ECHO Enhanced Controller
"Hook Count Application"
**** Infrared Photo Sensors ****
GCA 110 ECHO Controller
Version 3.5

Change History:

Feb 01, 2005

By request from CCS, the switch input that was previously used as EOC (end of cycle) was converted to be used as a hook switch. Then after the sensor detects the presence of a basket, the water is not started until the hook next hook switch is activated. The use of the hook switch in conjunction with the sensor for basket present was implemented for Auto Water modes only.

Mar 16, 2005

By request from CCS, the use of the hook switch change from Feb 01, 2005 has now been implemented for the Continuous Run water modes as well as the Auto Water Modes that were converted on Feb 01, 2005. Revision was changed from E3.0 to E3.1 for this change.

May 22, 2005

Due to differences in EPROMs and chipsets on older model controllers, the code was rebuilt using Kiel Micro vision for better performance across most if not all of the legacy GCA 110 controller boards. No functional changes in the program between version E3.1 and E3.2. Revision was changed from E3.1 to E3.2 for this change.

May 9, 2006

Changed code to fix a display flicker issue when displaying a basket count of zero.
Revision was changed from E3.2 to E3.43for this change.

June 5, 2006

Changed documentation to reflect the code change that will now water both upper and lower baskets simultaneously if both are detected at the same time.
Revision was changed from E3.3 to E3.4 for this change.

October 19, 2007

Changed documentation regarding the DB2 (debounce out) setting for photo cells. There is no longer a DB2 Setting. The value is now hard coded to 3 seconds. Meaning, that once a photo cell or tab switch is activated, the controller will consider it to be active (plant/basket present) for 3 seconds.
Revision was changed from E3.4 to E3.5 for this change.

November 5, 2007

Changed documentation regarding the basket count setting. The code was changed so that when a basket count of zero has been set, that the basket counting switch will actually be used as an end of cycle switch. Meaning that the baskets are watered as soon as the upper or lower switch is activated, and the cycle will run until the end of cycle switch is activated.
Revision was changed from E3.5-1 to E3.5-2 for this change.

Table of Contents

1. Purpose:

The ECHO 3.x Firmware Application was created to extend the functionality of the GCA 110 ECHO Green House Controller. In order to make use of technology improvements in switching and basket detection, new firmware was needed that would enable the controller to make use of Infrared Photoelectric Sensors, such as the Omron E3JK-DS30M1 direct detect relay switch. In order to use such equipment effectively, the controller's firmware needed to be upgraded to allow for programmable de-bounce timers. By programming different values for the de-bounce timers, the controllers sensitivity to input switches can now be adjusted to work effectively with the current physical contact switches or the infrared photoelectric switches.
In addition to the switching enhancement, the ECHO 3.x Firmware Application has enhanced the operation of automatic watering modes by incorporating separately programmable settings for Basket Count and Cycle Count, which combine to add flexibility and reliability into the duration and control of the automatic watering modes.

Purpose of this document:

- To describe the primary differences between the ECHO 3.x Firmware Application and the previous ECHO 2A7 Firmware application.

- To describe the operational enhancements provided by the ECHO 3.x Firmware Application.

- To provide technical and programming information for the ECHO 3.x Firmware Application.

- To record the specific requirements and upgrade requests verbally provided by Cherry Creek Systems.

2. Differences from ECHO 2A7 Firmware Application:

One of the primary benefits of the ECHO 3.x application is its ability to properly process the input signals from Infrared Photoelectric sensors. In addition to this enhancement, the ECHO 3.x application does not require an Enhanced or Basic mode of operation to determine how run-time-cycles or duration will be handled. The new application now uses a programmable basket count and cycle count to determine the run time duration of the automatic watering modes instead of using electronically timed cycle durations. Baskets are counted by a switch input that is activated every time a basket hook on the cable passes the switch.

The previous 2A7 application had two operating modes, Basic which would run until and End of Cycle marker was encounter and Enhanced, which would run for an electronically timed cable length based on an earlier cycle in which the time to encounter and End of Cycle marker was measured and stored for future automatic watering operation.

With the ECHO 3.x application, the user can set a basket count, which can be used to indicate the number of baskets on the cable and thus be used to determine the passing of one full revolution. The user can also set a cycle-count, which will determine the number of full cycles or revolutions that an automatic watering operation should run for. While the 3.x application runs an automatic watering operation, it monitors the number of baskets that have been watered and the number of cycles or revolutions that have been made. An automatic watering operation will continue until the number of cycles reaches the pre-set cycle count. Two events can occur that will cause the current number of cycles to be incremented:

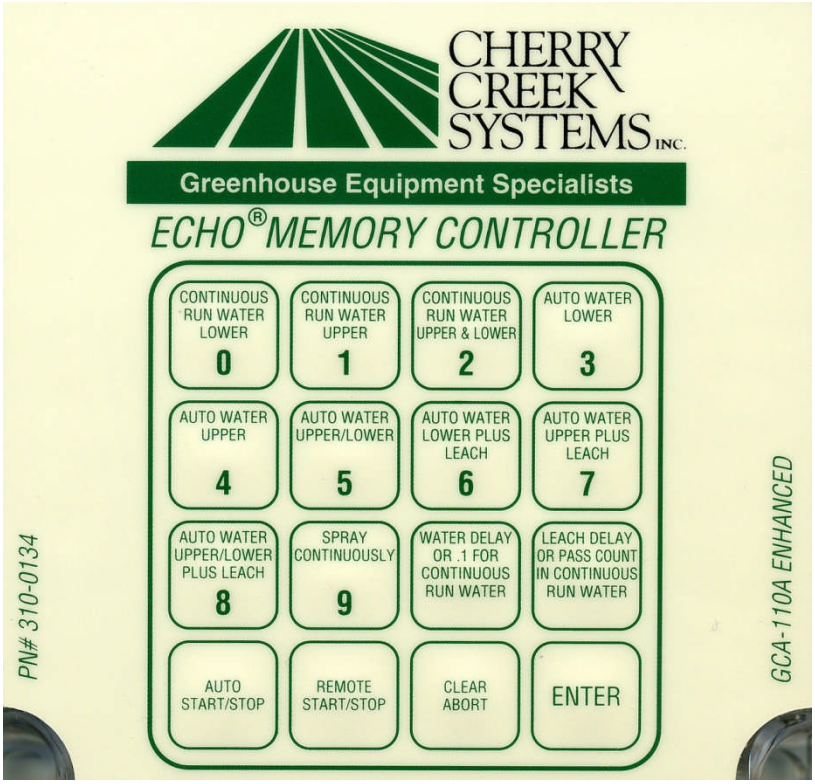
1. The current number of baskets encountered reaches the preset basket count.
2. An End-of-Cycle marker is encountered.

Once the current number of cycles reaches the pre-set cycle count, the automatic watering operation will be complete. The cycle count in the E3.x operation overtakes the Pass Count value used in the 2A7 application during Continuous Run Water modes.

For example, say a user has 1200 baskets on their cable, and no End of Cycle marker installed. If they set the basket count on the controller to 1200 and the cycle count to 3, and then start an automatic watering operation, then controller will run that operation until it has watered a total of 3600 baskets. Each time a cycle is counted, the number of baskets displayed will start over at 1.

While an automatic watering operation is running, the 3.x application alternates the display to show both the current cycle (incrementing counter) and the current number of baskets watered (decrementing counter). The current basket counter counts down from the preset basket count to zero. When the count reaches zero, the cycle count will be incremented counter reset to the preset basket count. When the controller is actually watering a basket, the number of seconds of water time remaining for the basket is displayed, and when the basket is complete, the controller will return to displaying the cycle counter and basket counter.

3. *Key Pad Layout and Definitions:*



ECHO Controller Key Pad

The keypad is a sealed membrane with tactile switches. The keypad is a 4 by 4 matrix of 16 individual keys. Operator interface to the controller for programming, setup is done via the keypad and LCD display. Ten automatic watering operations can be selected from they keypad. Automatic watering operations can be started and/or stopped via the keypad. And finally program settings can be changed to include, basket count, cycle count, water time, leach time, basket present de-bounce delay and basket absent de-bounce delay.

Each of the keys has one or more functions associated with them depending on the current mode that the controller is in and whether or not an automatic operation is currently in progress. The functions of most keys will only affect the controller when it is in programming mode – displaying the **E3.x** prompt on the LCD. The Auto Start/Stop and Remote Start/Stop keys only affect the controller after an automatic mode has been selected. The Clear / Abort key will affect the control in programming mode – to clear a programmable value or in an automatic mode, to stop or abort the current operation and to cause the controller to exit an automatic mode and return to the programming mode.

0 CL

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***basket count***. Otherwise, the key will select the Continuous Run Water Lower (**CL**) mode after 3 seconds.

1 CU

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***basket present de-bounce delay***. . Otherwise, the key will select the Continuous Run Water Upper (**CU)** mode after 3 seconds.

2 CUL

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***cycle count.*** Otherwise, the key will select the Continuous Run Water Upper & Lower (**CUL**) mode after 3 seconds.

3 AL

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Lower (**AL**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AL mode immediately.

4 AU

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper (**AU**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU mode immediately.

5 AUL

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper & Lower (**AUL**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU mode immediately.

6 AL+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Lower Plus Leach (**AL+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AL+ mode immediately.

7 AU+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper Plus Leach (**AU+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU+ mode immediately.

8 AUL+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper & Lower Plus Leach (**AUL+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AUL+ mode immediately.

9 SC

This key has one function. When this key is pressed, it will cause the controller to enter the Spray Continuously (**SC**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter SC mode immediately

10 Water Delay

This key has one function. 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.

11 Leach Delay

This key has one function. 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.

12 Auto Start/Stop

This key has one function. 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.

13 Remote Start/Stop

This key has one function. 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.

14 Clear/Abort

This key's functionality will depend on what the controller is doing at the time. When the controller is in programming mode and entering one of the programmable settings, this key will clear the setting currently being entered. If the controller is set for an automatic operation, but that operation is not currently in progress, this key will cause the controller to go back to programming mode. If an automatic operation is currently in progress, this key will stop the current operation.

15 Enter

This key is primarily used when entering the programmable settings. After a value has been entered, this key will cause the controller to store the new value and return to the programming mode prompt **E3.x**

4. Programming and Setup:

****** There are 6 programmable settings for the ECHO 3.x application ******

Basket Count:

This is normally the number of baskets on the cable, used by the controller to know when one full revolution of the cable has been completed. Valid values are from 0 to 1999. This value is counted down during an automatic operation. Baskets are counted by a switch input that is activated every time a basket hook on the cable passes the switch.

To enter the basket count, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***0*** (zero) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current basket count value or ***bc*** if the current basket count is 0.

The Clear/Abort key will clear the current value and display ***bc*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

De-bounce 1:

Basket Present. This is the switch de-bounce delay in HZ that is used to determine that a basket has entered the watering station. When the switch signal is continuously present for this amount of time, the controller will assume that a basket has just entered the watering station. Valid values are from 0 to 254. A value of 60 would indicate a de-bounce delay of 60HZ or 1 second, and a value of 120 would indicate 2 seconds, etc.

To enter the basket present de-bounce delay, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***1*** (one) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current de-bounce value or ***db1*** if the de-bounce delay setting is 0.

The Clear/Abort key will clear the current value and display ***db1*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

De-bounce 2:

****** As of code version 3.5, the DB2 setting is no longer needed. The code has been modified so that the value is internally set to 3 seconds to reduce programming complexity. ******

Basket Absent. This is the switch de-bounce delay in HZ that is used to determine that a basket has cleared the watering station. When the switch signal is continuously absent for this amount of time, the controller will assume that any baskets have cleared the watering station. Valid values are from 0 to 254. A value of 60 would indicate a de-bounce delay of 60HZ or 1 second, and a value of 120 would indicate 2 seconds.

To enter the basket absent de-bounce delay the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***2*** (two) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current de-bounce value or ***db2*** if the de-bounce delay setting is 0.

The Clear/Abort key will clear the current value and display ***db2*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

Cycle Count:

This is the number of cycles or revolutions that the controller should run during an automatic watering operation. The Basket Count setting determines the length of a single cycle. Valid values are from 0 to 99.

To enter the cycle count, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***2*** (two) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current basket count value or ***CC*** if the current cycle count is 0.

The Clear/Abort key will clear the current value and display ***CC*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

Water Delay:

This value is used to determine the amount of time that water solenoid will be activated for 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. Valid values are from 0 to 254.

To enter the water time, the controller must be in programming mode – displaying **E3.x** on the LCD.
From this mode, press the ***Water Delay*** key
The controller will display the current water time value or ***S-*** if the current value is 0.
The Clear/Abort key will clear the current value and display ***S-*** allowing a new value to be entered.
Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

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. Valid values are from 0 to 254.
To enter the leach time, the controller must be in programming mode – displaying **E3.x** on the LCD.
From this mode, press the ***Leach Delay*** key
The controller will display the current water time value or ***LCH*** if the current value is 0.
The Clear/Abort key will clear the current value and display ***LCH*** allowing a new value to be entered.
Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

5. 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 active 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. 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 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 active 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 basket count and cycle count do 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

6. Remote Inputs:

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

Remote Auto Start/Stop (for use w/ Environmental Controls):

This is a 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.

Remote Motor Start/Stop (for use with Pull Chain Remote Switch):

This is a switch input to the terminal block on the controller. When the switch is turned on (pulled high) it will cause the controller run the motor if no automatic operation is currently in progress. When the switch is turned on (pulled high) again, it will stop running the motor, if no automatic operation is currently in progress.

7. 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 an 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.

8. Wiring Diagram (AC Motor):

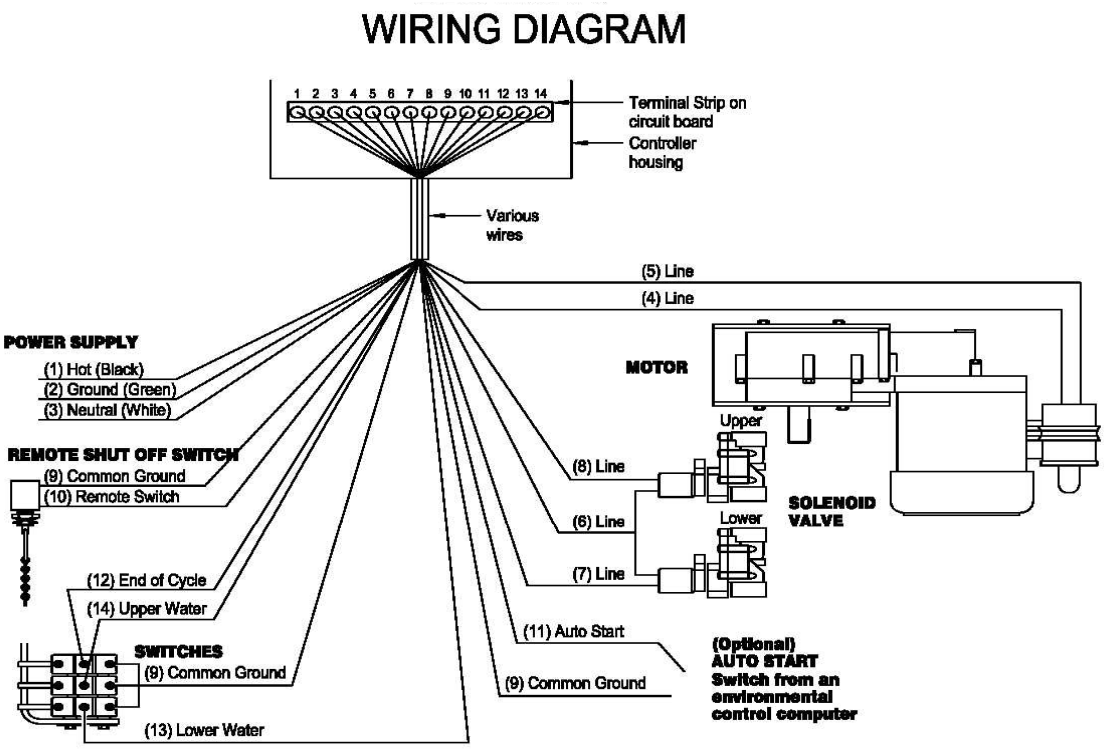
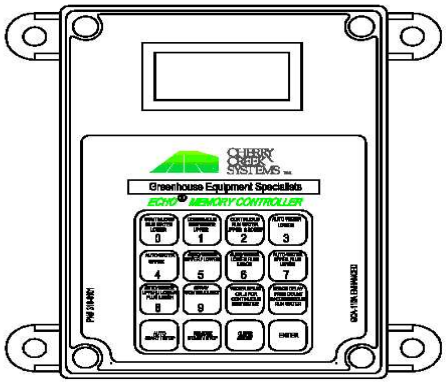


FIGURE 36

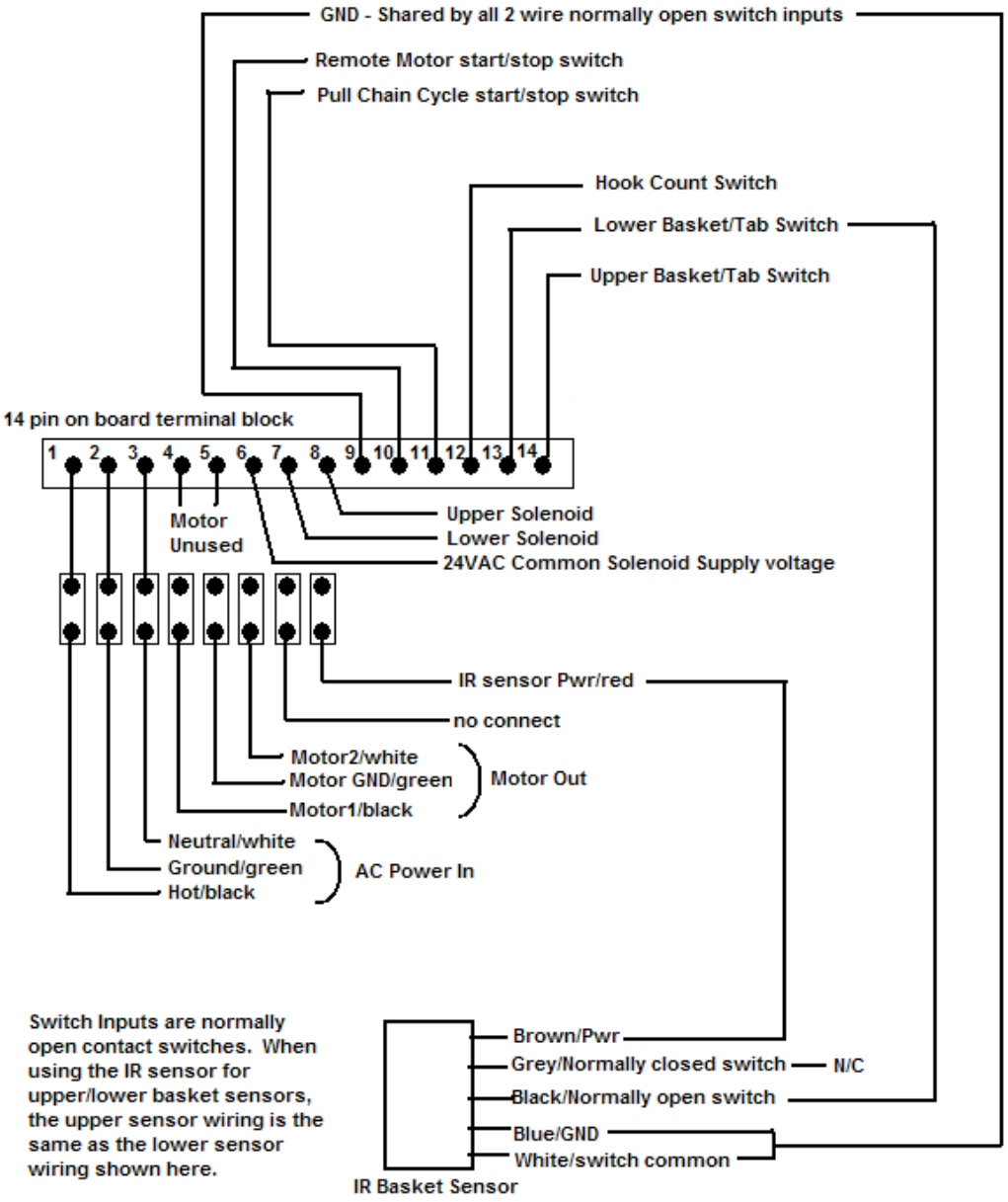
GCA-110 Enhanced Controller Wiring Diagram



ENHANCED CONTROLLER

9. Wiring Diagram (DC Motor & Photo-Eyes):

ECHO Wiring - GCA 110 Hardware
E 3.5 Firmware



Wiring the Photo-Eyes:

The photocells have 5 wires. The brown and blue are for the power supply, the white is the common of the relay output, and the black is the normally open and the grey is the normally closed.
The echo connections used will be pins 1, 2, 9, 12, 13, and 14. 1is AC hot, 2 is the ground, 9 is the common for the lever switches, 12 is the end of cycle input, 13 is the lower water input, and 14 is the upper water input.
Removing the wires from pins 1 and 2 and installing a short wire will make the conversion easier.
Remove the existing wire from pin 1 and install a short wire (approximately 6”), connect the brown wires from the photocells and the original wire (black) to the loose end of the wire now in pin 1.
Remove the existing wire from pin 2 and install a short wire (similar to the one used in pin 1). Connect the blue and white wires from the photocells and the original wire from pin 2 (green) to the loose end of the wire in pin 2.
The grey wire from the lower photocell replaces the wire in pin 13 (old wire is no longer used).
The grey wire from the upper photocell replaces the wire in pin 14 (old wire is no longer used).
The end of cycle switch is now the hook counter. The common terminal connects to pin 9 and the normally open terminal connects to pin 12 (this is the same as before).
The black wires from the photocells are not used. Clip or tape the ends.

Additional Notes:

****** These notes are provided as a summary of the major changes from previous program versions for the GCA 110 ECHO controllers ******

The new program is the *E3.x*, which is displayed on the 1st screen

- *Press **0 and then enter** (first push **0**, followed by **enter**; not at same time) to program the **basket count**. Press **clear abort** to change, or **enter** to leave the info the same. To change, press the **clear abort**, and "bc" will appear on the display. Type in the hook count number (up to 1999) and press **enter**.*

- *Press **1 and then enter** for the **de-bounce time** (when the basket is approaching the sensors). The previous time appears on the display (in hertz, 45 would be ¾ second, 60 is 1 second, 120 is 2 seconds etc.). To change press **clear abort** (db1 appears on the display) and type in new time. Press **enter**. If no change is necessary press **enter.***

- *Press **2 and then enter** for the **cycle count**. Current default number is displayed. The cycle count is the number of full irrigation revolutions that the system makes (1 full revolution is made when the system counts the hooks down to zero). Changing is the same procedure, press **clear abort**, type in the new number, and then press **enter.***

- *To change water delay, press water delay, clear abort, and type in new number and enter.*

- *To change the leach delay, press leach delay, clear abort and type in new number and enter.*

The watering programs are the same as before, continuous run waters without stopping the motor. The water time is still one tenth of the actual setting in continuous.
The major change is that there is no longer an enhanced and basic mode. Hook count and cycle count determine how long the system runs.

****** When a mode is selected, first that number appears on the display followed by the letters. If you select continuous run upper and lower by pressing 2, first you will see 2 and then CUL ******

Display Condition / Codes:

.E.3.5

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.

ECHO Enhanced Controller
"Hook Count Application"
Activator Tabs
GCA 110 ECHO Controller
Version 3.5

Change History:

Feb 01, 2005

By request from CCS, the switch input that was previously used as EOC (end of cycle) was converted to be used as a hook switch. Then after the sensor detects the presence of a basket, the water is not started until the hook next hook switch is activated. The use of the hook switch in conjunction with the sensor for basket present was implemented for Auto Water modes only.

Mar 16, 2005

By request from CCS, the use of the hook switch change from Feb 01, 2005 has now been implemented for the Continuous Run water modes as well as the Auto Water Modes that were converted on Feb 01, 2005.
Revision was changed from E3.0 to E3.1 for this change.

May 22, 2005

Due to differences in EPROMs and chipsets on older model controllers, the code was rebuilt using Kiel Micro vision for better performance across most if not all of the legacy GCA 110 controller boards. No functional changes in the program between version E3.1 and E3.2.
Revision was changed from E3.1 to E3.2 for this change.

May 9, 2006

Changed code to fix a display flicker issue when displaying a basket count of zero.
Revision was changed from E3.2 to E3.43for this change.

June 5, 2006

Changed documentation to reflect the code change that will now water both upper and lower baskets simultaneously if both are detected at the same time.
Revision was changed from E3.3 to E3.4 for this change.

October 19, 2007

Changed documentation regarding the DB2 (debounce out) setting for photo cells. There is no longer a DB2 Setting. The value is now hard coded to 3 seconds. Meaning, that once a photo cell or tab switch is activated, the controller will consider it to be active (plant/basket present) for 3 seconds.
Revision was changed from E3.4 to E3.5 for this change.

November 5, 2007

Changed documentation regarding the basket count setting. The code was changed so that when a basket count of zero has been set, that the basket counting switch will actually be used as an end of cycle switch. Meaning that the baskets are watered as soon as the upper or lower switch is activated, and the cycle will run until the end of cycle switch is activated.
Revision was changed from E3.5-1 to E3.5-2 for this change.

Table of Contents

1. Purpose:

The ECHO 3.x Firmware Application was created to extend the functionality of the GCA 110 ECHO Green House Controller. In order to make use of technology improvements in switching and basket detection, new firmware was needed that would enable the controller to make use of Infrared Photoelectric Sensors, such as the Omron E3JK-DS30M1 direct detect relay switch. In order to use such equipment effectively, the controller's firmware needed to be upgraded to allow for programmable de-bounce timers. By programming different values for the de-bounce timers, the controllers sensitivity to input switches can now be adjusted to work effectively with the current physical contact switches or the infrared photoelectric switches.
In addition to the switching enhancement, the ECHO 3.x Firmware Application has enhanced the operation of automatic watering modes by incorporating separately programmable settings for Basket Count and Cycle Count, which combine to add flexibility and reliability into the duration and control of the automatic watering modes.

Purpose of this document:

- To describe the primary differences between the ECHO 3.x Firmware Application and the previous ECHO 2A7 Firmware application.

- To describe the operational enhancements provided by the ECHO 3.x Firmware Application.

- To provide technical and programming information for the ECHO 3.x Firmware Application.

- To record the specific requirements and upgrade requests verbally provided by Cherry Creek Systems.

2. Differences from ECHO 2A7 Firmware Application:

One of the primary benefits of the ECHO 3.x application is its ability to properly process the input signals from Infrared Photoelectric sensors. In addition to this enhancement, the ECHO 3.x application does not require an Enhanced or Basic mode of operation to determine how run-time-cycles or duration will be handled. The new application now uses a programmable basket count and cycle count to determine the run time duration of the automatic watering modes instead of using electronically timed cycle durations. Baskets are counted by a switch input that is activated every time a basket hook on the cable passes the switch.

The previous 2A7 application had two operating modes, Basic which would run until and End of Cycle marker was encounter and Enhanced, which would run for an electronically timed cable length based on an earlier cycle in which the time to encounter and End of Cycle marker was measured and stored for future automatic watering operation.

With the ECHO 3.x application, the user can set a basket count, which can be used to indicate the number of baskets on the cable and thus be used to determine the passing of one full revolution. The user can also set a cycle-count, which will determine the number of full cycles or revolutions that an automatic watering operation should run for. While the 3.x application runs an automatic watering operation, it monitors the number of baskets that have been watered and the number of cycles or revolutions that have been made. An automatic watering operation will continue until the number of cycles reaches the pre-set cycle count. Two events can occur that will cause the current number of cycles to be incremented:

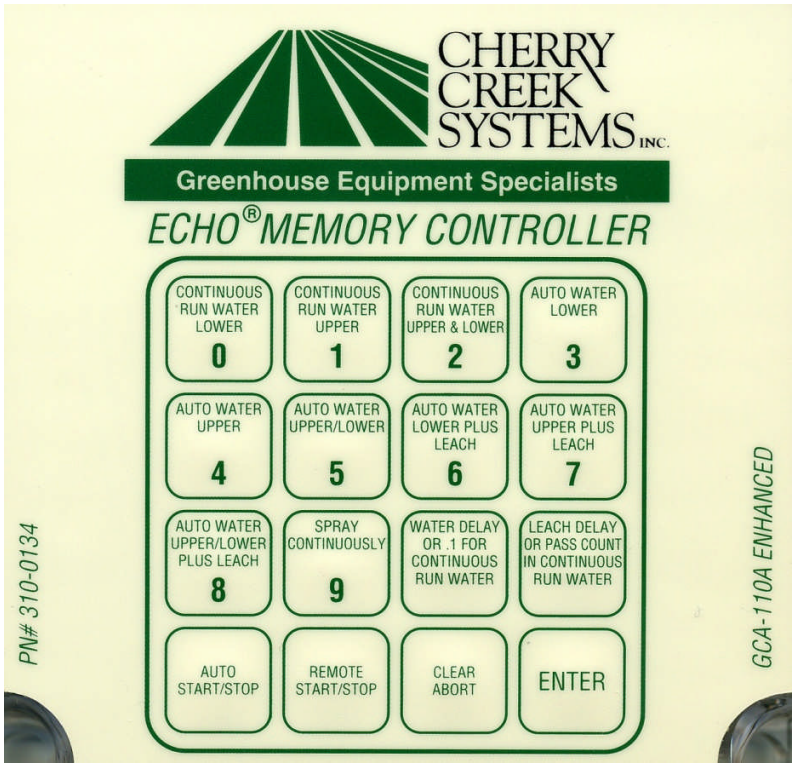
1. The current number of baskets encountered reaches the preset basket count.
2. An End-of-Cycle marker is encountered.

Once the current number of cycles reaches the pre-set cycle count, the automatic watering operation will be complete. The cycle count in the E3.x operation overtakes the Pass Count value used in the 2A7 application during Continuous Run Water modes.

For example, say a user has 1200 baskets on their cable, and no End of Cycle marker installed. If they set the basket count on the controller to 1200 and the cycle count to 3, and then start an automatic watering operation, then controller will run that operation until it has watered a total of 3600 baskets. Each time a cycle is counted, the number of baskets displayed will start over at 1.

While an automatic watering operation is running, the 3.x application alternates the display to show both the current cycle (incrementing counter) and the current number of baskets watered (decrementing counter). The current basket counter counts down from the preset basket count to zero. When the count reaches zero, the cycle count will be incremented counter reset to the preset basket count. When the controller is actually watering a basket, the number of seconds of water time remaining for the basket is displayed, and when the basket is complete, the controller will return to displaying the cycle counter and basket counter.

3. Key Pad Layout and Definitions:



ECHO Controller Key Pad

The keypad is a sealed membrane with tactile switches. The keypad is a 4 by 4 matrix of 16 individual keys. Operator interface to the controller for programming, setup is done via the keypad and LCD display. Ten automatic watering operations can be selected from they keypad. Automatic watering operations can be started and/or stopped via the keypad. And finally program settings can be changed to include, basket count, cycle count, water time, leach time, basket present de-bounce delay and basket absent de-bounce delay.

Each of the keys has one or more functions associated with them depending on the current mode that the controller is in and whether or not an automatic operation is currently in progress. The functions of most keys will only affect the controller when it is in programming mode – displaying the **E3.x** prompt on the LCD. The Auto Start/Stop and Remote Start/Stop keys only affect the controller after an automatic mode has been selected. The Clear / Abort key will affect the control in programming mode – to clear a programmable value or in an automatic mode, to stop or abort the current operation and to cause the controller to exit an automatic mode and return to the programming mode.

0 CL

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***basket count***. Otherwise, the key will select the Continuous Run Water Lower (**CL**) mode after 3 seconds.

1 CU

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***basket present de-bounce delay***. . Otherwise, the key will select the Continuous Run Water Upper (**CU)** mode after 3 seconds.

2 CUL

This key has two functions. When programming, if this key is pressed and then followed by the ***Enter*** key within 3 seconds it will cause the controller to prompt the user to enter the ***cycle count.*** Otherwise, the key will select the Continuous Run Water Upper & Lower (**CUL**) mode after 3 seconds.

3 AL

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Lower (**AL**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AL mode immediately.

4 AU

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper (**AU**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU mode immediately.

5 AUL

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper & Lower (**AUL**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU mode immediately.

6 AL+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Lower Plus Leach (**AL+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AL+ mode immediately.

7 AU+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper Plus Leach (**AU+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AU+ mode immediately.

8 AUL+

This key has one function. When this key is pressed, it will cause the controller to enter the Auto Water Upper & Lower Plus Leach (**AUL+**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter AUL+ mode immediately.

9 SC

This key has one function. When this key is pressed, it will cause the controller to enter the Spray Continuously (**SC**) mode within 3 seconds. If the ***Enter*** key is then pressed within that 3 seconds it will cause the controller enter to enter SC mode immediately

10 Water Delay

This key has one function. 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.

11 Leach Delay

This key has one function. 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.

12 Auto Start/Stop

This key has one function. 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.

13 Remote Start/Stop

This key has one function. 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.

14 Clear/Abort

This key's functionality will depend on what the controller is doing at the time. When the controller is in programming mode and entering one of the programmable settings, this key will clear the setting currently being entered. If the controller is set for an automatic operation, but that operation is not currently in progress, this key will cause the controller to go back to programming mode. If an automatic operation is currently in progress, this key will stop the current operation.

15 Enter

This key is primarily used when entering the programmable settings. After a value has been entered, this key will cause the controller to store the new value and return to the programming mode prompt **E3.x**

4. Programming and Setup:

****** There are 6 programmable settings for the ECHO 3.x application ******

Basket Count:

This is normally the number of baskets on the cable, used by the controller to know when one full revolution of the cable has been completed. Valid values are from 0 to 1999. This value is counted down during an automatic operation. Baskets are counted by a switch input that is activated every time a basket hook on the cable passes the switch.

To enter the basket count, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***0*** (zero) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current basket count value or ***bc*** if the current basket count is 0.

The Clear/Abort key will clear the current value and display ***bc*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

De-bounce 1:

Basket Present. This is the switch de-bounce delay in HZ that is used to determine that a basket has entered the watering station. When the switch signal is continuously present for this amount of time, the controller will assume that a basket has just entered the watering station. Valid values are from 0 to 254. A value of 60 would indicate a de-bounce delay of 60HZ or 1 second, and a value of 120 would indicate 2 seconds, etc.

To enter the basket present de-bounce delay, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***1*** (one) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current de-bounce value or ***db1*** if the de-bounce delay setting is 0.

The Clear/Abort key will clear the current value and display ***db1*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

De-bounce 2:

****** As of code version 3.5, the DB2 setting is no longer needed. The code has been modified so that the value is internally set to 3 seconds to reduce programming complexity. ******

Basket Absent. This is the switch de-bounce delay in HZ that is used to determine that a basket has cleared the watering station. When the switch signal is continuously absent for this amount of time, the controller will assume that any baskets have cleared the watering station. Valid values are from 0 to 254. A value of 60 would indicate a de-bounce delay of 60HZ or 1 second, and a value of 120 would indicate 2 seconds.

To enter the basket absent de-bounce delay the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***2*** (two) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current de-bounce value or ***db2*** if the de-bounce delay setting is 0.

The Clear/Abort key will clear the current value and display ***db2*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

Cycle Count:

This is the number of cycles or revolutions that the controller should run during an automatic watering operation. The Basket Count setting determines the length of a single cycle. Valid values are from 0 to 99.

To enter the cycle count, the controller must be in programming mode – displaying **E3.x** on the LCD.

From this mode, press the ***2*** (two) key and then press the ***Enter*** key within 3 seconds.

The controller will display the current basket count value or ***CC*** if the current cycle count is 0.

The Clear/Abort key will clear the current value and display ***CC*** allowing a new value to be entered.

Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

Water Delay:

This value is used to determine the amount of time that water solenoid will be activated for 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. Valid values are from 0 to 254.

To enter the water time, the controller must be in programming mode – displaying **E3.x** on the LCD.
From this mode, press the ***Water Delay*** key
The controller will display the current water time value or ***S-*** if the current value is 0.
The Clear/Abort key will clear the current value and display ***S-*** allowing a new value to be entered.
Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

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. Valid values are from 0 to 254.
To enter the leach time, the controller must be in programming mode – displaying **E3.x** on the LCD.
From this mode, press the ***Leach Delay*** key
The controller will display the current water time value or ***LCH*** if the current value is 0.
The Clear/Abort key will clear the current value and display ***LCH*** allowing a new value to be entered.
Once the desired value is keyed in, pressing the ***Enter*** key will cause the controller to store the value and return to programming mode.

5. 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 active 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. 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 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 active 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 basket count and cycle count do 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

6. Remote Inputs:

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

Remote Auto Start/Stop (for use w/ Environmental Controls):

This is a 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.

Remote Motor Start/Stop (for use with Pull Chain Remote Switch):

This is a switch input to the terminal block on the controller. When the switch is turned on (pulled high) it will cause the controller run the motor if no automatic operation is currently in progress. When the switch is turned on (pulled high) again, it will stop running the motor, if no automatic operation is currently in progress.

7. 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.

8. Wiring Diagram (AC Motor):

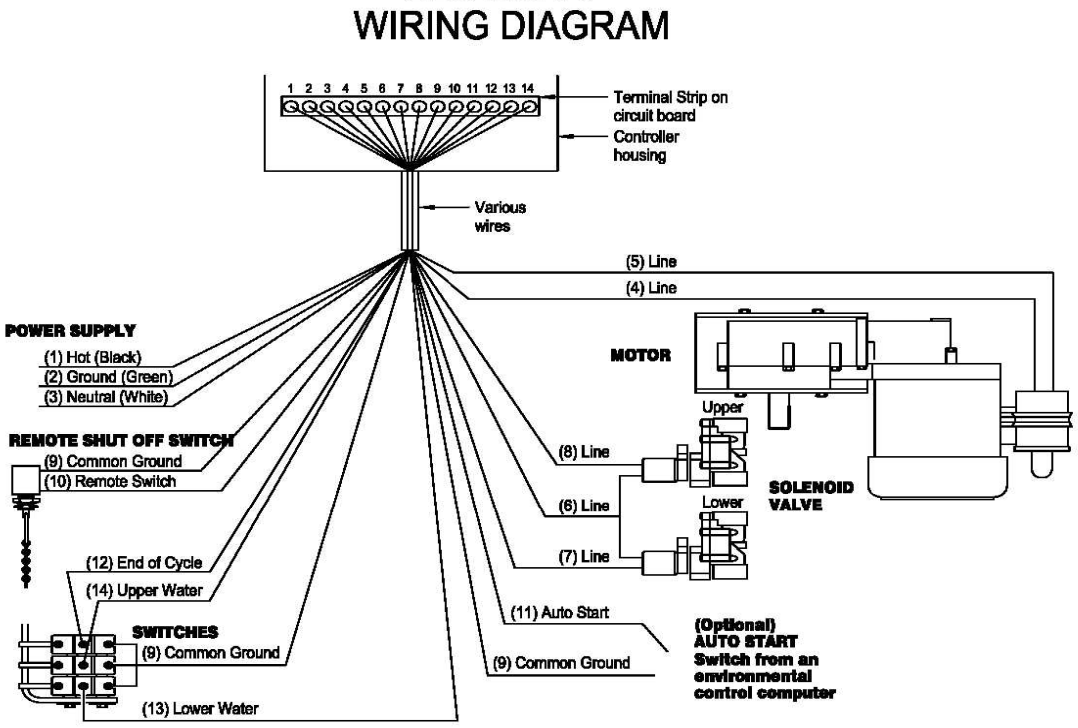
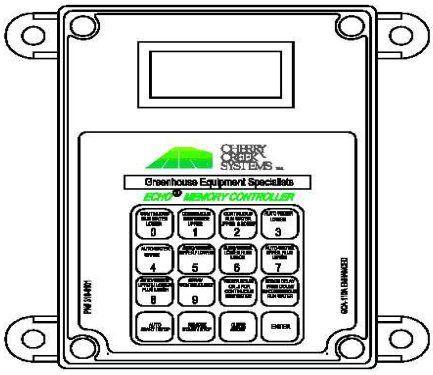


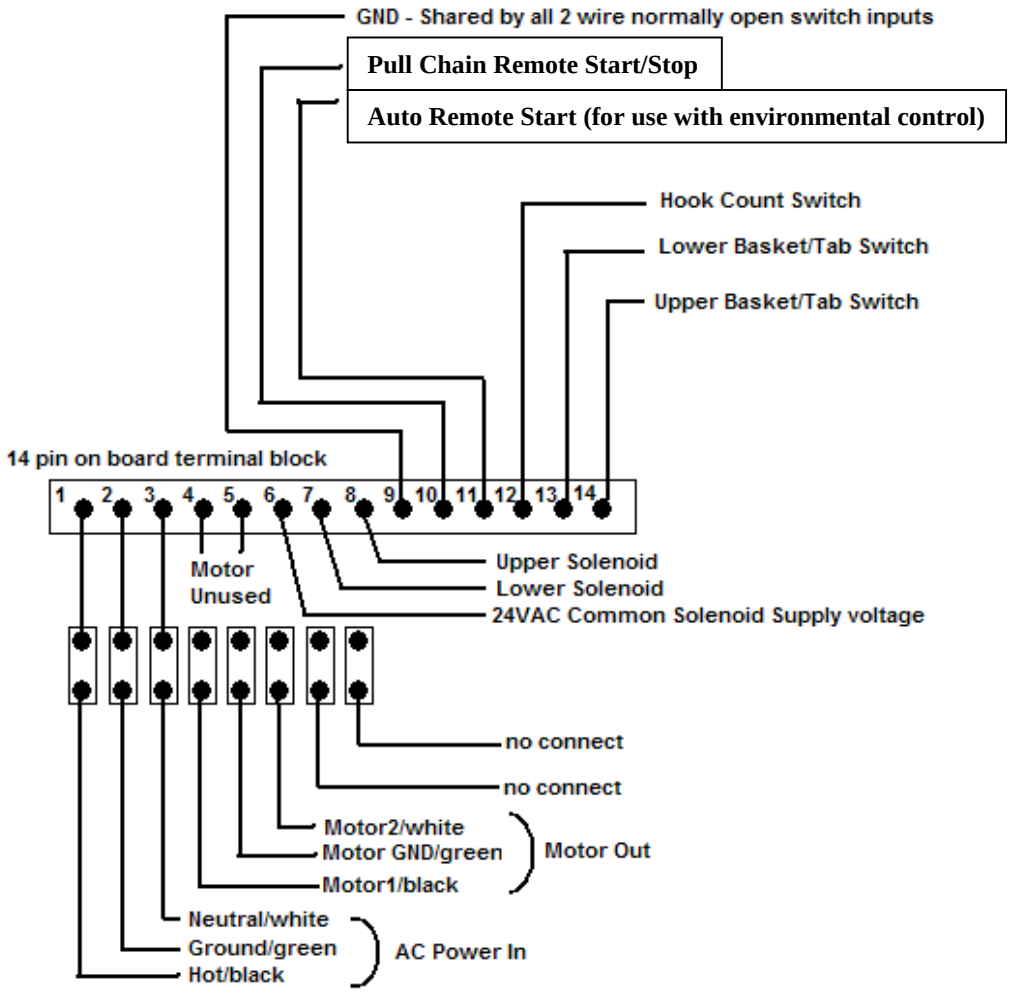
FIGURE 36

GCA-110 Enhanced Controller Wiring Diagram



ENHANCED CONTROLLER

9. Wiring Diagram (DC Motor):



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

Additional Notes:

****** These notes are provided as a summary of the major changes from previous program versions for the GCA 110 ECHO controllers ******

The new program is the *E3.x*, which is displayed on the 1st screen

- *Press **0 and then enter** (first push **0**, followed by **enter**; not at same time) to program the **basket count**. Press **clear abort** to change, or **enter** to leave the info the same. To change, press the **clear abort**, and "bc" will appear on the display. Type in the hook count number (up to 1999) and press **enter**.*

- *Press **1 and then enter** for the **de-bounce time** (when the basket is approaching the sensors). The previous time appears on the display (in hertz, 45 would be ¾ second, 60 is 1 second, 120 is 2 seconds etc.). To change press **clear abort** (db1 appears on the display) and type in new time. Press **enter**. If no change is necessary press **enter.***

- *Press **2 and then enter** for the **cycle count**. Current default number is displayed. The cycle count is the number of full irrigation revolutions that the system makes (1 full revolution is made when the system counts the hooks down to zero). Changing is the same procedure, press **clear abort**, type in the new number, and then press **enter.***

- *To change water delay, press water delay, clear abort, and type in new number and enter.*

- *To change the leach delay, press leach delay, clear abort and type in new number and enter.*

The watering programs are the same as before, continuous run waters without stopping the motor. The water time is still one tenth of the actual setting in continuous.
The major change is that there is no longer an enhanced and basic mode. Hook count and cycle count determine how long the system runs.

****** When a mode is selected, first that number appears on the display followed by the letters. If you select continuous run upper and lower by pressing 2, first you will see 2 and then CUL ******

Display Condition / Codes:

.E.3.5

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

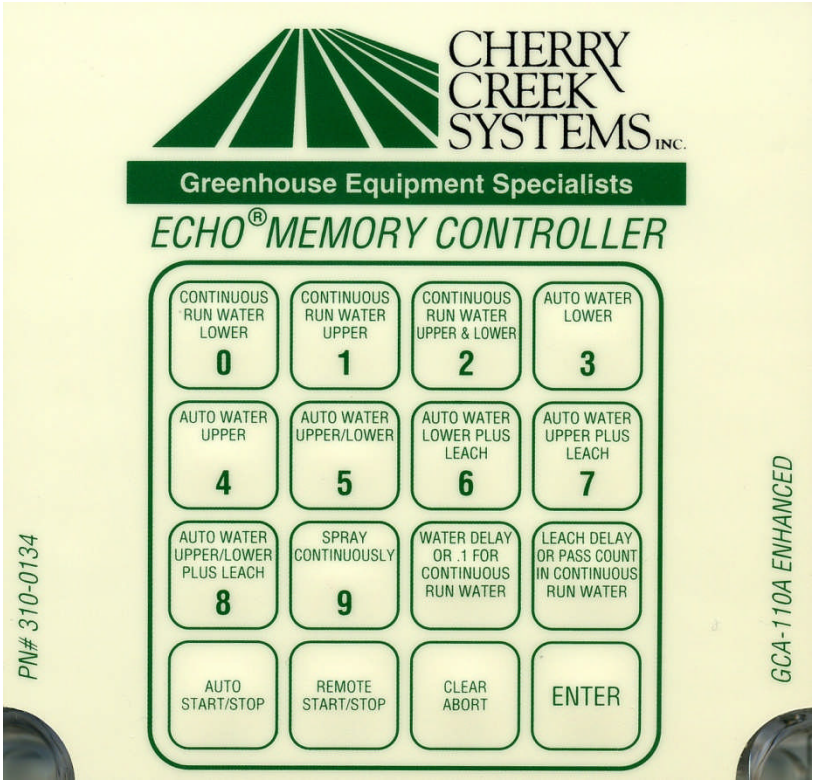
EEE

Error Code. 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.

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

Table of Contents

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 10^{th} 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 $1/10^{th}$ 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 10^{th} 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 that 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):

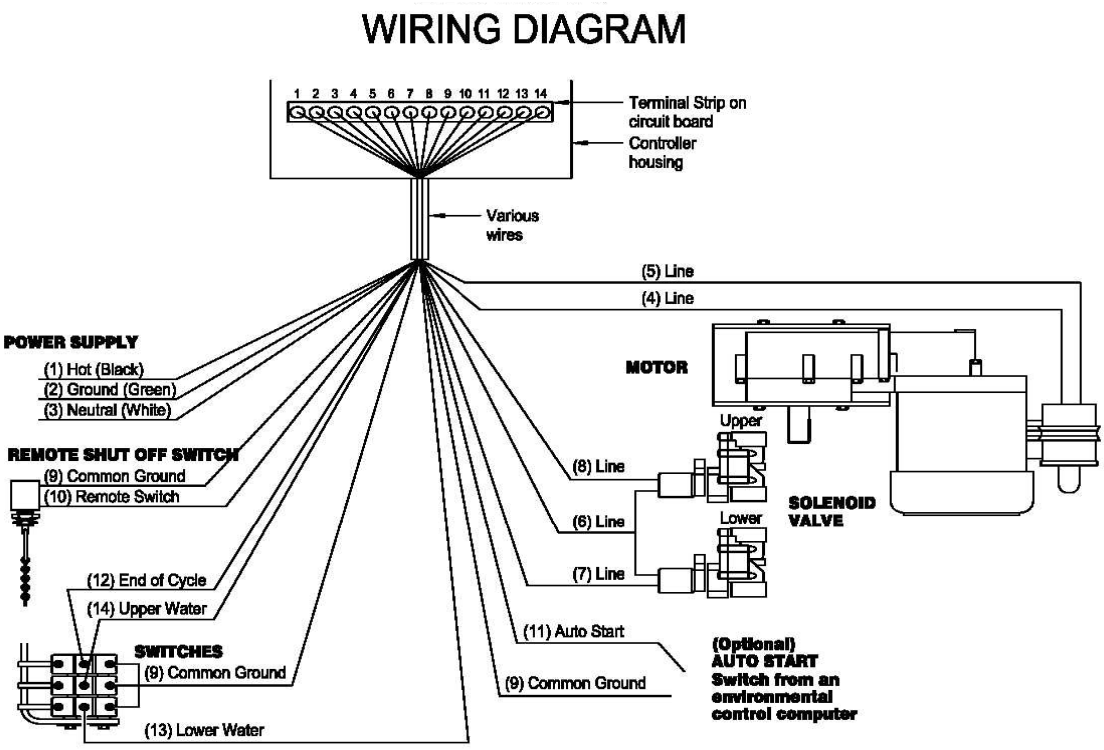
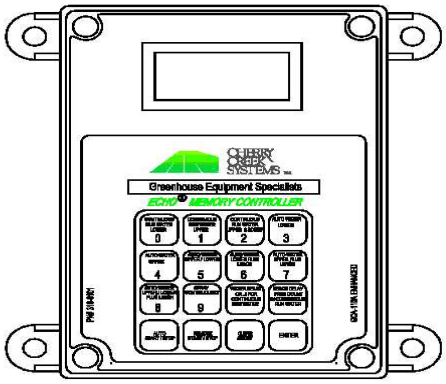


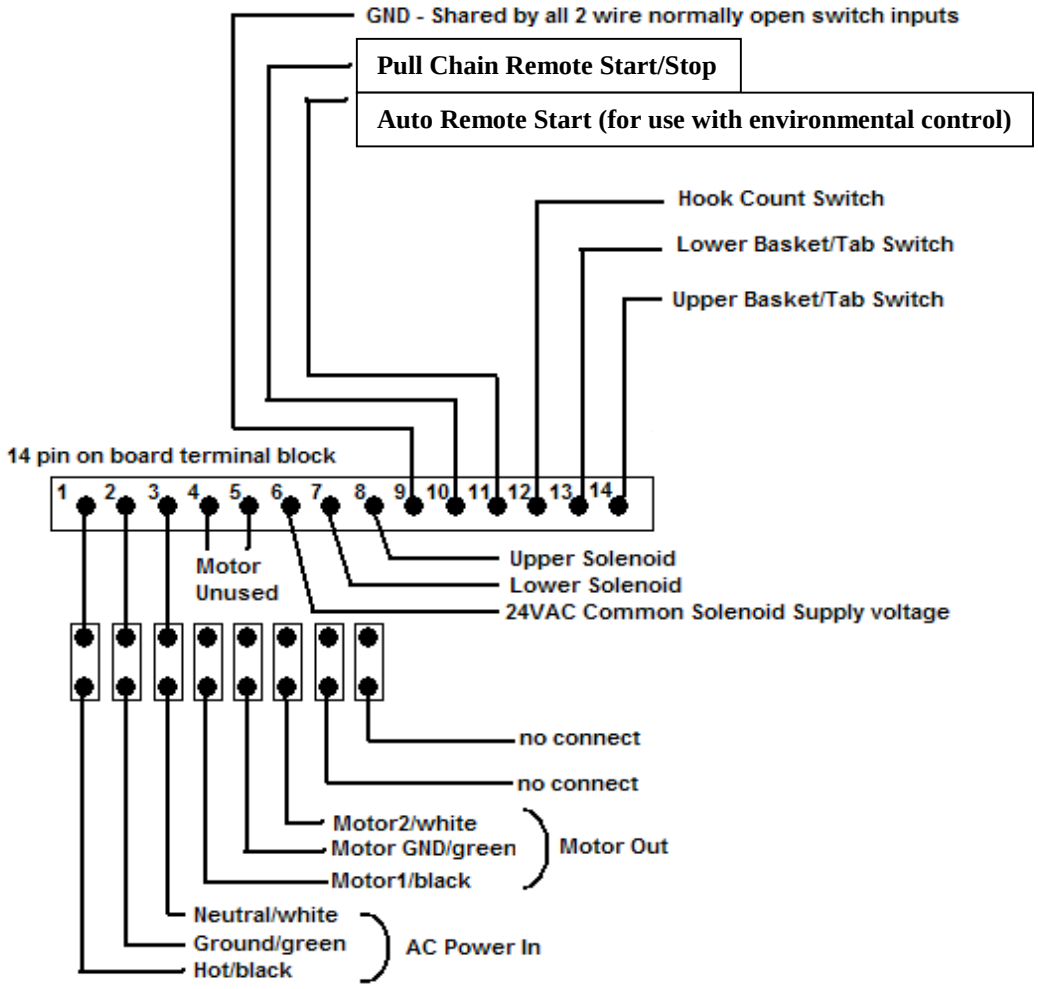
FIGURE 36

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 a 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 a 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 ***0 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 place. 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.

Wireless Irrigation Controller

ECHO

2675 Akers Drive
Colorado Springs, CO 80922
(719) 380-8373
(877) 558-3246

Contents

1. Introduction

This document describes the installation, programming, and operation of the Network Irrigation Controller. The controller was designed for a wide variety of greenhouse applications. The controller can be configured to run hanging baskets, single and double rail booms, tower booms and conveyor systems.

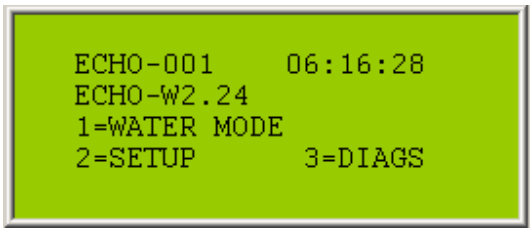
The controller's simple menu structure makes initial setup and operation easy to master. Passcode protection prevents unauthorized or accidental changing the systems critical settings. One button start makes operation easy for untrained personnel. Remote start capability allows interface to greenhouse environmental control systems. Scheduling enables a grower to repeat specific watering runs on an interval basis and repeat daily without user intervention. A variety of manual watering modes allow the grower flexibility to water a crop as needed. A wireless radio control option lets the grower operate controllers from a central hub, personal computer, or PDA.

The controllers reliable positioning system for booms makes the Step, Stop, and Water mode possible. The boom will move to a specific location then stop and water for the programmed time, and then step to the next location. The Walk and Water mode is useful for spot watering of a crop. The user can turn solenoids on or off while passing over the crop and control the speed of the boom. The Quick Water mode lets the user set up a one time run over a specific area. Up to sixteen crops can be defined for a bay, and sixteen specific areas can be set for each crop enabling the user to grow different crops in a single bay.

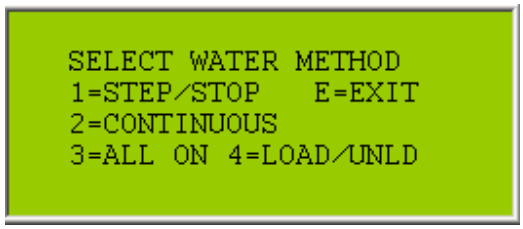
When the controller is used for a hanging basket or ECHO system, watering and leach times are programmable. Sensors will detect a baskets presence to determine if watering should take place. The number of cycles can be programmed or continuous watering can be selected. The Water by Weight option will determine if a basket needs watering by sensing the weight of the basket. If watering is needed, the controller will only water for a length of time determined by the basket's weight. Scheduling is also available for automatic operation.

2. WATER MODE

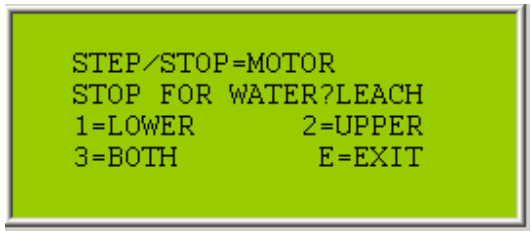
From the MAIN MENU:



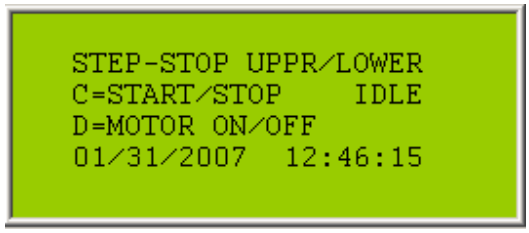
Press ‘1’ to select the watering method:



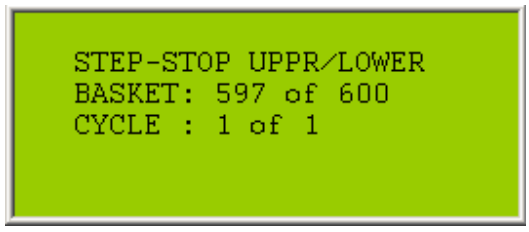
Press ‘1’ to select **STEP, STOP, AND WATER** mode:



Press ‘1’, ‘2’, or ‘3’ to select lower, upper, or both baskets. Here, BOTH was selected:

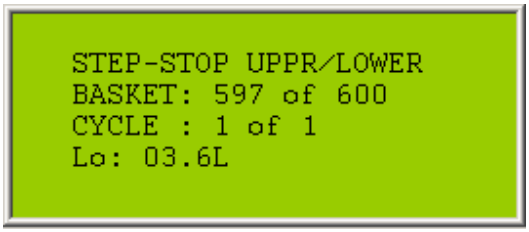


Pressing the ‘D’ key will just run the motor. Press the ‘C’ key to begin watering:



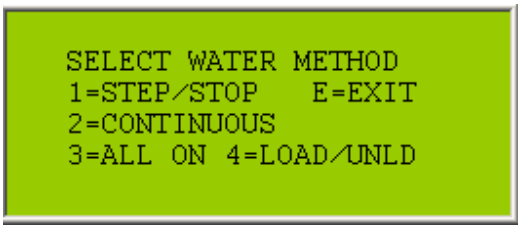
You can Press the ‘C’ key to stop watering.

You can change the speed while running by entering a new power setting. Using keys 0-9 you can enter a value between 0.0 and 55.0%
In STEP, STOP, AND WATER mode the baskets will stop and be watered for the time selected under SETUP. If a LEACH time was set, the basket will remain stopped until the leach time expires:

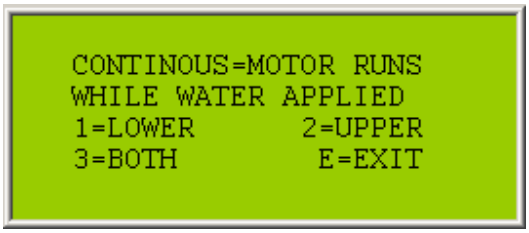


Pressing the ‘E’ key will exit each screen.

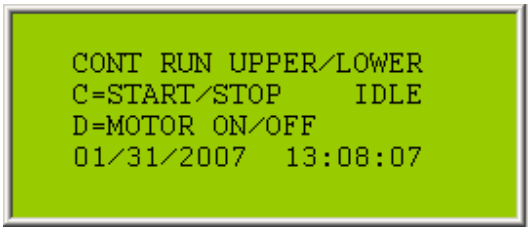
At the SELECT WATER METHOD screen:



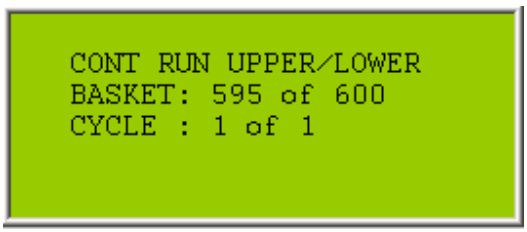
Press ‘2’ to select **CONTINUOUS** mode:



Press ‘1’, ‘2’, or ‘3’ to select lower, upper, or both baskets. Here, BOTH was selected:

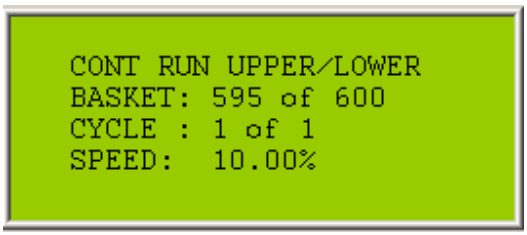


Press the ‘C’ key to begin watering.



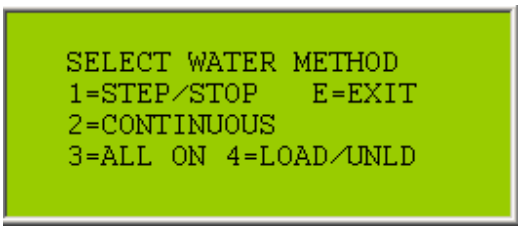
You can Press the ‘C’ key to stop watering.

You can change the speed while running by entering a new power setting. Using keys 0-9 you can enter a value between 0.0 and 55.0%:

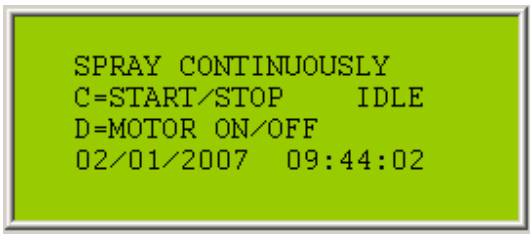


In CONTINUOUS mode the motor will not stop running. When a basket is detected the water will turn on for the time set under SETUP.

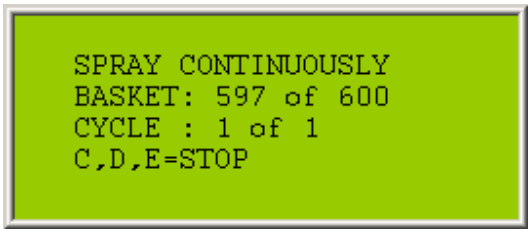
At the SELECT WATER METHOD screen:



Press ‘3’ to select **ALL ON** mode:

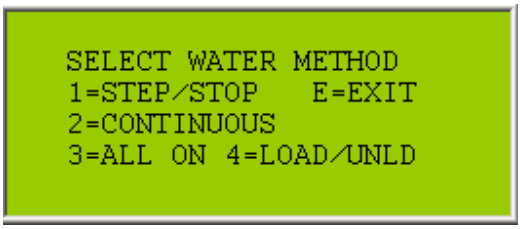


Press ‘C’ to begin watering:



In the ALL ON mode the motor will run continuously until stopped. Both upper and lower baskets will be sprayed continuously until stopped. Motor power can still be changed but does not appear on the screen. The ‘C’, ‘D’, or ‘E’ keys will stop watering.

At the SELECT WATER METHOD screen:

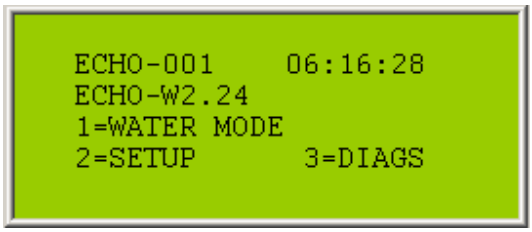


Press ‘4’ to select **LOAD/UNLOAD** mode:

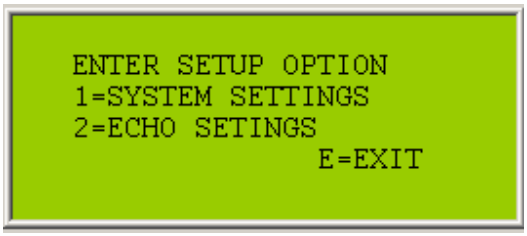
Press ‘C’ to begin loading or unloading. The ‘C’, ‘D’, or ‘E’ keys will stop running.
You can change the speed while running by entering a new power setting. Using keys 0-9 you can enter a value between 0.0 and 55.0%.

3. SETUP

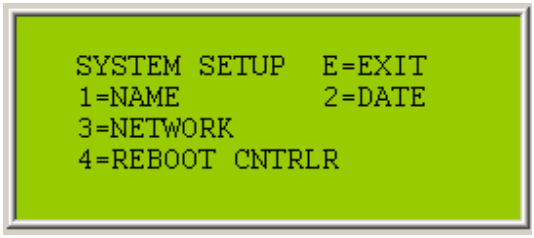
From the MAIN MENU:



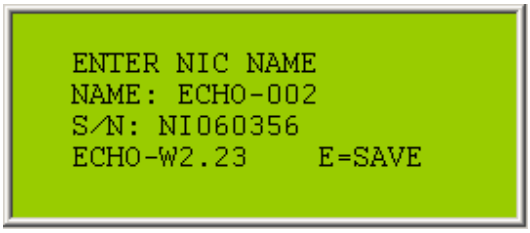
Press ‘2’ to enter the SETUP mode:



Press ‘1’ for SYSTEM SETUP:

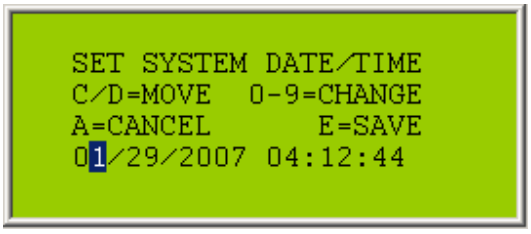


Press ‘1’ if you would like to change the controller’s NAME:



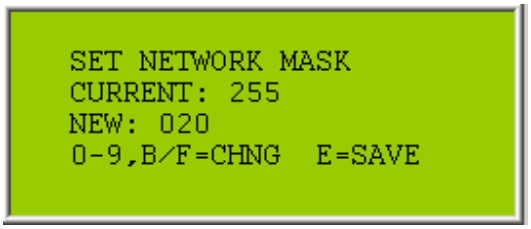
The default name will be the controller serial number. Use the ‘B’ and ‘F’ keys to scroll through the character set to enter a new name. Use the ‘C’ and ‘D’ keys to move to the next character. Press the ‘A’ key to copy the previous character. Press ‘E’ to save.

Press ‘2’ to set the SYSTEM DATE and TIME:

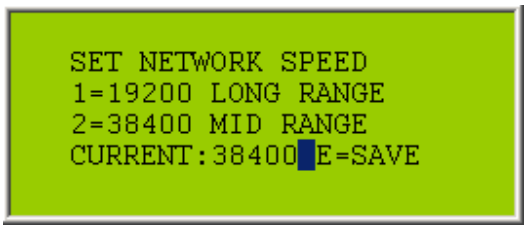


Use the ‘C’ and ‘D’ keys to move to the next field. This setting will be used to run crops automatically at the scheduled times. Press ‘E’ to save.

Press ‘3’ to set the NETWORK MASK:

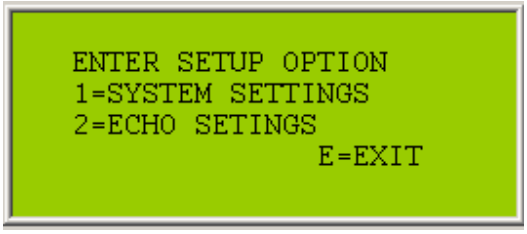


The default setting is 255. Any setting from 1 to 255 is valid. If you are using remote control the value should be the same as the remote controller’s NETWORK MASK. Press ‘E’ to save.

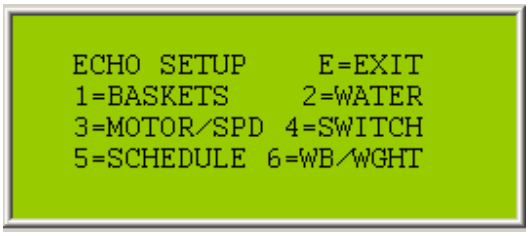


Select ‘1’ or ‘2’ depending on the radio installed in your controller. Press ‘E’ to save.

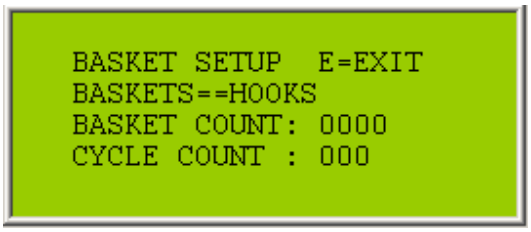
Press ‘E’ to return to the SETUP OPTION menu:



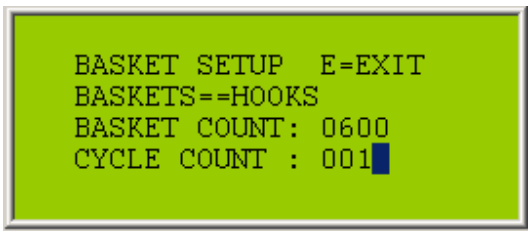
Press ‘2’ for the ECHO SETUP menu:



Press ‘1’ for BASKET SETUP menu:

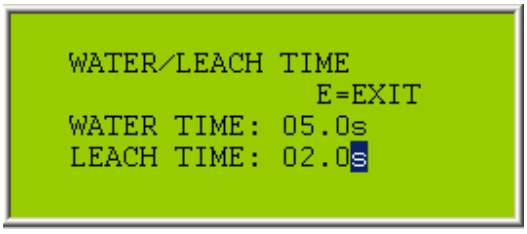


Enter the total number of hooks on the ECHO’s cable:



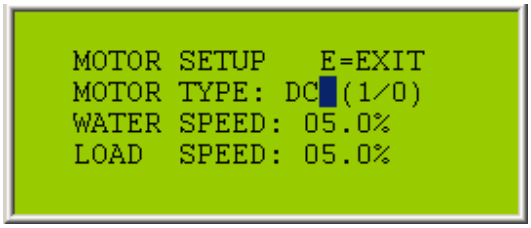
Use the ‘B’ or ‘F’ key to move to the next field and enter the number of cycles to run. A setting of ‘001’ will cycle through all 600 hooks one time. Press ‘E’ to save.

Press ‘2’ to set the WATERING and LEACH TIME:



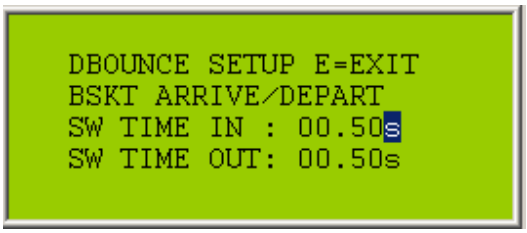
Enter the duration in seconds for watering each basket. Use the ‘B’ or ‘F’ key to move to the next field to set the leach time. If LEACH TIME is set to zero there will not be a pause between baskets. Press ‘E’ to save.

Press ‘3’ for the MOTOR SETUP menu:



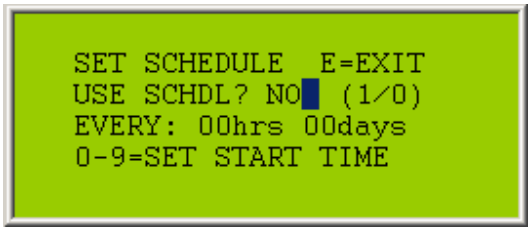
Press ‘0’ to select AC motor or ‘1’ to select DC motor. Use the ‘F’ key to move to the next field. Enter the percent power for watering and loading. Use keys 0-9 to enter a value from 00.0 to 55.0%. Press ‘E’ to save.

Press ‘4’ for the DBOUNCE SETUP menu:

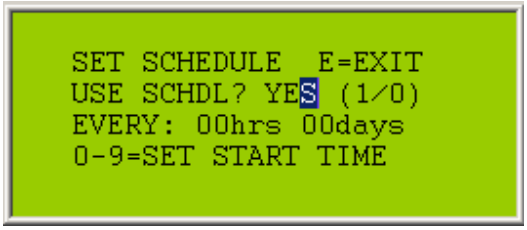


Since foliage hanging over the basket edge may trip the photo sensors, these delay times are necessary for the controller to be certain that a basket is really present. If the foliage is dense, longer delay times may be needed. Magnetic or micro switches do not require as long a delay as photo sensors. Use keys 0-9 to enter a new value and Press ‘E’ to save.

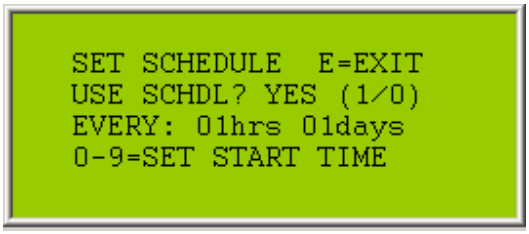
Press ‘5’ to enter the SET SCHEDULE menu:



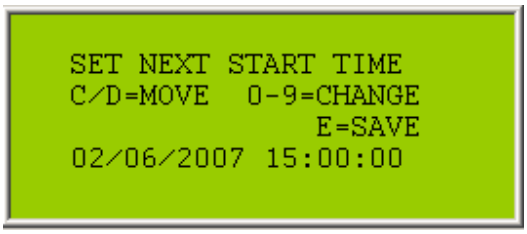
Press ‘1’ to set to YES or ‘0’ for NO:



Use the ‘F’ key to move to the next field.
Use keys ‘0-9’ to enter the hours and days desired for the repeat interval.



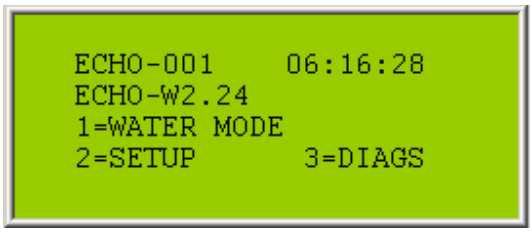
In this example the crop will run once every hour and will repeat every day until scheduling is turned off. Press ‘F’ to move to SET START TIME and use keys ‘0-9’ to enter the start date and time.



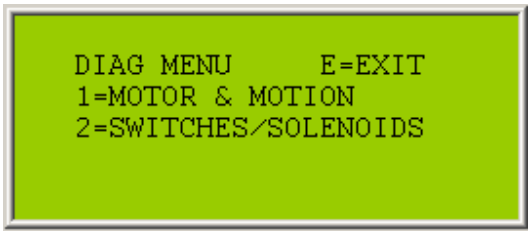
Use the ‘C’ key to move to the next field. Press ‘E’ to save. Press ‘E’ to exit.

4. SYSTEM DIAGNOSTICS

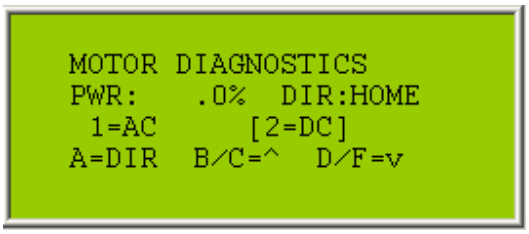
From the MAIN MENU:



Press ‘3’ for the DIAG MENU:

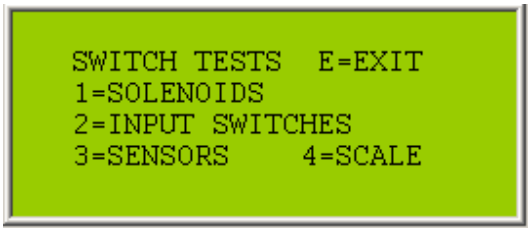


Press ‘1’ for the MOTOR DIAGNOSTICS:

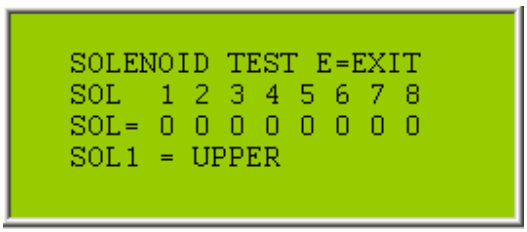


Press ‘1’ or ‘2’ to select the motor type. Use the ‘B’ and ‘C’ keys to increase power and use the ‘D’ and ‘F’ keys to decrease power. The ‘A’ key can be used to change direction but may cause damage to hook switches when running backwards. Press ‘E’ to exit.

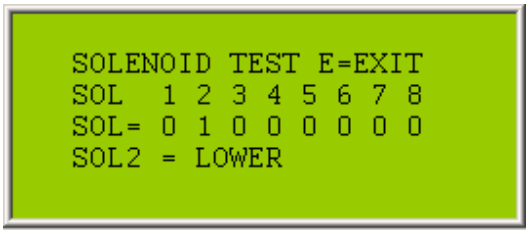
Press ‘2’ for the SWITCH TESTS menu:



Press ‘1’ for the SOLENOID TEST:

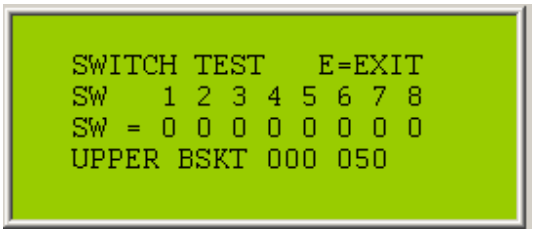


The Echo System only uses solenoids 1 and 2. Press the ‘1’ key to turn on solenoid 1 and press again to turn off. Here solenoid 2 is turned on:



Press ‘E’ to exit.

Press ‘2’ for the SWITCH TEST:



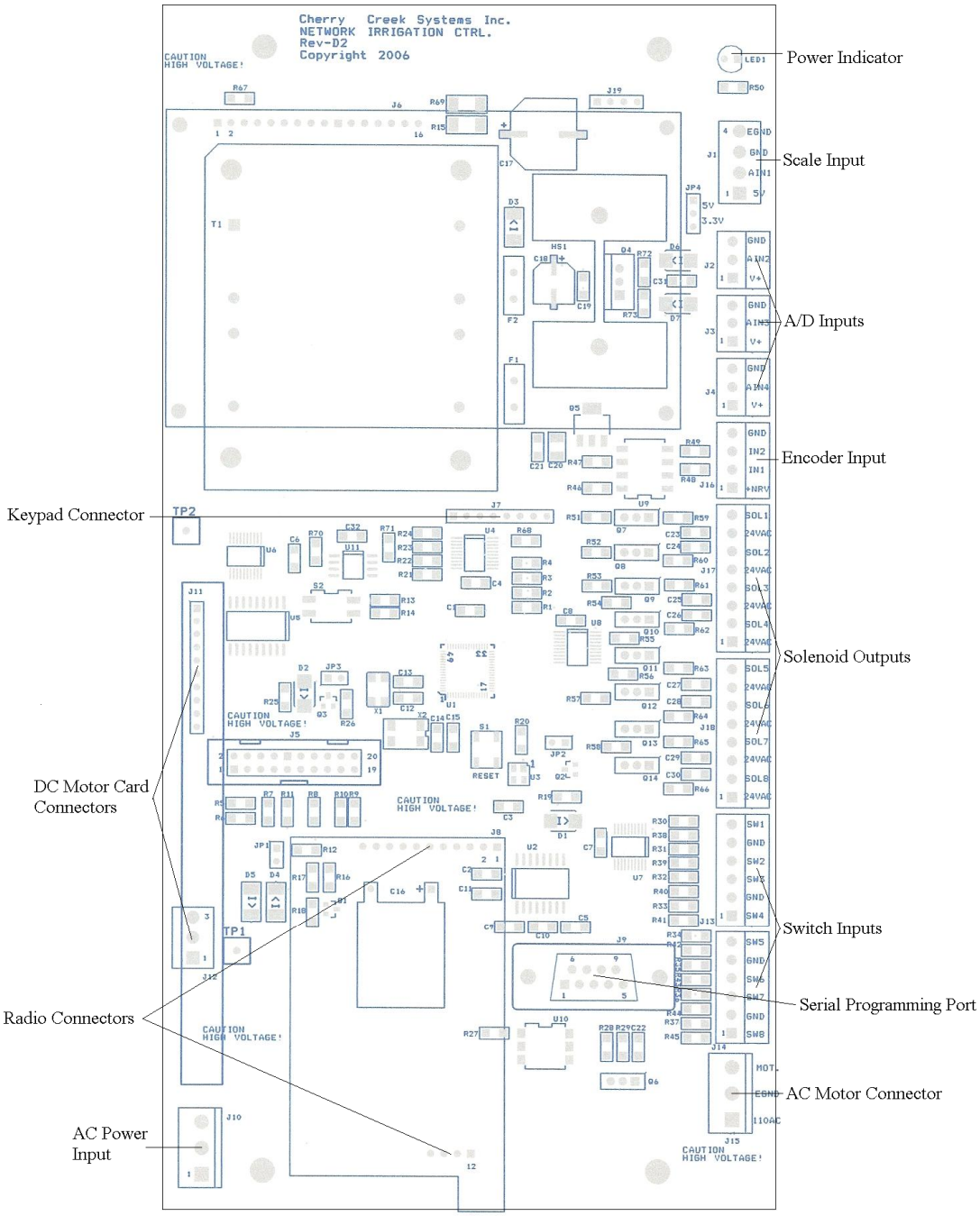
Switch SW1 is for the upper basket, SW2 is for the lower basket, and SW3 is for the hook switch. Closing a switch will change the ‘0’ to a ‘1’ in the display. Press ‘E’ to exit.

The SENSORS test is not used in the ECHO configuration.

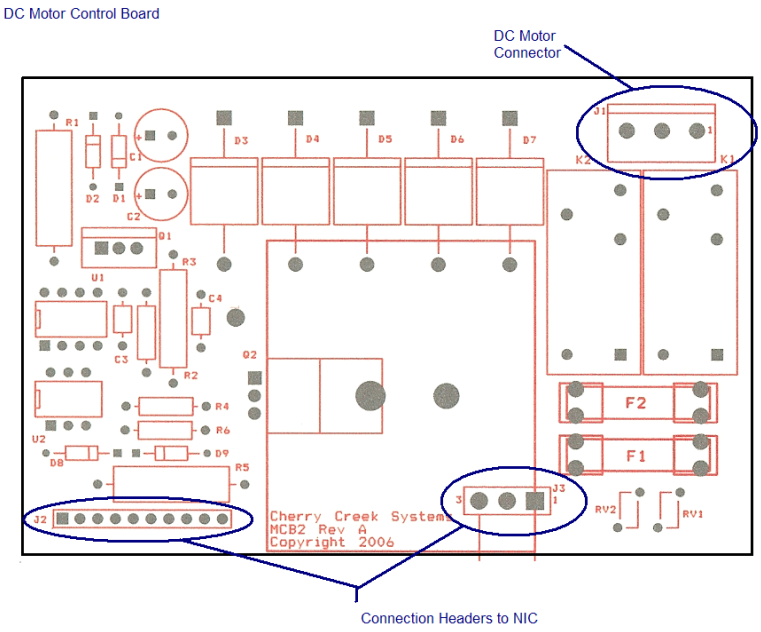
The SCALE test is only used in Water by Weight systems.

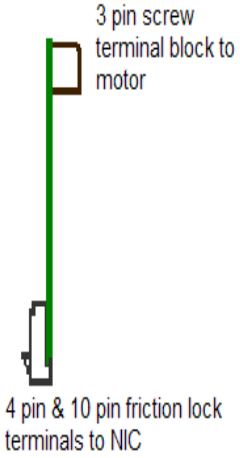
Press ‘E’ twice to return to the main menu.

5. WIRING DIAGRAMS



DC Motor Control Board

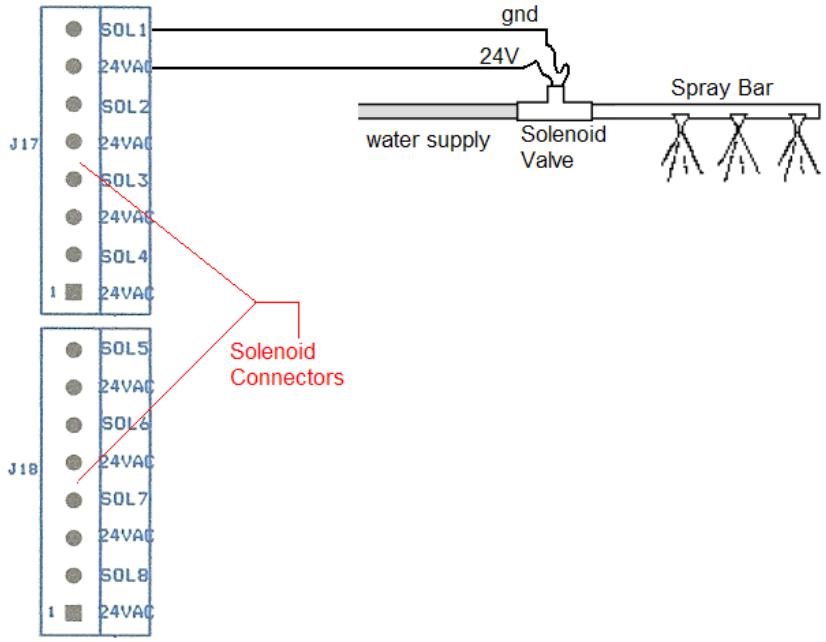




Fuses F1 and F2 are 8A/250V SLO-BLO 5x20mm.

Solenoids

There are eight 24-volt AC solenoid outputs.



Input Switches

SW1 = Upper Basket
SW2 = Lower Basket
SW3 = Hook
SW4 = Remote
SW5 = Motor
SW6 = Unused
SW7 = Unused
SW8 = Unused