

Decoder Installation Manual

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Decoder Installation Manual

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Reference Documents

Constellation® Decoder Programmer Operation Manual – P/N DOCCOMADPROG

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Regulatory Notices

FCC Statement (U.S.A.)

Declaration of Conformity: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Class B limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient the receiving antenna

Increase the separation between the equipment and the receiver

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected

Safety Symbols

Important safety information and warning messages appear throughout this manual. To ensure correct operation and to avoid additional expense, read this manual thoroughly before you begin installation.

Become familiar with the safety symbols presented in this section. These symbols will alert you to safety hazards and conditions that may result in personal injury, death, or property and equipment damage.

The following symbols are used in this document:



WARNING: Failure to observe this warning may result in personal injury or death.



CAUTION: Failure to observe this caution may result in property and equipment damage.



Note: Highlights important information or details.



Idea: Indicates a suggestion that helps you make better use of your system.

Personal Injury Warning



WARNING!

For your protection and the safety of the user, please abide by all Caution and Warning statements within this document. Assure all installation practices comply with all applicable electrical and construction codes for the area.

Operating this equipment in a residential area can cause interference to radio and television reception. The radio frequency energy emitted by this device complies with limits for a Class B computing device, described in FCC Rules Part 15, Subpart J.



WARNING!

ALL WIRING, CONNECTIONS AND REPAIRS TO THE CONTROLLER MUST BE PERFORMED BY A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH LOCAL AND NATIONAL ELECTRICAL CODES TO PREVENT INJURY OR DAMAGE TO THE PRODUCT.

WARNING! ALL EARTH GROUNDING MUST BE INSTALLED AND CONNECTED IN ACCORDANCE WITH LOCAL AND NATIONAL CODES.



WARNING!

ALL ELECTRICAL COMPONENTS AND INSTALLATION PROCEDURES MUST COMPLY WITH ALL APPLICABLE LOCAL AND NATIONAL ELECTRICAL CODES. SOME CODES MAY REQUIRE A MEANS OF DISCONNECTION FROM THE AC POWER SOURCE, INSTALLED THE FIXED WIRING, HAVING A CONTACT SEPARATION OF AT LEAST 0.120" (3mm) IN THE LINE AND NEUTRAL POLES.

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Decoder Run Length Application

This section describes the Decoder Run Length Application. Calculations of how wire length and loading affect decoder based control systems analyzed through this example of a typical wiring layout.



Make sure to use the right size wire splice for the size wire and number of wires involved e.g.; 3-14 gauge wires should use a DBR, 2-14 gauge wires can use the DBY.

Copper wire is not an ideal conductor so the wire resistance and current flowing through will result in a voltage drop. For very short wire runs or very small current levels, this affect is negligible. However, in decoder applications, wire lengths and current loads can be substantial, and their effects must be considered.

The wire voltage drop is calculated using Ohms law:

$$V = I \times R$$

Where **V** = Voltage (Volts), **I** = current (Amps), and **R** = Resistance (Ohms).

For example, if a single 220 mA solenoid is connected to a voltage source that is 2000 ft away using 12 gauge-wires (assume 1.588 Ohms /1000 ft); the voltage drop associated with the wiring is as follows:

$$0.22A \times (4 \times 1.588) = 1.4 \text{ Volts}$$



NOTE: This equation implies 4000 ft of wire are used; this is the case because the 2000 ft distance is a wire pair (live + common). The total length of the current path (i.e. the sum of the 2 wire lengths) must be considered.

Therefore, if the voltage source supplies 24VAC, the solenoid will only 'see' 22.6V.

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Example of a 5-Decoder System

Typically, 24VAC solenoids require a minimum of 19VAC to maintain their 'ON' state. Therefore, a designer must ensure each solenoid 'sees' at least 19VAC with proper decoder wire layout and irrigation scheduling.

An example of a 5-decoder system:

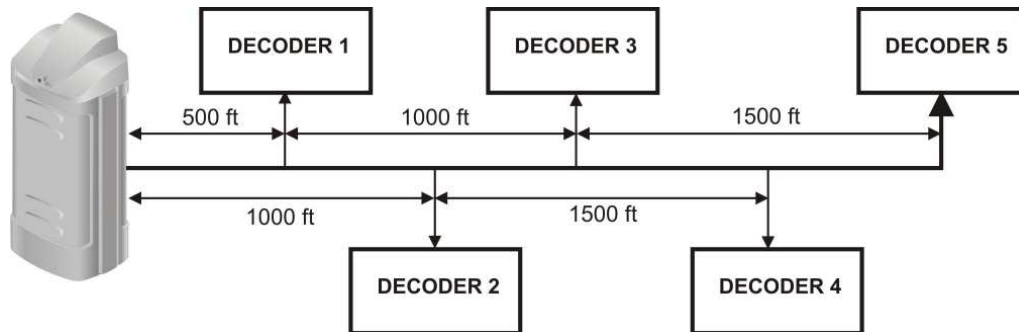


Figure 1 Example of a Five-Decoder System Cable Run.

The length of each decoder from the controller:

- Decoder 1 = 500 ft.
- Decoder 2 = 1000 ft.
- Decoder 3 = 1500 ft.
- Decoder 4 = 2500 ft.
- Decoder 5 = 3000 ft.

Additionally, we will make the following assumptions about the site:

- All wire is 12-gauge stranded copper, with a resistance of 1.588 Ohms / 1000 ft.
- All Decoders have 440 mA loads (approximately 2 solenoids).
- The controller output voltage is 28VAC.

If Decoder 5 is turned ON, the voltage at the solenoid is as follows:

$$28\text{VAC} - (0.44\text{A} \times (6 \times 1.588)) = 23.8\text{VAC}$$

Where 0.44A is the load current, and 6 = 6000 ft of wire. If we turn on decoder 3 also, the voltage at the decoder 3 solenoid is as follows:

$$28\text{VAC} - ([2 \times 0.44\text{A}] \times (3 \times 1.588)) = 23.8\text{VAC}$$

Where 0.88A (2 x 0.44A) is the load current for both the Decoder 3 and 5 solenoids, and 3 = 3000 ft. of wire.

Now, consider the voltage at decoder 5 with decoder 3 ON also. Because the current load at decoder 3 is only 1500 ft away (closer than decoder 5), the voltage drop associated with the combination of the loads must only be considered for the first 3000 ft. This has already been calculated above, with the voltage at decoder 3 @ 23.8V.

Therefore, at decoder 5:

23.8VAC - (0.44A'(3'1.588)) = 21.7VAC

Where 0.44A is the current load for decoder 5, and 3 = 3000 ft = the amount of wire between decoder 3 and 5 (a distance of 1500 ft).

Now, if we additionally turn ON Decoder 4, here is what happens to the voltages:

- Decoder 3: 28 VAC - $([3'0.44A]'(3'1.588)) = 21.7 \text{ VAC}$
- Decoder 4: 28 VAC - $([3'0.44A]'(3'1.588)) - ([2'0.44A]'(2'1.588)) = 18.9 \text{ VAC}$
- Decoder 5: 28 VAC - $([3'0.44A]'(3'1.588)) - ([2'0.44A]'(2'1.588)) - (0.44A'(1'1.588)) = 18.2 \text{ VAC}$

As you can see, decoders 4 and 5 are below the minimum operating voltage for a solenoid. However, we can run Decoder 5 with 2 additional decoders, but they should be chosen closer to the Control source to minimize the affect of the line voltage drop.

For example, if we ran Decoders 1, 3, and 5, they would 'see' the following voltages at their solenoid loads:

- Decoder 1: 28 VAC - $([3'0.44A]'(1'1.588)) = 25.9 \text{ VAC}$
- Decoder 2: 28 VAC - $([3'0.44A]'(1'1.588)) - ([2'0.44A]'(1'1.588)) = 24.5 \text{ VAC}$
- Decoder 5: 28 VAC - $([3'0.44A]'(1'1.588)) - ([2'0.44A]'(1'1.588)) - (0.44A'(3'1.588)) = 22.4 \text{ VAC}$

Idle State Decoder Current Consumption

Another factor we have not yet addressed is the quiescent current, the current consumption of a decoder in an idle state. With the Signature Control Systems Decoders, the current measures approximately 1 mA, which will have little effect on the line voltage drop. However, other decoders measured have in excess of 8 mA, which must be considered in line runs with many decoders.

For example, 100 idle decoders on one line would consume about 800 mA, nearly the load of 4 solenoids!

There are methods of improving the load / line distance tradeoff for decoders.

Two obvious solutions come to mind:

1. Reduce the solenoid current.
2. Reduce the line resistance.

Reducing the current required to actuate the solenoid is probably not a practical solution (for our discussion here), but we can affect the line resistance. We can do this by increasing the diameter of the wire or parallel (loop) the wire. If we loop the wire pair, we effectively cut the resistance in half (because we now have parallel, equal resistances).

In our example, if we loop the wire and turn ON decoders 3, 4, and 5, we observe the following voltages:

- Decoder 3: 28 VAC - $([3'0.44A]'(3'0.794)) = 24.9 \text{ VAC}$
- Decoder 4: 28 VAC - $([3'0.44A]'(3'0.794)) - ([2'0.44A]'(2'0.794)) = 23.4 \text{ VAC}$
- Decoder 5: 28 VAC - $([3'0.44A]'(3'0.794)) - ([2'0.44A]'(2'0.794)) - (0.44A'(1'0.794)) = 23.1 \text{ VAC}$

As you can see, with the wire loop we now have plenty of voltage to run all 3 decoders.

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Typical Installation

Decoders install on all buried cable runs with grounding, as per specification.

Decoders connect to Solenoids and to Signal (COM) and Neutral cable lines. The Number and performance depends on position of decoders in relation with cable length and type.

Cable Inline Runs:

- 1) Field Controller (Pedestal shown here)
- 2) Sold Separately: TWSPK Surge Arrestors should be installed every 250 to 500 ft (80-150 m) of cable run and within 250-500 ft (80-150 m) from each Decoder. The Decoder's three wires are Red, Green, and Black.
- 3) Sold Separately: Grounding Rod or plate (Green). Refer to "Grounding Decoders" on next page.
- 4) Signal (COM) cable run (Red)
- 5) Neutral cable run (Black)
- 6) Decoders attached to Solenoids

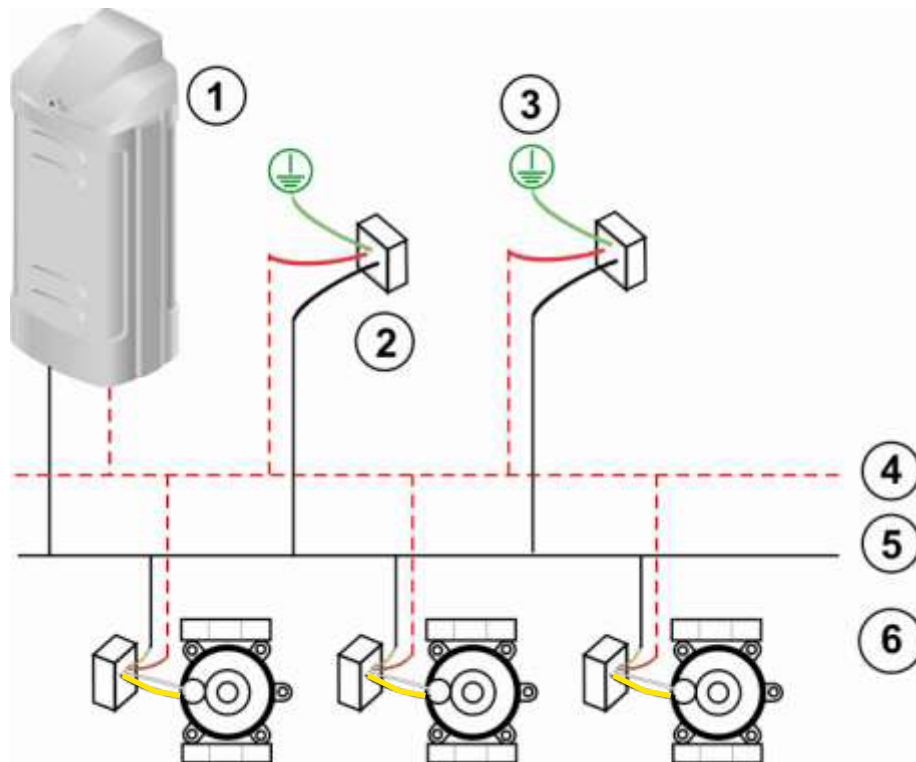


Figure 2 Decoders on Solenoids, and Field Surge Arrestors inline Cable Configuration

Grounding Decoders

Decoders and Lightning Arrestors

Inline decoders are surge protected when a Lightning Arrestor is grounded to a rod or plate.
All wire connections to be 3M DBY-6 (Paige Electric 270337) or DBR-6 (Paige Electric 270338).

Cable Two-Wire:

- 1) Field Controller (Pedestal shown here), Red (COM) and Black (Neutral) two-wire cable run.
- 2) Decoders: Signal (COM) cable (Red) ; Neutral cable (Black)
- 3) Solenoids
- 4) Sold Separately: Lightning Arrestor (TWSPK surge protector) should be installed every 250 to 500ft of cable run and within 250 & 500ft from each Decoder. The Arrestor's three wires are Red and Black, with Green grounding wire.
- 5) Sold Separately: Grounding Rod or Plate.

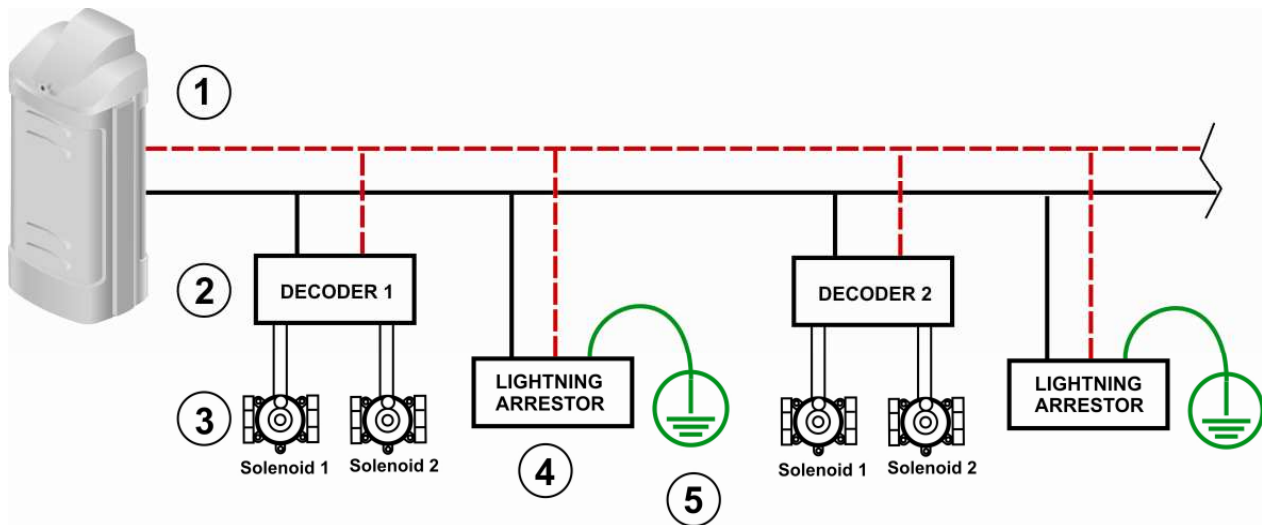


Figure 3 Decoders and External Lightning Arrestors Grounding Connections.

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Decoder Troubleshooting

Condition	Description	Action/Solution
Short Circuit in Decoder	Check to see if the short circuits are internal to one unit or related to the field wiring.	Turn the controller OFF/ON: If you get the short circuits, it is the internal wiring. If not, it is the field wiring.
Check short circuits Resistance with an Ohm Meter	Check resistance across the red and black wires to the field.	If there is a short, check all the connections to verify red-to-red, and black-to-black wiring. Check soldering is correct.
Continued Short Circuits	Check entire line for shorts	Disconnect the red wire at each Decoder one at a time to locate which decoder is causing the short. Use Ohm Meter to recheck each decoder.



Note: Troubleshooting Decoders differ for every configuration setup; for more detail on troubleshooting your specific decoder configuration, contact Technical Support, if necessary at **1-866-674-4628**.

Specifications

Bidding Specifications

- The decoders shall be Constellation® decoder Model CD-111, CD-112, CD-122, CD-132 and CD-142.
- The decoders shall be capable of controlling one, two or four valves per unit. This may be one or two solenoids per decoder address depending on the model specified. See following Technical Specifications.
- They shall be sealed in such a manner that they shall not be susceptible to moisture or inclement weather and can be buried underground.
- The decoders shall be controlled exclusively via a field controller/satellite and such field controller/satellite shall be Constellation® CDC or CON models as specified on the drawings.
- The decoder shall be programmed via a digital programming device and shall not rely on mechanical switches for address programming [part number ACPROG].
- The decoder shall be fully field programmable and addresses shall be able to be programmed in any sequence.
- The decoder shall be controlled via a digital signal communicated down the cable while connected to the decoder modulator [part number ACDEC1] as mounted in the field controller/satellite.
- The decoders shall be capable of operating on either 2-conductor wiring/cables, or 3-conductor wiring/cables.
- The decoder shall be programmable such that each decoder output can be individually controlled via instructions from the field controller/satellite.
- The decoder shall respond to all control commands and shall transmit electrical diagnostic data back to the field controller for further analysis.
- The field decoders shall be as shown on the drawings or as instructed and shall be furnished by Signature Control Systems.

Technical Specifications

Model:

CD-111:	Field Decoder, 1- address, 1-solenoid
CD-112:	Field Decoder, 1- address, up to 2-solenoid per address
CD-122:	Field Decoder, 2- addresses, up to 2-solenoids per address
CD-132:	Field Decoder, 3- addresses, up to 2-solenoids per address
CD-142:	Field Decoder, 4- addresses, up to 2-solenoids per address

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Controller to Decoder Specifications:

Power Draw:

CD-111: Idle: 1-2 mA ; Active: 10 mA plus solenoid load

CD-112: Idle: 1-2 mA ; Active: 10 mA plus solenoid load

CD-122: Idle: 1-2 mA ; Active: 10 mA plus solenoid load

CD-132: Idle: 1-2 mA ; Active: 10 mA plus solenoid load

CD-142: Idle: 1-2 mA ; Active: 10 mA plus solenoid load

Dimensions:

CD-111, CD-112, CD-122, CD-132, CD-142: Length: 3.5 in. (89 mm), Width: 1.2 in. (31 mm), Depth: 1.2 in. (31 mm)

Surge Protection:

CD-111, CD-112, CD-122, CD-132, CD-142: 68V, 1000A max surge current, 1 time @ 8/20 μ s

* Integrated within decoder. Requires optional grounding rod [part number TWSGK] and optional field surge protection device for extra protection [part number TWSPK].

Mounting and Encapsulation:

Mounted in valve box or direct burial. Fully waterproof for direct emersion into casual water

Address:

Fully field programmable using field programmer [part number ACPROG]; Addresses shall be able to be programmed in any sequence.

Electrical Input:

Nominal voltage: 24V AC

Minimum voltage: 19V AC

Electrical Output:

Max. Voltage [US]: 30V AC

Max. Voltage [EU]: 48V AC

Max. Load:

CD-111: 1 solenoid (1 per address)

CD-112: 1 solenoids (2 per address)

CD-122: 2 solenoids (2 per address)

CD-132: 3 solenoids (2 per address)

CD-142: 4 solenoids (2 per address)

Maximum Output Load:

CD-111: 1 solenoid; Single station control [1-address] *

CD-112: 1 or 2 solenoids simultaneously; Single station control [1-address] *

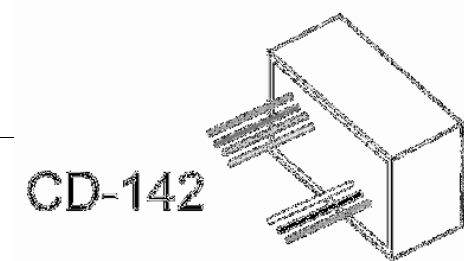
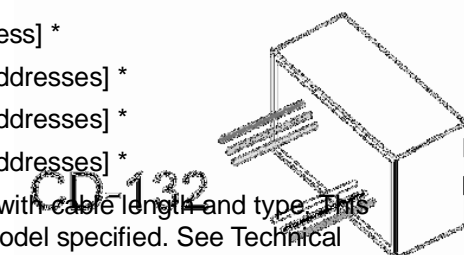
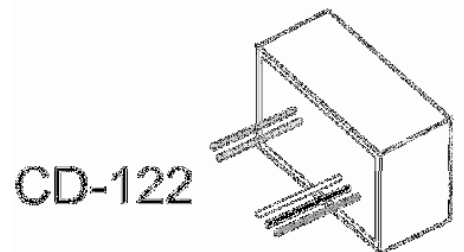
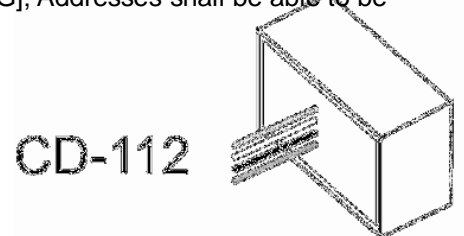
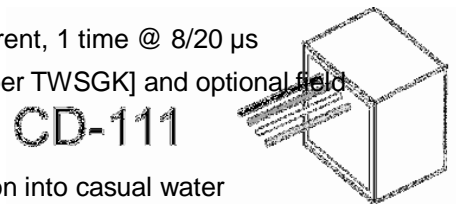
CD-122: 1 to 4 solenoids simultaneously; Individual station control [2-addresses] *

CD-132: 1 to 6 solenoids simultaneously; Individual station control [6-addresses] *

CD-142: 1 to 8 solenoids simultaneously; Individual station control [4-addresses] *

* Number and performance depends on position of decoder in relation with cable length and type. This may be one or two solenoids per decoder address depending on the model specified. See Technical Specifications above.

Connections:



CD-111: Connections as follows:

- Black wire to the neutral terminal
- Red wire to the signal terminal of the decoder modulator
- White wire to the solenoid
- Yellow wire to solenoid.

CD-112: Connections as follows:

- Black wire to the neutral terminal
- Red wire to the signal terminal of the decoder modulator
- White wire to the solenoid(s)
- Yellow wire to solenoid(s)

CD-122: Connections as follows:

- Black wire to the neutral terminal
- Red wire to the signal terminal of the decoder modulator
- White wire to all the solenoids
- Yellow wire to solenoid(s) for address number one on the decoder
- Orange wire to the solenoid(s) for address number two on the decoder

CD-132: Connections as follows:

- Black wire to the neutral terminal
- Red wire to the signal terminal of the decoder modulator
- White wire to all the solenoids
- Yellow wire to solenoid(s) for address number one on the decoder
- Orange wire to the solenoid(s) for address number two on the decoder
- Purple wire to the solenoid(s) for address number three on the decoder

CD-142: Connections as follows:

- Black wire to the neutral terminal
- Red wire to the signal terminal of the decoder modulator
- White wire to all the solenoids
- Yellow wire to solenoid(s) for address number one on the decoder
- Orange wire to the solenoid(s) for address number two on the decoder
- Purple wire to the solenoid(s) for address number three on the decoder
- Blue wire to the solenoid(s) for address number four on the decoder.

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Maximum Cable Runs:

Determined by the current Decoder Run-Length Application Note.

Total Electrical Resistance:

Max. 5 ohms - Calculated from controller output with all decoders connected and splices made.

Signature recommends using 3M-DBY electrical connectors for all connections.

Decoder to Solenoid Specifications:

Total Decoder Load Output:

Max. 5 ohms

Max. Distance Decoder/Solenoids:

Max. Cable length: 14 gauge: 450 feet

Minimum cabling requirements:

2 x 14-gauge (1.5 mm²) stranded copper, 1 x earth ground,

UF insulated type

2 x 14-gauge (1.5 mm²) solid copper, 1 x earth ground UF insulated type

Environment:

Working range: 32° to 122°F (0° to 50°C)

Storage range: -4° to 158°F (-20 to 70°C)

Humidity: 100%

Decoder Control Cable:

Decoder Control Cable P7313 Twisted [2-conductor]:

As a minimum, to meet the manufacturers' specifications, the decoder control cable shall be Paige Electric Co. model P7313, 2/C control-cable; to operate valve decoders consisting of 14AWG-10AWG solid conductors. Insulated with PVC and having low-density high molecular weight polyethylene insulation twisted, suitable for direct burial applications for operation up to 600volts, and conductor temperatures up to 60°C, as specified on the drawing.

Decoder Control Cable P7318 Twisted [3-conductor]:

For added lightning protection, to meet the "Paige Wiring Guide for Decoder Systems" specifications, the decoder control cable shall be Paige Electric Co. model P7318 3/C control-cable to operate valve decoders consisting of 14AWG-10AWG solid conductors. Insulated with PVC and having low-density high molecular weight polyethylene insulation twisted (suitable for direct burial applications), and operation up to 600volts and conductor temperatures up to 60°C, as specified on the drawing.

- The conductors shall be soft drawn bare copper meeting the requirements of ASTM specification B-3 or B-8.
- The cable shall be tested physically and electrically in accordance with UL Standard 493 and 83 (paragraphs 28.1, 29.1 and 29.2). All reels and cartons shall bear UL labels.
- The cable shall have a temperature rating of 55°C + 60°C.
- The cable shall have an insulation thickness of no less than 0.060" with conductor colors are black, red and reduced green for P7318 & blue and red for P7313. Conductors shall be twisted with a 4" lay.
- The cable shall be able to pass the following tests without showing signs of degradation.

Cold Bend:

The insulation shall not show any cracks when sample is bent around a mandrel of 3 x wire diameter, after being subjected to -55°C ± 1°C for one (1) hour.

Electrical:

AC test voltage, 5 minutes at 3,000 volts.

Environmental Aging:

Immersed for 14 days in concentrated solutions of fertilizers, herbicides and insecticides.

Surface marked with Paige-Electric, PE- 60, voltage rating, size and type, and UL file number.

The irrigation control cable P7313 &/or P7318 shall be manufactured by Paige Electric Co. L.P. Union, New Jersey.

Connection Recommendations:

Connections shall be accomplished using 3M DBY connectors. PVC adhesives or sealing compounds shall be utilized.

Signature recommends the soldering and using proper soldering techniques & equipment of all buried low voltage decoder electrical connections and the correct insertion into watertight enclosures such as the 3M DBY or DBR connectors as per manufacturers' specifications.



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