

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

APPLICATION

The MMC-401 plug-in control module is used only in conjunction with MM/MMR-500 series of modular motors for modulating operation of mixed air dampers to provide "free" Outside Air cooling with temperature or enthalpy override. Modular motor will return to normal spring return position upon power interruption. Adjustable minimum position control 0 to 50% of travel setting.

The module will accept a TS-5721-102 thermistor duct sensor input.

Each MMC-401 package contains:

- One (1) MMC-401 Control Module
- One (1) Module Label
- Eleven (11) 6" - 18 gauge color coded wires with 1/4" Spade Connectors attached to one end
- One (1) Wiring Template

Other Components Required:

- TS-5721-102 Thermistor sensor

Other Components That May Be Required:

- AD-931-105 Remote Minimum Positioner
- THC-4 Enthalpy controller
- AM-232 Gasket kit for MM/MMR-500 series motor
- TC-4115 Outside air change-over thermostat

SPECIFICATIONS

Control Signal Inputs:

Thermistor resistance, 10,000 ohm at 77°F (25°C) - TS-5721-102

Sequence of Operation: See Figure 4.

Power Requirements: 24 Vac + 10/-15%, 50/60 Hz., 3.8 VA
24 Vac transformer must be used to power the motor. Wiring must be Class I.

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/MMR-500 series motors without AM-232 gasket installed, NEMA Type 3R with AM-232 installed and motor mounted vertically - top up.

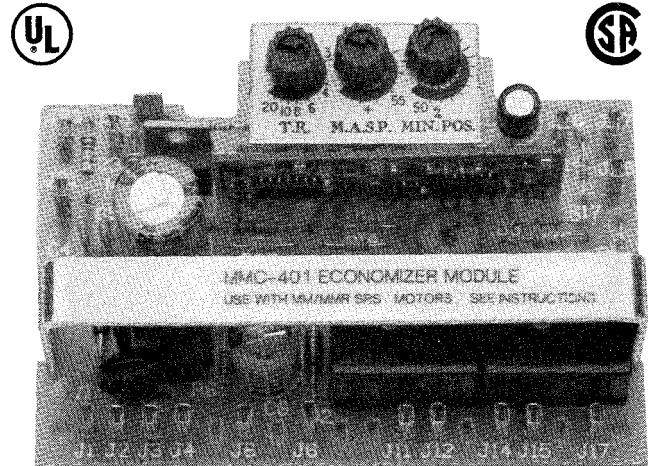
Adjustments:

Travel, The motor internal mechanical stop is factory set at 160°. The electrical travel limit of the motor is adjustable from 90° to 160° by potentiometer on MMC-401.

Mixed Air Set Point (M.A.S.P.), 40° to 65°F (4 to 18°C); factory set at 55°F (18°C).

Throttling Range (TR), 2° to 20°F (-16 to 7°C); factory set at 6°F (-14°C).

Minimum Positioner (Min. Pos.), 0 to 50% of the electrical travel setting.



Connections: The motor has 1/4" spade lugs. The MMC-401 includes 6" (152.4 mm) color coded leads crimped to 1/4" female disconnects. Field connections should be made to color coded leads.

Mounting: Plug-in mounting in the MM/MMR-500 series of motors. MMC-401 is not position sensitive.

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

Note: The TS-5721-102 Thermistor Sensor will mount in the same holes as the Honeywell C7046A or B Air Temperature Sensor but is not electrically compatible.

PRE-INSTALLATION

Inspection

Visually inspect the package for damage. If damaged, notify the appropriate carrier immediately. Visually inspect the device for obvious damage due to shipping. Return damaged products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
Digital volt-ohm meter (DVM)
Screwdriver

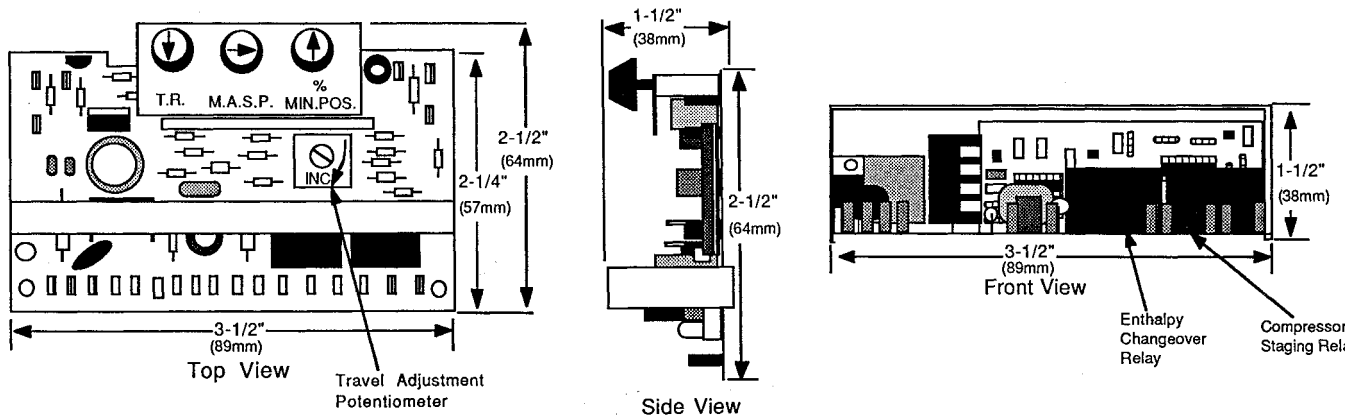


Figure-1 MMC-401 Control Module Dimensions.

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.

- Pick up the control module by the metal installation handle. Install the MMC-401 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 Figures 1 and 2).

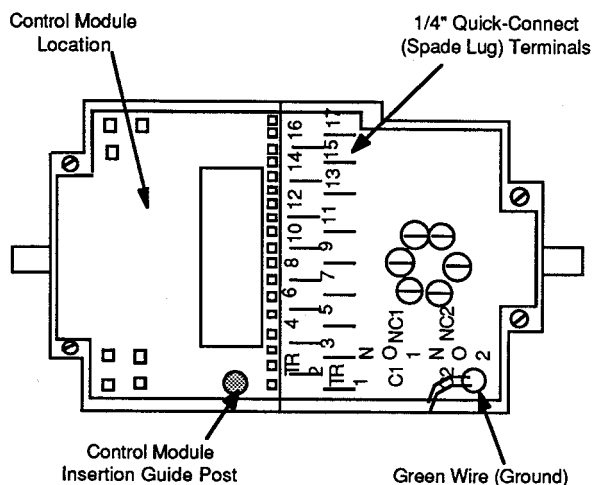


Figure-2 Terminal Board Connections and Control Module Location.

Table-1 Terminal Description.

Terminal	Description
TR1	24 VAC 50/60 Hz. Power Input
TR2	24 VAC 50/60 Hz. Power Input
T	Mixed Air Sensor 10K ohm (3)
24H	Cooling/Enthalpy Controller (4)
P1	Remote Minimum Positioner (6)
REL	Cooling/Enthalpy Controller (8)
T1	Mixed Air Sensor 10K ohm (11)
P	Remote Minimum Positioner (12)
NO2	Refrig. Normally Open Relay (14)
NC2	Refrig. Normally Closed Relay (15)
C2	Refrig. Common Relay (17)

Mounting and Wiring

- 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.

- The template supplied can be used for easy terminal installation. Place the template over the terminal block (See Figure 3).

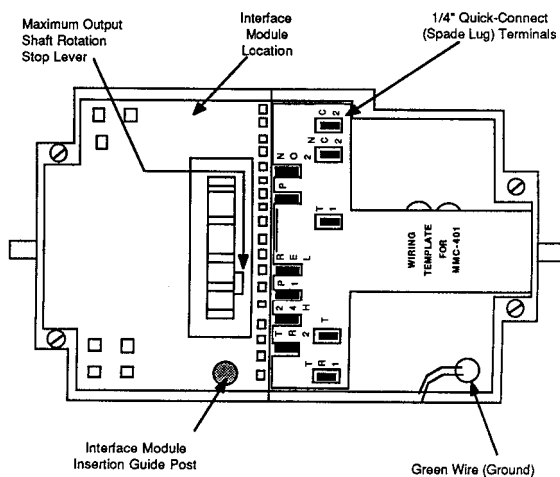


Figure-3 Wiring Template Positioning.

4. Make the wiring connections in accordance with job wiring diagram (See Figures 3, 4, 5 and Table 1). The field connections are made to 6" (152.4 mm) long color coded leads. Note: The color coded leads are supplied with MMC-401 and have 1/4" female disconnects crimped to them. Install the leads to 1/4" spade lugs in the motor.

Note: The MMC-401 Control Module is a one on one application - paralleling of additional actuators is not possible.

A. Power Wiring

See Table 2 for wiring limitations.

Caution: When multiple motors are powered from the same transformer, they must be in phase. That is connect the same transformer lead to the TR1 terminal on all motors and connect the other transformer lead to the TR2 on all motors.

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 is on the run divide the maximum run length shown in the table by the number of motors to determine actual maximum run length.

B. Control Wiring for Input Signals

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 controller only on the Com (-) terminal. Never connect the shield or common to earth ground.

5. Install the wiring label included with MMC-401 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 internal mechanical travel has been factory set to limit the maximum shaft rotation of 160°. The mechanical rotation of the motor is adjustable to 75°, 80°, 110° or 160° by use of the internal mechanical stop (See General Instructions F-23347 or F-23348).

Note: When MM/MMR-500 series motors are used with the MMC-401 Control Module, the shaft rotation can be adjusted between 160° and 90° by use of the electronic travel adjustment potentiometer on the control module. Make sure the mechanical travel is properly set before the control module is installed.

1. Remove the four (4) single slotted screws on the top of the motor cover.
2. Remove cover.
3. Remove the control module from the top of the motor using the metal installation handle.
4. Lift the stop lever away from the output gear using a thin single blade screwdriver [4" (102 mm) long minimum] until the lever can be rotated to a different setting. (See Figure 7).
5. Move the stop lever to the required setting.
6. Place the control module guide post holes over the insertion guide posts and push straight down on the metal insertion handle until the module is secured to the motor terminal cover.
7. Replace motor cover and cover screws.

Direction of Motor Rotation Versus Temperature Input Signal to MMC-401 Control Module

The MM/MMR-500 series of motors can have the load attached to either end of the motor. The ends of the MM/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". See Table 3 shown below for the direction of rotation versus temperature input signal.

Table-3 Direction of Rotation of MM/MMR-500 Series of Motors with Changing Temperature Input.

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

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

SEQUENCE OF OPERATION

When Enthalpy or Temperature is High, Economizer sequence is disabled:

- O. A. dampers will go to minimum position.
- Cooling Stage(s) controlled by room thermostat.
- Refrigeration programming relay C2 is made to NC2 (which allows 2nd stage of cooling).

When Enthalpy or Temperature is Low, Economizer sequence is enabled (O. A. can be used for cooling):

- O. A. dampers will modulate to maintain M. A. temperature setpoint.
- One stage of cooling is enabled and can be energized by a room thermostat.
- Refrigeration programming relay C2 is made to NO2 (disables 2nd stage cooling).

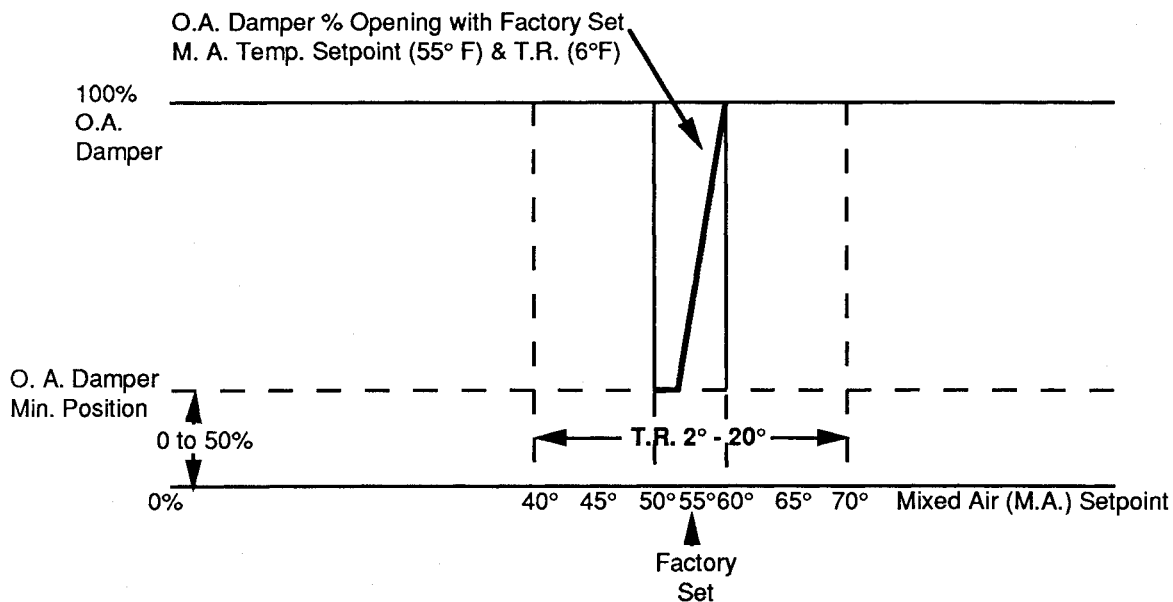


Figure-4 Economizer Sequence of Operation with Low O.A. Enthalpy/Temperature.

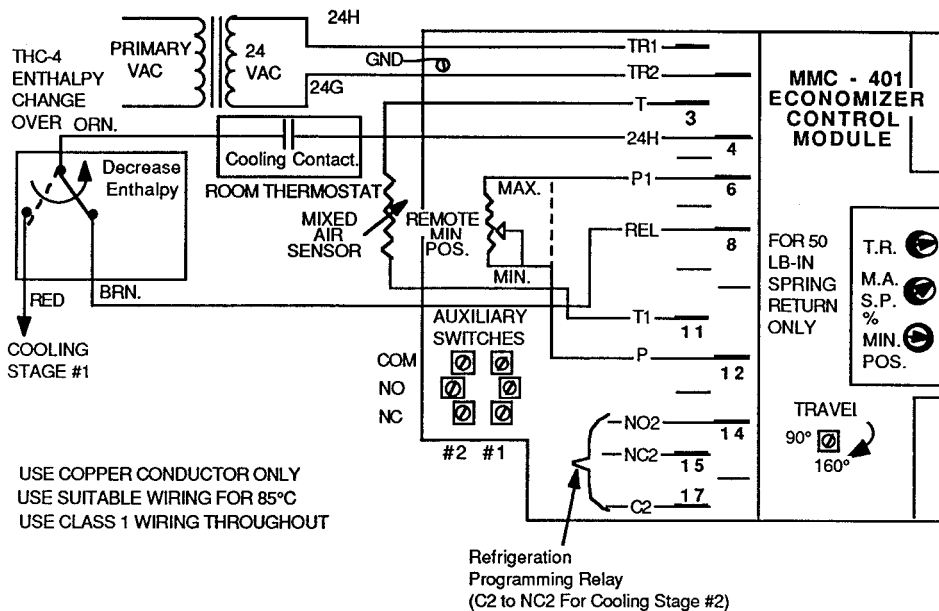


Figure-5 Typical Wiring Diagram with Room Thermostat and THC-4 Enthalpy Changeover.

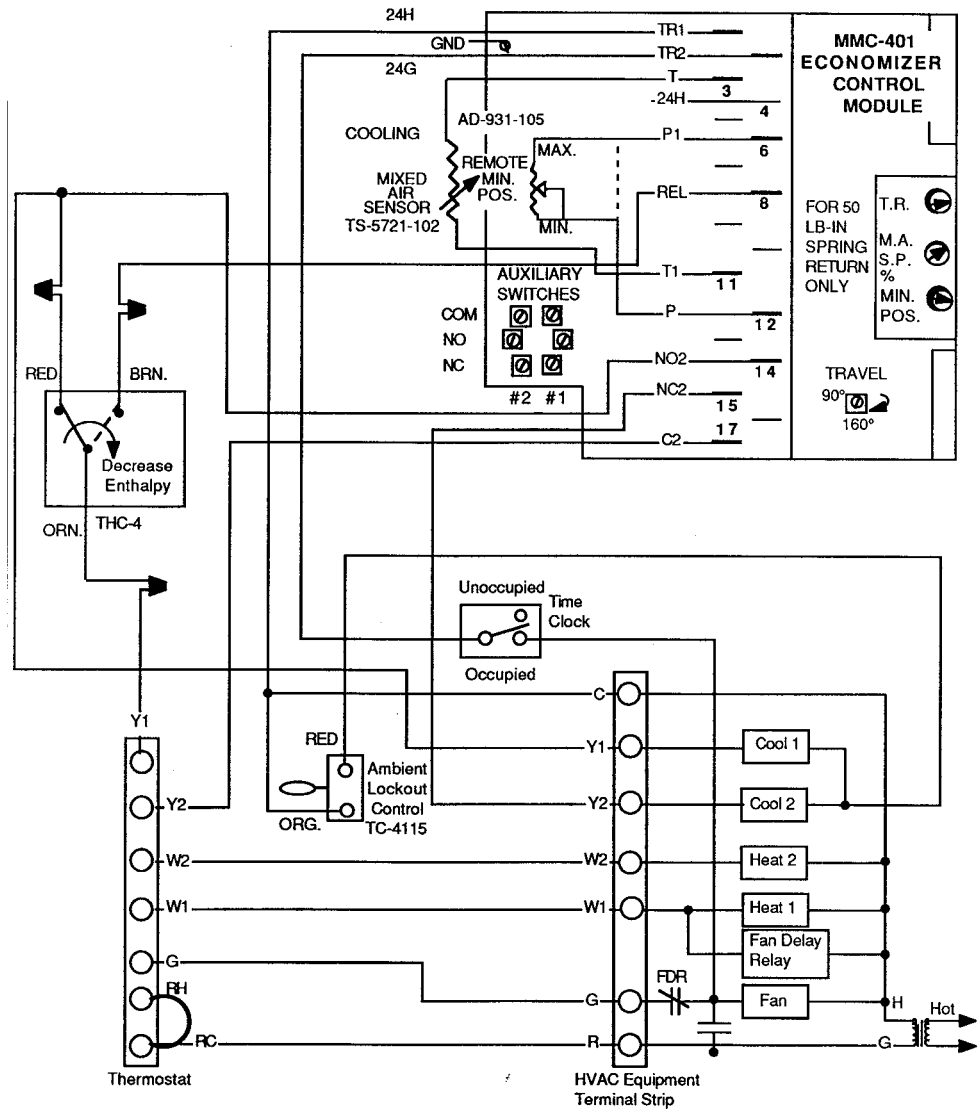


Figure-6 System Wiring Diagram.

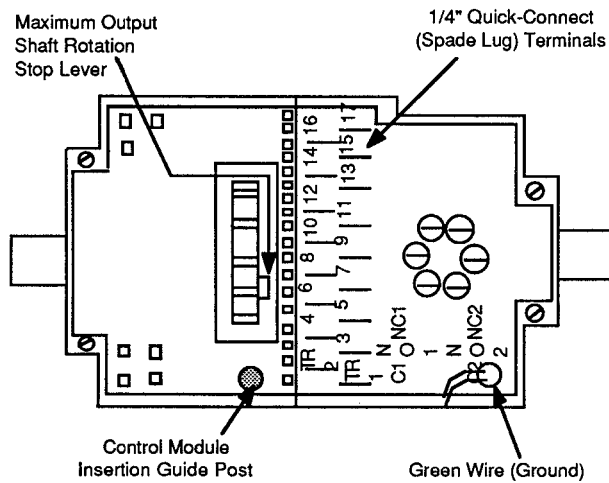


Figure-7 Maximum Output Shaft Rotation Stop Lever Location.

MMC-401 CONTROL MODULE ADJUSTMENTS:

The MMC-401 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.

A. Electronic Travel Adjustments

The electrical travel of the motor is adjustable from 90° to 160° by the use of the travel adjustment potentiometer on the MMC-401 control module (See Figure 1). The travel adjustment potentiometer setting does not affect the T.R. or M.A.S.P. potentiometer settings. Clockwise rotation of the travel potentiometer increases the travel. The mechanical rotation of the motor is also adjustable to 75°, 90°, 110° and 160° (See General Instruction F-23347 or F-23348). Make sure the mechanical travel is equal or greater than desired electrical travel. Typically only the electrical travel needs to be adjusted since mechanical travel is factory set for 160°. To set the electrical travel:

1. Place a jumper across the Thermistor T (3) and T1 (11) connections and across 24H (4) and Rel (8) connections on the MMC-401 Control Module to drive the "Load, Normally Closed - CCW spring return" end of motor to the full open (CW) position.
2. Adjust the travel adjustment potentiometer for the desired travel between 90° and 160° to adjust the electrical travel of the motor. Note: The travel potentiometer can be adjusted at any time since it has no effect on other settings.
3. Remove the jumper when adjustment is set.

B. Throttling Range (T.R.) Adjustments

Factory set at 6°F, but may be changed by:

1. Removing the four (4) single slotted screws on the top of the motor cover.
2. Remove cover.
3. Adjust the T.R. to the required setting (dial scale 2 to 20°F).
4. Replace the cover and screws.

C. Mixed Air Setpoint (M.A.S.P.) Adjustments

Factory set at 55°F, but may be changed by:

1. Removing the four (4) single slotted screws on the top of the motor cover.
2. Remove cover.
3. Adjust the M.A. setpoint to the required setting (range 40° to 65°F). The scale is set at 5°F spacing.
4. Replace the cover and screws.

D. Minimum Positioner (Min. Pos.) Internal

Note: If internal minimum positioner is going to be used a jumper must be placed between terminals P1 (6) and P (12) (See Figures 5 and 6).

Factory set at 0°, but may be changed by:

1. Removing the four (4) single slotted screws on the top of the motor cover.
2. Remove cover.
3. Move the minimum positioner dial to the required setting (maximum 50%).
4. Replace the cover and screws.

E. Minimum Positioner (Min. Pos.) Remote

If remote minimum positioning is required an AD-931-105 remote minimum position adjuster should be connected as shown in Figure 5 and 6.

Note: The internal minimum positioner must be rotated to the full clockwise position in order for the remote minimum positioner to function properly.

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 Instructions

sheet for MM-500 (F-23347) or the MMR-500 (F-23348) 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. Apply a jumper between terminals 24H (4) & REL (8); P1 (6) & P (12); and T (3) & T1 (11) this will drive the MM/MMR-500 modular motor to the full open position. Verify that the motor performs this operation properly.
4. Removing the jumper from terminals T (3) & T1 (11) will cause the MM/MMR-500 modular motor to spring return to the closed position. Verify that the motor performs this operation properly.
5. Disconnect the power.
6. Reconnect the control wiring.
7. Reconnect the 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-401 and/or motor.

THEORY OF OPERATION

General Description of MM/MMR-500 Series of Motors

The MM/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 7). When power is applied to the motor coil, the brake winding is not powered releasing the brake allowing the motor to run. 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. 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 settings of the M.A.S.P., T.R., minimum position and travel potentiometers and the feedback potentiometer in the motor are the inputs to the electronic circuit. With a given input signal [M.A.S.P., T.R., minimum position and travel potentiometers setting (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.

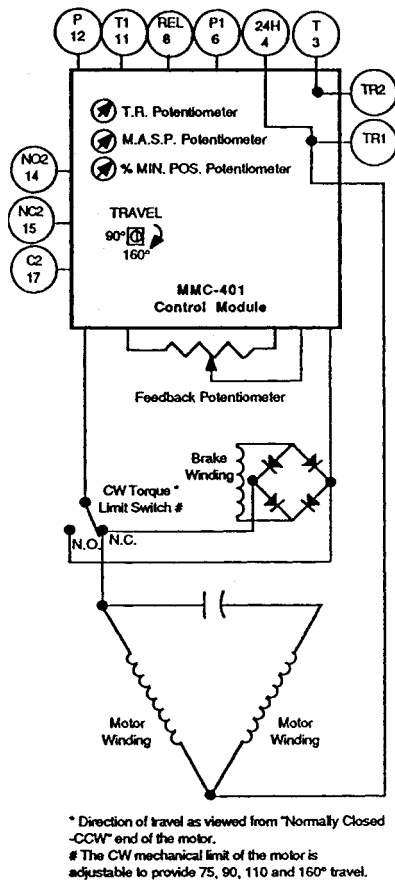


Figure-8 Internal Schematic of MM/MMR-500 Series of Spring Return Motors with MMC-401 Control Module.

Copyright 2008, TAC
All brand names, trademarks and registered
trademarks are the property of their respective
owners. Information contained within this
document is subject to change without notice.

F-23493-4

TAC
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL 61132-2940
www.tac.com

t.a.c. [®]
by Schneider Electric