JOHNSON CONTROLS
PENN

PRODUCT BULLETIN

MR10 Electronic Controls
for compressor and defrost management

The MR10 range of controllers has been specifically designed for 'static' or 'ventilated' refrigeration units working at positive or negative temperatures. It incorporates all the features needed by modern units such as compressor and evaporator fan full management, 'off-cycle' or 'active' defrost control.

Particular emphasis has been given to the cost, the MR10 offers the basic features for a complete solution maintaining the cost at a very competitive level.

Its style has been particularly studied in order to better suit your machine design.

**MR14 controller
with defrost and fan management**

Features and Benefits	
❑ **Attractive Panel mount enclosure**	Easy and quick installation
❑ **Up to 4 relays in a single package**	Reduced space
❑ **Up to 16A thermostat output**	Allows direct control of compressor without the need for an additional contactor.
❑ **230Volt power supply models available**	Reduced installation time
❑ **Accurate and interchangeable IP 68 sensor**	Accurate control performance No recalibration needed
❑ **Wide range of sensors with various enclosures available**	Possibility to match a wide variety of temperature sensing needs
❑ **SMD technology**	Higher quality and reliable components
❑ **Keyboard lock**	Avoids accidental tampering by personnel

# General feature

Display

The display has three 7-segment LEDs to display temperatures from -40°C to +70°C (-40 to 158°F). See Individual LEDs Status table here below.

Sensor input

This range of controllers uses Johnson Controls A99 temperature sensor. Its accuracy is within 0.5°C between -15 and 75°C. Its tolerance increases at temperatures outside this range, as shown below.
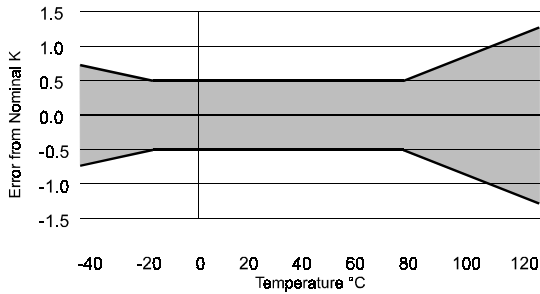
Its gas tight packaging makes it the best sensor for refrigeration applications. *For details please refer to A99 documentation.* An offset of the measured temperature can be configured for temperature compensation or cable extension.

Adjustable setpoint limits

The setpoint range can be limited in order to avoid "too high" or "too low" setpoint setting of the equipment. The final user cannot set a setpoint value exceeding these limits.

Anti short cycle protection

In order to protect the compressor against short cycling all models have a built-in anti short cycle protection. This feature determines the minimum time that must elapse between two start-ups of a compressor.

Keyboard lock

A sequence of keystrokes allows you to disable/enable modification of the internal parameters. This prevents unauthorised personnel from making parameter modifications.

Self-testing procedure

This feature helps you to check the installation and configuration of the controller once installed. After the keystroke sequence (▼) + (▲), it will cycle all outputs and flash all LED's.

Deep freezing

From the front panel, by pressing simultaneously the (▶) + (▲) keys it's possible to force the compressor output ON for a pre-set time in order to start a freezing cycle. This feature is very handy when a loading operation of a cold room or a display cabinet is performed and there is the need to bring down the temperature very quickly.

Alarm management

All devices include a high and low temperature limit alarm. This alarm is related to the main setpoint of the thermostat and displays "Hi" or "Lo" in case of exceeding temperature limits. A delay can be configured in order to prevent non-significant events from triggering the alarm (i.e. door open). The differential of the alarm is also adjustable. On models with defrost management, this alarm is disabled during defrost and for a period after defrost cycle.

Events such as a disconnected or short-circuited sensor will be detected, signaled and will results in a selectable status of the output relay(s). The output cannot only be forced permanently ON or permanently OFF, but it can also be switched ON and OFF alternately. This new and innovative function will control the output of the compressor according to the average of the last 10 cycles, allowing both energy savings and goods preservation.

Units
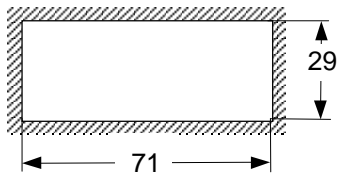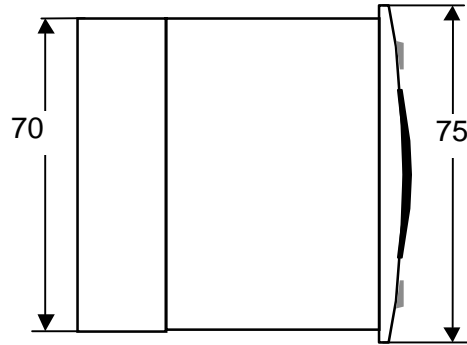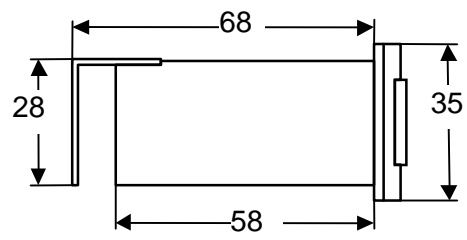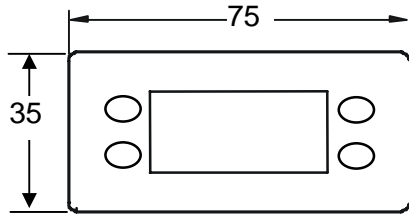
Units can be selected from degree Celsius or Fahrenheit.

Output relay rating

Some models feature a 16A thermostat output which allows direct control of compressor without the need for an additional contactor.

LEDs Status table

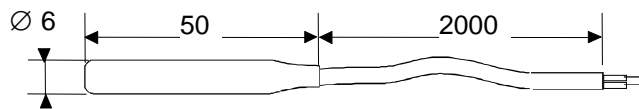| LED	Status	Signification
❄	ON	compressor ON
	Blinking	deep-freezing cycle active
❄	ON	defrost cycle active
✿	ON	Fan ON

Dimensions (in mm)

Panel cut-out

A99BB-200C Temperature sensor

Configuration

Set point   **Parameters**   **System check**

Keyboard Lock / Unlock   **Deep freezing**
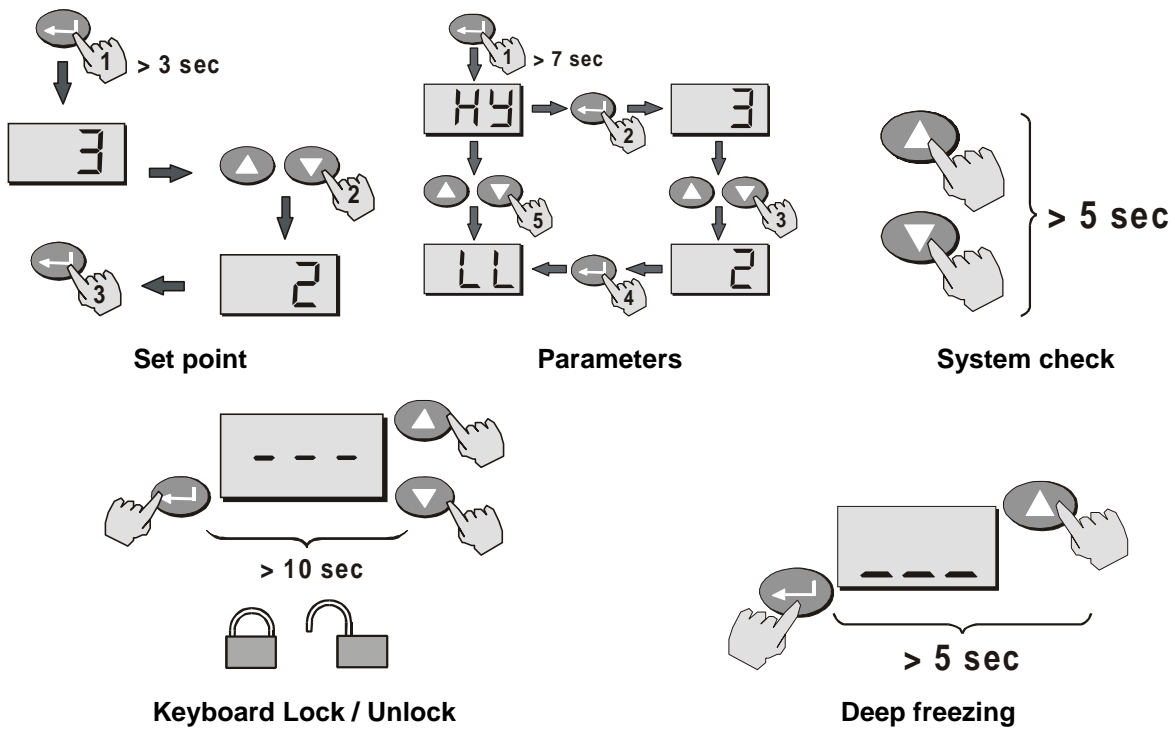
Wiring Instruction

> ⚠️ **WARNING**
>
> When wiring and servicing make sure that:
>
> - the electric supply to the actuator is switched off to avoid possible damage to the equipment, personal injury or shock.
> - you do not touch or attempt to connect or disconnect wires when electric power is on.

Note

These controls are intended to control equipment under normal operating conditions. Where failure or malfunction of the control could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory systems) intended to warn of or protect against failure or malfunction of the control must be incorporated into and maintained as part of the control system.

Compressor control - MR11

This control is specifically designed for the control of refrigeration units operating at positive temperatures.

Description

These controllers are equipped with an SPDT 8(3)A relay for the compressor control.
Two models are available, either with 12VAC/dc or 230Vac power supply.

Note: A detailed list of available parameters and their description can be found at the end of this documentation.
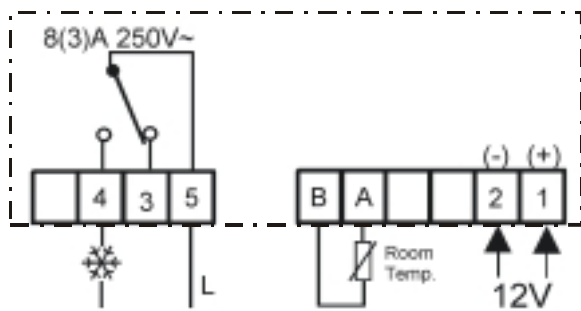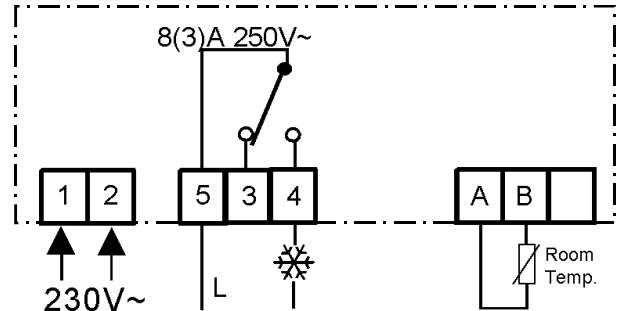
Wiring a)

Wiring b)

Selection table:

Item code	Enclosure	Power supply	Shipping weight	Wiring diagram
MR11PM12R-1C	Panel 75x35	12 Vac/dc 50/60 Hz	230 g	a)
MR11PM230-1C	Panel 75x35	230 Vac 50/60 Hz	300 g	b)

Note: Temperature sensor included in the package

Thermostat with "off cycle" defrost control - MR12

This control is specifically designed for the controls of static defrost refrigeration applications operating at positive temperatures.

Defrost functions

The defrost is initiated and terminated by a timer. The user sets the interval between successive cycles and its duration.
During the defrost cycle, the display can show \either the last measure before defrost or the setpoint. You can also delay the normal display function after a defrost cycle ends.
Manual defrost is possible by pressing the defrost key on the keypad.

Digital input functions

All defrost controllers are equipped with a digital input performing the following functions:

1. General Alarm

2. Delayed Alarm

3. Door Switch

Note: A detailed list of available parameters and their description can be found at the end of this documentation.

Wiring a)

Wiring b)
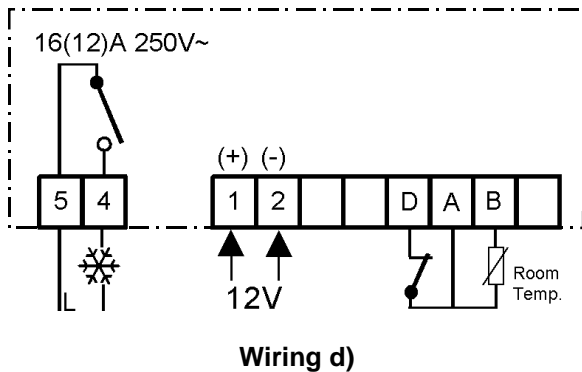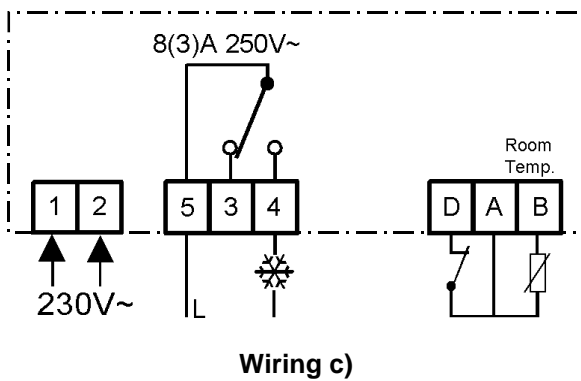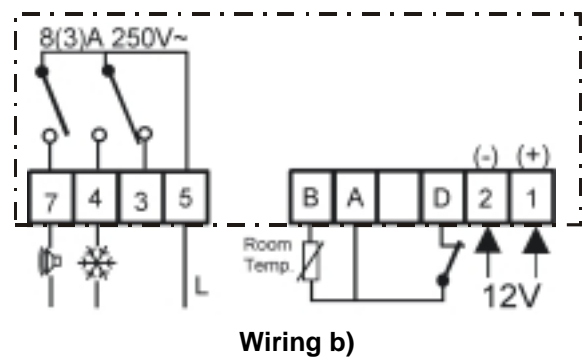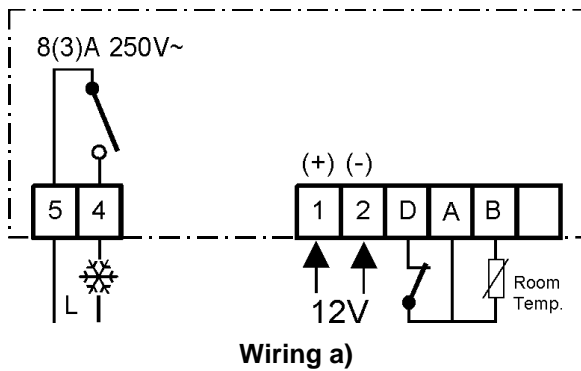
Wiring c)

Wiring d)

Selection table:

Item code	Enclosure	Power supply	Shipping weight	Wiring diagram
MR12PM12R-1C	Panel 75x35	12 Vac/dc 50/60 Hz	240 g	a)
MR12PM12R-A1C	Panel 75x35	12 Vac/dc 50/60 Hz	240 g	b)
MR12PM230-Z1C	Panel 75 x 35	230 Vac 50/60 Hz	240 g	c)
MR12PM12H-1C	Panel 75 x 35	12 Vac/dc 50/60 Hz	260 g	d)

Note: Temperature sensor included in the package

Thermostat with active defrost management - MR13

This control is specifically designed for the control of static units working at medium, low temperatures, requiring active defrost.

This control is equipped with two sensors, one for the control of the refrigeration unit, the other sensor manages the evaporator temperature.

Defrost functions

The defrost cycle is initiated by a timer and terminated either by temperature or time, whichever is first fulfilled.
The defrost function includes the following parameters:

*   Types of defrost (Hot gas or electrical heating).
*   Interval time to adjust defrost frequency.
*   Defrost termination: time or temperature.
*   Defrost end temperature.
*   Defrost maximum duration time.

You can stop the compressor for an additional configurable period called dripping time. This will allow the evaporator to dry prior to resuming normal operation.
In case of evaporator sensor failure, the defrost cycle will be terminated by the maximum defrost duration.
During defrost the display can be configured to show the last measurement before defrost or the setpoint.

Multifunctional digital input

The digital input (normally closed) can be configured according to the unit requirements. The functions available are:

1. General Alarm

2. Delayed Alarm

3. Door Switch

Note: A detailed list of available parameters and their description can be found at the end of this documentation
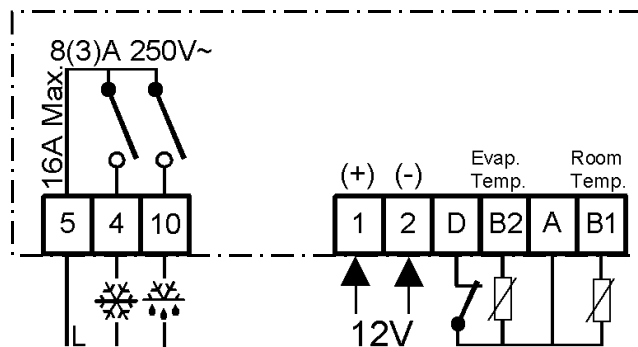
Wiring a)

Selection table:

Item code	Enclosure	Power supply	Shipping weight	Wiring diagram
MR13PM12R-2C	Panel 75x35	12 V ac/dc 50/60 Hz	330 g	a)

Note: **Two Temperature sensors** are included in the package

Thermostat with defrost and fan management - MR14

This control is specifically designed for the control of ventilated refrigeration applications requiring active defrost such as hot gas or electrical. This is also suitable for a small plant.

This control is equipped with two sensors, one for the control of the refrigeration unit, the other sensor manages the evaporator temperature.

Defrost functions

The defrost cycle is initiated by a timer and terminated either by temperature or time, whichever is first fulfilled.
The defrost function includes the following parameters:

- Types of defrost (Hot gas or electrical heating).
- Interval time to adjust defrost frequency.
- Defrost termination: time or temperature.
- Defrost end temperature.
- Defrost maximum duration time.

You can stop the compressor for an additional configurable period called dripping time. This will allow the evaporator to dry prior to resuming normal operation.
In case of evaporator sensor failure, the defrost cycle will be terminated by the maximum defrost duration.
During defrost the display can be configured to show the last measurement before defrost or the setpoint.

Fan management functions

With the MR4 models you can choose whether the fan is to be run in parallel with the compressor or whether it should remain constantly ON. In any case the fan is switched OFF during defrost. After defrost, the fan can resume its work after a preset time or after the evaporator temperature has dropped below an adjustable temperature.

Digital input functions

All defrost controllers are equipped with an additional digital input which can be configured to perform the following functions:

1. General Alarm

2. Delayed Alarm

3. Door Switch

Note: A detailed list of available parameters and their description can be found at the end of this documentation.
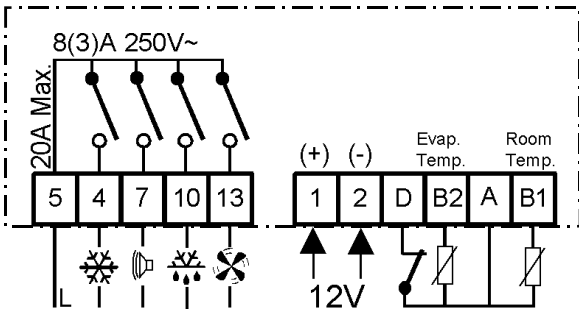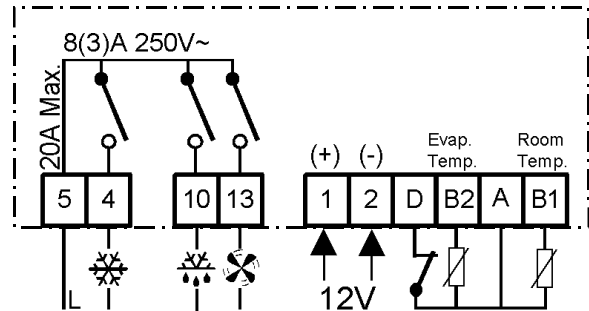
Wiring a)

Wiring b)

Selection table :

Item code	Enclosure	Power supply	Shipping weight	Wiring diagram
MR14PM12R-A2C	Panel 75x35	12 V ac/dc 50/60 Hz	330 g	a)
MR14PM12R-2C	Panel 75x35	12 V ac/dc 50/60 Hz	330 g	b)

Note: Two temperature sensors are included in the package

Description of each parameter

Setpoint:

is defined as the relay cut OFF.

Hy Hysteresis

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, related to the setpoint.
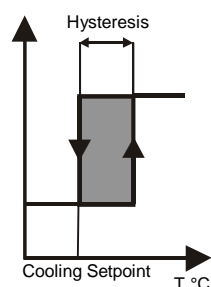

Example:

Cooling Setpoint = 4°C.
Differential = 2 K.
The compressor is switched ON when the temperature goes over 6°C, and is turned OFF when the temperature decreases to 4°C.

LL/HL Lower & Higher setpoint limit

The setpoint value cannot be adjusted outside the limits defined by these parameters, to avoid improper setpoint setting by the user.

CC Anti short cycle protection

This parameter prevents the compressor from being turned ON / OFF too often. The value that you set is the minimum time between two subsequent switches ON of the output.

Cooling demand

Comp. output

Anti cycle timer
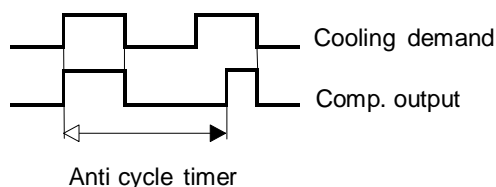
Co Deep freezing time

This is the time for which the compressor is forced ON when pressing the deep freezing cycle key from the faceplate.

AH High temperature alarm

High temperature alarm value relative to setpoint.
E.g. If your set point is at 4°C and AH = 5K the alarm will be triggered at 9°C.

AL Low temperature alarm

Low temperature alarm value relative to setpoint.
E.g. If your set point is at 4°C and AL = 3K below setpoint, it will be triggered at 1°C.

Ad Alarm differential

Useful to avoid alarm oscillation.
For example:
Setpoint = 4°C
Max. temperature alarm = 6 K
Alarm differential = 2 K
In this case, when the cold room temperature exceeds 4+6 = 10°C for a time greater than parameter 9 the alarm is activated; when temperature drops below 4+6-2 = 8°C the alarm is reset.

At Alarm time delay

Delay between the detection of the temperature alarm and the activation of the alarm sequences. This is useful to prevent temporary conditions from causing an alarm. Furthermore, the controller automatically ignores the temperature alarm condition in the following cases:
- for 20 minutes after the power-ON
- during defrost and for 20 minutes after the defrost-end.

dF Defrost function

Select the type of your installation and the way defrost is performed:
0 = Electrical defrost (Compressor OFF)
1 = Hot gas defrost (Compressor ON).

dE Defrost end function

Select the defrost termination type:
0 = timer based set with parameter **dd**
1 = temperature based set with param. **dt**.
Note: in any case the defrost ends after the time set through parameter **dd**.

dt Defrost termination temperature

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

di Defrost interval time

This is the time between two subsequent defrost cycles. This timer will initiate every defrost cycle.

dd Maximum defrost duration

The defrost cycle will stop after this time, even if the defrost end temperature has not been reached.

dC Dripping time

After defrost is terminated, the compressor is stopped to allow the evaporator to drip.

dU **First defrost cycle after power-on**

This parameter allows to delay a defrost cycle, after power-up. This will prevent a cycle from occurring before the cold room has reached its operation temperature. This function is disabled when set to "OF".

dP **Display during defrost**

You can select what to display during the defrost cycle. This is meant to avoid misleading users during the defrost cycle.
0 = last measured value before defrost cycle
1 = setpoint

dr **Delay displayed temperature after defrost**

During defrost cycles the ambient temperature is not displayed (see parameter **dp**). The actual temperature returns to display when its value reaches the setpoint value or, in any case, after the time defined by this parameter.

iF **Digital input function**

The digital input (normally closed) can be configured according to the plant requirements:
0 = the DI is not connected
1 = *General Alarm*: If the contact stays open (On) for longer than parameter **id** then:
- all outputs are de-energised;
- an alarm message (A1) is displayed;
- the alarm output is energised (if present).

The alarm condition automatically resets as soon as the contact closes back.
2 = *Delayed Alarm:* If the contact stays open (On) for longer than parameter **id** then:
- an alarm message (A2) is displayed;
- the alarm output is energised (if present).

All other functions continue as usual, the alarm condition resets as soon as the contact closes back.
3 = *Door Switch:* As soon as the contact opens (On) the fan is switched off (if applicable) and if it stays open for longer than parameter **id** then:
- an alarm message (A3) is displayed;
- the alarm output is energised (if present).

High and low alarms are disabled. The condition automatically resets as soon as the contact closes back.

id **Digital input time delay**

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 in parallel to the compressor
1 = fan is always ON
Note: in both cases, the fan is switched OFF during the defrost cycle.

Fd **Fan start-up delay after defrost end and power up**

This parameter is a safety function, 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 and power up**

Evaporator sensor temperature at which the fan is switched ON, after defrost cycle,

Note: in any case the fan is switched ON after the time set through parameter (**Fd**).

SF **Thermostat operating function when sensor failure**

This defines the cycle of the thermostat output in case of failure
0 = Compressor ON
1 = Compressor OFF
2 = Automatic
In the automatic mode, the controller will calculate the average time the compressor was ON for the last 10 cycles, and the compressor will run accordingly. If a deep freezing cycle or a defrost cycle occurred, they will not be taken into account nor will the first cycle afterwards.

So **Offset thermostat sensor**

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 formula:

$$Compensation = -\frac{5 \times length}{1000 \times area} \text{ K}$$
, where
length = length of the cable in meters
area = section of the cable in square millimetres and compensate for the calculated value

Un **Temperature units**

0 = Celsius degrees,
1 = Fahrenheit degrees.

PU **Display updating time delay**

The temperature value display of the MR will be refreshed with this defined period. It will not affect the control performance.

Parameters

	Parameter	Setting Range	Default	MR11	MR12	MR13	MR14
	Temperature control parameters						
Hy	Hysteresis (HY)	1 to 9 K	2	•	•	•	•
LL	Lower setpoint limit (LL)	-40°C to higher limit	-40	•	•	•	•
HL	Higher setpoint limit (HL)	lower limit to 70°C	70	•	•	•	•
CC	Anti short cycling (CC)	0 to 9 min	2	•	•	•	•
Co	Deep freezing time (Co)	0 to 99 min	60	•	•	•	•
	Alarm parameters						
AH	High. temperature alarm	0 to 50°C related to setpoint	10	•	•	•	•
AL	Low temperature alarm	-50 to 0°C related to setpoint	-10	•	•	•	•
Ad	Alarm differential	1 to 9 K	1	•	•	•	•
At	Alarm time delay	0 to 99 min	30	•	•	•	•
	Defrost parameters						
dF	Defrost function	0 = Electric heater 1 = Hot gas	0			•	•
dE	Defrost end function	0= by time 1= by temperature	1			•	•
dt	Defrost termination temp	0 to 20°C	7			•	•
di	Defrost interval time	0 to 99 hours	6		•	•	•
dd	Max. defrost duration	0 to 99 min	40		•	•	•
dC	Dripping time	0 to 99 min	5		•	•	•
dU	First defrost after power on	OFF, 0 to 99 min	OF		•	•	•
dP	Display during defrost	0 = Last value before defrost 1 = Set point	0		•	•	•
dr	Delay displayed temp after defrost	1 to 99 min	20		•	•	•
	Digital input parameters						
iF	Digital input function	0= not connected 1= High Level Al. 2= Delayed Alarm 3= door switch	0		•	•	•
id	Digital input time delay	0 to 99 min	5		•	•	•
	Fan control parameters						
FF	Fan operating function	0 = Parallel with compressor 1 = Continuous *Always OFF during defrost*	0				•
Fd	Fan start-up delay after defrost end and power up	0 to 99 min.	5				•
Fr	Fan start-up temperature after defrost end and power up	-30 to +5 °C	-5				•

	Parameter	Setting Range	Default	MR11	MR12	MR13	MR14
	Other parameters						
SF	Thermostat operating function if sensor failure	0 = Always ON 1 = Always OFF 2 = Automatic	2	•	•	•	•
So	Sensor offset	-20 to +20 k	0	•	•	•	•
Un	Temperature units	0 = °C 1 = °F	0	•	•	•	•
PU	Display updating time	1 to 99 sec	1	•	•	•	•

Accessories

Item Code	Description
TR230/12-1	Transformer 230 / 12,3 VA
A99BB-200C	Sensor, cable length: 2m

Alarm and Fault Codes

Error Codes and Status

Error Code (Codes will flash on the display)	System Status
F1 Open or shorted room temperature sensor	Alarm output energised (if present) Compressor output in function of param. **SF** Cycle power to reset
F2 Open or shorted evaporator temperature sensor	Alarm output energised (if present) Defrost end only by time Fan managed in parallel to compressor Automatic reset
A1 Digital input open for longer than param. **id** and **iF** = 1	Alarm output energised (if present) All other outputs go OFF Automatic reset
A2 Digital input open for longer than param. **id** and **iF** = 2	Alarm output energised (if present) Automatic reset
A3 Digital input open for longer than param. **id** and **iF** = 3	Alarm output energised (if present) Automatic reset
HI Calculated case temperature has reached or exceeded (Setpoint + **AH**)	Alarm output energised (if present) Automatic reset
LO Calculated case temperature has reached or fallen below (Setpoint + **AL**)	Alarm output energised (if present) Compressor output OFF Automatic reset
EE Program failure	Replace controller

Repair and replacement

Field repair is not possible. In case of defective or improperly functioning control, please check with your nearest supplier. When contacting the supplier for replacement, you should state the type-model number of the control. This number can be found on the data plate.

Specifications

Product	MR10 Electronic Controls				
Power Requirements	12 VAC/dc ±10%, 50/60 Hz 230 VAC ±10%, 50/60 Hz	Not all power supplies are available in every version. Please refer to selection tables.			
Power Consumption	2 VA				
Protection Class	**Panel** **mount**	Front plate Rear	IP 54 IP 20		
Ambient Operating Conditions	-10° to +55°C (14° to 131°F) 10 to 95 % RH (non condensing)				
Ambient Storage Conditions	-30° to +80°C (-22° to +176°F) 0 to 95 % RH (non condensing)				
Range	-40 to +70°C				
Accuracy & Precision	± 1°C				
Sensor cable	2 meters				
Output ratings	(250 VAC)	Compressor	Alarm	Defrost	Fan
	MR11PM12R-1C	SPDT 8(3)A			
	MR11PM230-1C	SPDT 8(3)A			
	MR12PM12R-A1C	SPDT 8(3)A	SPST 8(3)A		
	MR12PM12R-1C	SPDT 8(3)A			
	MR12PM230-Z1C	SPDT 8(3)A			
	MR12PM12H-1C	SPDT 16(12)A			
	MR13PM12R-2C	SPST 8(3)A		SPST 8(3)A	
	MR14PM12R-2C (*)	SPST 8(3)A		SPST 8(3)A	SPST 8(3)A
	MR14PM12R-A2C (*)	SPST 8(3)A	SPST 8(3)A	SPST 8(3)A	SPST 8(3)A
(*)	Max. current on common = 20 Amps				
Dimensions (H x W x D)	**Panel mount** 35 x 75 x 68 (1.38" x 2.95" x 2.68")				
C E **Compliance**	73/23 EEC directive: EN 60730 89/336 EEC directive: EN 50081-1, EN 50082-2				

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. This document is subject to change without prior notice.