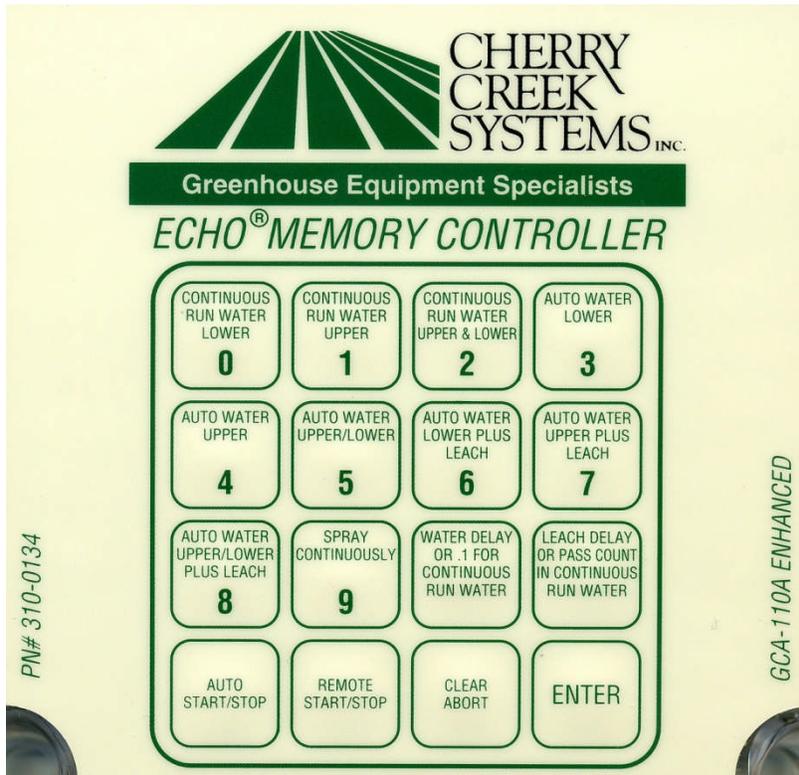


ECHO Enhanced Controller
“Continuous Run Water Mode”
GCA 110 ECHO Controller
Version 2A7

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1. Key Pad Layout and Definitions:



ECHO Controller Key Pad

Operator programming and setup is done via the keypad and LCD display. Ten automatic watering operations can be selected from the keypad. Automatic watering operations can be started and/or stopped via the keypad. Finally, the program settings can be changed to include **Pass Count** (the amount of times the ECHO will make a full rotation), **Auto Water time** (the time the basket stops to water), and **Leach time** (the Amount of time the baskets sits and waits after being watered).

The **Auto Start/Stop** key is used to start the programmed watering cycle. The **Remote Start/Stop** key is for the loading and unloading of product (turns on the motor, but not the watering functions). The **Clear / Abort** key is used to clear a programmable value.

Keypad Definitions:

0 CL

Continuous Run Water Lower (**CL**) mode

1 CU

Continuous Run Water Upper (**CU**) mode

2 CUL

Continuous Run Water Upper & Lower (**CUL**) mode

3 AL

Auto Water Lower (**AL**) mode

4 AU

Auto Water Upper (**AU**) mode

5 AUL

Auto Water Upper & Lower (**AUL**) mode

6 AL+

Auto Water Lower *plus* Leach (**AL+**) mode

7 AU+

Auto Water Upper *plus* Leach (**AU+**) mode

8 AUL+

Auto Water Upper & Lower *plus* Leach (**AUL+**) mode

9 SC

Spray Continuously (**SC**) mode

10 Water Delay

When this key is pressed, it will cause the controller prompt the user to enter the **Water Time**. The value is a countdown timer / delay for use in most of the automatic watering operations. * *definition following page* *

11 Leach Delay

When this key is pressed, it will cause the controller prompt the user to enter the **Leach Time**. The value is a countdown timer / delay for use in some of the automatic watering operations. * *definition following page* *

12 Auto Start/Stop

When this key is pressed, it will cause the controller to start an automatic watering operation or to stop an automatic watering operation that is currently in progress. * *definition following page* *

13 Remote Start/Stop

When this key is pressed, it will cause the controller run the motor if the motor is stopped and no automatic operation is currently in progress. It will cause the controller to stop the motor if it is running and no automatic operation is currently in progress. * *definition following page* *

14 Clear/Abort

When this key is pressed, it will Clear any info off the screen and enable the user to input new information.

15 Enter

When this key is pressed, it will Enter and Save the inputted data.

2. Concept Definitions:

Continuous Run Water:

When this operation is run the controller will continuously run the motor and water baskets as they pass by and trip the activator tab switches. Because the motor does not stop for a watering operation, the water timer is counted down in 10th of seconds rather than full seconds (25 = 2.5 seconds) and leaching does not apply.

Auto Water:

When this operation is run the controller will run the motor until the activator tab switches are activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the motor is started again. Because the motor stops for a watering operation, the water timer is counted down in full seconds (25 = 25 seconds)

Water Delay:

This value is used to determine the amount of time that water solenoid will be activated when a basket has entered a watering station. The same value is used for both the upper and lower watering solenoids. When in a ***Continuous Run Water*** mode, this value represents tenths of a second, where a value of 55 would run water for 5.5 seconds. When in any of the ***Auto Water*** modes, this value represents full seconds and a value of 15 would run water for 15 full seconds.

Leach: When watering is complete, the timer will be reset to the programmed leach time and both the water and the motor will remain off until the leach period expires, at which time the motor is started again.

Leach Delay:

This value is used to determine the amount of time after watering, that a basket will remain in the watering station to leach away excess water. When in an Auto Water mode with Leach, a basket will not be cleared from the station until the Leach time has elapsed. The same value is used for both the upper and lower watering stations. This value represents full seconds and a value of 15 would leach for 15 full seconds.

Spray Continuously:

When this operation is run the controller will simultaneously run the motor and the upper and lower water. This is the only mode in which the Pass Count does not determine when the operation is completed. This mode will run until stopped by the Auto Start/Stop key, the Clear/Abort key or the Remote Start/Stop switch input.

Auto Start/Stop: This button will Start and Stop the Programmed Watering Mode.

Remote Start/Stop: This button will Start and Stop the **Motor ONLY**.

3. Automatic Operations:

When the controller has been preset to specific automatic operation, the controller will display the characters codes at the top of each of the sections below to indicate what operation it has been set to. While that operation is running, the controller will alternately display the cycle counter and basket counter. The duration of all automatic operations, with the exception of Spray Continuously (SC), is determined by the combination of basket count and cycle count. Baskets are counted based in switch input to the controller where the switch is activated by basket hooks on the cable. This would imply that all baskets are counted, even though some automatic operations are only intended to water upper or lower baskets.

CL

Continuous Run Water Lower. When this operation is run the controller will continuously run the motor and water lower baskets as they pass by and trip the lower switch. Because the motor does not stop for a watering operation, the water timer is counted down in 10th of seconds rather than full seconds and leaching does not apply.

Continuous Motor Run
Senses Lower Switch only
Activates Lower Water Solenoid only
Waters for 1/10th programmed water time

CU

Continuous Run Water Upper. When this operation is run the controller will continuously run the motor and water upper baskets as they pass by and trip the upper switch. Because the motor does not stop for a watering operation, the water timer is counted down in 10th of seconds rather than full seconds and leaching does not apply.

Continuous Motor Run
Senses Upper Switch only
Activates Upper Water Solenoid only
Waters for 1/10th programmed water time

CUL

Continuous Run Water Upper & Lower. When this operation is run the controller will continuously run the motor and water both upper and lower baskets as they pass by and trip the upper and lower switches respectively. Because the motor does not stop for a watering operation, the water timer is counted down in 10th of seconds rather than full seconds and leaching does not apply.

Continuous Motor Run
Senses Upper & Lower Switches
Activates Upper & Lower Water Solenoid based on active switch input
Waters for 1/10th programmed water time

AL

Auto Water Lower. When this operation is run the controller will run the motor until the lower basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the motor is started again. Because the motor stops for a watering operation, the water timer is counted down in full seconds.

Motor Runs Until Basket Detected.
Senses Lower Switch only
Activates Lower Water Solenoid only
Waters for programmed water time
Leach – N/A

AU

Auto Water Upper. When this operation is run the controller will run the motor until the upper basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the motor is started again. Because the motor stops for a watering operation, the water timer is counted down in full seconds.

Motor Runs Until Basket Detected.
Senses Upper Switch only
Activates Upper Water Solenoid only
Waters for programmed water time
Leach – N/A

AUL

Auto Water Upper & Lower. When this operation is run the controller will run the motor until either the upper or lower basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the motor is started again. Because the motor stops for a watering operation, the water timer is counted down in full seconds.

Motor Runs Until Basket Detected.
Senses Upper & Lower Switches
Activates Upper & Lower Water Solenoid based on switch input
Waters for programmed water time
Leach – N/A

AL+

Auto Water Lower Plus Leach. When this operation is run the controller will run the motor until the lower basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. Because the motor stops for a watering and leaching operation, the water/leach timer is counted down in full seconds.

- Motor Runs Until Basket Detected.
- Senses Lower Switch only
- Activates Lower Water Solenoid only
- Waters for programmed water time
- Leaches for programmed leach time

AU+

Auto Water Upper Plus Leach. When this operation is run the controller will run the motor until the upper basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the timer will be reset to the programmed leach time and both the water and the motor will remain off until the leach period expires, at which time the motor is started again. Because the motor stops for a watering and leaching operation, the water/leach timer is counted down in full seconds.

- Motor Runs Until Basket Detected.
- Senses Upper Switch only
- Activates Upper Water Solenoid only
- Waters for programmed water time
- Leaches for programmed leach time

AUL+

Auto Water Upper & Lower Plus Leach. When this operation is run the controller will run the motor until either the upper or lower basket sensor switch is activated at which time the motor is stopped and the basket is watered for the programmed water time. When watering is complete, the timer will be reset to the programmed leach time and both the water and the motor will remain off until the leach period expires, at which time the motor is started again. Because the motor stops for a watering operation, the water timer is counted down in full seconds.

- Motor Runs Until Basket Detected.
- Senses Upper & Lower Switches
- Activates Upper & Lower Water Solenoid based on switch input
- Waters for programmed water time
- Leaches for programmed leach time

SC

Spray Continuously. When this operation is run the controller will simultaneously run the motor and the upper and lower water. This is the only mode in which the Pass Count does not determine when the operation is completed. This mode will run until stopped by the Auto Start/Stop key, the Clear/Abort key or the Remote Start/Stop switch input.

Continuous Motor Run
Continuous Upper & Lower Water
Water Time – N/A
Leach – N/A

Display Condition / Codes:

Enhanced End-of-Cycle Mode. System will use “timer” as the start and stop point on the ECHO cable run.

-:--

Basic End-of-Cycle Mode. System will use End-of-Cycle hanger as the start and stop point on the ECHO cable run.

.2.A.7

Switch Diagnostics. Each one of the decimal points (3 total) represents a switch input. The left dot is for the End-of-Cycle switch (top switch), the center dot is for the Upper Solenoid (middle switch), and the right dot is for the Lower Solenoid (bottom switch).

EHC

Enhanced Mode of Operation. Displayed after Reset, this shows that the ECHO is using the Enhanced Timing Mode for End-of-Cycle. After resetting controller, **pressing ENTER will say YES to the Enhanced Mode. Pressing CLEAR will say NO.**

EEE

Error Code. Displayed when the End-of-Cycle is NOT seen or upon resetting the controller. To clear and resume normal operation, **Press the 0 and ENTER keys simultaneously.** Then press either the **Enter key for Enhanced Mode** or press the **Clear/Abort for Basic Mode.** The Motor will start to turn the drum, then **depress the End-of-Cycle switch** to stop the Motor and return the controller to programming mode.

4. Enhanced vs. Basic Modes:

The Echo Controller operates in one of two modes: **Enhanced** or **Basic**. The selection of one of these modes is made right after the controller is Reset. Resetting is accomplished by pressing the **0** and **ENTER** keys at the same time. The controller will then display 2A7. This is the prompt for "do you want to enter Enhanced Mode?" If you press **ENTER** *this means yes, you want to enter Enhanced Mode*. If you want to enter **Basic Mode** press the **CLEAR** key. Once either of these keys is pressed then the motor will turn on and advance until an End-of Cycle-marker is seen. When detected the motor will stop and the display will have either "---" or "-:--" in it, representing Enhanced or Basic Modes, respectively.

In the **Enhanced Mode** the controller will advance the cable one complete revolution during the selected auto operation. The point on the cable at which the auto operation began is electronically marked. The controller will then count the amount of time the motor is on between baskets for each water or Continuous Run Water operation. The cable will advance until its equals to the previous stored value, which represents the time it takes for one revolution. The time it takes for the cable to make a complete revolution is updated each time the End of Cycle marker passes the watering station.

Two revolutions of the cable will never take exactly the same time, depending on a number of factors which include the number of stops during a revolution of the cable, the weight on the cable, how tight the cable is, and temperature. When each basket is watered the Echo normally stops and adds weight to the basket by adding water. Each one of these basket operations causes the Echo to coast slightly. The controller attempts to compensate for this coasting by subtracting a portion of the actual distance. If an auto operation is preformed repeatedly a cable revolution will be very accurately estimated. But, if the cable is running for a long period or baskets are added or removed from the echo the cable may not stop at very close to its starting point. During these periods it is advisable to identify the basket that was watered last prior to starting the auto mode. Another method to ensure that all baskets are watered is to start the auto watering operation and then stop it after a few baskets have been watered by pressing auto start/stop again. Starting the Echo again in auto mode will assure that the first couple of baskets are watered at least once. Remember that each time the auto mode, with the controller in the Enhanced mode, is started it will water what it believes is one full revolution of the cable and then stop.

In the **Basic Mode** the control will always stop when the end of cycle condition occurs. An End-of-Cycle marker must be sensed for the controller to automatically stop. There may be more than one End of Cycle marker on a cable. More than one marker will permit multiple crops on a single Echo. After the

controller stops at the End of Cycle marker the controller can be programmed for the next crop. One other advantage over the Enhanced Mode is that the Echo will always stop after the End of Cycle marker is sensed. The disadvantage is that the End of Cycle marker must always be at the point where the auto cycle will end. This is a distinct drawback when a second crop is under the Echo and the cable has been advanced. An example: Baskets that have been removed from or added to the cable without first removing the End of Cycle marker.

5. Remote Inputs:

***** There are 2 Remote Inputs to the controller *****

Remote Motor Start/Stop

This is the # 10 switch input to the terminal block on the controller. When the switch is pulled (activated) it will cause the controller run the motor if no automatic operation is currently in progress.

When the switch is pulled (activated) again, it will stop running the motor, if no automatic operation is currently in progress.

Remote Auto Start/Stop

This is the # 11 switch input to the terminal block on the controller. This input has the same functionality as the Auto Start / Stop key. As soon as the switch is activated, the controller will start the currently selected automatic operation. When the switch is activated again, it will cause the controller to stop an automatic operation currently in progress.

6. Wiring and Connections:

All external connections are made via the terminal strip connector on the large circuit board. There are 14 positions of screw terminals, the terminal housing plugs onto pins soldered into the circuit board. Pin 1 is located on the left-hand side of the board and pin 14 is on the right. The #'s of the pins are silk screened on the circuit board below the connector. Pin-outs for the board are as follows:

AC INTERFACE:

- P-1 120VAC / HOT / IN
- P-2 GROUND
- P-3 120VAC / NEUTRAL / IN
- P-4 120VAC / NEUTRAL / MOTOR OUT
- P-5 120VAC / HOT / MOTOR OUT
- P-6 24VAC Solenoid / COMMON / OUT
- P-7 24VAC Solenoid Switched / (LOWER) / OUT
- P-8 24VAC Solenoid Switched / (UPPER) / OUT

EXTERNAL SENSORS and CONTROLS:

- P-9 Sensor Ground / GROUND / IN
- P-10 Remote Switch / IN
- P-11 Remote Auto Start via Environmental Controls / IN
- P-12 End-of-Cycle Switch / IN
- P-13 LOWER Tab Activator Switch / IN
- P-14 UPPER Tab Activator Switch / IN

120Volt AC IN:

A 120VAC line is connected to P-1, -2, and -3. The Hot (or black) wire is connected to pin P-1. The Earth Ground (or green with yellow stripe) is connected to P-2. The Neutral (or white) is connected to P-3.

MOTOR AC OUT:

The ECHO drum motor is connected to pin 4, and -5. The Neutral (or white) wire is connected to P-4. The Hot (or black) is connected to P-5. Motor Earth Ground should be connected to P-2 or to another Earth Ground. Motor Neutral is connected directly AC in Neutral. Motor Hot is switched through a relay which will supply current when the LED identified as "MOTOR LED" is turned on.

WATER SOLENOIDS OUT:

The Water Solenoids are connected to pins 6, 7, and 8. 24 VAC is supplied to both solenoids via P-6. The 24 VAC is referenced to 0V or Earth Ground and is always present while AC power is applied to the controller. The Lower Level Solenoid is connected to P-7. The Upper Level Solenoid is connected to P-8. The appropriate "WATER LED" will light when the respective solenoid is being driven via its own triac.

EXTERNAL INPUTS:

External Sensors and Controls are on P-9 through P-14. All external inputs are pulled up towards +5V internally within the controller. The inputs are normally shorted to ground on P-9 but may also be driven between +12 and -12 volts, to improve the noise immunity. P-9 is the common logic ground for all input sensors and controls.

P-10 is the momentary Remote Start/Stop Switch, which is normally located near the watering station. **This switch will work only while the controller is not executing an AUTO WATER operation.**

P-11 is connected to a external auto start switch or driver, which could be controlled by an external computer system. If the cable length exceeds 15 feet it is recommended that the cable use for the **AUTO START** function is shielded. The shield should be directly connected to earth ground on one end. A convenient point would be the steel frame of the greenhouse; however the frame must be in direct contact with the earth. A separate wire should be used internally for the Sensor Ground, on P-9, as well as the Auto Start input on P-11. **Note: the controller has to have a mode previously selected, i.e. a Watering mode.** This input can only be used to start the auto operation, not stop it. Stopping the auto operation can only be done through the keyboard.

P-12 is connected to the top switch on the switch block at the watering station. When this switch is closed then opened again the End of Cycle function will be triggered. The End of Cycle function functions differently depending upon which mode the controller is in. In the normal Enhanced mode the switch is used to dynamically "measure" the length of the cable, it can change over time due to load on the cable and how tight the cable is. In the Basic mode the End of Cycle is used to stop the auto operation. If the End of Cycle function is not seen within 60 minutes of auto operation the controller when stopped will go to an error condition.

P-13 and P-14 are connected to the Upper and Lower solenoid switches located on the switch block located at the watering station. The middle switch is the Upper Switch and the bottom switch is the Lower Switch. The Upper and Lower Switches correspond directly to Upper and Lower Watering Solenoids. When a switch is closed then opened it will signal the controller that a upper or lower basket is under the watering station. If the controller is in the proper mode it will stop the motor and water the respective basket. These switches are also used with the End of Cycle Switch on P-12.

7. Wiring Diagram (AC Motor):

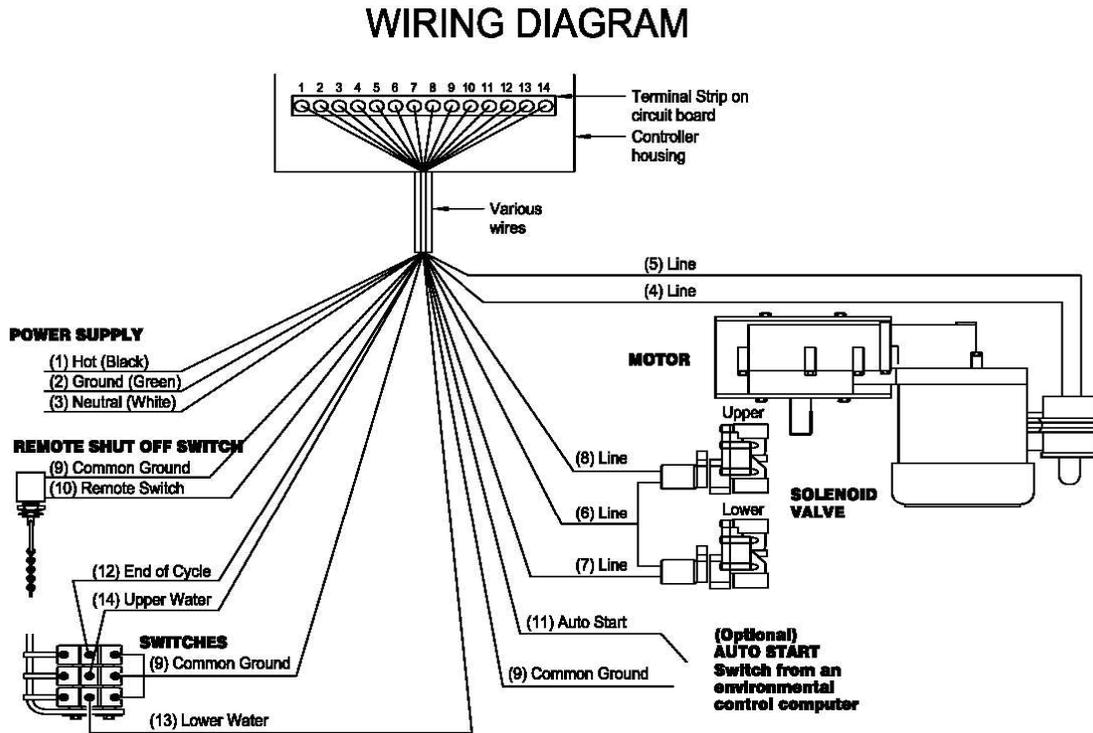
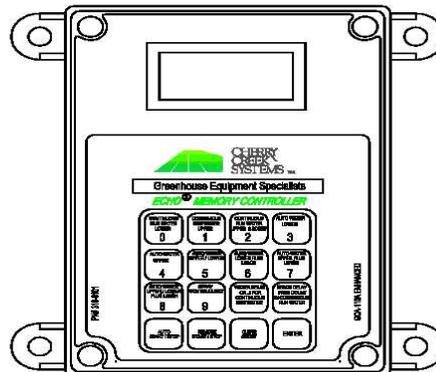
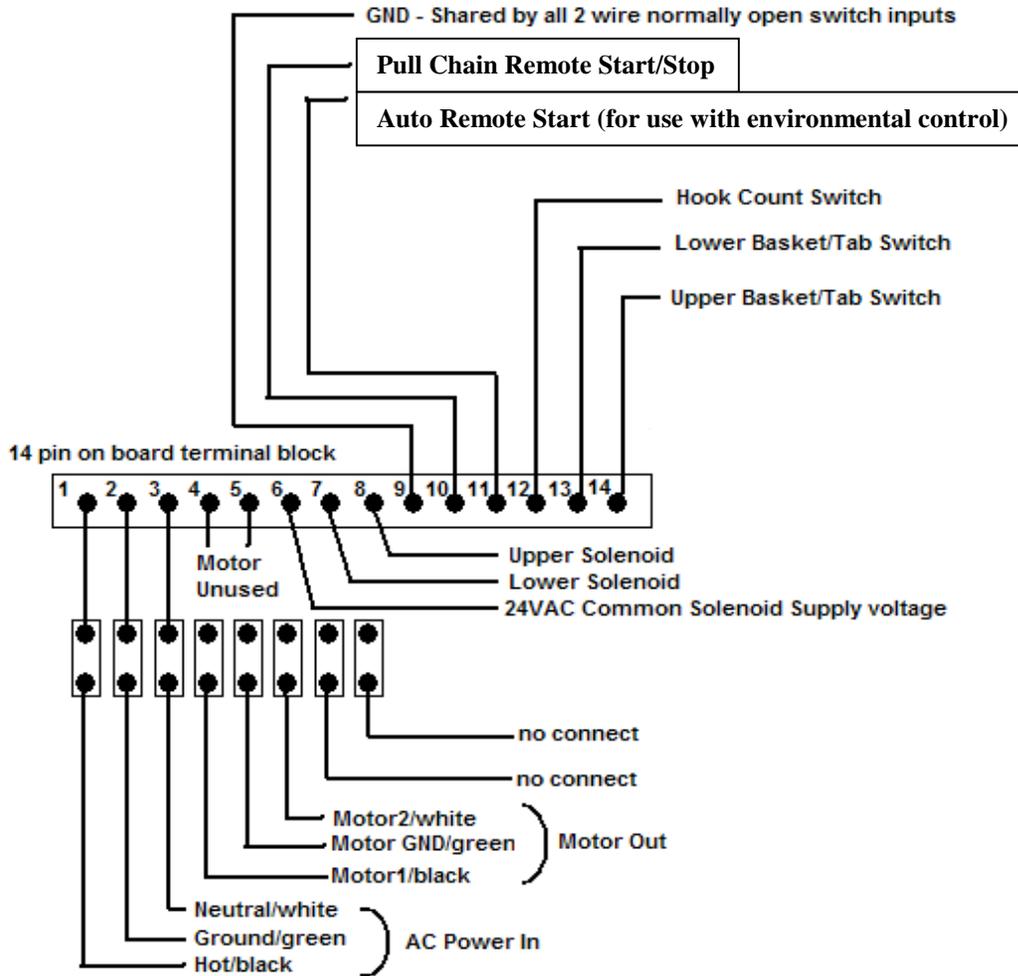


FIGURE 36
 GCA-110 Enhanced Controller Wiring Diagram



ENHANCED CONTROLLER

8. Wiring Diagram (DC Motor):



*****This diagram is for use with the DC Motor Upgrade installation*****

9. Reset and Set-Up:

The controller can be reset any time by pressing the **0 and ENTER** keys simultaneously. Resetting the controller should be done only when necessary. Two examples are; if the controller hangs up and does not respond or if you want to change the operating mode.

After the controller has been reset the display will show 2A7. The controller may be set to the Enhanced Mode by pressing ENTER or to the Basic Mode by pressing CLEAR. Once the correct key has been pressed the motor will start and the cable will advance until an end of cycle marker is detected. If any key on the keyboard is pressed before the End of Cycle is seen, the controller will detect an error and display EEE. **The only way to exit this mode is to reset the controller by pressing 0 and ENTER simultaneously.**

Once the controller has stopped the motor after detecting the End of Cycle marker the display will show the normally cleared pattern. For the Enhanced Mode it is three dashes (---) and for the Basic Mode it is three dashes with a colon (-:--). At this point either auto or manual modes may be used.

In the Enhanced Mode, when the End of Cycle marker crosses the switch station, the controller will store the time the motor must be on to make one revolution of the cable. If in Auto Mode the controller will stop the motor and end the Auto Mode. If in the Remote mode the cable will continue to advance and the time it took to make one revolution will be stored when the End of Cycle marker is detected.

In the Basic Mode the controller will always turn off the motor when an End of Cycle marker is detected. The time it took to make a revolution will not be stored.

To perform an auto operation the controller must have the display cleared, i.e. -- - or -:--. This is accomplished by pressing the CLEAR key. Select one of the 10 auto modes; 3 auto Continuous Run Water modes, 3 auto water modes, 3 auto water plus leach modes, and spray mode by pressing the respective key. The LCD will show the selected mode in the display. If you want to change it simply press CLEAR and select another mode. To start the Auto Mode press AUTO START/STOP key. The auto operation will begin and the controller will perform the selected auto operation. After one revolution of the cable the motor will stop. The LCD will still have the selected auto mode in the display.

10. Troubleshooting / Examples & Suggestions:

STARTING OR RESTARTING THE CONTROLLER:

1. Apply AC power to the ECHO System.
2. Be sure that a **End-of-Cycle marker** is on the cable at some point, if the marker is located just past the switch block it may take a half hour or more for the controller to find this marker (to make a full rotation). You may want to move it in front of the switch block.
3. Press the **O and ENTER** keys simultaneously, that is the upper left and lower right keys on the keypad. The display will have "2A7" after the keys have been released. The controller is asking 'Do you want to enter Enhanced Mode?'
4. Press the **ENTER** key for 'yes' and the **CLEAR** key for 'no'. After pressing one of the two keys the motor will start moving the cable.
5. When an **End-of-Cycle** is detected the motor will stop. The display will show the cleared condition, three dashes (---) for Enhanced Mode and three dashes plus a colon (- :--) for Basic Mode.
6. If the ECHO is in Basic Mode and the controller's setup is completed, then an auto operation will always end when an End of Cycle marker is detected.
7. If in Enhanced Mode, the controller will not complete its setup until it completes an auto operation. It is recommended a start stop operation similar to what will be normally used. An Auto Continuous Run Water Upper and Lower will start and stop at each basket. Here is a simulation of an Auto Water Upper and Lower.

STARTING AN AUTO WATER CYCLE USING THE 'ENHANCED TIMING' MODE:

From a cleared display press the desired **Auto mode** select key. [ex: Key '5' for Auto Water Upper and Lower]. The display will show 'AUL'. Press the **AUTO START/STOP** key to start the **Auto mode**. The ECHO will operate for one full rotation of the cable and return to its original starting point, just after the **End-of-Cycle marker** has passed the tab activator switch block.

At this point the cable length has been determined. The ECHO will make approximately one revolution of the cable regardless of where the End of Cycle marker is relative to the switch block.

CREATING A PERMANENT END OF CYCLE MARKER:

When operating in the Enhanced mode the controller requires an **End-of-Cycle** marker be attached permanently to a hook. An EOC hanger is provided for the Basic Mode but it is not suited to the Enhanced Mode because it must remain on the hook and without a basket it will most likely fall off or not hang straight enough to trip the switch. Use two Upper or Lower Hook Tabs to trip the top switch on a Lower Level Hook with a Basket Extension hanger. Place the two additional tabs at the position above where the upper basket marker would be placed. Place the second tab above the End-of-Cycle marker. This additional tab ensures that the End-of-Cycle switch will still be tripped even though there may not be a basket on the hook. Use this with a Lower Basket Tab and extension hanger and the End-of-Cycle switch will be tripped with or without a basket.

YOU ARE CONCERNED ABOUT THE ENHANCED MODE DRIFT:

As mentioned earlier the cable may not always stop in the same position as it started from when the last Auto Water operation was initiated. The drift usually is most noticeable when the load or the number of start-stop operations has changed. To monitor the drift you can place a marker on the first hook, which has just passed the watering station. With zero drift this should be at the same point as the previous Auto operation.

YOU ARE CONCERNED ABOUT MISSING THE FIRST HOOK OR TWO AT THE END OF THE AUTO WATER CYCLE:

This could result in possibly missing a basket or two. One remedy is to auto water a basket or two, then stop the auto mode. Then restart the auto watering. Each time the auto mode is started it electronically marks the spot on the cable as the starting point. By watering a couple of baskets before starting the second auto watering operation the controller will water its full cable revolution. If it does stop short of the full revolution then the possible missed baskets were watered by the first watering operation.