

Hunter®

PILOT® SYSTEM DESIGN GUIDE

GOLF COURSE IRRIGATION
Built on Innovation®



PILOT® GOLF CONTROL SYSTEM PUTS YOU IN TOTAL COMMAND.

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Pilot® refers to the entire Hunter Golf irrigation control system product line.

Field Interface

Indoor wall mount that links the PilotCC computer to the field, via long range communications options.



Field Controller

Conventionally-wired field controller, up to 80 station capacity, that stores and operates irrigation.



Decoder Controller

Two-wire decoder hub, up to 999 station capacity, for control of Pilot decoders or decoder-in-head rotors.



CENTRAL CONTROL

Pilot CC (Central Control) consists of both the computer and software that operates the system.

The software will arrive pre-loaded on the dedicated compact computer. The operating system comes with the latest Windows® operating system and all necessary supporting

utilities and drivers are also pre-loaded. An internet connection is required for Hunter to provide remote technical support.

A clean, climate-controlled indoor environment is required for reliable operation of the central computer.

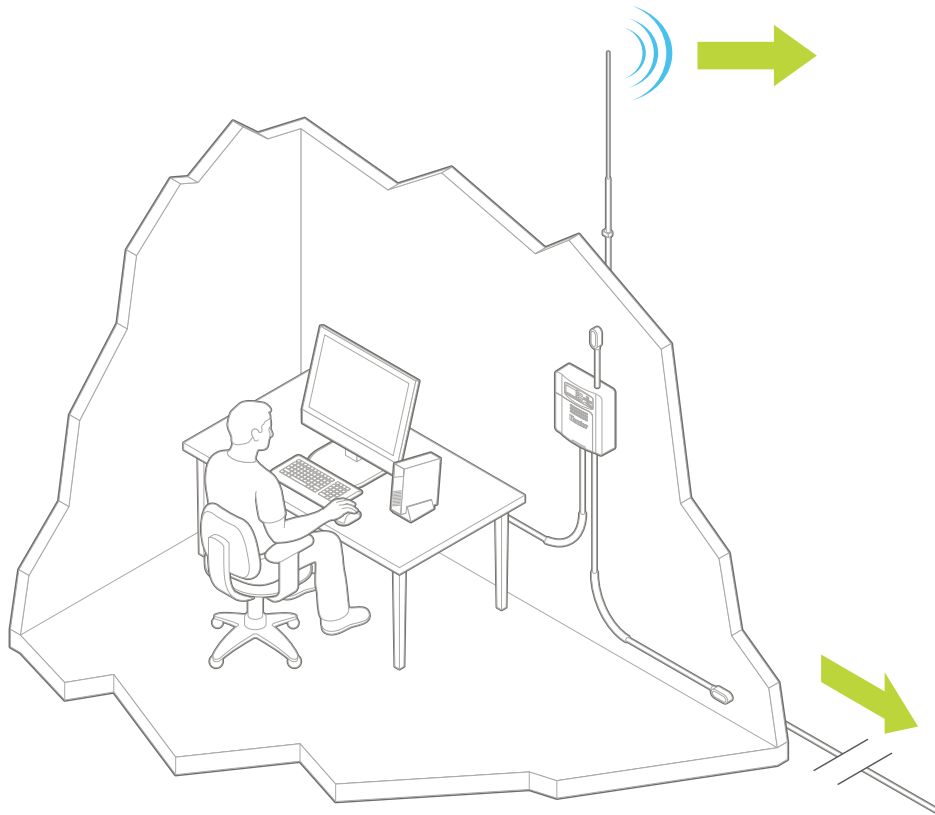


FIELD INTERFACE (FI)

The computer is connected to a wall-mounted indoor Field Interface, or FI, via USB connection. The purpose of the FI is to take the local output from the computer, and communicate over longer distances to the controllers or hubs that are connected to the irrigation valves.

The Field Interface is supplied with 8 ft/2.5 m of USB cable. It is designed to operate within this distance of the central computer.

The FI has a screen and user interface of its own. These are only used for setup and diagnostics, and have no irrigation control functions.




An FI is always required to connect the computer to the field controllers or hub(s). Most systems use only one FI, near the computer.

The FI may be loaded with up to two different types of communications in order to reach the controllers or hubs:

- Hardwire cable
- Narrowband (UHF) Radio
- Spread Spectrum Wireless communications

Pilot Field Interfaces are available as complete, pre-tested units. See the following chart for configurations:

PILOT-FI SPECIFICATION BUILDER

MODEL	STANDARD FEATURES	OPTIONS
 <p>Pilot-FI</p>	Plastic wall mount indoor enclosure	HWR Hardwire communications UHF UHF radio communications - US only LF License-free radio communications ILF License-free radio communications <i>(add up to two communication modules to any FI)</i>
		EXAMPLES PILOT-FI-HWR Field interface with hardwire communications PILOT-FI-UHF Field interface with UHF radio communications - US only PILOT-FI-ILF Field interface with international license-free radio communications

*One Pilot-FI is required with any central control system to link the central computer to the field equipment

CONTROLLERS AND HUBS

The controllers and hubs may be located virtually anywhere within the project. They are also equipped with the communication modules required to interact with the FI (and the software).

Hunter offers a Decoder-In-Head option on its Totally Top Serviceable (TTS) Golf rotors, which is highly recommended (see Decoder Design Guide).

Pilot supports the two primary types of irrigation control wiring to the valves:

Both types of control systems can use the full range of central communication options listed in the Communication Options section.

- Conventional solenoid wiring, with an individual wire running to each valve
- Two-Wire Decoder control, with one or more pairs of wires running through the project and a waterproof decoder spliced in wherever valve control is needed.

Line Voltage

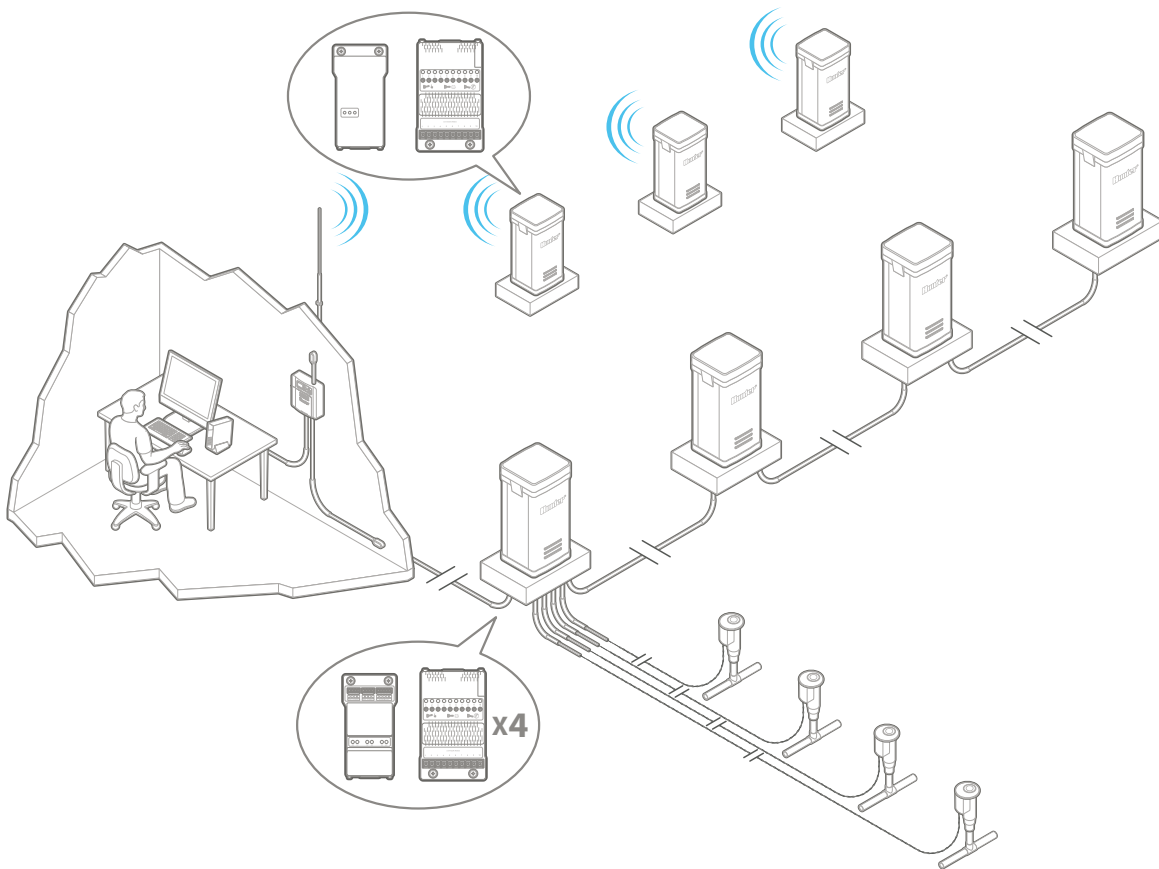
All Pilot FI interfaces, FC controllers, and DH hubs are capable of operating in 120VAC or 230VAC electrical systems, either 50 or 60 Hz. The voltage input is switch-selectable for local power conditions.

CONVENTIONAL SYSTEMS (FC)


The Pilot conventional wire solution is a Field Controller, or FC. The FC is a weatherproof outdoor plastic pedestal, which contains the power, communications, and output modules to operate the desired number of valves, or valve-in-head rotors, via individual wires.

Pilot FC controllers are ordered as complete pre-tested factory packages, with all communications and station output modules installed. The modular communications and outputs may also be replaced or expanded after initial installation. See the following chart for configurations.

Pilot FC controllers are available in increments of 10 stations, up to 80 stations max per controller.



PILOT-FC SPECIFICATION BUILDER

MODEL	STANDARD FEATURES	OPTIONS	
	Pilot-FC30 (30-station) Pilot-FC40 (40-station) Pilot-FC50 (50-station) Pilot-FC60 (60-station) Pilot-FC70 (70-station) Pilot-FC80 (80-station)	Plastic pedestal (gray) 120/230 VAC 50/60 Hz dual-voltage transformer (add -TAN for tan colored pedestal)	
		S Standalone field controller with no central communications HWR Hardwire communications UHF UHF radio communications - US only LF License-free radio communications ILF License-free radio communications	
	EXAMPLES		
	PILOT-FC40-S	40-station, standalone field controller, no central communications	
	PILOT-FC70-HWR	70-station field controller with hardwire communications	
	PILOT-FC80-ILF	80-station field controller with international license-free radio communications	

Conventionally-wired installations may have several FC controllers to operate different areas as a complete system.

Pilot FC controllers have their own user interface, or dashboard, and are fully programmable

without a central computer. They do not require a computer to irrigate. However, the central computer has the potential to schedule multiple controllers, balance irrigation for optimum flow management and energy savings, and much more.

DECODER HUBS (DH)

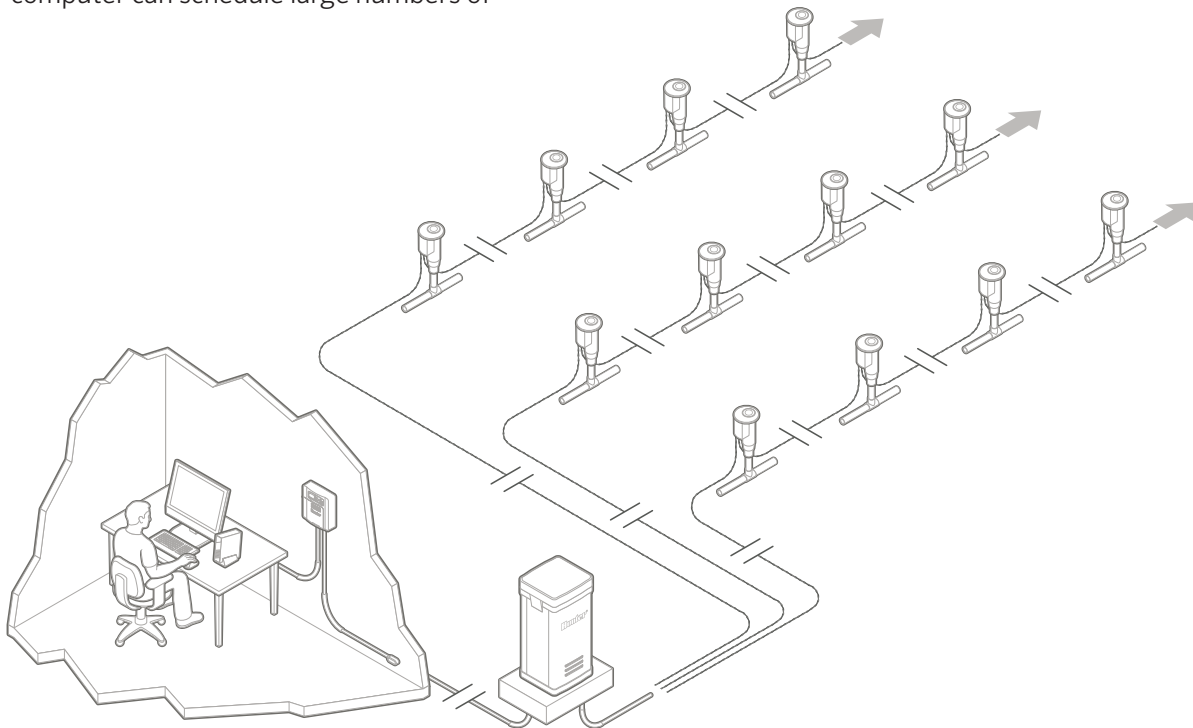
The Pilot two-wire decoder solution uses outdoor decoder “hubs” known as Pilot DH. The hub is a plastic pedestal, similar in appearance to the FC. A decoder hub can operate up to 999 two-wire Pilot decoders. Decoder systems generally have fewer hubs (often just one) than the number of FCs on conventional installations, but multiple

hubs can be installed to operate virtually any number of decoder stations.

The DH is also supplied as a complete unit, with communications and the desired number of output modules installed and pre-tested by the factory.


Pilot DH hubs have their own user interface, or dashboard. They are fully programmable without a central computer. They do not require a computer to irrigate. However, the central computer can schedule large numbers of

decoders, balance irrigation for optimum flow management and energy savings, and much more. It is possible to start with a standalone hub, and add the computerized central later.



Pilot DH is available in increments of 250 stations up to 999, max per hub. See the following chart for possible configurations.

PILOT-DH SPECIFICATION BUILDER

MODEL	STANDARD FEATURES	OPTIONS
 Pilot-DH250 (250-station) Pilot-DH500 (500-station) Pilot-DH750 (750-station) Pilot-DH999 (999-station)	Plastic pedestal (gray) <i>(add -TAN for tan colored pedestal)</i>	S Standalone field controller with no central communications HWR Hardwire communications UHF UHF radio communications - US only LF License-free radio communications ILF License-free radio communications
		EXAMPLES
		PILOT-FI-HWR Field interface with hardwire communications PILOT-FI-UHF Field interface with UHF radio communications - US only PILOT-FI-ILF Field interface with international license-free radio communications

COMMUNICATION OPTIONS

There are 3 main types of communication options for connecting the central computer and Field Interface to controllers around the project.

- Hardwired communications offer reliable, secure communications with in-ground cable.
- Wireless communications offer trenchless connections, and greatly reduced exposure to lightning.
- Spread spectrum wireless also offers trenchless connections, with less range than UHF radio, but with enhanced repeater capabilities. They are often available without a formal government license.

Wireless communications require a site survey in advance, to determine antenna selection and placement. Not all terrain is suitable for wireless connection.

TYPE	DISTANCE	MODULE	REQUIREMENTS
Hardwire Cable	10,000 feet/3 km between each device	PILOT- HWR	GCBL communications cable
Narrowband Radio	2 miles/3.5 km	PILOT-MOD-UHF	UHF Antenna, Government license
Spread Spectrum	.5 miles/800 m Line of Sight!	PILOT-MOD-LF (900 MHz) PILOT-MOD-ILF (2.4 GHz)	License Free in North America License Free in many countries

Hardwire Communications

“Hardwire” means that physical wiring links each controller to the Field Interface. A system may be wired from the FI to the first controller, from there to the next controller, and so on to connect all controllers.

Legs: A single run of hardwire cable to the field is referred to as a “leg” of communications.

More than 1 leg is possible. Legs can be split (at communication modules only) to go in multiple directions.

Hunter supplies GCBL cable for these connections. GCBL conveys 20 milliamp loop communications from the FI to the controllers. Each controller is connected to the next by a single run of cable. The cable does not need to be looped back to the FI. The wiring just stops at the last controller in any particular run of cable.

Hardwire Communication Module

Any device (FI, DH hub, or FC controller) that will communicate via hardwire cable requires a PILOT-HWR hardwire communication module.

At least 1 PILOT-HWR must be installed in the FI, to connect to hubs or controllers via GCBL. At least 1 PILOT-HWR must be installed in each additional device that will be part of the communications link.

Each PILOT-HWR has an input for hardwire from a preceding device. Each PILOT-HWR can support up to 2 outputs to the field, to continue on to other devices. There is no practical limit to the number of controllers that can be connected in a leg of communication.

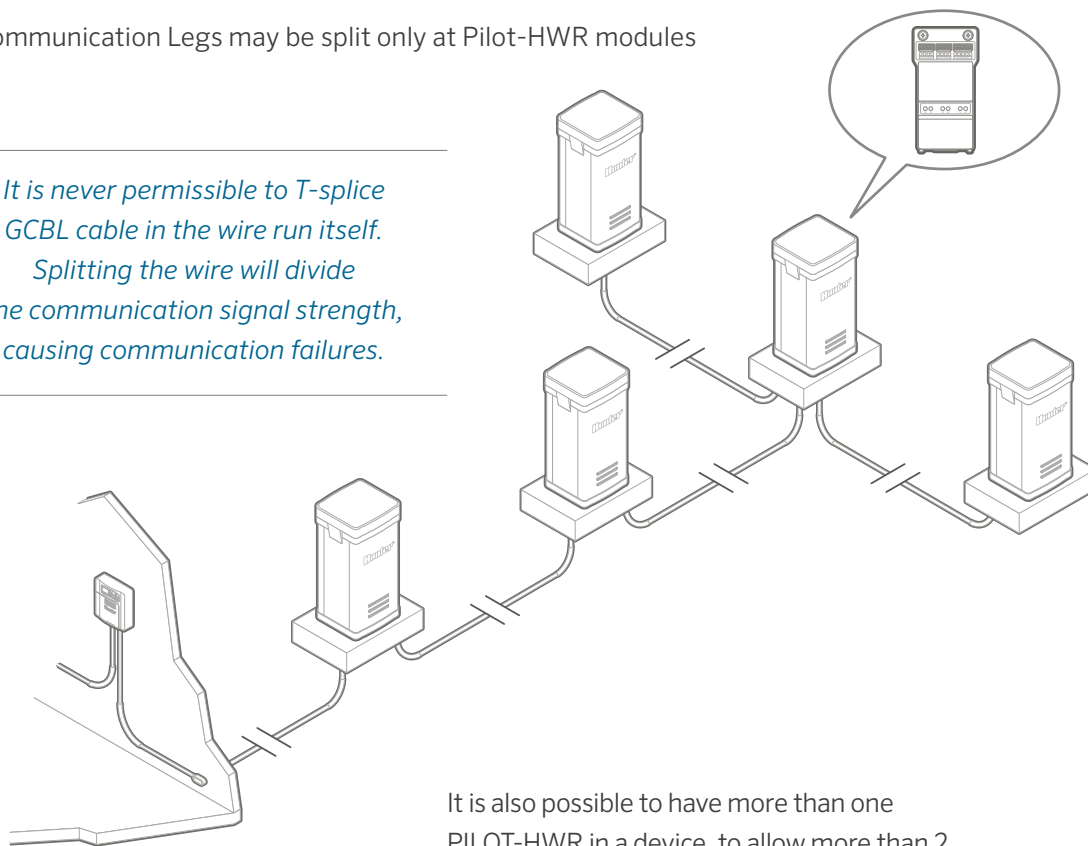
It is permissible to split a leg of communications into 2 different directions at the PILOT-HWR itself, by using the 2 different outputs to go in different directions.



Silver drain wire connection

Communication Legs may be split only at Pilot-HWR modules

It is never permissible to T-splice GCBL cable in the wire run itself. Splitting the wire will divide the communication signal strength, causing communication failures.

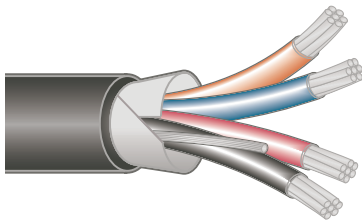


It is also possible to have more than one PILOT-HWR in a device, to allow more than 2 output paths. A controller with two PILOT-HWR modules could accept one input, and split the signal into 4 separate outputs, at any given controller.

GCBL Hardwire Cable Specifications

- Outer Jacket: Direct burial, black polyethylene sunlight and water resistant
- 4 Conductors: 2 twisted pairs, 18 AWG/.823 mm² stranded wire with PVC insulation
- Color-coded, Pair 1 red/black, Pair 2 blue/orange
- Drain Wire: 1 bare 20 AWG/.518 mm² tinned copper wire for connection to earth ground (one end only)
- Shield: .00235”/.05969 mm aluminum/mylar tape, helically applied

GCBL cable is priced by the foot (approx. 3 ft. = 1 m). Up to 4000’/1220 m may be loaded on a single spool.



GCBL Splices

GCBL may run up to 10,000 feet/3 km between each device.

GCBL may be end-spliced to extend a cable run:

- End splices shall be made in a valve box.
- High quality waterproof connectors shall be used to join each conductor individually, including the silver drain wire, for a total of 5 connections.
- Adequate slack and a strain relief at the splice shall be created to prevent stress on the connections from frost or soil expansion.

Never T-splice GCBL cable in the middle of the cable run. Splitting the wire into multiple legs will divide the communication signal strength, causing communication failures. This is a violation of the signal specification.

Hardwire runs may only be split at the PILOT-HWR communication module in a controller.

Earth Grounding Cable

Every run of GCBL cable shall have one end (not both) of the silver drain wire connected to the earth grounding terminal of the HWR module. The FI or controller must be thoroughly earth grounded to ground hardware, as specified in their respective installation instructions.

The silver drain wire shall be connected to the 5th terminal on the hardwire module, on the incoming side only. (see device manual for earth grounding specifications).

The purpose of earth grounding the silver wire is to make the foil shield effective in noise and surge suppression.

Only one end of each GCBL run is earth grounded, to prevent a differential between two earth ground points.

Narrowband (UHF/VHF) Radio Communications

Narrowband radios use modern wireless radios to communicate. These radios require a government license to operate in almost every country in the world. They offer great flexibility and reduced cost in system design, when and where they are practical.

Pilot radios are “narrowband”, meaning they conform to modern

12.5 kHz bandwidth regulations.

Pilot radios are available in various frequency ranges. Their effective range is approximately 2 miles/3.5 km, depending on terrain conditions. Buildings and hills may significantly reduce this coverage.



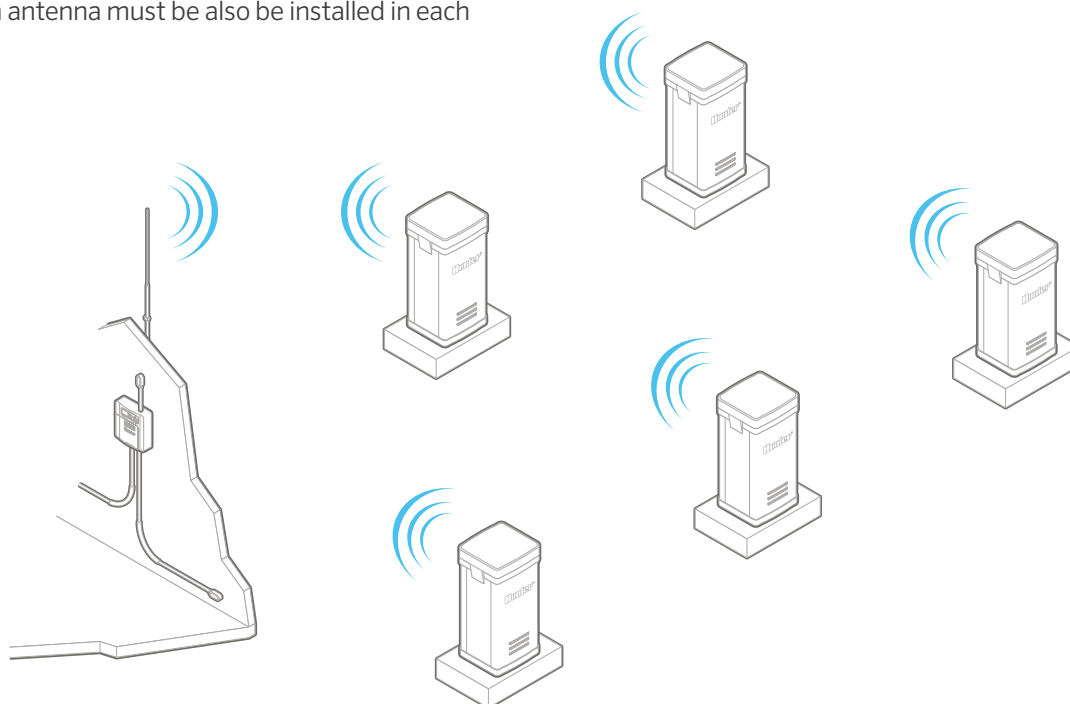
Narrowband Radio Modules

Any FI, FC, or DH which will use narrowband radio communications requires a PILOT-MOD-UHF communication module, and an appropriate antenna. See Site Surveys and Antenna Types table.

At least 1 PILOT-MOD-UHF plus antenna must be installed in the FI, to connect to hubs or controllers via radio. One PILOT-MOD-UHF and an antenna must be also be installed in each

additional FC or DH that will be part of the communications network.

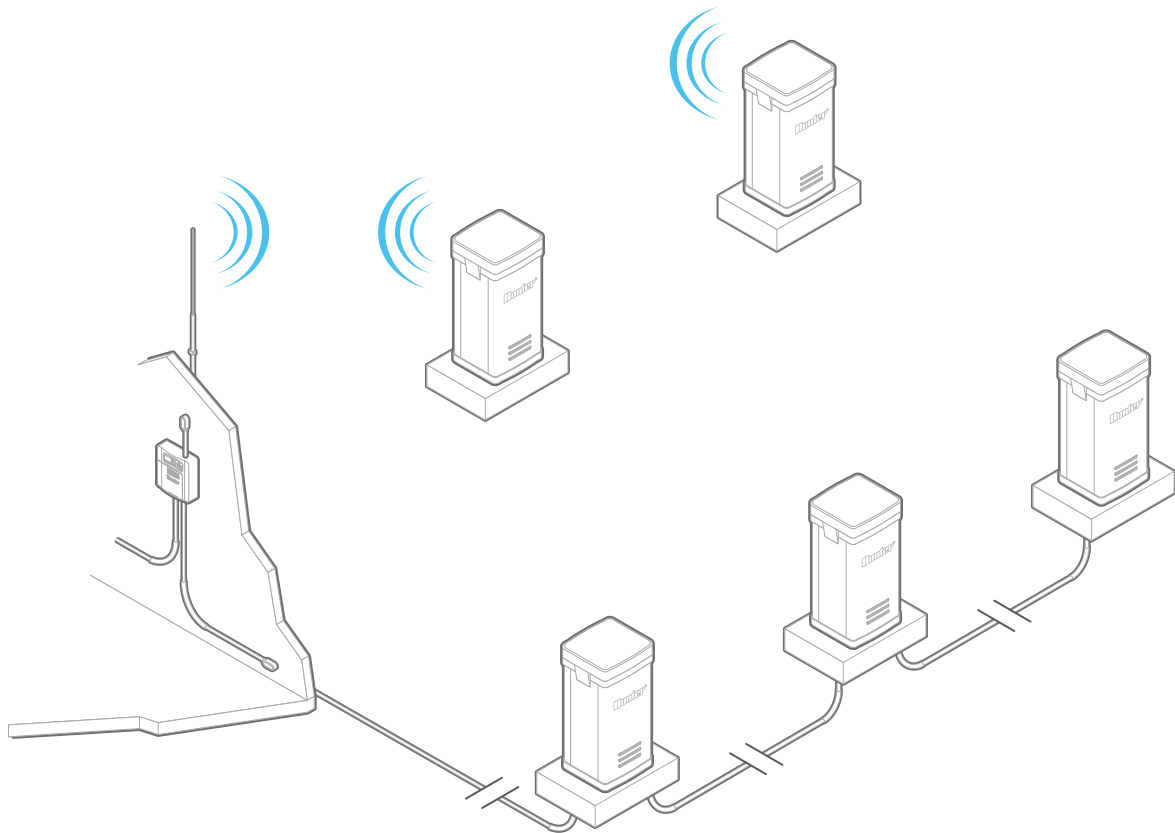
Narrowband radio systems normally broadcast from and to the FI to all controllers in the system individually. The signals are not relayed from one controller to the next. The FI talks directly to each radio controller in turn.



Hardwire and Radio Combined

Radio may be combined with hardwired communications in certain situations. The Field Interface has 2 communication slots, and it is

possible to have both hardwire (PILOT-HWR) and radio (PILOT-MOD-UHF) in the same FI, to operate different areas.



It is also possible to use hardwire up to a certain point, then add radio to jump over an obstacle such as a lake or road. This may only be done once per system.

This technique would only require PILOT-MOD-UHF modules and antennas in the controllers using the radio link. The FI would not require a radio and antenna in this configuration.

Narrowband Radio Specifications

Frequency range	450-470 MHz (primary); 400-440 MHz and 150-174 MHz available for selected markets
Bandwidth	12.5 kHz
Output Power	2 Watts, default setting (1-5 W with extended lead times)
Antenna connection	Female BNC

Site Surveys and Antenna Options

All radio installations require a site survey, in advance of actual installation. This is performed by a qualified technician on the actual site. The site survey determines which locations are suitable and which antennas are required.

Hunter offers several types of narrowband UHF antennas for golf project installations.

TYPE	MODEL	DESCRIPTION	REQUIREMENTS
FI Base Antenna	RA5M	5 ft/1.5 m fiberglass mast, omnidirectional	RG850NFNF or custom length of 50 Ohm antenna cable
Pedestal Lid Antennas	IMMS-ANT2	Stealth lid-mounted internal antenna	n/a, antenna, cable, mounting plate included in part
Specialty Long Range	RA3F, RA6F	Yagi directional antenna	RG850NFNF or custom length of 50 Ohm antenna cable

Hunter antenna options are available in the 450-470 MHz range. Equivalents in other frequency ranges (for appropriate international markets)

are available through local professional radio dealers.

It is the designer's responsibility to understand local regulations and licensing requirements for radio installations.

Spread Spectrum Wireless Options

Spread spectrum wireless options have shorter range than licensed narrowband radio. However, they do offer two significant advantages:

- **License-free operation:** Depending on national regulations, one or both frequency ranges may be available for use without licensing requirements.
 - 915 MHz (PILOT-MOD-LF) is legal in North America, and some other countries.
- **Repeater capability:** Spread spectrum radios can be configured to relay communications from one controller to another, to extend the range. If the central FI can reach controller 1, but not controller 2, it is possible to configure it so that signals for controller 2 are passed on by controller 1.

It is the installer's responsibility to know and follow local regulations regarding the legal use of wireless communications equipment.

Spread Spectrum Communication Modules

Any device (FI, DH hub, or FC controller) that will communicate via spread spectrum wireless requires a PILOT-MOD-LF (915 MHz) hardware communication module.

At least 1 PILOT-MOD-LF must be installed in the FI, to connect to hubs or controllers. At least 1 PILOT-MOD-LF must be installed in each additional device that will be part of the communications link.



Spread Spectrum Antennas and Site Surveys

Spread spectrum antennas are included with the PILOT-MOD-LF modules, and screw directly onto the gold connector at the top of the module. These antennas provide line of sight coverage to other devices, from inside the plastic enclosure.

Spread spectrum radios operate at very high frequencies, and at

controlled power output levels. Interference from foliage, buildings, and other terrain elements is more critical than with narrowband radio.

A site survey by a qualified technician is an absolute requirement for spread spectrum wireless installations.

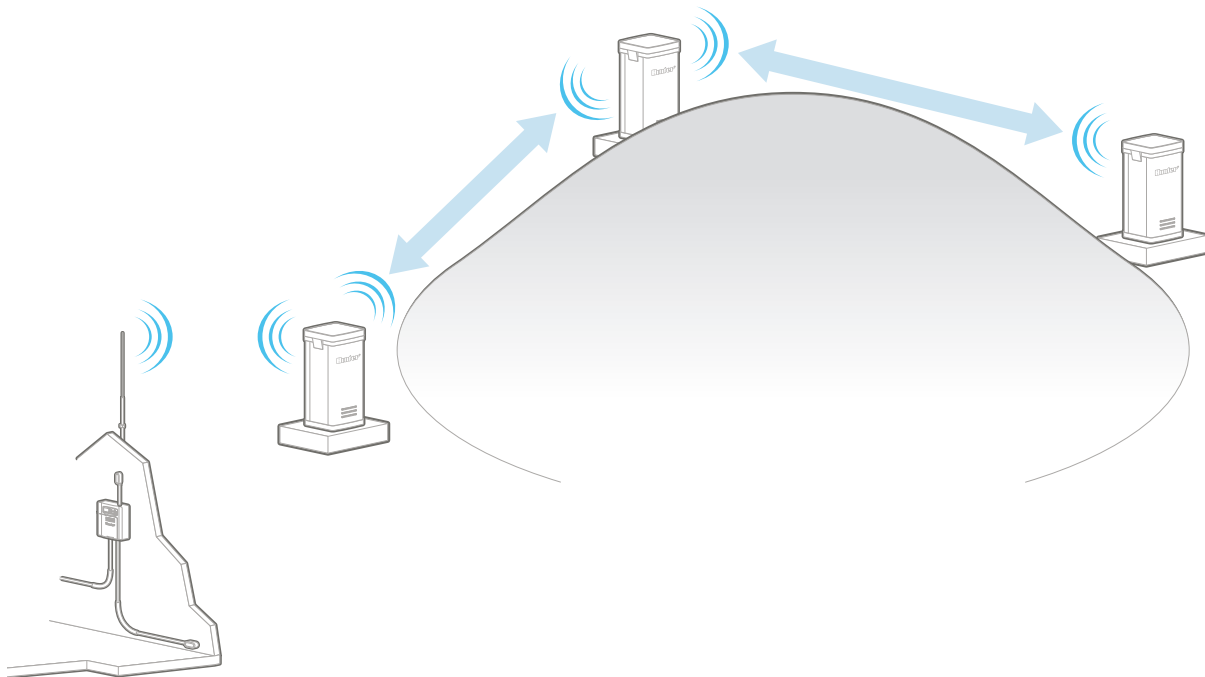


Repeater Operations with Spread Spectrum

Spread spectrum radios can be configured as miniature repeaters, to forward communications between more distant controllers and the FI.

In the example, the FI cannot reach the controller on the other side of the hill, and has no line of

sight to the controller on the far side of the hill. The first controller relays the signals to the second controller, and it relays to the third controller, allowing communications between all points in the system

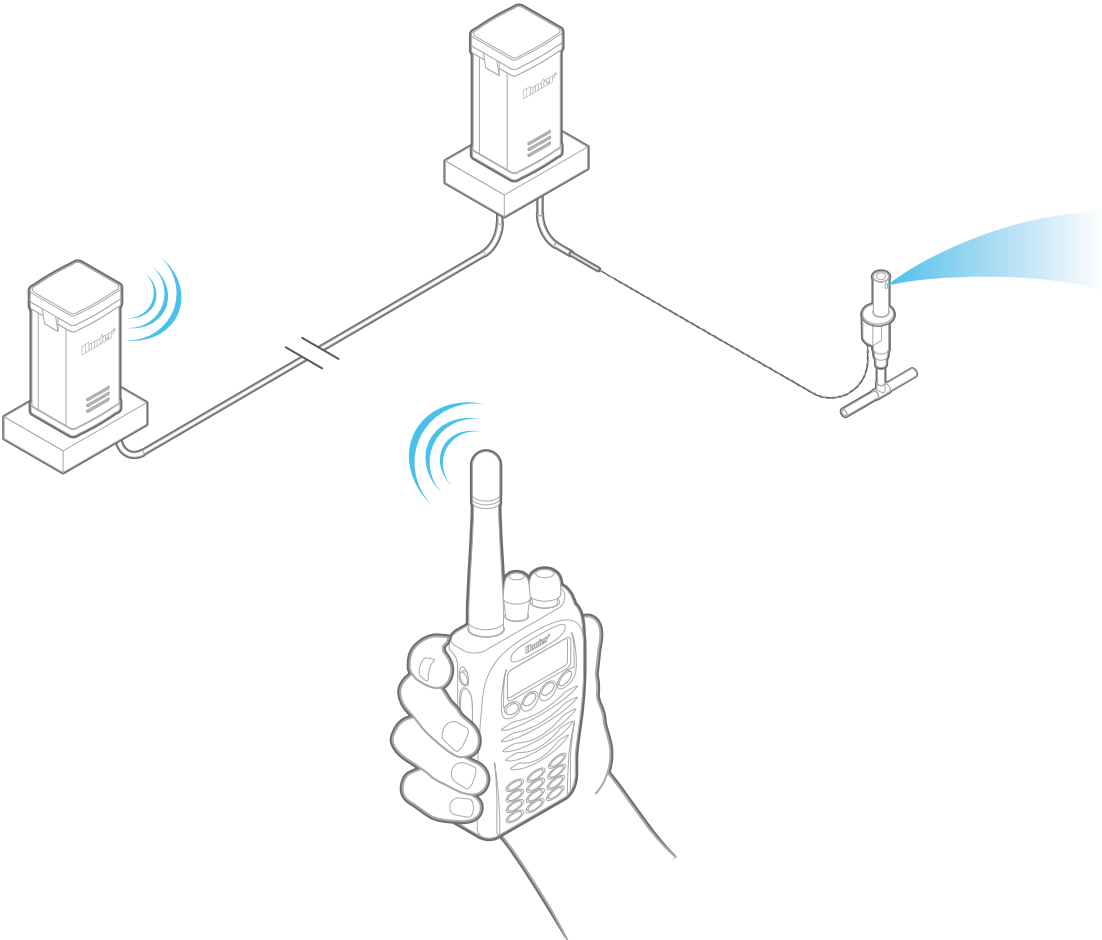


MAINTENANCE RADIO REMOTE

All Hunter Pilot systems can use Maintenance Radio remote control, if they are able to legally license UHF radios (Hunter model TRNR, specify frequency).

Controllers with PILOT-MOD-UHF radio communications can be addressed directly with StraightTalk™. There is nothing extra required.

Controllers with PILOT- HWR hardwired communications may be addressed via any radio-equipped FI or controller. At least one device in the system must have a legally licensed narrowband radio (PILOT-MOD-UHF) for Maintenance Radio to be used. The Maintenance Radio remote can then be used to address any other controller in the system.



There are no similar remote control devices available for Spread Spectrum radio communications. Remote capability can only be added to a spread spectrum system if one

licensed narrowband PILOT-MOD-UHF is installed in the FI, or a centrally-located FC or Hub.

WEATHER STATIONS

Pilot systems may be equipped with sophisticated TurfWeather stations, which connect independently to the PilotCC computer.

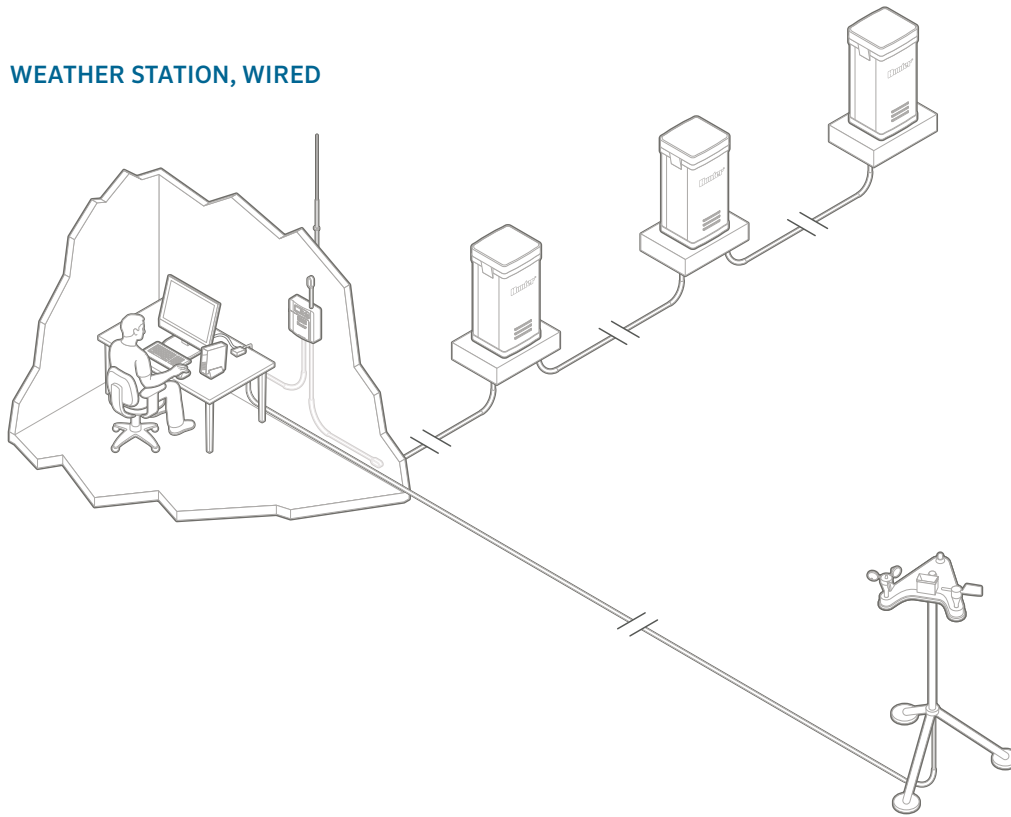
TurfWeather communications may be hard-wired, with the same type of GCBL cable used for Pilot hardwire. They may never be included in a Pilot hardwire run, however. They require a dedicated GCBL connection of their own to the central computer up to 10,000 ft/3,000 m.

TurfWeather may also be connected with license-free spread spectrum communication options. These communications are also separate from Pilot spread spectrum configurations and they are not connected via the Pilot FI. The spread spectrum option would have a dedicated receiver at the PilotCC, with its own antenna. There is also a solar power option for TurfWeather weather stations.

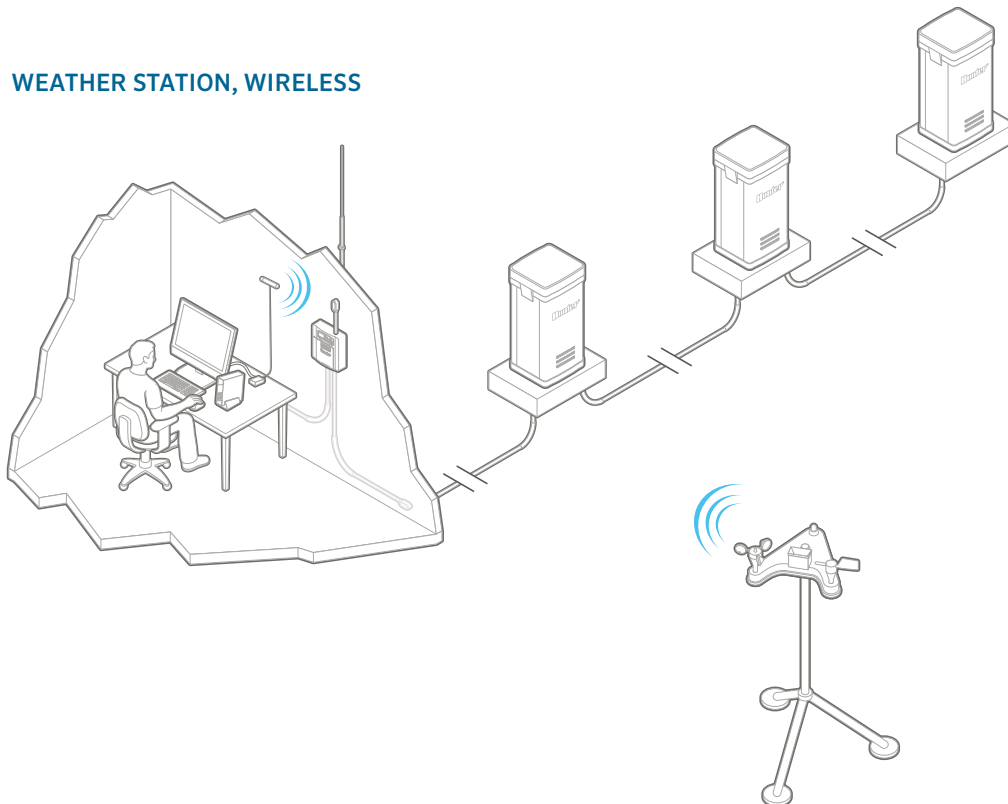
MODEL*	DESCRIPTION
TWHW	TurfWeather with AC adaptor & wired communications (GCBL cable required)
TW24	TurfWeather with AC adaptor & 2.4 GHz wireless communications
TW916	TurfWeather with AC adaptor & 916 MHz wireless communications
TW922A	TurfWeather with AC adaptor & 922 MHz wireless communications
TWSUN	Solar power kit for any TurfWeather package

*Complete package includes Hunter TurfWeather software

WEATHER STATION, WIRED



WEATHER STATION, WIRELESS





Helping our customers succeed is what drives us. While our passion for innovation and engineering is built into everything we do, it is our commitment to exceptional support that we hope will keep you in the Hunter family of customers for years to come.

A handwritten signature in white ink, appearing to read "G.R. Hunter", with a long horizontal flourish extending to the right.

Gregory R. Hunter, President of Hunter Industries

Website hunterindustries.com | **Customer Support** 760-744-5240 | **Technical Service** 760-591-7383

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