

**Control Module
General Instructions**

APPLICATION

Attention: This F-23350 General Instruction sheet is to be used with the MMC-90 Control Module built after February 1990, (date coded after 9009). For details on the MMC-90 Control Module built prior to February 1990, (date coded before 9009) see General Instruction sheet F-23350-2.

The MMC-90 plug-in control module is used in conjunction with the MM-400, MM-500, MMR-400 and MMR-500 series of modular motors.

The module will accept 135 ohms slidewire, 0 to 7 mADC as produced by a Honeywell's W973 and W7100 controllers, and Johnson control circuits type "B" and "J".

The module will also accept 2-position (Honeywell's series 40, 60, 80 and Johnson Type "A") control signals using AD-8961-401 provided.

Each MMC-90 package contains:

- One (1) Control Module
- One (1) AD-8961-401 150 ohm resistor kit pre-packaged with 1/4" female spade terminals and 6" color coded leads to interface to two position control circuits.
- One (1) Module Label
- One (1) Wiring Template
- Five (5) 6"-18 gauge color coded wires with 1/4" Spade Connectors attached to one end.

Other Components That May Be Required:

- AD-8961-407 Resistor package for parallel operation of 2 or 3 MM or MMR series of motors with MMC-90 control module from Series 60 or 90 & Johnson types "A", "B" & "J" control signals.
- AD-8961-408 Resistor package for operation of 1, 2, or 3 MM or MMR series of motors with MMC-90 control module from a Honeywell W973 controller.
- AM-236 Minimum positioner for operation of MM or MMR series of motors with MMC-90 control module from Series 90 control signal.
- TOOL-209 135 ohm slidewire and 0 to 7 mAdc manual positioner.

NOTE: AD-8961-402, AD-8961-403 & AD-8961-404 Resistor packages used with MMC-90 (date coded before 9009) will not work with MMC-90 (date coded after 9009) Control Module.

SPECIFICATIONS

Control Signal Inputs:

- 135 ohm slidewire**, Honeywell Series 90 and Johnson types "B" and "J".
- 0 to 7 mADC**, Honeywell W973 and W7100 controllers.
- 2-position SPST**, (MM or MMR-500 spring return series) Honeywell Series 40 and 80 and Johnson type "A" Requires AD-8961-401 (provided).

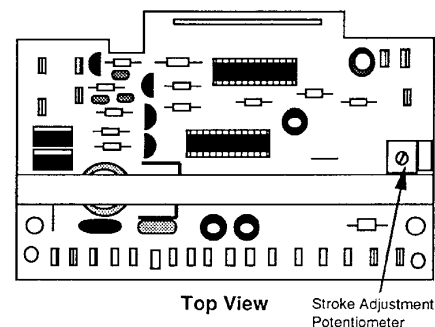
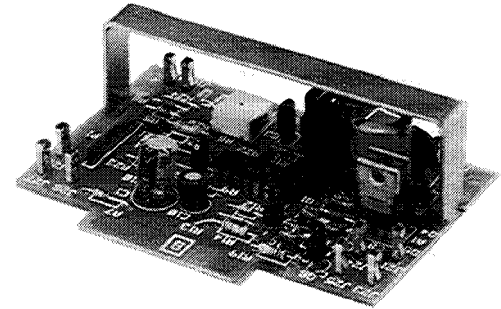


Figure-1 MMC-90 Control Module - Motor Stroke Adjustment.

2-position SPDT, (MM or MMR-400 non-spring return series) Honeywell S Eerie 40 and 80 and Johnson type "A". REquired AD-8961-401 (provided).

Power Requirements: 24 Vac + 10/-15 %, 50/60 Hz., 4.0VA.

Environment:

- Ambient Temperature Limits,**
- Shipping and Storage** -40 to 160°F (-40 to 71°C)
- Operating** -40 to 140°F (-40 to 60°C)

Humidity: 5 to 95% RH, non-condensing

Locations: The MMC-90 Control module is to be used with and mounted in MM or MMR Series Module Motors only

Adjustments: The electrical stroke of the motor is adjustable from 90° to 160° by the potentiometer on MMC-90, factory set at 160°.

Connections: The motor has 1/4" spade terminals. The MMC-90 includes 6" (152.4 mm) color coded leads crimped to 1/4" female disconnects. Field connections should be made to color coded leads.

Interchangeability: The MMC-90 Control Module with appropriate MM to MMR series of motors is interchangeable with Honeywell's Series 40, 60 (Snap Acting Only), 80 and 90, and Johnson 100 Series motors.

Mounting: Plug-in mounting in the MM or MMR series of motors. MMC-90 is not position sensitive.

Dimensions: 1-1/2" high x 3-1/2" wide x 2-1/2" deep (28.5 mm x 89 mm x 64 mm).

PRE-INSTALLATION

Inspection

Inspect the package for damage, If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
 - Digital volt-ohm meter (DVM)
 - Screwdriver
 - TOOL-209, 135 ohm slidewire and 0 to 7 mAdc manual positioner

INSTALLATION

Caution:

- Installer must be a qualified, experienced technician.
- Disconnect power supply before installation to prevent electrical shock and equipment damage.
- Make all connections in accordance with electrical wiring diagrams, and in compliance with national and local codes. *Use copper conductors only that are suitable for 85°C. Use Class 1 wiring only.*
- Do not exceed the ratings of the device.
- Avoid locations where excessive moisture, corrosive fumes or vibration are present.

Mounting and Wiring

1. Remove the motor cover by removing the four cover screws.

Note: If maximum output shaft rotation needs to be changed (factory set at 160°F), see Motor Stroke before installing control module.

2. Pick up the control module by the metal installation handle and install the MMC-90 control module into the motor wiring compartment by aligning the module and carefully pushing all the way onto the pins. Press in the area around both sides of the vertical part of handle. (See Figure 2).
3. The wiring template supplied can be used for easy terminal installation. Align the template over the terminal block (See Figure 3).
4. Make the wiring connections in accordance with the wiring diagram (See Figure 5 through 17). The field connections are made to 6" (152.4 mm) long color coded leads. Note: The color coded leads are supplied with MMC-90 and have 1/4" female disconnects crimped to them. Install the leads to 1/4" spade lugs on the terminal board, refer to Figure 2. See Table 1 for power wiring selection.

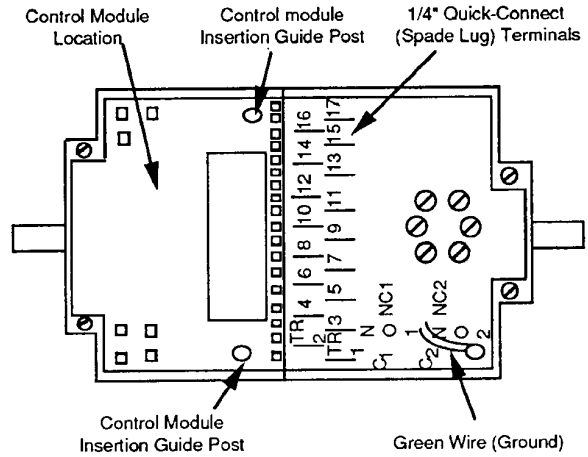


Figure-2 Terminal Board Connections and Control Module Location.

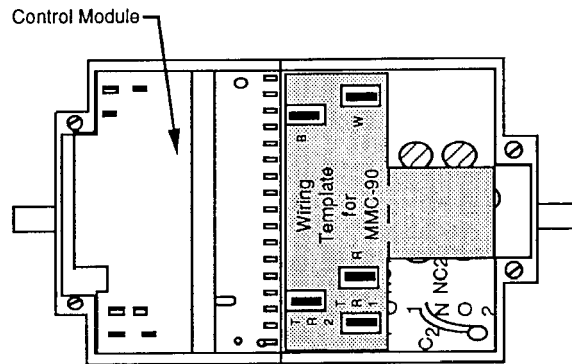


Figure-3 Wiring Template Installation.

Note: For Control Leads use 18 gauge shielded cable (twisted) when it is necessary to install the control leads in the same conduit with power wiring, or when high RFI/EMI generating devices are near. The shield should not be earth grounded at any point or connected to any wires or terminals.

5. Install the wiring label included with MMC-90 control module on the inside of the motor cover for future service or maintenance.
6. Replace the motor cover and cover screws if the checkout is not being done at this time.

Table-1 Wire Selection for Power Wiring to Motor or AM-231 Cover Transformer.

Voltage	Wire size (AWG) (Suitable for 85°C)	Maximum Run # Feet (m)
24	18	80 (24.3)
	14	210 (64)
	12	265 (80.7)
120	14	2,340 (713)
208/240	14	4,070 (1,240)

The maximum run is based on one motor being on the run. If more than one motor is on the run divide the maximum run length shown in the table by the number of motors to determine actual maximum run length.

Caution:

1. WHEN MULTIPLE MOTORS ARE POWERED FROM THE SAME TRANSFORMER, DAMAGE WILL RESULT UNLESS ALL TR1 MOTOR LEADS ARE CONNECTED TO THE SAME TRANSFORMER LEAD. CONNECT THE OTHER TRANSFORMER LEAD TO TR2 ON ALL MOTORS.
2. The MMC-90 control module and MM or MMR series of motors are designed to use the standard existing wiring of mechanical or solid state Series 90 motors. However in rare cases with very large electrical pickup present, the motor performance may become erratic. Either reroute the control wiring or install shielded cable (twisted).
3. The MMC-90 control module and MM or MMR series of motors can not replace slave motors controlled by Honeywell Q68 auxiliary potentiometers in mechanical balance relay master-slave motor systems.

Table-3 Direction of Rotation of MM or MMR Series of Motors Verses Series 60 (SPDT Snap Acting Only). See Figure 11.

SPDT Switch Function	Normally Closed or Load End of Motor	Normally Open or Optional End of Motor
Motor Terminal 3 (Red) Shorted to Terminal 16 (Blue)	Drives CW ("Open")	Drives CCW ("Closed")
Motor Terminal 3 (Red) Shorted to Terminal 17 (Yel/White)	Drives CCW ("Closed") *	Drives CW ("Open") *

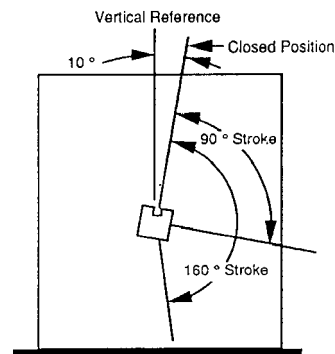
*This is also the normal or spring return position of the MM or MMR-500 series of spring return motors.

Direction of Motor Rotation Verses Input Signal to MMC-90 Control Module

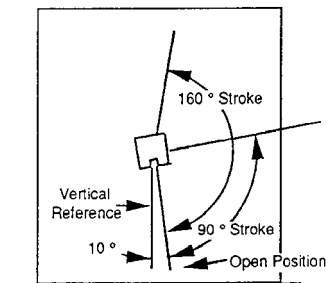
The MM and MMR series of motors can have the load attached to either end of the motor. the ends of the MM and MMR-400 series of non-spring return motors are identified as the "Load" (end typically used for load) and "Optional". The ends of the MM and MMR-500 series of spring return motors are identified as the "Load, Normally Closed - CCW" (end typically used for load) and the "Optional, Normally Open - CW". The Tables 2 through 5 shown below describe the direction of rotation of the two ends of the motor verses the different input signals that the MMC-90 control module will accept.

Table-2 Direction of Rotation of MM or MMR-500 Series of Spring Return Motors Versus Series 40 or 80 (SPST) Controller. See Figures 9 and 10.

SPST Switch Function	Normally Closed End of Motor	Normally Open End of Motor
Power to the Motor	Drives CW ("Open")	Drives CCW ("Closed")
Power Interrupted to the Motor	Spring Returns CCW ("Closed")	Spring Returns CW ("Open")



Motor stroke as viewed from the "Load" or "Normally Closed-CCW" end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-90.



Motor stroke as viewed from the "Optional" or "Normally Open-CW" end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-90.

Figure-4 Motor Stroke.

Table-4 Direction of Rotation of MM or MMR Series of Motor Verses Series 90 (135 ohm Slidewire) See Figures 5 through 8.

Series 90 Controller (135 ohm Slidewire) Function	"Standard Heating" Wiring with Series 90 Controller Terminals R, W & B Wired Respectively to Motor Terminals 3, 16 & 17		"Reversed Cooling" Wiring with Series 90 Controller Terminals R, W & B Wired Respectively to Motor Terminals 3, 16 & 17	
	Normally Closed or Load End of Motor	Normally Open or Optional End of Motor	Normally Closed or Load End of Motor	Normally Open or Optional End of Motor
Decrease in the Resistance Between R and B Terminals (Drop on Temperature)	Drives CW ("Opens") ("Heating Application")	Drives CCW ("Closes") ("Cooling Application")	Drives CCW ("Closes") ("Cooling Application")*	Drives CW ("Opens") ("Heating Application")*
Decrease in the Resistance Between R and W Terminals (Rise in Temperature)	Drives CCW ("Closes") ("Heating Application")*	Drives CW ("Opens") ("Cooling Application")*	Drives CW ("Opens") ("Cooling Application")	Drives CCW ("Closes") ("Heating Application")

*This is also the normal or spring return position of the MM or MMR-500 series of spring return motors.

Table-5 Direction of Rotation of MM or MMR Series of Motors Verses 0 to 7 mADC as Produced by Honeywell's W973 and W7100 Controllers. See Figures 12 thru 17.

W973 or W7100 Output	Normally Closed or Load End of Motor	Normally Open or Optional End of Motor**
Increasing mADC Output	Drives CW ("Open")	Drives CCW ("Closed")
Decreasing mADC Output	Drives CCW ("Closed") *	Drives CW ("Open") *

*This is also the normal or spring return position of the MM or MMR-500 series of spring return motors.

** This is not standard application.

Motor Stroke

The electrical stroke of the motor is adjustable from 90° to 160° by the use of the stroke adjustment potentiometer on the MMC-90 control module (See Figures 1 and 4). Clockwise rotation of the potentiometer increases the stroke. The mechanical rotation of the motor (by use of the internal mechanical stop) is also adjustable to 75°, 90°, 110° and 160° (See General Instruction F-23348). Make sure the mechanical stroke is equal or greater than desired electrical stroke. Typically only the electrical stroke needs to be adjusted since mechanical stroke is factory set for 160°.

CHECKOUT

After the entire system has been installed and the motor has been powered up, the following checks can be made for proper system operation. Also refer to the General Instruction sheet(s) for the motor and any accessories during the checkout procedure.

Go, No-Go Test (Two Position)

1. Remove the power from the motor. Disconnect the control leads from the motor.
2. Install the AD-8961-401 resistor kit supplied with the MMC-90 by attaching the blue lead to terminal 16 of the motor and yellow/white lead to terminal 17 of the motor. Attach the red lead supplied with MMC-90 to terminal 3 of the motor.
3. Reconnect the power.
4. To drive the motor CW as viewed from the Load or normally closed end of the motor, short the red lead to the blue lead.
5. To drive the motor CCW as viewed from the Load or normally closed end of the motor, short the red lead to the yellow/white lead.
6. Check for proper operation of the system as the motor is operated.
7. Disconnect the power and the AD-8961-401. Reconnect the control wiring and power.

Manual Positioning with TOOL-209 (135 ohm Slidewire Manual Positioner)

1. Remove the power from the motor. Disconnect the control leads from the motor.
2. Using 135 ohm leads, attach red wire TOOL-209 to terminal 3 of motor, blue wire to terminal 16 and yellow/white wire to terminal 17.
3. Reconnect the power.
4. To drive the motor CCW as viewed from the "Load" or "Load, Normally Closed - CCW spring return" end of the motor, turn the potentiometer on TOOL-209 in the increase direction.
5. To drive the motor CW as viewed from the "Load" or "Load, Normally Closed - CCW spring return" end of the motor, turn the potentiometer on TOOL-209 in the decrease direction.
6. Check for proper operation of the system as the motor is operated.
7. Disconnect the power and the TOOL-209.
8. Reconnect the control wiring and power.

Positioning the Motor with the Controller

If the sensed media is within the controllers setpoint range, the motor can be positioned by adjusting the controller setpoint up and down. Check for proper operation of the system as the motor is operated.

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance.

FIELD REPAIR

None. Either replace MMC-90 and/or motor.

THEORY OF OPERATION

General Description of MM or MMR-400 Series of Motors

The MM and MMR-400 series of motors have a permanent split capacitor motor (See Figure 18). The capacitor causes the magnetic fields of the two coils to be out-of-phase which results in a rotating field that causes the rotor to turn. The power can be connected to either field coil. There is a phase shift and change in direction of rotation when the power to the coils is reversed. The motors are of the torque limiting type. That is when the motor is being driven in one direction and torque exceeds the trip point of the switch, the switch opens and stops the motor. Therefore the motor stops when the motor hits its internal mechanical stops, the valve seat, or damper stops.

General Description of MM or MMR-500 Series of Motors

The MM and MMR-500 series of spring return motors have a permanent split capacitor motor that drives the motor in one direction and spring that powers it in the other direction (See Figure 19). When power is applied to the motor coil, the brake winding is not powered releasing the brake allowing the motor

to run. The torque limit switch wired to the motor coils operates the same as MM or MMR-400 series. To drive the motor in the spring return direction the brake winding is not powered which releases the brake allowing motor to spring return.

Series 90 (135 ohms Slidewire) Theory

The 135 ohm potentiometer in the controller, the feedback potentiometer in motor and resistor network/electronic circuit in MMC-90 form a feedback system. Whenever the system is balanced, the motor does not run. As the value of the controlled medium changes, the wiper of the control potentiometer moves, which unbalances the feedback system. The electronic circuit of the MMC-90 takes the unbalance and amplifies it to energize the triac switching to drive the motor in the correct direction to compensate for the media change. As the motor runs the feedback potentiometer is repositioned to balance the feedback system and stop the motor rotation.

Series 40 or 80 (SPST Control Switch) Theory with the MM or MMR-500 Series of Spring Return Motors

The SPST is used to switch the power to the motor. The AD-8961-401 resistor kit is connected to the MMC-90 to unbalance the feedback system in the MMC-90 so that when power is applied to the motor, it will drive to the full open position (CW) with respect to the Normally Closed end of the motor. When the motor is de-energized, the motor will spring return closed (CCW) with respect to the Normally Closed end of the motor.

Series 60 (SPDT Snap Acting Switch Only) Theory

The common of the SPDT control switch is connected to terminal 3 (R) of the motor and the other two contacts of the switch are connected to terminals 16 (B) and 17 (W). The AD-8961-401 resistor kit is connected to the MMC-90 to unbalance the feedback system. When the switch shorts terminals 3 and 16, the motor will drive to the open (CW) position with respect to the "Load" or "Load, Normally Closed - CCW spring return" end of motor. When the switch shorts terminals 3 and 17, the motor will drive (MM or MMR-500 series) to the closed (CCW) position with respect to the "Load" or "Load, Normally Closed - CCW spring return" end of motor.

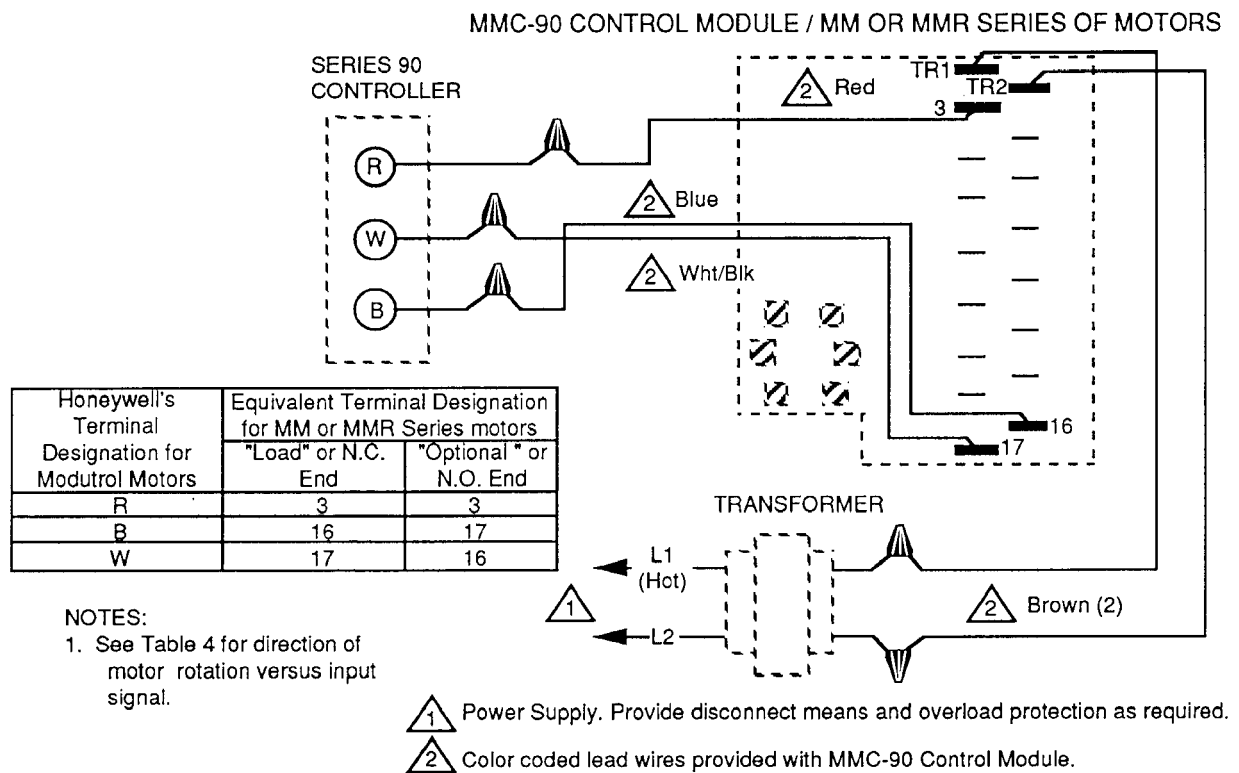


Figure-5 MMC-90 Control Module and MM or MMR Series of Motors Used with a Series 90 (135 ohm Slidewire) Controller.

MMC-90 CONTROL MODULE / MM OR MMR SERIES OF MOTORS

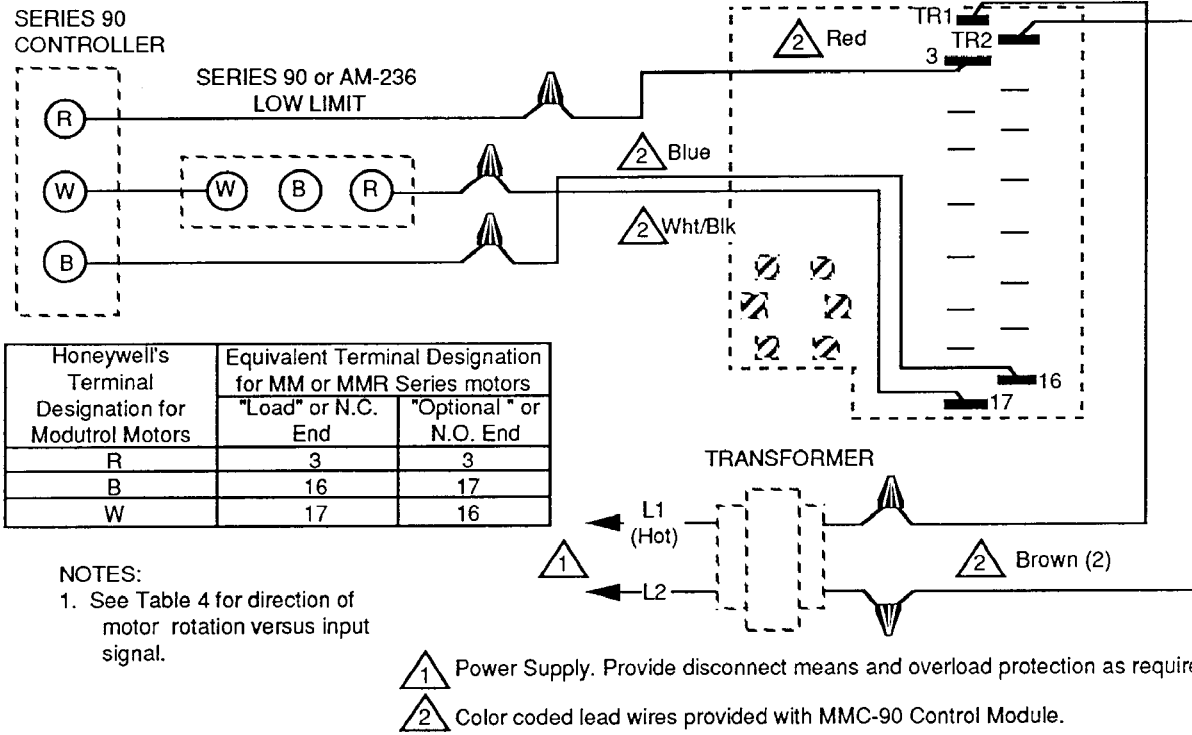
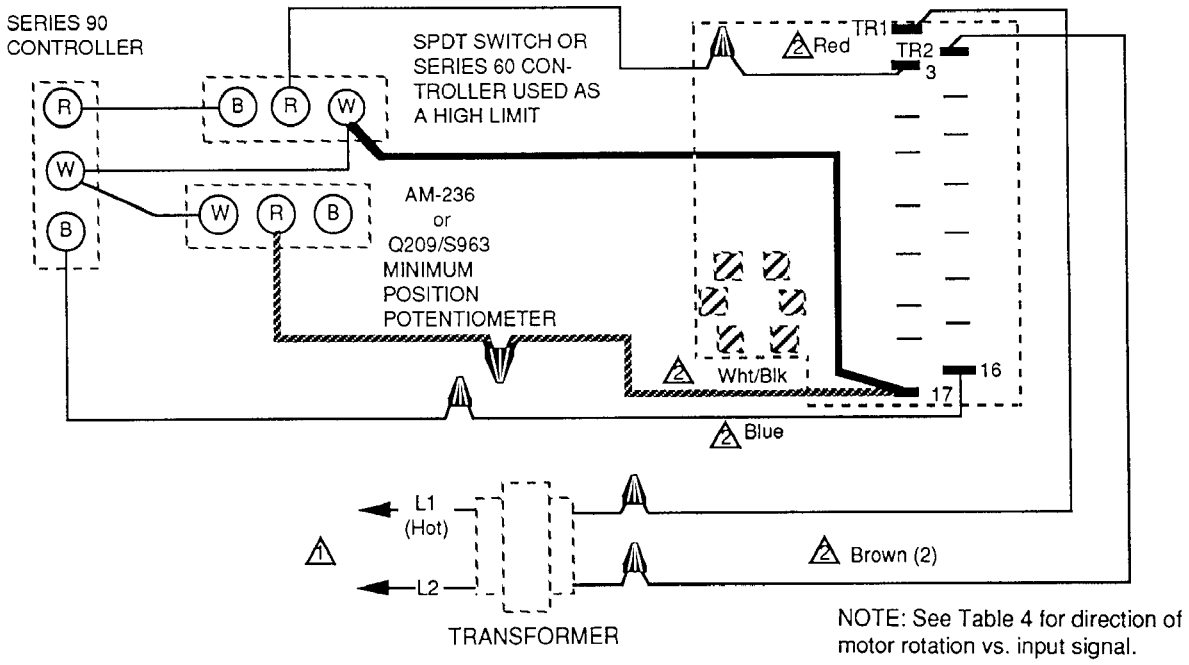


Figure-6 MMC-90 Control Module and MM or MMR Series of Motors Used with Modulating Low Limit.

MMC-90 CONTROL MODULE / MM OR MMR SERIES OF MOTORS

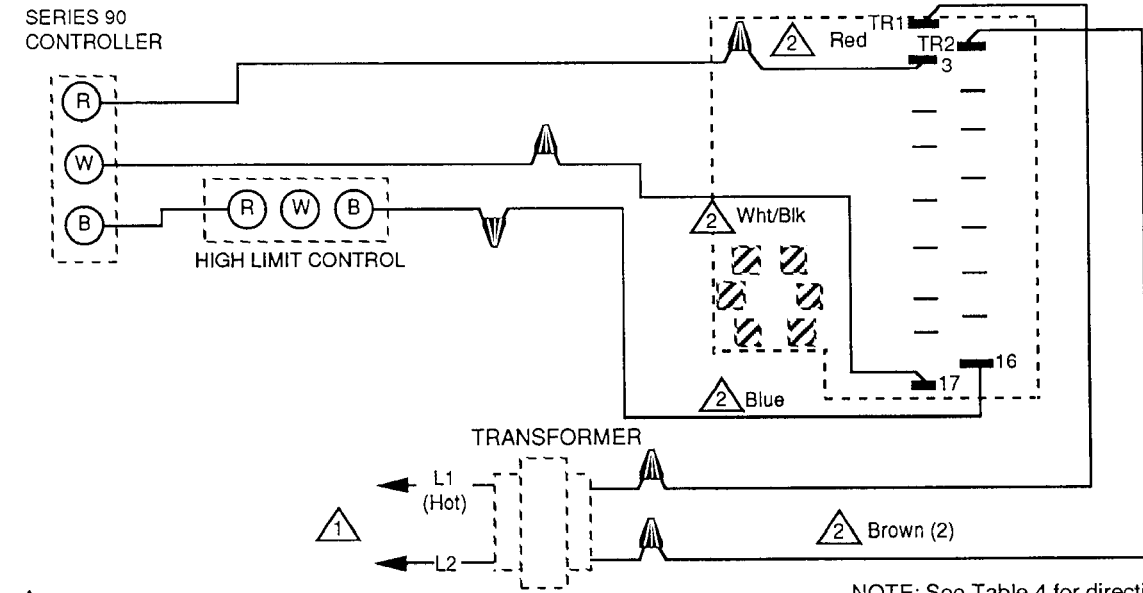


- 1 Power Supply. Provide disconnect means and overload protection as required.
2 Color coded lead wires provided with MMC-90 Control Module

Honeywell's Terminal Designation for Modutrol Motors	Equivalent Terminal Designation for MM or MMR Series of Motor	
	"Load" or N.C. End	"Optional " or N.O. End
R	3	3
B	16	17
W	17	16

Figure-7 MMC-90 Control Module and MM or MMR Series of Motors Used with a Series 90 Controller, a Manual Minimum Position Potentiometer, and SPDT Switch for 2-Position High Limit Control.

MMC-90 CONTROL MODULE / MM OR MMR SERIES OF MOTORS



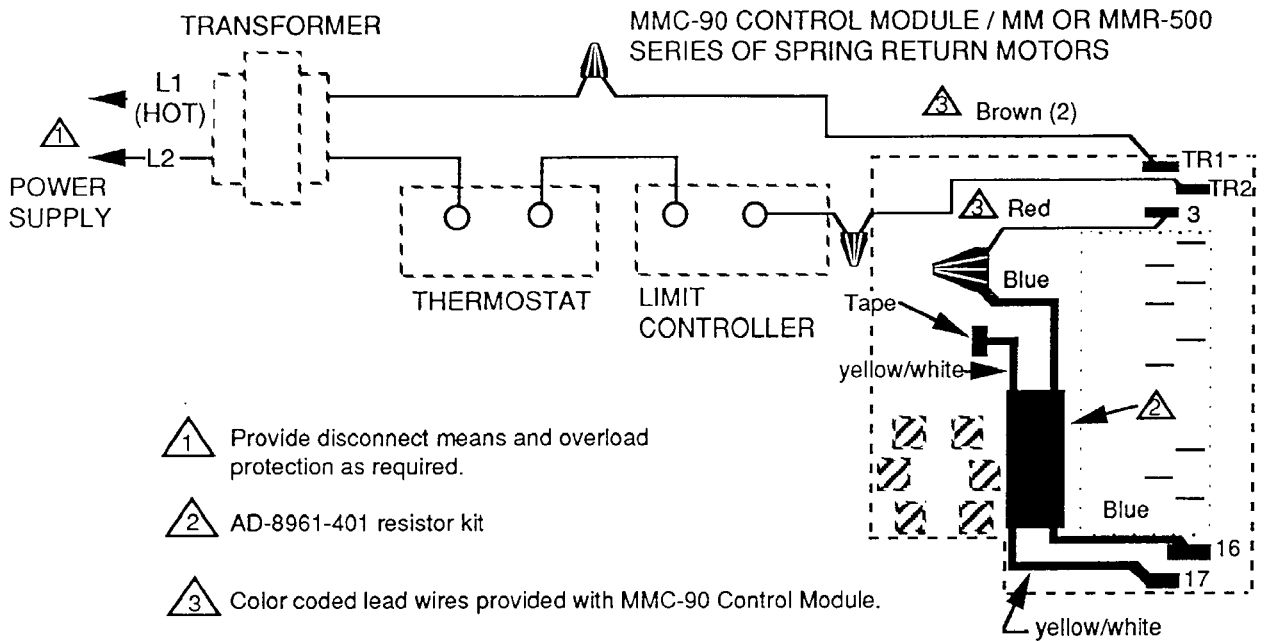
1 Power Supply. Provide disconnect means and overload protection as required.

NOTE: See Table 4 for direction of motor rotation vs. input signal.

2 Color coded lead wires provided with MMC-90 Control Module

Honeywell's Terminal Designation for Modutrol Motors	Equivalent Terminal Designation for MM or MMR Series of Motor	
	"Load" or N.C. End	"Optional" or N.O. End
R	3	3
B	16	17
W	17	16

Figure-8 MMC-90 Control Module and MM or MMR Series of Motors Used with a Series 90 Controller and a Modulating Series 90 High Limit.



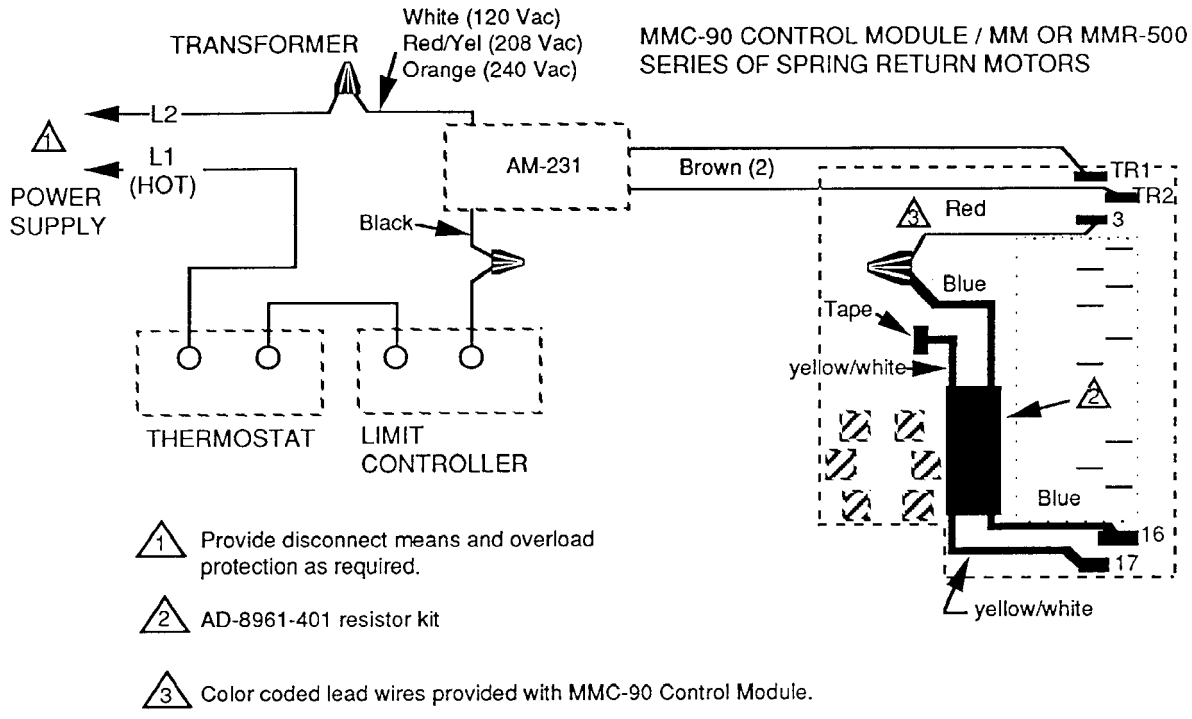
1 Provide disconnect means and overload protection as required.

2 AD-8961-401 resistor kit

3 Color coded lead wires provided with MMC-90 Control Module.

NOTE: See Table 2 for direction of actuator rotation versus input signal.

Figure-9 MMC-90 Control Module and MM or MMR-500 Series of Spring Return Motors Used with a Low Voltage Thermostat and Limit Controller in Series 80 Circuit.



NOTE: See Table 2 for direction of actuator rotation versus input signal.

Figure-10 MMC-90 Control Module and MM or MMR-500 Series of Spring Return Motors Used with AM-231 Transformer Installed. Use with a 120/208/240 Vac Thermostat and Limit Controller in Series 40 Circuit.

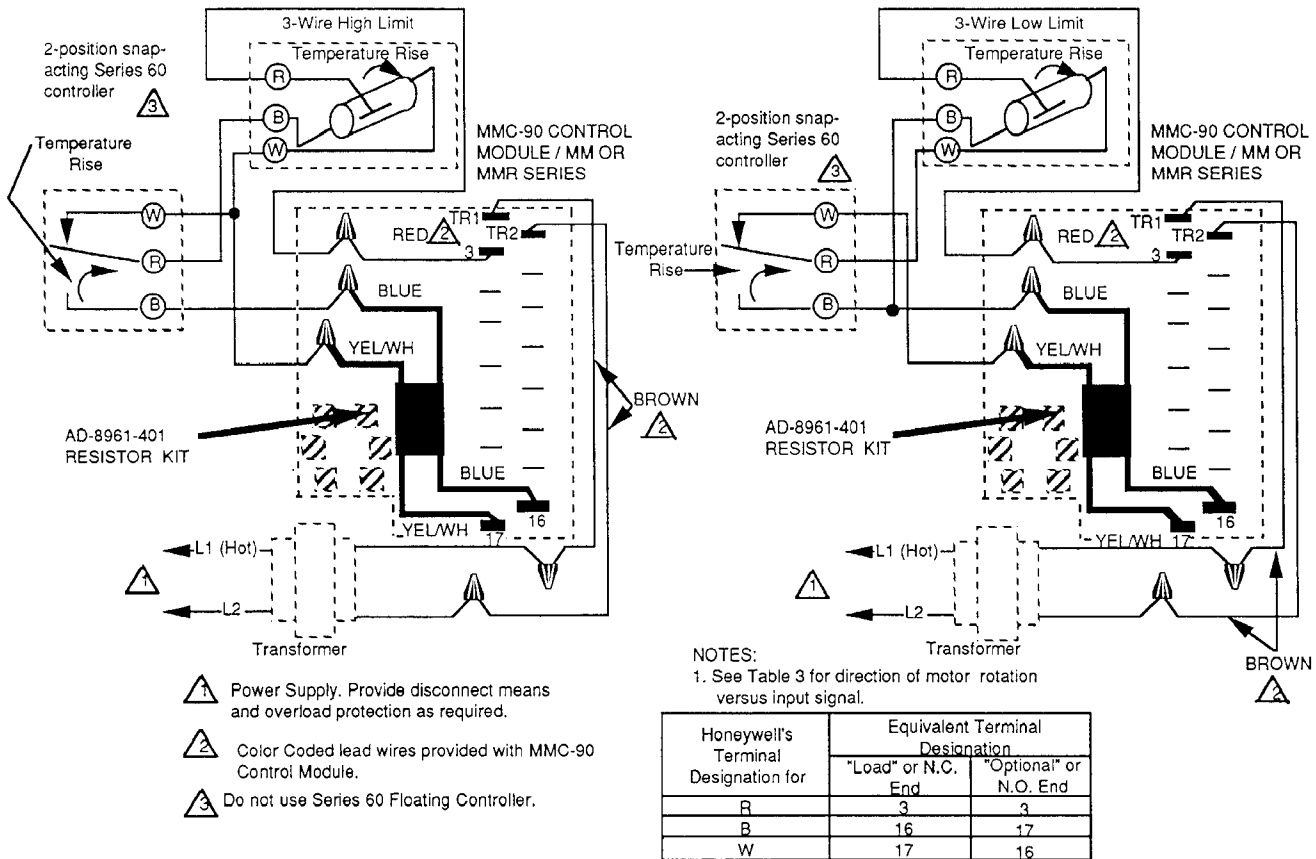


Figure-11 MMC-90 Control Module and MM or MMR Series of Motors Used with a 2-Position Controller and High or Low Limit Controller in Low Voltage Series 60 Circuit (heating application).

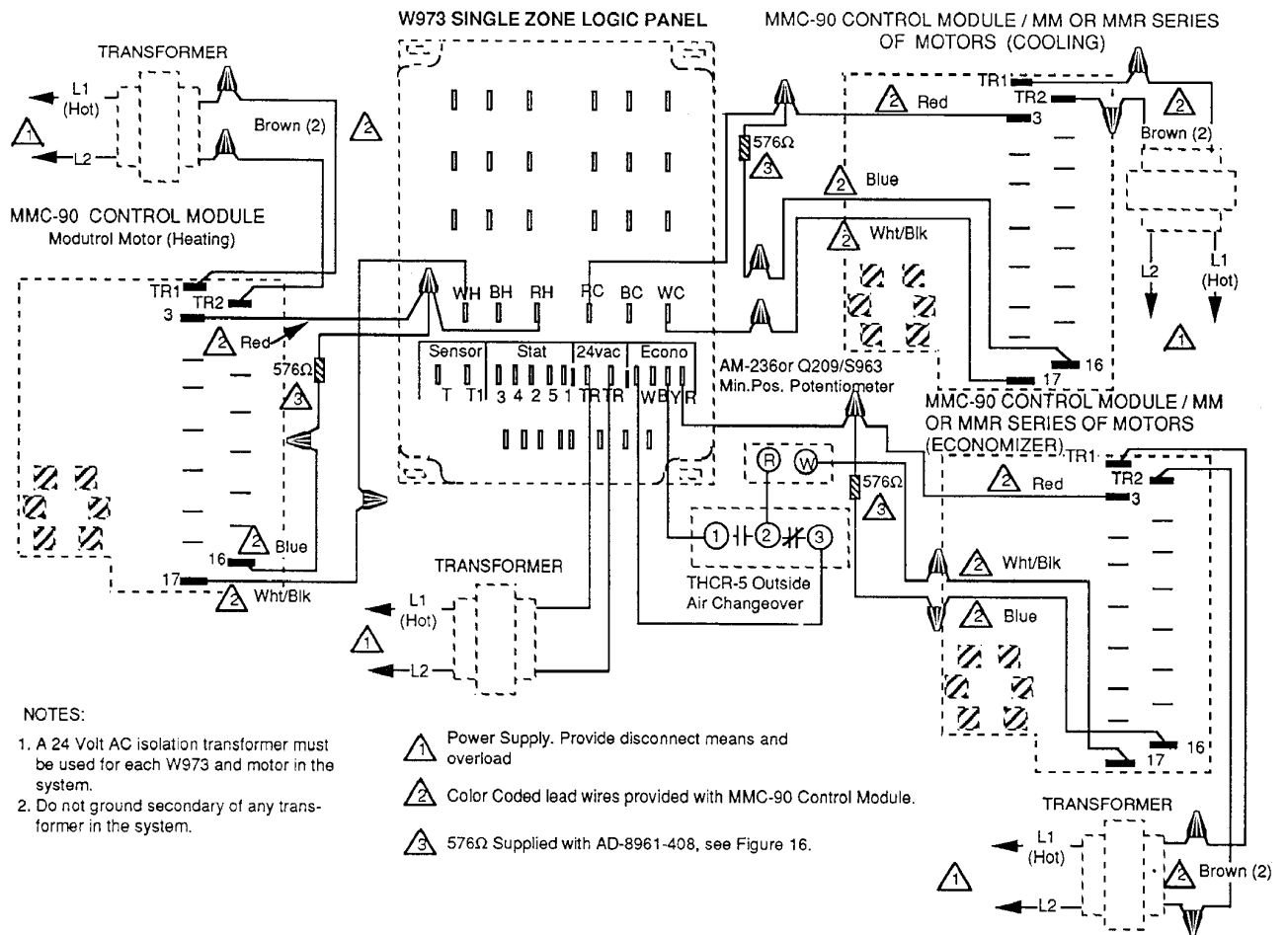


Figure-12 MMC-90 Control Module and MM or MMR Series of Motors Used with W973 Single Zone Logic Panel.

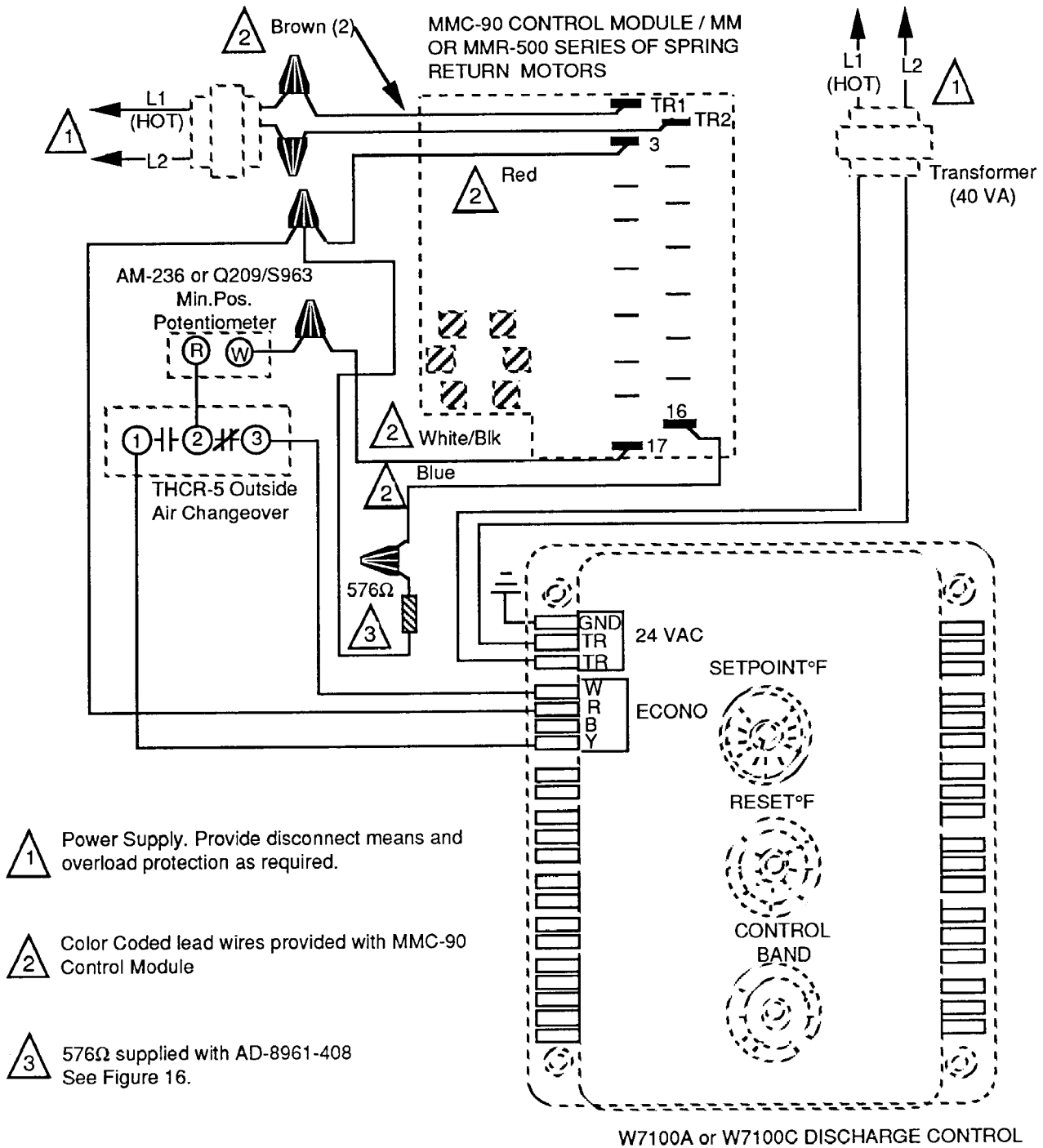


Figure-13 MMC-90 Control Module and MM or MMR Series of Motors (functioning as an economizer) with W7100C Discharge Controller.

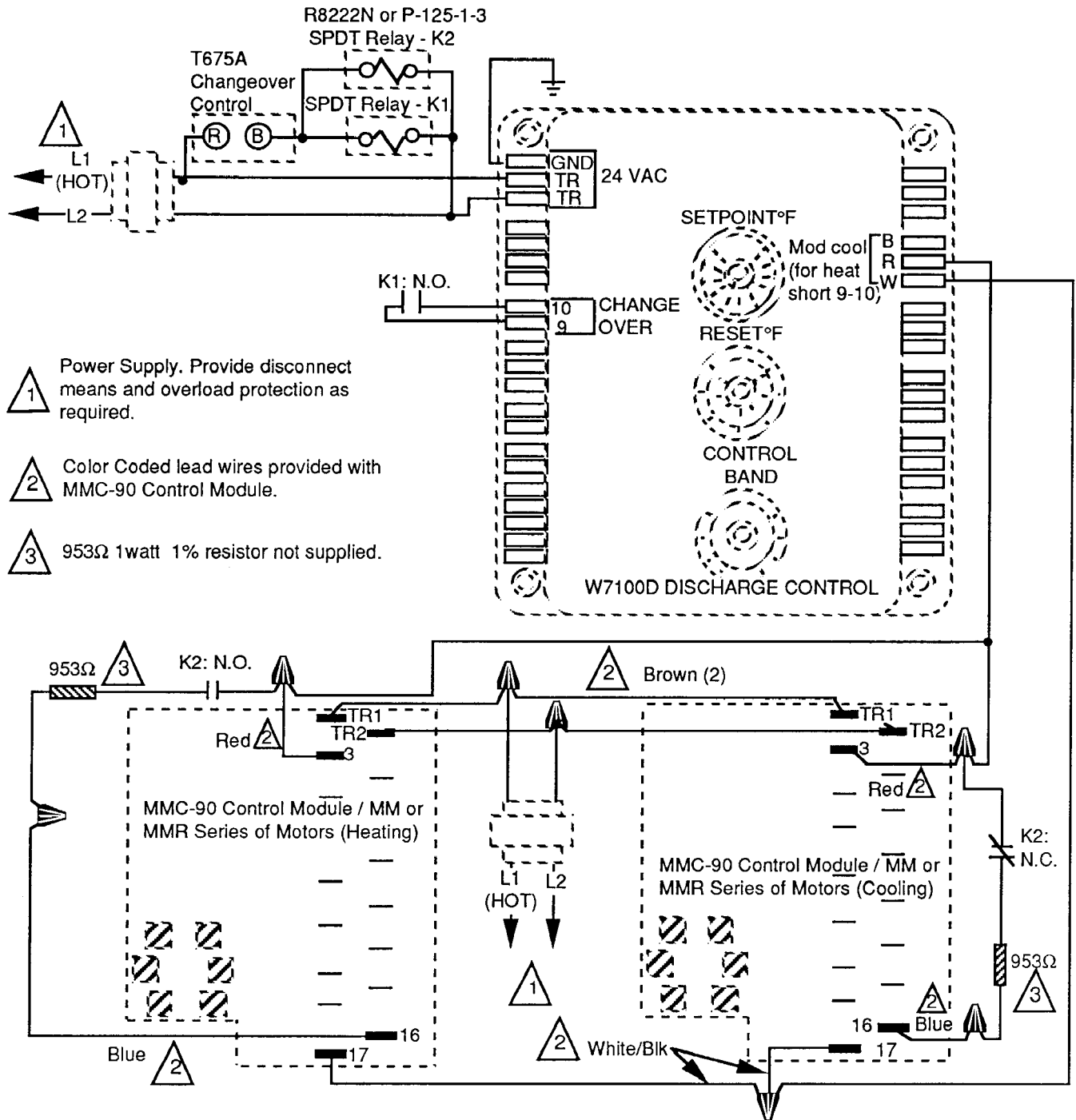


Figure-14 MMC-90 Control Module and MM or MMR Series of Motors with W7100D Discharge Controller.

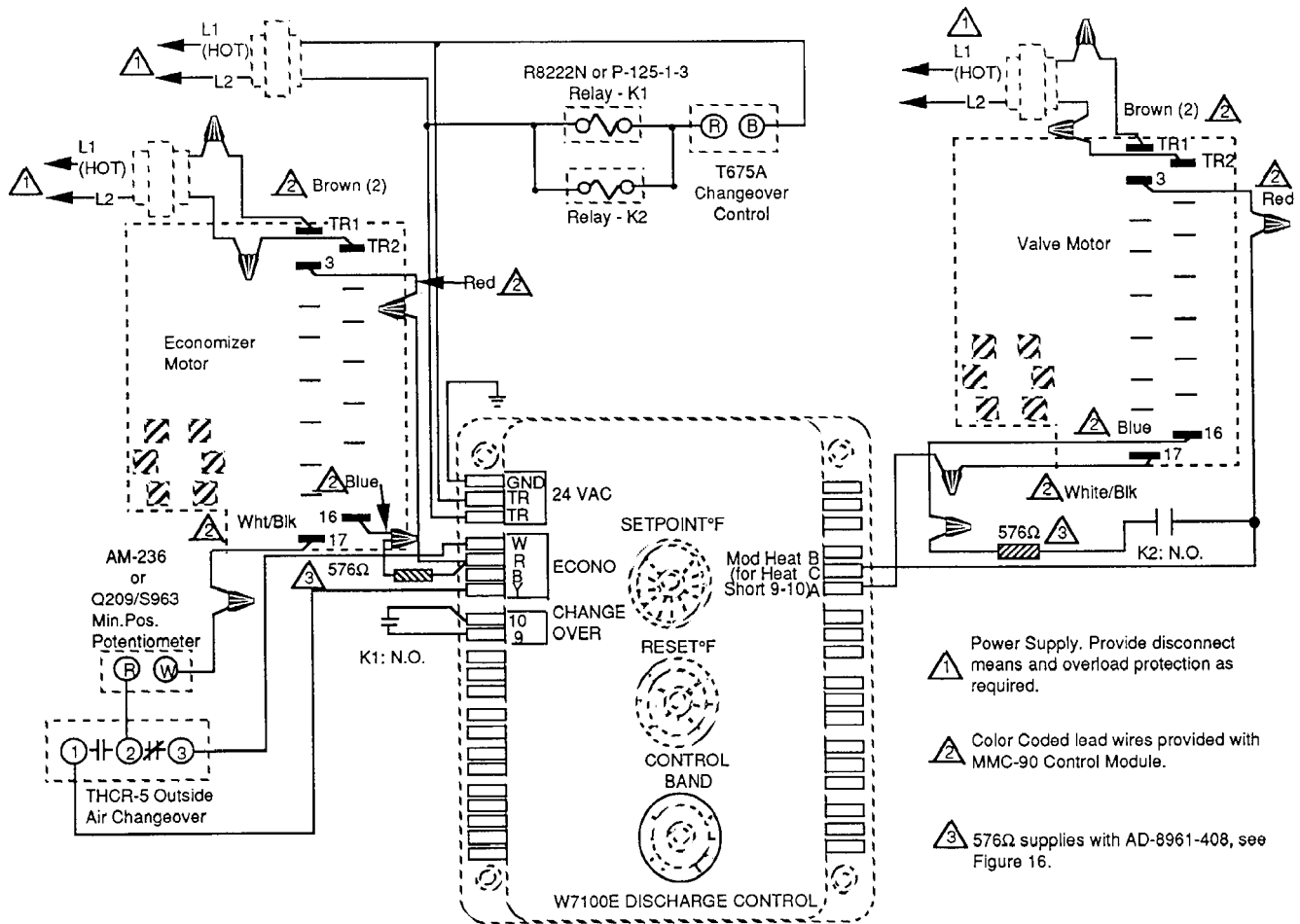
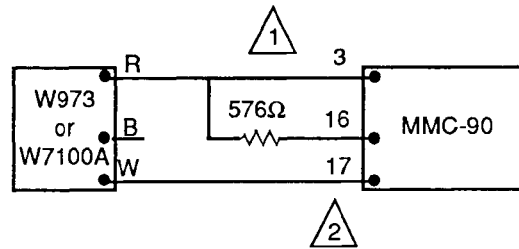


Figure-15 MMC-90 Control Module and MM or MMR Series Motors (shown in modulating heat with economizer mode) with W7100E Discharge Controller.

For Direct and Reverse Acting Applications using Honeywell W973 or W7100 Controllers with MM-500 Series Motors, it may be desired to change the spring return direction of the actuator in relation to increasing sensor temperatures. Refer to the Figures 16 and 17 for wiring information.

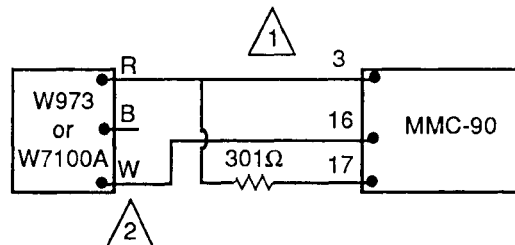


Temperature at W973	Direct Acting Systems (Standard Wiring)	Attach Crankarm to:	Actuator SR direction:
Increasing	Drives Actuator CW	N.C. - CCW End	Counterclockwise
Increasing	Drives Actuator CCW	N.O. - CW End	Clockwise

1 576Ω resistor is contained in the W973 Paralleling Kit part #AD-8961-408

2 Application figures 12 thru 15 illustrate Directing Acting systems.

Figure-16 (Standard) Direct Acting Wiring.

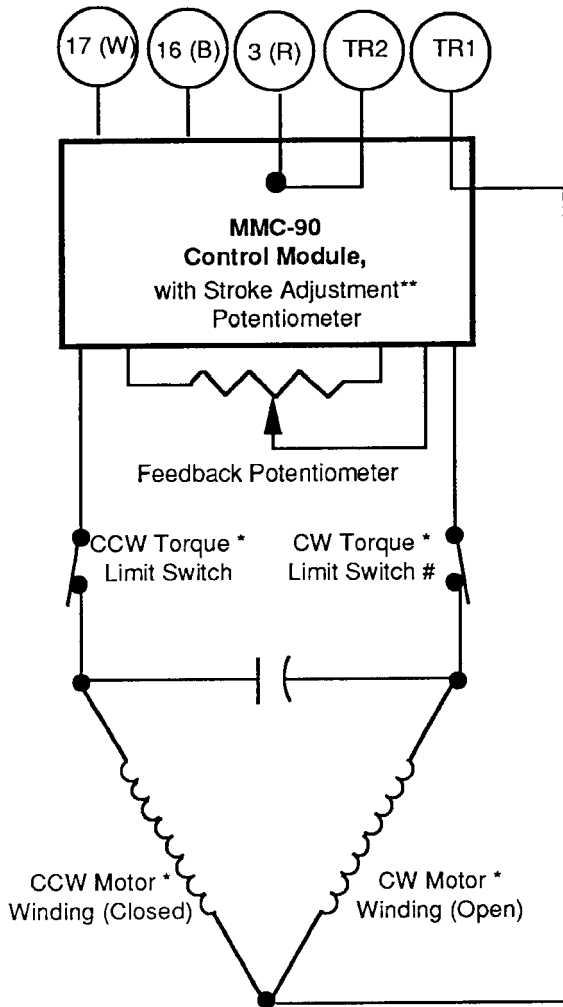


Temperature at W973	Reverse Acting Systems (Alternative Wiring)	Attach Crankarm to:	Actuator SR direction:
Increasing	Drives Actuator CCW	N.C. - CCW End	Counterclockwise
Increasing	Drives Actuator CW	N.O. - CW End	Clockwise

1 301Ω resistors are contained in the W973 Paralleling Kit part #AD-8961-408

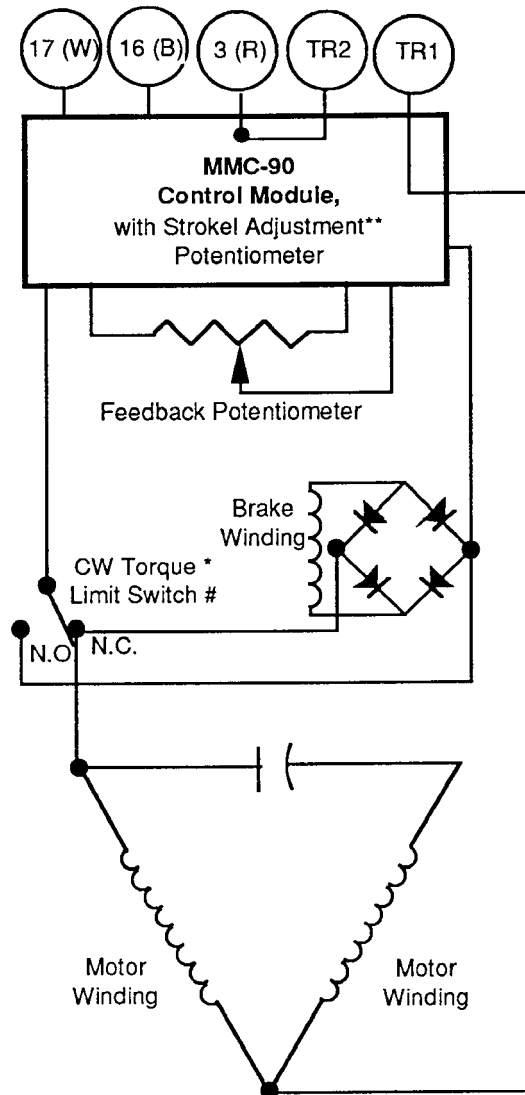
2 Application figures 12 thru 15 illustrate Directing Acting systems.

Figure-17 (Alternate) Reverse Acting Wiring.



- * Direction of travel as viewed from "Load" end of the motor.
- ** The stroke adjustment potentiometer of the MMC-90 provides an electrical stroke adjustment of 90 to 160° for the motor.
- # The CW mechanical limit of the motor is adjustable to provide 75, 90, 110 and 160° travel.

Figure-18 Internal Schematic of MM or MMR-400 Series of Non-Return Motors with MMC-90 Control Module.



- * Direction of travel as viewed from the "Normally Closed" end of the motor.
- ** The stroke adjustment potentiometer of the MMC-90 provides an electrical stroke adjustment of 90 to 160° for the motor.
- # The CW mechanical limit of the motor is adjustable to provide 75, 90, 110 and 160° travel.

Figure-19 Internal Schematic of MM or MMR-500 Series of Spring Return Motors with MMC-90 Control Module

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F-23350-5

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