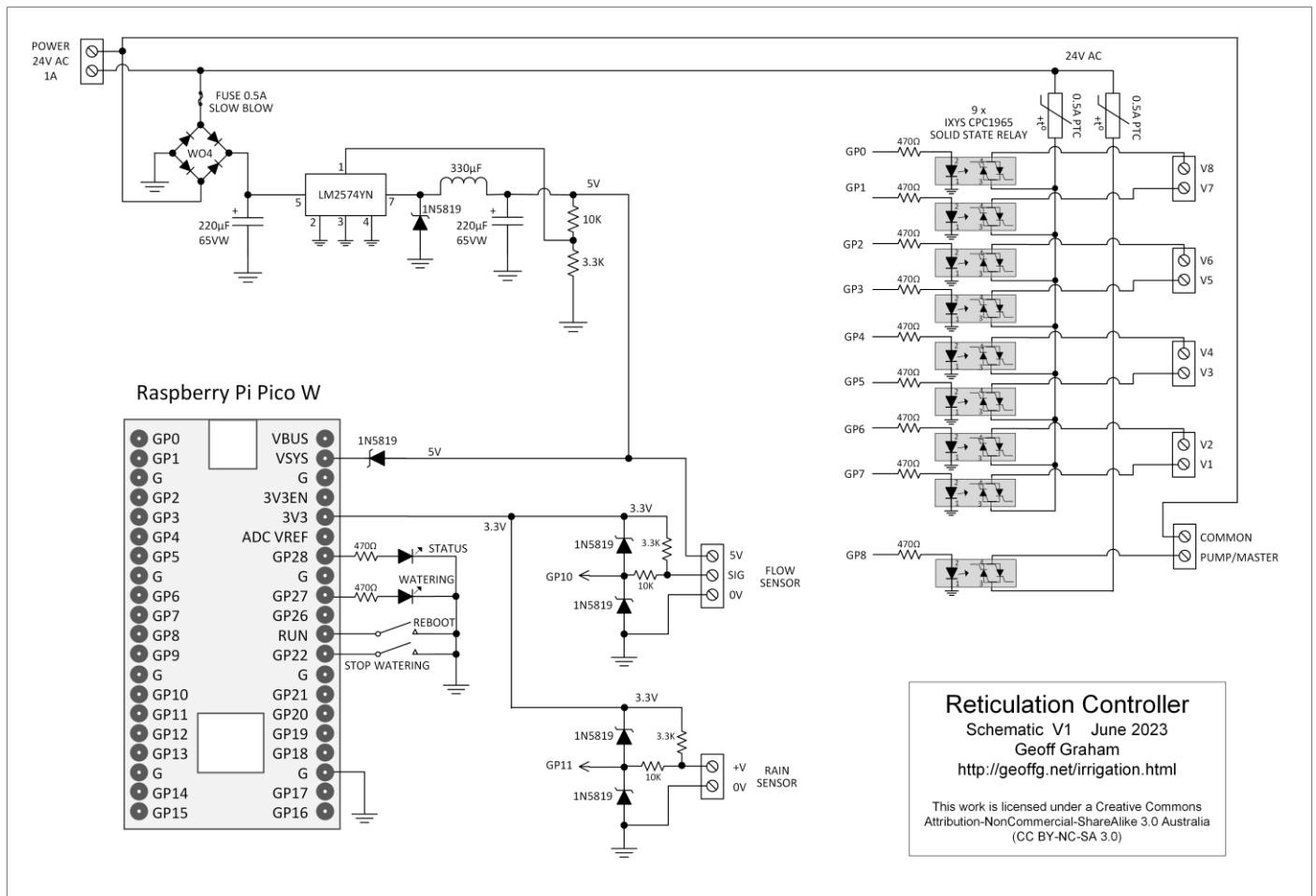


## Circuit



The circuit is centred around the Raspberry Pi Pico W (aka, the WebMite). This serves the web pages, accesses the internet for the time and weather, drives the solenoid valves and monitors the sensor inputs. The only other significant components are the power supply and the Solid State Relays (SSRs) driving the solenoid valves.

The controller is powered from 24V AC at a nominal 1A. In practice a supply of 0.75A or even less should work fine. The power supply is a simple buck regulator providing 5V. This type of circuit was chosen to reduce the heat generated within the sealed enclosure which could reduce the life of the electrolytic capacitors. This project has an expected lifespan of 10 to 20 years and the life of the electrolytic capacitors was a concern. For this reason high voltage, high temperature capacitors are specified with a value more than is strictly required.

The SSRs switch on the zero crossing of the AC waveform so there is no inductive kickback from the solenoid coil in the valve. The SSRs use a LED for isolation which is driven by about 5mA limited by the 470Ω resistor. The two PTCs in the power supply to the valves are resettable fuses which will go high impedance on excessive current and reset when the fault is removed. They are there to protect against a short circuit in the wiring or a solenoid valve.

The sensor inputs are pulled up to 3.3V by the 3.3K resistor and there is a protection circuit (2 Shockley diodes and a resistor) which protect against accidental miswiring, close lightning strikes, etc.

## Parts List

- 1 PC board 152 by 132 mm.
- 1 Raspberry Pi Pico W.
- 1 RITEC RP1285BF sealed enclosure (size 186 x 146 x 75 mm). (eg, Altronics H0310F, Digikey 164-RP1285BF-ND or Mouser 546-RP1285BF).
- 1 330uH 0.5A High Frequency Inductor/Choke (eg, Altronics L6227).

- 1 Solid State Relay (for the master valve) IXYS CPC1966Y or IXYS CPC1965Y (eg, Mouser 849-CPC1966Y or 849-CPC1965Y).
- 2 PPTC Resettable Fuse, Hold Current 500mA, Trip Current 1A (eg, Bourns MF-RX050/72-AP, Altronics R4550A).
- 2 Momentary Tactile Switch PCB Mounting (eg, Altronics S1120, Element14: 4511189).
- 2 2 Way 5mm 45 Deg. PCB Mount Terminal Block (eg, Altronics P2044A).
- 2 20 way Single Row Pin Header.
- 2 20 way Single Row Pin Header Socket.
- 2 3AG PCB Mount Fuse Clip (eg, Altronics S5980).
- 1 3AG Fuse 0.5A Slow Blow

## Semiconductors

- 1 LM2574YN Buck Regulator in PDIP-8 package.
- 1 W04 400V 1.2A Plastic Bridge Rectifier (eg, Altronics Z0073 or Z0073A).
- 2 1N5819 Schottky Diode.
- 1 LED, Red, 3mm.
- 1 LED, Green, 3mm.

## Capacitors

- 2 220µF Radial Electrolytic Capacitor, 63VW, 105°C Rating.

## Resistors (Thru Hole 0.25W 5%)

- 2 470Ω
- 1 3.3KΩ
- 1 10KΩ

## Power Source

- 1 24V AC plug pack (ie, Jaycar MP3032 or Altronics M9379A).
- or -
- 1 Small toroidal 24V 1A transformer (ie, Jaycar Cat MT2112 or Vigortronix VTX-146-030-212). Note that an electrician should be employed to terminate the primary and connect it into a house power circuit.

## Options

### Extra parts for a 4 valve controller

- 4 Solid State Relay IXYS CPC1966Y or IXYS CPC1965Y.
- 4 470Ω 1/4W thru hole resistors.
- 2 2 Way 5mm 45 Deg. PCB Mount Terminal Block.

### Extra parts for a 6 valve controller

- 6 Solid State Relay IXYS CPC1966Y or IXYS CPC1965Y.
- 6 470Ω 1/4W thru hole resistors.
- 3 2 Way 5mm 45 Deg. PCB Mount Terminal Block.

### Extra parts for an 8 valve controller

- 8 Solid State Relay IXYS CPC1966Y or IXYS CPC1965Y.

- 8 470Ω 1/4W thru hole resistors.
- 4 2 Way 5mm 45 Deg. PCB Mount Terminal Block.

#### Extra parts for the flow sensor

- 2 1N5819 Schottky Diode.
- 1 3.3KΩ 1/4W thru hole resistor.
- 1 10KΩ 1/4W thru hole resistor.
- 1 3 Way 5mm 45 Deg. PCB Mount Terminal Block.
- 1 Flow Sensor, 5V power, TTL output (eg, <https://valvesdirect.net> SKU: FS20).

#### Extra parts for the rain sensor

- 2 1N5819 Schottky Diode.
- 1 3.3KΩ 1/4W thru hole resistor.
- 1 10KΩ 1/4W thru hole resistor.
- 2 2 Way 5mm 45 Deg. PCB Mount Terminal Block.
- 1 Rain Sensor, Normally Closed Contacts, (eg, <https://valvesdirect.net> SKU: RS-1NC).

## Construction

The controller is built on a single PCB. The Gerber design files are in the construction pack and can be given to any PCB fabricator. The prototype PCB was made by <https://jlcpcb.com> who made five boards for about US\$12.

Follow the silk screen legend on the PCB and the high resolution photograph in the Construction Pack for component placement. Note that there is space on the top of the PCB for mounting a small toroid transformer if the controller is to be connected to a house power circuit.

The Raspberry Pi Pico W can be directly soldered to the PCB but it is much better to use header pins and sockets to make it into a plug in module – that way it can be removed for testing and programming. Before installing it you should load the firmware as described in the firmware download and test that it is working as you would expect.

The specified enclosure is waterproof so it can be mounted on an exterior wall. I elected to mount a waterproof power switch and the status LED on the front panel but you can vary this.

Note that there is a single connection point for the common return wire from all solenoid valves.

## Status LED

The red LED displays the status of the controller. When it is solidly illuminated everything (as far as the firmware is concerned) is operating correctly. When it is extinguished or flashing on/off it indicates a fault and you should check the controller's home web page for the error message. Note that when the controller is powering up the status LED may turn off or flash... this should only occur for 60 seconds at the most.

## Programming/Setup

As part of installing the firmware you should have noted the IP address given to the controller by your router. To setup the controller enter this address into the address bar of a web browser and you should see the home page as described here: <https://geoffg.net/retic.html>.

The router should give the controller the same IP address on the case of a restart but to ensure this you can go into your router's setup and define the address given to the controller as static.