JOHNSON
CONTROLS
PENN

MR4PMUHV Electronic
Temperature/Defrost Control with Relay Pack

The MR series temperature controls are designed for hot gas or electric heat defrost in both refrigeration and freezer units. Either time or temperature based defrost termination may be selected.

The MR series incorporates control functions such as compressor control, defrost management, fan management, and alarm management. One convenient package consolidates the functions of a thermostat, a digital temperature readout device, a timer, and a defrost termination switch. This microprocessor based control offers innovative features and state-of-the-art technology.

Figure 1: MR4PMUHV-12 Electronic Temperature/Defrost Control with Relay Pack

Features and Benefits

❏ **Single Package**	Provides the functionality of multiple components at a cost effective price
❏ **Mounting Flexibility**	Allows control and relay pack to be mounted together or separately, facilitating multiple configurations
❏ **Easily Readable Temperature Display**	Displays both evaporator and process temperature quickly; helps troubleshoot system
❏ **Accurate, Interchangeable Temperature Sensor**	Provides accurate control performance with up to 300 feet of wiring (An offset is provided for longer wiring.)
❏ **Heavy Duty Relays**	Allows direct control of compressors, fans heaters, and alarms; reduces installation time
❏ **Alarm Management Functions**	Provides both local alarm codes and a relay closure that can be used to trigger a remote alarm or a dial-out modem

*O*verview

WARNING: All MR4PMUHV 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.

These relay pack mounted controls provide direct control of compressors up to 2 hp, electric heater loads of up to 20 amperes, and evaporator fan loads of up to 3/4 hp. The need for separate relays is eliminated in these applications. In addition, the MR4PMUHV controls combine the functionality of an electromechanical thermostat, mechanical clock, defrost termination device, and temperature readout device with the accuracy of electronic technology.

Compressor Control Functions

Compressor Control: All MR4PMUHV controls feature temperature based, On/Off control of a compressor.

Anti-Short Cycle Delay: To avoid situations where the compressor starts, stops, and restarts in a short period of time, all models have a built-in anti-short cycle delay. This feature determines the minimum time between two subsequent On cycles of the compressor.

Deep Freeze Cycle

From the front panel, the compressor output can be forced On for a preset time to manually initiate a freeze cycle. This feature is handy when loading a cold room or a display cabinet.

Defrost Functions

Defrost Termination may be based on evaporator temperature or time.

Defrost Mode: The MR4PMUHV control can perform either hot gas or electrical defrost. During a hot gas defrost cycle, both the compressor and defrost terminals are energized. Hot gas is produced and delivered to the evaporator coil via a solenoid valve controlled by the defrost relay. During an electrical defrost cycle, the compressor terminals are de-energized and defrost terminals are energized to turn on the electric defrost heater.

Manual Defrost: Initiating the manual defrost sequence interrupts the current control state and begins an immediate defrost cycle.

Fan Control Functions

The MR4PMUHV control can manage an evaporator fan in one of two ways. The fan can either run continuously or run only when the compressor is on, and can be set to follow either time or evaporator temperature based startup after defrost. Because the MR4PMUHV control uses an SPDT relay for fan control, a reversible fan motor can also be wired to run in reverse to bring warm air over the evaporator coils in a timed defrost application.

Alarm Management Functions

High and Low Temperature Alarm: The high and low temperature alarms are set relative to the setpoint. If the temperature exceeds the alarm values, an alarm output relay is energized, and the display flashes either Hi or Lo. High and low temperature alarms are disabled during defrost and for 20 minutes after the defrost cycle. Alarms are also disabled for 20 minutes after startup.

Alarm Time Delay: A time delay can be configured in order to keep short-duration events from triggering the alarm (i.e., door open).

Alarm Differential: An alarm differential can be set to keep the alarm from cycling rapidly on and off.

Selectable Sensor Failure Mode: Temperature sensor failure is indicated by an alarm. The controller can be programmed for one of three sensor failure modes: (1) the system shuts down, (2) the system runs constantly, (3) the controller automatically starts and stops the compressor based on the average running times of the last four cycles.

Additional Features

Sensor Input: This series of controllers uses the Johnson Controls A99 temperature sensor. The controller allows you to program an offset of the measured temperature for temperature compensation or cable extension longer than 300 ft.

Adjustable Setpoint Stops: The setpoint stops restrict the amount of change that the end user can make to the setpoint. The end user cannot set a setpoint value exceeding these limits.

Keyboard Locking: A sequence of key strokes allows you to disable/enable modification of the setpoint and other parameters. This prevents accidental or unauthorized parameter modifications.

Self-test Procedure: This feature helps check controller operation. After a key stroke sequence, the control will cycle all outputs and test all LEDs.

Display Updating Time: The display update setting provides an adjustable refresh rate for the temperature readout. This feature is useful to avoid displaying minor intermittent changes of temperature.

Units of Measurement: Temperature units can be selected as either degrees Fahrenheit or degrees Celsius.

Display

The display has 2 LED digits and a minus (-) indication. It displays a temperature range from -40 to 99°F (-40 to 70°C) in increments of 1F° or C°.
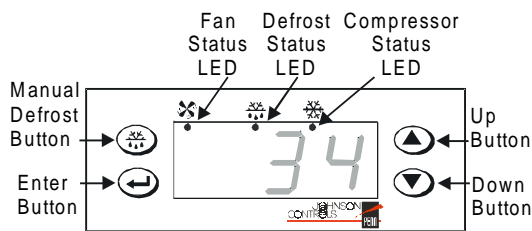

Figure 2: Front Panel and Display

During normal operation, the display shows the process temperature. By pressing the Up or Down buttons, you can view the temperature, evaporator sensor temperature and the digital input status. By pressing the Enter button, you can also view the setpoint. After 15 seconds of inactivity, the display will return to the process temperature display.

*F*CC 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.

*C*anadian 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.
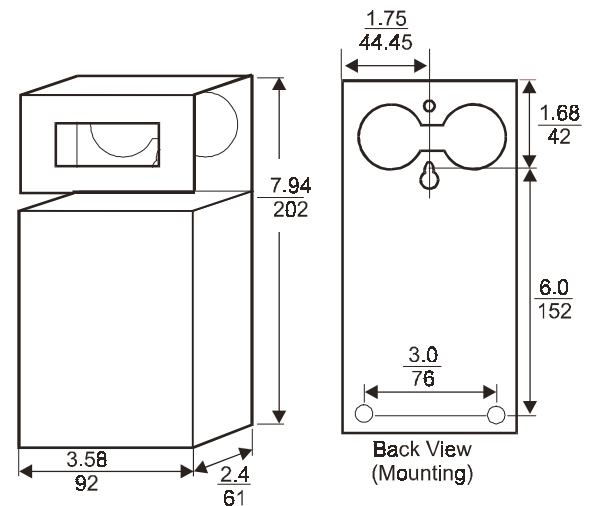
*D*imensions
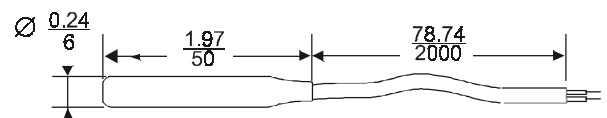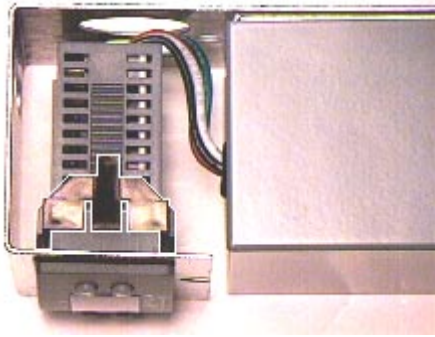

Figure 3: Relay Pack Dimensions, in. (mm)

Figure 4: A99B-9108 Sensor, in. (mm)

*S*eparating the Control and Relay Pack

The control may be mounted separately from the relay pack if desired. Follow the steps below to separate the control and the relay pack.

1. Locate the mounting clip that holds the control to the relay pack, as shown below.
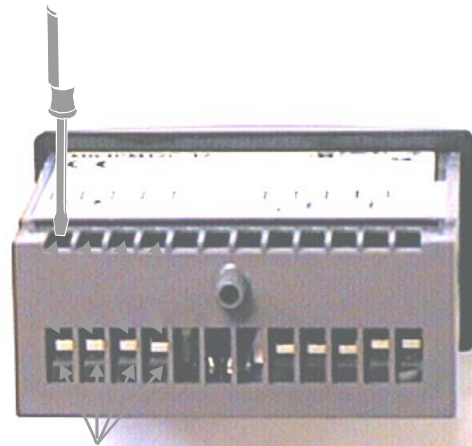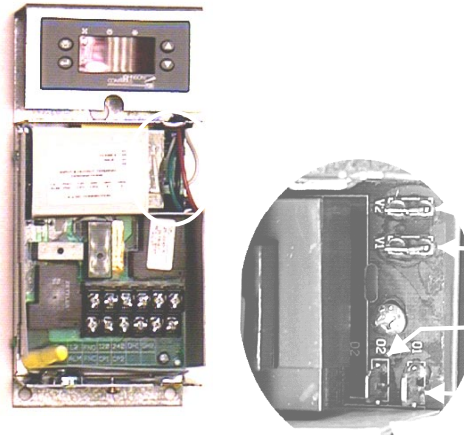

2. Squeeze the forward portion of the mounting clip together and slide the mounting clip back, as shown below.

3. Pull the control out of the mounting bracket on the relay pack, as shown below.

4. When needed, disconnect and reconnect Terminals V1, V2, O1, and O2 in the relay pack to the corresponding terminals on the control.

*W*iring the A99 Sensors and Digital Input

Wire the sensors and digital input (if used), as illustrated below. When wiring is complete, re-mount the control to the relay pack if desired.
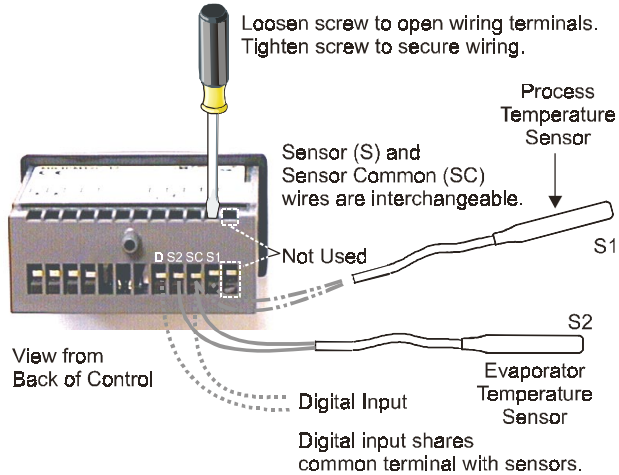

Figure 5: Wiring the A99 Sensor to MR4PMUHV

*R*elay Pack Terminal Block

Figure 6: Relay Pack Terminal Block

*W*iring the Relay Pack Control

> ⚠ WARNING: **Shock Hazard.** To avoid possible electrical shock or damage to equipment, disconnect power supply before wiring any connections.

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.

- Recommended wire gauge is 14 AWG for motor loads up to 12 FLA and non-inductive loads up to 15 A.

- Recommended wire gauge is 12 AWG with an insulation rating of 75°F for motor loads up to 16 FLA and non-inductive loads up to 20 A.
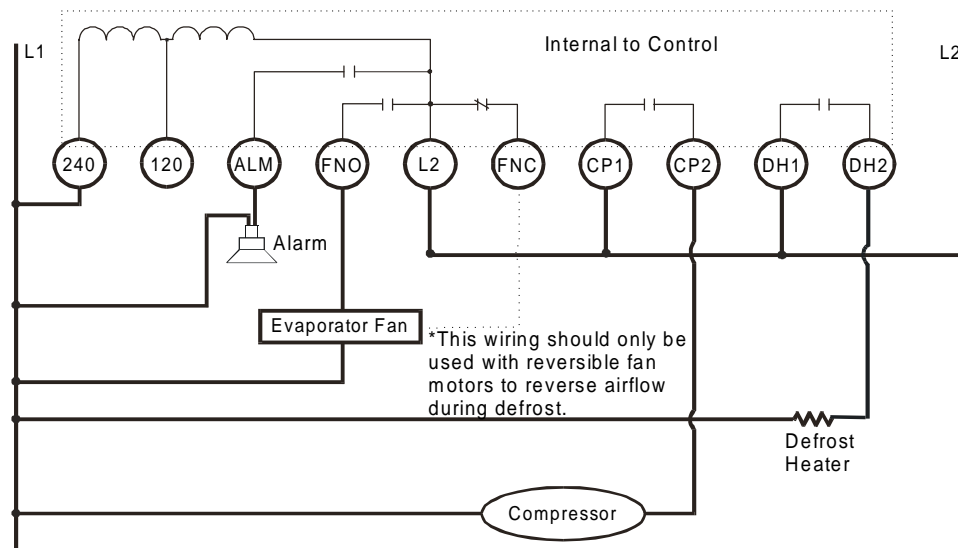
- Maximum recommended length is 50 feet.

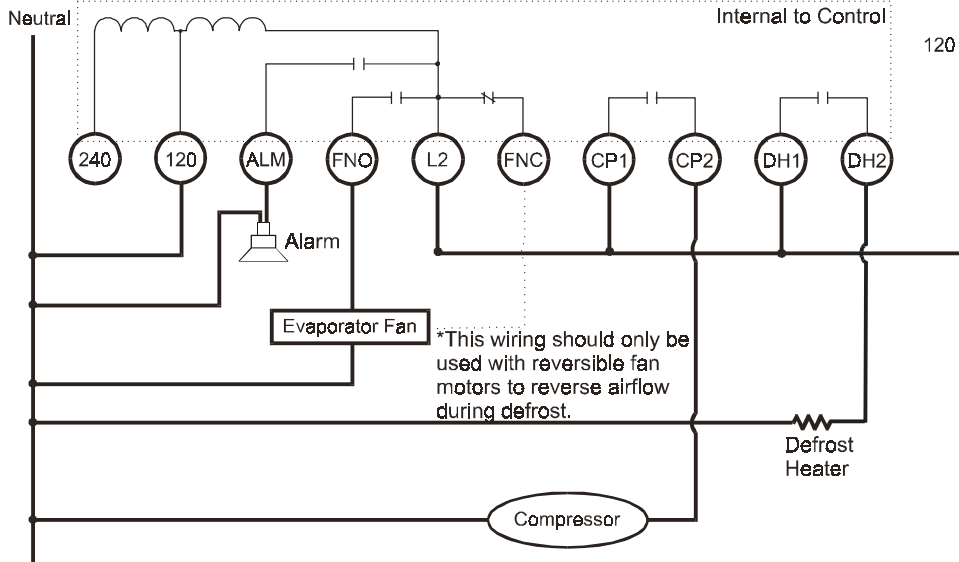**Figure 7: Typical 240 VAC Relay Pack Wiring Connections**

Figure 8: Typical 120 VAC Relay Pack Wiring Connections

Alarm and Fault Codes

These alarm and fault codes will flash on the display when the control detects the following faults:

Table 1: Error Codes and Status

| Error Code	System Status
F1 Indicates an open or shorted temperature sensor	Alarm output is on. Compressor runs according to the sensor failure mode selected (parameter SF). Cycle power to reset control.
F2 Indicates an open or shorted evaporator sensor	Alarm output is on. Defrost cycle is controlled by parameters di (defrost initiation) and dd (defrost duration). Correct problem to reset control.
A1 Indicates that the digital input was open for longer than the time delay (id) and digital input (iF) Option 1 is selected	Compressor output is off. Alarm output is on. Correct problem to reset control.
A2 Digital input closed for longer than time delay (id) and digital input (iF) Option 2 is selected	Alarm output is on. Correct problem to reset control.
A3 Digital input open for longer than the time delay (id) and digital input (iF) Option 3 selected	Fan output is off. Alarm output is on. Correct problem to reset control.
HI Temperature has exceeded the high temperature alarm value (AH)	Alarm output is on. Correct problem to reset control.
LO Temperature has fallen below the low temperature alarm value (AL)	Alarm output is on. Correct problem to reset control.
EE Program failure	Alarm output is on. Other outputs are off. Replace control.

*P*rogramming the Control

To lock and unlock the unit for programming
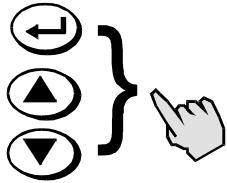
Press the Enter, Up, and Down buttons in sequence and hold them all down until "- - -" is displayed. Hold for about 10 seconds until the current temperature is displayed. This toggles the keypad between locked and unlocked.

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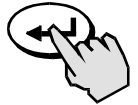
1. Hold the Enter button down for 3 seconds. The display will change to show the setpoint. Release the Enter button.
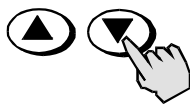
2. Press the Up or Down button until you reach the new setpoint.

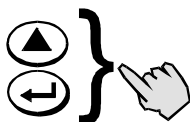3. Press the Enter button to save the new setpoint.

Note: If the Enter button is not pressed after selecting the new setpoint, the new setpoint is not saved, and the control will revert to the original setpoint.

To begin a Manual Defrost Cycle

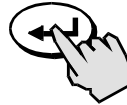Hold the Defrost button down for 3 seconds.

To begin a Deep Freeze Cycle

Press the Enter and Up buttons in sequence and hold both for 5 seconds. The compressor status LED will light.
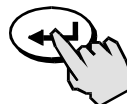
To program values other than the setpoint

A parameter settings reference page is included in Table 3 of this bulletin. Filling out the parameter settings before programming may be helpful.

1. Hold the Enter button down for about 10 seconds. The display will change to HY.
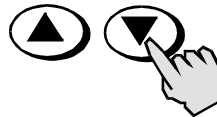
2. Press the Up or Down button until the desired parameter is displayed.

3. Press the Enter button. The parameter's current value is displayed.
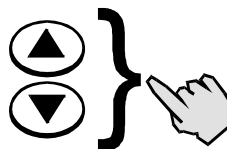
4. Press the Up or Down button until the desired value is shown.
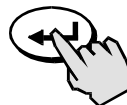
5. Press the Enter button to save the new value. After 10 seconds of inactivity, the display will return to its normal function.

Note: If the Enter button is not pressed after selecting the new value, the new value is not saved, and the control will revert to using the previous value.

To run the Self-test procedure
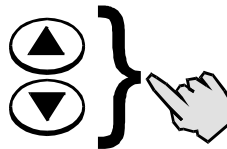
Press the Up and Down buttons in sequence, and hold for 5 seconds.

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

*P*arameter Definitions

Setpoint: This is defined as the relay cut-off.

The following parameters are described in the order that they are displayed on the control.

HY Hysteresis (Differential): This is the difference between the temperature at which the compressor output is switched Off and the temperature at which the output is switched On. This is an absolute value relative to the setpoint.

Example:

Setpoint = 34°F (4°C)
Hysteresis = 2 degrees.

The compressor is switched On when the temperature rises to 36°F (6°C), and is turned Off when the temperature falls to 34°F (4°C).

LL and HL Low and high setpoint stop: The setpoint value cannot be adjusted outside the range defined by these parameters to avoid improper setpoint setting by the user.
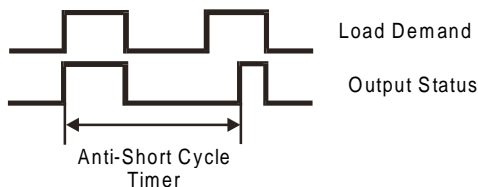
CC Anti-short cycle delay: This parameter prevents the compressor from being turned On, Off, and back On too quickly. The value set is the minimum time between two subsequent On cycles of the output.

Load Demand

Output Status

Anti-Short Cycle Timer

Co Deep freezing time: This is the amount of time that the compressor is forced On when the deep freezing cycle is initiated.

AH High temperature alarm: High temperature alarm value relative to setpoint.

Example:

If the set point is at 34°F and the alarm value is set to 5 degrees, the alarm is activated at 39°F.

AL Low temperature alarm: Low temperature alarm value relative to setpoint.

Example:

If the set point is 34°F and the alarm value is set at -3 degrees, the alarm is activated at 31°F.

Ad Alarm differential: Avoids alarm oscillation.

Example:

Setpoint = 34°F,
High temperature alarm = 6 degrees,
Alarm differential = 2 degrees.

When the temperature exceeds 34°F + 6F° = 40°F for a time greater than parameter **At**, the alarm is activated; when temperature drops below 34°F + 6F°-2F° = 38°F, the alarm is deactivated.

At Alarm time delay: Delay between the detection of a temperature alarm and the activation of the alarm. This allows the control to ignore short-term or transient alarm conditions during the time delay. The controller also ignores temperature alarms in the following cases:

- for 20 minutes after power On
- during defrost and for 20 minutes after the defrost end

dF Defrost type: Selects the type of installation and the way defrost is performed:

0 = Electrical defrost
(compressor off during defrost)

1 = Hot gas defrost
(compressor on during defrost)

dE Defrost end mode: Selects the defrost termination type:

0 = Timer based; set with parameter **dd**

Note: Evaporator fan operation will restart based on time

1 = Temperature based; set with parameter **dt**

Note: The defrost cycle always ends after the time set for parameter **dd** elapses.

dt Defrost termination temperature: Used only when parameter **dE**=1. When the evaporator temperature reaches this value, the defrost automatically ends.

di Defrost interval: This is the time between two subsequent defrost cycles.

Note: When the defrost interval (<u>di</u>) is 1 hour, the maximum defrost duration (**dd**) cannot be set at more than 40 minutes.

dd Maximum defrost duration: The defrost cycle will stop after this time, even if the defrost end temperature has not been reached. Setting **dd** to

0 disables the defrost cycle in both manual and automatic modes.

dC Dripping time: After defrost is terminated, the compressor is stopped for this length of time to allow the evaporator to drip.

dU First defrost after power-on: This parameter delays the first defrost cycle after powerup. The control will not initiate a defrost cycle for the length of time set in this parameter. It can be used to allow the system to reach operating temperature before the defrost cycle is initiated. Setting this parameter to **OF** (Off) disables the first defrost after power-on. Normally, the first defrost occurs after the **d** interval has elapsed.

dP Display during defrost: Selects what temperature is displayed during a defrost cycle:

0 = Last measured value before defrost cycle

1 = Setpoint

dr Display delay after defrost: During defrost cycles, the ambient temperature is not displayed (see parameter **dP**). The actual temperature is displayed when it reaches the setpoint value or after the time defined by this parameter.

iF Digital input function: The digital input (normally closed) can be configured according to installation requirements:

0 = The digital input is not connected

1 = If the contact is open for a time longer than that set through parameter **id**, the compressor, defrost, and fan outputs are switched Off, an alarm message (A1) is displayed, and the alarm output is switched On.

2 = Alarm function: If the contact is open for a time longer than that set through parameter **id**, an alarm message (A2) is displayed and the alarm output is switched On.

3 = Open door alarm: When the contact is open, the fan is switched Off. If the contact is open for longer than the time set through parameter **id**, an alarm message (A3) is displayed, the alarm output is switched On, and high and low temperature alarms are disabled.

id Digital input time delay: This is the time between the detection of the digital input opening and the enabling of the function selected through parameter **iF**.

FF Fan operating function:

0 = Fan runs when the compressor runs

1 = Fan is always On

Note: The fan is always switched Off during the defrost cycle.

Fd Fan start-up delay (after defrost): The fan is activated after this time even if the temperature set through parameter **Fr** has not been reached.

Fr Fan start temperature after defrost end: This is the evaporator sensor temperature at which the fan is switched On after a defrost cycle.

Note: If the start temperature is not reached, the fan is switched On after the time set in parameter **Fd**.

SF Sensor failure operation: This parameter defines how the control functions after a temperature sensor failure:

0 = Compressor remains On

1 = Compressor remains Off

2 = Automatic:

In automatic mode, the controller calculates the average time the compressor was On during the last four cycles. The controller then cycles based on the average of these cycles. If a deep freezing cycle or a defrost cycle occurred in the last four cycles, they will not be taken into account nor will the first cycle after the deep freeze or defrost.

So Temperature sensor offset: This value is added to or subtracted from the measured value to compensate for possible field measurement offset errors. To compensate for extra long copper cabling use the following table:

Table 2: Wire Size and Cable Length

Wire Size and Cable Length			Offset
18 AWG	**20 AWG**	**22AWG**	
300-599 ft	190-374 ft	120-239 ft	1F°
600-899 ft	375-564 ft	240-349 ft	2F°
900+ ft	565+ ft	350+ ft	3F°

Un Temperature units used: Determines temperature units used for parameter settings.

0 = Celsius degrees
1 = Fahrenheit degrees

PU Display refresh rate: The temperature display is refreshed at this rate. The display refresh rate does not affect control performance.

*P*arameter Settings

Table 3: Parameter Settings

Parameter	Range	Factory Setting	Application Setting
Setpoint	-67 to 99°F (-55 to 99°C)		
HY: Hysteresis (differential)	1 to 9F° (C°)	5	
LL: Low setpoint stop	-67°F (-55°C to HL)	-25	
HL: High setpoint stop	LL to 99°F (99°C)	40	
CC: Anti-short cycle delay	0 to 9 minutes	1	
Co: Deep freezing time	0 to 99 minutes	60	
AH: High temperature alarm	0 to 50F° (C°)	10	
AL: Low temperature alarm	-50 to 0F° (C°)	-10	
Ad: Alarm differential	1 to 9F° (C°)	5	
At: Alarm time delay	0 to 99 minutes	3	
dF: Defrost type	0 = electrical 1 = hot gas	0	
dE: Defrost end mode	0 = time 1 = temperature	1	
dt: Defrost termination temperature	32 to 68°F (0 to 20°C)	55	
di Defrost interval	1 to 99 hours	7	
dd: Maximum defrost duration	0 to 99 minutes	45	
dC: Dripping time	0 to 99 minutes	5	
dU: First defrost after power on	OF, 0 to 99 minutes	OF (Off)	
dP: Display during defrost	0 = last reading 1 = setpoint	0	
dr: Display delay after defrost	1 to 99 minutes	20	
iF: Digital input function	0 = none 1 = compressor off, alarm on 2 = alarm on 3 = fan off, alarm on	0	
id: Digital input time delay	0 to 99 minutes	0	
FF: Fan operating function	0 = parallel with compressor 1 = always on	0	
Fd: Fan startup delay (after defrost)	0 to 99 minutes	5	
Fr: Fan start temperature after defrost end	-22 to 41°F (-30 to 5°C)	40	
SF: Sensor failure operation	0 = compressor on 1 = compressor off 2 = based on last four cycles	2	
So: Temperature sensor offset	-20 to 20F (C°)	0	
Un: Temperature units used	0 = °C 1 = °F	1	
PU: Display refresh rate	1 to 99 seconds	1	

Ordering Information

Table 4: Order Information

Item Code	Description	Shipping weight
MR4PMUHV-12C	Relay pack defrost control with two A99 sensors	2.9 lb (1320g)
MR4PM12C-12C	Replacement control for use in relay pack only	1.6 lb (726g)
RP4MRUHV-1C	Relay pack without control	2.3 lb (1060g)
A99B-9108	Sensor, cable length: 6.6 ft (2m)	0.13 lb (60g)

Repair and Replacement

Field repair of the control is not possible. In case of a defective or improperly functioning control, please check with your nearest Johnson Controls/PENN representative. When contacting the supplier for replacement, state the model number of the control. This number can be found on the data plate.

Table 5: SPST Compressor Relay Electrical Ratings*

Motor Ratings (VAC)	24	120	208	240
Horsepower Rating		1	1.5	2
AC Full Load Ampere		16	11	12
AC Locked Rotor Ampere		96	66	72
Pilot Duty (VA)	125	750	875	1125

*Ambient Operation: As above for -40 to 44°C, derate electrical ratings 6.25% per 1C° between 45°C to 60°C.

Table 6: SPDT Fan Relay Electrical Ratings*

Motor Ratings (VAC)	24	120	208	240
Horsepower Rating		1/3	1/2	3/4
AC Full Load Ampere		7.2	5.65	6.9
AC Locked Rotor Ampere		43.2	33.9	41.4
Pilot Duty (VA)	50	325	450	600

*Ambient Operation: As above for -40 to 44°C, derate electrical ratings 6.25% per 1C° between 45°C to 60°C.

Table 7: SPST Defrost Heater Relay Electrical Ratings*

Motor Ratings (VAC)	24	120	208	240
Horsepower Rating		1	1.5	2
AC Full Load Ampere		16	11	12
AC Locked Rotor Ampere		96	66	72
Non-Inductive Load Ampere		20	20	20
Pilot Duty (VA)	125	750	825	1125

*Ambient Operation: As above for -40 to 44°C, derate electrical ratings 6.25% per 1C° between 45°C to 60°C.

Table 8: SPST Alarm Relay Electrical Ratings*

Motor Ratings (VAC)	24	120	208	240
Non-Inductive Load Ampere	5	5	5	5
Pilot Duty (VA)		125	250	325

*Ambient Operation: As above for -40 to 44°C, derate electrical ratings 6.25% per 1C° between 45°C to 60°C.

Input Power: 5VA @240, 5VA @120

Supply Level: 120 and L1: 120 VAC +10%/-15%
240 and L1: 240 VAC +10%/-15%

Operating Frequency: 60 Hz @ 120/240 VAC

Specifications

Product	MR4PMUHV-12C Defrost Control
Electrical Ratings	See *Tables 5-9.*
Frequency	60 Hz
Power Consumption	5VA @240, 5VA @120
Accuracy	± 1.8F° (± 1C°)
A99 Sensor Cable	6.6 ft (2m)
Ambient Operating Conditions	**MR4PMUHV-12C:** +14 to +111°F (-10 to +44°C); derate 6.25% per 1°C from 45°C to 60°C; 0 to 95 % RH (non-condensing)
	MR4PM12C-12C: +14 to +140°F (-10 to +60°C); 0 to 95 % RH (non-condensing)
	RP4MRUHV-1C: -40 to +111°F (-40 to +44°C); derate 6.25% per 1°C from 45°C to 60°C; 0 to 95 % RH (non-condensing)
Ambient Storage Conditions	**MR4PMUHV-12C:** -22 to +176°F (-30 to +80°C) 0 to 95 % RH (non-condensing)
	MR4PM12C-12C: -22 to +176°F (-30 to +80°C) 0 to 95 % RH (non-condensing)
	RP4MRUHV-1C -40 to +185°F (-40 to +85°C) 0 to 95 % RH (non-condensing)
Dimensions (H x W x D)	7.94 x 3.6 x 2.4 in. (202 x 92 x 61 mm)
Agency Listings	UL Listed (File SA516, UL Guide SDFY; cUL Guide SDFY7)
Shipping Weight	2.9 lb (1320g)

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