

**Control Module for MM/MMR-400/500 Series  
Modular Motors  
General Instructions**

**APPLICATION**

The MMC-420 plug-in control module is used in conjunction with MM-400, MM-500, MMR-400 and MMR-500 series of modular motors.

The module will accept a variable milliamp DC signal from a controller and accept a dry contact closure.

**Each MMC-420 package contains:**

- One (1) MMC-420 Control Module
- One (1) Module label
- Six (6) 6"-18 gauge color coded wires with 1/4" Spade Connectors attached to one end
- One (1) Wiring template

**Other TAC Components Required:**

None

**Other TAC Components That May Be Required:**

None

**SPECIFICATIONS**

**Control Signal Inputs:**

**Variable Milliamp DC,**

**Span** 4 mAdc to 20 mAdc, non-adjustable.

**Start Point** 4 mAdc, non-adjustable.

**Maximum Input Signal** 25 mAdc.

**Input Impedance** 25 ohm for constant current output controllers. Other impedances can be obtained by adding series or parallel resistors for controllers without a constant current output.

**Hysteresis (Dead Band)** Typically 1.33 mAdc

**Power Requirements:** 24 Vac +10/-15%, 50/60 Hz., 3.9 VA.

**Power Supply Available:** 20 Vdc ± 1 Vdc, 35 mA (Regulated and filtered power supply that can not be paralleled with another supply).

**Environment:**

**Ambient Temperature Limits,**

**Shipping and Storage** -40 to 160°F (-40 to 71°C)

**Operating** -40 to 140°F (-40 to 60°C)

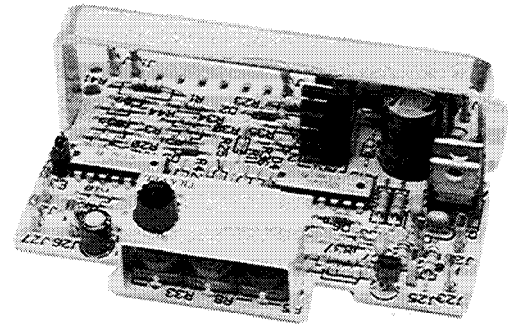
**Humidity**, 5 to 95% RH, non-condensing

**Locations**, NEMA Type 1 indoor only when installed in MM or MMR series of motors without AM-232 gasket installed (AM-232 provided with MMR series of motors) and motor mounted vertically - top up.

**Motor Stroke:** The internal mechanical stop of the motor is factory set at 160°.

The electrical stroke of the motor is adjustable from 90° to 160° by potentiometer on MMC-420.

The direction of motor rotation can be reversed with respect to the input signal. Factory set for CW rotation with respect to "Load" or "Load, Normally Closed - CCW Sprint Return" end of motor with increasing input signal.



**Connections:** The motor has 1/4" spade lugs. The MMC-420 includes 6" (152.4 mm.) color coded leads crimped to 1/4" female disconnects. Make field connections to color coded leads.

**Parallel Operation:** Do not parallel motors.

**Mounting:** Plug-in mounting in the MM or MMR series of motors. MMC-420 is not position sensitive.

**Dimensions:** 1-1/8" high x 3-1/2" wide x 2-1/2" deep (28.5 mm. x 89 mm. x 64 mm.) See Figure 1.

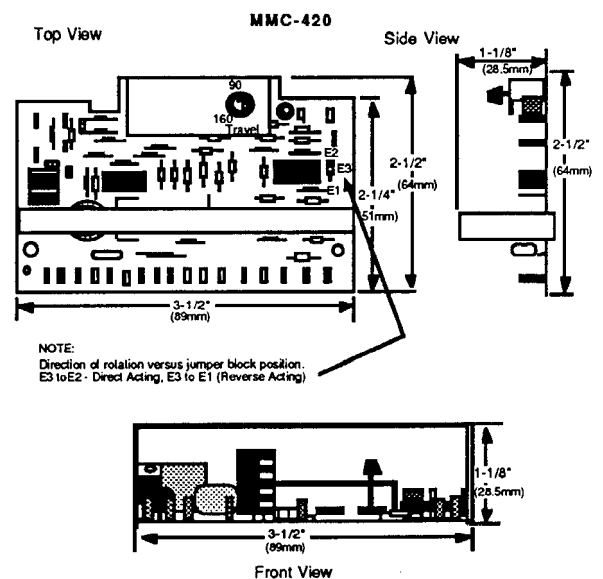


Figure-1 MMC-420 Plug-In Control Module Dimensions.

# PRE-INSTALLATION

## Inspection

Visually inspect the package for damage. If damaged, notify the appropriate carrier immediately. Visually inspect the device for obvious defects. Return damaged or defective products.

## Required Installation Items

- Wiring diagrams
- Tools (not provided)
  - Digital multimeter (DMM)
  - Screwdriver

# 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.

**Table-1 Motor Terminal Description.**

Terminal	Description
TR1	24 VAC 50/60 Hz. Power Input
TR2	24 VAC 50/60 Hz. Power Input
3	System Common (-)
5	+20 (20 Vdc ±1, 35 mA Power Supply)
9	System Common (-)
16	NOC, Dry Contact Closure
17	I11, Input Current (mAdc) (+)

## 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°), see Adjustments before installing control module.

2. Pick up the control module by the metal installation handle. Install the MMC-420 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.
3. The template supplied can be used for easy terminal installation. Place the template over the terminal block (See Figure 3).

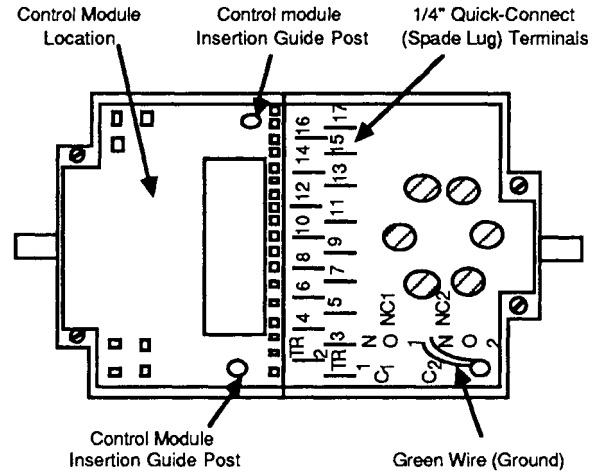


Figure-2 Terminal Board Connections and Control Module Location.

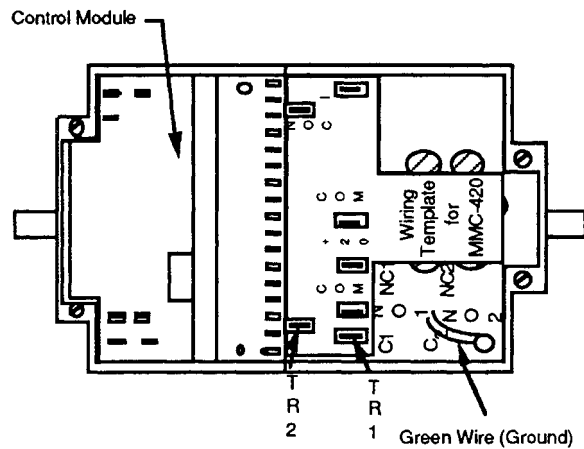


Figure-3 Terminal Board Connections with Wiring Template.

4. Make the wiring connections in accordance with job wiring diagram (See Figures 5, 6 and Table 2). The field connections are made to 6" (152.4 mm) long color coded leads. Note: The color coded leads are supplied with MMC-420 and have 1/4" female disconnects crimped to them. Install the leads to 1/4" spade lugs in the motor referring to Figures 5 and 6.

### a. Power Wiring

**Caution:** Use one (1) 24 Vac transformer per motor.

**Table-2 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 with transformer (AM-231) supplied by line voltage is on the run, divide the maximum run length shown in the table by the number of motors with transformer (AM-231) supplied by line voltage to determine actual maximum run length.

\* Use one (1) 24 Vac transformer per motor.

- b. **Control Wiring for mAdc Input Signal** Use 18 gauge 2-conductor twisted leads (TAC Part Number W-102) for runs up to 500 ft. (152 m) between motor and controller. Use a larger size on longer runs.

**Caution:** Use 18 gauge 2- conductor 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. Terminate the shield at the common terminal of the motor.

5. Install the wiring label included with MMC-420 control module on the inside of the motor cover so that the configuration of the motor can be determined at a later date.
6. Replace the motor cover and cover screws if the checkout is not being done at this time.

## ADJUSTMENTS

### MOTOR ADJUSTMENTS:

The mechanical stroke of motor is factory set for 160°. The mechanical rotation of the motor is adjustable to 75°, 90°, or 110° by use of the internal mechanical stop (See General Instructions F-23348 or F-23347).

*Note:* Make sure the mechanical stroke is properly set before the control module is installed.

Other mechanical adjustments are made in the linkages.

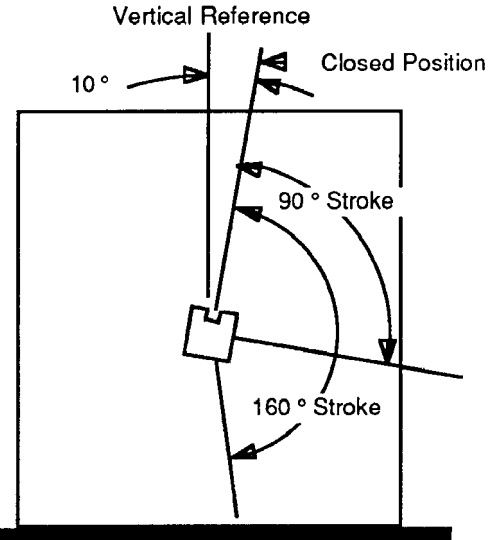
### MMC-420 CONTROL MODULE ADJUSTMENTS:

The MMC-420 control module provides the adjustments shown below. See Figure 1 for location of adjustments. In general the adjustments should be made in the order shown.

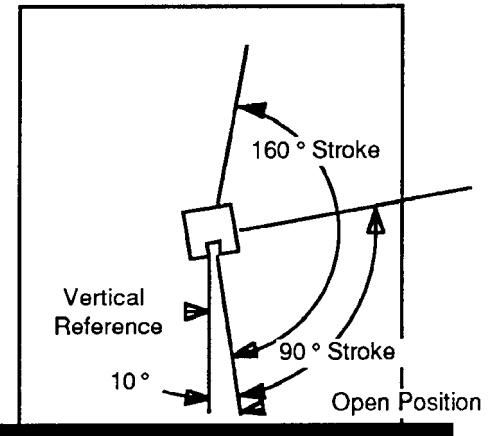
1. Jumper block to reverse the direction of motor rotation versus input signal.
2. Travel potentiometer to adjust the electrical travel of the motor.

### Direction of Motor Rotation Versus Input Signal to MMC-420 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 Spring Return" (end typically used for load) and the "Optional, Normally Open - CW Spring Return". The direction of rotation versus input signal can be reversed by rotation jumper block (See Figure 1). See Table 3 and 4 shown below for the direction of rotation versus input signal and rotation jumper block position. Put the rotation jumper block in the correct position for the application.



Motor stroke as viewed from the "Load" or "Load, Normally Closed-CCW Spring Return" end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-420.



Motor stroke as viewed from the "Optional" or "Optional, Normally Open-CW Spring Return" end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-420.

Figure-4 Motor Stroke.

**Table-3 Direction of Rotation of MM or MMR Series of Motors with the Rotation Jumper Block in Direct Acting Position [Factory Set Position (E3 to E2)].**

Signal	Normally Closed or Load End of Motor	Normally Open or Optional End of Motor
Increasing mAdc Signal	Drives CW ("Open")	Drives CCW ("Closed")
Decreasing mAdc Signal *	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.

**Table-4 Direction of Rotation of MM or MMR Series of Motors with the Rotation Jumper Block in Reverse Acting Position (E3 to E1).**

Signal	Normally closed or Load End of Motor	Normally Open or Optional End of Motor
Decreasing mAdc Signal	Drives CW ("Open")	Drives CCW ("Closed")
Increasing mAdc Signal *	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.

**Motor Stroke**

The electrical stroke of the motor is adjustable from 90° to 160° by the use of the travel adjustment potentiometer on the MMC-420 control module (See Figures 1 and 4). Clockwise rotation of the travel potentiometer increases the stroke. The mechanical rotation of the motor is also adjustable to 75°, 90°, 110° and 160° (See General Instructions F-23348 or F-23347). 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°. To set the electrical stroke:

1. Apply a control signal that drives the "Load" or "Load, Normally Closed - CCW Spring Return" end of motor to the full open (CW) position. For Reverse Acting, signal should be 4 milliamp value. For Direct Acting, signal should be 20 milliamp value.
2. Adjust the travel adjustment potentiometer for the desired stroke between 90° and 160°.

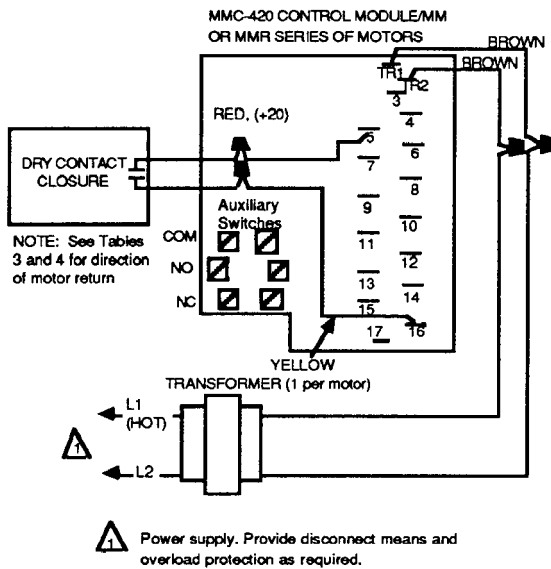


Figure-5 MMC-420 Control Module and MM or MMR Series of Motors Controlled From A Dry Contact Closure For Two Position Control.

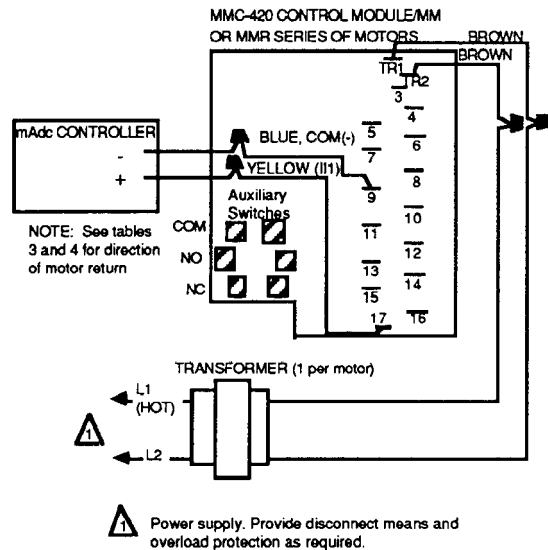


Figure-6 MMC-420 Control Module and MM or MMR Series of Motors Controlled From mAdc Controller.

**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. Refer to the General Instruction sheet(s) for the motor and any accessories during the checkout procedure. Also refer to the Adjustment Section above.

**Go, No-Go Test (Two Position)**

1. Remove the power from the motor. Disconnect the control leads from the motor.
2. Reconnect the power.
3. Jumper terminal 5 (+ 20) to terminal 16 (NOC). This is the same as a 20 mAdc ±1 input signal and should drive the motor to 20 mAdc position unless it already is in that position.
4. Remove jumper from terminal 5 (+ 20). This is the same as a 0 mAdc input signal and should drive the motor to 0 mAdc position.
5. Check for proper operation of the system as the motor is operated.
6. Disconnect the power from the motor.
7. Reconnect the control wiring from the motor.
8. Connect the power to the motor.

**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. Replace MMC-420 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 7). 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 capacitor type motor that drives the motor in one direction and spring that powers it in the other direction (See Figure 8). 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.

### Control Theory

The control signal; the setting of the stroke potentiometer; rotation jumper block position and the feedback potentiometer in motor are the inputs to the electronic circuit. With a given input signal [stroke potentiometer and rotation jumper block set (not varied)] there is only one motor position (feedback potentiometer position) that will balance the electronic circuit. As the value of the input signal changes, it unbalances the electronic circuit. The electronic circuit takes the unbalance and amplifies it to energize the triac switching to drive the motor in the correct direction to compensate for the input change. As the motor runs, the feedback potentiometer is repositioned to balance the electronic circuit and stop the motor rotation.

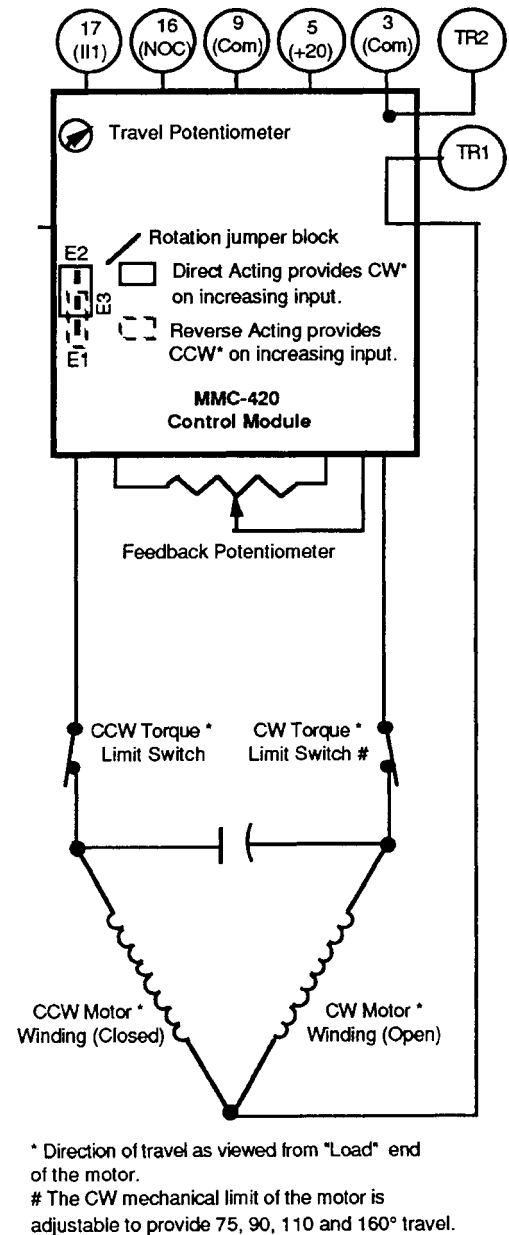
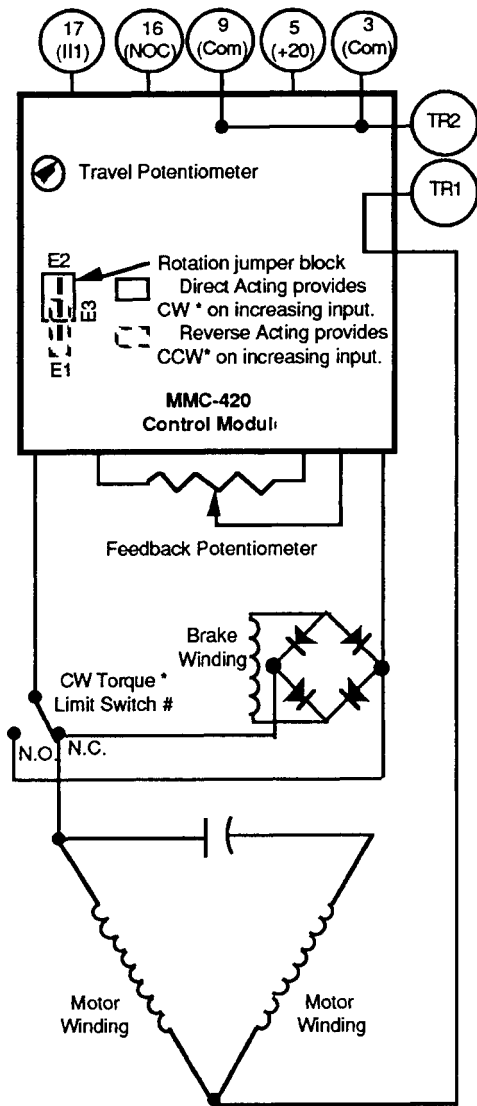


Figure-7 Internal Schematic of MM or MMR-400 Non-Spring Return Series of Motors with MMC-420 Control Module.



\* Direction of travel as viewed from "Normally Closed -CCW Spring Return" end of the motor.  
 # The CW mechanical limit of the motor is adjustable to provide 75, 90, 110 and 160° travel.

Figure-8 Internal Schematic of MM or MMR-500 Series of Spring Return Motors with MMC-420 Control Module.



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