AQUATERR

VALVE ACTUATING RECEIVERS
VAR-1/D, VAR-2/D, VAR-4/D

INSTALLATION MANUAL

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INTRODUCTION

Thank you for purchasing your Aquaterr Irrigation Control System. As you know, your transmitters and receivers work together to provide you with a "wireless" operating system to control valves.

The Aquaterr system provides you with:

Non-line of sight transmissions, the valve actuating receiver (VAR) does not need to "see" the transmitter.
5+ miles (8+ km), transmission range.
Discrete on and off signals, no confusion, between on and off signals.
Thousands of discrete on and off signals, so multiple VARs are not actuated unintentionally.
Multiple systems can function side by side without interfering with each other.
Field programmable receivers, allowing the units to be moved to different locations or used in combination.
"Stand alone" power, efficient battery powered VARs.

FUNCTIONAL OVERVIEW

The Valve Actuating Receiver (VAR) receives signals over a non-line-of-sight radio path sent by the Valve Control Transmitter (VAT). The VARs are battery-powered. The VARs decode transmitted radio signals and actuate (turn on or off) any 9/12 volt DC latching solenoids connected to the VAR's output.   The VAR's "System ID" and "Unit ID" are both field programmable, as are the "fail safe" time (an automatic safety shutdown), and the peak voltage and pulse width that drive the solenoid(s).

The VAR's dual radio antennas are both external and self contained. The VARs can be manually actuated by using a manual actuator switches or a Programmer. The Programmer can also be used as a diagnostic tool to remotely display, the VAR's battery voltage, and the power supply voltage used to actuate the solenoid(s).

In addition the Programmer can also be used to monitor the VAR's received data. This function is useful to determine the location of the VAR's with respect to the transmitters, in order to insure accurate operation of the radio linked system.

SPECIFICATIONS: VAR-1/D, VAR-2/D, & VAR-4/D POLE MOUNT VERSION

VAR-1/D/P

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 1.75AH, D size alkaline cells
Operation: One (1) output will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5 mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Solenoid Actuation: Activated with internal push button switch, or Aquaterr Programmer
Operational Range: 5+ miles (8+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0 -7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: UV resistant, weatherproof housing
Mounting: Will mount on 1-1$\frac{1}{2}$ inches (2.5- 3.8 cm) diameter pipe, at a height of 6 feet (1.85m)
Size: 8.75 L x 4 W x 4 H inches (22 x 10 x 10 cm)
Weight: 2.9 lb. (1.3kg)

VAR-2/D/P

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 17.5AH, D size alkaline cells
Operation: Each of two (2) outputs will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: Programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Solenoid Actuation: Activated with push button switches, or Aquaterr Programmer
Operational Range: 5+ miles (8+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0-7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: UV resistant, weatherproof housing
Mounting: Will mount on 1-1$\frac{1}{2}$inches (2.5-3.8 cm) diameter pipe, at a height if 6 feet (1.85m)

Size: 8.75 L x 4 W x 4 H inches (22 x 10 x 10 cm)
Weight: 2.9 lb. (1.3kg)

VAR-4/D/P

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 17.5 AH, D size alkaline cells
Operation: Each of four (4) outputs will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Actuation: Using internal switches, or Aquaterr Programmer
Operational Range: 5+ miles (8+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0-7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: UV resistant, weatherproof housing
Mounting: Will mount on 1- 1$1/2$ inches (2.5-3.8cm) diameter metal, at a height of 6 feet (1.85m)
Size: 10.5 L x 4 W x 4 H inches (26 x 10 x 10cm)
Weight: 3.1lb. (1.4kg)

SPECIFICATIONS: VAR-1/D/VB, VAR-2/D/VB, & VAR-4/D/VB VALVE BOX MOUNT VERSION

<u>**VAR-1/D//VB**</u>

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 1.75AH, D size alkaline cells
Operation: One (1) output will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5 mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Solenoid Actuation: Activated with internal push button switch, or Aquaterr Programmer
Operational Range: 2+ miles (3.2+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0 -7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: Modified standard valve box covers
Mounting: Standard valve boxes, buried to grade
Size: 19 L x 12.5 W x 4.75 H inches (48 x 32 x 12 cm)
Weight: 2.9 lb. (1.3kg)

<u>**VAR-2/D/VB**</u>

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 17.5AH, D size alkaline cells
Operation: Each of two (2) outputs will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: Programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Solenoid Actuation: Activated with push button switches, or Aquaterr Programmer
Operational Range: 2+ miles (3.2+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0-7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: Modified valve box covers

Mounting: Standard valve boxes, buried to grade
Size: 19 L x 12.5 W x 4.75 H inches (48 x 32 x 12 cm)
Weight: 2.9 lb. (1.3kg)

VAR-4/D/VB

Operating Voltage: 3VDC
Battery Type: four 1.5VDC, 17.5 AH, D size alkaline cells
Operation: Each of four (4) outputs will control a 12 VDC latching solenoid
Solenoid Peak Actuating Voltage: programmable using Aquaterr Programmer
Solenoid Pulse Width: Programmable using Aquaterr Programmer
Maximum Wire Run: 300 feet to 1000 feet (100 to 300m) solenoid type dependent
Wire Type: 14 AWG (1.5mm) Insulated wire
Fail Safe Feature: Programmable automatic safety shutdown using Aquaterr Programmer
Manual Actuation: Using internal switches, or Aquaterr Programmer
Operational Range: 2+ miles (3.2+ km)
Sensor Inputs: Moisture sensors with switch closure (2 required)
Sensor Operation: Sensor switch will inhibit solenoid "turn on" or will "turn off" (reset) solenoid if "on."
System ID: 0-7 Programmable using Aquaterr Programmer
Unit I.D.: 1-999 Programmable using Aquaterr Programmer
Enclosure: Modified standard valve box covers
Mounting: Standard valve boxes, buried to grade
Size: 19 L x 12.5 W x 4.75 H inches (48 x 32 x 12cm)
Weight: 3.1lb. (1.4kg)

OVERVIEW OF SETUP AND OPERATION

The system setup has five steps**:**

1. Site Preparation: Select the irrigation valves to be operated by the system, install metal poles for the VARs at the valves, and install the transmitter's antenna.

2. Device ID Address: Assign each valve an identification address (see the transmitters' user manual to determine ID addresses available with your system).

3. Transmitter Setup: Prepare the transmitter following instructions in the VAT-16, VAT-32 instruction manual.

4. VAR Setup: Attach the receivers to their metal poles and connect the wires to the valves' solenoids.

5. VAR Programming: Use the Programmer to "program" the VAR system number, unit I.D. address(s), fail safe time(s) (maximum operation time plus safety margin), solenoid peak actuation voltages, and pulse widths, into the VAR.

System operation is also important to keep in mind. The transmitter sends a unique coded radio signal to all VARs within range. These signals indicate which valves are to be actuated and whether they are turned "on" or "off".

Each VAR "looks" at the signal and determines two things: 1) Does this signal correspond to me? And, if so, 2) is the signal an "on" signal or an "off" signal? If the signal corresponds to the VAR identification number which you programmed during setup, then the VAR performs the "on" or "off" operation.

The VARs radio power on indicator blinks once every 15 seconds, indicating that the radio is being turned on, and looking for a signal**. The radio will stay on only if a signal is detected.** If no signal is found, the radio will turn off, and will be turned on again at 15 second intervals to look for a signal. If a signal is detected, the radio will stay on, and remain on 30 seconds after the VAT stops sending signals. The VARs output status indicator will start, and continue to blink after an on command is successfully decoded. This can happen anywhere from 1.5 to 18 seconds after the VAT starts sending an on command. The VARs output status indicator will stop blinking after an off command is decoded. This can happen anywhere from 1.5 to 18 seconds after the VAT starts sending an off command.

1: SITE PREPARATION

Prior to VAT and VAR installation:

1) Install Actuator Solenoids: Install the appropriate two wire 12VDC latching solenoids, at the valves and make certain that all the valves function in the manual mode.

2) Install VAR Mounting Posts: Bury pipes in the ground so that the VARs are mounted 6 feet (1.85 m) above the ground. (See Figures 1 and 2)

The VARs can be located up to 1000 feet (300 meters) away from the solenoid. However wires will need to be run from the VAR to the actuator so they should be located as close as possible.

2: DEVICE IDENTIFICATION

Using a site map, identify each device to be actuated with consecutive I.D. addresses corresponding to your VAT. Assign VARs that are to be operated simultaneously with the same address. The address assigned to a VAR does not determine the order in which it is actuated, as the transmitter is continually "looking" for actuation events and will not necessarily operate in lowest to highest numerical order.

3: TRANSMITTER PREPARATION
  Refer to the VAT installation manual for instructions required to prepare the transmitter for operation.

4: VAR SETUP

The following steps are required to prepare the receiver for operation:

A) Connect the Battery, and Check VAR
B) Program System Identification Number
C) Program ID Address(s)
D) Program VAR Fail Safe Time(s)
E) Program Solenoid Pulse Width
F) Program Peak Solenoid Actuating Voltage
G) Install VAR
H) Connect Solenoid Wires to VAR

Make certain that each VAR's ID address is programmed to numbers corresponding to one of the VAT's addresses.

A: CONNECT THE BATTERY AND CHECK VAR

Remove the top of the VARs enclosure. To remove the top, twist the cylindrical part of the cover counter clockwise while holding the bottom of the enclosure (the mounting base) stationary (see VAR Figure 3) once the top is removed, and the circuit board is exposed, remove the plastic isolation strip located between the battery and the battery holder. (See figure 7 or 8). Keep the

isolation strips in the VARs battery holder, for future use. If the batteries are removed for any reason, be certain to observe the correct polarities when they are replaced. Permanent circuit damage may result if proper polarity is not maintained.

Once the batteries are connected, the VAR can be checked with the internal manual actuating switch or with the VAR Programmer.

5: USING THE PROGRAMMER WITH THE VAR

Remove the top of the VARs enclosure. To remove the top, twist the cylindrical part of the cover counter clockwise while holding the bottom of the enclosure (the mounting base) stationary (see VAR Figure 3) once the top is removed, and the circuit board is exposed, remove the plastic isolation strip located between the battery and the battery holder. (See figure 7 or 8). Keep the isolation strips in the VARs battery holder, for future use. If the batteries are removed for any reason, be certain to observe the correct polarities when they are replaced. Permanent circuit damage may result if proper polarity is not maintained.

Once the batteries are connected, the VAR can be checked with the internal manual actuating switch or with the VAR Programmer.

The Programmer communicates to the VAR by cable, and is used with all the VARs to program and display important parameters associated with the VARs. The programmer can also be used with the VARs to manually actuate solenoids and to monitor data as it is received and decoded by the VARs.
Before using the Programmer, insert the plastic isolation strip between the battery, and the battery holder. (See Figure 7 or 8) Wait 1 minute, and connect the Programmer's cable to the VAR's circuit board. (See Figure 4 or 5) Push the "ON/OFF" switch on the Programmer, to turn the Programmer on, (See Figure 17) and remove the isolation strip. The Programmer is now ready to be used with the VAR.

Start Using Programmer

To start using the Programmer, press "**ON/OFF**" or any key. To turn off the Programmer OFF, press the **"ON/OFF"** key, or, if left alone, the Programmer will turn itself off automatically within 5 minutes. To Exit a menu function at any time, press **"CLR"**. When the Programmer is turned on, the display will show
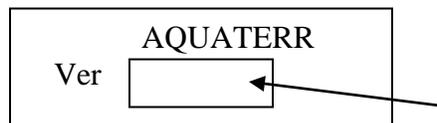
AQUATERR
Ver ⟵   The Programmer's software version number

And then will display:

Connect battery
to the VAR

11
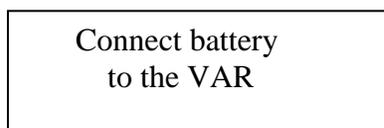
Connect the battery to the VAR, by removing the plastic isolation strip located between the battery and the battery holder. The display will
Display:

```
Select from menu
Download device data
```

The Programmer includes 11 VAR related functions. Use the "↑" and "↓" keys to select and display the following menu options:

1). DOWNLOAD DEVICE DATA
The Programmer will download data from the VAR.

 2). UPLOAD DEVICE DATA
The Programmer will upload data to the VAR.

3). CHANGE DEVICE SETTINGS
Downloaded data can be changed, and then must be uploaded to the VAR, in order for the change to be valid.

4). DISPLAY PARAMETERS
The Programmer will display the downloaded VAR parameters.

5). DISPLAY BUFFER
The Programmer will display the VAR's downloaded file registers (buffers). A memory map for each VAR must be used to interpret the data.

6). EDIT BUFFER
Downloaded file registers (buffers) can be changed, and then must be uploaded to the VAR.

7). ACTUATE VALVE
The Programmer will actuate the VAR's outputs.

8). READ/SEND COMMANDS
The Programmer will display commands sent by the VAT and decoded by the VAR.

 9). COMM LINK TEST
In this mode, the Programmer will engage in an ENQUIRE / ACKNOWLEDGE dialogue with a

VAR. This is used to check the Programmer to VAR communication link.

10). CHANGE PROGRAMMER SETTINGS (not supported currently)
Used for changing the Programmer's parameters such as language change (English to Spanish).

11). MONITOR RECEIVED DATA

The Programmer will display the VAR's decoded received data, as it is received and decoded by the VAR.

Note: Resetting the Programmer
If at any time the Programmer fails to respond to repeated attempts to use the "CLR" key, it will be necessary to reset the Programmer. To do this, pass the VAR's Manual Actuator within ¼" (60 mm), over the center rear of the Programmer's enclosure. (See figure 18)

Display the VAR's Current Parameters

To display the VAR's current parameters, select "download device data" as the menu option and press "ENT"

The display will show:

```
Change ESN?
00000>   ▢
```

A unique Electronic Serial Number (ESN) is assigned to each VAR at the factory. The ESN can not be changed by the user. Enter the ESN of the VAR. **If it is unknown, enter zero (Ø)**, then press "**ENT"**.

The Programmer is establishing communication with the VAR and will next display:

```
Identifying device
Please wait……..
```

The Programmer is determining what type of VAR is communicating with it (VAR-1, 2, 4)


```
VAR-     V     ESN
Press ENT to cont.
```

Press **"ENT"** then:

```
Please wait….
```

The Programmer is getting ready to download the VAR's data to the Programmer in 3 blocks.

```
Downloading block #01
Please wait…..
```

The first block is being downloaded.

```
Downloading block #02
Please wait…..
```

The second block is being downloaded.

```
Downloading block #03
Please wait…..
```

The third block is being downloaded, then

```
Shutting down VPC
Please wait…..
```

Then…

```
VPC Shutdown
```

The VAR has completed communication with the Programmer.

```
Download successful
Press CLR to EXIT
```

Press "**CLR**" to EXIT. The display will show:

```
Select from menu
Download device data
```

The VARs information is now stored in the Programmer.

NOTE: If the communications link from the Programmer to the VAR can not be established or is interrupted for any reason, Press "**CLR"**, wait 1 minute and try again.

The following are the Programming limits and default values, when using the Programmer.

	Min	Default	Max
System ID	0	0	7
Actuate Address	0	1, 2, 3, 4	1023
Failsafe Time (hours)	0	12	255
Failsafe Time (minutes)	0	0	255
Pulse Width (milliseconds/seconds)	10mS	40mS	2.55sec
Drive Voltage	9v	15v	16

Changing VAR Settings

To change the VAR's settings, use the "↑" **and** "↓" keys to select "change device settings" from the menu, then press "ENT", the display will show:

B: SYSTEM ID's

System ID <0-7>   Range of system ID's available
     0 >   ▭

Default system ID   New system ID
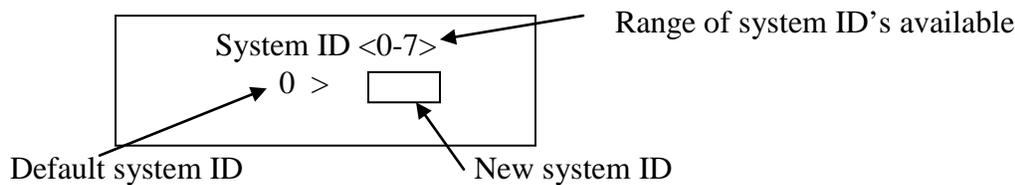
Enter a new system ID or zero (Ø) for the default system ID, then press "ENT"

In order to allow several systems which are located within the effective radio range of each other's equipment to function accurately, a unique system ID is assigned to each location's equipment, which prevents these locations from actuating each others' equipment.

C: TO PROGRAM A NEW ID ADDRESS

This step sets the ID address for the VAR(s) make sure that you refer to the irrigation design drawings which show the VALVE / VAR locations, and that the VARs are programmed with ID addresses which correspond to your transmitter. The ID address is placed in the receiver's memory as four (4) digits. When using the Programmer enter the digits in the order they would appear if you were to write them. For example, if the value ID address was 3796, you would:
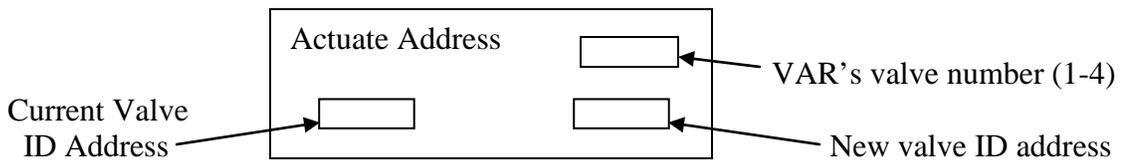enter digit #1 as "3"
enter digit #2 as "7"
enter digit #3 as "9"
enter digit #4 as "6"
To change the current valve ID address for the valve number displayed for a VAR-1, enter the new valve ID address, then press **"ENT"**.

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Actuate Address

VAR's valve number (1-4)

Current Valve ID Address

New valve ID address

Continue to use the "↑" **and "↓"** keys, to repeat this procedure for the remaining valve numbers. The range of possible ID addresses is from 1 to 999.

IMPORTANT: Remember to check that the valve ID addresses correspond to the transmitters' addresses.

D: PROGRAMMING FAILSAFE TIMES

If you continue using the "↑" **and "↓"** keys after displaying the last valve number, the display will show

Timeout hour (01)

>

Failsafe time   New failsafe time
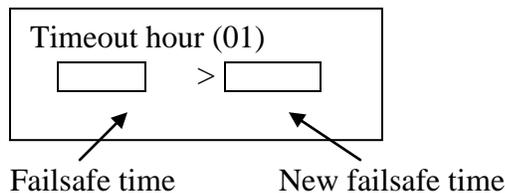
Each VAR is supplied with a failsafe mode of operation. If for any reason the transmitter fails to send an off signal to the receiver in the field, the failsafe will automatically turn off the valve it is controlling. Make sure that the failsafe time you program into the receiver is greater than the longest irrigation time you will require. Otherwise the failsafe will shut the valve down before the irrigation time is over. As an example: If your irrigation time is 5 hours, you should program a failsafe time of 5 hours and 30 minutes.

The failsafe is set in hours and minutes. If you do not set the failsafe, the receiver will automatically turn off the valve **12 hours after actuation.**

E: To Program a New Failsafe Time


Downloading block #02
Please wait…..

If the failsafe time in hours for a valve number one is correct, press "ENT". IF NOT, then enter the hours portion of the new time, and press "ENT."

The display will show:

Time out minutes (01)

Current minute portion of timeout time

>

New minute portion of timeout

16
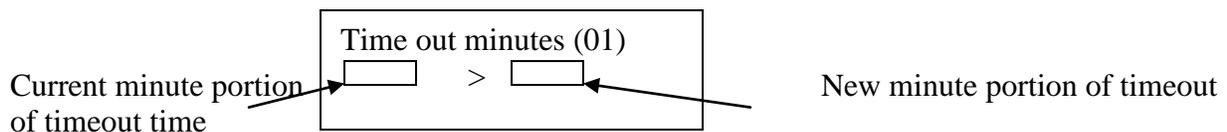
Press "↑" key or "ENT" key to scroll through the remaining valve numbers' time out time in hours and minutes. The time out range is 0 to 255 hours and 0 to 255 minutes.
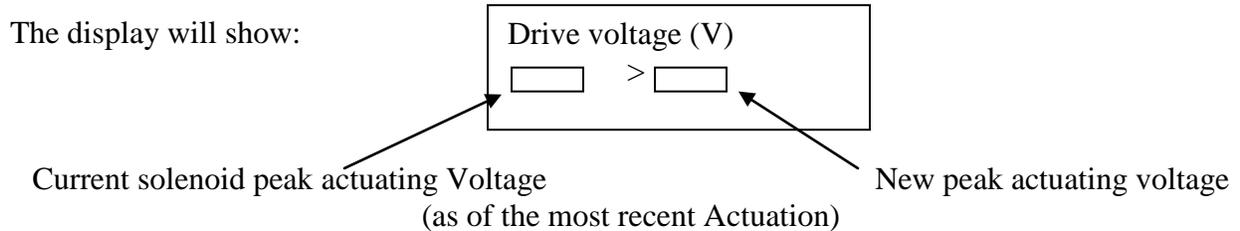
To Program a New Solenoid Actuator Pulse Width Time

The display will show:

```
Pulse width (x10mS)
  ⬚      >  ⬚
```

Current solenoid ——— pulse width
New solenoid pulse width
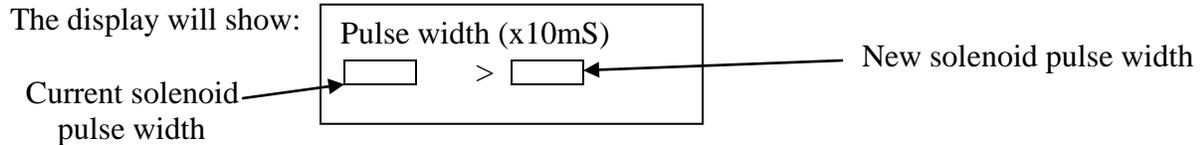
A programmable pulse width function has been provided in order to accommodate several types of latching solenoid actuators, and various lengths of wire runs from the VARs to the solenoids. The default pulse width is 40 milliseconds (mS). The available pulse width range is from 10 mS to 2550 mS (2.55 seconds).

Use the "↑" key, followed by "ENT" to select the appropriate pulse width, selecting 3, will program 30 milliseconds, selecting 4, will program 40 milliseconds, selecting 5, will program 50 milliseconds, etc.

F: TO PROGRAM A NEW "SOLENOID DRIVE VOLTAGE"

The display will show:

```
Drive voltage (V)
  ⬚    >  ⬚
```

Current solenoid peak actuating Voltage
(as of the most recent Actuation)
New peak actuating voltage

The "Drive Voltage" is the peak voltage which the VAR will apply to the actuating solenoid, in order to latch and unlatch the solenoid. Refer to the solenoid manufacturers' specifications, to determine the proper drive voltage required to accurately latch the solenoid.

Enter the new voltage (the range is 9VDC to 16VDC) volts and then "ENT".
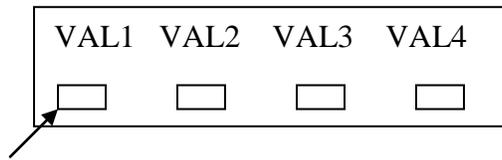
The display will show

```
System ID <0-7>
 0>
```

Press "**CLR**" to exit.

17
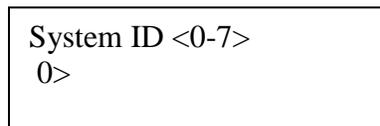
TO ACTUATE VALVES

The display will then show:

```
  VAL1   VAL2   VAL3   VAL4
  [   ]   [   ]   [   ]   [   ]
```

"On" if valve is on, and "Off" if valve is off
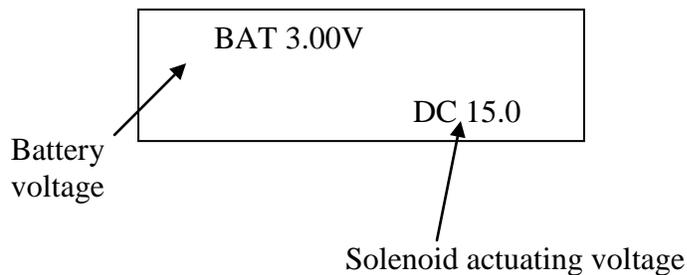
To manually control the VAR's outputs use the "1", "2", "3", or "↑" keys. To turn valve 1 on if it is off, or to turn it off, if it is on, press the "1" key and "ENT". If this is repeated the valve will again change its state. Similarly, "2" and "ENT" will control valve 2, "3" and "ENT" will control valve 3, and "↑" and "**ENT**" will control valve 4. When done press "**CLR**".

To Display VAR's Analog Parameters

Use the "**↑**" **and** "**↓**" keys to select "display parameters. The display will show:

```
Select from Menu
Display Parameters
```

Press "**ENT**" the display will show:

```
      BAT 3.00V

                 DC 15.0
```
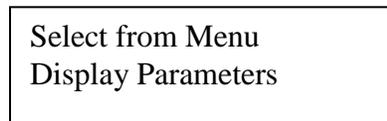
Battery
voltage

Solenoid actuating voltage

This option is used as a "self-test" to check the VAR's battery, and the solenoid actuators power supply. These measurements will have the following ranges:
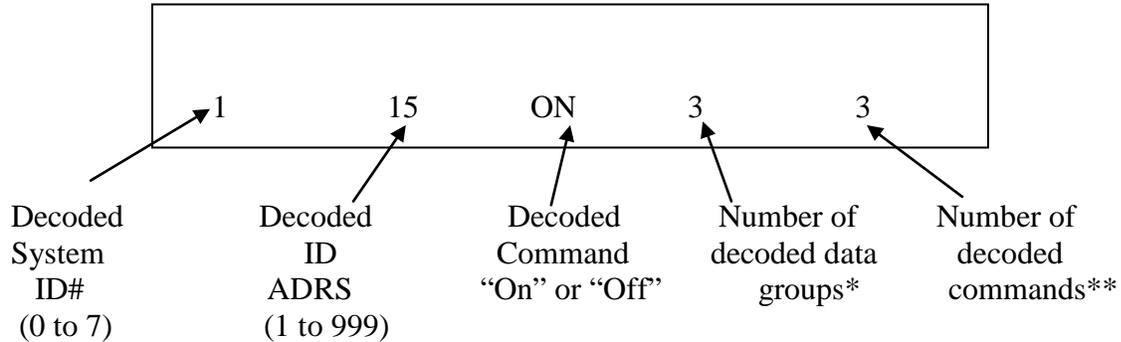
BAT: Battery Voltage 0 to 3.1 VDC
DC: Solenoid Peak Actuating Voltage   9 to 16 VDC

The displayed values for these parameters are the last measured values, and they will <u>not</u> automatically update. To update the values, select the "Actuate Valve" function from the Programmer's menu in order to actuate a valve or valves, or use a transmitter to send Valve on and off signals to the VAR. Then, select the "download device data" from the VAR to the Programmer, and finally select "Display Parameters" from the menu to display the updated parametric values.

TO MONITOR DATA BEING RECEIVED

Select "Monitor Received Data" and press **"ENT"**. The display will show:

```
┌─────────────────────────────────────────────────────────┐
│                                                           │
│                                                           │
│       1          15        ON       3         3          │
│                                                           │
└─────────────────────────────────────────────────────────┘
```

Decoded   Decoded   Decoded   Number of   Number of
System   ID   Command   decoded data   decoded
ID#   ADRS   "On" or "Off"   groups*   commands**
(0 to 7)   (1 to 999)

* 3 groups are sent 4 times, "3" represents the highest decoding accuracy, (3 out of 3 decoded).

** The data received will not automatically update. To update the data press "**CLR**", then "**ENT**". To select the next function Press "**CLR**" and use the "↑" **and** "↓" keys to scroll to the desired functions.

UPLOADING DEVICE DATA (PROGRAMMING THE VAR)

In order for the changed parameters to be valid, they must be uploaded to the VAR. Use the "↑" and "↓" keys to select "UPLOAD DEVICE SETTINGS", then press "**ENT**."

The display will show:

```
┌──────────────────────────────┐
│  Identifying device          │
│  Please wait…….              │
│                              │
└──────────────────────────────┘
```

The Programmer is determining what type of VAR (VAR-1, 2, or 4) it is communicating with.

```
┌──────────────────────────────┐
│  VAR-4 v:11  ESN 0123        │
│  Press "ENT" to continue     │
│                              │
└──────────────────────────────┘
```

Press "**ENT**".

The Programmer is uploading the new data to the VAR in 3 blocks.

```
Uploading block #01
Please wait…..
```

The first block has been uploaded.

```
Uploading block #02
Please wait…..
```

The second block has been uploaded.

```
Uploading block #03
Please wait…..
```

The last block has been uploaded.

```
Shutting down VPC
Please wait….
```

And then:

```
VPC Shutdown
```

Finally, the Programmer has finished communicating with the VAR.

```
Upload successful
Press CLR to Exit
```

Press "**CLR**" to Exit.
At this point, the new data has reconfigured the VAR

PROGRAMMING MULTIPLE VARS

If several VARs are to be programmed with the same parameters, but with different ID addresses; after the uploading sequence to the first VAR is completed, select "Change Device Settings" from the menu, change the ID address(s) appropriate to the next VAR, Exit the programmer function ("**CLR**"), and select the "Upload Device Data" function. Enter the new VAR's ESN, and complete the uploading sequence.

Exit the function "**CLR**" and select "Change Device Settings" from the menu. Change the ID, address(s) appropriate to the next VAR, etc. Repeat the process until all the VARs are programmed.

To Stop Using the Programmer: Push the "ON/OFF" Programmer switch, to turn the Programmer off, and insert the isolation strip between the batteries and the battery holder. Wait 1 minute, and remove the strip. The VAR is now ready for use.

G: INSTALL VAR

For optimum sensitivity, the VAR should be mounted at the top of a 6 foot (1.85m) long pipe. (See Figures1 and 2).

H: RECEIVER WIRING

Connect the VAR to a 12VDC solenoid actuator as shown in the wiring diagram. (See Figure 4 or 5)

With the system pressurized, use the internal manual actuating switch or the VAR programmer to turn the valve on and off. Make certain that the valve is left off. (The receiver's "on" indicator should not be blinking.) Follow your solenoid installation instructions completely. If you have any questions contact the manufacturer for more information.

6: VAR/VB, VALVE BOX COVER MOUNTED VARs

In addition to the pole mounted versions, the VAR/VB is also available in a version which is installed in a valve box cover. These units have all the features of the pole mounted versions, but can be buried to grade. The operational range of the valve box installed VARS is two miles.

SITE PREPARATION

Prior to VAT and VAR installation:

 Install Actuator Solenoids: Install the appropriate two wire 12VDC latching solenoids, at the valves and make certain that all the valves function in the manual mode.

Install Valve Boxes: Bury valve boxes to grade. (See Figure 13)

The VARs can be located up to 1000 feet (300 meters) away from the solenoid. However wires will need to be run from the VAR to the solenoid so they should be located as close as possible.

DEVICE IDENTIFICATION

Using a site map, identify each device to be actuated with consecutive I.D. addresses corresponding to your VAT. Assign VARs that are to be operated simultaneously with the same address. The address assigned to a VAR does not determine the order in which it is actuated, as the transmitter is continually "looking" for actuation events and will not necessarily operate in lowest to highest numerical order.

TRANSMITTER PREPARATION
Refer to the VAT installation manual for instructions required to prepare the transmitter for operation.

VAR/VB SETUP

The following steps are required to prepare the receiver for operation:

A) Connect the Battery, and Check VAR/VB
B) Program System Identification Number
C) Program ID Address(s)
D) Program VAR Fail Safe Time(s)
E) Program Solenoid Pulse Width
F) Program Peak Solenoid Actuating Voltage
G) Install VAR/VB
H) Connect Solenoid Wires to VAR/VB

Make certain that each VAR's ID address is programmed to numbers corresponding to one of the VAT's addresses.

CONNECT THE BATTERY AND CHECK VAR/VB

Remove the top of the junction box cover (See Figure 14 or 15). To remove the cover, remove the four retaining screws. Take care not to damage the cover's gasket. Turn the cover with the batteries over, open the in-line fuse holder, and remove the plastic battery isolation plug from the fuse holder, store the isolation plug, in the junction box for future use, and insert a 5 ampere fuse into the fuse holder. If the batteries are removed for any reason, be certain to observe the correct polarities when they are replaced. Permanent circuit damage may result if proper polarity is not maintained.

Once the batteries are connected, the VAR can be checked with the internal manual actuating switches, or with the VAR Programmer.

USING THE PROGRAMMER WITH THE VAR/VB

The Programmer is used with all the VARs to program and display important parameters associated with the VARs. The programmer can also be used with the VARs to manually actuate solenoids and to monitor data as it is received and decoded by the VARs.
The Programmer Communicates with the VAR by cable. To use the programmer, you must connect the Programmer's cable to the VAR's interface control circuit board. (See Figure 14 or 15)
Before using the Programmer, insert the plastic isolation plug into the fuse holder, Wait 1 minute, and connect the Programmers cable to the VAR's interface control circuit board. Push the "ON/OFF" switch on the Programmer, to turn the Programmer on, (See Figure 17) remove the isolation plug, and insert the 5 ampere fuse into the fuse holder. The Programmer is now ready to be used with the VAR.

For Programing instructions, go to page 11, and see "Start Using Programmer"). When you are finished programming the VAR/VB: Push the "ON/OFF" programmer switch to turn the Programmer off. Remove the fuse from the fuse holder, place the isolation plug into the holder, and wait 1 minute. Remove the Programmer to VAR cable, and the isolation plug from the fuse holder, and place the fuse in the fuse holder. The VAR/VB is now ready for use.

CONNECTING THE SOLENOIDS TO THE VAR/VB

Place the valve box cover next to the valve box. Connect the red and black wires from the VAR/VB encapsulated control board, (See Figure 13) to the valves latching solenoid using silicone filled wire connectors. The valve should be in the automatic mode, and the irrigation system should be pressurized with water.

The junction box (See Figure 14 or 15) contains the batteries, fuse holder, radio, and the interface control circuit board. The fuse holder contains a 5 ampere fuse.

The VAR/VB was shipped with the "test/run" jumper in a small plastic bag, this means that the VARs were shipped in the "run" mode. Use a jumper to put the VAR in the "test" mode. To actuate solenoids manually, use the manual actuate switches located on the interface control circuit board. The on/off indictor light will start blinking when a solenoid has been turned on (latched), and stop blinking when the solenoid is turned off (unlatched). The radios "test/run" jumper, was shipped with the jumper in a small plastic bag, this means that the radio was shipped in the run mode. Install a radio jumper in the "test" mode postion. Note that the radio on/off indicator, blinks once every 15 seconds.

 The following description assumes, that The VAT transmitter is connected to a controller, and that the VAR has an ID of 1.

Use the controller in the manual mode to turn on output 1. This will enable the VAT to send a signal to turn on output 1. The valve on/off indicator on the VAR interface control board will start to blink, the valves latching solenoid will latch on, and the valve will open.

Use the controller again to turn off output 1. The valves on /off indicator on the VAR interface control board will stop blinking, the valves latching solenoid will unlatch, and the valve will close.

Place the interface control board "test/run" jumper, in the "run" mode (remove jumper), and the radio "test/run" jumper in the "run" mode position (remove jumper). Replace the junction box cover, and tighten the covers screws.

Install the valve box cover in the valve box, and switch the controller to the program mode. This procedure should be repeated for each output.

7: USING THE VAT WITH THE VARs

In operation the system works as follows: an irrigation controller electronically sends a signal to the VAT. These signals indicate which of the 16 possible VARs are to be actuated and whether they are turned "on" or "off". Then the VAT sends a unique coded radio signal containing this information to all VARs within range. (See VAT manual)Each VAR "looks" at the signal and determines two things: 1) does this signal correspond to me? And, if so, 2) is the signal an "on" signal or an "off" signal? If the signal corresponds to the VARs identification number which was programmed during setup, then the VAR performs the "on" or "off" operation.
It is important to remember that, unlike hard wired devices, actuation of different addressed VARs can not take place simultaneously. Each transmission requires several seconds and only one VAR solenoid (address) is actuated at any time. For example, if devices 1, 2, 3, 15 and 16 are all turned off at the same clock time as #13 is turned on at the controller, it could be as much as 2.5 minutes before #13 is turned on.

Let's examine an operating system.

Let's look at a 16 station controller connected to a VAT having ID addresses available of 17 - 32 (16 stations) and we want to operate the controller's station #7. This will correspond to our VAT's station # 23 (clock #1 is VAT #17, clock #2 is VAT #18, ... clock #7 is VAT #23....). Use the controller to send VAR ID address 23 an "on" code. Clock station #7 sends the VAR a signal to turn on controller station #7. The VAR translates controller station #7 to VAR ID address 23. The VAT's "transmit" and "on" indicators should turn on for several seconds, indicating that a "turn-on" signal with an ID address 23 has been sent.

If a VAR has been programmed to ID address 23, the VAR's "on" indicator should be blinking and the valve should be open.

Now use the controller to send VAR address 23's "off" code. The controller sends the VAT a signal to turn off controller station #7. The VAT translates this to ID address 23. The VAT's "transmit" and "off" indicators should turn on for several seconds indicating that a turn-off signal with an ID address 23 has been sent. VAR address 23's "on" indicator should stop blinking and the valve should be closed.

8: USING VAR WITH MOISTURE LEVEL SENSORS

The VARs are compatible with Aquaterr's moisture sensors. Two (2) sensors are required; a "high level" sensor, buried shallow, and a "low level" sensor buried deep. (See Figures 9 &14, or 10 & 15) The high level sensor when wet, will inhibit solenoid "turn on" by radio control. The "low level" sensor when wet, will "turn off" (reset) the solenoid. Each of the moisture sensors

are field adjustable to one of several indicated moisture levels. Once the sensor measures a set moisture level, it enables the VAR which in turn controls its solenoids accordingly.

9: OPERATIONAL NOTES- VARs

- Make certain that each VAR's ID address is programmed to numbers corresponding to one of the VAT's addresses.
- If the battery is disconnected from the VAR or the battery voltage drops below 2.2 volts, the receiver will NOT assume the last fail safe time to which it was programmed.

BATTERIES
If batteries are exposed to temperatures below -85° F (-65° C) or above 149° F (65° C) for a prolonged period, they will be rendered useless.

10: TROUBLE SHOOTING GUIDE

DIAGNOSTICS FOR VAR PARAMETERS OUT OF RANGE

VAR FAILED BATTERY
If the VAR's battery voltage measures less than 2.0 volts (discharged battery), the VAR will terminate any active task and turn off a valve if the valve is on. The receiver will not respond to the manual actuation switches, the Programmer, or radio control. The VAR will recover once the batteries are replaced, and the battery voltage rises above 2.2 volts.

VAR/D/P Battery Replacement
Remove the top of the VAR's enclosure. To remove the top, twist the cylindrical part of the cover counter clockwise while holding the bottom of the enclosure (the mounting base) stationary (see VAR Figure 3) once the top is removed, and the batteries are exposed, replace the batteries. Be certain to observe the correct polarities when the batteries are replaced. Permanent circuit damage may result if proper polarity is not maintained. Use the manual actuating switches, or the Programmer to check for proper VAR operation, than replace the top of the VAR's enclosure.

VAR/D/VB Battery Replacement
Remove the valve box cover from the valve box. Remove the junction box cover, by removing the 4 retaining screws. Note the battery cell polarity, and replace the cells, keeping the same battery cell polarity. Use the manual actuating switches, or the Programmer to check for proper VAR operation, than replace the junction box cover, taking care not to damage the cover gasket.

VARs FAILED FUSE

Fuse replacement
A defective fuse will prevent the VAR from functioning.   To check the fuse condition: For a VAR/D/P, Remove the top of the VAR enclosure. For a VAR/D/VB, remove the cover of the

junction box. Measure the voltage across the fuse. If it is not zero, replace with a five (5) Amp. Fuse of the same type (5mm X 20mm). Then replace the VAR's top, or the junction box cover.

For other technical questions contact: Aquaterr Instruments & Automation LLC
1685 Babcock St. Unit A
Costa Mesa, CA 92627
Phone: 949 646 7274
office@aquaterr.net

LIMITED ONE YEAR WARRANTY

Aquaterr LLC ("Aquaterr") warrants that the Aquaterr VAR-1/D/P, VAR-2/D/P, VAR-4/D/P, ,VAR-1/D/VB, VAR-2/D/VB, & VAR-4/D/VB (Product) will be free from material defects in materials and workmanship for a period of one (1) year from the date of original purchase. Aquaterr agrees, as its sole responsibility under this limited warranty, at its sole option, either to repair, to replace with new or remanufactured product, or to refund the purchase price of any Product discovered to be defective within the warranty period, upon receipt of the defective Product by Aquaterr, shipping charges prepaid, with proof of date of purchase and an explanation of the problem. If you require additional assistance in obtaining warranty service, call our service number (949) 646-7274 or contact Aquaterr LLC headquarters at 1685 Babcock St., Costa Mesa, CA, 92627, Attn: Service Manager.

This limited warranty is not applicable to (i) normal wear and tear, (ii) loss or damage to the equipment due to abuse, accident, unreasonable use, mistreatment or neglect; (iii) damage caused by the equipment or system with which the product is used; or (iv) damage caused by modification or repair made or authorized by Aquaterr.

THIS WARRANTY AND THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES (INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE DISCLAIMED) AND NO OTHER REPRESENTATIONS OR CLAIMS OF ANY NATURE SHALL BE BINDING ON OR OBLIGATE AQUATERR. ANY WARRANTIES APPLICABLE TO THIS PRODUCT ARE LIMITED TO THE ONE YEAR PERIOD DESCRIBED ABOVE. IN NO EVENT WILL AQUATERR BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, DAMAGES RESULTING FROM USE OR MALFUNCTION OF THIS PRODUCT OR THE EQUIPMENT OR SYSTEM WITH WHICH IT IS USED, LOSS OF PROFITS OR REVENUE, OR COST OF REPLACEMENT GOODS.

Some states do not allow limitation of the period of time an implied warranty lasts and/or the exclusion or limitation of special, incidental, or consequential damages, so the above limitations and/or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

DIAGRAMS

FIGURE 1: VAR POLE MOUNT INSTALLATION

FIGURE 2: VAR POLE MOUNT INSTALLATION WITH VALVE

FIGURE 3: VAR BATTERY, RADIO RECEIVER, AND ANTENNA MOUNTING

FIGURE 4: VAR 1 & 2 CONNECTORS, FUSE, AND INDICATORS

FIGURE 5: VAR-4 CONNECTORS, FUSE, AND INDICATORS

FIGURE 6: VAR 1 & 2 SOLENOID CONNECTIONS & RADIO LOCATION

FIGURE 7: VAR 1&2 BATTERY PACK INSTALLATION

FIGURE 8: VAR 4 BATTERY AND RADIO RECEIVER INSTALLATION

FIGURE 9: VAR 1 & 2 MOISTURE SENSOR CONNECTIONS

FIGURE 10: VAR 4 MOISTURE SENSOR CONNECTIONS

FIGURE 11: VAR 1, 2 & 4/P IRRIGATION AUTOMATION SYSTEM

FIGURE 12: VAR 1, 2 & 4/VB IRRIGATION AUTOMATION SYSTEM

FIGURE 13: VAR 1, 2 & 4/VB INSTALLTION WITH VALVE

FIGURE 14: VAR 1, 2 & 4/VB INTERFACE CONTROL BOARD

FIGURE 15: VAR 4/VB INTERFACE CONTROL BOARD

FIGURE 16: VAR 1, 2 & 4/VB BATTERY LOCATION

FIGURE 17: PROGRAMMER FRONT VIEW

FIGURE 18: PROGRAMMER REAR VIEW

PIPE OR POST ⎯⎯⎯⎯⎯⎯→
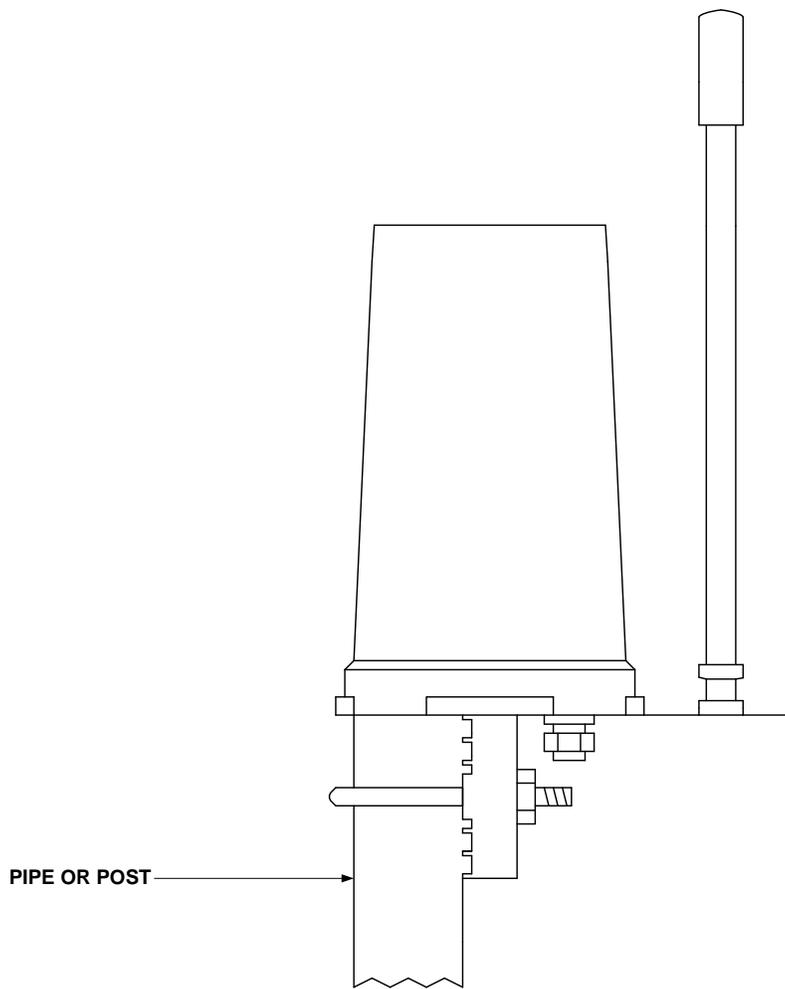
FIG 1: VAR POLE MOUNT INSTALLATION (3.30.2011)

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1" (254 mm) METAL PIPE, 6' (1.83m) ABOVE GROUND

TO SOLENOID
VALVE

VALVE BOX

FIG 2: VAR POLE MOUNT INSTALLATION WITH VALVE (3.30.2011)

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TO REMOVE COVER
TWIST CCW AGAINST BASE

COVER →

RADIO
RECEIVER →

BATTERIES →

"O" RING →

BASE →
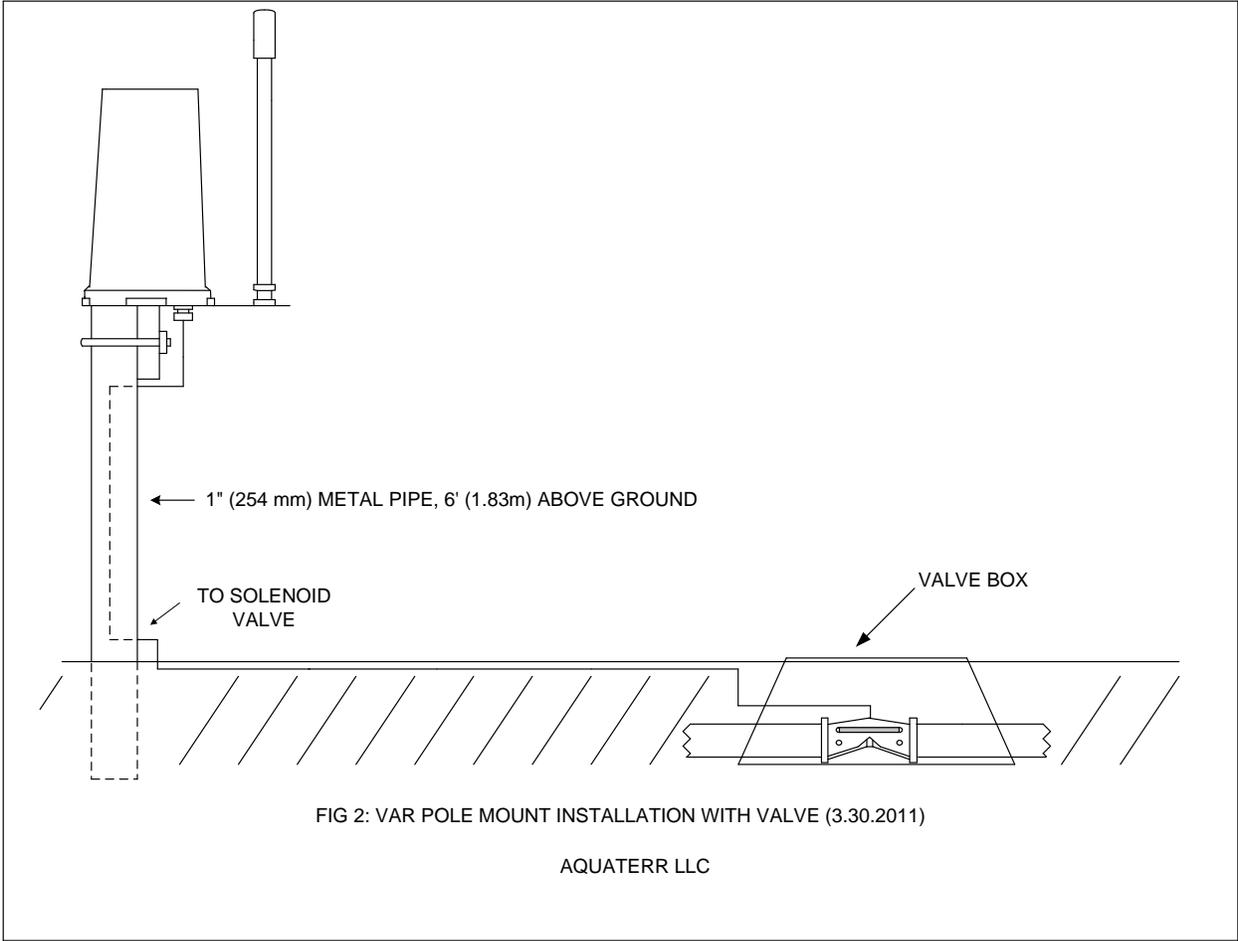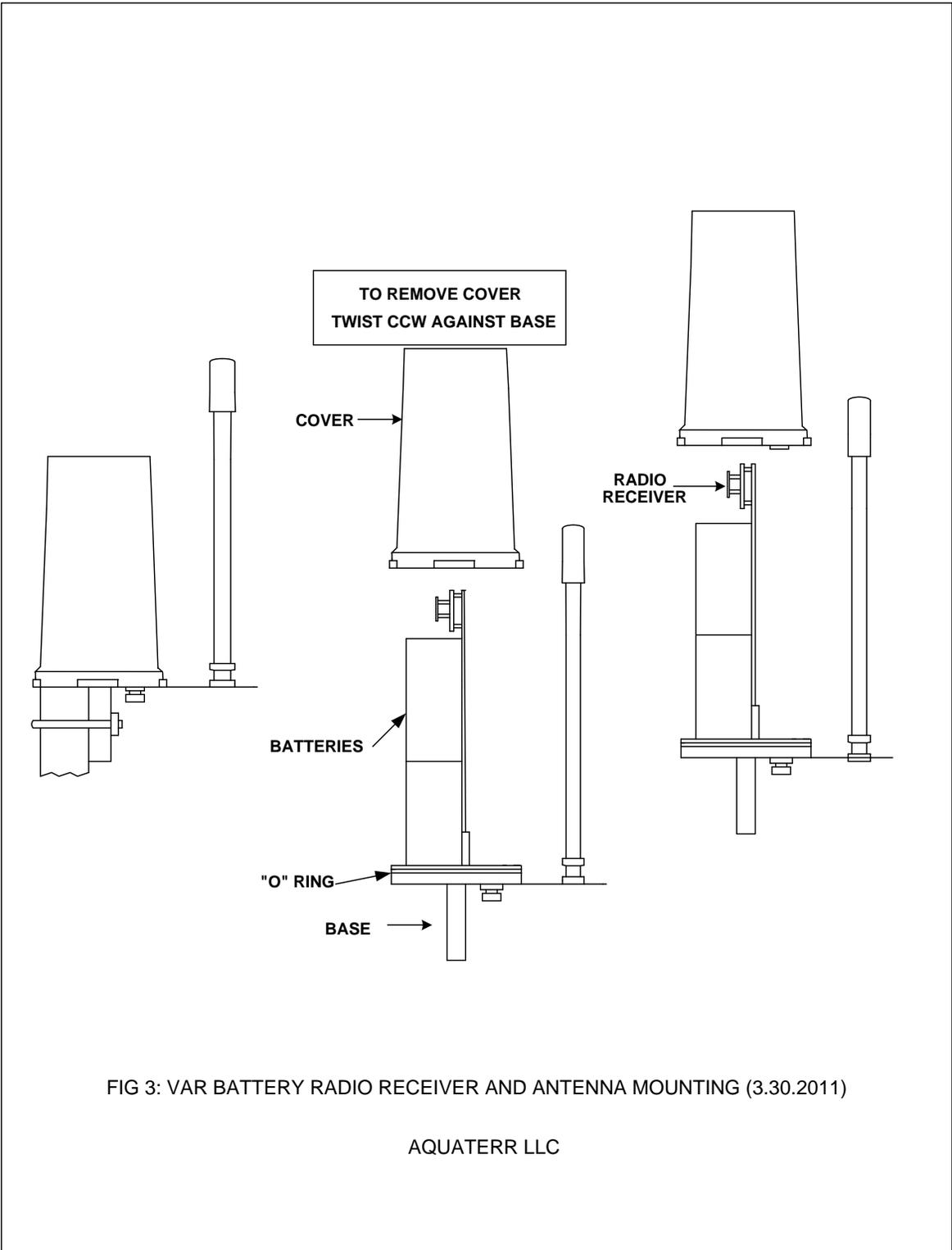
FIG 3: VAR BATTERY RADIO RECEIVER AND ANTENNA MOUNTING (3.30.2011)

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TO
PROGRAMMER

TO MOISTURE
SENSORS

TO RADIO
RECEIVER

ON/OFF INDICATORS

MANUAL ACTUATE
SWITCHES

2 1

2 1

FUSE

SOLENOID 2
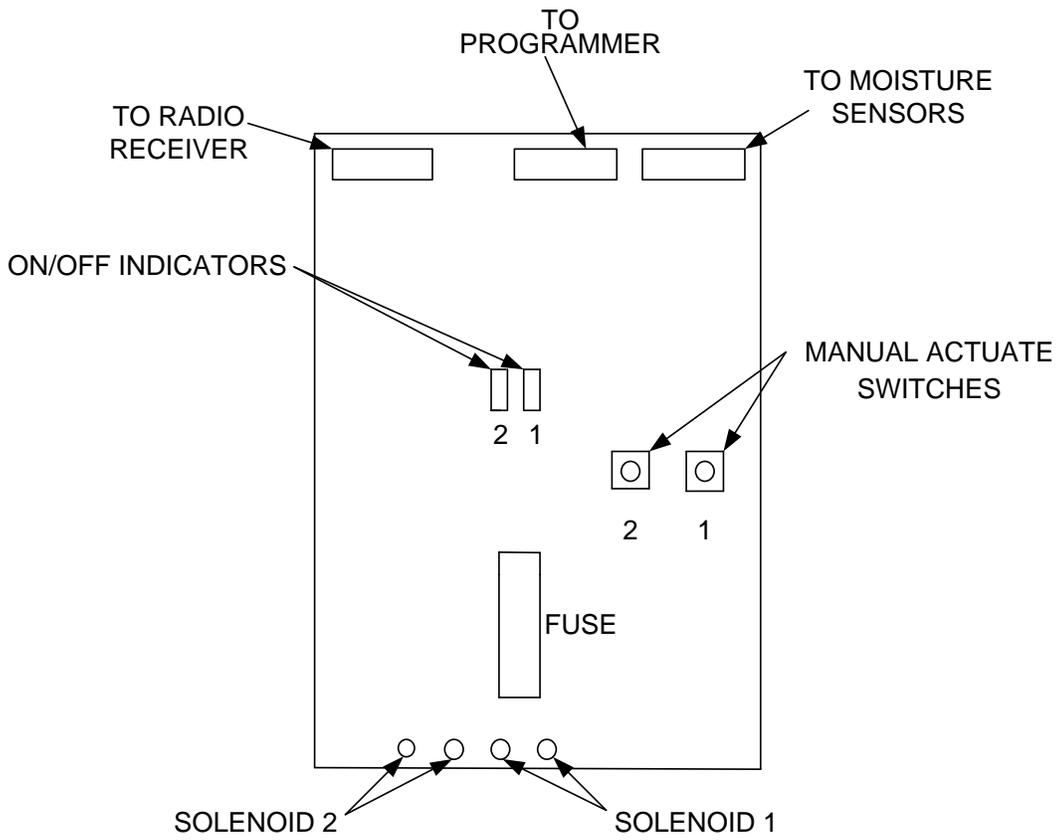
SOLENOID 1

FIG 4: VAR-1 & 2 CONNECTORS, FUSE, AND INDICATORS
(3.30.2011)

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TO RADIO
RECEIVER

TO
PROGRAMMER

TO MOISTURE
SENSORS

FUSE

1
2 ON/OFF
3 INDICATORS
4

1
2 MANUAL ACTUATE
3 SWITCHES
4

SOLENOIDS

2   1   3   4

FIG 5: VAR-4 CONNECTORS, FUSE, INDICATORS & SOLENOID
CONNECTIONS (3.30.11)

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RADIO

RADIO POWER
JUMPER

TEST   RUN

ON/OFF
INDICATORS

MANUAL
ACTUATE
SWITCHES

2 1   2 1

SOL 2   SOL 1
BLACK   RED
RED   BLACK
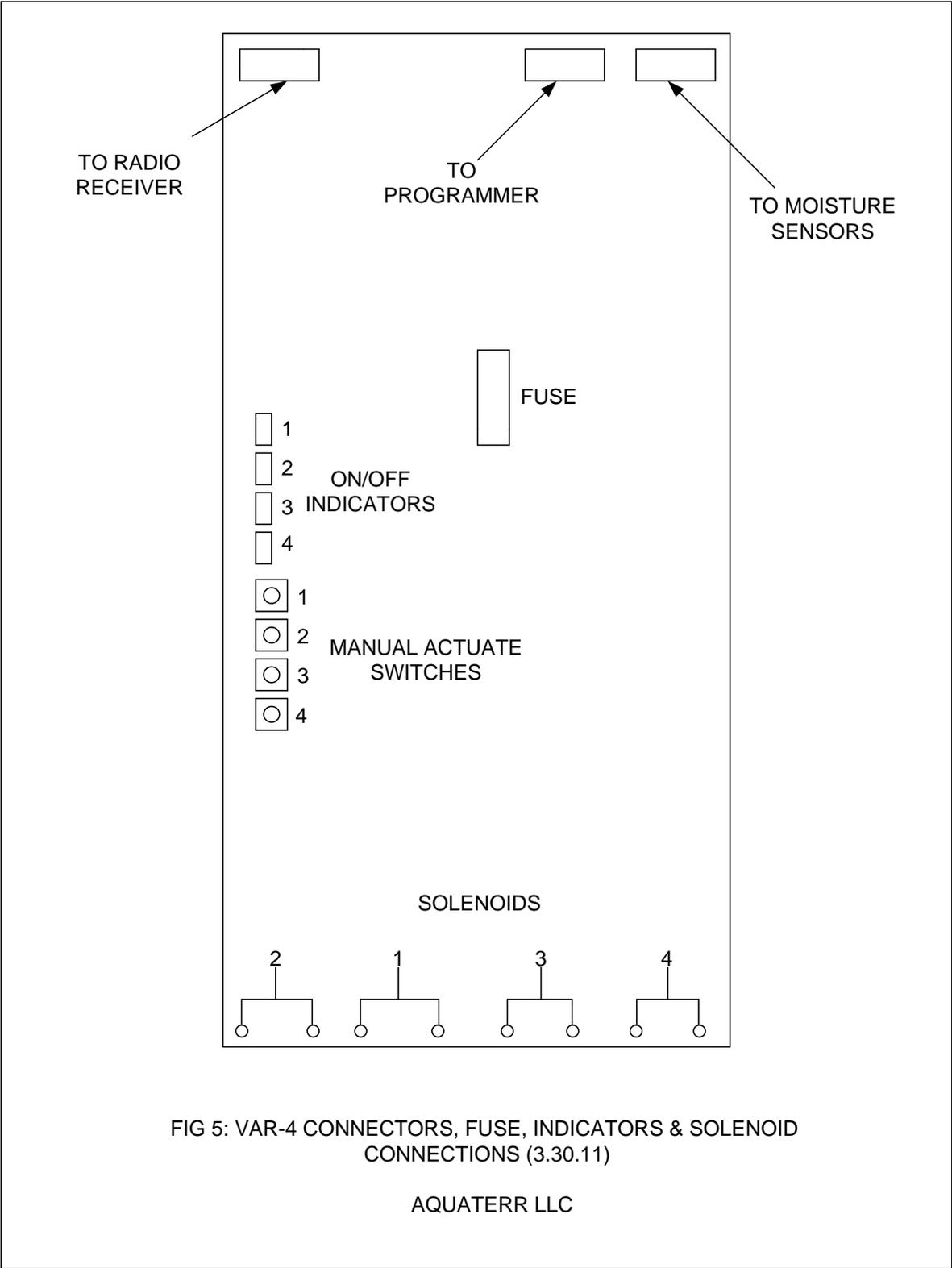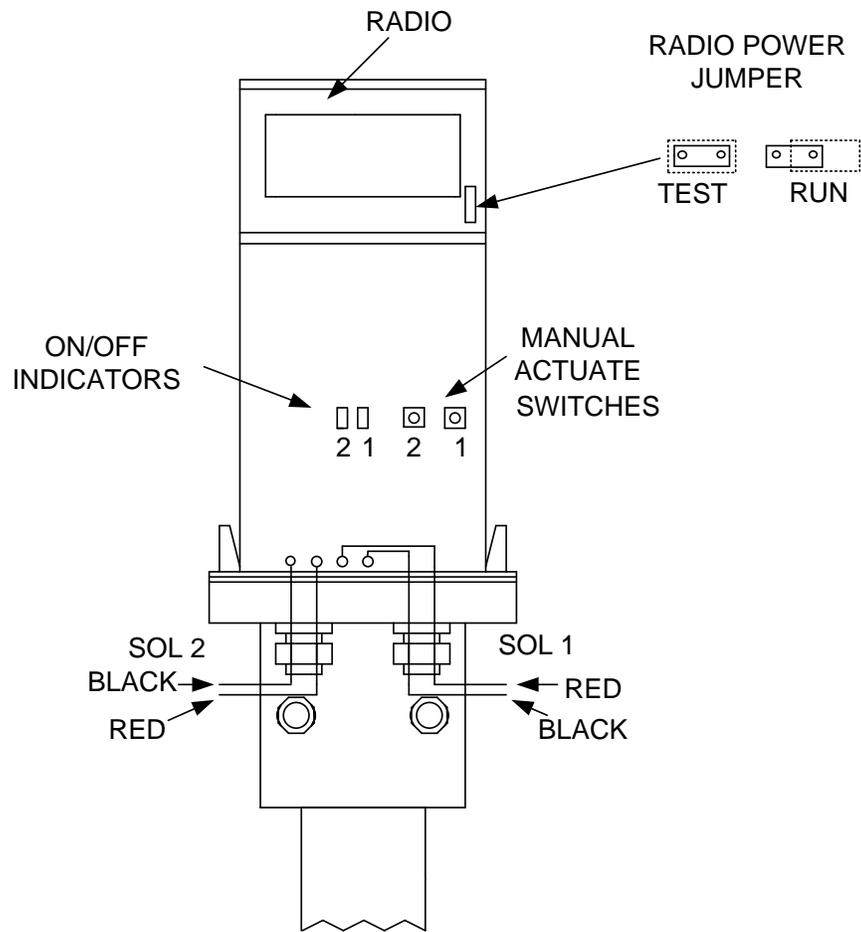
FIG 6: VAR-1 & 2: SOLENOID CONNECTIONS &
RADIO LOCATION (3.30.2011)

AQUATERR LLC

PLASTIC
ISOLATION
STRIP
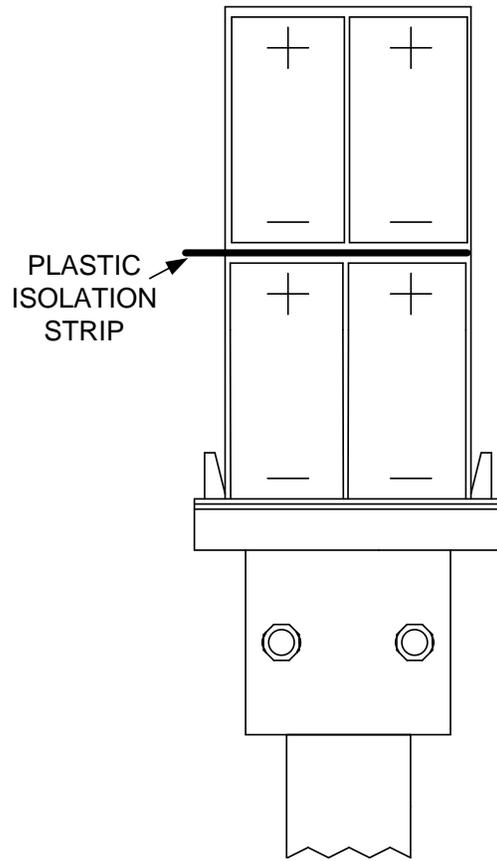
FIG 7: VAR 1& 2 BATTERY PACK INSTALLTION
(3.30.2011)

AQUATERR LLC

RADIO
RECEIVER

RADIO POWER JUMPER

TEST   RUN

BATTERIES

PLASTIC
ISOLATION
STRIP
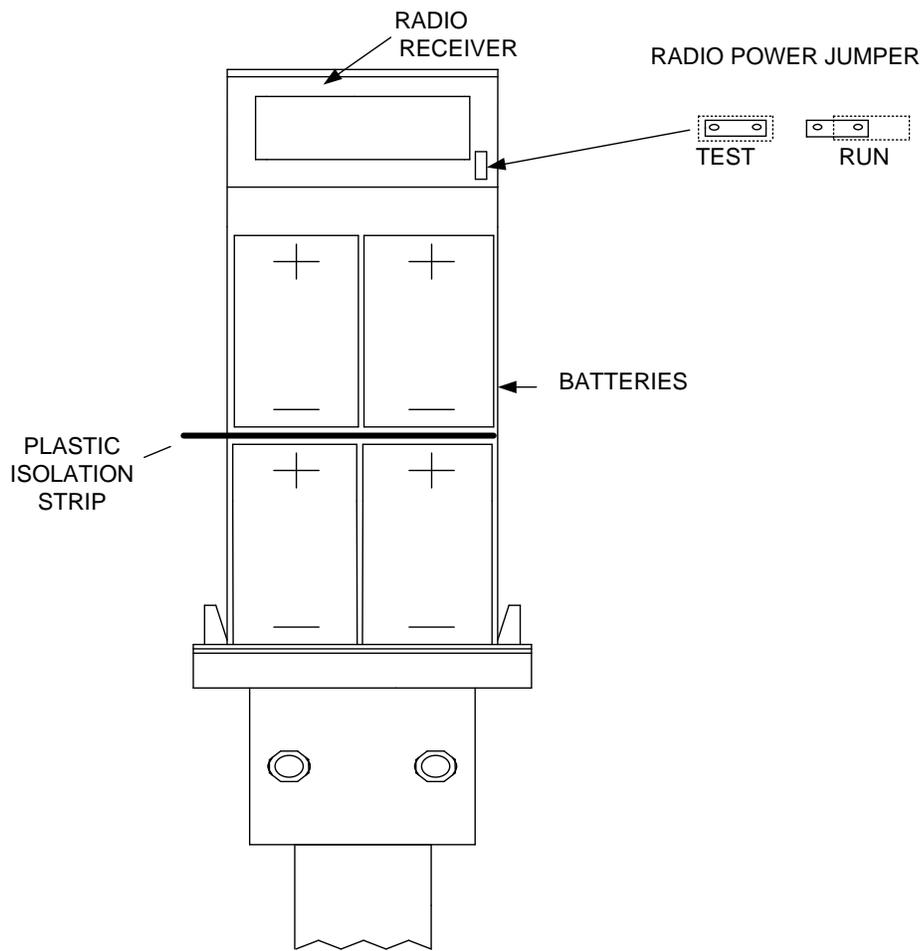
FIG 8: VAR-4 BATTERY & RADIO RECEIVER LOCATIONS
AQUATERR LLC (3.30.11)
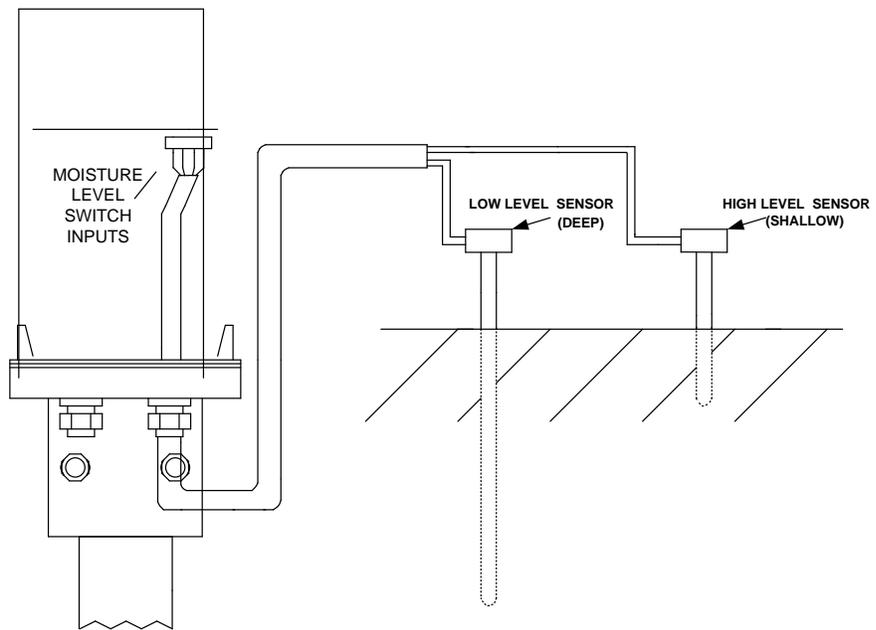
MOISTURE
LEVEL
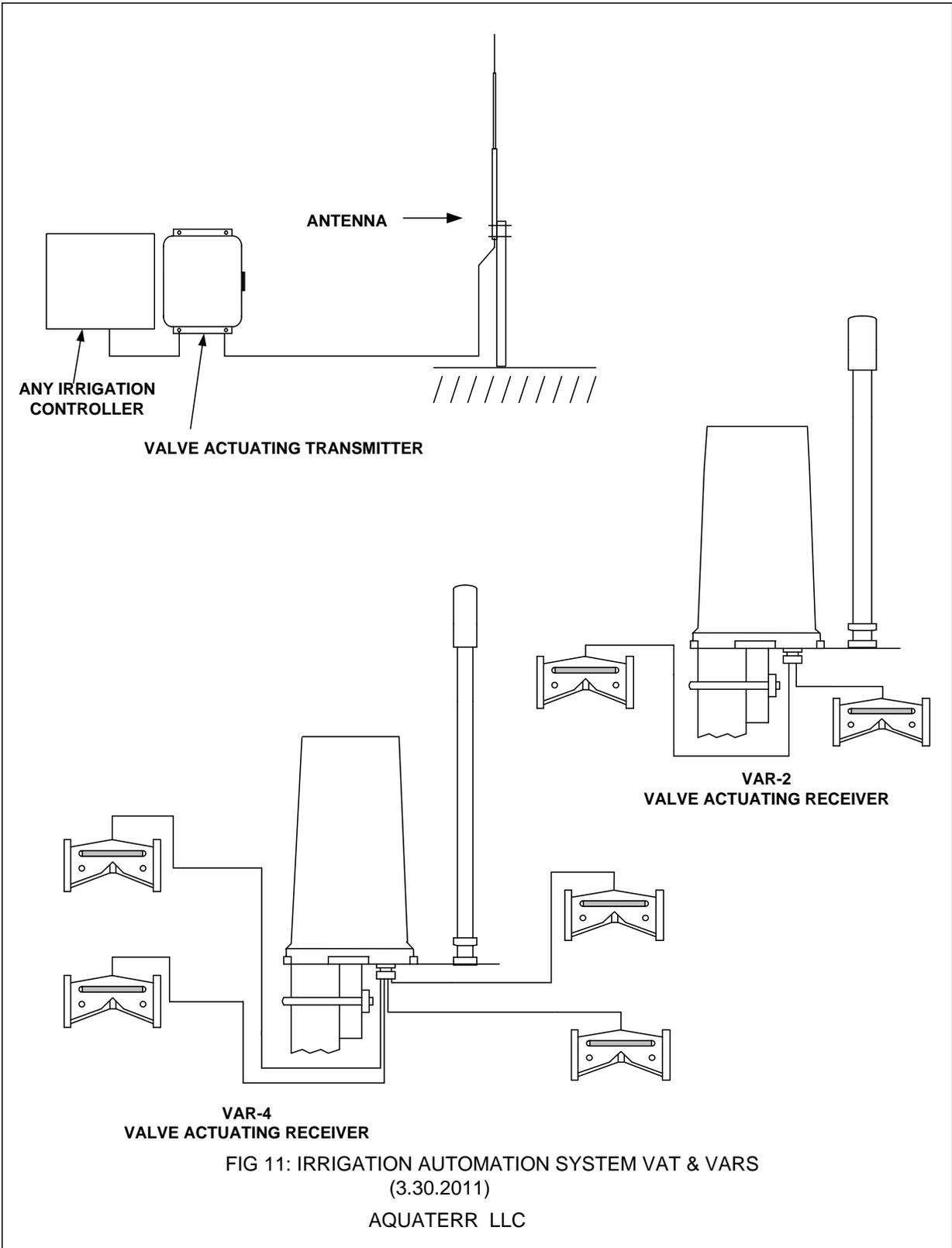SWITCH
INPUTS

LOW LEVEL SENSOR
(DEEP)

HIGH LEVEL SENSOR
(SHALLOW)

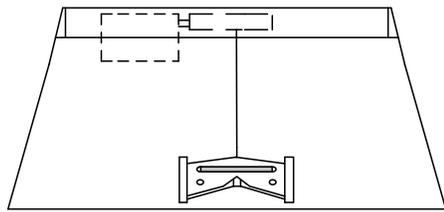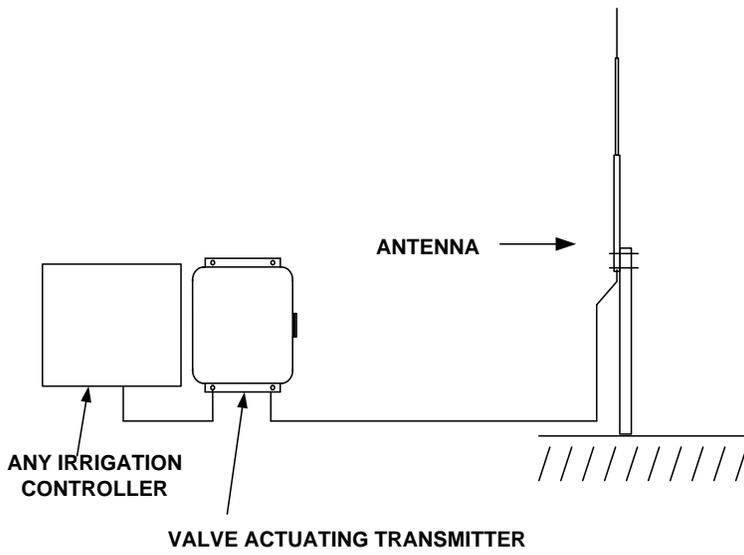FIG 9: VAR1 & 2 MOISTURE SENSOR CONNECTIONS (3.30.2011)

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MOISTURE
LEVEL
SWITCH
INPUTS

LOW LEVEL SENSOR
(DEEP)

HIGH LEVEL SENSOR
(SHALLOW)

FIG 10: VAR-4 MOISTURE SENSOR CONNECTIONS (3.30.2011)

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ANTENNA

ANY IRRIGATION
CONTROLLER

VALVE ACTUATING TRANSMITTER

VAR-2
VALVE ACTUATING RECEIVER

VAR-4
VALVE ACTUATING RECEIVER

FIG 11: IRRIGATION AUTOMATION SYSTEM VAT & VARS
(3.30.2011)

AQUATERR LLC
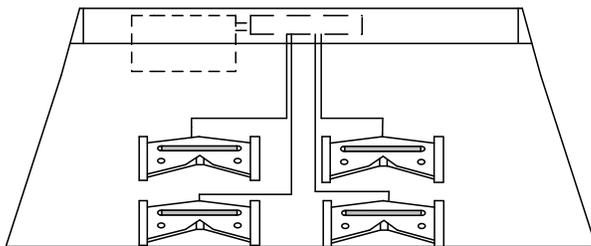
ANTENNA →

ANY IRRIGATION
CONTROLLER

VALVE ACTUATING TRANSMITTER
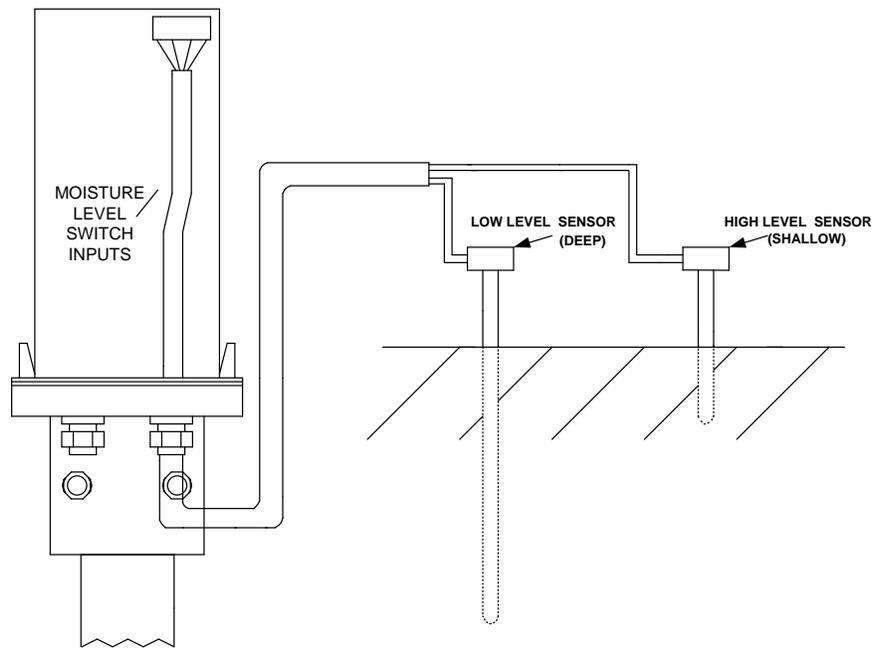
VAR-1/VB
VALVE ACTUATING RECEIVER
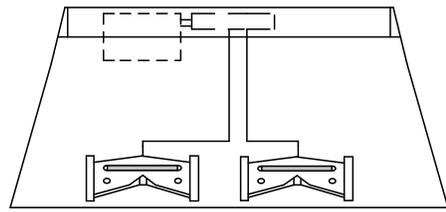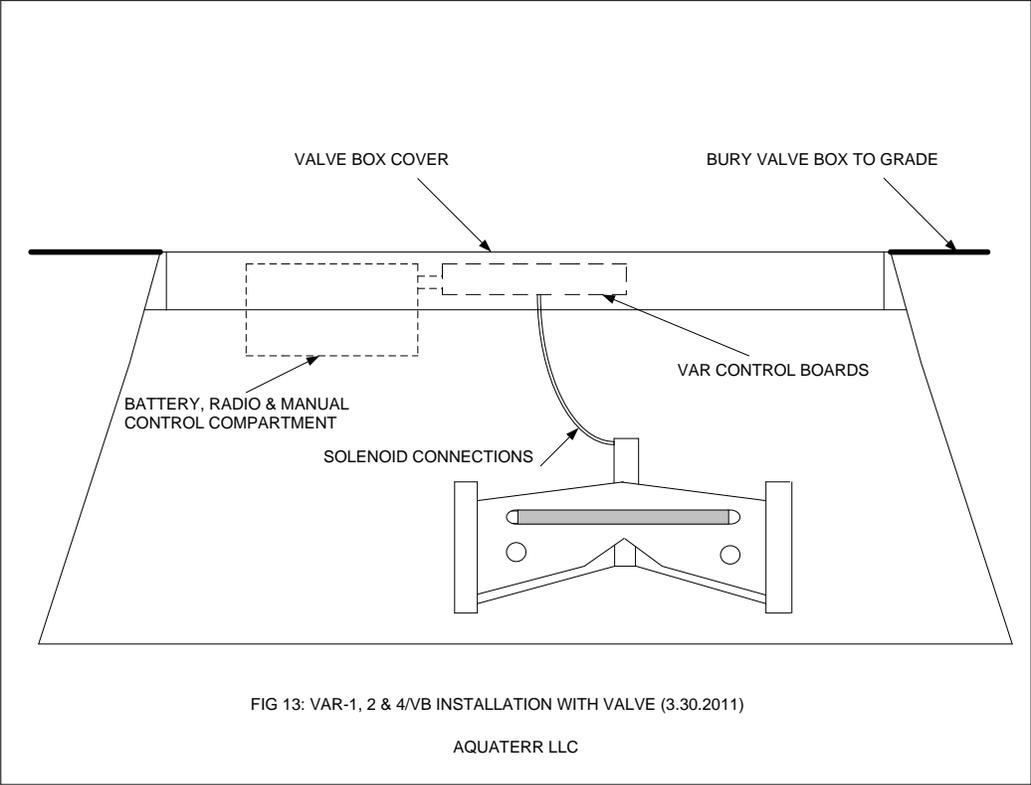
VAR-2/VB
VALVE ACTUATING RECEIVER

VAR-4/VB
VALVE ACTUATING RECEIVER

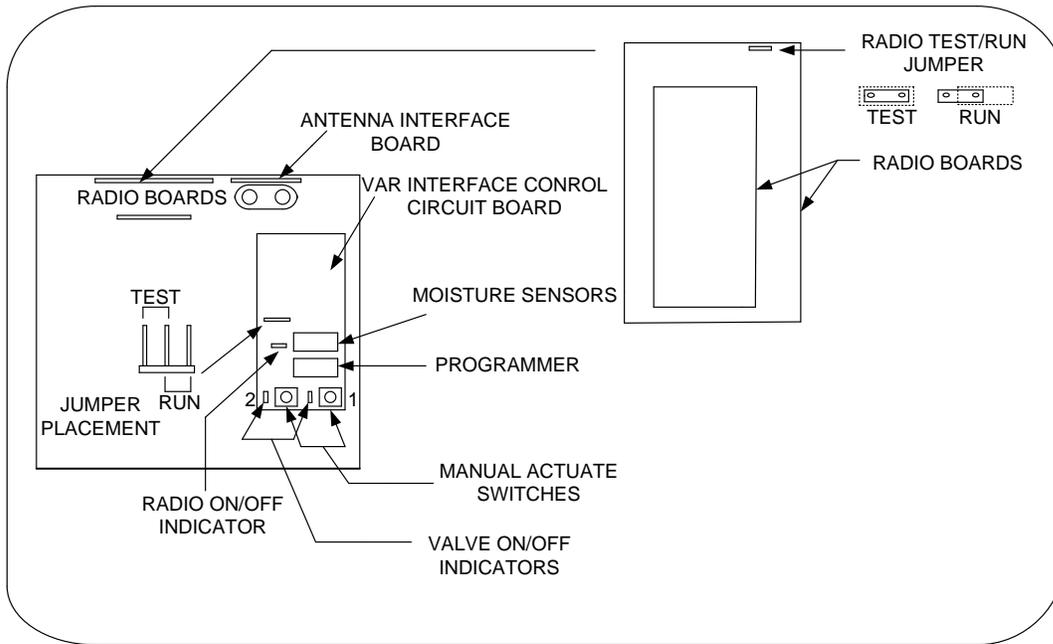FIG 12: IRRIGATION AUTOMATION SYSTEM VAT & VAR-1, 2 & 4 /VB
(3.30.2011)

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VALVE BOX COVER

BURY VALVE BOX TO GRADE

VAR CONTROL BOARDS

BATTERY, RADIO & MANUAL
CONTROL COMPARTMENT

SOLENOID CONNECTIONS

FIG 13: VAR-1, 2 & 4/VB INSTALLATION WITH VALVE (3.30.2011)

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RADIO TEST/RUN
JUMPER

TEST   RUN

RADIO BOARDS

ANTENNA INTERFACE
BOARD

RADIO BOARDS

VAR INTERFACE CONROL
CIRCUIT BOARD

MOISTURE SENSORS

PROGRAMMER

TEST

JUMPER   RUN
PLACEMENT

2   1

MANUAL ACTUATE
SWITCHES

RADIO ON/OFF
INDICATOR

VALVE ON/OFF
INDICATORS

FIG 14: VAR-1 & 2/VB INTERFACE CONTROL BOARD INSTALLATION (3.30.2011)

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RADIO TEST/RUN JUMPER

TEST   RUN

RADIO BOARDS

ANTENNA INTERFACE BOARD

RADIO ON/OFF INDICATOR

RADIO BOARDS

VAR INTERFACE CONROL CIRCUIT BOARD

PROGRAMMER

MANUAL ACTUATE SWITCHES

TEST

RUN

JUMPER PLACEMENT

VALVE ON/OFF INDICATORS

MOISTURE SENSORS
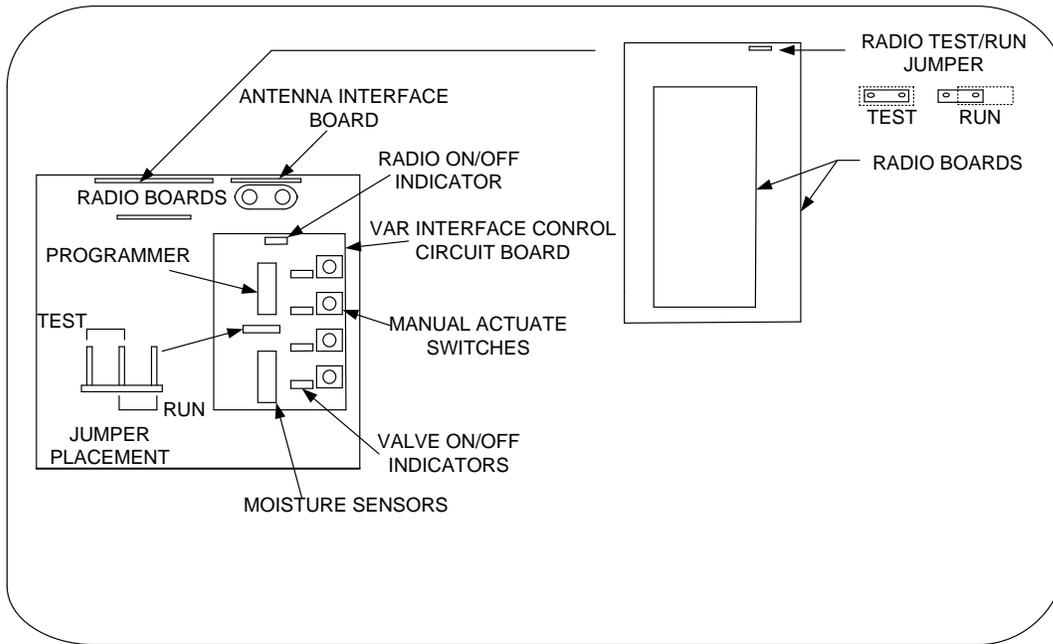
FIG 15: VAR-4/VB INTERFACE CONTROL BOARD INSTALLATION (3.30.2011)

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JUNCTION BOX COVER

+

−

FUSE

RED

FROM CONTROL
BOARD

BLK

TO BATTERY

JUNCTION BOX COVER
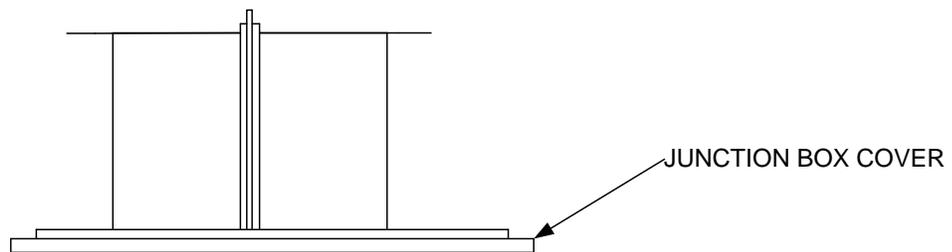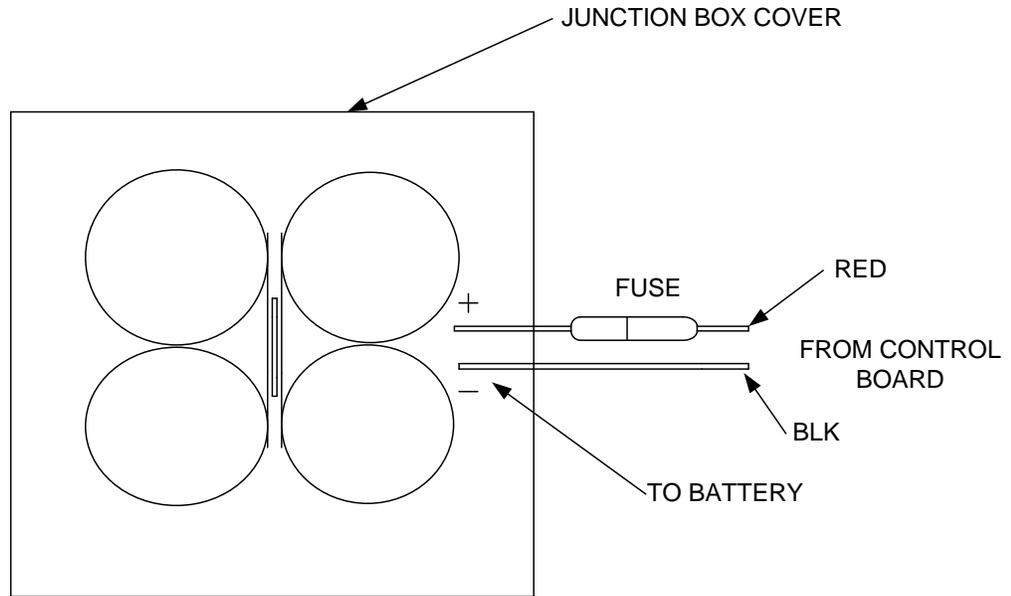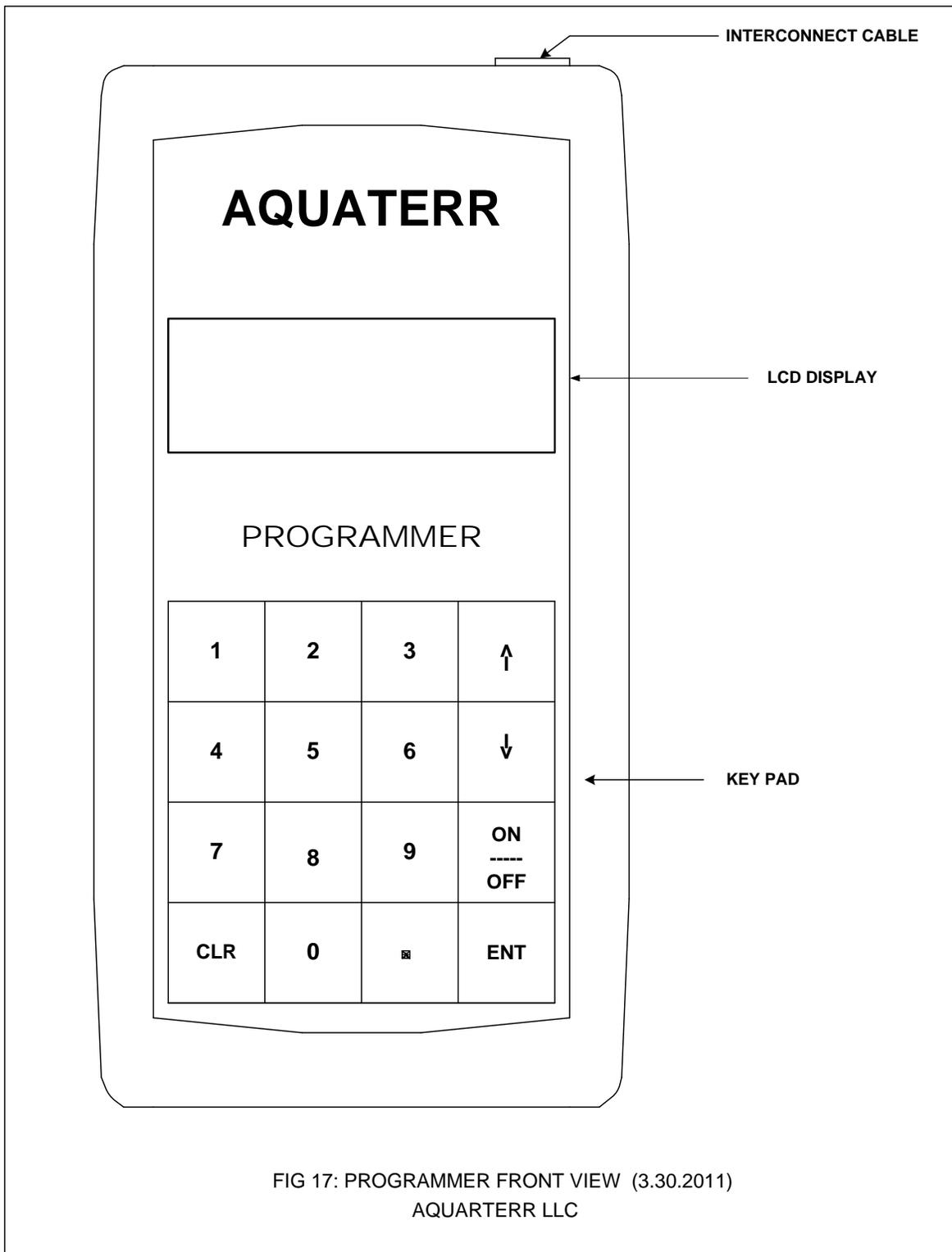
FIG 16: VAR-1, 2 & 4/VB BATTERY LOCATION (3.30.2011)

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INTERCONNECT CABLE

AQUATERR

LCD DISPLAY

PROGRAMMER

1	2	3	↑
4	5	6	↓
7	8	9	ON ----- OFF
CLR	0	⊠	ENT

KEY PAD

FIG 17: PROGRAMMER FRONT VIEW (3.30.2011)
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MAGNETIC RESET SWITCH
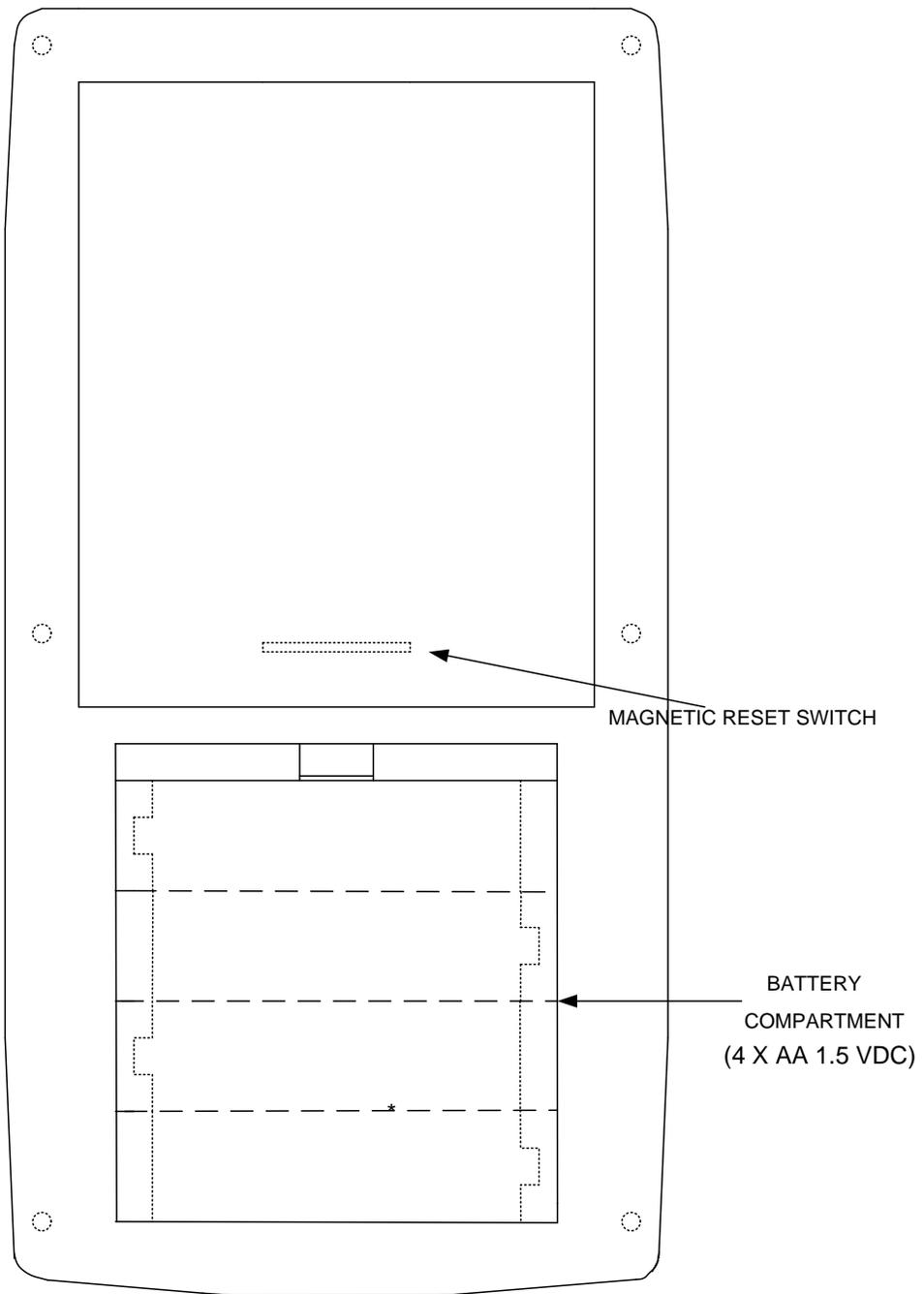
BATTERY
COMPARTMENT
(4 X AA 1.5 VDC)

FIG 18: PROGRAMMER REAR VIEW (3.30.2011)
AQUATERR LLC

DECLARATION OF CE CONFORMITY

AQUATERR LLC declares that their VAR-1/2/4 Receiver complies with EU Directive 99/05/CE: