

Terracotta Irrigation Controller for Latching Solenoids User Manual

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In ground installation of the Terracotta Irrigation Controller for Latching Solenoids



Above ground installation of the Terracotta Irrigation Controller for Latching Solenoids

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1. Introduction

The Terracotta Irrigation Controller for Latching Solenoids is suitable for automatic sprinkler irrigation or drip irrigation, and can be installed either above ground or in ground. The Terracotta Irrigation Controller includes a valve that 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). For in ground installation, the interval between irrigation events also responds automatically to the transpiration requirements of your plant at their current stage of growth.

All the power required is provided by a small 9 volt battery inside the control box.

Terracotta is porous and so the water level in the pot falls as water seeps through 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 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 inside the float disengages from the valve so that the valve closes and the irrigation stops.



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.

The valve has a 15 mm inlet and outlet, and so it is not suitable for large irrigation applications that require a bigger valve.



Valve and the 15mm inlet and outlet

2. Key features of the Terracotta Irrigation Controller for Latching Solenoids

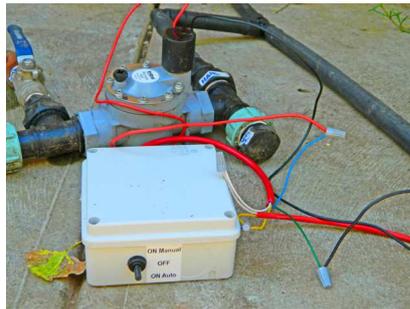
1. Use for any size irrigation application with any size latching solenoid valve
2. The power supply is a small 9 volt battery inside the control box
3. Water supply pressure 10 kPa to 800 kPa
4. Use for sprinkler irrigation or drip irrigation
5. Use for gravity feed or pressurised irrigation
6. Use with PC (pressure compensating) drippers or NPC (non pressure compensating) drippers
7. Adjust the water usage rate by adjusting the control dripper
8. Adjust the interval between irrigation events by adjusting the float
9. Adjusting the water usage rate does not affect the interval between irrigation events, and adjusting the interval between irrigation events does not affect the water usage rate
10. Responds automatically to on-site evaporation and rainfall
11. The irrigation frequency increases significantly during a heat wave
12. Install above ground or in ground
13. For in ground installation the controller responds automatically to plant transpiration
14. Provided the same drippers are used throughout the irrigation application (including the control dripper), the water usage rate is independent of the water supply pressure
15. Irrigate directly from a rainwater tank without using a pump
16. Water in the terracotta pot is protected from algae, mosquitoes and thirsty animals
17. Simple and low tech, and therefore fewer things can go wrong
18. Leave your irrigation application unattended for months on end

3. Installing the Terracotta Irrigation Controller for Latching Solenoids

- Step 1 (for above ground installation). 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 1 (for in ground installation). Dig a hole midway between two adjacent plants and position the Terracotta Irrigation Controller in the hole so that rim of the pot is above ground level. Back fill the soil around the pot. There should be no irrigation drippers near the two 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.
- Step 4. The control box has 4 colour-coded wires that need to be connected to the latching solenoid and the float switch.



Control box



Four colour-coded wires connected to the latching solenoid and the float switch

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 red wire from the latching solenoid.

Connect the **green** wire to the black wire from the latching solenoid.

If there are 2 latching solenoid valves, connect the second latching solenoid in parallel with the first latching solenoid.

4. How to use the Terracotta Irrigation Controller for Latching Solenoids

Turn on the water supply and the irrigation starts immediately. The control dripper drips water into the terracotta pot during the irrigation. The irrigation stops automatically after the control volume of water has dripped into the pot. The **control volume** is defined as the volume of water that seeps through the terracotta pot between irrigation events.

The irrigation starts again automatically after the control volume of water has seeped through the pot. 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. 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 Terracotta Irrigation Controller 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, 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 flow 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 control dripper is adjustable.

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 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 Terracotta Irrigation Controller.

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

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 floats. 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 floats, the amount of water used during the irrigation event increases automatically to ensure that the water usage rate (litres per week for example) remains the same.



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

The following table shows the control volume for various values of the gap between the upper and lower floats.

gap between the upper and lower floats	control volume
zero gap	77 ml
4 mm	109 ml
8 mm	141 ml
12 mm	173 ml
16 mm	205 ml
20 mm	237 ml
24 mm	269 ml
28 mm	300 ml

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

The gap between the upper and lower floats 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

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. You should also check the moisture in the soil.

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.

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 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 pot and obstruct the float. The drain holes in the additional pots are sealed.



With two additional pots the discharge during the irrigation event is slightly more than trebled.



The 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

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.

PC drippers stop working altogether at low pressure. Provided that the PC drippers continue to discharge water, they can be used outside the pressure range recommended by the manufacturer. 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.