

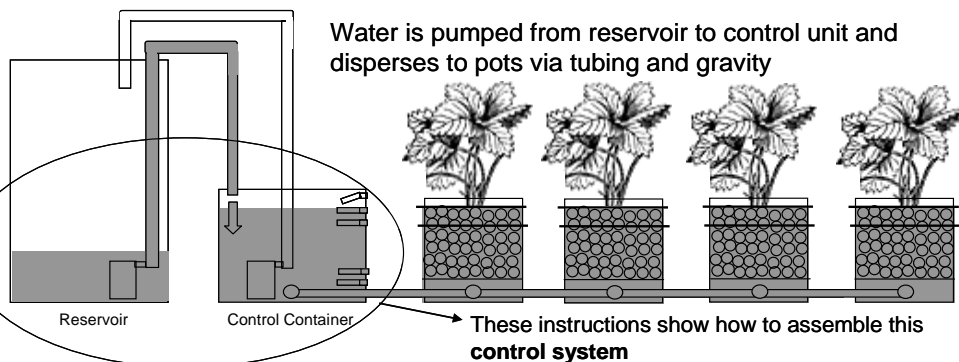
***This do-it-yourself project involves household 110 volt electricity, which, if mishandled can cause shock or death by electrocution. If you are not comfortable working with electricity, do not assemble this kit and return it for a refund. Proceed at your own risk.***

Your Ebb & Flow Control Kit provides the parts needed to build a control system for an ebb & flow hydroponics set-up. It consists of a fill-up system and a drain-out system, each controlled by a set of float switches. A timer controls which system is on at any one time.

*Consult with your local hydroponics store or the internet to determine certain things about managing your ebb and flow set-up such as planter arrangement, nesting the planters, tubing fittings, pH levels, watering times (and levels), growing media, etc. This kit provides the electronics necessary to manage the level in your control container. **The kit is designed for pumps rated at 10 AMPs or less.***

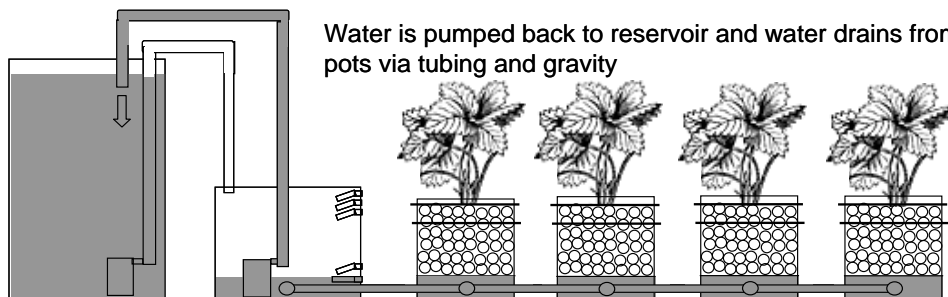
## Fill-Up System Filling Planters

Water is pumped from reservoir to control unit and disperses to pots via tubing and gravity



## Drain-Out System Emptying Planters

Water is pumped back to reservoir and water drains from pots via tubing and gravity



**Your kit includes:**

- 5 Horizontal Float Switches
- 2 each, 110VAC Relay & Relay Socket
- Timer
- Project Box
- 2 LEDs
- 2 Cord Grips
- 4 Screws
- 2 WAGO Connectors
- Crimp Caps
- Spade Connectors
- Spade Terminals
- 1 GFCI Cord
- 1 Altered Dual Outlet
- 6' of 18 gauge wire

**Purchase Separately:**

- 2 pumps (each < 10 amp at 120V)
- Tubing, fittings, control container

***Always use the GFCI provided with this kit.***

## 1. Mount the float switches in a plastic control container.

Mount the float switches in a flat-sided container made of a material that can be drilled into. Polypropylene or HDPE work well.

**NOTE: The container shown in these instructions is for illustration purposes only. Switch placement and proportions may vary in your system depending on the shape of your control container and the watering levels you want.**

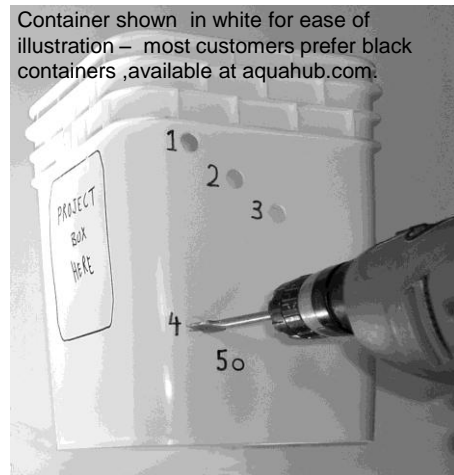
Lay out the control container and planters on a **flat surface** and determine how high you want the water to rise in the planters, sizing the reservoir and control container appropriately. The water levels in your system are up to you. These instructions show you where to place the float switches to maintain the levels you choose. The high water point will be the same height off a **level floor** in the control container as it is in the planters, since the water will seek its level via gravity as it flows between the containers.

Draw an outline where you will attach your project box to the control container, at least 3" off the floor. The box has double sided tape attached to the back for connecting to the control container. Don't attach the box now. Mark the next side of the container where you want to place the float switches. Place them at least 1" apart horizontally.

- 1) **Backup Fill Shutoff Switch** – only functions if main Fill Shutoff Switch fails.
- 2) **Fill Shutoff Switch** – place at your desired high water level for your system.
- 3) **Fill Turn-On Switch** – place about 1" below the Fill Shutoff Switch.
- 4) **Drain Turn-On Switch** – place about 1" above the Drain Turn-Off Switch.
- 5) **Drain Turn-Off Switch** – place as low as possible **but don't let the float touch bottom** and make sure that your pump will not run dry if it is not designed to do so. If the float is placed as low as possible without touching the container bottom, the pump will stop when the water depth is pumped down to about 1". Adjust accordingly.

### Question: Why use 2 float switches for the fill and drain points?

**Answer:** The switches are very sensitive. Using one switch to maintain a level would cause rapid cycling as nutrient flowed in and out of the control container. Relays isolate the on/off functions of two switches and also keep strong pump current out of the switches.

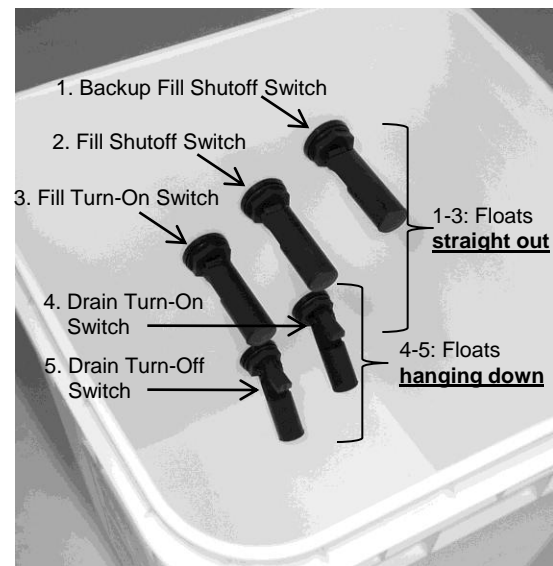


Drill switch holes using a 5/8" Spade drill bit, using low pressure. Don't use a knife to cut the holes. De-burr holes with coarse sandpaper.

Remove the nut and washers from each of 5 switches and place switches into the container, as shown in the photo, right. The wide end of the rubber washer goes against the inside of the container. The plastic washers and nuts on the outside. Snug nuts enough for a watertight seal. Don't over-tighten. The rubber washers fold over on themselves as you tighten to create a great seal.

**The top three switches should be rotated so that their floats are sticking out straight and the bottom two switches should have their floats hanging down.** All switch hinges should be level (i.e. parallel with the bottom of the container).

## 2. Prepare the float switch wires.



Strip ¼" of insulation off the ends of the wires, except strip ½" off the wires that show spade connectors in the photo, left, and double them over to make a good thickness for crimping on the connectors.

Polarity is not observed with the float switch wires. Each switch has two wires – either can go to either of the connections shown. The labels are used in Step 4.

**Crimping notes: float switch wires must be doubled to create the thickness needed for attaching a female spade connector. Use a crimping tool to attach female spade connectors.**

**If you use pliers instead (not recommended), press very firmly. Always confirm that the connectors are holding firmly to the wires – if not, solder them.**

The grey WAGO connectors are not used in this step. When applying labels, it is easiest to remove them from the backing first and then cut them with scissors.

### Float Switch 1

Wire 1 – crimp on a female spade connector and apply "Timer 3" label.

Wire 2 – shorten to 2-3" length. Also shorten a wire from Float Switch 2. Twist these together and crimp on a crimp cap (see photo).

### Float Switch 2

Wire 1 - already connected to Wire 2 from Float Switch 1.

Wire 2 – twist with a wire from Float Switch 3, attach "Fill 3" label.

### Float Switch 3

Wire 1 – already connected to Wire 2 from Float Switch 2.

Wire 2 – twist end, attach "Fill 8" label.

### Float Switch 4

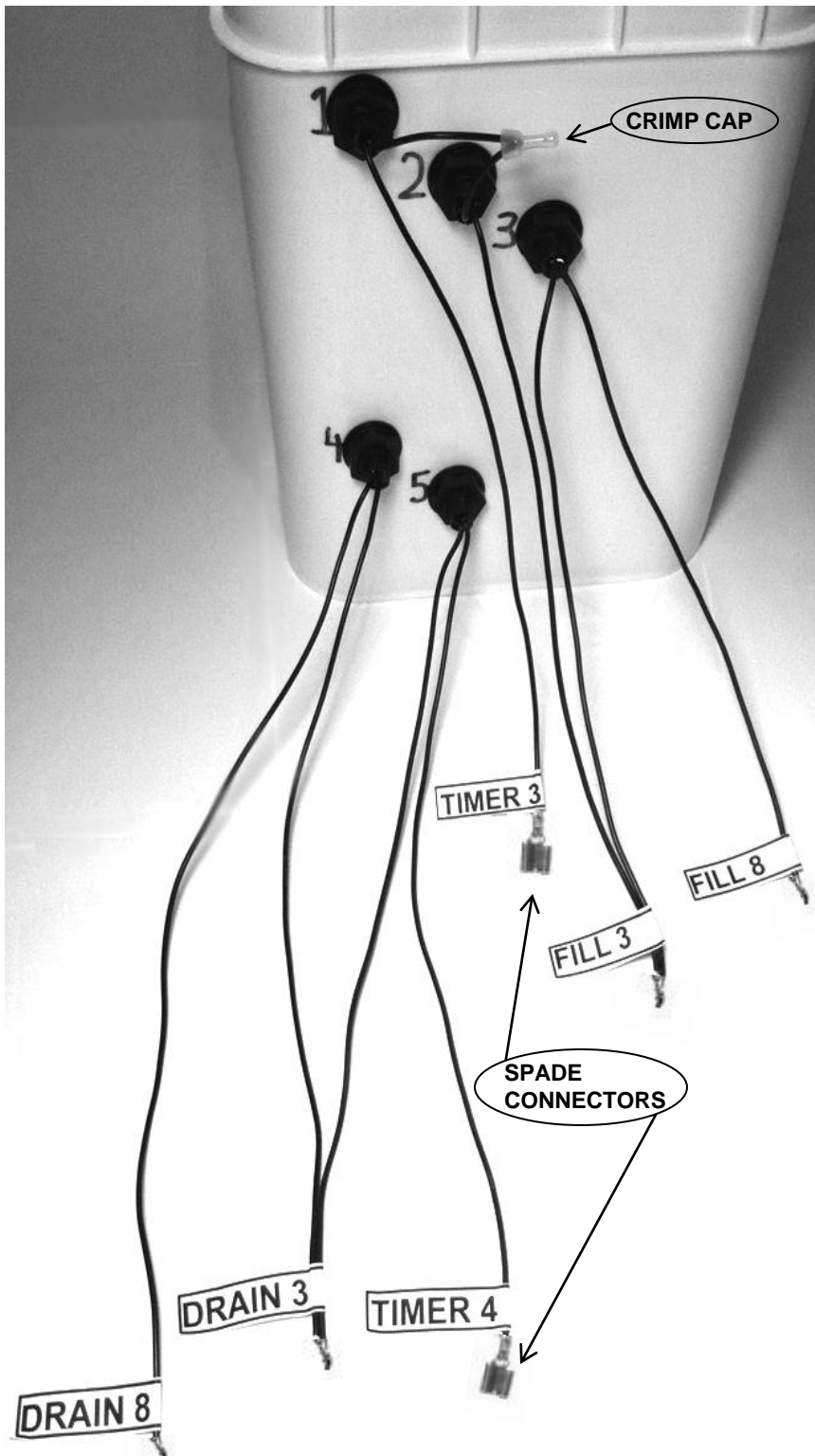
Wire 1 – twist end, attach "Drain 8" label.

Wire 2 – twist to a wire from Float Switch 5, attach "Drain 3" label.

### Float Switch 5

Wire 1 – already connected to Wire 2 from Float Switch 4.

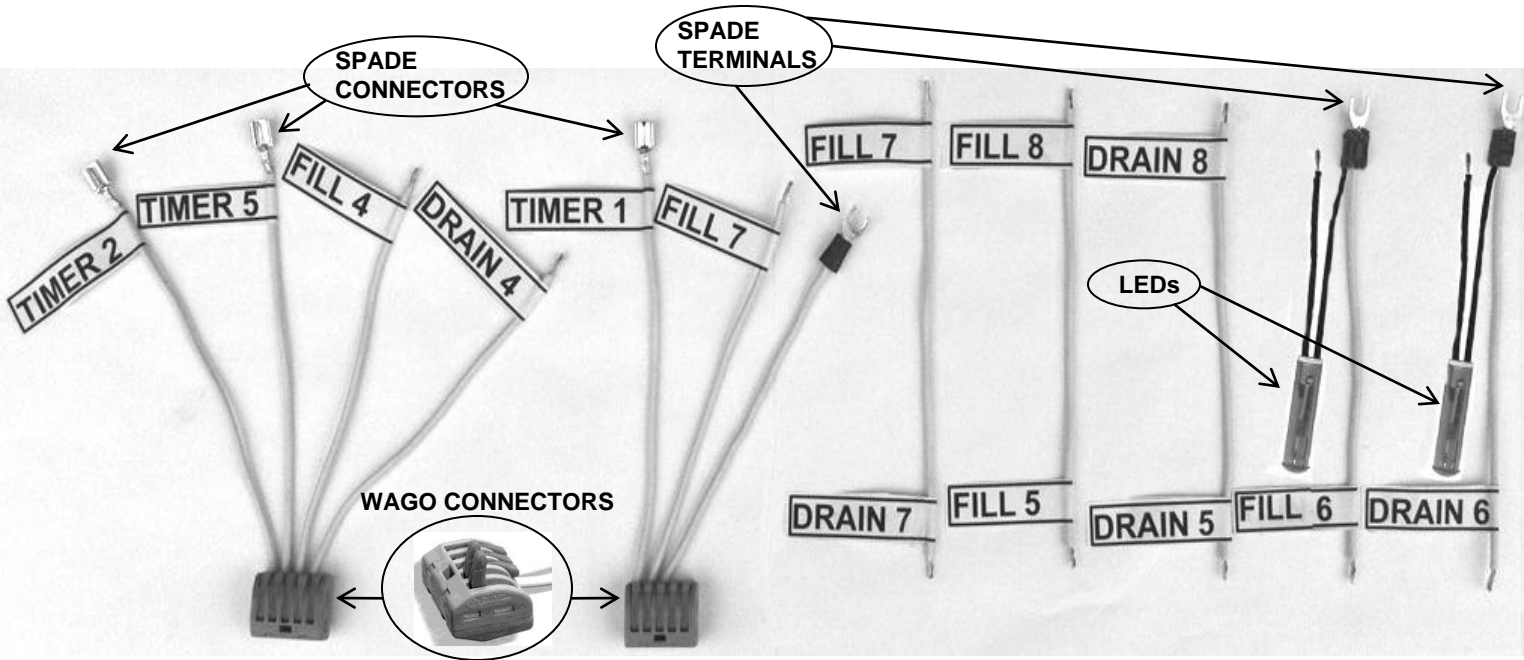
Wire 2 – crimp on a female connector and add "Timer 4" label.



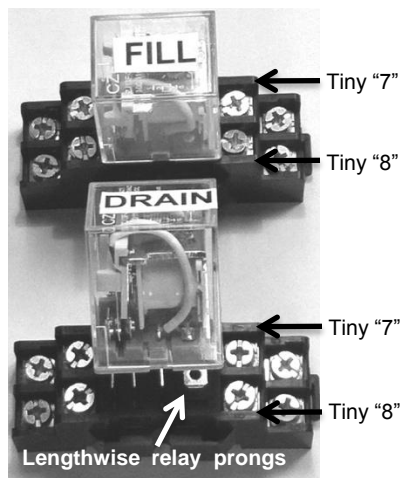
### 3. Prepare the wires that go to the timer and relay sockets.

Cut the 6' of 18 gauge wire into twelve 6" segments, stripping  $\frac{1}{4}$ " off the ends. Arrange and label as shown below. Crimp female spade connectors onto the wires labeled Timer 2, Timer 5 and Timer 1. Crimp spade terminals onto the unlabeled wire ends. Before attaching spade terminals to the ends of the Fill 6 and Drain 6 wires, twist one stripped LED wire to each. LED wires are longer than what is shown in the photo below.

**To use a WAGO connector:** lift an orange finger until it holds open at a 90-degree angle to the base (the springs inside are strong). Insert stripped wire completely. Push the finger down. It will snap closed, holding the wire securely. Tug firmly on the wire to test.



### 4. Prep relays; run wires into box and connect.



Cut one "FILL" and one "DRAIN" label and apply to relays lengthwise, with prongs to the right.

Insert the relays into the sockets as shown – press firmly until relay is fully seated.

The sockets have tiny numbers inscribed next to the screw terminals. You must be able to see these in the next steps. Use bright light and a magnifying glass if necessary.

Use the two long screws and nuts provided to attach the timer to the project box cover as shown, right. Don't over tighten.

Insert the cord grips into the round holes in the project box base, as shown, right. The base should be fastened tightly, but the dome-shaped heads should be loose so that the internal grip ring is completely open until all wires have been passed through. Then tighten the dome-shaped heads firmly until the inner grip ring compresses and the wires are held securely in place.



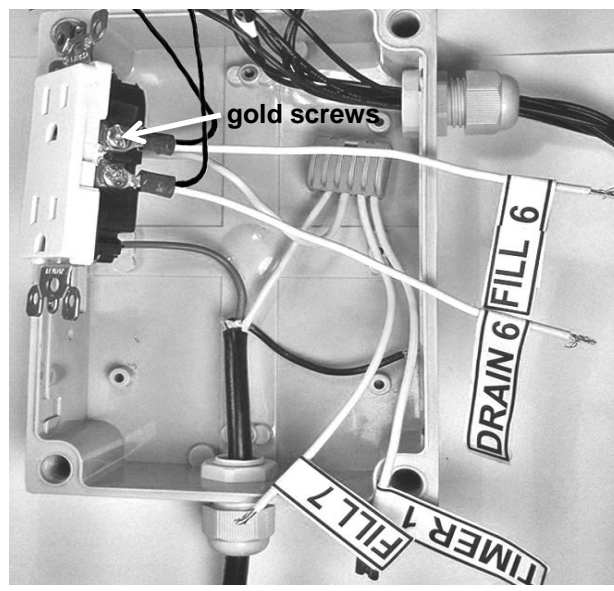
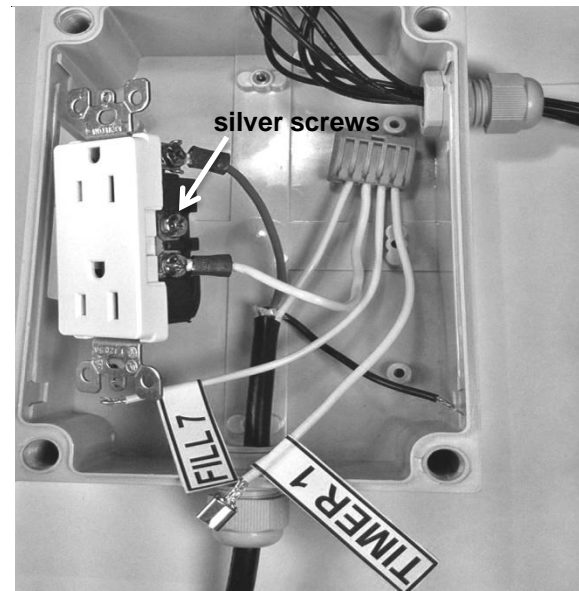
Wrapping the labels around each wire, gently feed the float switch wires through the upper right cord grip, opposite the rectangular opening. **The wires with female connectors must be fed through first.**

Feed the three wires from the GFCI plug into the bottom cord grip until the insulation is about 2" into the box. See photo, left.

Crimp a spade terminal onto the green wire from the GFCI plug. You must crimp firmly to make sure the terminal stays secure.

Screw the spade terminal from the green GFCI wire to the green or grey ground terminal on the dual outlet. See photo, below left.

Find the WAGO connector with the Timer 1 and Fill 7 wires attached to it. There is a third wire that has a spade terminal on it. Screw this spade terminal to either of the neutral silver screw terminals on the dual outlet. Then insert the white wire from the GFCI cord into an opening in this WAGO connector. See photo, below left.



Turn the dual outlet over. Pass the spade connectors opposite the Fill 6 and Drain 6 labels (along with the loose LED wires) through the small holes on the box cover marked "Fill System" and "Drain System", seating the LEDs and snapping them into the holes.

Screw the spade terminal from the wire marked Fill 6 to the upper hot screw terminal on the outlet and the spade terminal with the wire marked Drain 6 to the lower hot screw terminal. These terminals have gold screws. See photo, above center.

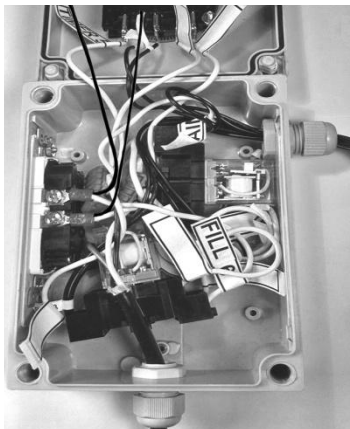
Mount the outlet in the box using the short screws provided in the kit materials. See photo, above right.

Twist the two loose wires from the LEDs together. Insert the twisted pair into the one remaining open slot in the WAGO with the white power cord wire (also has the Timer 1 and Fill 7 wires). All slots in this WAGO are now filled. This step not shown in photos.

Find the WAGO connector with the Timer 2, Timer 5, Fill 4 and Drain 4 wires attached to it. Insert the black hot wire from the GFCI plug into the one remaining open slot on this WAGO connector. All slots in this WAGO are now filled.

Attach the remaining wires and spade connectors to the relay sockets and timer posts as labeled. The post numbers are etched on the sockets and timer but they are tiny, so look closely. When connecting wires to the sockets, insert the wires between the metal plates and be certain that no exposed wire is showing. Screw the relay socket posts very tightly. For relay socket terminals that have two wires attached to them, place the wires on opposite sides of the screws.

Arrange the sockets in the box base so that no wires can short against each other. See photo below, left. Screw the top onto the box with the timer arrow up. Remove the backing from the self adhesive strips on the box and attach to the control container, being sure to press the inside of the container to get good adhesion to the strips. Alternatively, you can put screws through the control container (above the waterline) into the project box at the top, by running self tapping screws (not provided) into the holes opposite the upper top screws of the box top. If metal screws are exposed inside your control container, seal with silicon to prevent rust. Place drain and fill labels on the box cover as shown below. This indicates where the fill and drain pumps will plug in.



## 5. Test the system.

- Read the operating warnings on the enclosed sheet.
- Plug pumps (<10 Amps) into their respective outlets.
- Place the fill-up pump in the reservoir and the drain-out pump in the control container; run tubing for each.
- KEEP THE DRAIN-OUT PUMP 3" FROM THE FLOAT SWITCHES – SEE WARNING ON MAGNETIC FIELDS.
- The end of each section of pump tubing must never be below where it connects to its pump to avoid siphon.
- Connect your pots to the control container.
- Shape wires in a way that creates "drip loops" so water that drips onto them cannot seep into connections.

- Fill the reservoir with water/nutrient and program the timer for the fill-up and drain-out cycles as desired. Each tab pushed in on the timer turns on the fill-up system for 15 minutes. When the fill-up system is off, the drain-out system is on and vice-versa. The float switches then control the pumping action of each of the fill and drain pumps. Test your system carefully and watch it at watering times for a few days to assure that it is working to your expectations.