

LIQUITRON™ DC4500 CONTROLLER Series

Instruction Manual

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The LIQUITRON™ DC4500 is a microprocessor-based conductivity controller. It is designed for use in a variety of water treatment applications requiring precise control of totally dissolved solids and chemical feed. Among its many uses, the DC4500 will control conductivity and chemical feed in cooling towers and closed loop systems.

LMI's DC4500 Series of conductivity controllers allows the greatest programming flexibility for cooling tower system applications. This is accomplished through the use of an extensive options menu that is easy to use.

BLEED or BLOWDOWN of system water by valve control can be based on several set point options:

- Conductivity set point.
- Hysteresis delay (lower than set point) to avoid valve operation chattering.
- Rising or Falling conductivity trip points.

FEED of chemical (inhibitor) can be based on four (4) different methods and the pump control can be either ON / OFF or externally-triggered Variable Speed.

- FEED at the same time system BLEEDS. (lockout timer limits maximum FEED time)
- FEED time calculated as a percentage of total BLEED time.
- FEED based on a timed cycle. (pump is on for a percentage of this timed cycle)
- FEED based on flow meter input.

DUAL BIOCIDES chemical addition may be accomplished by the use of two (2) individually programmable relays or optocoupler outputs. These outputs provide control of two individual chemical addition pumps based on the following options:

- ON / OFF or externally-triggered Variable Speed pump control or BOTH for two pump / TIMER operation.
- 28-DAY programmable timer (1, 2, 3, or 4 week selectable cycle).

ALARM indicators and relay outputs are energized based on the following conditions:

- HIGH conductivity set point is reached.
- LOW conductivity set point is reached.
- NO FLOW condition exists. (flow switch must be installed)

The display is a 16-character backlit LCD (liquid crystal display) which is visible in all light conditions.

A three-key position membrane is used to enter data and settings (*see Figure 1*).

The conductivity range is 0 - 20,000 μ Siemens. The units can be either μ Siemens or PPM / TDS (total dissolved solids).

All set points and parameter settings are retained permanently in a special nonvolatile computer chip memory, preventing their loss due to a power outage. This nonvolatile memory chip allows the unit to be programmed before installation. No battery powered backup is required.

Built-in test circuits are provided to test each individual relay output wiring and to allow for quick field service isolation of faulty probe, circuit cards, pumps, or solenoids for ease of troubleshooting.

A display for temperature is also provided. The range is 32°F to 158°F [0°C to 68°C]. The display can be either fahrenheit or centigrade. This reading also provides the basis for temperature compensation which is performed in all modes.

SECTION 1 - INTRODUCTION

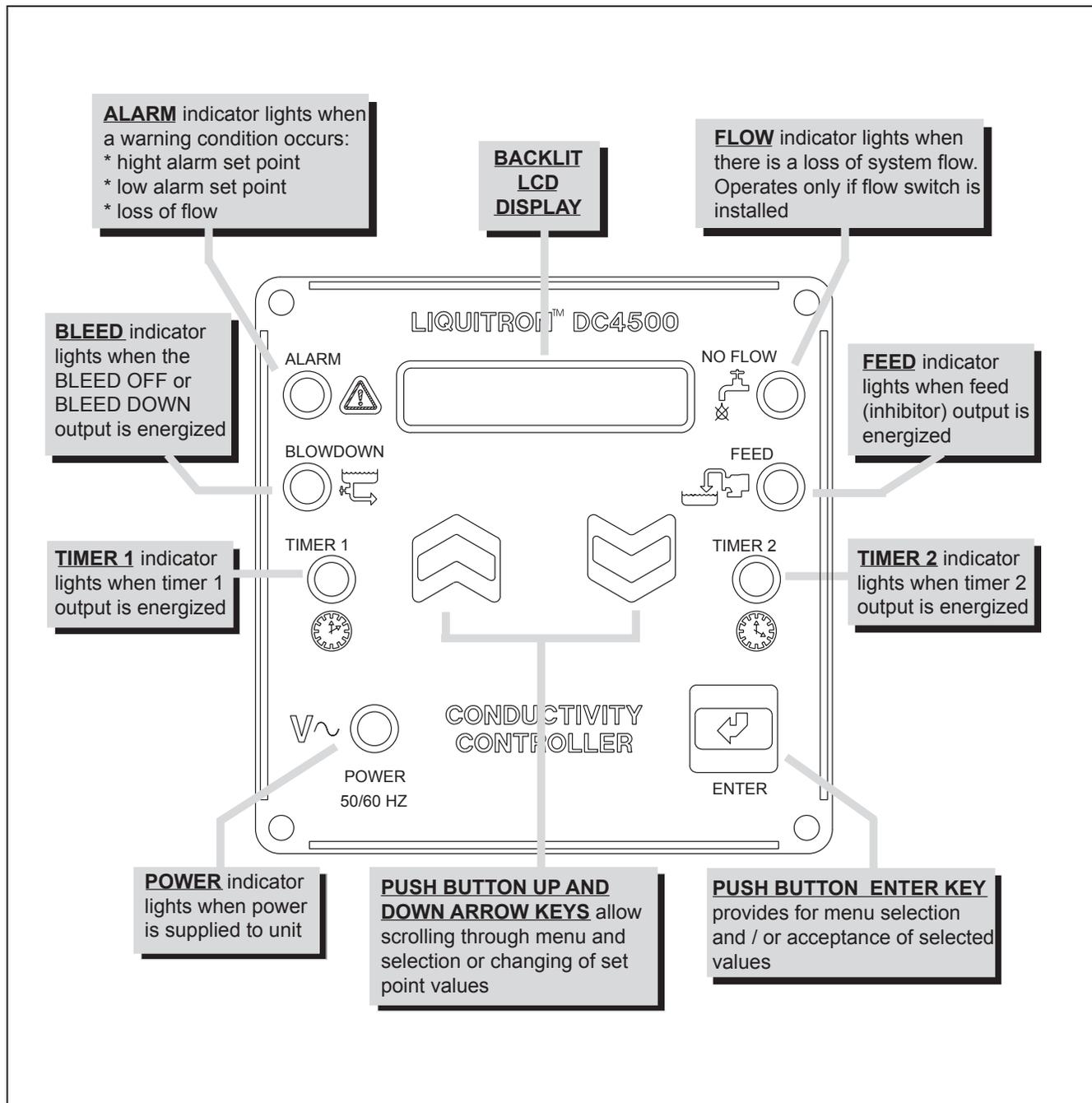


Figure 1



SECTION 1 - INTRODUCTION

An analog data (or control) output is provided. This is a non-isolated 4 - 20 mA signal. The conductivity reading that corresponds to minimum and maximum analog signals is fully adjustable. This signal can be used to power chart recorders or other pumps and devices.

The controller operates in two (2) distinct modes, 'SYSTEM RUN' and 'SYSTEM START-UP' or 'PROGRAMMING MODE'. The unit will be in the 'SYSTEM RUN' mode when it is first turned ON. The various program screen menus are used to calibrate the unit, set the control and alarm points, set the inhibitor feed operating parameters, program the biocide [two (2) chemical addition] pumps, and manually test the relays and wiring connections.

In the 'SYSTEM RUN' mode the DC4500 monitors the conductivity and activates the appropriate control or alarm relay as necessary based on the set points entered in the 'SYSTEM START-UP' mode.

The LIQUITRON™ DC4500 is packaged in a NEMA 12X, flame-retardant, molded TPE enclosure. When ordered, 115 VAC units come fully wired to include input power cord and relay output pigtailed to allow for simple installation. The unit can be hardwired through conduit to the lower junction box portion of the enclosure when required. Hardwiring makes the unit suitable for NEMA 4X applications.

SECTION 2 - INSTALLATION

2.1 MOUNTING THE CONTROLLER ENCLOSURE

The LIQUITRON™ DC4500 conductivity controller is supplied with integral wall-mounting flanges. It should be mounted with the display at eye level on a vibration free surface. All accessible mounting holes should be utilized. The maximum allowable temperature is 122°F [50°C]. This should be considered if installation is in a high temperature location. Once the DC4500 is wall mounted, the metering pumps may be located at any distance from the controller. The conductivity probe should be placed as close to the controller as possible, to a maximum distance of 300 ft [91 m]. Under 25 ft [7.6 m] is recommended. Over 25 ft [7.6 m], the cable may need to be isolated or shielded from background electrical noise.

2.2 ENCLOSURE MOUNTING DIMENSIONS

When using the prewired unit, the enclosure is configured as NEMA 12X. If the unit is connected through watertight conduit, the enclosure is configured as NEMA 4X.

The following clearances should be observed for proper mounting (see Figures 2 and 3).

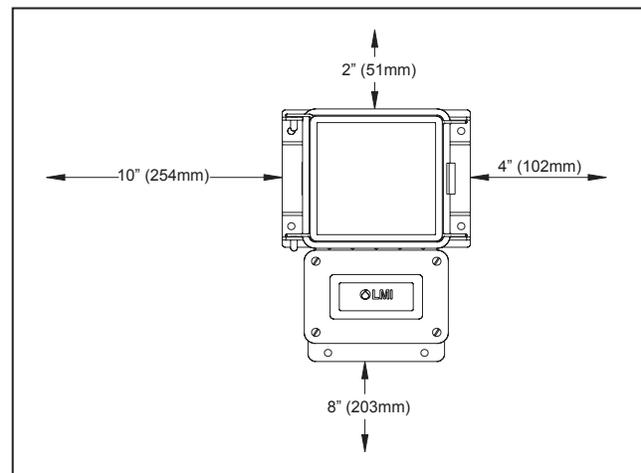


Figure 2

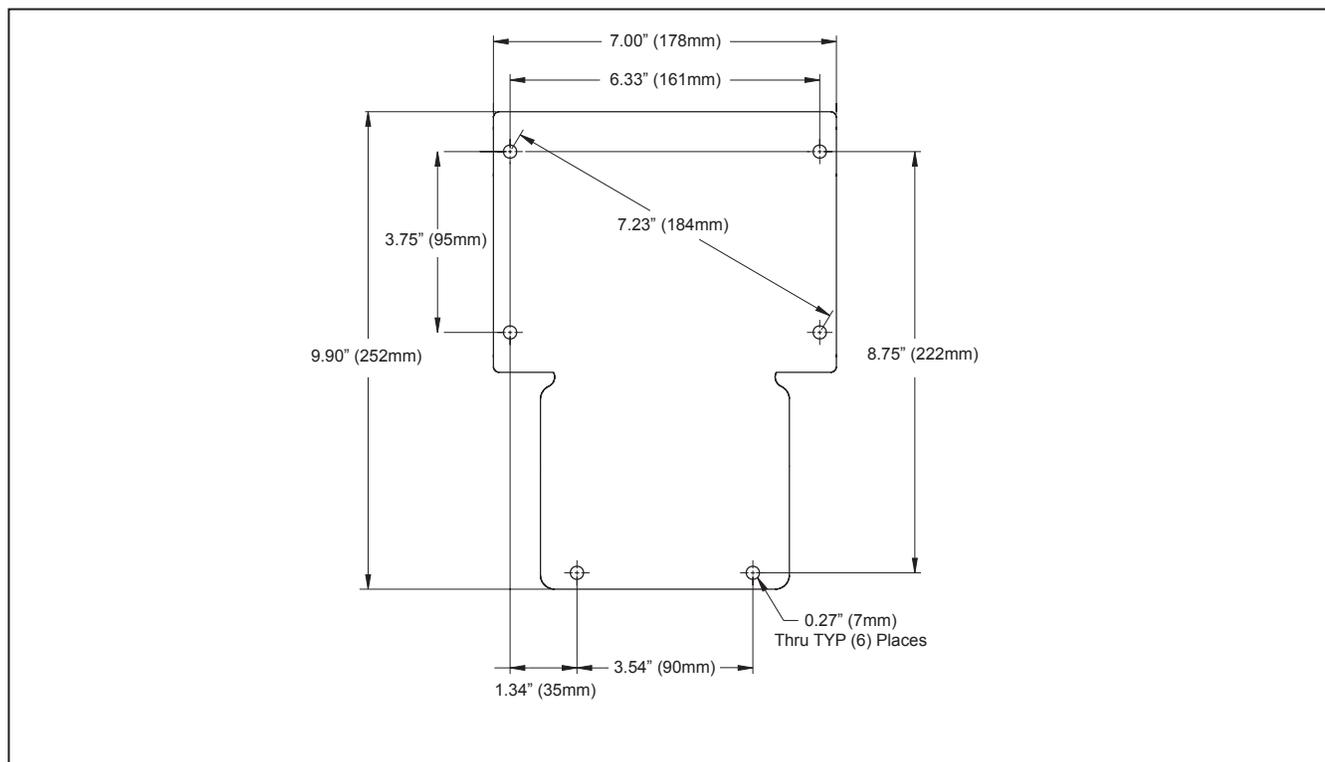


Figure 3

2.3 ELECTRICAL WIRING INFORMATION

CAUTION TO REDUCE THE RISK OF ELECTRICAL SHOCK, THE CONTROLLER MUST BE PLUGGED INTO A GROUNDED OUTLET WITH RATINGS CONFORMING TO THE SPECIFICATIONS ON THE DATA NAMEPLATE. IT MUST BE CONNECTED TO A VIABLE GROUND CIRCUIT. DO NOT USE ADAPTERS (SEE FIGURE 4). ALL WIRING MUST CONFORM TO REQUIRED ELECTRICAL CODES.

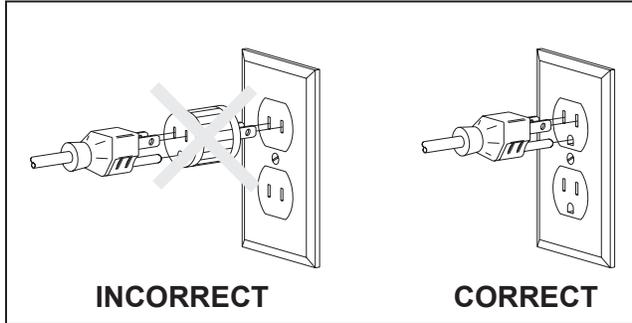


Figure 4

The LIQUITRON™ DC4500 conductivity controller is available in either 115 or 230 VAC 50/60 Hz. The 115 VAC version is supplied with one (1) 6-foot grounded AC power cord and four (4) 12-inch output pigtails for plug-in connection of controlled devices.

A four-pin connector is provided for the conductivity probe and temperature compensation probe.

Note:

The LIQUITRON™ DC4500 controller is provided with a voltage selector switch to allow the unit to be used with a 115 VAC or 230 VAC power source. To change the voltage selection, disconnect the unit from the power source and remove the front keypad panel. The selector switch is located on the circuit board attached to the back panel. When switching voltages ensure that power cord and pigtails are appropriately changed.

2.4 TERMINAL STRIP LAYOUT

To access the wiring connections inside of the conductivity controller:

1. Disconnect the unit from electrical power.
2. Remove the four (4) screws and the junction box cover on the lower half of the unit.
3. Consult the specific instructions below for the connections required.

AC Power Input	
Hot	TB2-1
Neutral	TB1-4
Ground	TB4-4
Bleed Blowdown Control Relay Output	
Hot (N.O.)	TB5-1
Hot (N.C.)	TB5-2
Neutral	TB1-3
Ground	TB4-3
Feed Output	
ON / OFF	
Hot	TB6-1
Neutral	TB1-2
Ground	TB4-2
External Trigger	
High	TB9-3
Low	TB9-4
Alarm Output	
Hot	TB6-2
Neutral	TB1-1
Ground	TB4-1
4 - 20 mAmp Output	
(+)	TB9-1
(-)	TB9-2

SECTION 2 - INSTALLATION

Biocide #1 Pump Output	
ON / OFF	
Hot	TB6-3
Neutral	TB2-4
Ground	TB3-4
External Trigger	
High	TB8-1
Low	TB8-2
Biocide #2 Pump Output	
ON / OFF	
Hot	TB6-4
Neutral	TB2-3
Ground	TB3-3
External Trigger	
High	TB8-3
Low	TB8-4

Flowmeter Input

The inputs are reversible when the flowmeter connection is a relay and has no polarity.

TB10-1
TB10-2

Flow Switch Input

This input can be used to connect a flow switch or other device providing a switch closure output. If a device such as this is connected to the DC4500, it will serve to disable the controller outputs when this switch is in the "OPEN" position.

This function can be used as a safety override to prevent controller / pump operation during loss of flow.

The inputs are reversible since the flow switch connection has no polarity.

TB10-3
TB10-4

Thermistor Probe Output (Hardwire Only)

Run the thermistor probe wiring through the PG9 connector on the right side of the DC4500 controller junction box keeping the wires away from any 115/230 VAC cables that may cause electrical interference.

Signal Output : TB11-1

Signal Return : TB11-2

Conductivity Probe (Hardwire Only)

Run the conductivity probe wiring through the PG9 connector on the right side of the DC4500 controller junction box keeping the wires away from any 115/230 VAC cables that may cause electrical interference.

Signal Output : TB11-3

Signal Return : TB11-4

SECTION 2 - INSTALLATION

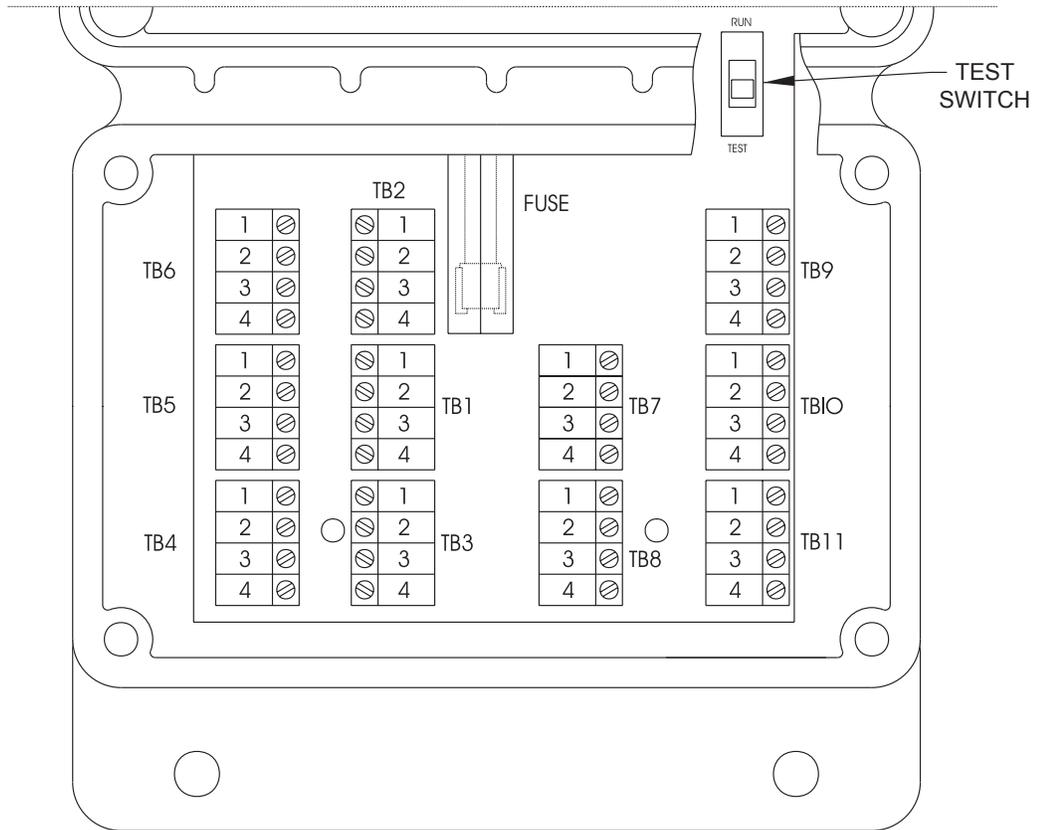
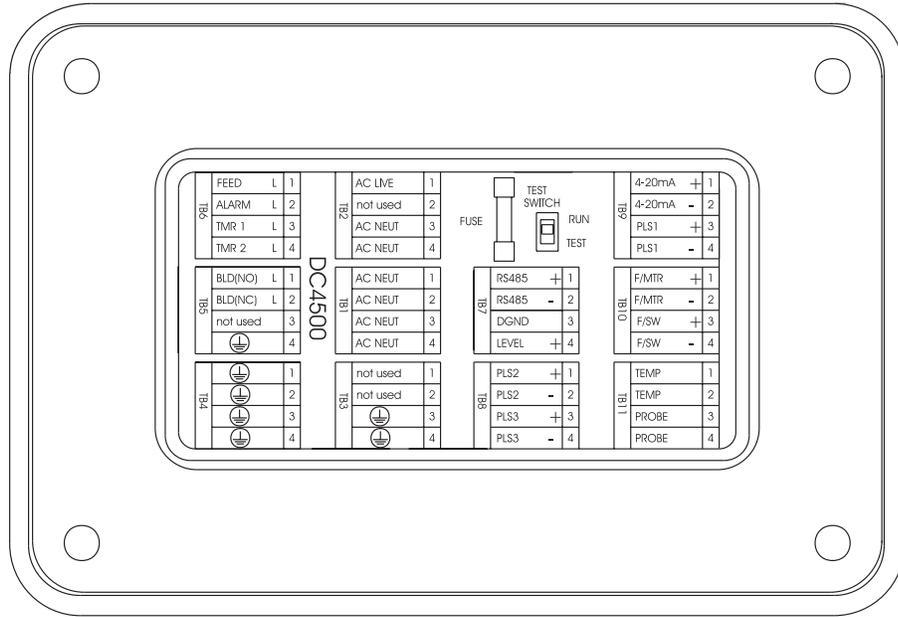
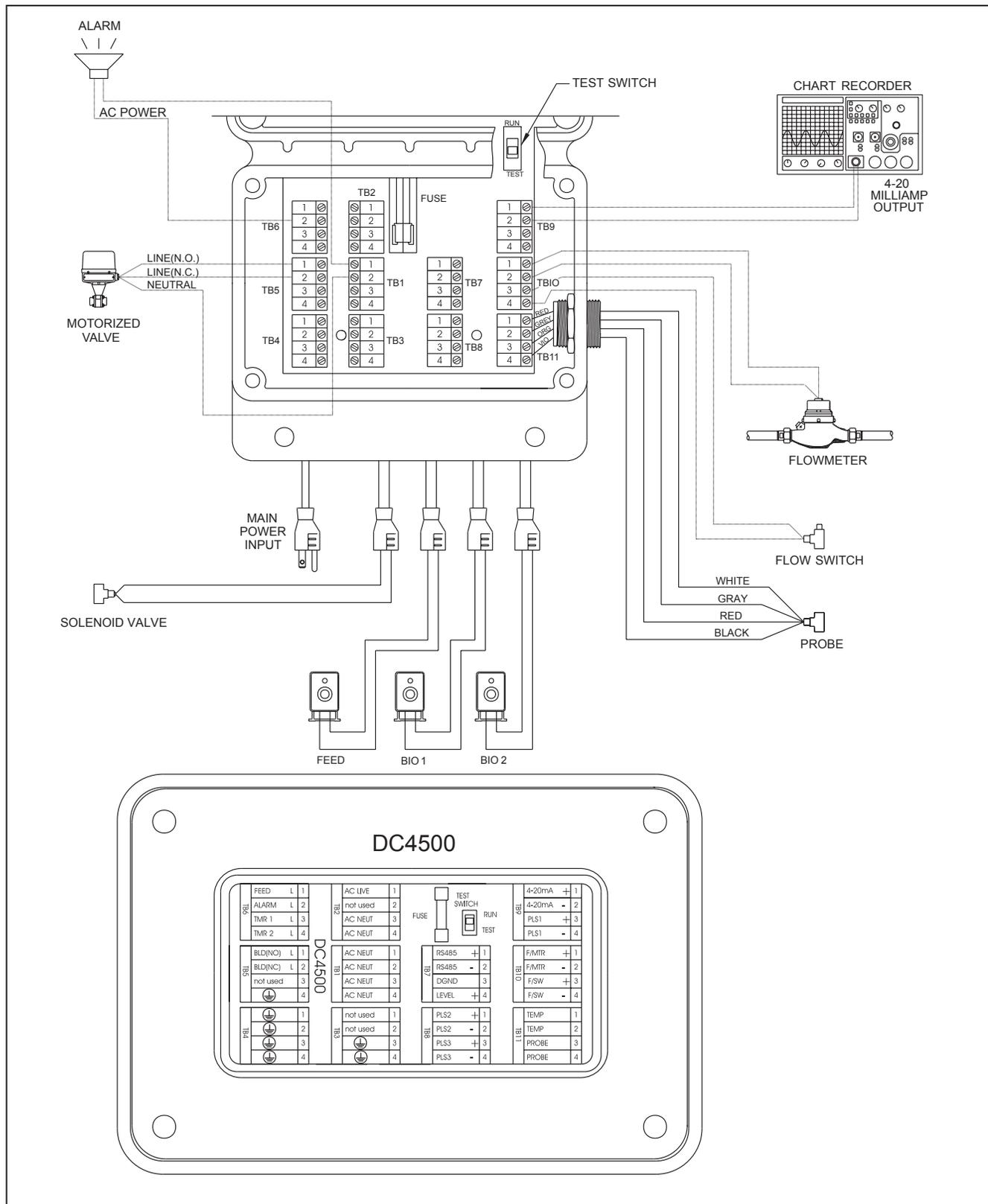


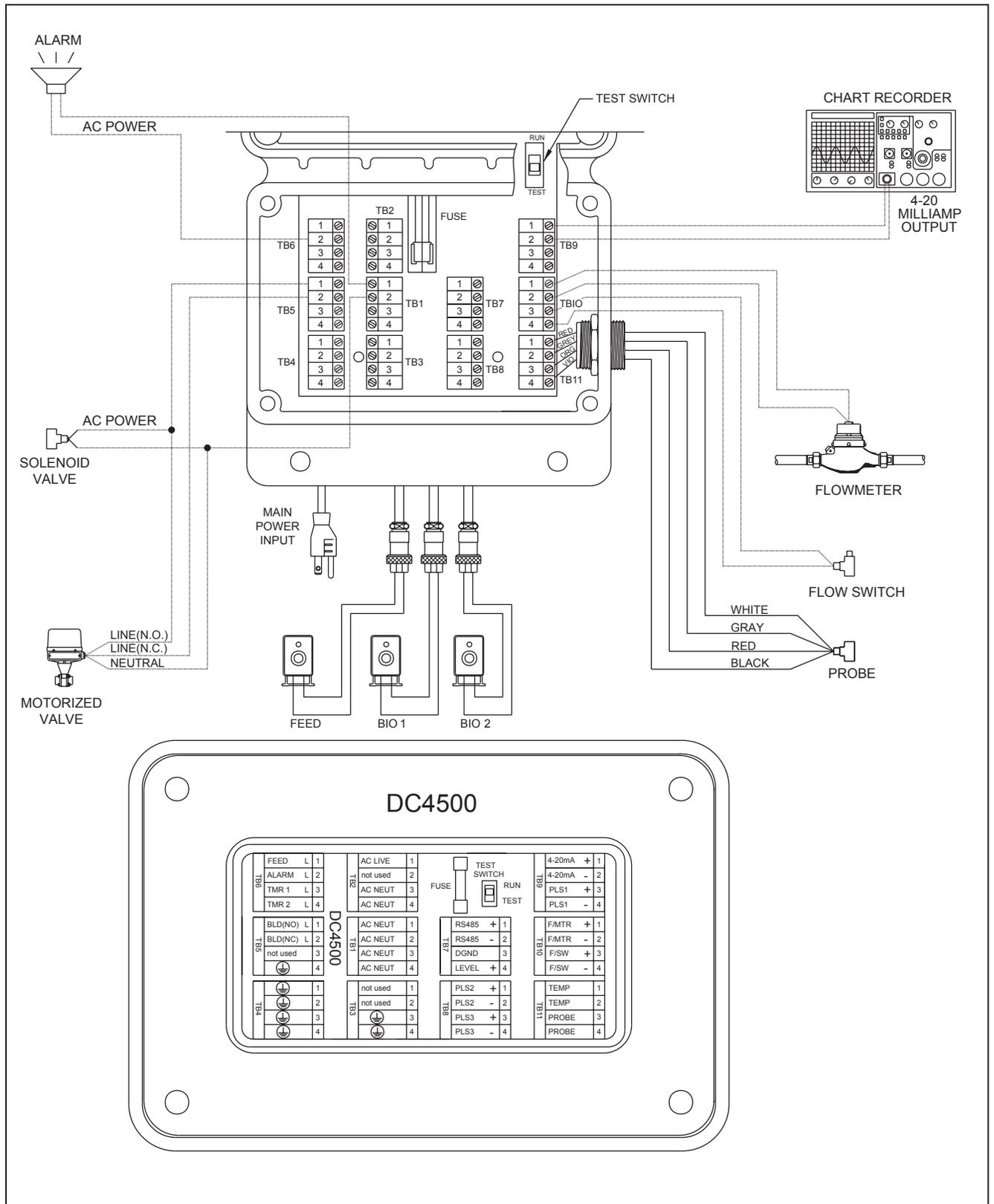
Figure 5. Bottom of controller with cover open

SECTION 2 - INSTALLATION



Wiring diagram for ON / OFF output control

SECTION 2 - INSTALLATION



Wiring diagram for external pulse output control

SECTION 3 - OPERATING THE CONTROLLER

The Conductivity Read Screen or “System Run”



COND: μS 1470

The normal operating display for the DC4500 Series Controller is the conductivity reading screen as (shown above). This screen is referred to as “System Run” throughout this manual. The screen will alternate between the conductivity reading and the day and time display. The controller relay outputs cannot be activated unless the unit is in the “System Run” or conductivity reading mode. The only exception is when the unit is in the test mode.

After reviewing or changing the conductivity controller programming set points, the unit must be returned to the “System Run” or conductivity reading screen to allow automatic control to proceed. There are three ways to return to the “System Run” screen and mode:

1. Use the  or  keys to move through the various menus, and back to the “System Run” screen.
2. Push ANY two (2) keys simultaneously. This will return the unit immediately to the “System Run” screen.
3. The unit will return to the “System Run” screen automatically after three (3) minutes if no keys are pressed.

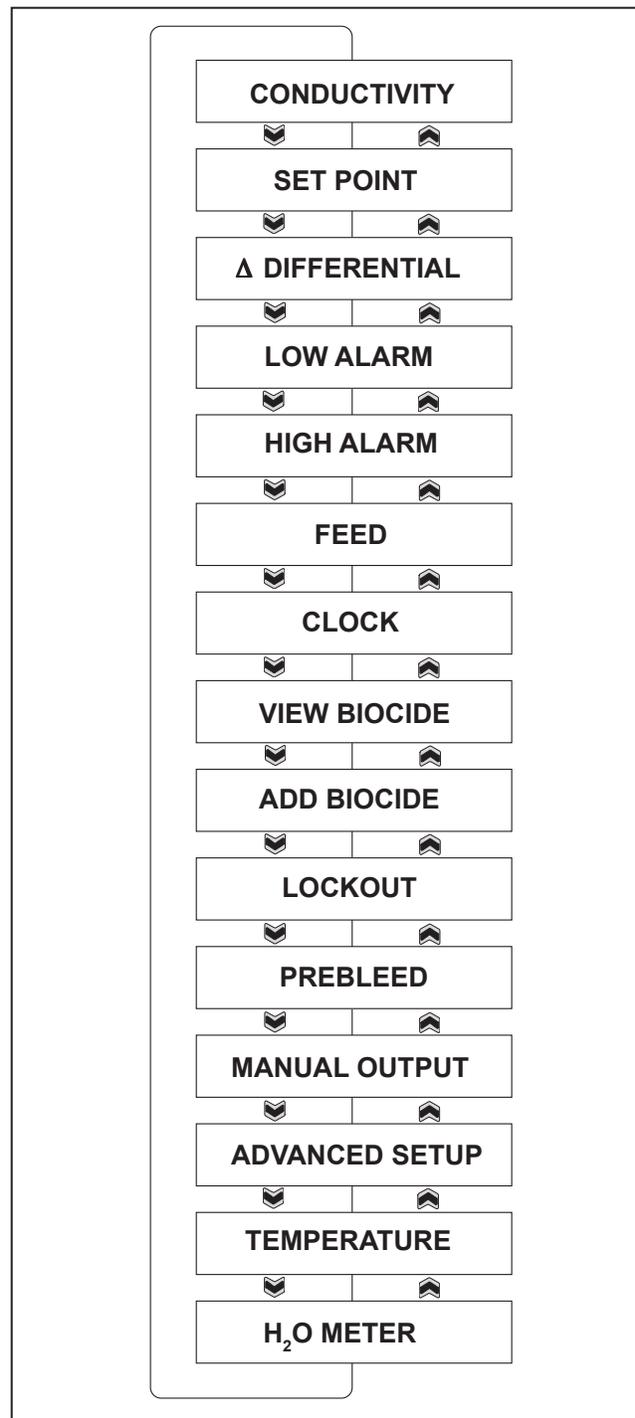
3.1 MENU OVERVIEW

When the “System Run” screen is displayed in the window, the unit automatically switches to the run / operate mode of operation.



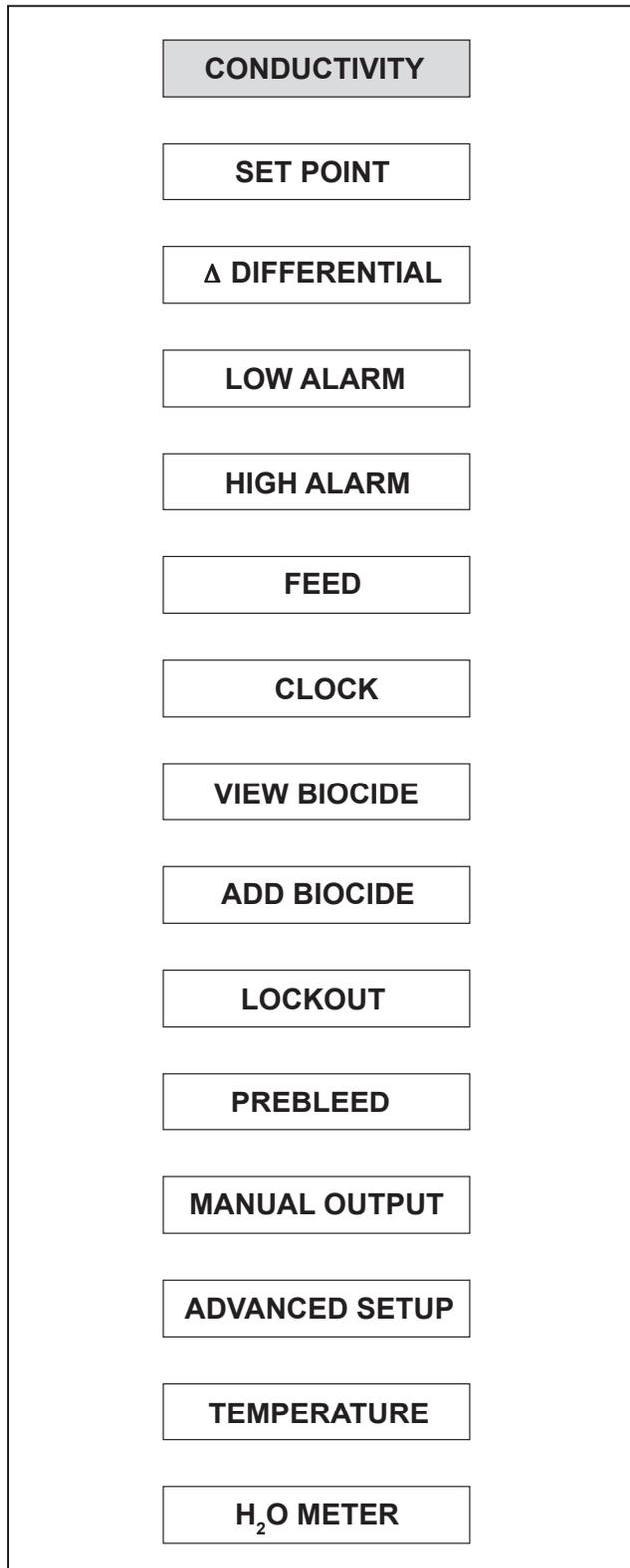
COND: μS 1470

This “System Run” display line is the top menu page item. Pressing the  or  keys will move the display window to another line item. When not in the “System Run” mode the outputs to the control relays are disabled. The following is the order of items in the main menu:



SECTION 3 - OPERATING THE CONTROLLER

3.2 CONDUCTIVITY



COND : (μS)3400

Conductivity Reading Screen

The “CONDUCTIVITY” screen displays the conductivity readings in either μSiemens or PPM/TDS (parts per million / total dissolved solids). When the controller is displaying this screen it is considered to be in the SYSTEM RUN mode. This means that the pumps, solenoids, and alarm outputs will be activated based on the controller’s programmed set points. When the controller is in any other display screen all the outputs are disabled and will not be energized.

COND : (μS)3400 **ENTER** **CAL: (μS) 3400**

From Conductivity Screen....press Enter....to access Calibration

Pressing the “ENTER” key when the “CONDUCTIVITY” screen is displayed accesses the calibration mode. From this “CALIBRATION” screen the “UP” or “DOWN” keys can be pressed to change the conductivity reading and adjust for inaccuracies. If calibration adjustment is attempted beyond 50% of the probe conductivity reading, the controller will flash a warning on the screen: “CALIBRATION LIMIT”. This alerts the operator that the probe needs to be serviced.

CAL : (μS) 1700 **ENTER** **CALIBRATION LIMIT**

If Calibration is attempted beyond ± 50%....

.....a Calibration Limit screen will appear

SECTION 3 - OPERATING THE CONTROLLER

3.3 SET POINT

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

SET PT 3000

Set Point Screen

The “SET POINT” screen allows access to the conductivity value that will energize the bleed output relay and allow for the opening of the bleed valve. The output trip setting may be changed in this screen. The relay can be programmed to respond to either rising or falling conductivity values (see “ADVANCED MENU” options under “TRIP”).

SET PT μS 3200

Pressing “ENTER” from the main menu “SET POINT” screen accesses the conductivity reading trip value and allows the value to be changed. The value will have a flashing cursor indicating that it can be changed. Press the “UP” or “DOWN” key to increase or decrease the value. Press “ENTER” to save the value.

SECTION 3 - OPERATING THE CONTROLLER

3.4 Δ DIFFERENTIAL

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

Δ DIFF 100

Differential or Dead Band

The “DIFFERENTIAL” or dead band setting allows for a hysteresis to be programmed in to the conductivity trip point. A programmed hysteresis value prevents the bleed relay and solenoid from cycling ON and OFF repeatedly when the conductivity reading hovers around the trip set point. The value entered in the “DIFFERENTIAL” is the amount of conductivity, away from the trip “SET POINT”, that the bleed relay will shut OFF.

Δ DIFF 100

Press “ENTER” from this screen to change the value. The value will have a flashing cursor indicating that it can be changed. Press the “UP” or “DOWN” key to increase or decrease the value. Press “ENTER” to save the “DIFFERENTIAL” value.

SECTION 3 - OPERATING THE CONTROLLER

3.5 LOW ALARM

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

LO ALARM *250*

Low Conductivity Alarm Set Point

The “LOW ALARM” screen allows programming of the Low Conductivity reading that activates an alarm LED and output relay.

LO ALARM *250*

Press “ENTER” from “LOW ALARM” screen to change this value. The setting will have a flashing cursor indicating that the value can be changed. Press the “UP” or “DOWN” key to increase or decrease the setting. Press “ENTER” to save the value.

SECTION 3 - OPERATING THE CONTROLLER

3.6 HIGH ALARM

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

HI ALARM

4000

High Conductivity Alarm Set Point

The “HIGH ALARM” screen allows programming of the High Conductivity reading that activates an alarm LED and output relay.

HI ALARM

4000

Press “ENTER” from “HIGH ALARM” screen to change this value. The setting will have a flashing cursor indicating that the value can be changed. Press the “UP” or “DOWN” key to increase or decrease the setting. Press “ENTER” to save the value.

SECTION 3 - OPERATING THE CONTROLLER

3.7 FEED

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCIDES
ADD BIOCIDES
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

FEED

(MODE)

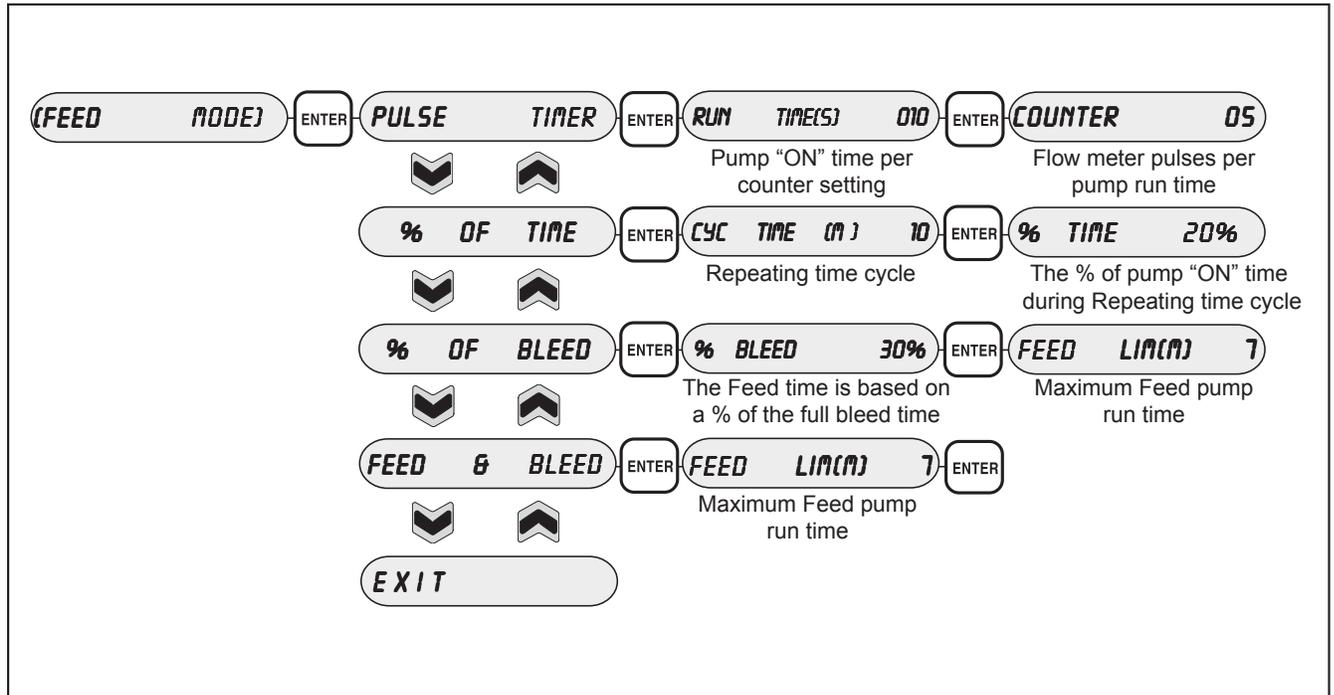
Feed Pump Screen

The “FEED” screen displays the current Inhibitor Feed Pump mode selected. There are four different FEED modes that may be selected from. The current active mode is displayed in parenthesis. The four possible modes to select from are:

1. Water Meter Pulse	Pump output based on flow meter input.
2. Feed as % of Time	Continuous pump output based on a repeating cycle timer.
3. Feed as % of Bleed	Feed after Bleed with a limit timer to control maximum pump run time. Pump output run time is based on a % of the total Bleed time.
4. Feed and Bleed	Feed and Bleed simultaneously with limit timer to control maximum feed pump run time.

Pressing the “ENTER” key from the main menu screen “FEED” (*Mode*) accesses the FEED sub-menu selections. Use the “UP” or “DOWN” key to scroll through the four different modes.

SECTION 3 - OPERATING THE CONTROLLER



When the mode desired is displayed on the screen press “ENTER” to access the particular settings for that mode. The variables and settings that are available for each option are shown above. Use the “UP” or “DOWN” key to change the settings and press “ENTER” to save that setting.

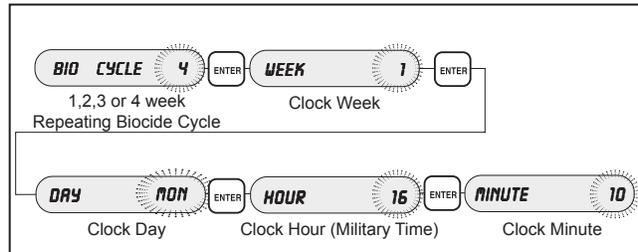
SECTION 3 - OPERATING THE CONTROLLER

3.8 CLOCK

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

WEEK 1 MON 16:05

The “CLOCK” screen displays the current week, day, and time. The time is based on a 24-hour clock. The number week that is displayed reflects the current week during the selected biocide programming based on a 1, 2, 3, or 4 week repeating cycle.



Pressing the “ENTER” key from the “CLOCK” screen accesses the various clock settings. The first screen displayed is the BIOCID cycle screen. The BIOCID cycle reflects the number of weeks that repeat in the BIO 1 and BIO 2 programming. For example, if a two week repeating biocide pumping cycle is desired, then a “BIO WEEK = 2” would be selected. The “weeks” may be selected to be a 1, 2, 3, or 4 week repeating cycle. A cursor will be flashing in this screen to indicate the value may be changed. Press the “UP” or “DOWN” key to change the value. Press “ENTER” to store the value and to move to the next “CLOCK” setting screen. The next screen is the “WEEK” setting Screen. This is the week that the clock is currently running in. Again, press the “UP” or “DOWN” key to change the value and “ENTER” to save. The next screen displayed is the “DAY” screen. Pressing the “UP” or “DOWN” key changes the setting and pressing “ENTER” saves the selection and moves to the “HOUR” screen. Pressing “UP” or “DOWN” changes this value and pressing “ENTER” saves this value and moves to the “MINUTE” screen. Pressing “ENTER” from the “MINUTE” screen returns to the “CLOCK” display screen.

SECTION 3 - OPERATING THE CONTROLLER

3.9 VIEW BIOCIDES

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCIDES
ADD BIOCIDES
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

VIEW

BIOCIDES

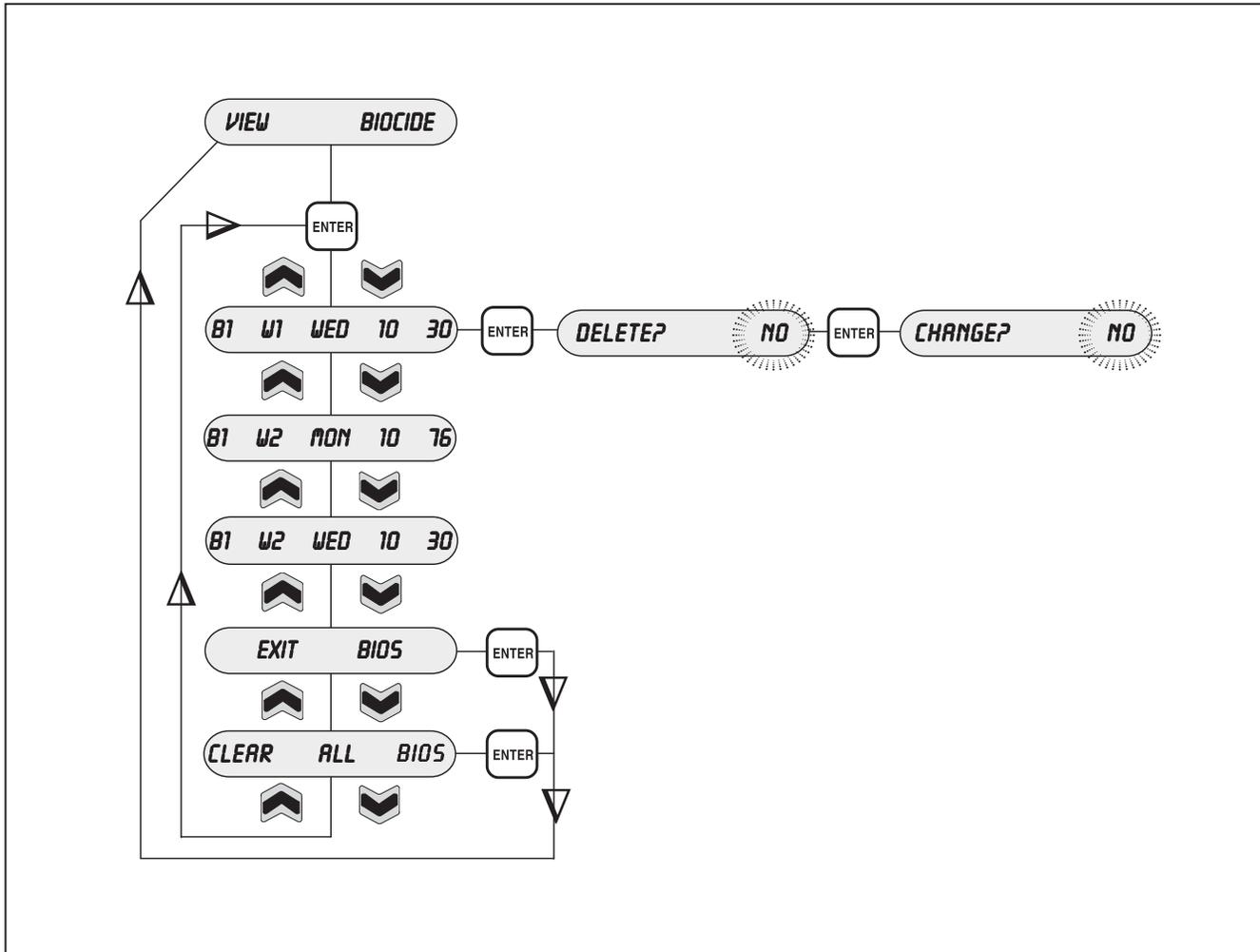
Review Current Programmed Biocides

The “VIEW BIOCIDES” menu screen allows the operator to review the list of the programmed Biocide pump “on” times. This list is for ALL programmed Biocides (both Biocide 1 and Biocide 2). Press “ENTER” from this main menu screen to access the list of biocide pump “on” times. The list of “on” times is presented in the numeric order of the Week first and then the Day. For example, a programmed pump “on” time for week “1” will be listed before a pump programmed for week “2”. A programmed pump “on” time for week “1” “Monday” will be listed before a pump programmed for week “1” Wednesday.

BIOCIDES	WEEK	DAY	PUMP TURN ON HOUR	PUMP RUN TIME
B1	W4	MON	15	55

The screen display for each of the programmed pump “on” times appears as shown above. The first alpha / numeric group “B1” represents the BIOCIDES selected (Biocide 1). The second group “W4” represents the WEEK selected (Week 4). The third group “MON” represents the day selected (Monday). The fourth group “15” represents the HOUR selected for the pump to turn ON (based on a 24-hour clock). In this example, the pump is programmed to turn on at hour 15, or at 3 o’clock in the evening. The fifth group “55” represents the duration of time that the pump will remain running. In this example the pump will run for 55 minutes. Based on the above example, biocide pump #1 is programmed to turn on at 3:00 pm for 55 minutes during week 4 on Monday.

SECTION 3 - OPERATING THE CONTROLLER



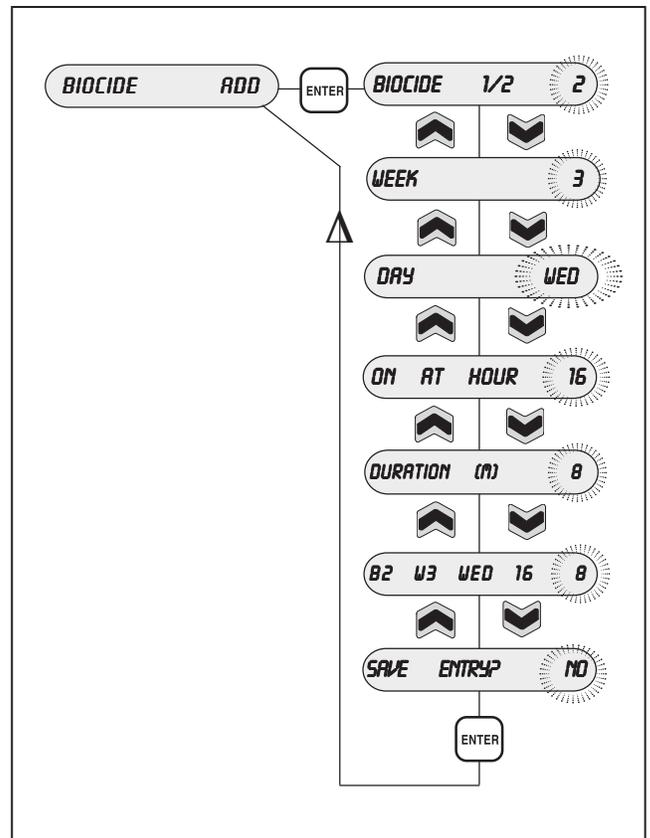
SECTION 3 - OPERATING THE CONTROLLER

3.10 ADD BIOCIDES

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCIDES
ADD BIOCIDES
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

BIOCIDES *ADD*

Biocide pump “on” times may be programmed or added in this main menu selection screen. Press “ENTER” to access the sub-menu screens that allow the programming options for each Biocide pump. Once in these sub-menu selection screens, press the “UP” or “DOWN” keys to change each one of the values. The values that may be changed will have a flashing cursor. Press the “ENTER” key to save that value and move to the next sub-menu screen.



SECTION 3 - OPERATING THE CONTROLLER

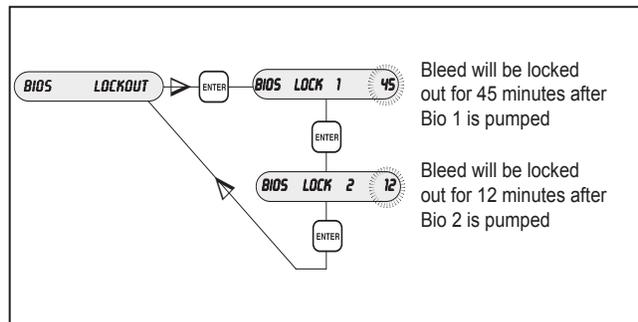
3.11 BIOCIDAL LOCKOUT

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCIDAL
ADD BIOCIDAL
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

BIDOS

LOCKOUT

The "BIOCIDE LOCKOUT" screen selection allows for the programming of a system Bleed lockout time. This option prevents the bleed of a cooling tower immediately following chemical biocide addition. Press "ENTER" to access the "LOCKOUT" screens where this option is programmed. The number of minutes that the bleed function needs to be disabled can be varied as required. Each Biocide pump lockout time can be individually programmed.



SECTION 3 - OPERATING THE CONTROLLER

3.12 BIOCIDES PREBLEED

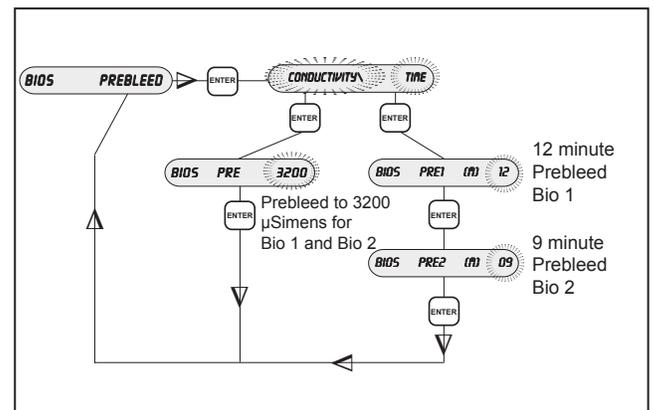
CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCIDES
ADD BIOCIDES
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

BIO5

PREBLEED

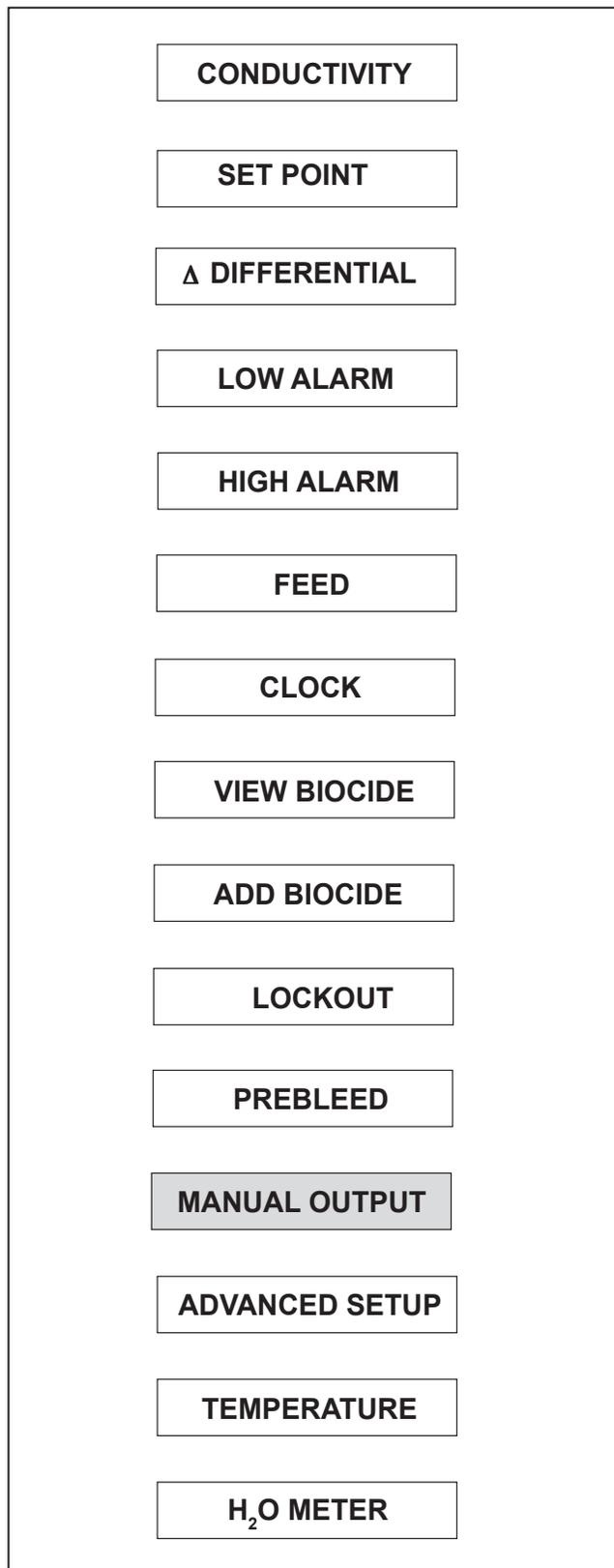
Biocides Prebleed Screen

The Biocides pump “PREBLEED” option is available in order to bleed down the cooling tower to below conductivity limits prior to biocide chemical addition. This option is programmable in one of two modes. The prebleed may be selected for either a programmed amount of time or a conductivity set point. If the time option is selected, then the cooling tower will be bled down for that programmed amount of time prior to the biocides pump “on” time. If the conductivity set point is selected, then the cooling tower will be bled down to this set point prior to the biocide chemical addition. This set point prebleed starts at the programmed biocides pump “on” time. The biocides pump will come on after this conductivity point has been reached.



SECTION 3 - OPERATING THE CONTROLLER

3.13 MANUAL OUTPUTS



MANUAL

OUTPUT

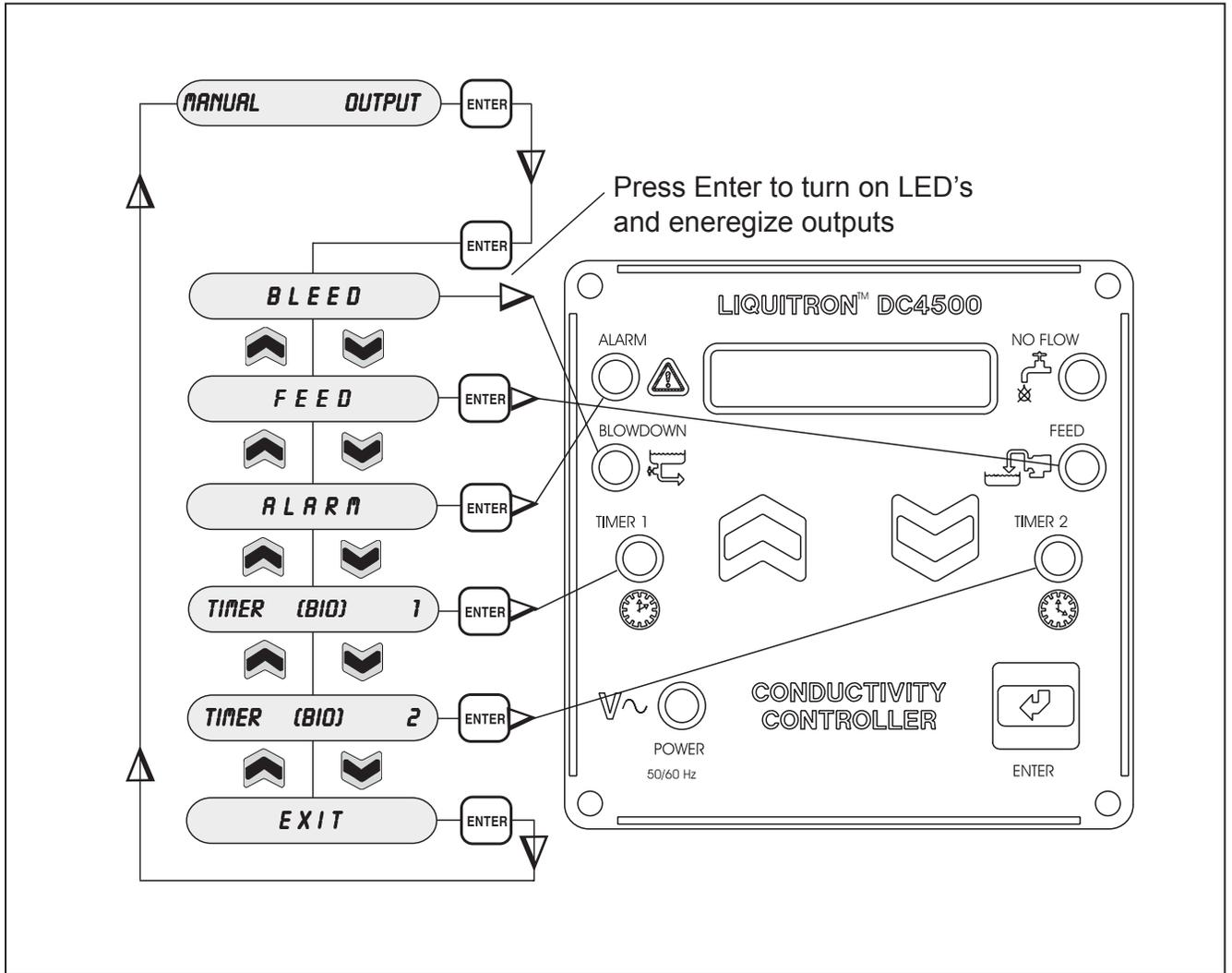
Manually Energize Relay Outputs

The “MANUAL OUTPUTS” mode is provided to allow for manual energizing of each relay output. Once the external devices have been connected, they may be individually or collectively energized and tested. Testing of all these components is recommended after system installation and prior to system start up. Press “ENTER” to access these sub-menu screens. Press the “UP” or “DOWN” key to move to each relay control screen. Press “ENTER” from each relay output screen to energize that output relay. Press “ENTER” a second time to de-energize that relay. One or all of the relays may be energized in this manner. The output relays will be de-energized if:

1. No Keys are pressed for 3 minutes and the controller returns to the “system run” screen.
2. The operator manually de-energizes each relay output.
3. The operator manually exits the “MANUAL OUTPUT” sub-menu screens.

SECTION 3 - OPERATING THE CONTROLLER

Main Screen



SECTION 3 - OPERATING THE CONTROLLER

3.14 ADVANCED SETUP

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

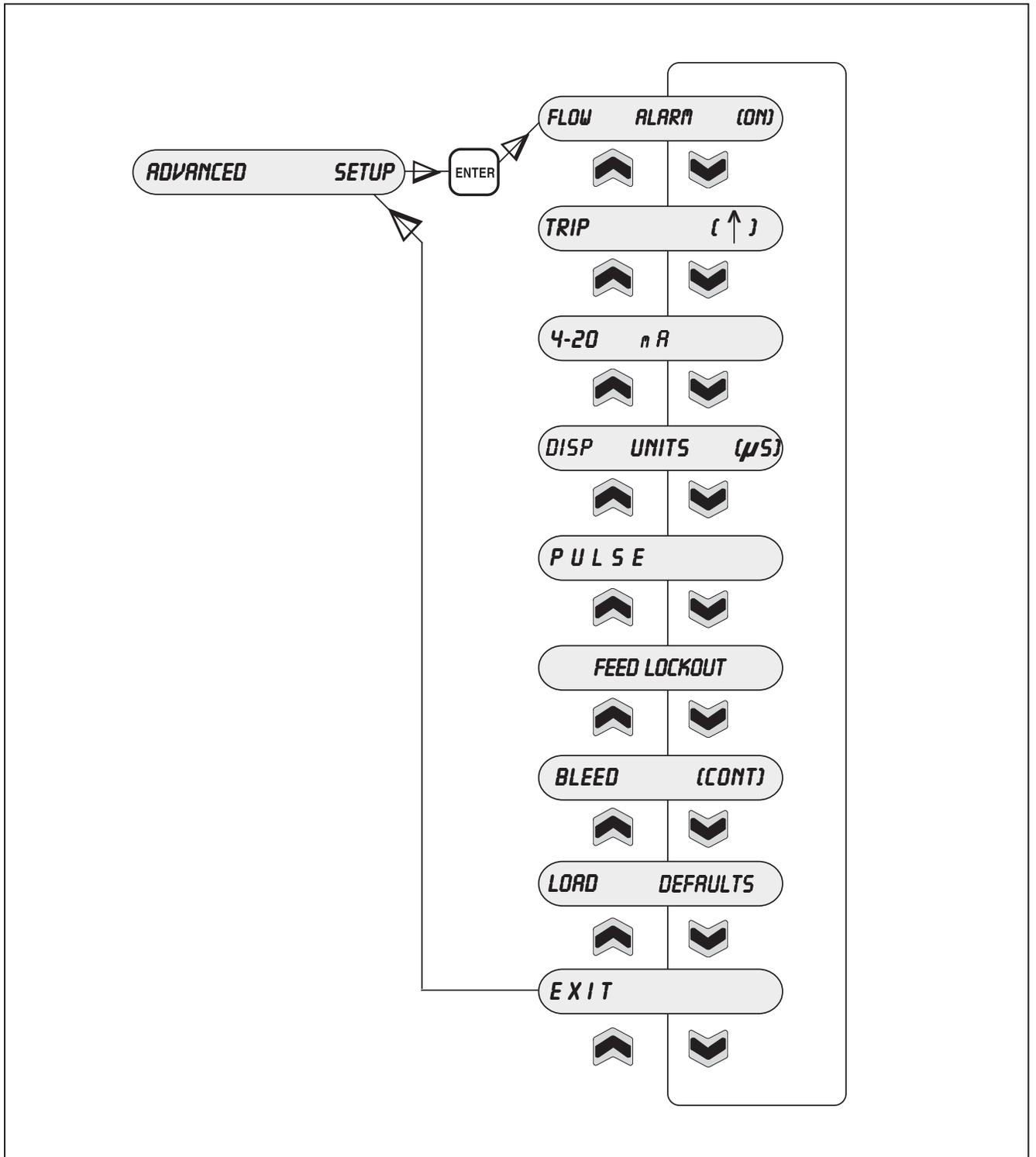
ADVANCED

SETUP

The “ADVANCED SETUP” screens allow for the special configuring of the controller for advanced options. These options include:

- FLOW ALARM (energizing the alarm output relay on loss of flow).
- FLOW SENSE (under FLOW ALARM the response of the flow switch may be changed from either normally open or normally closed logic).
- TRIP (bleed based on either rising or falling conductivity trip point).
- 4 - 20 mA recorder output programming, conductivity units DISPLAY may be either μ Siemens or PPM / TDS.
- PULSE OUTPUT (strokes per minute programming control of each individual pump).
- FEED LOCKOUT (prevents feed pump from operating during biocide addition).
- BLEED control (continuous or timed).
- LOAD DEFAULTS.

SECTION 3 - OPERATING THE CONTROLLER



SECTION 3 - OPERATING THE CONTROLLER

3.15 TEMPERATURE

CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H ₂ O METER

TEMP (F) 032°

The “TEMPERATURE” screen displays the temperature sensed by the externally connected thermistor [10K Ohms at 77°F / 25°C]. The screen may display temperature in either Degrees (F) or Degrees (C). Pressing “ENTER” from this screen accesses this option change. Pressing the “UP” or “DOWN” key toggles between displaying °F or °C. Pressing “ENTER” a second time saves the displayed Temperature selection.

TEMP (F)	032	ENTER	DEGREES	(F)	032
<i>Use  or  key to change from °C to °F</i>					

SECTION 3 - OPERATING THE CONTROLLER

3.16 H₂O METER

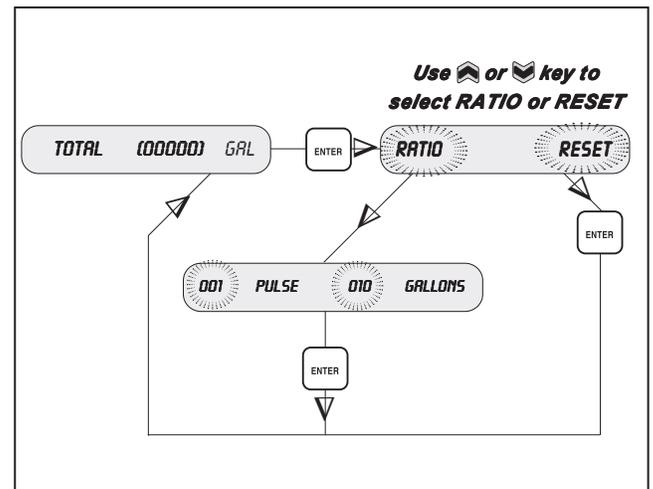
CONDUCTIVITY
SET POINT
Δ DIFFERENTIAL
LOW ALARM
HIGH ALARM
FEED
CLOCK
VIEW BIOCID
ADD BIOCID
LOCKOUT
PREBLEED
MANUAL OUTPUT
ADVANCED SETUP
TEMPERATURE
H₂O METER

TOTAL (00000) GAL

Water Meter Totalizer Screen

The “WATER METER TOTAL” screen allows for the display of the total gallons accumulated through a flow meter. The submenu’s allow for the programming of the:

1. counts-to-gallons ratio; and
2. reset of the totalizer.



SECTION 4 - START-UP

4.1 COOLING TOWER INSTALLATION

The LIQUITRON™ DC4500 Series of conductivity controller should be installed based upon the recommended system diagram below. A bypass loop for open recirculating water systems is the best method of conductivity monitoring and control.

The conductivity sensing electrode used with the conductivity controller must receive an active representative sample of system water. The electrode should be installed so that it is removed horizontally from its mounting tee. Water flow should enter from the bottom of the conductivity tee and exit out the top. This type of installation insures that the electrode tee is full of water whenever system flow is on and that the probe is fully emersed. This prevents the electrode from becoming air bound.

System shut OFF / isolation valves are recommended for installation on either side of the conductivity sensing electrode. This allows for ease of system isolation and electrode removal. A sample cock valve and a stainer are recommended to allow for periodic water sampling and water filtering.

Injection of required water treatment chemicals can be effected directly into the bypass line. When chemicals are injected into the bypass line, they should be downstream of the conductivity sensing electrode to avoid interference with readings.

An installed flow switch is recommended for the bypass line to allow for disabling of controller / pump operation during system maintenance or repair.

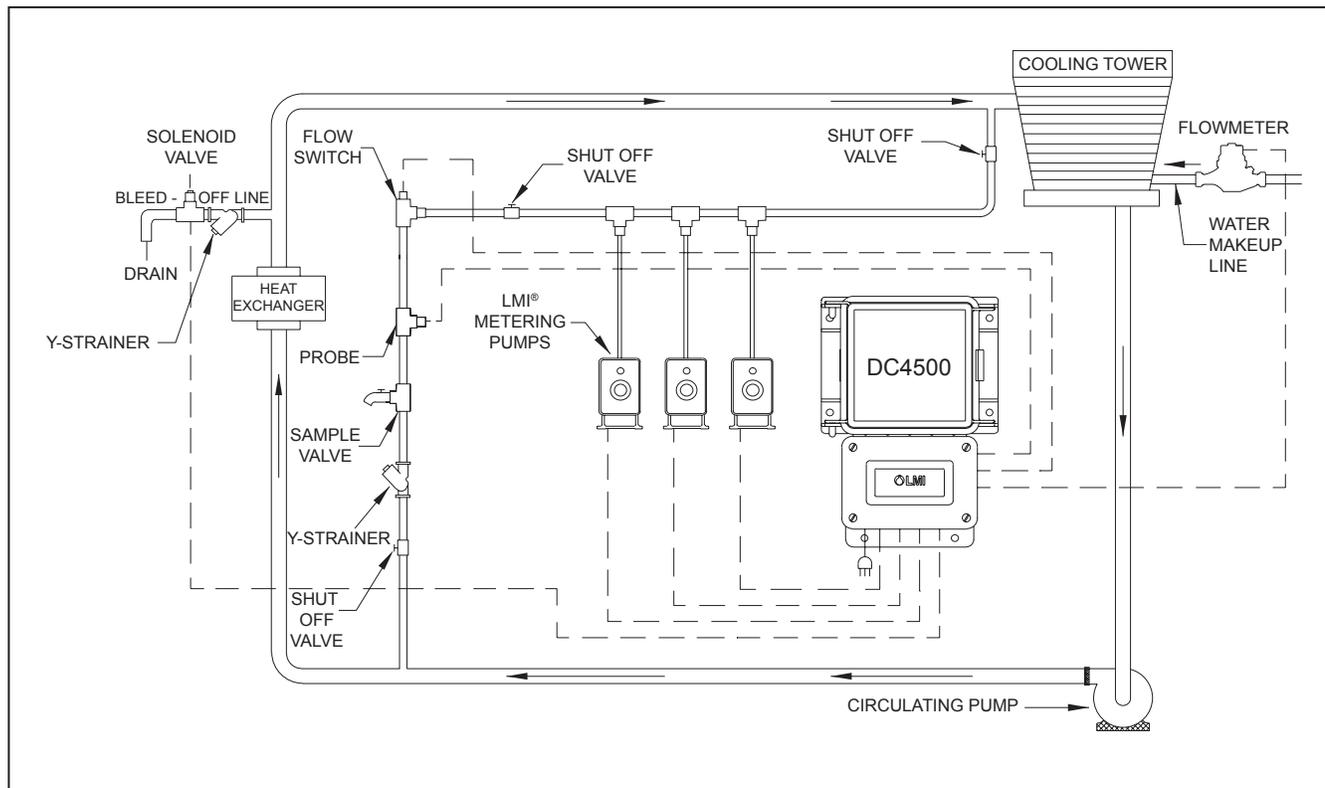


Figure 6

4.2 COOLING TOWER START-UP

The LIQUITRON™ DC4500 can be programmed for a multitude of tasks for cooling tower applications. Prior to powering up the DC4500 Conductivity Controller it is recommended that the following PRE-START UP work sheet be completed to determine required system operating parameters.

1. Current System Conductivity _____
2. Desired Conductivity Set Point _____
3. Differential (Hysteresis) Range _____
4. Method of Chemical Inhibitor Feed (choose one of the following) _____
 1. PULSE TIMER (Flowmeter based input response).
 2. % of TIME (Continuous repeating cycle with pump ON time based on percent of the cycle time.
 3. % of BLEED or BLOWDOWN (Amount of feed is based on a percent of the total bleed / blowdown time).
 4. LIMIT (Chemical inhibitor feed at the same time as system bleed or blowdown).

The Feed pump can be controlled by either a powered relay output or by direct variable speed control. The direct power or ON / OFF mode requires the pump to be connected to the 'FEED L' and any 'AC NEUT' terminal connection on the pc board. If an LMI® '7' or '9' series pump is being used the pump stroking speed may be directly controlled by the DC4500 pulsed output. The pump 4 pin connector must be wired to the 'PLS1 +' and 'PLS1 -' terminals on the pc board.

ON / OFF Pump Control _____

Variable Speed Pump Control _____

5. High Alarm Setting _____
6. Low Alarm Setting _____
7. Flow Switch Alarm activation (Yes / No) _____

SECTION 4 - START-UP

8. The LIQUITRON™ DC4500 controller can be configured to control dual-chemical (biocide) pumps for water contamination / biological growth control based on a selectable 1-4 week timer. Use the table below to assist in setting up the program operating periods for the pumps when using the 1-4 week timer option.

BIOCIDE CHEMICAL TIMETABLE				
	Week 1	Week 2	Week 3	Week 4
Sun				
Mon				
Tue				
Wed				
Thu				
Fri				
Sat				

The Biocide chemical pumps may be controlled by either ON / OFF or Direct Variable Speedmodes. The ON / OFF mode supplies AC power to the pump based on relay control. The Direct Variable Speed Control mode supplies a low voltage signal to the pump for pump stroke rate control.

The terminal connections on the I/O pc board for these modes are shown:

	ON / OFF		VARIABLE SPEED	
	AC Line	AC Neutral	Signal input	Signal output
Biocide 1	"TMR1 L"	"AC NEUT"	"PLS2 +"	"PLS2 -"
Biocide 2	"TMR2 L"	"AC NEUT"	"PLS3 +"	"PLS3 -"

9. Biocide Lockout Timer _____
10. Biocide Pre-Bleed Timer _____
11. 4 mA Output _____
12. 20 mA Output _____

Once the operating settings and parameters have been determined by the data entered in the previous pages, the DC4500 Controller can then be programmed. Supply power to the controller. Read the conductivity and verify the accuracy using a calibrated meter and conductivity sample. Calibrate the controller as needed. See *Calibration Section*.

- In the Main Menu, enter the required values for Conductivity, Differential, Low Alarm and High Alarm.
- Go to the FEED menu screen (see *FEED programming sheet in manual*) and enter the required mode and settings for the chemical inhibitor pump control.
- Go to the SET UP menu screen (see *SET UP programming sheet in manual*) and enter the Flow Alarm Option, Trip Actuation, 4 - 20 mAmp settings, Display Mode, Pulse Output Pump Control, and Control Cooling Tower.
- Go to the CLOCK menu screen (see *CLOCK programming sheet in manual*) and enter the current day and time information as well as the number of weeks required for the repeating Biocide Pump programming.
- Go to the BIOCIDE pump menu screen (see *BIOS programming sheet in manual*) and enter the required options for the Biocide Pumps.
- Use the MANUAL OUTPUTS menu (see *MANUAL OUTPUTS programming sheet in manual*) to check that all controlled devices are properly connected.

This completes the cooling tower start-up. Return the display to the 'SYSTEM RUN' or 'CONDUCTIVITY Reading' screen to begin operation.

Note:

The system will return to the 'SYSTEM RUN' mode automatically on its own after three (3) minutes if no keys are pressed.

SECTION 4 - START-UP

4.3 BLEED OR BLOWDOWN SAMPLING OPTION

Operating Mode

The LIQUITRON™ DC4500 Conductivity Controller can be configured to operate in one (1) of two (2) different operating modes for conductivity bleed or blowdown:

1. Timed Conductivity Blowdown Sampling
2. Continuous Conductivity Blowdown Sampling (Standard Method)

The Continuous Conductivity Bleed / Blowdown is the most commonly used method. When the conductivity is above a set point, a valve is opened and water is bled off until the conductivity is below the set point minus the hysteresis. All DC4500 Controllers are factory set for this method of control.

In the ADVANCED Menu, the operator is offered the option of changing this to a “TIMED SAMPLING” method of bleed control.

In the “TIMED SAMPLING” mode, the conductivity is only looked at periodically. If the conductivity is high, the valve will be opened and the water bled off until this conductivity is brought back to the desired set point. This is done when the probe is installed on the drain line itself. It allows for minimal piping installation.

The programmed settings for this method are 1 sampling time, and 2 sampling duration.

- **SAMPLING TIME** - is the amount of time in between active conductivity readings. If the conductivity is above the set point during this time, the unit will not bleed.
- **SAMPLING DURATION** - At the end of the Sampling Time, the bleed valve will automatically open up and start bleeding OFF water. The unit will bleed water off for the entire sample duration time. This is done to get a good clean sample near the probe. At the end of the sample duration the valve will be closed if the conductivity is below the set point, or held open if the conductivity is above the set point. It will then continue to bleed until the set point is reached.

Calibration will be required during system start up or when a variation in conductivity readings exists between the displayed conductivity and the conductivity value determined from a reliable source (such as a hand held tester). The conductivity probe should be cleaned prior to calibration (see 7.0 MAINTENANCE for probe cleaning instructions).

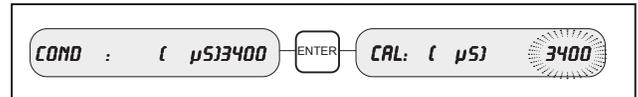
The 'SYSTEM RUN' or 'CONDUCTIVITY reading' screen is used to calibrate the controller. Press the 'ENTER' key from this main menu screen to access the calibration mode. The 'CALIBRATION' screen will display the word CAL and then the current conductivity reading. Place the probe in the conductivity standard. Allow the conductivity reading to stabilize. Use the 'UP' or 'DOWN' keys to enter the correct conductivity reading, and then press enter. This will save the reading value and re-calibrate the controller based on this value.

Note:

If the probe reading is off by more than 50%, then the controller will indicate an error by displaying 'CAL LIM uS'. This means that the probe has failed or needs cleaning.

Alternately, a sample of cooling tower water may be analyzed by a precalibrated conductivity monitor, and the DC4500 controller calibrated to match that reading using the sample as a standard solution.

From Conductivity Screen....press Enter....to Calibrate



In Calibration....

1. press or to adjust conductivity value.
2. press to save calibrated value.

The DC4500 Controller provides a circuit board test-switch to aid in troubleshooting the unit and system. The switch is located under the access cover on the lower section of the controller (see Figure 5).

The conductivity test-switch allows the user to determine if the conductivity circuit is operating correctly. When placed in the test position, this switch switches the conductivity probe and wiring out of the circuit and places an internal precision resistor. This resistor has a known conductivity reading of 3000 uS +/- 5%. If the unit has been calibrated then this reading could be displayed as + or - 50% of this 3000 μS value (+4500 μS, -1500 μS).

SECTION 6 - MAINTENANCE

6.1 CONTROLLER

The LIQUITRON™ DC4500 controller itself requires very little maintenance. Wiping the controller down with a damp cloth will clean it. Do not spray down the controller unless the enclosure door is closed and latched.

6.2 PROBE

Note:

The controller must be recalibrated after cleaning the probe.

6.2.1 Cleaning Procedure

The probe can normally be cleaned using a cloth or paper towel and a mild cleaning solution. Occasionally, a probe may become coated with various substances which require a more vigorous cleaning procedure. Usually the coating will be visible, but not always. To clean a coated probe, use a fine grit abrasive, such as fine sand paper. Lay the paper on a flat surface and move the probe in a back and forth motion as shown in *Figure 7*. The probe should be cleaned parallel to the carbon electrodes, NOT perpendicular.

6.2.2 Frequency

The probe should periodically be cleaned to maintain accurate measurements. The frequency of cleaning required will vary from application to application. In a new installation, it is recommended that the probe be cleaned after two (2) weeks of service. In order to determine the frequency of cleaning, use the following procedure.

1. Read and record the conductivity with probe in system.
2. Remove the probe, clean it, and place it back into the system.
3. Read the conductivity of the probe after it is cleaned and record it.

Compare the first conductivity with the second. If the variance in readings is greater than 5%, increase the frequency of probe cleaning. If there is less than a 5% change in the reading, the probe was not dirty and can be cleaned less often.

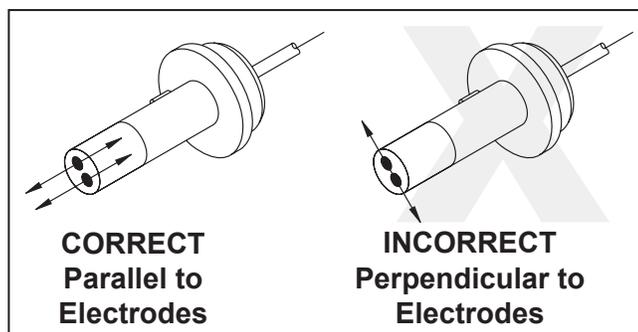


Figure 7

SECTION 7 - TROUBLESHOOTING

▲ CAUTION DISCONNECT POWER TO THE CONTROLLER BEFORE OPENING THE FRONT PANEL. TROUBLESHOOTING AND REPAIR OF A MALFUNCTIONING CONTROLLER SHOULD ONLY BE ATTEMPTED BY QUALIFIED PERSONNEL USING CAUTION TO INSURE SAFETY AND TO LIMIT UNNECESSARY FURTHER DAMAGE. CONTACT YOUR LOCAL LMI® DISTRIBUTOR OR THE FACTORY FOR ASSISTANCE.

PROBLEM	POSSIBLE CAUSE	SOLUTION
No Power Light	Blown main fuse	Test with multimeter / replace if required
	No power supplied	Check power source
	Loose/incorrect wiring	Verify wiring connections
No Display	Blown main fuse	Test with multimeter / replace if required
	Blown secondary fuse	Test with multimeter / replace if required
	Faulty pcboard	Consult factory
No Pump Power	Alarm State/No Flow Exists	Check flow switch : 'Alarm Light On' below
	Incorrect wiring to pump	Check wiring by using Relay Test program
	Pump has failed	Plug pump directly into live outlet
	Incorrect pump settings	Check programmed settings and modes
No Valve Power	Flow switch off	Check flow switch and wiring
	Incorrect wiring to valve	Check wiring by using Relay Test program
	Valve has failed	Test per manufacturers instructions
	Incorrect Blowdown setpoint	Verify setpoint and rising/falling trip selection
Low Conductivity	Bypass valve open	Verify valve alignment
	Airbound probe	Change probe location
	Solenoid valve stuck open	Repair or replace
	Sensor disconnected	Check and verify sensor
	Faulty cable or connector	Replace as required
High Conductivity	Probe is fouled or dirty	Clean as required - recalibrate
	Solenoid valve stuck shut	Repair or replace
Erratic Conductivity	Unit out of calibration	Recalibrate
	Unit will not calibrate	Out of range limits - Use Conductivity Test switch
	Stagnant sample	Check system for proper flow
	Reading is stuck on one value	Verify test switch is in Run mode not Test mode
	Faulty pc board	Consult factory
Alarm Light On	Alarm Condition Exists	Verify high conductivity set point
		Verify low conductivity set point
		Low chemical tank level (when wired)
Alarm & BIO LEDs On	Biocides pump at same time	Check programmed settings and modes
		Ensure prebleed and lockout do not conflict
No Flow Light On	No Flow circuit energized	Check wiring from flow switch to terminals
		Verify flow switch is moving freely
		Verify flow is present in manifold line

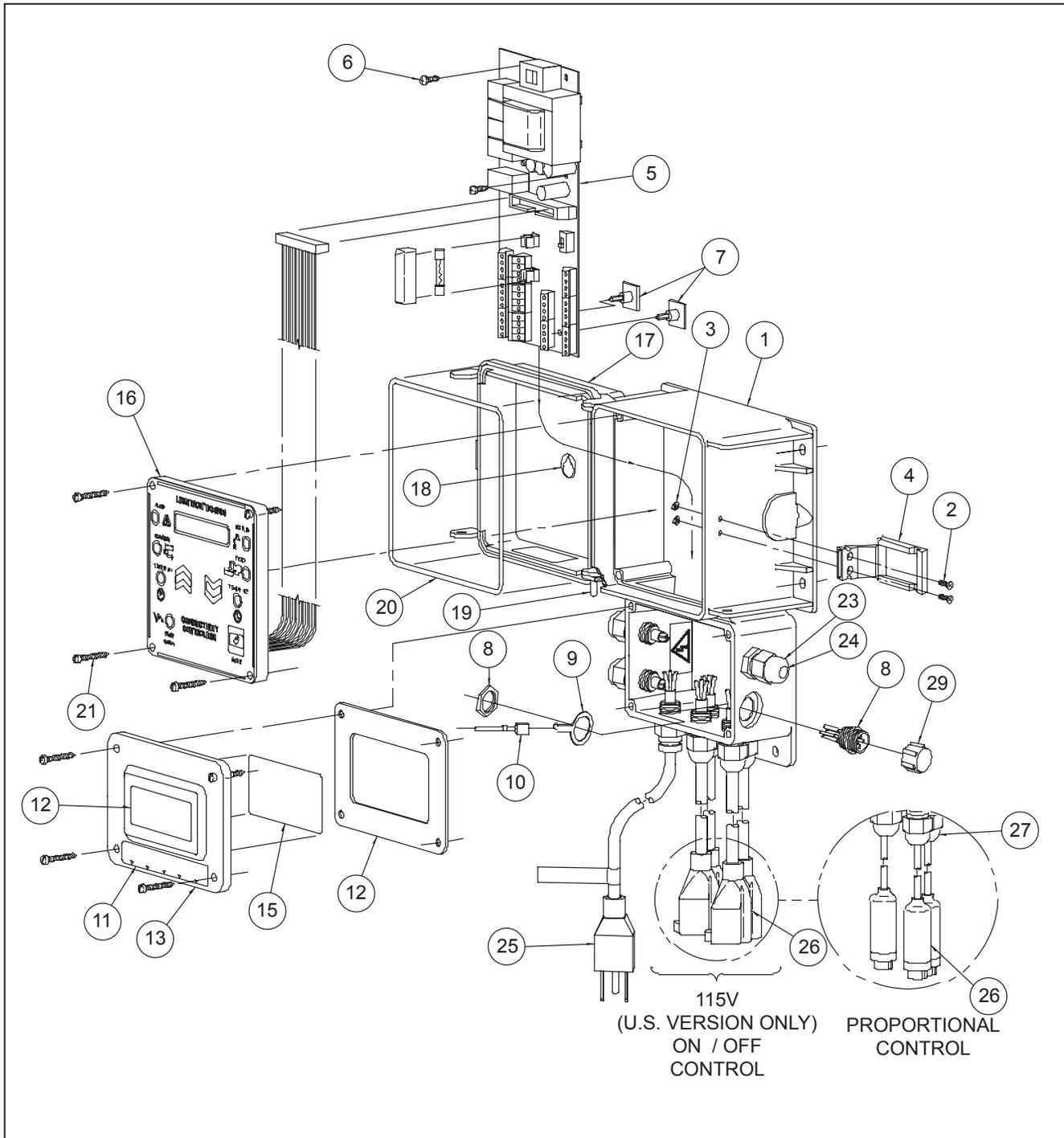
SECTION 8 - FACTORY SETTING

Day	Random
Hour	Random
Minute	Random
Temperature	Fahrenheit
Conductivity Set point	2000 μ S
Delta Differential	100 μ S
Low Alarm	100 μ S
High Alarm	4000 μ S
Feed Mode	Pulse Timer
Pulse Timer	10 seconds
Pulse Count	1 flow meter count
% Time - Cycle Time	10 minutes
% Time -	10%
Feed after Bleed	10%
Feed after Bleed - Limit	10 minutes
Limit (Feed & Bleed)	10 minute limit
Flow Alarm (On/Off)	Off
Trip (Rise/Fall)	Rise
4 mAmp setting	0 μ S
20 mAmp setting	20,000 μ S
Display (μ S/PPM TDS)	μ S
Pump Pulse Feed	100 strokes/minute
Pump Pulse Biocide #1	100 strokes/minute
Pump Pulse Biocide #2	100 strokes/minute
Controller Cooling Continuous/Timed	Continuous
Biocide Lockout	0 minutes
Biocide Prebleed	0 minutes
Biocide Week Cycle	4 week

SECTION 9 - PRODUCT SPECIFICATIONS

Power Requirements	115 VAC +/-15%, 50/60 Hz 230 VAC +/-15%, 50/60 Hz Voltage input selectable via a selector switch located on the I/O PCB. Fuse: 4A 250 VAC Time Delay
Inputs	Flow Switch. All low voltage inputs active low, i.e. the active state is when the switch is closed. The switch must be capable of switching 2 mA at +/-15 VDC.
Outputs	Pulse Pump A and B, Auxiliary, Alarm.
	All low voltage outputs capable of switching 2 mA at = 24 VDC. The pulse output frequency range is 0-100 SPM. The pulse output is active low. The pulse width is 100 milliseconds in the active low state. The output type is an opto-isolated NPN transistor open collector configuration. 4-20 mA: 600 ohms maximum
Keypad	Three key membrane keypad with tactile response. Material: Polyester with a hard coat finish. Actuation Force: 2.6N to 3.3N.
Temperature Input	Thermistor resistance 10k Ohms at 77° F [25° C] Circuit Accuracy: +/- 33° F [+/-0.5° C] Temperature Display: 32° F to 212° F [0° C to 100° C] Temperature resolution: +/- 1.8° F [+/- 1° C]
Probe Input	Cell constant of 1.5 ESD Protection: 700 Volts Three (3) sample readings / second : display updated every second
Relays	Fuse protected electromechanical. Control Relay (1): 250 VAC, 10amp contact relay Feed Relay (1): 250 VAC, 10amp contact relay Biocide Relay (2): 250 VAC, 10amp contact relay Contact type: Normally open and normally closed contacts (FORM C) Change over relay.
LCD Display	16-Digit Liquid Crystal Display [LCD] with green backlighting
Operating Temperature	32° F to 122° F [0° C to 50° C]
Memory Backup	EEPROM. Data retention of 10 years minimum.
Environmental	Printed pc boards conformally coated. Enclosure: IEC IP65, NEMA 4X - Door closed. IEC IP NEMA - 12X Door open
Mechanical	Two (2) pc boards [three (3) if communication option installed]. Control CPU board: microcontroller and display - low voltage. Terminal power I/O board: transformer, fuses, terminal blocks, relays. Option board: 4-20 mA output - low voltage.

SECTION 10 - PRODUCT EXPLODED VIEW



SECTION 11 - PRODUCT PARTS LIST

Item Number	Part Number	Description
1	35631	Housing, DC4500-100 & DC4500-200
	35623	Housing, DC4500 - all others
2	32186	Screw, 4-40 x 0.37
3	32187	Nut, 4-40 flush
4	32209	Latch, machined
5	35324	I/O board assembly
6	31632	Screw, #6 x 0.38
7	34716	Standoff, adhesive
8	25990	Connector assembly
9	33566	Solder lug terminal
10	34735	Ground wire assembly
11	35624	Label, DC4500 terminal cover
12	34074	Gasket, foam
13	34088	Cover, utility box
14	32094	Label
15	35378	Label, DC4500
16	36526	Front panel assembly
17	31617	Cover, Liquitron
18	30588	Label
19	32211	Cap, 0.125 x 0.38
20	32352	O-Ring sponge
21	32395	Screw, self-tapping
23	25957-1	Cord clamp
24	28892	Dowel
25	30749	Power cord, 115 V
	30751	Power cord, 230 V US
	30752	Power cord, DIN
	34783	Power cord, UK
	30754	Power cord, AUST
	34784	Power cord, SWISS
26	35711	Power cord, 115 V, NEMA 15-R, (DC4500-111 only)
	33636	4-pin cable assembly (DC4500-XX2 models)
27	31571	Cord clamp
29	25930	4-pin jack cap

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