Motoman NX100 Controller

Robotic Arc Welding Instruction Manual

for Miller® Auto-Axcess DI

Part Number: 148985-2CD
Revision 0

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Chapter 1
Introduction

1.1 About This Document

This manual provides information about a Motoman's robotic arc welding system using the Miller Auto-Axcess DI power sources. It is intended for welding personnel who have received operator training from Motoman, and are familiar with the operation of their Motoman robot model. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:

CHAPTER 1 - INTRODUCTION
This chapter provides general information about the Miller Auto-Axcess DI power source and its components, technical specifications, a list of reference documents, and customer service information.

CHAPTER 2 - SAFETY
This chapter describes the conventions used to identify precautionary text throughout this manual. This chapter also contains a list of general cautions and warnings that apply to many of the procedures described in this manual.

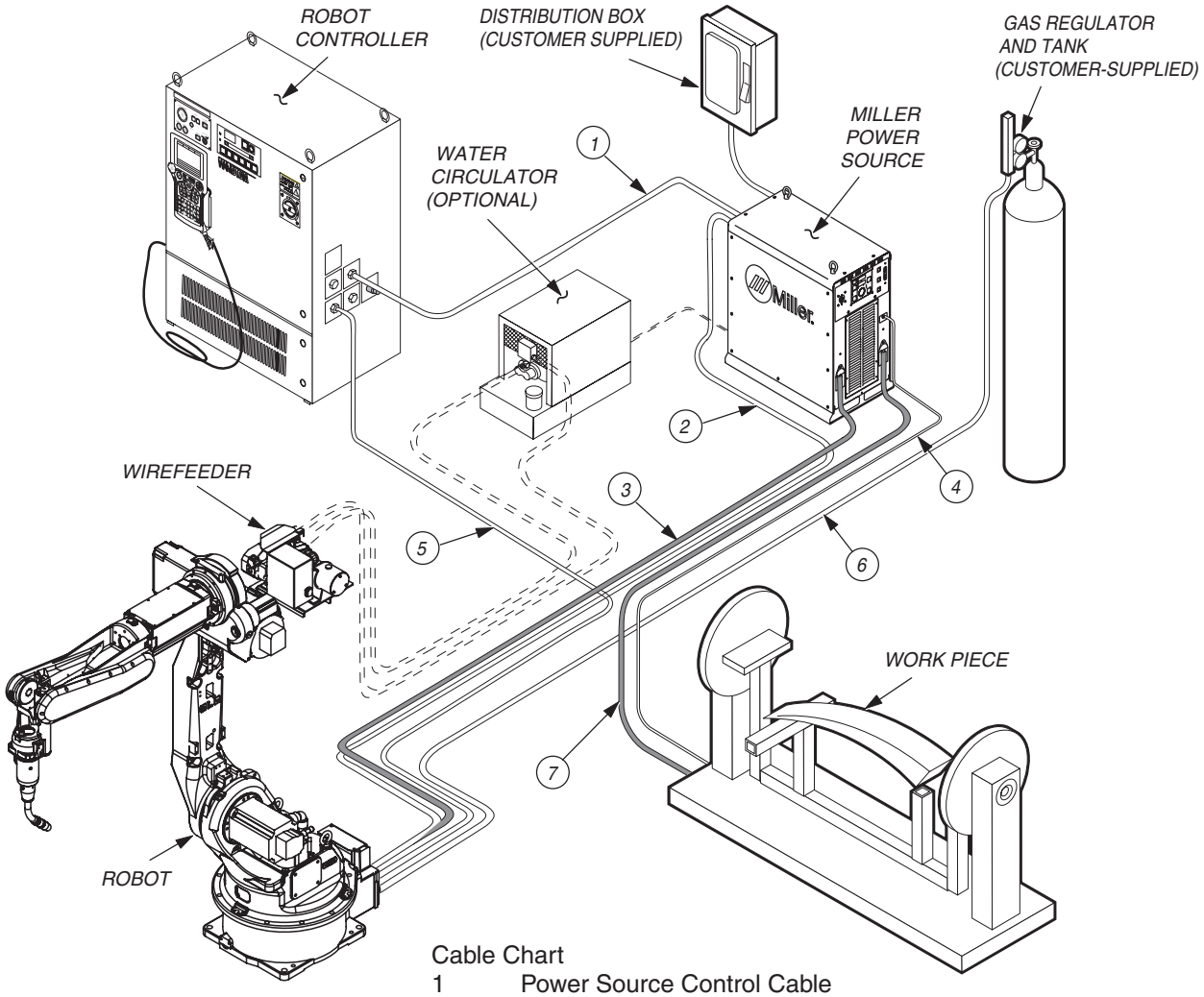
CHAPTER 3 - EQUIPMENT DESCRIPTION
This chapter provides instructions for basic setup and integration of a Motoman welding system with a Miller Auto-Axcess DI power source. This chapter also provides procedures for start-up and calibration.

CHAPTER 4 - THEORY OF OPERATION
This chapter describes general arc welding principles, how the welding system works, and identifies specific welding problems and requirements.

CHAPTER 5 - OPERATION
This chapter provides instructions for basic operation of the Auto-Axcess arc welding system. This chapter also provides procedures for start-up. Sample robot programs are also included here.

1.2 System Configuration

The Auto-Axcess arc welding system is an integrated package of tools and components designed for specific welding requirements. A typical system includes the following components and optional equipment.



Cable Chart

1	Power Source Control Cable
2	Feeder Control Cable
3	Weld Positive
4	Voltage Sense Cable
5	Shock Sensor Cable
6	Gas Hose
7	Weld Negative

Figure 1 Typical Auto-Axcess Welding System

1.2.1 Major Components

A typical system includes the following major components:

- Motoman manipulator and controller
- Welding equipment, including the following:
    - Miller Auto-Axcess DI power source
    - Miller AA-40GB wire feeder
    - Welding torch
- Optional welding equipment including:
    - Water circulator
    - Program devices - Palm Pilot with an RS232 adaptor
    - Nozzle cleaner
    - Bulk wire delivery package

1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman Manipulator Manual
- Motoman *Operator's Manual for Arc Welding* (P/N 149235-1)
- Motoman *Concurrent I/O Manual* (P/N 149230-1)
- Miller Auto-Axcess DI Manual
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type
- Application Type (welding)
- Power Supply Type (Miller Auto-Axcess DI 300, 450, or 675)
- System Type (ArcWorld III-6200)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of the controller)

NOTES

Chapter 2
Safety

2.1 Introduction

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

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

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

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

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

This safety section addresses the following:

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

2.2 Important Advisory Information

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

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

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

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

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

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

2.3 General Safeguarding Tips

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

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.

- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

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

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

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

2.5 Installation Safety

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

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

- 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).

NOTES

Chapter 3
Equipment Description

This chapter contains brief descriptions of The Miller Auto-Axcess welding system components.

3.1 Robot and Controller

The robot controller coordinates the operation of the various welding system components. The controller executes instruction sequences provided in a robot job file. As the controller steps through the series of instructions, it directs the movement of the torch, and operates the welding power supply. The robot moves the welding torch and supply lines through a series of programmed steps. The controller sets the speed, direction, and position of the robot as it moves from point to point. It communicates weld signals through a digital interface board mounted in the controller cabinet. The controller sends command values for wire feed speed, voltage/arc length, arcon and arcoff. The robot also selects one of eight weld programs by setting three outputs. The Miller Auto-Axcess DI power source communicates to the controller when the arc is established, when there is a fault condition, or when the wire is stuck to the puddle. The power source also communicates the fault type back to the NX100.

This enhanced interface also features a pendant application which allows weld data to be assigned to the eight weld programs. It also provides functionality similar to Millers' File Manager Software.

3.2 Miller Auto-Axcess DI Power Supply

The Miller Auto-Axcess DI power source is a three-phase, high-frequency, multi-process inverter welder. It operates on 190 to 630 volts, 50 or 60-hertz power, AC or DC. The Miller Auto-Axcess 300 DI is rated 8.3 kvA and produces 300 amps at 60 percent duty cycle and 225 amps at 100 percent duty cycle. The Miller Auto-Axcess 450 DI is rated 23.8 kvA and produces 580 amps at 60 percent duty cycle and 450 amps at 100 percent duty cycle.

Auto-Line™ automatically adjusts to line voltage, so no external adjustments are necessary. The power source has multi-process MIG capability consisting of standard MIG (GMAW), standard pulse MIG (GMAW-P), Accu-Pulse (GMAW-P), Accu-Speed (GMAW-P), Accu-Curve (GMAW-P), as well as an optional RMD (GMAW-SC) mode.

Accu-Pulse reduces burn through problems, increases welding travel speeds, and is superior to pulse mode when welding with short arc lengths. For even shorter arc lengths on steel Accu-Speed is available. Accur-Curve has a softer pulse that can be used on aluminum. The optional RMD (Regulated Metal Deposition) process is a short circuit transfer process in which the power source alters the welding current to improve the droplet transfer while minimizing spatter levels. It is limited to use at wire speeds below 250 ipm (depending on electrode diameter) on thin gauge steel applications.

The Miller Auto-Axcess DI uses a devicenet interface and is compatible with the NX100 controller.

Features:

- Broad range of input power (190 volts through 630 volts AC, single or 3-phase), automatically selected by Auto-Line
- Sharp Start™ feature provides consistent arc starts by assuring a ball is not left on the wire when welding stops
- Two forms of serial diagnostic ports: palm and PC interface (RS232)
- Eight remote selectable programs from the robot
- 115 VAC, 10 Amp auxiliary duplex power receptacle
- Multiple MIG modes of operation
- World-class product support from Miller Electric
- Quick-change feed rolls

3.3 Software

The Miller Auto-Axcess DI comes standard with many programs for carbon steel, aluminum, and stainless welding, including Accu-Pulse, standard or adaptive pulse, Accu-Speed, Accu-Curce, conventional MIG, and optional RMD. The optional Miller Palm Axcess file management system provides an array of functionality. The software allows the user to customize arc starting/arc ending timing, customize pulse shape and adaptive voltage, and customize synergic lines. Palm connectivity also allows the user to beam or email schedule and system data.

Most applications do not require customized factory settings. However, if customization is necessary, the following Palm software programs are available from Miller:

- Service Pak Utility - used to update board level software. Available at www.millerwelds.com.
- File Manager - allows weld programs to be uploaded/downloaded to welder, but does not allow modifications to programs. This software allows the user to set edit locks, start/end conditions, etc. The software is supplied on a memory card for the Palm SD expansion slot. The card must be installed to use the software.
- WaveWriter™ - allows the user to set pulse conditions, including peak time, background voltage, and other variables. Allows user to change parameters for RMD mode. Software is supplied on a memory card for the Palm SD expansion slot. The card must be installed to use the software.

3.4 Miller AA-40G Wire Feeder

The AA-40G Wire Feeder is an open frame-type wire feeder equipped with four (4) geared (0.045 in.) feed rolls as standard. The feeder is rated at 650 amps 100 percent duty cycle and weighs 7.5 kg. The wire feed speed range is 50-1400 ipm, with a default maximum of 999 ipm. If a wire feed speed greater than 1000 ipm is necessary, the data in the welder condition file must be reset.

3.5 Miller-Motoman Pendant Interface (HMI) Software

The Interface Software connects the NX100 Controller to each of the welding units (up to 4) that are part of the system. The HMI allows the operator to set the Miller Auto-Axcess DI parameters from the NX100 programming pendant.

This software is standard with the Miller Auto-Axcess DI/NX100 system.

3.5.1 Starting the Miller HMI

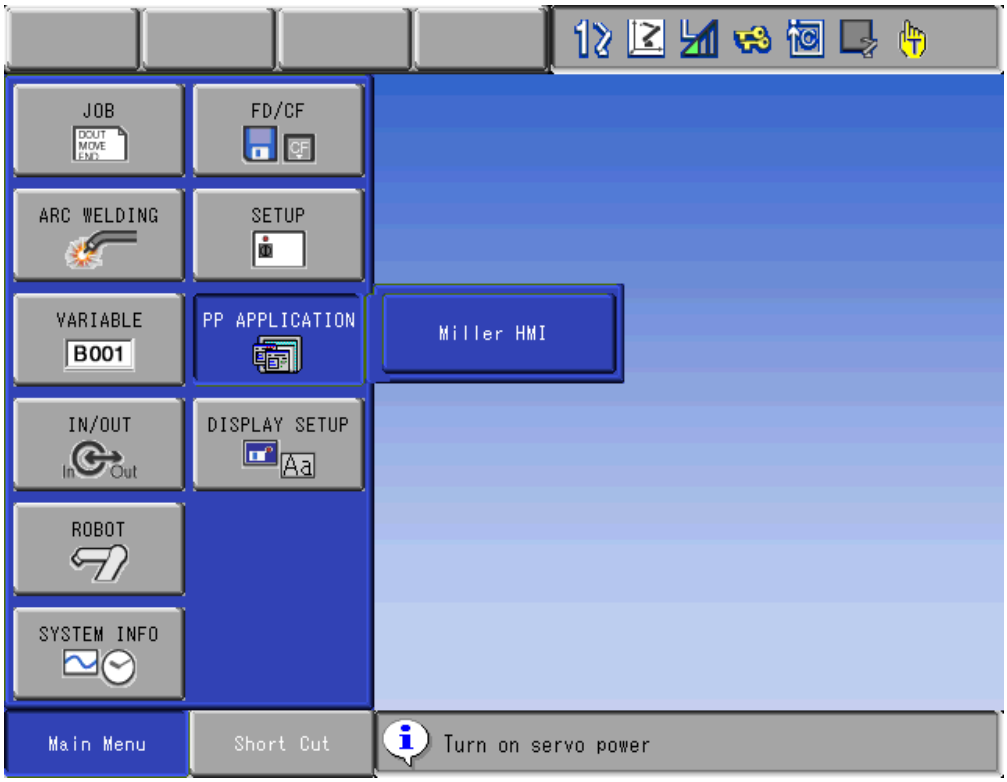


Figure 2 Start Up Screen

To start the Miller HMI program tap the "PP APPLICATION" button (Figure 2), then the "Miller HMI" button (Figure 2). The first time the program is launched the Welcome Screen (Figure 3) will appear. Once the program has been configured, touching the Miller HMI will bring up the Home screen shown in Figure 4.

3.5.2 Welcome Screen

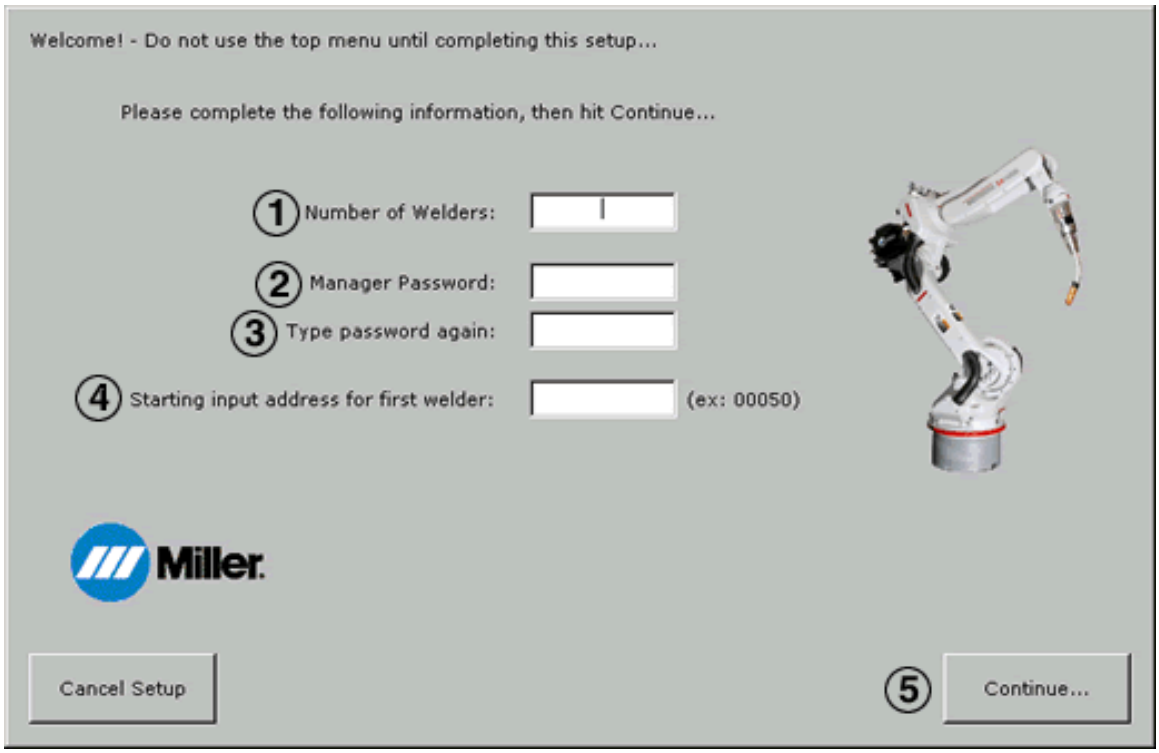


Figure 3 Welcome Screen

The Welcome Screen (Figure 3) appears the first time the Miller Human Machine Interface (HMI) application is loaded onto the NX100 programming pendant. It is used to configure the system for the number of welders, addressing, and passwords.

Note: This screen is usually set up by Motoman.

1. **Number of Welders:** Enter the number of welders attached to the system (1 - 4).
2. **Manager Password:** Factory Default is 99999999 (eight 9's). Enter the password (up to eight characters) for management rights.
3. **Type password again:** Re-enter the password to verify.
4. **Starting input address for first welder:** The Devicenet PC board in the NX100 that communicates with the welders requires a starting address and each welder requires 9 bytes. The default address is 00050. This location is used by the NX100 Ladder to complete the bridge between the device net board and the NX100 controller.

Note: If other devices are added to the NX100 controller after the original Devicenet installation, the starting address, as well as the ladder, may need to be changed.

5. **Continue:** When all the required fields above have been completed, push continue.

3.5.3 Home Screen

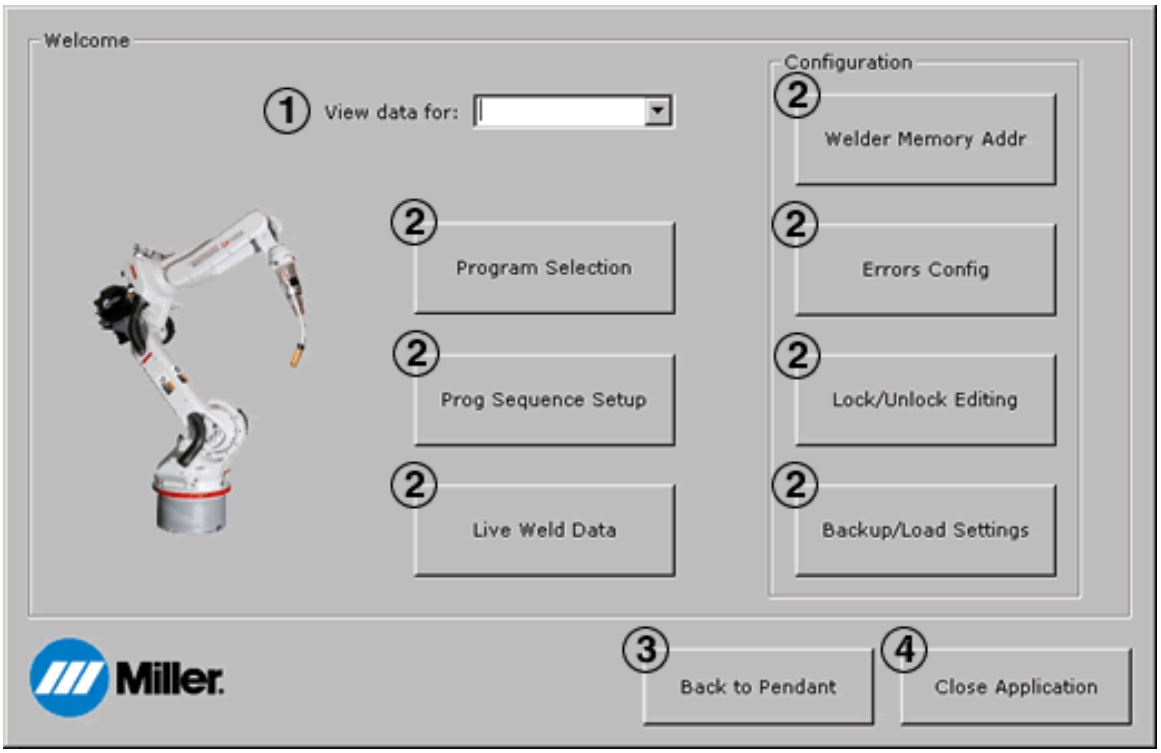


Figure 4 Home Screen

The Home Screen (Figure 4) will take you to the various applications shown on each button. These screens are described in more detail later.

1. **View data for:** If more than one welder is attached to the system, select the welder that you want to work with.
2. **Program Selection**
   Prog Sequence Setup
   Live Weld Data
   Welder Memory Addr
   Errors Config
   Lock / Unlock Editing
   Backup / Load Settings

   These buttons bring up additional screens where the function can be edited or data viewed.

Note: Some of the set-up functions cannot be changed in Play mode.

3. **Back to Pendant:** This button returns the user to the pendant programming menus without closing the Miller HMI application. The Miller HMI continues to run in the background. Use this button if you are going back and forth repeatedly and do not wish to continually re-open the program.
4. **Close Application:** This button closes the application and returns the user to the pendant programming menus. To re-enter the program, passwords, etc. must be entered. During normal system operation, if the program is not needed, it should be closed.

3.5.4 Program Selection Screen

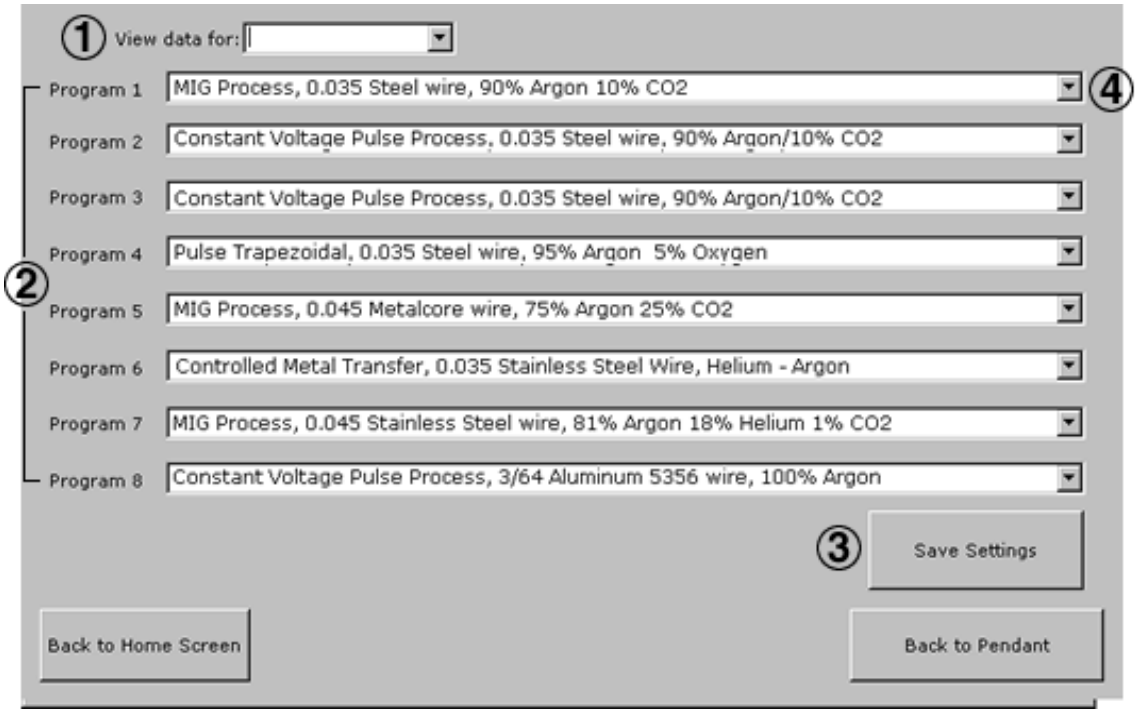


Figure 5 Program Selection Screen

The Miller Auto-Axcess DI has eight user definable weld programs (Figure 5). Each program can be configured for the process, wire size and type, and shielding gas.

1. **View data for:** If more than one welder is connected to the system, select the welder you wish to view.
2. **Program 1, 2, 3, 4, 5, 6, 7, 8:** Select the required welding program. Only those programs that are used need to the configured. To specify a new process in a program:

Note: The use of a stylus is recommended to ensure selection of the information you want to program.

- Using the stylus touch the down arrow button ④ on the right of the Program Selection Screen (Figure 5). The list of process options will be displayed.
- Scroll though the list to view the process options. They are listed in the following order: Mode, Material, Wire Size, Gas Mixture
- Select the desired process.

3. **Save Settings:** When a program has been changed, this button must be pushed to save the changed program to the welder. If the **Save Settings** is not pushed, any changes will be lost when leaving the screen. After pushing the **Save Settings** button, you will be prompted to OK the change. Press Yes to save or No to void the changes.

   Save Disabled: Is displayed on the pendant if the Manager has not assigned the operator the right to make process changes. To restore the SAVE function go to the Lock/Unlock Edit Screen (Figure 10) and log-in with the Manager's password.

3.5.5 Program Sequence Setup Screen

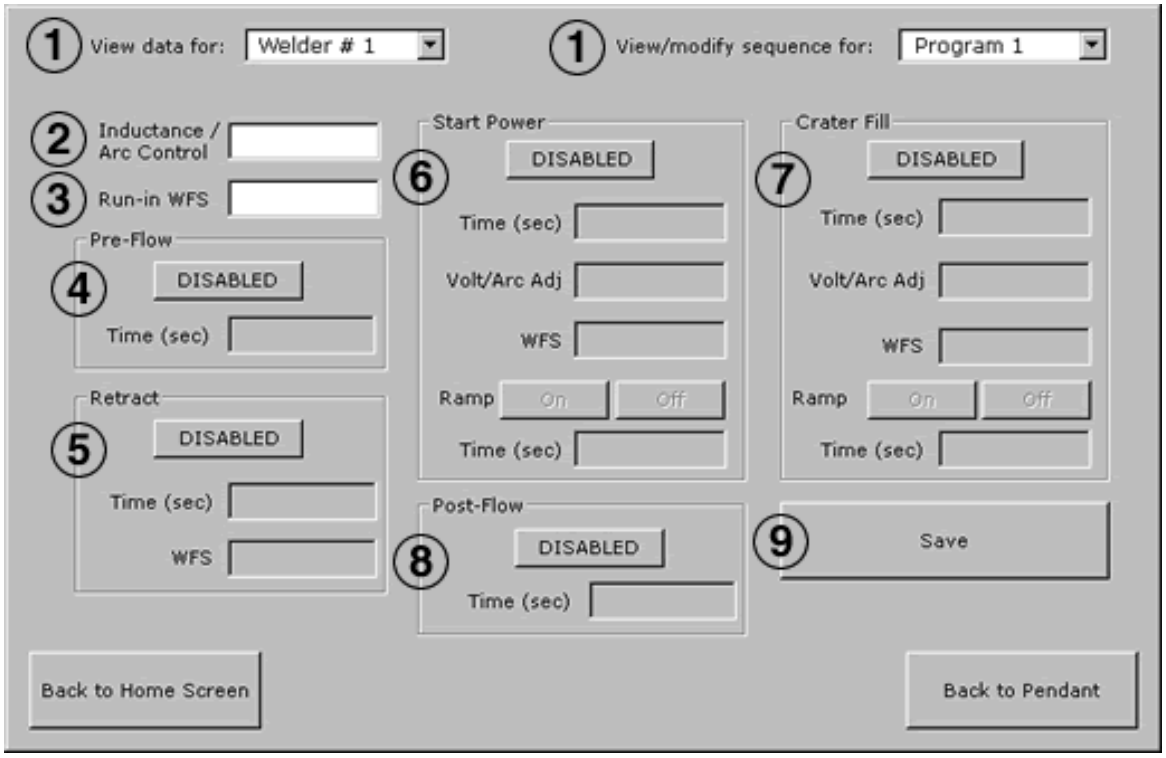


Figure 6 Program Sequence Setup Screen

The Program Sequence Setup screen (Figure 6) is used to configure each weld program. When making changes only the Welder # and Program # displayed are affected. The **Enabled / Disabled** buttons toggle back and forth between turning the functions on and off.

Note: These functions are controlled by the Miller Auto-Axcess DI. Pre-Flow, Run-in WFS, and Start power begin with an Arcon command. Crater Fill, Retract and Post flow start when the Arcoff command is issued. Motoman recommends the welding sequencing be done in AcrStart Files to ensure timing is coordinated with the robot motion.

1. **View data for:**
   View / modify sequence for: Select the welder (if more then one is connected to the system) and program number to view or change. Only that program will be affected.
2. **Inductance / Arc Control:** Set the desired Inductance (0-99) when using a MIG program. Set the desired Arc Control value (0-50) when using a Pulse, Accupulse, or RMD program.
3. **Run-in WFS:** This parameter sets the wire feed speed (WFS) during arc initiation. The wire feeds at the run-in speed when the arcon command is issued until an arc is established. Generally, the run-in speed is set lower than the WFS for the actual weld. This helps the arc start better. Once the arc is established, the WFS changes to the set value.

4. **Pre-Flow:** Sets the shielding gas pre-flow time. If enabled, the gas will come on for the specified length of time before the wire will start to feed. This will add cycle time at the Arc Start. There is a purge output, which can be turned on in the robot job file that does not add this extra time.
5. **Retract:** This function retracts the wire at the end of the weld. A time in seconds and a WFS must be specified. Typical settings are 100 ipm and 0.3 seconds. This helps create separation between the wire and weld puddle for large fillets.
6. **Start Power:** This function is used to modify the default start sequence. When enabled, the specified Volts / Arc Adjust and WFS parameters are used for the time indicated during the start of the weld, then changed to those in the Job program. When the Ramp function is disabled, the WFS and Volts / Arc Adjust remain constant during the Start Power time. When Enabled, the WFS and Volts / Arc Adjust begin at the specified values and time, then ramp up to the Job values over the time set in the ramp box. Robot motion starts once the arc is initiated unless timers are inserted.
7. **Crater Fill:** If a crater fill is desired at the end of the weld, enable the function and set a time, Volts / Arc Adjust and WFS. The Ramp function will slope the WFS and Volts / Arc. Adjust up or down to the crater fill parameters over the time specified. Use the Hyper Start function to set Welder Control if the robot is to wait for the welder crater fill.
8. **Post-Flow:** Continues the gas flow for the set amount of time after the arc ending sequence.
9. **Save:** This button must be pushed to activate and save any changes. If the screen is left without saving, the changes will be lost. Save Disabled indicates the operator does not have rights to make changes to the screen.

3.5.6 Live Weld Data Screen

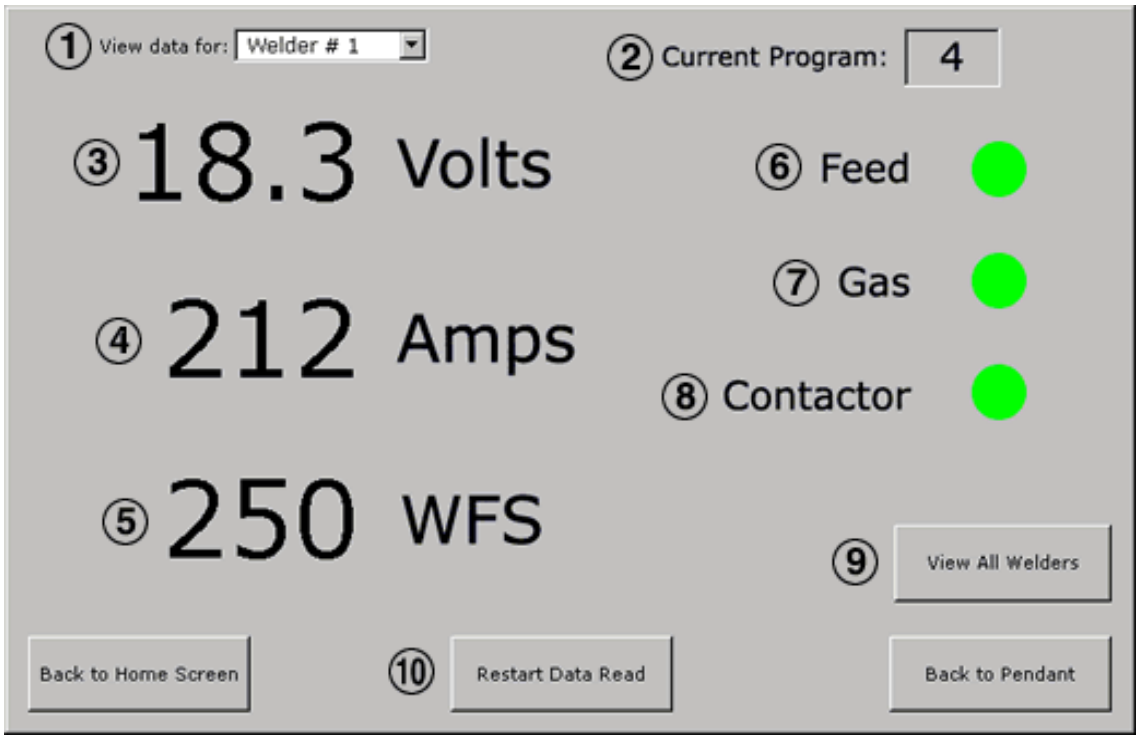


Figure 7 Live Weld Data Screen

The Live Weld Data screen (Figure 7) displays Voltage, Current, and Wire Feed Speed (WFS) during the weld. It also displays the status (On/Off) of the wire feeder, gas solenoid, and weld contactor.

1. **View data for:** If more than one welder is connected to the system, select the desired welder # to view its data.
2. **Current Program:** Displays the weld program (1-8) selected on the Miller Auto-Axcess DI.

Note: Programs are selected by changing outputs in the robot program. The Miller Auto-Axcess DI checks the output prior to welding. The program number being run is displayed while the Arc is on.

3. **Volts:** Actual welding voltage.
4. **Amps:** Actual welding Current, in Amps.
5. **WFS:** Actual welding Wire Feed Speed, in inches/minute.
6. **Feed:** Red=Wire Feeder is Off. Green=running in either forward (welding) or reverse (retracting wire).
7. **Gas:** Red=Gas solenoid off. Green=Gas solenoid on.
8. **Contactor:** Red=welder in standby. Green=Gun Switch is on.

9. **View All Welders:** Displays the Viewing Weld Data for All Welders screen (Figure 8) on top of the Live Weld Data screen. When returning from the Viewing Weld Data for All Welders screen to the Live Weld Data screen, the **Restart Data Read** button must be pressed to display live weld data again.

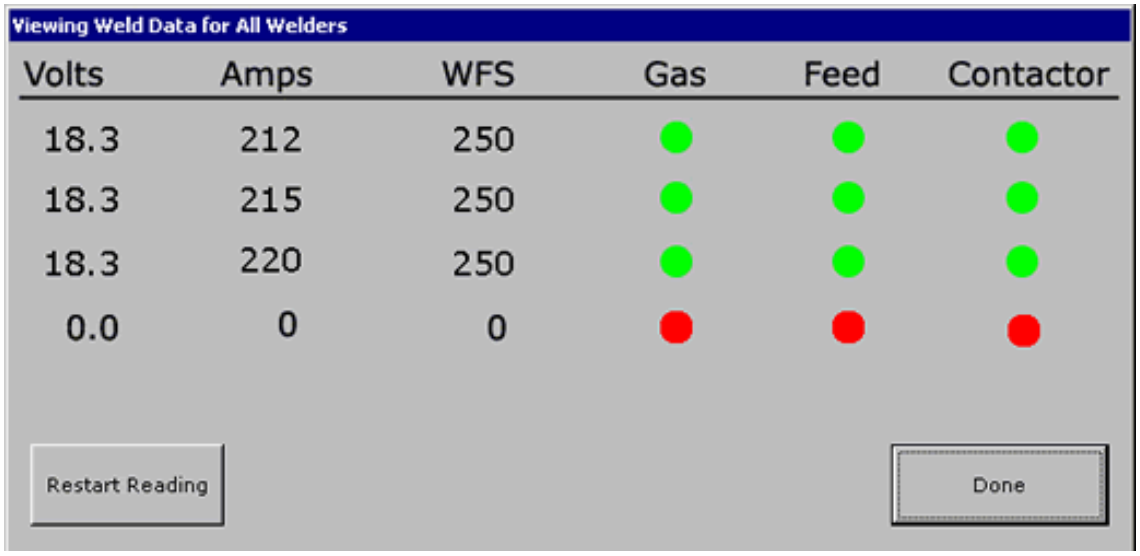


Figure 8 View All Welders

10. **Restart Data Read:** This button restarts the live weld data stream from the welder to the pendant. It must be pushed whenever the screen is left and returned to via the View All Welders or Back to Pendant buttons. Pushing it tells the welder to begin sending actual weld data again.

3.5.7 To Modify or Add a Welder

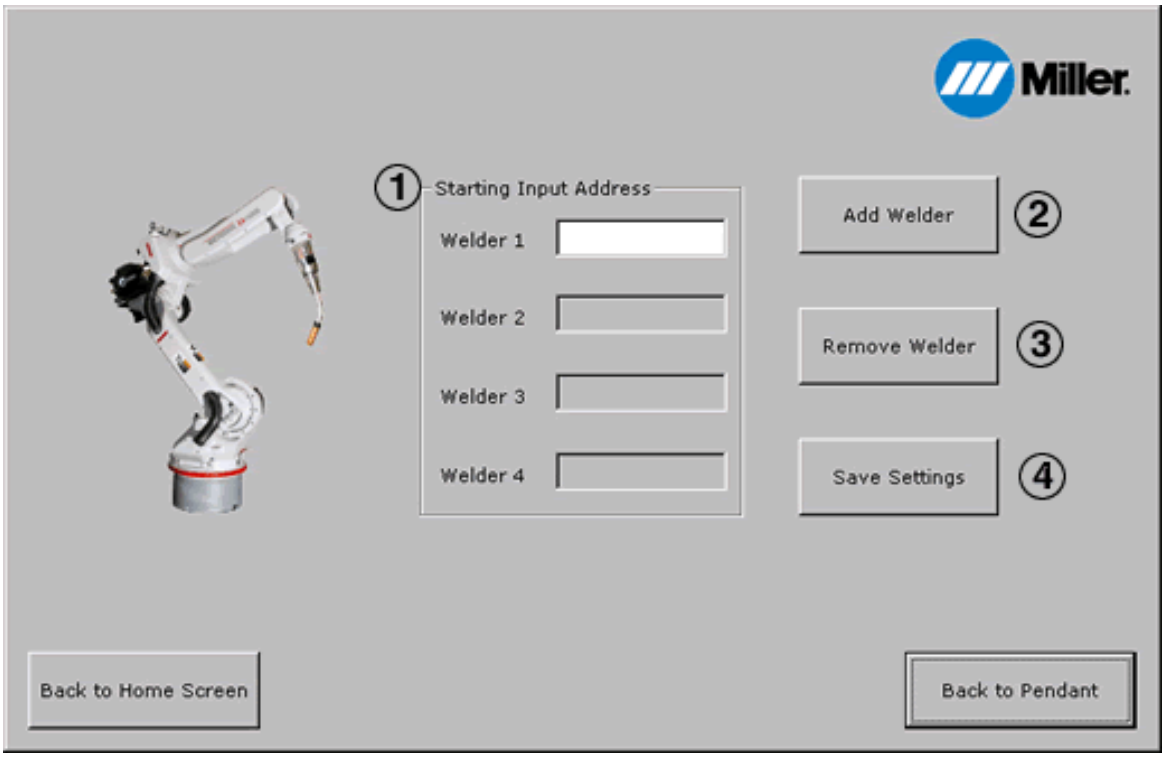


Figure 9 Modify/Add Screen

If a welder is to be added to the system or the starting input address has changed due to the addition of other options use the screen shown in Figure 9. If an additional welder is added, the starting address will not change, but ladder modifications may be needed. Some options, such as an Expanded I/O pc board, will require address changes as well as updating the NX100 ladder for the new address locations. Changing information on this screen requires the user to be in Manager mode.

Note: Changing the starting address location will make the system inoperable without also updating the User Section of the NX100 ladder to reflect the change.

Note: Adding a welder without also updating the NX100 System and User sections of the ladder will make the system inoperable.

1. **Starting Input Address:** Enter the new starting address location. The User section of the NX100 ladder will need to be modified with the address changes as well.
2. **Add Welder:** If a welder is added to the system use this button to update the number of welders and starting input addresses.
3. **Remove Welder:** If the number of welders connected to a system is reduced, use this button to remove it from the Miller HMI. After pressing Save Settings, no further action is required.
4. **Save Settings:** This button must be pressed to save any changes and make them active.

3.5.8 Error Preferences

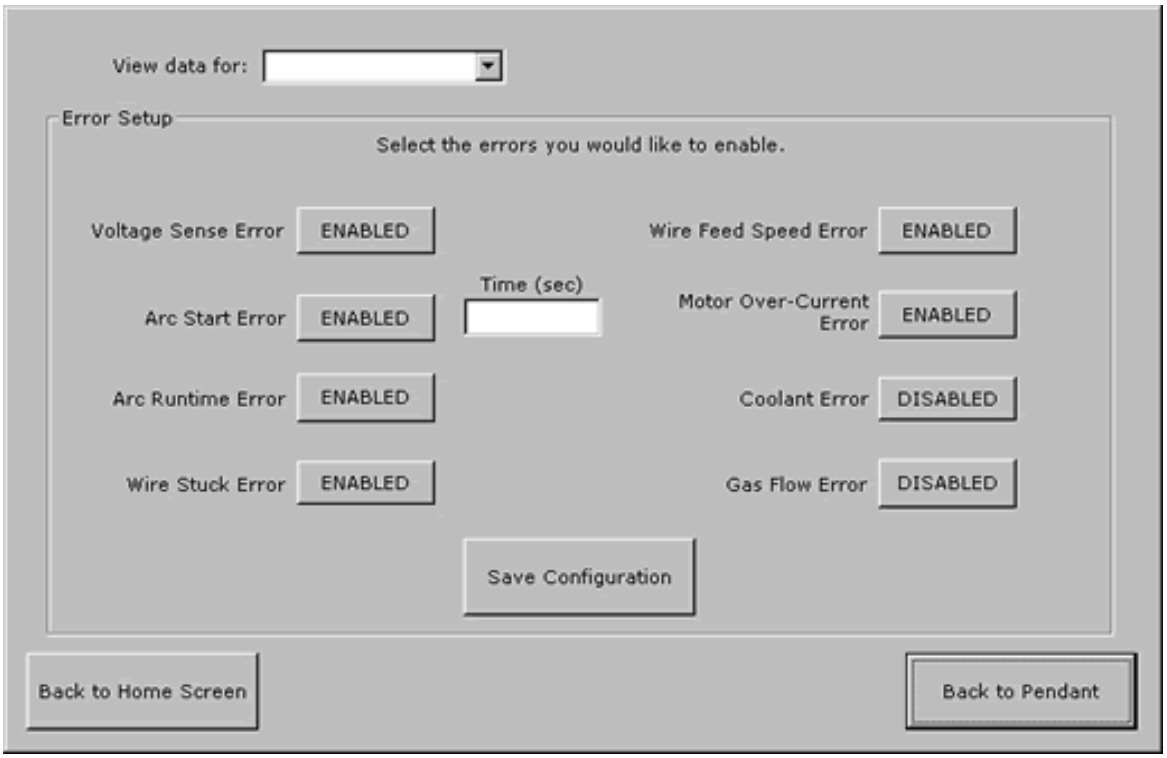


Figure 10 Error Preference Screen

The Miller Auto-Axcess DI has several errors that can be enabled or disabled depending on user preferences (Figure 10). Sometimes these errors will give "nuisance" trips, causing excessive downtime. If the actual error will not cause any safety issues or equipment damage, it can be turned off. When the errors are disabled, they will be ignored by the Miller Auto-Axcess DI and no error message will be sent to the robot controller.

These errors are global within the Miller Auto-Axcess DI. They affect all eight weld programs.

The DI interface includes a mapping of Miller error codes into the NX100 controller. Welder errors will generate a user alarm on the robot with the error message displayed. Welder alarm history can be viewed under user alarms (see Section 5.4). The error code is recorded along with the date, time, program, and step number of the error.

3.5.9 Lock/Unlock Editing

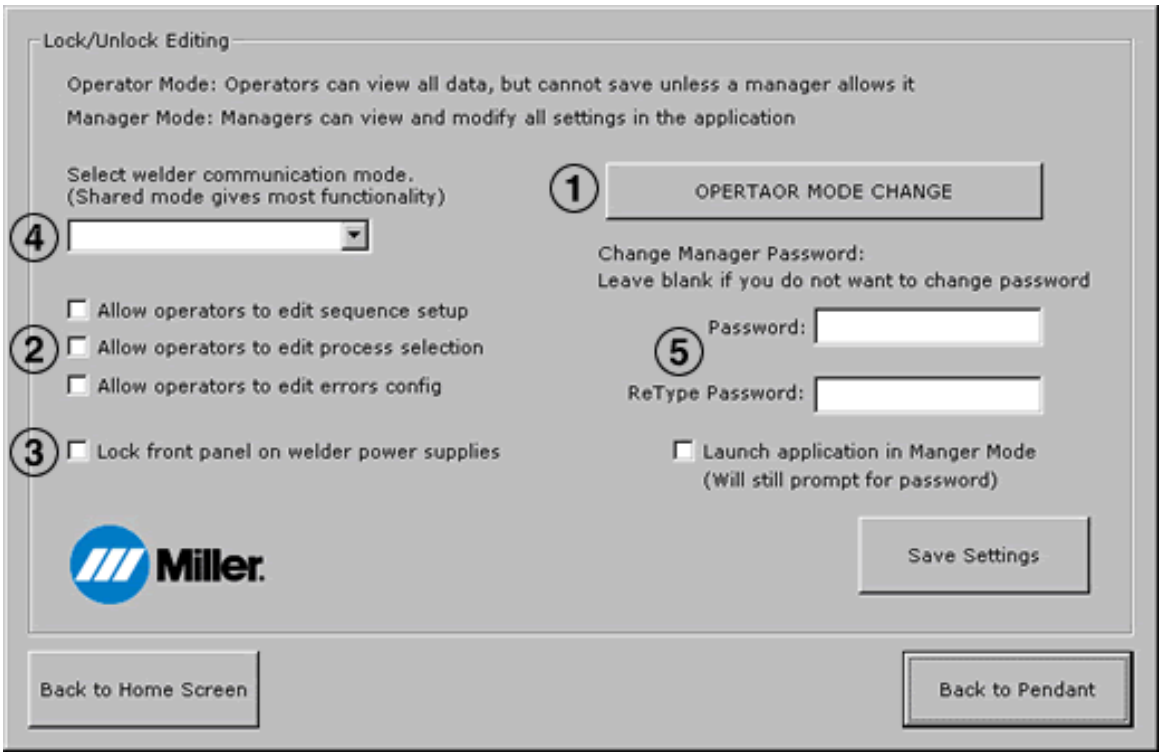


Figure 11 Lock/Unlock Editing Screen

The Lock/Unlock Editing screen (Figure 11) is used to set various levels of security and lock the Miller Auto-Axcess DI front panel.

1. **Operator Mode Change**: This button toggles the HMI between the Operator/Manager Mode - The default setting is "Operator Mode". In the Operator Mode, all the screens can be viewed, but the "Save" buttons are disabled and no data can be changed.
    - Pressing the Manager Mode button will prompt a dialog box to appear.
    - Enter the managers password (default is 99999999 [eight 9's]).
    - Confirm change by selecting the yes box.
2. **Editing Functions**: These statements allow various editing functions to be activated while in Operator Mode. To activate any combination of the Editing Functions, go to "Management Mode" and select the desired boxes.
3. **Lock front panel on welder power supplies**: In Management Mode, selecting this box will lock the front panel of all Miller Auto-Axcess DI's connected to the system. The "Lock" symbol on the Miller Auto-Axcess DI will be lit when this feature is activated. Users will not be able to make changes from the front panel.

4. **Select welder communication mode**: The Miller Auto-Axcess DI has 3 different levels of communication and is selected from this box:
    - **Shared Control** (the default setting) - This is the preferred setting, it allows both the NX100 and the Miller Auto-Axcess DI to control various features.
    - **Robot Control** - This setting allows only the NX100 to control various weld settings, such as pre-flow, post-flow, etc. These functions will be locked out from the HMI.
    - **Power Source Control** - This setting shifts all control to the power source. Only arc on and arc off are controlled by the Robot.
5. **Password** & **ReType Password**: To change the password select Manager Mode and create a new password in the **Password** window and confirm it in the **ReType Password** window. If the password does not need to be changed leave the windows blank.

3.5.10 Backup & Load Settings

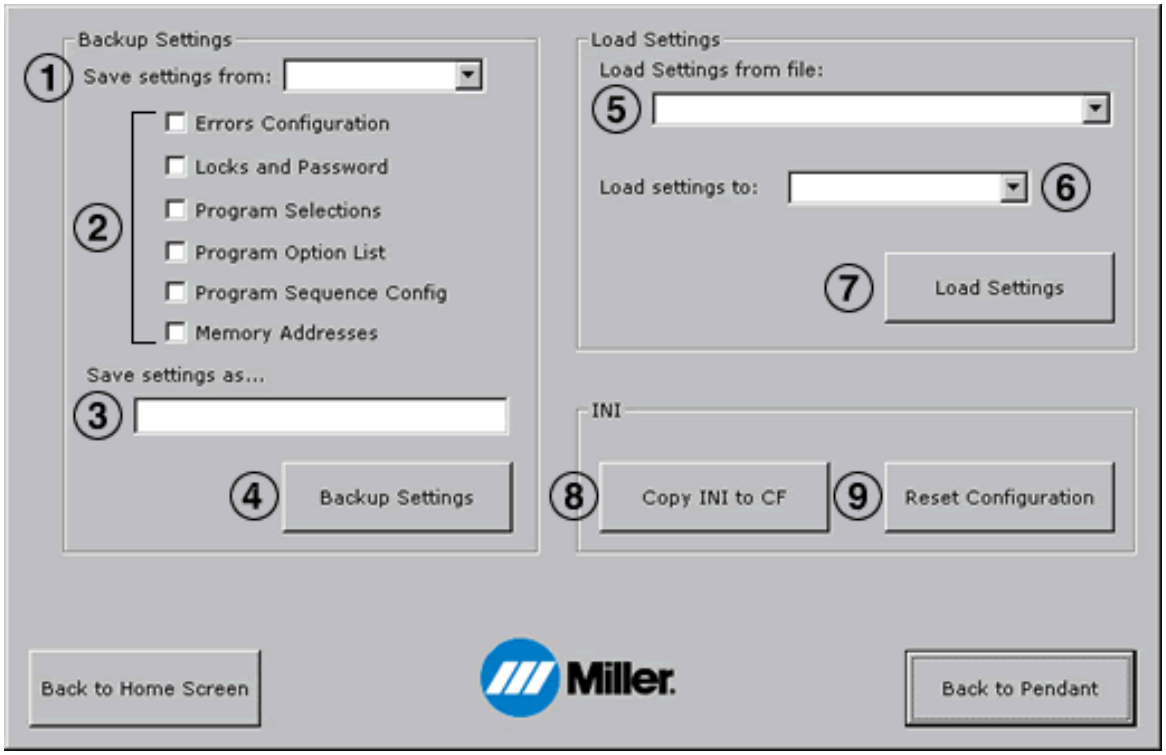


Figure 12 Backup & Load Settings Screen

The Backup & Load Settings Screen (Figure 12) has several functions; backing up a welder HMI Settings, copying a configuration to another welder, or copying or resetting the 'INI' file. This function only serves the robot HMI. The data is not a replacement for the Miller File Manager PDA software that saves data directly from the welder.

Note: A Compact Flash (CF) memory card must be installed in the programming pendant in order to backup the welder.

To Backup Settings

1. **Save settings from**: Select the welder number (#) that will be backed up or downloaded to.
2. Select the functions that need to be backed up. Only those functions selected will be backed up.
3. **Save settings as**: A default file name is created, using the date and time, that the settings will be backed up to. The file name can be changed but **do not** change the extension (.wst).
4. **Backup Settings button**: After selecting the welder #, items to be saved and file name, this button will save the information on the CF memory card in the file named in step 3 above.

To Load Settings:

5. **Load Settings from file**: Select the configuration file to be loaded into the welder. This file must be a *.wst file on the CF memory card.
6. **Load settings to**: Select the welder # you want the file to be loaded to.
7. **Load Setting**: Press this button to load the configuration file to the selected welder #.

The INI file contains information used by the HMI program. It resides on the programming pendant and contains data such as the number of welders.

8. **Copy INI to CF**: To backup the INI file, insert a CF memory card and touch this button. This creates a copy of the INI file on the CF memory card.
9. **Reset Configuration**: This resets the INI file to the factory default values.

NOTES

Chapter 4
Theory of Operation

The Miller Auto-Axcess DI is a Gas Metal Arc Welding (GMAW) power supply capable of non-pulsed, or MIG, and pulsed (GMAW-P) modes of operation.

The NX100 utilizes a DeviceNet interface to the Miller Auto-Axcess DI. This interface provides two basic levels of controls:

- Real time display of weld data.
- Programming of welder set-up data from the teach pendant.

Operators will not be aware of any programming difference between Digital or Analog interfaces with the Miller Auto-Axcess DI. Both interfaces function with the INFORM weld instructions utilized on the NX100 controller. The digital interface uses an application created by Motoman called the Miller HMI. This provides pendant screens with dialog boxes to allow Managers or Operators (if allowed by Managers) to make changes to programs in the welder.

The weld settings and sequence of operation are controlled by the robot. Traditionally, the current and voltage settings were communicated to the welder as a proportion of a 0-14 volt analog signal. The weld contactor, arc establish input, and error signals were discrete inputs and outputs. These basic signals were interfaced between the XEW01 board in the controller to the Auto-Axcess with a cable that had about a dozen wires.

These commands and signals are set and sequenced through the controller's concurrent I/O (CIO) program. This program has a system section which can not be edited by Users because of Safety functionality. The User section is provided for users to add fixture and cell control logic. INFORM functions such as RETRY and ANTI-STICK use signals in the ladder to operate. Motoman developed the HyperStart function to allow users to set values used in the system section to optimize cycle time and arc alarm conditions to suit the application.

The standard Auto-Axcess interface addresses the welding input and output signals to the physical I/O points on the XEW01 board. Weld settings, current and voltage, are entered in the robot program as an INFORM command or Arc Start File. These settings (i.e. 200 amps, 18.0 volts) are converted to a proportional analog value by referencing the Welder Condition File. The Welder Condition File is a table of 8 settings that allows the robot to be scaled to different wire types and power supplies. In the case of the Auto-Axcess, the Welder Condition File is scaled to be 0-999 ipm wire feed speed (instead of amperage) and 0-50.0 volts.

When the Miller Auto-Axcess DI is in a pulse mode, then the voltage value is 3/4 of the arc adjust setting (i.e. arc voltage setting of 22.5 provides an arc adjust setting of 45 on the welder). The arc adjust setting on the Miller Auto-Axcess DI has a setting of 0-100 with a nominal setting of 50. The welder is synergic which means an arc adjust value of 50 will provide good welding conditions through the whole range of wire feed settings. Users may want to reduce the arc adjust setting to get a shorter arc length to suit a given application.

The Miller Auto-Axcess DI has 8 program locations for different process settings. The process can be changed between welds or even during welding by setting I/O commands in the robot program to select a different program. There are 3 outputs from the robot to the welder for selecting schedules. These outputs should be labeled in the output display and programming instructions are provided in this manual.

The Miller Auto-Axcess DI functions in exactly the same manor, but signals are addressed to a DeviceNet board inside the NX100. The settings in the Welder Condition file are still necessary to convert the INFORM settings to a 16 bit Mregister in the CIO. AutoCal is not necessary (and is not available) on the Miller Auto-Axcess DI because the digital data is communicated as exact numbers.

WARNING!
Do not exchange Welder Condition Files (WELDER.DAT) or concurrent I/O programs (CIO.LST) between robots that have analog and digital interfaces. These files are different and will cause improper operation. Arc Start Files and Arc End Files can be transferred between robots regardless of digital or analog interface.

4.1 Miller HMI

The key feature of the Miller Auto-Axcess DI is the ability to perform set-up functions from the NX100 pendant. This is performed with a Motoman pendant application called the Miller HMI. When this button is pushed on the pendant, it starts an application which takes over the pendant display. This application provides much of the functionality of the Miller File Manager software used with a Palm PDA. The Miller Auto-Axcess DI retains the User Interface display. This allows users to change processes from the welder or confirm weld settings on the LED meter display.

Most of the pendant application is used for set-up functions. Most of the functionality is only available in TEACH mode to ensure signals are not passed while the power source is welding. There is Management password protection to allow administrators to determine if they want to allow operators access to change program information in the power source. They can initiate edit lock on the welder to keep operators from being able to make program changes from the welders.

Note: The pendant application allows users to set functions for start power and crater fill in the power source. Motoman recommends that these functions be set in arc start files or enhanced arc start files. The settings in the welder are not synchronized with robot motion and adverse welding conditions could be created.

The Miller Auto-Axcess DI functions as a Master on the DeviceNet network. The robot is a slave and other devices should not be connected to this network, unless they are for monitoring purposes. The digital interface utilizes a total of 9 bytes and would have been addressed by Motoman for your exact cell configuration. Users should make back up copies of their I/O settings including the concurrent I/O (CIO.LST). The pendant HMI application also allows the settings made on the HMI to be saved

to flash memory. This backup is only saving the selections made from the pendant and is not saving the welders memory. It is recommended that Users invest in the File Manager software from Miller to support maintenance functions (this is true whether Digital or Analog versions are in use).

With the Miller Auto-Axcess DI, Motoman is able to log error messages from the welder. These can be viewed on the message display when the alarm occurs. The error messages are logged in the robot's alarm history in the User Alarm section. The alarm is saved with date, time, job name, and step number when the alarm occurred.

4.2 Pulse Mode

Pulse Mode behaves identically to non-pulsed (MIG) mode except that spray current, (low/no-spatter) can be achieved for virtually the entire range of wire feed speeds. Spray transfer is accomplished by elevating the current above that required for globular transfer, holding the current while a droplet(s) is formed and detached from the electrode, and then dropping the current to a low background level. The amount of time at this background level is often based (inversely proportional) on the wire feed speed - higher wire feed speeds require more droplets per second and so shorter background times (higher frequencies) are often used. Pulse mode is recommended for welding conditions (wire feed speeds) wherein globular transfer would be achieved in non-pulsed mode. Pulse mode is typically used for all wire feeds speeds for aluminium GMA welding.

NOTES

Chapter 5
Operation

5.1 Set-Up Overview

This chapter covers set-up information that is unique to the NX100/Miller Auto-Axcess DI system. It covers:

- Setting the Welder Condition File
- Arc Start Files and Arc End Files
- Verifying the welder calibration
- Selecting weld programs

5.1.1 Welder Condition File

The Welder Condition file is set as follows (this has been preset by Motoman):

POWER SUPPLY: A / V

	<CURRENT OUTPUT CHARS.>		<WELDING VOLTAGE OUTPUT>	
RANGE	+		+	
ADJUST	1.00		1.00	
NO.	**REF. (V)**	**MEASURE (A)**	**REF. (V)**	**MEASURE (V)**
01	0.52	40	0.26	1.0
02	1.16	90	1.30	5.0
03	2.57	200	2.60	10.1
04	3.85	300	3.86	15.0
05	5.12	399	5.14	20.0
06	6.39	498	6.45	25.1
07	8.71	679	7.70	30.0
08	12.81	999	11.29	44.0

Note: Although the robot teach pendant displays "A", "AC" or "amps" in Arc Start Files, ARCON commands, etc., when using the above calibration data, the values used are in units of INCHES/MIN., NOT AMPERAGE, and correspond to the actual WIRE FEED SPEED of the wire feeder.

Note: The Digital Interface uses direct settings, no special procedures like AutoCal are required.

5.1.2 Arc Start Files

VOLTAGE: In the welding modes that require an Arc Length value (Pulse, Accupulse, . . .) the Voltage parameter is set to 1/2 the required setting. That is:

Arc Length = 2 X Voltage Setting

Example:
Arc Length value required is 50
In the Arc Start File (ASF) and/or Arc End File (AEF) set Voltage to 25.0

Example:
Arc Length value required is 47
In the Arc Start File (ASF) and/or Arc End File (AEF) set Voltage to 23.5

In MIG mode, the voltage value is the actual reference value desired.

Example:
Voltage required is 21.8 volts
In the Arc Start File (ASF) and/or Arc End File (AEF) set Voltage to 21.8

CURRENT: The Current setting is actually Wire Feed Speed in inches per minute. A setting of 300 will give 300 ipm of wire.

BURN BACK: The Miller Auto-Axcess DI has a Sharp Start routine to reduce wire ball size. Do not set high voltage or low wire feed speed setting in the Arc End files, this can create adverse results.

RETRY: If RETRY is used (ON), set the Voltage and Current in the Arc Auxiliary Condition File to the same values as in the Arc Start Files.

5.1.3 Arc End Files

CURRENT and VOLTAGE: Arc End Files are used if a crater fill is required at the end of the weld sequence. If no crater fill is required, a simple ARCOF command can be used. If it is desired to use the Arc End files, but no crater fill is needed, set the CURRENT and VOLTAGE to the same values as used in the corresponding Arc Start File, and set the ROBOT PAUSE TIME to 0.0 sec.

BURN BACK: The Miller Auto-Axcess DI has a Sharp Start routine to reduce wire ball size. Do not set high voltage or low wire feed speed settings in the Arc End files, this can create adverse results.

ANTI-STICK: The Miller Auto-Axcess DI has a built-in anti-stick feature, so in general this function is not needed and should be set to OFF.

5.1.4 Calibration Verification

Note: The Digital Interface uses direct settings and no special procedures like AutoCal are required.

To verify power supply calibration:

1. Insert an ARCSET command into a job.
2. Select the ARCSET command from the instruction side of the job line.
3. Press [SELECT]. The ARCSET command appears on the input buffer line.
4. Press [SELECT]. The Detail Edit screen appears.
5. Cursor to CURRENT and press [SELECT] or [AC=]. Referring to the calibration test examples, enter sample data using the number keypad (examples: AC=100; AC=300). Press [ENTER].
6. Cursor to VOLTAGE and press [SELECT] or [AV=]. Referring to the calibration test examples, enter sample data using the number keypad (examples: AV=15; AV=25). Press [ENTER] twice.
7. Execute the command by holding down the INT LOCK key and pressing FWD. Each time a value is executed, look at the display on the power supply and verify the requested value matches the set value. To change the display on the power supply, press the WFS/A button on the Miller Auto-Axcess DI until the Wire Feed Speed LED lights.

Calibration Test Examples:

	Required Setting	AC=WFS	Required Setting	AV=Voltage
MIG Mode	100 ipm	100	20 volts	20.0
	350 ipm	350	25 volts	25.0
	700 ipm	700	35 volts	35.0
	Required Setting	AC=WFS	Required Setting	AV=Arc Length
PULSE/ACCU-PULSE	100 ipm	100	40%	20.0
	350 ipm	350	50%	25.0
	700 ipm	700	70%	35.0

Note: To determine the value for Arc Length in Pulse, Accupulse or RMD mode, the power supply doubles the requested voltage value and converts it to a percentage value.

5.1.5 Selecting Weld Programs

Eight separate weld programs can be defined for the Miller Auto-Axcess DI. Each program can be configured for weld mode (MIG, Pulse, AccuPulse, Accu-Speed, Accu-Curve, RMD), wire type (Steel, Aluminium, etc.), diameter, and shield gas type. The programs can be selected by the robot using three outputs, as shown in Section 5.2.1. These outputs are assigned by Motoman, and cannot be changed. Check the Motoman system prints to verify which outputs are used, since they can vary depending on the controller configuration.

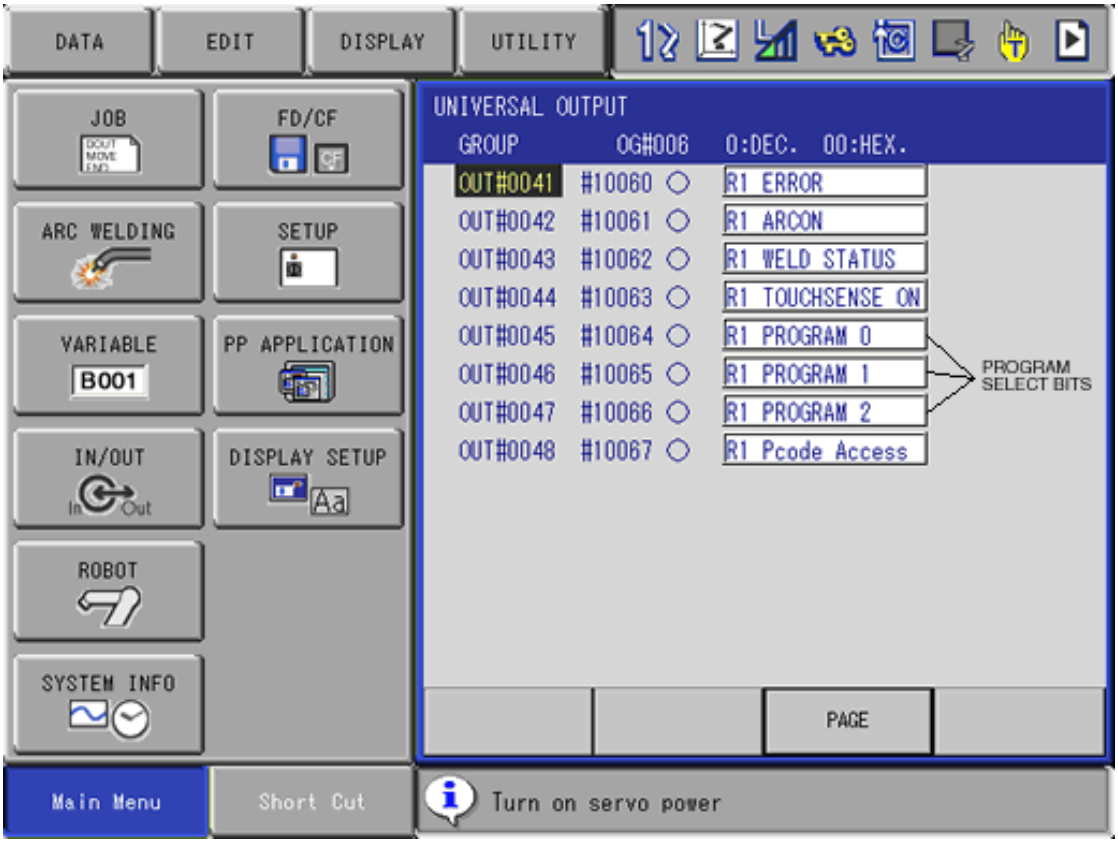


Figure 13 Universal Output Screen

The output status can be viewed by pressing the IN/OUT buttons then selecting Universal Outputs (Figure 13). The page key will index between different groups (8 bits). In this example, the Miller schedule select bits are labeled:

- OUT#0045 #10064 R1 PROGRAM 0
- OUT#0046 #10065 R1 PROGRAM 1
- OUT#0047 #10066 R1 PROGRAM 2

The table below shows the values necessary to select weld programs 1-8 using Universal Outputs 45, 46 and 47, which are OGH#(12). The outputs may change depending on the system configuration.

Auto Axcess Program#	Universal Outputs			
	OGH#(12)	OUT#0045	OUT#0046	OUT#0047
1	0	Off	Off	Off
2	1	On	Off	Off
3	2	Off	On	Off
4	3	On	On	Off
5	4	Off	Off	On
6	5	On	Off	On
7	6	Off	On	On
8	7	On	On	On

5.2 Robot Job Programming

5.2.1 Weld Program Selection

The robot selects one of the eight weld programs by setting three outputs. Typically a binary value (0-7), referenced by a DOUT instruction, is programmed into the robot job. This binary value of 0-7 corresponds to programs 1-8 in the Miller Auto-Axcess DI.

In this example, the schedule select bits have been connected to Universal Outputs 45, 46, and 47. These three bits comprise the first three bits of Output Group Half (OGH) #12.

Sample Robot Job:

```
0000   NOP
0001   MOVJ VJ=33.0           (Welding start position)
0002   DOUT OGH#(12)5         (Selection of Schedule #6)
0003   ARCON AC=285 AV=22.0   (ArcOn request)
0004   MOVL
0005   ARCOF
0006   MOVJ VJ=33.0
```

The above job selects Program #6 with the DOUT instruction. It also sets wire feed speed to 285 in./min and sets either voltage to 22.0V (MIG mode) or trim to 44% (Pulse or AccuPulse) depending on the mode selected in Program #6.

5.3 Welder Front Panel Display

When the welder is powered on, "MOTO" will appear on the welder display. During normal operation, the welder display shows the following:

- Power Supply Idle (not welding): Displays the set Wire Feed Speed and Voltage or Arc Length values.
- Power Supply Welding: Displays the actual average Amperage (or the wire feed speed) and actual average Voltage.
- Immediately after Welding: Displays the actual average Amperage and actual average Voltage for five seconds.

5.4 Troubleshooting

The Miller Auto-Axcess DI generates many error messages that are displayed on its front panel (see the *Miller Auto-Axcess DI Manual* for a complete list). Some of the more common errors are displayed and logged as User Alarms on the NX100 programming pendant. The less common errors are logged on the pendant as an Unknown Error, and the Miller Auto-Axcess DI must be checked to determine the exact error. For other service related problems, call Motoman Customer Service (937) 847-3200.

The following is a list of User Alarms and messages displayed for welder #1 on the programming pendant. These messages will repeat for welders #2, #3, #4.

User Alarm	Message Displayed	Auto-Axcess Display	Troubleshooting
9122 WELDER 1: ARC FAILED TO START	TOGGLE GAS TO CLEAR WELDER 1 ERR	ERR STRT	Arc did not start. Check/replace the tip and torch liner. Check the wire supply. Look for restrictions in the wire feeding system.
9123 WELDER 1: ROBOT COMMUNICATION	TOGGLE GAS TO CLEAR WELDER 1 ERR	ROBT COMM	1. Welder was turned on before the NX100 controller. Toggle gas to clear error. 2. If this message only displays on the welder, check the Devicenet connection between the power source and the controller.
9124 WELDER 1: E-STOP		E STOP	Check the E-Stop connection on the Miller Auto-Axcess DI. It must be cleared before the unit will operate.
9125 WELDER 1: TACH ERROR	TOGGLE GAS TO CLEAR WELDER 1 ERR	ERR TACH	The welder did not receive a tach signal from the wire feeder. Check the cable and connection between the wire feeder and welder.
9126 WELDER 1: UNKNOWN ERROR		Varies, depending on error	See the *Miller Auto-Axcess DI Manual.*

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S *(continued)*

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