



Two-Wire System Design Guide

Welcome to the Weathermatic Two-Wire System Design Guide. This guide has been developed to provide an overview and detailed notes and tips for contractors and specifiers who are working with Weathermatic Two-Wire systems.

This guide includes the information necessary to specify a Weathermatic Two-Wire systems. Written specifications in CSI and Microsoft Word format as well as CAD details reference herein are available on the Weathermatic website at www.weathermatic.com

INTRODUCTION

Two-wire decoder technology has been around the irrigation industry for more than three decades beginning in the golf industry (primarily in Europe) in the mid 1980's as a cost effective method for wiring irrigation valve-in-head rotors used extensively in golf irrigation systems. The cost savings was a result of eliminating thousands of feet of copper wire used to control valves. Two-wire systems also made it far easier to trace and connect wire from the irrigation controller to the sprinkler head without having to use specialized tone equipment and multiple installers.

By the late 1990's, manufacturers began to bring two-wire technology to the U.S. Early systems primarily used DC current, which is highly susceptible to faults in wiring, which led to a number of system failures as contractors had to learn to be diligent with wiring. Additionally, DC latching solenoids, which are highly susceptible to "sticking" open, were required to be used on each irrigation valve. Fortunately, irrigation manufacturers figured out how to convert the two-wire DC signal to AC thus eliminating the valve failure problem.

Today, two-wire irrigation system are a high majority of the types of new irrigation systems being installed in the U.S. especially in the Central and Eastern U.S.

WHAT IS A TWO-WIRE IRRIGATION SYSTEM?

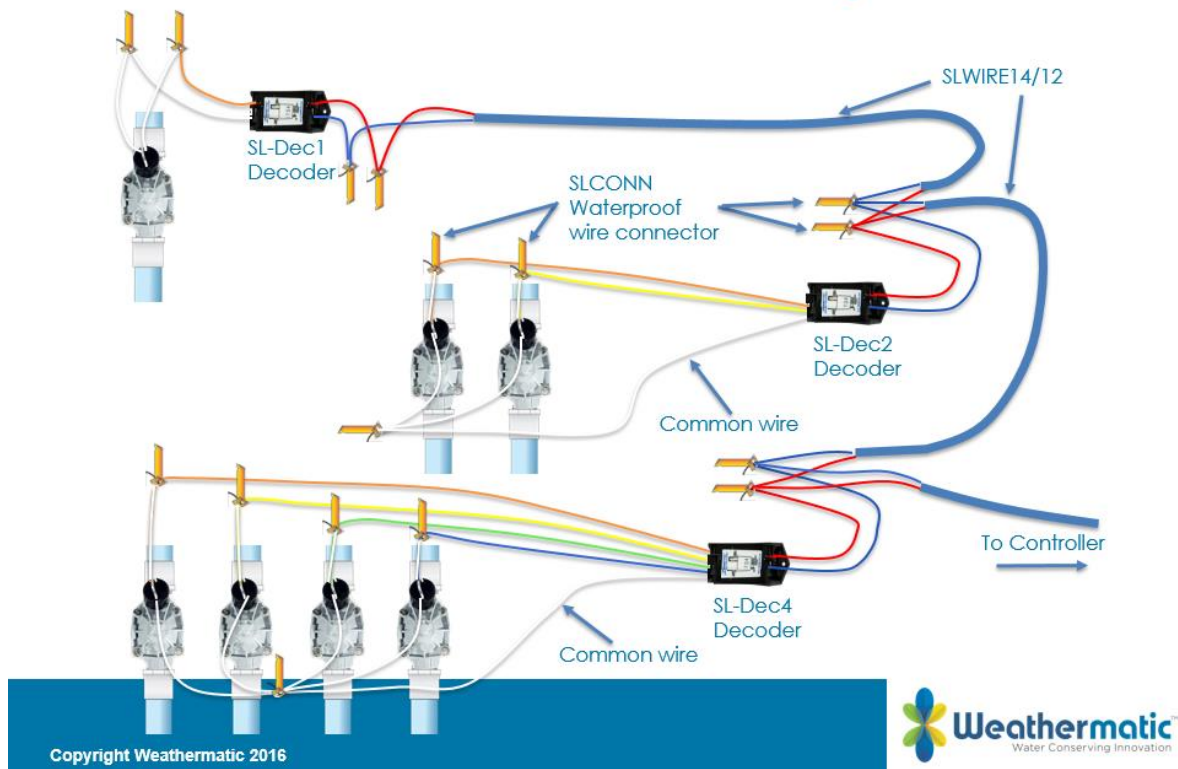
In a two-wire decoder system, a single pair (thus the name "two-wire") of poly insulated wires is run to all valve locations on a "wire path". At each irrigation valve location, a valve "decoder" is wired to each valve. Each decoder has a programmable address (typically the zone number), which identifies it to the two-wire decoder irrigation controller. The two-wire cable is connected to all these decoders on the wire path.

During operation, the controller broadcasts an "ON" command to activate a specific address. All of the decoders wired on the same two-wire path "decode" the message, but only the appropriate decoder responds and turns the attached valve on. The decoder also reports back to the controller that it received the command and has responded. The lack of response or an electrical issue will trigger an error code on the controller to aid in troubleshooting. When the irrigation cycle is finished, the controller stops sending the "ON" command and decoder responds by turning the valve off.

Electrically a two-wire controller actually sends the "ON" command hundreds of times per second thus enabling the system to communicate to multiple decoders at the same time over the same wire path

over long distances. Operating this way provides the benefit of longer wire runs, lower power consumption and increased lifespan controller and valves.

Two-Wire Decoder Systems



BENEFITS OF A TWO-WIRE SYSTEM

- Less Labor to Install - Two-wire path installation is easier to install and connect to controller and valves saving labor. With only a single cable with two conductors, the installation requires smaller trench space and enables the contractor to quickly lay the wire in the ground without concern for routing the cable to the proper valves or later trying to identify station wires.
- Easier and Faster to Troubleshoot – When conventionally wired controller wires are accidentally dug up or trenched through a repair would require several hours. A two-wire cable, on the other hand, would be an easy repair. The contractor simply has to splice the black wire to black and red to red to successfully make the repair. Also when a group of zones fail to operate, troubleshooting is made easier by identifying the part of the wire path that does not work and finding the splice or wire defect that is the cause of the problem. On a





conventionally wired system, a single valve failure can take hours to troubleshoot because the technician must trace the entire length of the wire to find the defect.

- Less Wire Means Fewer Problems - Exposure to shovels, rodents, and even lightning is minimized with two-wire paths because there is less wire in the ground.
- Extend System in Phases - Irrigation systems can be easily expanded or subdivided after the original installation without running spare wires, or retrofitting new wiring back to the controller. On a two-wire system expansion can take place by simply splicing into the end of a two-wire path and continuing the wire to the new phase of a project.
- Decoders can be positioned anywhere along the two-wire path – Positioning, adding or moving decoders and valves is easy because they can be positioned anywhere along the two-wire path during construction or after.
- Better Water Management – Adding, splitting, or moving zones makes it easier to hydrozone plant material and/or modify planting plans in the field after the original design is completed.
- Reduced Electrical Cost – Two-wire systems are more efficient at power consumption. Because a two-wire controller actuates the valve hundreds of times a second, the decoder doesn't actually operate for the full run time thus consuming less electricity. This is especially important for solar two-wire systems where power consumption is a critical issue.
- Valves Last Longer – The cyclical nature of two-wire power use to the valve leads to longer valve lifespan. Because a two-wire controller actuates the valve hundreds of times a second, the solenoid on the valve doesn't actually operate for the full run time thus extending the life of the solenoid.
- Resists Lightning – Since a two-wire system has less wire in the ground, it tends to be less susceptible to lightning damage vs a conventionally wired system if the decoders are installed in protected clusters. Proper grounding and wire splicing is critical to ensuring a two-wire system is more resistant to the effects of lightning.
- Two Wire Decoder Systems can be Less Expensive than Conventional Wire Systems – Larger station count two-wire systems are less impacted by high wire costs than conventional systems. The primary driver in this is the cost of copper and its influence on irrigation wire prices.

EXAMPLE	Conventional Systems	Two-Wire Systems
48 station controller	\$660	\$590
1 1/2" Valve	\$3,240	\$3,240
Decoder	N/A	\$3,619
Wire	\$6,774	\$1,166
TOTAL	\$10,672	\$8,614

WEATHERMATIC SMARTWIRE™ TWO-WIRE DESIGN

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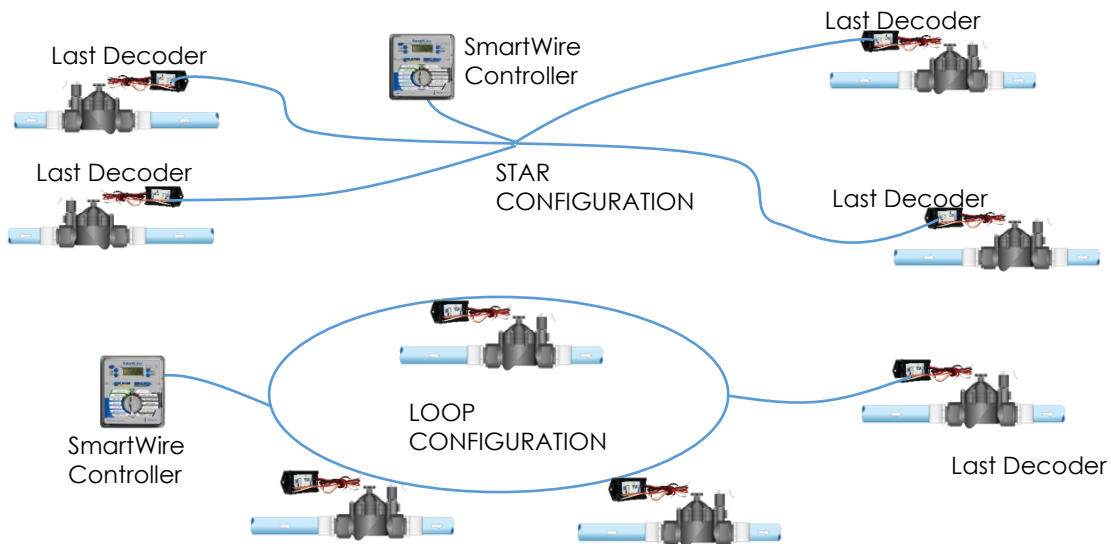
TWO-WIRE PATH LAYOUT

Two-wire controllers typically have connections for multiple wire paths enabling the system to power decoders running in multiple directions. The Weathermatic SmartWire™ two-wire controllers have 3 separate wire path connections. These are labeled 1, 2, & 3 for wire path #1, wire path #2 and wire path #3 respectively.

Although wire paths can be designed to run in multiple directions, attention should be given to the limitations on distance that each wire can be installed.

The Weathermatic SmartWire™ system allows you to have several options in cable routing to determine the most efficient two-wire layout for your project. Maximum decoder to valve distance is 100 feet (30.5m).

Each two-wire run can be laid out in Straight Run, Complete Loop, Star, or Combination configurations as shown below.





It is suggested that a continuous loop be laid out around the site. This usually follows the main water lines. The loop will start at the SmartLine® controller and continue around the site and then return to the controller. This provides the best communication and power path for the system. The loop provides a redundant path for the power and signal allowing the system to continue operation if the loop is cut.

Branches can come off the main loop and they do not need to be looped back to the main trunk line. These branches can be other loops, stars or single dead-end lines. The system will work with most wiring configurations if the wire length requirements are met.

WIRE SIZES

The configuration and size of the wire conductor used will determine the maximum length a wire path can run. The chart below summarizes these distances:

Star Configuration - Wire distance to the furthest decoder, no loop:

Wire Size (Gauge)	#18	#16	#14	#12
Wire Length (feet)	1,000	2,000	4,000	6,000

Loop Configuration - Wire distance to the furthest decoder in the loop:

Wire Size (Gauge)	#18	#16	#14	#12
Wire Length (feet)	2,000	4,000	10,000	10,000

NOTE: Maximum total wire path length is 10,000 feet

TWO-WIRE

Weathermatic recommends the use of Weathermatic SLWIRE12 or SLWIRE14 cable specifically designed for an irrigation control system and complying with the following specifications:

- Conductors must be soft drawn, annealed, solid copper conforming to ASTM 33
- Conductor insulation must be 4/64-inch thick polyvinyl chloride (PVC) conforming to UL #493
- The two insulated conductors laid in parallel and encased in a single outer jacket of 3/64-inch thick, high-density, sunlight resistant polyethylene conforming to ICEA S-61-402 and NEMA WC5, having a minimum wall thickness of .045-inch
- The two conductors must be color-coded: normally one conductor red and the other black. Both conductors shall be the same size.

HOW TO SPECIFY:

Weathermatic SmartWire™ Wire

SLWIRE-122 – 12 gauge, 2 conductors with poly outer jacket, available in 1,000 or 2,500 foot rolls, blue outer jacket is standard (other outer jacket color options are available as special order but can be expensive)

SLWIRE-142 – 14 gauge, 2 conductors with poly outer jacket, available in 1,000 or 2,500 foot rolls, blue outer jacket is standard (other outer jacket color options are available as special order but can be expensive)

WEATHERMATIC SMARTWIRE™ SURGE ARRESTOR

Weathermatic SLGDT gas discharge tube lightning arrestors must be used on all two-wire grids. The SLGDT lightning arrestor attaches directly to the two-wire system and helps dissipate static electricity generated by a nearby lightning strike. While Weathermatic components have lightning arresting features, the SLGDT provides an extra measure of protection.

Features:

- Conductors must be soft drawn, annealed, solid copper conforming to ASTM 33
- Conductor insulation must be 4/64-inch thick polyvinyl chloride (PVC) conforming to UL #493
- Protects the two-wire system from excessive static charges created by a lightning strike.
- Sealed and impervious to moisture, salts, fertilizers and mild chemicals.
- Shock resistant.
- Freeze/heat resistant (-20° to 60° C).
- No electrical contact with the soil.
- **Each Lightning Arrestor protects a 300-foot radius.**



SLGDT

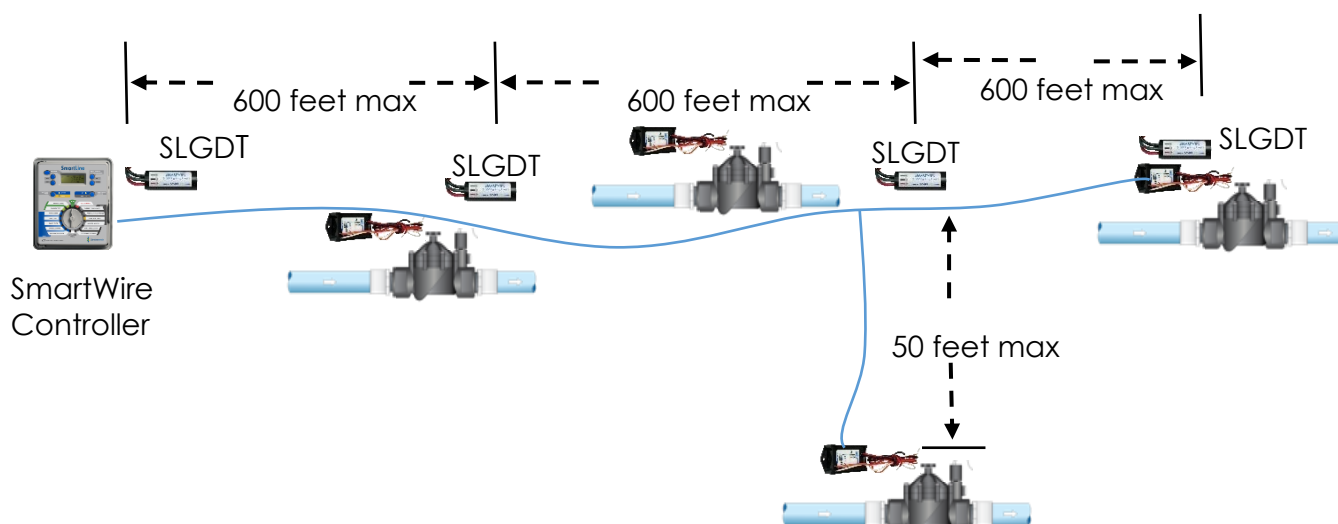
Electrical Specifications

- Requires no power from the two-wire system
- Can only be connected to SmartWire™ two-wire systems

HOW TO SPECIFY:

Weathermatic SmartWire™ Surge Arrestor

SLGDT – Surge Arrestor (install every 600 feet). Use SLGDT at beginning and end of each wire run (if greater than 50 feet) and at a maximum of 600 foot intervals. See below.



WEATHERMATIC SMARTWIRE™ WIRE SPLICE

The wire splice is the most important part of any two-wire system. The majority of issues seen in two-wire systems is primarily due to bad wire splices. The following issues can be a result of bad wire splices on any two-wire system:

- Valves fail to turn on
- Decoder not found error codes at the controller
- System works initially but fails after water infiltrates a bad splice
- Some valves turn on normally while other valves fail to turn on.
- Controller shows an over current alert

Most of these issues can be avoided if splices are installed correctly.

The correct type of splice kit which should be used includes an electrical spring connector (commonly called a “wire nut” and a high impact, UV-resistant polypropylene tube prefilled with moisture-resistant gel. If installed correctly the two-wire splice kit will be waterproof.

HOW TO SPECIFY:

Weathermatic SmartWire™ Splice Kit

SLCONN – Waterproof wire connector for 2 wires connections



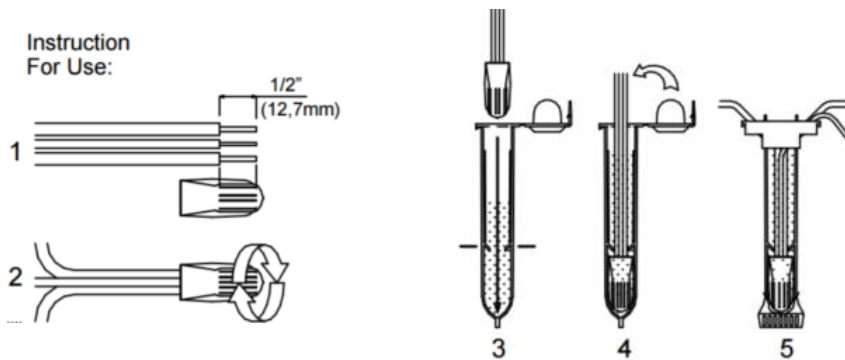
SL-CONN

Note – (2) SL-CONN kits are included in each Weathermatic SmartWire™ Decoder

Proper Splice (see diagram below)

1. Strip wires ½”
2. Twist stripped wire clockwise with lineman’s pliers. Apply the electrical connector and twist in a clockwise direction.
3. Insert the splice into the gel-filled insulator tube. Push past the locking fingers to hold the connector in place. Bottom it out.
4. Position wire channels and snap insulator tube cover closed.
5. Pull on wires to ensure waterproof connection.

Note: Keep BLACK to BLACK and RED to RED when wiring two-wire connections.



Splice issues usually arise from any of the following:

- Electrical connector not fully twisted on to wires. This causes an open wire condition
- Splice not full inserted into insulator tube. This allows water to infiltrate into the splice causing a wire short. Usually this issue doesn’t show up until a few months after installation.
- Insulator cap not closed. This also allows water to infiltrate into the splice causing a wire short. Usually this issue doesn’t show up until a few months after installation.

It is a good practice to test a few splices during jobsite inspection by taking a couple random splices apart to inspect for the issues mentioned above. The contractor will have to re-splice the connection with a new splice kit* but this practice ensures the installer has likely installed the remaining wire splices correctly. If the random sample of splices are not correct, it is highly likely the remaining splices were also installed incorrectly and the system will fail.

*Note: Wire splice kits CANNOT be reused.

WEATHERMATIC SMARTWIRE™ GROUNDING REQUIREMENTS

Grounding all electrical connections of a two-wire system is a critical step to ensure the system is protected from damage by electrical surges and nearby lightning strikes. Although every irrigation controller (conventional wired or two-wire) should be grounded, this step is often overlooked during the installation. System failures and even a fire can be easily avoided by following a few simple steps.

Lightning, in particular can do a lot of damage to an irrigation system because irrigation systems have a lot of wires underground where lightning can access the entire valves and wire network. Although grounding can prevent a lot of electrical damage to an irrigation system, a direct hit from lightning will likely cause damage even if the system is properly grounded.

The critical measurement for determining whether a system is grounded properly is call “resistance-to-ground” In other words, it is the measurement of how easily a surge of electricity or lightning can enter to the earth once it is made its way on to an irrigation systems electrical circuits. The lower this measurement is, the better. Typically, if the resistance to ground is lower than the resistance of an irrigation systems electrical components, the electrical surge will find its way to earth and not through the electrical components. This is called least path of resistance.

The objective of proper grounding techniques is to provide the least path of resistance for any potential electrical surge or lightning strike.

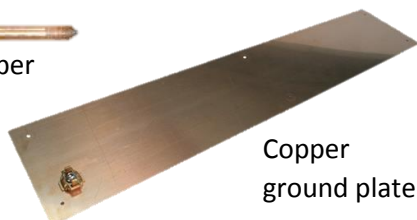
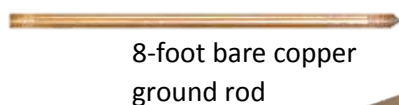
The green wire on any irrigation equipment is the wire that needs to be connected directly to the grounding circuit. For Weathermatic SmartWire™ equipment, any GREEN ground wire must be attached to a #8* solid bare copper wire using the SLCONN splice kit. The bare ground wire must be connected to a grounding circuit with 12 Ohms or less resistance to earth ground, measured with a ground resistance meter or Megger. (see below)

*Ground wire must be one size larger than the largest wire in the system.



A grounding circuit is comprised of 4 major components:

- Ground Rod(s) and/or Plate(s).
- Ground Conductor - #8 bare copper wire
- Exothermic or Cadmium Weld connections.
- Soil and/or Ground Enhancement Materials.



Ground Rods/Plates must be installed 6” below grade or below frost line, located within an irrigated zone to maintain soil moisture and maximum ground performance. All connections must be made in a minimum 6” min. valve box. Rods are installed perpendicular to the ground while plates are installed horizontal to the ground. See manufacturers recommendation for correct installation.

Ground Rods shall be UL listed “copper clad”, 5/8” minimum diameter, 8’ of length, and must meet the requirements of NEC article 250-52(c).

Ground Plates shall be a copper alloy specifically intended for grounding, with a minimum thickness of 0.060”. Each plate shall expose a minimum of 5 square feet of surface area to contact the soil, and meet the requirements of NEC article 250-52(d).

Grounding Conductor shall be a solid, bare copper wire or strap used to connect the green ground wire to the ground rod or plate, sized appropriately to achieve specified resistance.

NOTE: The bare copper wire should run perpendicular to the two-wire path

Exothermic or Cadmium Weld products such as CADWELD One Shot[®], shall be used to connect the #8 AWG bare copper ground conductor to the ground rod or plate.

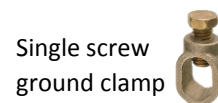
Ground Enhancement Materials such as Powerset[®], PowerFill[®], and GEM[®] shall be used as required to achieve specified resistance to earth ground.

Local soil and site conditions will dictate what extent of grounding measures will be required. Generally there are 3 soil types that each require different methods and equipment to achieve the 12 Ohm minimum resistance to ground:

- Clay soils: A single ground rod is typically sufficient, located in an irrigated zone, with CADWELD connections and no soil amendments. Some sites require a 6” diameter hole to be augured and backfilled with Ground Enhancement Materials.
- Loam Soils: Typically a 3-ground rod grid is required, located in an irrigated zone, with CADWELD connections, 6” augured holes and Ground Enhancement Material as required.
- Sandy soils: Require the most extensive ground circuits which require combinations of ground rods, plates, CADWELD connections and ground enhancement materials, located in an irrigated zone.

Any combination of the above recommendations should be considered to achieve 12 Ohms or less. Long-term maintenance of any ground system requires that it be located within an irrigated or wetted zone.

NOTE - DO NOT USE single screw ground clamps as these clamps will loosen over time.



Weathermatic recommends the use Exothermic or Cadmium Weld connections for all ground rod and plate connections. See <https://youtu.be/T5DoB26TFtI> for video of how this is done.



HOW TO SPECIFY:

Weathermatic SmartWire™ Grounding

- Use #8 bare copper wire
- Maximum 12 Ohms resistance to earth ground
 - Test with 3-point Megger or ground resistance clamp-on meter
- Use Exothermic or Cadmium Weld for all ground connections
- Use grounding enhancement material (GEM) to decrease resistance to ground

Specification Example:

Contractor shall test each grounding grid at completion of project to comply with 12 Ohms or less electrical requirement. Contractor shall rectify and ground grids that test above this requirement prior to project completion.

Weathermatic Recommended Grounding Grid Configurations

- 3-rod grid
- 1-rod & 1-plate grid
- 2-plate grid

Grounding – 3-rod grid

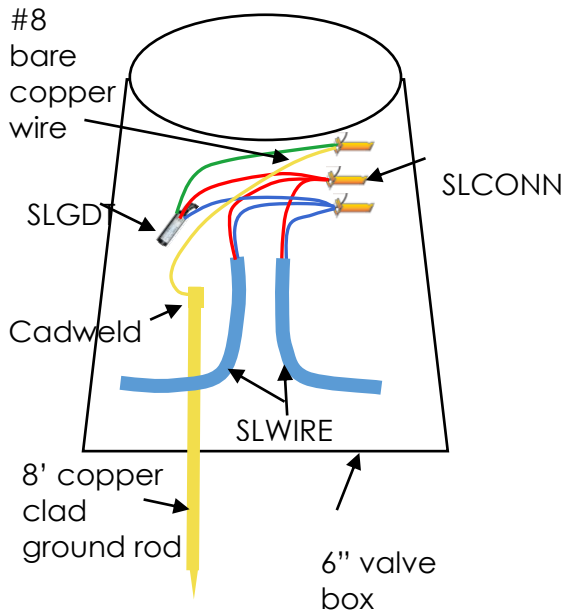
- 8-foot ground rod triangle grid

Perpendicular to wire path

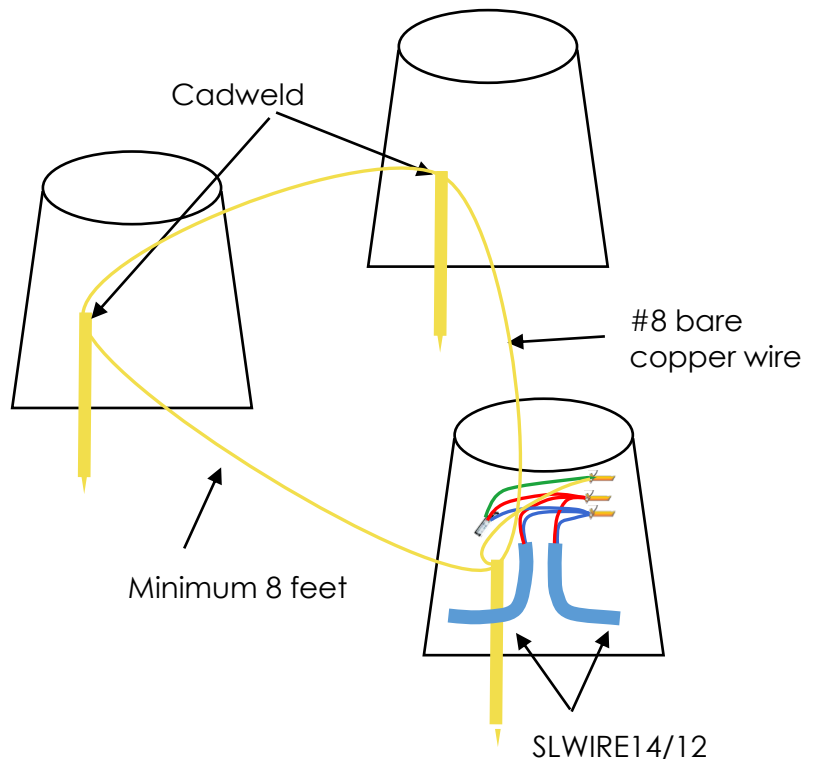
Two-wire Path

Grounding

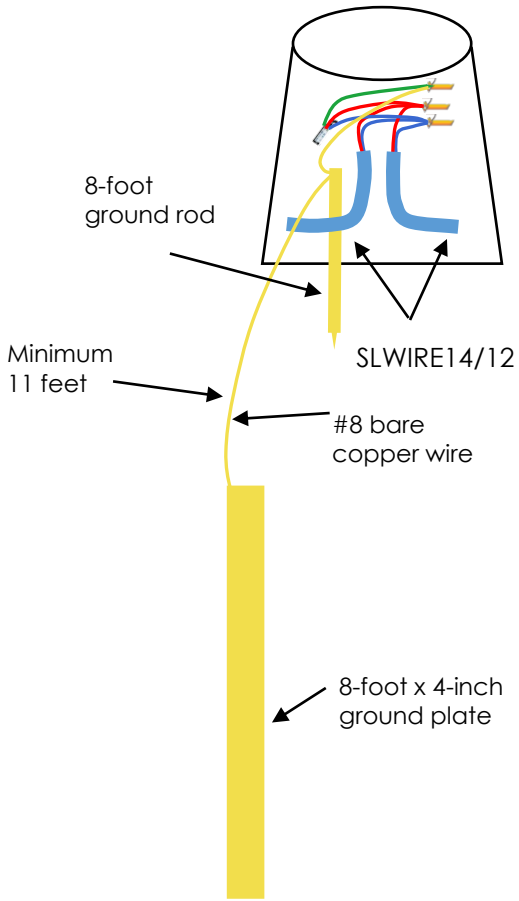
First Rod Connections



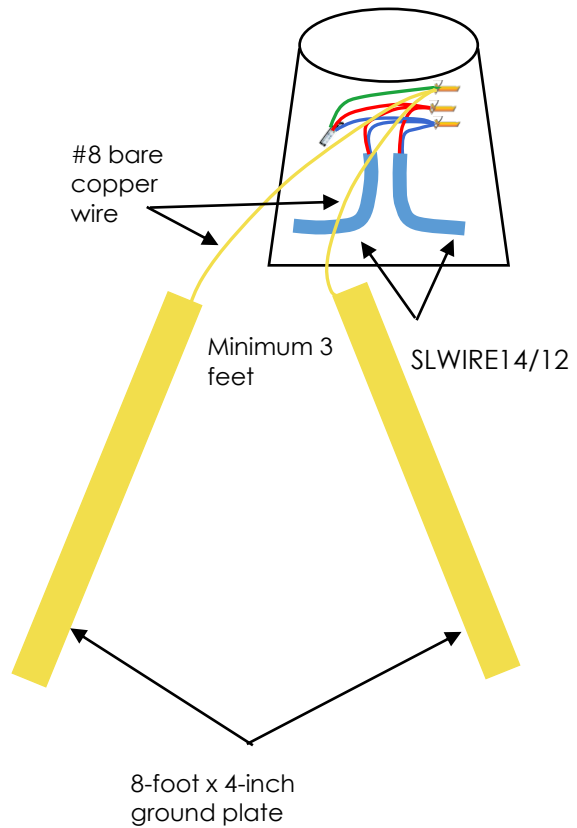
3-Rod Ground Grid Configuration



Grounding – Rod & Plate Configuration



Grounding – 2-Plate Configuration





WEATHERMATIC SMARTWIRE™ CONTROLLERS

The Weathermatic SL9600TW is pre-configured for large two-wire installations.

The SL9600TW is available to operate up to 48 decoders (SL9648TW) or up to 96 decoders (SL9696TW)

HOW TO SPECIFY:

Weathermatic SmartLine Two-Wire Controller

For up to 48 decoders/stations:

SL9648TW – SmartLine Controller. Up to 48 decoder addresses

For up to 96 decoders/stations:

SL9696TW – SmartLine Controller. Up to 96 decoder addresses

WEATHERMATIC WEATHER STATION

The SLW weather station can be added to any SmartLine Two-Wire Controller to enable ET to be used for weather adjusted run times. SLW is available in a wired (SLW1) and a wireless (SLW5) version. In addition, the SLW weather station incorporates a rain sensor to shut down for rain settable at ¼" - ½" and a freeze sensor which will interrupt irrigation when the temperature drops below 37°F.

HOW TO SPECIFY:

Weathermatic SmartLine Weather Station

SLW1 – Wired Weather Station

OR

SLW5 – Wireless Weather Station*

*Note: The SLW5 wireless weather station can be located up to 1,500 from the SmartLine controller.

WEATHERMATIC SMARTWIRE™ RAIN/FREEZE SENSOR

The RFS rain/freeze sensor can be added to any ProLine Two-Wire Controller to incorporate a rain sensor to shut down for rain settable at ¼" - ½" and a freeze sensor which will interrupt irrigation when the temperature drops below 37°F degrees. The RFS is available in a wired (RFS1) and a wireless (RFS5) version.

HOW TO SPECIFY:

Weathermatic ProLine Rain/Freeze Sensor

RFS1 – Wired Rain/Freeze Sensor

OR

RFS5 – Wireless Rain/Freeze Sensor*



*Note: The RFS5 wireless weather station can be located up to 1,500 from the ProLine controller.

WEATHERMATIC SMARTWIRE™ DECODERS

A decoder is installed at each valve box to activate the valves. Each decoder has a unique address which identifies it to the Weathermatic SmartWire™ Controllers. The SmartWire™ controller broadcasts a command to activate on a certain address. All the decoders on the two-wire system “decode” the message but only the appropriate decoder responds and turns the attached valve on or off. The decoder responds back to the decoder module with a status message.

Weathermatic SmartWire™ Decoders are available in 1, 2, or 4 address configurations. Valves that are grouped together can use a 2 or 4 address decoder to reduce the number of decoders needed for a system.

Each decoder will have RED and BLACK wires. These are the wires that will connect to the two-wire path. The RED and BLACK are also the wires that you will insert in the Programming Ports on the Weathermatic SmartWire™ Controllers to program the decoder.

The wires on the other end of each decoder are for connection to the valves. A white wire on the decoder is used for the common to all valves connected to the decoder.

HOW TO SPECIFY:

Weathermatic SmartWire™ Two-Wire Decoders

SL-DEC1 – Single Address Decoder

SL-DEC2 – Two Address Decoder

SL-DEC4 – Four Address Decoder

While Weathermatic SmartWire™ Two-Wire Decoders have lightning arresting features built into each unit, Weathermatic strongly recommends the installation the SLGDT surge arrester. The SLGDT provides an extra measure of lightning protection. The SLGDT lightning arrester attaches directly to the two-wire system and helps dissipate static electricity generated by a nearby lightning strike.

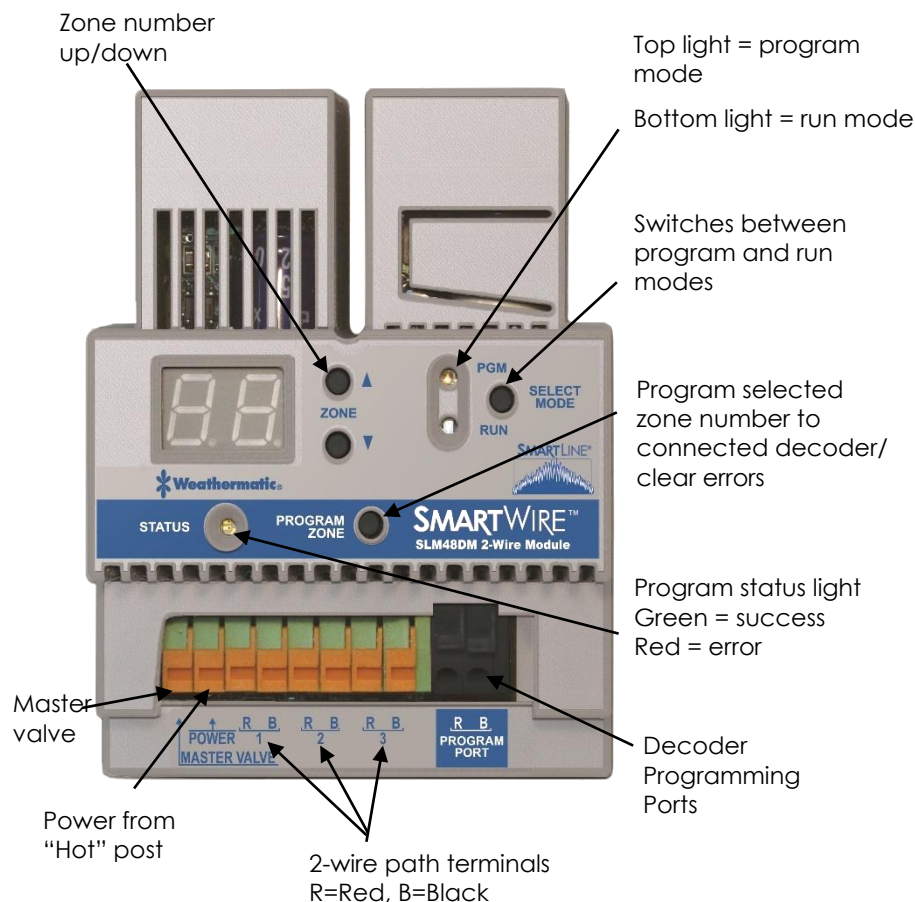
WEATHERMATIC DECODER COMPATIBILITY

Weathermatic SmartWire™ Two-Wire Decoders are only compatible with the Weathermatic SmartWire™ Controllers. Each manufacturer uses proprietary programming to program their respective decoders therefore each manufacturer’s decoders are not compatible with any other manufacturer. For retrofitting a decoder project with Weathermatic SmartWire™, the existing decoders MUST be changed out to Weathermatic SmartWire™ Two-Wire Decoders.

Programming each decoder's address is easy using the Weathermatic SmartWire™ Decoder Module

Weathermatic SmartWire™ Decoder Module Programming Steps

1. Select the PGM mode
2. Insert the RED and BLACK wires into the Programming Ports
3. Use up/down arrow buttons to select the zone number.
4. Push Program Zone button
5. A GREEN status light will confirm your selection.
6. Mark the zone number programmed on the decoder.



DECODER SYSTEM ERROR CODES

If a decoder cannot be located or a short, open or over current or over temperature is sensed by the Weathermatic SmartWire™ Decoder Module, it will cause a FAULT message to appear on the display of the SmartLine® controller. Open the SmartLine® panel and check the FAULT on the display of the Weathermatic SmartWire™ Decoder Module. After the FAULT is repaired, press the Program Zone button on the Weathermatic SmartWire™ Decoder Module to clear the error message. Refer to the table below for Weathermatic SmartWire™ Decoder Module error messages.

Error Codes – Errors will be displayed in screen

Fault Code	Description
E1	No decoder found
E2	Two-wire over current
E3	Open circuit at solenoid
E4	Short Circuit at solenoid
E5	Decoder Communication Error
E6	High Temperature Shut Down
E7	Decoder Programming Failure

MASTER VALVE(S)

If you are using a master valve or pump start relay, must connect the master valve or pump start relay to a SLDEC1 decoder. You will also need to program a decoder as (Zone 97 and 98 for SL9600TW – the SL9600TW can operate 2 master valves) for use with the pump start relay or master valve.

HOW TO SPECIFY:

Master Valve

8200CR-010 – 1" 8200 Brass Commercial Dirty-Water Master Valve

8200CR-012 – 1 ¼" 8200 Brass Commercial Dirty-Water Master Valve

8200CR-015 – 1 ½" 8200 Brass Commercial Dirty-Water Master Valve

8200CR-020 – 2" 8200 Brass Commercial Dirty-Water Master Valve

8200CR-025 – 2 ½" 8200 Brass Commercial Dirty-Water Master Valve

8200CR-030 – 3" 8200 Brass Commercial Dirty-Water Master Valve

MAX-DW-10 – 1" MAX Commercial Dirty-Water Master Valve

MAX-DW-15 – 1 ½" MAX Commercial Dirty-Water Master Valve

MAX-DW-20 – 2" MAX Commercial Dirty-Water Master Valve

SB-10F – 1" Silver Bullet Light Commercial Dirty-Water Master Valve

SB-15 – 1 ½" Silver Bullet Light Commercial Dirty-Water Master Valve

SB-20 – 2" Silver Bullet Light Commercial Dirty-Water Master Valve

NOTE: Wired to decoder - Master valve must be wired directly to its own decoder. Be sure to program it as zone 97 or 98 in SL9600TW using a 1-valve decoder



FLOW SENSOR

The Weathermatic SmartWire™ Controller can utilize a flow sensor provided the controller is connected to a SmartLink Aircard. Due to the need for accuracy in the flow measurement, flow sensors must be wired back to the Aircard using a double-jacketed, shielded, twisted pair, direct bury PE type cable

FLOW SENSOR SIZING

Flow sensors should be sized to accommodate the range of flows they will measure, rather than match the size of the pipeline. Generally accepted design practices recommend that the maximum velocity of water in PVC piping systems does not exceed velocities of 5 feet per second (f/s). Keeping the velocity below this level helps minimize the effects of water hammer and protects the pipe. In addition, pipe size may be oversized to reduce pressure drop caused by friction losses.

Irrigation systems don't operate at a fixed flow rates; there are always variations in the size of flow zones or differences in the types of sprinkler heads or emitters used. Often times the velocity in the pipeline is far less than the maximum flow and can be so low that it can't be detected. No flow sensor can measure down to zero flow. There is always a minimum flow rate or velocity below which there is not enough energy in the water to turn the impeller and generate a flow signal. WEATHERMATIC flow sensors have a wide measurement range from ¼ foot per second to 15 feet per second. This means that a 2-inch flow sensor can easily handle the design flow rate of a 3-inch pipeline without exceeding its maximum velocity. More often, the lower limit of the flow range is far more important. With the new water conserving technology of stream rotors, micro-sprays and low volume drip emitters, it is easy to reduce irrigation zone flow rates below minimum velocity ranges of line-sized sensors. Check the irrigation program or flow zones to determine minimum and maximum flow rates. Then use this table to select the flow sensor size with the best fit between these ranges.

FLOW SENSOR FLOW RANGE

SmartLink Flow	SLFSI-T10	SLFSI-T15	SLFSI-T20	SLFSI-S30	SLFSI-S40	SLFSI-S60	SLFSI-B15	
Sensor Model	1"	1 1/2"	2"	3"	4"	6"	1 1/2"	
	Feet/Sec	GPM	GPM	GPM	GPM	GPM	GPM	
Minimum Flow	0.25	0.86	1.8	2.8	6	10	23	
	1	3.5	7.24	11.3	25	40	90	
	2	7	14.5	23	50	90	180	
	3	10.4	22	34	75	120	270	
	5	17	36	57	125	200	450	
	7	24	51	79	175	280	630	
	10	35	72	113	250	400	900	
	12	42	97	136	300	490		
Maximum Flow	15	52	108	170			83	
Friction Loss at Max Flow		.025 psi	.018 psi	0.15 psi	0.15 psi	0.15 psi	0.07 psi	0.18 psi

FLOW SENSOR WIRING

Wiring may be extended up to 2,000 feet with SLFLOW-WIRE-193 cable. Size of the conductors is not as important as the twisting and shielding because flow sensor signals are more subject to interference from outside sources than from line losses. Outside interference may be generated by electrical wiring for motors, lights or signals that cross or pass close by the flow sensor cable. Interference may result in momentary loss of flow signal or an increase in signal frequency resulting in flow measurement errors.

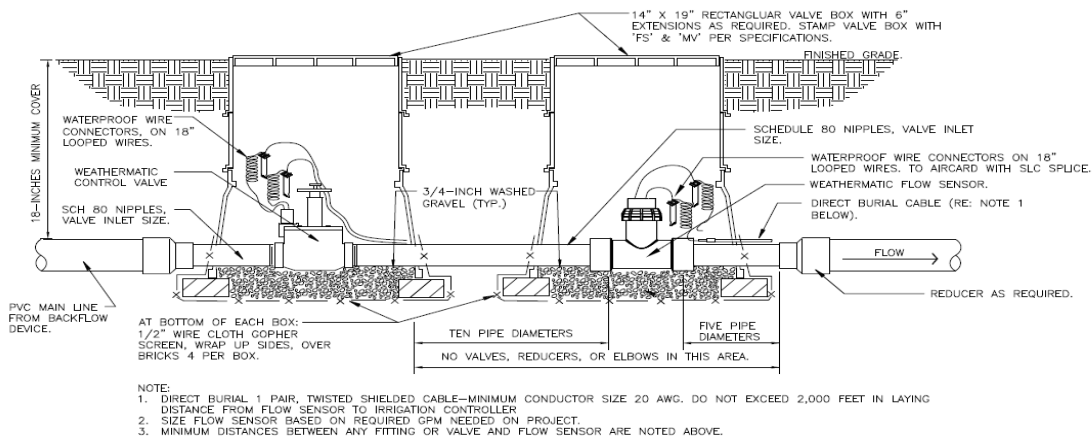
The chance for interference increases with the increase in distance between the flow sensor and the receiving device. Use good installation practices when installing communication cables. Also avoid splices in the flow sensor cable if possible. If splices are required, make sure they are mechanically tight, waterproofed and shielded. In longer runs, over 500 feet, it is always a good practice to connect one end (only) of the cable shield to a properly installed 8-foot copper ground rod.

NOTE: Using 14 gauge, two wire cable or irrigation “multi-strand” wire for flow sensor wire will increase potential interference of the flow sensor signal and create poor flow sensor readings.

FLOW SENSOR INSTALLATION

A straight section of pipe is required to eliminate distortions in the water flow that cause inaccurate measurements. When water moves through a pipeline at the rates associated with pressurized irrigation systems, it moves at about the same velocity all across the pipe. It moves a little faster in the center of the pipe and a little slower closer to the inside wall in a predictable shape called a ballistic profile. When water is forced to bend around an elbow, the water takes a longer path around the outside than the inside changing the local velocity and distorting the profile. Other distortions may be caused by valves or fittings that produce eddy currents (swirls in the flow) as they change the path of the water. If these profile distortions are close to the sensor impeller they will change its speed and produce inaccurate measurements.

The minimum length of straight pipe needed to correct these distortions is generally given as 10 times the diameter of the pipe before (upstream of) the flow sensor and 5 times the diameter of the pipe after (downstream of) the sensor. If possible, provide more than these minimum lengths.



MASTER VALVE AND FLOW SENSOR

NOT TO SCALE

Weathermatic

HOW TO SPECIFY:

Flow Sensor ONLY

- SLFSI-T10** – 1" PVC Tee Mounted Flow Sensor
- SLFSI-T15** – 1 1/2" PVC Tee Mounted Flow Sensor
- SLFSI-T20** – 2" PVC Tee Mounted Flow Sensor
- SLFSI-S30** – 3" PVC Saddle Mounted Flow Sensor
- SLFSI-S40** – 4" PVC Saddle Mounted Flow Sensor
- SLFSI-S60** – 6" PVC Saddle Mounted Flow Sensor
- SLFSI-B15** – 1 1/2" Brass Tee Mounted Flow Sensor



Flow Sensor Master Valve Combination

SLFSI-T10-MAX – 1” Flanged Assembly with MAX-DW-10 Master Valve and SLFSI-T10 Flow Sensor

SLFSI-T15-MAX – 1 ½” Flanged Assembly with MAX-DW-15 Master Valve and SLFSI-T15 Flow Sensor

SLFSI-T20-MAX – 2” Flanged Assembly with MAX-DW-20 Master Valve and SLFSI-T20 Flow Sensor

Flow Sensor Communication Cable

SLFLOW-WIRE-193-1000 – 19 gauge, 3-conductor, direct burial, twisted pair, shielded cable

WEATHERMATIC SMARTWIRE™ LIGHTNING WARRANTY

- 3-Year warranty including lightning warranty if SLWIRE and SLCONN are used
- 2-Year warranty including lightning warranty if SLWIRE and SLCONN are NOT used

WEATHERMATIC SMARTWIRE™ SOLAR

SmartWire™ is available in a solar option

- Converts SmartLine to a totally “portable” water management system by using proven solar technology
- Uses industry standard 24VAC valves, which outperform debris-prone latching solenoids required with battery operated systems
- Dual deep cycle batteries provide up to 7 days of operation with no solar charge
- LCD display indicates battery and solar power condition

SmartWire™ Solar* comes with all hardware including:

- SL9648TW or SL9696TW
- Stainless Steel Enclosure
- Solar panels with mounting brackets
- Deep cycle batteries
- Power conversion and digital display equipment

*Add an SLW5, Flow sensor and AIRCARD for complete solar central control system

WEATHERMATIC SMARTWIRE™ WITH SMARTLINK

Weathermatic provides an affordable web-based irrigation control for all SmartLine and ProLine Controllers. With SmartLink™, a user can manage all of his or her sites from any computer, mobile device, or a web-browser. There is no software to install.

SmartLink™ is a web application that provides the ability to make controller program changes, manage flow, use the on-site inspection tools, receive email alerts, send global commands, and generate water use, runtime and ET calculation data. Having mobile access using a tablet or smartphone enables the user to respond faster to irrigation needs. A reliable cellular network ensures the connection is stable and always available to the user to access the system.

For more information about the SmartLink™ system see: <https://youtu.be/OBHqXndL4bc>

For more information about the SmartLink™ system components see: <https://youtu.be/PJtk3PEwdMw>

Our custom SmartLink Bundles makes it easy to specify. Bundles include a SmartLine Controller, SLW5 Weather Station, SmartLink™ Aircard and access to the SmartLink™ network.

Use the simple to follow chart below to build the bundle for your project. Simply choose a controller to fit the size of your project, and add a service. Adding the optional flow capability provides even more control over the irrigation system.

HOW TO SPECIFY:
SmartLink™ Bundle

1 Choose your SmartLine Controller.

Model	Description
SL1616-	16 Zone Controller
SL4824-	24 Zone Controller
SL4848-	48 Zone Controller
SL4848TW-	48 Zone Two-Wire Controller
SL9696TW-	96 Zone Two-Wire Controller
SLSOLAR48-	48 Zone Solar Controller
SLSOLAR48TW-	48 Zone Solar Two-Wire Controller
SLSOLAR96TW-	96 Zone Solar Two-Wire Controller

2 Add a service plan.

Model	Description
1YR-BUNDLE	1 Year Service Plan
3YR-BUNDLE	3 Year Service Plan
5YR-BUNDLE	5 Year Service Plan
10YR-BUNDLE	10 Year Service Plan
-UNL-BUNDLE	Unlimited Service Plan

3 Add optional flow.

Model	Description
-FLOW	Aircard with Flow

Examples:	
Model	Description
SL1600-1YR-BUNDLE-FLOW	SL1600 conventional wire, plus flow 1-Year Bundle
SL4800-3YR-BUNDLE	SL4800 conventional wire, No flow 3-Year Bundle
SL9696TW-5YR-BUNDLE-FLOW	SL9696TW two-wire, plus flow 5-Year Bundle
SLSOLAR48TW-1YR-BUNDLE	SL9648TW Solar two-wire, No flow 1-Year Bundle



WEATHERMATIC SMARTWIRE™ SPECIFICATION CHECKLIST

Use the following checklist to ensure your WEATHERMATIC SMARTWIRE™ specification is complete:

I. TWO-WIRE CONTROLLER

Select One or Select One from Section III below

- SL9648TW - 48 Decoders
- SL9696TW - 96 Decoders

II. TWO-WIRE WEATHERSTATION

Select One or Select One from Section III below

- SLW1 - Wired Weather Station. Requires SL1600 or SL9600TW
- SLW5 - Wireless Weather Station. Requires SL1600 or SL9600TW

III. TWO-WIRE SMARTLINK BUNDLE* - This Option replaces section I & II above.

Select One

- SL9648TW-1YEAR-BUNDLE
- SL9696TW-1YEAR-BUNDLE
- SL9648TW-1YEAR-BUNDLE-FLOW
- SL9696TW-1YEAR-BUNDLE-FLOW

*Includes SmartLine Controller, SLW5 Weather Station, SL-Aircard (Optional FLOW), 1-Year Subscription

- OPTIONAL: Additional Subscription Years

IV. TWO-WIRE RAIN/FREEZE SENSOR

Select One

- RFS1 - Wired Rain/Freeze Sensor. Requires PL1600
- RFS5 - Wireless Rain/Freeze Sensor. Requires PL1600

V. TWO-WIRE DECODERS

Select All That Apply

- SLDEC1 - 1 Address Decoder
- SLDEC2 - 2 Address Decoder
- SLDEC4 - 4 Address Decoder

VI. TWO-WIRE SURGE ARRESTORS

- SLGDT - Surge Arrestor

NOTE: Required at beginning and end of each wire run and every 600 feet along wire path.

VII. TWO-WIRE SPLICE KITS

- SLCONN - Waterproof Splice Kit

VIII. DECODER SYSTEM WIRE

Select One

- SLWIRE142 - 14.2 gauge direct bury decoder wire
- SLWIRE122 - 12.2 gauge direct bury decoder wire

IV. TWO-WIRE GROUNDING GRID

Select One

- 3 Copper Clad Ground Rods

Select ALL

- and #8 bare Copper Wire
- and Exothermic or Cadmium Weld Kits
- and (3) Valve Boxes
- and Grounding enhancement material
- and Resistance to ground (12 Ohms or less) test requirement

- (1) Copper Clad Ground Rod; (1) Copper Clad Plate

Select ALL

- and #8 bare Copper Wire
- and Exothermic or Cadmium Weld Kits
- and (1) Valve Box
- and Grounding enhancement material
- and Resistance to ground (12 Ohms or less) test requirement

- (2) Copper Clad Plates

Select ALL

- and #8 bare Copper Wire
- and (1) Valve Box
- and Grounding enhancement material
- and Resistance to ground (12 Ohms or less) test requirement

X. MASTER VALVE

Select One or Select One from Section XII below

- 8200CR-010 – 1” 8200 Brass Commercial Dirty-Water Master Valve
- 8200CR-012 – 1 ¼” 8200 Brass Commercial Dirty-Water Master Valve
- 8200CR-015 – 1 ½” 8200 Brass Commercial Dirty-Water Master Valve
- 8200CR-020 – 2” 8200 Brass Commercial Dirty-Water Master Valve
- 8200CR-025 – 2 ½” 8200 Brass Commercial Dirty-Water Master Valve
- 8200CR-030 – 3” 8200 Brass Commercial Dirty-Water Master Valve
- MAX-DW-10 – 1” MAX Commercial Dirty-Water Master Valve
- MAX-DW-15 – 1 ½” MAX Commercial Dirty-Water Master Valve
- MAX-DW-20 – 2” MAX Commercial Dirty-Water Master Valve
- SB-10F – 1” Silver Bullet Light Commercial Dirty-Water Master Valve



- SB-15 – 1 ½” Silver Bullet Light Commercial Dirty-Water Master Valve
- SB-20 – 2” Silver Bullet Light Commercial Dirty-Water Master Valve

XI. FLOW SENSOR

Select One or Select One from Section XII below

- SLFSI-T10 – 1” PVC Tee Mounted Flow Sensor
- SLFSI-T15 – 1 ½” PVC Tee Mounted Flow Sensor
- SLFSI-T20 – 2” PVC Tee Mounted Flow Sensor
- SLFSI-S30 – 3” PVC Saddle Mounted Flow Sensor
- SLFSI-S40 – 4” PVC Saddle Mounted Flow Sensor
- SLFSI-S60 – 6” PVC Saddle Mounted Flow Sensor
- SLFSI-B15 – 1 ½” Brass Tee Mounted Flow Sensor

XII. FLOW SENSOR ASSEMBLY*

Select One

- SLFSI-T10-MAX – 1” Flanged Assembly with MAX-DW-10 Master Valve/SLFSI-T10 Flow Sensor
- SLFSI-T15-MAX – 1 ½” Flanged Assembly with MAX-DW-15 Master Valve/SLFSI-T15 Flow Sensor
- SLFSI-T20-MAX – 2” Flanged Assembly with MAX-DW-20 Master Valve/SLFSI-T20 Flow Sensor

*Includes Master Valves and Flow Sensor