PILOT® INTEGRATED HUB

System Design Guide

Hunter®

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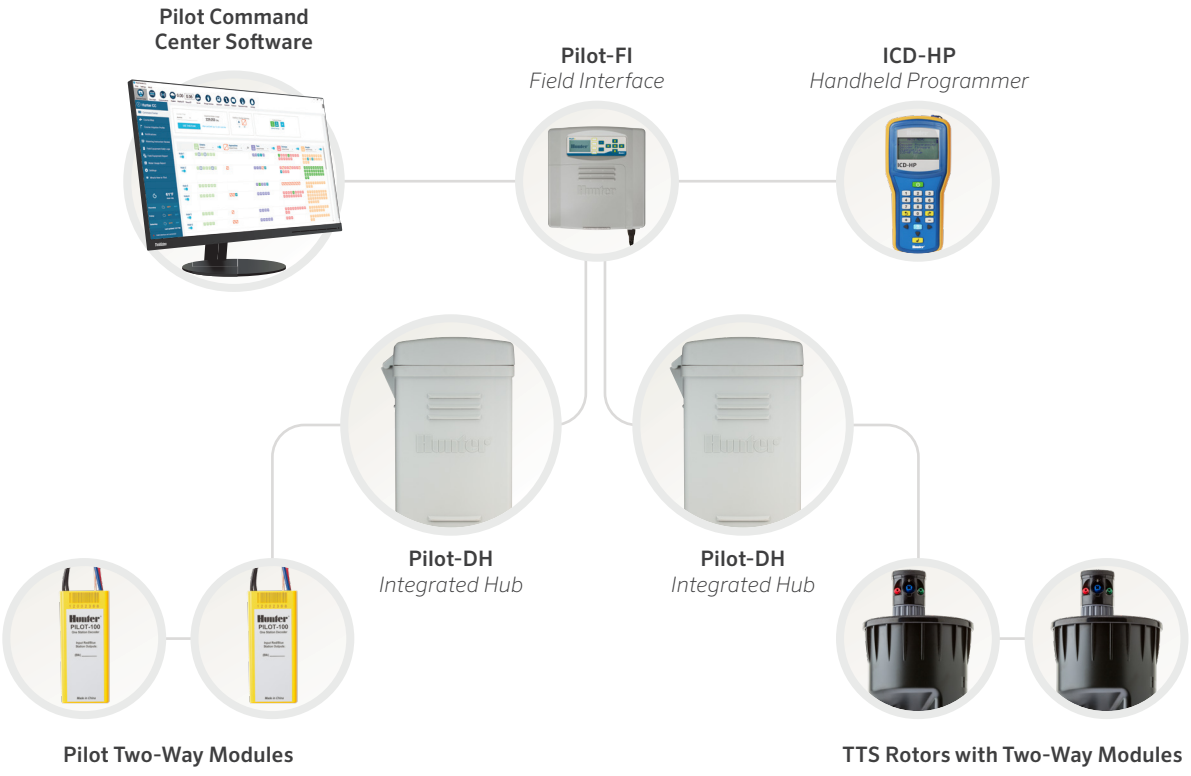
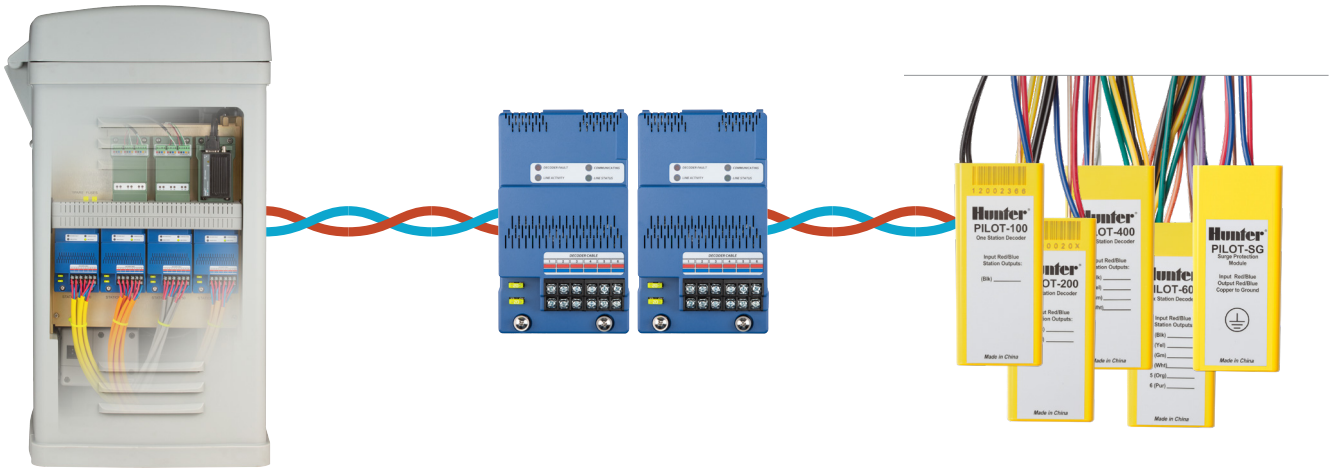
Schematic of Pilot Integrated Hub System Layout
A Pilot Integrated Hub system consists of the following elements:

- Irrigation computer with Pilot Command Center Software typically located in the maintenance office.
- Pilot-FI Field Interface placed as close as possible to the irrigation computer and connected to it by USB. The Field Interface links the central control computer to the field equipment.
- One or more Pilot-DH Integrated Hubs.
- Some mixture of 1-, 2-, 4-, and 6-station two-way modules with one output for every solenoid in the system.
- At least one ICD-HP Handheld Programmer is recommended for each Integrated Hub system.



In this design guide, a conventional or conventionally wired system is one that has a separate wire terminal for each station output. Valve wires attached to these terminals run from the controller to each valve or sprinkler solenoid.

In a two-wire system, two-conductor cables start at the Integrated Hub and run throughout the course. The cable supplies power and communication to two-way modules spliced along its length. The two-way module outputs connect to the valve or sprinkler solenoid wires.



Pilot-DH Integrated Hub

Housed in a plastic pedestal enclosure, a Pilot-DH Integrated Hub is an advanced piece of field equipment capable of operating up to 999 stations. Output modules plug into the Pilot-DH Integrated Hub. Each output module is capable of running 250 stations with 30 simultaneously active stations.

Pilot-DH Output Module

Each Pilot-DH Output Module has a 250-station capacity. They are connected using two-wire cable, which is then run throughout the golf course. The Integrated Hub holds up to four modules for a total of 999 stations.

Pilot Two-Way Modules

Pilot Two-Way Modules are bright yellow plastic devices with color-coded wires and electronics used to activate sprinkler solenoids. Each is completely filled with black epoxy, making the device waterproof.

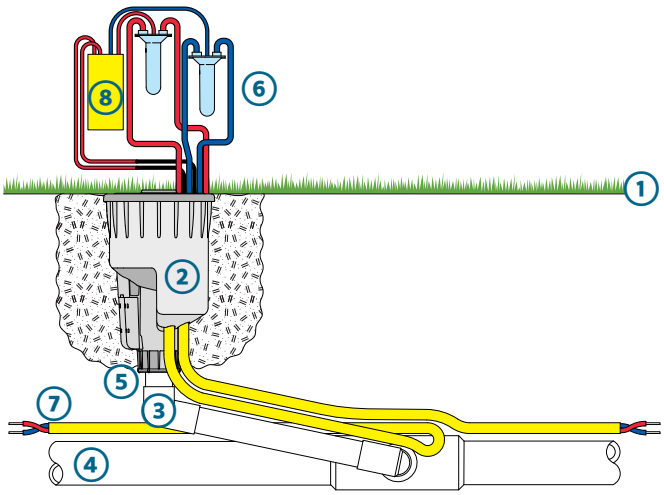
Two-Way Module Design

Two-way module (TWM) designs make the most efficient use of hardware in golf irrigation systems. Integrated Hub Systems house the TWM within the rotor compartment, combining the benefits of Hunter Total-Top-Serviceability (TTS) Golf Rotors with the power and flexibility of TWM Technology. This configuration eliminates valve boxes on the fairways and wire splices between the two-way modules and the rotor. Hunter rotors are available in 1- or 2-station TWM configurations, prewired to the rotor solenoid and ready to install.

Hunter TWM Rotors may also be wirelessly programmed and inspected through the TTS flange compartment lid using the ICD-HP Handheld Programmer, without removing a single screw.

TTS Rotor with Two-Way Module

This configuration eliminates valve boxes on the fairways and all wire splices between the two-way modules and the rotor.



INSTALLED ROTOR WITH TWM
❶ Finish grade
❷ GT-885-D full- and part-circle rotor as specified
❸ 1½" (38 mm) HSJ or as specified
❹ Sub main pipe
❺ 1½" (38 mm) male Acme
❻ Wire splice 3M DBRY-6 on two-wire path
❼ Two-wire path
❽ Two-way module/solenoid assembly inside TTS compartment

BENEFITS OF AN *Integrated Hub System*

Cost Savings

One of the most important benefits of an Integrated Hub system is that it saves wire. With a Pilot Integrated Hub system, each output module over a single two-conductor cable can manage up to 250 stations. One Integrated Hub can manage up to 999 stations over four two-conductor cables. Managing this many stations using a conventionally wired system is much more difficult, requiring 999 individual valve wires plus several valve common wires.

Cable needed for a conventional system

Cable needed for a two-wire system

Vibratory plows cut slots in the soil rather than digging a trench to minimize turf damage

System Flexibility

As long as the two-wire path is reasonably accessible throughout the golf course, stations can be added later quite easily. Simply splice a new two-wire path leg onto the existing cable, then splice additional two-way modules into the path wherever they're needed.

Two-conductor wire runs are typically T-spliced to follow pipe trenches and minimize wasted wire. Because Pilot Integrated Hubs are housed in weatherproof plastic pedestals, they can be placed strategically. This reduces the amount of two-conductor cable versus systems that require all cable to be routed back to the maintenance office.

The 999-station, pedestal-mounted hub architecture of Pilot Integrated Hub systems offers the perfect compromise between central computer-only systems and multiple field controllers. For most golf courses, one hub is sufficient. In drier climates, a golf course may need multiple hubs. You can have as few as one and as many as 999 Integrated Hubs on your golf course, depending on your need for infield control.

Pilot-DH Integrated Hubs include full-featured facepacks for convenient, in-field control anytime. They also offer standalone watering during the construction phase of a project.

For greater flexibility, you can add a PILOT-MOD-UHF Radio Communications Module. With Hunter's unique Straight Talk™ technology, you can use the TRNR Maintenance Radio as a remote control before the central control is even set up.

Electrical Capacity

Pilot Integrated Hubs can run 30 solenoids at a time on each 250-station output module. That means a fully loaded 999-station Integrated Hub can run up to 120 solenoids at one time.

With 14 AWG (2.1 mm^2) Hunter ID1 Wire, a Pilot Integrated Hub can activate solenoids up to 8,000' (2,438 m) away. With 12 AWG (3.3 mm^2) Hunter ID2 Wire, they can operate stations up to 14,000' (4,267 m) away.

Pilot Integrated Hub Systems have sufficient terminals to connect six wire paths to each 250-station output module. Therefore, a controller using ID1 cable can have up to six 8,000' (2,438 m) legs for each of four Pilot-DH-250 Output Modules. If preferred, all 250 stations can be connected to a single two-wire cable.

Note: *AC power supply wires for the Pilot-DH Integrated Hub must be 14 AWG (1.5 mm^2) or larger.*

Pilot-DH Integrated Hub electrical specifications:

PILOT-DH INTEGRATED HUB POWER	
Supply input voltage	120/230 VAC at 50/60 Hz
Input current for 120 VAC	5.5 A maximum (fully loaded and running maximum simultaneous stations)
Input current for 230 VAC	2.75 A maximum (fully loaded and running maximum simultaneous stations)

PILOT-DH INTEGRATED HUB OUTPUT VOLTAGE	
Pilot-DH-250 communication output module voltage	40 V
Maximum allowable voltage drop on two-wire path	20 V

PILOT TWO-WAY MODULES	
Standby current (solenoid off)	1.2 mA
Active current (solenoid on)	45 mA for Hunter solenoid with power factor set to two (default)

WIRE SPECIFICATIONS

Using high-quality, two-wire cable and installing it properly are key factors in successful two-way module installations. Substituting wire and wire splices is a major cause of startup service problems and is done at the installer's own risk.

Hunter cable types for use with Pilot Integrated Hub systems:

MODEL	AWG/METRIC	CONDUCTOR	SPOOL SIZE	COLOR OPTIONS
ID1	14 AWG (2.1 mm^2)	Two insulated (one red and one blue), soft-drawn solid copper wires, twisted with a minimum lay of 4" (10 cm) enclosed in a direct-burial, high density polyethylene jacket	2,500' (760 m)	Gray, Purple, Yellow, Orange, Blue, Tan
ID2	12 AWG (3.3 mm^2)	Two insulated (one red and one blue), soft-drawn solid copper wires, twisted with a minimum lay of 4" (10 cm) enclosed in a direct-burial, high density polyethylene jacket	2,500' (760 m)	Gray, Purple, Yellow, Orange, Blue, Tan

Hunter requires twisted wire meeting the above specification on all paths. The twist in the wire is an essential part of the surge suppression scheme. Because lightning damage is not covered by warranty, it's in the installer's best interest to follow Hunter's guidance, which is based on nearly two decades of system installations.

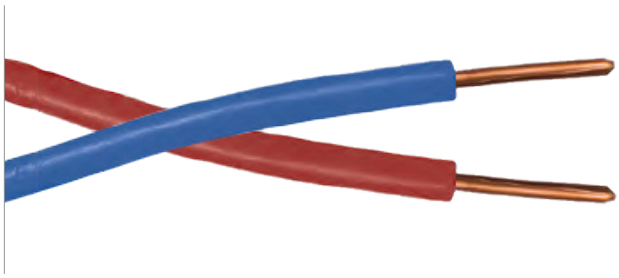
The twisted pairs are not shielded or armored. Voltage on the two-wire path is under 40 VAC, so unless local regulations require it, conduit is not necessary. Shielding, steel armor, and conduit will not inhibit performance and can be used if desired.

Each two-wire run from a 250-station output module is called a path.

A fully loaded Integrated Hub can have a minimum of four (one for each of four modules) to 24 (six for each of four modules) paths. For each output module, up to 250 two-way modules can be installed in any combination of one to six cable paths.

Cable paths should never be connected from one output module to another. For example, a cable extending from output module 1 should not be connected to output module 2, 3, or 4.

Each path runs from its output module to the last two-way module in the path and simply stops there.



Hunter ID two-wire cable

Reusing Existing Cable

Using wire left in the ground from a previous system is never a good idea and may void your warranty. Buried cable ages over time. As it ages, wire insulation shrinks, resulting in ground faults. Even if the cable in the ground has not aged to the point where problems exist, the life of that cable is already reduced. Replacing older systems because they don't work is quite common. A big part of the problem is the poor condition of the cable caused by multiple repairs and aging. From a more practical standpoint, the existing cable is unlikely to meet the specifications for gauge, twist, and solid copper. Often the conductor insulation is not color-coded red/blue, which can lead to confusion during the installation process. In short, experience has shown that trying to reuse existing wire usually takes longer because it will likely need repairs so it works with the new system. It also tends to cost more in the long run.

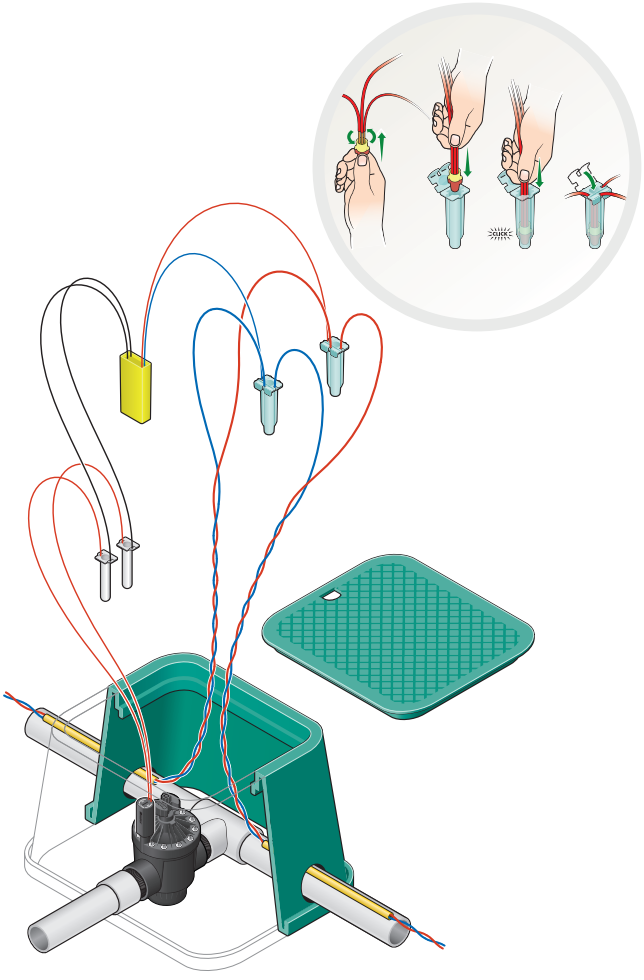
3M DBR/Y-6 direct-bury splice

Wire Connectors

All wire joints in the red/blue two-wire path must be made with 3M™ DBRY-6 or equally waterproof connectors. DBRY-6 connectors are rated for 600 V and should not be confused with DBR/DBY connectors, which are rated for 30 V.

Whenever a splice is made, it's important to leave adequate slack in the wires. Leave 5' (1.5 m) of slack to allow for convenient service or inspection, and to prevent contraction of the wire from damaging the connections. Wire slack may be coiled neatly or tucked out of the way.

Two-way module-to-solenoid connections may be made with standard DBY waterproof connectors. These connectors are rated for 30 V. As with the red/blue two-wire path, leave 5' (1.5 m) of slack to allow for convenient service or inspection, and to prevent contraction of the wire from damaging the connections.



Typical wiring connections in a valve box

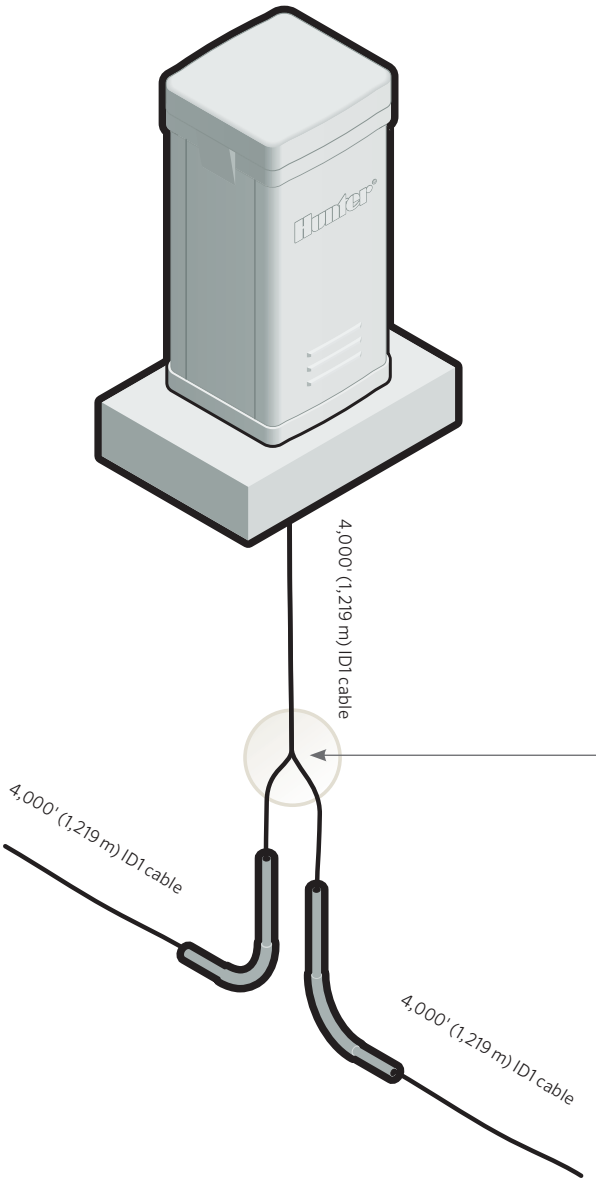
T-Splicing Two-Conductor Wire

It's possible to T-splice the cable paths in the Pilot Integrated Hub System. T-splices consist of making a three-way connection in the red and blue wires. All T-splices must be made in valve boxes with high-quality, waterproof splices such as 3M DBRY-6. They are large enough to hold three 14 AWG (2.1 mm^2) conductors (for ID1 wire) or three 12 AWG (3.3 mm^2) conductors (for ID2 wire).

It's especially important to allow adequate slack in a three-way splice. You should be able to withdraw each splice from the valve box for above-ground inspection and service.

Where possible, run the cable in the same trench as the irrigation pipe. The pipe will provide some protection to the wire and logically leads to the valves where two-way modules will be positioned.

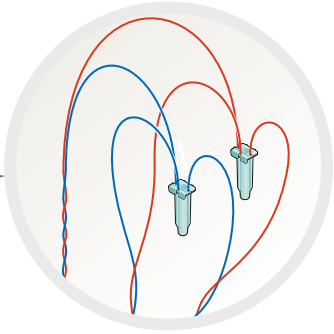
If ID1 wire is used and the total distance from the controller to the end of each arm of the T-splice is less than 8,000' (2,438 m), the system meets specification. This is true even if the total amount of wire is more than 8,000' (2,438 m).



For example, let's say you run 14 AWG (2.1 mm^2) ID1 wire and place a T-splice 4,000' (1,219 m) from the controller. If you run two arms in different directions from the T-splice, each run being an additional 4,000' (1,219 m), the wire is within specifications. That's because it's only 8,000' (2,438 m) to the end of each arm of the T from the controller, even though there is 12,000' (3,658 m) total wire connected to the output.

It's possible to have more than one splice in a wire run, provided all the above conditions are met.

In very large systems, the length of the wire run and the number of two-way modules installed along its length may reduce the number of stations that can be run simultaneously near the end of the wire path. This will not damage the equipment, but may require adjusting station timing to prevent underpowering the solenoid outputs.



Lightning

While no irrigation system is immune to lightning, Integrated Hub Systems offer an advantage because they have less wire in the ground. When properly installed, they have excellent grounding and surge suppression. As a result, they're popular in regions with high lightning exposure.

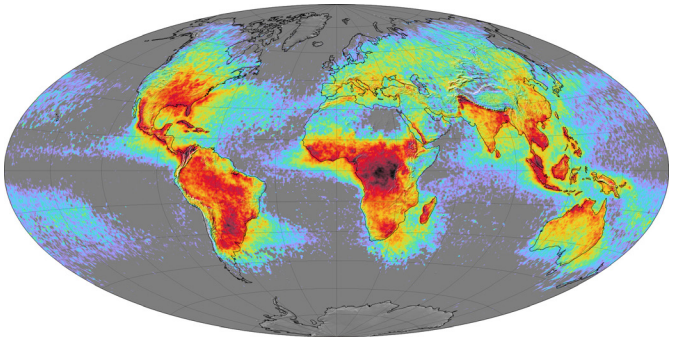


Photo courtesy of NASA MSFC lightning imaging sensor (LIS) science team

Earth Grounding

Earth grounding of Integrated Hub Systems requires planning and careful installation. Properly grounded Integrated Hub Systems perform very well in high-lightning regions. Poor grounding will result in unnecessary equipment losses and irrigation downtime.

Pilot Integrated Hub Systems required ground grids:

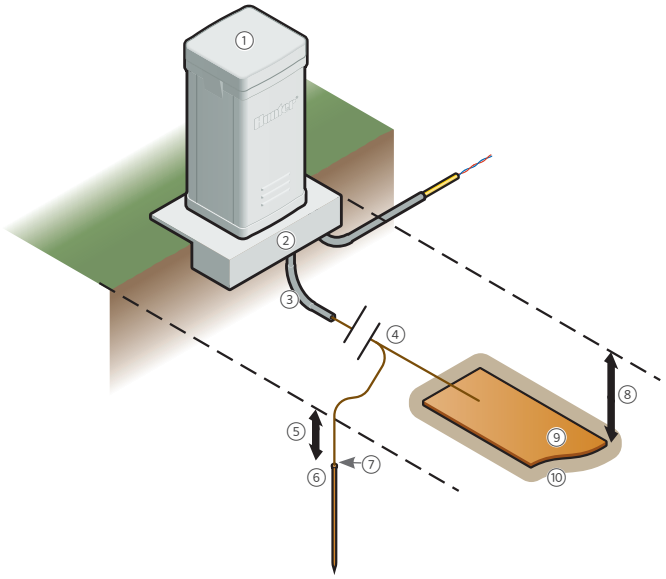
LOCATIONS	CONNECTIONS	RESISTANCE TO GROUND	PLACEMENT
Central Control	**Copper ground lug inside Pilot-FI Field Interface**	< 10 Ω (using megger)	**1 at central control**
Integrated Hubs	**Copper ground lug inside Pilot-DH plastic pedestal**	< 10 Ω (using megger)	**1 at each hub**

Earth grounding for Pilot Integrated Hub systems should follow specifications published by the American Society of Irrigation Consultants (ASIC) and published as a design guide called Earth Grounding Electronic Equipment in Irrigation Systems. The design guide can be found online at: www.asic.org/Design_Guides.aspx.

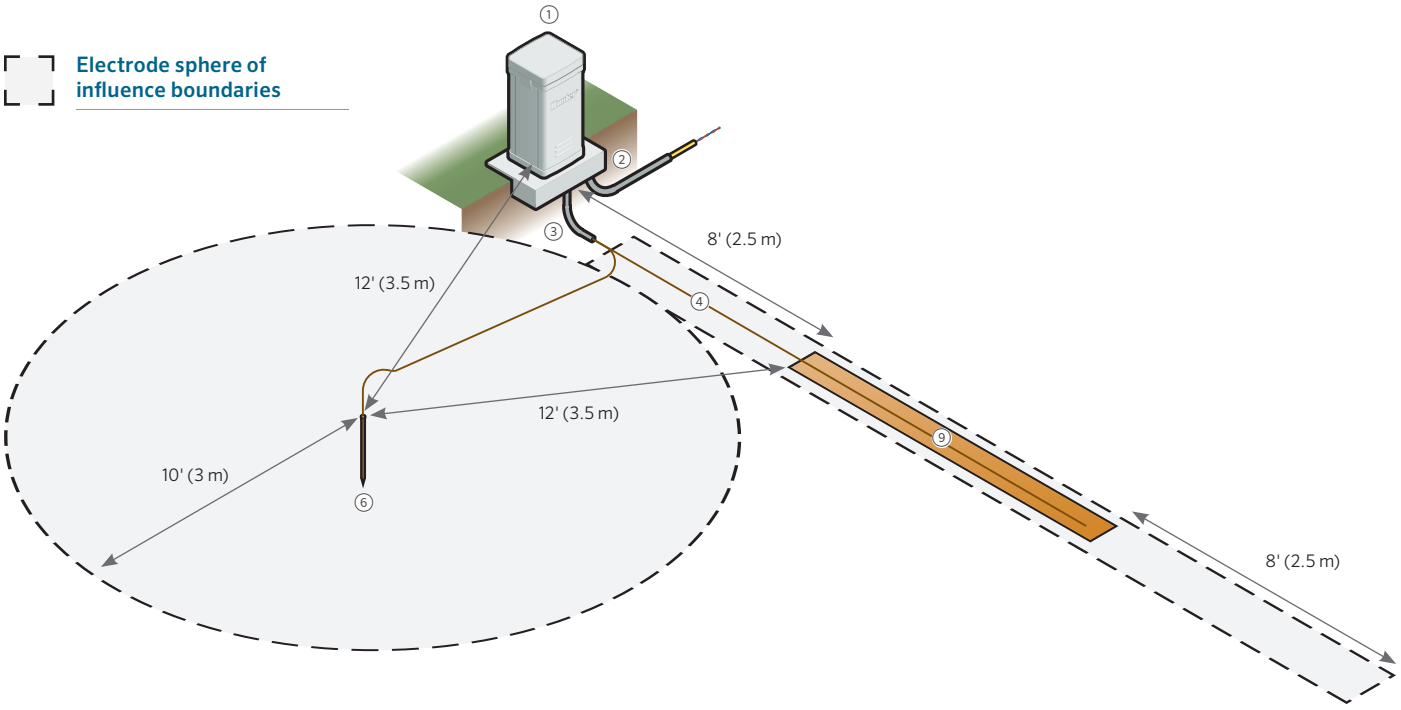
Pilot-FI and Pilot-DH Grounding Grid Design

Typical ASIC grounding grid design for Field Interface and Integrated Hub

A large copper ground lug or clamp is provided for connection of bare copper wire to earth grounding hardware. During installation, lay the grounding wire perpendicular to the two-wire path. This ensures the ground grid dissipates excess energy into the earth and not onto the Integrated Hub system's two-wire path where it could damage other system components.



PILOT INTEGRATED HUB GROUNDING DESIGN GRID	
1	Pilot Integrated Hub
2	Concrete pad
3	1½" (3.5 cm) or larger PVC sweep ell
4	8 AWG (6 mm²) solid bare copper wires
5	12" (30 cm) installation depth
6	10" (16 mm) ground rod
7	Cadwell connection
8	30" (75 cm) installation depth
9	4" x 96" x 0.0625" (10 cm x 2.5 m x 1.5 mm) grounding plate
10	Earth contact material



Note: *Do not install any other wires or cable within the sphere of influence.*

Earth Ground Placement

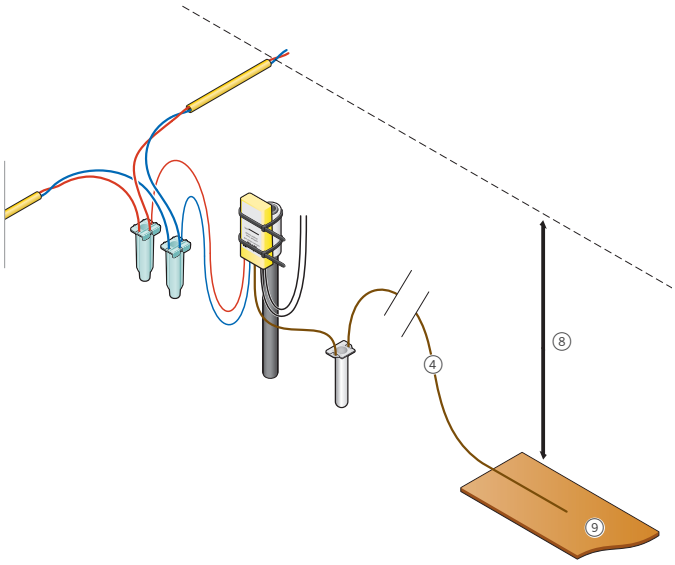
Pilot Two-Way Modules that feature integrated surge suppression are equipped with a bare copper wire for connection to earth ground hardware. Pilot Integrated Hub Systems require external surge suppression by adding Pilot-SG Suppressors at specified intervals. These are also equipped with a bare copper wire for connection to earth ground hardware.

Connect the bare copper wire for the integrated ground at every 12th two-way module or every 1,000' (300 m) of wire run, whichever is shorter. The two-way module station size (1, 2, 4 or 6) is not taken into account. Just like 1-station two-way modules, 6-station two-way modules count as one of the 12 two-way modules.

The final two-way module in any wire run should be grounded. This includes the final two-way module in each of the different arms of a T-spliced junction.

Ground wires on two-way modules between those that have been connected are not used. It's not necessary to remove the unused ground wire or bury it; simply fold it out of the way. This allows future additional grounding or use of the two-way module in another location.

Note: *Two-way module grounding hardware should always be placed at right angles to the run of the two-wire path.*



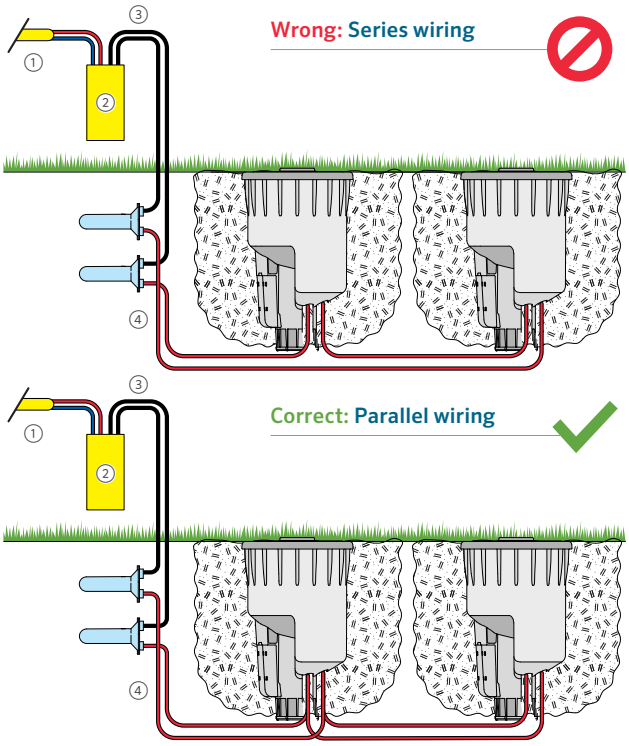
Typical grounding plate installation for Pilot Two-Way Module integrated surge protection. Installation using Pilot-SG Inline Surge Protectors is similar.

LOCATIONS	CONNECTIONS	RESISTANCE TO GROUND	PLACEMENT
Two-way module integrated surge connection	**Bare copper wire from integrated surge suppressor on each two-way module**	< 10 Ω (using megger)	**Every 12th two-way module or 1,000' (300 m), whichever is shorter and at the end of each wire run**
Surge arrestors when using DIH rotors	**Requires addition of Pilot-SG Surge Arrestors**	< 10 Ω (using megger)	**Every 12th two-way module or 1,000' (300 m), whichever is shorter and at the end of each wire run**

Two-Way Module to Solenoid Wiring

From the two-way module outputs to the individual solenoids, use standard irrigation wire sized for the length of the run. Wiring from the two-way module to the solenoid should not exceed 240' (73 m). For installations using electric inline valves, the two-way module is often in the same valve box as the solenoid it controls. In these cases, you can use standard 18 AWG (1.0 mm^2) wire.

Each station output on a two-way module can power up to two standard Hunter golf solenoids. When doubling solenoids on a two-way module output, the solenoids must be wired in parallel rather than in series. The two-way module station output leads should run to the two leads from the first solenoid, then connect (usually in a three-way splice) to the leads from the second solenoid.



PILOT INTEGRATED HUB GROUNDING DESIGN GRID

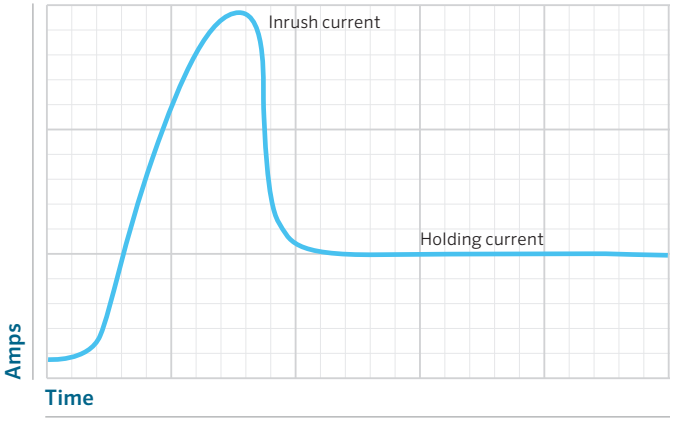
1. Two-wire communication cable
2. Pilot Two-Way Module
3. Station wiring
4. Rotor solenoid wire

Power Factor and Inrush

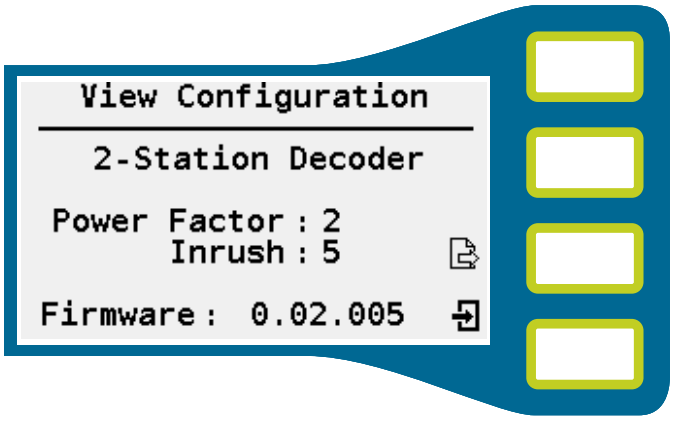
The color-coded station outputs of individual two-way modules are designed to operate standard Hunter golf irrigation solenoids. **Solenoid inrush current** is the initial increase in power required to energize the solenoid and overcome water pressure to open the diaphragm valve. **Solenoid holding current** is the power required by the solenoid to keep the valve open once it has been opened by the inrush current.

For Pilot Two-Way Modules, the **power factor** is factory preset to two. The inrush setting for Pilot two-way modules is five. This is the correct setting for most applications. Some high-draw solenoids and pump start relays may require higher inrush settings.

Warning: *Factory preset power factor and inrush settings should only be changed in consultation with Hunter technical personnel.*



Inrush current energizes the solenoid to open the valve. Power is then reduced, and the valve is kept open by the holding current.



Power factor and inrush setting in Pilot-DH Integrated Hub

Pilot Integrated Hub System Hardware

When using solenoids other than Hunter, consult the manufacturer's solenoid specifications before planning a system.

In a Pilot Integrated Hub System, you never need to open splices, cut wire, or otherwise disrupt the system to make changes to the power factor or inrush settings. If it becomes necessary to customize these settings for use with non-standard solenoids, you can use both the ICD-HP Handheld Programmer and Pilot-DH Integrated Hub to make the adjustments. The ICD-HP connects to a two-way module wirelessly by placing its sensor close to the two-way module. The Pilot-DH Integrated Hub has a programming port in the facepack.

This energy is not running at 50/60 Hz. Therefore, it will not look like 24 VAC on a conventional voltmeter.

Pilot Integrated Hubs are designed to work with either 120 VAC or 230 VAC input power. The hub uses an advanced power supply, which automatically detects and adjusts for the type of incoming power. Thus, there is no switch for changing between 120 VAC and 230 VAC.

Note: Each color-coded station output on a two-way module generates the energy required to operate up to 24 VAC solenoids.

Pilot Integrated Hub System Components

Pilot Two-Way Modules are bright yellow to distinguish them from other decoder models. The color also makes them easier to find on construction sites and in the bottom of dark valve boxes. Pilot Two-Way Modules are completely waterproof. They have built-in surge suppression with a bare copper wire for connection to a ground rod or plate. TTS Rotors do not include integrated surge protection, so separate PILOT-SG inline surge protection devices are required.

Each Pilot Two-Way Module has one pair of communication wires for connecting to the two-wire path. One of the wires is red. The other is blue. Inside the Hunter ID Wire Cable there are two conductors: One is red and one is blue to make wiring the system easy with little risk of mistakes.

In addition to the red/blue communication wires, Pilot Two-Way Modules include pairs of color-coded wires. These are station output wires. The colors are used to identify the two-way modules' station outputs. Pilot-100 One-Station Two-Way Modules have a single pair of black station wires. On Pilot Two-Station Two-Way Modules,, the first output is black and the second output is yellow. A different color is used for each output.

Each station can be turned on independently of the others and each station output can activate up to two solenoids.

Theoretically, each multi-station two-way module can activate the number of stations x 2 solenoids simultaneously. For example, a six-station two-way module can operate up to (6 stations) x (2 solenoids) = 12 total solenoids. Some limitations may apply for very high-draw solenoids and pump start relays.

Pilot Two-Way Modules are CE approved and meet other relevant international standards as well.

Note: *Pilot Two-Way Modules themselves are low-voltage products and do not require a separate UL listing on their own. They are part of a UL-listed Pilot Integrated Hub System.*

MODEL	STATION COUNT
PILOT-100	1
PILOT-200	2
PILOT-400	4
PILOT-600	6
PILOT-SG	N/A

Pilot Two-Way Modules are yellow to easily distinguish them from other decoders

STATION WIRE COLORS
1 = Black
2 = Yellow
3 = Green
4 = White
5 = Orange
6 = Purple

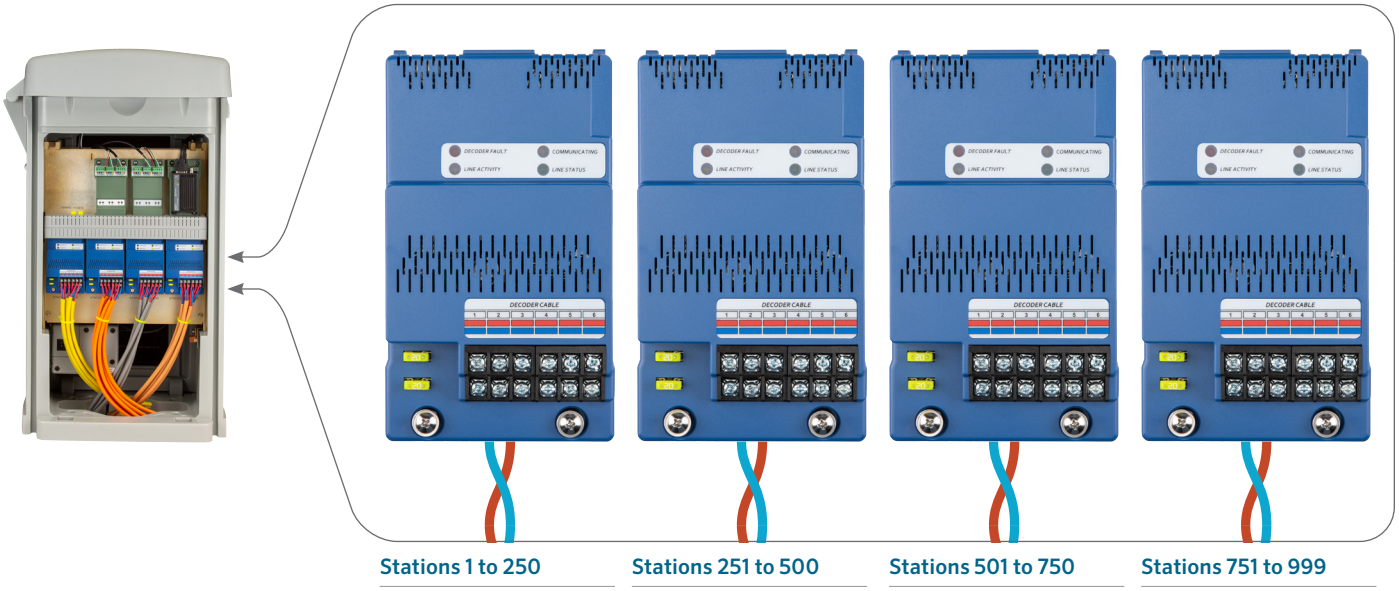
Addressing Two-Way Modules

Each Pilot Two-Way Module arrives without a station address. You must assign two-way module addresses before they can be used. Each output on a two-way module needs its own unique address. That means a Pilot-100 One-Station Two-Way Module needs one address and a Pilot-600 Six-Station Two-Way Module needs six addresses. Two-way module addresses can be any number from 1 to 999. You can use address numbers only once. Pilot-DH Integrated Hubs accept up to four 250-station output modules. Although any numbers from 1 to 999 may be used as two-way module addresses, numbering per output module must be done as shown here.

With Pilot Two-Way Modules, the address can be specified in advance so the number can be put into a record drawing. Once the two-way modules are spliced onto the wire path, the installer can take a copy of the plan and the wireless ICD-HP Handheld Programmer, then walk along the wire path programming each two-way module.

If a two-way module needs to be swapped out later, you can assign the existing station address to its replacement using the ICD-HP Handheld Programmer or Integrated Hub Facepack. Immediately test the new module to confirm proper operation.

Pilot Two-Way Module addressing for output modules in a Pilot-DH Integrated Hub



Addressing Two-Way Modules Using the Pilot-DH Integrated Hub

Use the Pilot-DH Integrated Hub to address any Pilot Two-Way Module. Every two-way module, regardless of the station count, will have one red and one blue wire. These are the communication wires which will later be spliced onto the two-wire cable. Insert the red and blue wires from the two-way module into the programming port on the facepack of the Pilot Integrated Hub. It doesn't matter which color (red/blue) goes in which hole of the programming port. During the addressing process, place the two-way module into the recessed holder on the right side of the pedestal.

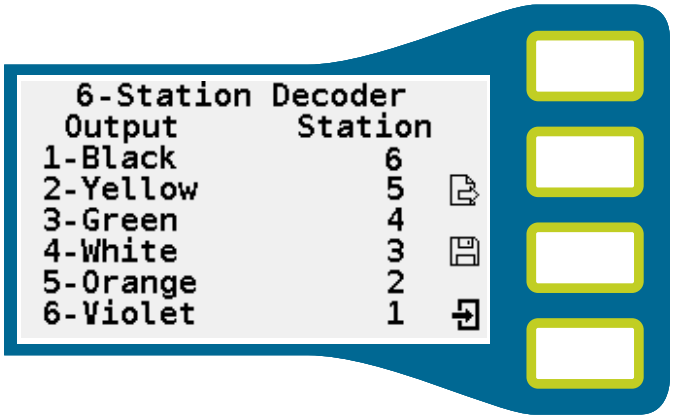
After inserting the wires in the programming port, press the **SETTINGS** button on the Pilot Integrated Hub Facepack. Choose **TESTING** from the menu shown on the display, then select **PROGRAM A DECODER**. The Integrated Hub will search for a two-way module connected to the programming port. If a two-way module is found, the display will change to show all available stations on the two-way module.

Station outputs will be identified by number and also by the wire color for each output on the two-way module. Using the keypad and arrow buttons on the facepack, assign each station an address.

Once all station outputs have been addressed, press the **SAVE** button. As the Integrated Hub configures the two-way module with the desired addresses, the programming light on top of the facepack will blink.

Note: *Do not create duplicate stations. Every Pilot Two-Way Module output on the golf course needs a unique ID. The Pilot Integrated Hub and two-way modules have two-way communication between each other on the two-wire path. Each command from the hub requires reply from the two-way module. If two two-way modules have the same address, they will both try to respond. In this case, both may turn on, neither may turn on, or there will be communication errors.*

PILOT-DH Integrated Hub programming screen for a Pilot Six-Station Two-Way Module



PILOT-DH Integrated Hub programming port for Pilot Two-Way Modules

Addressing Two-Way Modules Using the ICD-HP Handheld Programmer

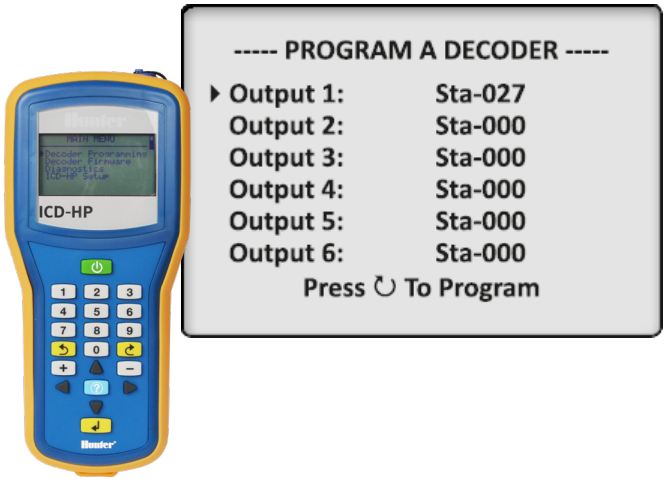
The Hunter ICD-HP Handheld Programmer is a powerful device that should be included with any Pilot Integrated Hub System. It can be used to wirelessly link to a two-way module even if it's inside the compartment of a TTS Rotor. It's used to troubleshoot Integrated Hub Systems, update two-way module addresses, inrush and power factor settings; perform functional tests on the two-way modules, and update two-way module firmware.

To set a two-way module's address using the ICD-HP, turn the unit on. Connect to a two-way module and select the **DECODER PROGRAMMING MENU**. Select **PROGRAM DECODER,** then press **NEXT.** The display will show all available station outputs. Use the arrow keys to select the desired output, then use the number keys to set the address for the selected output.

Note: *Do not create duplicate stations. Every two-way module output on the golf course needs a unique ID. The Pilot Integrated Hub and two-way modules have two-way communication between each other on the two-wire path. Each command from the hub requires reply from the two-way module. If two two-way modules have the same address, they will both try to respond. In this case, both may turn on, neither may turn on, or there will be communication errors.*

Use the ICD-HP handheld programmer to wirelessly program a Hunter TTS golf rotor.

ICD-HP programming screen for a six-station two-way module



Note: *To use the ICD-HP Handheld Programmer wirelessly, the Pilot Two-Way Modules must be connected to the wire path and powered on. The ICD-HP can be used with two-way modules that are not powered.*

Visit our website for additional support.

https://hunter.help/**icdhp**

Wireless Remote Control

The TRNR Maintenance Radio is a narrowband UHF radio operating in the 450 to 470 MHz frequency range. It can wirelessly control Pilot Integrated Hubs with or without a central control system in place. This option requires installation of a PILOT-MOD-UHF Radio Module. The operator may then use a Hunter model TRNR portable radio or a similarly programmed UHF radio with DTMF keypad to control up to 999 stations.

Using Hunter StraightTalk™ Technology, the TRNR talks directly to the controller for total wireless remote control up to 2 miles (3.2 km) away from each controller.

TRNR Maintenance Radio and PILOT-MOD-UHF Radio Module

Integrated Hub System Installation Specification

General

Cable layout and design is relatively simple. The general rule is to run the two-wire paths in the pipe trenches so that they pass near each solenoid location. In special circumstances, or if cable sizes need to be trimmed down to a minimum, use the charts in this document.

Cable

It's important to always use solid core, color-coded, twisted-pair cable. The twist of the core protects the system from most types of noise and small surges. This is the same technology that's been used by telephone and data companies for many years. Cable size selection depends on run distance and the number of standby and active two-way modules on the path.

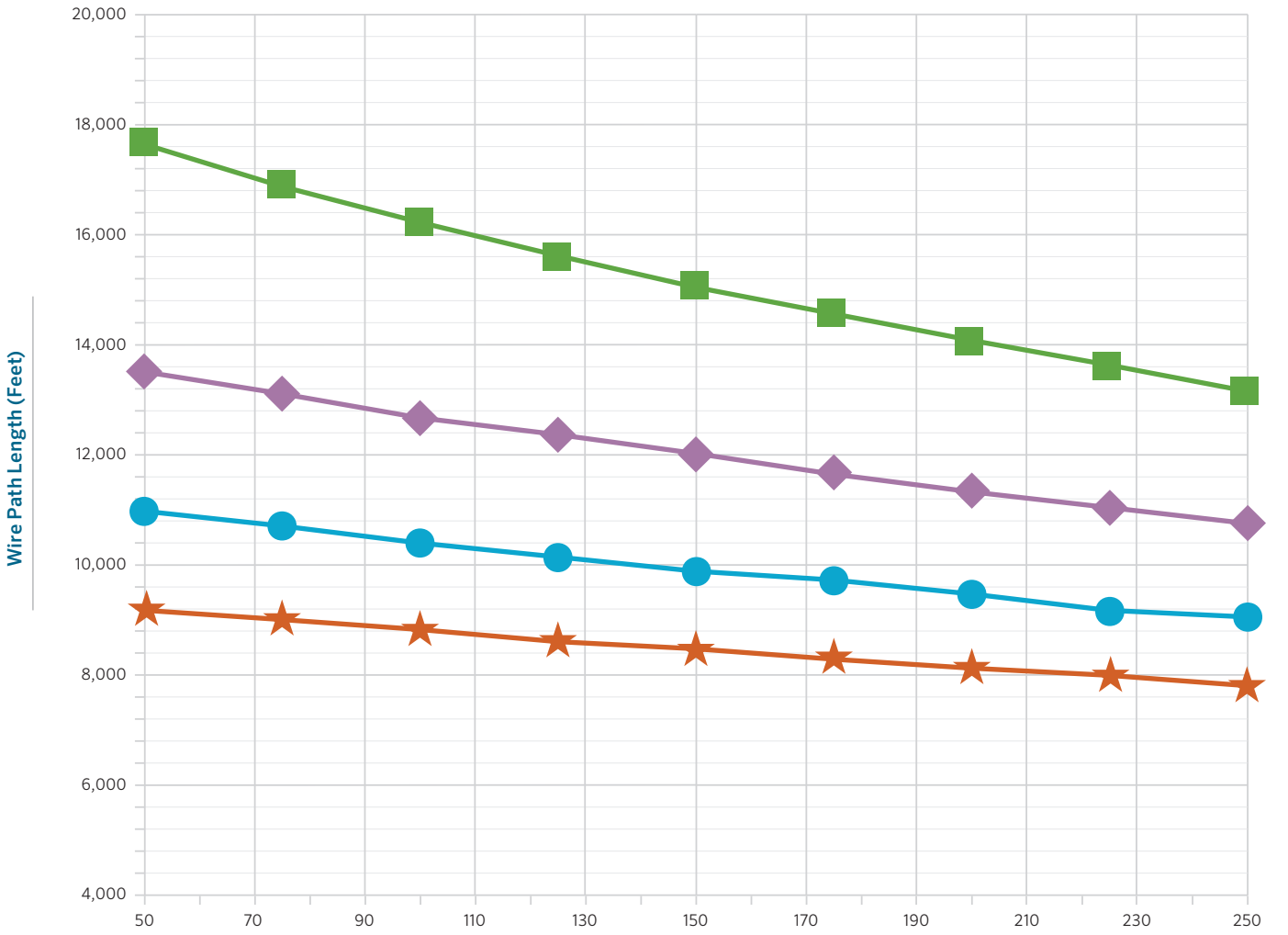
As a general rule, 14 AWG (2.1 mm^2) ID1 wire is recommended for wire path lengths up to 8,000' (2,438 m) and 12 AWG (3.3 mm^2) ID2 wire for wire path lengths up to 14,000' (4,267 m).

Use these maximum wire path lengths when activating 30 standard Hunter golf solenoids with 250 Pilot One-Station Two-Way Modules per output module. If the output module must activate more than 30 solenoids at a time, shorten the maximum wire length. If the maximum wire length needs to be longer, run fewer stations simultaneously. See the charts at the end of this manual for guidelines regarding wire lengths and simultaneous stations.

Avoid running power cables and two-wire cable in parallel, especially if they're in close proximity. If a high-voltage cable must be crossed, it's best to cross at right angles.

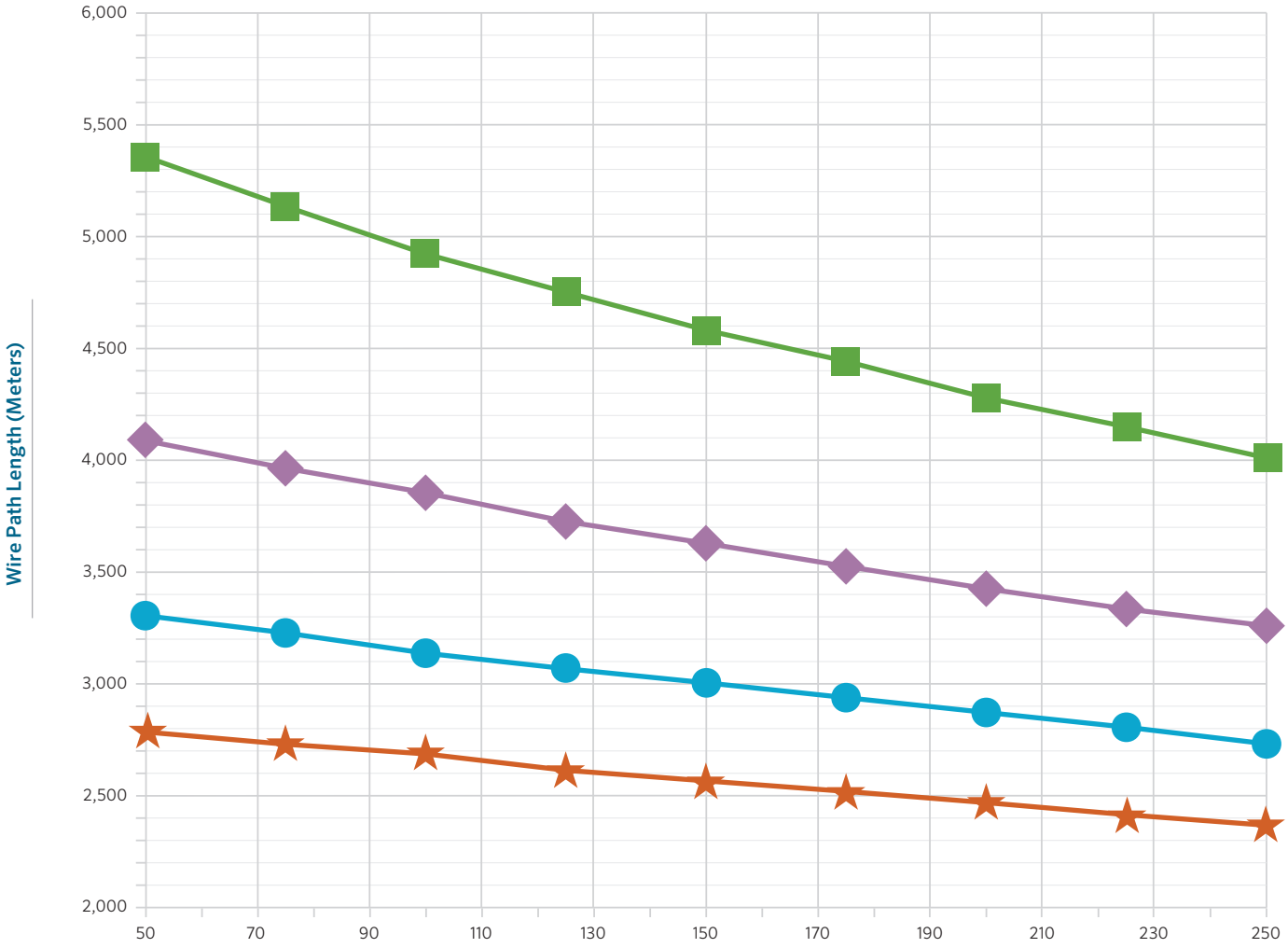
Note: *The total system cable length is unimportant. It's the length from the controller output module to the farthest two-way module on each path that's critical.*

Active Stations Based on Wire Length and Number of Two-Way Modules Using ID2 (12 AWG) Wire



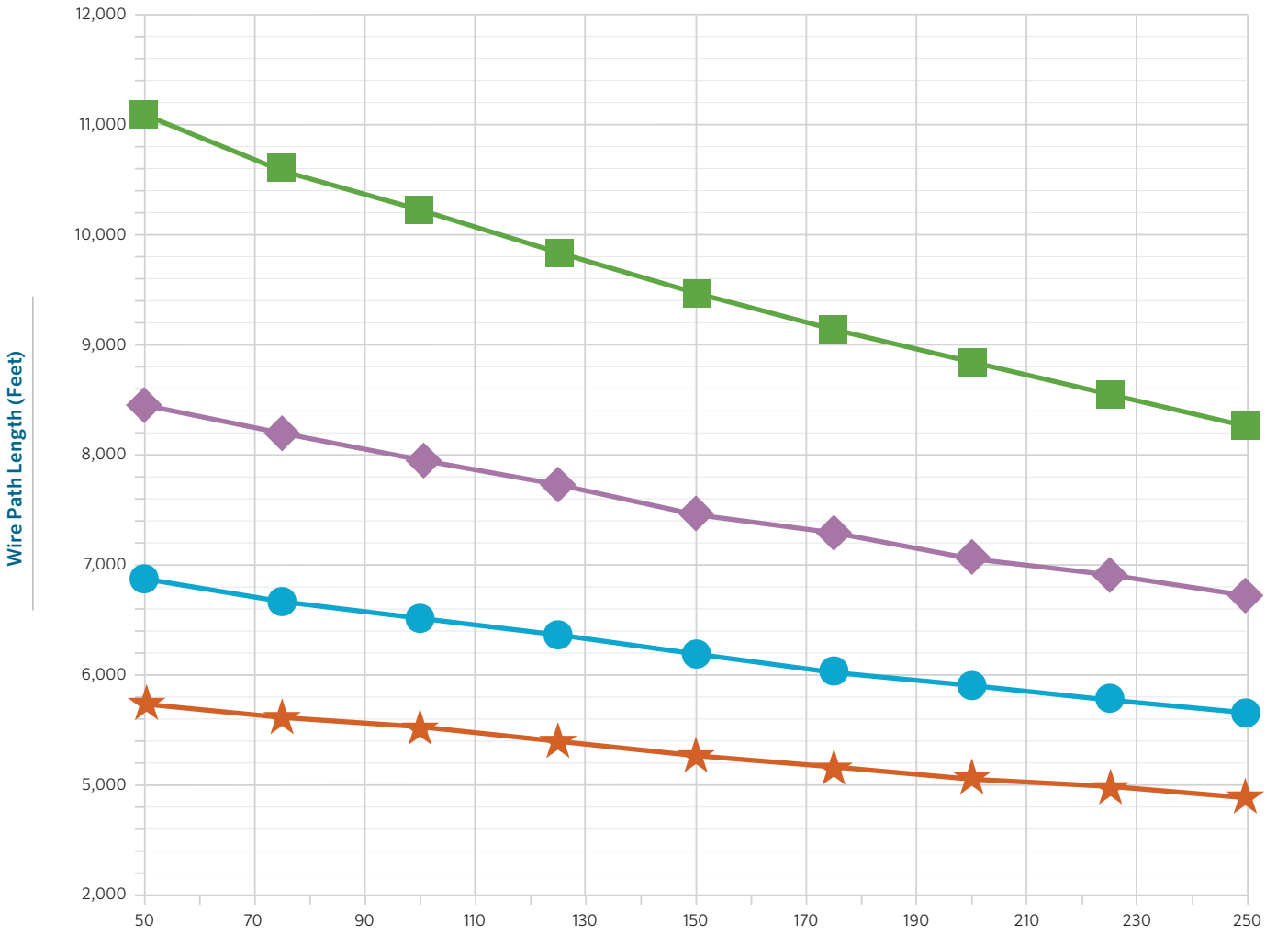
ACTIVE STATIONS	
■	15
◆	20
●	25
★	30

Active Stations Based on Wire Length and Number of Two-Way Modules Using ID2 (3.3 mm^2) Wire

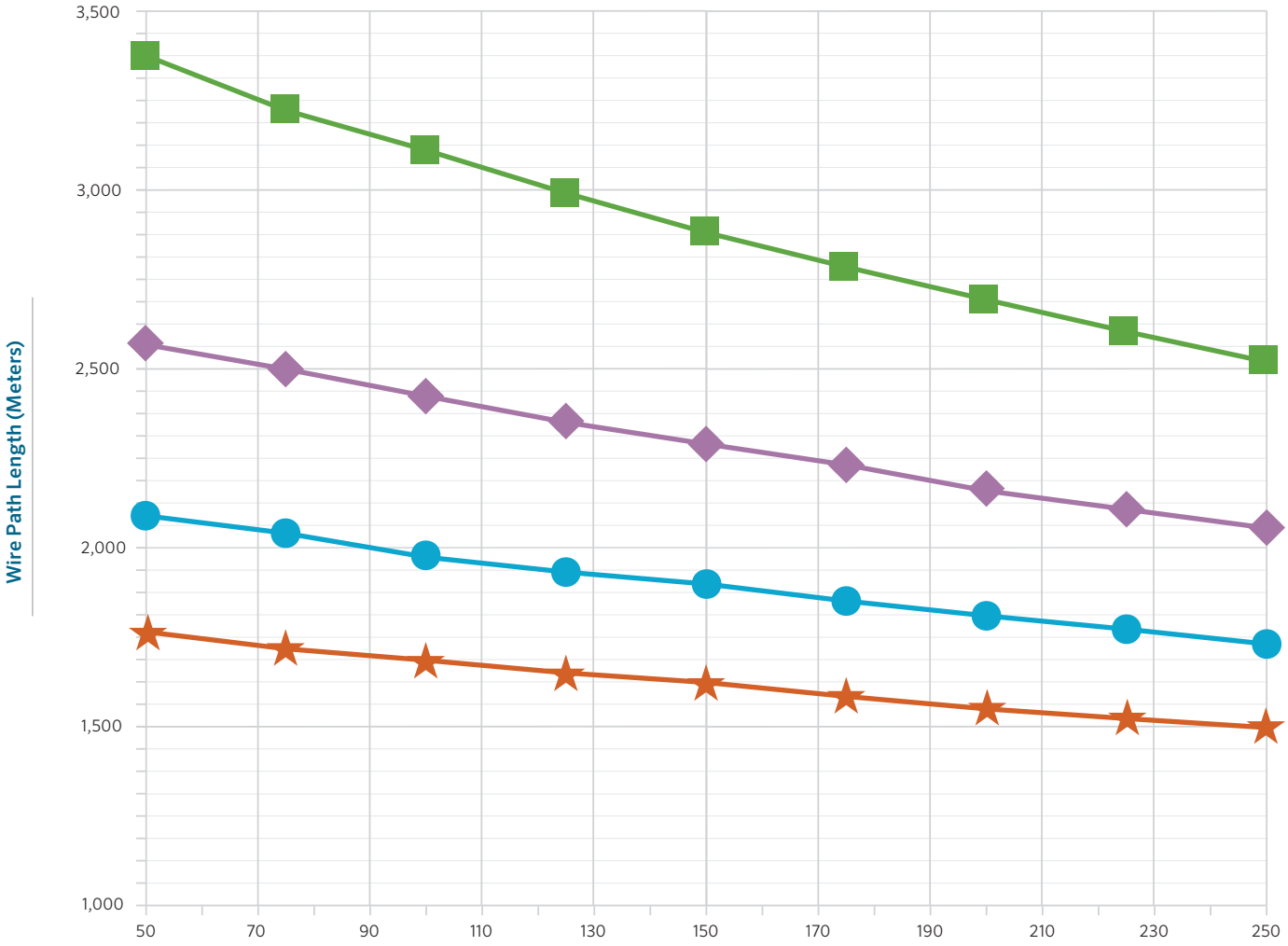


ACTIVE STATIONS	
■	15
◆	20
●	25
★	30

Active Stations Based on Wire Length and Number of Two-Way Modules Using ID1 (14 AWG) Wire



Active Stations Based on Wire Length and Number of Two-Way Modules Using ID1 (2.2 mm^2) Wire



ACTIVE STATIONS	
■	15
◆	20
●	25
★	30

Conversion Chart for American Wire Gauge (AWG) to Metric System

CONVERSION CHART FOR AMERICAN WIRE GAUGE TO METRIC SYSTEM

SIZE (AWG)	METRIC (mm^2)	CIRCULAR (Mils)	EQUIVALENT CIRCULAR (Mils)	APPROXIMATE WIRE DIAMETER (Inches)	(mm)
–	0.50	–	937	0.032	0.81
20	–	1,020	–	0.036	0.91
–	0.75	–	1,480	0.039	0.99
18	–	1,620	–	0.046	1.16
–	1.00	–	1,974	0.051	1.30
16	–	2,580	–	0.051	1.29
–	1.50	–	2,960	0.063	1.60
14	–	4,110	–	0.073	1.84
–	2.50	–	4,934	0.081	2.06
12	–	6,530	–	0.092	2.32
–	4.00	–	7,894	0.102	2.59
10	–	10,380	–	0.116	2.93
–	6.00	–	11,840	0.126	3.21
8	–	16,510	–	0.146	3.70
–	10.00	–	19,740	0.162	4.12
6	–	26,240	–	0.184	4.66
–	16.00	–	31,580	0.204	5.18
4	–	41,740	–	0.232	5.88
–	25.00	–	49,340	0.260	6.60
2	–	66,360	–	0.292	7.42
–	35.00	–	69,070	0.305	7.75
1	–	83,690	–	0.332	9.43
–	50.00	–	98,680	0.365	9.27

Conversion Chart for American Wire Gauge (AWG) to Metric System

CONVERSION CHART FOR AMERICAN WIRE GAUGE TO METRIC SYSTEM					
SIZE (AWG)	METRIC (mm^2)	CIRCULAR (Mils)	EQUIVALENT CIRCULAR (Mils)	APPROXIMATE WIRE DIAMETER (Inches)	(mm)
1/0	–	106	–	0.373	9.46
2/0	–	133	–	0.419	10.60
–	70	–	138.1	0.430	10.90
3/0	–	168	–	0.471	12.00
–	95	–	187.5	0.504	12.80
4/0	–	212	–	0.528	13.40
–	120	–	237.8	0.567	14.40
–	–	250	–	0.575	14.60
–	150	300	–	0.630	16.00
–	–	6,530	–	0.092	2.32
–	185	–	365.1	0.700	17.80
–	–	400	–	0.728	18.50
–	240	–	473.6	0.801	20.30
–	–	500	–	0.814	20.70
–	300	–	592.1	0.700	17.80
–	–	600	–	0.089	22.10
–	–	700	–	0.964	24.50
–	–	750	–	0.999	25.40
–	400	–	789.4	1.026	26.10
–	–	800	–	1.032	26.20
–	500	–	986.8	1.152	29.30
–	–	1,000	–	1.153	29.30
–	625	–	1,233.7	1.287	32.70

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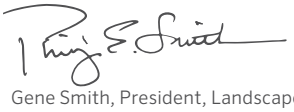

Gene Smith, President, Landscape Irrigation and Outdoor Lighting

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