Lynx® SmartHub for LSM, LAC, and GAC

Installation and User Guide (DEC, LAC, and DAC Series)

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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), LAC, or GAC.

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 twelve versions:

- DEC-RS-1000-DR (digital radio)
- DEC-RSP-1000-M (modem only)
- DEC-RSB-1000-M
- DEC-RST-1000-M
- LAC-RS-1000-M
- LAC-RSP-1000-M
- LAC-RSB-1000-M
- LAC-RST-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.

Note for model numbers:
DEC is also referred to as LSM.
DAC is also referred to as GAC.

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.

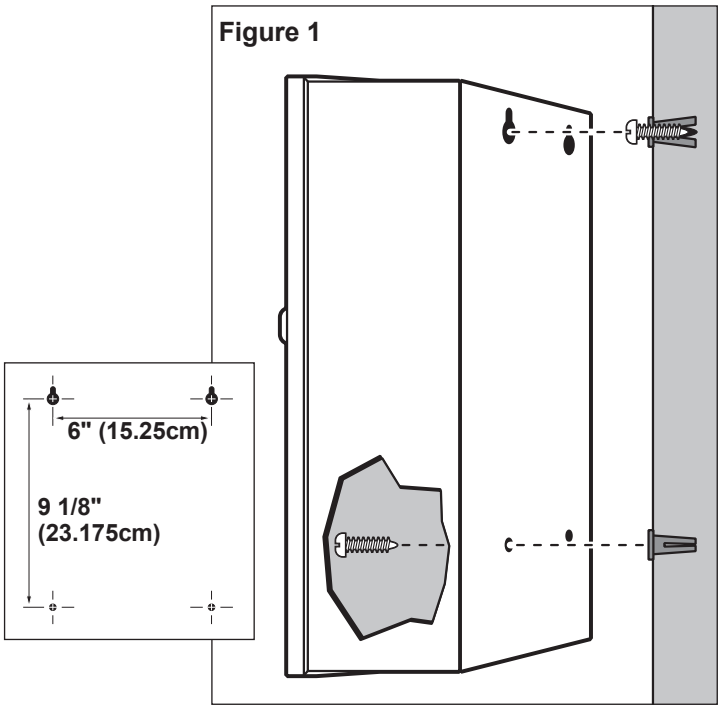
IMPORTANT! Use power tool and equipment suitable for the application. Consult and follow the safety guidelines outlined by the power tool or equipment manufacturer.

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.

   User a #10 one-inch screw or equivalent. 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

IMPORTANT SAFETY INSTRUCTIONS

THIS PRODUCT MUST BE INSTALLED IN ACCORDANCE WITH THE APPLICABLE INSTALLATION CODE AND LOCAL JURISDICTION BY A PERSON FAMILIAR WITH THE CONSTRUCTION, INSTALLATION, AND OPERATION OF THE PRODUCT AND THE HAZARDS INVOLVED.

THE USE OF OR INSTALLATION OF JUNCTION BOXES, CONDUIT BODIES, AND FITTINGS SHALL BE FOR THE INSTALLATION AND INTENDED USE AND IN ACCORDANCE WITH APPLICABLE ELECTRICAL CODE. CONSULT WITH A QUALIFIED ELECTRICIAN AND LOCAL ELECTRICAL CODES BEFORE INSTALLING ANY ELECTRICAL PRODUCT.

DISCONNECT ALL POWER BEFORE SERVICING. ENSURE MAIN AC BREAKER IS OFF. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY DUE TO ELECTRICAL SHOCK HAZARD.

Steps:

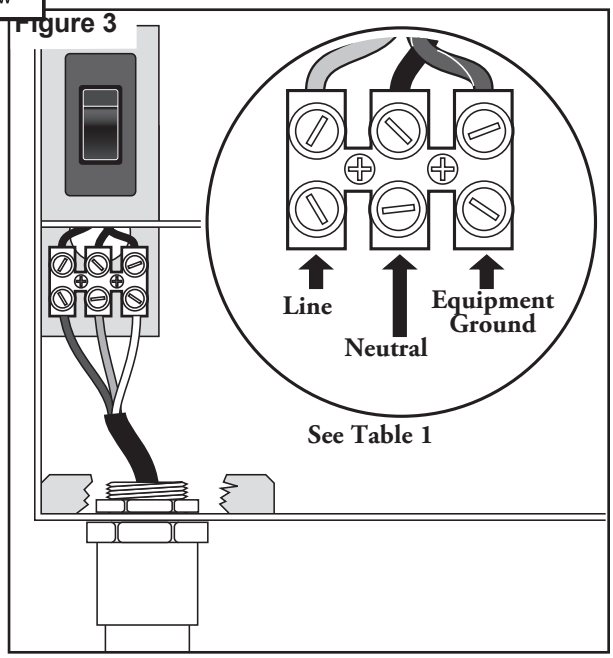
1. Turn off the power at the power source location and place the controller's power switch to OFF. Connect and route the appropriate size 3-conductor cable (14 AWG [2.5mm^2] maximum) from the power source to the controller cabinet.

   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
200 – 240 VAC (International)	Hot (Brown)	Neutral (Blue)	Green / Yellow

Figure 3



Pedestal Installation

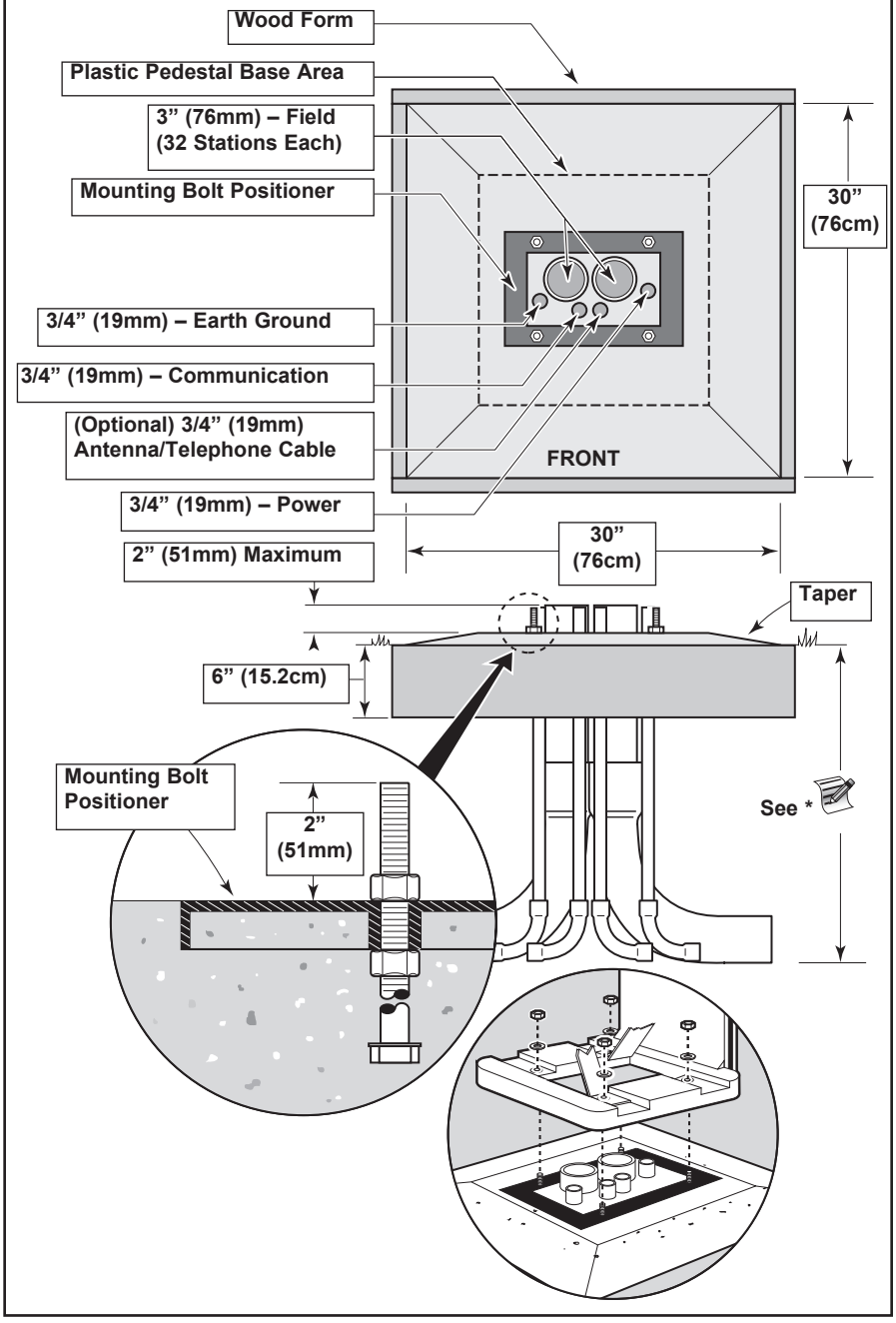
Foundation Construction

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).

IMPORTANT! Prior to excavating, digging, or trenching, consult with local utility locating service or authority having jurisdiction to prevent damage and protect utility infrastructure.

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' (10mm² 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 (10mm²) 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.

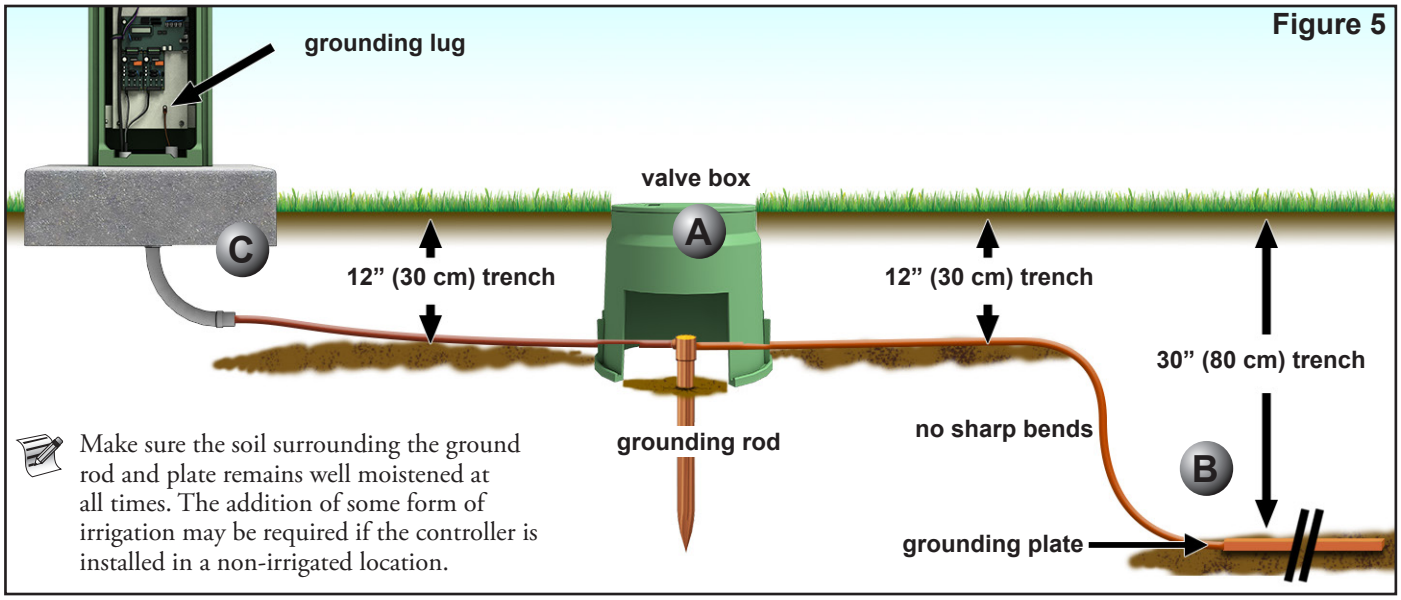
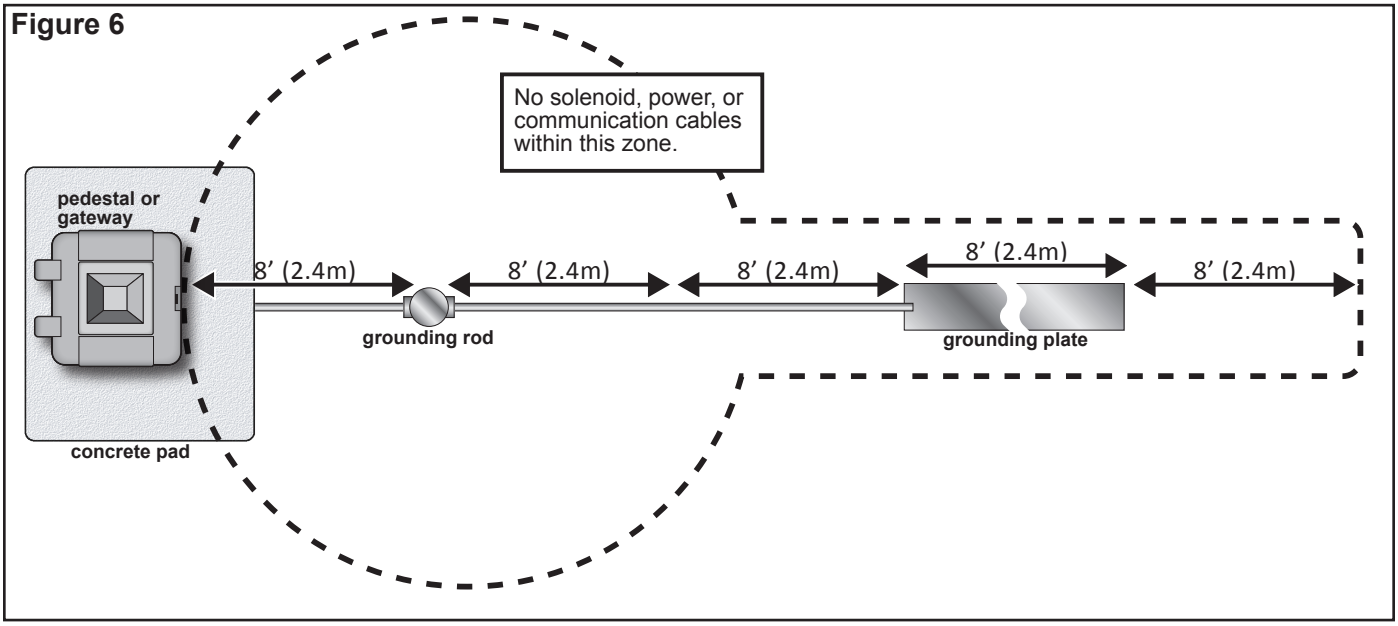


Figure 5

Figure 6



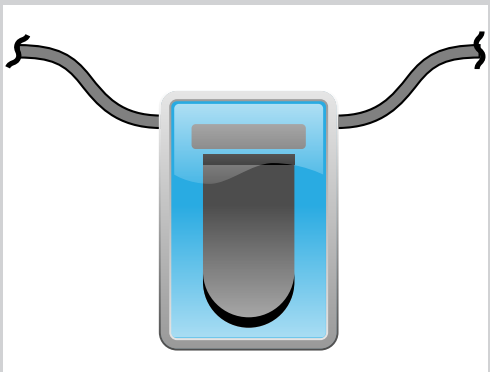
Toro-Approved Wire Splices for the Lynx Smart Module Communication Cable

CAUTION: All wire splices must be made using appropriate methods and materials to protect the connection from water contamination.

In 2-wire control systems, the communication cable is powered for extended periods providing data communication to each sprinkler via a control cable that is daisy chained from sprinkler to sprinkler with a critical splice at each sprinkler along the wire path.

The operational nature of these systems and the sheer quantity of wire connections requires that the wire splice be done in a very professional manner using the highest quality materials that provide true waterproofing in the most severe conditions that include being fully submerged.

For this reason, the Toro Company has created a specification for approved cable and wire splices, form number **373-1046**. Please refer to this specification to identify the cable and wire splices approved by the Toro Company for use in 2-wire system applications.



Throughout this manual the symbol to the left is used to represent a Toro-approved water-proof wire-splice.

For a complete list of Toro approved 2-wire communication cable and wire splices, see document ***373-1046, Lynx Smart Module Wire and Splices***.

When properly installed, Toro-approved wire splices will ensure the integrity of the connection and communications even in the most adverse conditions such as full submersion.

Power Source

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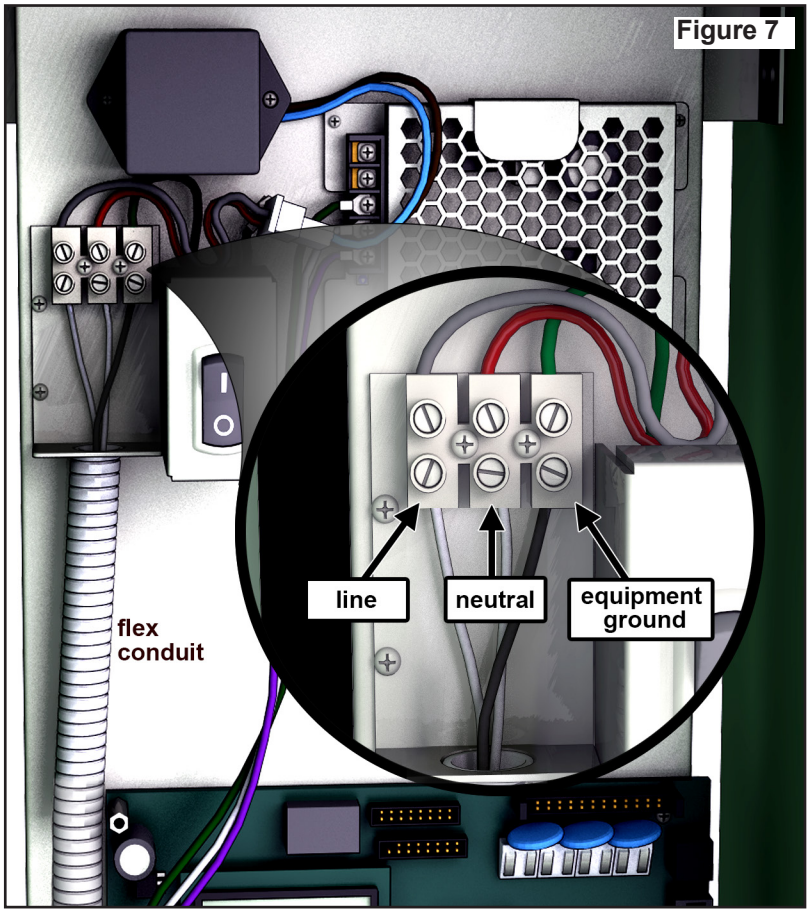
1. Turn off the power at the power source location and place the controller's power switch to OFF. Connect and route the appropriate size 3-conductor cable (14 AWG [2.5mm2] maximum) from the power source to the controller pedestal.

   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
200 – 240 VAC (International)	Hot (Brown)	Neutral (Blue)	Green / Yellow



Lynx Smart Module Installation

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 mm2), solid copper, jacketed 2-conductor, direct burial.

Recommended Module-to-Solenoid cable: 14 AWG (2.1 mm2), 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.

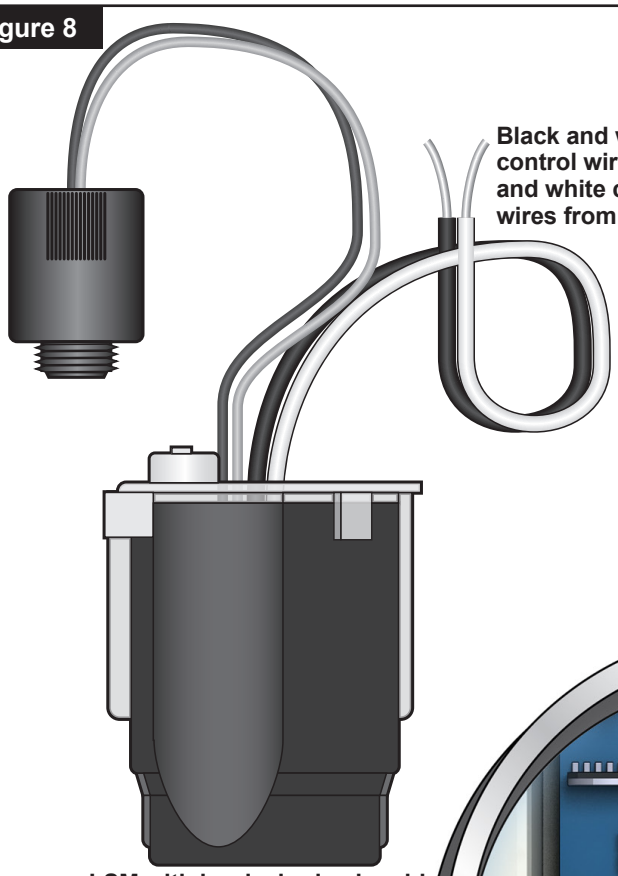
Steps:

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 (2.5mm²) 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.

Wire splices

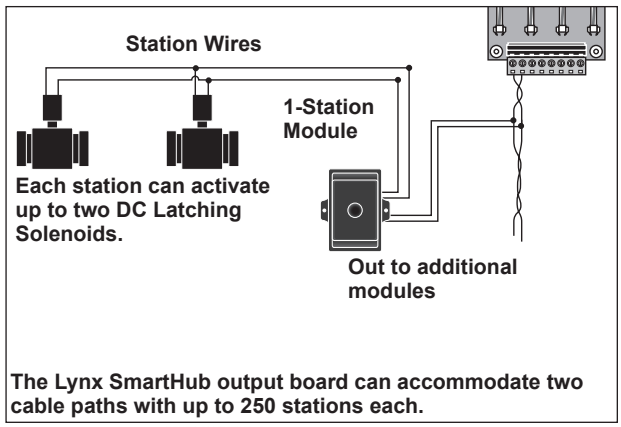
For an explanation of Toro-approved wire splices indicated by the wire splice symbol please refer to the **Toro-Approved Wire Splices** inset on **page 8**.

Figure 8

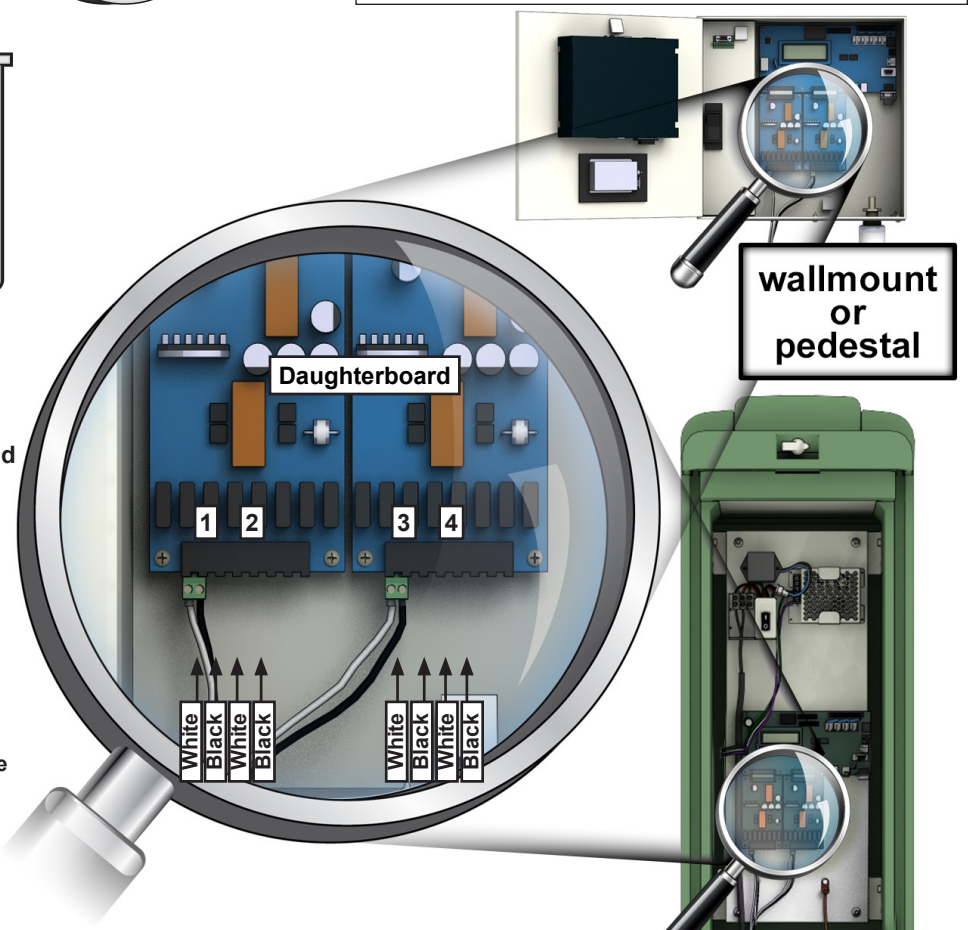


Black and white control wires to black and white control wires from controller.

LSM with hard-wired solenoid



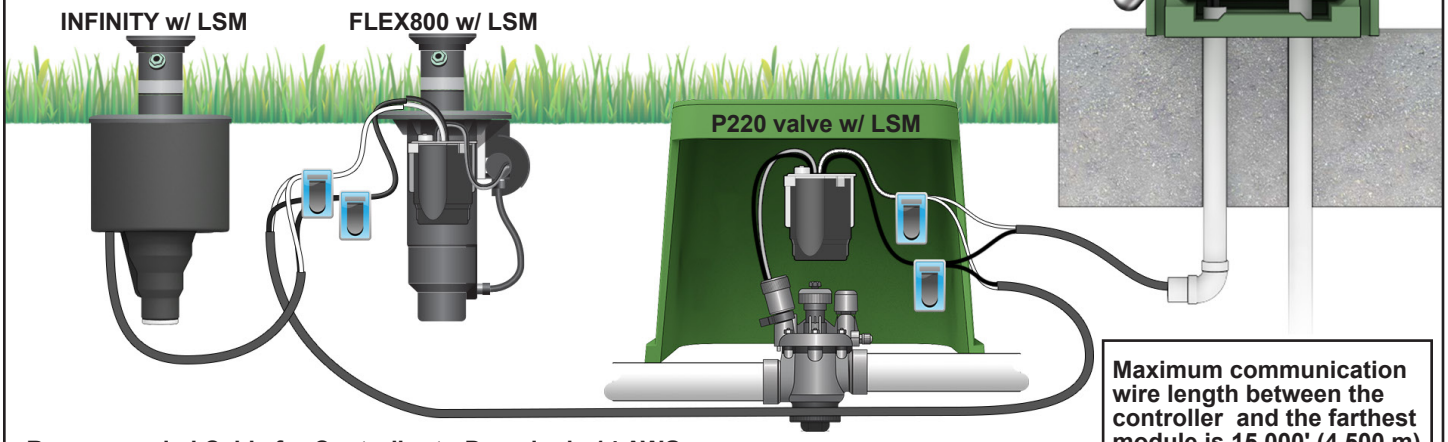
The Lynx SmartHub output board can accommodate two cable paths with up to 250 stations each.



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.



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

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

LAC Decoder Installation

The LAC SmartHub controller supports older FD (field decoder) type decoders and newer LAC (Lynx AC) decoders. Both types of decoders can be installed in parallel along a two-wire communication cable that connects to the controller. LAC decoders provide more diagnostics and are available in 1, 2, 4, and 6-station outputs. One and two station LAC decoders are available with outputs for single or dual solenoids. The controller pedestal and cabinet have one daughter board that can handle up to 800 decoders or stations. One hub can have a maximum of 800 LAC or 500 FD type decoders installed. See the **Maximum Number of Decoders** section on the next page for mixing these types.

LAC is meant to be installed as a new system or as an upgrade to an existing system. Existing systems should be qualified with an LAC site evaluation worksheet. The evaluation process involves recording or measuring cable type, cable length, cable configuration, the number of decoders and stations, testing of furthest decoder from controller, measuring capacitance, voltage at the end of line, and leakage current.

Communication Cable Type and Configuration

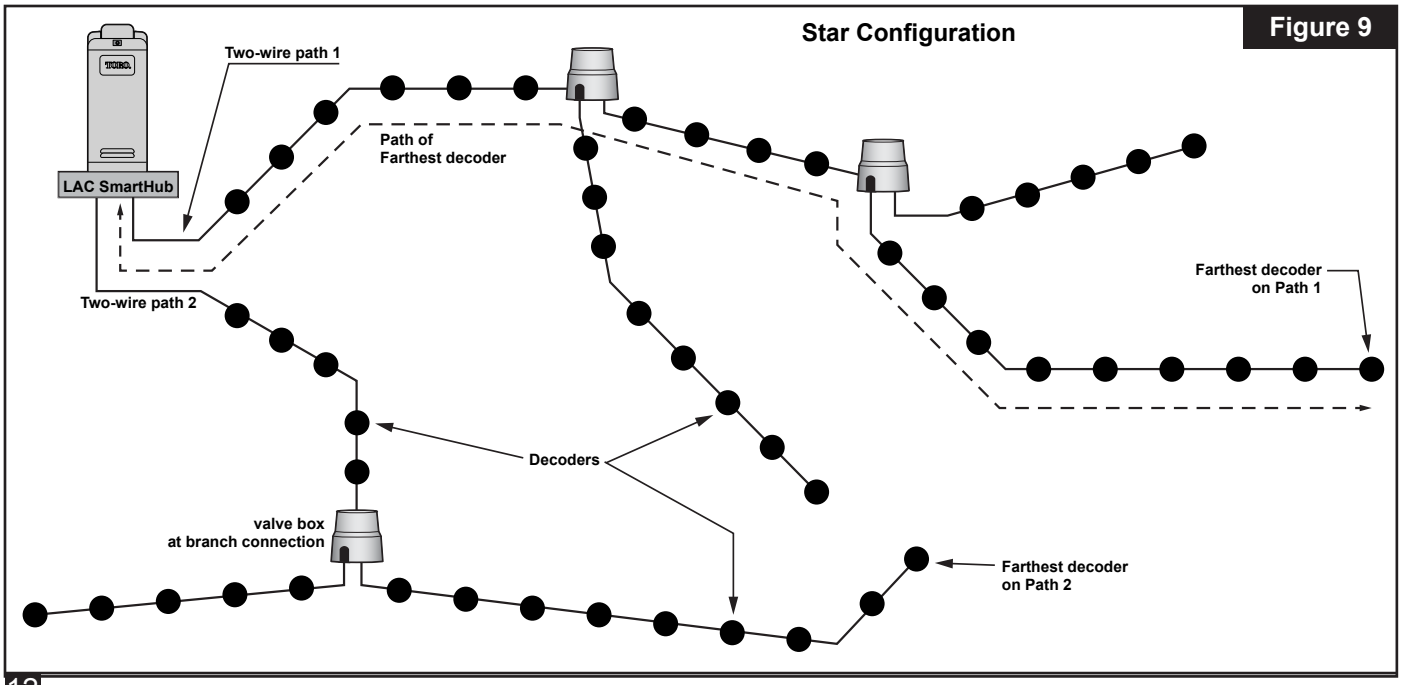
The recommended controller-to-decoder cable is 2.5mm^2 or 14 AWG, solid copper, jacketed 2-conductor, direct burial. 14 AWG has a slight decrease in maximum cable length from the 2.5mm^2. Use approved splices to waterproof all connections. Exposed ends must be capped and sealed with approved splices.

The LAC controller communicates and provides power to decoders through cables that consist of two insulated wires. These two-wire cables connect to the hub at the daughter board output terminals. One cable wire goes to a terminal labeled A and the other to B.

The two-wire path can be installed in two types of configuration: Star and Loop. Star configurations are when the two-wire cables branch throughout the course from the hub and terminates on the course (**Figure 9**). The path can branch multiple times from the terminals as long as distance and resistance requirements between hub and decoders are not exceeded. Star configurations are recommended because they are easier to troubleshot.

Loop configurations are when the two-wire cable goes out and loops back to the terminals. Both ends of the cable connect at or near the terminals. They support longer cable distances but are more difficult to troubleshoot.

The LAC controller output terminals accommodate up to 4 two-wire cable connections (8 individual wires). It can handle a maximum of 4 star or 2 loops. There are four terminal screws that can accommodate two wires. More than two cables will require two wires to be secured with one terminal screw.



Communication Cable Length

The maximum two-wire cable length to the furthest decoder from the LAC SmartHub depends on the wire gauge used. For 2.5mm², it is 3,000 meters (9,800') for star configurations and 12,000 meters (39,370') for loop configurations. For loop configuration, it is the total distance from the SmartHub out and back. This is four times the cable length of the star configuration but is not recommended as they are difficult to troubleshoot.

Maximum cable length to furthest decoder:

Wire	Star	Loop
2.5mm²	3km (9,800')	12km (39,200')
4.0mm²	4.7km (15,400')	18.8km (61,600')
14 AWG	8,800' (2.7km)	35,200' (10.8km)
12 AWG	14,000' (4.2km)	56,000' (16.8km)

Measuring Cable Resistance

For star configurations, the resistance of the two-wire cable path between the SmartHub to the furthest decoder should be 45 Ohms or less. This can be measured by shorting the wires together at one end of the cable near the hub and measuring the resistance between the wires at the other end near the furthest decoder. Alternately, the wires at the far end can be shorted and the resistance measured at the end near the hub.

For loop configurations, both ends of the two-wire cable path are at the hub terminals. Short the wires together at one end and not the other. The resistance between the wires at the non-shorted end should be 180 Ohms or less.

Maximum Number of Stations

A station is one addressable decoder output. The maximum number of stations on one LAC SmartHub is 800 LAC or 500 FD stations. One wire path from the SmartHub that terminates on the course (star configuration) can have a maximum of 400 LAC decoders or 250 FD decoders. Multiple runs can be used. For mixed systems of both types, the maximum number is given by the following:

LAC stations per hub = 800 – (1.6 * FD stations).

FD stations per hub = (800 – LAC stations)/1.6.

LAC stations per wire path = 400 – (1.6 * FD stations)

FD stations per wire path = (400 – LAC stations)/1.6

Example 1: with 200 FD stations, the maximum number of LAC stations per hub is 800 – (1.6 * 200) = 480. The maximum for that wire path is 400 – (1.6 * 200) = 80. More than 80 LAC stations requires another wire path.

Example 2: with 351 LAC stations, the maximum number of FD stations per hub is (800 – 351)/1.6 = 280. The maximum for that wire path is (400 – 351)/1.6 = 30. More than 30 FD stations requires another wire path.

Burial Depth on New installations

Toro recommends that new installations have a minimum cover of 6" (150mm) on controller-to-decoder and decoder-to-solenoid cables. 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. Splices must be accessible to facilitate troubleshooting and/or service.

Communication Cable to Power Cable Spacing

This recommendation applies to LAC 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 LAC 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.

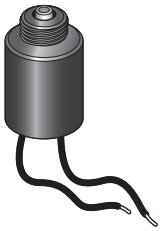
- 2.5mm² or 14 AWG - Max. length is 275m (900')
- 1.5mm² or 16 AWG - Max. length is 175m (575')
- 0.9mm² or 18 AWG - Max. length is 122m (400')

Valve Compatibility

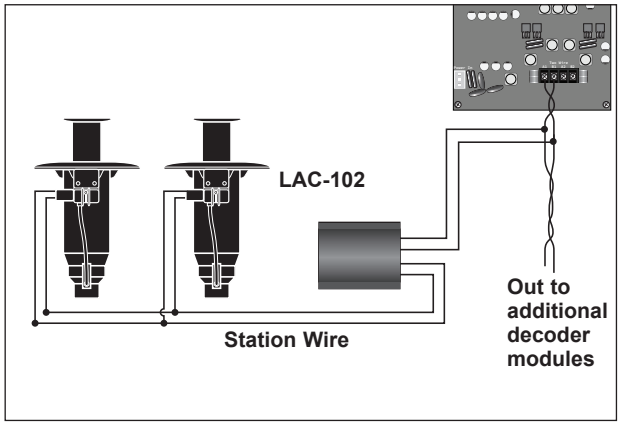
LAC is compatible with the same valves as GAC. Please see GAC Valve Compatibility section on page 20.

In addition, LAC is compatible with 102-4979 solenoids with spike guard protection. They were qualified in 1-1/2 inch P220 values at 200psi. They will also work with VIH. P254 one inch values using 9-6528 and 89-0878 solenoids should also work with a higher drive parameter (20V, 50ms, 5.1V).

Figure 10



AC Solenoid



Output 1
Brown wires drive solenoid from address 4000128

Output 2
Red wires drive solenoid from address 4000129

Output 3
Orange wires drive solenoid from address 4000130

Output 4
Black wires drive solenoid from address 4000131

Communication
Blue wires connect to two-wire line from the daughterboard. Polarity does not matter.

Surge Arrestor
Green-yellow wires connect to earth through ground rod, plate, or solenoid.

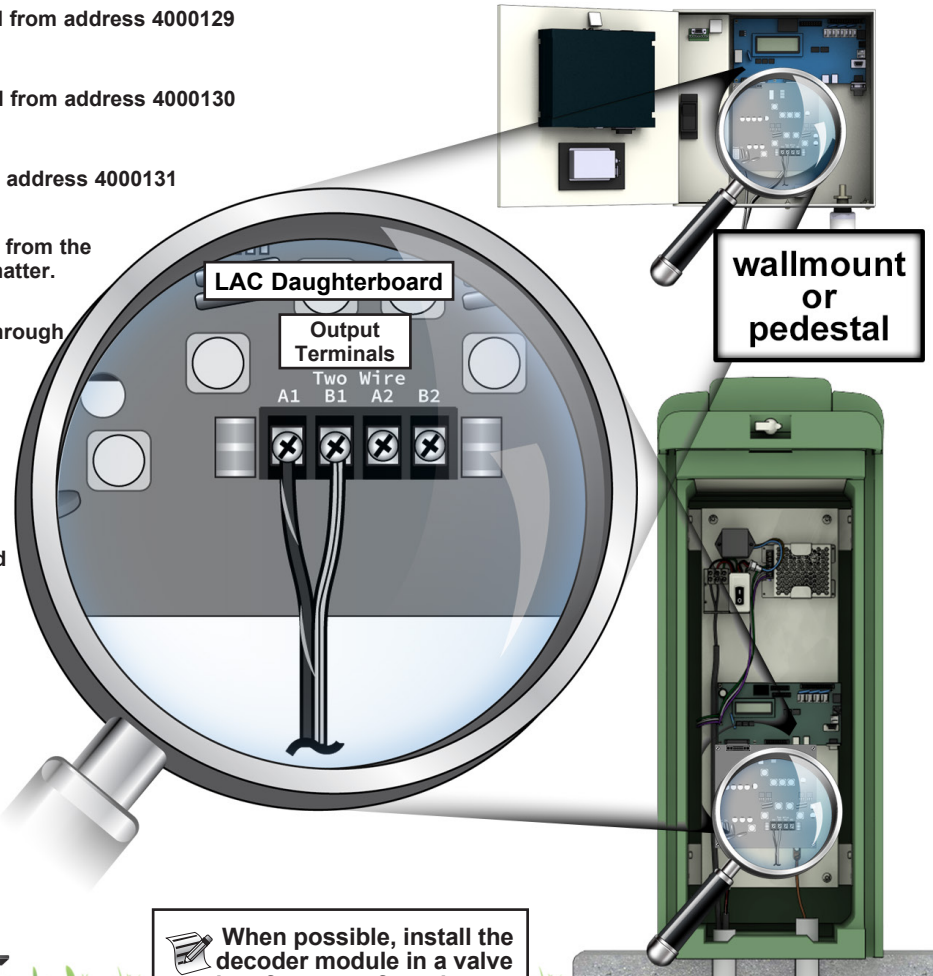
Connect both wires to solenoids. Common wires are discouraged because of surge protection and diagnostic capability.

If this connection is not possible on existing installations with one common wire to solenoids, do a continuity check on decoder wires to identify which ones can be connected to common.

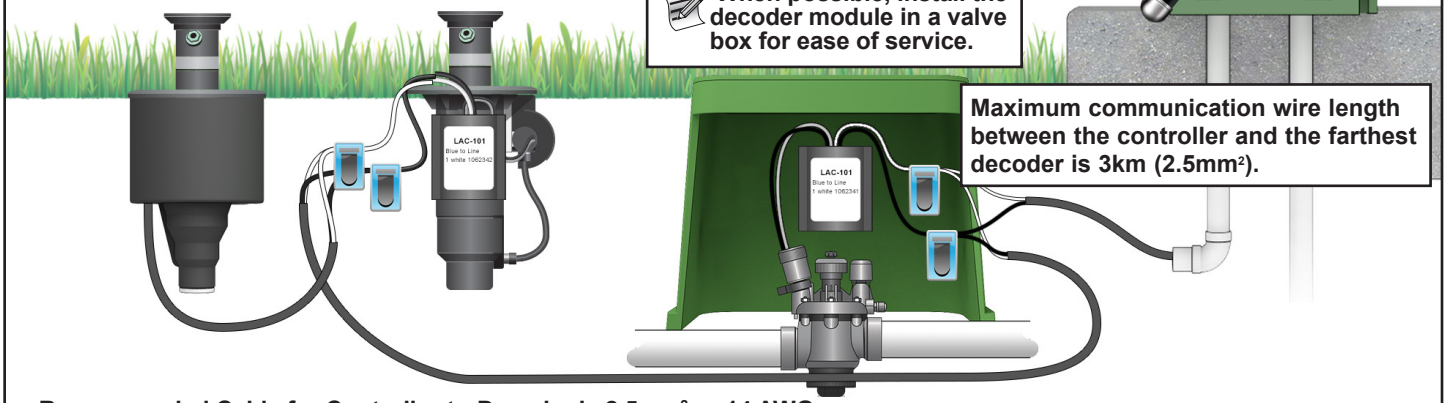
The maximum wire length between the decoder and solenoid is 175m (1.5mm²).

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 3km (2.5mm²).

Recommended Cable for Controller-to-Decoder is 2.5mm² or 14 AWG, Solid Copper, Jacketed 2-Conductor, Direct Burial cable.

Decoder Installation Steps

Decoders are installed along the two-wire path by connecting the blue wires from the decoders to the path using approved splice kits. Decoder output wires are spliced to solenoid wires. Use Toro-approved splices to properly water-proof all wire connections.

1. Secure the two-wire communication wires from a cable to terminals A1 and B1 or A2 and B2 of the SmartHub output board. Polarity does not matter. See **Figure 10**.
2. For new installations, route communication cable from controller to the decoder installation location. See communication cable length section for maximum lengths.
3. Decoders are recommended to be installed in a valve box. Record the decoder type and addresses found on the decoder. The address identifies the station(s) that the decoder controls.
4. Secure the communication wires from the two-wire path to the decoder blue wires using approved splices to make a water-proof connection. Polarity does not matter. If necessary, remove old decoders by cutting out splices. Make sure to cut wires back to remove any green or corroded copper.
5. Route output wires from decoder to the solenoid. Make sure not to exceed the maximum length. Connect solenoids to decoder output wires using approved splices to water-proof connections. Wire colors are shown in **Table 3**. Each station or output has a maximum load of one solenoid unless it's an LAC-102, LAC-202, FD-102, or FD-202; they can have up to two solenoids.
6. See the LAC Decoder Surge Protection and Grounding section below if connecting decoders to earth. Four and six output decoders have built in surge arrestors with green-yellow wires that may be used for lighting surge protection.
7. Repeat steps 3-6 for additional decoders.

LAC Decoder Surge Protection and Grounding

Refer to the Earth Ground section (page 7) for protecting the controller. The following explains how to protect decoders:

Surge arrestors LAC- LSP are required to protect decoders from lightning. LAC-401 and LAC-601 decoders have an internal surge arrestor. The two blue wires connect to the two-wire communication path and the two green-yellow wires connect to earth through ground rods, plates or solenoid cores. One or both wires are attached to a copper grounding rod or plate. If the surge arrestors are located close to a Rain Bird green solenoid, then one wire can be securely connected to the core tube of the solenoid with a stainless steel nut, and the other to the grounding rod or plate. If not, then we recommend both green-yellow wires be secured to a grounding rod or plate. The ground resistance should be 50 ohms or less. If the resistance is greater than 50 ohms, more ground rods or plates should be added.

Install surge arrestors along the two-wire path so that there are no more than 8 decoders between them and there is no more than 500 feet (150m) of cable between arrestors (see **Figure 11**). This includes decoders with built-in surge arrestors. A surge arrestor should also be installed at the last decoder before a two-wire path terminates (dead ends). If the decoder is a 4 or 6 station decoder mentioned above, then the surge arrestor built into it can be used.

For site upgrades, replace existing surge arrestors with new LAC-LSP devices. For surge arrestors inside decoders, add an additional LAC-LSP device near it or replace the decoder with an LAC-401 or LAC-601.

A 5/8" by 8' (17mm x 2.5m) copper clad steel rod is recommended to achieve 50 ohms or less resistance. If multiple ground rod or plates are required, we recommend a minimum size of 10AWG (6mm^2) bare copper wires to connect them. A 5/8" (17mm) clamp or exothermic-weld fastener can be used to attach the green-yellow wire to the rod.

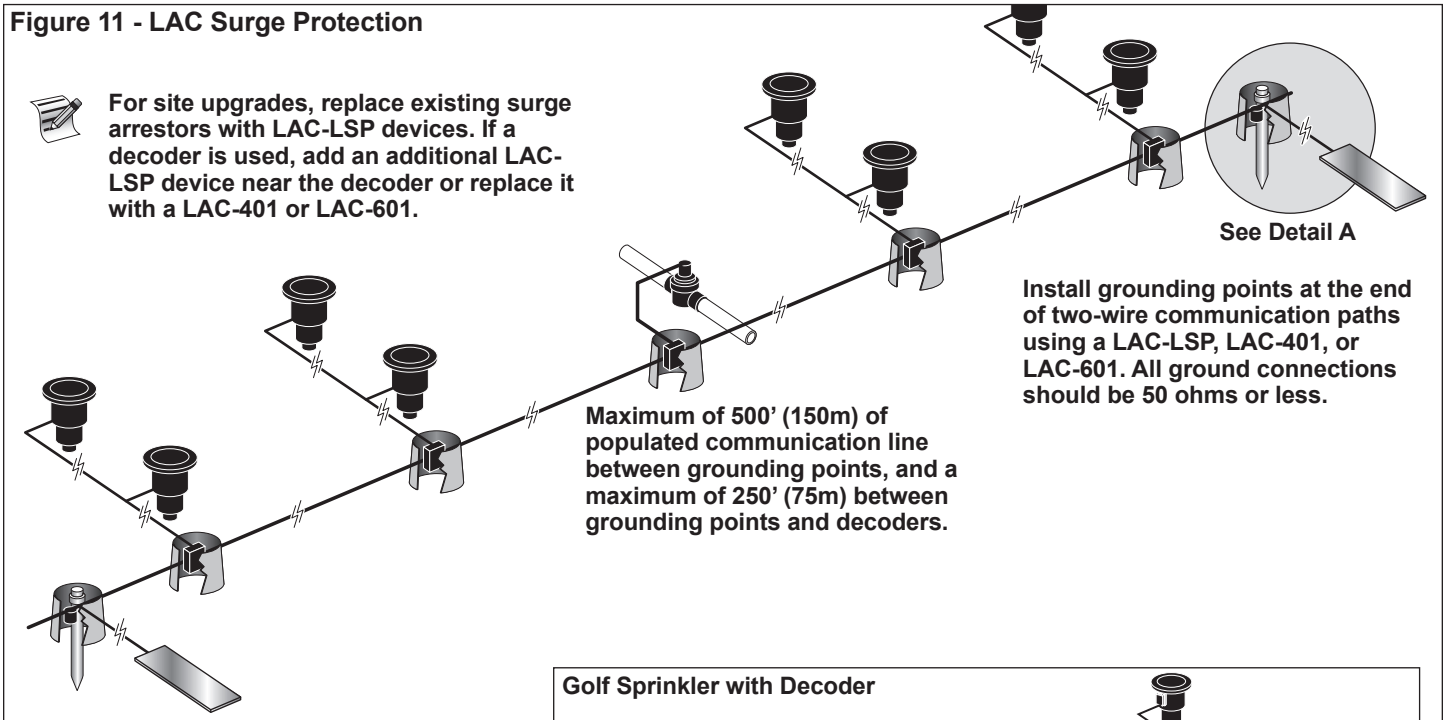
Table 3 - Wire Color

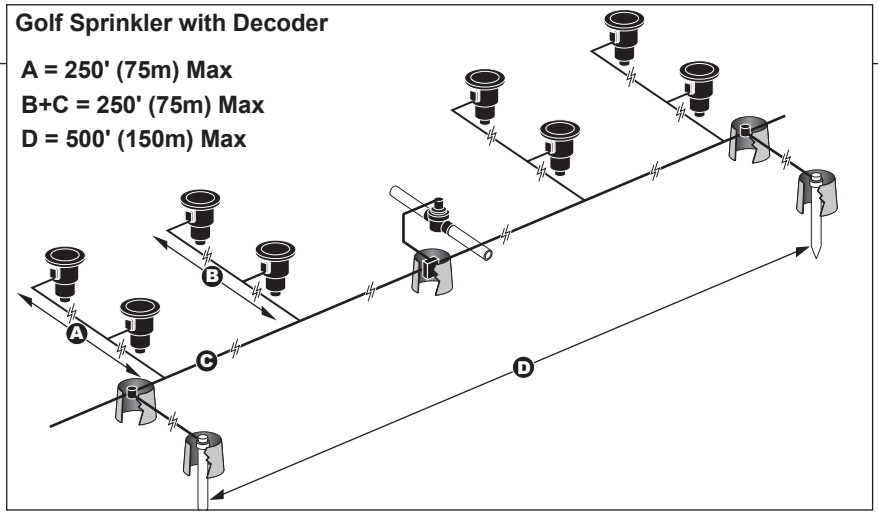
LAC Decoder	Description	Decoder Output (solenoid) Wire Color					
		Out 1	Out 2	Out 3	Out 4	Out 5	Out 6
LAC-101	Single station, single solenoid per output	white					
LAC-102	Single station, dual solenoid per output	white					
LAC-201	Two station, single solenoid per output	brown	white				
LAC-202	Two station, dual solenoid per output	brown	white				
LAC-401	Four station, single solenoid per output	brown	red	orange	black		
LAC-601	Six station, single solenoid per output	brown	red	orange	black	grey	white
LAC-LSP	Surge arrestor, no outputs						

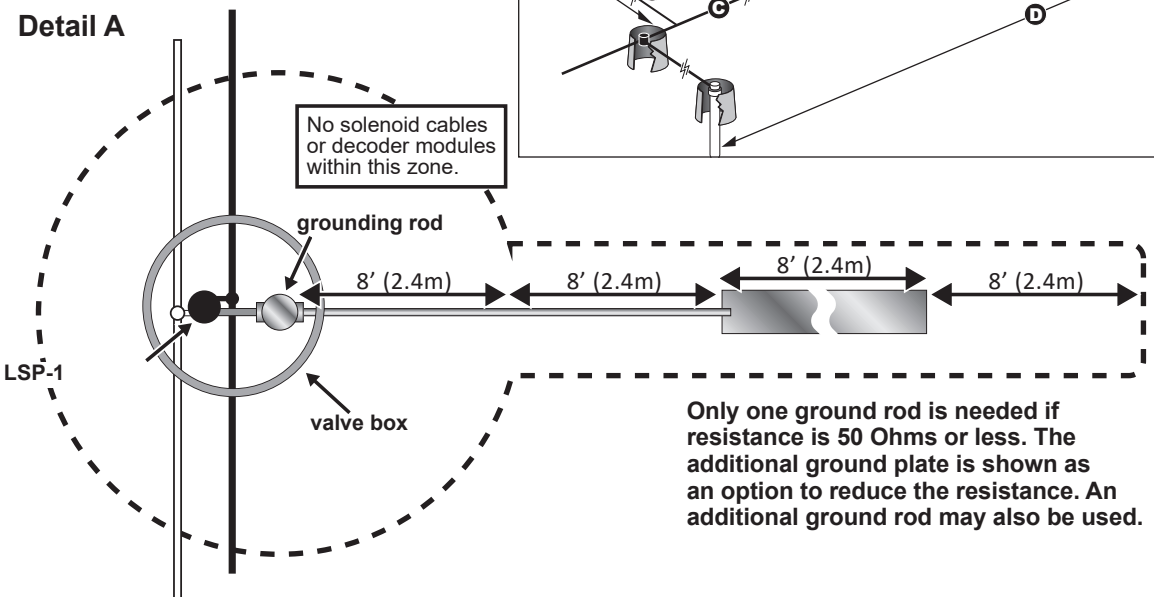
All decoders connect to Two-Wire Path with blue wires. LAC-401 and -601 decoders have internal surge protection with two green-yellow wires for earth ground connections like the LAC-LSP.

Figure 11 - LAC Surge Protection

For site upgrades, replace existing surge arrestors with LAC-LSP devices. If a decoder is used, add an additional LAC-LSP device near the decoder or replace it with a LAC-401 or LAC-601.



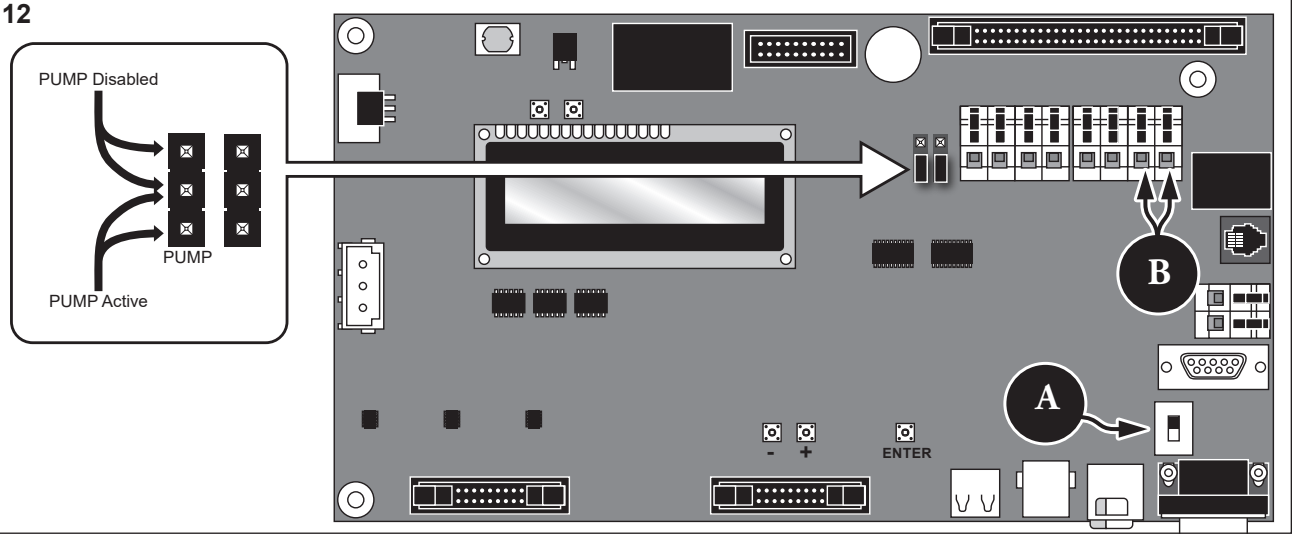




Only one ground rod is needed if resistance is 50 Ohms or less. The additional ground plate is shown as an option to reduce the resistance. An additional ground rod may also be used.

LAC Motherboard Connections

Figure 12



WARNING: Before connecting any type of sensor or device, be sure the controller has been powered down.

LAC does not support sensors.

Switch Position

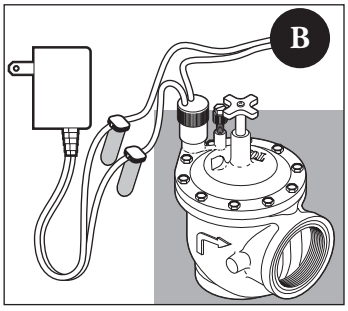
LAC motherboard switch position for **Figure 12, A** must be in "down" position.

Sychronization

Synchronization is not required for LAC.

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 12, B**.
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 power switch to ON.

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^2), 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.

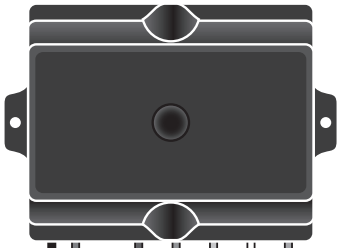
- Use only wire approved for direct burial if installing the wires underground without conduit.
- All field wiring splices must be accessible to facilitate troubleshooting and/or service.

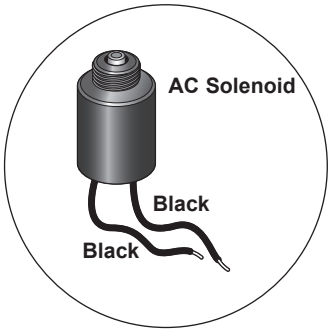
Steps:

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 13**.
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.

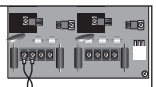
Figure 13

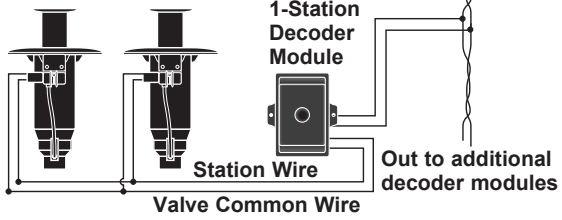
GAC Decoder





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





Each output circuit can accommodate up to
125 Decoder Modules.

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.

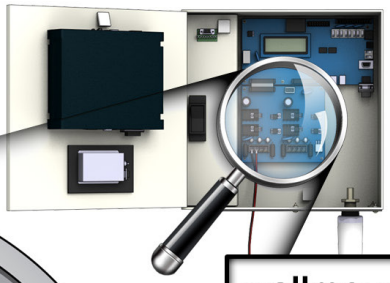
Station 2
Yellow Wire: Connect to one of Station 2's solenoid wires.

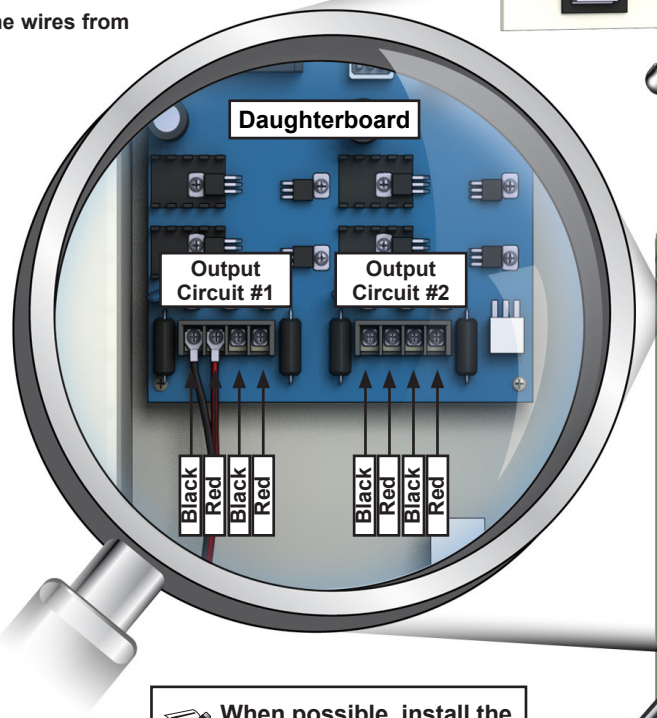
Station 1
Violet Wire: Connect to one of Station 1's solenoid wires.

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

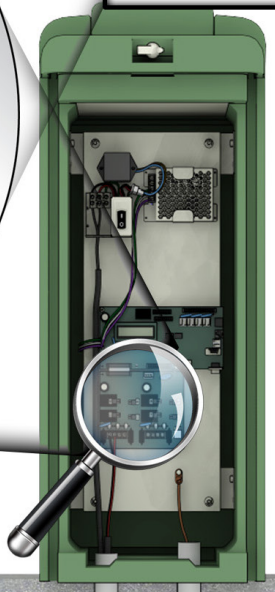
Red Power/Communication Wire

Black Power/Communication Wire





wallmount or pedestal

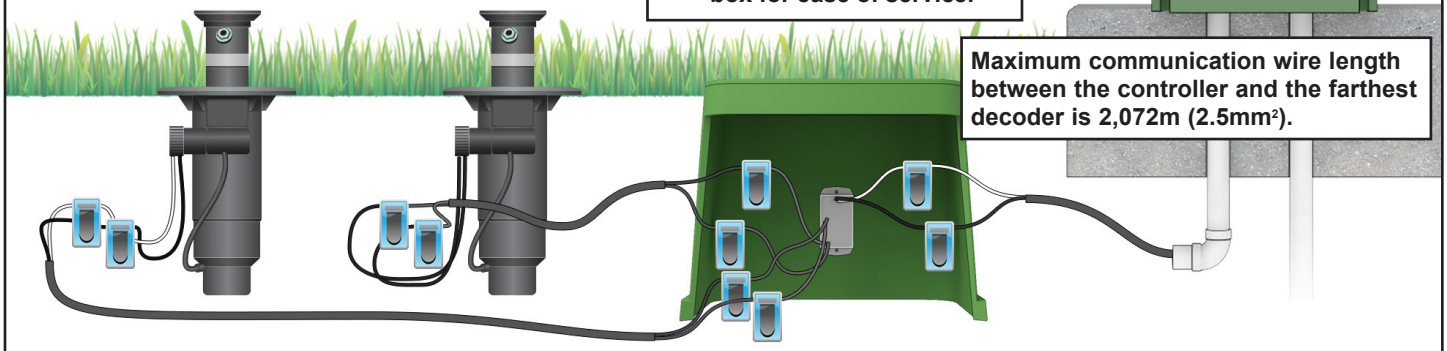


The maximum communication wire length between the decoder module and the solenoid is 575' (175m).

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 (2.5mm²).

Recommended Cable for Controller-to-Decoder is 2.5mm² or 14 AWG, Solid Copper, Jacketed 2-Conductor, Direct Burial cable.

Upgrade of Existing System, Using Existing Wiring for GAC

Communication Cable Type

Should be 2 or 3 copper conductors, solid or stranded, with PE pr 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^2) cable. The total amount of wire path is 14,000' (4267 meters) for 14 AWG (2.5mm^2) 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, remdiation will be required to meet the minimum spacing listed in **Table 4** below.

Table 4

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 1.5mm2 – Maximum length is 575 feet (175m)

For 18 AWG or 0.9mm2 – 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

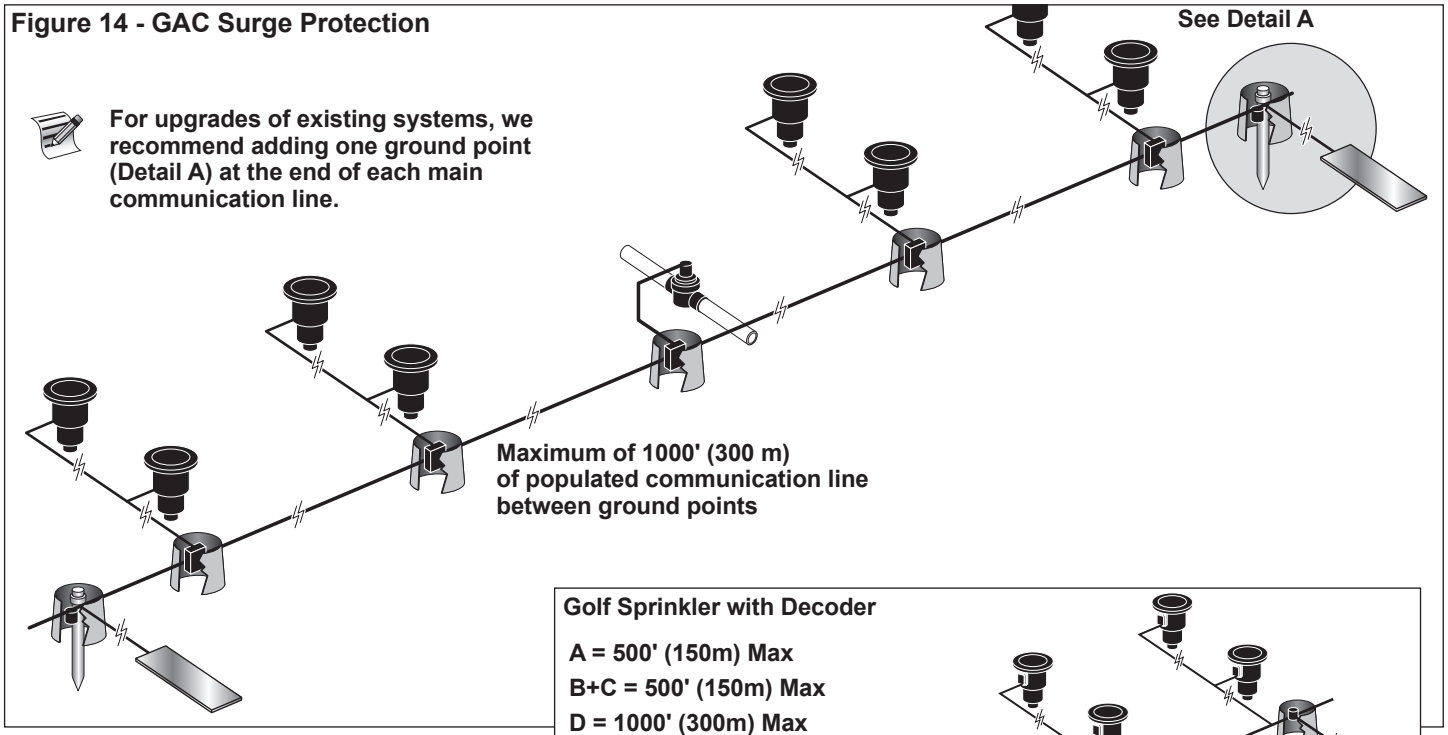
Toro	Golf VIH (Solenoid 89-1905 or 118-0248) at 150 PSI 400ft (122m) Max Solid Core, 18 AWG or 0.9mm2 Cable 2.3 Ohms/Conductor (400ft), 1 per Output 575ft (175m) Max Solid Core, 16 AWG or 1.5mm2 Cable 2.3 Ohms/Conductor (575ft), 2 per Output
Toro	252 Valve (Solenoid 102-1905 or 118-0248) at 150 PSI at 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 0.9mm2 Cable 1.2 Ohms/Conductor, 1 per Output 328ft Max Solid Core, 16 AWG or 1.5mm2 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

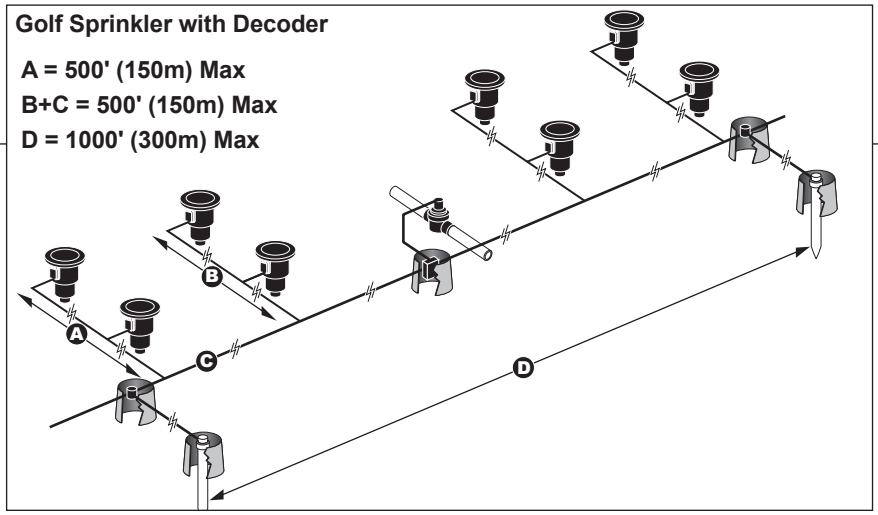
Grounding GAC and DC Decoder Communication Cable

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 14** illustrates the proper grounding and wiring of the arrester.

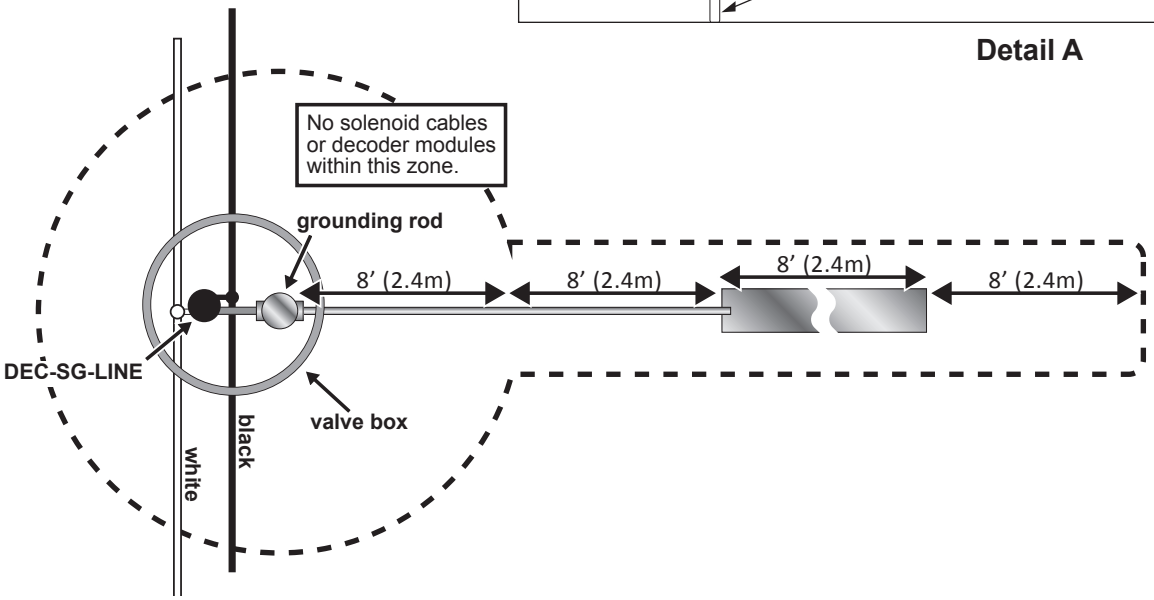
1. Locate decoder's power/communication wires (black and white wires).
2. Strip the insulation from lightning arrester's white wire and connect it to the white wires from the decoder and controller-to-decoder cable. Use approved splice to properly water-proof all wire connections.
3. Strip the insulation 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). For 2-Wire systems, install the ground rod adjacent to the communication cable (**Figure 14**). 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. 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.
7. 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' (10mm² 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 14 - GAC Surge Protection





Detail A

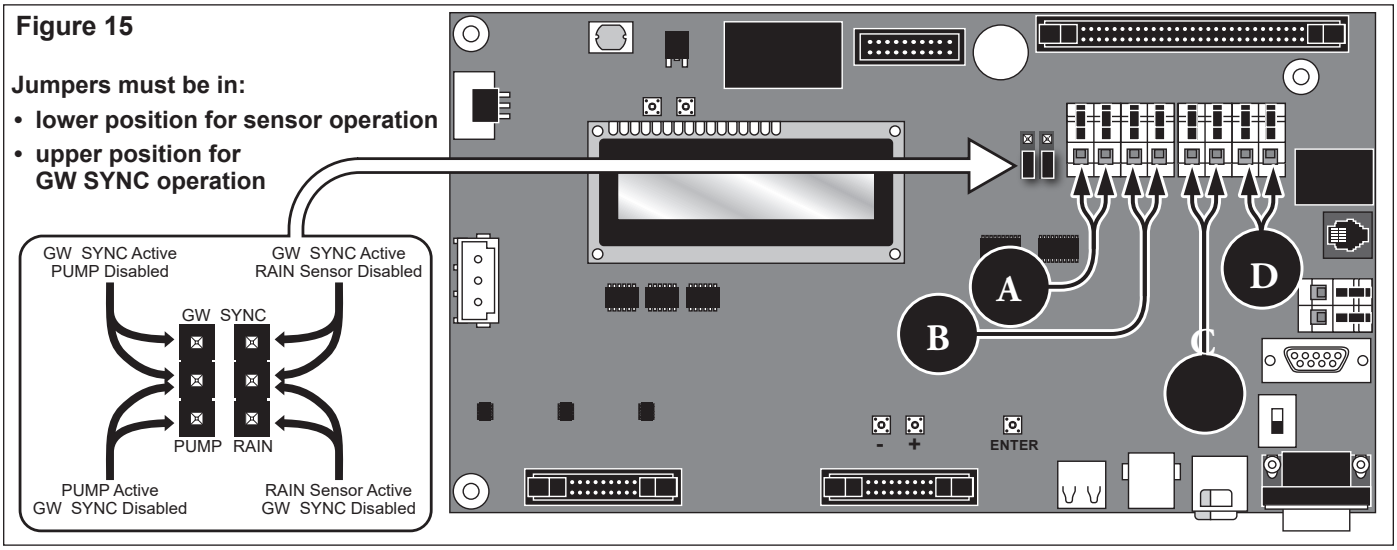


GAC and LSM Motherboard Connections

Figure 15

Jumpers must be in:

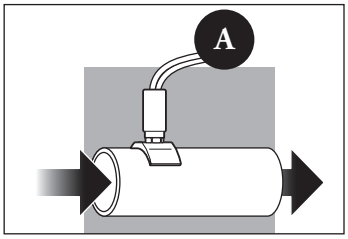
- **lower position for sensor operation**
- **upper position for GW SYNC operation**



WARNING: Before connecting any type of sensor or device, be sure the controller has been powered down.

Sychronization

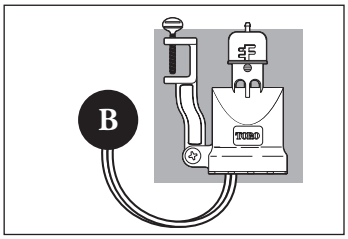
If there are two Lynx SmartHub controllers that are co-located or will have communication output wiring that is installed in a common trench or conduit, the controllers must be synchronized with each other for proper communication. Please see **Synchronization** insert on **page 29**.



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.

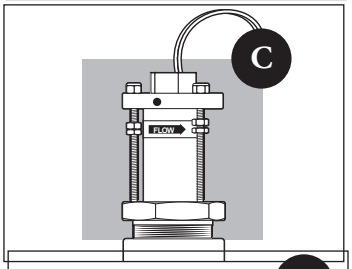
1. Route the status switch cable into the controller.
2. Connect the cable wires to the status switch terminals labeled **A** in **Figure 15**.
3. Place the controller's power switch to ON.



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.

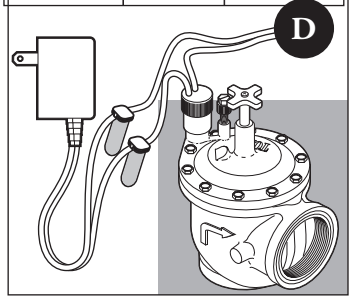
1. Route the rain sensor's cable into the controller.
2. Connect the cable wires to the Rain Sensor Terminals labeled **B** in **Figure 15**.
3. Place the controller's power switch to ON.



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 15**. Red wire to the **+** terminal, black wire to the **-** terminal.
3. Place the controller's power 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 15, 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 power switch to ON.

Lynx Communication Cable

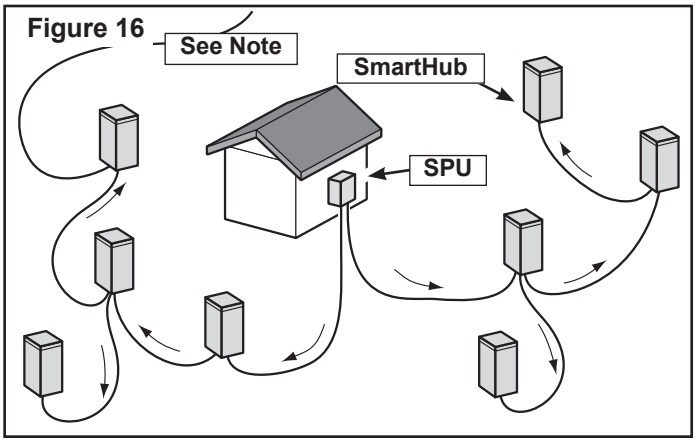
Please note the following communication cable installation requirements and suggestions:

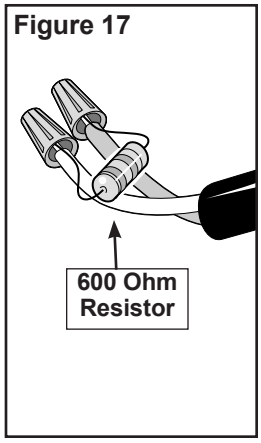
- The remote SmartHub is designed for use with shielded, twisted-pair, communication cable. Toro recommends R7162D or equivalent.
- More than one cable run can be connected to the Surge Protection Unit (SPU, part #35-7353).
- A remote SmartHub communication cable can emanate from another remote SmartHub 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:

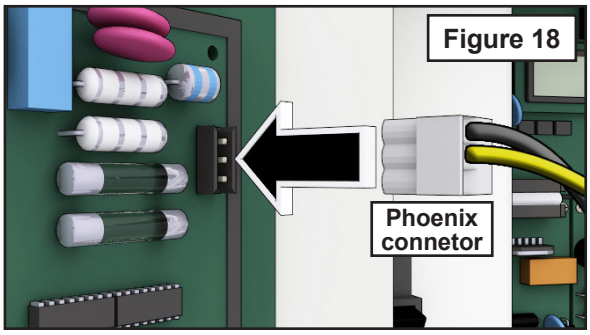
1. Starting at the Surge Protection Unit (SPU, part #35-7353), route the communication (comm) cable to each SmartHub leaving enough cable at each location to enable connection.
   See **Figure 16**.

   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 17**.



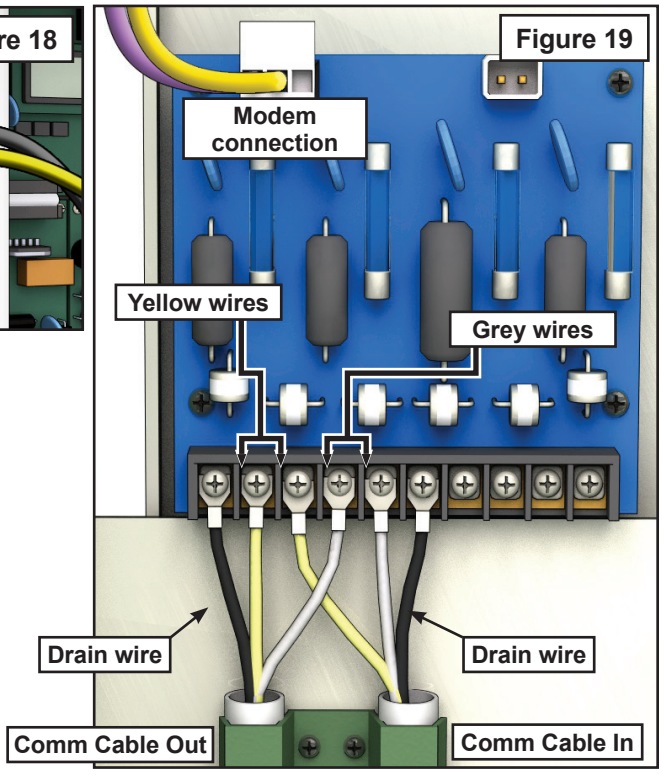


2. At the SmartHub, cut the cable and pull both ends into the SmartHub through the 3/4" (16mm) sweep conduit.



3. At the cable ends, strip the outer jacket and inner insulation to expose the comm wires.

- **Wallmount**: Attach grey and yellow wires to Phoenix 3-hole connector, plug into modem port (**Figure 18**).
- **Pedestal**: Attach grey and yellow wires per **Figure 19**.



Communicating Between Lynx and 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.

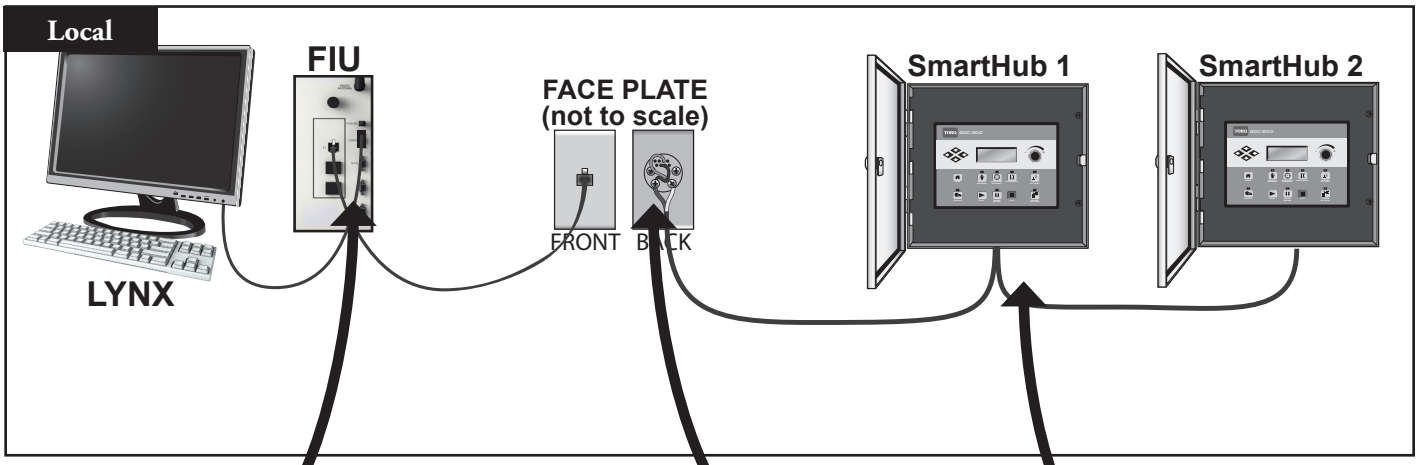
The Lynx computer is attached to a Field Interface Unit (FIU) which sends commands to the SmartHubs throughout the golf course.

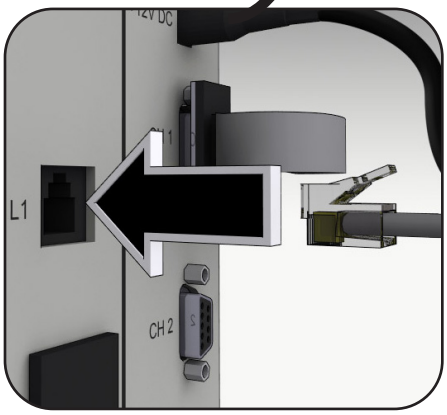
There are two ways for the FIU to communicate with SmartHubs: by Wireline or by radio. This document shows **three typical layouts** making use of one or both methods.

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

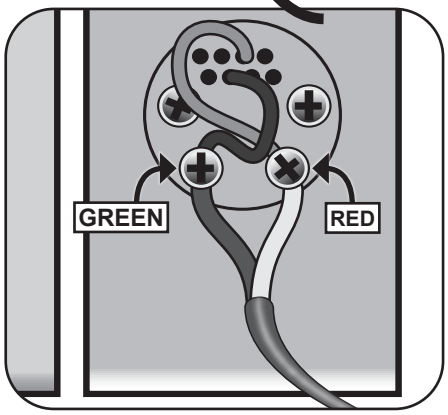
Layout 1 - Local

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.

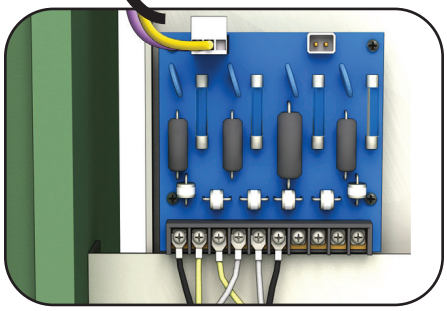


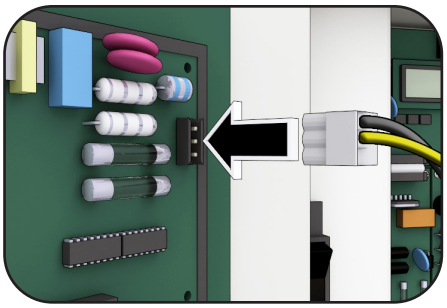


Connect RJ11 cable to L1 of the FIU and face plate.



Gray wire to green terminal. Yellow wire to red terminal.

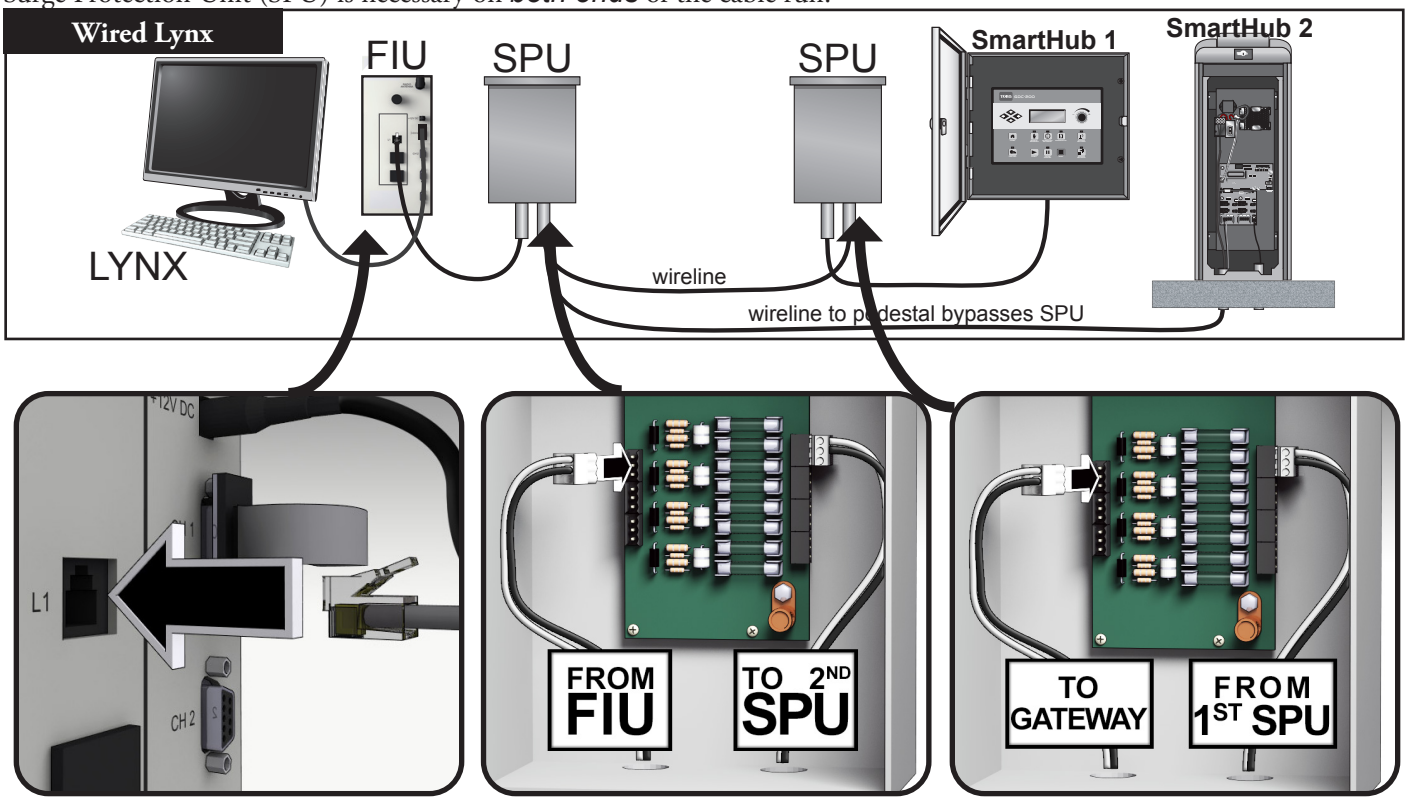




Connect grey and yellow wires as shown.

Layout 2 - Wired Lynx

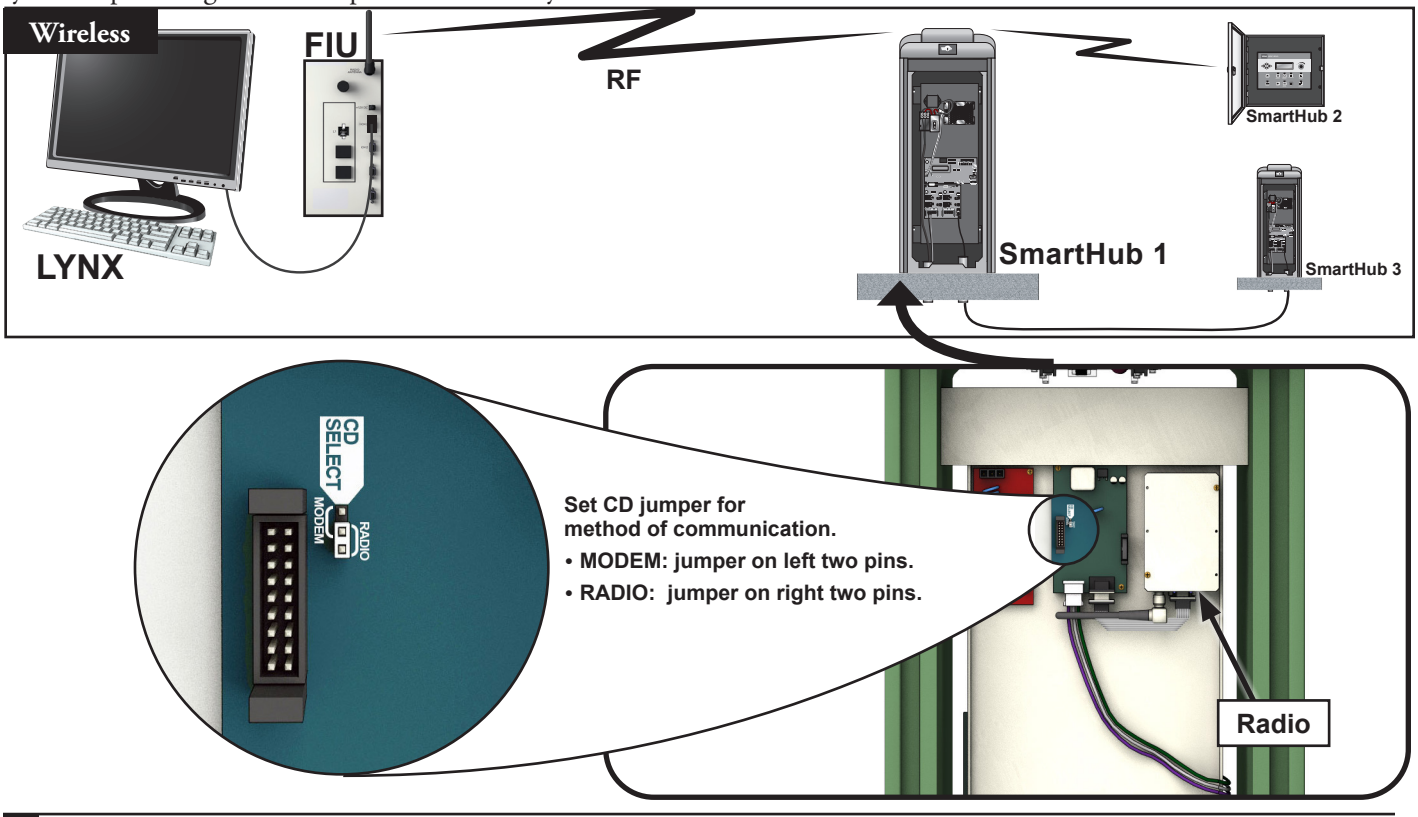
The Field Interface Unit is attached to the SmartHub which is out in the field. Due to this distance (see note below), a Surge Protection Unit (SPU) is necessary on ***both ends*** of the cable run.



The Wireline connection is limited to about 9 miles.

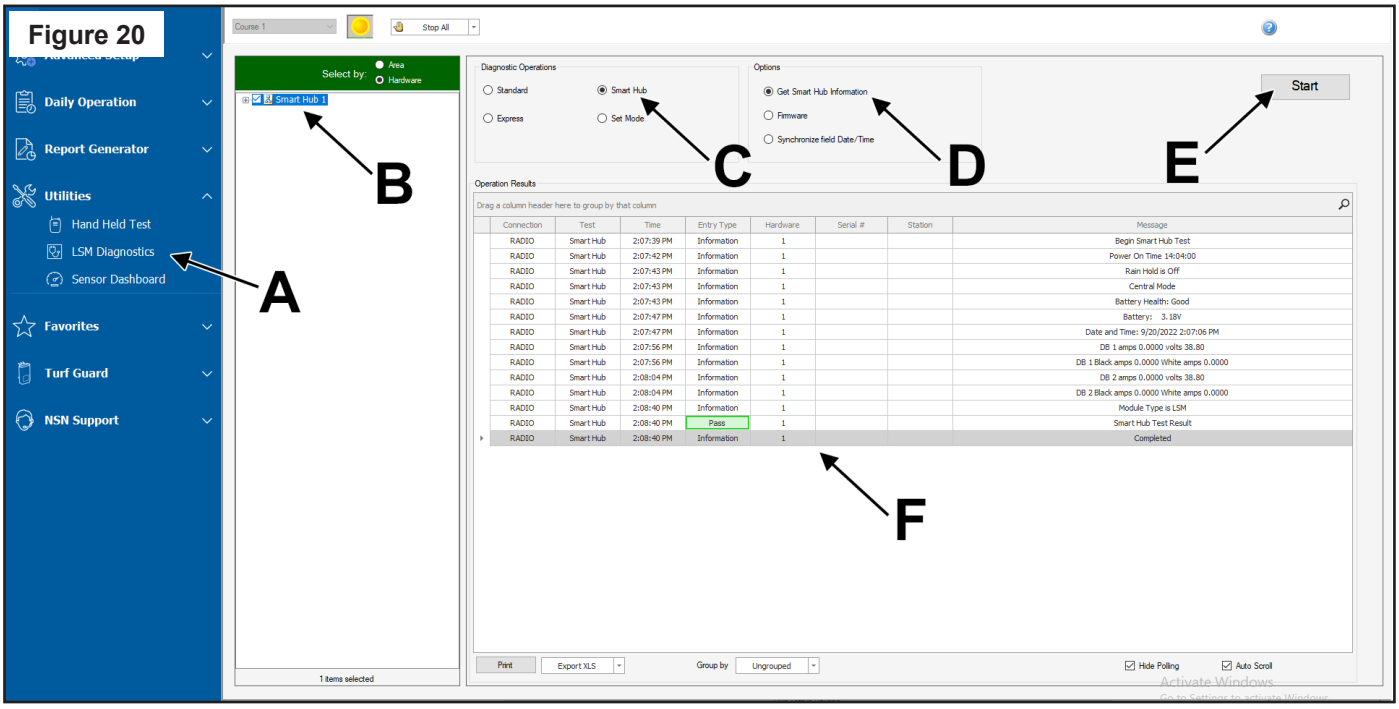
Layout 3 - Wireless

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.



Communication Test Between Lynx and SmartHub

1. Launch Lynx.



2. Click **LSM Diagnostics** under the **Utility** bar (**Figure 20, A**).
3. Select the desired hub (**Figure 20, B**).
4. Select the **Smart Hub** button (**Figure 20, C**).
5. Select **Get Smart Hub Information** button (**Figure 20, D**).
6. Click **Start** button (**Figure 20, E**). Information should be displayed on the screen under "Message". It will show "Pass" or "Fail" for the Result (**Figure 20, F**), indicating if communication is working. Some models will show this result in a different color.

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 21**).
4. Connect Phoenix power cable into 12V power supply. Plug other end into DC IN port on radio (**Figure 22**).
5. Plug in 12V power supply.
6. Launch Radio Manager. See **Figure 23**.
7. Select appropriate COM port (**Figure 23, A**).
8. Change the baud rate to 1200 (**Figure 23, B**)
9. Press 'Discover Radio' button (**Figure 23, C**). The computer should discover the radio (**Figure 24**).
10. To see current radio frequency, enter **ATFX** into the command line (**Figure 25**).
11. To change the frequency, simply add an appropriate frequency number to that command. Example: **ATFX 460.5**

UHF frequency range is from 450 to 470 MHz. Frequency number specified must be between those numbers.

12. Software will confirm the change (**Figure 26**). 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.

Figure 21

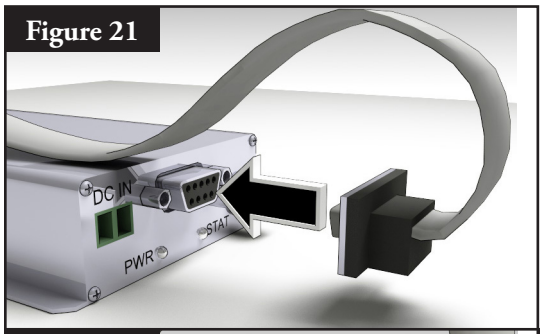


Figure 22

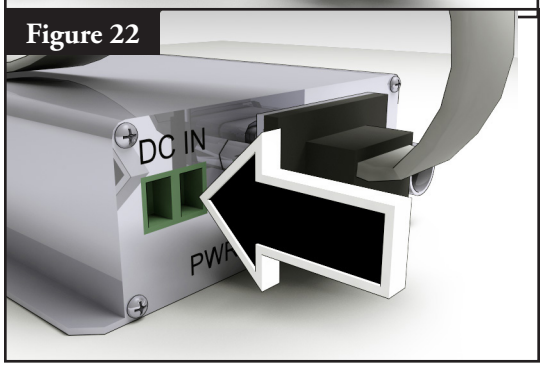


Figure 23

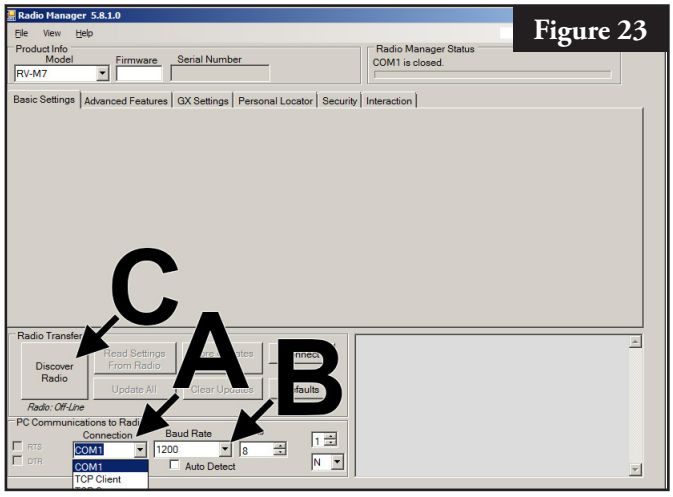
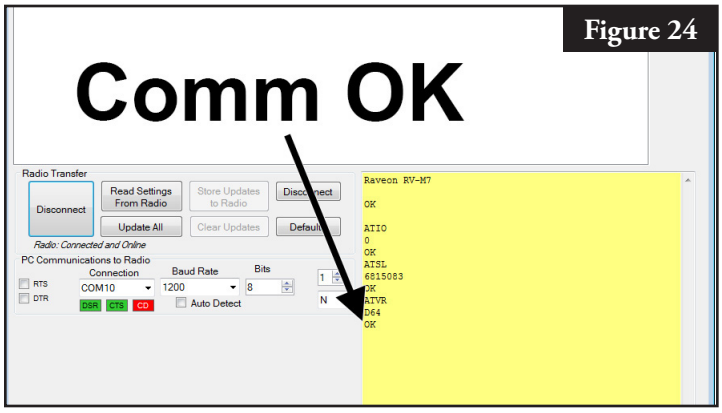
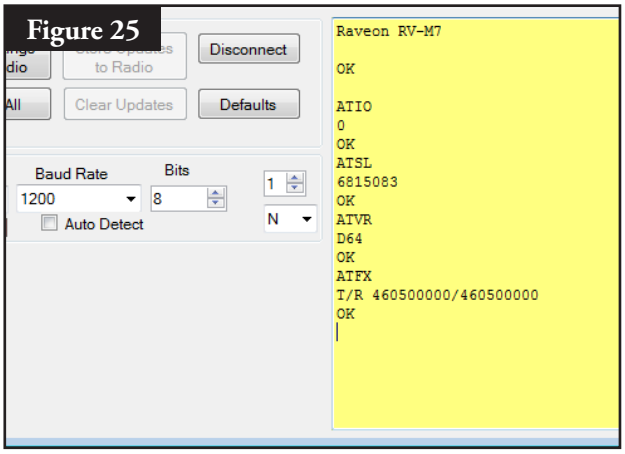
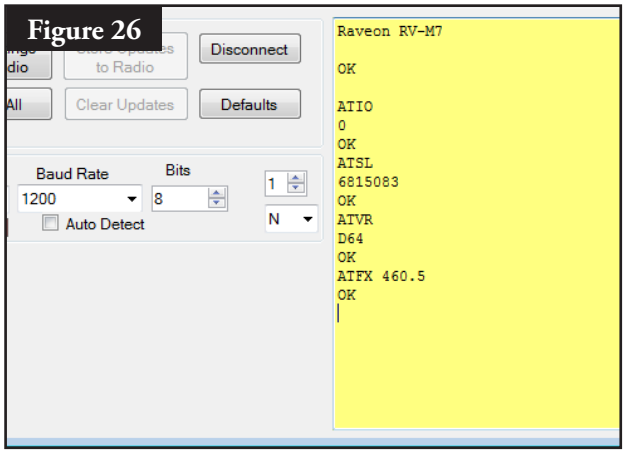


Figure 24







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.

Synchronization *(not used for LAC)*

To synchronize two Lynx SmartHub controllers that are co-located or will have communication output wiring that is installed in a common trench or conduit, follow these steps:

Step 1 – Route a 2-wire cable (10' [3m] maximum length with a minimum diameter of 1.0mm^2 [18 AWG]) from the first controller to the second controller.

Step 2 – Connect the 2-wire cable into the Synchronization terminals of both controllers (Use either the PUMP or RAIN sensor terminals). Make sure that the wire polarity is the same (the wire connected to the left terminal on the first controller is connected to the left terminal of the second controller).

Step 3 – Activate the sensor terminals being used for Synchronization (GW SYNC). See **Figure 28**.

The synchronization is achieved using a shared terminal with either the RAIN sensor or the PUMP PRESSURE sensor. To enable synchronization, the PUMP or RAIN sensor terminal jumper must be placed in the GW SYNC position (top two terminals).

Note: Sensor function is disabled for the terminal with GW SYNC jumper position. If the controller is utilizing both PUMP and RAIN sensor terminals, disconnect one of the sensors and install in the other controller with an unused sensor terminal.

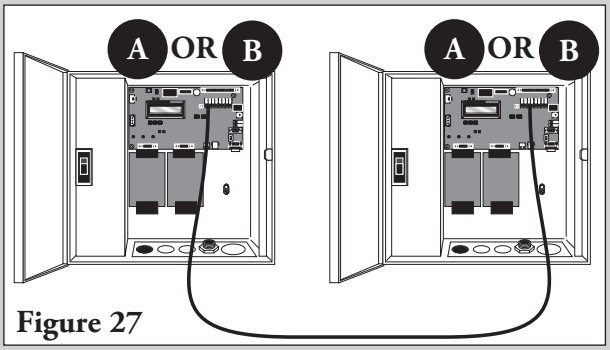
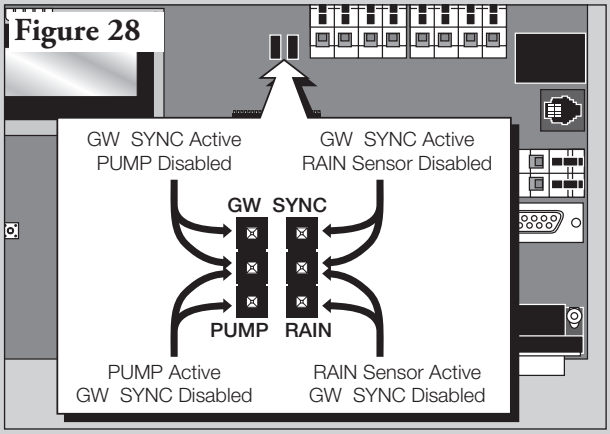


Figure 27



SmartHub 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 **Unit Settings** and selecting **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.

Initial Setup

There are a few settings to establish before the SmartHub is fully operational. These settings are in the **Unit Setting** menu.

- Display contrast at the bottom of the menu may need to be adjusted to see the display properly.
- The language can be set. It has a flag symbol by it.
- CSG and Hub address must be set to communicate with Lynx.

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 the Home display.

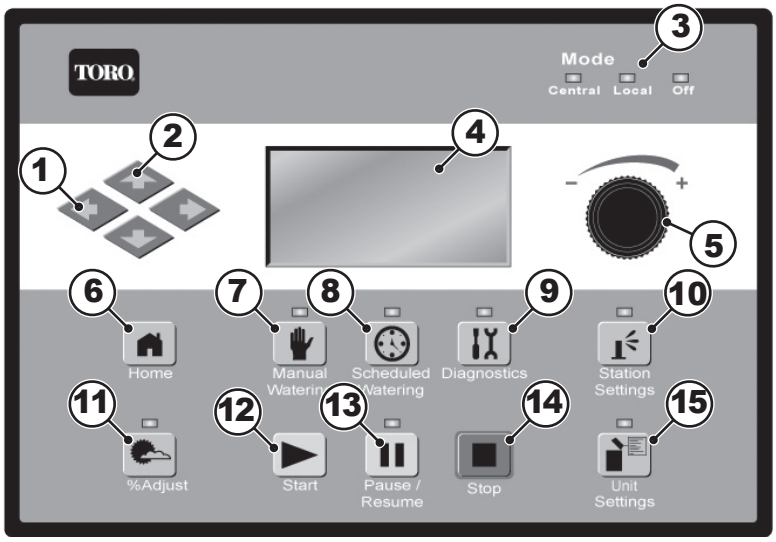
If no keypad activity is detected within five minutes, the SmartHub will automatically save any modifications and revert back to Home display.

Editing Large Values

When modifying large values, it can be time consuming to rotate the dial through all the values. Some three digit values can be changed by modifying each digit separately using the back arrow button. For example, a station number may be changed from 001 to 365 by the following procedure.

1. Press the back arrow twice when on the field for the station number. Only the first digit is now highlighted.
2. Rotate the dial to increase the first digit from 0 to 3. Now 301 is displayed.
3. Press the right arrow button to highlight the first and second digit. Rotate the dial to increase the first two digits from 30 to 36. Now 361 is displayed.
4. Press the right arrow button again to get all three digits highlighted. Rotate the dial to increase the value from 361 to 364.

Timing Mechanism Components



5. **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.

6. **Up and Down Arrows** allow you to scroll up and down through the menu items.

7. **Operation Mode LED Display** will indicate the current gateway operation mode.

8. **LCD Panel** is the display screen.

9. **Input Dial** allows you to scroll through the value selection within the selected entry field.

10. **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.

11. **Manual Watering** button allows you to activate station(s), syringe, or program(s) manually. See page 39.

12. **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 downloaded from Lynx. See page 38.

13. **Diagnostics** button allows you to view the gateway's firmware version as well as other diagnostic information by rotating the dial through different options. See page 41.

14. **Station Settings** button shows settings and data for each station. It shows the stations decoder address, activity for the day, if it's disabled or on hold, and if it is set as a switch. There may be other setting depending on the SmartHub model. See page 36 for more details. Modifications can be made here but can also be overwritten by Lynx.

15. **Percent Adjust** allows you to adjust run times at either the satellite, program, or station level. See page 36.

16. **Start** button will execute selected manual operation. See page 33.

17. **Pause** will suspend watering for a selected duration. The watering will continue after the duration.

18. **Stop** button will cancel currently running program(s) or station(s). See page 33.

19. **Unit Settings** button shows SmartHub settings such as the communication mode, rain hold duration, power mode, language, controller address, date and time, and display contrast. It also allows defaults to be reset for stations, programs, or the whole unit. Some settings can be modified here but may be overwritten by Lynx. A password may also be set to limit modification access throughout the timing mechanism. See page 34.

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

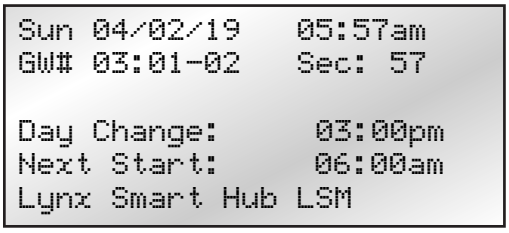
Line 3: Last Power Downtime Date and Time

Example:

Rev: 2.01p16,12/02/19

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

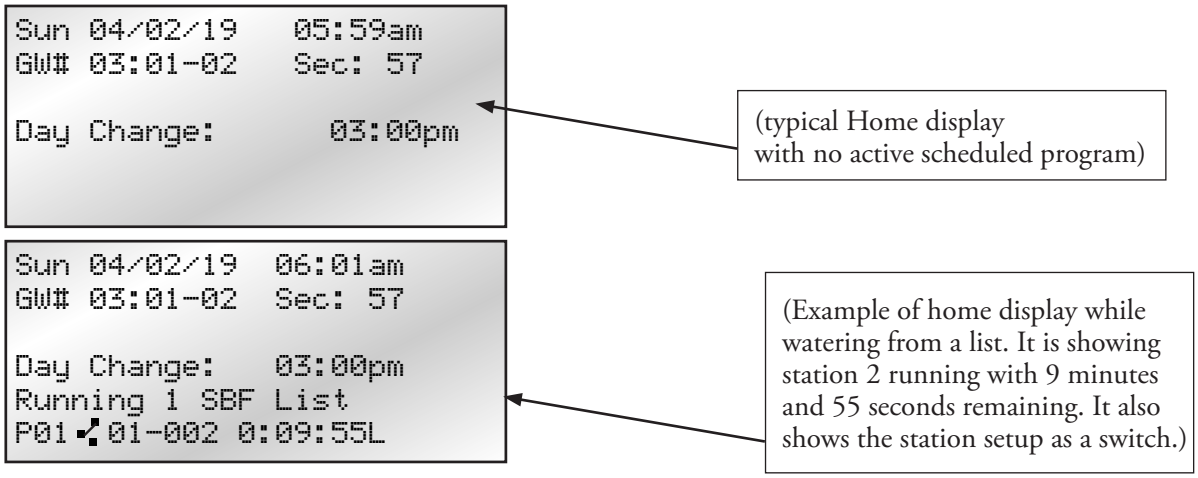
The default Home display will follow after the diagnostic display has timed-out. Home display example:



Home Button

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

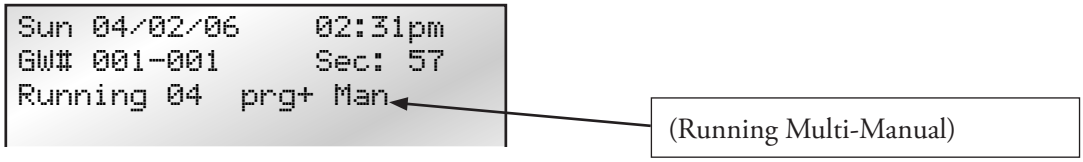
Home display examples:



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.

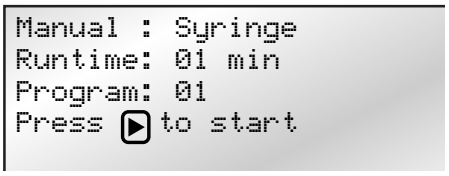
If the SmartHub has an active running program, the display will read:



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

Start Button

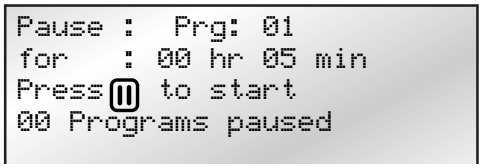
Use the Start button to execute either an irrigation program, a Multi-Manual operation, or a Syringe. These are explained fully in the Manual Watering section, page 31.



Press the Stop button to cancel.

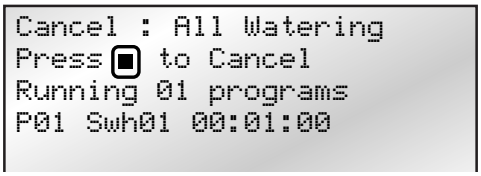
Pause Button

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



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 ALL daughterboards regardless of station activity.



Unit Settings

Unit 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 setting prevents scheduled watering from starting when set to a duration. The duration can be set to **Today**, **2-30** days, **Permanent**, or **None**. The setting does not cancel manual watering or prevent manual watering from starting.
Hold Rain:	This setting cancels all watering and prevents scheduled watering from starting. The duration can be set to **Today**, **2-30** days, **Permanent**, or **None**. Manual watering can still be started during rain holds. Rain hold does not 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. **Reset All Programss to defaults 05 STOP to escape** 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. **Reset All Stations to defaults 05 STOP to escape** 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. **Reset All Defaults 10 STOP to escape** 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". LAC will have a 50Hz short finding option to read current with clamp meters. It will automatically time out. The duration left in this mode is shown on the home screen.
LSM System: (DC systems)	This sets the type of decoders attached to the SmartHub controller. Options: Yes or No. The selection is set to Yes if all decoders on the SmartHub are LSM.

Send OFFs: (Not available on LAC systems.) 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: This selects the language that shows on the display.

Clock Set: This 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 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: The Day Change time is the time that the SmartHub will advance to the next irrigation day. The default day change is 12:00 am. Adjusting it allows 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 sets the CSG (Central SmartHub Group) address. Lynx uses this address to identify different SmartHubs. Each hub should have its own unique CSG address; ie, hub 1 is CSG1, hub 2 is CSG2, etc.

SAT Address: This sets the station group address. It is the value of the first station group number.

Sta Delay: This sets the delay in seconds. It is the minimum delay time between a station turning on and the next one turning on. It is also the delay between a station turning off and the next one turning off. The feature helps avoid water hammer. Note that there is an inherent delay due to messaging even if the delay is set to zero.

Max Sim Sta: This 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.

Chk Ovrload This setting checks that the current and voltage along the wire paths is sufficient before activating a station. If not sufficient, the controller will not allow the station to turn on. This setting should not be changed unless directed to.

LAC Speed: The setting indicates how fast LAC type decoders communicate. It can be set from 1 to 4. The default is 3 and should not be changed unless directed to.
The setting is only for LAC SmartHubs.

LAC coil: The setting indicates when certain error checks are made when turning the station on or off.
It defaults to check when stations turn-off (down arrow) and should not be changed unless directed to.
The setting is only for LAC SmartHubs.

FD coil: The setting checks FD type decoder solenoids when stations turn on. It is enabled by default. The SmartHub will not detect FD type decoder errors if disabled.
The setting is only for LAC SmartHubs.

% (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.

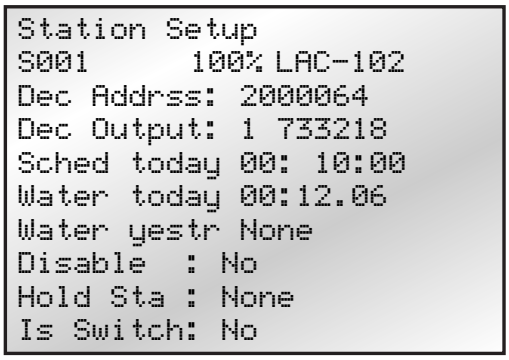
Command	Function
Sensor Setup Menu **(Sensors only available on LSM systems.)**	Access the Sensor Setup menu by changing the board number. The Sensor Setup menu is accessible for ***editing*** when the statellite is in Local Mode and Off Mode. If satellite is controlled by a Lynx Central computer, this menu is available for ***review*** only. To get started, select which input the sensor is connected to (see page 16). Next, select the type of sensor, either `RAIN`, `STAT`, or `FLOW`. Input 1 only accepts flow sensors. Input 2 can accomodate either STATUS or RAIN sensors. 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.
Board	Select the daughterboard, 1 or 2.
Sat	Displays the address of the currently accessed daughterboard. This value cannot be changed.
Sta	Station Setup screen. Select the station to edit in this field. Choose from Station 01 through the SmartHub maximum station count of 500 (LSM) or 250 (GAC).

```
Sensor Setup Menu
Input:  1  Type: FLOW
I_WTW  :  12:00pm
O_WTW  :  11:59pm
I_Min  :  00000 gpm
I_Max  :  00000 gpm
```

```
Sensor Setup Menu
Input:  2   Type: RAIN
Tip   : 0.01 in
Max   : 00.00 in
Units : English(in)
Alarm : Off
```

```
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
```

LAC Station Setup screen is pictured at right. →
733218 is the drive parameter in hexadecimal for Station 1. These values are set in Lynx and loaded into the SmartHub along with the address when mapping.
73 represents an activation voltage of 16V.
32 represents an activation time of 50ms.
And 18 represents a hold voltage of 2.4V.



% This is the percent adjust of the selected station.
100% means that it is not adjusted.
The adjustment does not affect list or manual watering.

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.

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.
Group express numbers only work for LSM systems.

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.

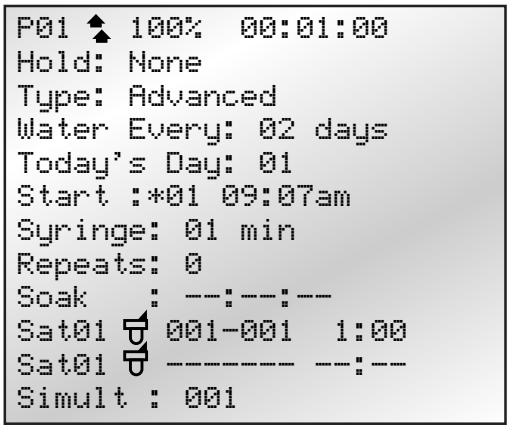
Disable: A disabled station will countdown as if it is running, but will not turn on.
Disable station operation by selecting **Yes**.
Enable station operation by selecting **No**.

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 downloaded from Lynx will water in Central mode. Programs will not. Lists cannot be edited at the faceplate. See the **Station Based Flow Management** section on the next page for viewing the downloaded watering list from Lynx.

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. An optional Syringe time can be specified. (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. An optional Soak time may be specified for programs. This is a delay between programs that repeat. It gives the water a chance to soak into the soil without running off.
10. Set run times for individual stations attached to the satellite.
11. Specify a Simultaneous number. This is the number of stations that will run at one time during the program. Stations run in the order of station number.

Station Based Flow Management:

To review the SBF (Station Based Flow) list, 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. SBF modifications must be made at the Central computer and downloaded to the SmartHub to implement changes.

SBF Lists are disabled from watering when the controller is in Local Mode.

Manual Watering

There are three types of watering that can be manually started: Program, Syringe, and Multi-Manual. Manual watering may be started in the Local or Central mode.

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.

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.

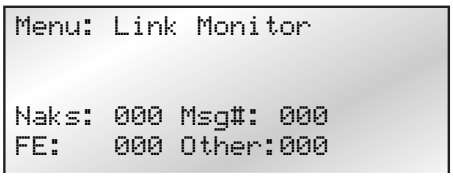
Diagnostics

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

Monitors communication between Lynx and the SmartHub.



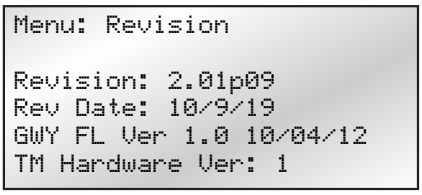
Menu: System Monitor

Monitors communication between Lynx and all SmartHubs in the system.

Menu: Revision

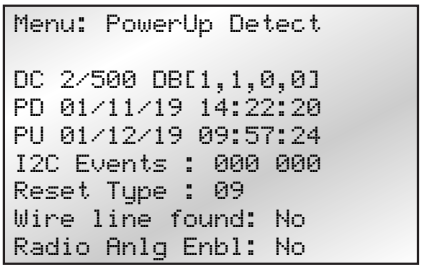
Displays the SmartHub firmware version and creation date.

Scroll down to view the motherboard firmware version as well. The daughterboard version is also available on some platforms.



Menu: PowerUp Detect

Displays the number of detected stations and the 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 through the informations.

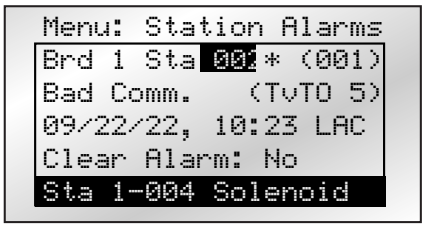


Menu: Stations Alarms

Displays problems detected when turning on and off stations. The example to the right shows a communication problem for station 2 on an LAC system. Detailed information for each alarm can be found by rotating the knob in the station number field.

The last inverted line on the bottom automatically changes every second to display all stations with alarms.

Alarms may not show if Lynx reports them and then clears them. Station alarms may automatically clear each irrigation day on some systems.



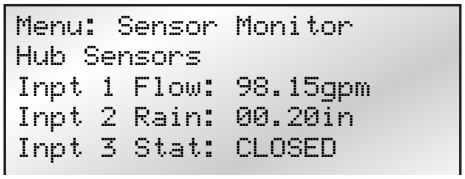
Menu: Station Last On (LSM only)

Displays the time, date, current, and voltage of the last activated station.

Menu: Sensor Monitor (LSM only)

Displays real-time sensor information for all enabled sensors.

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



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    VL:-3.5V
```

Menu:
DB Monitor (for LSM)

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       None
Amps    0.000A
L1      0.000A
L2      0.000A
```

DB Monitor (for LAC)

Besides voltage and current, LAC will show if the power is on, off, or in 50Hz short finding mode. Each set of DB terminals has a relay that is turned on when in use. The examples shows Path 1 and 2 are both on. They can individually be forced off here for troubleshooting.

```
Menu: DB Monitor
Power = On    14:46:29
Paths = 1 On  2 On
Volts = 41750 mV
Amps = 7 mA (1)
State = Operating 00
```

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 decoders.

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

Menu: Decoder Diagnostics

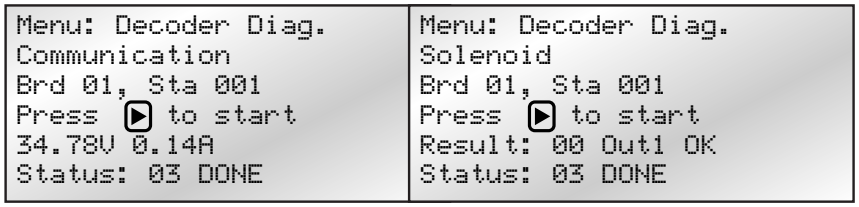
This command allows the user to run diagnostic tests that send messages to decoders and modules. The faceplate will show the last test performed at the TM. The tests include:

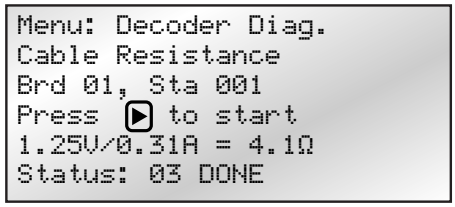
- communication (pictured below)
- solenoid (pictured below)
- LSM voltage
- LSM amps
- LSM version
- LSM Hardware Errors
- LSM Grp02 Info
- LSM Grp16 Info
- LSM Group Ping
- Group Volts
- Group Amps
- Group Errors
- Group Sta's On
- LSM Grp Charge Fail
- Cable Resistance (pictured below) *
- Decoder Output *
- Decoder Version *
- DBoard Output *
- DBoard Version *
- Solenoid Resistance †
- Get Solenoid Drive †
- Learn Solenoid Drive †
- Cable Resistance (to decoder) †
- LAC Input Voltage †
- LAC Version †
- LAC leakage Amps †
- LAC Temperature †
- Factory Reset †
- Get LAC Object †
- Discover LAC address †

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

LSM-only tests are marked as such

Tests marked with a cross (†) are for LAC only.

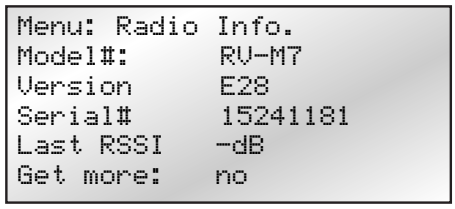




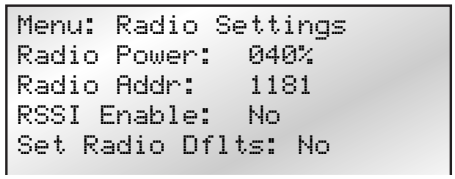
Menu: Radio Tx Chars This menu item transmits numerical sequences to another radio for troubleshooting purposes.

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.

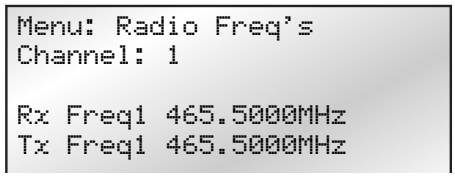
Menu: Radio Information Displays information about the installed radio.



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



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

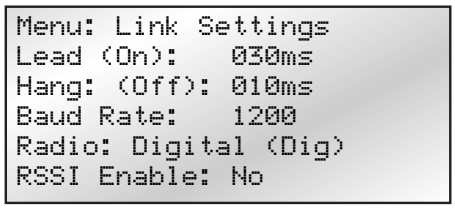


Menu: Message Log Displays the logged messages.

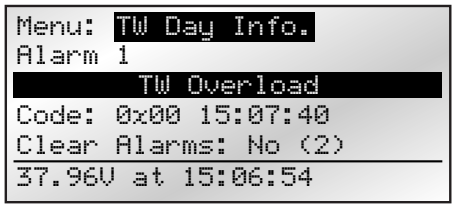
The Message Log history can be cleared from this screen as well.

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.

If a radio is used, the Radio Setting should be set here for it to work correctly.



Menu: TW Day Info (LAC only) Shows up to four two-wire daughter board alarms during the irrigation day. The last line is not alarm information--it alternates between showing the highest two-wire current and lowest voltage recorded for the irrigation day.



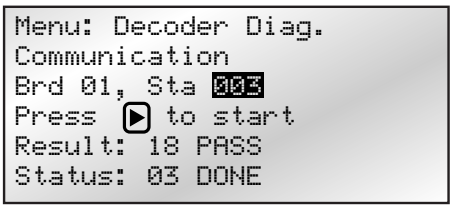
LAC Decoder Diagnostics

FD Test
There is one test available for FD type decoders. This checks both the communication and solenoid and is available in Lynx. The test will fail if the solenoid is not connected.

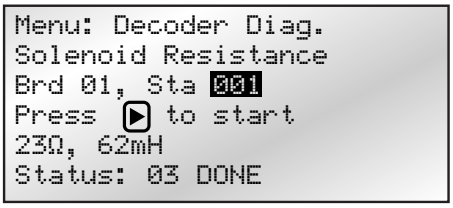
LAC Communication Test and LAC Solenoid Test
LAC type decoders have separate communication and solenoid tests. The communication test checks if the hub can communicate with decoders. It does not require solenoids and will not cause watering.

The LAC solenoid test checks the solenoid for opens and shorts. If the SmartHub cannot communicate to the decoder during the test it will fail and say timeout.

Both tests are available in Lynx but results may show a different failure if the SmartHub cannot communicate to a decoder.



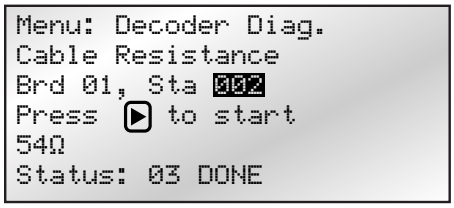
Solenoid Resistance
Retrieves the coil resistance determined when the station was last turned on. This is for an LAC type decoder.



Get Solenoid Drive
Reads a LAC decoder's drive parameters.

Learn Solenoid Drive
Learns a LAC type decoder's drive parameter. We do not recommend using this. It can be overwritten and may cause brief watering.

Cable Resistance
Determines cable resistance from the SmartHub to a LAC type decoder.



LAC Input Voltage
Determines the two-wire voltage at the input of a LAC decoder.

LAC Version
Reads a LAC decoder's firmware version.

LAC Leakage Amps
Determines the ground leakage on the solenoid side of a LAC decoder station.

Discover LAC Address
This will read the address out of a LAC decoder when it's the only one attached to the SmartHub.

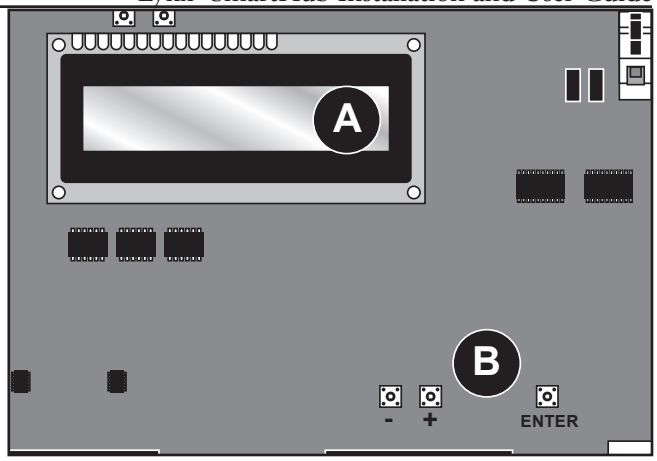
LAC Temperature
Reads a LAC decoder temperature in Kelvin.

Factory Reset
Resets a LAC decoder. Not intended for normal operation.

Motherboard Diagnostic Display

The motherboard display and buttons are useful for models that do not have Timing Mechanisms. The SmartHub motherboard (LSM shown) 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.

All screenshots below are for the LSM motherboard.



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.

Note regarding GAC motherboards: The GAC motherboard display operates similar to LSM except that it shows currents and message commands to four GAC daughterboards. GAC also shows the current for both phases of the AC signal. Most information is also available using the timing mechanism. All models have the firmware version and ability to adjust the display contrast.

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

If a wiring issue causes excessive power consumption (> 1.65 Amps), the SmartHub limits the voltage to 6V which prevents system shutdown and allows for troubleshooting.

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
Note: Radio not included with LAC.

Fuse and Circuit Breaker

Power Supply (for pedestal configurations only):
1.5A On/Off Switch/Circuit Breaker – Main Power Input
3.2A Fuse (Slow-Blow) – Field Output
Output Board (for LSM only): 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 (800 for LAC)
- **Rated Input Voltage**: 100-240 VAC, 50/60 Hz
- **Rated Output Voltage:** 40VAC (42.2VAC for LAC)
- **Rated Input Current**: 1.6A
- **Rated Output Current**: 1.8A max. (1.1A for LAC)
- **SmartHub output power**: 75W max.
- **Automatic Action**: Type 1.C product
  Impulse Voltage: 2500V
- **Altitude:** 2000m max
- **Ingress Protection:** IP44
- **Operating Temperature**: 0°C to +60°C (32°F to 140°F)
- **LAC:** 0°C to +50°C (32°F to 122°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 Agency Statement

Warranty

The Toro Company offers warranties for golf product. Please see the current catalog at the time of installation for warranty information.

FCC / IC / EMC Statement

North America: 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 32 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.

Products with transformer: Utilize a Class 2 transformer tested to UL1585 and satisfies the requirements of a Class 2 Power Source as defined in the NFPA 70 (NEC), Article 725.121(A)(3).

TORO® Count on it.

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

Patent: www.ttcopats.com

Form Number 373-0965 Rev. H