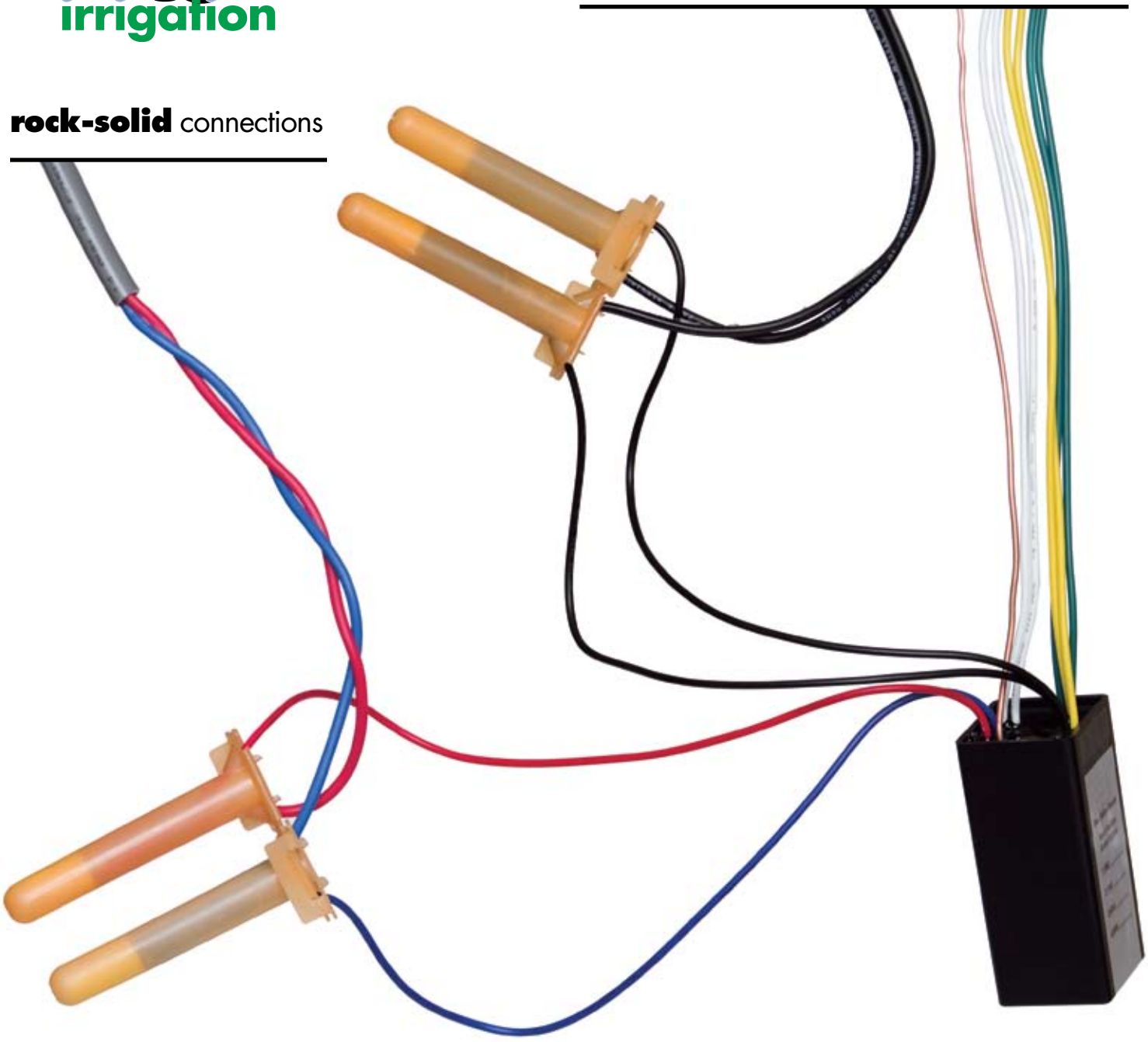
The Paige® irrigation decoder wiring guide. Your **low-cost** and **hassle-free** solution.

rock-solid connections



one-touch maintenance

The Paige Irrigation Wiring Guide for Decoder Systems

Background:

The decoder system was first introduced to the irrigation industry in the late 1960s. It was invented by the world renowned golf course architect, the late Robert Trent Jones, Sr. The first system was installed in Mr. Jones' personal golf course, Coral Ridge Country Club, in Ft. Lauderdale, Florida. The product was commercialized by John's Manville Irrigation as the Binar® System in the early 1970s. Rain Bird introduced their version of the decoder system, Multipath®, in the mid 1970s.

These products proved to be unreliable for many reasons:
- Off-the-shelf wires and cables were used and they were not robust enough. The Binar® Cable was developed by Paige Electric to solve this problem. This later became Rain Bird's "Maxi® Cable" for central control system communication circuits. Today, Maxi Cable is also used in Rain Bird's decoder system. Reliable cables are now available from Paige Electric for all manufacturers' decoder systems, as discussed below.
- Connectors were not so good. The 3M Company has since developed connectors that solve this problem. These NEC-compliant products are discussed below.
- Electronic components were not nearly as reliable as they are today.
- Massive failures were caused by lightning and power surges. This problem still exists today with modern systems and earth grounding and lightning protection must be done properly to ensure reliability. This subject is covered extensively in this Guideline.

Decoder versus Conventional Systems:

Figures 1 and 2 show typical wiring diagrams for conventional and decoder irrigation electrical systems:

Figure 1

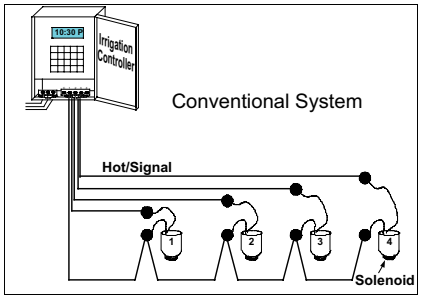
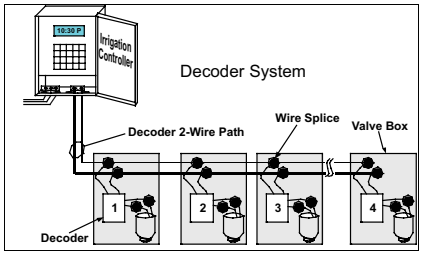


Figure 2



As can be seen, there is a significant reduction in the amount of wire used in a decoder system. But there are a number of tradeoffs and unique problems that result from this reduction of wire. These issues and their solutions are discussed below.

Typical Decoder System Wiring Diagram:

Figure 3 is a typical wiring diagram showing the various wires, cables and the connections to decoders and valve solenoids. It also shows each decoder grounded to the earth.

Note that Decoder #1 controls a single solenoid valve (referred-to as the "address") and it uses five wire splices compared to a conventional system that requires only 2 splices per solenoid, as shown in Figure 1.

Decoder #2, which controls six solenoids, requires 27 splices compared to 12 splices in a conventional system.

Wire splices are the weak link of an electric circuit and because we have so many on a decoder system it is critically important to do it properly, in accordance with the prevailing electrical code. This subject is discussed in detail below.

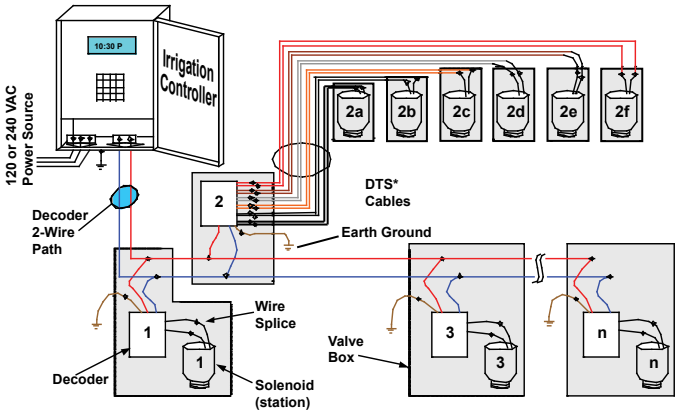


Figure 3

Components, requirements, and best recommended practices for decoder systems are discussed below.

Cable Burial Depth:

The 2-wire path of most decoder systems operates at voltages between 30 and 40 volts. The 2005 edition of the National Electrical Code®, Article 300-5, requires that wires and cables subjected to voltages higher than 30 volts are to have a minimum cover of 24 inches.

If the voltage on the cable is 30 volts or less, as is the case in the DTS cables, only 6 inches of cover are required. Of course, the proper depth should be selected in order to protect the cables from mechanical damage from routine maintenance, such as aerefying of soils.

Paige Electric Cables for 2-Wire Paths:

There are many types of decoder cables, as required by the manufacturers of "2-Wire" decoder systems. The basic differences are in the color of the inner wires (to match the colors of the decoder wires) and the colors of the outer jackets (to distinguish the various zones connected to the controller, and in

the trench.) The Hunter and Toro cables feature an innovative tubular jacket that can be easily stripped to expose the inner conductors. The following is a summary of these cables. Paige Electric also provides these types of products for decoder systems by Tucor, Rain Master, Hit Products, Baseline, etc.

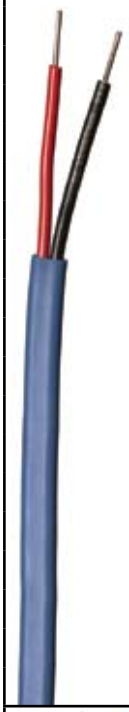
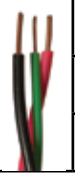
	Paige Electric		AWG & No. of Conductors	Colors	
	Part No.	Spec No.		Conductors	Outer Jacket
Hunter 	170116RB	P7313	14/2c	Red & Blue	None
	170109B		12/2c		
	170801BU	P7354D	14/2c		Blue
	170801GY				Gray
	170801OG				Orange
	170801PR				Purple
	170801TN				Tan
	170801YL				Yellow
	170802BU		12/2c		Blue
	170802GY				Gray
	170802OG				Orange
	170802PR				Purple
	170802TN				Tan
	170802YL				Yellow
Rain Bird 	180115	P7072D	14/2c	Red & Black	Red
	180126				White
	180127				Black
	180114				Orange
	180116				Blue
	180118				Yellow
	1801181				Purple
	1801182				Brown
	1801151				Pink
	1801183				Gray
	180117				Green
	180161		12/2c		Red
	180160				Black
	180165				Orange
	180162				Blue
	180163				Yellow
	180168				Purple
	180166				Brown
	180167				Gray
	180164				Green
Toro 	170116BKWT	P7313	14/2c	Black & White	None
	170800	P7350D			Red
	170800BK				Red & Black Stripe
	170800GN				Red & Green Stripe
	170800YL				Red & Yellow Stripe
John Deere Signature 	150531	P7318	14	Black, Red, Green	None
	150532		12 14	Black, Red Green	
	150353		10 14	Black, Red Green	

Table 1

Troubleshooting & Decoder Cable Switching Devices™ (DCSD):

Although today's controllers are able to perform diagnostic routines to help troubleshoot faults in the wiring circuits, sometimes the problem is just too complicated for the average person. Oftentimes, maintenance personnel resort to trial-and-error methods in an effort to isolate the problem. Trial-and-error methods usually cause cables to be cut and splices to be undone. By the time the fault is isolated, the cable is cut-up in many locations.

To reduce the number of cable cuts, it is advisable to install DCSD's in strategic locations where the 2-Wire paths split, as shown in Figure 4. It also helps to install them half way along very long cable paths. By so doing, cable sections can be connected and disconnected with a flip of a switch.

TYPICAL WIRING DIAGRAM USING DCSDs

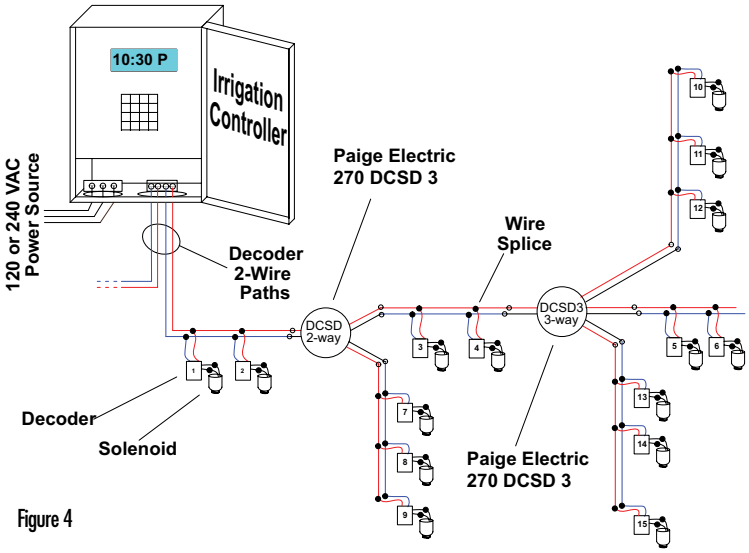


Figure 4

Lightning Protection, Grounding, Bonding and Shielding:

In decoder systems, the lightning protection/arresters are either built into the decoder or wired externally, depending on the manufacturer. Without lightning arresters, the decoders are vulnerable to lightning damage. In order for these arresters to discharge lightning energy efficiently, they must be grounded. Manufacturers of decoder systems recommend that a ground grid is installed every 300 to 1000 feet, depending on the available budget. Generally speaking, the further the electronic equipment is from the ground grid, the higher the likelihood of being damaged by lightning. All decoders should be grounded to the closest ground grid.

It is important to try to maintain the same voltage at all points of the 2-wire path in order to minimize lightning damage. The technique known as "bonding" is used to accomplish this. 10 AWG solid bare copper wires should be used to connect

decoders and lightning arresters to the ground grids and to interconnect ground grids of a circuit. This bonding wire can be used to "shield" the 2-wire path from lightning energy by placing it directly above the decoder cable. Here are typical recommended grounding grids for decoder systems with internal and external lightning arresters:

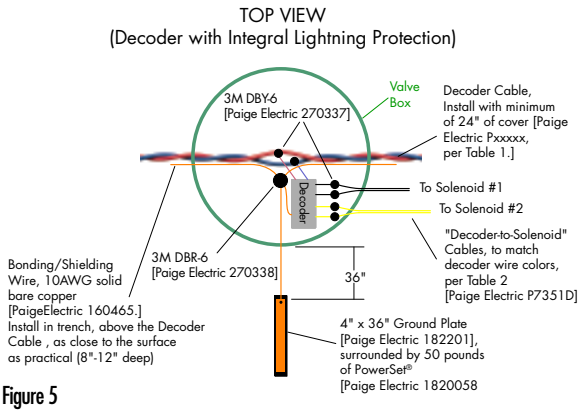


Figure 5

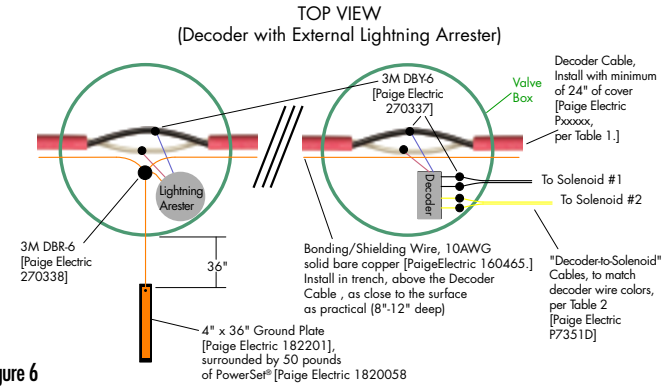


Figure 6

Paige Electric Decoder-to-Solenoid (DTS) Cables™:

The wiring inside a valve box can be very complicated as can be seen in Figure 3 for Decoder #2. DTSTM Cable colors can be chosen to match the colors the decoder output wires (addresses) to untangle the confusion. These cables are made-up of two conductors held together by a thin membrane to keep the pairs together during the installation process. The two conductors can be easily torn apart when making splices. The insulation on one wire of the DTSTM Cable is smooth and has a print legend on it while the other wire has raised ridges. This is ideal for systems requiring polarization, like the Toro system that utilizes latching solenoids.

The following table shows the matching colors of DTSTM Cable, by major decoder manufacturer and decoder model number.

Decoder-to-Solenoid Cables (DTS Cables), Specification P7351D

Table 2

DTS Cable Color & Paige Electric Part Numbers

Toro Model/Address #		Red 170803RD	Blue 170803BL	Green 170803GN	Orange 170803OG
DEC-1 CDEC-1	1	•			
DEC-2 CDEC-2	2			•	•
DEC-4 CDEC-4	4	•	•	•	•

Hunter Model/Address #		Green 170803GN	Orange 170803OG	Black 170803BK	Yellow 170803YL	White 170803WT	Purple 170803PR
ICD-100	1			•			
ICD-200	2			•	•		
ICD-400	4	•		•	•	•	
ICD-600	6	•	•	•	•	•	•

Rain Bird Model/Address #		Red 170803RD	Brown 170803BN	Gray 170803GY	Orange 170803OG	Black 170803BK	White 170803WT
FD-101 FD-102	1						•
FD-202	2		•				•
FD-401	4	•	•		•	•	
FD-601	6	•	•	•	•	•	•

John Deere Model/Address #		Blue 170803BL	Orange 170803OG	Yellow 170803YL	Purple 170803PR
AD-111	1			•	
AD-122	2		•	•	
AD-132	3		•	•	•
AD-142	4	•	•	•	•

Signature Model/Address #		Blue 170803BL	Orange 170803OG	Yellow 170803YL	Purple 170803PR
CD-111	1			•	
CD-122	2		•	•	
CD-132	3		•	•	•
CD-142	4	•	•	•	•

Cable Splices:

In order for the wire connections to comply with the 2005 edition of National Electrical Code® Articles 300.5 (Underground Installations) and 110.14 (Electrical Connections), in wet or damp locations, the connector must be listed under specification "UL 486D" if installed in a valve box. It must be listed under specification "UL 486D-Direct Burial" if buried in dirt. This requirement applies to all electrical connections in wet or damp locations, regardless of voltage. The 3M DBY-6 and DBR-6 are listed as "UL 486D-Direct Burial" and meet these requirements for all underground installations. These products comply with the electrical code requirements for the USA (UL), Canada (CSA), Mexico, and the European Community (CE.) They may also comply with the requirements of other countries around the world.

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