System 350™
S350C Temperature Slave Stage Module

The S350C Temperature Slave Stage Module is used in conjunction with the A350 Temperature Control to add multiple stage capability with independently adjustable setpoints. The S350C is an electronic control with a Single-Pole, Double-Throw (SPDT) relay output.

As are all System 350 products, the S350C is housed in a NEMA 1, high-impact plastic enclosure. The modular design provides easy, plug-together connections for quick installation and future expandability.

Figure 1: S350C Temperature Slave Stage Module

Features and Benefits

❑ **Modular Design**	Enables stage, display, and transformer modules to be purchased and installed as needed
❑ **Plug-together Connectors and 35 mm DIN Rail Mountability**	Eliminates wiring between modules, which reduces installation costs
❑ **Adjustable Setpoint (°F or °C) Independent of A350 Temperature Control**	Stages equipment with different setpoint requirements using one dual scale setpoint (°F or °C)
❑ **Shares Sensor Input with A350 Temperature Control**	Eliminates the need for a separate sensor
❑ **Wide, Adjustable Differential**	Enables the user to match equipment cycle rate and/or sequencing for a given application
❑ **Field-selectable Mode of Operation**	Suitable for cooling or heating applications
❑ **Light-Emitting Diode (LED) Indication of Relay Status**	Aids in adjustment and troubleshooting

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Application

The S350C Slave Stage Module receives power and sensor inputs from the A350 Temperature Control to which it is connected. The S350C features an adjustable setpoint, independent of the A350 Control's setpoint. The output of the S350C is a Single-Pole, Double-Throw (SPDT) relay.

The maximum number of stages that can be used in a system varies with the type of control module (on-off, proportional, or reset), type of stage module (on-off, slave, or proportional), and type of power supply (external transformer or Y350R). Use the following table to determine the maximum number of stages that may be used with each control module.

Table 1: Maximum S350 Stage Modules per Control Module

Control (Power Supply)	Maximum S350A or S350C Stage Modules	Maximum S350A or S350C (with 1 S350P)	Maximum S350A or S350C (with 2 S350Ps)
A350A, A350B, A350E, A350R, A350S (using Y350R)	9	6	4
A350P (using Y350R)	4	2	0
Any A350 (using an external transformer)	9	8	7

Note: For each S350P added, the number of S350A or S350C Stage Modules that can be used with a Y350R decreases by two. If an external transformer is used, the number of S350A and S350C Stage Modules that can be used decreases by one for each additional S350P.

Operation

IMPORTANT:	All System 350 controls are designed for use **only** as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

The S350C is powered by the A350 and provides an SPDT relay output. A front panel LED lights to indicate that the relay is energized. Features include:

- adjustable setpoint
- adjustable differential
- selectable cooling or heating mode of operation

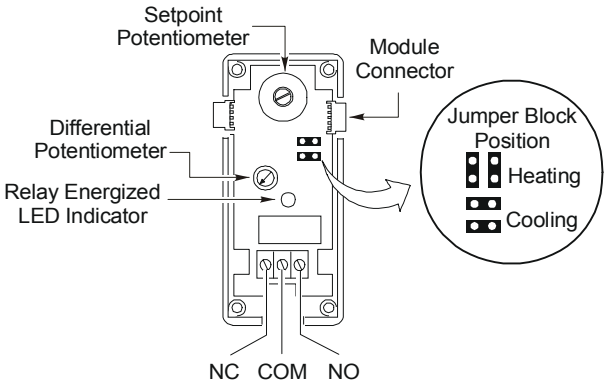

Figure 2: Interior View of S350C Module

Setpoint

The S350C Module features an adjustable setpoint, with both Fahrenheit and Celsius scales, which is independent of the A350's setpoint. The S350C Module's setpoint is defined as the temperature at which the S350C Module's relay will de-energize. With the mode jumper in either the cooling or heating mode of operation, the relay will de-energize when the sensor temperature reaches setpoint. The setpoint can be adjusted between -30 and 130°F (-34 to 54°C). Adjustment is made using the setpoint potentiometer shown in Figure 2.

Differential

Differential is defined as the change in sensor temperature between energization and de-energization of the relay. The differential can be adjusted between 1 and 30F° (0.5 to 17C°). Adjustment is made using the differential potentiometer shown in Figure 2.

Included with the S350C is a Celsius Differential scale decal. If the Celsius scale is desired, follow the Celsius scale conversion procedure in the *Installation and Wiring* section.

Cooling or Heating Operation

The S350C features field-selectable operation, allowing its use in either cooling or heating applications.

Select the mode by positioning the operation jumpers vertically for heating or horizontally for cooling, as shown in Figure 2. As shipped from the factory, the jumpers are installed in the vertical position.

When set for cooling, the differential is above the S350C's setpoint. The relay is de-energized and the LED indicator is off when the sensor temperature drops to the setpoint setting. As the temperature rises to the setpoint *plus* the differential, the relay energizes and the LED illuminates. See Figure 3.

When heating is selected, the differential is below the S350C's setpoint. The relay is de-energized and the LED indicator is off when the sensor temperature rises to setpoint. As the temperature drops to setpoint *minus* the differential, the relay energizes and the LED illuminates.

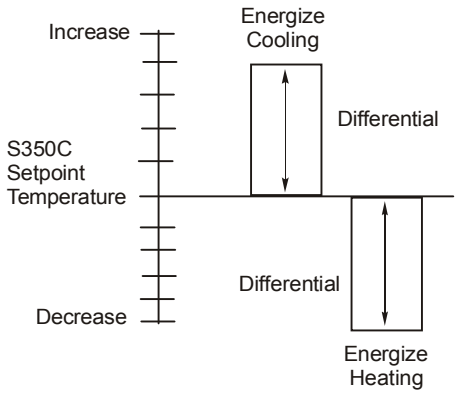

Figure 3: S350C Relay Operation Relative to Setpoint and Mode of Operation

Dimensions

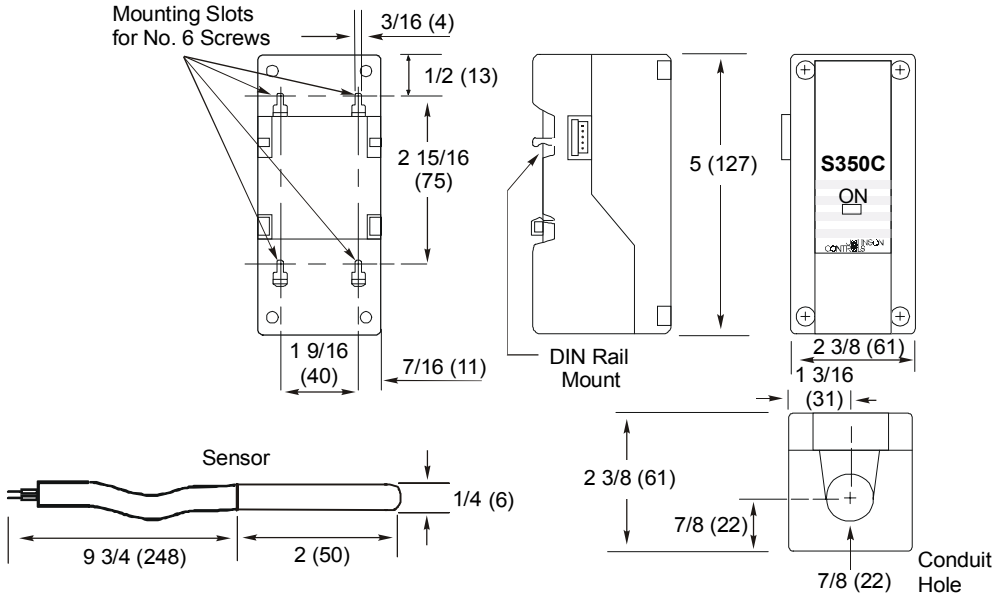

Figure 4: S350C Dimensions, in (mm)

Installation and Wiring

Celsius Scale Conversion

Included with the S350C is a Celsius scale decal for the differential potentiometer. If the Celsius scale is desired:

1. Use a small screwdriver to pry underneath the existing decal, and remove it along with the differential potentiometer knob.
2. Apply the Celsius scale decal in the same place as the original decal. (Number 9 should be at the top.)
3. Rotate the knob stem completely counterclockwise.
4. Reinstall the potentiometer knob so the arrow points to the minimum scale temperature.

Mounting the S350C

The S350C Slave Stage Module is housed in a compact NEMA 1 plastic enclosure designed for standard 35 mm DIN rail mounting. The S350C is not position sensitive but should be mounted for convenient wiring and adjustment. Use the four key-slot mounting holes on the back of the control case for surface mounting.

Note: When mounting the S350C (or any System 350 module) to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure.

Wiring

> ⚠ WARNING: **Risk of Electrical Shock.** Disconnect power supply before making electrical connections to avoid possible electrical shock or equipment damage.

- Install all wiring to conform to the National Electrical Code and local regulations. For maximum electrical rating, refer to the label inside the control cover. Use only copper conductors.
- Consult Figures 5 and 6 for proper wiring and terminal designations.

Adjustments

Follow this procedure to set up the S350C for the types of operation desired.

1. Remove the S350C's cover by loosening the four captive cover screws.
2. Set the cooling/heating jumpers to the desired position: horizontally for cooling or vertically for heating. See Figure 2.
3. Adjust the differential potentiometer (DIFF) to the desired setting.
4. Adjust the setpoint potentiometer to the desired setting. Clockwise rotation increases setpoint.
5. Reinstall the cover and secure in place with the four captive cover screws.

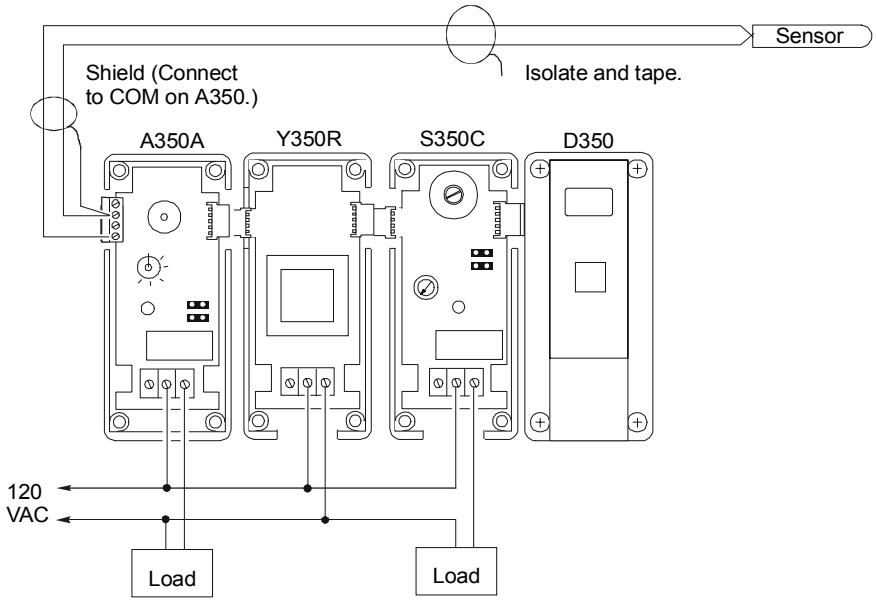

Figure 5: Typical Wiring Diagram for an S350C, Y350R, and A350 Temperature Control

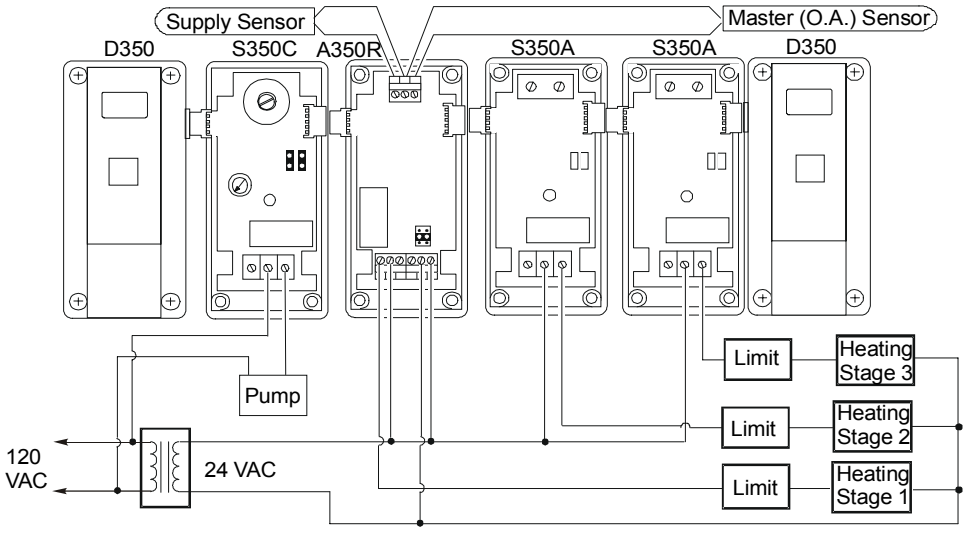

Figure 6: Typical Wiring Diagram for an S350C, Y350R Power Module, and A350R Temperature Reset Control for Pump Control

Checkout Procedure

Before applying power, make sure that the installation and wiring connections comply with job specifications. After necessary adjustments and electrical connections have been made, put the system in operation and observe at least three complete operating cycles before leaving the installation.

Troubleshooting

If the control system does not function properly, verify that the proper operation is selected on each module (for example, heating or cooling) and perform the following procedures to determine the cause of the problem:

1. Check for proper voltage applied to the A350 Control.
   a. Connect a digital voltmeter (DVM) between the 24V (+) and COM (-) terminals located on the A350's terminal block.
      - If an external transformer is used, select AC volts on the DVM and verify that the voltage is between 20 and 30 VAC.
      - If a Y350R Power Module is used, select DC volts on the DVM and verify that the voltage is between 16 and 38 VDC.
   b. If the DVM reading is within the indicated voltage range, proceed to Step 2.
   c. If the DVM reading is **not** within the indicated voltage range, you may need to correct the wiring, replace the Y350R, or replace the external transformer.
2. Check sensor for proper resistance at a given temperature. (The resistance across the sensor changes with the temperature of the sensor.)
   a. Disconnect power from the A350 control.
   b. Disconnect the sensor from the control and measure the resistance across sensor leads.
   c. When measuring the sensor's resistance, use an accurate thermometer to measure the temperature at the sensor.
   d. Refer to Figure 7 to determine the optimal resistance for the measured temperature.
   e. If the measured resistance varies substantially from the optimal resistance for that temperature, the sensor or wiring must be replaced.
   f. If the sensor's resistance conforms to the chart in Figure 7, reconnect the sensor to the control.
   g. Reconnect power to the control.

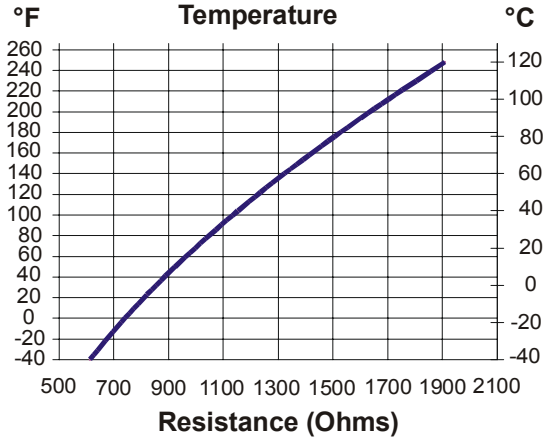

Figure 7: Temperature vs. Resistance Chart for the A99B Series Sensor

Note: The sensor reading indicated by the D350 may differ from thermometer readings due to sensor tolerances, time constants, thermometer accuracy, and other factors.

3. Check the S350C for proper operation.

   a. Remove the cover from the S350C and adjust its setpoint potentiometer to below the sensor temperature (T_S) determined in Step 2.

   b. Increase the S350C's setpoint by slowly adjusting the setpoint potentiometer until the control relay and LED turn On and Off.

   c. If the relay does **not** perform as indicated in Table 2, adjust the differential potentiometer to minimum and try again.

   d. If the relay still does **not** turn On and Off, replace the defective S350C.

Note: Though unlikely, it is possible that a defect in one stage module could cause defective symptoms in all modules. To verify, plug each stage into the control individually and check its performance as outlined in Steps 3a and 3b.

Table 2: S350C Relay Troubleshooting

Action	LED	NO Relay Status	S350C Setpoint Dial Setting
Heating	ON	Closed	(T_S)* = Sp - Diff
Heating	OFF	Open	(T_S) = Sp
Cooling	ON	Closed	(T_S) = Sp + Diff
Cooling	OFF	Open	(T_S) = Sp

* (Ts) is sensed temperature.

Repairs and Replacement

Do not make field repairs or perform calibration. Temperature sensors and replacement controls are available through local Johnson Controls representatives.

Ordering Information

Table 3: Ordering Information

Product Code Number	Description
S350CC-1C	Temperature Slave Stage Module

Specifications

Product	S350C Temperature Slave Stage Module		
Supply Voltage	5 VDC reference and 24 V power supply provided by the A350		
Ambient Temperatures	Operating: -30 to 150°F (-34 to 66°C) Shipping: -40 to 185°F (-40 to 85°C)		
Humidity	0 to 95% RH non-condensing; maximum dew point: 85°F (29°C)		
Setpoint Adjustment Range	-30 to 130°F (-35 to 55°C)		
Differential Adjustment Range	1 to 30F° (0.5 to 17C°)		
SPDT Relay Output		**120V**	**208 to 240V**
	Horsepower:	1/2	1/2
	Full Load:	9.8A	4.9A
	Locked Rotor:	58.8A	29.4A
	Non-Inductive:	10A at 24 to 240 VAC	
	Pilot Duty:	125 VA at 24 to 240 VAC	
Output Indication	LED		
Mode of Operation	Cooling or heating mode is jumper selectable.		
Material	Case, Cover: NEMA 1 high-impact thermoplastic		
Agency Listing	UL Listed, CCN XAPX , File E27734 UL Listed for Canada, CCN XAPX7, File E27734		

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Johnson Controls Application Engineering at (414) 274-5535. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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