CD-V120A
CD-V260A

DUAL PULSE CD POWER SUPPLIES

TL-V080B-F, TL-V088B-F
TL-V080B-A, TL-V088B-A

THINLINE WELD HEADS

USER MANUAL

AMADA®

990-936 REV G

Revision Record

Revision	EO	Date	Basis of Revision
A	44868	02/18	Original edition
B	45120	07/18	Change Model Numbers + minor updates
C	45399	04/19	Update Repetition Rates + minor updates
D	45711	12/19	Change CD-V Model Numbers. See ECO for details.
E	45833	04/20	Update Company Name (Amada Weld Tech)
F	46292	04/21	See ECO for details
G	47206	01/24	Update Manual Title

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CONTENTS (Continued)

CONTACT US

Thank you for purchasing an AMADA WELD TECH CD-V Capacitive Welding System.

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

The purpose of this manual is to provide the information required for proper and safe operation and maintenance of the AMADA WELD TECH CD-V Capacitive Welding System.

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

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

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 Capacitive Discharge 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.

SAFETY PRECAUTIONS

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 Capacitive Discharge 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 meaning 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 Chassis. Do ***not*** touch the inside of the Power Supply unnecessarily with the power turned ON. You may receive and 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's 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.

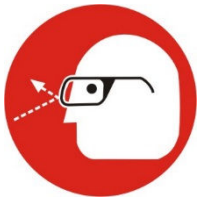
Confier toutes les modifications de programme ou de réglages à un technicien qualifié.

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 menu feature to stop weld current from flowing*

Bedieningshandleding - Voedingsbronnen voor AMADA WELD TECH.
Användarhandledning - Kraftaggregat för AMADA WELD TECH.
Käyttöopas – AMADA WELD TECH tehonlähteet.
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EC Declaration of Incorporation
For Incomplete Machinery

In accordance with EN ISO 17050-1: 2004

We, AMADA WELD TECH INC.
of 1820 S Myrtle Avenue
Monrovia, CA 91016

In accordance with the following Directive(s):

2014/30/EU	**The Electromagnetic Compatibility Directive**
2014/35/EU	**Low Voltage Directive**
2011/65/EU	**RoHS2 Directive**

hereby declare that:

Equipment Function:	Capacitive Discharge Resistance Welding Power Supply
Model Number:	CD-V120A, CD-V260A
Serial Number:	See Individual Unit Label

is in conformity with the applicable requirements of the following documents

Ref No:

EN61326-1, EN62135-1, EN55011 Class A Group 1, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-8, EN61000-4-11, EN50581:2012 (EU RoHS)

We hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications and is in accordance with the requirements of the Directive(s)

In accordance with the following Directive for the same equipment:

2006/42/EC **The Machinery Directive**

we hereby declare that the basic requirements (appendix 1) of the above directive are conformed:

1.2.1,1.2.2,1.5.1, 1.5.11,1.6.1-1.6.3, 1.7.2, 1.7.3

we hereby declare that the following EHSRs have been complied with:

IEC13849-1: Safety of machinery – Safety Related Parts of Control Systems

and the technical documentation is compiled in accordance with Annex VII (B of the Directive).

We undertake to transmit, in response to a reasoned request by the appropriate national authorities, relevant information on the partly completed machinery identified above. The method of transmission shall be at the discretion of AMADA WELD TECH INC.

The machinery is incomplete and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive.

Signed by: 

Name: Matthew Green
Position: Manager, Standard Product Research and Development
Done at: 1820 S. Myrtle Ave
Monrovia, CA 91016
On: 12/2019

The technical documentation for the machinery is available from:

Name: Dieter Kemmerer-Fleckenstein
AMADA WELD TECH GmbH
Lindberghstrasse 1; D-82178 Puchheim; Deutschland / Germany

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 the Sellers 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 **CD-V120A and CD-V260A** are Dual Pulse Capacitive Discharge design Resistance Welding Power Supplies. These models have the same construction and functionality except for the available maximum weld energy. The CD-V120A and CD-V260A have maximum weld energy ratings of 120 and 260 Watt-seconds respectively.

Each CD-V power supply is designed to be combined with either an AMADA WELD TECH TL-V080B-A / TL-V080B-F or TL-V088B-A / TL-V088B-F weld head to form a complete welding system. Each weld head includes the appropriate stand, weld head cables, electrode holders, flexures, foot switch, and hardware to connect and begin welding. Additional types of electrode holders, electrodes, and other items are available as optional accessories.

Available weld heads are chosen based on the application and include models driven by a manual foot cable, standard air solenoid driven models in both single weld head opposed and dual weld head configurations for series welding. Compliance with CE Machinery Directive can be achieved with additional accessories.

CD-V Power Supply Features

- Dual Pulse capability in *Independent Dual Pulse* mode or *Linked Dual Pulse* Mode.
- *Rise Time Control* of weld pulse to slow energy delivery for some applications.
- *Roll Spot* mode for welding with roll spot electrode.
- Configurable pulse window for each pulse allows for control of pulse delivery timing.
- Built-in color display shows programming parameters, status information, and peak current of last weld.
- Up to 9 individual Weld Schedules (sometimes referred to as *weld profiles*) can be programmed and stored for easy retrieval.
- Easy to use interface.
- Schedule Lock feature to prevent accidental change to welding parameters.
- Peak Current Monitor for each pulse displayed on screen (for reference only).

CD-V and TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A Weld Head Features

Each weld head part number is provided with everything needed to get started welding including a foot pedal, stand, electrode holders, flexures, weld head cables, hardware, and sample electrodes.

Manual Weld Heads

a) 2-360-01, Model TL-V080B-F Single Weld Head Opposed Electrode Weld Head
b) 2-360-02, Model TL-V088B-F Dual Weld Head Parallel Gap Electrode Weld Head

Manual Weld Heads options

a) 10-260-06, CP Foot Pedal with 6 foot cable and 1" stroke for TL-V080B-F Weld Head
b) 10-314-02, MSP 5:1, 100lb. maximum force Foot Pedal for TL-V088B-F Weld Head

Manual cable driven weld heads use a Bowden cable or linkage connected between the weld head and foot pedal to actuate weld head motion. The weld force fire switch in the weld head activates when the set force is reached. Weld force is a function of the force tube setting and foot pressure applied by the operator. The weld head must be permanently installed on a suitable table.

Standard Air Solenoid Driven Weld Heads

a) 2-361-01, Model TL-V080B-A Single Weld Head Opposed Electrode Air Weld Head
b) 2-361-02, Model TL-V088B-A Dual Weld Head Parallel Gap Electrode Air Weld Head

Standard Air Solenoid driven weld heads use a single air cylinder and solenoid controlled by an electrical foot switch to trigger weld head motion. The weld fire switch in the weld head activates when the set force is reached and the foot switch is completely depressed. Weld force and behavior during follow-up while the material is molten is a function of spring setting, regulated air pressure, and flow valve settings on the weld head. This is more repeatable and constant than a manual weld head but careful control of these pneumatic settings are necessary to prevent over-force provided by the air cylinder.

Applications

The CD-V capacitive discharge resistance welding system is ideal for many types of welding including battery tabs, honeycomb, automotive, and other spot weld applications. In addition by use of a roll spot circular rotating welding wheel applications requiring multiple welds in sequence are possible.

The CD-V welder delivers stored energy from the capacitor bank through a high speed MOSFET power delivery circuit. The actual current delivered is controlled by the programmed energy (capacitor bank voltage) and resistance of the load in accordance with Ohm's Law. One of the useful features of the CD-V welding system is that the weld current rise upslope can be controlled at the beginning of the weld to provide for a "softer" current delivery for delicate materials that can dramatically reduce sparking and blowouts while providing full energy delivery and excellent welding performance. Peak current is limited at 8kA to prevent equipment damage if problems in the secondary occur.

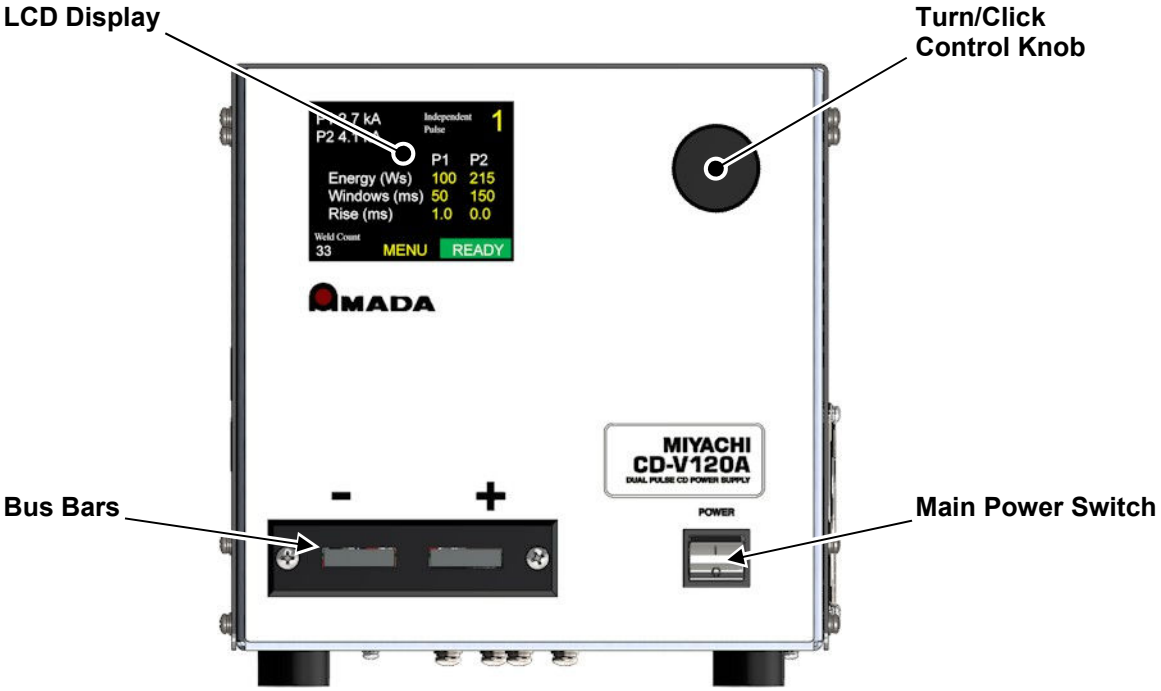
Programming and configuration of the CD-V welder settings is described in *Chapter 3, Programming and Using the Power Supply*, which describes the Power Supplies functions and how to use them for different welding applications. The CD-V welder can be configured to provide independent dual pulse control or linked pulse delivery depending on application requirements.

Since the CD-V system is a capacitive discharge design, a weld process entails discharging a certain amount of energy from a capacitor bank through a load created by the electrodes and parts to be welded. This means that the actual weld current through part and actual duration of the weld current is determined by the resistance of the part/electrode combination as the welder discharges the programmed amount of weld energy. Product specifications are given with respect to a fixed reference load.

Section II: Power Supply Description

Overview

The front panel of the Power Supply contains the **Liquid Crystal Display** (**LCD**), and rotary control **knob**. The display and the control knob are used together when programming and operating the Power Supply. Instructions on how to do this are in *Chapter 3, Programming and Using the Power Supply.*



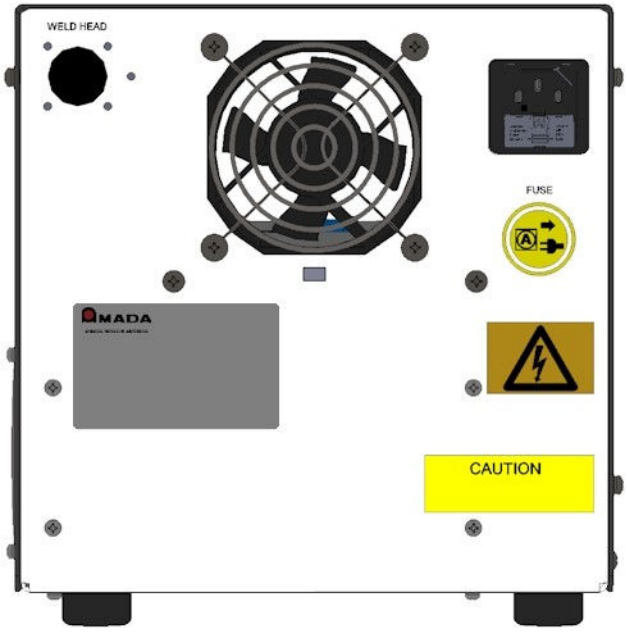
CD-V120A Front Panel

The display shows all of the setup, programming, and operating information for the Power Supply. The control knob allows you to enter data for programming weld schedules, customize the configuration parameters of the Power Supply, and monitor your welding equipment. It also allows you to view measurements of peak current measured within the device and provides information on the charging status of the capacitor bank. Weld schedules may contain one or two weld pulses and may be configured in "Independent Dual Pulse", "Roll Spot", or "Linked Pulse" mode. Each mode contains a separate set of weld schedules consisting of:

- Programmed weld energy values for each pulse or total energy as applicable
- Weld pulse window parameters controlling the temporal relationship of one pulse to the next
- Rise Time Control setting allowing for weld pulse energy delivery to be tailored to the individual application
- A schedule number from 1-9 each containing a unique set of welding parameters for easy selection

- Repetition rate in Roll Spot mode

You can program and store up to 9 different weld schedules in each mode to meet a variety of welding applications. Schedules are selected by the control knob. It is possible to lock schedule parameters to prevent validated processes from being inadvertently modified.



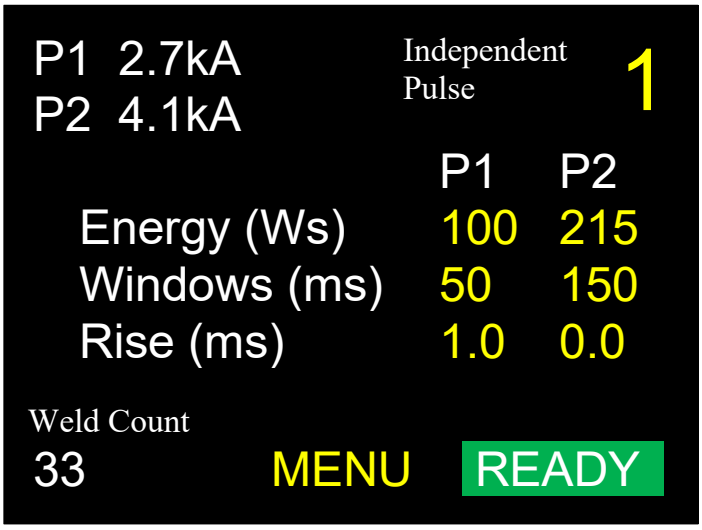
CD-V120A Rear Panel

The rear panel contains the power input connection, fuse panel, and weld head connections. Connection instructions are described in *Chapter 2, Installation and Setup*.

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

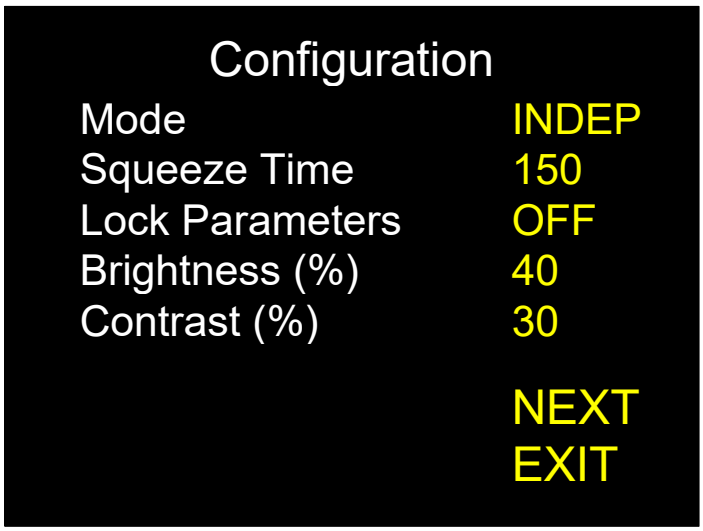
Connector pin identification and specifications as applicable are listed in *Appendix B, Connections and Timing*

LCD Display Screens



CD-V Schedule/Weld Control Screen

The display above shows an example screen for an Independent Dual Pulse schedule. There are two screen categories - Schedule screens (above) and Configuration screens. While a schedule screen is selected and the "READY" indicator is present, the system will weld when given an appropriate input.



CD-V Configuration Screen

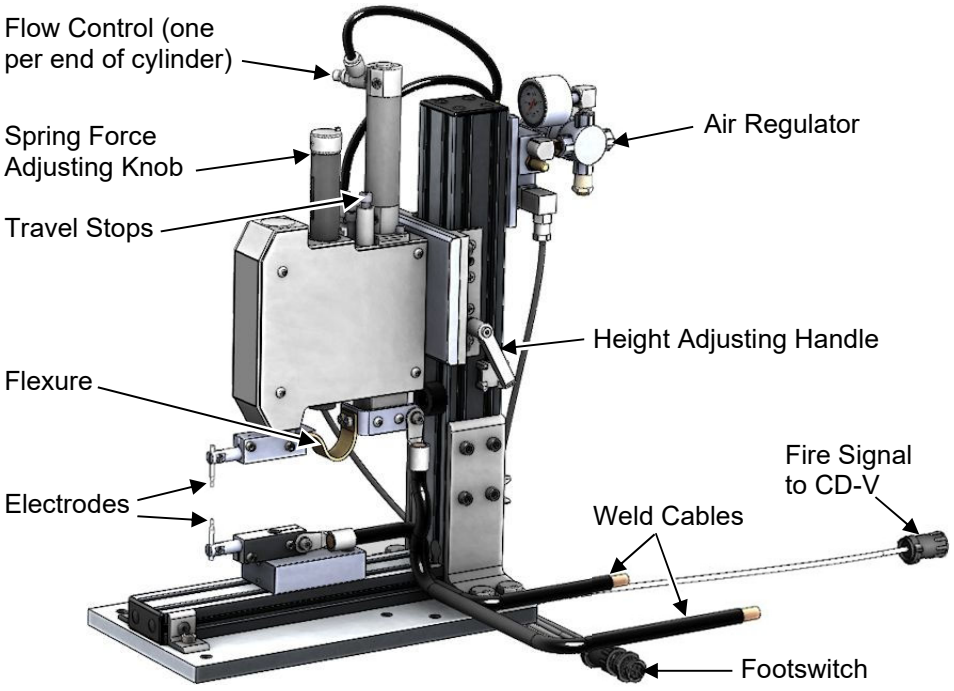
The display above shows an example of the configuration screen. Configuration screens contains a list of parameters that can be adjusted by selecting and then clicking on them with the rotary knob.

NOTE: Details on parameters and configuration are found in *Chapter 3 – Programming and Using the Power Supply.*

Section III: Weld Head Description

Introduction

A weld head is used to provide consistent and repeatable force between weld electrodes and materials to be welded during a resistance welding cycle. During the weld as the weldment becomes molten the weld head must consistently apply follow-up force to the weld to prevent material expulsion. To provide a consistent and repeatable force several strategies are used including utilizing a stiff stand, adjustable force springs, a force-firing switch that triggers the weld when weld force is reached, copper flexures between moving and static parts to allow weld current to flow without the mass and routing of heavy weld head cables affecting force, and adjustable pneumatics if equipped. Weld head movement and force application is controlled by either electrically controlled pneumatic actuators or a mechanical linkage. Best results will not be achieved without these features.



Single Actuator Pneumatic TL-V080B-A Weld Head

The weld head itself consists of an adjustable stand, base plate for attaching the weld head to a table surface, one or more mechanical actuators, weld head cables to the power supply, electrodes, electrode holders, one or more flexures, and a method of user actuation such as an electrical two-level foot switch or mechanical foot pedal assembly. In all configurations a force-firing switch is connected to the power supply trigger input.

Weld heads can be characterized by the number of actuators and the methods of actuator control during the welding process. Weld heads are available in either single actuator versions for opposed electrode welding or dual actuator versions for parallel or series electrode welding with independent force control.

A single actuator weld head can also perform parallel or series electrode welding for applications in which independent force control is not required.

A handpiece can be used instead of a weld head for truly manual welding applications.

TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A Weld Heads come in different sizes and configurations and may be installed on the supplied mounting stand or installed directly on your equipment using the tapped holes on the rear of the weld head. Some weld heads are manually-actuated, others are air-actuated. Mounting templates and all necessary installation hardware are shipped with each weld head.

AMADA WELD TECH Thin-Line TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A are precision, low inertia, force-fired Weld Heads with a narrow vertical profile. The 1-3/4 inch (4.5 cm) width, 1 in. (2.5 cm) stroke, 20 pound (89 N) maximum force range, and throat depth allow their use in a wide variety of precision resistance welding applications. Both in-line and offset electrode holders are available. The dimensions of the mounting post and the main shaft have been selected to ensure that the electrodes do not "wipe" more than 0.003 in. (0.076 mm) on the weld heads. This is an important consideration in critical welding applications such as hermetic seals and pressure transducers.

The TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A is a "production line" weld head with a bearing life designed for a minimum of 20 million operations. AMADA WELD TECH Weld Heads excel at precisely placing consistent, high quality welds. Their low inertia, lightweight design assures fast dynamic response, allowing the electrodes to follow the minute expansion and contraction of the weld joint as it heats and cools during the welding cycle. A differential motion Force-Firing System initiates the power source at the precise moment the Preset Firing Force is applied to the workpieces. Linear ball bearing bushings and an oversized, anti-rotational bearing system provide true, vertical in-line electrode motion, assuring smooth vertical travel of the upper electrode arm. This system minimizes the wiping action of the electrodes, even at maximum force settings.

Preset Firing Force

Firing force is continuously adjustable from 8 ounces (0.22 kg) for air-driven Weld Heads (TL-V080B-A / TL-V088B-A) or 4 ounces (0.11 kg) for manual Weld Heads (TL-V080B-F / TL-V088B-F) to 20 lbs. (89 N). An adjustable Tare Spring compensates for the weight of the electrode holders. The Firing Force Adjustment Cam easily adjusts the sensitivity of the Firing Force Switch.

Up And Down Stops

TL-V080B-A / TL-V080B-F Weld Heads have adjustable Upstops and Downstops. The Downstop can be used to limit excessive downward travel. The Upstop controls the stroke, and consequently, the travel time of the weld head. In automated machine applications, using a stroke of less than 1/8 in. (3.2 mm) may significantly reduce bearing life.

Electrodes

TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A Weld Heads accept a wide variety of standard and special purpose electrodes. There are models available, which accept 1/8 in. (3.2 mm) or 1/4 in. (6.4 mm) diameter electrodes, 0.245 in. (6.2 mm) diameter eccentric electrodes, Unibond, and Unitip Electrodes.

Insulation

The Terminal Block, Flexible Copper Strap, and Upper Electrode Assembly are electrically insulated from the frame of the Weld Head. The Frame, Support Post, and Support Base are grounded to the bench top.

Welding Head Cables

Welding head cables are provided to connect TL-V080B-F / TL-V088B-F / TL-V080B-A / TL-V088B-A Welding Heads to the power source. Longer or larger gauge welding head cables are available.

Footpedal Actuation

The TL-V080B-F / TL-V088B-F Weld Heads, model number suffix "F," are footpedal (manually) actuated by the provided foot pedal assembly. AMADA WELD TECH provides two different footpedal styles:

1 The Model CP Cable Pedal is a treadle-type cable actuator providing an approximate 3 to 1 mechanical advantage. This pedal is used with single actuator model TL-V080B-F.

2 The Model MSP Swing Action Footpedal, provides an approximate 5 to 1 mechanical advantage and is used with the Model TL-V088B-F dual actuator model.

The TL-V080B-A / TL-V088B-A Weld Heads, model number suffix “A”, are footpedal (air) actuated by the provided 2-level 24 V electrical foot pedal assembly.

Model TL-V080B-A and TL-V080B-F

These are conventional, 20 lb. (89 N) capacity welding heads with offset, opposed electrodes on an adjustable stand. Both the upper weld head assembly and lower electrode assembly can be removed and replaced by custom fixtures. All air actuated weld heads in the TL-V080B-A are driven by 24 V power supplied by the CD-V power supply through a 2-level foot switch. Models TL-V080B-A and TL-V088B-A are supplied with one pair ES0450, 1/8 in. (3.2 mm) diameter Glidcop® Straight electrodes. Glidcop is a registered trademark of Glidden Metals Company.

Model TL-V088B-A and TL-V088B-F

These are designed to function as either a series or a parallel weld head. The Electrode Holders are designed to hold eccentric electrodes which can be rotated, parallel to their length and adjusted with the electrode holders, so that the separation between the electrode faces is from 0.00 - 0.330 in. (0.0 - 8.4 mm). The welding force on each electrode can be independently set. The TL-V088B-A is supplied with two regulators and four flow controls that allow the force and the speed of each electrode to be controlled independently. Models TL-V088B-A and TL-V088B-F Weld Heads are supplied with one pair of ES0850E, Glidcop® Eccentric Electrodes.

Air Actuation

TL-V080B-A / TL-V088B-A Weld Heads are equipped with standard air-actuation.

Standard Air-Actuation

Models TL-V080B-A and TL-V088B-A are equipped with a top mounted Air Cylinder with two Flow Controls, one or two Air Pressure Regulators, and a four-way Solenoid controlled by a two-level foot switch. Two Flow Controls are used to adjust the up and down speed of the upper electrode. The Air Solenoid Valve can be energized by the provided 2-level foot switch. Foot switch level one brings the weld head down and applies the welding force. Foot switch level two triggers the weld. Releasing the foot pedal at any point in the process aborts the process. AMADA WELD TECH suggests that lubricators not be used in "clean" environments. However, the user will then be required to periodically put a few drops of oil in the cylinder. Some users use lubricators, some do not.

CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning for Installation

Space Requirements

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

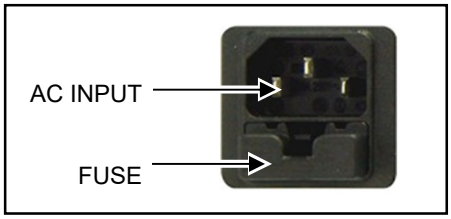
- Allow sufficient clearance around both sides and the back for power and signal cable runs as well as sufficient air for cooling.
- Allow ample workspace around the power supply so that it will not be jostled or struck while welding.
- The work surface must be level, stable, free from vibration, and capable of supporting the combined weight of the total welding system.
- The weld head should be firmly secured to the work surface to prevent injury.
- Assure that there are no sources of high-frequency energy close by.

Utilities

The power input requirement is:

100 – 240 VAC ± 10%, 50/60 Hz

Single Phase



AC Input (Rear Panel)

The power cable for the Power Supply is equipped with a connector that mates with the **AC INPUT** plug on the rear of the Power Supply. The input power wiring diagram is in *Appendix B, Connections and Timing.*

TL-V080B-A / TL-V088B-A Air Actuation Specifications

PARAMETER / MODEL	TL-V080B-A, TL-V088B-A
Input Air Pressure - Nominal / Maximum	65/100 psi (448/690 kPa)
Regulator Output - Maximum	65 psi (448 kPa)
Cycle Rate (full strokes/sec) at Min. Force at greater than 20% of Rated Force	1.0 2.5
DC Solenoid Valve Voltage	24 VDC, provided by CD-V
Air Cylinder Inside Diameter	0.75 in. (1.9 cm)

Section II: Unpacking

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

When purchased together, a power supply and weld head kit create a complete welding system with all the accessories and parts necessary to begin welding.

The included accessories include:

- **2 Level Footswitch** (with wire leads to be connected to Weld Head Control Cable Harness) or **Manual Foot Pedal**
- **30" #1 Weld Head Cables** (attached to weld head at the factory. Other lengths available)
- **Air Weld Head Control Cable Harness** (attached to the weld head from the factory. Connect to foot switch and power supply)
- **Manual Weld Head Firing Switch Cable** (manual weld heads only, connect to power supply)
- **Electrode Holder** (1/8" opposed electrodes)
- **Electrode Set**
- **Power Cable**
- **Air Delivery Tubing** (Air weld heads only)

Verify that the equipment shows no signs of damage. If you see any damage, please contact the carrier. Also, contact AMADA WELD TECH immediately.

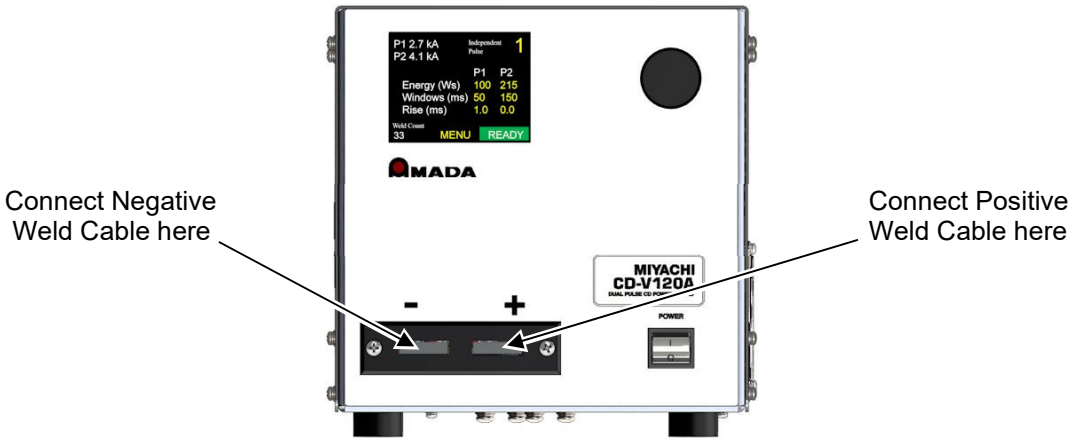
NOTE: Save the packing material. Carefully place the packing materials back in the packing boxes and store for future shipping.

Section III: Compliance with the EU Machinery Directive

The CD-V power supply and CD-V power supply equipped with manual model weld heads are compliant with relevant CE norms and regulations per the CE declaration in the introductory chapter and exempt from the Machinery Directive. When equipped with TL-V080B-A or TL-V088B-A pneumatic weld heads the system does not comply with the CE Machinery Directive without the inclusion of additional safety hardware accessories to ensure compliance to IEC13849-1. Please contact your local AMADA WELD TECH distributor for more details and instructions on achieving compliance.

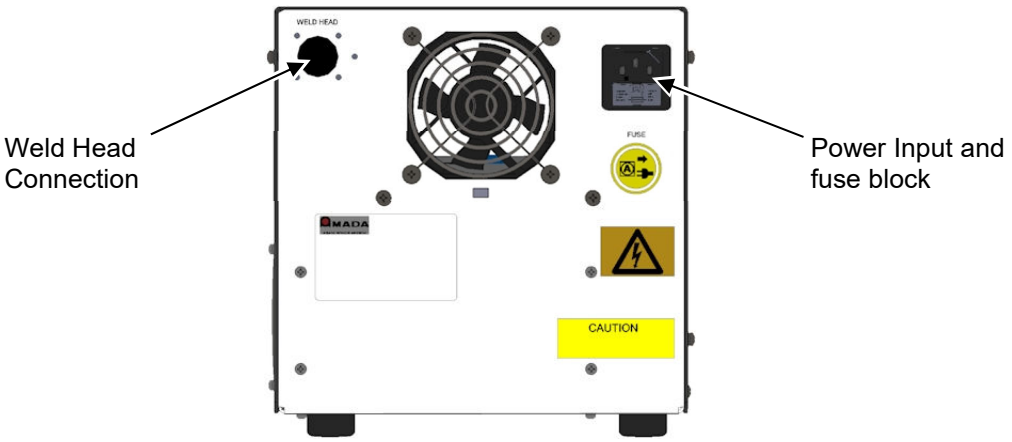
Section IV: CD-V Power Supply Electrical Connections

There are only two front panel connections – the weld head cable positive and weld head cable negative connections on or from the power delivery bus bars. Weld head cable polarity determines direction of current flow through the resistance weld. Weld head cables are unmarked – best practice is to indicate "+" on each end of the cable to be designated as the positive cable to prevent accidental connection reversal.



Front Panel Connections

There are only two rear panel connections – the input power connection and the Weld Head connection.



Rear Panel Connections

NOTES:

- The Weld Head connector is intended to be used with packaged weld heads intended for use with the CD-V welding system. Connect the weld head fire switch cable here.
- Wiring of cables and connectors going to the Power Supply should ***only*** be done by qualified service personnel. Connector pin identification and specifications for the rear panel connectors are located in *Appendix B. Connections and Timing*.

Section V: Foot Switch and Firing Cable Installation

The two position electrical foot switch is used for TL-V080B-A and TL-V088B-A weld head models. When using the two position foot switch connect the foot switch cable to the appropriate mating connector on the weld head. Operation details can be found in *Chapter 4: Operating the Welding System*.

All weld heads have a firing switch cable that must be attached to the power supply Weld Head Connection socket. This cable powers air-actuated weld heads and triggers the power supply weld process when appropriate weld force has been reached.

Section VI: Weld Head Installation

Bench Mounting

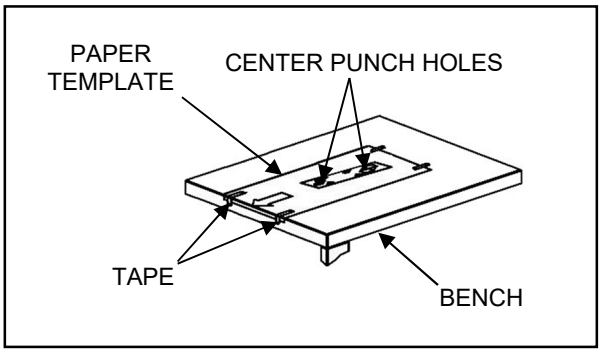
Each weld head comes mounted to a high-rigidity extrusion stand with hand-adjustable height control, baseplate, weld head cables, and pneumatic or mechanical linkage attached. In addition flexures, electrode holders, and a set of starter 1/8" Nicopp electrodes are installed as well. Electrodes and holders can be customized or replaced as required for an individual application.

Weld heads must be mounted to the bench for safety and operator convenience. Manual weld heads require additional bench modification to mount the cable foot pedal or MSP foot pedal actuator.

NOTE: Allow sufficient working space, usually 8 - 10 in. (20.32 - 25.4 cm), between the front edge of the bench and the mounting base. This allows the operator to use the bench as a support when positioning the workpiece.

1 Place the mounting template in the desired location on the workbench and tape it in place.

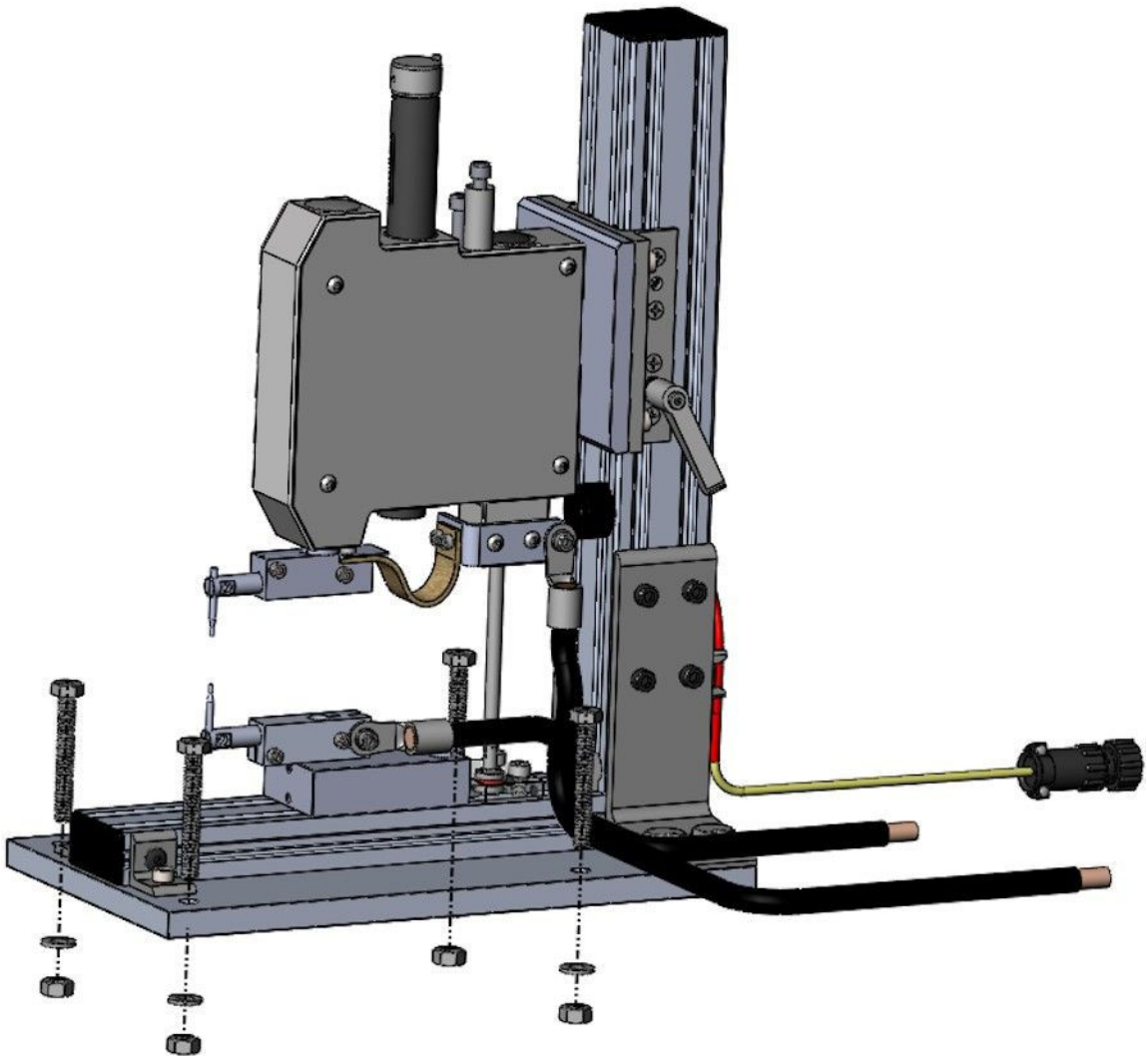
2 Drill the mounting holes as shown on the template.



Model TL-V080B-F with Model CP Foot Pedal Installation

The Model TL-V080B-F weld head with CP foot pedal uses a Bowden cable connection between the weld head and foot pedal.

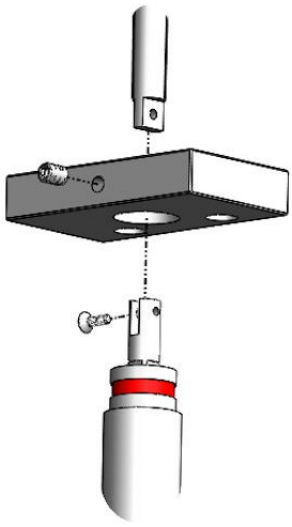
1. For an easier installation loosen the lower electrode block and slide forward in the extrusion slot. This step is not required.
2. Install weld head on bench, lining up previously drilled mounting holes in the bench with the holes in the baseplate and cable passthrough hole.



Weld Head installed on Bench (bench not shown)

3. Place cable mounting block over hole in stand.
4. Lower weld head as low as possible using adjustment handle. Raising and lowering the height through the installation process improves ease of assembly.

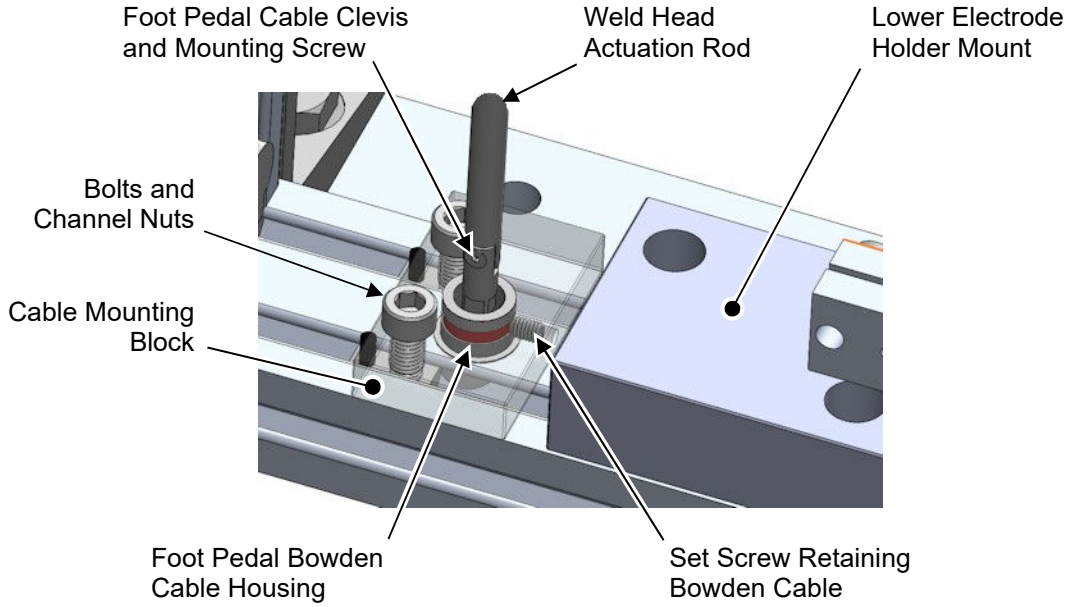
5. Feed foot pedal cable clevis through the bench and position over the matching hole in the weld head actuation rod. Install the small clevis hex screw to firmly attach the foot pedal clevis to the weld head actuation rod. Use a 0.050" hex key to tighten the screw.



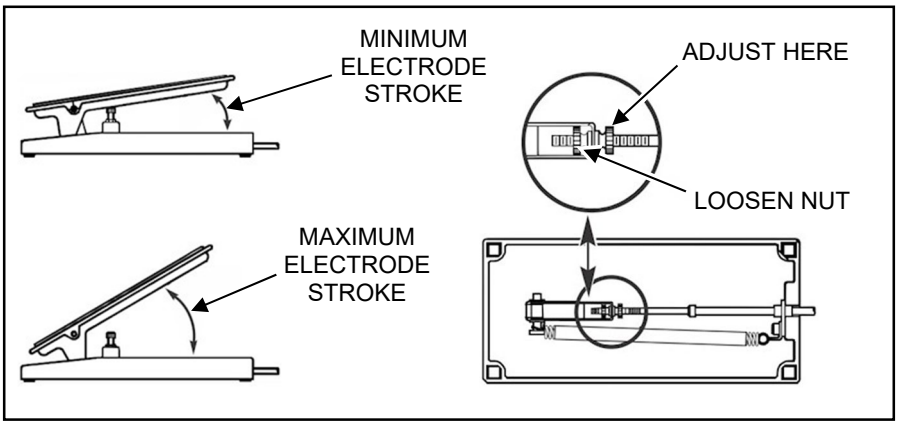
Simplified View of clevis and bowden cable mounting plate attachments

6. Drop one extrusion slot nut into each of the extrusion slots near the weld head cable passthrough in the base extrusion.
7. Raise the weld head using the adjustment handle until the bowden cable housing end rises through the hole in the baseplate and hits a hard stop in the cable mounting plate as shown in the diagram above. When the cable housing end is fully inserted further raising of the weld head will not raise the electrode holders. By adjusting the weld head height, the correct position for the bowden cable can be obtained.
8. Position the foot pedal cable mounting block and tighten the set screw using a hex key. The set screw will fit into a ridge cut in the bowden cable housing end indicated in the illustration above by a red band. The set screw can face forward or backward depending on which is best for tool access.

9. Attach the cable mounting block to the extrusion nuts to secure the assembly.



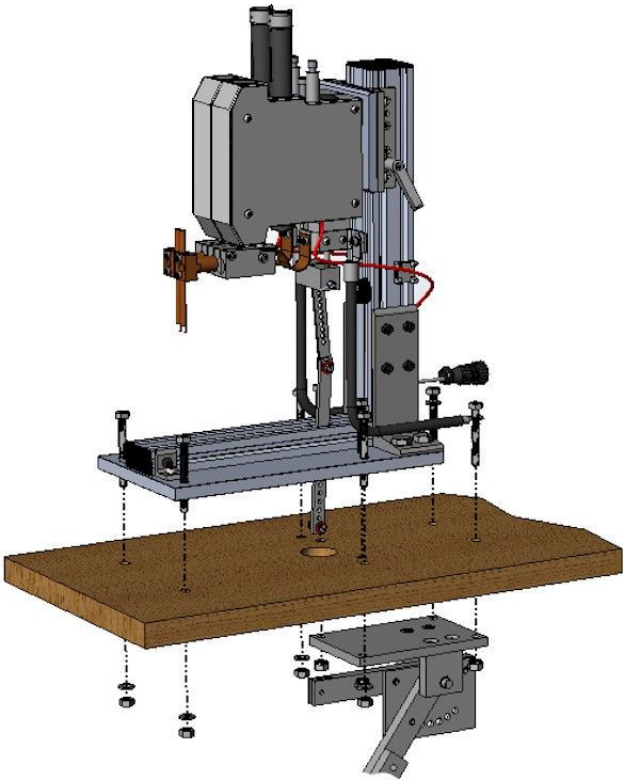
Completed Assembly



Foot Pedal Adjustment

10. The usable height and stroke of the electrodes are set by the combination of foot pedal and weld head height adjustment. Adjust foot pedal so that the electrode holders move the distance required by the application. This adjustment must be made in concert with weld head height adjustment using the adjustment handle. When properly configured there should be no slack in the cable when the pedal is up completely but when the pedal is depressed the electrodes should be able to make contact and build enough force to trigger the weld switch.
11. Adjust the angle of the foot pedal so that it provides the electrode stroke necessary for the application and is comfortable for the operator.

Model TL-V088B-F with Model MSP Footpedal Installation



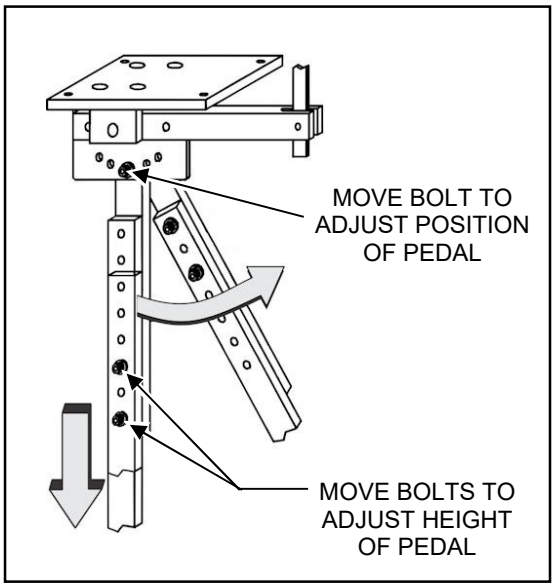
1 Screw the weld head to the bench and Model MSP Footpedal using four (4) bolts, washers, and nuts supplied with the shipping kit. Use two (2) additional bolts, nuts, and washers to secure the front of the weld head to the bench.

2 To adjust the height of the weld head use the height adjusting handle on the side of the stand.

3 Pull out the pin on footpedal adapter block just below the flexures on the weld head. Insert the pullrod and allow the pin to snap back into place.

5 Attach the pullrod to footpedal. Adjust the height of weld head, loosen two Allen head cap screws on the mounting plate adapter as shown, and slide weld head up or down the mounting stand.

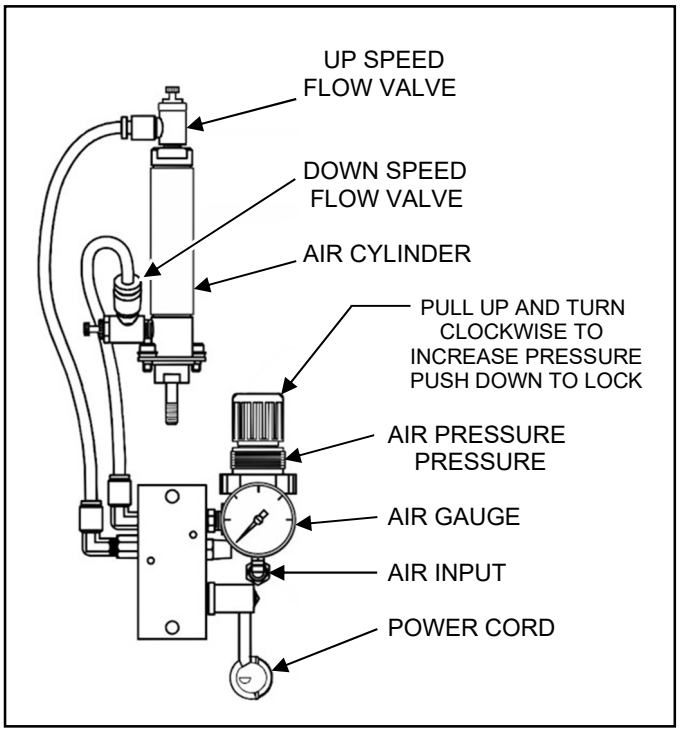
6 Adjust the angle and length of the footpedal so that it is comfortable for the operator.



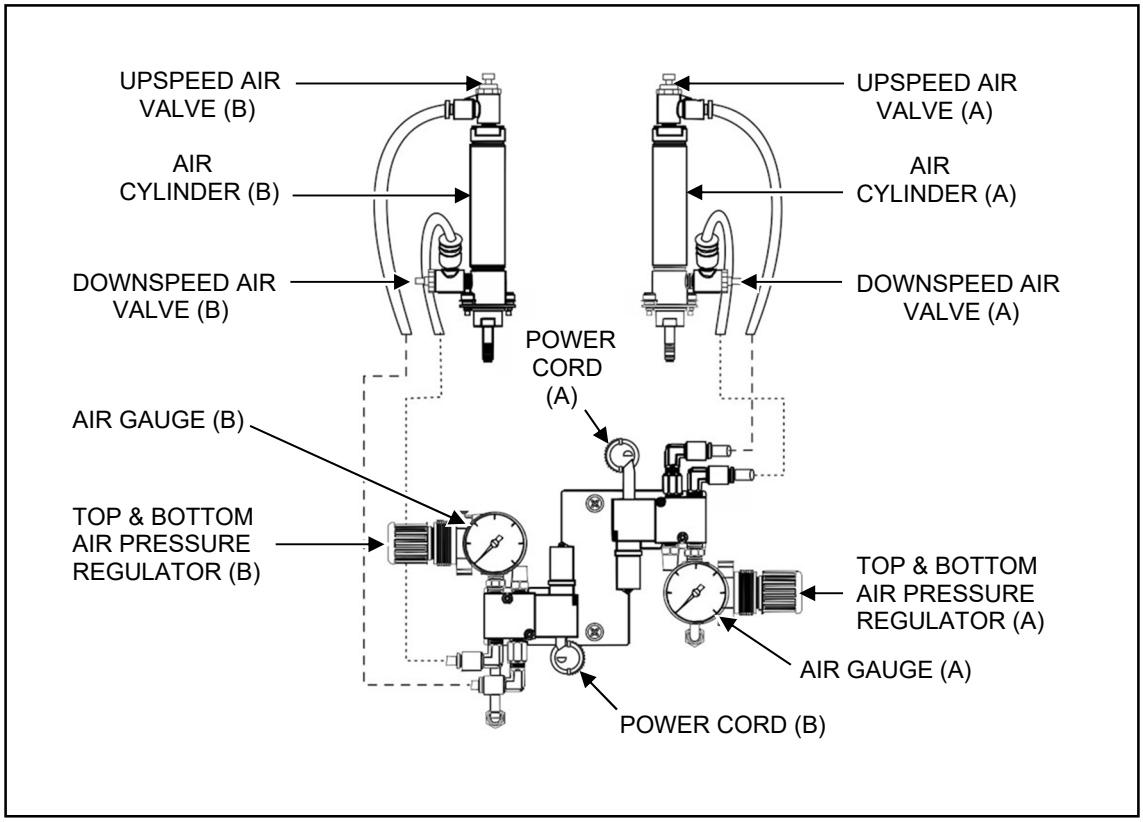
Models TL-V080B-A and TL-V088B-A Air Weld Head Installation

1 Insert a 0.25 in. (6.35 mm) outside diameter plastic hose, with a rated burst pressure of 250 psi (1,724 kPa), into the Air Input of the air solenoid valve assembly, as illustrated. The air input line uses a "quick release" fitting so special tools are not needed. Simply push the hose into the "quick release" fitting as far as it will go.

2 Connect the other end to a *properly filtered air supply* (100 psi/690 kPa maximum). Use the *shortest* air lines possible to obtain the fastest mechanical response. The inside diameter of the main air supply line must be at least 0.5 in. (13 mm) to allow sufficient air flow. The air supply should be filtered to ensure the maximum life of the air cylinder, flow controls, and regulator.



Single-Air Installation



TL-V088B-A Dual-Air Installation

NOTES:

- AMADA WELD TECH suggests that in-line lubricators ***only*** be used in automated applications, since excess oil can blow-by worn seals in the Air Cylinder and be deposited on the workpieces.
- If an in-line lubricator is ***not*** used, then the air line should be removed from the top of the cylinder(s) once every 1 million cycles, and several drops of a light machine oil should be squirted into the top of the cylinder(s).
- To facilitate dressing the electrodes, reduce the air pressure to the top of the cylinder. As an alternative to changing the setting of the Top Air Pressure Regulator, a customer supplied bleeder valve connected to the output of the Top Air Pressure Regulator can be used to reduce the air pressure.

3 Connect the power cord from the solenoid air valve as specified in the Users' Manual for the appropriate power supply or controller.

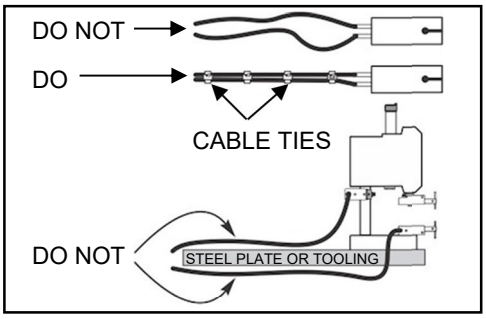
4 Install the system in accordance with established safety practices and standards. Anti-Tie Down Palm Buttons are not usually required if the electrode spacing will not allow the operator's fingers to fit between them.

Section VII. Connect Weld Head Cables

Weld Head Cables and Energy Losses

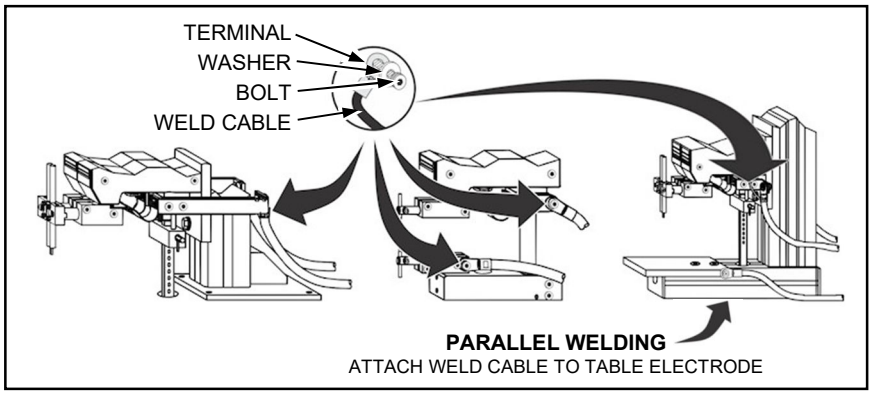
All AMADA WELD TECH weld heads are supplied with the correct weld head cables to provide maximum weld energy. If you need to install longer cables, or replace damaged cables, contact AMADA WELD TECH.

- ***Use # 2 AWG for lengths under 12 in. (30.5 cm) and # 2/0 AWG for longer lengths***. Tie or tape cables together to minimize inductive losses. A separation of weld head cables surrounding an area of one square foot could result in losses of up to 65%.
- ***Use the shortest possible Weld Head Cables***. It is common to have losses of up to 50% per foot for # 6 cables and 20% for #2 cables.
- ***Route weld cables together as long as possible before separating the cables to connect with the weld head terminals***. Route cables so that they do ***not*** surround magnetic materials such as air solenoids, tooling, or steel weld heads. The cable routing and weld head design should be such that the secondary loop does not encompass magnetic materials (steel) and/or is not encompassed by any magnetic material.



Connect Cables to Weld Head

Choose polarity based on desired direction of current flow



1 **Model TL-V080B-A / TL-V080B-F**: Connect one of the two cables supplied to the Power Bar. Connect the other cable to the fixed electrode holder.

Model TL-V088B-F / TL-V088B-A: Connect one cable to each Power Bar.

2 Place the washer, which is supplied, between the head of the Socket Head Screw and the Terminal on the Cable. ***Do NOT place the washer between the Terminal and the Power Bar.*** Tighten connections securely; they must be free from oxidation, dirt, and/or grease.

3 Connect the other end of the cables to the power supply or output transformer, in accordance with the instructions in its Users' Manual.

Section VIII. Install Electrodes for Welding

CAUTION

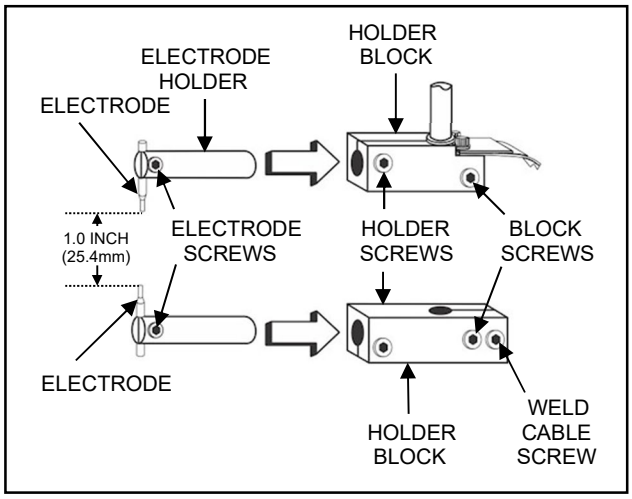
Do ***not*** modify the electrode holders or attach additional mechanisms to the moving parts of the weld head. Doing so may hurt welding performance, damage the weld head, and ***void the warranty***.

Model TL-V080B-A / TL-V080B-F

1 Loosen screws and insert electrodes. Loosely tighten screws to hold electrodes in position.

2 Align the electrodes, then tighten into position.

NOTE: The maximum distance between the electrode tips is 1.0 in. (25.4 mm).



Model TL-V088B-A / TL-V088B-F

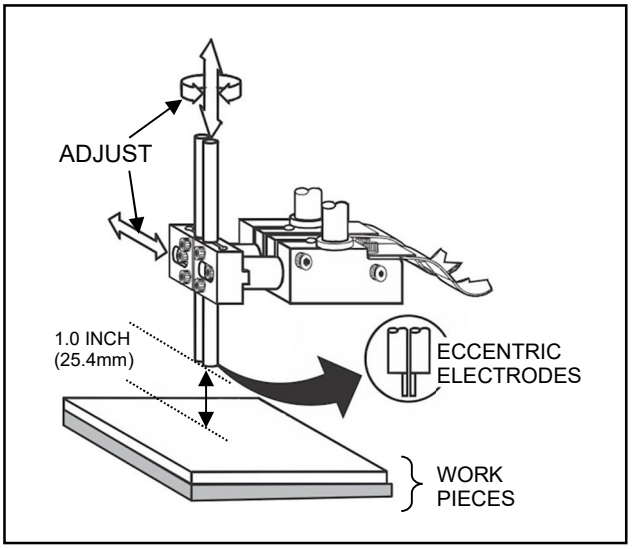
1 Insert electrodes into electrode holders.

2 Lower the electrodes onto a flat workpiece.

3 Align the electrodes so that they are parallel as well as perpendicular to the workpiece. Align the electrode tips.

4 Rotate the electrodes to obtain the desired distance between the tips (gap). Tighten the screws on the electrode holders.

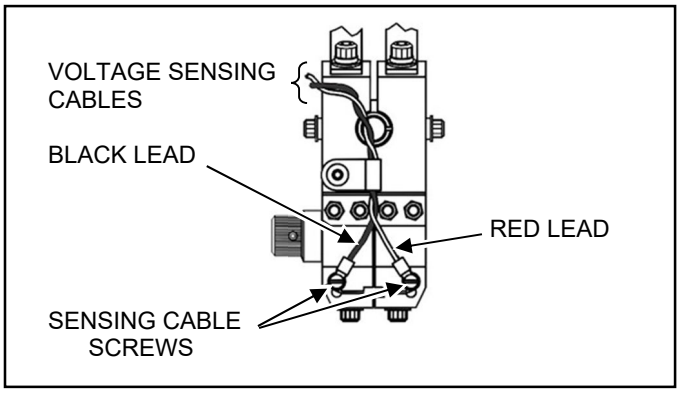
NOTE: The maximum distance between the electrode tips and the workpiece is 1.0 in. (25.4 mm).



Accessory Unibond Electrodes

1 Loosen block screws and remove existing electrode holders from shaft.

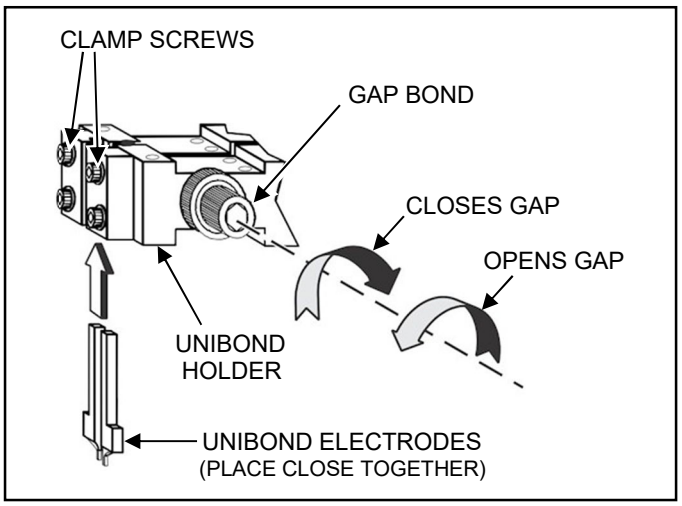
Note: Although Unibond electrodes are configured for voltage sensing cables by default the CD-V power supply does not require their presence. Remove any cables that may be present.



2 Loosen the electrode holder clamp screws. Set the electrode gap adjustment knob for maximum gap width and insert the Unibond electrodes into the holders as illustrated.

3 Loosely hold the electrodes in place and rotate the gap adjustment knob to its fully-clockwise (closed) position.

4 Orient the electrodes so they contact each other along their entire length and are perpendicular to the surface of the workbench.



NOTE: Position the electrodes vertically in the holder so the electrode tips are aligned.

5 Tighten the electrode holder clamp screws.

CAUTION: Do *not* over-torque the clamp screws. Doing so will deform the flexure, dramatically reducing its life.

6 Open the electrodes to the desired operating gap by turning the gap adjustment knob counterclockwise. The maximum distance between the tip of the electrode and the workpiece is 1.0 in. (25.4 mm).

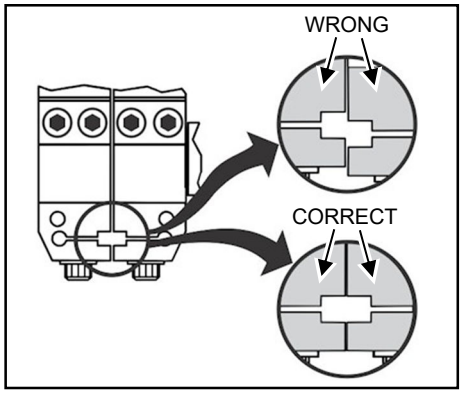
Note: Modification kit 4-40884-01 is available that will convert a TL-V080B-F Opposed Weld Head to an 86F Unibond Weld Head.

Accessory Unitip Electrodes

1 Loosen block screws and remove existing electrode holders from shaft.

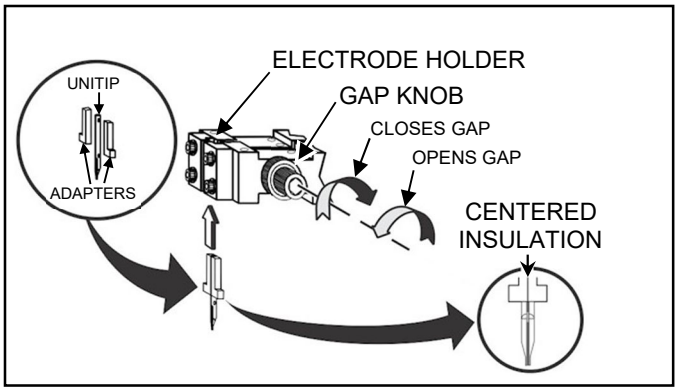
2 Look at the electrode holders from the top and verify that the holders are aligned from front-to-rear.

CAUTION: Unitip electrodes will be destroyed if the electrode holders are misaligned. The displacement will cause the Unitip to be sheared when the electrode holder clamp screws are tightened.



3 Assemble Unitip inside the Model UTA Unitip Adapter as shown. The vertical line (insulation) must be centered between the edges of the Unitip Adapter. Insert the assembled electrode into the electrode holder.

4 Rotate the gap adjustment knob on the electrode holder clockwise until the assembled electrode is lightly held in place. The Unitip and Unitip Adapter should be flush with the top surface of the electrode holder.



NOTE: Unitip electrodes have a fixed gap which can ***not*** be adjusted. If necessary, rotate the Unitip so that the vertical line on the tip formed by the insulation layer is exactly between the two adapter halves as illustrated. Tighten the two screws on the electrode holder.

CAUTION: ***Unitips can be severely damaged by applying excessive bonding forces.*** The table on the right lists the maximum operational force limits in both kilograms force (kgf) and ounces (oz). See Chapter 4 for Unitip cleaning and dressing instructions.

Use of Unibond Electrodes and Unitips should be limited to footpedal actuated weld heads. Their use in air-actuated weld heads requires great caution in adjusting electrode forces.

The maximum distance between the tip of the electrode and the workpiece is 1.0 in. (25.4 mm).

MAXIMUM UNITIP FORCE

Unitip Model	Max. Force (kgf)	Max. Force (oz)
UTM111L	0.94	33
UTM112L	0.94	33
UTM152L	0.48	17
UTM222L	3.74	132
UTM111C	0.94	33
UTM112C	0.94	33
TM222C	3.74	132
UTM224C	3.74	132
UTM237C	4.56	161

CHAPTER 3
Programming and Using the Power Supply

Section I: User Interface and Control Overview

The CD-V power supply is programmed by using a rotary control knob to select and adjust values on a small color LCD display. There are two types of display screens – the main display showing parameters and settings particular to a particular mode of operation and configuration screens that allow unit configuration parameters to be adjusted. Yellow parameters indicate items the user can interact with.

Figure 1 shows the main display screen in Independent Pulse Mode with all fields called out. Each of the three main modes have different Weld Parameter layouts but the information presented will be similar between each mode.

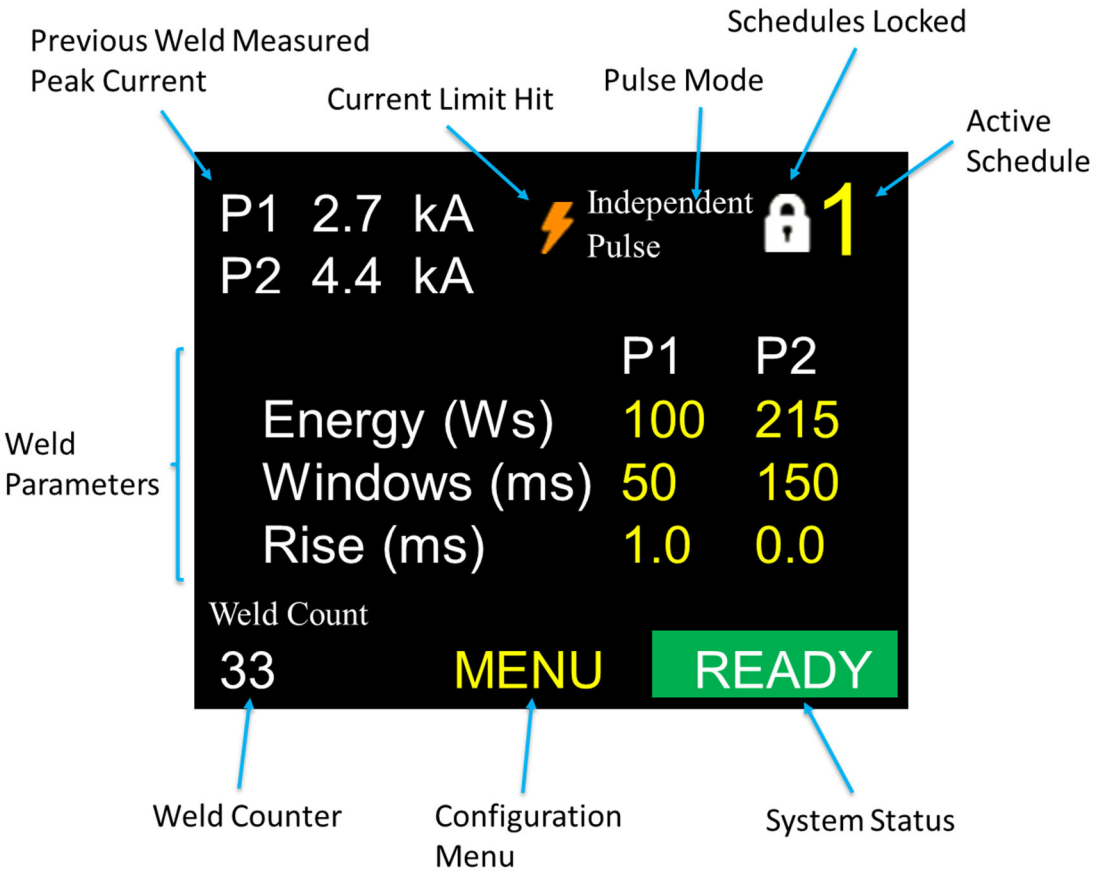


Figure 1 - Weld Screen – Independent Pulse Mode

Measured Peak Current Values: The upper left corner readings (P1, P2) show the measured peak current values for Pulse 1 and Pulse 2, if enabled. If the reading displays "---", no previous reading is available. If the measurements are displayed in a red font the previous weld window truncated the weld.

Pulse Mode: The upper middle of the screen shows the pulse mode, either Independent Pulse, Linked Pulse, or Roll Spot.

Weld Schedule Number: The upper right corner shows the number of the active Weld Schedule from 1-9. Each mode has a unique set of schedules.

Weld Schedule Parameters: The center of the screen shows all the weld parameters. This screen will vary depending on Pulse Mode.

Weld Counter: The lower left corner shows the number of welds the operator has performed since last reset.

Configuration Menu: Selecting this option allows the user to access the configuration menu.

Schedules Locked: The lock icon indicates that the settings have been locked against accidental modification. The lock can be enabled or disabled in the Configuration Menu.

Current Limit Hit: During a capacitive discharge weld, the welding current is determined by the energy setting and the resistance of the load. This resistance is determined by length and gauge of the weld head cables, various electrical resistances to the electrode tips, electrode to part resistance, and most notably the resistance at the interface between the materials to be welded where the weld is to occur. If the load resistance is not adequate -- caused by shorted output terminals, dry-firing the system without a part in place, etc.-- a current can be generated that will damage the machine. To prevent this event the machine has internal current limiting that will prevent the peak current from exceeding damaging levels. When the current limit is hit during a weld, the current is limited in real time to the limit value (8 kA) but the weld is allowed to proceed. After the weld, the lightning bolt icon is presented to inform the user that the previous weld hit the current limit. The icon will be present until the next weld.

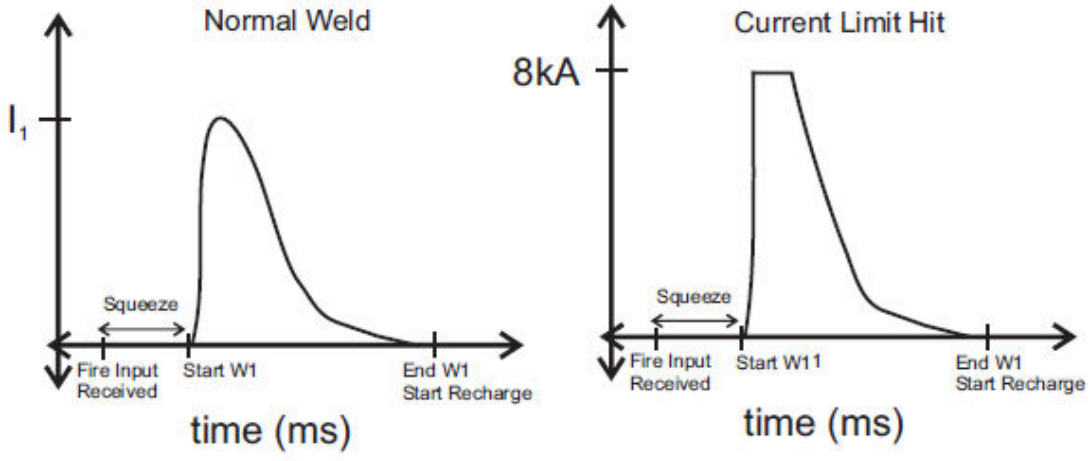


Figure 2 – Current Limiting

System Status: The lower right shows the system status. The possible values are:

READY (green background) – The system is charged to the schedule required voltage and is ready to accept a weld input from the head.

CHARGE (red background) – The system is currently charging and welding is prohibited.

NO WELD (red background) – The system is in "No Weld" mode and welding is prohibited. To enter/exit NO WELD mode long-press to rotary knob for 2 seconds.

PROGRM (blue background) – One of the parameters is selected and can be adjusted by turning the control knob. Welding is prohibited.

ROLL (red background) – Displayed for the duration of roll spot welding (fire signal on)

OVERTMP (red background) – Displayed when an over temperature condition is detected. Welding is inhibited. Allow the machine to cool.

Section II: Using the Rotary Control Knob

The single rotary control knob on the front of the unit is used to control and configure the various configuration and schedule values. Interacting with a value is simple – use the rotary control knob to select the value, provide a single short click to enter *PROGRM* mode, and rotate the control knob to set the new value. Once the value has been set, click the control knob to exit *PROGRM* mode. The control knob is speed-sensitive and values will change faster as the knob is turned more quickly.

Values with which the user can interact are shown with yellow text. When the rotary knob is moved, a value is highlighted, shown as a yellow background around the highlighted black text. After 8 seconds of inactivity the yellow highlighting disappears and the unit returns to the standard view.

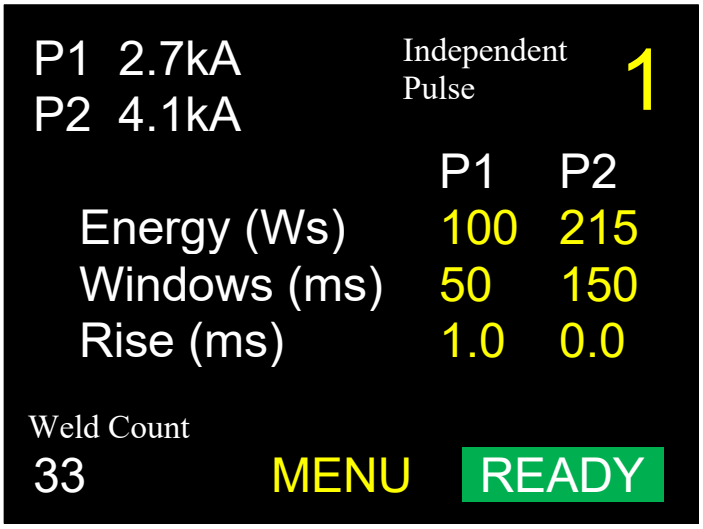


Figure 3 – Weld Screen Standard View

Rotating the front control knob highlights a value and toggles through the values with which the user can interact.

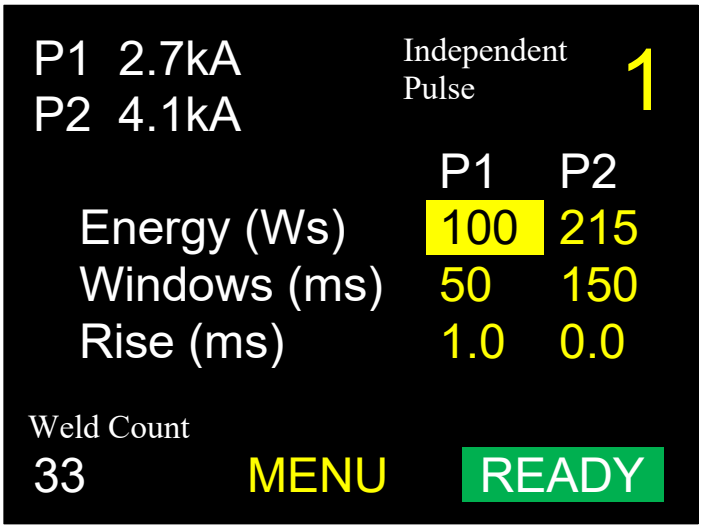


Figure 4 – Weld Screen with highlighted value for P1 Energy

Clicking on a value enters *PROGRM* mode. Once in *PROGRM* mode, the control knob can be rotated to adjust the value within the allowable range. Turning the rotary knob faster will change the values more quickly. For some values, changing below a certain threshold will change from a whole number ex."100" to a value with a single decimal place for added precision ex. "10.5".

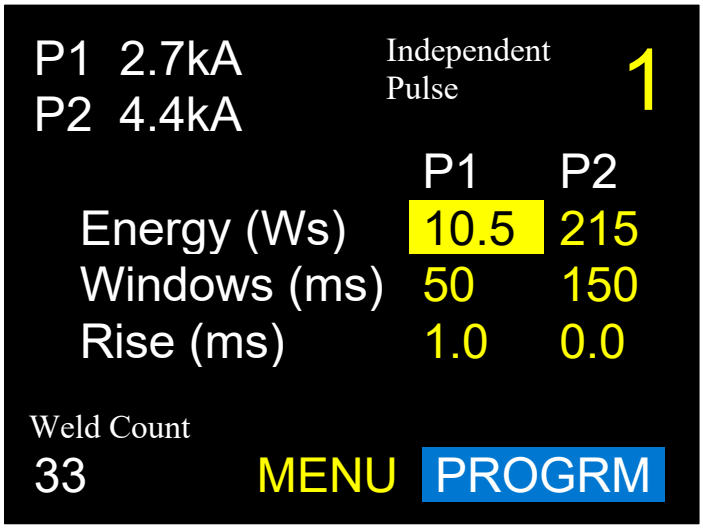


Figure 5 – Changing P1 Energy parameter in *PROGRM* mode to 10.5 Ws

Section III: Independent Pulse Mode

Independent Pulse Mode allows fine tuning and programming of each pulse in the two-weld sequence triggered by the weld head force fire signal. Welds can have independent power levels, rise times, and pulse windows. In independent pulse mode, each pulse can be set up to the maximum power level of the unit since the unit will charge or discharge the capacitor bank to the appropriate energy level as required during the weld sequence. After each weld the bank will recharge. A CD-V120A can output up to two 260 Ws pulses in a single cycle. This mode is best when fine tuning of weld pulses is required since it makes available rise time control and weld window control. If cycle time or pulse to pulse speed is a concern, consider Linked Pulse Mode since two pulses can be fired rapidly after a single charge.

Independent Pulse Mode requires 3 parameters to be set for each pulse. Setting P2 energy to zero will cause the unit to skip the second pulse. P1 must be at least 5 Ws.

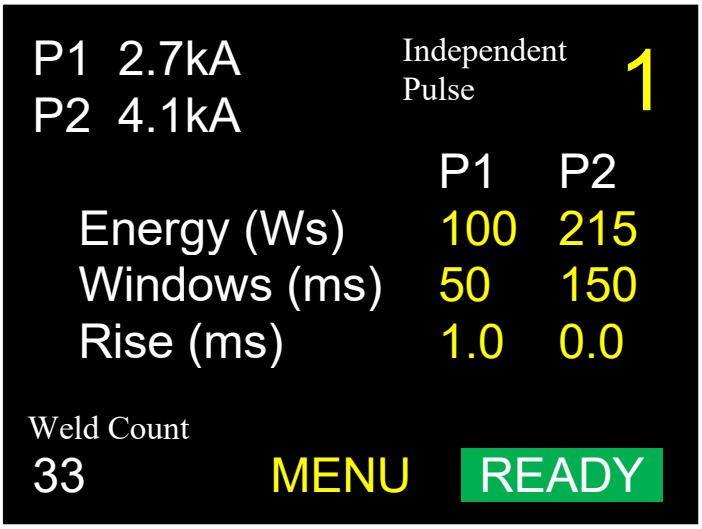


Figure 6 - Independent Pulse Mode Parameters

Energy (Ws) – This value sets the desired energy in Watt-seconds for each pulse, corresponding to the charge level of the capacitor bank for each pulse. Immediately upon changing a P1 Energy value or changing schedule, the unit will charge or discharge to the appropriate energy level and then display the green "READY" indicator.

Windows (ms) – This value sets the desired weld window for each pulse. A weld window is a period of time during which the energy delivery transistors in the unit are on and allowing the weld to occur. Since the actual weld pulse is determined by the energy setting and load resistance, changing the weld windows to longer time values will not affect the energy delivery but will let the material cool and slow the overall process. Setting the weld window to a time shorter than that required to discharge the required energy will truncate the weld. If a weld is truncated, the peak current monitor for that pulse will display with a red font. Optimizing the weld window for shortest possible time while not truncating the weld will provide the highest possible weld repetition rate for a given application.

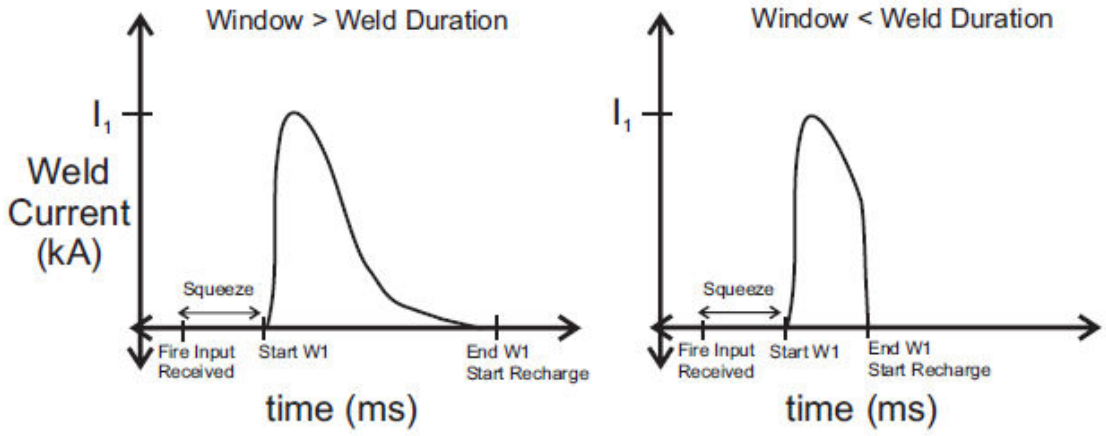


Figure 7 – Weld Window operation. Weld truncation due to short window settings will cause the peak current monitor to display red after a truncated weld.

Rise (ms) – Each pulse in independent pulse mode has rise time control. Under normal operation without weld rise time control the power delivery transistors turn completely on and stay on throughout the entire weld window. When rise time is enabled the power delivery transistors will gradually ramp up the current providing slower more linear initial weld energy delivery by pulse width modulating the transistors from 0 - 100% duty cycle over the ramp period. This important feature is very useful in minimizing initial weld spatter and providing better control of the weld process especially for highly resistive materials. When the weld starts the transistors are completely off. When the rise time period has elapsed they are completely on, and the rest of the weld proceeds as normal. Since the rise has been slowed the resulting weld will have lower peak current but a longer pulse width. Each pulse can have its own independent rise time setting in independent pulse mode.

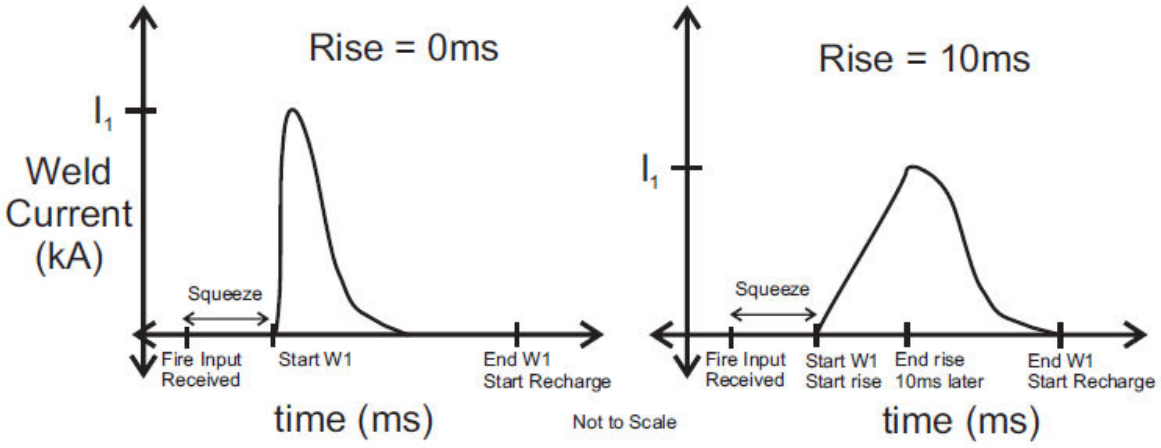


Figure 8 - Rise Time Operation

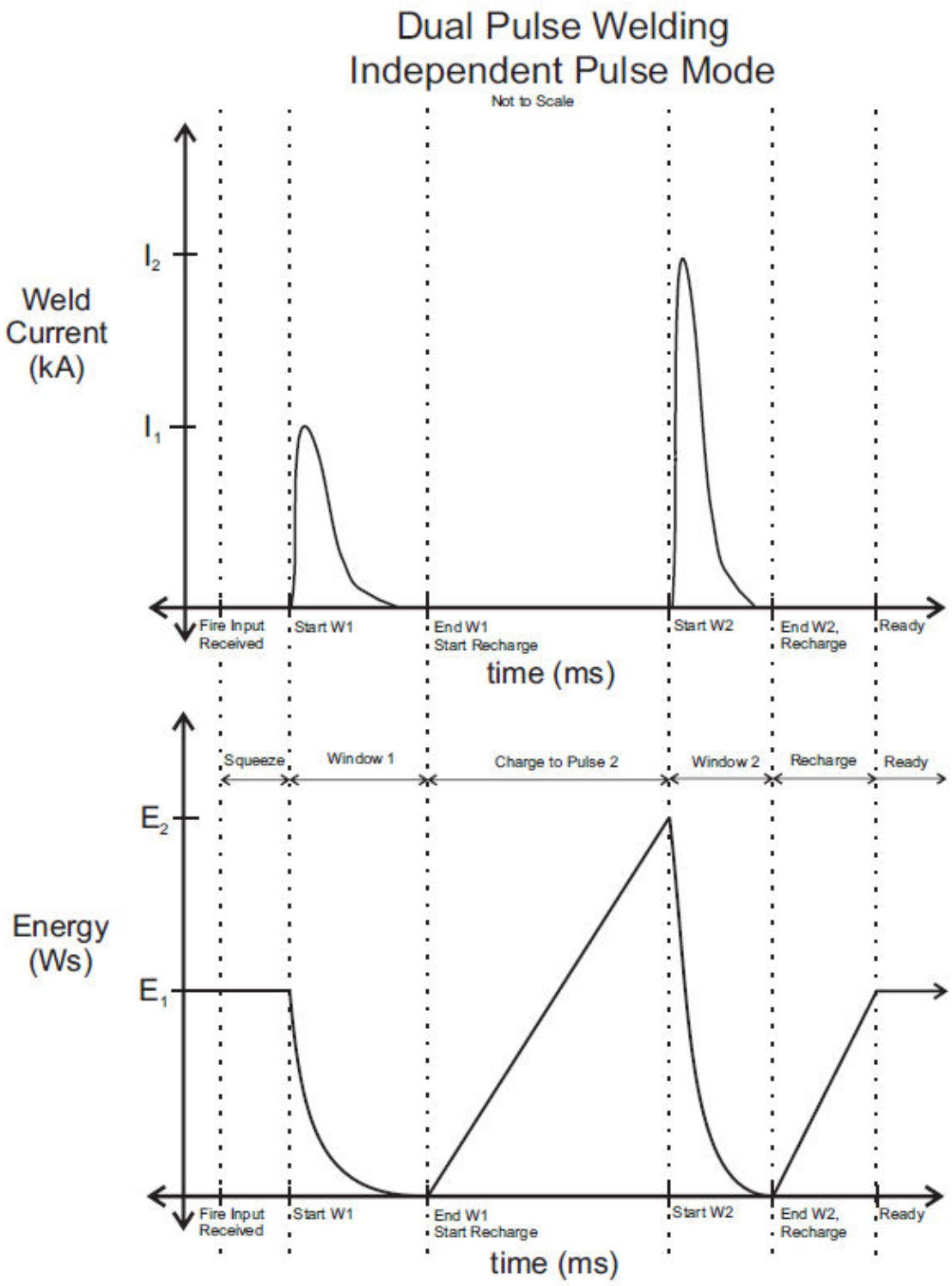


Figure 9 – Weld Current and Bank Energy during Dual Pulse Welding in Independent Pulse Mode

Section IV: Linked Pulse Mode

Linked pulse mode allows two pulses to be fired from a single bank charge. In Linked Pulse mode the user sets a total energy level, a Pulse 1 energy, a Pulse 2 energy, and a delay time between pulses. Instead of individual pulses charged to an energy level, discharged fully, then recharged as in Independent Pulse mode, Linked Pulse mode charges the complete amount of energy used by the process at the beginning and then reduces it in two steps.

The unit will charge the bank to the total requested energy level when the schedule is selected or values are changed. Once a fire signal is received and the squeeze time has elapsed the unit will discharge the programmed Pulse 1 amount of energy, wait for the delay to elapse, then discharge the programmed Pulse 2 energy. After Pulse 2 has discharged it will charge and wait for the next fire sequence. Pulse 1 will necessarily have a higher peak current than Pulse 2 due to the higher bank voltage at the beginning of the sequence. Rise time and window settings are unavailable in Linked Pulse Mode.

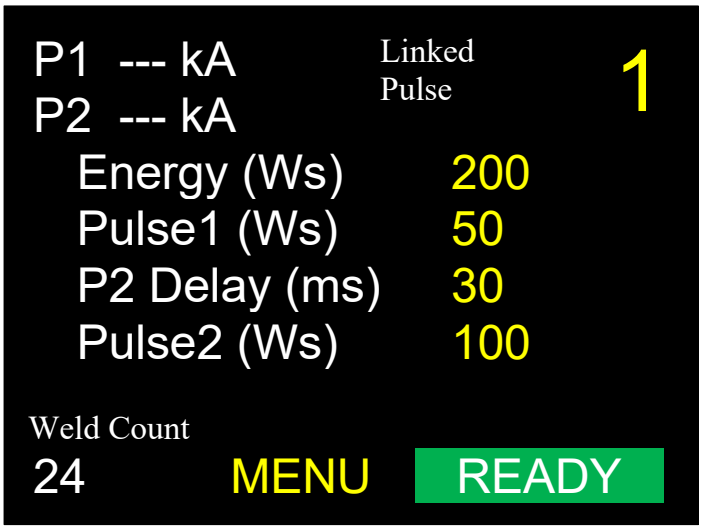


Figure 10 – Linked Pulse Mode parameters

Energy (Ws) – The total energy level for the Linked Pulse process. This value can be up to the maximum rated unit energy value. Total energy must be greater than the sum of Pulse 1 + Pulse 2.

Pulse1 (Ws) – How much energy to discharge during Pulse 1. This value can be set to zero if two pulses are not required.

P2 Delay (ms) – The delay between the two pulses.

Pulse2 (Ws) – How much energy to discharge during Pulse 2. Pulse 2 must be greater than Pulse 1.

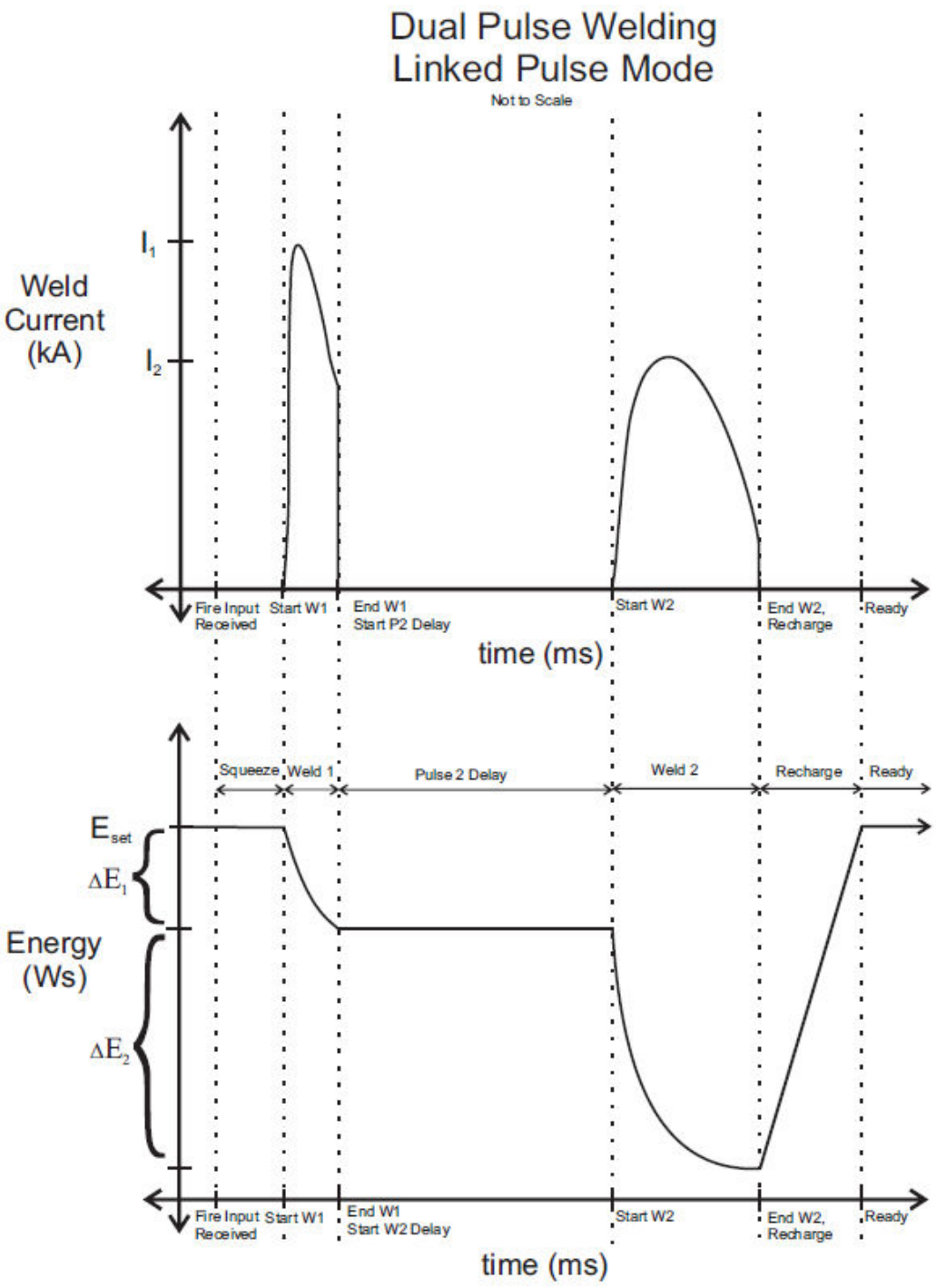


Figure 11 – Weld Current and Bank Energy in Linked Pulse Mode

Section V: Roll Spot Mode

Roll Spot is a special welding mode designed to execute multiple sequential welds in series typically combined with a rolling electrode. In this mode, a persistent fire signal is provided to the power supply which will output a series of pulses until the fire signal is removed. The user can control the energy of each pulse, rise time of each pulse, and interval between pulses. When the power supply detects that a pulse has been completed, it immediately recharges and waits until the specified interval has elapsed.

The energy setting, recharge time, and rise time, as well as the actual discharge time through a specific load, together determine the overall minimum interval for a particular weld schedule. If an interval below the calculated minimum is programmed a warning will appear, "Interval too low for energy setting". In this situation the weld is allowed to occur but the specified interval will not be achieved.

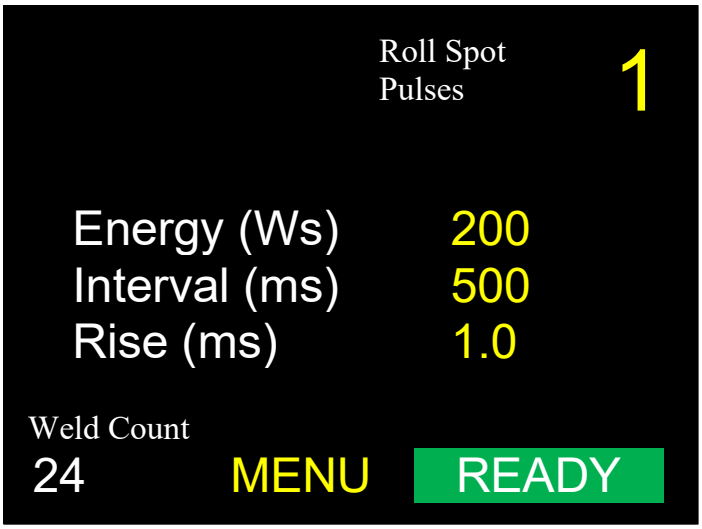


Figure 12 – Roll Spot Mode

Energy (Ws) – The programmed energy level for each pulse. Can be set up to maximum unit capacity.

Interval (ms) – The amount of time between pulses, defined from the beginning of one pulse to the beginning of the next. If the interval is set below the calculated minimum achievable value a warning message will be displayed "Interval too low for energy setting".

Figure 13 – Error Message

Rise (ms) – The rise time setting for each pulse. Rise time is discussed in detail in the Independent Pulse Mode section of this chapter.

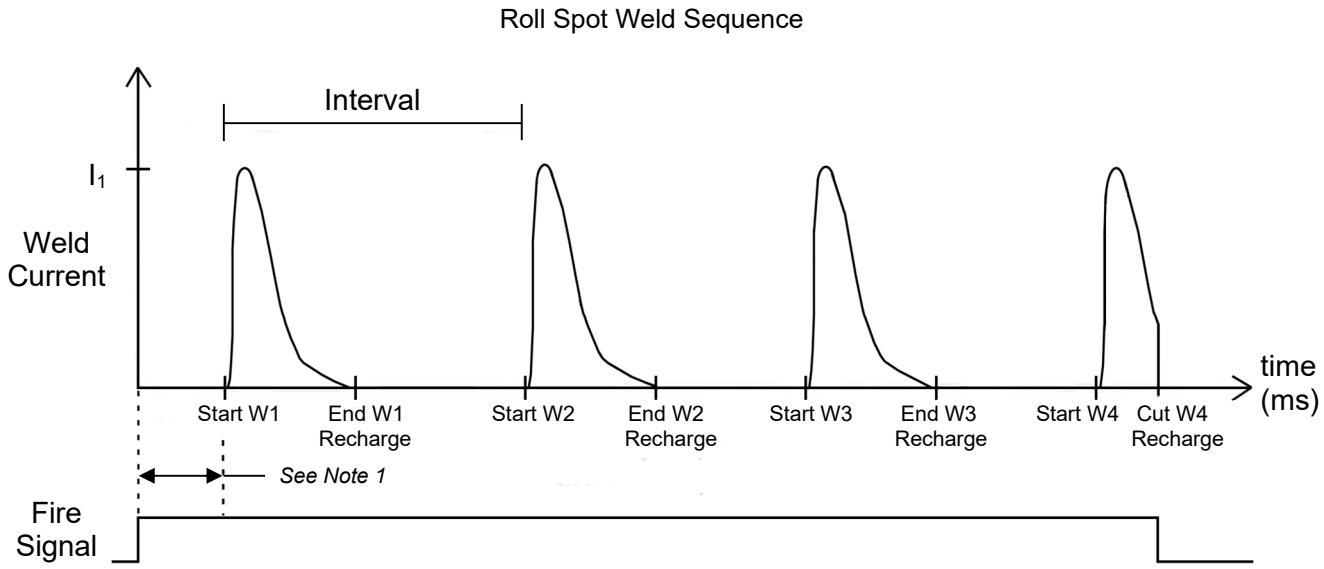


Figure 14 – Roll Spot Sequence

Note 1: There is a 115 ms delay time between the "Fire Signal" and when the first weld occurs when in Roll Spot Mode.

Section VI: Configuration Menus

Figure 15 shows Configuration Menu Screen 1 of 2.

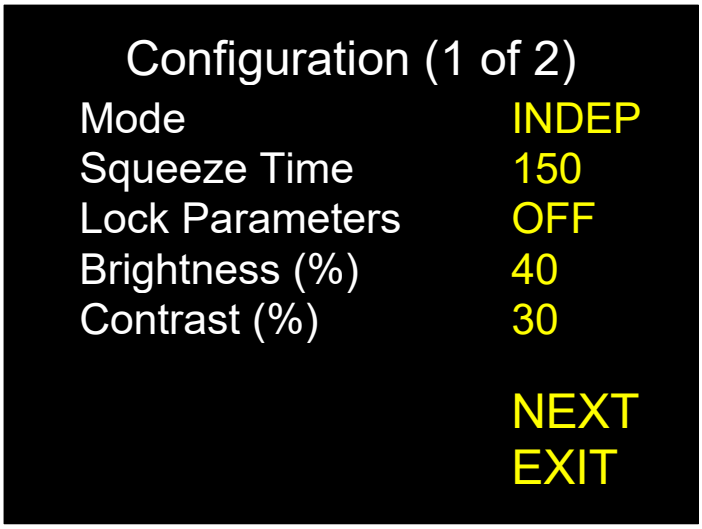


Figure 15 – Configuration Menu Screen 1 of 2

Mode – The Mode parameter can be set to INDEP, LINKED, and ROLL indicating Independent Pulse Mode, Linked Pulse Mode, and Roll Spot respectively.

Squeeze Time – The Squeeze time parameter determines the delay between the welder receiving a force fire switch input in milliseconds from the weld head and when the weld energy delivery is initiated. It is important for best results to set the squeeze time long enough to ensure that the material to be welded is fully compressed at a stable force.

Lock Parameters – Lock Parameters can be set to ON or OFF. When Lock Parameters is ON, changing weld schedule parameters from the operation screens is prohibited but it is still possible to select between the 9 schedules. When Lock Parameters is OFF, values can be changed. Default value is OFF. A padlock icon is shown on the main welding screen when Lock Parameters are set to ON.

Brightness (%) – Allows the user to change the display brightness from 0 - 100%. Default value 40%.

Contrast (%) – Allows the user to change the display contrast from 0 - 100%. Default value is 30%.

NEXT – Moves to configuration screen 2 of 2.

EXIT – Exit the configuration screen and return to the main weld display screen.

Figure 16 shows Configuration Menu Screen 2 of 2

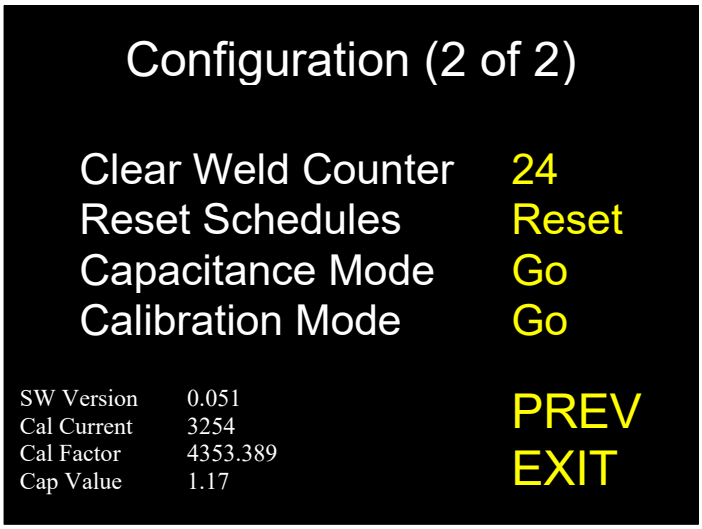


Figure 16 – Configuration Menu Screen 2 of 2

Clear Weld Counter – The current weld counter value is displayed. Clicking on this field will reset it to zero.

Reset Schedules – Selecting "Reset" will clear all schedules in Independent Pulse, Linked Pulse, and Roll Spot modes.

Capacitance Mode – To accurately deliver energy, the system needs to know the exact value of the installed capacitors. This routine is performed during initial factory calibration and does not need to be repeated unless repairs or other hardware modifications change the internal capacitance. Refer to *Appendix D: Power Supply Calibration* for details.

Calibration Mode –Although calibration is performed at the factory prior to shipment, it is possible to confirm and update unit calibration. Calibration requires an external shunt current measurement device. For calibration procedure details and required equipment please refer to the *Appendix D: Power Supply Calibration* in this document.

Version and Calibration Information - The current software version, current calibration values, and most recent capacitor measurement are shown for reference.

CHAPTER 4
Operating the Welding System

Section I: Before you step on the pedal

Background

Resistance welding is a complex subject and multiple factors affect the quality of the weld achieved with any welding system. The goal of the process is to accurately control heat into the weld zone to allow a strong bond to form. Factors to consider when getting ready to use the CD-V system include:

- Weld energy delivery programmed into the power supply schedule
- Weld current, determined by resistive stack up of electrodes/parts/cables/etc. and weld energy
- Part materials and geometry
- Electrode configuration, size, and material
- Weld force including follow-up force
- Single vs. Dual Pulse, pulse window delay
- Weld current rise limiting using upslope feature
- Weld head cable length and gauge
- Squeeze and Hold time duration applied by operator

Detailed information on how resistance welding works and how to develop a suitable set of settings for a successful weld process can be found in *Appendix C: Defining the Optimum Process*.

Detailed information on selecting electrodes and testing weld strength can be found in *Appendix C: Defining the Optimum Process*.

Pre-Weld Configuration

Each part to be welded must have an individual set of weld parameters developed to achieve maximum strength and best process yield. The acceptable range of process parameters is determined by the process window which is unique for each individual part to be welded. As the process changes due to material contamination, electrode wear, environmental changes, or other factors, it may be necessary to make small adjustments to keep the weld parameters within the acceptable process window. Some welds have wide, tolerant windows which will accept a number of process imperfections. Other welds require more precision and care when setting up and maintaining the equipment.

When preparing to weld it is important to confirm both electrical and physical parameters are correctly set for a particular application.

Check these items before beginning a new part type, or if welding performance isn't as expected:

1) Is the CD-V power supply set to the correct schedule for the application?
   See *Chapter 3: Programming and Using the Power Supply* for details on configuring the CD-V power supply

2) Are the correct electrodes installed, cleaned, and adjusted to the right height?
   See *Chapter 2: Installation and Setup* for details

3) Are the weld head cables installed to provide the desired weld polarity?
   See *Chapter 2: Installation and Setup* for details

4) Is the pneumatic weld head set up correctly, if equipped?
   Follow the procedures later in this chapter to configure the pneumatic weld head

   a. Is the supply air pressure to the pneumatic weld head set appropriately?
   b. Is/Are the force fire switch(es) configured to the desired welding force?
   c. Is/Are the welding regulator(s) on the weld head set to the correct pressure level to prevent over-force from being applied?
   d. Are the flow valves on the pneumatic weld head cylinder(s) set to provide the correct weld head speed?

5) Is the manual weld head set up correctly, if equipped?
   Follow the procedures later in this chapter to configure the manual weld head

   a. Is/Are the force fire switch(es) configured to set the desired welding force?
   b. Is the mechanical or cable linkage set up for appropriate stroke?

6) Does the power supply say "READY"?

Safety Precautions

Before welding it is necessary to take some safety precautions. Although the total energy delivered is limited and voltages are low, currents up to 8 kA are developed during the welding process and metals are melted. Molten weldment or electrode material (weld spatter) can be expelled under certain circumstances and hazardous fumes can be generated. It is imperative that all personnel in the area of a resistance weld wear safety glasses to protect against weld spatter.

Follow all required safety procedures including these which are specific to the resistance welding process:

- **Always wear safety glasses when firing the welder to protect from flying weld spatter.**
- Remove all jewelry, rings, watches, or other metal or conductive articles from your hands and wrists that could possibly come in contact with the welding electrodes.
- Remove metal tools, implements, or other conductive implements from the area that could possibly come in contact with the welding electrodes.
- Remove any flammable chemicals or material from the area which could catch fire if hit by molten weldment or electrode material.
- Restrain any loose clothing or hair that could get caught in the weld head mechanism.
- If using an air-powered weld head in an area under the jurisdiction of the CE Machinery Directive it is necessary to install an accessory Emergency Stop device in the system to be compliant. Contact AMADA WELD TECH for details.
- Always wear safety glasses when firing the welder to protect from flying weld spatter.
- Utilize caution as the welding process generates a strong electromagnetic field.
- Be aware that some materials can generate toxic fumes when welded. Protect personnel as required by a suitable risk analysis.

Section II: Welding

Performing a Weld

Once the weld head force, electrode configuration, and power supply settings have been configured it is time to perform a weld. Follow these steps to make a weld:

1) Put on your safety glasses.
2) Select the appropriate weld schedule on the power supply and verify the status is "READY".
3) Insert the materials to be welded between or under the electrodes.
4) Depress the two-level electric foot switch to level 1, or use the manual foot pedal to close the electrodes without reaching welding force.
5) Inspect the alignment of electrodes and parts to be welded. If everything seems OK continue. Otherwise release your foot, adjust alignment, and try again. If alignment is difficult put the welding system in "NO WELD" by long-pressing and releasing the rotary control knob on the power supply to ensure the system doesn't fire while you investigate the problem. Once the problem is resolved long-press and release the knob again to return to "READY".
6) Depress the two-level electric foot switch to level 2 and hold, or else increase the manual foot pedal until you hear the "click" of the force firing switch. If using a manual weld head hold the force as close as possible to the force firing switch level until the weld is complete.
7) Once the weld is complete release the pedal and remove the welded part.
8) The system will recharge immediately after the weld is completed and as soon as "READY" is displayed the next weld can begin.

Two-Level Foot Switch Operation

The two-level foot switch provided with pneumatic weld heads is designed to allow for consistent, repeatable weld force application. Since electronic solenoids driving pneumatic cylinders in the weld head are responsible for applying the weld force a highly repeatable process is possible independent of operator skill level. The first level of the two-level foot switch is designed to extend the weld head against the part and reach welding force without causing a weld. This allows the operator to verify correct alignment of the parts before triggering weld energy. When the foot switch is pressed to level 1, the pneumatic solenoid(s) and air cylinder(s) are activated causing the weld head to move down to the bottom of its stroke or until an obstruction is encountered. The speed of movement is controlled by the flow valve setting. When a part is encountered the weld head will build to the force allowed by the regulator's pressure setting and hold at the set force. If the weld head is correctly configured the force fire switch will detect when the desired welding force is applied and close but a weld will not be triggered pending foot switch level 2.

The second level of the two-level foot switch tells the power supply to begin the weld. If correct force is reached and the second level switch is closed the system will receive a fire switch input, wait for the programmed squeeze time, and execute the programmed weld schedule. Level 2 must be held throughout the entirety of a weld cycle or an incomplete weld will result and an error message will occur. Upon completion of the weld the operator must release the foot switch completely to retract the weld head.

Releasing the foot switch at any time will cause the power supply to stop delivering energy if a weld is in process and the weld head to retract immediately. If a weld is interrupted a red screen will display "WELD ABORTED, FIRE SIGNAL ABORT".

Manual Foot Pedal Operation

The manual weld head is a simpler and less repeatable device than the pneumatic weld head. When using the manual foot pedal a cable or linkage controlled by the operator's foot controls weld force. Although the weld process will always fire at the configured weld force the operator's foot will control force during and after the weld. An overzealous operator can easily continue increasing force after the fire switch occurs or release force during the weld process, negatively affecting weld quality. Operator skill and consistency is a major factor regulating the success of a manual weld head weld process.

Unlike the two-level electric switch used by the pneumatic weld heads, manual weld heads simply send a fire signal to the power supply when the set fire force is reached. It is possible to use the foot pedal to extend the weld head and grasp the part without triggering welding force, inspect the electrode positioning, and then apply additional force to trigger the weld. NO WELD mode can also be used to aid in part alignment.

Releasing the manual foot pedal such that the force firing switch opens will interrupt any ongoing weld and a red screen will display "WELD ABORTED, FIRE SIGNAL ABORT".

Section III: Configuring Weld Head Process Force

Follow the procedures in the remainder of the chapter to set up the force firing switches, maximum welding force, and stroke limits for each weld head. Remember that the maximum welding force should not substantially exceed the firing force.

One substantial advantage to the TL-V080B-x and TL-V088B-x weld heads is their force firing mechanism that triggers on proper weld force regardless of part thickness or electrode offset. This means that dressing/cleaning or changing of the electrodes will not require changes to the force calibration.

If a previously functioning process starts showing lower yield or poor performance it is tempting to turn up the weld energy, raise the force, and go back to making parts. Only change the process force adjustment or schedule settings when changing to a new type of part, performing process development, or when force measurement indicates that the weld head may not be delivering the expected force values. Defects or quality issues with welds should be investigated and other causes considered before adjusting force or energy settings. Some other change in process variables (part plating, cleanliness, thickness, electrode condition, etc.) may be causing the substandard welds and adjusting the force or energy to compensate will only mask the true problem.

Information on weld process parameters and their effect on the weld can be found in the appendices.

Section III-a. Model TL-V080B-A Air-Actuated Single Weld Head Process Adjustment

This Section describes the following adjustments, to be made in this order:

- **Firing force** to the value required by the specific application. When the firing switch hits firing force it will send a signal to the power supply to begin the weld cycle.
- **Maximum force** the electrodes can exert on the workpiece during the welding cycle.
- **Down stroke** limits.

The weld application will determine the correct force setting. Start as suggested below and iterate through this adjustment process.

CAUTION: Excessive force can damage the electrodes and/or the workpiece.

In high speed applications, the maximum repetition rate is usually limited by the stroke of the weld head and the air pressure on the top of the air cylinder. The higher the pressure, the faster the upper arm will move. The air pressure on the top of the cylinder will determine the *welding, but not the firing force*. If the welding force exceeds the firing force, which is set by the force adjustment knob on the weld head, by more than five percent, a noticeable decrease in weld quality often results.

1 Use the flow control on the bottom of the cylinder to reduce the down speed.

2 Use the force adjustment knob to set the weld head force indicator to "4". Indicator is located on the front of the force tube just below the force adjustment knob.

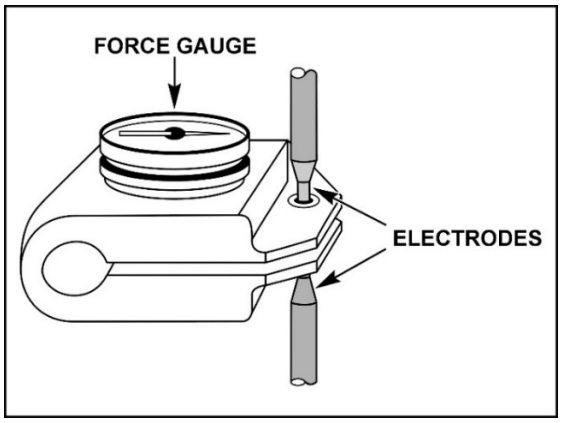
3 Close, but do not tighten, both air flow control valves.

4 Re-open each valve 3 or 4 turns.

5 Adjust the air pressure regulator to an indicated 10 psi (69 kPa).

6 Cycle the weld head by depressing and releasing the footswitch. Adjust the upspeed air flow control valve located at the ***top*** of the air cylinder, so that the upper arm moves up at a reasonable rate. It should not move so rapidly that it slams against the upstop.

7 Adjust the electrode spacing so that an AMADA WELD TECH Force Gauge, part number 7-004-02-01, fits between the electrodes, as illustrated.



8 Depress and hold the footswitch. Note the force indication on the force gauge when the weld head firing switch "clicks." If the firing switch does not close, increase the pressure from the air pressure regulator until the firing switch does close. If the firing switch closure is inaudible, it is easily detected by observing the status switch indicator on the welding power supply / controller.

9 Use the force gauge reading from the previous step as a starting point. Use the force adjustment knob to increase the indicated force if the initial force reading is less than the required force setting. If the initial force reading is greater than the required force setting, decrease the indicated force.

10 Release and depress the footswitch. Verify that the welding force applied by the upper arm does not exceed the force required to close the firing switch by more than five percent (5%). If necessary, adjust the pressure from the air pressure regulator and/or the force adjustment knob on the weld head.

11 After setting the required force, remove the force adjustment knob by loosening the two set screws which secure it to the shaft. Invert the knob and place it on the shaft. Be sure to insert the locking tab on the knob into the slot on the force tube. Re-tighten both set screws.

12 If necessary, re-adjust the electrodes in their holders to accommodate the workpiece.

13 Turn the downstop screw counter-clockwise to its fullest extension without actually disengaging it. This will allow maximum downward travel of the upper arm. The following downstop adjustment should be made only if the workpiece would be damaged if the upper arm travels too far. In most applications, use of the downstop is not recommended.

A) Depress and ***hold*** the footswitch. Slowly rotate the downstop counter-clockwise until the force firing switch in the weld head closes. Rotate the downstop one or two additional turns counter-clockwise. The additional turn(s) will allow for electrode wear and/or the slight variations of the position of the electrode in its holder.

B) Re-check that the firing switch consistently closes.

CAUTION: Do ***not*** attempt to use the downstop adjustment to limit the force which is applied to the workpiece. This will result in inconsistent welds.

14 Depress the footswitch. Adjust the downspeed air flow control valve so that the upper electrode arm descends slowly enough to prevent impact damage to the workpiece and electrodes.

15 Re-adjust upspeed air flow control valve if necessary.

16 Once the required firing force is setup, ***do not change the regulator setting*****!** Use only the air flow control valves to control the up and down speed of the upper arm. Changes in the regulator setting will change the welding force.

Section III-b. Model TL-V088B-A Air-Actuated Dual Weld Head Process Adjustment

This Section describes the following adjustments, to be changed in this order:

- **Firing force** to the value required by the specific application.
- **Maximum force** the electrodes can exert on the workpiece during the welding cycle.
- **Down stroke** limits.

The weld application will determine the correct force setting. Start as suggested below and iterate through this adjustment process.

CAUTION: Excessive force can damage the electrodes and/or the workpiece.

In high speed applications, the maximum repetition rate is usually limited by the stroke of the weld head and the air pressure on the top of the air cylinder. The higher the pressure, the faster the upper arm will move. The air pressure on the top of the cylinder will determine the *welding, but not the firing force*. If the welding force exceeds the firing force, which is set by the force adjustment knob on the weld head, by more than five percent, a noticeable decrease in weld quality often results. Use the flow control on the bottom of the cylinder to reduce the down speed. Firing switches are wired in series so both must be activated to trigger a weld.

NOTE: Start with the ***right*** side of the weld head.

1 Connect the firing switch cable to the power supply firing switch connector.

2 Adjust the left side electrodes so that they will touch during the testing of the right side.

3 Set the left side firing force to the minimum value to ensure that the firing switch is activated during configuration of the right side. This way the right side can be adjusted independently.

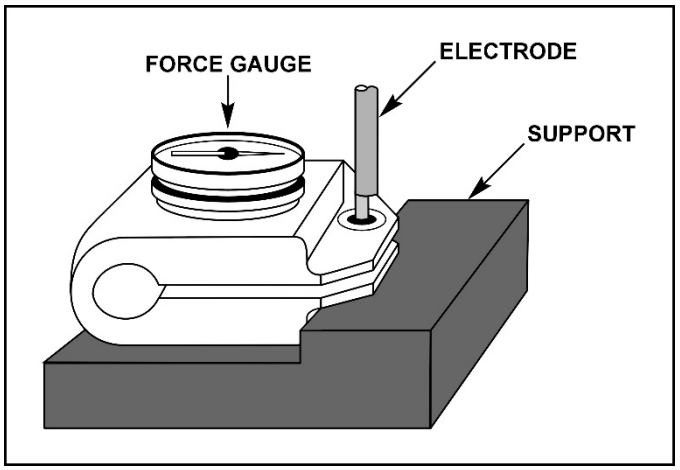
4 Use the force adjustment knob to set the right side weld head force indicator to "4". Indicator is located on the front of the force tube just below the force adjustment knob.

5 Close, but do not tighten, both air flow control valves.

6 Re-open each valve 3 or 4 turns. Adjust air pressure regulator for the side being adjusted to an indicated 10 psi (69 kPa).

7 Cycle the weld head by depressing and releasing the footswitch. Adjust the upspeed air flow control valve located at the ***TOP*** of the air cylinder, so that the upper arm moves up at a reasonable rate. It should not move so rapidly that it slams against the upstop.

8 Place an AMADA WELD TECH Force Gauge, part number 7-004-02-01, beneath the electrode as shown. The force gauge ***must*** be supported on the ***bottom of the force gauge squeeze tab*** for proper indication of force.



NOTE: If the application is a welding application, adjust the spacing so that an AMADA WELD TECH Force Gauge fits between the right electrode and a workpiece.

9 Depress and hold the footswitch. **NOTE:** the force indication on the force gauge when the weld head firing switch "clicks."

10 If the firing switch does not close, increase the pressure from the air pressure regulator until the firing switch does close.

NOTE: If the firing switch closure is inaudible, it is easily detected by observing the status indicator on the welding power supply / controller.

11 Use the force gauge reading from the previous step as a starting point. Use the force adjustment knob to increase the indicated force if the initial force reading is less than the required force setting. If the initial force reading is greater than the required force setting, decrease the indicated force.

12 Place a block in the right side or adjust the electrodes so that the electrodes trigger the right side firing switch during configuration of the left side.

13 Repeat steps 4, 7, 8, and 9 on the left side.

14 Release and depress the footswitch. Verify that the welding force applied by the upper arm does not exceed the force required to close the firing switch by more than five percent (5%). If necessary, adjust the pressure from the air pressure regulator and/or the force adjustment knob on the weld head.

15 After setting the required force and completing weld development, remove the force adjustment knob by loosening the two set screws which secure it to the shaft. Invert the knob and place it on the shaft. Be sure to insert the locking tab on the knob into the slot on the force tube. Re-tighten both set screws.

16 Re-adjust the electrodes in their holders to accommodate the workpiece. The faces of both electrodes should be in the same plane and the gap (spacing) between the electrodes should be uniform.

17 Turn the downstop screws counter-clockwise to their fullest extension without actually disengaging them. This will allow maximum downward travel of the upper arms. The following downstop adjustments should be made only if the workpiece would be damaged if the upper arms travel too far. In most applications, use of the downstop is not recommended.

A) Start with the right downstop. Place the workpiece in the appropriate position. Rotate the downstop screw clockwise until the electrode no longer contacts the workpiece. Check the adjustment by depressing and releasing the footswitch.

B) Depress and ***hold*** the footswitch. Slowly rotate the downstop counter-clockwise until the force firing switch in the weld head closes. Rotate the downstop one or two additional turns counter-clockwise. The additional turn(s) will allow for electrode wear and/or the slight variations of the position of the electrode in its holder. Re-check that the firing switch consistently closes.

C) Repeat this procedure for the left downstop.

CAUTION: Do ***not*** attempt to use the downstop adjustments to limit the force which is applied to the workpiece. This will result in inconsistent welds.

18 Depress the footswitch. Adjust the downspeed air flow control valves so that the upper electrode arms descend slowly enough to prevent impact damage to the workpiece and electrodes.

19 Re-adjust upspeed air flow control valves if necessary.

20 Once the required firing force is setup, **DO NOT CHANGE THE REGULATOR SETTING!** Use only the air flow control valves to control the up and down speed of the upper arm. Changes in the regulator setting will change the welding force.

Section III-c. Model TL-V080B-F Manually-Actuated Single Weld Head Process Adjustment

This Section describes the following adjustments, to be changed in this order:

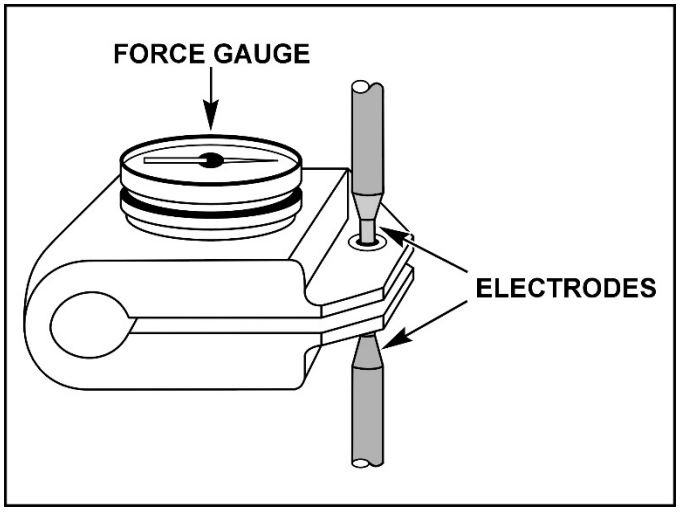
- **Firing force** to the value required by the specific application.
- **Maximum force** the electrodes can exert on the workpiece during the welding cycle.
- **Down stroke** limits.

The weld application will determine the correct force setting. Start as suggested below and iterate through this adjustment process.

CAUTION: Excessive force can damage the electrodes and/or the workpiece.

1 Use the force adjustment knob to set the weld head force indicator to "4." The indicator is located on the front of the force tube just below the force adjustment knob. Set weld heads with digital readouts to "100."

NOTE: If the application is a welding application, adjust the electrode spacing so that an AMADA WELD TECH Force Gauge, part number 7-004-02-01, fits between the electrodes, as illustrated.



2 Depress and hold the footpedal. Note the force indication on the force gauge when the weld head firing switch "clicks."

3 Use the force gauge reading from the previous step as a starting point. Use the force adjustment knob to ***increase*** the indicated force if the initial force reading is ***less than*** the required force setting. If the initial force reading is ***greater than*** the required force setting, ***decrease*** the indicated force.

4 Depress and release the footpedal. Verify that the force applied by the operator does not exceed the force required to close the firing switch by more than five percent (5%).

5 After setting the required force, remove the force adjustment knob by loosening the two set screws that secure it to the shaft. Invert the knob and place it on the shaft. Be sure to insert the locking tab on the knob into the slot on the force tube. Re-tighten both set screws.

6 If necessary, re-adjust the electrodes in their holders to accommodate the workpiece.

7 Turn the downstop screw counter-clockwise to its fullest extension without actually disengaging it. This will allow maximum downward travel of the upper arm. The following downstop adjustment should be made ***only*** if the workpiece would be damaged if the upper arm travels too far. ***In most applications, use of the downstop is not recommended***.

A) Place the workpiece in the appropriate position. Rotate the downstop screw clockwise until the electrode(s) or thermode no longer contacts the workpiece. Check the adjustment by depressing and releasing the footpedal.

B) Depress and ***hold*** the footpedal. Slowly rotate the downstop counter-clockwise until the force firing switch in the weld head closes. Rotate the downstop one or two additional turns counter-clockwise. The additional turn(s) will allow for electrode wear and/or the slight variations of the position of the electrode in its holder. Re-check that the firing switch consistently closes.

CAUTION: Do ***not*** attempt to use the downstop adjustment to limit the force which is applied to the workpiece. This will result in inconsistent welds.

Section III-d Model TL-V088B-F
Manually-Actuated Dual Weld Head Process Adjustment

This Section describes the following adjustments, to be changed in this order:

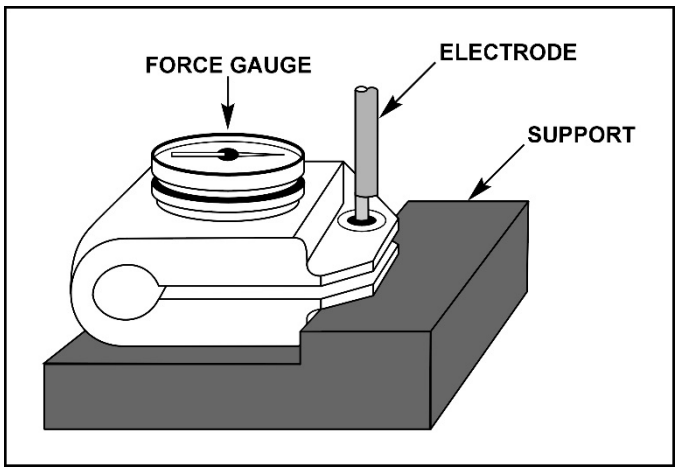
- **Firing force** to the value required by the specific application.
- **Maximum force** the electrodes can exert on the workpiece during the welding cycle.
- **Down stroke** limits.

The weld application will determine the correct force setting. Start as suggested below and iterate through this adjustment process.

CAUTION: Excessive force can damage the electrodes and/or the workpiece.

1 Start with the **right** side of the weld head. Connect the firing switch cable to the power supply firing switch connector. Use the force adjustment knob to set the right side weld head force indicator to "4." The indicator is located on the front of the force tube just below the force adjustment knob. Set the left side to the lowest setting and adjust the left side electrodes so they close fully during testing.

2 Place an AMADA WELD TECH Force Gauge, part number 7-004-02-01, beneath the right side electrode, as shown. The force gauge ***must*** be supported on the ***bottom of the measurement flange*** for proper indication of force.



NOTE: Adjust the electrode spacing so that an AMADA WELD TECH Force Gauge fits between the right electrode and a workpiece.

3 Depress and hold the pedal. Note the force indication on the force gauge when the weld head firing switch "clicks."

4 Use the force gauge reading from the previous step as a starting point. Use the force adjustment knob to ***increase*** the indicated force if the initial force reading is ***less than*** the required force setting. If the initial force reading is ***greater than*** the required force setting, ***decrease*** the indicated force.

5 Adjust the right side electrodes so they will close fully during testing.

6 Repeat steps 1 through 4 to set the firing force on the **left** side of the weld head.

7 Depress and release the footpedal. Verify that the force applied by the operator does not exceed the force required to close the firing switch by more than five percent (5%).

8 After setting the required force, remove the force adjustment knob by loosening the two set screws that secure it to the shaft. Invert the knob and place it on the shaft. Be sure to insert the locking tab on the knob into the slot on the force tube. Re-tighten both set screws.

9 Re-adjust the electrodes in their holders to accommodate the workpiece. The faces of both electrodes should be in the same plane and the gap (spacing) between the electrodes should be uniform.

10 Turn the downstop screws counter-clockwise to their fullest extension without actually disengaging them. This will allow maximum downward travel of the upper arms. The following downstop adjustments should be made ***only*** if the workpiece would be damaged if the upper arms travel too far. ***In most applications, use of the downstop is not recommended***.

11 Start with the right downstop. Place the workpiece in the appropriate position. Rotate the downstop screw clockwise until the electrode no longer contacts the workpiece. Check the adjustment by depressing and releasing the footpedal.

A) Depress and ***hold*** the footpedal.

B) Slowly rotate the downstop counter-clockwise until the force firing switch in the weld head closes. Rotate the downstop one or two additional turns counter-clockwise.

C) The additional turn(s) will allow for electrode wear and/or the slight variations of the position of the electrode in its holder.

D) Re-check that the firing switch consistently closes.

12 Repeat this procedure for the left downstop.

CAUTION: Do ***not*** attempt to use the downstop adjustments to limit the force which is applied to the workpiece. This will result in inconsistent welds.

CHAPTER 5
MAINTENANCE and TROUBLESHOOTING

Section I: Operator Maintenance – Power Supply

Clean all electrical connections every six months to minimize welding circuit resistance.

The Power Supply does not require any Operator Maintenance. To ensure consistently accurate performance of the peak current monitor, AMADA WELD TECH recommends that you calibrate the Power supply at least once a year. For calibration instructions, please refer to *Appendix D, Power Supply Calibration*.

Section II: Operator Maintenance – Weld Head

Inspection

Inspect all air fittings, linkages, and cables daily for signs of leakage or wear. Inspect all bearings and braces for excessive wear every three years and replace as necessary. Verify weld head calibration as frequently as required by application.

Lubrication

All bearing surfaces are designed for non-lubricated operation. Do ***not*** oil any bearings or sleeves ***except*** for the use of a dry lubricant on weld heads used in automated, air actuated systems.

Section III. Standard Resistance Welding Electrode Cleaning

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.

1 Re-surface tips periodically to remove oxides and welding debris from the electrodes.

2 Put the power supply in NO WELD mode by long-pressing the rotary knob until the status indicator changes to NO WELD.

3 Clean the electrodes using 400 to 600 grit emery paper. Fold the emery paper over a *flat, rigid backing* with the grit surface facing out. The rigid backing will maintain the "flatness" of the electrode face during cleaning.

4 Place emery paper and backing between electrodes. If the weld head is air actuated, reduce the pressure on the top of the cylinder. Actuate the weld head. The electrodes should contact with the paper with a force which is low enough to allow the paper to be moved without damaging its surface. Move the paper in a circular motion while maintaining the contact force.

5 Wipe the electrodes so that they are clean and reset any adjustments made.

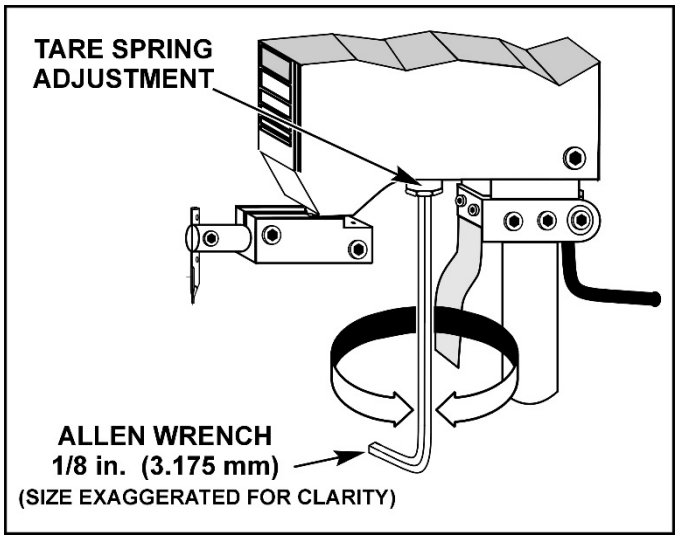
Section IV. Tare Spring Adjustment Model TL-V080B-x and TL-V088B-x

The tare spring adjustment compensates for the varying mass of different upper electrodes and adapters.

1 With the weld head in a vertical position and the upper arm and electrodes installed, set the force adjustment to ***minimum*** by turning the firing force adjustment knob fully counterclockwise.

2 Hold a measuring scale beside the upper electrode adapter block, grasp the block, and move the block up and down between the tare spring travel limits. The total travel will be about ⅛ inch (3.2 mm). Push the block down against the bottom limit, then gently release it. The tare spring should exert enough force to return the electrode to the center of its travel, approximately 1/16 inch (1.6 mm) from either extreme. If the electrode block does not re-center, adjust the tare spring.

3 If necessary, adjust the tare spring tension adjustment screw setting with a ⅛ inch (3.2 mm) Allen wrench. The adjustment screw is recessed in the center of the tare spring assembly at the bottom of the force spring tube.



4 Adjust the screw until the electrode block centers itself after being depressed and released. Tightening the screw increases tare spring tension, which increases the upward force on the upper electrode assembly. If the upper electrode interconnecting flexure interferes with the adjustment procedure, temporarily disconnect it from the upper electrode adapter block.

5 After adjusting the tare spring tension, recheck the firing force adjustment and readjust if required.

Section V: 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.

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. Contaminated weld piece surface/ plating. Wrong electrode material. Contaminated electrode surface.
Electrode Sparking.	Excessive current/energy set at the Power supply. Ramp up time period too short 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.
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.

Troubleshooting Chart	
PROBLEM	**CAUSE (In Order of Probability)**
Insufficient Weld Nugget	Insufficient current/ energy set at the power supply. Wrong electrode material/tip shape. Worn/mushroomed electrodes. 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	Possible failed LCD display assembly. Contact AMADA WELD TECH for support.
System LCD indicates that firing is taking place but no welding occurs	Possible open circuit in the secondary circuit. Electrodes did not close properly. If electrodes were closed confirm peak current reading on power supply monitor indicates energy was delivered.
Weld Head closes on part but no fire signal is issued to the power supply	Incorrect weld head configuration resulting in failure to trigger force firing switch, failed force firing switch, or similar issue in the firing circuit
LCD is operational, the Power supply status reads “CHARGE”, but will not go ready	Possible failed Capacitor Charging Power Supply. Contact AMADA WELD TECH for support.

Troubleshooting Chart	
PROBLEM	**CAUSE (In Order of Probability)**
Metal Expulsion	Excessive current/energy set at the Power supply. Insufficient weld head force. Misaligned parts. Ramp up value too short 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.
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 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.
Weld Piece Warping	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.

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 for the Power supply that is installed on the rear panel.

For replacement parts for the weld head or foot switch components please contact **AMADA WELD TECH** with the part number of your machine.

Fuse

DESCRIPTION	LOCATION
Standard 10 Amp, 250 VAC, 5 x 20 mm AMADA WELD TECH Pt # 330-210	Rear Panel

Appendix A
Technical Specifications

System Environmental, Electrical, and Air Specifications

a) Environmental Specifications

Ambient Temperature	41 – 104 ºF (5 – 40 ºC)
Relative Humidity	Less than 90% Non-condensing
Installation Site	Do not use where there is considerable dirt, dust, oil mist, chemicals, fumes, moisture, vibration or near a high frequency noise source
	Note: Internal AC-DC Switching Power Supply does not comply with pollution degree 3 as described by EN62135-1. Take necessary measures to protect the unit from metalliferous dust or other pollution as required by the local environment up to and including using an IP-Rated Enclosure.

b) Power Supply Electrical Specifications

CD-V120A, CD-V260A

Power Supply	100 - 240 VAC ± 10%, 50/60 Hz, Single Phase
Maximum Current	10 A @ 120 VAC
Typical Running Current	3 A RMS @ 120 VAC
Recommended AC Service	15 A @ 120 VAC

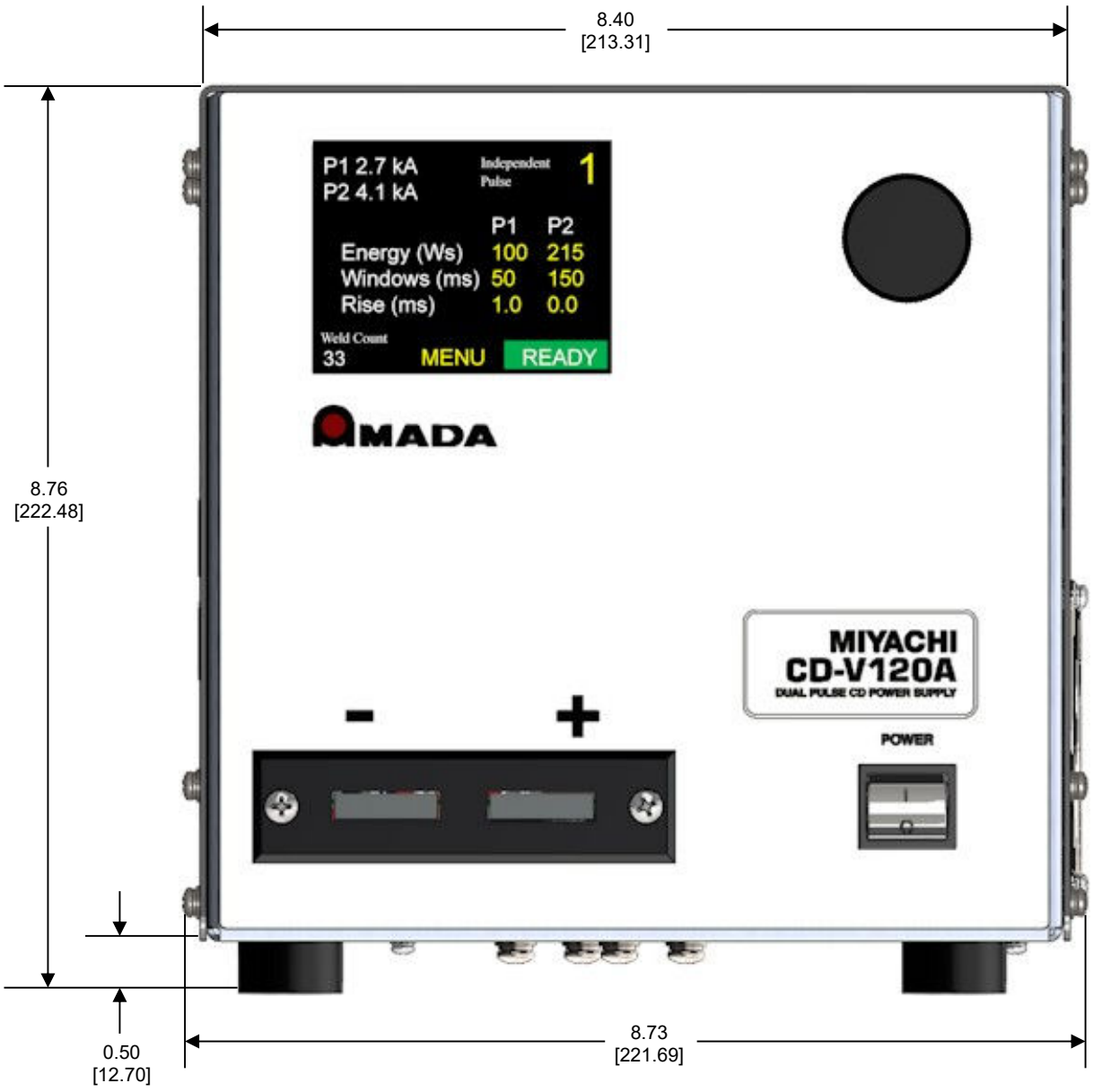
c) TL-V080B-A/TL-V088B-A Specifications

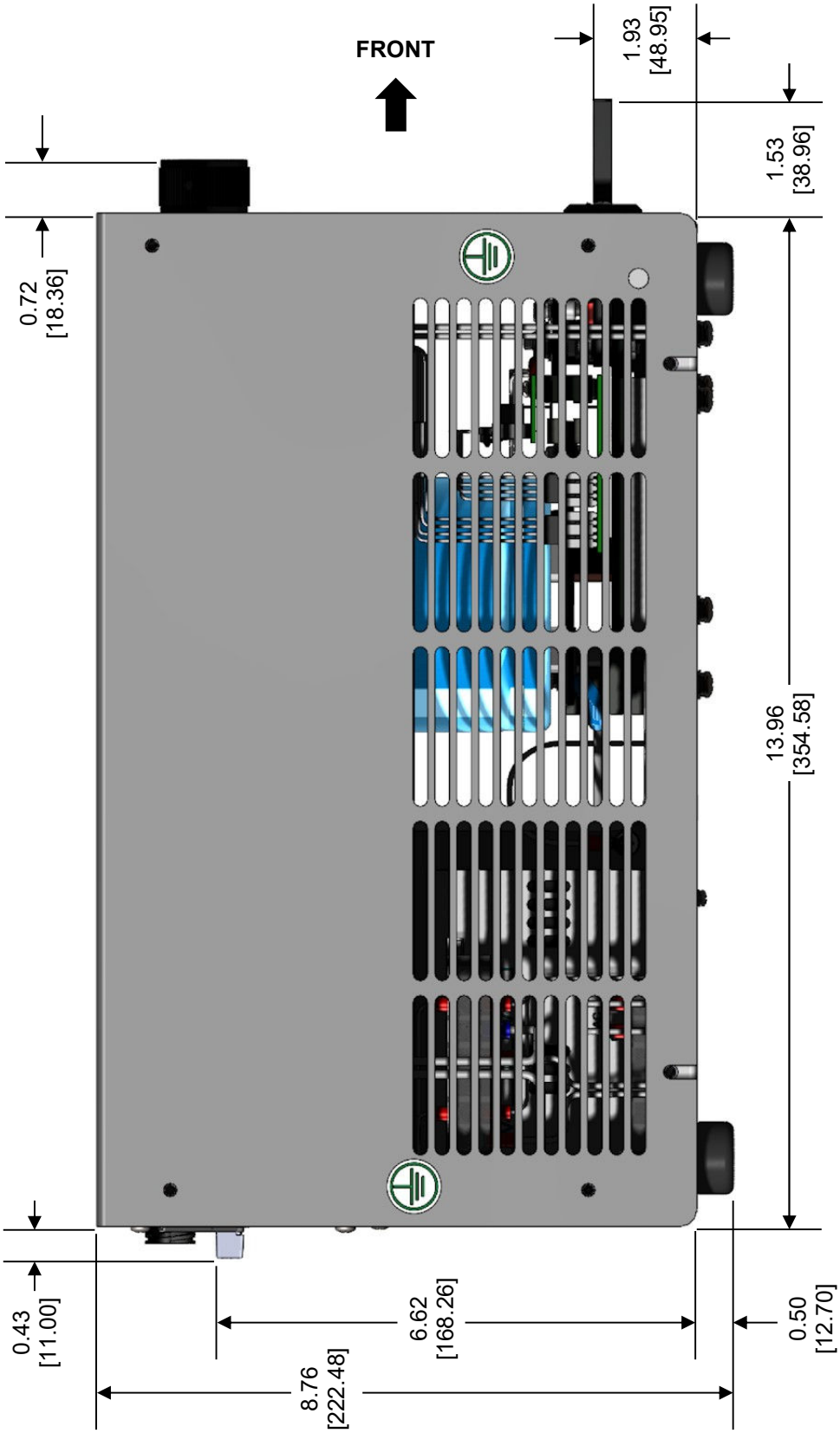
PARAMETER / MODEL	TL-V080B-A, TL-V088B-A
Input Air Pressure - Nominal / Maximum	65/100 psi (448/689 kPa)
Regulator Output - Maximum	65 psi (448 kPa)
Cycle Rate (full strokes/sec) at Min. Force at greater than 20% of Rated Force	1.0 2.5
Solenoid Valve Voltage (DC volts, supplied by CD-V power supply)	24 V Standard
Air Cylinder Inside Diameter	0.75 in. (1.9 cm)

d) Power Supply Weight

Power supply weight 28 lb. (12.7 kg)

Dimensions – CD-V120A, CD-V260A Power Supply

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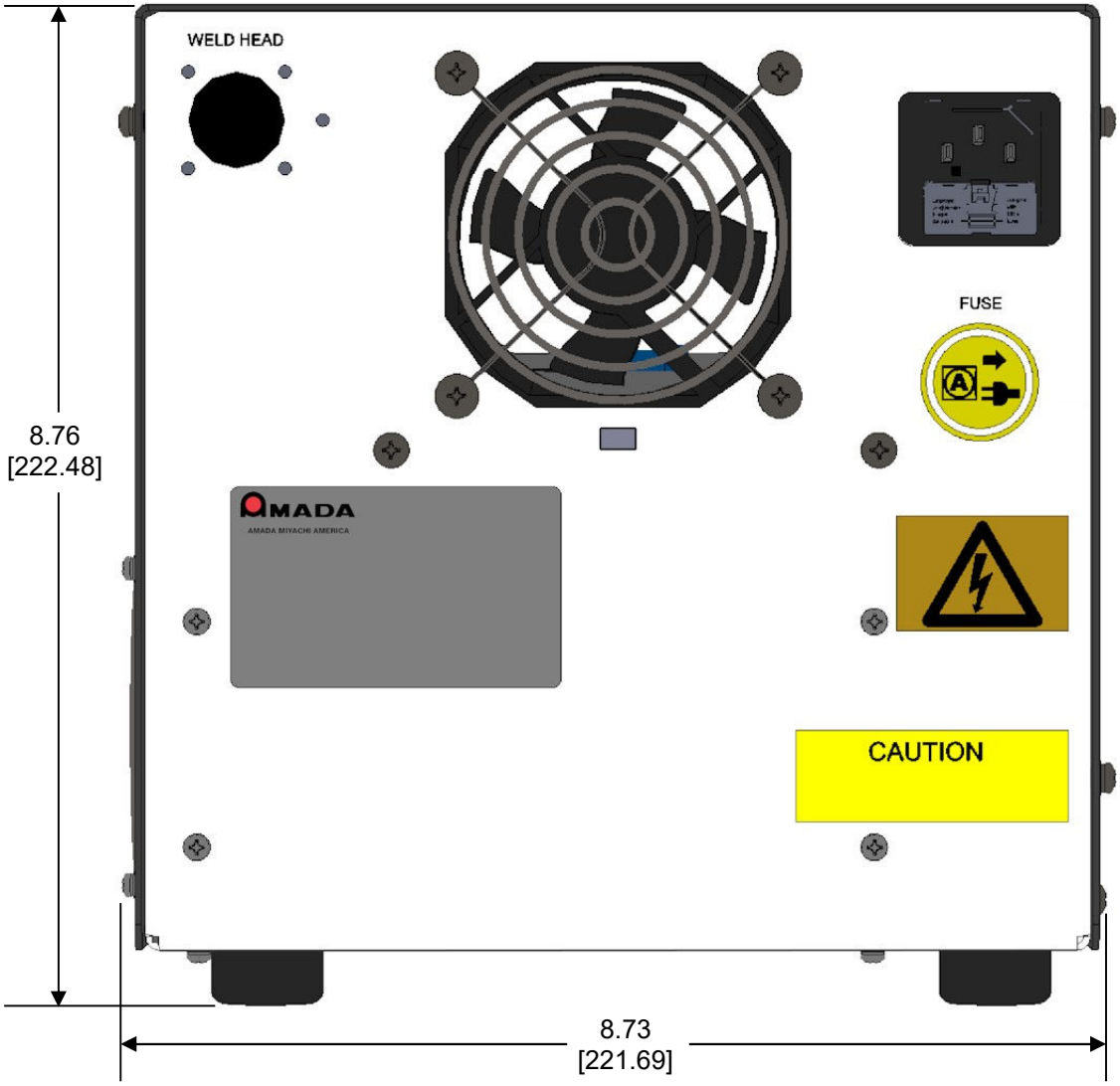
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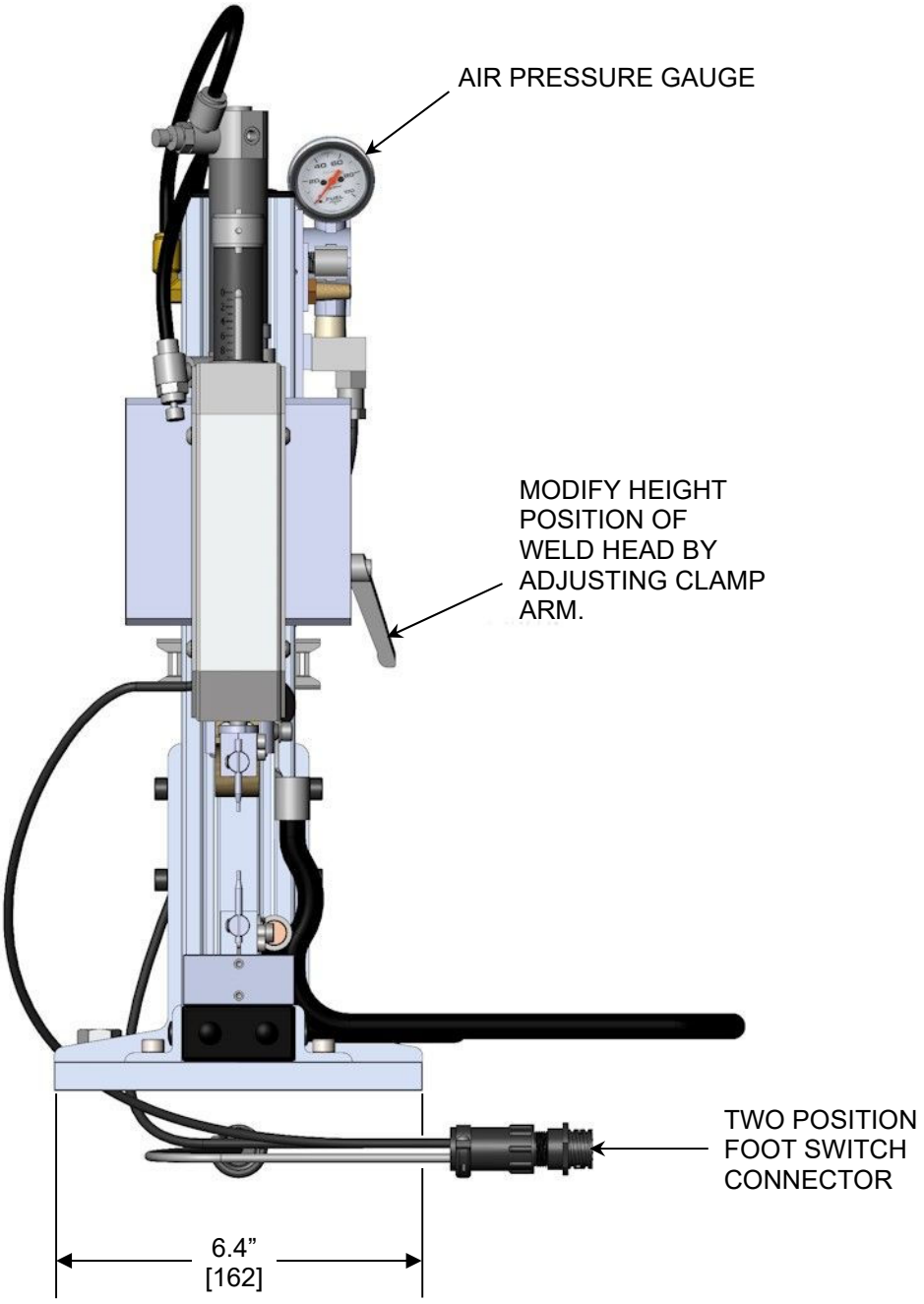
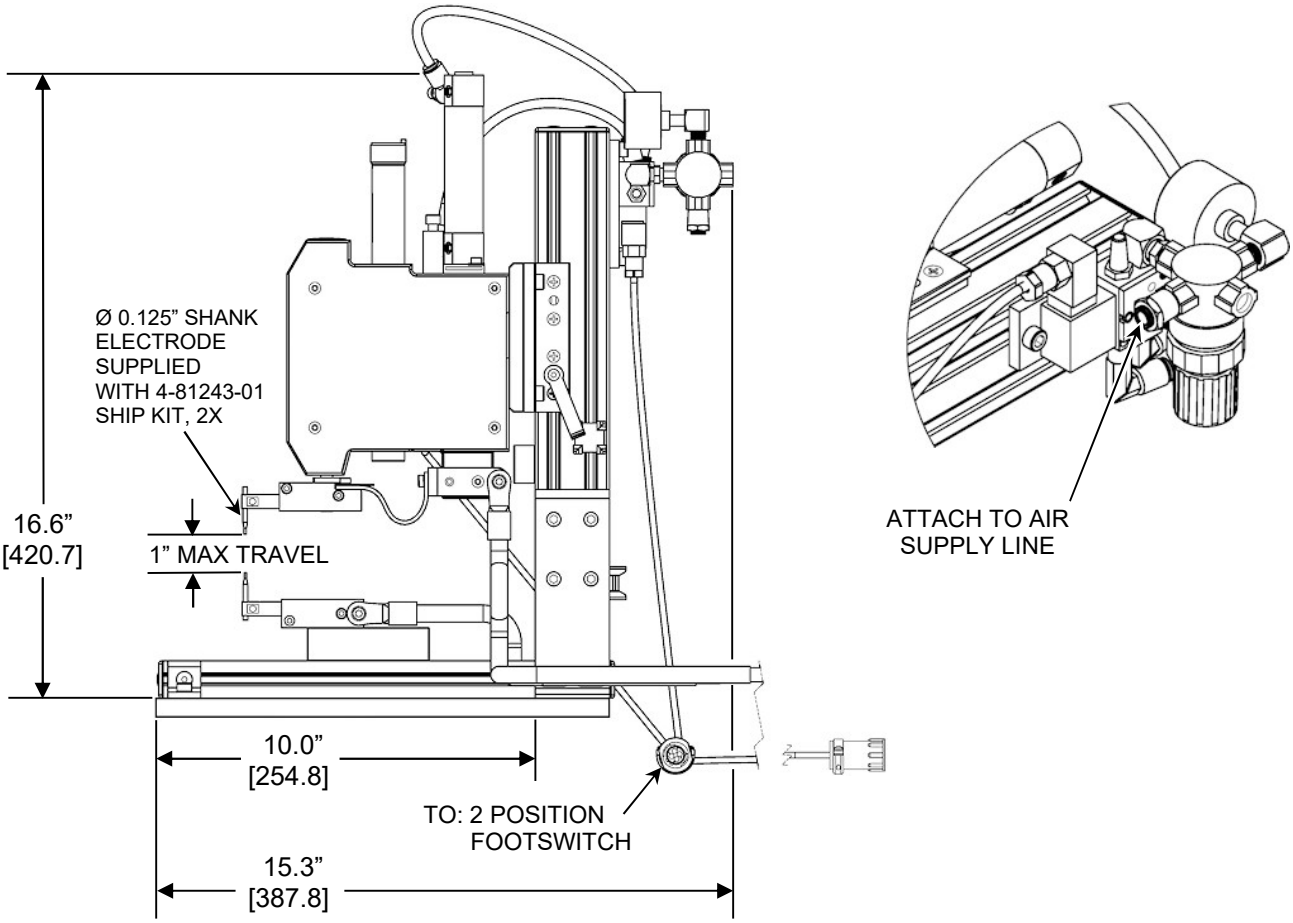
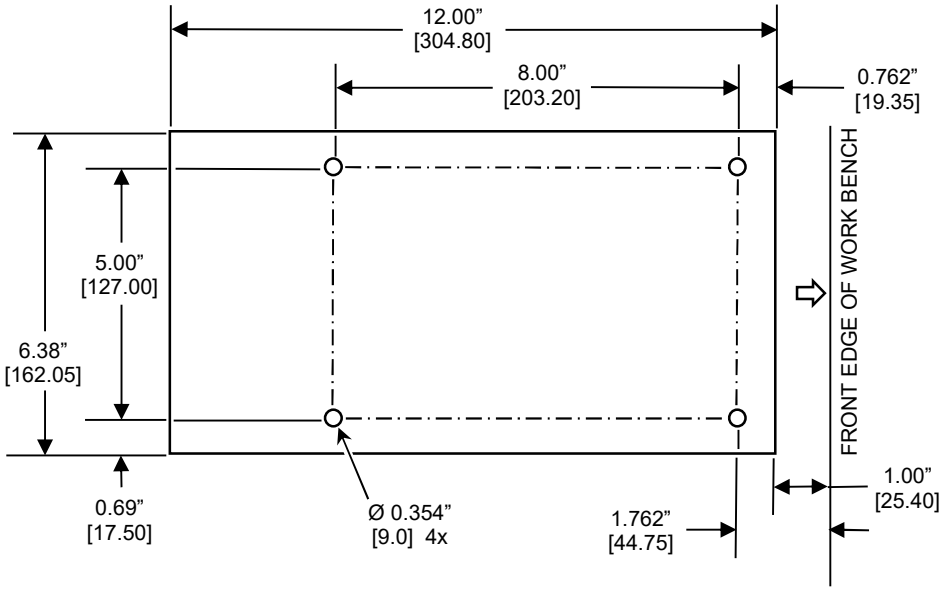
Dimensions – TL-V080B-A Weld Head

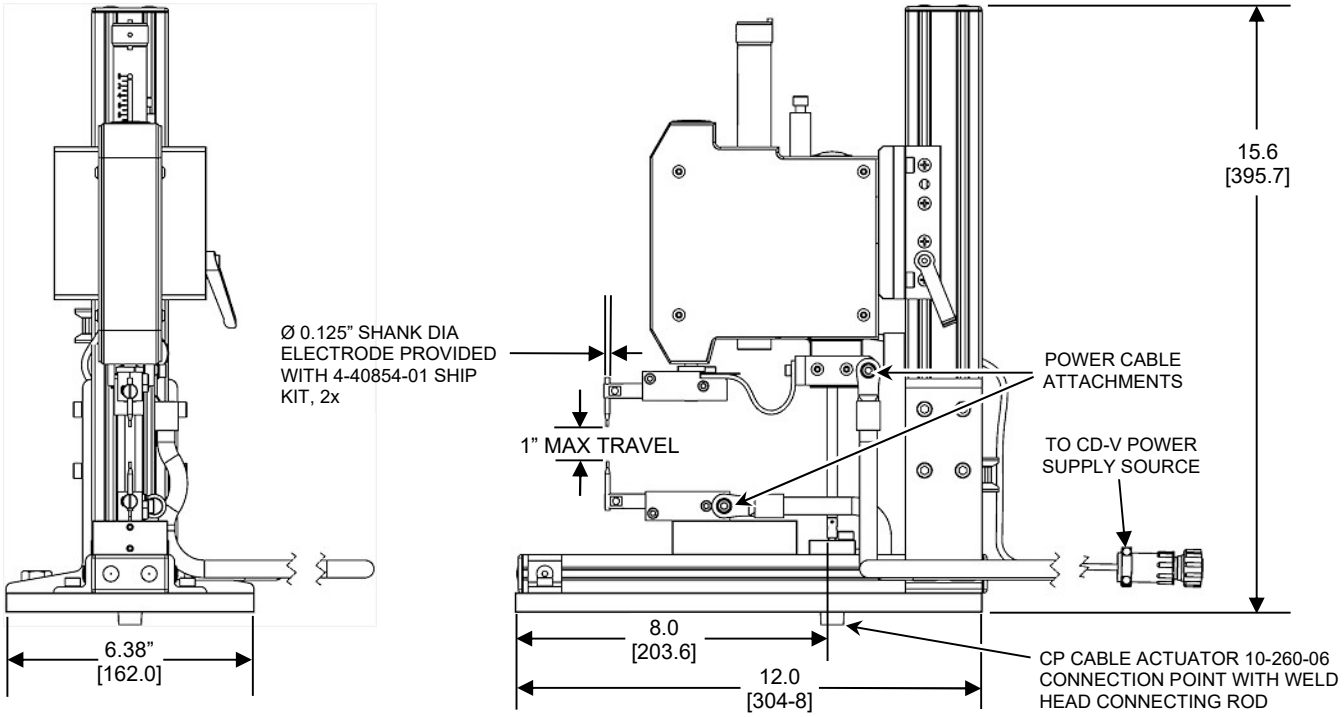




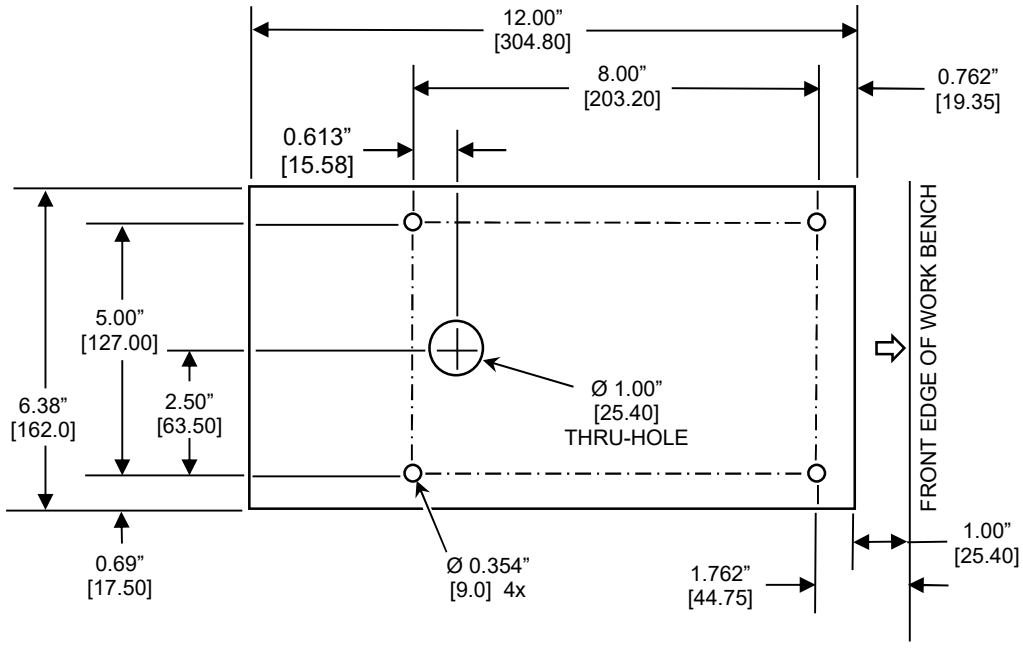
Mounting Hole Template – TL-V080B-A Weld Head – Use M9 metric or "T" sized Drill Bit



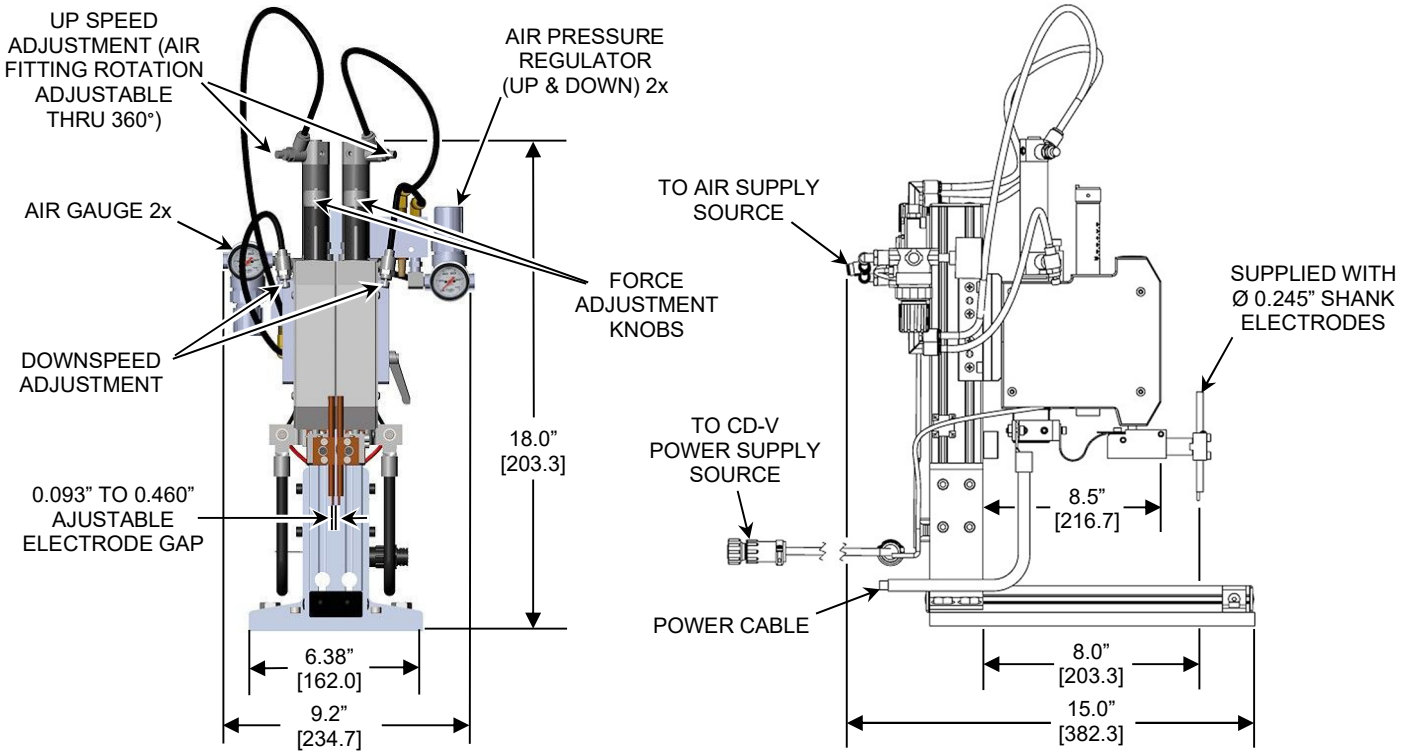
Dimensions – TL-V080B-F Weld Head



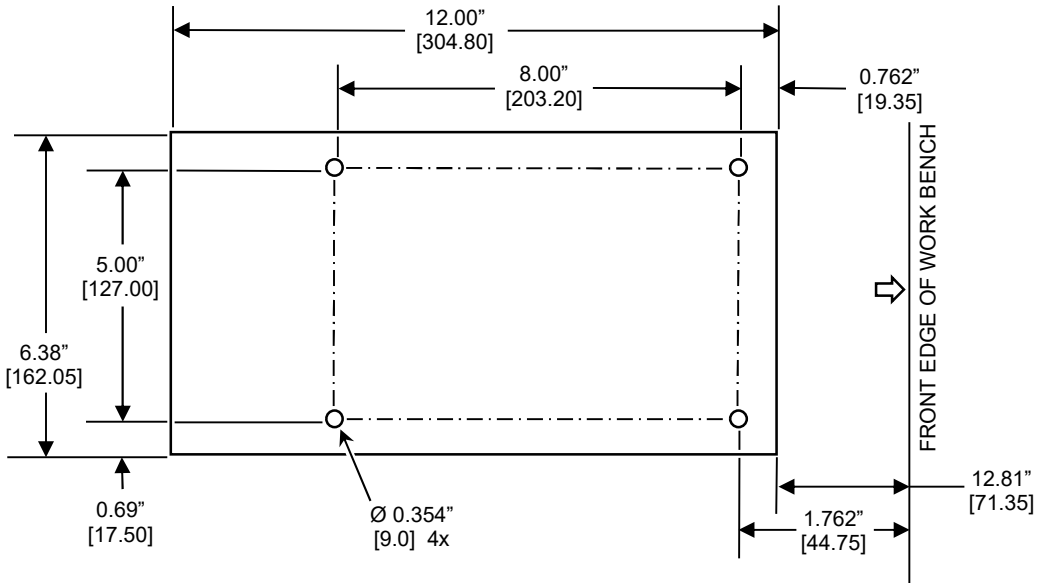
Mounting Hole Template – TL-V080B-F Weld Head – Use M9 metric or "T" sized Drill Bit



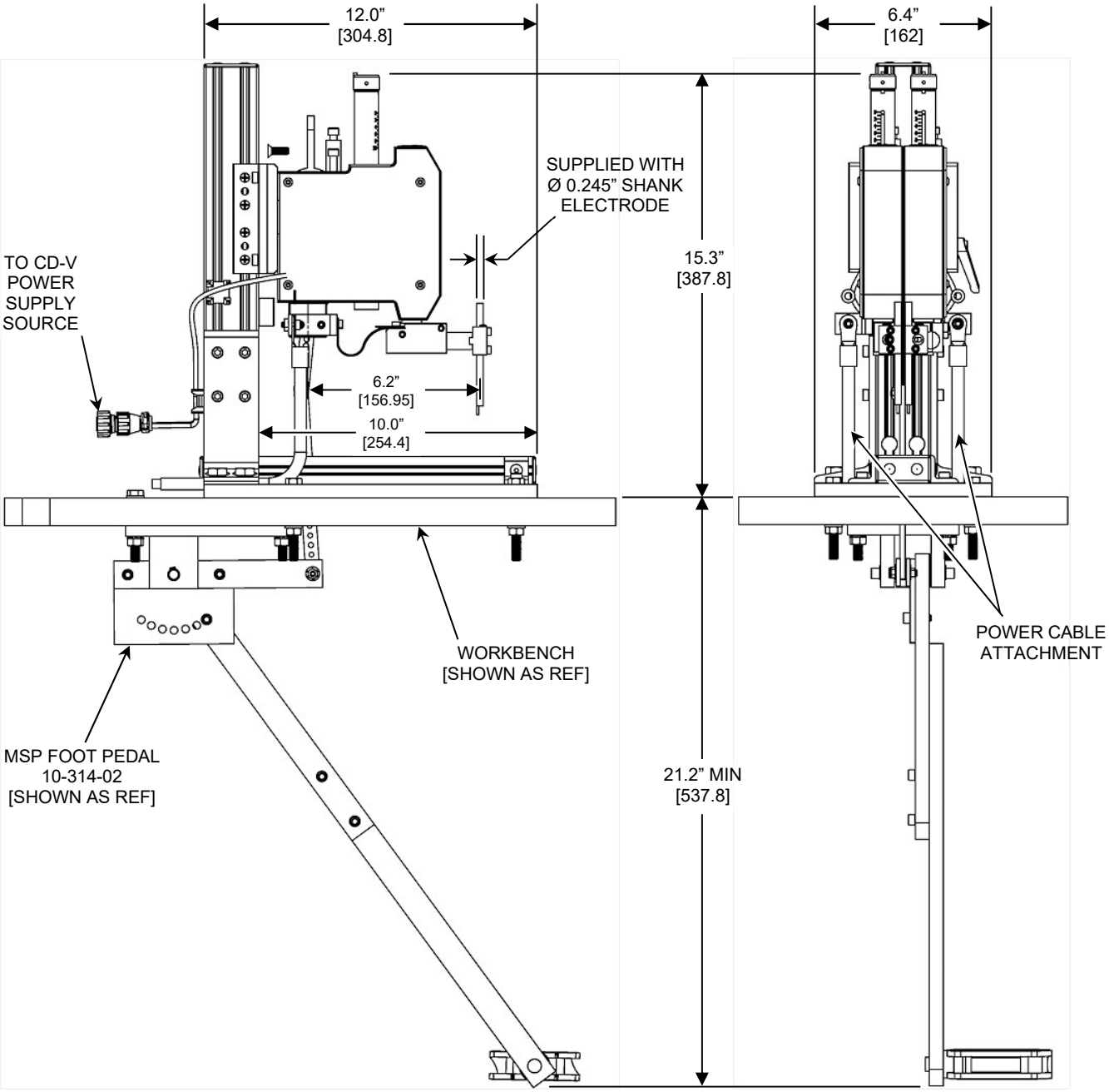
Dimensions – TL-V088B-A Weld Head



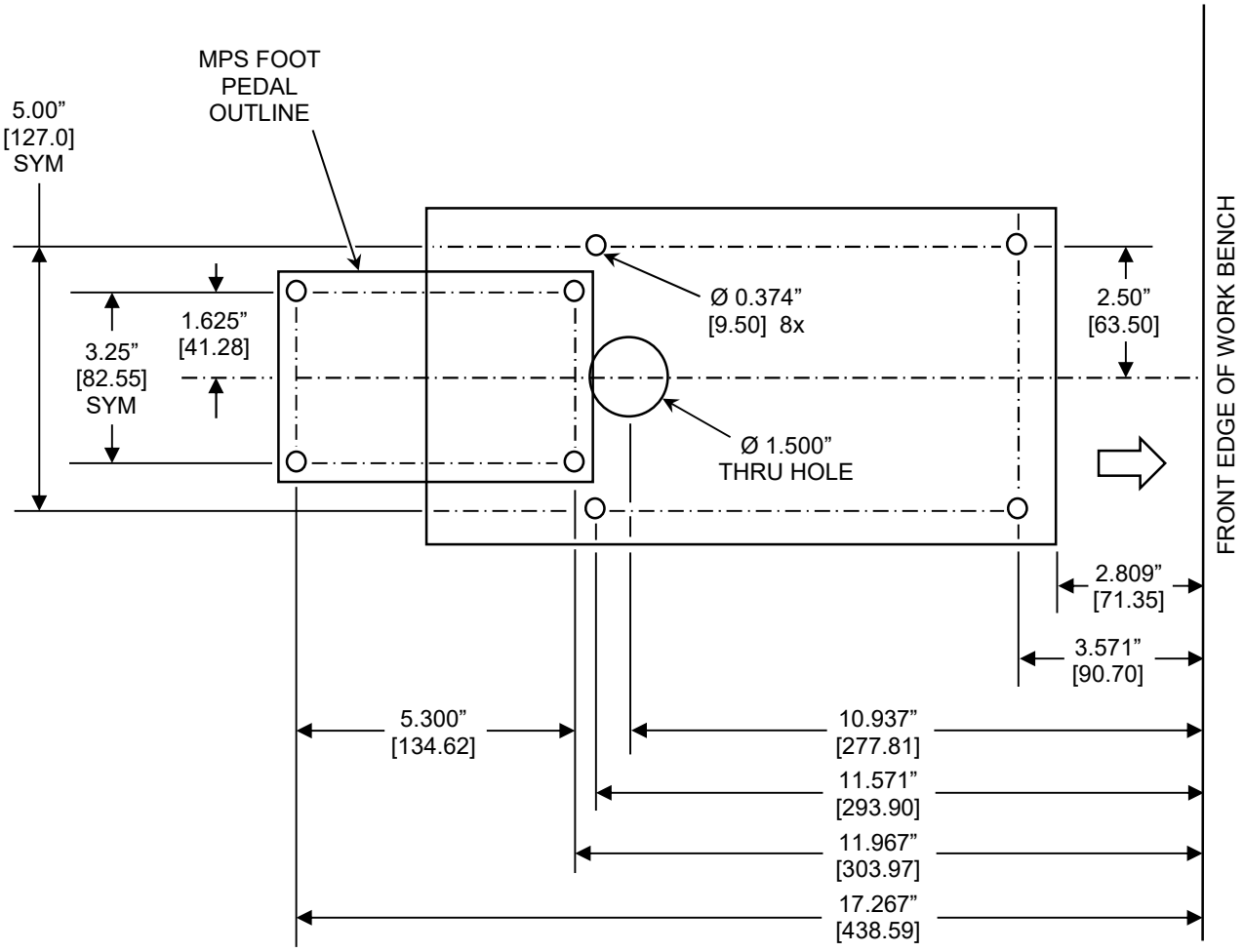
Workbench Mounting Hole Template – TL-V088B-A Weld Head – Use M9.5 metric or 3/8" Drill Bit



Dimensions – TL-V088B-F Weld Head



Workbench Mounting Hole Template – TL-V088B-F Weld Head – Use M9.5 metric or 3/8" Drill Bit



Power Supply Default Values

Default Schedule Settings	
Independent Pulse Mode	
Pulse 1 Energy (Ws)	100
Pusle 1 Window (ms)	15
Pulse 1 Rise Time (ms)	0.0
Pulse 2 Energy (Ws)	100
Pusle 2 Window (ms)	15
Pulse 2 Rise Time (ms)	1.0
Linked Pulse Mode	
Total Energy (Ws)	100
Pulse 1 Energy (Ws)	50
Pulse 1 Pulse 2 Delay (ms)	30
Pulse 2 Energy (Ws)	50
Roll Spot Mode	
Pulse Energy (Ws)	100
Pulse Repetition Rate (ms)	500
Pulse Rise Time (ms)	0.0

Welding and Parameter Specifications

Welding Parameters and Performance Specs				
Model	**CD-V120A**	**CD-V260A**	Settable Increment	Accuracy Tolerance
Nominal Stored Energy (W*s)	120	260		
Peak Current	8 kA	8 kA	N/A	Load Dependent
P1 Settable Energy	5.0 – 120 W*s	5.0 – 260 W*s	0.1W*s <= 20.0W*s 1W*s > 20W*s	± 2% Full Scale
P2 Settable Energy	OFF, 5.0 – 120 W*s	OFF, 5.0 – 260 W*s	0.1W*s <= 20.0 W*s 1W*s > 20W*s	± 2% Full Scale
P1 Pulse Window	1.0 – 150ms, default 15 ms	1.0 – 150ms, default 15 ms	0.1 ms ≤ 19.9 ms 1 ms ≥ 20 ms	± 2% Setting or ± 0.1 ms, whichever is greater
P2 Pulse Window	1.0 – 150 ms, default 15 ms	1.0 – 150 ms, default 15 ms	0.1 ms ≤ 19.9 ms 1 ms ≥ 20 ms	± 2% Setting or ± 0.1 ms, whichever is greater
Pulse Rise Time Regulation Period (each pulse)	0.0 – 15 ms	0.0 – 15 ms	0.1 ms	± 0.1 ms
Squeeze Time (System Parameter)	5 – 250 ms default 100 ms	5 – 250 ms default 100 ms	5 ms	± 1.5 ms
Peak Current Monitor Accuracy	-	-	-	± 5% of measured peak current

TL-V080B-x / TL-V088B-x Weld Head Specifications

FEATURES		TL-V080B-F	TL-V080B-A	TL-V088B-F	TL-V088B-A
Actuation		Manual	Air	Manual	Air
Weld Head Force	Max. (lbs/N) Min. (lbs/N)	20/89 0.5/2.2	20/89 0.5/2.2	20/89 0.5/2.2	20/89 0.5/2.2
Maximum Rating	(kVA) (watt-seconds)	2 260	2 260	5 260	5 260
Electrode Stroke	(in) (mm)	1 25	1 25	1 25	1 25
Electrode Diameter	(in) (mm)	1/8 3.2	1/8 3.2	0.245 6.2	0.245 6.2
Electrode Holder Type		Offset	Offset	Series	Series
Max. Throat Size Height x Depth	(in) (mm)	1.94 x 6.0 49 x 152	1.94 x 6.0 49 x 152	6.2 x 6.25 157 x 159	6.2 x 6.25 157 x 159
Maximum Distance between Electrodes	(in) (mm)	- -	- -	0.75 19	0.75 19
Electrode Series		ES-0400	ES-0400	ES-0800E	ES-0800E
Weld Head Cable Size: Length:	(AWG) (in/cm)	#1 30/762	#1 30/762	#1 30/762	#1 30/762
Foot Pedal Model Number		CP	-	MSP	-
Air Solenoid Voltage (VDC)		-	24VDC -5% +10%	-	24VDC -5% +10%
Air Pressure for Max. Force	(psi) (kPa)	-	50 345	-	50 345
Cylinder Inside Dia.	(in/mm)	-	0.75/19.0	-	0.75/19.0
Cycle Rate (full strokes/sec) at Min. Force At greater than 20% of Rated Force		-	1 2.5	-	1 2.5
Weight (stand included)	(lbs) (kg)	13 5.9	16.1 7.3	28 12.7	22 10

Part Numbers and Supported Configurations

Power Supply Part Numbers

a) 120 W*s **CD-V120A** part number **1-361-01**
b) 260 W*s **CD-V260A** part number **1-362-01**

Weld Head Kit Part Numbers

Each weld head kit contains the weld head, stand, regulator, flow switches, standard weld head cables, standard 1/8" electrodes and holders, and a foot switch/foot pedal in a complete ready-to-weld package

Manual Cable Driven Weld Heads
a) 2-360-01, Model TL-V080B-F Single Head Opposed Electrode Weld Head

Manual Linkage Driven Weld Heads
a) 2-360-02, Model TL-V088B-F Dual Head Parallel Gap Electrode Weld Head

Standard Air Solenoid Driven Weld Heads
a) 2-361-01, Model TL-V080B-A Single Weld Head Opposed Electrode Air Weld Head
b) 2-361-02, Model TL-V088B-A Dual Weld Head Parallel Gap Electrode Air Weld Head

Standard Accessory Part Numbers
Refer to the following drawings available from AMADA WELD TECH showing the standard accessory kit shipped with each model.

a) TL-V080B-A part number 4-40805-01
b) TL-V080B-F part number 4-40806-01
c) TL-V088B-A part number 4-40817-01
d) TL-V088B-F part number 4-40809-01

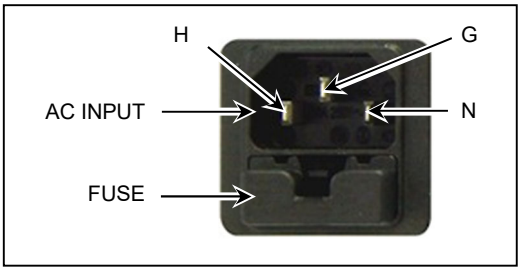
Appendix B
Connections

Introduction

This Appendix describes the electrical connectors located on the rear panel of the power supply. Each connector is illustrated with pin identification. Following each picture is a table listing the technical specifications for that connector. Connectors are described in the order in which they appear on the rear panel of the Power Supply, starting at the top left.

External wiring timing diagrams are not provided as no external user I/O is available. Operational timing can be found in *Chapter 4: Operating the Welding System*

AC Input Power Connection



AC INPUT POWER CONNECTION SPECIFICATIONS			
MODEL	**TERMINAL**	**MAXIMUM VOLTAGE**	**MAXIMUM CURRENT**
CD-V120A **CD-V260A**	Hot (H)	100 - 240 volts ± 10%, 50/60 Hz	10 amps
	Neutral (N)		
	Ground (G)	--	

CD-V Weld Terminals

CD-V WELD TERMINAL SPECIFICATIONS			
TERMINAL	**MAXIMUM VOLTAGE**	**MAXIMUM CURRENT**	**COMMENTS**
+	22 volts	8,000 amps	Variable, load dependent
-	--	--	Return

Power Supply Weld Head Connection

The weld head connection is used by the weld head force fire switch(es) to indicate to the power supply that force has been reached and a weld should begin. This input must be closed throughout the weld process or a fault will occur. The fire input is typically routed through the weld head force fire switch and 2-level foot switch, if equipped, to give the user control over the weld process. Use of weld heads not designed for the AMADA WELD TECH CD-V Power Supplies is not recommended. Modification of weld head wiring is not recommended.

Weld Head Connection	
Pin	**Function**
1	+24 VDC
2	GND
3	Fire Return
4	Fire
5	not used
6	not used
7	not used
8	Chassis Ground

Foot Switch Connector – Models TL-V080B-A / TL-V088B-A Only

The 2-level foot switch is connected to the weld head by a 4 pin connector. If a different model foot switch is desired it can be wired to the weld head. Switch inputs must be dry contact, 2 A DC per channel.

APPENDIX C
QUALITY RESISTANCE WELDING SOLUTIONS: DEFINING THE OPTIMUM PROCESS

Introduction

A quality resistance welding solution meets both 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 (Design of Experiment)
- Use of factorial DOE's (Design of Experiment)

Resistance Welding -- A Material World

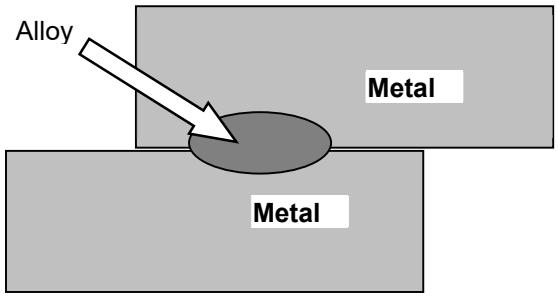
The first consideration in designing a quality welding solution is the properties of the materials to be joined and the quality requirements of the desired welded joint. At this stage, it is worthwhile to review the way the resistance welding process works and the likely outcome when the parts are resistance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

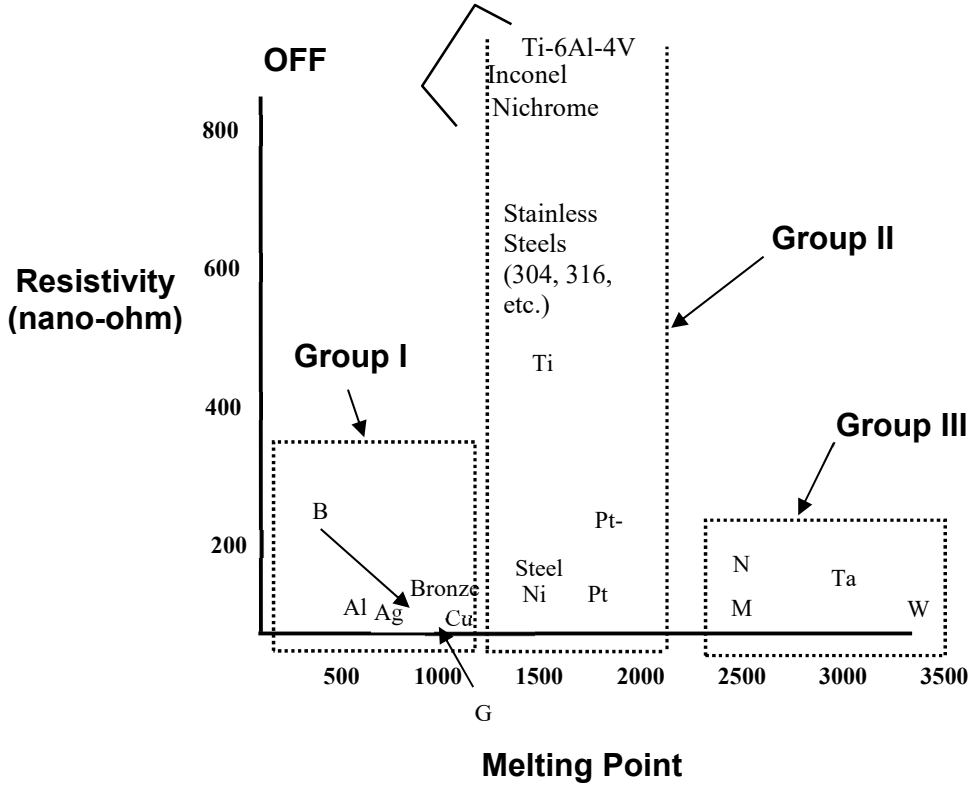
Many micro-resistance welding challenges involve joining dissimilar metals in terms of their melting points, electrical conductivity, and hardness. A solid-state joint can be an ideal solution for these difficult applications; there is no direct mixing of the two materials across the weld interface thus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

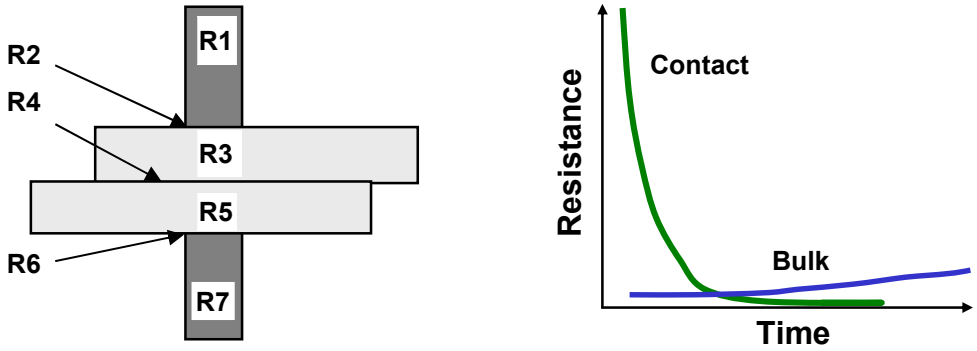
- **Group III – Refractory Metals**

  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 & R6 The electrode-to-part and part-to-part "Contact Resistances" determine the amount of heat generation in these areas. The contact resistances decline over time as the parts achieve better fit up.

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

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

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

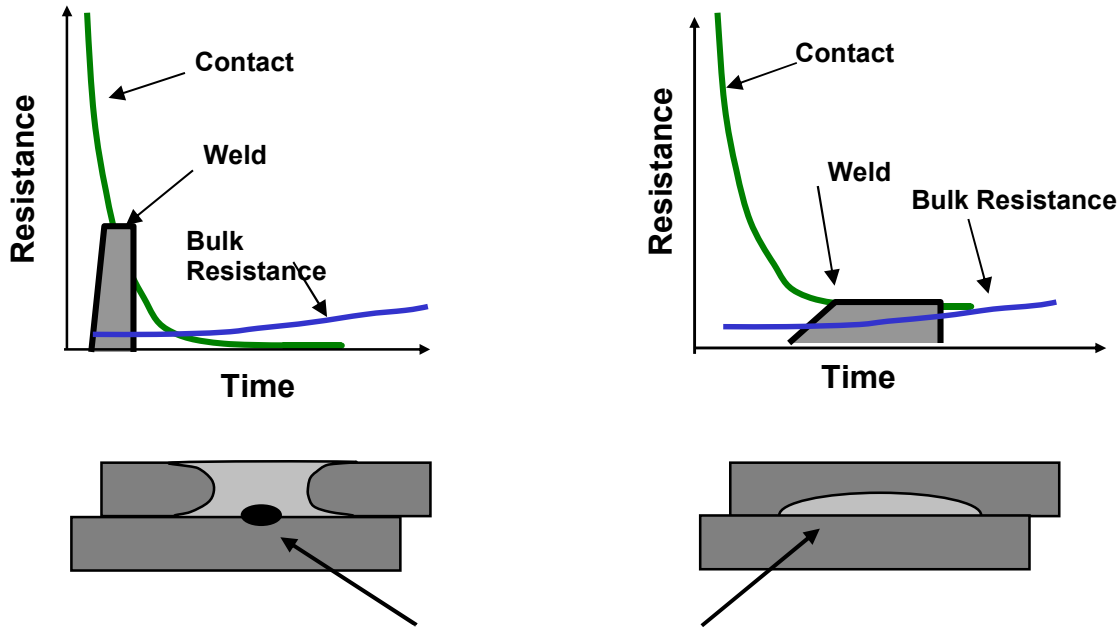
Alternately, conductive materials can be welded by using high contact resistance and fast heating because their bulk resistance is not high and cannot be relied upon for heat generation.

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

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

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

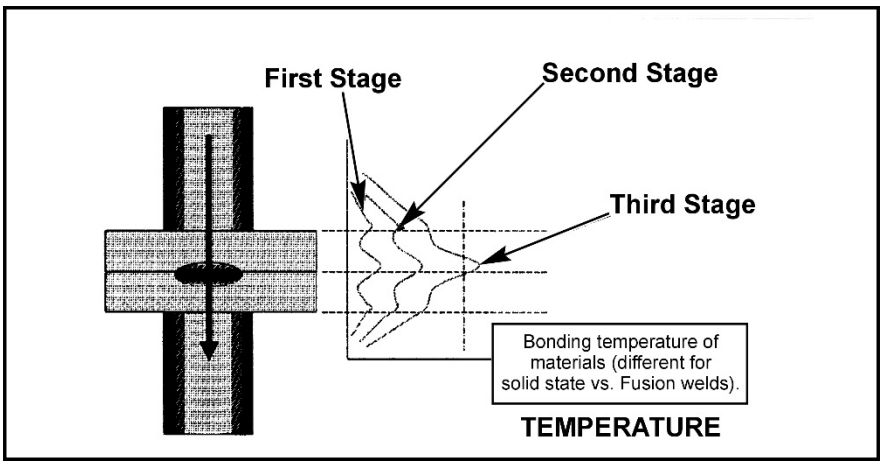
The figure shows a weld that is initiated when the contact resistance is lower; in this example, we are using bulk resistance to generate our weld heat.



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

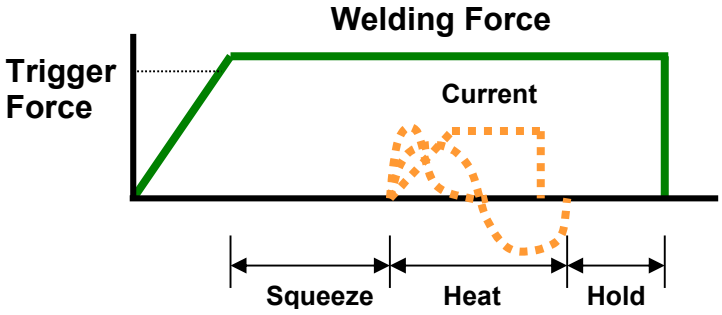
In general, conductive materials benefit from a faster heating rate, as the higher contact resistances assist heat generation in the weld. Resistive materials benefit from slower heating rates which allow the contact resistances to reduce significantly. Bulk resistances, therefore, become the major source for heat generation. The heat-affected zone is also much smaller in this case producing a weld with less variation.

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

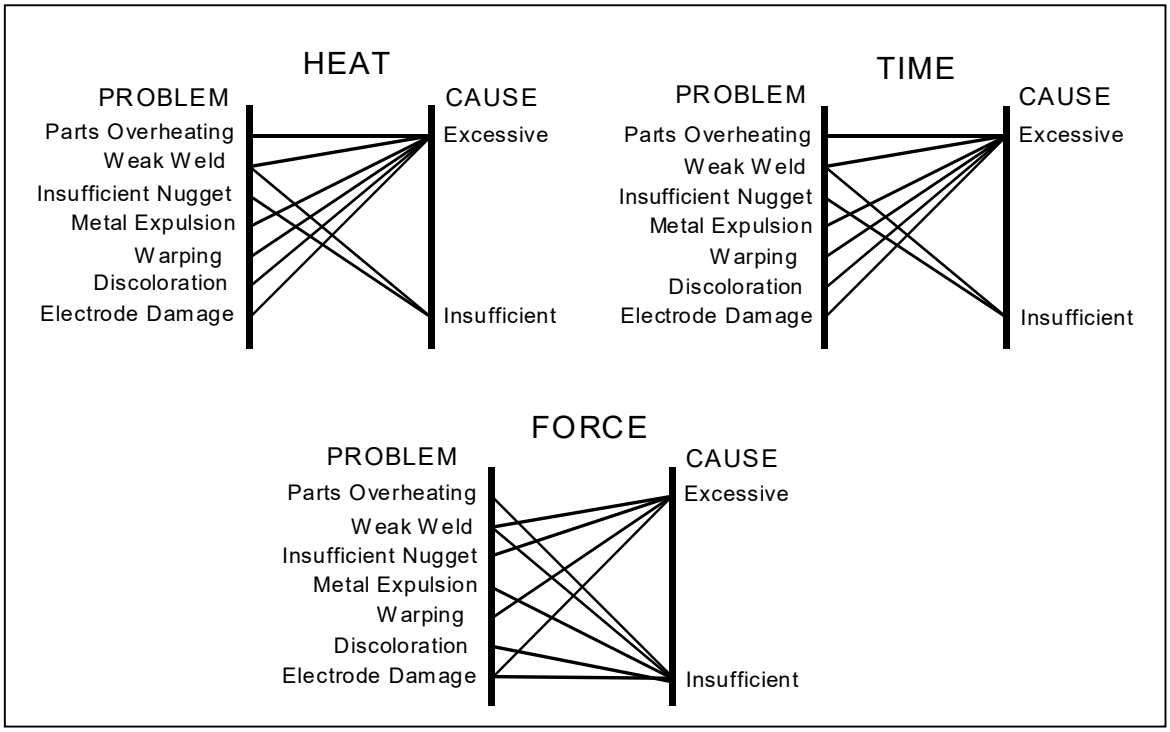
Power supply technology selection is based on the requirements of both the application and process. In general, closed loop power supply technologies are the best choice for consistent, controlled output and fast response to changes in resistance during the weld.

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

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

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?

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 the Welding System*.

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

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

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

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

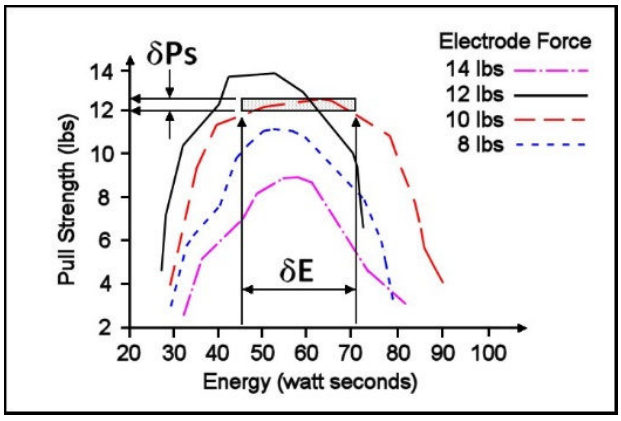
3 Repeat steps 1 through 2 for different weld forces, then create a plot of part pull strength versus weld current, voltage, or power for different weld forces as shown in the illustration, *Typical Weld Strength Profile*.

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.

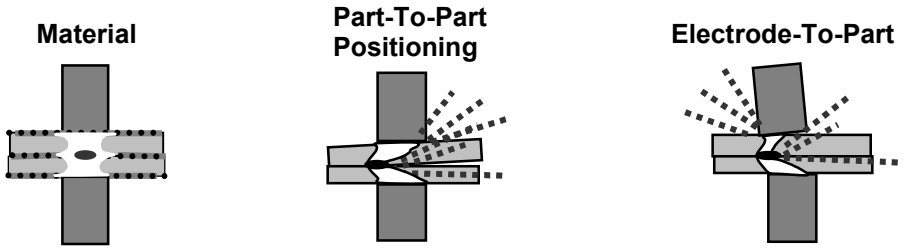
A comparison of weld schedules for several different applications might show that they could be consolidated into one or two weld schedules. This would have obvious manufacturing advantages.



Typical Weld Strength Profile

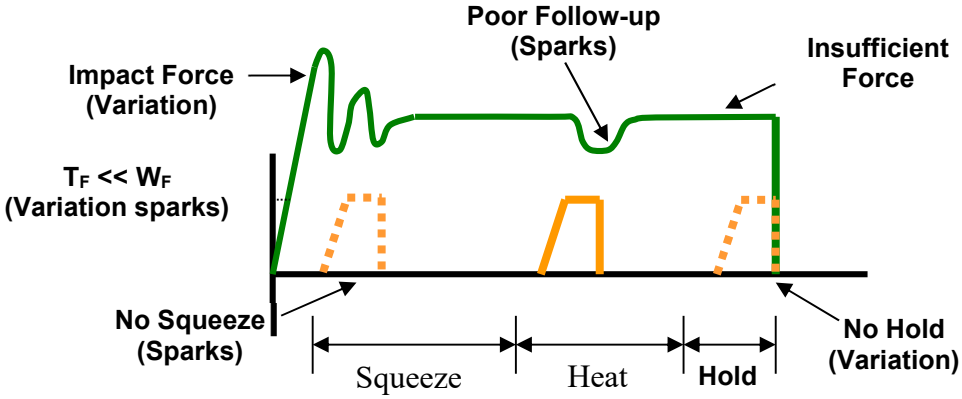
Common Problems

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.

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

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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Inconel	-2	Kulgrid	-2
Invar	-2	Invar	-2
Iridium	-2	Iridium	-2
Iridium	-2	Platinum	-2
Iron	-2	Iron	-2
Karma	-2	Karma	-2
Karma	-2	Nickel	-2
Karma	-2	Platinum	-2
Kovar, Gold Plate	-2	Kovar, Gold Plate	-2
Kovar, Gold Plate	-2	Kulgrid	-2
Kovar, Gold Plate	-2	Nickel	-2
Kovar, Gold Plate	-2	Silver	-11, -14
Kovar, Gold Plate	-2	Stainless Steel	-2
Magnesium	-1	Magnesium	-1
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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
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
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 the 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.

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.

Appendix D
Power Supply Calibration

Introduction

This Appendix describes calibration procedures which can be used to ensure the CD-V system is operating within factory specifications.

Calibration is a two-step process - First performing a capacitance self-calibration and then performing a current monitor calibration. Calibration is performed from screen 2 of the configuration menu. Calibration values can be recorded from this menu for future reference.

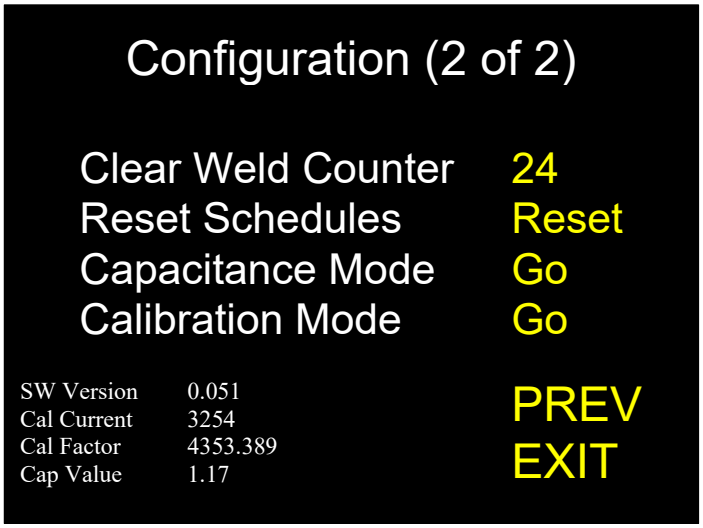


Figure 1 - Configuration Menu Screen 2 of 2

Self-Calibrating Capacitance (Calibration Item 1 of 2)

Equipment Required – None

Procedure – Select and click "Go" on Capacitance Mode menu item, wait for completion

To accurately deliver energy, the system needs to know the exact value of the installed capacitors. Selecting "Go" on the Capacitance Mode option causes the system to perform an internal test routine to measure the internal capacitance. No user intervention is required. Once the test is performed, the new value will be automatically provided to the system for use in energy delivery calculations. This routine is performed during initial factory calibration and does not need to be repeated unless repairs or other hardware modifications change the internal capacitance.

Figure 2 shows the Capacitance Test Screen. The capacitance test screen is used as part of the energy calibration routine. When the Capacitance Test Screen is entered, the system will charge and discharge the capacitor bank and determine the time constant and capacitance of the bank inside that particular unit. This is performed at the factory and does not need to be repeated except due to hardware changes.

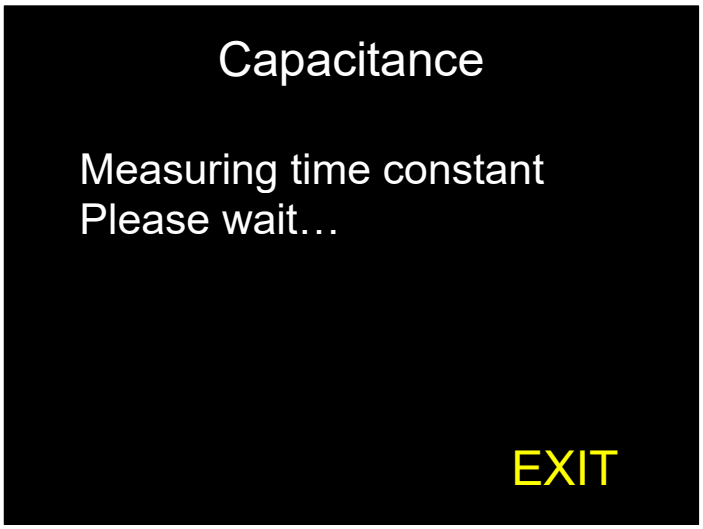


Figure 2 - Capacitance Measurement in Progress

Figure 3 shows the result of a capacitance measurement test. No user action is necessary as the value will be automatically updated for calibration purposes. The display is for informational purposes only.

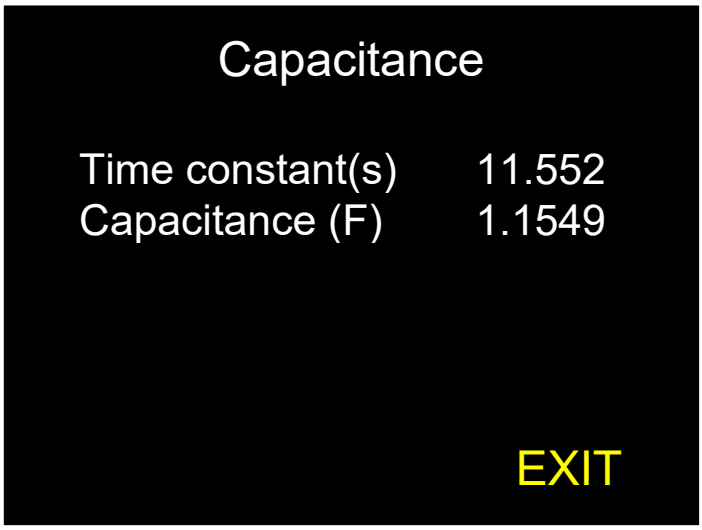


Figure 3 - Capacitance Test Results

Calibrating the internal Peak Current Monitor (Calibration Item 2 of 2)

Although calibration is performed at the factory prior to shipment, it is possible to confirm and update unit calibration. Calibration requires an external shunt to measure current measurement.

Equipment Required

1) Precision 0.001 ohm ± 2% shunt, butterfly type. AMADA WELD TECH # 4-35495-01 recommended
2) 1:1 gain isolated differential probe
3) Oscilloscope
4) 2x clamps or vise-grip pliers
5) Firing switch or weld head
6) Wrenches for weld head cable bolt removal

Procedure

a) Remove the weld head cables from the power supply

b) Connect the 1 mΩ shunt terminals to the output weld terminals using clamps or vice grips to ensure good contact between the shunt. Polarity is not important since the shunt is bi-directional

c) Connect the positive differential probe to power supply + terminal.

d) Connect the negative differential probe to power supply – terminal

e) Connect differential probe BNC to oscilloscope.

f) Set up oscilloscope to measure up to 6000 A across the shunt (6 V). On a 1:1 differential probe 1000 A through the 1 mΩ shunt will read as 1.000 V on the oscilloscope.

g) From Configuration Menu screen 2 of the CD-V user interface select Calibration Mode and click "Go"

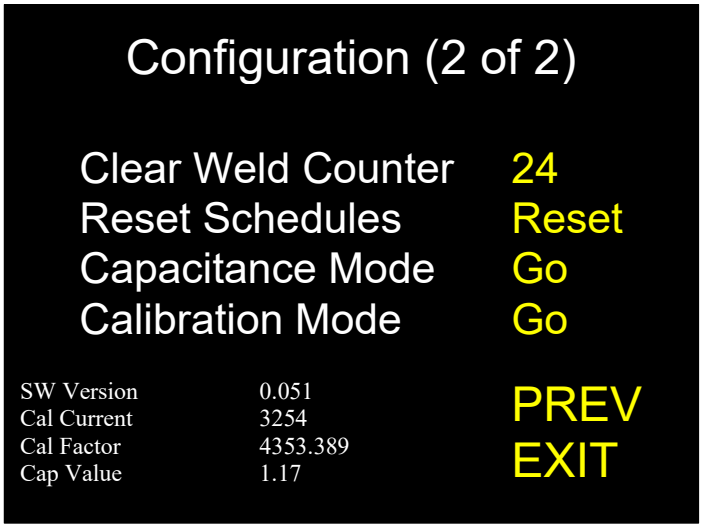


Figure 4 - Configuration Menu Screen 2 of 2

h) Using a fire switch or weld head send a fire signal to the power supply and hold for 1 second so a test weld can be performed through the shunt. Once fired the unit will proceed to the next screen automatically.

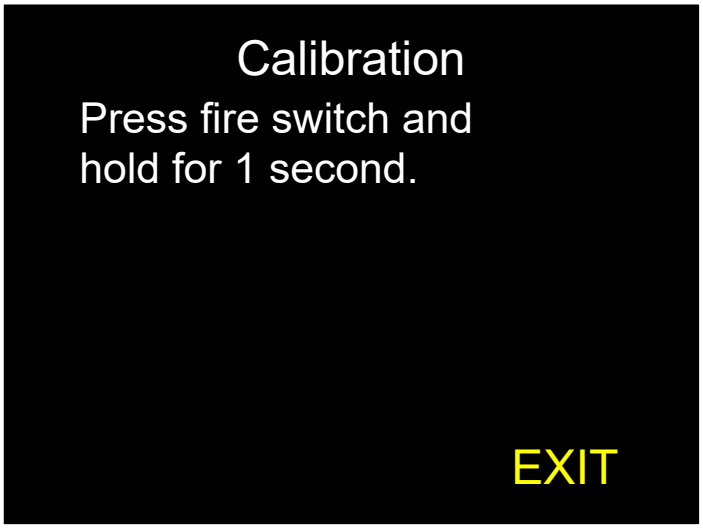


Figure 5 - Calibration Mode

i) If necessary Fire again. Using an Oscilloscope, measure the peak voltage of the weld pulse. Calculate the peak current by using the following formula. Then select NEXT:

$$I_{PEAK} = \frac{\text{Peak Voltage}}{\text{Shunt Resistance}}$$

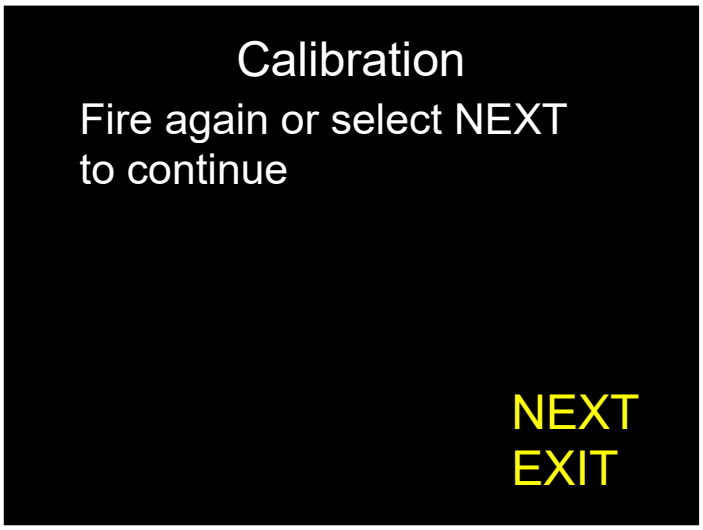


Figure 6 - Calibration Mode (cont.)

j) Using the control knob, dial the calculated peak current into the Dial measured current (A) box.

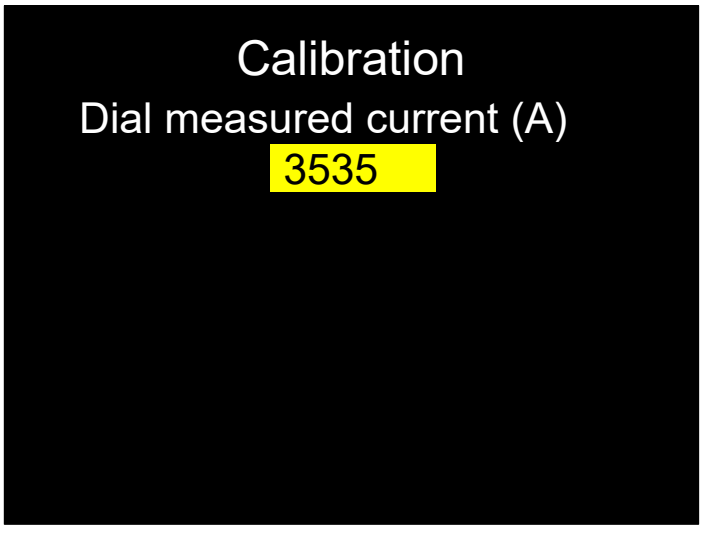


Figure 7 - Entering Current Measurement

k) Click on the control knob to save the value and return to the configuration screen.

Reading and Recording Version and Calibration Information

The current software version, current calibration values, and most recent capacitor measurement are shown for reference; see Figure 4. Record these values for future reference

APPENDIX E
REPETITION RATES

Section I. Introduction

The term repetition rate refers to how often weld pulses can be repeated based on the power supply's 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 based on bank capacity, and time must be provided between welds for the capacitor bank to recharge.

The nature of an open loop capacitive discharge power supply and Ohm's Law dictate that weld pulse width is a consequence of secondary weld circuit load resistance and inductance. The total energy delivered is constant as programmed into the power supply. Charge time is directly related to the schedule weld energy. Lower energies and lower secondary loads will allow for a higher repetition rate.

If the secondary circuit is changed, the pulse width and peak power will change. The secondary circuit includes everything downstream from the power supply weld terminals as the current flows through the weld cables, flexures, electrode holders, electrodes, and parts to be welded. A change in resistance caused by part oxidation, a loose connection, or other factors can and will affect the weld and for this reason it is important to keep these items as consistent as possible.

The graph on the next page details typical repetition rate and recharge times for a series of welds performed on a standard 1 mΩ test load by a CD-V120A. The secondary circuit resistance and/or inductance of a weld head and cable configuration will affect actual results and may reduce actual repetition rates.

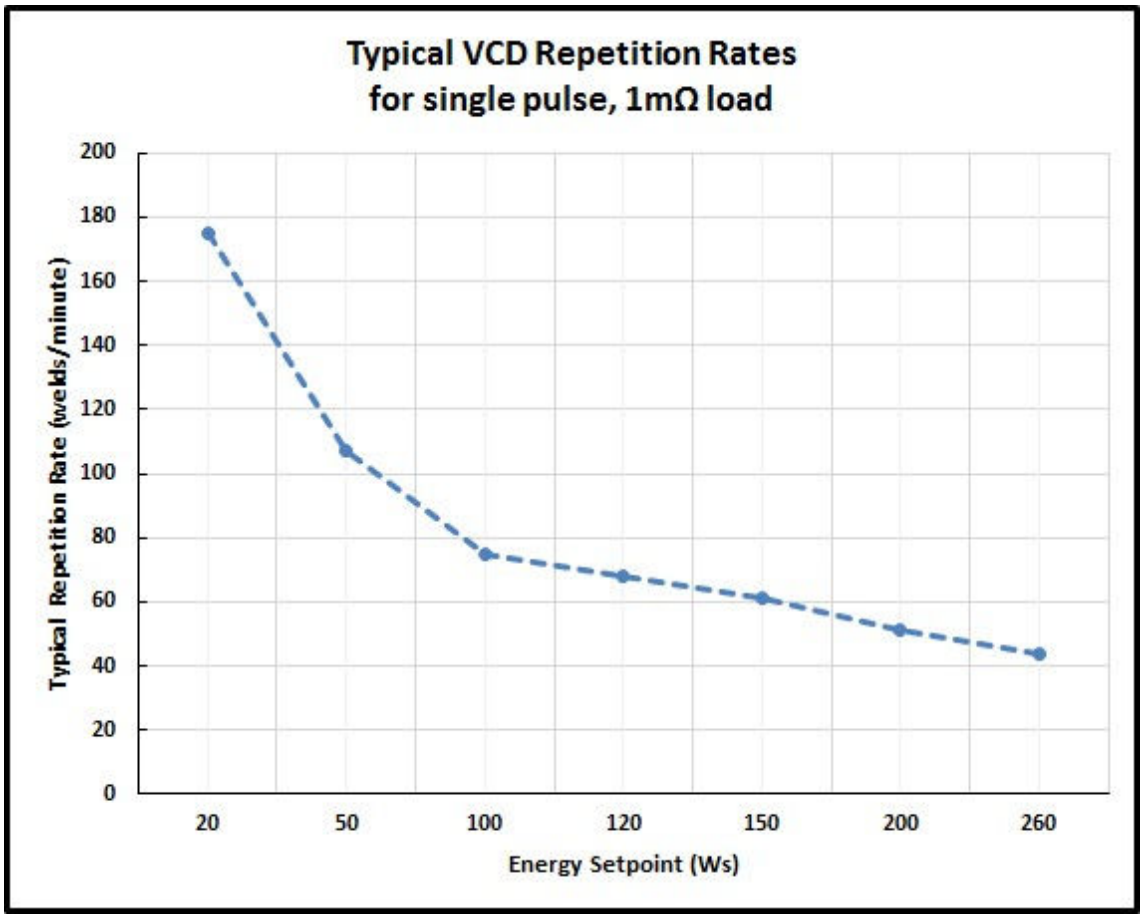
This data is provided for single welds. When performing a dual pulse weld the repetition rate will be affected by mode (linked/independent pulse), window, pulse delay, upslope, squeeze time, and other factors.

The power supply is equipped with a weld fire lockout function that will prevent firing until the capacitor bank has charged to the programmed level.

This data is for reference only and is not intended to guarantee minimum performance.

Section II. CD-V Repetition Rates

Note: CD-V120A and CD-V260A have the same performance below 120 Ws.



Typical Repetition Rate - CD-V120A, CD-V260A		
CD-V120A measurements for values ≤ 120 watt seconds		
Watt Seconds	**Period (ms)**	**Repetition Rate (Welds/minute)**
20	343	175
50	561	107
100	800	75
120	882	68
150	984	61
200	1176	51
260	1360	44

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