

Motoman® NX100 Controller

**ArcWorld® II-6200
DRC
System Manual**

Part Number: 150317-2
Revision: 0

MOTOMAN
a YASKAWA company

West Carrollton, Ohio 45449 USA
937.847.6200 (Voice)
937.847.6277 (Fax)
937.847.3200 (24-Hour Support)
www.motoman.com

info@motoman.com

The information contained within this document is the proprietary property of Motoman, Inc., and may not be copied, reproduced or transmitted to other parties without the expressed written authorization of Motoman, Inc.

©2006 by MOTOMAN®
All Rights Reserved

Because we are constantly improving our products, we reserve the right to change specifications without notice.

MOTOMAN® is a registered trademark of YASKAWA Electric Manufacturing.

Table of Contents

| | |
|---|----|
| Chapter 1 | |
| Introduction | 1 |
| 1.1 About This Document | 1 |
| 1.2 System Overview | 2 |
| 1.2.1 System Layout | 3 |
| 1.2.2 Major Components | 3 |
| 1.2.3 Optional Welding Equipment | 4 |
| 1.3 Reference Documentation | 4 |
| 1.4 Customer Support Information | 4 |
| Chapter 2 | |
| Safety | 5 |
| 2.1 Introduction | 5 |
| 2.2 Standard Conventions | 6 |
| 2.3 General Safeguarding Tips | 6 |
| 2.4 Mechanical Safety Devices | 7 |
| 2.5 Installation Safety | 7 |
| 2.6 Programming, Operation, and Maintenance Safety | 8 |
| Chapter 3 | |
| Equipment Description | 9 |
| 3.1 Robot Description | 9 |
| 3.2 NX100 - DRC Controller | 9 |
| 3.3 Programming Pendant | 10 |
| 3.4 Operator Station | 12 |
| 3.4.1 Operator Station Function – Cycle Start/Cycle Latched | 12 |
| 3.4.2 Operator Station Function – Emergency Stop (E-Stop) | 13 |
| 3.4.3 Operator Station Function – Positioner Auto/Manual | 13 |
| 3.5 MRM2-250 STX Positioner | 13 |
| 3.6 Welding Equipment | 14 |
| 3.6.1 Welding Power Sources | 14 |
| 3.6.2 Wire Feeder | 15 |
| 3.6.3 GMAW Torch | 15 |
| 3.7 Safety Features | 15 |
| 3.7.1 Welding Arc Protection | 16 |
| 3.7.2 Safety Fencing | 16 |
| 3.7.3 Light Curtain System | 16 |

| | |
|---|----|
| 3.7.4 Emergency Stop (E-Stop) | 17 |
| 3.7.5 Programming Pendant ENABLE Switch | 17 |
| 3.7.6 Emergency Braking System | 18 |
| 3.7.7 Interlocked Work Cell Door | 18 |

Chapter 4

| | |
|--|----|
| Installation | 19 |
| 4.1 Required Materials | 19 |
| 4.1.1 Customer-Supplied Items | 19 |
| 4.1.2 Recommended List of Hand Tools and Equipment | 20 |
| 4.2 Site Preparation | 20 |
| 4.3 Removal of System Components from Shipping Skids | 22 |
| 4.4 Component Installation | 22 |
| 4.4.1 Place System Components | 22 |
| 4.4.2 Level and Anchor System Components | 23 |
| 4.4.3 Attach Arc Curtains to Work Cell Fence Panels | 24 |
| 4.5 Removal of Robot Shipping Bracket | 25 |
| 4.6 Cable Connections | 26 |
| 4.6.1 Connection to Earth Ground | 26 |
| 4.6.2 Connection to Local Electrical Service | 27 |
| 4.6.2.1 NX100–DRC Controller | 27 |
| 4.6.2.2 Welding Power Sources | 28 |
| 4.7 Safety / Operation Check | 28 |
| 4.8 Installation of Tooling and Fixtures | 29 |

Chapter 5

| | |
|-----------------------------------|----|
| Operation | 31 |
| 5.1 Programming | 31 |
| 5.2 Sweeping the Positioner | 32 |
| 5.3 Daily Operation | 32 |
| 5.3.1 Start-Up | 33 |
| 5.3.2 Robot Home Position | 33 |
| 5.3.3 Master Job | 34 |
| 5.3.4 Operation Cycle | 34 |
| 5.3.5 Shutdown | 35 |
| 5.4 System Recovery | 35 |
| 5.4.1 Alarms and Errors | 35 |
| 5.4.1.1 Error Messages | 35 |
| 5.4.1.2 Minor Alarms | 36 |
| 5.4.1.3 Major Alarms | 36 |

| | |
|-----------------------------------|----|
| 5.4.2 E-Stop Recovery | 36 |
| 5.4.3 Shock Sensor Recovery | 36 |
| 5.4.4 Brake Release | 37 |
| | |
| Chapter 6 | |
| Maintenance | 39 |
| | |
| Appendix A | |
| Anchoring | 41 |
| | |
| Index | 43 |

NOTES

Chapter 1

Introduction

1.1 About This Document

This System Manual provides an overview of the complete Motoman ArcWorld®II-6200 DRC system. For detailed information on any specific system component listed in this document, please refer to the documentation package that is included with your ArcWorld®II-6200 DRC system (refer to Section 1.3).



Note: This manual documents a standard Motoman system. If your system is custom or modified, please use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for your specific system. The drawings, schematics, and parts listing are included in the documentation package supplied with your Motoman system.

This System Manual contains the following chapters –

CHAPTER 1 – INTRODUCTION

This chapter introduces the ArcWorld®II-6200 DRC System Manual, provides an overview of the ArcWorld®II-6200 DRC system, lists reference documents that are included with the documentation package, and provides Motoman Customer Support contact information.

CHAPTER 2 – SAFETY

This chapter provides general information regarding the safe installation, maintenance, and operation of the ArcWorld®II-6200 DRC system.

CHAPTER 3 – DESCRIPTION OF EQUIPMENT

This chapter describes the major components of the ArcWorld®II-6200 DRC system.

CHAPTER 4 – INSTALLATION

This chapter provides installation instructions for ArcWorld®II-6200 DRC system components.

CHAPTER 5 – OPERATION

This chapter provides an overview of ArcWorld®II-6200 DRC system operation — start-up, loading, normal operations, fault recovery, and system shutdown.

CHAPTER 6 – MAINTENANCE

This chapter provides a listing of preventive maintenance suggestions for certain components of the ArcWorld®II-6200 DRC system.

APPENDIX A – ANCHORING

Appendix A gives foundation and anchoring suggestions for ArcWorld®II-6200 DRC system components that require anchoring.

1.2 System Overview

The ArcWorld®II-6200 DRC system provides a complete arc welding solution in a standardized configuration (see Figure 1). The system is designed around two Motoman EA-series robots (EA1400N or EA1900N), an NX100-DRC controller assembly, two welding power sources, and one MRM2-250 STX positioner.

Refer to Section 3.2 for a description of features and advantages of the NX100-DRC controller configuration.

Refer to Section 3.5 for a description of the MRM2-250 STX positioner.

The ArcWorld®II-6200 DRC system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06 standard, and is designed to safeguard both personnel and equipment. Heavy-gauge wire mesh safety fencing prevents unintended entry of personnel into the work cell while it is in operation. Arc curtains cover the wire mesh fencing to block ultraviolet light that would otherwise radiate from the work cell during welding operations. An interlocked access door, at the rear of the work cell, provides convenient access to equipment while providing a safety interlock to disable all equipment should the access door be opened while the robots are active. A safety light curtain system provides a “sensing field” in front of the positioner to protect the operator from positioner movement. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot.

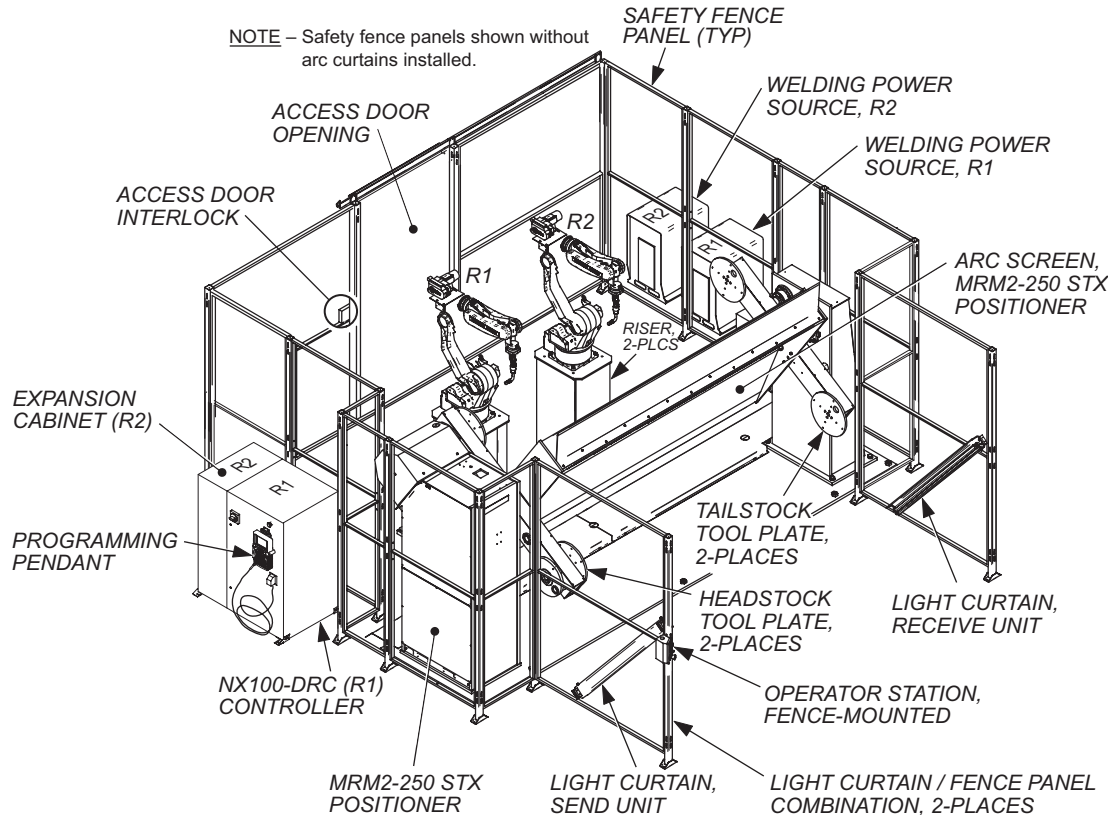


Figure 1 Overview and Component Location – ArcWorld®II-6200 DRC System

1.2.1 System Layout

Major components of the ArcWorld®II-6200 DRC system are anchored individually to the floor, as this system does not use common equipment bases. Heavy-gauge, wire mesh safety fencing is provided for installation at the customer's location. When installed, this safety fencing completely surrounds the work cell. The NX100-DRC controller assembly and both welding power sources are located outside of the work cell. All system controls, including those on the Programming Pendant, NX100-DRC controller assembly, welding power supplies, and Operator Station are safely accessible from outside the ArcWorld®II-6200 DRC work cell (see Figure 1 for location of these components).

1.2.2 Major Components

The ArcWorld®II-6200 DRC system includes the following major components –

- Two Motoman EA1400N or EA1900N manipulators (robots)
- One NX100-DRC controller assembly
- One MRM2-250 STX positioner
- One Programming Pendant
- One fence-mounted Operator Station (see Figure 1 for location)
- Welding equipment for each robot –
 - Welding power supply
 - Welding torch (air-cooled – standard; water-cooled – optional)
 - Wire feeder
 - Applicable welding interface
 - Torch mount
- Safety equipment –
 - Heavy gauge, wire-mesh safety fencing
 - Heavy gauge arc curtains
 - Interlocked safety light curtain system
 - Interlocked work cell entry door
 - Integral arc screen on the MRM2-250 STX positioner

1.2.3 Optional Welding Equipment

The following optional welding equipment is available for use with the ArcWorld®II-6200 DRC system –

- Torch cleaner
- Wire cutter
- Water-cooled torch (w / coolant circulator)
- Bulk wire dereeler, 454 kg (1000 lbs)
- ComArc™ (seam tracking)
- TouchSense™ (starting point detection)
- ToolSight® (auto verification of correct torch alignment)

1.3 Reference Documentation

For additional information on individual ArcWorld®II-6200 DRC components, refer to the following documentation that is included with your ArcWorld®II-6200 DRC system –

- Motoman *EA1400N Manipulator Manual* (P/N 149208-1) or Motoman *EA1900N Manipulator Manual* (P/N 149894-1)
- Motoman *NX100 Controller Manual* (P/N 149201-1)
- Motoman *NX100 Maintenance Manual* (P/N 150133-1)
- Motoman *NX100 Operator's Manual for Arc Welding* (P/N 149235-1)
- Motoman *NX100 Concurrent I/O Parameter Manual* (P/N 149230-1)
- Motoman *NX100 Independent/Coordinated Control Function Manual* (P/N 149648-1)
- Motoman *MRM2-250 STX Positioner Manual* (P/N 148911-1)
- Motoman *INFORM User's Manual* (P/N 150078-1)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Support Information

If you need technical assistance with your ArcWorld®II-6200 DRC system, please contact Motoman Customer Support at the following 24-hour telephone number –

937. 847. 3200

Please have the following information ready before you call –

- SYSTEM — ArcWorld®II-6200 DRC
- ROBOTS — EA1400N or EA1900N
- CONTROLLER — NX100-DRC
- POSITIONER — MRM2-250 STX
- PRIMARY APPLICATION — Arc welding
- SOFTWARE VERSION — Access this information on the Programming Pendant display screen by selecting MAIN MENU → SYSTEM INFO → VERSION
- ROBOT SERIAL No — Located on data plate of each robot
- ROBOT SALES ORDER No — Located on data plate of NX100-DRC controller, R1
- WARRANTY ID CODE — Located on back of the Programming Pendant

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. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06-1999.

Here is RIA contact information –

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, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **THE ROBOT MUST NOT BE OPERATED BY PERSONNEL WHO HAVE NOT BEEN TRAINED!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety chapter 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 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.



DANGER!

Information appearing in a **DANGER** concerns the protection of personnel from the 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 in a **WARNING** 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 in a **CAUTION** 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 provides additional information which is 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.
- 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 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).

Chapter 3

Equipment Description

3.1 Robot Description

The ArcWorld®II-6200 DRC system uses two Motoman EA1400N or EA1900N six-axis robots. Each robot is specifically designed for arc welding applications. The EA1400N robot has a payload capability of 3 kg (6.6 lbs.), and features a horizontal reach of 1388 mm (54.6 inches). The EA1900N robot has a payload capability of 3 kg (6.6 lbs.), and features a horizontal reach of 1904 mm (75.0 inches). Each robot features a relative positioning accuracy of ± 0.08 mm (± 0.003 inch). Both robot types feature an internal cabling design that provides high flexibility and streamlines the robot profile, thus allowing access into confined spaces. Each robot's B-axis (Pitch/Yaw) features an expanded range of motion that improves circumferential welding on cylindrical work pieces. The T-axis (Twist) can rotate the welding torch $\pm 360^\circ$ without cable interference.

For additional information on the Motoman EA-Series robots, please refer to the *EA1400N Manipulator Manual* or the *EA1900N Manipulator Manual* that are included with your ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

3.2 NX100 - DRC Controller

The ArcWorld®II-6200 DRC system features one NX100-DRC controller assembly that consists of one NX100 controller mated to an expansion cabinet (see Figure 2). This combination provides the same functionality of two full-size controllers, while reducing the overall width by 250 mm (9.8 in) when compared to two, full-size NX100 controllers. This configuration also reduces the cost to the operator by eliminating certain redundant components and circuit assemblies.

Through specific internal cable interconnections, the NX100-DRC is configured as controller R1 and controller R2 (see Figure 2). This configuration allows the two robots to operate as a dual system that takes advantage of all the unique functions available only in a dual system configuration. With the ArcWorld®II-6200 DRC system, the full-size NX100 controller cabinet is designated R1, while the smaller, expansion cabinet is designated R2.

In addition to controlling the movement of the two robots, the NX100–DRC also controls the two welding power sources, the positioner, and provides the signals necessary to operate the two welding systems.

The NX100–DRC controller features an embedded real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language.

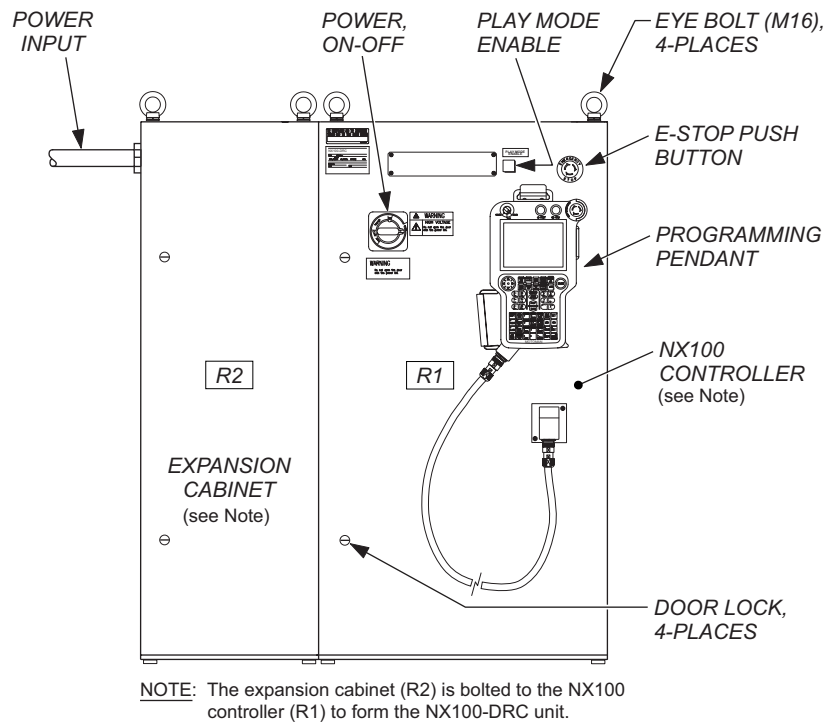


Figure 2 NX100–DRC Controller

3.3 Programming Pendant

The Programming Pendant (see Figure 3) provides the primary means of programmer / operator interaction with the ArcWorld® II–6200 DRC system. The pendant features the Windows® CE operating system and displays information on a 6½ -inch, color LCD, touch-screen display. The pendant also incorporates a CompactFlash® card slot for program backups. The Programming Pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the robots. Most operator controls are located on the Programming Pendant. This allows remote installation of the NX100–DRC controller assembly. By using the Programming Pendant, the operator can teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable / disable Operator Station control of the ArcWorld® II–6200 DRC system. For detailed information on the pendant programming keys, programming functions, and display functions, refer to the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld® II–6200 DRC system documentation package (refer to Section 1.3).

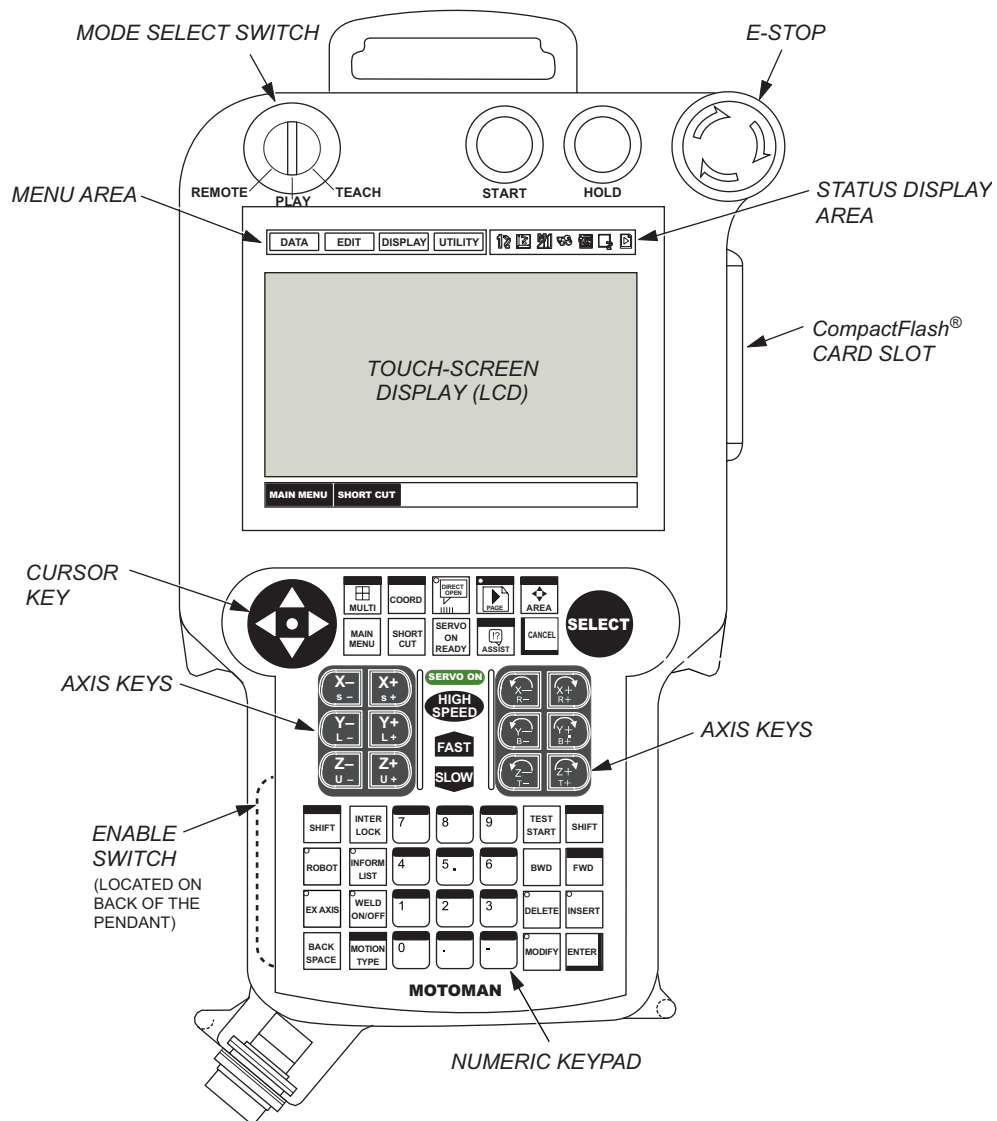




Figure 3 NX100-DRC Programming Pendant

 *Note: The Programming Pendant LCD touch screen display features a “screen saver” that causes the screen to go dark after a few minutes of inactivity. Press any key to restore screen.*

 *Note: Operator Station “enable” or “disable” is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld® II-6200 DRC system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE.*

3.4 Operator Station

The Operator Station (see Figure 4) is mounted on one of the safety light curtain fence panels. See Figure 1 for location of the Operator Station in relation to other components of the ArcWorld®II-6200 DRC system.

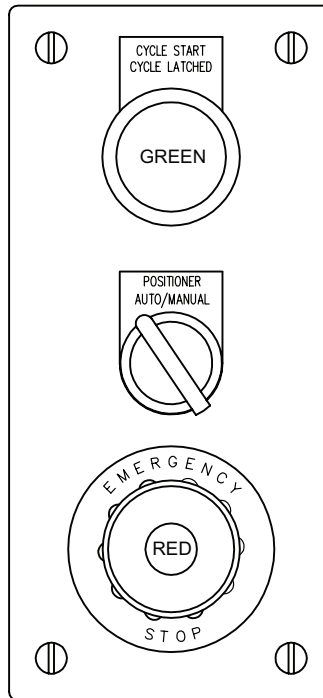


Figure 4 Operator Station Controls

3.4.1 Operator Station Function – Cycle Start/Cycle Latched



WARNING!

The operation of the **CYCLE START** button is dependent on the structure of the Master Job. Any alteration of the Master Job could result in injury to personnel or damage to equipment.

Pushing the green **CYCLE START/CYCLE LATCHED** push button, located on the Operator Station, initiates a positioner sweep cycle if the robots are in the Home (Safe) position. If the **CYCLE START/CYCLE LATCHED** push button is pressed while the robots are still welding, or otherwise not in the Home (Safe) position, the **CYCLE START** command is “latched” into (stored in) the NX100–DRC controller circuitry. When the robots return to the Home (Safe) position, the “latched” **CYCLE START** command is executed and the positioner sweeps. Circuitry in the NX100–DRC controller prevents the positioner from continuously cycling, should the operator depress and hold the **CYCLE START/CYCLE LATCHED** push button.

3.4.2 Operator Station Function – Emergency Stop (E-Stop)

Pressing the Operator Station E-Stop push button initiates an emergency stop (E-Stop). Refer to Section 3.7.4 for a discussion of the E-stop function, and procedures for recovering the ArcWorld®II-6200 DRC system from the emergency stop (E-Stop) condition.

3.4.3 Operator Station Function – Positioner Auto/Manual

The POSITIONER AUTO/MANUAL selector switch is used to select AUTO or MANUAL mode for the positioner. When the selector switch is in the AUTO position, the robots weld parts immediately after the positioner sweeps. In MANUAL mode, the positioner sweeps but the robots do not weld parts until the operator selects AUTO mode.



Note: The POSITIONER AUTO / MANUAL command depends upon the structure of the Master Job.

3.5 MRM2-250 STX Positioner

The Motoman MRM2-250 STX is an AC servo-driven headstock/tailstock (HS/TS) positioner that features a patented single motor drive (see Figure 1 and Figure 5). A positioner of this type is often referred to as a “Ferris wheel” positioner because of the operational dynamics.

A customer-supplied fixture frame is typically mounted between the headstock and tailstock tooling plates (see Figure 1). Customer-supplied tooling fixtures are either mounted on, or integrated into, these frames for positioning and clamping of production parts. Pneumatic and electrical signals can be routed to the fixtures, if required.

The MRM2-250 STX positioner has a load capacity of 250 kg (551.1 lbs) per side, a 1170 mm (46.1 in) maximum tooling diameter, and a “Side A to Side B Sweep Time” of 4 seconds. The standard distance between the headstock / tailstock face plates is 2600 mm (102.4 in). Positioning accuracy for the MRM2-250 STX is ± 0.1 mm (± 0.004 in).

The MRM2-250 STX positioner is capable of synchronized motion between various components depending on the job configuration. Synchronized components move at the same time during welding operations. Each robot can be synchronized with the MRM2-250 STX positioner. The MRM2-250 STX positioner is also capable of true coordinated motion, where linear, circular, or spline motion can be coordinated between the robots and the positioner. Coordinated motion allows the robots to weld while the positioner rotates the parts. For additional information on coordinated motion, refer to the *NX100 Independent / Coordinated Control Function Manual* included with your ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

The MRM2-250 STX positioner is equipped with fixture locking pins that prevent the headstock and tailstock face plates from turning when the servo motor disengages. The fixture locking pins are spring-loaded, to ensure pin engagement when the servo motor retracts. Each headstock face plate incorporates two locking pins.

For additional positioner information (including an illustrated parts list, lifting and levelling instructions, load capabilities, and dimensions), refer to the *MRM2-250 STX Positioner Manual* that is included with your ArcWorld® II-6200 DRC system documentation (refer to Section 1.3).



Note: The customer shall supply all tooling and fixtures for the MRM2-250 STX positioner.



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

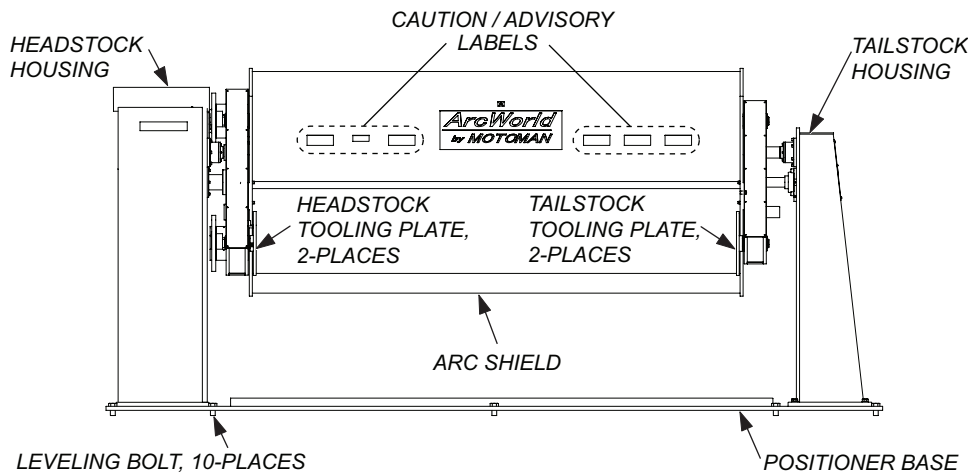


Figure 5 MRM2-250 STX Positioner

3.6 Welding Equipment

In its standard configuration, the ArcWorld® II-6200 DRC system includes a welding power source, wire feeder, torch, and torch mount for each of the two EA-series robots. Optional welding equipment is available for the ArcWorld® II-6200 DRC system (refer to Section 1.2.3). Optional welding equipment may be included with your ArcWorld® II-6200 DRC system shipment.

3.6.1 Welding Power Sources

Motoman offers various brands and types of welding power sources. The actual brand and type of welding power source supplied with the ArcWorld® II-6200 DRC system depends on the customer's specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® II-6200 DRC system, refer to the welding power source vendor manual that is included with your system (refer to Section 1.3.).

3.6.2 Wire Feeder

A welding wire feeder is mounted on each robot. The wire feeder is the “4-roll” type and provides reliable wire feeding at rates up to 750 inches per minute (ipm). An integral gas valve provides fast shielding gas response time. Interchangeable feed rolls are used to accommodate different wire gauges and wire types. For additional information on how the wire feeder is mounted to a robot, including allowable loads and installation position, refer to the documentation for the particular EA-Series robots that are included with your ArcWorld®II-6200 DRC system (refer to Section 1.3).

3.6.3 GMAW Torch

The ArcWorld®II-6200 DRC system uses either an air-cooled or a water-cooled robotic/automatic GMAW torch for each robot. These are heavy-duty torches designed for quick replacement and a minimum of robot reprogramming. The GMAW torch is installed at the end of the robot wrist flange. For applications that use the optional water-cooled torch, the ArcWorld®II-6200 DRC system includes a water circulator kit for each robot.

A torch mount on each robot, protects the robot, work piece, fixture, and positioner. It provides multi-directional impact detection. Any torch impact (collision) triggers a system E-Stop condition (refer to Section 3.7.4).

For additional information on the torches and mounts that are supplied with your system, refer to the documentation that is included with your ArcWorld®II-6200 DRC system (refer to Section 1.3).

3.7 Safety Features

The ArcWorld®II-6200 DRC system features Motoman’s *Total Safety Environment*. The system incorporates a practical level of safeguarding to satisfy most plant conditions. If the customer complies with all standard safety precautions, the safety equipment helps to ensure safe operation of the robot work cell.



Note: ArcWorld®II-6200 DRC safety features are independent of program logic. All safeguards are “hard wired” and provide protection that is independent of any software program. System safeguards do not depend upon a programmer correctly inputting an instruction in the operating program.



Note: ArcWorld®II-6200 DRC system safeguards are interfaced with normally closed (NC) “fail-to-safe” switch contacts. These components will stop work cell operation if they are disconnected or damaged.



Note: Users are responsible for determining that the safeguards provided with the ArcWorld®II-6200 DRC system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.

3.7.1 Welding Arc Protection

One by-product of the welding arc is an intense level of ultraviolet light. The ultraviolet light radiates outwardly (equal strength in all directions) from the weld point whenever an arc is established. If not blocked, the radiated ultraviolet light can present a health risk to personnel near the welding arc.

Two forms of welding arc protection are part of the ArcWorld®II-6200 DRC system –

- steel arc screen on the positioner
- arc curtains attached to the steel mesh safety fencing

The steel arc screen on the positioner is always positioned between the welding arc and the operator. This protects the operator from ultraviolet light radiation and sparks that result from the welding operation (see Figure 1).



WARNING!

Although safety fence arc curtains block the radiation of ultraviolet light, never look directly at the welding arc without protective eye wear.

The arc curtains block most of the ultraviolet light radiation that would otherwise escape the work cell. Just as the arc screen on the positioner protects the operator from intense ultraviolet light, the arc curtains protect other personnel who are near the work cell.

3.7.2 Safety Fencing

The heavy-gauge steel mesh safety fencing provided with the ArcWorld®II-6200 DRC system is designed to enclose the entire robotic work cell. After installation, it forms a physical barrier that prevents the movement of personnel or objects into the work cell during automatic operation. An interlocked sliding door is part of the safety fencing, and provides an entrance for personnel at the rear of the work cell (refer to Section 3.7.7).

3.7.3 Light Curtain System

The main function of the Light Curtain System is to protect an operator from positioner movement. The Light Curtain System consists of a SEND unit, RECEIVE unit, and associated wiring (see Figure 1). The Light Curtain System establishes an infrared light path between the SEND and RECEIVE units to define a protected zone in front of the positioner. The positioner will not initiate a sweep if an operator (or an object) is in a location that interrupts (breaks) the established light path. Interruption of the established light path during a positioner sweep immediately triggers an E-Stop condition (refer to Section 3.7.4).

For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

3.7.4 Emergency Stop (E-Stop)

E-Stop is a primary safety feature of the ArcWorld®II-6200 DRC system. A work cell access door interlock, a safety light curtain system, robot welding torch impact (collision) detection circuitry (refer to Section 3.6.3), and E-Stop push buttons can all trigger an E-Stop condition. An E-Stop condition immediately de-energizes the control system and activates the robot braking system (refer to Section 3.7.6). The E-Stop push buttons are used for an intentional shutdown of the ArcWorld®II-6200 DRC system, and are installed at the following locations –

- Programming Pendant
- NX100-DRC controller (R1)
- Operator Station

To resume operation after an E-Stop system shutdown, the operator must clear and reset the action that caused the E-Stop condition (refer to Section 5.4.2).

3.7.5 Programming Pendant ENABLE Switch

The ENABLE switch is part of the Programming Pendant, and provides a safety feature that controls servo power while the system is in TEACH mode (see Figure 3 and Figure 6). When pressed in, this switch allows the operator to enable servo power. However, should the operator release the switch or grasp it too tightly, servo power is immediately disabled, thus preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

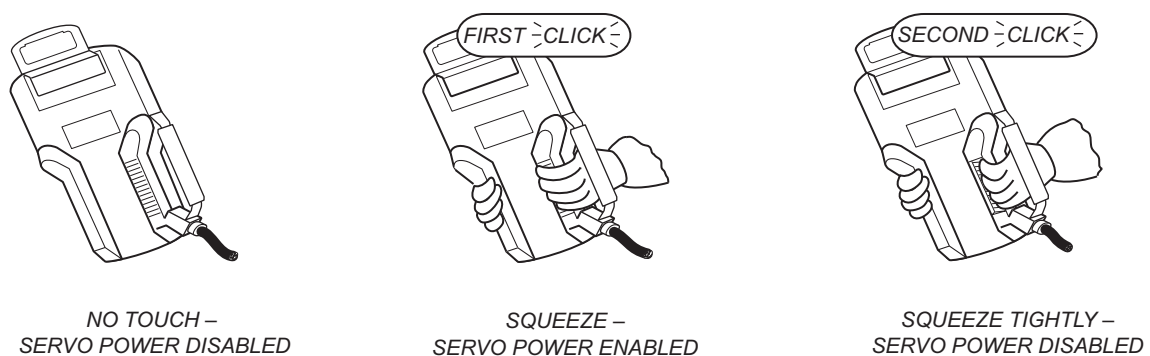


Figure 6 Programming Pendant ENABLE Switch – Location and Operation

3.7.6 Emergency Braking System

The robot incorporates a braking system that protects personnel from injury and prevents equipment damage if servo power is disabled. Upon loss of servo power, the brake system activates to hold all robot axes in place. The brake system incorporates a feature that allows the operator to release the brake of a specific robot axis upon loss of servo power. Brake release is accomplished with the Programming Pendant (refer to Section 5.4.4).

3.7.7 Interlocked Work Cell Door

A redundant circuit safety interlock is installed on the sliding work cell access door (see Figure 1). Opening the work cell access door while the robots are in PLAY mode triggers an E-Stop condition (refer to Section 3.7.4).

Chapter 4

Installation



CAUTION!

The ArcWorld®II-6200 DRC system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.



CAUTION!

Handle all system components with care. The ArcWorld®II-6200 DRC system is not extremely fragile, but it is a sophisticated robotic system that can be damaged by rough handling.



Note: The customer shall supply all anchoring hardware for the ArcWorld®II-6200 DRC system. Please refer to Appendix A of this document for suggested anchoring hardware and foundation specifications.

Two to three qualified technicians can install the ArcWorld®II-6200 DRC system in a reasonable amount of time. Always comply with established safety procedures throughout the installation process (refer to Chapter 2).

4.1 Required Materials

All system components and most of the materials and fasteners needed for installation of the ArcWorld®II-6200 DRC system are included with shipment from the factory. However, the customer must supply some required items and installation tools (refer to Section 4.1.1 and Section 4.1.2).

4.1.1 Customer-Supplied Items

- Shielding gas for the welding torches
- Local electrical service
- Earth ground wires for the robots and the NX100–DRC controller assembly
- Earth ground rods and/or buried copper sheeting (quantity and placement depth as required to achieve specified resistance-to-ground reading of 100 ohms or less)

- Chemical (optional) to increase conductivity of soil in the vicinity of the earth ground system
- Welding wire
- Clean, dry air supply (for torch tender or wire cutter options) –
 - Flow Rate 0.425 m³/min (15 cfm)
 - Pressure 620 kPa (gage) [90 psi (gage)]
- Forklift(s) and/or overhead crane
- Special anchor bolts and drill bits (refer to Appendix A for suggested anchoring hardware)

4.1.2 Recommended List of Hand Tools and Equipment

- Safety glasses
- Face shield
- Gloves (heavy-duty leather recommended)
- Level (short and long)
- Ratchet Handle (with 3/4-inch hex socket)
- Adjustable wrench (large and small)
- Hammer drill with appropriate concrete bits
- Phillips and flat-blade screwdrivers
- Hammer (dead-blow and steel)
- Hammer (non-marring)
- Socket set (SAE and Metric)
- Air-impact gun (with 3/4-inch hex socket)
- Open-end wrench set (SAE and Metric)
- "Allen" wrench set (SAE and metric)

4.2 Site Preparation



WARNING!

During installation planning, allow sufficient room for access to the work cell door, Operator Station, and system components that are exterior to the work cell. Failure to observe this warning could result in injury to personnel during system operation and maintenance.

To prepare your site, proceed as follows –

1. Clear floor space and overhead area needed for the ArcWorld[®]II-6200 DRC system (see Figure 7 and Figure 8). Allow an additional 1.2 - 1.5 m (4 to 5 ft) on all sides of the work cell to provide the clearance needed for installation.
2. Gather all customer-supplied items and required tools (refer to Section 4.1).

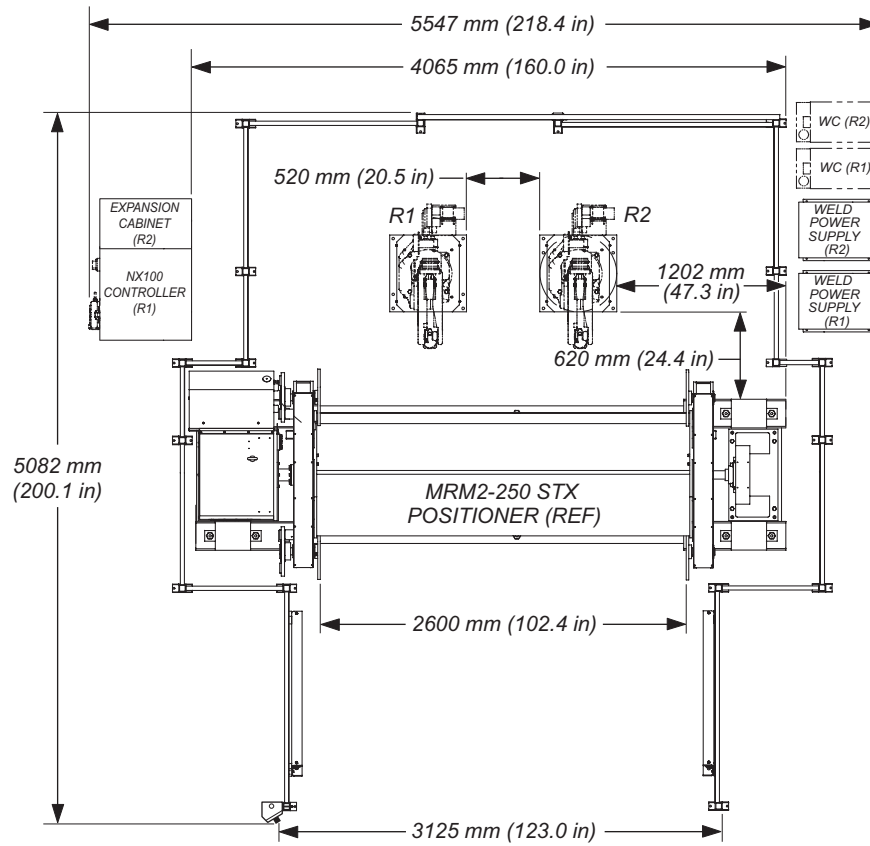


Figure 7 ArcWorld®II-6200 DRC – Installation Dimensions and Component Locations (Plan View)

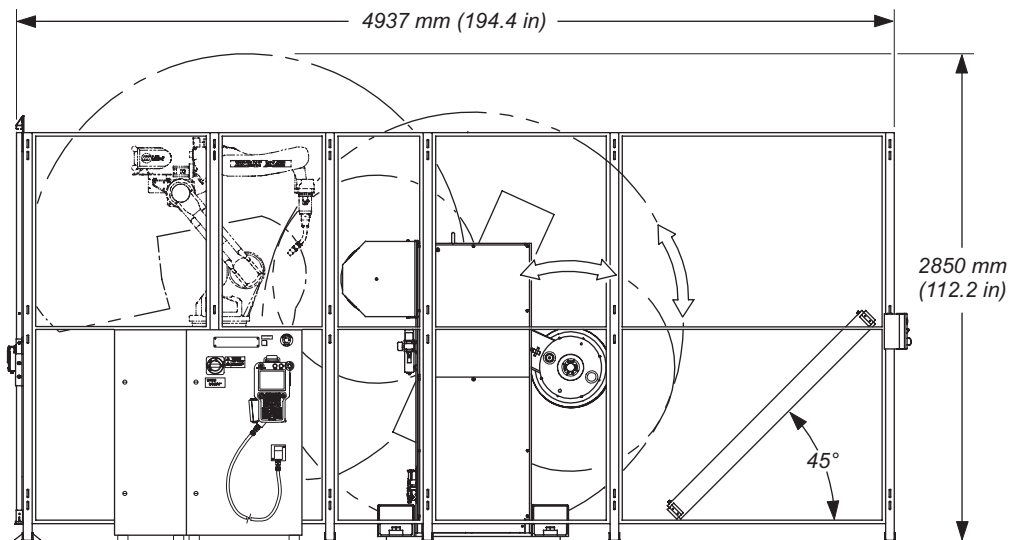


Figure 8 ArcWorld®II-6200 DRC – Installation Dimensions and Component Locations (Elevation View)

4.3 Removal of System Components from Shipping Skids

System components are attached to wooden shipping skids and/or wooden blocks at the factory, prior to shipment to the customer. The customer is responsible for removing the shipping skids and/or blocks and inspecting the components for shipping damage.



Note: If you notice any equipment damage, notify your shipping contractor as soon as possible.

1. Unbolt each component from its shipping skid or block using a $\frac{3}{4}$ -inch socket (see Figure 9).
2. Use forklift(s) or overhead crane to lift each component away from its shipping skid.
3. Discard or recycle the shipping skids and other shipping materials.

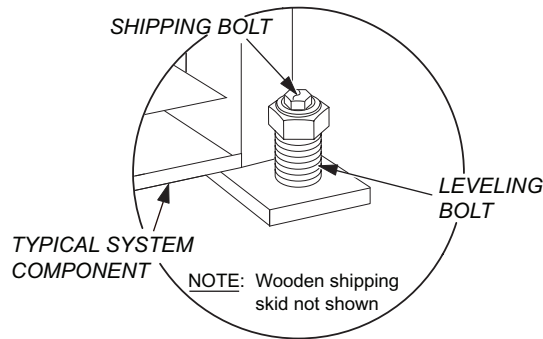


Figure 9 Removal of Typical Shipping Bolt

4.4 Component Installation

To make sure the ArcWorld®II-6200 DRC work cell is complete and to verify the correct amount of floor space for the installation, Motoman recommends that all system components (except the safety arc curtains) be set in place prior to anchoring the components to the foundation. See Figure 7, and the system drawings supplied with your ArcWorld®II-6200 DRC system, to correctly place system components.

4.4.1 Place System Components

Before permanently anchoring the cell components to the floor, set all pieces in place in the following order –

1. Place the MRM2-250 STX positioner to define the front of the cell (see Figure 7).
2. Place the robots (with risers) in the specified location relative to the positioner (see Figure 7).
3. Interconnect the safety fence panels and place them in position so that they enclose the work cell (see Figure 7 and refer to fence installation documentation that is supplied with the ArcWorld®II-6200 DRC system).



Note: Do not install the arc curtains to the fence panels at this time. The arc curtains will be attached to work cell fence panels after the fencing system has been anchored to the foundation.

4. Ensure that the final placement of the assembled safety fence conforms to the placement dimensions shown in Figure 7.
5. Install the work cell sliding door to the safety fencing (refer to Figure 7 and the safety fencing documentation that is supplied with the ArcWorld®II-6200 DRC system).
6. Remove both light curtain fence panels from their shipping position and attach each to the safety fence with the supplied hardware. The light curtains are oriented properly when the status lights are located near the base of the positioner (see Figure 1).



Note: The light curtain components – send unit and receive unit – are each pre-attached to a safety fence panel at the factory (see Figure 1).

7. Place the NX100–DRC controller assembly and welding power sources (see Figure 7 and the ArcWorld®II-6200 DRC system drawings for the correct location for these components).



Note: Do not place the NX100–DRC controller assembly or welding power sources any closer than 152.4 mm (6 in) to the work cell safety fencing.

4.4.2 Level and Anchor System Components

When all ArcWorld®II-6200 DRC system components are in correct position, proceed with the following steps in this section to level system components (if required) and anchor them to the foundation (refer to Appendix A for foundation and anchoring suggestions).



CAUTION!

Be absolutely certain of the correct location for each ArcWorld®II-6200 DRC system component before anchoring it to the foundation.



WARNING!

Wear protective eye wear during the anchoring process. Failure to observe this warning could result in eye injury for the installation technician.

1. If required, level a system component by adjusting levelling bolts (see Figure 10).



Note: Refer to the MRM2-250 STX Positioner Manual for detailed levelling information for the positioner (refer to Section 1.3).

2. After positioning and levelling (if required) a system component, insert a drill bit through the center of each levelling bolt for that component and drill a hole into the foundation to accept an anchor bolt (refer to Appendix A for foundation and anchoring suggestions)
3. Use compressed air to remove all concrete dust from each drilled hole.
4. Anchor the system component to the foundation with suitable anchor bolts (refer to Appendix A for foundation and anchoring suggestions).
5. Repeat all steps in this section for each system component that requires anchoring to the foundation.

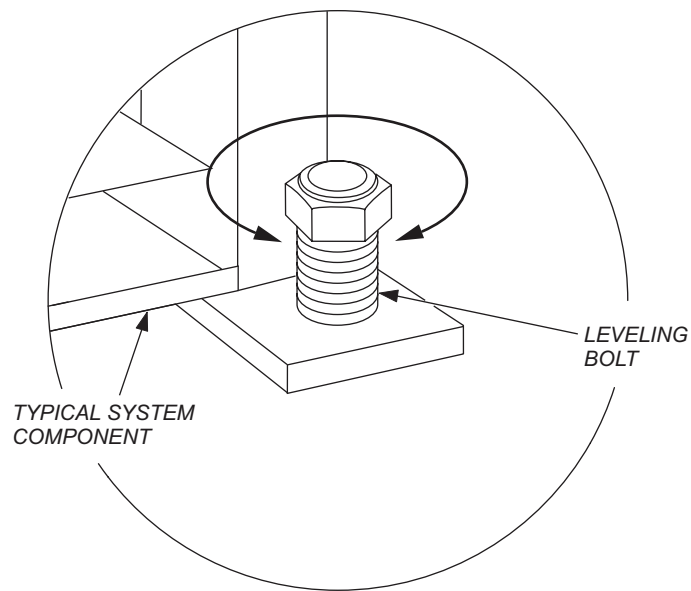


Figure 10 Typical Levelling Bolt

4.4.3 Attach Arc Curtains to Work Cell Fence Panels

The arc curtains are packaged in an accessories box that is shipped with the ArcWorld® II-6200 DRC system.



WARNING!

Ensure that the work cell safety fence is anchored in place before installing the arc curtains. Unanchored fence panels can fall and cause injury to personnel or damage to equipment.

Install the arc curtains as follows –

1. Unfold each arc curtain and install one arc curtain on the inside of each work cell safety fence panel, using supplied plastic cable ties and the eyelets in each arc curtain (see Figure 7 and Figure 11).



Note: The arc curtains are pre-cut to match the work cell fence panels. Each arc curtain bag contains documentation that includes the arc curtain dimensions. If necessary, these dimensions can be used to match the arc curtain to the correct work cell fence panel.

2. Make sure there are no gaps between the arc curtains.
3. Install the door panel arc curtain on the inside of the door panel, using the supplied plastic cable ties and the eyelets in the arc curtain (see Figure 7 and Figure 11).

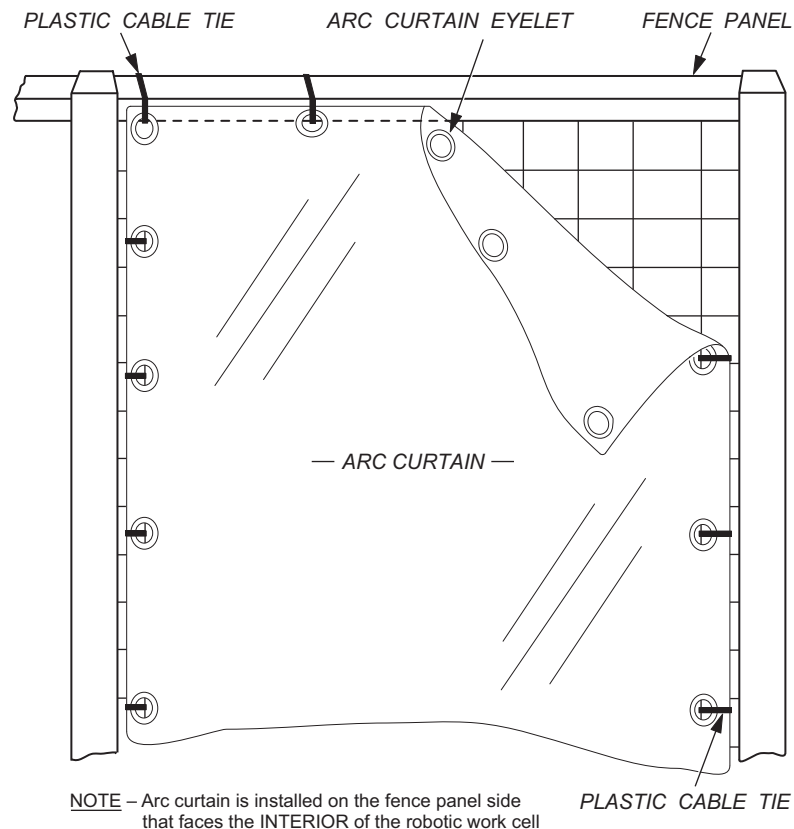


Figure 11 Arc Curtain Installation on Typical Work Cell Safety Fence Panel

4.5 Removal of Robot Shipping Bracket



CAUTION!

Remove the shipping bracket from each robot prior to power-up or operation. Operation of a robot, without first removing the shipping bracket, can damage the robot drive components.

A bracket is installed on each robot at the factory to prevent undesired movement during shipping (see Figure 12). The bracket is painted bright yellow for easy location and identification. The bracket secures the lower arm of the robot to the S-axis housing. In addition, the bracket provides the correct attachment points for a hoisting sling, should a robot need to be lifted or moved. Upon bracket removal, be sure to keep the brackets and attaching hardware in a secure location, should they be needed in the future.

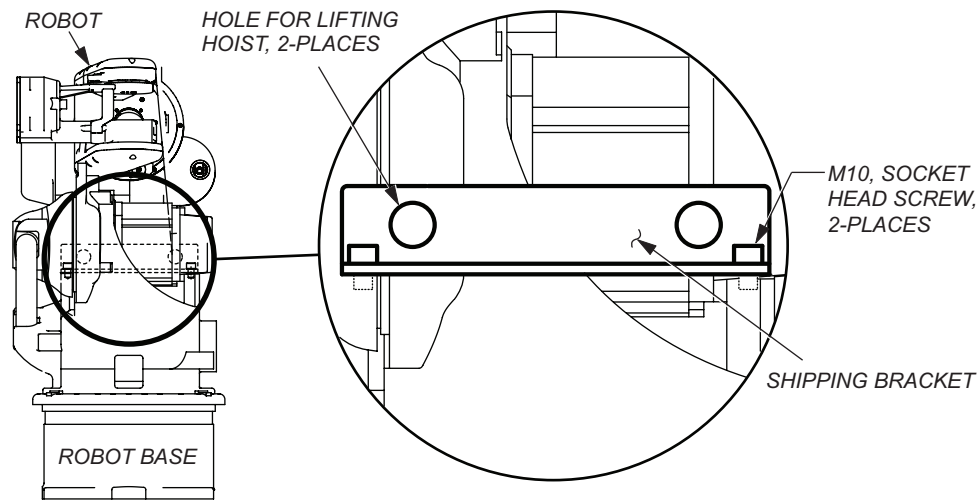


Figure 12 Robot Shipping Bracket

4.6 Cable Connections

After the ArcWorld®II-6200 DRC system components and peripherals are anchored in their correct locations, locate the interconnect cables for the system components and route them according to the system drawings and schematics included in the ArcWorld®II-6200 DRC system documentation package. All cables and connectors are labelled to ensure correct connection to the mating connectors on the applicable system component.



Note: A small gap of approximately 100 mm (4 in) exists between the bottom of the work cell safety fence and the floor. This gap provides a passage for cables that link components outside the work cell with those that are inside the work cell.

4.6.1 Connection to Earth Ground



WARNING!

Do not use the ArcWorld®II-6200 DRC system unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the electric power source, welder, etc. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between a component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.

The EA-Series robots and NX100-DRC controller assembly must be connected to a low-resistance earth ground. If a ground stake is used, it should be driven at least 2.43 m (8 ft) into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. The earth ground may require more than a single driven ground rod, depending on soil conditions. Often, multiple

ground rods (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Specialized electronic measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.



Note: The customer shall supply all wires associated with the earth ground. The customer is responsible for establishing the correct gauge of all wires associated with the earth ground and maintaining an adequate earth ground (measured resistance of 100 ohms or less).

Connect both robots and NX100–DRC controller assembly to the earth ground as follows –

1. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of robot R1. Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot R1.
2. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of robot R2. Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot R2.
3. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NX100–DRC R1 controller (see Figure 2). Connect the other end of the earth ground wire to the low-resistance earth ground.
4. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NX100–DRC R2 expansion cabinet (see Figure 2). Connect the other end of the earth ground wire to the low-resistance earth ground.

4.6.2 Connection to Local Electrical Service



WARNING!

Local electrical service connection to the ArcWorld® II-6200 DRC system must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as all local electrical codes.



Note: The ArcWorld® II-6200 DRC system is configured for 3-phase 460/480V AC primary power. For additional information, refer to the electrical drawings and schematics that are included with your system documentation package (refer to Section 1.3).

After all of the system components have been properly installed and interconnected, connect local electrical service to the NX100–DRC controller assembly and welding power sources (refer to Section 4.6.2.1 and Section 4.6.2.2).

4.6.2.1 NX100–DRC Controller

For detailed electrical service interconnect procedures for the NX100–DRC controller assembly, refer to the *NX100 Controller Manual* and ArcWorld®II-6200 DRC system drawings / schematics that are included with your system documentation package (refer to Section 1.3).

4.6.2.2 Welding Power Sources

Refer to the welding power source documentation and ArcWorld®II-6200 DRC system drawings / schematics for electrical service connection procedures and diagrams for the welding power sources.

4.7 Safety / Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform the following safety/operation check –

1. Ensure that the shipping bracket is removed from each robot (refer to Section 4.5).
2. Ensure correct alignment and operation of the safety light curtain system (refer to safety light curtain documentation that is included with the ArcWorld®II-6200 DRC system).
3. Check the security and integrity of all cable connections.
4. Ensure that the work cell sliding access door is closed and that the door interlock is engaged.
5. Verify the correct settings for the welding power sources (refer to the welding power source documentation that is included with your ArcWorld®II-6200 DRC system).
6. Verify that local electrical service complies with the power requirements for your ArcWorld®II-6200 DRC system.
7. Verify that local electrical service is correctly wired into the NX100–DRC controller assembly and the welding power sources (refer to Section 4.6.2).



CAUTION!

The ArcWorld® II-6200 DRC system is now ready for power-up. Qualified, trained personnel, who are familiar with this system, should perform the power-up sequence.

8. Rotate the POWER ON-OFF Switch on NX100–DRC R1 controller to ON (see Figure 2).



Note: An electrical service disconnect box for the NX100–DRC controller assembly shall be supplied (if desired) by the customer. It is not part of the ArcWorld®II-6200 DRC system shipment.

9. Set POWER ON-OFF switch on welding power source R2 to ON.
10. Set POWER ON-OFF switch on welding power source R1 to ON.



WARNING!

Before operating the robots, verify that each E-Stop push button disables servo power when activated (pushed in). Each E-Stop push button must immediately stop robot and positioner movement when activated (pushed in).

11. Check for correct operation of all E-Stop push buttons (refer to Section 3.7.4).
12. Check for correct operation of the system HOLD button on the Programming Pendant.
13. Check for correct action of the work cell access door safety interlock.
14. Remove power from the ArcWorld®II-6200 DRC system after completion of the safety / operation check.

4.8 Installation of Tooling and Fixtures

The ArcWorld®II-6200 DRC system is now ready for attachment of tooling fixtures to the MRM2-250 STX positioner tooling plates. Motoman recommends that you assign this task to personnel who are familiar with ArcWorld®II-6200 DRC system operation and set-up. After installation of tooling fixtures, test the MRM2-250 STX positioner for correct operation.



Note: All tooling and fixtures for the MRM2-250 STX positioner shall be supplied by the customer.



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

NOTES

Chapter 5

Operation



CAUTION!

The customer is responsible for providing trained operators to run the equipment. The customer is also responsible for making sure that the equipment is operated in accordance with the ANSI/RIA R15.06-1999 Robot Safety standard, as well as any other local or state standards.

This chapter provides a brief overview of the operating procedures and precautions for your ArcWorld®II-6200 DRC system. For more detailed operating information, refer to specific component manuals that are part of the ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

The ArcWorld®II-6200 DRC system is a fully integrated robotic GMAW welding cell.

Two EA1400N or EA1900N robots weld parts on one side of the MRM2-250 STX positioner, while the operator loads the opposite side of the positioner with parts to be welded. When the robots complete the welding process, they return to a Home (Safe) position. The operator can then initiate another positioner sweep cycle from the Operator Station. This moves the previously loaded parts into the robot work area, where the robots then move from the Home (Safe) position to complete another welding cycle.



Note: The customer shall supply all tooling fixtures for the positioner.

5.1 Programming

The operation of the ArcWorld®II-6200 DRC system is programming dependent. The following operating instructions are based on one possible configuration for this system. Your system configuration and job structure may differ slightly from that presented here; however, basic operation will be the same. For additional programming procedures and information, refer to the NX100-DRC controller documentation that is included with your ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

Any changes made to your system configuration or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original jobs and system

configuration of your ArcWorld®II-6200 DRC system. If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original. Modifications must be performed by trained and experienced personnel who are familiar with the operation of the ArcWorld®II-6200 DRC system. If you have questions concerning the configuration of your system, please contact Motoman 24 hour Customer Support (refer to Section 1.4).

5.2 Sweeping the Positioner



Note: The robots must be in the Home position before you can sweep the positioner.

Selecting MANUAL mode on the Operator Station POSITIONER AUTO/MANUAL switch allows the operator to sweep the MRM2-250 STX positioner without activating the robots. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the welding zone, before teaching the robots a series of moves. To sweep Side A or Side B of the positioner into the robot's welding zone, proceed as follows –

1. Place the robots in Home position (refer to Section 5.3.2).
2. Make sure that the Operator Station is enabled (Programming Pendant MODE SELECT SWITCH set to REMOTE).
3. Set the Operator Station POSITIONER AUTO/MANUAL switch to MANUAL and start Master Job (refer to Section 5.3.3). Normally, the robots will not move out of Home position when the POSITIONER AUTO/MANUAL switch is set to MANUAL (this depends on job structure).



Note: Cycle Start latching is not operative in MANUAL mode.

4. Press the CYCLE START/CYCLE LATCH push button on Operator Station (the MRM2-250 STX positioner sweeps each time the CYCLE START/cycle latch push button is pressed).

5.3 Daily Operation

The procedures below represent the typical operating sequence from power up to shutdown. Your basic operating procedures may vary depending on your situation.

- Perform start-up procedures (refer to Section 5.3.1).
- Move robots to Home position (refer to Section 5.3.2).
- Select Master Job (refer to Section 5.3.3).
- Perform operation cycle (refer to Section 5.3.4)
- Perform shutdown procedures (refer to Section 5.3.5)

5.3.1 Start-Up

To start up the ArcWorld®II-6200 DRC work cell from a power-off condition, proceed as follows –



Note: Electrical service disconnect boxes shall be supplied (if desired) by the customer. They are not part of the ArcWorld®II-6200 DRC system shipment.

1. Rotate the NX100–DRC controller (R1) POWER ON-OFF switch to ON (see Figure 2).
2. Set POWER ON-OFF switch on each welding power source to ON (ON-OFF indicator lamp on each welding power source will illuminate).
3. Open regulator valve on welding gas supply.
4. Make sure that the work cell access door is closed and door safety interlock engaged.
5. Make sure all E-Stop push buttons are released. E-Stop push buttons are installed at the following locations –
 - Programming Pendant
 - NX100–DRC controller (R1)
 - Operator Station
6. Select TEACH mode on the Programming Pendant.
7. Place robots in Home position (refer to Section 5.3.2).

5.3.2 Robot Home Position

To move the robots to the Home position –

1. Select TEACH mode on the Programming Pendant.
2. Select MAIN MENU on Programming Pendant touch screen.
3. Select JOB on Programming Pendant touch screen.
4. Select SELECT JOB on Programming Pendant touch screen (a job list appears on the screen).
5. Use the navigation cursor key to move the cursor to R1 SAFE job and press SELECT (the job appears on the display screen).
6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
7. Use the FWD button on Programming Pendant to jog robot (R1) to Home position.
8. Use the navigation cursor key to move the cursor to R2 SAFE job and press SELECT (the job appears on the display screen).
9. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
10. Use the FWD button on Programming Pendant to jog robot (R2) to Home position.

5.3.3 Master Job

With the system powered up and in TEACH mode, call up the Master Job –

1. Select JOB on Programming Pendant touch screen.
2. Select CTRL MASTER on Programming Pendant touch screen. Press SELECT twice to activate the Master Job.
3. Select PLAY mode on Programming Pendant and press the PLAY ENABLE button on the NX100–DRC controller (R1) door (job playback operation is enabled). See Figure 2 for location of the PLAY ENABLE button on the controller.
4. Press SERVO ON button on the Programming Pendant.
5. Press START button on Programming Pendant (the Master Job cycles, waiting for a CYCLE START input from Operator Station).
6. Transfer control to the Operator Station by selecting REMOTE on the Programming Pendant MODE SELECT SWITCH.

The ArcWorld®II–6200 DRC work cell is now ready for operation.

5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld®II–6200 DRC work cell after start-up –

1. Operator loads the fixture (on operator side of positioner) with parts to be welded.
2. Operator steps out of safety zone created by the safety light curtain system, and moves to the fence-mounted Operator Station.
3. Operator presses the green CYCLE START button on Operator Station. The MRM2-250 STX positioner sweeps, thus placing parts to be welded into the robot work area. The robots then begin to weld the parts (if the Operator Station POSITIONER AUTO/MANUAL switch is set to AUTO).
4. While the robots are welding, the operator loads the operator side of the positioner with the next group of parts to be welded.
5. The operator again moves to the Operator Station and presses the green CYCLE START button (CYCLE LATCHED light illuminates). When the robots are finished welding, they return to Home position. The MRM2-250 STX positioner sweeps again to return completed, welded parts to the operator position, while moving the next group of parts into the robot work area.
6. Operator moves back to the operator side of the MRM2-250 STX positioner and unloads completed, welded parts.

5.3.5 Shutdown

Use the following procedure to perform a normal shut down of the ArcWorld®II-6200 DRC system –

1. Make sure the robots are in Home position.
2. Turn off system servo power by pressing the E-Stop button on Operator Station or Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Rotate NX100–DRC (R1) controller POWER ON-OFF switch to OFF (see Figure 2).
5. Set both welding power source POWER ON-OFF switches to OFF.
6. Close regulator valve on welding gas supply.

The ArcWorld®II-6200 DRC system is now shut down.

5.4 System Recovery

When a system error or alarm occurs, you must clear the error or alarm to return the system to normal operation. The paragraphs below describe the different types of alarms and errors you may encounter, and how to clear them.

5.4.1 Alarms and Errors

Alarms and errors will stop the program. There are three levels –

- Error Messages
- Minor Alarms
- Major Alarms

For more detailed information on alarm and error recovery, refer to the NX100–DRC controller and EA-Series robot documentation that is included with your ArcWorld®II-6200 DRC documentation package (refer to Section 1.3).

5.4.1.1 Error Messages

Error messages are usually the result of simple, easily-cleared operation errors. The following is one example –

- Pressing the START button when the robots are not in PLAY mode

Clear errors of this type by pressing the CANCEL button on the Programming Pendant.

5.4.1.2 Minor Alarms

Minor alarms usually involve programming errors. Clear alarms of this type by pressing the CANCEL button on the Programming Pendant.

5.4.1.3 Major Alarms

Clear alarms of this type by cycling the NX100–DRC (R1) controller in accordance with the following steps –

1. Rotate the NX100–DRC (R1) POWER ON-OFF switch to OFF (see Figure 2).
2. Allow the NX100–DRC (R1) POWER ON-OFF switch to remain in the OFF position for approximately 10 seconds.
3. Rotate the NX100–DRC (R1) POWER ON-OFF switch back to ON.

5.4.2 E-Stop Recovery

An E-Stop (emergency stop) condition is triggered by any of the following conditions –

- An E-Stop push button switch is activated
- The work cell access door is opened while the robot is not in TEACH mode
- The light curtain system is tripped while the positioner is sweeping
- A welding torch collision triggers a shock sensor output (refer to Section 5.4.3)

If an E-Stop condition is triggered, restart the ArcWorld®II–6200 DRC system as follows –



CAUTION!

If an E-Stop condition occurs while the positioner is sweeping, the positioner will complete the sweep when the ArcWorld®II–6200 DRC system is restarted.

1. Press the SERVO ON button on the Programming Pendant.
2. Select REMOTE mode on the Programming Pendant MODE SELECT SWITCH to transfer control of the system to the Operator Station.
3. Press the green START button on the Operator Station.

The ArcWorld®II–6200 DRC system is now ready to continue operation.

5.4.3 Shock Sensor Recovery

The ArcWorld®II–6200 DRC welding package includes a Motoman gun mount for each EA-series robot. This mount is designed to protect the torch from damage in case of an impact (collision). A slight deflection of the torch activates a SHOCK SENSOR signal that triggers a system E-Stop condition. To clear the E-Stop condition, you must override the shock sensor and move the robot(s) clear of the impact.

Refer to the following procedures to override the shock sensor –



CAUTION!

Always reactivate the Shock Sensor before continuing system operation. The robots can be damaged if the Shock Sensor Override Switch remains in the “Override” position.

1. Press MAIN MENU on the Programming Pendant.
2. Use the Programming Pendant CURSOR KEY to select the ROBOT icon, then press SELECT.
3. Use the Programming Pendant CURSOR KEY to select OVERRUN-S.SENSOR, then press the SELECT key.
4. Select RELEASE to release the shock sensor.
5. Turn servo power ON (depress and hold the Programming Pendant ENABLE switch in the middle position while pressing the SERVO ON / READY push button).
6. Move the affected robot clear of impact position.

The ArcWorld®II-6200 DRC system is now ready to continue operation.

5.4.4 Brake Release

The robot braking system is designed to protect the robots and other system components from damage in the event of a system / robot failure or loss of drive power. If a system / robot failure or loss of drive power occurs, you must release the brakes on the affected robot in order to move it.

To release the brakes, proceed as follows –



WARNING!

Always support the robot axis to be released BEFORE you release it. Without adequate robot axis support, brake release could cause personal injury or machine damage.

1. On the Programming Pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the pendant display (touch) screen.
3. Select the BRAKE RELEASE option.
4. Use the CURSOR key to select desired robot axis for release.
5. Press and hold the pendant ENABLE switch in its middle position (see Figure 3 and Figure 6), while pressing the INTERLOCK key and the SELECT key.
6. The brake for the selected axis will release.

NOTES

Chapter 6

Maintenance

Assign ArcWorld®II-6200 DRC system maintenance to technicians who are trained in the operation and repair of a robotic system (preferably the ArcWorld®II-6200 DRC system). Be sure to read and understand the documentation for a particular component before doing any type of maintenance on that component.

Maintenance intervals given in this chapter are recommendations, only. Adjust the frequency and level of maintenance to suit your specific equipment schedules and shop environment.

Maintenance procedures and schedules for individual components of the system are given in the component manuals supplied with the ArcWorld®II-6200 DRC system documentation package (refer to Section 1.3).

Table 1 Periodic Maintenance

| FREQUENCY | COMPONENT | PROCEDURE |
|--|--|---|
| Daily | Water Circulator (optional) (see NOTE below) | Check level of coolant / antifreeze. If necessary, add a mixture of Motoman coolant / antifreeze (P/N 131224-1) and distilled water. Mix antifreeze and distilled water in proportions shown on the antifreeze container. |
| Daily | All safeguard items – work cell door interlock, E-Stop push buttons, safety light curtains, arc curtains, etc. | Check physical condition of safeguard item and ensure that the safeguard item is working correctly. |
| On Condition | ArcWorld®II-6200 DRC work cell | Remove accumulated dirt, grease, and debris from inside and outside the work cell. |
| Every 6 Months | EA-Series Robots MRM2-250 STX Positioner | Check integrity and security of anchor hardware in accordance with HILTI® documentation. Check torque of hold-down nuts in accordance with HILTI® documentation (refer to Appendix A). |
| <p>NOTE: If your system uses a water-cooled torch, use only Motoman-specified antifreeze. Typical automotive antifreeze contains additives that can clog the small cooling ports in the torch, and can damage sealing gaskets in the water circulator pump.</p> | | |

NOTES

Appendix A


Anchoring

The customer shall determine all anchoring and foundation requirements, and supply the appropriate anchoring hardware and foundation for a particular system installation. Table A.1 gives anchoring and foundation suggestions.

Table A.1 Suggested Anchor, Floor Plate, and Foundation Specifications

| SYSTEM EQUIPMENT | MINIMUM HILTI® ANCHOR ROD DIA / TYPE | MINIMUM FLOOR PLATE | MINIMUM FOUNDATION |
|--|--|---|---|
| ROBOTS HP3JC, HP3, HP3C, HP3CL, HP3XF, HP5, HP5C | 1/2" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 380 mm (15 in) Length 380 mm (15 in) Width 19 mm (0.7 in) Thick | 381 mm (15.0 in) Length 381 mm (15.0 in) Width 76 mm (3.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS UP6, UP20 UP20-6, EA1400, EA1900 | 5/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 600 mm (24 in) Length 600 mm (24 in) Width 38.1 mm (1.5 in) Thick | 762 mm (30.0 in) Length 762 mm (30.0 in) Width 178 mm (7.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS HP6, HP6S, HP6R, HP20, HP20-6, EA1400N, EA1900N, DX1350N | 5/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 600 mm (24 in) Length 600 mm (24 in) Width 38.1 mm (1.5 in) Thick | 762 mm (30.0 in) Length 762 mm (30.0 in) Width 178 mm (7.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS UP20M, UP50 SP80 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 900 mm (35.4 in) Length 900 mm (35.4 in) Width 50.8 mm (2.0 in) Thick | 1524 mm(60.0 in) Length 1524 mm(60.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS HP50, HP50-20, HP50-35, EPL80 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 900 mm (35.4 in) Length 900 mm (35.4 in) Width 50.8 mm (2.0 in) Thick | 1524 mm(60.0 in) Length 1524 mm(60.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS UP120,UP130 UP165,SP100 SP160,SP250 SP400 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1200 mm(47.2 in) Length 1200 mm(47.2 in) Width 50.8 mm (2.0 in) Thick | 1828 mm(72.0 in) Length 1828 mm(72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS HP165, HP165N-100, HP165R, ES165RN, ES165N, ES165N-100, EPL100, EPL160 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1200 mm(47.2 in) Length 1200 mm(47.2 in) Width 50.8 mm (2.0 in) Thick | 1828 mm(72.0 in) Length 1828 mm(72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |

Table A.1 Suggested Anchor, Floor Plate, and Foundation Specifications

| SYSTEM EQUIPMENT | MINIMUM HILTI® ANCHOR ROD DIA / TYPE | MINIMUM FLOOR PLATE | MINIMUM FOUNDATION |
|---|---|---|--|
| ROBOTS UP200 | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1200 mm (47.2 in) Length 1200 mm (47.2 in) Width 50.8 mm (2.0 in) Thick | 1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS HP200, ES200N, HP200T, HP200RN, ES200RN, EPL300 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1200 mm (47.2 in) Length 1200 mm (47.2 in) Width 50.8 mm (2.0 in) Thick | 1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS UP350, UP500, SK300X | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1500 mm (59.1 in) Length 1500 mm (59.1 in) Width 50.8 mm (2.0 in) Thick | 1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| ROBOTS HP350, HP350-200, HP500, HP600, EPL450, EPL500 (Note 2) | 7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6) | 1500 mm (59.1 in) Length 1500 mm (59.1 in) Width 50.8 mm (2.0 in) Thick | 1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete |
| POSITIONER Rotary Turntable Type | 5/8" HVA Chemical Anchor (Note 3) (Note 6) | Not Applicable | Refer to Applicable Positioner Manual |
| POSITIONER "Ferris wheel" type with headstock and tailstock (HS/TS) | 7/8" HVA Chemical Anchor (Note 3) (Note 6) | Not Applicable | Refer to Applicable Positioner Manual |
| PERIPHERAL EQUIPMENT | 1/2" Kwik Bolt II Expansion Anchor (Note 4) (Note 6) | Not Applicable | 3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete |
| WORK CELL FENCE POSTS | 3/8" Kwik Bolt II Expansion Anchor (Note 4) (Note 6) | Not Applicable | 3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete |
| <p>Notes –</p> <p>(1) Minimum robot lagging requirements are based on <i>Maximum Repulsion Forces and Hilti® Anchor Design Program</i> (v3.3b).</p> <p>(2) SP and EPL series robots require base plates and/or risers to be level to $\pm 2^\circ$. Grout if necessary.</p> <p>(3) Reference source: <i>Hilti® Product Technical Guide</i> (section 4.2.1) for hardware specifications or equivalent.</p> <p>(4) Reference source: <i>Hilti® Product Technical Guide</i> (section 4.3.3) for hardware specifications or equivalent.</p> <p>(5) Cast-in anchors are specified in some robot manuals. The Hilti® HVA Chemical Anchors listed in this table can be substituted for the cast-in anchors.</p> <p>(6) Refer to <i>Hilti® Product Technical Guide</i> for suggestions on the correct size and type of drill bit to use with each anchor type.</p> <p> Contact Information –</p> <p>1-800-879-8000 (USA) http://us.hilti.com</p> <p>1-800-363-4458 (CAN) http://ca.hilti.com</p> | | | |

Index

A

about this document, 1
alarms, 36
anchoring, 41

B

back-ups / copies of jobs and programs, 31
braking system (robot)
 brake release, 37
 description, 18

C

cable connections
 earth ground. *See* earth ground
 local electrical service, 27–28
 system components, 27
components (system), 3
controller. *See* NX100–DRC controller
customer support
 contact phone number, 4
 information needed before you call, 4
customer-supplied items, 19

D

daily operation, 32
documentation (reference), 4
door (work cell access)
 location, 2
 safety interlock, 18

E

earth ground
 connection to, 27–28
 importance, 27–28
 maximum allowable resistance, 27–28
emergency stop (E-Stop)
 description, 17
 push button locations, 17
 recovery from, 36
 and safety / operation check, 28

E (continued)

emergency stop (E-Stop), *continued*
 and system shutdown, 35
 and system start-up, 33
ENABLE switch. *See* programming pendant
equipment description, 9

F

fencing
 arc curtain installation, 24
 description, 16
 installation, 22–23

G

general safeguarding tips, 6

I

installation
 and qualified personnel, 19
 required materials, 19
 safety, 7
 tooling and fixtures, 29
introduction, 1

L

layout (system), 3
low-resistance earth ground. *See* earth ground

M

MRM2-250 STX. *See* positioner
maintenance
 intervals, 39
 periodic (preventive), 39
 procedures, 39
master job. *See* programming
mechanical safety devices, 7

N

NX100–DRC controller
 description, 9–10
 DRC configuration, 9
 function, 9
 INFORM programming language, 10

O

- operation (system), 31
- operator station
 - controls, 12
 - functions, 12-13
 - location, 12
- optional weld equipment. *See* welding equipment

P

- positioner
 - description, 13–14
 - tooling fixtures, 14
- power sources. *See* welding equipment
- preventive maintenance. *See* maintenance
- programming
 - back-ups and copies, 31–32
 - INFORM language, 10
 - master job, 34
 - personnel requirements, 32
- programming pendant
 - and NX100–DRC controller, 10
 - description, 10-11
 - ENABLE switch, 11, 17

R

- robot
 - braking system. *See* braking system (robot)
 - description, 9
 - home position, 33
 - shipping bracket removal, 25–26
- required installation materials, 19

S

- safety
 - equipment, 3
 - features, 15
 - fencing. *See* fencing

S (continued)

- safety (*continued*)
 - general safeguarding tips, 6
 - installation, 7
 - introduction, 5
 - light curtain system, 16
 - mechanical safety devices, 7
 - programming, operation, and maintenance, 8
 - safety / operation check, 28
 - standard conventions, 6
- shipping skid removal, 22
- shock sensor, 36
- site preparation, 20
- system
 - components, 3
 - layout, 3
 - overview and component location, 2
 - recovery, 35
 - shutdown, 35
 - start-up, 33

T

- tools and equipment
 - customer-supplied, 19–20
 - recommended, 20

W

- water circulator
 - and antifreeze / coolant, 39
 - as optional equipment, 4
- welding equipment
 - optional, 4
 - power sources, 14
 - protection (arc / UV radiation), 16
 - shutdown, 35
 - start-up, 33
 - torch, 15
 - wire feeder, 15