The design of the M100M is to provide direct interface with the following Honeywell® Controllers:

1. All Series 90™ 135 ohm slidewire controllers.
2. W973 and W7100 Series Controllers for modulating valves in heating, cooling and water source economizer applications.

In addition, W973 and W7100 Series Controllers can be accommodated in air-to-air economizer damper applications when using a diode (1N4002) and resistor (620 ohm, 1/2 watt).

Note: The M100M is not a direct replacement for air side economizers with minimum position and outside air changeover logic as Honeywell wiring diagrams indicate. Refer to the wiring section for logic connections.

The following table lists the torque rating for each model (MXXXMYZ—where X = Model No.):

**Table 1: Torque Rating**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>M110</td>
<td>25 in-lb (2.8 N·m) Torque with Spring Return</td>
</tr>
<tr>
<td>M120</td>
<td>35 in-lb (4.0 N·m) Torque, Non-Spring Return</td>
</tr>
<tr>
<td>M130</td>
<td>50 in-lb (5.6 N·m) Torque with Spring Return</td>
</tr>
<tr>
<td>Model</td>
<td>Torque</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>M140</td>
<td>75 in-lb (8.5 N-m)</td>
</tr>
<tr>
<td>M150</td>
<td>150 in-lb (17 N-m)</td>
</tr>
</tbody>
</table>
The following table lists the input voltage options available (MXXXMYZ—where Y = Power Source Option):

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>120 VAC</td>
</tr>
<tr>
<td>D</td>
<td>240 VAC</td>
</tr>
<tr>
<td>G</td>
<td>24 VAC</td>
</tr>
<tr>
<td>H</td>
<td>24 VAC 1:1 Isolation</td>
</tr>
</tbody>
</table>

The following table lists the factory mounted accessories available (MXXXMYZ—where Z = Accessory Option):

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>No auxiliary switch</td>
</tr>
<tr>
<td>B</td>
<td>One SPDT switch S91DJ-1 installed on auxiliary end of M100</td>
</tr>
<tr>
<td>C</td>
<td>Two SPDT switches S91EJ-1 installed on auxiliary end of M100</td>
</tr>
<tr>
<td>D</td>
<td>S91 Potentiometer (1000 ohm) installed on auxiliary end of M100</td>
</tr>
</tbody>
</table>

The M100M horizontal terminal board is divided into two sections, Series 90 and W7100/W973.

The labeling of the Series 90 section contains Honeywell terminal designations R, B, and W. The wiring for a Series 90 Controller is color for color in heating applications and reversing W and B in cooling applications.

For heating applications, as the wiper arm R on the Series 90 Controller moves toward terminal B, the motor drives clockwise as viewed from the load end. As the wiper arm moves towards terminal W, the motor drives counterclockwise. All Series 90 overrides and minimum position networks are applicable.

The labeling of the W7100/W973 section is with terminal designations R1/T1 and W1. The labels of the W973 terminals are RH and WH for heating, RC and WC for cooling, and R and W for economizer applications. The labels of the W7100 terminals are R and W for heating, cooling and economizer applications. Terminals R1/T1 and W1 respond to the control signal generated by the W973/W7100.

Note: The M100M must be the master motor actuator. It is not to be a slave.
The M100M can slave up to ten M100J slave actuators. Each slave actuator must have a separate transformer. Do not mix Johnson Controls and Honeywell actuators in a master/slave application. All slave actuators must be of the same manufacturer as the master actuator.

The voltage between terminals T and X (when jumpered from XD or XR) is approximately 6 VDC at zero rotation of the output shaft. Full rotation of the output shaft occurs when the voltage between T1 and X is approximately 10 VDC.

**Travel and Timing**

The M100M Motor Actuator travel is factory set at 90 degrees and is adjustable from 65 to 270 degrees.

The timing of the actuator is 38 seconds for 90 degree rotation and 60 seconds for 160 degree rotation.
**Direction of Rotation**

![Direction of Rotation Diagram](image)

All reference to the direction of rotation is when viewing the load end as stamped on the actuator housing shown in Figure 2. From this view, the CCW limit is the zero reference.

The actuators are factory set at zero position which is 10 degrees clockwise from vertical (see Figure 2) and for 90 degrees clockwise travel. When using Y20 linkage kits, each 15 degrees of actuator rotation results in 0.1 inch (2.54 mm) of linear movement of the rack assembly.

**Dimensions**

![Dimensions Diagram](image)

**Figure 3: M100 with Spring Return Dimensions**
Figure 3 shows the dimensions for a standard M100 Series Motor Actuator. Additional space is to be allowed for options such as a switch kit (two inches additional length at auxiliary end).

## Installation Procedures

### Tools Needed
- Screwdriver, Phillips-head (No. 1 or 2 tip)
- Screwdriver, flat-blade, 1/8 inch tip

### Precautions and Code Requirements
Note: All Series M100 Motor Actuators are for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the user to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against and/or warn of control failure.

- Follow NEC and local electrical codes.
- Disconnect all power supplies.
- Observe the following ranges and limitations:

<table>
<thead>
<tr>
<th>Power Requirements</th>
<th>24 VAC at 50/60 Hz, 25 VA spring return, 20 VA non-spring return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Operating</td>
<td>-40°F to 125°F (-40°C to 52°C), 90% RH non-spring return</td>
</tr>
<tr>
<td>Conditions</td>
<td>-35°F to 125°F (-37°C to 52°C), 90% RH spring return</td>
</tr>
<tr>
<td>Ambient Storage</td>
<td>-40°F to 125°F (-40°C to 52°C), 90% RH</td>
</tr>
<tr>
<td>Conditions</td>
<td></td>
</tr>
</tbody>
</table>

- Do not install the motor actuator in atmospheres with explosive vapors or escaping gases, or where vapors having deteriorating properties might attack the actuator’s metal parts.
- Wiring into return air systems should be sealed to prevent aspiration of corrosive air into the actuator.

### Mounting
Upright mounting of the motor actuator is required.

When mounting on a valve, do not mount below the horizontal plane of the valve piping to prevent damage to the motor actuator if the valve leaks or develops condensation.

Valve medium temperatures above 250°F (121°C) are permissible only if the maximum ambient temperature at the motor actuator is less than 105°F (41°C).

Locate the motor actuator where the shaft and wiring terminals are accessible.

Follow installation procedures for the linkage kit used to couple the motor actuator and the controlled device.
When not utilizing a damper or valve linkage kit, use four 1/4 x 1 inch bolts for mounting the motor actuator.

Perform travel adjustments as described in the *Travel Adjustment* section.

**R81 Installation**

To install the R81 interface kit in a Series M100X Base Motor Actuator or remove and/or replace the electronic circuit boards in an existing Series M100 Motor Actuator, proceed as follows:

### Removing Boards

⚠ **CAUTION:** Disconnect the electrical power supply before attempting to remove the wiring connections and the boards to prevent possible electrical shock or damage to the equipment.

1. Remove the motor actuator’s top cover by loosening the two cover screws.
2. Verify that power is removed from the unit and disconnect all wiring connections to the terminal board.
3. Loosen the bracket screw and remove the bracket.
4. Pull the vertical board straight upward. Be careful not to bend or damage the pin terminals.
5. Remove the two screws from the terminal board.
6. Remove the terminal board by grasping the receptacles and lifting straight upward being careful not to bend or damage the pin terminals.

### Installing Boards

1. Install the terminal board by carefully placing the terminal receptacles onto the pin terminals.
2. Fasten the board in place using the screws that are supplied with the R81 kit.

3. Install the vertical board by carefully placing the terminal receptacles onto the pin terminals as shown in Figure 5.

   Note: Align all pins within the receptacle.
4. Place the bracket, supplied with the motor actuator, over the vertical board and fasten the bracket in place with captive screw as shown in Figure 6.

![Figure 7: Installing Identification Label](image)

5. Install the adhesive backed label supplied in the R81 kit.

**IMPORTANT:** As shown in Figure 7, locate the label on the insulation barrier. The letter on the R81 label will complete the number that identifies the Series M100 with the R81 installed.

6. Install the motor actuator.
7. Make control and 24 VAC wiring connections.
8. Turn on power supply.
9. Adjust, and check operation.

### Control Wiring

⚠️ **CAUTION:** Disconnect the electrical power supply before wiring the motor actuator to avoid possible electrical shock or damage to the equipment. Always disconnect the 24 VAC power supply before attempting to make any wiring connections.
Make all wiring connections using copper conductors only. Wire in accordance with National Electric Code and local regulations.

![Wiring Compartment](image)

**Figure 8: Attaching Wiring Junction Box To M100**

Make all splices in junction boxes using approved solderless connectors, or by soldering and then taping the connections. Locate all splicing and excess wiring outside the motor actuator wiring compartment. If desired, add a standard electrical box to the wiring compartment of the motor actuator as shown in Figure 8.

Runs less than 50 feet (15 m) long require no shielded cable for the VDC/mA control wiring. Avoid running low voltage control wiring in the same conduit as line voltage wiring or other conductors that supply highly inductive loads (contactors, coils, motors, generators, etc.).

If the control wiring is over 50 feet (15 m) long, run in a common conduit, or near inductive loads, we recommend the use of shielded cable. Use 22 AWG gauge, Beldfoil 8761 or equivalent for runs up to 250 feet (76 m). For 250 feet (76 m) to 500 feet (152 m) runs, use 18 AWG gauge Beldfoil 8760 or equivalent. Connect the shield only at the controller. Do not connect shield to any other point.
To connect the wires:

1. Loosen the two screws securing the top cover and remove the top cover for access to the wiring terminals.
2. Use a hammer and punch to drive out one of the access hole plugs.
3. Install the conduit connector to the motor actuator and secure using the conduit nut provided with the connector.
4. Connect the controller to the terminals located in the wiring compartment.
5. Connect 24 VAC to terminals T1 and T2.

Note: To avoid potential miswiring or control signal problems, the use of separate transformers on each M100 is required.

Note: For further information on any of the controllers illustrated, reference the applicable controller literature.
Figure 11: Proportional Override with Series 90 Controller

Figure 12: Minimum Positioning with Series 90 Controller
Figure 13: Typical Master/Slave Heating Application

Note: Slave actuators must be equipped with R81JAA-1 boards. Up to ten slaves may be accommodated by a single 135 ohm controller. Use separate transformers for each actuator.

Figure 14: Typical Heating/Cooling with W7100 Controller
Figure 15: Typical Water Economizer with W7100 Controller

Figure 16: Air-Side Economizer with Remote Minimum Positioning and Changeover with W7100 Controller
Note: Slave actuators must be equipped with R81JAA-1 boards. Up to ten slaves may be accommodated by a single 135 ohm controller. Use separate transformers for each actuator.

Figure 17: Master/Slave Valve Control with W973 Controller

Note: Slave actuators must be equipped with R81JAA-1 boards. Up to ten slaves may be accommodated by a single 135 ohm controller. Use separate transformers for each actuator.

Figure 18: Air-Side Economizer with Remote Minimum Positioning and Changeover with W973 Controller
Note: Slave actuators must be equipped with R81JAA-1 boards. Up to ten slaves may be accommodated by a single 135 ohm controller. Use separate transformers for each actuator.

Calibration Procedures

Travel Adjustment

The travel adjustment potentiometer mounted on the R81M horizontal terminal board enables positioning the M100 Actuator from 65 to 270 degrees rotation. Changing the travel adjustment affects the clockwise limit. Turn the adjustment clockwise to increase travel and counterclockwise to reduce total travel.

To make adjustments, use the following procedure or refer to the appropriate valve or damper linkage instruction.

1. Set the travel adjustment potentiometer fully counterclockwise.
2. Remove all control wires.
3. Apply 24 VAC between R1/T1 and T2.
4. Jumper terminals R and B to drive the motor to the fully clockwise position as viewed from the load end.
5. Slowly rotate the travel adjustment potentiometer clockwise to increase motor rotation until the corresponding valve or damper is in the desired position.
6. Remove the jumper between terminals R and B, enabling the motor to return to the full counterclockwise position as viewed from the load end.
7. Repeat steps four through six to provide proper stroking.
8. Turn off the 24 VAC and remove the 24 VAC from terminals R1/T1 and T2. Connect all control wires.

⚠️ CAUTION: Disconnect the electrical power supply before attempting to remove the wiring connections and the boards to prevent possible electrical shock or damage to the equipment.
Troubleshooting Procedures

Remote Relay Override Wiring

Before manually overriding the motor actuator, disconnect any control wiring and then jumper terminals R and B for CW direction, and R and W for CCW direction.

To checkout the system:

1. Connect all control wiring and apply 24 VAC.
2. Adjust the controller setpoint above and below the ambient temperature, making sure that the motor correctly drives open and closed. Refer to Honeywell’s controller checkout procedure if necessary.
3. If the motor does not drive correctly, check the motor operation with Steps 4 through 10. If the motor drives correctly, proceed to Step 11.
4. Remove all control wiring.

Figure 19: Configurations for Remote Relay Override

Checkout Series 90 Controller
CAUTION: Disconnect the electrical power supply before attempting to remove the wiring connections and the boards to prevent possible electrical shock or damage to the equipment.

5. Apply 24 VAC between R1/T1 and T2.
6. Jumper terminals R and B to drive the motor to the fully clockwise position as viewed from the load end.
7. Remove the jumper from between terminals R and B enabling the motor to return to the full counterclockwise position as viewed from the load end.
8. If the motor does not drive, check the 24 VAC power supply between R1/T1 and T2.
9. If the supply power wiring checks out, replace the R81M board and repeat the checkout procedure.
10. If the motor still does not drive properly, replace the base actuator.
11. If the motor drives properly, proceed to the controller checkout procedure. Refer to Honeywell’s Series 90 literature.

To check system (motor and controller) operation, proceed as follows:
1. Connect all control wiring and apply 24 VAC.
2. Adjust the controller set point above and below the ambient temperature, making sure that the motor drives open and closed correctly. Refer to Honeywell’s controller checkout procedure if necessary.
3. Set a voltmeter to the 10 VDC scale and place the leads across terminals R1/T1 (-) and W1 (+).
4. Check for nominal 0.5 to 1.4 VDC. At 0.5 VDC or less, the motor should be fully clockwise. At 1.4 VDC or more, the motor should be fully clockwise.
5. If 1.4 VDC is present and the motor does not drive, check the motor operation.
6. Remove all wiring.

CAUTION: Disconnect the electrical power supply before attempting to remove the wiring connections and the boards to prevent possible electrical shock or damage to the equipment.
7. Apply 24 VAC to R1/T1 and T2.
8. Jumper terminals R and B to drive the motor to the fully clockwise position as viewed from the load end.
9. Remove the jumper from between terminals R and B enabling the motor to return to the full counterclockwise position as viewed from the load end.
10. If the motor does not drive, check the 24 VAC power supply between R1/T1 and T2.
11. If the supply power wiring checks out, replace the R81M board and repeat the checkout procedure.
12. If the motor still does not drive properly, replace the base actuator.
13. If the motor drives properly, proceed to the controller checkout procedure. Refer to Honeywell’s W7100/W793 literature.

The drive motor and gear train are immersed in oil and sealed in a die cast case. Therefore, maintenance is not necessary.

Make no field repairs except for replacement of R81 plug-in interface kits. For repair parts or replacement, contact the nearest Johnson Controls Commercial Systems wholesaler or Systems and Services Division branch office.