

OpenSprinkler Pi (OSPi) v1.4+ User Manual

(Updated May 31, 2015)

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Introduction

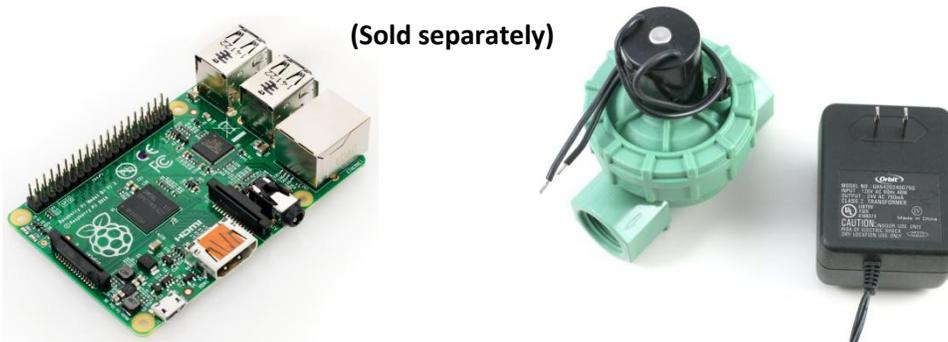
[OpenSprinkler Pi \(OSPi\)](#) is an open-source sprinkler / irrigation extension board for the Raspberry Pi. It's an easy and low-cost solution to transform your Raspberry Pi into a capable sprinkler controller with unlimited number of stations, for lawn and plant watering, farm irrigation and other similar applications.

The OSPi v1.4 kit includes the **enclosure** (with a clear acrylic window), assembled and tested **OSPi circuit board**, **terminal blocks**, and microSD to SD adapter (excluded in the **Plus** version). The built-in components include 24V AC to 5V DC switching regulator, solenoid drivers, rain sensor terminal, DS1307 RTC and battery, PCF8591T 8-bit A/D D/A converter (4 input and 1 output), fuse, per-station transient voltage protector. The image on the right below shows the final assembled product.



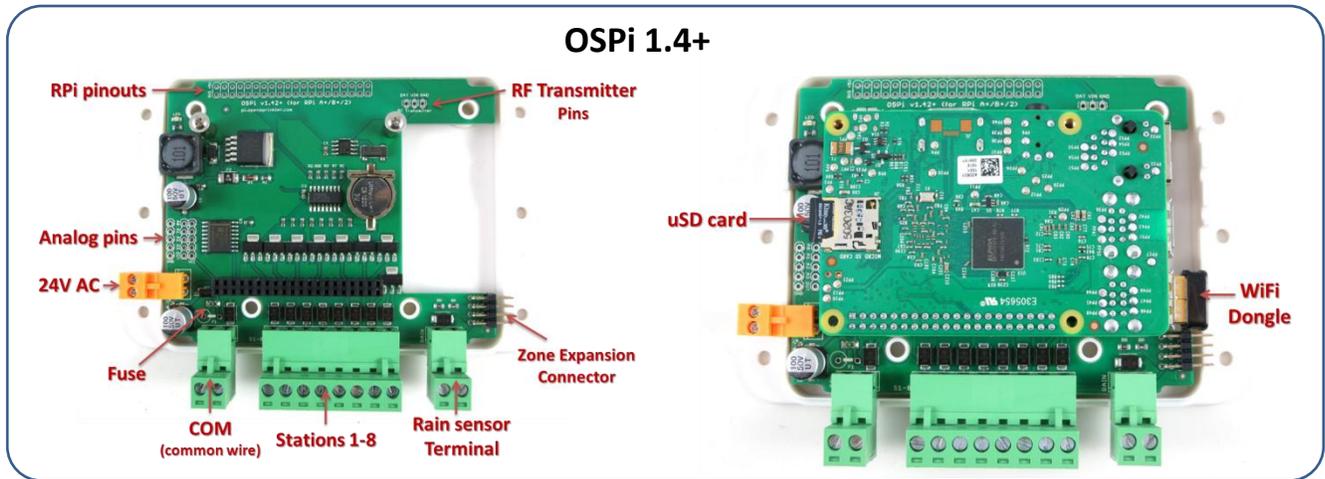
To get started, you will also need the following, which are **NOT** included in the kit and have to be purchased separately.

- a Raspberry Pi (any revision. **NOTE: OSPi 1.4+ only supports RPi 1 A+/B+ or RPi 2**)
- a [nano-size USB WiFi dongle](#) (or alternatively a RJ45 Ethernet cable if not using WiFi)
- a [4GB or above microSD card](#)
- 24V AC [sprinkler transformer](#) (output voltage 22V AC ~ 30V AC, **note that it's AC, not DC!**)
- 24V AC [sprinkler valves](#) (**note that it's 24V AC valve, not DC or latching solenoid valve!**)



Hardware Interface

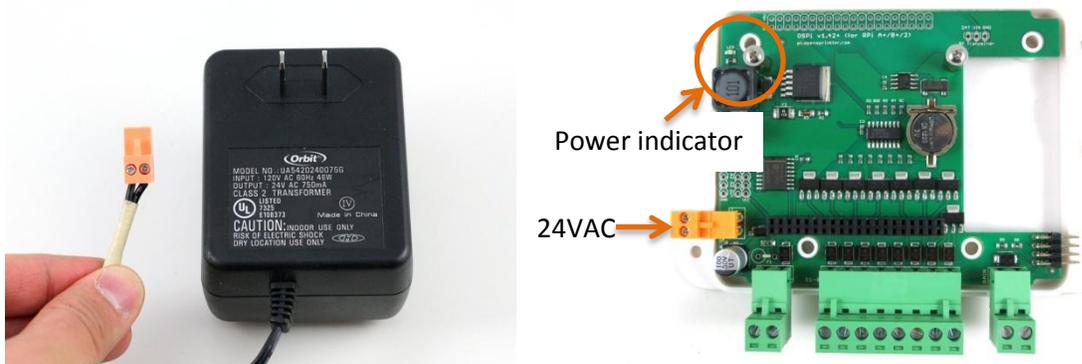
The left image marks the connectors, and RPi mapped out pins. The right image below marks the locations of the USB WiFi dongle, SD card, and wired Ethernet cable (if not using WiFi) on the RPi.



Hardware Setup

1. Test Power Supply

Insert the sprinkler transformer wires into the **orange** screw terminal, then plug it in to the matching terminal on OSPi. The green LED should light up, indicating power is on. See pictures below.



Warning: if the LED doesn't light up, please unplug the power immediately. Check if there is any visible damage. If you have a multimeter, check if the fuse is still good. If you can't figure out the problem, send an email to support@opensprinkler.com.

2. Attach RPi to OSPi

OSPi has two support pillars that match the screw holes on RPi. **First, remove the top screws from the support pillars;** then, plug RPi into OSPi through the 2x20 pin headers, with SD card slot facing the left, and USB and Ethernet jack facing the right.

Double check the orientation and make sure all pins are aligned. The two screw holes should also match the support pillars. Insert RPi all the way to the end. The USB and Ethernet connector should go through the cutouts on the PCB. Finally tighten the two screws.



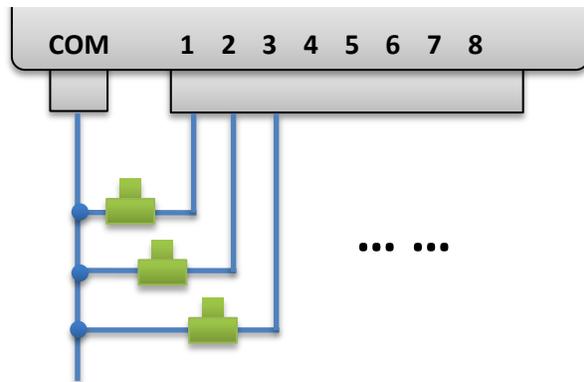
3. Web Connectivity

OSPi fits a nano-size USB WiFi dongle. You can insert the dongle into any of the available RPi USB ports.

If you prefer wired connection, note that there is no special cutout for the Ethernet cable, therefore you need to use a Dremel to make a cutout yourself, in order to allow Ethernet cable to pass through.

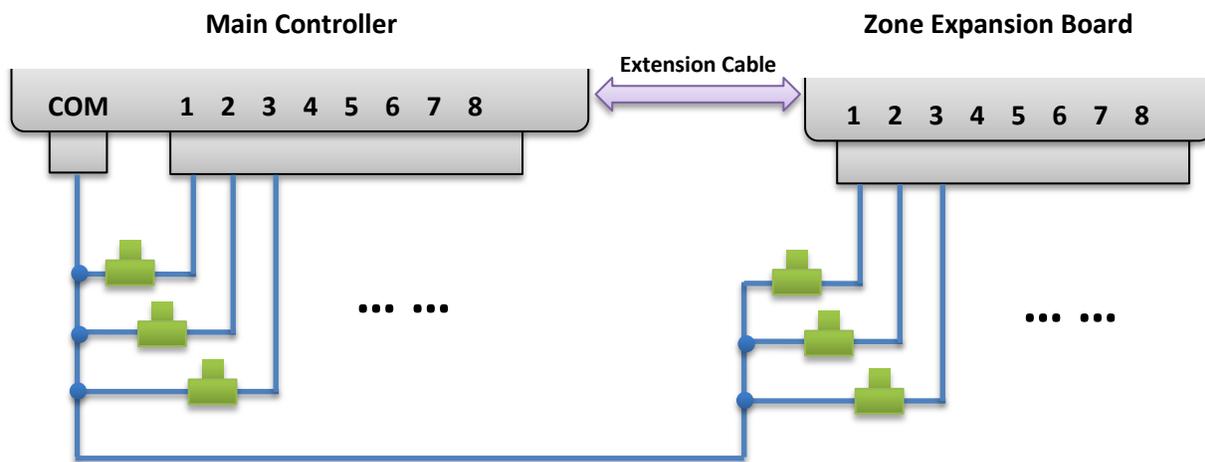
4. Wiring Sprinkler Valves

To connect a sprinkler valve, insert one wire to the **COM** (common) terminal, and the other wire to any of the station terminals (1-8). The COM terminal has two ports – they are internally connected so either port is fine. To connect multiple valves, one wire from each valve should come together and go to the **COM** terminal; and the other wire from each valve goes to an individual station terminal. See the diagram below.



5. Zone Expansion Board

To connect a zone expansion board, use the extension cable you received to link the OSPi's **OUT** port to the expansion board's **IN** port. The connector on the cable is polarized (with a bump on the top), so there is only one way to plug it in. If you have multiple expansion boards, you can daisy chain them in the same way, by following the OUT -> IN links. When using zone expansion boards, the sprinkler valves are wired the same way as before: one wire from each valve should come together and go to the **COM** terminal on the OSPi; and the other wire from each valve goes to an individual station terminal.



6. Rain Sensor

If you have a [rain sensor](#), you can connect it to OSPi v1.4 via the rain sensor terminal. The rain sensor has two wires and is essentially a rain-activated switch. The OSPi software can decide what to do when rain is detected, such as turn off stations or ignore rain.

7. Analog-Digital Converter (Advanced Topic)

OSPi v1.4 has a built-in PCF8591T A/D D/A converter, which provides four 8-bit analog inputs, and one analog output. The analog inputs can be used to read analog sensors, such as light, temperature, soil humidity. Details on how to use this converter can be found in this [blog post](#).

Software Setup

1. OSPi Pre-configured SD Image

A pre-configured SD card image is provided for you to quickly set up software for OSPi.

- **The latest version:** [OSPi SD Card Image 2](#) (with Unified Firmware, update 05/31/15)
 - MD5SUM: edc2264a267d7330441855bafdb69dea

The process to burn the image onto an SD card is the same as burning a Raspbian image. Below is a brief summary. Detailed instructions can be found [on this website](#).

- Decompress the image file (.7z) to your computer.
 - On Windows, use the [7-zip](#) software.
 - On Mac, use the [unarchiver](#) software.
 - Linux has built-in support for 7z files.
- Insert an SD card (**4GB or above**) to your computer. Back up any important file on the SD card.
 - If using microSD card, you need a microSD to full-size SD adapter, or USB adapter.
- On Windows, use the [Win32DiskImager](#) software.
- On Mac or Linux, use the **dd** command in a terminal. For example:
`sudo dd bs=4M if=ospi2new.img of=/dev/partition_to_burn_to`
- **IMPORTANT:** make sure you have typed in the correct partition name – if you accidentally typed in the wrong partition name, you may end up wiping out your hard disk!

Once the SD card is ready, pop it into your RPi. As WiFi is not configured yet, you should first connect RPi directly to your router with a wired Ethernet cable, or connect it to a screen and keyboard, set the WiFi SSID and password, then you can use the wireless connection.

Next, open a browser, and type in http://ospi_ip/ where ospi_ip is the RPi's IP address (such as <http://192.168.x.x>). You should see a **welcome page with further instructions**. If you see this page, congratulations, the image is successfully burned onto your SD card.

- **To ssh or log in to RPi, the default user name is `pi`, and password `raspberry`.**

2. OSPi Firmwares

The default firmware set to run on start-up is the OpenSprinkler Unified Firmware. It's available at port 8080. Open a browser, and type in http://ospi_ip:8080/ to start using the firmware.

The two alternative firmwares are the Python Interval Program (written by Dan Kimberling) and the `sprinklers_pi` program (written by Rich Zimmerman). The welcome page (see above) has instructions on how to install and run these firmwares.

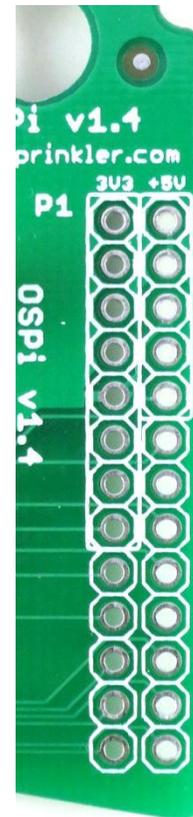
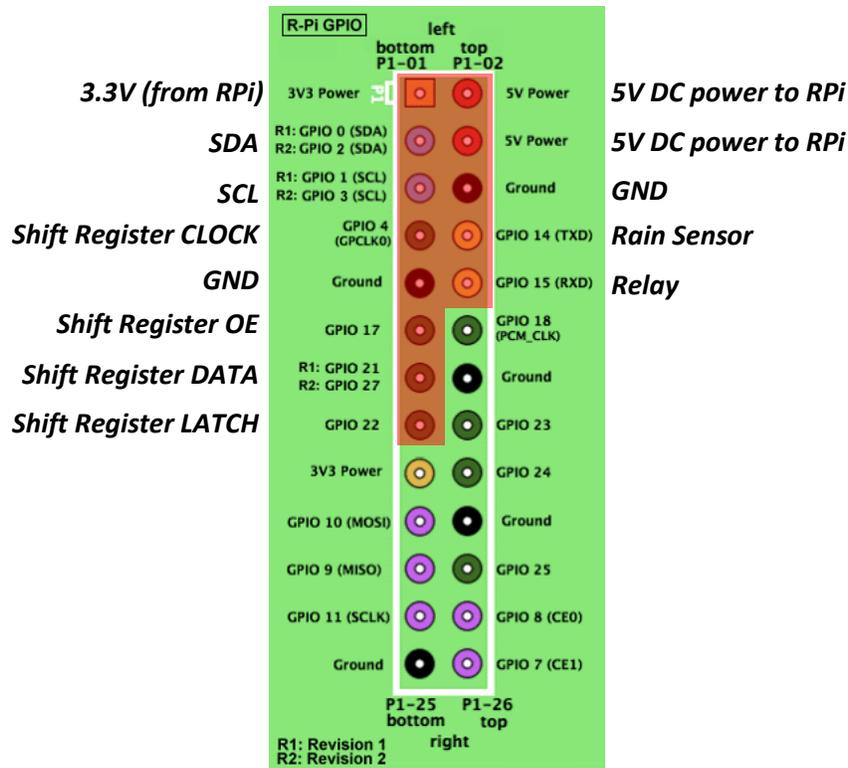
If you want to write your own firmware, use the provided firmwares as examples. In addition, in the `~/demo/` folder, there is a simple self-test program that shows basic solenoid control.

Technical Details

The OSpi v1.4 circuit design consists mainly of a 24V AC to 5V DC switching converter (based on LM2596S-5.0), shift register (74HC595D), solenoid drivers (based on BT1308W triac), RTC with battery (DS1307), 4-channel ADC (PCF8591T).

RPi Pin Uses

OSpi v1.4 uses the following GPIO pins on the RPi (shaded in red). The other pins are free to use. The power pins as well as SDA/SCL pins can be shared with other devices. All 40 pins from RPi are mapped out in the pinout area at the upper left corner of the circuit board. The layout of the mapped out pins match the GPIO pins. The pins uses by OSpi are marked by a white outline.



Specifications

- **Input Voltage:** 22V AC to 30V AC.
- **DC Output Current:** 500mA @ 5V (to power RPi).
- **Number of Zones:** 8 on the OSPi, expandable by linking zone expansion boards.
- **AC Output Current:** 800mA continues @ 24V AC per zone / station, 8A impulse / inrush.
- **Over-voltage Protection:** 48V bi-directional TVS on each zone, AC input, and rain sensor terminal.
- **Over-current Protection:** 2A on AC input; 1A on 5V DC.
- **On-board Relay:** 3A @ 250V AC, or 30V DC.
(Though rated at 250V AC, it's not recommended for power-line voltage due to PCB traces and pinout size)
- **Size:** 135mm x 100mm x 32mm (5.3" x 4" x 1.26")
- **Weight:** 150g (5.3oz) w/o RPi

Terms and Conditions

OpenSprinkler Pi (OSPi) is an open-source project. The hardware design and software code are made publicly available under the [Creative Commons Attribution-ShareAlike \(CC BY--SA\) 3.0](https://creativecommons.org/licenses/by-sa/3.0/) license. The product is open-source for educational purpose and to promote innovations. The hardware and software are provided as is. We (Rayshobby LLC) are not responsible for any damage or accident that may occur due to hardware or software error, or during the assembly, use, and modification of OSPi.

Open-Source Links

- [OSPi Github Repository](#)
- [OSPi homepage](#)

