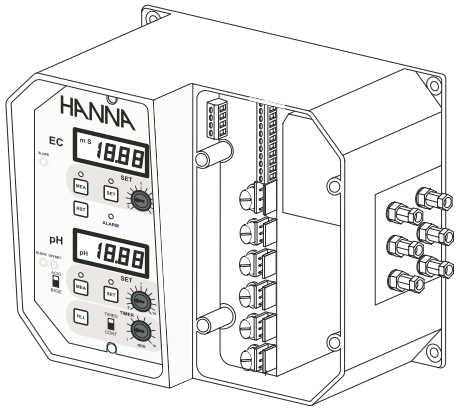
Instruction Manual

HI 9914
Wall mounted Fertigation Controller



HANNA instruments®

www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna Product. Please read this instruction manual carefully before using the instrument.

This manual will provide you with the necessary information for a correct use of the instrument, as well as a precise idea of its versatility.

If you need more technical information, do not hesitate to e-mail us at **tech@hannainst.com**.

This instrument is in compliance with CE directives.

TABLE OF CONTENTS

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, notify your Dealer.

Note: Save all packing materials until you are sure that the instrument functions correctly. Any defective item must be returned in the original packaging, together with the supplied accessories.

- Read carefully the instructions before using the instrument.
- Never install the controller outdoors, in a wet or humid area or under direct sun light. Nor install the controller where liquids may be sprayed or poured on it.
- The instrument has to be connected to a mains socket.
- The instrument's mains power line is protected by a 400 mA fuse. Use only a 400 mA fuse for replacement.
- The instrument's dosage, water nozzle, feeding pump, circulation pump and alarm terminals are protected by separate 2 A fuses. Use only 2 A fuses for replacement.

GENERAL DESCRIPTION

HI 9914 wall mounted fertigation controller is designed to meet specific process control requirements in agricultural, horticultural and hydroponics applications.

The controller is provided with two measuring channels, one for pH and one for conductivity. The actual values of pH and conductivity are displayed separately on two large LCDs with backlight feature for a best easy reading.

The EC probe is designed with a built-in temperature sensor which allows the controller to automatically compensate for the temperature effect.

The matching pin prevents potential grounding problems and thus ensure longer life to the pH electrode.

The controller includes two regulators for pH and conductivity, each of them can be adjusted from the front panel and the setpoint values will be displayed.

The conductivity regulator adds fertilizer in order to increase the conduc-

tivity of the irrigation water, while the pH regulator can be set for high or low pH correction.

For a better result, the conductivity and pH controls are time separated and a timed operation mode avoids overdosing of fertilizer or acid.

The controller is designed with relay outputs for pH and conductivity control (2A/240V), each one corresponding to a status LED for visual check.

Three level sensors are used to offer the best control of water level, alarm conditions and irrigation sequences.

The beginning of the irrigation can be triggered through an external signal, while an additional input allows to restart the cycle at any time.

The good water composition is signaled on the front panel and with an external signal for remote operating purposes.

The controller is equipped with an alarm system activated when an unusual working condition occurs.

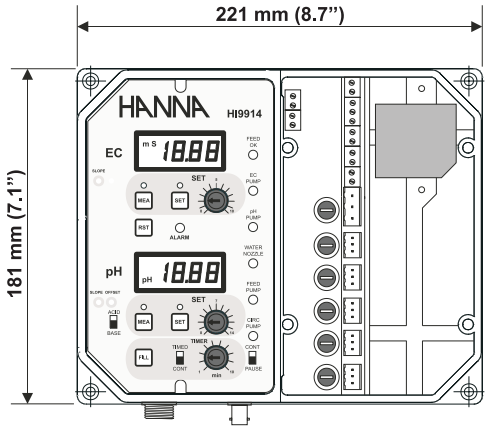
A humidity detector can be used to stop the controller if any leakage is detected.

Water nozzle, circulation pump, feeding pump and alarm are equipped with 2A (240 V) relays.

Two models are available, with different power supply input:

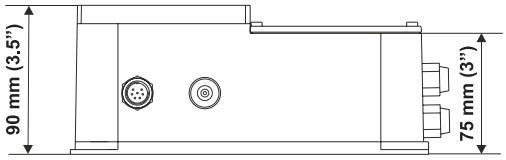
- **HI 9914-1** works with 110/115 Vac input
- **HI 9914-2** works with 220/240 Vac input

MECHANICAL LAYOUT



Front view

The molded mounting holes in the 4 corners provide for quick and secure installation. No additional tool is needed. All the electrical connections and control are located on the front panels so that adjustments can be made without removing the unit.

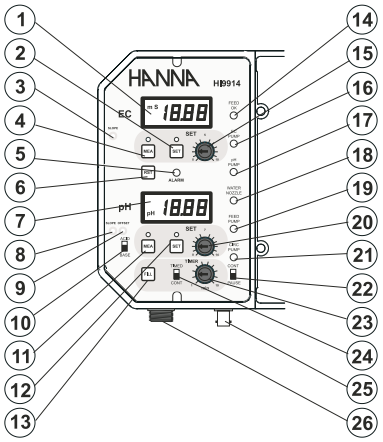


Bottom view

The modular design isolates the control circuitry from the contacts, making possible to wire the connections and then close the compartment. Adjustments can be made through the "control area" (left panel), without open the connection compartment (right panel).

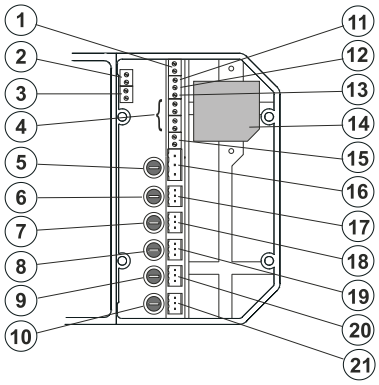
FUNCTIONAL DESCRIPTION

LEFT PANEL



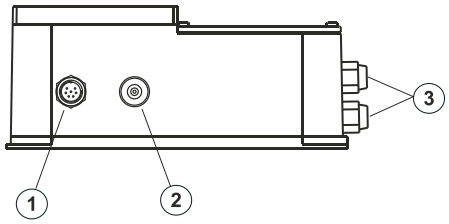
1. LCD for Conductivity readings
2. EC SET button
3. EC slope adjustment trimmer
4. EC MEAsure button
5. Alarm LED
6. Reset button
7. LCD for pH readings
8. pH slope adjustment trimmer
9. pH offset adjustment trimmer
10. Acid / Base selector switch
11. pH MEAsure button
12. pH SET button
13. FILL button
14. Feed OK LED
15. EC setpoint knob
16. EC pump LED
17. pH pump LED
18. Water nozzle LED
19. Feed pump LED
20. pH setpoint knob
21. Circulation pump LED
22. RUN/STOP switch for Circulation pump
23. Timer knob
24. Timer mode selection switch
25. BNC connector for pH electrode
26. DIN connector for EC probe

RIGHT PANEL



1. Connections for matching pin
2. EC analog output
3. pH analog output
4. Level sensors input
5. Mains power fuse
6. Fuse for pH and EC correction dosing pumps
7. Fuse for Water nozzle relay
8. Fuse for Feeding pump
9. Fuse for Circulation pump
10. Fuse for Alarm relay
11. Feed OK output
12. Connections for external fill switch
13. Irrigation start
14. Mains power transformer
15. Humidity sensor input
16. Power input
17. pH and EC pumps output
18. Water nozzle output
19. Feeding pump output
20. Circulation pump output
21. Alarm output

Bottom view



1. DIN connector for EC probe
2. BNC connector for pH electrode
3. Wiring access ports

SPECIFICATIONS

Conductivity	
Range	0.00 to 10.00 mS/cm
Resolution	0.01 mS/cm
Accuracy (@20°C/68°F)	±5% Full Scale
Typical EMC Deviation	±2% Full Scale
Setpoint	Adjustable, from 0.50 to 10.00 mS/cm
Temp.Compensation	Automatic from 0 to 50°C
Calibration	Manual, 1 point with slope trimmer (80 to 120%) on the front panel
Analog output	0-5V ±5% (0.5V / mS)
Controller output	2A, 220V relay
pH	
Range	0.00 to 14.00 pH
Resolution	0.01 pH
Accuracy (@20°C/68°F)	±0.02 pH
Typical EMC deviation	±0.1 pH
Setpoint	Adjustable, from 0.5 to 14.0 pH
Calibration	Manual, 2 point, with offset (±2 pH) and slope (80 to 120%) trimmers

Analog output	0-7V ±5% (0.5V / pH)
Controller Output	2A, 220V relay
Other Features	
Timer	Adjustable, from 1 to 10 minutes within a 15-minutes-time frame
Feed OK output	12V, 15 mA current source
Humidity sensor	Activated if resistivity is below 220 KΩ
Water nozzle output	2A, 220V relay
Circulation pump output	2A, 220V relay
Feeding pump output	2A, 220V relay
Alarm output	2A, 220V relay
Water level inputs	Contact type water level sensors
User input	Contact type switch
External FILL button	Contact type push-button
Power supply	220/240V or 110/115V; 50/60Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Dimensions	221 x 181 x 90 mm (8.7 x 7.1 x 3.5")
Weight	1.75 kg (3.9 lb.)

INSTALLATION

Install the **HI 9914** controller on a wall, indoors, in a dry area and not under direct sun light. Assure that liquids can not be sprayed or poured on it. Fix the controller at a proper height to easily reach the front panels and fix the 4 screws at the 4 corners.

Install the controller near the tank to keep short the cables of pH electrode and Conductivity probe.

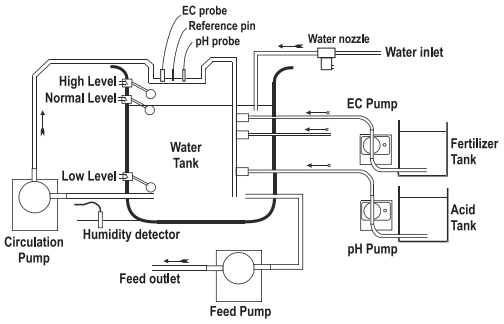
Assure the proper working voltage.

TANK ASSEMBLY SETUP

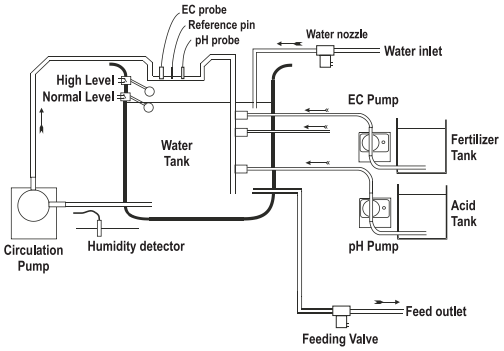
HI 9914 can work with different tank volumes and with various complexity of tank assembly. For proper operation of the controller, the tank assemblies must be set minding the following:

- the pH electrode and EC probe should rapidly detect any modifications in the water characteristics;
- it is recommended to use a circulation pump to mix water with fertilizer and acid;
- fertilizer and acid should be added to the water at distance from sensors to assure good mixing before the measuring point is reached;
- make sure that the pH electrode is always wet;
- the level sensors must be in the correct order, bottom to top: low level, normal level and high (alarm) level;
- place the sensors in the area with the minimum waves amplitude;
- when a level is reached, the corresponding level sensor will close the contact;
- the humidity detector must be placed outside the tank, where water leakage can be detected;
- the inlets for the circulation and the feeding pumps must be under the minimum water level (low level sensor);
- the normal level sensor must be used in all tank arrangements;
- if the high (alarm) level sensor is not used, leave the pin unconnected;
- if the low-level sensor is not used, connect the corresponding pin to the common;
- if the humidity sensor is not used, leave the pin unconnected;
- for activate external refill, press the corresponding push-button.

Typical arrangements for the Tank assembly



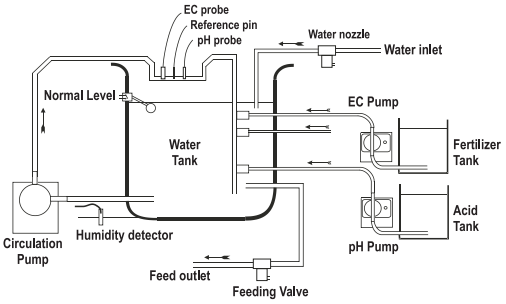
Complete tank assembly: all the sensors and pumps are mounted; the best control of water composition and irrigation sequence is assured. The inlet and outlet of the circulation pump are below the Low Level to avoid that the pH electrode remains dry.



Simplified tank assembly: the low level detector is not used; the controller does not react if the water level is too low.

Note: If a feed pump is used, provide a little water volume to keep always the level in the tank above the circulation pump inlet.

Note: The inlet of the circulation pump must be below its outlet to avoid damages to the pump itself.



Minimal tank assembly: only the normal level sensor is used, the irrigation is made manually, regardless of the water composition or level. The controller will refill the tank if the water goes under normal level for about 15 minutes or if the fill button is pressed.

Note: The inlet of the circulation pump must be below its outlet to avoid damages to the pump itself.

CONNECTIONS AND WIRING

Wiring the controller

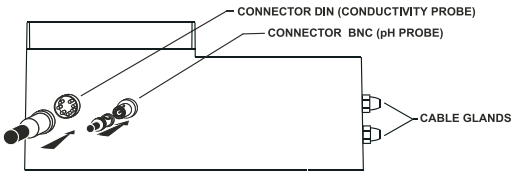
- Make sure the power supply is disconnected.
- Make sure all the auxiliary power sources are off.
- Unscrew the 4 screws from the right hand panel and remove the lid and the gasket.
- Thread the wires through the access port on the right hand side of the controller.
- Before connecting the controller to the mains, wire it completely, connect the pumps, valves, alarm, probes, level sensors and user input.
- Replace the lid. Connect the controller to mains line.
- Turn on all the auxiliary sources.

pH electrode and ground probe connections

- Attach the in-line pH electrode (for example **HI 1001**) to the BNC socket on the bottom of the controller.
- Use the matching pin (differential input) to prevent potential grounding problems and thus ensure longer life to the electrode.
- If the matching pin is not used, short pin 1 and pin 2 of the external connector located in the right panel.

- If the matching pin is used, connect the matching pin terminal to the connector pin 2 located on the right panel.

- Immerse the matching pin near the pH electrode.



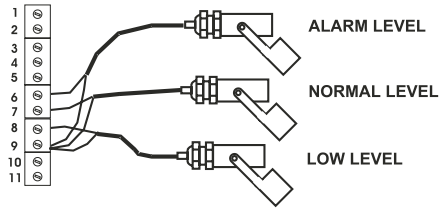
Conductivity probe connection

- Attach the conductivity probe (**HI7632/D** or **HI3003/D**) to the DIN socket located on the bottom of the controller. Align the guide on the connector with the socket, push-in the connector and tighten the retainer ring.
- The probe is provided with a built-in temperature sensor, which allows automatic temperature compensation of the readings.

Level inputs connections

All level sensors must have a contact type output.

If the water level is above the sensor position, the corresponding contact is closed. If the water is below the sensor, the contact is open.



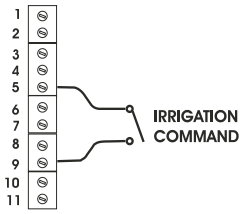
Each sensor will be connected between the *INPUT COMMON* (pin 9) and the corresponding input pin (*LOW LEVEL, NORM LEVEL, HIGH/ALARM LEVEL*).

- Place the low-level sensor to indicate the minimum water level for the correct function of both the circulation and feeding pumps.
- Connect the sensor between *INPUT COMMON* and *LOW LEVEL* pins.
- Place the normal-level sensor to indicate the filling level when the tank is full.
- Connect the sensor between *INPUT COMMON* and *NORMAL LEVEL* pins.
- Place the alarm-level sensor to limit the highest water level.
- Connect the sensor between *INPUT COMMON* and *HIGH (ALARM) LEVEL* pins.

Note: The level sensors act correctly if the sensor switch is closed when the water is above the corresponding level

Irrigation start connection

Connect the irrigation-start switch between *INPUT COMMON* and *IRRIGATION START* pins.

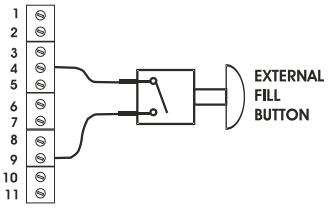


Irrigation can be controlled by:

- using a switch connected between the *INPUT COMMON* and *IRRIGATION START*: the irrigation is started by closing the switch, and lasts until the contact is open.
- using a 5V-logic signal, connected to the *IRRIGATION START* and referred to *INPUT COMMON:* the irrigation starts at level "0" (0V) and stops at level "1" (5V).
- using a level sensor that will be open when the desired level is reached: the controller will irrigate until the desired level is reached, and the irrigation will restart if the water falls below this level.

External fill button connection

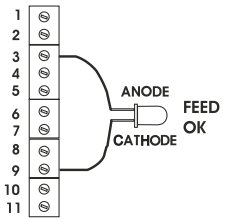
- Connect the button between *FILL* and *INPUT COMMON* pins.
- The tank will be immediately filled with water if the external fill button is pressed and the water level is below the normal level float.



External FEED OK connection

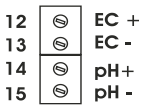
This output is a current source from the *FEED OK* pin.

- Connect a LED, buzzer or other device between *FEED OK* and *INPUT COMMON* pins.
- When the water composition is good for irrigation, the *FEED OK* will source about 15mA and activate the device.



Analog output connections

- Connect an external device between the EC+ and EC- (for Conductivity signal) or pH+ and pH- (for pH signal) pins.



- The output voltage is related to the value displayed on LCD. For EC the output will be 0V for 0.00 on LCD and 5V for 10.00 on LCD; for pH the output will be 0V for 0.00 on LCD and 7V for 14.00 on LCD.

Note: Never connect "EC" with "pH". Make sure there is no galvanic connection between the EC and the pH analog outputs, otherwise the measured values will be not reliable and probes can be damaged.

Relay connections

The controller is provided with six relay outputs (2A, 220V) protected by 2A fuses.

When a relay is off the *COMMON* pin is connected with the *NC* pin; when is on the *COMMON* pin is connected with the *NO* pin.

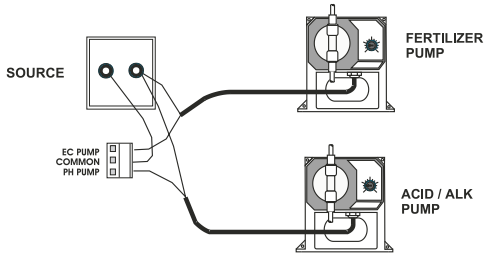
The *NC* pin is not accessible for the pH and EC pumps and the COMMON

pin is the same, so that the voltage of the power source has to match the working voltage of the selected device and both the pH and EC correction pumps have to work at the same voltage.

Acid and fertilizer dosing pump connection

The pH and EC correction relays (2A, 240V) have a common pin: if the pH correction pump is on, the *COMMON* pin is connected to the *pH PUMP* pin; if the EC pump is activated, the *COMMON* pin is connected to the *FERT. PUMP* pin.

- Connect one pin of the source to the *COMMON* pin.
- Connect the pH correction pump between the *pH PUMP* pin and the remaining pin of the source.
- Connect the EC correction pump between the *FERT PUMP* pin and the remaining pin of the source.

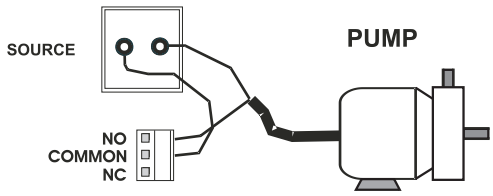


Note: Both pH and EC correction pumps must have the same operating voltage. The rated power of the pumps can be different.

Water nozzle, Circulation and Feeding pump connection

The Water nozzle, Circulation pump and Feeding pump outputs are relay type (2A, 240V). Both the *NO* (normally open) and *NC* (normally closed) contacts are available to the user. If the device is off, the *COMMON* pin is connected to corresponding *NC* pin. If the device is on, the *COMMON* pin is connected to the *NO* pin.

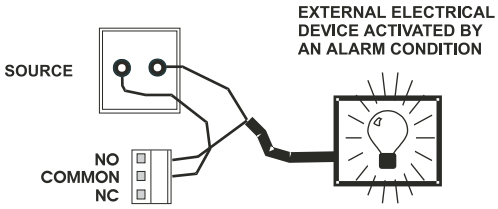
- Connect one pin of the source to the *COMMON* pin.
- Connect the device between the *NO* pin and the remaining source pin.



Alarm connection

The Alarm output is relay type (2A, 240V). Both the NO (normally open) and NC (normally closed) contacts are available to the user. If the alarm is off, the COMMON pin is connected to the NC pin. If the alarm is off, the COMMON pin is connected to the NO pin.

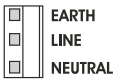
- Connect one pin of the source to the *COMMON* pin of the alarm output.
- Connect the alarm device between the *NO* output pin and the remaining source pin.



Main power supply connection

Before connecting the unit to the mains, make sure the controller is completely wired and all the connections for pumps, alarm, probes, etc. have been done.

- Connect the mains power wires to the power supply input pins.
- Replace the right panel lid and tighten the four provided screws.
- Connect the controller to the mains.



CONTROLLER START-UP

Before starting-up make sure the controller has been properly calibrated, and the pH and conductivity setpoints have been adjusted (see the following pages).

The pH electrode, conductivity probe and any reference pin must be properly connected and wired to the controller (see the section above).

The EC probe must be immersed in the solution above the air-vent holes on the external sleeve, and installed in such a way to minimize the presence of air bubbles (see probe installation tips at the end of the manual).

Remove the protective cap from the pH electrode and immerse the electrode (at least 4cm/1.5") into the solution to be tested. Install the electrode in such a way that it permanently lies in the solution.

The level sensors, user input, external fill button and humidity sensor must be connected accordingly with the chosen tank assembly.

If some of the inputs are not used, they must be connected as explained in the TANK ASSEMBLY section.

The pumps, water nozzle and alarm must be wired as described above.

Turn on the water supply and start the controller by connecting it to the mains power supply.

The **HI 9914** controls different status and gives visual information through various LED:

- When the dosing pumps are active, the corresponding EC and pH pump LEDs are on.
- When the circulation or the feeding pump is running, the corresponding LED is ON.
- When the water nozzle is open, the water nozzle LED is ON.

- When the water is good for irrigation, the Feed OK LED is ON.
- If any alarm condition occurs (see pag.22), the ALARM LED turns ON.

The controller can be restarted by pressing the RESET button.

If the alarm condition is still present, the controller goes back in alarm status.

When the controller is powered, the actual pH and conductivity values are displayed on the two LCDs in pH and mS/cm units respectively.

NORMAL OPERATION

When the **HI 9914** controller is turned on, the meter performs a status check of the level sensors and provides the commands depending on the input status.

All the inputs have a delay of about 1 second in order to avoid wrong commutations caused by the waves.

Step 1:

At start-up the controller checks the normal level and low-level sensors.

- If the tank is empty, both sensors are open and the controller goes to step 2.
- If the low-level sensor is closed and the normal level sensor is open (the water level is between low and normal level), the controller goes to step 3.

Step 2:

The water nozzle is activated (open) and the tank is filled with water.

When the low level is reached, the controller goes to step 3.

- If the controller remains in this status for more than 30 seconds, an alarm condition occurs.

Step 3:

The water nozzle is open, the circulation pump is running and the tank is filled with water.

When the normal level is reached (the normal level sensor is closed) the controller goes to step 4.

Step 4:

The water nozzle is closed, circulation pump is running and the Conductivity & pH controls are activated. The Conductivity control has the priority over the pH control.

- If the timer feature is activated, the control is on for a selected period (1-10 minutes) and off for the remaining period until 15 minutes.
- If both the conductivity and pH values are good for at least 30 seconds, the controller goes to step 5.
- If the normal level sensor remains open for about 15 minutes, the controller goes back to step 3.

Step 5:

The Conductivity & pH values are good. The Circulation pump is running and the controller waits for user input. This state is signaled on the front panel by *FEED OK* LED and externally through a 15mA current between the *FEED OK* and *INPUT COMMON* pins.

- If the water composition is not good, the controller goes back to step 4.
- If the normal level sensor remains open for about 15 minutes, the controller goes back to step 3.
- If the FILL button (or the external fill button connected between *FILL* and *INPUT COMMON*) is pressed while the *NORMAL LEVEL* sensor is open, then the controller goes back to step 3.
- If the user input command is active (the contact is closed between the *USER INPUT* and *INPUT COMMON* pins), the controller goes to step 6.

Step 6:

The Feeding pump is activated. The control of Conductivity and pH is inhibited.

- If the user input becomes inactive (the contact between the *USER INPUT* and *INPUT COMMON* pins is open), the controller goes back to step 3.
- If the low level is reached (the low-level sensor contact is open), the controller goes back to step 3.
- If the water remains under normal level for about 15 minutes (the normal level contact is open), the controller goes back to step 3.

The tank can also be filled by pressing the *FILL* button on the front panel (or the external fill button connected between *FILL* and *INPUT COMMON* pins) when the irrigation is completed.

If the *CONT/PAUSE* switch of the Circulation pump is in *CONT* position, the circulation pump will act as described above.

If the *CONT/PAUSE* switch of the Circulation pump is in *PAUSE* position, the circulation pump will not run the step 5.

When the low-level sensor is not used, the low-level condition is not sensed by the controller. The user must take care to stop the user input command before the water in the tank goes below the low level.

When the high (alarm) level sensor is not used and the normal level sensor does not work properly, the controller is unable to detect when the water reaches the high (alarm) level. In order to stop the controller, the humidity sensor must be placed where it can sense if the water pours down from the tank.

If the tank assembly is minimal, the irrigation takes place without using the user input command. Only the normal level and humidity sensors are used. The controller fills the tank at normal level and begins the Conductivity & pH correction. The user can add water at any time or wait until a good water composition is signaled.

ALARM CONDITIONS

When an alarm condition is reached, the *ALARM* LED turns ON and the alarm relay contact is closed (short between the *COMMON* and *NO* pins). All the pumps and the water nozzle are off. The Conductivity and pH measuring channels display the EC and pH values.

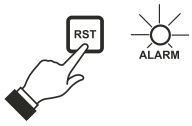
An alarm condition occurs when:

- the water remains below the low level (the sensor contact is open) for about 30 seconds;
- the high (alarm) level is reached (the sensor contact is closed);
- the humidity sensor detects water leakage;
- an impossible condition is detected, for example when the low level is not reached and the normal level is reached.

Reset button

To return to normal function, it is necessary that:

- the water level in the tank decreases below the high (alarm) level sensor;
- the level sensors operate correctly;
- the humidity sensor is dry;
- the *RESET* button is pressed.

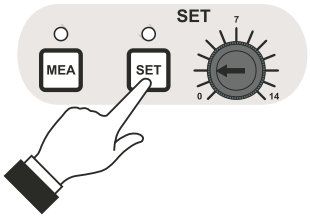


CONTROLLER SETTINGS

SETTING THE pH CONTROL

To adjust the pH setpoint:

- Press the SET button close to the pH display to read the setpoint value.



- Turn the SET knob until the display shows the desired value.
- Return to measurement mode by pressing the MEA button.

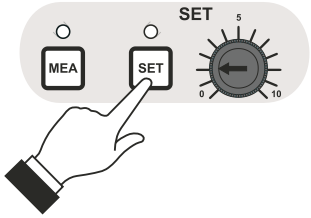
To select the dosing direction:

- Select the desired solution for pH correction by setting the ACID/BASE switch.
- If the switch is in the ACID position, the pH pump is activated when the pH value exceeds the setpoint. The controller will dose acidic solution to reduce the pH until the user-selected setpoint is reached.
- If the switch is in the BASE position, the pH pump is activated when the pH value falls below the setpoint. The controller will dose alkaline solution to increase the pH until the user-selected setpoint is reached.

SETTING THE EC CONTROL

To adjust the Conductivity setpoint:

- Push the SET button close to EC display to read the setpoint value.



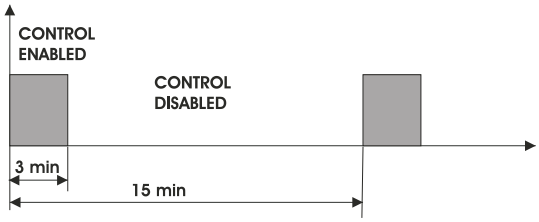
• Turn the SET knob until the display shows the desired value.

• Turn back in measurement mode by pressing the MEA button.

Note: The internal pH and EC regulators have a small hysteresis to prevent oscillations of the relay output that can damage the pumps. As a result, the selected pH and EC values are equal to the set value ± hysteresis value.

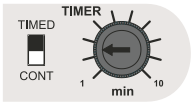
SETTING EC AND pH CONTROL TIMERS

The Timer feature is provided to avoid overdosing in a system with a long response time. The running time of the dosing pumps is set through the *TIMER* knob. The total time frame is 15 minutes. For example, if the *TIMER* is set to 3 minutes, the EC or pH correction pumps will be active for 3 minutes and off for 12 minutes (3+12=15 minutes).



Setting the timer:

- In order to activate the timed dosing feature put the TIMED/CONT switch to the TIMED position.
- To set the duty cycle of the dosing pumps, turn the TIMER knob to the desired position, from 1 to 10 minutes, depending on the tank volume.



When the TIMED/CONT switch is at the CONT position, the EC and pH correction pumps will run continuously.

SETTING THE CIRCULATION PUMP WORKING REGIME

- Set the CONT/PAUSE switch to CONT to enable a continuous running of the Circulation pump (if no ALARM condition is present).
- Set the CONT/PAUSE switch to PAUSE to stop the Circulation pump after the good water composition is reached (do not run the Step 5). The pump will start again when an adjustment of water composition is needed or the irrigation takes place.

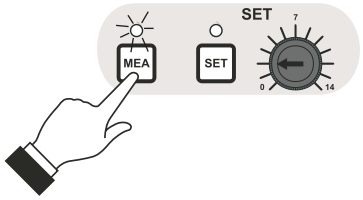
CALIBRATION

Disconnect the pumps, the water nozzle and the alarm or assure that the start of one of them will cause no damage.

ON, OFF or blinking LEDs have no effect on the measurement and calibration of pH and EC.

pH CALIBRATION

To calibrate the controller, first set it in measurement mode by pressing the MEA button (MEA LED is on).



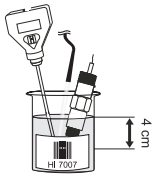
Make sure the pH electrode and matching pin have been properly connected and wired to the controller, and the meter is plugged to the mains.

The calibration should be performed at a temperature similar to that of the liquid to be monitored. Use the Hanna ***Checktemp*** (or other accurate thermometer) as reference.

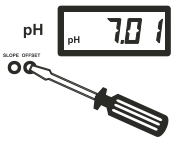
Remove the protective cap from the electrode.

During calibration, move the electrode and the ground probe (if in use) together from one buffer to the next.

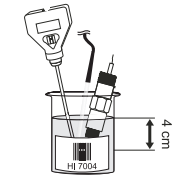
Offset adjustment



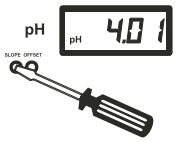
- Rinse the tip of the electrode with pH7.01 solution (**HI 7007**), dip the bottom 4 cm (1.5") of the electrode and ground probe in the pH7.01 buffer.
- Place also the ***Checktemp*** thermometer in the solution.
- Wait for the reading to stabilize and adjust the OFFSET trimmer to display the correct pH value at the measured solution temperature; e.g. 7.01 at 25°C (77°F). See the "pH VALUES AT DIFFERENT TEMPERATURES" section.



Slope adjustment



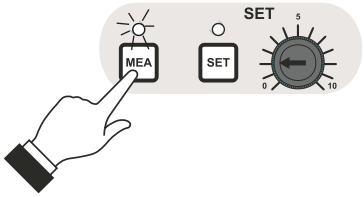
- Rinse the electrode and the ground probe thoroughly with water and immerse the bottom 4 cm (1.5") in a pH10.01 (**HI 7010**) or a pH4.01 (**HI 7004**) buffer solution.
- Stir the electrode and wait for the reading to stabilize before adjusting the SLOPE trimmer to display the correct pH value at the measured solution temperature; e.g. 4.01 (or 10.01) at 25°C (77°F). See the "pH VALUES AT DIFFERENT TEMPERATURES" section.



The pH calibration is now complete.

CONDUCTIVITY CALIBRATION

To calibrate the controller, first set it in measurement mode by pressing the MEA button (the MEA LED lights up).



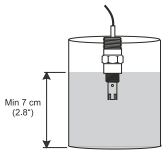
Make sure the conductivity probe has been properly connected and wired to the controller and the meter is plugged to the mains.

The calibration should be performed at a temperature similar to that of the liquid to be monitored.

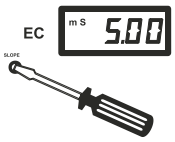
Slope adjustment

- Pour in a beaker a solution of known conductivity value, which should be close to the sample stream to be monitored. For example, if measurements are in the 1.2 to 2.5 EC range, choose **HI 7031** (1.41 mS/cm @25°C). Similarly, if measurements are in the 4 to 6 mS/cm range utilize **HI 7031** or **HI 7039** (5.00 mS/cm @25°C).
- Immerse the probe in the beaker ensuring that the holes on the probe sleeve are completely covered.

- Stir the probe and tap it gently to the bottom of the beaker to ensure that any air bubbles trapped inside it.
  For best results, do not put the probe close to the walls of the beaker or lying on the bottom.



- Wait for the reading to stabilize. Adjust the SLOPE trimmer to display the same value as the calibration solution @25°C. For example, with **HI 7039** buffer solution, adjust the trimmer to display "5.00".



Note: Once the controller has been calibrated by referring to the value @25°C of the calibration solution, all the subsequent measurements are temperature compensated to 25°C. Temperature compensation to a different temperature reference point can be obtained by calibrating the meter to that value. For example, the conductivity value of **HI 7031** @20°C is 1.28 mS/cm. By adjusting the trimmer to display this values, all the subsequent measurements will be compensated to a temperature of 20°C.

The conductivity calibration is now complete.

pH ELECTRODE CONDITIONING & MAINTENANCE

Preparation

Remove the protective cap.

DO NOT BE ALARMED IF ANY SALT DEPOSITS ARE PRESENT. This is normal with pH electrodes and they will disappear when rinsed with water.

During transportation tiny air bubbles may have formed inside the glass bulb (membrane). Shake down the electrode, as you would do with a glass thermometer to remove the bubbles.

If the bulb and/or junction are dry, soak the electrode overnight in **HI 70300** Storage Solution.

Storage

To minimize noise and assure a quick response time, the glass bulb and the junction should be kept moist at any time and not allowed to dry out. This can be achieved by installing the electrode in such a way that it is constantly in a well filled with the sample.

When not in use, pour a few drops of **HI 70300** Storage Solution or **HI 7007** pH 7.01 Buffer Solution in the protective cap and place it on the electrode.

NEVER USE DISTILLED OR DEIONIZED WATER FOR STORING PURPOSES.

Periodic maintenance

Rinse off any salt deposits with water.

Inspect the electrode and the cable. The electrode connection cable must be intact. There must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. If any scratches or cracks are present, replace the electrode.

The connector must be perfectly clean and dry.

Cleaning procedure

Soak the electrode in **HI 7061** General Cleaning Solution for approximately half an hour.

For a more specific cleaning procedure, refer to the electrode's instruction manual.

Note: After performing a cleaning procedure, rinse the electrode thoroughly with distilled water and recalibrate the controller.

Troubleshooting

Evaluate the electrode performance based on the following:

• Noise (readings fluctuate up and down) could be due to clogged/dirty junction:

- Dry Membrane/Junction: soak in **HI 70300** Storage Solution overnight. Check that the installation has been done to create a well to maintain the electrode bulb constantly moist.

• Low Slope:

- Check the electrode for cracks in the glass stem or bulb (replace the electrode if cracks are found).

- Make sure that cable and connections are neither damaged nor lying in a pool of water or solution.

• Slow Response/Excessive Drift:

- Soak the tip in **HI 7061** Solution for 30 minutes, rinse thoroughly with distilled water and then recalibrate the meter.

Note: It is always recommended to keep at least one spare electrode handy. When anomalies are not resolved with a simple maintenance, change the electrode (and recalibrate the controller) to see if the problem is solved.

CONDUCTIVITY PROBE MAINTENANCE

Preparation

Make sure that the protective sleeve is on the probe shaft and is intact.

Storage

Conductivity probes should be stored dry. If they are not to be used for a while, clean and dry them thoroughly before storing them in a dry place.

Periodic maintenance

Inspect the probe and the cable. The cable used for the connection to the controller must be intact. There must be no points of broken insulation on the cable or cracks on the probe sleeve. If any cracks are present, replace the probe and cable.

The connector must be clean and dry.

Cleaning procedure

Soak the probe in **HI 7061** General Cleaning Solution for 1 hour.

If the probe has been left in highly concentrated fertilizer solution and does not seem to have become clean, repeat the cleaning procedure. The pins can also be cleaned with a cloth. The cloth has to be made of a soft and nonabrasive material and does not scratch the pins.

Note: After performing a the cleaning procedure, rinse the probe thoroughly with distilled or tap water. Dry the probe and recalibrate the controller.

Troubleshooting

• If the controller does not respond properly or constantly reads zero or a value close to it:

- Check the probe and cable for cracks and replace it if needed.

• If the controller display shows **1.** :

- The cable may be shorted or the probe broken. Replace it if needed.

• If the response seems sluggish:

- Follow the above cleaning procedure.

• If there are anomalies such as fluctuating numbers:

- Ensure that the probe has been properly mounted and constantly lies in a well filled with solution.

- Air bubbles also disturb measurements and the probe should be installed in such a way as to minimize them.

Note: It is always recommended to keep at least one spare probe handy. When anomalies are not resolved with a simple maintenance, change the electrode (and recalibrate the controller) to see if the problem is alleviated.

Note: Ensure that the probe is installed in such a way that it permanently lies in the solution whether in the tank or the circulation pipe.

ACCESSORIES

pH electrodes

HI 1001	pH electrode for continuous flow-through monitoring
HI 1002	pH electrode for continuous flow-through monitoring
HI 1003	pH electrode with matching pin

EC probes

HI 7632/D	Conductivity probe, ATC, 1/2" thread, with DIN connector and 2 m (6.6') cable, for continuous flow-through monitoring up to 3 atm pressure
HI 3003/D	Conductivity probe, ATC, Pt-ring, Kynar® body, 1/2" thread, with DIN connector and 2 m (6.6') cable, for continuous flow-through monitoring up to 6 atm pressure

pH calibration solutions

HI 7004L	pH 4.01 buffer solution, 500 mL bottle
HI 7007L	pH 7.01 buffer solution, 500 mL bottle
HI 7010L	pH 10.01 buffer solution, 500 mL bottle

EC calibration solutions

HI 7031L	1.41 mS/cm calibration solution, 500 mL bottle
HI 7039L	5.00 mS/cm calibration solution, 500 mL bottle

Maintenance solutions

HI 70300L	Electrode storage solution, 500 mL bottle
HI 7061L	General cleaning solution, 500 mL bottle

Other accessories

BL1.5, BL3, BL5, BL7, BL10, BL15, BL20
Dosing pumps with flow rate from 1.5 to 18.3 lph (0.4 to 4.8 gph)

APPENDIX - A

pH VALUES AT VARIOUS TEMPERATURES.

The temperature directly affects the pH value.
For example, if the buffer's temperature is 25°C (77°F), calibrate the meter to read 7.01, 4.01 or 10.01; if the temperature is 20°C, calibrate the meter to 7.03, 4.00 or 10.06; if the temperature is 50°C, calibrate the meter to 6.98, 4.06 or 9.82; etc.
Please refer to the following chart for a more accurate pH calibration.

TEMP		pH VALUES				
°C	°F	4.01	6.86	7.01	9.18	10.01
0	32	4.01	6.98	7.13	9.46	10.32
5	41	4.00	6.95	7.10	9.39	10.24
10	50	4.00	6.92	7.07	9.33	10.18
15	59	4.00	6.90	7.04	9.27	10.12
20	68	4.00	6.88	7.03	9.22	10.06
25	77	4.01	6.86	7.01	9.18	10.01
30	86	4.02	6.85	7.00	9.14	9.96
35	95	4.03	6.84	6.99	9.10	9.92
40	104	4.04	6.84	6.98	9.07	9.88
45	113	4.05	6.83	6.98	9.04	9.85
50	122	4.06	6.83	6.98	9.01	9.82
55	131	4.07	6.84	6.98	8.99	9.79
60	140	4.09	6.84	6.98	8.97	9.77
65	149	4.11	6.85	6.99	8.95	9.76
70	158	4.12	6.85	6.99	8.93	9.75

APPENDIX - B

Composition of nutrient solution for several plants growth in hydroponic system utilized in nursery and cutting plants cultivation.

Factors	Measure Unit	Tomato	Pepper	Cocumber	Melon
EC	mS/cm	2.30	2.20	2.20	2.30
pH		5.5-6.2	5.5-6.2	5.5-6.2	5.5-6.2
NO_3^-	mM/L	13.75	15.50	16.00	16.50
$H_2PO_4^-$	mM/L	1.25	1.75	1.50	1.50
SO_4^{2-}	mM/L	3.75	1.75	1.50	1.50
Cl^-	mM/L				
NH_4^+	mM/L	1.25	1.25	1.25	1.00
K^+	mM/L	8.75	7.00	8.00	7.00
Ca^{2+}	mM/L	4.25	5.00	4.00	5.00
Mg^{2+}	mM/L	2.00	1.50	1.50	1.50
Na^+	mM/L				
Si^{4+}	mM/L			0.75	0.75
Fe^{3+}	µM/L	15.00	15.00	15.00	15.00
Mn^{2+}	µM/L	10.00	10.00	10.00	10.00
B^{3+}	µM/L	30.00	35.00	25.00	25.00
Zn^{2+}	µM/L	5.00	5.00	5.00	5.00
Cu^{2+}	µM/L	0.75	0.75	0.75	0.50
Mo^{6+}	µM/L	0.50	0.50	0.50	0.50

Factors	Measure Unit	Courgette	Eggplant	Haricot
EC	mS/cm	2.20	2.10	1.70
pH		5.5-6.2	5.5-6.2	5.5-6.2
NO_3^-	mM/L	16.50	15.50	12.00
$H_2PO_4^-$	mM/L	1.50	1.50	1.25
SO_4^{2-}	mM/L	1.75	1.50	1.15
Cl^-	mM/L			
NH_4^+	mM/L	1.25	1.50	1.00
K^+	mM/L	7.50	6.75	5.50
Ca^{2+}	mM/L	4.00	3.50	3.25
Mg^{2+}	mM/L	2.00	2.50	1.25
Na^+	mM/L			
Si^{4+}	mM/L			
Fe^{3+}	µM/L	10.00	15.00	10.00
Mn^{2+}	µM/L	10.00	10.00	10.00
B^{3+}	µM/L	30.00	30.00	20.00
Zn^{2+}	µM/L	5.00	4.00	4.00
Cu^{2+}	µM/L	0.85	0.75	0.50
Mo^{6+}	µM/L	0.50	0.50	0.50

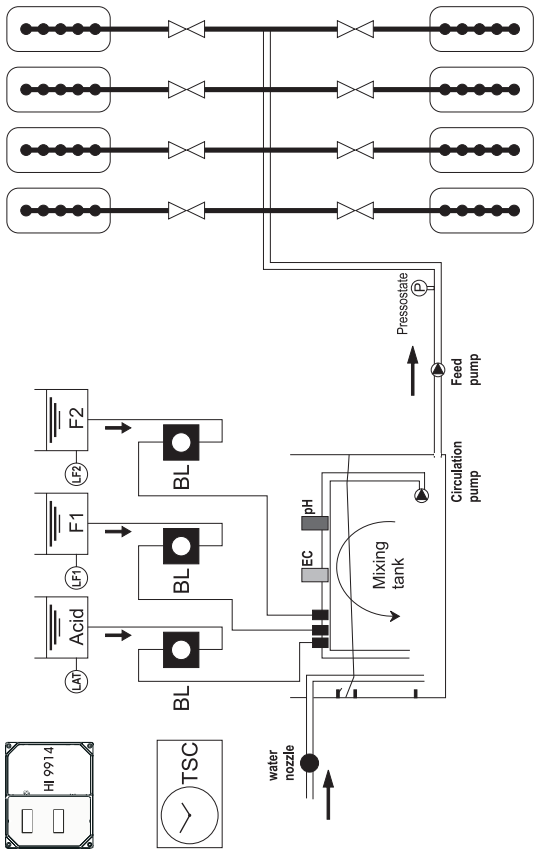
Factors	Measure Unit	Strawberry	Nursery	Cutting Plants
EC	mS/cm	1.60	2.40	3.30
pH		5.5-6.2	5.5-6.2	5.5-6.2
NO_3^-	mM/L	11.25	16.75	15.00
$H_2PO_4^-$	mM/L	1.25	1.50	3.50
SO_4^{2-}	mM/L	1.50	2.50	6.00
Cl^-	mM/L			4.00
NH_4^+	mM/L	1.00	1.25	3.00
K^+	mM/L	5.50	6.00	11.00
Ca^{2+}	mM/L	3.50	5.00	4.50
Mg^{2+}	mM/L	1.35	3.00	3.50
Na^+	mM/L			4.00
Si^{4+}	mM/L			
Fe^{3+}	µM/L	20.00	25.00	40.00
Mn^{2+}	µM/L	10.00	15.00	10.00
B^{3+}	µM/L	15.00	35.00	40.00
Zn^{2+}	µM/L	7.00	5.00	5.00
Cu^{2+}	µM/L	0.75	1.00	1.00
Mo^{6+}	µM/L	0.50	0.50	0.50

Reference:

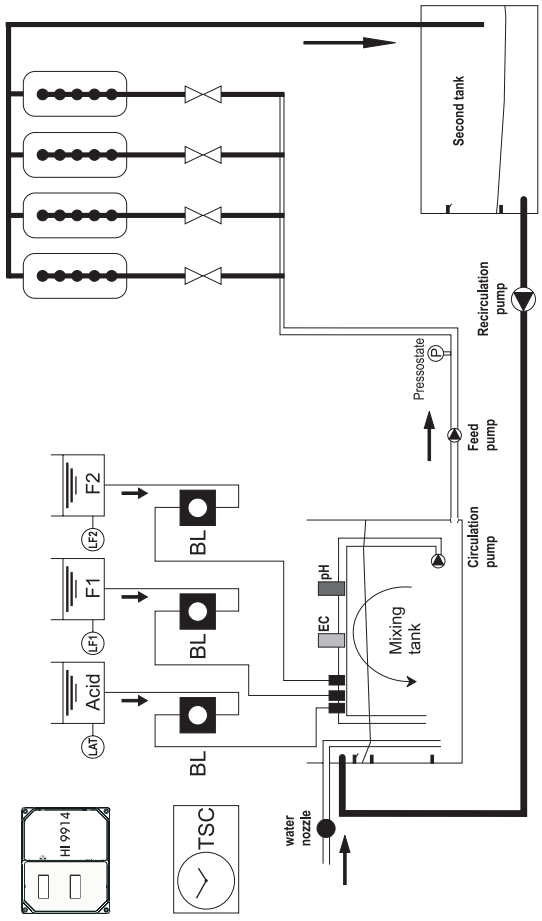
"Principi tecnico-agronomici della fertirrigazione e del fuori suolo", pag.115, published by "Veneto Agricoltura-Centro Sperimentale Ortofloricolo *Po di Tramontana*", coordinator Prof. F.Pimpini, Agricultural Faculty, University of Padova - Oct. 2001

APPENDIX - C

INSTALLATION EXAMPLES



Block diagram for a typical installation of an irrigation system, with **HI9914** controller.



Block diagram for an irrigation system with recirculation circuit.

WARRANTY

All Hanna controllers are **warranted for two years** against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. **Electrodes and probes are warranted for a period of six months.**

Damages due to accident, misuse, tampering or lack of prescribed maintenance are not covered. This warranty is limited to free of charge or replacement of the meter only, if any malfunctioning is due to manufacturing defects.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of failure. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization Number from the Customer Service department and then send it with shipment costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

CE DECLARATION OF CONFORMITY

HANNA instruments

CE

DECLARATION OF CONFORMITY

We

Hanna Instruments Italia Srl
via E.Fermi, 10
35030 Sarmeola di Rubano - PD
ITALY

herewith certify that the pH and EC controller:

HI 9914

has been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normatives:

EN 50082-1: Electromagnetic Compatibility - Generic Immunity Standard
IEC 61000-4-2 Electrostatic Discharge
IEC 61000-4-3 RF Radiated
IEC 61000-4-4 Fast Transient

EN 50081-1: Electromagnetic Compatibility - Generic Emission Standard
EN 55022 Radiated, Class B

EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use

Date of Issue: 15/01/2002

A.Marsilio - Technical Director

On behalf of
Hanna Instruments S.r.l.

Recommendations for Users:

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential area could cause unacceptable interferences to radio and TV equipment.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

Unplug the instrument from the power supply before replacing the fuse or making any electrical connections.

SALES AND TECHNICAL SERVICE CONTACTS

Australia:
Tel. (03) 9769.0666 • Fax (03) 9769.0699

China:
Tel. (10) 88570068 • Fax (10) 88570060

Egypt:
Tel. & Fax (02) 2758.683

Germany:
Tel. (07851) 9129-0 • Fax (07851) 9129-99

Greece:
Tel. (210) 823.5192 • Fax (210) 884.0210

Indonesia:
Tel. (21) 4584.2941 • Fax (21) 4584.2942

Japan:
Tel. (03) 3258.9565 • Fax (03) 3258.9567

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Malaysia:
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Tel. 6296.7118 • Fax 6291.6906

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Taiwan:
Tel. 886.2.2739.3014 • Fax 886.2.2739.2983

Thailand:
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United Kingdom:
Tel. (01525) 850.855 • Fax (01525) 853.668

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MAN9914R1 05/05

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