

INSTALLATION BULLETIN

MS2 Two Stage Electronic Temperature Control

IMPORTANT: All MS2 controls are designed for use **only** as operating controls. Where an operating control failure would result in personal injury 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.

Refer to the *MS Series Multi-Stage Electronic Temperature Controls Product Bulletin, LIT-125198*, for necessary information on operation and performance specifications for this product.

Mounting

The MS2 control is not position-sensitive but should be mounted for convenient wiring and adjustment.

To mount the DIN Rail Mount version, install the DIN rail where appropriate. Snap the control onto the rail in position.

To mount the Panel Mount version, ensure that there is sufficient space behind the panel. At least 2-3/4 inches (70 mm) are needed. Make a cutout 1-3/16 by 2-13/16 inches (29 by 71 mm). Remove retaining clip from control. Insert the control into the hole. Install retaining clip and adjust for tightness.

Wiring

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

Follow these wiring guidelines:

- All wiring must conform to the National Electric Code and local regulations.
- Make all wiring connections using adequate gauge copper conductors only. Connectors are rated for 14-22 AWG wiring.

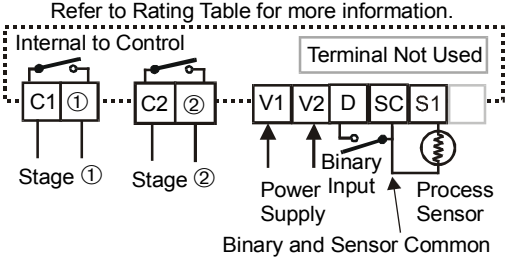


Figure 1: MS2 Panel Mount Wiring

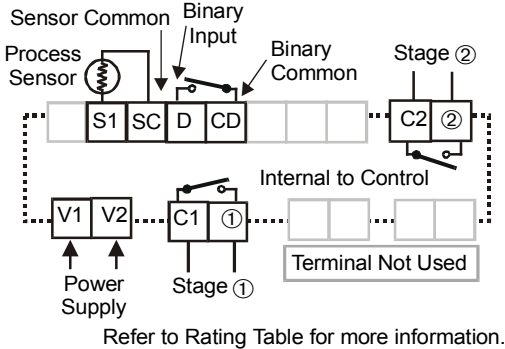


Figure 2: MS2 DIN Rail Mount Wiring

Use this table, with function So, to compensate for long sensor wire.

Table 1: Sensor Wire Size and Length

18 AWG	20 AWG	22 AWG	Offset
300-599 ft 91-183 m	190-374 ft 58-114 m	120 -239 ft 36-73 m	1F° 1C°
600-899 ft 183-274 m	375-564 ft 114-172 m	240-349 ft 73-107 m	2F° 2C°
900+ ft 274+ m	565+ ft 172+ m	350+ ft 107+ m	3F° 3C°

Table 2: Rating Table

Rating Category	120 VAC	240 VAC	24 VDC
Horsepower	1/4	1/2	-
Full Load Amperes	5.8	4.9	-
Locked Rotor Amperes	34.8	29.4	-
Inductive (non-motor) Amperes	8	8	8
Pilot Duty VA	275	450	-

Relay outputs must not exceed 20 amperes total connected load. Power supply is 24 VAC.

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

Canadian DOC Compliance

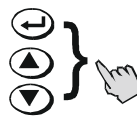
This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Display

Press Up and Down buttons to scroll through process temperature and binary input status (On or OF). After 15 seconds of inactivity, the display shows the process temperature.

Setting Up the Stage Control

To lock/unlock the unit for programming



Press the Enter, Up, and Down buttons simultaneously and hold until "--" is displayed. Hold for about 10 seconds until the current temperature is displayed. This toggles the keypad between locked and unlocked.

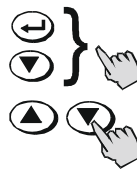
To run the self test procedure

IMPORTANT: Disconnect loads before beginning self-test procedure. Cycle power to resume normal operation.



Press the Up and Down buttons in sequence, and hold for 5 seconds.

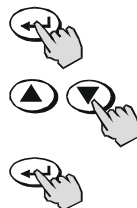
To select the mode of operation



1. Press and hold the Enter and Down buttons simultaneously for approximately 7 seconds.
2. Press the Up or Down button until the desired setting is shown.
 - 2d = Direct (cool)
 - 2r = Reverse (heat)
 - 2b = Deadband
 - 2i = Independent Setpoint
3. Press the Enter button to save the new mode of operation.



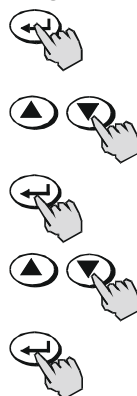
To change the setpoint (modes b, d, and r only)



1. Hold the Enter button down for 3 seconds. The display will change to show the setpoint.
2. Press the Up or Down button until you reach the new setpoint.
3. Press the Enter button to save the new setpoint.

Note: If you do not press the Enter button after selecting the new setpoint, it is not saved. The control reverts to old setpoint.

To program other settings (modes b, d, r only) or to program setpoints and settings (mode i only)



1. Hold the Enter button down for about 10 seconds. The display will change to HY. (The display shows S1 if in Mode i.)
2. Press the Up or Down button until the desired setting is shown.
3. Press the Enter button. The setting's current value is displayed.
4. Press the Up or Down button until the desired value is shown.
5. Press the Enter button to save the new value. After 10 seconds of inactivity, the display will return to its normal function.

Note: If you do not press the Enter button after selecting the new value, it is not saved. The control reverts to the old value.

Table 3: Functions and Settings

Mode	2d = Direct 2r = Reverse 2b = Deadband 2i = Independent Setpoint		d
Setting	Description	Setting Range	Default
SI Setpoint	Modes d, r, b: relay cut-off point Mode i: heating independent setpoint	-40 to 99°F (-40 to 70°C)	—
H1 Differential (Hysteresis)	Temperature difference relative to setpoint or offset at which the load is switched On or Off	1 to 9F° (1 to 9C°)	5
S2 Setpoint 2 (Offset)	Modes d, r: difference between setpoint and Stage 2 Mode b: deadband (centered on setpoint) Mode I: cooling independent setpoint	d, r: 1 to 40F° (1 to 40C°) b: 2 to 40F° (2 to 40C°) I: LL to HL	5
H2 Differential (Hysteresis) 2	See Differential (hysteresis)	1 to 9F° (1 to 9C°)	5
LL Low Setpoint Stop	Lower limit of end-user setpoint adjustment	-40F° (-40C°) to HL	32
HL High Setpoint Stop	Upper limit of end-user setpoint adjustment	LL to 99°F (70°C)	90
Cc Anti-short Cycle Timer, Cool	Time delay between equipment On cycles for cooling stages	0 to 9 minutes	2
CH Anti-short Cycle Timer, Heat	Time delay between equipment On cycles for heating stages	0 to 9 minutes	0
rt Soft Start	Rate at which process temperature approaches setpoint	0 to 99 minutes/degrees	10
AH High Temperature Alarm	High temperature alarm setpoint relative to main setpoint	0 to 50F° (0 to 50C°) above setpoint	15
AL Low Temperature Alarm	Low temperature alarm setpoint relative to main setpoint	-50 to 0F° (-50 to 0C°) below setpoint	-15
Ad Alarm Differential	Temperature difference relative to high and low alarms at which alarm output is switched Off	1 to 9F° (1 to 9C°)	5
At Alarm Time Delay	Delay between alarm detection and activation	0 to 99 minutes	15
So Sensor Offset	Compensates for long sensor leads or sensor location	-20 to +20F° (-20 to +20C°)	0
Un Units Used	Temperature units used	0 = °C 1 = °F	1
PU Display Refresh Rate	Time delay between display refreshes	1 to 99 seconds	1
IF Binary Input Function	Configuration for normally closed binary input	0 = No binary input 1 = Shutoff/alarm signaling 2 = Setback 3 = Remote shutoff	0
Sb Setback	Value of setpoint shift when binary input is open and IF=2	0 to 20F° (0 to 20C°)	10
Id Binary Input Time Delay	Time between binary input detection and enabling of IF	0 to 99 minutes	0
iS Interstage Time Delay	Minimum amount of time between two successive stages	3 to 90 seconds	3

Repair and Replacement

Field repair must not be made. In case of defective or improperly functioning control, contact your nearest authorized Johnson Controls/PENN distributor.

When requesting a replacement, reference the model number found on the data plate of the control.

Fault/Alarm Codes

Table 4: Status Codes (steady on display)

Status Code	Indicates
On	Binary Input is closed.
OF	Binary Input is open.

Table 5: Fault/Alarm Codes

Error Code (Flashing on Display)	System Status
EE Program failure; control must be replaced.	Alarm message displays, other outputs off.
FI Indicates an open or shorted temperature sensor.	Alarm message displays. Correct problem and cycle power to reset.
AI Binary input (IF) Option 1 selected and binary input open for longer than time delay (id).	Control output is switched off; alarm message displays. Correct condition to reset.
DF Binary input (IF) Option 3 is selected and binary input open.	Control output is switched off. Close binary input to reset.
HI Temperature has reached or exceeded (setpoint + AH).	Alarm message displays. Correct condition to reset.
LO Temperature has reached or fallen below (setpoint - AL).	Alarm message displays. Correct condition to reset.

Ordering Information

Table 6: Specifications

Power Requirements	3.7 VA @ 24 VAC, 50/60 Hz, Class 2 (20-30 VAC)
Ambient Conditions	Operating: +14 to +140°F (-10 to +60°C); 0 to 95% RH (non-condensing) Storage: -22 to +176°F (-30 to +80°C); 0 to 95% RH (non-condensing)
Accuracy	+1.8 F° (+1C°)
Agency Listings	UL Recognized: File E194024, CCN XAPX2 Canadian UL Recognized: File E194024, CCN XAPX8 FCC Compliant per Class A Digital Device, Part 15 Canadian DOC Compliant per Class A, Radio Interference Regulations

Table 7: Ordering Information

Item Code	Description
MS2DR24T-11C	MS2 DIN Rail Mount Control; A99BB-200C sensor included
MS2PM24T-11C	MS2 Panel Mount Control; A99BB-200C sensor included
A99BB-200C	A99B Temperature Sensor; Cable length 6-1/2 ft (2 m)

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



Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Printed in U.S.A.
www.johnsoncontrols.com