

# **Lynx<sup>®</sup> SmartHub for LSM & GAC**

*Installation and User Guide (DEC and DAC Series)*

**TORO**



## Overview: Lynx Radio Repeater

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## Toro's Commitment to Excellence

Toro is committed to developing and producing the highest quality, best performing, most dependable products on the market. Because your satisfaction is our first priority, we have provided the Toro Helpline to assist you with any questions or problems that may arise. If for some reason you are not satisfied with your purchase or have questions, please contact us toll free at **1-877-345-8676**.

## Introduction

Congratulations on purchasing Toro's Lynx SmartHub for LSM (Lynx Smart Module) and GAC (Golf control module for AC solenoid) modules.

The SmartHub combines modular flexibility, ease of use and increased programmability in a single controller. The user interface is easy to use and includes a backlight for improved visibility in low-light conditions, yet it is completely viewable in direct sunlight. The faceplate's combination of menu buttons, navigation arrows and input dial allows for easy and quick menu navigation.

The Lynx SmartHub comes in eight versions:

- DEC-RS-1000-DR (digital radio and modem)
- DEC-RS-1000-M (modem only)
- DEC-RSP-1000-DR
- DEC-RSP-1000-M
- DAC-RS-1000-DR
- DAC-RS-1000-M
- DAC-RSP-1000-DR
- DAC-RSP-1000-M

The Lynx SmartHub satellite controller pedestal is designed for installation on a substantial concrete foundation with imbedded conduit of various diameters to enable power, field, ground and communication wiring to be routed into the pedestal for connection. A mounting bolt positioner and basic mounting hardware components are included with each controller. Additional materials required to complete the installation must be obtained separately. A material list can be compiled by reading through the instructions completely prior to starting the installation.



**CAUTION:** For your protection and the safety of the product user, comply with all Caution and Warning statements within this document. All installation practices must comply with all applicable national and/or local electrical and construction codes.

## Cabinet Installation

### Wallmount

Selecting the proper installation site for the Lynx SmartHub is essential to safe and reliable operation. The SmartHub features a weather resistant cabinet designed for indoor or outdoor installation.

Install the Lynx SmartHub:

- on a vertical wall or other sturdy structure
- so that the display is at or below eye level
- near a grounded power source
- so that it is in shade during the hottest hours of the day
- with as much protection from direct sunlight, rain, wind and snow as possible



**IMPORTANT! Do not mount the controller where it is exposed to direct spray from the irrigation system.**

#### Steps:

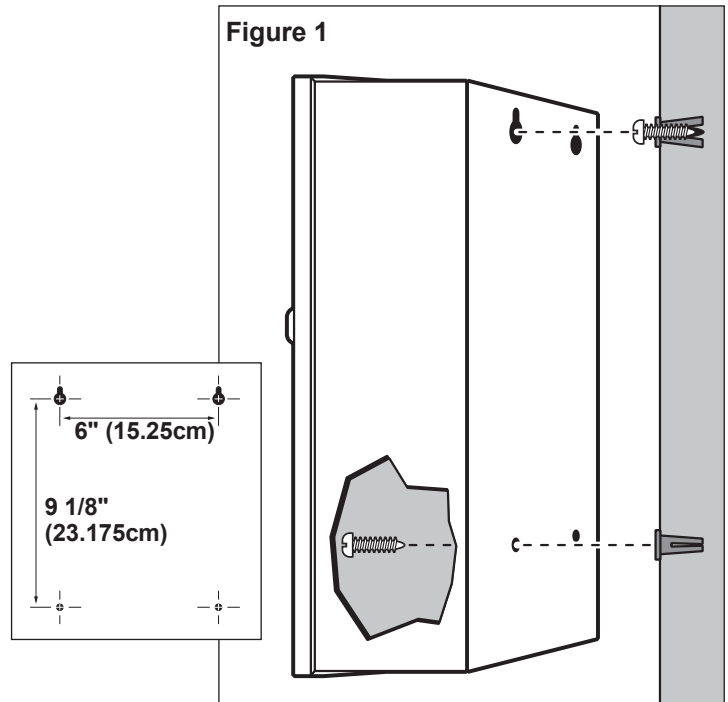
1. Drill two pilot holes 6" (15.25cm) apart for the top keyholes of the controller cabinet.
2. Install the top screws leaving approximately 1/4" (5–6mm) of exposed screw to accommodate the cabinet.



If mounting the cabinet on dry wall or masonry, install the appropriate type of screw anchors or fasteners to ensure secure installation.

3. Hang the cabinet using the top keyhole slots. See **Figure 1**.
4. Open the cabinet door and install the two bottom screws to secure the cabinet.

**Figure 1**





## Power Source



**WARNING! AC POWER WIRING MUST BE INSTALLED AND CONNECTED BY QUALIFIED PERSONNEL ONLY.**

**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 IN THE FIXED WIRING, HAVING A CONTACT SEPARATION OF AT LEAST 3mm IN THE LINE AND NEUTRAL POLES.**

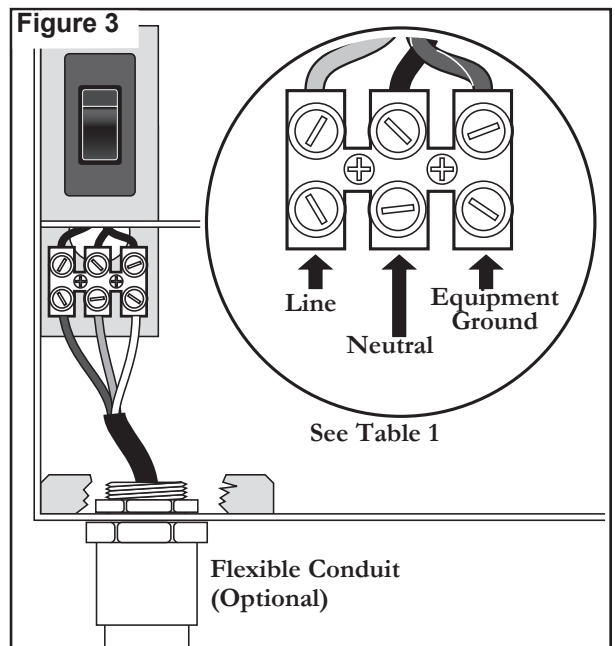
**ENSURE THE AC POWER SOURCE IS OFF PRIOR TO SERVICING. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY DUE TO ELECTRICAL SHOCK HAZARD.**

### Steps:

1. Turn off the power at the power source location and place the controller's power switch to OFF. Connect and route the appropriate size 3-conductor cable (14 AWG [2.5mm<sup>2</sup>] maximum) from the power source to the controller cabinet.  
The provided power cable access hole can accommodate a 1" (25mm) conduit fitting. If conduit is required, install a section of flexible 1" (25mm) electrical conduit from the power source conduit box to the cabinet's access hole.
2. Open the cabinet door and remove the two retaining screws from the power supply cover.
3. Strip the power cables and secure them to the terminal block (**Figure 3**). Reference **Table 1** for the appropriate type of power connection.
4. Reinstall the power supply cover.
5. Apply power to the controller.

**Table 1**


AC Service Type	Line	Neutral	Equipment Ground
100 – 120 VAC (Domestic)	Hot (Black)	Neutral (White)	Green
220 – 240 VAC (International)	Hot (Brown)	Neutral (Blue)	Green / Yellow



## Pedestal Installation

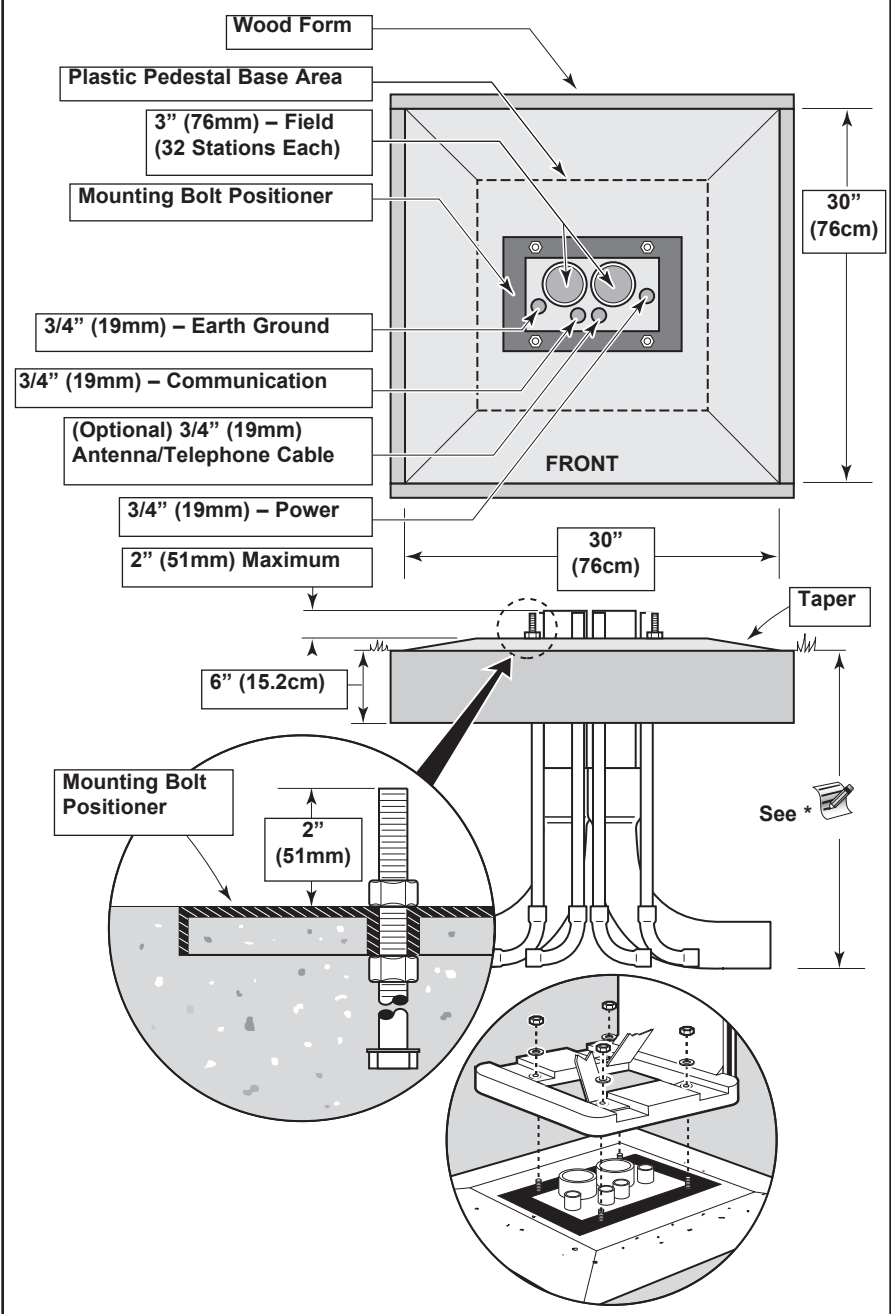
### Foundation Construction

1. Prepare a hole for the foundation and wiring conduit using the minimum recommended dimensions shown in **Figure 4**.

\*  Refer to local electrical codes for required depth of buried wiring.

2. Trench to the foundation site as required for each wiring run.
3. Position straight and sweep elbow conduit sections in foundation hole as shown. Tape the conduit ends to seal out dirt. Backfill soil to form a 6" (15.2cm) foundation depth. Conduit should not extend more than 2" above the finished top surface of the foundation.
4. Prepare the sides of the foundation hole with wood forms.
5. Prepare the mounting bolt positioner with the 5/16 x 4-1/2" bolts and nuts (provided) as shown in Figure 3. The threads should extend 2" (51mm) from the top surface of the bolt positioner.
6. Pour concrete into the formed foundation hole. Press the mounting bolt positioner into the concrete until it is flush and level with the foundation surface and aligned with the conduit.
7. Finish the concrete with a level flat area for the pedestal base (13" x 13" [33cm x 33cm] for the metal pedestal or 16" x 16" [41cm x 41cm] for the plastic pedestal). To prevent pooling at the base of the pedestal, add a slight taper away from the pedestal base contact area. Allow concrete to sufficiently harden before continuing.
8. Remove the hex nuts from the mounting studs. Carefully position the controller onto the studs. Install a flat washer and a hex nut on each stud and tighten securely.

**Figure 4** (Conduit Recommendations)



## Earth Ground

**⚠ IMPORTANT!** The Lynx SmartHub surge protection components cannot properly function unless an efficient pathway to earth ground is provided. The ground path must be as direct as possible, without sharp bends and should not exceed 10 Ohm resistance (when measured with an earth ground resistance device). All electrical components throughout the irrigation system should be grounded similarly to provide the same ground potential.

The following instructions depict one of several acceptable earth grounding methods. Due to variables in soil composition and terrain, the method shown may not be suitable for your installation site. Contact your local Toro distributor for assistance and availability of the required earth ground resistance test instrument. Recommended ground testers are: AEMC Instruments, model 3710 clamp-on tester, or Biddle Megger, model 250260 (or equivalent).

### Procedure

1. Drive a 5/8" by 8' (17mm x 2.5m) copper clad steel rod into well moistened soil not less than 8' (2.5m) or not more than 12' (3.7m) from the controller cabinet (see **Figure 5 and 6**). The top of the ground rod should be flush with or below ground level, and should be protected

from damage using a valve box (A).

2. Measure the ground resistance per the instructions provided with the ground test instrument.
  - If reading is 10 ohms or less, proceed to step 4.
  - If reading is greater than 10 ohms, proceed to step 3.
3. Install a 4" by 96" (10cm x 2.5m) copper ground plate. The plate should be at least .06" thick (1.5mm) and should have a 6 AWG x 12' (10mm<sup>2</sup> x 4m) solid copper, insulated wire welded to the plate. The plate should go into a trench that is at least 30" (80cm) deep (B). Use ground enhancement material (GEM) per the manufacturer's directions.
4. Using a 5/8" (17mm) clamp or exothermic-weld fastener, attach an 8 AWG (10mm<sup>2</sup>) solid copper wire near the top of the ground rod.
5. Route the wire through conduit and into the controller cabinet, avoiding wire bends of less than 8" (20cm) radius and more than 90° (C). Secure the wire to the copper ground lug in the controller.
6. Measure the ground resistance again. A reading of 10 ohms or less is recommended.

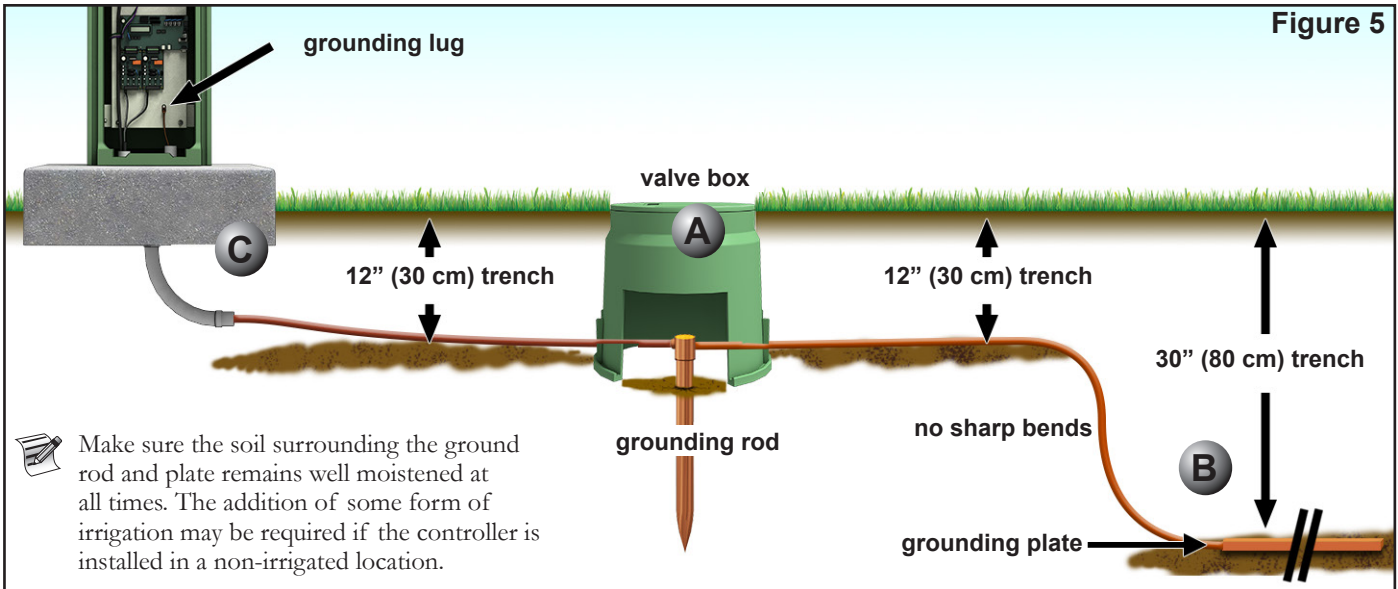
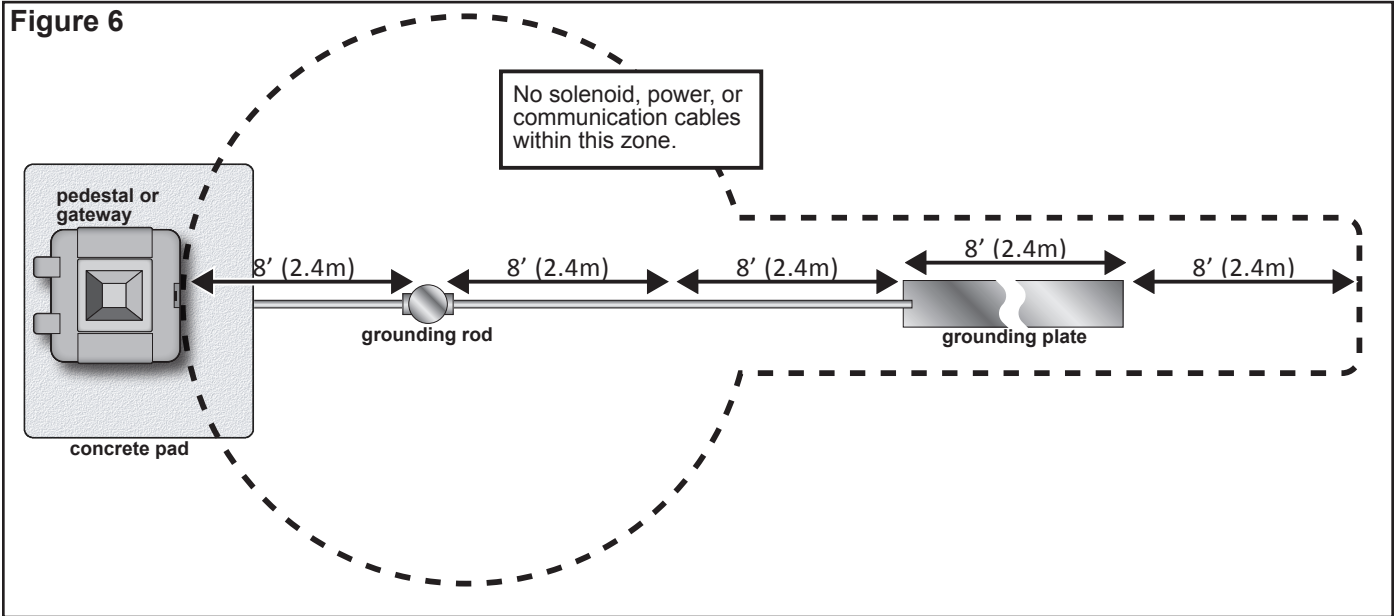


Figure 6





## Power Source



### WARNING!

AC POWER WIRING MUST BE INSTALLED AND CONNECTED BY QUALIFIED PERSONNEL ONLY.

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 IN THE FIXED WIRING, HAVING A CONTACT SEPARATION OF AT LEAST 3mm IN THE LINE AND NEUTRAL POLES.

ENSURE THE AC POWER SOURCE IS OFF PRIOR TO SERVICING. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY DUE TO ELECTRICAL SHOCK HAZARD.

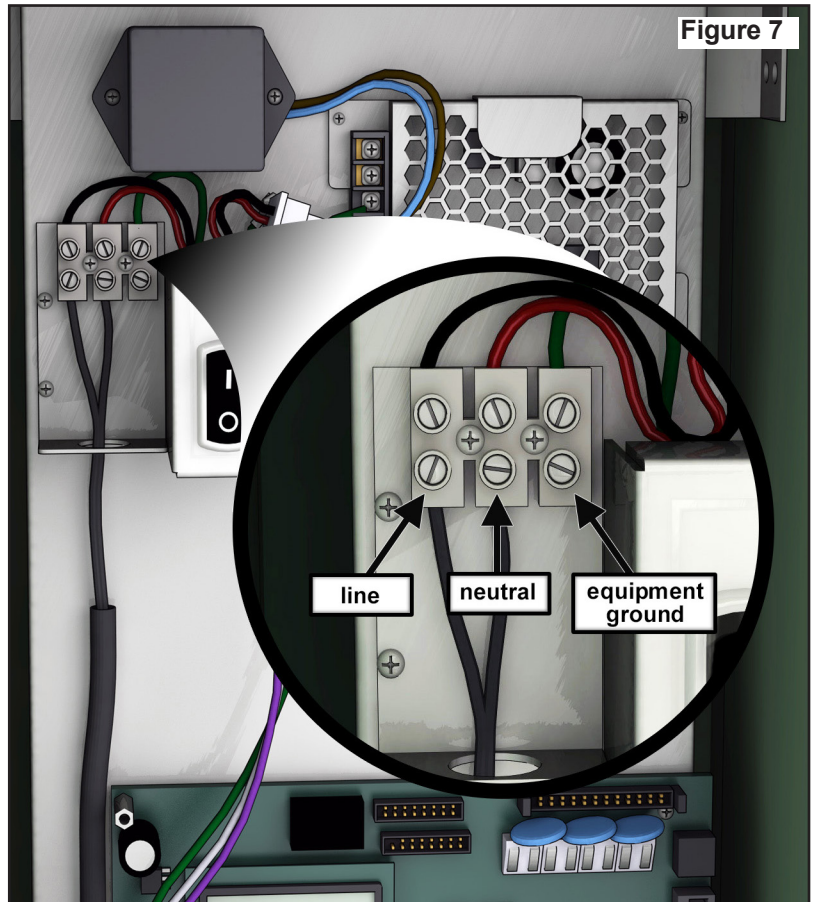
1. Turn off the power at the power source location and place the controller's power switch to OFF. Connect and route the appropriate size 3-conductor cable (14 AWG [2.5mm<sup>2</sup>] maximum) from the power source to the controller pedestal.

The provided power cable access hole can accommodate a 1" (25mm) conduit fitting. If conduit is required, install a section of flexible 1" (25mm) electrical conduit from the power source conduit box to the pedestal's access hole.

2. Strip the power cables and secure them to the terminal block. Reference **Table 1** and **Figure 7** for the appropriate type of power connection.
3. Reinstall the power supply cover.
4. Apply power to the controller.

**Table 1**

AC Service Type	Line	Neutral	Equipment Ground
100 – 120 VAC (Domestic)	Hot (Black)	Neutral (White)	Green
220 – 240 VAC (International)	Hot (Brown)	Neutral (Blue)	Green / Yellow



## Lynx Smart Module

### New System or New Communication Cable

Lynx Smart Modules are available in 1-station configurations.

The SmartHub pedestal and cabinet can handle up to 1000 modules or 1000 stations each. The SmartHub with Lynx Smart Modules (LSMs) can accommodate up to two daughterboards with two output circuits. Each daughterboard can handle up to 500 modules and stations. The modules can be connected in parallel anywhere on the two-wire communication line connected to the station terminals. Each cable path can handle up to 250 modules and stations. Each station can activate up to two solenoids.

It is recommended that the modules are installed in an approved valve box to provide easy access to the wiring.

Use approved splice to waterproof all connectors.

**Recommended Controller-to-Module cable:** 14 AWG (2.1 mm<sup>2</sup>), solid copper, jacketed 2-conductor, direct burial.




**Recommended Module-to-Solenoid cable:** 14 AWG (2.1 mm<sup>2</sup>), solid copper, 2-conductor, direct burial.

### Burial Depth

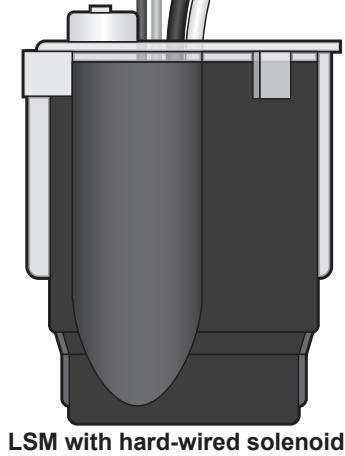
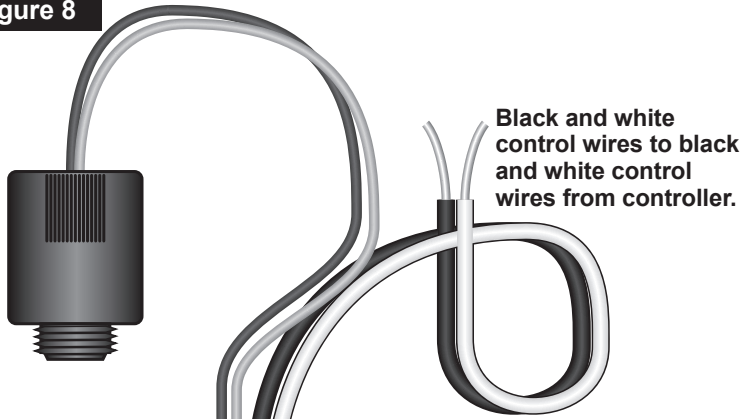
Toro recommends that the Controller-to-Module and Module-to-Solenoid cables should have a minimum cover of 6" (150mm). The irrigation plan may specify additional depth to be consistent with the depth of mainline or lateral pipe work and/or soil conditioning procedures such as aeration. Installation procedures must comply with all applicable local and national electrical codes.

- Use only wire approved for direct burial if installing the wires underground without conduit.
- All field wiring splices must be accessible to facilitate troubleshooting and/or service.

#### Steps:

1. Route communication cable from the controller to the station module installation location.  
 The maximum wire length between the controller and the module is 15,000' (4500 m).
2. Secure the communication wires to terminal 1 of the SmartHub output board. White wire onto the 1st terminal and black wire onto the second terminal. See **Figure 8**.
3. Install the module in a valve box. Record the module's address number found on the side label. This address number identifies the station(s) that the module control.
4. Secure the communication wires to the module's black and white wires.  
 Connect the black communication wire to the black module wire.  
 Connect the remaining communication wire (red or white) to the white module wire.  
 Use approved splice to properly water-proof all wire connections.
5. Route output wires from the module to the solenoid.  
 The maximum wire length between the module and the solenoid is 410' (125m) for 14 AWG (2.5mm<sup>2</sup>) wire.
6. Connect the solenoid wires to the module's station wires. The station wires are color coded for easy identification.  
 Connect the solid red colored station wire to the red/white solenoid wire.  
 Connect the similar color station wire with black stripe to the black solenoid wire.  
 Use approved splice to properly water-proof all wire connections.
7. Connect an additional solenoid to the station wire as necessary.  
 Each station has a maximum load of two solenoids.
8. Repeat Steps 3–8 for additional modules.

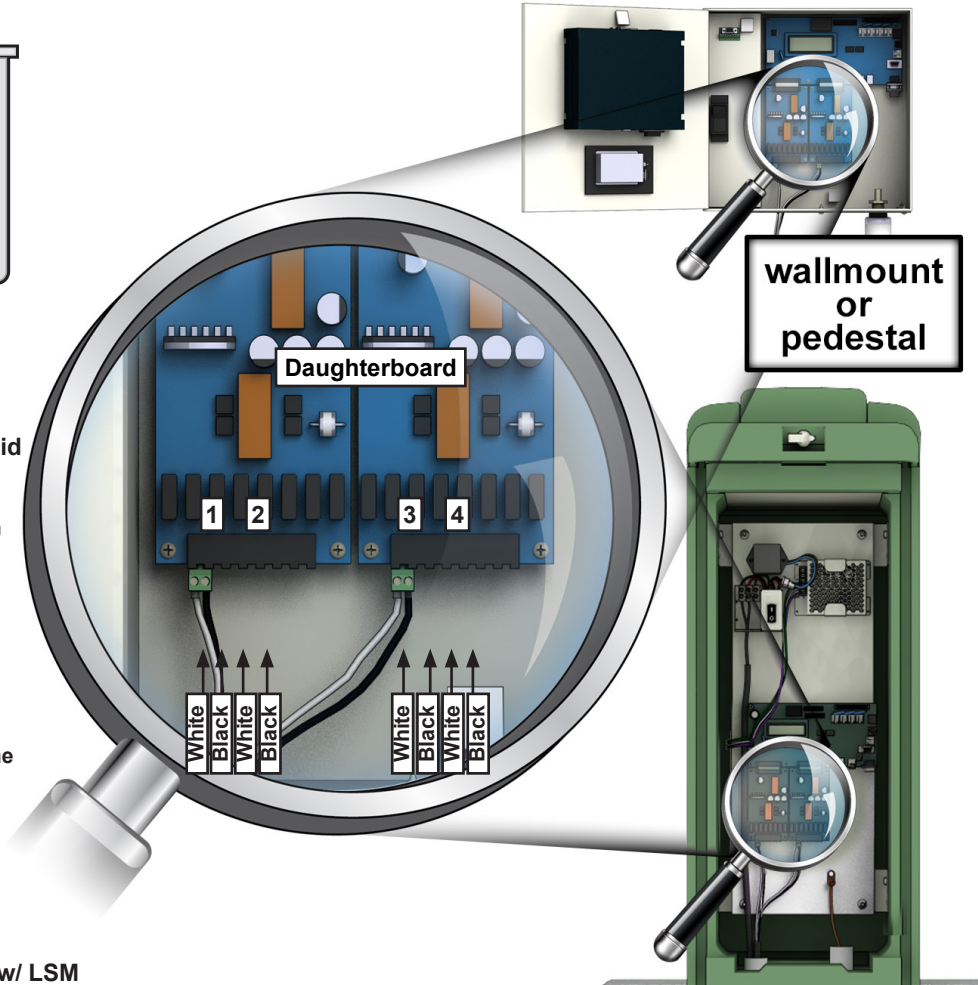
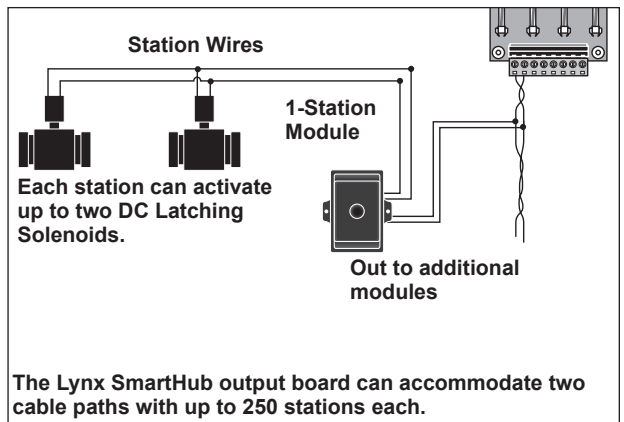
**Figure 8**



The maximum communication wire length between the module and the solenoid is 410' (125m).

Recommended Cable for Module-to-Solenoid: 14 AWG, Solid Copper, 2-Conductor, Direct Burial cable.

To easily identify stations for troubleshooting, install wires with the same color code as the station wires.



INFINITY w/ LSM

FLEX800 w/ LSM

P220 valve w/ LSM

Recommended Cable for Controller-to-Decoder is 14 AWG, Solid Copper, Jacketed 2-Conductor, Direct Burial cable.

Maximum communication wire length between the controller and the farthest module is 15,000' (4,500 m).

## GAC Decoder Installation

### New System or New Communication Cable

AC station decoder modules are available in 1-station, 2-station, 4-station configuration or a Toro golf sprinkler with an integrated 1-station decoder.

The SmartHub pedestal and cabinet can accommodate either two or four daughterboards. An expansion unit is required to install the 2nd daughterboard. Each daughterboard has two output circuits. Each output circuit can handle up to 125 decoder modules (250 modules per daughterboard then) and 500 stations. The decoder modules can be connected in parallel anywhere on the two-wire communication line connected to the station terminals. Each station can activate up to two solenoids.

It is recommended that the decoder modules are installed in an approved valve box to provide easy access to the wiring. Use approved splice to waterproof all connectors.




Recommended Controller-to-Decoder cable: 14 AWG (2.5mm<sup>2</sup>), solid copper, jacketed 2-conductor, direct burial.

### Burial Depth

Toro recommends that the Controller-to-Decoder and Decoder-to-Solenoid cables should have a minimum cover of 6" (150mm). The irrigation plan may specify additional depth to be consistent with the depth of mainline or lateral pipe work and/or soil conditioning procedures such as aeration. Installation procedures must comply with all applicable local and national electrical codes.

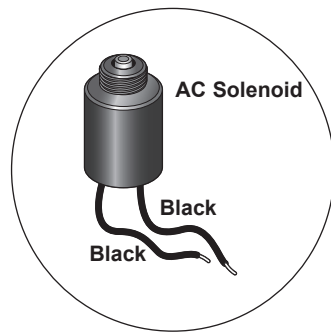
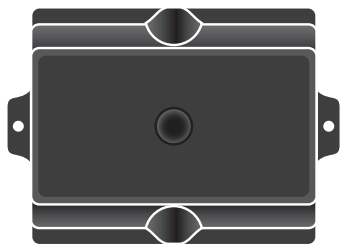
- Use only wire approved for direct burial if installing the wires underground without conduit.
- All field wiring splices must be accessible to facilitate troubleshooting and/or service.

#### Steps:

1. Route communication cable from the controller to the station decoder module installation location.  
 The maximum wire length between the controller and the decoder module is 6,800' (2072 m).
2. Secure the communication wires to terminal 1 of the SmartHub output board. Black wire onto the 1st terminal and Red wire onto the second terminal. See **Figure 9**.
3. Install the decoder module in a valve box. Record the decoder module's address number found on the side label. This address number identifies the station(s) that the decoder module controls.
4. Secure the communication wires to the decoder module's black and red wires. Connect the black communication wire to the black decoder module wire. Connect the remaining communication wire (red) to the red decoder module wire. Use approved splice to properly water-proof all wire connections.
5. Route output wires from the decoder module to the solenoid.  
 The maximum wire length between the decoder module and the solenoid are 400' (122m) for 18 AWG wire and 575' (175m) for 16 AWG wire.
6. Connect the solenoid wires to the decoder module's station wires. The station wires are color coded for easy identification (Station 1 = Violet, Station 2 = Yellow, Station 3 = White, Station 4 = Orange and Common Wire = Brown). Connect the solid colored (violet, yellow, white or orange) station wire to one of the solenoid wire. Connect the similar color station wire with black stripe to the remaining solenoid wire. Use approved splice to properly water-proof all wire connections.
7. Connect an additional solenoid to the station wire as necessary.  
 Each station has a maximum load of up to two solenoids.
8. Repeat Steps 3–8 for additional decoder modules.



**Figure 9**



**Station 4**

Orange Wire: Connect to one of Station 4's solenoid wires.

**Station 3**

White Wire: Connect to one of Station 3's solenoid wires.

**Station 2**

Yellow Wire: Connect to one of Station 2's solenoid wires.

**Station 1**

Violet Wire: Connect to one of Station 1's solenoid wires.

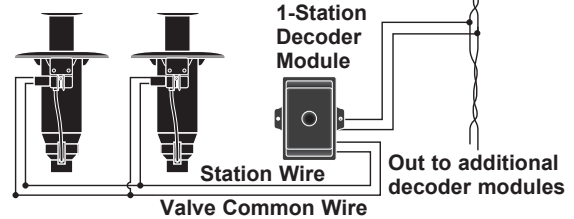
**Valve Common**

Brown Wire: Connect to one of the wires from each of the four solenoids.

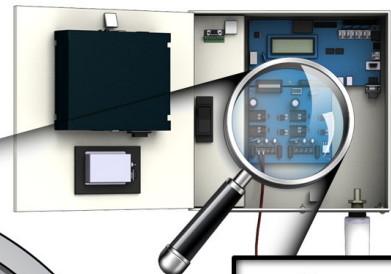
Red Power/Communication Wire

Black Power/Communication Wire

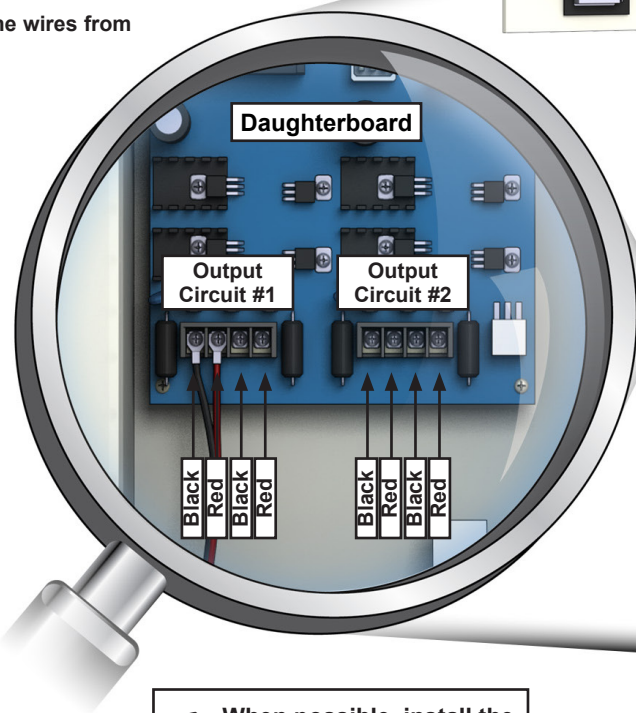
Each station can activate up to 2 solenoids. (See valve compatibility for details.)



Each output circuit can accommodate up to 125 Decoder Modules.



**wallmount  
or  
pedestal**



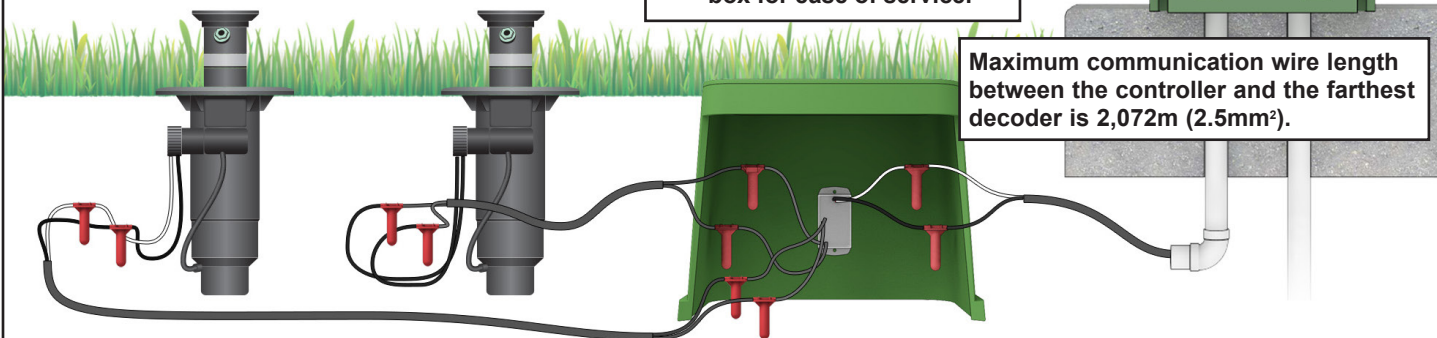
The maximum communication wire length between the decoder module and the solenoid is 575' (175m).

Recommended Cable for Decoder-to-Solenoid is a Solid Copper, 2-Conductor, Direct Burial cable.

To easily identify stations for troubleshooting, install wires with the same color code as the station wires.

When possible, install the decoder module in a valve box for ease of service.

Maximum communication wire length between the controller and the farthest decoder is 2,072m (2.5mm<sup>2</sup>).



Recommended Cable for Controller-to-Decoder is 14 AWG, Solid Copper, Jacketed 2-Conductor, Direct Burial cable.

## Upgrade of Existing System, Using Existing Wiring

### Communication Cable Type

Should be 2 or 3 copper conductors, solid or stranded, with PE or PVC insulation, rated for at least 600V. For 3-conductor cables, the third conductor will not be used and any exposed ends must be capped and sealed with an approved splice.

### Communication Cable Length

The maximum wire run from the SmartHub to the farthest decoder is 6800' (2072 meters) for 14 AWG (2.5mm<sup>2</sup>) cable. The total amount of wire path is 14,000' (4267 meters) for 14 AWG (2.5mm<sup>2</sup>) cable.

### Resistance

The maximum resistance of the wire path with the end shorted can be 37.7 Ohms. The minimum resistance of the wire path with the end open should be 1000 Ohms.

### Noise

For the wire path to be tested, disconnect from the DIU (or other controller), connect an oscilloscope across the wire path, and power up the pump and any other equipment that would be running when watering. Measure the voltage across the open wire path. It should be less than 1 V p-p.

### Short Circuits

After the GAC decoders are installed, measure the resistance across the two open wire path wires to insure that it is still greater than 1000 Ohms to insure that no shorts were introduced during the installation process.

### Communication Cable to Power Cable Spacing

This recommendation applies to GAC communication installation. This minimum spacing to any power cable should be maintained to minimize the possibility of electrical interference which could affect the integrity of the GAC communication to decoders. If there are power cables already installed running next to the communication cables that do not meet the minimum spacing, remediation will be required to meet the minimum spacing listed in **Table 2** below.

Table 2	
Power Cable Circuit Rating (Minimum KVA*)	Recommended Minimum Spacing**
0-3	6 inches (15 cm)
3-10	12 inches (30 cm)
10-20	24 inches (60 cm)
20-50	36 inches (90 cm)
50-100	48 inches (120 cm)
>100	60 inches (150 cm)

\*Maximum voltage x current rating of circuit

\*\*These are minimum spacing recommendations to minimize noise coupling. There may be greater separation required by safety agencies or local codes.

### Decoder to Sprinkler Wires

Wire Type - Should be copper conductors, solid core, with PE or PVC insulation, rated for at least 600V

### Wire Length

For 16 AWG or 1.5mm<sup>2</sup> – Maximum length is 575 feet (175m)

For 18 AWG or 0.9mm<sup>2</sup> – Maximum length is 400 feet (122m)

### Decoder Module Installation

Remove an old decoder by cutting out the old splices. Make sure to cut the communication wires and station wires back to remove any green or corroded copper. Strip the wires and connect a new decoder module per Figure 4. All splices must be made with approved splice kits.

### Valve Compatibility

Toro	Golf VIH (Solenoid 89-1905 or 118-0248) at 150 PSI 400ft (122m) Max Solid Core, 18 AWG or 0.9mm <sup>2</sup> Cable 2.3 Ohms/Conductor (400ft), 1 per Output 575ft (175m) Max Solid Core, 16 AWG or 1.5mm <sup>2</sup> Cable 2.3 Ohms/Conductor (575ft), 2 per Output
Toro	252 Valve (Solenoid 102-1905 or 118-0248) at 150 PSI at AC Decoder, 1 per Output
Toro	220 Valve (Solenoid 102-0927) up to 220 PSI (passing is 150 PSI) at AC Decoder, 1 per Output
Toro	216 Brass Valve (Solenoid 89-1673), Up to 220 PSI (passing is 150 PSI) at AC Decoder, 1 per Output
Rain Bird	Green Golf VIH Solenoid at 150 PSI 200ft Max Solid Core, 18 AWG or 0.9mm <sup>2</sup> Cable 1.2 Ohms/Conductor, 1 per Output 328ft Max Solid Core, 16 AWG or 1.5mm <sup>2</sup> Cable 1.2 Ohms/Conductor, 2 per Output
Rain Bird	DV Solenoid (Black Wires) at 150 PSI at AC Decoder, 1 per Output
Rain Bird	PGA/PESB Solenoid (White Wires) at 150 PSI at Decoder, 1 per Output

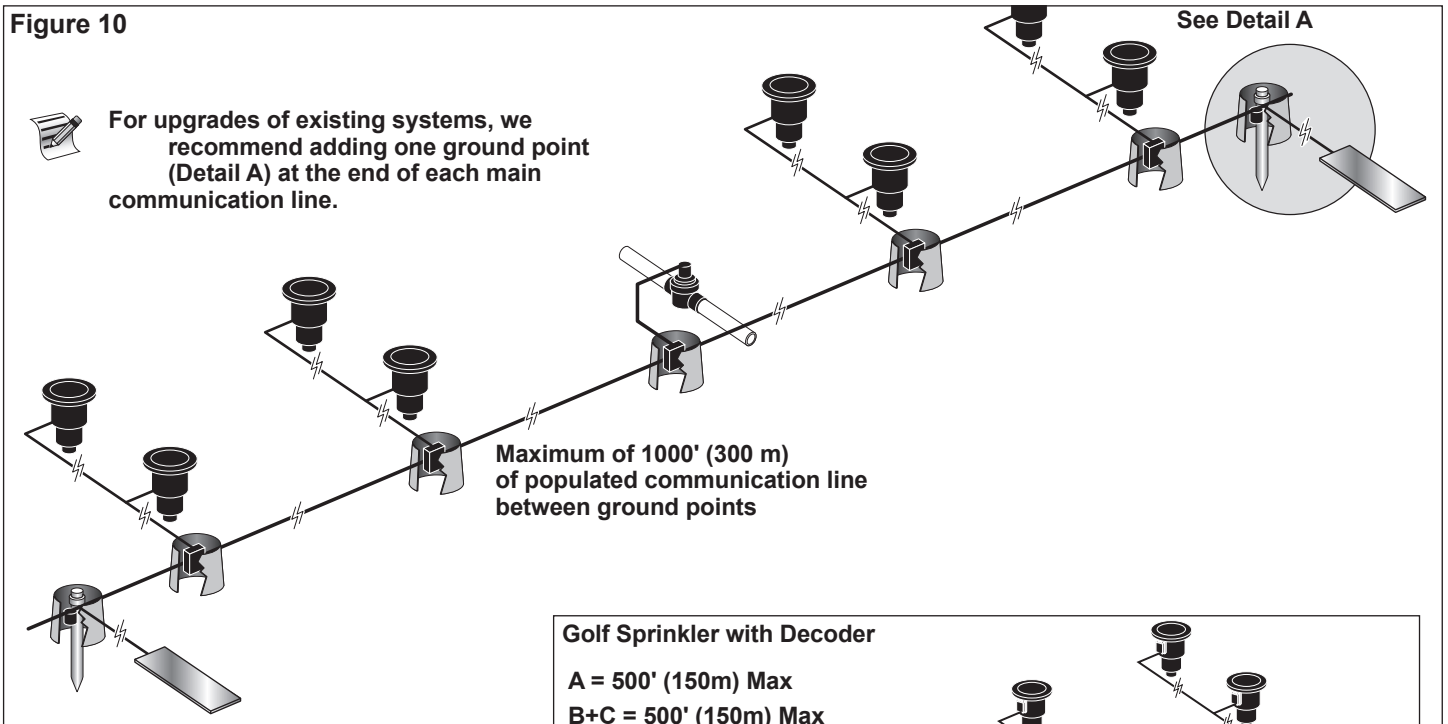
## Grounding the Communication Cable

### (for both AC and DC decoders)

The lightning arrester (Toro P/N DEC-SG-LINE) is required to protect the decoder module from lightning. Without lightning arresters, decoders are vulnerable to lightning damage. For these arresters to discharge lightning energy efficiently, they must be properly grounded. To be effective, a resistance of 10 Ohms or less is recommended at each earth ground point. If the resistance with a single ground rod or plate is greater than 10 ohms, a second ground plate should be added. **Figure 10** illustrates the proper grounding and wiring of the arrester.

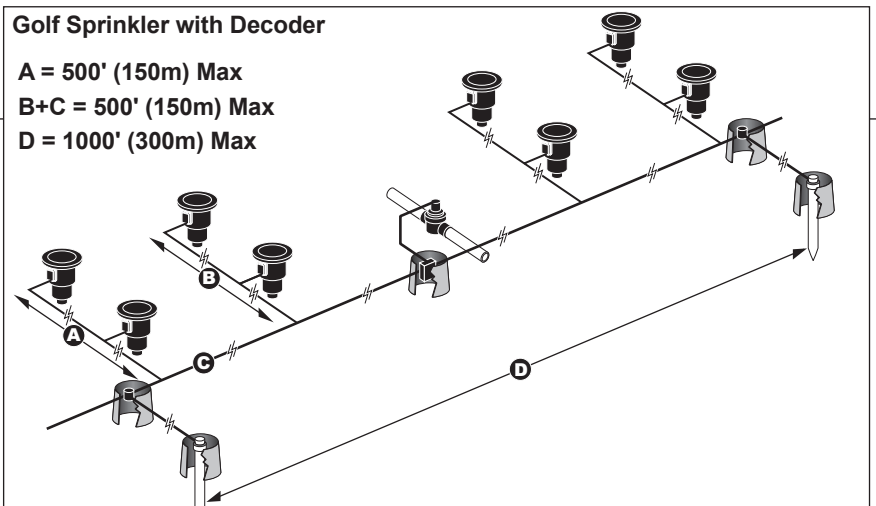
1. Locate decoder's power/communication wires (black and white wires).
2. Strip the insulation from lightning arrester's white wire and connect it to the white wires from the decoder and controller-to-decoder cable. Use approved splice to properly water-proof all wire connections.
3. Strip the insulation from lightning arrester's black wire and connect it to the black wires from the decoder and controller-to-decoder cable. Use approved splice to properly water-proof all wire connections.
4. Connect the lightning arrester's ground wire to the ground rod or plate's wire. If the ground rod or plate is not pre-wired, use a 10 AWG bare copper wire.
5. Drive a 5/8" by 8' (17mm x 2.5m) copper clad steel rod into well moistened soil not less than 8' (2.5m) or not more than 12' (3.7m) from the controller cabinet (**Figure 6**). For 2-Wire systems, install the ground rod adjacent to the communication cable (**Figure 10**). The top of the ground rod should be flush with or below ground level, and should be protected from damage using a valve box ( A ).
6. Using a 5/8" (17mm) clamp or exothermic-weld fastener, attach an 8 AWG (10mm<sup>2</sup>) solid copper wire near the top of the ground rod.
7. Measure the ground resistance per the instructions provided with the ground test instrument. A reading of 10 ohms or less is recommended. If the resistance is greater than 10 ohms, proceed to step 8.
8. Install a 4" by 96" (10cm x 2.5m) copper ground plate. The plate should be at least .06" thick (1.5mm) and should have a 6 AWG x 12' (10mm<sup>2</sup> x 4m) solid copper, insulated wire welded to the plate. The plate should go into a trench that is at least 30" (80cm) deep ( B ). Use ground enhancement material (GEM) per the manufacturer's directions. Connect the ground wire from the ground plate to the ground rod installed in step 5.

**Figure 10**

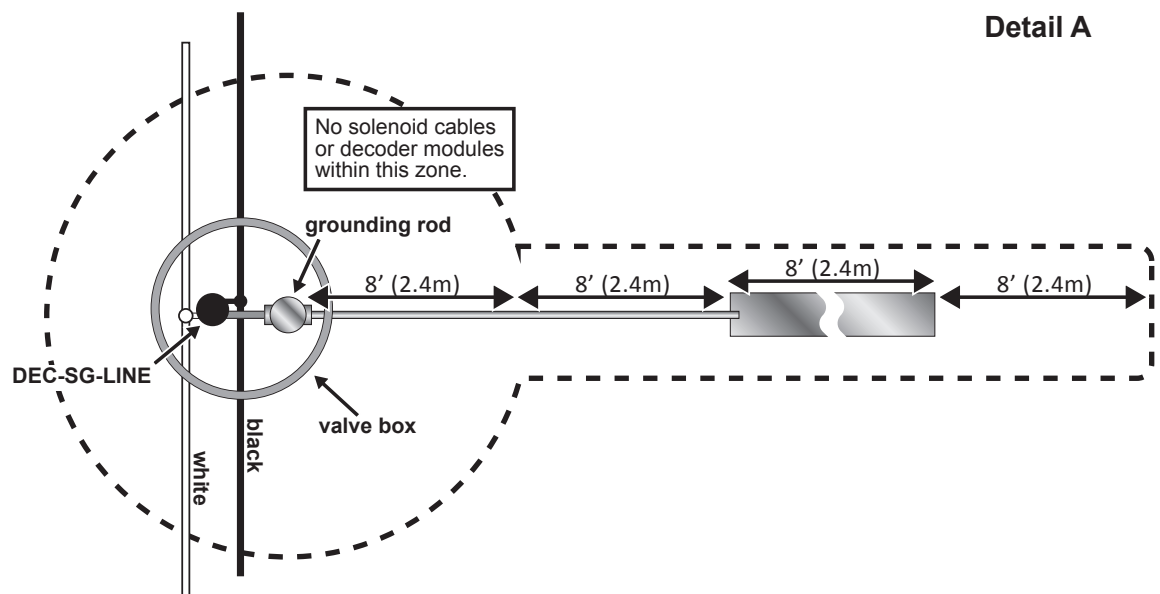


**Golf Sprinkler with Decoder**

- A = 500' (150m) Max
- B+C = 500' (150m) Max
- D = 1000' (300m) Max



**Detail A**



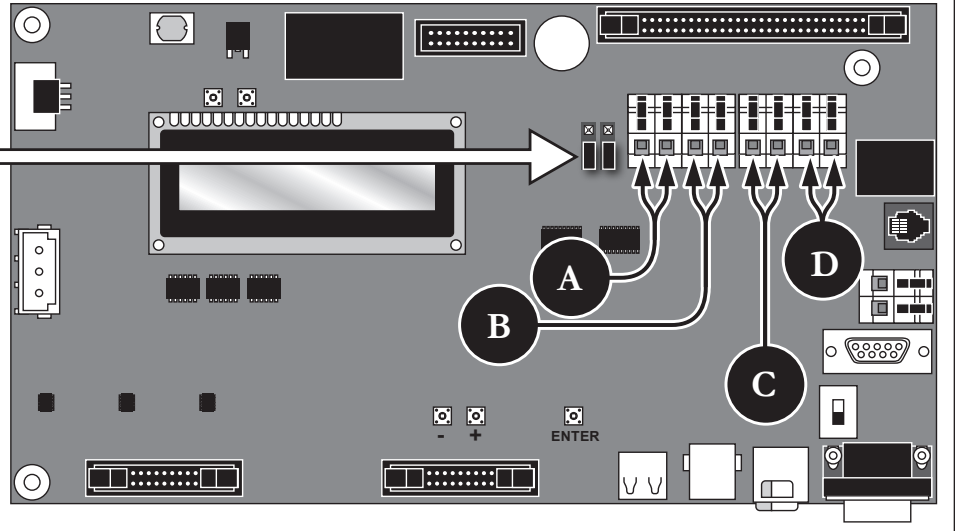
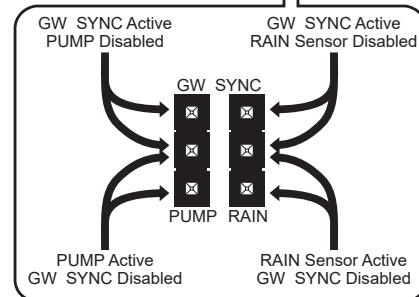


## Motherboard Connections

**Figure 11**

Jumpers must be in:

- lower position for sensor operation
- upper position for GW SYNC operation

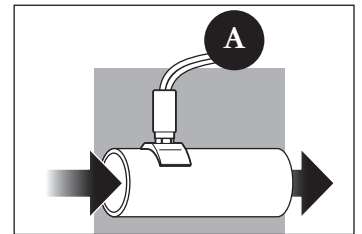


**Before connecting any type of sensor, be sure the controller has been powered down.**

### Status Sensor

The Lynx SmartHub controller is designed to accept both a normally-open and normally-closed status switch. For example, a pressure switch may be connected to this sensor input to detect pressure over a maximum value.

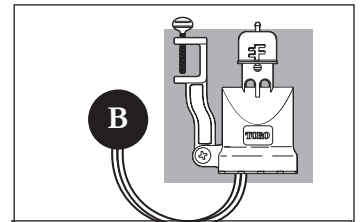
1. Route the status switch cable into the controller.
2. Connect the cable wires to the status switch terminals labeled **A** in **Figure 11**.
3. Place the controller's switch to ON.



### Rain Sensor

LSM systems can use either a rain bucket or a normally-open / normally-closed rain switch. GAC systems can use only a normally-open / normally-closed switch.

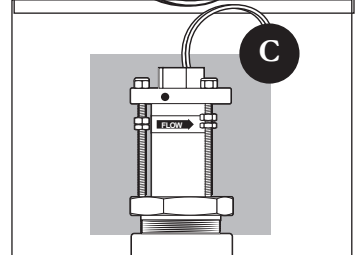
1. Route the rain sensor's cable into the controller.
2. Connect the cable wires to the Rain Sensor Terminals labeled **B** in **Figure 11**.
3. Place the controller's switch to ON.



### Flow Sensor

LSM systems can use either a Badger Meter / Data Industrial series 200 insertion type flow sensor or a Bermad 900 series flow meter.

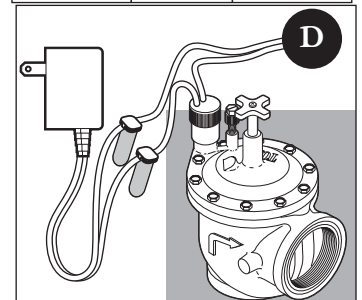
1. Route the flow sensor's cable into the controller.
2. Connect the cable wires to the Pressure Sensor Terminals labeled **C** in **Figure 11**.  
Red wire to the + terminal, black wire to the - terminal.
3. Place the controller's switch to ON.



### Master Valve / Pump Relay

The Lynx SmartHub provides an output to control a master valve or pump relay. The output is active when any station is on, and off otherwise. Stations defined as switches do not cause the output to activate.

1. Connect the Positive/Hot wire of the power source that controls the master valve or the pump relay to the Master valve/Pump relay switch terminal. See **Figure 11, D**.
2. Route another wire from the Master Valve / Pump terminal and connect it to the master valve solenoid or pump relay.
3. Connect the Negative/Equipment ground wire of the power source to the master valve solenoid or pump relay.
4. Place the controller's switch to ON.



## Communication Cable

Please note the following communication cable installation requirements and suggestions:

- The remote SmartHub is designed for use with shielded, twisted-pair, communication cable. Toro recommends R7162D or equivalent.
- More than one cable run can be connected to the Surge Protection Unit (SPU, part #35-7353).
- A remote SmartHub communication cable can emanate from another remote SmartHub connection.
- If additional communication cable runs are installed for future system expansion, each cable wire pair must be terminated with a 600 ohm resistor (**Figure 15**).
- If the communication cable is routed in the same trench as main power wires, or the SmartHub to decoder module cables, a minimum of 12" (30.5cm) separation is recommended to prevent voltage induction on the communication cable. Check local codes for actual requirements.
- Refer to the installation instructions provided with the central control system for communication cable testing procedures.
- If in-ground cable splices or repairs are required, the connection must be properly insulated with a waterproof splicing device. Using an appropriate splicing kit, such as Scotchcast 82-A1 (or equivalent), is recommended. Placing the cable splice in a small valve box for protection and accessibility is a good installation practice.

### Steps:

1. Starting at the Surge Protection Unit (SPU, part #35-7353), route the communication (comm) cable to each SmartHub leaving enough cable at each location to enable connection. See **Figure 12**.

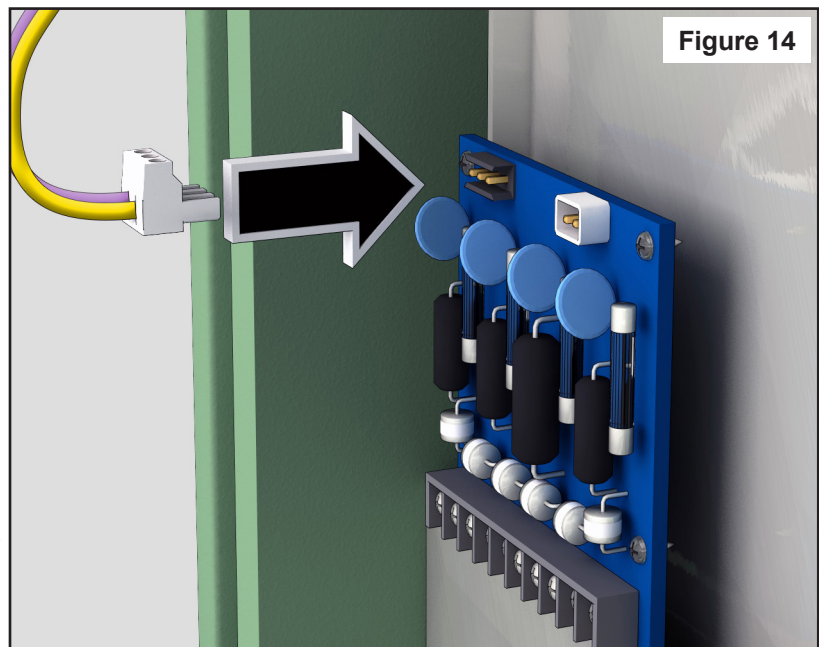
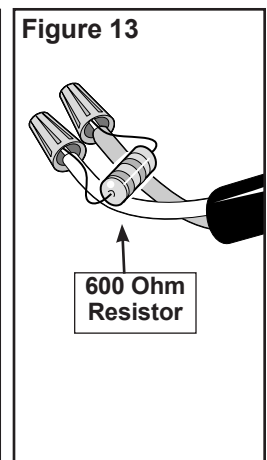
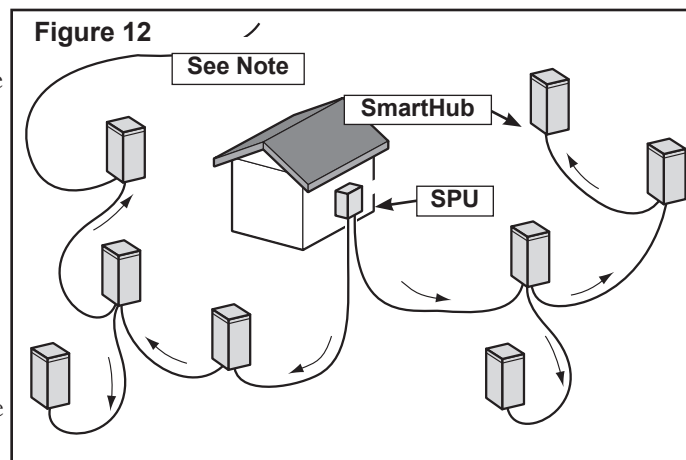


If additional communication cable is installed for future system expansion, connect a 600 ohm resistor across the wire pair at the end of the cable as shown in **Figure 13**.

2. At the SmartHub, cut the cable and pull both ends into the SmartHub through the 3/4" (16mm) sweep conduit.
3. At the cable ends, strip the outer jacket and inner insulation to expose the comm wires.
  - **SmartHub connection:** Attach a Phoenix 3-hole connector.
  - **SPU connection:** Attach a Phoenix 3-hole connector.
  - **FIU connection:** Attach a RJ-11 connector.
4. For the SmartHub, plug comm line into the modem port (**Figure 14**).



Remove the modem wire connector(s) until the comm cable has been tested. Refer to the installation instructions provided with the Central controller for testing procedures.




## Communicating with the Lynx SmartHub

A personal computer running Toro's "Lynx" software is necessary to communicate with the Lynx SmartHub. The SmartHub allows Lynx software to control over 9,000 sprinkler heads with individual precision.

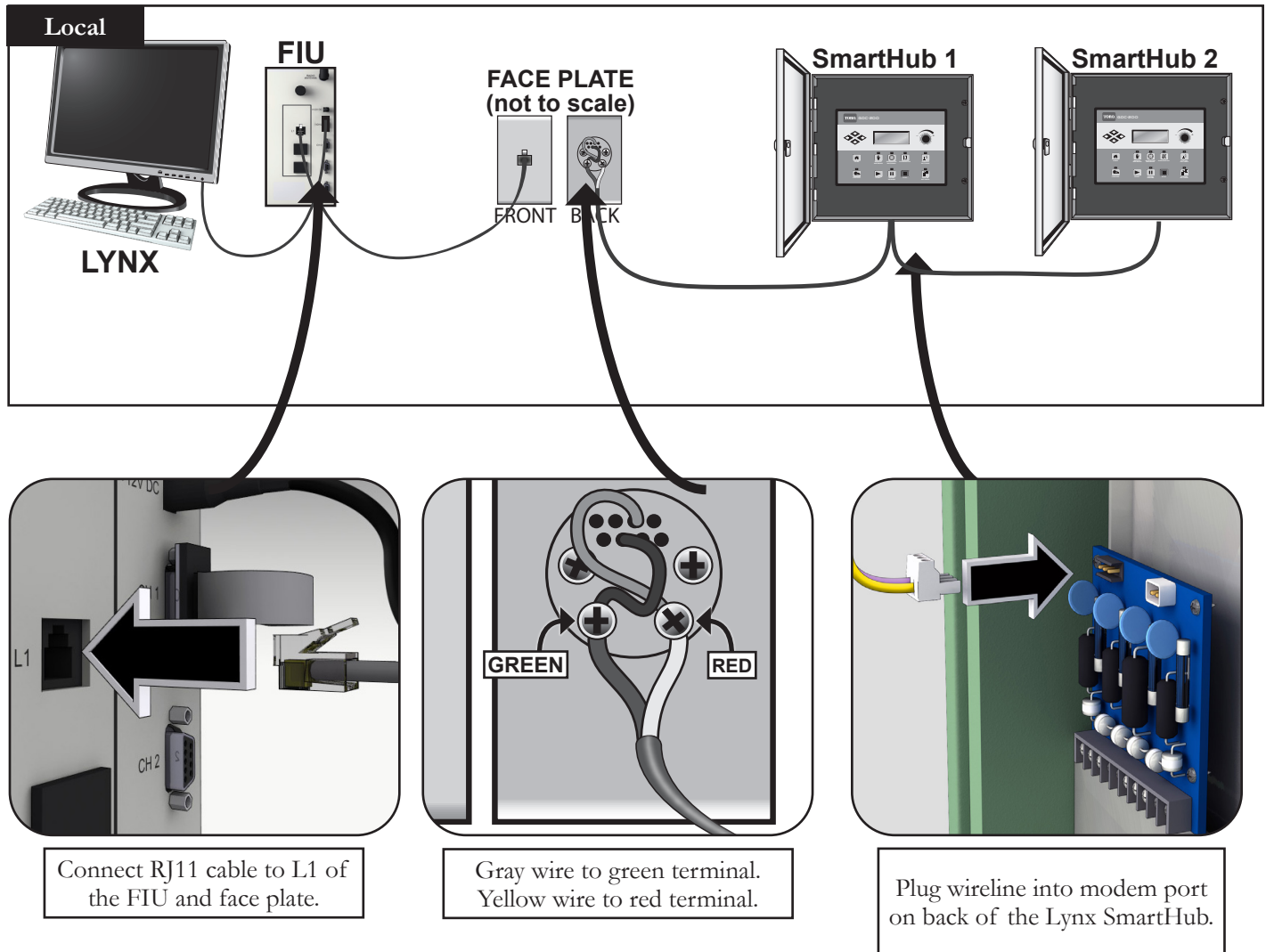
The Lynx computer is attached to a Field Interface Unit (FIU) which sends commands to the SmartHubs throughout the golf course.

There are two ways for the FIU to communicate with SmartHubs: by Wireline or by radio. This document shows **three typical layouts** making use of one or both methods.

 For the purposes of the layouts, the pedestal and cabinet Smart Hubs are interchangeable with each other.

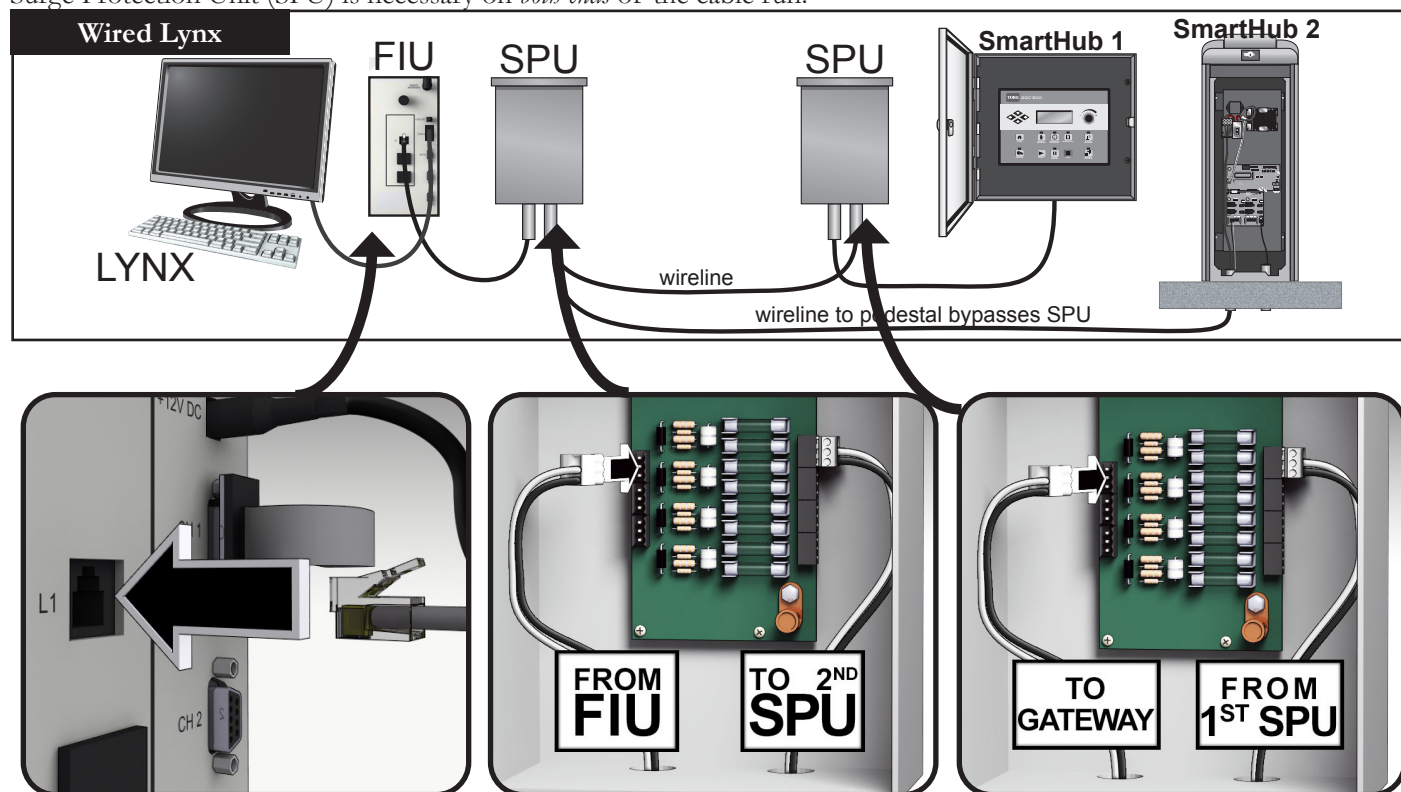
### Layout 1 - Local

The SmartHub is attached to the Field Interface Unit by a Wireline. The SmartHub typically resides in the office with the Lynx computer and FIU.



## Layout 2 - Wired Lynx

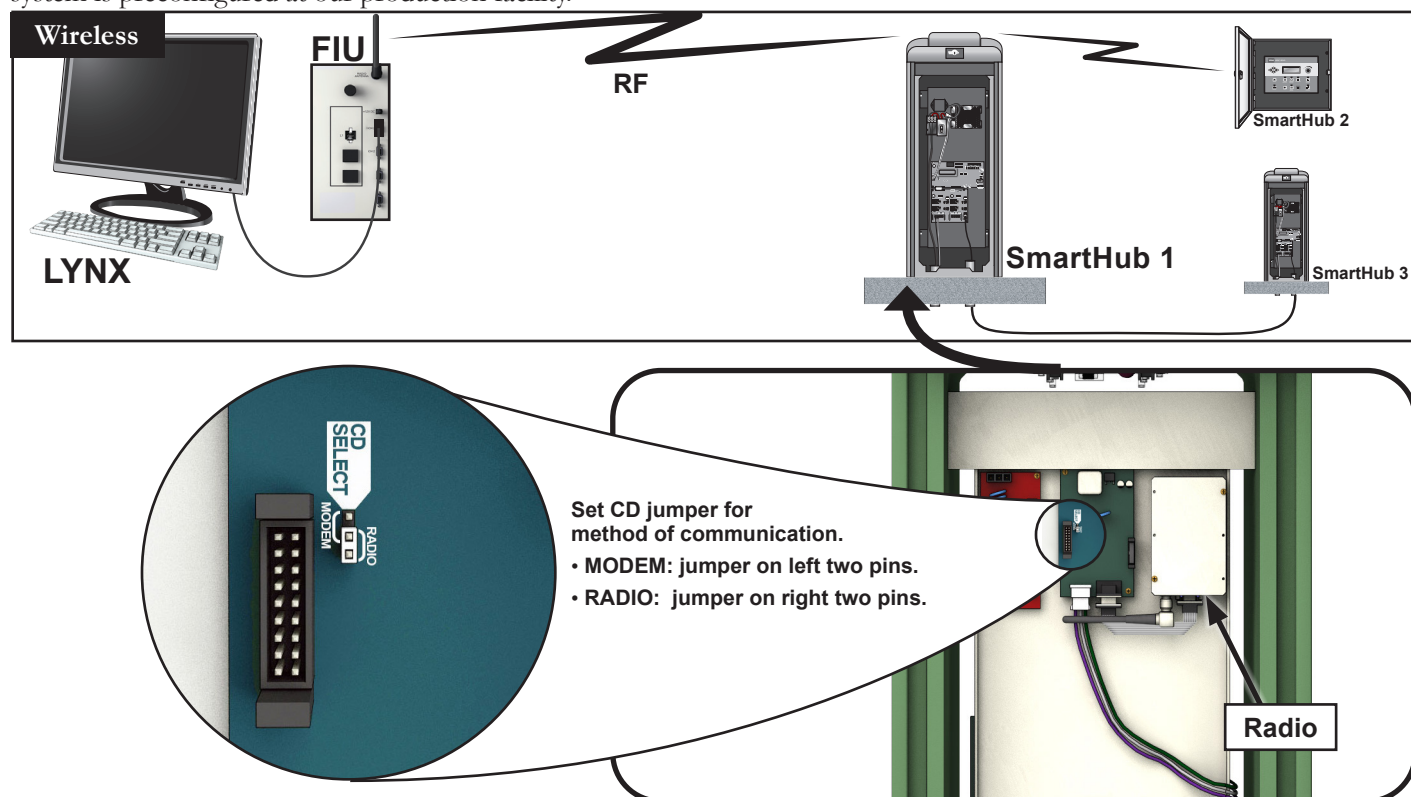
The Field Interface Unit is attached to the SmartHub which is out in the field. Due to this distance (see note below), a Surge Protection Unit (SPU) is necessary on *both ends* of the cable run.



The Wireline connection is limited to about 9 miles.

## Layout 3 - Wireless

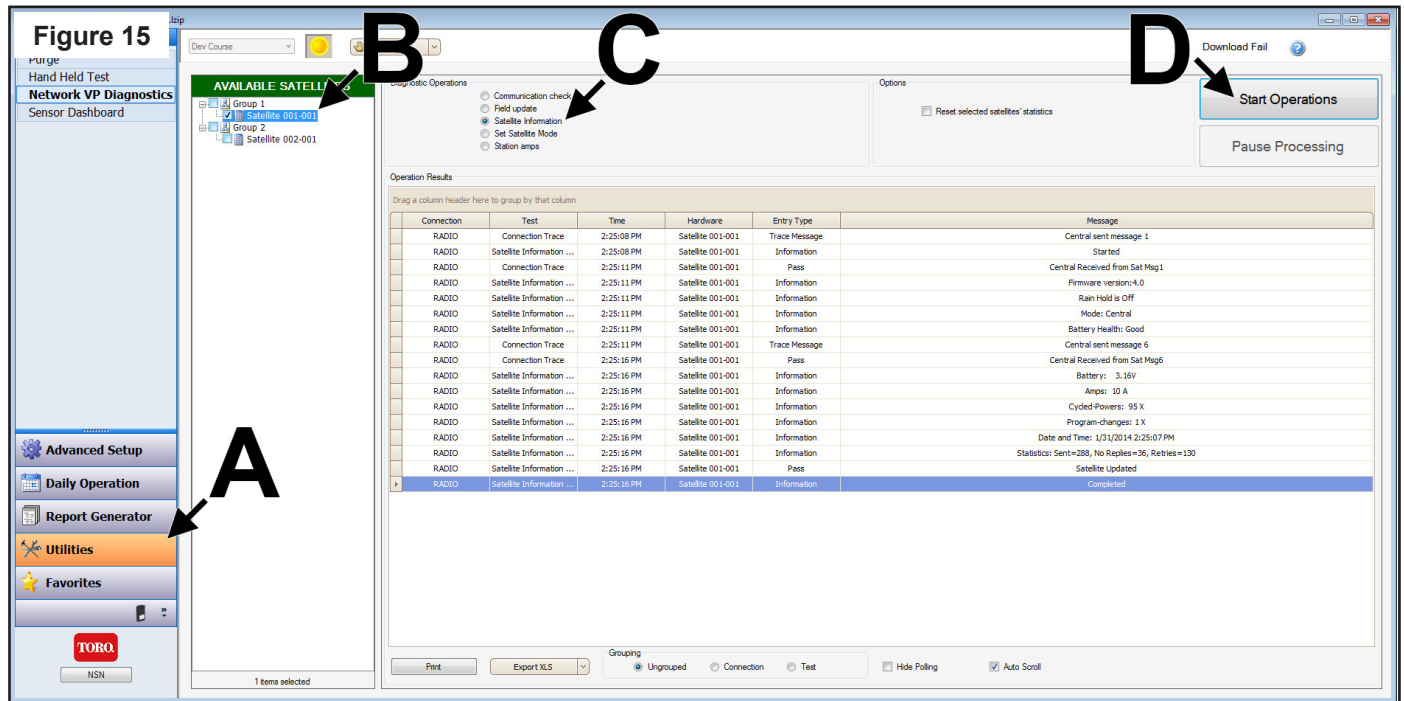
The Lynx SmartHub DEC-RS-1000-DR (digital radio and modem) communicates with the Lynx computer via radio. The system is preconfigured at our production facility.





## To Test Radio Communication Between the FIU and the Lynx SmartHub

1. Launch Lynx. See Figure 15.



- Click the Utilities bar (Figure 15, A).
- Select the desired satellite from the list (Figure 15, B).
- Select **SmartHub Information** radio button (Figure 15, C).
- Click **Start Operations** button (Figure 15, D). Certain SmartHub information should be displayed on the screen (Figure 16). If communication fails, the software will display a “fail” message (Figure 17).

**Figure 16**

Reset selected satellites' statistics

Drag a column header here to group by that column

Connection	Test	Time	Hardware	Entry Type	Message
RADIO	Connection Trace	2:25:08 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Satellite Information ...	2:25:08 PM	Satellite 001-001	Information	Started
RADIO	Connection Trace	2:25:11 PM	Satellite 001-001	Trace Message	Central Received from Sat Mag1
RADIO	Satellite Information ...	2:25:11 PM	Satellite 001-001	Information	Pass
RADIO	Satellite Information ...	2:25:11 PM	Satellite 001-001	Information	Firmware version: 4.0
RADIO	Satellite Information ...	2:25:11 PM	Satellite 001-001	Information	Rain Hold is Off
RADIO	Satellite Information ...	2:25:11 PM	Satellite 001-001	Information	Mode: Central
RADIO	Satellite Information ...	2:25:11 PM	Satellite 001-001	Information	Battery Health: Good
RADIO	Connection Trace	2:25:11 PM	Satellite 001-001	Trace Message	Central sent message 6
RADIO	Connection Trace	2:25:16 PM	Satellite 001-001	Trace Message	Central Received from Sat Mag6
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Pass
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Battery: 3.16V
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Amps: 10 A
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Cycled-Powers: 95 X
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Program-changes: 1 X
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Date and Time: 1/31/2014 2:25:07 PM
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Statistics: Sent=288, No Replies=36, Retries=130
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Pass	Satellite Updated
RADIO	Satellite Information ...	2:25:16 PM	Satellite 001-001	Information	Completed

**Figure 17**

Options

Reset selected satellites' statistics

Set Satellite Mode

Station amps

Drag a column header here to group by that column

Connection	Test	Time	Hardware	Entry Type	Message
RADIO	Connection Trace	2:27:06 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Satellite Information ...	2:27:06 PM	Satellite 001-001	Information	Started
RADIO	Connection Trace	2:27:18 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Connection Trace	2:27:30 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Connection Trace	2:27:41 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Connection Trace	2:27:53 PM	Satellite 001-001	Trace Message	Central sent message 1
RADIO	Satellite Information ...	2:27:59 PM	Satellite 001-001	Information	MSG1 failed to respond after 4 attempts.
RADIO	Satellite Information ...	2:27:59 PM	Satellite 001-001	Information	Statistics: Sent=283, No Replies=36, Retries=130
RADIO	Satellite Information ...	2:27:59 PM	Satellite 001-001	Information	Request timed out
RADIO	Satellite Information ...	2:27:59 PM	Satellite 001-001	Information	Completed



Radio range can vary. Under normal conditions, a range of two miles should be feasible. To boost radio range, mount radio antennas on masts.





If radio interference is a problem, please see the section below, “Changing the Frequency of the Radio”.

## Changing the Frequency of the Radio

At the time of installation, your authorized Toro installer should configure the radio to work properly. In the future, if it becomes necessary to change the radio frequency, there are two ways to change radio frequencies.

### Radio installed in SmartHub

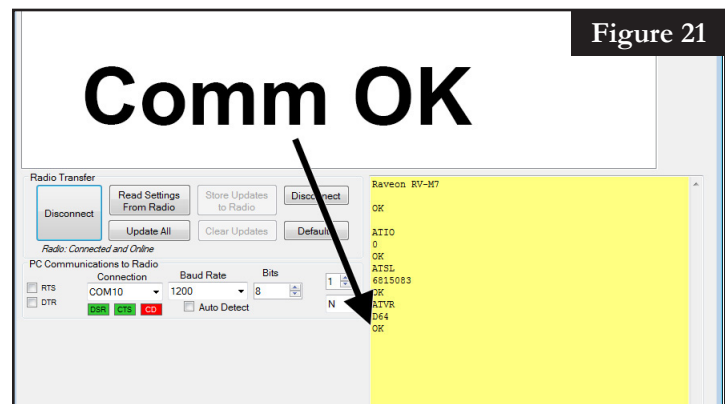
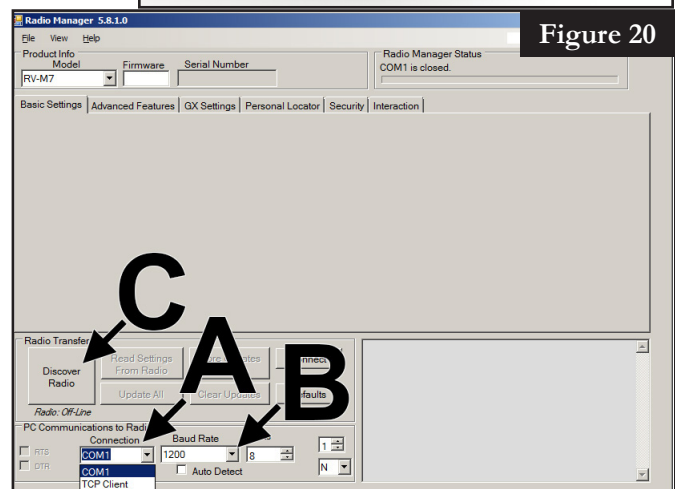
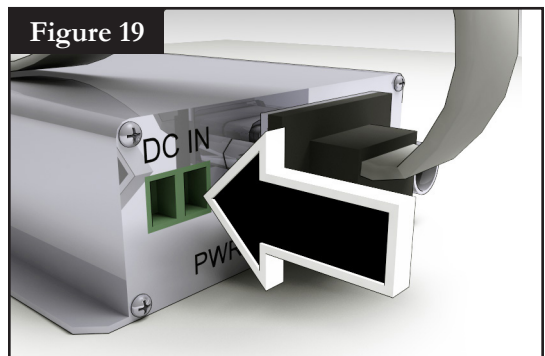
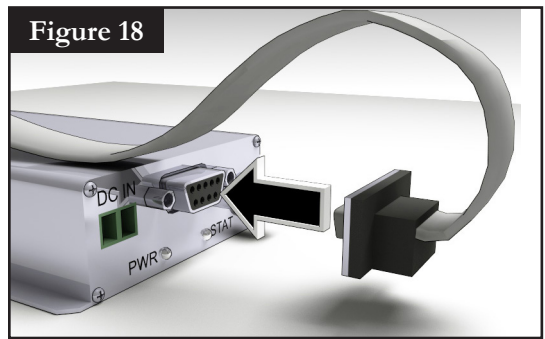
From the controller faceplate:

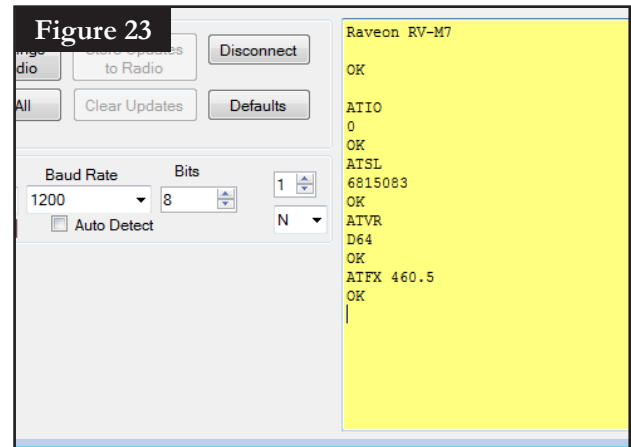
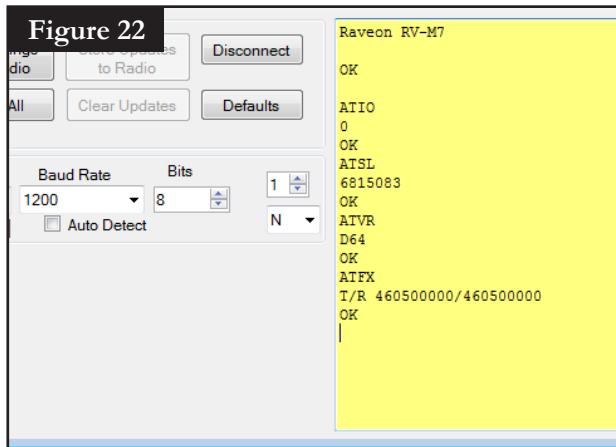
1. Press the  Diagnostics button.
2. Scroll to Radio Frequencies.
3. Use the arrow keys and Control Dial to adjust radio frequencies as needed.
4. Press  Home when done to save settings.

### Radio installed in FIU

You will need:

- Radio Manager software from Raveon
  - USB to Serial (DB9) cable with included drivers
  - 12V Phoenix power connector (from authorized Toro distributor)
  - 12V power supply for radio (from authorized Toro distributor)
1. Disconnect all power to the FIU. Remove the radio. Place it next to the Lynx computer on a static-free surface.
  2. At the computer running Lynx, install the drivers for the USB to Serial (DB9) cable. Reboot computer.
  3. Plug USB cable into a USB port and Serial port on radio (**Figure 18**).
  4. Connect Phoenix power cable into 12V power supply. Plug other end into DC IN port on radio (**Figure 19**).
  5. Plug in 12V power supply.
  6. Launch Radio Manager. See **Figure 20**.
  7. Select appropriate COM port (**Figure 20, A**).
  8. Change the baud rate to 1200 (**Figure 20, B**).
  9. Press 'Discover Radio' button (**Figure 20, C**). The computer should discover the radio (**Figure 21**).
  10. To see current radio frequency, enter **ATFX** into the command line (**Figure 22**).
  11. To change the frequency, simply add an appropriate frequency number to that command. Example: **ATFX 460.5**
  12. Software will confirm the change (**Figure 23**). It is possible to manually confirm the change by simply typing in **ATFX** again.
  13. Power down power supply and disconnect power line and serial cable.
  14. Install radio back into FIU.
  15. The UHF frequencies of the two radios involved (one in the FIU, one in the Lynx SmartHub) must match. Follow the above procedure with the radio from the Lynx SmartHub to specify a matching frequency.







An FCC license is required to operate on any given UHF frequency. Frequency coordination (selection) is handled through the Personal Communications Industry Association (PCIA) (800-759-0300) and an application must be submitted to the FCC. There is a PCIA fee and FCC license fee that must be paid as well.

## Operation

### Modes of Operation







The Lynx SmartHub can be placed in three operating modes: Central, Local, and Off. In all three modes, the SmartHub will accept communications from Lynx®. Select the mode of operation by pressing **Satellite Settings**  and selecting **Comm Mode**. Select from the three modes using the Input Dial .

**Central Mode** - When placed in Central mode, the SmartHub will water from irrigation lists, not programs. Irrigation lists are downloaded from the central; programs are not. Programs can be entered from the faceplate in all three modes, but will only water in Local mode. Central mode also allows Lynx to change most settings. If communication between central and SmartHub is interrupted for more than one hour, the Central Mode LED indicator will start flashing until communication is reestablished.

**Local Mode** - When placed in Local mode, the SmartHub will water from irrigation programs but not from lists. In Local mode, the SmartHub allows the central to set the date and time, but not affect programs or other settings that impact watering.
















**Off Mode** - When placed in Off mode, the SmartHub will not execute any watering operation whether it is program or manually initiated. Any watering operation will terminate once the SmartHub is placed in Off mode. Watering operations will resume once the SmartHub is placed back to Central or Local mode. In Off mode, the SmartHub will allow the central to edit time, date and operation mode but will not allow modification of settings affecting irrigation programs.

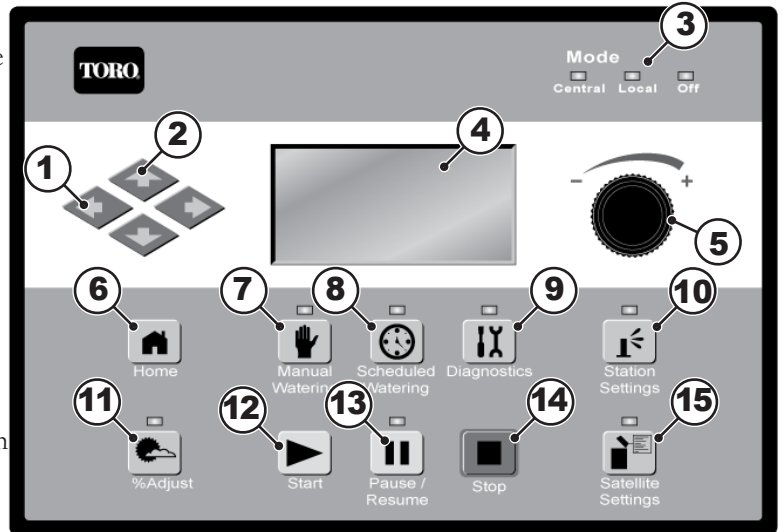
### General Editing

Pressing a menu key on the Lynx SmartHub will display menu items. Items with fields containing values that can be edited are called Entry Fields. Use the Arrow Keys     to navigate through the menus and entry fields. Modify any selected value by scrolling through the selection using the Input Dial . Values will be saved automatically when you exit an entry field or press another menu key. Pressing the HOME  button will also save any modification and revert back to Home display.

If no keypad activity is detected within five minutes, the SmartHub will automatically save any modifications and revert back to Home display.

## Timing Mechanism Components

1.   **Left and Right Arrows** allow you to select the next entry field within the same menu line. Any changes will be saved after you exit that entry field.
2.   **Up and Down Arrows** allow you to scroll up and down through the menu items.
3. **Operation Mode LED Display** will indicate the current gateway operation mode.
4. **LCD Panel** is the display screen.
5.  **Input Dial** allows you to scroll through the value selection within the selected entry field.
6.  **Home** button allows you to exit from any function menu and return the gateway to normal operation. After pressing the Home Key, all modifications to the settings will be saved.
7.  **Manual Watering** button allows you to activate station(s), syringe, or program(s) manually. See page 31.
8.  **Scheduled Watering** button allows you to create an irrigation program as well as view the Station Based Flow (SBF) list, which is the automatic watering schedule. See page 30.
9.  **Diagnostics** button allows you to view the gateway's firmware version as well as other diagnostic information. See page 33.
10.  **Station Settings** button allows you to modify station parameters. Within this setting, you can disable the station from any activity, hold station watering for a specific number of days, set the station type to a switch, review how long a particular station has run during the day, and add stations. See page 29.
11.  **Percent Adjust** allows you to adjust run times at either the satellite, program, or station level. See page 28.
12.  **Start** button will execute selected manual operation. See page 26.
13.  **Pause** will cancel a currently running station. See page 26.
14.  **Stop** button will cancel currently running program(s) or station(s). See page 26.
15.  **Satellite Settings** button allows the user to modify the SmartHub parameters. Users can specify the gateway communication mode, hold duration for gateway's activity, the language, clock settings, date, day change, CSG address, gateway address, station delay, maximum number of stations to run simultaneously, units and display contrast. Within this menu, the user can also reset all programs, reset the station parameters and reset all disabled stations. See page 27.





## Power-Up Diagnostics

Upon power-up, the SmartHub will display:

### Gateway TM Booting

The SmartHub TM will initiate a diagnostic test automatically during power-up. This function will take approximately ten seconds and it cannot be bypassed. If a problem is detected during the diagnostic test, it will be indicated on the display. The status information cannot be edited. The information is as follows:

Line 1: SmartHub Firmware Version and Revision Date

Line 2: Number and type of daughterboards detected

Line 3: Last Power Downtime Date and Time

Example:

```
Rev: 2.01p16,12/02/19
```

```
Detect: 2 DC DBoards
PD 12/11/19 09:00:51
```

The default Home display will follow after the diagnostic display has timed-out. Home display example:

```
Sun 04/02/19    05:57am
GW# 03:01-02    Sec: 57

Day Change:      03:00pm
Next Start:      06:00am
Lynx Smart Hub LSM
```

## Home Button

 Pressing the Home button will revert to the default display. When editing irrigation programs, Station or SmartHub settings, pressing the Home button will save any setting modifications and return the user to the Home display.

Home display examples:

```
Sun 04/02/19    05:59am
GW# 03:01-02    Sec: 57

Day Change:      03:00pm
```

(typical Home display with no active scheduled program)

```
Sun 04/02/19    06:01am
GW# 03:01-02    Sec: 57

Day Change:      03:00pm
Running 1 SBF List
P01 01-002 0:09:55L
```

(Example of home display while watering from a list. It is showing station 2 running with 9 minutes and 55 seconds remaining. It also shows the station setup as a switch.)

The GW# line displays the address of the controller. In the example above, the address of the SmartHub is Group 3. The address of the first station board is 01. The second station board address is 02.

The Day Change line displays the next program start time (Next Start: HH:MM) if the current day is an active watering day. If the SmartHub is running a program, the Day Change line will display **Running XX programs** to indicate the number of active programs.

If the SmartHub has an active running program, the display will read:

```
Sun 04/02/06    02:31pm
GW# 001-001    Sec: 57
Running 04 prg+ Man
```

(Running Multi-Manual)

P01 Sta01 (The “%” symbol before the runtime indicates that station 01 is percent adjusted.)  
 %00:05:00  
 P01 Sta02 (P01 indicates Program 01 is currently active)  
 00:05:00  
 P01 Sta03D (The “D” symbol after the station number indicates that station 03 is disabled.)  
 00:05:00  
 P02 Sta10P (The “P” symbol after the station number indicates that program 02 is paused.)  
 00:05:00  
 Man Sta21 (“Man” indicates Manual Watering is currently active)  
 00:10:00  
 Man Sta22S (The “S” symbol after the station number indicates that program 02 is stacked.)  
 00:10:00

## Start Button

► Use the Start button to execute either an irrigation program, a Multi-Manual operation, or a Syringe.

These are explained fully in the Manual Watering section, page 31.

```
Manual : M-Manual
Sat01 001-012 00:05
Simult : 003
Press ► to start
```

```
Manual : Start Prog
Program: 01
Press ► to start
```

```
Manual : Syringe
Runtime: 01 min
Program: 01
Press ► to start
```

Press the Stop button to cancel.

## Pause Button

⏸ The Pause button can be used to pause any running irrigation program or all irrigation activity.

```
Pause : Prg: 01
for : 00 hr 05 min
Press ⏸ to start
00 Programs paused
```






## Stop Button



■ Use the Stop function to cancel all irrigation (pictured), an active program, an individual station, a manual operation, or even a switch. If the Lynx SmartHub has no current activity, pressing the Stop button will have no effect. The Stop function causes a system cancel including power-down / power-up sequence for BOTH daughterboards regardless of station activity.

```
Cancel : All Watering
Press ■ to Cancel
Running 01 programs
P01 SwH01 00:01:00
```

SmartHub Settings



 Satellite Settings allows you to set SmartHub parameters such as Time, Date and Language.

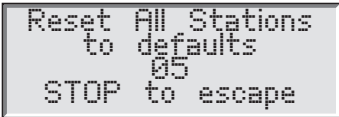
- Use the Up or Down Arrows   to navigate through the menus.
- Use the Left and Right Arrow   to advance to the next entry field on the same menu line.
- Use the Input Dial  to select values when editing.

Command	Function
Comm Mode:	Use this menu item to select the SmartHub mode of operation between Central, Local or Off mode.
Hold All:	This command suspends satellite operation. Select the suspension duration from <b>Today</b> , <b>02-30</b> days, <b>Permanent</b> or <b>None</b> . This does not affect manual starts from the front panel.
Hold Rain:	This command suspends satellite operation. Select the suspension duration from <b>Today</b> , <b>02-30</b> days, <b>Permanent</b> or <b>None</b> . When activated, Hold Rain will cancel any current watering, along with suspending operation. This does not affect manual starts from the front panel, nor does it affect stations defined as switches.
Reset Prg's:	This command resets all programs by selecting Yes All. After selecting Yes All, press the Up or Down Arrows   to activate. There is a short countdown before the command executes during which the command can be cancelled.






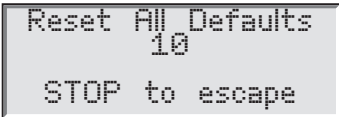
All program settings will be erased after a successful reset.

**Reset Sta's:** This command resets all station settings by selecting Yes. After selecting Yes, press the Up or Down Arrows   to activate. There is a short countdown before the command executes during which the command can be cancelled.













All station settings will be erased after a successful reset.

**Reset Unit:** This command resets the SmartHub settings by selecting Yes. Select Yes using the Input Dial  and press the Up or Down Arrows   to activate. There is countdown during which the command can be cancelled before the SmartHub reboots.




Resetting the unit will erase all user-defined program data and configuration values in the SmartHub's memory.

Power Mode:	This setting shows the power mode as “Switched” or “Continuous”. We recommend “Switched”.
LSM System:	This setting sets the type of decoders attached to the SmartHub controller. Options: Yes or No.
Send OFFs:	This setting will send an extra OFF command when a station or irrigation program is stopped or ends. Options: Yes or No. We recommend No.
Enable Sta's:	This setting resets all disabled stations with one execution. Select Yes All using the Input Dial  and press the Up or Down Arrows   to activate. Select No to cancel. Individual stations can be enabled/disabled by using the Disable function within the Station Settings menu.
Language:	Default language is English. Options are English, Spanish, French, and Italian.


- Clock Set:** This setting sets the current time. Use the Left and Right Arrow Keys   to select the Hours and Minutes parameters then use the Input Dial  to modify the values.
- Clock Mode:** Use this menu item to select the clock mode between Am/Pm (12-Hour) and 24-Hour mode.
- Date Mode:** Use this menu item to select the date mode: MMDDYY or DDMMYY.
- Date:** This setting sets the current date. Use the Left and Right Arrow Keys   to select the Month, Date and Year parameters then use the Input Dial  to modify the values.
- Day Change:** This setting sets the “day change” time. The “day change” is the specified time that the SmartHub will advance the date. The default day change is 12:00 am. Adjusting the day change time will allow programs to start throughout the night on the same active day schedule. Programs with runtimes beyond the day change time are allowed to finish.
- CSG Address:** This setting sets the CSG (Central SmartHub Group) address. Lynx uses this address to identify different SmartHub groups.
- SAT Address:** This setting sets the SmartHub address. Each SmartHub must be given a unique SmartHub address. Lynx uses this address to identify individual SmartHubs when sending SmartHub specific commands.
- Sta Delay:** This setting sets the station delay, in seconds, before any individual station activates. This feature helps avoid water hammer.
- Max Sim Sta:** This setting sets the maximum number of simultaneously operating stations. This threshold will be applied to all programs and manual irrigation functions. Each program can be set with a lower limitation if necessary. This setting is set in Lynx and downloaded to the SmartHub.
- Set Password:** Use this command to set a password to prevent unauthorized access to the menu system. The menu system can still be reviewed but no values changed.
- Display Adj:** This setting adjusts the contrast of the LCD screen. Use the Input Dial  to darken or lighten the text display.

## % (Percent) Adjust


 The percent adjust function allows you to fine tune irrigation programs, stations, or the satellite as a whole (as in, all Programs and all stations connected to the satellite). With weather conditions changing constantly, Percent Adjust allows you to tune runtimes in your system easily without changing all the runtime values individually in the program.






Use the arrow keys and Input Dial to modify percentage values for the Satellite, selected program, or selected station.

```
Percent Adjust...
Satellite:      100%
Program:   P01   100%
Station:   S001   100%
```

 Percent Adjust does not affect manual operations or scheduled list activity.

Station Settings

 Station Settings allows you to set parameters specific to each station as well as access the Sensor Setup Menu for setting up a Rain or Flow sensor.

- Use the Up or Down Arrows   to navigate through the menus.
- Use the Left and Right Arrow Keys   to advance to the next entry field on the same menu line.
- Use the Input Dial  to select values when editing.

Command	Function	
Sensor Setup Menu	<p>Access the Sensor Setup menu by changing the board number.</p> <p>The Sensor Setup menu is accessible for <i>editing</i> when the statellite is in Local Mode and Off Mode.</p> <p>If satellite is controlled by a Lynx Central computer, this menu is available for <i>review</i> only.</p> <p>To get started, select which input the sensor is connected to (see page 16).</p> <p>Next, select the type of sensor, either RAIN, STAT, or FLOW.</p> <p>Input 1 only accepts flow sensors.</p> <p>Input 2 can accomodate either STATUS or RAIN sensors.</p> <p>Finally, configure sensor settings, such as whether a sensor is Normally Open or Normally Closed, the tipping point on a rain bucket sensor, whether a sensor generates an alarm or not, what activity will follow if a station does generate an alarm, and more.</p>	<div><pre>Sensor Setup Menu Input:  1  Type: FLOW I_WTW   : 12:00pm O_WTW   : 11:59pm I_Min   : 00000 gpm I_Max   : 00000 gpm</pre></div> <div><pre>Sensor Setup Menu Input:  2  Type: RAIN Tip     : 0.01 in Max     : 00.00 in Units   : English(in) Alarm   : Off</pre></div>
Board	Select the daughterboard, 1 or 2.	<div><pre>Board 1 Sat 001-001 S001 100% Dec Addrss: 174F42 Group 001-001, 001-1 Sched today 02:20:00 Water today 00:13:00 Water yestr None Disable  : No Hold Sta : None Is Switch: No</pre></div>
Sat	Displays the address of the currently accessed daughterboard. This value cannot be changed.	
Sta	Select the station to edit in this field. Choose from Station 01 through the SmartHub maximum station count of 500 (LSM) or 250 (GAC).	
%	Allows the operator to set the percent adjust for the selected station, if desired.	
Dec Addrss:	Decoder module addresses are downloaded from Lynx and can be entered or changed at the faceplate. Lynx will overwrite address changes in the TM when mapping or during a download.	
Group	Displays the express group numbers assigned to a station that allows it to work with express tests. If it says "LSM not assigned," then the station will not work with express tests. The assignment occurs when a station's address is changed and is not zero.	
Sched Today:	Total scheduled station runtime for the current irrigation day.	
Water Today:	Total station runtime that has occurred for the current irrigation day.	
Water Yestr:	Total station runtime that occurred for the previous irrigation day.	
Disable:	A disabled station or switch will countdown as if it is running, but will not turn on. Disable station operation by selecting <b>Yes</b> . Enable station operation by selecting <b>No</b> .	



- Hold Sta:** Use this menu item to skip scheduled operations for this station or switch for a specified period of time. Select the hold duration from **01–30 days**, **Permanent** or **None**. Holds do not affect manual operation.
- Is Switch** A station output can be configured as either a station or switch. A running station will turn the motherboard pump output on and will turn off during rain holds. A switch will not.

## Scheduled Watering



Scheduled Watering consists of watering from locally-scheduled programs in Local Mode or watering from the SBF List in Central Mode.

### Central Mode

Lists download from Lynx will water in Central mode. Programs will not. Lists cannot be edited at the faceplate.

### Local Mode - Programming a Program

1. Select the **Program** number.
2. Select a **percent adjust** number.
3. Specify a **hold** from zero to thirty days, or even permanent.
4. Select the **type** of irrigation program:
  - **Basic:** Irrigation is activated every day at the specified time for the specified duration.
  - **Advanced:** Irrigation occurs at specified intervals from 1 to 30 days (2 days pictured) or by selecting individual days over a two week period.
  - **Grow In:** A Grow In program is a user-defined additional irrigation cycle that runs in addition to the regular irrigation schedule. This is typically done when plants, trees, or lawn need extra water. A new sod lawn, for example, would benefit from a grow-in program for a couple of weeks or month.
5. For interval schedules, it is necessary to define **today's day** number. As in, if you specify a five day interval, and specify today's day as day 3, then the five day interval will start in two days.
6. Specify a Start time.
7. Specify a Syringe time (if any).  
(A syringe operation is a specific user-defined programmed additional "injection" of water into the normal irrigation cycle. A syringe operation might be scheduled to cool artificial turf on a hot day, for example.)
8. Specify a Repeats number. This is the number of times a syringe operation will run, separated by Soak times.
9. Specify a Soak time.  
Soak time is the time between syringe operations during which irrigation will not occur. It gives the water a chance to soak into the soil without running off, before the next syringe repeat operation commences.
10. Set run times for individual stations attached to the satellite.
11. Specify a Simultaneous number.







```
P01 100% 00:01:00
Hold: None
Type: Advanced
Water Every: 02 days
Today's Day: 01
Start : *01 09:07am
Syringe: 01 min
Repeats: 0
Soak : --:--:--
Sat01 001-001 1:00
Sat01 ----- --:--
Simult : 001
```

Besides setting up an irrigation program, it is also possible to review the Station Based Flow Management Lists, which are the automatic programs downloaded from the Central computer running Lynx software.

## Station Based Flow Management:

To review the SBF (Station Based Flow) Lists, access the SBF screen from the Scheduled Watering menu.

Follow the steps to access.

1. Press the Scheduled Watering Key . The cursor is initially located at the program selection field. Use the Input Dial  to select **SBF List** which is located between the first and last programs.  
 The SBF List is only available after a successful download from the Central computer.  
 There can be two lists in a LSM/GDC controller. They are accessed by arrowing to the right and adjusting the Sat field. For example, Sat01 is the first list that runs stations from the first daughterboard, and Sat02 is the second list that waters stations from the second daughterboard.
2. Use the Right arrow  to navigate to the event number.
3. Use the Input Dial  to select the event number you want to review.


SBF (Station Based Flow) Sample Screen:

```






SBF List Event   001  (1st line will indicate the Event Number)
Start   12:00am   S22  (2nd line will indicate the Start Time followed by the Station Number)
Run     00:10:00  P26  (3rd line will indicate the Runtime [Hrs:Min:Sec]
                        followed by the Program Number)
Program Start   (80)  (4th line indicate Miscellaneous Functional Code)
  
```

- 
- Editing the SBF List is not allowed at the SmartHub level. SBF modifications must be made at the Central computer and downloaded to the SmartHub to implement changes.
- 
- 
- SBF Lists are disabled when the controller is in Local Mode.

## Manual Watering


 The Manual Watering functions are used for additional watering if the irrigation program is not sufficient. They can also be used to troubleshoot each station for proper operation. The button accesses the Multi-Manual function, Start Program function, and a Syringe function .

**Start Program** - Use this command to manually activate an entire irrigation program. The irrigation program must of course already be configured correctly to manually activate one. A program on hold can still be manually activated.








1. Press the Manual Watering Key .
2. The cursor should be located in the Manual field, use the Input Dial  to select Start Prog.
3. Press the Down Arrow  to move to the Program field.  
Use the Input Dial  to select the program to run.
4. Press the Start Key . Irrigation begins immediately.

```


Manual : Start Prog
Program: 01

Press  to start
  
```

**Syringe** - Select a Syringe program to activate all stations in a selected irrigation program for a specified runtime.

1. Press the Manual Watering Key .
2. The cursor should be located in the Manual field.  
Use the Input Dial  to select Syringe.
3. Press the Down Arrow  to move to the Runtime field.  
Use the Input Dial  to specify the desired runtime in minutes.
4. Press the Down Arrow  to move to the Program field.  
Use the Input Dial  to select the program to run.
5. Press the Start Key . Irrigation begins immediately.

```

Manual : Syringe
Runtime: 01 min
Program: 01
Press  to start
  
```

**M-Manual** - Select M-Manual to activate a station or group of stations with a specified runtime.

### Multi-Manual Station Activation Directions

Manual station activation example: Activate stations 1–12 with a runtime of 5 minutes each and limit watering to 3 stations simultaneously.



The Multi-Manual function is limited to the maximum simultaneous station settings of the SmartHub. In cases where a program is running and a multi-manual activated, the SmartHub will activate all stations specified in the multi-manual in addition to the currently activated stations. Thus, the multi-manual will allow the SmartHub to exceed the maximum simultaneous station settings.

1. Press the Manual Watering Key .
2. The cursor should be located in the Manual field.  
Use the Input Dial to select M-Manual.
3. Press the Down Arrow to advance the cursor to the Sat#: field.  
Use the Input Dial to select the correct value of the station group or daughterboard or satellite to run.  
Use the Right Arrow to advance the cursor to the first station of the range to run. Use the Input Dial to select the correct value of the first station being irrigated. For this example, select station 01.
4. Press the Right Arrow to advance the cursor to the last station of the range. If irrigating only one station, this value should be the same as the first value. For our example, select station 12.
5. Press the Right Arrow to advance the cursor to the next entry field. This entry field will indicate the runtime in hours and minutes (HH:MM). Use the Input Dial and the Right Arrow Key to select the appropriate runtime value. For our example, set the value to 00:05.
6. Press the Down Arrow to advance the cursor to the next entry field. Notice that a new Station: line was created. Fill this line only if irrigating a second range of stations. Otherwise, leave this line blank.
7. Press the Down Arrow to advance the cursor to the Simult: field. Use the Input Dial to select the maximum simultaneous irrigating stations. For this example, set the value to 03.
8. Once finished, press the Start Key to activate.  
To cancel, press the Home Key . The screen will revert back to the default display.

```
Manual : M-Manual
Sat01 001-012 00:05
Simult : 003
Press  to start
```



Pressing the Home Key saves the entered values.





The SmartHub containing the desired station to be started can be selected by highlighting 'x' in the "BDx" field.

When reviewing the Multi-Manual program by pressing the Manual Watering button, the display removes the stations that watered or are currently watering from the list.

Modifying the Multi-manual appends the added stations to the currently running manual operation. Currently running stations are not affected. The SmartHub runs the stations in sequential order, disregarding the order in which the stations were entered.

## Diagnostics

 The Diagnostics function of the remote SmartHub allows for easy system troubleshooting. Within this function, the user can monitor the SmartHub's internal voltages as well as check the firmware version.

Use the Input Dial  to navigate through the menus while in the **Menu:** field.

**Menu: Link Monitor** Allows user to monitor communication network traffic.

```
Menu: Link Monitor

Naks: 000 Msg#: 000
FE: 000 Other:000
```


**Menu: System Monitor** Allows user to monitor all the SmartHubs in the system.

**Menu: Revision** Displays the SmartHub firmware version and creation date.

Scroll down to view the motherboard firmware version as well.

```
Menu: Revision

Revision: 2.01p09
Rev Date: 10/9/19
GWY FL Ver 1.0 10/04/12
TM Hardware Ver: 1
```

**Menu: PowerUp Detect** Displays the number of detected stations, number of detected sensors. It will also display the date and time of the last power-down (PD) and last power-up (PU). Press the Down arrow  to scroll down the informations.

```
Menu: PowerUp Detect

DC 2/500 DB[1,1,0,0]
PD 01/11/19 14:22:20
PU 01/12/19 09:57:24
I2C Events : 000 000
Reset Type : 09
Wire line found: No
Radio Anlg Enbl: No
```

**Menu: Stations Alarms** Displays any alarms generated by communication failures between the TM and any of its stations.

**Menu: Station Last On** Displays the time, date, current, and voltage of the last activated station.

**Menu: Sensor Monitor** Displays real-time sensor information for all enabled sensors.

Scroll down to review Rain Today, Rain Yesterday, and Rain Window amounts.

```
Menu: Sensor Monitor
Hub Sensors
Inpt 1 Flow: 98.15gpm
Inpt 2 Rain: 00.20in
Inpt 3 Stat: CLOSED
```

**Menu: VA Monitor** Allows user to monitor the SmartHub's amperage, voltages and temperature in real-time. This would be used when troubleshooting the SmartHub's internal circuit voltages.




```
Menu: VA Monitor
Battery: 3.2V
LCD: 27C UL:-3.5V
```

**Menu: DB Monitor**

Displays the voltage and amperage of the daughterboards attached to the motherboard, as well as the amps for L1 and L2 (black and white respectively) terminals.

```
Menu: DB Monitor
          DB1      DB2
Volts    38.8V
Amps     0.000A
L1       0.000A
L2       0.000A
```

**Menu: Event Codes**

Displays the SmartHub's Event Code log. You can clear the log from this option. Navigate to the Clear field using the Down arrow , select Yes using the Input Dial  + and press the Down arrow  to activate.

```
Menu: Event Codes
Clear log: No
Last Code: 131, 005
01/12/12, 09:37:20
```

**Menu: Decoder Communications**

Displays real-time communication data between the TM and a decoder.


```
Menu: Decoder Comm.
Sent: Rd Flow Bd1
Resp: Ok
Total bad Resp: 000
Total Timeouts: 000
Clear Totals : No
```


**Menu: Decoder Diagnostics**

This command allows the user to run diagnostic tests that send messages to decoders and modules. The faceplate will show the last test performed at the TM. The tests include:

- communication (pictured)
- solenoid (pictured)
- LSM voltage
- LSM amps
- LSM version
- LSM Hardware Errors
- LSM Grp02 Info
- LSM Grp16 Info
- LSM Group Ping
- Group Volts
- Group Amps
- Group Errors
- Group Sta's On
- LSM Grp Charge Fail
- Cable Resistance (pictured) \*
- Decoder Output \*
- Decoder Version \*
- DBoard Output \*
- DBoard Version \*

```
Menu: Decoder Diag.
Communication
Brd 01, Sta 001
Press  to start
34.78V 0.14A
Status: 03 DONE
```

```
Menu: Decoder Diag.
Solenoid
Brd 01, Sta 001
Press  to start
Result: 00 Out1 OK
Status: 03 DONE
```

```
Menu: Decoder Diag.
Cable Resistance
Brd 01, Sta 001
Press  to start
1.25V/0.31A = 4.1Ω
Status: 03 DONE
```

**Note:** Tests marked with an asterix (\*) are for GAC only.

**Menu: Radio Tx Chars**

This menu item transmits numerical sequences to another radio for troubleshooting purposes.



**Menu: Radio Ping** For this menu item to work, the radio needs an address. The radio address is generated from the Satellite address. The radio within the satellite and the target radio must be on the same frequency. The number returned is the communication time between the radios in ms.

**Menu: Radio Information** Displays information about the installed radio.

```
Menu: Radio Info.
Model#:      RU-M7
Version      E28
Serial#      15241181
Last RSSI    -dB
Get more:    no
```

**Menu: Radio Settings** Displays the radio address, power consumption, and whether RSSI is enabled or not. RSSI is Received Signal Strength Indication.

```
Menu: Radio Settings
Radio Power:  040%
Radio Addr:   1181
RSSI Enable:  No
Set Radio Dflts: No
```

**Menu: Radio Frequencies** Displays the radio's send and receive frequencies. The frequencies can be adjusted from this screen.

```
Menu: Radio Freq's
Channel: 1

Rx Freq1 465.5000MHz
Tx Freq1 465.5000MHz
```

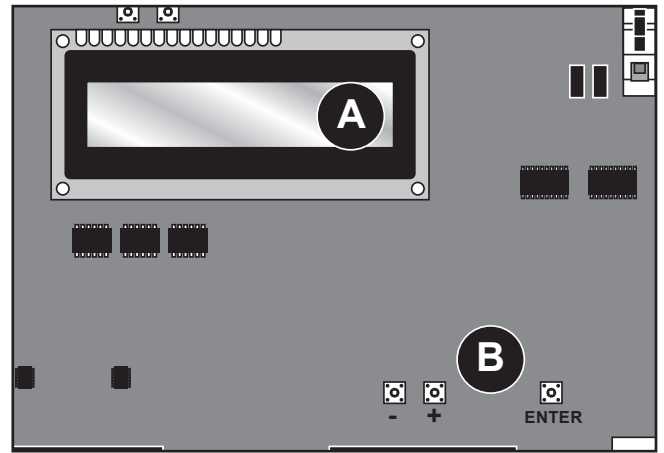
**Menu: Message Log** Displays the logged messages. The Message Log history can be cleared from this screen as well.

**Menu: Link Settings** View the SmartHub's communication settings. A couple of parameters, such as lead time and whether there is a radio or not, can be edited.

```
Menu: Link Settings
Lead (On):   030ms
Hang: (Off): 010ms
Baud Rate:   1200
Radio: Digital (Dig)
RSSI Enable: No
```

## Motherboard Diagnostic Display

The SmartHub motherboard features a 2-line, 16 character LCD display (A) for quickly viewing for system diagnostic information. Use the - and + buttons (B) to scroll through the display lines and available options and the ENTER button to clear alarms when prompted.



```
Rev 10.1.3
11/13/2019
```

After power up, the screen will display board's firmware version.

```
D1 = OFF
D2 = OFF
```

```
D1=0.024 38.6V
D2=0.024 38.6V
```

After the initial Revision screen, the display will show the real time current and voltage for both daughterboards if they are on.

```
D1L1=0.24A
D1L2=0.24A
```

```
D2L1=0.24A
D2L2=0.24A
```

The display will also show the load currents by individual wires of a two-wire communication line.

```
1 open 0
2 open 0
```

The display will show the Rain and Pump Pressure sensor state followed by count and will be updated in real time.

```
Tx: ----
Rx: ----
```

The display will show the information contained in the message during transmission execution. The information will only be displayed while the transmission is being executed. The display will refresh if a different command is transmitted.

```
10:47:18
11/21/2019
```

The display will show the time and date.

```
Flow = 00.00 Hz
```

The display will show the real time pulse frequency of the flow sensor input.

## Alarm Conditions

All of the Alarm Conditions, when active, toggle back and forth between the two message states below.

### Thermal Alarm

```
D1 Thermal
D2 A=0.500
```

```
Hold Entr to Clr
D2 A=0.500
```

- Shuts off and disables daughterboard indefinitely.
- Motherboard LCD toggles alarm and instruction on how to re-enable the daughterboard.
- Affected daughterboard's alarm LED blinks on and off.

### Amp Limited Alarm

```
D1 Amp Limited
D2 A=0.500
```

```
D1 A=1.100
D2 A=0.500
```

- Triggered when individual daughterboard's load current is above 1.0 Amps.
- Does NOT shut off or disable daughterboard.
- Motherboard LCD toggles alarm and instruction on how to clear the alarm.
- Affected daughterboard's alarm LED blinks on and off.

### Phase Current

#### Imbalance Alarm

```
D1L1 High Amp
D2 A=0.500
```

```
D1L1 A=0.750
D2 A=0.500
```

- Triggered when load current of one wire is 2x higher than the opposite wire for a minimum 20 seconds.
- 20 second timer is reset when load current of one wire is no longer 2x higher.
- Does NOT shut off or disable daughterboard.
- Motherboard LCD toggles alarm and instruction on how to clear the alarm.
- Affected daughterboard's alarm LED blinks on and off.



The display difference between the **High Current Alarm** and **Phase Current Imbalance Alarm** is subtle: Notice the two-character difference in the display on the first line: "D1" (High Current Alarm) vs. "D1L1" (Phase Imbalance).

### Clear Alarms

To clear any of the above alarm conditions, hold ENTER to clear the alarm.

## Specifications

### Radio

Equipment Type – Data radio, Raveon RV-M7-UC  
 Frequency Band – UHF  
 RF Output Power – 2.0 watt  
 Current Consumption:  
 Standby (Muted) – < 65 mA  
 Transmit 2 watts RF power – < 1.0A  
 FCC License: FCC ID# SRS-RV-M7-UC

### Fuse and Circuit Breaker

#### Power Supply:

1.5A On/Off Switch/Circuit Breaker – Main Power Input  
 3.2A Fuse (Slow-Blow) – Field Output

**Output Board:** 3.2A Fuse

### Lynx SmartHub

- **Cabinet:** Non-corrosive, lockable wall mount, indoor/outdoor installation
- **Pedestal:** Non-corrosive, lockable pedestal, indoor/outdoor installation
- Six 1" (25.4mm) conduit openings and one 1 1/2" (38mm) conduit opening
- Controls up to 1000 stations
- **Rated Input Voltage:** 100-240 VAC, 50/60 Hz
- **Rated Input Current:** 1.6A
- **Rated Output Current:** 1.8A max.
- **SmartHub output voltage:** 40 VAC
- **SmartHub output power:** 75W max.
- **Automatic Action:** Type 1.C product  
Impulse Voltage: 2500V
- **Operating Temperature:** 0°C to +60°C (32°F to 140°F)
- **Storage Temperature:** -30°C to +60°C (-22°F to 140°F)
- **Ball Pressure Test Temperature:** 257°F (125°C)  
**Glow Wire Test Temperature:** 1,562°F (850°C)

## Warranty and FCC Notice

### Warranty

The Toro Company and its affiliate, Toro Warranty Company, pursuant to an agreement between them, jointly warrants to the owner each new piece of irrigation equipment (featured in the current catalog at date of installation) against defects in material and workmanship for a period described below, provided they are used for irrigation purposes under manufacturer's recommended specifications.

During the warranty period, we will repair or replace, at our option, any part found to be defective. Your remedy is limited solely to the replacement or repair of defective parts.

This warranty does not apply (i) to Acts of God (e.g., lightning, flooding, etc.); or (ii) to products not manufactured by Toro when used in conjunction with Toro products, or (iii) where equipment is used, or installation is performed in any manner contrary to Toro's specifications and instructions, nor where equipment is altered or modified.

Return the defective part to your irrigation contractor or installer, or your local Golf Irrigation Distributor, or contact The Toro Company, 5825 Jasmine St., Riverside, California, 92504, (800) 664-4740, for the location of your nearest Toro distributor, or outside the United States, call (951) 688-9221.

Neither Toro nor Toro Warranty Company is liable for indirect, incidental or consequential damages in connection with the use of equipment, including but not limited to vegetation loss, the cost of substitute equipment or services required during periods of malfunction, or resulting non-use, property damage or personal injury resulting from installer's actions, whether negligent or otherwise. Some states do not allow the exclusion of incidental or consequential damages, so the above exclusion may not apply to you.

All implied warranties, including those of merchantability and fitness for use, are limited to the duration of this express warranty.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state-to-state.

All Toro golf control systems (central controls, field satellite controllers, GDC, CDS and Turf Guard), unless covered by a Toro NSN Support Plan, are covered by this warranty for one year from date of installation.

### Radio complies with FCC Part 22 and Part 90 of the FCC Rules

**Domestic:** This equipment has been tested and found to comply with the limits for a FCC Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to the radio communications. Operation in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**International:** This is a CISPR 22 Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures. Each station can activate up to two solenoids.

This product, utilizing a Class 2 transformer tested to UL1585, satisfies the requirements of a Class 2 Power Source as defined in the NFPA 70 (NEC), Article 725.121(A)(3).

Notes

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 WARNING: Cancer and Reproductive harm – [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).  
For more information, please visit [www.toro.com/CAProp65](http://www.toro.com/CAProp65).

Patent: [www.ttcopats.com](http://www.ttcopats.com)