

**APPLICATION**

For operation of air control dampers and water valves in HVAC systems.

**Each MM package contains:**

- One (1) MM Motor
- One (1) Factory installed Weather Resistant Kit
- One (1) TOOL-16 (used with MM "-002" models only.)
- One (1) General Instructions sheet

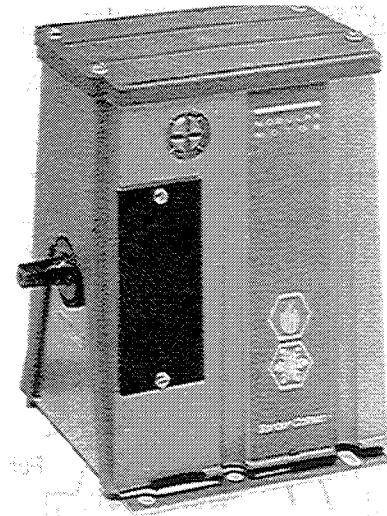
**Other Barber-Colman Components Required:**

MMC Control Module (refer to Table 3. Control Module Selection).

**Other Barber-Colman Components That May Be Required:**

**DAMPER LINKAGE**

- AM-111 Damper crank arm for 5/16" (7.9 mm) damper shaft.
- AM-112 Damper crank arm for 3/8" (9.5 mm) damper shaft.
- AM-113 Damper crank arm for 1/2" (12.7 mm) damper shaft.
- AM-115 Damper crank arm for 7/16" (11.1 mm) damper shaft.
- AM-122 Linkage connector, straight type.
- AM-123 Damper clip.
- AM-125 5/16" (7.9 mm) diameter x 20" (508 mm) damper rod.
- AM-125-048 5/16" (7.9 mm) diameter x 48" (1219 mm) damper rod.
- AM-132 Ball joint connector.
- AM-230 Motor crank arm
- AM-234 Damper linkage kit.
- AM-235 Multiple damper linkage kit.
- AM-301 90° angle mounting bracket.



**ACCESSORIES**

- AM-231 Transformer Kit (if power voltage not 24 VAC).
- AM-241 One (1) SPDT Auxiliary Switch Kit.
- AM-242 Two (2) SPDT Auxiliary Switch Kit.
- AV-632 Adaptor Kit (for mounting motor to Honeywell and Johnson valve linkages).

**VALVE LINKAGE**

- AV-630 Valve Linkage Kit (for mounting to Barber-Colman VB-9000 series valves).
- AV-633 Valve Linkage Kit with manual override feature (for mounting to Barber-Colman VB-9000 series valves).

**SPECIFICATIONS**

**TABLE 1. MM-400/500 SERIES MOTORS**

| Motor Part Number | Torque                  |                         | VA (Maximum) | Duty Cycle | Auxiliary Switch SPDT Snap-Acting** | Spring Return | Shipped from Factory with Shaft |
|-------------------|-------------------------|-------------------------|--------------|------------|-------------------------------------|---------------|---------------------------------|
|                   | Rated                   | Limit*                  |              |            |                                     |               |                                 |
| MM-500            | 50 lb-in<br>(5.6 N-m)   | 65 lb-in<br>(7.3 N-m)   | 20           | 50%        | None                                | Yes           | Full CCW Position               |
| MM-500-002        |                         |                         |              |            | 2                                   |               |                                 |
| MM-400            | 150 lb-in<br>(16.9 N-m) | 180 lb-in<br>(20.3 N-m) | 23           |            | None                                | No            |                                 |
| MM-400-002        |                         |                         |              |            | 2                                   |               |                                 |

\* Will not exceed under stall conditions.

\*\* Independently field adjustable within 160° of motor rotation. Differential factory set at 2°, field adjustable 2° to 10°. Switches must not be used for safety or limiting applications.

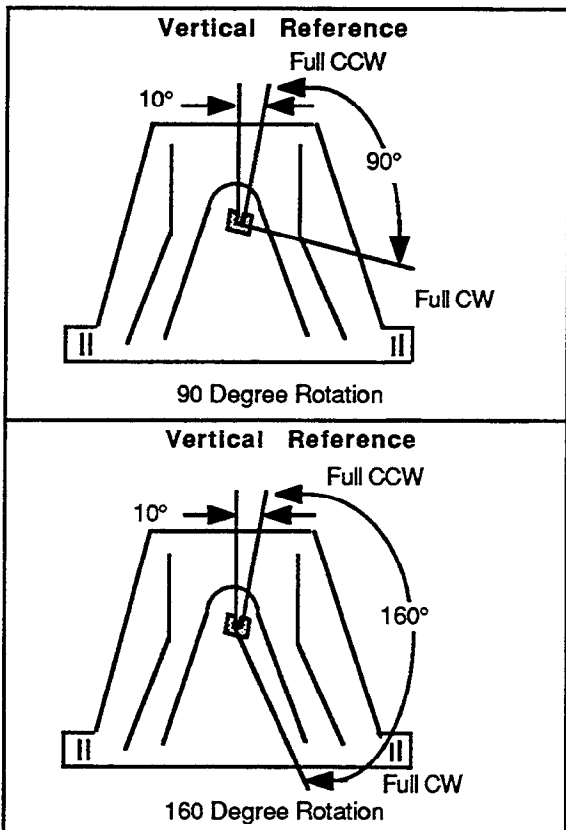
# SPECIFICATIONS

**TABLE 2. SPECIFICATIONS**

| MOTOR PART NUMBER | SHAFT ROTATION   |               |                                                    | NOMINAL DAMPER AREA SQ. FT. (SQ. M)* |               |
|-------------------|------------------|---------------|----------------------------------------------------|--------------------------------------|---------------|
|                   | ENERGIZED        | SPRING RETURN | MAXIMUM                                            | PARALLEL BLADE                       | OPPOSED BLADE |
| MM-500            | CW               | CCW           | 160°(FACTORY SET)<br>adjustable to<br>75°,90°,110° | 28 (2.6)                             | 36 (3.3)      |
| MM-500-002        |                  |               |                                                    |                                      |               |
| MM-400            | CW** OR<br>CCW** | —             |                                                    | 84 (7.8)                             | 108 (10.0)    |
| MM-400-002        |                  |               |                                                    |                                      |               |

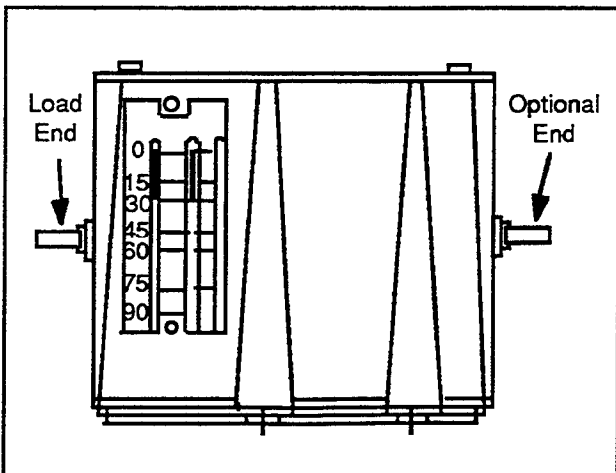
\* Damper ratings are nominal and based on standard (not low leakage) dampers at 1" (25.4 mm) W.C. pressure and 2000 fpm (10m/s).

\*\* Motor shipped from the factory at full CCW as viewed from "Load" end.

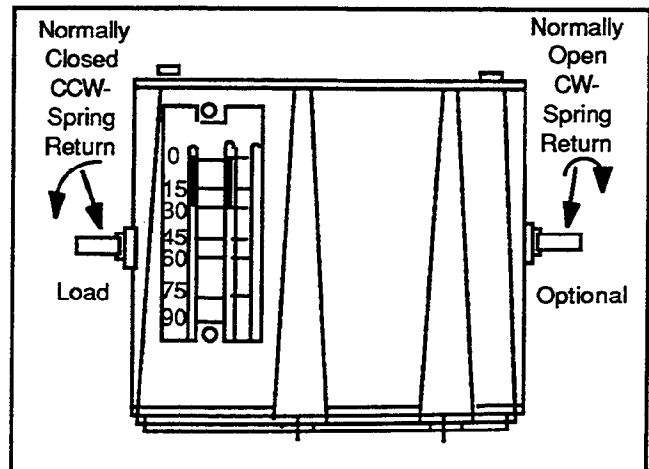


Full CW and CCW Position of Output Shaft as Viewed from the Load (Normally Closed) End of the Motor

**Figure 1. Motor Output Shaft Rotation**



**Figure 2. Output Shaft Designation for MM-400 Series**



**Figure 3. Output Shaft Designation for MM-500 Series**

**Control Circuit:**

Select the MMC Series Control Module for the control circuit being used, See Table 3.

**TABLE 3. CONTROL MODULE SELECTION**

| Control Signal                 | Control Module |
|--------------------------------|----------------|
| Two Position SPST or SPDT      | MMC-468        |
| 135 ohm slidewire              | MMC-90         |
| 0 to 20 mAdc or 0 to 20 Vdc    | MMC-8000       |
| TS-5721-102 Temperature Sensor | MMC-401*       |
| 4 to 20 mAdc                   | MMC-420        |

\*MMC-401 economizer module can be used only with MM-500 Series motor.

**Power Supply Required:** 24Vac Class 2 (+10/-15%) 50/60 Hz.

**Output Shaft, See Figures 1, 2, & 3:**

**Description,** Dual 3/8" (9.5 mm) square shafts with 3/64" x 3/16" (1.2 mm x 4.8 mm) keyways and #8-32 1/2" (12.7 mm) tapped hole in each end of shaft.

**Rotation,** (See Table 2) Shaft rotation as viewed from the front of the motor. *The front of the motors defined as the left end when facing the auxiliary switches adjustments.*

**Dead Weight Load,** 200 lb. (90.9 kg) either end.

**Timing,** See Table 4.

**TABLE 4. TIMING AT RATED TORQUE**

| Motor Part No. | Timing 160° @ 75°F (24°C) |                  |
|----------------|---------------------------|------------------|
|                | Drive                     | Spring Return    |
| MM-500         | 55 sec. ± 5 sec.          | 42 sec. ± 5 sec. |
| MM-500-002     |                           |                  |
| MM-400         | 50 sec. ± 5 sec.          | —                |
| MM-400-002     |                           |                  |

**Environment:**

**Ambient Temperature Limits,**

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

**Operating**

**MM-500** -40 to 140°F (-40 to 60°C).

**MM-400** -40 to 140°F (-40 to 60°C).

50% duty cycle, 10 minute maximum continuous run time.

**MM-400/500 with AM-231 Transformer Kit**

-40 to 130°F (-40 to 54°C).

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

**Vibration,** Maximum 1 G in any plane.

**Locations,** NEMA type 1 when mounted in any position; NEMA type 3R when mounted in vertical position up only, AM-232 gasket kit (factory installed) and Appleton ST-50 flexible metal conduit connection with STG-50 gasket field installed.

**Connections:**

**Control,** 1/4" quick-connect (spade lug) terminals.

**Auxiliary Switch,** Screw terminals.

**TABLE 6. AUXILIARY SWITCH SCREW TERMINAL DESIGNATION**

| TERMINAL        | FUNCTION        |
|-----------------|-----------------|
| NO <sub>1</sub> | Normally Open   |
| NC <sub>1</sub> | Normally Closed |
| C <sub>1</sub>  | Common          |
| NO <sub>2</sub> | Normally Open   |
| NC <sub>2</sub> | Normally Closed |
| C <sub>2</sub>  | Common          |

**Housing:** Glass reinforced thermoplastic (PET) UL-94-5V flame rated housing material to meet UL-465 requirements for air plenum mounting, plated steel base. One (1) 1/2" conduit knock-out on two sides of housing.

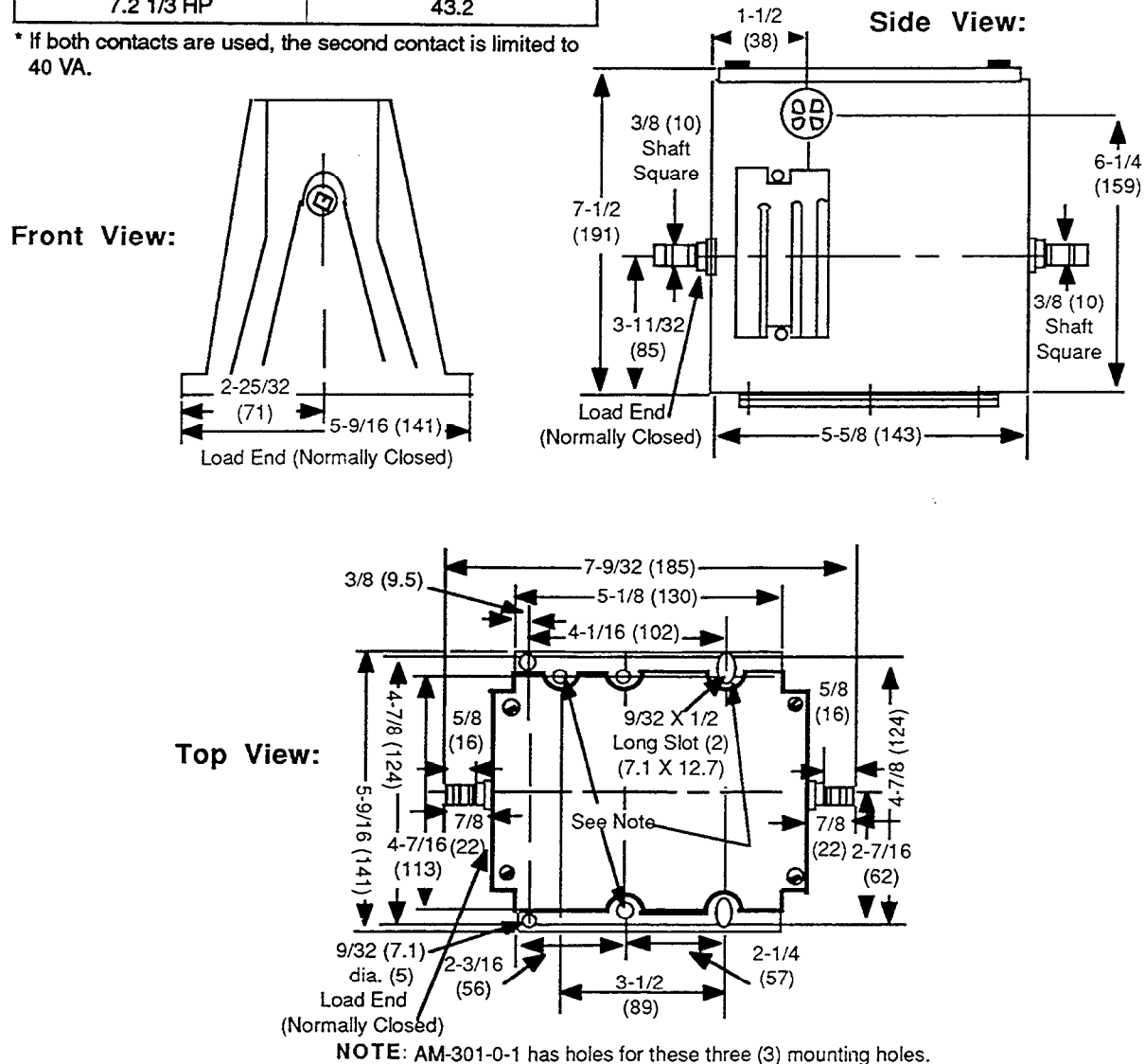
**Mounting:** Any position. Seven mounting holes for 1/4" machine screws.

**Dimensions:** 7-1/4" high x 5-9/16" wide x 5-5/8" deep (184 mm x 141 mm x 143 mm), see Figure 4.

**TABLE 5. AUXILIARY SWITCH AMP RATINGS\***

| 24 Vac     |      |
|------------|------|
| FLA        | LRA  |
| 7.2 1/3 HP | 43.2 |

\* If both contacts are used, the second contact is limited to 40 VA.



**Figure 4. Mounting Dimensions for MM-400, MM-500 Series**

## THEORY OF OPERATION

MM-400 and MM-500 Series modular motors are designed to be used with MMC-Series control modules. Functions, detailed wiring and typical application information will be found on control module General Instruction sheets.

The motor output shaft will travel between 0° and 160° depending on the control signal applied and the setting of the internal field adjustable stop lever.

## PRE-INSTALLATION

### Inspection

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

### Required Installation Items

- Appropriate MMC-Series control module.
- Wiring diagram.
- Tools (not provided):  
Volt-ohm meter.  
Appropriate screwdriver or wrench for mounting screws or bolts.  
Appropriate drill and drill bit for mounting screws or bolts.
- Appropriate accessories.
- Mounting screws or bolts (not provided).

## INSTALLATION

### CAUTION

1. Installer must be a qualified, experienced technician.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes. *Use copper conductors only that are suitable for 85°C. Wire to Class 2 circuits only.*
4. Do not exceed ratings of the device.
5. Avoid locations where excessive moisture, corrosive fumes or vibrations are present. NEMA Type 1 housings are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment. NEMA Type 3R housings when mounted in vertical position up only, AM-232 gasket kit factory installed, and Appleton ST-50 flexible metal conduit connection with STG-50 gasket field installed, are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet and external ice formation.

**Mounting** (See Figure 4 for mounting dimensions).

**Motor Location:** The motor can be mounted in any position in a weather protected area. Seven 9/32" (7.1mm) mounting holes for 1/4" screws or bolts are provided in the base of the motor (see Figure 4). Two (2) mounting screws or bolts on one side and one (1) screw or bolt on the other side of the motor are the minimum number of required fasteners. Locate the motor as close to the damper as possible.

## MMC CONTROL MODULES

### MOUNTING AND WIRING GUIDELINES

See Figure 5

Consult MMC Control Module General Instructions for complete mounting and wiring details.

1. Select the proper control module for the required application.
2. See **Field Adjustments** section of these instructions before installing control module.
3. Make the wiring connections in accordance with the wiring diagrams and as detailed in the MMC Control Module General Instruction Sheet.
4. Remove the four (4) top cover screws from the modular motor and remove the cover.

### NOTE

If maximum output shaft rotation needs to be changed (factory set at 160°). See Field Adjustments before installing control module.

5. Pick up the control module by the metal installation handle.
6. Place control module guidepost holes over insertion guide posts and push straight down on both ends of the metal insertion handle until module is secured to motor terminal cover.
7. Install the wiring label included with control module on the inside of the motor cover so that the configuration of the motor can be determined at a later date.
8. Proceed with field wiring.

### WIRING TO LINE VOLTAGE POWER SOURCES. (See Figure 5 for Terminal Designations)

MM-400/500 Modular Motors require 24 Vac Class 2 power source if motor is to be wired to line voltage power source (120, 208, and 240 Vac):

1. Use existing 24 Vac transformer (if available) or ...
2. Use an external line-to-24 Vac transformer or ...
3. Use Barber-Colman AM-231 Transformer Kit (120/208/240 Vac multiple tap primary to 24 Vac secondary). Consult AM-231 Transformer Kit General Instructions (F-23363) for complete installation instructions.

### 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.

*Not all control modules - check appropriate control module General Instructions - enable multiple motors to be powered from the same transformer.*

## LINKAGES

### Dampers:

See AM-230 Series General Instructions (F-23377) for specific installation instructions.

### Valves:

**MOUNTING TO BARBER-COLMAN VB-9000 SERIES VALVE BODIES,**  
AV-630 or AV-633 Series Linkages are required to mount Modular motor to Barber-Colman VB-9000 Series valve bodies. See AV-630 or AV-633 General Instructions (F-23352 or F-23355) for specific installation instructions.

### MOUNTING TO HONEYWELL AND JOHNSON VALVE LINKAGES:

AV-632 Adaptor kit is required to adapt motor to Honeywell and Johnson supplied valve linkages. See AV-632 General Instructions (F-23354) for specific installation instructions).

## FIELD ADJUSTMENTS

### SETTING MAXIMUM OUTPUT SHAFT ROTATION

(See Figures 5, 6 & 7)

The internal mechanical stop has been factory set to limit the maximum shaft rotation to 160°.

### NOTE

When MM motor is used with a control module that does not have a maximum shaft rotation adjustment potentiometer, maximum shaft rotation for less than 160° must be set by the internal mechanical stop lever.

The shaft rotation may be changed to 75°, 90°, or 110° by:

1. Removing the four (4) single slotted screws on the top of the motor cover.
2. Remove the cover.
3. Remove the control module from the top of the motor using the metal installation handle.
4. Run the motor until the stop lever on the output gear is accessible (See Figures 5, 6 and 7):

#### MM-400 Series:

- a. Apply 24Vac across P21 and P25. Motor should drive clockwise(CW) as viewed from the "Load" end.
- b. Apply 24Vac across P21 and P24. Motor should drive counterclockwise(CCW) as viewed from the "Load" end.

#### MM-500 Series:

- a. Apply 24Vac across P21 and P25. Motor should drive clockwise(CW) as viewed from the "Load, Normally Closed - CCW Spring Return" end.
- b. Remove power and the motor should spring return counterclockwise as viewed from the "Load, Normally Closed - CCW Spring Return" end.
- c. During spring return apply 24Vac across P21 and P23. The motor should stop. Remove power and the motor should continue to spring return.

5. Lift the stop lever away from the output gear using a thin single blade screwdriver [4" (102 mm) long min.] until the lever can be rotated to a different setting.
6. Move the stop lever to the required setting.
7. 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.
8. Replace motor cover and cover screws.

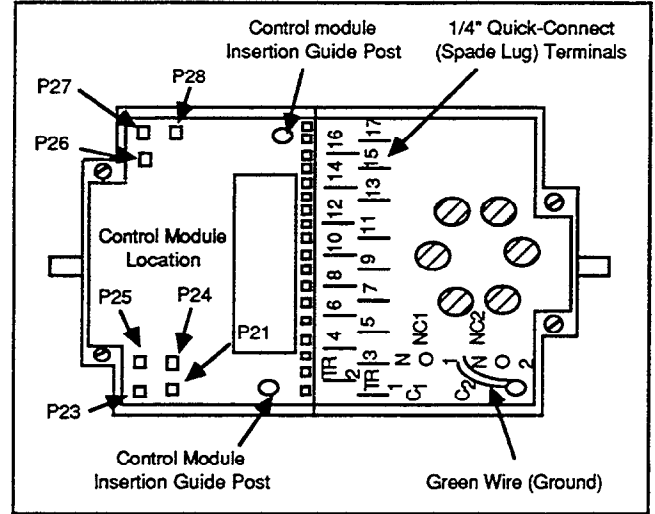


Figure 5. Terminal Board Connections and Control Module Location

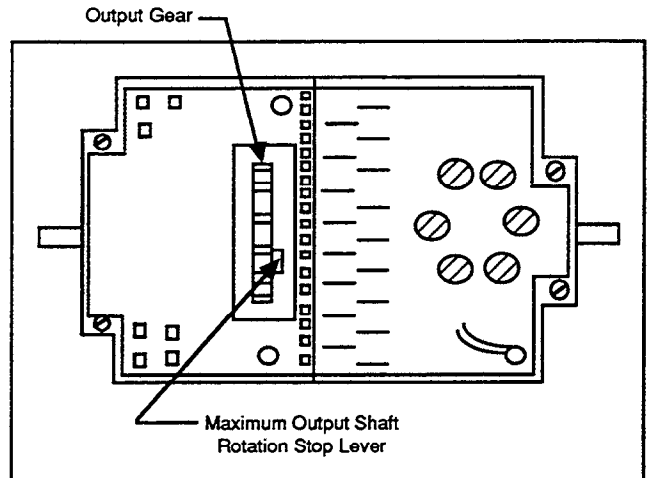


Figure 6. Maximum Output Shaft Rotation Stop Lever Location

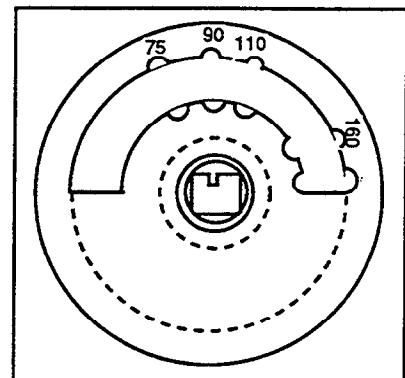


Figure 7. Output Gear Maximum Rotation Markings

**SETTING INTERNAL AUXILIARY SWITCHES (MM-400-002 & MM-500-002 Only) (See Figure 8)**

Remove the internal auxiliary switch cover plate, located just below a knockout, by loosening the two (2) single slotted screws on the plate.

**Settings - Field Adjustable:**

For switch settings between 0° and 90° shaft rotation.

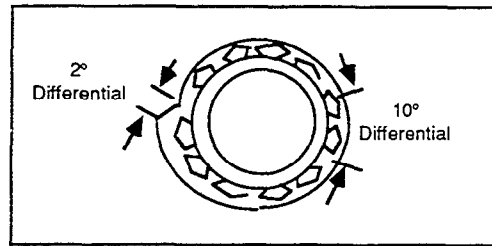
1. Move the appropriate switch adjustment lever to the required setting (each "click" on the movement of the lever is approximately 3°).
2. Power the motor and run through full stroke to check switch action using continuity test.
3. Replace the adjustment lever cover plate and screws.

For switch settings between 90° and 160° shaft rotation.

1. Insert TOOL-16 into place on auxiliary switch #1 or #2 cam.
2. Rotate the cam 90° CW with respect to the "Load" or "Load, Normally Closed - CCW Spring Return" end of the motor, add "90°" to the auxiliary switch settings marked next to the adjustment levers.
3. Power the motor and run through full stroke to check switch action using continuity test.
4. Replace the adjustment lever cover plate and screws.

**Differential - Factory Set at 2° (approximately) field adjustable to 10° (approximately) (See Figures 8 and 9):**

1. Insert TOOL-16 into place on auxiliary switch #1 or #2 cam.
2. Rotate the cam 180°. The switch differential will now be 10° (approximately).
3. Power the motor and run through full stroke to check switch action using continuity test.
4. Replace the adjustment lever cover plate and screws.



**Figure 9. Auxiliary Switch Cam Differential**

**CHECKOUT**

After the entire system has been installed, the following check for proper operation can be made:

1. Be sure that the system power is connected and ON.
2. Be sure control (manual or automatic) is operating the modular motor properly per system requirements.
3. Action of auxiliary switch (on MM-400-002 and MM-500-002 only):
  - a. C made to NC when motor is at de-energized and spring return to 0°.
  - b. C made to NO when motor shaft rotation reaches auxiliary switch setting.
4. Be sure there is no binding of the linkage at any point in the stroke.
5. If the motor fails to run, check the field wiring to insure proper voltage supply.
6. If the field wiring is correct and the motor fails to run, remove the control module and check motor function using the following procedure (See Figure 5):

**MM-400 Series:**

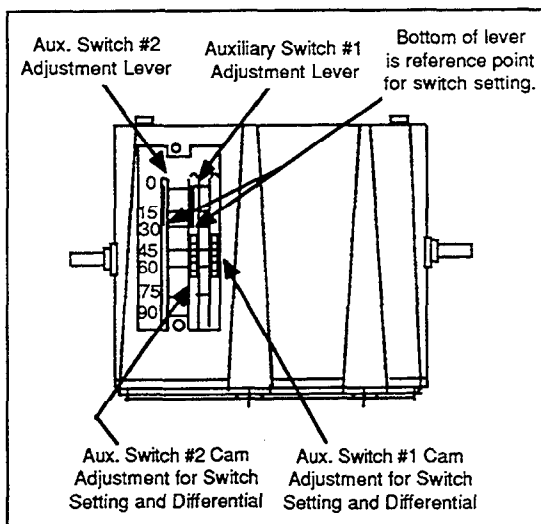
- a. Apply 24Vac across P21 and P25. Motor should drive clockwise(CW) as viewed from the "Load" end.
- b. Apply 24Vac across P21 and P24. Motor should drive counterclockwise(CCW) as viewed from the "Load" end.

**MM-500 Series:**

- a. Apply 24Vac across P21 and P25. Motor should drive clockwise(CW) as viewed from the "Load, Normally Closed - CCW Spring Return" end.
- b. Remove power and the motor should spring return counterclockwise as viewed from the "Load, Normally Closed - CCW Spring Return" end.
- c. During spring return apply 24Vac across P21 and P23. The motor should stop. Remove power and the motor should continue to spring return.

7. To check the potentiometer proceed as follows:

- a. Measure the resistance across motor terminals P26 and P27. Resistance should be as shown in Table 7.
- b. Measure the resistance across motor terminals P28 and P27. Resistance should be as shown in Table 7.



**Figure 8. Auxiliary Switch Adjustments (Shown with Adjustment Lever Cover Removed)**

**TABLE 7. POTENTIOMETER RESISTANCE CHANGE FOR FULL STROKE (160° Rotation) OF THE MOTOR**

| Load End or N.C. End of Motor | Optional End or N.O. End of Motor | Resistance Terminal P27 (Wiper) to P26 | Resistance Terminal P27 (Wiper) to P28 |
|-------------------------------|-----------------------------------|----------------------------------------|----------------------------------------|
| CCW End of Motor Stroke       | CW End of Motor Stroke            | 343Ω ±11%                              | 657Ω ±11%                              |
| CW End of Motor Stroke        | CCW End of Motor Stroke           | 957Ω<br>+15%, -10%                     | 0 to 75Ω                               |

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**CAUTION**

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This device is limited to 50% duty cycle. To achieve maximum service life, check the system to verify proper operation. The actuator shaft should not be continuously moving. After initial start-up and system stabilization, the actuator shaft should be moving less than 50% of the time. Exceeding 50% duty cycle limit will result in reduced life.

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**NOTE**

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If the actuator shaft is continuously moving, the system may be "hunting." System instability or "hunting" can be caused by:

- Throttling range too narrow
- Integral term set too fast
- Large temperature fluctuations caused by external influences at the sensor (e.g., fork lift truck exhaust, open garage doors)
- Oversized valves or mechanical equipment
- Other control strategies which may cause continuous actuator movement

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**MAINTENANCE**

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

**FIELD REPAIR**

None. Replace with a functional motor.

