Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

YASKAWA MOTOMAN INSTRUCTIONS
YASKAWA MOTOMAN-NX100 CONTROLLER INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR’S MANUAL
NX100 MAINTENANCE MANUAL

The NX100 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.
This manual describes the specifications, precautions for operation and required items for maintenance or inspections, for proper application of the YASKAWA MOTOMAN-NX100 Controller. Read this manual carefully and be sure to understand its contents before handling the YASKAWA MOTOMAN.

General items related to safety are listed in the Section 1: Safety of the NX100 Instructions. To ensure correct and safe operation, carefully read the NX100 Instructions before reading this manual.

Refer to NX100 Operator’s Manual for the operation methods.

Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product’s warranty.
Definition of Terms Used Often in This Manual

MOTOMAN is a YASKAWA industrial robot product. The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and supply cables. In this manual, the equipment is designated as follows.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 controller</td>
<td>NX100</td>
</tr>
<tr>
<td>NX100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>

Description of the Operation Procedure

In the explanation of the operation procedure, the expression “Select • • •” means that the cursor is moved to the object item and the [SELECT] key is pressed, or that the item is directly selected by touching the screen.
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Chapter 1   Introduction

1.1   About This Document

This manual is intended as an introduction and overview for personnel who have received operator training from YASKAWA, and who are familiar with the operation of their YASKAWA robot model. For more detailed information, refer to the manuals listed in section 1.3 "Reference to Other Documentation". This manual contains the following sections:

CHAPTER 1 - INTRODUCTION
Provides general information about the HD Drive Module and its components, a list of reference documents, and customer service information.

CHAPTER 2 - SAFETY
Provides information regarding the safe use and operation of the HD Drive Module.

CHAPTER 3 - INSTALLATION
Provides instructions for set up and installation of the HD Drive Module.

CHAPTER 4 - MAINTENANCE
Contains a table listing periodic maintenance requirements for the components of the HD Drive Module.

APPENDIX A - POSITIONER ASSEMBLY KIT
Provides detailed information on the HD table positioner kit.

APPENDIX B - ILLUSTRATED PARTS LIST
Appendix B provides exploded views and illustrated parts lists for the MotoSweep O.

1.2   Overview

The HD Drive Module is an AC servo drive module designed for use in a variety of applications including; primary axis for large multi-axes positioners, custom MotoSweep O HD transporters, high capacity headstocks, and high-capacity positioning tables. The simple design provides high reliability and ease of installation and maintenance, while the compact, low-profile configuration provides increased application flexibility. The drive system achieves smooth and stable motion with zero gear lash in hold mode, and minimal lash during rotate mode. An optional floor mount, positioner assembly kit is available for more flexible design integration. For more information, refer to Appendix A. Fig. 1-1 illustrates the system layout of the HD Drive Module.

Fig. 1-1  Layout

RADIAL BEARING
BRAKE ASSEMBLY
PINION GEAR
DRIVE FRAME
The secondary reduction gear (radial bearing) is driven by an AC servo motor through an RV reducer and primary reduction gear (pinion). The AC servo motor is controlled by the NX100 controller. All customer supplied adapter plates or fixturing mount directly to the secondary reduction gear (radial bearing) and must conform to specific dimensions (see Fig. 1-2).

**NOTE**

OUTER CIRCUMFERENCE DETERMINED BY CUSTOMER

6X 12 X 1.75 THRU (FOR BRAKE PLATE 15 MIN)

2X 30

24X M12 X 1.75 THRU (FOR LIMIT SWITCH OPTION)

6X 30

12x R20

11x 20°

12x 10°

25

40

R352

θ35

θ980

256.6 MM (10.1 IN.)

303.6 MM (12.0 IN.)

2X 290.1

215.3 MM (8.5 IN.)

167.5 MM (6.6 IN.)

167.5 MM (6.6 IN.)

25

6X 307

335 MM (13.19 IN.)

335 MM (13 IN.)

HOMING PIN HOLE

24 X M24 X 3 THRU (FOR ATTACHMENT TO BEARING)

TOP - LOOKING DOWN AT BEARING

Fig. 1-2  Customer Adapter Plate Configuration
1.2.1  Dimensions

Fig. 1-3  Dimensions
1.2.2 Specifications

Table 1.1 HD Drive Module Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Speed</td>
<td>3.9</td>
</tr>
<tr>
<td>Reduction Ratio (Number)</td>
<td>21</td>
</tr>
<tr>
<td>Reduction Ratio (Denom)</td>
<td>21375</td>
</tr>
<tr>
<td>Motor Power</td>
<td>3.7</td>
</tr>
<tr>
<td>Motor P/N (YEC)</td>
<td>SGMRS-37A2B-YR14</td>
</tr>
<tr>
<td>Motor P/N (Motoman)</td>
<td>149568-8</td>
</tr>
<tr>
<td>Servo Amp P/N (YEC)</td>
<td>SGDR-SDB710A018</td>
</tr>
<tr>
<td>Servo Amp P/N (Motoman)</td>
<td>149472-3</td>
</tr>
<tr>
<td>Maximum Motor Speed</td>
<td>4000</td>
</tr>
<tr>
<td>Rated Torque</td>
<td>12,000</td>
</tr>
<tr>
<td>Rated Moment</td>
<td>60,000</td>
</tr>
<tr>
<td>Rated Inertia</td>
<td>14,500</td>
</tr>
<tr>
<td>Rated Thrust</td>
<td>10,000</td>
</tr>
</tbody>
</table>

1.3 Reference to Other Documentation

For additional information refer to the following:

- YASKAWA Motoman Manipulator Manual
- YASKAWA Motoman NX100 Controller Manual (P/N 149201-1CD)
- YASKAWA Motoman Concurrent I/O Parameter Manual (P/N 149230-1CD)
- Vendor manuals for system components not manufactured by YASKAWA
1.4 Customer Support Information

If you need assistance with any aspect of your NX100 Controller system, please contact YASKAWA Customer Support at the following 24-hour telephone number:

(937) 847-3200

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

techsupport@motoman.com

When using e-mail to contact YASKAWA 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.

Please have the following information ready before you call Customer Support:

- **System**: NX100 Controller
- **Robots**: ________________
- **Primary Application**: ________________
- **Controller**: NX100
- **Software Version**: Access this information on the Programming Pendant’s LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
- **Robot Serial Number**: Located on the robot data plate
- **Robot Sales Order Number**: Located on the NX100 controller data plate

**NOTE**: Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact YASKAWA Customer Support at the telephone number shown above.
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 R15.06-2012). 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 equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

This safety section addresses the following:
• Notes for Safe Operations (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 Notes for Safe Operations

Read this manual carefully before installation, operation, maintenance, or inspection of the YASKAWA MOTOMAN.
In this manual, the Notes for Safe Operation are classified as “DANGER”, “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

- **DANGER**: Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **CAUTION**: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
- **MANDATORY**: Always be sure to follow explicitly the items listed under this heading.
- **PROHIBITED**: Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

**NOTE**
To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”.

Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the NX100 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

When the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
- View the manipulator from the front whenever possible.
- Always follow the predetermined operating procedure.
- Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

Confirm that no persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
- Turning ON the NX100 power.
- Moving the manipulator with the programming pendant.
- Running the system in the check mode.
- Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem. The emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.
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 R15.06-2012, and 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 R15.06-2012 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 R15.06-2012 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.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.
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 YASKAWA will VOID YOUR WARRANTY!
- Some operations require standard passwords and some require special passwords. Special passwords are for YASKAWA 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).
Chapter 3 Installation

Installation of the HD Drive Module should be performed by personnel who are familiar with this YASKAWA Motoman product. Follow established safety procedures at all times throughout the installation process. Failure to use safe work practices can result in damage to the equipment and injury to the workers.

Due to the variety of installation applications, it is not possible to provide detailed installation instructions in this manual. However, general installation guidelines are provided. Contact the YASKAWA customer service for help integrating the HD Drive Module into your system.

3.1 Materials Required

This section identifies customer-supplied items and tools required to complete installation.

3.1.1 Customer-Supplied Items

- Incoming power supply to controller – 240/480/575 volts
- Ring gear adaptor plate
- Appropriate mounting hardware

3.1.2 List of Tools

- Safety glasses
- Gloves
- Level
- Ratchet with 3/4-inch socket
- Adjustable wrench set
- Phillips and flat screwdrivers
- Socket set
- Forklift and/or overhead crane
- Air-impact gun with 3/4-inch socket
- Open-end wrench set
- Wrench sets (standard and metric)
- 255 N•m (188 ft. lb) torque wrench

CAUTION

Installation of the HD Drive Module is not a task for the novice. The drive module is not fragile, but it is a highly sophisticated positioning system. Handle components with care. Rough handling can damage system electronic components.
3.2 Lifting Instructions

The HD Drive Module is shipped on a wooden shipping skid. The customer is responsible for removing the positioner from the shipping skid and inspecting for shipping damage. The HD Drive Module can be moved by forklift, or by overhead crane and straps using the M16 eyebolts provided. To install the HD Drive Module, proceed as follows:

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
</table>

Forklift truck operation should be performed only by licensed personnel. Never place any part of your body under a suspended load or move a suspended load over any part of another person's body. Careless handling may result in severe personal injury or death.

1. Carefully remove protective plastic wrapping from drive assembly.
2. Inspect drive assembly for shipping damage.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
</table>

If any equipment is damaged, notify the shipper immediately.

3. Unbolt the module from the shipping skid using a ¾-inch socket.
4. Attach slings from lifting device to the four lifting eyes (see Fig. 3-1 Shipping).

5. Using the lifting device, lift the drive assembly and place in desired location.
3.3 Installation Safety

Warning signs and restrictive devices such as fencing, chains, safety mats, or light beams must be placed around the working area of the robot/positioner. Warning signs should indicate hazardous conditions and results that may occur if the warning is disregarded. Refer to local regulations regarding Machine Safety.

3.3.1 Dimensions

![Dimensions Diagram]

Fig. 3-2 Dimensions
3.3.2 Mounting

The HD Drive Module should be firmly mounted on a base plate or foundation rigid enough to support the weight and also withstand repulsion forces. The surface should be level and even. If it is uneven, grind the swell and flatten the surface. If installing on concrete, YASKAWA recommends the use of an adapter plate (P/N 150903-1) with grout. All floor requirements are application specific and must be determined by the project engineer overseeing the installation.

3.4 Connection to YASKAWA NX100 Controller

Installation and connection to NX100 comprises hardware as well as software installation, and must be carried out by YASKAWA Service personnel. When the HD Module is delivered together with a robot, this installation is complete.

See separate schematics for electrical connections:

---

DANGER

Forklift truck operation should be performed only by licensed personnel. Never place any part of your body under a suspended load or move a suspended load over any part of another person's body. Careless handling may result in severe personal injury or death.

---

WARNING

Install all electrical cables connecting the HD Module, controller, and electrical supply wiring cables so that there is no possibility of their being walked on or run over. Do not put any object directly on the cables and do not install cables across other cables.

The HD Module is controlled from the robot controller/operators panel. Install these so that the module is in full view from the controller.

The drive gear cover may need to be removed to connect the motor cables.

---

CAUTION

With drive guard removed, remove the pinion gear grease wiper before servicing drive assembly. Failure to do so may destroy the wiper and damage the gears.
3.4.1 Conducting a Safety/Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform a safety/operation check. To conduct a safety/operation check:

1. Check that safeguards have been installed and are adequate for plant conditions per ANSI/RIA R15.06-2012 Robot Safety Standard.
2. Verify that cable connections are tight and system is level and secure.

Your HD Drive Module is now ready for power-up. This system should be operated only by personnel who have received operator training from YASKAWA and who are familiar with the operation of this YASKAWA Motoman robot model. Turn the main power ON, and continue the safety/operation check.

3. Check all system E-STOPS (pendant, op-station, controller door).
4. Check system Hold buttons.
3.5 Drive Pinion Adjustment

Drive pinion adjustment is performed at the factory. The following procedure should be used for maintenance or as required during installation. Properly adjusted gear alignment and engagement provide smooth and reliable drive operation.

3.5.1 List of Tools

- Digital indicator and base
- Digital level
- 370 Nm torque wrench - 3/4” drive recommended
- 30 mm socket; same drive as torque wrench
- Pry bar

CAUTION

All jog motions should be performed by the technician performing the adjustments in TEACH mode.

1. Remove drive gear cover and pinion grease wiper.

CAUTION

With drive guard removed, remove the pinion gear grease wiper before servicing drive assembly. Failure to do so may destroy the wiper and damage the gears.
3.5.2 Coarse Adjustment/Gear Alignment

1. Loosen the three M20 bolts locking the levelling bolts.

2. Loosen the four M20 bolts securing the spring assembly.
3. Loosen the jam nut and back off the spring assembly adjuster bolt.

4. Using a pry bar, back the pinion away from the ring gear providing a loose engagement.
5. Snug the four M20 spring assembly securing bolts.
6. Adjust the three levelling bolts to provide a uniform gap (approximately 3 mm) between the drive assembly plate and support structures.

7. Locate a digital level on the lower surface of the ring gear, near the pinion gear, and oriented in the 'X' direction. Zero the level.
8. Place the level on the top surface of the pinion gear in the 'X' direction.

9. Raise B and C levelling bolts as required to zero the level. Turn levelling bolt 'B' clockwise to raise the front of the pinion gear (away from the ring gear). Turn levelling bolt 'C' clockwise to raise the back of the pinion gear towards the ring gear.

**NOTE**

It's best to use only one of the B and C leveling bolts to level the pinion in the X coordinate. Always adjust by lifting up. If you over-adjust, back off the leveling screw, and use the locking bolt to re-seat the leveling bolt before lifting again.

Fig. 3-10 Level X Coordinate
10. Place the digital level on the lower surface of the ring gear, near the pinion gear, and oriented in the 'Y' direction. Zero the level.

11. Place the level on the top surface of the pinion gear in the 'Y' direction.

12. Turn levelling screw 'A' clockwise to tip the top of the pinion to the right. Again, it is best to adjust by lifting, so if the gear must tip to the left, back off the levelling screw and overcompensate to the left, making the final adjustment by lifting to the right.

![Fig. 3-11 Level Y Coordinate](image)

**NOTE**

Take care to maintain minimum gap (approximately 3 mm) between the drive assembly plate and support structures. If necessary, turn both B and C leveling screws equally 1/2 turn.

13. Once the pinion has been made level with the ring gear, snug the three locking bolts.

14. Loosen the spring assembly securing bolts and using the adjusting screw, drive the pinion gear into the ring gear.

![Fig. 3-12 Engage Pinion](image)
15. Once the pinion has been firmly seated into the ring gear, back off the adjusting screw until loose and re-tighten until the bolt just touches the assembly.
16. Tighten the spring assembly securing bolts.

Fine Adjustment, Checking Gear Mesh:
1. Using the programming pendant, slowly rotate the ring gear in both the forward and reverse directions to create an engagement pattern on the teeth of the ring gear. Rotate the ring gear forward until the engagement pattern can be seen.

**NOTE** A gear marking compound can be used if the engagement pattern is difficult to read.

2. Observe the engagement pattern. The desired pattern is full contact, equal on opposing tooth faces. See Figure 9 for pattern details.
### Table 3.1 Gear Mesh Pattern

<table>
<thead>
<tr>
<th>Engagement Pattern</th>
<th>Description</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| ![Pattern Diagram](image) | Proper Tooth Contact  
Pattern is visibly equal on both top and bottom. | Full contact is achieved. Final torque the three locking bolts to 370 Nm. |
| ![Pattern Diagram](image) | Top Too Tight  
Pattern is visibly equal only at the top. | Turn levelling screw 'B' clockwise to tip the top of the pinion gear away from the ring gear (Loosen and re-tighten locking bolt as required). |
| ![Pattern Diagram](image) | Top Too Loose  
Pattern is visibly equal only at the bottom | Turn levelling screw 'C' clockwise to tip the top of the pinion gear towards the ring gear (Loosen and re-tighten locking bolt as required). |
| ![Pattern Diagram](image) | Tipped Left  
Pattern shows only top left tooth and lower right tooth | Turn levelling screw 'A' clockwise to tip the top of the pinion to the right (Loosen and re-tighten locking bolt as required). |
| ![Pattern Diagram](image) | Tipped Right  
Pattern shows only top right tooth and lower left tooth | Turn levelling screw 'A' counter-clockwise to tip the top of the pinion to the left. Again, it is best to adjust by lifting up, so if the gear must tip to the left, back off the levelling screw and overcompensate to the left, making the final adjustment to the right by lifting. (Loosen and re-tighten locking bolt as required). |

3. Re-check the pattern and adjust as required to achieve the desired full contact, equal pattern.

---

**WARNING**

Over adjusting can cause the pinion to collide with the adapter plate. Take care to maintain adequate spacing between the top of the pinion and the bottom of the adapter plate.

4. When full contact is achieved, final torque the three locking bolts to 370 Nm.
3.5.3 Adjusting Gear Engagement (Gear Lash)

Normal adjustment of gear engagement provides zero lash at rest. The spring assembly provides proper running lash.

1. Jog the adaptor plate to the HOME position, pointing away from the drive pinion.
2. Set up the dial indicators to rest on a ring gear tooth face on both gears to measure tangential motion.

3. Set the robot speed to slow speed.
4. Jog the pinion until the indicators show movement.
5. Zero both indicators.
6. Change jog speed to inching and rotate the pinion in reverse direction until movement is detected on the pinion indicator.
7. When the lash is properly adjusted, both indicators will read the same value.
8. Use the adjusting screws as required to achieve 0 lash between the pinion and ring gears. Take care not to over adjust.
9. Once any lash has been eliminated, torque the spring assembly securing bolts to 100 Nm.
10. Set dial indicator aside and jog the boom +/- 15-20 degrees while watching the ring and pinion gears. The motion should be smooth and quite, with no visible lash between the two gears.
11. Double check the engagement pattern. With full contact and lash removed, final torque the spring assembly securing bolts to 370 Nm.
12. Reinstall the pinion grease wiper and the drive gear cover.

The gear system may loosen some during the first few hours of operation. This would be evidenced by noisy operation during boom movement, noise during aggressive robot motions, or visible lash between the two gears when jogging the boom in TEACH. Adjust as required. Always check gear alignment when adjusting the engagement.

3.6 Installation of Tooling and Fixtures

Your HD Drive Module is now ready for the installation of tooling and fixtures for your application. Installation of tooling and fixtures should be performed by personnel who are familiar with the operation of this system. Tooling and fixtures are supplied by the customer. After tooling is installed, test the module for proper operation.
Chapter 4  Maintenance

Maintenance of the HD Drive Module components should be performed by authorized personnel who are familiar with the design and construction of this positioner. The following procedures should be performed only as needed. Read through the instructions completely before performing any maintenance procedure. Be sure that you understand the procedure, have the proper tools, and observe all applicable safety precautions.

4.1 Ordering Parts

Contact the YASKAWA service staff at 937.847.3200 to order spare parts. Please have the following information ready before you call:

- Machine type (Positioner)
- Machine Name (MotoSweep O)
- Part No. (YASKAWA Motoman)
- Part(s) name
- Number of parts

Place your order with:  YASKAWA Customer Service
Telephone: (937) 847-3200
Telefax: (937) 847-3211
4.2 Drive Motor Maintenance

The servo drive motor is virtually maintenance free. If the servo motor is physically damaged due to a load collision or misuse, or if there is grinding or excessive noise, contact YASKAWA Service Department at (937) 847-3200.

4.2.1 Servopack

The servopack does not require any special maintenance. Remove dust and tighten screws periodically.

Fig. 4-1 Maintenance of AC Servo Motor

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Frequency</th>
<th>Inspection Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration</td>
<td>Daily</td>
<td>Feel manually</td>
</tr>
<tr>
<td>Noise</td>
<td>Daily</td>
<td>Aurally</td>
</tr>
<tr>
<td>Exterior and cleaning</td>
<td>as required</td>
<td>Clean with dry cloth or compressed air</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>Annually</td>
<td>Make sure that it is more than 10 M Ohm by measuring with a 500V insulation tester (Megger) after disconnecting the motor from the controller</td>
</tr>
<tr>
<td>Overhaul</td>
<td>Every 20,000 hours or 5 years</td>
<td>If worn or damaged, replace after disconnecting the motor from the machine. Contact YASKAWA Service.</td>
</tr>
</tbody>
</table>

4.3 Lubrication and Maintenance Schedule

Table 4.1 Lubrication and Maintenance Schedule

<table>
<thead>
<tr>
<th>Interval</th>
<th>Point</th>
<th>Method</th>
<th>Lubricant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>Security Check bolts for fixtures and anchor bolts.</td>
<td>Visually, wrench key</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cables and hoses Check wear and condition</td>
<td>Visually</td>
<td></td>
</tr>
<tr>
<td>500 h</td>
<td>Ring and pinion gear It recommended to lube the pinion and gear with the same grease.</td>
<td>Grease gun</td>
<td>Moly Delux #2 grease P/N 132434-1</td>
</tr>
<tr>
<td>Yearly</td>
<td>Top off primary reducer</td>
<td>Grease gun</td>
<td>Moly White, P/N 132412-3</td>
</tr>
<tr>
<td>20,000 h or 5 year</td>
<td>Flush primary reducer</td>
<td>Grease gun</td>
<td></td>
</tr>
</tbody>
</table>
4.4 Resetting Axis To Home Position

Resetting the HD Drive Module axis to Home position is typically done during initial installation or after the servo motor has been serviced. These procedures assume that the customer supplied adapter plate has been design to YASKAWA Motoman specifications and includes the homing pin hole (see Fig. 1-2 Customer Adapter Plate Configuration).

To reset Home position, proceed as follows:

1. Place robot in TEACH MODE and slowly jog axis until homing pin hole on adaptor plate is accessible.
2. Install homing pin into homing pin hole in adaptor plate. The pin may need to be tapped in with a hammer.
3. Jog the axis slowly until homing pin just touches stationary edge of structure. If you jog the axis too far, the pin will bend, causing an inaccuracy. Slowly jog the axis in reverse until pin is straight, but still touching the edge of structure.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press the TOP MENU key on the programming pendant.
6. Cursor to ROBOT and press SELECT.
7. Cursor to HOME POSITION and press SELECT.
8. Press the PAGE OVER key to the desired station (indicated in the top right corner).
9. Make sure the axis is in the position that you want to teach as Home and press SELECT.
10. Cursor to YES and press SELECT. The HD Drive Module axis is now reset to zero.
11. Remove the homing pin from the adaptor plate.
4.5 Inspecting/Adjusting Brake Pads

To determine brake pad wear, proceed as follows:

1. Remove brake wear plate as required for access.

2. Loosen the M12 lock nuts.

3. Adjust brake pad by turning each of the M12 adjusting bolts counter-clockwise approximately 1/2 turn.

4. Tighten the lock nuts.

**NOTE**

One turn maximum should be enough to adjust for normal wear. If motion is still unacceptable, there may be other problems with your system. Contact YASKAWA Service Dept.
4.6 Troubleshooting

Table 6-2 identifies common problems that could occur. To troubleshoot your system, identify the type of problem and look for it in the PROBLEM column. Next to this column is a list of PROBABLE CAUSES and CORRECTIVE ACTIONS.

Be aware that sometimes more than one problem can occur at the same time. After identifying and resolving a problem, test the system thoroughly to make sure no other problems exist.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No axis movement</td>
<td>Loose connection</td>
<td>Check all wire connections.</td>
</tr>
<tr>
<td></td>
<td>Incorrect wiring</td>
<td>Check that system has been wired correctly.</td>
</tr>
<tr>
<td></td>
<td>Overload</td>
<td>Reduce load and re-check. Repeat until problem stops.</td>
</tr>
<tr>
<td>Unstable operation</td>
<td>Brake out of adjustment</td>
<td>If positioner movement is unstable, check brakes and replace if necessary (see Section 4.5).</td>
</tr>
<tr>
<td></td>
<td>Loose mounting</td>
<td>Check all mounting bolts and tighten as needed.</td>
</tr>
<tr>
<td></td>
<td>Improper gear alignment and/or gear lash adjustment</td>
<td>Check gear alignment and lash, and adjust as needed (see Section 3.5).</td>
</tr>
<tr>
<td>Motor overheats</td>
<td>Excessive ambient temperature</td>
<td>Reduce ambient temperature below 45° C (104° F). Positioner has an operating range of 0 to 45° C (32 to 113°F).</td>
</tr>
<tr>
<td></td>
<td>Motor surface is dirty</td>
<td>Clean motor surface.</td>
</tr>
<tr>
<td></td>
<td>Motor overloaded</td>
<td>Check motor connections and correct as needed.</td>
</tr>
<tr>
<td>Unusual noise</td>
<td>Motor is going bad</td>
<td>Call YASKAWA customer service.</td>
</tr>
<tr>
<td></td>
<td>Brakes</td>
<td>Inspect/replace the brake pads (see Section 4.5).</td>
</tr>
</tbody>
</table>

NOTE: Shaded text, remedies should be carried out after turning power off.
Appendix A  Options Installation

A.1  Installing the Over Travel Limit Switch

To install the over travel limit switch option, proceed as follows:

1. Mount limit switch actuators in desired locations along the limit switch diameter of the customer supplied adapter plate using M16x70 hardware provided.

2. Mount limit switch brackets to the top of the drive assembly mounting plate using the M6x20 hardware provided.

WARNING

When properly installed, the over-travel limit switches provide overtravel electrical signals to the controller. The limit switches are not designed as physical limits or hard stops.
3. Connect the limit switch Turck cables to the hard stop limit switches. Refer to system prints for additional wiring information.

4. Reset the soft limits to appropriate values. Refer to Concurrent I/O and Parameters manual for instructions for resetting soft limits.

A.2 Installing the Zone Ring

To install the optional zone ring, proceed as follows:

1. Remove the adaptor plate and brake wear plate to provide access to the drive frame.

2. Install the limit switch mounting brackets directly to the drive frame using the M6x20 hardware provided (see Figure 22 for standard configuration).

3. Mount the J-box and mounting plate directly to drive frame using M6x20 hardware provided.

4. Connect limit switch cables to the J-box module. Refer to system prints for additional wiring information.
Appendix B  Illustrated Parts List

B.1  Introduction

The Illustrated Parts List identifies, describes, and illustrates detail parts of the main assemblies for the HD Drive Module manufactured by YASKAWA.

This list provides parts identification and descriptive information for use in provisioning, requesting, purchasing, storing, and issuing spare parts.

B.1.1  Explanation of Parts List

B.1.1.1  Contents

The parts list contains a breakdown of the equipment into detail parts. All parts of the equipment are listed except the following:

1. Standard hardware items (attaching parts) such as nuts, screws, washers, etc., which are available commercially.
2. Bulk items such as wire, cable, sleeving, tubing, etc., which are also commercially available.
3. Permanently attached parts which lose their identity by being welded, soldered, riveted, etc., to other parts, or assemblies.

B.1.1.2  Parts List Form

This form is divided into four columns as follows:

1. “Figure - Item Number” Column
   This Figure column lists the figure number of the illustration applicable to a particular parts list and also identifies each part in the list by an item number. These item numbers also appear on the illustration. Each item number on the illustration is connected to the part to which it pertains by a leader line and arrow. Thus, the figure and item numbering system ties the parts list to the illustrations and vice versa.

2. “Part Number” Column
   All part numbers appearing in this column are YASKAWA Motoman part numbers.

3. “Description” Column
   The item nomenclature appears in this column.

4. “QTY” Column
   This column indicates the quantity of parts required for an assembly or sub assembly in which the part appears. This column does not necessarily reflect the total used in the complete end item.
B.2 Parts List

B.2.1 Explanation of Parts List Arrangement

The parts list is arranged so that the illustration will appear on left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

B.2.2 Symbols and Abbreviations

The following is a list of symbols and abbreviations used in the parts list.

- amp – ampere
- AC – alternating current
- cyl – cylinder
- DC – direct current
- fig – figure
- hex – hexagon
- ID – inside diameter
- in. – inch
- m – meter
- mm – millimeter
- No. – number
- psi – pounds per square inch
Fig. B-4 Exploded View
### Table B.1 Exploded View

<table>
<thead>
<tr>
<th>Item Number</th>
<th>P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>149736-1</td>
<td>PLATE, WEAR</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>150974-1</td>
<td>PLATE, ADAPTOR (Optional)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>148154-1</td>
<td>BEARING, RADIAL</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>150976-2</td>
<td>GUARD, GEAR., RH</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>150976-1</td>
<td>GUARD, GEAR, LH</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>149724-1</td>
<td>DRIVE ASSY</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>149824-1</td>
<td>PLATE WASHER</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>149729-1</td>
<td>SPRING ASSY</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>149819-1</td>
<td>BRACKET SUPPORT DRIVE ASSY</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>149734-1</td>
<td>BRAKE, MOTOSWEEP HD</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>150926-1</td>
<td>DRIVEFRAME MOTOSWEEP HD</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>150269-1</td>
<td>GUARD, INNER</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>150688-1</td>
<td>GUARD, OUTER</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>145558-1</td>
<td>TUBE, 6MM UPPER</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>149733-1</td>
<td>HOUSING</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>133937-1</td>
<td>ZERK, GREASE</td>
<td>1</td>
</tr>
</tbody>
</table>
Table B.2 149724-1 Drive Assembly

<table>
<thead>
<tr>
<th>Item Number</th>
<th>P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150270-1</td>
<td>GUARD, WIPER <em>(Not used on Revision 2 or newer.)</em></td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>149728-1</td>
<td>GEAR, PINION, 21T</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>149726-1</td>
<td>RV-450E</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>149725-1</td>
<td>PLATE, MTG, DRIVE, ASSY, R1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>149727-1</td>
<td>PINION, RV-450E</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>149568-1</td>
<td>MOTOR, 3.7 SGMRS, 37A2A</td>
<td>1</td>
</tr>
</tbody>
</table>
Table B.3 149821-1 Optional Zone Ring Kit

<table>
<thead>
<tr>
<th>Item Number</th>
<th>P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>146429-1</td>
<td>MODULE, J-BOX, 4-PORT</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>151043-1</td>
<td>PLATE, MTG, J-BOX</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>143963-1</td>
<td>SWITCH, LIMIT, MINIATURE ROLLER</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>149735-1</td>
<td>BRACKET, MOUNTING, LIMIT SWITCH</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>143789-1</td>
<td>PLATE, MTG, SWITCH, THREADED</td>
<td>2</td>
</tr>
</tbody>
</table>
Fig. B-7 Optional Over Travel Limit Kit
Table B.4  149821-1 Optional Over Travel Limit Kit

<table>
<thead>
<tr>
<th>Item Number</th>
<th>P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>149779-1</td>
<td>BLOCK, ACTUATOR, LIMIT SWITCH</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>143789-1</td>
<td>PLATE, MTG, SWITCH, THREADED</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>143963-1</td>
<td>SWITCH, LIMIT, MINIATURE ROLLER</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>149735-2</td>
<td>BRACKET, MOUNTING, LIMIT SWITCH</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>146548-2</td>
<td>SCREW, SHOULDER, M16X50</td>
<td>4</td>
</tr>
</tbody>
</table>
YASKAWA MOTOMAN-NX100
CONTROLLER INSTRUCTIONS
FOR HD DRIVE MODULE

Specifications are subject to change without notice
for ongoing product modifications and improvements.