Automation Kit for Farm Pond Irrigation

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Unpowered Terracotta Irrigation Controller

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1. Introduction to the Automation Kit for Farm Pond Irrigation

The Automation Kit for Farm Pond Irrigation is for smallholders with a farm pond and gravity feed drip irrigation from a header tank. Water is pumped automatically from the farm pond to the header tank and your small farm is irrigated automatically by an Unpowered Terracotta Irrigation Controller. You can leave your farm unattended for weeks on end, and so you can become involved in other activities away from the farm; for example, travelling to the market to sell your produce.

The Automation Kit for Farm Pond Irrigation can be purchased online at the Measured Irrigation website.

It is assumed that the bottom of the farm pond is no more than 4 metres lower than the irrigation drippers. The water supply pressure from the header tank should be at least 1 metre head.

Farm pond in Kenya for gravity feed drip irrigation

The Kit includes an Unpowered Terracotta Irrigation Controller to supply water to approximately 300 non-pressure compensating (NPC) drippers on flat land (assuming that each dripper has a flow rate of 2 L/H at 100 kPa). If your farm requires more than 300 drippers, you can subdivide your farm into zones with up to 300 drippers per zone (each zone has a separate controller). The Unpowered Terracotta Irrigation Controller can be purchased online from the Measured Irrigation website.

2. Contents of the Automation Kit for Farm Pond Irrigation

As well as the User Manual, the kit includes the following four components:

Waterproof pump controller with solar charge controller inside

Double pump (two pumps connected in series) with an inlet filter, fittings to connect to 19 mm poly pipe, and 9 metres of waterproof electrical cable

Float switch

Unpowered Terracotta Irrigation Controller

The following items will be required to install the kit and may be purchased locally:

- 12V battery
- 20W solar panel
- 2-strand electrical cable
- wire connectors

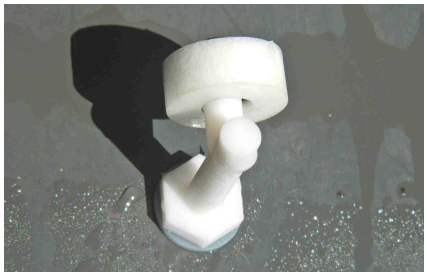
3. Instructions for installing the Automation Kit for Farm Pond Irrigation

Step 1. Connect the pump.

Remove the header tank inlet pipe from the farm pond and connect it to the outlet from the pump.

Step 2. Install the float switch on the header tank.

Drill a 13 mm (half inch) hole in the side of the header tank so that the hole is about 5 cm lower than the inlet to the header tank. Install the float switch on the inside of the header tank so that the float shaft points up.



Float switch on the inside of the header tank with the float shaft pointing up

Step 3. Purchase and install a solar panel (not in kit).

A 12 volt 20 watt solar panel should provide all the power required.

Solar panel mounted on a pole

Step 4. Purchase a battery (not in kit).

A rechargeable 12 volt lead acid battery is required. You may be able to find a used car battery in good condition. If you buy a new battery then I recommend a sealed lead acid battery with a capacity of at least 7 amp hours and a standby voltage of at least 13.5 volts.

Note that the solar panel and the battery may be replaced by a 12V 5A power adaptor. If you are using a power adaptor, the charge controller inside the pump controller is not required. Remove the charge controller, connect the two red wires, and connect the two black wires.

7 amp hour battery

Step 5. Connect the pump controller.

The pump controller has 8 colour-coded wires to be connected to the components as follows:

Connect the **red** wire to the positive terminal on the battery.
Connect the **black** wire to the negative terminal on the battery.
Connect the **blue** wire to the positive wire form the solar panel.
Connect the **green** wire to the negative wire form the solar panel.
Connect the **yellow** wire to one of the wires from the float switch on the header tank.
Connect the **white** wire to the other wire from the float switch on the header tank.
Connect the **brown** wire to the yellow (+) wire from the pump.
Connect the **purple** wire to the black (-) wire from the pump.

If you are using a power adaptor instead of a battery, connect the **red** wire to the positive wire from the power adaptor, and connect the **black** wire to the negative wire from the power adaptor.

The switch on the pump controller has 3 positions: ON Manual, OFF, and ON Auto. For automatic filling of the header tank the switch should be in the ON Auto position.

There is a 30 second delay between the float switch turning off and the stopping of the pump.

Pump controller with the switch in the ON Auto position

Step 6. Submerge the pump in the farm pond

The pump inlet should be at least 15cm above the bottom of the pond to avoid pumping sediment from the bottom of the pond and clogging the inlet filter. If clogging of the filter becomes a problem, you may wish to install a larger filter.

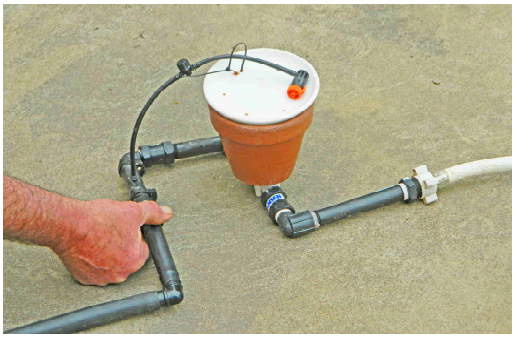
The two pumps provided in the kit are connected in series. If the top of the header tank is less than 3.5 metres higher than the pumps, then it is recommended that the two pumps be connected in parallel rather than in series.

Step 7. Above ground installation of the Unpowered Terracotta Irrigation Controller

For above ground installation, position the Unpowered Terracotta Irrigation Controller in a suitable location in your farm so that the evaporation matches the evaporation at your plants.

Connect the water supply from the header tank to the inlet pipe and connect the irrigation application to the outlet pipe (note that the control dripper is connected to the outlet pipe).

Connect the water supply to the inlet pipe



Connect the irrigation application to the outlet pipe

Alternative Step 7. In ground installation of the Unpowered Terracotta Irrigation Controller

In ground installation is ideal for drip irrigation of row crops. Follow the installation steps below.

Step 7.1. Dig a hole midway between two adjacent plants. There should be no irrigation drippers near these two plants.

Step 7.2. Adjust the inlet and outlet pipes so that they are vertical. Position the controller in the hole so that rim of the pot is above ground level. Back fill the soil around the pot.

Step 7.3. Connect the water supply to the inlet pipe and connect the irrigation application to the outlet pipe.

Because the terracotta pot is in the ground near the roots of plants, the Unpowered Terracotta Irrigation Controller responds to changes in plant transpiration. As the crop grows and requires more water, the irrigation frequency increases automatically.

4. How to use the Unpowered Terracotta Irrigation Controller

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 plot unattended for weeks 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 Unpowered Terracotta 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 terracotta 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 Unpowered 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 nearest weather station.

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 if 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 decrease 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

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. Troubleshooting

Problem	Possible cause	Solution
Pump continues to operate when the switch on the pump controller is moved from the ON Auto position to the OFF position	This is usually not a problem. The time delay has not elapsed yet (time delay is preset to 30 seconds, see ** below)	Wait for the time delay to elapse
Pump is not working	Low voltage on the battery (the solar charge controller protects the battery from over-discharge, see * below)	Recharge the battery with a battery charger or the solar panel. Use a multimeter to check the standby voltage on the fully charged battery. If the standby voltage is less than 13 volts replace the battery. Move the switch on the pump controller to the OFF position before reconnecting the battery.
	Float switch on the header tank is mounted incorrectly	Make sure that the float shaft is pointing up.
	Float switch on the header tank is faulty	Replace the float switch (available online from the Measured Irrigation website: https://www.measuredirrigation.com/product-page/float-switch).
	The pump controller has a fault	You may be able irrigate manually by moving the switch on the pump controller to the ON Manual position.
Pump has low power	One of the pumps in the double pump has become faulty	Replace the faulty pump (available online from the Measured Irrigation website: https://www.measuredirrigation.com/product-page/12-volt-14-watt-submersible-pump).
	The pump inlet filter has become clogged	Clean the pump filter or replace the filter with a larger filter.
Pump stopping when the water level in the header tank is below the float switch	Low voltage on the battery (the solar charge controller protects the battery from over-discharge, see * below)	Recharge the battery with a battery charger or the solar panel. Use a multimeter to check the standby voltage on the fully charged battery. If the standby voltage is less than 13 volts replace the battery. Turn the switch on the pump controller to the OFF position before reconnecting the battery.
	Solar panel has not fully charging the battery between irrigation events	If this is a regular problem, you may need a bigger solar panel.
	A fully charged battery can't meet the power requirements of the system	If this is a regular problem, you may need a bigger battery.
Header tank is empty before the end of the irrigation event	The irrigation is draining water from the header tank faster than the pump can refill the tank	Turn off the water supply from the header tank until the pump has refilled the header tank.

Header tank is overflowing	Float switch on the header tank is mounted incorrectly Float switch on the header tank is faulty	Make sure that the float shaft is pointing up. Replace the float switch (available online from the Measured Irrigation website: https://www.measuredirrigation.com/product-page/float-switch).
Terracotta pot is dry and the irrigation is no starting	Water supply has been turned off The control dripper is not dripping water into the pot The magnet at the bottom of the float is not opening the valve	Turn on the water supply. Clean the control dripper and position it so that it drips into the pot via the saucer. Push the terracotta pot onto the valve and make sure there is no obstruction between the bottom of the float and the bottom of the pot.
Terracotta pot is overflowing and the irrigation is not stopping	Insufficient space between the top of the float and the bottom of the saucer to allow the magnet to disengage from the valve	Increase the space between the top of the float and the bottom of the saucer by adjusting the upper float. Alternatively, the saucer may be removed.
Some drippers are not working	The pressure at the drippers is too low	Increase the pressure at the drippers by removing some drippers or raising the header tank. Alternatively, you may need to create another zone with a separate Unpowered Terracotta Irrigation Controller.

* One of the functions of the solar charge controller is to protect the battery from over-discharge. When the battery voltage is less than 10.8 volts, the solar charge controller isolates the battery so that the pump and solenoid valve stop operating. The over-discharge recovery voltage is 12.8 volts to so a fully charged battery should have a voltage greater than 13 volts to allow the system to start working again.

** There is a 30 second time delay between the float switch closing and the pump stopping. You may reset the time delay module inside the pump controller. The delay timer has a 3 digit display for the time delay in seconds (preset to 30 seconds). To change the time delay, turn the switch on the pump controller to the OFF position and then press the middle button to select the digit you wish to change. The digit will flash to indicate that it is ready to be changed. Then press the right hand button to change the digit. When the time delay has been reset press the middle button until no digits are flashing. Do not press the left hand button.