

# Terracotta Irrigation Controller User Manual

Dr Bernie Omodei  
Measured Irrigation  
5/50 Harvey Street East, Woodville Park SA 5011  
Mobile 0403 935277  
Email [bomodei@measuredirrigation.com.au](mailto:bomodei@measuredirrigation.com.au)  
Website [www.measuredirrigation.com.au](http://www.measuredirrigation.com.au)

June 2022



In ground installation of the Terracotta Irrigation Controller



Above ground installation of the Terracotta Irrigation Controller

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## 1. Introduction

Terracotta is porous and so the water level in the pot falls as water evaporates from the outside surface of the pot. A float inside the pot floats on the water. When the water level reaches the low level, a magnet inside the float activates an unpowered valve so that the valve opens and the irrigation starts automatically. During the irrigation event, an adjustable control dripper drips water into the pot and the water level rises. When the water level reaches the high level, the magnet inside the float disengages from the valve so that the valve closes and the irrigation stops automatically. The adjustable control dripper is used to adjust the water usage rate to suit the water requirements of the plants. The adjustable float is used to adjust the frequency of irrigation.

Note that the term **water usage rate** refers to the number of litres used per week, month or year.



Terracotta pot showing float and water level



Float showing the ring magnet at the bottom of the float

Having set the adjustable control dripper, the water usage rate (litres per week for example) responds to the prevailing on site evaporation and rainfall. The water usage rate is proportional to the net evaporation rate (evaporation minus rainfall).

## **2. Key features of the Terracotta Irrigation Controller**

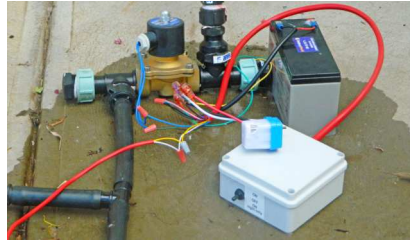
1. Use for any size irrigation application with any size solenoid valve
2. The water in the terracotta pot is protected from debris, algae, mosquitoes and thirsty animals
3. Completely automatic
4. Smart irrigation – the irrigation is controlled by the prevailing weather conditions
5. The unpowered valve operates in the pressure range 10 kPa to 800 kPa
6. Use for gravity feed or pressurised irrigation
7. Use for sprinkler or drip irrigation
8. Use for PC (pressure compensating) drippers or NPC (non pressure compensating) drippers
9. Use for porous hose irrigation (for example, weeper hose or soaker hose)
10. Adjust the water usage rate by adjusting the control dripper
11. Adjust the irrigation frequency by adjusting the float to change the volume of water discharged by the control dripper during the irrigation event (between 90 ml and 275 ml)
12. Adjusting the water usage rate does not affect the irrigation frequency, and adjusting the irrigation frequency does not affect the water usage rate
13. The water usage rate and irrigation frequency are directly proportional to the net evaporation rate (evaporation minus rainfall)
14. Responds appropriately when there is an unexpected heat wave
15. When it rains, water enters the terracotta pot and delays the start of the next irrigation
16. A timer is not required
17. If you are using the same drippers throughout the irrigation application including the control dripper, the water usage rate is independent of the pressure
18. You can irrigate directly from a rainwater tank without using a pump
19. A light sensor provides the option of irrigating at night time only
20. Uses much less water without affecting the yield
21. Simple and low tech, therefore fewer things can go wrong
22. Provided you have a continuous water supply, you can leave your irrigation application unattended for months on end

### 3. Installing the Terracotta Irrigation Controller

- Step 1. Position the Terracotta Irrigation Controller in a suitable location in your garden so that the evaporation at the controller matches the evaporation at your plants.
- Step 2. Connect a water supply to the irrigation controller. The water pressure should be at least 10 kPa during the irrigation event.
- Step 3. Connect the adjustable control dripper to the irrigation zone so that it drips water into the terracotta saucer during the irrigation event. Use a cable tie to secure the adjustable dripper
- Step 4. The control box has 11 colour-coded wires which need to be connected to the various components as follows:



Control box



Eleven colour-coded wires connected to the relevant components

- Connect the **red** wire to the positive terminal from the 12V DC power supply.
- Connect the **black** wire to the negative terminal from the 12V DC power supply.
- Connect the **yellow** wire to one of the wires from the float switch.
- Connect the **white** wire to the other wire from the float switch.
- Connect the **blue** wire to one of the wires from the solenoid valve.
- Connect the **green** wire to the other wire from the solenoid valve.
- Connect the **brown** wire to the white wire from the light sensor (connected prior to shipment).
- Connect the **purple** wire to the black wire from the light sensor (connected prior to shipment).
- Connect the **orange** wire to the red wire from the light sensor (connected prior to shipment).

#### 12V DC power supply for the solenoid valve

- Connect the **pink** wire to the positive terminal from the 12V DC power supply.
- Connect the **grey** wire to the negative terminal from the 12V DC power supply.

#### Alternative power supply for the solenoid valve

- Connect the **pink** wire to one of the wires from the alternative power supply.
- Connect the **grey** wire to the other wire from the alternative power supply.

#### 4. Using the Terracotta Irrigation Controller

The switch on the control box had 3 positions: **ON** (switch up), **OFF** (middle position), and **ON night only** (switch down).

When the switch on the control box is in the **ON** position, the irrigation starts automatically after sufficient water has evaporated from the outside of the porous terracotta pot. The irrigation stops automatically when the control dripper has replaced the evaporated water.

When the switch on the control box is in the **ON night only** position, the irrigation happens at night time only.

Provided the switch is in the **ON** position, you can start the irrigation manually by pressing the float down. For example, on a very hot day you may wish to irrigate in the middle of the day.

After the unpowered valve under the terracotta pot closes, water needs to drain from the outlet assembly before the float switch can open. There is a small delay between the closing of the unpowered valve and the irrigation stopping.

Turn on the water supply and the irrigation will start immediately. The control dripper drips water into the terracotta pot during the irrigation. The irrigation stops automatically after the control volume of water have dripped into the pot. The **control volume** is the volume of water required to raise the water level in the pot from the low level to the high level.

The irrigation starts again automatically after the control volume of water has evaporated from the outside surface of the porous terracotta pot. The cycle continues indefinitely and so you can leave your garden unattended for months on end. A terracotta saucer sits on top of the pot so that the water in the pot is protected from algae, mosquitoes and thirsty animals. There are 6 small drain holes in the saucer.

When using a conventional irrigation controller, you need to set the start time and the end time for each irrigation event. However, with the self-controlled terracotta valve you don't need a timer. The duration of the irrigation event is simply the time it takes for the control volume of water to drip into the pot.

It is important to note here that the control dripper is adjustable. If you reduce the flow rate of the control dripper, then it will take a lot longer for the control volume to drip into the pot and so the duration of the irrigation event increases and your plants will get more water. On the other hand, if you increase the flow rate of the control dripper, the control volume will drip into the pot more quickly and so the duration of the irrigation event decreases and your plants will 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.



Switch in the **ON night time** position



The control dripper is adjustable.

The interval between irrigation events is the time it takes for the control volume to evaporate from the outside surface of the porous terracotta pot. The important thing to realise here is that the time it takes for the control volume to evaporate is determined by the prevailing weather conditions. When it is hot and dry, the water will evaporate more quickly and so the interval between irrigation events will be shorter. When it is cool and overcast, the water will evaporate more slowly and so the interval between irrigation events will be longer.

If it rains, rainwater will collect in the saucer and drain into the pot. This means that the start of the next irrigation event will be delayed. In addition to the control volume that needs to evaporate, the rainwater that has entered the pot will also need to evaporate.

The Terracotta 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 Terracotta Irrigation Controller can be used for both gravity feed and pressurised irrigation. It can be used with pressure compensating drippers and non pressure compensating drippers. It can also be used with weeper hose or 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 at the bottom of the pot.

It is recommended that you adjust the irrigation frequency before adjusting the water usage rate. You may need to adjust the irrigation frequency and the water usage rate as the plants grow and their water requirements change.

### How to adjust the irrigation frequency

You can adjust the irrigation frequency by adjusting the gap between the upper and lower discs on the float. Note that the irrigation frequency is controlled by the net evaporation from the outside surface of the terracotta pot between irrigation events. To adjust the gap by 4 mm rotate the upper disc by two and a quarter turns.

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



To adjust the irrigation frequency, adjust the gap between the upper and lower discs

The following table shows the control volume (net evaporation from the outside surface of the terracotta pot between irrigation events) for various values of the gap between the upper and lower discs.

Gap between the upper and lower discs	Net evaporation from the outside surface of the terracotta pot between irrigation events (control volume)
zero gap	90 ml
4 mm	122 ml
8 mm	154 ml
12 mm	186 ml
16 mm	218 ml
20 mm	250 ml
23 mm	275 ml

The gap between the upper and lower discs 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.

Another way to decrease the irrigation frequency (without changing the water usage rate) is to increase the control volume by connecting an additional container to the terracotta pot so that the water level in the container is the same as the water level in the terracotta pot. Water should not evaporate from the container and rainfall should not enter the container. One way of connecting the container to the terracotta pot is to drill a 10 mm hole in the bottom of the terracotta pot and to use a 6 mm ID (10 mm OD) rubber grommet, a 6 mm barbed elbow and 6 mm flexible tubing. You may need to cut the rubber grommet and the barbed elbow so that they don't protrude into the pot.

### **How to adjust the water usage rate**

Before adjusting the water usage rate it is recommended that the flow rate of the control dripper be approximately the same as the flow rate of the irrigation drippers.

Position an empty measuring container under one of the drippers so that water drips into the container during the irrigation event. At the end of the irrigation event check the amount of water in the measuring container. At the end of the irrigation event the wetting front should have reached the bottom of the root zone. A soil moisture sensor or probe may be used to determine if the soil is wet at the bottom of the root zone. A wetting front detector is an ideal tool for determining if the soil is wet at the bottom of the root zone.



Position an empty measuring container under one of the drippers

If your plants are not getting enough water, turn the control dripper clockwise to 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, turn the control dripper anticlockwise to increase the flow rate of the control dripper.

## 5. When is dripper discharge independent of pressure?

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 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 drippers (including the control dripper) at approximately the same level and negligible variations in the pressure within the zone due to frictional head loss, the Terracotta 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 Terracotta Irrigation Controller in this way, many zones with PC drippers can be combined into a single zone with NPC drippers and a single Terracotta Irrigation Controller, and so the cost of the irrigation system can be reduced dramatically.



The adjustable control dripper has been replaced by an on-line irrigation dripper.



The adjustable control dripper has been replaced by an in-line irrigation dripper.

The terracotta pot is quite small and so the control volume is restricted to the range 77 ml to 300 ml. Because each irrigation dripper discharges the control volume of water during the irrigation event, the water usage rate is often insufficient for your plants at their current stage of growth.

The discharge of the irrigation drippers can be increased by connecting additional terracotta pots to the terracotta pot with the float so that the water level is the same in all pots. With one additional pot the same size as the pot with the float, the dripper discharge is slightly more than doubled. With two additional pots the same size as the pot with the float, the dripper discharge is slightly more than trebled. Continuing in this way the discharge continues to increase. A large increase in the dripper discharge can be achieved by using a terracotta pot that is much larger than the terracotta pot with the float.

Each additional terracotta pot should be covered with a saucer with drain holes.

One way of connecting the terracotta pots is to drill a 10 mm hole in the bottom of the pots and to use 6 mm ID (10 mm OD) rubber grommets, 6 mm barbed elbows and 6 mm flexible tubing. You may need to cut the rubber grommet and the barbed elbow so that they don't protrude into the terracotta pot and obstruct the float. The drain holes in the additional pots are sealed.



The terracotta pots are connected by 6 mm flexible tubing so that the water level is the same in all the pots.



## Using different NPC drippers

We now consider a method of using different NPC (non pressure compensating) drippers for the irrigation application so that dripper discharge remains largely unaffected by changes in pressure. NPC drippers are usually available with flow rates of 2 L/H, 4 L/H and 8 L/H (at a pressure of 100 kPa). Suppose that a combination of these drippers is used for the irrigation application (including the control dripper). Provided that all drippers have the same emitter discharge exponent (see the manufacturer's specifications), that all drippers are at approximately the same level, and that variations in pressure within the zone due to frictional head loss are negligible, then the Terracotta Irrigation Controller ensures that the volume of water discharged by an irrigation dripper during the irrigation event remains approximately constant within the manufacturer's recommended pressure range. For example, a dripper discharge of 1076 ml occurs when the gap between the upper and lower discs is 24 mm, the control dripper is 2 L/H (at 100 kPa) and the irrigation drippers are 8 L/H (at 100 kPa).

In practice the emitter discharge exponent for drippers with a different flow rate is unlikely to be exactly the same. It is therefore preferable to use identical drippers throughout the irrigation zone.

## Gravity feed irrigation from a rainwater tank

Suppose you are using gravity feed drip irrigation on level ground from a rainwater tank without using a pump. If you are using a conventional irrigation controller, you are faced with the problem that the dripper discharge decreases as the water level in the tank falls. This problem is solved by using the Terracotta Irrigation Controller with the appropriate control dripper. The volume of water discharged by each dripper during an irrigation event is independent of the water level in the tank. The water level in the tank should be at least one metre higher than the valve at the bottom of the Terracotta Irrigation Controller. A header tank on a stand at least 1 metre is ideal. A low cost transfer pump can be used to fill the header tank between irrigation events.

The Terracotta Irrigation Controller for Latching Solenoids is a **game-changer** for automated gravity feed irrigation on level ground from a rainwater tank.

## When is sprinkler discharge independent of pressure?

Within their operational pressure range, sprinklers have an emitter discharge exponent of 0.5.

Therefore the sprinkler discharge during the irrigation event is independent of pressure provided that the emitter discharge exponent of the control dripper is also 0.5.

## 6. Conclusion

The Terracotta 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](http://www.measuredirrigation.com.au)

Conventional irrigation systems **indirectly** control the volume of water discharged by a dripper by using PC drippers to control the flow rate and an irrigation controller to control the time. However, Measured Irrigation **directly** controls the volume of water discharged by a dripper, rather than controlling the flow rate and the time. Because it is no longer necessary to control the flow rate, one can use NPC drippers as well as PC drippers.

NPC drippers can be used with any water supply pressure in the range 10 kPa to 800 kPa.

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

The Terracotta Irrigation Controller for Latching Solenoids is a game-changer for automated irrigation on level ground from a rainwater tank. If you are using pressurised irrigation with pressure compensating drippers, the following items are required.

- Pump for the rainwater tank
- Additional solenoid valves (one needed for each additional zone)
- Conventional irrigation controller
- Hose clamps

None of these items are required when you use the Terracotta Irrigation Controller for Latching Solenoids, and so the cost of installing and running the irrigation systems can be reduced dramatically.