

Motoman® NX100 Controller

ArcWorld® III-1200 DRC System Manual

- MSR-500 SIGMA-III Positioner
- SSA2000 Manipulator (Robot)

Part Number: 150313-3CD
Revision: 0

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NOTES

Chapter 1

Introduction

1.1 About This Document

This manual provides information about the Motoman® ArcWorld® III-1200 DRC Robotic Welding System, and is organized as follows –



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.

CHAPTER 1 – INTRODUCTION

Chapter 1 provides general information about the ArcWorld® III-1200 DRC and its components, a list of reference documents, and customer service contact information.

CHAPTER 2 – SAFETY

Chapter 2 provides general information regarding the safe installation, maintenance, and operation of the ArcWorld® III-1200 DRC system.

CHAPTER 3 – EQUIPMENT DESCRIPTION

Chapter 3 provides a description of the major components of the ArcWorld® III-1200 DRC system.

CHAPTER 4 – INSTALLATION

Chapter 4 provides instructions for installation of the ArcWorld® III-1200 DRC system.

CHAPTER 5 – OPERATION

Chapter 5 provides an overview of ArcWorld® III-1200 DRC system operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

CHAPTER 6 – MAINTENANCE

Chapter 6 provides a listing of preventive maintenance requirements for certain components of the ArcWorld® III-1200 DRC system.

APPENDIX A – ANCHORING

Appendix A gives foundation and anchoring suggestions for ArcWorld® III-1200 DRC system components that require anchoring.

1.2 System Overview

The ArcWorld[®] III-1200 DRC system provides a complete arc welding solution in a standardized configuration (see Figure 1). The system is designed around two Motoman SSA2000 robots, an NX100-DRC controller package, two welding power sources, and an MSR-500 SIGMA-III rotary positioner. The rotary positioner allows an operator to prepare and set-up parts on one side of the positioner, while the robots weld on the other side of the positioner.

Refer to Section 3.2 for a more detailed description of the features and advantages of the DRC configuration.

The ArcWorld[®] III-1200 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 attenuate the amount of arc radiation that escapes the work cell during the welding operations.

Dual-interlocked access doors, one on each side of the work cell, provide convenient access to equipment while providing a safety interlock to disable all equipment should either of the doors be opened while the robots are active. A dual-channel, safety light curtain system provides a “sensing field” in front of the rotary positioner to protect the operator. Rotary positioner motion is prevented whenever an operator is in a position to disrupt the sensing field of the light curtain system. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot.

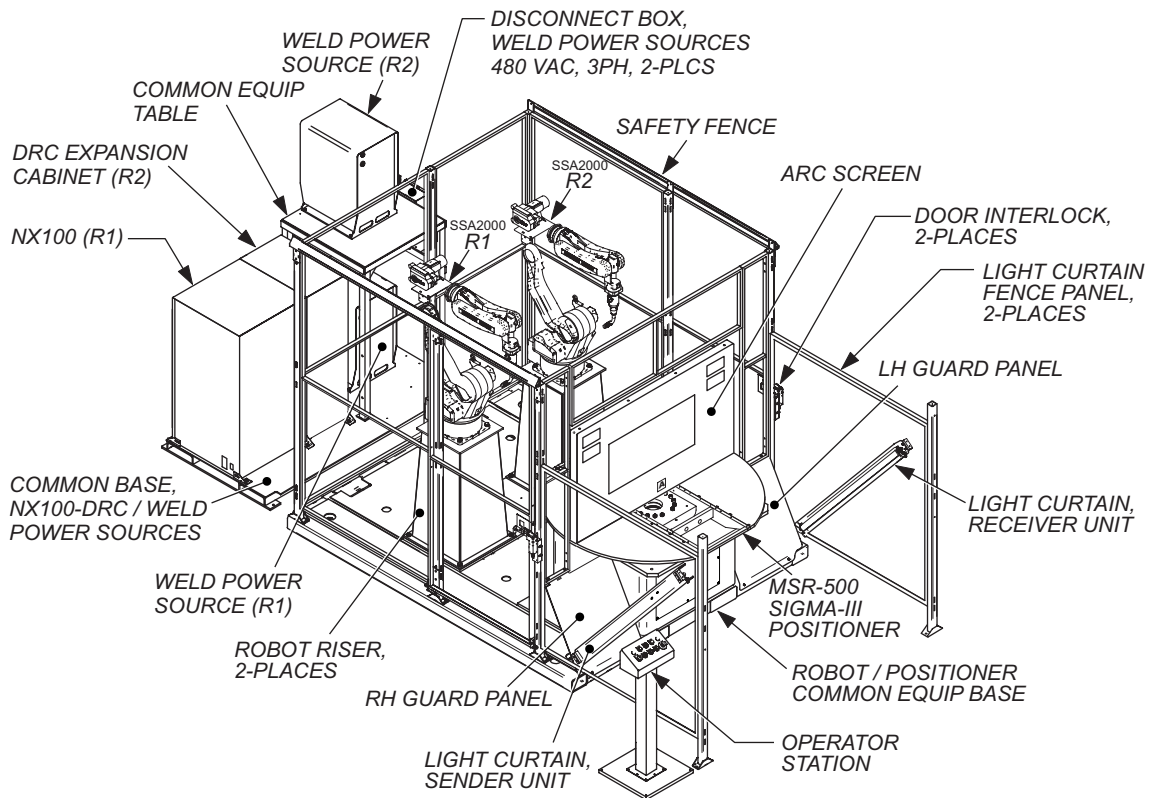


Figure 1 Layout/Component Locations — ArcWorld[®] III-1200 DRC Robotic Welding System

1.2.1 System Layout

Two SSA2000 manipulators (robots), an MSR-500 SIGMA-III positioner, and heavy-gauge wire mesh safety fencing all share a common steel base for ease of installation and assurance of proper alignment between the robots and rotary positioner. The wire mesh safety fencing completely surrounds the ArcWorld® III-1200 DRC work cell. The NX100-DRC robot controller shares a common platform with the welding power sources. This equipment platform is located outside of, and to the rear of, the work cell. This arrangement allows most of the component wiring interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required of the customer. All operator controls, including those on the Programming Pendant, NX100-DRC controller, welding power supplies, and Operator Station pedestal are accessible from outside the ArcWorld® III-1200 DRC work cell.

1.2.2 Major Components

The ArcWorld® III-1200 DRC system includes the following major components:

- Two Motoman SSA2000 manipulators (robots)
- One NX100-DRC robot controller assembly
- One MSR-500 SIGMA-III positioner
- One Programming Pendant
- One Operator Station
- Welding equipment (for each robot) –
 - Welding power supply
 - Welding torch (air-cooled)
 - Wire feeder
 - Applicable welding interface
 - Torch mount
- Safety equipment –
 - Heavy gauge, wire-mesh safety fencing
 - Arc curtains (cover the safety fencing)
 - Dual-channel, interlocked safety light curtain system
 - Dual-channel, interlocked work cell entry doors
 - Steel arc screen on the MSR-500 SIGMA-III positioner

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld® III-1200 DRC system –

- Torch cleaner
- Wire cutter
- Water-cooled torch (with water circulator)
- TouchSense (starting point detection)
- ComArc (seam tracking)

1.3 Reference Documentation

For additional information on individual components of the ArcWorld® III-1200 DRC system, refer to the following documentation that is included with your system –

- Motoman *SSA2000 Manipulator Manual* (P/N 153599-1)
- 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 Manual* (P/N 149230-1)
- Motoman *MSR-Series SIGMA-III Positioner Manual* (P/N 152988-1)
- Motoman *NX100 Independent/Coordinated Control Function Manual* (P/N 149648-1)
- Motoman *INFORM User's Manual* (P/N 150078-1)
- Vendor manuals for components not manufactured by Motoman, but supplied with your ArcWorld® III-1200 DRC Robotic Welding System.

1.4 Customer Support Information

If you need assistance with any aspect of your ArcWorld® III-1200 DRC system, please contact Motoman Customer Support at the following 24-hour telephone number –

937-847-3200

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

techsupport@motoman.com

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



Note: 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 Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you call –

- System ArcWorld® III-1200 DRC
- Primary Application Arc Welding
- Robots SSA2000
- Positioner MSR-500 SIGMA-III
- Controller NX100-DRC
- Software Version Access this information on the Programming Pendant LCD display screen by accessing MAIN MENU ➔ SYSTEM INFO ➔ VERSION
- Robot Serial Number Located on robot data plate
- Robot Sales Order Number Located on NX100-DRC controller (R1) data plate

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. The address is as follows –

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 robotic system. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the robotic work cell. **Never allow untrained personnel to operate, program, or repair the robotic system.**

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

This indicates an imminently hazardous situation which, if not avoided, will result in personnel death or serious injury.



WARNING!

This indicates a potentially hazardous situation which, if not avoided, could result in serious personnel injury or major equipment damage.



CAUTION!

This indicates a situation which, if not avoided, could result in minor personnel injury or damage to the equipment.



Note: Provides supplementary information, emphasizes a point or procedure, or gives a tip for easier operation.

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
- Access door interlocks
- Emergency stop (E-Stop) push 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 work cell 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 work cell.
- 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® III-1200 DRC system uses two Motoman SSA2000 six-axis robots. Each SSA2000 robot is specifically designed for arc welding applications. Each robot has a payload capability of 3 kg (6.6 lbs.) and features a horizontal reach of 1388-mm (54.6 inches). Each robot features a relative positioning accuracy of ± 0.08 mm (± 0.003 inch). The SSA2000 robot has an internal cabling design that provides high flexibility and streamlines the robot profile, thus allowing access into confined spaces. The 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 ± 360 degrees without cable interference.

For additional information on the Motoman SSA2000 robots, please read the *SSA2000 Manipulator Manual* that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

3.2 NX100-DRC Controller

The ArcWorld® III-1200 DRC system features one NX100-DRC controller 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.

Through specific cable interconnections (internal to the NX100-DRC), 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® III-1200 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 MSR-500 SIGMA-III rotary 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.

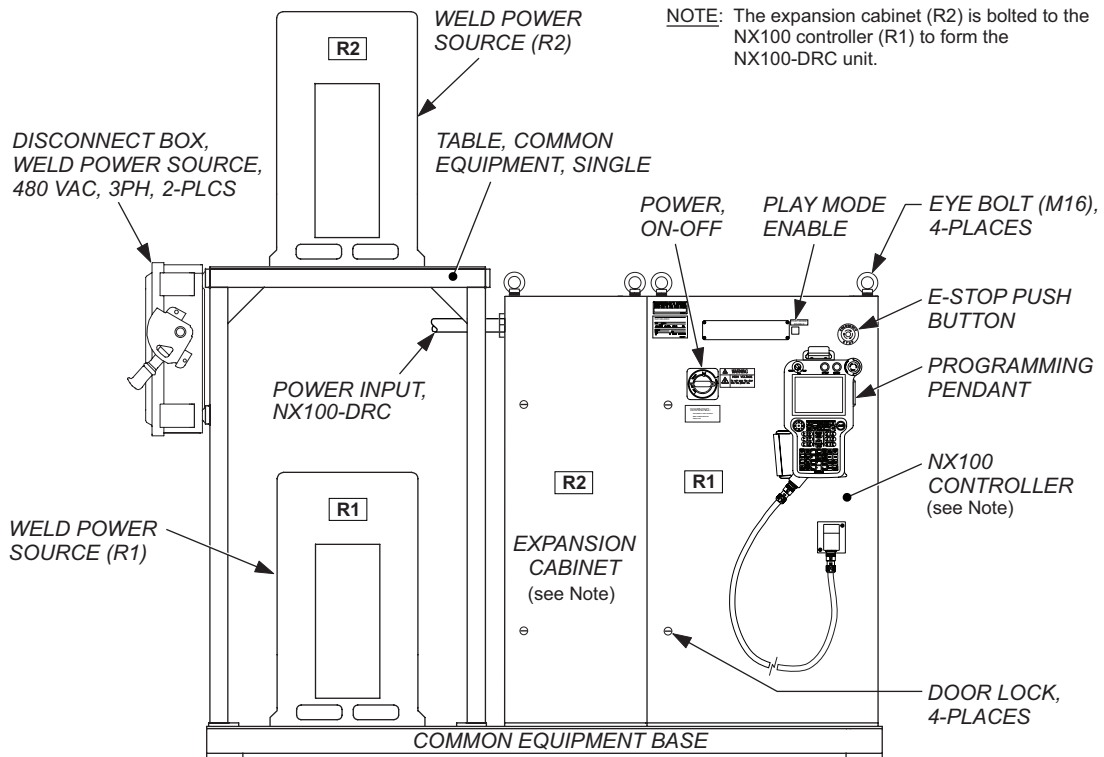


Figure 2 NX100-DRC Controller

3.3 Programming Pendant

The Programming Pendant (see Figure 3) provides the primary means of programmer/operator interaction with the ArcWorld[®] III-1200 DRC system. The pendant features the Windows[®] CE operating system and displays information on a 6½ -inch, color LCD, touch-screen display (640 X 480 VGA). 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. 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[®] III-1200 DRC system. For detailed information on the pendant programming keys, programming functions, and display functions, please read the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld[®] III-1200 DRC system documentation package (refer to Section 1.3).

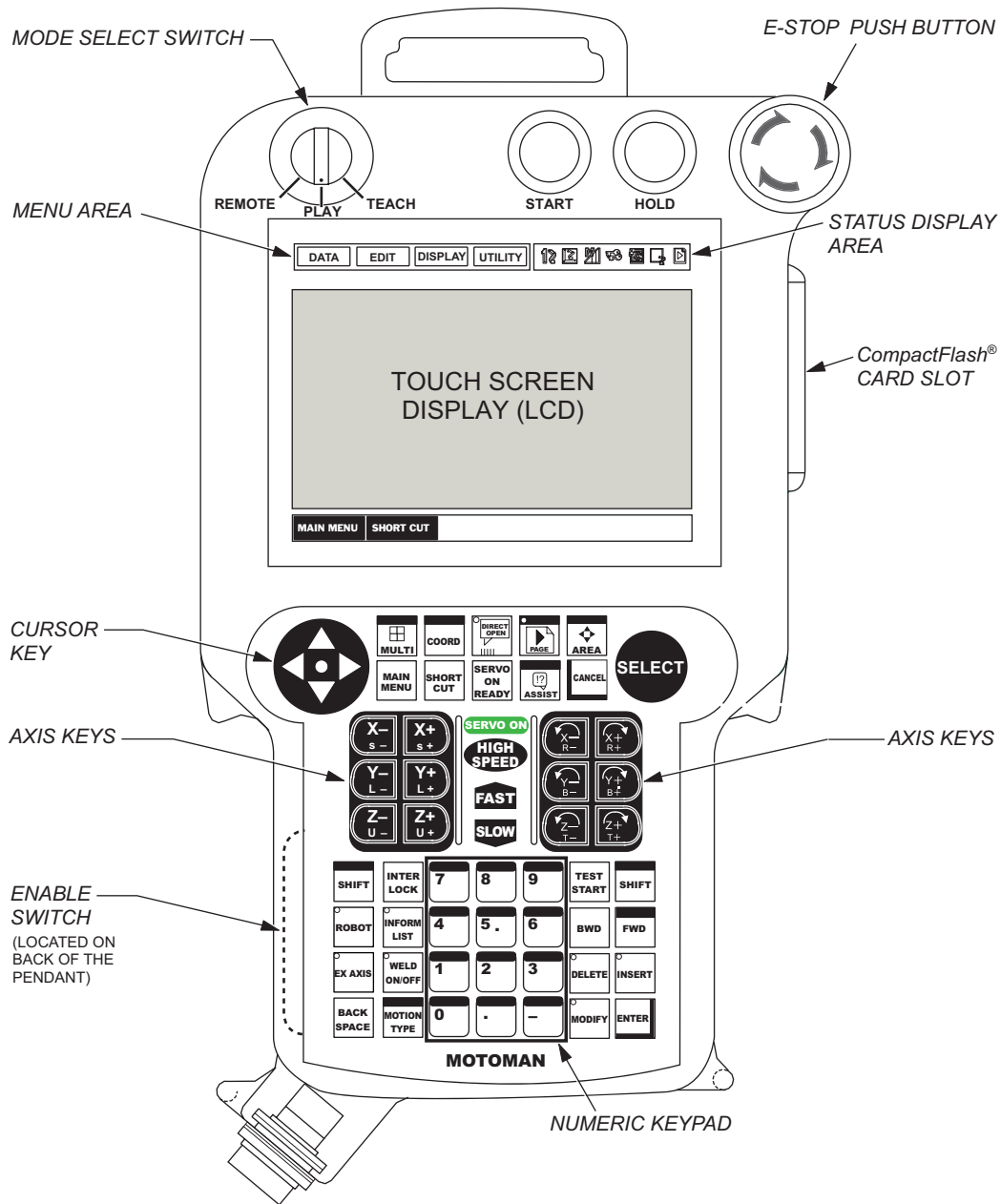


Figure 3 NX100-DRC Programming Pendant



Note: The Programming Pendant LCD display goes dark after a few minutes of inactivity. Press any key to restore screen.



Note: Operator Station ENABLE/DISABLE is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld® III-1200 DRC system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE. The Operator Station ENABLE/DISABLE function cannot be selected at the Operator Station.

3.4 Operator Station

The Operator Station (see Figure 4) includes a NEMA enclosure on a stand-alone pedestal. See Figure 1 for location of the Operator Station Pedestal in relation to other components of the ArcWorld® III-1200 DRC system.

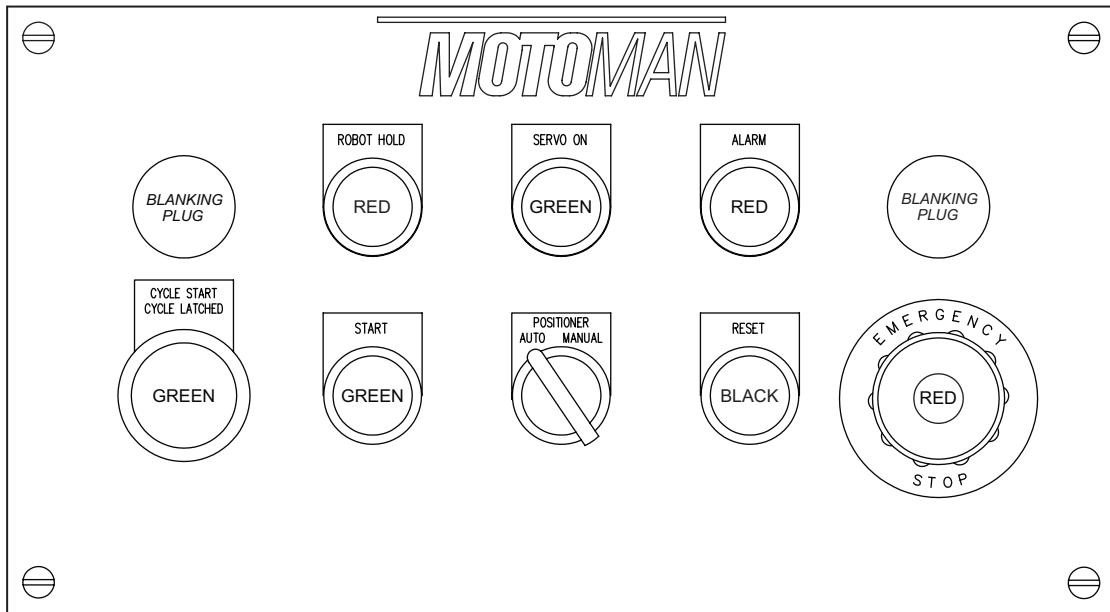


Figure 4 Operator Station Controls

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 robot is in the HOME (Safe) position. If the **CYCLE START/CYCLE LATCHED** push button is pressed while the robot is 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 robot returns 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® III-1200 DRC system from the emergency stop (E-Stop) condition.

3.4.3 Operator Station Function – Robot Hold

Pressing the red ROBOT HOLD button stops robot operation and interrupts the job until the operator presses the green START button to resume operation. Operation resumes at the point in the program where the ROBOT HOLD state was initiated.

3.4.4 Operator Station Function – Alarm

A red ALARM lamp illuminates to indicate that the NX100-DRC controller has encountered an alarm condition.

3.4.5 Operator Station Function – Positioner Auto / Manual

The POSITIONER AUTO/MANUAL switch is used to select AUTO or MANUAL mode for the MSR-500 SIGMA-III rotary positioner. With the switch set to the AUTO position, the robot welds the parts immediately after the positioner sweeps. With the switch set to the MANUAL position, the robot does not immediately start to weld after the positioner sweeps. The robots remains in the HOME position.



Note: The POSITIONER AUTO / MANUAL signal depends upon the structure of the Master job.

3.4.6 Operator Station Function – Start

Pressing the green START button starts the current, active job. The Operator Station must be enabled and servo power must be ON for the START button to function.

3.4.7 Operator Station Function – Reset

The black RESET button is used to clear a minor alarm or error condition.

3.4.8 Operator Station Function – Servo ON

The green SERVO-ON push button turns servo power ON when the robot is in PLAY mode and the Operator Station is enabled.

3.5 MSR-500 SIGMA-III Positioner



WARNING!

Do not operate the MSR-500 SIGMA-III positioner unless the arc screen is in place. Operation of the positioner without the arc screen in place can result in burns or serious eye damage for the operator.

The MSR-500 SIGMA-III positioner is mounted on the same common equipment base as the SSA2000 robots and the wire mesh safety fencing (see Figure 1 and Figure 5). The MSR-500 SIGMA-III is a high-speed rotary positioner that features controlled rotary motion and a 500 kg (1,102 lb) payload capacity per side. A steel arc screen divides the positioner table top, providing two semicircular work areas (Side A and Side B). The steel arc screen creates a barrier that safeguards the operator from arc radiation and sparks produced during the welding operation. The MSR-500 SIGMA-III uses a rotary motion to sweep each side of the circular turntable 180° from the operator's loading zone, into the robot work zone, and back to the operator again. The positioner can accept optional external axis control for coordinated motion between the positioner and the robots.

For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, read the *MSR-Series Positioner Manual* that is included with your ArcWorld® III-1200 DRC documentation package (refer to Section 1.3).



Note: The customer shall supply all tooling and fixtures for the MSR-500 SIGMA-III positioner.



Note: Motoman recommends application of a corrosion / rust inhibitor (MIL-C-16173D, Grade 2) to tooling and fixtures that are located in a hot and / or high-humidity environment. LPS-3, available from LPS Labs or most jobbers, is Motoman-approved for this application.

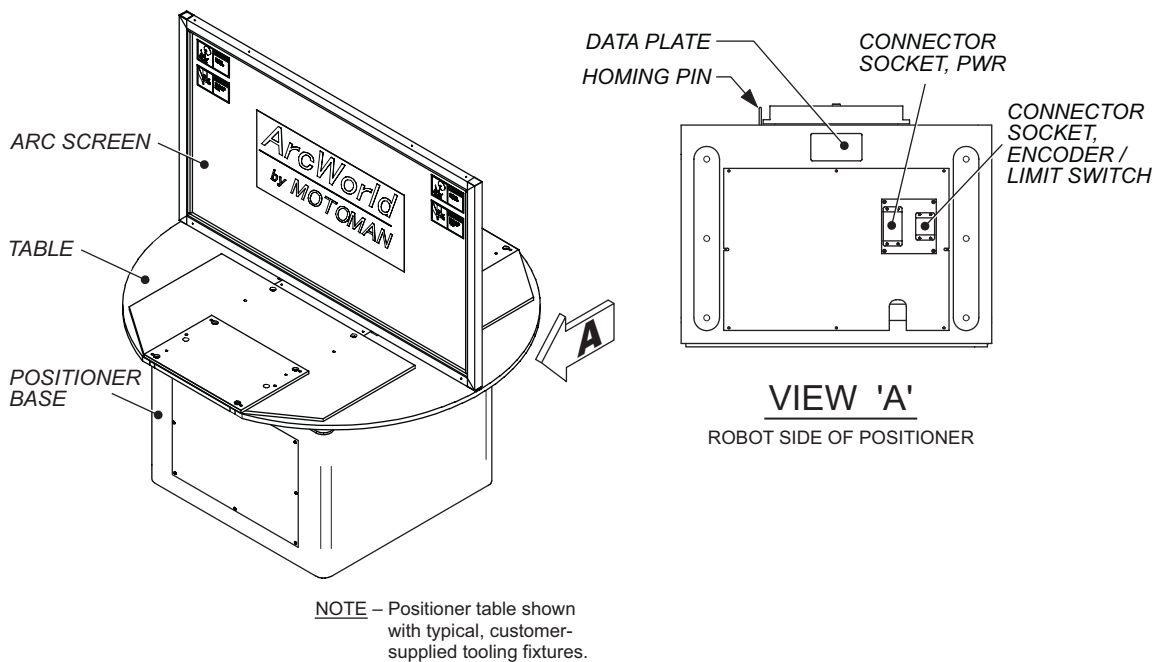


Figure 5 MSR-500 SIGMA-III Positioner

3.6 Welding Equipment

In its standard configuration, the ArcWorld® III-1200 DRC system includes a welding power source, wire feeder, torch, and torch mount for each of the two SSA2000 robots. Optional equipment – water-cooled torch, water circulators, ComArc seam tracking units, and torch tenders – may also be included with your ArcWorld® III-1200 DRC system.

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® III-1200 DRC system depends on the customer's specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® III-1200 DRC system, read the welding power source vendor manual that is included with your system documentation package (refer to Section 1.3).

3.6.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of each SSA2000 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 the robot upper arm, including allowable load and installation position, read the wire feeder documentation that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

3.6.3 GMAW Torch

The ArcWorld® III-1200 DRC system incorporates an air-cooled or (optional) water-cooled robotic/automatic GMAW torch for each robot. These are heavy-duty torches designed for quick replacement and minimum 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® III-1200 DRC system includes a water circulator kit for each robot. For additional information on the torches that are supplied with your system, read the documentation that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

3.7 Safety Features

The ArcWorld® III-1200 DRC system includes a total safety environment. If you comply with all standard safety precautions, the safety equipment helps to ensure safe operation of the robot work cell.



Note: Users are responsible for determining that the safeguards provided with the ArcWorld® III-1200 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



WARNING!

Although safety fence arc curtains block dangerous arc radiation, never look directly at the arc without protective eye wear.

Two forms of welding arc protection are part of the ArcWorld® III-1200 DRC system –

- a steel arc screen on the MSR-500 SIGMA-III rotary positioner
- arc curtains that are attached to the steel mesh safety fencing

The steel arc screen on the MSR-500 SIGMA-III positioner protects the operator from arc radiation and sparks that result from the welding operation (see Figure 1 and Figure 5).

Arc curtains cover the steel mesh safety fencing that surrounds the entire work cell. The curtains provide protection from arc flash and reduce the amount of ultra-violet radiation that escapes from the work cell during welding operations.

3.7.2 Safety Fencing

The heavy-gauge steel mesh safety fencing, provided with the ArcWorld® III-1200 DRC system, attaches to the robot/positioner common base and encloses the entire work cell. It forms a physical barrier that prevents personnel from entering the work cell during automatic operation. For additional information on the safety fencing, read the vendor manual that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

3.7.3 Safety Light Curtains

The safety light curtain system consist of two units (a SEND unit and a RECEIVE unit) that emit and receive infrared light to create an invisible protective field in front of the MSR-500 SIGMA-III positioner (see Figure 1). If an object or person penetrates the protective field while the positioner is sweeping, the light curtain system creates an E-Stop condition (refer to Section 3.7.4). The safety light curtain system incorporates a dual-channel safety feature that provides redundant circuitry to ensure fail-safe operation and a continuous field of coverage for the protected area in front of the positioner. For additional information on the safety light curtain system, read the vendor manual that is included with your ArcWorld® III-1200 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® III-1200 DRC system. Work cell access door interlocks, 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® III-1200 DRC system, and are installed at the following locations –

- NX100 Programming Pendant
- NX100 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 6). When grasped by the operator, the ENABLE switch allows the operator to ENABLE servo power. However, should the operator release the switch or grasp it too tightly, servo power is immediately removed, thus preventing further robot movement. For detailed information about the operation of the ENABLE switch, read the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

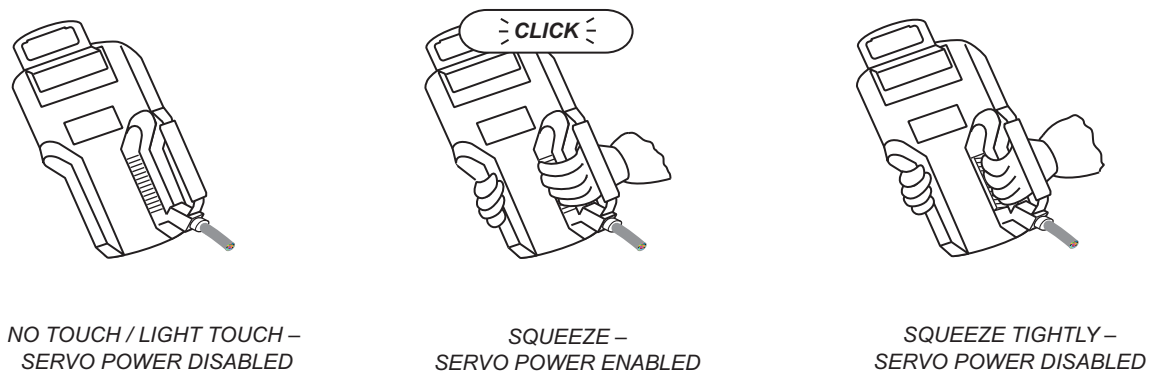


Figure 6 Programming Pendant ENABLE Switch—Location and Operation

3.7.6 Emergency Braking System

Each SSA2000 robot incorporates a braking system that protects personnel from injury and prevents equipment damage if servo power is removed. 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 when drive power has been removed from the system. Brake release is accomplished with the Programming Pendant (refer to Section 5.4.4).

3.7.7 Interlocked Work Cell Doors

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

NOTES

Chapter 4

Installation



CAUTION!

The ArcWorld® III-1200 DRC system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.



CAUTION!

The ArcWorld® III-1200 DRC system is not extremely fragile. It is, however, a sophisticated robotic system that can be damaged by rough handling. Be sure to handle all system components with care.

Two to three qualified technicians can install the ArcWorld® III-1200 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 hardware required for installation of the ArcWorld® III-1200 DRC system are included with your shipment. There are, however, some required items that the customer must supply (hand tools, special anchor bolts, etc.). These are not included with your shipment.

4.1.1 Customer-Supplied Items

- Welding gas supply
- Local electrical service
- Earth ground wires for the SSA2000 robots, NX100-DRC controller, and peripheral equipment.
- Earth ground rods and/or buried copper sheeting (quantity 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 and/or overhead crane

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 (small and large)
- 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!

Be sure to allow for sufficient room for maintenance on the robots, NX100-DRC controller, and other peripheral equipment. Failure to observe this precaution could result in injury to personnel during system maintenance.

Procedure –

1. Clear floor space needed for the ArcWorld[®] III-1200 DRC system (see Figure 7). Allow an additional 1.2 - 1.5 m (4 to 5 ft) on all sides of the work cell to facilitate installation.
2. Gather all customer-supplied items and required tools (refer to Section 4.1, "Required Materials").

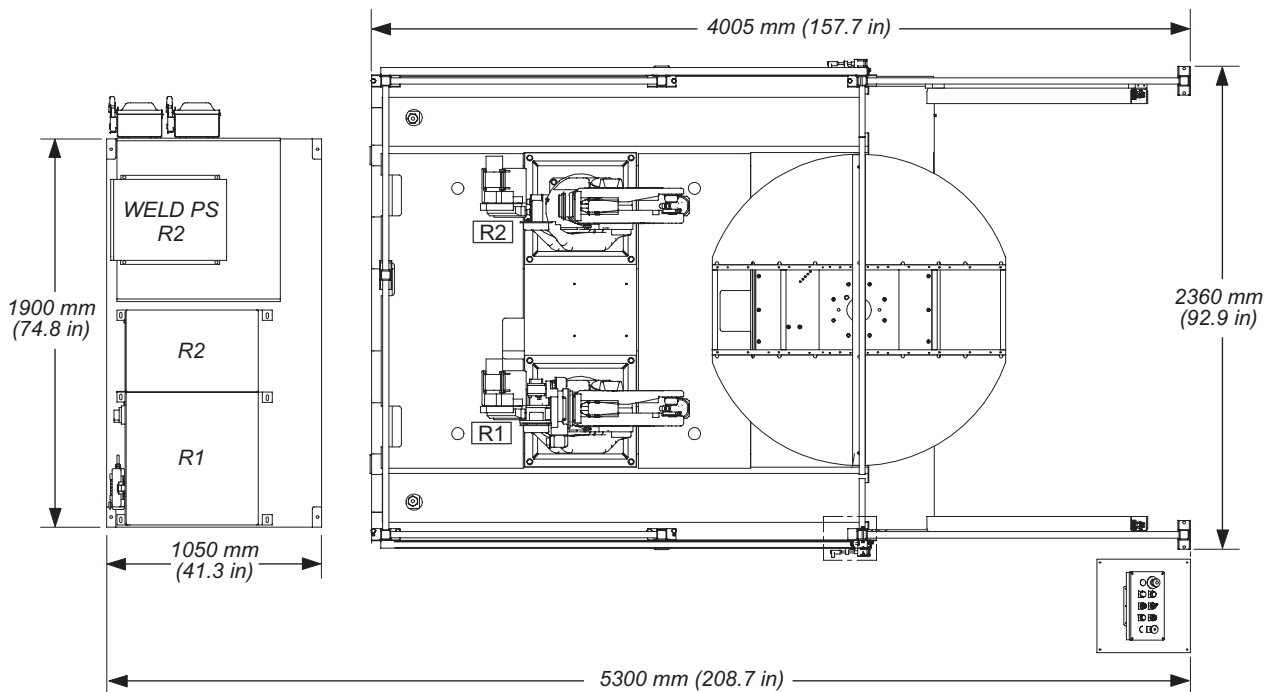


Figure 7 Plan View — ArcWorld[®] III-1200 DRC System

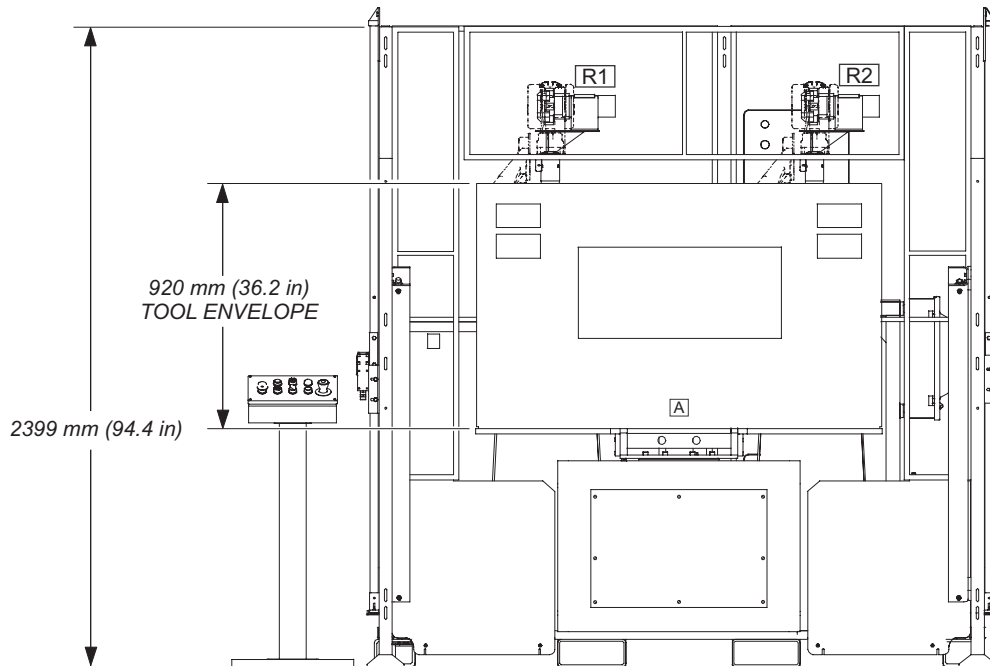


Figure 8 Elevation View — ArcWorld® III-1200 DRC System

4.3 Installing and Levelling the Robot / Positioner Common Base

The robot/positioner common base and Operator Station are shipped on a wooden shipping skid. To install the robot/positioner common base, proceed as follows:



CAUTION!

Handle system components carefully. Some components can be damaged if dropped or otherwise handled roughly.

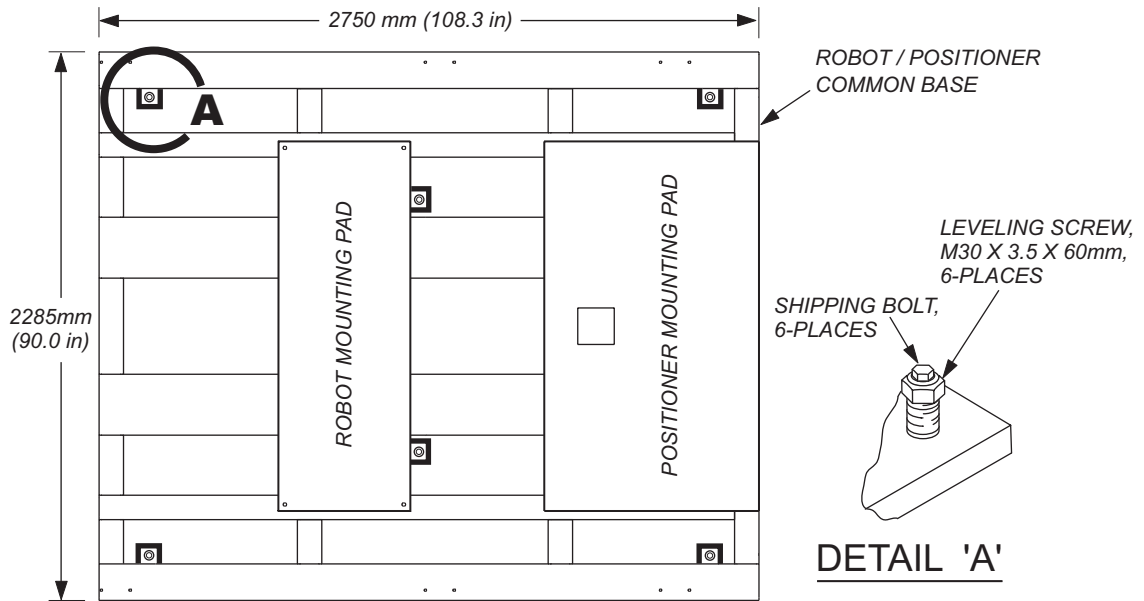
1. Unbolt the robot/positioner common base from the wooden shipping skid. The bolts that secure the common base to the wooden shipping skid go down through the hollow levelling screws and are threaded into the wooden shipping skid (see Figure 9). It may be necessary to hold the levelling screws in place with a suitable open-end wrench, while removing the shipping bolts.
2. Locate the Operator Station pedestal and set it aside in a secure location for later installation (refer to Section 4.5).



WARNING!

As shipped, the robot / positioner common base (with equipment) weighs approximately 2275 kg (5016 lbs). Make sure that your lifting devices (overhead crane, fork-lifts, etc) are rated to safely handle this load.

3. Using an overhead crane, lift the common base from wooden shipping skid. Discard or recycle the wooden shipping skid.



NOTE: To clearly illustrate leveling points for the common equipment base, the system components that mount to the base are not shown in this view.

Figure 9 Stabilizing and Lag Points (Robot / Positioner Common Equipment Base)

- Place robot/positioner common base in position (see Figure 7).



Note: Make sure there is adequate room on all sides of the robot/positioner common base for the Operator Station, the light curtains, and the NX100-DRC/weld power source common base (see Figure 7).

- Carefully remove protective plastic wrapping from the robots, torches, and the positioner.
- Inspect the robots, torches, and positioner for shipping damage.



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

- Use an M36 socket to loosen or tighten each levelling bolt to level the robot/positioner common base (see Figure 9).



CAUTION!

Be absolutely certain of the correct location for the robot/positioner common base before securing the base with anchor (lag) bolts.

- Secure the robot/positioner common base to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to Appendix A, "Anchoring" for drill bit and anchor bolt suggestions). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.
- Unfold arc curtains and install one arc curtain on the inside of each work cell safety fence panel in accordance with instructions supplied with the ArcWorld[®] III-1200 DRC system (refer to Section 1.3).



Note: The arc curtains are packaged in an accessories box that is shipped with your ArcWorld[®] III-1200 DRC system.

4.4 Installing the NX100-DRC / Welding Power Source Common Base

The NX100-DRC controller, two welding power sources, two electrical service disconnect boxes (one for each welding power source), and a common equipment table for the welding power sources are mounted on a common base (see Figure 2 and Figure 10). As delivered to the customer, the common base is attached to wooden shipping blocks by four shipping bolts.

Procedure –

1. Separate the wooden shipping blocks from the common base by removing all four shipping bolts (see Figure 10).



WARNING!

As shipped, the NX100-DRC / Welding Power Sources common base (with equipment) weighs approximately 2000 kg (4409 lbs). Make sure that your lifting devices (overhead crane, fork-lifts, etc) are rated to safely handle this load.

2. After you remove the shipping bolts, use an overhead crane or forklift to lift the common base just enough to allow the wooden shipping blocks to be pushed out from under the common base. Discard or recycle the shipping blocks.
3. Place the common base in position behind the ArcWorld® III-1200 DRC work cell (see Figure 7).
4. Remove protective plastic wrapping, cardboard, and other protective shipping material from the common base, and the ArcWorld® III-1200 DRC components mounted to the common base.
5. Inspect the common base and all attached components for shipping damage.



Note: Immediately notify your shipping contractor, if you notice any shipping damage.



CAUTION!

Be absolutely certain of the correct location for the NX100-DRC / Welding Power Sources common base before securing the base with anchor (lag) bolts.

6. Secure the common base to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to Appendix A, "Anchoring" for correct drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.



Note: The lag bolts use the same holes in the common base as did the previously removed shipping bolts.

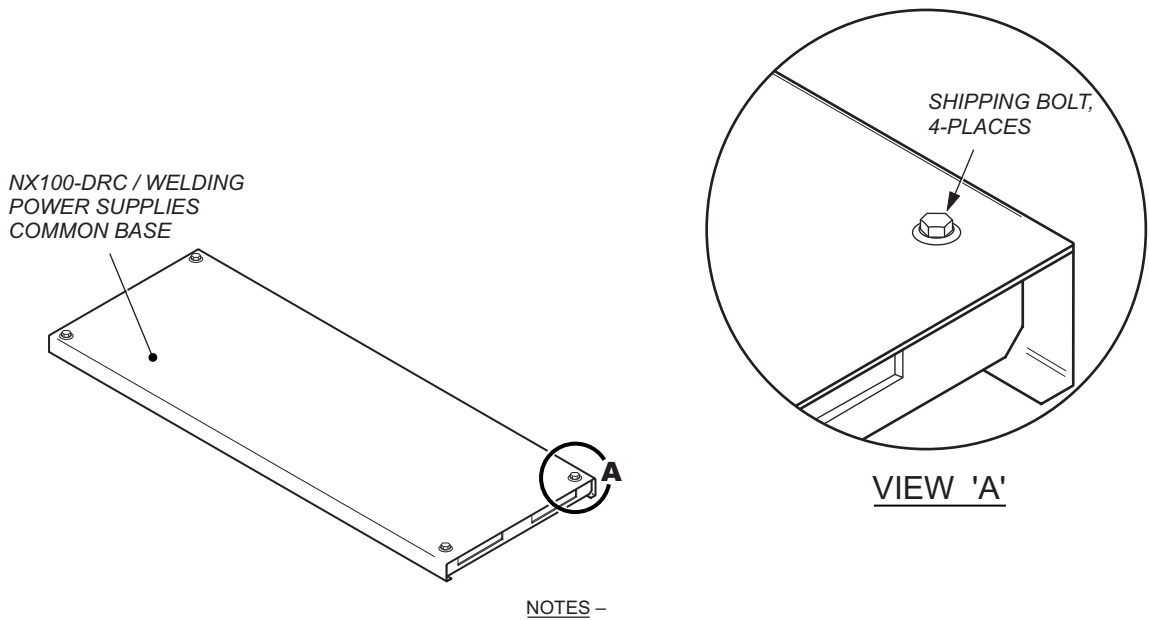


Figure 10 NX100-DRC / Weld Power Sources Common Base

4.5 Installing the Operator Station Pedestal

Procedure –

1. Locate Operator Station pedestal (previously put aside in secure location).
2. Carefully remove protective plastic wrapping from Operator Station pedestal.
3. Inspect the Operator Station pedestal for shipping damage.



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

4. Place the Operator Station pedestal outside light curtain fence panels (see Figure 7 and Figure 8 for recommended location).



CAUTION!

Be absolutely certain of the correct location for the Operator Station pedestal before securing the pedestal with anchor (lag) bolts.

5. Secure the Operator Station pedestal to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to Appendix A, "Anchoring" for anchoring suggestions). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

4.6 Installing the Light Curtains

4.6.1 Installation

The light curtain components – the send unit, the receiver unit, and the two fence panels to which the light curtain units are attached – are pre-assembled and secured inside the work cell for shipping. Refer to Figure 11 and install the light curtain assemblies to the work cell safety fencing as follows:

1. Remove both light curtain fence panels from their shipping position.
2. Install the light curtain fence panels to the wire mesh safety fencing. Use the three bolt holes located on the safety fence posts to mount the light curtain fence panels to the safety fencing (see Figure 11).



Note: The light curtains are oriented properly when the light curtain status indicator lamps (on each light curtain unit) are located closest to the floor.

3. The light curtain signal cables are secured and stowed under the base of the MSR-500 SIGMA-III rotary positioner prior to shipping. Locate those cables and attach them to the light curtain sender unit and receiver unit.

4.6.2 Anchoring Light Curtain Fence Panels

When the light curtain fence panels are correctly attached to the wire mesh safety fencing, perform the following steps to complete the installation of the light curtain fence panels –

1. Check alignment of light curtain fence panels. Each light curtain fence panel should be parallel to the safety fence panel to which it is attached. Adjust as required (see Figure 7).
2. Secure the light curtain fence panel posts to the floor (see Figure 7 and Figure 11). Use a suitable concrete drill bit and special anchor (lag) bolts (refer to Appendix A, "Anchoring" for suggested drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

4.6.3 Light Curtain Alignment

After anchoring the light curtain fence panels (refer to Section 4.6.2, "Anchoring Light Curtain Fence Panels"), check the alignment of the light curtain send unit and receiver unit, and adjust as necessary for correct operation. The light curtain sender unit and receiver unit must be accurately positioned, relative to each other, to ensure correct operation. Complete alignment procedures are included in the light curtain documentation that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

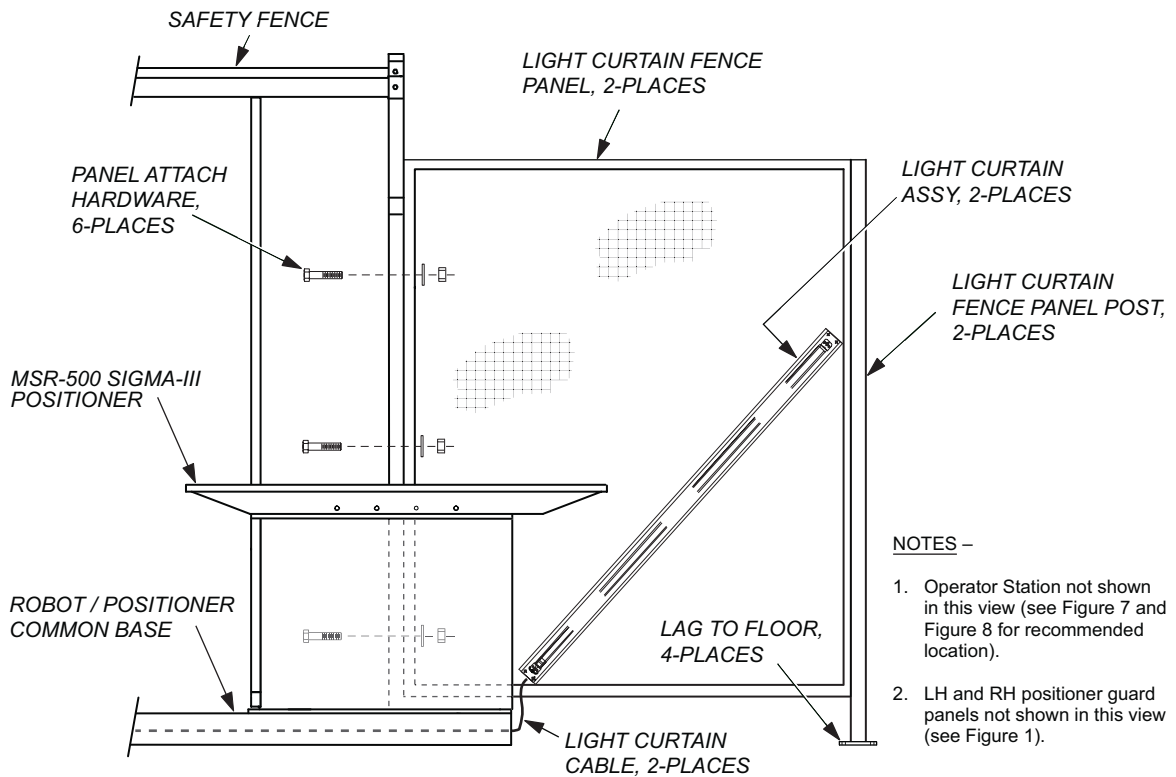


Figure 11 Light Curtain Fence Panel Installation

4.7 Removing the Robot Shipping Bracket



CAUTION!

Be sure to remove the shipping bracket from each SSA2000 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 a bright yellow color for easy location and identification. The bracket secures the lower arm (L-axis) of the robot to the S-axis housing. In addition, the bracket provides the correct hoisting points should either of the robots need to be removed from the ArcWorld® III-1200 DRC work cell. Upon bracket removal, be sure to keep both brackets and attaching hardware in a safe location, should they be needed in the future.



Note: Refer to special lifting procedures in the SSA2000 Manipulator Manual should the robot need to be lifted and moved from the robot/positioner common base. Incorrect lifting technique can damage the robot.

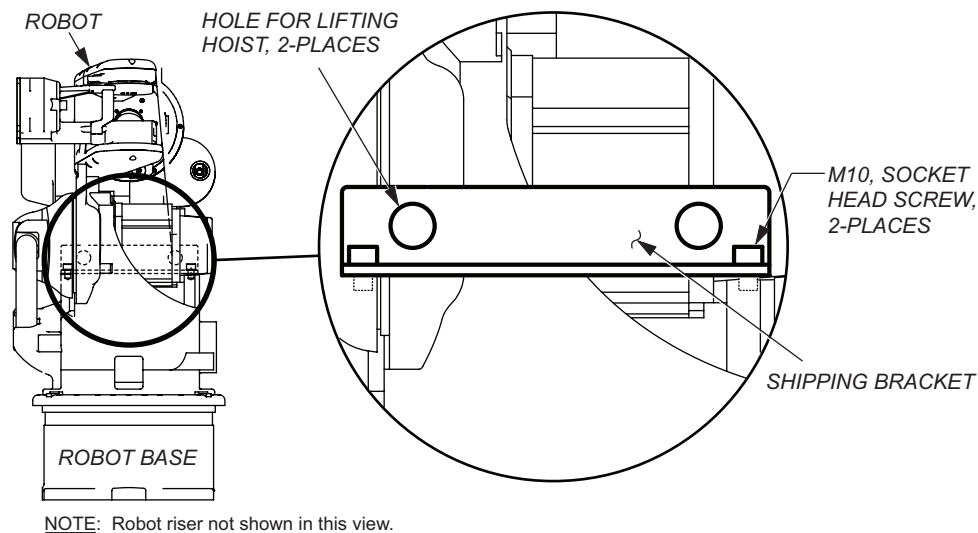


Figure 12 Robot Shipping Bracket

4.8 Cable Connections



CAUTION!

Route cables away from hazardous work areas. It is important to keep cables covered / hidden as much as possible to avoid cable damage and possible interruption of work cell operation.

After the ArcWorld® III-1200 DRC components and peripherals are secured in their correct locations, unwrap the cables from around the equipment and route them according to the cable diagrams included in the documentation supplied with your ArcWorld® III-1200 DRC system. All cables are labelled to match the labels at the connection points.



Note: A small gap exists between the bottom of the work cell safety fence and the robot/positioner common base. This gap provides a passage for cables that must run between components that are outside the work cell and those that are inside the work cell.

4.8.1 Connection to Earth Ground



WARNING!

Do not use the ArcWorld® III-1200 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 the 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.

Each robot and the NX100-DRC controller must be connected to an 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. This is often referred to as a “low-resistance earth ground” and may require quite a bit more than a single driven ground rod, depending on soil conditions. Often, multiple ground stakes (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). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.



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

Connect both robots and the NX100-DRC controller 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 SSA2000 robot (R1). Connect the other end of the earth ground wire to the low-resistance earth ground.
2. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of SSA2000 robot (R2). Connect the other end of the earth ground wire to the low-resistance earth ground.
3. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside the NX100-DRC controller (R1). Connect the other end of the earth ground wire to the low-resistance earth ground.

4.8.2 Connection to Local Electrical Service



WARNING!

Connection of the ArcWorld® III-1200 DRC system to local electrical service must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC) as well as local electrical codes.

After installation and interconnection of ArcWorld® III-1200 DRC system components, connect local electrical service at the following locations –

- Two disconnect boxes (one for each welding power source). These are located on the NX100-DRC / Welding Power Sources common base (see Figure 1 and Figure 2)
- Power input to the NX100-DRC controller (see Figure 2).



Note: The ArcWorld® III-1200 DRC is configured for 3-phase 460/480 VAC primary power. For additional information, please refer to the electrical drawings and schematics that are included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

4.9 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 SSA2000 robot (refer to Section 4.7).
2. Ensure a clearance of at least 2.5 cm (1 in.) exists on either side of the MSR-500 SIGMA-III positioner.
3. Ensure correct alignment and operation of the safety light curtain send and receive units.
4. Ensure that both work cell access doors are closed and door interlocks engaged.
5. Check the torque and security of all cable connections.
6. Ensure the correct setting of the welding power sources (refer to the welding power source documentation that is included with your ArcWorld® III-1200 DRC system).
7. Verify that local electrical service is correctly wired into the NX100-DRC controller (refer to Section 4.8.2).
8. Verify that local electrical service is correctly wired into each welding power source disconnect box (located on NX100-DRC / Welding Power Sources common base (refer to Section 4.8.2)).
9. Verify that the local electrical service line voltage and phase comply with the voltage and phase requirements for your ArcWorld® III-1200 DRC system.



CAUTION!

The ArcWorld® III-1200 DRC system is now ready for power-up. Ensure that qualified, trained operators, who are familiar with the ArcWorld® III-1200 DRC system, perform this power-up sequence.

10. Set POWER ON-OFF switch on the NX100-DRC controller (R1) to ON (see Figure 2).
11. Switch ON the electrical service disconnect box for each welding power source. These are located on the NX100-DRC / Welding Power Sources common base (see Figure 2).



WARNING!

Before operating the robots, check each E-Stop push button to verify that servo power can be disabled by activation of the E-Stop. Injury to personnel or equipment damage can result from an E-Stop circuit defect. The E-Stop push buttons must be able to positively stop robot and positioner movement during an emergency situation.

12. Check system E-Stop push buttons (refer to Section 3.7.4 for locations).
13. Check system HOLD buttons.
14. Ensure correct action of safety interlocks on both work cell access doors.
15. Remove power from the ArcWorld® III-1200 DRC system after completion of the safety / operation check.

4.10 Installation of Tooling and Fixtures

Your ArcWorld® III-1200 DRC system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld® III-1200 DRC system should do the installation. After the installation, test the MSR-500 SIGMA-III positioner for correct operation.



Note: All tooling and fixtures for the MSR-500 SIGMA-III rotary positioner shall be supplied by the customer.



Note: Motoman recommends application of a corrosion / rust inhibitor (MIL-C-16173D, Grade 2) to tooling and fixtures that are located in a hot and / or high-humidity environment. LPS-3, available from LPS Labs or most jobbers, is Motoman-approved for this application.

Chapter 5

Operation

The ArcWorld® III-1200 DRC system is a fully integrated robotic GMAW welding cell. Two Motoman SSA2000 robots weld on one side of the MSR-500 SIGMA-III rotary positioner while the operator loads the opposite side with a part to be welded. When the robots complete a welding cycle, they return to a HOME (Safe) position. The operator then enables the positioner sweep, allowing the robots to start welding on the next part. This section provides operation instructions for the ArcWorld® III-1200 DRC system.

5.1 Programming

The operation of this system is programming dependent. The following operating instructions are based on one possible configuration of 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, read the NX100-DRC controller documentation that is included with your ArcWorld® III-1200 DRC system documentation package (refer to Section 1.3).

Any changes made to your system configuration and/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® III-1200 DRC system. If you do make changes to the original jobs and/or system configuration, be sure to make those changes to a COPY of the original. Keep the original as a backup. Do not modify the originals. Modifications must be performed by trained and experienced personnel, who are familiar with the ArcWorld® III-1200 DRC system. If you have questions concerning the configuration of your ArcWorld® III-1200 DRC system, please contact Motoman 24 hour Customer Support (refer to Section 1.4).

5.2 Sweeping the Positioner



CAUTION!

Ensure that both SSA2000 robots are in the HOME (Safe) position before sweeping the positioner.

MANUAL mode allows you to sweep the MSR-500 SIGMA-III 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. Move both robots to HOME (Safe) 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 switch to MANUAL mode and start Master Control job (see Section 5.3.3). Normally, robots will not move out of HOME (Safe) position when the POSITIONER switch is in MANUAL. (This depends on job structure.)



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

4. Press the CYCLE START button on Operator Station (the MSR-500 SIGMA-III positioner sweeps each time the CYCLE START 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 (Safe) 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 standard shutdown procedures (refer to Section 5.3.5)

5.3.1 Start-Up

Procedure –

1. Set POWER ON-OFF switch on NX100-DRC controller (R1) to ON (see Figure 2).
2. Switch both welding power source electrical service disconnect boxes to ON (see Figure 2).
3. Set POWER ON-OFF switch on each welding power source to ON (ON-OFF indicator lamp on each welding power source will illuminate).
4. Open regulator valve on welding gas supply.
5. Make sure that both work cell doors are closed and door safety interlocks engaged.
6. Make sure all E-Stop push buttons are released. E-Stop push buttons are installed at the following locations:
 - Programming pendant
 - Door of the NX100-DRC controller (R1)
 - Operator Station pedestal
7. Select TEACH mode on the Programming Pendant.
8. Move robots to HOME (Safe) position (refer to Section 5.3.2).

5.3.2 Move Robots to HOME (Safe) Position

Procedure –

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 (Safe) 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 (Safe) position.

5.3.3 Select Master Job

Procedure –

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).
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® III-1200 DRC work cell is now ready for operation.

5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld® III-1200 DRC work cell after start-up –

1. Operator loads the fixture (on operator side of positioner) with part to be welded.
2. Operator steps out of safety zone created by the safety light curtain system, and moves to front of Operator Station pedestal.
3. Operator presses the green CYCLE START button on Operator Station pedestal. The MSR-500 SIGMA-III positioner sweeps 180°, thus placing part to be welded into the robot work area. The robots then begin to weld the part (if the Operator Station POSITIONER AUTO/MANUAL switch is set to AUTO).
4. While the robots are welding, the operator loads operator side of the positioner with the next part to be welded.
5. The operator again moves to the Operator Station pedestal and presses the green CYCLE START button (CYCLE LATCHED light illuminates). When the robots are finished welding, they return to HOME (Safe) position. The MSR-500 SIGMA-III positioner then sweeps 180° to return the completed, welded part to the operator position, while moving the next part into the robot work area.
6. Operator moves back to the operator side of the MSR-500 SIGMA-III positioner and unloads completed, welded part.

5.3.5 Standard Shutdown

Procedure –

1. Verify that both robots are in the HOME (Safe) position.
2. Disable system servo power by pressing the E-Stop push button on the Operator Station pedestal or NX100-DRC Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Set NX100-DRC controller (R1) POWER ON-OFF switch to OFF position.
5. Set both welding power source POWER ON-OFF switches to OFF position.
6. Close regulator valve on welding gas supply.
7. Switch all electrical service disconnect boxes to OFF

The ArcWorld® III-1200 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 procedures you should use to clear them.

5.4.1 Alarms and Errors

Alarms and errors will stop the program. The following three categories are possible –

- Error Messages
- Minor Alarms
- Major Alarms.

For more detailed information on alarm and error recovery, read the NX100-DRC controller and SSA2000 robot documentation that is included with your ArcWorld® III-1200 DRC system 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. An example could include 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

Major alarms usually involve hardware failures. Examples could include:

- An overload condition
- An abnormal speed

Clear alarms of this type by cycling the NX100-DRC controller (R1). Cycling involves setting the POWER ON-OFF switch to OFF for 5 to 8 seconds, then back to ON.

5.4.2 E-Stop Recovery

An E-Stop (emergency stop) will occur under any of the following conditions –

- An E-Stop push button is pushed in (activated)
- Either work cell access door is opened while the robots are not in TEACH mode
- The safety light curtain system is triggered while the positioner is sweeping
- A welding torch collision triggers a shock sensor output

Procedure –

1. To clear the E-Stop condition, perform any of the following actions that apply –
 - Release the activated E-Stop push button
 - Close the work cell access door(s)
 - Clear the area in front of the positioner that is protected by the safety light curtain system
 - Clear the welding torch shock sensor condition (refer to Section 5.4.3).



CAUTION!

If an E-Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® III-1200 DRC system is restarted.

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

The ArcWorld® III-1200 DRC system is now ready to continue operation.

5.4.3 Shock Sensor Recovery

Each SSA2000 robot includes a Motoman welding torch mount. This mount protects the torch from damage in case of a collision. A slight deflection of the welding torch activates a SHOCK SENSOR signal that triggers an E-Stop condition. To clear the E-Stop condition, you must temporarily override the shock sensor and move the affected robot clear of the impact.

Procedure –

1. Select MAIN MENU on Programming Pendant touch screen.
2. Select ROBOT on Programming Pendant touch screen.
3. Select OVERRUN-S.SENSOR on Programming Pendant touch screen.
4. Select RELEASE to release shock sensor.
5. Enable servo power (grasp the Programming Pendant ENABLE switch while pressing SERVO ON READY).
6. Move the affected robot clear of the impact position.

The ArcWorld® III-1200 DRC system is now ready to continue operation.

5.4.4 Brake Release



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.

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 or robot failure occurs, you must release the brakes on the affected robot in order to move it.

Procedure –

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

NOTES

Chapter 6

Maintenance

Maintenance of the ArcWorld® III-1200 DRC system and components must be performed by authorized personnel who are familiar with the ArcWorld® III-1200 DRC system. Perform the procedures given in this chapter only as needed (on condition). Be sure to read and understand the documentation for a particular component before doing repair maintenance or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with safety precautions given in Chapter 2.

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

For periodic maintenance procedures and schedules for the individual components of your ArcWorld® III-1200 DRC system, refer to the documentation package (refer to Section 1.3).



CAUTION!

If your system uses water-cooled torches, use only Motoman-specified antifreeze. Typical automotive antifreeze contains additives that can clog the small cooling ports in the torches, and can damage sealing gaskets in the water circulator pumps.

Table 1 Periodic Maintenance

FREQUENCY	COMPONENT	PROCEDURE
Daily (or on condition)	Water Circulators (water-cooled torch application, only)	Add a mixture of Motoman antifreeze (P/N 131224-1) and distilled water, as required. Mix antifreeze and distilled water in proportions shown on the anti-freeze container.
	All safeguard items – work cell door interlocks, E-Stop push buttons, safety light curtains, arc curtains, etc.	Check physical condition of safeguard items and ensure that each safeguard item is working correctly
Monthly (or on condition)	ArcWorld® III-1200 DRC work cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.

NOTES

Appendix A

Anchoring

The customer must 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 DX1350N, EA1400N, EA1900N, HP20, HP20-6, HP6, HP6R, HP6S, SSA2000, SSF2000, UP20, UP20-6, UP6	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 EPL80, HP50, HP50-20, HP50-35, SP80, UP20M, UP50 (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 EPL100, EPL160, EPL300, ES165N, ES165N-100, ES165RN, ES200N, ES200RN, HP165, HP165N-100, HP165R, HP200, HP200SP, HP200RN, HP200T, SP160, SP250, SP400, UP120, UP130, UP165, UP200 (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 EPL450, EPL500, HP350, HP350-200, HP500, HP600, SK300X, UP350, UP500 (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

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

SYSTEM EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIA / TYPE	MINIMUM FLOOR PLATE	MINIMUM FOUNDATION
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

Notes –

- (1) Minimum robot lagging requirements are based on *Maximum Repulsion Forces and Hilti® Anchor Design Program* (v3.3b).
- (2) SP and EPL series robots require base plates and/or risers to be level to $\pm 2^\circ$. Grout if necessary.
- (3) Reference source: *Hilti® Product Technical Guide* (section 4.2.1) for hardware specifications or equivalent.
- (4) Reference source: *Hilti® Product Technical Guide* (section 4.3.3) for hardware specifications or equivalent.
- (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.
- (6) Refer to *Hilti® Product Technical Guide* for suggestions on the correct size and type of drill bit to use with each anchor type.

 **Contact Information –**

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 1-800-363-4458 (CAN) <http://ca.hilti.com>

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