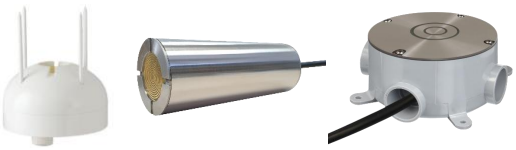
JUNE 2025

Snow Melting Product Guide

Key Highlights of Frio Systems

Frio S1-A controllers are now **compatible with local moisture sensors**

- Gutter Sensor
- Aerial Sensor
- Pavement Sensor



Pilot Duty Mode allows you to use a Frio controller to drive a multi-circuit contactor panel

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Remote operation and monitoring from your Phone or Computer offers users flexibility and peace of mind

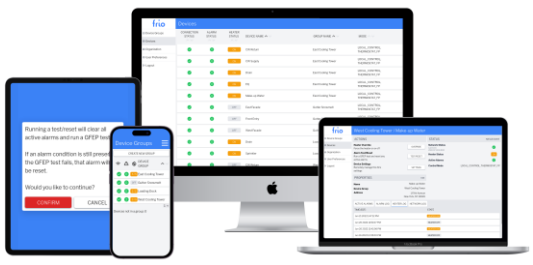


Table of Contents

Snow Melting Overview

Key Highlights of Frio Systems

Local moisture sensors (Gutter, Aerial, and Pavement)

- Up to 6 Sensors per controller for robust system designs
- Sensor loss alarm triggers if sensors are damaged or lost
- Ambient fallback mode ensures your system keeps running if sensors are damaged

Pilot Duty Mode allows you to use a Frio controller to drive a multi-circuit contactor panel

- Dedicated pilot duty mode ensures easy of setup
- 120VAC control signal works with most existing contactor panels
- Frio is now offering 2,4,6,8 & 12 Circuit GFEP panels

Connected features enable best-in-class control, operation and monitoring options only available from Frio

- Online Weather Forecast Control uses Frio's Proprietary algorithms and NOAA weather forecast data from the systems location to active the heaters, allowing for simple, sensor less systems
- Remote operation and monitoring from your Phone of Computer offers peace of mind for your customer

Frio offers multiple methods and configurations to meet your snow melt project needs, including local snow sensors and online weather forecast control. Configurations include:

- **Single circuit operation** for small systems
- **Satellite contactor mode** to control multiple circuits from one set of sensors
- **Pilot duty mode** to use the Frio S1 controller to drive a contactor panel which provides power to the heating system

For help with your snow melting project, please contact us.

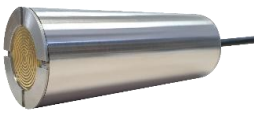
Snow Melting: Local Sensors

Local Snow Sensors

Local snow sensors detect if moisture is present, then send this information via Modbus to the Frio S1-A controller. The Aerial Sensor (AER-1) and Gutter Sensor (GUT-1) also send temperature to the Frio S1-A, while the Pavement Sensor (PVT-1) requires the use of a separate ambient temperature sensor which can be the thermistor that come with the S1-A. When moisture and freezing temps are detected, the heating system is activated. The sensors are connected to a junction box (SM-JB-1) with a 30 foot (10 m.), 24V 4 wires cable (can be extended up to 1000 ft. with 4-wire shielded cable, 18-AWG or larger). The SM-JB-1 junction box includes a 24VAC power supply to provide power to the sensors. Each Frio S1-A can accept any combination of up to (6) total snow sensors and will activate when any single sensor detects snow or ice. Frio offers three different snow sensors that are suitable for all types of snow melting systems:

AER-1 Aerial Sensor: Designed to detect falling snow, the AER-1 can be mounted on a vertical piece of conduit or by using the optional wall mount bracket (AER-WM). The AER-1 includes anti-nesting spikes to protect the sensor from birds. This sensor includes an ambient temperature sensor and operates on 24VAC from the SM-JB-1.

GUT-1 Gutter Sensor: The robust rust-proof gutter sensor is designed to lay flat in a gutter to detect moisture, meltwater, or snow accumulations. This sensor includes an ambient temperature sensor and operates on 24VAC from the SM-JB-1.



PVT-1 Pavement Sensor: The pavement sensor can be installed in the ground and is designed to detect moisture or snow accumulations. The sensor is mounted via four screws to a standard PVC 4” diameter round junction box, allowing easy removal for service. The PVT-1 requires a thermistor to be connected to the S1-A to sense ambient temperature. The PVT-1 operates on 24VAC from the SM-JB-1.

SM-JB1 Snow Sensor Junction Box: The Snow Sensor Junction Box includes a 24VAC power supply to power the snow sensors, as well as terminal blocks to wire the sensors to a Frio S1-A. Each junction box can power up to 6 AER-1 or GUT-1 sensors, or up to 2 PVT-1 pavement sensors, and can be wired to accept input voltage 120 – 277VAC.

Online Weather Forecast Control

Both the Frio S1-A and the Frio S1-B can be connected to the internet via Wi-Fi or ethernet allowing users to control their snow melt system using one of Frio's proprietary snow melt algorithms. This functionality eliminates the need for local moisture sensors for some applications, which can reduce project cost and simplify installation. Web-based control is an excellent option for surface melting systems, systems designed to keep ledges clear of ice and snow, and systems where users want additional control.

Frio's Online Weather Forecast Control uses NOAA forecast data which is analyzed by Frio's proprietary control algorithms to provide accurate and robust control. Frio offers two different control algorithms and programable hold-on times to allow users to customize control of their system.

- **Efficient Control Algorithm:** This algorithm looks at temperature, precipitation type, and precipitation intensity to activate the system only when falling snow or ice is present and may accumulate. This system is up to 45% more efficient than a standard aerial snow sensor.
- **Conservative Control Algorithm**: Works similar to the efficient algorithm with a different precipitation intensity threshold to activate for all precipitation under 39°F (3°C) and operates much like a standard aerial snow sensor.

Remote Control and Monitoring - (Works with all control methods)

All of Frio's controllers may be connected to the internet to allow users to **monitor and control systems remotely from their phone, tablet or computer** regardless of control method. Connected system users can:

Set Remote Overrides ON or OFF

- Turn systems OFF if they are not needed to save energy. (i.e. skip a storm if you are not home and don't need to melt the driveway)
- Turn systems ON if they require more melting.

Monitoring and Alerts

- Check if the system is on and running
- Set up email and text alerts if the system goes into alarm

System Checks and Set-up

- Run a Spot Check to see heating system health and generate system report.
- Change settings and adjust the configuration

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Snow Melting: System Settings

Slab Temperature Control

Slab temperature control allows users to maintain the snow melting surface at a constat temperature. This configuration requires a sensor embedded in the slab. The optimal slab temperature setting for your system will depend on heater power, slab depth, and sensor placement. Higher slab temperatures will result in quicker melt out, while lower slab temperatures will resulting less energy use and lower operating costs.

For surface melting systems using just an aerial sensor, the thermistor that comes with the Frio S1 can be used as the slab sensor. For systems using the pavement sensor, the thermistor is used as an ambient temperature sensor and **an RTD must be included to be used as the slab temperature sensor.**

Fallback Mode

All snow melt control methods offer two fallback modes incase the sensor of internet connection is lost:

- **Ambient Fallback (Recommended):** When the system is configured with an ambient temperature sensor, it will automatically fall back to ambient control if the sensors or internet connection is lost. This ensures that the system will continue to operate if freezing conditions are present, but will prevent the system from operating during warm weather. This fallback mode provides users time to troubleshoot and fix their system while ensuring the system operates with relative efficiency. The Frio S1-A and S1-B controllers include a thermistor which can be used as the ambient sensor to provide this fallback mode.
- **ON/OFF Fallback:** For systems without an ambient temperature sensor, or in the case where all sensors have failed, users can set a fallback mode of Heater ON or Heater OFF. For critical systems such as egress and gutters, Frio recommends setting this mode to Heater ON. For large, high-power systems such as driveways, Frio recommends this be set to Heater OFF.

Hold-On Time

All of Frio's control methods include a user-settable hold-on time which keeps the heating system active after snow is no-longer detected. The hold-on time will depend on the system installation and type. It is best to experiment with your system to determine the best hold-on on time.

Longer Hold-on Time (6-10 hrs.)

- Critical egress and busy walkways
- Systems in high-snow areas
- Lower powered systems or embedded systems that are buried deep

Shorter Hold-on Time (2-6 hrs.)

- Energy conscious users (i.e. residential driveway)
- High powered systems with quick melt times

How to Design and Quote a Snow Melting System

1

Choose your control method and sensor configuration based on the application and project requirements.

- Does the system require Slab Temperature Control?
- Pick a fallback mode in case of sensor failure.

2

Determine the layout of your system

- Determine the number of unique areas requiring sensors
- Divide the system into control zones
- Calculate the size of each control zone and determine the number of heating circuits in each zone

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3

Choose the system configuration for each control zone

- Primary Controller – Determine number of sensors and junction boxes
- System Configuration – Choose between using single circuit control, satellite contactors, or pilot duty.

4

Build your BOM and Quote

For questions about your system or help with design, please contact us at info@frio.co

1 Choosing your Control Method – Roof & Gutter Systems

Roof and Gutter systems include; gutter melting systems, roof edge de-icing systems to prevent ice-dams, and combination systems that employ both together. All these types of systems are designed to limit snow and ice accumulation and maintain a melt path to ensure proper drainage.

Due to variations in local roof conditions and the need to drain adjoining areas that are not heated, Frio recommends using local sensors for roof and gutter applications.

Good

MODE: Ambient Control

SENSORS: Thermistor

APPLICATIONS:
Small systems
Complex systems with refreezing

Ambient Control offers a simple solution with the lowest upfront cost for roof and gutter heating. The heaters will turn on whenever the temperature drops below the setpoint (38°F (3°C) ensuring that a melt path is open whenever freezing could occur.

Ambient Control is better for small systems, since the heater will run more than is needed resulting in higher operating cost.

Better

MODE: Local Snow Melt

SENSORS: Gutter Only

APPLICATIONS:
Residential Gutters
Simple Systems

Using a gutter sensor will significantly reduce operating cost by only turning on when meltwater is present, eliminating wasted operation on dry days that are below freezing.

Gutter sensors must be located where they will be exposed to meltwater. Multiple gutter sensors should be used if there are different gutter conditions that may see melt water at different times.

Best (Recommended)

MODE: Local Snow Melt

SENSORS: Aerial & Gutter

APPLICATIONS:
Critical Roof & Gutter Systems
Large Systems

The most robust option is to use an aerial sensor with multiple gutter sensors to ensure that the system will always operate when needed.

Typically, an aerial sensor will detect snow earlier in a storm while a gutter sensor will remain active for a longer period after the storm.

Redundant sensors also ensure your system will remain operation if one sensor is damaged.

Snow Melting: Surface Melting

1 Choosing your Control Method – Surface Melting Systems

Surface melting systems include driveways, sidewalks, emergency egress, loading docks, patios, roof decks, ledges, and any other surface where the intent is to maintain a surface free from snow and ice. These systems must be activated when snow, sleet, or freezing rain is falling, and must remain on long enough to complete melt out and ensure an ice-free surface.

Online-weather forecast control works well for these types of systems and can help reduce operating costs. When connected, users can also set remote overrides to turn the system on or off. This allows users to "skip" storms if they do not need the area to be melted.

Good

MODE: Online Weather Forecast

SENSORS: Thermistor (optional)

APPLICATIONS:
Energy Efficient Users
Low-cost Systems

Weather-forecast control works well for many types of surface melting systems, especially where energy use and upfront cost are concerns. Users can pick from two different control algorithms and set the hold-on time to customize control to their liking.

These types of systems are popular with residential users who are looking for a more cost-effective system and who enjoy the ability to check the system remotely and override the system off to limit energy use when they are not at home.

Better

MODE: Local Snow Melt

SENSORS: Aerial Only

APPLICATIONS:
Smaller Systems
Simple Systems

Using an aerial sensor allows for simple set-up that is relatively low cost while still being reliable. Since the sensor is local, this configuration does not require an internet connection.

This configuration is great for commercial projects looking for a simple and low-cost way to keep an area free of snow and ice. Examples include loading docks and ledges.

Best (Recommended)

MODE: Local Snow Melt

SENSORS: Aerial & Pavement

APPLICATIONS:
Commercial Driveway/Walkway
Large Systems
Safety-Critical Egress

The most robust option is to use one aerial sensor with one or more pavement sensors. The pavement sensors should be placed to detect any meltwater that may make its way onto the heated surface from adjacent snowbanks.

Systems with pavement sensors require a separate ambient temperature sensor.

This approach is best for critical systems such as busy sidewalks and emergency egresses where it is crucial to prevent any ice buildup.

2 Determining Your System Layout

A. Identify Unique Areas

- **Control Methods: Ambient Control and Online Weather Forecast Control, and Local Snow Melt with (1) Aerial Sensor**
  - For these control methods, the entire system can be treated as one control zone with no unique areas. When determining whether to use one of these control modes take care to ensure this will be sufficient for proper operation of your system.
- **Control Methods: Local Snow Melt with Gutter Sensors or Pavement Sensor**
  - For systems with gutter sensors or pavement sensors, identify the unique heating areas based on the characteristics listed below as well as site specific conditions. Each unique area should have at least one moisture sensor to ensure the system operates when freezing or accumulation occurs in that area:
    - **Aspect and Sun Exposure:** The sun often plays a key role in both melting out snowfall and generating meltwater that needs to be drained. Areas with different sun exposure will often require operation at different times. For example, the east side of a roof will see more meltwater in the morning while the west side will see more in the afternoon.
    - **Wind and Sheltering**: Wind and drifting snow can have a large influence on how much snow builds up in a particular area. Areas with drifting need to have sensors to ensure the system activates when snow drifts into that area which can happen after snow has stopped falling.
    - **Gutter Layout**: Larger gutter systems with different sections, levels, or roof areas, require a sensor in each section. It can be difficult to understand how melt water flows through gutter systems, so placing a sensor in each section ensures that the system will see meltwater and turn on when needed.

2A ***Determine the number of unique areas***

2 Determining Your System Layout

B. Determine Number of Control Zones

- Once you have identified all the unique areas and the number of sensors needed, you must decide if you want the entire system to turn on at once (single control zone), or if different areas should be controlled separately (multiple control zones).
- For systems with areas that are dissimilar enough to require operation at different times, using multiple control zones will ensure each zone will only operate when needed, reducing operating cost. One example would be gutters located on opposite sides of a roof that will see meltwater at different times and thus require heating at different times. Splitting out control zones is highly recommended for large systems.
- Each S1-A can take inputs from up to 6 sensors, allowing for a maximum of 6 unique areas per control zone.

2B ***Determine the number of control zones and number of sensors for each zone (limit 6)***

C. Determine Number of Heating Circuits per Control Zone

For each control zone, you need to determine the number of heating circuits required. Please consult the heat trace manufacturer to determine what type of heat trace and how many circuits you require. Frio recommends using 30A heating circuits. However, using 40A or 50A circuits is possible with pilot duty mode and a contactor panel.

The number of circuits per zone for gutter systems will depend on the total length and type of heat trace used. For surface melting systems, the number of circuits will depend on the total area, power density, and type of trace used.

2C ***Determine the number of circuits in each control zone***

3 Choosing a System Configuration: Primary Controller

Each control zone requires a primary controller configured based on the control method selected in step one.

Control Method: Ambient Control or Online Weather Forecast Control - The primary controller will be a single S1-B (or S1-A if Modbus or BACnet is required). A thermistor is required for ambient control. The thermistor is optional for Online Weather Forecast Control, however it is recommended since it can be configured as an effective fallback option if the internet connection is lost.

Control Method: Local Snow Sensors - The primary controller will be a Frio S1-A with up to (6) sensors, and at least one SM-JB-1. The SM-JB-1 can power up to (6) AER-1 or GUT-1 sensors and up to (2) PVT-1 sensors. Systems with more than (2) pavement sensors on a single S1-A controller will require multiple SM-JB-1 junction boxes.

How may SM-JB-1 junction boxes per primary controller?

Each moisture sensor includes a small heater to ensure the sensing surface does not freeze. The SM-JB-1 includes a power supply which runs these heaters and serves as a junction box to tie together the Modbus signals from each sensor. At least one SM-JB-1 is required for each S1-A acting as a primary controller using snow sensors. The SM-JB-1 can power up to (6) AER-1 or GUT-1 sensors and up to (2) PVT-1 sensors.

Combinations with (1) SM-JB-1

- (6) AER-1 or GUT-1 (any mix)
- (2) PVT-1
- (1) PVT-1 and (1) AER-1

Combinations with (2) SM-JB-1

- (4) PVT-1
- (3) PVT-1 and (1) AER-1

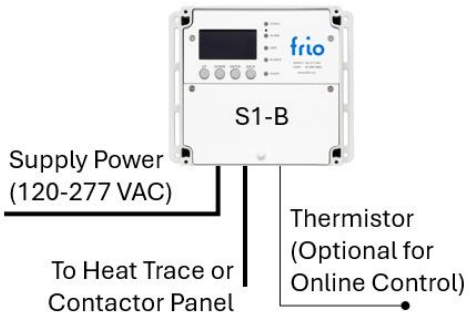
Combinations with (3) SM-JB-1

- (6) PVT-1
- (5) PVT-1 and (1) AER-1

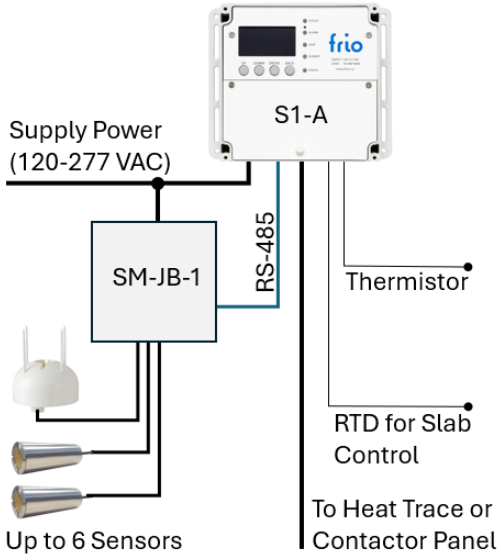
Primary Controller Configurations

Ambient Control

& Online Weather Forecast Control



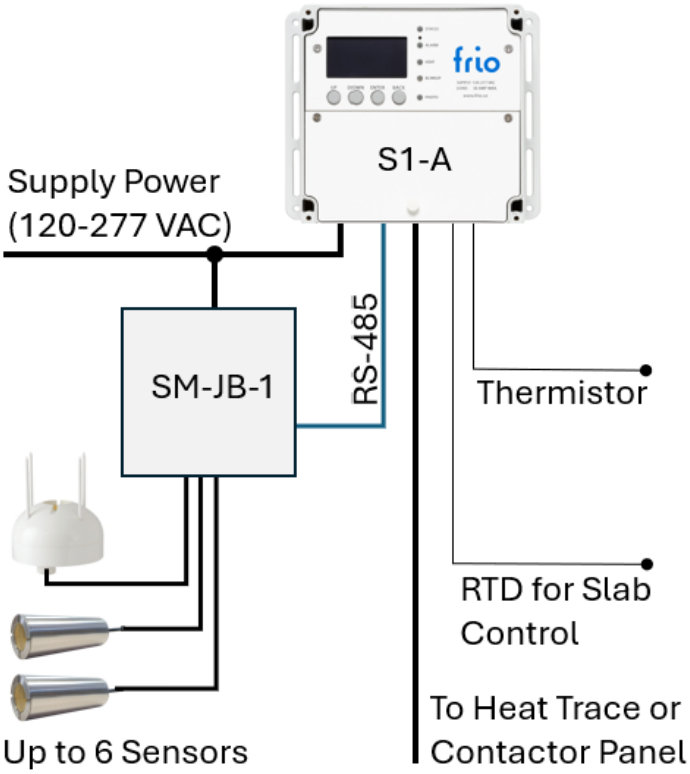
Local Snow Sensors



3 Choosing a System Configuration: Heating Circuits

Option A: Single Circuit Control

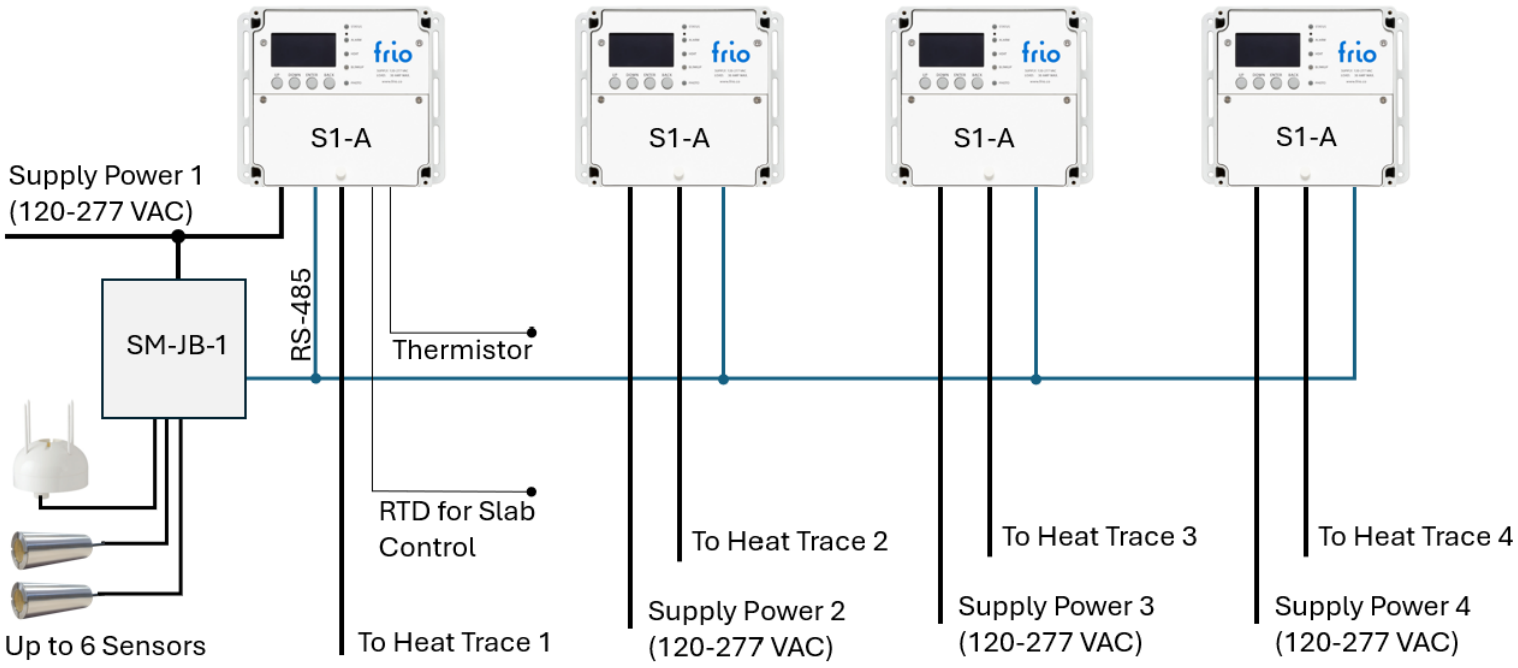
- **Summary:** The primary controller directly controls the heating circuit.
- **Sizing:** 1 circuit per control zone
- **Considerations:** Single circuit control is best for smaller systems and systems where each control zone consists of a single heating circuit which is configured as a primary controller.



3 Choosing a System Configuration: Heating Circuits

Option B: Satellite Contactors

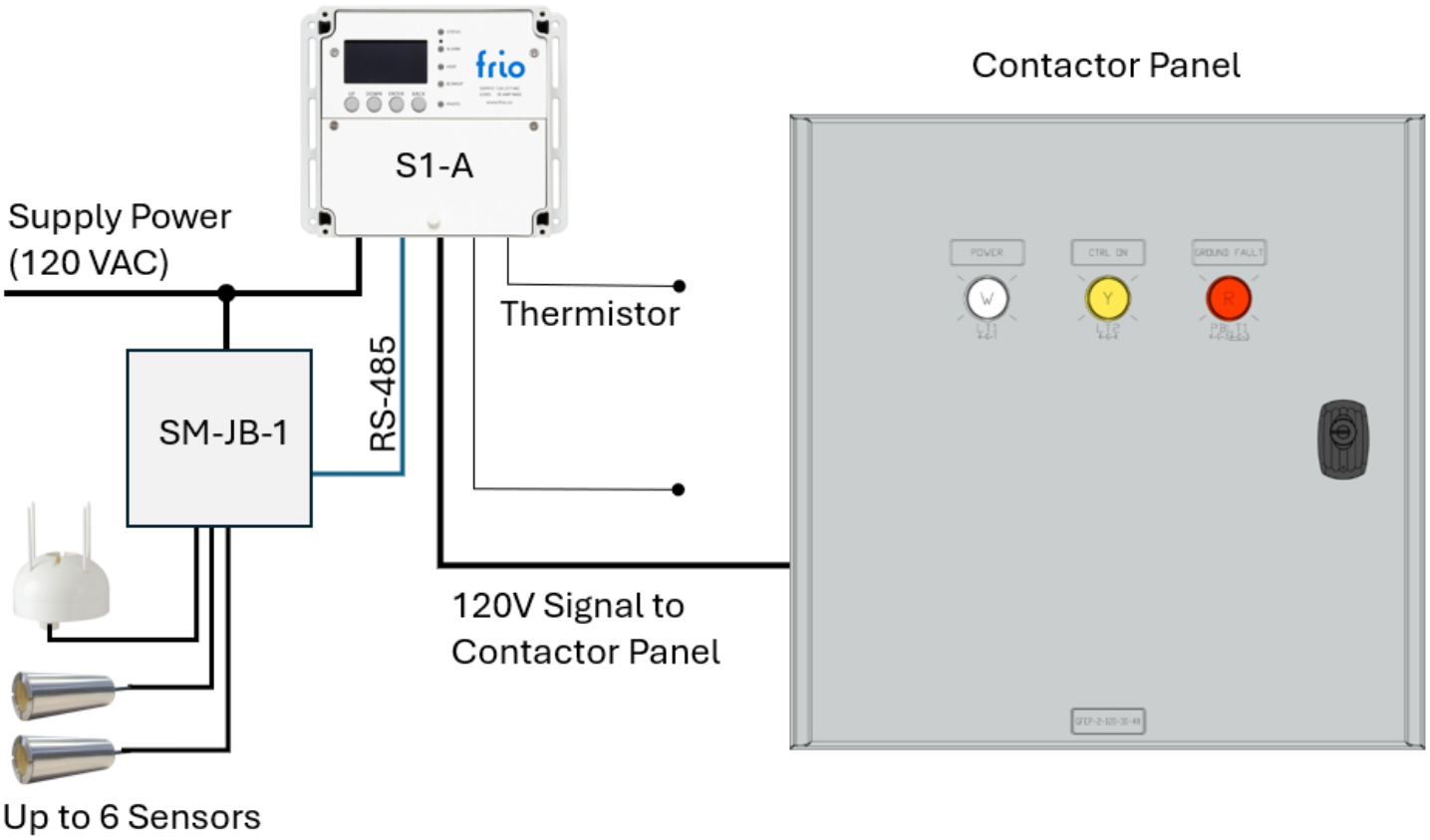
- **Summary**: The primary controller takes the sensor inputs and drives up to (20) additional S1-A controllers configured as satellite contactors.
- **Sizing:** 2 to 21 30A circuits per control zone
- **Considerations**: Primary controller must be an S1-A configured as a Modbus client (master). Up to 20 additional S1-As acting as satellite contactors, can then be connected to the primary controller via an RS-485 Modbus connection and configured as servers (slaves). Satellite contactors will mirror the primary controller, turning on when it calls for heat. Each satellite controller must be programed with a unique Modbus address.



3 Choosing a System Configuration: Heating Circuits

Option C: Pilot Duty with Contactor Panels

- **Summary:** Primary controller drives a contactor panel that powers the heating circuits.
- **Sizing:** 2-12 circuits per control zone w/ Frio panels (12+ circuits with custom panels)
- **Considerations:** Pilot duty mode allows the primary controller to send a 120VAC signal to activate a contactor panel which turns on multiple heating circuits. Frio offers contactor panels with Ground Fault Protection (GFEP) in 2, 4, 6, 8, and 12 circuit configurations. Standard panels include 30A contactors, and custom panels can be built with 40A or 50A contactors. Pilot duty mode works with a wide range of contactor panels available from multiple manufacturers provided they are controlled by a 120VAC relay. To understand whether pilot duty will work with your panel design, please contact Frio.



4 How to Quote: Roof and Gutter System

START HERE: Choose Control Method [1]

- ***Ambient Temperature Control***
  - *Choose Local Communication*
    - None or Dry-Contact
    - Modbus
    - BACnet
- ***Local Snow Sensors***
  - *Complete for each Control Zone* [2B]
    - Sensors & Junction Boxes
      - Number of Sensors (up to 6 total) [2A]
      - Junction Boxes
    - System Configuration [3]
      - Single Circuit
      - Satellite Contactor
      - Pilot Duty

What to Quote

SKU	QTY	NOTES:
COMPLETE FOR ENTIRE SYSTEM		
S1-B-2002	(1)	Per circuit [2C]
S1-A-0002	(1)	Per circuit [2C]
S1-A-0002	(1)	Per circuit [2C]
FR-BAC-001	(1)	Frio Gateway
NOTE: Use (1) gateway for each group of up to (10) S1-A controllers.		
COMPLETE A & B FOR EACH CONTROL ZONE		
A) PRIMARY CONTROLLER SENSORS		
GUT-1	(1-6)	Up to 6 total sensors
AER-1	(1)	Aerial sensor optional
SM-JB-1	(1)	Junction box required
B) CONTROL ZONE CONFIGURATION		
S1-A-0002	(1)	
S1-A-0002	(1)	Per circuit [2C]
NOTE: In the satellite contactor configuration, each control zone can be up to (21) circuits		
S1-A-0002	(1)	Pilot duty controller
FR-GFEP-##	(1)	Contactor Panel
NOTE: Frio offers contactor panels with GFEP in 2,4,6,8 & 12 circuit configurations. Please contact us for more information.		

4 How to Quote: Surface Melting System

START HERE: Choose Control Method [1]

- ***Online Weather Forecast Control***
  - *Choose Local Communication*
    - None or Dry-Contact
    - Modbus
    - BACnet
- ***Local Snow Sensors***
  - *Complete for each Control Zone* [2B]
    - Sensors & Junction Boxes
      - Number of Sensors (up to 6 total) [2A]
      - Junction Boxes
      - Slab Sensor (If required)
    - System Configuration [3]
      - Single Circuit
      - Satellite Contactor
      - Pilot Duty

What to Quote

SKU	QTY	NOTES:
COMPLETE FOR ENTIRE SYSTEM		
S1-B-2002	(1)	Per circuit [2C]
S1-A-0002	(1)	Per circuit [2C]
S1-A-0002	(1)	Per circuit [2C]
FR-BAC-001	(1)	Frio Gateway
NOTE: Use (1) gateway for each group of up to (10) S1-A controllers.		
COMPLETE A & B FOR EACH CONTROL ZONE		
A) PRIMARY CONTROLLER SENSORS		
PVT-1	(0-6)	Up to 6 total sensors
AER-1	(1)	Aerial sensor optional
SM-JB-1	(1-3)	Junction box required
NOTE: See page 12 to determine how many SM-JB-1 junction boxes are required		
FR-RTD	(1)	Slab rated PT100 RTD
B) CONTROL ZONE CONFIGURATION		
S1-A-0002	(1)	
S1-A-0002	(1)	Per circuit [2C]
NOTE: When using the satellite contactor configuration, each control zone can be up to (21) circuits		
S1-A-0002	(1)	Pilot duty controller
FR-GFEP-##	(1)	Contactor Panel
NOTE: Frio offers contactor panels with GFEP in 2,4,6,8 & 12 circuit configurations. Please contact us for more information.		