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MMC-8000

Control Module General Instructions

APPLICATION

The MMC-8000 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 volt DC signal or a variable milliamp DC signal from a controller and accept Johnson type "G" control signals.

Each MMC-8000 package contains:
One (1) MMC-8000 Control Module
One (1) Module Label
Six (6) 6"-18 gage color coded wires with 1/4" Spade Connectors attached to one end
One(1) Wiring Template

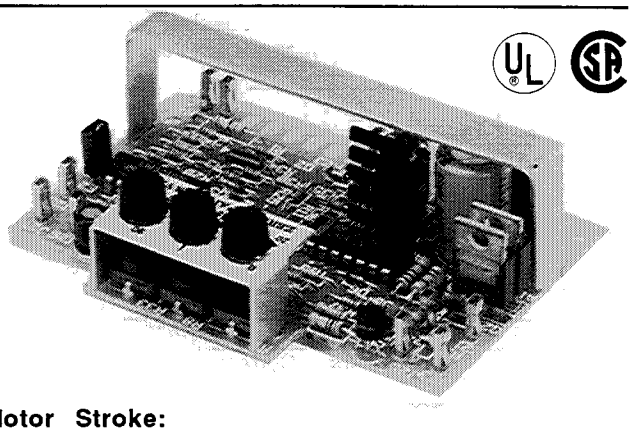
Other Components Required:
None

Other Components That May Be Required:
None

SPECIFICATIONS

Control Signal Inputs:
Variable VDC
Factory Setting, 6 to 9 Vdc.
Span, 1 to 20 Vdc (adjustable by span potentiometer)
Start Point, 12% of span setting to 20 Vdc (adjustable by zero potentiometer)
Maximum Input Signal, 25 Vdc
Input Impedance, 10 K Ω
Hysteresis (Dead Band), Typically 8.3 % of Span
Alternate Input Adjustment
Variable Milliamp DC
Span, 2 mAdc to 20 mAdc (adjustable by span potentiometer)
Start Point, 12% of span setting to 20 mAdc (adjustable by zero potentiometer)
Maximum Input Signal, 25 mAdc
Input Impedance, 250 Ω for 2 to 20 mA current output controllers. Other impedances can be obtained by adding series or parallel resistors for controllers with other current outputs.
Hysteresis (Dead Band), Typically 8.3 % of Span

Power Requirements: 24 Vac +10/-15 %, 50/60 Hz. , 3.9 VA.
Power Supply Available: 20 Vdc ± 1 Vdc, 35 mA (This regulated and filtered power supply must not be connected to +20 or red lead of 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, NEMA Type 3R with AM-232 installed (AM-232 provided with MMR series of motors) and motor mounted vertically - top up.



Motor Stroke:
The internal mechanical stop is factory set at 160°.
The electrical stroke of the motor is adjustable from 90° to 160° by potentiometer on MMC-8000.
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 Spring Return" end of motor with increasing input signal.
Connections: The motor has 1/4" spade lugs. The MMC-8000 includes 6" (152.4 mm) color coded leads crimped to 1/4" female disconnects. Field connections should be made to color coded leads.
Parallel Operation: Up to 6 MM or MMR motors with MMC-8000 control module in VDC mode of operation can be controlled from a System 8000 controller. Do not parallel actuators when using a variable input milliamp DC controller signal.
Mounting: Plug-in mounting in the MM or MMR series of motors. MMC-8000 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.

PRE-INSTALLATION

Inspection

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

Required Installation Items

- Wiring diagrams
- Tools (not provided):

  Digital volt-ohm meter (DVM)

  Screwdriver

  TOOL-201, Calibration kit for System 8000

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. Terminal Description

Terminal	Description
TRI	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	IV1, Input Voltage (VDC) One (+)
17	II1, Input Current (mADC) One (+)

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-8000 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 2 and 3).

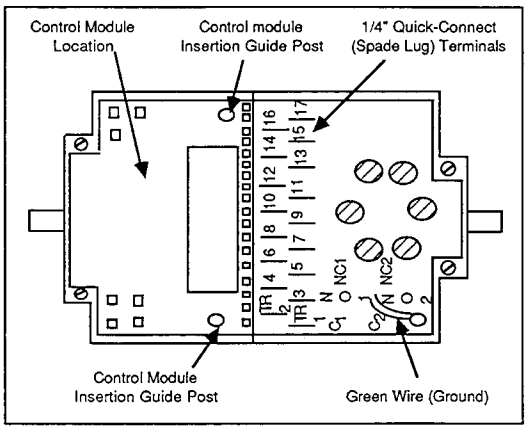


Figure 2. Terminal Board Connections and Control Module Location

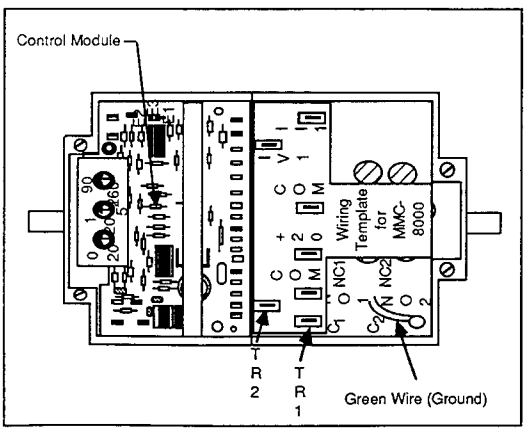


Figure 3. Terminal Board Connections With Wiring Template

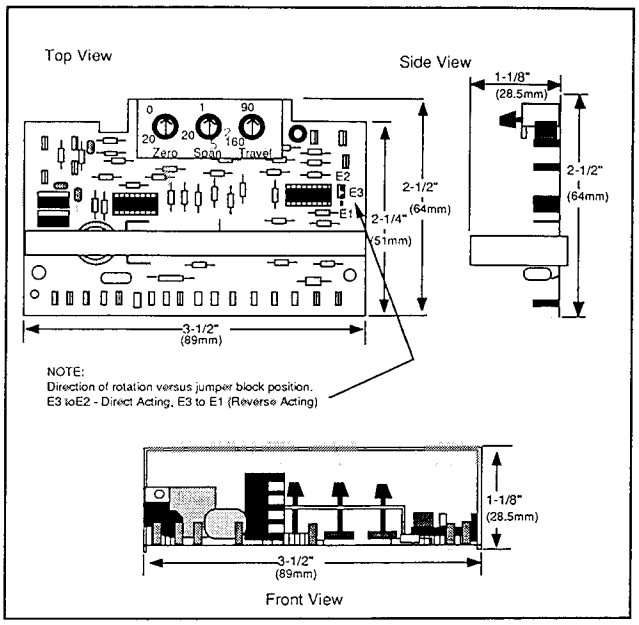


FIGURE 1. MMC-8000 PLUG-IN CONTROL MODULE DIMENSIONS

3. Make the wiring connections in accordance with job wiring diagram (See Figures 5 through 11 and Table 2).

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.

4. The field connections are made to 6" (152.4 mm) long color coded leads. Note: The color coded leads are supplied with MMC-8000 and have 1/4" female disconnects crimped to them.

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

6. Install the leads to 1/4" spade lugs in the motor referring to Figures 5 through 11.

A. Power Wiring

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.

B. Control Wiring for VDC Input Signal

Use 18 gage 3 - conductor twisted leads (Barber - Colman Part Number W-103) for runs up to 1,000 ft. (305 m) between motor and controller. Use a larger size on longer runs.

CAUTION

Use 18 gage 3 - 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 System 8000 controller only on the Com (-) terminal. Never connect the shield or common to earth ground.

C. **Control Wiring for mADC Input Signal**

Use 18 gage 2- conductor twisted leads (Barber - Colman 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 gage 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.

7. Install the wiring label included with MMC-8000 control module on the inside of the motor cover so that the configuration of the motor can be determined at a later date.

8. 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).

NOTE

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

Other mechanical adjustments are made in the linkages.

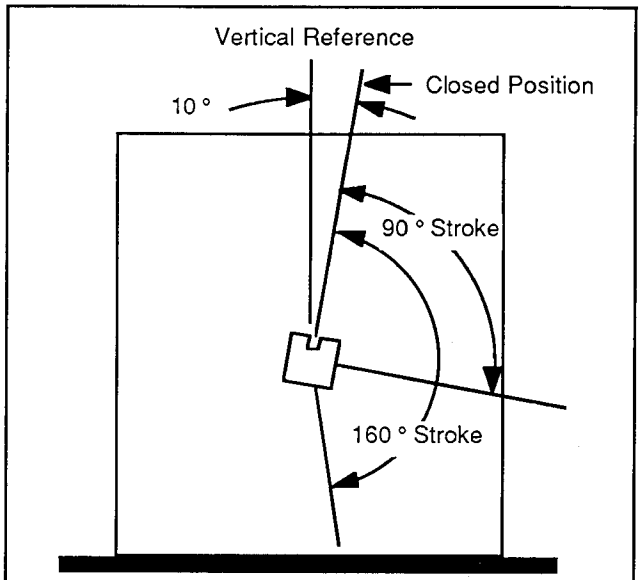
MMC-8000 CONTROL MODULE ADJUSTMENTS:
The MMC-8000 control module provides the adjustments shown below. See Figure 1 for location of adjustments. In general the adjustments should be made in the order shown.

1. Jumper block to reverse the direction of motor rotation versus input signal

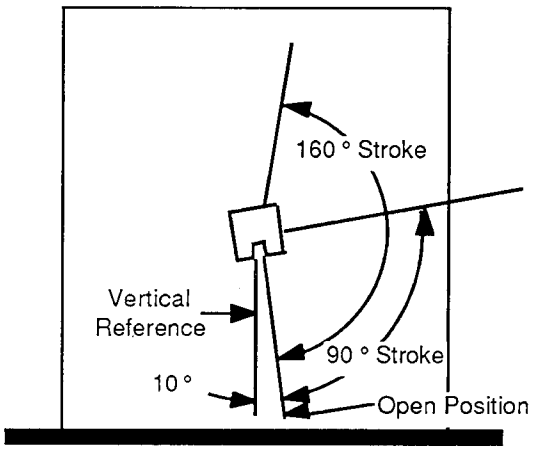
2. Span potentiometer to adjust span of input signal required to drive motor full stroke.

3. Zero potentiometer to adjust zero or the start point of the motor.

4. Travel potentiometer 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.



Motor stroke as viewed from the "Load" or "Load, Normally Closed-CCW' end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-8000.



Motor stroke as viewed from the "Optional" or "Optional, Normally Open-CW" end of motor. The stroke is adjustable from 90° to 160° with the stroke adjustment potentiometer on the MMC-8000.

Figure 4. Motor Stroke

Direction of Motor Rotation Versus Input Signal to MMC-8000 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 Tables 3 and 4 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.

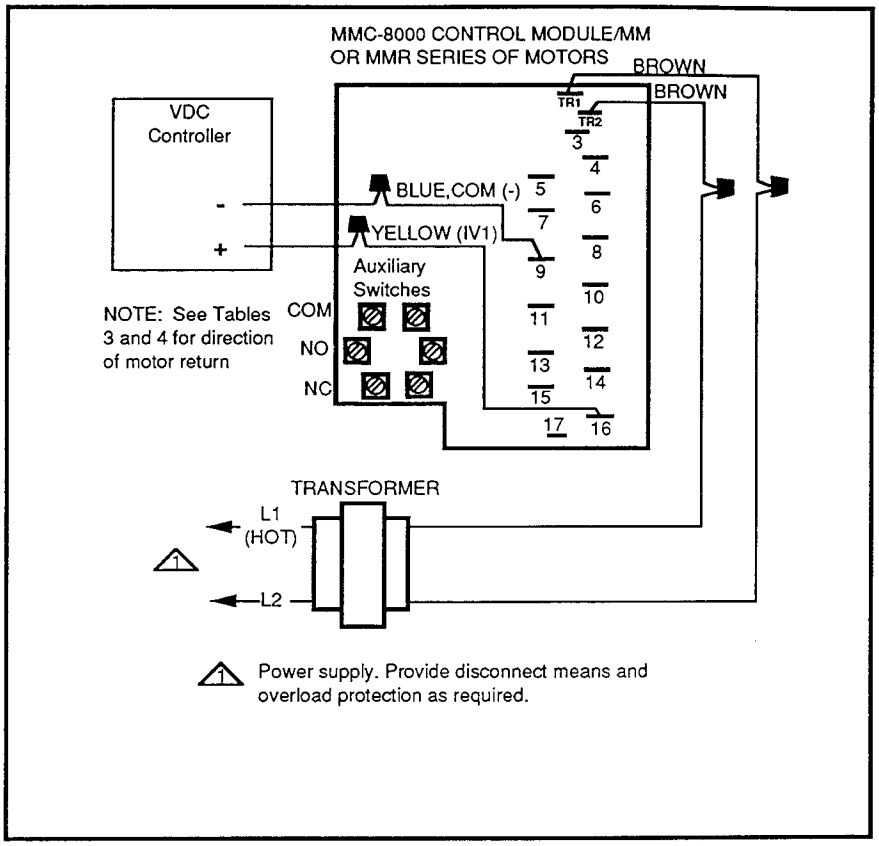


Figure 5. MMC-8000 Control Module and MM or MMR Series of Motors Controlled from a VDC Controller

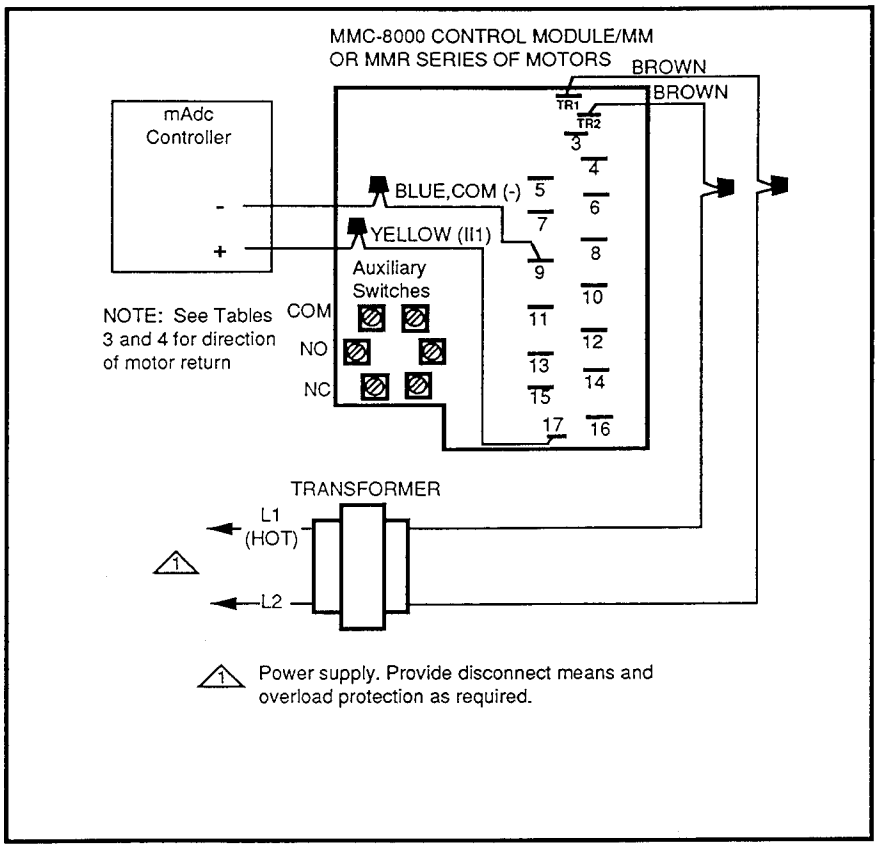


Figure 6. MMC-8000 Control Module and MM or MMR Series of Motors Controlled from a mADC Controller

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 or VDC Signal	Drives CW ("Open")	Drives CCW ("Closed")
Decreasing mADC or VDC 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 or VDC Signal	Drives CW ("Open")	Drives CCW ("Closed")
Increasing mADC or VDC 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.

Span Adjustment and Zero Adjustment (Start Point) of Input Signal

The span adjustment potentiometer should be set first since it has some effect on zero adjustment potentiometer. After the motor is powered and adjustable control signal VDC or mADC is available the final settings can be made using the procedure shown below.

1. Turn the span adjustment potentiometer to the approximate required settings per the scale and zero adjustment potentiometer fully clockwise.

2. Attach a digital volt - ohm meter (DVM) to terminals: For VDC input the terminals are 9 (-) and 16 (+); For mADC input the terminals are 9 (-) and 17 (+). For mADC conversion to VDC across terminals 9 and 17 (See Table 5).

3. Adjust the input signal to MMC-8000 until the desired Zero (Start Point) voltage (VDC) is read on DVM.

4. Slowly turn the Zero potentiometer in the decrease direction (CCW) until the motor starts and runs about 2 degrees from the zero position.

5. Slowly turn the Zero potentiometer in the increase direction (CW) until motor just stops running (closes to zero position).

6. Adjust the input signal to MMC-8000 until the desired end of stroke (Zero plus Span) voltage (VDC) is read on DVM. The motor should drive to or close to end of stroke position.

7. Slowly turn the Span potentiometer in the increase direction (CW) until the motor moves a couple of degrees toward zero position.

8. Slowly turn the Span Potentiometer in decrease direction (CCW) until the motor just stops moving (runs to end of stroke position).

9. Repeat steps 3 through 8 until the required results are obtained.

Table 5. The VDC Voltage Across (250 Ω) Terminals 9 (Com) and 17 (II1) with mADC Control Signal

mADC Control Signal	VDC Across Term. 9 &17	mADC Control Signal	VDC Across Term. 9 &17
0	0	13	3.25
1	.25	14	3.5
2	.50	15	3.75
3	.75	16	4.0
4	1.0	17	4.25
5	1.25	18	4.5
6	1.5	19	4.75
7	1.75	20	5.0
8	2.0	21	5.25
9	2.25	22	5.5
10	2.5	23	5.75
11	2.75	24	6.0
12	3.0	25	6.25

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-8000 control module (See Figures 1 and 4). The travel adjustment potentiometer setting does not effect the span or zero potentiometer settings. 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 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°. To set the electrical stroke:

1. Apply a control signal that drives the "Load" or "Load, Normally Closed-CCW" end of motor to the full open (CW) position. For Reverse Acting, signal should be ZERO (volt or milliamp) value. For Direct Acting, signal should be ZERO plus SPAN (volt or milliamp) values.

2. Adjust the travel adjustment potentiometer for the desired stroke between 90° and 160°.

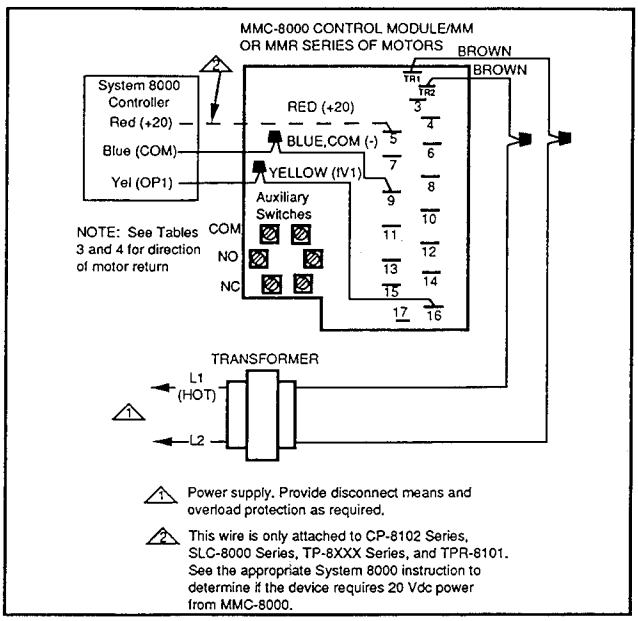


Figure 7. MMC-8000 Control Module and MM or MMR Series of Motors Controlled from a System 8000 Controller

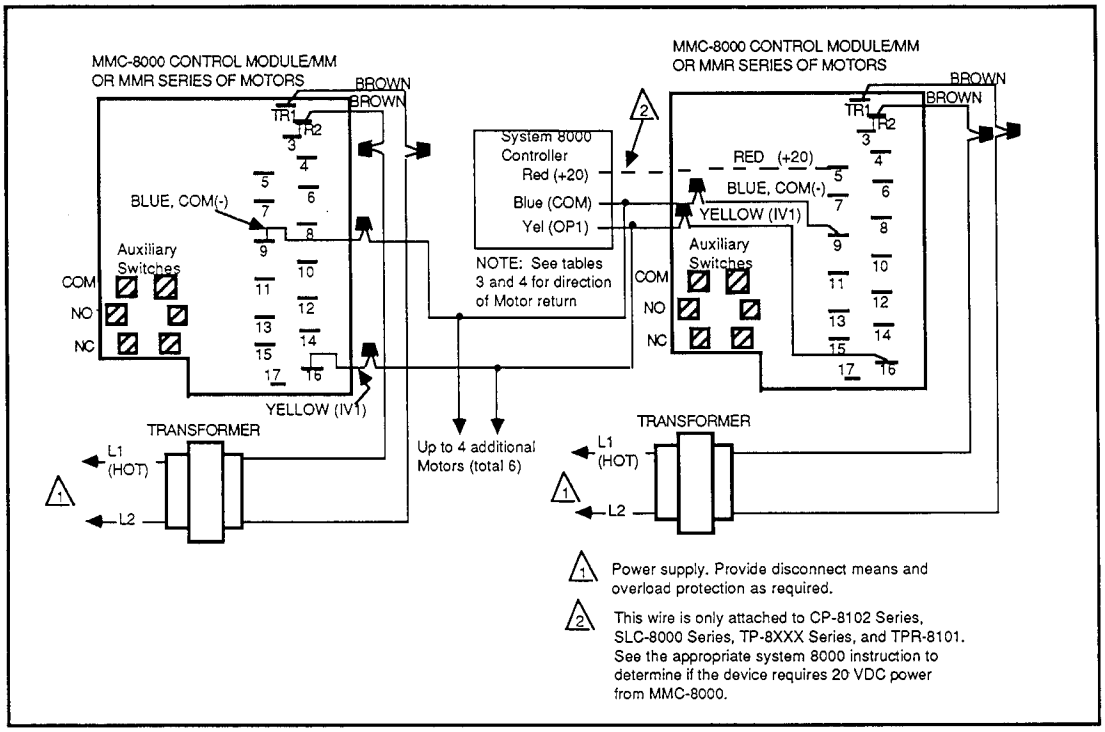


Figure 8. Parallel or Sequenced Operation of Up to 6 MMC-8000 Control Modules and MM or MMR Series Motors Controlled from a System 8000 Controller

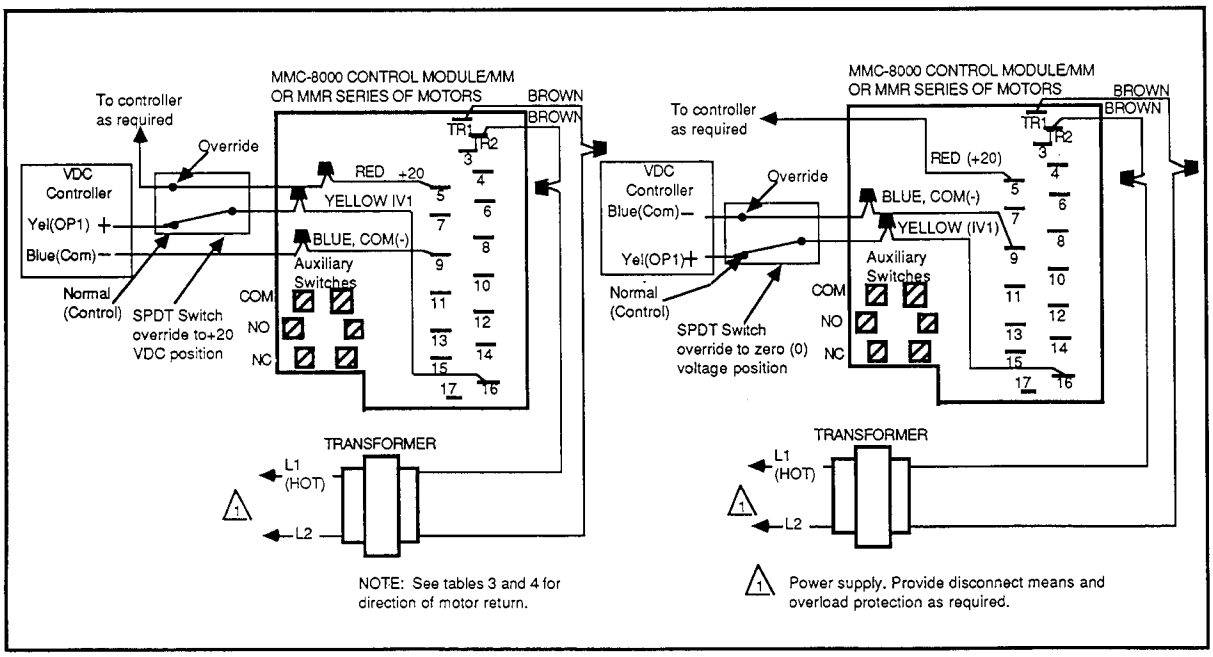


Figure 9. MMC-8000 Control Module and MM or MMR Series of Motors from VDC Controller with an Override

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(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 (red lead, + 20) to terminal 16 (yellow lead, IV1). This is the same as a 20 VDC ±1 input signal and should drive the motor to 20 VDC position unless it already is in that position.
4. Jumper terminal 9 (blue lead, Com) to terminal 16 (yellow lead, IV1). This is the same as a 0 VDC input signal and should drive the motor to 0 VDC position.
5. Check for proper operation of the system as the motor is operated.
6. Disconnect the power. Reconnect the control wiring and the power.

Manual Positioning with TOOL-201 (Calibration Kit for System 8000)

1. Remove the power from the motor. Disconnect the control leads from the motor.
2. Attach red lead of TOOL-201 to terminal 5 (+ 20) of motor, blue lead to terminal 9 (Com) and yellow to terminal 16 (IV1).
3. Attach a digital volt - ohm meter (DVM) to terminals 3 (-) and 16 (+)
4. Reconnect the power.
5. By turning the knob on TOOL-201 a 2 to 15 VDC signal can be produced.
6. While adjusting TOOL-201 check for proper operation of the system and the motor.
7. Disconnect the power, the DVM and the TOOL-201. 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-8000 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 10). 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 11). 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 settings of the zero, span and stroke potentiometers; rotation jumper block position and the feedback potentiometer in motor are the inputs to the electronic circuit. With a given input signal [zero, span and stroke potentiometers 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 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.

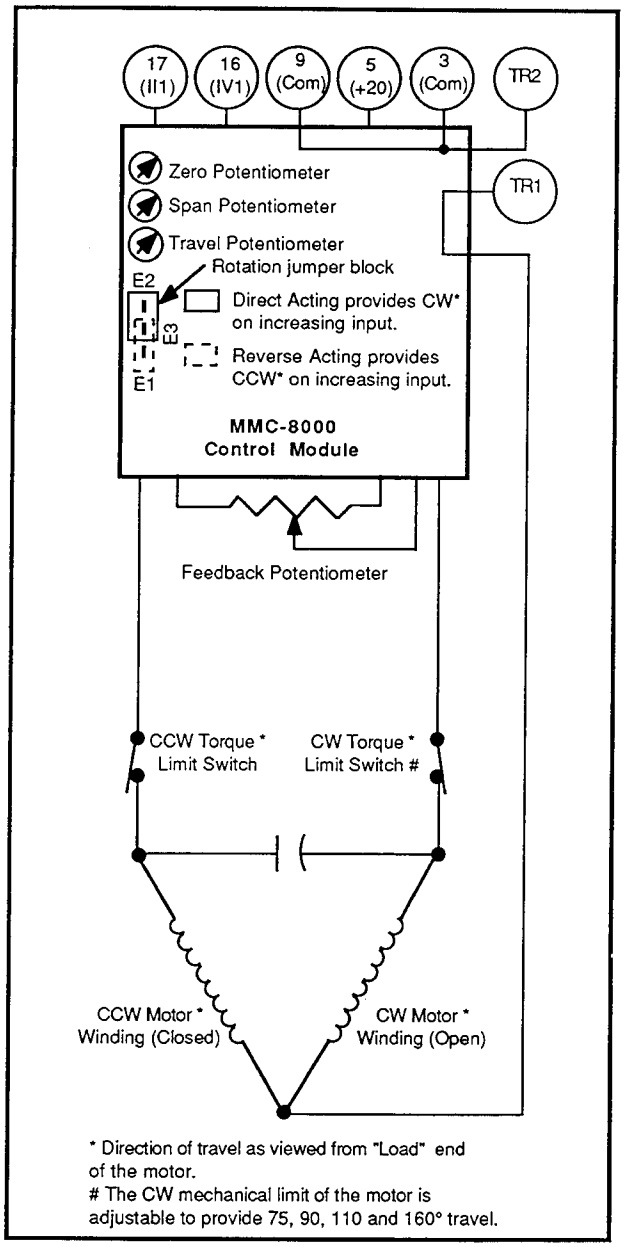


Figure 10. Internal Schematic of MM or MMR-400 Series of Motors with MMC-8000 Control Module

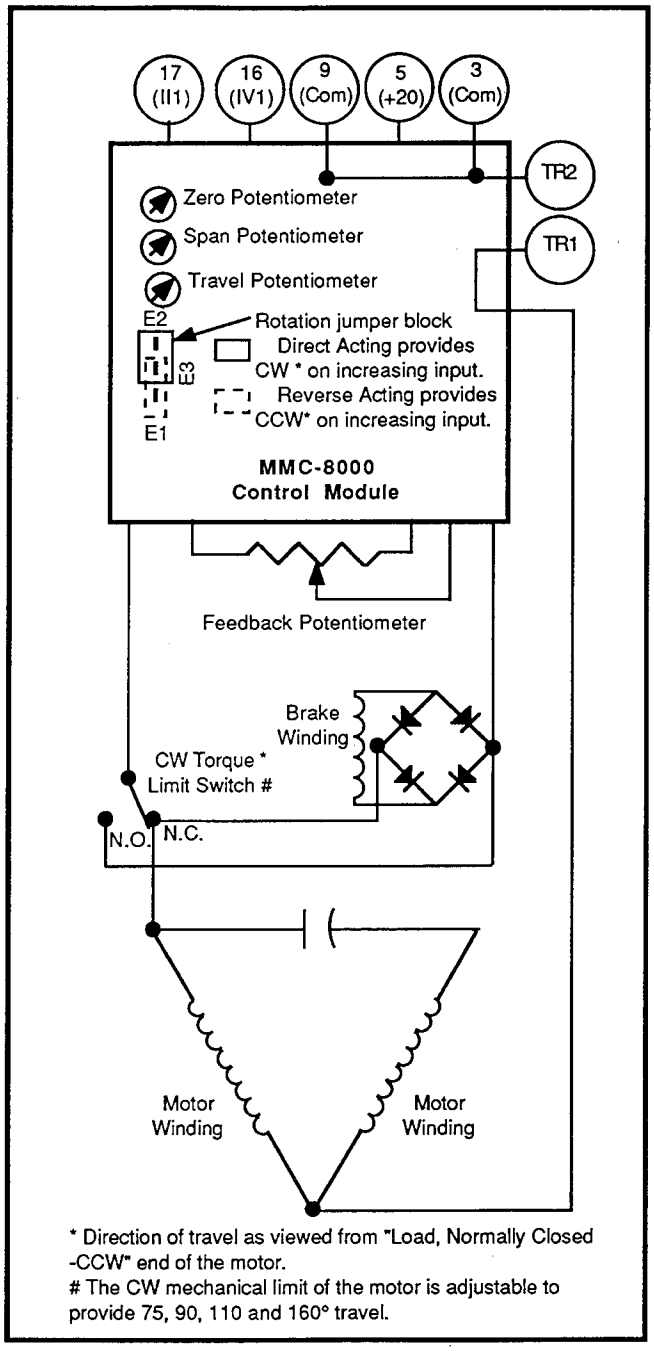


Figure 11. Internal Schematic of MM or MMR-500 Series of Spring Return Motors with MMC-8000 Control Module