Unpowered Irrigation Controller

User Manual

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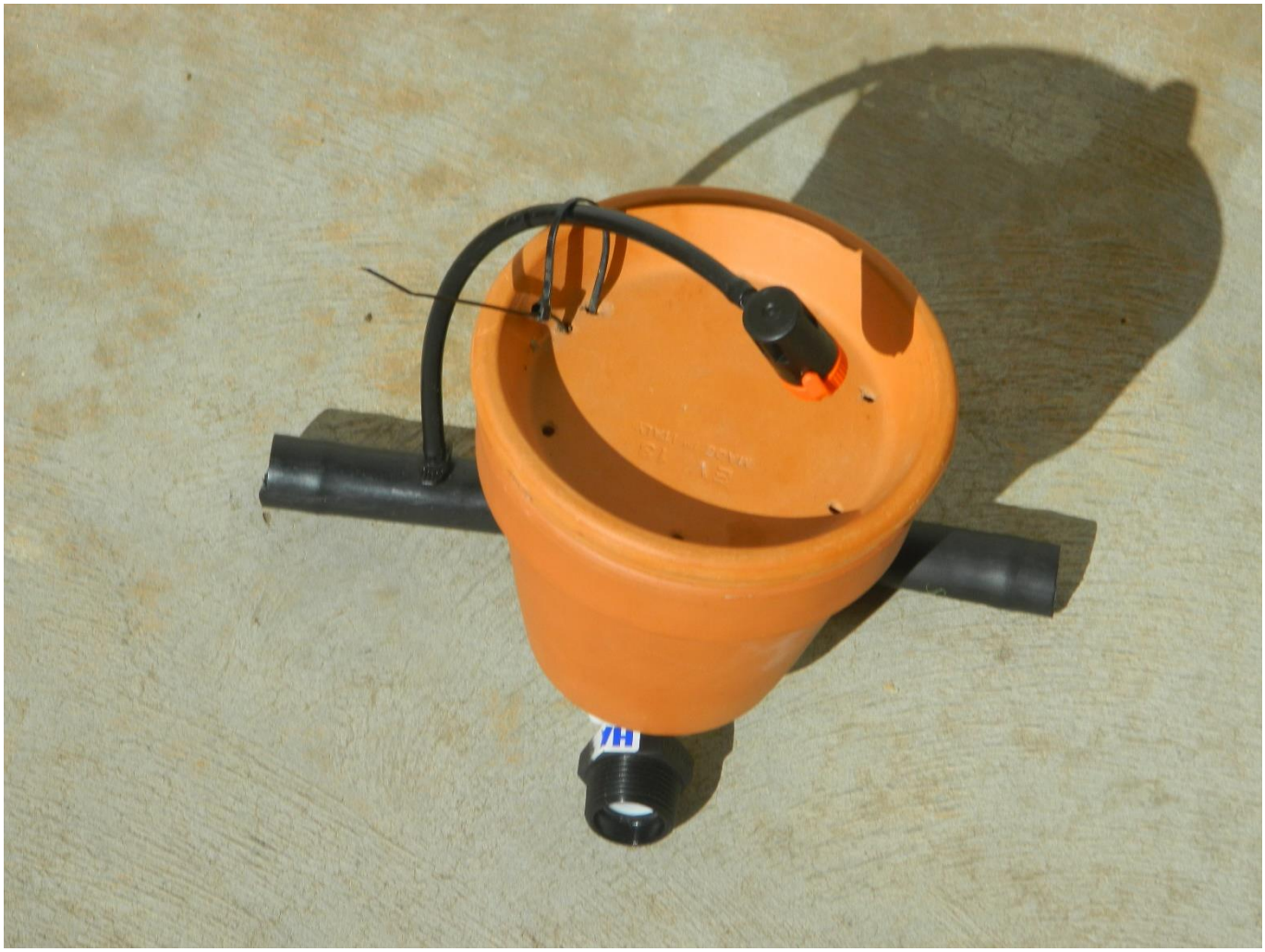
August 2024



Unpowered Irrigation Controller

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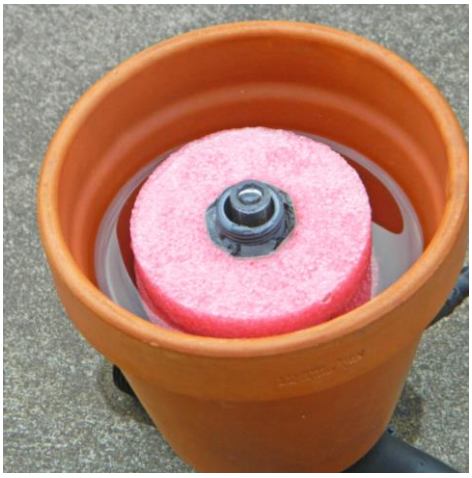
1. Introduction

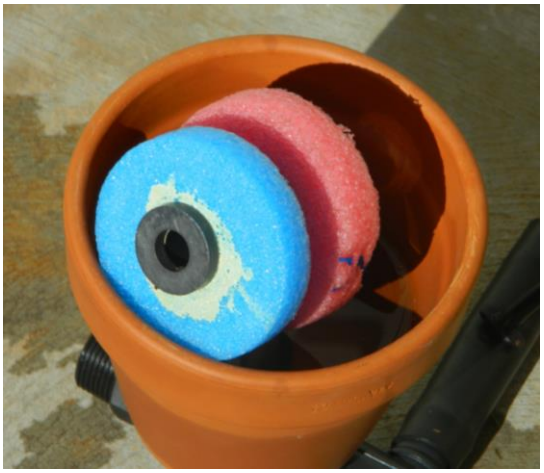
It is recommended that you watch the YouTube video Unpowered Irrigation Controller: https://www.youtube.com/watch?v=A90f5aAxvHA

The Unpowered Irrigation Controller is suitable for automatic sprinkler irrigation or drip irrigation. The valve operates with water supply pressure in the range 10 kPa to 800 kPa. The interval between irrigation events responds automatically to the on-site prevailing weather conditions (namely, evaporation and rainfall).

Terracotta is porous and so the water level in the pot falls as water seeps through the pot. A float inside the pot consists of an upper float (pink) and a lower float (blue). When the water level reaches the low level, a magnet at the bottom of the lower float activates the valve so that the valve opens and the irrigation starts. During the irrigation event a control dripper drips water into the pot and the water level rises. When the water level reaches the high level, the magnet at the bottom of the lower float disengages from the valve so that the valve closes and the irrigation stops.



Unpowered Irrigation Controller showing the float and the water level



Float showing the ring magnet at the bottom of the float

This remarkable low-cost invention may enable poor smallholders in remote locations to grow higher-valued crops cost-effectively.

If the flow rate through the valve is inadequate, you may wish to subdivide the irrigation application into zones with an Unpowered Irrigation Controller for each zone. If the water supply has the minimum pressure of10 kPa (1 metre head), the Unpowered Irrigation Controller can deliver water to at least 400 2 L/H drippers (note that a 2 L/H dripper delivers 2 L/H @ 100 kPa). Provided the water supply pressure is at least 10 kPa and your plot can be irrigated with 400 2 L/H drippers (or 800 1 L/H drippers), then one Unpowered Irrigation Controller will be adequate for your irrigation application.

A clear acrylic tube connected to the valve is quite fragile, so be very careful not to break it.

The **control volume** is the volume of water that drips into the pot during the irrigation event. It is also the volume of water that seeps through the terracotta pot to evaporate between irrigation events. By adjusting the float, the control volume may be set to any value between 55 ml and 373 ml.

Conventional drip irrigation systems control the volume of water discharged by a dripper by using PC (pressure compensating) drippers to control the flow rate and an irrigation controller to control the start time and the run time. In a domestic garden with mains water supply, many zones are usually required to ensure that the pressure in each zone does not fall below the lower limit for pressure compensation. The irrigation controller is programmed so that each zone is irrigated at a different time.

With identical NPC (non pressure compensating) drippers at approximately the same level and negligible variations in the pressure within the zone due to frictional head loss, the Unpowered Irrigation Controller ensures that the volume of water discharged by each dripper during the irrigation event is approximately the same regardless of the pressure. If the water supply pressure decreases, the flow rate of the NPC drippers also decreases. However, the duration of the irrigation event increases automatically to ensure that the control volume of water is discharged by each dripper.

For domestic gardens on level ground, the irrigation system can usually be designed so that variations in pressure within the zone due to frictional head loss are negligible.

By using the Unpowered Irrigation Controller, many zones with PC drippers may be combined into a single zone with NPC drippers and a single Unpowered Irrigation Controller, and so the cost of the irrigation system can be reduced dramatically.

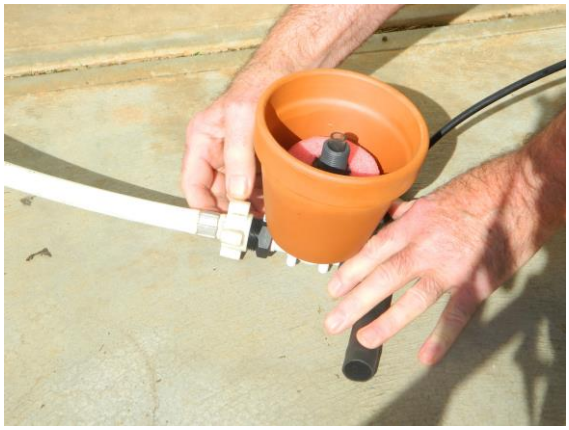
2. Installation of the Unpowered Irrigation Controller

Connect the two pieces of 19 mm poly pipe to the two the barbs on the tee.

Position the Unpowered Irrigation Controller in a suitable location in your garden so that the evaporation matches the evaporation at your plants.

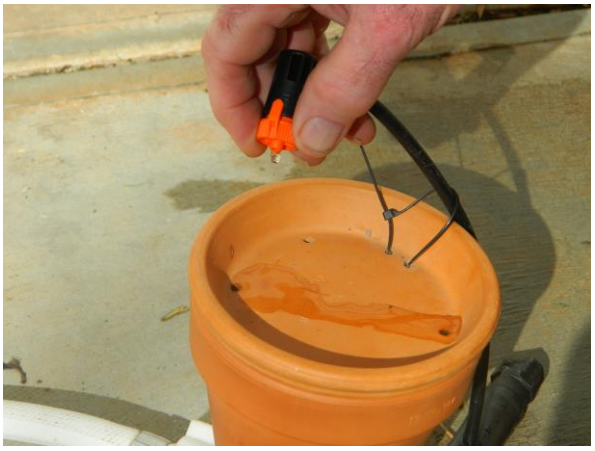
Connect the water supply to the valve inlet and connect the irrigation application to the 19 mm poly pipe (note that an arrow under the valve indicates the direction of flow). You may need to block one of the pieces of poly pipe with a 19 mm barbed end plug.

Place the terracotta saucer on the terracotta pot so that the control dripper drips water into the pot via the small holes in the saucer. The control dripper should be at the same level as the irrigation drippers in your application.



Connect the water supply to the valve inlet

Connect the irrigation application to the 19 mm poly pipe



Place the terracotta saucer on the terracotta pot so that the control dripper drips water into the pot

3. How to use the Unpowered Irrigation Controller

Turn on the water supply and the irrigation should start immediately. The control dripper drips water into the terracotta pot during the irrigation. The irrigation stops automatically when the control volume of water has dripped into the pot. The irrigation starts again automatically after the control volume of water has seeped through the pot and evaporated. The cycle continues indefinitely and so you can leave your garden unattended for months on end. A saucer sits on top of the pot so that the water in the pot is protected from algae, mosquitoes, and thirsty animals.

When using a conventional irrigation controller, you need to set the start time and the run time for each irrigation event. However, with the Unpowered Irrigation Controller you don't need a timer. The duration of the irrigation event is the time it takes for the control volume of water to drip into the pot, and the interval between irrigation events is the time it takes for the control volume of water to seep through the pot.

It is important to note that the control dripper is adjustable. If you reduce the flow rate of the control dripper, it takes a lot longer for the control volume of water to drip into the pot and so the duration of the irrigation event increases and your plants get more water. On the other hand, if you increase the low rate of the control dripper, the control volume of water drips into the pot more quickly and so the duration of the irrigation event decreases and your plants get less water. Adjust the control dripper so that the irrigation delivers the appropriate amount of water to your plants at their current stage of growth.

The time it takes for the control volume of water to seep through the pot depends on the prevailing on-site weather conditions. When it is hot and dry, the water seeps more quickly and so the interval between irrigation events is shorter. When it is cool and overcast, the water seeps more slowly and so the interval between irrigation events is longer.

If it rains, rainwater collects in the saucer and drains into the pot. This means that the start of the next irrigation event is delayed. In addition to the control volume of water that needs to seep through the pot between irrigation events, any rainwater that has entered the pot between irrigation events also needs to seep through the pot.

To avoid irrigating during the heat of the day, you can turn off the water supply. Alternatively, a tap timer can be used so that water is only available between sunset and sunrise.

The Unpowered Irrigation Controller uses on-site weather data (namely, evaporation and rainfall). Most smart irrigation controllers do not use on-site weather data. Instead, they use weather data from the Bureau of Meteorology.

The Unpowered Irrigation Controller can be used for both gravity feed and pressurised irrigation. It can be used with sprinklers, drippers (PC or NPC), weeper hose and soaker hose.

You can irrigate directly from a rainwater tank by gravity feed without using a pump provided that the water level in the tank is at least 1 metre higher than the valve.

Note that the term **water usage rate** refers to the number of litres per week used by the irrigation system.

How to adjust the interval between irrigation events

You can adjust the interval between irrigation events by adjusting the gap between the upper and lower float. The interval between irrigation events is the time it takes for the control volume of water to seep through the porous terracotta pot. To adjust the gap by 4 mm, rotate the upper float by two and a quarter turns.

Adjusting the interval between irrigation events does not change the water usage rate. For example, if you increase the interval between irrigation events by increasing the gap between the upper and lower float, the amount of water used during the irrigation event increases automatically to ensure that the water usage rate remains the same.

To adjust the interval between irrigation events, adjust the gap between the upper and lower float

gap between the upper and lower float	control volume
zero gap	55 ml
4 mm	81.5 ml
8 mm	108 ml
12 mm	134.5 ml
16 mm	161 ml
20 mm	187.5 ml
24 mm	214 ml
28 mm	240.5 ml
32 mm	267 ml
36 mm	293.5 ml
40 mm	320 ml
44 mm	346.5 ml
48 mm	373 ml

Table 1. Control volume for various gaps between the upper and lower float

The gap between the upper and lower float should be chosen so that the next irrigation event starts when there is no further soil moisture available to the plants. Soil moisture sensors or probes may be used to determine the soil moisture profile.

You can start the irrigation at any time by pushing the float down. You can stop the irrigation at any time by lifting the float up.

How to adjust the water usage rate

If your plants are not getting enough water, reduce the flow rate of the control dripper. Reducing the flow rate of the control dripper increases the duration of the irrigation event and so your plants get more water. If your plants are getting too much water, increase the flow rate of the control dripper.

Adjusting the water usage rate does not affect the interval between irrigation events.

You may wish to position an empty measuring container under one of the drippers so that water drips into the container during the irrigation event. The amount of water in the container is the amount of water discharged by each irrigation dripper during the irrigation event.

5. Key features of the Unpowered Irrigation Controllerx

1. Unpowered (no batteries, no solar panels, no electronics, no computers, and no WiFi)
2. Water supply pressure 10 kPa to 800 kPa
3. Use for sprinkler irrigation or drip irrigation
4. Use for gravity feed or pressurised irrigation
5. Can deliver water to at least 400 2 L/H drippers
6. Adjust the water usage rate by adjusting the control dripper
7. Adjust the interval between irrigation events by adjusting the float
8. Responds automatically to on-site evaporation and rainfall
9. The irrigation frequency increases significantly during a heat wave
10. Irrigate directly from a rainwater tank without using a pump
11. Water in the terracotta pot is protected from debris, algae, mosquitoes and thirsty animals
12. Simple, unpowered, and low tech, and therefore fewer things can go wrong
13. Leave your irrigation application unattended for months on end

6. Conclusion

The Unpowered Irrigation Controller uses a radically different approach to irrigation scheduling called Measured Irrigation. See the Measured Irrigation website for more information: www.measuredirrigation.com.au

Conventional irrigation systems **indirectly** control the volume of water discharged by a dripper by using PC (pressure compensating) drippers to control the flow rate and an irrigation controller or timer to control the start time and the run time. However, measured irrigation **directly** controls the volume of water discharged by a dripper, rather than controlling the flow rate and the time. It is recommended that NPC (non pressure compensating) drippers be used for measured irrigation.

The Unpowered Irrigation Controller uses on-site weather information rather than information from the Bureau of Meteorology, and so it is ideal for greenhouse applications.