LINEAR DC RESISTANCE WELDING CONTROL

UB-500A
UB-1500A
UB-4000A

USER MANUAL

AMADA®

990-919 REV S

Revision Record

Revision	EO	Date	Basis of Revision
A	42477	02/13	None. Original edition
B	42665	06/13	Updated technical information
C	42736	08/13	Updated Repetition rates
D	42903	10/13	Updated technical information
E	42953	11/13	Updated to Miyachi America name and logo
F	43199	05/14	Updated technical information
G	43228	05/14	Updated technical information
H	43482	12/14	Updated to Amada Miyachi America name and logo
J	43838	08/15	Updated to Amanda Miyachi America format
K	44031	01/16	Added UB29A
L	44137	03/16	Updated UB29A specifications
M	44362	08/16	Updated UB29A specifications
N	44640	05/17	See ECO for detailed changes
P	45829	04/20	Update Company Name (Amada Weld Tech) + Model Names
Q	46154	01/21	Update Model Numbers. Add new UB- rear panel images
R	46300	04/21	Correct Calibration Kit contents + EU Disposal Statement
S	47205	01/24	Update Manual Title + Miscellaneous Corrections

FOREWORD

Thank you for purchasing an AMADA WELD TECH, UB-500A/UB-1500A/UB-4000A Linear DC Resistance Welding Control. For the rest of this manual, the UB-500A/UB-1500A/UB-4000A will be referred to simply as the ***Power Supply***, except in specific instances where unique descriptions are required such as specifications, connections, etc. In those instances the UB-500A, UB-1500A, or UB-4000A will be specified.

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 91016-7133
Telephone: (626) 303-5676
FAX: (626) 358-8048
e-mail: info@amadaweldtech.com

The purpose of this manual is to supply operating and maintenance personnel with the information needed to properly and safely operate and maintain the Power Supply.

We have made every effort to ensure that 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 phone number or address above.

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

This manual covers the following models:

Original Model Name	Original P/N		Current Model Name	Interim P/N	Current P/N
UB29	1-335-03	→	UB-500A	1-335-04	1-335-05
UB29A	1-336-03	→	UB-1500A	1-336-04	1-336-05
DC29	1-340-03	→	UB-4000A	1-340-04	1-340-05

The UB29/UB29A/DC29 Power Supplies are legacy branded model names that have been replaced by the UB-500A/UB-1500A/UB-4000A model names respectively. This manual covers all power supplies listed above with emphasis on the current UB- model name. In most cases only the UB- model name is mentioned, however this same information also applies to the legacy UB/DC model names as well.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

Page

SAFETY PRECAUTIONS

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

Before performing any maintenance on the Inverter Power Supply, read *Chapter 5, Maintenance* thoroughly. 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.

HIGH VOLTAGE is used in the operation of this equipment.

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

WHEN WELDING always wear safety glasses.

Before using this equipment, read the **SAFETY PRECAUTIONS** carefully to understand the correct usage of the equipment.

- These precautions are given for safe use of the Inverter 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:

⚠ 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.

⚠ CAUTION

Denotes operations and practices that may result in personal injury or damage to the equipment 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 Cabinet. 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.

Bedieningshandleding - Voedingsbronnen voor AMADA WELD TECH.

Användarhandledning - Kraftaggregat för AMADA WELD TECH.

Käyttöopas – AMADA WELD TECH tehonlähteet.

Guide d'utilisation - Alimentation de électrique AMADA WELD TECH.

Bedienungsanleitung - Energieversorgung für AMADA WELD TECH.

Guida dell'operatore - Alimentazioni di corrente delle apparecchiature AMADA WELD TECH.

Guia do Operador - Componentes eléctricos da AMADA WELD TECH.
Guía del operador - Fuentes de alimentación de AMADA WELD TECH.

CAUTION! This symbol designates an operation which requires a qualified technician and User's Manual

OPGELET! Dit symbool duidt een bediening aan waarvoor een gekwalificeerde technicus en de gebruikershandleiding vereist zijn.

VARNING! Denna symbol indikerar ett arbetsmoment som bör utföras av en kvalificerad tekniker med hjälp av Användarhandledningen.

VAARA! Tämä merkki osoittaa toimenpiteen, jossa tarvitaan asiantuntevaa teknikkoa sekä käyttökäsikirjaa.

ATTENTION ! Ce symbole désigne une opération exigeant un technicien qualifié et le Manuel d'utilisation.

VORSICHT! Dieses Symbol kennzeichnet einen Arbeitsgang, der einen qualifizierten Techniker sowie ein Benutzerhandbuch erfordert.

ATTENZIONE! Questo simbolo indica un'operazione che richiede un tecnico qualificato ed il manuale dell'utente.

CUIDADO! Este símbolo indica uma operação que requer um técnico qualificado e o Manual do Usuário.
¡PRECAUCIÓN! Este símbolo designa una operación que requiere un técnico competente y el Manual del usuario.

1. Install power supply system

Installeer het voedingssysteem.

Installera kraftaggregatsystemet.

Asenna voimanlähdejärjestelmä.

Installer le système d'alimentation électrique.

Das Elektroenergieversorgungssystem installieren.

Installazione del sistema d'alimentazione elettrico.

Instale o sistema de fonte de alimentação.
Instale el sistema de fuente de alimentación.

2. Refer all program or setting changes to a qualified technician

Alle programma- of instellingswijzigingen moeten door een gekwalificeerd technicus.

Hänvisa alla program- och inställningsändringar till en kvalificerad tekniker.

na kaikki ohjelman tai asetusten muutokset asiantuntevan teknikon suoritettaviksi.

Confier toutes les modifications de programme ou de réglages à un technicien qualifié.

Sämtliche Programm - oder Einstellungsänderungen müssen einem qualifizierten Techniker überlassen werden.

Rivolgersi ad un tecnico qualificato per tutti i cambiamenti di programma di impostazione.
Consulte um técnico qualificado quanto a qualquer alteração de programa ou ajuste.

3. *Use eye protection*

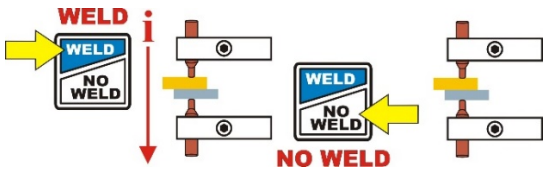
Oogbescherming dragen.
Använd skyddsglasögon.
Käytä silmäsuojaimia.
Porter une protection oculaire.
Augenschutz verwenden.
Usare occhiali di protezione.
Use óculos de proteção.
Use protección para los ojos.

4. *Examine weld terminals*

Kijk de lasterminals na.
Inspektera svetsterminalerna.
Tarkista hitsausterminaalit.
Examiner les bornes de soudure.
Schweißverbindungen prüfen.
Esaminare i terminali di saldatura.
Examine os terminais de soldagem.
Examine las terminales soldadas.

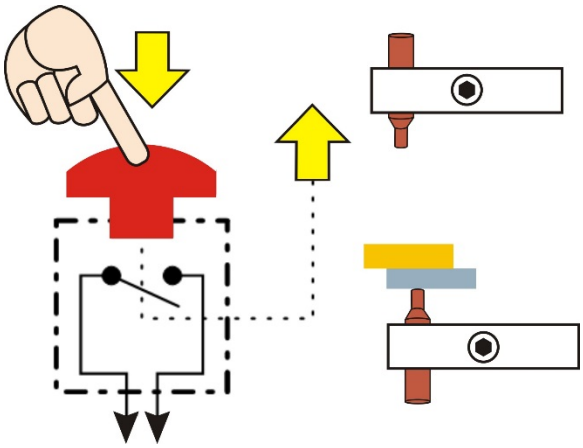
5. *Use WELD/NO WELD switch to stop weld current from flowing*

Bedieningshandleding - Voedingsbronnen voor AMADA WELD TECH.
Användarhandledning - Kraftaggregat för AMADA WELD TECH.
Käyttöopas – AMADA WELD TECH tehonlähteet.
Guide d'utilisation - Alimentation de électrique AMADA WELD TECH.
Bedienungsanleitung - Energieversorgung für AMADA WELD TECH.
Guida dell'operatore - Alimentazioni di corrente delle apparecchiature AMADA WELD TECH.
Guia do Operador - Componentes eléctricos da AMADA WELD TECH.
Guía del operador - Fuentes de alimentación de AMADA WELD TECH.



Use WELD/NO WELD switch to stop weld current from flowing

NOODSTOPOODSTOP Open het elektrische circuit om de laskop terug te trekken.
NÖDSTOPP - Öppna den elektriska kretsen för att dra tillbaka svetstråden.
HÄTÄKYTKIN POIS - Avaa virtapiiri vetääksesi hitsauspään takaisin.
ARRET D'URGENCE - Ouvrez le circuit électrique pour retirer la tête de soudure.
NOT-AUS-SCHALTER – Öffnet den elektrischen Kreis, der Schweißkopf wird zurückgezogen.
EMERGENZA DISINSERITA - Aprire il circuito elettrico per ritrarre la testa della saldatura.
DESCONEÇÃO DE EMERGÊNCIA - Abra o circuito elétrico para retrair a cabeça da soldadura.
DESCONECCION DE EMERGENCIA - Abra el circuito eléctrico para retraer la cabeza de soldadura.



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.

(b) Buyer shall not copy, modify, or disassemble, or permit others to copy, modify, or disassemble, the Software, nor may Buyer modify, adapt, translate, reverse assemble, decompile, or otherwise attempt to derive source code from the Software. Buyer shall not transfer possession of the Software except as part of, or with, the Goods, and each such transfer shall be subject to the restrictions contained herein. Buyer may not sublicense, rent, loan, assign or otherwise transfer the Software or documentation, and Buyer shall retain on all copies of the Software and documentation all copyright and other proprietary notices or legends appearing therein or thereon. Seller may terminate this license upon written notice for any violation of any of the terms of this license or any material breach of any provision of this Agreement. Buyer shall immediately discontinue use of the Software upon any termination of this license or Agreement. This license shall terminate upon any termination of the Agreement.

(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

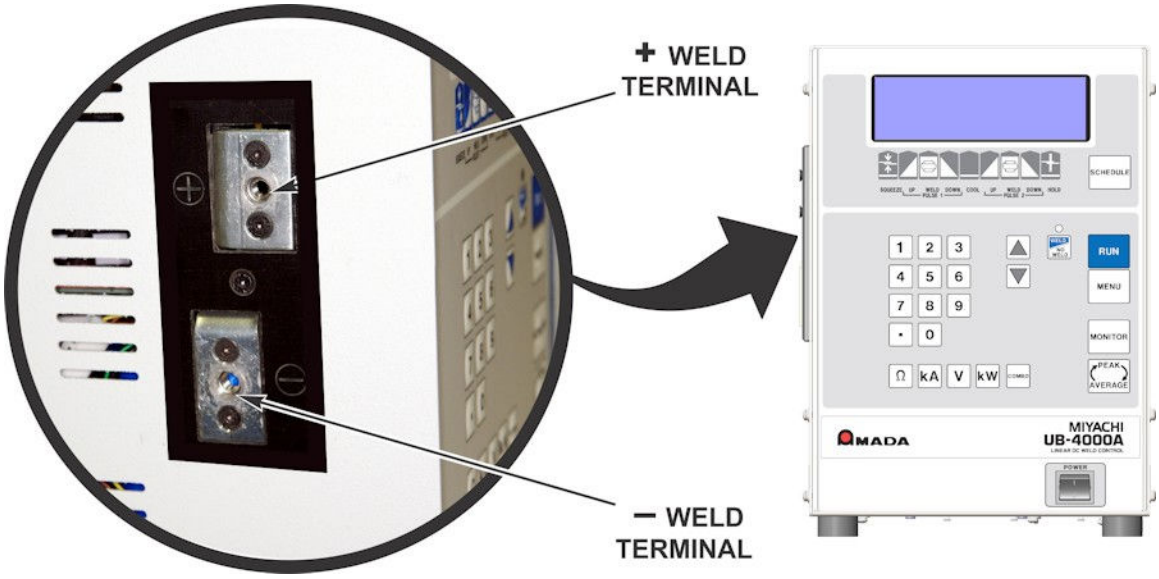
Section I: Introduction

Features

The **UB-500A, UB-1500A,** and **UB-4000A** are Resistance Welding Power Supplies. These models have the same functionality except the **UB-500A** has a maximum weld current output of 500 Amps, the **UB-1500A** has a maximum weld current output of 1500 Amps, and the **UB-4000A** has a maximum current output of 4000 amps. The design of the UB-500A and UB-1500A, with their lower maximum current level, provides greater accuracy at lower weld current settings.

- Programming of time in 100 µsec increments (minimum) provides shorter weld times, less part deformation, longer electrode life, and greater weld strength with more part ductility.
- Built-in Liquid Crystal Display (LCD) shows a graphical "trace" of weld current, voltage, power and resistance, plus alphanumeric peak and average values.
- Up to 99 individual Weld Schedules (sometimes referred to as *weld profiles*) can be programmed and stored. Weld schedules can be used individually or in sequence with others using the "chain schedules" function.
- Easy-to-set limits establish process window for acceptable quality.
- Weld limits and user programmable relays can be used in conjunction with visual and audible signals for operators and automation interface.
- Able to abort process if process parameter moves outside of user set limits.
- Digital inputs for process automation include schedule selection, weld inhibit, and alarm reset.
- Five programmable relay outputs.
- Rear-mounted RS-232 connector allows for remote programming, weld schedule selection, and data logging for SPC purposes.

- Side-mounted weld terminals (bus bars) on the left side of the Power Supply give you a less cluttered workspace in front or behind of the Power Supply.



- Calibration traceable to NIST standards.
- Password protection provides process security.

Applications

The Power Supply is ideal for micro-joining applications, which require exceptional control and highest quality throughput. The Power Supply has a closed-loop feedback circuit that allows the user to program **constant current**, **constant voltage**, or **constant power** welding pulses along with a combination control mode which first controls voltage and then switches to current control. *Chapter 3, Using Welding and Monitor Functions*, describes the Power Supplies functions and how to use them for different welding applications.

The Power Supply requires only single-phase input power. The UB-500A, UB-1500A, and UB-4000A can respectively supply weld current up to 500 amps, 1500 amps, and 4,000 amps. The advanced linear control circuit provides instantaneous update of the welding pulse in response to changes in the resistance of the work piece during the weld. This level of control is essential to achieve consistent welds in applications where the resistance changes dramatically.

The graphical display and intuitive weld monitor make understanding the weld and the weld optimization process easy. Data output provides the necessary process documentation for critical applications and permits data logging for SPC purposes.

Section II: Description

UB-4000A Front Panel

The front panel contains all the controls and indicators necessary to operate the Power Supply. You can program the Power Supply using the data input keys and information appearing in the Liquid Crystal Display (LCD). Descriptions for each button and display are in *Section IV* of this chapter, *Controls and Indicators*. The power **ON / OFF** and **WELD / NO WELD** switches are located on the front panel.

All electrical connectors and data connectors are located on the rear panel of the Power Supply. Connection instructions are described in *Chapter 2, Getting Started*.

Complete technical specifications for the Power Supply are listed in *Appendix A, Technical Specifications*.

Connector pin identification and specifications are listed in *Appendix B, Electrical and Data Connectors*.

Overview

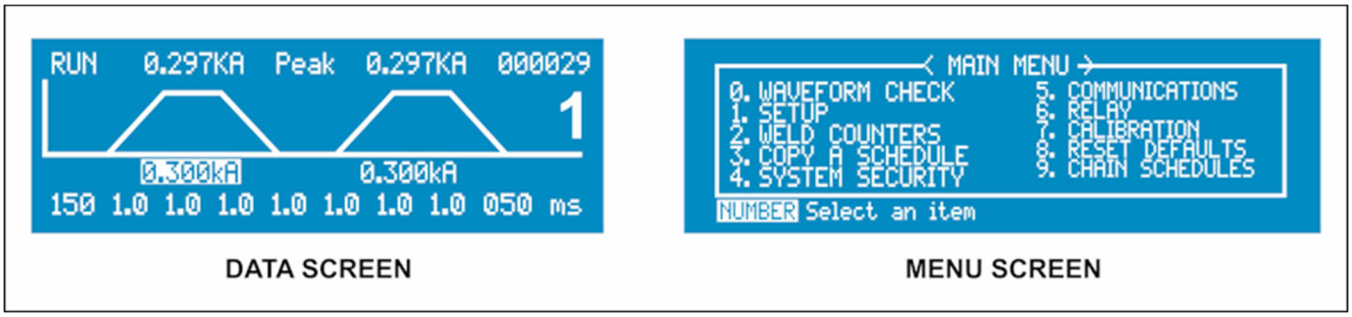
The front panel of the Power Supply contains the **Liquid Crystal Display** (**LCD**), and pushbutton **keys** (Weld Selector Keys, Numeric Keypad, and Operational Controls). Each is described in *Section IV, Controls and Indicators*. The display and the front panel keys are used together when programming and operating the Power Supply. Instructions on how to do this are in *Chapter 4, Operating Instructions.*

The display shows all of the setup, programming, and operating information for the Power Supply. The front panel keys allow you to enter data for programming custom weld schedules, customizing the operating parameters of the Power Supply, and operating your welding equipment. The keys also allow you to program the precise voltage, current, power, and time of each energy pulse into individual weld schedules, which may contain one or two weld pulses. Weld schedules consist of:

- Squeeze time before the weld pulse(s) [after the firing input is given]
- The time and energy for each weld period
- Cooling time between Pulse 1 and Pulse 2 [if two pulses are used]
- Hold time after the welding pulse(s)

You can program and store up to 99 different weld schedules to meet a variety of welding applications.

LCD Display Screens



LCD Display Screens

The display shows two types of screens: **Data** screens and **Menu** screens.

NOTE: The purpose of this section is to describe the ***content*** of LCD screens. For clarity, LCD screens are shown here ***without*** the Weld Selector keys located directly under the display.

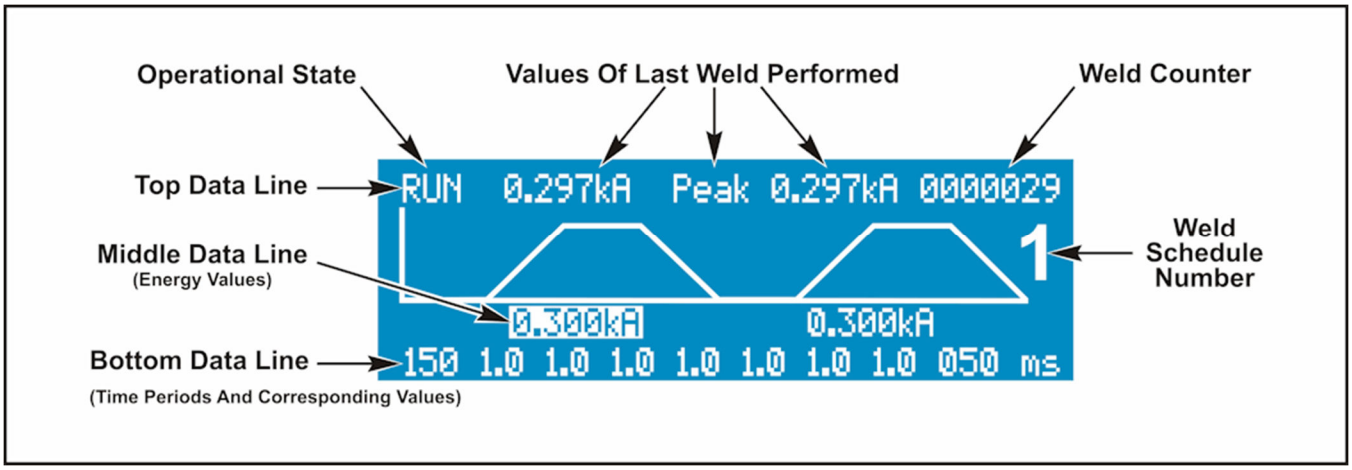
Menu Screens

Menu screens are text screens that allow you to select and customize the operating parameters of the Power Supply and performance of the welding equipment. Each menu screen lists several choices, with some offering additional menu screens listing more choices. The numeric keypad and Up and Down arrows are used to select choices from the menu.

Data Screens

The Data screens display the information necessary to program, run, and monitor welds. Data is displayed in both alphanumeric and graphic form on the same screen. The graph displays **time** values from left to right, and **energy** values from bottom to top, showing the waveform of the weld schedule. The waveform gives you an easy-to-see "before and after" comparison of how you programmed the weld, and how the weld was actually performed.

Alphanumeric Data



Alphanumeric Data

Alphanumeric data is displayed on three lines. Operating instructions will refer to alphanumeric data as the **Top Line**, **Middle Line**, and **Bottom Line** as shown above. *Chapter 4, Operating Instructions*, describes how to enter alphanumeric data, and how to select between voltage, current, power, peak/average display, and operational states.

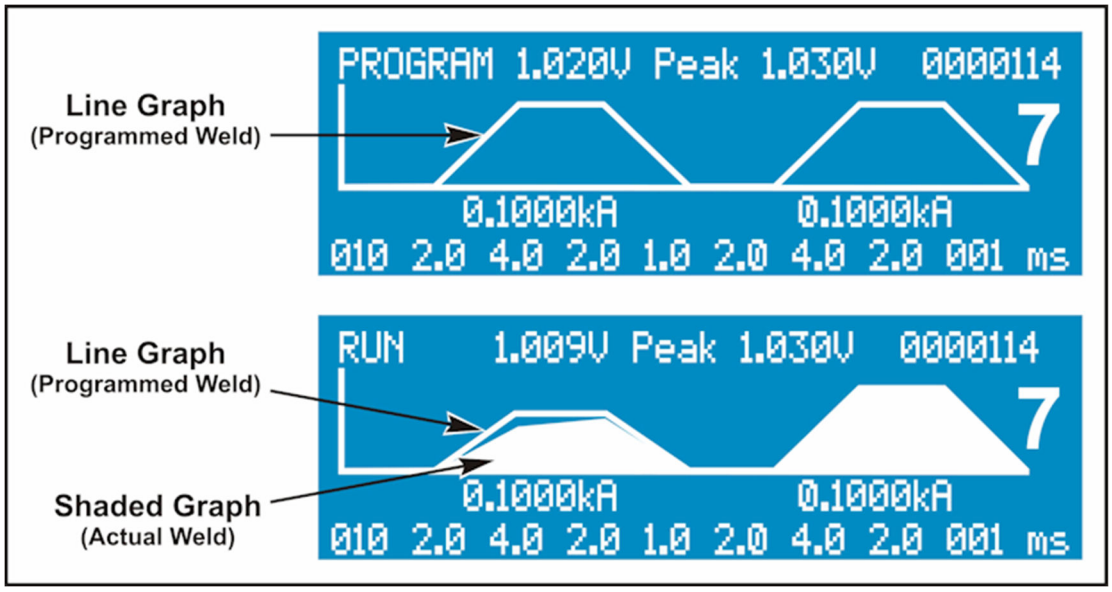
Operational States

Each **Data Screen** displays the current operational state of the Power Supply in the **Top Line** of data (left side). Menu Screens do not display the operational state, but the menu itself indicates the Power Supply is in the **MENU** state. The following table describes each of the Power Supplies operational states.

UB-500A/UB-1500A/UB-400A Operational States

STATE	DESCRIPTION
RUN	This state indicates the Power Supply is ready to weld and waiting for a start signal. Press the **RUN** key on the front of the Power Supply to put the Power Supply in this state.
NO WELD	In this state, the Power Supply does **not** deliver weld energy to the weld head heads in order to prevent electrical shock. This state is used for cleaning electrodes, adjusting electrodes, or adjusting the air regulators on air actuated weld. If a start signal is received, the Power Supply will execute its programmed weld schedule(s) -- but **no** energy will go to the weld head, and the LCD will display a **WELD SWITCH IN NO WELD POSITION** alarm. The **WELD/NO WELD** switch toggles the Power Supply between the **WELD** and **NO WELD** states.
PROGRAM	In this state, the weld time and energy values can be modified and new schedules can be selected. From the **RUN** state, press any one of **the WELD SELECTOR KEYS** to put the Power Supply in the **PROGRAM** state.
STANDBY	When an air actuated weld head is being used, the Power Supply will go to the **STANDBY** state when the footswitch is pressed.
SQUEEZE	When a start signal has been received, the Power Supply enters the **SQUEEZE** state for the duration programmed in the schedule. An adequate amount of squeeze time should be programmed to allow the weld head to settle before the **WELD** period begins. The default **SQUEEZE** time is 150ms (milliseconds). **NOTE:** In addition to the debounce time, there is a delay of no greater than 5ms before the start signal is recognized by the Power Supply.
WELD	The **WELD** period begins after **SQUEEZE** time has ended and includes both weld pulses as well as the Cool time between Pulse 1 and Pulse 2.
HOLD	The **HOLD** period begins after the **WELD** period ends and lasts for the duration programmed in the schedule. An adequate amount of hold time should be programmed to allow the electrodes to sink the heat away from the welded parts. The default **HOLD** time is 50ms. It is during the **HOLD** time that the weld strength is formed.
END	The Power Supply will enter the **END** state after the **HOLD** period if the firing switch or footswitch has not yet been released.
MONITOR	This state allows you to view waveforms of weld **voltage**, **current**, **power**, and **resistance**. Press the **MONITOR** key to go to the **MONITOR** state. The LCD will show the actual trace of energy of the last weld performed. You can also view the peak or average energy value for each weld pulse as selected by pressing the **PEAK/AVERAGE** key. If a start signal is received while in the **MONITOR** state, the Power Supply will execute the programmed weld schedule and the waveform trace will update with the new weld data. The operational state will then read **RUN**, and the LCD screen will show the monitored data.
ALARM	The Power Supply automatically goes into an alarm state when it recognizes any alarm condition (these are described in detail in *Appendix D*, *LCD Display Messages*).
MENU	Pressing the **MENU** key puts the Power Supply in the **MENU** state, which displays the **MAIN MENU** on the LCD. A series of menu and sub-menu screens enable you to change the Power Supplies operating parameters (see *Chapter 4, Operating Instructions*).

Graphed Data



Graphed Data

Line Graph. When you enter data to program a weld schedule, the Power Supply automatically draws the data in graphic form, a line graph [or *waveform*] of a **programmed** weld schedule. As you enter data on the keypad, you will see the graph change as you program new data. When you have entered all the data, you will see the completed waveform.

Shaded Graph. After each weld is performed, the LCD displays a white, **shaded graph** showing the waveform of the actual weld pulse. The LCD now displays both graphs together, allowing you to visually compare the line graph to the shaded graph to see if the weld was completed properly.

The actual weld energy delivered [**shaded graph**] is dependent on the load resistance, including cables, the weld head, and parts to be welded. A missing area of the **shaded graph** indicates that the Power Supply is not able to deliver the programmed energy, most likely due to the load resistance. If the front part of the shaded graph is missing, the load resistance is not allowing the Power Supply to instantly deliver the programmed energy. You can compensate for this by using the upslope feature when programming a weld schedule [see *Chapter 3, Using Welding and Monitoring Functions* and *Chapter 4, Operating Instructions*]. The data lines on the LCD may also display alarm messages showing that the weld was inhibited, stopped, or terminated and the reason why the action was taken.

Section III: Controls and Indicators

Introduction

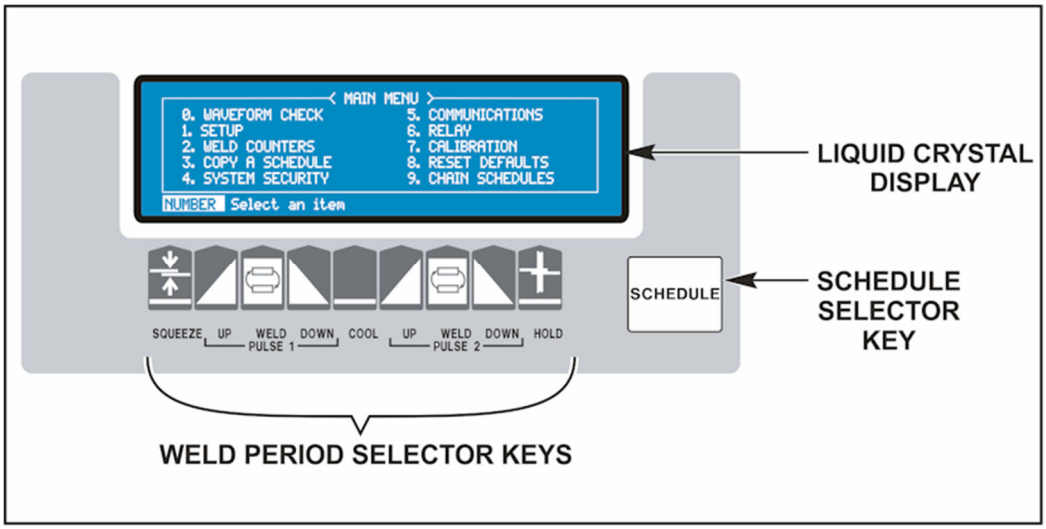
The Controls and Indicators on the front panel of the Power Supply are grouped in two clusters:

- **Liquid Crystal Display (LCD) and Weld Selector Keys**
- **Numeric Keypad and Operational Controls**

Various functions of the Power Supply may require the use of buttons or keys from each cluster. This section describes each button and key on the front panel. Descriptions are given in the order they appear on the front panel from left-to-right, and from the top of the panel to the bottom.

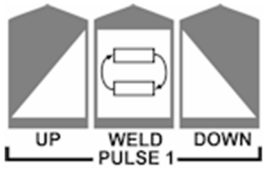
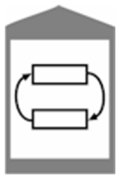
Step-by-step instructions on how to use the controls and indicators are in *Chapter 4. Operating Instructions*. Operating Instructions will list the buttons and keys in the sequential order necessary to perform each task.

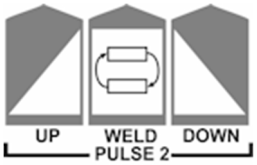
Liquid Crystal Display and Weld Selector Keys



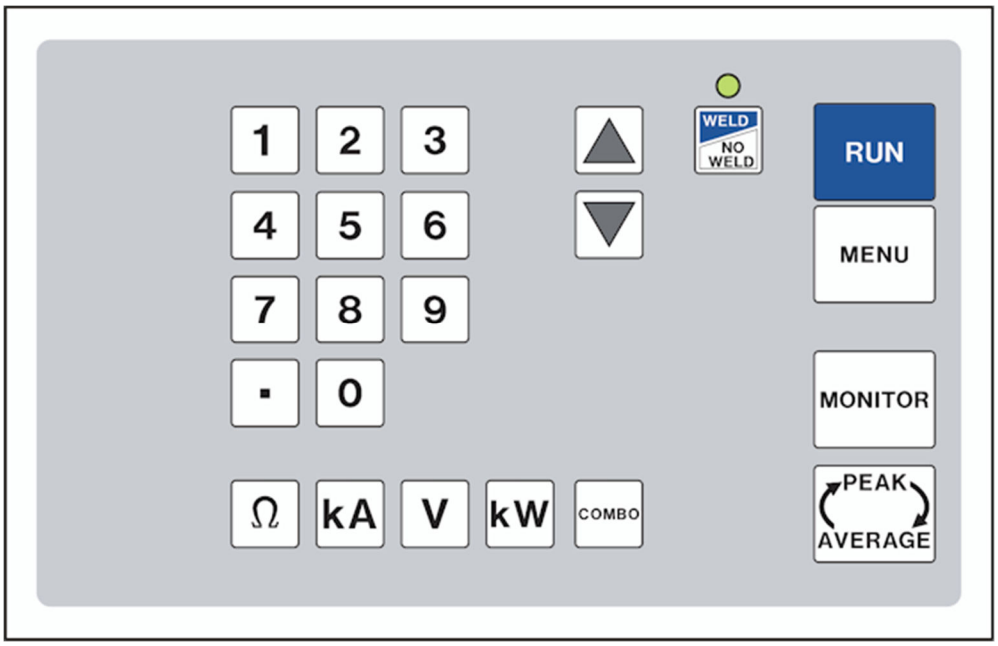
LCD and Weld Selector Keys

KEY	FUNCTION
	**Weld Selector Keys.** A group of nine keys used to program the time periods and energy levels for each complete weld schedule.

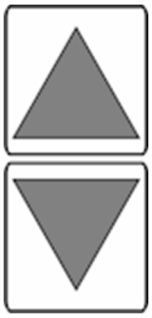
KEY	FUNCTION
	Press to view and select a *Weld Schedule*. After pressing the **SCHEDULE** key, you can use **either** the ▲▼ (up/down) keys on the front panel to scroll through the 99 stored *Weld Schedules,* **or** use the numeric keypad to enter the two-digit number of the desired schedule.
	Press to enter the squeeze time before the weld. To select the value, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers. The squeeze time will start after a firing signal is given to the Power Supply. **NOTE:** In addition to the debounce time, there is a delay of no greater than 5 ms before the start signal is recognized by the Power Supply.
	A group of 3 individual keys used to program the **time** and **energy** for Pulse 1. Each key is described below.
	Press to enter the amount of **time** Weld Pulse 1 upslope. To select the value, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers.
	This switch toggles between the **middle** and **bottom** data lines on the LCD. To enter weld **energy** values (energy level and feedback mode), press the switch to highlight the **middle** line. To enter **weld time** values [in milliseconds], press the **WELD** switch again to highlight the **bottom** line. To select **energy** and **time** values, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers and decimal point. To select **feedback mode**, press the **kA**, **V**, **kW** or **COMBO** key when the **energy** value is highlighted.
	Press to enter the amount of time for Weld Pulse 1 downslope. To select the value, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers and decimal point.

KEY	FUNCTION
	Press to enter the amount of time for the cool period. To select the value, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers and decimal point.
	A group of three individual keys that program Pulse 2. These keys have the exact same function as the Pulse 1 Keys.
	Press to enter the amount of time for the hold period after the weld. To select the value, use **either** the ▲▼ (up/down) keys, **or** use the numeric keypad to enter the numbers.

Numeric Keypad and Operational Controls



Numeric Keypad and Operational Controls

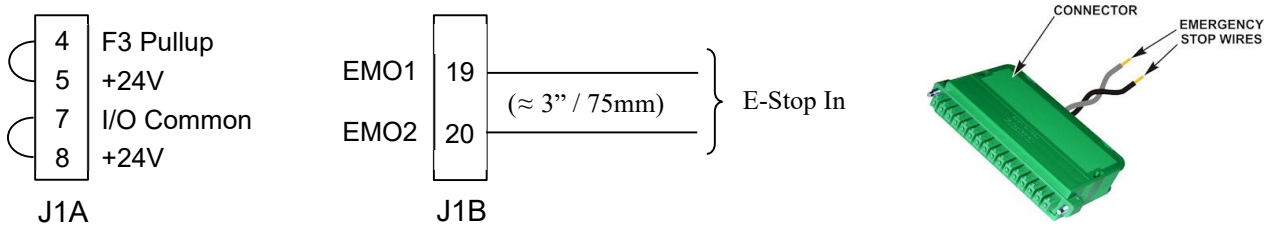
KEY	FUNCTION
	**Numeric Keypad** • Enter or modify weld period time and energy values. • Enter or modify monitor and limit values. • Directly recall a specific weld schedule. • Select menu items when **MENU** screens are displayed.
	Press to insert a decimal point into the time and energy values you enter.
	Press to: • **Increment** (increase) or **decrement** (decrease) numeric values on the display • **Scroll** the weld schedule numbers up and down.
	Press to switch **Control** between **WELD** and **NO WELD** modes. The LED above will be green when in **WELD** mode and dark when in **NO WELD** mode. **WELD** position -- when a weld is initiated, the Power Supply delivers energy to the weld head. **NO WELD** -- allows the Power Supply to execute a complete weld sequence **but does not deliver energy to the weld head**. This function is useful for testing and adjusting the weld head before operation, and when cleaning electrodes.
	Press to return to the **RUN** state or to clear alarms. When using any **MENU** screen, press this key to **exit** the menu.
	Press to display the **MENU** screen. *Chapter 4, Operating Instructions* describes how to use the different **MENU** options.

KEY	FUNCTION
MONITOR	This state allows you to view waveforms of weld **voltage**, **current**, **power**, and **resistance**. Press the **MONITOR** key to go to the **MONITOR** state. The LCD will show the actual trace of energy of the last weld performed. You can also view the peak or average energy value for each weld pulse as selected by pressing the **PEAK/AVERAGE** key. If a start signal is received while in the **MONITOR** state, the Power Supply will execute the programmed weld schedule and the waveform trace will update with the new weld data. The operational state will then read **RUN**, and the LCD screen will show the monitored data.
PEAK / AVERAGE	Switches the display between the **peak** welding energy and the **average** welding energy readings. Data is displayed in the **top** data line on the LCD.
Ω	Pressing the **Ω** key displays the resistance monitor. This screen shows the results of the most recent weld. This screen also allows the operator to set limits that automatically interrupt the weld when they are reached. You can also program the power monitor to output an alarm when the limits are exceeded.
NOTE: The **kA, A**, **V**, and **kW** keys are used to: • Set the feedback mode for Pulse 1 and Pulse 2 in the weld schedule. • Set the feedback parameters for upper and lower monitor limits. • Select the monitor mode to be viewed on the LCD display.	
kA	When **PROGRAM** is displayed, this key is used to set **current** as the feedback mode for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired output level with the numeric keypad, then press the **kA** key to change the feedback mode to **current**. Note: UB-500A models display "A" instead of "kA" When in the **MONITOR** state, this key is used to set **current** as the limit parameter for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the **kA** key to change the limit parameter to **current**. When **RUN** is displayed in the **MONITOR** state, press the **kA** key to view the **current** graph on the LCD display.

KEY	FUNCTION
	When **PROGRAM** is displayed, this key is used to set **voltage** as the feedback mode for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired output level with the numeric keypad, and then press the **V** key to change the feedback mode to **voltage**. When in the **MONITOR** state, this key is used to set **voltage** as the limit parameter for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the **V** key to change the limit parameter to **voltage**. When **RUN** is displayed in the **MONITOR** state, press the **V** key to view the **voltage** graph on the LCD display.
	When **PROGRAM** is displayed, this key is used to set **power** as the feedback mode for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired output level with the numeric keypad, and then press the **kW** key to change the feedback mode to **power**. When in the **MONITOR** state, this key is used to set **power** as the limit parameter for Pulse 1 or Pulse 2. First, use the **WELD** key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the **kW** key to change the limit parameter to **power**. When **RUN** is displayed in the **MONITOR** state, press the **kW** key to view the **power** graph on the LCD display.
	The **COMBO** key is used to set the feedback mode for Pulse 1 in the weld schedule. If the present schedule is in **Current**, **Voltage** or **Power** mode and are either on the **RUN** screen or have a time or energy parameter highlighted for editing, press the **COMBO** key to change to **COMBO** mode. If the present schedule is in **COMBO** mode, pressing the **COMBO** key while either on the **RUN** screen or when the time or energy parameters are highlighted for editing, will change the schedule to **Current** mode and change the screen to the **RUN** screen. For more information on **COMBO** mode, refer to *Chapter 3, Using Welding and Monitor* Functions

Section IV: Emergency Stop Switch and I/O Connections

Depending on the model and accessories ordered, the I/O connections on the rear panel will differ in location and functionality. In general the Power Supply is shipped with two single row 16-pin mating plugs. These mating plugs need to be installed on the two I/O connectors (**J1A** and **J1B**) on the rear panel of the Power Supply. These two mating plugs are typically pre-wired with the following configuration:

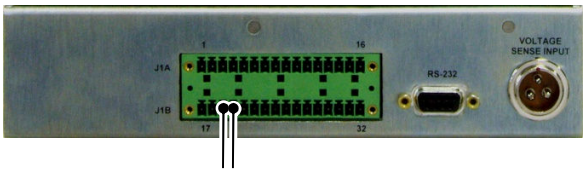


The wiring of the J1A - I/O Connector (as shown above) will configure the Power Supply I/O to operate on negative logic. For connector pin identification and specifications, see *Appendix B, Electrical and Data Connectors.*

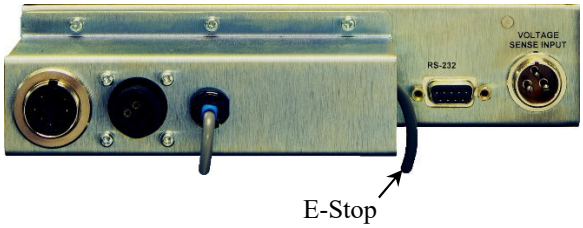
> ***Note: In order to operate the Power Supply, the Emergency Stop Input circuit needs to be connected to a normally closed Emergency (E-Stop) Switch***. If you wish to operate the Power Supply without an external E-Stop Switch, make sure to short / connect both E-Stop leads together for proper operation. The Power Supply will ***not*** function if the E-Stop inputs are not terminated properly.

If a legacy UB29/29A or DC29 is being configured, then the J1B external I/O mating plug should be terminated with an external E-Stop switch connected between J1B-19 and J1B-20 as shown on the right.

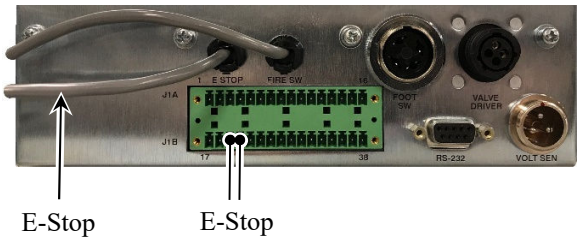
Note: When the UB/DC was originally shipped from the factory, the J1B mating plug was pre-wired with a pair of 3" E-Stop wires.



If a legacy UB29/29A or DC29 with the optional 10-372-01 - I/O Accessory Box is being configured, then the E-Stop input will come out from behind the I/O Accessory Box as shown on the right. Connect this 2-conductor cable to an external E-Stop switch.



The UB-500A/1500A/4000A includes both the J1A and J1B – I/O connectors as well as the panel connectors that control the power supply functions. The UB-500A/1500A/4000A Power Supply has two parallel connected Emergency Stop inputs. Either connect an E-Stop switch between J1B-19 to J1B-20 or to the E-Stop Cable that comes out of the back panel. Either E-Stop input may be used.



Note: only use one of the available E-Stop inputs.
Do not use both. Leave the other open (not connected).

For clarity, the E-Stop input connections will be labeled with the following 2-sided tag to indicate the E-Stop (Emergency Stop) input:

- EMERGENCY STOP-
Open electrical circuit to retract weld head.
- DESCONECCION DE EMERGENCIA -
Abra el circuito eléctrico para retraer la cabeza de soldadura.
- PARADA DE EMERGÊNCIA -
Abrir o circuito elétrico para tirar a cabeça da maquina.
- ARRESTO D'EMERGENZA-
Interrompere l'alimentazione per risalita testa.
- HÄTÄKYTKIN POIS -
Avaa virtapiiri vetääksesi hitsauspään takaisin.

- ARRET D'URGENCE -
Ouvrez le circuit électrique pour retirer la tête de soudure.
- NOODSTOP -
Open het elektrische circuit om de laskop terug te trekken.
- NÖDSTOPP -
Öppna den elektriska kretsen för att dra tillbaka svetstråden.
- NOT AUSSCHALTER -
Würd den elektrischen Kreis öffen, der Schweißkopf würd zurück gezogen.

Emergency Stop Switch Instruction Tag

To operate ***with*** an Emergency Stop Switch, connect a normally closed, Emergency Stop Switch across the two wires of the emergency stop leads as noted above. This switch, when actuated (opening the circuit), will immediately stop the weld cycle and retract the weld head. This emergency stop does not require the intervention of the microprocessor.

CAUTION

When used, the E-stop circuit should be connected to one or more activation switched connected in series. These switches ***must*** be rated for at least 28 VDC and 2 amps. To avoid damaging equipment this circuit must ***not*** be interconnected to any other circuitry.

To restart the Power Supply after an emergency stop condition; make sure to close the E-Stop Switch, then press the **RUN** key on the front panel (or set the I/O **RESET DIGITAL INPUT** to **ACTIVE**). Verify that the desired schedule is still displayed on the front panel, and then resume welding.

CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning for Installation

Space Requirements

We recommend that the Power Supply be installed in a well-ventilated area that is free from excessive dust, acids, corrosive gasses, salt, and moisture. Other installation considerations are**:**

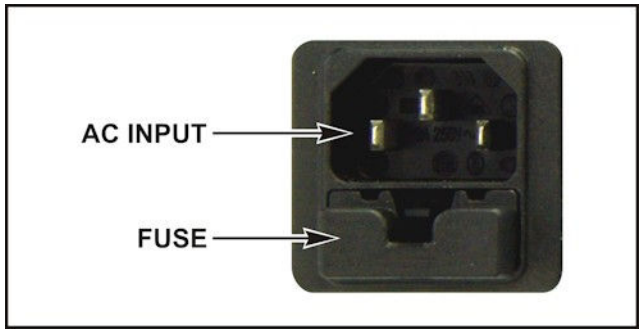
- Allow sufficient clearance around both sides and the back for power and signal cable runs.
- Allow ample workspace around the Power Supply so that it will not be jostled or struck while welding.
- The work surface must be level, stable, free from vibration, and capable of supporting the combined weight of the total welding system.
- The Power Supply must be far enough from the weld head to avoid contact with weld splash.
- Assure that there are no sources of high-frequency energy close by.

Utilities

The power input requirement is:

88 – 264 VAC, 47 – 63 Hz

Single Phase



AC Input (Rear Panel)

The power cable for the Power Supply is equipped with a standard IEC-320-C13 connector for the Power Supply Rear Panel **AC INPUT** plug (AWTA # 205-129). The input power wiring diagram is in *Appendix B, Electrical and Data Connectors.*

If you will require compressed air and cooling water service for the weld head, please refer to the weld head manufacturer's user's manual for service specifications.

Section II: Unpacking

As you unpack the shipping container, find the Shipping Kit List. Verify that contents of the container agree with the kit list.

Verify that the equipment shows no signs of damage. If you see any damage, please contact the carrier. Also, contact AMADA WELD TECH immediately by telephone, FAX, or the postal or e-mail address shown in the front of this manual.

NOTE: Save the packing material. Carefully place the packing materials back in the packing boxes and store for future shipping.

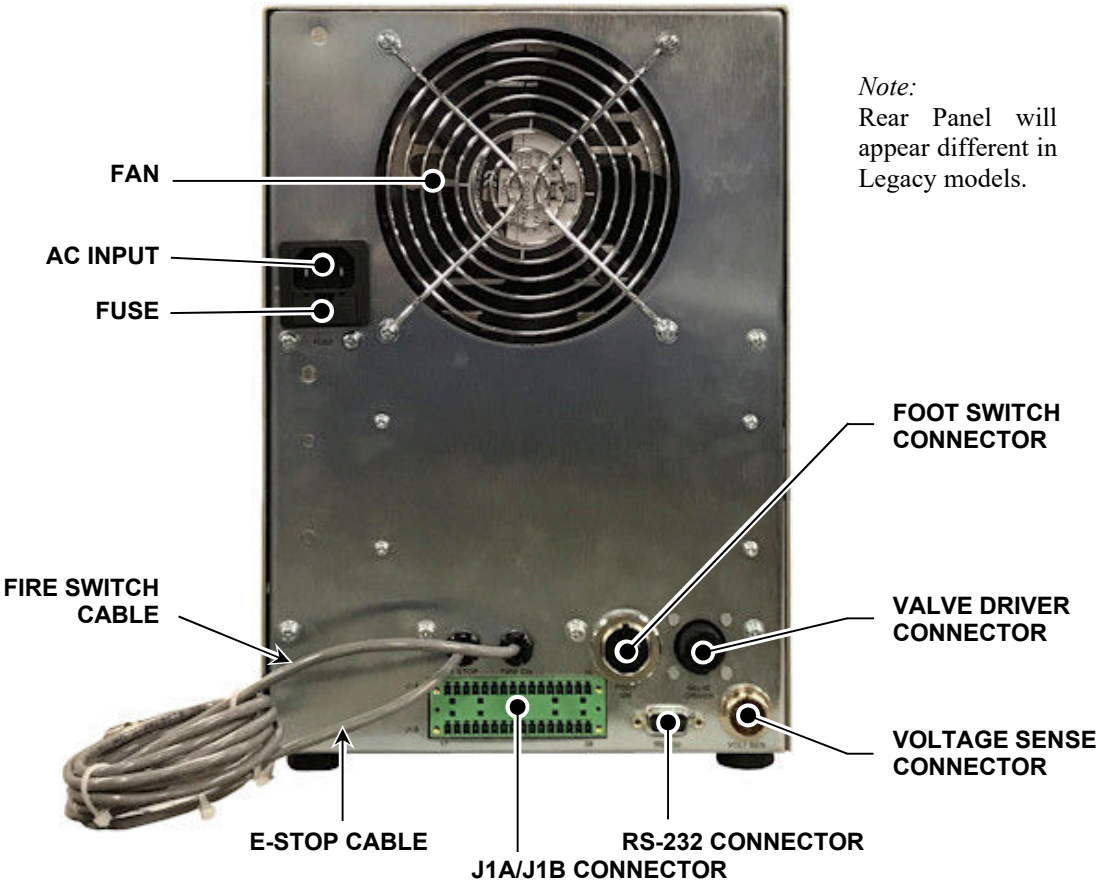
I/O Mating Connectors

The I/O mating connectors for the UB-500A/UB-1500A/UB-4000A power supply are available through AMADA WELD TECH. The connectors listed in the table below are un-populated. Refer to *Appendix B: Electrical and Data Connections* for information on pin-out and function.

CONNECTOR	AWTA #	DESCRIPTION
J1A and J1B	678-203	16-position, 180° Phoenix header plug (28-16 awg), 2 required
Voltage Sense	520-110	3-pin Socket Connector
Valve Driver	520-107	3-pin Plug Connector
	253-055	Male Pins (18-14 awg), 2 minimum
	245-084	Strain Relief
Footswitch	520-009	4-pin Plug Connector
Fire Switch	520-011	2-pin Socket Connector
RS-232	250-193	9-pin D-Sub Male Connector
	250-194	9-pin D-Sub backshell

Section III: Electrical and Data Connections

All connections between the Power Supply, switches, Weld Head, and external equipment, such as PLC and data collection systems, are made on the rear panel of the power supply. All connections shown in this section will be for the UB-500A/1500A/4000A Power Supply. The external connections for the legacy UB29/UB29A/DC29 Power Supply are similar, except that the connection locations will be different. Refer to *Appendix B: Connections* for a comprehensive list of connector locations.



Note:
Rear Panel will appear different in Legacy models.

Rear Panel Connections

For the Power Supply programmable relay connections, PLC, data logging, or other I/O connections, you will have to fabricate the appropriate connecting cables. For the Power Supply connector pin identification and specifications, see *Appendix B, Electrical and Data Connectors.*

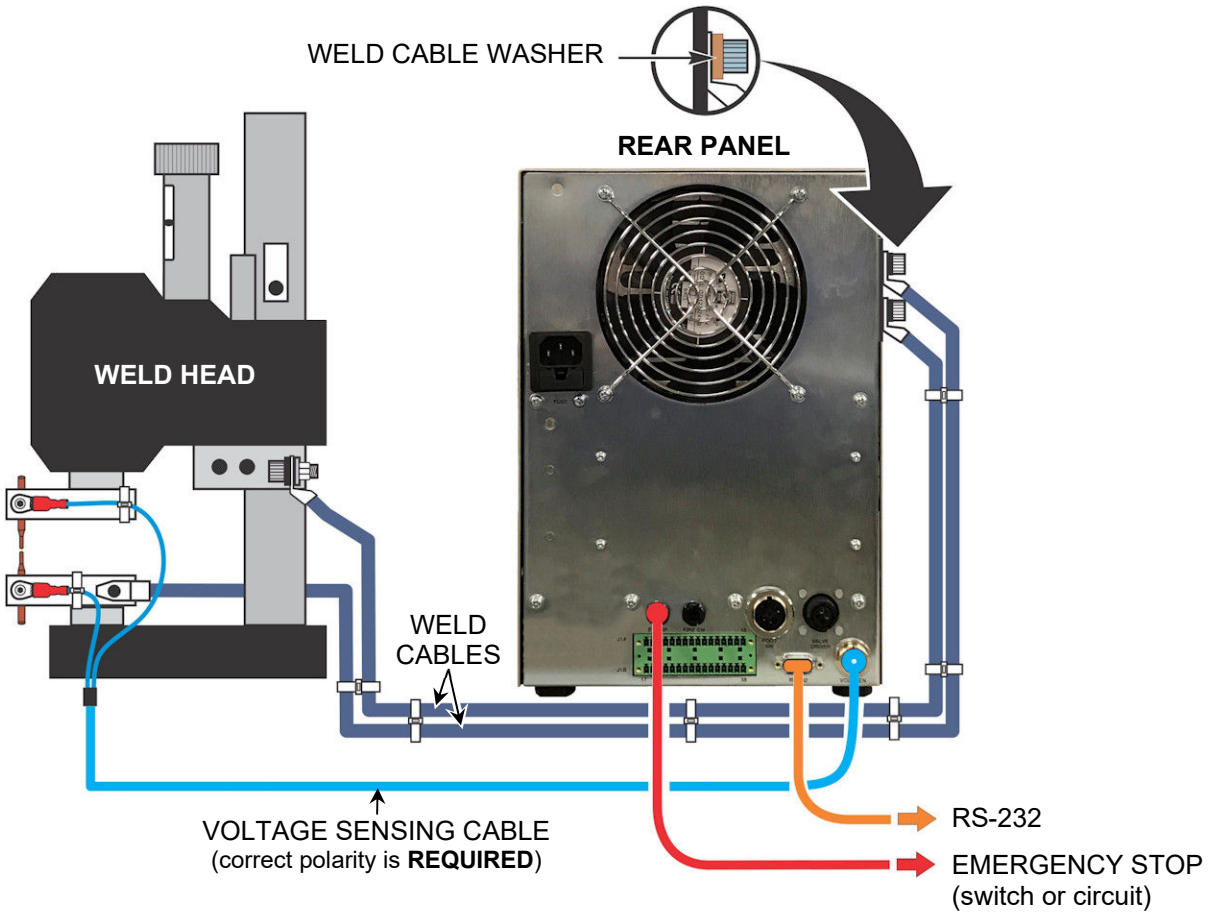
For legacy UB29/UB29A/DC29 power supplies, two 16-pin mating plugs for J1A and J1B were shipped with the Power Supply. Refer to *Appendix B, Electrical and Data Connectors* for connection details.

Section IV: Setup

Manual Weld Head Connections

1. Connect one end of a weld cable to the negative (-) weld terminal on the Power Supply.
2. Connect one end of the second weld cable to the positive (+) weld terminal on the Power Supply.

   Note: Install weld cable washers between the screw heads and cable terminals, NOT between the cable terminals and Power Supply terminals. Threads on screws should be 12 mm or less. ***Using longer screws may damage the Power Supply***.
3. Dress weld cables together with cable ties to minimize induction loss.

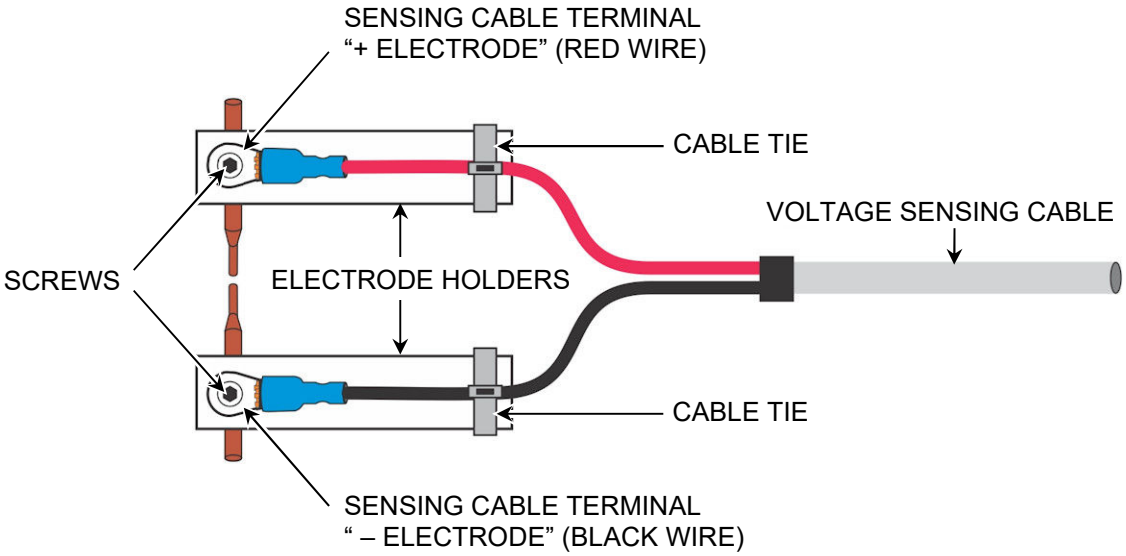


Manual Weld Head Connections

Note: Rear Panel will appear different in Legacy models.

4. Attach the voltage sensing cable connector to the **VOLTAGE SENSE INPUT** connector.
5. Install electrodes in the weld head electrode holders.
6. Attach voltage sensing cables to the screws on the electrode holders as shown.

ENSURE THAT THE ELECTRODE CONNECTED TO THE "+" TERMINAL IS CONNECTED TO THE RED TERMINAL OF THE VOLTAGE SENSING CABLE

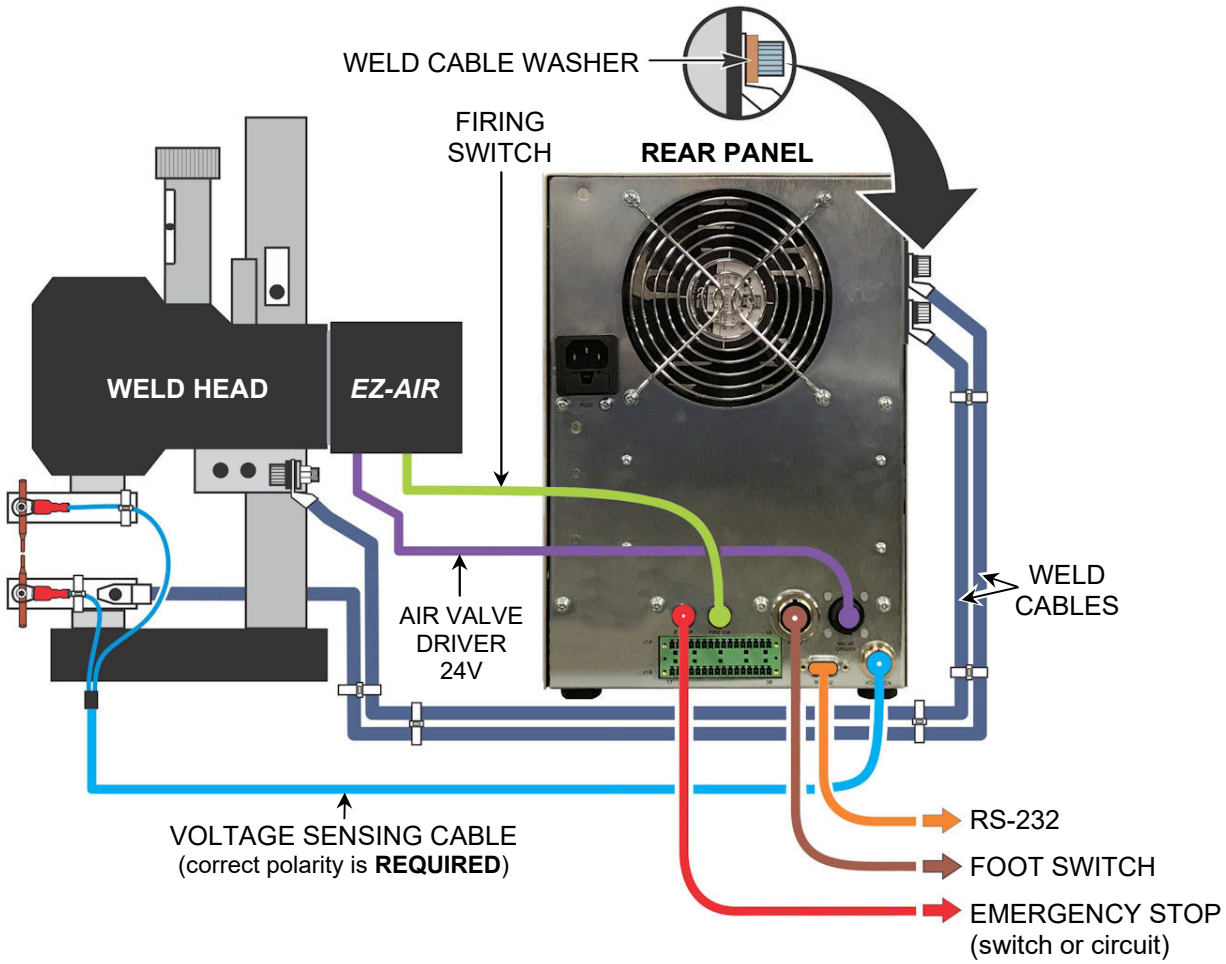


Voltage Sensing Cable Installation – POLARITY SENSITIVE

7. Using a cable tie as a strain relieve, attach each voltage sensing lead to its corresponding electrode holder so that the lead terminals will not break away under heavy production operating conditions.
8. Connect the Firing Switch cable connector from the weld head to the back panel I/O connector. See *Appendix B, Electrical and Data Connections* for details.
9. Connect other I/O connections as needed for your application.

Air-Actuated Weld Head Connections

1. Make the same connections to the Air-Actuated Weld Head as the Manual Weld Head (refer to the instructions above). Make sure to observe the same caution note when connecting the weld cables to the Power Supply.
2. In addition to the connections needed for a manual head, you will also need to connect:
   - Model FS1L or FS2L **Foot Switch** cable to the Footswitch Connector.
   - Connect the weld head **Air Valve** to the Valve Driver Connector. Note: This Power Supply connector provides 24 VDC power only. It will ***not*** drive 115 VAC or 24 VAC air valves. Refer to the weld head manufacturer's manual.
   - Connect the EZ-Air to the Fire Switch Connector.



Air Head Connections

Note: Rear Panel will appear different in Legacy models.

See *Appendix B, Electrical and Data Connections* for details.

CHAPTER 3
USING WELDING AND MONITORING FUNCTIONS

Section I: Introduction

To ensure accurate, consistent welds, the Power Supply delivers extremely precise pulses of energy to the weld head. Each pulse is comprised of weld-time and weld-energy (**voltage**, **current**, or **power**) values pre-programmed by the user. The Power Supply is a closed-loop resistance welding power supply that uses internal and external sensors to measure the weld-energy delivered to the weld head. Weld-energy feedback instantly goes to the Power Supplies logic circuits that actively correct the pulse to compensate for any variation in part resistance. The Power Supply also has several monitor functions that give you remarkable control over the welding and production process. Together, these features ensure precise, consistent welds, higher productivity, a lower rejection rate, and longer electrode life.

Before operating the Power Supply, it is important to know how to match the Power Supplies capabilities to specific weld applications. This chapter provides **Weld**, **Feedback**, and **Monitor** details in the following sections:

- **Weld Schedules**
  - **Single-Pulse**
  - **Upslope/Downslope**
  - **Dual-Pulse**
- **Programmable Feedback Modes**
- **Weld Monitor**
  - **Active Part Conditioner**
  - **Energy Limits**
  - **Pre-Weld Check**

Chapter 4, Operating Instructions, contains the step-by-step instructions on how to program each of the functions above.

Section II: Weld Schedules

Definition

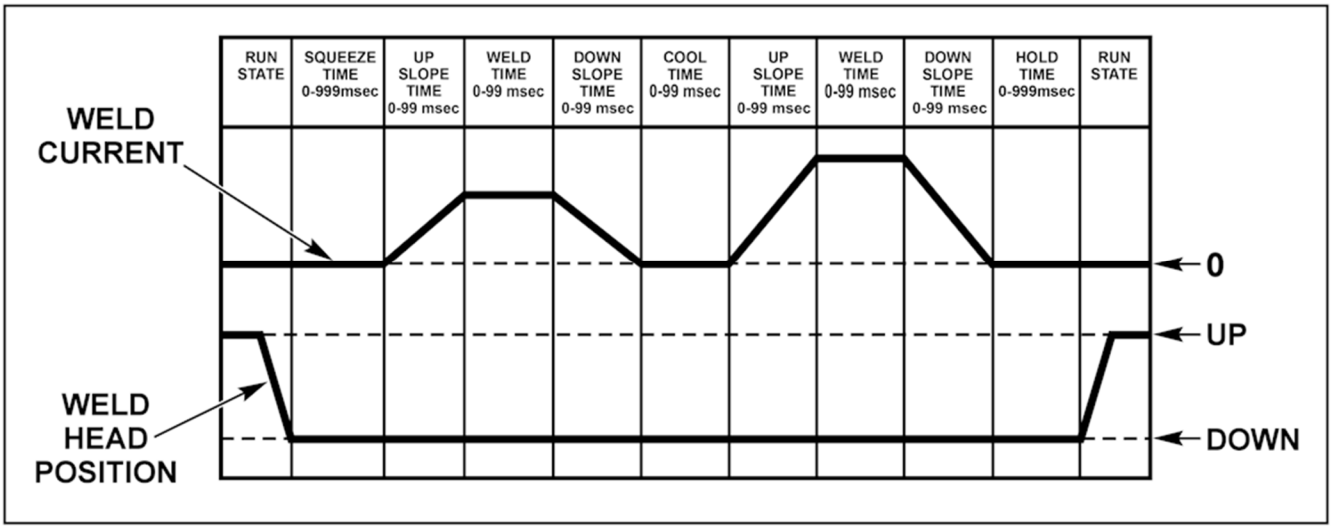
Weld Schedule is the name given to each of 99 separate *weld profiles* stored in the Power Supply, numbered from **01** → **99**. A weld profile is the graphic representation [or *waveform*] of the numeric weld-time and weld-energy values.

NOTE: When time and energy values are entered using the numeric keypad, the Power Supply displays a line-graph of the weld profile on the LCD screen. You can see the graph change as you enter new time and energy values.

Weld profiles may be programmed for **single-pulse**, **upslope/downslope**, or **dual-pulse** operation. Weld schedules may also use special monitoring features of the Power Supply such as **Energy Limit, Active Part Conditioner,** and **Pre-Weld Check**. These features are described later in this chapter.

Weld Sequence Timing

A weld schedule is a unique heat profile programmed in constant **current**, **voltage**, **power**, or a combination of a linear ramp in **voltage** and then constant **current** that is applied over a fixed time period, to resistance weld different parts. The entire weld can include all of the following time periods: Squeeze Time, Upslope 1, Weld Pulse 1, Downslope 1, Cool Time, Upslope 2, Weld Pulse 2, Downslope 2, and Hold Time. The sample dual-pulse profile [or *waveform*] below shows the weld current and the corresponding position of the weld head. The graph labeled **WELD CURRENT** displays on the LCD when you schedule a weld profile in constant **current**.



Sample Weld Sequence (Dual-Pulse)

Welding Applications

Weld Pulse Profile		Typical Application
Single-Pulse		Can be used for many of spot-welding applications. Use on flat parts without plating, or on conductive parts such as those made of copper or brass.
Upslope/Downslope		Upslope/Downslope should be used for the majority of spot welding applications. Weld round parts, parts that are not flat, spring steel parts, or heavily plated or oxidized parts.
Dual-Pulse		Use for spot welding parts with plating. First pulse can be used to displace plating or oxides and the second pulse to achieve the weld.

For a detailed coverage of resistance welding theory, please refer to *Appendix C, The Basics of Resistance Welding*.

Weld Head Applicability

The Power supply is best used with an AMADA WELD TECH force-fired, manual weld heads, AMADA WELD TECH low force programmable electronic weld heads, or force fired air actuated weld heads.

Manual Weld Heads

For manually actuated weld heads, the weld sequence begins when the force-firing switch closes. If footswitch weld abort is ON, then opening the fire switch before the weld has completed will terminate the welding sequence. If footswitch weld abort is OFF, opening the fire switch will NOT terminate the welding sequence.

Force Fired Air Actuated Weld Heads

For force fired, air actuated weld heads, the weld sequence begins when both levels of a two-level foot switch are closed and the force firing switch in the air actuated weld head closes.

a) If FS1 closes and FS2 closes the unit will wait 10 seconds for the firing switch to close. In 10 seconds the unit will abort regardless of the state of the footswitch weld abort if the firing switch does not close. This protects against welding with insufficient force.

b) If FS1 closes and then opens the head will lift and abort regardless of the condition of footswitch weld abort.

c) If FS1 closes and the fire switch closes the unit will wait for FS2 to close. While waiting for FS2 to close, if FS1 or the fire switch opens the unit will abort and the head will lift regardless of the state of the footswitch weld abort.

d) After FS1, FS2, and fire switches have been closed the state of the footswitch weld abort now matters. If footswitch weld abort is ON, then opening FS1, FS2, or fire switches will terminate the welding sequence. If footswitch weld abort is OFF then opening FS1, FS2, or fire will NOT terminate the welding sequence.

When the Power Supply is used with any air actuated weld head, the squeeze period must be long enough to allow sufficient time for the electrodes to close and apply the required weld force to the parts before the weld current begins. Weld current begins when the squeeze period ends. In addition, the hold period can be used to automatically keep the electrodes closed on the parts after weld current has terminated to provide additional heat sinking or parts cooling. The weld strength is formed during the hold period.

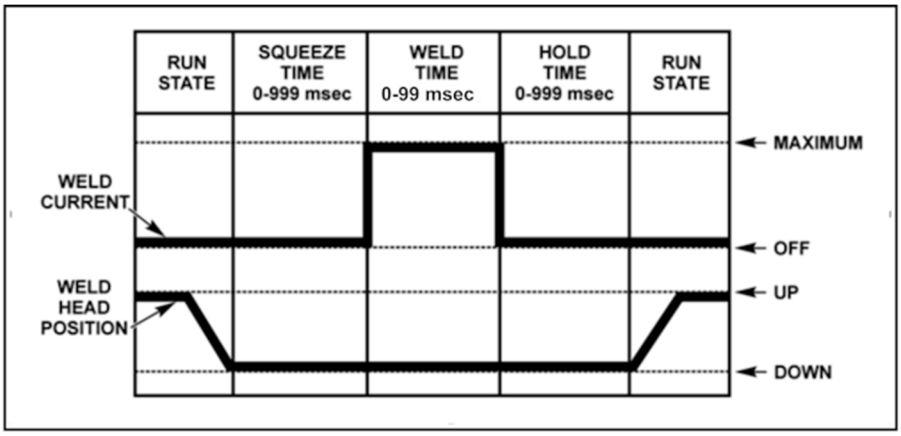
Single-Pulse Weld Profile

Applications

- Flat parts that do not have any plating or heavy oxides.
- Conductive parts made of copper or brass.

Description

Single-Pulse is a term used by the industry to describe the simplest heat profile used for many resistance spot-welding applications.



Single-Pulse Weld Profile

Upslope/Downslope Weld Profile

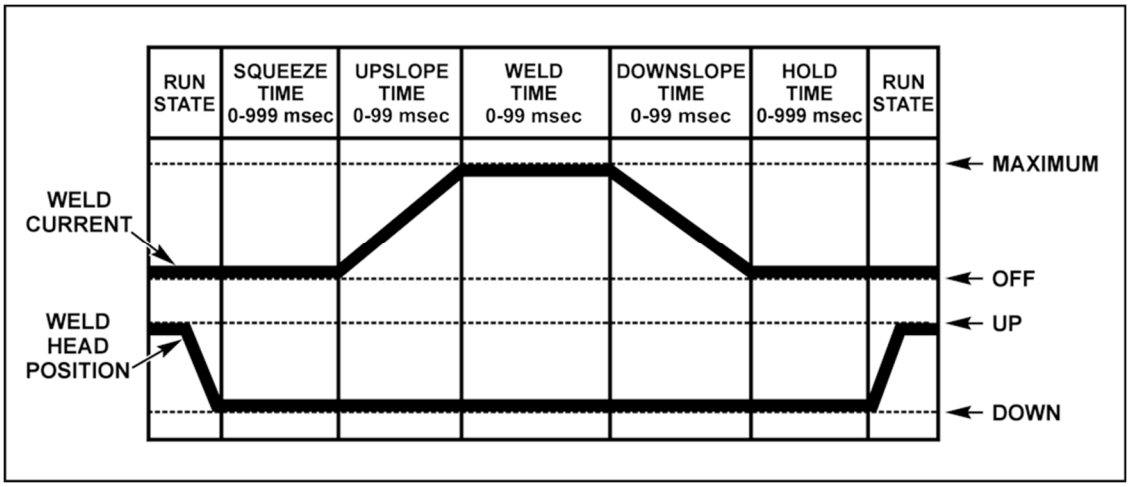
Applications

- Round or non-flat parts and most resistive materials.

Description

Upslope allows a gradual application of weld energy which permits the parts to come into better contact with each other reducing the electrode-to-part contact resistances. Upslope can allow a lighter electrode force to be used, resulting in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation. It 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 (annealing) assists in the grain refinement of certain heat-treatable steels, and prevents cracking in aluminum and other materials by reducing the cooling rate. Annealing is not typically used for welding small parts.



Upslope / Downslope Weld Profile

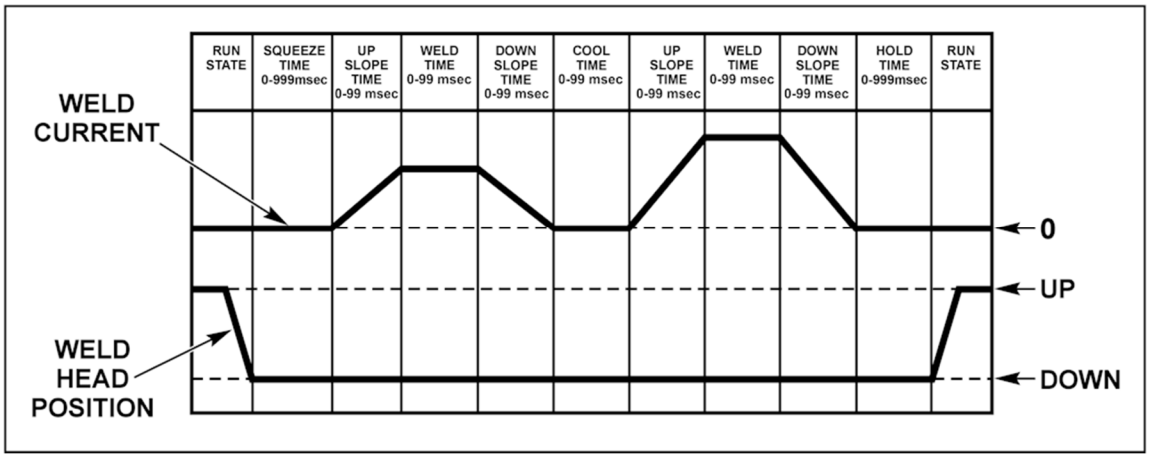
Dual-Pulse Weld Profile

Applications

- Flat-to-flat parts.
- Round-to-round parts.
- Round-to-flat small parts that may or may not be plated.

Description

Adding upslope to the front of both weld periods allows a reduction in electrode force. This results in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation.



Upslope will also help to displace plating and/or oxides, reduce flashing and spitting, and reduce thermal shock when welding parts containing glass-to-metal seals. In the normal application of dual-pulse, the Pulse 1 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 cool period allows time to dissipate the heat generated during Pulse 1.

The Pulse 2 weld period completes the structural weld. The Pulse 2 weld current is typically greater than the Pulse 1 weld current by a factor of 3, as the first pulse significantly reduces the resistance of the interface between the parts. The purpose for the downslope period following either welding pulse is to control grain refinement in brittle parts by slowly reducing the weld current to zero during the downslope period.

The dual-pulse weld profile is very valuable for pre-checking gross parts positioning problems and reducing parts scrap. Use the Pulse 1 weld at 0.100 kA and 2.0 ms as a pre-check pulse. Experiment with upper and lower limit values that you can use to inhibit the Pulse 2 weld if the test conditions measured by the Pulse 1 weld are out of limits.

NOTE: Upslope is required when a lower limit value is programmed.

NOTE: If the weld time parameter of Pulse 1 is set to 0 ms (upslope only or triangular waveform for Pulse 1) then the weld time parameter of Pulse 2 must be greater than 0 ms.

Section III: Programmable Feedback Modes

Introduction

The feedback mode (**current**, **voltage**, **power, combo**) is one of the selections entered when programming a weld schedule. Programming weld schedules is explained in *Chapter 4, Operating Instructions*.

Current Mode

Application

- Flat parts where the part-to-part and electrode-to-part contact is controlled and consistent.

Description

This mode delivers the programmed current regardless of work piece resistance changes. This compensates for slight changes in part thickness without affecting weld quality.

Voltage Mode

Application

- **Ideal for welding round or non-flat parts.**

Description

This mode controls the voltage across the work piece during welding. It helps to compensate for part misplacement and force problems and automatically reduces weld splash, which is often associated with non-flat parts and wire welds.

Power Mode

Application

- Breaking through surface oxides and plating.
- Automated applications where part or electrode surface conditions can vary over time.

Description

This mode precisely varies the weld current and voltage to supply consistent weld energy to the parts. The power mode has been shown to extend electrode life in automated applications.

Combo Mode (V-A Mode)

Application

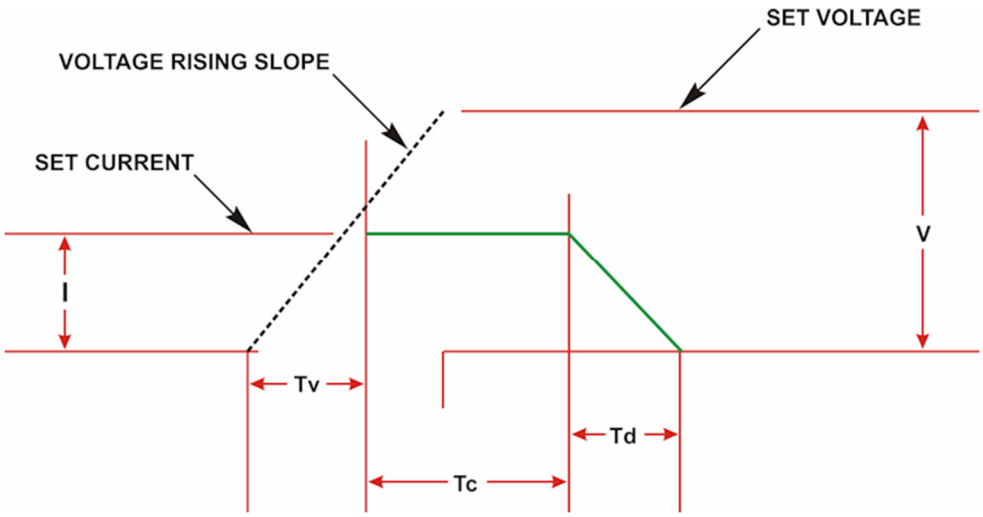
- Where there is a possibility of sparking due to variability of part surface conditions or part positioning.

Description

This mode ramps up voltage until a set current level is reached. Then, this mode delivers a programmed current.

Combo allows the user to start a weld with a controlled ramp up of the voltage. The slope of the ramp is calculated by the Power Supply based on user set time value, **Tv**, and the user set voltage value, **V**. When the current reaches a user set current value, **I**, the unit switches to a current control mode. Current is first controlled to a fixed current level for a user set period of time, **Tc**, and then an optional downslope of current can be executed.

If the current fails to reach the user-selected current level **I** after the voltage control time, **Tv**, ends, an error message will be displayed and alarm will be activated. Also, the combo pulse will be terminated and the second pulse, if any, will not be executed.



Set voltage waveform

Controlled Current waveform

Tc Constant current control time period (milliseconds)

Tv Maximum allowable time for Voltage Ramp up (milliseconds)

V Maximum allowable voltage during Voltage Ramp up (volts)

I Constant current control level (amperes)

Td Current downslope period (milliseconds)

After **Tv** or **I** is entered, the unit will calculate current ramp up rate and provide an error message if the calculated current ramp is greater than 500 amps/msec. If the calculated rate is greater than 500 amps /msec then change the **Tv** setting so that the calculated current ramp up rate will be 500 amps/msec or less.

NOTE: In a dual-pulse weld profile **combo** mode can only be used for the first pulse. For example, a constant power first pulse can be used to break through plating in combination with a constant current second (welding) pulse. **CURRENT FEEDBACK** must be used for the first pulse

RUN SCREEN WITH COMBO FEEDBACK MODE

Combo Feedback Mode ramps up voltage until a set current level is reached. Then, this mode delivers a programmed current.

A typical Weld Schedule is shown on the right.

NOTE: In **COMBO** mode Pulse 1 ***must*** be in **CURRENT FEEDBACK** mode.

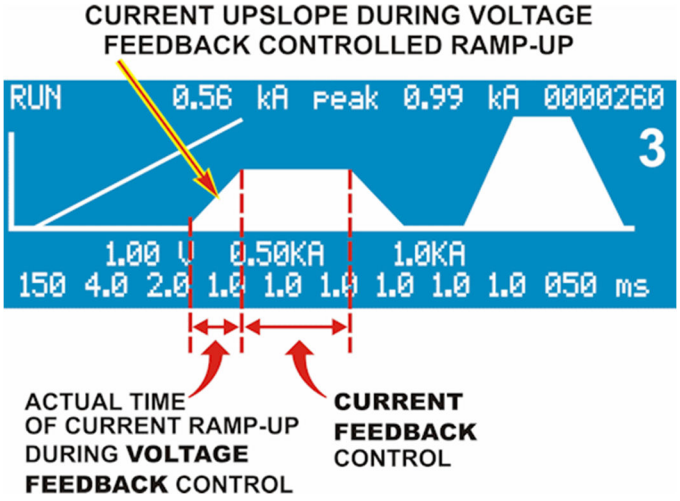
After a weld, the Power Supply will plot the actual current for Pulse 1 as a shaded region on the **RUN** screen. The Power Supply does ***not*** plot voltage during the Voltage Control portion of Pulse 1. Instead it plots the current while the voltage is being ramped up at a controlled rate.

For Pulse 2, the Power Supply will plot current if in **current feedback** mode, voltage if in **voltage feedback** mode or power if in **power feedback** mode.

The actual time of the voltage control portion of Pulse 1 will typically be less than the user set time, **Tv**, for the voltage ramp up time.

Since the Power Supply immediately switches to the **Current Feedback** Control portion of Pulse 1 as soon as the Current ramps up to the user set current level, the Power Supply positions the actual ramp up in current on the screen adjacent to the **Current Feedback** Control shaded region.

In the screen shown on the right, the actual time for the current to ramp up was 1.1 ms as compared to the user set maximum allowable time, **Tv**, of 4 ms.



Section IV: Weld Monitor

Introduction

The Power Supplies feedback sensors not only control weld energy output, but they can also be used to monitor each weld. The Power Supplies monitor features allow you to view graphic representations of welds, visually compare programmed welds to actual welds, look at peak or average energy values, set upper and lower limits for welds, and make use of these features:

- Active Part Conditioner (APC)
- Energy Limits
- Pre-Weld Check

Active Part Conditioner (APC)

Application

- Displace surface oxides and contamination.
- Reduce contact resistances before delivering the main weld energy.

Description

In the production environment, it is common to see large variations in:

- Oxide and contamination.
- Plating thickness and consistency.
- Shape and fit up.
- Contact resistances due to varying part fit up.

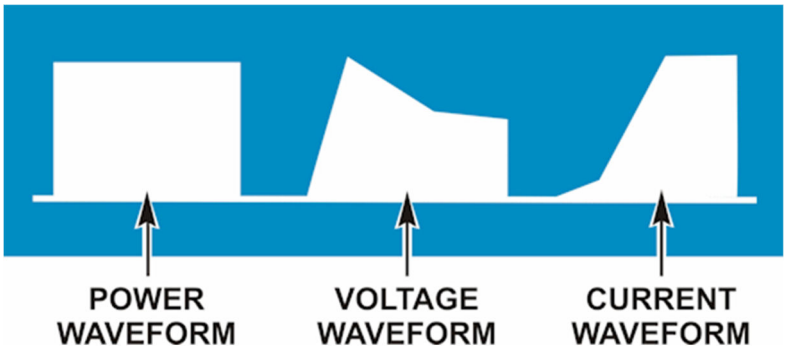
In order for a weld to occur, the surface oxides and contamination must be displaced to allow proper current flow through the parts. Levels of oxide and contamination vary from part to part over time, which can have an adverse effect on the consistency of the welding process. If production parts are plated, there can also be a plating process variation over time resulting in inconsistent welds. These minor material variations are a major cause of process instability, and it is best welding practice to seek to minimize their effect.

Active Part Conditioner is designed to cope with material contamination, material variation, and can be programmed to apply the exact power to the parts required to displace oxide or contaminants. In addition, the "Part Conditioner" pulse will terminate at a precise current flow preventing the sudden high flow, which occurs when the oxide is displaced. This prevents weld splash and material expulsion, which occurs as a result of an excessively fast heating rate. Part conditioning can help to reduce variations in contact resistance from part to part caused by different fit up of parts. It will stabilize the contact resistances before the main welding pulse, therefore reducing variation from weld to weld.

How It Works

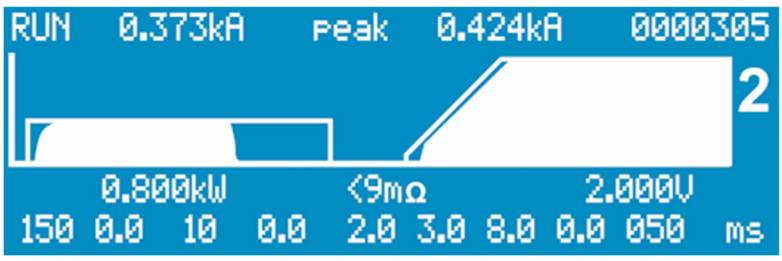
Both **constant current** feedback and **constant voltage** feedback modes are limited in their ability to deal with varying levels of part contamination and oxide. If **constant current** feedback were used, the power supply would ramp the voltage to very high levels in order to achieve current flow through the oxide. This rapid input of current is likely to cause splash, especially with round parts. **Constant voltage** mode is not ideal for this purpose either, as the voltage will be restricted from reaching sufficient levels to break down the oxide.

Constant power is ideal for this purpose. As the power supply tries to achieve constant power to the weld, it raises the voltage to high levels early in the output waveform, since current cannot flow due to the oxide. As the high voltage breaks down the oxide layer, more current flows to the weld and the voltage and resistance drop. It will achieve this in a controlled fashion to maintain constant power to the weld.



Constant Power Waveform with Corresponding Voltage and Current Waveforms

Active Part Conditioning uses a dual-pulse output. The first pulse is programmed for **constant power**, and the second for either **constant current, constant voltage**, or **constant power**. (**Constant voltage** is used if there is still a chance of weld splash). The purpose of a dual-pulse operation is to enable the first pulse to target displacement of oxides and good fit up, the second pulse achieves the weld.



Active Part Conditioning Waveform

The use of a current limit monitor for the first pulse enables the pulse to be terminated when a predetermined amount of current flow is achieved. The rise of the current waveform is proof positive that the oxide is breaking down and the parts are fitting up together, ready to weld. The first pulse, therefore, should be programmed to be much longer than generally required. The power supply will terminate the pulse based on the reading of current in the power supply's monitor.

Instructions

Instructions for programming for Active Part Conditioning are listed in *Chapter 4, Operating Instructions*.

Energy Limits

Applications

- Part-to-part positioning problems.
- Electrode-to-part positioning problems.
- Parts with narrow weld window.

Energy Limits can be used in two different ways:

- To detect work piece resistance changes that occur when parts are positioned incorrectly at the weld head. In this case, the energy limits will prevent blowouts, parts damage, and electrode damage. Limits can be set to terminate the weld if this occurs.
- To stop the weld when a sufficient **current**, **voltage**, or **power** level is reached. Using limits in this way ensures a more consistent input of energy, which produces consistently good welds.

Description

This function terminates the weld energy during the welding process if pre-set weld **current**, **voltage**, or **power** limits are exceeded. In addition to inhibiting the weld, the Power Supply has four programmable relay outputs which can be used to trigger alarms to signal operators of weld faults, or signal automation equipment to perform pre-programmed actions, such as stopping the production line so the faulty weld piece can be removed.

The monitor measures the weld energy parameters during the weld period and compares the measurements against the programmed limits. If any of the programmed limits are exceeded, the energy limits monitor sets the Power Supply to a state selected from the **OUT OF LIMITS ACTION** menu. In addition, the Power Supplies relays can be programmed to trigger alarms, or trigger an action in an automated welding system.

Note: When using the energy limits monitor, always select a monitor mode that is ***different*** from the feedback mode. For example:

- If you are welding in **constant current**, monitor **voltage**.
- If you are welding in **constant voltage**, monitor **current**.
- If you are welding in **constant power**, monitor **current** or **voltage**.

Example 1: Energy Limit Weld Termination

Example #1: In the profile above, the weld current is exceeding the selected upper limit before the end of the welding cycle. The spike in the current waveform indicates that parts were misplaced. In this case, the operator has selected the option to terminate the weld energy under this condition, so the energy limits monitor terminates the Pulse 1 weld and inhibits the Pulse 2 weld if it had been programmed.

Example 2: Sufficient Current Level

Example #2: In the profile above, the weld current limit is at a sufficient level to get a good weld.

Pre-Weld Check

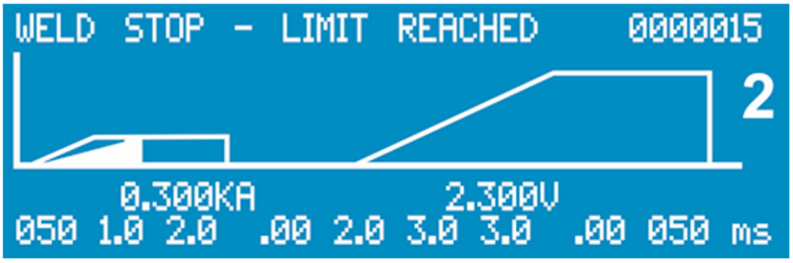
Application

- Detect Misaligned or Missing parts.

Function

This is used to see if parts are misaligned or missing ***before*** a welding pulse is delivered to the weld head. If a part is missing or misaligned, you do ***not*** want the machine to weld because the result would be an unacceptable weld and/or damaged electrodes.

Pre-Weld Check is similar to **Energy Limits**, however in this case Pulse 1 should be very **short** (1-2 milliseconds), and the current should be **low**, about 10% of the Pulse 2 current. Pulse 1 should be used as a measurement pulse and should ***not*** perform a weld.



Pre-Weld Check Waveform

Example: To detect misaligned parts, use constant current and set upper and lower voltage limits for Pulse 1. If parts are **misaligned**, the work piece resistance will be higher, so the voltage will be higher. If parts are **missing**, voltage will be lower. In either case, the Pulse 1 upper or lower limits will be exceeded, and Pulse 1 can be inhibited.

NOTE: You must have **upslope** programmed into the pulse in order to set a lower limit.
In addition to inhibiting the weld, the Power Supply has five programmable relay outputs which can be used to trigger alarms to signal operators of weld faults or signal automation equipment to perform pre-programmed actions, such as stopping the assembly line so the faulty weld piece can be removed.

CHAPTER 4
OPERATING INSTRUCTIONS

Section I: Introduction

This Chapter tells you how to turn the Power Supply on, use menu screens to customize operating parameters, match the Power Supply to your welding system, and how to operate the Power Supply. This chapter is divided into the following sections:

- Initial Setup
- Programming Weld Schedules
- Programming The Weld Monitor
- Programming For Active Part Conditioning
- Operation

Before operating the Power Supply, you must be familiar with the following:

- The **location** and **function** of Controls and Indicators. For more information, see *Chapter 1* of this manual.
- How to **select** and **use** the Power Supply functions for your specific welding applications. For more information, see *Chapter 3, Using Welding and Monitoring Functions*.

The principles of resistance welding and the use of programmed weld schedules. For more information, see *Appendix G, The Basics of Resistance Welding*. For additional information on the welding process, see *Appendix H, Quality Resistance Welding Solutions, Defining the Optimum Process*.

Section II: Initial Setup

Pre-Operational Checks

Always perform these checks ***before*** attempting to operate the Power Supply.

Connections

Verify that the Power Supply has been connected to a manual or air-actuated weld head as described in *Chapter 2* of this manual. Verify that the Emergency Stop Switch shorting wires are connected ***or*** verify that an Emergency Stop Switch is connected properly.

Power

Verify that power is connected as described in *Chapter 2* of this manual.

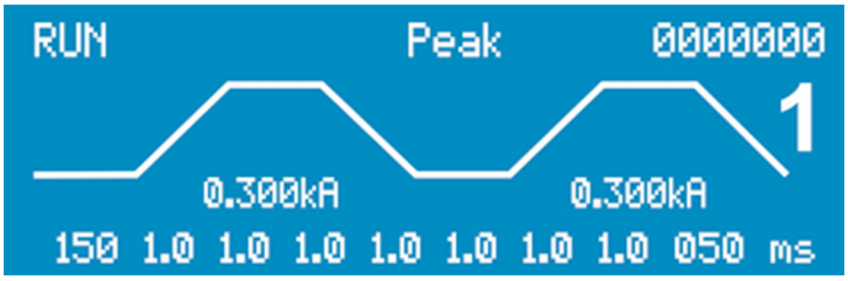
Compressed Air

If you are using an air-actuated weld head, verify that compressed air is connected as described in the appropriate sections of your weld head manual. Turn the compressed air ON**,** and adjust it according to the instructions in your weld head manual.

Initial Setup Instructions

1. Adjust the weld head force adjustment knob for a force appropriate for your welding application. A good starting point is the mid-point in the range of the weld head force.
2. Set the **WELD/NO WELD** switch on the Power Supply front panel to the **NO WELD** status. In this position, the Power Supply will operate the weld head ***without*** producing weld energy.

   NOTE: When you are ready to perform a weld, be sure to set the status back to the **WELD** status.
3. Turn the **ON/OFF** switch on the front panel of the Power Supply to the **ON** position. The default **RUN** screen will be displayed. You will use this screen to enter welding parameters.

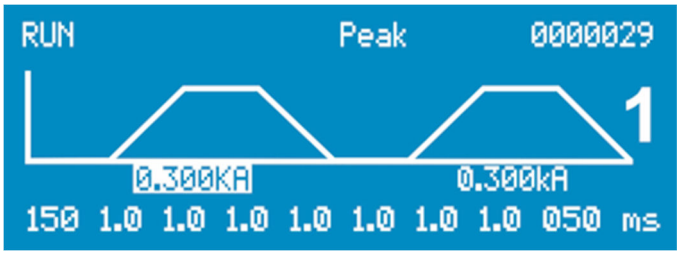


Default RUN Screen

Section III: Programming Weld Schedules

Introduction

The Power Supply comes with 99 factory-installed weld schedules, numbered from **01** through **99**. Each schedule is set to the same preset value and looks like the display on the right. See *Chapter 3, Using Welding And Monitoring Functions* for descriptions of the features available in weld schedules.



The process of **Programming** a weld schedule consists of:

- **Select** a weld schedule.
- **Enter** new values in the selected schedule.

NOTE: For reference and convenience, you might want to keep a written list of your programmed weld schedule values using the two-digit weld schedule number.

Select A Weld Schedule

1. To select weld schedules, first make sure that the **RUN** state is displayed on the LCD. If not, press the **RUN** button on the front of the Power Supply.
2. Press the **SCHEDULE** button on the right of the Power Supply.
3. Use ***either*** of the methods below to select a schedule:
   - Use the ▲▼ (Up/Down) buttons to scroll through the list.

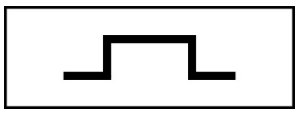
     OR
   - Use the numeric keypad to enter the two-digit number of the schedule you want.

Enter New Values

Some welding applications require no more than a simple weld schedule, programmed for Single-Pulse, Upslope/Downslope, or Dual-Pulse operation. For other applications, you may want to use the ***Energy Limits Monitor*** or ***Active Part Conditioning*** features of the Power Supply. To **enter new values**, follow the instructions for Single-Pulse, Upslope/Downslope, or Dual-Pulse weld schedules on the following pages.

NOTE: If the same energy parameters entered for Pulse 1 and Pulse 2, such as both Pulse 1 and Pulse 2 are both set to current feedback mode, the Power Supply can be set to 0 ms Cool Time. If different energy parameters are entered for Pulse 1 and Pulse 2, the Power Supply will require a minimum of 1.0 ms Cool Time. If a Cool Time is set lower than 1.0 ms, but not zero, the Power Supply will default to 1.0 ms Cool Time.

Single-Pulse Weld Schedule (For Current, Voltage, and Power Feedback Modes)



1. 

Press the **SCHEDULE** button, then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad.

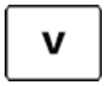
2. 
Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **999** ms. **NOTE**: We recommend 150 ms.

3. 
Press the **PULSE 1 UPSLOPE** button to enter the amount of time for the Weld Pulse 1 **upslope**. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter **0** ms.

4. 
Press the **PULSE 1 WELD** key to **highlight** the **middle line** of the LCD to enter **weld energy**. Use the numeric keypad to enter the **energy level** or use the ▲▼ arrows. The Power Supply output ranges are:
   - **Current:** from **0.200** → **4.000** kA for UB-4000A, **0.015** → **1.500** kA for UB-1500A or **5** → **500** amps for UB-500A.
   - **Voltage:** from **0.100** → **9.9** volts for all models
   - **Power:** from **0.100** → **25.00** kW for UB-4000A, **0.070** → **9.999** kW for UB-4000A or **0.050** – **4.99** kilowatts for UB-500A.

5. 
Press the **PULSE 1 WELD** key again to **highlight** the **bottom line** of the LCD to enter the weld time. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

6. Perform ***one*** of the following:
   - 

Press the **kA** key to program **current** as the feedback mode.
   - 

Press the **V** key to program **voltage** as the feedback mode.
   - 

Press the **kW** key to program **power** as the feedback mode.

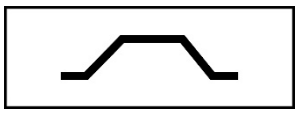
7.  Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the ▲▼ arrows. Enter **0** ms.

8.  Press the **COOL** key to enter the amount of time for the cool period after Pulse 1. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter **1.0** ms.

9. Program Pulse 2 by repeating Steps 3 through 7 above using the keys for Pulse 2, entering the value **0**.

10.  Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad or the ▲▼ arrows. Enter a time between **0** and **999** ms. We recommend at least **50** ms as weld strength is formed in the hold time.

Upslope / Downslope Weld Schedule (For Current, Voltage, and Power Feedback Modes)



1. 

Press the **SCHEDULE** button, then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad.

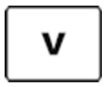
2. 
Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the ▲▼ arrows. We recommend 150 ms.

3. 
Press the **PULSE 1 UPSLOPE** button to enter the amount of time for the Weld Pulse 1 **upslope**. Use the numeric keypad or the ▲▼ arrows to enter the time. Enter a time between **0** and **99** ms. A good starting point is **5** ms.

4. 
Press the **PULSE 1 WELD** key to **highlight** the **middle line** of the LCD to enter **weld energy**. Use the numeric keypad to enter the **energy level** or use the ▲▼ arrows. The Power Supply output ranges are:
   - **Current:** from **0.200** → **4.000** kA for UB-4000A, **0.015** → **1.500** kA for UB-1500A or **5** → **500** amps for UB500A.
   - **Voltage:** from **0.100** → **9.9** volts for all models
   - **Power:** from **0.100** → **25.00** kW for UB-4000A, **0.070** → **9.999** kW for UB-4000A or **0.050** – **4.99** kilowatts for UB-500A.

5. 
Press the **PULSE 1 WELD** key to again **highlight** the **bottom line** of the LCD to enter the weld time. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

6. Perform ***one*** of the following:
   - 

Press the **kA** key to program **current** as the feedback mode.
   - 

Press the **V** key to program **voltage** as the feedback mode.
   - 

Press the **kW** key to program **power** as the feedback mode.

7.  Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the ▲▼ arrows to enter the time. Enter a time between **0** and **99** ms. A good starting point is **5** ms.

8.  Press the **COOL** key to enter the amount of time for the cool period after Pulse 1. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter **1.0** ms.

9. Program Pulse 2 by repeating Steps 3 through 7 above using the keys for Pulse 2, entering the value **0**.

10.  Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad or the ▲▼ arrows. Enter a time between **0** and **999** ms. We recommend at least **50** ms as weld strength is formed in the hold time.

Dual-Pulse Weld Schedule (For Current, Voltage, and Power Feedback Modes)

1. 

Press the **SCHEDULE** button, then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad.

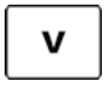
2. 
Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the ▲▼ arrows. We recommend 150 ms.

3. 
Press the **PULSE 1 UPSLOPE** button to enter the amount of time for the Weld Pulse 1 **upslope**. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **19** ms.

4. 
Press the **PULSE 1 WELD** key to **highlight** the **middle line** of the LCD to enter **weld energy**. Use the numeric keypad to enter the **energy level** or use the ▲▼ arrows. The Power Supply output ranges are:
   - **Current:** from **0.200** → **4.000** kA for UB-4000A, **0.015** → **1.500** kA for UB-1500A or **5** → **500** amps for UB-500A.
   - **Voltage:** from **0.100** → **9.9** volts for all models
   - **Power:** from **0.100** → **25.00** kW for UB-4000A, **0.070** → **9.999** kW for UB-4000A or **0.050** – **4.99** kilowatts for UB-500A.

5. 
Press the **PULSE 1 WELD** key again to **highlight** the **bottom line** of the LCD to enter the weld time. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

6. Perform ***one*** of the following to program the Pulse 1 feedback mode:
   - 

Press the **kA** key to program **current** as the feedback mode.
   - 

Press the **V** key to program **voltage** as the feedback mode.
   - 

Press the **kW** key to program **power** as the feedback mode.

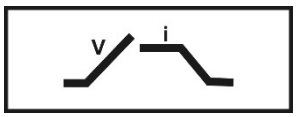
7. 
Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

8.  Press the **COOL** key to enter the amount of time between Pulse 1 and Pulse 2. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms. We recommend at least 2 ms.

9. Program Pulse 2 by repeating Steps 3 through 7 above using the keys for Pulse 2, entering appropriate values for Pulse 2.

10.  Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **999** ms. We recommend at least **50** ms.

Combo Mode (V-A) Single-Pulse and Dual-Pulse Weld Schedules: Combo (V-A) Feedback Mode



NOTE: Refer also to the description of Combo Mode in *Section III of Chapter 3, Using Welding and Monitoring Functions.*

1. 

Press the **SCHEDULE** button, then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad.

2. 

Press the **COMBO** button, to select Combo mode (V-A). The screen will look like this:

3. 
Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **999** ms. **NOTE**: We recommend 150 ms.

4. 
Press the **PULSE 1 UPSLOPE** button to enter the voltage rise time (Tv) for the Weld Pulse 1. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

5. 
Press the **PULSE 1 WELD** key to **highlight** the Current Setpoint (I) on the **middle line** of the LCD. Use the numeric keypad to enter the **current level** or use the ▲▼ arrows. The Power Supply output range is:

- **Current:** from **0.200** → **4.000** kilo amps. (UB-4000A)

6. 
Press the **PULSE 1 WELD** key again to **highlight** the Voltage Setpoint (V) on the **middle line** of the LCD to enter the weld time. Use the numeric keypad to enter the **voltage level** or use the ▲▼ arrows. The Power Supply output range is:

- **Voltage:** from **0.100** → **9.9** volts.

7. 
Press the **PULSE 1 WELD** key again to **highlight** the **bottom line** of the LCD to enter the current weld time (Tc). Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter a time between **0** and **99** ms.

8.  Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the ▲▼ arrows. Enter **0** ms.

9.  Press the **COOL** key to enter the amount of time for the cool period after Pulse 1. Use the numeric keypad to enter the time or use the ▲▼ arrows. Enter **1.0** ms.

10. If your application requires a second pulse, program Pulse 2 by following Steps 3 through 7 of the previous Single-Weld Pulse Schedule for Current, Voltage or Power Feedback Modes using the keys for Pulse 2, entering appropriate values for Pulse 2

11.  Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad or the ▲▼ arrows. Enter a time between **0** and **999** ms. We recommend at least **50** ms as weld strength is formed in the hold time.

Section IV: Programming the Weld Monitor

1. SCHEDULE — Press the **SCHEDULE** button, then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad. Fire the welder and view the output waveform (shaded graph) on the display.

2. MONITOR — Press the **MONITOR** key to access the **MONITOR** screen.

3. Perform a weld and view the trace of the weld parameter, use the kA V kW *or* MONITOR key to view the desired waveform.

4. Toggle the Pulse 1 weld time/energy selector key to select the **upper** limit field for the weld period. Use the numeric keypad or the ▲▼ arrows to enter the **upper limit** value for the Pulse 1 weld period. The Power Supply can monitor:
   - **Current:** from **0.200** → **4.000** kA for UB-4000A, **0.05** → **1.500** kA for UB-1500A, or **5** → **500** amps for UB-500A.
   - **Voltage:** from **0.100** → **9.9** volts for all models
   - **Power:** from **0.100** → **25.00** kW for UB-4000A, **0.070** → **9.999** kW for UB-4000A or **0.050** – **4.99** kilowatts for UB-500A.

5. Perform ***one*** of the following to program the Pulse 1 monitor limit mode:
   - kA — Press the **kA** key to program **current** as the limit mode.
   - V — Press the **V** key to program **voltage** as the limit mode.
   - kW — Press the **kW** key to program **power** as the limit mode.

6. Toggle the Pulse 1 weld time/energy selector key to select the **lower limit** field for the weld period. Enter the lower limit value for the Pulse 1 weld period.

   NOTE: In order for a Pulse 1 **lower limit** to be programmed, you must ***first*** program a Pulse 1 upslope in the weld schedule.

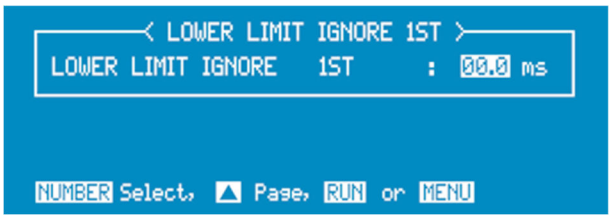
   The lower limit mode (current, voltage, or power) will automatically be the same as the upper limit mode programmed in Step 5.

7. From the **MONITOR** screen, press the **Pulse 1 UP** weld period key. This will bring up the **PULSE 1 MONITOR LIMITS** screen. This feature allows you to modify the time that the limits are active during Pulse 1. When this feature is not being used, the Upper Limit is active during the entire upslope, weld and downslope periods. If the measured output value is greater than the limit at any point during those three periods, an alarm will occur. This is equivalent to checking the peak value during those three periods.

   The Lower Limit is active during the weld period only. If the measured output is less than the limit during the weld period, an alarm will occur. It does not use an average value; it looks at every point during the weld period.

8. Use the numeric keypad to select **1, 2, 3,** or **4**:

9. Use the numeric keypad or ▲▼ arrow keys to enter the time, in milliseconds, that the limit will ignore. Press **MONITOR** to return to the **PULSE 1 MONITOR LIMITS** screen.

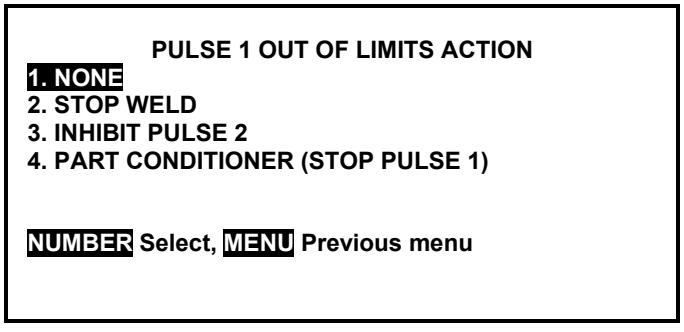


   NOTE: The Upper and Lower limits must be a minimum of 0.5 milliseconds in length. The Power Supply will automatically adjust the **IGNORE 1ST** or **IGNORE LAST** time as appropriate if too much time is entered.

10. Use the numeric keypad to make another choice or press the **MONITOR** key to view the **MONITOR** screen. The dashed lines on the monitor screen will reflect the changes you made to the limits.

11. Press the **COOL** weld period key. This will bring up the **PULSE 1 OUT OF LIMITS ACTION** screen. This screen allows you to select the action that the Power Supply will take if the Pulse 1 upper or lower limits are exceeded.

    You have **four** choices:



- **NONE** takes no action if upper or lower energy limits are exceeded.
- **STOP WELD** stops the weld immediately during Pulse 1, and prevents Pulse 2 from firing (if applicable).
- **INHIBIT PULSE 2** stops the weld at the end of Pulse 1, and prevents Pulse 2 from firing. This function will not operate if both pulses are joined ***without*** a cool time.
- **PART CONDITIONER (STOP PULSE 1)** stops Pulse 1 immediately after upper limit is exceeded, but allows Pulse 2 to fire. This function will not operate if both pulses are joined ***without*** a cool time.

  NOTES:

  - Power Supply will not allow you to enter a lower limit.
  - See "Active Part Conditioner" in *Chapter 3.*

12. After making your selection the display will automatically return to the monitor screen.

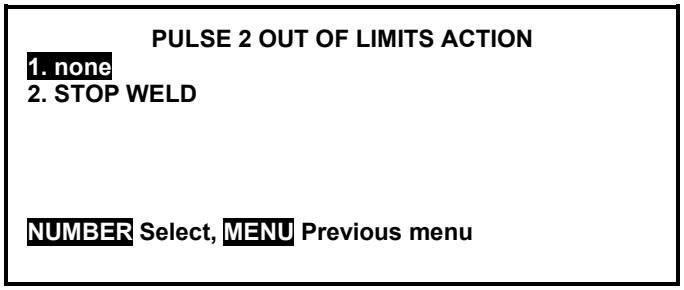
13. Program the upper and lower limits for Pulse 2 by repeating Steps 4 through 7 above using the keys for Pulse 2, entering appropriate values for Pulse 2.

    NOTE: The monitor limit mode (current, voltage, or power) for Pulse 2 can be different than the monitor limit mode for Pulse 1.

14. 

    Press the **HOLD** period key. This will bring up the **PULSE 2 OUT OF LIMITS ACTION** screen.

    This screen allows you to select the action that the Power Supply will take if the Pulse 2 upper or lower limits are exceeded. You have **two** choices:

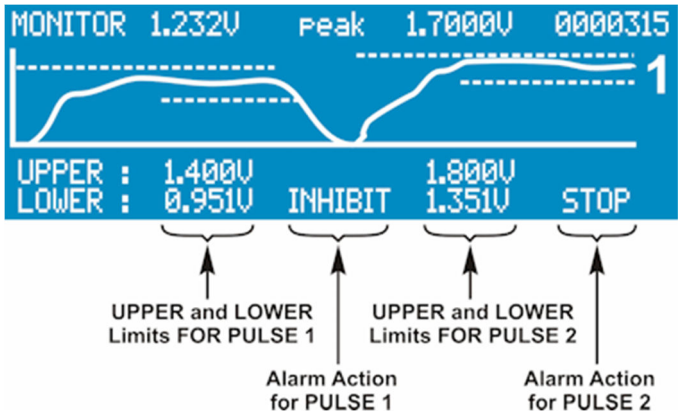


- **NONE** takes no action if upper or lower energy limits are exceeded.
- **STOP WELD** stops **PULSE 2** immediately after upper or lower energy limits are exceeded.

15. After you have made your selection, the display will automatically return to the **MONITOR** screen.

NOTE: The Power Supply adds dotted lines to the appropriate graph to show the ***programmed limits***.

The screen on the right shows how the **Limits** and **Alarm** actions appear when an actual weld trace is displayed on the LCD.



NOTE: All lower limits apply only to the Pulse 1 and Pulse 2 **WELD** periods. Lower limits do ***not*** cover any upslope or downslope periods. All upper limits apply to the entire Pulse 1 and Pulse 2 periods, including their upslope and downslope periods.

Section V: Programming For Active Part Conditioning

Before you program for Active Part Conditioning, make sure you are familiar with these procedures described in this manual:

- *Chapter 3, Using Welding And Monitoring Functions*
- *Chapter 4, Section III, Programming Weld Schedules*
- *Chapter 4, Section IV, Programming The Weld Monitor*

1. SCHEDULE — Press the **SCHEDULE** button, and then select a Weld Schedule using **either** the ▲▼ arrows **or** the numeric keypad.

2. Program a single pulse for **Constant Power** operation. Program the power level and weld time to cause slight sticking between the two parts. Make a few welds and pull them apart. Increase or decrease the power setting until a light tack weld is achieved.

3. MONITOR — Push the **MONITOR** button to monitor the waveforms for **voltage**, **resistance**, **current**, and **power**.

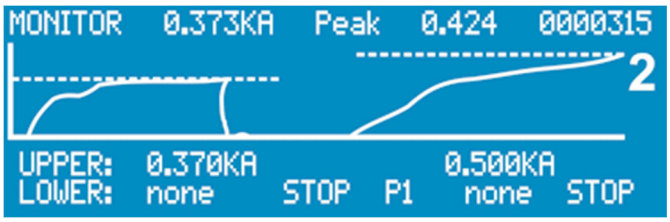
4. V — Push the voltage **V** key and observe the high peak of the voltage waveform.

5. Ω — Push the **Ω MONITOR** (resistance) key and observe the resistance waveform. This should appear to begin high, then start to drop as a tack weld is made and oxides are removed.

6. kA — Push the current **kA** (current) key and observe the current waveform starting to rise as the oxidization breaks down. If the current waveform starts to flatten, this is an indication that the resistance has stabilized and the parts have come into closer contact.

7. RUN — Push **RUN** and optimize the energy and time setting of Pulse 1 (constant power) to provide an adequate tack weld and also a current waveform (view in the monitor screen) that has started to flatten out, but is still rising. This indicates that a full melt has not yet occurred.

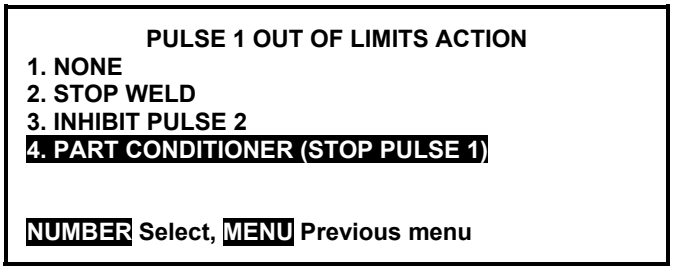
8. MONITOR — Push the **MONITOR** button to switch to **MONITOR** mode. Program an upper current limit on the **MONITOR** screen.



NOTE: You can toggle between peak and average readings by pressing the **PEAK/AVERAGE** button.

9. 

Press the **COOL** weld period key. This will bring up the **PULSE 1 OUT OF LIMITS ACTION** screen.



10. Select **4. APC: STOP PULSE 1/ALLOW PULSE 2.**

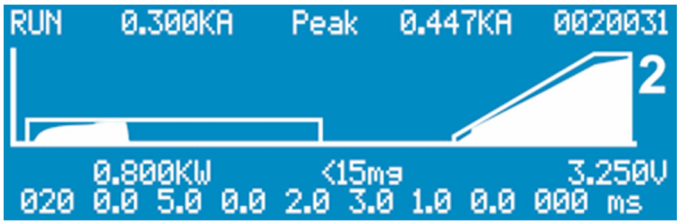
NOTE: For details, see "Active Part Conditioner" in *Chapter 3.*

11. 

Since different levels of oxide require different amounts of time to reach the current limit, return to the **RUN** screen and extend the programmed weld time (usually double the time works). This will ensure that there will be enough time for the current to rise and reach the limit, even with heavily oxidized parts.

12. Try welds with varying amounts of oxide present (clean and dirty). The power supply terminates the first pulse when your programmed current is reached. A clean part will reach the current limit sooner and the pulse will terminate early. A dirty part will require more time before the oxide is broken down and current can flow.

13. Program your second welding pulse as normal to achieve a strong weld. Constant voltage is recommended for round parts and constant current for flat parts. An upslope may be required to restrict the current flow early in the second pulse and avoid weld splash.



Section VI: Operation

General Operator Safety

WARNING

ALWAYS wear safety goggles and other appropriate safety equipment when you are **performing a welding operation**.

Manual Welding

Operation

1. Verify that all components of your welding system have been properly connected and turned ON.
2. Verify that all welding components are operating properly and ready for use.
3. Verify that you have programmed the Power Supply with all necessary schedules for your welding application.
4. Set the **WELD/NO WELD** switch on the front panel to the **WELD** position.
5. Select the desired weld schedule and begin welding using normal operating procedures.

Normal STOP

When finished welding, turn the Power Supply OFF.

Automated Welding

Operation

1. Verify that all components of your welding system have been properly connected and turned ON.
2. Verify that all welding components are operating properly and ready for use.
3. Verify that you have programmed the Power Supply with all necessary schedules for your welding application.
4. Verify that the Automation and Communication software has been properly programmed.
5. Perform all software Test and Setup procedures to verify that the PLC is communicating properly with the Power Supply.
6. Set the **WELD/NO WELD** switch on the front panel to the **WELD** position.
7. Begin welding using normal automation operating procedures.

Normal STOP

1. When finished welding, follow the **Turn Off/Power Down** procedures established for your automated welding system.
2. Turn the Power Supply OFF **-- *unless*** the procedures for your automated welding system require leaving it ON.

EMERGENCY STOP

NOTE: Connections for an external Emergency Stop Switch are described in Appendix B.

1. Push the Operator Emergency Stop Switch any time necessary to prevent injury to personnel or damage to weld pieces or the welding system.
2. Clear the condition that caused the operator to hit the Operator Emergency Stop Switch.

Re-Set After EMERGENCY STOP

1. Clear the condition that caused the **EMERGENCY STOP** condition (whether initiated by an Operator or by a programmed action from the PLC).
2. Inspect the electrodes, weld head, and weld cables to make sure there are no shorts or damage that could prevent normal welding.
3. Inspect the production area to verify it is ready to continue welding.
4. Press the **RUN** key on the front of the Power Supply to clear the Emergency Stop message and verify the desired weld schedule is displayed on the LCD.
5. Continue to weld following normal automation procedures.

CHAPTER 5
SOFTWARE SETUP

Section I: Introduction

Overview

The Power Supply contains internal software that gives you a great deal of flexibility in the setup and use of your welding system. The Power Supply software displays various menu screens on the LCD display, each containing prompts telling you which of the Power Supplies front panel controls to use in order to customize operating parameters, set the Power Supply for use in an automated welding system, and program communication settings for use with data-gathering devices such as a host computer.

This chapter is divided into the following sections:

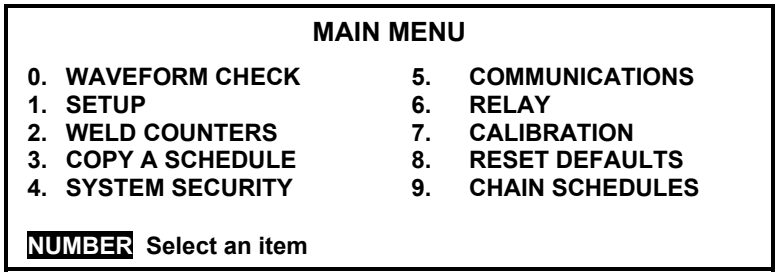
How to Use Menu Screens	• Main Menu	• Setup Menus
System Settings & Operator Preferences	• Footswitch Weld Abort • End Of Cycle Buzzer • Buzzer On Weld Stop • Update Graph After Weld • All Screen Updates	• Display Contrast • Buzzer Loudness • Switch Debounce Time • Firing Switch • Save System
Functions	• Waveform Check • Weld Counters • Copy A Schedule • System Security	• Calibration • Reset Defaults • Chain Schedules
Communication and Data	• Requirements • Communication	• I.D. Number • Baud Rate
Relay Settings	• Function	• Programming Instructions

Before programming the Power Supply, you must be familiar with the **location** and **function** of the display and front panel controls. If you need more information, see *Chapter 1* of this manual.

Section II: How to Use Menu Screens

Main Menu

All of the Power Supplies programming functions are accessed through the **MAIN MENU**. To go to the **MAIN MENU**, press the **MENU** key on the front of the Power Supply. Each menu screen lists several choices, with some offering additional screens (sub-menus) listing more choices.



Always look at the prompt at the bottom of each menu screen. These prompts vary from screen to screen, and they all tell you what action to take, how to go to the next menu screen (if applicable), and how to return to the **MAIN MENU**. Some prompts display **NUMBER**, which means that you should use the numeric keypad to enter the number of a desired function listed on the menu. Some prompts display **▲▼** which means that you should use the UP or DOWN keys on the front panel to take the next action. Other prompts may **highlight** a specific key, which means you should press the key indicated to take the next action.

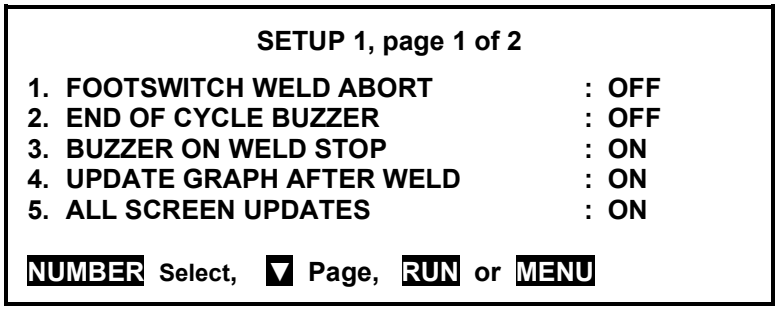
When using menu screens, you can return to the **RUN** screen at any time simply by pushing the **RUN** button on the front panel.

Setup Menus

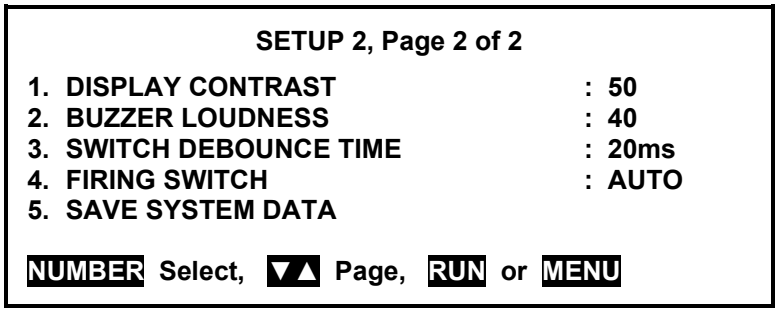
SETUP menus are accessed in sequence: **MAIN MENU → SETUP 1 → SETUP 2**.

1. From the **MAIN MENU**, press **1** to go to the **SETUP 1** menu.
2. To go to the **SETUP 2** menu, press the ▼ (down) key.

   NOTE: The **SETUP 2** menu is ***only*** available through the **SETUP 1** menu.



3. To scroll back to the **SETUP 1** menu, press the ▲ (UP) key.
4. When you have finished programming the desired functions, press the **MENU** key on the front panel to return to the **MAIN MENU**.



Section III: System Settings and Operator Preferences

Footswitch Weld Abort

1. Go to the **SETUP 1** screen.
2. Press the **1** key to toggle between **FOOTSWITCH WELD ABORT ON** and **FOOTSWITCH WELD ABORT OFF**.

STATE	PREFERRED APPLICATION	FUNCTION
ON	**Human operated welding** stations where the operator holds parts.	Allows you to abort the weld process by releasing the foot switch used with an air-actuated weld head. Will also terminate the welding sequence ***if*** the footswitch is **opened** before the firing switch is initiated.
OFF	**Computer or PLC controlled welding** stations. Also, for human operated stations where tooling holds the parts, and where the welding sequence can be initiated with a single momentary start pulse.	Once the footswitch (second level of a two level footswitch) and firing switches have both been **closed**, the welding sequence will continue to its conclusion regardless of footswitch or firing switch position.

3. Keep pressing the **MENU** key on the front panel to return to the **MAIN MENU**.

End Of Cycle Buzzer

1. Go to the **SETUP 1** menu.
2. Press the **2** key to toggle the end of cycle buzzer **ON** or **OFF**.

   NOTE: This function is normally used with manually actuated weld heads. **ON** means that an audible signal will be given at the end of each weld process to signal the operator to release the foot pedal.

SETUP 1, page 1 of 2

1. FOOTSWITCH WELD ABORT : OFF
2. END OF CYCLE BUZZER : OFF
3. BUZZER ON WELD STOP : ON
4. UPDATE GRAPH AFTER WELD : ON
5. ALL SCREEN UPDATES : ON

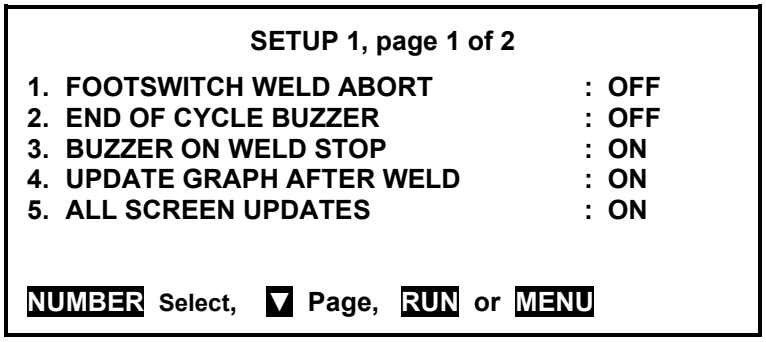
NUMBER Select, ▼ Page, RUN or MENU

3. Press the **MENU** key to return to the **MAIN MENU**.

Buzzer On Weld Stop

This function ***only*** applies to weld schedules that have **STOP ON PULSE 1** ***or*** **STOP ON PULSE 2** programmed in the monitor (refer *to Chapter 4, Section IV, Programming the Weld Monitor*). **ON** means that an audible signal will be given when a limit is reached.

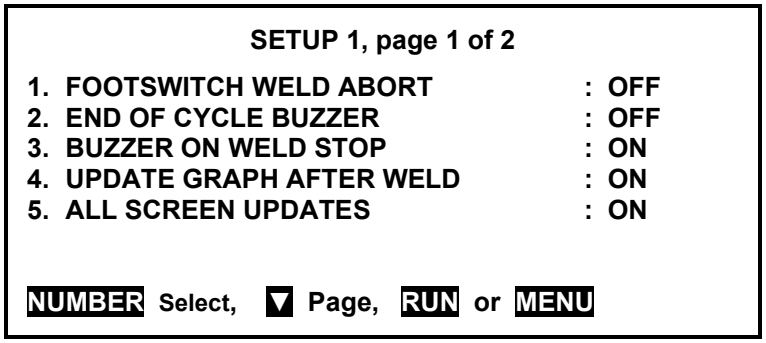
1. Go to the **SETUP 1** menu.
2. Press the **3** key to toggle the buzzer function **ON** or **OFF**.
3. Press the **MENU** key on the front panel to return to the **MAIN MENU**.



Update Graph After Weld

1. Go to the **SETUP 1** menu.
2. Press the **4** key to toggle the update function **ON** or **OFF**.

   NOTE: **ON** means that the actual weld energy profile (shaded graph) will overlay the programmed weld profile (line graph) on the display after each weld is made.

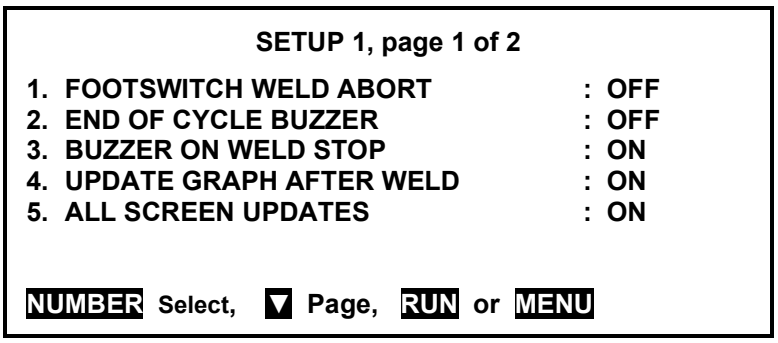


   The weld graph is useful for detecting a faulty weld, which will be indicated by the shaded graph not filling completely. **OFF** gives you the fastest operating time for automated welding because the control processor does ***not*** have to redraw the screen.

3. Pressing the **MENU** key on the front panel to return to the **MAIN MENU**.

All Screen Updates

1. Go to the **SETUP 1** menu.



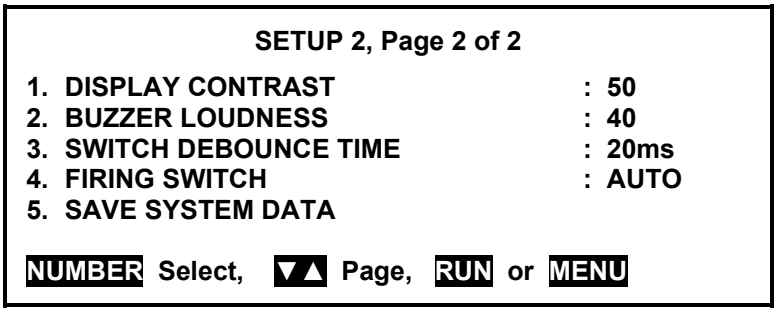
2. Press the **5** key to toggle the update function **ON** or **OFF**.

   NOTE: **ON** means that the Numeric figures for the monitored Peak or Average Value and the number of welds are updated on the **RUN** screen after each weld. **OFF** gives you the fastest operating time for automated welding because the control processor does ***not*** have to write numeric values to the screen.

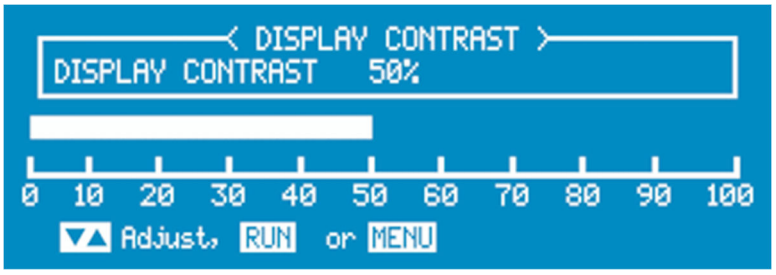
3. Pressing the **MENU** key on the front panel to return to the **MAIN MENU**.

Display Contrast

1. Go to the **SETUP 2** menu.



2. Press the **1** key to access the **DISPLAY CONTRAST** adjustment screen.

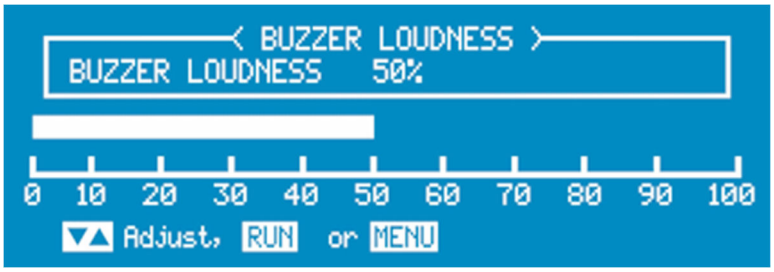


3. Use the ▲▼ keys to adjust the screen contrast for comfortable viewing for your ambient lighting conditions.

4. Press the **MENU** key to return to the **MAIN MENU.**

Buzzer Loudness

1. Go to the **SETUP 2** menu.
2. Press the **2** key to access the **BUZZER LOUDNESS** adjustment screen.
3. Use the up ▲ and ▼ keys to adjust the buzzer tone so that it is set at your desired level.



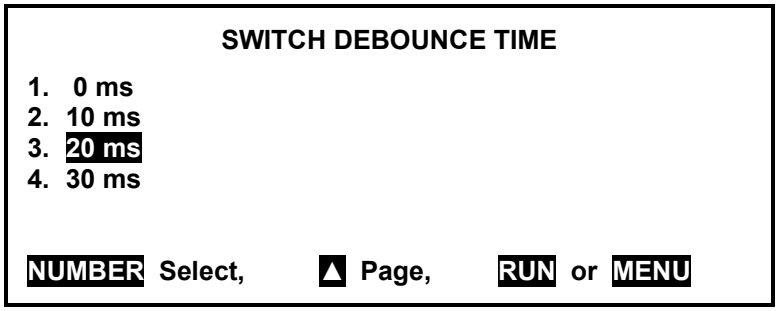
4. Press the **MENU** key to return to the **MAIN MENU.**

Switch Debounce Time

The contacts of mechanical firing switches "bounce" when they close. The switch debounce time function allows you to specify that the initiation switch contacts must remain closed for 10, 20, or 30 ms before the weld period can be initiated, thereby avoiding false starts caused by the switch contact bouncing. In addition to the debounce time, there is a delay of no greater than 5 - 7 ms before the start signal is recognized by the Power Supply.

NOTE: The factory default debounce time is 10 ms.

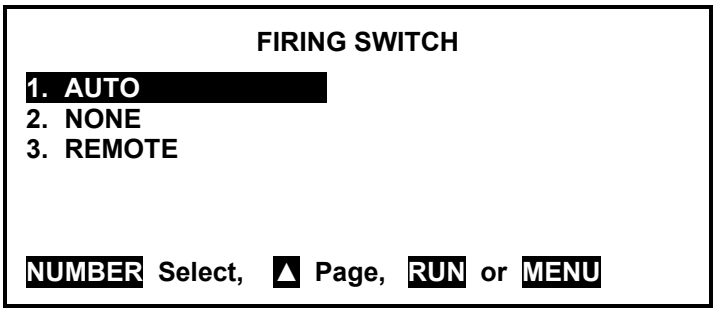
1. Go to the **SETUP 2** screen.
2. Press the **3** key to access the **SWITCH DEBOUNCE TIME** menu.



3. Select the required debounce time by pressing the **1**, **2**, **3**, or **4** key. The display will automatically return to the **SETUP 2** screen and the **SWITCH DEBOUNCE TIME** line will now reflect your time selection.
4. If you wish to exit the screen, press the **MENU** key to return to the **MAIN MENU.**

Firing Switch

1. Go to the **SETUP 2** screen.
2. Press the **4** key to get the **FIRING SWITCH** menu.
3. Press the **1, 2,** or **3** key to select switch type. The display will automatically return to the **SETUP 1** menu with your selection highlighted.



NOTES:

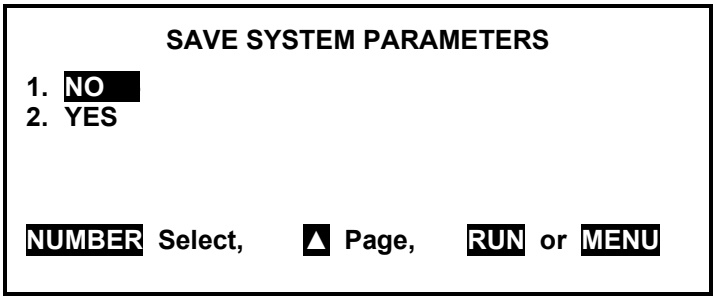
- **AUTO** accepts a single pole, double pole, or optical firing switch input, typically from an AMADA WELD TECH weld head. Firing switch activation indicates that the weld head has reached the set weld force and is ready for the weld energy sequence (including squeeze time) to start.
- **NONE** is used when welding with a non force-fired weld head. With **NONE** selected, a footswitch closure activates the 24 VAC Air Valve Driver and initiates the weld energy sequence (including squeeze time). Sufficient squeeze time must be programmed in the weld schedule to allow the weld head to close and the weld force to stabilize before the weld current starts.

  In addition to the debounce time, there is a delay of no greater than 2.5 ms before the start signal is recognized by the Power Supply.
- **REMOTE** can be used in automated applications or when using a PLC to control the weld head. The weld energy sequence is initiated via the Remote Schedule Select input lines, which also select the weld schedule number. (Refer to *Appendix B, Electrical and Data Connectors*, for I/O connector pin connections and specifications.)

Save System

When you change **SCHEDULE** or **System** settings, the Power Supply saves the changes to non-volatile memory periodically after you have finished entering changes. If you turn the Power Supply OFF immediately after making a change, changes may ***not*** be saved to non-volatile memory and will be lost. After making a change, wait 60 seconds before turning the Power Supply OFF to allow it to automatically save. If you want to turn the Power Supply OFF immediately after making a change, use the **SAVE SYSTEM** command.

1. Go to the **SETUP 2** screen.
2. Press the **3** key to access the **SAVE SYSTEM PARAMETERS** menu.
3. Press the **2** key to save all System Parameters. Press the **1** key if you wish to exit this screen without saving.



4. Press the **MENU** key to return to the **MAIN MENU.**

Section IV: Functions

Waveform Check

The **WAVEFORM CHECK** screen is used to access the **WELD FIRE LOCKOUT** and **ENERGY CAPACITY LIMIT** features. The **WELD FIRE LOCKOUT** feature guarantees that the capacitor bank is charged to a user defined percentage before the Power Supply is allowed to fire. This advanced feature prevents poor welds caused by operating at too high of a repetition rate, which can deplete the capacitor bank charge.

The **ENERGY CAPACITY LIMIT** feature confirms if a user defined percentage of the capacitor bank charge remains at the end of a weld. If the actual charge goes below the user set percentage, the Power Supply triggers an error message.

These feature is totally independent of Weld Monitor features described in *Chapter 3* of this manual.

Waveform Check ON/OFF

1. From the **MAIN MENU**, press **0** to get to the **WAVEFORM CHECK** menu.

```
                    MAIN MENU
0. WAVEFORM CHECK          5. COMMUNICATIONS
1. SETUP                   6. RELAY
2. WELD COUNTERS           7. CALIBRATION
3. COPY A SCHEDULE         8. RESET DEFAULTS
4. SYSTEM SECURITY         9. CHAIN SCHEDULES

NUMBER Select an item
```

2. From the **WAVEFORM CHECK** menu, press the **1** key to toggle the Weld Fire Lockout function **ON** or **OFF**.

   On Line 2, the actual % charge will be displayed to the right of the set point.

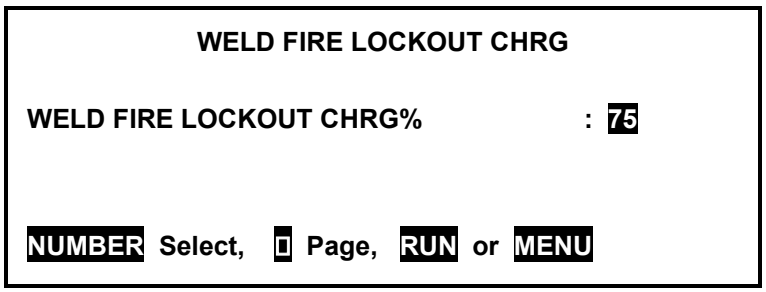
```
                  WAVEFORM CHECK
1. WELD FIRE LOCKOUT          : OFF
2. WELD FIRE LOCKOUT CHRG%    : 75     0
3. ENERGY CAPACITY % LIMIT    : 10     0 / 0


NUMBER Select,   MENU Previous menu
```

   On Line 3, the actual energy capacity % for Pulse 1 and Pulse 2 will be displayed to the right of the set point.

Weld Fire Lockout Charge % Setting

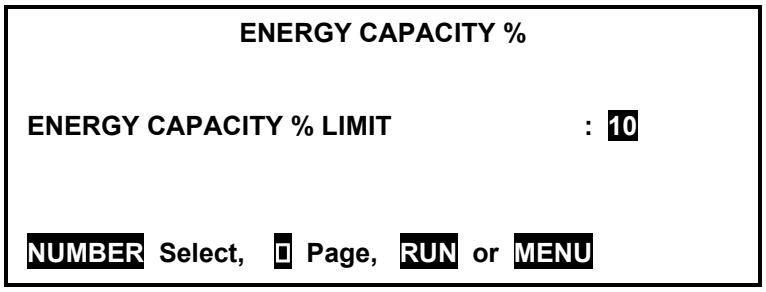
1. From the **WAVEFORM CHECK** menu, press the **2** key to access the **WELD FIRE LOCKOUT CHRG** setting screen.
2. Use the numeric keypad to enter the required amount of energy in the capacitor bank before the next weld is allowed. The settable range is 70 % → 90 %.



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

Energy Capacity Limits

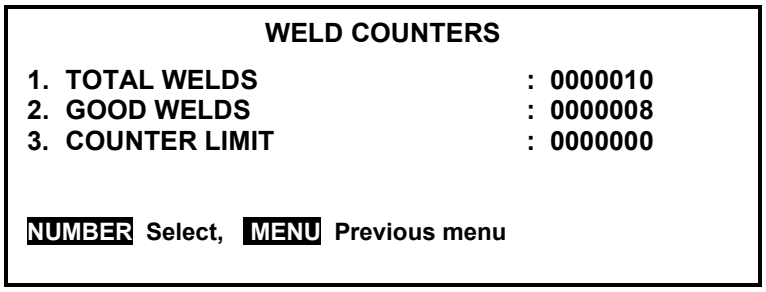
1. From the **WAVEFORM CHECK** menu, press the **3** key to access the **ENERGY CAPACITY LIMITS** setting screen.
2. Use the numeric keypad to enter the minimum amount of energy in the capacitor bank that should be allowed after a weld. The settable range is 0 % → 50 %.



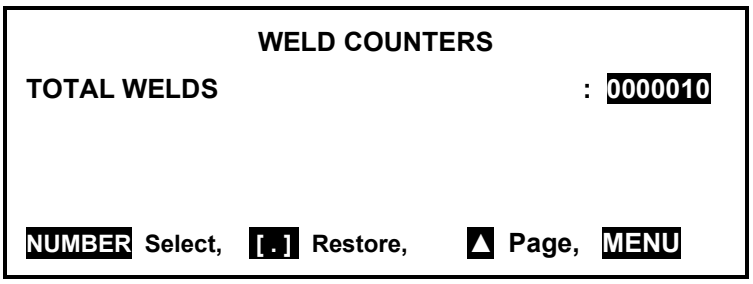
3. Press **MENU** to return to the **MAIN MENU**.

Weld Counters

1. From the **MAIN MENU**, press the **2** key. This will bring up the **WELD COUNTERS** screen. Use steps 2 through 5 below to reset each counter.
2. Press the **1** or **2** key to select the desired weld counter.



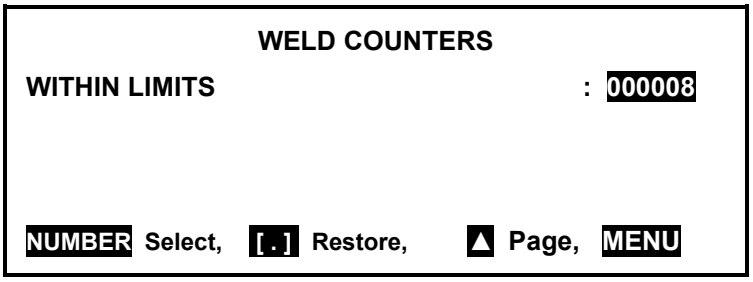
NOTE: The example to the right shows the **TOTAL WELDS** screen.



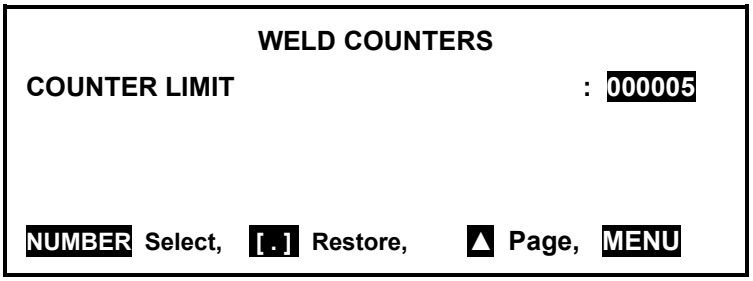
3. To reset the counter, press 0 on the numeric keypad. To input a preset number, use the numeric keypad. Press the ▲ key to save and return to the **Weld Counter** screen or press **MENU** to save and return to the return to the **MENU** screen.

NOTE: If you accidentally enter a wrong number, press the . (period/decimal point) key. The original count will reappear.

4. Press the ▲ key to return to the **WELD COUNTERS** screen.

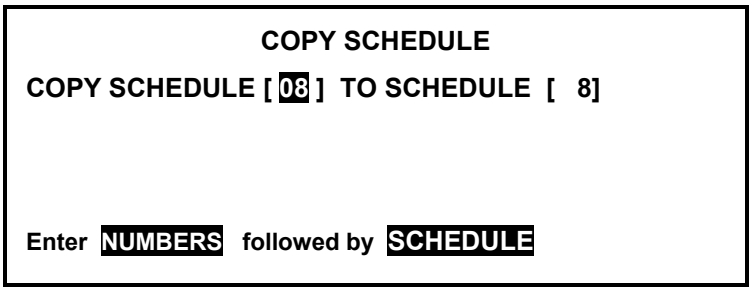


5. When all counters have been reset, press the **MENU** key to return to the **MAIN MENU**.



Copy A Schedule

1. From the **MAIN MENU**, press the **3** key to get to the **COPY SCHEDULE** screen.



NOTE: There are two fields in the **COPY SCHEDULE** screen. These fields determine which schedule will be copied (**source**) and which schedule will be overwritten (**destination**). The number of the schedule most recently displayed initially appears in the **source** schedule and the next consecutive schedule appears in the **destination** schedule.

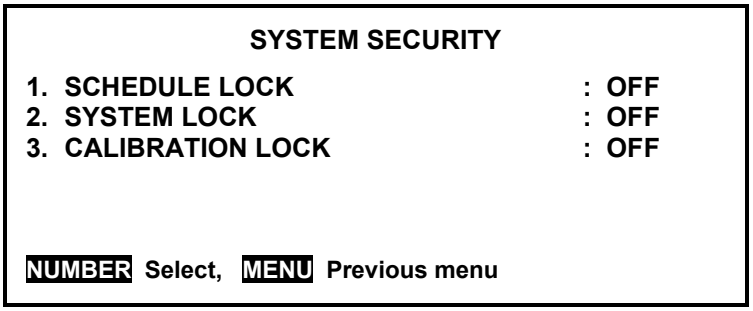
2. Use the numeric keypad to enter the number of the **source** schedule.

3. Press the schedule key to select the **destination** schedule number field.
4. Use the numeric keypad to enter the number of the **destination** schedule.
5. Press the schedule key. The contents of the source schedule will be copied to the destination schedule, overwriting the previous contents of the destination schedule.

   NOTE: All monitor settings and limits are also copied.

System Security

1. From the **MAIN MENU**, press the **4** key to get the **SYSTEM SECURITY** screen.

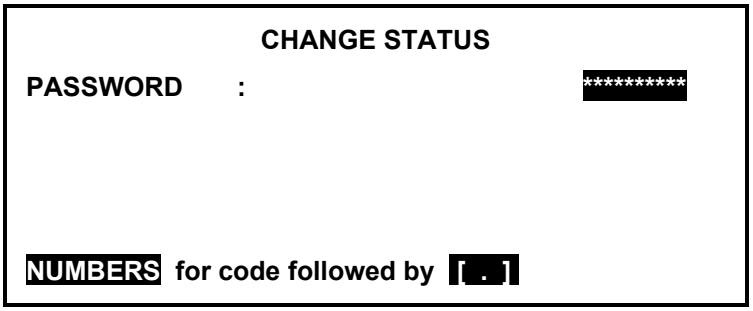


NOTES:

- **SCHEDULE LOCK** prevents unauthorized users from selecting any weld schedule other than the displayed schedule, and from changing any weld energy/time parameters within the weld schedule.
- **SYSTEM LOCK** prevents unauthorized users from changing any energy/time parameters within weld schedules, but does allow different schedules to be selected. This function also prevents any changes to menu settings.
- **CALIBRATION LOCK** prevents unauthorized users from modifying any of the calibration settings.

All security options use the ***same*** procedure to enter a security code and to turn off the security code.

2. Press the **1** key to select **SCHEDULE LOCK**. This will bring up the **CHANGE STATUS** screen.



3. Enter a 7-digit number, from 0000001 to 9999999, in the code field, then enter a period. This will bring up the **SYSTEM SECURITY** menu screen, this time with **SCHEDULE LOCK: ON**. With **ON** selected, all other weld schedules are locked out and cannot be modified or used for welding.
4. To unlock the Power Supply from security protection, return to the **CHANGE STATUS** screen and enter the code that you entered in Step 3. This will bring up the **SYSTEM SECURITY** menu screen, this time with **SCHEDULE LOCK: OFF**.
5. If you forget the security code and wish to unlock the Power Supply from security protection**:**

a) Return to the **CHANGE STATUS** screen.

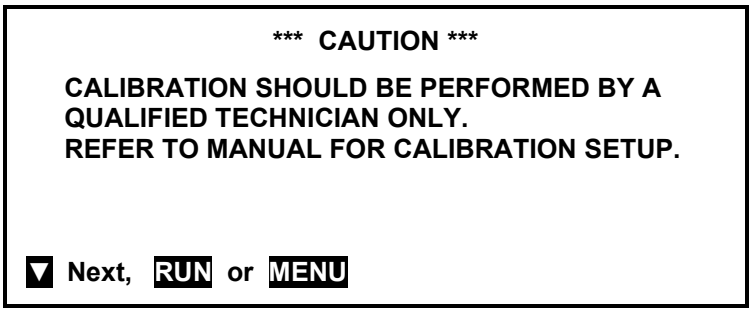
b) Enter a security code of **414**, followed by a period.

6. Keep pressing the **MENU** key to return to the **MAIN MENU.**

Calibration

NOTE: Calibration should ***only*** be performed by authorized personnel.

1. From the **MAIN MENU**, press the **7** key to access the first **CALIBRATION** screen.
2. Follow the calibration procedures in *Chapter 7, Calibration*.



Reset Defaults

The Power Supply is manufactured and shipped with the factory-set defaults. Any of these settings may be changed.

Defaults for Setup Menu 1

SYSTEM PARAMETER	DEFAULT SETTING
Foot Switch Weld Abort	OFF
END OF CYCLE BUZZER	OFF
BUZZER ON WELD STOP	OFF
UPDATE GRAPH AFTER WELD	ON
ALL SCREEN UPDATES	ON

Defaults for Setup Menu 2

SYSTEM PARAMETER	DEFAULT SETTING
Display Contrast	080%
Buzzer Loudness	030%
Switch Debounce Time	10 ms
Firing Switch	AUTO

Defaults for Waveform Check

SYSTEM PARAMETER	DEFAULT SETTING
Weld Fire Lockout	OFF
Weld Fire Lockout Charge	90 %

Defaults for Communication Menu

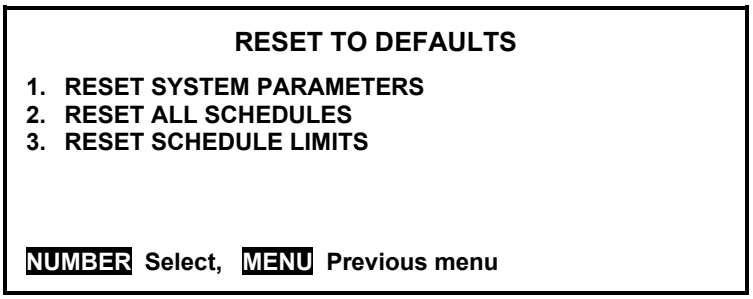
SYSTEM PARAMETER	DEFAULT SETTING
Communication Role	CLIENT
RS-485 ID Number	01
Baud Rate	19.2

Defaults for Chain Schedules Menu

SYSTEM PARAMETER	DEFAULT SETTING
Chain Schedules	OFF

Defaults for Relay Menu

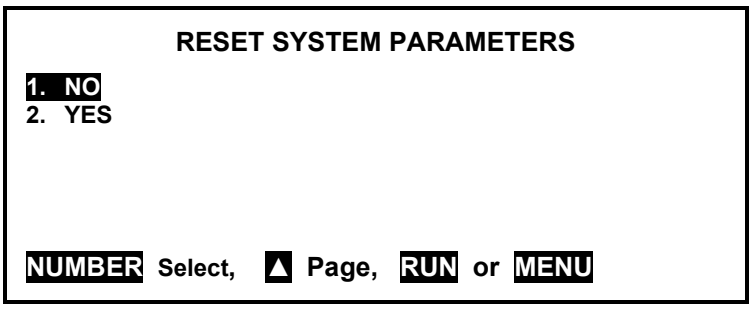
SYSTEM PARAMETER	DEFAULT SETTING
Relays 1 through 4	ON WHEN ALARM



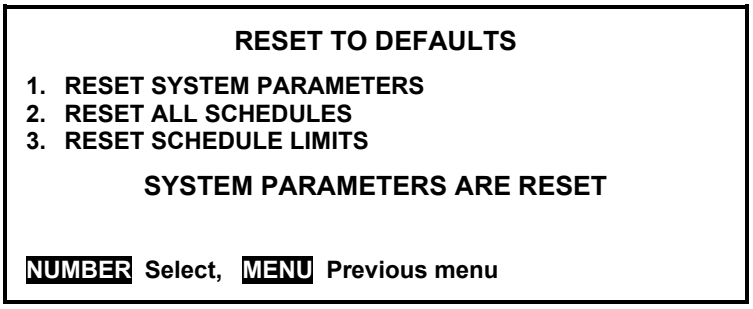
It is common to change system and schedule settings when you customize the Power Supply for specific welding needs. If you wish to reset the Power Supply to the original default settings, go to the **MAIN MENU**, then press the **8** key to get the **RESET TO DEFAULTS** menu. This menu allows you to reset all system programmed parameters, all weld schedules and all schedule limits to the original factory default settings.

Reset System Parameters

1. From the **MAIN MENU**, press the **8** key to go to the **RESET DEFAULTS** menu.
2. From **RESET DEFAULTS**, press the **1** key to go to the **RESET SYSTEM PARAMETERS** menu.



3. Press the **2** key to select **YES**. This will automatically reset the system parameters to the factory defaults and return the screen to the **RESET DEFAULTS** menu. There will be a message on this screen indicating successful reset.

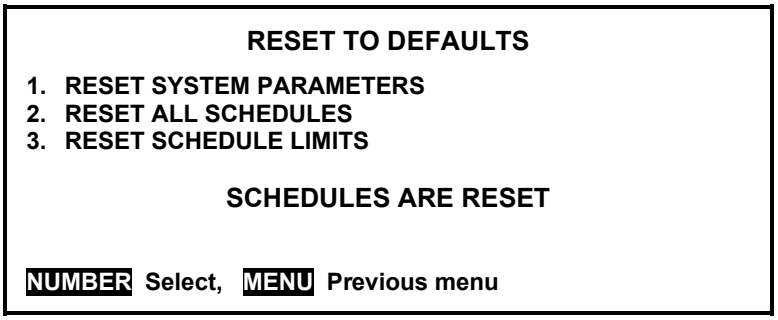


4. Press **MENU** to return to the **MAIN MENU.**

Reset All Schedules

1. From the **RESET DEFAULTS** menu, press the **2** key to get to the **RESET ALL SCHEDULES** menu.

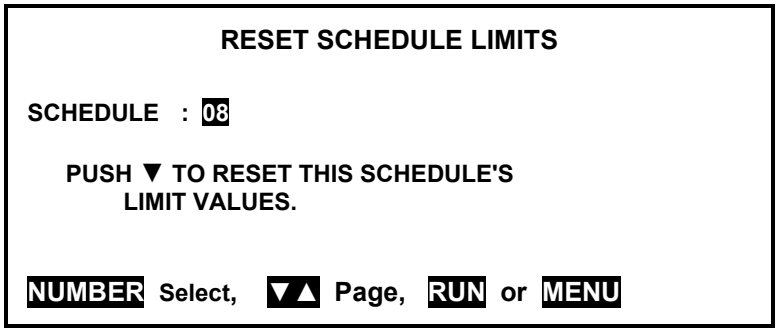
2. Press the **2** key to select **YES.** This will automatically reset all weld schedule parameters to the factory defaults and return the the display to the **RESET TO DEFAULTS** menu. There will be a message on this screen indicating successful reset.



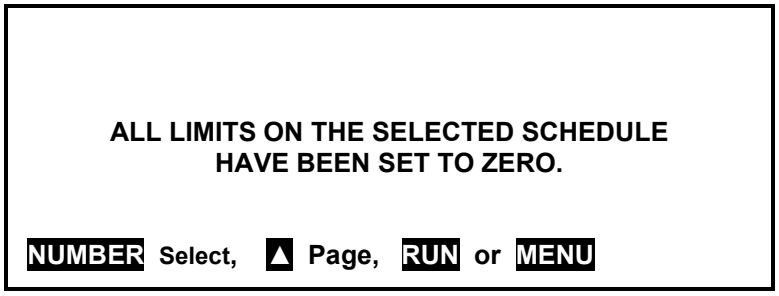
3. Press **MENU** to return to the **MAIN MENU**.

Reset Schedule Limits

1. From the **RESET DEFAULTS** menu, press the **2** key to get to the **RESET SCHEDULE LIMITS ALL SCHEDULES** menu.
2. Enter the number of the schedule whose limits you want to delete. Then press the down ▼ arrow to reset the limits for this schedule.



3. A screen will be displayed informing you that the schedule limits have been reset. Press **MENU** to return to the **MAIN MENU.**



Chain Schedules

This feature allows you to automatically change from any weld schedule to any other schedule after a preset count, creating a "chain" of schedules that can accommodate a variety of welding needs. For example:

- A single work piece requires four welds, two weld points require the same weld schedule, each of the other two points require different weld schedules.

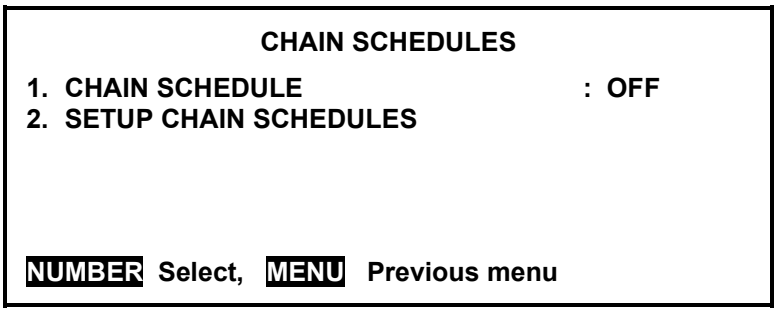
  In this case you would program a sequence, or "chain," that looks like this: **Schedule 01** [2 times] → **Schedule 02** [1 time] → **Schedule 03** [1 time] → **Schedule 01**. This sequence will repeat, or "loop," until you turn **Chain Schedules** OFF.
- Some applications require a lower current for a number of welds after the electrodes have been replaced or resurfaced. Once the electrodes have been "seasoned", the current can be increased as required. If the electrodes require 100 welds to "season", Schedule 01 can be programmed with a lower current and Schedule 02 can be programmed with a higher current. The chain would look like this: **Schedule 01** [100 times] → **Schedule 02** [1 time] → **Schedule 02** [1 time].

  In this chain, Schedule 02 will just keep repeating ***after*** the 100 welds made using Schedule 01. When the electrodes are replaced or resurfaced, you can manually switch back to Schedule 01 to restart the sequence.

You can program any of the Power Supplies 99 stored schedules to chain to any other schedule, or back to itself as in the second example above. The chain code becomes part of each weld schedule. You can turn the **CHAIN SCHEDULES** feature **ON** or **OFF**, or re-program chains, any time you want.

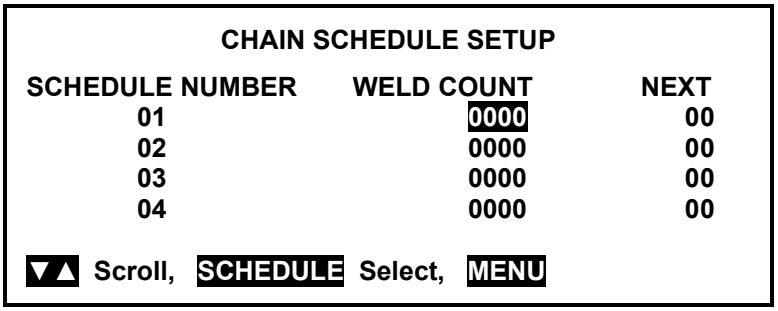
1. From the **MAIN MENU**, press the **9** key to go to the **CHAIN SCHEDULES** menu.

   NOTE: You should program, or "setup," the chain of schedules you want ***before*** you turn this feature **ON**.

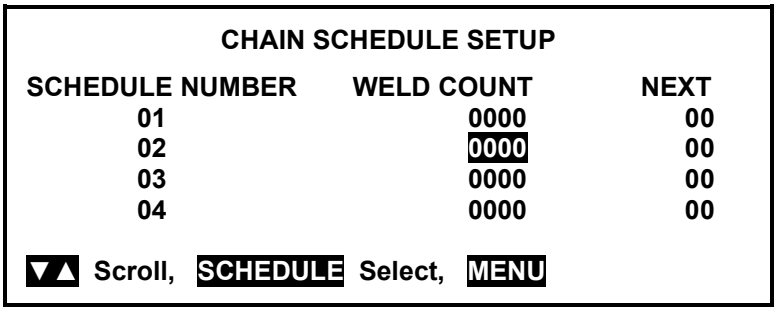


2. Press the **1** key to toggle **CHAIN SCHEDULES ON** or **OFF**.

3. From the **CHAIN SCHEDULE** menu, press the **2** key to go to the **CHAIN SCHEDULE SETUP** menu.



4. Use the ▲▼ (Up/Down) keys on the front panel to scroll vertically through the Schedules 1 to 99 to **highlight** the weld count for the schedule you want to chain.



5. Use the numeric keypad to enter the number of times you want this schedule to weld before going to the next schedule.
6. Use the **SCHEDULE** key to move the highlight horizontally to select **NEXT**.

CHAIN SCHEDULE SETUP

SCHEDULE NUMBER	WELD COUNT	NEXT
01	0005	00
02	0000	00
03	0000	00
04	0000	00

▼▲ Scroll, SCHEDULE Select, MENU

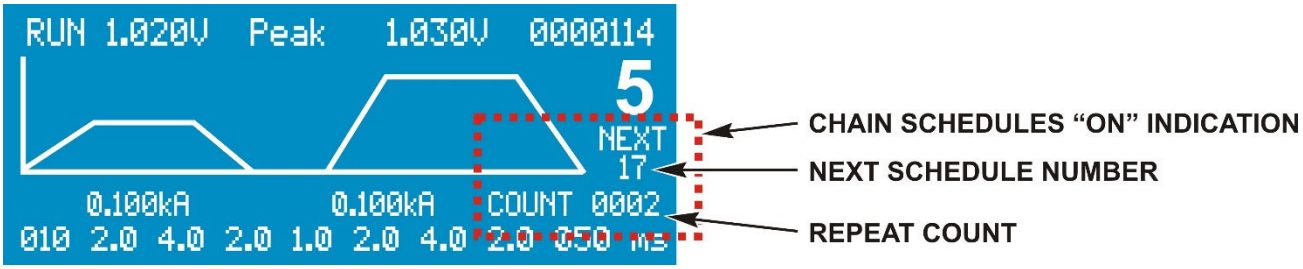
7. Use the numeric keypad to enter the number of the next schedule in the chain.
8. Use the **SCHEDULE** key to move the highlight horizontally back to the **WELD COUNT** column. Repeat Steps 4 through 8 to program the rest of the chain.

CHAIN SCHEDULE SETUP

SCHEDULE NUMBER	WELD COUNT	NEXT
01	0005	00
02	0000	00
03	0000	00
04	0000	00

▼▲ Scroll, SCHEDULE Select, MENU

9. When you finish programming the chain, press the **MENU** key to return to the **MAIN** menu.
10. Return to the **CHAIN SCHEDULES** menu to turn the **Chain Schedules** feature **ON** or **OFF** as needed by pressing the **1** key.
11. Press the **RUN** key on the front panel, then use the ▲▼ (Up/Down) keys to select the first weld schedule in the chain you want to use. The Power Supply will now weld in the "chain" mode until you turn the **CHAIN SCHEDULES** feature OFF.
12. **NOTE:** When **CHAIN SCHEDULES** is turned ON, the display changes to show the chain information on the right side of the screen.



Below the current schedule number, you can see the number of times the current schedule will be repeated, and the number of the next schedule in the chain.

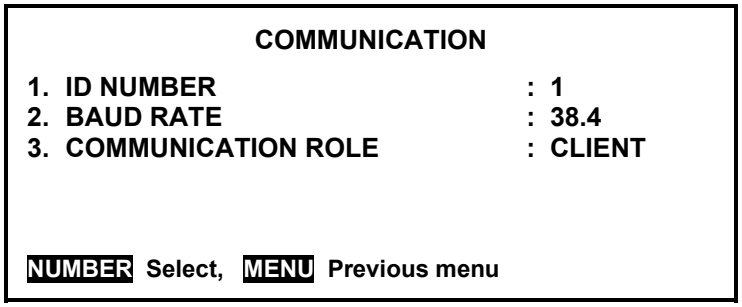
Section V. Communication and Data

Requirements

The following menu screens tell you how to set the Power Supplies communication and data options. Please also refer to *Appendix B, Connections* and *Appendix E, RS-232 Communications*.

Communication

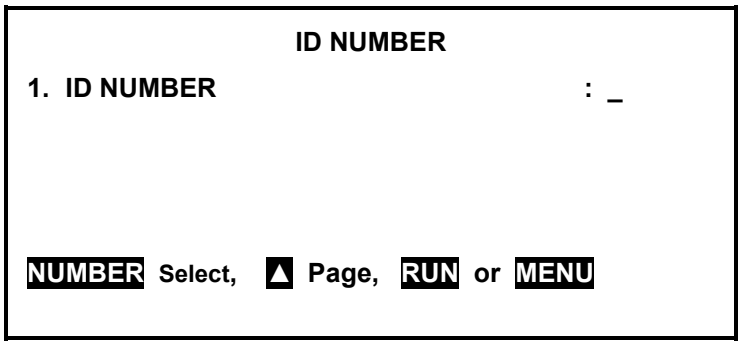
From the **MAIN MENU,** press the **5** key to go to the **COMMUNICATION** menu (shown with default settings).



I.D. Number

The Power Supply includes an I.D. number on many of the character strings that the Power Supply outputs on the RS-232 port. A host computer may be used to talk with multiple Power Supplies. To provide unit identification, each Power Supply can be assigned a unique identification number. To enter an identification number for the Power Supply, proceed as follows:

1. From the **MAIN MENU**, press the 5 key to go to the **COMMUNICATIONS MENU**.
2. From the **COMMUNICATIONS MENU** screen, press the 1 key to get the **I.D. NUMBER** entry screen.
3. Enter a two-digit number, from **01** to **99**, in the **I.D. NUMBER** field.

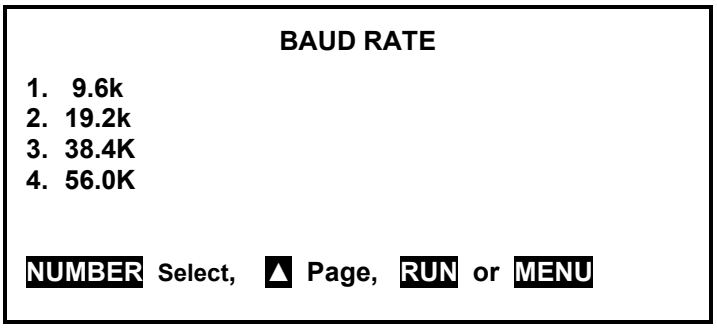


3. Press the ▲ up arrow key to save the I.D. number and return to the **COMMUNICATION** menu screen. This time the **I.D. NUMBER** line will display your I.D. number entry. You can also press **MENU** key to save the I.D. number and to return to the **MAIN MENU.**

Baud Rate

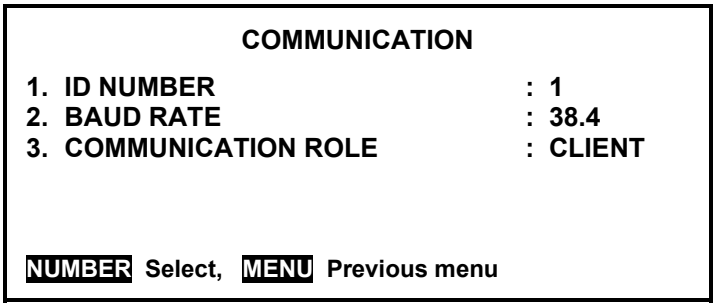
The baud rate at which the data is sent must match the baud rate of the host computer. To enter the baud rate, proceed as follows:

1. From the **COMMUNICATION** menu, press the **3** key to get the **BAUD RATE** selection screen.
2. Use the numeric keypad to select the baud rate of the receiving device. The display automatically returns to the **COMMUNICATION** menu, which shows the new baud rate.
3. Press **MENU** to return to the **MAIN MENU.**



Communication Role

1. From the **COMMUNICATION** menu**,** press the 3 key to toggle the Communication Role between buzzer **HOST** or **CLIENT**.
2. Press **MENU** to return to the **MAIN MENU.**



- In the **HOST** role, the Power Supply will output the weld data on the RS-232 port after each weld operation. This setup may be useful for:
  - Collection of weld data by a host computer.
  - Printing of weld data to a serial printer, providing a printout of the average voltage and current values for each weld, generating a "paper history" of welds performed.
- In the **CLIENT** role, the Power Supply will send weld data only when requested by the host computer.

Section VI. Relay Settings

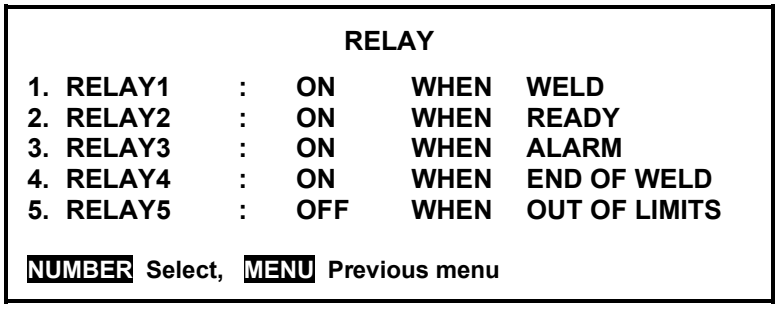
Function

The Power Supplies five relays can be programmed to activate outputs under eighteen user-programmed conditions. Relay connections are made through the 16-pin **J1B** I/O connector on the rear of the Power Supply. See *Appendix B, Electrical And Data Connectors* for pin connections. *Appendix C, Relay Timing Diagrams* provides the timing sequences for the four relays.

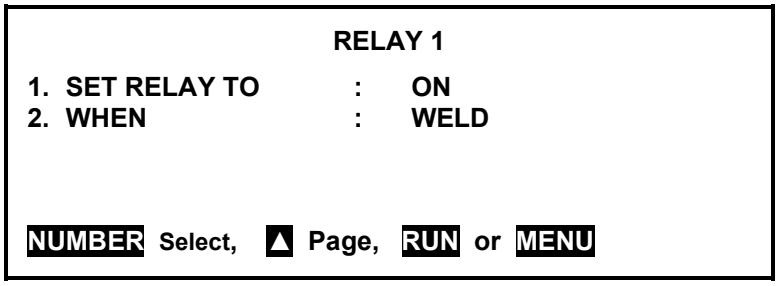
Programming Instructions

NOTE: Programming for each of the relays is ***identical***.

1. From the **MAIN MENU**, press the **6** key to get the **RELAY** menu.

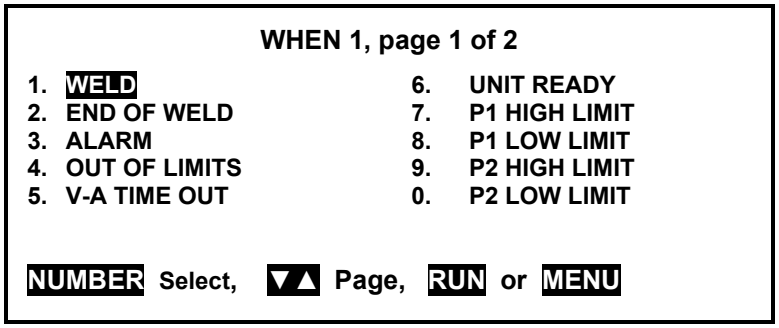


2. From the **RELAY** menu, press the **1, 2, 3, 4** or **5** key to select a relay menu.
3. Press the **1** key to toggle the relay contact signal state: **ON** (closed) or **OFF** (open).

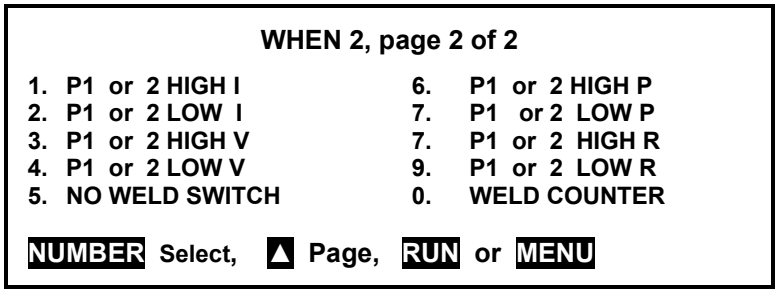


4. Press the **2** key to select the **WHEN** menu. This menu allows you to choose when the relay is activated. The **WHEN** states are described on the next page.

   NOTE: There are two Relay When screens that are accessed by using the ▼▲ keys.



5. Use the numeric keypad to select when the relay will energize. The display screen automatically returns to the **WHEN** menu.



- **WELD** — When welding, the relay output signal will start within ± 5 ms of the start of **SQUEEZE** and will stay energized for 0 – 150 ms after the end of the **HOLD** period.
- **END OF WELD** — When welding, the relay output signal will start 0 – 10 ms after the end of the **HOLD** period and will stay energized for 650 – 850 ms. If another weld is initiated within this time, the **END OF WELD** relay will be reset at the start of the next weld. The relay will still close in the event of an aborted weld.
- **ALARM** — The relay output signal will start when the Power Supply senses certain **ALARM** conditions (with the ***exception*** of **OUT OF LIMITS** alarms) and will stay energized until the **ALARM** state is cleared by pressing the **RUN** button (refer to *Appendix D, LCD Display Messages*).
- **OUT OF LIMITS** — The relay will switch when the Power Supply senses any **OUT OF LIMITS** condition. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **V-A TIME OUT** — The relay will switch if the actual time exceeds the user set time for Tv for a Pulse using the **Combo** (V-A) feedback mode. It will start 0 – 5 ms after the end of **Pulse 1** is aborted and will stay energized until the **V-A TIME OUT** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **UNIT READY** — Relay will be energized when Power Supply is ready to weld. It will de-energize 0 – 5 ms after receipt of a fire signal. It will energize 0 – 250 ms after the end of **HOLD** period. The relay will also de-energize when a schedule is being edited, the **MENU** button functions are accessed, or the **SCHEDULE** button is pressed to change a schedule.
- **P1 HIGH LIMIT** — The relay signal will switch when the Power Supply senses that the Pulse 1 energy is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).

- **P1 LOW LIMIT** The relay signal will switch when the Power Supply senses that the Pulse 1 energy is lower than the programmed lower limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P2 HIGH LIMIT** The relay signal will switch when the Power Supply senses that the Pulse 2 energy is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P2 LOW LIMIT** The relay signal will switch when the Power Supply senses that the Pulse 2 energy is lower than the programmed lower limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 HIGH I** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 current is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 LOW I** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 current is lower than the programmed lower limit. It will start 0-5ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 HIGH V** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 voltage is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 LOW V** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 voltage is lower than the programmed lower limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **NO WELD SWITCH** The relay signal with switch when **WELD/NO WELD** button on the front panel is pressed. It will switch within 0 – 5 ms after the button is pressed.
- **P1 or 2 HIGH P** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 power is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).

- **P1 or 2 LOW P** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 power is lower than the programmed lower limit. It will start 0 - 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 HIGH R** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 resistance is higher than the programmed upper limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **P1 or 2 LOW R** The relay signal will switch when the Power Supply senses that the Pulse 1 or 2 resistance is lower than the programmed lower limit. It will start 0 – 5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to *Appendix D, LCD Display Messages*).
- **WELD COUNTER** The relay signal will switch when the **TOTAL WELD COUNTER** value reaches the user set value for **COUNTER LIMIT**. It will start 0 - 5ms after the end of **HOLD** and will stay energized until the user changes the **TOTAL WELDS** or **COUNTER LIMIT** on the **WELD COUNTERS** Setup screen.

6. Press the **MENU** key to return to the **RELAY** screen.
7. Repeat Steps 2 through 6 to program the other relays as needed.
8. Press **MENU** to return to the **MAIN MENU.**

CHAPTER 6
MAINTENANCE

Section I: Precautions

General Operator Safety

ALWAYS wear safety goggles and other appropriate safety equipment when you are **performing a welding operation**.

Section II: Operator Maintenance

The Power Supply does not require any Operator Maintenance other than calibration. To ensure consistently accurate welds, AMADA WELD TECH recommends that you calibrate the Power Supply at least once a year. For calibration instructions, please refer to *Chapter 7, Calibration*.

Section III: Troubleshooting

The Power Supply is designed with reliability as a top user priority. From time to time, however, you may run into a problem and need some help to get back to normal operation. Reading this Chapter will speed up the process.

General Kinds of Problems

It has been our experience that most resistance welding power supply "problems" are caused by lack of material control, process control, and electrode tip surface maintenance. The problems that you might encounter fall into two groups: **Soft** and **Hard**.

Soft

The problem is transient, and you can correct it by resetting the system or parameter limits. For example, you should ensure that:

- Correct force is set at the weld head
- Correct weld energy and time is set at the Power Supply
- The equipment is set up properly
- All electrical connections are tight
- Electrode alignment allows flush contact with the weld pieces
- Electrodes are properly dressed

Hard

The problem is embedded in the system and some form of repair will be needed. For example, repair might include replacing a broken weld head flexure.

In either case, you may telephone the AMADA WELD TECH Applications Laboratory for assistance by calling the telephone number listed in the Foreword and asking for the Applications Laboratory.

Alarm Messages

Built-in automatic self-test and self-calibration routines will bring up alarm messages on the display screens. These messages will usually let you know what action is required of you to correct the reason for the alarm. For a complete listing of the alarm messages, what they mean, and what to do about them, please refer to *Appendix D, LCD Display Messages.*

NOTE: Although multiple messages may occur simultaneously only one can be displayed at a time.

Troubleshooting

The following Troubleshooting Chart is a comprehensive listing of system and equipment problems, and their probable cause.

Troubleshooting Chart

PROBLEM	CAUSE (In Order of Probability)
Air-operated weld head will not close	Air valve driver cable not connected. (Check that the Power Supply switches to STANDBY state when footswitch is activated). Check that the air supply is properly connected to the weld head.
Electrode Damage	Excessive current/energy set at the Power Supply. Excessive or insufficient weld head force. Wrong electrode tip shape. Misaligned parts. Excessive weld time set at the Power Supply. Contaminated weld piece surface/ plating. Wrong electrode material. Contaminated electrode surface.

Troubleshooting Chart	
PROBLEM	**CAUSE (In Order of Probability)**
Electrode Sparking	Excessive current/energy set at the Power Supply. Insufficient weld head force. Slow weld head follow-up. Incompatible weld piece projection design. Misaligned parts. Contaminated weld piece surface/ plating. Wrong electrode tip shape. Wrong electrode material. Contaminated electrode surface. Polarity reversed on Voltage Sense cable.
Electrode Sticking	Contaminated weld piece surface/ plating. Wrong electrode material/ tip shape. Insufficient weld head force. Excessive current/energy set at the Power Supply. Misaligned parts. Excessive weld time set at the Power Supply. Contaminated electrode surface. Slow weld head follow-up.
Insufficient Weld Nugget	Insufficient current/ energy set at the Power Supply. Wrong electrode material/ tip shape. Worn/mushroomed electrodes. Insufficient weld time set at the Power Supply. Incorrect weld head polarity. Misaligned parts. Contaminated weld piece surface/ plating. Excessive weld head force. Insufficient weld head force. Contaminated electrode surface. Incompatible weld piece projection design. Slow weld head follow-up. Incompatible weld piece materials. No cover gas on weld piece.
LCD Display is blank, and Weld/No Weld LED can be switched ON and OFF.	Possible failed LCD display assembly. Contact AMADA WELD TECH for support.

Troubleshooting Chart	
PROBLEM	**CAUSE (In Order of Probability)**
LCD is operational, the Power Supply will attempt to fire, but no energy is provided to the weld and the graphs in the **RUN** screen will not fill in.	Possible open circuit in the secondary circuit. Electrodes did not close properly. Possible failed Capacitor Charging Power Supply. Contact AMADA WELD TECH for support.
Metal Expulsion	Excessive current/energy set at the Power Supply. Insufficient weld head force. Misaligned parts. Slow weld head follow-up. Incompatible weld piece projection design. Contaminated weld piece surface/ plating. Incompatible weld piece materials. Contaminated electrode surface. Wrong electrode tip shape. No cover gas on weld piece. Excessive weld time set at the Power Supply. Misaligned parts. Polarity reversed on Voltage Sense cable
Weld Piece Discoloration	Excessive weld time set at the Power Supply. No cover gas on weld piece. Excessive current/energy set at the Power Supply. Insufficient weld head force. Contaminated weld piece surface/ plating. Wrong electrode material/tip shape. Contaminated electrode surface.
Weld Piece Overheating	Excessive weld time set at the Power Supply. Excessive current/energy set at the Power Supply. Misaligned parts. Insufficient weld head force. Incompatible weld piece materials. Wrong electrode material/tip shape. Contaminated electrode surface.

Troubleshooting Chart	
PROBLEM	**CAUSE (In Order of Probability)**
Weld Piece Warping	Excessive weld time set at the Power Supply. Excessive weld head force. Incompatible weld piece projection design. Incompatible weld piece materials. Wrong electrode tip shape. Excessive current/energy set at the Power Supply.

Technical Assistance

If you need further technical assistance, please contact either your authorized service agent or **AMADA WELD TECH** by telephone or FAX, or at the postal or e-mail addresses shown in the *Foreword* of this manual.

Electrode Maintenance

When a welding schedule has been suitable for a particular welding application over many welds, but poor quality welds are now resulting, electrode deterioration could be the problem. If you need to increase welding current to maintain the same weld heat, the electrode tip has probably increased in surface area (mushroomed), effectively decreasing weld current density, thus cooling the weld. Try replacing the electrodes.

The rough surface of a worn electrode tip tends to stick to the work pieces. So, periodic tip resurfacing (dressing) is required to remove pitting, oxides and welding debris from the electrode. You should limit cleaning of an electrode on the production line to using a # 600 grit, silicon carbide electrode polishing disk. If you must clean a badly damaged tip with a file, you must use a polishing disk after filing to ensure the electrode faces are smooth.

The best method of preventing electrode problems is to regularly re-grind electrode tip surfaces and shapes in a certified machine shop.

Parts Replacement

WARNING

- Only qualified technicians should perform internal adjustments or replace parts.
- Removal of the unit cover could expose personnel to high voltage.
- Removal of the unit cover may void the warranty.

There are no replaceable parts for the Power Supply, other than the protection fuse that is installed on the rear panel.

Fuse

DESCRIPTION	LOCATION
Standard 10 Amp, 250 VAC, 5 x 20 mm	Rear Panel

CHAPTER 7
CALIBRATION

Section I: Introduction

Overview

CAUTION

To avoid injury or damage to the equipment, these procedures should ***only*** be performed by authorized personnel.

Calibration instructions are displayed on the series of screens displayed on the Power Supplies LCD. Current, Voltage, and Power parameters are calibrated. There are ***two*** Calibration equipment setups: one is used for **Calibration of Current, Voltage and Power,** the other is used for **Verification of Voltage Measurement After Calibration**. After you connect the Power Supply to the equipment as instructed, follow the instructions shown on each LCD screen.

NOTE: It takes approximately ***one hour*** to calibrate the Power Supply. Once you are familiar with the calibration process, it will become faster and easier to do. After performing these procedures, the Power Supply will store the calibration values in memory, where they will be used as standards for the operational welding parameters.

Calibration Equipment Required

To properly calibrate the UB Welding Power Supply, you will need the following items:

- Digital oscilloscope, *Agilent* MSO6034A or equivalent
- DC Power Supply *Agilent 3630A* or equivalent
- Calibration Kit. See table below for Kit part number and list of contents (by part number).

Item	UB-500A Cal Kit Pt # 10-390-01	UB-1500A Cal Kit Pt # 10-397-01	UB-4000A Cal Kit Pt # 10-398-01
Shunt	563-218 (0.01 Ω)	563-004 (0.004 Ω)	563-001 (0.0025 Ω)
Shunt Adapter	4-39426-01	4-39426-01	4-39426-01
Weld Cables (pair)	18-20U-BB-12	18-20U-BB-12	18-20U-BB-12
Calibration Support Kit	4-35914-01	4-35914-01	4-35914-01
Firing Switch Cable	4-39179-01	4-39179-01	4-39179-01
Connection Hardware	*included*	*included*	*included*

The following shunt kits are included in the Calibration Kits listed above. If replacing or sourcing the shunt resistors, use the following shunts for calibration:

Model	Coaxial Resistor	T&M Research Products P/N
UB-4000A	2.500 milliohm ± 0.5 %	Model K-2000-4, 150 Watts, Mod 0.0025
UB-1500A	4.000 milliohm ± 0.5 %	Model K-1000-2, 150 Watts, Mod 0.0040
UB-500A	10.00 milliohm ± 0.5 %	Model K-500-1, 150 Watts, Mod 0.0100

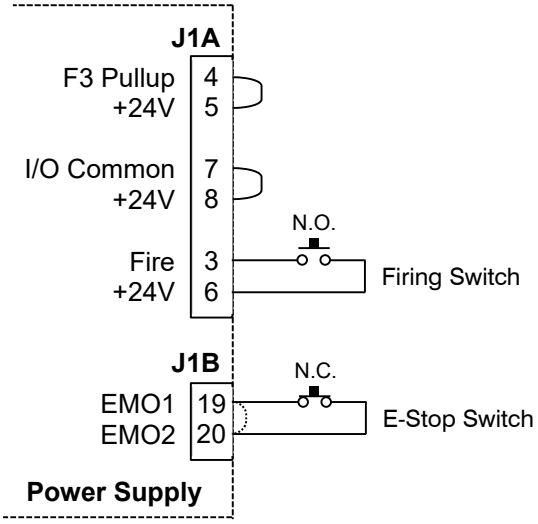
Source for shunt resistors:

T & M Research Products, Inc.
139 Rhode Island Street NE
Albuquerque, New Mexico 87108

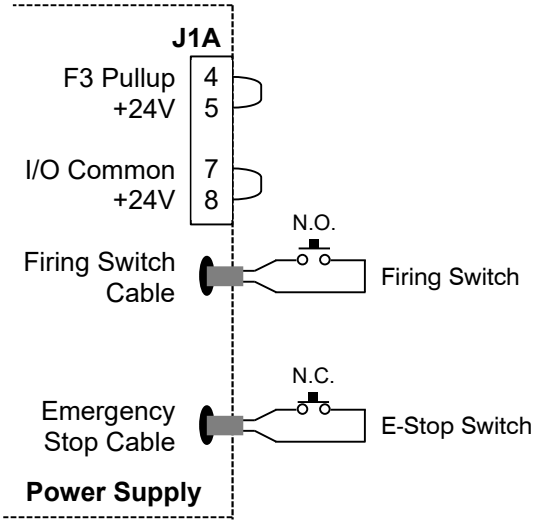
Telephone: (505) 268-0316
E-Mail: www.tandmresearch.com

4-39179-01 Firing Switch Calibration Cable

The 4-39179-01 Firing Switch Calibration Cable allows for easy power supply control through the J1A and J1B – I/O connectors. When calibration is controlled through J1A and J1B, make sure none of the other panel mounted connectors are terminated (if applicable). An alternative to using the 4-39179-01 cable, is to wire up the connectors as shown in the schematic below. Refer to *Chapter 2: Installation and Setup, Section II* for a list of available mating power supply connectors.



4-39179-01 Firing Switch
Calibration Cable Schematic

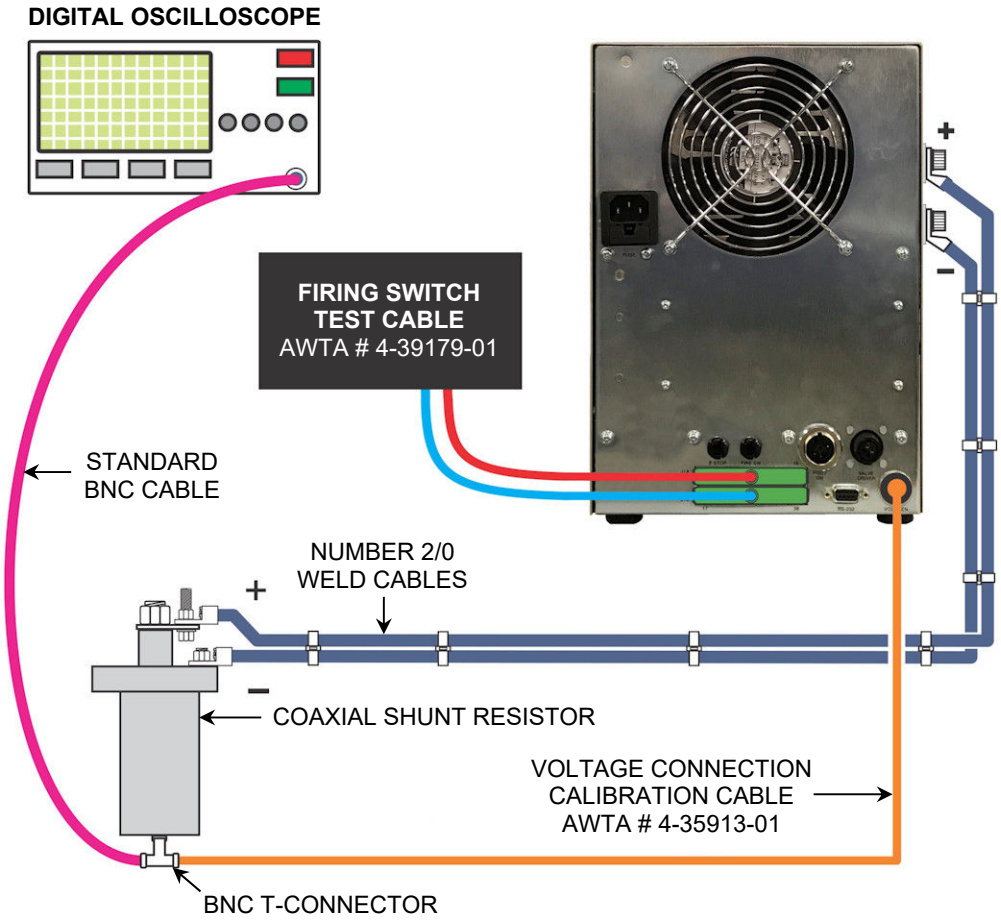


4-39179-01 Equivalent Schematic
(when using available I/O connectors)

Section II: Calibration Equipment Setup

Get the required calibration equipment listed in *Section I* and set it up as shown below in the following two diagrams.

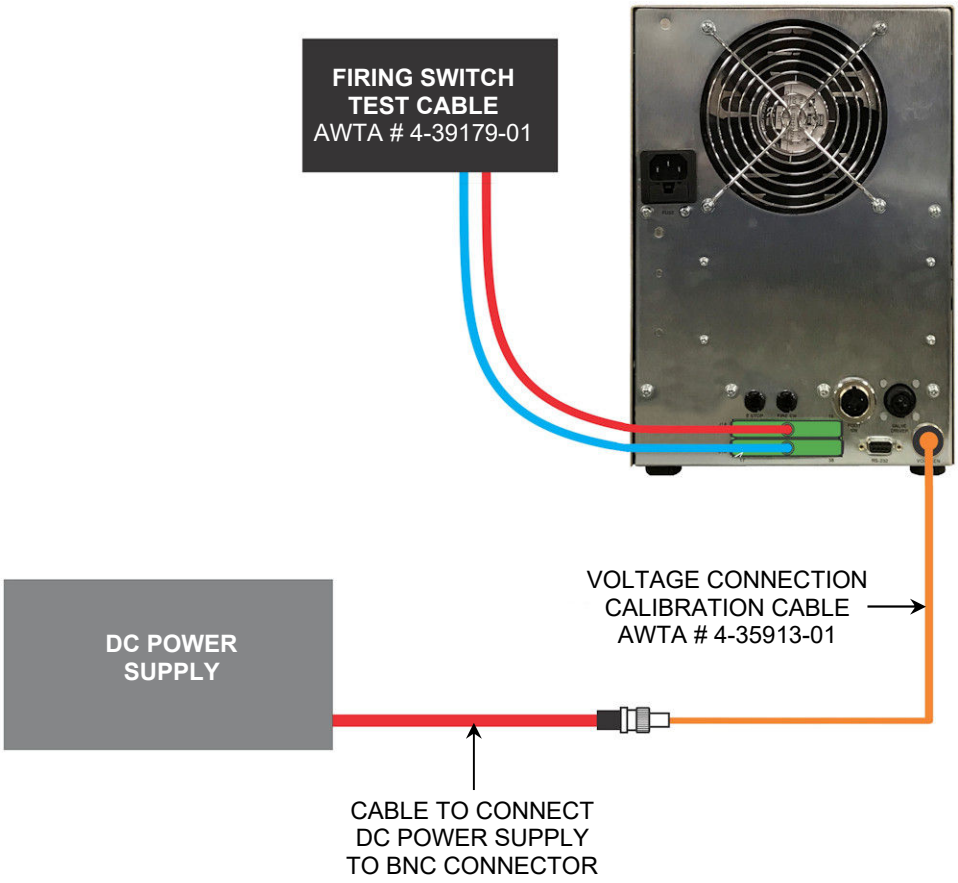
Calibration Setup for Current, Voltage and Power



NOTES:

- The Rear Panel will appear different in Legacy models.
- The ground of the oscilloscope should be isolated from the ground of the electrical "live" by an isolation transformer or other means.
- The filter in the Calibration Kit goes between the BNC cable and the oscilloscope input.

Calibration Setup for Verification of Voltage Measurement after Calibration

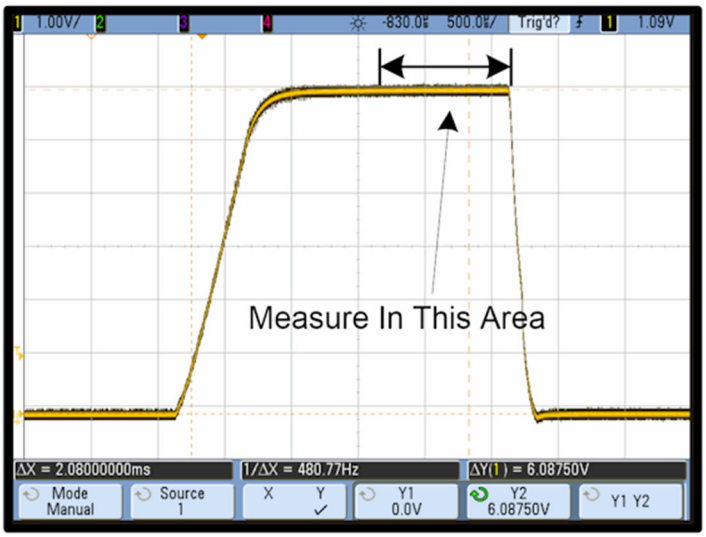


Section III: Calibration Procedure for Current and Power

The Power Supply uses a two point calibration for both current and power. The values used for calibration are shown in the following table. The screens shown in this section are the UB-4000A screens. The UB-500A/UB-1500A screens are the same as the UB-4000A ***except*** the low and high calibration point values shown on the screens are different.

The UB-4000A/UB-500A use a test waveform for calibration that consists of a 0.5 ms upslope followed by a 2.0 ms pulse. All measurements for calibration are to be done during the last 1 ms of the 2 ms pulse.

Measurement Location



Calibration Point	UB-500A	UB-1500A	UB-4000A
Low Value Voltage	1.00 V	0.50 V	1.00 V
High Value Voltage	4.00 V	5.00 V	6.00 V
Low Value Current	50 Amps	0.10 kA	0.40 kA
High Value Current	400 Amps	1.00 kA	2.50 kA
Low Value Power	0.100 kW	0.10 kW	0.40 kW
High Value Power	2.0 kW	6.50 kW	15.0 kW

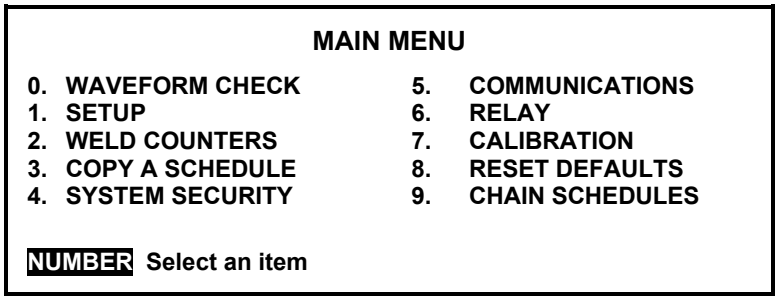
SHUNT LOAD RESISTANCE FOR UB-4000A: 2.5 mΩ

SHUNT LOAD RESISTANCE FOR UB-1500A: 4 mΩ

SHUNT LOAD RESISTANCE FOR UB-500A: 10 mΩ

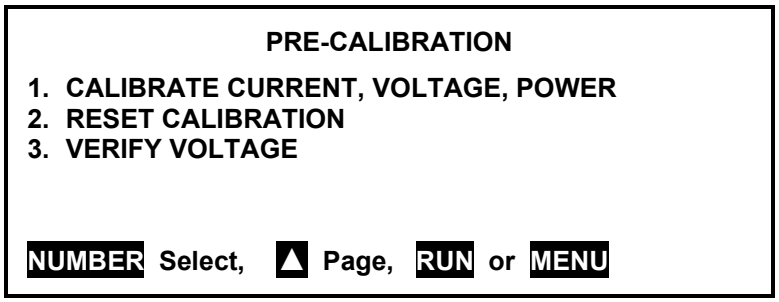
Pre-Calibration Procedure

1. Verify that the equipment is connected as shown in *Section II* in the **Calibration Setup** diagram.
2. Turn the Power Supply **ON**.
3. Press the **MENU** key to bring up the **MAIN MENU** screen.
4. Press the **7** key to select **CALIBRATION**.



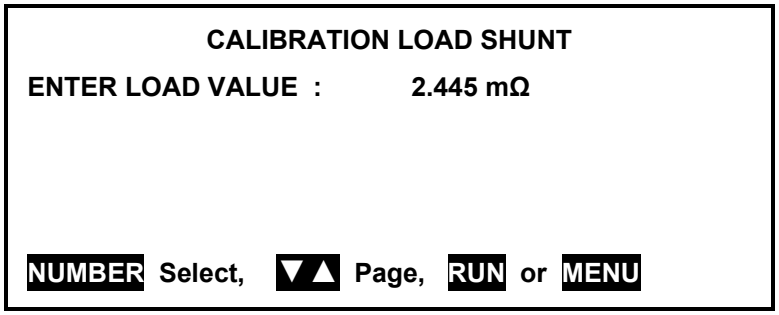
5. From the first calibration screen, press the ▼ (down) key to go to the **PRE-CALIBRATION** screen.

6. From the **PRE-CALIBRATION** screen, press the **1** key to start the sequence of on-screen calibration instructions.



The next screen is **CALIBRATION SHUNT** screen, which requires you to enter the actual value of the 2.5 or 10 milliohm shunt (the value is typically printed on the exterior of the shunt).

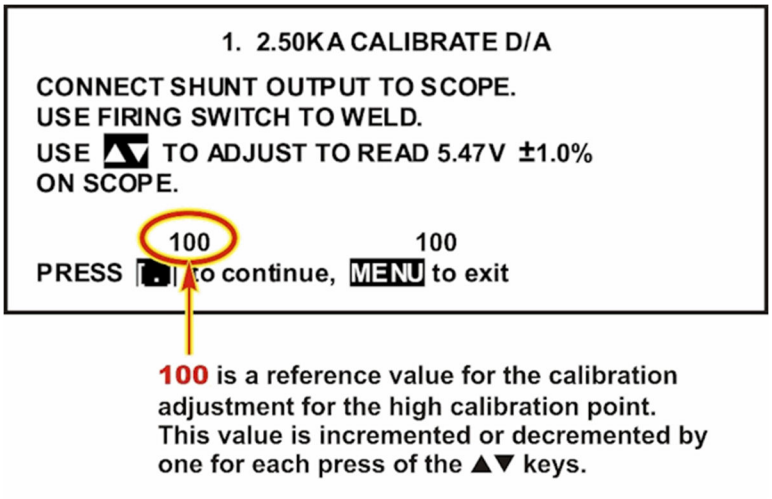
7. Enter the value using the numeric keypad, then go to the next screen by pressing the ▼ (down) key.



Current Calibration (UB-4000A Screens Shown)

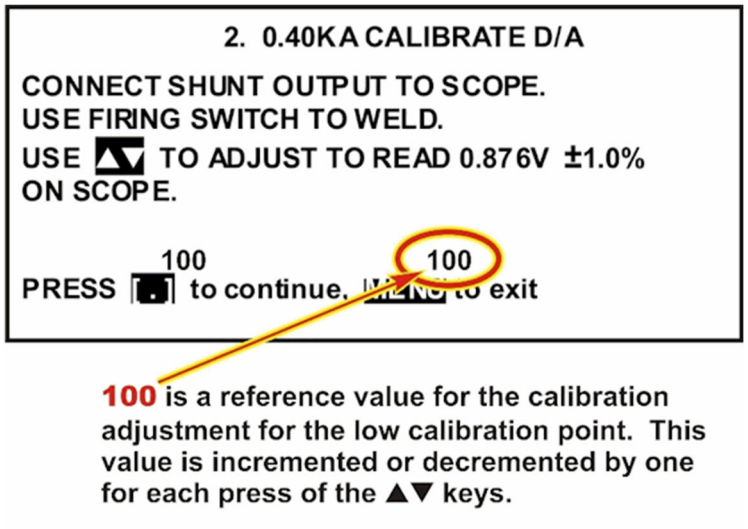
The **2.5 KA CALIBRATE D/A** screen is used to calibrate the upper calibration point for **Current**. This screen for the UB-4000A is shown below. When this screen is displayed, fire the Power Supply and look at the current waveform output on the oscilloscope. For correct calibration the upper part of the waveform shown on the oscilloscope should be at the voltage reading listed on this screen of the unit under test in the area outlined at the beginning of this section. Verify that the voltage reading on the oscilloscope is within tolerance.

1. If the waveform is too low, press the ▲ key. If the waveform is too high, press the ▼ key. Adjust values within ± 1.0% of expected
2. Fire the Power Supply again and observe the output on the oscilloscope.
3. Repeat as needed.
4. When the top of the waveform is at the proper level press the ▪ key to go to the next calibration screen.



The **0.40KA CALIBRATE D/A** screen is used to calibrate the lower calibration point for **Current**. When this screen is displayed, fire the Power Supply and look at the current waveform output on the oscilloscope. For correct calibration the upper part of the waveform shown on the oscilloscope should be at the voltage reading listed on this screen of the unit under test in the area outlined at the beginning of this section. Verify that the voltage reading on the oscilloscope is within tolerance.

5. If the waveform is too low, press the ▲ key. If the waveform is too high, press the ▼ key. Adjust values within ± 1.0 % of expected.
6. Fire the Power Supply again and observe the output on the oscilloscope. Repeat as needed.
7. When the top of the waveform is at the proper level, press the ▪ key to go to the next calibration screen. The previous **2.5 KA CALIBRATE D/A** screen will be displayed. The previous calibration for the upper calibration point may have moved due to the calibration of the lower calibration point.

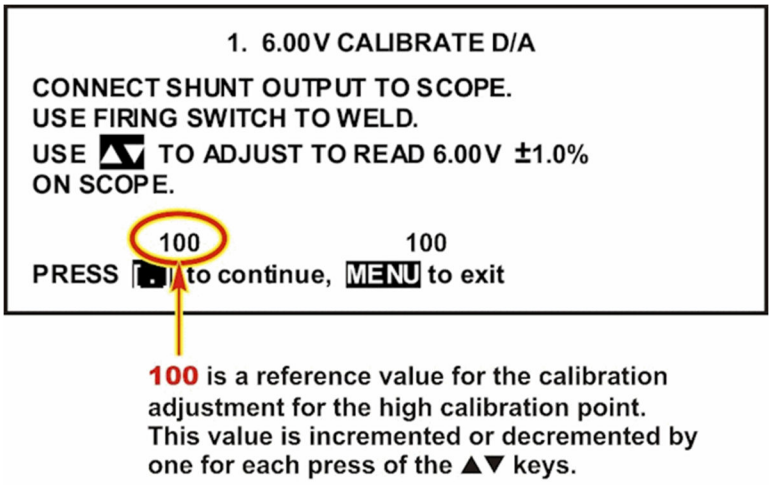


8. Repeat the calibration process for the upper calibration point.
9. Repeat the calibration process for the lower calibration point. Press the ▪ key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.
10. When complete, press the **MENU** key to go to the next calibration screen.

VOLTAGE CALIBRATION (UB-4000A Screens Shown)

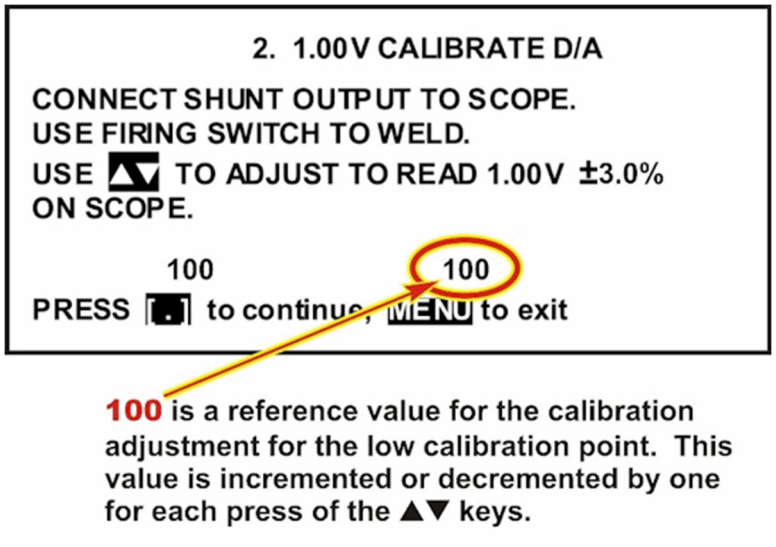
The **6.00 V CALIBRATE D/A** screen is used to calibrate the upper calibration point for **Voltage**. This screen for the UB-4000A is shown below. When this screen is displayed, fire the Power Supply and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down arrow key. Adjust values within ± 1.0 % of expected.
2. Fire the Power Supply again and observe the output on the oscilloscope. Repeat as needed.
3. When the top of the waveform is at the proper level press the ▪ key to go to the next calibration screen.



The **1.00 V CALIBRATE D/A** screen is used to calibrate the lower calibration point for **Voltage**. This screen for the UB-4000A is shown below. When this screen is displayed, fire the Power Supply and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down arrow key. Adjust values within ± 1.0 % of expected.
2. Fire the Power Supply again and observe the output on the oscilloscope. Repeat as needed.
3. When the top of the waveform is at the proper level, press the ▪ key to go to the next calibration screen. The previous **6.00 V CALIBRATE D/A** screen will be displayed. The previous calibration for the upper calibration point may have moved due to the calibration of the lower calibration point.

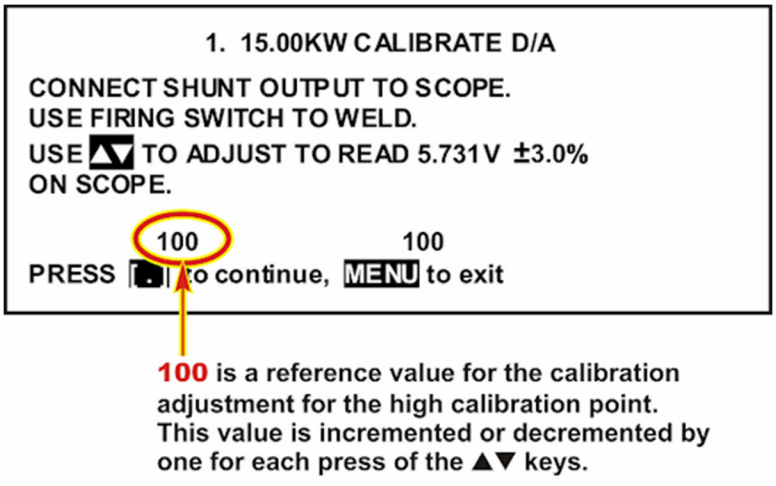


4. Repeat the calibration process for the upper calibration point.
5. Repeat the calibration process for the lower calibration point. Press the ▪ key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.
6. When complete, press the **MENU** key to go to the next calibration screen.

POWER CALIBRATION (UB-4000A Screens Shown)

The **15.00 KW CALIBRATE D/A** screen is used to calibrate the upper calibration point for **Power**. This screen for the UB-4000A is shown below. When this screen is displayed, fire the Power Supply and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

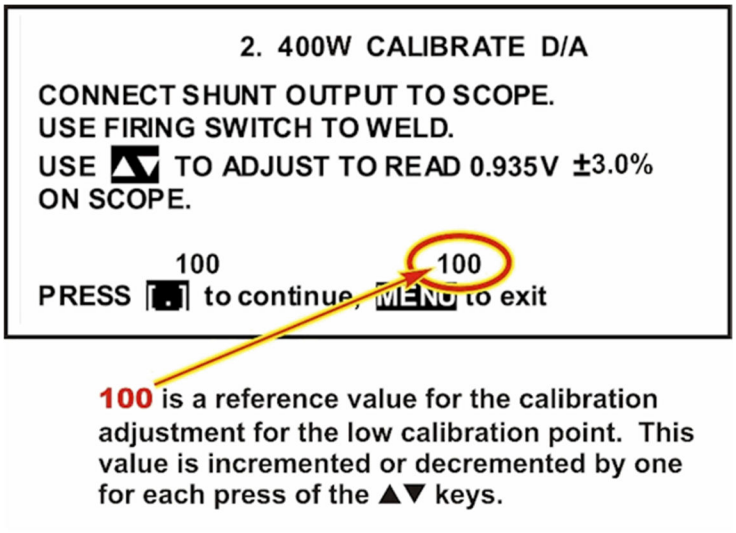
1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down arrow key. Adjust values within ± 3.0 % of expected.
2. Fire the Power Supply again and observe the output on the oscilloscope. Repeat as needed.
3. When the top of the waveform is at the proper level press the ▪ key to go to the next calibration screen.



The **400W CALIBRATE D/A** screen is used to calibrate the lower calibration point for **Power**. This screen for the UB-4000A is shown below. When this screen is displayed, fire the Power Supply and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

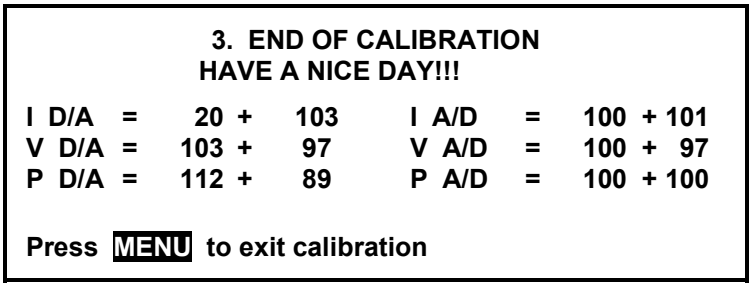
1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down arrow key. Adjust values within ± 3.0 % of expected.
2. Fire the Power Supply again and observe the output on the oscilloscope. Repeat as needed.
3. When the top of the waveform is at the proper level, press the ▪ key to go to the next calibration screen.

   The previous **15.00 KW CALIBRATE D/A** screen will be displayed. The previous calibration for the upper calibration point may have moved due to the calibration of the lower calibration point.



4. Repeat the calibration process for the upper calibration point.
5. Repeat the calibration process for the lower calibration point. Press the ▪ key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.
6. When complete, press the **MENU** key to exit calibration.

   Press the **MENU** key again to exit the calibration and go to the **MAIN MENU**. (example values shown)



Section IV: Verification Check for Voltage

1. Verify that the equipment is connected as shown in *Section II* in the **Setup for Verification of Voltage Measurement After Calibration** diagram. Turn the DC Power Supply ON and set to 1.00 Volt output.
2. Turn the Power Supply **ON**.
3. Press the **MENU** key to bring up the **MAIN MENU** screen.
4. Press the **7** key to select **CALIBRATION**.

MAIN MENU

0. WAVEFORM CHECK	5. COMMUNICATIONS
1. SETUP	6. RELAY
2. WELD COUNTERS	7. CALIBRATION
3. COPY A SCHEDULE	8. RESET DEFAULTS
4. SYSTEM SECURITY	9. CHAIN SCHEDULES

NUMBER Select an item

5. From the first calibration screen, press the ▼ (down) key to go to the **PRE-CALIBRATION** screen.

*** CAUTION ***

CALIBRATION SHOULD BE PERFORMED BY A QUALIFIED TECHNICIAN ONLY.
REFER TO MANUAL FOR CALIBRATION SETUP

▼ Next, RUN or MENU

6. From the **PRE-CALIBRATION** screen, press the **3** key to verify the voltage measurement is correct.

PRE-CALIBRATION

1. CALIBRATE CURRENT AND POWER
2. RESET CALIBRATION
3. VERIFY VOLTAGE

NUMBER Select, ▲ Page, RUN or MENU

The **VERIFY VOLTAGE** screen displays the voltage level measured by the Power Supply. In the screen shown on the right, this value is 1.01 volts. This reading should be within the specification for the Power Supply. If it is not, please consult AMADA WELD TECH. You can change the output of the DC Power Supply from **0** to **9.9** Volts

VERIFY VOLTAGE

CONNECT A VOLTAGE TO VOLTAGE INPUT
AND VERIFY ON SCREEN.
V = 1.01 volts

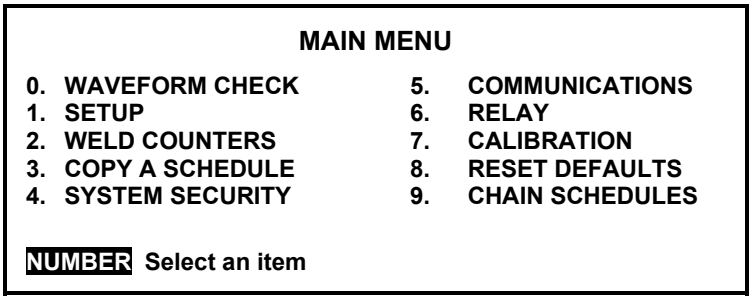
▲ Page, RUN or MENU

DO NOT EXCEED 10 VOLTS. Too high a voltage may damage the Power Supply. Press **RUN** or **MENU** to exit this screen.

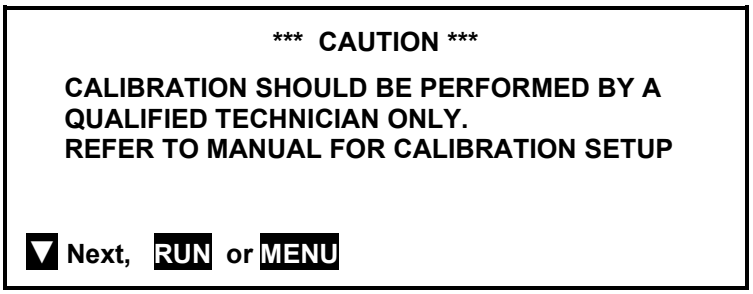
Section V: Reset Calibration

The calibration of the Power Supply can be reset to the default settings with the following procedure.

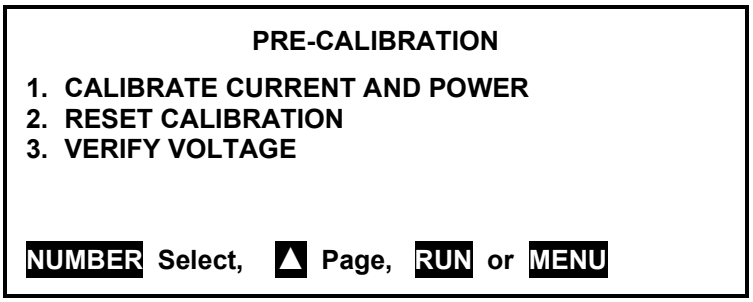
1. Turn the Power Supply **ON**.
2. Press the **MENU** key to bring up the **MAIN MENU** screen.
3. Press the **7** key to select **CALIBRATION**.



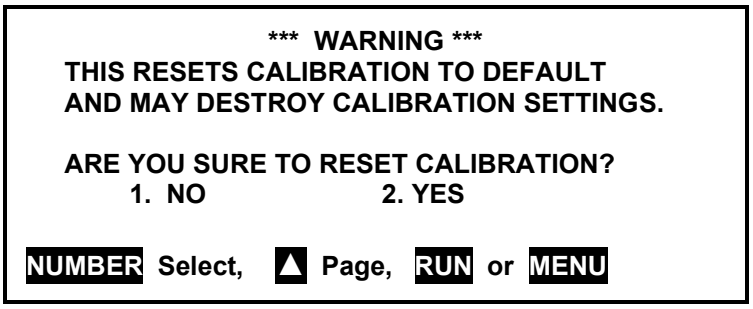
4. From the first calibration screen, press the ▼ (down) key to go to the **PRE-CALIBRATION** screen.



5. From the **PRE-CALIBRATION** screen, press the **2** key to reset the calibration values to the default settings.

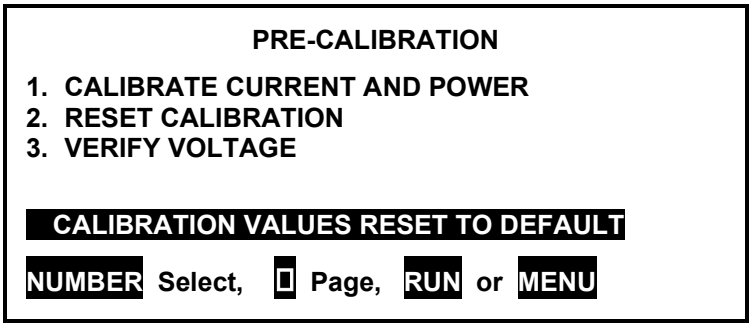


6. A **WARNING** screen will appear. Press the **1** key to exit the screen without resetting to default values.
7. Press the **2** key to reset to default calibration values. The **RUN** or **MENU** keys can also be pressed to exit this screen.



If the **2** key was pressed on the previous screen, the **PRE-CALIBRATION** screen will be displayed with a message confirming the values were reset to default values.

8. Press **RUN** or **MENU** to exit this screen.



APPENDIX A
TECHNICAL SPECIFICATIONS

General

The UB-4000A and UB-500A are linear DC resistance welding power supplies that send energy directly into a weld without the use of a welding transformer. They are capable of executing any weld function at low current, voltage or power levels with high stability and good control.

NOTE: The specifications listed in this Appendix may be changed without notice.

Physical Characteristics	
Dimensions: **See Illustration:** **Weight:** **49 Pounds (22 Kg)**	

NOTE: In the following table, Values are for both **UB-4000A** and **UB-500A** unless noted otherwise

DESCRIPTION	VALUE
Input Line Voltage (1 phase):	Standard nominal voltages and suggested breaker ratings: 88-264 VAC, 47 – 63Hz
Input kVA: (max demand):	1.5 kVA
Output Capability: (max available to load):	Based on load

APPENDIX A: TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE	NOTES
Output Current/Steps: (Programmable)		Actual achievable output based on load.
		Note: Limit detection occurs within;
UB-500A	5-500 Amps, 1 Amp/step	± 4 A of programmed limit value for UB-4000A
UB-1500A	15-1500 Amps, 1 Amp/step	± 3 A of programmed limit value for UB-1500A
UB-4000A	200-4000 Amps, 10 Amps/step	± 2 A of programmed limit value for UB-500A.
Output Voltage/Steps: (Programmable)	0.10 – 9.99 V (10mV steps)	Actual achievable output based on load. **Note:** Limit detection occurs within ± 40 mV of programmed limit value
Output Power/Steps: (Programmable)		Actual achievable output based on load. **Note:** Limit detection occurs within ± 5% of programmed limit value.
UB-500A	0.05 – 4.99 kW, 10 watts/step	
UB-1500A	0.1 – 9.99 kW, 10 watts/step	
UB-4000A	0.1 – 25.00 kW, 10 watts/step	
Resistance Monitoring Limits	---	**Note:** Limit detection occurs within ± 5% of programmed limit value
Weld Period:		
Squeeze	0 – 999 ms, 1.0 ms / step	
First/Second Pulse	0 – 99 ms, 0.1 ms/step	**Note:** If downslope is greater than 0 ms, then upslope or weld pulse must be greater than 0 ms.
Up/Downslope	0 – 99 ms, 0.1 ms/step	
Cool	0 – 99 ms, 0.1 ms/step	
Hold	0 – 99 ms, 0.1 ms/step	
Duty Cycle:	Based on load	See *Repetition Rates*
Weld Control: (Average values are regulated)	Weld Current, Voltage, or Power with simultaneous limits on one unregulated parameter for each pulse	---
Regulation During Load Resistance Fluctuation:	Current: +/-2% of setting +/- 10 A Voltage: +/-2% of setting +/- 0.05 V Power: +/-5% of setting +/-50 W	Load variation from 0.5 to 10 milliohms, exclusive of ripple. After weld time of 2 ms.
Steady State Regulation During Line Fluctuations:	Output: +/- 2% of reading	Line voltage within input range

DESCRIPTION	VALUE	NOTES
Power Supply Range and Accuracy:		Measurements are taken during the last 1 ms of a test pulse with 0.5 ms rise time and 2 ms pulse width using standard test configuration
Current UB-500A	5 – 500 Amps, ± 2% of setting or ± 2.5 A whichever is greater	
Current UB-1500A	15 - 1500 Amps, ±2% of setting or ± 7.0 A whichever is greater	
Current UB-4000A	200 – 4000 Amps, ± 2% of setting or ± 10A whichever is greater	
Voltage	0.1 – 9.99 Volts, ± 2% of setting or ± 0.05 V whichever is greater	
Power UB-500A	0.050 – 4.99 kWatts, ± 5% of setting or ± 12W whichever is greater	
Power UB-1500A	0.070 – 9.999 kWatts, ± 5% of setting or ± 40 W whichever is greater	
Power UB-4000A	0.100 – 25.00 kWatts, ± 5% of setting or ± 50 W whichever is greater	
Measurement Range and Accuracy:		User selectable limits on peak values of one of three parameters: current, voltage, or power. When a parameter goes outside of limits, the unit can be set to report the error, terminate the weld, or inhibit a second pulse. During rise times of < 300 µs limit events may not be detected. Accuracy measurements are taken during the last 1 ms of a test pulse with 0.5 ms rise time and 2 ms pulse width using standard test configuration. Voltage monitoring is not guaranteed below 0.1 V
Current UB-500A	0 – 500 Amperes, ± 2 % of actual value or 5 A whichever is greater.	
Current UB-1500A	0 – 1500 Amperes, ± 2 % of actual value or 10 A whichever is greater	
Current UB-4000A	0 – 4000 Amperes, ± 2 % of actual value or 20 A whichever is greater	
Voltage	0 – 9.99 Volts, ± 2 % of actual value or 50 mV whichever is greater	
Power UB-500A	0 – 4.99 kW, ± 5 % of actual value or 10 W whichever is greater	
Power UB-1500A	0 – 4.99 kW, ± 5 % of actual value or 10 W whichever is greater	
Power UB-4000A	0 – 25.00 kW, ± 5 % of actual value or 50 W whichever is greater	
Rise Time:		---
Current, Voltage and Power Control Modes	Limited by External secondary circuit	
V-A Control Mode	500 A/ms maximum	
Weld Schedules:	99	---
Data Communications:	Remote capability to upload / download weld schedule; monitor welds; set up parameters; select schedule; and read weld results buffer	---

Environmental Characteristics		
DESCRIPTION	**VALUE**	**NOTES**
Operating Ambient Air Temperature:	0 - 40 °C	---
Operating Humidity:	10 – 95 % Relative Humidity	(Non-condensing)

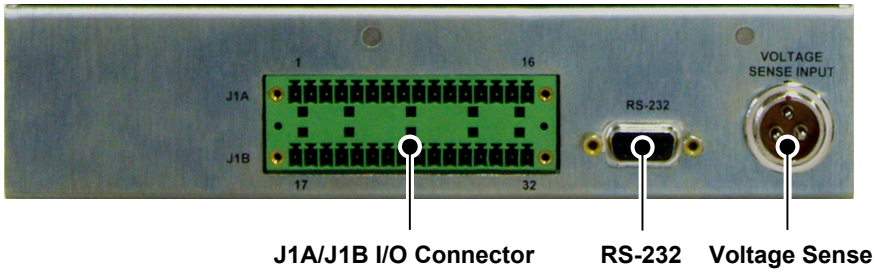
DESCRIPTION	VALUE
Digital Inputs	24 VDC 5 mA typical, 2500 VRMS optically isolated
Digital Outputs	30 VAC or VDC 0.5 amps, optically isolated solid state relays
Fire, Footswitch, Alarm, Alarm Reset, Schedule Selection, Weld Inhibit Signal Inputs	24 VDC inputs, 5 mA, hardware selectable for positive or negative logic.
Emergency Stop Input	External Emergency Stop Switch rated for 24 VDC, 2 amps
Voltage Sense Input	15 VDC, 0.1 A maximum
Head Valve Driver	24 VDC, 0.5 A maximum
Programmable Relays	Contact rating: 0.5 A at 30 VAC or 30 VDC maximum

APPENDIX B
ELECTRICAL AND DATA CONNECTIONS

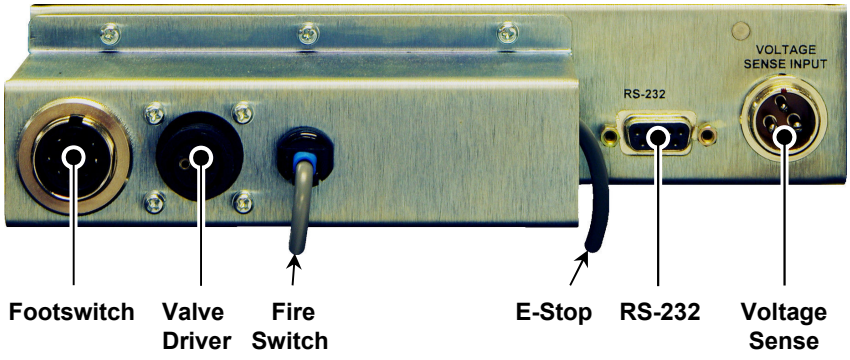
Introduction

This Appendix describes the electrical and data connectors located on the rear panel of the Power Supply. Depending on the model and accessories ordered, the I/O connections on the rear panel will differ in location. Below is a summary of the connector locations. The UB29/UB29A/DC29 is a legacy product.

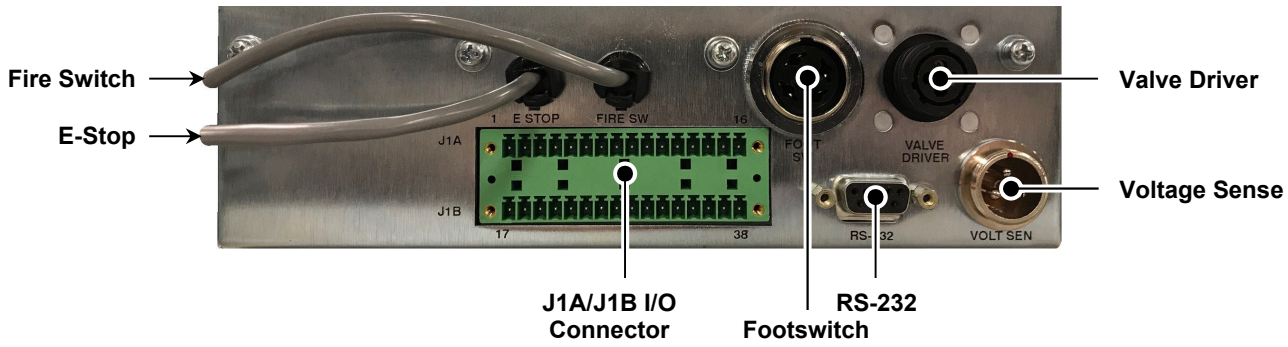
UB29, UB29A and DC29, Connector Layout:



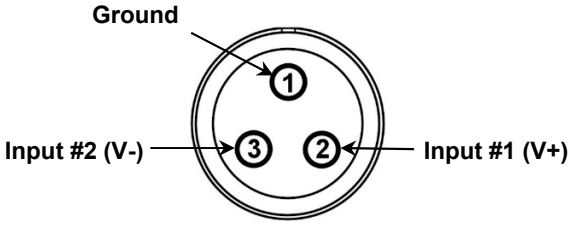
UB29, UB29A and DC29 with optional 10-372-01 – I/O Accessory Box, Connector Layout:



UB-500A, UB-1500A and UB-4000A, Connector Layout:



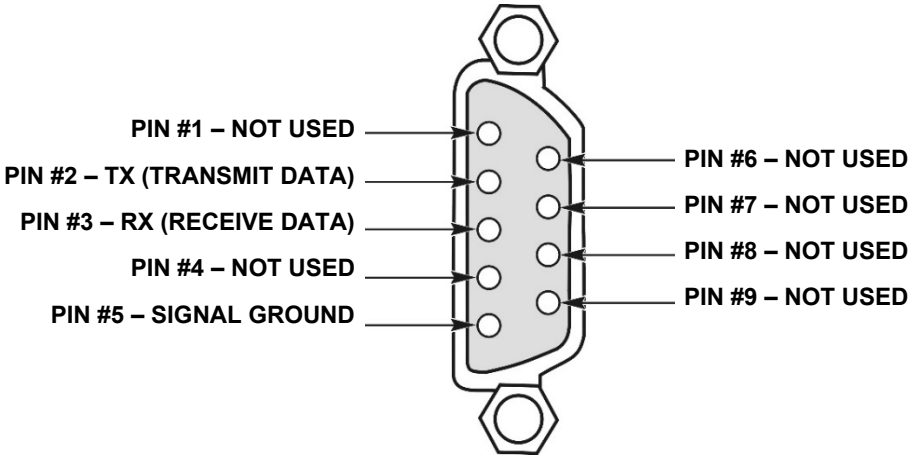
Voltage Sense Input Connector



VOLTAGE SENSE INPUT CONNECTOR SPECIFICATIONS

PIN #	SIGNAL		MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS
	NAME	TYPE				
1	GND	---	---	---	---	Ground
2	Input #1 V+	Pulse	15 V	0.1 A	I	Note: Polarity of Pins 1 & 2 ***must*** be set correctly.
3	Input #2 V-	Pulse	15 V	0.1 A	I	

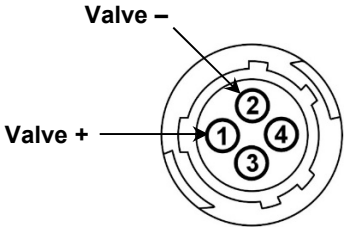
RS-232 Connector



RS-232 CONNECTOR SPECIFICATIONS

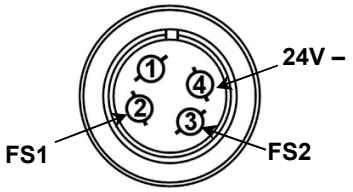
PIN #	DESCRIPTION	PIN TYPE
1	Not Used	
2	TX (Transmit Data)	RS-232 Driver
3	RX (Receive Data)	RS-232 Receiver
4	Not Used	
5	Signal Ground	Analog Ground (ISOGND1)
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	

Valve Driver Connector



PIN #	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS
1	Valve +	24 VDC	0.5 A	O	Same as J1B-31
2	Valve –	24 VDC	0.5 A	O	Same as J1B-32
3	Not Used				
4	Not Used				

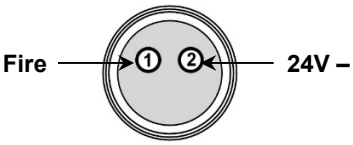
Foot Switch Connector



PIN #	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS
1	Not Used				
2	FS1	24 VDC	5 mA	I	Same as J1A-1
3	FS2	24 VDC	5 mA	I	Same as J1A-2
4	24V-	---	---	---	Same as J1A-3

Fire Switch Cable

The Fire Switch Cable is only available on the UB-500A/1500A/4000A or UB29/UB29A/DC29 with the optional 10-372-01 – I/O Accessory Box.



PIN #	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS
1	Fire	24 VDC	5 mA	I	Same as J1A-3
2	24V-	---	---	---	Same as J1A-6

J1A and J1B - I/O Signal Interface Connector

The J1A and J1B – I/O Connectors are available with all versions of the Power Supply. However these two connectors will not be accessible if the optional 10-372-01 – I/O Accessory Box is present on the UB29/UB29A/DC29 Power Supply models. Instead the common signals from J1A and J1B are brought out to panel connectors.

The UB-500A/1500A/400A Power Supply model integrates the I/O functionality of the 10-372-01 – I/O Accessory Box while also leaving the J1A and J1B – I/O Connectors accessible.

The I/O specifications for the J1A and J1B – I/O Connectors are listed below.

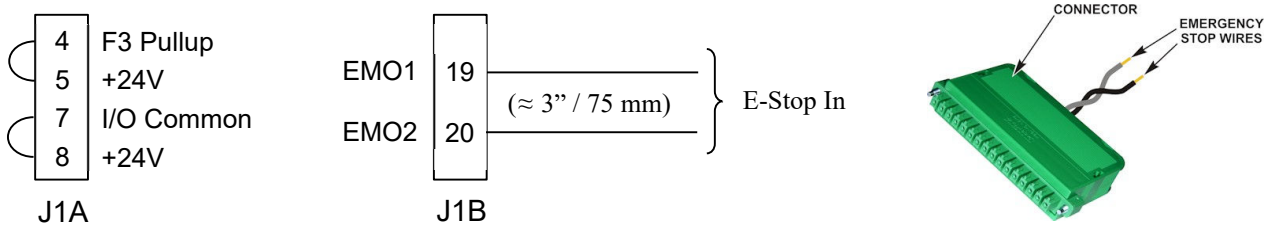
J1 A - I/O SIGNAL INTERFACE CONNECTOR SPECIFICATIONS

PIN #	NAME	I/O	VOLTAGE (Max.)	CURRENT (Max.)	SIGNAL TYPE	COMMENTS
J1A-1	FS1	I	+ 24 VDC	5 mA	voltage signal	Foot Switch 1 input
J1A-2	FS2	I	+ 24 VDC	5 mA	voltage signal	Foot Switch 2 input
J1A-3	Fire	I	+ 24 VDC	5 mA	voltage signal	Firing Switch input
J1A-4	F3 Pullup	I	+ 24 VDC	15 mA	voltage signal	Jumper to pin no. 5 or 6, as appropriate, to receive FS1, FS2, and Fire switch input circuit excitation
J1A-5	24V +	O	---	---	24V_I/O DC Power Supply	Provide FS1, FS2, and Fire switch input circuit excitation
J1A-6	24V -	O	---	---	24V_I/O DC Power Supply	Provide FS1, FS2, and Fire switch input circuit excitation
J1A-7	I/O Common	I	+ 24 VDC	45 mA	voltage signal	Jumper to pin no. 8 or 9, as appropriate, to receive input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs
J1A-8	24V +	O	---	---	24V_I/O DC Power Supply	Provide input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs
J1A-9	24V -	O	---	---	24V_I/O DC Power Supply	Provide input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs
J1A-10	Binary 0	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-11	Binary 1	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-12	Binary 2	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-13	Binary 3	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-14	Binary 4	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-15	Binary 5	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs
J1A-16	Binary 6	I	+ 24 VDC	5 mA	voltage signal	Binary Schedule Inputs

J1B - I/O SIGNAL INTERFACE CONNECTOR SPECIFICATIONS

PIN #	NAME	I/O	VOLTAGE (Max.)	CURRENT (Max.)	SIGNAL TYPE	COMMENTS
J1B-17	Weld Inhibit	I	+ 24 VDC	5 mA	voltage signal	Prevent Weld Pulse
J1B-18	Reset Alarm	I	+ 24 VDC	5 mA	voltage signal	Reset Alarms and Relay Outputs
J1B-19	EMO1	O	+24 VDC	2 A	---	Emergency Stop (EMO) Switch terminal 1
J1B-20	EMO2	I	+24 VDC	2 A	---	Emergency Stop (EMO) Switch terminal 2
J1B-21	RELAY1N	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 1 Negative
J1B-22	RELAY1P	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 1 Positive
J1B-23	RELAY2N	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 2 Negative
J1B-24	RELAY2P	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 2 Positive
J1B-25	RELAY3N	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 3 Negative
J1B-26	RELAY3P	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 3 Positive
J1B-27	RELAY4N	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 4 Negative
J1B-28	RELAY4P	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 4 Positive
J1B-29	RELAY5N	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 5 Negative
J1B-30	RELAY5P	O	30 VAC OR 30 VDC	0.5 A	relay contact	Relay output 5 Positive
J1B-31	VALVE+	O	+24 VDC	0.5 A	voltage signal	Valve Driver +
J1B-32	VALVE-	O	+24 VDC	0.5 A	voltage signal return	Valve Driver -

The Power Supply is shipped with two single row 16-pin mating plugs. These mating plugs need to be installed on the two I/O connectors (**J1A** and **J1B**) on the rear panel of the Power Supply in order to operate the Power Supply. These two mating plugs are pre-wired with the following configuration:



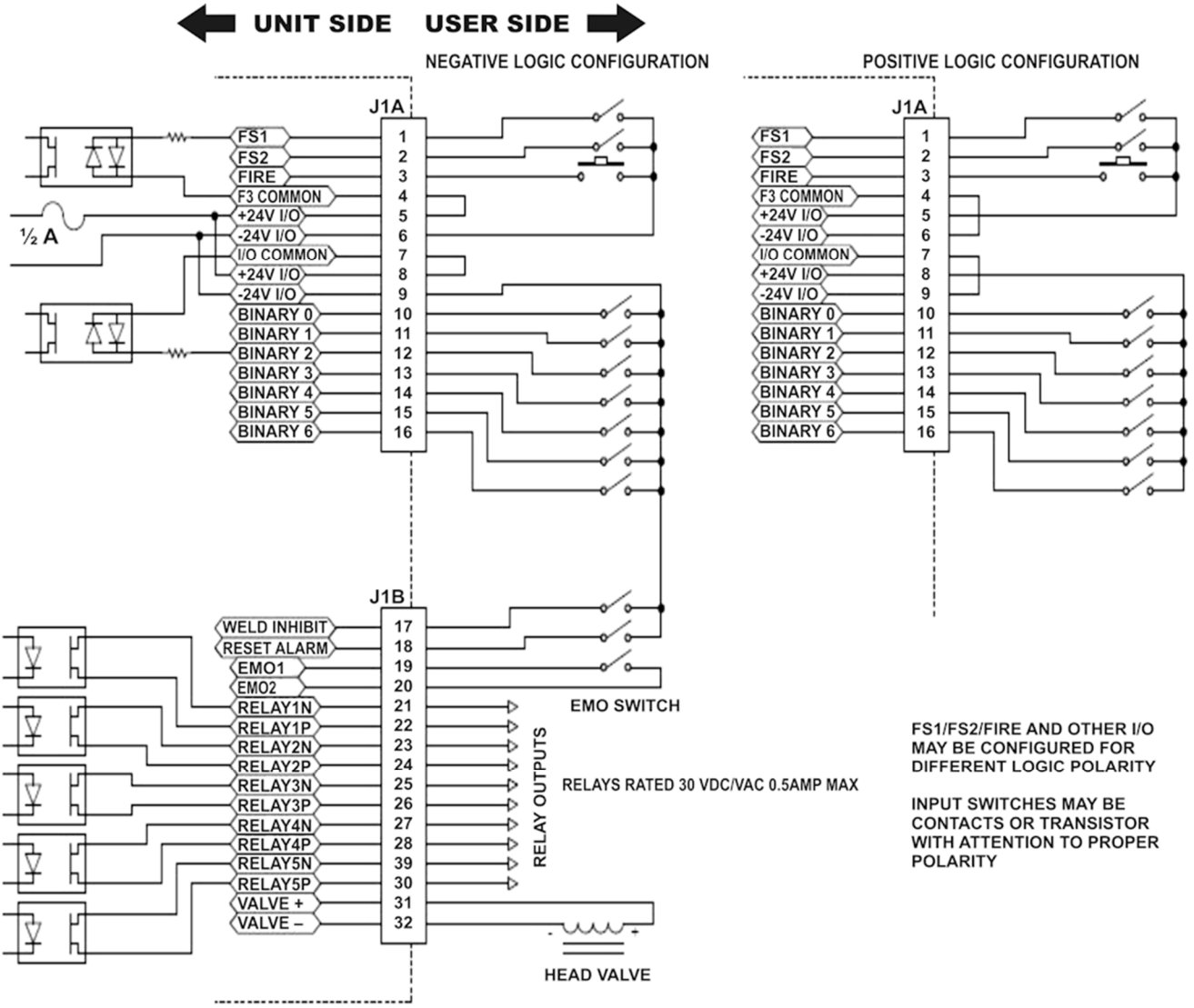
The wiring of the J1A - I/O Connector (as shown above) will configure the Power Supply I/O to operate on negative logic inputs.

Note: If the UB29/29A or DC29 was ordered with the optional 10-372-01 - I/O Accessory Box, then the J1A and J1B - I/O connectors will be pre-wired and terminated to the connectors on the rear face of the Accessory Box.

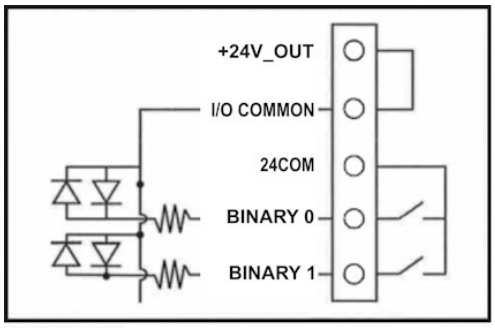
Emergency Stop Connections

Refer to *Chapter 1: Description, Section IV* for details on wiring up the **Emergency Stop** circuit.

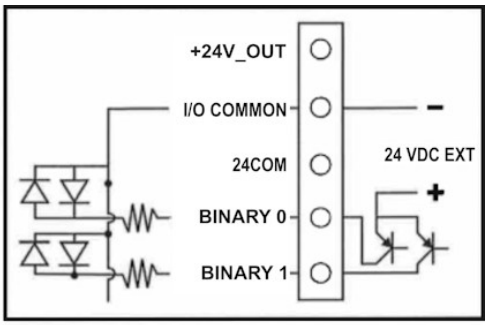
J1A and J1B – I/O Wiring Diagram



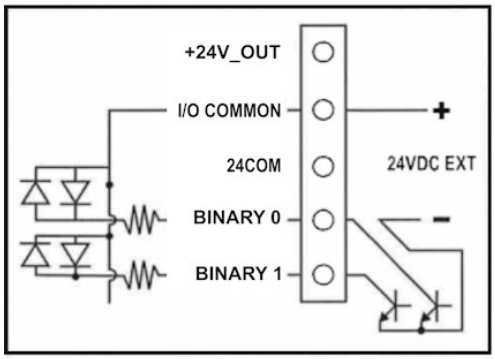
J1A and J1B – Configuration for Common Input Connections:



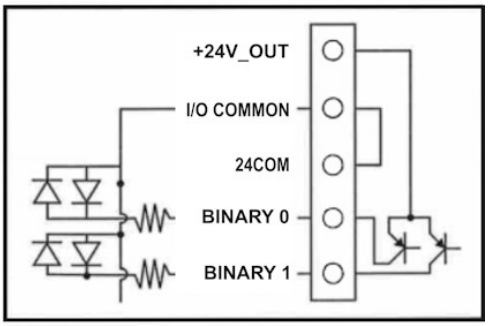
DRY CONTACT INPUT



COMMON POSITIVE INPUT
(External Power)

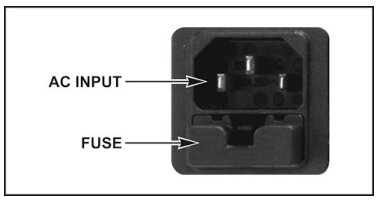


COMMON NEGATIVE INPUT
(External Power)



COMMON POSITIVE INPUT
(Internal Power)

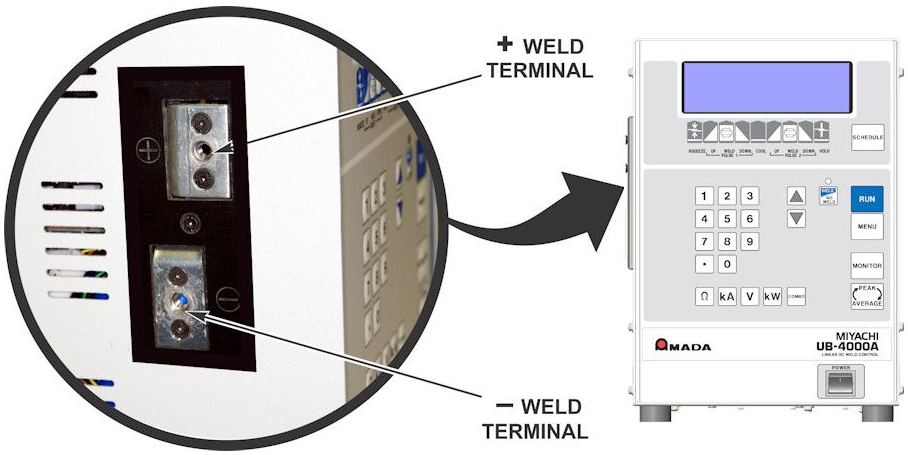
AC Input Power Connection



AC INPUT POWER CONNECTION SPECIFICATIONS

MODEL	TERMINAL	MAXIMUM VOLTAGE	MAXIMUM CURRENT
UB-500A UB-1500A UB-4000A	Hot	85 - 264 volts	10 amps
	Neutral	--	--
	Ground	--	--

Weld Terminals



UB-500A (UB29) WELD TERMINAL SPECIFICATIONS

TERMINAL	MAXIMUM VOLTAGE	MAXIMUM CURRENT	COMMENTS
+	9.9 volts	500 amps	Variable
-	--	--	Return

UB-1500A (UB29A) WELD TERMINAL SPECIFICATIONS

TERMINAL	MAXIMUM VOLTAGE	MAXIMUM CURRENT	COMMENTS
+	9.9 volts	1500 amps	Variable
-	--	--	Return

UB-4000A (DC29) WELD TERMINAL SPECIFICATIONS

TERMINAL	MAXIMUM VOLTAGE	MAXIMUM CURRENT	COMMENTS
+	9.9 volts	5,000 amps	Variable
-	--	--	Return

APPENDIX C
RELAY TIMING DIAGRAMS

Introduction

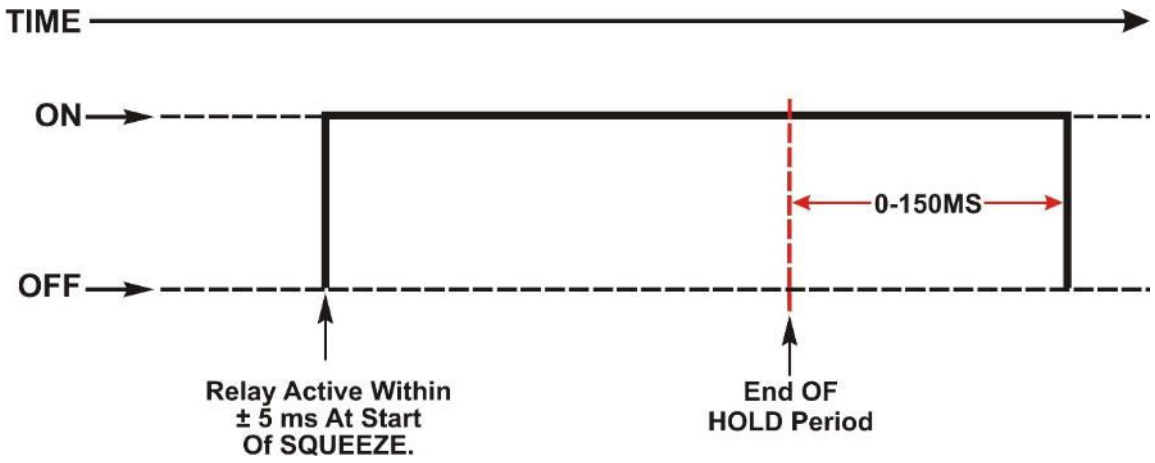
Instructions for relay setup are in *Chapter 5, Section V, Relay Settings.* Instructions cover the **ON/OFF** state, the **SET RELAY TO** and the **WHEN** states:

- **WELD**
- **END OF WELD**
- **ALARM**
- **OUT OF LIMITS**
- **V-A TIME OUT**
- **UNIT READY**
- **WELD COUNTER**
- **OUT OF LIMITS CONDITIONS**
  - **P1 HIGH LIMIT**
  - **P1 LOW LIMIT**
  - **P2 HIGH LIMIT**
  - **P2 LOW LIMIT**
  - **P1 or P2 HIGH CURRENT**
  - **P1 or P2 LOW CURRENT**
  - **P1 or P2 HIGH VOLTAGE**
  - **P1 or P2 LOW VOLTAGE**
  - **P1or P2 HIGH POWER**
  - **P1 or P2 LOW POWER**
  - **P1 or P2 HIGH RESISTANCE**
  - **P1 or P2 LOW RESISTANCE**

The following diagrams show the timing sequence for each relay **WHEN** state.

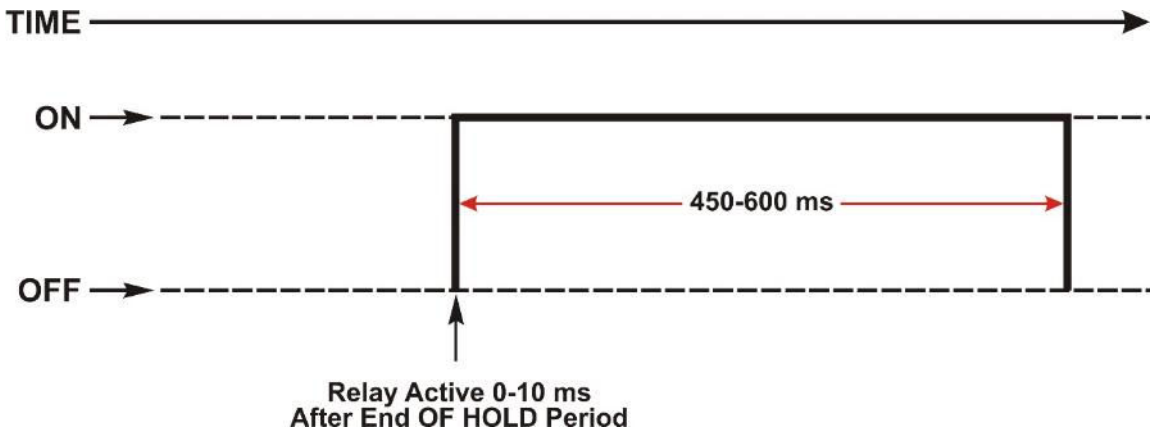
APPENDIX C: RELAY TIMING DIAGRAMS

WELD



When welding, the relay output signal will start within ± 5 milliseconds of the start of **SQUEEZE** and will stay energized for 0 - 150 milliseconds after the end of the **HOLD** period.

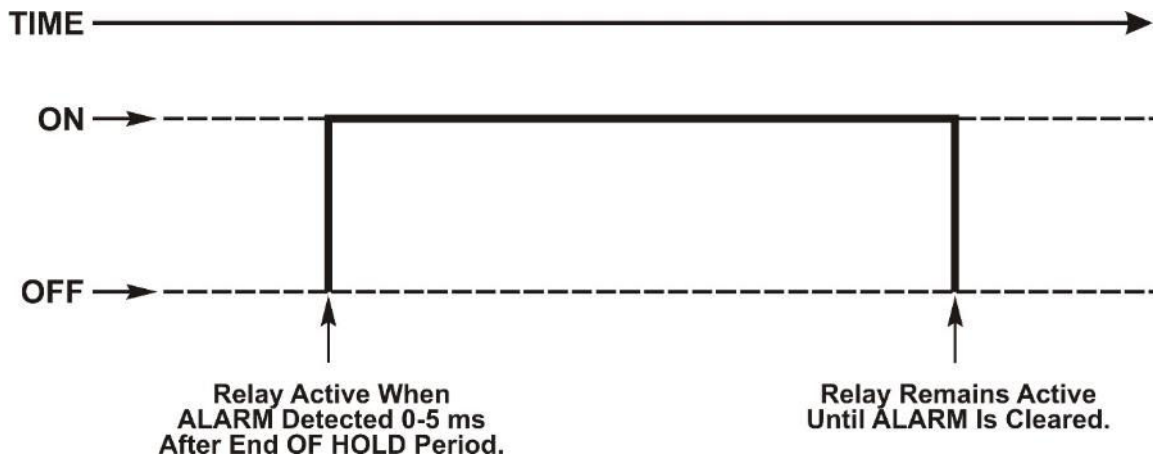
END OF WELD



When welding, the relay output signal will start 0 - 10 milliseconds after the end of the **HOLD** period and will stay energized for 600 - 850 milliseconds.* The relay will still close in case of an aborted weld.

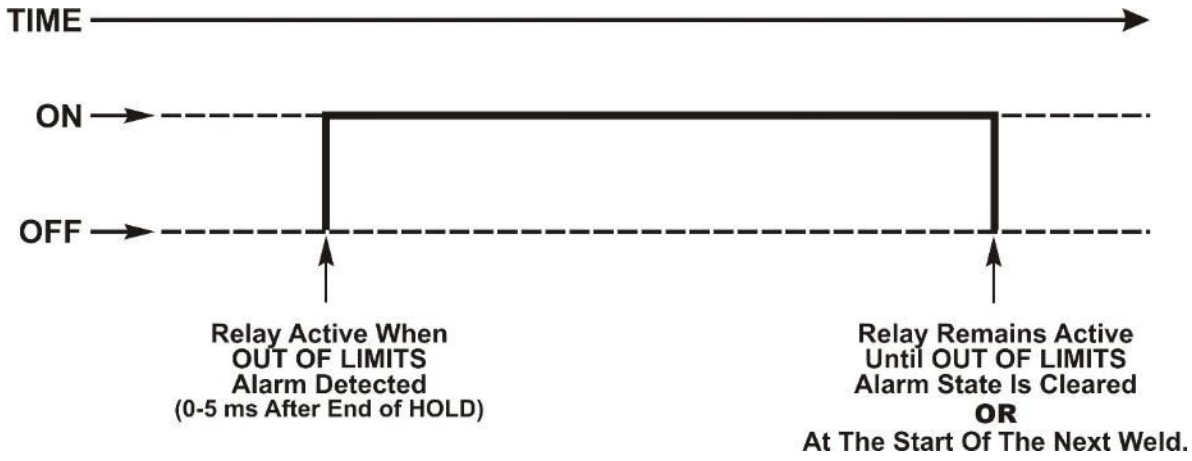
* If another weld is initiated within this time, the **END OF WELD** relay will be reset at the start of the next weld.

ALARM



The relay output signal will start when the Control senses an **ALARM** condition. For all **ALARMS**, except for **EMERGENCY STOP**, **OVER TEMPERATURE,** and **A/D FAILURE,** it will stay energized until the **ALARM** state is cleared by pressing the **RUN** button, setting the **RESET** digital input active, or initiating the next weld. For an **EMERGENCY STOP** alarm, pressing the **RUN** button only, or setting the **RESET** digital input to active, will reset the **ALARM** state. For the **OVER TEMPERATURE** or **A/D FAILURE** alarm, the unit power must be cycled to reset the **ALARM** state.

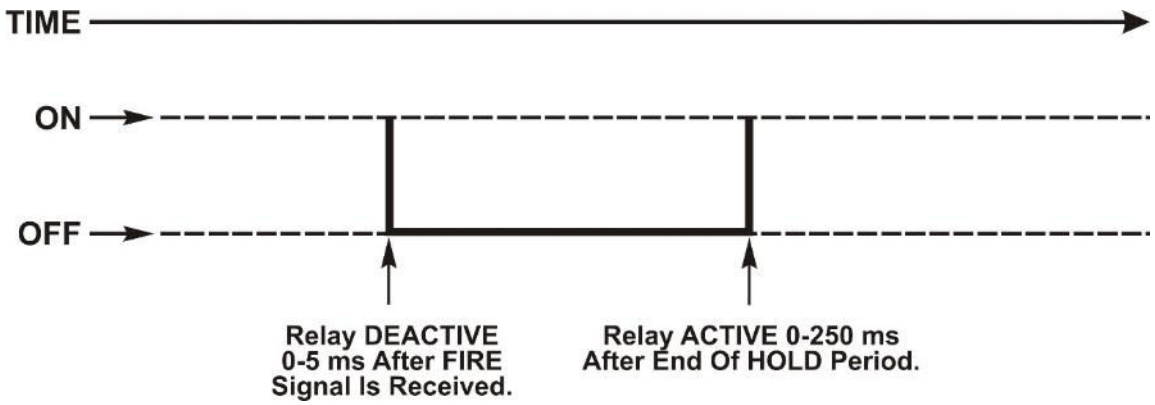
Out of Limits



The relay will switch when the Control senses any **OUT OF LIMITS** condition. It will start 0 - 5 milliseconds after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld.

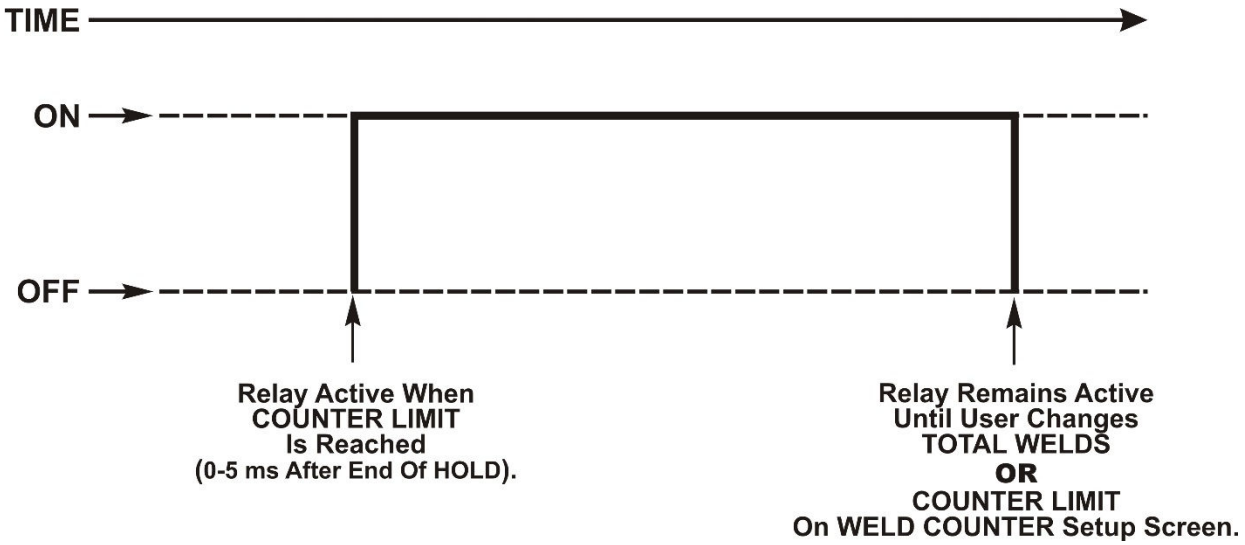
APPENDIX C: RELAY TIMING DIAGRAMS

UNIT READY



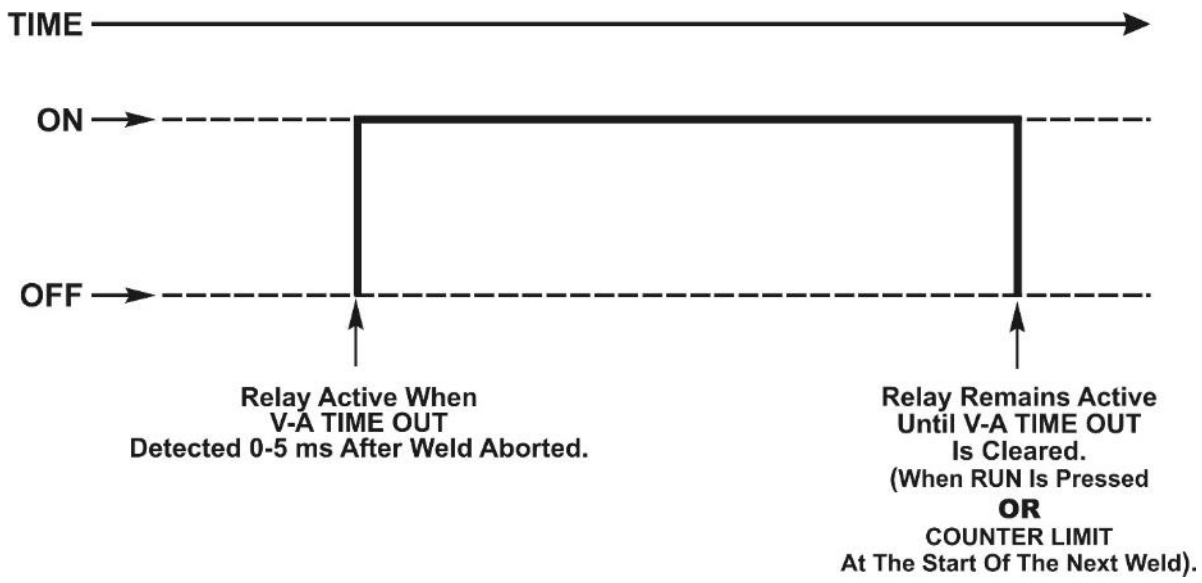
The relay will be energized when the Control is ready to weld. It will de-energize 0 - 5ms after receipt of a fire signal. It will energize 0 - 250ms after the end of **HOLD** period. The relay will also de-energize when a schedule is being edited, the **MENU** button functions are accessed, or the **SCHEDULE** button is pressed to change a schedule

WELD COUNTER



The relay signal will switch when the **TOTAL WELD COUNTER** value reaches the user set value for **COUNTER LIMIT**. It will start 0 - 5ms after the end of **HOLD** and will stay energized until the user changes the **TOTAL WELDS** or **COUNTER LIMIT** on the **WELD COUNTERS** Setup screen

V-A TIME OUT (Combo Mode)



The relay will switch when the Control determined that **V-A** ramp-up time was exceeded. It will start 0 - 5 milliseconds after the weld is aborted and will stay energized until the **V-A TIME OUT** alarm is cleared by pressing the **RUN** button, or at the start of the next weld.

APPENDIX D
LCD DISPLAY MESSAGES

Introduction

The Control displays three types of messages on the LCD screen to alert the operator of the status of the Control:

- **Alarm**
- **Out of Limits**
- **General Status**

You may see these messages when setting-up and programming the Control, or when performing spot welding. Only one message can be displayed at a time.

Relay Activation

Alarm and **Out Of Limits** messages activate the output relays as described in *Appendix C, Relay Timing Diagrams*. **General Status** messages do ***not*** activate the output relays.

Clearing Alarm Conditions to Resume Operation

If an alarm condition occurs, you ***must*** do the following:

1 Take the **Corrective Action** shown next to the **Alarm** message in the list of messages.

2 Clear the **Alarm** condition on the Control in order to resume operation:

- Press the **RUN** key on the front panel of the Control.

OR

- Momentarily close the Reset Alarm Inhibit input on I/O Connector J1B on the rear panel.

3 Repeat until all alarms are cleared

No action is required to resume operation if you see either **Out of Limits** or **General Status** messages.

List of Messages

The following pages list LCD display messages in alphabetical order.

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
ACCESS DENIED! SCHEDULE LOCK ON	Operator tried to change a weld schedule or individual weld parameters.	Press **MENU**, select System Security, then enter your access code to turn off Schedule Lock. **NOTE:** Entering a security code of 414 will always unlock the system.	GENERAL STATUS
ACCESS DENIED! SYSTEM SECURITY ON	Operator tried to change parameters of an individual weld schedule, I/O switch functions, or calibration parameters.	Press **MENU**, select System Security, then enter the correct access code to turn off the System or Calibration Lock protection features. **NOTE:** Entering a security code of 414 will always unlock the system.	GENERAL STATUS
A/D FAILURE	Control failed to convert either voltage or current monitor signal to digital signal. Weld Aborted.	Cycle power to clear error.	ALARM
ALL LIMITS ON THE SELECTED SCHEDULE HAVE BEEN SET TO ZERO	User programmed the Control to automatically reset all limits for the present schedule to their factory-set default values.	**CAUTION:** Be careful when using the **MENU** default features. There is no way to undo a **RESET TO DEFAULTS** action.	
CALIBRATION VALUES RESET TO DEFAULT	User entered calibration values have been reset to factory default values.	Execute the built-in calibration procedure to get the correct setting. See Calibration section in manual.	GENERAL STATUS
CAPACITY LIMIT EXCEEDED – CAP BANK	The charge on the capacitor bank is too low. Pulse energy level and/or time are too high due to user setpoint for **Energy Capacity Limi**t..	Reduce the energy level and/or time setting.	ALARM
(Schedule Number) NEXT (Schedule Number)	Chain Schedules function is active. Schedule has been incremented. NOTE: Display will appear like this example**: 23 NEXT 13**	Normal operation. See Chapter 5 for more information.	GENERAL STATUS
CHECK INPUT SWITCH STATUS	One or more of the Firing or Foot Switch input signals is preventing the Control from continuing to operate.	Remove the I/O input control signal condition preventing further Control operation. **NOTE:** The correct removal action depends on how the **INPUT SWITCH SELECT** in the Setup 1 menu was programmed by the user.	ALARM

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
CHECK VOLTAGE CABLE	No electrode voltage measurement was made.	Verify that the Voltage Sense Cable is properly connected to the electrodes or electrode holder. **NOTE:** Polarity is important for the cable connection.	OUT OF LIMITS
COOL TIME ADDED, DIFFERENT FEEDBACK	The Control automatically added Cool Time to the schedule because Pulse 1 and Pulse 2 feedback modes are different, or Pulse 1 and Pulse 2 energy levels are different.	Normal operation.	GENERAL STATUS
CURRENT 1 GREATER THAN UPPER LIMIT	Actual weld current is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
CURRENT 1 LOWER THAN LOWER LIMIT	Actual weld current is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
CURRENT 2 GREATER THAN UPPER LIMIT	Actual weld current is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
CURRENT 2 LOWER THAN LOWER LIMIT	Actual weld current is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
CURRENT IS AT MAXIMUM	The Control is providing the maximum current possible.	Determine the cause of the high current output. Changes to the welding setup of process can affect the energy delivered.	OUT OF LIMITS
EMERGENCY STOP - OPERATOR ACTIVATED	The Operator Emergency Stop switch has been activated. All power outputs are disabled.	Remove any unsafe operating conditions at the welding electrodes. Reset the Operator Emergency Stop switch. Press RUN to reset, verify that correct weld schedule is selected.	ALARM
FIRING SWITCH BEFORE FOOT SWITCH	The Firing Switch input has been activated before the Foot Switch has been activated.	Check the weld head for an improperly adjusted firing switch. Automation Only - Check the timing on the PLC control lines to the Firing Switch and Foot Switch inputs.	ALARM
FIRING SWITCH DIDN'T CLOSE IN 10 SECONDS	The Firing Switch input was not activated within 10 seconds after the Foot Switch was closed.	Press **RUN** to clear alarm. Check air pressure setting on weld head. Check Firing Switch connection.	ALARM
ILLEGAL SECURITY CODE ENTERED	The wrong security code was entered to de-activate the System, Schedule, or Calibration Lock protection features.	Press **MENU**, select System Security, then enter the correct access code to turn off System, Schedule, or Calibration Lock protection features. **NOTE:** Entering a security code of 414 will always unlock the system.	GENERAL STATUS
INHIBIT 2ND PULSE	A monitor action is programmed to inhibit the second pulse and the first pulse energy limit was reached.	Normal operation if this function is used. See Chapter 4, Operating Instructions.	OUT OF LIMITS
INHIBIT Control SIGNALS ACTIVATED	The Inhibit input control signal is activated, preventing the Control from continuing to operate. **NOTE:** Activating the Inhibit input terminates only future operations. It does NOT terminate any present Control operation.	Remove the Inhibit signal condition preventing further the Control operation. **NOTE:** The correct removal action depends on how the control signal I/O logic was programmed by the user.	ALARM

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
INPUT TOO LARGE	The user has attempted to program a weld energy or time that exceeds the capability of the Control.	Re-program welding parameters to be within the capability of the Control.	GENERAL STATUS
INPUT TOO SMALL	The user has attempted to program a weld energy or time that is below the capability of the Control.	Re-program welding parameters to be within the capability of the Control.	GENERAL STATUS
INVALID ERROR	An internal software error occurred	Consult factory	GENERAL STATUS
IT MODE RISE TIME TOO SMALL 500A/ms	Control calculated that user setpoint for time is too short to reach current setpoint for Combo Mode	Increase time or decrease current setpoints	GENERAL STATUS
LOWER LIMIT ADJUSTED	The user has attempted to program a lower or upper limit delay, which results in a limit time of less than 0.5 milliseconds.	Verify that the automatic correction by the Control is acceptable. Reprogram if necessary.	GENERAL STATUS
LOWER LIMIT GREATER THAN UPPER LIMIT	The user has tried to program a Lower Limit value that is greater than the Upper Limit value for Pulse 1 or Pulse 2 time periods.	Re-program the invalid Lower Limit value.	GENERAL STATUS
NO CURRENT READING	No current measurement was made. Possible open circuit.	Check that a closed secondary circuit is present when the Control fires. If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact AMADA WELD TECH for support.	OUT OF LIMITS
NO VOLTAGE READING	No voltage measurement was made. Possible open circuit or possible voltage lead connection problem.	Check that a closed secondary circuit is present when the Control fires. Check voltage cable connection. If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact AMADA WELD TECH for support.	OUT OF LIMITS
NO WELD	User has tried to activate the Control with the **WELD/NO WELD** Switch in the No Weld Position. **INOWELD** signal might have been activated.	Set the **WELD/NO WELD** switch to the Weld position. Deactivate **INOWELD.**	OUT OF LIMITS
OVER TEMPERATURE	One of the internal thermal switches reaches it switching temperature indicating internal unit temperatures are too high.	Check that cooling fan on rear panel and internal power supply are functioning.	GENERAL STATUS

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
P1 STOPPED - LIMIT REACHED	When in **APC** mode, the user set Upper Limit value has been reached, and the weld energy has been terminated for Pulse 1.	Normal operation if this function is used. See Chapter 4, Operating Instructions for information on Pulse 1 **OUT OF LIMITS ACTION** for PART CONDITIONER.	OUT OF LIMITS
POWER 1 GREATER THAN UPPER LIMIT	Actual weld power is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
POWER 1 LOWER THAN LOWER LIMIT	Actual weld power is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
POWER 2 GREATER THAN UPPER LIMIT	Actual weld power is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
POWER 2 LOWER THAN LOWER LIMIT	Actual weld power is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
RESISTANCE 1 GREATER THAN UPPER LIMIT	Actual weld resistance is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
RESISTANCE 1 LOWER THAN LOWER LIMIT	Actual weld resistance is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
RESISTANCE 2 GREATER THAN LOWER LIMIT	Actual weld resistance is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
RESISTANCE 2 LOWER THAN LOWER LIMIT	Actual weld resistance is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
SCHEDULES ARE RESET	User programmed the Control to automatically reset all weld schedules to their factory set default values.	**CAUTION:** Be careful when using the **MENU** default features. There is no way to undo a reset to defaults action.	GENERAL STATUS
SCREEN UPDATES ARE OFF	This message is displayed when the user goes to the **RUN** screen or changes the schedule while on the **RUN** screen when **SCREEN UPDATES** have been set to OFF.	None needed. This is a reference message only.	GENERAL STATUS

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
SYSTEM & SCHEDULE RESET TO DEFAULTS	During power-up, if the Control detects that internal memory is corrupt, the Control resets memory to defaults.	Re-enter user settings. Consult the factory if this message reoccurs.	GENERAL STATUS
SYSTEM PARAMETERS ARE RESET	User programmed the Control to automatically reset all I/O and other system parameters to their factory set default values.	**CAUTION:** Be careful when using the **MENU** default features. There is no way to undo a reset to defaults action.	GENERAL STATUS
UPSLOPE REQUIRED FOR LOWER LIMIT	User has attempted to program a Lower Limit value for Weld 1 or Weld 2 periods without using an upslope period.	Delete the Weld 1 or Weld 2 Lower Limit value. Add an upslope period before Weld 1 or Weld 2 if a Lower Limit value is desired.	GENERAL STATUS
V-A TIME OUT	Weld current did not reach current setting within the user set time for Tv for a Pulse using the **Combo** (V-A) feedback mode.	Refer to Combo Mode description in Chapter 3 and change current and/or Tv.	OUT OF LIMITS
VOLTAGE 1 GREATER THAN UPPER LIMIT	Actual weld voltage is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
VOLTAGE 1 LOWER THAN LOWER LIMIT	Actual weld voltage is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
VOLTAGE 2 GREATER THAN UPPER LIMIT	Actual weld voltage is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS

LCD Display Messages

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
VOLTAGE 2 LOWER THAN LOWER LIMIT	Actual weld voltage is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
VOLTAGE IS AT MAXIMUM	The Control is providing the maximum voltage possible.	Determine the cause of the high current output. Changes to the welding setup of process can affect the energy delivered.	OUT OF LIMITS
WELD FIRE LOCKOUT – CAP BANK TOO LOW	A weld was initiated before the capacitor bank charge reached the required level as programmed in the WAVEFORM CHECK menu. Default value for WELD FIRE LOCKOUT is 90% charge. Reducing this value with high energy levels or longer weld times could exceed the capacity of the Control.	Reduce the repetition rate. See Chapter 5 for programming information. See Appendix F for Repetition Rate and Control capability details.	ALARM
WELD TIME TOO SMALL	The user has attempted to program zero for all upslope, weld, and downslope time periods.	Re-program the welding parameters to be within the capability of the Control.	GENERAL STATUS

APPENDIX E
RS-232 CONNECTIONS

Section I. RS-232 Connections

Overview

The Power Supply has an RS-232 Serial Port connector that is used to transmit commands and weld data to/from a Personal Computer (PC) / host computer or other serial communications device.

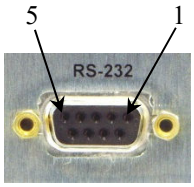
Interface Protocol

Parameter	Description
Baud Rate	6.2k, 19.2k, 38.4k or 56.0k bits/second
Stop Bits	1
Data Bits	8
Parity	None

RS-232 Serial Port Connections

The RS-232 Serial Port connector is a standard 9-pin female D-Sub connector. You only need to connect to the TxD (transmit), RxD (receive) and ground pins.

Pin	Signal
2	TxD (transmit)
3	RxD (receive)
5	Ground



Connect a standard RS-232 cable between your host computer COM port and the UB-4000A /UB-500A Power Supply serial data port or build your own cable with a standard DB9-M connector (Pt # 250-193) and backshell (Pt # 250-194).

Note: Rear Panel will appear different in Legacy models.

Section II. Command Format

Remote Data Collection and Programming

The Power Supply data communication protocol includes the capability of collecting basic weld information for each individual weld.

In order to do the simple data collection, the Power Supply must be in **CLIENT** mode. The host only needs to send an ASCII character string to the Power Supply. This allows ease of comprehension and debugging remote data collection development.

An example string would look like "*#ID* **REPORT OLD** *number<crlf><lf> "*. The string must begin with a " # ", then the *ID* or identification number of the Power Supply you wish data from. The "**REPORT OLD**" is one command from the command list in Section III.

NOTES:

- The letters ***<cr>*** (13) represent "carriage return."
- The letters ***<lf>*** (10) represent "line feed."
- For additional remote data collection commands, see *Section III, Computer Originated Commands and Power Supply Originated Commands.)*

The "***number"*** is the quantity of welds you would like to acquire from the Power Supply. This number can be greater or lesser than the number of welds made since the last data collection. The carriage return line feed line feed sequence "***<crlf><lf>"*** terminates the command and is required.

The Power Supply will then send the requested number of weld reports up to the amount stored into the Power Supply since the last data collection. The Power Supply erases all the weld data sent from the weld data buffer. Each weld report data is separated with a carriage return line feed sequence **"*<crlf>".*** The fields within the report are separated with a comma. This allows you to import this data into a spreadsheet program like *Microsoft Excel*.

The Host is requesting the Power Supply with ***ID*** #1 to send the last 10 weld reports from the stored accumulated weld reports by sending the following command:

#01 REPORT OLD 10 *<crlf><lf>*

The weld data counter in the Power Supply is decremented by 10. The corresponding Power Supply with ***ID*** #1 responds with:

#1 REPORT 10 <*crlf*>
1,1,0,0,0,0,551,552,908,920,410,835,89,123,0,0,931,1246,1250,1941,1476,2427,122,15,9 <*crlf*>
1,1,0,0,0,0,551,550,908,920,409,835,89,123,0,0,932,1248,1250,1941,1478,2427,122,15,10 <*crlf*>
1,1,0,0,0,0,551,550,912,914,410,829,89,121,0,0,932,1249,1250,1941,1479,2427,124,16,11 <*crlf*>
1,1,0,0,0,0,550,550,912,914,409,833,89,119,0,0,931,1246,1250,1941,1476,2427,122,16,12 <*crlf*>
1,1,0,0,0,0,551,552,912,914,410,833,89,121,0,0,932,1249,1250,1945,1480,2431,123,15,13 <*crlf*>
1,1,0,0,0,0,551,554,912,933,411,842,89,122,0,0,931,1248,1250,1948,1478,2435,123,15,14 <*crlf*>
1,1,0,0,0,0,551,554,908,927,412,839,89,120,0,0,932,1249,1250,1941,1480,2427,123,15,15 <*crlf*>
<*lf*>

When no information is being passed, the host passes an empty token, which is a packet consisting of the token followed by the end of packet sequence (<crlf><lf>). If the Power Supply has a message to return, it sends the message along with the token to the host. Otherwise, if the Power Supply has no message to return, it returns an empty token.

A message consists of any command and its parameters or other data accompanying the command. Each token-message packet must conclude with an end of packet sequence. The Power Supply ignores any packet beginning with a unit ID that does not match its programmed value, up to the point that an idle line is detected. Thus, at least one character time of idle line is required between packets to wake up all Power Supplies on the communication line in order to recognize any subsequent packet that may be addressed to them.

Command Format

#*ID* **KEYWORD** *parameters* <crlf><lf>

UNIT IDENTIFICATION: #*ID* (*ID* is any number from "00" to "30", must be a two digits).

COMMAND KEYWORDS: BOLD.

VARIABLE: *italics.*

REQUIRED PARAMETERS: {enclosed in braces} (one parameter required and allowed).

CHOICE OF PARAMETERS: separated by vertical bar **"|"** indicates one *OR* another of choices presented.

REQUIRED/OPTIONAL PARAMETERS: [enclosed in brackets] (one or more allowed, used in the **SET** parameter)(zero allowed in the **READ** parameter).

RANGE OF PARAMETERS: *low_end - high_end* (separated by hyphen).

END OF PARAMETER TERMINATOR: <crlf> (carriage return followed by linefeed).

TERMINATION OF COMMAND: <lf> (linefeed - must be preceded by the end of line terminator <crlf>).

Each unit identifier, command keyword, and parameters must be separated by one or more spaces except the termination of command <lf> must follow the end of parameter terminator<crlf> immediately. i.e. **"<crlf><lf>"**

Communication examples:

1. COUNTER:

Example 1:

Send: **#01 COUNTER READ<crlf><lf>**

Receive: **#01 COUNTER**
TOTAL XX
GOOD XX
LIMIT XX

Example 2:

Send: **#01 COUNTER SET<crlf>**
TOTAL XX<crlf>
GOOD XX<crlf>
LIMIT XX<crlf><lf>

Receive: **Nothing**

2. ALARM:

Example 1:

Send: **#01 ALARM CLEAR<crlf><lf>**

Receive: **Nothing**

Example 2:

Send: **#01 ALARM READ<crlf><lf>**

Receive: **#01 ALARM NONE**

3. SECURITY:

Example 1:

Send: **#01 SECURITY READ<crlf><lf>**

Receive: **#01 SECURITY**
SCHEDULE OFF (or ON)
SYSTEM OFF (or ON)
CALIBRATION OFF (or ON)

Example 2:

Send: **#01 SECURITY {OFF|SCHEDULE|SYSTEM|CALIBRATION} <crlf><lf>**
(OFF sets all security to OFF, SCHEDULE sets security to ON, SYSTEM sets security to ON, CALIBRATION sets security to ON)

Receive: **Nothing**

Section III. Power Supply Communication Codes

When you issue a command to the Power Supply, you need to wait about 500 ms. before you issue the next command. The answer timeout is set to about 500 ms, in case the Power Supply doesn't respond to a command.

Suggested error checking procedure on the external host side of the interface:

1. For a host "read" command, e.g. read profile data, the host must timeout if the unit does not send a complete response within a reasonable amount of time. Host can also check the number of bytes received against the expected number for that message, range check the received data, or do whatever else is thought necessary to have confidence in the received data.
2. Following a host "set" command, the host must subsequently read the data just "set" and make sure the data "set" matches data "read." For example, if a "set schedule 1" command is sent, the unit must then do a "read schedule 1" and compare the set data against the read data.

Significance of the Unit's COMMUNICATIONS ROLE Parameter on the Communications Screen:

1. This parameter must be set to **HOST** under normal running conditions to turn on the "Read Report" command which sends the results of the latest weld to the host automatically.
2. When the parameter is set to **CLIENT**, this reporting will be turned off and the unit will accept both "Read" and "Set" from the host.
3. When in **HOST**, the unit will not accept any commands from the host. This avoids potential collisions between these commands and the automatic reporting of reflow results.
4. **HOST** or **CLIENT** must be set at the Control panel by pressing the **MENU** key and selecting option 5: **COMMUNICATIONS**.

Host Originated Commands

These are the commands sent by the host computer, RS-232 to a Power Supply.

Command	**STATUS**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the status of the weld data buffer. Power Supply returns **STATUS** with either "**OK**" or "**OVERRUN.**"

Command	**TYPE**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to return the type of welder, release number, and revision letters.

Command	**COUNT**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the number of weld data accumulated since the last data collection. Power Supply returns the COUNT even if there is no weld data available.

Command	**ERASE**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to erase all the weld reports. Note: The Power Supply does not send back any reply for this command, if it was successful.

Command	**SYNC**<crlf><lf>
Control State	Any
Description	Provides synchronization of the commands. The Power Supply returns SYNC command back to the host computer.

Command	**CURRENT**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the sampled Current data of the last weld. Power Supply shall return with CURRENT report. See CURRENT command under *Power Supply Originating Commands* section.

Command	**VOLTAGE**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the sampled Current data of the last weld. Power Supply shall return with VOLTAGE report. See VOLTAGE command under *Power Supply Originating Commands* section.

Command	**POWER**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the sampled Current data of the last weld. Power Supply shall return with POWER report. See POWER command under *Power Supply Originating Commands* section.

Command	**OHMS**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to report the sampled Current data of the last weld. Power Supply shall return with RESISTANCE report. See OHMS command under *Power Supply Originating Command*s section.

Command	**IT { READ | SET }**<crlf><lf>
Control State	Run State
Description	Provides control over the Power Supply schedule parameters related specifically only the Combo mode. When used with the "READ" keyword, the specific Combo mode parameters pertaining to the currently loaded schedule are returned (see SCHEDULE under *Power Supply Originated Commands*). When the "SET" keyword is used, the host may set (change) the value of the Combo specific parameters pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter_name and value variables. **ENABLE** { ON | OFF } enable Combo (V-A) Mode **VOLT1** { weld_energy } maximum allowable voltage for ramp **CURRENT1** { weld_energy } constant current control level Note: The Power Supply does not send back any reply for the **IT SET** command, if it was successful.

Command	**COUNTER READ**<crlf><lf>
Control State	Any
Description	Requests the Power Supply to return the Power Supply weld counter contents. **TOTAL** returns the total number of weld counter. **GOOD** returns the within limits counter. **LIMIT** returns the limit set point.

Command	**REPORT {OLD | NEW | ERASE}** *number* <crlf><lf>
Control State	Any
Description	Requests the Power Supply to send the weld report. **OLD**: requests to send the number of oldest weld reports since the last data collection. **NEW**: requests to send the number of newest weld reports and then erases them from the buffer. **ERASE:** will erase the number of oldest weld reports. ***number:*** the quantity of weld data to be sent or erased. If the number is greater than the number of weld data in the buffer, than the number of welds stored will be sent. **NOTE:** There must be a space between two fields.

Command	**STATE {READ}**<crlf><lf>
Control State	Any
Description	Commands the Power Supply to identify its current state (see STATE under *Power Supply Originated Commands* section) or go to either RUN state or PROGRAM state. **NOTE: The MONITOR is only available on the DC 25 and UB 25.**

Command	**LOAD** {*schedule_number*}<crlf><lf>
Control State	RUN state
Description	Selects the schedule_number as the currently loaded schedule. schedule_number may be any number from 1 to 99. There must be a space between LOAD and schedule_number. Note: The Power Supply does not send back any reply for this command, if it was successful.

Command	**COPY** {*from_schedule_number*} {*to_schedule_number*}<crlf><lf>
Control State	Any
Description	Allows one schedule to be copied to another schedule number. From_schedule_number and to_schedule_number may be any number from 1 to 99. Copying a schedule to itself has no effect. Note: The Power Supply does not send back any reply for this command, if it was successful.

Command	**SCHEDULE**<crlf><lf>
Control State	Any state ***except*** while welding.
Description	Requests the Power Supply to return the currently selected schedule number.

Command	**SCHEDULE** {READ │ SET}<crlf><lf> [*parameter_name value*<crlf><lf>]
Control State	RUN state.
Description	Provides control over the Power Supply schedule parameters. When used with the "READ" keyword, all parameters pertaining to the currently loaded schedule are returned (see SCHEDULE under *Power Supply Originated Commands*). When the "SET" keyword is used, the host may set (change) the value of one or more of the parameters pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter name and value variables:

ENG1	{ *weld energy* }	energy amount for pulse 1
FEEDBACK1	{ **KA** │ **V** │ **kW**}	feedback type for pulse 1
ENG2	{ *weld energy* }	energy amount for pulse 2
FEEDBACK2	{ **KA** │ **V** │ **kW**}	feedback type for pulse 2
SQUEEZE	{ *squeeze_time* }	squeeze time
UP1	{ *weld_time* }	up slope time of pulse 1
WELD1	{ *weld_time* }	weld time of pulse 1
DOWN1	{ *weld_time* }	down slope time of pulse 1
COOL	{ *weld_time* }	cool time
UP2	{ *weld_time* }	up slope time of pulse 2
WELD2	{ *weld_time* }	weld time of pulse 2
DOWN2	{ *weld_time* }	down slope time of pulse 2

HOLD { weld time } hold time

- ***squeeze_time*** and ***hold_time*** is the parameter that defines the time for the given period in 1ms. Valid range is from 0 to 999.
- ***weld_time*** is the parameter that defines the time for the given period. Valid ranges shown below.
- ***weld_energy*** is the parameter that specifies the amount of weld energy. In the current feedback mode, weld_energy is in unit of 0.001 KA. In the voltage feedback mode, weld_energy is in units of 0.001 V. In the power feedback mode, weld_energy is in units of 0.001 kW.
- The Power Supply does not send back any reply for the **SCHEDULE SET** command, if it was successful.

Command **MONITOR** {**READ** | **SET**}<crlf><lf>
[*parameter_name value*<crlf>], where *value* is an integer.

Control State Any state ***except*** while welding.

Description Provides control over the basic weld monitor settings of the Power Supply schedule. When used with the "READ" keyword, the basic weld monitor settings of the currently loaded schedule are returned (see MONITOR under *Power Supply Originated Commands*). When the "SET" keyword is used, the host may set (change) the value of one or more of the parameters of the basic weld monitor settings pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter_name and value variables:

TYPE1	**{ KA | V | KW | R }**	Monitor Type for pulse 1
ACTION1	**{ NONE | STOP | INHIBIT | APC }**	Out of Limit Action for pulse 1
UPPER1	**{** *limit_value* **}**	Upper Limit for pulse 1
LOWER1	**{** *limit_value* **}**	Lower Limit for pulse 1
TYPE2	**{ KA | V | KW | R }**	Monitor Type for pulse 2
ACTION2	**{ NONE | STOP }**	Out of Limit Action for pulse 2
UPPER2	**{** *limit_value* **}**	Upper Limit for pulse 2
LOWER2	**{** *limit_value* **}**	Lower Limit for pulse 2
P1LDLY1	{*delay_value*}	Pulse 1 Lower Limit Delay Start Time
P1LDLY2	{*delay_value*}	Pulse 1 Lower Limit Delay End Time
P1UDLY1	{*delay_value*}	Pulse 1 Upper Limit Delay Start Time
P1UDLY2	{*delay_value*}	Pulse 1 Upper Limit Delay End Time
P2LDLY1	{*delay_value*}	Pulse 2 Lower Limit Delay Start Time
P2LDLY2	{*delay_value*}	Pulse 2 Lower Limit Delay End Time
P2UDLY1	{*delay_value*}	Pulse 2 Upper Limit Delay Start Time
P2UDLY2	{*delay_value*}	Pulse 2 Upper Limit Delay End Time

limit_value is the parameter that specifies the range of the valid readings. If the reading was within the range of the *limit_value*, no alarm will occur. If the reading was out of the valid range, an alarm will occur. If the monitor type is KA, the *limit_value* is in unit of 1 A. If the monitor type is V, the *limit_*value is in unit of 1 mV. If the monitor type is kW, the *limit_*value is in unit of 1 W. The valid number for *limit_value* is 1 through 999 and 0 is for none.

The ***delay_value*** is the parameter that defines the time for the given period in 0.1 ms. Valid range is from 0 to 99. Lower delay value is only valid during WELD time. Upper delay value is valid during UP time, WELD time, and DOWN time.

Note: The Power Supply does not send back any reply for the **MONITOR SET** command, if it was successful

Command **RELAY** {**READ** | **SET**}<crlf><lf>
[*parameter_name value*<crlf>], where *value* is an integer.

Control State Any state ***except*** while welding.

Description Provides control over the Power Supply schedule parameters for relay settings. When used with the "**READ**" keyword, the relay settings of the currently loaded schedule are returned (see **RELAY** under *Power Supply Originated Commands*). When the "**SET**" keyword is used, the host may set (change) the value of one or more of the relay settings of the currently loaded schedule. The following is a list of valid literal substitutions for the *parameter_name* and *value* variables:

ACTIVE1	**{ OFF | ON }**	Relay 1 Active High or Active Low
CONDITION1	*condition_value*	Relay 1 Active Conditions
ACTIVE2	**{ OFF | ON }**	Relay 2 Active High or Active Low
CONDITION2	*condition_value*	Relay 2 Active Conditions
ACTIVE3	**{ OFF | ON }**	Relay 3 Active High or Active Low
CONDITION3	*condition_value*	Relay 3 Active Conditions
ACTIVE4	**{ OFF | ON }**	Relay 4 Active High or Active Low
CONDITION4	*condition_value*	Relay 4 Active Conditions
ACTIVE5	**{ OFF | ON }**	Relay 5 Active High or Active Low
CONDITION5	*condition_value*	Relay 5 Active Conditions

condition_value is:

{ WELD | END | ALARM | LIMITS | TIME | READY | P1HI | P1LOW | *P2HI* | P2LOW | P12HII | P12LOWI | P12HIV | P12LOWV | P12HIP | P12LOWP | P12HIR | P12LOWR | COUNTER }

Note: The Power Supply does not send back any reply for the **RELAY SET** command, if it was successful.

Command **CHECK** {**READ** | **SET**}<crlf><lf>
[*parameter_name value*<crlf>], where *value* is an integer.

Control State Any state ***except*** while welding.

Description Requests the Power Supply to return the waveform check values. When used with the "**READ**" keyword, all parameters pertaining to the waveform check values are returned (see **CHECK** under *Power Supply Originated Commands*). When the "**SET**" keyword is used, the host may set (change) the value of one or more of the waveform check parameters. The following is a list of valid literal substitutions for the *parameter_name* and *value* variables:

ENABLE	**{OFF | ON}**	Enable waveform check
CHARGE	{charge_value}	Weldfire Lockout charge %.
CAPACITY	**{***capacity_value* **}**	Energy capacity % limit.

NOTE: The valid number for the delay value is 0 through 99, representing 0.0 through 9.9 ms delay time.

charge_value is the weld fire lockout %. This limit is the % of capacitor bank charge that must be present before the next weld is allowed.

capacity_value is the capacity % limit. This limit is the % below the set point the energy is allowed to be at the end of the weld pulse.

Note: The Power Supply does not send back any reply for the **CHECK SET** command, if it was successful.

Command	**SYSTEM** {**READ** │ **SET**}<crlf><lf> [*parameter_name value*<crlf>], where *value* is an integer.
Control State	Any
Description	Provides control over the Power Supplies system parameters. When used with the "**READ**" keyword, all system parameters are returned (see **SYSTEM** under *Power Supply Originated Commands*). When used with the "**SET**" keyword, the host may set (change) the value of one or more of the system parameters. The following is a list of valid literal substitutions for the *parameter_name* and *value* variables:

WELDABORT	**{ OFF | ON }**	Footswitch weld abort
BUZZER	**{ OFF | ON }**	End of cycle buzzer
BUZSTOP	**{ OFF | ON }**	Buzzer at weld stop
GRAPH	**{ OFF | ON }**	Update Graph
UPDATE	**{ OFF | ON }**	Update all screens
LIGHT	**{ *light_value* }**	LCD contrast
LOUDNESS	**{ *loudness_value* }**	Buzzer Loudness
DEBOUNCE	**{ NONE | 10 | 20 | 30 }**	Switch debounce time in ms
FIRESW	**{ AUTO | REMOTE | NONE }**	Firing Switch Type
DISPLAY	**{ PEAK | AVG }**	Display mode

These parameters pertain to the settings of the option menus available via the front panel user interface.
light_value is a number 0 to 100 for brightness of the LCD. 0 is dark and 100 is the brightest.
loudness_value is a number 0 to 100 for buzzer loudness. 0 is off and 100 is the loudest.

Note: The Power Supply does not send back any reply for the **SYSTEM SET** command, if it was successful.

Command	**ALARM {READ** │ **CLEAR** │ **SET** *error_number* │ **DISPLAY** *alarm_message_string***}**<crlf><lf>
Control State	Any
Description	Provides access to the Power Supply alarm logic. When used with the "READ" keyword, the current error condition value is returned. See Appendix D. for list of alarm messages. When the "CLEAR" keyword is used, all alarm conditions are canceled. When the "SET" keyword is used, the host may invoke an error identified by error_number. When the "DISPLAY" keyword is used, an error condition can be created with any message desired. The length of the error message must be limited to 40 characters or less. No help message will be available in connection with this created error message. Note: The Power Supply does not send back any reply for the **ALARM CLEAR** or **ALARM SET** command, if it was successful.

Command	**SECURITY {OFF** | **READ** | **SCHEDULE** | **SYSTEM** | **CALIBRATION}**<crlf><lf>
Control State	Any
Description	Allows control of the system security mode. “OFF” sets all security status Power Supply to “OFF.” “SCHEDULE” sets the schedule lock to “ON.” “SYSTEM” sets the system lock to “ON.” “CALIBRATION” sets the calibration lock to “ON.” “READ” requests the Power Supply to return the present condition of the above four parameters. Note: The Power Supply does not send back any reply for this command, if it was successful.

Power Supply Originated Commands

These are the commands sent from a Power Supply to a host computer.

Command	**STATUS** *state_name*<crlf><lf>
Control State	Any
Description	Identifies the current status of the weld data buffer. May be in response with “OK” or “OVERRUN.” “OK” means that the Power Supply weld buffer did not over-run since the last data collection and all the data are intact. “OVERRUN” means that the Power Supply weld buffer did over-run since the last data collection and only the latest 1200 weld data are available to report.

Command	**TYPE** *type, release numbers, revision letters*<crlf><lf>
Control State	Any
Description	Returns software version.

Command	**COUNT** *number*<crlf><lf>
Control State	Any
Description	Returns the number of weld data available in Power Supply. The total number of weld data that the Power Supply holds in the buffer is 1,024.

Command	**SCHEDULE** *schedule_number*<crlf><lf>
Control State	Any
Description	Returns the current schedule number to the host. schedule_number may be any number from 1 to 99.

Command	**REPORT** *number_of_reports*<crlf><lf> *report <crlf> report <crlf> . . . . report <crlf><lf>*
Control State	Any
Description	Returns the requested number of weld reports. First field is the number of reports to be sent. Then follows the packets of report. One report pack hold all the information about a weld. Each report packet is separated by <crlf> and this Command ends with <crlf><lf>. ***number_of_reports:*** This is the number of reports that shall be included in this command. If the host computer requests more weld data than is available in the weld data buffer, the Power Supply sends only the weld reports in the weld buffer and the *number_of_reports* is the number of weld reports available in the weld data buffer. After the report is sent to the host computer, the Power Supply erases the weld data sent to the host from the weld data buffer. ***report****:* {*unit_number*, *schedule_number , weld_error1, weld_error2, weld_error3, weld_error4, average_current_1, peak_current_1, average_voltage_1, peak_voltage_1, average_power_1 , peak_power_1, average_resistance_1, peak_resistance_1, energy_capacity_1, average_current_2, peak_current_2 , average_voltage_2, peak_voltage_2, average_power_2, peak_power_2, average_resistance_2, peak_resistance_2, energy_capacity_2, weld_count}*

The fields in the report packet are separated with a comma and all fields are in integer format. There are always 25 fields in a report packet.

unit_number:	ID# of the unit
schedule_number:	The schedule number of the weld.
weld_error1:	Weld error, 1of 4 reported, no error = 0.
weld_error2:	Weld error, 1of 4 reported, no error = 0.
weld_error3:	Weld error, 1of 4 reported, no error = 0.
weld_error4:	Weld error, 1of 4 reported, no error = 0.
average_current_1:	The average current of pulse 1 (in A).
peak_current_1:	The peak current of pulse 1 (in A).
average_voltage_1:	The average voltage of pulse 1 (in mV).
peak_voltage_1:	The peak voltage of pulse 1 (in mV).
average_power_1:	The average power of pulse 1 (in W).
peak_power_1:	The peak power of pulse 1 (in W).
average_resistance_1:	The average resistance of pulse 1 (in $10^{-5}\,\Omega$).
peak_resistance_1:	The peak resistance of pulse 1 (in $10^{-5}\,\Omega$).
energy_capacity_1:	The energy capacity result (% at start of weld)
average_current_2:	The average current of pulse 2 (in A).
peak_current_2:	The peak current of pulse 2 (in A).
average_voltage_2:	The average voltage of pulse 2 (in mV).
peak_voltage_2:	The peak voltage of pulse 2 (in mV).
average_power_2:	The average power of pulse 2 (in W).
peak_power_2:	The peak power of pulse 2 (in W).
average_resistance_2:	The average resistance of pulse 2 (in $10^{-5}\,\Omega$).
peak_resistance_2:	The peak resistance of pulse 2 (in $10^{-5}\,\Omega$).
energy_capacity_2:	The energy capacity result (% at end of weld).
weld_count:	Weld count for this report.

Command	**STATE** *state_name*<crlf><lf>
Control State	Any
Description	Identifies the current state of operation of the Power Supply. May be in response to the **STATE READ** Command sent by the host, or may be sent as a result of a state change from the Power Supply front panel. ***state_name*** may be "**RUN", "MENU**", **"PROGRAM", "MONITOR" "WELD", CALIBRATION", "TEST"**, **"ALARM", "RUN <NO WELD>", "MENU <NO WELD>",** or **"PROGRAM <NO WELD>".**

Command	**COUNTER** *number*<crlf><lf>
Control State	Any
Description	Returns the requested current Power Supply weld counter number.

Command	**CURRENT** *number_of_data*<crlf><lf> data <crlf> data <crlf> . . . . data <crlf><lf>
Control State	Any
Description	Returns the Current reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. ***number_of_data:*** This is the number of data that shall be included in this command. The Power Supply samples current every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: *total weld time ÷ 50 μs.* This number will be always less than 2000. ***data****:* an integer number in unit of A.

Command	**VOLTAGE** *number_of_data*<crlf><lf> data <crlf> data <crlf> . . . . data <crlf><lf>
Control State	Any
Description	Returns the Voltage reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. ***number_of_data****:* This is the number of data that shall be included in this command. The Power Supply samples Voltage every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: *total weld time ÷ 50 μs.* This number will be always less than 2000. ***data****: A*n integer number in unit of mV.

Command	**POWER** *number_of_data*<crlf><lf> data <crlf> data <crlf> . . . . data <crlf><lf>
Control State	Any
Description	Returns the Power reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. ***number_of_data****:* This is the number of data that shall be included in this Command. The Power Supply samples Current and Voltage every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: *total weld time ÷ 50 μs.* This number will be always less than 2000. ***data****: A*n integer number in unit of W.

Command	**OHMS** *number_of_data*<crlf><lf> data <crlf> data <crlf> . . . . data <crlf><lf>
Control State	Any
Description	Returns the Resistance reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. ***number_of_data****:* This is the number of data that shall be included in this Command. The Power Supply samples Current and Voltage every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: *total weld time ÷ 50 μs.* This number will be always less than 2000. ***data****: A*n integer number in unit of Ω (10^{-5}).

Command	**IT** *number*<crlf><lf>	
	ENABLE	{ ON | OFF } <crlf> enable Combo (V-A) Mode
	VOLT1	{ weld_energy } <crlf> maximum allowable voltage for ramp
	CURRENT1	{ *weld_energy* } <crlf> constant current control level
	<lf>	
Control State	Any	
Description	Reports the Combo mode specific settings of the currently loaded Power Supply schedule parameters. The ***schedule_number:*** variable identifies which schedule is currently loaded, and may be any value from 1 to 99.	

Command	**SCHEDULE**	***schedule_number*** <crlf>
	ENG1	***weld_energy*** <crlf>
	FEEDBACK1	**{ KA | V | kW }** <crlf>
	ENG2	***weld_energy*** <crlf>
	FEEDBACK2	**{ KA | V | kW }** <crlf>
	SQUEEZE	***squeeze_time*** <crlf>
	UP1	***weld_time*** <crlf>
	WELD1	***weld_time*** <crlf>
	DOWN1	***weld_time*** <crlf>
	COOL	***weld_time*** <crlf>
	UP2	***weld_time*** <crlf>
	WELD2	**weld_time** <crlf>
	DOWN2	***weld_time*** <crlf>
	HOLD	***hold_time*** <crlf>
	<lf>	
Control State	Any	
Description	Reports the settings of the currently loaded Power Supply schedule parameters. The ***schedule_number:*** variable identifies which schedule is currently loaded, and may be any value from 1 to 99. ***squeeze_time*** and ***hold_time*** are the parameter that defines the time for the given period in 1 msec. Valid range is from 0 to 999. ***weld_time*** is the parameter that defines the time for the given period in 0.01 msec. For the UB25, the valid range is from 0 to 9900 (0 to 99.00 ms).	

HOST		Power Supply	
Increments	**Range**	**Time Range**	**Increments**
1	0 - 100	0 - 0.1 ms	0.01 ms
10	110 - 1000	1.1 - 10 ms	0.1 ms
100	1100 - 9900	11 - 99 ms	1.0 ms

weld_energy is the parameter that specifies the amount of weld energy.

- **Current Feedback** mode: the *weld_energy* range for the UB-500A is from 5 A to 500 A, for the UB-4000A, the range is from 100 A - 4,000 A, for the UB-1500A the range is from 50 A – 1500 A
- **Voltage Feedback** mode: *weld_energy* for the UB-500A is in units of 0.01 V, and the range is from 0.1 to 9.9 V (100 to 9900). For the UB-4000A, the range is from 0.1 to 9.9 V (100 to 9900) for the UB-4000A.
- **Power Feedback** mode: *weld_energy* for the UB-500A is in units of 10 W, and the range for the UB-500A is from 10 to 4900 W (10 - 4900). For the UB-4000A, the range is from 100 W to 9900 W (100 - 9900). For the UB-1500A the range is from 100 to 4900 W

pid gain: is the PID gain of the last weld

Command	**IT** *number*<crlf><lf> **ENABLE** { ON | OFF } <crlf> enable Combo (V-A) Mode **VOLT1** { weld_energy } <crlf> maximum allowable voltage for ramp **CURRENT1** { *weld_energy* } <crlf> constant current control level <lf>
Control State	Any
Description	Reports the Combo mode specific settings of the currently loaded Power Supply schedule parameters. The ***schedule_number:*** variable identifies which schedule is currently loaded, and may be any value from 1 to 99.

Command	**CHECK**<crlf> **ENABLE** **{ OFF | ON }<**crlf**>** **CHARGE** *capicity_value*<crlf> **CAPACITY** *capicity_value*<crlf> <lf>
Control State	Any except while welding
Description	Returns the parameters for the waveform check. ***charge_value*** is the weld fire lockout %. This limit is the % of capacitor bank charge that must be present before the next weld is allowed. ***capacity_value*** is the capacity % limit. This limit is the % below the set point the energy is allowed to be at the end of the weld pulse.

Command	**RELAY** <crlf>	
	ACTIVE1	**{ OFF | ON }** <crlf>
	CONDITION1	*condition value*<crlf>
	ACTIVE2	**{ OFF | ON }** <crlf>
	CONDITION2	*condition value*<crlf>
	ACTIVE3	**{ OFF | ON }** <crlf>
	CONDITION3	*condition value*<crlf>
	ACTIVE4	**{ OFF | ON }** <crlf>
	CONDITION4	*condition value*<crlf>
	ACTIVE5	**{ OFF | ON }** <crlf>
	CONDITION5	*condition value*<crlf>
	<lf>	
	condition value is **{ WELD | END | ALARM | LIMITS | READY | P1HI | P1LOW | P2HI | P2LOW | P12HII | P12LOWI | P12HIV | P12LOWV | P12HIP | P12LOWP | P12HIR | P12LOWR | COUNTER }**	
Control State	Any	
Description	Reports the relay settings.	

Command	**MONITOR**	*schedule_number*<crlf>
	TYPE1	**{ KA | V | KW | R }**<crlf>
	ACTION1	**{ none | STOP | INHIBIT | APC }**<crlf>
	UPPER1	**{** *limit_value* **}**<crlf>
	LOWER1	**{** *limit_value* **}**<crlf>
	TYPE2	**{ KA | V | KW | R }**<crlf>
	ACTION2	**{ none | STOP }**<crlf>
	UPPER2	**{** *limit_value* **}**<crlf>
	LOWER2	**{** *limit_value* **}**<crlf>
	<lf>	
Control State	Any	
Description	Reports the settings of the weld monitor of the currently loaded Power Supply schedule. The ***schedule_number*** variable identifies which schedule is currently loaded, and may be any value from 1 to 99. The possible value for all variables listed after their parameter name correspond to the values listed under **MONITOR** in *Host Originated Commands* of this manual.	

Command	**SYSTEM** <crlf>	
	WELDABORT	**{ OFF | ON }** <crlf>
	BUZZER	**{ OFF | ON }** <crlf>
	BUZSTOP	**{ OFF | ON }** <crlf>
	GRAPH	**{ OFF | ON }** <crlf>
	UPDATE	**{ OFF | ON }** <crlf>
	LIGHT	**{** ***light_value*** **}** <crlf>
	LOUDNESS	**{** ***loudness_value*** **}** <crlf>
	DEBOUNCE	**{NONE | 10 | 20 | 30 }** <crlf
	FIRESW	**{ AUTO | REMOTE | NONE }** <crlf>
	DISPLAY	**{ PEAK | AVG }** <crlf>
	<lf>	
Control State	Any	
Description	Reports the current settings of the Power Supply system parameters.	
	light_value is a number 0 to 99 for brightness of the LCD. 0 is dark and 100 is the brightest.	
	loudness_value is a number 0 to 99 for buzzer loudness. 0 is off and 100 is the loudest.	

Section IV. RS-232 Error Codes

If trouble occurs while using RS-232 communications, a Power Supply error code describing the problem will be transmitted. A list of possible errors is listed below:

```
ERRNONE        0    // No Error occurred
ALSWITCH       1    // Switch Input Error
ALCFIRESW      2    // FIRING SWITCH BEFORE FOOT SWITCH
ALEMGSTOP      3    // Emergency STOP
ALNFIRESW      4    // FSW didn't closed in 10 sec
ALTFHEAT       5    // Unit Over Heated
ALINHIBIT      6    // INHIBIT CONTROL SIGNALS ACTIVATED
ALMAXCURR      7    // CURRENT IS AT MAXIMUM
ALMAXVOLT      8    // Voltage is at Maximum
ALNOCURR       9    // No Current
ALNOVOLTC      10   // No Voltage
ALNOWELD       11   // WELD SWITCH IN NO WELD POSITION
ERCHKVOLT      12   // Check Voltage Cable
IT_RISETIME    13   // Combo Mode Rise Time too Small 500 A/ms
ERLIMIT        14   // Limit Error
ERCOOLADD      15   // Cool Time Added for feedback
ERDEFAULT      16   // System and Schedule Reset
ERCHAIN        17   // Chained to next schedule
ERP1LLIM       18   // Invalid lower limit delays for Pulse 1
ERP1ULIM       19   // Invalid upper limit delays for Pulse 1
ERP2LLIM       20   // Invalid lower limit delays for Pulse 2
ERP2ULIM       21   // Invalid upper limit delays for Pulse 2
ERNOUPSLOPE    22   // Upslope required for lower limit
ERBIG          23   // Input too large
ERSMALL        24   // Input too small
ERNOTREADY     25   // Press RUN before weld
ERSCHLOC       26   // Schedule Lock Error
ERLIMDLYS      27   // Limit delays adjusted
ERPROT         28   // System is protected
EROVERCUR1     29   // Over Current 1
ERLOWCUR1      30   // Low Current 1
EROVERVOL1     31   // Over Voltage 1
ERLOWVOL1      32   // Low Voltage 1
EROVERPWR1     33   // Over Power 1
ERLOWPWR1      34   // Low Power 1
EROVERRES1     35   // Over Resistance 1
ERLOWRES1      36   // Low Resistance 1
EROVERCUR2     37   // Over Current 2
ERLOWCUR2      38   // Low Current 2
EROVERVOL2     39   // Over Voltage 2
ERLOWVOL2      40   // Low Voltage 2
EROVERPWR2     41   // Over Power 2
ERLOWPWR2      42   // Low Power 2
EROVERRES2     43   // Over Resistance 2
ERLOWRES2      44   // Low Resistance 2
```

```
ERINHIBIT       45    // Inhibit 2nd pulse out of limit
ERWSTOP         46    // weld stop after P1 or P2 reached limit
ERRSTSCH        47    // Schedules are reset to default
ERRSTSYS        48    // System Parameters are reset to default
ERTSMALL        49    // Total weld time is too small
ERCAPBANK       50    // Test weld cap charge level too low
ALCAPCHG        51    // Capacitor charge level low
ERNOUPDATES     52    // Screen updates turned off
ER_IT_NOI       53    // IT MODE - NO CURRENT SET POINT REACHED
ER_AD_FAIL      54    // A/D Failure to Convert
ERCOUNTLIMIT    55    // Counter has reached its limit
ERNOWELDTIME    56    // Weld Time required for lower limit
ERBADFLASH      57    // Bad Flash
ALPOWERLOSS     58    // POWER LOSS DETECTED - SHUTTING DOWN
DISPLAYERROR    59    // Display Timeout
```

APPENDIX F
REPETITION RATES

Section I. Introduction

The term repetition rate refers to how often weld pulses can be repeated based on the Power Supplies recharging time. The Power Supply stores energy internally in a capacitor bank. This energy is used to provide the desired weld pulses. There are limits to the duration of weld pulses the unit can provide, and time must be provided between welds for the capacitor bank to recharge.

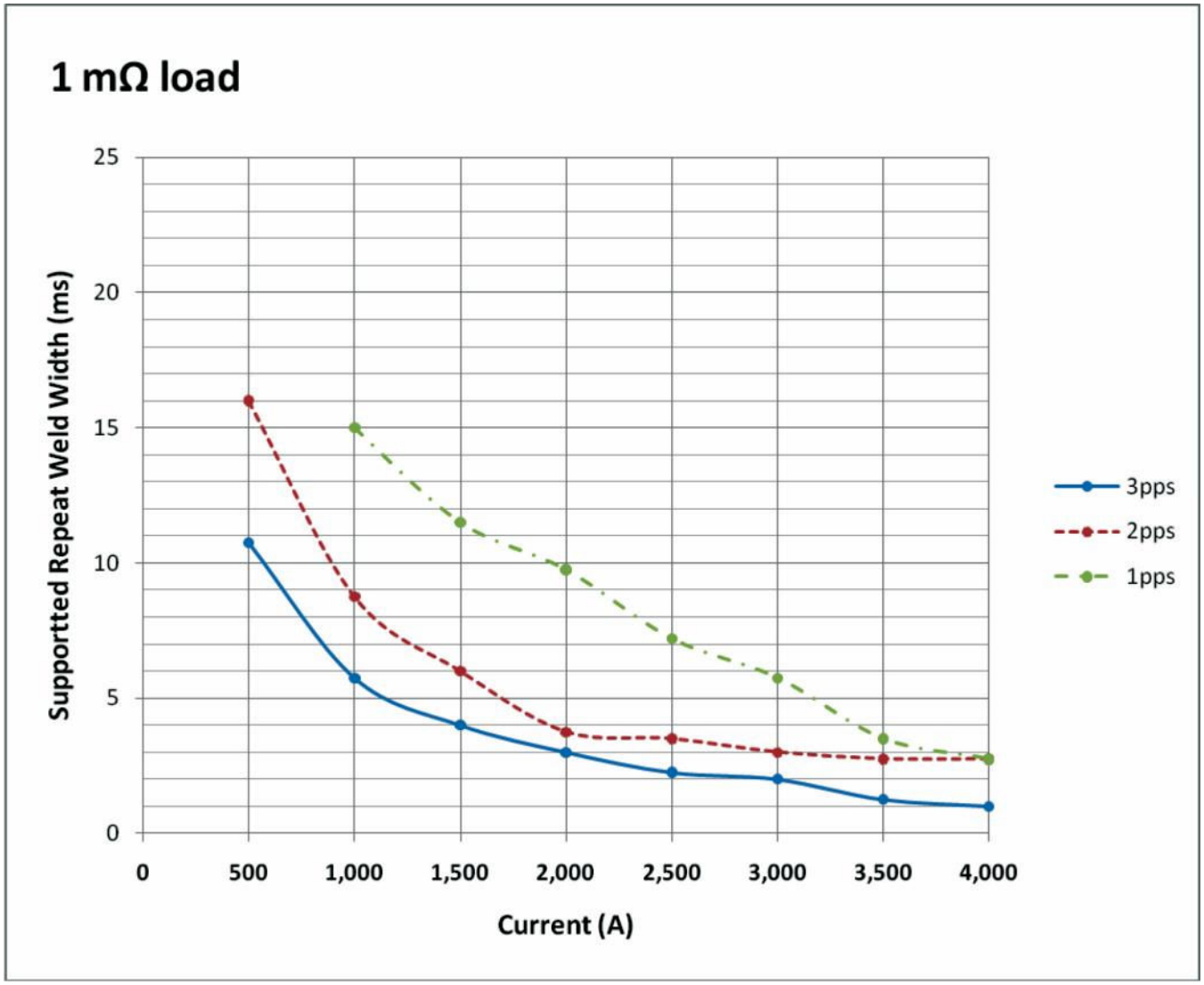
The graph on the next page details the maximum acceptable pulse durations at various current levels for repetition rates of 1, 2, and 3 welds per second. The secondary circuit resistance and/or inductance will affect actual results and may reduce actual repetition rates.

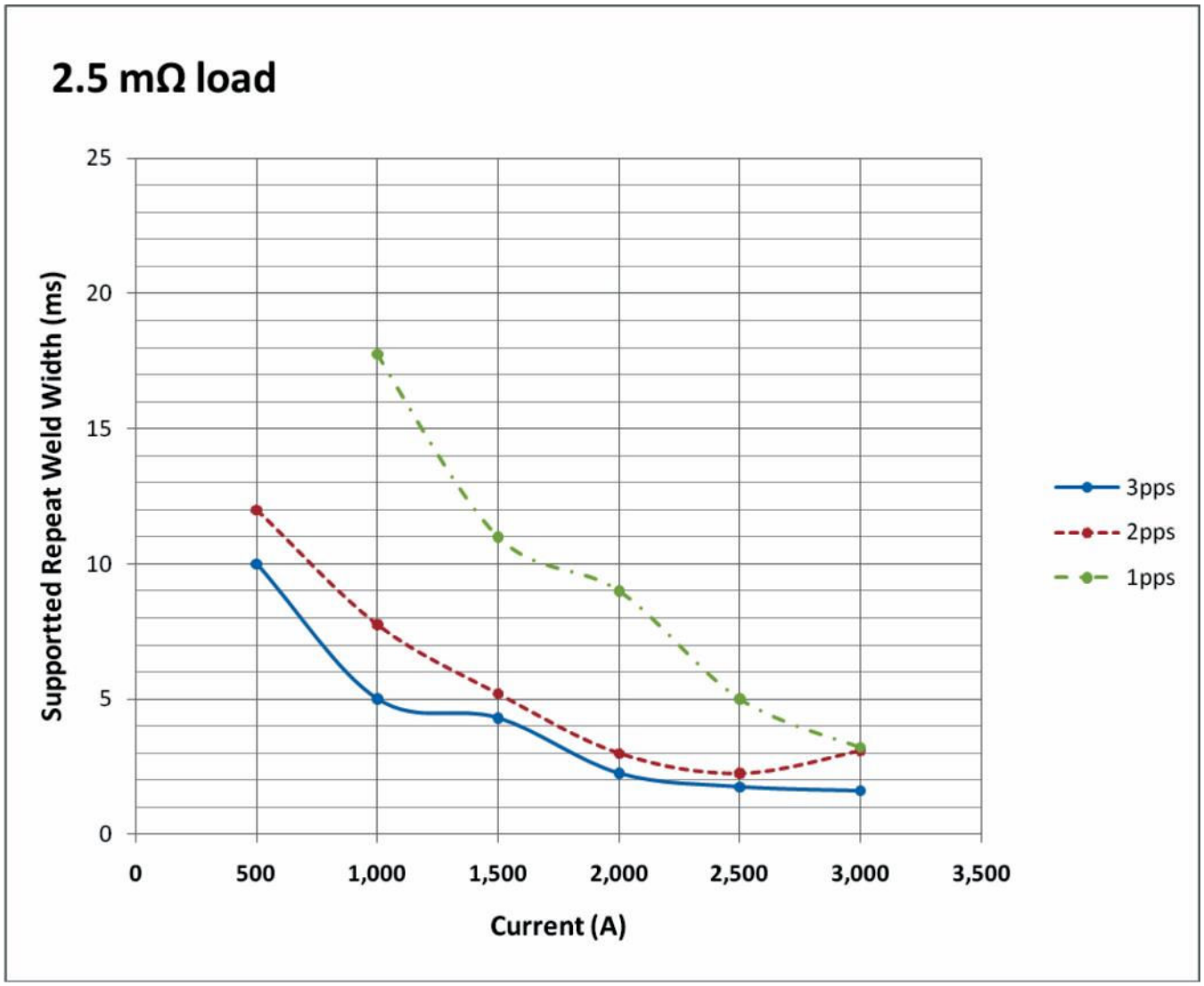
Weld pulses that fall below the lines are within the capability of the Power Supply for the stated repetition rates. The time to be used in determining the duration is the sum of the weld period and ½ the periods of upslope and downslope, if any. For dual-pulse welding, the sum of both pulses must be compared to the chart.

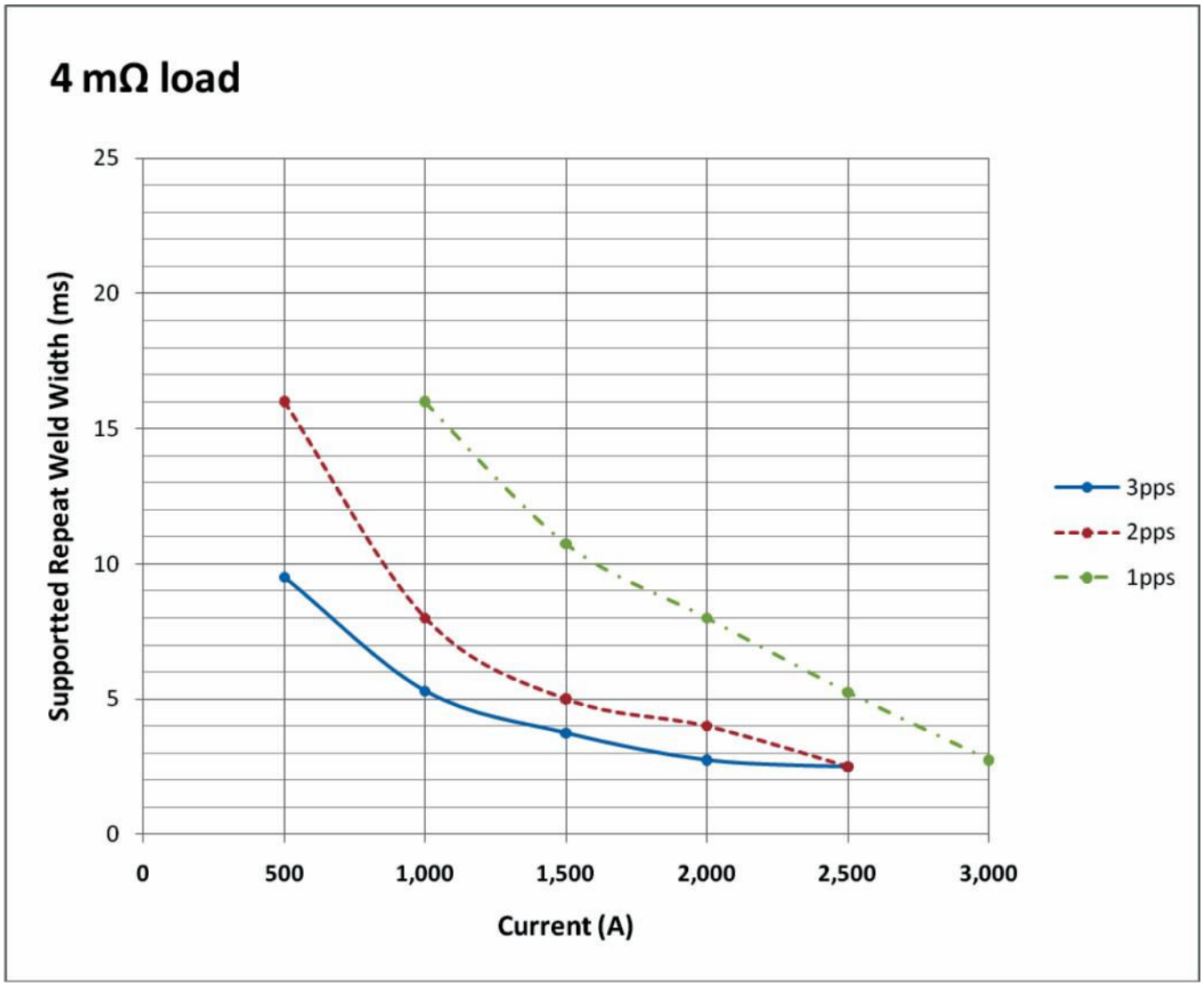
For welds using the current control mode, the durations can be read directly off the chart. For welds in the voltage control or power control modes, the average current from the monitor screen and the programmed duration can be compared to this chart.

It is possible that longer durations may be provided by the Power Supply (depending upon the details of the secondary circuit) but the stability of the waveform may decrease. In this circumstance, a reduction of the secondary circuit resistance and/or inductance will be beneficial. (Shorten weld cables and/or tie them together.) Testing with the actual secondary circuit to be used will be required in this case.

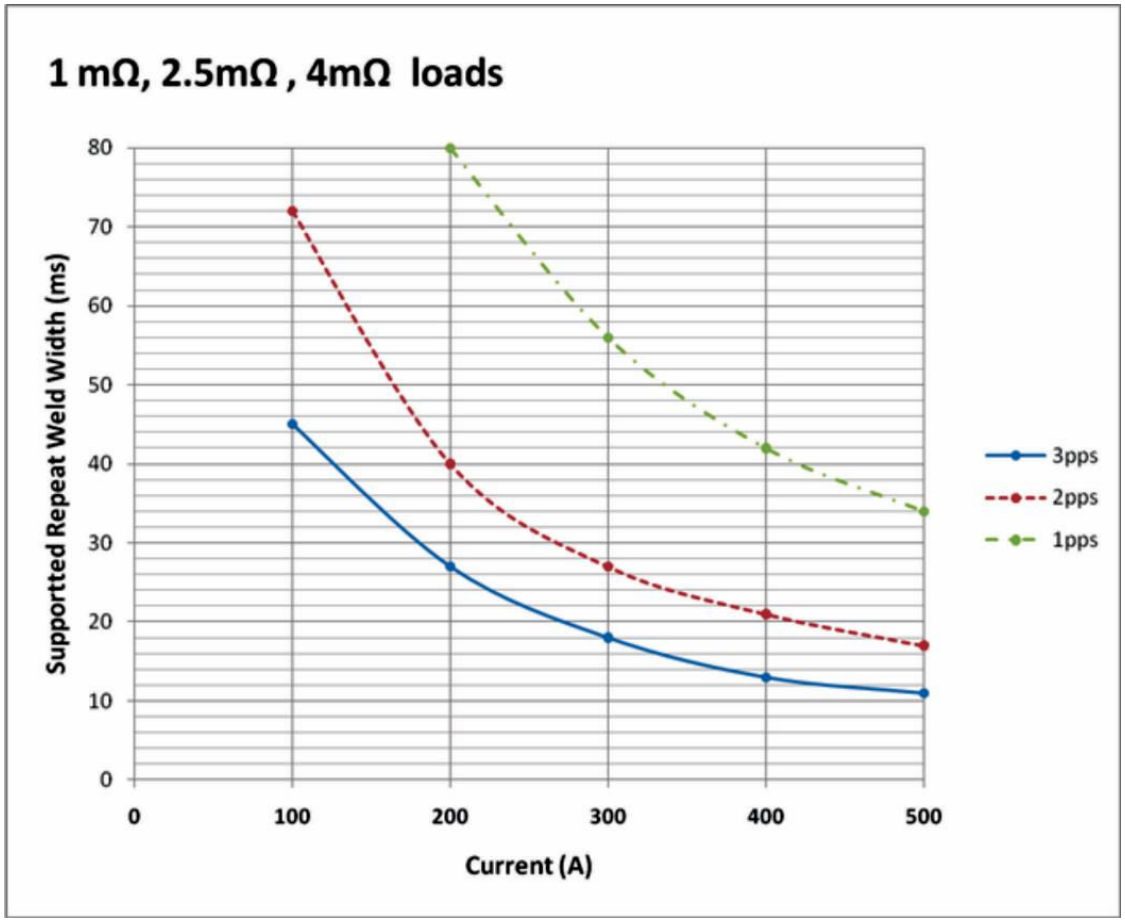
Section II. UB-4000A Repetition Rates



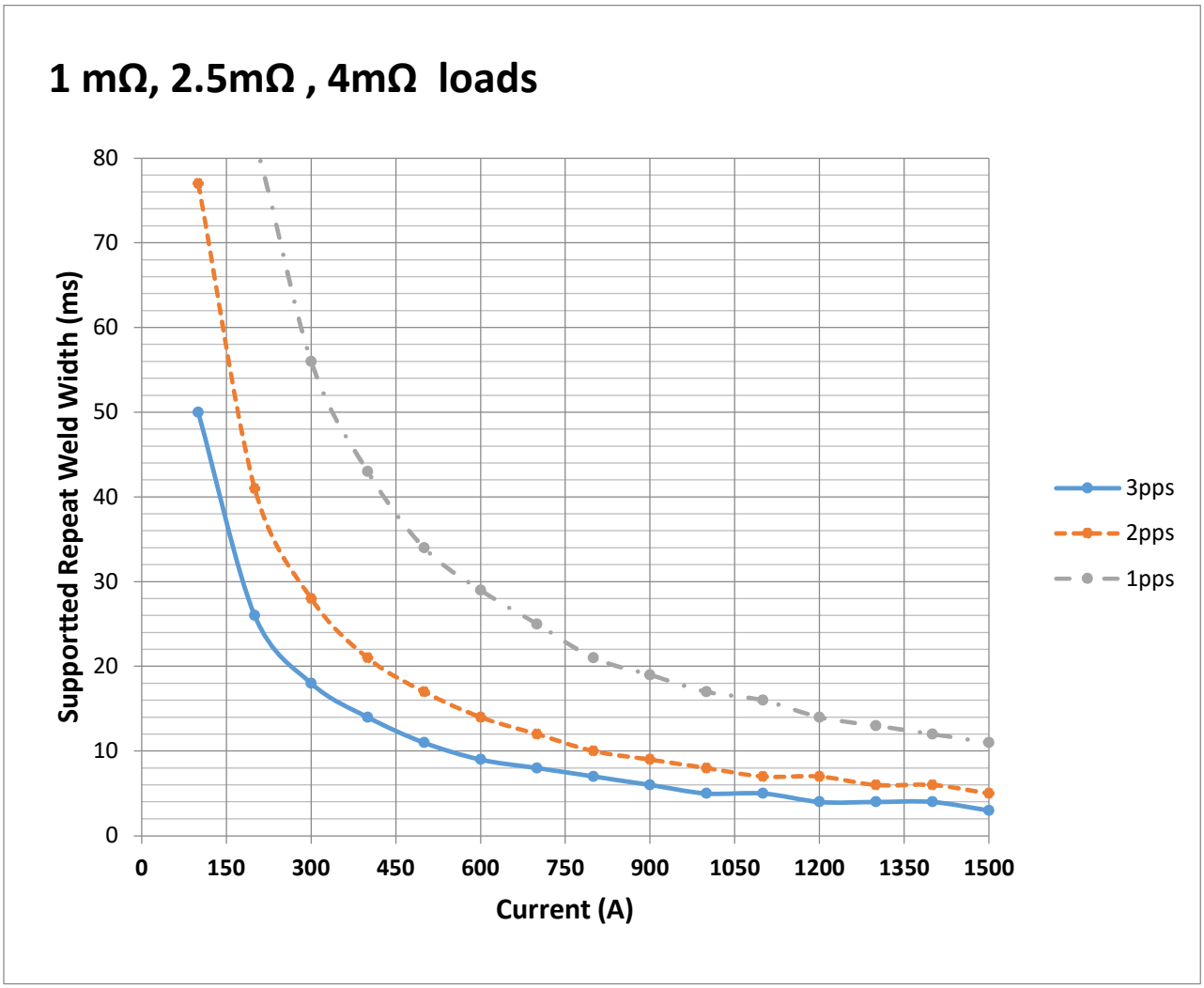

2.5 mΩ load
Supportted Repeat Weld Width (ms)
25
20
15
10
5
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Current (A)
3pps
2pps
1pps


4 mΩ load
Supportted Repeat Weld Width (ms)
25
20
15
10
5
0
0
500
1,000
1,500
2,000
2,500
3,000
Current (A)
3pps
2pps
1pps

Section III. UB-500A Repetition Rates



UB-1500A Repetition Rates



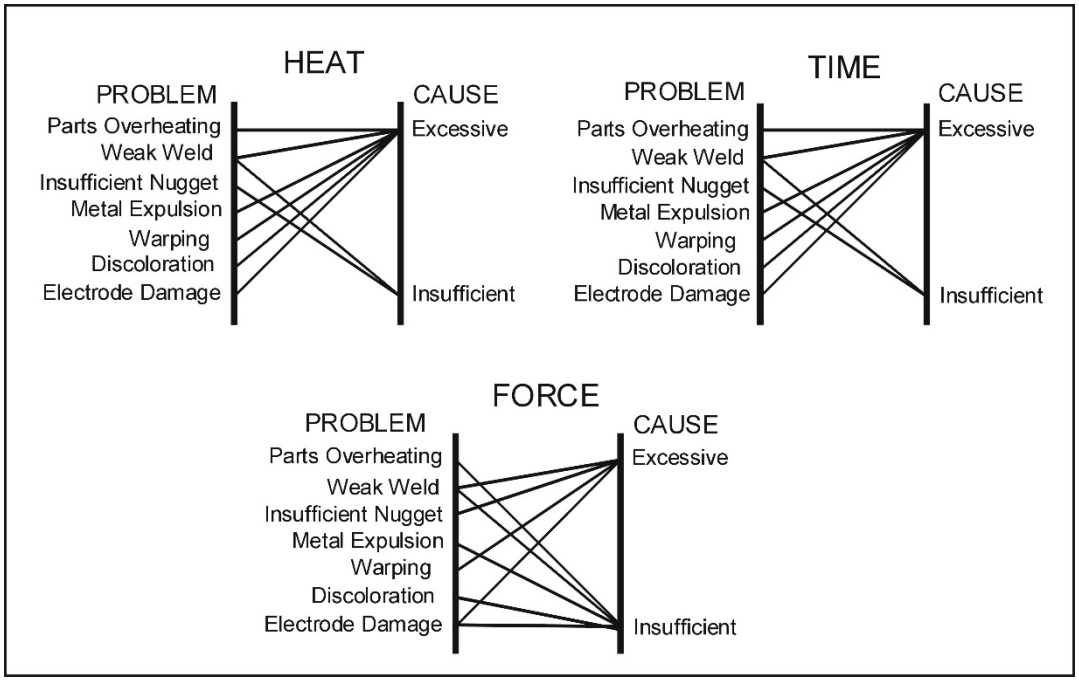
APPENDIX G
THE BASICS OF RESISTANCE WELDING

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
Beryllium Copper	-2	Cold Rolled Steel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
Molybdenum	-2	Molybdenum	-2
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
NiSpan C	-2	NiSpan C	-2
NiSpan C	-2	Cold Rolled Steel	-2
NiSpan C	-2	Stainless Steel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
Silver	-11, -14	Cold Rolled Steel	-2
Silver	-11, -14	Stainless Steel	-2
Cold Rolled Steel	-2	Cold Rolled Steel	-2
Cold Rolled Steel	-2	Stainless Steel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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	Rhenium	-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 *Chapter 4, 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 1ms 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.

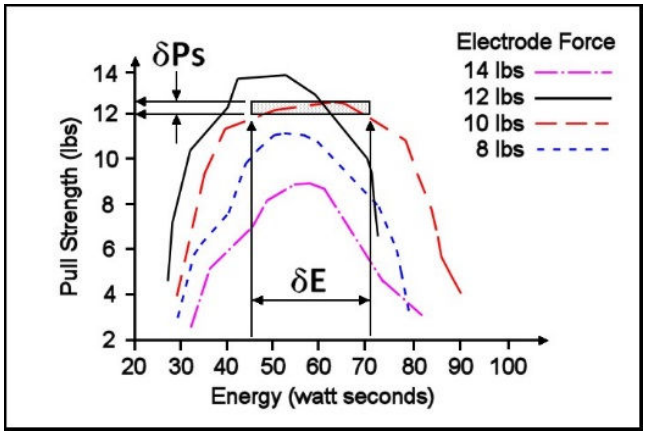
3 Repeat steps 1 through 3 for different weld forces, then create a plot of part pull strength versus weld current, voltage, or power for different weld forces as shown in the illustration below, *Typical Weld Strength Profile*.

Typical Weld Strength Profile

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

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

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



Typical Weld Strength Profile

APPENDIX H
QUALITY RESISTANCE WELDING SOLUTIONS: DEFINING THE OPTIMUM PROCESS

Introduction

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

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

Resistance Welding -- A Material World

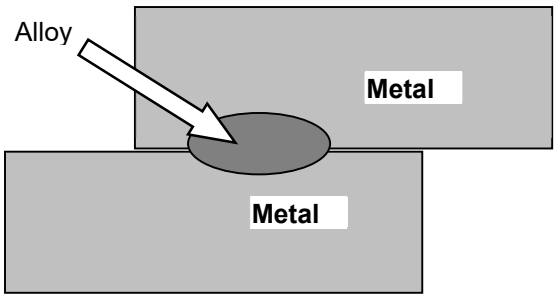
The first consideration in designing a quality welding solution is the properties of the materials to be joined and the quality requirements of the desired welded joint. At this stage, it is worthwhile to review the way the resistance welding process works and the likely outcome when the parts are resistance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

There are four main types of structural materials:

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

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

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



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

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

- **Solder or Braze Joint**

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

- **Solid-State Joint**

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

- **Fusion Joint**

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

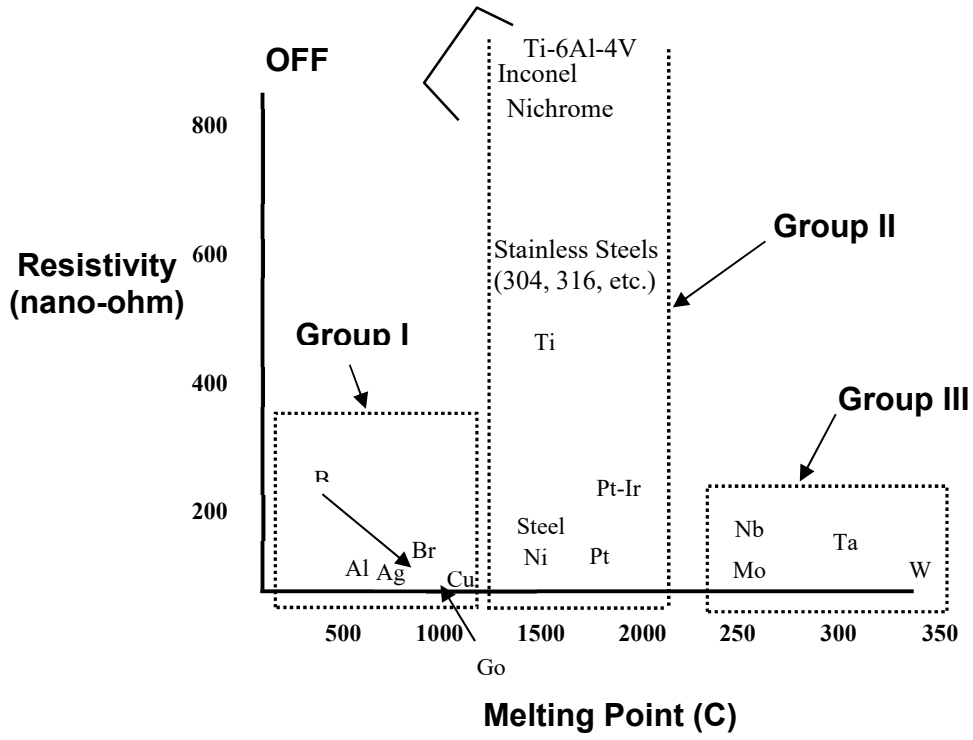
Many micro-resistance welding challenges involve joining dissimilar metals in terms of their melting points, electrical conductivity, and hardness. A solid-state joint can be an ideal solution for these difficult applications; there is no direct mixing of the two materials across the weld interface thus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

Consider the Material Properties

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

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

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



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

- **Group I – Conductive Metals**

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

- **Group II – Resistive Metals**

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

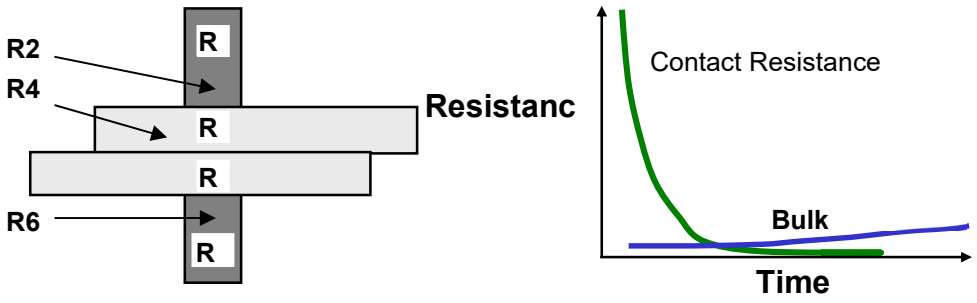
- **Group III – Refractory Metals**

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

The chart below gives some guidance on the type of joint that can be expected and design considerations required when joining materials from the different groups.

	Group I	Group II	Group III
Group I (Copper)	• Solid-State • W/Mo electrodes	• Solid-State • Projection on Group I	• Solid-State • Fine projections on Group III
Group II (Steel)		• Solid-State or Fusion	• Solid-state or braze of II on III • Projection on III
Group III (Moly)			• Solid-State

Basic Principles



The figure above shows the key resistances in a typical opposed resistance weld and the relationship between contact resistances and bulk resistances over time, during a typical resistance weld:

R1 & R7 The electrode resistances affect the conduction of energy and weld heat to the parts and the rate of heat sinking from the parts at the end of the weld.

R2, R4 & R 6 The electrode-to-part and part-to-part "Contact Resistances" determine the amount of heat generation in these areas. The contact resistances decline over time as the parts achieve better fit up.

R3 & R5 The metal "Bulk Resistances" become higher during the weld as the parts are heated.

If a weld is initiated when the contact resistances are still high, the heat generated is in relation to the level and location of the contact resistances, as the materials have not had a chance to fit up correctly. It is common for the heat generated at the electrode-to-part and part-to-part resistances to cause multiple welding problems when welding resistive materials including:

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

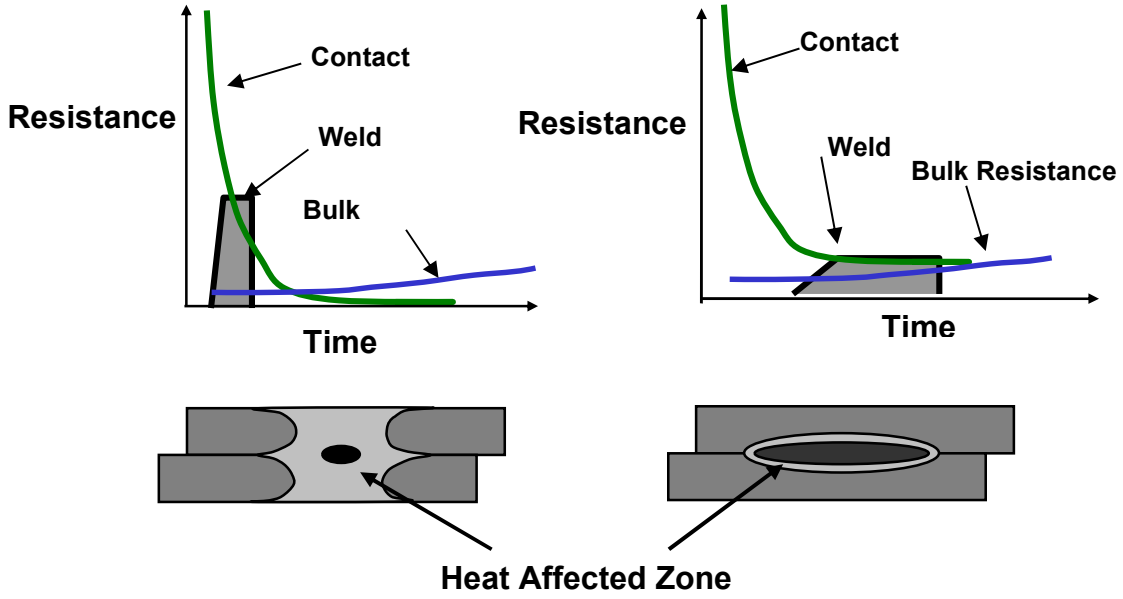
Alternately, conductive materials can be welded by using high contact resistance and fast heating because their bulk resistance is not high and cannot be relied upon for heat generation.

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

The contact resistances present at the weld when the power supply is fired have a great impact on the heat balance of a weld and, therefore, the heat affected zone.

The figure below shows a weld that is fired early on in the weld sequence when the contact resistance is still quite high.

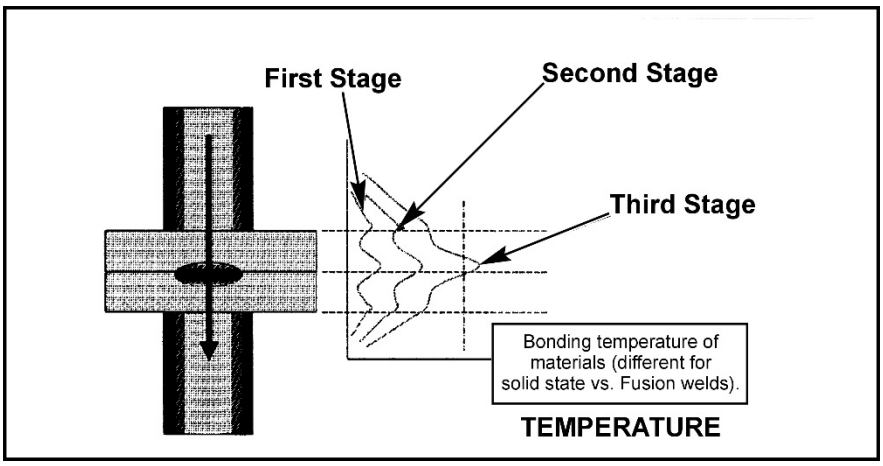
The figure shows a weld that is initiated when the contact resistance is lower; in this example, we are using bulk resistance to generate our weld heat.



(NOTE: Larger nuggets are possible with longer weld times when using bulk

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.

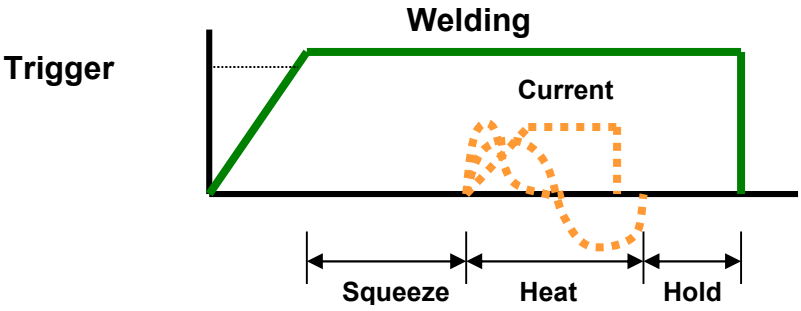
The following figure shows the three stages of heat generation for resistive materials in a fusion weld. In the first stage, the heat is focused in the part-to-part and electrode-to-part contact areas, since contact resistance is high relative to bulk resistance. In the second stage, contact resistance 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

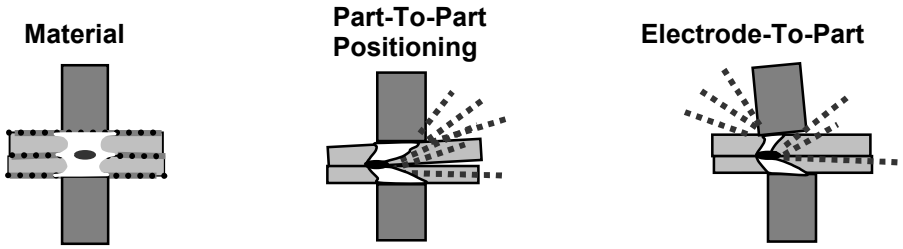
- Materials: Resistivity, melting point, thermal mass, shape, hardness, surface properties.
- Heat balance: Electrode materials, shape, Polarity, heating rate (upslope).
- Observation: visual criteria, cross section, and impact of variables on heat balance.

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?

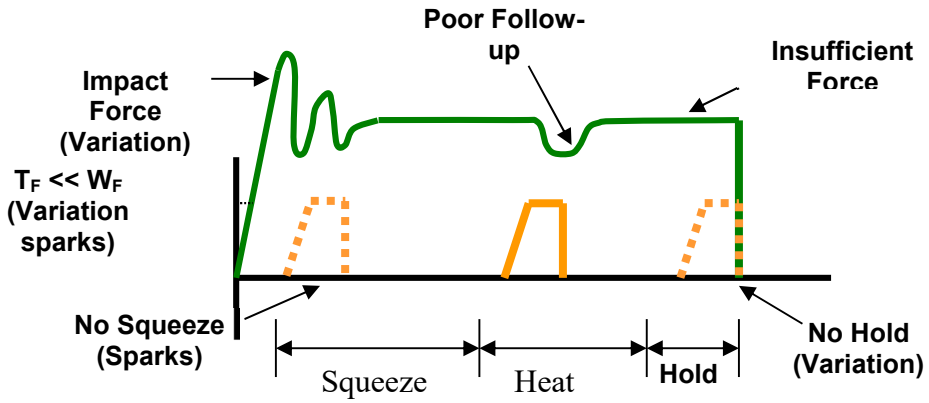
Common Problems

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.

AMADA WELD TECH INC.

http://www.amadaweldtech.com

AMADA WELD TECH INC.

1820 South Myrtle Ave., Monrovia, CA 91016, U.S.A.

TEL. +1-626-303-5676 FAX, +1-626-358-8048

http://www.amadaweldtech.com

AMADA WELD TECH CO., LTD.

200, Ishida, Isehara-shi, Kanagawa 259-1196, Japan

AMADA WELD TECH KOREA CO., LTD.

28, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, 18423, Korea

TEL. +82-31-8015-6810 FAX. +82-31-8003-5995

AMADA WELD TECH SHANGHAI CO., LTD.

Unit 401, A206(C8), No. 77, Hongcao Road, Xuhui District, Shanghai, China

TEL. +86-21-6448-6000 FAX. +86-21-6448-6550

AMADA WELD TECH GmbH

Lindberghstrasse 1, DE-82178 Puchheim, Germany

TEL. +49-89-839403-0 FAX. +49-89-839403-68

AMADA WELD TECH TAIWAN CO., LTD.

Rm. 5, 2F., No. 9, Dehui St., Zhongshan Dist., Taipei 10461, Taiwan (R.O.C.)

TEL. +886-2-2585-0161 FAX. +886-2-2585-0162

AMADA VIETNAM CO., LTD.

469 Ha Huy Tap Road, Yen Vien, Gia Lam, Ha Noi, Vietnam

TEL. +84-4-6261-4583 FAX. +84-4-6261-4584

AMADA (THAILAND) CO., LTD.

Asia Industrial Estate Suvarnabhumi (AIES) 88/41 Moo 4, Khlongsuan, Bangbo, Samutprakarn 10560, Thailand

TEL. +66 2170-5900 FAX. +66 2170-5909

AMADA WELD TECH INDIA PVT. LTD.

G-A Ground Floor, 5C-409, 5th Cross, Kammanahalli Main Road, HRBR Layout, Kalyan Nagar, Bengaluru, - 560043, India

TEL. +91-80-4092-1749 FAX. +91-80-4091-0592

AMADA WELD TECH LTDA.

Av. Tamboré, 965/973, Salas P22e F11, bairro Tamboré, 06460-000-Barueri-SP, Brazil

TEL. +55-11-4193-1187

AMADA WELD TECH INC.
1820 South Myrtle Ave., Monrovia, CA 91016, U.S.A.
TEL. +1-626-303-5676 FAX. +1-626-358-8048