ELECTRONIC WELD HEAD CONTROLLER

SL-320A

USER MANUAL

990-925 REV J

Revision Record

Revision	EO	Date	Basis of Revision
A	43096	02/14	None. Original edition.
B	43607	02/15	Updated to Amada Miyachi America name and logo and updated technical information.
C	43785	06/15	Added EC Declaration of Conformity.
D	43838	08/15	Updated to Amada Miyachi America format.
E	44255	05/16	Updated technical information.
F	44457	05/17	Added RS-232 Communications syntax
G	44889	10/19	Updated Document Name + Updated High Force Value
H	45789	04/20	Update Company Name (Amada Weld Tech) + Model Names
J	47209	01/24	Update Manual Title

FOREWORD

Thank you for purchasing an Amada Weld Tech SL-320A Electronic Weld Head 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, California 91016
Phone: (626) 303-5676
FAX: (626) 358-8048
E-mail: info@amadaweldtech.com

The purpose of this manual is to supply operating and maintenance personnel with the information needed to properly and safely operate and maintain the SL-320A Electronic Weld Head System.

We have made every effort to ensure that the information in this manual is accurate and adequate.

Should questions arise, or if you have suggestions for improvement of this manual, please contact us at the above location/numbers.

Amada Weld Tech is not responsible for any loss due to improper use of this product.

This manual covers the following models:

Original Model Name	Original P/N		Current Model Name	Current P/N
321H, 1/8” Inline Opposed	2-321-03-01	→	SL-321A, 1/8” Inline Opp	2-321-05-01
321H, 3mm Inline Opposed	2-321-03-02	→	SL-321A, 3mm Inline Opp	2-321-05-02
322H, Unitip Inline	2-322-03-01	→	SL-322A, Unitip Inline	2-322-05-01
323H, Unibond Offset	2-323-03-01	→	SL-323A, Unibond Offset	2-323-05-01
323H, Microjoin Offset	2-323-03-02	→	SL-323A, Microjoin Offset	2-323-05-02
324H, Offset 1/8” Opposed	2-324-03-01	→	SL-324A, Offset 1.8” Opp	2-324-05-01
324H, Offset 3mm Opposed	2-324-03-02	→	SL-324A, Offset 3mm Opp	2-324-05-02

352 Weld Head Controller	2-352-01	→	SL-320A WH Controller	2-352-02

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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 Inverter Weld Head and for prevention of injury to operators or others.
- Be sure to read each of the instructions, as they are all important for safe operation.
- The meanings of the words and symbols are as follows:

⚠ WARNING

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

⚠ WARNING

Denotes operations and practices that may 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

NEVER DISASSEMBLE, REPAIR, OR MODIFY THE WELD HEAD.

These actions can cause electric shock and fire. ***NEVER*** do anything other than the maintenance described in this 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.

Only use specified cables.

A cable with insufficient capacity or loose connections can cause electric shock or fire.

Only apply the specified power.

Application of a voltage or current out of the specified range can cause electric shock or fire.

Do NOT use a damaged connecting cables, or plugs.

Do ***not*** step on, twist, or tense any cable. 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 Weld Head.

When the Weld Head is operating, it generates a magnetic field, which adversely affects pacemakers. People who use a pacemaker must ***not*** approach the Weld Head, or walk around the welding shop while the Weld Head 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

Keep water and water containers away from the Weld Head.

Water spilled on the Weld Head 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.

Do NOT damage connecting cables or connectors during use.

Do ***not*** step on, twist, or tense any cable. 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.

Install the Weld Head on a firm, level surface.

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

Keep combustible matter away from the Weld Head.

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

Do NOT cover the Weld Head with a blanket, cloth, etc.

Heat generated by the operating Weld Head 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 Weld Head.

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.

Installation Precautions

Do ***not*** install this Weld Head in ***any*** of the following:

- Damp places where humidity is 90% or higher.
- Dusty places.
- Places where chemicals are handled.
- Places near a high-frequency noise source.
- Hot or cold places where temperatures are above 40°C or below 0°C, or places where water will condense.

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 head, and ***void the warranty***.

Operating Precautions

- Do ***not*** put anything other than a workpiece (tool, screw, coin, etc.) between the electrodes or on the Weld Head or you may damage the Weld Head or cause a short circuit or fire.
- Operate the Welding Head ***only*** according to the instructions in this manual.
- Operate the button carefully ***by hand***. If it is operated roughly or with the tip of a tool you may damage the Weld Head.

Disposal Precaution

The Motor Controller photo-coupler contains **GaAs**. Follow ***all*** local environmental regulations for disposal.

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

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

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

3. Non-delivery.

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

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

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

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

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

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

7. Inspection and Rejection of Nonconforming Goods.

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

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

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

8. Price.

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

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

9. Payment Terms.

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

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

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

10. Intellectual Property; Software License.

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

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

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

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

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

12. Limited Warranty.

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

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

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

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

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

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

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

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

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

13. Limitation of Liability.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

19. Force Majeure. Seller shall not be liable or responsible to Buyer, nor be deemed to have defaulted or breached this Agreement, for any failure or delay in fulfilling or performing any term of this Agreement when and to the extent such failure or delay is caused by or results from acts or circumstances beyond the reasonable control of Seller including, without limitation, acts of God, flood, fire, earthquake, explosion, governmental actions, war, invasion or hostilities (whether war is declared or not), terrorist threats or acts, riot, or other civil unrest, national emergency, revolution, insurrection, epidemic, lock-outs, strikes or other labor disputes (whether or not relating to either party's workforce), or restraints or delays affecting carriers or inability or delay in obtaining supplies of adequate or suitable materials, materials or telecommunication breakdown or power outage (each a "**Force Majeure Event**"), provided that, if the event in question continues for a continuous period in excess of thirty (30) days, Buyer shall be entitled to give notice in writing to Seller to terminate this Agreement.

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

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

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

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

24. Dispute Resolution.

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

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

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

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

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

CHAPTER 1
DESCRIPTION

Section I: Features

For the rest of this manual, all of the **SL-320A Weld Heads** will simply be referred to as ***the Weld Head***. When features of a specific weld head are discussed the weld head will be identified by model number. The **Control Unit** will simply be referred to as ***the Control***. When describing the Weld Head and Controller connected together, they will simply be referred to as ***the System***.

Overview

This System is designed for any bench-top, semi or fully automated resistance welding applications. It provides programmable, highly-controlled weld force and extremely fast follow-up response required by precision resistance welding applications. The system consists of either an in-line or offset weld head, called the Actuator, and a control. An optional stand assembly is also available.

Performance Features

Through two unique features – programmable follow-up force and weld-to-displacement – the System solves critical problems in conventional pneumatic or cam-driven welding systems.

Programmable Follow-Up Force

Through programmable follow-up force, the System is able to quickly and repeatedly position the electrode during the molten or plastic phase of the welding process. This unique feature prevents workpiece expulsion during the welding operation. Maximum strength welds result, and previously difficult-to-weld material combinations, such as tungsten wire to tungsten wire and tungsten wire to molybdenum foil, are easily made. Furthermore, due to the absence of sparking, electrode life is dramatically increased.

Weld-to-Displacement

This feature ensures consistent nugget size by regulating the energy cutoff point of the power supply, thus controlling the amount of material collapse or set-down.

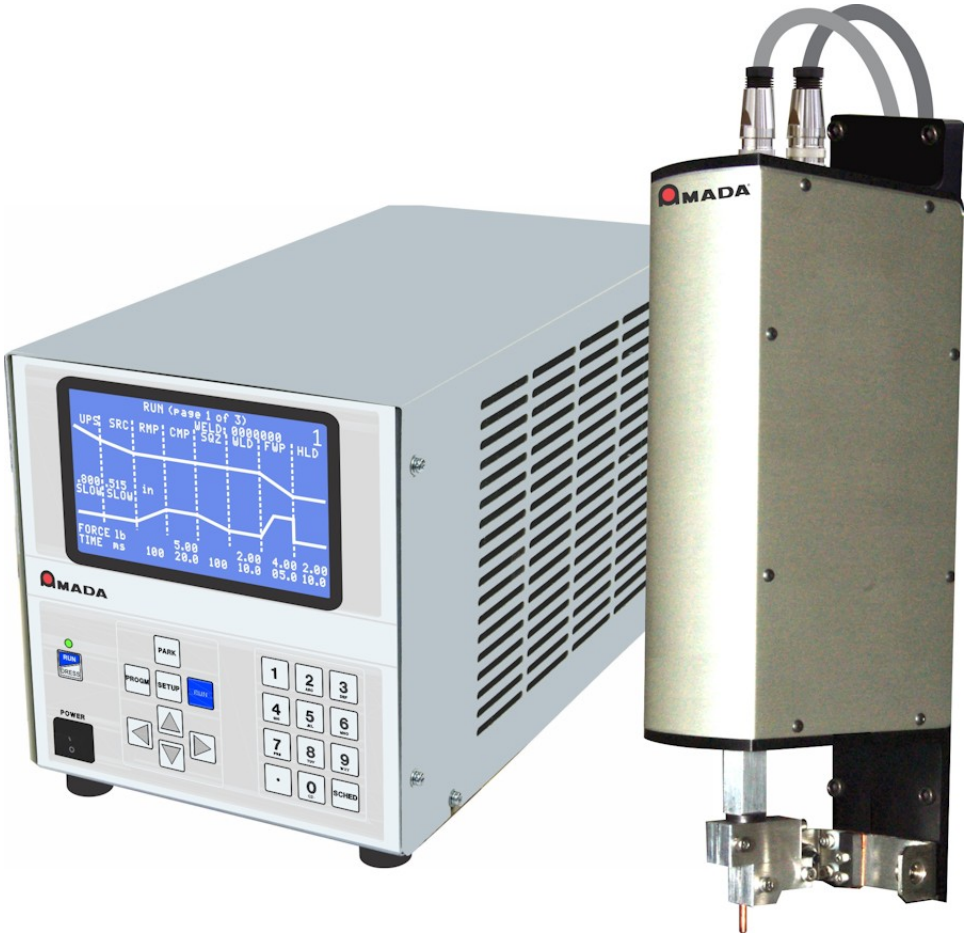
Weld Head Dynamics

The dynamics of the Actuator during the weld operation are detailed in *Appendix C*. The information will be useful in installing, setting up and operating the System.

Other Important Features

Other important performance features of the System are:

- Precise measurement of setdown displacement for each weld provides an indication of weld quality.
- Weld-to-displacement feature shuts off the power supply when a programmed setdown displacement is reached.
- Over force and “hammering” are eliminated, even at high weld repetition rates.
- Real time graphical display of programmed and actual weld force and setdown displacement for each weld.
- Storage of up to 127 welding schedules allows rapid setups for applications that require different force and setdown control.
- Unique electrode dress mode that minimizes electrode maintenance down time.



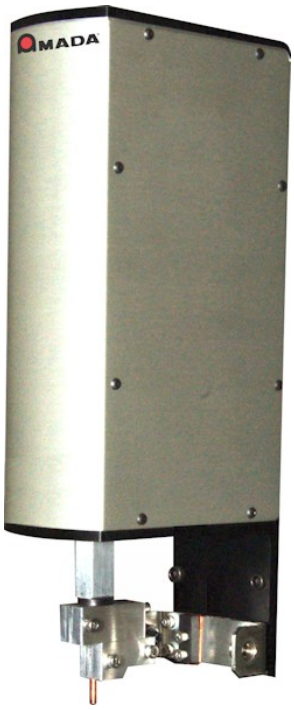
Section II: Components

Equipment Description

The System consists of the SL-320A Electronic Weld Head Controller and one of the SL-320A Weld Heads.

The SL-320A Weld Heads can be used with in-line, opposed offset, 50mm offset, and Unitip electrodes.

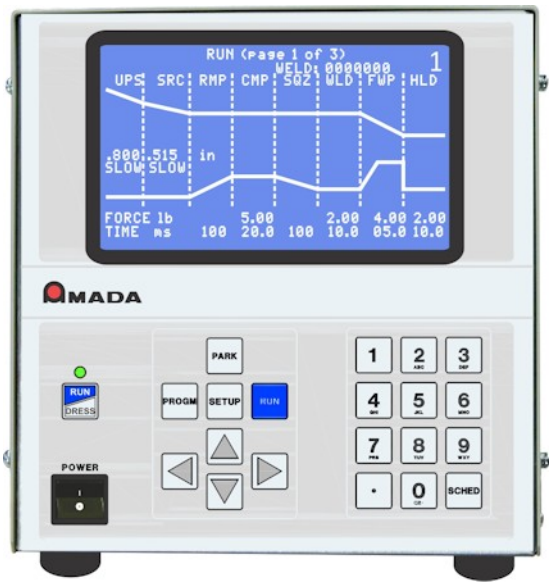
Additional equipment required, but not supplied, includes an appropriate resistance welding power supply and either a two-level or linear foot switch. An optional Weld Head Stand is also available with two microscope options.



SL320A Weld Head (Typical)

NOTE: For clarity of communication throughout this manual, it is assumed you are using the UB-500A or UB-1500A Power Supply and the FS2L Foot Switch with your System.

If you are using equivalent equipment, please refer to the manufacturer's manuals for information about that equipment.



SL-320A Electronic Weld Head Controller

SL-320A Weld Head Controller and Weld Head Equipment List

PART NUMBER	APPLICATION
2-321-05-01	SL-321A Single, Opposed, Inline, includes 1/8” diameter electrode holder
2-321-05-02	SL-321A Single, Opposed, Inline, includes 3mm diameter electrode holder
2-322-05-01	SL-322A Single, Inline, includes Unitip electrode holder
2-323-05-01	SL-323A Single, Offset, includes Unibond electrode holder
2-323-05-02	SL-323A Single, Offset, includes Microjoin electrode holder
2-324-05-01	SL-324A Single, Opposed, Offset, includes 1/8” diameter electrode holder
2-324-05-02	SL-324A Single, Opposed, Offset, includes 3mm diameter electrode holder

Other Required Items (Not Supplied)

EQUIPMENT	PART NUMBER	APPLICATION	NOTES
Welding Power Supply Options	1-336-04	15 - 1500 Amps	UB-1500A
	1-335-04	5-500 Amps	UB-500A
Two-level Foot Switch **OR** Linear Foot Switch	10-240-02	---	Equivalent to legacy FS2L
	10-243-01	---	---

Optional Items

EQUIPMENT	PART NUMBER	APPLICATION	NOTES
Electrode Holder, Lower, Adjustable	10-336-01	Inline Opposed Electrode configurations	Lower holder for opposed electrodes. Attaches to 10-335-01 stand
Weld Head Stand	10-335-01	All Benchtop Applications	Designed for Minimum Deflection
Microscope (Ergo)	10-333-01	Recommended for comfortable viewing of weld process over multiple hours at discrete magnifications	270 degree Adjustable Eyepiece Position, 6 Discrete Magnifications
Microscope (Standard)	10-395-01, 15X	Recommended when continuous zoom is required	Continuous Zoom Magnification, Fixed Eyepieces
OMA Microscope Mounting Kit	10-266-01	Required for Microscope	Contains brackets for mounting Microscopes to Weld Head Stand

The SL-320A Weld Head (includes; SL-321A, SL-322A, SL-323A and SL-324A) is electro-magnetically controlled by the SL-320A Controller according to the travel and force profile program that you select. Through the program electrode position can be controlled to within 0.00063 in. (±16 µm) but measured to within (1 µm= 0.00004 in). The weld force and duration can be set to between 0.44 lb (200 g) and 7.00 lbs (3175 g) with a following force of 7.76 lbs (3520 g).

Depending on the travel and force profile that you select, weld rate can be as high as two per second with no impact force on the weld parts.

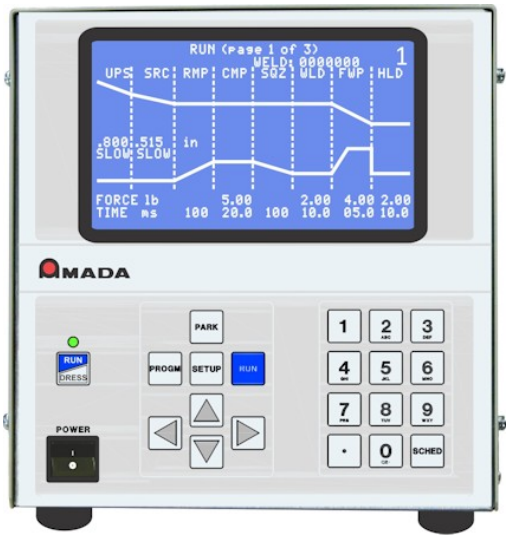
The Controller will interface with any programmable power supply that will initiate weld energy through a dry-contact closure. However, the Controller is particularly effective when used with a power supply that can be programmed to turn on weld energy in 1 millisecond increments.

Communication with external, user-supplied equipment is handled by the Controller serial ports for RS-232 data communications. The addressable RS-232 serial port permits on-line logging of weld dynamics data and alarm conditions on your data logger or PC.

System Controls

All of the System Controls are on the front panel of the SL-320A Controller.

Run screens allow you to program up to 127 different weld force profiles and monitor alarm conditions. Program screens allow you to fine-tune the time, follow-up force and weld energy relationships.



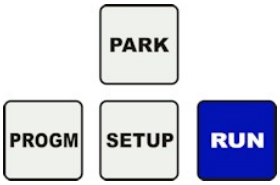
Front Panel Controls

Data Keypad

This cluster of twelve numerical keys enters numerical information. Use the keys to enter values directly to the screens instead of incrementally with the ▲▼ keys.

Control Keypad

This cluster of four keys allows you to access the various control screens on the display and control the editing (changing) of data on the screens.



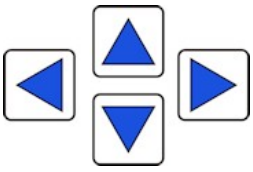
PARK Pressing **PARK** moves the upper electrode to the upstop position, and engages the brake. The system will give you a message to either power off the unit or press **RUN key to continue operation**. If the **RUN** key is pressed the system will release the brake and return the system to the Ready state. After **RUN** key is pressed it will take a few seconds before the system recovers from **PARK** mode.

PROGM Each time you press **PROGM**, it accesses the next programming screen in a sequence of programming screens. It also disables the **RUN** state

SETUP Pressing **SETUP** enters the setup menu where the user can edit the system options, weld counters, security, calibration, and other system settings. The setup menu also allows the user to monitor system functions such as I/O status.

RUN Pressing **RUN** exits the **PROGRAM** state (the state in which the Weld Head Controller is to be programmed) and enters the **RUN** state. In the **RUN** state, you can view the screens while you make a weld and analyze weld force, weld current, and electrode position (follow-up) relationships dynamically. Pressing **RUN** saves the changes to the weld schedule that you just entered to the program screen, then automatically selects the **RUN** state.

Select Keypad



This is a cluster of four arrow keys. To select a schedule press the **SCHED** button. Next, increment or decrement the schedule using the up and down arrow keys. In the **RUN** state these arrow buttons are not active.

In the **PROGRAM** state use the left and right arrow keys to select a field.

Use the Up and Down arrow keys to increment or decrement the value. In **SETUP** menus use the Up and Down arrow keys to switch between pages. Use the Left and Right arrow keys to decrease or increase programmable fields.

RUN/DRESS Key (Weld Head Controller)

Toggling this switch to the **RUN** state (LED On) allows normal execution of the weld cycle. In the **DRESS** state (LED OFF), it allows you to dress (clean) the electrodes by executing a setdown on cleaning material that you insert between the electrodes. Setdown force for dressing is programmable.

NOTE: LED located above switch not shown.

CHAPTER 2
INSTALLATION AND SETUP

Section I: Installation

Space Requirements

We recommend that you install the SL-320A Electronic Low Force Weld Head System in a well-ventilated area that is free from excessive dirt and moisture. Allow sufficient clearance around both sides and back of the Controller and the Welding Power Supply so that cooling air can flow properly.

SL-320A Installation Dimensions

Equipment	Width (in/cm)	Height (in/cm)	Depth (in/cm)	Weight (lbs/kg)
SL-320A Weld Head Controller	8.8” / 22.3	9.2” / 23.4	16.7” / 42.4	18.5 lb / 8.4
SL-320A Weld Head(s)	2.55” / 6.47	14” / 35.6	5.5” / 14.0	8.0 lb / 3.6
Weld Head Stand (optional)	10” / 25.4	23.3” / 59.2	16” / 40.6	37.5 lb / 17.0

Weld Head Installation

All units of the SL-320A System are stand-alone except the Weld Head which must be mounted on a stable, vibration-proof work surface. The Weld Head has two pairs of mounting holes with identical hole patterns. The unit can be mounted vertically, horizontally, and can be mounted in either direction. If the unit is mounted horizontally, the electrode direction can be either to the left or right.

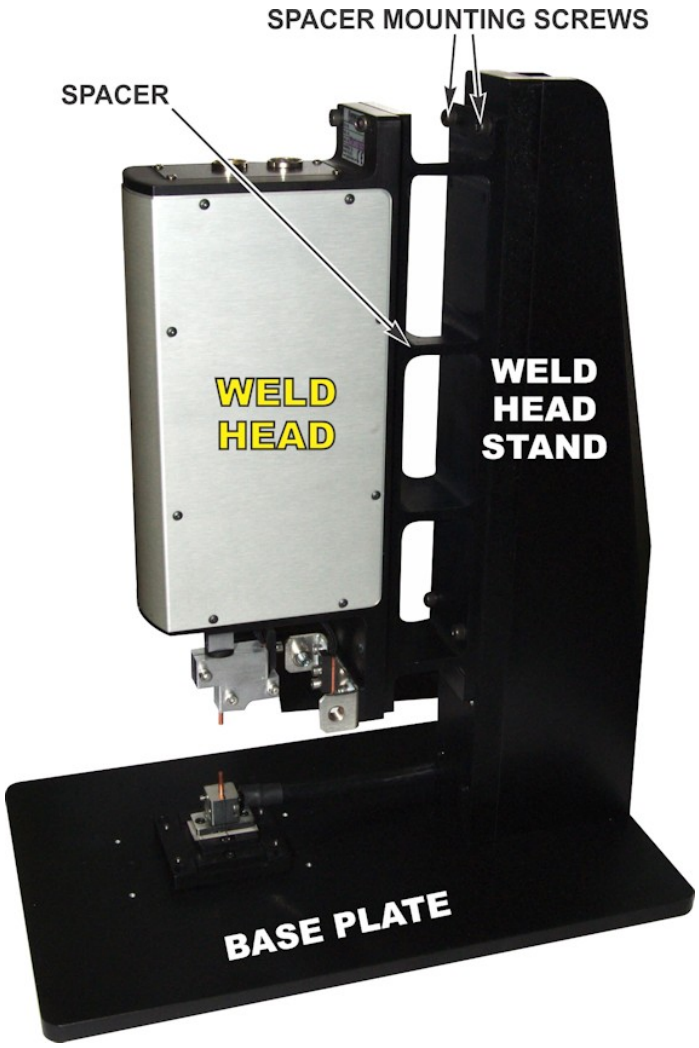
1. Secure the actuator to an adapter plate with four ¼-20 x ¾ flat head Phillips screws (P/N 625-595).
2. The adapter plate can be mounted to any rigid, vibration free surface that has the proper threaded mounting holes. The threaded holes would be the same as the threaded holes that are on the optional stand.

   NOTE: The height of the upper electrode holder above the lower electrode holder should allow ***for no more than 0.996" (25mm) of upper electrode travel***.

   The height of the lower electrode should be high enough such that the "downstop out of range" error message is not generated when a weld is performed. The downstop (encoder) position can be monitored in the calibration menu. This value should be zero or higher.
3. Secure the lower electrode holder (user furnished) to the horizontal work surface, in alignment with the upper electrode holder. The misalignment between the upper and lower electrode center lines should be less than 10% of the ***smallest*** electrode diameter or width dimensions.

Optional Weld Head Stand Installation

SL-320A Weld Heads are shipped without the optional Weld Head Stand. If you use the stand you can adjust the height of the Weld Head by installing the Spacer into any of the multiple sets of threaded holes on the stand. The Weld Head Stand contains a completely-assembled stand, spacer, base plate, and lower electrode holder. The Ship Kit contains the necessary mounting hardware.



After Installing the Weld Head to the Stand

1. Adjust the height of the upper electrode holder above the lower holder to all for ***no more than 0.996" (25mm)***.
2. Adjust the lower electrode holder so that any misalignment between the upper and lower electrodes is ***less than 10% of the smallest electrode diameter or width dimensions***.
3. Adjust the height of the lower electrode such that the "downstop out of range" error message is not generated when a weld is performed. The downstop (encoder) position can be monitored in the calibration menu. This value should be zero or higher.

Section II: Connections

CAUTION

The Controller is assembled at the factory for operation at a specific input power line voltage. ***Serious damage can result if an input voltage is used other than the voltage for which the Weld Head Controller is wired.***

Power Line Voltage, Current, and Wire Size Requirements

Use the values listed in the table below to select the correct power line circuit breaker and wire gauge sizes for installing the Controller.

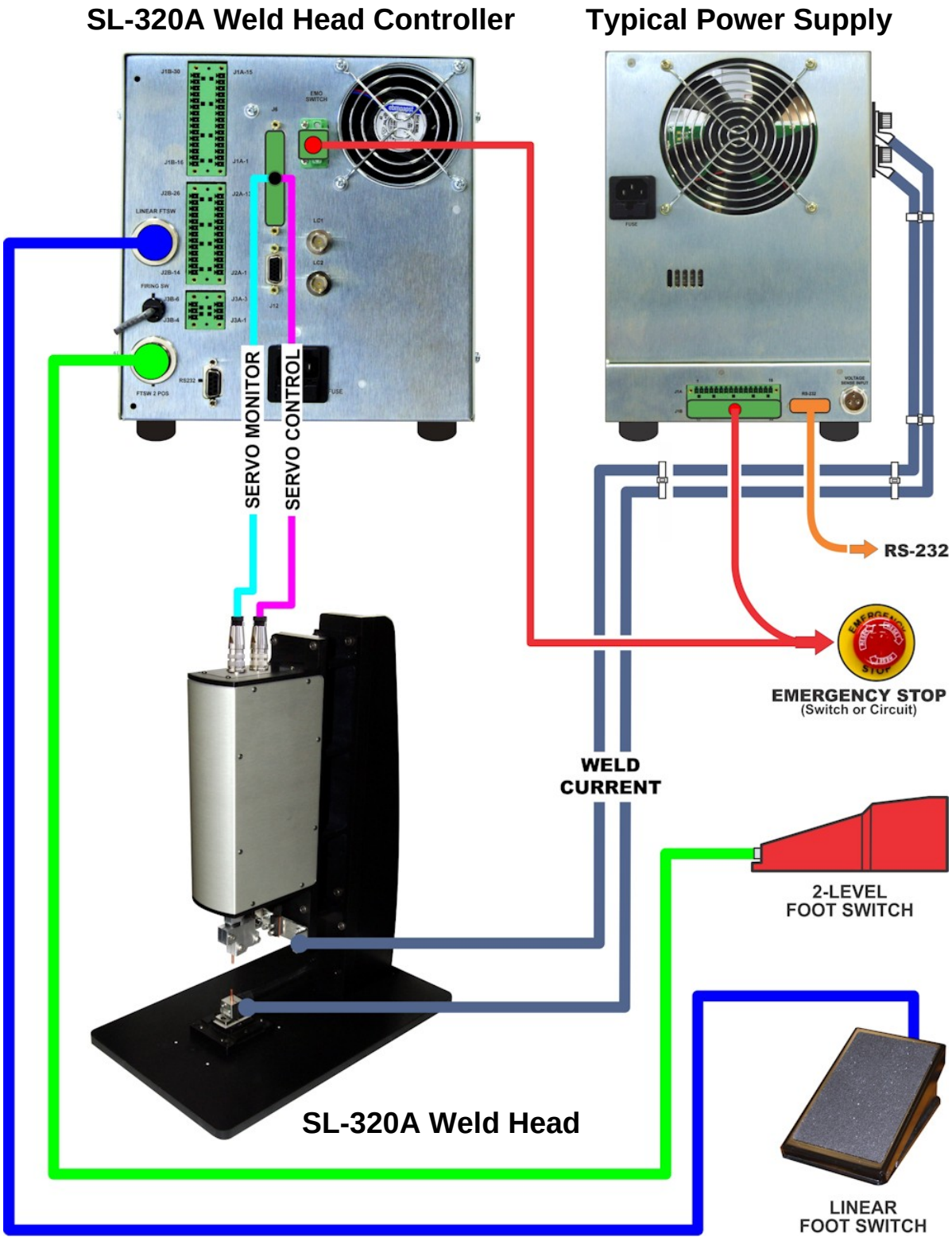
Input Power Circuit Breaker and Wire Size Recommendations

Service Voltage (RMS)	Circuit Breaker Current (RMS)	Copper AWG Wire Gauge	Outside Wire Diameter
115	8 Amps	18	0.040” / 1.02mm
208 → 230	4 Amps	18	0.040” / 1.02mm

Connect the Weld Head, Weld Head Controller & Welding Power Supply

This manual ***only*** describes the primary connections of the Weld Head and Weld Head Controller (see the connection diagram on the next page). The functions and pin assignments of the connector on the Controller rear panel are described in *Appendix B, Electrical and Data Connections*.

For instructions on how to connect your Welding Power Supply to the Weld Head, follow all instructions in the manual supplied with your Welding Power Supply including connections for **Weld Current, Polarity, Monitoring**, and other functions.


SL-320A Weld Head Controller
Typical Power Supply
SERVO MONITOR
SERVO CONTROL
RS-232
EMERGENCY STOP
(Switch or Circuit)
WELD
CURRENT
2-LEVEL
FOOT SWITCH
SL-320A Weld Head
LINEAR
FOOT SWITCH

EMO Mating Plug

> **CAUTION**
>
> You should evaluate your **EMERGENCY STOP** requirements based on your application needs and local regulations.

This connector is included in the Ship Kit supplied with the Controller. It should be attached to the connector on the rear panel labeled **EMO SWITCH** during installation. The connector is provided unwired. Final integration wiring by the user is required according to the diagram in the Appendices of this document and in compliance with safety requirements of the final integrated machine.

NOTE: Opening this connection will cause the Controller to initiate an Emergency Stop. The display will show **EMERGENCY STOP ACTIVATED** and a beep will sound. An Emergency Stop will disable all power outputs. To reset the condition, the switch connection must be closed, and the **RUN** key must be pushed on the front panel, or the **RESET DIGITAL INPUT** must be set to **ACTIVE** after the alarm output is off in order to reset the Controller. Users should verify that the weld Schedule is correct. If not, reset to the correct schedule if necessary.

CHAPTER 3
USING CONTROL PROGRAMMING FUNCTIONS

Section I: Before You Start

Preparation

Before operating the Weld Head, read both this manual ***and*** the *Operator Manual* that came with your Power Supply/Welding controller. Particularly note the specific hazards associated with those components. You ***must*** be familiar with the general principles of welding, programming weld schedules, and the operating procedures of your Power Supply/Welding Controller.

Use the checklist below to make sure that all connections and settings are correct to ensure that you will achieve the highest quality welds possible.

PRE-WELD CHECKLIST	
✓	Confirm that a qualified Engineer or Technician has properly installed and setup the equipment according to the instructions in *Chapter 2, Installation and Setup.*
✓	Set the **WELD/NO WELD** Switch, located on the front of the Power Supply/Welding Controller to the WELD position.
✓	Check that the weld power cables are correctly attached at both ends.
✓	Verify that the Firing Switch Cable is attached to the welding controller.
✓	Verify that the Power Supply/Welding Controller is connected to the appropriate power source and that the power source is turned **ON**.
✓	Verify that the Power Supply/Welding Controller is turned **ON**.

Operator Safety

DANGER

- ***Always*** wear protective safety glasses when performing any welding operation.
- ***Always*** wear appropriate personal protective gear when welding.

Section II: Operation

Overview

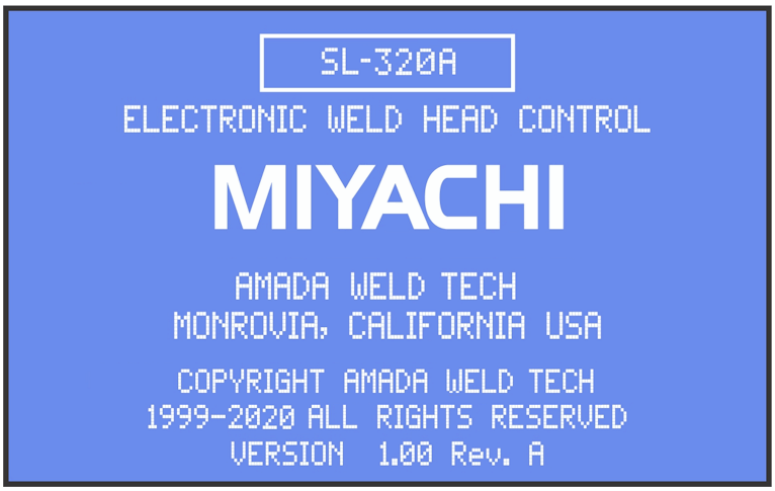
Welding consists of:

- Adjusting the electrodes and Weld Head height to match the pieces being welded.
- Adjusting the welding force if necessary.
- Using the Controller to program the motor drive settings.
- Welding using normal shop procedures.

Controller Display Screens

All of the Weld Head programming and control functions are programmed through the Controller. The Controller's display screen has a blue background that displays both alphanumeric and graphical information.

For clarity and simplicity, all of the display screens in the rest of this manual will be shown as smaller black & white screens.



Display screens allow you to customize parameters for your specific welding needs. The list below shows you the primary menu screens, several of them have sub-menus so that you may further refine Control parameters.

SETUP MENU

OPTIONS

OPTIONS, page 1 of 2

FOOTSWITCH TYPE
FOOTSWITCH RESPONSE MODE
END WELD BUZZER
BUZZER LOUDNESS
SCREEN BRIGHTNESS
DEBOUNCE TIME
FORCE UNITS
POSITION UNITS
SET OUTPUT RELAYS

OPTIONS, page 2 of 2
- **SELF-CHECK FORCE LIMIT**
- **MATERIAL SEARCH FORCE**
- **OBJECT DETECTION FORCE**
- **INITIAL POSITION ABORT**
- **DRESS SPEED**

WELD COUNTERS

COPY SCHEDULE

SYSTEM SECURITY

CALIBRATION

SET TO DEFAULTS

COMMUNICATIONS

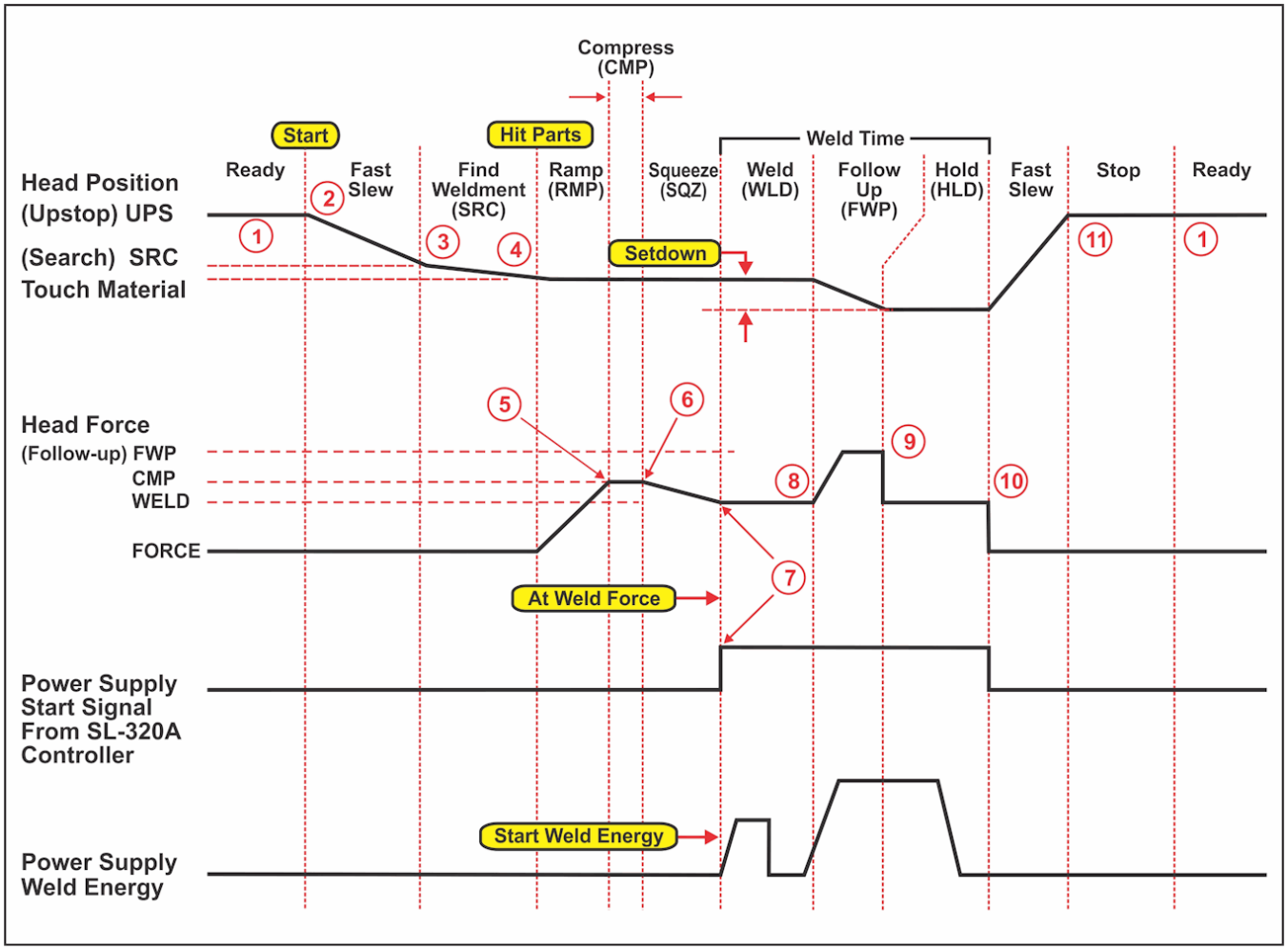
I/O STATUS

Overview of the SL-320A Weld Head Operation

An understanding of the processes involved in the weld cycle will be helpful in the programming instructions for the Controller. The Controller, in conjunction with the Power Supply, executes the sequence of actions shown in the following display screens during the weld cycle. The circled numbers refer you to the step numbers in weld head cycle table.

Two-Level Footswitch Operation

When doing manual welding, the two-level Foot Switch FS2L allows you to move the electrode between the Upstop (**UPS**) position and the search (**SRC**) position as often as you need before completing the weld with setdown (**STDN**). This way, you can carefully align the materials to be welded during the first downstroke of the electrode (first level of the foot switch), then commit to the weld with the final downstroke of the electrode (second level of the foot switch).



Complete Weld Cycle for Two-Level Footswitch Operation

STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
1	Ready	At UPS position.	Run state. Ready to make a weld.
2	First level of the foot switch is actuated	Moves to SRC position.	Slew rate is programmable: FAST, MED, SLOW. If the foot switch is released, the weld head moves back to the UPS position. By activating and releasing the first level of the foot switch, the weld head moves between the UPS and SRC positions.

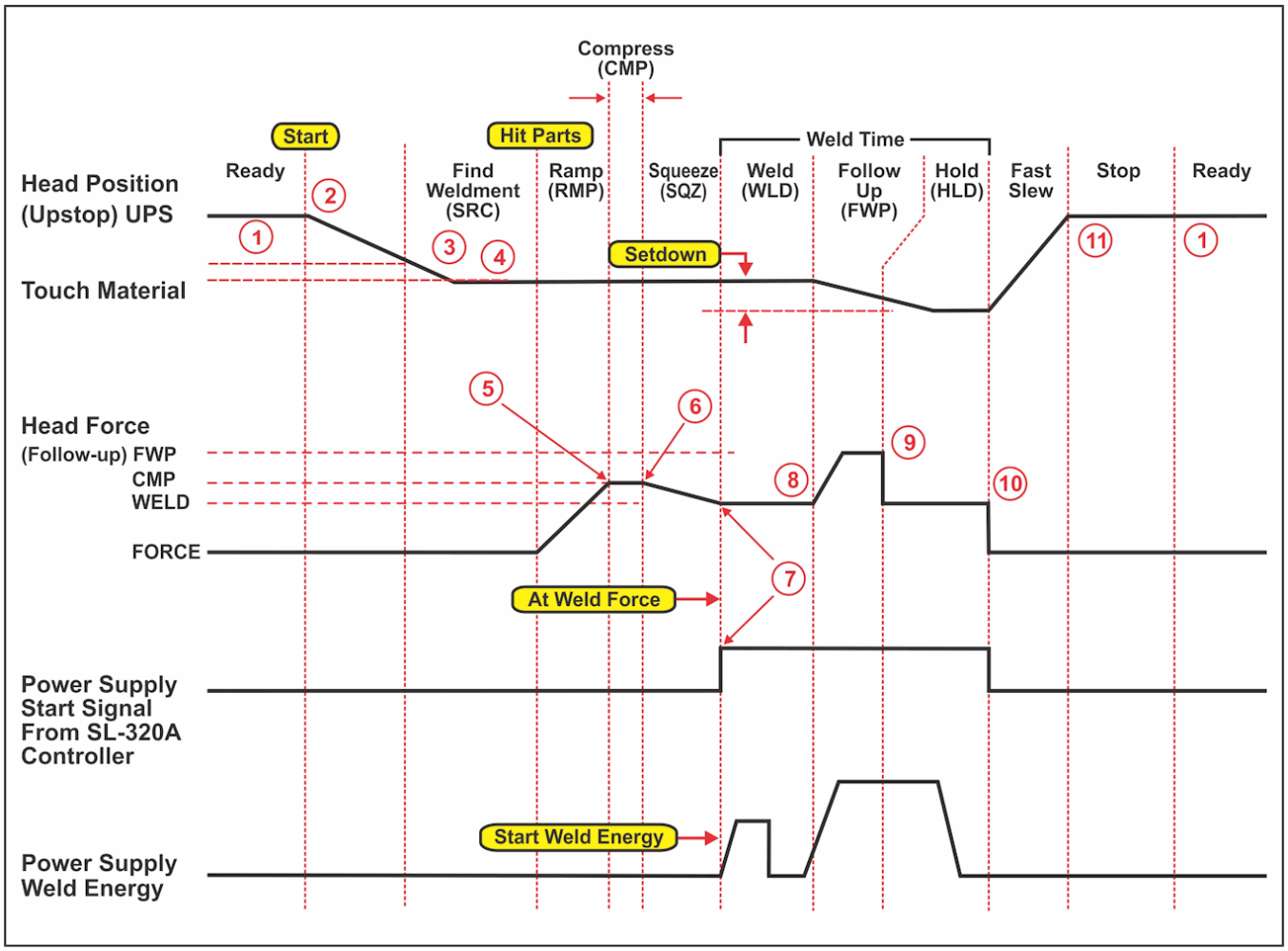
STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
3	Second level of the foot switch is actuated	Moves toward weld material.	Slew rate is programmable: FAST, MED, SLOW.
4	Electrode touches weld material	Force ramps up to COMPRESS or WELD force.	The time required to reach the COMPRESS force is programmable. This is called the RAMP (RMP) time. RAMP is an optional step. If the COMPRESS TIME is set to “0” then the RAMP is skipped along with COMPRESS. The minimum value for RAMP when RAMP is used is “1”.
5	COMPRESS Force is reached	Maintains constant force.	COMPRESS is an optional step. If the time for COMPRESS is set to "0." Then COMPRESS time is skipped.
6	End of COMPRESS time.	Force adjusts from COMPRESS force to WELD force.	The time required to reach the WELD force is programmable. This is called SQUEEZE (SQZ) time.
7	WELD force is reached	Start signal (contact closure) to Power Supply is initiated and follow-up force delay timer (WELD) is started.	An initial position reading is taken for weld-to-displacement. You must set the firing switch debounce time in the power supply to 0ms.
8	WELD time is expired	Force rapidly increases from the WELD force to the follow-up (FWP) force.	Force change occurs in about 1 millisecond and remains at the FWP force level for the programmed FWP time duration. Round-to-round or round-to-flat parts collapse (set down) during the FWP period. Flat-to-flat parts expand.
9	End of FWP time	Force rapidly decreases to the HOLD force.	HOLD force is applied for the HOLD time.
10	End of HOLD time	Weld Head retracts to the SRC. Position at the completion of hold. If the second level of the two position foot switch was released and reactivated a new weld can be started (back to step 3). If both footswitch levels are released the weld head moves to the UPS position.	Slew rate is the same as in step 2. The final position reading is taken at the end of HOLD. If HOLD is set to zero the final position will be measured at the end of FWP.
11	UPS position is reached	Weld Head remains at the UPS position for the duration of a hidden STOP time, which is automatically determined from the programmed and actual force and time information.	New weld cannot be initiated until the end of the STOP time. Also, the foot switch must be released and reactivated to start the next weld cycle. The STOP time ensures that the weld head will not overheat.

Linear Footswitch Operation

When doing manual welding, the Linear Foot Switch allows you to move the electrode between the Upstop (**UPS**) position and part position as often as you need before completing the weld. This way, you can carefully align the materials to be welded. Positioning of footswitch will position the actuator and start the automated weld cycle.

In first 20% of footswitch motion, no movement or action will occur. Motion will occur between 20% and 80% of footswitch movement and correspond to travel between the **UPS** position and end of travel. The last 80% to 100% of movement will cause no additional movement.

When electrode contacts part to be welded, unit will build up force to the user setpoint for **MATERIAL SEARCH FORCE**. If the material search force has been reached and the foot switch reaches the 95% depressed position the unit will initiate automated weld cycle beginning at the start of the **SQUEEZE** step. During movement, the unit travels at the user setting for Search Speed. The linear footswitch speed is not programmable.



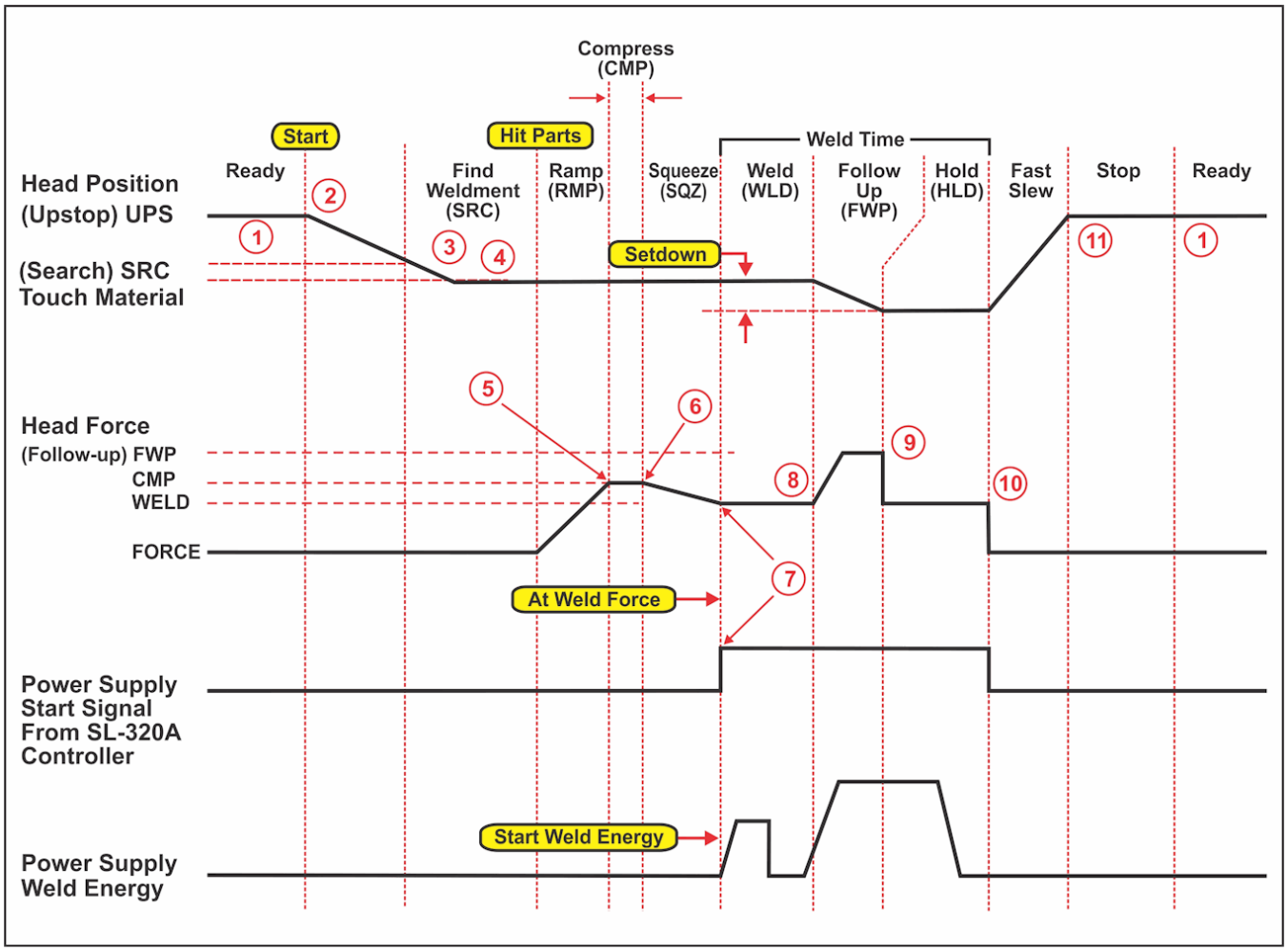
Complete Weld Cycle for Linear Footswitch Operation

STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
1	Ready	At UPS position.	Run state. Ready to make a weld.
2	Footswitch is actuated	Positions weld head based on footswitch position	Movement of the footswitch between 20% and 80% depressed positions the weld head between the UPS and SETDOWN positions. If the foot switch is released, the weld head moves back to the UPS position.
3	Electrode touches weld material	Force builds up to SETDOWN force.	
4	Footswitch is actuated further	Unit starts automated weld cycle beginning with Ramp (RMP) step	The Ramp (RMP) step is initiated when footswitch is 95% depressed. If COMPRESS time is set to 0, then both RAMP and COMPRESS are skipped
5	COMPRESS Force is reached	Maintains constant force.	COMPRESS is an optional step. If time for COMPRESS is set to "0." then COMPRESS time is skipped.
6	End of COMPRESS time.	Force rapidly adjusts from COMPRESS force to WELD Force.	The time required to reach the WELD force is programmable. This is called SQUEEZE (SQZ) time.
7	WELD force is reached	Start signal (contact closure) to Power Supply is initiated and follow-up force delay timer (WELD) is started.	An initial position reading is taken for weld to displacement. You must set the switch debounce time in the Power Supply to 0 msec.
8	WELD time is expired	Force rapidly increases from the WELD force to the follow-up (FWP) force.	Force change occurs in about 1 millisecond and remains at the FWP force level for the programmed FWP time duration. Round-to-round or round-to-flat parts collapse (set down) during the FWP period. Flat-to-flat parts expand.
9	End of FWP time	Force rapidly decreases back to the HOLD force.	HOLD force is applied for HOLD time.
10	End of HOLD time	Weld Head retracts to the SRC position. Once the linear footswitch moves a distance equal to SRC position a new weld can be made. **Note:** Search position relay output does not apply in linear footswitch mode	Slew rate is the same as in step 2. The final position reading is taken. See page 3-5 step 10.

STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
11	UPS position is reached	Weld Head remains at the UPS position for the duration of a hidden STOP time, which is automatically determined from the programmed and actual force and time information.	New weld cannot be initiated until the end of the STOP time. Also, the foot switch must be released and reactivated to start the next weld cycle. The STOP time ensures that the weld head will not overheat.

External Input Switch Operation (Digital I/O)

For applications which require the use of external control to activate the welds (ie. PLC's), the external input 1 is comparable to level 1 on a 2-level footswitch, and external input 2 is comparable to level 2 on a 2-level footswitch. The two levels allows you to move the electrode between the Upstop (**UPS**) position and the search (**SRC**) position.



Complete Weld Cycle for External Input Switch Operation

STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
1	Ready	At UPS position.	Run state. Ready to make a weld.
2	External input 1 is actuated	Moves to SRC position.	Slew rate is programmable: FAST, MED, SLOW. If the foot switch is released, the weld head moves back to the UPS position. By activating and releasing the first level of the foot switch, the weld head moves between the UPS and SRC positions.
3	External Input 2 is actuated	Moves toward weld material.	Slew rate is programmable: FAST, MED, SLOW.
4	Electrode touches weld material	Force ramps up to COMPRESS or WELD force.	The time required to reach the COMPRESS force is programmable. This is called the RAMP (RMP) time. RAMP is an optional step. If the COMPRESS TIME is set to “0” then the RAMP is skipped along with COMPRESS.
5	COMPRESS Force is reached	Maintains constant force.	COMPRESS is an optional step. If time for COMPRESS is set to "0." Then COMPRESS time is skipped.
6	End of COMPRESS time.	Force adjusts from COMPRESS force to WELD force.	The time required to reach the WELD force is programmable. This is called SQUEEZE (SQZ) time.
7	WELD force is reached	Start signal (contact closure) to Power Supply is initiated and follow-up force delay timer (WELD) is started.	An initial position reading is taken for weld-to-displacement. You must set the switch debounce time in the Power Supply to 0ms minimum.
8	WELD time is expired	Force rapidly increases from the WELD force to the follow-up (FWP) force.	Force change occurs in about 1 millisecond and remains at the FWP force level for the programmed FWP time duration. Round-to-round or round-to-flat parts collapse (set down) during the FWP period. Flat-to-flat parts expand.
9	End of FWP time	Force rapidly decreases to the HOLD force.	HOLD force is applied for the HOLD time.
10	End of HOLD time	Weld Head retracts to the SRC position. If the second level was released and reactivated a new weld can be started (back to step 3). If both levels are released the weld head moves to the UPS position.	Slew rate is the same as in step 2.

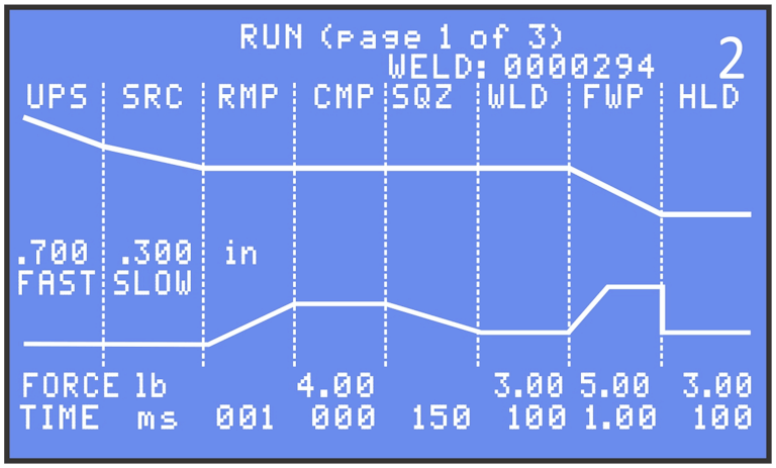
STEP	EVENT	LINEAR ACTUATOR ACTION	COMMENTS
11	UPS position is reached	Weld Head remains at the UPS position for the duration of a hidden STOP time, which is automatically determined from the programmed and actual force and time information.	New weld cannot be initiated until the end of the STOP time. Also, the foot switch must be released and reactivated to start the next weld cycle. The STOP time ensures that the weld head will not overheat.

PROGRAM Screens

Press the **PROGM** key to enter the program mode. Repeatedly pressing the **PROGM** key cycles the display through three programming screens. Each screen is updated with the programming changes, regardless of which screen is used to enter the schedule information.

PROGRAM (page 1 of 3)

This screen allows you to set all force and time fields using the numerical keys. Use the ◄► keys to select the various fields, and the up and down arrow keys to increment or decrement the values. The numeric keypad can also be used to enter values.

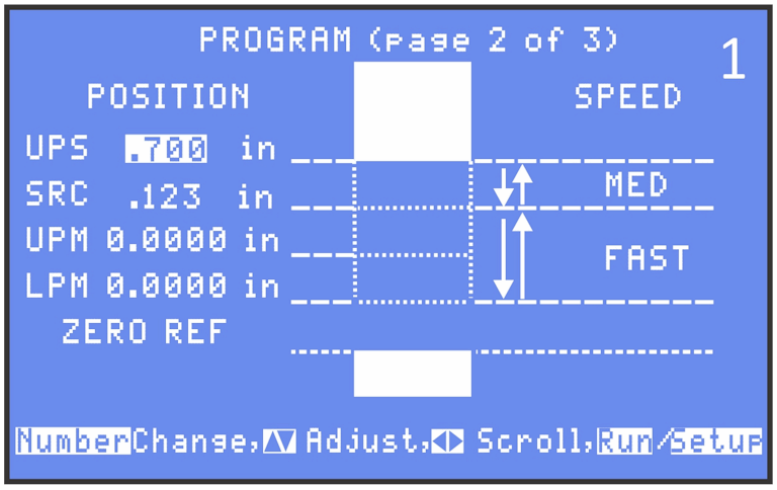


PROGRAM (page 2 of 3)

This screen is for programming the **Upstop** position, the **SEARCH** position, Upper Position Material, Lower Position Material, and **SPEED**.

The **UPS** position is where the weld head is located while the System is ready (in the **RUN** state).

Upon entering this screen, the weld head is positioned at the **UPS** position. You use the στ keys to raise or lower the weld head, or program the **UPS** position directly using the numerical keys.



Since the weld head responds immediately to your actions, this screen is particularly helpful for fine tuning the **UPS** position.

The search **SRC** position is the location where the weld head stops on its way down to allow the user to accurately align the materials to be welded. Typically, this position is set up so the electrodes are just above the weld material.

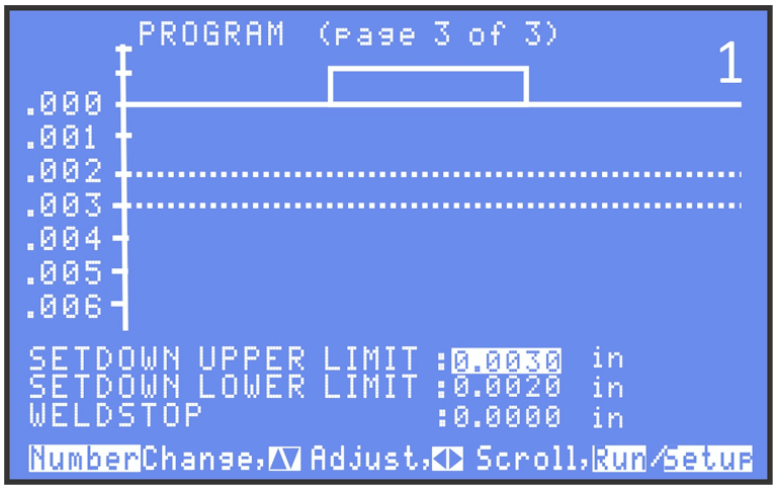
Upon selecting the **SRC** field the weld head slowly moves to the **SRC** position. You use the στ keys to lower the weld head, or program the **SRC** position directly using the numerical keys. Since the weld head responds immediately to your actions, this screen is particularly helpful for fine-tuning the **SRC** position.

The UPM (Upper Position Material) is the limit of the maximum thickness of the material. If a value is assigned to this variable, then the system will generate a message if the material is thicker than the value. If set to zero, then there is no limit.

The LPM (Lower Position Material) is the limit of the minimum thickness of the material. If a value is assigned to this variable then the system will generate a message if the material is either thinner than the value, or if there is no material present. If set to zero, then there is no limit.

PROGRAM (page 3 of 3)

The term 'setdown' (**STDN**) is the small electrode position displacement that occurs during the weld. This screen shows the actual setdown versus time graph of the last weld, and allows you to superimpose upper and lower setdown displacement limits.



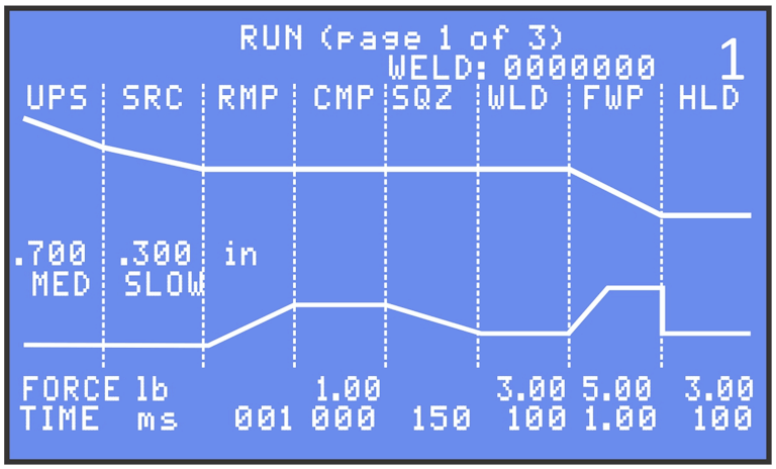
In addition, the weld-to-displacement feature is programmed on this screen (refer to *Weld-to-Displacement Feature* at the end of Chapter 4). Set the limit and stop line values with the στ keys or numeric keypad

NOTE: The **LOWER** setdown limit must be programmed to a value less than the **UPPER** limit. To cancel the settings set the values to **0.0000.** Setdown limits are represented by dotted lines and weld stop limits are represented by dashed lines

RUN Screens

RUN (page 1 of 3)

Press the **RUN** key to ensure that the Controller is in the **RUN** state. Now press the **RUN** key a few times. Notice that the display changes screens each time you press the **RUN** key. The **RUN** key alternates the display among three **RUN** screens.

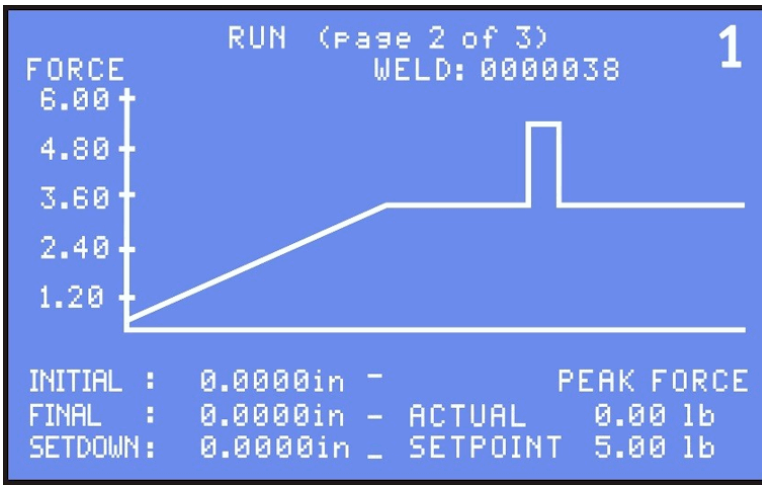


Page 1 of 3 displays 2 graphic lines. The top line is a graphical example of the position of the electrodes during a weld cycle. The bottom line is a graphical representation of the programmed weld forces.

To change the **FORCE** and **TIME** values, press the **PROGRAM** key and the first **FORCE** value will be highlighted. Use the ◀▶ keys to select the field(s) you want to change. When a field is **highlighted**, use the ▲▼ keys to increase or decrease the values. You can also use the numeric keypad to enter the value. When you are finished, press the **RUN** key and your changes will be saved.

RUN (page 2 of 3)

The graphical force **RUN** screen relates the programmed and actual **FORCE** (vertical axis) with time (horizontal axis). The force profile shows the complete weld time interval, including the **SQZ** time (force ramp-up) and the **FWP** force impulse. The programmed force is shown as a line graph, and the actual force is shown as a "filled-in" graph after the weld cycle is repeated.



The **FORCE** is shown on the vertical axis, and the time is shown on the horizontal axis.

The initial, final, and setdown displacement are shown in the lower left corner. After a weld cycle is completed, the peak **FWP** force is indicated in the lower right corner.

Cycle the weld head a few times. Notice that the force graph is redrawn each time.

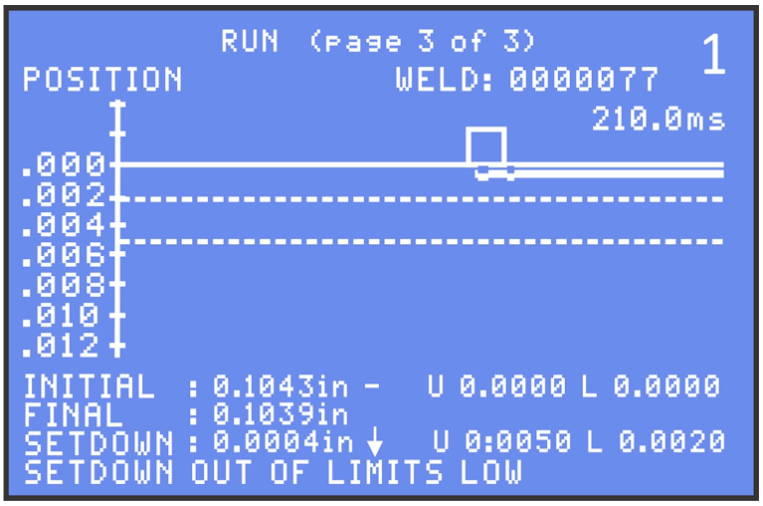
NOTE: Force accuracy of unit is ***only*** maintained if the weld head is calibrated in the same position as it is used. Weld Head is factory calibrated in the vertical position. This does not affect force repeatability.

RUN (page 3 of 3)

This screen displays three categories of information:

- **INITIAL** Position
- **FINAL** Position
- **SETDOWN** position

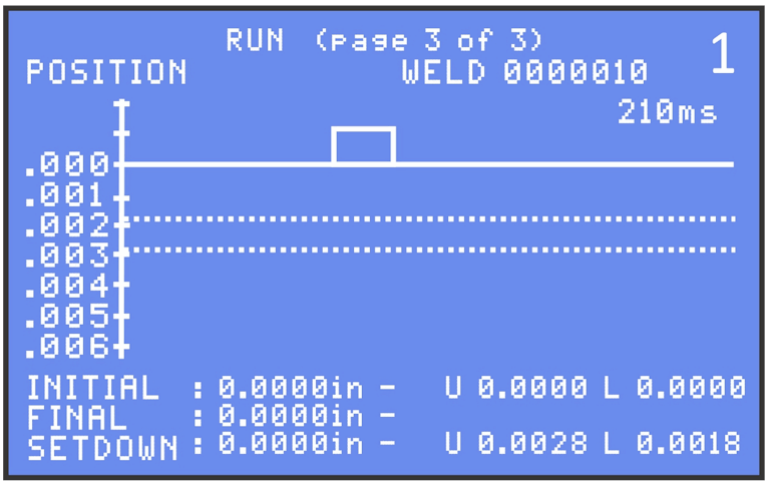
If your weld requires limits you can change them on the screen. Press the **PROGRAM** key several times until setdown upper limit is highlighted in Program (3 of 3). Use the ◀▶ keys to select setdown upper limit, setdown lower limit, or weld stop. When a field is highlighted, use the ▲▼ keys to increase or decrease the values. You can also use the numeric keypad to enter the values.



Note: After performing a weld one of four symbols may appear next to limit settings:

↑ = Upper limit exceeded, ↓ = Lower Limit Exceeded, ○ = Within Limits, -- = No Limit Set

When you are finished, press the **RUN** key and your changes will be saved. The upper and lower limits are shown on the graph by the dotted lines only if you have programmed them. Weld Stop is represented by dashed lines.



SETUP MENU

To access this screen press the **SETUP** key on the front of the Controller.

To select one of the eight options press the corresponding number key on the front of the Controller.

Example: Press the 1 key on the front of the Controller to go to the **OPTIONS** menu.

```
< SETUP MENU >
1. OPTIONS
2. WELD COUNTERS
3. COPY SCHEDULE
4. SYSTEM SECURITY
5. CALIBRATION
6. SET TO DEFAULTS
7. COMMUNICATIONS
8. I/O STATUS

NUMBER Select an item, Run / Setup
```

OPTIONS Page 1 of 2

1. Press the 1 key on the front of the Controller to get this screen. The Controller makes 14 different system options available to you through two screens: **OPTION 1** and **OPTION 2**. Most of these programmed options allow you to modify how an external input, such as a foot switch, interfaces with the Controller.

   Output relay options allow you to interface the Controller with an external computer or Programmable Logic Control (PLC).

2. From the **MAIN MENU** screen, select **OPTIONS**. The **OPTIONS, page 1 of 2** screen appears.

```
< OPTIONS, page 1 of 2 >
1. FOOTSWITCH TYPE            :   2-LEVEL
2. FOOTSWITCH RESPONSE MODE   :   ABORT
3. END WELD BUZZER            :   OFF
4. BUZZER LOUDNESS            :   0%
5. SCREEN BRIGHTNESS          :   50%
6. DEBOUNCE TIME              :   30 msec
7. FORCE UNITS                :   lb
8. POSITION UNITS             :   in
9. SET OUTPUT RELAYS

NUMBER Select, ▼ Page, Run / Setup
```

FOOTSWITCH TYPE

Press the **1** key on the front of the Controller to select the footswitch type. Press the **1** key again until the Footswitch Type you want displays on the screen:

- **2-LEVEL**
- **LINEAR**
- **DIGITAL I/O**

Press the **RUN** key to save the changes, or if you want to edit another option press the numerical key which corresponds with the option you want to edit.

FOOTSWITCH RESPONSE MODE

Press the 2 key on the front of the Controller to select the response mode. Press the 2 key until either **ABORT** or **LATCH** displays on the screen:

Press the **RUN** key to save the changes, or if you want to edit another option press the numerical key which corresponds with the option you want to edit.

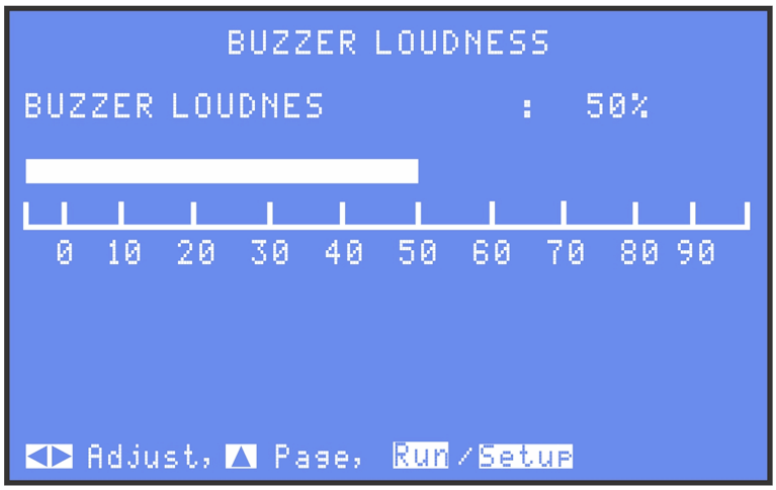
END WELD BUZZER

Press the 3 key on the front of the Controller to select end of weld buzzer. Press the 3 key again until either ON or OFF displays on the screen.

Press the **RUN** key to save the changes, or if you want to edit another option press the numerical key which corresponds with the option you want to edit.

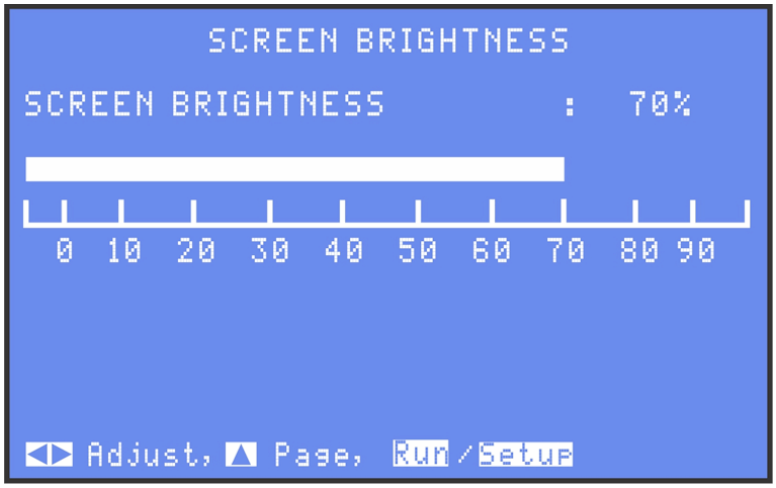
BUZZER LOUDNESS

1. Press the 4 key on the front of the Controller to get this screen.
2. Use the ◀▶ keys to turn the loudness up or down as shown on the right.
3. Press the ▲ to return to **OPTIONS, page 1 of 2**.



SCREEN BRIGHTNESS

1. Press the 5 key on the front of the Controller to get this screen.
2. Use the ◀▶ keys to turn the brightness up or down as shown on the right.
3. Press the ▲ to return to **OPTIONS, page 1 of 2**.



DEBOUNCE TIME

1. Press the 6 key on the front of the Controller to select the debounce time. Press the 6 key again until the Debounce Time you want displays on the screen:
   - **0ms**
   - **10ms**
   - **20ms**
   - **30ms**
2. Press the **RUN** key to save the changes, or if you want to edit another option press the numerical key which corresponds with the option you want to edit.

FORCE UNITS

1. Press the 7 key on the front of the Controller to select **Force Units**.
2. Press the 7 key again until **lb, gm, or N** displays on the screen:
3. Press the **RUN** key to save the changes. If you want to edit another option press the numerical key which corresponds with the option you want to edit.

POSITION UNITS

1. Press the 8 key on the front of the Controller to select position units.
2. Press the 8 key again until either **IN** or **MM** displays on the screen:
3. Press the **RUN** key to save the changes. If you want to edit another option press the numerical key which corresponds with the option you want to edit.

SET OUTPUT RELAYS

1. Press the 9 key on the front of the Controller to get this screen.
2. Press the number key on the front of the Controller that corresponds to the relay you want to modify.

   Example: Press the 1 key and the following screen displays.

```
                    < RELAYS >

1. RELAY  1:OPEN       WHEN NOT ACTIVE
2. RELAY  2:OPEN       WHEN NOT ACTIVE
3. RELAY  3:OPEN       WHEN NOT ACTIVE
4. RELAY  4:OPEN       WHEN NOT ACTIVE


NUMBER Select, ▼ Page, Run / Setup
```

3. Press the 1 key to get this screen.
4. Press the 1 key again to "Set Relay To" either **OPEN** or **CLOSED**.
5. Press the 2 key to set the **WHEN** condition of the relay. In the **WHEN** condition screen select events such as Welding, Weld Cycle, End of Weld, etc.

```
                   < RELAYS 1>

1. SET RELAY TO    :   OPEN
2. WHEN            :   NOT ACTIVE




NUMBER Select, ▲ Page, Run / Setup
```

   The relay will cycle during the event that is chosen.

6. Press the ▲ key to return to the previous screen. Or press the ▼key to see more WHEN" options.

RELAY 1 "WHEN" OPTIONS

These are the options for **WHEN** to activate the relay.

NOTES:

- From the 1st **WHEN** screen press the ▲ key to get to the **Set Relay To** screen.
- From the **Set Relay To** screen, press the ▲ key to get to the main Relay screen which shows all four relays.

```
                    < RELAY 1 >
1. WELDING
2. WELD CYCLE
3. K1/K2 CAL
4. END OF WELD
5. ALARM
6. SEARCH POSITION
7. DRESS
8. WELD COUNTER
9. OUT OF LIMITS

   PAGE FOR MORE RELAY SETTINGS

        Select, ▼▲ Page, Run / Setup
```

1. From the **WHEN** options screen press the ▼ key on the Controller to get to the 2nd when options screen.

2. Press the ▲ key to return to the previous "**WHEN**" screen.

```
                    < RELAY 1 >
1. INIT  POS LIMITS
2. INIT  POS HIGH
3. INIT  POS LOW
4. SETDOWN LIMITS
5. SETDOWN HIGH
6. SETDOWN LOW
7. NOT ACTIVE

▲ PAGE FOR MORE RELAY SETTINGS

NUMBER Select, ▲ Page, Run / Setup
```

OPTIONS Page 2 of 2 Menu

1. From the **OPTIONS, page 1 of 2** screen press the ▼ key to get to the OPTIONS page 2 of 2 screen.

2. To set the **SELF-CHECK FORCE LIMIT** press the **1** key enter the self-check force limit screen.

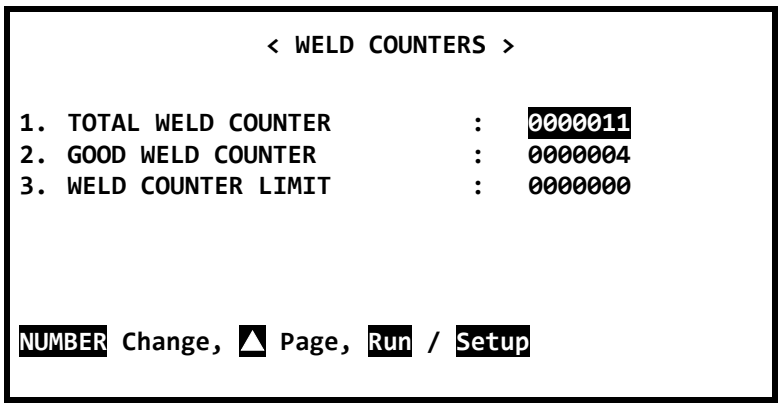
```
              < OPTIONS, page 2 of 2 >
1. SELF-CHECK FORCE LIMIT      :   0.22 lb
2. MATERIAL SEARCH FORCE       :   0.22 lb
3. OBJECT DETECTION FORCE      :   0.55 lb
4. INITIAL POSITION ABORT      :   OFF
5. DRESS SPEED                 :   1


NUMBER Select, ▲ Page, Run / Setup
```

3. Use the numeric keys on the front of the Controller to enter the limits. Press **RUN** to save the setting or press the ▲ key to return to the previous screen.

4. To set the **MATERIAL SEARCH FORCE** press the 2 key to enter the **Material Search Force** screen.
5. Use the numeric keys on the front of the Controller to enter the force. Press **RUN** to save the setting or press the ▲ key to return to the previous screen
6. To set the **OBJECT DETECTION FORCE** press the 3 key to enter the object detection force screen.
7. Use the numeric keys on the front of the Controller to enter the force. Press **RUN** to save the setting or press the ▲ key to return to the previous screen
8. To set **INITIAL POSITION ABORT** press the 4 key until either **ON** or **OFF** displays on the screen. Press RUN to save the setting.
9. To set **DRESS SPEED** press the 5 key to enter the **Dress Speed** screen.
10. Use the numeric keys on the front of the Controller to enter the speed. Press **RUN** to save the setting or press the ▲ key to return to the previous screen
11. From the **OPTIONS page 2 of 2** screen, press the ▲ key to get back to **OPTIONS page 1 of 2**. All options are edited directly on the options page.

WELD COUNTERS

1. From the **SETUP MENU** press the 2 key on the Controller to get this screen.
2. To select an item press the 1, 2, or 3 key to enter the counter screens.
3. Use the numeric keypad to enter a counter value or 0 to "zero" the counters.



4. Press the ▲ key to return to the previous screen.

COPY SCHEDULE

1. From the **SETUP MENU** press the 3 key on the Controller to get this screen.

2. The first **SCHEDULE** will be **highlighted** as your "Source." Use the numeric keys to enter the number of the schedule you want to copy followed by the ▶ key to highlight the **TO** schedule.

```
< COPY SCHEDULE >

COPY SCHED [001] TO [001] THRU [001]

ENTER NUMBERS followed by the ▶ arrow
    Use  Run  or  Setup  to abort
```

3. Use the numeric keys to enter the schedule number. You may also enter a **THRU** number if you wish to copy to more than one schedule.

4. After the **THRU** number is entered, press the right arrow key to initiate the copy.

5. After pressing the ▶ arrow key the setup menu is displayed. Select 3 again to copy more schedules.

SYSTEM SECURITY

1. From the **SETUP MENU** press the 4 key on the Controller to get this screen.
2. Press 1 or 2 key to set or enter the password for system security (See **CHANGE PASSWORD**). Once the password is set the **SYSTEM SECURITY** screen will be displayed.

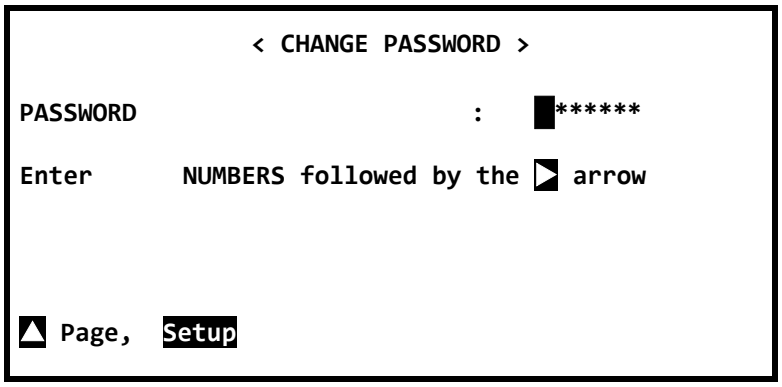
```
< SYSTEM SECURITY >

1. SCHEDULE LOCK          :   OFF
2. SYSTEM LOCK            :   OFF




NUMBER Select, ▲ Page, Run / Setup
```

3. Press the 1 key until the **SCHEDULE LOCK** displays either **ON** or **OFF**.
4. Press the 2 key until the **SYSTEM LOCK** displays either **ON** or **OFF**.
5. Press the ▲ key to return to the previous screen.

CHANGE PASSWORD

When you choose either system lock or schedule lock the system will take you to this screen automatically.

1. The **PASSWORD** field on the right will be **highlighted**. Use the numeric keys to enter a new numeric password, then press the ▶ key. The previous screen will be displayed



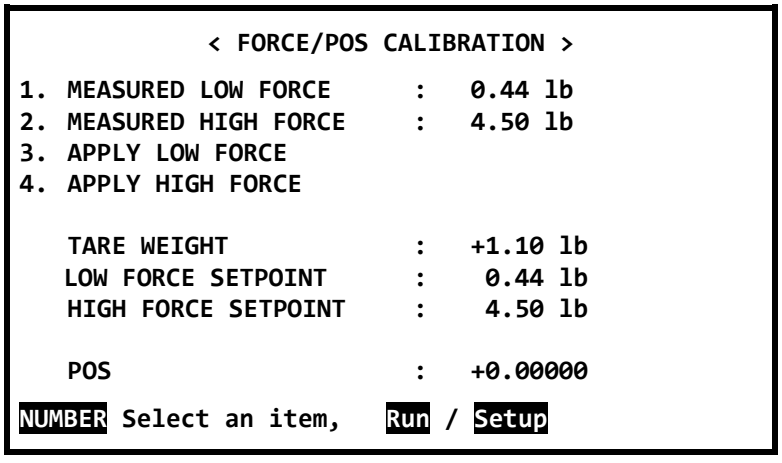
2. Record the password in a secure location

CALIBRATION

The force Calibration screen allows the user to perform a 2 point calibration of the force. The system is calibrated at 4.50 lbs. (**HIGH FORCE**) and 0.44Lbs. (**LOW FORCE**). This screen allows you to take measurements of both the applied high force and applied low force. Once you enter the measured forces, the system automatically compensates, and adjusts the force closer to the target calibrated force. Measurements will have to be taken multiple times, and entered multiple times in order for the system to be fine-tuned to within the force specifications.

3. From the **SETUP MENU** press the 5 key on the Controller to get this screen. See Chapter 5 for calibration procedure.

4. Press **SETUP** or **RUN** to exit this screen.



SET TO DEFAULTS

1. From the **SETUP MENU** press the 6 key on the Controller to get this screen.
2. Press 1 for **YES** or 2 for **NO**.

   NOTE: this will reset every schedule and system parameter value to factory settings

```
          < RESET TO DEFAULTS MENU>

   DO YOU WISH TO SET ALL PARAMETERS TO
   THEIR SYSTEM DEFAULT VALUES?

                1. YES      2.  NO




NUMBER Select, ▲ Page, Run / Setup
```

3. Press the ▲ key to return to the previous screen.

COMMUNICATIONS

1. From the **SETUP MENU** press the 7 key on the Controller to get this screen.

2. Press the 1 key to change from **SLAVE** to **MASTER**.

3. Press the 2 key to change from **01** through **31**.

```
                < COMMUNICATION >

1. COMMUNICATION ROLE          :   SLAVE
2. RS232 ID NUMBER             :   01
3. BAUD RATE                   :   9600




NUMBER Select, ▲ Page, Run / Setup
```

4. Press the 3 key to go to the **BAUD RATE** screen below.

5. Press **RUN** or **SETUP** to save changes.

BAUD RATE

1. Press the 1, 2, or 3 key to select the **BAUD RATE** you want.

2. Press the ▲ key to return to the previous screen.

```
                   < BAUD RATE >

1. 9600
2. 19.2k
3. 38.4k




NUMBER Select, ▲ Page, Run / Setup
```

I/O STATUS

There are two **I/O STATUS** screens, each is ***Read-Only***.

1. From the **SETUP MENU** press the 8 key on the Controller to get this screen which displays the status of the **INPUTS**.

2. Press the ▼ key to go to the next screen which displays the status of the **OUTPUTS**.

```
                I/O STATUS - INPUTS
SCHED0          :   0       START WELD 1 :   0
SCHED1          :   0       START WELD 2 :   0
SCHED2          :   0       PARK
SCHED3          :   0       SPARE INPUT0 :   0
SCHED4          :   0       SPARE INPUT1 :   0
SCHED5          :   0       SPARE INPUT2 :   0
SCHED6          :   0       ESTOP        :   0
DRESS           :   0       FSW LEVEL 1  :   0
RESET           :   0       FSW LEVEL 2  :   0
PROCESS INHIB   :   0       24VIO        :   1

THERMISTOR      :   0396 MOTOR FORCE      :0346
LOAD CELL1      :   0512 LINEAR FSW       :0001

▼▲ Page,  Run / Setup
```

3. Press the ▲ key to return to the previous screen**.**

```
                I/O STATUS - OUTPUTS
SCHED0          :   1   PWRSUPPLY CUTOFF :   0
SCHED1          :   0   DIGITAL OUT 0    :   0
SCHED2          :   0   DIGITAL OUT 1    :   0
SCHED3          :   0   VALVE            :   0
SCHED4          :   0   ALARM            :   0
SCHED5          :   0   WELD IN PROGRESS :   0
SCHED6          :   0   PARK             :   0
RELAY1          :   0   ACKNOWLEDGE      :   0
RELAY2          :   1   READY            :   0
RELAY3          :   1   FIRE SWITCH OUT  :   0
RELAY4          :   1

▲ Page,  Run / Setup
```

CHAPTER 4
OPERATION

Section I: Before You Start

Preparation

Before operating the Weld Head, read both this manual ***and*** the *Operator Manual* that came with your Power Supply/Welding controller. Particularly note the specific hazards associated with those components. You ***must*** be familiar with the general principles of welding, programming weld schedules, and the operating procedures of your Power Supply/Welding Controller.

Use the checklist below to make sure that all connections and settings are correct to ensure that you will achieve the highest quality welds possible.

PRE-WELD CHECKLIST	
✓	Confirm that a qualified Engineer or Technician has properly installed and setup the equipment according to the instructions in *Chapter 2, Installation and Setup.*
✓	Set the **WELD/NO WELD** Switch, located on the front of the Power Supply/Welding Controller to the WELD position.
✓	Check that the weld power cables are correctly attached at both ends.
✓	Verify that the Firing Switch Cable is attached to the welding controller.
✓	Verify that the Power Supply/Welding Controller is connected to the appropriate power source and that the power source is turned **ON.**
✓	Verify that the Power Supply/Welding Controller is turned **ON**.

Operator Safety

DANGER

- ***Always*** wear protective safety glasses when performing any welding operation.
- ***Always*** wear appropriate personal protective gear when welding.

Section II: Overview

Overview

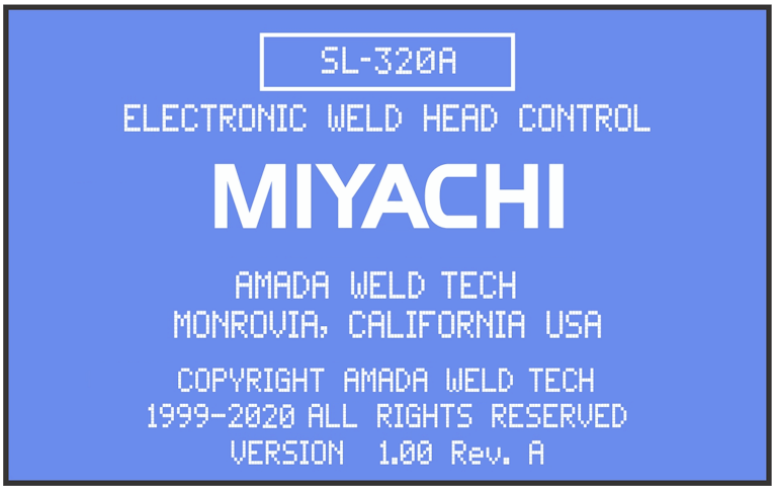
Welding consists of:

- Adjusting the electrodes and Weld Head height to match the pieces being welded.
- Adjusting the welding force if necessary.
- Using the Controller to program the motor drive settings.
- Welding using normal shop procedures.

Controller Display Screens

All of the Weld Head programming and control functions are programmed through the Controller. The Controller's display screen has a blue background that displays both alphanumeric and graphical information.

For clarity and simplicity, most of the display screens in the rest of this manual will be shown as smaller black & white screens.



Section III: *Quick Start* -- Making the First Weld

NOTE: The information in this section gives you a 'quick start' method for starting to weld with minimal programming. For more detailed information regarding the screens and their functions see *Chapter 3, Using Control Programming Functions*.

Nomenclature and Symbols

The following nomenclature, symbols, and conventions are used in this manual for expressing control and key actuations, and display readings, on the Weld Head System (both the SL-320A Weld Head Controller and the UB-4000A Power Supply). If you are not using a UB-4000A Power Supply, refer to the user's manual for the power supply you are using for the appropriate nomenclature:

Electrode Installation

Install the appropriate electrodes in the Weld Head electrode holders. Your choice of electrodes depends on your specific welding applications, but keep in mind the following considerations:

- 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.
- Pencil point electrodes cause severe electrode sticking to the parts and unexplained explosions. They also increase the required weld heat substantially because of the reduced electrode-to-part contact area.

Weld Head Controller Power Up and Initialization

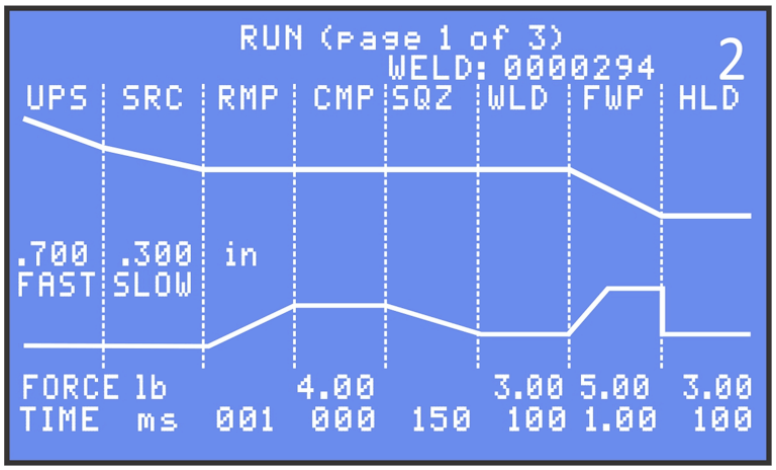
1. Turn the Weld Head Controller power ON. It will automatically run a self-test cycle, during which it:
   - Determines the downstop position of the opposing electrode.
   - Resets the downstop position so that it is calibrated as 0.000.
   - The upstop (**UPS**) and search (**SRC**) positions are referenced to the downstop.
   - Verifies the calibration of the position and force control systems.

   - Determines the location of the inward-most position of the Linear Actuator output shaft relative to the downstop. The location is the maximum **UPS** to which the Weld Head System can be programmed for the current length and placement of the electrodes.
   - Measures Tare Weight of moving assembly including user electrodes.

2. At the end of the self-test the **RUN** screen appears. The first time it appears it will show the factory default settings.

   If the space between the top and bottom electrodes is less than

   0.7 inch (20.3 mm), the default settings for the **UPS** and **SRC** positions will be different than those shown.



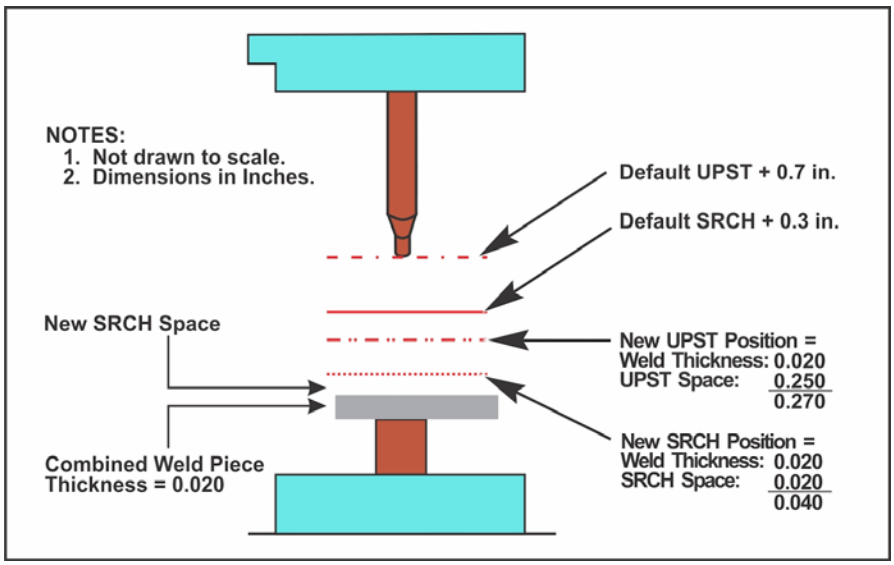
   NOTE: The Weld Head moves to the upstop position (**UPS**) specified by the initial positioning schedule.

   NOTE: The Weld Head requires an opening of 0.5-0.996" (12.7-25.3mm) between upper and lower electrodes for self-calibration to take place.

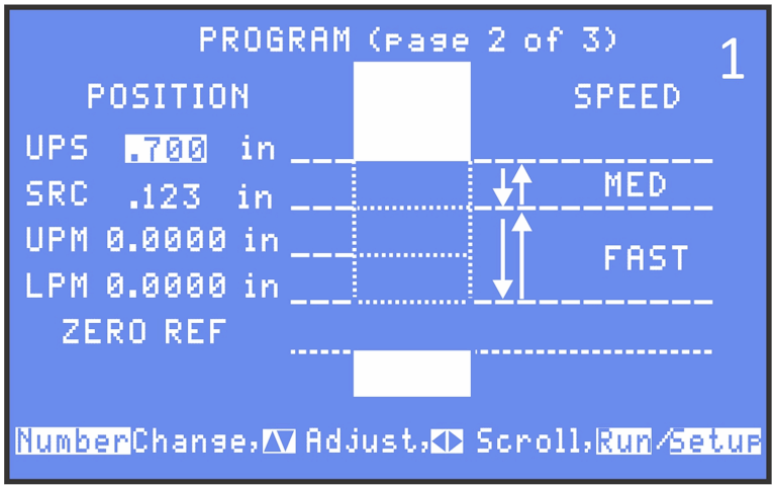
Setting the Upstop and Search Positions

Note on the alphanumerical **RUN** screen that the default positions for electrode upstop (**UPS**) and electrode search (**SRC**) are .700 inch (20.3 mm) and .300 inch (2.5 mm) respectively. These positions are with respect to the position of the lower electrode, which the Weld Head Controller senses during its power up calibration cycle. You will now need to reset these values to accommodate the combined thickness of the workpieces that you will be welding.

The figure below shows an example of setting new **UPS** and **SRC** positions that are suitable for a typical combined workpiece thickness of 0.020 inch (0.51 mm). A space of 0.25 inch (6 mm) between the upper electrode tip and the workpieces will set the **UPS** position at 0.270 inch (6.8 mm). A nominal space of 0.25 inch (6 mm) reduces the travel time for the upper electrodes to reach the workpieces. Enter the **UPS** value of 0.27 inch as follows.



Calculating the UPS and SRC Positions



1. With the default **RUN** screen still accessed (Step 2 of the power up Weld Head Controller procedure in the previous section), press the **PROG** key ***twice*** to access the **PROGRAM** screen.
2. Use the ◀▶ keys to select (highlight with the cursor) the **UPS** position, which now reads the default value of .700.
3. Enter the new **UPS** position value directly with the **DATA** keypad. In this example enter **.270** and press ▶.
4. The **SRC** position value is currently at **.300**. A **SRC** space that is 0.020 inch (0.5 mm) greater than the combined workpiece thickness helps to visually align the upper electrode with the workpieces. In this example, key in .040 inch. At this point, you have entered the new **SRC** position, but you have not yet saved it.
5. Press **RUN** to save both the **UPS** and **SRC** positions to the weld schedule.

   NOTE: In **RUN** (page 1 of 3) **UPS** and **SRC** are represented with 3 digits and any remainder is truncated. As an example, if **UPS** was programmed for 12.75mm **RUN** (page 1 of 3) will display 12.7mm. This does not affect operation.

Welding Power Supply Power Up and Initialization

1. Turn the Power Supply ON.
2. Set the **WELD/NO WELD** switch to **NO WELD**.

> **WARNING**
>
> Whenever you are not welding material, to avoid serious injury or damage to other objects in the weld path (ie. load cells used for force measurement), verify that the **WELD/NO WELD** switch is in the NO WELD position

Making Test Welds with Round-to-Round or Round-to-Flat Stock

To arrive at the point where you make a successful first weld will require you to make several test welds, using identical weld pieces each time for true process control.

You should make the first test welds with low energy settings. You can then adjust each of the welding parameters ***one at a time*** until you can make a successful weld.

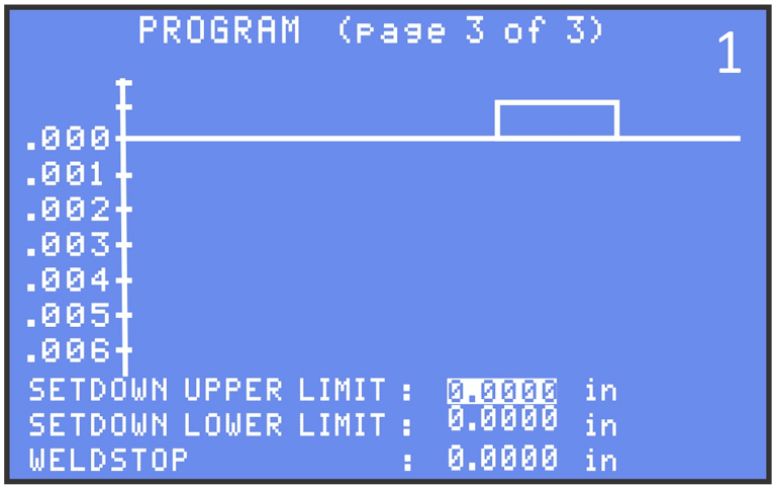
You will be adjusting weld energy (current over time) with the Power Supply, and weld force (**WLD**), follow-up force (**FWP**), and hold (**HLD**) with the Weld Head Controller.

WARNING: Always wear safety glasses when welding.

The First Test Weld: Default Settings

1. At the Power Supply, set the **WELD/NO WELD** switch to **WELD** to go to the run state. Note that **NO WELD** on the Power Supply graphical **RUN** screen disappears.
2. At the Weld Head Controller, press **RUN** ***twice*** to access the Weld Head Controller graphical setdown **RUN** screen.

3. Make a test weld by placing the weld pieces on the lower electrode and pressing on the Weld Head foot switch. The first level press of the foot switch will send the upper electrodes to the **SRC** position that you programmed, 0.020 inch above the workpieces. The second level pressing of the foot switch will send the upper electrode to the weld piece surface and trigger the weld cycle.



4. If a partial weld has taken place, peel the welded materials apart. A satisfactory weld will show residual material pulled from one material to the other.

   The Power Supply **RUN** screen **CURRENT** and **WELD TIME** should be set according to the type of material you are welding. The default settings of the Power Supply will most likely need to be adjusted. Also, weld force will need to be adjusted at the Controller.

   NOTE: When insufficient weld energy is supplied, oscillations just below the **.000** setdown line are typical for round-to-round or round-to-flat welding applications. When sufficient weld energy is applied, a negative (downward) swing of the setdown trace is typical.

The Second Test Weld: Increasing Power Supply Weld Current and Weld Time

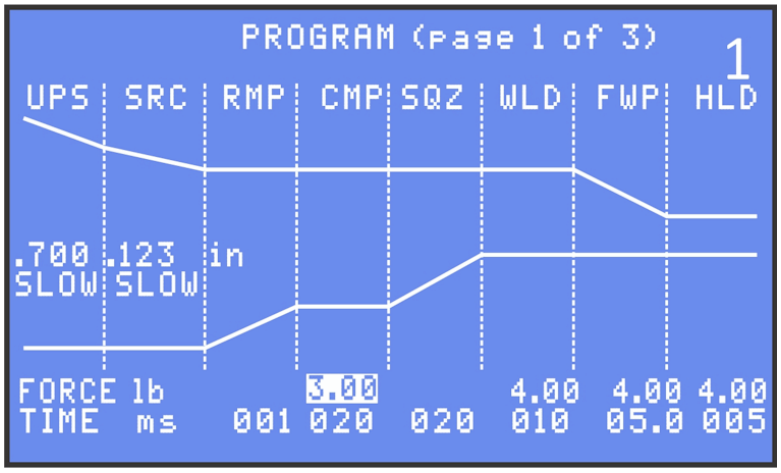
NOTE: Use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

Keep adjusting the weld time and weld current for each test weld until the setdown trace on the graphical setdown **RUN** screen is swinging negatively below the .000 setdown reference line and a weld nugget has formed between the two workpieces.

The Optimum Test Weld: Adjusting the Weld Head Delay Time

The relationship of the follow-up force profile and the electrode setdown trace is important. Its center must be fairly well aligned with the center of the setdown curve. If there is misalignment, you can adjust the weld time which will align the follow-up force profile with the actual setdown curve.

1. Press **PROG** to access the Weld Head Controller **PROGRAM Screen 1 of 3**.
2. Select **WLD TIME** with the ◀▶ keys. The screen now shows a delay time of 10.0
3. Increase or decrease **WLD** time by 1 millisecond.



4. Press **RUN** ***three times*** to display the graphical setdown **RUN** screen.
5. Make another test weld.
6. Repeat Steps 1 through 5 to achieve co-incidence between the centers of the follow-up profile and the setdown trace.

   NOTE: If you get sparking between the electrodes and the workpieces, or within the workpieces, you need to adjust the Weld Head Controller weld force and follow-up force.

   As before, use the Weld Head Controller alphanumerical **PROGRAM 1 of 3** screen to make adjustments in the force and time until the sparking ceases
7. Repeat Steps 1 through 6 to optimize the weld.

Making Test Welds with Flat-to-Flat Stock

The approach to selecting weld values for this type of stock is the same as for round-to-flat or round-to-round stock. The only difference is in the appearance of the setdown trace in the Weld Head Controller graphical set-down screen, where the setdown trace will always be initially in the positive direction (above the .0000 setdown line). This is because, when weld energy is first applied to flat stock, expansion of the stock forces the electrode upward until melting and electrode penetration occurs.

NOTE: When insufficient weld energy is applied, an oscillation of the setdown trace about the .000 setdown line is typical.

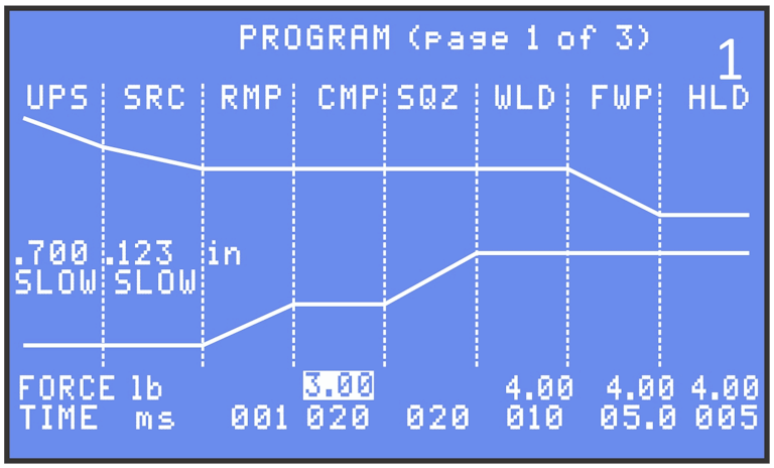
Just as for round stock welding applications, the relationship of the follow-up force profile to the electrode setdown trace is important. Their centers should be aligned as closely as possible.

Section IV. Program Screen Details

Press the **PROG** key to enter the program mode. Repeatedly pressing the **PROG** key cycles the display through three programming screens. Each screen is updated with the programming changes, regardless of which screen is used to enter the schedule information.

Weld Sequence PROGRAM Screen

This screen allows you to set all force, and time fields using the numerical keys. Use the ◄► keys to select the various fields. The setdown displacement alarms and the weld-to-displacement feature are not programmed on this screen; they are programmed in the setdown **PROGRAM 3 of 3** screen.

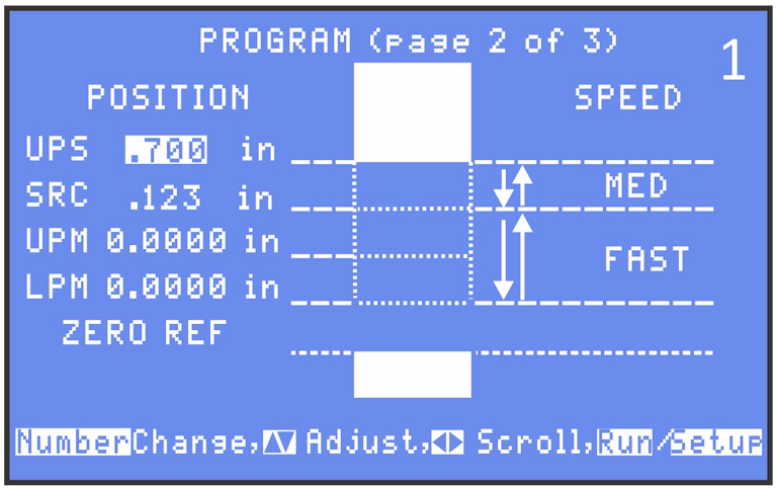


UPM, LPM, UPS, SRC, and SPEED Position PROGRAM Screen

This screen allows you to set the positions, speed, and material thickness limits. The **UPS** position is where the weld head is located while the SL-320A System is ready (in the run state).

Upon entering this screen, the weld head is positioned at the **UPS** position. Use the στ keys to raise or lower the weld head, or program the **UPS** position directly using the numerical keys. Since the weld head responds immediately to your actions, this screen is particularly helpful for fine tuning the **UPS** position.

The search (**SRC**) position is the location where the weld head stops on its way down to allow the user to accurately align the materials to be welded. Typically, this position is set up so the electrodes are just above the weld material.



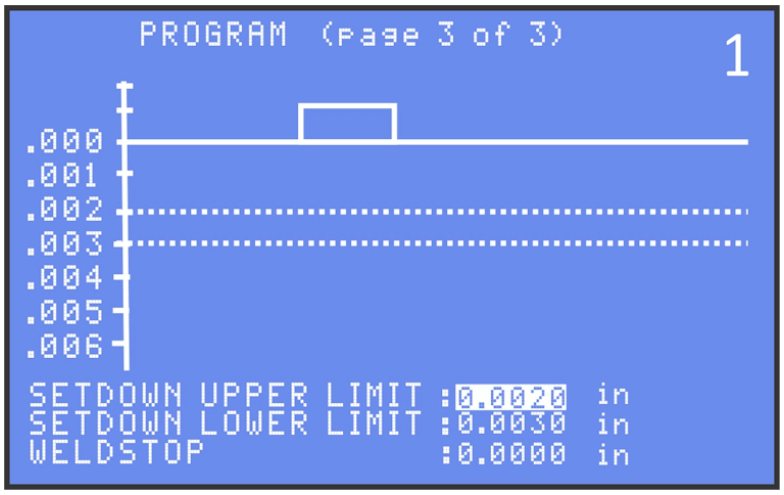
Upon selecting the **SRC** field the weld head slowly moves to the **SRC** position. Use the στ keys to lower the weld head, or program the **SRC** position directly using the numerical keys. Since the weld head responds immediately to your actions, this screen is particularly helpful for fine-tuning the **SRC** position.

The speeds for the approach and search can also be programmed on this screen. The speeds available for each are **FAST**, **MEDIUM**, and **SLOW**.

The **UPM** can be programmed on this screen. The **UPM** is the limit for the maximum thickness of the material being welded. The **LPM** can also be programmed on this screen. The **LPM** is the limit for the minimum thickness of the material being welded.

Setdown PROGRAM Screen

The term "setdown" (**STDN**) is the small electrode position displacement that occurs during the weld. This screen allows you to program upper and lower setdown displacement limits.
In addition, the weld-to-displacement feature (WELDSTOP) is programmed on this screen (refer to *Weld-to-Displacement Feature* at the end of this chapter). Press ◀▶to select the **UPPER** or **LOWER** setdown limit alarms, or the **WELD STOP** displacement for the weld-to-displacement feature.



Set the limit and stop line values with the στ keys or numeric keypad. Note that the **LOWER** setdown limit must be programmed less than the **UPPER** limit

A Closer Look at the RUN Screens

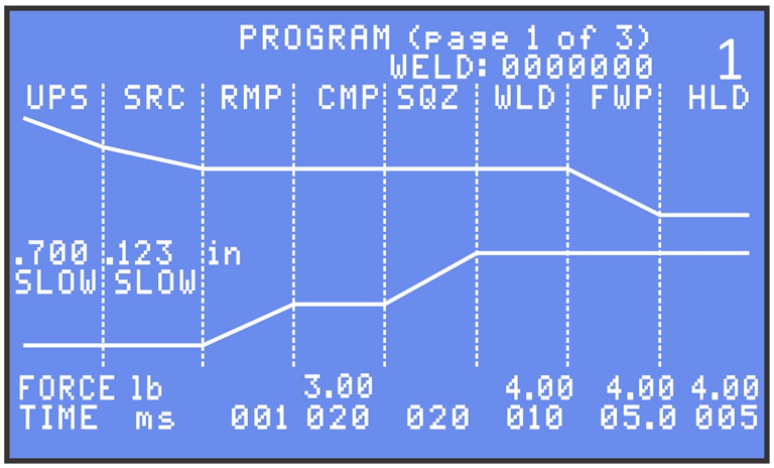
Press the **RUN** key to ensure that the Weld Head Controller is in the **RUN** sate. Now press the **RUN** key a few times. Notice that the display changes screens each time you press the **RUN** key. The **RUN** key alternates the display among three **RUN** screens:

- Main **RUN** Screen
- Graphical Force (force over time)
- Graphical Setdown (electrode position over time)

Main RUN Screen

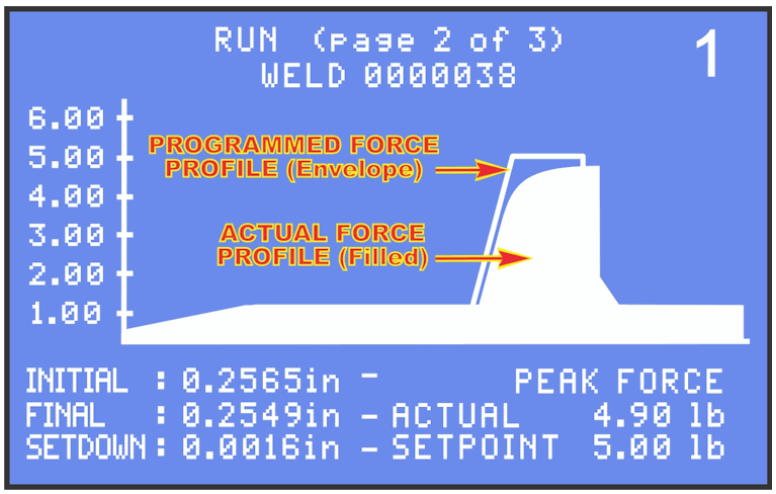
This screen displays the schedule number and all the programmed schedule information.

Other information such as **SCHEDULE** number, and cumulative **WELD** count are also displayed. The fields are defined in the following table after the graphical force run screen description.



Graphical Force RUN Screen

The graphical force **RUN** screen relates the programmed and actual force (vertical axis) with time (horizontal axis). The force profile shows the complete **WELD** time interval, including the **SQZ** time (force ramp-up) and the **FWP** force impulse.



The programmed force is shown as a line graph, and the actual force is shown as a "filled-in" graph after the weld cycle is repeated.
The force is shown on the vertical axis, and the time is represented on the horizontal axis, although no scale of the time is shown. After a weld cycle is completed, the peak **FWP** force is indicated in the upper right corner.

Cycle the weld head a few times. Notice that the actual force graph is redrawn each time.

NOTE: When a weld is aborted while the graphical RUN screen is displayed the line graph will only be filled in up to the time at which the weld was aborted. The partially filled in graph will not be displayed again once the screen changes.

Alphanumerical Screen Field Definitions

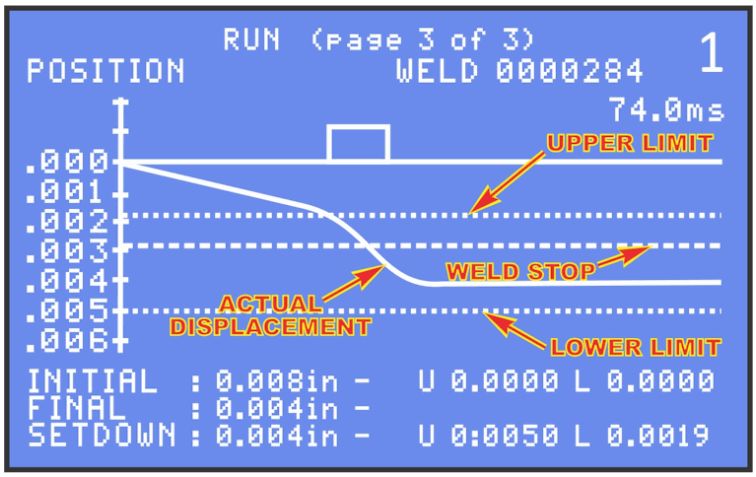
FIELD	FUNCTION
SCHEDULE: 000	Schedule number from 001 - 127. Use the **SCHED** key then σ τ keys or numerical keys to select a different schedule number when in the RUN state.
WELD: 0000000	Weld counter. Increments each time a weld is completed.
SPEED: UPS	Rate at which the weld head moves toward or away from the upstop position: FAST: 30 inches (76.2 cm)/second MED: 8 inches (20.3 cm)/second SLOW 1 inch (2.5 cm)/second
POSITION: UPS	Upstop position is relative to 0.000, where the electrodes touch each other.
SPEED: SRC	Rate at which the weld head moves between search position and where the electrode touches the weld material: FAST: 0.5 inches (12.7 mm)/second MED: 0.1 inches (2.5 mm)/second SLOW: 0.05 inches (1.3 mm)/second
POSITION: SRC	Search height position is relative to 0.000, where the electrodes touch each other.
TIME: SQZ	Time duration for force to build up to the WELD force.(50ms recommended)
TIME: WLD	Time interval from the start of the WELD period to application of follow-up force. The optimal programming of this parameter to achieve good welds is important. Refer to *The Importance of Follow-Up Force* in this chapter. The start signal to the Power Supply is asserted for this time period.
FORCE: WLD *	Force maintained for the duration of the WELD time, except for the interval during which the follow-up force is applied.
TIME: RMP	Ramp time over which the force rises from SRC to pre-weld CMP force
FORCE: CMP *	Compression force at which the parts will be squeezed together prior to the weld.
TIME: CMP	Time interval over which the compression force is applied
TIME: FWP	Time duration of follow-up force. The optimal programming of this parameter to achieve good welds is important. Refer to *The Importance of Follow-Up Force* in this chapter.
FORCE: FWP *	Follow-up force must be greater than or equal to WELD force.
TIME: HLD	Hold time at the end of the process between the end of Follow-up and the completion of the weld process

***NOTE:** Force accuracy of unit is only maintained if the weld head is calibrated in the same position as it is used. Weld Head is factory calibrated in the vertical position. This does not affect force repeatability.

Graphical Setdown RUN Screen

The graphical setdown **RUN** screen shows six categories of information:

- Follow-up (**FWP**) time profile.
- Actual electrode setdown into the workpieces.
- User programmed weld stop (setdown limit).
- User programmed lower limit.
- User programmed upper limit.
- Material thickness limits



Setdown upper and lower limits are shown on the graph by the dotted lines only if you have programmed them. If you have programmed the weld-to-displacement (weld stop) feature, the weld stop horizontal dashed line is shown intersecting the actual displacement graph at the exact displacement at which the Power Supply start signal is terminated. The displayed time is the total programmed **WLD, FWP,** and **HLD** time period.

The initial, final, and setdown displacement are shown at the bottom left of the screen. The total weld time (74ms in this example) is indicated in the upper right corner of the screen. The weld counter is shown at the top center of the screen.

Select each of these screens and exercise the weld head to see how the fields and graphs update during and after each weld cycle.

The MAIN MENU Screen

You set up the program options for the Weld Head Controller through a menu system, as presented on the **MAIN MENU** screen. The options are normally set up during installation, and they affect the operation of the system regardless of which schedule you select.

Like a tree with many branches, there are multiple menu levels. You access each new menu level by selecting an option using the numeric keypad.

```
< SETUP MENU >

1. OPTIONS
2. WELD COUNTER
3. COPY SCHEDULE
4. SYSTEM SECURITY
5. CALIBRATION
6. SET TO DEFAULTS
7. COMMUNICATION
8. I/O STATUS


Number Select an item, Run  /  Setup
```

Press the ▲ key to return to a previous menu level.

The OPTIONS 1 Menu

The Weld Head Controller makes several different system options available to you through two screens: **1** and **2**. Most of these programmed options allow you to modify how an external input, such as a foot switch, interfaces with the Weld Head Controller.

Output relay options allow you to interface the Weld Head Controller with an external computer or Programmable Logic Control (PLC).

```
< OPTIONS, page 1 of 2 >

1. FOOTSWITCH TYPE            :   LINEAR
2. FOOTSWITCH RESPONSE MODE   :   ABORT
3. END WELD BUZZER            :   OFF
4. BUZZER LOUDNESS            :   50%
5. SCREEN BRIGHTNESS          :   50%
6. DEBOUNCE TIME              :   30msec
7. FORCE UNITS                :   lb
8. POSITION UNITS             :   in
9. SET OUTPUT RELAYS

Number Select, ▼ Page, Run  /  Setup
```

From the **MAIN MENU** screen, select **OPTIONS**. The **OPTIONS 1** screen appears. Nine option items appear as shown.

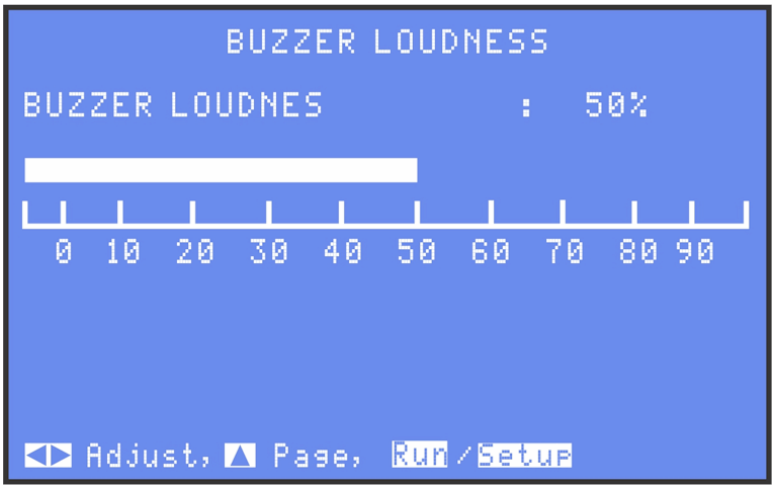
- **FOOTSWITCH TYPE:** Select **LINEAR, 2-LEVEL**, or **DIGITAL I/O**
- **FOOTSWITCH RESPONSE MODE:** Select **ABORT** or **LATCH**. This option controls how the Weld Head Controller interfaces with each footswitch type. The **ABORT** selection means the welding process is initiated by the closure of the initiation switch(es) and continues to its conclusion as long as the initiation switch(es) remain closed. If level 2 of the initiation switch(es) or the linear footswitch open during the welding process the welding process will terminate.

  The **ABORT** selection is preferred for human operators since it allows you to abort the welding process by releasing the footswitch. Use **LATCH** when controlling the Weld Head Controller with a host computer or PLC or you do not want a human operator to be able to abort a process after it has begun.

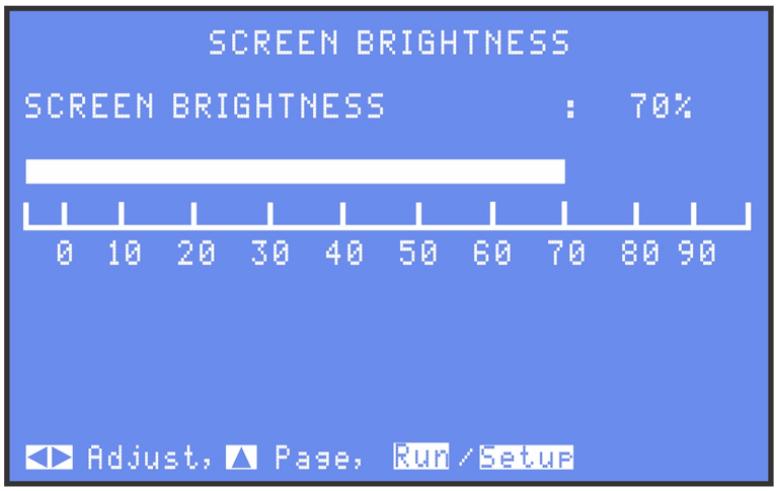
NOTE: If the weld is aborted between WLD-HLD periods the weld counter will be incremented. End of Weld alarm relay will not activate when weld is aborted.

- **END WELD BUZZER:** ON means that an audible signal will be given at the end of each weld process as your signal to release the foot pedal. Press the number 3 to select **ON** or **OFF**.

  Press **4** to get to the **BUZZER LOUDNESS screen**. Once in the buzzer loudness screen use the ◀▶ keys to adjust the buzzer loudness.



- **SCREEN BRIGHTNESS:** Once in the screen brightness screen use the ◀▶ keys to adjust the screen brightness.



- **DEBOUNCE TIME:** Single pole mechanical switch contacts 'bounce' when they close. The debounce time feature allows you to specify that the input switch must remain closed for 0, 10, 20, or 30 milliseconds before the weld period can be initiated to minimize false weld cycle initiation due to contact 'noise' on the switch. Press **the** 6 key to select 0, 10, 20, or 30 msec. This is valid for firing and other input switches.
- **FORCE UNITS:** Press the 7 key to select pounds, grams or Newtons as units of force measurement.
- **POSITION UNITS:** Press the 8 key to select inches or millimeters as units of position measurement.
- **SET OUTPUT RELAYS:** Press the number 9 key to get to the **OUTPUT RELAYS** screen. Once you are in the output relays screen press the number 1 through 4 key to select which relay you want to edit. When the relay number is selected, the edit screen for that relay comes up. In the relay edit screen select number 1 to choose either close or open. Select number 2 to bring up the list of conditions when you would like the relay to be activated. There are two pages of conditions, so you'll have to press the arrow down key to get to the second page of conditions.

To choose a condition, press the number key that corresponds to the condition. Use the arrow up key to bring you back up to the previous menus.

OPTIONS 2 Menu

From the main options page 1 of 2 press the ▼ key to get to the **OPTIONS page 2 of 2** screen.

```
          < OPTIONS (page 2 of 2) >
1. SELF-CHECK FORCE LIMIT     :   0.22lb
2. MATERIAL SEARCH FORCE      :   0.70lb
3. OBJECT DETECTION FORCE     :   0.55lb
4. INITIAL POSITION ABORT     :   OFF
5. DRESS SPEED                :   1

Number Select an item, Run  /  Setup
```

- **SELF-CHECK FORCE LIMIT:** With this option, you may limit the amount of force applied by the electrodes during calibration (self-check) so that the force will not bend miniature or angled electrodes.

  NOTE: This option does ***not*** apply to weld force or follow-up force. You should set the self-check force to 0.22 pounds for directly opposed electrodes. For angled electrodes, select the maximum force the electrodes can tolerate without bending.

- **MATERIAL SEARCH FORCE:** This is the force used to detect the weld material. You can set it from 0.22 to 0.77 lbs.

  NOTE: Also it is recommended that you set the material search force ***above the minimum force rating of the system which is 0.22Lbs or 100 grams***. False material sensing can occur at forces below this as a result of the acceleration of the motor and bearing friction.

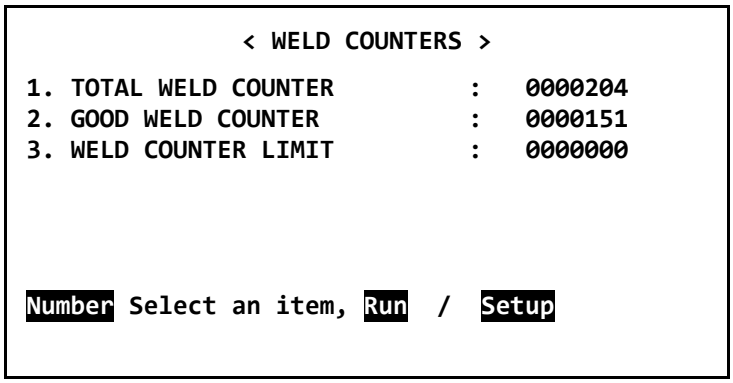
- **OBJECT DETECTION FORCE:** This is the maximum force to be used during the approach mode (from upstop to search position). You can set the force from 0.22 lbs. to 0.77 lbs. You want to set this high enough such that no false sensing occurs. False sensing will depend on the speed of the weld head during the approach. Fast speeds tend to cause a significant force change because of the acceleration and bearing friction.

  INITIAL POSITION ABORT: Press the number 4 key to turn initial position abort ON or OFF. The initial position abort will abort the weld process if the material thickness limits (**UPM** or **LPM**) are set and the material causes an out of limits condition.

- **DRESS SPEED:** Press the number 6 button to select between the dress speeds. The speed options are **1** through **9**. This sets the speed at which the weld head travels downward when in the dress mode.

WELD COUNTERS

The Weld Head Controller contains two weld counters that increment each time a weld is made in any weld schedule. The **TOTAL WELD COUNTER** increments whenever a weld is made or aborted (as long as the weld sequence has reached the **WELD** period). The **GOOD WELD COUNTER** increments whenever the weld head is actuated and the weld process is completed without an abort. The **WELD COUNTER LIMIT** when set to a numeric value greater than zero generates a message indicating the limit has been reached when the **TOTAL WELD COUNTER** reaches the limit.



From the **MAIN MENU** screen, select **WELD COUNTER**. The **WELD COUNTER** screen appears.

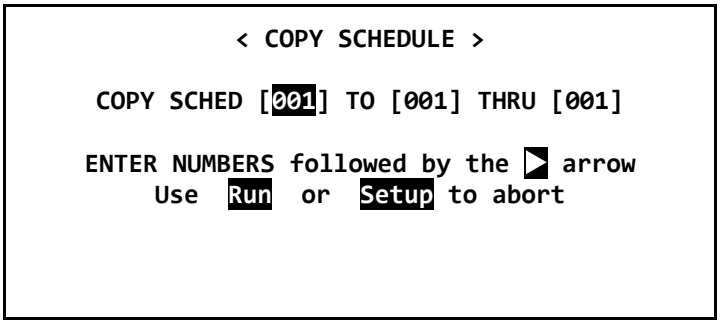
2. Select the weld option that you want to edit.
   - To zero, select the count number or limit, and press the **0** numerical key.
   - To another number, select the count number or limit, key in the change with the numerical keys.
3. Press **MENU** to return to the **MAIN MENU** screen, or press **RUN** to return to the weld graphical **RUN** screen.

COPY A SCHEDULE

All Weld Head Controller weld schedules can be easily copied from one weld schedule to another by using the **COPY A SCHEDULE** option listed under the **MAIN MENU**.

1. From the **MAIN MENU**, select **COPY SCHEDULE**. The **COPY SCHEDULE** Screen will appear

   With the numerical keys, key in the schedule to copy from and the schedule or schedules to copy to, such as **[001] THRU [002]** as shown on the right.



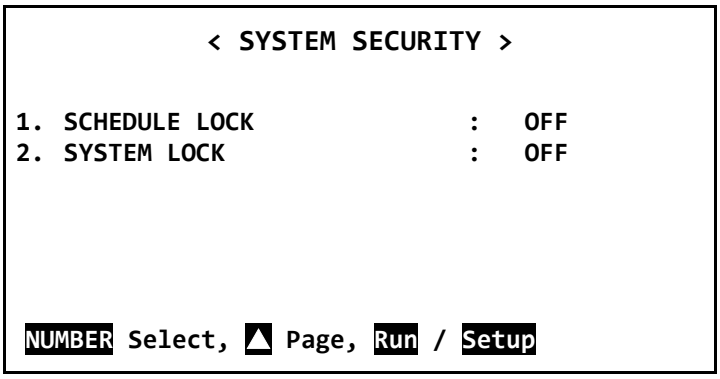
   NOTE: Schedule information previously stored in **Schedule 002** will be overwritten by the new information coming from the source schedule **001**.

2. Press ▶ to select **TO FIELD** or **THRU FIELD**. With the numerical keys, key in the number of the source schedule. For example, key in **12 THRU 15** as the source schedule. After the number for thru is entered, press the right arrow key again to initiate the copy. The setup menu will be displayed afterwards.
3. Press **RUN** to return to the weld graphical **RUN** screen.

SYSTEM SECURITY

All Weld Head Controller weld schedules and system settings can be protected from operator changes by programming the Weld Head Controller with a user defined protection code.

1. From the **MAIN MENU** screen, select **SYSTEM SECURITY**. The **SYSTEM SECURITY** screen will appear.
2. Press the number **1** key to select Schedule Lock or the number **2** key to select System Lock. The system will then take you to a screen where you can enter the security code.



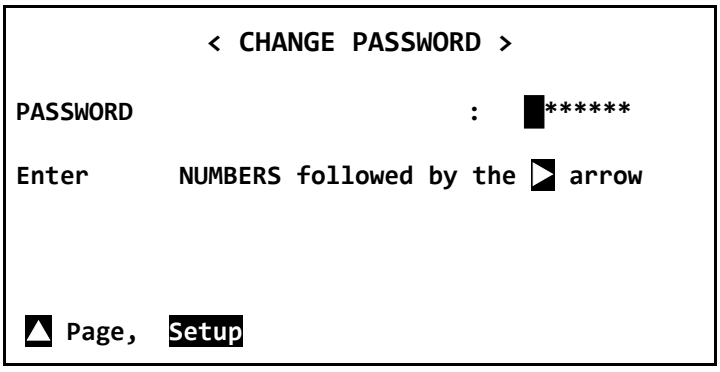
Schedule Lock prevents modification of schedules without the configured password. System Lock prevents modification of schedule profile (allows access to all schedules) and system settings without the configured password.

3. **CHANGE PASSWORD** screen will be displayed. Enter a number from 1-9999999. Press the right arrow key to set the password. The **SYSTEM SECURITY** page will be displayed. Schedule Lock and System Lock can now be set on or off by pressing **1** or **2**, respectively.
4. Press **RUN** to go back to the **RUN** screen.
5. To unlock the Weld Head Controller, return to the **SYSTEM SECURITY** screen and re-enter the security code. After entering the security code, the system security for the schedule will be turned off.

CHANGE PASSWORD

To change the password:

1. Enter the ***original*** password to turn the system security OFF.
2. Perform steps 2 and 3 above to enter a new password.

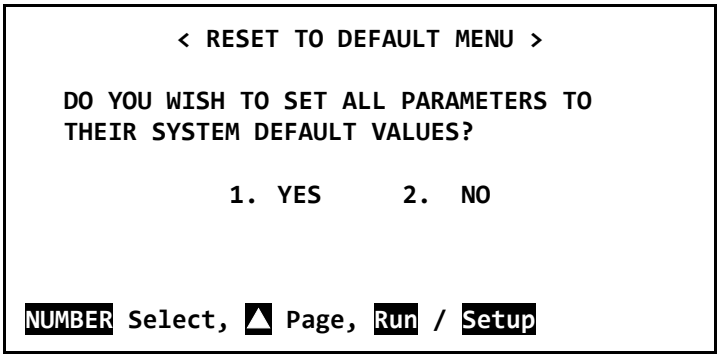


RESET DEFAULTS

The **RESET DEFAULTS** feature allows you to reset all system parameters and all weld schedules to their original factory default settings.

1. From the **SETUP MENU**, select **6. RESET TO DEFAULTS.** The **RESET DEFAULTS** screen will appear.
2. Select **1. YES** to reset system parameters.

   A message will appear indicating that factory defaults have been set.



Default System Parameters

SYSTEM PARAMETERS	DEFAULT
Screen Brightness	99%
End Weld Buzzer	Off
Dress Speed	5
Relays OPEN CONDITION	WHEN NOT ACTIVE
Footswitch Type	Linear
Self Check Force Limit	0.55 Lbs.
Object Detection Force	0.55 Lbs.
Weld Counters	Zero
Communication Role	Slave
Baud Rate	9600
RS232 ID Number	01
Tare Weight	Set automatically by system

SYSTEM PARAMETERS	DEFAULT
Footswitch Response Mode	Abort
Debounce Time	30ms
Force Units	lb.
Position Units	inch
Buzzer Loudness	50%
Material Search Force	0.55 Lbs.
Initial Position Abort	On
Weld Counter Limit	Zero
Measured Low Force	0.44Lbs.
Measured High Force	7.50 Lbs (> Rev E)
	4.50 Lbs. (≤ Rev E)

The Weld-to-Displacement Feature

Successfully using the weld-to-displacement feature requires some understanding of the timing relationship between the Power Supply and the Weld Head Controller. The discussion below assumes that the Weld Head Controller is connected to an Amada Weld Tech power supply. If you are not using an Amada Weld Tech power supply, refer to your power supply user's manual for specific instructions.

When the weld head reaches the **WELD** force, the firing switch solid state relay closes. This is the "start" signal to the Power Supply. The Power Supply starts within a couple of milliseconds, and the **FWP** force occurs later, exactly at the time set for **WLD** (Delay) milliseconds. You ***must*** set up the Power Supply properly so that the **FWP** force occurs at the right point in the weld cycle. Here is a check-list to ensure that the Power Supply and the Weld Head Controller are synchronized for the weld-to-displacement function (it assumes that the units are interconnected as described in *Chapter 2*.

ON THE WELDING POWER SUPPLY

Program the weld function and weld energy as follows:

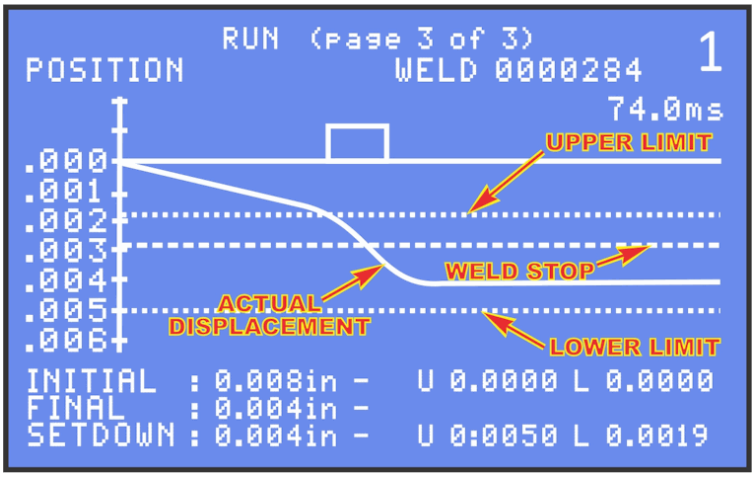
1. Set the switch debounce option to **0 ms**. This eliminates the time delay between receipt of the start signal to the time when the Power Supply actually delivers energy to the weld.
2. Set the footswitch abort option to **ON**. This allows the Weld Head Controller to shut the Power Supply **OFF** by disabling the start signal when the programmed displacement is reached.
3. Set the weld current to a low value. For example, try 100A.

ON THE WELD HEAD CONTROLLER

Program the profile for the weld as follows:

1. Access the graphical setdown **RUN** screen.
2. Try a weld.

   NOTE: The weld time that you program into the Weld Head Controller is the total time that the Power Supply energy will be supplied to the weld materials. Start out with short weld times and work up to the minimum time that a weld requires.



3. Gradually increase the **WELD** time and/or the Power Supply weld energy until you produce a satisfactory weld.
4. Note the appearance of the **SETDOWN** graph on the setdown **RUN** screen. The graph should not have abrupt changes in it, but rather a 'sideways S' shape as shown.

5. Set the WLD (Delay) time so that the **FWP** force impulse (the trapezoid on the top line) occurs just when the **SETDOWN** graph shows the welding materials just starting to melt (that is, the **SETDOWN** displacement just starts to change rapidly).
6. Experiment with **WELD** time, **WELD** force, **FWP** time, **FWP** force **WLD** (Delay) time, and Power Supply energy until you achieve the desired weld and setdown displacement.

   NOTE: Do ***not*** experiment with Power Supply time.
7. Access the graphical setdown **PROGRAM** screen and select the **WELD STOP** feature. Using the σ▼ keys, move the weld stop line to just above the final setdown line.
8. Increase the **WELD** time by 20 milliseconds. Now, the weld-to-displacement programming will shut off the Power Supply when the programmed setdown displacement is achieved.
9. Repeat the weld. The Power Supply should now shut OFF prior to the end of the **WELD** time programmed on the Weld Head Controller.
10. Experiment with the **WELD STOP** program to achieve consistently good welds with the desired setdown displacement.

The Importance of Follow-Up Force

The programmable follow-up force is the key to high performance and consistent weld quality achievable with the Weld Head System. Depending on the type of weld, the weld material melts or becomes plastic as the weld progresses, causing the force between the electrodes to diminish. Unless the weld head can quickly accelerate the electrode into the weld material during this crucial time period, material will be expelled from the material, producing a poor weld. The small movement of the electrodes during the course of the weld is called 'follow-up.' The ability to rapidly accelerate the electrodes during follow-up, thus maintaining force on the weld material and preventing expulsion, is a key performance measure of a weld head.

Conventional weld heads – whether pneumatic, pedal, hand, or cam operated – typically use a mechanical spring or pneumatic cylinder to develop the weld force. The maximum follow-up acceleration is limited by the moving weld head mass (including electrode, electrode holder, and output shaft) and the weld force. The relationship between follow-up acceleration, weld force, and moving mass follows Newton's first law of motion: Acceleration = force/mass. Since the moving mass is constant for a given weld head, the maximum follow-up acceleration is proportional to the weld head force. This means that for low force welds, or for welds that require a lot of follow-up acceleration (such as wire-to-foil or cross-wire welds), conventional weld heads have a fundamental limit to their follow-up performance.

The SL-320A Weld Head System, however, uses an electromagnetic linear actuator to develop the weld force. A user-programmed force impulse **FWP** accelerates the electrode into the material during the follow-up period. The resulting precise weld head movement outperforms any other weld head technology.

Use the following procedure as a starting point to set up the **FWP** force:

1. Start with default **WLD**, **FWP** force, and **FWP** time settings.
2. Use the graphical setdown **RUN** screen and **PROGRAM** screen to assist in fine-tuning the programming of the timing and magnitude of the follow-up force.
3. Make a few welds. Notice where the setdown displacement starts to change rapidly. This is the point where the weld materials start to melt. Adjust the WLD (Delay) to position the **FWP** impulse at this point.
4. If sparking or splashing occurs, increase both the **WLD** and **FWP** forces. To calculate the new **FWP** force, multiply 2.5 lbs./0.001 inch (44.6 kg/0.0254 mm) by the measured electrode displacement. Add this new constant to the weld force value. Use the combined total as the new **FWP** force.
5. For large **WLD** and **FWP** force operations, increase the **FWP** time to match the actual melting or setdown period as indicated by the 'S' shaped portion of the actual setdown graph.
6. Experiment with the **FWP** force, time duration, and delay time to optimize the weld.

CHAPTER 5
MAINTENANCE

Section I: Service Precautions

General Operator Safety

WARNINGS

- ***Always*** wear safety glasses any time you are operating the Weld Head.
- ***Never*** wear loose clothing or jewelry when operating the weld head. It could be caught in the mechanism.

Before operating the Weld Head, read this manual and the power supply manual. Particularly note the specific hazards associated with those components.

Section II: Operation Troubleshooting

Your SL-320A Low Force Weld Head system is designed with reliability as a top user priority. But, occasionally, you will 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

NOTE: It has been our experience that 99% of all weld head and 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** – The problem is transient, and you can correct it by re-calibrating the system or re-setting limits, for example.
- **HARD** – The problem is embedded in the system and some form of repair or upgrade will be needed.

In either case, built-in automatic self-test and self-calibration routines will bring up alarm messages on the display screen. These messages will usually let you know what action is required of you to correct the reason for the alarm. For a complete listing of the alarm messages, what they mean, and what to do about them, please refer to the following table.

Alarm Messages

ALARM MESSAGE	DESCRIPTION	CORRECTIVE ACTIONS
ACCESS DENIED! SCHEDULE LOCK ON	Schedules are protected, and all schedule data is locked if the schedule lock is turned ON in the system security. If the external schedule inputs on the back panel are active, then the schedule cannot be changed by the front panel schedule button. However, the active schedule data can still be changed.	Unlock the schedule as follows: 1. Press SETUP, access the SYSTEM SECURITY selection. 2. Enter your security code and change SCHEDULE LOCK to OFF. 3. If the external schedule inputs are active, then clear the schedule inputs on the back panel and press the SCHED key on the front panel to change the schedule number.
ACCESS DENIED! SYSTEM LOCK ON	System is protected and all system data is locked.	Unlock the schedule as follows: 1. Press SETUP, access the SYSTEM SECURITY selection. 2. Enter your security code and change SYSTEM LOCK to OFF.
EMERGENCY STOP ACTIVATED	An Emergency Stop signal was received on the CONTROL SIGNALS connector. The Weld Head Controller cannot operate in the RUN state.	Remove the emergency stop signal and Press RUN to continue.
SEARCH POSITION NOT REACHED	Electrode encountered an obstacle before it reached the programmed search position.	Remove the obstacle.
NO WELD MATERIAL / DOWNSTOP OUT OF RANGE	Weld Head output shaft bottoms out before the upper electrode reaches the lower electrode.	Adjust the position of the lower electrode, using the centering bar displayed in the DRESS mode. Set the RUN/DRESS switch to RUN. The Weld Head Controller will automatically recalibrate the downstop position.
SETDOWN OUT OF LIMITS HIGH	Measured setdown is greater than the programmed upper limit.	1. Reprogram a higher upper setdown limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.

ALARM MESSAGE	DESCRIPTION	CORRECTIVE ACTIONS
SETDOWN OUT OF LIMITS LOW	Measured setdown is less than the programmed lower limit.	1. Reprogram a lower lower setdown limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.
ILLEGAL SECURITY CODE ENTERED	The system is security-protected against unauthorized entry and you have attempted to enter an unauthorized security code.	Enter the original code used to protect the system.
INITIAL POSITION OUT OF LIMITS HIGH	Measured initial position is less than the programmed upper limit.	1. Reprogram a higher upper initial position limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.
INITIAL POSITION OUT OF LIMITS LOW	Measured initial position is less than the programmed lower limit.	1. Reprogram a higher lower initial position limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.
INVALID DATA – VERIFY SRC < UPS	Search position entered was greater than the Upstop position, or the Upstop position entered was lower than the search position.	Verify that Search position is lower than the Upstop position
PROCESS INHIBIT	Process Inhibit input is set. This disables all footswitch, dress, and park functions.	Clear the Process Inhibit input.
WELD ABORTED: INITIAL THICKNESS	Initial thickness is out of limits.	Adjust initial position limits or press SETUP and go to OPTIONS (page 2) to turn off INITIAL POSITION ABORT.
WELD COUNT LIMIT REACHED	The weld counter has exceeded the weld count limit.	Press SETUP then select WELD COUNTERS to either clear the TOTAL WELD COUNTE or to increase the WELD COUNTER LIMIT.
WELD ABORTED: FOOT SWITCH OPEN	The footswitch response mode is set for abort and the initiation switch(es) opened during weld **HOLD** period	If the weld was not intended to be aborted check footswitch wiring and/or confirm that operator is keeping foot switch depressed through the end of the weld process

ALARM MESSAGE	DESCRIPTION	CORRECTIVE ACTIONS
INVALID DATA – VERIFY UPPER LIM > LOWER LIM	The upper limit value is less than or equal to the lower limit.	Change the limits
INVALID DATA – SRC > UPM > LPM	Search position isn't greater than initial Upper Position Monitor limit	Ensure that the search position is above UPM and LPM
INVALID DATA – SRC > LPM	Search position isn't greater than initial Lower Position Monitor limit	Ensure that the search position is above LPM initial position limit
DRESS MODE TIME EXCEEDED	The system has been left in dress mode for more than two minutes	Dress the electrodes and exit dress mode before the two minute timer expires
ACCESS DENIED! REMOTE SCHEDULE SELECTED	The user has attempted to change the schedule while the system is in remote schedule control mode.	Release the remote schedule control and attempt to change the schedule again
UPSTOP CHANGED	The electrode position has changed since the last power cycle and a smaller weld head actuator travel is available than was available the last time the power was cycled. The system will set the upstop to the highest attainable value if it can't reach the previous upstop position and actuator travel will be decreased.	Verify the electrodes are correctly installed and not moving. This error is most common when the bottom electrode or tooling reference surface moves "up" towards the electrode(s) mounted on the weld head
SRC POSITION TOO HIGH – PRESS PRGM 2X TO SET	The search position is too high with respect to the upstop. Pressing the program button twice will set the search position to the highest attainable position.	Lower the search position setting
NO WELD HEAD DETECTED	The weld head is not plugged into the weld head controller	Verify cables are connected per this manual
POWER LOSS DETECTED – SHUTTING DOWN	The system has detected a power loss.	Verify power supplied to unit is of appropriate voltage and capable of handling required current and cycle power switch.

Section III: Operator Service Procedures

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 are needing to increase weld current to maintain the same welding quality, the electrode tip has probably increased in surface area (that is, mushroomed), effectively decreasing weld resistance. Try replacing the electrode.

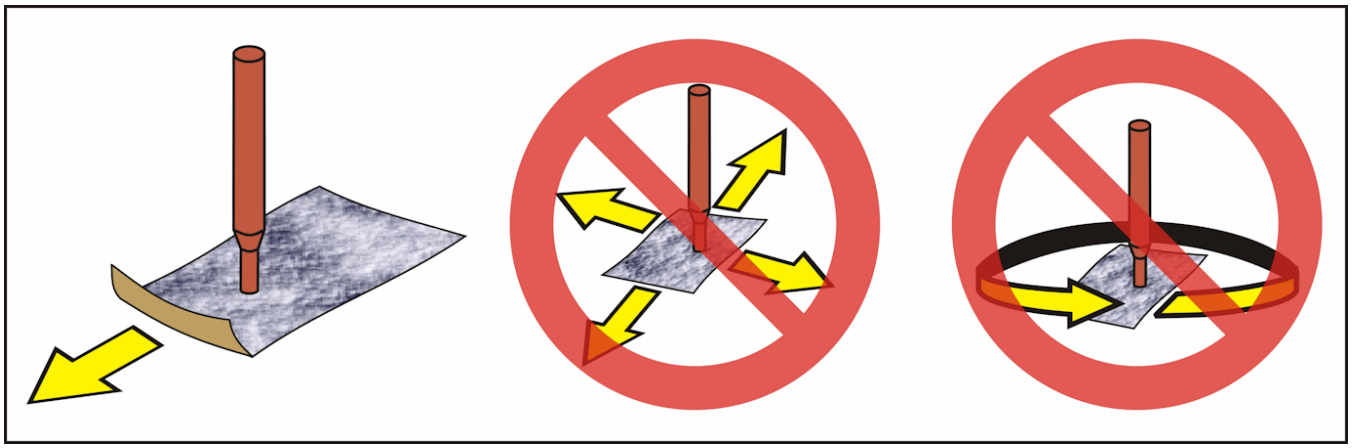


Figure 4-1. Electrode Tip Surface Maintenance

The rough surface of a worn electrode tip tends to stick to the workpieces. So, periodic tip resurfacing (dressing) is required to remove pitting, oxides and welding debris from the electrode. You should limit cleaning of an electrode tip on the production line to using a #400-600 grit electrode polishing disk.

If you must clean a badly damaged tip with a file, be sure that the electrode surfaces are maintained parallel, and use a polishing disk after filing to ensure that the electrode tip 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.

Section IV: Repair Service

Parts Replacement

CAUTION

Only authorized repair personnel should replace parts. Removal of the unit covers by unauthorized personnel could be hazardous and may void the warranty.

Repair Parts List

AMADA WELD TECH P/N	DESCRIPTION	APPLICATION
4-39422-01	Flexure	4-39487-01 Unibond, 4-39487-02 Microjoin, 4-39486-01 Unitip, 4-39485-xx Opposed 50mm Offset, and 4-39484-xx Opposed In-Line
4-39479-01	Unibond Electrode Holder	4-39487-01 Unibond
4-39479-02	Microjoin Electrode Holder	4-39487-02 Microjoin
4-30381-01	Insulator	4-39487-01 Unibond, 4-39487-02 Microjoin
4-39475-01	Adapter, Flexure RHS	4-39487-01 Unibond, 4-39487-02 Microjoin
4-39476-01	Adapter, Flexure LHS	4-39487-01 Unibond, 4-39487-02 Microjoin
4-39477-01	Collar, Clamping	4-39487-01 Unibond, 4-39487-02 Microjoin
4-39478-01	Knob, Adj, Elec Holder	4-39487-01 Unibond, 4-39487-02 Microjoin
4-39150-01	Adapter Upper Unitip Holder	39486-01 Unitip
4-39148-01	Holder Electrode Unitip RHS	39486-01 Unitip
4-39147-01	Holder Electrode Unitip LHS	39486-01 Unitip
4-31995-01	Bearing Set Modified	39486-01 Unitip
4-39149-01	Block, Insulator, LFWH	39486-01 Unitip
4-39464-01	Holder Upper Opposed In-Line	4-39485-xx Opposed 50mm Offset, and 4-39484-xx Opposed In-Line
4-39473-01	Adapter Upper Opposed 50mm Offset	4-39485-xx Opposed 50mm Offset
4-39463-01	Adapter, Upper Opposed In-Line	4-39484-xx Opposed In-Line

AMADA WELD TECH P/N	DESCRIPTION	APPLICATION
4-30365-01	Sleeve, Elec Holder	4-39487-01 Unibond, 4-39487-02 Microjoin, 4-39486-01 Unitip, 4-39485-xx Opposed 50mm offset, and 4-39484-xx Opposed In-Line

Technical Assistance

If you need further technical assistance, please contact either your authorized service agent or Amada Weld Tech Customer Service at the number provided in **CONTACT US** in the front of this manual.

Section V. Calibration

Equipment Required

- An NIST traceable force gauge in the 5-10 lb range with sufficient force accuracy to resolve ±0.01 lb or better.

WARNING

Make sure that there is no weld power supply hooked up to the system when this procedure is being done. If there is a power supply hooked up, make sure that it is powered off, or that the **WELD/NO WELD** switch is set to **NO WELD**.

Failure to do this may cause the load cell to have weld current running through it which can cause serious burns to the user or damage the load cell.

Preliminary Setup

Set the **POWER** switch to the **ON** position and allow the Weld Head Controller and all test equipment to warm up for 15 minutes prior to calibrating the system.

NOTE: The unit is calibrated with the weld head oriented vertically. If the weld head is to be oriented horizontally in production, a factory HIGH/LOW recalibration in this orientation is required to assure that the low end of the force range remains fully within the stated specifications. Once recalibrated for horizontal operation, a subsequent recalibration is required if the weld head is returned to a vertical orientation.

Procedure

1. From the **SETUP MENU** press **5. CALIBRATION**.
2. In the calibration menu check that the **HIGH FORCE SETPOINT,** and **MEASURED HIGH FORCE** are 4.50 lbs (by default they should be 4.50 lbs).

   In the calibration menu check that the **LOW FORCE SETPOINT** and **MEASURED LOW FORCE** are 0.44 lbs (by default they should be 0.44 lbs).
3. Hold the load cell in between the lower and upper electrodes, with the load cell resting centered on the lower electrode. Make sure that the up stop and search positions are set such that the upper electrode clears the load cell at the up stop and search positions.

   In the **CALIBRATION** screen, select **APPLY HIGH FORCE**, and initiate a weld by pressing either the 2 position footswitch or linear footswitch. Look at the force reading on the Load Cell readout. If

the force is within the calibrated range of 4.50 lbs +/-0.01 lbs, then continue to Step 6. If ***not*** select **MEASURED HIGH FORCE** and enter the force that was measured.

4. Repeat **Step 3** until the force is 4.50 lbs +/-0.01lbs
5. In the **CALIBRATION** screen, select **APPLY LOW FORCE** and initiate a weld by pressing either the 2 position footswitch or linear footswitch. Look at the force reading on the Load Cell readout.

   If the force is 0.44 lbs +/-0.01 lbs then continue to **Step 7**. If the force is outside of the calibrated range then select menu option **MEASURED LOW FORCE** and enter the force that was measured.

   The lowest force that can be entered for measured is 0.3 lbs. If the force is measured by the load cell as 0 lbs, go ahead and enter 0.3 lbs for the measured force. If the next measurement taken is still below 0.3 lbs, then enter 0.4 lbs as the measured force. The way the current software works, the measured force entered has to be ***different*** than the previous measured force entered in order for the system to adjust the calibration.

   Repeat until 0.44 lbs +/-0.01 lbs is achieved, then move on to the next step.

   NOTE: Programmable force range

   Measured Low Force:

   Min 0.3 lb, Max 0.55 lb

   Measured High Force:

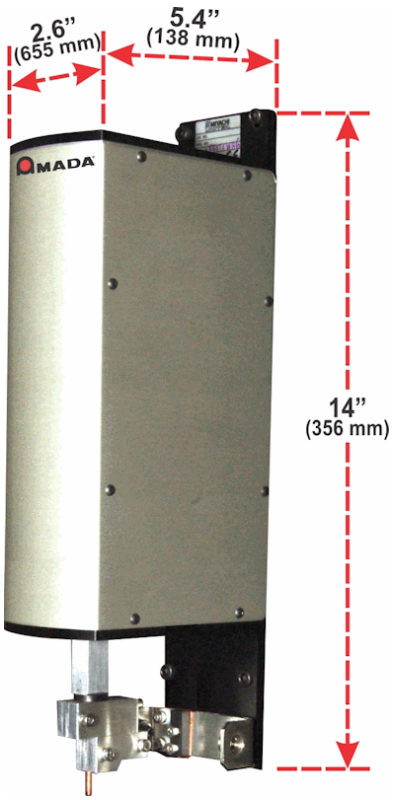
   Min 4.00 lb, Max 5.00 lb
6. Exit the calibration screen by pressing the **RUN** button. Calibration data is saved.
7. Turn the Controller power OFF, then ON, and repeat **Steps 1** through **Step 6** again to re-check and recalibrate (if needed) the forces at both levels (4.50 lbs and 0.44 lbs).

   NOTE: Because the high force calibration and low force calibration will affect each other, these values may have to be fine-tuned to achieve the calibration at both high and low forces. The high force may have to be calibrated slightly off from the desired force so that when the low force is calibrated, the high force will be offset enough to achieve the desired high force.

   Example: The high force may have to be calibrated slightly more or less than 4.50 lbs, (ie. 4.47 or 4.53 lbs) so that when the low force calibration is performed it will shift the high force calibration to 4.50 lbs.

APPENDIX A
TECHNICAL SPECIFICATIONS

Dimensions & Weight

Item	Description
Controller **Weight:** **18.5 lbs (8.4 kg)**	
Weld Head **Weight:** **8.0 lbs (3.6 kg)**	

APPENDIX A: SPECIFICATIONS

SL-320A Electronic Control

Item		Description
Line Voltage Input		85-264 VAC, 50\60hz, Single Phase
Operating Environment		5 – 40 °C, 10 - 95% Relative Humidity non condensing
WELD	**Ramp Period**	1 – 999ms, 1ms step
	Compress Period	0-500ms, 1ms step
	Squeeze Period	1-999ms, 1ms step
	Weld Period	2-700ms, 1ms step
	Follow-Up Period	0-99.9ms, 0.1ms step
	Hold Period	0-999ms, 1ms step
Upstop Position		0.15-25.3mm (0.006-0.996in)
Search Position		0.13-25.2mm (0.005-0.995in)
Graphical Run Screens		Graphical display of weld schedule, force profile with result, and initial, final, and setdown results.
Object Detection		User settable force which detects presence of objects in electrode path between upstop and search positions and will automatically return electrode back to upstop position.
Weld Schedules		127 schedules each with 8 user programmable process steps.
Run/Dress Modes		Provides ability to easily dress electrodes then automatically recalibrate closed position of electrode tips.

Control I/O

Item	Description
Footswitch Inputs	Process initial by 2 position or linear footswitch. For automation applications, apply 0 – 5VDC at linear footswitch input.
Digital Inputs	Schedule select, dress, reset, process inhibit, park, start weld 1 and 2: 24VDC inputs, 5 mA, hardware selectable for positive or negative logic.
Digital Outputs	Schedule select, alarm, in process, parked, acknowledgement, ready: 30 VAC or VDC 0.5 amps, optically isolated solid state relays
Programmable Relay Outputs	4 Relays, Contact rating: 0.5 amps at 30 VAC or 30 VDC maximum
Fire Switch Output	Output for initiating power supply
Weld to Displacement (power supply cutoff) Output	30 VAC or VDC 0.5 amps, optically isolated solid state relays
Valve Output	0.5 amp at 24 VDC
Emergency Stop	
Force Output	Analog output proportional to force of last weld when requested with RS-232 command.
Position Output	Quadrature output
RS-232	Schedule read/write, status read, data output

SL-321A, SL-322A, and SL-323A Weld Heads

Item	Description
Stroke (Maximum) mm (inches)	25.3 (0.996”)
Force (Maximum) grams (lbs)	3520 (7.76) Follow-up Only
Force (Weld) grams (lbs)	200 -3175 (0.44 – 7.0)
Force Rating (continuous) grams (lbs)	1100 (2.42)
Force Linearity over entire stroke (15 °C temperature variation)	+/- 3% or +/- 20 grams whichever is greater.
Force Response Time	Assuming no shaft movement, the rise time going from 0 gms force to a step input of 3200 grams (7.0 lbs) is 1 msec maximum.
Slew Rate (Maximum)	75 cm/sec (30 in/sec)
Operating Environment	5 – 40° C

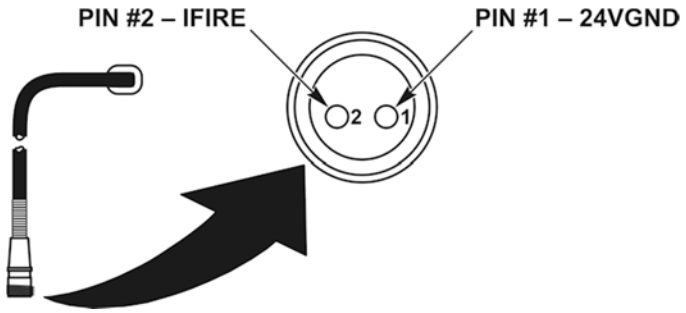
APPENDIX B
ELECTRICAL AND DATA CONNECTIONS

Introduction

This Appendix describes the electrical and data connectors located on the rear panel of the Controller. 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 Controller, starting at the top left.

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

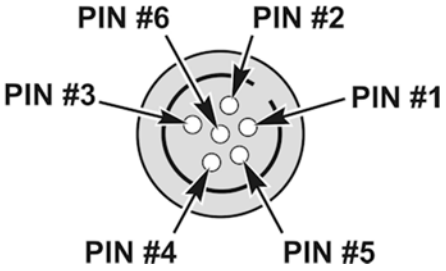
Firing Switch Cable Output



FIRING SWITCH CONNECTOR SPECIFICATIONS						
PIN NO.	SIGNAL		MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS
	NAME	TYPE				
1	Firing Switch -	Digital	SGND	20mA	--	Firing Switch signal ground.
2	Firing Switch +	Digital	+24V	10mA	I	Firing Switch normally open.
SHIELD	CGND	--	CGND	--	--	Chassis ground.

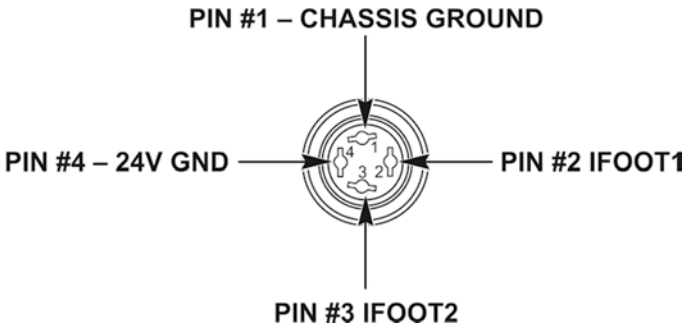
NOTE: In addition to the debounce time, there is a delay of no greater than 2.5ms before the start signal is recognized by the Controller.

Linear Foot Switch Input



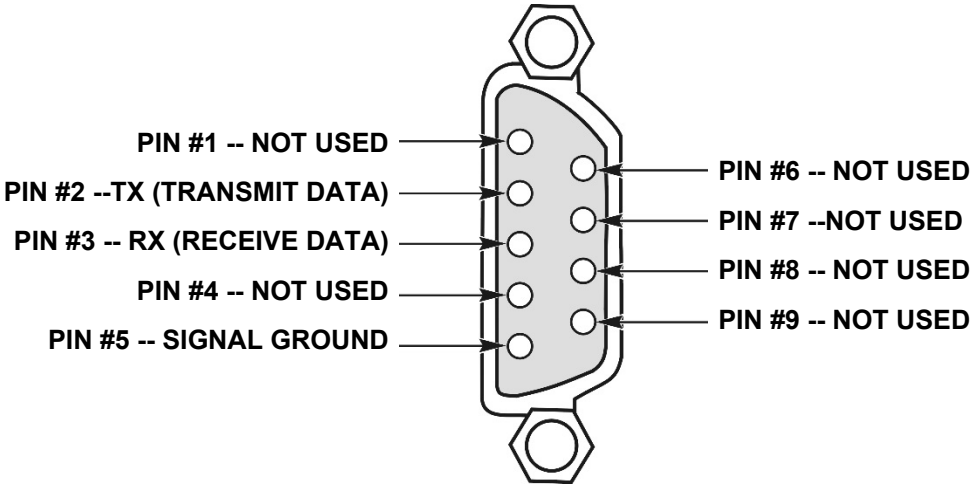
LINEAR FOOT SWITCH INPUT CONNECTOR				
PIN NO.	SIGNAL		I/O	COMMENTS
	NAME	TYPE		
1	Potentiometer 1	Analog	I	+5 V
2	Potentiometer 1	Analog	I	Position
3	Potentiometer 1	Analog	I	Ground
4	Ground	Analog	I	Chassis Ground
5	Not connected			
6	Not connected			

Two Position Foot Switch Input



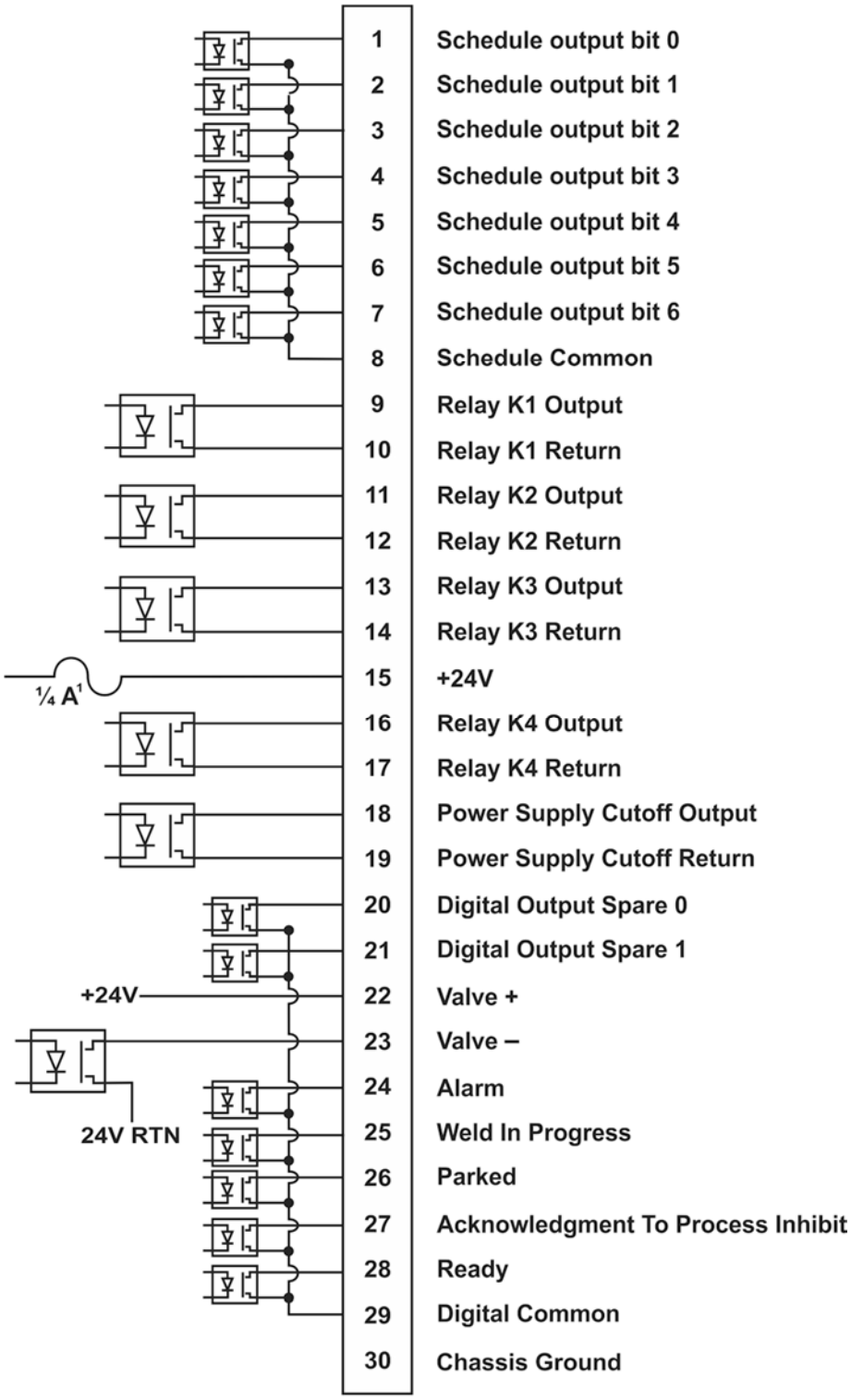
FOOT SWITCH CONNECTOR SPECIFICATIONS						
PIN NO.	SIGNAL		VOLTAGE	MAX CURRENT	I/O	COMMENTS
	NAME	TYPE				
1	CGND	--	--	--	--	Chassis ground
2	IFOOT1	Digital	+5V	10mA	I	Foot switch SW1 (Level 1) normally open
3	IFOOT2	Digital	+5V	10mA	I	Foot switch SW2 (Level 2) normally open
4	Input Common F1/F2	Digital	SGND	20mA	I	Foot switch signal ground

RS-232



RS-232 CONNECTOR SPECIFICATIONS		
PIN NO.	**DESCRIPTION**	**PIN TYPE**
1	Not Used	
2	TX (Transmit Data)	RS-232 Driver
3	RX (Receive Data)	RS-232 Receiver
4	Not Used	
5	Signal Ground	Analog Ground (ISOGND1)
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	

Digital Outputs – Pins 1-15 on J1A and 16-20 on J1B

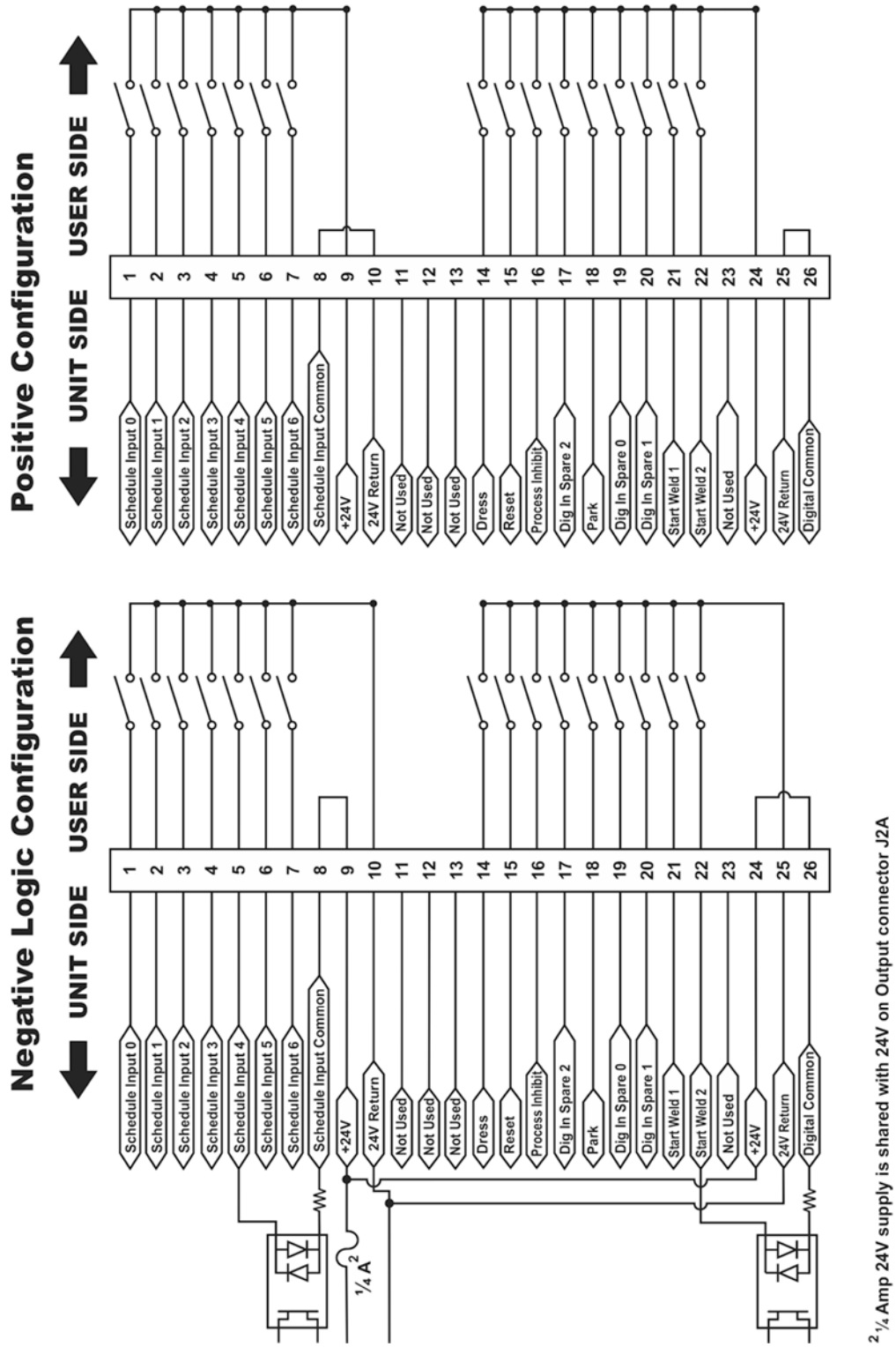


[1] ¼ Amp 24V supply is shared with 24V on Input connector J1B

DIGITAL OUTPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS						
PIN #	**NAME**	**I/O**	**VOLTAGE (Max.)**	**CURRENT (MAX.)**	**SIGNAL TYPE**	**COMMENTS**
J1A-1	Binary 0	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A-2	Binary 1	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -3	Binary 2	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -4	Binary 3	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -5	Binary 4	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -6	Binary 5	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -7	Binary 6	O	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J1A -8	Binary Common	O			voltage signal	Binary Schedule Common for pins 1, 2, 3, 4, 5, 6, 7
J1A -9	RELAY1P	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 1 Positive
J1A -10	RELAY1N	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 1 Negative
J1A -11	RELAY2P	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 2 Positive
J1A -12	RELAY2N	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 2 Negative
J1A -13	RELAY3P	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 3 Positive
J1A -14	RELAY3N	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 3 Negative
J1A -15	+24V_FUSED		+24V_FUSED	0.5 A		
J1A -16	RELAY4P	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 4 Positive
J1B-17	RELAY4N	O	30Vac OR 30Vdc	0.5 A	relay contact	Relay output 4 Negative
J1B-18	Power Supply Cutoff +	O	30Vac OR 30Vdc	0.5 A	relay contact	Power Cutoff Positive
J1B-19	Power Supply Cutoff -	O	30Vac OR 30Vdc	0.5 A	relay contact	Power Cutoff Negative
J1B-20	Dig Out Spare 0	O	30Vac OR 30Vdc	0.5 A	relay contact	spare
J1B-21	Dig Out Spare 1	O	30Vac OR 30Vdc	0.5 A	relay contact	spare
J1B-22	Valve +	O	24V dc	0.5 A	voltage signal	Valve Driver +
J1B-23	Valve -	O			voltage signal return	Valve Driver -
J1B-24	Alarm	O	30Vac OR 30Vdc	0.5 A	relay contact	Alarm output
J1B-25	Weld in Process	O	30Vac OR 30Vdc	0.5 A	relay contact	Weld In Process output
J1B-26	Parked	O	30Vac OR 30Vdc	0.5 A	relay contact	Parked output
J1B-27	ACK to Process Inhibit	O	30Vac OR 30Vdc	0.5 A	relay contact	ACK output

DIGITAL OUTPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS						
PIN #	**NAME**	**I/O**	**VOLTAGE (Max.)**	**CURRENT (MAX.)**	**SIGNAL TYPE**	**COMMENTS**
J1B-28	Ready	O	30Vac OR 30Vdc	0.5 A	relay contact	Ready output
J1B-29	Digital Common	O				Common for pins 20, 21, 24, 25, 26, 27, 28
J1B-30	Chassis Ground	O				

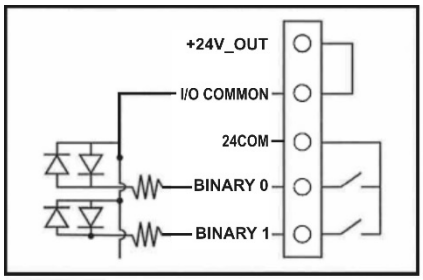
Digital Inputs Pins 1 to 13 on J2A and Pins 14 to 26 on J2B



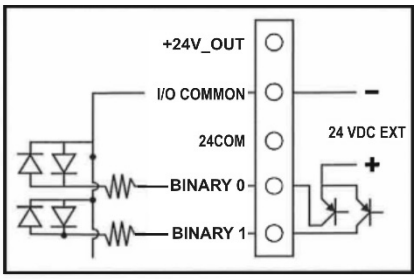
DIGITAL INPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS						
PIN #	**NAME**	**I/O**	**VOLTAGE (Max.)**	**CURRENT (MAX.)**	**SIGNAL TYPE**	**COMMENTS**
J2A-1	Binary 0	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -2	Binary 1	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -3	Binary 2	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -4	Binary 3	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -5	Binary 4	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -6	Binary 5	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -7	Binary 6	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Inputs
J2A -8	Binary Common	I	+ 24V dc	5 mA	voltage signal	Binary Schedule Common for pins 1, 2, 3, 4, 5, 6, 7
J2A -9	+24V	I			24V I/O DC Power Supply	Provide input circuit excitation for Binary 0 to Binary 6
J2A -10	24V Return	I			24V I/O DC Power Supply	Provide input circuit excitation for Binary 0 to Binary 6
J2A -11	Not used	I				
J2A -12	Not used	I				
J2A -13	Not used	I				
J2B -14	Dress Input	I	+ 24V dc	5 mA	voltage signal	Dress input
J2B -15	Reset	I	+ 24V dc	5 mA	voltage signal	Reset input
J2B -16	Process Inhibit	I	+ 24V dc	5 mA	voltage signal	Process and movement inhibit
J2B-17	Dig In Spare 2	I	+ 24V dc	5 mA	voltage signal	Spare 2 input
J2B-18	Park	I	+ 24V dc	5 mA	voltage signal	Move to park position
J2B-19	Dress Up/Down	I	+ 24V dc	5 mA	voltage signal	Dress Up/Down input
J2B-20	Dig In Spare 1	I	+ 24V dc	5 mA	voltage signal	Spare 1 input
J2B-21	Start Weld 1	I	+ 24V dc	5 mA	voltage signal	Start Weld 1 input (FS1)
J2B-22	Start Weld 2	I	+ 24V dc	5 mA	voltage signal	Start Weld 2 input (FS2)
J2B-23	Not used					
J2B-24	+24V	I			24V I/O DC Power Supply	Provide input circuit excitation for J1B-14 through J1B1-22

DIGITAL INPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS						
PIN #	**NAME**	**I/O**	**VOLTAGE (Max.)**	**CURRENT (MAX.)**	**SIGNAL TYPE**	**COMMENTS**
J2B-25	24 V Return	I			24V I/O DC Power Supply	Provide input circuit excitation for J1B-14 through J1B1-22
J2B-26	Digital Common					

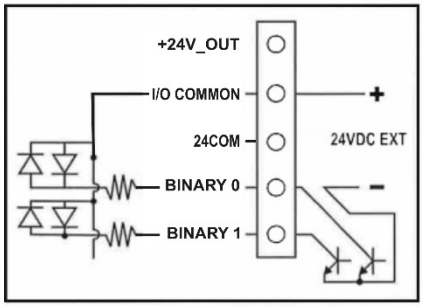
Configuration for Common Input Connections:



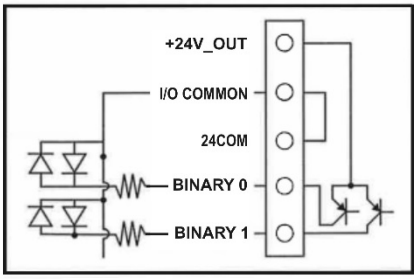
DRY CONTACT INPUT



COMMON POSITIVE INPUT
(External Power)



COMMON NEGATIVE INPUT
(External Power)

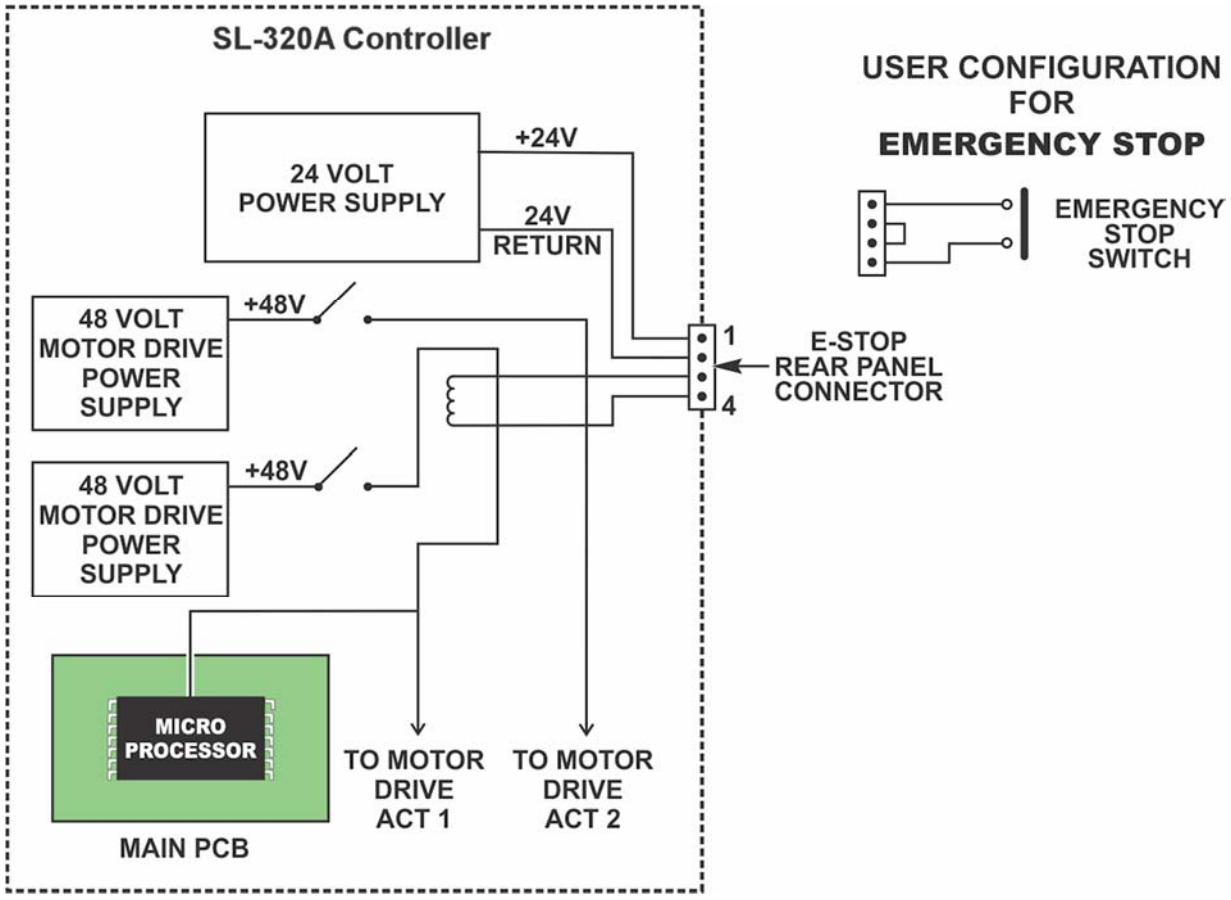


COMMON POSITIVE INPUT
(Internal Power)

Analog Outputs

I/O SIGNAL INTERFACE A CONNECTOR SPECIFICATIONS						
PIN #	**NAME**	**I/O**	**VOLTAGE (Max.)**	**CURRENT (MAX.)**	**SIGNAL TYPE**	**COMMENTS**
J3-1	ISO Force 1	O	0 – 10 VDC	10mA	voltage signal	For unit diagnostic purposes only.
J3-2	ISO Position 1	O	Logic level 5V quadrature outputs	10mA	voltage signal	Actuator 1 Position
J3-3	Ground	O			voltage signal	Ground
J3-4	Not used	O	0 – 10 VDC	10mA	voltage signal	Do not make any connections to this pin
J3-5	Not used	O	0 – 10 VDC	10mA	voltage signal	Do not make any connections to this pin
J3-6	Not used	O				Do not make any connections to this pin

Emergency Stop Connections



Emergency Stop Connector (Rear Panel)		
PIN NO.	**DESCRIPTION**	**PIN TYPE**
1	+24V	24V DC Power Supply
2	24V Return	24V DC Power Supply
3	Remote Emergency Stop A Input	EMO Switch rating 100mA minimum
4	Remote Emergency Stop B input	EMO Switch rating 100mA minimum

EMO Mating Plug

CAUTION

You should evaluate your EMERGENCY STOP requirements based on your application needs and local regulations.

A connector is included in the Ship Kit supplied with the Controller. It should be attached to the green 4-pin connector on the rear panel labeled **EMO SWITCH** during installation. Opening this connection will cause the Controller to initiate an Emergency Stop. The display will show **EMERGENCY STOP – OPERATOR ACTIVATED** and a beep will sound. An Emergency Stop will disable all power outputs.

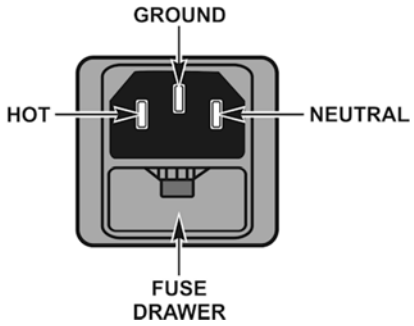
To reset the condition first the **EMO SWITCH** connection must be closed. Once switch is closed and the Alarm output goes off it is possible to reset the unit. To do so the **RUN** key must be pushed on the front panel or the **RESET DIGITAL INPUT** must be set to **ACTIVE**. Users should verify that the weld Schedule is correct. If not, reset to the correct schedule if necessary.

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

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

Emergency Stop Switch Instructions

AC Input Power Connection



AC INPUT POWER CONNECTION SPECIFICATIONS			
MODEL	**TERMINAL**	**MAXIMUM VOLTAGE**	**MAXIMUM CURRENT**
SL-320A	Hot	85 - 264 volts	8 amps
	Neutral	--	--
	Ground	--	--

Digital I/O Functions

NOTE: During power-up sequence all schedule outputs will momentarily activate.

DIGITAL OUTPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS				
PIN #	**NAME**	**I/O**	**Functionality**	**COMMENTS**
J1A-1	Binary 0	O	When the Schedule Binary Inputs are set for a schedule, the Schedule Binary Output Bits 0 through 6 are updated within 0 to 500 milliseconds	Binary Schedule Outputs
J1A-2	Binary 1	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-3	Binary 2	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-4	Binary 3	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-5	Binary 4	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-6	Binary 5	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-7	Binary 6	O	See Binary 0 functionality	Binary Schedule Outputs
J1A-8	Binary Common	O		Binary Schedule Common for pins 1, 2, 3, 4, 5, 6, 7
J1A-9	RELAY1P	O	Refer to Relay Functionality Table shown below	Relay output 1 Positive
J1A-10	RELAY1N	O		Relay output 1 Negative
J1A-11	RELAY2P	O	Refer to Relay Functionality Table shown below	Relay output 2 Positive

DIGITAL OUTPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS				
PIN #	**NAME**	**I/O**	**Functionality**	**COMMENTS**
J1A-12	RELAY2N	O		Relay output 2 Negative
J1A-13	RELAY3P	O	Refer to Relay Functionality Table shown below	Relay output 3 Positive
J1A-14	RELAY3N	O		Relay output 3 Negative
J1A-15	Not used			
J1B-16	RELAY4P	O	Refer to Relay Functionality Table shown below	Relay output 4 Positive
J1B-17	RELAY4N	O		Relay output 4 Negative
J1B-18	Power Supply Cutoff +	O	Switches active within 0 to 500 microseconds of when WeldStop position has been reached. Switches in active within 0 to 50 milliseconds of end of HOLD	Power Cutoff Positive
J1B-19	Power Supply Cutoff -	O		Power Cutoff Negative
J1B-20	Dig Out Spare 0	O	No functionality. Microprocessor to back panel connector connection should be present for future use	spare
J1B-21	Dig Out Spare 1	O	No functionality. Microprocessor to back panel connector connection should be present for future use	spare
J1B-22	Valve +	O	Set active within 0 - 5ms of when Linear Footswitch initiates weld head movement, Two Position Footswitch SW1 is activated, or Digital Input Start Weld 1 is activated. Set inactive within 0 – 100ms of end of HOLD.	Valve Driver +
J1B-23	Valve -	O		Valve Driver -
J1B-24	Alarm	O	Set active within 0 – 5ms of when an ALARM condition occurs or set active within 0 - 5ms of the end of HOLD when an out of limits condition occurs. Set inactive when Reset Digital input is set active or Up Arrow button is pressed. If Emergency Stop circuit was not reset or actuator temperature is too high, this output will remain active.	Alarm output
J1B-25	Weld in Process	O	Set active within 0 - 5ms of when Linear Footswitch initiates weld head movement, Two Position Footswitch SW1 is activated, or Digital Input Start Weld 1 is activated. Set inactive within 0 – 100ms of end of HOLD.	Indicates Controller is executing weld sequence

DIGITAL OUTPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS				
PIN #	**NAME**	**I/O**	**Functionality**	**COMMENTS**
J1B-26	Parked	O	Set active 0 – 500ms after Controller has moved the weld head to the PARK position and both the brake has been engaged and current is off to the motor. Will switch inactive 0 – 500ms after user switches Park Digital Input to inactive or user presses PARK button, and Controller has moved weld head to Upstop position. To initiate Controller to move the weld head to PARK position, user either presses PARK button or sets Park Digital Input active. Upon initial power up of Controller, the Parked output will not be active even if unit is in Parked position. After initial power up, unit will go through startup routine and move to Upstop position.	Indicates Controller has moved weld head to fully retracted position and has set the brake to prevent weld head movement.
J1B-27	Ack to Inhibit	O	Set active 0 - 500ms after unit has received Process Inhibit digital input and Controller is in Ready state. Controller will ignore Footswitch inputs and Dress, Retract, Start Weld1, Start Weld2 digital inputs when Process Inhibit Digital input is active	Acknowledgement that Controller is in Process Inhibit mode
J1B-28	Ready	O	Set active 0 – 100ms after unit has transitioned to Ready state, such as after both levels of footswitch are released after a weld. Set inactive 0 -5ms after unit has transitioned out of Ready state, such as when a footswitch input has been received.	Ready output
J1B-29	Digital Common	O		Common for pins 20, 21, 24, 25, 26, 27, 28
J1B-30	Chassis Ground	O		

PROGRAMMABLE RELAY OUTPUT FUNCTIONALITY

RELAY STATE	I/O	FUNCTIONALITY	COMMENTS
Welding	O	This relay is active when welding is in process	Active while Controller is executing a weld
Weld Cycle	O	This relay is active during certain states of a weld cycle.	Active while Controller is in the WELD, FOLLOWUP, or HOLD
End of Weld	O	This relay indicates when the weld HOLD period has been reached. Activates for 100ms	Indicates end of HOLD period has been reached. Will not activate when weld is aborted.
Alarm	O	This relay indicates an alarm condition	
Search Position	O	This relay is active when the search position is reached	Search position relay will not activate when system is configured for Linear Foot Switch
Dress	O	This relay is active in Dress mode	
Weld Counter	O	This relay is active when the weld counter is out of limits (weld counter limit is set on the WELD COUNTER screen - #2 on SETUP MENU)	
Out of Limits	O	This relay is active for 100ms when an Out of Limits condition is present	
Init Pos Limits	O	This relay is active for 100ms when the Initial Position limits have been reached	
Init Pos High	O	This relay is active for 100ms when the Initial Position High limit has been reached	
Init Pos Low	O	This relay is active for 100ms when the Initial Position Low limit has been reached	
Setdown Limits	O	This relay is active for 100ms when the Setdown Limits have been reached	
Setdown High	O	This relay is active for 100ms when the Setdown High limit has been reached	
Setdown Low	O	This relay is active for 100ms when the Setdown Low limit has been reached	
Not Active	O	Relay State not assigned to Relay	

DIGITAL INPUT SIGNAL INTERFACE CONNECTOR SPECIFICATIONS

PIN #	NAME	I/O	FUNCTIONALITY	COMMENTS
J2A-1	Binary 0	I	When the Schedule Binary Inputs are set for a schedule, the loaded schedule will be updated within 0 – 2 seconds	Binary Schedule Inputs
J2A -2	Binary 1	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -3	Binary 2	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -4	Binary 3	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -5	Binary 4	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -6	Binary 5	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -7	Binary 6	I	See Binary 0 functionality	Binary Schedule Inputs
J2A -8	Binary Common	I		Binary Schedule Common for pins 1, 2, 3, 4, 5, 6, 7
J2A -9	+24V	I		
J2A-10	24V Return	I		
J2A -11	Not used	I		
J2A -12	Not used	I		
J2A -13	Not used	I		
J2B -14	Dress Input	I	Used to enter/exit Dress Mode. When this input is set active, the controller will enter Dress Mode.	Dress input
J2B -15	Reset	I	When set active, alarms and out of limits conditions are cleared. If E-Stop circuit has not been reset or actuator temperature is still too high in the case of an Over Temperature Alarm, alarm will not be cleared	Reset input
J2B -16	Process Inhibit	I	When set active, unit will ignore any Footswitch inputs and Dress, Retract, Start Weld1, Start Weld2 digital inputs.	Process and movement inhibit
J2B-17	Dig In Spare 2	I	No functionality. Microprocessor to back panel connector connection should be present for future use	Spare 2 input
J2B-18	Retract	I	When set active, actuator will move to Park position, engage brake, and then cut current to motor	Move to park position
J2B-19	Dress Up/Down	I	The Dress Up/Down Input (J2B-19) is used to position the weld head. When set to active, the weld head is in the down position (Dress Down). When set to non-active, the weld head is in the up position (Dress Up).	Dress Up/Down *Note: Available on models manufactured after 8/14/17*

PIN #	NAME	I/O	FUNCTIONALITY	COMMENTS
J2B-20	Dig In Spare 1	I	No functionality. Microprocessor to back panel connector connection should be present for future use	Spare 1 input
J2B-21	Start Weld 1	I	Same functionality as Foot Switch Level 1	Start Weld 1 input (FS1)
J2B-22	Start Weld 2	I	Same functionality as Foot Switch Level 2	Start Weld 2 input (FS2)
J2B-23	Not used			
J2B-24	+24V	I		
J2B-25	24 V Return	I		
J2B-26	Digital Common			

APPENDIX C
RS-232 COMMUNICATIONS

Section I. RS-232 Connections

Overview

The SL-320A Weld Head Controller has an RS-232 Serial Port connector that is used to transmit commands and weld data to/from a Personal Computer (PC) / host computer or other serial communications device.

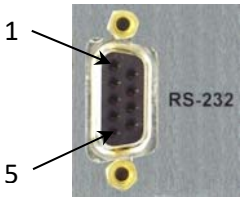
Interface Protocol

Parameter	Description
Baud Rate	9.6k, 19.2k, 38.4k bits/second
Stop Bits	1
Data Bits	8
Parity	None

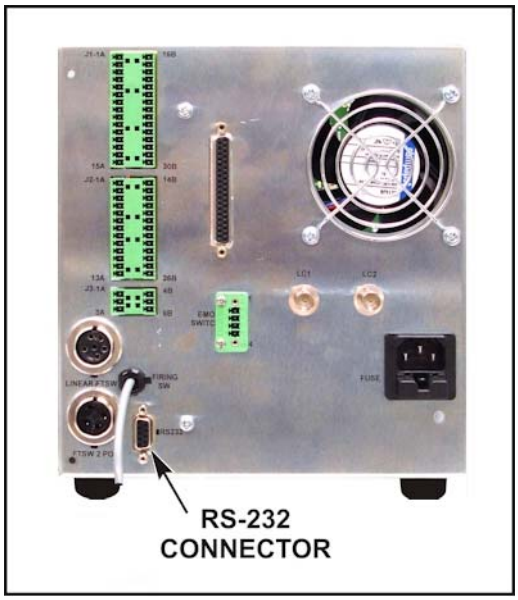
RS-232 Serial Port Connections

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

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



Connect a standard RS-232 cable between your host computer COM port and the SL-320A Controller serial data port or build your own cable with a standard DB9-M connector (P/N 250-193) and backshell (P/N 250-194).



Section II. Command Format

Remote Data Collection and Programming

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

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

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

NOTES:

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

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

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

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

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

The weld data counter in the Controller is decremented by 10. The corresponding control of the Controller with ***ID*** #1 responds with:

#1 REPORT 2 <*crlf*>
1,4,2,1071,12,2100,0,526,0,0 <*crlf*>
1,5,2,567,8,2100,0,521,0,0 <*crlf*>
<*lf*>

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

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

Command Format

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

UNIT IDENTIFICATION: #*ID* (*ID* is any number from "01" to "31", must be a two digit number).

COMMAND KEYWORDS: **BOLD.**

VARIABLE: *italics.*

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

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

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

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

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

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

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

Section III. Control Communication Codes

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

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

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

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

1. This parameter must be set to **MASTER** under normal running conditions to turn on the "Read Report" command which sends the results of the latest weld to the host automatically.
2. When the parameter is set to **SLAVE**, this reporting will be turned off and the unit will accept both "Read" and "Set" from the host.
3. When in **MASTER**, the unit will not accept any commands from the host. This avoids potential collisions between these commands and the automatic reporting of reflow results.
4. **MASTER** or **SLAVE** must be set at the Control panel by pressing the **SETUP** key and selecting option 7: **COMMUNICATIONS**.

Host Originated Commands

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

Command **STATUS**<crlf><lf>

Description Requests the Controller to report the status of the weld data buffer. Controller returns **STATUS** with either "**OK**" or "**OVERRUN.**"

Command **TYPE**<crlf><lf>

Description Requests the Controller to return the type of welder, release number, and revision letters.

Command **COUNT**<crlf><lf>

Description Requests the Controller to report the number of weld data accumulated since the last data collection. Controller returns the COUNT even if there is no weld data available.

Command **ERASE**<crlf><lf>

Description Requests the Controller to erase all the weld reports.

Command **SYNC**<crlf><lf>

Description Provides synchronization of the commands. The Controller returns SYNC command back to the host computer.

Command **COUNTER READ**<crlf><lf>

OR

COUNTER SET {TOTAL | GOOD | LIMIT} *number* <crlf><lf>

Description Requests the Controller to return All Control weld counter contents or Set total, limit, or good counter value.

Command **REPORT** {**OLD** | **NEW | ERASE**} *number* <crlf><lf>

Description Requests the Controller to send the weld report.

OLD: requests to send the number of oldest weld reports since the last data collection.

NEW: requests to send the number of newest weld reports and then erases them.

ERASE: will erase the number of oldest weld reports.

NEW will erase the number of welds requested from the buffer after requesting them.

number: the quantity of weld data to be sent or erased.

If the number is greater than the number of weld data in the buffer, than the number of welds stored will be sent. **NOTE:** There must be a space between two fields.

Command **LOAD** {*schedule_number*}<crlf><lf>

Description Selects the schedule_number as the currently loaded schedule. schedule_number may be any number from 1 to 127. There must be a space between LOAD and schedule_number.

Command **COPY** {*from_schedule_number*} {*start_schedule_number*} {*end_schedule_number*}<<crlf><lf>

Description Allows one schedule to be copied to a range of schedules beginning at start_schedule_number through end_schedule_number. From_schedule_number, start_schedule_number and end_schedule_number may be any number from 1 to 127. Copying a schedule to itself has no effect. End_schedule_number must be >= start_schedule_number.

Command **SCHEDULE**<crlf><lf>

Description Requests the Controller to return the currently selected schedule number.

Command

SCHEDULE {READ | SET} <crlf>
[*parameter_name value*<crlf>]
<lf>

Description

Provides control over the Controller schedule parameters. When used with the "READ" keyword, all parameters pertaining to the currently loaded schedule are returned (see SCHEDULE under Control ORIGINATED COMMANDS). When the "SET" keyword is used, the host may set (change) the value of one or more of the parameters pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter_name and value variables:

FUNITS	**{ LB | GM | NT }**	force units (read only, uses system limits)
DUNITS	**{ IN | MM }**	distance units (read only, uses system units)
APRSPD	**{ FAST | MED | SLOW }**	approach speed
SRCHSPD	**{ FAST | MED | SLOW }**	search speed
UPSTOPPOS	{ *upstop_pos* }	upstop position
SEARCHPOS	{ *search_pos* }	search position
RAMPT	{ *ramp_time* }	ramp time
COMPRESSF	{ *compress_force* }	compress force
COMPRESST	{ *compress_time* }	compress time
SQUEEZET	{ *squeeze_time* }	squeeze time
WELDF	{ *weld_force* }	weld force
WELDT	{ *weld_time* }	weld time
IMPULSEF	{ *followup_force* }	followup force
FOLLOWUPT	{ *followup_time* }	followup time
HOLDF	{ *hold_force* }	hold force
HOLDT	{ *hold_time* }	hold time

NOTES:

- ***Upstop_pos*** is the parameter that defines the upstop position. Valid ranges are dependent on the distance units. (.001 **IN** = 6 to 996, .1 **MM** = 15 to 253)
- ***Search_pos*** is the parameter that defines the search position. Valid ranges are dependent on the distance units. (.001 **IN** = 5 to 995, .1 **MM** = 12 to 252)
- ***ramp_time, squeeze_time,*** and ***hold_time*** are the parameters that define the times for the given periods in 1 msec. Valid range is from 0 to 999.
- ***compress_time*** is the parameter that defines the time for the given period in 1 msec. Valid range is from 0 to 500.
- ***weld_time*** is the parameter that defines the time for the given period in 1 msec. Valid range is from 1 to 700.
- ***followup_time*** is the parameter that defines the time for the given period in .1 msec. Valid range is from 0 to 999.
- ***compress_force, weld_force and hold_force*** are the parameters that define the force for the given period. Valid ranges are dependent on the specified force units. (**LB** = 44 to 700, **GM** = 200 to 3175, **NT** = 20 to 216)
- ***followup_force*** is the parameter that defines the force for the given period. Valid ranges are dependent on the specified force units. (**LB** = 44 to 776, **GM** = 200 to 3520, **NT** = 20 to 345)

Command **RELAY {READ | SET}** <crlf>
[*parameter_name value*<crlf>]
<lf>

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

ACTIVE1	**{ CLOSED | OPEN }**	Relay 1 Active Closed or Open
CONDITION1	*condition_value*	Relay 1 Active Conditions
ACTIVE2	**{ CLOSED | OPEN }**	Relay 2 Active Closed or Open
CONDITION2	*condition_value*	Relay 2 Active Conditions
ACTIVE3	**{ CLOSED | OPEN }**	Relay 3 Active Closed or Open
CONDITION3	*condition_value*	Relay 3 Active Conditions
ACTIVE4	**{ CLOSED | OPEN }**	Relay 4 Active Closed or Open
CONDITION4	*condition_value*	Relay 4 Active Conditions

***condition_value* can be selected betweeen**:

{ WELD | WELDCYCLE | END | ALARM | SEARCHPOS | DRESS | COUNTER | LIMIT | INITLIM | INITHI | INITLOW | SETDOWNLIM | SETDOWNHI | SETDOWNLOW | NOTACTIVE }

Command **RELAY {READ | SET}** <crlf>
[*parameter_name value*<crlf>]
<lf>

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

ACTIVE1	**{ CLOSED | OPEN }**	Relay 1 Active Closed or Open
CONDITION1	*condition_value*	Relay 1 Active Conditions
ACTIVE2	**{ CLOSED | OPEN }**	Relay 2 Active Closed or Open
CONDITION2	*condition_value*	Relay 2 Active Conditions
ACTIVE3	**{ CLOSED | OPEN }**	Relay 3 Active Closed or Open
CONDITION3	*condition_value*	Relay 3 Active Conditions
ACTIVE4	**{ CLOSED | OPEN }**	Relay 4 Active Closed or Open
CONDITION4	*condition_value*	Relay 4 Active Conditions

***condition_value* can be selected betweeen**:

{ WELD | WELDCYCLE | END | ALARM | SEARCHPOS | DRESS | COUNTER | LIMIT | INITLIM | INITHI | INITLOW | SETDOWNLIM | SETDOWNHI | SETDOWNLOW | NOTACTIVE }

Command **SYSTEM {READ | SET}**<crlf>
[*parameter_name value*<crlf>]<lf>

Description Provides control over the Controllers system parameters. When used with the "**READ**" keyword, all system parameters are returned (see **SYSTEM** under CONTROL ORIGINATED COMMANDS). When used with the "**SET**" keyword, the host may set (change) the value of one or more of the system parameters.

The following is a list of valid literal substitutions for the *parameter_name* and *value* variables:

BUZZER	**{ OFF | ON }** <crlf>
FUNITS	**{ LB | GM | NT }**<crlf>
DUNITS	**{ IN | MM }** <crlf>
FSWTYPE	**{ 2LEVEL | LINEAR | DIGIO }** <crlf>
FSWRESP	**{ ABORT | LATCH }** <crlf>
DEBOUNCE	**{ 0 | 10 | 20 | 30 }** <crlf>
INITPOSABORT	**{ OFF | ON }** <crlf>
MAXFORCE	**{ *force_value* }** <crlf>
SRCHFORCE	**{ *force_value* }** <crlf>
OBJFORCE	**{ *force_value* }** <crlf>
DRESSSPD	**{ 1 - 9 }** <crlf>
DRESSFORCE	**{ dressforce_*value* }** <crlf>
LOUDNESS	**{ *loudness_value* }** <crlf>

These parameters pertain to the settings of the option menus available via the front panel user interface.

force_value is the parameter that defines the force for the defined period. Valid ranges are dependent on the specified force units. (**LB** = 22 to 77, **GM** = 100 to 349, **NT** = 10 to 34).

dressforce_value is the parameter that defines the force during dress mode. Valid ranges are dependent on the specified force units. (**LB** = 11-242, **GM** = 50-1100, **NT =** 1 to 108).

loudness_value is a number 0 to 99 for buzzer loudness. 0 is off and 99 is the loudest.

Command **ALARM {READ | CLEAR | SET** *error_number* **| DISPLAY** *alarm_message_string***}**<crlf><lf>

Description Provides access to the Controller alarm logic. When used with the "READ" keyword, the current error condition value is returned. See Appendix D. for list of alarm messages. When the "CLEAR" keyword is used, all alarm conditions are canceled. When the "SET" keyword is used, the host may invoke an error identified by error_number. When the "DISPLAY" keyword is used, an error condition can be created with any message desired. The length of the error message must be limited to 40 characters or less. No help message will be available in connection with this created error message.

Command **SECURITY {OFF | READ | SCHEDULE | SYSTEM }**<crlf><lf>

Description Allows control of the system security mode.

"OFF" sets all security status Control to "OFF."

"SCHEDULE" sets the schedule lock to "ON."

"SYSTEM" sets the system lock to "ON."

"READ" requests the Controller to return the present condition of the above four parameters.

Control Originated Commands

These are the commands sent from a Controller to a host computer.

Command **STATUS** <crlf><lf>

Description Identifies the current status of the weld data buffer. May be in response with "OK" or "OVERRUN." "OK" means that the Controller weld buffer did not over-run since the last data collection and all the data are intact. "OVERRUN" means that the Controller weld buffer did over-run since the last data collection and only the latest 512 weld data are available to report.

Command **TYPE** <crlf><lf>

Description Returns software version. .

Command **COUNT** *number* <crlf><lf>

Description Returns the number of weld data available in the weld buffer. The total number of weld data in the buffer is 512.

Command **SCHEDULE** *schedule_number* <crlf><lf>

Description Returns the current schedule number to the host. schedule_number may be any number from 1 to 99.

Command **REPORT** *number_of_reports* <crlf>
report <crlf> report <crlf> . . . . *report* <crlf><lf>

Description Returns the requested number of weld reports. First field is the number of reports to be sent. Then follows the packets of report. One report pack hold all the information about a weld. Each report packet is separated by <crlf> and this Command ends with <crlf><lf>.

number_of_reports: This is the number of reports that shall be included in this command. If the host computer requests more weld data than is available in the weld data buffer, the Controller sends only the weld reports in the weld buffer and the *number_of_reports* is the number of weld reports available in the weld data buffer. After the report is sent to the host computer, the Controller erases the weld data sent to the host from the weld data buffer.
The fields in the report packet are separated with a comma and all fields are in integer format. There are always 9 fields in a report packet.

report: { *unit_number, weld_count, schedule_number ,thickness, setdown, weldtime, peak_force, initial_thickness_result, , setdown_result}*

The fields in the report packet are separated with a comma and all fields are in integer format. There are always 9 fields in a report packet.

unit_number:	The unit ID number (1 – 31)
weld_count	Weld count
schedule_number:	The schedule number of the weld (1 – 127)
thickness:	Initial Thickness (0.0001in)
setdown:	Setdown (0.0001in)
weldtime:	Weldtime (0.1ms)
peak_force:	Peak force (gm)
initial_thickness_result:	Initial Thickness Result 0 = no limits programmed 1 = within limits 2 = over upper limit 3 = below lower limits
setdown_result:	Setdown Result 0 = no limits programmed 1 = within limits 2 = over upper limit 3 = below lower limits

Command **COUNTER** *number* <crlf><lf>

Description Returns the requested current Controller weld counter number.

Command	**SCHEDULE**	***schedule_number*** <crlf>
FUNITS	**{ LB | GM | NT }**<crlf>	force units (read only)
DUNTIS	**{ IN | MM }** <crlf>	distance units (read only)
APRSPD	**{ FAST | MED | SLOW }**<crlf>	approach speed
SRCHSPD	**{ FAST | MED | SLOW }** <crlf>	search speed
UPSTOPPOS	{ *upstop_pos* } <crlf>	upstop position
SEARCHPOS	{ *search_pos* }<crlf>	search position
RAMPT	{ *ramp_time* }<crlf>	ramp time
COMPRESSF	{ *compress_force* }<crlf>	compress force
COMPRESST	{ *compress_time* }<crlf>	compress time
SQUEEZET	{ *squeeze_time* }<crlf>	squeeze time
WELDF	{ *weld_force* } <crlf>	weld force
WELDT	{ *weld_time* }<crlf>	weld time
IMPULSEF	{ *followup_force* }<crlf>	followup force
FOLLOWUPT	{ *followup_time* }<crlf>	followup time
HOLDF	{ *hold_force* }<crlf>	hold force
HOLDT	{ *hold_time* }<crlf>	hold time
	<lf>	<lf>

NOTE: **FUNITS** and **DUNITS** are read-only, you cannot change the units. Use SYSTEM COMMAND to change the Units.

Description Reports the settings of the currently loaded Controller schedule parameters. The ***schedule_number:*** variable identifies which schedule is currently loaded, and may be any value from 1 to 127.

NOTES:

- ***Upstop_pos*** is the parameter that defines the upstop position. Valid ranges are dependent on the distance units. (0.001 **IN** = 6 to 996, .1 **MM** = 15 to 253)
- ***Search_pos*** is the parameter that defines the search position. Valid ranges are dependent on the distance units. (0.001 **IN** = 5 to 995, .1 **MM** = 15 to 252)
- ***ramp_time, squeeze_time,*** and ***hold_time*** are the parameters that define the times for the given periods in 1 msec. Valid range is from 0 to 999.
- ***compress_time*** is the parameter that defines the time for the given period in 1 msec. Valid range is from 0 to 500.
- ***weld_time*** is the parameter that defines the time for the given period in 1 msec. Valid range is from 1 to 700.
- ***followup_time*** is the parameter that defines the time for the given period in 1 msec. Valid range is from 0 to 999.
- ***compress_force, weld_force and hold_force*** are the parameters that define the force for the given period. Valid ranges are dependent on the specified force units. (**LB** = 44 to 700, **GM** = 200 to 3175, .1 **NT** = 20 to 216)
- ***followup_force*** is the parameter that defines the force for the given period. Valid ranges are dependent on the specified force units. (**LB** = 44 to 776, **GM** = 200 to 3520, .1 **NT** = 20 to 345)

Command

RELAY <crlf>
ACTIVE1 **{ CLOSED | OPEN }** <crlf>
CONDITION1 *condition value*<crlf>
ACTIVE2 **{ CLOSED | OPEN }** <crlf>
CONDITION2 *condition value*<crlf>
ACTIVE3 **{ CLOSED | OPEN }** <crlf>
CONDITION3 *condition value*<crlf>
ACTIVE4 **{ CLOSED | OPEN }** <crlf>
CONDITION4 *condition value*<crlf>
ACTIVE5 **{ CLOSED | OPEN }** <crlf>
CONDITION5 *condition value*<crlf>
<lf>
condition_value is

{ WELD | WELDCYCLE | END | K1K2 | ALARM | SEARCHPOS | DRESS | COUNTER | LIMIT | INITLIM | INITHI | INITLOW | SETDOWNLIM | SETDOWNHI | SETDOWNLOW | NOTACTIVE }

Description

Reports the relay settings.

Command

MONITOR	*schedule_number*<crlf>	
DUNITS	**{ IN | MM }**	distance units (read only)
WELDSTOP	**{** *limit_value* **}**<crlf>	weld stop position
INITUpper	{ limit_value }<crlf>	Initial Position Upper Limit
INITLower	{ limit_value }<crlf>	Initial Position Lower Limit
SETDUpper	{ limit_value }<crlf>	Setdown Upper Limit
SETDLower	{ imit_value }<crlf>	Setdown Lower Limit
<lf>		

limit_value is the parameter that specifies the range of the valid readings. If the reading was within the range of the *limit_value*, no alarm will occur. If the reading was out of the valid range, an alarm will occur. The valid number for *limit_value* is 1 through 1000 (units of 0.0001") and 0 disables the limit.

Description

Reports the settings of the weld monitor of the currently loaded Controller schedule. The ***schedule_number*** variable identifies which schedule is currently loaded, and may be any value from 1 to 127. The possible value for all variables listed after their parameter name correspond to the values listed under **MONITOR** in *Host Originated Commands* of this manual.

Command

SYSTEM <crlf>	
BUZZER	**{ OFF | ON }** <crlf>
FUNITS	**{ LB | GM | NT }**<crlf>
DUNITS	**{ IN | MM }** <crlf>
FSWTYPE	**{ 2LEVEL | LINEAR | DIGIO }** <crlf>
FSWRESP	**{ ABORT | LATCH }** <crlf>
DEBOUNCE	**{ 0 | 10 | 20 | 30 }** <crlf>
INITPOSABOR	**{ OFF | ON }** <crlf>
MAXFORCE	**{** ***force_value*** **}** <crlf>
SRCHFORCE	**{ force_*value* }** <crlf>
OBJFORCE	**{ force_*value* }** <crlf>
DRESSSPD	**{ 1 - 9 }** <crlf>
DRESSFORCE	**{ force_*value* }** <crlf>
LOUDNESS	**{** ***loudness_value*** **}** <crlf>
<lf>	

Description

Reports the current settings of the Controller system parameters.

force_value is the parameter that defines the force for the defined period. Valid ranges are dependent on the specified force units. (**LB** = 22 to 77, **GM** = 100 to 349, .1 **NT** = 10 to 34).

loudness_value is a number 0 to 99 for buzzer loudness. 0 is off and 99 is the loudest.

dressforce_value is a parameter that defines the dressforce. Valid ranges are dependent on the specified force units. (**LB** = 11-242, **GM** = 50-1100, **NT =** 1 to 108)

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