



USER MANUAL

→ **SureStart™ Control Cabinet**
When MAYBE is not an Option



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1 Product Description and Specifications

1.1 Overview

Spectrum's SureStart™ Control Cabinet ensures proper operation of rail track switches. The SureStart™ Control Cabinet supplies power to *Flat-Jacket Snow Melters* and to *Crib Heaters* strategically placed at turnouts to keep them free of snow and ice.

The SureStart™ Control Cabinet can support from one to twelve circuits, supplying power to multiple switch points.

The SureStart™ name comes from the Control Cabinet's ability to be activated in multiple ways:

- Manually, via a switch on the interior door
- Remotely, via an external switch such as a three-wire signal interface relay in a control house
- Automatically, when the cabinet's integrated *Snow Sensor* detects conditions that could produce snowfall
- Automatically, when the cabinet's integrated Johnson Controls *Temperature Sensor* detects air temperatures at or below a pre-set level

Optional *Ground Fault and Power On Indication Lights* can provide visual indications from a distance that a circuit has a GFI condition and/or power is on.



Fig. 1
SureStart™ Control Cabinet

1.1.1 Available Models

The SureStart™ Control Cabinet is available in several different configurations and enclosures. Contact Spectrum for pricing.

1.1.1.1 Enclosure Construction

The SureStart™ Control Cabinet is an outdoor, free-standing NEMA rated enclosure containing circuit breakers, switch heater control contactors, control relays, and ground fault indicators. The enclosure is available in aluminum, painted steel, or stainless steel.

Enclosure Type	Thickness
Aluminum 5052-H32	11 gauge
Painted Steel	14 gauge
Stainless steel A240-304	14 gauge

Each enclosure type features:

- Welded construction
- Seams continuously welded and ground smooth
- Reinforced doors and body
- Gaskets around all openings to provide protection from liquids and contaminants



The cabinet exterior door has a heavy-duty three-point latching mechanism operated by a padlocking handle. Rollers on the ends of the latch rods allow for easier door closing.

1.1.1.2 Electrical Capacity

The Control Cabinet is rated at either 240 or 480 AC volts, in either single-phase or three-phase. For more information, see [5.1 Main Feed Amperage](#) on page 29 and [5.2 Current Draw for Control Cabinets, Flat-Jackets, and Crib Heaters](#) on page 31.



Fig. 2

1 – 6 Circuit (left) and 7 – 12 Circuit (right)
Cabinet Models

1.1.2 Dimensions and Weights

	1 – 6 Circuits	7 – 12 Circuits
Height	48"	72"
Width	36"	36"
Depth	16"	24"
Weight	200 – 220 lbs.*	410 – 430 lbs.*

* Final cabinet weight determined by number of circuits

1.2 Control Cabinet Features

The SureStart™ Control Cabinet contains several integrated features that ensure the switch area remains clear of snow and ice during inclement weather.



Fig. 3

Top of Control Cabinet, with
Johnson Controls Temperature Sensor (left) and Snow Sensor (right)

1.2.1 Snow Sensor



Fig. 4
Snow Sensor

The Snow Sensor automatically activates the Control Cabinet when precipitation occurs and the temperature falls to a preset level (default 38°F). Attached to the top of the Control Cabinet, the Snow Sensor is a self-contained unit incorporating a heated precipitation sensing grid, temperature probe, sensor electronics, and internal relay. A green LED on the Snow Sensor illuminates when power is available to the Control Cabinet, and this green LED blinks when environmental conditions are met.

After the Snow Sensor has activated the Control Cabinet, the cabinet remains activated as long as temperatures remain at 38°F or lower and precipitation is present. When precipitation stops and/or the temperature rises above 38°F, the Snow Sensor keeps the Control Cabinet active for a preset time (default two hours) to ensure complete ice and snow removal. When the time has elapsed, the Snow Sensor de-activates the Control Cabinet.

A second Snow Sensor can be installed remotely from the Control Cabinet. This optional second sensor is typically positioned trackside. For more information, see [1.3.3 Remote Snow Sensor](#) on page 11.

Values that control when the Snow Sensor activates and de-activates the Control Cabinet are adjustable on a settings panel which is accessed by removing the Snow Sensor's front cover. For more information, see [3.1 Adjusting Snow Sensor Settings](#) on page 22.

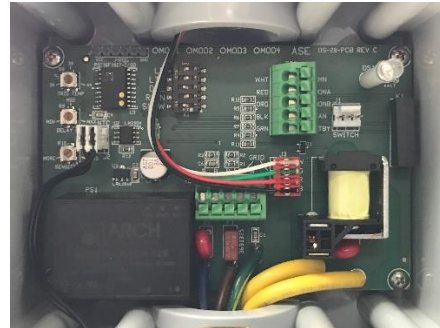


Fig. 5
Snow Sensor Settings Panel

1.2.2 Temperature Sensor



Fig. 6
Temperature Sensor

The Johnson Controls Temperature Sensor automatically activates the Control Cabinet when the temperature falls to a preset level (default 0°F). Attached to the top of the Control Cabinet, the Johnson Controls Temperature Sensor is a self-contained unit incorporating a temperature probe, sensor electronics, and internal relay.

After the Temperature Sensor has activated the Control Cabinet, the cabinet remains activated as long as temperatures remain below 5°F. When the temperature rises to 5°F or higher, the Temperature Sensor de-activates the Control Cabinet.

Values that control when the Temperature Sensor activates and de-activates the Control Cabinet are adjustable on the temperature sensor control panel (Fig. 7) which is accessed by opening the Control Cabinet's *Interior "Dead Front" Door*. For more information, see [3.2 Adjusting Temperature Sensor Settings](#) on page 22.



Fig. 7

Temperature Sensor Control Panel



NOTE:

When either the Snow Sensor or Temperature Sensor activates the Control Cabinet, the individual sensor must complete its cycle before the sensor will power-off the Control Cabinet.

Remote switches WILL NOT power-off the Control Cabinet if a sensor has not completed its cycle. The Control Cabinet must be manually powered off to interrupt

a sensor's cycle. Remote switches can be used to keep power on to the Control Cabinet after a sensor cycle completes.

1.2.3 Interior "Dead Front" Door



Fig. 8

Interior "Dead Front" Door

Opening the exterior door of the Control Cabinet reveals an interior "dead front" door.

The "dead front" door is a safety feature that blocks access to the high voltage components on the *Circuit Panel* while the main breaker is on. The *Main Breaker Switch* must be switched to **Off** on the interior door for the handle to disengage and allow the "dead front" door to open.

**WARNING:**

SureStart™ Control Cabinets with 7 to 12 circuits are double-sided cabinets with circuit panels on both sides. There is one “dead front” door (with *Main Breaker Switch*) that will kill power to the entire cabinet. The back side of the Control Cabinet has an inside door that DOES NOT contain a main breaker switch. Should this door be opened prior to opening the “dead front” door, high voltage components will still have power. The *Main Breaker Switch* should be set to **Off** prior to accessing the circuit panel on the back side of the Control Cabinet.

**NOTE:**

When the Main Breaker Switch is set to **On**, the green LED at the top of the *Snow Sensor* is illuminated.

The Main Breaker Switch also functions as the handle for the *Interior “Dead Front” Door*. The Main Breaker Switch must be set to **Off** to open the “dead front” door and access the *Circuit Panel*.

**WARNING:**

SureStart™ Control Cabinets with 7 to 12 circuits are double-sided cabinets with circuit panels on both sides. There is one “dead front” door (with *Main Breaker Switch*) that will kill power to the entire cabinet. The back side of the Control Cabinet has an inside door that DOES NOT contain a main breaker switch. Should this door be opened prior to opening the “dead front” door, high voltage components will still have power. The *Main Breaker Switch* should be set to **Off** prior to accessing the circuit panel on the back side of the Control Cabinet.

1.2.3.1 Main Breaker Switch



Fig. 9
Main Breaker Switch

The Main Breaker Switch must be set to **On** to provide power to the Control Cabinet. Setting the switch to **On** also illuminates the Cabinet's *LED Light Bar*.



1.2.3.2 Auto/On Switch



Fig. 10
Auto/On Switch

The two settings on the Auto/On switch control how the Control Cabinet is activated.

- The **Auto** setting is the default and keeps the Control Cabinet de-activated until it is activated by a remote switch, *Snow Sensor*, or *Temperature Sensor*. When the Control Cabinet is activated, the **Auto** setting keeps the cabinet activated until it is de-activated by the remote switch, *Snow Sensor*, or *Temperature Sensor*.
- The **On** setting keeps the Control Cabinet active. With this setting, the activation and de-activation features of the *Snow Sensor* and *Temperature Sensor* are disabled.

1.2.3.3 Heater On Indicator



Fig. 11
Heater On Indicator

An LED on the *Interior "Dead Front" Door* illuminates whenever the *Internal Heater* is active.

1.2.3.4 GFI Fault Lights



Fig. 12
GFI Fault Lights

Each circuit in the Control Cabinet is protected by a ground fault sensor, consisting of a ground fault current sensing relay and pick up coil. If a ground fault is detected on a circuit, the tripped LED for that circuit illuminates on the *Interior "Dead Front" Door*.

1.2.3.5 Convenience Power Outlet



Fig. 13
Convenience Power Outlet

A 120V, 5A outlet has been provided on the *Interior “Dead Front” Door* for the user’s convenience.

1.2.3.6 LED Light Bar



Fig. 14
LED Light Bar

An LED light bar on the inside of the cabinet illuminates when the exterior door is open and the *Main Breaker Switch* is set to **On**. This light can be removed from its resting place and repositioned for better lighting.

1.2.4 Circuit Panel



Fig. 15
Circuit Panel

The circuit panel behind the *Interior “Dead Front” Door* holds the components for up to 6 individual circuits, depending on the Control Cabinet model. On cabinets with more than 6 circuits, there will be an interior door and circuit panel on each side of the Control Cabinet. See the Warning for [1.2.3.1 Main Breaker Switch](#) on page 5.



1.2.4.1 Internal Heater

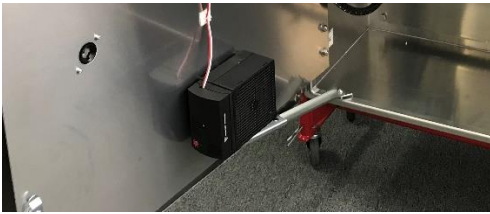


Fig. 16
Internal Heater

A 950W internal panel heater provides heat to the inside of the cabinet, reducing the amount of moisture that forms on the electrical components. By default, the internal heater is activated when its internal temperature sensor reaches 37°F. This setting can be adjusted by setting the dial on the side of the heater.



Fig. 17
Internal Heater Adjustment Dial

1.2.4.2 Individual Circuit Breaker Protection



Fig. 18
Circuit Breaker Panel

Each circuit is protected by a circuit breaker (see [5.1 Main Feed Amperage](#) on page 29 for quantity and ratings). If the components on a circuit are drawing too much current, only the breakers on that circuit will trip, allowing the remaining circuits that are working properly to continue operation.

1.2.4.3 Delay Timer



Fig. 19
Delay Timer

For Control Cabinets with more than one circuit, the delay timer function allows the second and subsequent circuits to be powered from anywhere between one second to several minutes after the previous circuit's start time (default delay time is two seconds). Each circuit's delay timer is set separately. This option helps reduce the startup current draw, especially useful with lower voltage systems such as 240VAC single-phase systems.

The default delay time of two seconds can be changed. For more information, see [3.3 Adjusting the circuit startup delay timer](#) on page 23.

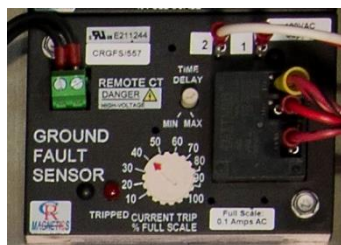


Fig. 20
Ground Fault Sensor

1.2.4.4 Individual Ground Fault Protection

Each circuit is protected by its own ground fault sensor. If a ground fault is detected on a single circuit, the sensing relay trips and illuminates its associated *GFI Fault Lights* on the *Interior "Dead Front" Door*. It also triggers

a 120V output signal for customer monitoring. For more information, see [1.2.3.4 GFI Fault Lights](#) on page 6.

The sensitivity (number of milliamps required to trip the sensor) of each ground fault sensor can be adjusted. For more information, see [3.4.1 Adjusting GFI Sensitivity](#) on page 24.



Fig. 21
Ground Fault Reset (left) and
Ground Fault By-Pass Switches (right) for each
of two circuits

1.2.4.5 Ground Fault Reset Switch

The ground fault reset switch is located at the top left of the circuit panel. After the cause of a ground fault is found and corrected, pressing up on the reset switch reactivates any circuit currently at fault. For more information, see [3.4.2 Resetting a ground fault on one or more circuits](#) on page 25.

1.2.4.6 Ground Fault By-Pass Switch

Each ground fault sensor has a ground fault by-pass switch. The by-pass switch for the first circuit is located to the immediate right of the *Ground Fault Reset Switch*, and the by-pass switches for each subsequent circuit are in order to the right. If a ground fault sensor is detecting a false ground fault, the by-pass switch can be manually engaged to TEMPORARILY disable the ground fault sensor and keep the circuit functional while a solution for the incorrect ground fault reading



is found. For more information, see [3.4.3 By-passing a ground fault sensor](#) on page 25.



WARNING:

By-passing a ground fault sensor will disengage any ground fault protection for the corresponding circuit.

When the ground fault sensor by-pass is engaged, the *GFI Fault Lights* on the Interior “Dead Front” Door will be illuminated even though the circuit is enabled.

1.2.4.7 Control Power Transformer



Fig. 22
Control Power Transformer

A transformer is installed at the top of the Control Cabinet to provide 120V AC power from the main breaker to the Control Cabinet electrical components.

1.2.4.8 Customer Connection Terminal Block



Fig. 23
Customer Connection Terminal Block

The terminal block is used to enable remote control and indication features of the Control Cabinet. Via this terminal block, customers

are able to remotely activate and de-activate the Control Cabinet, receive indication that the Control Cabinet is activated or de-activated, and receive indication if there is a ground fault detected. For more information, on installing the indication lights, see [2.2.1 Fault and Power On Indication Lights Installation](#) on page 18.



NOTE:

For information on installing a remote switch, contact Spectrum.

1.3 Control Cabinet Accessories

Several Control Cabinet accessories are available to ensure the switch area is clear of snow or ice. Each accessory is purchased separately from the Control Cabinet.

1.3.1 Mounting Legs



Mounting legs (4' in height) can be installed on the bottom of the cabinet to elevate the cabinet to a more desirable height. The mounting legs are intended to be buried in dirt or cement for extra stability.

Fig. 24
Mounting Legs

Mounting legs suitable for pad mounts are also available. For information on installing the Mounting Legs, see [2.1.2 Install Cabinet Mounting Legs \(Optional\)](#) on page 17.

1.3.2 Ground Fault and Power On Indication Lights

An indication light can be mounted outside the Control Cabinet and configured to provide a visual signal when a ground fault occurs on one of the circuits. Alternatively, the indication light could be configured to illuminate when heater circuits are



*Fig. 25
Indication
Light*

activated. If desired, two separate indication lights could be installed, one for ground faults and the other for the heater circuits. The default light color is white, with additional colors available upon request.

For information on installing the Indication Lights, see [2.2.1 Fault and Power On Indication Lights Installation](#) on page 18.

1.3.3 Remote Snow Sensor

A second, optional Snow Detector can be installed remotely from the Control Cabinet. The Remote Snow Sensor can be mounted trackside or any other desired location. Like the integrated *Snow Sensor* attached to the top of the Control Cabinet, the Remote Snow Sensor is a self-contained unit incorporating a heated precipitation sensing grid, temperature probe, sensor electronics, and internal relay.

The Remote Snow Sensor activates the Control Cabinet when precipitation occurs, and the temperature falls to a preset level (default 38°F). After the Remote Snow Sensor activates the Control Cabinet, the cabinet remains activated as long as temperatures remain at 38°F or lower and precipitation is present. When precipitation stops, and/or the temperature rises to 38°F or higher, the Remote Snow Sensor keeps the Control Cabinet active for an additional two hours to

ensure complete ice and snow removal. When the two hours have elapsed, the Remote Snow Sensor de-activates the Control Cabinet unless the Temperature Sensor continues to keep the cabinet activated.

For information on installing the Remote Snow Sensor, see [2.2.3 Remote Snow Sensor Installation](#) on page 19.

Values that control when the Remote Snow Sensor activates and de-activates the Control Cabinet are adjustable. For more information, see [3.1 Adjusting Snow Sensor Settings](#) on page 22.



NOTE:

If the Remote Snow Sensor activates the Control Cabinet, only that sensor can de-activate the cabinet. If the remote switch is enabled, the switch cannot de-activate the cabinet if it has been activated by the Remote Snow Sensor. However, the remote switch can be used to keep the Control Cabinet activated after it has been de-activated by the Remote Snow Sensor.

1.4 Control Cabinet Optional Equipment

Optional equipment can be used with the Control Cabinet to ensure the switch area is clear of snow and ice. Optional equipment is purchased separately from the Control Cabinet.

1.4.1 Flat-Jacket Snow Melters



Fig. 26 Flat-Jacket Snow Melter

Flat-Jacket Snow Melters are resistance-heating elements in a stainless steel sheath. They are attached to the stock rail using *Snow Melter Mounting Hardware*. The flat-jackets are single ended (both leads come out of one side) and are rated to a specific voltage (+/- 5%).

For additional information on purchasing and installing Flat-Jacket Snow Melters, contact Spectrum.

1.4.2 Snow Melter Mounting Hardware

SnapTite Rail Clips or bolt-on clips should be used between every tie to attach the *Flat-Jacket Snow Melters* to the rail. This assures proper heating of the switch.



NOTE:

Failure to use these clips properly will result in poor snow clearance and premature element failure.

SnapTite Rail Clips clamp on to the *Flat-Jacket Snow Melters* and bottom of the field side of the rail.



Fig. 27 SnapTite Rail Clips

Bolt-on clips are bolted directly to the field or gauge side of the rail and clamp on to the *Flat-Jacket Snow Melters*.

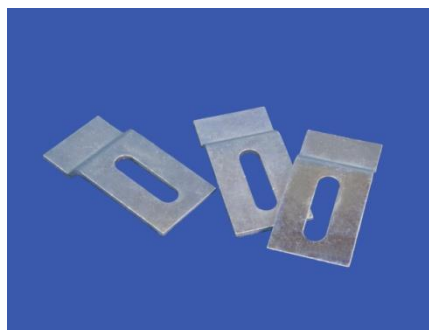


Fig. 28 Bolt-On Clips

1.4.3 Crib Heater



Fig. 29 Crib Heater



Fig. 30 Crib Heater Hardware (optional)

Crib heaters contain a resistance-heating element within an aluminum housing designed to go under the switch points and prevent them from freezing. The vent holes are designed for air flow and are meant to face down towards the ballast. The crib heaters come in multiple sizes depending on the application, from 4 feet to 10 feet long.

For additional information on purchasing and installing crib heaters, contact Spectrum.

1.4.4 Wiring Box

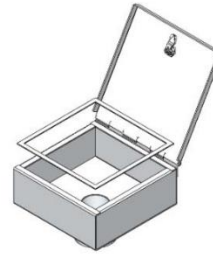


Fig. 31
Wiring Box
(hinged lid)

The wiring box is an optional junction box used to connect track switch heating accessories, such as *Flat-Jacket Snow Melters* and *Crib Heaters*, to the Control Cabinet. Using a wiring box can reduce the number of cables running out of the Control Cabinet. The wiring box comes in two sizes:

Size	Interior Dimensions		
	Width	Depth	Height
WB-2	5"	6.25"	4"
WB-6	12"	12"	4"

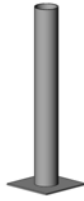
Each wiring box comes with a weather-tight lid that is secured to the wiring box with either a hinged and lockable lid or machine screws. A variety of fittings, from cord grips to barbed fittings, can be installed on the ports of the wiring box to run wires through.

For information on installing the wiring box, see [2.2.2 Wiring Box and Wiring Box Post Installation](#) on page 18.



1.4.5 Wiring Box Post

A recommended option for the *Wiring Box* is a wiring box post. This post bolts to the bottom sleeve of the *Wiring Box* and provides 27" of pipe that can be



buried in the ground for a secure mounting position. Power wires can be run through the bottom of the post and into the *Wiring Box*.

Fig. 32
Wiring Box Post

For information on installing the wiring box post, see [2.2.2 Wiring Box and Wiring Box Post Installation](#) on page 18.

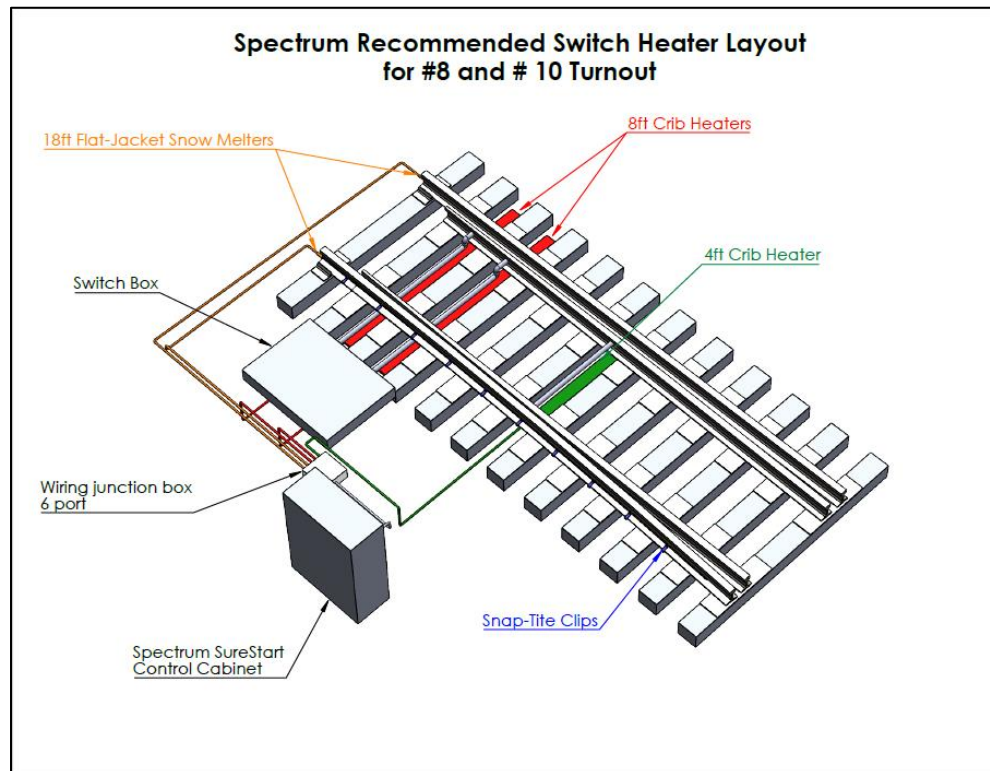
2 Installation

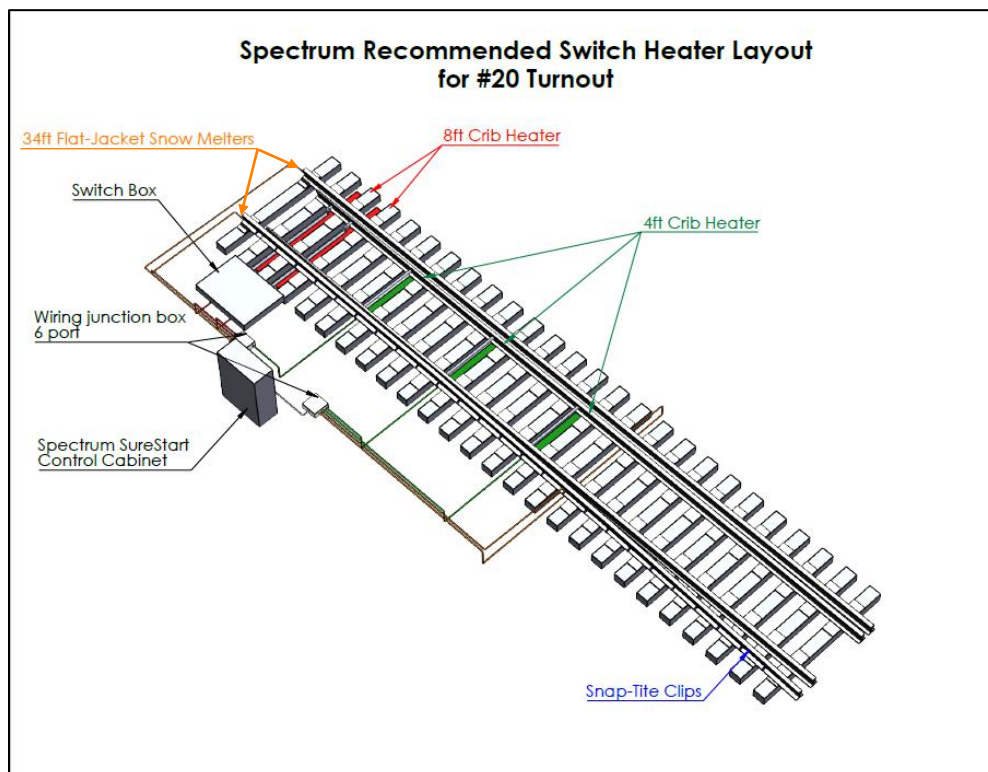
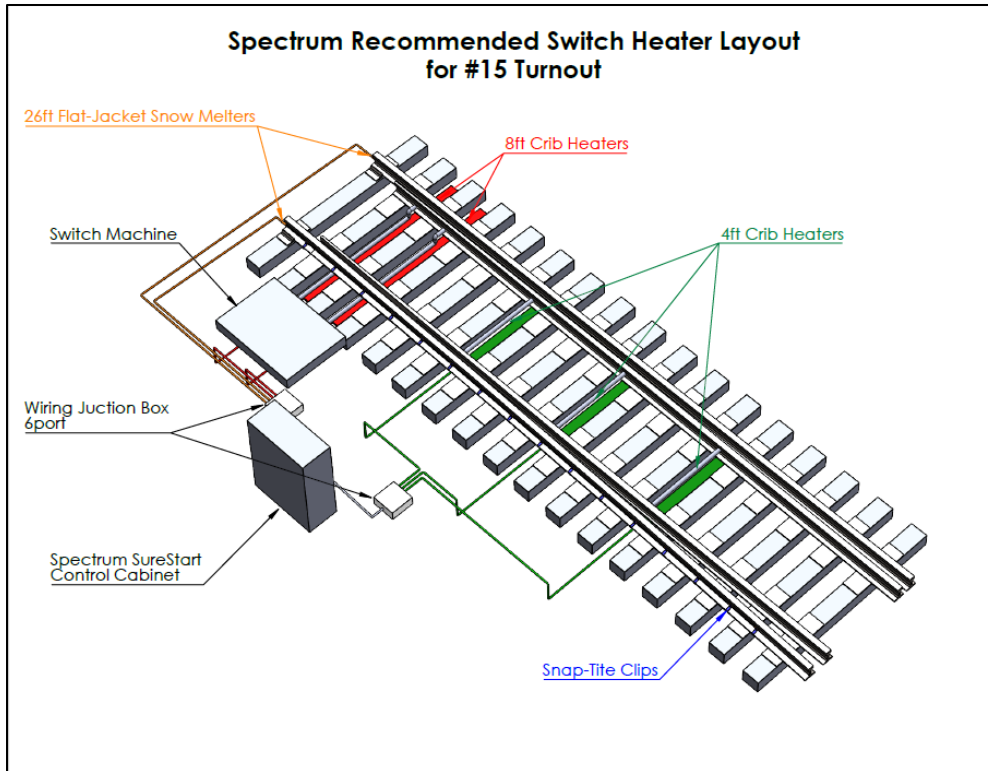
IMPORTANT INSTALLATION NOTICE

This is a guidance document for the convenience of the railroad. When installing electrical equipment, it is important that you meet the NFPA 70: National Electric Code requirements to protect people and property from electrical hazards. Follow all railroad safety procedures, related railroad standards, and any applicable third party standards. Spectrum does not assume the obligation of enforcing National, State, or City electrical code requirements.

The Control Cabinet is designed as a “drop and go” unit, meaning it is shipped as a factory-assembled unit and ready for immediate use. Some assembly is required for Control Cabinet accessories and optional equipment.

The following illustrations show recommended switch heater layouts based on turnout.





2.1 Installing the Control Cabinet

The Control Cabinet should be placed in a location that has minimal contact with water. Do not install the Control Cabinet in any area where standing water can pool or accumulate. Do not install near a drainage basin, surface/ground or roof runoff, sewer collection, or any location where water can back up or collect. If flooding can occur, we recommend a different location. Do not operate if any portion of the Control Cabinet is submerged. Always install above grade. *Mounting Legs* (optional) can be used to elevate the control cabinet above the ground.

2.1.1 Route Power to Cabinet

The Main Breaker on the control panel has three connections terminals. Cables to the Control Cabinet should be of adequate size to handle maximum rated load according to the National Electrical Code and any local codes.

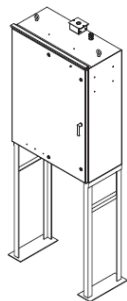


NOTE:

Voltage needs to be +/- 5% of rated cabinet.

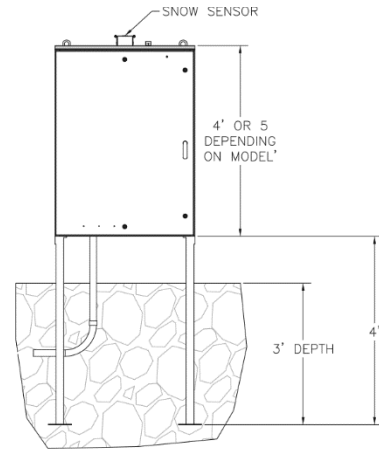
2.1.2 Install Cabinet Mounting Legs (Optional)

1. If purchased, attach the cabinet *Mounting Legs* to the bottom of the cabinet, using the supplied hardware



*Fig. 33
Control Cabinet
with Mounting Legs attached*

2. If the *Mounting Legs* are to be buried, the bottom of the *Mounting Legs* should be at least 3' below the surface.



*Fig. 34
Minimum Depth Requirements for
Mounting Leg burial*



2.1.3 Wiring the Cabinet

The cables coming in from the power source should be able to handle the maximum breaker amperage per local NEC code. The recommended conduit entry point is at the bottom of the Control Cabinet. Exit wiring to the wiring box or directly to the heating elements should also be through the cabinet bottom.



Fig. 35
Sample Wiring Layout

2.1.4 Equipment Grounding

An approved earth ground must be supplied from the main power source to the SureStart Cabinet. Using an approved ground conductor, wire from the cabinet ground stud to the power source ground, and in turn, connect to solid earth ground. Ground wiring should be installed by qualified personnel only and must be installed in accordance with all applicable National Electric Code, Railroad Codes and any local codes.

2.2 Installing Accessories and Optional Equipment

If purchased, some assembly is required for Control Cabinet accessories and optional equipment.

2.2.1 Fault and Power On Indication Lights Installation

The *Ground Fault and Power On Indication Lights* are connected to the Control Block.

- Connect the Ground Fault Indication Light to the TB1-8-2 and TB2-3-3 terminal blocks
- Connect the Power On Indication Light to the TB1-10-2 and TB2-3-3 terminal blocks

2.2.2 Wiring Box and Wiring Box Post Installation

The *Wiring Box Post* and *Wiring Box* can reduce the amount of cables running from the Control Cabinet.

1. The *Wiring Box Post* can be buried to a maximum depth of 22".
2. Install the conduit from the Control Cabinet through the bottom of the *Wiring Box*.
3. Wiring from the *Flat-Jacket Snow Melters* and *Crib Heater* is typically enclosed in protective conduit.

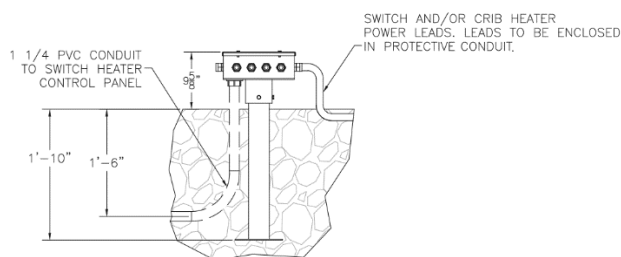


Fig. 36
Wiring Box and
Wiring Box Post Installation

4. Connect the cables from the Control Cabinet and the heating elements inside the *Wiring Box*.



NOTE:

Optional AAR terminals and 3-conductor feed through terminal are available.



2.2.3 Remote Snow Sensor Installation

If installed, connect the wires for the *Remote Snow Sensor* to TB7-1, TB7-2, TB7-3, and TB7-4 on the *Customer Connection Terminal Block*.

2.3 Activating the Control Cabinet for the First Time

After the Control Cabinet along with all accessories and optional equipment is installed, ensure the Control Cabinet is working by performing the following procedures.

2.3.1 Manual Activation

Verify the Control Cabinet is operating when set to manual activation.

1. Open the Control Cabinet exterior door.
2. Set the *Main Breaker Switch* to **On**.
3. Verify the green LED is illuminated on the *Snow Sensor*, and the *LED Light Bar* installed on the *Interior "Dead Front" Door* is illuminated.
4. Set the *Auto/On Switch* to **On**.
5. Listen for the circuits to engage. For multi-circuit cabinets, there should be a 2-second delay (default setting) between each circuit engaging.
6. Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating.
7. Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions.



2.3.2 Snow Sensor Activation

Verify the Control Cabinet can be activated by the *Snow Sensor*.

1. Open the Control Cabinet exterior door.
2. Set the *Main Breaker Switch* to **On**.
3. Set the *Auto/On Switch* to **Auto**.
4. Verify the green LED is illuminated on the *Snow Sensor*, and the *LED Light Bar* installed on the *Interior "Dead Front" Door* is illuminated.
5. Put water on the moisture sensor and use freeze spray on the temperature probe of the *Snow Sensor*.
6. Verify the green LED on the *Snow Sensor* is blinking.
7. Listen for the circuits to engage. For multi-circuit cabinets, there should be a 2-second delay (default setting) between each circuit engaging.
8. Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating.
9. Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions.

**NOTE:**

If you have installed the optional *Remote Snow Sensor*, perform the same above procedures, and on step 5, use the sensors on the remote sensor.

2.3.3 Temperature Sensor Activation

Verify the Control Cabinet can be activated by the *Temperature Sensor*.

1. Open the Control Cabinet exterior door.
2. Set the *Main Breaker Switch* to **On**.
3. Set the *Auto/On Switch* to **Auto**.
4. Verify both the green LED on the *Snow Sensor* and the *LED Light Bar* installed on the *Interior "Dead Front" Door* are illuminated.
5. Use freeze spray on the temperature probe of the *Temperature Sensor*.
6. Listen for the circuits to engage. For multi-circuit cabinets, there should be a 2-second delay (default setting) between each circuit engaging.
7. Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating.
8. Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions.



2.3.4 Remote (dispatch) Activation (optional)

If installed, verify the Control Cabinet can be activated by remote (dispatch) activation.

1. Set the remote switch to Off.
2. Open the Control Cabinet exterior door.
3. Set the *Main Breaker Switch* to **On**.
4. Set the *Auto/On Switch* to **Auto**.
5. Verify both the green LED on the *Snow Sensor* and the *LED Light Bar* installed on the *Interior "Dead Front" Door* are illuminated.
6. Request dispatch to activate the cabinet remotely.
7. Listen for the circuits to engage. For multi-circuit cabinets, there should be a 2-second delay (default setting) between each circuit engaging.
8. Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating.
9. Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions.

3 Adjusting Control Cabinet Settings

3.1 Adjusting Snow Sensor Settings

By default, the *Snow Sensor* activates the Control Cabinet when the temperature falls to 38°F and moisture is detected on the sensor's moisture sensor. The sensor will keep the Control Cabinet activated for an additional 2 hours after the temperature rises above 38°F and/or moisture is no longer detected. Follow these steps to adjust these settings:

1. Remove front cover of the *Snow Sensor* by removing the four mounting screws holding it in place.



Fig. 37
Snow Sensor Settings Panel

2. Using a flat-head screwdriver, adjust the knobs of the three settings as desired:

- **TRIG TEMP** – the temperature which activates or de-activates the Control Cabinet. The setting can be set from 34°F to 44°F.

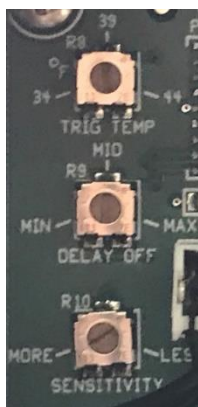


Fig. 38
Snow Sensor Settings

- **DELAY OFF** – the amount of time the Control Cabinet remains activated after the TRIG TEMP has been reached. The setting can be set from MIN (2 hours) to MAX (6 hours).
 - **SENSITIVITY** – the amount of precipitation on the moisture sensor required to activate the Control Cabinet. The setting can be set from MORE to LESS.
3. When finished, replace the front cover of the *Snow Sensor* and install the four mounting screws.

3.2 Adjusting Temperature Sensor Settings

By default, the *Temperature Sensor* activates the Control Cabinet when the temperature falls to 0°F, and keeps the Control Cabinet activated until the temperature rises to 5°F or higher. To adjust these settings, you must first access the *Circuit Panel*:

1. Open the Control Cabinet exterior door.
2. Set the *Main Breaker Switch* to **Off**.
3. Open the *Interior "Dead Front" Door*.

Temperature Sensor settings are adjusted using the Temperature Sensor Control Panel.



Fig. 39
Temperature Sensor Control Panel

3.2.1 Adjusting the temperature which activates the Control Cabinet

1. Press and hold the **Menu** button until the display changes to a flashing SP. This takes about two seconds.
2. Press the **Menu** button again. The temperature for activating the Control Cabinet (default 0°F) displays.
3. Press the **Up** or **Down** button to adjust the setting.
4. Press the **Menu** button to save the new setting.

3.2.2 Adjusting the temperature which de-activates the Control Cabinet

1. Press and hold the **Menu** button until the display changes to a flashing SP. This takes about two seconds.
2. Press the **Up** button until the display changes to a flashing diF.
3. Press the **Menu** button again. The temperature for de-activating the Control Cabinet (default 5°F) displays.
4. Press the **Up** or **Down** button to adjust the setting.
5. Press the **Menu** button to save the new setting.

3.3 Adjusting the circuit startup delay timer

For Control Cabinets with more than one circuit, the *Delay Timer* function allows the second and subsequent circuits to be powered from anywhere between one second to several minutes after the previous circuit's start time (default delay time is to two seconds). Each circuit's delay timer is set separately. Follow these steps to adjust any circuit's delay timer.

1. Open the Control Cabinet exterior door.
2. Set the *Main Breaker Switch* to **Off**.
3. Open the *Interior "Dead Front" Door*.



- Each delay timer has 10 switches, with digital values ranging from 1 to 512. Each switch sets the number of seconds for the delay. By default, each circuit will have the 2-switch turned on.



Fig. 40
Delay Timer Switches

- Set the switches to the desired delay start time for the circuit.
- Repeat these steps as desired for each additional circuit.

3.4 Adjusting GFI settings

The settings that control when ground faults are detected are accessed through the *Circuit Panel*.

- Open the Control Cabinet exterior door.
- Set the *Main Breaker Switch* to **Off**.
- Open the *Interior "Dead Front" Door*.

The *Ground Fault Reset Switch* and each circuit's *Ground Fault By-Pass Switch* are located on the upper left side of the circuit panel.



Fig. 41
Ground Fault Reset (left) and
Ground Fault By-Pass Switches (right) for each
of two circuits

3.4.1 Adjusting GFI Sensitivity

By default, each ground fault sensor is set to a sensitivity rating of 40 milliamps. Follow these procedures to adjust the ground fault sensor sensitivity for a circuit.

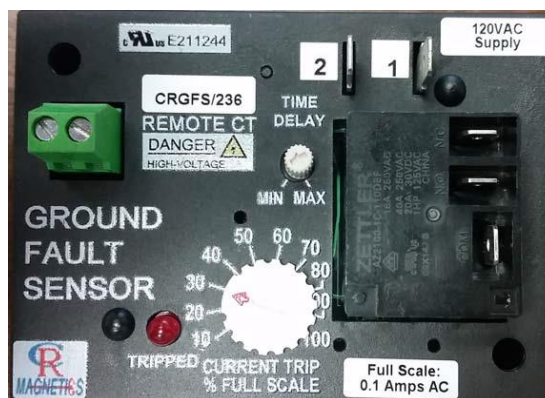


Fig. 42 Ground Fault Sensor
The sensitivity dial is located
at the bottom center

- Open the exterior door and *Interior "Dead Front" Door* to access the *Circuit Panel*.
- On the *Circuit Panel*, locate the sensitivity dial on the ground fault sensor.
- Using a flat-headed screwdriver, turn the sensitivity dial from 10 to 100 milliamps.



4. Manually turn on the main breaker.

**WARNING:**

Power will be supplied to the Control Cabinet, and the circuits will be live. Use extreme caution.

5. Turn the *Auto/On Switch* to **On**.
6. Allow the Control Cabinet to activate and energize the heating elements for at least 10 minutes.
7. Using a flat-headed screwdriver, adjust the sensitivity dial down towards 0 until the ground fault sensor trips.
8. Once tripped, adjust the sensitivity dial back to 10.

3.4.2 Resetting a ground fault on one or more circuits

After the cause of a ground fault is found and corrected, follow this procedure to reset any circuit currently at fault.

1. Locate the *Ground Fault Reset Switch*, at the far left of the of the circuit breaker panel.
2. Press the reset switch up.

3.4.3 By-passing a ground fault sensor

If a ground fault sensor is detecting a false ground fault for a circuit, the sensor can be TEMPORARILY disabled and keep the circuit functional while a solution for the incorrect ground fault reading is found.

**WARNING:**

By-passing a ground fault sensor will disengage any ground fault protection for the corresponding circuit.

Follow these procedures to TEMPORARILY disable a circuit's ground fault sensor.

1. Locate the circuit's *Ground Fault By-Pass Switch*. The first circuit's switch is to the immediate left of the *Ground Fault Reset Switch*, with the switch for each subsequent circuit following along the left.
2. Press up on the switch.

**NOTE:**

When the ground fault sensor by-pass is engaged, the *GFI Fault Lights* for the circuit on the *Interior "Dead Front" Door* will be illuminated even though the circuit is enabled.

3. After locating and correcting the cause of the incorrect ground fault reading, press the *Ground Fault Reset Switch* down to enable ground fault protection on the circuit.



4 Seasonal Maintenance

4.1 Pre Winter Maintenance

4.1.1 Cabinet

- ☐ Inspect the outside door and *Interior "Dead Front" Door* for damage that would prevent them from being shut and locked
- ☐ Verify the *Interior "Dead Front" Door* cannot be opened without setting the *Main Breaker Switch* to **Off**
- ☐ If installed, inspect (and tighten if necessary) the bolts attaching the Control Cabinet to the *Mounting Legs*

4.1.2 Main Panel

- ☐ Verify the main power source to the Control Cabinet is off
- ☐ Disconnect the main power wires coming into the cabinet from the main breaker
- ☐ Open the exterior door and set the *Main Breaker Switch* to **Off**
- ☐ Open the *Interior "Dead Front" Door* and reconnect all wires coming from the *Wiring Box* (or direct from the heating elements) to their respective terminal blocks
- ☐ Reconnect the main power wires coming into the cabinet from the main breaker
- ☐ Close the *Interior "Dead Front" Door* and leave the *Main Breaker Switch* to **Off**
- ☐ Turn on the main power source to the Control Cabinet, then set the *Main Breaker Switch* to **On**
- ☐ Verify the Control Cabinet has power by checking the green LED on the *Snow Sensor* and the *LED Light Bar* installed on the interior door are both illuminated

4.1.3 Manual Activation

- ☐ Set the *Auto/On Switch* to **On**
- ☐ Verify the Control Cabinet is activated by checking the green LED on the *Snow Sensor*
- ☐ Listen for the circuits to engage. For multi-circuit cabinets, each circuit after the first will turn on after the one before it according to that circuit's *Delay Timer* setting.
- ☐ Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating
- ☐ Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions

4.1.4 Snow Sensor Activation

- ☐ Remove the black sensor cover over the *Snow Sensor* and store it in a safe place to be reused after winter
- ☐ Wipe off the moisture sensor (located on top of the sensor) with a damp cloth. If there is an excessive amount of sediment buildup on the sensor that cannot be removed with a damp cloth, use a non-metallic scouring pad and LIGHTLY clean off the sensor.
- ☐ Set the *Auto/On Switch* to **Auto**
- ☐ Verify the Control Cabinet is de-activated by checking the green LED on the *Snow Sensor* is illuminated, but not flashing
- ☐ Put water on the moisture sensor and use freeze spray on the temperature probe of the *Snow Sensor*



- Verify the green LED on the *Snow Sensor* is flashing
- Listen for the circuits to engage. For multi-circuit cabinets, each circuit after the first will turn on after the one before it according to that circuit's *Delay Timer* setting.
- Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating
- Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions

4.1.5 Temperature Sensor Activation

- Set the *Auto/On Switch* to **Auto**
- Verify the Control Cabinet is de-activated by checking the green LED on the *Snow Sensor* is illuminated, but not flashing
- Use freeze spray on the temperature probe of the *Temperature Sensor*
- Listen for the circuits to engage. For multi-circuit cabinets, each circuit after the first will turn on after the one before it according to that circuit's *Delay Timer* setting.
- Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating
- Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions

4.1.6 Remote (dispatch) Activation (if installed)

- Set the remote switch to Off
- Open the Control Cabinet exterior door
- Set the *Main Breaker Switch* to **On**
- Set the *Auto/On Switch* to **Auto**.
- Verify both the green LED on the *Snow Sensor* and the *LED Light Bar* installed on the *Interior "Dead Front" Door* are illuminated
- Request dispatch to activate the cabinet remotely
- Listen for the circuits to engage. For multi-circuit cabinets, there should be a 2-second delay (default setting) between each circuit engaging.
- Walk to the actual heaters and take the surface temperature to verify heaters are getting power and are heating
- Leave the cabinet activated for 10-15 minutes to allow the heaters to come up to temperature and verify there are no GFI faults or heater malfunctions



4.2 Post-Winter Maintenance

4.2.1 Cabinet

- Inspect the outside door and *Interior “Dead Front” Door* for damage that would prevent them from being shut and locked
- Verify the *Interior “Dead Front” Door* cannot be opened without setting the *Main Breaker Switch* to **Off**
- If installed, inspect (and tighten if necessary) the bolts attaching the Control Cabinet to the *Mounting Legs*

4.2.2 Main Panel

- Verify the main power source to the Control Cabinet is off
- Open the exterior door and set the *Main Breaker Switch* to **Off**
- Open the *Interior “Dead Front” Door*
- Label and disconnect all wires coming from the *Wiring Box* (or direct from the heating elements) from their respective terminal blocks. Lay the wires in the bottom of the cabinet for reconnection prior to winter.
- Disconnect the main power wires coming into the cabinet from the main breaker
- When closing the *Interior “Dead Front” Door*, leave the *Main Breaker Switch* to **Off**, utilizing the wing knobs to secure the door

4.2.3 Snow Sensor

- Wipe off the moisture sensor (located on top of the *Snow Sensor*) with a damp cloth. If there is an excessive amount of sediment buildup on the sensor that cannot be removed with a damp cloth, use a non-metallic scouring pad and LIGHTLY clean off the sensor.
- Put black sensor cover over the *Snow Sensor* to protect it when not in use



5 Specifications

5.1 Main Feed Amperage

SureStart™ Cabinet Main Feed Amperage 480V 3P				
Number of Circuits	Cabinet Part Number	Design Load per Circuits	Breaker Size for Each Circuit	Main Breaker Amperage Rating
1	SS14803	80	2 X 50A	200
2	SS24803	160		
3	SS34803	240		
4	SS44803	320		350
5	SS54803	400		
6	SS64803	480		
7	SS74803	560		500
8	SS84803	640		
9	SS94803	720		
10	SS104803	800		600
11	SS114803	880		
12	SS124803	960		

SureStart™ Cabinet Main Feed Amperage 480V 1P				
Number of Circuits	Cabinet Part Number	Design Load per Circuits	Breaker Size for Each Circuit	Main Breaker Amperage Rating
1	SS14801	80	2 X 50A	200
2	SS24801	160		300
3	SS34801	240		400
4	SS44801	320		500
5	SS54801	400		600
6	SS64801	480		800
7	SS74801	560		1200
8	SS84801	640		
9	SS94801	720		
10	SS104801	800		
11	SS114801	880		
12	SS124801	960		



SureStart™ Cabinet Main Feed Amperage
240V 3P

Number of Circuits	Cabinet Part Number	Design Load per Circuits	Breaker Size for Each Circuit	Main Breaker Amperage Rating
1	SS12403	80	2 X 50A	200
2	SS22403	160		
3	SS32403	240		
4	SS42403	320		
5	SS52403	400		400
6	SS62403	480		
7	SS72403	560		500
8	SS82403	640		
9	SS92403	720		600
10	SS102403	800		
11	SS112403	880		
12	SS122403	960		

SureStart™ Cabinet Main Feed Amperage
240V 1P

Number of Circuits	Cabinet Part Number	Design Load per Circuits	Breaker Size for Each Circuit	Main Breaker Amperage Rating
1	SS12401	100	2 X 63A	200
2	SS22401	200		300
3	SS32401	300		400
4	SS42401	400		500
5	SS52401	500		600
6	SS62401	600		

SureStart™ Cabinet Main Feed Amperage
240V 1P – 6 Wire

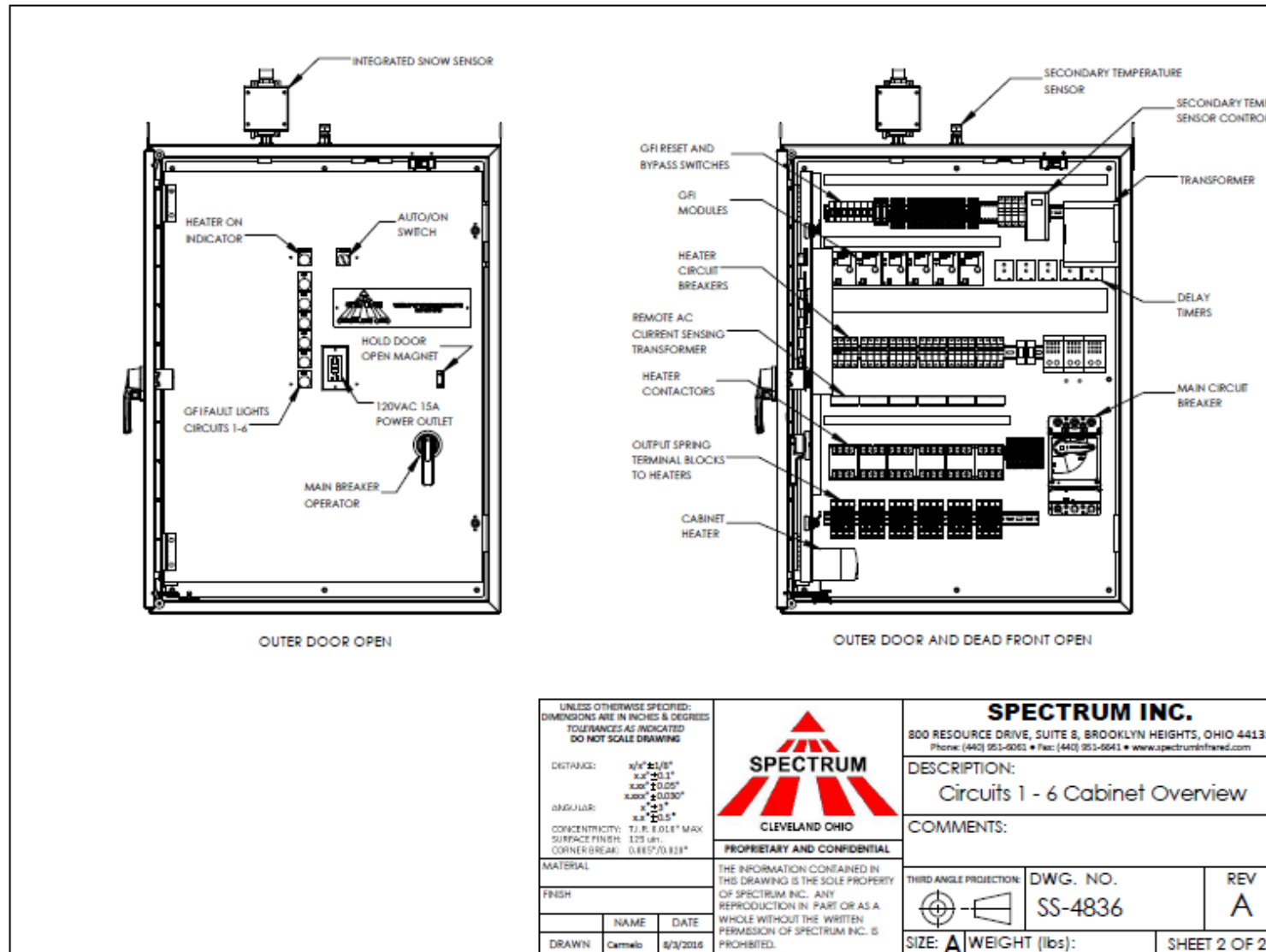
Number of Circuits	Cabinet Part Number	Design Load per Circuits	Breaker Size for Each Circuit	Main Breaker Amperage Rating
1	SS12401-6	120	3 X 50A	200
2	SS22401-6	240		300
3	SS32401-6	360		500

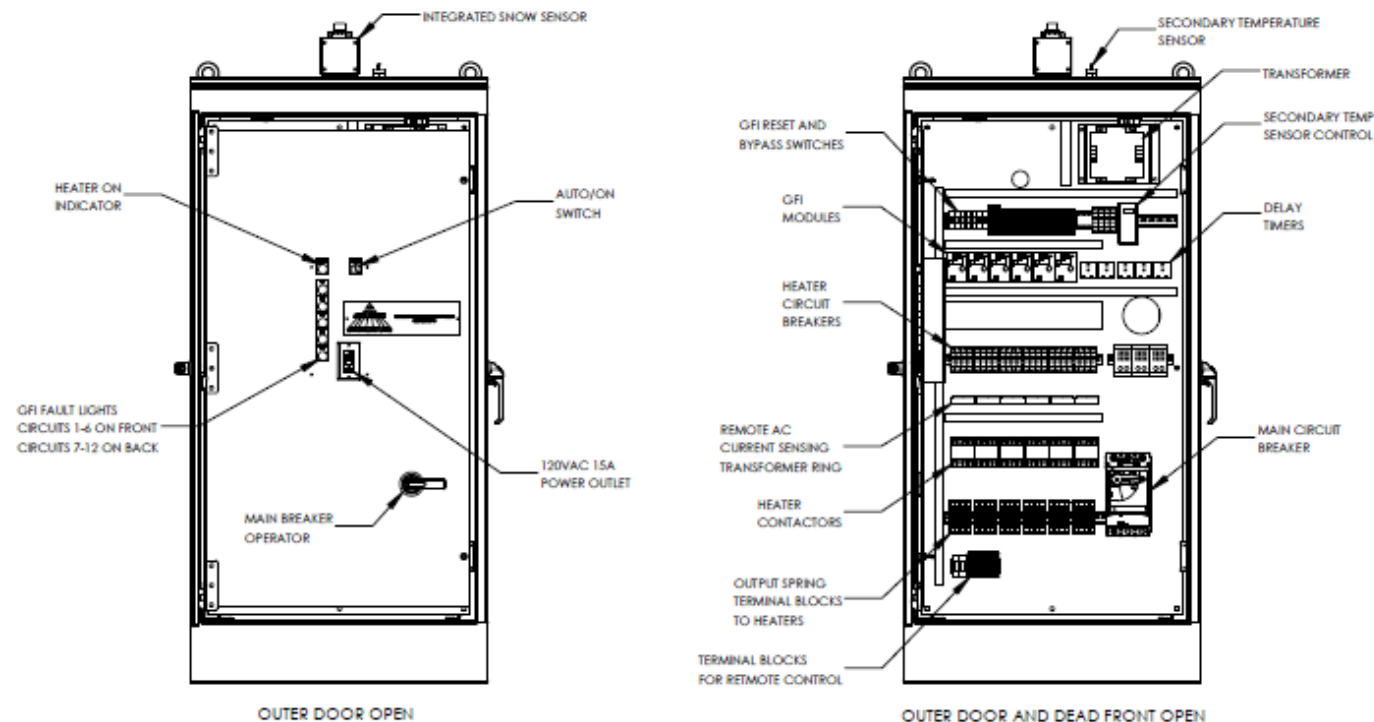



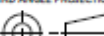

5.2 Current Draw for Control Cabinets, Flat-Jackets, and Crib Heaters

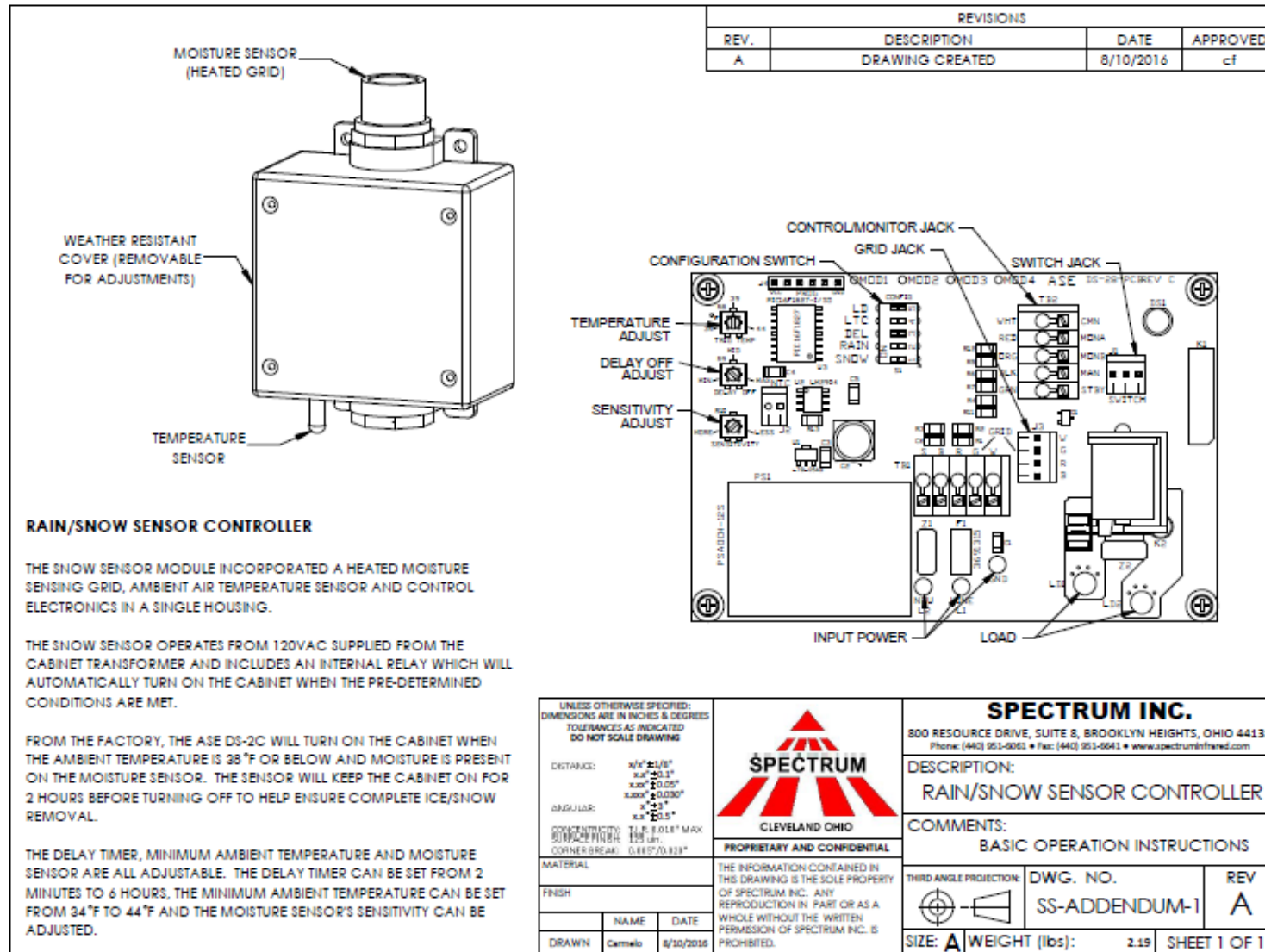
	Snow Melters & Accessories (OAL = Overall Length)	
Spectrum Part #	SureStart™ Control Cabinets	Amp Draw
SS...	Control Cabinet, 240V or 480V, 1PH or 3PH, 1 - 12 circuits	4.2
Spectrum Part #	240 Volt Flat-Jacket	Amp Draw
FJ-240-8	Heater, Flat, 240 volt, 8 ft OAL, 2,400 watts total, 15 ft/#10 AWG leads	10.0
FJ-240-18	Heater, Flat, 240 volt, 18 ft OAL, 5,200 watts total, 15 ft/#10 AWG leads	21.6
FJ-240-26	Heater, Flat, 240 volt, 26 ft OAL, 7,600 watts total, 15 ft/ #10 AWG leads	31.6
FJ-240-34	Heater, Flat, 240 volt, 34 ft OAL, 9,600 watts total, 15 ft/#8 AWG leads	40.0
Spectrum Part #	480 Volt Flat-Jackets	
FJ-480-8	Heater, Flat, 480 volt, 8 ft OAL, 2,400 watts total, 15 ft/#10 AWG leads	5.0
FJ-480-14.5	Heater, Flat, 480 volt, 14.5 ft OAL, 4350 watts total, 15 ft/#10 AWG leads	9.0
FJ-480-16	Heater, Flat, 480 volt, 16 ft OAL, 4800 watts total, 15 ft/#10 AWG leads	10.0
FJ-480-500-16	Heater, Flat, 480 volt, 16 ft OAL, 8,000 watts total, 15 ft/#10 AWG leads	16.6
FJ-480-18	Heater, Flat, 480 volt, 18 ft OAL, 5,200 watts total, 15 ft/#10 AWG leads	10.8
FJ-480-26	Heater, Flat, 480 volt, 26 ft OAL, 7,600 watts total, 15 ft/ #10 AWG leads	15.8
FJ-480-34	Heater, Flat, 480 volt, 34 ft OAL, 9,600 watts total, 15 ft/#10 AWG leads	20.0
Spectrum Part #	600 Volt Flat-Jackets	
FJ-600-18	Heater, Flat, 600 volt, 18 ft OAL, 5,200 watts total, 15 ft/#10 AWG leads	8.6
FJ-600-26	Heater, Flat, 600 volt, 26 ft OAL, 7,600 watts total, 15 ft/ #10 AWG leads	12.6
FJ-600-34	Heater, Flat, 600 volt, 34 ft OAL, 9,600 watts total, 15 ft/#10 AWG leads	16.0
Spectrum Part #	Crib Heaters	Amp Draw
SHBC2300-4	Crib Heater Assembly - 240 volt, 4 ft OAL 1,200 watts total, 15 ft/#10 AWG leads.	5.0
SHBC2300-6	Crib Heater Assembly - 240 volt, 6 ft OAL 1,800 watts total, 15 ft/#10 AWG leads.	7.5
SHBC2300-8	Crib Heater Assembly, 240 volt, 8ft OAL, 2,400 watts total, 15 ft/#10 AWG leads.	10.0
SHBC2300-10	Crib Heater Assembly, 240 volt, 10ft OAL, 3,000 watts total, 15 ft/#10 AWG leads.	12.5
SHBC4300-4	Crib Heater Assembly - 480 volt, 4 ft OAL 1,200 watts total, 15 ft/#10 AWG leads.	2.5
SHBC4300-6	Crib Heater Assembly, 480 volt, 6ft OAL, 1,800 watts total, 15 ft/#10 AWG leads.	3.8
SHBC4300-8	Crib Heater Assembly, 480 volt, 8ft OAL, 2,400 watts total, 15 ft/#10 AWG leads.	5.0
SHBC4300-10	Crib Heater Assembly, 480 volt, 10ft OAL, 3,000 watts total, 15 ft/#10 AWG leads.	6.3
SHBC6300-6	Crib Heater Assembly, 600 volt, 6ft OAL, 1,800 watts total, 15 ft/#10 AWG leads.	3.0
SHBC6300-8	Crib Heater Assembly, 600 volt, 8ft OAL, 2,400 watts total, 15 ft/#10 AWG leads.	4.0
SHBC6300-10	Crib Heater Assembly, 600 volt, 10ft OAL, 3,000 watts total, 15 ft/#10 AWG leads.	5.0
NOTE: Each circuit in the cabinet is 1 phase power. Even with 3 phase power coming in, it is split into single phase for each circuit. For above calculations, use single phase formula.		

6 Schematics





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DISTANCE: N/A $\pm 1/8"$ N/A $\pm 0.1"$ N/A $\pm 0.05"$ N/A $\pm 0.030"$ ANGULAR: N/A $\pm 3"$ N/A $\pm 0.5"$ CONCENTRICITY: T1, R: 0.018" MAX SURFACE FINISH: 125 GR. CORNER RADIUS: 0.015" / 0.033"						
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DRAWN Carmelo 9/1/2016			SIZE:  WEIGHT (lbs):		SHEET 2 OF 2	



**A419 Control Front-Panel**

The front panel of the A419 control has a three-button touchpad and LCD for adjusting control function values, and an LED indicator that displays the On/Off status of the SPDT output relay. See Figure 5.

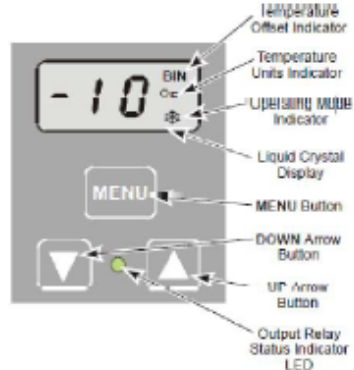
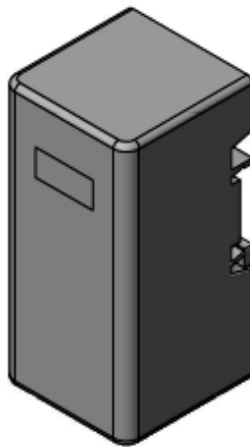


Figure 5: A419 Control Front-Panel with Display

**JOHNSON CONTROLS TEMPERATURE SENSOR OPERATION**

SETTING THE SETPOINT: TEMPERATURE AT WHICH CABINET WILL TURN ON - OVERRIDES SNOW SENSOR OPERATION.

INITIAL SETTING: 0 °F


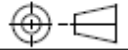
1. PRESS AND HOLD THE MENU BUTTON UNTIL THE DISPLAY CHANGES TO FLASHING SP. THIS WILL TAKE ABOUT 2 SECONDS
2. PRESS THE MENU BUTTON AGAIN. THE CURRENT SETPOINT IS DISPLAYED.
3. PRESS THE UP OR DOWN BUTTON TO ADJUST THE SETPOINT TEMPERATURE.
4. PRESS THE MENU BUTTON TO SAVE. THE DISPLAY THEN RETURNS TO THE SENSOR TEMPERATURE.

SETTING THE DIFFERENTIAL: TEMPERATURE DIFFERENTIAL AT WHICH CABINET WILL TURN OFF.

INITIAL SETTING: 5 °F

5. PRESS AND HOLD THE MENU BUTTON UNTIL THE DISPLAY CHANGES TO FLASHING SP. THIS WILL TAKE ABOUT 2 SECONDS
6. PRESS THE UP BUTTON UNTIL dif is DISPLAYED. PRESS THE MENU BUTTON TO DISPLAY THE CURRENT VALUE.
7. PRESS THE UP OR DOWN BUTTON TO CHANGE TO THE DESIRED VALUE.
8. PRESS THE MENU BUTTON TO SAVE. THE DISPLAY THEN RETURNS TO DISPLAY THE SENSOR TEMPERATURE.

OTHER MENU ITEMS, SHOULD BE SET TO ZERO: Asd, SF, OFS

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DETAIL: 1/16" ± 1/8" 1/32" ± 0.1" 1/64" ± 0.05" 1/80" ± 0.030"	ANGULAR: 1/2° ± 1° 1/4° ± 0.5°			DESCRIPTION: TEMPERATURE CONTROLLER WITH SENSOR	
CONCENTRICITY: T1.8, 0.018" MAX SURFACE FINISH: 125 uin CORNER RADIUS: 0.0157/0.038"		COMMENTS:		THIRD ANGLE PROJECTION: 	
MATERIAL: FINISH:		THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SPECTRUM INC.. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SPECTRUM INC. IS PROHIBITED.		DWG. NO. SS-ADDENDUM-2	REV A
DRAWN	Carmelo	DATE	8/10/2016	SIZE: A	WEIGHT (lbs):
				SHEET 1 OF 1	



Spectrum Inc. Limited Warranty

Products purchased from Spectrum have the warranties stated below.

Limited Warranty

Company warrants the Equipment manufactured by Company for a period of the lesser of 12 months from initial start-up or 18 months from date of shipment, whichever is less, against failure due to defects in material and manufacture and that it has the capacities and ratings set forth in Company's catalogs and bulletins ("Warranty"). Exclusions from this Warranty include damage or failure arising from: wear and tear; corrosion, erosion, deterioration; modifications made by others to the Equipment; repairs or alterations by a party other than Company that adversely affects the stability or reliability of the Equipment; vandalism; neglect; accident; adverse weather or environmental conditions; abuse or improper use; improper installation; unusual physical or electrical or mechanical stress; operation with any accessory, equipment or part not specifically approved by Company; and/or lack of proper maintenance as recommended by Company. Company's obligations and liabilities under this Warranty are limited to furnishing replacement equipment or parts, at its option, FCA (Incoterms 2000) factory or warehouse (f.o.b. factory or warehouse for US domestic purposes) at Company-designated shipping point, freight-allowed to Company's warranty agent's stock location, for all non-conforming Company-manufactured Equipment (which have been returned by Customer to Company.) Returns must have prior written approval by Company. Equipment, material and/or parts that are not manufactured by Company are not warranted by Company and have such warranties as may be extended by the respective manufacturer. No warranty liability

whatsoever shall attach to Company until Customer's complete order has been paid for in full and Company's liability under this Warranty shall be limited to the purchase price of the Equipment shown to be defective. Additional warranty protection is available on an extra-cost basis and must be in writing and agreed to by an authorized signatory of the Company. Warranty claims must be submitted within 30 days of failure; claims made after the 30 days may not be honored. **EXCEPT FOR COMPANY'S WARRANTY EXPRESSLY SET FORTH HEREIN, COMPANY DOES NOT MAKE, AND HEREBY EXPRESSLY DISCLAIMS, ANY WARRANTIES, EXPRESS OR IMPLIED CONCERNING ITS PRODUCTS, EQUIPMENT OR SERVICES, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF DESIGN, MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, OR OTHERS THAT ARE ALLEGED TO ARISE FROM COURSE OF DEALING OR TRADE.** NOTWITHSTANDING ANYTHING TO THE CONTRARY, IN NO EVENT SHALL COMPANY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING WITHOUT LIMITATION, PRODUCT LOSS, LOST REVENUE OR PROFITS), OR PUNITIVE DAMAGES WHETHER CLAIMED UNDER CONTRACT, WARRANTY, NEGLIGENCE, STRICT LIABILITY OR ANY OTHER LEGAL THEORY OF FACTS.