USER'S MANUAL **990-057**
Revision M **June 2012**

MODEL HF2
2 kHz HIGH FREQUENCY
INVERTER WELDING CONTROL

MODEL NUMBER	STOCK NUMBER
HF2/230	**1-264-03**
HF2/380	**1-264-03-01**
HF2/460	**1-264-03-02**
HF2/208	**1-264-03-03**
HF2S/230	**1-265-03**
HF2S/380	**1-265-03-01**
HF2S/460	**1-265-03-02**
HF2S/208	**1-265-03-03**

Units with the built-in Weld Sentry Option
Also require User's Manual No. 990-291

REVISION RECORD

Revision	EO	Date	Basis of Revision
A	ENRG-RLSE	3/95	Released original manual.
B	None	9/95	Reorganize manual into chapters.
C	None	1/96	Amend to Firmware V1.17 or higher.
D	None	2/96	Update cover stock numbers
E	None	4/97	Amend to Firmware V1.19 or higher.
F	17472	6/98	1. Remove existing calibration procedure and reference User Calibration Procedure 994-001. 2. Miscellaneous corrections. 3. Remove SAVE error.
G	18951	8/01	1. Include EO# 17693 in manual. 2. Add latest version of Operator Guide.
H	19012	9/01	1. Include EO# 118951 in manual. 2. Add latest version of Operator Guide.
J	19146	1/02	1. Include EO# 19012. 2. Miscellaneous Corrections. 3. Add Appendix F, Quality Resistance Welding Solutions, and Appendix G, Replacement of Programmed Integrated Circuits.
K	20016	5/04	Updated wire data.
L	N/A	N/A	N/A
M	42009	6/12	Updated to Miyachi Unitek format and updated RS-485 connection information.

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CONTACT US

Thank you for purchasing a Miyachi Unitek™ Model HF2 2kHz High Frequency Inverter Welding Control.

Upon receipt of your equipment, please thoroughly inspect it for shipping damage prior to its installation. Should there be any damage, please immediately contact the shipping company to file a claim, and notify Miyachi Unitek at:

1820 South Myrtle Avenue
P.O. Box 5033
Monrovia, CA 91017-7133

Telephone: **(626) 303-5676**

FAX: **(626) 358-8048**

e-mail: **info@unitekmiyachi.com**

The purpose of this manual is to provide the information required for proper and safe operation and maintenance of the Miyachi Unitek™ HF2 2kHz High Frequency Inverter Welding Control.

We have made every effort to ensure that information in this manual is both accurate and adequate. If you have any questions or suggestions to improve this manual, please contact us at the phone number or addresses above.

Miyachi Unitek Corporation is not responsible for any loss or injury due to improper use of this product.

NOTICE

Miyachi Unitek Corporation may be released from all warranty obligations if repairs or modifications are made by persons other than its own service personnel, or authorized representatives' personnel, unless such repairs or modifications are specifically authorized in writing by the Miyachi Unitek Corporation.

SAFETY NOTES

General

This instruction manual describes the operation and maintenance of the Control and provides instructions relating to its safe use. Procedures described in this manual ***must*** be performed as detailed by ***Qualified*** and ***Trained*** personnel.

For ***Safety***, and to effectively take advantage of the full capabilities of the Control, please read this instruction thoroughly ***before*** attempting to use it.

After reading this manual, retain it for future reference when any questions arise regarding the proper and ***safe*** operation of the Control.

Operation

Procedures other than those described in this manual or not performed as prescribed in this manual, may expose personnel to ***electrical shock*** or ***DEATH***.

When operating any welder, ***always*** wear appropriate personal protective gear.

Maintenance/Service

Use the appropriate tools for terminating the connecting cables, being careful not to nick the wire conductors.

Do ***not*** modify the Control without prior written approval from Unitek Miyachi.

DANGER

DEATH ON CONTACT may result if personnel fail to observe the safety precautions labeled on the equipment and noted in this manual.

Contact with high voltages present in this Control may cause serious or fatal injuries. Please read the manual completely and note all cautions and warnings before attempting to install, operate or maintain the Control.

WARNING

Always wear safety glasses when welding to avoid eye injuries.

SAFETY PRECAUTIONS

- These precautions are given for safe use of the Control and for prevention of injury to operators or others.
- Be sure to read each of the instructions, as they are all important for safe operation.
- The meanings of the words and symbols are as follows:

⚠ CAUTION

Denotes operations and practices that may result in personal injury or damage to the equipment if not correctly followed.

⚠ WARNING

Denotes operations and practices that may result in serious injury or loss of life if not correctly followed.

⚠ DANGER

Denotes operations and practices that may imminently result in serious injury or loss of life if not correctly followed.

These symbols denote **PROHIBITION**. They are warnings about actions that should ***not*** be performed because they can damage the equipment and will void the warranty.

These symbols denote actions which operators ***must*** take.

Each symbol with a triangle denotes that the contents gives notice of **DANGER**, **WARNING**, or **CAUTION** to the operator.

⚠ DANGER

DO NOT TOUCH THE INSIDE OF THE CONTROL UNNECESSARILY.

High Voltages are present inside the Control Cabinet. Do ***not*** touch the inside of the Control unnecessarily wit the power turned ON. You may receive an electric shock. When inspecting the inside of the Control, be sure to turn the power source OFF and push and hold the **DISCHARGE** switch until the **CHARGE** light goes OFF.

NEVER DISASSEMBLE, REPAIR, OR MODIFY THE CONTROL.

These actions can cause electric shock and fire. Do ***not*** do anything other than the maintenance described in the Operator Manual.

WARNING

Do NOT put your hands or fingers between the electrodes.
When welding, keep your hands and fingers away from the electrodes.

Do NOT touch any welded part or electrode during, or just after welding.
The welded parts and electrodes are very ***hot***. If you touch them you will be burned.

Ground the equipment.
If the equipment is not grounded, you may get an electric shock.

Use a ground fault breaker.
Use a ground fault breaker to prevent an electric shock.

Only use specified cables.
A cable with insufficient capacity or loose connections can cause electric shock or fire.

Do NOT use a damaged power cable, connecting cables, or plugs.
Do ***not*** step on, twist, or tense any cable. The power cable and connecting cables may be damaged which can cause electric shock, short circuit, or fire. If any part needs to be repaired or replaced, consult Unitek Miyachi or your distributor.

Stop operation if any trouble occurs.
If you detect a burning smell, abnormal sounds, abnormal heat, smoke, etc., turn power OFF immediately to prevent fire or electric shock. Contact Unitek Miyachi or your distributor for help.

People with pacemakers MUST stay away from the Control.
When the Control is operating, it generates a magnetic field, which adversely affects pacemakers. People who use a pacemaker must ***not*** approach the Control, or walk around the welding shop while the Control is operating, ***unless*** their medical doctor has deemed it safe to do so.

Wear protective gear.
Put on protective gear such as protective gloves, long sleeved jacket, and leather apron to avoid being burned.

CAUTION

Apply the specified source voltage.

Applying the ***wrong*** voltage can cause fire and electrical shock.

Keep water and water containers away from the Control.

Water spilled on the Control can cause a short circuit, electrical shock, or fire.

Use proper tools (wire strippers, pressure wire connectors, etc.) for terminations of the connecting cables.

Do ***not*** nick the wire conductor. Doing so can cause a short circuit, electric shock, or fire.

Install the Control on a firm, level surface.

Injury may result if the Control falls over or drops from an uneven surface.

Keep combustible matter away from the Control.

Spatter can ignite combustible materials. If you cannot remove all combustible materials, cover them with a non-combustible material.

Do NOT cover the Control with a blanket, cloth, etc.

Heat generated by the operating Control may ignite a blanket or cover.

Wear ear protectors.

Loud noises can damage hearing.

Keep a fire extinguisher nearby.

Make sure there is a fire extinguisher in or near the welding shop in case of fire.

Regularly inspect and maintain the Control.

Regular inspection and maintenance is essential to safe operation and long life of the equipment. If you see any damage, make necessary repairs before operation.

UNITEK MIYACHI CORPORATION

Declaration of Conformity

Directive(s)	EMC, LOW VOLTAGE, MACHINERY
Type of Equipment:	Resistance Welding Power Supply Equipment
Applied Standards:	EN-50081-2,EN50082-1,EN55011,IEC 801-2,IEC 801-3,IEC 801-4 EN 60204-1,EN50063
Model Nos.:	HF2/230,HF2S/230,HF2/380,HF2S/380,HF2/208,HF2S/208, HF2/460,HF2S/460, X11/4000A, X11/4/460, X3/4/380, X3/4000A,X5/3000A,X3/4/460A

Authorized Representative
Within European Community:

Weld Equip Sales BV
Engelseweg 217
Postbus 164
5700 AD Helmond HOLLAND

Manufacturer's Name and Address:

UNITEK MIYACHI CORPORATION
1820 South Myrtle Avenue
Monrovia, CA 91017 U.S.A.

Based on the Declaration of Conformity Certificates issued by the test laboratories, I declare that the equipment specified above conforms to the listed directive and standards.

Place: Monrovia, CA

Date: December 16, 1996

Robert J. Wallish
Signature

Mark G. Rodighiero
Signature

Robert J. Wallish
Full Name

Mark G. Rodighiero
Full Name

Director of Quality Assurance
Title

Vice President, Engineering
Title

CHAPTER 1
DESCRIPTION

The **Miyachi Unitek HF2 High Frequency Inverter Welding Control** is a 2 KHz, three-phase, state-of-the-art inverter welding control. For the rest of this manual the HF2 High Frequency Inverter Welding Control will simply be called ***the Control***. For the rest of this manual the HF2 Transformer will simply be called ***the Transformer***.

The Control is designed for joining precision small parts at high speed with controllable rise times using 2 KHz output pulses superimposed on pure DC welding energy. High speed (250 micro-second) digital feedback automatically controls weld current, voltage, or power, providing more welding consistency compared to traditional direct energy (AC) or stored energy (CD) technologies. Microprocessor technology automatically compensates for changes in workpiece resistance, load inductance, weld transformer saturation, and ñ 13% changes in line voltage. The Control uses IGBT power device technology for precisely controlling the weld energy at both high and low energy levels.

Easy to use constant weld current, voltage or power feedback ensures repeatable welding and has proven to extend electrode life in many applications by a factor of five or more. A selectable weld energy limiting feature also contributes to repeatable welds and high nugget quality. The user can program the Control using a graphical or numerical interface. The Weld Graph Program Mode (Figure 1-1) emulates many of the popular word processing programs by using the front panel cursor keys to easily modify any time period, current, voltage, or power value. The Weld Graph Run Mode (Figure 1-2) gives the user instant visual feedback on the actual current, voltage or power used to make each weld.

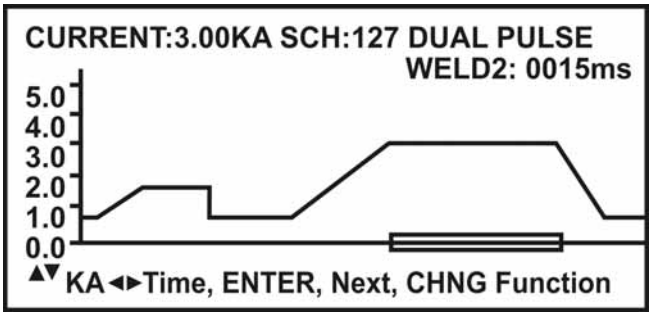


Figure 1-1. Program Mode

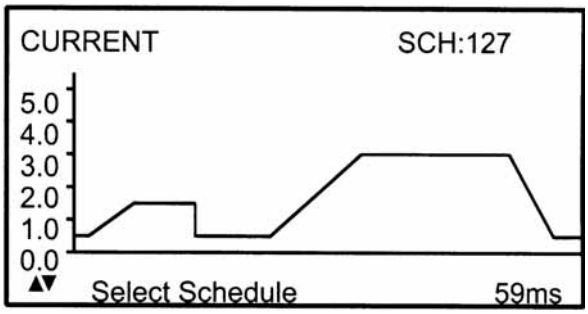


Figure 1-2. Actual Weld Current

The Control's exclusive, context sensitive, User Help Screens quickly guide the user through even the most complex program. Each weld schedule can use any one of 10 different Weld Functions, thus matching the appropriate weld energy profile to the application.

Simple automated welding control is easily accomplished using the BCD Remote Schedule Select feature. For more complex automation processes, a host computer can use the Control Bi-Directional RS422/RS485 Communications Port to select Control Weld Schedules and receive average weld current and weld voltage data for each weld. Refer to the separate RS-485 Datacom Manual, P/N: 990-058, for Advanced RS-485 Datacom operation. The 2 KHz operating frequency ensures that the Control Weld Transformers are light weight and compact, providing a significant advantage when they are built into robotics or automatic machines.

CHAPTER 2
GENERAL SET-UP

REQUIRED CONNECTIONS

Physical Space Requirements

Miyachi Unitek recommends that the Control and Transformer be installed in a well ventilated area that is free from excessive dust, acids, corrosive gases, salt and moisture. Allow sufficient clearance around both sides and back of the Control and Transformer so that cooling air may flow properly. Figure 2-1 shows the cooling airflow pattern for the Control. Figure 2-2 shows the cooling airflow pattern for the Transformer.

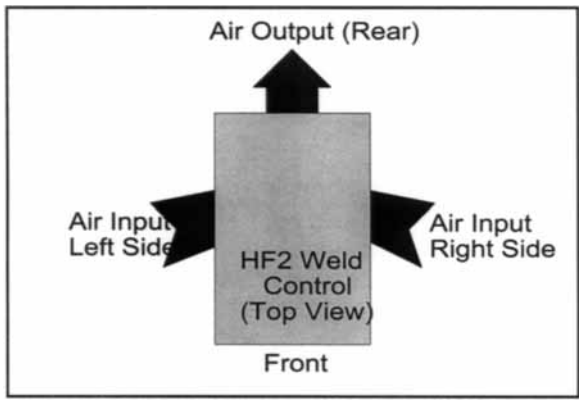


Figure 2-1. Control Air Flow Pattern

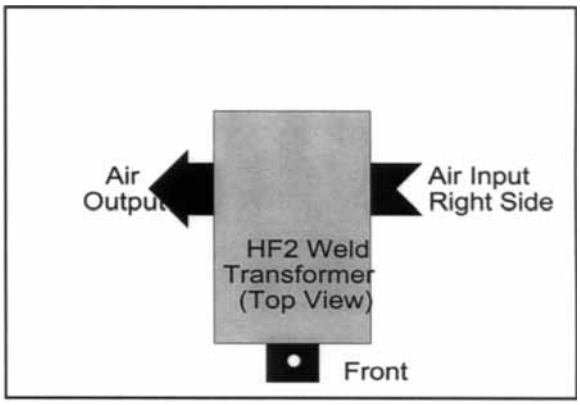


Figure 2-2. Transformer Air Flow Pattern

Control Dimensions

Width (in/cm)	Height (in/cm)	Depth (in/cm)	Weight (lbs/Kg)
10.5 / 26.7	8.5 / 21.5	15.0 / 38.1	42 / 19

HF2 Weld Transformer Dimensions

Model	Height (in/cm)	Width (in/cm)	Depth (in/cm)	Weight (lbs/Kg)
X2/2000A	7.0 / 17.6	5.4 / 13.8	11.0 / 28.0	14.3 / 6.5
X3/4000A	7.2 / 18.3	7.2 / 18.3	13.4 / 34.0	28.6 / 13
X5/3000A	7.5 / 18.9	7.2 / 18.3	14.2 / 36.0	31 / 14
X11/4000A	7.5 / 18.9	7.2 / 18.3	17.9 / 45.5	46 / 21
X11/4/460A	7.4 / 18.8	7.2 / 18.3	18.9 / 48.5	55 / 25
X3/4/380A	7.2 / 18.3	7.2 / 18.3	13.4 / 34.0	28.6 / 13
X3/4/460A	7.2 / 18.3	7.2 / 18.3	13.4 / 34.0	28.6 / 13

Power Line Voltage, Current, and Wire Size Requirements

WARNING: The Control and Transformer are assembled at the factory for operation at a specific input power line voltage. Serious damage can result if these units are used on different voltage other than the voltage for which they are wired. The Transformer input voltage must match the Control power line voltage.

Use the following table to select the correct power line circuit breaker and wire gauge size. To minimize peak power losses, use single unbroken wire lines. Note: To minimize peak power losses, Miyachi Unitek recommended wire gauge sizes exceed the USA National Electrical Code recommendations.

3-Phase Service Voltage (RMS)	3-Phase Service Breaker Current (RMS)	Copper Wire Gauge Size (AWG)
208V to 230V	50A	AWG 8 @ 133 strands
380V to 460V	30A	AWG 10 @ 105 strands

Insulation Requirement

Oil-resistant synthetic rubber rated at 90°C and 600V.

Power Line Fuse Requirements

Service Voltage	Fuse Size: F1, F2	Miyachi Unitek P/N
208, 230, 380	3AG, 440 V, 2 A	330-071
460	3AG, 500 V, 2 A	330-100

HF2 Weld Transformer Electrical Specifications

Model	Input Volts (Rms)	Input kva (Rms)	Duty Cycle (%)	Peak Open Ckt Output Voltage	Peak Output Max. (Amps)	Max Sec Resist. (μΩ)
X3/4/380A	380	9	6	6.5	4,000	500
X3/4/460A	460	9	6	6.5	4,000	500
X3/4000A	230	9	6	6.5	4,000	500
X9/6000A	230	19	6	9.3 (32:1 TR)	4,900	500
X11/4/460A	380	4	5	11.8 (44:1 TR) 10.0 (52:1 TR) 8.6 (60:1 TR) 7.5 (68:1 TR)	4,000 4,000 4,000 4,000	1,300 1,100 950 825
	460	4	5	14.3 (44:1 TR) 12.1 (52:1 TR) 10.5 (60:1 TR) 9.2 (68:1 TR)	4,000 4,000 4,000 4,000	1,300 1,100 950 825
X11/4000A	230	15	5	10.7 10.0 (52:1 TR) 8.6 (60:1 TR) 8.7 8.8 8.9	4,000 4,000 4,000	1,300 1,100

TRANSFORMER SPECIFICATION NOTES:

1 For the Model X11/4/460A, turns ratios (TR) are selectable by a switch on the transformer rear panel.

2 Control Input voltage selection must be jumpered at E12 on the HF2 Weld PCB as shown in Figure 2-3. E12 is located at the center of the PCB left edge.

3 Maximum weld time at Maximum Short Circuit Current is 50 milliseconds.

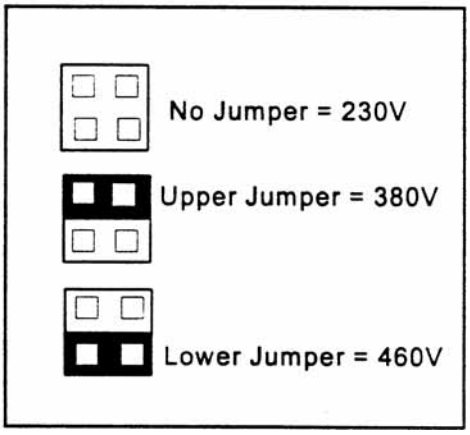


Figure 2-3. Voltage Jumpers

HF2 Welding System Maximum Secondary Loop Resistance

To use the Control and HF2 Weld Transformer system to its maximum capability, the Maximum Secondary Loop Resistance must ***not*** exceed the values listed in the preceding table. Exceeding these maximums will produce a **FEEDBACK RANGE EXCEEDED** alarm.

HF2 Maximum Secondary Loop Resistance Measurement (Figure 2-4)

1 Connect a four terminal micro-ohmmeter as shown in Figure 2-4.

2 Put the parts to be welded between the electrodes.

3 Measure the total loop resistance which includes both Weld Cables, Weld Head, Electrodes, and parts.

4 If the total loop resistance exceeds the table value, use:

A) Larger diameter Weld Cables

B) Shorter length Weld Cables, or

C) Copper Bus Bars to connect the HF2 Weld Transformer to the Weld Head. If these suggestions do not work, then a different Weld Transformer Model may be required.

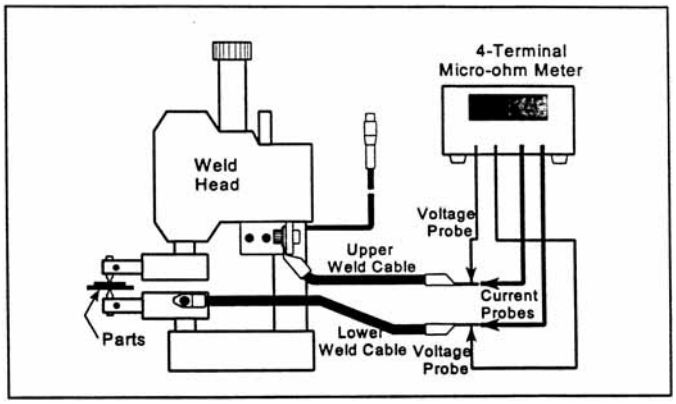


Figure 2-4. Secondary Resistance Measurement

CAUTION: For product safety, the system power cable and all inter-unit cabling should be as short as possible, and be dressed so that all cables stay separated.

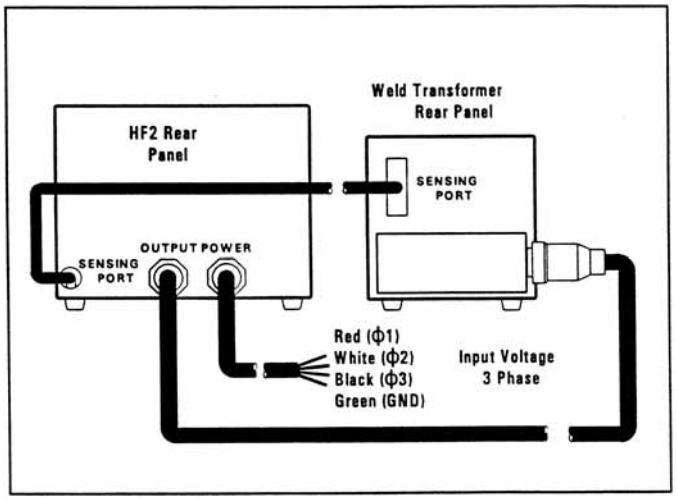
Control to Transformer Connections (Figure 2-5)

The Control must always be connected to the Transformer as shown in Figure 2-5, regardless of what Weld Head System is used.

1 Connect the Control **POWER** Cable to the line voltage source as specified in *Chapter 2, Power Line Voltage, Current, and Wire Size Requirements.*

2 Connect the Control **OUTPUT** Cable to the matching connector on the Transformer.

3 Connect the Control **SENSING PORT** Cable to the matching connector on the Transformer.



Weld Transformer to Weld Head Connections (Figure 2-6)

1 Connect the Upper Weld Cable to the Positive Terminal on the Transformer.

2 Connect the Lower Weld Cable to the Negative Terminal on the Transformer.

3 Attach the Voltage Sensing Cable connector to the Transformer **INPUT** connector.

4 Attach each lead at the opposite end of the Voltage Sensing Cable to each Electrode Holder.

NOTE: Polarity is ***not*** important.

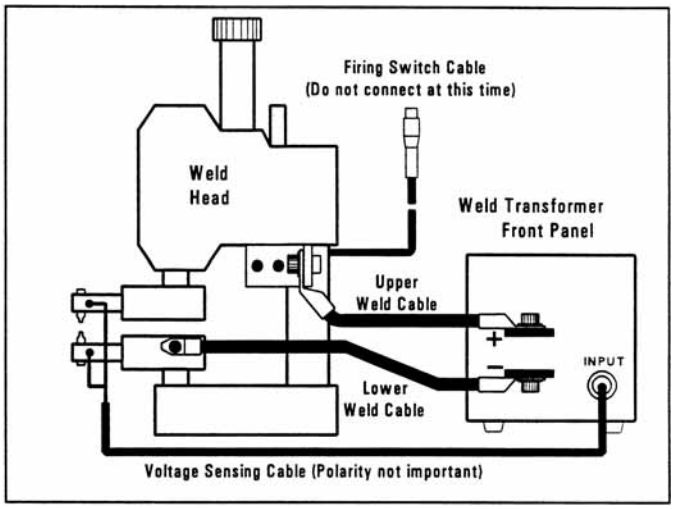


Figure 2-6. Transformer to Weld Head Connections

5 Strain relief each Voltage Sensing lead to its corresponding Electrode Holder so that the lead will not break or move under heavy production operating conditions.

6 Do ***not*** attach the Firing Switch Cable at this time. This procedure is covered in *Chapter 3*.

Weld Sentry Option

A small tag displaying the message **WELD SENTRY INSTALLED** will be attached to the front panel of the Control if the optional Weld Sentry Module has been installed. Refer to the separate Weld Sentry User's Manual, 990-291 for Weld Sentry operation.

The Built-in Weld Sentry Module can be added to the Control after purchase by ordering the HF2 Weld Sentry Module, P/N 3-130-01-01.

Help Screen Languages

Integrated circuit chip **U2** on the Main printed circuit board varies in memory capacity according to the help screen languages available. Refer to *Appendix F* for special jumpering instructions for the installation of IC chip **U2**.

CHAPTER 3
WELDING SYSTEM SET-UP

Welding System Set-Up Guide

To complete the welding system installation, select the welding system that best matches your Weld Head configuration using the Welding System Set-Up Guide listed below:

General Programming Instructions

The following nomenclature and symbols will be used for programming the Control:

Use the vertical cursor keys ▲▼in conjunction with the horizontal cursor keys ◄► to select or highlight a requested Menu Option, followed by the **ENTER** key.

Words shown in *UPPER CASE ITALIC* letters indicate flashing Menu Options on the Control LCD Display.

Miyachi Unitek Equipment Force Fired, Foot Actuated Weld Head System

Weld Head Set-up

1 Adjust the Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

2 Install electrodes in Weld Head Electrode Holders.

Firing Switch Cable Connection

Connect the Weld Head Firing Switch Cable Connector to the matching cable connector on the rear of the Control.

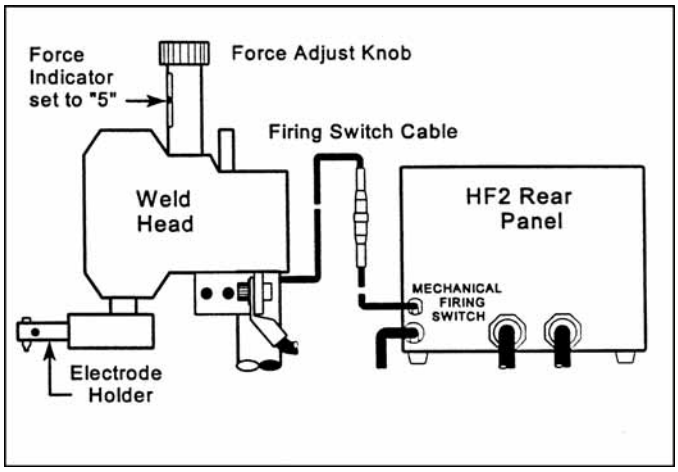


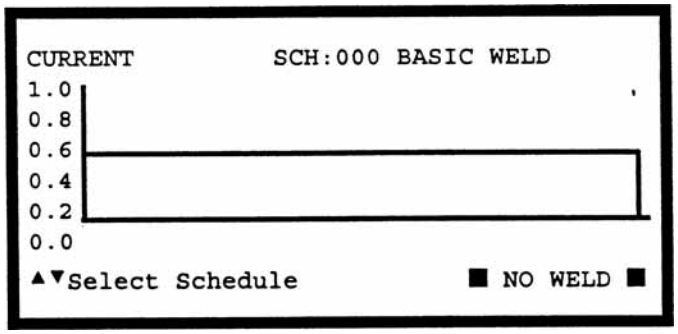
Figure 3-1. Firing Switch Cable Connection

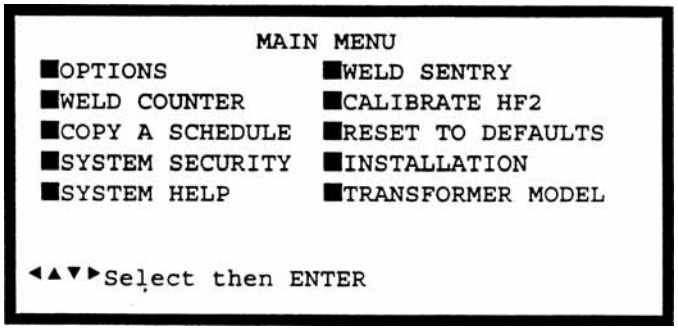
Quick Start Programming Guide

1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the circuit breaker switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph RUN screen for the **BASIC WELD Function.**

3 Press **MENU**. The **MAIN MENU** screen will appear.

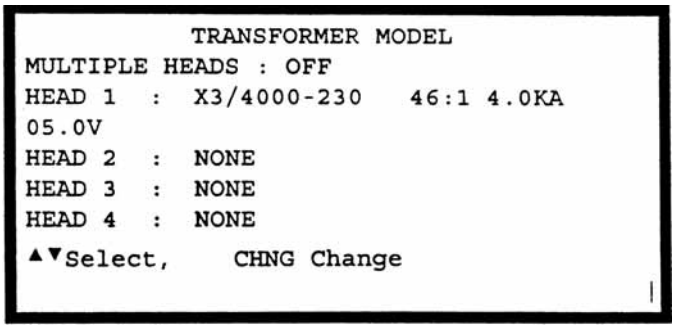




4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

5 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, then press **CHNG** until **OFF** is displayed.

6 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.



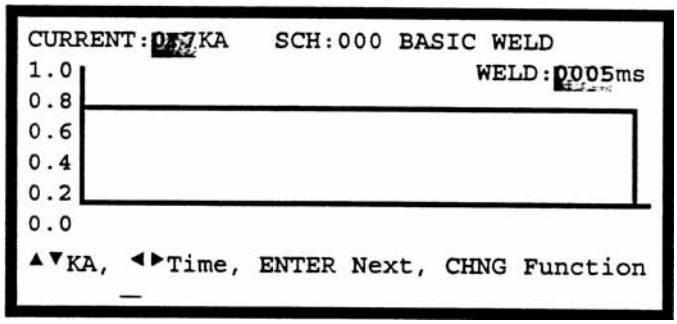
7 Press **RUN** to return to the Graphical **RUN** screen.

7 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

8 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 kA may not be sufficient to make a good weld.

9 Press **PROG**. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time.

In this example, weld CURRENT has been increased to 0.7 kA and WELD time has been increased to 5ms.



10 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

11 Make additional test welds and then reprogram WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

12 Up to 128 different weld schedules can be created and saved. To recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

Miyachi Unitek Equipment Force Fired, Single Air Actuated Weld Head System

Weld Head Set-up (Figure 3-2)

1 Adjust the Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

2 Install electrodes in Weld Head Electrode Holders.

3 Connect a properly filtered air line to the Inlet Air Line on the Weld Head Air Valve Driver Solenoid assembly which is located on the back of the Weld Head. Use 0.25 inch O.D. by 0.17 inch I.D. plastic hose with a rated burst pressure of 250 psi. A lubricator should only be used with automated installations. Turn on the air system and check for leaks.

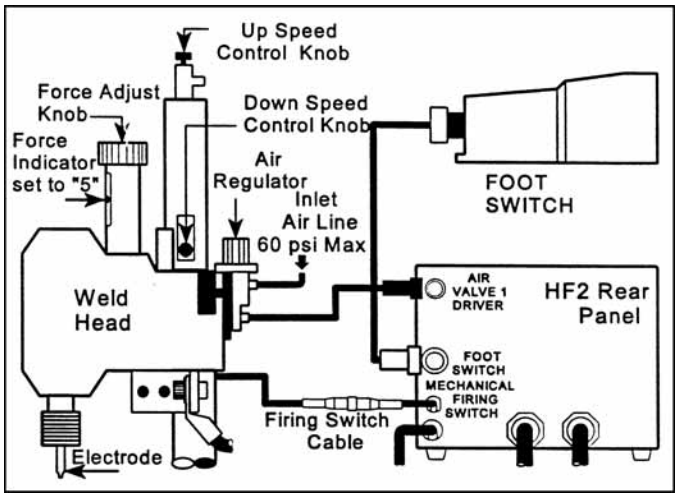


Figure 3-2. Single Air Actuated Weld Head Connections

Firing Switch Cable Connection (Figure 3-2)

Connect the Weld Head Firing Switch Cable Connector to the matching cable connector on the rear of the Control.

Weld Head Valve Driver No. 1 Connection (Figure 3-2)

A single air actuated Weld Head has one Solenoid Valve Driver Cable for automatic actuation and timing control by the Control. The Control will automatically recognize the solenoid voltage of the Weld Head. Connect the 4 pin black plastic connector on the cable to the matching Air Valve 1 Driver connector located on the Control rear panel.

Foot Switch Connection (Figure 3-2)

1 Connect a Model FS1L, 1-Level, or a Model FS2L, 2-Level Foot Switch to the FOOT SWITCH connector located on the Control rear panel. The Control will automatically recognize which model of Miyachi Unitek Equipment Foot Switch has been connected.

2 **1- Level Foot Switch** - The l-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control will automatically return the Upper Electrode to its up position.

2-Level Foot Switch - When a 2-Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control will automatically return the Upper Electrode to its up position so that the parts can be repositioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control will automatically return the Upper Electrode to its up position.

Single Air Regulator Adjustment (Model 80 Series Weld Heads - Figure 3-2)

Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

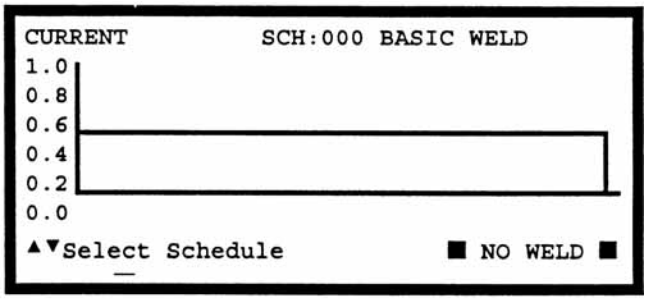
1 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** function.

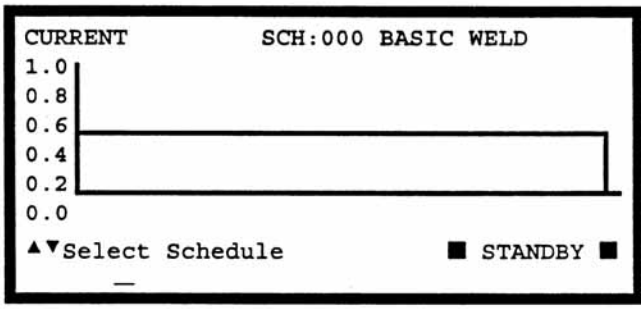
2 Turn the Air Regulator Clockwise (CW) to produce 10 psi on the Pressure Gauge.

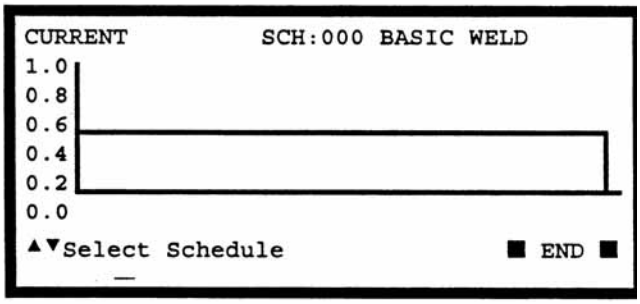
3 Press and hold the Foot Switch completely down to close all switch levels. The lower right hand corner of the display should show the status message ■ **STANDBY** ■.

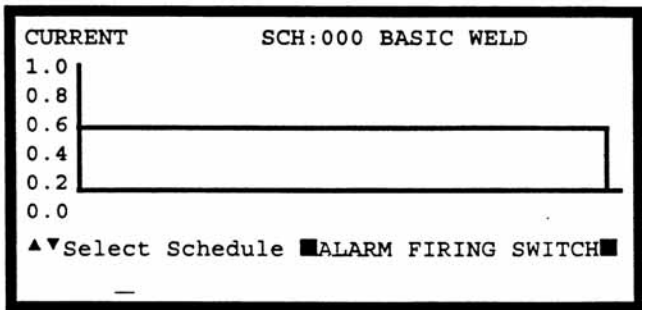
4 Continuing turning the Air Regulator Clockwise (CW) until the Control automatically returns the Upper Electrode to its "up position". The lower right hand corner of the display should now show the status message ■ **END** ■ if you have not released the Foot Switch. Release the Foot Switch.

NOTE: You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Control will automatically return the Upper Electrode to its up position. The status message changes from ■ **STANDBY** ■ to ■ **ALARM FIRING SWITCH** ■. Press **RUN** to clear the alarm and then repeat steps 4 and 5.









5 Adjust the Down Speed Control Knob so the Upper Electrode descends smoothly onto the parts.

6 Adjust the Up Speed Control Knob so that the Upper Electrode Holder does not impact upon returning to in "up position".

Dual Air Regulator Adjustments (Model 180 Series and Model 90 Series Weld Heads - Figure 3-2)

1 Turn the Air Regulator located on the right-hand side of the Weld Head Clockwise (CW) to produce 10 psi on the Pressure Gauge.

2 Adjust the left-hand side Air Regulator following steps 4, 5, and 6 for the Single Air Regulator Adjustment.

3 Re-adjust the right-hand side Air Regulator to produce the same air pressure as finally used on the left-hand side Air Regulator.

4 Repeat steps 7 and 8 for the Single Air Regulator Adjustment.

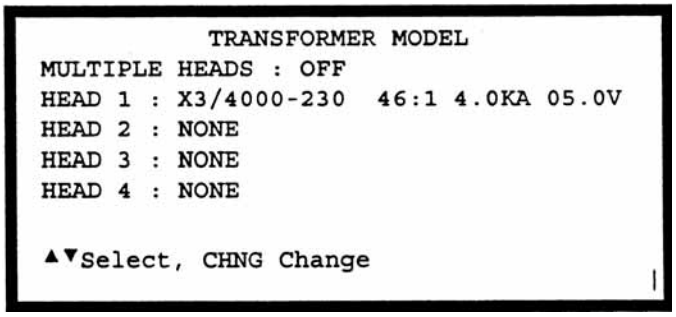
Quick Start Programming Guide

1 Press **MENU**. The **MAIN MENU** screen will appear.

2 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

3 Select **MULTIPLE HEADS: OFF**. If the display reads ON, then press **CHNG** until OFF is displayed.

4 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

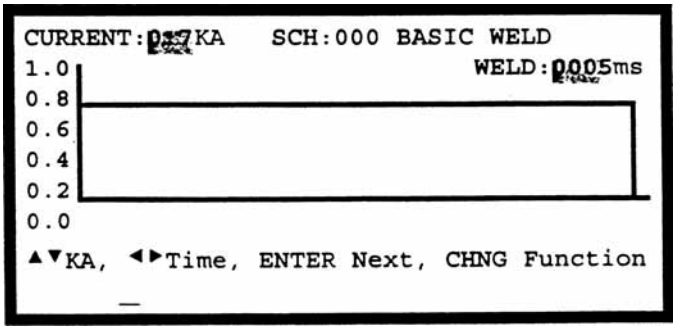


5 Press RUN to return to the Weld Graph **RUN** State.

6 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

7 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

8 Press **PROG**. Press **ENTER** to change **SQUEEZE** to **WELD**, as displayed in the upper right corner. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



9 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

10 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Strive to use minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

11 Up to 128 different weld schedules can be created and saved. To recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

Miyachi Unitek Equipment Force Fired, Dual Air Actuated Weld Head System

General Information

Dual Air Actuated Weld Head System operation uses sequential action to activate one Weld Head and then a second weld head using a single Control and Transformer. The operator must close and release the Foot Switch to initiate each sequential weld. Sequential Weld Head activation ensures that only one weld current path exists at a single point in time. To use multiple Weld Heads simultaneously, refer to Chapter 3, Non-Force Fired, Multiple Air Actuated Weld Head System.

Control, Jumper Modifications (Figure 3-3)

WARNING: ***Before*** modifying jumpers, disconnect the 3-phase input power to the Control to prevent serious injury.

1 Remove the Control cover.

2 The Control PCB is located on the right-hand side of the Control. Locate Jumpers **E10** and **E11** by looking in the lower right-hand corner of the Control PCB.

3 Using a needle nose pliers, move Jumpers **E10** and **E11** from the **RELAY** position to the **HEAD2** position.

4 Replace the Control cover.

5 Connect 3 phase input power to the Control.

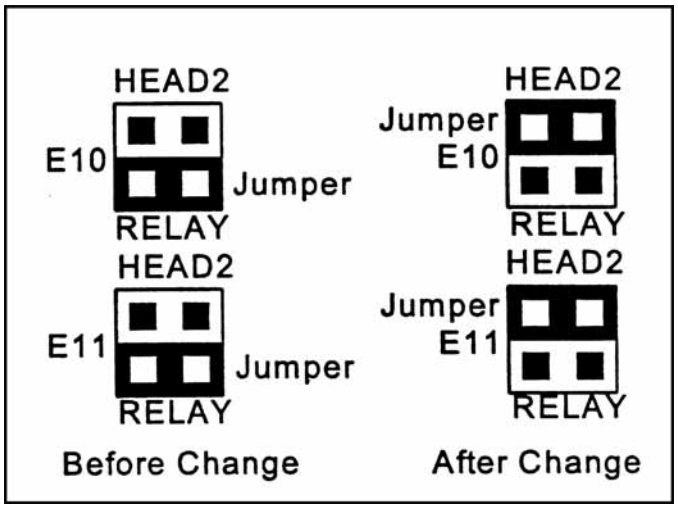


Figure 3-3. HF2 Jumper Modifications

Weld Head Set-up (Figure 3-4)

1 Connect the Upper Weld Cable from each Weld Head to the Positive Terminal on the Transformer.

2 Connect the Lower Weld Cable from each Weld Head to the Negative Terminal on the Transformer.

3 Adjust each Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

4 Install electrodes in each Weld Head Electrode Holder.

5 Parallel two sets of twisted wire cables to the clip end of the standard Voltage Sensing Cable that is connected to the Weld Transformer front panel. Connect one twisted wire cable to the Left Weld Head electrodes and the other twisted wire cable to the Right Weld Head electrodes.

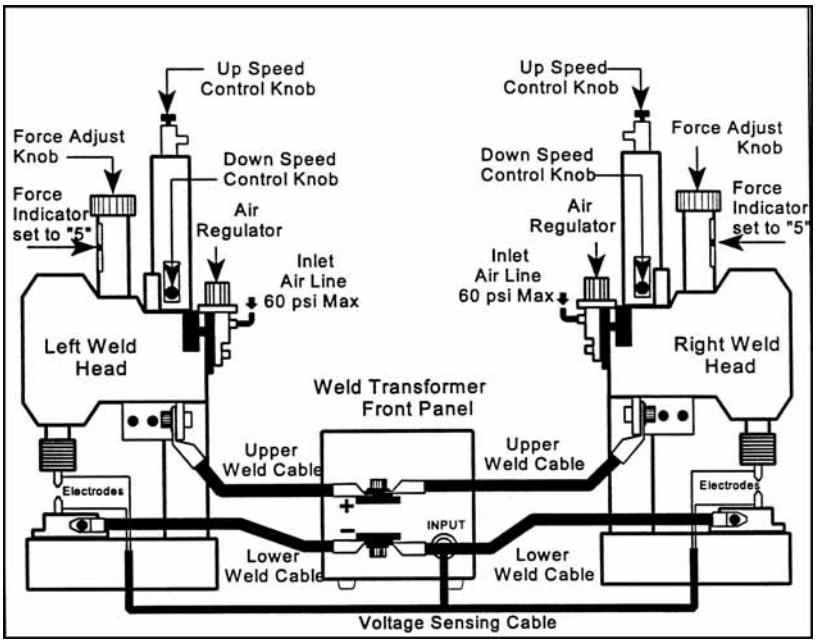


Figure 3-4. Weld Cable and Air Line Connections for Dual Air Actuated Weld Heads

6 Connect a properly filtered air line to the Inlet Air Line on the Weld Head Air Valve Driver Solenoid assembly which is located on the back of the Weld Head. Use 0.25 inch O.D. by 0.17 inch I.D. plastic hose with a rated burst pressure of 250 psi. Run separate air lines to each Inlet Air Line. Do not split a single 0.25 O.D. line into two lines or the Weld Heads will not have sufficient air flow to work properly. A lubricator should only be used with automated installations. Turn on the air system and check for leaks.

Firing Switch Cable Connection (Figure 3-5)

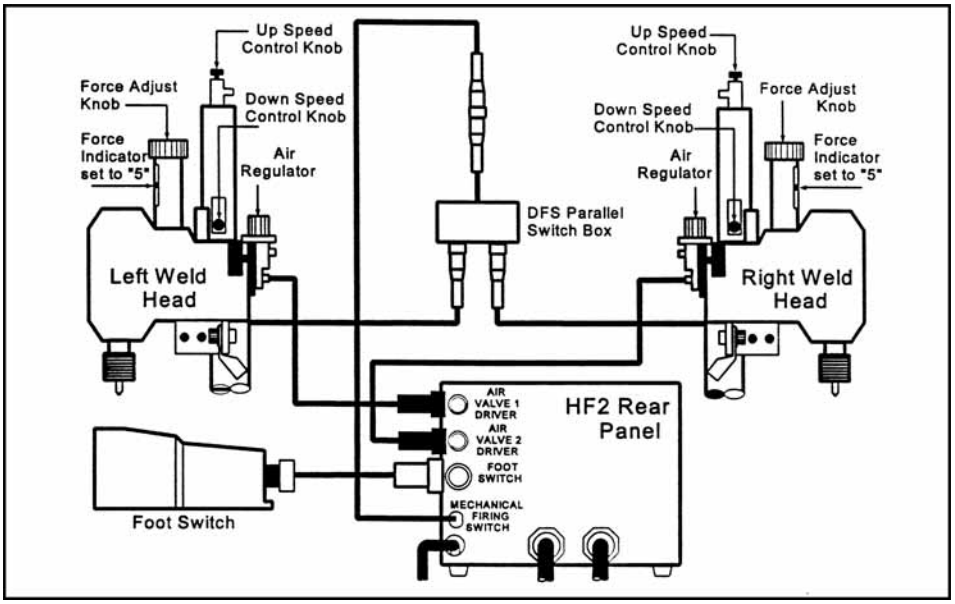


Figure 3-5. Dual Air Actuated Weld Heads Electrical Connections

Connect the Weld Head Firing Switch Cable Connector on each Weld Head to the matching connectors on the Model DFS Parallel Switch Box. Connect the Model DFS Firing Switch Cable to the matching cable connector on the rear of the Control.

Weld Head Valve Driver Connections (Figure 3-5)

1 Each air actuated Weld Head has one Solenoid Valve Driver Cable for automatic actuation and timing control by the Control. The Control will automatically recognize the solenoid voltage of your Weld Head. Connect the 4 pin black plastic connector on the Left Weld Head Solenoid Valve Driver Cable to the matching **Air Valve 1 Driver** connector located on the Control rear panel.

2 Connect the 4 pin black plastic connector on the Right Weld Head Solenoid Valve Driver Cable to the matching **Air Valve 2 Driver** connector located on the Control rear panel.

Foot Switch Connection (Figure 3-5)

1 Connect a Model FS1L, 1-Level, or a Model FS2L, 2-Level Foot Switch to the FOOT SWITCH connector located on the Control rear panel. The Control will automatically recognize which model of Miyachi Unitek Equipment Foot Switch has been connected.

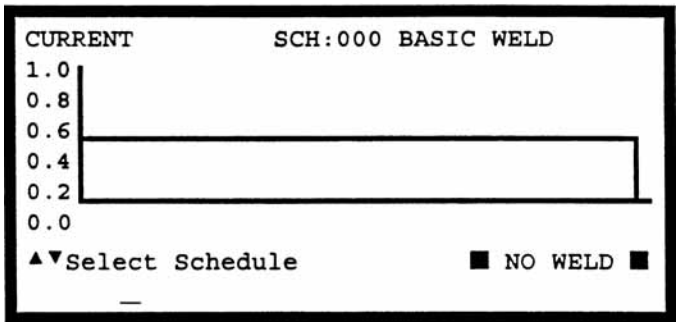
2 **1-Level Foot Switch** -- The l-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control will automatically return the Upper Electrode to its up position.

3 **2-Level Foot Switch** -- When a 2-Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control will automatically return the Upper Electrode to its up position so that the parts can be repositioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control will automatically return the Upper Electrode to its up position.

Dual Air Regulator Adjustment (Model 188 - Figure 3-5)

1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** Function.



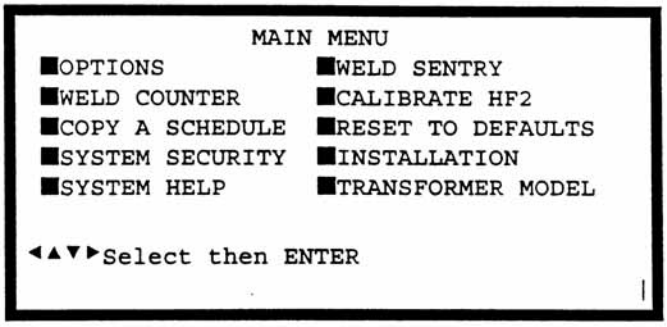
3 Press **MENU**. The **MAIN MENU** screen will appear.

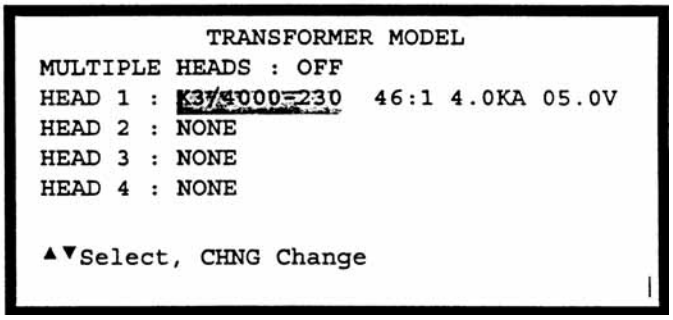
4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

5 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, press **CHNG** until **OFF** is displayed.

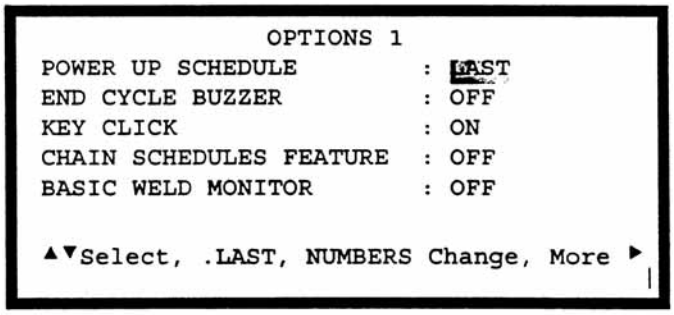
6 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

7 Press **MENU** to return to the **MAIN MENU** screen.





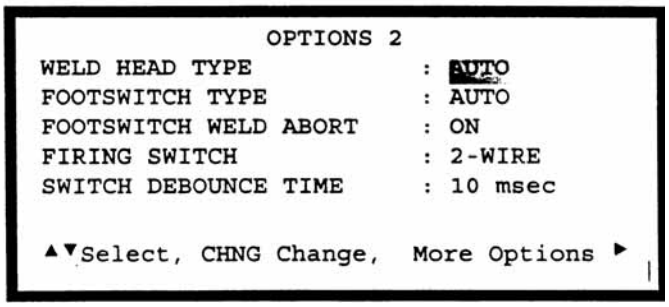
8 Select **OPTIONS**. The **OPTIONS 1** screen appears.



9 Press ► to select the **OPTIONS 2** screen.

10 Select **WELD HEAD TYPE: AUTO**. Press **CHNG** until the **DUAL AIR** option appears.

11 Press **MENU** to return to the **MAIN MENU**.



12 Select **COPY A SCHEDULE**. The **COPY SCHEDULE** screen will appear.

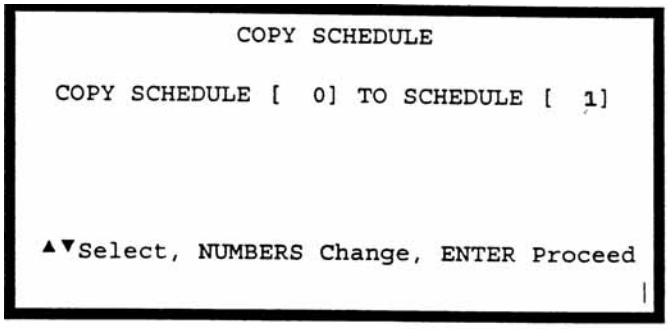
13 Select the last flashing **0** of **TO SCHEDULE 0** and use the number keys to change the flashing **0 TO SCHEDULE 1**.

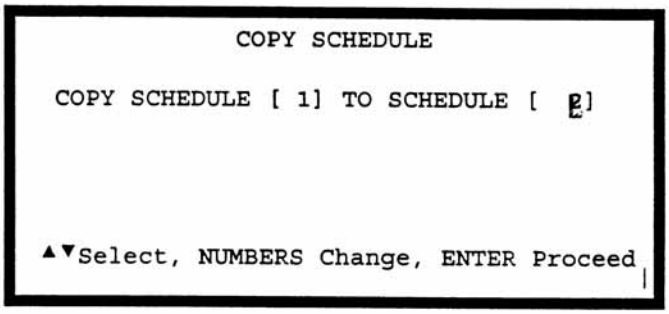
14 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

15 Press **MENU** to return to the **MAIN MENU**.

16 Select **COPY A SCHEDULE**. The **COPY SCHEDULE** screen will appear.

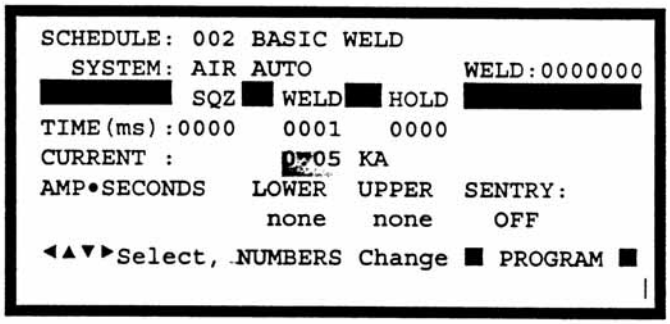
17 Select the last flashing **1** of **TO SCHEDULE 1** and use the number keys to change the flashing **1 TO SCHEDULE 2**.





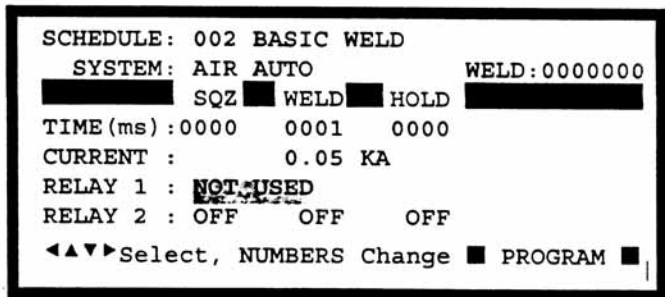
18 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

19 Press **PROGRAM** ***twice*** to select the Alphanumeric **PROGRAM** screen.



20 Press the down vertical cursor key ▼ until the **RELAY 1: NOT USED** and **RELAY 2: OFF** option items appear.

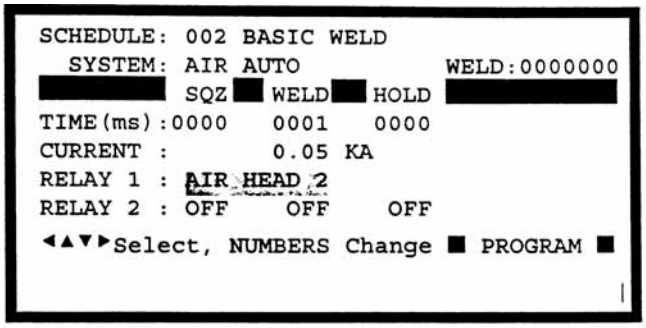
21 Select **RELAY 1: NOT USED**. Press **CHNG** to select the **AIR HEAD 2** option.

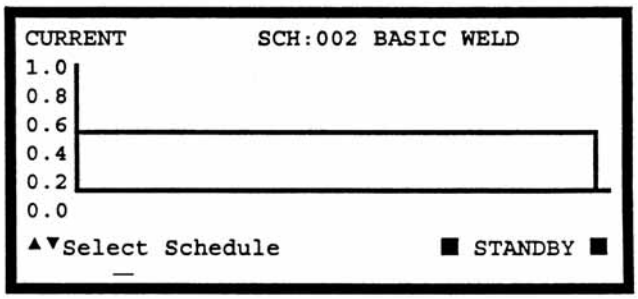


22 Press **SAVE** to update Schedule 2, then press **CHNG** to automatically return to the Weld Graph **RUN** State. You are now ready to adjust the Right Weld Head Air Regulators.

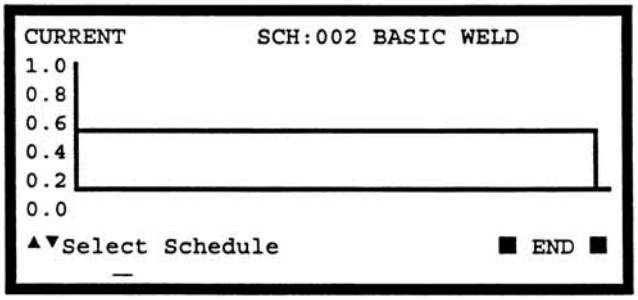
23 Turn both Air Regulators located on the right-hand side of the Right Weld Head Clockwise (CW) to produce 10 psi on the Pressure Gauge.

24 Press and hold the Foot Switch completely down to close all switch levels. The lower right hand corner of the display should show the status message **STANDBY**.

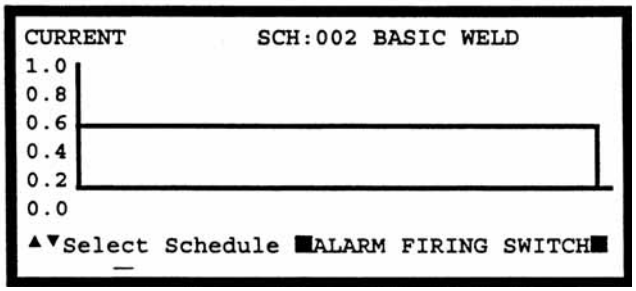




25 Turn the Air Regulator that feeds the Top Right Air Cylinder on the Right Weld Head Clockwise (CW) until the Control automatic-ally returns the Upper Electrode to its up position. The lower right hand corner of the display should now show the status message END if you have not released the Foot Switch. Release the Foot Switch.



NOTE: You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Control will automatically return the Upper Electrode to its up position. The status message changes from **STANDBY** to **ALARM FIRING SWITCH** . Press **RUN** to clear the alarm, then repeat steps 24 and 25.



26 Re-adjust the Air Regulator that feeds the Bottom Right Air Cylinder on the Right Weld Head to produce the same air pressure as finally used on the Top Air Regulator on the Right Weld Head.

27 Adjust the Right Weld Head Down Speed Control Knob so the Right Weld Head Upper Electrode descends smoothly onto the parts.

28 Adjust the Right Weld Head Up Speed Control Knob so that the Right Weld Head Upper Electrode Holder does not impact upon returning to in up position.

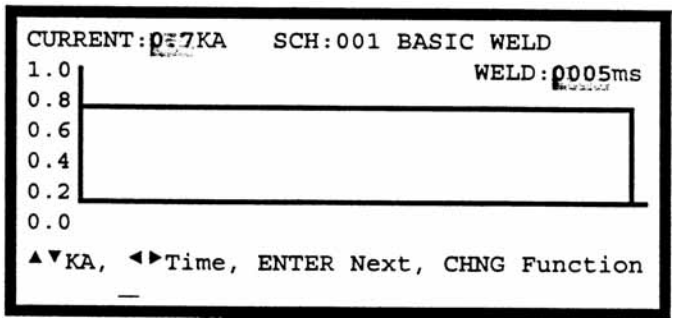
29 Press ▼ to select **SCH:001 BASIC WELD**. You are now ready to adjust the Left Weld Head Air Regulators.

30 Repeat steps 24 through 29 for the Dual Air Weld Head System, All Regulator Adjustments for the Left Weld Head.

Quick Start Programming Guide

1 Make a test weld using Schedule 1 by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

2 Press **PROG**. Press **ENTER** to change **SQUEEZE** to **WELD**, as displayed in the upper right corner. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



3 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

4 Press **SAVE** to save the updated Schedule 1. You are now back in the Weld Graph **RUN** State.

5 Press ▲ to select **SCH:002 BASIC WELD**. You are now ready to make test welds using the Right Weld Head.

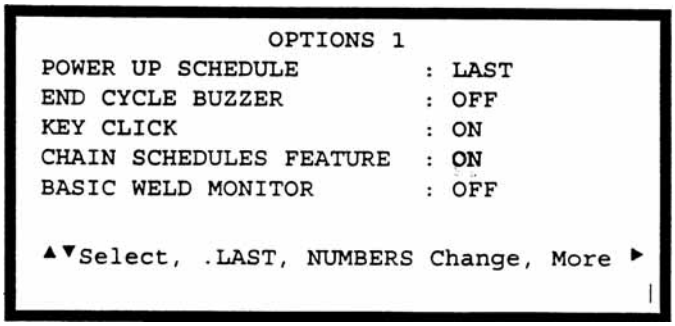
6 Repeat steps 1 through 3 using the Right Weld Head.

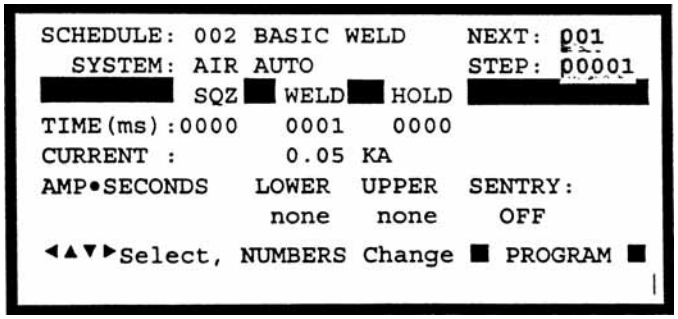
7 Press **SAVE** to save the updated Schedule 2. You are now back in the Weld Graph **RUN** State and ready to turn on the Chaining Feature, which will enable Schedule 1 to automatically sequence to Schedule 2, then back to Schedule 1.

8 Press **MENU** and then select **OPTIONS**. Use the horizontal cursor key ◄ to select the **OPTIONS 1** screen.

9 Select **CHAIN SCHEDULES FEATURE: OFF**. Press CHNG to change to **ON**.

10 Press **RUN** to return to the Weld Graph **RUN** State.





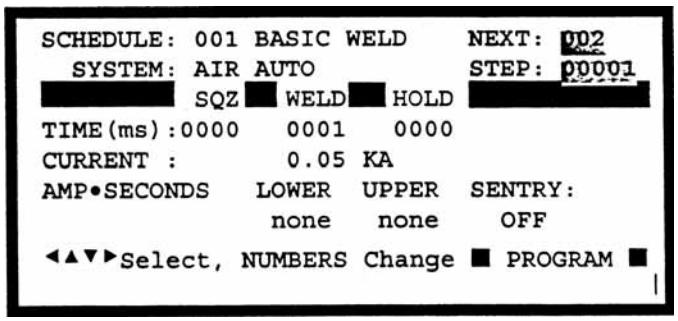
11 Press **PROGRAM** twice to select the Alphanumeric **PROGRAM** screen for Schedule 2.

12 Verify that **NEXT: 001** is correctly displayed so that Schedule 2 will automatically advance to Schedule 1 after one weld has been completed. If you want to make more than one weld using Schedule 2 before advancing to Schedule 1, change **STEP : 00001** to the desired number of welds.

13 Press **SAVE** to save the updated Schedule 2.

14 Press ▼ to select **SCH:001 BASIC WELD**.

15 Press **PROGRAM** once to select the Alphanumeric **PROGRAM** screen for Schedule 1.



Select **NEXT: 001**. Change **001** to **002** so that Schedule 1 will automatically advance to Schedule 2 after one weld has been completed. If you want to make more than one weld using Schedule 1 before advancing to Schedule 2, change **STEP : 00001** to the desired number of welds.

Press SAVE to save the updated Schedule 1. Press CHNG to return to the Weld Graph RUN State. You are now ready to make alternating welds, beginning with Schedule 1, by just pressing on the Foot Switch to activate each weld.

Non-Force Fired, Air Or Cam Actuated Weld Head System

PLC to Control Electrical Connections (Figure 3-6)

1 Connect your Programmable Logic Control (PLC) or Host Computer output control signals to the Control inputs using reed relays or the open collector of an opto coupler. The emitter of each opto coupler must be connected to The Control Rear Panel Control Signals connector, Pin 11.

For a complete description of how to program Relay 1 and Relay 2, reference *Chapter 5, Programming Modes, Output Relays*.

For a complete description on how to use the RS-485 Datacom feature, reference *Appendix B, RS-485 Connection*.

2 All weld schedules must be entered and saved using the Control Front Panel keys. After saving the desired weld schedules, each schedule can be recalled prior to initiating the welding process cycle by closing the binary Remote Schedule Select lines according to the following table:

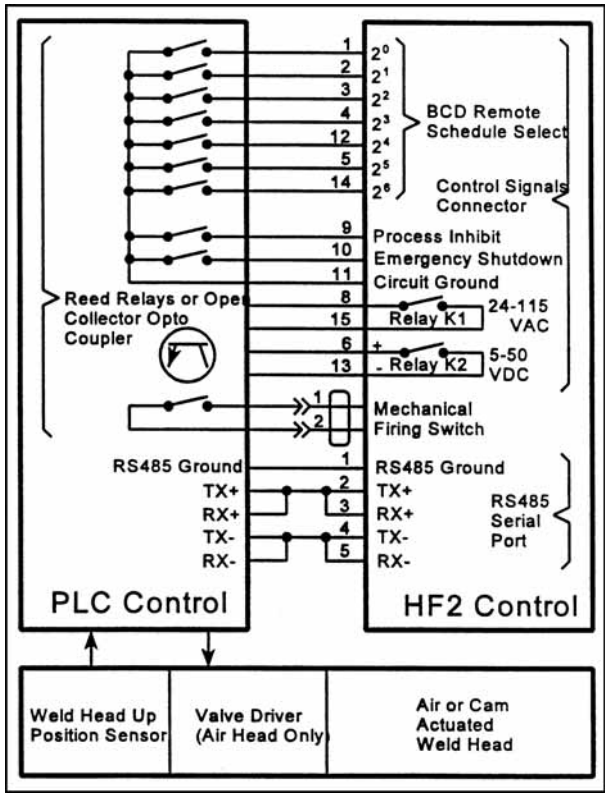


Figure 3-6. PLC to Control Electrical Connections

WELD SCHEDULE	20 Pin 1	21 Pin 2	22 Pin 3	23 Pin 4	24 Pin 12	25 Pin 5	26 Pin 14
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	1	1	0	0	0	0	0
4	0	0	1	0	0	0	0
Binary progression from 5 to 126							
127	1	1	1	1	1	1	1

NO TE: 0 = Open; 1 = Closed

PLC Timing Diagram (Figure 3-7)

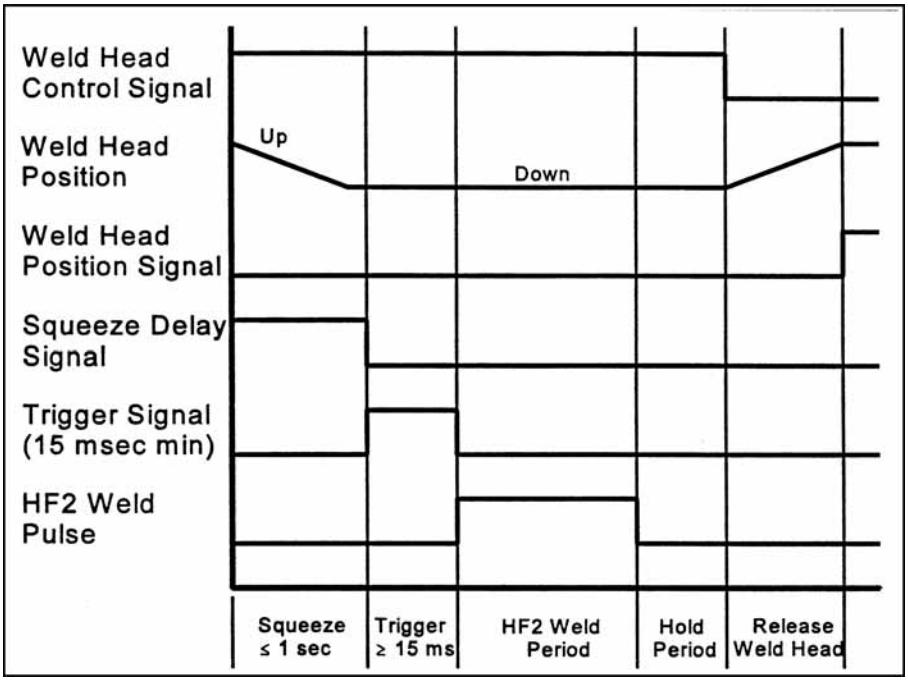


Figure 3-7. PLC Timing Diagram.

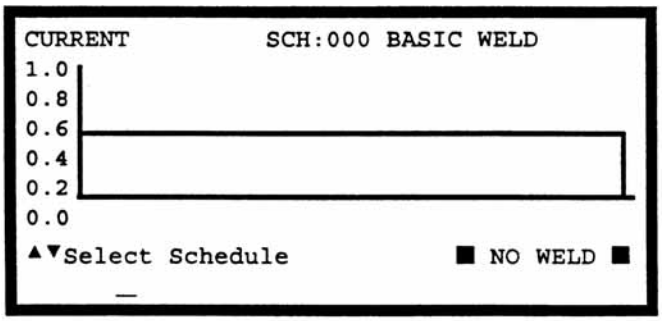
Quick Start Programming Guide

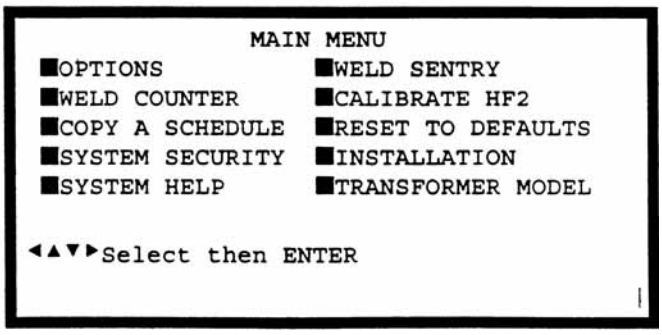
1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear.

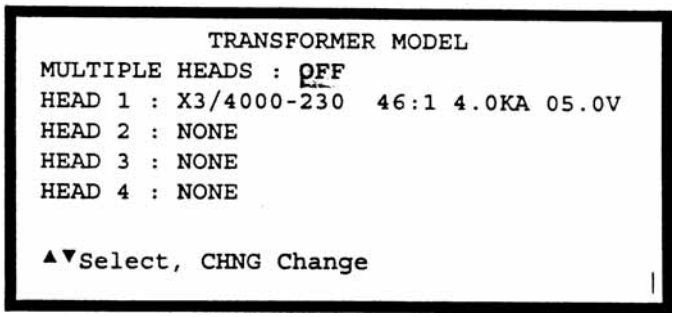
3 Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** Function.

4 Press **MENU**. The **MAIN MENU** screen will appear.





5 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

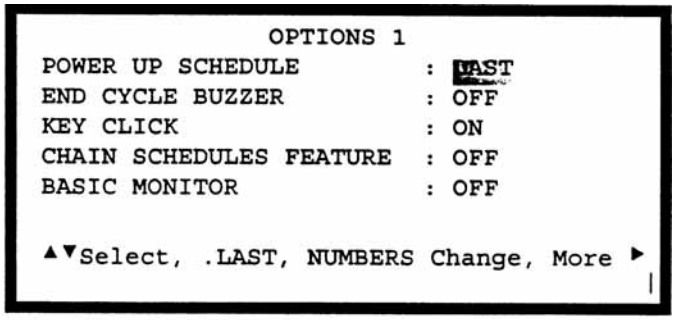


6 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, press **CHNG** until OFF is displayed.

7 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

8 Press **MENU** to return to the **MAIN MENU** screen.

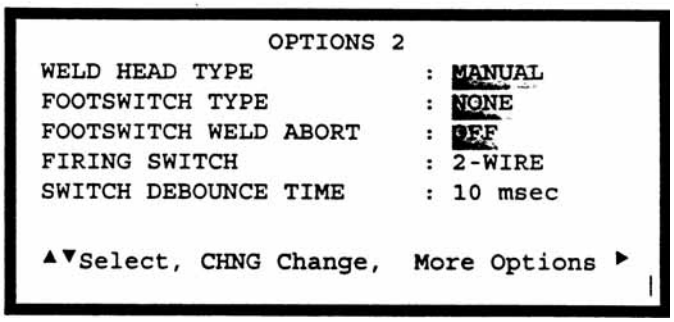
9 Select **OPTIONS**. The **OPTIONS 1** or **OPTIONS 2** screen appears. This example shows the **OPTION 1** screen.



10 Press ◄► to select the **OPTIONS 2** screen.

11 Select **WELD HEAD TYPE: AUTO**. Press **CHNG** until the **MANUAL** option appears.

NOTE: FOOTSWITCH TYPE: AUTO will automatically change to **NONE**.



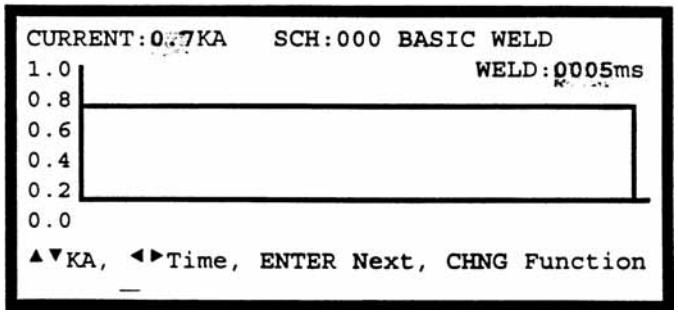
12 Select **FOOTSWITCH WELD ABORT: ON**. Press **CHNG** until the **OFF** option appears.

13 Press **RUN** to return to the Weld Graph **RUN** State.

14 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

15 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

16 Press **PROG**. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



17 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

18 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

Up to 128 different weld schedules can be created and saved. To manually recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

19 To recall any weld schedule automatically, use the binary Remote Schedule Select Control Lines as discussed under the Step 4 of the PLC to Control Electrical Connections section.

Non-Force Fired, Multiple Air Actuated Weld Head System

This system configuration is not released.

Miyachi Unitek Equipment Force Fired, Foot Actuated Weld Head System

Weld Head Set-up

1 Adjust the Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

2 Install electrodes in Weld Head Electrode Holders.

Firing Switch Cable Connection

Connect the Weld Head Firing Switch Cable Connector to the matching cable connector on the rear of the Control.

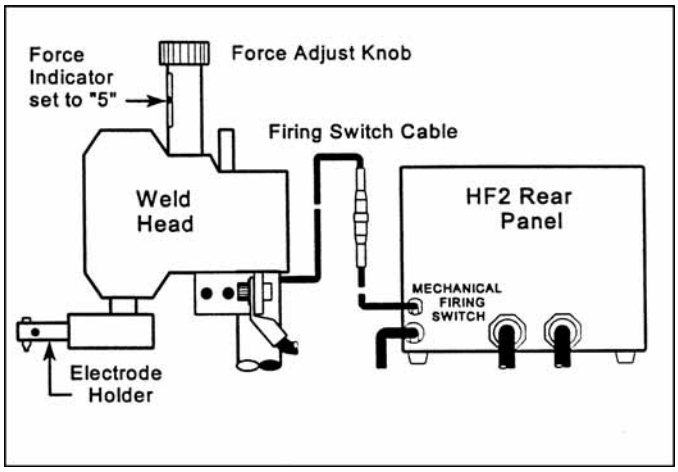


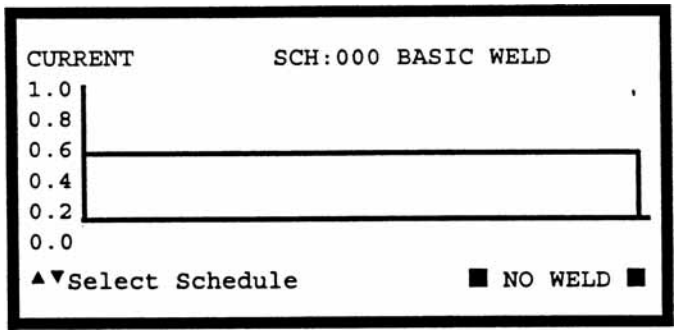
Figure 3-1. Firing Switch Cable Connection

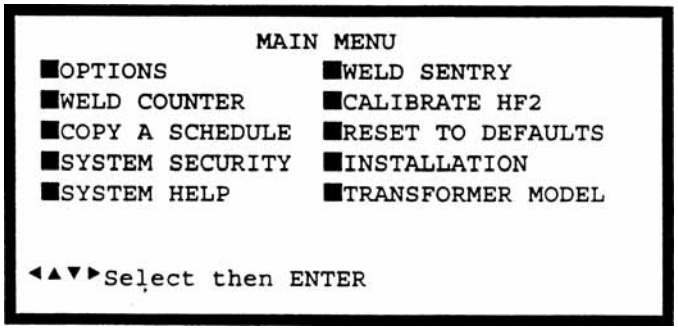
Quick Start Programming Guide

1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the circuit breaker switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph RUN screen for the **BASIC WELD Function.**

3 Press **MENU**. The **MAIN MENU** screen will appear.

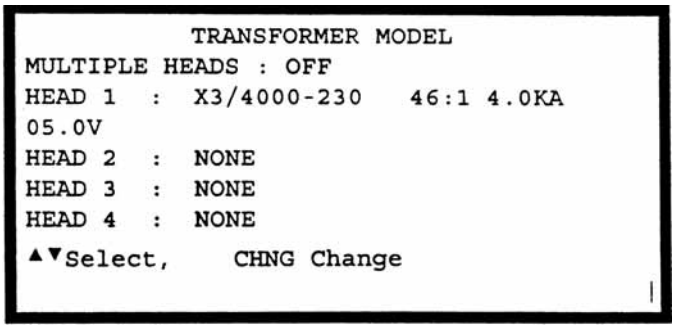




4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

5 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, then press **CHNG** until **OFF** is displayed.

6 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.



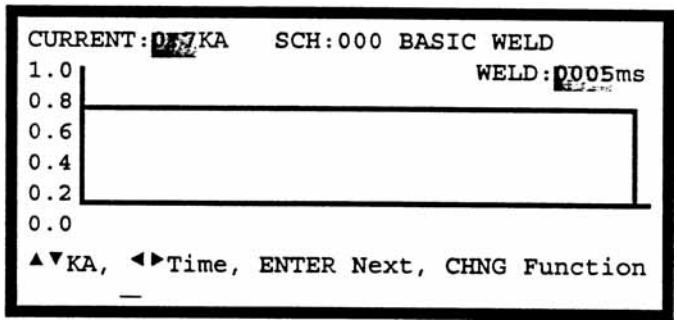
7 Press **RUN** to return to the Graphical **RUN** screen.

7 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

8 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 kA may not be sufficient to make a good weld.

9 Press **PROG**. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time.

In this example, weld CURRENT has been increased to 0.7 kA and WELD time has been increased to 5ms.



10 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

11 Make additional test welds and then reprogram WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

12 Up to 128 different weld schedules can be created and saved. To recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

Miyachi Unitek Equipment Force Fired, Single Air Actuated Weld Head System

Weld Head Set-up (Figure 3-2)

1 Adjust the Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

2 Install electrodes in Weld Head Electrode Holders.

3 Connect a properly filtered air line to the Inlet Air Line on the Weld Head Air Valve Driver Solenoid assembly which is located on the back of the Weld Head. Use 0.25 inch O.D. by 0.17 inch I.D. plastic hose with a rated burst pressure of 250 psi. A lubricator should only be used with automated installations. Turn on the air system and check for leaks.

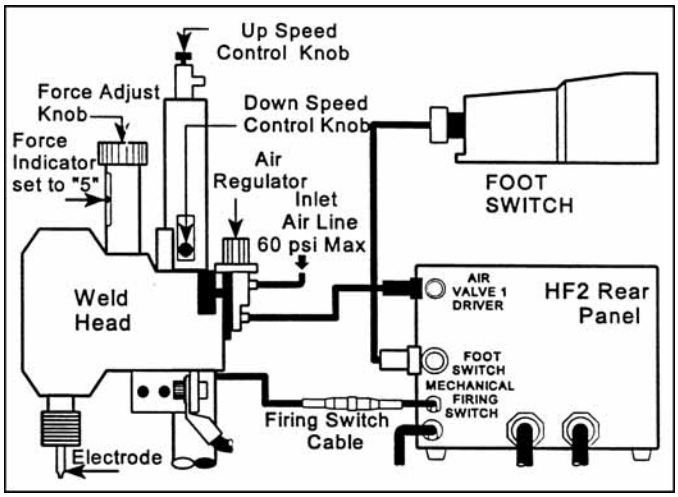


Figure 3-2. Single Air Actuated Weld Head Connections

Firing Switch Cable Connection (Figure 3-2)

Connect the Weld Head Firing Switch Cable Connector to the matching cable connector on the rear of the Control.

Weld Head Valve Driver No. 1 Connection (Figure 3-2)

A single air actuated Weld Head has one Solenoid Valve Driver Cable for automatic actuation and timing control by the Control. The Control will automatically recognize the solenoid voltage of the Weld Head. Connect the 4 pin black plastic connector on the cable to the matching Air Valve 1 Driver connector located on the Control rear panel.

Foot Switch Connection (Figure 3-2)

1 Connect a Model FS1L, 1-Level, or a Model FS2L, 2-Level Foot Switch to the FOOT SWITCH connector located on the Control rear panel. The Control will automatically recognize which model of Miyachi Unitek Equipment Foot Switch has been connected.

2 **1- Level Foot Switch** - The l-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control will automatically return the Upper Electrode to its up position.

2-Level Foot Switch - When a 2-Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control will automatically return the Upper Electrode to its up position so that the parts can be repositioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control will automatically return the Upper Electrode to its up position.

Single Air Regulator Adjustment (Model 80 Series Weld Heads - Figure 3-2)

Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

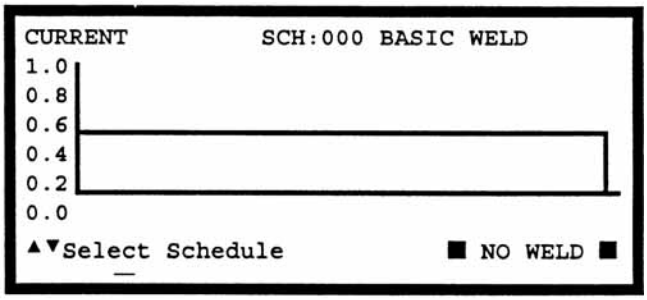
1 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** function.

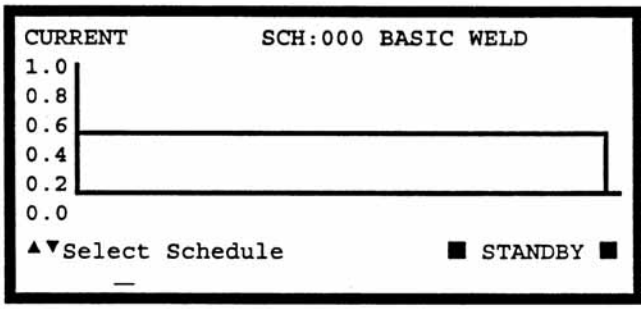
2 Turn the Air Regulator Clockwise (CW) to produce 10 psi on the Pressure Gauge.

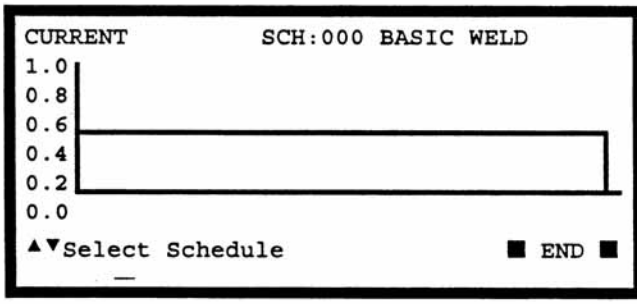
3 Press and hold the Foot Switch completely down to close all switch levels. The lower right hand corner of the display should show the status message ■ **STANDBY** ■.

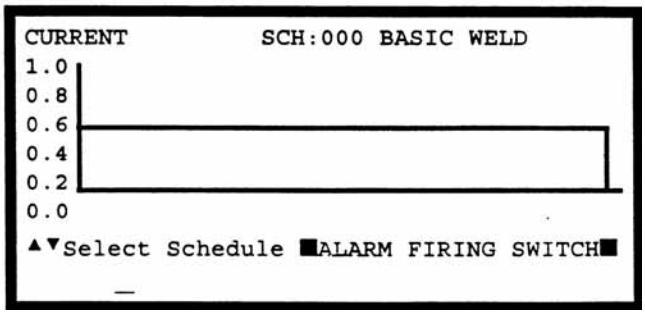
4 Continuing turning the Air Regulator Clockwise (CW) until the Control automatically returns the Upper Electrode to its "up position". The lower right hand corner of the display should now show the status message ■ **END** ■ if you have not released the Foot Switch. Release the Foot Switch.

NOTE: You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Control will automatically return the Upper Electrode to its up position. The status message changes from ■ **STANDBY** ■ to ■ **ALARM FIRING SWITCH** ■. Press **RUN** to clear the alarm and then repeat steps 4 and 5.









5 Adjust the Down Speed Control Knob so the Upper Electrode descends smoothly onto the parts.

6 Adjust the Up Speed Control Knob so that the Upper Electrode Holder does not impact upon returning to in "up position".

Dual Air Regulator Adjustments (Model 180 Series and Model 90 Series Weld Heads - Figure 3-2)

1 Turn the Air Regulator located on the right-hand side of the Weld Head Clockwise (CW) to produce 10 psi on the Pressure Gauge.

2 Adjust the left-hand side Air Regulator following steps 4, 5, and 6 for the Single Air Regulator Adjustment.

3 Re-adjust the right-hand side Air Regulator to produce the same air pressure as finally used on the left-hand side Air Regulator.

4 Repeat steps 7 and 8 for the Single Air Regulator Adjustment.

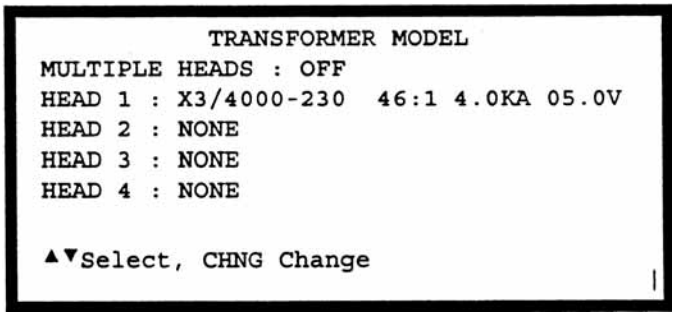
Quick Start Programming Guide

1 Press **MENU**. The **MAIN MENU** screen will appear.

2 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

3 Select **MULTIPLE HEADS: OFF**. If the display reads ON, then press **CHNG** until OFF is displayed.

4 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

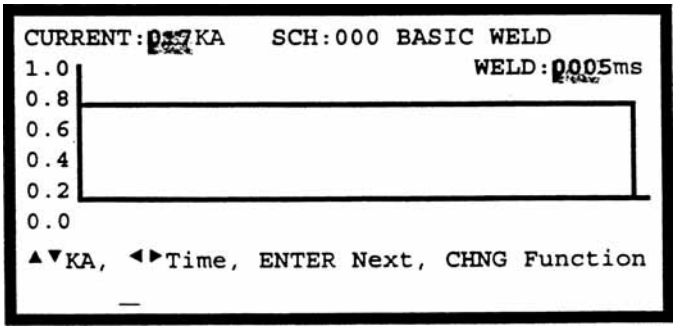


5 Press RUN to return to the Weld Graph **RUN** State.

6 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

7 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

8 Press **PROG**. Press **ENTER** to change **SQUEEZE** to **WELD**, as displayed in the upper right corner. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



9 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

10 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Strive to use minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

11 Up to 128 different weld schedules can be created and saved. To recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

Miyachi Unitek Equipment Force Fired, Dual Air Actuated Weld Head System

General Information

Dual Air Actuated Weld Head System operation uses sequential action to activate one Weld Head and then a second weld head using a single Control and Transformer. The operator must close and release the Foot Switch to initiate each sequential weld. Sequential Weld Head activation ensures that only one weld current path exists at a single point in time. To use multiple Weld Heads simultaneously, refer to Chapter 3, Non-Force Fired, Multiple Air Actuated Weld Head System.

Control, Jumper Modifications (Figure 3-3)

WARNING: ***Before*** modifying jumpers, disconnect the 3-phase input power to the Control to prevent serious injury.

1 Remove the Control cover.

2 The Control PCB is located on the right-hand side of the Control. Locate Jumpers **E10** and **E11** by looking in the lower right-hand corner of the Control PCB.

3 Using a needle nose pliers, move Jumpers **E10** and **E11** from the **RELAY** position to the **HEAD2** position.

4 Replace the Control cover.

5 Connect 3 phase input power to the Control.

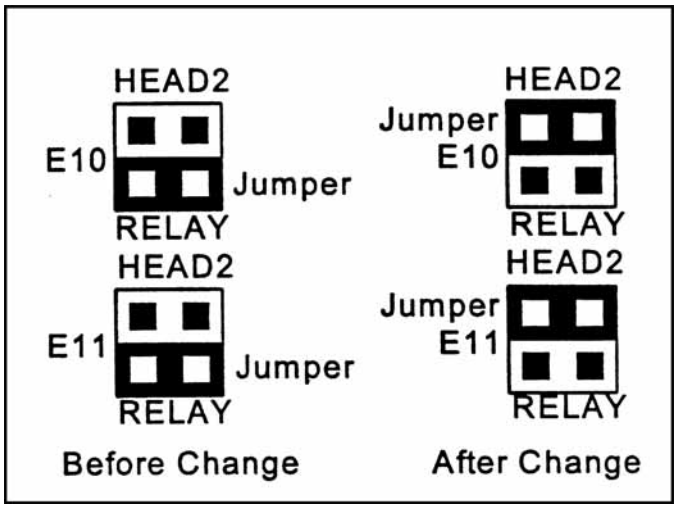


Figure 3-3. HF2 Jumper Modifications

Weld Head Set-up (Figure 3-4)

1 Connect the Upper Weld Cable from each Weld Head to the Positive Terminal on the Transformer.

2 Connect the Lower Weld Cable from each Weld Head to the Negative Terminal on the Transformer.

3 Adjust each Weld Head Force Adjust Knob to produce 5 units of force as displayed on the Force Indicator. For a complete description of force control and its effect on the welding process, please refer to your Weld Head manual.

4 Install electrodes in each Weld Head Electrode Holder.

5 Parallel two sets of twisted wire cables to the clip end of the standard Voltage Sensing Cable that is connected to the Weld Transformer front panel. Connect one twisted wire cable to the Left Weld Head electrodes and the other twisted wire cable to the Right Weld Head electrodes.

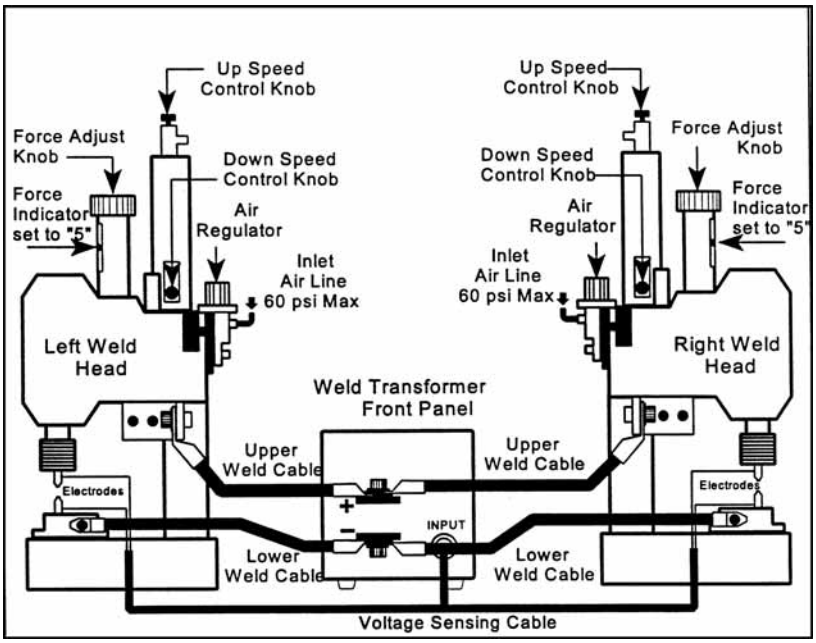


Figure 3-4. Weld Cable and Air Line Connections for Dual Air Actuated Weld Heads

6 Connect a properly filtered air line to the Inlet Air Line on the Weld Head Air Valve Driver Solenoid assembly which is located on the back of the Weld Head. Use 0.25 inch O.D. by 0.17 inch I.D. plastic hose with a rated burst pressure of 250 psi. Run separate air lines to each Inlet Air Line. Do not split a single 0.25 O.D. line into two lines or the Weld Heads will not have sufficient air flow to work properly. A lubricator should only be used with automated installations. Turn on the air system and check for leaks.

Firing Switch Cable Connection (Figure 3-5)

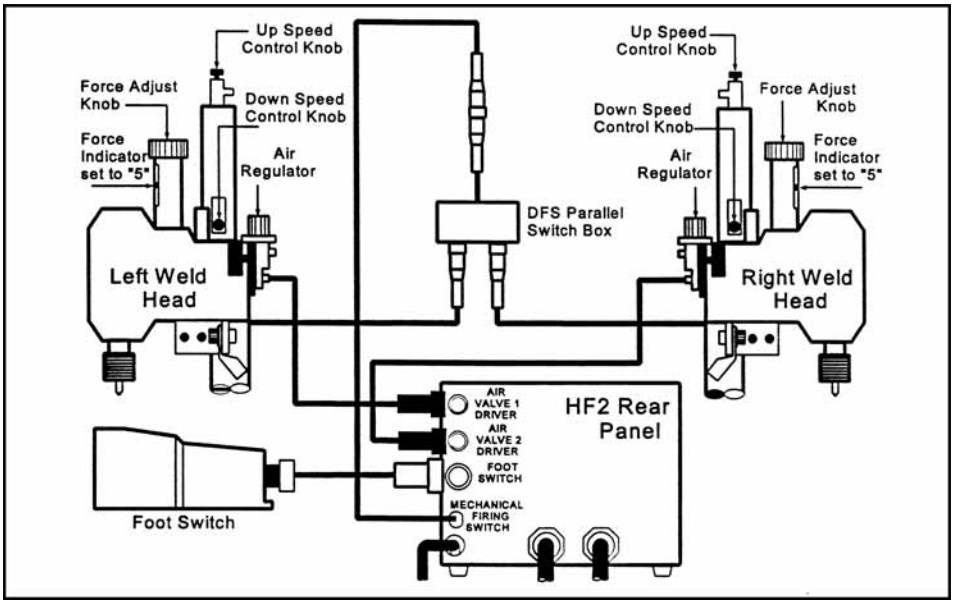


Figure 3-5. Dual Air Actuated Weld Heads Electrical Connections

Connect the Weld Head Firing Switch Cable Connector on each Weld Head to the matching connectors on the Model DFS Parallel Switch Box. Connect the Model DFS Firing Switch Cable to the matching cable connector on the rear of the Control.

Weld Head Valve Driver Connections (Figure 3-5)

1 Each air actuated Weld Head has one Solenoid Valve Driver Cable for automatic actuation and timing control by the Control. The Control will automatically recognize the solenoid voltage of your Weld Head. Connect the 4 pin black plastic connector on the Left Weld Head Solenoid Valve Driver Cable to the matching **Air Valve 1 Driver** connector located on the Control rear panel.

2 Connect the 4 pin black plastic connector on the Right Weld Head Solenoid Valve Driver Cable to the matching **Air Valve 2 Driver** connector located on the Control rear panel.

Foot Switch Connection (Figure 3-5)

1 Connect a Model FS1L, 1-Level, or a Model FS2L, 2-Level Foot Switch to the FOOT SWITCH connector located on the Control rear panel. The Control will automatically recognize which model of Miyachi Unitek Equipment Foot Switch has been connected.

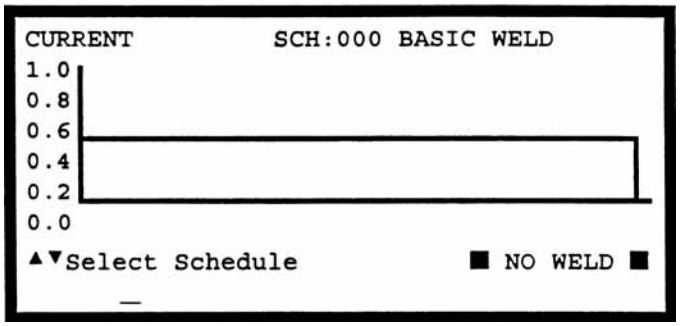
2 **1-Level Foot Switch** -- The l-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control will automatically return the Upper Electrode to its up position.

3 **2-Level Foot Switch** -- When a 2-Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control will automatically return the Upper Electrode to its up position so that the parts can be repositioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control will automatically return the Upper Electrode to its up position.

Dual Air Regulator Adjustment (Model 188 - Figure 3-5)

1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** Function.



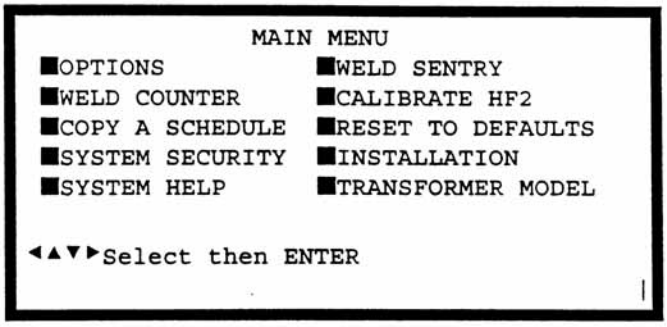
3 Press **MENU**. The **MAIN MENU** screen will appear.

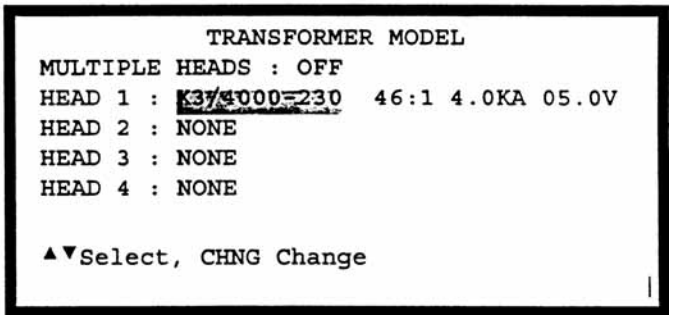
4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

5 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, press **CHNG** until **OFF** is displayed.

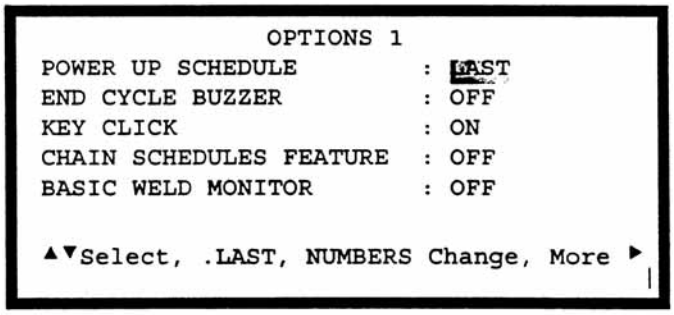
6 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

7 Press **MENU** to return to the **MAIN MENU** screen.





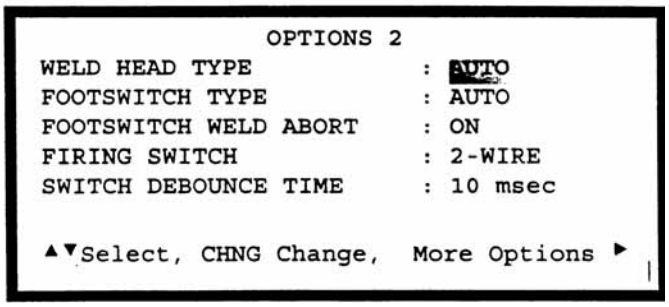
8 Select **OPTIONS**. The **OPTIONS 1** screen appears.



9 Press ► to select the **OPTIONS 2** screen.

10 Select **WELD HEAD TYPE: AUTO**. Press **CHNG** until the **DUAL AIR** option appears.

11 Press **MENU** to return to the **MAIN MENU**.



12 Select **COPY A SCHEDULE**. The **COPY SCHEDULE** screen will appear.

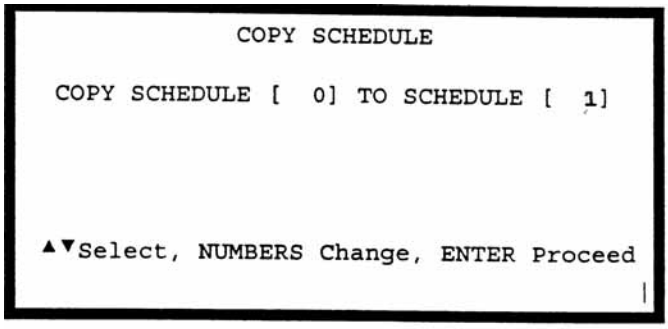
13 Select the last flashing **0** of **TO SCHEDULE 0** and use the number keys to change the flashing **0 TO SCHEDULE 1**.

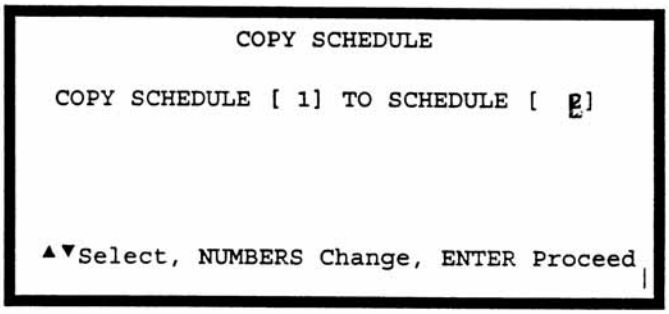
14 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

15 Press **MENU** to return to the **MAIN MENU**.

16 Select **COPY A SCHEDULE**. The **COPY SCHEDULE** screen will appear.

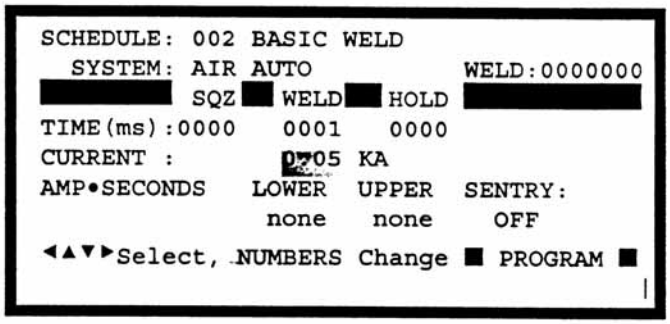
17 Select the last flashing **1** of **TO SCHEDULE 1** and use the number keys to change the flashing **1 TO SCHEDULE 2**.





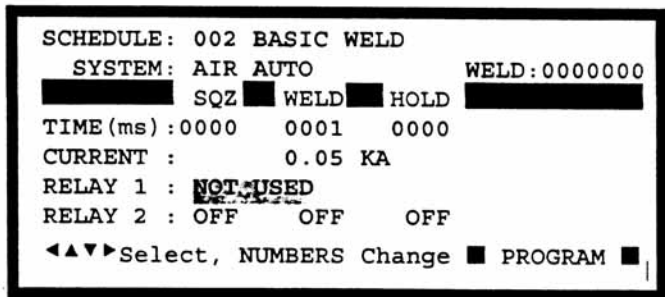
18 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

19 Press **PROGRAM** ***twice*** to select the Alphanumeric **PROGRAM** screen.



20 Press the down vertical cursor key ▼ until the **RELAY 1: NOT USED** and **RELAY 2: OFF** option items appear.

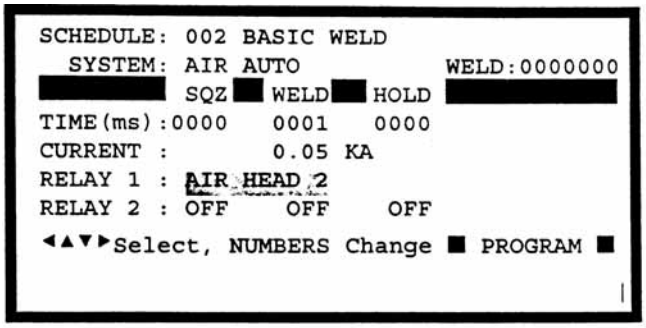
21 Select **RELAY 1: NOT USED**. Press **CHNG** to select the **AIR HEAD 2** option.

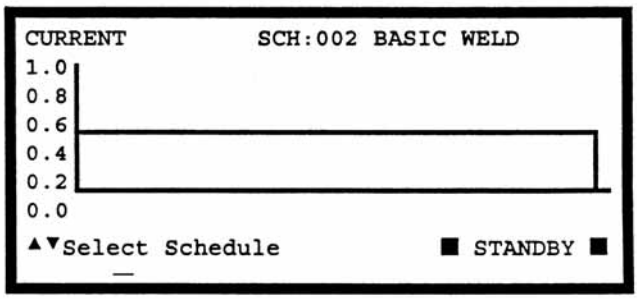


22 Press **SAVE** to update Schedule 2, then press **CHNG** to automatically return to the Weld Graph **RUN** State. You are now ready to adjust the Right Weld Head Air Regulators.

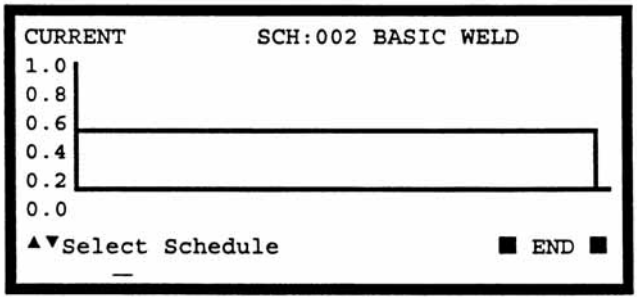
23 Turn both Air Regulators located on the right-hand side of the Right Weld Head Clockwise (CW) to produce 10 psi on the Pressure Gauge.

24 Press and hold the Foot Switch completely down to close all switch levels. The lower right hand corner of the display should show the status message **STANDBY**.

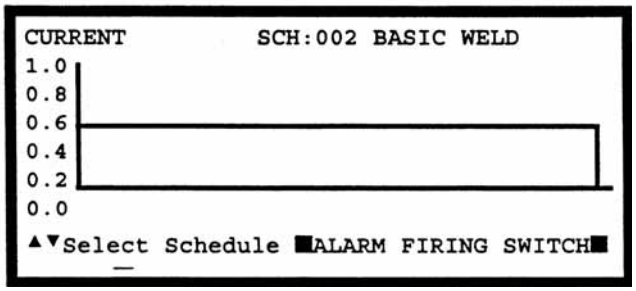




25 Turn the Air Regulator that feeds the Top Right Air Cylinder on the Right Weld Head Clockwise (CW) until the Control automatic-ally returns the Upper Electrode to its up position. The lower right hand corner of the display should now show the status message END if you have not released the Foot Switch. Release the Foot Switch.



NOTE: You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Control will automatically return the Upper Electrode to its up position. The status message changes from **STANDBY** to **ALARM FIRING SWITCH** . Press **RUN** to clear the alarm, then repeat steps 24 and 25.



26 Re-adjust the Air Regulator that feeds the Bottom Right Air Cylinder on the Right Weld Head to produce the same air pressure as finally used on the Top Air Regulator on the Right Weld Head.

27 Adjust the Right Weld Head Down Speed Control Knob so the Right Weld Head Upper Electrode descends smoothly onto the parts.

28 Adjust the Right Weld Head Up Speed Control Knob so that the Right Weld Head Upper Electrode Holder does not impact upon returning to in up position.

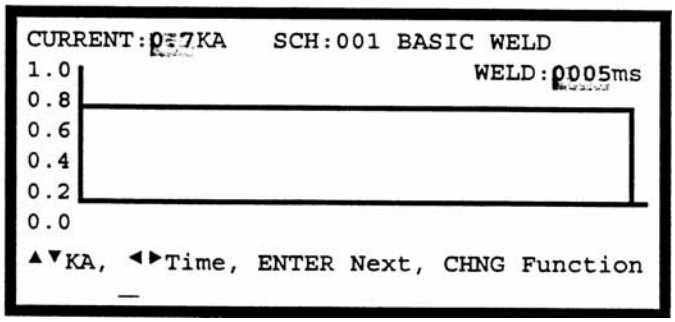
29 Press ▼ to select **SCH:001 BASIC WELD**. You are now ready to adjust the Left Weld Head Air Regulators.

30 Repeat steps 24 through 29 for the Dual Air Weld Head System, All Regulator Adjustments for the Left Weld Head.

Quick Start Programming Guide

1 Make a test weld using Schedule 1 by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

2 Press **PROG**. Press **ENTER** to change **SQUEEZE** to **WELD**, as displayed in the upper right corner. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



3 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

4 Press **SAVE** to save the updated Schedule 1. You are now back in the Weld Graph **RUN** State.

5 Press ▲ to select **SCH:002 BASIC WELD**. You are now ready to make test welds using the Right Weld Head.

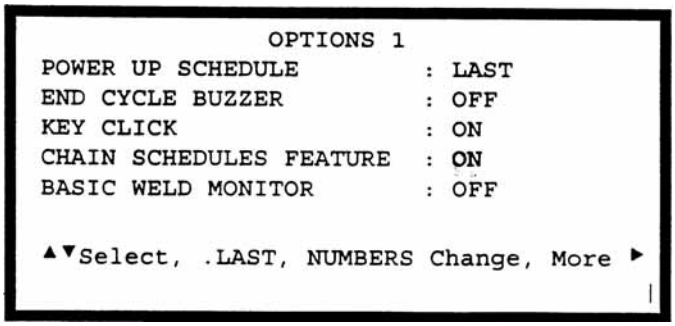
6 Repeat steps 1 through 3 using the Right Weld Head.

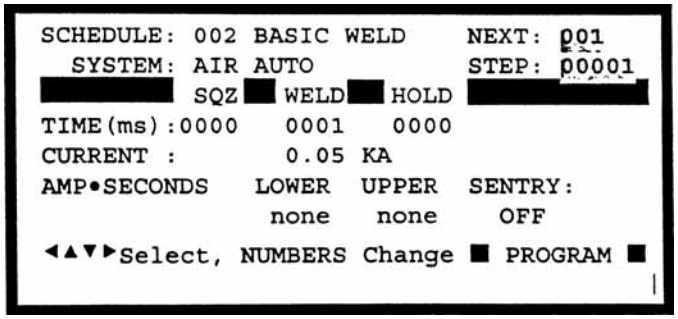
7 Press **SAVE** to save the updated Schedule 2. You are now back in the Weld Graph **RUN** State and ready to turn on the Chaining Feature, which will enable Schedule 1 to automatically sequence to Schedule 2, then back to Schedule 1.

8 Press **MENU** and then select **OPTIONS**. Use the horizontal cursor key ◄ to select the **OPTIONS 1** screen.

9 Select **CHAIN SCHEDULES FEATURE: OFF**. Press CHNG to change to **ON**.

10 Press **RUN** to return to the Weld Graph **RUN** State.





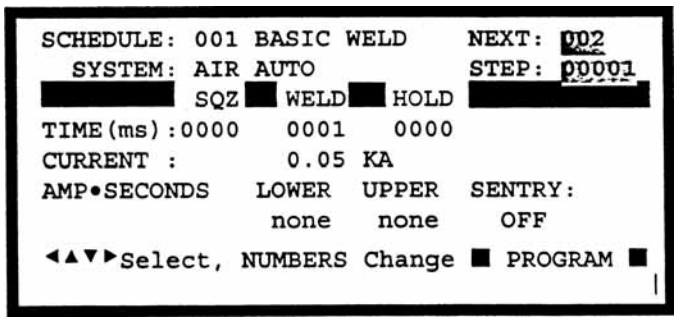
11 Press **PROGRAM** twice to select the Alphanumeric **PROGRAM** screen for Schedule 2.

12 Verify that **NEXT: 001** is correctly displayed so that Schedule 2 will automatically advance to Schedule 1 after one weld has been completed. If you want to make more than one weld using Schedule 2 before advancing to Schedule 1, change **STEP : 00001** to the desired number of welds.

13 Press **SAVE** to save the updated Schedule 2.

14 Press ▼ to select **SCH:001 BASIC WELD**.

15 Press **PROGRAM** once to select the Alphanumeric **PROGRAM** screen for Schedule 1.



Select **NEXT: 001**. Change **001** to **002** so that Schedule 1 will automatically advance to Schedule 2 after one weld has been completed. If you want to make more than one weld using Schedule 1 before advancing to Schedule 2, change **STEP : 00001** to the desired number of welds.

Press SAVE to save the updated Schedule 1. Press CHNG to return to the Weld Graph RUN State. You are now ready to make alternating welds, beginning with Schedule 1, by just pressing on the Foot Switch to activate each weld.

Non-Force Fired, Air Or Cam Actuated Weld Head System

PLC to Control Electrical Connections (Figure 3-6)

1 Connect your Programmable Logic Control (PLC) or Host Computer output control signals to the Control inputs using reed relays or the open collector of an opto coupler. The emitter of each opto coupler must be connected to The Control Rear Panel Control Signals connector, Pin 11.

For a complete description of how to program Relay 1 and Relay 2, reference *Chapter 5, Programming Modes, Output Relays*.

For a complete description on how to use the RS-485 Datacom feature, reference *Appendix B, RS-485 Connection*.

2 All weld schedules must be entered and saved using the Control Front Panel keys. After saving the desired weld schedules, each schedule can be recalled prior to initiating the welding process cycle by closing the binary Remote Schedule Select lines according to the following table:

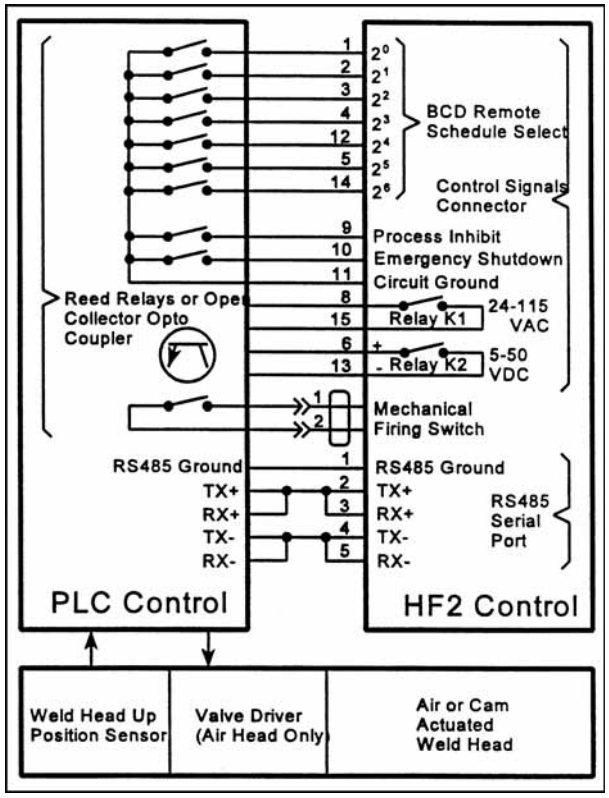


Figure 3-6. PLC to Control Electrical Connections

WELD SCHEDULE	20 Pin 1	21 Pin 2	22 Pin 3	23 Pin 4	24 Pin 12	25 Pin 5	26 Pin 14
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	1	1	0	0	0	0	0
4	0	0	1	0	0	0	0
Binary progression from 5 to 126							
127	1	1	1	1	1	1	1

NO TE: 0 = Open; 1 = Closed

PLC Timing Diagram (Figure 3-7)

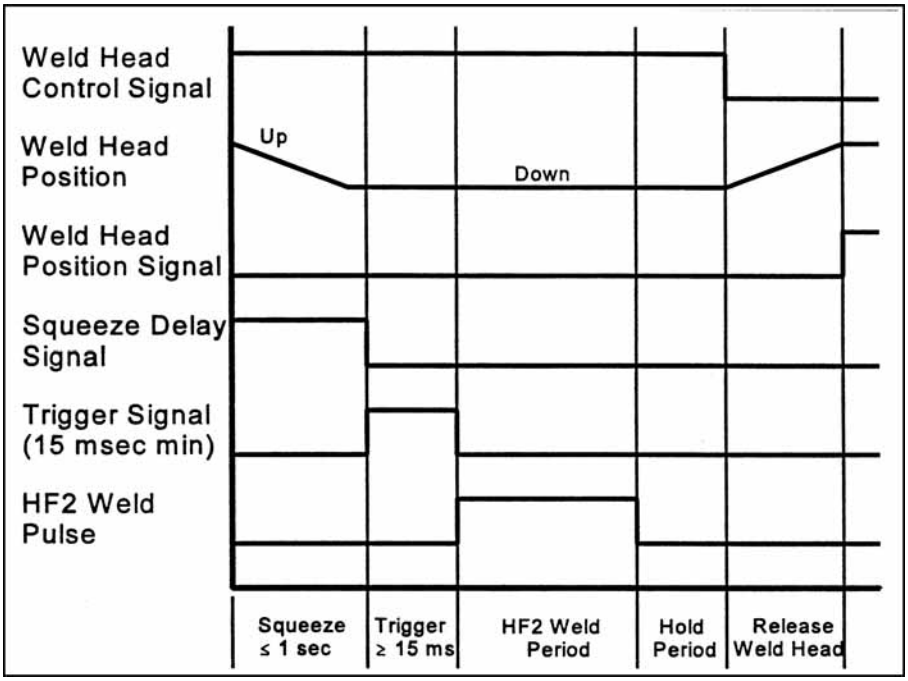


Figure 3-7. PLC Timing Diagram.

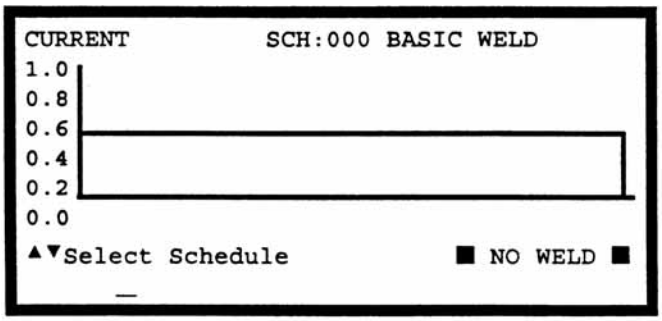
Quick Start Programming Guide

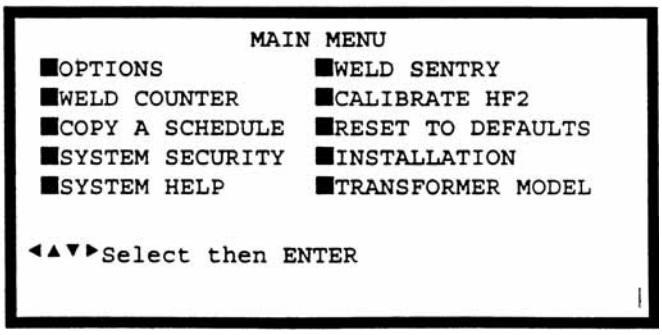
1 Set the Control front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the Power Switch located on the Control rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear.

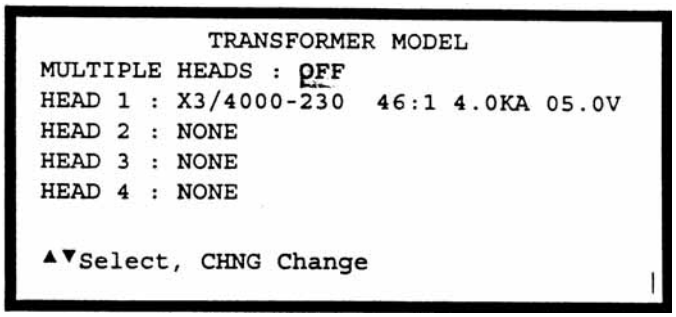
3 Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** Function.

4 Press **MENU**. The **MAIN MENU** screen will appear.





5 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

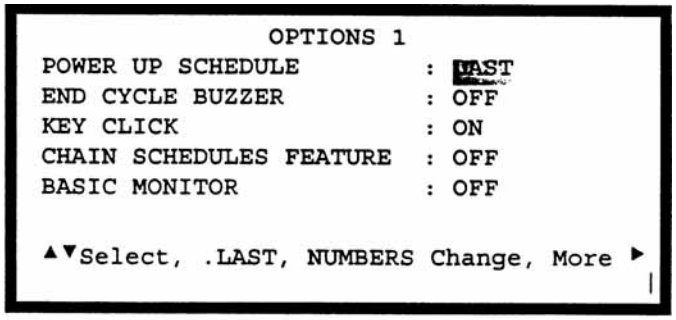


6 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, press **CHNG** until OFF is displayed.

7 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.

8 Press **MENU** to return to the **MAIN MENU** screen.

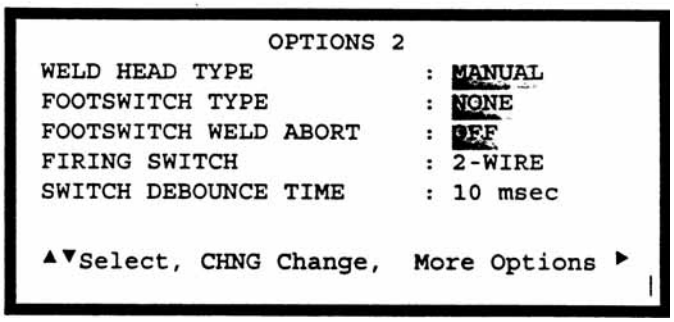
9 Select **OPTIONS**. The **OPTIONS 1** or **OPTIONS 2** screen appears. This example shows the **OPTION 1** screen.



10 Press ◄► to select the **OPTIONS 2** screen.

11 Select **WELD HEAD TYPE: AUTO**. Press **CHNG** until the **MANUAL** option appears.

NOTE: FOOTSWITCH TYPE: AUTO will automatically change to **NONE**.



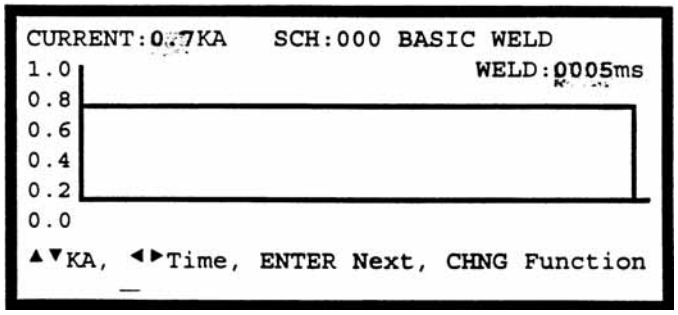
12 Select **FOOTSWITCH WELD ABORT: ON**. Press **CHNG** until the **OFF** option appears.

13 Press **RUN** to return to the Weld Graph **RUN** State.

14 Set the Control front panel **WELD/NO WELD** switch to **WELD**.

15 Make a test weld by pressing on the Weld Head foot actuator until the Control fires. The default WELD time of 1 ms and the default CURRENT of 0.5 KA may not be sufficient to make a good weld.

16 Press **PROG**. Use the vertical cursor keys ▲▼ to increase the weld CURRENT. Use the horizontal cursor keys ◄► to increase or decrease the WELD time. In this example, weld CURRENT has been increased to 0.7 KA and WELD time has been increased to 0.5 ms.



17 Press **SAVE** to save your program. You are now back in the Weld Graph **RUN** State.

18 Make additional test welds and then re-program WELD time and weld CURRENT as necessary to make a good weld. Try to use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

Up to 128 different weld schedules can be created and saved. To manually recall any specific weld schedule, press the up or down vertical arrow keys ▲▼ until the desired schedule number appears on the display screen. A faster technique for recalling a specific schedule is to input the Schedule number using the number keys.

19 To recall any weld schedule automatically, use the binary Remote Schedule Select Control Lines as discussed under the Step 4 of the PLC to Control Electrical Connections section.

Non-Force Fired, Multiple Air Actuated Weld Head System

This system configuration is not released.

CHAPTER 4
CONTROLS

Control Front Panel

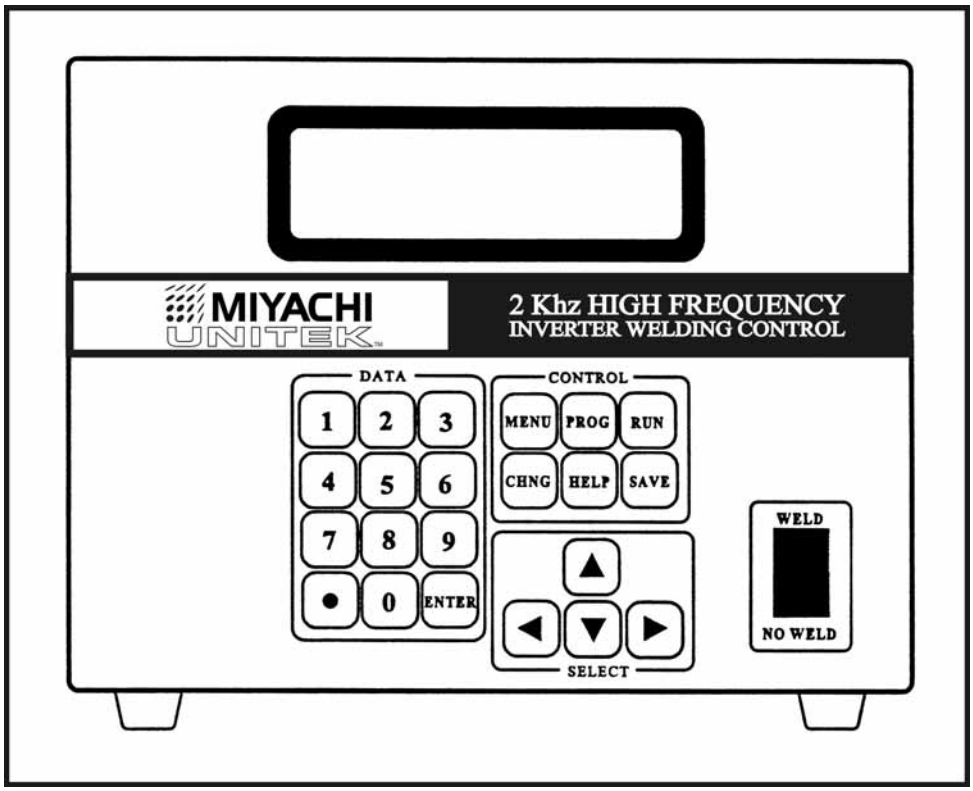


Figure 4-1. Control Front Panel

KEY	DESCRIPTION
KEYPAD	Use the numeric keys to enter numeric information. Use the **.** to enter decimal values.
KEYPAD	Use the numeric keys to change weld schedules without the need to use the ▲▼ keys. For example, pressing 1 0 will recall weld schedule 10.
▲▼	In the **RUN** State, press ▲ to select a higher number weld schedule or press ▼ to select a lower number weld schedule.
▲▼	In **PROGRAM** and **MENU** States, use both ▲▼ to move up and down on the LCD Display to select user options.
◄►	In the **PROGRAM** and **MENU** States, use ◄► to select user options.

PROG	In the **RUN** State, press **PROG** to enter the Graphical **PROGRAM** State to make changes to the selected weld schedule fields. Press **PROG** a second time to make changes using the Alphanumeric **PROGRAM** State. Press **PROG** a third time to make changes to the Weld Sentry programs related to the selected weld schedule. Press **PROG** a fourth time to return to the HF2 Graphical Program screen.
RUN	In the **PROGRAM** State, press **RUN** to exit the **PROGRAM** State without saving the changed weld schedule. The changed weld schedule will become Weld Schedule 0 and will not be written to permanent memory. Welding parts is done in the **RUN** State.
RUN	In the **MENU** State, press **RUN** to exit the **MENU** State and begin welding parts.
SAVE	In the **PROGRAM** State, press **SAVE** to save the selected weld schedule and its related Weld Sentry programs to permanent memory. The Control will then automatically exit the **PROGRAM** State and return to the **RUN** State. **SAVE** has no function in the **RUN** State.
MENU	In either the **RUN** or **PROGRAM** States, press **MENU** to provide a menu list of user options which are common to all weld schedules.
HELP	Press this key whenever you need **HELP** or additional information on any user menu option or flashing user programmable field. The Control contains a built-in operating manual. Press **HELP** a second time to return to the original State.
CHNG	In the **PROGRAM** State, press **CHNG** to restore the previous contents of a user programmable field.
CHNG	In the **MENU** State, press **CHNG** to select different menu options.
CHNG	In the **RUN** State, press **CHNG** to change the Graphical **RUN** State screen to the Alphanumeric **RUN** State screen.
ENTER	Press **ENTER** after keying in numeric program data.
WELD/NO WELD SWITCH	Weld current will not flow when this switch is in the **NO WELD** position. However, operation in the **NO WELD** switch position permits the Control to initiate and execute a complete welding sequence without weld current flowing. Operating the Control in the **NO WELD** position is required to adjust Miyachi Unitek Weld Heads. This switch ***must*** be in the **WELD** position in order to make a weld.

Control - Rear Panel Inputs and Outputs

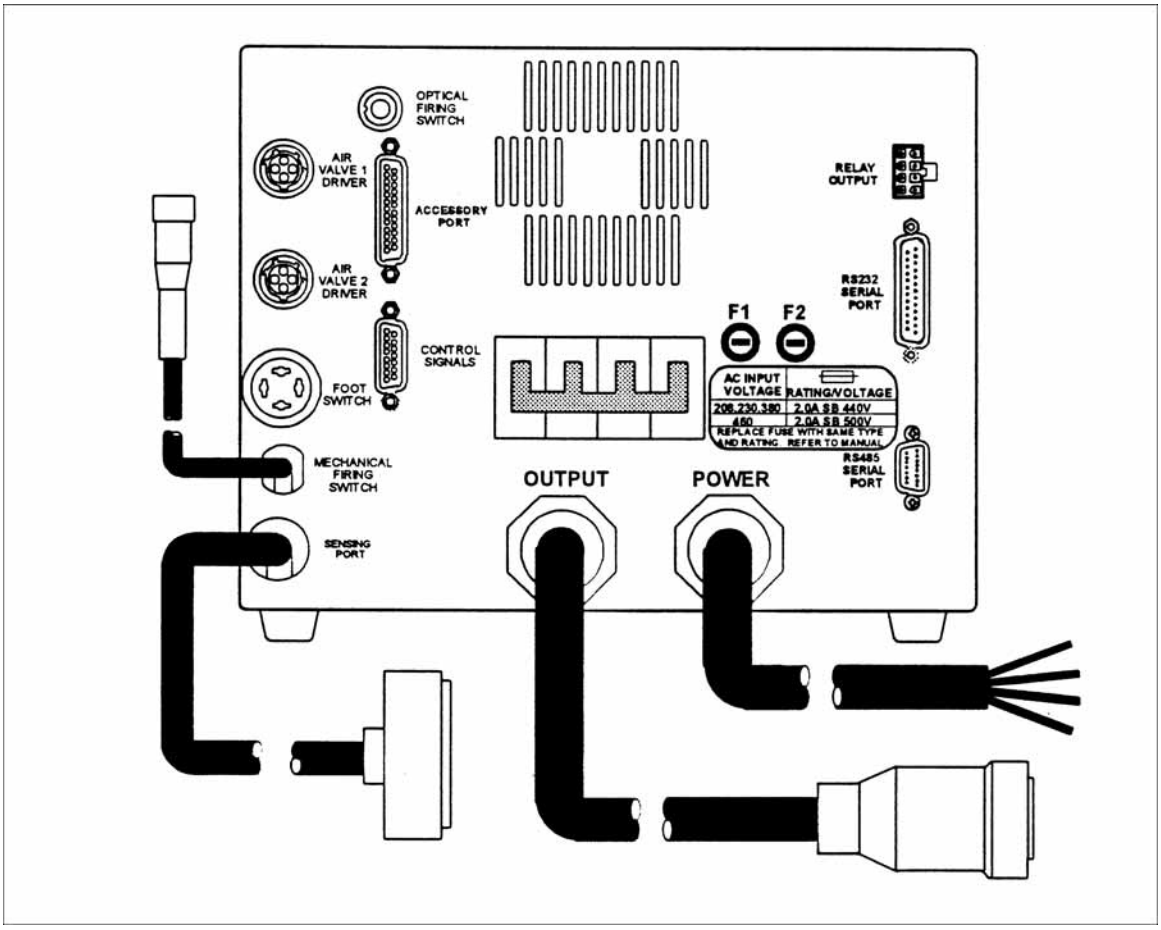


Figure 4-2. Control Rear Panel

- **POWER** - Refer to *Chapter 2, Power Line Voltage, Current, and Wire Size Requirements,* for complete instructions on how to properly apply power to the Control.
- **FUSES F1, F2** - Refer to *Chapter 2, Power Line Fuse Requirements* for complete specifications for Power Line Fuse sizes.
- **SENSING PORT**

  The Sensing Port contains both input and output lines for communicating to the Transformer and the MA-600 Multiple Weld Head Selection Box. The connector attached to the end of the Sensing Port Cable is a 16 pin Honda, P/N: MC16LSF, (Miyachi Unitek Part # 250-235). This connector mates with the connector on the Transformer.

Sensing Port - Connector Pin Assignments

Pin No.	Wire Color	Description
1	Red	Secondary Weld Current Measurement
2	Red	+12 VDC
3	Red	Secondary Weld Voltage Measurement
4	Red	Weld Transformer Select Line 2 (For MA-600)
5	Red	Weld Transformer Thermo Switch
6	Red	Weld Transformer Select Line 4 (For MA-600)
7	Red	Digital Signal Ground
8	Black	230 VAC Weld Transformer Fan
9	Black	Secondary Weld Current Measurement Return
10	Black	Weld Transformer Select Line 1 (For MA-600)
11	Black	Secondary Weld Voltage Measurement Return
12	Black	Weld Transformer Select Line 3 (For MA-600)
13	Black	Weld Transformer Thermo Switch Return
14	Black	Future Expansion
15	Red	Future Expansion
16	Red	230 VAC Weld Transformer Fan Return

OUTPUT

The Output Cable feeds high voltage, pulse width modulated, primary weld current to the primary winding of the Transformer. The connector attached to the end of the Output Cable is an AMP 206136-1 (Miyachi Unitek Part # 520-115). The mating connector on the Transformer is an AMP 206137-1 (Miyachi Unitek Part # 550-071).

Pin No.	Wire Color	Description
1	Black	Primary HF2 Weld Transformer
2	Red	Primary HF2 Weld Transformer
4	Green	Chassis Ground
6	White	Primary HF2 Weld Transformer Return
7	Orange	Primary HF2 Weld Transformer Return

FOOT SWITCH Connector

Control **FOOT SWITCH** connector uses a 4-pin Amphenol 91-PC4F (Miyachi Unitek Part # 550-1-006) bulkhead connector that mates with an Amphenol 91-MC4M (Miyachi Unitek Part # 520-1-009).

Single-Level Foot Switch (Figure 4-3)

1 A Single-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control will automatically return the Upper Electrode to its up position.

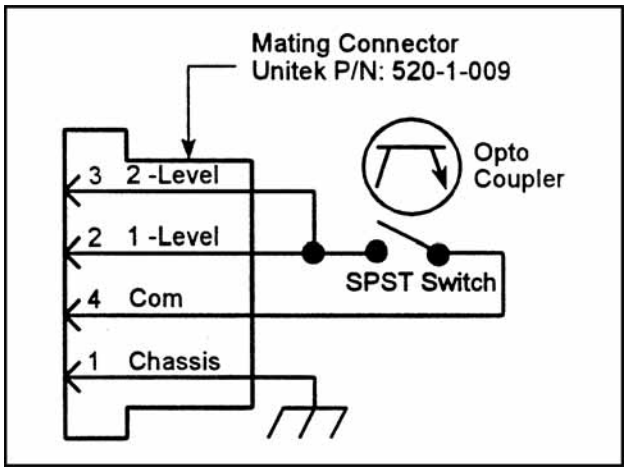


Figure 4-3. Single-Level Foot Switch

2 Connect a Miyachi Unitek Model FS1L Foot Switch, reed relay, or the open collector of an opto coupler to the Foot Switch
connector to initiate the welding process. The emitter of the opto coupler must be connected to Pin 4.

3 When using a non-Miyachi Unitek Foot Switch, connect Pin 2 to Pin 3.

Two-Level Foot Switch (Figure 4-4)

1 When a Two -Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control will automatically return the Upper Electrode to its up position so that the parts can be re-positioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control willautomatically return the Upper Electrode to its up position.

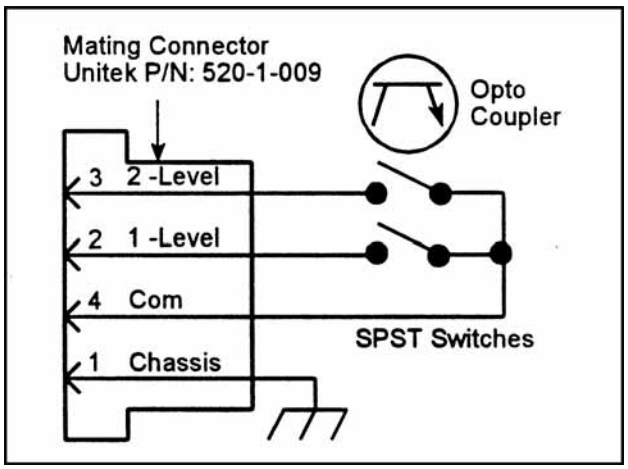


Figure 4-4. Two-Level Foot Switch

2 Connect a Miyachi Unitek Model FS2L Foot Switch, reed relay, or the open collector of an opto coupler to the Foot Switch connector to initiate the welding process. The emitter of the opto coupler must be connected to Pin 4.

Firing Switch Operation

The Control can use: (a) a Single Pole, Single Throw Switch (SPST); (b) a Single Pole, Double Throw (SPDT 3-wire) Switch; or (c) an Optical Switch as an input signal to indicate when the Weld Head has applied the proper force to the parts. Weld Heads with single pole Firing Switches should be connected to the Mechanical Firing Switch Connector. A 3-Wire Switch or Optical Firing Switch, either of which should be connected to the Optical Firing Switch Connector, eliminate switch bounce, which causes false triggering, and should be used when the welding speed exceeds 1.5 welds per second.

MECHANICAL FIRING SWITCH Cable

1 The Mechanical Firing Switch Cable is 5 feet long, Type 2/C, 600 volt cable and contains 2 shielded, twisted 22 AWG conductors of high-flex stranded wire. The Firing Switch Connector is a 2-pin Amphenol 80-MC2FI (Miyachi Unitek Part # 520-011), with strain relief that mates with an Amphenol 80-MC2M (Miyachi Unitek Part # 520-001). Pin 2 is Digital Ground.

2 Connect a Miyachi Unitek Model Weld Head Firing Switch, reed relay, or the open collector of an opto coupler to the Foot Switch connector to initiate weld current. The emitter of the opto coupler must be connected to Digital Ground, Pin 2.

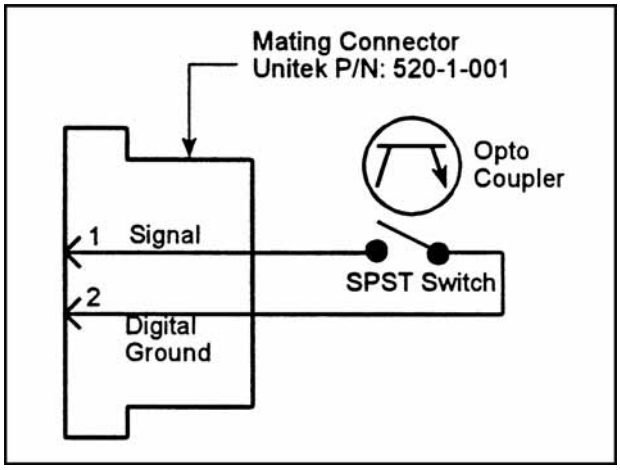


Figure 4-5. Mechanical Firing Switch

OPTICAL FIRING SWITCH Connector

The Optical Firing Switch Connector is a 5 pin AMP 212044-1 (Miyachi Unitek Part # 550-064) bulkhead connector and mates with an AMP Assembly consisting of an AMP 212437-3 Plug, 212435-7 Ferrule and 212800-1 Strain Relief. The Optical Firing Switch can be used in two configurations for initiating a welding process: a) Single Pole Double Throw (SPDT 3-wire); or b) Opto Coupler.

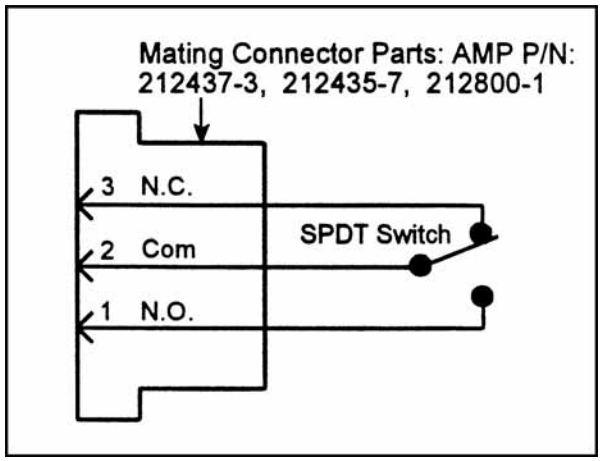


Figure 4-6. Wire Firing Switch

Mechanical Firing Switch - 3-Wire Connection

A SPDT (3-wire) mechanical switch can be connected to the Optical Firing Switch connector to eliminate the use of Switch Debounce Time when welding at rates of 1.5 welds/second.

Opto Coupler Firing Switch - 3-Wire Connection

A SPDT opto coupler switch can be connected to the Optical Firing Switch connector to eliminate the use of Switch Debounce Time when welding at rates of greater than 1.5 welds/second.

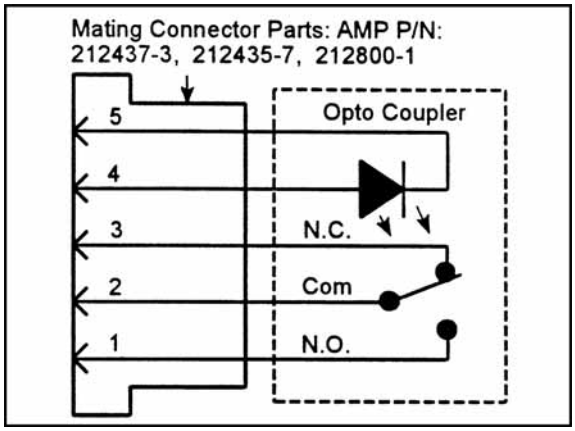


Figure 4-7. Opto Coupler Firing Switch

Control SIGNALS Connector

1 A 15-pin, sub-miniature "D" Control Signals Connector includes inputs for: (a) Remotely selecting weld schedules 1 through 127; (b) Inhibiting the Control from beginning a new welding process; and (c) Invoking an Emergency Stop Condition which abruptly terminates the welding process. The Control Signals inputs and outputs are designed to be used with a Programmable Logic Control (PLC) (see Figure 4-8) or a Host Computer in automated environments.

2 When an external chain control box is connected to the Control Signals Connector in place of a PLC, chained weld schedules can be implemented semi-automatically with an external chain control box (see Figure 4-9).

3 The Control Signals Connector also includes outputs for: a) One DC Solid State Relay; and b) One AC Solid State Relay.

4 The 15 pin connector is a Viking DMRST15RA05CG (Miyachi Unitek Part # 250-1-195). The mating connector is a TRW Cinch Connector comprised of a DA-15P (Miyachi Unitek Part # 250-1-199) male connector and a DE-51210-1 (Miyachi Unitek Part # 250-1-200) plastic junction shell. The mating connector is included in the Control Shipping Kit.

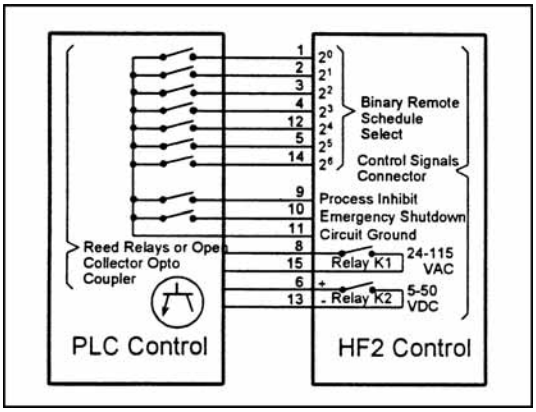


Figure 4-8. Control Signals Connection

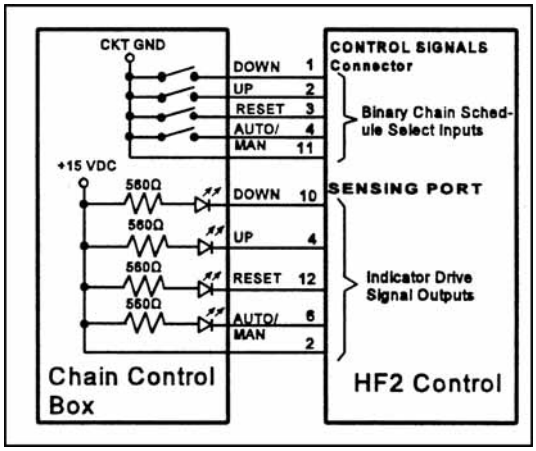


Figure 4-9. Remote Chain Control Box Input/Output Signals

5 Connect a reed relay, or the open collector of an opto coupler to the Control Signals connector to initiate the selection process. The emitter of the opto coupler must be connected to Pin 11. Keep the selected input closed to maintain the selection.

Control Signals - Pin Assignments

Pin No.	I/O	Description
1	Input	PLC input: Remote Weld Schedule Selection, Control Line 20 Chain control box (CCB) input: Schedule Down (decrement number)
2	Input	PLC input: Remote Weld Schedule Selection, Control Line 21 CCB input: Schedule Up (increment number)
3	Input	PLC input: Remote Weld Schedule Selection, Control Line 22 CCB input: Reset (set schedule # to power up schedule #)
4	Input	PLC input: Remote Weld Schedule Selection, Control Line 23 CCB input: Auto/Manual (enable/disable chain function)
5	Input	Remote Weld Schedule Selection, Control Line 25
6	Out-put	Relay K2, + 5-50 VDC (User must supply power)
7	NC	
8	Out-put	Relay K1, 24-115 VAC (User must supply power)
9	Input	Process Inhibit
10	Input	Emergency Stop
11	Input	Circuit Ground
12	Input	Remote Weld Schedule Selection, Control Line 24
13	Out-put	Relay K2, + 5-50 VDC Return
14	Input	Remote Weld Schedule Selection, Control Line 26
15	Out-put	Relay K1, 24-115 VAC Return

Control Signals - Remote Weld Schedule Selection Input

All weld schedules must be entered and saved using the Control Front Panel keys. After saving the desired weld schedules, each schedule can be recalled prior to initiating the welding process cycle. Using the PLC (Figure 4-8), remote weld schedule selection (chain schedule feature turned off) can be implemented by closing the binary Remote Schedule Select lines according to the following table:

WELD SCHED	2^0 Pin 1	2^1 Pin 2	2^2 Pin 3	2^3 Pin 4	2^4 Pin 12	2^5 Pin 5	2^6 Pin 14
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
Binary progression from 3 to 126							
127	1	1	1	1	1	1	1

NOTE: 0 = Open; 1 = Closed

Using a remote chain control box in place of the PLC, a semi-automatic chain weld schedule can be used to control the remote schedule select lines through the Control Signals Connector in accordance with the following table:

Pin No.	Function	Description
1	Schedule Down	Decrement the schedule number
2	Schedule Up	Increment the schedule number
3	Reset	Set the schedule number = power up schedule number
4	Auto/Manual	Enable (Auto)/disable (Manual) the chain schedule function

Note: If (Manual) is selected on pin 4, the chain control box will override the Control chain schedule on/off function and weld schedules can be selected manually from the chain control box (see Figure 4-9).

Control Signals - Emergency Stop Input (Figure 4-8)

Connect a reed relay, or the open collector of an opto coupler to Pin 10 of the Control Signals connector to immediately terminate the welding process. No welding process can be initiated until the switch closure has been removed. The emitter of the opto coupler must be connected to Pin 11.

Control Signals - Process Inhibit Input (Figure 4-8)

Connect a reed relay, or the open collector of an opto coupler to Pin 9 of the Control Signals connector to prevent a new welding process from beginning. No welding process can be initiated until the switch closure has been removed. The emitter of the opto coupler must be connected to Pin 11.

Control Signals - Output Relays (Figure 4-8)

There are two output relays which can be used to provide status or timing signals to a user Programmable Logic Control (PLC) or Host Computer. Relay K1 can switch a 24 to 115 VAC signal. Relay K2 can switch a 5 to 50 VDC signal. When used for status signals, these relays can be independently programmed to close (a) when the Control is initiated; (b) when any portion of the welding process is completed; (c) when the Firing Switch opens; or (d) when the Control is waiting for the welding process sequence to start.

Relay K1 (Figure 4-10)

1 Connect a 24 to 115 VAC voltage source and PLC load to Pins 8 and 15 on the Control Signals Connector. Maximum relay current is limited to 250 ma.

2 Relay K1 is also used to control the Air Valve 2 Driver for sequentially activating a second Air Actuated Weld Head. Refer to *Chapter 3, Miyachi Unitek, Force Fired, Dual Air Actuated Weld Head System* for complete instructions to set up and operate two sequential action Air Actuated Weld Heads. When MENU, OPTIONS 2, WELD HEAD TYPE: is set to DUAL AIR, the options for RELAY 1 must be either AIR HEAD 2 or NOT USED. Air Valve 2 Driver will be actuated in any Schedule in which RELAY 1 is defined as AIR HEAD 2. Air Valve 1 Driver is actuated in any Schedule in which RELAY 1 is defined as NOT USED.

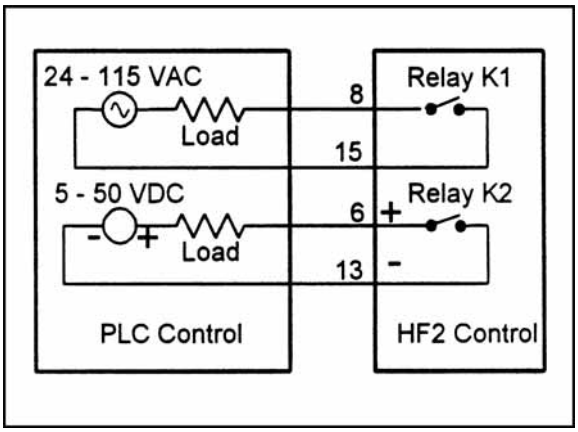


Figure 4-10. Relay K and K2 Connections

Relay K2 (Figure 4-10)

Connect a 5 to 50 VDC voltage source and PLC load to Pins 6 (Positive) and 13 (Negative) on the Control Signals Connector. Maximum relay current is limited to 250 ma.

Accessory Port (Figure 4-2)

A 25-pin, sub-miniature D-type connector, located on the rear panel, is provided to control other devices contemplated for future expansion.

AIR VALVE 1 and AIR VALVE 2 Driver Connectors (Figure 4-11 and Figure 4-12)

Air Valve 1 Driver (Figures 4-11 and 4-12)

Each Air Valve Driver uses a 4-pin black plastic AMP 206430-1 (Miyachi Unitek Part # 550-062) bulkhead connector. The mating plug is an AMP 206429-1 (Miyachi Unitek Part # 520-107) which uses a cable clamp, Amp 206358-2 (Miyachi Unitek Part # 245-084) and 3 male pins AMP 66361-2 (Miyachi Unitek Part # 253-055). When using a non-Miyachi Unitek Air Actuated Weld Head, connect Pin 2 to Pin 4. The Control can sequentially operate two separate Air Actuated Weld Heads using Air Valve 1 Driver and Air Valve 2 Driver outputs.

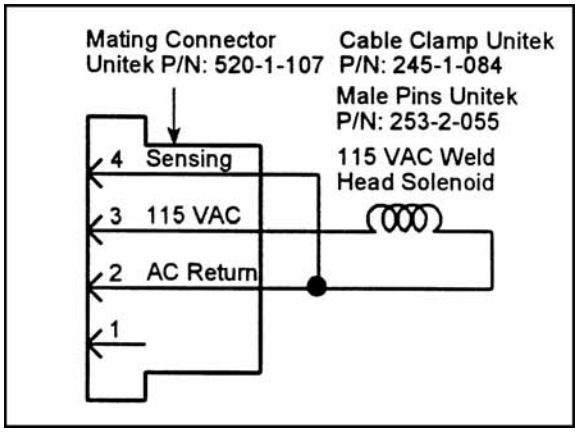


Figure 4-11. 115 VAC Weld Head Solenoid

Air Valve 1 Driver (Figures 4-11 and 4-12)

The output of Air Valve 1 Driver is 12 VA at 115 or 24 volts VAC. The Control automatically applies the correct solenoid voltage to the Air Actuated Weld Head connected to the Air Valve 1 Driver.

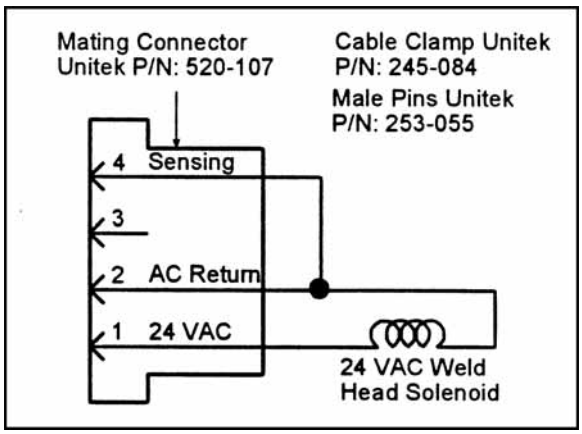


Figure 4-12. 24 VAC Weld Head Solenoid

Air Valve 2 Driver (Figure 4-12)

Air Valve 2 Driver provides 24 VAC at 12 VA to power a second Air Actuated Weld Head. To provide 24 VAC to Air Valve 2 Driver, jumpers E10 and E11 on the control board must be moved to the correct positions. Refer to *Chapter 3, Miyachi Unitek, Force Fired, Dual Air Actuated Weld Head System* for complete instructions to set up and operate two sequential action Air Actuated Weld Heads. Note: When Air Valve 2 Driver is used, Relay K1 cannot be used for marking weld periods or activating alarm conditions.

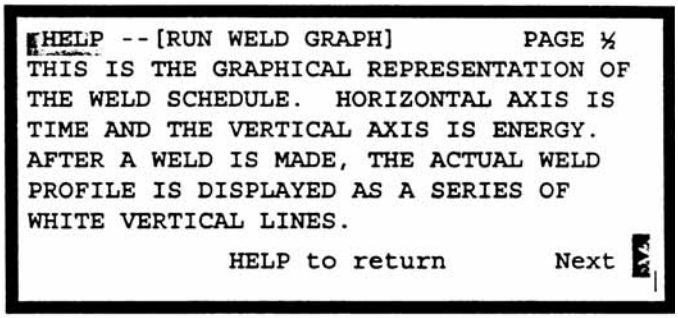
CHAPTER 5
PROGRAMMING MODES

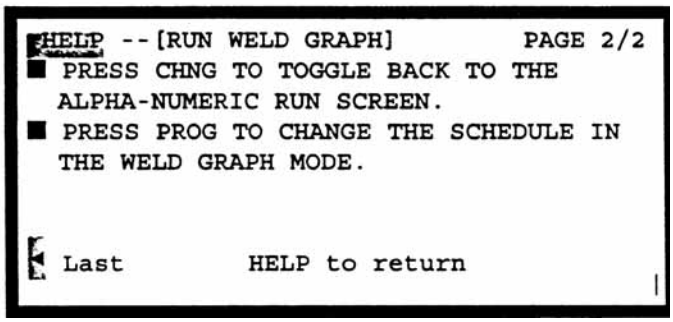
Help Screens

NOTE: We offer our non-English speaking users help screens written in various languages (refer to *Appendix D*). For further information, please contact the factory.

1 The Control offers the user context sensitive **HELP** when running or programming. Press **HELP** whenever you want information about a Menu Option or program variable. Press **HELP** again to return to the original screen. For example, if you press **HELP** from the **RUN** State, information on the function of the Weld Graph and Alphanumeric screens will appear.

2 To read the second page of help information, press the right horizontal cursor key ▶.





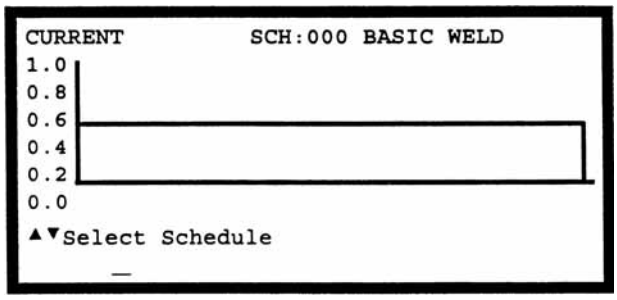
3 To return to the first page of help information, press the left horizontal cursor key ◀.

Machine States

The Control has eight Machine States: **RUN, NO WELD, STANDBY, ALARM, FIRE, MENU, PROGRAM**, and **HELP**. The **NO WELD** State represents the positional status of the **WELD/NO Switch** on the front panel. The **STANDBY, ALARM**, and **FIRE** states are functions of **MECHANICAL FIRING, OPTICAL FIRING**, and **FOOT SWITCH** input states. The operator can force the Control into the **RUN, MENU, PROGRAM**, and **HELP** states by pressing the **RUN, MENU, PROG** or **HELP** keys.

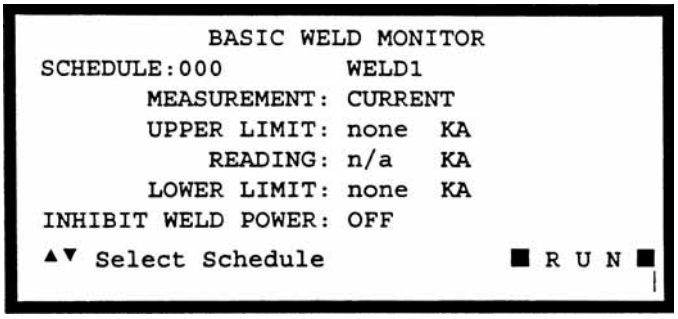
Weld Graph RUN State

In the Weld Graph **RUN** State, the Control is ready to make a weld. You can select, but not change, any weld schedule by using the vertical cursor keys ▲ or ▼ on the Front Panel. Weld schedules may also be selected by using the numeric keypad to key in the desired weld schedule number: 000 through 127.



Basic Weld Monitor Run State

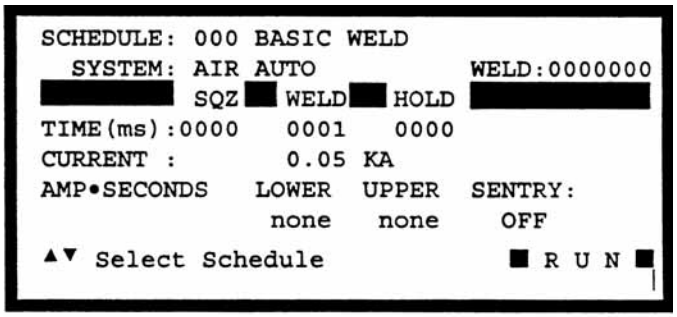
When **MENU, OPTIONS 1, WELD MONITOR:** is set to **BASIC**, pressing **CHNG** will cause the display screen to switch from the Weld Graph **RUN** screen to the Basic Weld Monitor **RUN** screen. Setting **WELD MONITOR** to **LIMIT** causes the Energy Limit Monitor screen to be displayed. See *Chapter 7* and *Chapter 8* for detailed instructions.



Pressing **CHNG** again causes the Basic Weld Monitor **RUN** screen to switch to the Alphanumeric RUN screen. Pressing **CHNG** once more returns the display screen to the Weld Graph **RUN** screen.

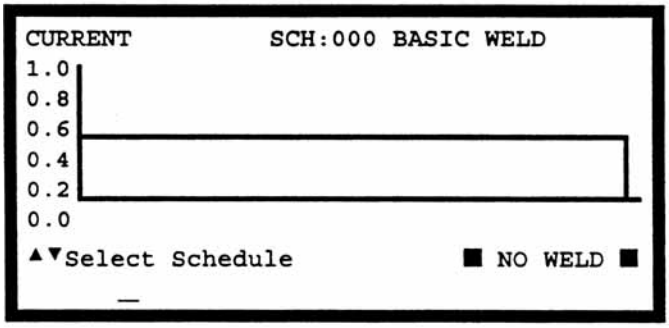
Alphanumeric RUN State

Pressing **CHNG** will cause the display screen to change from the Basic Weld Monitor **RUN** screen, if this option has been set to **ON**, to the Alphanumeric **RUN** screen. Pressing **CHNG** again will return the Control to the **Weld Graph** screen. Welding can be performed in any **RUN** screen.



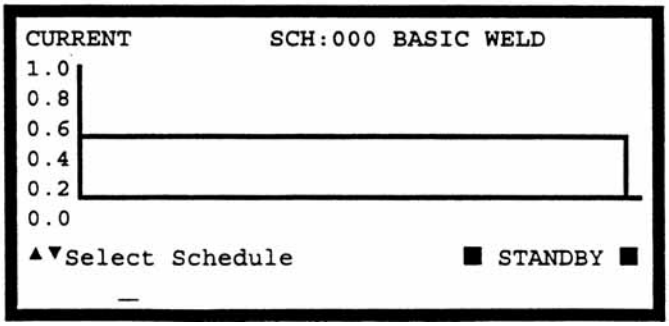
NO WELD State

Switching the **WELD/NO WELD** front panel switch to the **NO WELD** position prevents weld current from flowing but does permit the Control to performing its electronic functions. Use the **NO WELD** State when adjusting the air regulators on Air Actuated Weld Heads.



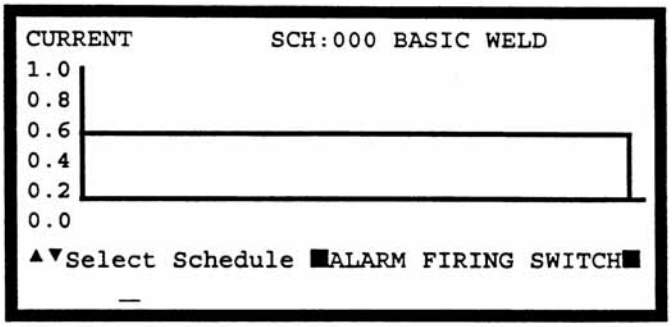
STANDBY State

The Control is waiting for a mandatory event to occur such as: (a) the Firing Switch in a Miyachi Unitek Air Actuated Weld Head to close; (b) the second level of a 2-Level Foot Switch to close; or (c) waiting to be reset to another schedule after a **STOP** Command in a Chained Schedule.



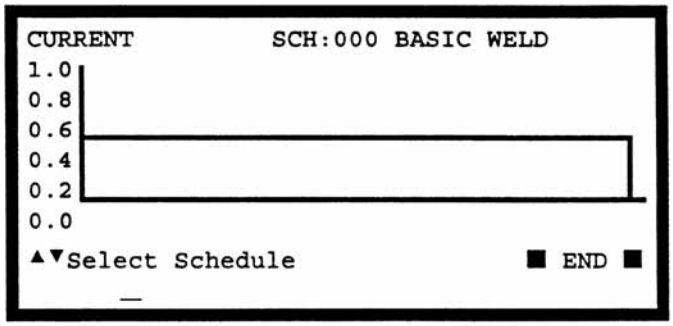
ALARM State

The Control automatically recognizes many alarm conditions which are described in detail under *Appendix C, Alarm Messages*. The **ALARM FIRING SWITCH** screen shown on the right is displayed when the Firing Switch of a Miyachi Unitek Air Actuated Weld Head does not close within 10 seconds.



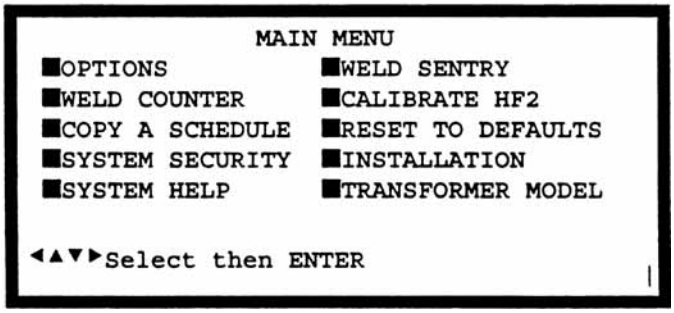
FIRE State

Once weld current is flowing, the Control is in the Fire State. Weld current can be terminated by: (a) removing the first level of a single-level Foot Switch; (b) removing the second level of a two-level Foot Switch; or (c) shorting the Emergency Stop Control Signals Input Pin 10 to Pin 11. Completion of the Firing State is indicated by momentary appearance of the END status message as shown in the example to the right.



MENU State

Pressing **MENU** puts the Control in the **MENU** State, which offers you different options common to all weld schedules such as how the Control interfaces with the Firing Switch, Foot Switch, and Weld Head. Like a tree with many branches, there are multiple Menu levels. Each new level is accessed by making an option selection, then pressing **ENTER**. To return to a previous Menu level, press **MENU**. For a complete description on Menu Options, refer to *Chapter 7, System Options.*



PROGRAM State

1 In the **PROGRAM** State, the Control allows the user to change and save any weld schedule. In those units which include the Weld Sentry Option, the **PROGRAM** State also allows the user to change the Measurement Unit, the Limits related to each Weld Sentry program, as well as the other parameters associated with the Weld Sentry.

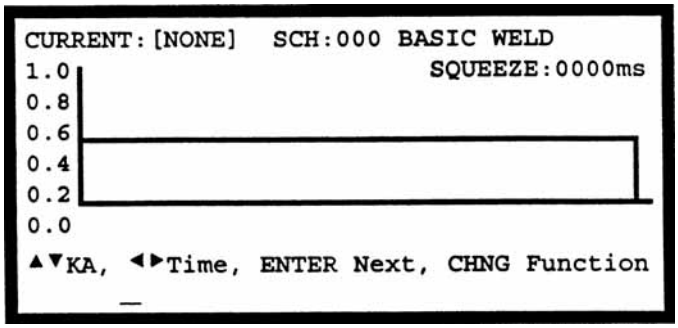
2 A single weld schedule uses one Weld Function. A Weld Function is defined as a series of user programmable time periods, some of which have programmable weld current, voltage, or power levels. Some periods such as **SQUEEZE, COOL, QUENCH, HOLD**, and **OFF** do not have any weld current values associated with them. For a complete description of all Weld Functions, their time periods, and limit values, refer to *Chapter 6, Advanced Welding Functions.*

3 SQUEEZE Time is automatically included as a weld schedule program variable when **MENU OPTIONS 2, WELD HEAD TYPE:** is set to **AUTO, AIR**, or **DUAL AIR** and an Air Actuated Weld Head is connected to the Control. Squeeze Time allows sufficient time for a non-force fired Weld Head to apply the required weld force to the work pieces. Squeeze Time is not normally used with Miyachi Unitek force fired Weld Heads. The weld period will start as soon as the Squeeze Time expires. Squeeze Time can be set to any number between 0 and 2000 ms.

NOTE: There are two methods of programming the Control: (a) use the Weld Graph **PROGRAM** State; or (b) use the Alphanumeric **PROGRAM** State.

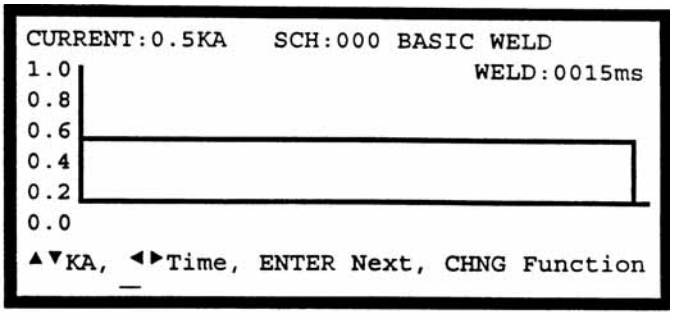
Weld Graph PROGRAM State

Use the vertical cursor keys ▲▼ to select the weld schedule that you want to modify. Press **PROG** to enter the Weld Graph **PROGRAM** State.

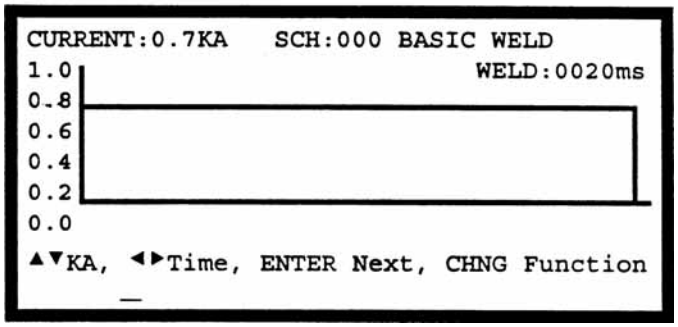


Press **ENTER** to select the period that you want to modify. Note: the upper right-hand corner shows the selected period. Use the horizontal cursor keys ◄► to increase or decrease the period time base which is also displayed in the upper right-hand corner following the selected period. You can also change the period time base by using the keypad to directly enter the exact time. Periods such as **SQUEEZE, COOL, QUENCH, HOLD,** and **OFF** do not have any weld current, voltage, or energy values. This example shows an Air Actuated Weld Head schedule with the **SQUEEZE** period set to 0000 ms.

3 Periods such as **WELD, WELD1, WELD2**, and **TEMPER** have user programmable time base values and weld current, voltage, or energy values. To change the Feedback Type for any of these weld periods, press the keypad decimal point . multiple times until the upper left-hand portion of the screen shows the desired Feedback Type. This example shows a WELD period of 15 ms with the weld CURRENT set to 0.5 kA.



4 To change the weld current, use the vertical cursor keys ▲▼ to increase or decrease the weld CURRENT. Note: when holding the vertical cursor keys down to change the weld CURRENT, the horizontal bar representing the weld CURRENT will not move to its new position until the vertical cursor keys ◄► are released. However, the weld CURRENT value displayed in the upper left-hand corner will automatically scroll during this change process. In this example, weld CURRENT has been increased to 0.7 kA and WELD time has been increased to 20 ms.

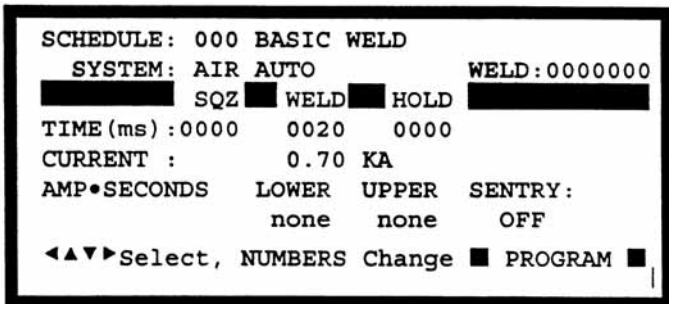


5 Press **SAVE** to save the updated weld schedule. You are now back in the Weld Graph **RUN** State.

Alphanumeric PROGRAM State

1 Use the vertical cursor keys ▲▼ to select the weld schedule that you want to modify. From the Weld Graph **RUN** State or Basic Weld Monitor **RUN** State, press **PROG** multiple times to enter the Alphanumeric **PROGRAM** State. If you are already in the Alphanumeric **PROGRAM** State, press **PROG** once.

2 Use the vertical cursor keys ▲▼ and horizontal cursor keys ◄► to select the program value that you want to change. Use **CHNG** to select **CURRENT, VOLTAGE** or **POWER** Feedback. Use the numeric keypad to enter variable values. This example shows the alpha-numeric version of weld schedule 000 in the middle of this



3 page. Weld **CURRENT** is set to 0.7 kA and **WELD** time to 20 ms.

4 Press **SAVE** to save the updated weld schedule.

5 Press **CHNG** to operate the Control in the Weld Graph State.

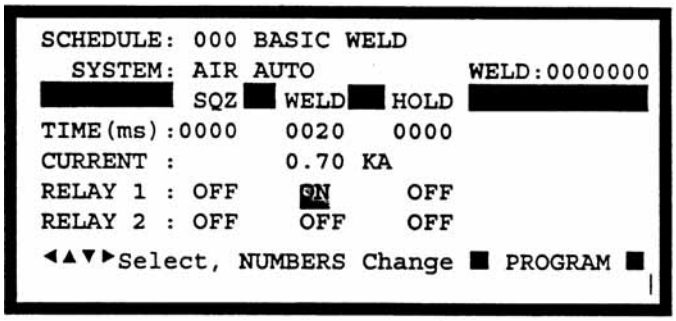
Output Relays

The Control has two solid state relays which can be used to provide status or timing signals to a user Programmable Logic Control (PLC). For a full description on how to connect Relay K1 and Relay K2, refer to *Chapter 4, Control Signals, Output Relays.*

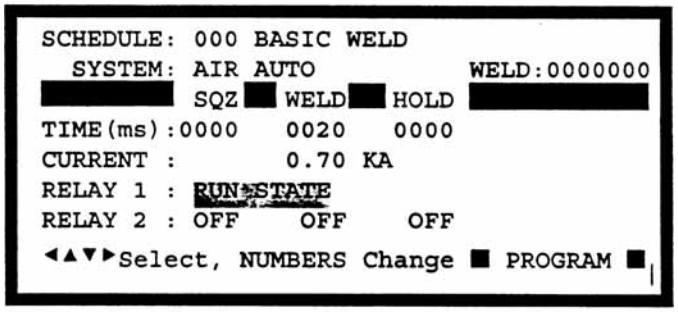
1 Relay **K1** and Relay **K2** can only be programmed in the Alphanumeric **PROGRAM** State.

2 Use the vertical cursor keys ▲▼ to select the weld schedule that you want to modify. From the Weld Graph **RUN** State or Basic Weld Monitor **RUN** State, press **PROG** multiple times to enter the Alphanumeric **PROGRAM** State. If you are already in the Alphanumeric **PROGRAM** State, press **PROG** once.

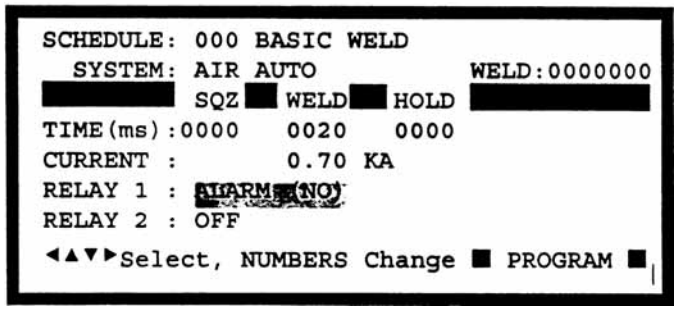
3 Press ▼ until the **RELAY 1** and **RELAY 2** legends are displayed. Both relays can be activated in the **SQUEEZE, WELD**, and **HOLD** periods. Press **CHNG** to select **ON**. In this example, **RELAY** 1 will turn on during the **WELD** period.



4 There are four more **RELAY 1** options listed under the **SQZ** period column. Press **CHNG** to select the **RUN STATE** option. In this example, notice that the **RELAY 1** options for the **WELD** and **HOLD** periods disappear. Selecting the **RUN STATE** option will cause **RELAY 1** to always be on when the Control is not making a weld.



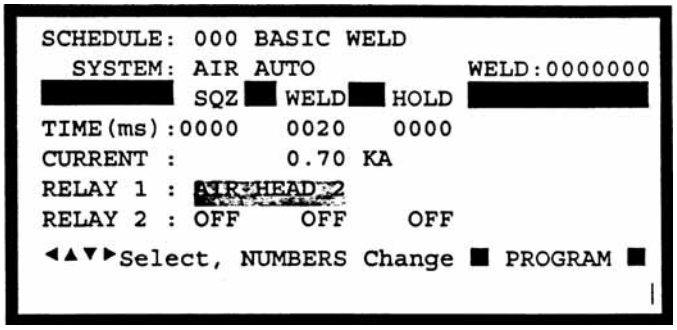
5 Press **CHNG** until the **ALARM (NO)** option appears. An **ALARM** condition causes **RELAY 1** to switch from the normally open **(NO)** state to the closed state. **RELAY 1** automatically opens when the alarm condition is cleared by pressing **RUN** or when the next welding sequence begins.



6 Press **CHNG** until the **ALARM (NC)** option appears. An alarm condition causes **RELAY 1** to switch. An alarm condition causes **RELAY 1** to switch from the normally closed state **(NC)** to the normally open state. **RELAY 1** automatically closes when the alarm condition is cleared by pressing **RUN** or when the next welding sequence begins.

7 Press **CHNG** until the **END PROCESS** option appears. **RELAY 1** automatically turns **ON** for a period of 20 msec after the last **TIME** period.

RELAY 1 - Dual Air Head Operation



1 **RELAY 1** has one additional option not shared with **RELAY 2**. **RELAY 1** is also used to control the Air Valve 2 Driver for sequentially activating a second Air Actuated Weld Head. Refer to Chapter 3, Miyachi Unitek, Force Fired, Dual Air Actuated Weld Head System for complete instructions to set up and operate two sequential action Air Actuated Weld Heads.

2 When **MENU OPTIONS 2, WELD HEAD TYPE:** is set to **DUAL AIR**, the options for **RELAY 1** must be either **AIR HEAD 2** or **NOT USED**. Air Valve 2 Driver will be actuated in any Schedule in which **RELAY 1** is defined as **AIR HEAD 2**. Air Valve 1 Driver is actuated in any Schedule in which **RELAY 1** is defined as **NOT USED**. This example shows **RELAY 1** set to turn on **AIR HEAD 2**.

3 Press **SAVE** to save the updated weld schedule.

4 Press **CHNG** to operate the Control in the Weld Graph State.

CHAPTER 6
ADVANCED WELD FUNCTIONS

Weld Functions

A weld function is a unique heat profile created by weld current, voltage, or power that is applied over a fixed time period, to resistance weld different parts. Welding applications requiring the use of specialized weld functions include: (**a**) parts plated with cadmium, tin, zinc, or nickel; (**b**) parts with heavy oxide coatings such as aluminum; (**c**) parts that are round or not flat; or (**d**) parts made of refractory metals such as molybdenum or tungsten.

The Control is shipped with ten pre-programmed weld functions that are saved in Weld Schedules 001 through 010. While these factory pre-programmed weld functions do not contain sufficient weld time or weld energy for most welding applications, they are a useful starting point to begin welding. Please note that **WELD/REPEAT** will only work with Air Actuated Weld Heads. The table below lists each Weld Function and its general application.

Weld Function	Pre-Prog Schedule	Typical Application
BASIC WELD	001	Make single spot welds on simple flat parts without plating.
WELD/REPEAT	002	Make multiple semi-automatic spot welds using an operator.
QUENCH/TEMPER	003	Spot weld flat or round parts that have minimum plating thickness.
PRE/POSTHEAT	004	Forge weld heavily oxidized or refractory parts such as molybdenum or tungsten.
UP/DOWNSLOPE	005	Weld round parts, parts that are not flat, spring steel parts, or heavily plated or oxidized parts such as aluminum.
BRAZE	006	Reflow two parts together using a braze material.
ROLLSPOT	007	Make automated multiple weld spots using automatic feeders and PLC or host computer.
SEAM	008	Make automated hermetic seam welds using automatic feeders, and PLC or host computer control. Make manual or semi-automatic non-hermetic seam welds using an operator.
DUAL PULSE	009	Use for best control of miniature and small parts spot welding with or without plating.
PULSATION	010	Use only for spot welding simple parts where the total weld energy or weld time required to make an acceptable weld using any other Weld Function is marginal. Using the Pulsation Weld Function can damage the crystal structure of the parts.

BASIC WELD (Figure 6-1)

Basic Weld is a term used by the industry to describe the simplest heat profile used in the majority of resistance spot welding applications. Use Basic Weld to make single spot welds on flat parts that do not have any plating or heavy oxides.

Basic Weld can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

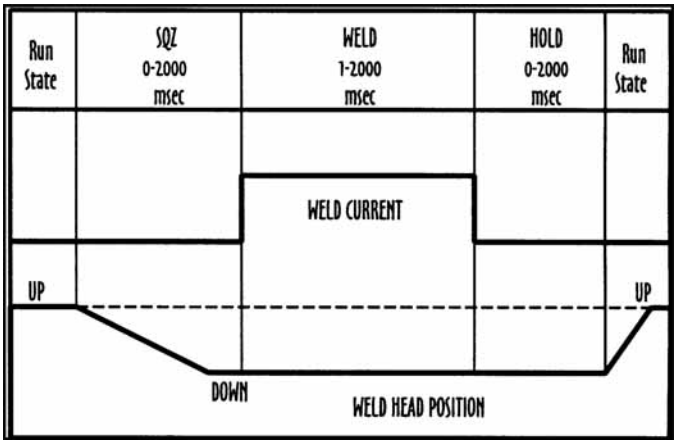


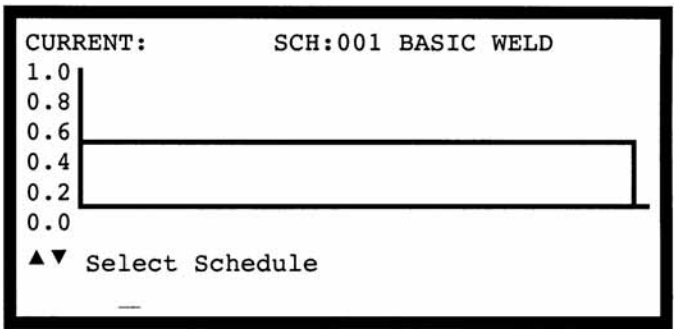
Figure 6-1. Basic Weld

When Basic Weld is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Basic Weld is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

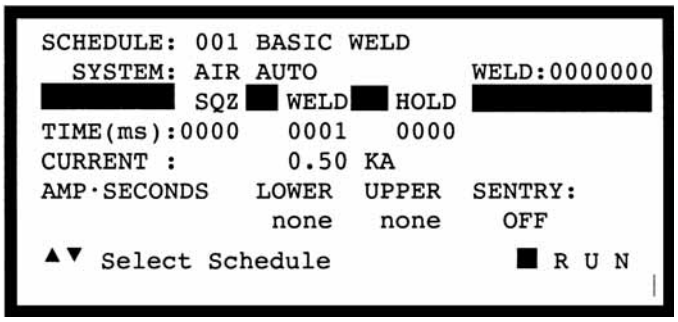
Basic Weld - Weld Graph Run Screen (Figure 6-2)

Weld Schedule 001 is pre-programmed at the factory for Basic Weld operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.



Basic Weld - Alphanumeric Run Screen (Figure 6-3)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.



WELD/REPEAT (Figure 6-4)

Weld/Repeat provides a repeat capability for simple automated Air Actuated Weld Head applications using an operator. This weld function is ideal for volume production, which requires a single schedule.

Weld/Repeat can only be used with an Air Actuated Weld Head. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

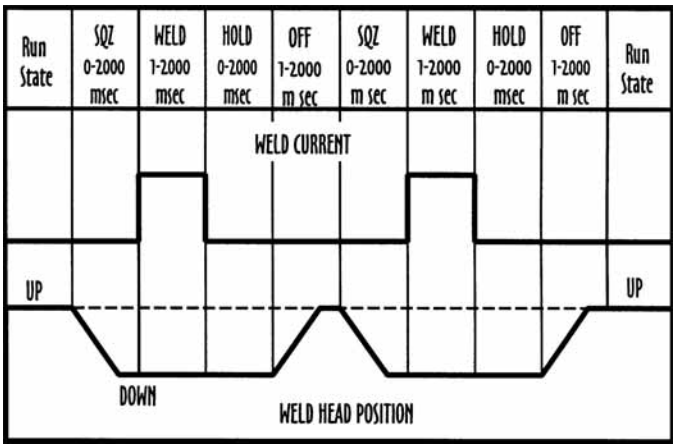


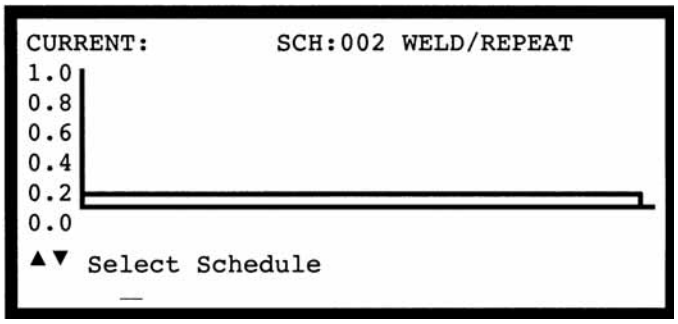
Figure 6-4. Weld/Repeat

When Weld/Repeat is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Weld/Repeat is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens. Off Period, which is applicable only to Weld/Repeat, sets the cycling rate between spot welds by controlling how long the electrodes remain open to allow the parts to be repositioned before the entire weld process repeats.

Weld/Repeat Weld Graph Run Screen (Figure 6-5)

Weld schedule 002 is pre-programmed at the factory for Weld/Repeat operation and will only function using an Air Actuated Weld Head.



Weld/Repeat Alphanumeric Run Screen (Figure 6-6)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

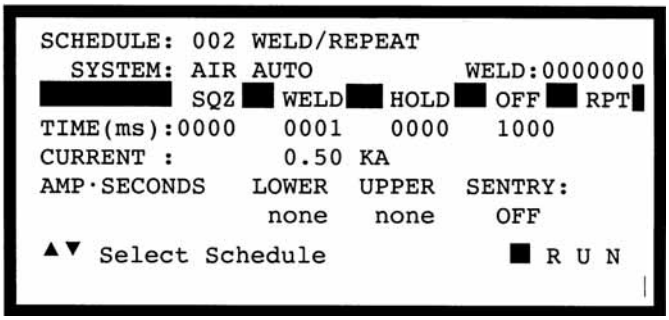


Figure 6-6. Weld/Repeat Alphanumeric Screen.

QUENCH/TEMPER (Figure 6-7)

Quench/Temper is typically used to weld flat-to-flat, round-to-round, or round-to-flat parts together that are plated. Properly used, Quench/Temper can significantly reduce weld splash and electrode sticking.

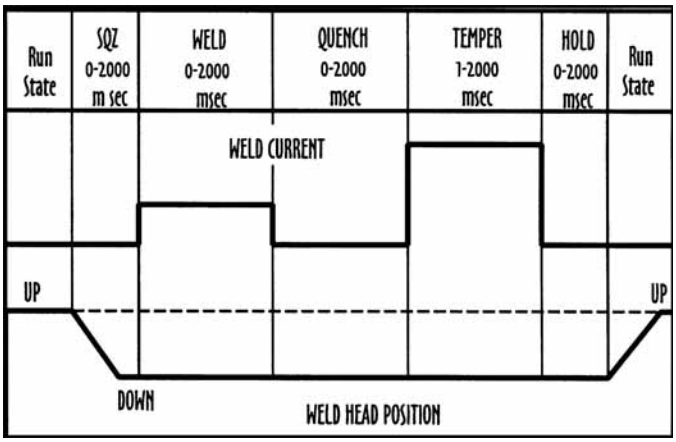


Figure 6-7. Quench/Temper

In the normal application of Quench/Temper, the Weld Period provides sufficient heat to displace the plating or oxides, seat the electrodes against the base metals, and force the parts into intimate contact. The Quench Period allows time to dissipate the heat generated during the Weld Period. The Temper Period completes the structural weld. The Temper Period weld current should be greater than the Weld Period weld current by a factor of two or three since the first bond significantly reduces the resistance of the interface between the parts.

Another use for Quench/Temper is to control grain refinement in the parts. In this application, the Weld Period weld current makes the structural weld. The parts cool during the Quench Period. The low level Temper Period weld current completes the heat treating process by providing sufficient heat to permit grain realignment. In this application, the weld current magnitudes for both the Weld and Temper Periods are completely opposite to those shown in Figure 6-7. 410 stainless steel is one of the materials which must be heat treated (annealed) in order to eliminate the brittle, crystalline structure caused by the weld current. This application of Quench/Temper is not usually used in the form just described for welding small parts.

Quench/Temper can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Quench/Temper is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Quench/Temper is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Quench/Temper - Weld Graph Run Screen (Figure 6-8)

Weld schedule 003 is pre-programmed at the factory for Quench/Temper operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

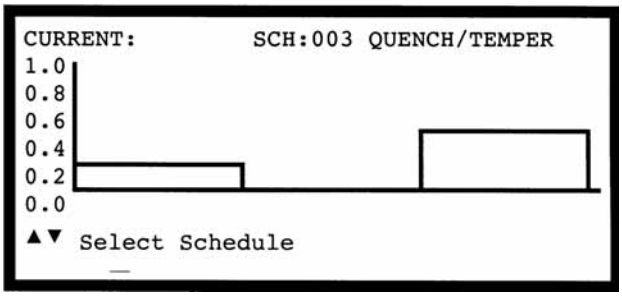


Figure 6-8. Quench/Temper - Weld Graph Run Screen

Quench/Temper - Alphanumeric Run Screen (Figure 6-9)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

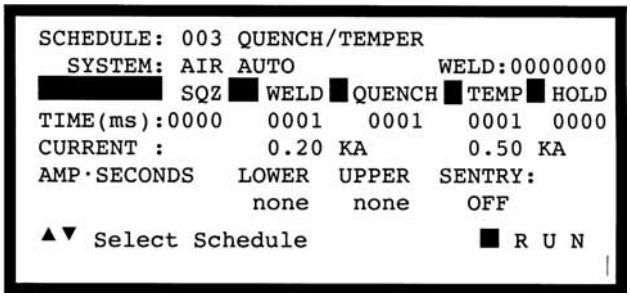


Figure 6-9. Quench/Temper - Alphanumeric Screen

PRE/POSTHEAT (Figure 6-10)

Pre/Postheat is very similar to Quench/Temper. Pre/Postheat is also typically used to weld flat-to-flat, round-to-round, or round-to-flat parts together that may or may not be plated. In addition, Pre/ Postheat works well to create forge type welds when welding refractory materials such as molybdenum and tungsten together. Pre/ Postheat is the most versatile of all of the weld functions. The user can construct a custom weld function by controlling the three Periods, Preheat, Weld, and Postheat and their related weld currents.

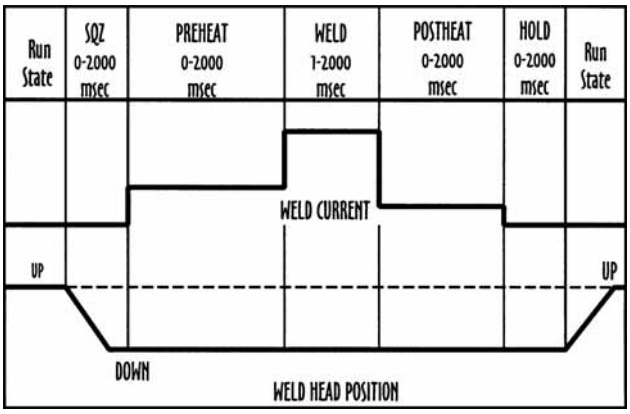


Figure 6-10. Pre/Post Heat

Weld Periods not required can be set to zero. Properly used, Pre/Postheat can significantly reduce weld splash and electrode sticking.

In the normal application of Pre/Postheat, the Preheat Period provides sufficient heat to displace the plating or oxides, seat the electrodes against the base metals, and force the parts into intimate contact. The Preheat Period should be two or three times longer than the Weld Period, which completes the structural weld. The Weld Period weld current should be greater than the Preheat Period weld current by a factor of two or three since the first bond significantly reduces the resistance of the interface between the parts. The Postheat Period immediately follows to provide grain refinement in the parts.

Pre/Postheat can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Pre/Postheat is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (**SQZ**) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Pre/Postheat is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Pre/Postheat - Weld Graph Run Screen (Figure 6-11)

Weld schedule 004 is pre-programmed at the factory for Pre/Postheat operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

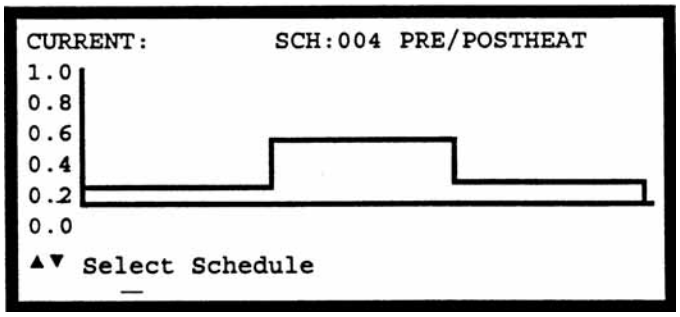


Figure 11. Pre/Postheat Weld Graph Screen

Pre/Postheat - Alphanumeric Run Screen (Figure 6-12)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

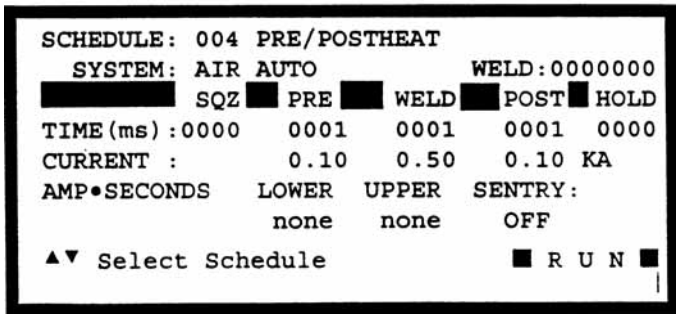


Figure 12. Pre/Postheat Alphanumeric Screen

UP/DOWNSLOPE (Figure 6-13)

Up/Downslope facilitates welding material combinations such as aluminum-to-aluminum or platinum-to-tungsten. Up Slope allows a reduction in electrode force, resulting in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation. Up Slope can also be used to displace plating and/or oxides, reduce flashing and spitting, or reduce thermal shock when welding parts containing glass-to-metal seals. Downslope assists in the grain refinement of certain heat-treatable steels and prevents cracking in aluminum and other materials by reducing the cooling rate.

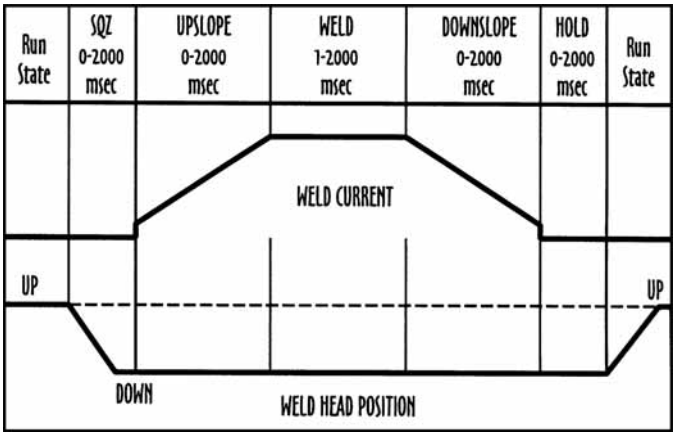


Figure 13. Pre/Postheat Alphanumeric Screen

Up/Downslope can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Up/Downslope is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Up/Downslope is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Up/Downslope - Weld Graph Run Screen (Figure 6-14)

Weld schedule 005 is pre-programmed at the factory for Up/Downslope operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

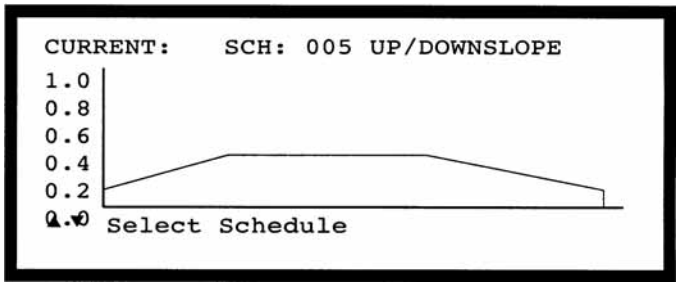


Figure 14. Up/Downslope Weld Graph Screen

Up/Downslope - Alphanumeric Run Screen (Figure 6-15)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

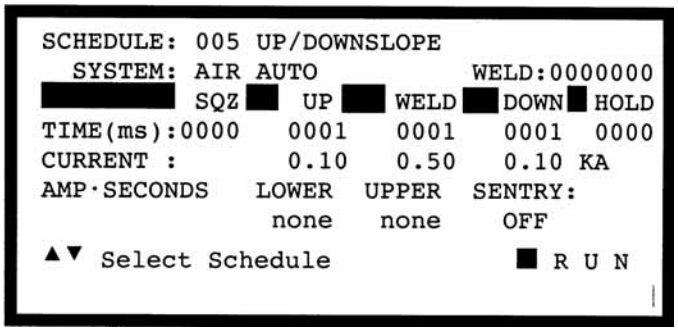


Figure 15. Up/Downslope Alphanumeric Run Screen

BRAZE (Figure 6-16)

This function is ideal for brazing two parts together using a brazing alloy as a "sandwich" between the parts. The brazing alloy can be pre-formed for convenient handling or can be a tin or solder plating on both parts. To ensure complete solidification of the brazing alloy, use the Hold Period to cool the parts.

CAUTION: It is easy to exceed the duty cycle rating for the HF2 Weld Transformer using the Braze weld function. Refer to *Chapter 2, HF2 Weld Transformer Electrical Specifications.*

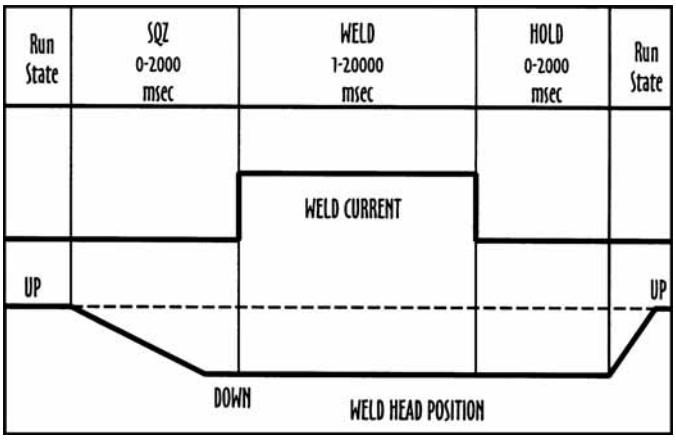


Figure 16. Braze

Braze can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Braze is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (**SQZ**) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Braze is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Braze - Weld Graph Run Screen (Figure 6-17)

Weld schedule 006 is pre-programmed at the factory for Braze operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

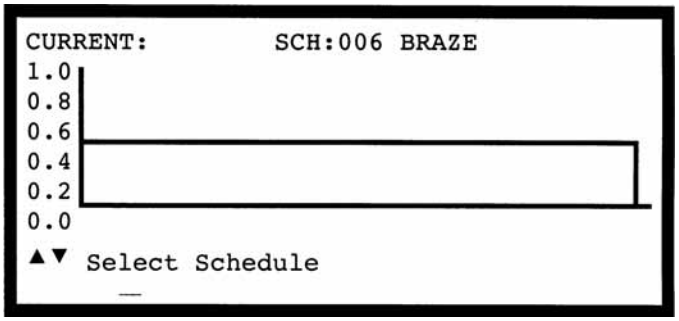


Figure 6-17. Braze - Weld Graph Run Screen

Braze - Alphanumeric Run Screen (Figure 6-18)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

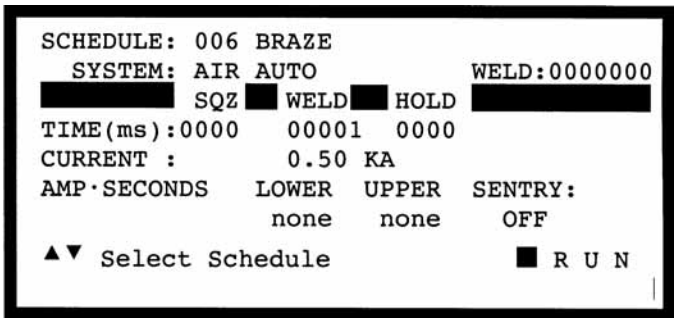


Figure 6-18. Braze - Alphanumeric Run Screen

ROLLSPOT (Figure 6-19)

Rollspot is a special form of seam welding. Typically, upper and lower wheel electrodes, in conjunction with an automatic parts feeder, are used to make a Rollspot weld. Because of the weld current shunting effect after the first weld, set the Weld2 Period weld current greater than Weld1 by a factor of 20% to 50%. Use the larger percentage for closer spacing. Assuming the rotational speed of the wheel is fixed, the Weld2 Period controls the length of the spot and the Cool Period controls the distance between spots.

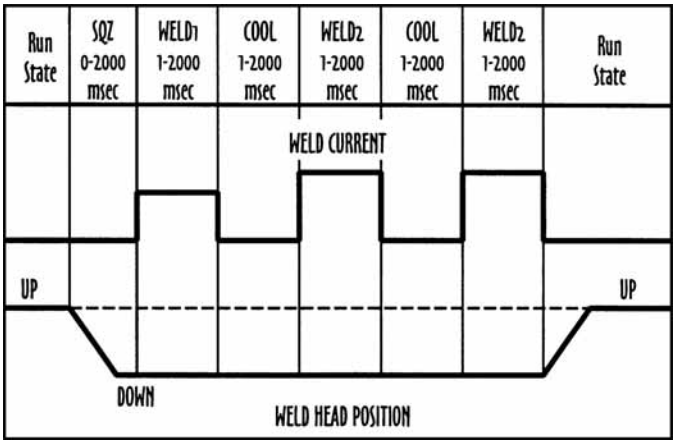


Figure 6-19. Rollspot.

CAUTION: It is easy to exceed the duty cycle rating for the Transformer using the Rollspot weld function. Refer to *Chapter 2, HF2 Weld Transformer Electrical Specifications*.

Rollspot can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Rollspot is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

Rollspot welding continues for as long as all switches remain closed. Hold has no meaning with Manually Actuated Weld Heads and does not appear on either the weld schedule Program or Run screens.

Rollspot - Weld Graph Run Screen (Figure 6-20)

Weld schedule 007 is pre-programmed at the factory for Rollspot operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

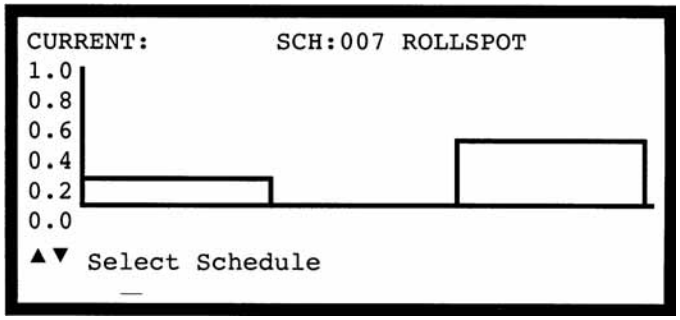


Figure 6-20. Rollspot - Weld Graph Run Screen

Rollspot - Alphanumeric Run Screen (Figure 6-21)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

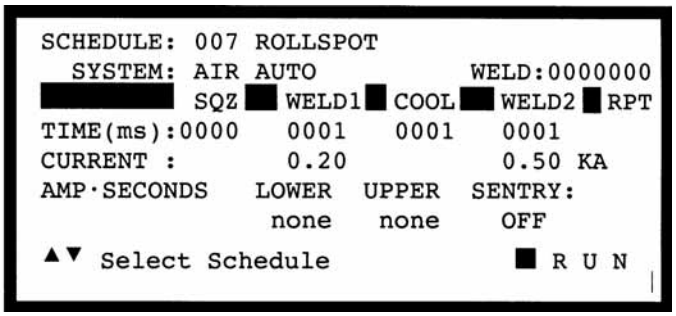


Figure 6-21. Rollspot - Weld Graph Run Screen

SEAM (Figure 6-22)

Seam can be used to make automated hermetic seam welds using automatic feeders, and PLC or host computer control. Seam can also be used to make manual or semi-automatic non-hermetic seam welds using an operator.

CAUTION: It is easy to exceed the duty cycle rating for the Transformer using the Rollspot weld function. Refer to *Chapter 2, HF2 Weld Transformer Electrical Specifications.*

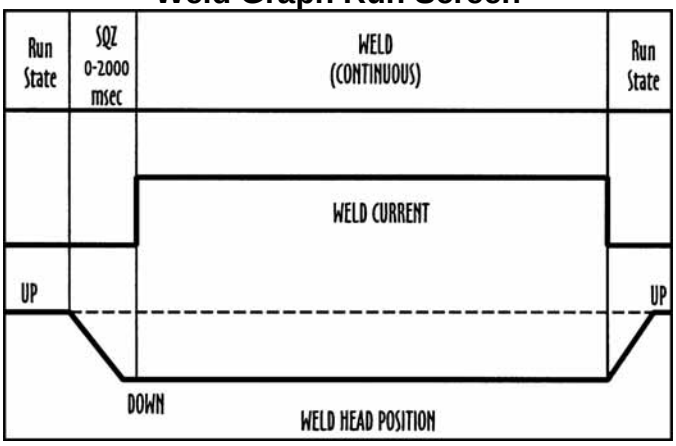


Figure 6-22. Seam

Seam can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Seam is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed. Weld Current flows as long as all switches remain closed.
Hold Period has no meaning with Manually Actuated Weld Heads and does not appear on either the weld schedule Program or Run screens.

Seam - Weld Graph Run Screen (Figure 6-23)

Weld schedule 008 is pre-programmed at the factory for Seam operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

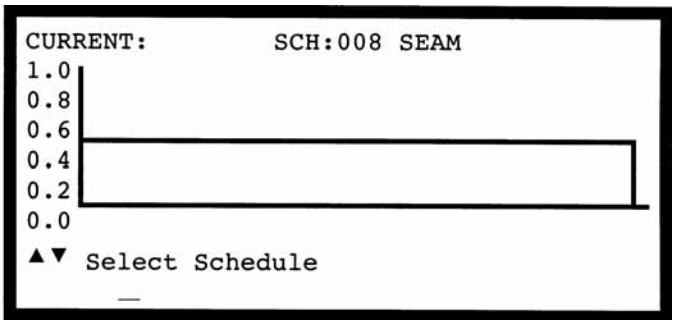


Figure 6-23. Seam Weld Graph Run Screen

Seam - Alphanumeric Run Screen (Figure 6-24)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

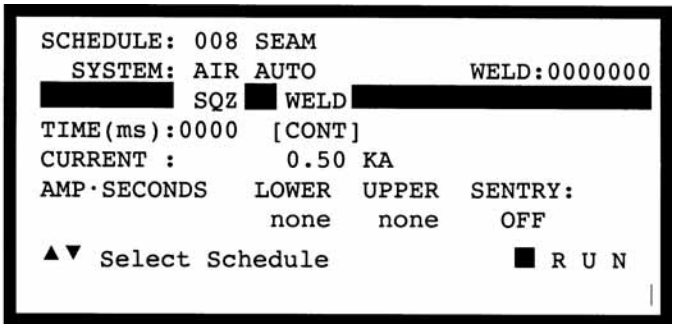


Figure 6-24. Seam Alphanumeric Run Screen

DUAL PULSE (Figure 6-25)

Dual Pulse combines the best features of Up/Downslope with Quench/Temper. Use Dual Pulse for best welding control of flat-to-flat, round-to-round, or round-to-flat small parts that may or may not be plated.

Adding Up Slope to the front of each weld period allows a reduction in electrode force, resulting in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation. Up Slope will also help to displace plating and/or oxides, reduce flashing and spitting, or reduce thermal shock when welding parts containing glass-to-metal seals.

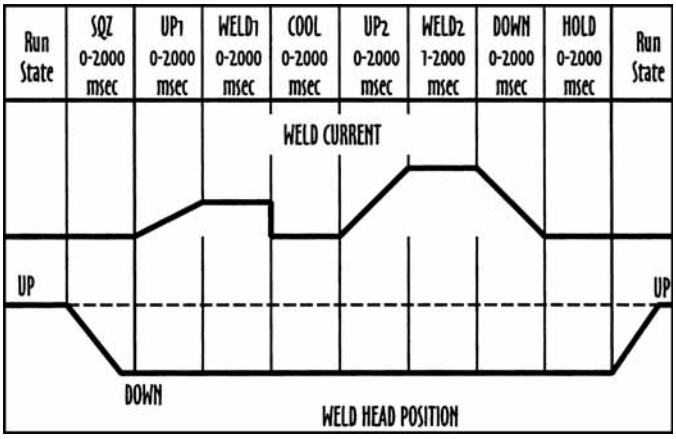


Figure 6-25. Dual Pulse

In the normal application of Dual Pulse, the Weld1 Period provides sufficient heat to displace the plating or oxides, seat the electrodes against the base metals, and force the parts into intimate contact. The Cool Period allows time to dissipate the heat generated during the Weld1 Period.

The Weld2 Period completes the structural weld. The Weld2 Period weld current should be greater than the Weld1 Period weld current by a factor of 2 or 3 since the first bond significantly reduces the resistance of the interface between the parts. The only use for the Down Slope Period following the Weld2 Period is to control grain refinement in brittle parts by slowing reducing the Weld2 Period weld current to zero during the Down Slope Period.

Dual Pulse can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Dual Pulse is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (SQZ) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Dual Pulse is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Dual Pulse - Weld Graph Run Screen (Figure 6-26)

Weld schedule 009 is pre-programmed at the factory for Dual Pulse operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

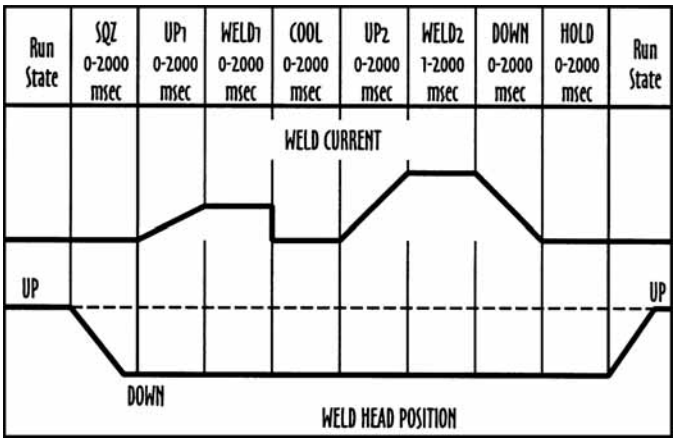


Figure 6-26. Dual Pulse - Weld Graph Run Screen

Dual Pulse - Alphanumeric Run Screen (Figure 6-27)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner. Note: when programming the Dual Pulse weld function that uses an Air Actuated Weld Head, press ► to scroll the program screen to the right to access the Down and Hold periods.

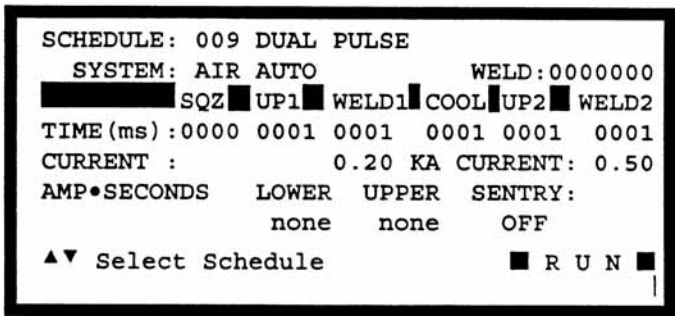


Figure 6-27. Dual Pulse - Alphanumeric Run Screen

PULSATION (Figure 6-28)

Pulsation allows the Control and largest Transformer to be used for applications normally requiring more weld energy by pumping in more total weld heat through the use of many sequential weld pulses. The first Weld Period is followed by an alternating sequence of Cool and Weld Periods. The Pulsation number defines how many Cool/Weld Periods will follow the first Weld Period. Using the Pulsation can damage the crystal structure of the parts by making them more brittle.

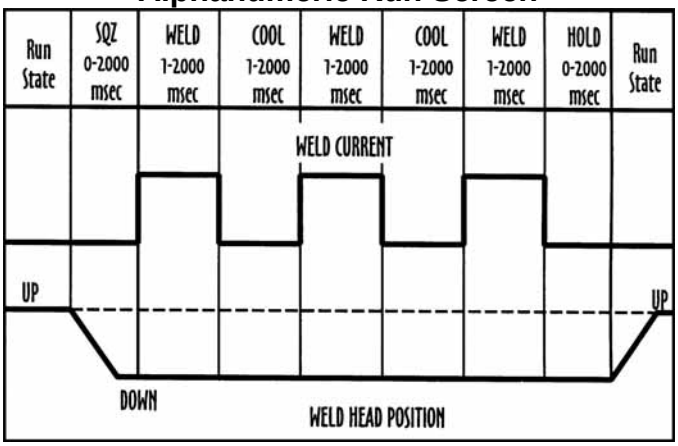


Figure 6-28. Pulsation

Pulsation can be used with Miyachi Unitek Force Fired Manual or Air Actuated Weld Heads. For Manually Actuated Weld Heads, weld current begins when the Force Firing Switch closes. For Force Fired Air Actuated Weld Heads, weld current begins when both levels of a two-level Foot Switch are closed and the Force Firing Switch in the Air Actuated Weld Head closes.

When Pulsation is used with a Non-Force Fired Air Actuated Weld Head, the Squeeze (**SQZ**) Period must be used to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the Weld Period begins. Weld current begins when the Squeeze Period ends and both levels of a two-level Foot Switch are closed.

When Pulsation is used with any type of Air Actuated Weld Head, the Hold Period can be used to automatically keep the electrodes closed on the parts after weld current has terminated for the purpose of providing additional heat sinking or parts cooling. Squeeze and Hold Periods have no meaning with Manually Actuated Weld Heads and do not appear on either the weld schedule Program or Run screens.

Pulsation - Weld Graph Run Screen (Figure 6-29)

Weld schedule 010 is pre-programmed at the factory for Pulsation operation. The Control automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

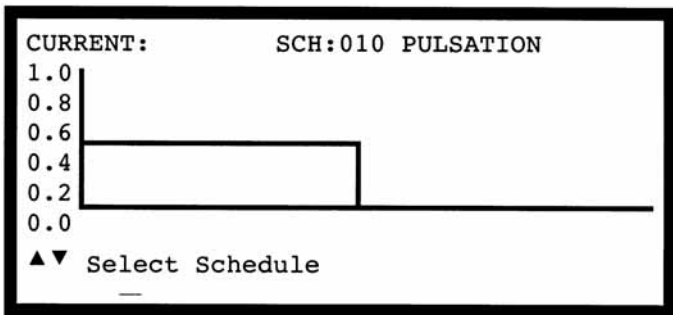


Figure 6-29. Pulsation Weld Graph Run Screen

Pulsation - Alphanumeric Run Screen (Figure 6-30)

To simultaneously view all pre-programmed time periods and energy settings, press **CHNG** to select the Alphanumeric Run screen. The 7 digit Weld Counter is displayed in the upper right corner.

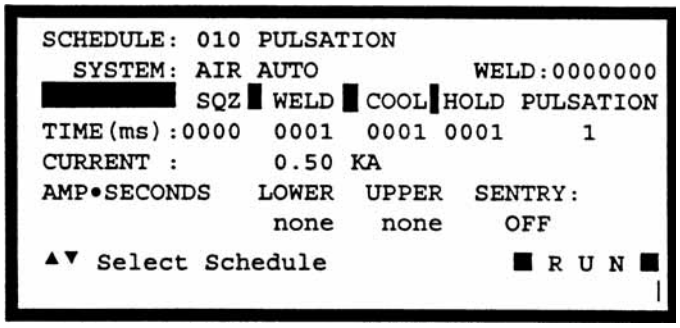


Figure 6-30. Pulsation Alphanumeric Run Screen

CHAPTER 7
SPECIAL FEATURES

System Options

The Control has ten different system options available. Most of these user programmable options allow you to modify how an external input such as a Foot Switch interfaces with the Control. Other options allow the operator to decide what type of Weld Head will be used and how the Weld Head will interface with the Control.

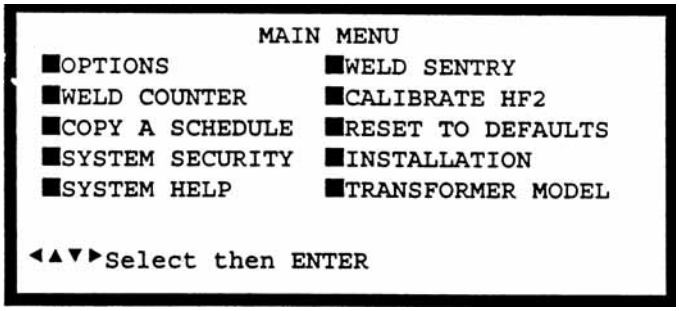


Figure 7-1. Main Menu Screen

OPTIONS 1 (Figure 7-1)

1 Press **MENU**. The **MAIN MENU** screen will appear.
Select **OPTIONS**. The last **OPTIONS** screen displayed will appear. Press the ► key until the **OPTIONS 1** screen is displayed. Five items appear as shown in Figure 7-2.

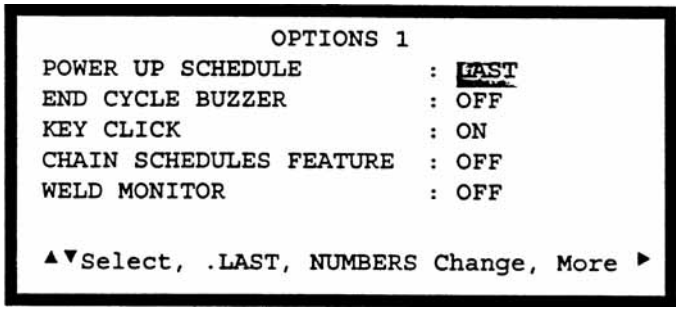


Figure 7-2. OPTIONS 1 Screen

POWER UP SCHEDULE (Figure 7-2)

This option determines which weld schedule will be used when the Control is switched ON: (a) Schedule Number 0-127 or (b) the weld schedule which was selected just before the power was switched OFF.

1 Press **CHNG** to select 000 and then key in a weld schedule number that you want the Control to display on power up.

2 Press . to change a specific weld schedule to **LAST**.

END CYCLE BUZZER (Figure 7-2)

3 This option is normally used with Manually Actuated Weld Heads. ON means that an audible signal will be given at the end of each weld process as a signal to the operator to release the Foot Pedal. Press **CHNG** to select **ON** or **OFF**. **NOTE:** The selection **END CYCLE BUZZER** on the **OPTIONS 1** screen will read **END WELD BUZZER** if you are using the **BASIC WELD** function.

KEY CLICK (Figure 7-2)

This option provides a "click" sound when any front panel key is pressed. Press **CHNG** to select **ON** or **OFF**.

CHAIN SCHEDULES FEATURE (Figure 7-2)

CHAIN SCHEDULES FEATURE is used to sequentially advance from one weld schedule to another specified weld schedule. When Chain Schedules Feature is turned **ON**, the Run Screen and Program Screen for each weld schedule will have additional fields for both **STEP COUNT** and **NEXT SCHEDULE**. **Step Count** and **Next Schedule** are used to chain weld schedules together.

STEP COUNT is a weld counter which counts down to 0. Any number from 00001 to 99999 can be entered as a Step Count. When the Step Count reaches zero, the weld schedule will change as specified by the **NEXT SCHEDULE**. If a weld process is not completed and/or the **WELD/NO WELD** Switch is set to **NO WELD**, the Step Counter will not count down.

NEXT SCHEDULE is the number of the Next Weld Schedule to be used when the Step Count reaches zero. Any weld schedule number from 001 to 127 can be used and any number of weld schedules can be chained together. Exceptions are as follows:

- **NEXT SCHEDULE=000** can only be used at the beginning of a chain.
- **NEXT SCHEDULE=Setting** this number to the same weld schedule currently being used prevents chaining from occurring.
- **NEXT SCHEDULE=**. causes the Control to stop after the Step Count has reached zero and issue a Standby Stop Command alarm.
- **Weld Function=Rollspot** can only be used as the last weld schedule in a chain.

There are three ways to implement the chaining feature:

- Locally from the HF2 control panel
- Remote control using a chain schedule control box connected at the Control Signals Connector
- Remote control of all 127 weld schedules using a PLC. For inter-connection information, refer to *Chapter 4, Control Signals, Remote Weld Schedule Selection Input.*

Turning the Chain Schedules Feature ON

Figure 7-3 shows what a typical weld schedule looks like in the Program State when the chaining feature is turned on. To turn it on:

1 From the **MAIN MENU** screen, select **OPTIONS**.

2 Access the **OPTIONS 1** screen.

3 Set the chain schedules selection to **CHAIN SCHEDULES FEATURE : ON**

4 Save the setting to return to the Alphanumeric **RUN** screen.

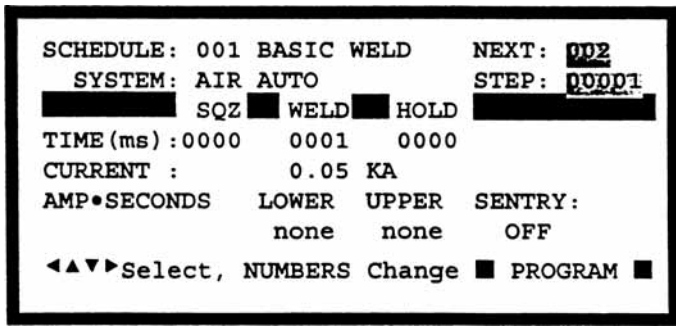


Figure 7-3. Weld Schedule in PROGRAM State -- CHAIN Feature Turned ON.

Local Control

1 From the Weld Graph **RUN** State, press **PROGRAM** twice to select the Alphanumeric **PROGRAM** screen for Schedule 001.

2 Select **NEXT: 001.** Change 001 to the desired next schedule, 002 in this example, so that Schedule 001 will automatically advance to **Schedule 002** after one weld has been completed. If you want to make more than one weld using **Schedule 001** before advancing to **Schedule 002**, change **STEP : 00001** to the desired number of welds.

3 Press **SAVE** to save the updated Schedule 001. You are now back in the Weld Graph **RUN** State.

Remote Control -- Chain Schedule Control Box

The following procedure will program an example weld schedule chain of Schedule 001 through 004, with 001 being the default power up schedule. NOTE: Only four weld control schedules can be used with the chain schedule control box.

1 From the **MAIN MENU** screen select **TRANSFORMER MODEL**. On the **TRANSFORMER MODEL** screen, set:

- **MULTIPLE HEADS: ON**.
- All transformer types to the same model (it does not matter which one)

2 From the **MAIN MENU** screen select **OPTIONS**. Access the **OPTIONS 1** menu and select **POWER UP SCHEDULE**. Enter 001 as the power up schedule.

3 Access the **OPTIONS 2** menu. Select **WELD HEAD TYPE** and change the type to **AUTO**.

4 Access the Alphanumeric **PROGRAM** screen. Select the following parameters:

- **SCHEDULE 001**
- **BASIC WELD**
- **NEXT: 002**
- **HEAD 1**

5 The Alphanumeric **PROGRAM** screen will now appear as shown in Figure 7-4. Save the settings for Schedule 003. The remaining schedules need to be programmed.

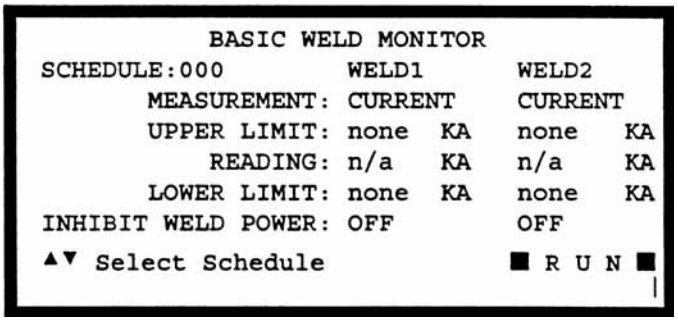


Figure 7-4. Weld Schedule in PROGRAM State -- Power Up Weld Schedule Programmed.

5. Repeat steps 4 and 5 for Schedules 002, 003 and 004 with the following settings:

SCHEDULE 002	SCHEDULE 003	SCHEDULE 004
SCHEDULE 002	**SCHEDULE 003**	**SCHEDULE 004**
NEXT: 003	**NEXT: 004**	**NEXT: .**
HEAD 2	**HEAD 3**	**HEAD 4**
SAVE	**SAVE**	**SAVE**

NOTE: The **NEXT** schedule in **Schedule 004** (the last schedule in the chain) has an entry of the decimal point. This entry tells the Control that **Schedule 004** is the last schedule in the chain.

Remote Control PLC

Refer to *Chapter 4, Control Signals, Remote Weld Schedule Selection Input.*

WELD MONITOR (Figure 7-5)

This option is used to select either of two monitoring functions: the **Basic Weld Monitor** or the **Energy Limit Monitor**.

Once selected, the **Basic Weld Monitor** or **Energy Limit Monitor** screens apply to all weld schedules. For example, if Schedule 001 uses the **Basic Weld Monitor** function, Schedules 002 through 127 will also display the **Basic Weld Monitor** function. Using both Weld Monitor functions simultaneously is not possible.

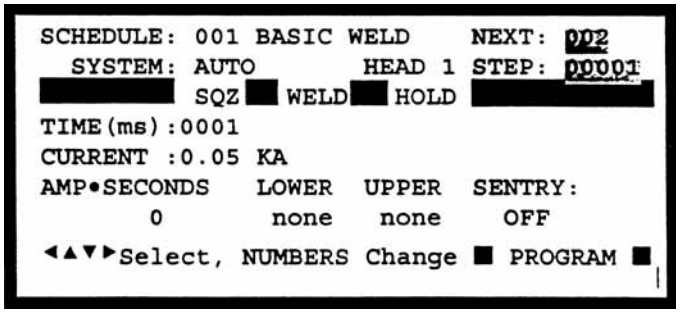


Figure 7-5. Basic Weld Monitor Screen: RUN State Displaying WELD1 and WELD2 Periods.

The **Basic Weld Monitor** permits you to monitor the average peak weld current, voltage, power, or resistance during the **WELD, WELD1**, or **WELD2** periods. For detailed programming instructions, refer to *Chapter 8, Basic Weld Monitor Programming*.

The **Energy Limit Monitor** permits you to automatically turn welding OFF when your programmed current, voltage, power, or resistance limits have been reached during a weld. You may use this function with any of the advanced welding functions, as described in *Chapter 6*.

Energy Limit Monitor

Figure 7-6 shows what a typical energy limit screen looks like in the **Run** state before it is programmed. For detailed programming instructions, refer to *Chapter 8, Energy Limit Monitor Programming.*

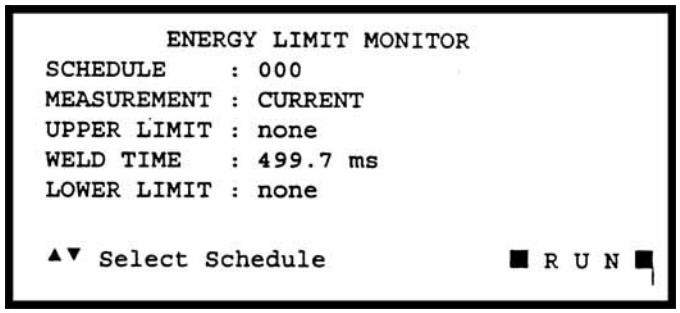


Figure 7-6. Energy Limit Monitor: RUN State

OPTIONS 2 (Figure 7-7)

Press ▶ to select the **OPTIONS 2** screen.

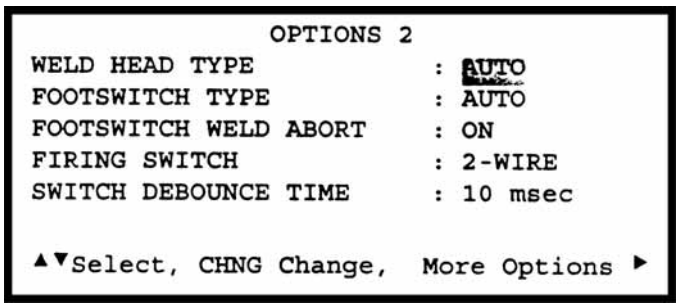


Figure 7-7. OPTIONS 2 Screen.

WELD HEAD TYPE (Figure 7-7)

The Control can be used with a Manual or Air Actuated Weld Head. Air Actuated means that the Control will provide a 24 or 115 VAC output which can be used to control an air valve (solenoid) on an Air Actuated Weld Head. The Control can automatically detect the presence of a Miyachi Unitek Air Actuated Weld Head when **AUTO** is selected. Press **CHNG** to select **AIR, MANUAL, DUAL AIR**, or **AUTO**. For most applications, it is best to leave this option as **AUTO**. For a complete description on how the **DUAL AIR** option can be used to sequentially control two Air Actuated Weld Heads, reference *Page 17, Miyachi Unitek Force Fired, Dual Air Actuated Weld Head System.*

FOOTSWITCH TYPE (Figure 7-7)

The Control requires the use of a Single-Level (1-Level) or Two-Level (2-Level) Foot Switch in order to control an air actuated weld head. The Control automatically detects whether a Miyachi Unitek 1-Level or 2-Level Foot Switch is connected to the Foot Switch Connector located on the rear panel.

A Single-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies the Preset Firing Force, the Control automatically returns the Upper Electrode to its up position.

When a Two-Level Foot Switch is pressed to the first level, the Control energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the operator presses the Foot Switch to the second level, the Control automatically returns the Upper Electrode to its up position so that the parts can be re-positioned. Once the second level has been reached and the Force Firing Switch in the Weld Head has closed, Weld Current will flow and the Control will automatically return the Upper Electrode to its up position.

The Control can automatically detect the presence of a 1-LEVEL or 2-LEVEL Foot Switch when **AUTO** is selected. Press **CHNG** to select **1-LEVEL, 2-LEVEL**, or **AUTO**. For most applications, it is best to leave this option as **AUTO**.

NOTE: When the **WELD HEAD TYPE** option is **MANUAL**, the **FOOTSWITCH TYPE** selection is automatically **NONE**.

For a complete electrical description of the Foot Switch Connector, turn to *Chapter 4, Foot Switch Connector.*

FOOTSWITCH WELD ABORT (Figure 7-7)

This option controls how the Control interfaces with a Foot Switch or Force Firing Switch. Either or both switches will be defined as the Initiation Switch. **FOOTSWITCH WELD ABORT : ON** means the welding process is initiated by the closure of the Initiation Switch(es) and continues to its conclusion as long as the Initiation Switch(es) remains closed. Should the Initiation Switch(es) open during the welding process, the welding process will terminate. **FOOTSWITCH WELD ABORT: ON** is preferred since it allows the operator to abort the welding process by releasing the Foot Switch or Foot Pedal, in the case of a Manually Actuated Weld Head. Press **CHNG** to select **ON** or **OFF**.

FIRING SWITCH (Figure 7-7)

The Control can use as an input signal to indicate when the Weld Head has applied the proper force to the parts either a:

- Single Pole, Single Throw Switch (SPST 2-Wire)
- Single Pole, Double Throw (SPDT 3-wire) Switch
- Optical Switch.

Weld Heads with single pole Firing Switches should be connected to the Mechanical Firing Switch Cable Connector. A 3-Wire Switch or Optical Firing Switch, either of which should be connected to the Optical Firing Switch Connector, eliminates switch bounce, which causes false triggering, and should be used when the welding speed exceeds 1.5 welds per second.

Press **CHNG** to select **2-WIRE, 3-WIRE, OPTO**, or **REMOTE**. Miyachi Unitek Force Fired, Foot Actuated, Weld Heads use a 2-WIRE Firing Switch.

For a complete electrical description of the Firing Switch Connector, turn to *Chapter 4, Firing Switch Operation.*

SWITCH DEBOUNCE TIME (Figure 7-7)

Single Pole, Mechanical Firing Switches 'bounce' when they close. This feature allows you to specify that the Firing Switch must remain closed for 0, 10, 20, or 30 milliseconds before the Weld Period can be initiated. The Control automatically sets the **SWITCH DEBOUNCE TIME** to 0.0 msec whenever a 3-**WIRE** or **OPTO** switch is selected. Press **CHNG** to select 0, 10, 20, or 30 msec.

OPTIONS 3 (Figure 7-8)

Press ► to select the **OPTIONS 3** screen.

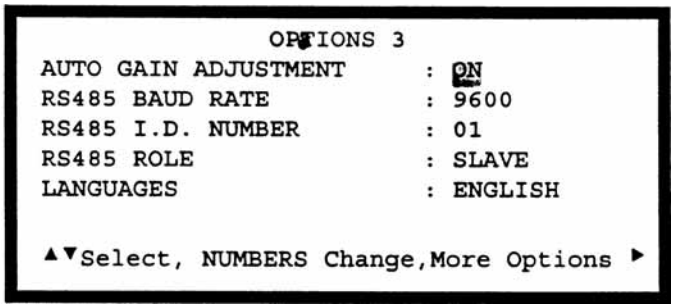


Figure 7-8. OPTIONS 3

AUTO GAIN ADJUSTMENT (Figure 7-8)

The Control uses a special mathematical function to control how fast and accurately weld current, voltage, or power responds to electrical resistance changes in the parts being welded. When set to ON, the Control automatically adjusts the individual constants in the function to produce the fastest and most accurate feedback response. Press **CHNG** to select **ON** or **OFF**. For best welding results, use **ON**.

RS485 BAUD RATE (Figure 7-8)

The **RS485 SERIAL PORT** Connector, located on the back of the Control, can send out welding data to a serial data collection device such as a host computer or serial printer for SPC analysis. The baud rate at which the data is sent must match the baud rate of the data collection device. Press **CHNG** to select 1200, 2400, 4800, 9600, 14.4K, 19.2K, or 28.8K. For more information on data collection, refer to *Chapter 9, RS-485 Datacom.*

RS485 I.D. NUMBER (Figure 7-8)

A host computer can be used to talk with multiple Controls using a single RS485 communications line. However, in order to avoid communications confusion, each Control must be assigned a unique Identification Number (I.D.). Use the numeric keys to enter an I.D. number ranging from 01 to 99. For more information on data collection, refer to *Chapter 9, RS-485 Datacom.*

RS485 ROLE (Figure 7-8)

RS485 Role specifies how the Control communicates with a host computer. Press **CHNG** to select **MASTER** which will automatically send weld data out the RS485 Serial Port after each weld. When **SLAVE** is selected, The Control will only send weld data when controlled by the simple RS485 Datacom software found in the Control Ship Kit or when so requested by a Host Computer. For simple weld data collection, see *RS-485 Connection*. For Host Computer control, refer to the Advanced RS485 Datacom Operation, User's Manual, 990-058, for complete instructions on how to use the **SLAVE** option.

LANGUAGES (Figure 7-8)

The **HELP** screen instructions can be displayed in either English or French. To select the language of your choice, select the **LANGUAGES** option with the ▲ or ▼ key and use the **CHNG** key to toggle between either **ENGLISH** or **FRENCH**.

WELD COUNTER

The Control contains one standard weld counter and three additional weld counters if the Built-in Weld Sentry has been added to the Control.

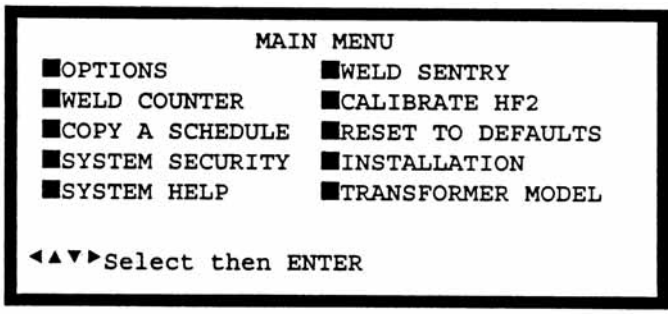
1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen

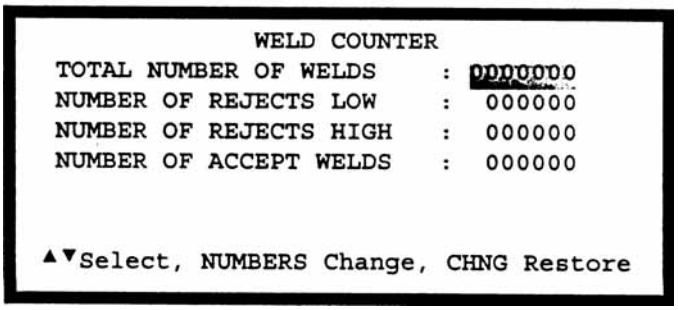
2 Select **WELD COUNTER**. The **WELD COUNTER** screen will appear.

3 Select the weld count number for **TOTAL NUMBER OF WELDS**. This counter increments each time a weld is made in any weld schedule.

4 To set any counter to zero, select the count number and then press the 0 number key. If you accidentally reset the wrong counter, press **CHNG** before leaving the Weld Counter screen and the original count will reappear.

5 Refer to Manual 990-291 for detailed information on the Reject Low, Reject High, and Accept Weld counters.



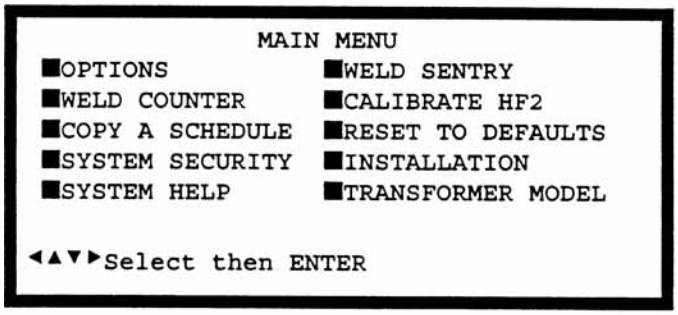


6 Press **MENU** to return to the **MAIN MENU** screen or press **RUN** to return to the Weld Graph **RUN** screen.

COPY A SCHEDULE

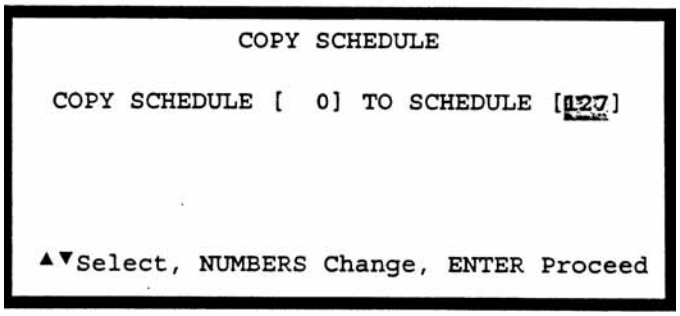
All Control weld schedules and their associated Built-in Weld Sentry programs can be easily copied from one weld schedule to another using the COPY A SCHEDULE option listed under the

1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen.



2 Select **COPY A SCHEDULE**. The **COPY SCHEDULE** screen will appear.

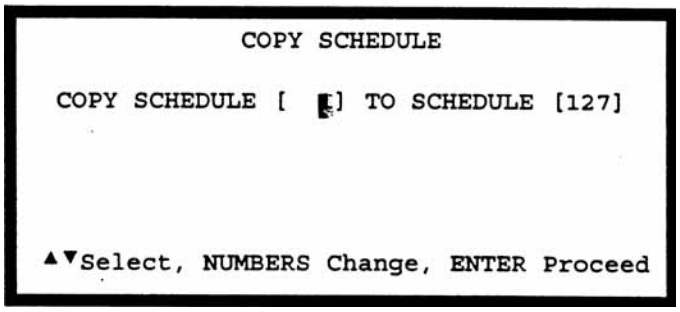
3 Select the last flashing **0** of **TO SCHEDULE 0** and use the number keys to change the flashing **0** to the schedule destination. In this example, **Schedule 127** is the destination schedule.



NOTE: Schedule information previously stored in Schedule 127 will be over-written with new information from the source schedule.

4 **Select the 0 of COPY SCHEDULE 0** and use the number keys to change the flashing **0** to the schedule source. In this example, **Schedule 1** is the source schedule.

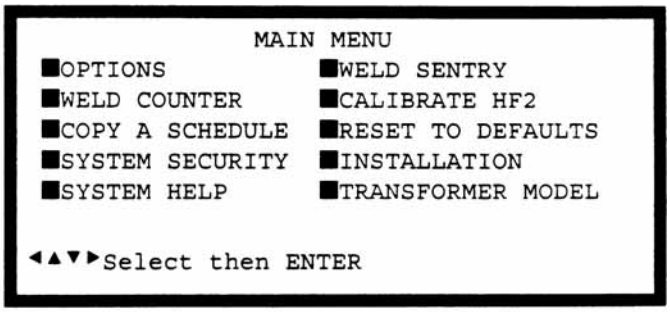
5 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** screen.



SYSTEM SECURITY

All Control weld schedules and their associated Built-in Weld Sentry programs can easily be protected from operator changes by programming the Control with a user defined Protection Code using the **SYSTEM SECURITY** option listed under the **MAIN MENU**.

1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen.



2 Select **SYSTEM SECURITY**. The **SYSTEM SECURITY** screen will appear. The first blank of the of Code Status line should be flashing.

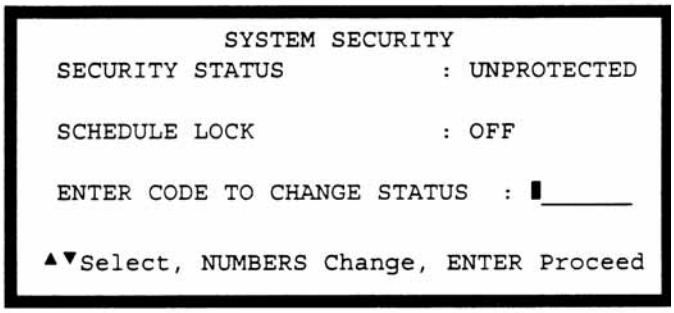
3 Enter a 7 digit number from 0000000 9999999.

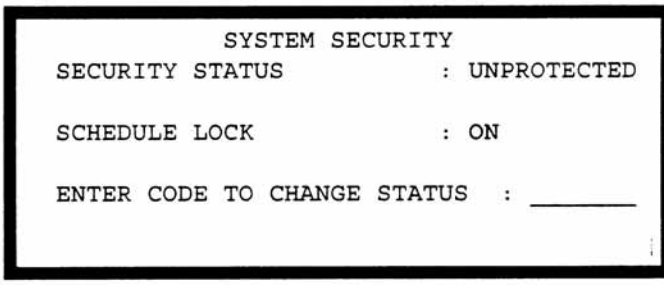
4 If the operator is to kept from changing weld schedules, select **SCHEDULE LOCK: OFF** and use **CHNG** to select **ON**. When **ON** is selected, all other weld schedules are locked out and cannot be used for welding.

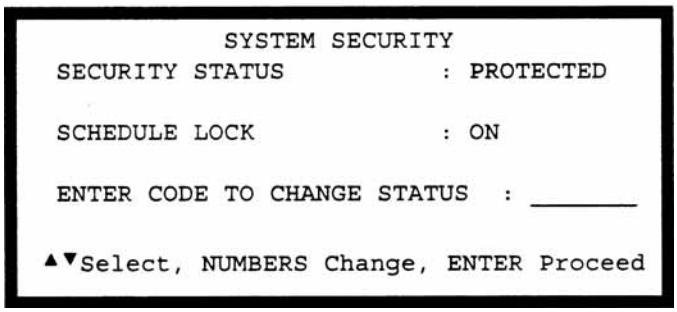
5 Press **ENTER** to enable System Security. **SECURITY STATUS**: will now display **PROTECTED**.

6 Press **MENU** to return to the **MAIN MENU** screen or press **RUN** to return to the Weld Graph **RUN** screen.

7 To unlock the Control, return to the System Security screen and re-enter the security code. The **SECURITY STATUS:** will now display **UNPROTECTED**.







8 If the security code is forgotten or misplaced:

a. Set the **WELD/NO WELD Switch** to **NO WELD**.

b. Return to the System Security screen.

c. Press and hold ◄.

d. Press **SAVE**, then release ◄. **SECURITY STATUS:** will now display **UNPROTECTED**.

SYSTEM HELP

System Help provides detailed descriptions of all hardware features on the Control. Press **ENTER** to display the **SYSTEM HELP** screen. Select the desired topic followed by pressing **ENTER**. Use the horizontal cursor keys ◄► to review each page.

WELD SENTRY

Weld Sentry option provides access to the optional Built-in Weld Sentry Module functions. Refer to the *Built-in Weld Sentry Manual 990-291* for complete Weld Sentry operating instructions.

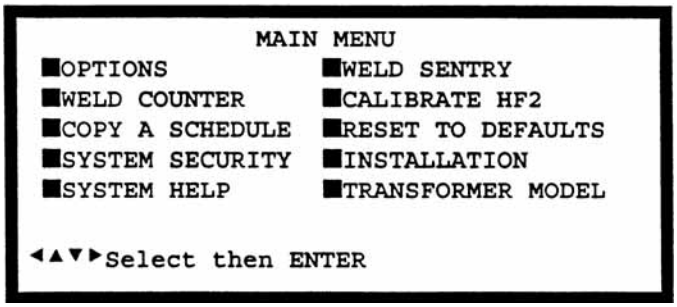
CALIBRATE THE CONTROL

Refer to User Calibration Procedure, Document No. 994-001.

RESET TO DEFAULTS

The Reset To Defaults option permits you to reset all System Parameters or all Weld Schedules to their original factory default settings.

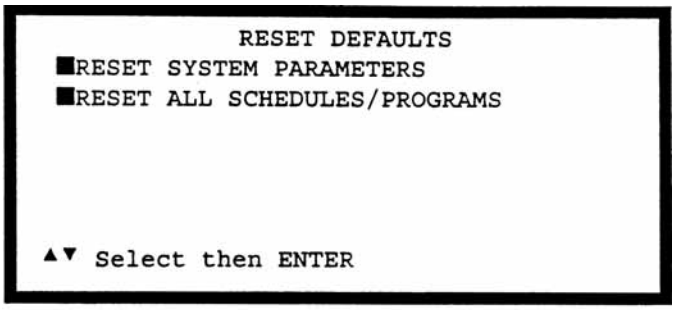
1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen.

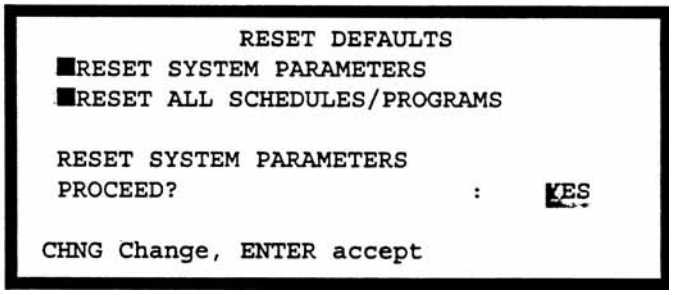


2 Select **RESET TO DEFAULTS**. The **RESET DEFAULTS** screen will appear.

3 Select **RESET SYSTEM PARAMETERS** and Press **ENTER**. The **RESET SYSTEM PARAMETERS PROCEED?** option line appears.

4 Press **CHNG** to change **NO** to **YES** to reset all System Parameters to their factory default settings, followed by **ENTER**. Refer to the table below for a list of the factory default settings. When the reset process is complete, the bottom of the screen will display the message **SYSTEM PARAMETERS ARE RESET**.

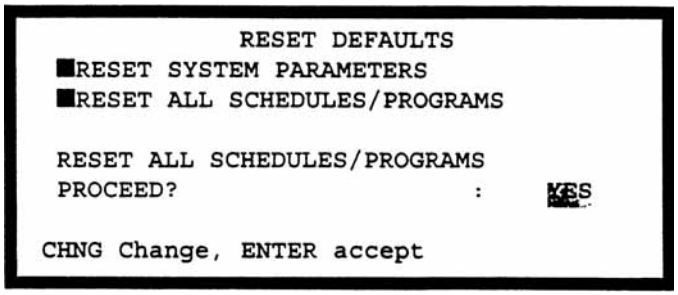




SYSTEM PARAMETERS	DEFAULT	SYSTEM PARAMETERS	DEFAULT
POWER UP SCHEDULE	LAST	FIRING SWITCH	2-WIRE
END CYCLE BUZZER	OFF	SWITCH DEBOUNCE TIME	10 msec
KEY CLICK	ON	AUTO GAIN ADJUSTMENT	ON
CHAIN SCHEDULES FEATURE	OFF	RS485 BAUD RATE	9600
BASIC WELD MONITOR	OFF	RS485 I.D. NUMBER	01
WELD HEAD TYPE	AUTO	RS485 ROLE	SLAVE
FOOTSWITCH TYPE	AUTO	RELAY 1, RELAY 2	OFF
FOOTSWITCH WELD ABORT	ON		

5 Select **RESET ALL SCHEDULES/PROGRAMS**. Press **ENTER**. The **RESET ALL SCHEDULES/PROGRAMS PROCEED?** option line appears.

6 Press **CHNG** to change **NO** to **YES** to reset all Weld Schedules and Built-in Weld Sentry Programs to their factory default settings, followed by **ENTER**.



NOTE: If SPC data has been collected using the optional Built-in Weld Sentry, a warning message will follow the **ENTER** key asking if you want to continue. Press **ENTER** a second time if you want to compete the reset process. When the reset process is complete, the bottom of the screen will display the message **SCHEDULES/PROGRAMS ARE RESET**.

7 Press **MENU** to return to the **MAIN MENU** screen or press **RUN** to return to the Weld Graph **RUN** screen.

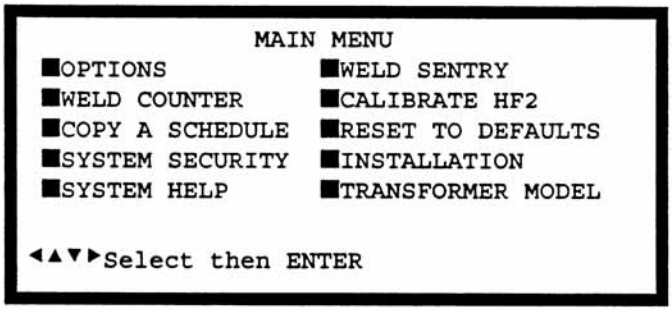
INSTALLATION

The Installation option provides 17 pages of written (no illustrations) instructions on how to set up the HF2 Welding System. Press **ENTER** to select this option, followed by ┼ for each page. The best procedure is to follow *Chapter 2, General Set-up* and *Chapter 3, Welding Systems Set-up* in this manual.

TRANSFORMER MODEL

The Control cannot automatically detect what Transformer has been connected to its rear panel **OUTPUT Cable Connector**. If the correct Transformer is not selected before beginning to weld then, at best, the weld current, voltage, or power actually delivered to the parts will not match the programmed weld schedule settings. At worst, the Control or Transformer may automatically shut down due to thermal overloading.

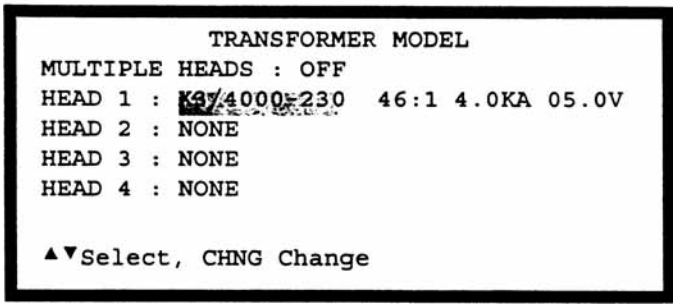
1 Press **MENU**. The **MAIN MENU** screen will appear.

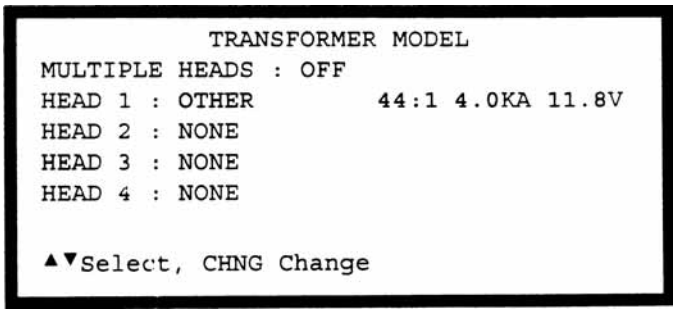


2 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen will appear.

3 Select **MULTIPLE HEADS: OFF**. If the display reads **ON**, then press **CHNG** until **OFF** is displayed.

4 Select **HEAD 1 : X3/4000-230**. X3/4000-230 is the default Transformer Model number. Press **CHNG** until the correct Transformer Model that you have purchased appears.





NOTE: If you are using Voltage Feedback in your weld schedule, you may want to limit the maximum weld current. When using Power Feedback, you may want to limit both the maximum weld current and weld voltage. Select **OTHER**, then program the correct Turns Ratio for your Transformer Model, maximum weld current, and maximum voltage. This example shows a Turns Ratio of 44:1, a maximum weld current of 4.0KA, and a maximum weld voltage of 11.8V. These limits apply to any weld schedule Feedback option.

5 Press **MENU** to return to the **MAIN MENU** screen or press **RUN** to return to the Weld Graph **RUN** screen.

CHAPTER 8
WELD MONITORING

The Control offers two different weld monitoring techniques:

- Basic Weld Monitor.
- Energy Limit Monitor.

The Basic Weld Monitor measures one electrical welding parameter during the weld period only, then compares this measurement against user set limits after the weld period pulse is finished.

The Energy Limit Monitor measures one electrical welding parameter during all weld periods, including any up or down slope periods, then compares this measurement against user set limits during the entire weld. If any user set limit is exceeded, weld energy is immediately terminated.

Basic Weld Monitor General Description (Figure 8-1)

The Control contains a simple, built-in Basic Weld Monitor that can be enabled to measure the average peak weld current, voltage, power, or resistance during the **WELD1** or **WELD2** periods.

Only one welding parameter can be measured for each weld period. The **WELD2** period is only available in the Quench/Temper and Dual Pulse welding functions. Measuring Up Slope, Down Slope, Preheat, or Postheat weld periods is not possible using the simple Basic Weld Monitor.

User set Upper and Lower Limits can be used to create alarm signals by programming **RELAY 1** or **RELAY 2** to turn on under any **ALARM** condition.

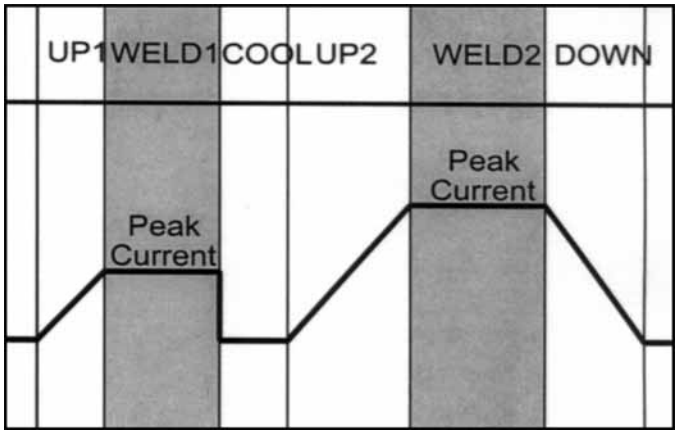


Figure 8-1. Basic Weld Monitor Measurements

In addition, The Basic Weld Monitor feature allows the user to inhibit **WELD2** from occurring if the actual measurement reading from **WELD1** falls outside the user set Upper or Lower Limits. Figure 8-1 shows a Dual Pulse welding function with both the **WELD1** and **WELD2** periods being measured.

Weld Current and Weld Voltage Measurements (Figure 8-2)

The measurements made by the Basic Weld Monitor are derived by averaging the maximum and mini-mum peak value of the weld current and weld volt-age. Figure 8-2 shows a **WELD 2** voltage measurement example when the Control is using constant current feedback. The dotted line represents the average peak reading.

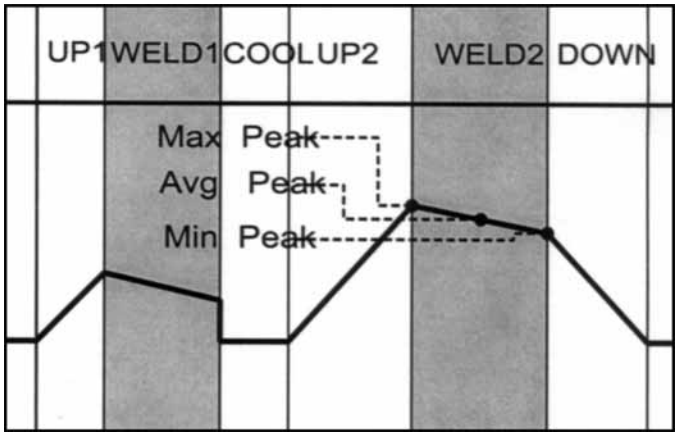


Figure 8-1. Average Peak Measurement.

For a truly independent audit of weld current and weld voltage, use the optional Built-in Weld Sentry Module with user flexibility on measuring any part of a complex weld pulse profile. In addition, the Built-in Weld Sentry can simultaneously monitor up to five different measurement parameters, thus reducing the time to determine which measurement parameter is the best indicator of weld quality changes. Refer to the *Built-in Weld Sentry User's Manual, Part No. 990-291*, for detailed information on this product.

Data Output Capabilities

Weld current, weld voltage, and the % control capacity for the **WELD1** and **WELD2** periods can be sent from the Control **RS485 Serial Port** to a data collecting device such as a Host Computer. Weld power and weld resistance are not transmitted but can be calculated by the Host Computer. Detailed instructions on how to connect a PC to the RS-485 of the Control are in *Appendix B, RS-485 Connection*.

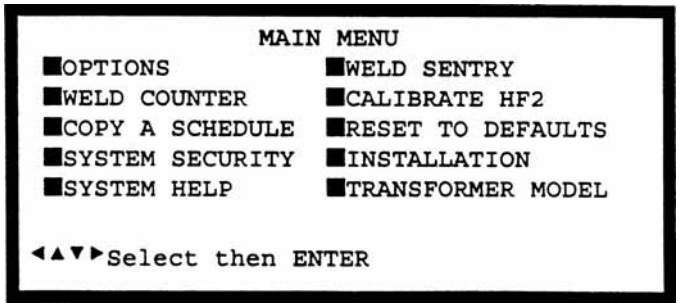
Weld Monitoring Suggestions

Use a Basic Weld Monitor measurement parameter that is different from the welding parameter that is used to maintain the constant weld output pulse. For example, monitoring weld current when using constant current feedback produces measurement readings that change very little and have no correlation to changes in weld quality. A better choice in this case would be to monitor weld voltage, power, or resistance.

The Dual Pulse welding function has two weld pulses, **WELD1** and **WELD2**. **WELD1** can be used to test the misalignment of the electrodes to the parts and misalignment of the upper part to the lower part. If the peak resistance reading made during the **WELD1** pulse is within user set limits, the **WELD2** pulse will automatically complete the weld. If the **WELD1** resistance reading falls outside of the programmed limits, **WELD2** can be inhibited from firing, thus permitting the operator to re-position the parts to make the proper weld. To make this measurement without affecting the actual weld, set WELD1 current, voltage, or power to one-tenth or less of the **WELD2** pulse amplitude and the **WELD1** time to 3 msec. Make multiple good and bad welds to establish a practical range for the Upper and Lower Limits. Program the Upper and Lower Limit values, then turn on the **WELD1** inhibit option.

Basic Weld Monitor Programming

1 Press **MENU**. The **MAIN MENU** screen will appear.



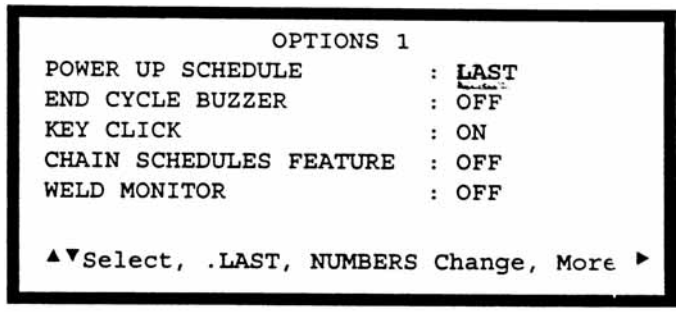
2 Select **OPTIONS**. The **OPTIONS 1** screen will appear. Select **WELD MONITOR: OFF**.

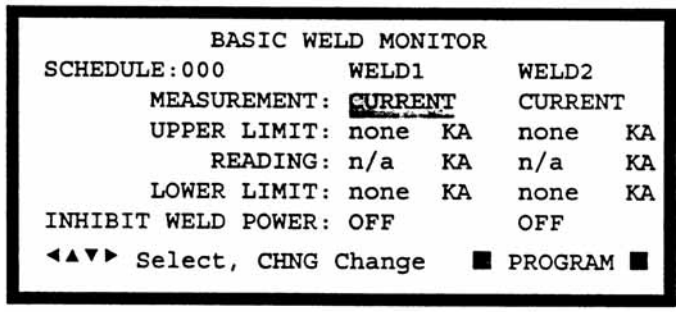
3 Press **CHNG** to set **WELD MONITOR:** to **BASIC**.

4 Press **RUN** to return to the Weld Graph **RUN** screen.

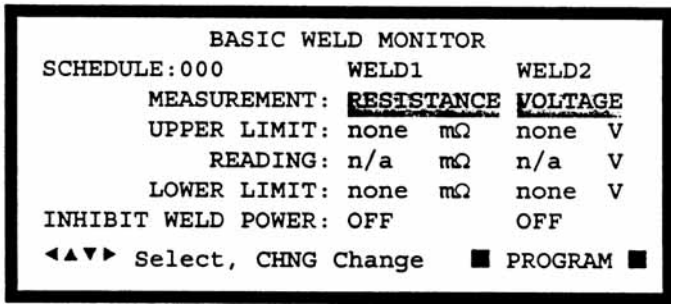
5 Press **PROG** multiple times until the Basic Weld Monitor **PROGRAM** screen appears. **CURRENT of WELD1, MEASUREMENT:** should be flashing. This example shows the **PROGRAM** screen for the Dual Pulse welding function.

6 Press **CHNG** to select **CURRENT, VOLTAGE, POWER**, or **RESISTANCE**.





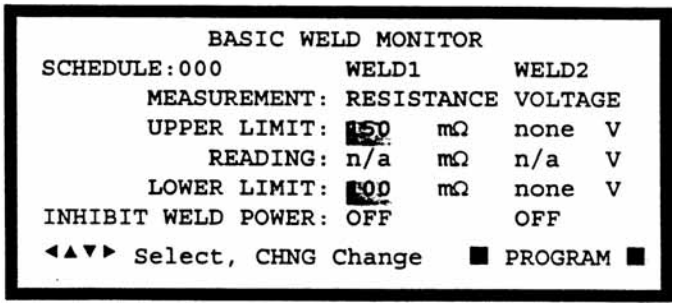
NOTE: Select a measurement unit that is different from the measurement unit that is controlling the **FEEDBACK TYPE** used to make the weld. This example shows that **RESISTANCE** will be measured during the **WELD1** period and **VOLTAGE** during the **WELD2** period.



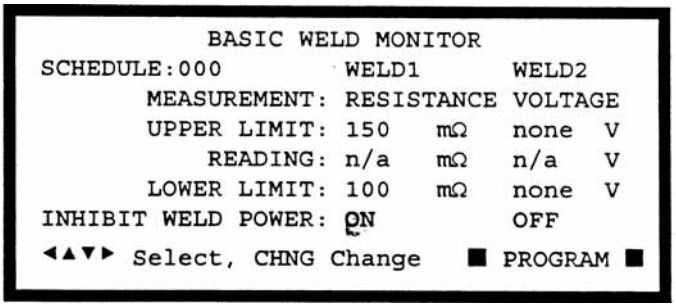
NOTE: Measuring Resistance during the **WELD2** period is usually not productive since the resistance reading is extremely low due to the solidified metal and changes very little with weld quality.

7 Select **UPPER LIMIT:** none. Use the numeric keypad to enter limit values. This examples shows that the **UPPER LIMIT** has been set to 150 mΩ and the **LOWER LIMIT** has been programmed for 100 mΩ.

NOTE: The **LOWER LIMIT** value must always be less than the **UPPER LIMIT** value or the Control will "beep" at you.



8 Select **INHIBIT WELD POWER: OFF**. Press **CHNG** to set to **ON** if you want an out of limit condition to prevent the **WELD2** pulse from automatically completing the weld process. When an out of limit condition occurs on **WELD1**, the **READING** for **WELD2** will be zero, indicating that no energy has been delivered during the **WELD2** period.



9 Repeat steps 6 through 8 to program the **WELD2** period measurement unit, limits, and inhibit options. Multiple **WELD2** readings must be obtained to see if they correlate with weld quality.

10 Press **SAVE** to save the updated Schedule. You are now back in the Basic Weld Monitor **RUN** State.

Energy Limit Monitor General Description (Figure 8-3)

The Control contains a built-in Energy Limit Monitor for terminating weld energy during a weld if the actual user selected measurement parameter exceeds a user set Upper Limit or falls below a user set Lower Limit. In addition, the Energy Limit Monitor records the actual welding time up to weld energy termination.

The Energy Limit Monitor is best used when welding conditions include heavy oxide or contamination on the parts that could cause the non-feedback control parameter to suddenly rise or fall, causing severe expulsion.

The Energy Limit Monitor can be used only with the Basic, Weld Repeat, or Up/Downslope Weld

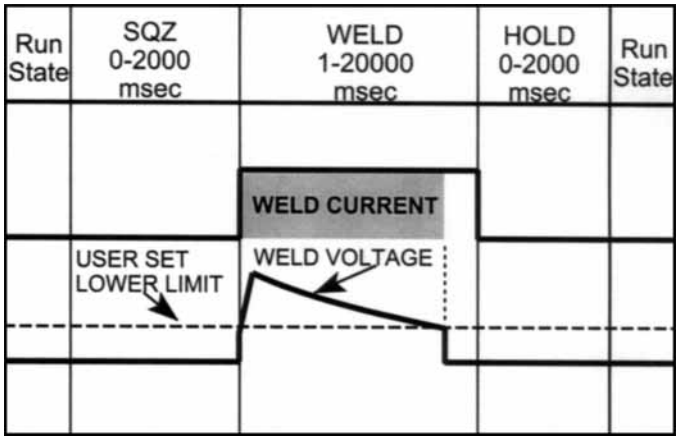


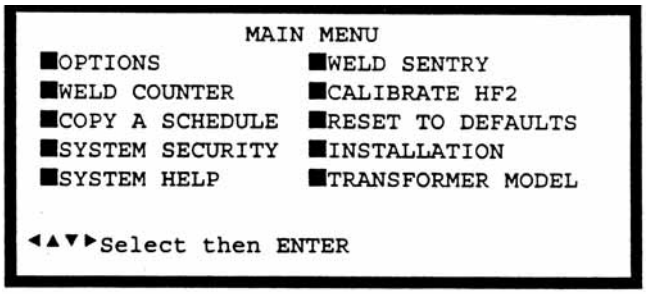
Figure 8-3. Energy Limit Monitor of Weld Voltage

Functions. It does not work on the **Quench/Temper, Pre/Postheat, Rollspot, Seam, Pulsation**, or **Dual Pulse** Functions. Unlike the Basic Weld Monitor, the **Energy Limit Monitor** monitors the user-selected parameter during the entire weld function. In the case of the Up/Downslope weld function, the **UP**, **WELD**, and **DOWN** periods are all monitored.

Figure 8-3 shows a constant current Basic Weld Function with a user selected Voltage Lower Limit. Note that the weld current is terminated automatically when the measured weld voltage drops below the user set Lower Limit.

Energy Limit Monitor Programming

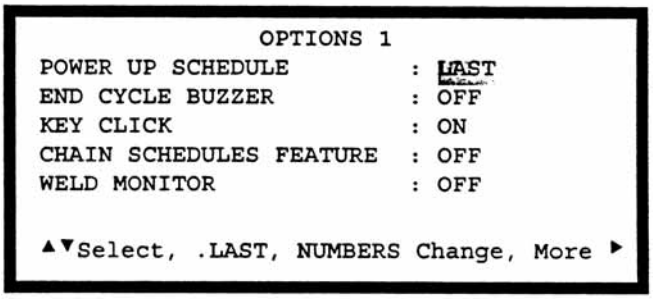
1 Press **MENU**. The **MAIN MENU** screen will appear.



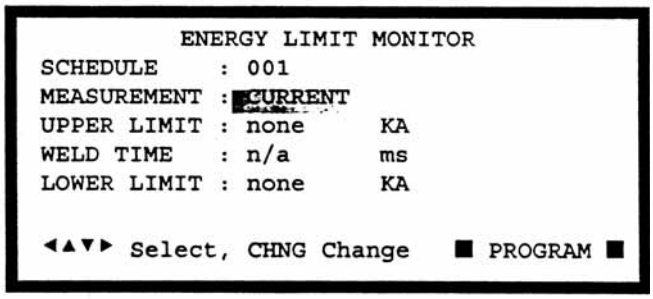
2 Select **OPTIONS**. The **OPTIONS 1** screen will appear. Select **WELD MONITOR: OFF.**

3 Press **CHNG** to set **WELD MONITOR: to LIMIT**.

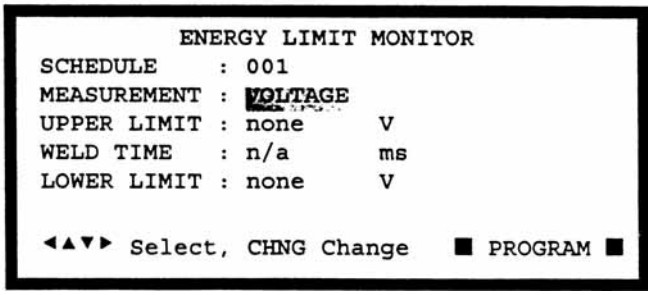
4 Press **RUN** to return to the Weld Graph **RUN** screen.



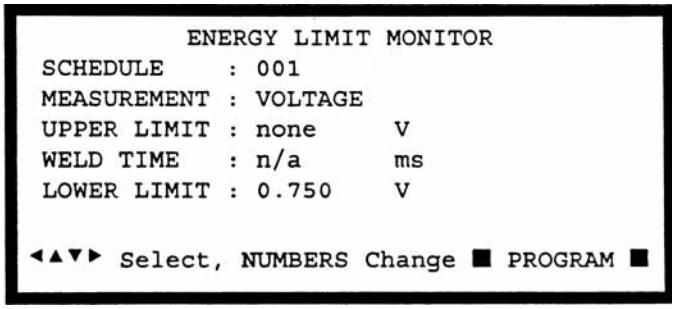
5 Press **PROG** multiple times until the Energy Limit Monitor **PROGRAM** screen appears. **CURRENT** in the **MEASUREMENT**: field should be flashing. This example shows the **PROGRAM** screen for the Basic Welding Function.



6 Press **CHNG** to select **CURRENT, VOLTAGE, POWER,** or **RESISTANCE**. This example shows that **VOLTAGE** will be measured during the constant current weld period.



7 Select **UPPER LIMIT: none** or **LOWER LIMIT: none**, using Table 8-1 as a guide. Use the numeric keypad to enter limit values.

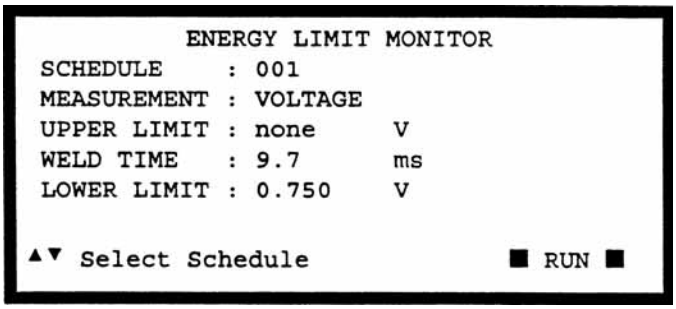


This example shows that the **UPPER LIMIT** has been set to none and the **LOWER LIMIT** has been programmed for 0.750 V. Use the Basic Weld Monitor, as previously described in this chapter, to gather measurements that can be used in setting the Upper Energy Limit or the Lower Energy Limit.

Energy Limit Monitor Measurement and Limit Selections

Feedback	Measurement	Upper Limit	Lower Limit
Current	Voltage	none	0.0 - 9.999 V
Voltage	Current	0.0 - 9.999 KA	none
Power	Current	0.0 - 9.999 KA	none

8 Press **SAVE** to save the updated schedule. You are now back in the Energy Limit Monitor **RUN** State. If the actual measured value goes above the Upper Limit or below the Lower Limit, the Control automatically terminates welding and records the actual period during which the weld energy was on. This example shows that the weld energy dropped below the 0.750 V Lower Limit 9.7 ms after the start of the weld.



APPENDIX A
TECHNICAL SPECIFICATIONS

The specifications listed in this appendix may be changed without notice.

Power

Input Power Line Voltage Range..... 208/230/380/460, 3 Phase, 50/60 Hz
Output Current (peak maximum).....4 KA
Control Frequency .....2 KHz

Environment

Ambient Operating Temperature ..... 0ø to +45øC (32ø to 113øF)

Physical

Dimensions:

Height .....21.5cm (8.5 in.)
Width .....26.7 cm (10.5 in.)
Depth.....38.1 cm (15.0 in.)
Weight.....19 Kg (42 lb)

Weld Head System Compatibility

Force Fired	Non Force Fired
Foot Actuated	Single Valve Air or Cam Actuated
Single Valve Air Actuated	Multiple Valve Air Actuated
Dual Valve Air Activated	

Welding Transformer Compatibility

Model	Input Voltage (RMS)	Duty Cycle (%)	Peak Open Circuit Output Voltage (V)	Peak Maximum Output Current (A)
X2/2000A	230	8	6.3	2,000
X3/4000A	230	6	6.5	4,000
X5/3000A	230	5	8.6	3,000
X11/4000A	230	5	10.7	4,000
X11/4/460A	380	5	11.8 (44:1 TR) 10.0 (52:1 TR) 8.6 (60:1 TR) 7.5 (68:1 TR)	4,000 4,000 4,000 4,000
	460	5	14.3 (44:1 TR) 12.1 (52:1 TR) 10.5 (60:1 TR) 9.2 (68:1 TR)	4,000 4,000 4,000 4,000
X3/4/380A	380	6	6.5	4,000
X3/4/460A	460	6	6.5	4,000

Welding Functions

Basic Weld	Braze
Weld Repeat	Seam
Quench/Temper	Seam Pulse
Pre/Post Heat	Dual Pulse
Up/Down Slope	Pulsation

Feedback

Mode ..... Constant Voltage, Current, or Power
Type and Speed..... Digital, 250 microseconds
Range:
Current .....0.05 to 4.00 KA
Voltage.....0.10 to 9.99 V
Power .....0.10 to 9.99KW

Weld Cycle Period Ranges (ms)

Squeeze ..... 0 - 2000
Weld (continuous for Seam function)..... 1 - 2000
Hold..... 0 - 2000
Off ..... 0 - 2000
Quench ..... 0 - 2000
Temper ..... 0 - 2000
Pre or Post Heat ..... 0 - 2000
Up or Down Slope ..... 0 - 2000
Cool..... 1 - 2000

System Parameter Factory Defaults

SYSTEM PARAMETERS OPTIONS 1	DEFAULT
BASIC WELD MONITOR	OFF
CHAIN SCHEDULES FEATURE	OFF
END CYCLE BUZZER	OFF
KEY CLICK	ON
POWER UP SCHEDULE	LAST
SWITCH DEBOUNCE TIME	10 msec
SYSTEM PARAMETERS OPTIONS 2	**DEFAULT**
FIRING SWITCH	2-WIRE
FOOTSWITCH TYPE	AUTO
FOOTSWITCH WELD ABORT	ON
WELD HEAD TYPE	AUTO
SYSTEM PARAMETERS OPTIONS 3	**DEFAULT**
AUTO GAIN ADJUSTMENT	ON
LANGUAGE	ENGLISH
RS485 BAUD RATE	9600
RS485 I.D. NUMBER	01
RS485 ROLE	SLAVE

Basic Weld Monitor

Measurement Parameters (Weld 1 or Weld 2):

Current
Voltage
Power
Resistance

Current Limits:

Upper ..... 9.999 KA
Lower ..... 0.0000 KA

Voltage Limits:

Upper ..... 9.99 V
Lower ..... 0.000 V

Power Limits:

Upper ..... 9.999 KW
Lower ..... 0.000 KW

Resistance Limits:

Upper ..... 9.999 mê
Lower ..... 0.000 mê

Inhibit Weld Power on Weld 2 ..... OFF, ON

Energy Limit Monitor

Measurement Parameters:

Current
Voltage
Power

Measurement Limits, Upper or Lower:

Current ..... 0.0 - 9.999 KA
Voltage ..... 0.0 - 9.999 V
Power ..... 0.0 - 9.999 KW

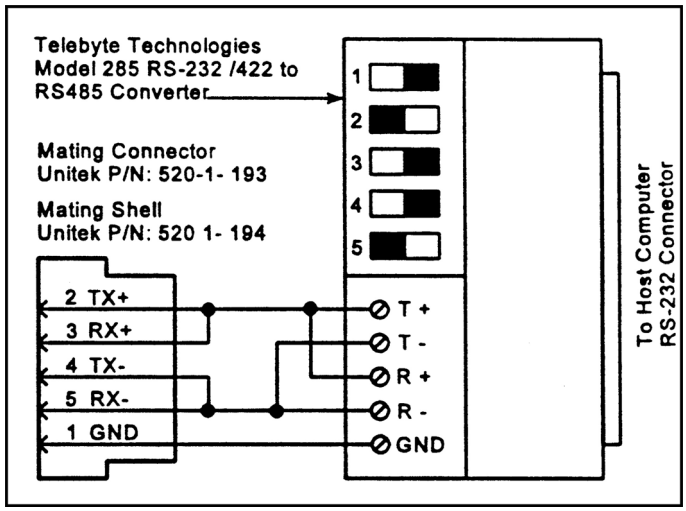
APPENDIX B
RS-485 CONNECTION

Description

The Control has a single RS485 SERIAL PORT connector for transmitting weld data to a serial data collecting device such as a PC or Host Computer. Multiple Controls can be placed on a multi-drop RS485 communications line for weld data collection by a Host Computer using the ASCII command language and protocol listed in the Advanced *RS485 Datacom User's Manual (Miyachi Unitek Part # 990-058)*. This manual is also included in the HF2 Weld Control Shipping Kit.

Connection

The **RS485 SERIAL PORT** Connector is a 9 pin AMP 747052-4 (Miyachi Unitek P/N 250-196) bulkhead connector that mates with a connector assembly consisting of a CINCH DE-9P (Miyachi Unitek P/N 250-193) plug and an AMP 748677-11 (Miyachi Unitek P/N 250-194) connector shell.



1. Connect an RS-232-to-RS-485 Converter between your Host Computer **COM1** or **COM2** ports and the Control **RS485 SERIAL PORT**.
2. Set the DIP switches on the Model 285 as shown above. The black square ■ indicates the ON position.

RS-232-to-RS-485 Converter

An RS-232-to-RS-485 Converter can be connected between the Control **RS485 SERIAL PORT** and into the COM1 or COM2 port on any PC.

A **Model 285 RS-232-to-RS-485 Converter** is available from:

Telebyte Technology, Inc.
355 Marcus Boulevard
Hauppauge, New York 11788

Telephone: (800) 835-3298

FAX: (631) 423-3267

APPENDIX C
RECOMMENDED SPARE PARTS

The following list represents all major sub-assemblies used in the HF2 Welding Control.

Item	Unitek P/N	Description
Display	4-32991-01	Front Panel LCD Display Assembly
Driver Board	4-32875-01	Drives IGBT Transistor Assembly
Front Panel Overlay	4-32297-01	Front Panel Touch Switches
Power Board	4-32893-01	HF2 Internal Power Supply Assembly
Transistor Assembly 208/230 VAC	4-32971-01	208/230 VAC IGBT Transistor and Heat Sink Assembly
Transistor Assembly - 380/460 VAC	4-33097-01	380/460 VAC IGBT Transistor and Heat Sink Assembly
Circuit Breaker -208/230 VAC	240-049	240 VAC, 50 AMPS
Circuit Breaker - 380/460 VAC	240-048	460 VAC, 30 AMPS

APPENDIX D
ALARM MESSAGES

The HF2 Welding control has three types of Alarm Messages, those caused by:

- Improper hardware inputs
- Attempting to program invalid parameter values
- Completion of a certain process.

For your convenience in locating a specific Alarm Message, the Alarm Messages are listed alphabetically.

Alarm Message	Description	Corrective Actions
ALARM EMERGENCY STOP	An Emergency Stop signal was received on the Control Signals Connector.	Remove the Emergency Stop signal.
ALARM FIRING SWITCH	Force-Firing Switch in the Weld Head did not: Close within 10 seconds after the first level of a 1-Level Foot Switch closed or the second level of a 2-Level Foot Switch closed. Stay closed during the welding process.	Reduce the space between the upper electrode and the parts. Increase Weld Head Down Air pressure. Lower Weld Head Downstop. Replace Weld Head Force-Firing Switch. Check Firing-Switch Cable connection between HF2 Welding control and Weld Head. Replace Weld Head Firing Switch
ALARM INPUT SWITCH	Force-Firing Switch closed before the HF2 was in the RUN State.	Release Foot Switch or Foot Pedal, then re-actuate.
CHAINED TO NEXT SCHEDULE	The Step Counter has expired and last weld schedule was selected.	Press [HELP] to turn off Buzzer. Select starting weld schedule.
ERROR NEXT SCHEDULE	Input error for Next Schedule	Valid weld schedule numbers are 1 to 127. Schedule 0 can only be used as the first schedule in a chain. Weld/Repeat and Rollspot weld functions can not be used in a chain.
FEEDBACK RANGE EXCEEDED	HF2 could not reach the set weld current, voltage, or power level.	Reduce weld cable length. Increase weld cable size. Change Weld Transformer Model to a higher voltage model.
FOOTSWITCH ERROR	HF2 is reading an incorrect signal on the Foot Switch Connector.	Verify the Foot Switch electrical connection. Connect Pin 2 to Pin 3 on a user supplied 1-Level Foot Switch.
ILLEGAL CODE ENTERED	Illegal System Security Code was entered.	To change the System Security Status to Unprotected, enter the original code. If the original code was lost, press and hold [◄] and press [SAVE]. Release both keys.

APPENDIX C: ALARM MESSAGES

Alarm Message	Description	Corrective Actions
INPUT ERROR SCHEDULE NUMBER	Illegal weld schedule number was entered	Enter a weld schedule number from 0 to 127.
INPUT TOO LARGE	Parameter value entered was too large.	Press [HELP] to see the maximum value. Enter a correct value.
INPUT TOO SMALL	Parameter value entered was too small.	Press [HELP] to see the maximum value. Enter a correct value.
INVALID FUNCTION	Weld/Repeat and Rollspot cannot be part of any chain of weld schedules.	Weld/Repeat cannot be used with a Manually Actuated Weld Head. Re-program the incorrect weld schedule in the chain. Use a different weld function or install an Air Actuated Weld Head.
INVALID WELD FUNCTION	Welding System is configured for a Manually Actuated Weld Head. Weld/Repeat requires an Air Actuated Weld Head.	Use a different weld function or install an Air Actuated Weld Head.
LOW CURRENT	Actual weld current is less than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Lower Limit value.
LOW POWER	Actual weld power is less than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Lower Limit value.
LOW RESISTANCE	Actual weld resistance is less than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Lower Limit value.
LOW VOLTAGE	Actual weld voltage is less than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Lower Limit value.
NO CURRENT	No Weld current is detected.	Check parts for an invisible insulation coating. Clean each electrode face to remove embedded invisible insulating material. Check Weld Cables for bad connector-to-terminal and connector-to-copper cable connections.
INHIBIT CHANGED TO OFF	Basic Weld Monitor Inhibit option is ON but no Upper or Lower Limits have been programmed.	Program Upper and Lower Limits for each weld pulse in the Basic Weld Monitor Program State.
NO OTHER TRANSFORMER EXISTS	Multiple Head Option is ON even though only one Weld Transformer is specified.	Add Weld Transformer Models.
NO VOLTAGE	No Weld Voltage is detected.	Check the Voltage Sensing Cable connections to the electrodes or electrode holders.

Alarm Message	Description	Corrective Actions
OVER CURRENT	The input to the Weld Transformer exceeded 220 amps.	Power Transistor shorted. Weld Transformer shorted. HF2 Welding control is out of calibration. Perform HF2 Calibration procedure using the Main Menu HF2 CALIBRATION option.
OVER CURRENT	Actual weld current is greater than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Upper Limit value.
OVER POWER	Actual weld power is greater than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Upper Limit value.
OVER RESISTANCE	Actual weld resistance is greater than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Upper Limit value.
OVER VOLTAGE	Actual weld voltage is greater than the Basic Weld Monitor user set Lower Limit.	Tighten welding process variables. Change Upper Limit value.
POWER TRANSISTOR OVERHEATED	Excessive heat build-up has opened the Power Transistor circuit thermostat.	Wait for HF2 Welding control to cool down and close the internal thermostat. Reduce welding process duty cycle.
SCHEDULE LOCKED	System is "Protected" and all weld schedules are Locked.	To change the System Security Status to Unprotected, enter the original code. If the original code was lost, press and hold [◀] and then press [SAVE]. Release both keys.
SCHEDULES/PROGRAMS ARE RESET	All weld schedules and Sentry programs are reset to their factory default values.	Press [RUN] to go to the RUN State. Press [MENU] to return to the MAIN MENU.
SCHEDULE SAVED	The modified weld schedule has been saved in permanent memory.	No action required.
SINGLE PHASE	The HF2 detected that the input power line is a single-phase line.	HF2 will function normally, but will limit the weld current, voltage, or power to one-half of the maximum possible setting. Unitek Miyachi strongly advises using 3-phase input power.
STANDBY FIRING SWITCH	The HF2 is waiting for the Force-Firing Switch in an Air Actuated Weld Head to close.	Increase Weld Head Down Air pressure Lower Weld Head Downstop. Replace Weld Head Force-Firing Switch.
STANDBY REMOTE SCHEDULE	HF2 is waiting for the BCD weld schedule code to be placed on the Control Signals Connector.	Refer to *Chapter 4, Control Signals, Remote Weld Schedule Selection Input.*.
STANDBY STOP COMMAND	HF2 is waiting to be reset to the beginning weld schedule when the last weld schedule in a chain is a stop schedule.	Select starting weld schedule.

APPENDIX C: ALARM MESSAGES

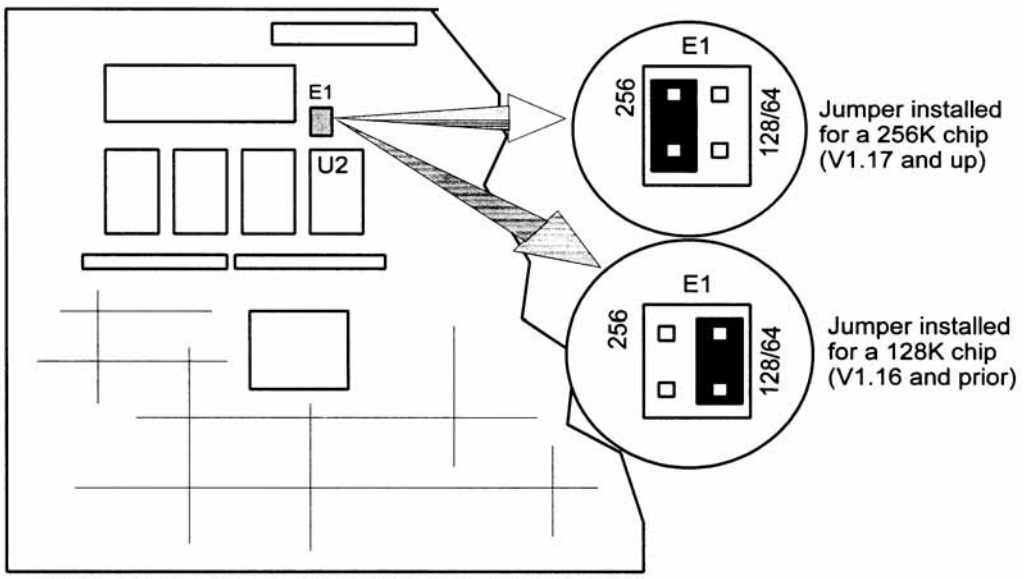
Alarm Message	Description	Corrective Actions
STATUS IS CHANGED	System Security Status is changed.	To change the System Security Status to Unprotected, enter the original code. If the original code was lost, press and hold [◀] and then press [SAVE]. Release both keys.
SYSTEM PARAMETERS ARE RESET	All System Parameters are reset to their factory default values.	Press [RUN] to go to the RUN State. Press [MENU] to return to the MAIN MENU.
SYSTEM PROTECTED	All System Parameters are protected.	To change the System Security Status to Unprotected, enter the original code. If the original code was lost, press and hold [◀] and then press [SAVE]. Release both keys.
WELD TIME TOO SMALL	Total weld time is set to zero.	Total weld time must be greater or equal to 1 msec.
WELD TRANSFORMER OVERHEATED	Excessive heat build-up has opened the Weld Transformer thermostat. This condition was caused by exceeding the Weld Transformer duty cycle.	Wait for Weld Transformer to cool down and close the internal thermostat. Reduce welding process duty cycle.
ALARM NO WELD	WELD/NO WELD switch is in NO WELD position and operator tried to make a weld.	Set switch to WELD position before trying to weld.

APPENDIX E
HELP SCREEN LANGUAGES

The Control **HELP** screens are available in the languages listed below at the time of publication of this manual. In software version V1.17 and up, the languages available are listed on the **OPTIONS 3** screen. Please contact the factory for current language availability.

Language	Software Version
English	V1.16
English, French	V1.17

NOTE: The help screen firmware is stored in IC chip **U2** on the main printed circuit board. The type of chip (its memory capacity) is selectable by an adjacent jumper, **E1**. The Version 1.16 chip requires jumper **E1** to be in-stalled in the **128/64 K** position. The Version 1.17 chip requires jumper **E1** to be installed in the **256 K** position. If you are installing chip **U2**, be sure to install jumper **E1** as illustrated below:



MAIN PRINTED CIRCUIT BOARD (PARTIAL)

APPENDIX F
REPLACEMENT OF PROGRAMMED INTEGRATED CIRCUITS

Required Skills

- Familiarity with basic Control operation.
- Familiarity with integrated circuits in dual in-line (DIP) packages.
- Ability to identify pin number 1 on such an IC.
- Experience in removing and replacing socketted DIP integrated circuits.

Procedure

1 Disconnect the main power to the Control.

CAUTION: Wait 5 minutes for the high voltage capacitors to fully discharge.

2 Remove the six screws that secure the cover to the Control chassis. Remove the cover from the Control.

3 Locate the main control printed wiring board assembly. When facing the front of the Control, the main control printed wiring board assembly is the circuit board on the right hand side of the Control.

4 Locate integrated circuits at location U2 and U3.

5 Note the location of pin 1 on each IC.

6 Examine the labels on the integrated circuits provided with this kit. Note which IC is labeled U2 and which is labeled U3.

7 Examine the integrated circuits provided with this kit.

a) Note the location of pin 1 on each IC.

b) Note and record the version number printed on the label.

8 Remove the IC from location U2. Replace it with the IC labeled U2 provided with this kit.

9 Remove the IC from location U3. Replace it with the IC labeled U3 provided with this kit.

10 If necessary, move Jumper E1 on the main control printed wiring board assembly to the 256 position.

11 Re-install the cover and screws on the Control.

12 Connect main power to the Control.

13 Power up the Control. Observe the LCD display and verify that the displayed software version number matches the number recorded in step 7b. Installation is now complete.

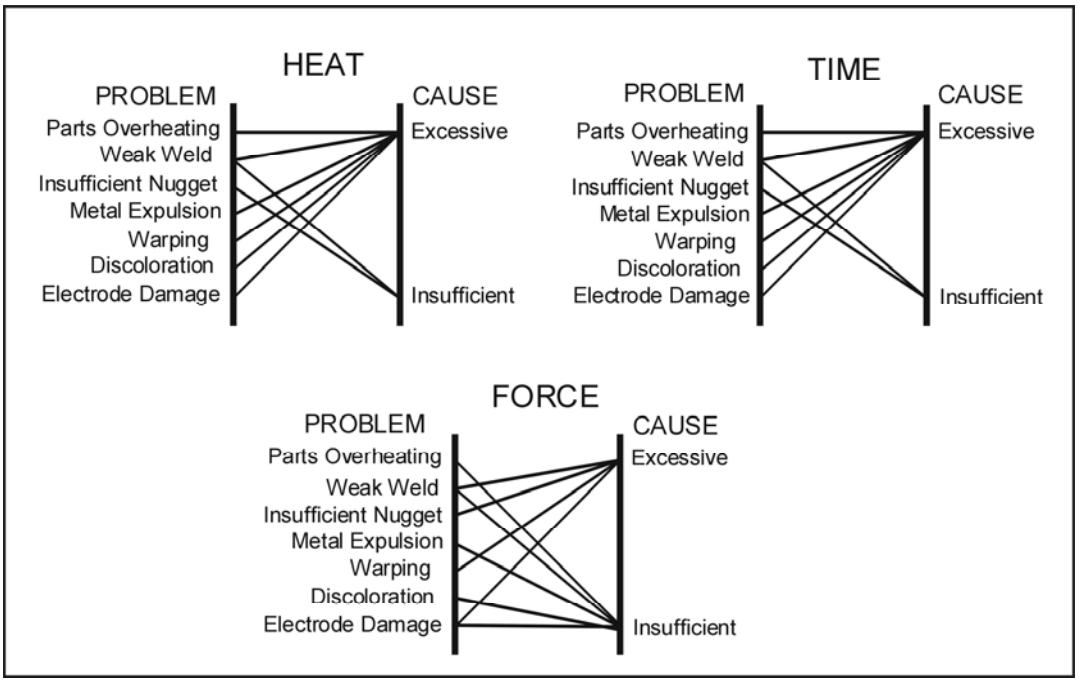
APPENDIX G
THE BASICS OF RESISTANCE WELDING

Resistance Welding Parameters

Resistance welding heat is produced by passing electrical current through the parts for a fixed time period. The welding heat generated is a function of the magnitude of the weld current, the electrical resistance of the parts, the contact resistance between the parts, and the weld force applied to the parts. Sufficient weld force is required to contain the molten material produced during the weld. However, as the force is increased, the contact resistance decreases. Lower contact resistance requires additional weld current, voltage, or power to produce the heat required to form a weld.

The higher the weld force, the greater the weld **current**, **voltage**, **power**, or **time** required to produce a given weld. The formula for amount of heat generated is $\mathbf{I^2RT}$ -- the square of the weld current [**I**] times the workpiece resistance [**R**] times the weld time [**T**].

Welding Parameter Interaction



Interaction of Welding Parameters

Electrode Selection

Correct electrode selection strongly influences how weld heat is generated in the weld area. In general, use conductive electrodes such as a RWMA-2 (Copper alloy) when welding electrically resistive parts such as nickel or steel so that the weld heat is generated by the electrical resistance of the parts and the contact resistance between the parts. Use resistive electrodes such as RWMA-13 (Tungsten) and RWMA-14 (Molybdenum) to weld conductive parts such as copper and gold because conductive parts do not generate much internal heat so the electrodes must provide external heat. Use the following Electrode Selection Table for selecting the proper electrode materials.

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Alumel	-2	Alumel	-2
Alumel	-2	Chromel	-2
Alumel	-2	Dumet	-2
Aluminum	-1	Aluminum	-1
Aluminum	-1	Aluminum Alloys	-1
Aluminum	-1	Cadmium Plating	-1
Aluminum	-1	Tinned Brass	-14
Aluminum	-1	Tinned Copper	-14
Aluminum	-1	Gold Plated Dumet	-2
Aluminum	-1	Gold Plated Kovar	-2
Aluminum	-1	Kovar	-2
Aluminum	-1	Magnesium	-1
Aluminum	-1	Cold Rolled Steel	-2
Aluminum	-1	Stainless Steel	-2
Beryllium Copper	-2	Beryllium Copper	-2
Beryllium Copper	-2	Brass	-2, -14
Beryllium Copper	-2	Copper	-14
Beryllium Copper	-2	Tinned Copper	-14
Beryllium Copper	-2	Nickel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Beryllium Copper	-2	Cold Rolled Steel	-2
Beryllium Copper	-2	Stainless Steel	-2
Brass	-2, -14	Brass	-2, -14
Brass	-2, -14	Tinned Brass	-14
Brass	-2, -14	Consil	-2
Brass	-2, -14	Constantan	-2
Brass	-2, -14	Copper	-14
Brass	-2, -14	Tinned Copper	-14
Brass	-2, -14	Dumet	-2
Brass	-2, -14	Nichrome	-2
Brass	-2, -14	Nickel	-2
Brass	-2, -14	NiSpan C	-2
Brass	-2, -14	Paliney 7	-2
Brass	-2, -14	Silver	-11, -14
Brass	-2, -14	Cold Rolled Steel	-2
Brass	-2, -14	Stainless Steel	-2
Bronze	-2, -11	Bronze	-2, -11
Bronze	-2, -11	Tinned Copper	-14
Bronze	-2, -11	Iron	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Bronze	-2, -11	Nichrome	-2
Bronze	-2, -11	Nickel	-2
Chromel	-2	Chromel	-2
Chromel	-2	Constantan	-2
Chromel	-2	Copel	-2
Chromel	-2	Copper	-14
Chromel	-2	Tinned Copper	-14
Chromel	-2	Dumet	-2
Chromel	-2	Nichrome	-2
Chromel	-2	Cold Rolled Steel	-2
Consil	-2	Consil	-2
Consil	-2	Tinned Copper	-14
Consil	-2	Dumet	-2
Constantan	-2	Constantan	
Constantan	-2	Copper	-14
Constantan	-2	Tinned Copper	-14
Constantan	-2	Iron	-2
Constantan	-2	Nichrome	-2
Constantan	-2	Nickel	-2
Copper	-14	Copper	-14
Copper	-14	Dumet	-2
Copper	-14	Invar	-2
Copper	-14	Karme	-2
Copper	-14	Manganin	-2
Copper	-14	Nichrome	-2
Copper	-14	Nickel	-2
Copper	-14	Paliney 7	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Copper	-14	Silver	-11, -14
Copper	-14	Cold Rolled Steel	-2
Copper	-14	Stainless Steel	-2
Dumet	-2	Dumet	-2
Dumet	-2	Nichrome	-2
Dumet	-2	Nickel	-2
Dumet	-2	Platinum	-2
Dumet	-2	Cold Rolled Steel	-2
Evanohm	-14	Copper	-14
Gold	-14	Gold	-14
Gold	-14	Kovar	-2
Hastalloy	-2	Titanium	-2
Inconel	-2	Inconel	-2
Inconel	-2	Kulgrid	-2
Invar	-2	Invar	-2
Iridium	-2	Iridium	-2
Iridium	-2	Platinum	-2
Iron	-2	Iron	-2
Karma	-2	Karma	-2
Karma	-2	Nickel	-2
Karma	-2	Platinum	-2
Kovar, Gold Plate	-2	Kovar, Gold Plate	-2
Kovar, Gold Plate	-2	Kulgrid	-2
Kovar, Gold Plate	-2	Nickel	-2
Kovar, Gold Plate	-2	Silver	-11, -14
Kovar, Gold Plate	-2	Stainless Steel	-2
Magnesium	-1	Magnesium	-1

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Molybdenum	-2	Nickel	-2
Molybdenum	-2	Tungsten	-2
Nichrome	-2	Nichrome	-2
Nichrome	-2	Nickel	-2
Nichrome	-2	Cold Rolled Steel	-2
Nichrome	-2	Stainless Steel	-2
Nickel	-2	Nickel	-2
Nickel	-2	Cold Rolled Steel	-2
Nickel	-2	Stainless Steel	-2
Nickel	-2	Tantalum	-2
Nickel	-2	Tungsten	-2
Nickel Alloy	-2	Nickel Alloy	-2
Nickel Alloy	-2	Tinned Brass	-14
Nickel Alloy	-2	Beryllium Copper	-2
Nickel Alloy	-2	Consil	-2
Nickel Alloy	-2	Tinned Copper	-14
Nickel Alloy	-2	Nichrome	-2
Nickel Alloy	-2	Nickel	-2
Nickel Alloy	-2	Cold Rolled Steel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
NiSpan C	-2	NiSpan C	-2
NiSpan C	-2	Cold Rolled Steel	-2
NiSpan C	-2	Stainless Steel	-2
Niobium	-2	Niobium	-2
Platinum	-2	Platinum	-2
Paliney 7	-2	Paliney 7	-2
Silver	-11, -14	Silver	-11, -14
Silver	-11, -14	Cadmium	-13
Cold Rolled Steel	-2	Cold Rolled Steel	-2
Cold Rolled Steel	-2	Stainless Steel	-2
Cold Rolled Steel	-2	Tantalum	-2
Stainless Steel	-2	Stainless Steel	-2
Stainless Steel	-2	Tungsten	-2
Tantalum	-2	Tantalum	-2
Titanium	-2	Titanium	-2
Tungsten	-2	Tungsten	-2
Tungsten	-2	henium	-2
Zinc	-14	Zinc	-14

Electrode Maintenance

Depending on use, periodic tip resurfacing is required to remove oxides and welding debris from electrodes. Cleaning of electrodes on production line should be limited to use of #400-600 grit electrode polishing disks. For less critical applications, a file can be used to clean a badly damaged tip. However, after filing, polishing disks should then be used to ensure that the electrode faces are smooth. If this is not done, the rough surface of the electrode face will have a tendency to stick to the work piece.

Weld Schedule Development

Developing a weld schedule is a methodical procedure, which consists of making sample welds and evaluating the results. The first weld should be made at low energy settings. Adjustments are then made to each of the welding parameters ***one at a time*** until a successful weld is made.

1 Install the correct electrodes in the electrode holders on the Weld Head. See the preceding Table for electrode material recommendations.

2 Use a flat electrode face for most applications. Use a "domed" face if surface oxides are a problem. If either of the parts is a wire, the diameter of the electrode face should be equal to or greater than the diameter of the wire. If both parts are flat, the face should be at least one-half the diameter of the electrodes. Pencil point electrodes cause severe electrode sticking to the parts, unexplained explosions, and increase the weld heat substantially because of the reduced electrode-to-part contact area.

3 Use the Force Adjustment Knob on the Weld Head to set the Firing Force and adjust an Air Actuated Weld Head.

4 Program a weld schedule, then make your first weld. Always observe safety precautions when welding and wear safety glasses. For a complete procedure on making welds, refer to *Operating Instructions*.

5 Use pliers to peel the welded materials apart. A satisfactory weld will show residual material pulled from one material to the other. Tearing of base material around the weld nugget indicates a material failure NOT a weld failure. Excessive electrode sticking and/or "spitting" should define a weld as unsatisfactory and indicates that too much weld current, voltage, power, or time has been used.

6 If the parts pull apart easily or there is little or no residual material pulled, the weld is weak. Increase the weld time in 1 msec increments. Increase weld current, voltage, or power if a satisfactory weld achieved using 10 msec of weld time.

NOTE: Actual weld strength is a user-defined specification.

7 Polarity, as determined by the direction of weld current flow, can have a marked effect on the weld characteristics of some material combinations. This effect occurs when welding materials with large differences in resistivity, such as copper and nickel or when welding identical materials with thickness ratios greater than 4 to 1. The general rule is that the more resistive material or the thinner material should be placed against the negative (-) electrode. Polarity on the Control can only be changed by reversing the Weld Cables.

Weld Strength Testing

Destructive tests should be performed on a random basis using actual manufacturing parts. Destructive tests made on spot welds include tension, tension-shear, peel, impact, twist, hardness, and macro-etch tests. Fatigue tests and radiography have also been used. Of these methods torsional shear is preferred for round wire and a 45-degree peel test for sheet stock.

Weld Strength Profiles

Creating a weld strength profile offers the user a scientific approach to determining the optimum set of welding parameters and then displaying these parameters in a graphical form.

1 Start at a low weld current, voltage, or power, making five or more welds, then perform pull tests for each weld. Calculate the average pull strength. Increase weld current, voltage, or power and repeat this procedure. Do not change the weld time, weld force, or electrode area.

2 Continue increasing weld current, voltage, or power until any unfavorable characteristic occurs, such as sticking or spitting.

3 Repeat steps 1 through 3 for different weld forces, then create a plot of part pull strength versus weld current, voltage, or power for different weld forces as shown in the illustration on the next page, *Typical Weld Strength Profile*.

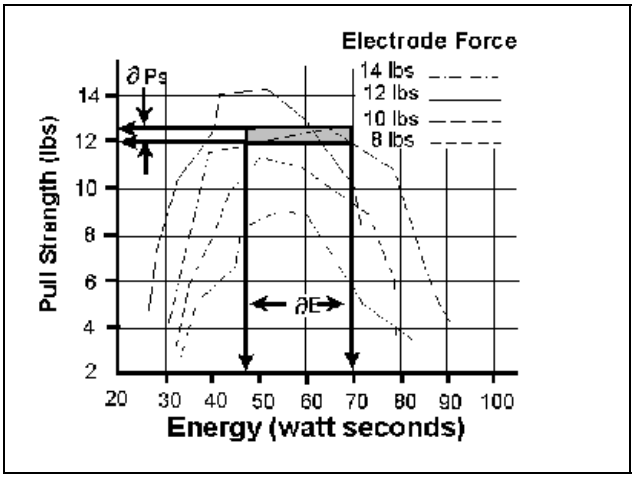
4 Repeat steps 1 through 3 using a different but fixed weld time.

Typical Weld Strength Profile

The picture on the right illustrates a typical weld strength profile. The 14 lb electrode force curve shows the highest pull strengths but the lowest tolerance to changes in weld current, voltage, or power. The 12 lb electrode force curve shows a small reduction in pull strength, but considerably more tolerance to changes in weld energy. Weld heat will vary as a result of material variations and electrode wear.

The 12 lb electrode force curve is preferred. It shows more tolerance to changes in weld current, voltage, or power and has nearly the same bond strength as the 14 lb electrode force curve.

A comparison of weld schedules for several different applications might show that they could be consolidated into one or two weld schedules. This would have obvious manufacturing advantages.



Typical Weld Strength Profile

APPENDIX H

Quality Resistance Welding Solutions: Defining the Optimum Process

Introduction

A quality resistance welding solution both meets the application objectives and produces stable, repeatable results in a production environment. In defining the optimum process the user must approach the application methodically and consider many variables. In this article we will look at the following key stages and principles to be considered when defining the optimum resistance welding process:

- Materials and their properties
- Basic resistance welding
- principles
- Weld profiles
- Approach to development
- Common problems
- Use of screening DOE's
- Use of factorial DOE's

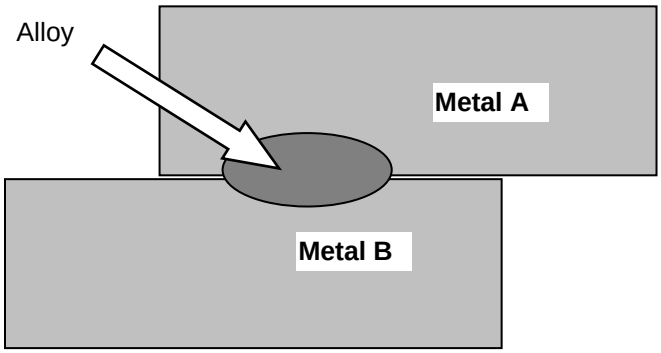
Resistance Welding -- A Material World

The first consideration in designing a quality welding solution is the properties of the materials to be joined and the quality requirements of the desired welded joint. At this stage, it is worthwhile to review the way the resistance welding process works and the likely outcome when the parts are resistance welded.

There are four main types of structural materials:

- Metals (silver, steel, platinum)
- Ceramic (alumina, sand)
- Plastics/polymers (PVC, teflon)
- Semiconductors (silicon, geranium)

Of these, only metals can be resistance welded because they are electrically conductive, soften on heating, and can be forged together without breaking.



Alloys are a mixture of two or more metals. An alloy is normally harder, less conductive, and more brittle than the parent metal which has bearing on the type of joint one can expect when resistance welding a combination of different metals.

Metals atoms are naturally attracted to other metal atoms even in different parent materials. Metals and alloys will bond together once surface contaminants such as dirt, grease, and oxides removed. Resistance welding generates heat at the material interface, which decomposes the dirt and grease and helps to break up the oxide film. The resultant heat softens or melts the metal and the applied force brings the atoms on either side into close contact to form the bond. The strength of the joint develops as it cools and a new structure is formed.

There are three main types of bonds that can be formed using the resistance welding process:

- **Solder or Braze Joint**

  A filler material such as a solder or braze compound is either added during the process or present as a plating or coating. Soldered joints are typically achieved at temperatures less than 400°C and brazed joints such as Sil-Phos materials melt at temperatures above 400°C.

- **Solid-State Joint**

  A solid state joint can be formed when the materials are heated to between 70-80% of their melting point.

- **Fusion Joint**

  A fusion joint can be formed when both metals are heated to their melting point and their atoms mix.

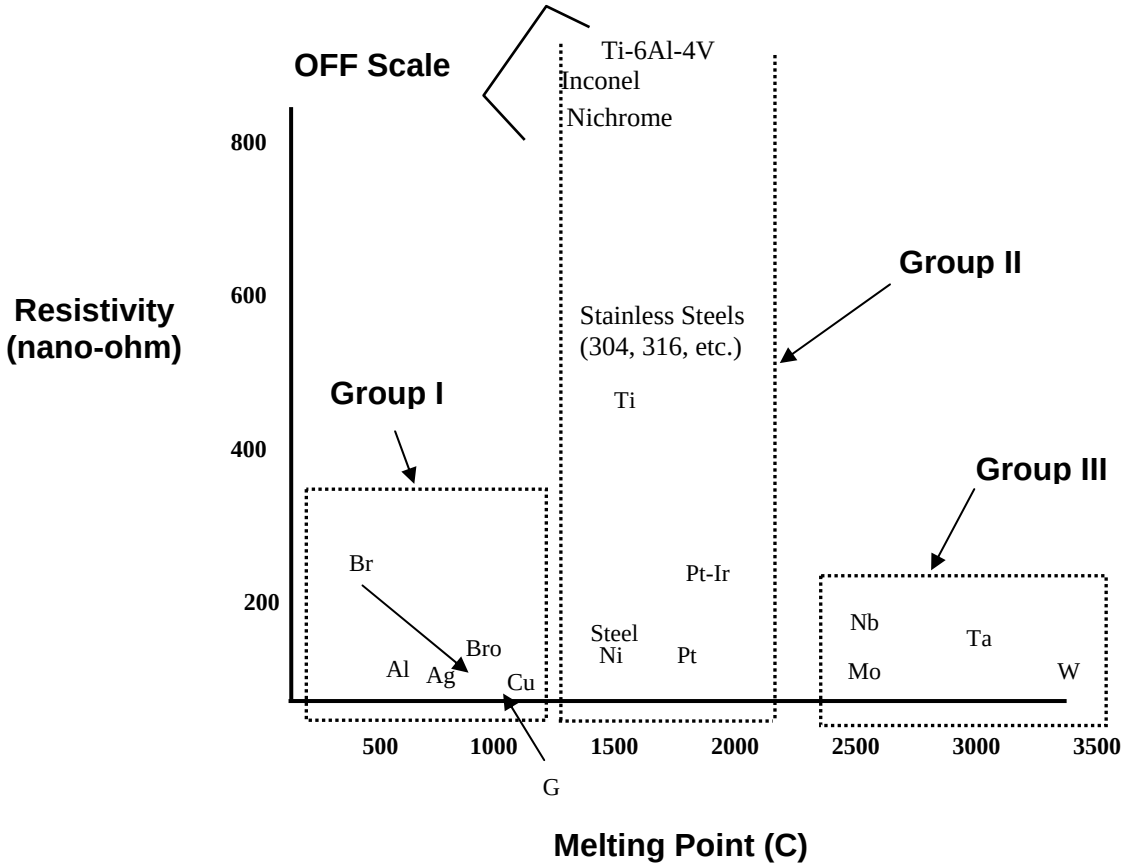
Many micro-resistance welding challenges involve joining dissimilar metals in terms of their melting points, electrical conductivity, and hardness. A solid-state joint can be an ideal solution for these difficult applications; there is no direct mixing of the two materials across the weld interface thus preventing the formation of harmful alloys that could form brittle compounds that are easily fractured. Remember that in a solid-state joint, the metals are only heated to 70-80% of their respective melting points, resulting in less thermal stress during heating and subsequent joint cooling in comparison to a fusion weld. As there is no real melting of the materials in a solid-state joint, there is less chance of weld splash or material expulsion. A weld nugget can still be achieved with a solid-state joint.

Consider the Material Properties

The important material properties to be considered in the resistance welding process are:

- ***Electrical and thermal conductivity***
- ***Plating and coating***
- ***Hardness***
- ***Melting point***
- ***Oxides***

The figure below illustrates the variance in resistivity and melting points for some of the more common materials used in micro resistance welding today.



The materials can be grouped into three common categories. The types of joints achievable within each of the main groups are detailed below:

- **Group I – Conductive Metals**

  Conductive metals dissipate heat and it can be difficult to focus heat at the interface. A solid-state joint is therefore preferred. Typically, resistive electrode materials are used to provide additional heating.

- **Group II – Resistive Metals**

  It is easier to generate and trap heat at the interface of resistive metals and therefore it is possible to form both solid state and fusion welds depending on time and temperature. Upslope can reduce contact resistances and provide heating in the bulk material resistance.

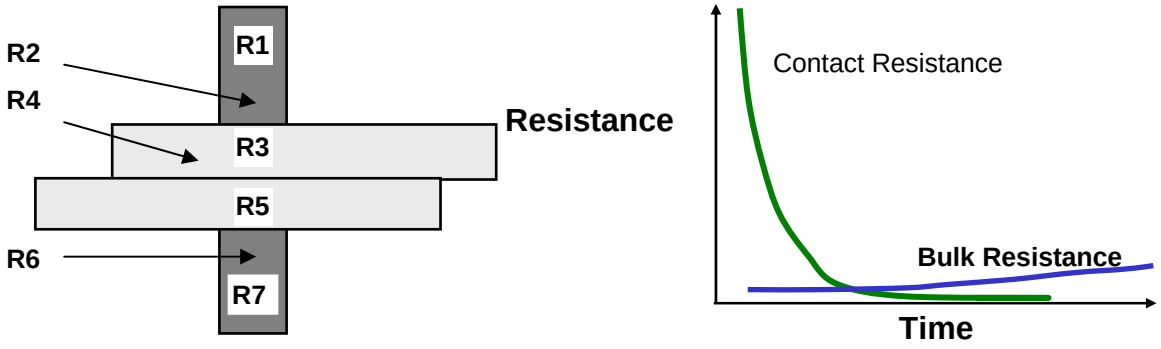
- **Group III – Refractory Metals**

  Refractory metals have very high melting points and excess heating can cause micro-structural damage. A solid-state joint is therefore preferred.

The chart below gives some guidance on the type of joint that can be expected and design considerations required when joining materials from the different groups.

	Group I	Group II	Group III
Group I (Copper)	• Solid-State • W/Mo electrodes	• Solid-State • Projection on Group I	• Solid-State • Fine projections on Group III
Group II (Steel)		• Solid-State or Fusion	• Solid-state or braze of II on III • Projection on III
Group III (Moly)			• Solid-State

Basic Principles



The figure above shows the key resistances in a typical opposed resistance weld and the relationship between contact resistances and bulk resistances over time, during a typical resistance weld:

R1 & R7 The electrode resistances affect the conduction of energy and weld heat to the parts and the rate of heat sinking from the parts at the end of the weld.

R2, R4 & R 6 The electrode-to-part and part-to-part "Contact Resistances" determine the amount of heat generation in these areas. The contact resistances decline over time as the parts achieve better fit up.

R3 & R5 The metal "Bulk Resistances" become higher during the weld as the parts are heated.

If a weld is initiated when the contact resistances are still high, the heat generated is in relation to the level and location of the contact resistances, as the materials have not had a chance to fit up correctly. It is common for the heat generated at the electrode-to-part and part-to-part resistances to cause multiple welding problems when welding resistive materials including:

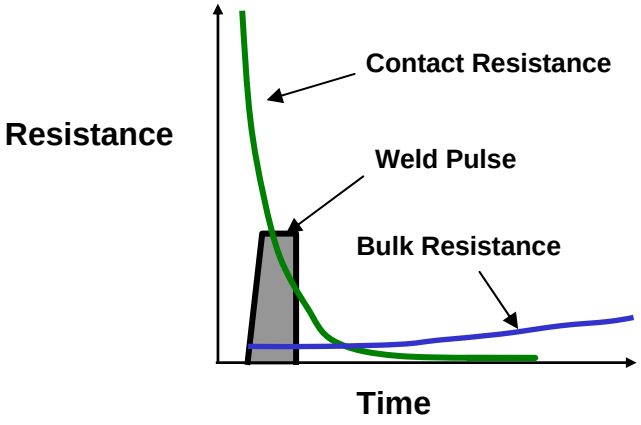
- Part marking and surface heating
- Weld splash or expulsion
- Electrode sticking
- Weak welds

Alternately, conductive materials can be welded by using high contact resistance and fast heating because their bulk resistance is not high and cannot be relied upon for heat generation.

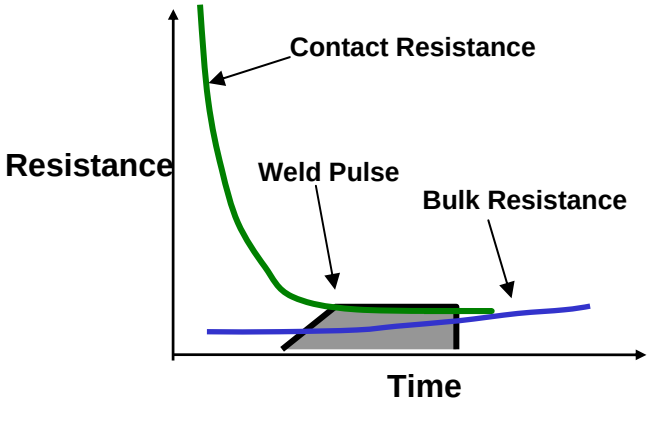
If a weld is initiated when both parts and electrodes are fitted up correctly, the contact resistance is lower and bulk resistance now controls the heat generation. This type of weld is achieved with a slower heating rate and normally longer time is preferred for welding resistive materials, which can generate heat through their bulk resistance.

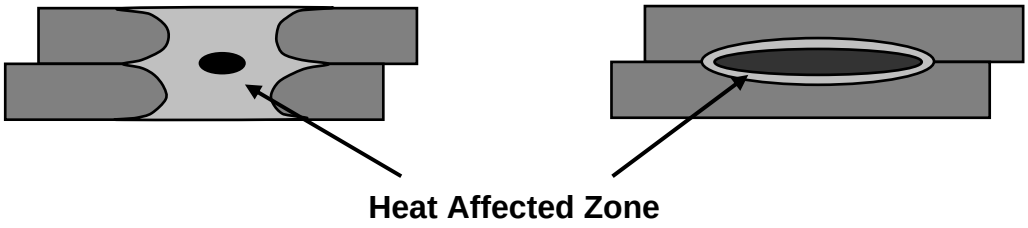
The contact resistances present at the weld when the power supply is fired have a great impact on the heat balance of a weld and, therefore, the heat affected zone.

The figure below shows a weld that is fired early on in the weld sequence when the contact resistance is still quite high.



The figure shows a weld that is initiated when the contact resistance is lower; in this example, we are using bulk resistance to generate our weld heat.

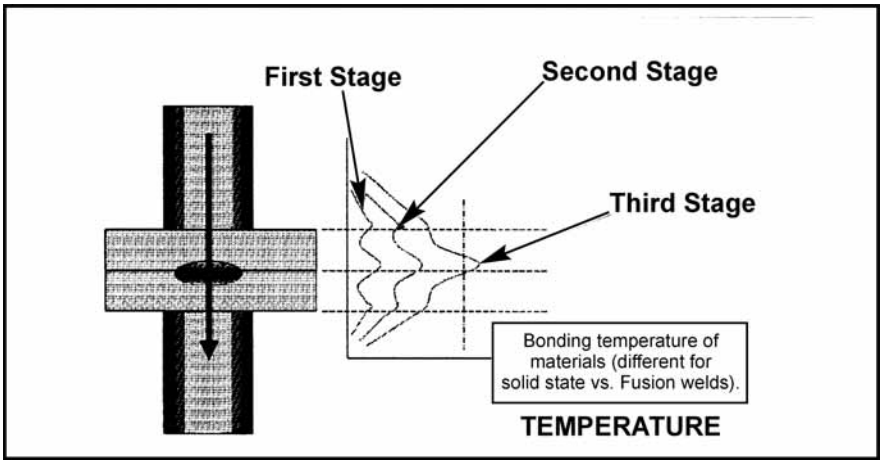




(NOTE: Larger nuggets are possible with longer weld times when using bulk resistance.)

In general, conductive materials benefit from a faster heating rate, as the higher contact resistances assist heat generation in the weld. Resistive materials benefit from slower heating rates which allow the contact resistances to reduce significantly. Bulk resistances, therefore, become the major source for heat generation. The heat-affected zone is also much smaller in this case producing a weld with less variation.

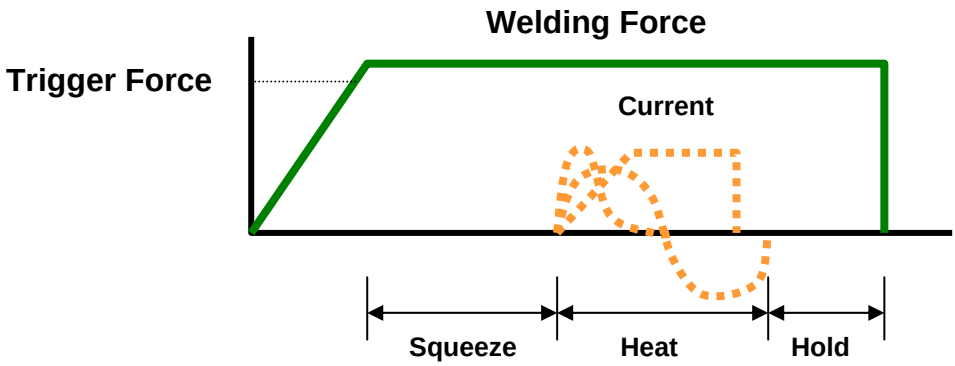
The following figure shows the three stages of heat generation for resistive materials in a fusion weld. In the first stage, the heat is focused in the part-to-part and electrode-to-part contact areas, since contact resistance is high relative to bulk resistance. In the second stage, contact resistance decreases as the electrodes seat better to the parts. Less heat is generated in the electrode-to-part contact areas, and a greater amount of heat is generated in the parts as the bulk resistance increases. In the third stage, the bulk resistance becomes the dominant heat-generating factor and the parts can reach their bonding temperature at the part-to-part interface. The stages of heat generation for conductive materials will be similar to that of resistive materials, but there will be less heat generated in the bulk resistance due to the conductivity of the materials.



Weld Profiles

The basic welding profile (or schedule) consists of a controlled application of energy and force over time. Precision power supplies control the energy and time and therefore heating rate of the parts. The weld head applies force from the start to finish of the welding process.

The figure on the right shows a typical welding sequence where the force is applied to the parts; a squeeze time is initiated which allows the force to stabilize before the current is fired. Squeeze time also allows time for the contact resistances to reduce as the materials start to come into closer contact at their interface. A hold time is initiated after current flows to allow the parts to cool under pressure before the electrodes are retracted from the parts. Hold time is important as weld strength develops in this period. This basic form of weld profile is sufficient for the majority of small part resistance welding applications.



Power supply technology selection is based on the requirements of both the application and process. In general, closed loop power supply technologies are the best choice for consistent, controlled output and fast response to changes in resistance during the weld (for further details comparison see the Unitek Equipment “slide rule” tool).

Approach to Weld Development

The first stage in developing a quality welding process is to fix as many of the variables as possible in the welding equipment set up. The welding variables can be grouped in the following categories:

- **Material Variables**
  - Base material
  - Plating
  - Size
  - Shape
- **Weld Head & Mechanical Variables**
  - Force, squeeze, hold
  - Actuation method
  - Electrode material and shape
- **Power Supply Variables**
  - Energy
  - Time (squeeze, weld, hold)
- **Process Variables**
  - Tooling, level of automation
  - Repetition rate
  - Part positioning
  - Maintenance, electrode cleaning
- **Quality Requirements**
  - Pull strength
  - Visual criteria
  - Test method, other weld joint requirements

The first stage in developing a quality welding process is to fix as many of the variables as possible in the welding equipment set up. Welding variables can be grouped in the following categories:

Initial Welding Trials -- The “Look See” Tests

“Look see” welding tests are a series of mini welding experiments designed to provide a starting point for further statistical development of the welding parameters. The user should adjust the key welding variables (energy, force, time) in order to identify the likely good “weld window.” Close visual inspection of the weld parts will promote better understanding of the heating characteristics of the application.

The mini-experiments should also be used to understand the weld characteristics from both application and process perspective. Key factors in this understanding are as follows:

Application Perspective

- Materials: Resistivity, melting point, thermal mass, shape, hardness, surface properties.
- Heat balance: Electrode materials, shape, Polarity, heating rate (upslope).
- Observation: visual criteria, cross section, and impact of variables on heat balance.

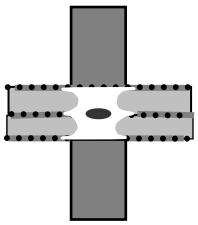
Process Perspective

- What are the likely variables in a production process?
- How will operators handle and align the parts?
- What tooling or automation will be required?
- How will operators maintain and change the electrodes?
- What other parameters will operators be able to adjust?
- What are the quality and inspection requirements?
- What are the relevant production testing methods and test equipment?
- Do we have adequate control over the quality of the materials?

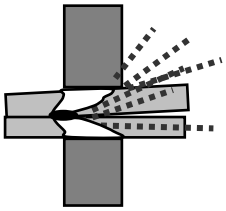
Common Problems

During this stage of process development, it is important to understand that the majority of process problems are related to either materials variation, or part-to-electrode positioning. Some examples are shown below.

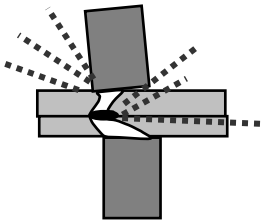
Material Control



Part-To-Part Positioning

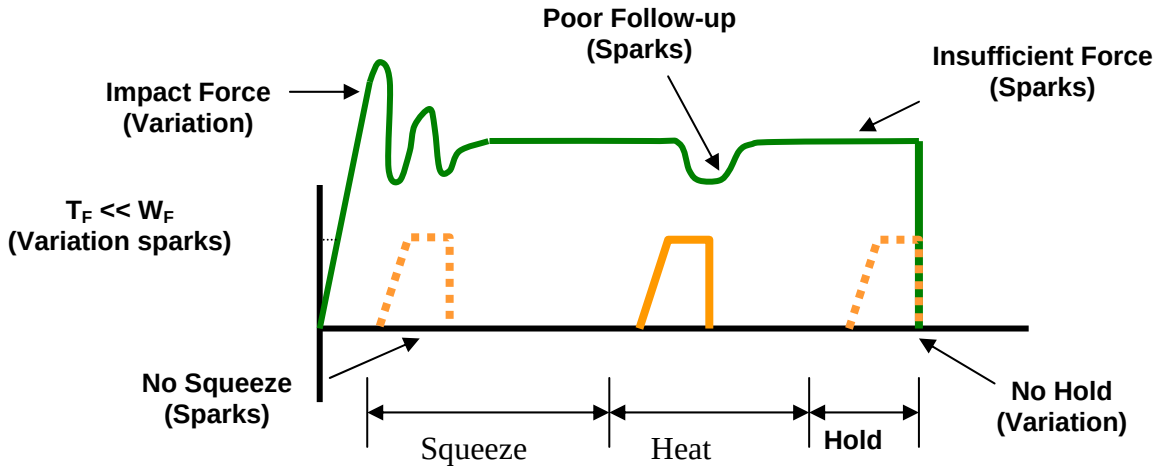


Electrode-To-Part Positioning



The changes detailed above generally result in a change in contact resistance and always affect the heat balance of the weld. During weld development these common problems must be carefully monitored so as not to mislead the course and productivity of the welding experiments.

In summary, the “look see” welding experiments should be used to fix further variables from an application and process perspective and also to establish a “weld window” for energy, time and force. This part of weld development is critical in order to proceed to a statistical method of evaluation (Design of Experiments or “DOEs”). Random explosions or unexpected variables will skew statistical data and waste valuable time.



Common welding problems can often be identified in the basic set up of the force, energy, and time welding profile shown above. These problems can lead to weld splash, inconsistency, and variation (contact Unitek Equipment for further information and support).

What are Screening DOE'S?

The purpose of a Screening DOE is to establish the impact that welding and process parameters have on the quality of the weld. Quality measurement criteria should be selected based on the requirements of the application. A Screening DOE will establish a relative quality measurement for the parameters tested and the variation in the welded result. This is important, as identifying variation in process is critical in establishing the best production settings. Typically, welded assemblies are assessed for strength of joint and variation in strength.

A Screening DOE tests the high, low settings of a parameter, and will help establish the impact of a parameter on the process. A Screening DOE is a tool that allows the user to establish the impact of a particular parameter by carrying out the minimum number of experiments to gain the information. A five-factor screening DOE can be accomplished in as few as 24 welds, with three welds completed for each of 8 tests. By comparison, it would take 96 welds to test every combination. The DOE promotes understanding of many variables in a single experiment and allows the user to interpret results, thus narrowing the variables for the next level of statistical analysis. If many variables are still not understood, multiple Screening DOE's may be required. Unitek Equipment provides a simple Screening DOE tool that is run in Excel® and is sufficient for the majority of possible applications (contact Unitek Equipment for details). Sophisticated software is also available from other vendors designed specifically for this purpose.

Criteria for Success

Before running the series of experiments, the user must establish an acceptable window for energy, time, and force, thus preventing voided results. It is common practice to include one or all of the above variables in a Screening DOE. This is only recommended if sufficient understanding has been established for the other application and process variables that can impact quality Users should first try to screen out all common application and process variables that require further exploration from the results of the "look see" mini experiments and then include the three key welding variables (energy, force and time). Several Screening DOE's may be required.

Results should be interpreted carefully. Typically, one would look for the highest result in terms of quality with the least variation. A Screening DOE provides only a measurement that indicates the relative importance of a parameter and not the ideal setting. Factorial DOE's should be used to establish the correct or best setting for a parameter once many of the other variables have been screened and fixed. This is also the time to assess the measurement accuracy and consistency of the test method and procedure. Variation in test method can invalidate the test and lead to misinterpretation of results.

What are Factorial DOE's?

The purpose of a Factorial DOE is to narrow in on the optimal setting for a particular parameter. This method is generally used when the critical or main key variables have been identified, and we need to establish the best settings for the process. A factorial DOE may also give an indication as to how wide the acceptable weld window is in relation to quality requirements. We recommend data be gathered from a monitoring perspective so that this can provide a starting point for establishing a relationship between quality and the monitored measurement parameter.

Criteria for Success

Critical parameters should be identified from the list of unfixed variables left from the Screening DOE's. A mini-experiment may be required establishing reasonable bounds for the combination of parameters to be tested. This will prevent void data and wasted time. At this stage, it is useful to record multiple relevant quality measurement or inspection criteria so that a balanced decision can be reached. For example, if part marking and pull strength are the relevant criteria, a compromise in ideal setting may be required.

As with all experiments, the test method should be carefully assessed as a potential source of variation and inconsistency. Once the optimum parameters have been established in this series of experiments, a validation study can be run which looks at the consistency of results over time. It is good practice to build in variables such as electrode changes and cleaning, as well as equipment set up by different personnel. This will ensure that the solution is one that can run in a real production environment. Welded assemblies should be tested over time and under real use conditions to ensure that all functional criteria will be met. Validation testing is usually required to prove the robustness of the process under production conditions.

Conclusion

The resistance welding process can deliver a reliable and repeatable joining solution for a wide range of metal joining applications. Defining the optimum welding process and best production settings can be achieved through a methodical and statistical approach. Time spent up front in weld development will ensure a stable welding process and provide a substantial return in quality and long term consistency. Welding problems can more easily be identified and solved if sufficient experimental work is carried out to identify the impact of common variables on the quality and variation of the welded assembly. Unitek Equipment frequently uses the Screening DOE tool to establish the impact of key variables and to assist customers with troubleshooting. Often, the testing described above will provide the information and understanding to predict common failure modes and causes. A troubleshooting guide can be requested in the form of a slide rule, to assist users in identification of welding problems and likely causes.