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INVERTER WELDING POWER SUPPLY

# HF2/HF2S

# USER MANUAL




990-057 REV T

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## REVISION RECORD

| Revision | EO | Date | Basis of Revision |
|---|---|---|---|
| A | ENRG-RLSE | 03/95 | Released original manual. |
| B | None | 09/95 | Reorganize manual into chapters. |
| C | None | 01/96 | Amend to Firmware V1.17 or higher. |
| D | None | 02/96 | Update cover stock numbers |
| E | None | 04/97 | Amend to Firmware V1.19 or higher. |
| F | 17472 | 06/98 | 1. Remove existing calibration procedure and reference User Calibration Procedure 994-001.<br>2. Miscellaneous corrections.<br>3. Remove SAVE error. |
| G | 18951 | 08/01 | 1. Include EO# 17693 in manual.<br>2. Add latest version of Operator Guide. |
| H | 19012 | 09/01 | 1. Include EO# 118951 in manual.<br>2. Add latest version of Operator Guide. |
| J | 19146 | 01/02 | 1. Include EO# 19012.<br>2. Miscellaneous Corrections.<br>3. Add Appendix F, Quality Resistance Welding Solutions, and Appendix G, Replacement of Programmed Integrated Circuits. |
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| Q | 43808 | 08/15 | Updated to Amada Miyachi America format. |
| R | 45804 | 04/20 | Update Company Name (Amada Weld Tech) |
| S | 46311 | 04/21 | See ECO for Details |
| T | 47208 | 01/24 | Change Manual Title |

# FOREWORD

Thank you for purchasing an AMADA WELD TECH - HF2 - 2kHz High Frequency Inverter Welding Power Supply. For the rest of this manual, the HF2 will be referred to simply as the ***Power Supply***.

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 us at:

**AMADA WELD TECH INC.**
**1820 South Myrtle Avenue**
**Monrovia, CA 91017-7133**
**Telephone: (626) 303-5676**
**FAX: (626) 358-8048**
**e-mail: info@amadaweldtech.com**

The purpose of this manual is to provide the information required for proper and safe operation and maintenance of the AMADA WELD TECH - HF2 - 2kHz High Frequency Inverter Welding Power Supply.

We have made every effort to ensure that the information in this manual is both accurate and adequate. The contents of this manual are subject to change without notice. Should questions arise, or if you have suggestions for improvement of this manual, please contact us at the above location/numbers.

AMADA WELD TECH is not responsible for any loss or injury due to improper use of this product.

The contents of this manual apply to the following models:

| AMADA WELD TECH Model | AWTA P/N |
|---|---|
| HF2/230 | 1-264-0x |
| HF2/280 | 1-264-0x-01 |
| HF2/460 | 1-264-0x-02 |
| HF2/208 | 1-264-0x-03 |

| | |
|---|---|
| HF2S/230 | 1-265-0x |
| HF2S/380 | 1-265-0x-01 |
| HF2S/460 | 1-265-0x-02 |
| HF2S/208 | 1-265-0x-03 |

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# SAFETY NOTES

## General

This instruction manual describes the operation and maintenance of the Power Supply 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 Power Supply, 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 Power Supply.

## 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 Power Supply without prior written approval from AMADA WELD TECH.



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 Power Supply 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 Power Supply.



WARNING

***Always*** wear safety glasses when welding to avoid eye injuries.

# SAFETY PRECAUTIONS

- These precautions are given for safe use of the Power Supply 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 POWER SUPPLY UNNECESSARILY.**

High Voltages are present inside the Power Supply Enclosure. Do ***not*** touch the inside of the Power Supply unnecessarily with the power turned ON. You may receive an electric shock. When inspecting the inside of the Power Supply, 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 POWER SUPPLY.**

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 AMADA WELD TECH 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 AMADA WELD TECH or your distributor for help.



**People with pacemakers MUST stay away from the Power Supply.**

When the Power Supply is operating, it generates a magnetic field, which adversely affects pacemakers. People who use a pacemaker must ***not*** approach the Power Supply, or walk around the welding shop while the Power Supply 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 Power Supply.**
Water spilled on the Power Supply 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 Power Supply on a firm, level surface.**
Injury may result if the Power Supply falls over or drops from an uneven surface.



**Keep combustible matter away from the Power Supply.**
Spatter can ignite combustible materials. If you cannot remove all combustible materials, cover them with a non-combustible material.



**Do NOT cover the Power Supply with a blanket, cloth, etc.**
Heat generated by the operating Power Supply 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 Power Supply.**
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.



**Disposal**
Properly handle and dispose of used materials.
For the disposal of electronic waste please contact AMADA WELD TECH.

# LIMITED WARRANTY

**GENERAL TERMS AND CONDITIONS FOR THE SALE OF GOODS**

**1. Applicability.**

(a) These terms and conditions of sale (these "**Terms**") are the only terms which govern the sale of the goods ("**Goods**") by Amada Weld Tech Inc. ("**Seller**") to the buyer identified in the Sales Quotation and/or Acknowledgment (as each defined below) to which these Terms are attached or incorporated by reference ("**Buyer**"). Notwithstanding anything herein to the contrary, if a written contract signed by authorized representatives of both parties is in existence covering the sale of the Goods covered hereby, the terms and conditions of said contract shall prevail to the extent they are inconsistent with these Terms.

(b) The accompanying quotation of sale (the "**Sales Quotation**") provided to Buyer, and/or sales order acknowledgement ("**Acknowledgement**") and these Terms (collectively, this "**Agreement**") comprise the entire agreement between the parties, and supersede all prior or contemporaneous understandings, agreements, negotiations, representations and warranties, and communications, both written and oral. For clarification, after the Acknowledgement is received by Buyer, the order for Goods is binding and cannot be cancelled by Buyer for any reason and the full purchase price amount set forth in the Acknowledgement shall be due and payable by Buyer to Seller pursuant to the payment schedule set forth in the Acknowledgement unless otherwise agreed to in writing by Seller. All terms and conditions contained in any prior or contemporaneous oral or written communication which are different from, or in addition to, the terms and conditions in this Agreement are hereby rejected and shall not be binding on Seller, whether or not they would materially alter this Agreement. These Terms prevail over any of Buyer's terms and conditions of purchase regardless whether or when Buyer has submitted its purchase order or such terms. Fulfillment of Buyer's order does not constitute acceptance of any of Buyer's terms and conditions and does not serve to modify or amend these Terms. Notwithstanding anything herein to the contrary, all orders for Goods must be for a minimum purchase price of $100 or such orders will be rejected by Seller.

**2. Delivery.**

(a) The Goods will be delivered within a reasonable time after Seller provides Buyer the Acknowledgment, subject to availability of finished Goods. Seller will endeavor to meet delivery schedules requested by Buyer, but in no event shall Seller incur any liability, consequential or otherwise, for any delays or failure to deliver as a result of ceasing to manufacture any product or any Force Majeure Event. Delivery schedules set forth in the Acknowledgment are Seller's good faith estimate on the basis of current schedules. In no event shall Seller be liable for special or consequential damages resulting from failure to meet requested delivery schedules.

(b) Unless otherwise agreed in writing by the parties in the Acknowledgement, Seller shall deliver the Goods to Seller's plant in Monrovia, CA, USA (the "**Shipping Point**") using Seller's standard methods for packaging and shipping such Goods. Buyer shall take delivery of the Goods within three (3) days of Seller's written notice that the Goods have been delivered to the Shipping Point. Buyer shall be responsible for all loading costs (including freight and insurance costs) and provide equipment and labor reasonably suited for receipt of the Goods at the Shipping Point. Seller shall not be liable for any delays, loss or damage in transit.

(c) Seller may, in its sole discretion, without liability or penalty, make partial shipments of Goods to Buyer, if applicable. Each shipment will constitute a separate sale, and Buyer shall pay for the units shipped whether such shipment is in whole or partial fulfillment of Buyer's purchase order.

(d) If for any reason Buyer fails to accept delivery of any of the Goods on the date fixed pursuant to Seller's notice that the Goods have been delivered at the Shipping Point, or if Seller is unable to deliver the Goods at the Shipping Point on such date because Buyer has not provided appropriate instructions, documents, licenses or authorizations: (i) risk of loss to the Goods shall pass to Buyer; (ii) the Goods shall be deemed to have been delivered; and (iii) Seller, at its option, may store the Goods until Buyer picks them up, whereupon Buyer shall be liable for all related costs and expenses (including, without limitation, storage and insurance).

**3. Non-delivery.**

(a) The quantity of any installment of Goods as recorded by Seller on dispatch from Seller's place of business is conclusive evidence of the quantity received by Buyer on delivery unless Buyer can provide conclusive evidence proving the contrary.

(b) Seller shall not be liable for any non-delivery of Goods (even if caused by Seller's negligence) unless Buyer gives written notice to Seller of the non-delivery within three (3) days of the date when the Goods would in the ordinary course of events have been received.

(c) Any liability of Seller for non-delivery of the Goods shall be limited to (in Seller's sole discretion) replacing the Goods within a reasonable time or adjusting the invoice respecting such Goods to reflect the actual quantity delivered.

**4. Shipping Terms.** Unless indicated otherwise in the Acknowledgment, Delivery shall be made EXW (Incoterms 2010), Shipping Point, including without limitation, freight and insurance costs. If no delivery terms are specified on the Acknowledgement, the method of shipping will be in the sole discretion of Seller. Unless directed in writing otherwise by Buyer, full invoice value will be declared for all shipments.

**5. Title and Risk of Loss.** Title and risk of loss passes to Buyer upon delivery of the Goods at the Shipping Point. As collateral security for the payment of the purchase price of the Goods, Buyer hereby grants to Seller a lien on and security interest in and to all of the right, title and interest of Buyer in, to and under the Goods, wherever located, and whether now existing or hereafter arising or acquired from time to time, and in all accessions thereto and replacements or modifications thereof, as well as all proceeds (including insurance proceeds) of the foregoing. The security interest granted under this provision constitutes a purchase money security interest under the California Commercial Code.

**6. Amendment and Modification.** These Terms may only be amended or modified in a writing which specifically states that it amends these Terms and is signed by an authorized representative of each party.

**7. Inspection and Rejection of Nonconforming Goods.**

(a) Buyer shall inspect the Goods within two (2) days of receipt ("**Inspection Period**"). Buyer will be deemed to have accepted the Goods unless it notifies Seller in writing of any Nonconforming Goods during the Inspection Period and furnishes such written evidence or other documentation as required by Seller. "**Nonconforming Goods**" means only the following: (i) product shipped is different than identified in Buyer's Acknowledgement; or (ii) product's label or packaging incorrectly identifies its contents. Notwithstanding the foregoing, for shipped Goods that require field installation, the "re-verification" terms in the Acknowledgement shall apply and for custom installations, the inspection and verification shall take place at Buyer's site immediately after the installation is completed.

(b) Seller will only accept Nonconforming Goods that are returned under Seller's Return Material Authorization procedures then in effect ("**RMA**"). Buyer shall obtain a RMA number from Seller prior to returning any Nonconforming Goods and return the Nonconforming Goods prepaid and insured to Seller at 1820 South Myrtle Avenue, Monrovia, CA 91016 or to such other location as designated in writing by Seller for the examination to take place there. If Seller reasonably verifies Buyer's claim that the Goods are Nonconforming Goods and that the nonconformance did not developed by use from Buyer, Seller shall, in its sole discretion, (i) replace such Nonconforming Goods with conforming Goods, or (ii) credit or refund the Price for such Nonconforming Goods pursuant to the terms set forth herein. Notwithstanding the foregoing, the only remedy for Nonconforming Goods that are custom systems is repair (not refund or replacement). No returns for Nonconforming Goods are allowed after thirty (30) days from the original shipping date.

(c) Buyer acknowledges and agrees that the remedies set forth in Section 7(a) are Buyer's exclusive remedies for the delivery of Nonconforming Goods. Except as provided under Section 7(a) and Section 14, all sales of Goods to Buyer are made on a one-way basis and Buyer has no right to return Goods purchased under this Agreement to Seller.

**8. Price.**

(a) Buyer shall purchase the Goods from Seller at the prices (the "**Prices**") set forth in Seller's published catalogue literature in force as of the date of the Sales Quotation. However, the Prices shown in such catalogue literature or any other publication are subject to change without notice. Unless specifically stated to the contrary in the Sales Quotation, quoted Prices and discounts are firm for thirty (30) days from the date of the Sales Quotation. Unless otherwise stated, prices are quoted EXW (Incoterms 2010), Shipping Point. Unless otherwise stated in the Acknowledgement, if the Prices should be increased by Seller before delivery of the Goods to a carrier for shipment to Buyer, then these Terms shall be construed as if the increased prices were originally inserted herein, and Buyer shall be billed by Seller on the basis of such increased prices.

(b) All Prices are exclusive of all sales, use and excise taxes, and any other similar taxes, duties and charges of any kind imposed by any governmental authority on any amounts payable by Buyer. Buyer shall be responsible for all such charges, costs and taxes (present or future); provided, that, Buyer shall not be responsible for any taxes imposed on, or with respect to, Seller's income, revenues, gross receipts, personnel or real or personal property or other assets.

**9. Payment Terms.**

(a) Unless otherwise provided in the Acknowledgement, if Buyer has approved credit with Seller, Buyer shall pay all invoiced amounts due to Seller within thirty (30) days from the date of Seller's invoice. If Seller does not have Buyer's financial information and has not provided pre-approved credit terms for Buyer, the payment must be made in cash with order or C.O.D. in US dollars. If Buyer has approved credit terms, the payment may be made by cash with order, wire transfer of immediately available funds, or check in US dollars. Certain products require a down payment. Any payment terms other than set forth above will be identified in the Acknowledgement. Notwithstanding anything herein to the contrary, all prepaid deposits and down payments are non-refundable. If a deposit is not received when due, Seller reserves the right to postpone manufacturing of Goods until payment is received. Seller will not be responsible for shipment delays due to deposit payment delays.

(b) In Seller's sole discretion, Seller may access Buyer interest on all late payments at the lesser of the rate of 1.5% per month or the highest rate permissible under applicable law, calculated daily and compounded monthly. Buyer shall reimburse Seller for all costs incurred in collecting any late payments, including, without limitation, attorneys' fees. In addition to all other remedies available under these Terms or at law (which Seller does not waive by the exercise of any rights hereunder), Seller shall be entitled to suspend the delivery of any Goods if Buyer fails to pay any amounts when due hereunder and such failure continues for ten (10) days following written notice thereof.

(c) Buyer shall not withhold payment of any amounts due and payable by reason of any set-off of any claim or dispute with Seller, whether relating to Seller's breach, bankruptcy or otherwise.

**10. Intellectual Property; Software License.**

(a) To the extent that any Goods provided under this Agreement contains software, whether pre-installed, embedded, in read only memory, or found on any other media or other form ("**Software**"), such Software and accompanying documentation are licensed to Buyer, not sold and shall remain the sole and exclusive property of Seller or third party licensors of Seller. Seller grants Buyer a non-exclusive license to use the Software solely as provided in and in connection with the use of the Goods in which such Software is contained and in accordance with any applicable user documentation provided with such Goods and subject to the provisions of this Agreement. Certain of Seller's Goods may include third party software such as computer operating systems. Licenses to such third party software are subject to the terms and conditions of any applicable third party software license agreements. Unless identified in the Acknowledgement, no license is granted by Seller with respect to such third party software products that may be provided with the Goods (if any). Seller makes no warranties regarding any third party software that may accompany the Goods or otherwise and such software is explicitly included in the definition of Third Party Products below.

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(c) All patents, trademarks, copyrights or other intellectual property rights embodied in the Goods, including without limitation the Software, are owned by Seller and its licensors. Seller and its licensors retain all right, title and interest in such intellectual property rights. Except as expressly set forth herein, no license rights or ownership in or to any of the foregoing is granted or transferred hereunder, either directly or by implication. ALL RIGHTS RESERVED.

(d) If Buyer is the United States Government or any agency thereof, each of the components of the Software and user documentation are a "commercial item," and "computer software" as those terms are defined at 48 C.F.R. 2.101, consisting of "commercial computer software" and "commercial computer software documentation," as such terms are used in 48 C.F.R. 12.212. Consistent with 48 C.F.R. 12.212 and 48 C.F.R. 227.7202-1 through 227.7202-4, all United States government Buyers acquire only those rights in the Software and user documentation that are specified in this Agreement.

**11. Installation and Other Services.** Seller shall provide installation services ("**Installation Services**") to Buyer if set forth in the Acknowledgment. If Installation Services are provided for in the Acknowledgement, Buyer will prepare the location for the installation consistent with Buyer's written specifications and Buyer will install necessary system cable and assemble any necessary equipment or hardware not provided by Seller, unless agreed otherwise in writing by the parties. For Goods that will be operated on or in connection with Buyer supplied hardware or software, Buyer is responsible for ensuring that its hardware and software conform with Seller minimum hardware and software requirements as made available to Buyer. Seller shall provide other field services, such as maintenance visits and field repairs (the "**Other Services**" and together with the Installation Services, the "**Services**") if set forth in the Acknowledgement.

**12. Limited Warranty.**

(a) Subject to the exceptions and upon the conditions set forth herein, Seller warrants to Buyer that for a period of one (1) year from the date of shipment ("**Warranty Period**"), that such Goods will be free from material defects in material and workmanship.

(b) Notwithstanding the foregoing and anything herein to the contrary, the warranty set forth in this Section 12 shall be superseded and replaced in its entirety with the warranty set forth on **Exhibit A** hereto if the Goods being purchased are specialty products, which include, without limitation, laser products, fiber markers, custom systems, workstations, Seller-installed products, non-catalogue products and other custom-made items (each a "**Specialty Product**").

(c) **EXCEPT FOR THE WARRANTY SET FORTH IN SECTION 12(A), SELLER MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE GOODS (INCLUDING ANY SOFTWARE) OR SERVICES, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.**

(d) Products manufactured by a third party and third party software ("**Third Party Product**") may constitute, contain, be contained in, incorporated into, attached to or packaged together with, the Goods. Third Party Products are not covered by the warranty in Section 12(a). For the avoidance of doubt, **SELLER MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO ANY THIRD PARTY PRODUCT, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.** Notwithstanding the foregoing, in the event of the failure of any Third Party Product, Seller will assist (within reason) Buyer (at Buyer's sole expense) in obtaining, from the respective third party, any (if any) adjustment that is available under such third party's warranty.

(e) Seller shall not be liable for a breach of the warranty set forth in Section 12(a) unless: (i) Buyer gives written notice of the defect, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect and such notice is received by Seller during the Warranty Period; (ii) Seller is given a reasonable opportunity after receiving the notice to examine such Goods; (iii) Buyer (if requested to do so by Seller) returns such Goods (prepaid and insured to Seller at 1820 South Myrtle Avenue, Monrovia, CA 91016or to such other location as designated in writing by Seller) to Seller pursuant to Seller's RMA procedures and Buyer obtains a RMA number from Seller prior to returning such Goods for the examination to take place; and (iii) Seller reasonably verifies Buyer's claim that the Goods are defective and that the defect developed under normal and proper use.

(f) Seller shall not be liable for a breach of the warranty set forth in Section 12(a) if: (i) Buyer makes any further use of such Goods after giving such notice; (ii) the defect arises because Buyer failed to follow Seller's oral or written instructions as to the storage, installation, commissioning, use or maintenance of the Goods; (iii) Buyer alters or repairs such Goods without the prior written consent of Seller; or (iv) repairs or modifications are made by persons other than Seller's own service personnel, or an authorized representative's personnel, unless such repairs are made with the written consent of Seller in accordance with procedures outlined by Seller.

(g) All expendables such as electrodes are warranted only for defect in material and workmanship which are apparent upon receipt by Buyer. The foregoing warranty is negated after the initial use.

(h) Subject to Section 12(e) and Section 12(f) above, with respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: (i) repair or replace such Goods (or the defective part) or (ii) credit or refund the price of such Goods at the pro rata contract rate, provided that, if Seller so requests, Buyer shall, at Buyer's expense, return such Goods to Seller.

(i) **THE REMEDIES SET FORTH IN SECTION 12(H) SHALL BE BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN SECTION 12(A).** Representations and warranties made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty, as set forth above, shall not be binding upon Seller.

**13. Limitation of Liability.**

(a) **IN NO EVENT SHALL SELLER BE LIABLE FOR ANY CONSEQUENTIAL, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR PUNITIVE DAMAGES, LOST PROFITS OR REVENUES OR DIMINUTION IN VALUE, LOSS OF INFORMATION OR DATA, OR PERSONAL INJURY OR DEATH ARISING IN ANY WAY OUT OF THE MANUFACTURE, SALE, USE, OR INABILITY TO USE ANY GOODS, SOFTWARE OR SERVICE, ORARISING OUT OF OR RELATING TO ANY BREACH OF THESE TERMS, WHETHER OR NOT THE POSSIBILITY OF SUCH DAMAGES HAS BEEN DISCLOSED IN ADVANCE BY BUYER OR COULD HAVE BEEN REASONABLY FORESEEN BY BUYER, REGARDLESS OF THE LEGAL OR EQUITABLE THEORY (CONTRACT, TORT OR OTHERWISE) UPON WHICH THE CLAIM IS BASED, AND NOTWITHSTANDING THE FAILURE OF ANY AGREED OR OTHER REMEDY OF ITS ESSENTIAL PURPOSE.**

(b) **IN NO EVENT SHALL SELLER'S AGGREGATE LIABILITY ARISING OUT OF OR RELATED TO THIS AGREEMENT, WHETHER ARISING OUT OF OR RELATED TO BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, EXCEED THE TOTAL OF THE AMOUNTS PAID TO SELLER FOR THE GOODS SOLD HEREUNDER.**

(c) **ALL WARRANTIES SET FORTH HEREIN, DIRECT OR IMPLIED, ARE VOIDED IF THE INITIAL INSTALLATION AND START-UP OF THE SUBJECT GOOD IS NOT SUPERVISED BY AN AUTHORIZED REPRESENTATIVE OF SELLER. AFTER INSTALLATION, ANY RE-ALIGNMENT, RE-CLEANING, OR RE-CALIBRATION, PROVIDED THEY ARE NOT RELATED TO A PROVEN DEFECT IN MATERIALS OR WORKMANSHIP, SHALL BE PERFORMED BY AN AUTHORIZED REPRESENTATIVE OF SELLERAT THE CURRENT SERVICE RATES.**

(d) **WHERE GOODS ARE SUBJECT TO A MOVE TO ANOTHER LOCATION AFTER THE ORIGINAL INSTALLATION HAS BEEN MADE, THE WARRANTY MAY BE MAINTAINED ONLY IF SUPERVISED BY AN AUTHORIZED REPRESENTATIVE OF SELLER. SELLER, FOR A SERVICE CHARGE, WILL ARRANGE FOR AND SUPERVISE THE DISCONNECTION, TRANSPORTATION, REINSTALLATION AND START-UP OF THE EQUIPMENT. CLAIMS FOR DAMAGE IN SHIPMENT ARE THE RESPONSIBILITY OF BUYER AND SHALL BE FILED PROMPTLY WITH THE TRANSPORTATION COMPANY.**

**14. Return Goods Policy.** Seller's products may be returned to Seller for credit within sixty (60) days of shipment subject to the following conditions.

(a) In order to return products for credit, Buyer must obtain a RMA number from Seller. Upon receipt, it must be executed by an authorized person and then returned with the Goods. Goods returned to Seller without a RMA will be returned at Buyer's expense.

(b) Goods are to be returned to Seller at 1820 South Myrtle Avenue, Monrovia, CA 91016 with Freight Prepaid. Seller will not accept collect shipments.

(c) Restocking fees will be assessed in accordance with the following schedules: (i) Goods returned within the first thirty (30) days from shipment date will be restocked less twenty percent (20%) of the amount billed on the original invoice. (ii) Goods returned over thirty (30) days of shipment but less than sixty (60) days will be restocked less thirty percent (30%) of the amount billed on the original invoice. (iii) No returns are allowed after sixty (60) days from the original shipping date.

(d) The restocking fees set forth above are the minimum fees. If a returned Good requires rework to restore it to a saleable condition, further charges will be assessed. Seller's quality assurance department will document the condition of the Goods when received by Seller and report their findings to Buyer.

(e) **Notwithstanding the foregoing provisions of this Section 14, the following Goods cannot be returned, are not eligible for any credit and cannot be restocked: (i) custom or modified products and (ii) any expendable product(s) that have been used.**

**15. Compliance with Law and Indemnification.** Buyer shall comply with all applicable laws, regulations and ordinances. Buyer shall maintain in effect all the licenses, permissions, authorizations, consents and permits that it needs to carry out its obligations under this Agreement. Buyer shall comply with all export and import laws of all countries involved in the sale of the Goods under this Agreement or any resale of the Goods by Buyer. Goods, Services and technical data delivered by Seller shall be subject to U.S. export controls. Buyer shall, and shall cause its customers to, obtain all licenses, permits and approvals required by any government and shall comply with all applicable laws, rules, policies and procedures of the applicable government and other competent authorities. Buyer will indemnify and hold Seller harmless for any violation or alleged violation by Buyer of such laws, rules, policies or procedures. Buyer shall not transmit, export or re-export, directly or indirectly, separately or as part of any system, the Goods or any technical data (including processes and Services) received from Seller, without first obtaining any license required by the applicable government, including without limitation, the U.S. government. Buyer also certifies that none of the Goods or technical data supplied by Seller under this Agreement will be sold or otherwise transferred to, or made available for use by or for, any entity that is engaged in the design, development, production or use of nuclear, biological or chemical weapons or missile technology. No Buyer information will be deemed "technical data" unless Buyer specifically identifies it to Seller as such. Buyer assumes all responsibility for shipments of Goods requiring any government import clearance. Seller may terminate this Agreement if any governmental authority imposes antidumping or countervailing duties or any other penalties on Goods. For all international shipments, Seller requires that all required Export Control documentations, including Form BIS-711 Statement by Ultimate Consignee and Purchases, are submitted by Buyer along with the purchase order. Seller reserves the right to postpone shipment until all documentations are completed and submitted to Seller. Seller will not be responsible for shipment delays due to non-compliance by Buyer of the foregoing two sentences.

**16. Termination.** In addition to any remedies that may be provided under these Terms, Seller may terminate this Agreement with immediate effect upon written notice to Buyer, if Buyer: (i) fails to pay any amount when due under this Agreement and such failure continues for ten (10) days after Buyer's receipt of written notice of nonpayment; (ii) has not otherwise performed or complied with any of these Terms, in whole or in part; or (iii) becomes insolvent, files a petition for bankruptcy or commences or has commenced against it proceedings relating to bankruptcy, receivership, reorganization or assignment for the benefit of creditors.

**17. Waiver.** No waiver by Seller of any of the provisions of this Agreement is effective unless explicitly set forth in writing and signed by Seller. No failure to exercise, or delay in exercising, any rights, remedy, power or privilege arising from this Agreement operates or may be construed as a waiver thereof. No single or partial exercise of any right, remedy, power or privilege hereunder precludes any other or further exercise thereof or the exercise of any other right, remedy, power or privilege.

**18. Confidential Information.** All non-public, confidential or proprietary information of Seller, including, but not limited to, specifications, samples, patterns, designs, plans, drawings, documents, data, business operations, customer lists, pricing, discounts or rebates, disclosed by Seller to Buyer, whether disclosed orally or disclosed or accessed in written, electronic or other form or media, and whether or not marked, designated or otherwise identified as "confidential," in connection with this Agreement is confidential, solely for the use of performing this Agreement and may not be disclosed or copied unless authorized in advance by Seller in writing. Upon Seller's request, Buyer shall promptly return all documents and other materials received from Seller. Seller shall be entitled to injunctive relief for any violation of this Section 18. This Section 18 does not apply to information that is: (a) in the public domain through no fault of Buyer; (b) known to Buyer at the time of disclosure without restriction as evidenced by its records; or (c) rightfully obtained by Buyer on a non-confidential basis from a third party.

**19. Force Majeure.** Seller shall not be liable or responsible to Buyer, nor be deemed to have defaulted or breached this Agreement, for any failure or delay in fulfilling or performing any term of this Agreement when and to the extent such failure or delay is caused by or results from acts or circumstances beyond

the reasonable control of Seller including, without limitation, acts of God, flood, fire, earthquake, explosion, governmental actions, war, invasion or hostilities (whether war is declared or not), terrorist threats or acts, riot, or other civil unrest, national emergency, revolution, insurrection, epidemic, lock-outs, strikes or other labor disputes (whether or not relating to either party's workforce), or restraints or delays affecting carriers or inability or delay in obtaining supplies of adequate or suitable materials, materials or telecommunication breakdown or power outage (each a "**Force Majeure Event**"), provided that, if the event in question continues for a continuous period in excess of thirty (30) days, Buyer shall be entitled to give notice in writing to Seller to terminate this Agreement.

**20. Assignment.** Buyer shall not assign any of its rights or delegate any of its obligations under this Agreement without the prior written consent of Seller. Any purported assignment or delegation in violation of this Section 20 is null and void. No assignment or delegation relieves Buyer of any of its obligations under this Agreement.

**21. Relationship of the Parties.** The relationship between the parties is that of independent contractors. Nothing contained in this Agreement shall be construed as creating any agency, partnership, joint venture or other form of joint enterprise, employment or fiduciary relationship between the parties, and neither party shall have authority to contract for or bind the other party in any manner whatsoever.

**22. No Third-Party Beneficiaries.** This Agreement is for the sole benefit of the parties hereto and their respective successors and permitted assigns and nothing herein, express or implied, is intended to or shall confer upon any other person or entity any legal or equitable right, benefit or remedy of any nature whatsoever under or by reason of these Terms.

**23. Governing Law.** All matters arising out of or relating to this Agreement is governed by and construed in accordance with the internal laws of the State of California without giving effect to any choice or conflict of law provision or rule (whether of the State of California or any other jurisdiction) that would cause the application of the laws of any jurisdiction other than those of the State of California.

**24. Dispute Resolution.**

(a) If Buyer is an entity formed under the laws of the United States of America, or any of its states, districts or territories ("**U.S. Law**"), then any dispute, legal suit, action or proceeding arising out of or relating to this Agreement shall be adjudicated and decided in the federal courts of the United States of America or the courts of the State of California in each case located in the City of Los Angeles and County of Los Angeles, California and each party irrevocably submits to the exclusive and personal jurisdiction of such courts in any such dispute, suit, action or proceeding.

(b) If Buyer is an entity formed under the laws of any country, state, district or territory other than U.S. Law, then the parties irrevocably agree that any dispute, legal suit, action or proceeding arising out of or relating to this Agreement shall be submitted to the International Court of Arbitration of the International Chamber of Commerce ("**ICC**") and shall be finally settled under the Rules of Arbitration of the ICC. The place and location of the arbitration shall be in Los Angeles, California, pursuant to the ICC's Rules of Arbitration and shall be finally settled in accordance with said rules. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator and the two arbitrators so selected shall select the third arbitrator, who shall act as presiding arbitrator. Notwithstanding the foregoing, if the matter under dispute is $500,000 or less, there shall only be one arbitrator who shall be mutually selected by both parties. If the party-selected arbitrators are unable to agree upon the third arbitrator, if either party fails to select an arbitrator, or in the case that only one arbitrator is required and the parties are unable to agree, then the International Court of Arbitration shall choose the arbitrator. The language to be used in the arbitral proceeding shall be English. The arbitrator(s) shall have no authority to issue an award that is contrary to the express terms of this Agreement or the laws of the State of California or applicable US Federal Law, and the award may be vacated or corrected on appeal to a court of competent jurisdiction for any such error. The arbitrator(s) shall be specifically empowered to allocate between the parties the costs of arbitration, as well as reasonable attorneys' fees and costs, in such equitable manner as the arbitrator(s) may determine. The arbitrator(s) shall have the authority to determine issues of arbitrability and to award compensatory damages, but they shall not have authority to award punitive or exemplary damages. Judgment upon the award so rendered may be entered in any court having jurisdiction or application may be made to such court for judicial acceptance of any award and an order of enforcement, as the case may be. In no event shall a demand for arbitration be made after the date when institution of a legal or equitable proceeding based upon such claim, dispute or other matter in question would be barred by the applicable statute of limitations. Notwithstanding the foregoing, either party shall have the right, without waiving any right or remedy available to such party under this Agreement or otherwise, to seek and obtain from any court of competent jurisdiction any interim or provisional relief that is necessary or desirable to protect the rights or property of such party, pending the selection of the arbitrator(s) hereunder or pending the arbitrator(s)' determination of any dispute, controversy or claim hereunder.

**25. Notices.** All notices, request, consents, claims, demands, waivers and other communications hereunder (each, a "**Notice**") shall be in writing and addressed to the parties at the addresses set forth on the face of the Acknowledgement or to such other address that may be designated by the receiving party in writing. All Notices shall be delivered by personal delivery, nationally recognized overnight courier (with all fees pre-paid), facsimile (with confirmation of transmission) or certified or registered mail (in each case, return receipt requested, postage prepaid). Except as otherwise provided in this Agreement, a Notice is effective only (a) upon receipt of the receiving party, upon confirmation of delivery by nationally recognized overnight courier or upon forty-eight (48) hours after being sent by certified or registered mail (as applicable), and (b) if the party giving the Notice has complied with the requirements of this Section 25.

**26. Severability.** If any term or provision of this Agreement is invalid, illegal or unenforceable in any jurisdiction, such invalidity, illegality or unenforceability shall not affect any other term or provision of this Agreement or invalidate or render unenforceable such term or provision in any other jurisdiction.

**27. Survival.** Provisions of these Terms which by their nature should apply beyond their terms will remain in force after any termination or expiration of this Order including, but not limited to, the following provisions: Compliance with Laws, Confidentiality, Governing Law, Dispute Resolution, Survival, and the restrictions on Software in Sections 10(b), (c) and (d).

# CHAPTER 1
# DESCRIPTION

The **AMADA WELD TECH - HF2 High Frequency Inverter Welding Power Supply** is a 2 KHz, three-phase, state-of-the-art inverter welding power supply. This manual covers the following models:

| MODEL NUMBER | STOCK NUMBER |
|---|---|
| HF2/230 | 1-264-04 |
| HF2/380 | 1-264-04-01 |
| HF2/460 | 1-264-04-02 |
| HF2/208 | 1-264-04-03 |
| HF2S/230 | 1-265-04 |
| HF2S/380 | 1-265-04-01 |
| HF2S/460 | 1-265-04-02 |
| HF2S/208 | 1-265-04-03 |

**NOTE:** HF2**S** units with the built-in **Weld Sentry Option** also require User's Manual # 990-291.

For the rest of this manual the HF2 High Frequency Inverter Welding Power Supply will simply be called the ***Power Supply*** and the HF2 Transformer will simply be called the ***Transformer***.

The Power Supply 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 up to 13% changes in line voltage. The Power Supply 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 Power Supply 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.

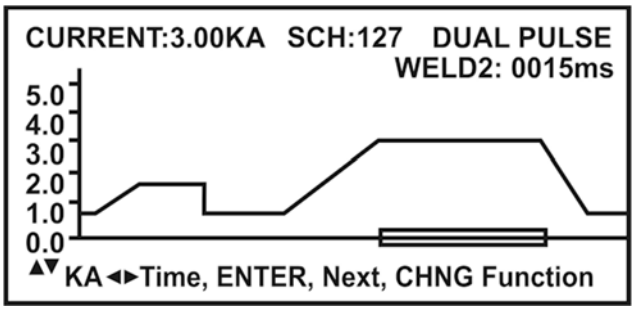



**Figure 1-1. Program Mode**

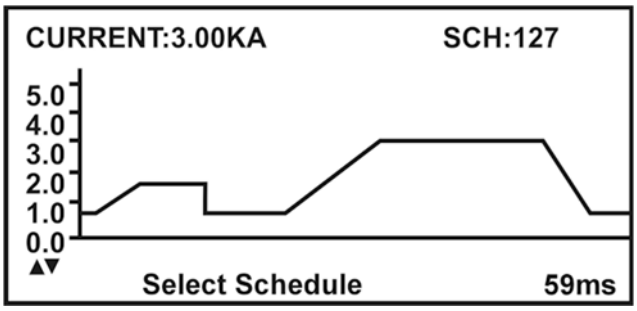



**Figure 1-2. Actual Weld Current**

The Power Supplies 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 Power Supplies Bi-Directional RS-422 / RS-485 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 Data Communications Manual, P/N: 990-058, for advanced RS-485 data communications operation. The 2 KHz operating frequency ensures that the Power Supply 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

AMADA WELD TECH recommends that the Power Supply 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 Power Supply (Figure 2-1) and Transformer (Figure 2-2) so that cooling air may flow properly.

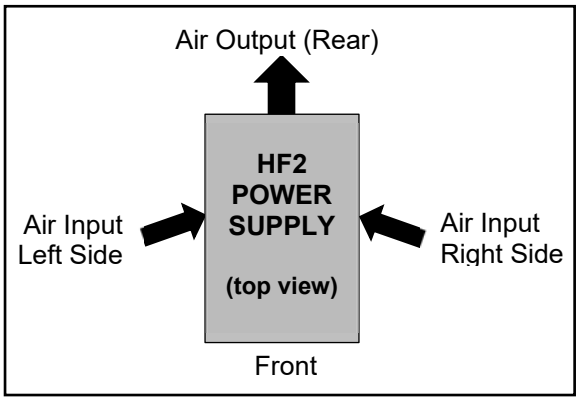



**Figure 2-1. Power Supply Air Flow Pattern**

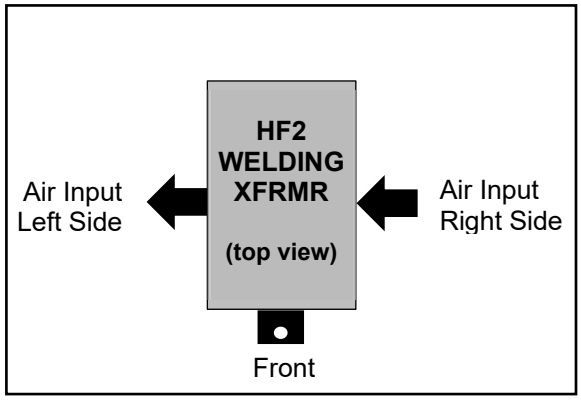



**Figure 2-2. Transformer Air Flow Pattern**

### HF2 Welding Power Supply Dimensions

| Width (in / cm) | Height (in / cm) | Depth (in / cm) | Weight (lb. / kg) |
|---|---|---|---|
| 10.5 / 26.7 | 8.5 / 21.5 | 15.0 / 38.1 | 42 / 19 |

### HF2 Welding Transformer Dimensions

| Model | Height (in / cm) | Width (in / cm) | Depth (in / cm) | Weight (lb. / kg) |
|---|---|---|---|---|
| IT-X2A/2000A | 7.0 / 17.6 | 5.4 / 13.8 | 11.0 / 28.0 | 14.3 / 6.5 |
| IT-X3A/4000A | 7.2 / 18.3 | 7.2 / 18.3 | 13.4 / 34.0 | 28.6 / 13 |
| IT-X11A/4000A | 7.5 / 18.9 | 7.2 / 18.3 | 17.9 / 45.5 | 46 / 21 |
| IT-X11A/4/460A | 7.4 / 18.8 | 7.2 / 18.3 | 18.9 / 48.5 | 55 / 25 |
| IT-X3A/4/380A | 7.2 / 18.3 | 7.2 / 18.3 | 13.4 / 34.0 | 28.6 / 13 |
| IT-X3A/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 Power Supply 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 Power Supply 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, AMADA WELD TECH recommends wire gauge sizes that exceed the USA National Electrical Code recommendations.

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

### Insulation Requirements

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

### Power Line Fuse Requirements

| Service Voltage | Fuse Size: F1, F2 | AMADA WELD TECH Part Number |
|---|---|---|
| 208, 230, 380 | 3AG, 440 V, 2 A | 330-071 |
| 460 | 3AG, 500 V, 2 A | 330-100 |

## HF2 Welding 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) |
|---|---|---|---|---|---|---|
| IT-X3A/4/380A | 380 | 9 | 6 | 6.5 | 4,000 | 500 |
| IT-X3A/4/460A | 460 | 9 | 6 | 6.5 | 4,000 | 500 |
| IT-X3A/4000A | 230 | 9 | 6 | 6.5 | 4,000 | 500 |
| IT-X11A/4/460A | 380 | 4 | 5 | 11.8 (44:1 TR)<br>10.0 (52:1 TR)<br>8.6 (60:1 TR)<br>7.5 (68:1 TR) | 4,000<br>4,000<br>4,000<br>4,000 | 1,300<br>1,100<br>950<br>825 |
| | 460 | 4 | 5 | 14.3 (44:1 TR)<br>12.1 (52:1 TR)<br>10.5 (60:1 TR)<br>9.2 (68:1 TR) | 4,000<br>4,000<br>4,000<br>4,000 | 1,300<br>1,100<br>950<br>825 |
| IT-X11A/4000A | 230 | 15 | 5 | 10.7<br>10.0 (52:1 TR)<br>8.6 (60:1 TR)<br>8.7<br>8.8<br>8.9 | 4,000<br>4,000<br>4,000 | 1,300<br>1,100 |

### TRANSFORMER SPECIFICATION NOTES:

1 For the IT-X11A/4/460A transformer, the turns ratios (TR) is selectable by a switch on the transformer rear panel.

2 Power Supply Input voltage selection must be jumpered at E12 on the HF2 Power Supply 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.

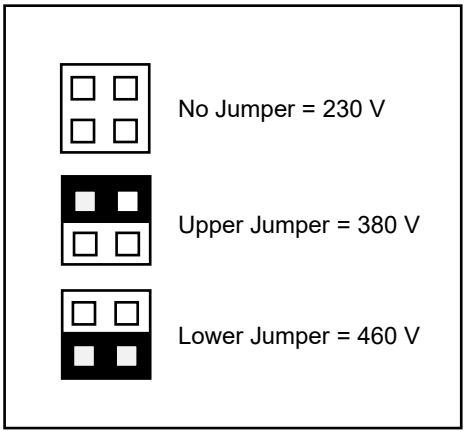



**Figure 2-3. Voltage Jumpers**

### HF2 Welding System Maximum Secondary Loop Resistance

To use the Power Supply and HF2 Welding 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

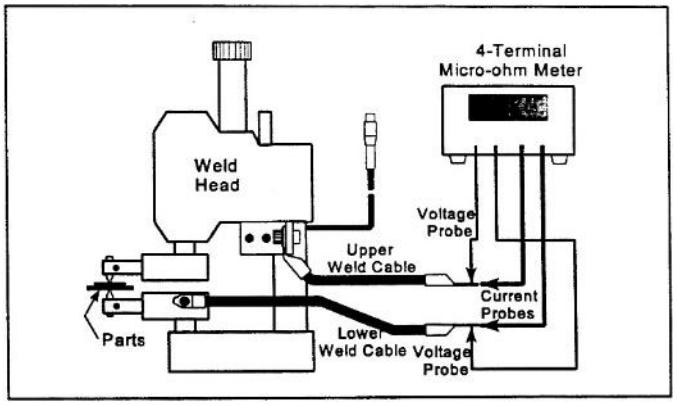



**Figure 2-4. Secondary Resistance Measurement**

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

**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.

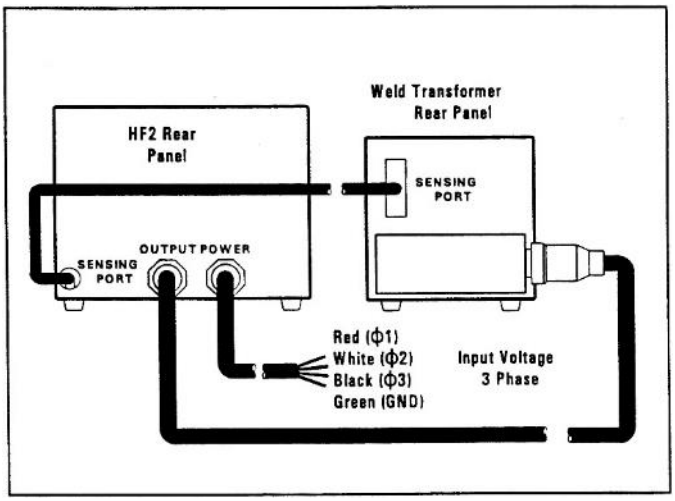
### HF2 Welding Power Supply to HF2 Welding Transformer Connections (Figure 2-5)

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

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

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

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



### HF2 Welding 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.

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.

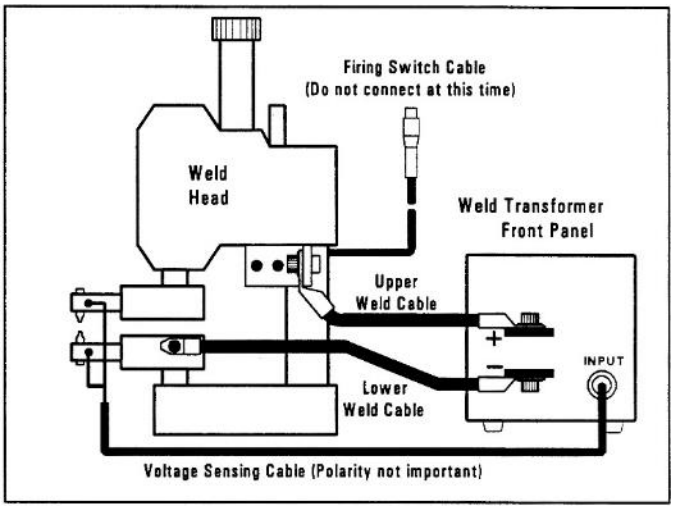



**Figure 2-6. Transformer to Weld Head Connections**

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 HF2S Power Supply if the optional Weld Sentry Module has been installed (as indicated by the "S" in the model number). 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 Power Supply 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:


| Welding System Set-Up Guide | Page |
|---|---|
| AMADA WELD TECH Force Fired, Foot Actuated Weld Head | 3-2 |
| AMADA WELD TECH Force Fired, Single Air Actuated Weld Head | 3-4 |
| AMADA WELD TECH Force Fired, Dual Air Actuated Weld Head | 3-7 |
| Non-Force Fired, Single Air or Cam Actuated Weld Head | 3-16 |


## General Programming Instructions

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

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 Power Supply LCD Display.

## AMADA WELD TECH 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 Power Supply.

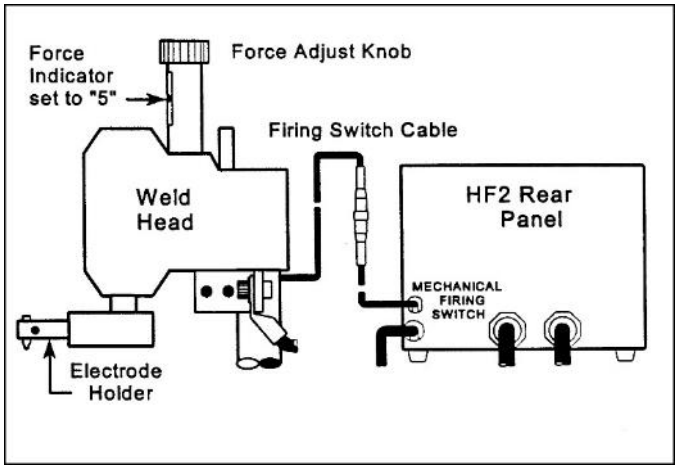


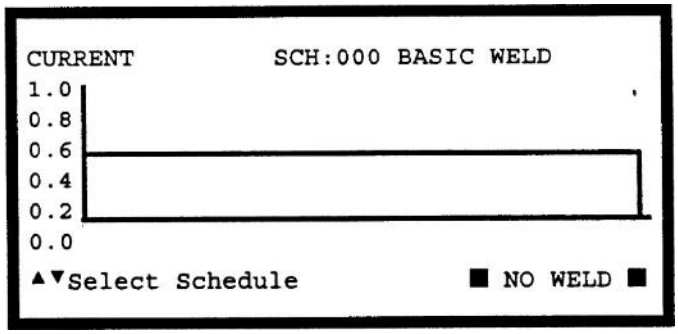

**Figure 3-1. Firing Switch Cable Connection**

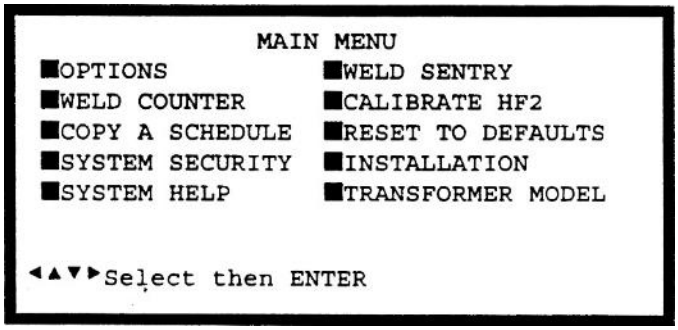
### Quick Start Programming Guide

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

2 Turn the circuit breaker switch located on the Power Supply 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.

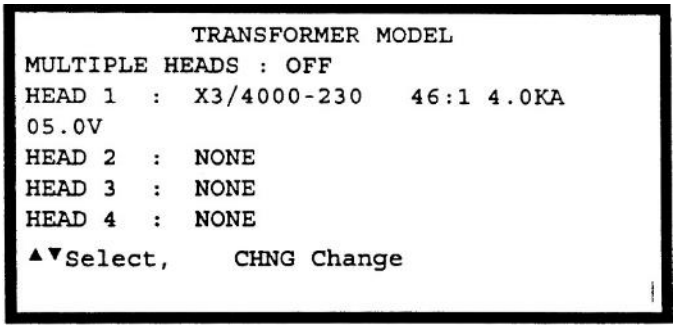


4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

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

6 Select **HEAD 1: X3/4000-230**. The IT-X3A/230 transformer is the default Transformer number. Press **CHNG** until the correct Transformer Model that you have purchased appears.



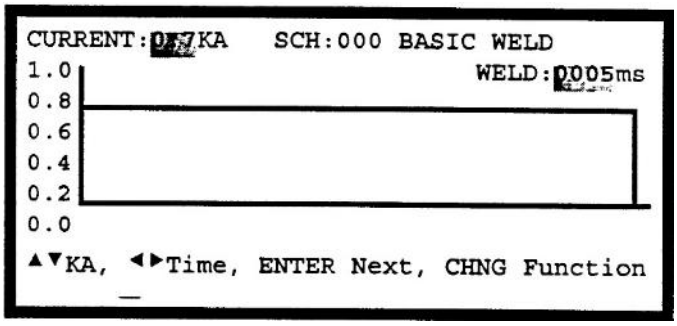

7 Press **RUN** to return to the Graphical **RUN** screen.

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

8 Make a test weld by pressing on the Weld Head foot actuator until the Power Supply 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 5 ms.




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.

## AMADA WELD TECH 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.

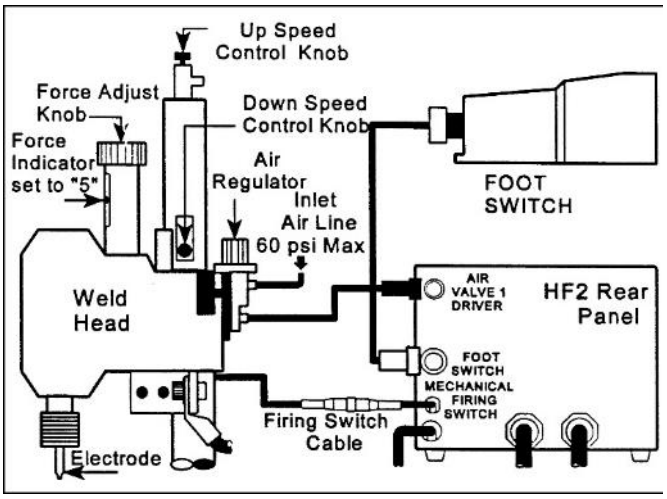



**Figure 3-2. Single Air Actuated Weld Head Connections**

### 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 Power Supply.

### 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 Power Supply. The Power Supply 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 Power Supply 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 Power Supply rear panel. The Power Supply will automatically recognize which model of AMADA WELD TECH 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 Power Supply 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 Power Supply 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 Power Supply 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 Power Supply 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 Power Supply will automatically return the Upper Electrode to its up position.

### Single Air Regulator Adjustment (TL-080B Series Weld Heads - Figure 3-2)

Set the Power Supply front panel **WELD/NO WELD** switch to **NO WELD**.

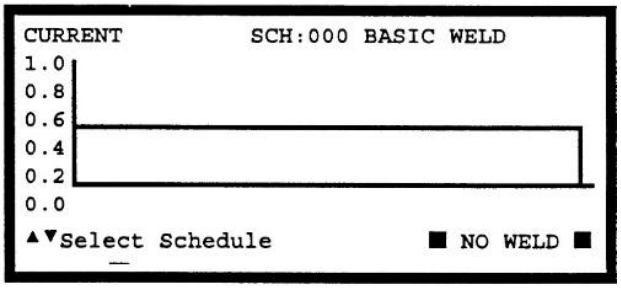
1 Turn the Power Switch located on the Power Supply rear panel to **ON**. After a series of power up screens, the last **RUN** screen displayed will appear. Press the **CHNG** key to access the Weld Graph **RUN** screen for the **BASIC WELD** function.

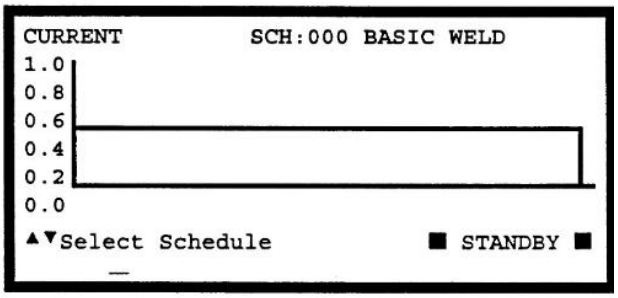
2 Turn the Air Regulator Clockwise (CW) to produce 10 psi on the Pressure Gauge.

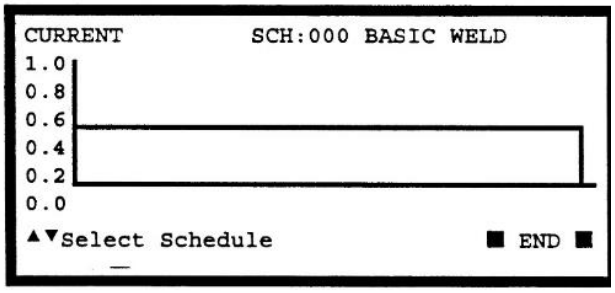
3 Press and hold the Foot Switch completely down to close all switch levels. The lower right hand corner of the display should show the status message ■ **STANDBY** ■.

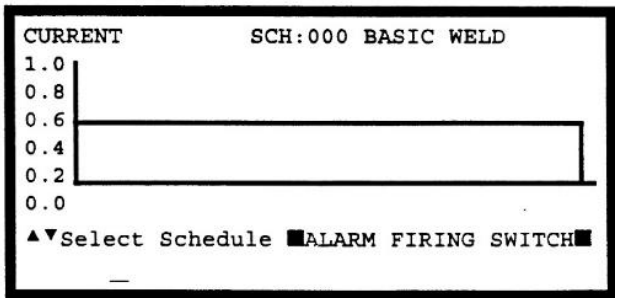
4 Continuing turning the Air Regulator Clockwise (CW) until the Power Supply automatically returns the Upper Electrode to its "up position". The lower right hand corner of the display should now show the status message ■ **END** ■ if you have not released the Foot Switch. Release the Foot Switch.

**NOTE:** You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Power Supply 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 (TL-180B 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.

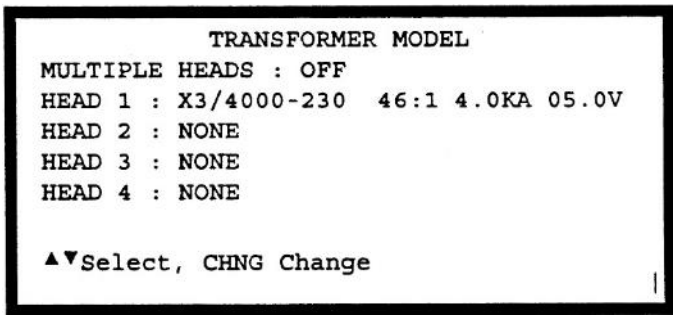
### Quick Start Programming Guide

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**. The IT-X3A/230 transformer is the default Transformer Model. Press **CHNG** until the correct Transformer Model that you have purchased appears.

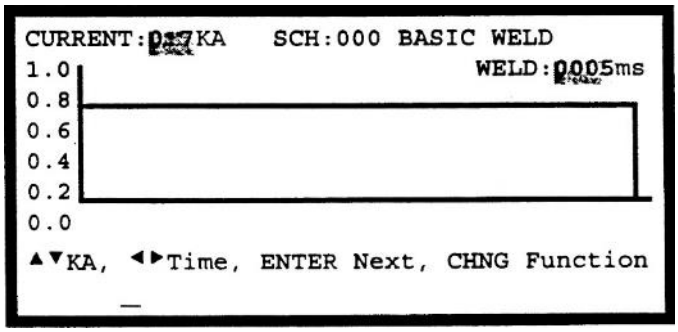



5 Press RUN to return to the Weld Graph **RUN** State.

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

7 Make a test weld by pressing on the Weld Head foot actuator until the Power Supply 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.

## AMADA WELD TECH 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 Power Supply 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.

### Power Supply, Jumper Modifications (Figure 3-3)

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

1 Remove the power supply cover.

2 The Control PCB is located on the right-hand side of the Power Supply. 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 Power Supply cover.

5 Connect 3 phase input power to the Power Supply.

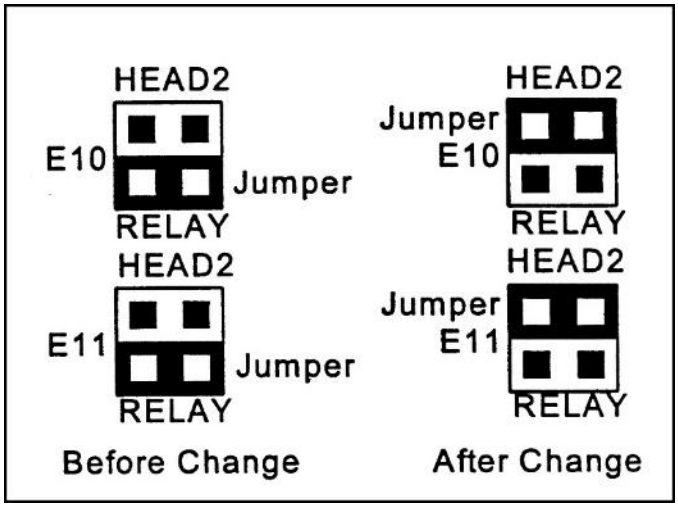



**Figure 3-3. HF2 Jumper Modifications**

### 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.

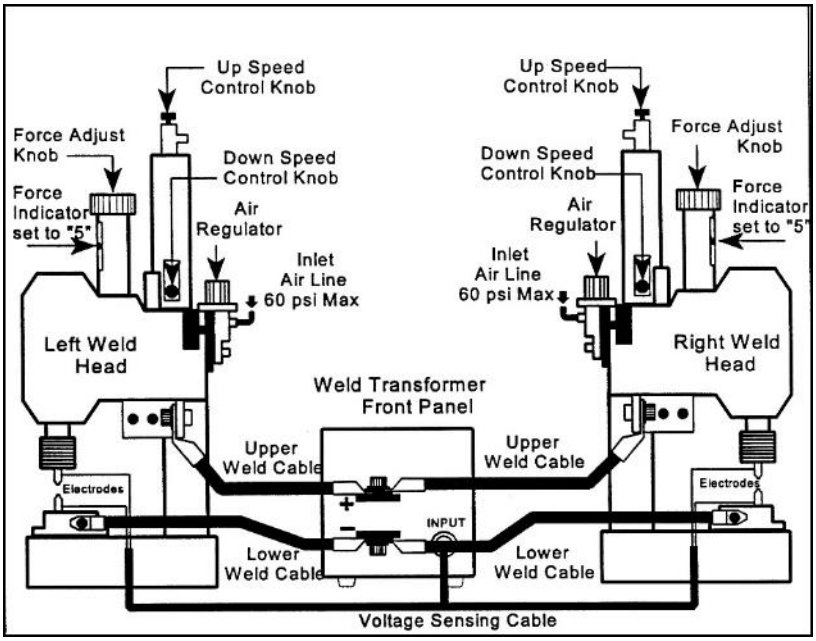



**Figure 3-4. Weld Cable and Air Line Connections for Dual Air Actuated Weld Heads**

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)

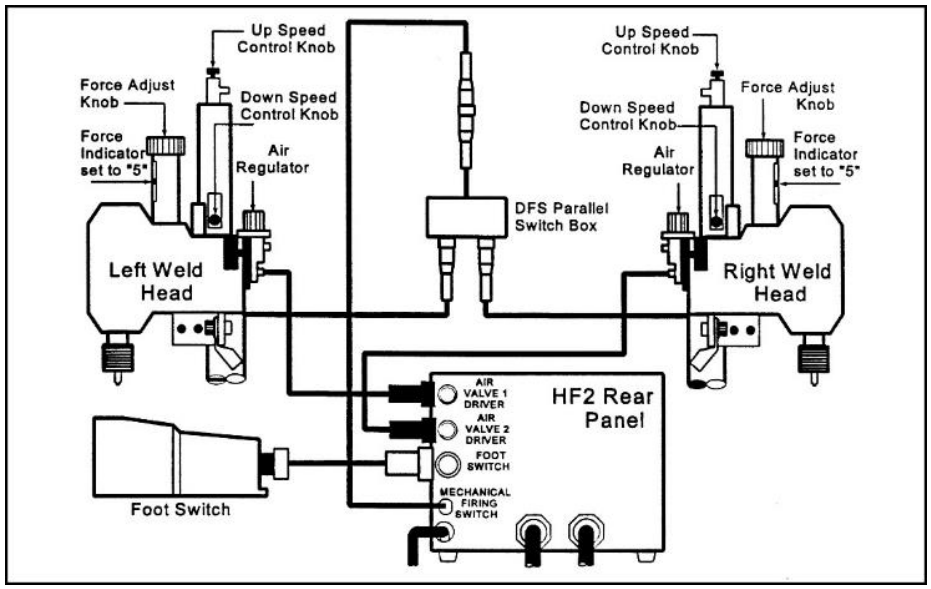



**Figure 3-5. Dual Air Actuated Weld Heads Electrical Connections**

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 Power Supply.

### 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 Power Supply. The Power Supply 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 Power Supply 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 Power Supply 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 Power Supply rear panel. The Power Supply will automatically recognize which model of AMADA WELD TECH Foot Switch has been connected.

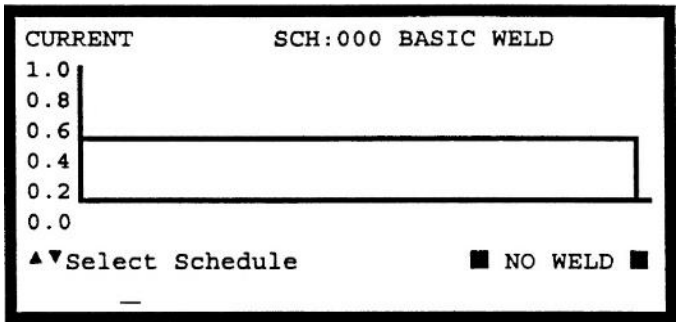
2 **1-Level Foot Switch** -- The l-Level Foot Switch must be fully depressed by the operator. When the Foot Switch closes, the Power Supply energizes the Air Actuated Weld Head, causing the Upper Electrode to descend and apply force to the parts. If the Foot Switch is released before the Weld Head applies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

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

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

2 Turn the Power Switch located on the Power Supply 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.



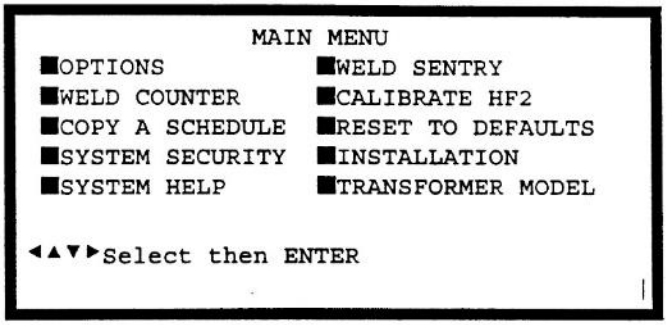

3 Press **MENU**. The **MAIN MENU** screen will appear.

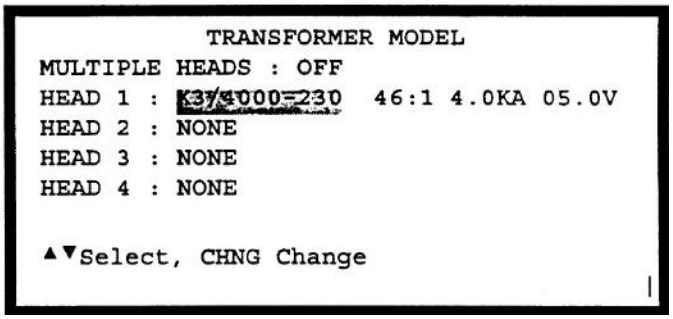
4 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

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

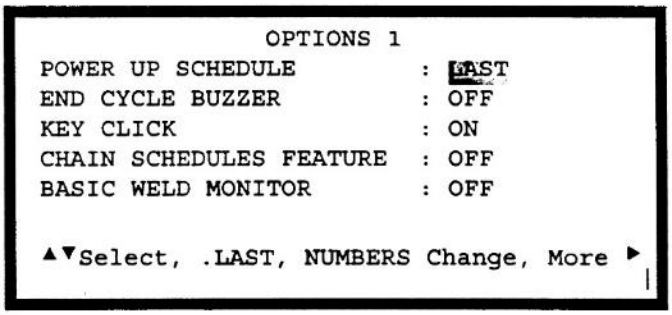
6 Select **HEAD 1: X3/4000-230**. The IT-X3A/230 is the default Transformer Model. Press **CHNG** until the correct Transformer Model that you have purchased appears.

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



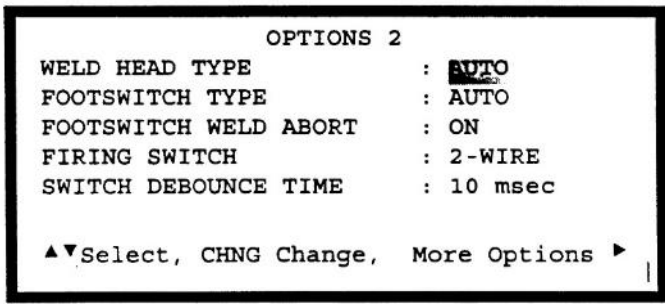
8 Select **OPTIONS**. The **OPTIONS 1** screen appears.




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.

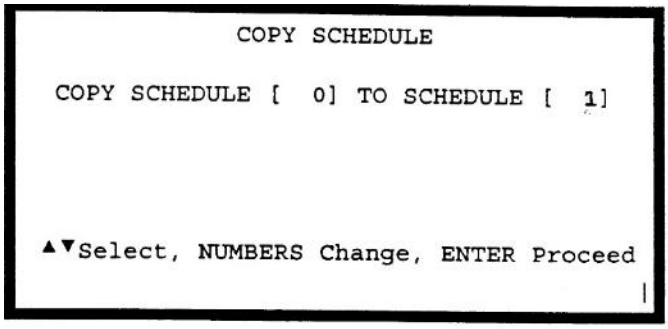
13 Select the last flashing **0** of **TO SCHEDULE 0** and use the number keys to change the flashing **0 TO SCHEDULE 1**.

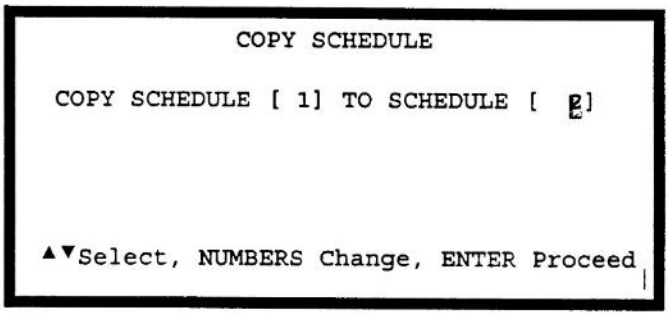
14 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

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

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

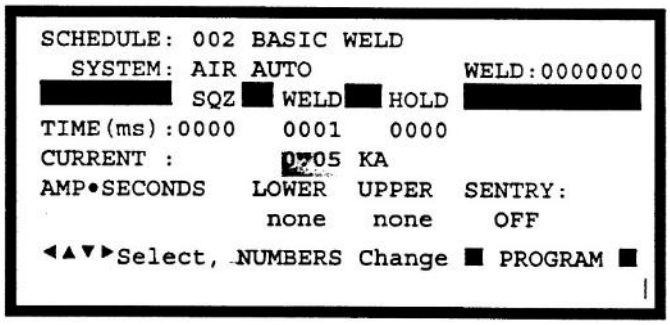
17 Select the last flashing **1** of **TO SCHEDULE 1** and use the number keys to change the flashing **1 TO SCHEDULE 2**.



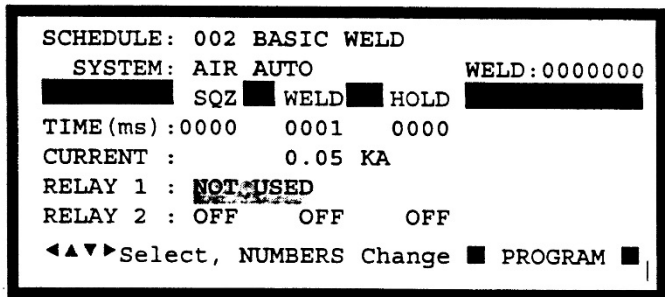
18 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** State.

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.

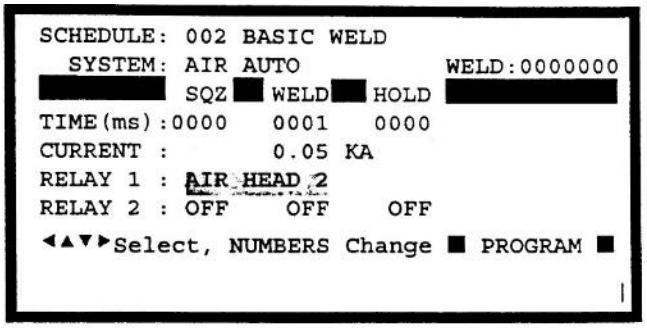
21 Select **RELAY 1: NOT USED**. Press **CHNG** to select the **AIR HEAD 2** option.

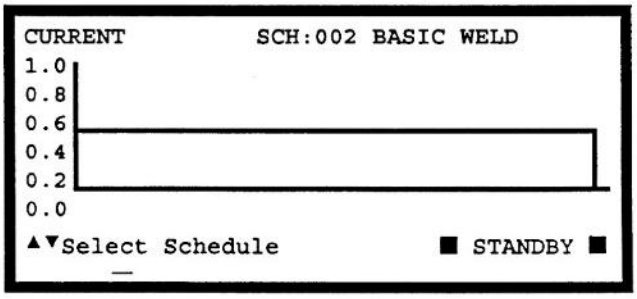



22 Press **SAVE** to update Schedule 2, then press **CHNG** to automatically return to the Weld Graph **RUN** State. You are now ready to adjust the Right Weld Head Air Regulators.

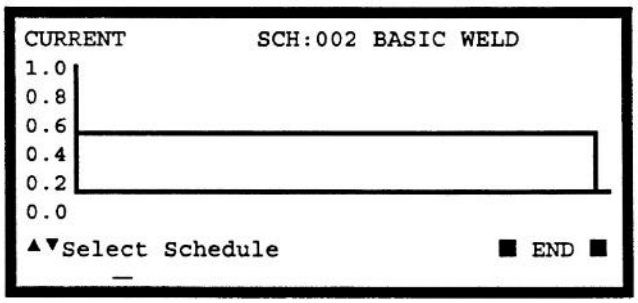
23 Turn both Air Regulators located on the right-hand side of the Right Weld Head Clockwise (CW) to produce 10 psi on the Pressure Gauge.

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**.

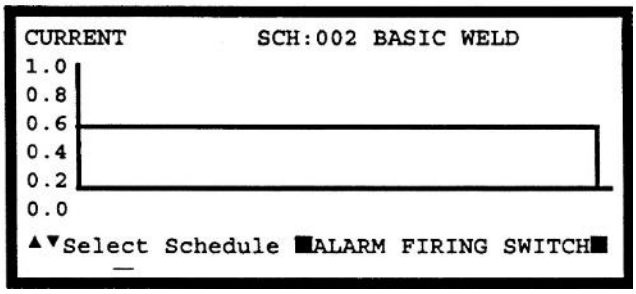


25 Turn the Air Regulator that feeds the Top Right Air Cylinder on the Right Weld Head Clockwise (CW) until the Power Supply automatically returns the Upper Electrode to its up position. The lower right hand corner of the display should now show the status message END if you have not released the Foot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




**NOTE:** You have 10 seconds to make the Air Regulator adjustment or a buzzer alarm will sound and the Power Supply 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.

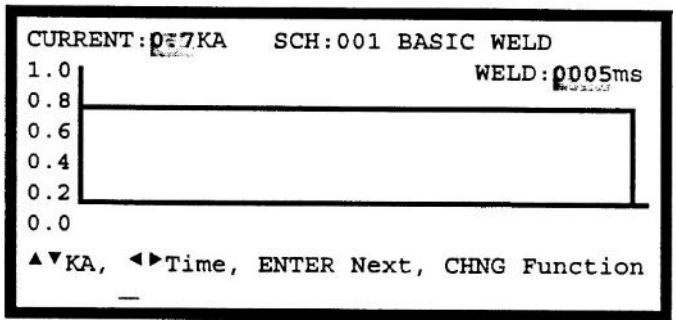
29 Press ▼ to select **SCH:001 BASIC WELD**. You are now ready to adjust the Left Weld Head Air Regulators.

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 Power Supply 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.

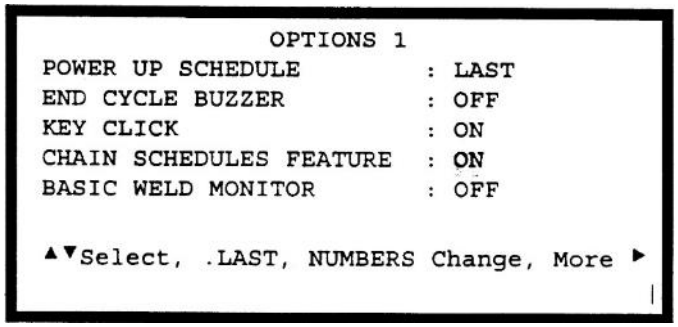
6 Repeat steps 1 through 3 using the Right Weld Head.

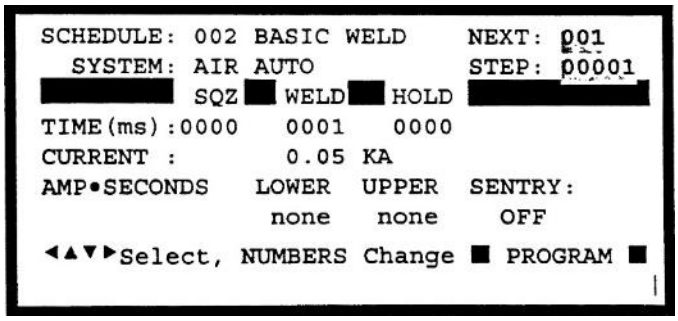
7 Press **SAVE** to save the updated Schedule 2. You are now back in the Weld Graph **RUN** State and ready to turn on the Chaining Feature, which will enable Schedule 1 to automatically sequence to Schedule 2, then back to Schedule 1.

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.





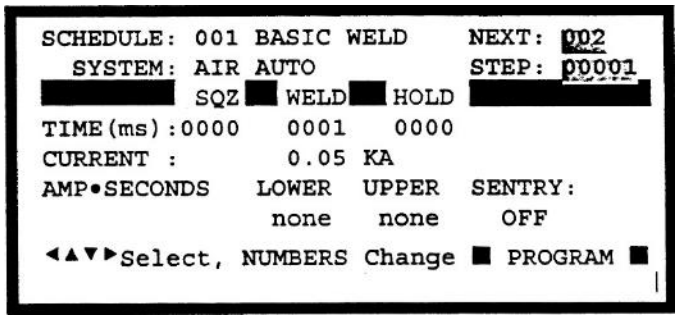

11 Press **PROGRAM** twice to select the Alphanumeric **PROGRAM** screen for Schedule 2.

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 uploaded 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 Power Supply Electrical Connections (Figure 3-6)

1 Connect your Programmable Logic Control (PLC) or Host Computer output control signals to the Power Supply inputs using reed relays or the open collector of an opto-coupler. The emitter of each opto-coupler must be connected to The Power Supply 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 connect for RS-485 Data Communications, reference *Appendix B, RS-485 Connection*.

2 All weld schedules must be entered and saved using the Power Supply 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:

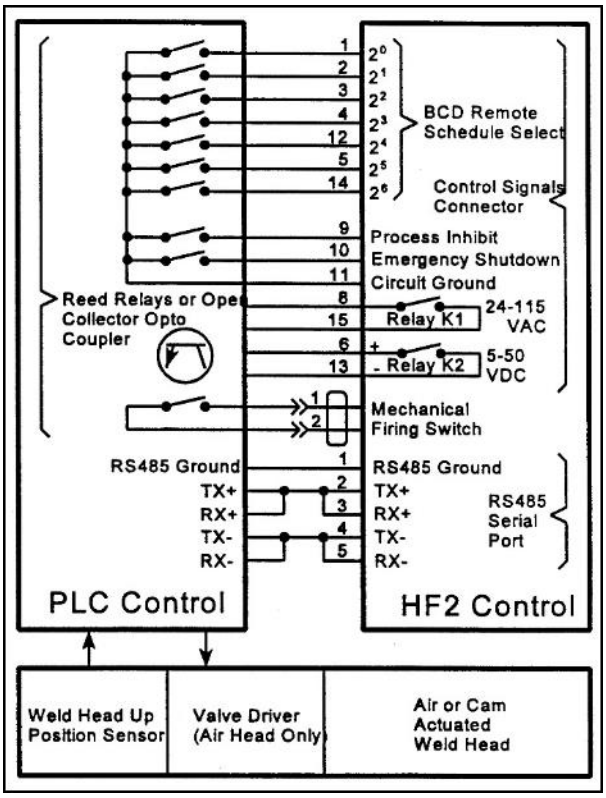



**Figure 3-6. PLC to Power Supply Electrical Connections**

| 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 |

**NOTE:** 0 = Open; 1 = Closed

### PLC Timing Diagram (Figure 3-7)

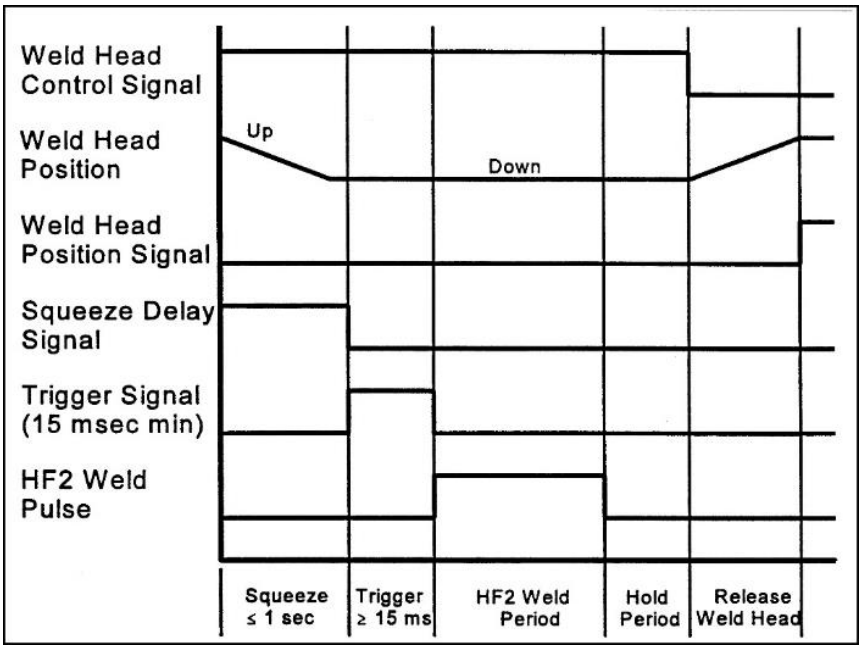



**Figure 3-7. PLC Timing Diagram.**

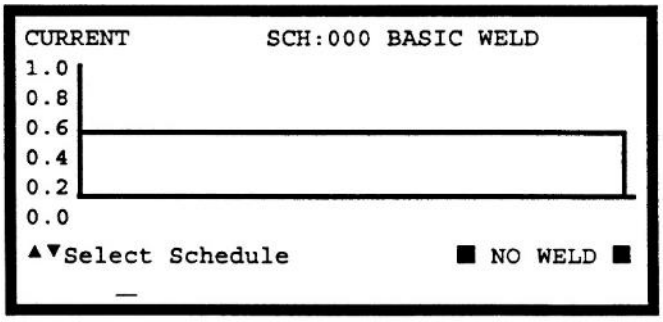
### Quick Start Programming Guide

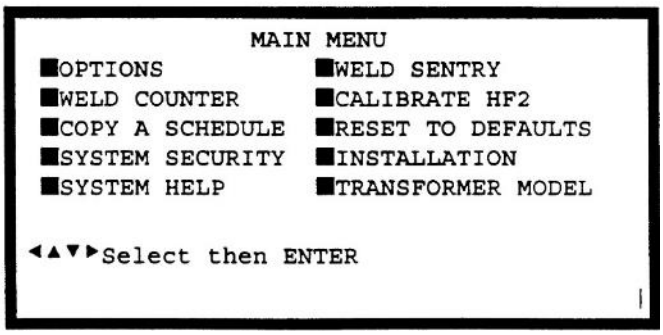
1 Set the Power Supply front panel **WELD/NO WELD** switch to **NO WELD**.

2 Turn the Power Switch located on the Power Supply 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.

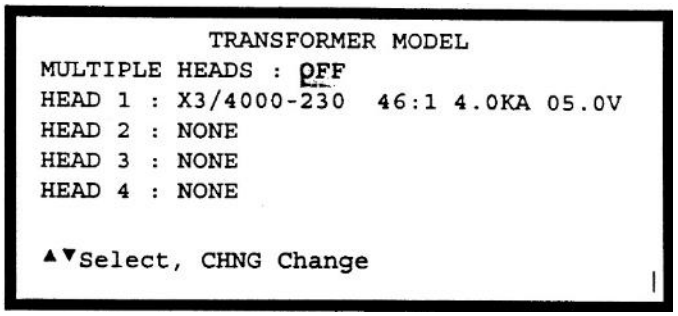


5 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen appears.

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

7 Select **HEAD 1: X3/4000-230**. The IT-X3A/230 is the default Transformer Model. 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.

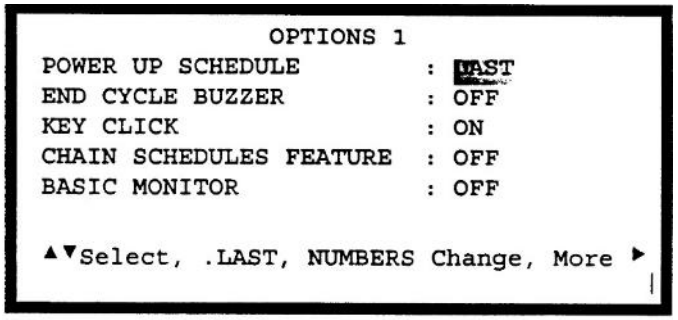
11 Select **WELD HEAD TYPE: AUTO**. Press **CHNG** until the **MANUAL** option appears.

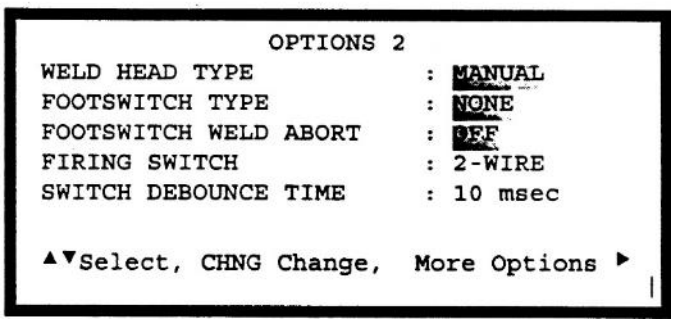
**NOTE: FOOTSWITCH TYPE: AUTO** will automatically change to **NONE**.

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

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

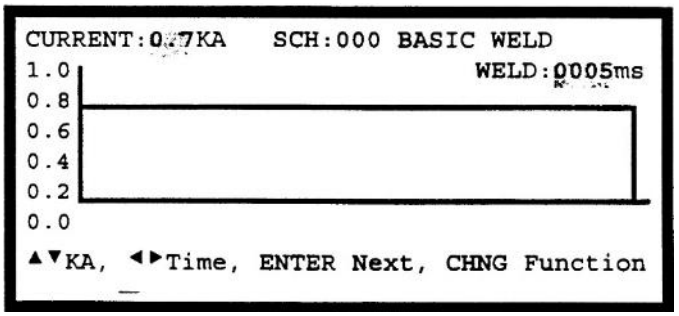
14 Set the Power Supply front panel **WELD/NO WELD switch to WELD.**




15 Make a test weld by pressing on the Weld Head foot actuator until the Power Supply 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 Power Supply Electrical Connections section.

# CHAPTER 4
# CONTROLS

## Power Supply Front Panel

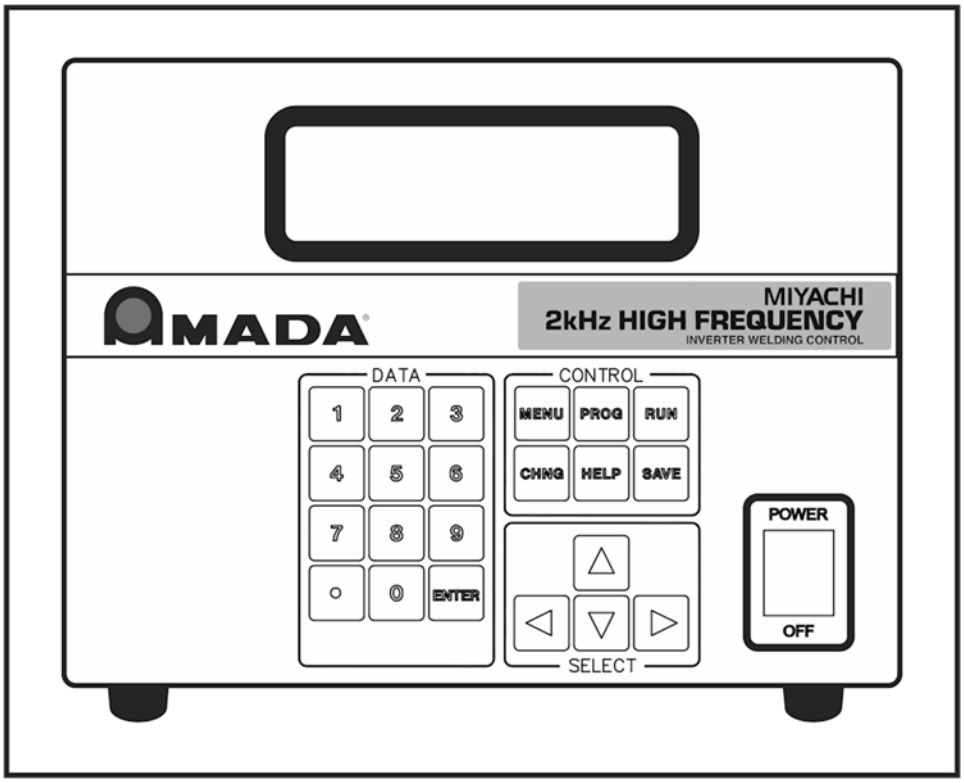



**Figure 4-1. Power Supply Front Panel**

| 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 Power Supply 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 Power Supply 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 Power Supply to initiate and execute a complete welding sequence without weld current flowing. Operating the Power Supply in the **NO WELD** position is required to adjust AMADA WELD TECH Weld Heads. This switch ***must*** be in the **WELD** position in order to make a weld.

### Power Supply - Rear Panel Inputs and Outputs

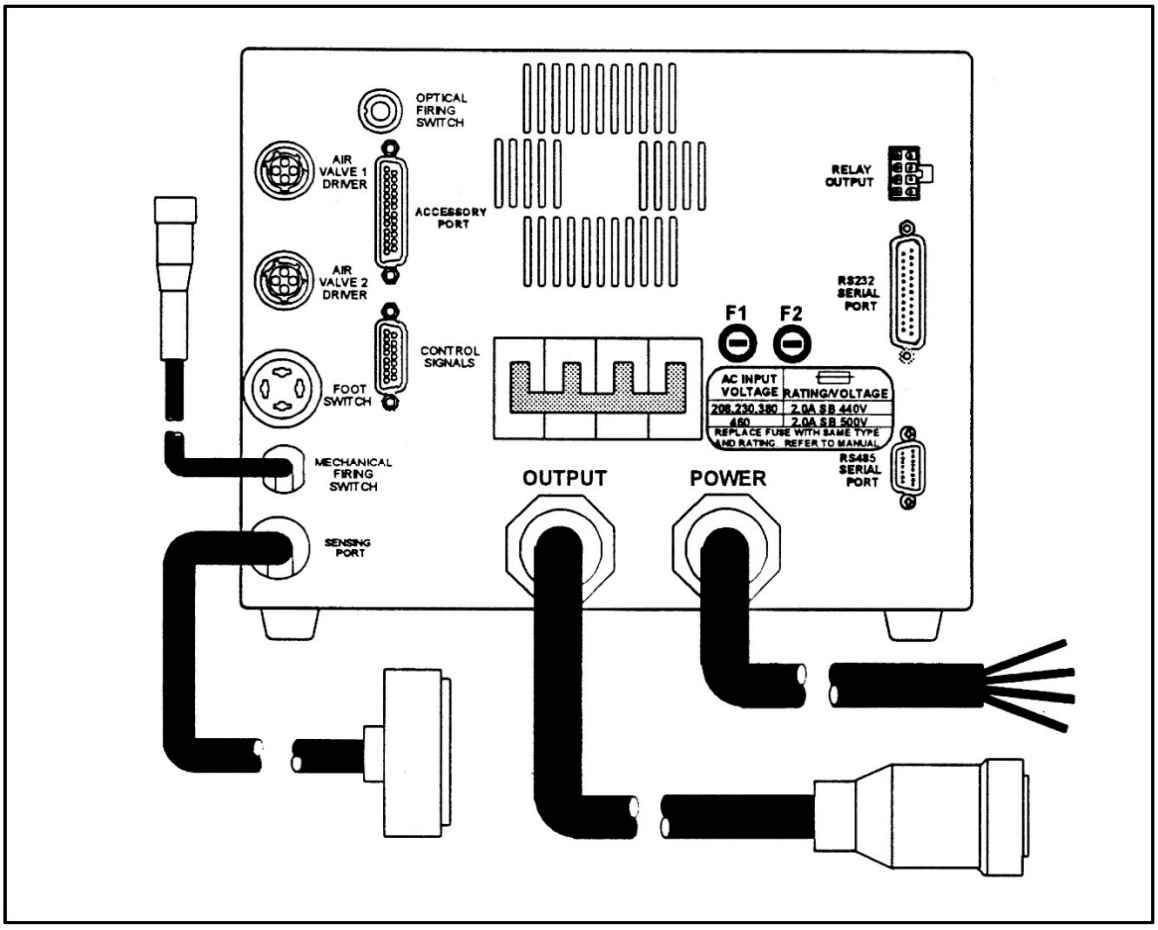



**Figure 4-2. Power Supply Rear Panel**

- **POWER** - Refer to *Chapter 2, Power Line Voltage, Current, and Wire Size Requirements,* for complete instructions on how to properly apply power to the Power Supply.
- **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 connector, Part #: MC16LSF. This connector mates with the connector on the Transformer. As of the time of this revision, the Honda connector is no longer being manufactured and there is no available substitute.

### 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 a TE Connectivity 206136-1 (AWTA Part # 520-115). The mating connector on the Transformer is a TE Connectivity 206137-1 (AWTA 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

Power Supply **FOOT SWITCH** connector uses a 4-pin Amphenol 91-PC4F (AWTA Part # 550-006) bulkhead connector that mates with an Amphenol 91-MC4M (AWTA Part # 520-009).

### 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 Power Supply 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 Power Supply will automatically return the Upper Electrode to its up position.

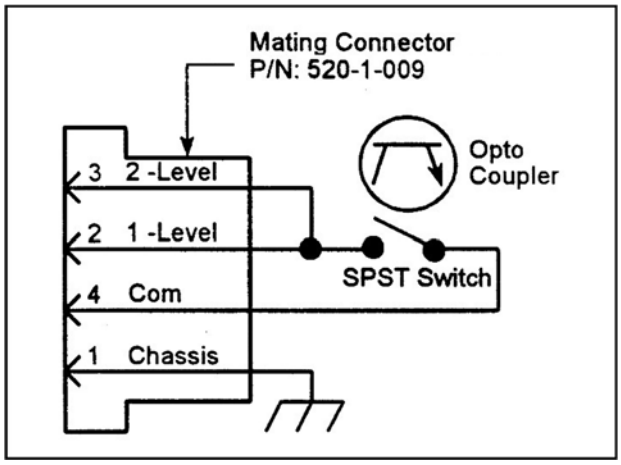



**Figure 4-3. Single-Level Foot Switch**

2 Connect a AMADA WELD TECH - 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-AMADA WELD TECH 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 Power Supply 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 Power Supply 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 Power Supply will automatically return the Upper Electrode to its up position.

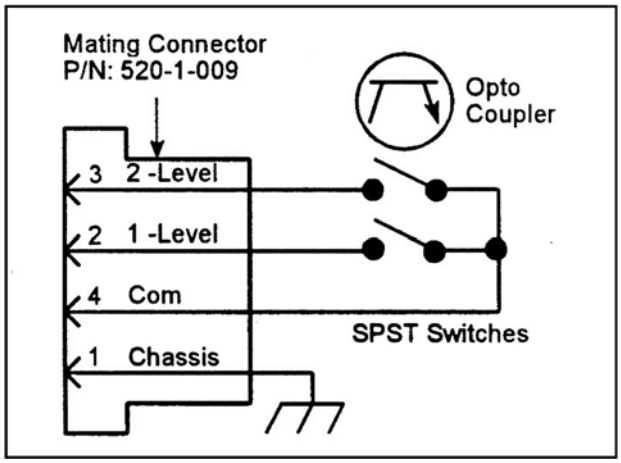



**Figure 4-4. Two-Level Foot Switch**

2 Connect an AMADA WELD TECH - 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 Power Supply 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 (AWTA Part # 520-011), with strain relief that mates with an Amphenol 80-MC2M (AWTA Part # 520-001). Pin 2 is Digital Ground.

2 Connect an AMADA WELD TECH 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.

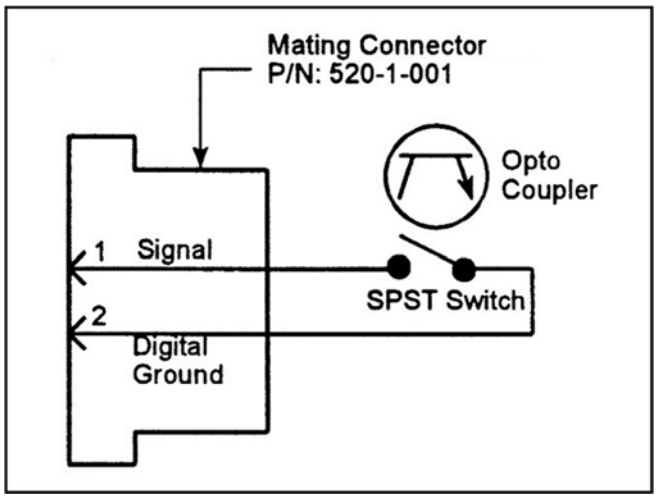



**Figure 4-5. Mechanical Firing Switch**

### OPTICAL FIRING SWITCH Connector

The Optical Firing Switch Connector is a 5 pin TE Connectivity 212044-1 (AWTA Part # 550-064) bulkhead connector and mates with an TE Connectivity Assembly consisting of a TE Connectivity 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.

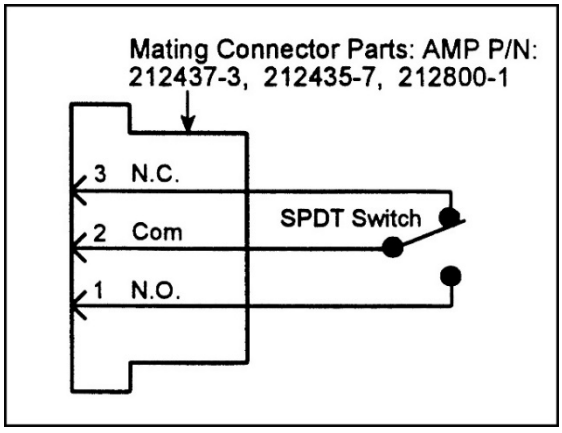



**Figure 4-6. Wire Firing Switch**

### 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.

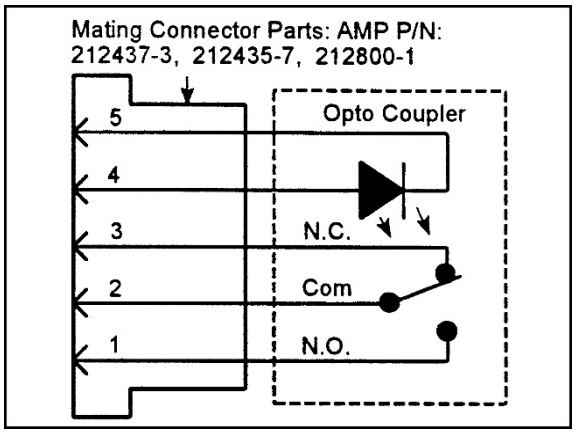



**Figure 4-7. Opto-coupler Firing Switch**

### Control SIGNALS Connector

A 15-pin, sub-miniature "D" Control Signals Connector includes inputs for: (a) Remotely selecting weld schedules 1 through 127; (b) Inhibiting the Power Supply 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.

1. 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).
2. The Control Signals Connector also includes outputs for: a) One DC Solid State Relay; and b) One AC Solid State relay.
3. The 15 pin connector is a Viking DMRST15RA05CG (AWTA Part # 250-195).

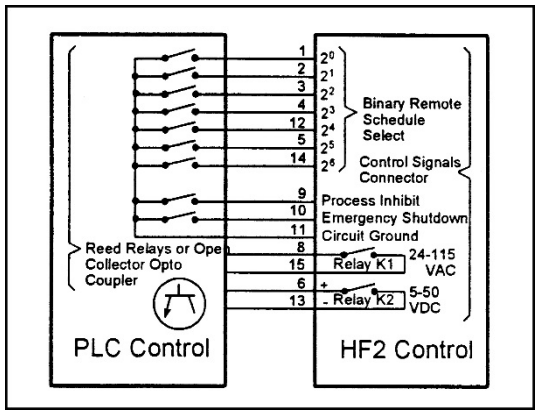



**Figure 4-8. Control Signals Connection**

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

4 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.

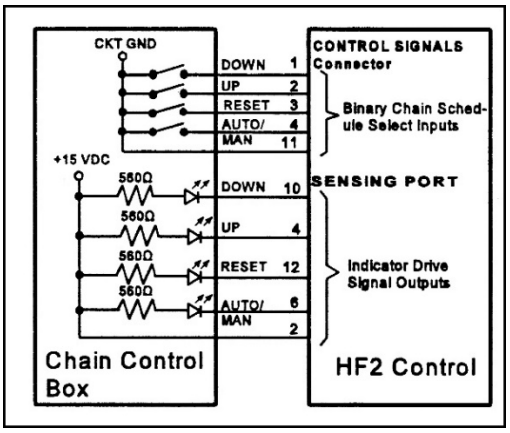



**Figure 4-9. Remote Chain Control Box Input / Output Signals**

### Control Signals - Pin Assignments

| Pin No. | I/O | Description |
|---|---|---|
| 1 | Input | PLC input: Remote Weld Schedule Selection, Control Line 20<br>Chain control box (CCB) input: Schedule Down (decrement number) |
| 2 | Input | PLC input: Remote Weld Schedule Selection, Control Line 21<br>CCB input: Schedule Up (increment number) |
| 3 | Input | PLC input: Remote Weld Schedule Selection, Control Line 22<br>CCB input: Reset (set schedule # to power up schedule #) |
| 4 | Input | PLC input: Remote Weld Schedule Selection, Control Line 23<br>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 Power Supply 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 Power Supply is initiated; (b) when any portion of the welding process is completed; (c) when the Firing Switch opens; or (d) when the Power Supply 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, AMADA WELD TECH, 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 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.

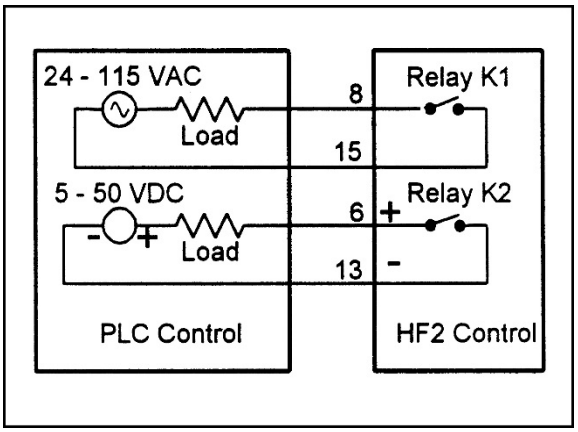



**Figure 4-10. Relay K and K2 Connections**

### 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 TE Connectivity 206430-1 (AWTA Part # 550-062) bulkhead connector. The mating plug is a TE Connectivity 206429-1 (AWTA Part # 520-107) which uses a cable clamp, TE Connectivity 206358-2 (AWTA Part # 245-084) and 3 male pins TE Connectivity 66361-2 (AWTA Part # 253-055). When using a non-AMADA WELD TECH Air Actuated Weld Head, connect Pin 2 to Pin 4. The Power Supply can sequentially operate two separate Air Actuated Weld Heads using Air Valve 1 Driver and Air Valve 2 Driver outputs.

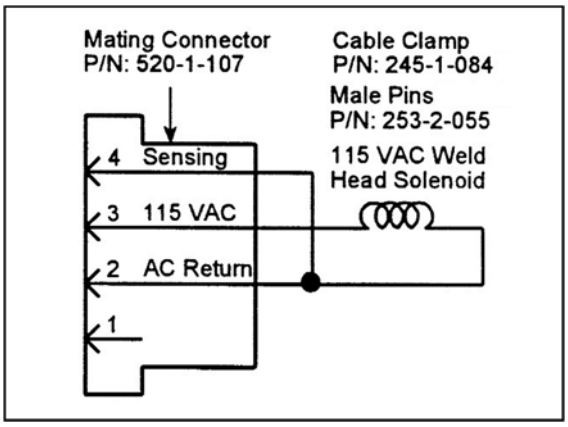



**Figure 4-11. 115 VAC Weld Head Solenoid**

### 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 Power Supply automatically applies the correct solenoid voltage to the Air Actuated Weld Head connected to the Air Valve 1 Driver.

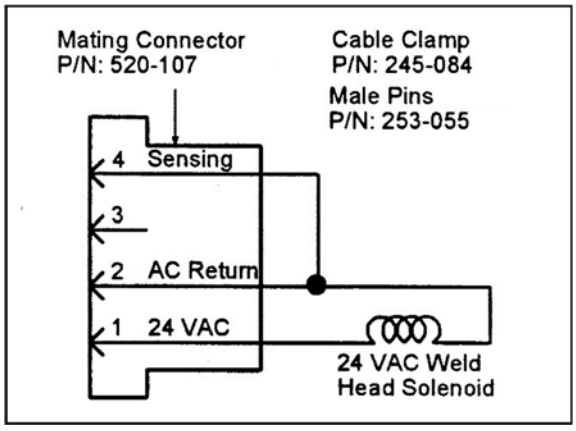



**Figure 4-12. 24 VAC Weld Head Solenoid**

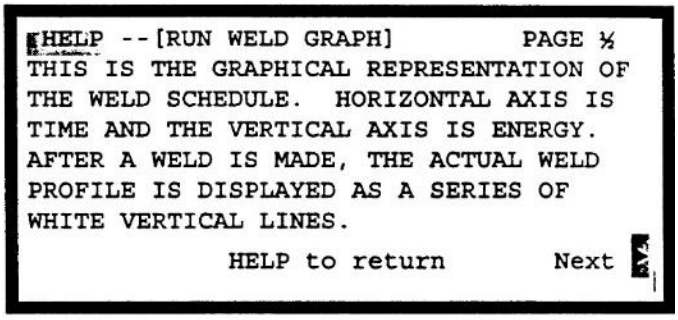
### Air Valve 2 Driver (Figure 4-12)

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, AMADA WELD TECH, 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.

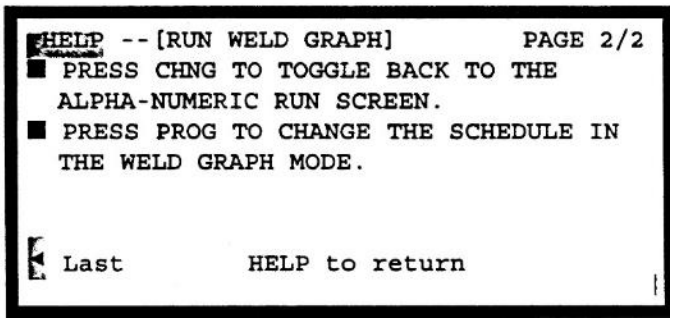
# CHAPTER 5
# PROGRAMMING MODES

## 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 Power Supply 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 ▶ .

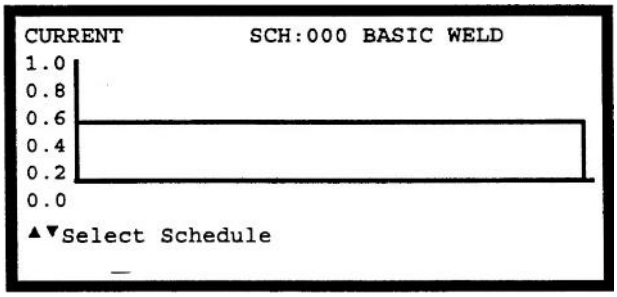
3 To return to the first page of help information, press the left horizontal cursor key ◀ .

### Machine States

The Power Supply 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 Power Supply into the **RUN, MENU, PROGRAM**, and **HELP** states by pressing the **RUN, MENU, PROG** or **HELP** keys.

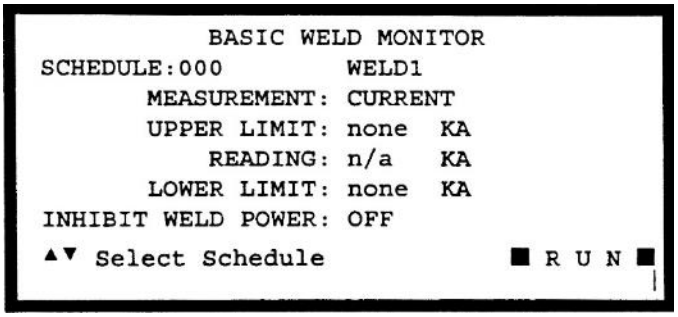
### Weld Graph RUN State

In the Weld Graph **RUN** State, the Power Supply 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

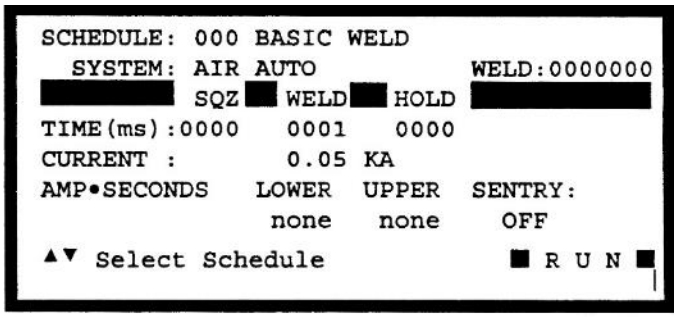
When **MENU, OPTIONS 1, WELD MONITOR:** is set to **BASIC**, pressing **CHNG** will cause the display screen to switch from the Weld Graph **RUN** screen to the Basic Weld Monitor **RUN** screen. Setting **WELD MONITOR** to **LIMIT** causes the Energy Limit Monitor screen to be displayed. See *Chapter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

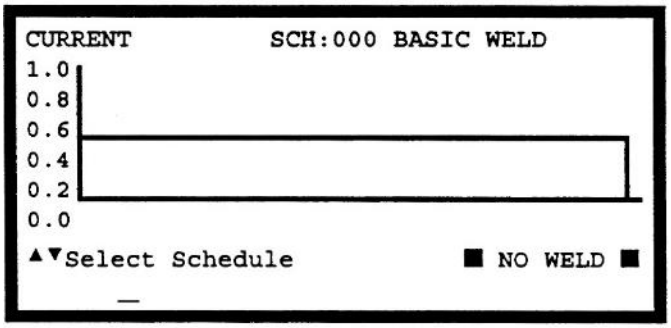
### Alphanumeric RUN State

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 Power Supply to the **Weld Graph** screen. Welding can be performed in any **RUN** screen.



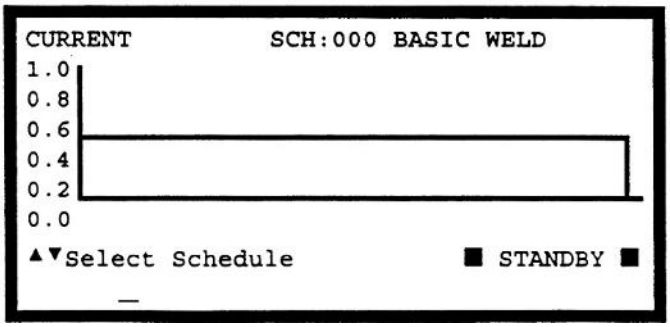

### NO WELD State

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



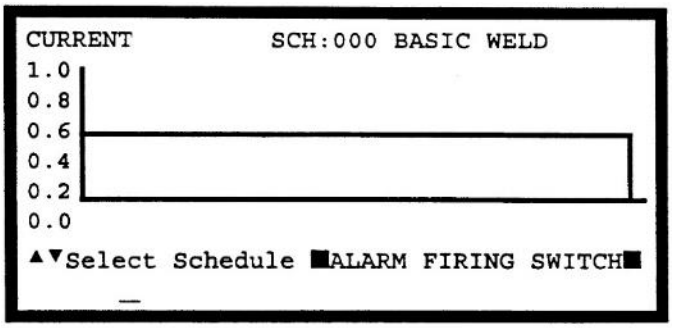

### STANDBY State

The Power Supply is waiting for a mandatory event to occur such as: (a) the Firing Switch in an AMADA WELD TECH 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.



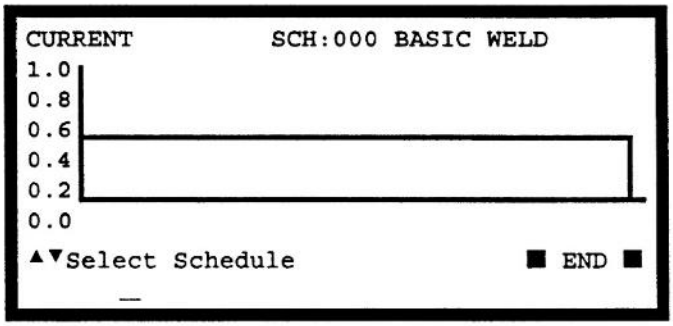
### ALARM State

The Power Supply 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 an AMADA WELD TECH Air Actuated Weld Head does not close within 10 seconds.



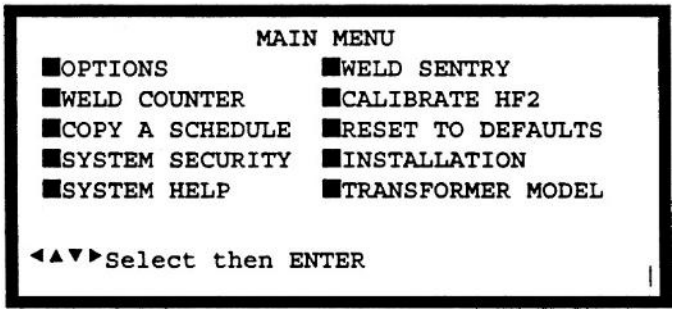

### FIRE State

Once weld current is flowing, the Power Supply 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 Power Supply in the **MENU** State, which offers you different options common to all weld schedules such as how the Power Supply 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 Power Supply 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.

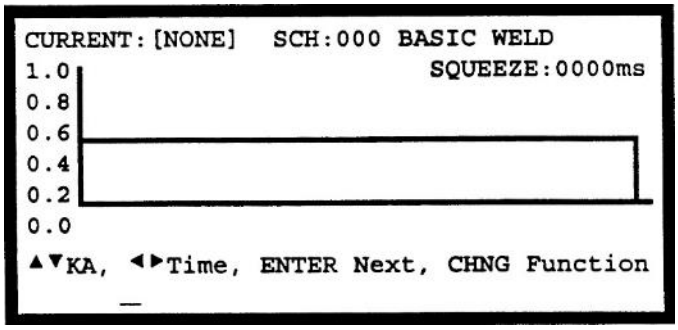
2 A single weld schedule uses one Weld Function. A Weld Function is defined as a series of user programmable time periods, some of which have programmable weld current, voltage, or power levels. Some periods such as **SQUEEZE, COOL, QUENCH, HOLD**, and **OFF** do not have any weld current values associated 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 Power Supply. 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 AMADA WELD TECH 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 2,000 ms.

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

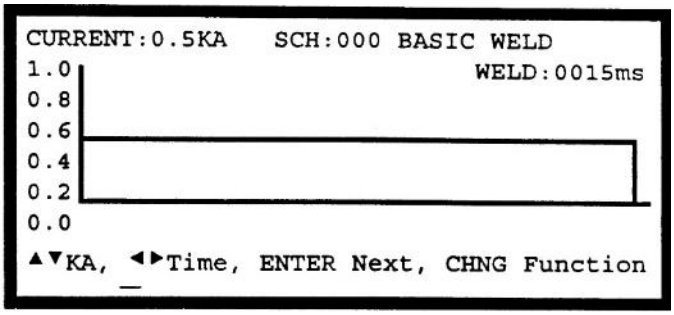
### Weld Graph PROGRAM State

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

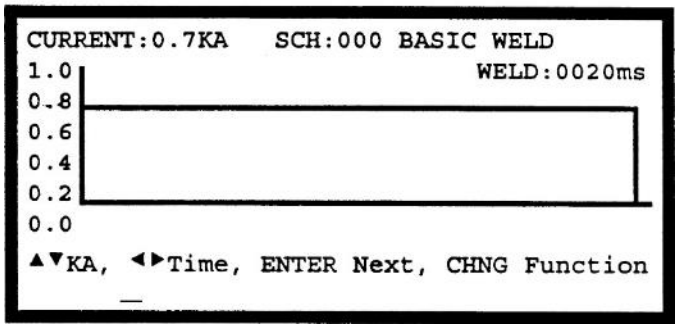



Press **ENTER** to select the period that you want to modify. Note: the upper right-hand corner shows the selected period. Use the horizontal cursor keys ◄ ► to increase or decrease the period time base which is also displayed in the upper right hand corner following the selected period. You can also 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.

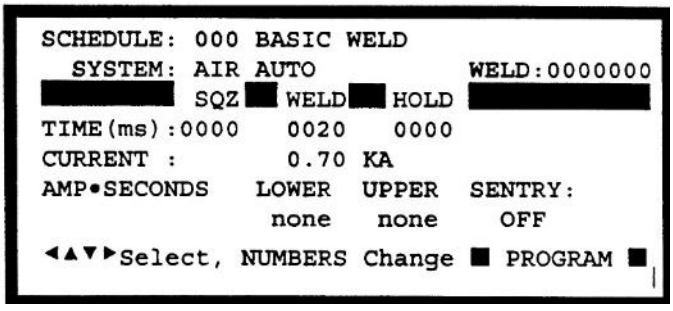



5 Press **SAVE** to save the updated weld schedule. You are now back in the Weld Graph **RUN** State.

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




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

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

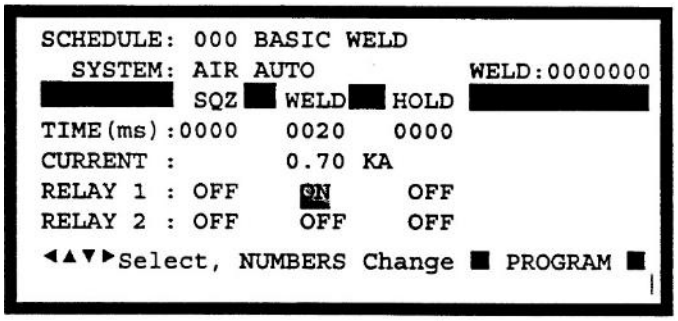
### Output Relays

The Power Supply 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.*

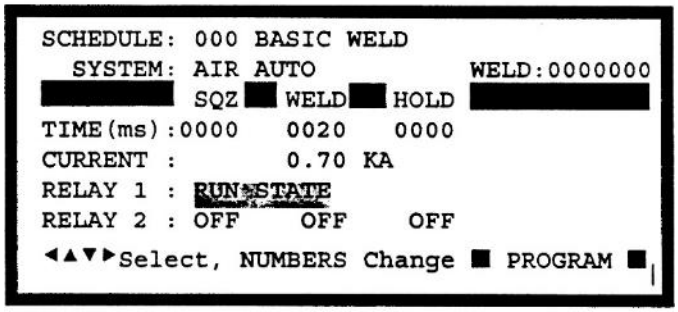
1 Relay **K1** and Relay **K2** can only be programmed in the Alphanumeric **PROGRAM** State.

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.

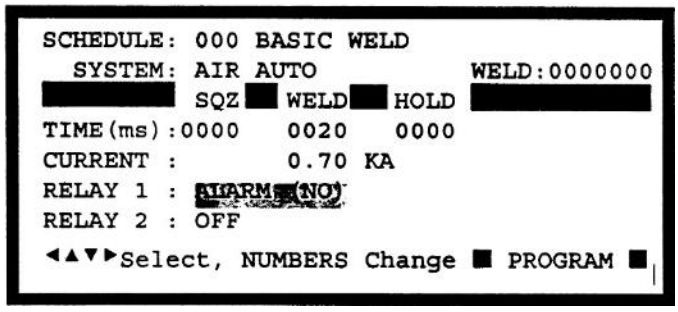
3 Press ▼ until the **RELAY 1** and **RELAY 2** legends are displayed. Both relays can be activated in the **SQUEEZE, WELD**, and **HOLD** periods. Press **CHNG** to select **ON**. In this example, **RELAY** 1 will turn on during the **WELD** period.




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 Power Supply 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.

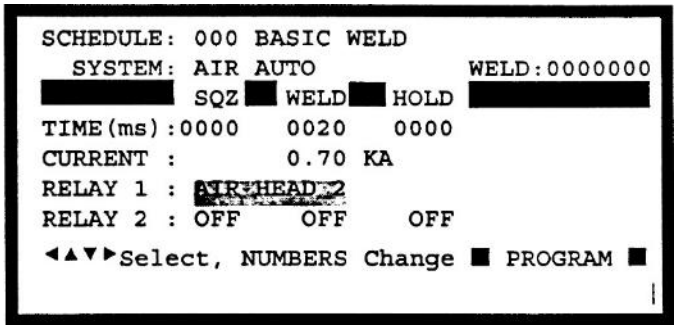



6 Press **CHNG** until the **ALARM (NC)** option appears. An alarm condition causes **RELAY 1** to switch. An alarm condition causes **RELAY 1** to switch from the normally closed state **(NC)** to the normally open state. **RELAY 1** automatically closes when the alarm condition is cleared by pressing **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 ms 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, AMADA WELD TECH, 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 Power Supply 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 Power Supply 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.<br>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 AMADA WELD TECH 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.

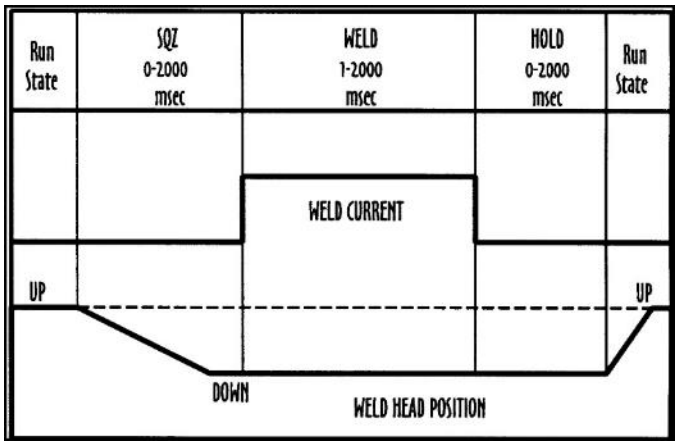


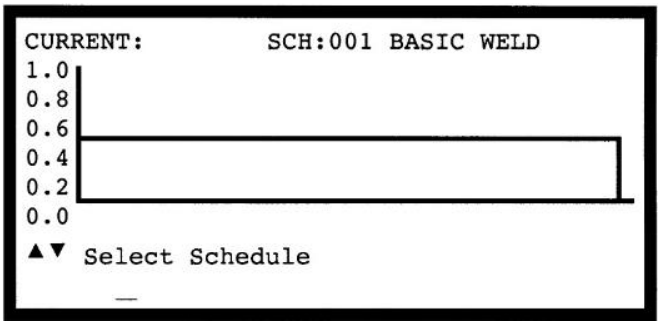

**Figure 6-1. Basic Weld**

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.

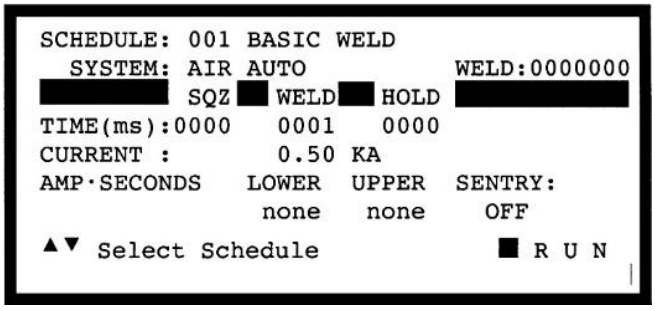
### Basic Weld - Weld Graph Run Screen (Figure 6-2)

Weld Schedule 001 is pre-programmed at the factory for Basic Weld operation. The Power Supply 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.

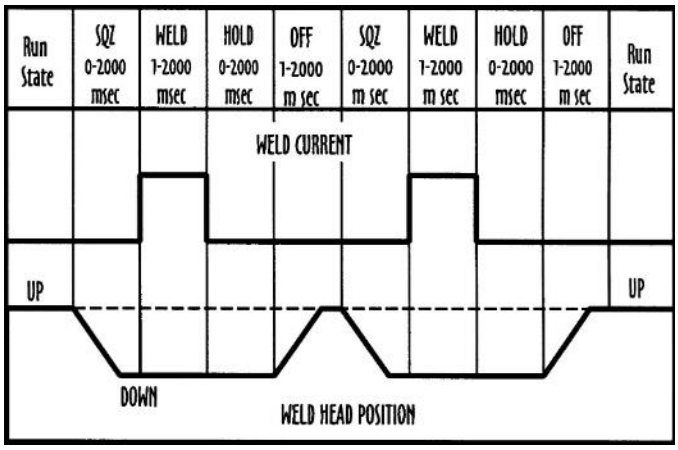


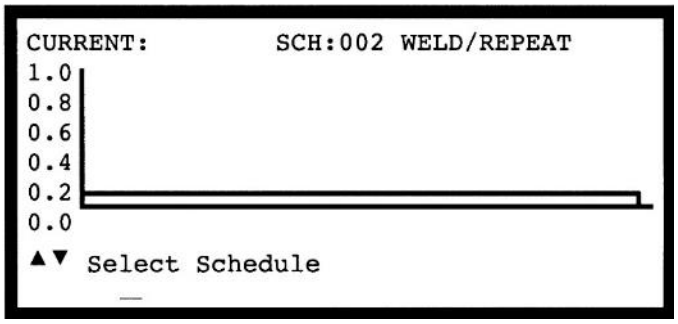

**Figure 6-4. Weld/Repeat**

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.

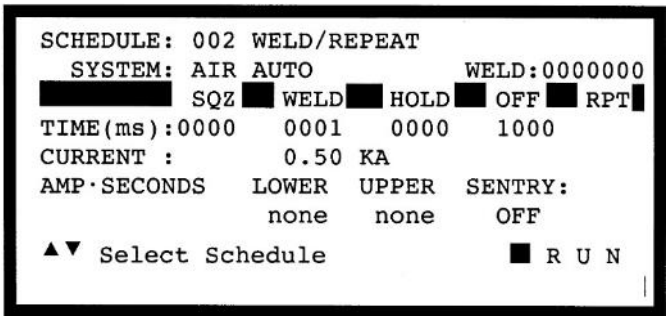



**Figure 6-6. Weld/Repeat Alphanumeric Screen.**

### 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.

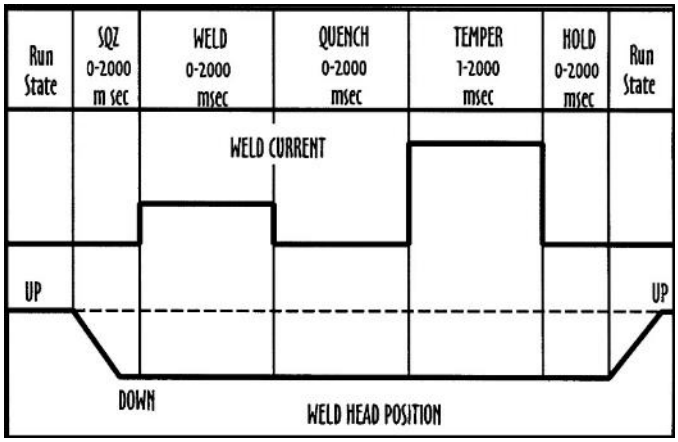



**Figure 6-7. Quench/Temper**

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 AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

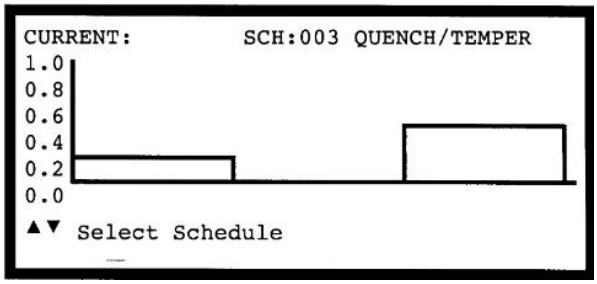



**Figure 6-8. Quench/Temper - Weld Graph Run Screen**

### 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.

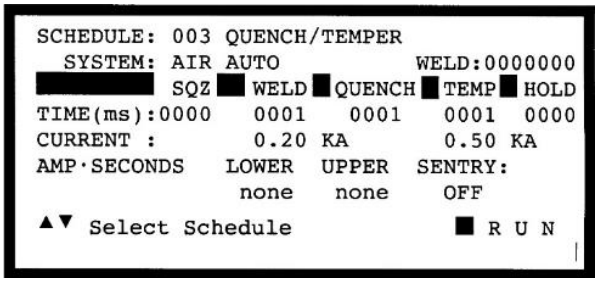



**Figure 6-9. Quench/Temper - Alphanumeric Screen**

### 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.

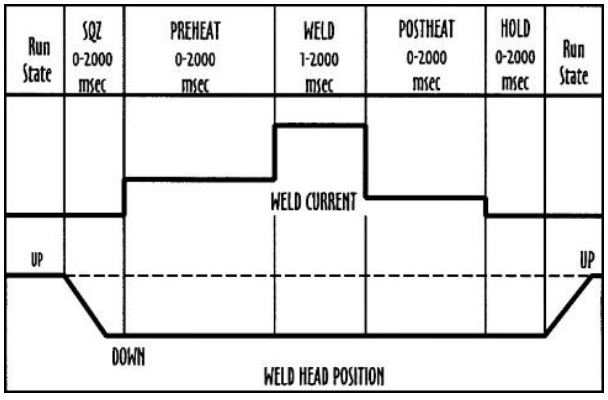



**Figure 6-10. Pre/Post Heat**

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 AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

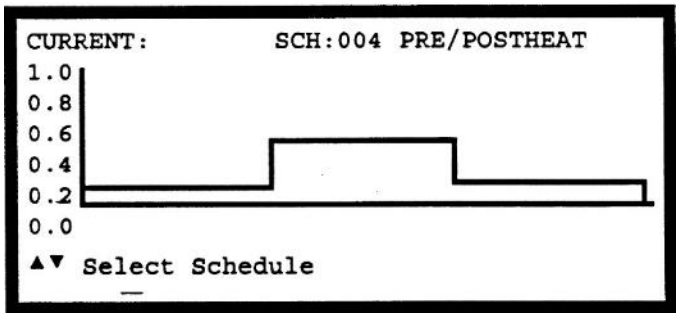



**Figure 11. Pre/Postheat Weld Graph Screen**

### 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.

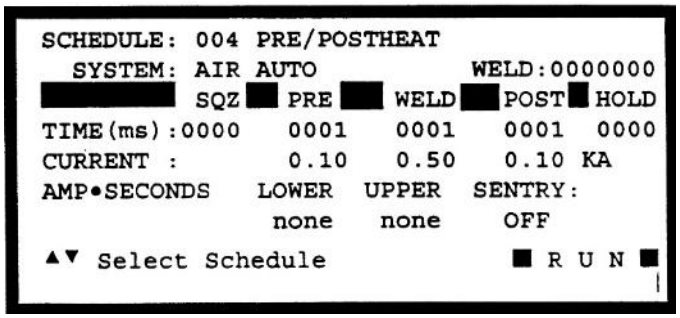



**Figure 12. Pre/Postheat**

### 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.

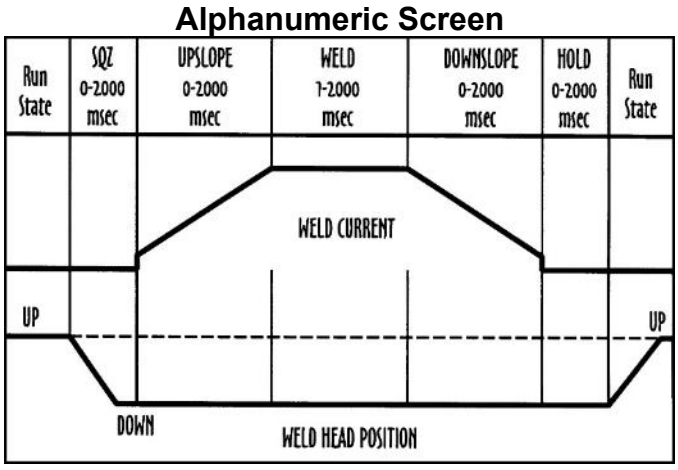



**Figure 13. Pre/Postheat Alphanumeric Screen**

Up/Downslope can be used with AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

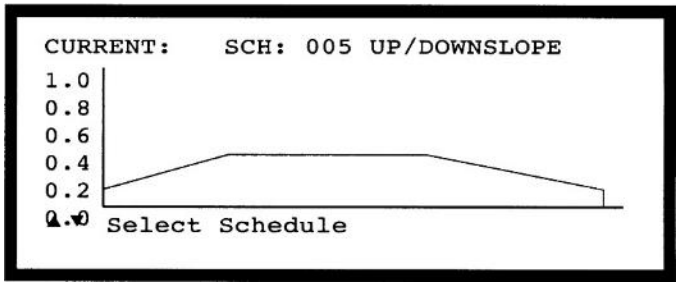



**Figure 14. Up/Downslope Weld Graph Screen**

### 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.

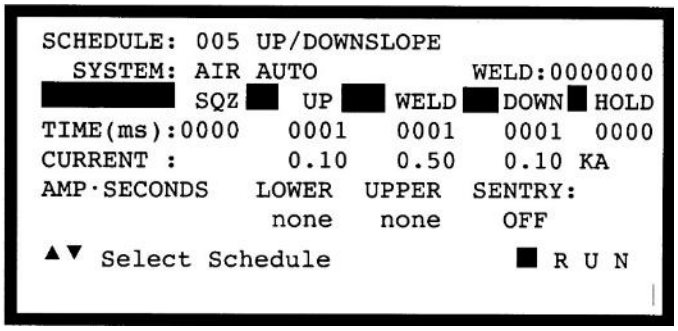



**Figure 15. Up/Downslope Alphanumeric Run Screen**

## 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.*

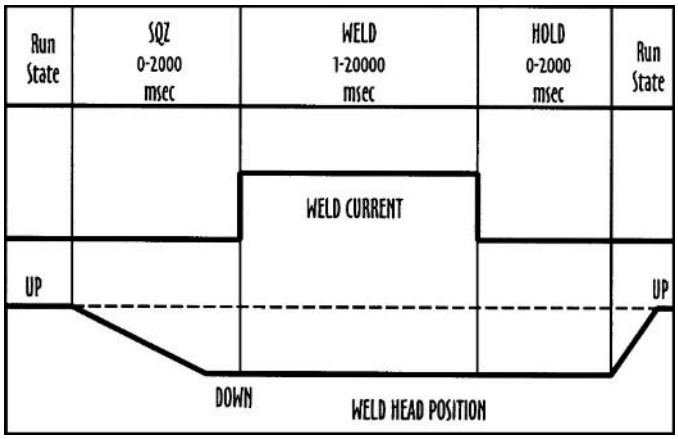



**Figure 16. Braze**

Braze can be used with AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

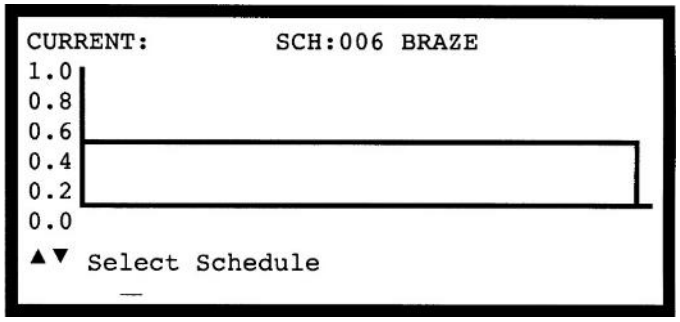



**Figure 6-17. Braze - Weld Graph Run Screen**

### 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.

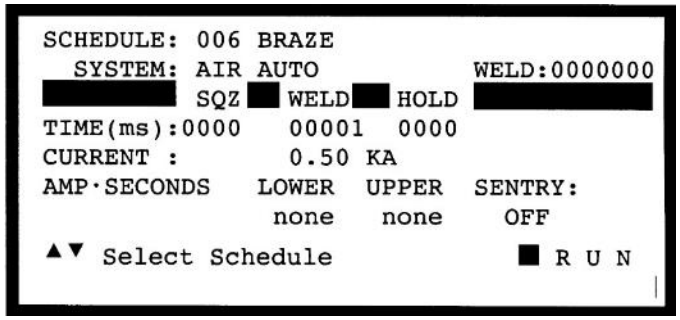



**Figure 6-18. Braze - Alphanumeric Run Screen**

### 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.

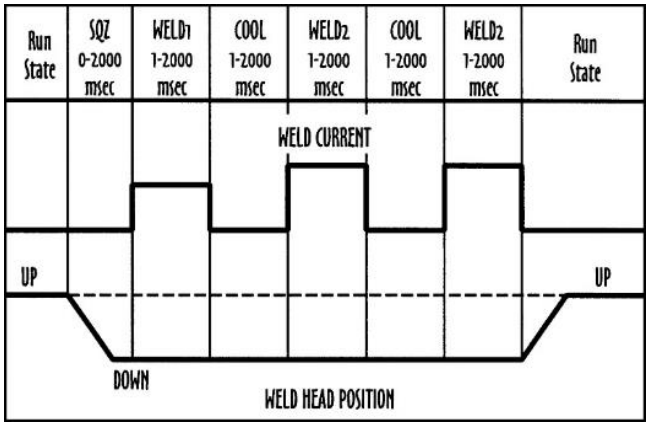



**Figure 6-19. Rollspot.**

**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 AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

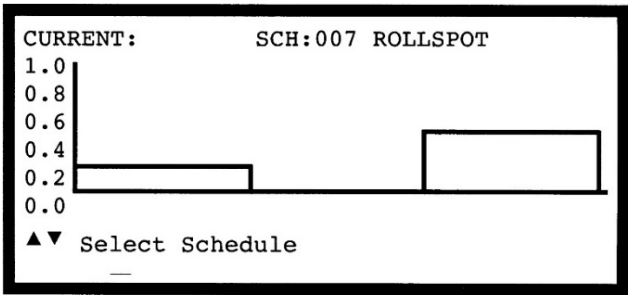



**Figure 6-20. Rollspot - Weld Graph Run Screen**

### 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.

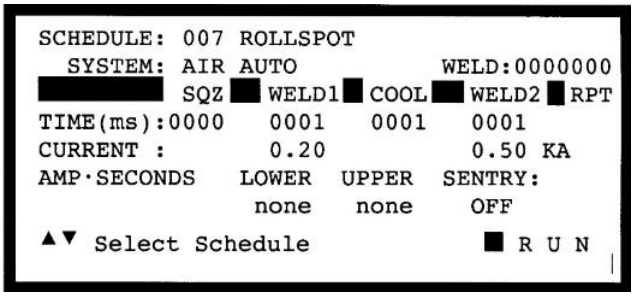



**Figure 6-21. Rollspot - Weld Graph Run Screen**

### 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.*

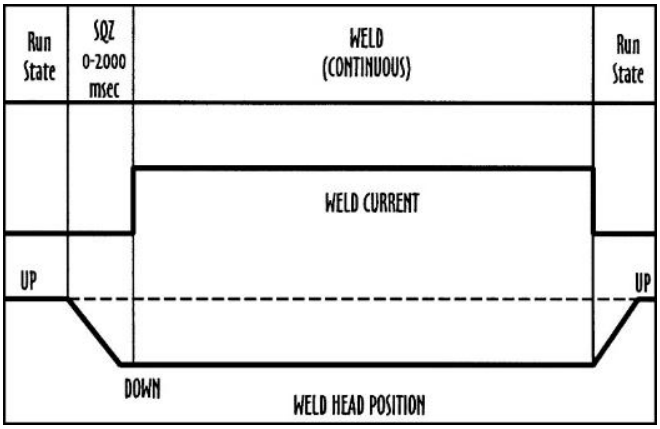



**Figure 6-22. Seam**

Seam can be used with AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

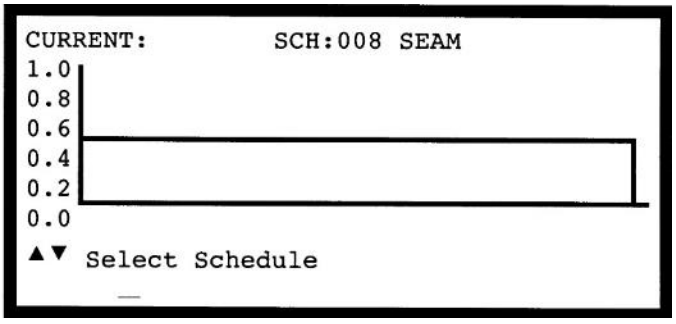



**Figure 6-23. Seam Weld Graph Run Screen**

### 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.

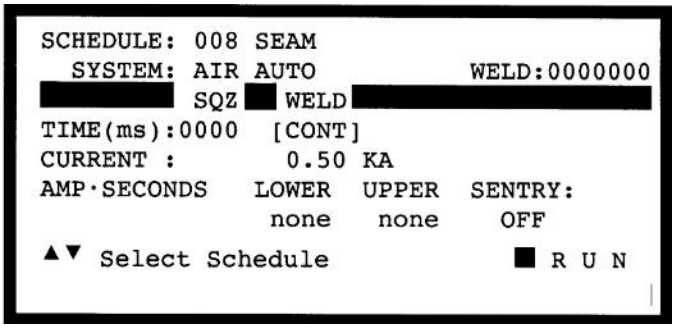



**Figure 6-24. Seam Alphanumeric Run Screen**

### 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.

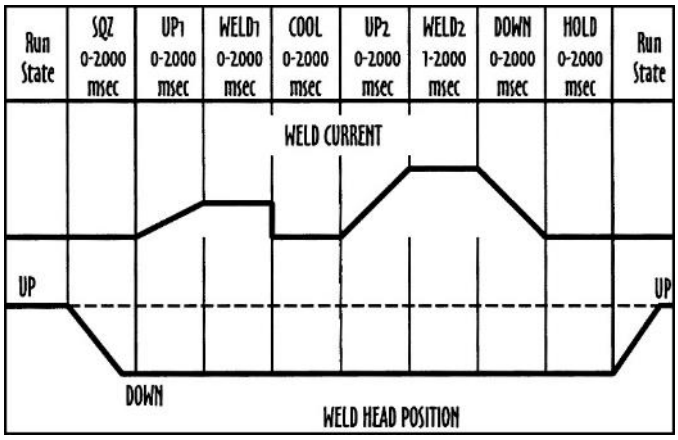



**Figure 6-25. Dual Pulse**

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 AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

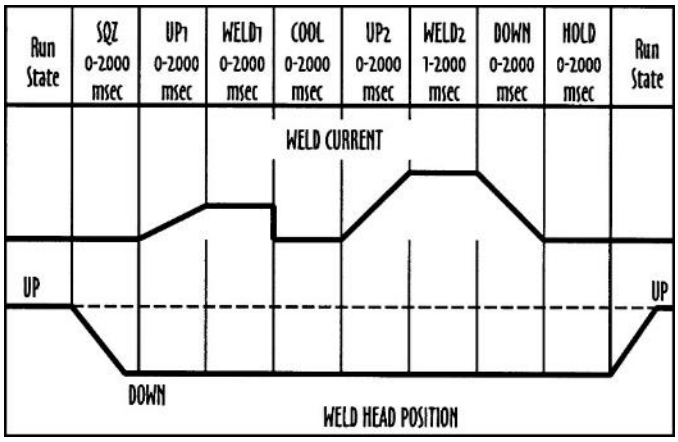



**Figure 6-26. Dual Pulse - Weld Graph Run Screen**

### 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.

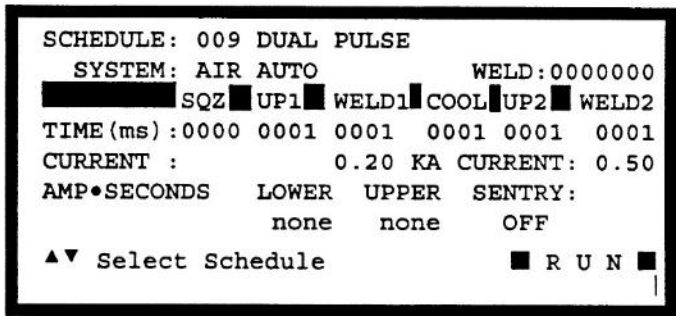



**Figure 6-27. Dual Pulse - Alphanumeric Run Screen**

### PULSATION (Figure 6-28)

Pulsation allows the Power Supply 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.

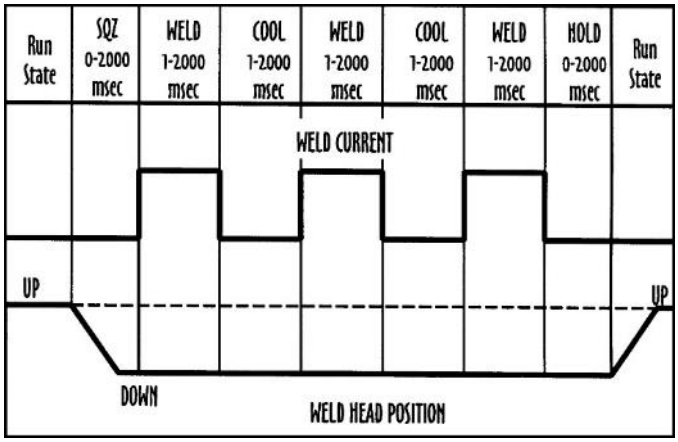



**Figure 6-28. Pulsation**

Pulsation can be used with AMADA WELD TECH 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 Power Supply automatically recognizes the presence of a Manually or Air Actuated Weld Head before the first weld is made.

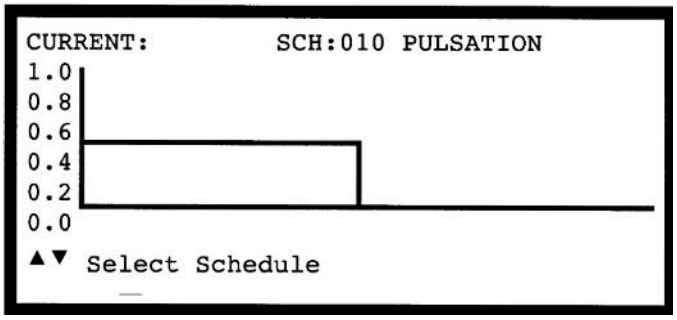



**Figure 6-29. Pulsation Weld Graph Run Screen**

### 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.

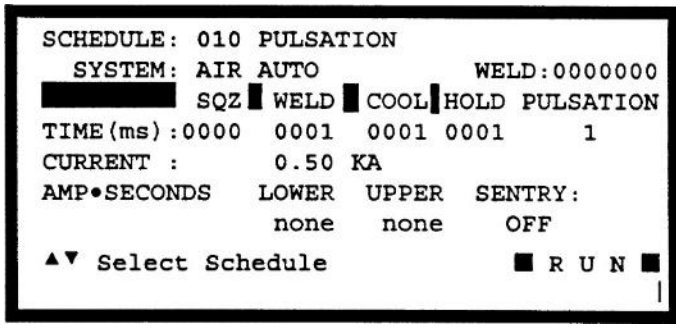



**Figure 6-30. Pulsation Alphanumeric Run Screen**

# CHAPTER 7
# SPECIAL FEATURES

## System Options

The Power Supply 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 Power Supply. Other options allow the operator to decide what type of Weld Head will be used and how the Weld Head will interface with the Power Supply.

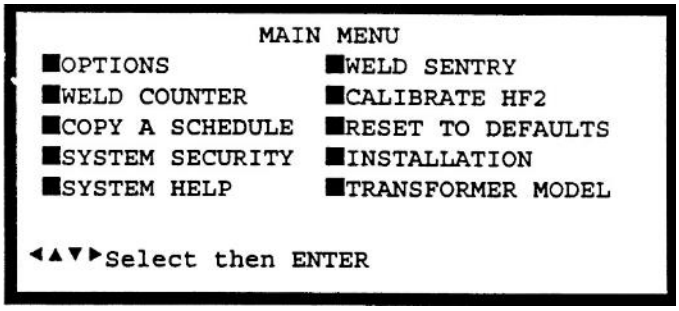



**Figure 7-1. Main Menu Screen**

## 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.

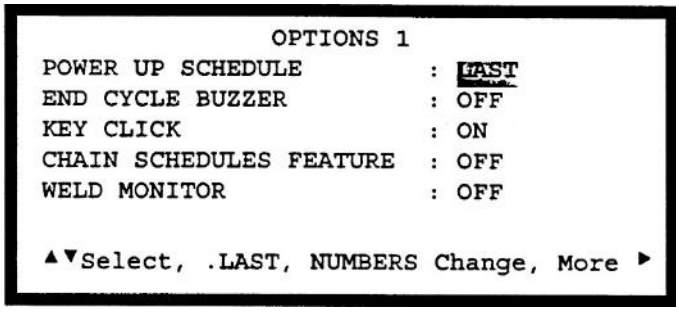



**Figure 7-2. OPTIONS 1 Screen**

## POWER UP SCHEDULE (Figure 7-2)

This option determines which weld schedule will be used when the Power Supply 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 Power Supply 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 Power Supply 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 Power Supply panel.
- Remote control using a chain schedule control box connected at the Power Supply 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.

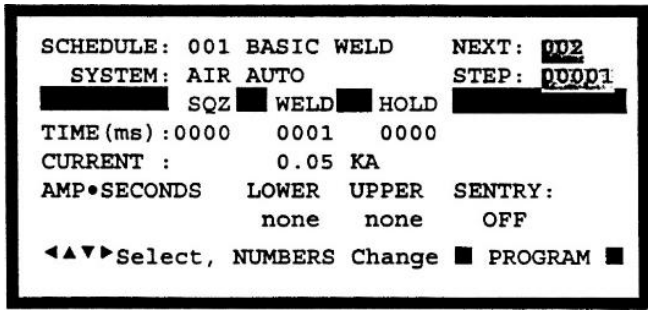



**Figure 7-3. Weld Schedule in PROGRAM State -- CHAIN Feature Turned ON.**

### 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 program-med.

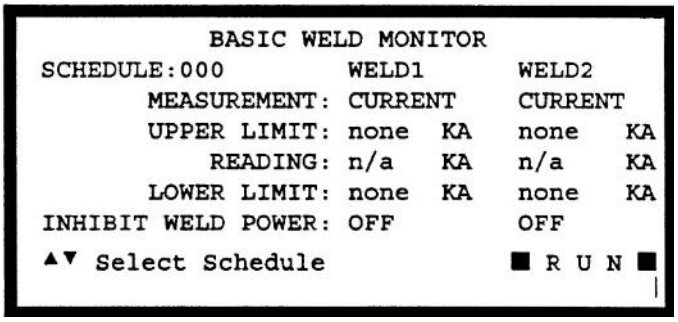



**Figure 7-4. Weld Schedule in PROGRAM State -- Power Up Weld Schedule Programmed.**

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 Power Supply 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.

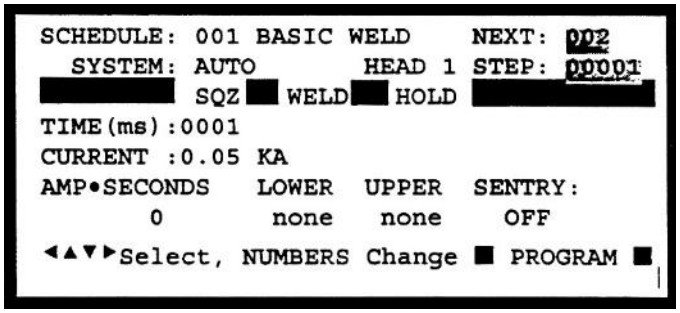



**Figure 7-5. Basic Weld Monitor Screen: RUN State Displaying WELD1 and WELD2 Periods.**

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.*

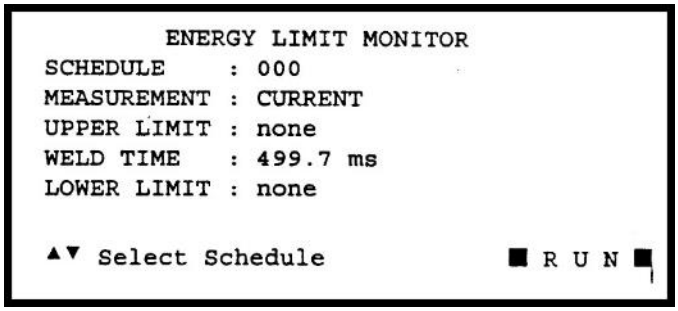



**Figure 7-6. Energy Limit Monitor: RUN State**

### OPTIONS 2 (Figure 7-7)

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

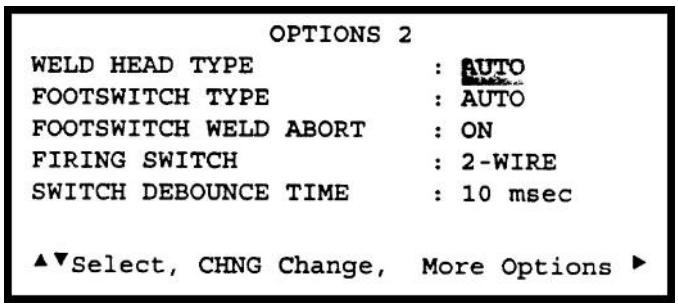



**Figure 7-7. OPTIONS 2 Screen.**

### WELD HEAD TYPE (Figure 7-7)

The Power Supply can be used with a Manual or Air Actuated Weld Head. Air Actuated means that the Power Supply 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 Power Supply can automatically detect the presence of an AMADA WELD TECH 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, AMADA WELD TECH Force Fired, Dual Air Actuated Weld Head System.*

### FOOTSWITCH TYPE (Figure 7-7)

The Power Supply 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 Power Supply automatically detects whether an AMADA WELD TECH - 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 Power Supply 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 Power Supply automatically returns the Upper Electrode to its up position.

When a Two-Level Foot Switch is pressed to the first level, the Power Supply 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 Power Supply 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 Power Supply will automatically return the Upper Electrode to its up position.

The Power Supply 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 Power Supply 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 Power Supply 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**. AMADA WELD TECH 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 Power Supply 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.

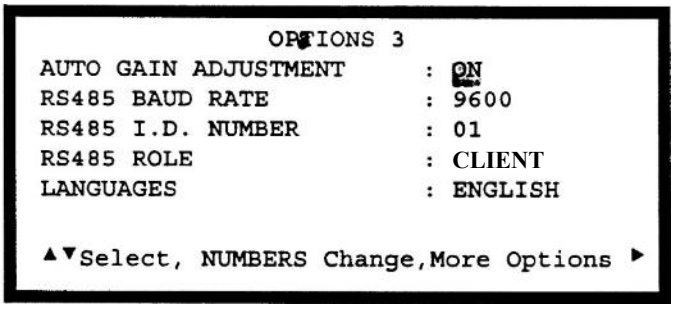



**Figure 7-8. OPTIONS 3**

### AUTO GAIN ADJUSTMENT (Figure 7-8)

The Power Supply 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 Power Supply 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**.

### RS-485 BAUD RATE (Figure 7-8)

The **RS-485 SERIAL PORT** Connector, located on the back of the Power Supply, 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.

### RS-485 I.D. NUMBER (Figure 7-8)

A host computer can be used to talk with multiple Power Supplies using a single RS-485 communications line. However, in order to avoid communications confusion, each Power Supply must be assigned a unique Identification Number (I.D.). Use the numeric keys to enter an I.D. number ranging from 01 to 99.

### RS-485 ROLE (Figure 7-8)

RS-485 Role specifies how the Power Supply communicates with a host computer. Press **CHNG** to select **HOST** which will automatically send weld data out the RS-485 Serial Port after each weld. When **CLIENT** is selected, The Power Supply will only send weld data when controlled by a Host Computer. For simple weld data collection, see *RS-485 Connection*. For Host Computer control, refer to the Advanced RS-485 Communication, User's Manual, 990-058, for complete instructions on how to use the **CLIENT** 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 Power Supply contains one standard weld counter and three additional weld counters if the Built-in Weld Sentry has been added to the Power Supply.

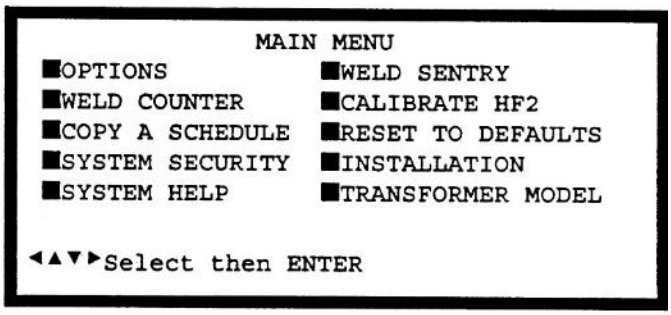
1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen

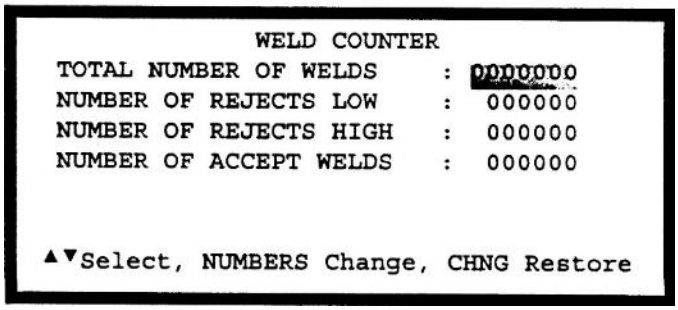
2 Select **WELD COUNTER**. The **WELD COUNTER** screen will appear.

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.



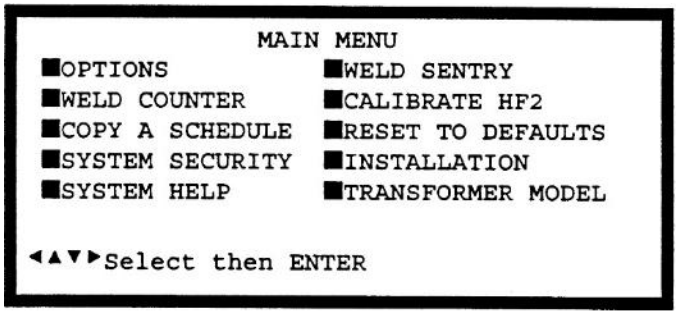




6 Press **MENU** to return to the **MAIN MENU** screen or press **RUN** to return to the Weld Graph **RUN** screen.

## COPY A SCHEDULE

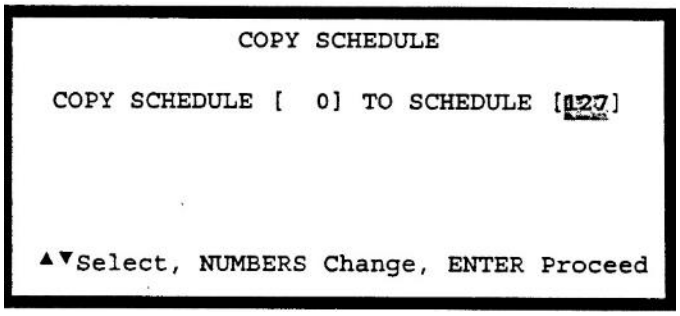
All Power Supply weld schedules and their associated Built-in Weld Sentry programs can be easily copied from one weld schedule to another using the COPY A SCHEDULE option listed under the Main Menu.

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.

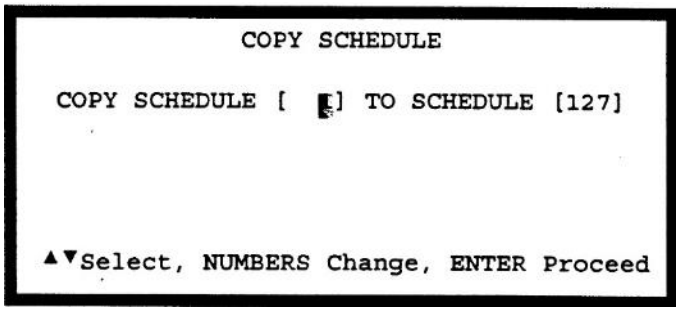
3 Select the last flashing **0** of **TO SCHEDULE 0** and use the number keys to change the flashing **0** to the schedule destination. In this example, **Schedule 127** is the destination schedule.




**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.

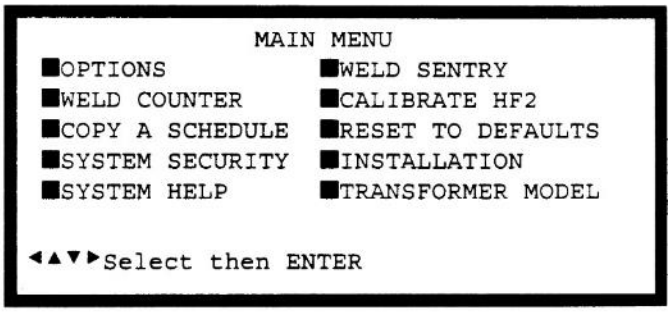
5 Press **ENTER** to complete the schedule copy process and to automatically return to the Weld Graph **RUN** screen.




## SYSTEM SECURITY

All Power Supply weld schedules and their associated Built-in Weld Sentry programs can easily be protected from operator changes by programming the Power Supply 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.

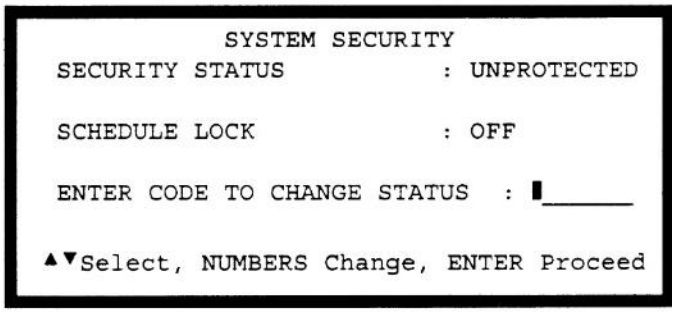
3 Enter a 7 digit number from 0000000 9999999.

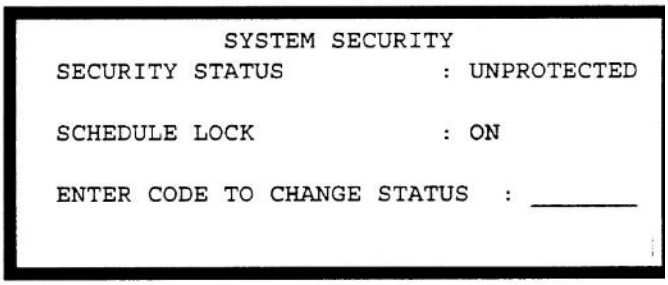
4 To prevent the operator from changing weld schedules, select **SCHEDULE LOCK: OFF** and use **CHNG** to select **ON**. When **ON** is selected, all other weld schedules are locked out and cannot be used for welding.

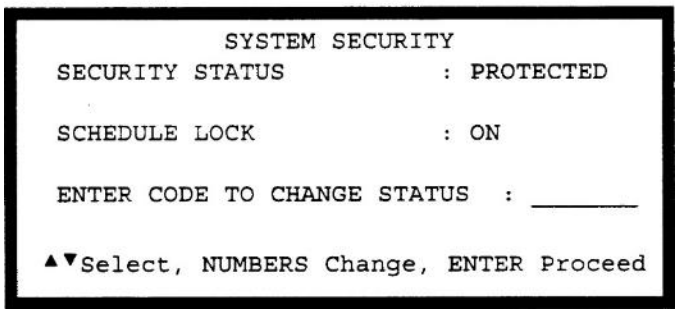
5 Press **ENTER** to enable System Security. **SECURITY STATUS**: will now display **PROTECTED**.

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 Power Supply, 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 Power Supply. 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.

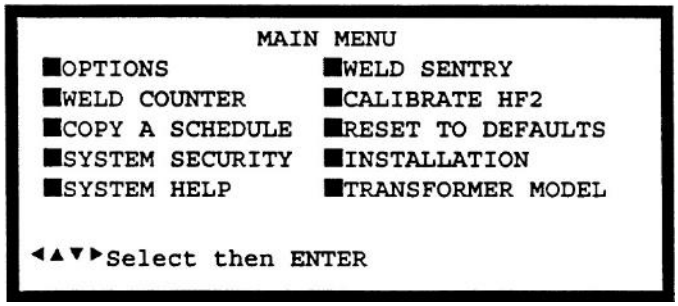
## CALIBRATE THE POWER SUPPLY

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.

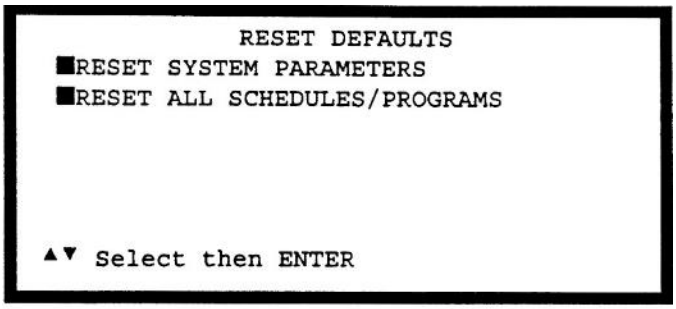
1 Press **MENU** from the **Run** or **Program** States to select the **MAIN MENU** screen.

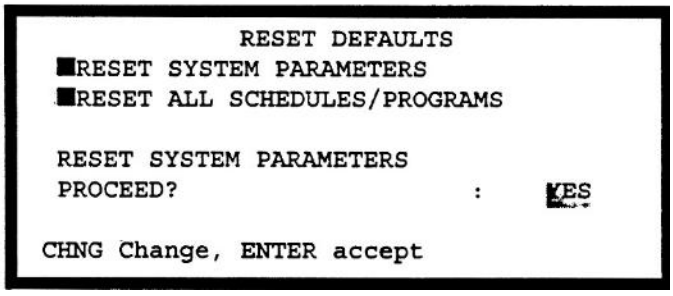


2 Select **RESET TO DEFAULTS**. The **RESET DEFAULTS** screen will appear.

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**.

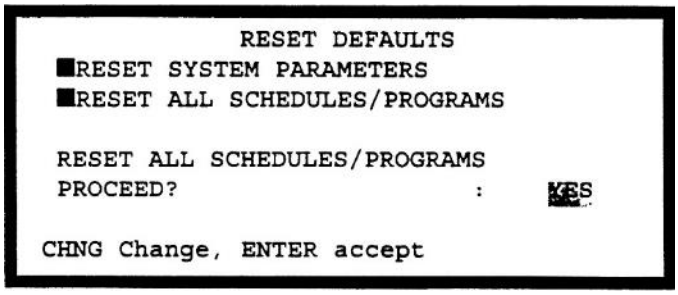



| SYSTEM PARAMETERS | DEFAULT | SYSTEM PARAMETERS | DEFAULT |
|---|---|---|---|
| POWER UP SCHEDULE | LAST | FIRING SWITCH | 2-WIRE |
| END CYCLE BUZZER | OFF | SWITCH DEBOUNCE TIME | 10 ms |
| KEY CLICK | ON | AUTO GAIN ADJUSTMENT | ON |
| CHAIN SCHEDULES FEATURE | OFF | RS-485 BAUD RATE | 9,600 |
| BASIC WELD MONITOR | OFF | RS-485 I.D. NUMBER | 01 |
| WELD HEAD TYPE | AUTO | RS-485 ROLE | CLIENT |
| 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.

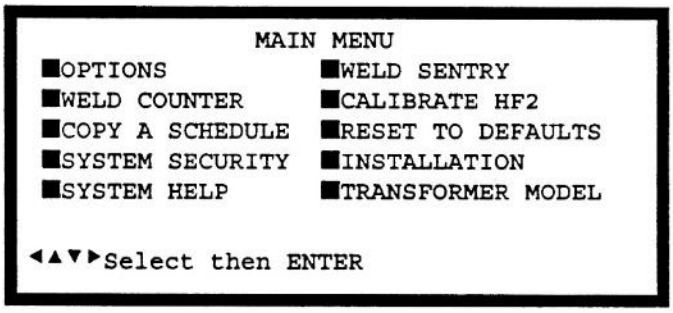
## INSTALLATION

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 Power Supply 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 Power Supply or Transformer may automatically shut down due to thermal overloading.

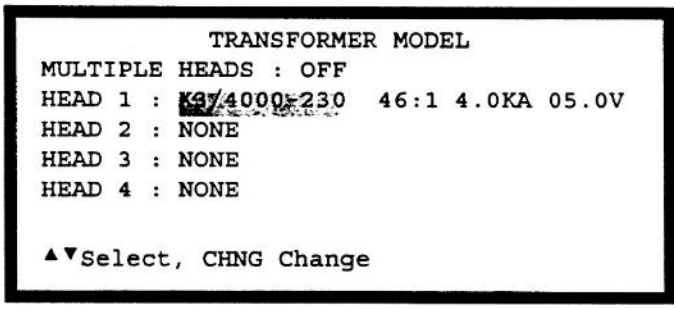
1 Press **MENU**. The **MAIN MENU** screen will appear.

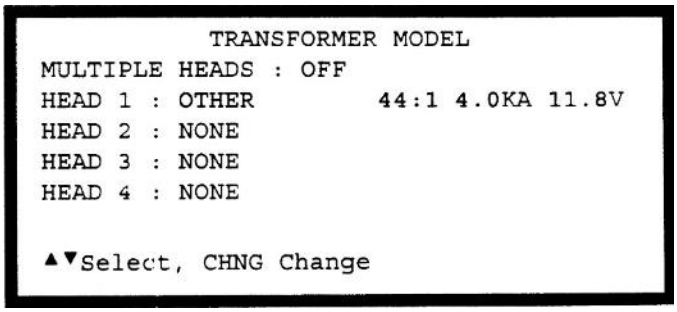



2 Select **TRANSFORMER MODEL**. The **TRANSFORMER MODEL** screen will appear.

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

4 Select **HEAD 1 : X3/4000-230**. IT-X3/230 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 4.0 KA, and a maximum weld voltage of 11.8 V. 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 Power Supply 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 Power Supply 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.

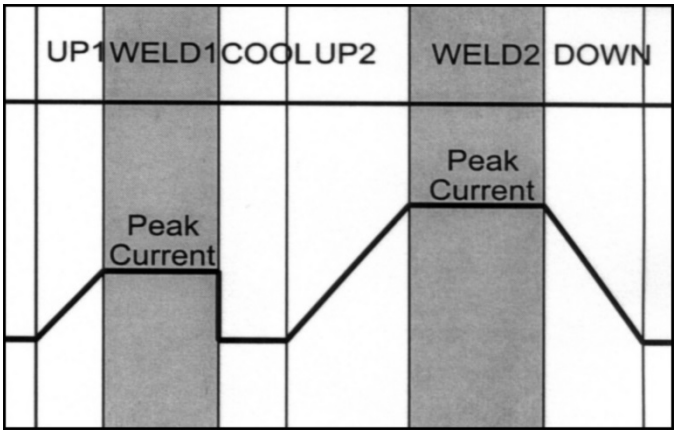



**Figure 8-1. Basic Weld Monitor Measurements**

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 voltage. Figure 8-2 shows a **WELD 2** voltage measurement example when the Power Supply is using constant current feedback. The dotted line represents the average peak reading.

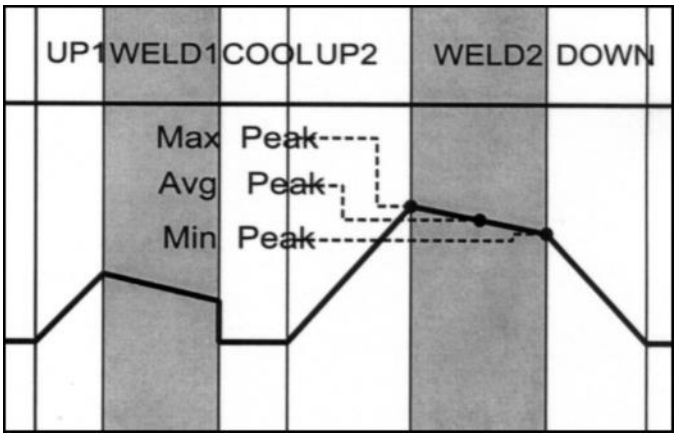



**Figure 8-1. Average Peak Measurement.**

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 Power Supply **RS-485 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.

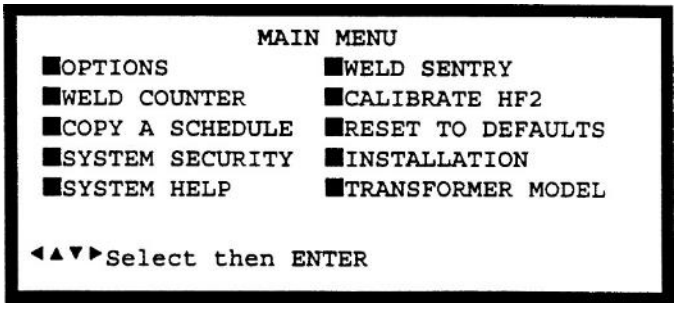
### Weld Monitoring Suggestions

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.

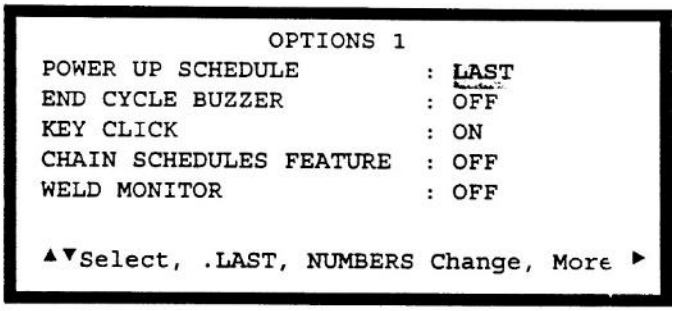


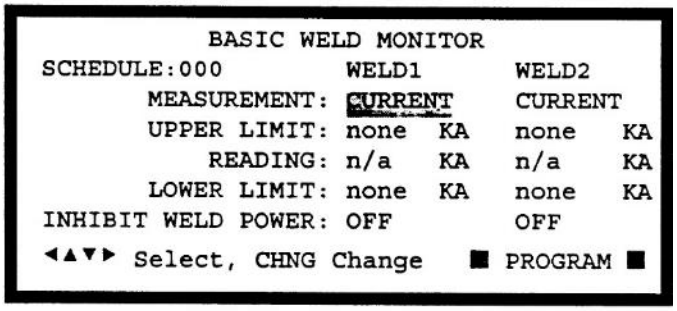

2 Select **OPTIONS**. The **OPTIONS 1** screen will appear. Select **WELD MONITOR: OFF**.

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

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

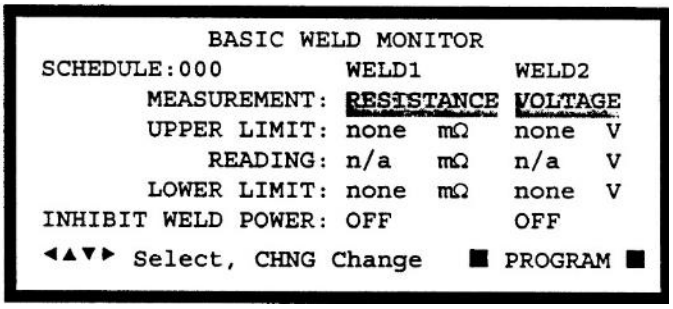
5 Press **PROG** multiple times until the Basic Weld Monitor **PROGRAM** screen appears. **CURRENT of WELD1, MEASUREMENT:** should be flashing. This example shows the **PROGRAM** screen for the Dual Pulse welding function.




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

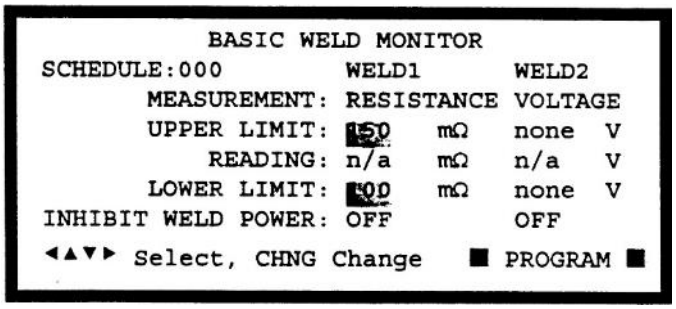
**NOTE:** Select a measurement unit that is different from the measurement unit that is controlling the **FEEDBACK TYPE** used to make the weld. This example shows that **RESISTANCE** will be measured during the **WELD1** period and **VOLTAGE** during the **WELD2** period.



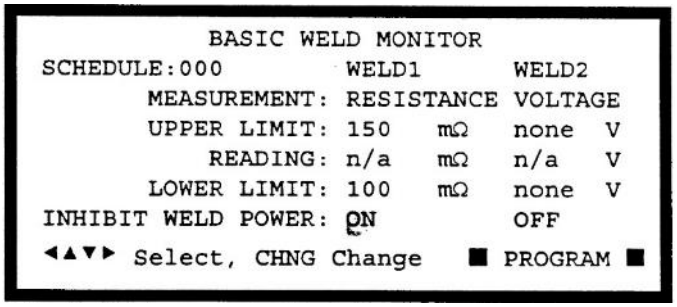

**NOTE:** Measuring Resistance during the **WELD2** period is usually not productive since the resistance reading is extremely low due to the solidified metal and changes very little with weld quality.

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 Power Supply will "beep".




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 Power Supply 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

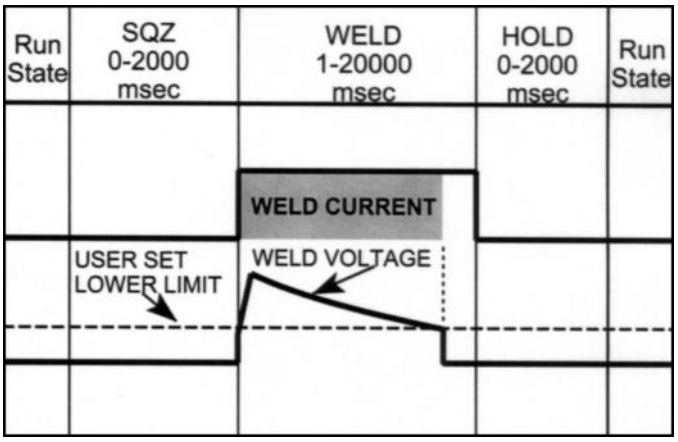


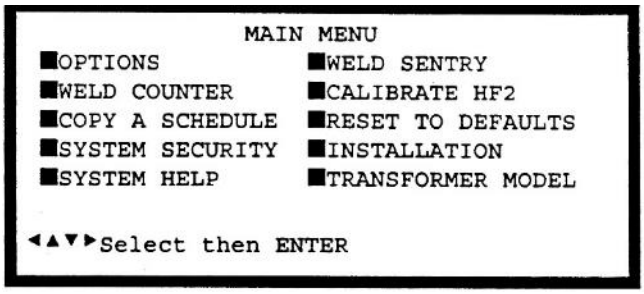

**Figure 8-3. Energy Limit Monitor of Weld Voltage**

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

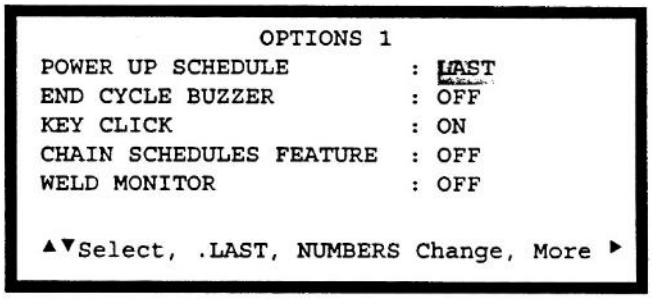
1 Press **MENU**. The **MAIN MENU** screen will appear.



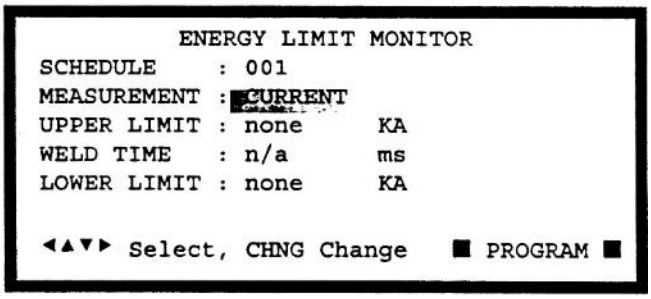

2 Select **OPTIONS**. The **OPTIONS 1** screen will appear. Select **WELD MONITOR: OFF.**

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

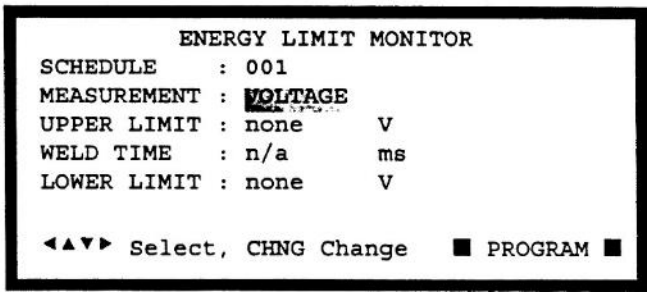
4 Press **RUN** to return to the Weld Graph **RUN** screen.



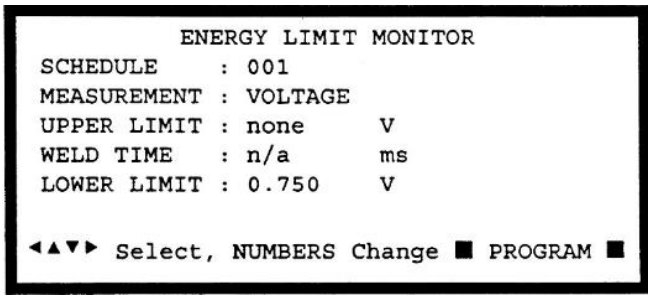

5 Press **PROG** multiple times until the Energy Limit Monitor **PROGRAM** screen appears. **CURRENT** in the **MEASUREMENT**: field should be flashing. This example shows the **PROGRAM** screen for the Basic Welding Function.




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.

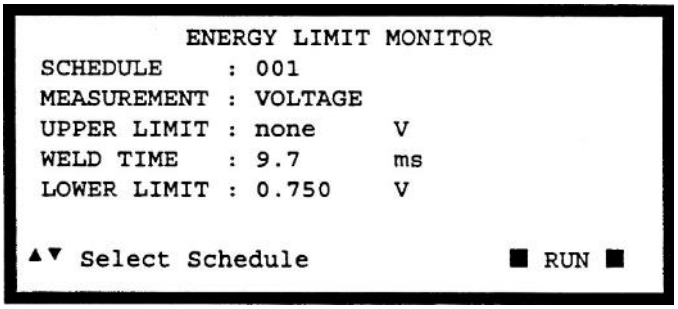



This example shows that the **UPPER LIMIT** has been set to none and the **LOWER LIMIT** has been programmed for 0.750 V. Use the Basic Weld Monitor, as previously described in this chapter, to gather measurements that can be used in setting the Upper Energy Limit or the Lower Energy Limit.

**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 Power Supply 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
Power Supply Frequency .....2 KHz

### Environment

Ambient Operating Temperature .....0 °C to 45 °C (32 °F to 113 °F)

### Physical

Dimensions:

Height .....21.5 cm (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) |
|---|---|---|---|---|
| IT-X2A/230 | 230 | 8 | 6.3 | 2,000 |
| IT-X3A/230 | 230 | 6 | 6.5 | 4,000 |
| IT-X11A/230 | 230 | 5 | 10.7 | 4,000 |
| IT-X11A/380 | 380 | 5 | 11.8 (44:1 TR)<br>10.0 (52:1 TR)<br>8.6 (60:1 TR)<br>7.5 (68:1 TR) | 4,000<br>4,000<br>4,000<br>4,000 |
| IT-X11A/460 | 460 | 5 | 14.3 (44:1 TR)<br>12.1 (52:1 TR)<br>10.5 (60:1 TR)<br>9.2 (68:1 TR) | 4,000<br>4,000<br>4,000<br>4,000 |
| IT-X3A/380 | 380 | 6 | 6.5 | 4,000 |
| IT-X3A/460 | 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 9.99 kW

### Weld Cycle Period Ranges (ms)

Squeeze .....0 – 2,000
Weld (continuous for Seam function).....1 – 2,000
Hold.....0 – 2,000
Off.....0 – 2,000
Quench .....0 – 2,000
Temper .....0 – 2,000
Pre or Post Heat .....0 – 2,000
Up or Down Slope .....0 – 2,000
Cool.....1 – 2,000

### 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 ms |
| **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 |
| RS-485 BAUD RATE | 9600 |
| RS-485 I.D. NUMBER | 01 |
| RS-485 ROLE | CLIENT |

## 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 mΩ
Lower..... 0.000 mΩ

**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

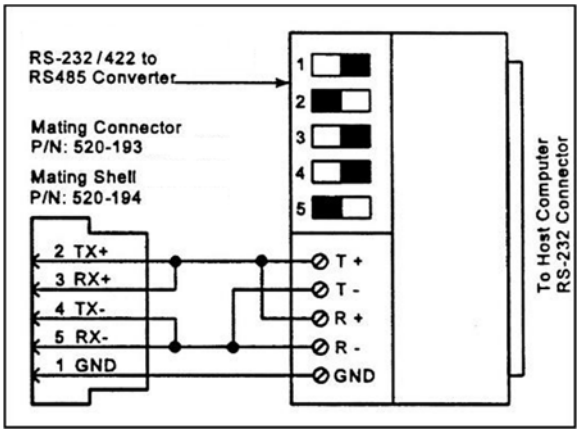
# APPENDIX B
# RS-485 CONNECTION

## Description

The Power Supply has a single RS-485 SERIAL PORT connector for transmitting weld data to a serial data collecting device such as a PC or Host Computer. Multiple Power Supplies can be placed on a multi-drop RS-485 communications line for weld data collection by a Host Computer using the ASCII command language and protocol listed in the Advanced *RS-485 Advanced Data Communications Operation Manual (AMADA WELD TECH Part # 990-058)*.

## Connection

The **RS-485 SERIAL PORT** Connector is a 9 pin TE Connectivity 747052-4 (AMADA WELD TECH Part # 250-196) bulkhead connector that mates with a connector assembly consisting of a CINCH DE-9P (AMADA WELD TECH Part # 250-193) plug and an TE Connectivity 748677-11 (AMADA WELD TECH Part # 250-194) connector shell.




1. Connect an RS-232-to-RS-485 Converter between your Host Computer **COM1** or **COM2** ports and the Power Supply **RS-485 SERIAL PORT**.
2. Set the DIP switches on the converter for the correct configuration. In the illustration above the Telebyte Model 285 converter settings are shown (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 Power Supply **RS-485 SERIAL PORT** and into the COM1 or COM2 port on any PC.

# APPENDIX C
# RECOMMENDED SPARE PARTS

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

| Item | AMADA WELD TECH Part Number | 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 Power Supply 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 Power Supply 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.<br>Increase Weld Head Down Air pressure.<br>Lower Weld Head Downstop.<br>Replace Weld Head Force-Firing Switch.<br>Check Firing-Switch Cable connection between HF2 Welding Power Supply and Weld Head.<br>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.<br>Schedule 0 can only be used as the first schedule in a chain.<br>Weld/Repeat and Rollspot weld functions cannot 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.<br>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.<br>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.<br>If the original code was lost, press and hold [ ◄ ] and press [SAVE]. Release both keys. |

# APPENDIX D: 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.<br>Re-program the incorrect weld schedule in the chain.<br>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.<br>Change Lower Limit value. |
| LOW POWER | Actual weld power is less than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Lower Limit value. |
| LOW RESISTANCE | Actual weld resistance is less than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Lower Limit value. |
| LOW VOLTAGE | Actual weld voltage is less than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Lower Limit value. |
| NO CURRENT | No Weld current is detected. | Check parts for an invisible insulation coating.<br>Clean each electrode face to remove embedded invisible insulating material.<br>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.<br>Weld Transformer shorted. HF2 Welding Power Supply 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.<br>Change Upper Limit value. |
| OVER POWER | Actual weld power is greater than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Upper Limit value. |
| OVER RESISTANCE | Actual weld resistance is greater than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Upper Limit value. |
| OVER VOLTAGE | Actual weld voltage is greater than the Basic Weld Monitor user set Lower Limit. | Tighten welding process variables.<br>Change Upper Limit value. |
| POWER TRANSISTOR OVERHEATED | Excessive heat build-up has opened the Power Transistor circuit thermostat. | Wait for HF2 Welding Power Supply to cool down and close the internal thermostat.<br>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.<br>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. AMADA WELD TECH 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<br>Lower Weld Head Downstop.<br>Replace Weld Head Force-Firing Switch. |
| STANDBY REMOTE SCHEDULE | HF2 is waiting for the BCD weld schedule code to be placed on the Power Supply 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 D: ALARM MESSAGES

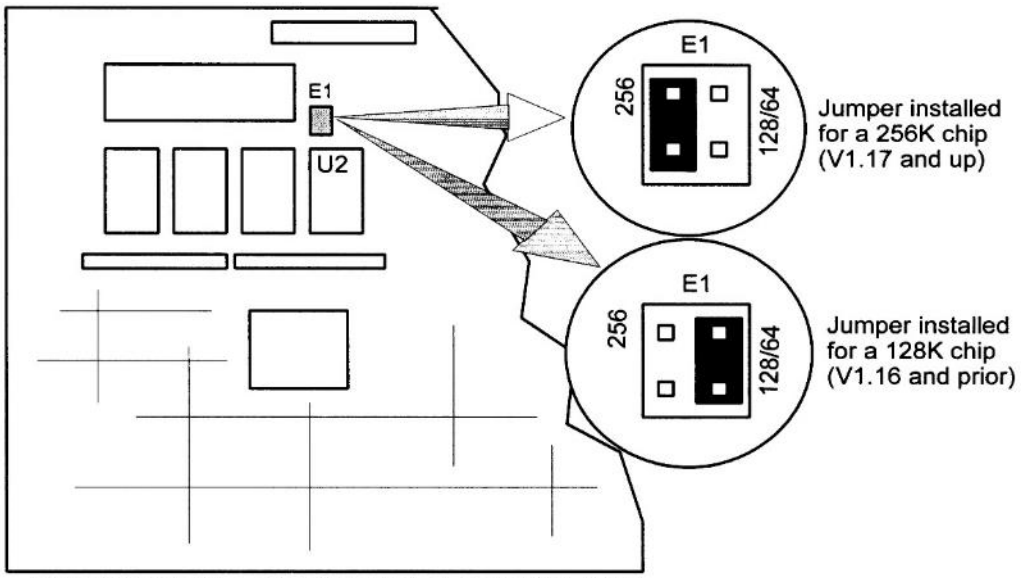
| Alarm Message | Description | Corrective Actions |
|---|---|---|
| STATUS IS CHANGED | System Security Status is changed. | To change the System Security Status to Unprotected, enter the original code. If the original code was lost, press and hold [ ◀ ] and then press [SAVE]. Release both keys. |
| 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.<br>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 Power Supply **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 Power Supply 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 socketed DIP integrated circuits.

### Procedure

1 Disconnect the main power to the Power Supply.

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

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

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

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 Power Supply.

12 Connect main power to the Power Supply.

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

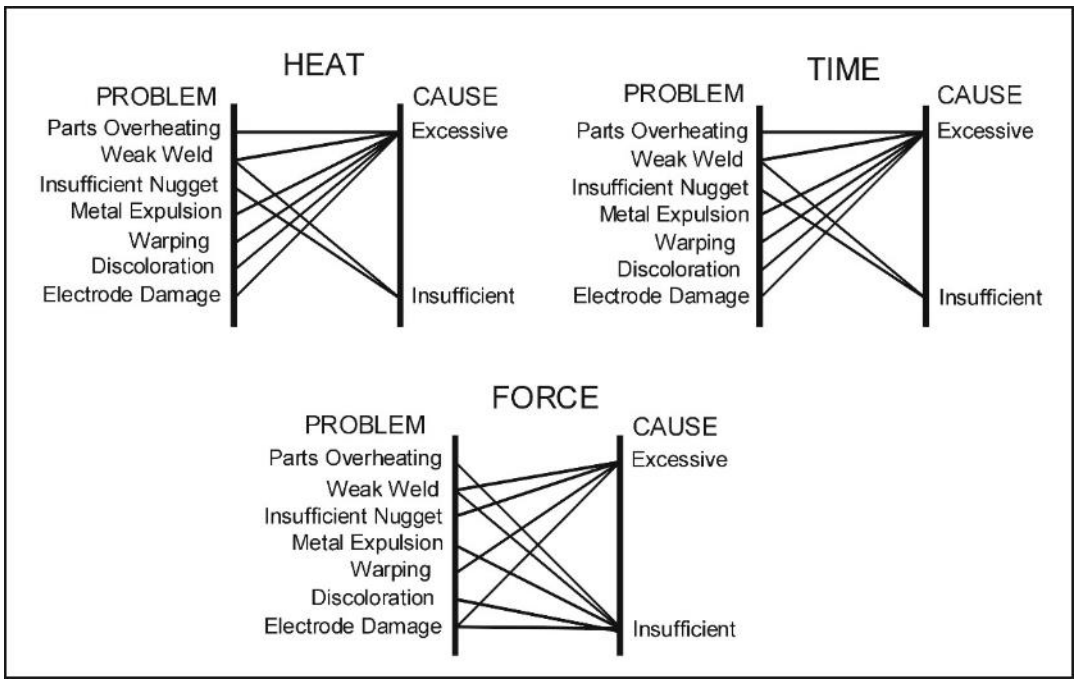
# APPENDIX G
# THE BASICS OF RESISTANCE WELDING

## 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 ms increments. Increase weld current, voltage, or power if a satisfactory weld achieved using 10 ms 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 Power Supply 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 below, *Typical Weld Strength Profile*.

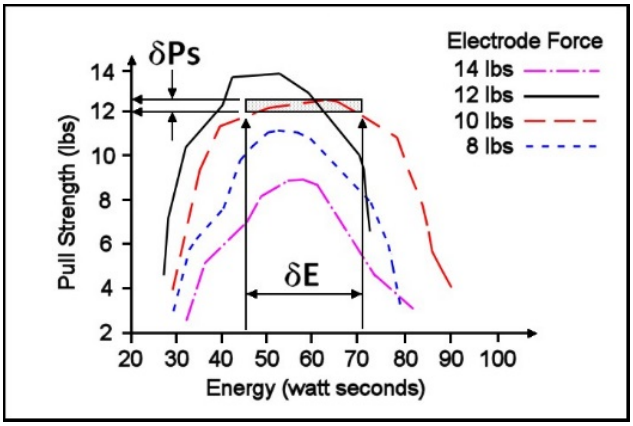
4 Repeat steps 1 through 3 using a different but fixed weld time.

## 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

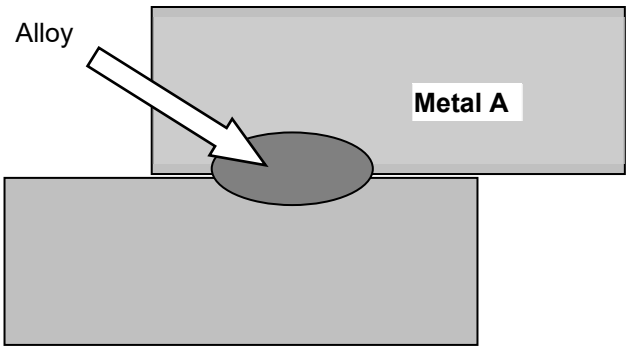
The first consideration in designing a quality welding solution is the properties of the materials to be joined and the quality requirements of the desired welded joint. At this stage, it is worthwhile to review the way the resistance welding process works and the likely outcome when the parts are resistance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

# APPENDIX H: DEFINING THE OPTIMUM PROCESS




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.

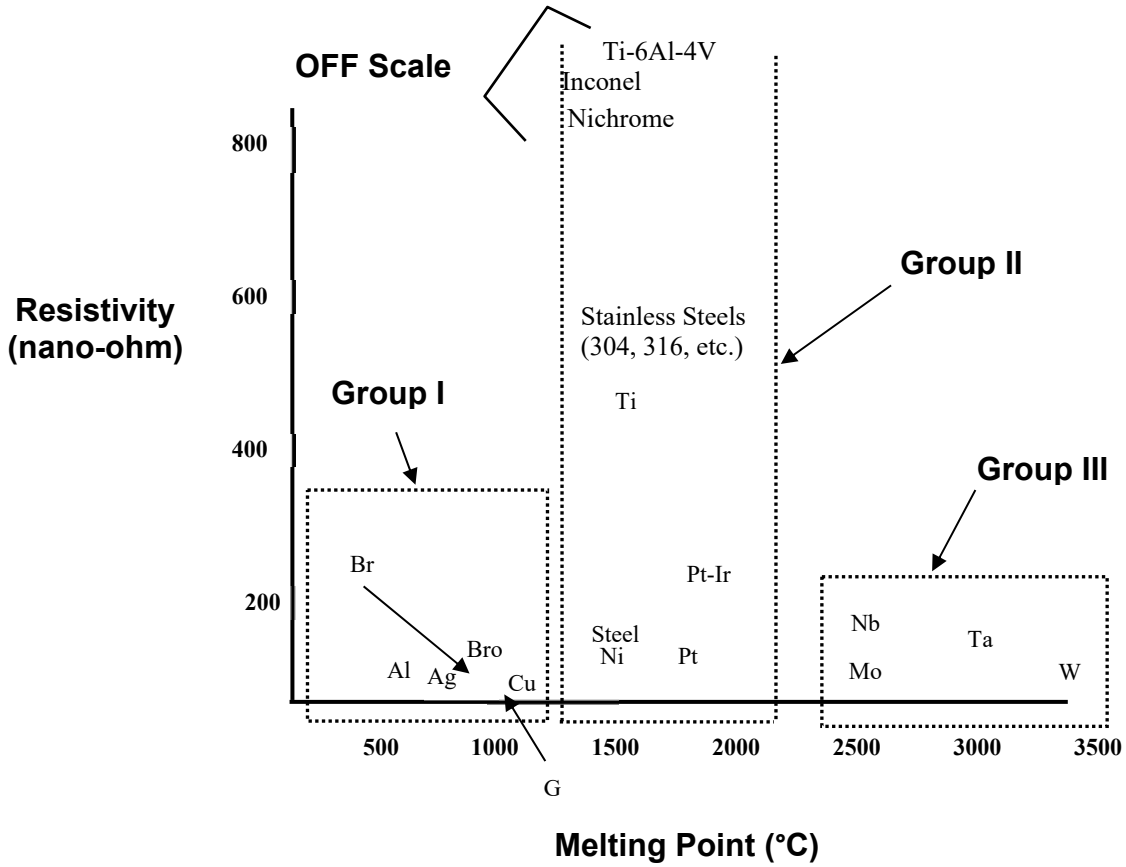
Many micro-resistance welding challenges involve joining dissimilar metals in terms of their melting points, electrical conductivity, and hardness. A solid-state joint can be an ideal solution for these difficult applications; there is no direct mixing of the two materials across the weld interface thus 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.

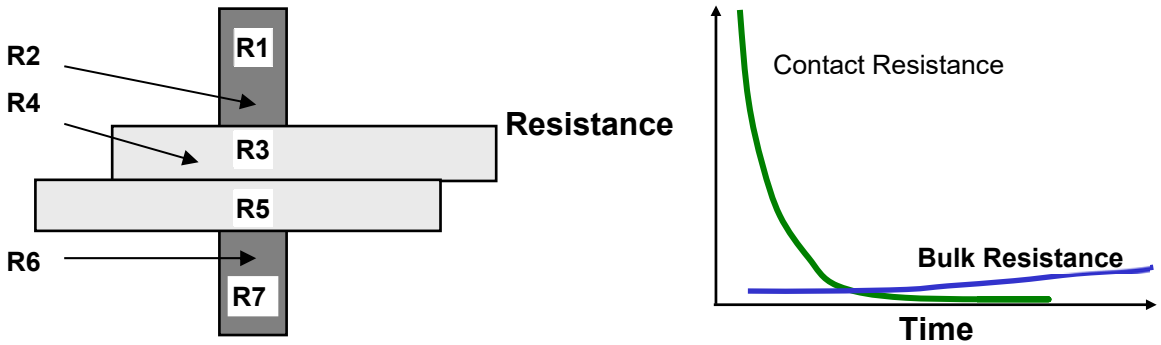
- **Group III – Refractory Metals**

  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<br>• W/Mo electrodes | • Solid-State<br>• Projection on Group I | • Solid-State<br>• Fine projections on Group III |
| **Group II (Steel)** | | • Solid-State or Fusion | • Solid-state or braze of II on III<br>• 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:

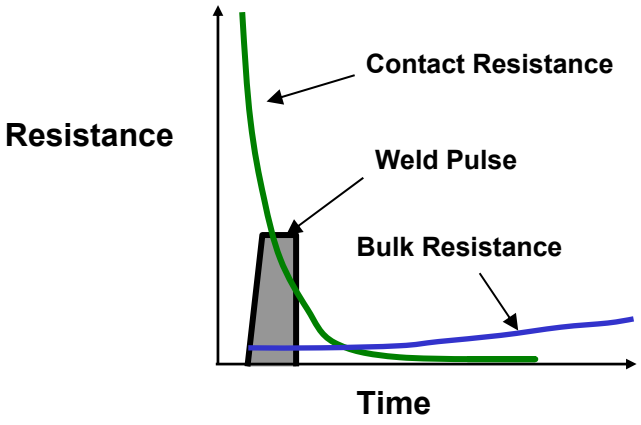
- Part marking and surface heating
- Weld splash or expulsion
- Electrode sticking
- Weak welds

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.

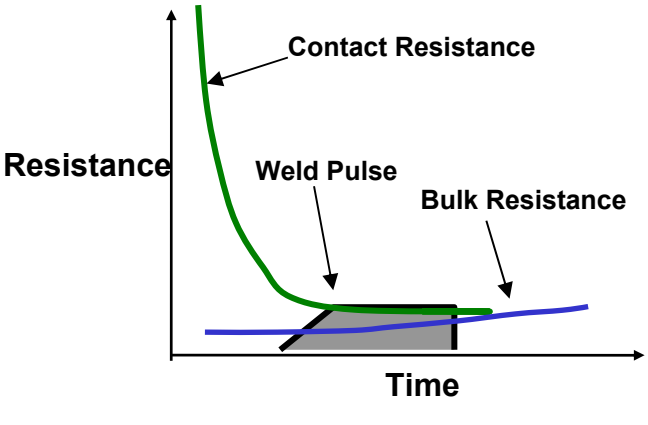
If a weld is initiated when both parts and electrodes are fitted up correctly, the contact resistance is lower and bulk resistance now controls the heat generation. This type of weld is achieved with a slower heating rate and normally longer time is preferred for welding resistive materials, which can 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.



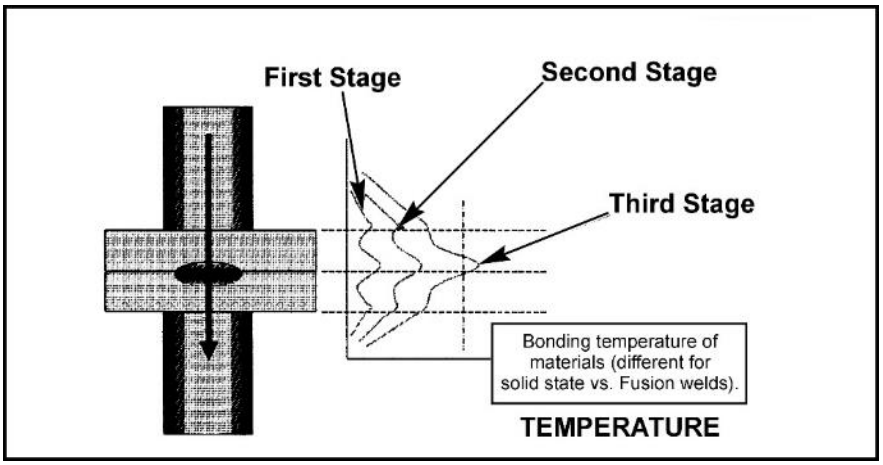




**(NOTE: Larger nuggets are possible with longer weld times when using bulk resistance.)**

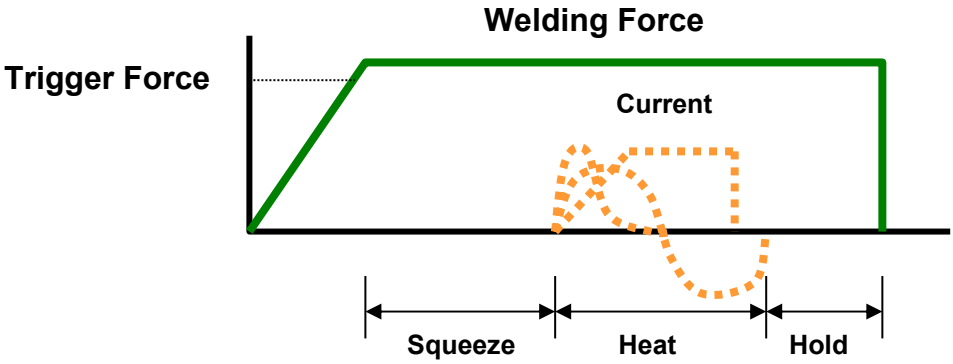
In general, conductive materials benefit from a faster heating rate, as the higher contact resistances assist heat generation in the weld. Resistive materials benefit from slower heating rates which allow the contact resistances to reduce significantly. Bulk resistances, therefore, become the major source 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.

## 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

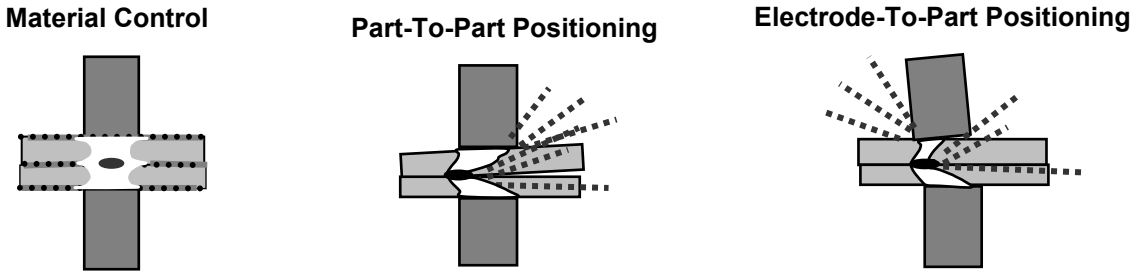
- Materials: Resistivity, melting point, thermal mass, shape, hardness, surface properties.
- Heat balance: Electrode materials, shape, Polarity, heating rate (upslope).
- Observation: visual criteria, cross section, and impact of variables on heat balance.

### 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?

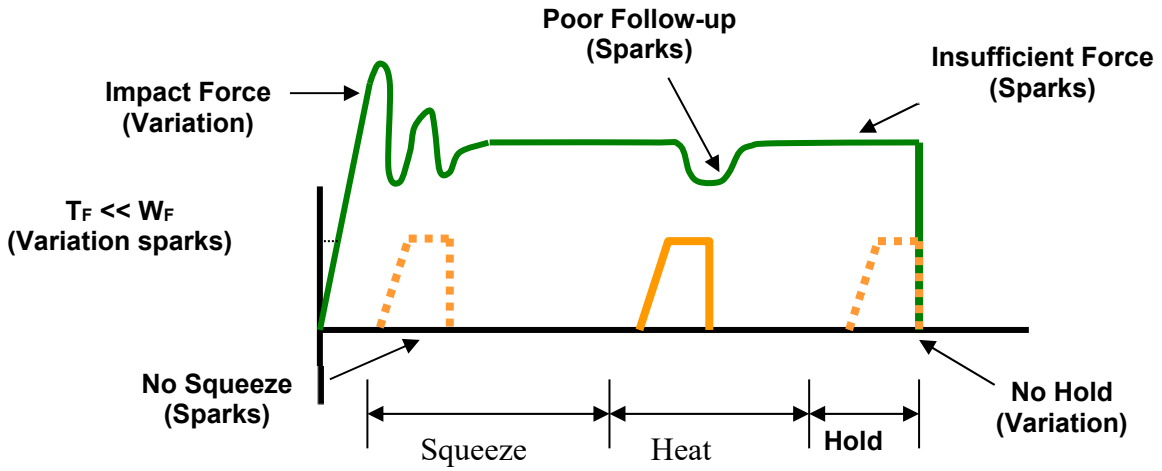
## Common Problems

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.




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 AMADA WELD TECH 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. AMADA WELD TECH provides a simple Screening DOE tool that is run in Excel® and is sufficient for the majority of possible applications (contact AMADA WELD TECH 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. AMADA WELD TECH 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.

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