Motoman®

MRM2-600 M3
Sigma III
Positioner Manual

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Chapter 1
Introduction

1.1 About This Document

This manual provides information about the Motoman MRM2-600 M3 positioner, and is organized as follows –

CHAPTER 1 - INTRODUCTION
Chapter 1 introduces this Positioner Manual, provides an overview of the MRM2-600 M3 positioner, discusses differences between left hand (LH) (-1) and right hand (RH) (-2) versions of the MRM2-600 M3 positioner, provides a table of MRM2-600 M3 positioner technical specifications, and provides Motoman 24-Hour Customer Support contact information.

CHAPTER 2 - SAFETY
Chapter 2 provides general information regarding the safe installation, maintenance, and operation of the MRM2-600 M3 positioner.

CHAPTER 3 - INSTALLATION
Chapter 3 provides instructions and procedures for set-up and installation of the MRM2-600 M3 positioner.

CHAPTER 4 - MAINTENANCE
Chapter 4 provides suggested procedures on basic and preventive maintenance for the MRM2-600 M3 positioner.

APPENDIX A - ILLUSTRATED PARTS LIST
Appendix A contains the Illustrated Parts List (IPL). The IPL provides detailed views (with part numbers) of MRM2-600 M3 positioner components.
1.2 Positioner Overview

The MRM2-600 M3 positioner can be used with a variety of applications that require precise parts movement. Typically, two MRM2-600 M3 positioners are installed as a pair (LH, -1 and RH, -2) and are integrated with a Motoman robot and controller in a work cell arrangement.

The Motoman MRM2-600 M3 positioner is an AC servo-driven, two-station headstock (HS) positioner. The MRM2-600 M3 does not use a tailstock assembly, as the tooling fixtures are “cantilevered” from each of the tooling plates attached to the positioner swing arm (see Figure 1). This means that each tooling fixture is attached and supported at one end, only. With the MRM2-600 M3 positioner, no tailstock assembly is necessary to support the tooling fixture (within rated load capacity).

Figure 1 Main Components – MRM2-600 M3 Positioner

NOTE:
Left hand positioner (-1) shown. Right hand positioner (-2) is a mirror image and is identical to the (-1) except for position of hardstops and position of welded hardstop contact points on the swing arm assembly (refer to Section 1.2.1 of this manual).
The swing arm and both tooling plates are rotated by individual AC servo-driven motors (working through gear reduction units) that are controlled by servo circuitry located in a controller. The controller can rotate all three axes of the MRM2-600 M3 positioner during a sweep motion, resulting in tooling fixtures being in the desired position at the end of the sweep motion. In addition, movement of the MRM2-600 M3 positioner can be coordinated with robot motion to allow complex jobs such as the welding of circumferential joints.

The swing arm assembly rotates around a central axis and is limited in rotation by hardstops located on the main drive assembly mounting plate (see Figure A.2, Items 6 and 7). Hardstop mounting points differ between LH (-1) and RH (-2) MRM2-600 M3 positioners (see Figure 2). As a result, swing arm assemblies also differ between LH (-1) and RH (-2) MRM2-600 M3 positioners, in the location of the welded hardstop contact points on the swing arm housing.

Dual “in position” switches are mounted to the main drive assembly plate (see Figure A.3, Item 4). These provide switch closures, as a backup to encoder data, to indicate to safety circuitry whether or not the swing arm assembly is in the correct and safe position.

A tooling plate multiple angle control feature allows the programmer to define the angle of the tooling presented to the operator (with a resolution of approximately 2.5°). This improves load station ergonomics and part tacking (see Figure 3).

![Figure 2](image_url)

**Figure 2** Hardstop Mounting Points – LH (-1) and RH (-2) MRM2-600 M3 Positioner
Mounting holes in the tooling plates provide for tooling fixture mounting (see Figure 9).

Each servo motor incorporates a small, external Lithium-Ion “keep alive” battery that maintains servo positioning data in memory should the main cables between the positioner and controller be disconnected. A battery for each servo motor encoder is part of each cable assembly (internal to the MRM2-600 M3 positioner) that connects each servo motor to its associated multi pin plug on the base of the headstock assembly (see Figure 13). These batteries have a very long life. However, if they drop below a certain charge level, an indication appears on the display screen of the Programming Pendant.

A metal arc screen is mounted to the swing arm to protect the operator from arc flash and sparks created during the welding process (see Figure 1).

Refer to Table 1 for MRM2-600 M3 positioner technical specifications.
1.2.1 MRM2-600 M3 Positioner Configuration ( -1 and -2)

The MRM2-600 M3 positioner is available in either a LH version (-1 designation) or a RH version (-2 designation). Typically, one RH and one LH MRM2-600 M3 positioner are placed together in a robotics work cell. A RH (-2) MRM2-600 M3 positioner is a “mirror image” of a LH (-1) hand MRM2-600 M3 positioner. Both are identical except for location of the swing arm hardstops (see Figure 2), and the location of the welded hardstop contact points on the swing arm assembly. Shipment of a LH positioner, RH positioner, or both, is determined by the customer’s preference and original order.

Note: LH (-1) and RH (-2) positioner designation is always in reference to the location of the welding robot. Looking at the MRM2-600 M3 positioners from the robot position in a work cell, a LH (-1) MRM2-600 M3 positioner is always on the left, while a RH (-2) MRM2-600 M3 positioner is always on the right.

1.2.2 Welding Ground System

The MRM2-600 M3 positioner incorporates spring-loaded carbon brushes to connect each tooling plate to the welding ground system. A gang of 3 carbon brushes contact the posterior side of each tooling plate (see Figure 12 and Figure A.4, Items 5, 6, and 7). The negative (–) ground cable to the welding power source is connected to a ground block located inside the MRM2-600 M3 positioner headstock assembly (see Figure A.2, Item 5).

1.2.3 Major Components

Each MRM2-600 M3 positioner (LH or RH) includes the following major components –

- One headstock housing
- One AC servo-driven swing arm
- Two AC servo-driven tooling plates
- One arc screen
- Three cables (2 data, 1 power) to interconnect the MRM2-600 M3 positioner with a controller
- One assembly kit for the controller (servo packs, etc.)
1.3 Customer Support Information

If you need assistance with any aspect of your MRM2-600 M3 system, please contact Motoman Customer Support at the following 24-hour telephone number –

937. 847. 3200

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address –

techsupport@motoman.com

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Note: Use e-mail for routine inquiries, only. If you have an urgent or emergency need for service, replacement parts, or information, please contact Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you call –

- Positioner (MRM2-600 M3, without MotoMount®)
- Positioner Serial Number (located on positioner data plate)
- Controller Type (NX100, DX100, etc.)
- Primary Application (arc welding)
1.4 Positioner Dimensions

Figure 4 MRM2-600 M3 Positioner Dimensions
## 1.5 Technical Specifications

**Table 1** MRM2-600 M3 Positioner Technical Specifications

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>UNITS</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model P/N</td>
<td></td>
<td>153065-1, 153065-2</td>
</tr>
<tr>
<td>Sweep Motor Power</td>
<td>kW</td>
<td>4.4</td>
</tr>
<tr>
<td>Tooling Motor Power</td>
<td>kW</td>
<td>2.0</td>
</tr>
<tr>
<td>Power Requirements</td>
<td></td>
<td>480 VAC, 3-Phase</td>
</tr>
<tr>
<td>Controller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated Payload per Station</td>
<td>kg</td>
<td>600</td>
</tr>
<tr>
<td>Tooling Axis Ratio (Gear Reduction)</td>
<td></td>
<td>171 : 1</td>
</tr>
<tr>
<td>Rated Tooling Sweep Speed</td>
<td>rpm</td>
<td>17.2</td>
</tr>
<tr>
<td>Rated Tooling 180° Index</td>
<td>sec</td>
<td>2.24</td>
</tr>
<tr>
<td>Maximum Tooling Diameter *</td>
<td>mm</td>
<td>1300 *</td>
</tr>
<tr>
<td>Sweep Axis Ratio (Gear Reduction)</td>
<td></td>
<td>2626 : 9</td>
</tr>
<tr>
<td>Rated Sweep Speed</td>
<td>rpm</td>
<td>12.9</td>
</tr>
<tr>
<td>Rated Sweep Time 180°</td>
<td>sec</td>
<td>2.9</td>
</tr>
<tr>
<td>Rated Sweep Torque</td>
<td>N•m</td>
<td>5386</td>
</tr>
<tr>
<td>Rated Tooling Torque</td>
<td>N•m</td>
<td>1389</td>
</tr>
<tr>
<td>Position Repeatability</td>
<td>mm</td>
<td>0.1</td>
</tr>
<tr>
<td>Tooling Bearing Allowable Thrust</td>
<td>kgf</td>
<td>1500</td>
</tr>
<tr>
<td>Sweep Bearing Allowable Thrust</td>
<td>kgf</td>
<td>314793</td>
</tr>
<tr>
<td>Positioner Weight</td>
<td>kg</td>
<td>1952</td>
</tr>
</tbody>
</table>

* Tooling fixture that passes under is limited to a MAXIMUM depth of 450 mm. See Figure 4 for a graphical representation of this requirement.
Chapter 2
Safety

2.1 Introduction

It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-1999). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the robot system. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the robot cell. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE ROBOT SYSTEM!

We recommend approved Motoman training courses for all personnel involved with the operation, programming, or repair of the robot system. This training is designed to familiarize personnel with the safe and correct operation of the robot system.
This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming, Operation, and Maintenance Safety (Section 2.6)

2.2 Important Advisory Information

Throughout this manual you will find advisory paragraphs (denoted by graphic symbols and bold typeface). All of these (except “NOTE”) direct the reader’s attention to information and procedures that are essential to the safety of personnel or protection of equipment.

The type of information contained in the various advisories is described below. These are listed here in descending order of importance to the safety of personnel and protection of equipment.

DANGER!
Information appearing under the DANGER caption concerns the protection of personnel from an immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

WARNING!
Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

CAUTION!
Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

Note: Information appearing in a Note caption provides additional information that can be helpful in understanding the item being explained.

2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator’s manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
• Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

• The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

• In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

• Safety fences and barriers
• Light curtains and/or safety mats
• Door interlocks
• Emergency stop palm buttons located on operator station, robot controller, and programming pendant

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

• Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
• Identify the work envelope of each robot with floor markings, signs, and barriers.
• Position all controllers outside the robot work envelope.
• Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-Stop button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.
- The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.
- Check and test any new or modified program at low speed for at least one full cycle.
• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
• Use proper replacement parts.
• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
NOTES
Chapter 3
Installation

3.1 Preparing to Lift the MRM2-600 M3 Positioner

**WARNING!**
All forklift operators should be licensed and trained in correct forklift operation and safety.

**WARNING!**
Never place any part of your body under a suspended load or move a suspended load over any part of another person’s body. A shifted or dropped load could result in serious injury or death.

**CAUTION!**
Ensure that your forklift is rated to handle the weight of the MRM2-600 M3 positioner. The positioner weighs approximately 1850 kg.

1. Carefully insert forklift tangs into the fork pockets installed in the base of the headstock housing (see Figure 5).

*Note: Forklift pockets are spaced 440 mm between centers.*

2. Carefully position the MRM2-600 M3 positioner as close to the forklift body as possible.

3. Carefully lower the forklift fork so that the MRM2-600 M3 positioner is at the lowest transport position that still provides adequate ground clearance. This provides a lower load center of gravity, resulting in safer transport of the positioner.

![Figure 5 MRM2-600 M3 Positioner Forklift Pockets](image-url)
3.2 Lifting the MRM2-600 M3 Positioner from Shipping Skid

The MRM2-600 M3 positioner is attached to a wooden shipping skid at the factory, prior to shipment to the customer. The customer is responsible for removing the positioner from the shipping skid and inspecting for shipping damage.

**Note:** Notify your shipping agent immediately if you notice any shipping damage.

1. Unbolt the positioner from the shipping skid using a 3/4 in. socket (see Figure 6).

![Figure 6 Typical Shipping Bolt](image)

2. Remove any protective plastic or cardboard shipping material from the MRM2-600 M3 positioner.
3. Use a forklift to lift the positioner away from the shipping skid (refer to Section 3.1).
4. Discard or recycle the wooden shipping skid and any associated shipping materials.

3.3 Placing and Securing the MRM2-600 M3 Positioner

Place the MRM2-600 M3 positioner on a base plate or foundation rigid enough to support the positioner and withstand repulsion forces. Make sure that the foundation surface is level and even. If it is uneven, grind the swell and flatten the surface.

The concrete foundation must be at least 150 mm in thickness.

**CAUTION!**
Ensure that your forklift is rated to handle the weight of the MRM2-600 M3 positioner. The positioner weighs approximately 1850 kg.
1. Use a forklift to place the MRM2-600 M3 positioner in a desired location (refer to Section 3.1).
2. Adjust the stabilizing leveling bolts, as required, to stabilize and level the positioner (see Figure 7).

**CAUTION!**
Be absolutely certain of the desired location for MRM2-600 M3 positioner(s) (LH, RH, or both) before anchoring to the foundation.

**WARNING!**
Be sure to wear protective eye wear during the anchoring process. Failure to observe this precaution could result in eye injury for the installation technician.

3. Insert an M20 concrete drill bit into one of the nine lag point holes located around the base of the headstock housing (see Figure 7).
4. Drill a hole in the foundation to a minimum depth of 102 mm to accept an anchor bolt. Repeat this process for all nine lag points (see Figure 7).
5. Use compressed air to remove all concrete dust from the drilled holes.
6. Use nine M20 or 3/4 in. anchor bolts to anchor the headstock housing (see Figure 7).

**Figure 7  Lag Points and Stabilizing Bolts – MRM2-600 M3 Positioner**

### 3.4 Connecting the MRM2-600 M3 Positioner to a Motoman® Controller

Three multi pin connectors are installed on the headstock housing of each MRM2-600 M3 positioner (see Figure 8). These connectors accept cables (2 data, 1 power) that interconnect an MRM2-600 M3 positioner with a Motoman controller.

When MRM2-600 M3 positioners (LH and RH) are delivered with a complete Motoman robotic welding system, documentation of data and power interconnects (between each MRM2-600 M3 positioner and a Motoman controller) are typically covered in the robotic welding system documentation package.
3.5 Installing Customer-Supplied Tooling Fixtures

**CAUTION!**
Tooling fixture installation should be performed by technicians who are familiar with MRM2-600 M3 positioner operation.

A tooling fixture can be attached to each of the MRM2-600 M3 positioner tooling plates (see Figure 1). Tooling fixture mounting hole locations and dimensions are shown in Figure 9.

*Note: The customer shall supply all tooling fixtures for the MRM2-600 M3 positioner.*

*Note: Motoman recommends application of a corrosion/rust preventive compound to tooling fixtures located in a high-humidity environment.*

---

**Figure 8** Data and Power Connectors – MRM2-600 M3 Positioner Headstock Housing
3.6 Monitoring Maximum Positioner Load

The MRM2-600 M3 positioner supports customer-supplied tooling fixtures and parts at one end, only (cantilevered mounting). Cantilevered mounting is a proven method of tooling fixture mounting. However, if overloaded, this type of mounting can subject the positioner bearing system to high loads. To ensure correct operation of the MRM2-600 M3 positioner, along with continued positioning accuracy and long bearing life, do not overload the positioner.

Table 2 gives the MAXIMUM allowable bearing moment load for the swing arm axis and each tooling plate axis of the MRM2-600 M3 positioner.

See Figure 4 for the maximum allowable diameter for tooling fixtures attached to the tooling plates.

Table 2 Maximum Allowable Bearing Moment Load – MRM2-600 M3 Positioner

<table>
<thead>
<tr>
<th>AXIS</th>
<th>UNITS</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swing Arm Axis</td>
<td>N•m</td>
<td>35800</td>
</tr>
<tr>
<td>Tooling Plate Axis (each)</td>
<td>N•m</td>
<td>2925</td>
</tr>
</tbody>
</table>

NOTES –
(1) The moment load for the sweep arm is already part of the allowable moment loads given in this table.
(2) Moment Load (M) = Load (W) X Distance from bearing center (D)
See Figure 10 for a graph of *Stand Headstock Load Allowable Overhang* for the MRM2-600 M3 positioner.

See Figure 11 for a graph of *Load CG Overhang* for the MRM2-600 M3 positioner.

**Figure 10** Stand Alone Headstock Load Allowable Overhang

**Figure 11** Load CG Overhang
Chapter 4

Maintenance

4.1 General

**WARNING!**
Make sure that all sources of hazardous energies are de-energized / disconnected before inspecting or servicing the MRM2-600 M3 positioner. Because of typical interconnections between the MRM2-600 M3 positioner and related peripheral equipment (such as a controller), more than one source of hazardous energy can exist.

**WARNING!**
Ensure that servo power is off before performing the following procedures. Observe standard lockout / tagout practices.

Maintenance of the MRM2-600 M3 positioner should be performed only by Motoman service technicians or authorized personnel who are familiar with the design and construction of the MRM2-600 M3 positioner. The following procedures should be performed only as necessary (on condition). Read through the instructions completely, or contact Motoman Customer Service (refer to Section 1.3) before starting any maintenance procedures. Be sure that you understand the procedure, have the proper tools, and comply with all safety precautions.

4.2 Recommended Spare Parts List

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MOTOMAN PART NUMBER</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush, Ground, Metal, Graphite (GR-K076, Style QP5)</td>
<td>144371-1</td>
<td>6</td>
</tr>
<tr>
<td>Terminal, Quick Disconnect, Weld Ground</td>
<td>144370-1</td>
<td>3</td>
</tr>
</tbody>
</table>
4.3 How to Order Spare or Replacement Parts

To order spare parts or replacement parts for the MRM2-600 M3 positioner, please contact Motoman Customer Service (refer to Section 1.3).

4.4 General Cleaning

The MRM2-600 M3 positioner usually requires only occasional cleaning to remove dust and welding by-products. Use compressed air or vacuum, and a bristle brush (if required).

*Note: Motoman recommends application of a corrosion/rust preventive compound to tooling fixtures located in a high-humidity environment.*

4.5 AC Servo-Drive Motors

The three AC servo-drive motors (swing arm axis and each tooling plate axis) are sealed units and have no parts that need inspection or replacement on a regular basis. Do not attempt to disassemble any of the servo-drive motors. If you suspect that a servo-drive motor is in need of overhaul, please contact Motoman Customer Service (refer to Section 1.3).

4.6 Servo Pack

The servo pack (located in the controller) does not require customer maintenance. If you suspect a problem with the servo pack, please contact Motoman Customer Service (refer to Section 1.3).

4.7 Swing Arm Axis Reduction Gear Unit (VIGO RD-320E-81)

The Swing Arm Reduction Gear Unit (VIGO RD-320E-81) is a sealed unit and contains no parts that need inspection or replacement on a regular basis (see Figure A.3, Item 2). Do not attempt to disassemble the reduction gear unit or remove it from the AC servo-drive motor. If you suspect that the Swing Arm Axis Reduction Gear Unit is in need of overhaul, please contact Motoman Customer Service (refer to Section 1.3).

4.8 Tooling Plate Axis Reduction Gear Unit (VIGO RV-160E-145)

The Tooling Plate Reduction Gear Unit (VIGO RV-160E-145) is a sealed unit and contains no parts that need inspection or replacement on a regular basis (see Figure A.5, Item 5). Do not attempt to disassemble the reduction gear unit or remove it from the AC servo-drive motor. If you suspect that the Tooling Plate Axis Reduction Gear Unit is in need of overhaul, please contact Motoman Customer Service (refer to Section 1.3).
4.9 Swing Arm Axis Hardstops

The MRM2-600 M3 positioner incorporates two buffered hardstops that position the swing arm correctly (see Figure 2). Proper adjustment of the swing arm hardstops is important to achieve reliable positioning of the tooling fixtures. These units are preset at the factory for correct performance, and should need no further adjustment. Should you suspect that the hardstops need replacement or adjustment, please contact Motoman Customer Service (refer to Section 1.3). Hardstops for a LH (-1) positioner and a RH (-2) positioner are located in different positions (refer to Section 1.2.1).

4.10 Welding Ground System

4.10.1 Inspection and Cleaning of Carbon Brushes

Inspect the ground brushes where they contact the rear of tooling drive plates. Make sure that the contact area is clean and free of dust and welding by-products. Use compressed air and a small bristle brush to clean the ground brushes where they contact the tooling plates.

Note: Always ensure that welding ground connections and brushes in the MRM2-600 M3 positioner are clean and tight. If the ground points are not properly made and kept clean and secure, high welding currents can bypass the normal return path and, instead, pass through the drive components of the positioner. This is especially hard on positioner drive bearings when they are under load. The high welding current, if allowed to pass through the drive components, can result in increased bearing wear and premature need for replacement.

4.10.2 Ground Brush Replacement

4.10.2.1 Ground Brush Removal

The welding ground brushes (three for each tooling plate) are rugged units and should provide many hours of trouble-free operation in the MRM2-600 M3 positioner.

However, if you suspect that a ground brush is defective, replace the brush as follows –

1. Remove all hazardous energies from the MRM2-600 M3 positioner and other system components.
2. Remove a swing arm assembly rear access cover (see Figure A.4, Item 2) to gain access to the desired ground brush assembly. With the access cover removed, the brush assembly is visible just to the side of the tooling plate drive assembly (see Figure A.4, Item 3 and Figure 12).

Note: Each ground brush is enclosed in a box-shaped brush holder that is attached to a mounting plate. The brush holder incorporates a spring tensioner device at the rear of the brush holder. This tensioner (black in color) holds the ground brush, under spring tension, against the rear of the tooling plate when locked into position.

3. Release the spring tensioner by squeezing together both of the black levers that are visible at the rear of the brush holder. While squeezing the levers together, pull out and away from the brush holder. This should produce the ground brush.
4. Each ground brush has two braided copper leads that connect to silver-plated, high current quick disconnect posts on the ground brush mounting plate (see Figure 12). After the ground brush is free and clear of the brush holder, use a flat blade screwdriver or needle nose pliers to disconnect each of the braided copper brush leads from the quick disconnect posts.
4.10.2.2 Ground Brush Installation

1. Connect braided copper brush cables (from the new brush) to the quick disconnect posts on the ground brush mounting plate (see Figure 12).

Note: This is a good time to check the cleanliness and condition of the quick disconnect posts. If you notice dirt or grease buildup on the posts, clean them. Use a small bristle brush (toothbrush size) and compressed air.

2. Make sure that the spring tensioner in the brush holder is released and pulled as far back as possible.

3. Insert the new brush into the brush holder and push forward as far as possible.

4. Lock the new brush into position by squeezing together the black tensioner levers and pushing the tensioner forward into the brush holder until it “clicks” into the locked position.

Figure 12  Ground Brush Component Location
4.10.3 **Inspection of Welding Ground Connections**

Inspect all welding ground cable connections for cleanliness and security.

*Note: Ground cable connections must be clean and tight. A loose or dirty connection can cause excess heat (high resistance connection) or arcing. Either of these conditions can damage the cable and cable connection point.*

4.11 **Inspecting or Changing Encoder Back-Up Battery**

The swing arm axis and tooling plate axis drive motors each incorporate a small, external Lithium-Ion “keep alive” battery that maintains encoder positioning data in memory should the main cables between the positioner and controller be disconnected. The batteries have a very long life in this particular application. Should one or more of these batteries drop below a certain charge level, an indication will appear on the controller Programming Pendant or display screen indicating the need for battery renewal. Changing an encoder back-up battery is a simple matter of accessing the encoder plug at the rear of each AC servo drive motor, locating the battery, and replacing with a new battery of the same type (see Figure 13).

![Figure 13](image-url)  
*Figure 13  Encoder Back-Up Battery*
4.12 **Setting a Tooling Plate Axis to Home (Zero) Position**

To set each tooling plate axis to home (zero) position, install the plastic alignment pin in the tooling plate hole (see Figure 9 and Figure 14).

*Note: Make sure that the tooling plate hole is in the approximate position shown in Figure 9.*

1. Make sure that robot(s) are in Home position.
2. Place the Programming Pendant in TEACH mode, and slowly jog the tooling plate in the direction indicated in Figure 12 until the plastic alignment pin just contacts the swing arm housing.

*Note: If you go too far with the tooling plate rotation, the plastic alignment pin will bend and result in an inaccurate adjustment. If this happens, slowly reverse the tooling plate rotation until the pin returns to a straight position.*

3. Enter this point in the controller as the Home or Zero position for the tooling plate.
4. After setting the tooling plate axis Home (Zero) position, remove plastic alignment pins and store them in a secure location.

![Figure 14 Tooling Plate Axis Home Position](image-url)
## 4.13 MRM2-600 M3 Positioner Inspection Schedule

### Table 4 Inspection Schedule

<table>
<thead>
<tr>
<th>INSPECTION ITEM</th>
<th>FREQUENCY</th>
<th>INSPECTION OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical damage</td>
<td>Daily</td>
<td>Check for physical damage; this indicates a load collision and is evidence of misuse.</td>
</tr>
<tr>
<td>Excessive or unusual noise</td>
<td>Daily</td>
<td>Listen for unusual noise. Contact Motoman Customer Service (refer to Section 1.3).</td>
</tr>
<tr>
<td>Ground brushes</td>
<td>Weekly</td>
<td>Check for dirt between brushes and tooling plates. Check for full contact with the tooling plates.</td>
</tr>
<tr>
<td>Complete positioner</td>
<td>On condition</td>
<td>Clean with dry cloth, bristle brush, and compressed air</td>
</tr>
<tr>
<td>AC servo drive motor vibration</td>
<td>Daily</td>
<td>Feel manually. Contact Motoman Customer Service (refer to Section 1.3).</td>
</tr>
<tr>
<td>AC servo drive motor noise</td>
<td>Daily</td>
<td>Listen for unusual noise. Contact Motoman Customer Service (refer to Section 1.3).</td>
</tr>
<tr>
<td>Complete servo motor</td>
<td>Every 20,000 hours or 5 years</td>
<td>If worn or damaged, Contact Motoman Customer Service (refer to Section 1.3).</td>
</tr>
<tr>
<td>Fixture and anchor bolts</td>
<td>Weekly</td>
<td>Visual inspection; Check torque and security</td>
</tr>
<tr>
<td>Cables and hoses</td>
<td>Weekly</td>
<td>Visually and by hand (bend cables and hoses to check for cracks, checking, scuffing, etc.)</td>
</tr>
</tbody>
</table>
Appendix A

Illustrated Parts List

A.1 Introduction

A.1.1 Arrangement

Appendix A is arranged as follows –
Appendix A.1 – Introduction
Appendix A.2 – Illustrated Parts List (IPL)

A.1.2 General

The Illustrated Parts List (IPL) identifies, describes, and illustrates detail parts of the MRM2-600 M3 positioner.

A.1.3 Purpose

The IPL provides parts identification and descriptive information for use in provisioning, purchasing, storing, and issuing spare parts.

A.2 Illustrated Parts List (IPL)

The Illustrated Parts List contains illustrations (exploded views) and associated parts list tables that show detail parts of a particular component, assembly, or subassembly.

A.2.1 IPL Layout

The IPL is arranged so that the illustration (exploded view) for an assembly appears directly above the parts list table for that illustration. This format presents the illustration and its associated parts list table to the reader in one view, regardless of viewing format (PDF or printed). With this format, the reader is not required to turn a page to see the parts list table that is associated with an illustration.
A.2.2 Item Categories Not Included in the IPL

The following item categories are not included in the IPL –

1. Standard hardware items (attaching parts) such as nuts, screws, washers, etc. These are commercially available to the customer.

2. Bulk items and consumables such as wire, cable, sleeving, tubing, certain fluids, etc. These are commercially available to the customer.

3. Permanently attached parts that lose their identity because they are welded, soldered, riveted, etc., to other parts, assemblies, or subassemblies.

A.2.3 Parts List Table Structure

Each figure’s parts list table contains the following data columns –

- **FIGURE & ITEM NUMBER**
  
  An entry in this column gives the item number for a part shown in the associated illustration (exploded view). The item number listed in this column is the same as the item number shown on the illustration. Item numbers on the illustration are identified by a circled number and leader line that points to the particular part (item) on the illustration.

- **MOTOMAN PART NUMBER**
  
  An entry in this column gives the Motoman part number for an item. Refer to this number when ordering or referencing the part.

- **DESCRIPTION**
  
  An entry in this column gives the description (nomenclature) for an item number or part number.

- **QTY**
  
  An entry in this column gives the total quantity of an item or part number required for an assembly or subassembly in which the part appears. The quantity given in this column may or may not be the total quantity required for the complete end item.
Figure A.1 MRM2–600 M3 Positioner – Major Components

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM NUMBER</th>
<th>MOTOMAN PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1 –1</td>
<td>153065-1</td>
<td>MRM2-600 M3 POSITIONER (LH)</td>
<td>REF</td>
</tr>
<tr>
<td>2</td>
<td>153065-2</td>
<td>MRM2-600 M3 POSITIONER (RH)</td>
<td>REF</td>
</tr>
<tr>
<td>3</td>
<td>152526-3</td>
<td>HOUSING ASSY, HEADSTOCK (LH)</td>
<td>1</td>
</tr>
<tr>
<td>–4</td>
<td>152526-1</td>
<td>HOUSING ASSY, HEADSTOCK (RH)</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>152523-3</td>
<td>ARM ASSY, SWING (LH)</td>
<td>1</td>
</tr>
<tr>
<td>–6</td>
<td>152523-2</td>
<td>ARM ASSY, SWING (RH)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>150850-1</td>
<td>SCREEN, ARC SHIELD</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTES
- A dash (–) preceding an item number indicates that the item is not shown in the illustration
- REF indicates a reference to the top assembly in the figure
**Figure A.2** Headstock Assembly Components

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM NUMBER</th>
<th>MOTOMAN PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.2 1</td>
<td>148715-1</td>
<td>COVER, HEADSTOCK</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>148716-1</td>
<td>COVER, HOUSING</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>149172-1</td>
<td>SUPPORT, CABLE, HANGER</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>148709-1</td>
<td>HOUSING, HEADSTOCK</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>152527-1</td>
<td>DRIVE, ASSY, MAIN, SIGMA III (RH)</td>
<td>1</td>
</tr>
<tr>
<td>–6</td>
<td>152527-3</td>
<td>DRIVE, ASSY, MAIN, SIGMA III (LH)</td>
<td>1</td>
</tr>
</tbody>
</table>

A dash (–) preceding an item number indicates that the item is not shown in the illustration.
**Figure A.3** Main Drive Assembly Components

<table>
<thead>
<tr>
<th>FIGURE ITEM NUMBER</th>
<th>MOTOMAN PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.3 1</td>
<td>149568-10</td>
<td>MOTOR, AC SERVO SIGMA III, 4.4 KW</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>148712-5</td>
<td>REDUCER (RD-320E-81)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>150074-1</td>
<td>GEAR ASSY, INPUT</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>148711-1</td>
<td>PLATE, MOUNTING, MAIN DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>140786-2</td>
<td>BEARING, SLEWING, EXT</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>148813-2</td>
<td>GUARD, UPPER, MAIN DRIVE, LH</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>148812-1</td>
<td>GUARD, LOWER, MAIN DRIVE GEAR</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>148813-2</td>
<td>GUARD, UPPER, MAIN DRIVE, RH</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>148814-1</td>
<td>SHOCK ABSORBER ASSY</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>132652-8</td>
<td>PIN, DOWEL M12X40</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>153084-1</td>
<td>COUPLING, TORQUE, RD320E</td>
<td>1</td>
</tr>
</tbody>
</table>
**Figure A.4** Swing Arm Assembly Components
### Table A.4 Parts List - Swing Arm Assembly Components

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM NUMBER</th>
<th>MOTOMAN PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.4 –1</td>
<td>152523-3</td>
<td>ARM ASSY, SWING (LH)</td>
<td>REF</td>
</tr>
<tr>
<td>–2</td>
<td>152523-2</td>
<td>ARM ASSY, SWING (RH)</td>
<td>REF</td>
</tr>
<tr>
<td>3</td>
<td>148775-1</td>
<td>COVER, BACK</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>152524-1</td>
<td>DRIVE ASSY, TOOLING</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>148780-1</td>
<td>GUARD, SWITCH (LH)</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>148761-1</td>
<td>PLATE, MTG, GROUND BRUSH</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>144371-1</td>
<td>BRUSH</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>144372-1</td>
<td>BRUSH HOLDER</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>148089-2</td>
<td>BLOCK, MTG, SENSOR</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>148089-2</td>
<td>SENSOR, SLOT</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>148090-2</td>
<td>ACTUATOR, SENSOR</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>148780-2</td>
<td>GUARD, SWITCH (RH)</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>148762-2</td>
<td>PLATE, FACE (LH)</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>148090-2</td>
<td>ACTUATOR, SENSOR</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>148759-2</td>
<td>HOUSING, SWING ARM (LH)</td>
<td>1</td>
</tr>
<tr>
<td>–16</td>
<td>148759-1</td>
<td>HOUSING, SWING ARM (RH)</td>
<td>1</td>
</tr>
</tbody>
</table>

**NOTES**

- A dash (–) preceding an item number indicates that the item is not shown in the illustration.
- REF indicates a reference to the top assembly in the figure.
Figure A.5 Tooling Plate Drive Components

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM NUMBER</th>
<th>MOTOMAN PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.5 1</td>
<td>149568-12</td>
<td>MOTOR, 2.0 KW, SIGMA III</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>130425-2</td>
<td>SCREW BHCS M6X10</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>132527-7</td>
<td>WASHER, FLAT, M6</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>153064-1</td>
<td>GEAR, PINION, RV-160E</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>148819-2</td>
<td>REDUCER (RV-160E-171)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>479147-5</td>
<td>WASHER, FLAT, M8</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>148781-1</td>
<td>ADAPTER, GEAR, HEADSTOCK</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>151349-1</td>
<td>SEAL, QUAD RING 234.5ID</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>148763-1</td>
<td>ADAPTER, GEAR</td>
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<tr>
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<td>133997-1</td>
<td>SCREW, SET, M6X8</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>133997-1</td>
<td>SCREW, SET, M6X8</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>145523-11</td>
<td>FITTING, ELBOW, MAKE</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>407248-17</td>
<td>SCREW</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>152525-1</td>
<td>ADAPTER, MOTOR GEAR</td>
<td>1</td>
</tr>
</tbody>
</table>
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