TWICE™
Two Wire Integrated Communication Exchange

DX2

User Manual

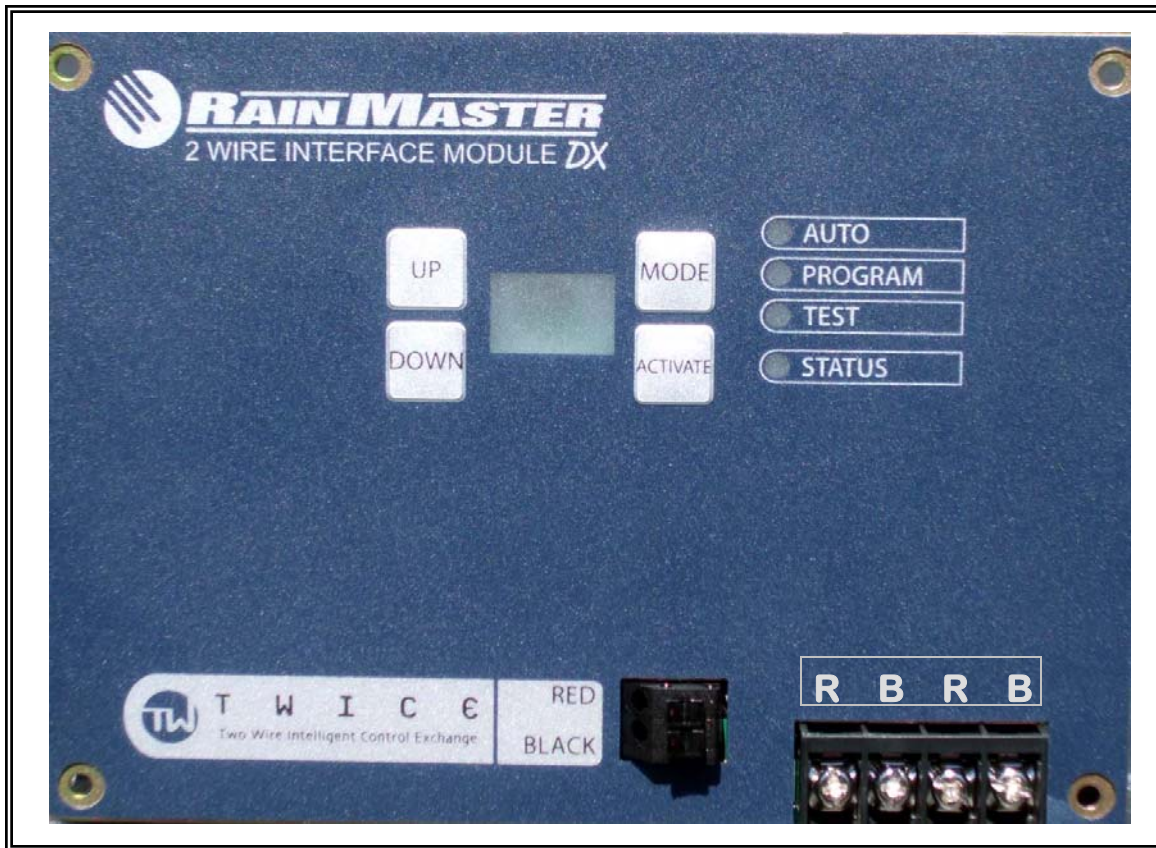RAIN MASTER

WATER SAVER®

Table of Contents

1.0 Introduction

1.1 CONCEPT

The TWICE DX2 family of Controllers integrates two-wire technology into the DX2 family of controllers and offers the following advantages:

- Reduced field wiring
- Ease of Expansion
- Reduced wiring maintenance expense.

Additionally Rain Master's TWICE protocol provides a two-way communication link between the Controller, Decoders and Valves. This enables a means for testing the installation as well as providing diagnostic capabilities within the two wire path.

For a complete description of the DX2 Controllers and their set-up, please refer to the appropriate manuals that are included in each shipment.

1.2 OUTLINE

A typical two-wire set would consist of the DX-TWICE module installed with a Controller either in a wall-mount version or a free standing pedestal.

Figure 1: TWICE-DX2 –Wall Mount Version   **Figure 2: TWICE-DX2 Pedestal Version**

2.1 Description

2.2 Major Components

A standard two-wire installation will include one or more Controllers, each with a TWICE-DX2 Module, sufficient Decoders, Lightning Arrestors, Grounding Rods (8' typical) and Two-wire cable to link all the components together. Installation details are discussed in Section 3.0. The main components are shown in Figures 3-5.
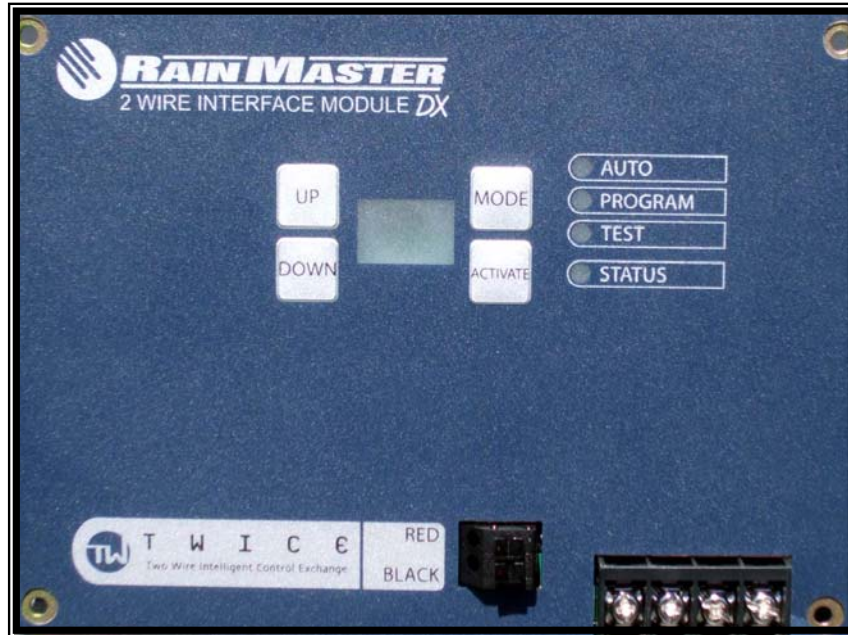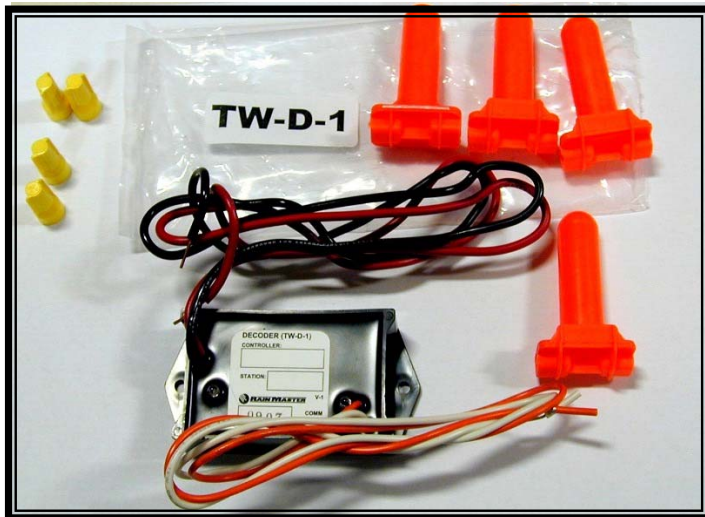

Figure 3: The TWICE-DX2 Module

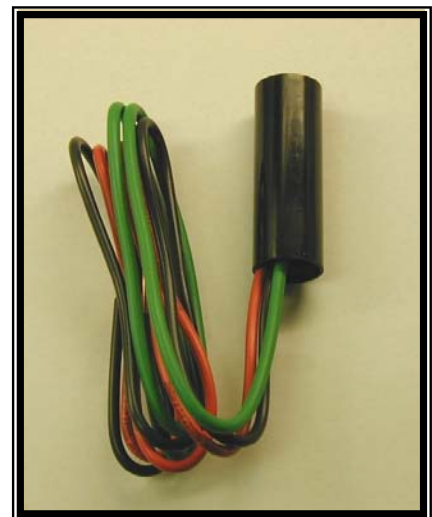**Figure 4: A Typical Decoder with water-proof Wire Nuts and standard wire nuts**

Figure 5: A Lightning Arrestor

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2.2 The TWICE DX2 Module

The TWICE DX2 Interface Module performs the (3) main functions that are typical to a "Two-Wire" application:

1. **Programming of Decoders-** This is the first task in any installation. Station Numbers have to be assigned to each and every decoder before they are installed at the valve locations.

2. **Testing of Decoders –** Before installation, it is necessary to validate that the Station Numbers have been correctly accepted into the decoder.

3. **Monitoring the "Controller/Decoder" Communication -** During operation it is helpful to know the station that is active at any given time. Furthermore if a problem is encountered it is essential to identify its origin.
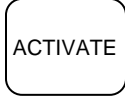
The TWICE DX2 Keyboard is the interface through which the end user can fully utilize the features offered by the module.

The TWICE DX2 Keyboard:

The Keyboard, as shown in Figure 2, contains all the necessary keys, connectors, indicator lights and a display to enable the user to program and test decoders as well as to monitor the status during normal operation.

Its contemporary layout promotes a quick understanding of the tasks necessary to accomplish the (3) main functions listed above.

Specifically:

1. The User can select the desired task from among PROGRAM, TEST or RUN by

   pressing the | MODE | key once or twice. The adjacent LED's will correspondingly light

   up to indicate the selection.

2. To execute the PROGRAM or TEST task, the user presses the | ACTIVATE | key.

3. The | UP | , | DOWN | keys enable the user to scroll to the desired station

   number which will be shown in the display.

4. The Display will indicate active stations during the AUTO mode. An error code will be displayed if a problem is encountered. The STATUS LED will turn RED under such conditions.

5. The Connector for programming Decoders, and Terminals for connecting to Decoders at the site, are located at the bottom of the panel.

MODE Key allows the user to **select** the applicable function such as **Program, Test** or **Auto (Run)**

ACTIVATE Key allows the user to **execute** the selected task (PROGRAM or TEST)

UP/DOWN Keys are to be used to incrementally **scroll** up or down through Station # in the PROGRAM or TEST modes

LED's indicate the selected MODE.

STATUS LED is bi-color. It turns RED if an error is encountered.

RAIN MASTER
2 WIRE INTERFACE MODULE *DX*

UP

DOWN

MODE

ACTIVATE

AUTO
PROGRAM
TEST
STATUS

DISPLAY shows Station # or ERROR CODE

TWICE
Two Wire Intelligent Control Exchange

RED
BLACK

R B R B

CONNECTOR FOR PROGRAMMING DECODERS REFER TO PAGE 6

CONNECTION TO RED & BLACK WIRES FROM MAIN BRANCH (REF. PGS 9-11)

OPTIONAL CONNECTION TO RED & BLACK WIRES FROM A DIFFERENT PATH (REF. PGS 9-11)
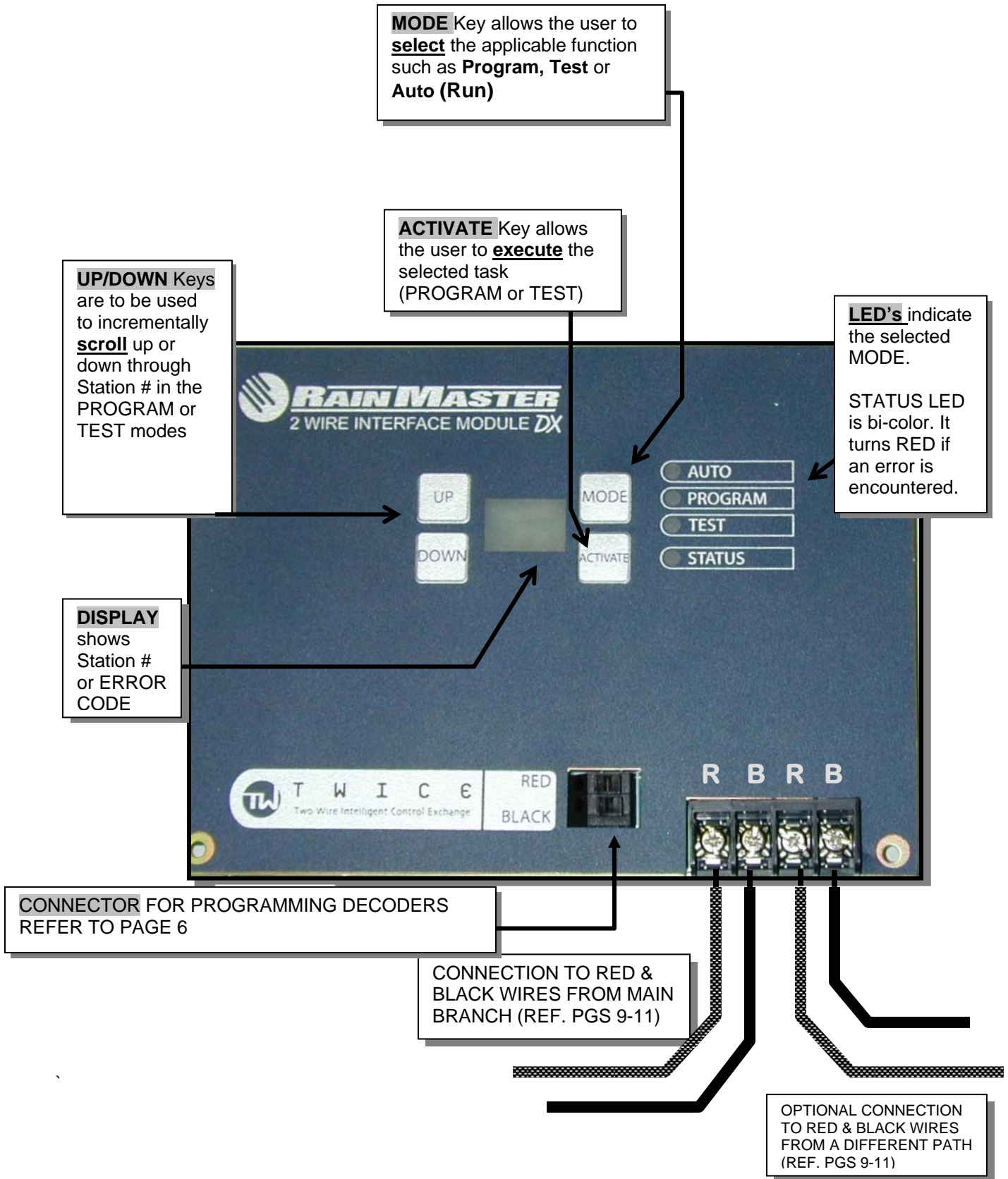
Figure 6: TWICE-DX2 Panel Functions

2.3 DECODERS

RAIN MASTER Twice Decoders come in 1, 2, and 4 Valve versions. They are used to activate valves in the field. Each decoder has to be programmed in advance with a unique valve address which identifies it to the TWICE-DX2 Controller. The Controller broadcasts a command along the Twice Two-Wire path and the appropriate decoder responds and turns the attached valve on or off. Decoders have two-way communication which means that in addition to turning on valves, they also responds back with valve voltage, current and status messages.

2.4 DECODER PROGRAMMING, TESTING AND MARKING

2.4.1 PROGRAMMING

After the Controller is powered up, individual decoders are programmed by connecting them to the connector on the panel as shown in *Figure 7*.

1. Then press **MODE** a few times until **PROGRAM** LED is illuminated.

2. Next press the **UP** or **DOWN** key as necessary until the desired number is displayed.

3. Finally press **ACTIVATE** to program the address into the decoder.

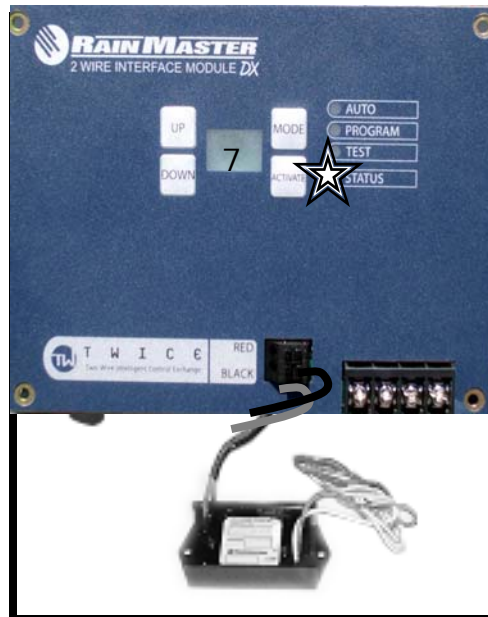If the decoder is programmed successfully, the STATUS LED on the panel will turn GREEN.

Figure 7: Decoder Programming

Figure 7, above, shows a successful example of Decoder programming, #7 in this case: The Decoder number "7" is displayed and the Status light is GREEN.

2.4.2 DECODER NUMBER ASSIGNMENT

The TWICE DX2 Module has pre-allocated ranges for various station numbers as follows:

Decoder #1- 48 –VALVES

Decoder # 49-95-UNASSIGNED

Decoder # 96: Pump

Decoder #97 N.O. Output

Decoder # 98: Secondary Master Valve

Decoder #99 Primary Master Valve

2.4.3 DECODER TESTING

To test a **programmed** Decoder, or to ascertain the station number of an unmarked decoder, carry out the following steps:

1. Connect its red and black wires to the connector on the TWICE DX2 panel of a powered-up controller.

2. Then press MODE until TEST LED is illuminated (green).

3. Press ACTIVATE to test the decoder.

The display will show the Station # that is programmed into the decoder and the STATUS LED on the panel will turn GREEN.

2.4.4 DECODER MARKING

After the decoder is programmed the Controller Serial # and Station number must be noted on the label. (Please use permanent ink marker.)
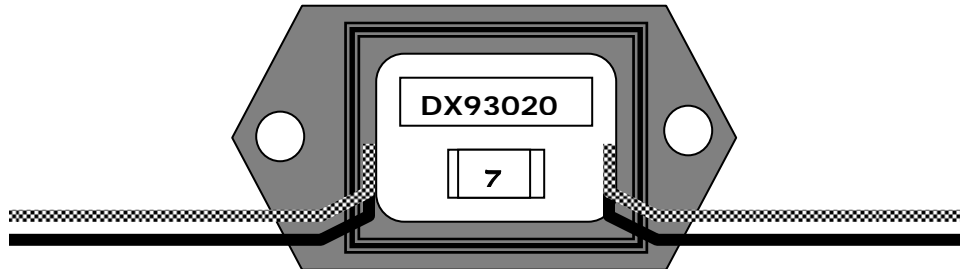
SINGLE DECODER

DX93020

7

Figure 8: Decoder Identification

DUAL & FOUR STATION DECODERS

Two- and Four- valve decoders will use consecutive station numbers following the station number that is programmed.

For example in the case of a dual type, that is programmed with #7, the first valve will be #7 and #8 will automatically be programmed into the second output of the decoder.

A 4-station decoder would end up with #8, #9 and #10 for the other three stations.
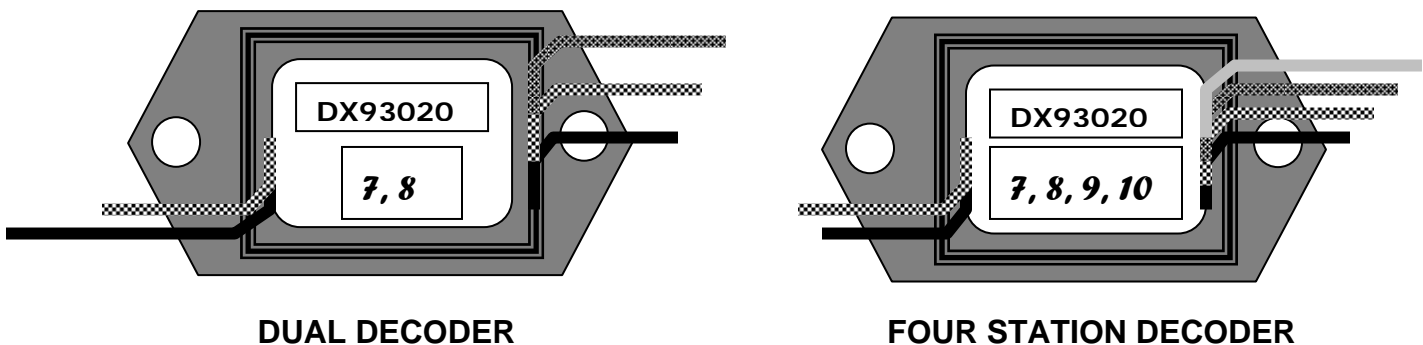
DX93020

7, 8

DX93020

7, 8, 9, 10

DUAL DECODER   **FOUR STATION DECODER**

Figure 9: Examples of Decoder Number Allocation for Dual and 4-Station Decoders

3.0 INSTALLATION

3.1 METHODOLOGY

The Two-Wire system requires a different approach to electrical wiring of components in the field, as compared to the conventional "multi-wire" method.

Specifically:

- Each valve solenoid is addressed (energized) by a Decoder that must be programmed to match the valve number prior to installation.

- A two-wire cable provides Power and Communication signals to the entire array of decoders.

- The cable may be routed in one of three different ways to meet the requirements of the landscaping topography as shown in Section 3.3 subject to (3) conditions:

  1. The maximum distance from the furthest valve to the controller is 5000 feet.
  2. There must be a lightning arrestor (LA-1) installed every 600 feet or less.
  3. The maximum distance from a valve to its decoder is less than 100 feet.

The set up is accomplished through four major steps shown in Figure 10.

3.2 SET-UP SEQUENCE

STEP 1:
Mount controller and
connect power
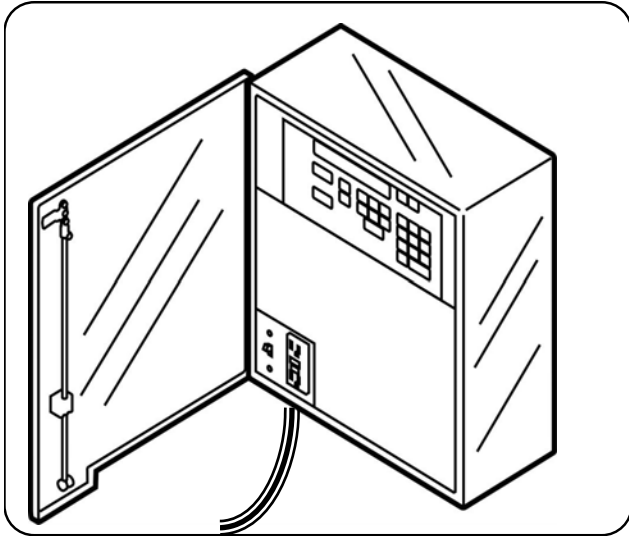
STEP 2:
Program decoders with
assigned station numbers
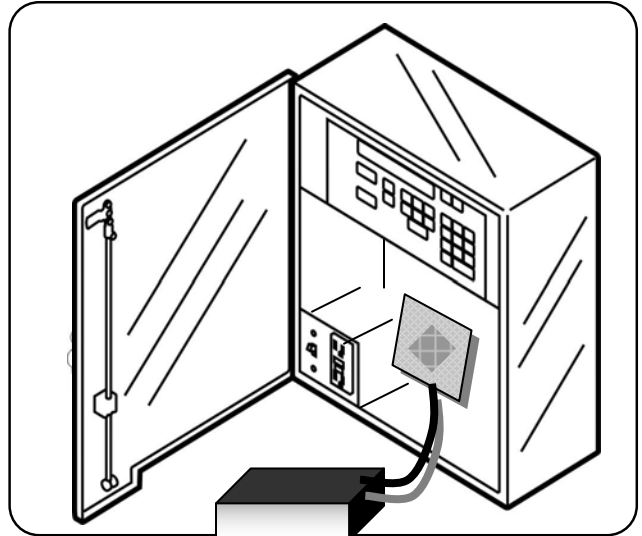
STEP 3:
Install decoders in the field
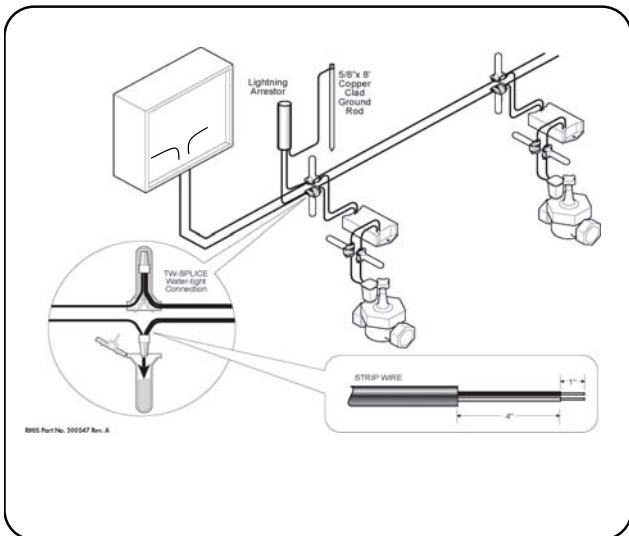
STEP 4:
Connect 2-wire cable to controller
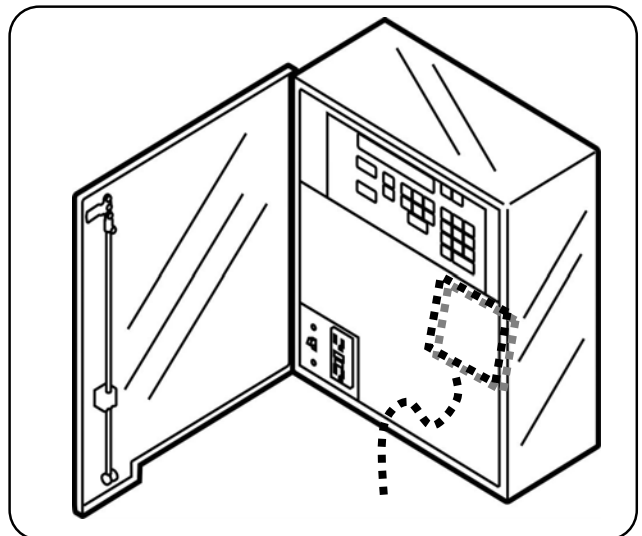
Figure 10: Four Stages of Installation

3.3 FIELD LAYOUT RECOMMENDATIONS

Figures 11 thru14 provide recommendations for field wiring and termination.

FIGURE 11: TERMINATION SCHEME FOR VARIOUS COMPONENTS
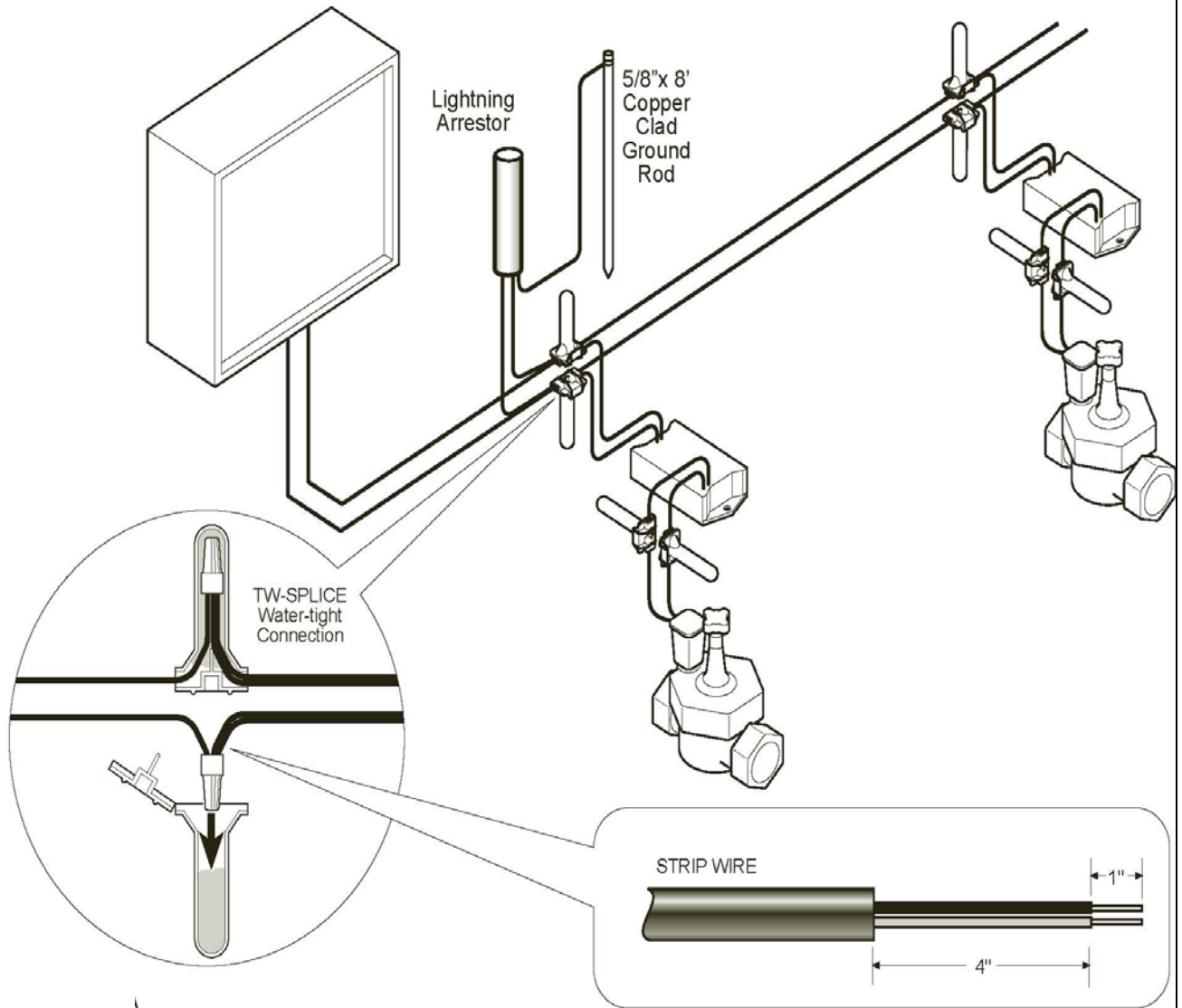
FIGURE 12: A <u>STRAIGHT LINE</u> WIRING CONFIGURATION
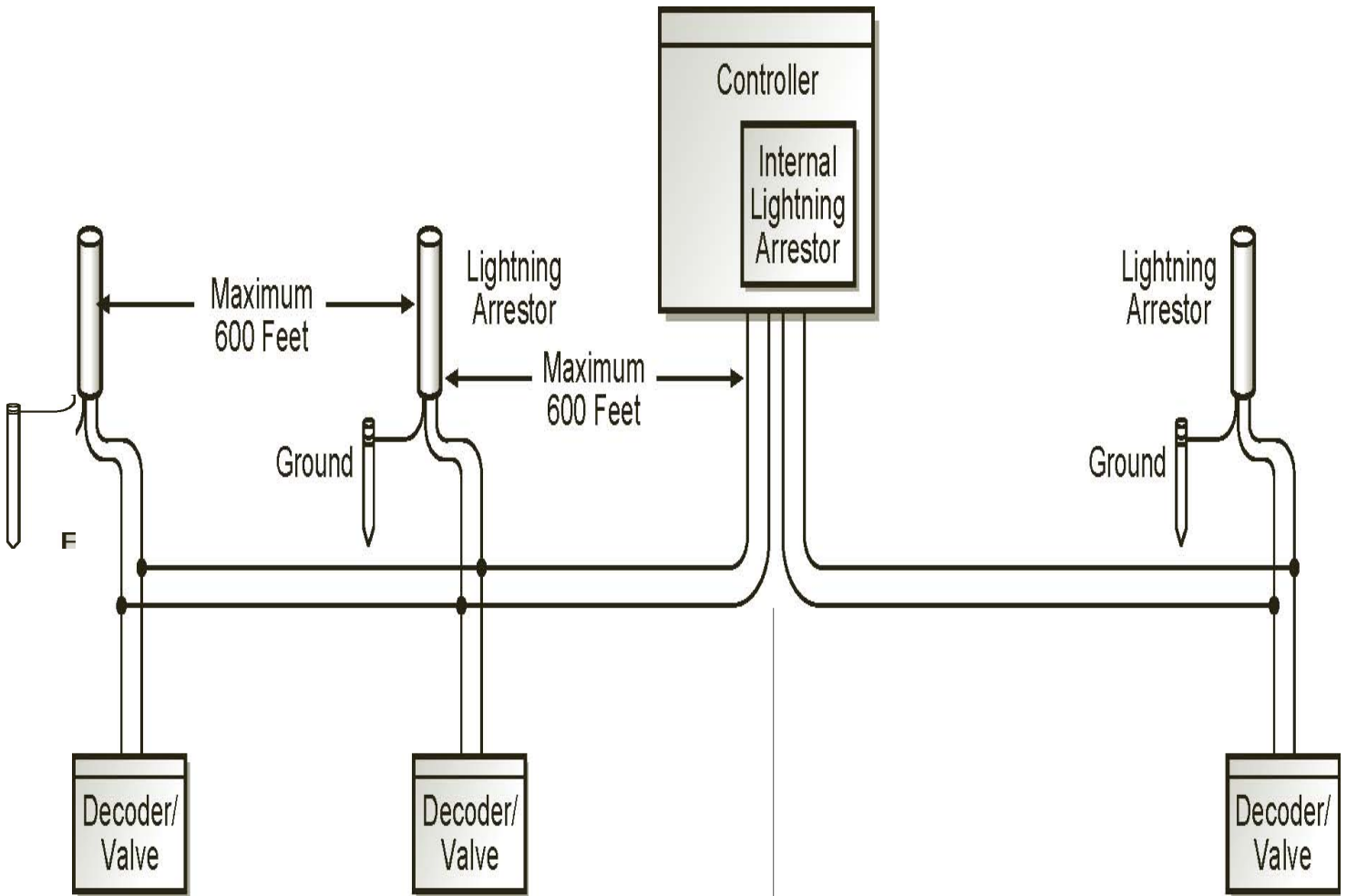
FIGURE 13: A <u>GRID</u> WIRING CONFIGURATION
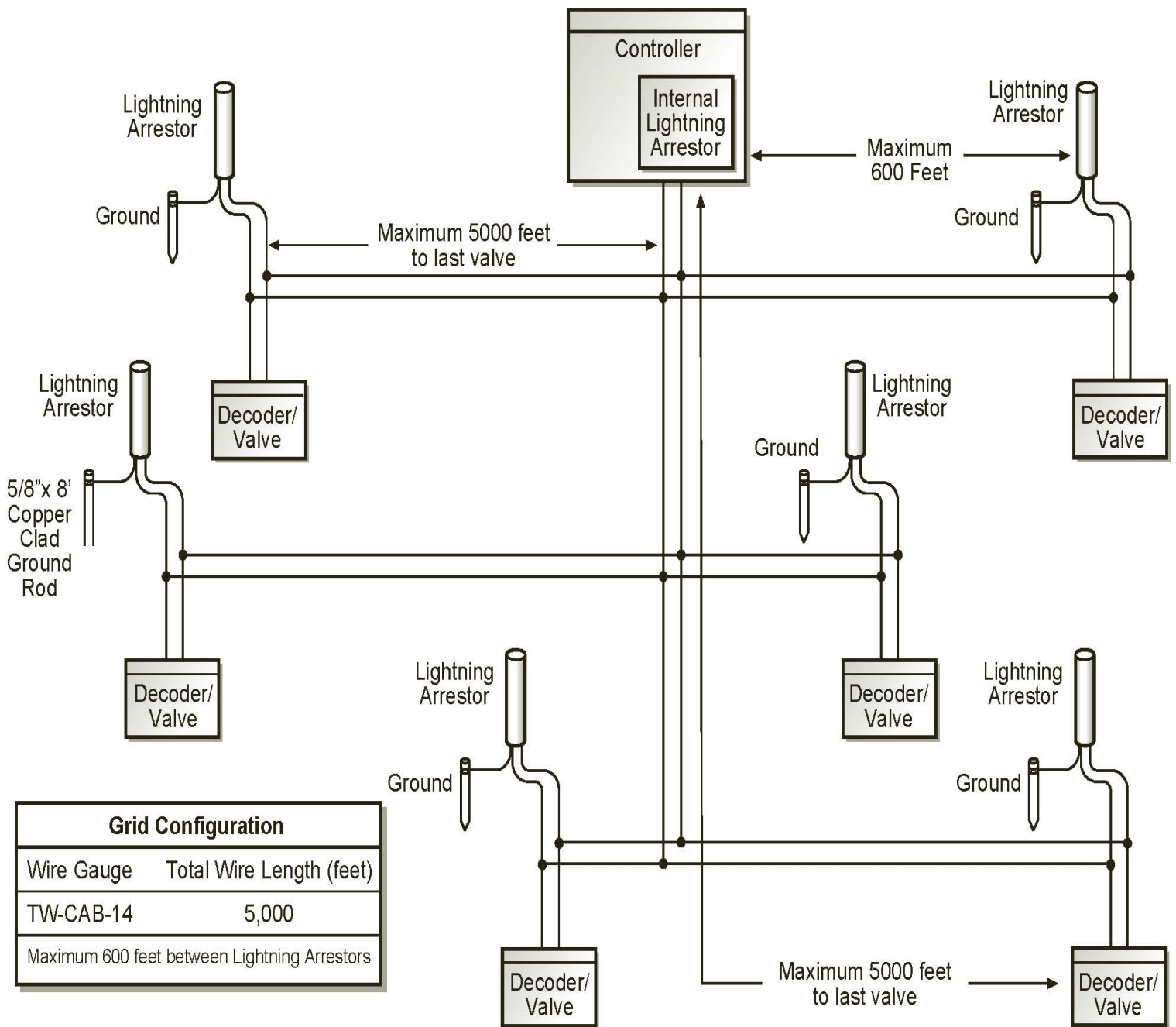
FIGURE 14: A <u>LOOP</u> WIRING CONFIGURATION

Controller

Internal Lightning Arrestor

| Loop Configuration		
Wire Gauge	Total Loop Length (feet)	Distance to furthest valve (ft)
TW-CAB-14	10,000	5,000
Maximum 600 feet between Lightning Arrestors		

Maximum 600 Feet

Decoder/ Valve

Decoder/ Valve

Lightning Arrestor

Lightning Arrestor

5/8"x 8' Copper Clad Ground Rod

Ground

Decoder/ Valve

Decoder/ Valve

Lightning Arrestor

Lightning Arrestor

Maximum 600 Feet

Ground

Ground

Maximum 600 Feet

Decoder/ Valve

Decoder/ Valve

3.4 TERMINATION INTO CONTROLLER

The TWICE-DX2 PANEL is situated behind the blank Panel on the Controller (for WALLMOUNTED units) or the Door in case of Pedestal enclosures.

The Terminal Strip has (2) pairs of terminal screws. Most station configurations can be supported by two-wire cable (TW-CAB-14) originating from one pair of terminals.

In some situations a separate branch may become necessary, in which case the second pair on the terminal strip can be utilized.

Note: Be sure to leave a sufficient service loop in the wires, for strain relief.
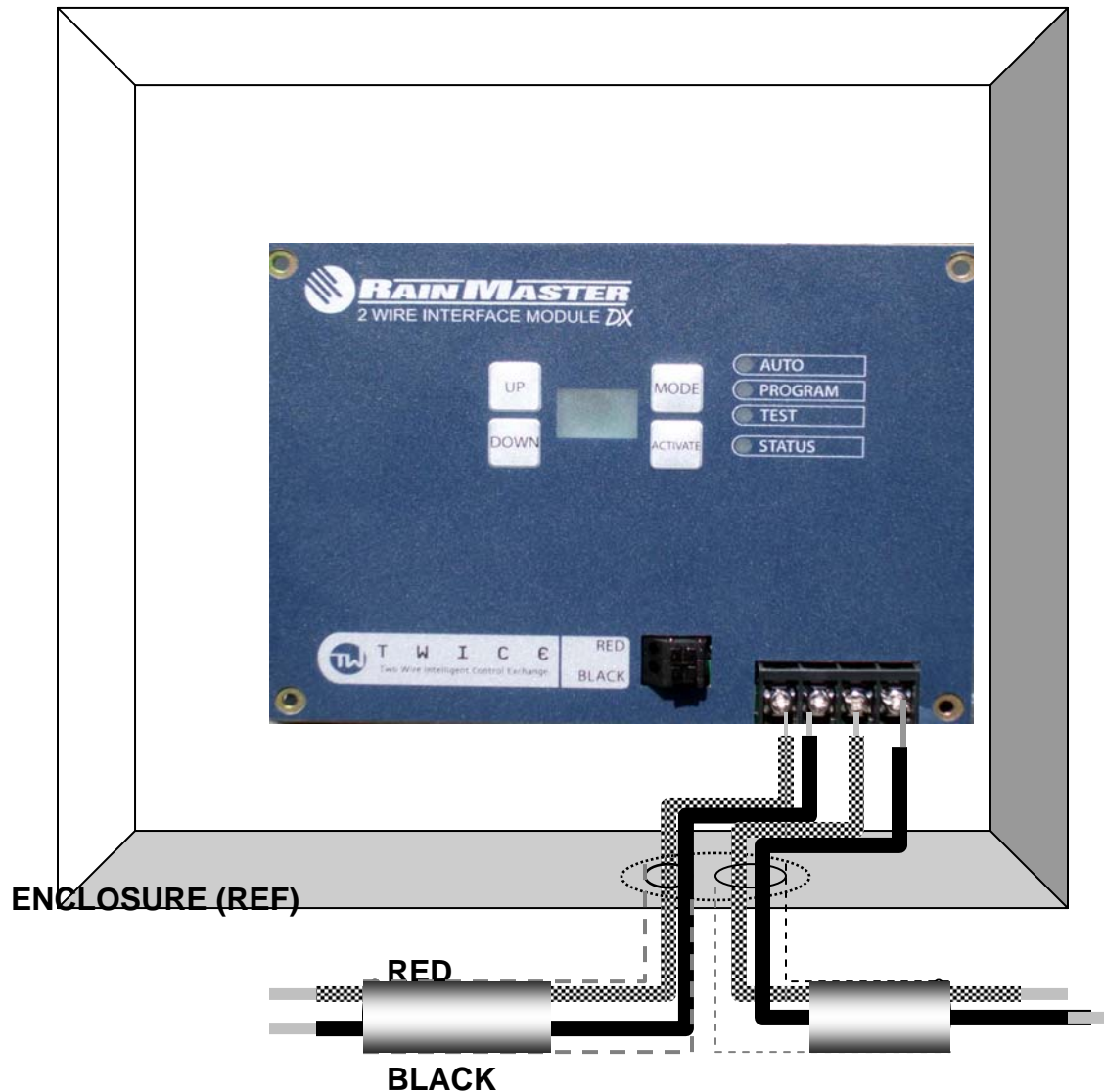
Figure 15: Final 2- Wire Hook-Up into Controller

4.0 FINAL TEST AND START UP

Upon completion of connection of the 2-wire cable into the controller, the system is ready for Final Testing and subsequent operation.

To run a TEST of the system two steps should be followed:

1. Refer to the DX2 Controller manual to carry out all preliminary controller tests prior to automatic operation.

2. Put the TWICE DX2PANEL in the TEST MODE and test individual Decoders one at a time followed by a sequential cycle of all Decoders, Master Valve and Pump as applicable.

3. If any error messages are observed take the necessary corrective action to resolve the problem, such a checking the wiring, or reprogramming the decoders. (see Appendix for trouble shooting tips)

4. Put the TWICE DX2 panel in AUTO MODE. This enables the Controller to assume control of all decoder activities.

The system should now be fully operational.

APPENDIX A

A1: Twice DX2 Panel Programming Details

This section explains the programming capabilities by providing details related to:

- Tactile Key Functions
- Display Messages
- Error Codes
- Quick Programming Guide

Tactile Key Functions

The tactile Keys on the TWICE Control Panel perform different tasks based upon the Mode that is selected. The Table below lists the task that each Key will perform when pressed, depending upon the MODE that the panel set up in at the time.

Key	Automatic Mode	Program Mode	Test Mode
MODE	Will change the <u>Module's mode</u> to **PROGRAM** Mode	Will change to **TEST** Mode	Will change to **AUTOMATIC** Mode
UP	No Action	Will Increment decoder number	Will Increment decoder number
DOWN	No Action	Will Decrement decoder number	Will Decrement decoder number
ACTIVATE	If not active will Clear the displayed error code	Program decoder to specific number	• Run test on decoder number • Test all decoders if decoder address is zero
UP + DOWN	Displays the 2-Wire Interface Module version number	Displays the 2-Wire Interface Module version number	Displays the 2-Wire Interface Module version number
ACTIVATE + UP	Displays the 2 Wire Interface Module temperature, in Centigrade	Displays the 2 Wire Interface Module temperature, in Centigrade	Displays the 2 Wire Interface Module temperature, in Centigrade

Display Messages/Interpretation

The chart below explains the different messages are displayed and the conditions that prompt them, in the three different MODES.

Automatic Mode (When the 2-wire cable is connected to the Terminal Strip on the TWICE Panel)

Display				Condition
--	=			Displayed when the Controller and 2-Wire Interface Module are in Automatic Mode, and no valves are on.
00	Then	07	=	Displayed when the controller and the 2-Wire Interface Module are in Automatic Mode and a valve is active. In this example the display is blank for ½ second then the active decoder number is displayed, 07 is ON. Additionally, the STATUS LED will be RED if errors are encountered, GREEN otherwise.
(mode)	=			Pressing the MODE key changes the MODE from Automatic Mode to Program Mode.

Decoder Program Mode (When the Decoder is connected to the panel)

Display				Condition
	then	E1	=	Displayed until a decoder is attached. The display is blank for two seconds, then E1 is displayed.
00	=			Displayed when a decoder is attached, but has not been programmed.
07	then	E5	=	Displayed when a decoder is attached, but has an error. In this example, decoder communications error.
07	=			Displayed when a decoder has been programmed. In this example, decoder number 07.
(mode)	=			Pressing the MODE key changes the MODE from Program Mode to Test Mode.

Decoder # Assignments (Default)

Decoder #1- 48 -VALVES

Decoder #99 Primary Master Valve **Decoder # 98: Secondary Master Valve**

Decoder #97 N.O. Output **Decoder # 96: Pump**

Test Mode (Decoders are connected to the surge board)

Display				Condition
07 =				Entry and display of the decoder to Test, in this example decoder 07. The decoder numbers can be between 0 to 36, and 99 for the Master Valve. The following display will appear when the TEST key is depressed.
	then	07 1.0 24		After test is complete, the display will blank for ½ second, then the decoder number will be displayed for 2 seconds (or Error Code E1 will be displayed, in case of an Error). If no errors are detected, then the Decoder Firmware is displayed followed by the valve current draw. In this example: 1.0 for firmware rev. and 24 = 0.24 Amperes of current draw.
(mode) =				Pressing the MODE key changes the MODE from Test Mode to Automatic Mode.

Error Code Chart

This chart discusses conditions under which certain error codes are displayed and the actions to be taken to address them.

Table 5 - Error Codes

Code	Error Description	Cause	Action
E1	No Decoder Was Found	• Wiring error • Bad decoder • Bad two wire circuit • Program Mode no decoder was found.	• Check wiring • Move the decoder closer to the controller • Replace the decoder • Replace the 2-Wire Interface Module

E2	Two Wire Circuit is in Over Current	• Shorted wiring
		• Wire connected to earth ground
		• Improper wiring connections
		• Shorted (failed) decoder
		• Valve connected directly to 2-wire circuit
			• Troubleshooting wiring problems
			  1. Undo last item installed.
			  2. Break the 2-Wire network in half to isolate the problem

E3	Open Circuit at Solenoid	• The decoder detects no solenoid current when activated • Defective decoder • Open solenoid • Poor connections or wiring between decoder and solenoid	• Check decoder to solenoid connections • Resistance check the solenoid • Replace the solenoid • Replace the decoder
E4	Short Circuit at Solenoid	• Decoder measures excessive current in solenoid • Shorted or failed solenoid • Improper connections of solenoid wires to two wire circuit •	• Check wiring • Replace solenoid • Replace decoder

Code	Error Description	Cause	Action
E5	Decoder Communications Error	• Poor quality wiring between the 2-Wire Interface Module and the decoder • Two Wire connected to earth ground • Defective decoder • Defective 2-Wire Interface Module • Multiple decoders with same address	• Test two wire resistance to ground • Isolate decoder which in faulting • Check for duplicate addresses • Valve wire is connected to earth ground or in water
E6	High Temperature Shut Down	• 2-Wire Interface Module has exceeded 185° F • 2-Wire Interface Module has defective temperature sensor	• Shade controller • Replace 2-Wire Interface Module • Install cooling fan in enclosure
E7	Decoder Programming Failure	• Programming multiple decoders at one time • Decoder removed before programming cycle was completed • Defective decoder • Defective 2-Wire Interface Module	• Retry programming of the decoder • Replace the decoder • Replace the 2-Wire Interface Module

Table 5 - Error Codes (contd)

A2: Two-Wire Interface Parts List

Item #	RMIS Part #	Description
1	TW-D-1	Single valve decoder
2	TW-D-2	Dual valve decoder
3	TW-D-4	Quad valve decoder
4	PCTW-INTERFACE	2 Wire Interface Module
5	TW-CAB-14	2 conductor, direct burial 2 Wire cable
6	TW-LA-1	Lighting Arrestor
7	TW-SPLICE-14	Waterproof Wire Nut*

* NOTE: The specified wire nut is acceptable for a majority of terminations in the field. However if a requirement is encountered where a larger nut is needed, RMIS recommends that the end-user select from various other commercially available waterproof wire nuts.

A3: TWICE DX2 GENERAL SPECIFICATIONS

The DX2™ irrigation controller shall be manufactured by Rain Master. The controller shall have the following features and functions:

Part 1.0 - Hardware Features

- Available in painted or stainless steel wall mount cabinet or pedestal enclosure.
- Station configuration options1- 48 stations. Dedicated outputs for 2 normally closed master valves, 1 normally open master valve, and 1 pump.
- Connectivity for 4 input sensing devices. Four pulse input type devices e.g. flow sensors, flow meters, ET device, rain gauge, anemometer, etc.
- 80 character LCD display with 24-key membrane keypad.
- Built-in remote control jack. Permanent internal remote mount available.
- Built-in transient protection.
- Optional lightning protection available.
- Audible tone(s) for valid or invalid operator entry.
- Lifetime retention of the user's program and date/time, without the use of batteries.
- All outputs are protected from field wiring short circuits.
- Built in amperage meter to accurately measure and diagnose valve solenoid electrical problems.
- Modular architecture. Modular output boards (6 or 12 station) facilitate maintenance and eliminates total controller down time.

2.0 - Scheduling Capabilities

- Operation of 12 conventional programs with 8 start times, 48 ISC (individual station control) or a combination of each.
- Watering based upon 14-day schedules, skip day schedules, or 31-day schedules.
- Continuous cycling of programs based upon user established start and end times, with a programmable delay/soak time.
- Water budget per program from 0 to 999% in 1% increments for adjustment of program run times
- Program by time.
- Programmable monthly water total terminates over budget irrigation.
- Quick station programming allows groups of stations to be programmed with the same runtime.
- Programmable water window.

3.0 Program Setup Options

- Programs overlap protection or concurrent operation.
- Irrigation programs, lighting programs, security, etc. (Non-irrigation programs are independent of rain shutdown mode.)
- Inter station delay from 0 to 255 seconds.
- Runtimes from 1 second to 24 hours programmable in hours/minutes or minutes/seconds.
- Master valve selections: 2 Normally Closed Valves or Normally Open Valves with programmable delay from 0 to 600 seconds.

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4. 0 Maintenance and Alarm Diagnostic Capabilities

- Flow monitoring. Automatic alarm processing (which provides station and/or master valve shut down and program advance as required) diagnosing and reporting station underflow and overflow, mainline breaks, and unscheduled flows. Maximum upper flow limit is 2000 GPM.
- Electrical field wire monitoring. Automatic alarm processing (which provides station shutdown and program advance) for station over current, short circuits, broken field wiring or faulty solenoids.
- Power monitoring. Automatic alarm processing/reporting for power outages and power restoration. Intelligent program resumption for all outages or power glitches, no lost cycles or water window violations.
- Communication monitoring. Automatic alarm generation/reporting for lost communications or restoration when using hard wire communications. Automatic fault isolation of communication wiring problems to wire path between controllers.
- Diagnostic lights (LEDs) for: MV1, MV2, N.O. MV, and PUMP. Lights indicate when 24 VAC is at output terminal.
- Built-in test (BIT) functions allow selected controller circuitry to be field-tested.
- Manual test mode. Allows user to automatically advance from station to station using manual run time while displaying valve solenoid electrical current for each station as well as station flow in GPM.
- Manual station and manual multi-station modes. - Turns on any station for user entered runtime and automatically selects usage of the proper master valve and/or pump for this station. Multi-station mode allows any single station or output to be turned on individually or in combination with any other station(s). Valve solenoid electrical current is displayed.
- Manually entered program. Allows user to enter a one-time program to be run immediately or scheduled for later in the day. The manual program is independent of automatic programs and shall start only one time.
- Manual start of automatic programs (1-12). Start any program independent of the scheduled start time and water day.

5.0 Miscellaneous Features

- English/Spanish language selection.
- Automatic limit setup (learn mode) for flow and current. Global percentage adjust for limit establishment.
- Omit by date allows the user to enter up to 15 dates to exclude irrigation.
- Operates as a standalone or central.
- Fertilizer injector station with programmable delay from 0 to 255 seconds.
- Flow Max - This exclusive feature allows controllers with a single point of connection to share a pump, master valves, and flow meters without the need for peripheral wiring/relays. All flow limits are dynamically managed as stations across controllers transition off and on. Features include:

  A. Automatic protection and report for main line breaks, unscheduled flow, station high and low flow.
  B. Read flow at any controller
  C. Dynamic monitor shows system status at all times
  D. Pump protection during exception conditions

6.0 Electrical Specifications

6.1   Input Power Required: 117 VAC +/- 15%, 60 HZ, 20 VA, plus load current.
6.2   Maximum load current per station or master valve output: 1 AMP
6.3   Maximum combined load current: 2 AMPS
6.4   No batteries required.

7.0 Certification and Warranty

- Underwriters and FCC approved.
- Manufacturer's limited 2-year warranty.

8.0 Mechanical Specifications

- Heavy duty 18-gauge steel enclosure jet coat and powder coated to protect it for indoor and outdoor environments.
- Addition enclosure and pedestal options available.

A4: RAIN MASTER® LIMITED TRADE WARRANTY

Rain Master warrants to the first "trade" customer purchaser that this Rain Master brand product (the "product"), when shipped in its original container, will be free from defective workmanship, and materials and agrees that it will, at its option, either repair the defect or replace the defective product or part thereof at no charge to the purchaser for parts or labor for the time period set forth below.

This warranty does not apply to any appearance items of the product nor to any product the exterior of which has been damaged, or defaced, which has been subjected to misuse, abnormal service or handling, or which has been altered or modified in design or construction. (See additional exclusion below).

In order to enforce the rights under this limited warranty, the purchaser should ship or carry the product to a Rain Master authorized service depot, or send product prepaid to Rain Master at the address below (ensuring product is packaged correctly for shipment). For nearest location, call Rain Master Service Center 1-805-527-4498.

This limited warranty described above is in addition to whatever implied warranties may be granted to purchasers by law. All implied warranties including the warranty of merchantability, and fit for use are limited to the periods from date of purchase set forth below.

Neither the sales personnel of the seller nor any other person is authorized to make any warranties other than those described above, or to extend the duration of any warranties beyond the time period described herein.

The warranties described above shall be the sole and exclusive warranties granted by Rain Master Irrigation Systems Inc. and shall be the sole and exclusive remedy available to the purchaser. Correction of defects, in the manner and period of time described herein, shall constitute complete fulfillment of all liabilities and responsibilities of Rain Master to the purchaser with respect to the product, and shall constitute full satisfaction of all claims, whether based on contract, negligence, and strict liability or otherwise.

In no event shall Rain Master be liable or in any way responsible, for any damages or defects in the product which were caused by repairs or attempted repairs performed by anyone other than a Rain Master Service dealer or center. Nor shall Rain Master be liable or in any way responsible for an incidental or consequential economic or property damage. Some states do not allow the exclusion of incidental or consequential damages, so the above exclusion may not apply to you.

This limited warranty does not apply to improper installation or grounding, acts of God, such as lightning and/or power surges, floods, earthquakes, hurricane, tornados, vandalism etc.
All "R M E" Series Controllers have a **5-year** limited warranty from date of initial "trade" purchase.
All other Rain Master Brand products carry a **2-year** limited warranty unless otherwise specified.
All Software products, which include but are not limited to, Evolution, AIM, Advanced ET, OASIS, Weather Station, etc, carry a **90-day** limited warranty.
ALL computer hardware purchased from Rain Master in conjunction with its software is NOT covered by any Rain Master warranty. Computer hardware and its subsequent operating system are specifically covered by the hardware manufacture's warranty as provided by the hardware manufacturer.

SERVICE
Should it be necessary to service your controller, contact your local Rain Master distributor or contact Rain Master at 1-805-527-4498 for a listing of distributors in your area.   When sending a controller or a component of the controller back to be serviced, ensure it is properly protected with a soft packaging material, and that the box will withstand normal shipping abuses. Enclose a complete description of the type of problem that is occurring, and be sure to put your name, address and phone number where you can be reached.

NOTE: The user is cautioned that changes and modifications made to the equipment without the express written consent of the manufacturer will void this warranty.

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