the LCD screen.

- **What types of sensors does OpenSprinkler support?**

  Currently we support standard rain sensor (wired or wireless), flow sensor, or program switch / button. Development is under way to integrate soil moisture sensor. As OpenSprinkler is open-source, you can modify the software to integrate additional sensors such as water level sensor, motion sensor. If you are not familiar with programming, this provides a great motivation to start learning to program.

- **How do I set a static IP address?**

  The recommended way to set static IP address is by using your router's **DHCP Reservation** or **Bind IP to MAC** feature. Alternatively, you can set a static IP address on OpenSprinkler by turning off OpenSprinkler's DHCP option, then manually set a static IP and the gateway (i.e. router) IP.

- **How do I access OpenSprinkler remotely, such as from office or when I am traveling away?**

  You can access OpenSprinkler remotely by using the **Port Forwarding** feature that's available on most routers. To do so, you need to log on to your router's configuration page → Port Forwarding section, then set up an entry that maps an external request to OpenSprinkler's IP address and port number. Tutorial videos can be found in the Support page. Once set up, you'll be able to access OpenSprinkler remotely, by using your router's external IP address. You can find out your external IP address from your router's status page, or simple open a browser and search 'what's my ip'.

- **Does it support push notifications?**

  Yes, this firmware supports push notifications through IFTTT. Check Page 9 for details.

- **How do I restore settings to factory default?**

  Turn off OpenSprinkler. Then **press and hold button B1 while turning OpenSprinkler back on**, until you see the message *Reset All Settings?* Click button B1 to select *Yes*, then press and hold B3 until the controller restarts and finishes resetting.

- **Can I develop my own app, or use my own scripts to interface with OpenSprinkler?**

  Absolutely. Please refer to the OpenSprinkler Support page for API documentation.

- **How can I help OpenSprinkler to support more languages?**

  OpenSprinkler's language localization feature is crowed-sourced so anyone can help. Go to the **Web Interface -> Sidebar -> About** page, click on the link to the localization website.

- **How does OpenSprinkler's weather-based adjustment work?**

  The weather-based adjustment first uses your location to query Wunderground.com for real-time weather data (available worldwide). It then calculates a **% Watering** value which is applied to all station water times. The percentage value is calculated based on your local temperature, humidity, and precipitation (rainfall), and varies between 0% to 250%. The value

is updated every 15 minutes. For example, low temperature, high humidity, and/or considerable rainfall all lead to reduced watering, thus saving water usage.

- **What's the relationship between Rain Delay, Rain Sensor, and Weather-based Adjustment?**
  Rain Delay is a manual control – it stops the controller from watering for a specified amount of time. Rain Sensor requires installing an external rain sensor, and it stops the controller from watering when the sensor detects rain. Weather-based Adjustment makes use of real-time data at your nearby weather stations, and automatically calculates a watering percentage that combines not only information about rain but also temperature and humidity. Although these three features are conceptually related, they are independent. See the chart below:

Trigger	Action	Delay Time	Notes
Rain sensor	Stations (except those that ignore rain) will stop watering when the sensor reports rain.	Rain sensor has a built-in mechanical delay, adjustable by opening/closing evaporation vents on the sensor.	Stations that are stopped, or scheduled to run during the delay time will **NOT** restart or resume after the delay time is over.
Change Rain Delay	Manual. Stations (except those that ignore rain) will stop watering during the specified rain delay time.	Specified by the user.	
Weather-based Adjustment	Water time is scaled by a watering percentage value (0% to 250%), updated every 15 minutes.	No explicit delay time. Water time may decrease (<100%) or increase (>100%) based on weather.	Requires WUnderground API key. Accuracy depends on the proximity of your closest weather station.

- **What license is OpenSprinkler published under?**
  All content, including hardware and software, are published under **Creative Commons Attribution-ShareAlike 3.0** license. The product is open-source for educational purpose and to promote technology innovations.

Specifications

- **Input Voltage:**   22~28V AC (OpenSprinkler AC); 5~12V DC (OpenSprinkler DC)
- **Power Consumption:**   1 to 1.5 watts
- **Number of Zones:**   8 on the main controller, extendable to 56 with zone expansion boards
- **Max Output Current:**   OpenSprinkler AC: 800mA continuous per zone; 8A inrush.
                             OpenSprinkler DC: 1.5A continuous per zone; 8A inrush.
- **Over-voltage Protection:** Bi-directional TVS on each zone, power input, and sensor terminal
- **Product Size:**   135mm x 100mm x 32mm (5.3" x 4" x 1.26")
- **Product Weight:**   250g (9oz)

Links and Resources

- **OpenSprinkler Home Page**
- **OpenSprinkler Support page**
- **OpenSprinkler Github repository**

OpenSprinkler