INVERTER POWER SUPPLY

IS-2200CA/4500CA

USER MANUAL

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C	44980	06/18	Update info on IS-2200CR & IS-4500CR
D	45546	07/19	Update EtherNet/IP™ terminology + content
E	45804	04/20	Update Company Name (Amada Weld Tech) + Model Names
F	45984	07/20	Update Fuse values in Maintenance section
G	46130	12/20	Update I/O Schematics in Appx B
H	46311	04/21	See ECO for details
J	47208	01/24	Update Manual Title

FOREWORD

About This Equipment

Thank you for purchasing an AMADA WELD TECH IS-2200CA/4500CA Inverter Power Supply. For the rest of this manual, the **IS-2200CA/4500CA** will be referred to simply as ***the Power Supply***.

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

AMADA WELD TECH INC.
1820 South Myrtle Avenue
Monrovia, California 91016
Phone: (626) 303-5676
FAX: (626) 358-8048
E-mail: info@amadaweldtech.com

About This Manual

The purpose of this manual is to supply operating and maintenance personnel with the information needed to properly and safely operate and maintain the IS-2200CA/4500CA Inverter Power Supply.

We have made every effort to ensure that the information in this manual is accurate and adequate. The contents of this manual are subject to change without notice.

Should any 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
IS-2200CR, 380V	IS-2200CR-xx-xx	→	IS-800CA/380	IS-800CA-xx-xx
IS-2200CR, 480V	IS-2200CR-xx-xx	→	IS-800CA/480V	IS-800CA-xx-xx
IS-4500CR, 480V	IS-4500CR-xx-xx	→	IS-4500CA/480	IS-4500CA-xx-xx

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SAFETY PRECAUTIONS

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

HIGH VOLTAGE is used in the operation of this equipment.

WHEN WELDING **always** wear safety glasses.

General

This instruction manual describes the operation and maintenance of the Power Supply and provides instructions relating to its SAFE use. Procedures described in this manual ***must*** be performed as detailed by QUALIFIED and TRAINED personnel.

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

After reading this manual, retain it for future reference when any questions arise regarding the proper and SAFE operation of the Power Supply.

Operation

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

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

Maintenance/Service

Before performing any maintenance on the Inverter Power Supply, read *Chapter 5, Maintenance* thoroughly. Use the appropriate tools for terminating the connecting cables, being careful not to nick the wire conductors.

Do ***not*** modify the Power Supply without prior written approval from AMADA WELD TECH.

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

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

⚠ WARNING

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

⚠ DANGER

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

⚠ CAUTION

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

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

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

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

⚠ DANGER

DO NOT TOUCH THE INSIDE OF THE POWER SUPPLY UNNECESSARILY.

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

NEVER DISASSEMBLE, REPAIR, OR MODIFY THE POWER SUPPLY.

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

WARNING

Do NOT put your hands or fingers between the electrodes.

When welding, keep your hands and fingers away from the electrodes.

Do NOT touch any welded part or electrode during, or just after welding.

The welded parts and electrodes are very ***hot***. If you touch them you will be burned.

Ground the equipment.

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

Use a ground fault breaker.

Use a ground fault breaker to prevent an electric shock.

Only use specified cables.

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

Do NOT use a damaged power cable, connecting cables, or plugs.

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

Stop operation if any trouble occurs.

If you detect a burning smell, abnormal sounds, abnormal heat, smoke, etc., turn power OFF immediately to prevent fire or electric shock. Contact AMADA WELD TECH or your distributor for help.

People with pacemakers MUST stay away from the Power Supply.

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

Wear protective gear.

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

CAUTION

Apply the specified source voltage.

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

Keep water and water containers away from the Power Supply.

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

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

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

Install the Power Supply on a firm, level surface.

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

Keep combustible matter away from the Power Supply.

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

Do NOT cover the Power Supply with a blanket, cloth, etc.

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

Wear ear protectors.

Loud noises can damage hearing.

Keep a fire extinguisher nearby.

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

Regularly inspect and maintain the Power Supply.

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

Disposal

Properly handle and dispose of used materials.

For the disposal of electronic waste please contact AMADA WELD TECH.

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
SYSTEM DESCRIPTION
Section I: Features

Basic and Advanced Units

The AMADA WELD TECH IS-2200CA/4500CA is an inverter-type power supply specially designed to be used for spot welding and fusing. The AMADA WELD TECH IS-2200CA/4500CA will simply be referred to as ***the Power Supply***, unless a feature or procedure unique to a specific model is described.

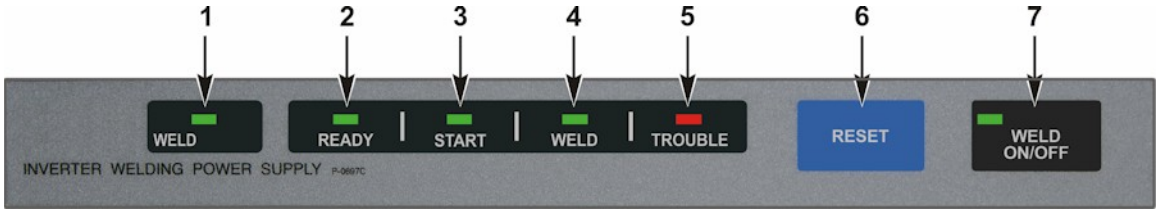
You program and monitor Power Supply operation by using the external MA-660A Program Unit which is sold separately. This Program Unit is commonly referred to as "the Pendant." For the rest of this manual the MA-660A will simply be referred to as ***the Pendant.***

- The power supply accepts 3-phase voltage from 380 VAC to 480 VAC.
- Welding-current monitoring function for judgment of weld quality.
- Six control systems:
  - Primary constant-current effective value control.
  - Secondary constant-current effective value control.
  - Secondary constant-power effective value control.
  - Primary constant-current peak value control.
  - Secondary constant-voltage effective value control, and Constant-phase control for stable weld quality. The control method can be set for WELD1 to WELD3, respectively.
  - Pulse and upslope (downslope) can be set for WELD1 to WELD3, respectively.
- The welding frequency can be adjusted from 600 - 1000 Hz in 100 Hz steps in each schedule. Higher frequencies aid in the welding of finer applications. Please match the frequency of the welder to the transformer.
- Comes equipped with a current-shutoff function, which shuts off current in response to external input (e.g., displacement of the electrode) for WELD1 to WELD3 respectively, ensuring stable fusing.
- Use of an inverter allows for high power factor and stable power conditions.
- Easy setting of a variety of items through the menu selection system.
- Applicable to inverter transformers manufactured by various companies by changing the frequency (600 Hz to 1,000 Hz in units of 100 Hz).

- Seven protective functions for maximum ease of operation:
  - No-current / no-voltage
  - Over current
  - Temperature
  - Self diagnostics
  - Grounding error
  - Load short error
  - Phase error
- Circuit breaker is included (IS-2200CA: 800 amps; IS-4500CA: 1200 amps).
- 120 VAC valve voltage: 500 VA
- 24 VDC valve voltage: 5 amps (optional)
- CE compliance optional.
- RS-232 communications standard, RS-485 optional.
- The analog output terminal (voltage output proportional to force) for electro-pneumatic proportional valve and the analog input terminal (voltage input proportional to force) for force measurement have two channels, respectively.
- Welding can be stopped at the set displacement by connecting the displacement gauge and measuring the displacement produced in fusing.

Section II: System Components for IS-2200CA

Front Panel



1. WELD POWER Lamp

Indicator that lights when the power is supplied to the Power Supply.

2. READY Lamp

Indicator that lights when the system is ready to start welding. For this status to exist, the following conditions must be met:

- The **WELD ON/OFF** button must be pressed to ON (The **WELD ON/OFF** indicator is lit)
- The **WELD ON/OFF** setting on the MA-660A pendant must be ON, and
- External **WELD ON/OFF** signal be ON.

3. START Lamp

Indicator that lights when the Start signal is present.

4. WELD Lamp

Indicator that lights when the weld current is flowing.

5. TROUBLE Lamp

Indicator that lights when trouble is detected. The Pendant will also make a beeping sound. When this condition occurs, the unit operation is interrupted.

6. RESET Pushbutton Switch

This switch resets a trouble condition ***only if the trouble has been corrected***. If the cause of trouble is not removed, the operation will again be interrupted and the **TROUBLE** indicator will light again. After the RESET pushbutton switch is pressed, the START signal must be re-sent to the Power Supply for welding to begin.

7. WELD ON/OFF Pushbutton Switch

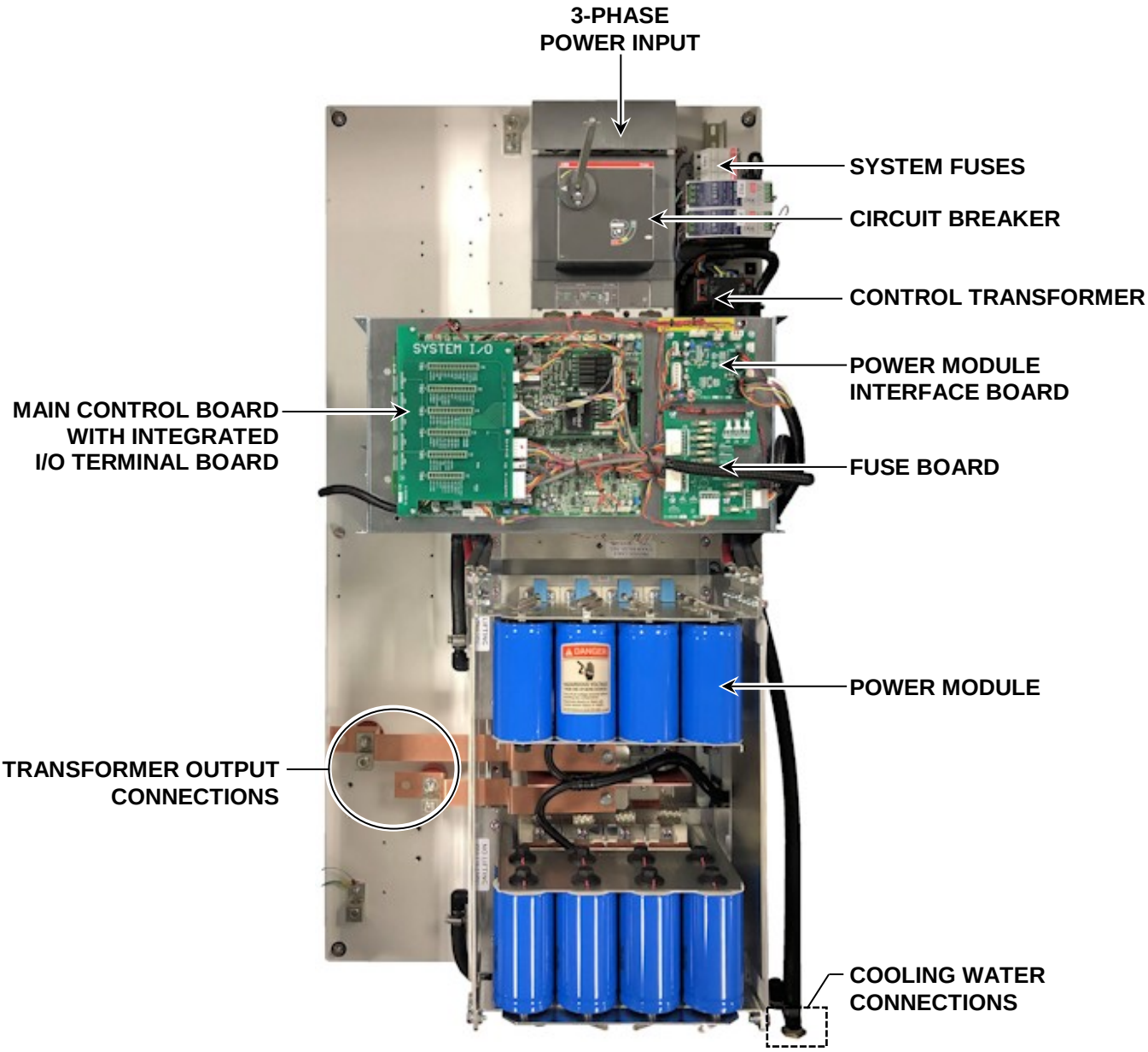
This switch enables the unit to weld. When **ON**, the green indicator lights. When operating, the switch needs to be held until the green LED lights (or goes out). This is one of three conditions required to place the unit in the Ready condition; see "READY," above.

Internal Components

DANGER

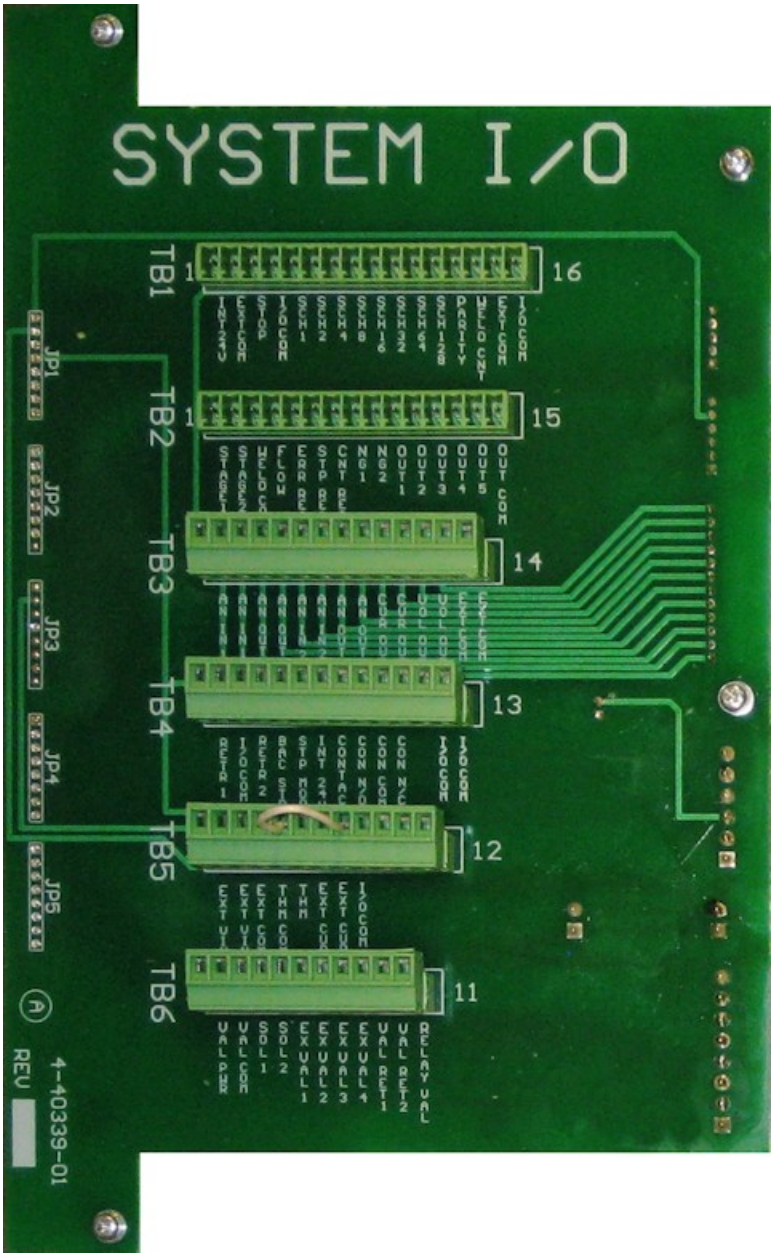
Do ***not*** touch the inside of the ***Power Supply*** for at least 20 minutes after power down, since you may get a severe electric shock.

NOTE: There are minor differences between the size and connector locations between the IS-2200CA and the IS-4500CA, but in all other respects the internal components of the two models are identical.



Connecting Terminal Strip for External Input / Output Signals

Used to input start signals and output trouble signals.



CHARGE INDICATOR Lamp

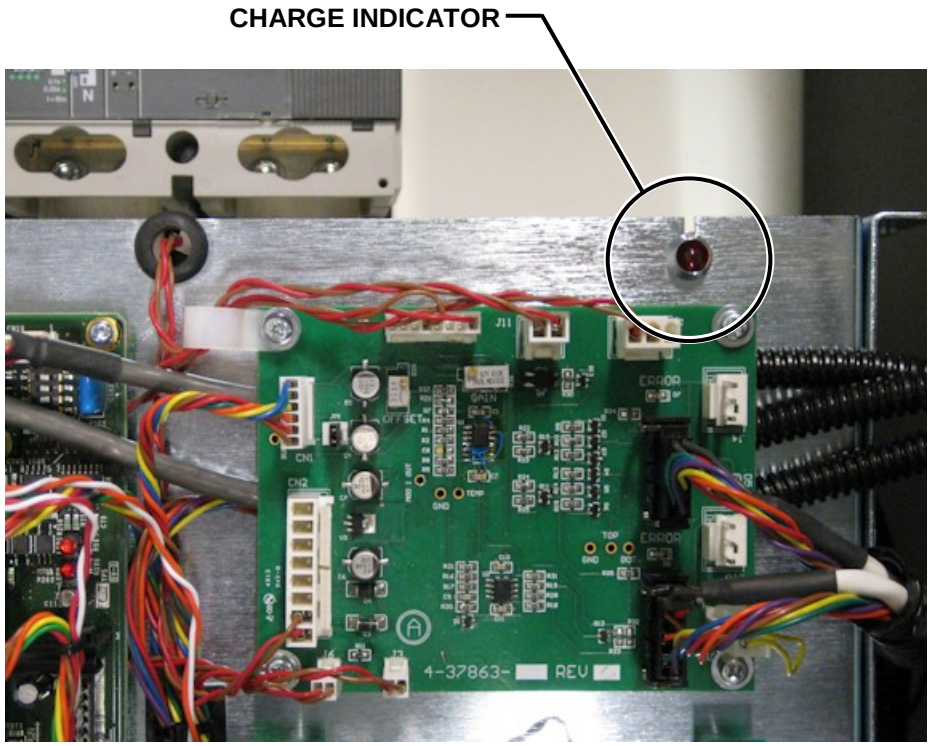
DANGER

Lethal voltages are present when the capacitors are charged. Do ***not*** touch the interior of the Power Supply when the LED is ON. ***Leave it alone for at least 20 minutes after turning the Power Supply OFF.***

DO NOT REMOVE SHIELD WITH POWER ON OR OPERATE THE MACHINE WITH SHIELD REMOVED! THIS WILL RESULT IN DEATH.

This lamp is located on the panel next to the transformer **INPUT/OUTPUT** terminals on the Power Module.

The charge level of this electrolytic capacitor is indicated by the brightness of the **CHARGE INDICATOR** lamp. The more the capacitor is charged, the brighter the **CHARGE INDICATOR** lamp will be.



External Connections

Cooling Water Pipe Connectors

Located on the bottom of the unit. Used for the supply (input) and drain (output) of cooling water, which cools the inside of the enclosure and power supply unit.

Fittings: 1/2" FNPT

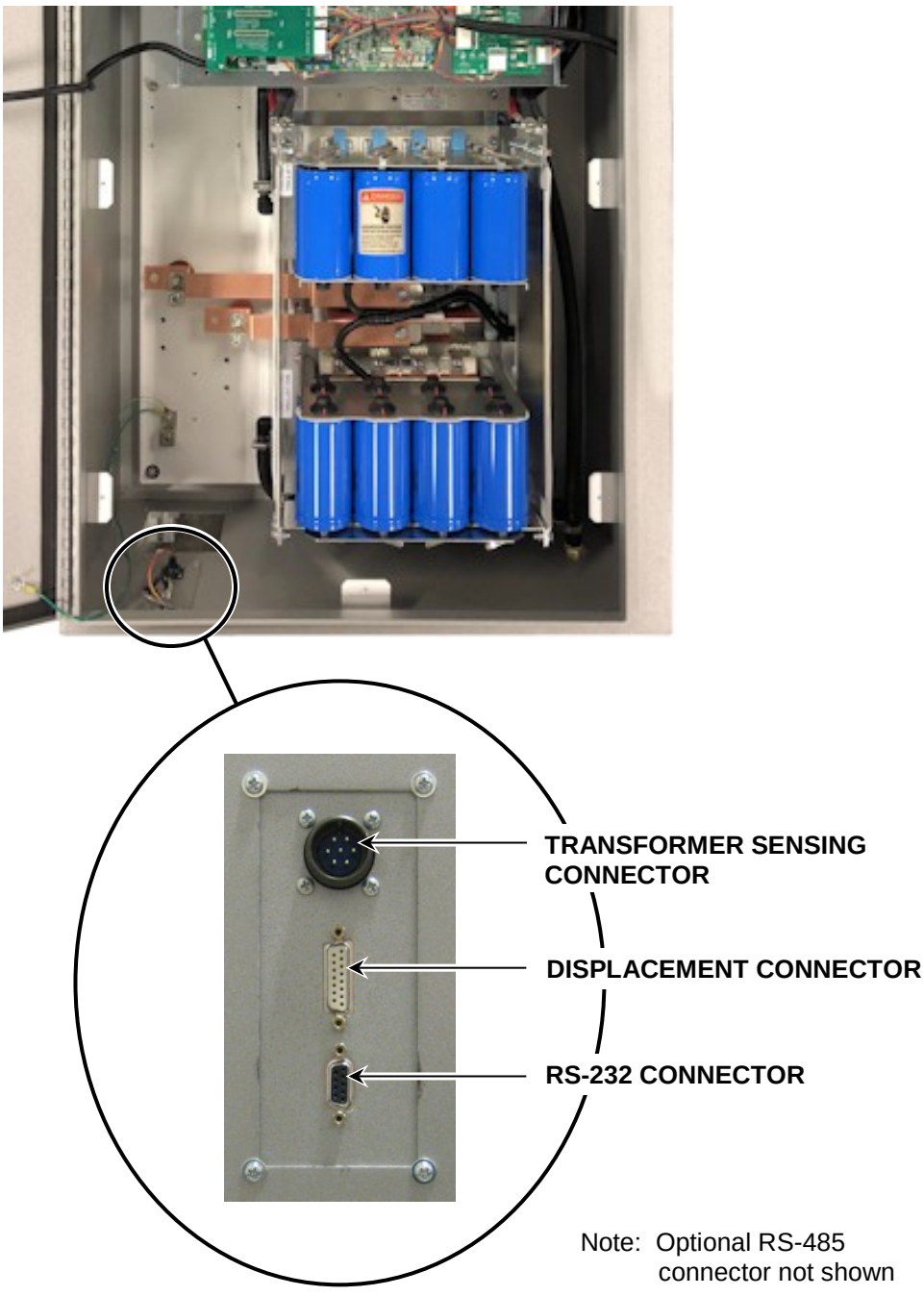
BOTTOM VIEW

RS-485/RS-232C Connector

For external communication see *Appendix E, Communications*.

TRANSFORMER SENSING CONNECTOR (Optional Toroidal Coil)

The Toroidal Coil is attached on the transformer away from the Power Supply. The signal comes through the **TRANSFORMER SENSING CONNECTOR** on bottom of Power Supply. The coil is used for the secondary constant-current effective value control and secondary constant-power effective value control.



Section III: System Components for IS-4500CA

Front Panel

CONTROL AND MONITOR UNIT CONNECTOR – Used to connect the MA-660A Program Unit.

WELD POWER Lamp – Indicator that lights when power is supplied to the Power Supply.

READY Lamp – Indicator that lights when system is ready to start welding. For this status to exist, the following conditions must be met:

- The **WELD ON/OFF** button must be pressed to ON (The **WELD ON/OFF** indicator is lit).
- The **WELD ON/OFF** setting on the MA-660A Pendant must be ON, and
- The External **WELD ON/OFF** signal must be ON.

START Lamp – Indicator that lights when the Start signal is present.

WELD Lamp – Indicator that lights when the weld current is flowing.

TROUBLE Lamp – Indicator that lights when trouble is detected. The Pendant will also make a beeping sound. When this condition occurs, the unit operation is interrupted.

RESET Pushbutton Switch– This switch resets a trouble condition ***only if the trouble has been corrected***. If the cause of trouble is not removed, the operation will again be interrupted and the **TROUBLE** indicator will light again. After the RESET pushbutton switch is pressed, the START signal must be re-sent to the Power Supply for welding to begin.

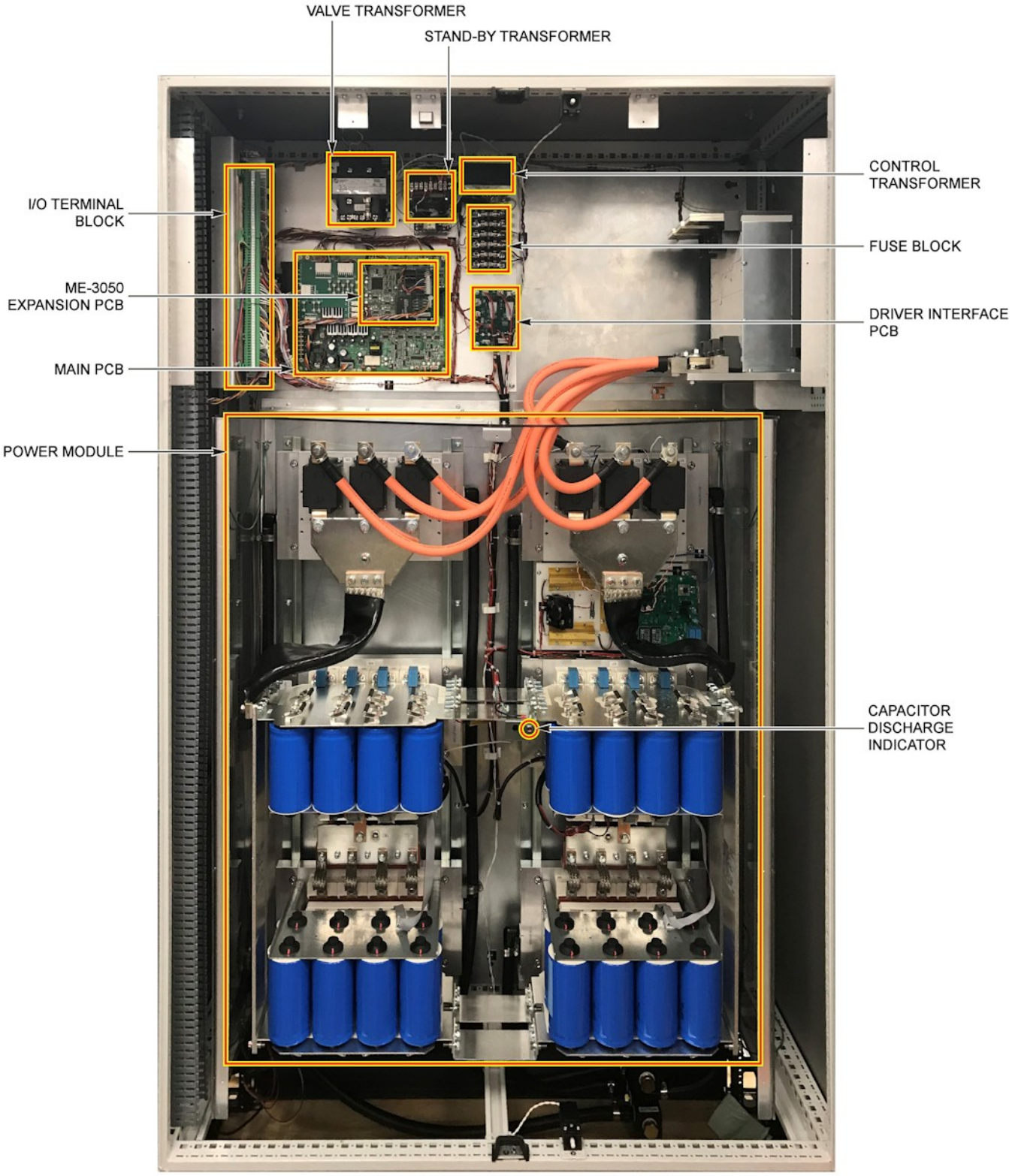
WELD ON/OFF Pushbutton Switch – This switch enables the unit to weld. When **ON**, the green indicator lights. When operating, the switch needs to be held until the green LED lights (or goes out). This is one of three conditions required to place the unit in the Ready condition; see "READY," above.

Internal Components

WARNING

Before opening the doors, disconnect ***all*** power to the unit order to prevent electrical shock or DEATH. Power is ***not*** turned OFF when the handle is turned and the door opened. ***Remove power from the IS and wait at least 20 minutes for the capacitors to discharge.*** Be sure capacitors are discharged before removing internal protective plastic panel.

To open the cabinet doors, insert the silver key into the lock on the right door and turn to unlock. The left door is unlocked with a handle inside the door. Note: Images of internal components may be different than shown due to revision changes, but basic connections will be the same.


VALVE TRANSFORMER
STAND-BY TRANSFORMER
CONTROL TRANSFORMER
I/O TERMINAL BLOCK
FUSE BLOCK
ME-3050 EXPANSION PCB
DRIVER INTERFACE PCB
MAIN PCB
POWER MODULE
CAPACITOR DISCHARGE INDICATOR

Power Module – The Power Module contains the IS-4500CA Power Modules.

Main PCB – This is the Main Control PCB that operates the IS-4500CA.

ME-3050 Expansion Board – This expansion board controls multiple valve outputs, the displacement input and the proportional valve outputs.

I/O Terminal Block – This terminal block is used to connect all input and output control signals. See *Appendix B* for details of these input and output signals.

Valve Transformer – Supplies power to the 24 V Power Supply for valve output.
Note: The 24 V power supply is located behind the I/O Terminal Block (not shown in the picture above).

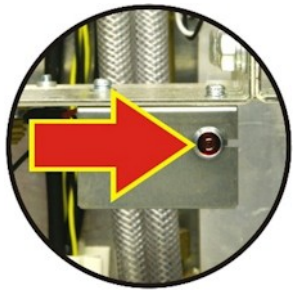
Standby Transformer – This transformer supplies power to Circuit Breaker enable control.

Control Transformer – Supplies power to the Main PCB.

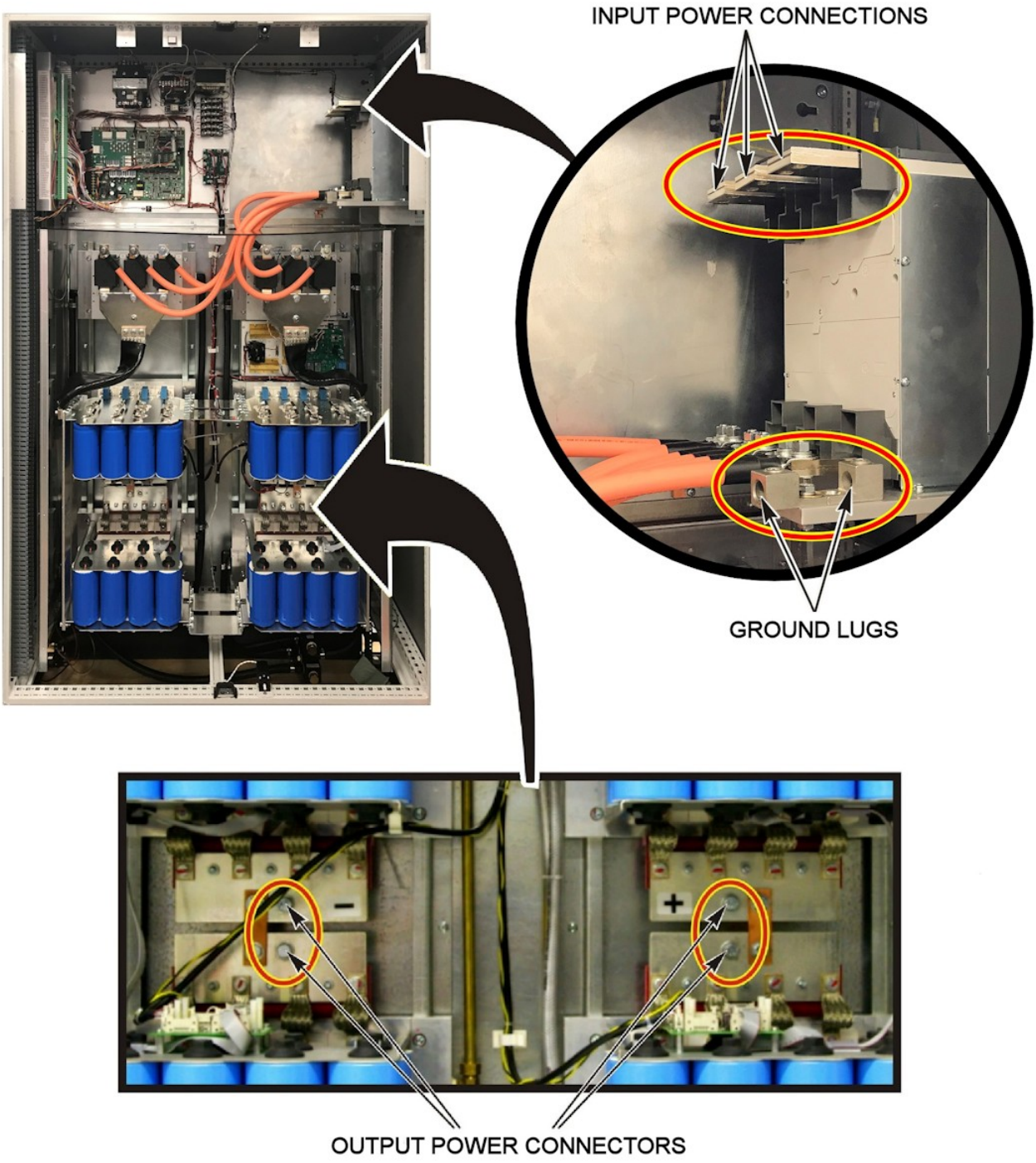
Fuse Block – Contains all of the transformer power fuses.

Driver Interface PCB – Supplies the control signals to the Semikron Modules in the Power Module.

Capacitor Discharge Indicator – The electrolytic capacitors in the Power Module are charged to a high voltage during operation of the IS-4500CA. The charge level is indicated by the brightness of the red indicator. The brighter the indicator, the higher the charge.



Power and Ground connections



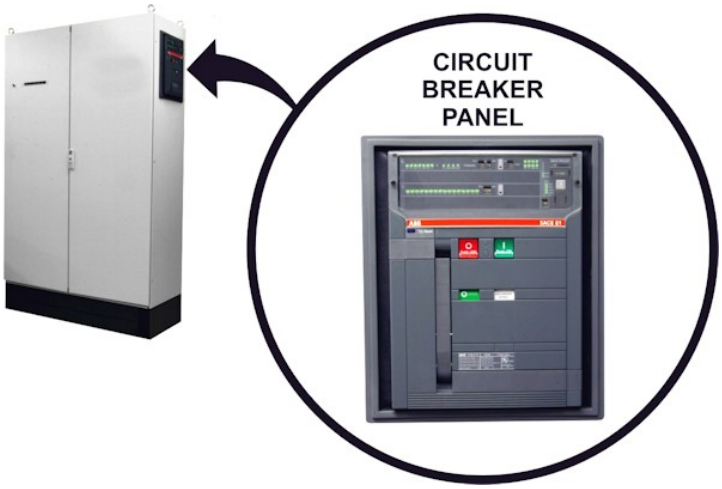
Input Power Connections – Input power is brought into the Power Supply through an access plate in the top. The plate can be removed for drilling appropriate size hole for input power cable conduit. Connections are made directly power lugs or an optional Circuit Breaker. Chassis ground connection is made to the Grounding Lug.

Circuit Breaker– Input power cables are connected to the Circuit Breaker.

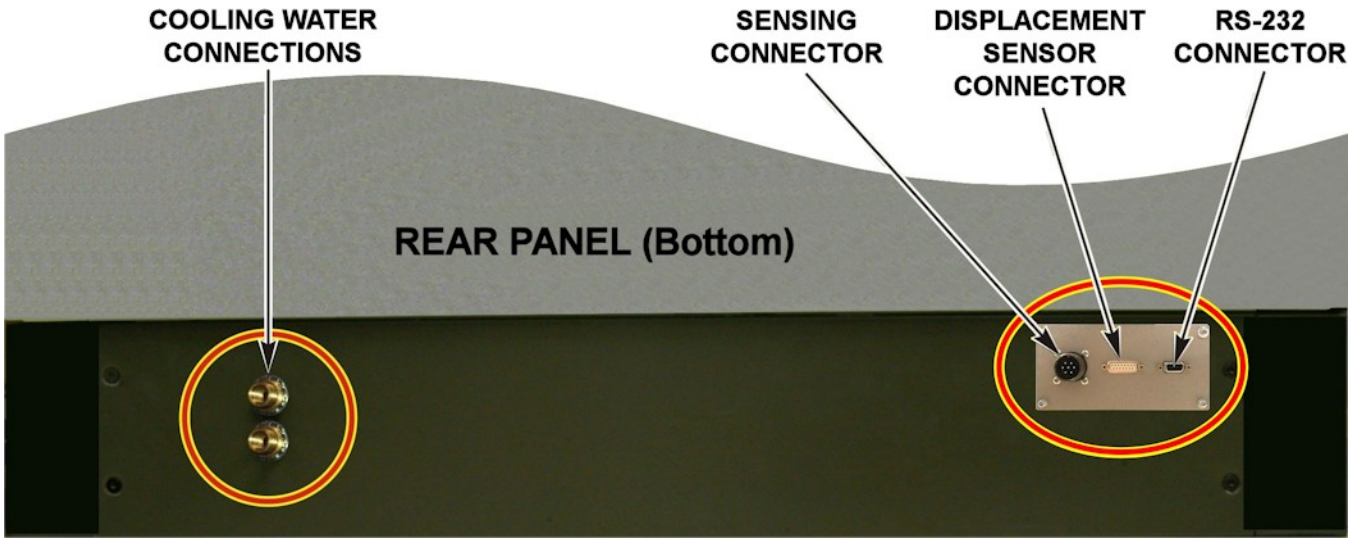
NOTE: The internal connections are shown on the previous page, the external panel is shown on the right.

Grounding Lug – Chassis ground connection point for input power.

Output Power Connections – The connection points for the output power to the weld transformer are as shown. The cables should exit through a conduit mounted in a convenient location on the bottom panel of the unit.



Rear Panel Base Connections



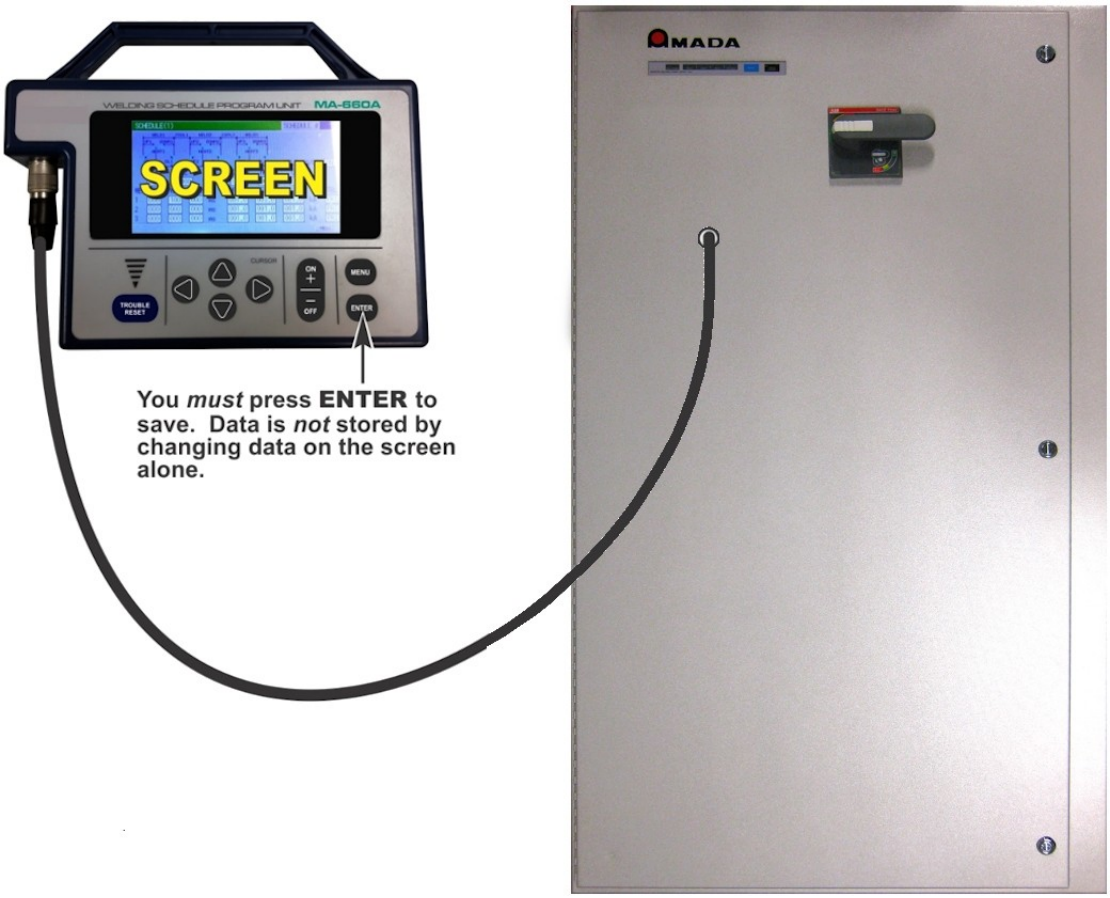
Cooling Water Fittings – These fittings provide source and drain connections for cooling water. See Chapter 2 for required specifications of cooling water.

Secondary Current Sensor Input Connector – This connector is used to connect a secondary current sensor to the Power Supply.

Section IV: MA-660A Program Unit ("The Pendant")

(Sold Separately)

The ***Power Supply*** uses the ***Pendant*** to set the weld schedules and see the monitored results. The Pendant is connected to the Power Supply by a cable attached to the connector on the front door of the Power Supply as shown below.



TROUBLE RESET key

Press this key after the cause of trouble is eliminated. Once selected all error messages that appear on the screen will turn off.

CURSOR Keys

Used to move the cursor or to select an item.

+ON/-OFF Keys

Used to change the value of a selected item or turn it on and off.

ENTER Key

Used to write the set or changed value and [ON/OFF] data in the Power Supply connected to the MA-660A. After any data is set or changed, be sure to press this **ENTER** key to write that data before moving the cursor.

If this **ENTER** key is not pressed, the Power Supply connected to the MA-660A will not recognize the set data.

The Power Supply writes data into FLASH ROM on the control board when a setting is changed or a schedule data is copied. The **READY** lamp on the front panel and the external **READY** signal are turned off during writing. Check that the **READY** lamp is turned on to start welding.

It takes about 3 seconds maximum to change a setting, about 125 seconds to copy a schedule, and about 5 seconds maximum to initialize schedules in FLASH ROM. During that time, do not turn off the power.

MENU Key

Used to display the **MENU** screen. Press this key to return to **MENU** screen from any other screen.

CAUTION

No setting changes can be made while the start signal is ON or during a weld sequence.

If a setting is changed during the welding sequence, an error message will appear. Press the **TROUBLE RESET** key to clear the message.

Also, when making a screen change to call up another setting schedule during a welding sequence, the **TROUBLE RESET** key will not work even if the following screen appears. In this case, you need to recycle the power to the Unit.

CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning

Environmental Factors

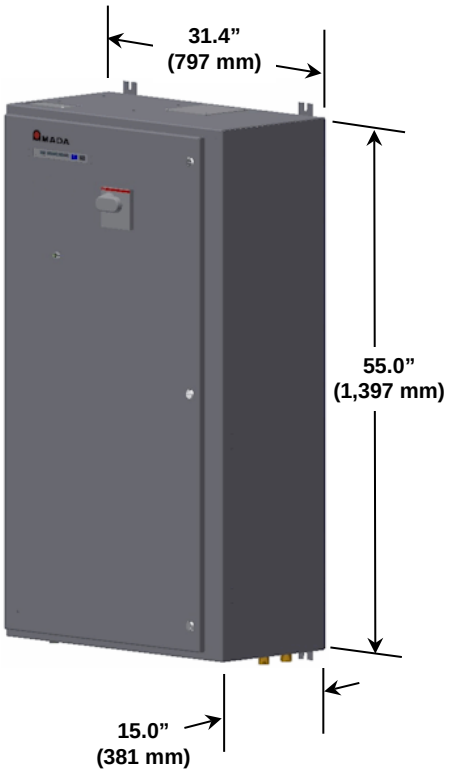
We recommend that you install the Power Supply in a well-ventilated area that is free from excessive dust, weld expulsion, acids, corrosive gasses, salt, moisture, oil, coolant, and contaminants. Allow adequate space around the unit for power and signal cabling runs, water-cooling hose connections, and to open the front door. Electrical input is made from the top of the Power Supply; output power (to the weld transformer) is made from the bottom of the Power Supply. Signal connections may be made from either the top or bottom of the Power Supply.

The Power Supply is designed to work in the following ambient conditions:

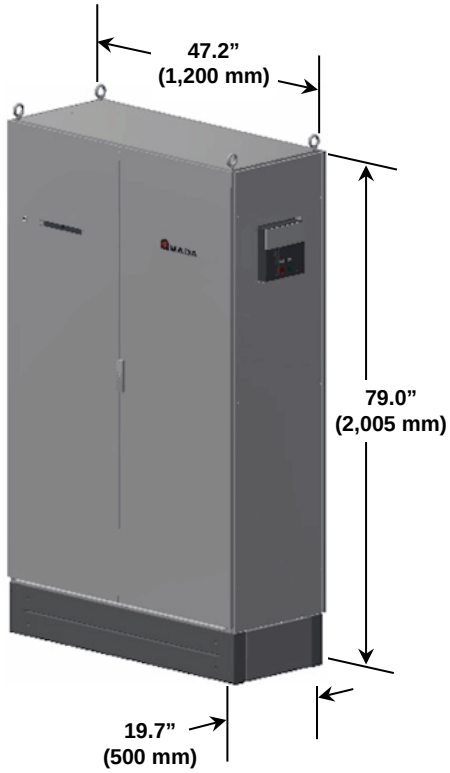
- Temperature: 41 – 104 °F (5 – 40 °C)
- Humidity: Less than 90%, non-condensing

Space and Mounting Requirements

IS-2200CA



IS-4500CA



Power Requirements

Power required for the Power Supply is three-phase, 380 or 480 VAC (nominal), 50 - 60 Hz. When changing the input voltage, the valve transformer input leads will need to be changed to the new voltage.

NOTES:

- All items other than IS-2200CA/4500CA are sold separately.
- In the secondary constant-current effective value control and secondary constant-power effective value control, a toroidal coil and a volt-sensing cable are required. Connect the volt-sensing cable near an electrode and connect the opposite side of the cable to pins TB5-1 and TB5-2 on the external I/O terminal strip.

  NOTE: If used with AMADA WELD TECH - IT Transformers, you can purchase the 18-045-01 transformer sense cable which will have these connections.

Section II: Installation of IS-2200CA

CAUTION

- Make sure the mounting location can support the ***weight*** of the unit!
- A mechanical lift or hoist should be used for unpacking and installation due to the weight of the unit!
- Protect electronic components from metal shards when drilling pilot holes and punching holes in the cover plates to connect external equipment. We recommend removal of the plates before drilling and punching, but if plates cannot be removed, be sure ***all*** metallic shards from the Power Supply after completion of the work.

Unpacking

Unpack the Power Supply from its shipping box. Carefully save and store packing materials for future storage or shipment of the Power Supply.

Installation

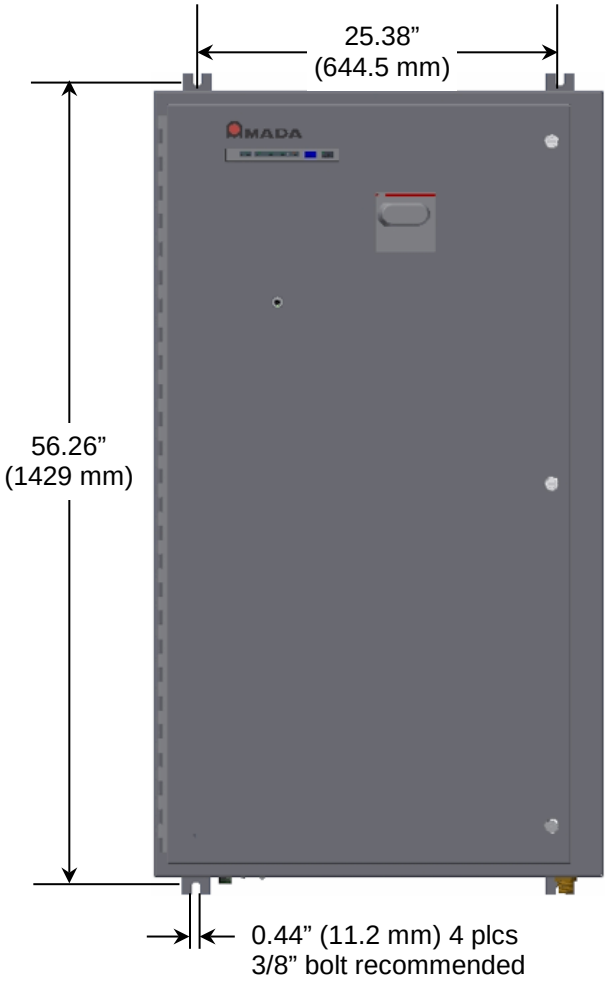
Installation consists of mounting the unit and making power, signal, and cooling water connections.

Mounting the Power Supply

The unit has four mounting tabs, two with mounting holes, and two with mounting slots, as shown below. As each installation is different, no mounting hardware is provided for the unit. The holes on the mounting tabs are 0.44 inch diameter, and are designed for 7/16" screws or bolts. You will need to provide the appropriate screws or bolts, flat and lock washers, and nuts.

1. Loosely install the two lower mounting screws.
2. Slide the Power Supply bottom (slotted) tabs into the two lower mounting screws.
3. While the Power Supply is being held in place, install the two upper mounting screws then tighten the two lower mounting screws.

IS-2200CA Mounting Hole Locations



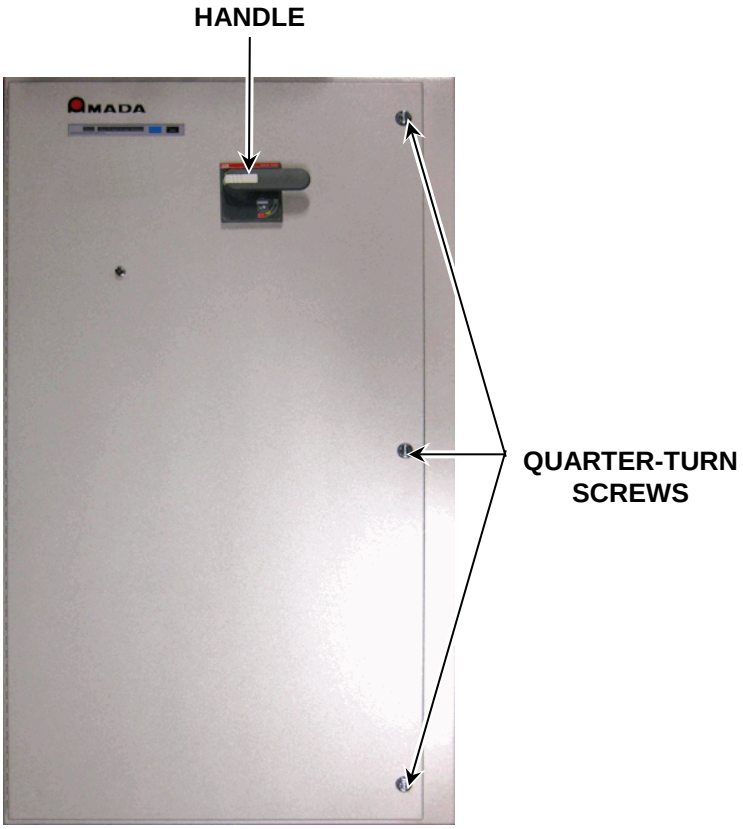
Electrical Connections

DANGER

- Do ***not*** install power to the Power Supply without the input power service being turned off and tagged (Lock-out Tag-out). Serious injury or death can result from contacting live power lines. If the Power Supply was previously powered up, allow 20 minutes for the internal capacitor bank to discharge.
- The installer ***must*** make electrical connections in accordance to all applicable codes. For appropriate cable ratings, see *Appendix D, Wire + Breakers.*

Input Power Connections

Electrical input is made from the top of the Power Supply through the Line-In cover plate. We recommend removal of the cover plate to an area away from the Power Supply before drilling holes. This will reduce the need to protect the electronics from metallic shards that otherwise could damage the unit or injure personnel.



1. Make sure the input 3-phase power coming from the wall is off.
2. Open the front door by turning the two quarter-turn screws and turning the handle.

   NOTE: When the IS-2200CA handle is turned the circuit breaker turns OFF.

3. Remove the terminal cover from the top of the circuit breaker by grasping the cover on both sides and pulling it toward you.
4. Remove the four screws that secure the Line-In Cover Plate directly above the circuit breaker.
5. Drill appropriate hole(s) in the plate to receive the input power conduit(s).

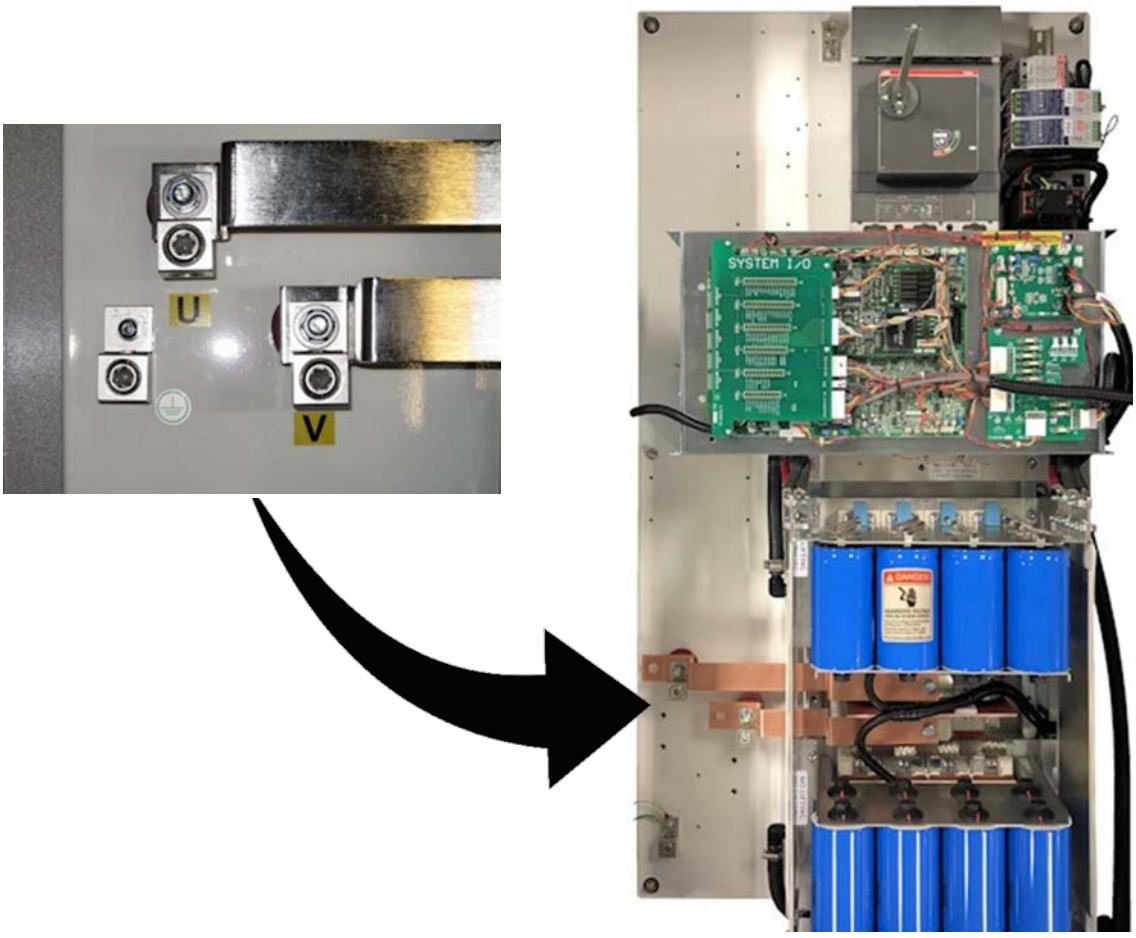
   NOTE: *Remove all metal shards,* then re-install the plate.
6. Install service conduit to plate and feed input power cables into the Power Supply.
7. Connect three-phase power cables to the three socket head screws in the circuit breaker. Input is not phase dependent.

8. Connect the ground cable to the chassis ground terminal to the right of the circuit breaker.
9. Slide the circuit breaker terminal cover back on to the circuit breaker.
10. Remove the four screws that secure the Line-Out Cover Plate on the bottom of the Power Supply.
11. Drill appropriate hole(s) in the plate to receive the weld transformer power conduit(s).

    NOTE: ***Remove all metal shards,*** then re-install the plate.
12. Install the weld transformer conduit to the plate and feed cables into the Power Supply.
13. Connect the ground cable to the ground lug.
14. Connect the two transformer cables to connectors labeled U and V in the power module. (*see next page*)

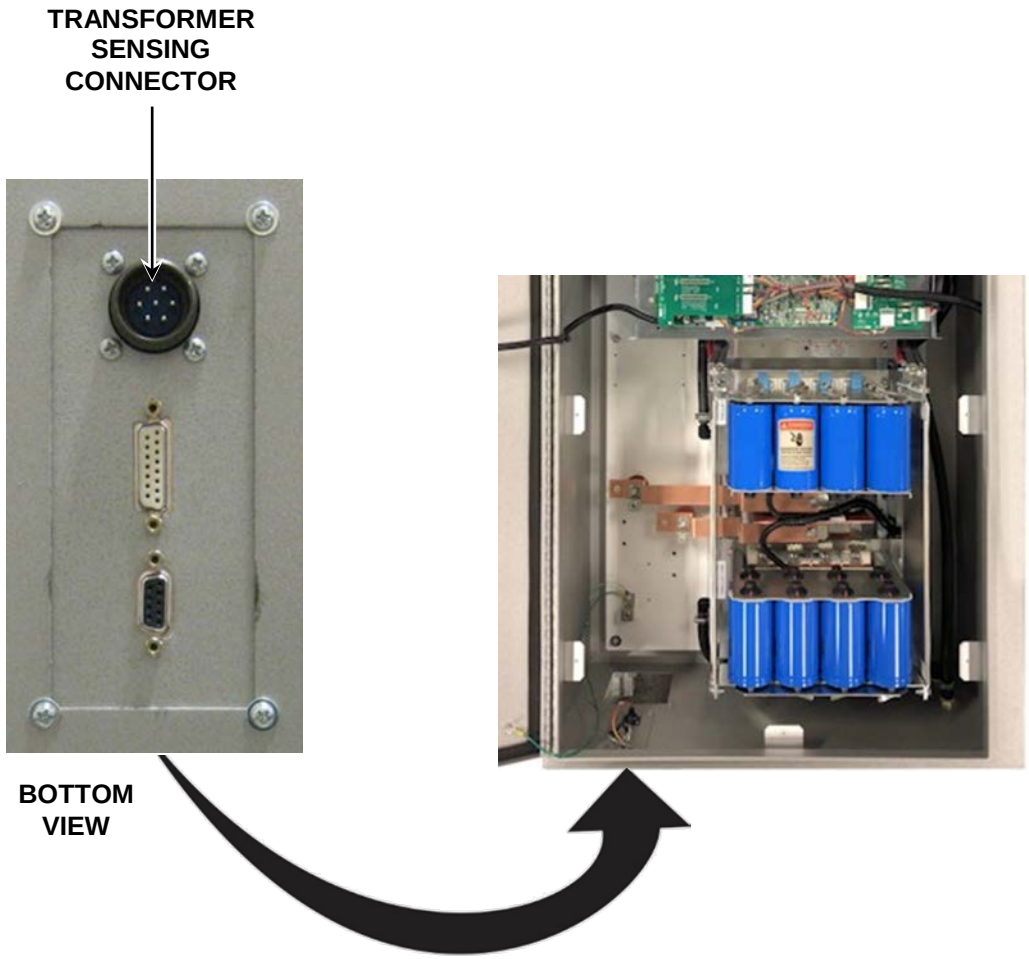
Output Power Connections

Weld transformer connections are made from the bottom of the Power Supply through the Line-Out Cover Plate. We recommend that you remove the cover plate to an area ***away*** from the Power Supply ***before*** drilling holes. This will reduce the need to protect the electronics from metallic shards that otherwise could damage the unit or injure personnel.



Signal Sensing Connections

See *Appendix B, Electrical and Data Connections, Section I, Data Connectors* for connector pin information and *Section II, Input / Output Signal Configuration* for connection and configuration instructions.



IS-2200CA Cooling Water Requirements

The connections to the Power Supply are made with 1/2" FNPT fittings through the bottom of the Power Supply. We recommend the installation of quick-disconnect fittings to expedite water draining or Power Unit replacement. See *Appendix A, Technical Specifications* for cooling water specifications.

CAUTION: If the temperature drops below 32 °F (0 °C), the water inside the Power Supply can freeze and damage the equipment. If the temperature is likely to drop ***below*** 32 °F (0 °C), drain the water in accordance to the procedure in *Chapter 4, Maintenance*. To prevent condensation, which may damage the Power Supply, do ***not*** run cooling water through an unused Power Supply unit if the water is 4 °F (2.2 °C) ***below*** the minimum operating ambient temperature. Therefore, take special care to keep the water temperature above the minimum operating ambient temperature.

The installation site should be free of sudden temperature fluctuations and the humidity should be ≤ 85% (non-condensing).

CAUTION:

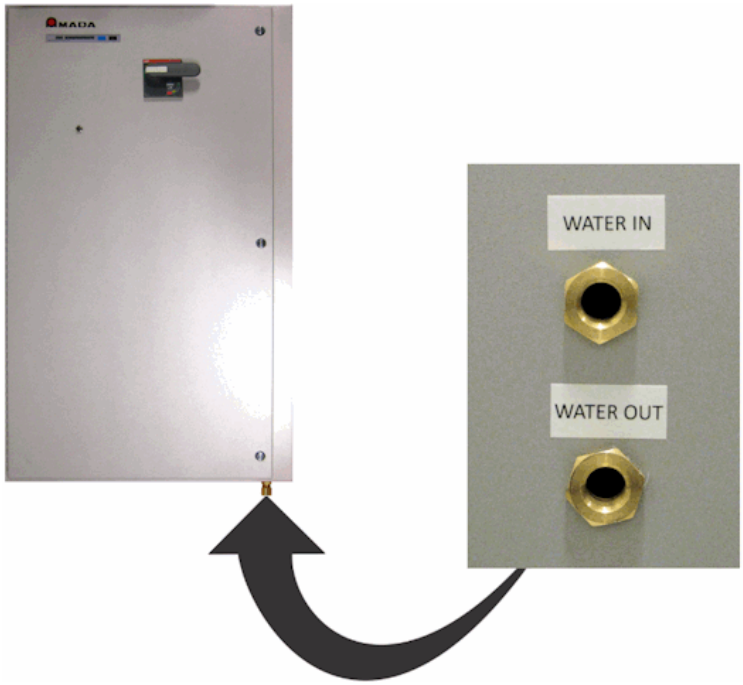
Verify that the cooling water lines do not condense with moisture. If necessary, increase the external cooling water temperature to raise the dew point and prevent condensation.

IS-2200CA Cooling Water Hose Connections

CAUTION: Do ***not*** perform service on cooling system unless the Power Supply is turned OFF and the breaker handle tagged! (Lock-Out Tag-Out)

NOTE: Internal Cooling Water hoses are factory-installed with quick-disconnect fittings.

1. Install a water flow failure indicator on the water outlet. The flow failure indicator output signals should be connected to the appropriate pins of the I/O Signals terminal block.
2. ***After*** you connect all cooling water hoses, turn the water ON and check for leaks.



NOTE: Adjust the cooling water flow rate to at least 6 L/min. If it is low, the IGBT thermostat error will be detected and operation will stop.

Section III: Installation of IS-4500CA

WARNING

- Make sure the mounting location can support the ***weight*** of the unit.
- A mechanical lift or hoist should be used for unpacking and installation due to the weight of the unit!
- Protect electronic components from metal shards when drilling pilot holes or punching holes in the cover plates to connect external equipment. We recommend removal of the plates before drilling and punching, but if plates cannot be removed, be sure ***all*** metallic shards from the Power Supply after completion of the work.

Unpacking

Unpack the Power Supply from its shipping crate. Carefully save and store packing materials for future storage or shipment of the Power Supply.

Installation

Installation consists of mounting the unit and making power, signal, and cooling water connections. Holes must be drilled into the Power Supply in order to install the Input and Output Power cables.

Mounting the Power Supply

The unit is free standing on legs. The legs need to be bolted to the floor for safety.

As each installation is different, no mounting hardware is provided with the unit. You will need to provide the appropriate screws or bolts, flat and lock washers, and nuts.

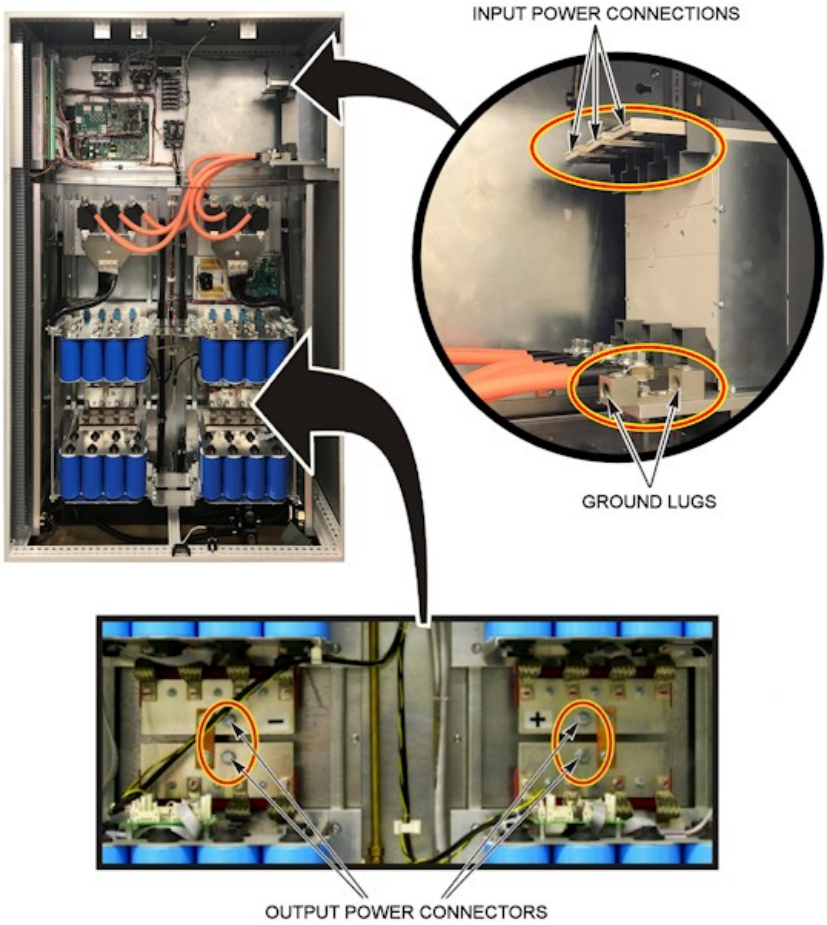
Electrical Connections

DANGER

- Do ***not*** install power to the Power Supply without the input power service being turned off and tagged (Lock-out Tag-out). Serious injury or death can result from contacting live power lines. If the Power Supply was previously powered up, allow 20 minutes for the internal capacitor bank to discharge.
- The installer ***must*** make electrical connections in accordance to all applicable codes. For appropriate cable ratings, see *Appendix D, Wire + Breakers.*

Input Power Connections

Electrical input is made from the top of the Power Supply through the Line-In cover plate. We recommend removal of the cover plate to an area away from the Power Supply before drilling holes. This will reduce the need to protect the electronics from metallic shards that other wise could damage the unit or injure personnel.

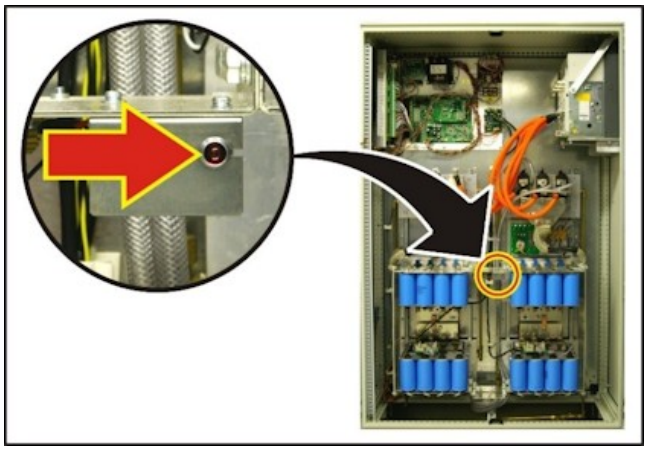


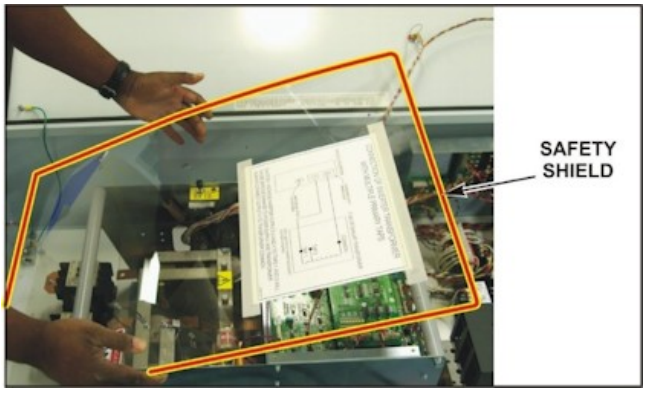
1. Make sure the input 3-phase power coming from the wall is off.
2. Open the front doors by turning the respective handles. Verify that the capacitor bank is discharged.
3. Remove the four screws that secure the Line-In Cover Plate.
4. Drill appropriate hole(s) in the plate to receive the input power conduit(s).
   NOTE: ***Remove all metal shards***, then re-install the plate.
5. Install service conduit to the enclosure and feed input power cables into the Power Supply.
6. Connect three-phase power cables to the circuit breaker. Input is not phase dependent.
7. Connect the ground cable to the chassis ground terminal at the bottom corner of the circuit breaker.

Output Power Connections

Weld transformer connections are made from the bottom of the Power Supply through removable lower side panels. We recommend that you remove these panels to an area ***away*** from the Power Supply ***before*** drilling holes. This will reduce the need to protect the electronics from metallic shards that otherwise could damage the unit or injure personnel.

1. Verify that all power to the Power Supply has been turned OFF.
2. Open the front door by turning the door handles.
3. Wait 20 minutes until the **CAPACITOR DISCHARGE INDICATOR** is completely OFF.
4. Remove the screws holding the plastic Safety Shield in place. The Safety Shield has been outlined for clarity.





5. Drill appropriate hole(s) in the removable lower panels to receive the output power (weld transformer) conduit(s).

   NOTE: ***Remove all metal shards,*** then re-install the plate.

6. Install the weld transformer conduit to the plate and feed cables into the Power Supply.
7. Connect the ground cable to the ground lug.
8. Connect the two transformer cables to the power module.
9. Replace the plastic high voltage protection panel and secure it in place with the screws removed in Step 1.

Signal Sensing Connections

See *Appendix B, Electrical and Data Connections, Section I, Data Connectors* for connector pin information and *Section II, Input / Output Signal Configuration* for connection and configuration instructions.

Breaker

Breaker Rated Current

Calculate the average Input current using output current (momentary maximum current) and duty cycle:

Effective continuous current = I x 0.817 x $\sqrt{\frac{\alpha}{100}}$

(I : Output current (momentary maximum current) of **IS-2200CA/4500CA**
α : Duty cycle (%))

Select the breaker rated current of at least the average input current above. Check the coordination of output current (momentary maximum current) and tripping time on the tripping characteristic curve of the breaker to select the appropriate breaker.

Output current = 4500A / Duty cycle = 10%
$4500 \times 0.817 \times \sqrt{\frac{10}{100}} = 1163$ amps Breaker of at least 1163A (e.g., 1200 amps) must be selected.

Input / Output Cable

An input/output cable is determined by the average input current and the average output current. Calculate the average input current and the average output current using output current (momentary maximum current) and duty cycle.

Effective continuous current = I x 0.817 x $\sqrt{\frac{\alpha}{100}}$

Effective continuous current = I x $\sqrt{\frac{\alpha}{100}}$

(I: Output current (momentary maximum current) of **IS-2200CA/4500CA**
α: Duty cycle (%))

Check the manufacturer's characteristic table to select the cross section of the cable according to the allowable current. Although a four-core cable is used for the input cable and a three-core cable is used for the output cable, one of the cores is for grounding. Therefore, use the allowable current of three cores for input cable and that of two cores for output cable.

Output current (momentary maximum current) = 1000 amps / Duty cycle = 15%

Average input current is as follows.

$1000 \times 0.817 \times \sqrt{\frac{15}{100}} = 316$ amps

Average output current is as follows.

$1000 \times \sqrt{\frac{15}{100}} = 387$ amps

Use a cable of a nominal cross section with 316 amps or more of allowable current of three cores for input cable and 387 amps or more of allowable current of two cores for output cable.

IS-4500CA Cooling Water Requirements

The connections to the Power Supply are made with 1/2" FNPT fittings through the rear of the Power Supply. See *Appendix A, Technical Specifications* for cooling water specifications.

CAUTION: If the temperature drops below 32 °F (0 °C), the water inside the Power Supply can freeze and damage the equipment. If the temperature is likely to drop ***below*** 32 °F (0 °C), drain the water in accordance to the procedure in *Chapter 4, Maintenance*. To prevent condensation, which may damage the Power Supply, do ***not*** run cooling water through an unused Power Supply unit if the water is 4 °F (2.2 °C) ***below*** the minimum operating ambient temperature. Therefore, take special care to keep the water temperature above the minimum operating ambient temperature.

The installation site should be free of sudden temperature fluctuations and the humidity should be ≤ 85% (non-condensing).

CAUTION:

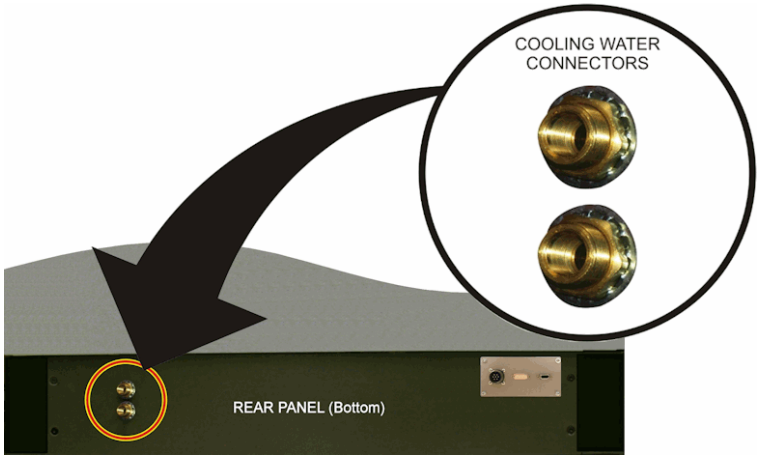
Verify that the cooling water lines do not condense with moisture. If necessary, increase the external cooling water temperature to raise the dew point and prevent condensation.

IS-4500CA Cooling Water Hose Connections

CAUTION: Do ***not*** perform service on cooling system unless inverter power is OFF and breaker handle tagged!

CAUTION: Do ***not*** perform service on cooling system unless the Power Supply is turned OFF and the breaker handle tagged! (Lock-Out Tag-Out)

NOTE: Internal Cooling Water hoses are factory-installed with quick-disconnect fittings.



1. Install a water flow failure indicator on the water outlet. The flow failure indicator output signals should be connected to the appropriate pins of the I/O Signals terminal block.
2. ***After*** you connect all cooling water hoses, turn the water ON and check for leaks.

   NOTE: Adjust the cooling water flow rate to at least 6 L/min. If it is low, the IGBT thermostat error will be detected and operation will stop.

CHAPTER 3
IS-2200CA/4500CA: USING PROGRAMMING FUNCTIONS

Introduction

FLASH ROM The Power Supply writes data into FLASH ROM on the control board when a setting is changed or a schedule data is copied. The **READY** lamp on the front panel and the external **READY** signal are turned off during writing. Check that the **READY** lamp is turned on to start welding. It takes about 2 seconds at longest to change a setting and about 1 minute to copy a schedule into FLASH ROM. During that time, do ***not*** turn the power OFF.

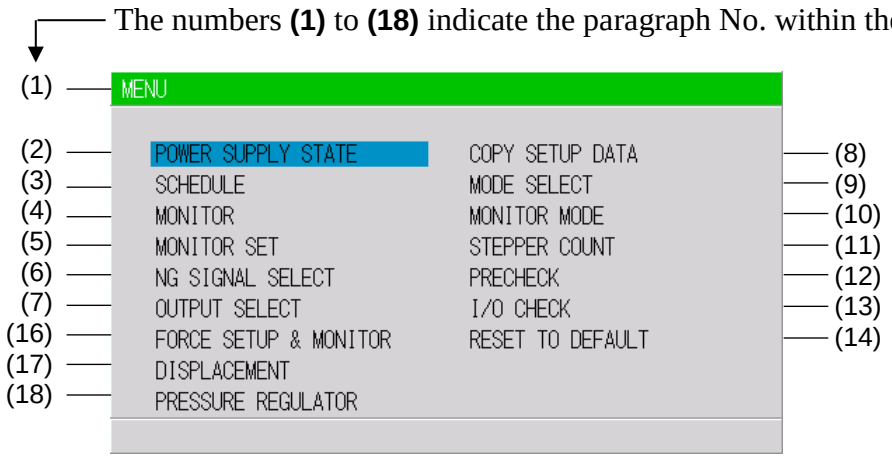
SHADED CHARACTERS Items for which a value must be input, or which must be set ON or OFF will be shaded. Move the cursor to the item and type in the appropriate changes.

WARNING

It is possible that weld current is flowing even though error message **E-05** (**NO CURRENT**) is displayed. ***To avoid electrocution use extreme caution.***

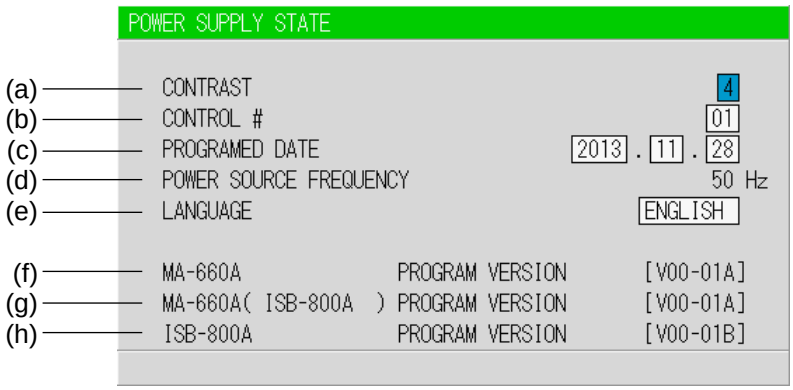
1. MENU Screen

The **MA-660A** has various functions that are set from the respective screens. The MENU screen displays these functions in menu form.
Move the cursor () to the desired item; press the **ENTER** key to move to the selected screen.



2. POWER SUPPLY STATE Screen

This screen is used to display and set data for the Power Supply. Move the cursor to change the value.



a. LCD CONTRAST

Sets the screen contrast. The contrast can be set in a range from 0 to 9. The larger the value, the darker the screen. Adjust the contrast if the screen is difficult to view.

b. CONTROL

Input the identification No. of your Power Supply.
If you have two or more Power Supply units, input 01 for the first one, 02 for the second one, 03 for the third one, and so on. Used for communication.

c. PROGRAMMED DATE

Input the date on which a schedule is set as data. The date does not affect the set schedule. When the Power Supply memory is initialized, the date is also initialized to the date on which the ROM version is created.

d. POWER SOURCE FREQUENCY

The frequency of the welding power is measured and indicated automatically.

e. LANGUAGE

Select the language from Japanese and English.

f. MA-660A ROM VERSION

Indicates the ROM version No. of program unit MA-660A.

g. MA-660A (IS-2200CA/4500CA) PROGRAM VERSION

Indicates the program version No. of the Power Supplies screen display part.

h. IS-2200CA (IS-4500CA) ROM VERSION

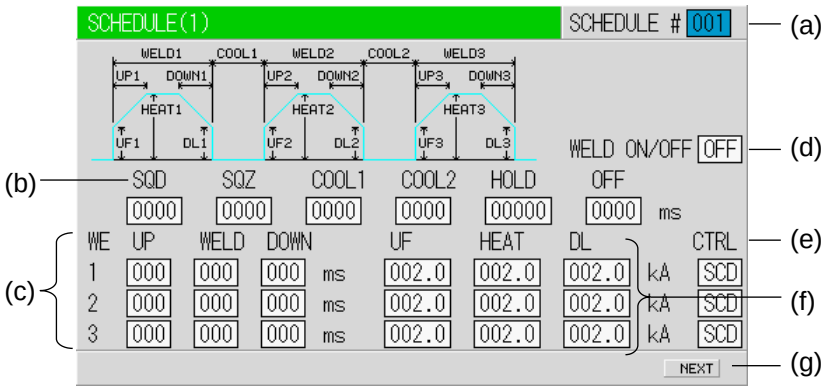
Indicates the ROM version No. of the Power Supply.

3. SCHEDULE Screen

Up to 255 welding schedules can be set on the Power Supply. These schedules are indicated as SCHEDULE #1 to #255.In the SCHEDULE screen, there is a Current and Time setting screen and a PULSATION and transformer screen.

CURRENT and TIME Setting Screen

This screen is used to set the SCHEDULE No., length of weld time, welding current, and so on. The ms mode or CYC mode can be changed via WELD TIME (Refer to *Chapter 3, Section 10*) on the MODE SELECT screen.



NOTE: The unit, resolution, and setting range change depending on the settings of CTRL/CURR RANGE.

a. SCHEDULE

Select from #1 to #255 to set the SCHEDULE. Normally select #1 first, then select additional schedules in sequential order.

b. TIME

Set the time for each operation during welding. Units of time are in ms or CYC. The screen above is in ms setting. CYC can be selected via the MODE SELECT screen. See the Timing Chart for each operation.

SQD / Squeeze delay time	Length of time added to SQZ; only for the first weld after start signal in repeat operation.
SQZ / Squeeze time	Length of time until proper squeeze is applied to workpiece.
COOL1 / Cooling time 1 and **COOL2** / Cooling time 2	Length of time to cool workpiece after turning off welding current.
HOLD / Hold time	Length of time to hold workpiece after turning off welding current.
OFF / Off time (*)	Length of time to turn off valve signal between repeated operations. (No repeat operation if set to "0" or the upper/lower limit judgment error occurs in a sequence.)

* OFF/Off time

- Count and step value are updated each welding.
- **RE-WELD** does not work simultaneously with **OFF**. When **OFF** is set, **RE-WELD** becomes invalid.
- **START SIG.MODE** has limitations. When OFF is set, **MAINTAINED** of **START SIG.MODE** does not work. It works as **LATCHED**.

c. WELD (1, 2, 3)

Set the length of time to allow welding current to flow. As units of time, ms and CYC may be selected. Either unit can be selected via the MODE SELECT screen.

UP (1, 2, 3)

Set the upslope time (to increase the welding current gradually).

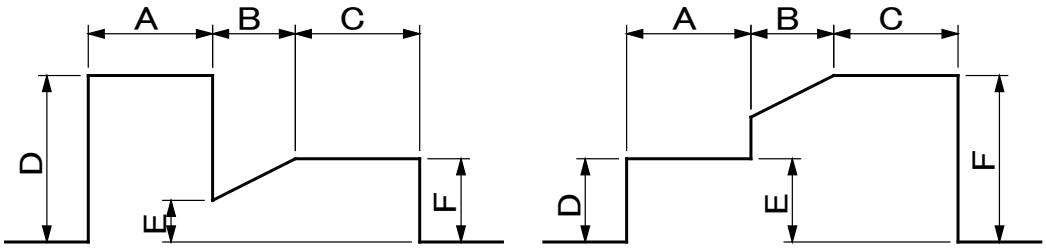
DOWN (1, 2, 3)

Set the downslope time (to decrease the welding current gradually).

NOTE: Upslope / Downslope waveform when COOL (cooling time) is set to 0. The welding current normally increases from the UF set value to the HEAT set value and decreases from the HEAT set value to the UF set value, but E-10 (Schedule setting error) will occur when the Power Supply starts with the following setting.

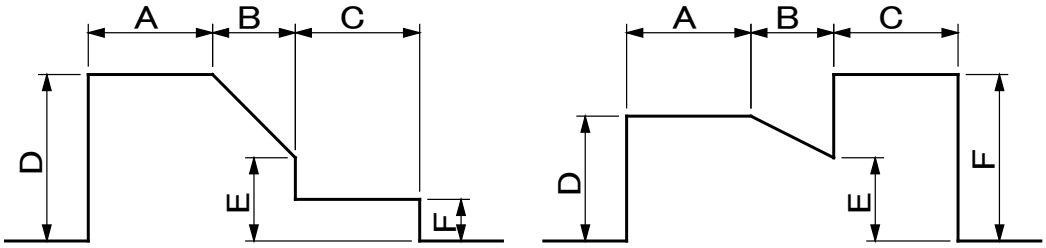
When the control methods for the previous and subsequent stages in the multi-stage welding are changed. The control method for the previous stage is different from that for the subsequent stage.

When the upslope time is set for the subsequent stage in the multi-stage welding, the upslope time is set for the subsequent stage, and the **HEAT** setting of **D** and the **UF HEAT** setting of **E** are different.



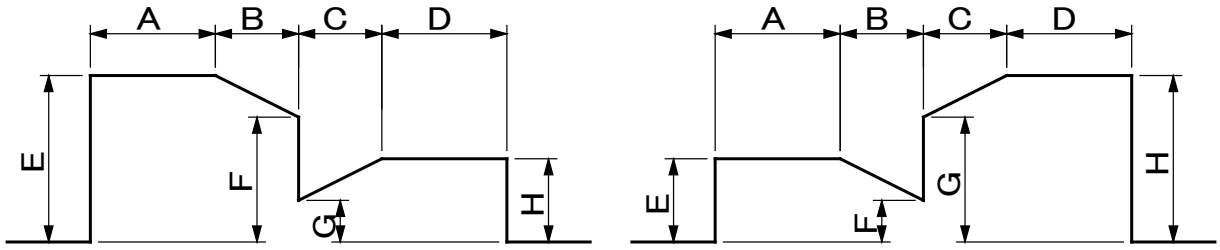
A: WELD1 time or WELD2 time
B: UP2 time or UP3 time
C: WELD2 time or WELD3 time
D: WELD1 HEAT or WELD2 HEAT
E: UF2 HEAT or UF3 HEAT
F: WELD2 HEAT or WELD3 HEAT

When the downslope time is set for the previous stage in the multi-stage welding, the downslope time is set for the previous stage, and the **DL HEAT** setting of **E** and the **HEAT** setting of **F** are different.



A: WELD1 time or WELD2 time
B: DOWN1 time or DOWN2 time
C: WELD2 time or WELD3 time
D: WELD1 HEAT or WELD2 HEAT
E: DL1 HEAT or DL2 HEAT
F: WELD2 HEAT or WELD3 HEAT

When the slope times are set for the previous and subsequent stages in the multi-stage welding. The downslope time is set for the previous stage, the upslope time is set for the subsequent stage, and the **DL HEAT** setting of **F** and the **UF HEAT** setting of **G** are different.

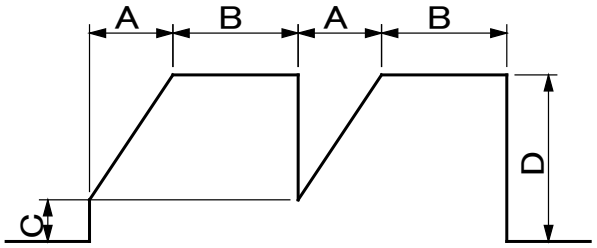


A: WELD1 time or WELD2 time
B: DOWN1 time or DOWN2 time
C: UP2 time or UP3 time
D: WELD2 time or WELD3 time
E: WELD1 HEAT or WELD2 HEAT
F: DL1 HEAT or DL2 HEAT
G: UF2 HEAT or UF3 HEAT
H: WELD2 HEAT or WELD3 HEAT

NOTES:

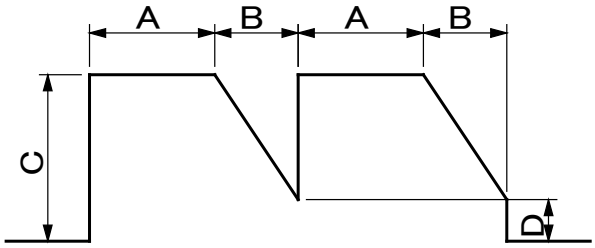
- Set 1 (ms/CYC) or more for at least one of WELD1, WELD2 and WELD3. Also, set the total time of UP and DOWN to be shorter than WELD. If not, E-10 (Schedule setting error) will be displayed.
- Upslope / Downslope waveform when INT (downtime) is set to 0.
- E-10 (Schedule setting error) will occur when the Power Supply starts with the setting below.

When the upslope time is set in the pulsation welding. The upslope time is set, and the UF HEAT setting of C and the HEAT setting of D are different.



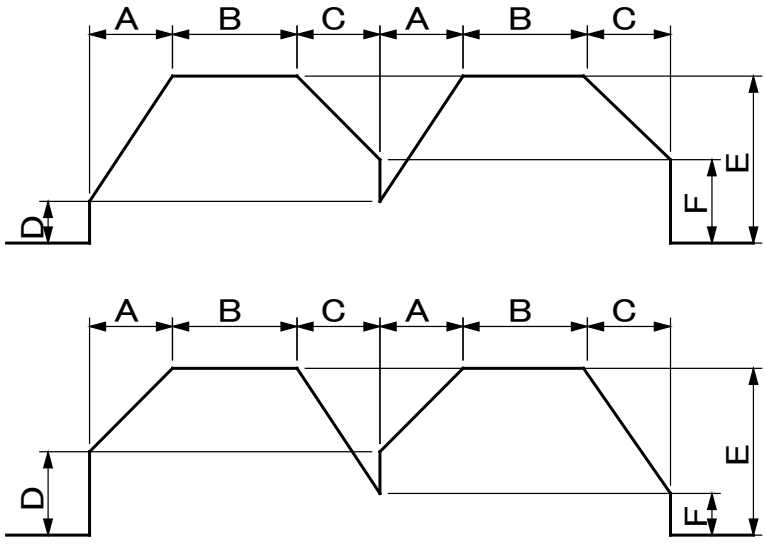
A: UP1 to 3 time
B: WELD1 to 3 time
C: UF1 to 3 HEAT
D: HEAT1 to 3

When the downslope time is set in the pulsation welding. The downslope time is set, and the **HEAT** setting of **C** and the **DL HEAT** setting of **D** are different.



A: WELD1 to 3 time
B: DOWN1 to 3 time
C: HEAT1 to 3
D: DL1 to 3 HEAT

When the upslope time and the downslope times are set in the pulsation welding. The upslope time and the downslope time are set, and the **UF HEAT** setting of **D** and the **DL HEAT** setting of **F** are different.



A: UP1 to 3 time
B: WELD1 to 3 time
C: DOWN1 to 3 time
D: UF1 to 3 HEAT
E: HEAT1 to 3
F: DL1 to 3 HEAT

d. WELD ON/OFF

One of the settings required to turn the READY lamp of the Power Supply ON.

NOTE: Even if this switch is ON, the Power Supply cannot supply welding current if the WELD ON/OFF key on the front panel or external WELD ON/OFF signal is OFF. In order for the Power Supply to supply welding current, this switch, the WELD ON/OFF key, and the external WELD ON/OFF signal must all be ON.

e. CTRL

Select one from the following six welding current control methods for **WE1**, **WE2** and **WE3**, respectively. Press **+ON/-OFF** key to switch the setting. The initial setting is the secondary constant-current effective value control (**SCD**).

Display	Control method
PRI	Primary constant-current effective value control
SCD	Secondary constant-current effective value control
PWR	Secondary constant-power effective value control
PLM	Primary constant-current peak value control
VLT	Secondary constant-voltage effective value control
FPL	Constant-phase control

(Note) Control method of the inverter-type welding power supply

CONTROL METHOD	FEATURE	APPLICATION	CONTROL MECHANISM
Primary constant-current control (PWM effective value control)	Requires no connection of toroidal coil on the secondary side of the transformer. Requires turn ratio setting of the inverter-type transformer. The loss inside the transformer is not considered.	Used for welding in a robot or an environment where the weld head moves and that causes disconnection of toroidal coil and cable.	Detects the primary current by the current sensor mounted into the power supply to compare the measured current obtained by calculating with each control frequency to the primary current obtained by "set current ÷ turn ratio", and controls pulse width so that there is no difference in these values.
Secondary constant-current control (PWM effective value control)	Compared to the primary constant-current control, the current accuracy is high since the welding is directly controlled, being detecting the welding current.	Commonly used for general welding.	Detects the welding current with toroidal coil to compare the measured current obtained by calculating with each control frequency to the set current, and controls pulse width so that there is no difference in these values.

CONTROL METHOD	FEATURE	APPLICATION	CONTROL MECHANISM
Secondary constant-power control (PWM effective value control)	Controls so that the power between electrodes becomes constant. Responds to change in work piece state during welding to make heat input constant.	Used when you want to reduce expulsion in early welding, shunt current is occurred at welding, or make heat generation constant.	Detects the welding current with toroidal coil and the voltage between electrodes with the voltage detecting cable to compare the power calculated by the measured current obtained by calculating with each control frequency and voltage to the set current, and controls pulse width so that there is no difference in these values.
Primary constant-current peak value control (PWM peak value control)	Requires no connection of toroidal coil on the secondary side of the transformer. Requires turn ratio setting of the inverter-type transformer. The loss inside the transformer is not considered. Compared to the effective value control, the rise of the current is fast, but the effective current changes depending on how large the current ripple is.	Used for welding of coated metal or dissimilar metal.	Sets the primary current obtained by the set current and the transformer turn ratio as current limiter, and controls pulse width so that the switching is turned off when the primary current detected by the current sensor mounted into the power supply has reached to the current limiter.
Secondary constant-voltage control (PWM effective value control)	Controls with the voltage between electrodes. Provides welding without expulsion by making voltage from the rise constant and reducing the current.	Used for welding of high specific resistance material, welding of high contact resistance work piece such as cross wire, and projection welding, which has resistance change in early welding to reduce expulsion.	Detects the voltage between electrodes with the voltage detecting cable to compare the measured current obtained by calculating with each control frequency to the set voltage, and controls pulse width so that there is no difference in these values.
Constant-phase control (Non-constant current)	Welding with the fixed pulse width. No feedback control.	Used for special cases such as the test of welder, and not used for normal welding.	Controls switching with the set pulse width.

f. HEAT

Set the welding current for **WELD1**, **WELD2**, and **WELD3**, respectively. When **CTRL** is changed, the content to be set also change. Also, the settable range of welding current changes depending on the current range.

UF (UP SLOPE FIRST)

Sets the initial current value of upslope. The set value is the as **HEAT**.

DL (DOWN SLOPE LAST)

Sets the final current value of downslope. The set value is the as **HEAT**.

NOTE: When **UP/DOWN** is set, **UF/DL** becomes effective. It becomes a target value in the effective value control, so a difference occurs between the set value and the value of actual welding.

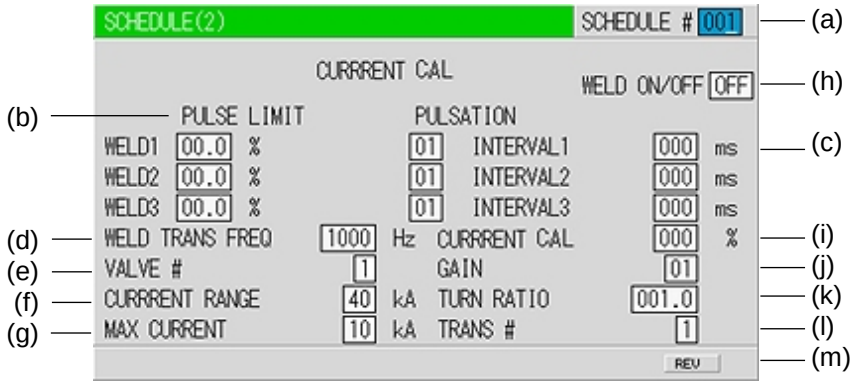
DANGER

Even though **E-07** (**No-current** error) is displayed, current is flowing. Exercise caution in handling.

g. NEXT

When the cursor is at ▼, moving the cursor down will change the display to **PULSATION** and transformer screen.

PULSATION and transformer screen



a. SCHEDULE

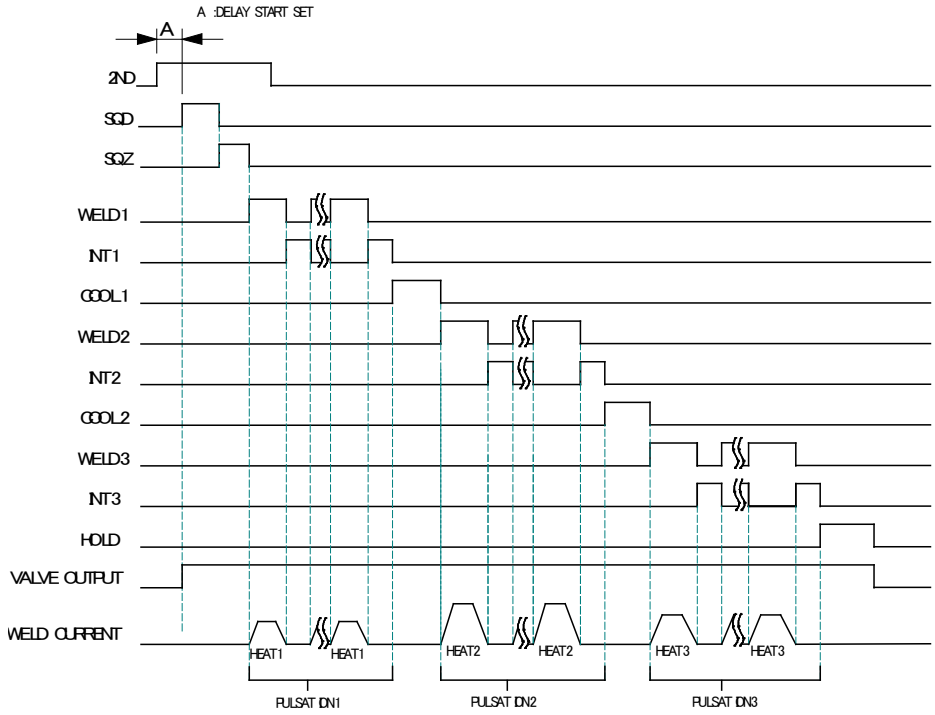
Select from #1 to #255 to set the **SCHEDULE**. Normally select #1 first, then select additional schedules in sequential order.

b. PULSE LIMIT

When limiting the pulse width in Primary constant-current peak value control, set the limit for each of **WE1**, **WE2** and **WE3**.

c. PULSATION / INTERVAL 1 to 3

Set the number of repetitions **PULSATION (01 to 19)** and the downtime (**INT1** to **3**) in **WE1** to **3** (See the figure below). However, when the number of repetitions is set to 01, the downtime does not work.



- When performing a welding with the setting **PULSATION** to **02** or more and **INT1** to **3** to **0**, set the control system to the primary constant-current effective value control or the primary constant-current peak value control. If a welding is performed with the other controls, control and monitored value may not function correctly.
- When performing a welding with the setting **PULSATION** to **02** or more, only the last welding data is displayed as the monitored value of **WELD2** after completion of sequence. In the timing chart above, the data of the third time is displayed, see the **MONITOR** screen. If the current gets out of the range of upper/lower limit judgment during repeated **PULSATION** operation, a caution signal is output after completion of welding (see the **MONITOR SET** screen.)

d. WELD TRANS FREQ

Sets the frequency of the welding transformer to be used. It can be set 600 Hz to 1,000 Hz in units of 100 Hz. If a value greater than 1,000 Hz is entered, a SET ERROR will result upon firing.

CAUTION

Do ***not*** use the welding transformer whose frequency is higher than the output frequency of the inverter power supply, this will cause a malfunction. When setting the output frequency of the inverter power supply, check the frequency of the welding transformer.

e. VALVE

1-4 valves (welding heads) can be connected to the Power Supply. Use this setting to select which of the 4 valves to use.

f. CURRENT RANGE

Selects the current range in accordance with the welding current to use.

Range	IS-2200CA		IS-4500CA	
	Current Setting Range	Power Setting Range	Current Setting Range	Power Setting Range
160/320 kA	16.0 – 160.0 kA	16.0 – 240.0 kW	32.0 – 320.0 kA	32.0 – 480.0 kW
80/160 kA	8.0 – 80.0 kA	8.0 – 120.0 kW	16.0 – 160.0 kA	16.0 – 240.0 kW
40/80 kA	4.0 – 40.0 kA	4.0 – 60.0 kW	8.0 – 80.0 kA	8.0 – 120.0 kW
20/40 kA	2.0 – 20.0 kA	2.0 – 30.0 kW	4.0 – 40.0 kA	4.0 – 60.0 kW
10/20 kA	2.0 – 9.99 kA	2.0 – 9.99 kW	4.0 – 20.0 kA	4.0 – 30.0 kW

g. MAX CURRENT

Sets the maximum current of transformer.

h. WELD ON/OFF

One of the settings required to turn on the **READY** lamp of the Power Supply.
ON: **WELD ON****OFF**: **WELD OFF**

i. CURRENT CAL

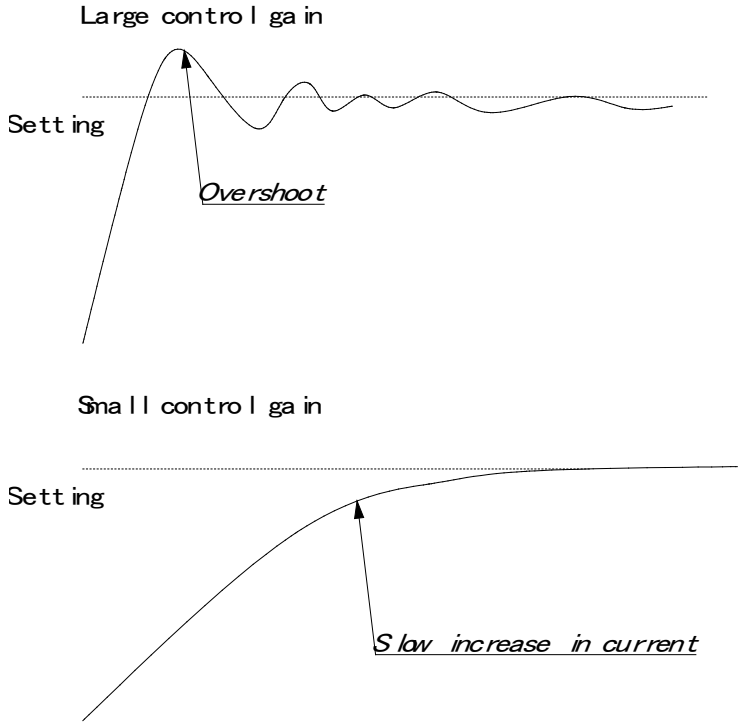
Primarily used to compensate for different current coils, when Secondary control modes are used. The default value is "0" with an adjustment range of +/- 24% of the heat setting. As an example, let's say a heat setting of 10 ka generates an output current of 9 kA due to a different feedback coil. If you adjust the Current Cal value to 11 the output current will then become 9.99 kA.

j. GAIN (01-09)

Sets the amount of feedback correction in the primary constant-current effective value control, secondary constant-current effective value control, secondary constant-power effective value

control, and secondary constant-voltage effective value control. Though 1 is normally used, the larger value will give the shorter rise time. (Invalid in the primary constant-current peak value control and the constant-phase control.)

NOTE: Control gain refers to a correction amount in feedback control. Although the current rises more rapidly with greater control gain, the current waveform may experience overshoot. On the other hand, a smaller control gain suppresses current waveform overshoot but causes a slower increase in current. The Power Supply offers nine 9 choices of gain levels.



k. TURN RATIO

Set the welding transformer turns ratio. The turns ratio can be set in a range from 001.0 to 199.9.

NOTE: When using the primary constant-current effective value control or primary constant-current peak value control, always set the correct turns ratio.
An incorrect ratio will result in incorrect output.

NOTE: When using the primary constant-current effective value control or primary constant-current peak value control, always set the correct turns ratio.
An incorrect ratio will result in incorrect output.

l. TRANS

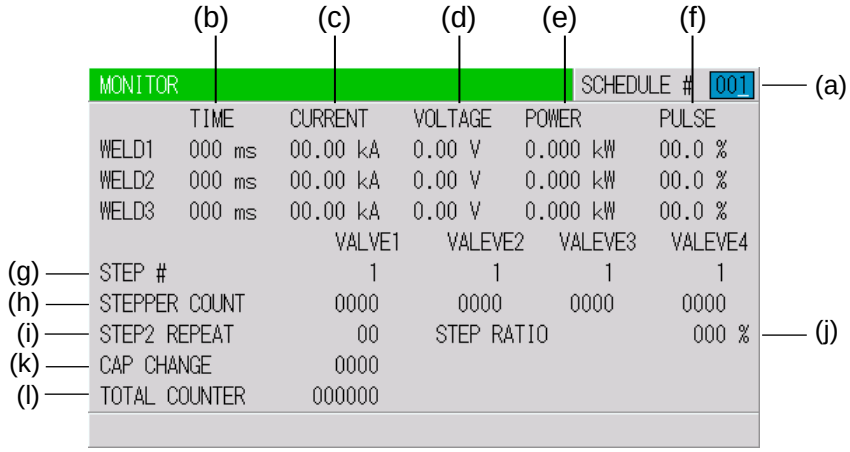
Keep set to 1. Feature is not active.

m. REV

When the cursor ( ) is displayed, pressing the **ENTER** key will change the display to Current and time setting screen.

4. MONITOR Screen

In this screen, you can confirm the operational conditions during welding. Monitored data is displayed for each **SCHEDULE**.



NOTE: The screen shows the settings for 10 kA or 05 kA range. In 20 kA, 40 kA, or 80 kA range, CURRENT is 000.0 kA to 999.9 kA and POWER is 000.0 kW to 999.9 kW.

a. SCHEDULE

Set the No. of the **SCHEDULE** to monitor. The measured values (welding current, voltage, etc.) for welding within that **SCHEDULE** are displayed. The Power Supply stores the latest measured values of each **SCHEDULE** number. The stored measurement values are not erased even when the power is turned off, and thus can be checked for the next job.

b. TIME

The lengths of periods during which current was supplied in the course of **WELD1**, **WELD2** and **WELD3** operations are displayed. The latest measured value welded with the displayed **SCHEDULE** No. is displayed. As units of time, ms and CYC may be selected. Either unit can be selected via the **MODE SELECT** screen.

c. CURRENT

The current during which current was supplied in the course of **WELD1**, **WELD2** and **WELD3** operations are displayed. The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

d. VOLTAGE

The voltage during which current was supplied in the course of **WELD1**, **WELD2** and **WELD3** operations are displayed. To display the voltage, you need to measure the secondary voltage by connecting the voltage detecting cable. The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

e. POWER

The power during which current was supplied in the course of **WELD1**, **WELD2** and **WELD3** operations are displayed. The value calculated from current and voltage (current x voltage) is displayed. To display the voltage, you need to measure the secondary voltage by connecting the voltage detecting cable. The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

f. PULSE

The widest pulse among the supplied primary pulse current is displayed as a percentage of pulse width in full wave mode. The pulse width in full wave mode varies with the frequency setting (**WELD TRANS FREQ**). The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

NOTE: The value displayed on the MONITOR screen is the average of value sampled at each welding pulse. Therefore, the value may differ from the measurement value of a weld checker (**MM-370B** etc.).

g. STEP

The present number of steps is displayed when **STEPPER MODE** is not OFF on the MODE SELECT screen.

h. STEPPER COUNT

The number of welds in the present step is displayed when **STEPPERMODE** is not OFF on the MODE SELECT screen.

i. STEP2 REPEAT

Remaining number of repetition for the stepper used for STEP2 of the displayed SCHEDULE is displayed when **STEPPERMODE** is not OFF on the MODE SELECT screen. The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

j. STEP RATIO

The step-up (-down) ratio is displayed when **STEPPERMODE** is not OFF on the MODE SELECT screen. The latest measured value welded with the displayed **SCHEDULE** No. is displayed.

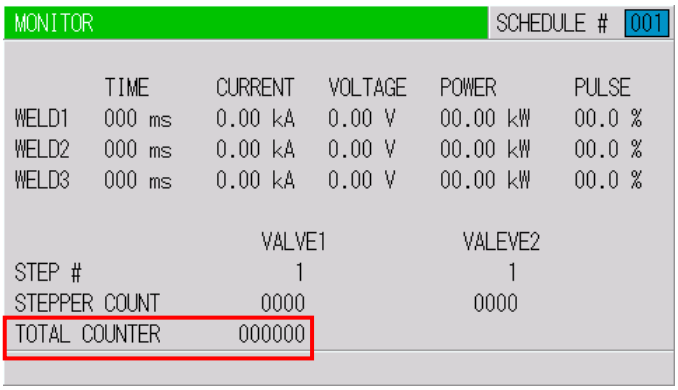
k. CAP CHANGE

The number of times before prior notice for cap change setting for the stepper used for the displayed SCHEDULE is displayed when STEPPERMODE is not OFF on the MODE SELECT screen. The latest measured value welded with the displayed SCHEDULE No. is displayed.

l. TOTAL COUNTER

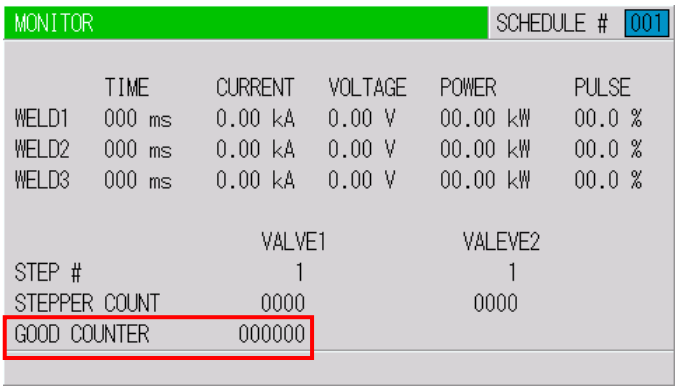
The display changes depending on the setting of WELD2 STOP/WELD COUNT and COUNTER on the MODE SELECT screen.

1. When **WELD2 STOP/WELD COUNT** is **WELD2 STOP** and **COUNTER** is **TOTAL**



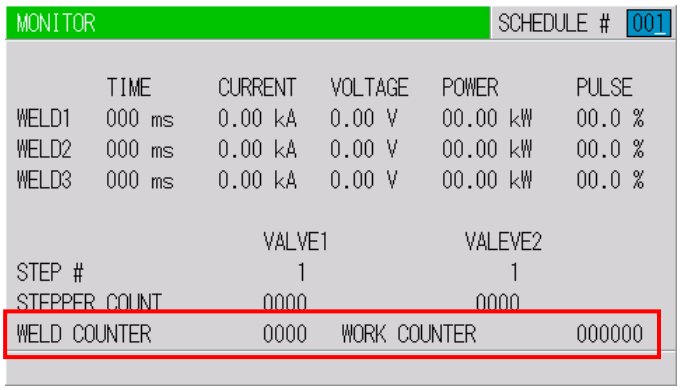
TOTAL COUNTER is displayed. The count value is incremented by one despite the result of the upper/lower limit judgment in monitoring.

2. When **WELD2 STOP/WELD COUNT** is **WELD2 STOP** and **COUNTER** is **GOOD.**



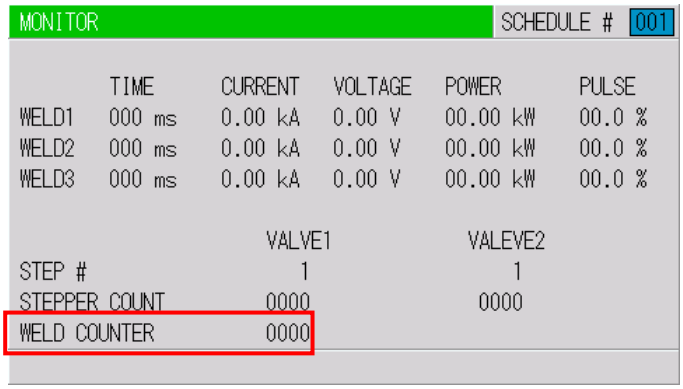
GOOD COUNTER is displayed. The count value is incremented by one when the monitored value is within the range of the upper/lower limit.

3. When **WELD2 STOP/WELD COUNT** is **WELD2 STOP and COUNTER is WORK:**



WELD COUNTER and **WORK COUNTER** are displayed. When the count reaches the set **WELD** count value, **WORK** count value is incremented by one. This is different from **WELD COUNTER** described below.

4. When **WELD2 STOP/WELD COUNT** is **WELD COUNT:**



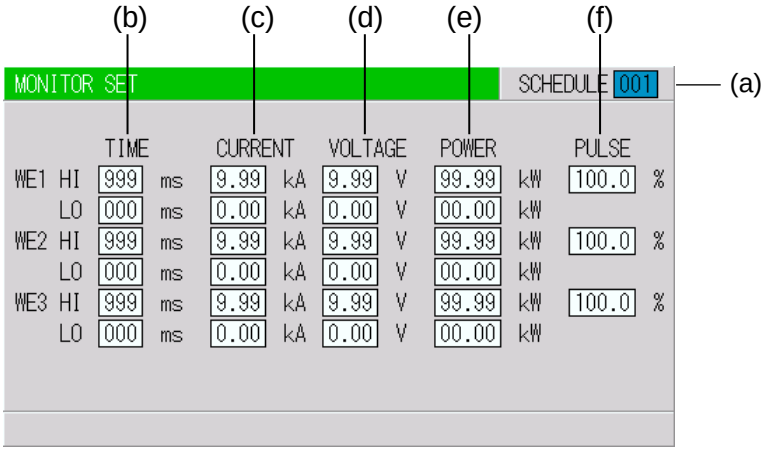
WELD COUNTER is displayed.
This is different from **WELD COUNTER** described above.

Monitored Value Notes:

- Only the last monitored value and the number of counts of each **SCHEDULE** are kept for a period of 10 days after the power is turned off.
- When the repetition welding is performed with **PULSATION** or OFF time setting, only the last data is displayed as the monitored value. The passing data is not displayed.
- The monitor display is not automatically updated depending on the **MONITOR DISP MODE** setting.

5. MONITOR SET Screen

Set the conditions for determining a good or bad weld, including values for welding current, upper or lower limits for the secondary voltage, etc. If the monitored welding current, secondary voltage, etc., do not meet the set conditions, a caution signal is output, and can be used to activate an alarm buzzer, alarm lamp, or similar event.



(Note) The screen shows the settings for 10 kA or 5 kA range. In 20 kA, 40 kA, or 80 kA range, CURRENT is 000.0 to 999.9 kA and POWER is 000.0 to 999.9 kW.

a. SCHEDULE

Input the number of the **SCHEDULE** to monitor.

b. TIME

Set the upper limit (**HI**) and lower limit (**LO**) of the weld time for each of **WE1**, **WE2** and **WE3**. Use this function to monitor the weld time when it becomes unstable by the welding stop input.

c. CURRENT

Set the upper limit (**HI**) and lower limit (**LO**) of the welding current for each of **WE1**, **WE2** and **WE3**.

d. VOLTAGE

Set the upper limit (**HI**) and lower limit (**LO**) of the secondary voltage for each of **WE1**, **WE2** and **WE3**.

e. POWER

Set the upper limit (**HI**) and lower limit (**LO**) of the electric power for each of **WE1**, **WE2** and **WE3**.

f. PULSE

If the ratio of welding current pulse / pulse width in full wave mode exceeds the percentage set in the **PULSE HIGH**, an **ERROR** signal is output. Pulse width is expressed assuming that the full wave is 100%.

NOTE: Upper/Lower limit judgment value when **STEPPER MODE** is set to **ON**

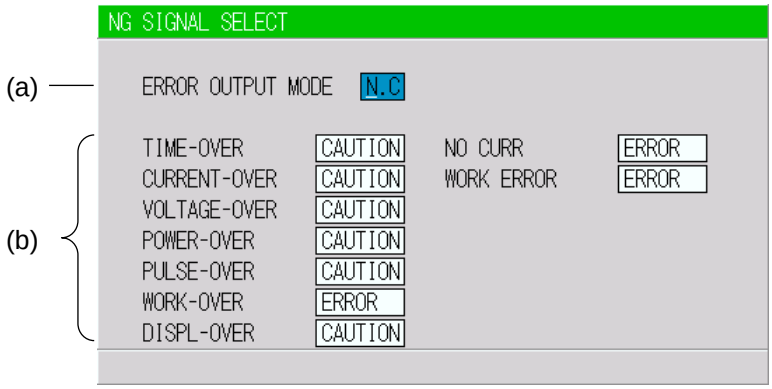
The upper/lower limit judgment value set here is for the current when a welding is performed, not for the initial setting. Therefore, when **STEPPER MODE** is set to **ON** to perform step-up (step-down) for the initial setting, the upper/lower limit judgment value is stepped up or down automatically.

EXAMPLE: When the current is set to 2 kA, HI; 2.2 kA, LO; 1.8 kA. When the step becomes 150%, **H** and **L** become as follows.

H: 2.2 x 1.5 = 3.3 kA
L: 1.8 x 1.5 = 2.7 kA

6. NG SIGNAL SELECT Screen

Sets the output mode and the signal for each item to output, **ERROR** or **CAUTION**, in an error occurring.



NOTE: This screen shows initial settings.

a. ERROR OUTPUT MODE

Sets the output modes of **NG1** of the external output signals.

N.C.	(NORMAL CLOSE) Closed at normal / Open at error
N.O.	(NORMAL OPEN) Open at normal / Closed at error

NOTE: NG2 is N.O. only

b. TIME-OVER / CURR-OVER / VOLT-OVER / POWER-OVER / PULSE-OVER / NO CURR / WRK ERR.

Sets the signal to output, **ERROR** or **CAUTION**. The signal is output in the following states.

TIME-OVER	When the weld time exceeds the upper/lower limit
CURRENT-OVER	When the current exceeds the upper/lower limit
VOLTAGE-OVER	When the voltage exceeds the upper/lower limit
POWER-OVER	When the power exceeds the upper/lower limit
PULSE-OVER	When the pulse width exceeds the upper limit
WORK-OVER	When the work piece detection by displacement measurement exceeds the upper/lower limit
DISPL-OVER	When the final displacement by displacement measurement exceeds the upper/lower limit
NO CURR	When the no-current error occurs (For the no-current error, see **Troubleshooting**.)
WORK ERROR	When the pre-check error occurs

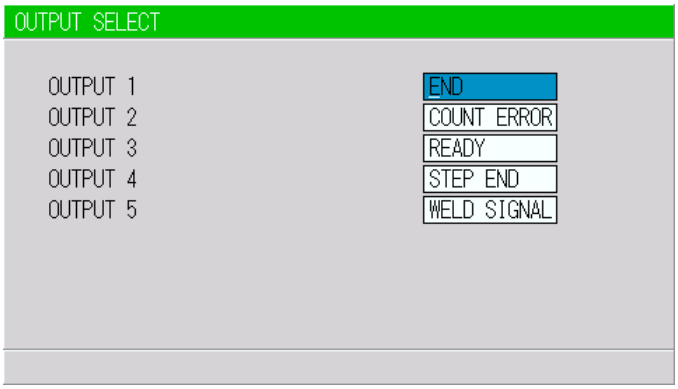
When two or more items are the same settings, the **ERROR** signal or the **CAUTION** signal is output if either one meets the condition above.

NOTE: Receiving the start signal after error output and Continuous welding operation

		START SIGNAL AFTER ERROR OUTPUT	CONTINUOUS WELDING WITH OFF TIME (OFF)
Upper/lower limit monitor error	**ERROR**	Receive	Stop
	CAUTION	Receive	Not stop
No-current error, Work piece error	**ERROR**	Not receive	Stop
	CAUTION	Receive	Stop
Counter error		Receive	Stop
Other device error		Not receive	Stop

7. OUTPUT SELECT Screen

Sets the output signals OUT1 to OUT5 of the external output signals.



NOTE: This screen shows initial settings.

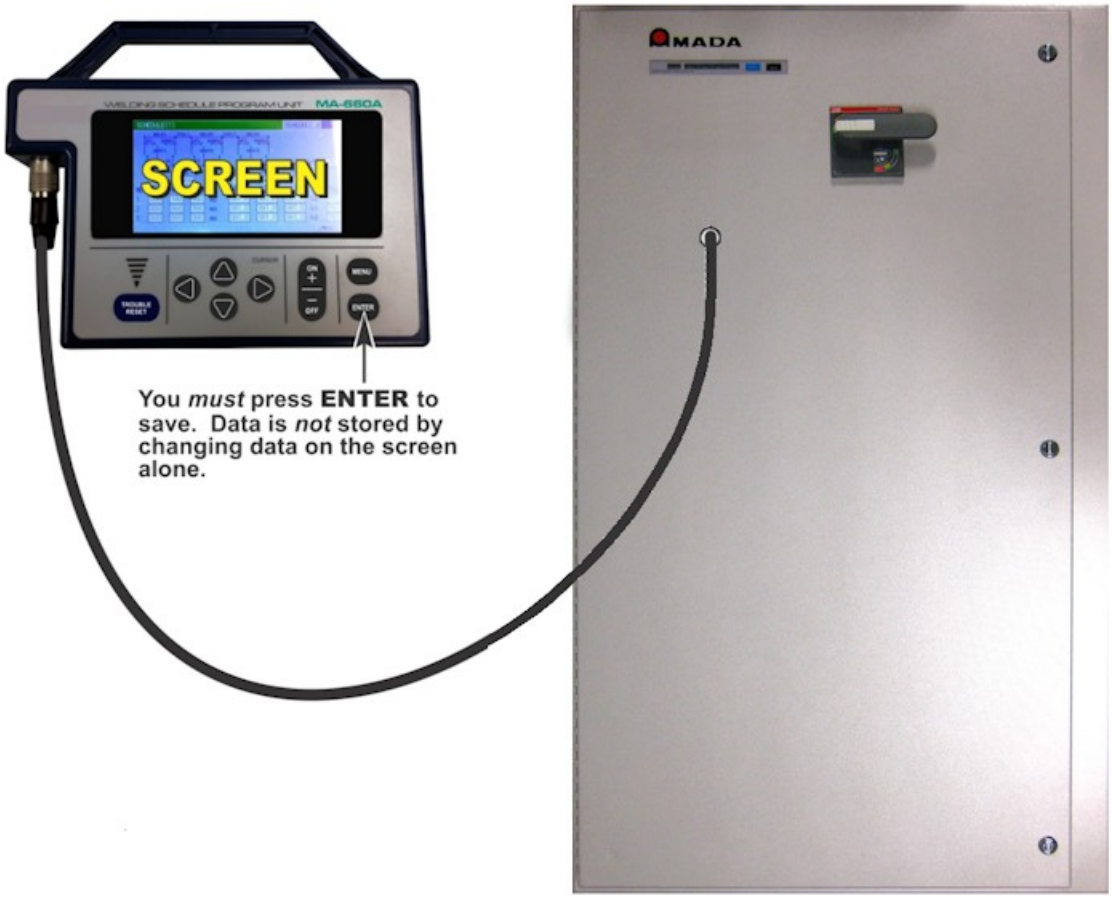
Pressing the **+ON** key switches the signal in the following order (in the reverse direction when pressing -**OFF** key):

END (end signal) → **COUNT ERROR** (count error signal) → **READY** (ready signal)
→ **STEP END** (step end signal) → **WELD SIGNAL** (welding timing signal)
→ **GOOD** (normal signal) → **COUNT UP** (count up signal)
→ **OUT I** (OUT I timing output) → **OUT II** (OUT II timing output)

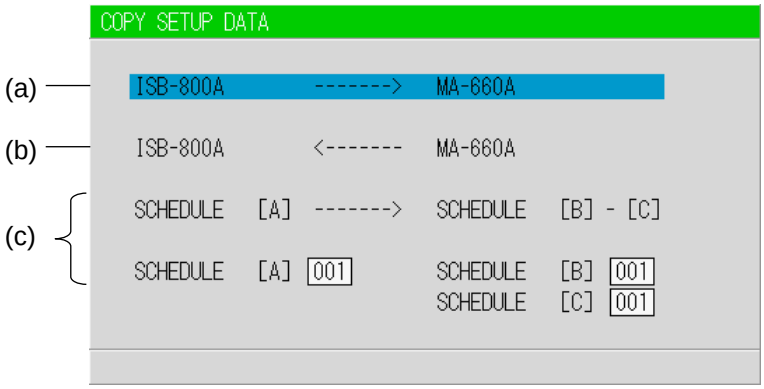
For output timings of **END**, **WELD SIGNAL**, **GOOD**, **OUT I**, and **OUT II**, see the Timing Chart.

8. COPY SETUP DATA Screen

The MA-660A can store data as shown in the figure below. When the MA-660A is connected to the Power Supply, the data stored in the Power Supply memory is displayed on the Monitor Panel. When the data is changed and the **ENTER** key is pressed, the contents of the memory of the Power Supply are overwritten by the new setting.



NOTE: The **MA-660A** stores data for only one **IS-2200CA/4500CA** unit. When two or more the Power Supply units are used and the contents of the memory of the first unit need to be copied to the second unit, copy the data from the first unit to the memory of MA-660A temporarily, then copy this data to the second unit.



Move the cursor ▲▼◀▶to the required item then press the ENTER key; the data will be copied.

a. Power Supply → MA-660A. The data in the Power Supply is copied to MEMORY of MA-660A. When copy is complete, **<END>** is displayed.

b. Power Supply ← MA-660A. The data in MEMORY of MA-660A is copied to the Power Supply. When copy is complete, **<END>** is displayed.

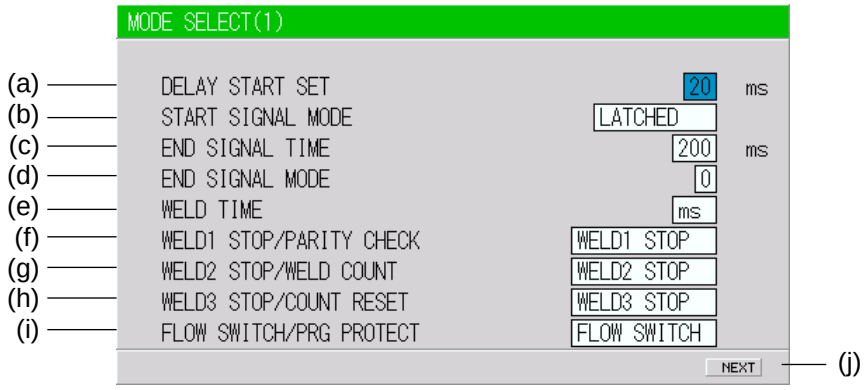
c. SCHEDULE [A]→ SCHEDULE [B]–[C]. This function is used to copy the SCHEDULE (welding condition). The Power Supply can set up to 255 schedules, indicated as SCHEDULE #1 – #255. This function is also used to change from the SCHEDULE #1 setting, to perform welding according to another schedule.

EXAMPLES:

- **Schedule #2** can be set by switching from **SCHEDULE #1** as follows:
  - **SCHEDULE 001→ SCHEDULE 002–002.** Be sure to press the **ENTER** key before moving the cursor).
  - Move the cursor to the left of the letters of **SCHEDULE** and press the **ENTER** key. The data for **SCHEDULE #1** is copied to **SCHEDULE #2** through this operation. Call up #2 on the **SCHEDULE screen**, and change the values, if necessary.
- **SCHEDULE #1** can be copied immediately to **SCHEDULE #2** via **SCHEDULE #4** through the following setting:
  - **SCHEDULE 001 -----> SCHEDULE 002 - 004**

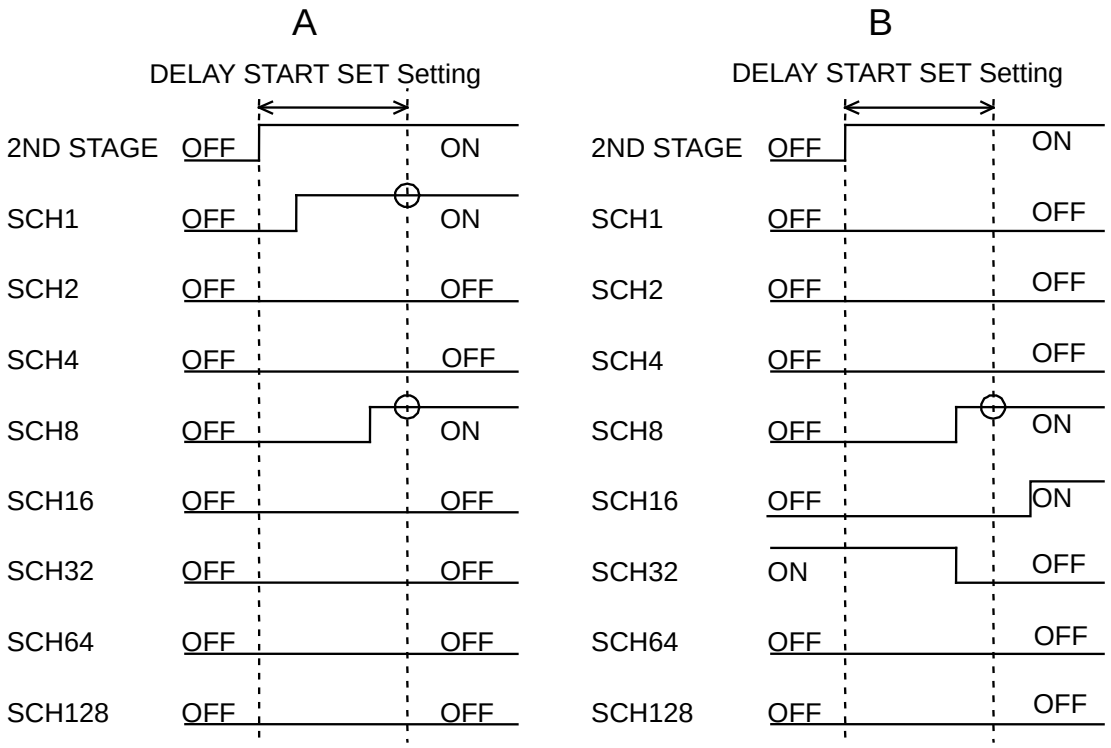
NOTE: Do ***not*** operate the program unit until the copy is complete.

9. MODE SELECT Screen



a. DELAY START SET

One welding condition is determined via **DELAY START SET**, a value corresponding to chatter prevention time, after a start signal is input. The **DELAY START SET** period can be set in a range from 1 to 20 ms, in unit of 1 ms.



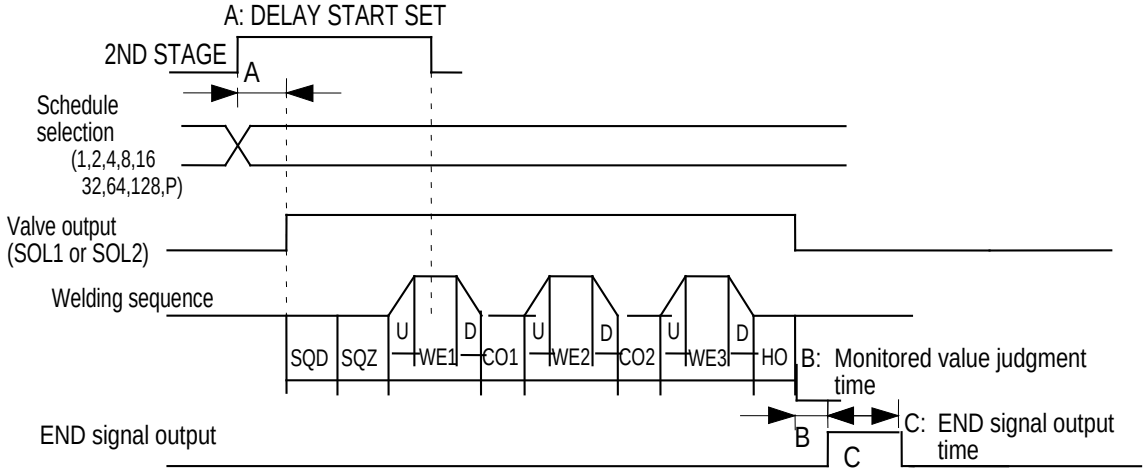
In Figure A above, the schedule signals 1 and 8 are ON. Therefore, welding is performed using schedule number. 9. In Figure B above, only schedule signal 8 is ON. As a result, welding is performed using schedule number 8. Schedule signals 16 and 32 are invalid because they are OFF when the schedule is determined.

NOTE: When **DELAY START SET** is 1 ms or 2 ms, the schedule number when the **2ND STAGE** signal is received is selected. Therefore, in Fig. A above, the schedule number is not selected and the schedule signal input error occurs. When **DELAY START SET** is **1** ms or **2** ms, input the schedule signal in advance before the **2ND STAGE** signal is received.

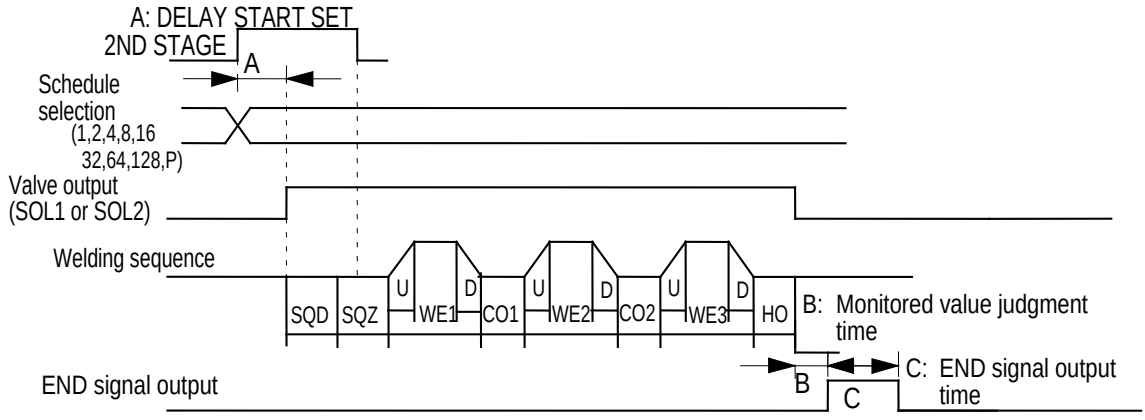
b. START SIGNAL MODE

Set the input method of the start signal to activate the Power Supply.

- **WHEN LATCHED.** The welding sequence halts if the **2ND STAGE** signal stops during squeeze time (SQZ). The welding sequence proceeds to completion when the **2ND STAGE** signal stops during Weld 1 time (WE1) or later.

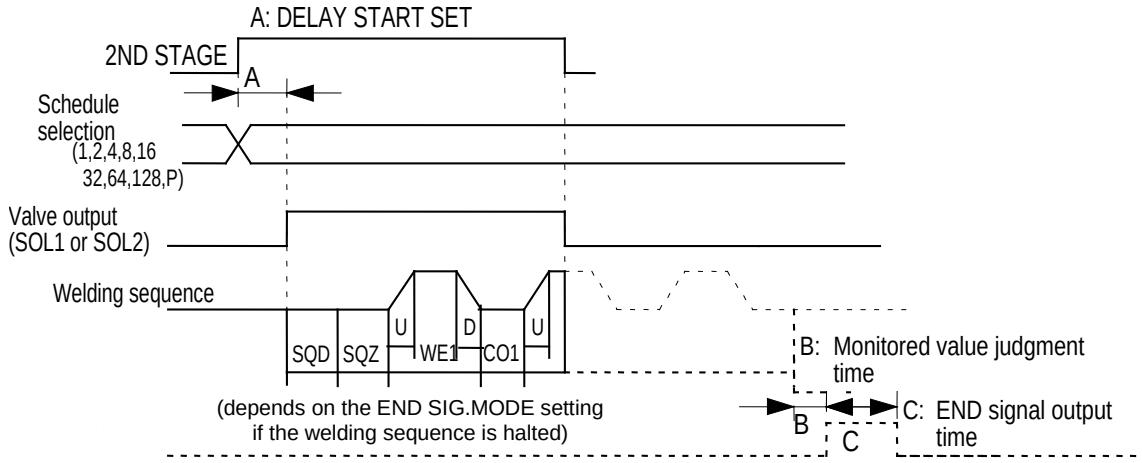


- **WHEN PULSED.** When the **2ND STAGE** signal is input for more than the time set through **DELAY START SET** and then stops, the welding sequence will proceed to completion.



- **WHEN MAINTAINED.** If the **2ND STAGE** signal stops halfway through the welding sequence (from the beginning of initial squeeze delay time through the end of hold time), the welding sequence will halt at that point.

  NOTE: The **END** signal depends on the **END SIG.MODE** setting.



c. END SIGNAL TIME

Set the length of time for output of the end signal. The output time can be set in a range from 10 to 200 ms and in units of 10 ms. Setting 0 ms switches to **HOLD** and maintains the end signal output during the start input. When **OFF** is set, actually output **END** time changes depending on the **OFF** setting even if a value is set for **END SIG.TIME** (see below). Also, this is not output depending on the **END SIGNAL MODE** setting.

EXAMPLE: END SIGNAL TIME is 0 ms

1) OFF is 0 ms (OFF time = 0 ms)
   a) When the start input time is longer than the sequence time, the end signal time is the start input time (Sequence time ≤ start input time → **END** time = start input time)
   b) When the start input time is shorter than the sequence time, the end signal time is the 10 ms. Sequence time > start input time→ **END** time = 10 ms)
2) OFF time is 10 ms to 200 ms (10 ms ≤ **OFF** time ≤ 200 ms). End signal time is the set **OFF** time (**END** time = **OFF** time).
3) **OFF** time is 200 ms or more (**OFF** time > 200 ms). End signal time is the 200 ms. (**END** time = 200 ms).

EXAMPLE: END SIGNAL TIME is 10 to 200 ms

1) **OFF** is 0 ms (**OFF** time = 0 ms). End signal time is the set **END SIG.TIME** time. (**END** time = **END SIG.TIME** time).

2) **OFF** time is set (10 ms ≤ OFF time)
   a) **END SIG.TIME** time is shorter than **OFF** time (**END SIG.TIME** time <**OFF** time) End signal time is the set **END SIG.TIME** time. (**END** time = **END SIG.TIME** time).
   b) OFF time is longer than **END SIG.TIME** time (**END SIG.TIME** time ≥ **OFF** time) End signal time is the **OFF** time. (**END** time = **OFF** time)

d. END SIGNAL MODE

Set the conditions for output of the end signal upon completion of the weld sequence.

0. Outputs the end signal even when the monitored value is outside the upper and lower tolerance limits. The end signal will not be output in the event of an error or when the sequence is interrupted by **START SIGNAL MODE (MAINTAINED).**
1. The end signal will not be output when the monitored value is outside the upper and lower tolerance limits (*****), in the event of an error, or when the sequence is interrupted by **START SIG.MODE (MAINTAINED)**.
2. The end signal will be output even when the monitored value is outside the upper and lower tolerance limits (*), even in the event of an error, and even when the sequence is interrupted by **START SIGMODE (MAINTAINED).**

NOTE: There is no distinction between **ERROR** and **CAUTION**.

END signal output

END SIG. MODE	NORMAL	COUNT-RELATED ERROR	UPPER/LOWER LIMIT ERROR	OTHER ERRORS AT WELDING	STOPPED HALFWAY (MAINTAINED)
0	Output	Output	Output	No output	No output
1	Output	Output	No output	No output	No output
2	Output	Output	Output	Output	Output

NOTE: For faults, see the Fault Code List. Priority is “Stopped halfway” = “Other errors at welding” > “Upper/lower limit error” > “Count-related error”.

e. WELD TIME

Use this setting to change the units for time settings available on the **SCHEDULE screen**.

CYC	50Hz: 1CYC = 20 ms 60Hz: 1CYC = 16.6 ms
ms	—

f. WELD1 STOP/PARITY CHECK.

Set external input pin 13.

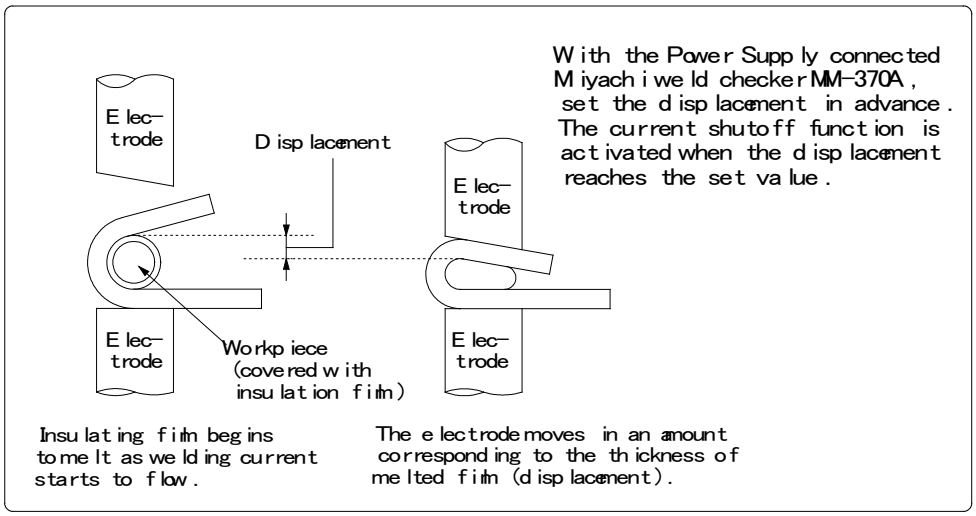
- When **WELD1 STOP** is selected. Parity check will not be performed. The sequence will proceed to COOL1 if external input pin 13 is closed during the **WELD1** sequence operation. (Refer to Note 2, "Current shutoff function.")
- When **PARITY CHECK** is selected. Parity check will be performed. This check allows for detection of a failure resulting from a wire break in the schedule selection signal lines. Be sure that the total number of closed schedule selection and parity signal lines is always odd. (Refer to Note 1, "Schedule Numbers and Schedule Selection Pins.")

NOTE: Schedule Numbers and Schedule Selection Pins

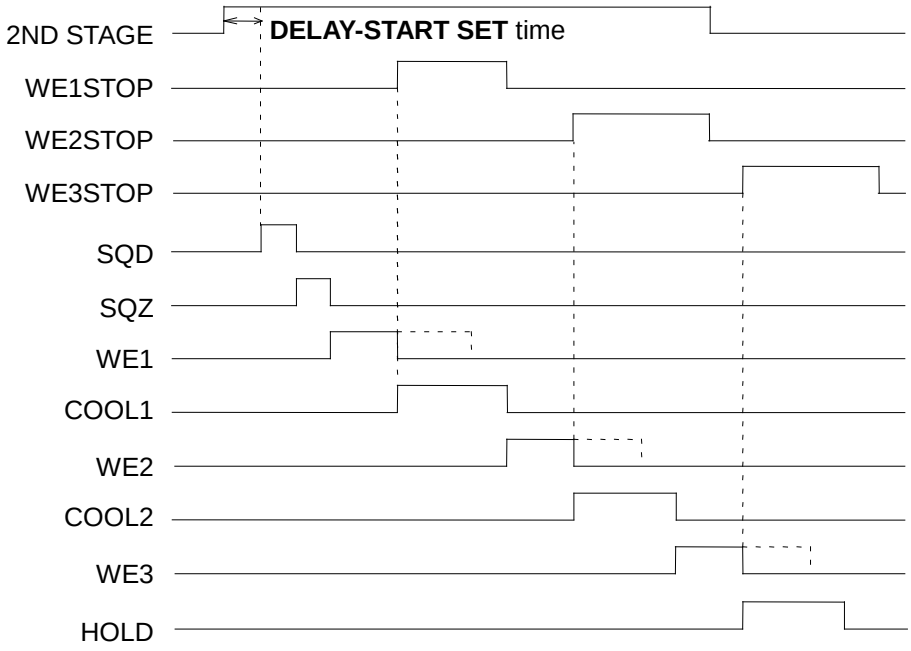
●: Closed Blank: Open

SCHEDULE #	SCH 1	SCH 2	SCH 4	SCH 8	SCH 16	SCH 32	SCH 64	SCH 128	PARITY
1	●								
2		●							
3	●	●							●
4			●						
5	●		●						●
6		●	●						●
7	●	●	●						
8				●					
9	●			●					●
10		●		●					●
11	●	●		●					
12			●	●					●
13	●		●	●					
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
247	●	●	●		●	●	●	●	
248				●	●	●	●	●	
249	●			●	●	●	●	●	●
250		●		●	●	●	●	●	●
251	●	●		●	●	●	●	●	
252			●	●	●	●	●	●	●
253	●		●	●	●	●	●	●	
254		●	●	●	●	●	●	●	
255	●	●	●	●	●	●	●	●	●

NOTE: Current shutoff function. The current shutoff function shuts off current when the proper weld penetration is achieved—for example, during fusing—thus preventing excessive penetration. (Refer to the figure below.)



Timing chart for stopping current



The **WE1STOP** signal shuts off current immediately when input during the **WE1** period, switching the sequence to **COOL1**. The **WE1STOP** signal shuts off current immediately after the **WE1** starts (the current is supplied for about 1 cycle) when input before the **WE1** period, switching the sequence to **COOL1**. The **WE1STOP** signal will not shut off current if input during the **WE2** or **WE3** period.

The **WE2STOP** signal shuts off current immediately when input during the **WE2** period, switching the sequence to **COOL2**. The **WE2STOP** signal shuts off current immediately after the **WE2** starts (the current is supplied for about 1 cycle) when input before the **WE2** period, switching the sequence to **COOL2**. The **WE2STOP** signal will not shut off current if input during the **WE3** period.

The **WE3STOP** signal shuts off current immediately when input during the **WE3** period, switching the sequence to **HOLD**. The **WE3STOP** signal shuts off current immediately after the **WE3** starts (the current is supplied for about 1 cycle) when input before the **WE3** period, switching the sequence to **HOLD**.

When the welding stop signal is input before the start signal is received, the welding stop error occurs.

When **WELD STOP OFF TIME** is set, the current is supplied for the time period in **WE1/2/3**.

This weld time is the **WELD** repetition time except for the **INT** time.

EXAMPLE: When **WELD STOP OFF TIME: 60 ms**, **WELD: 15 ms**, **INT: 10 ms**, and repetition: **3**, the total time is 75 ms. The welding current is supplied for at least 60 ms and neglected for 15ms (**WELD: 5 ms** + **INT: 10 ms**).

This is also effective when the off time (**OFF**) is set. A welding is stopped when the signal is input before each **WE**. A welding is performed when the signal is released before each **WE**.

g. WELD2 STOP/WELD COUNT

Set external input to pin 14. When **WELD2 STOP** is selected the weld count will not be checked. The sequence will proceed to **COOL2** if external input pin 14 is closed during the **WELD2** sequence operation. When the **WELD2 STOP** signal is input before the start signal is input even if the **WELD1** is set, the welding stop error occurs. When **WELD COUNT** is selected the weld count will be checked.

h. WELD3 STOP/COUNT RESET

Set external input to pin 25. When **WELD3 STOP** is selected the count will not be reset. The sequence will proceed to **HOLD** if external input pin 25 is closed during the **WELD3** sequence operation. When the **WELD3 STOP** signal is input before the start signal is input even if the **WELD1** or the **WELD2** is set, the welding stop error occurs. When **COUNT RESET** is selected the count will be reset.

i. FLOW SWITCH / PRG PROTECT

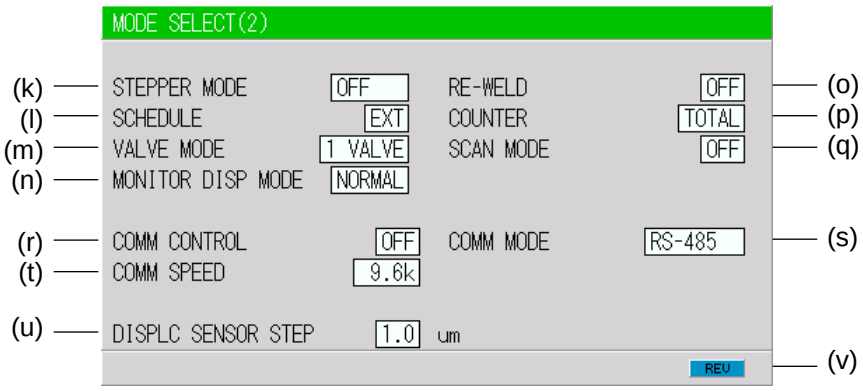
Set external input pin 21.

When **FLOW SWITCH** is selected
Flow switch input pin. Opening this pin will result in a flow rate error.

When **PRG PROTECT** is selected
Program inhibit input pin. Closing this pin will not allow you to change the settings.

j. NEXT

When the cursor () is displayed, pressing the **ENTER** key will change the display to the MODE SELECT (2) screen.



k. STEPPER MODE

Select whether or not to perform step-up (step-down) operation, refer to the **STEPPER COUNT** Screen.

OFF	Step-up (step-down) will not be performed.
FIXED	Step-up (step-down) will be performed. (Stepwise)
LINER	Step-up (step-down) will be performed. (Linear)

NOTE: RATIO has an effect on **HEAT** only. Fixed for **UF/DL**. When the **HEAT** value multiplied by **RATIO** falls below the **UF/DL** value, an error occurs.

The **COUNT** value works as each **STEP** value. **Example: STEP1 0020 STEP2 0010** indicates that **STEP1** is 20 times and **STEP2** is 10 times. The conditions for stepper count-up is the same as the **TOTAL** counter.

l. SCHEDULE

Sets the selection method of schedule number.

EXT	Selects the schedule number by binary of the I/O terminal strip.
INT	Selects the schedule number by the SCHEDULE number of **MA-660A**. (see Note)

NOTE: When setting SCHEDULE to INT, be sure to connect **MA-660A** and select the SCHEDULE screen or the MONITOR screen.

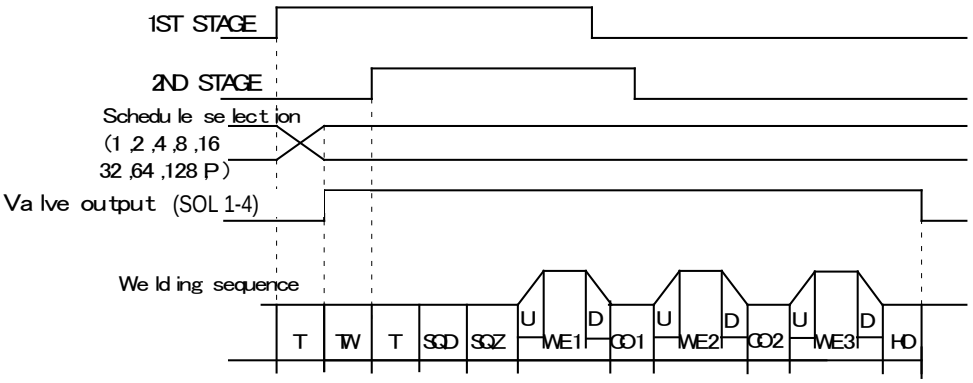
m. VALVE MODE

Select the output method (1 VALVE or 2 VALVE) of the solenoid valve signal.

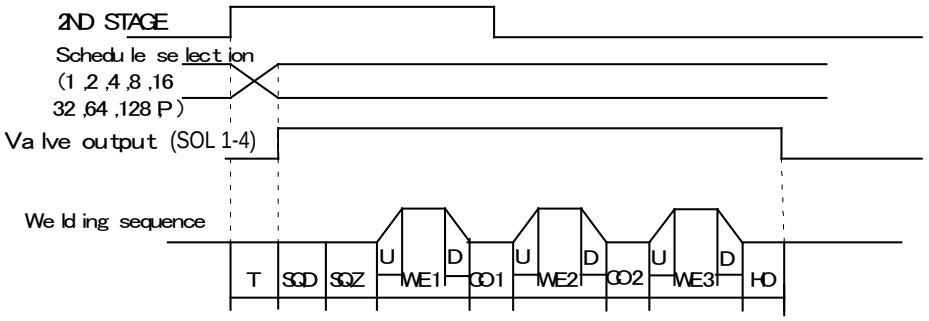
When **1 VALVE** is selected

When the 1ST STAGE signal is input, the valve signal (SOL1 - 4) with the selected schedule number is output and the sequence waits for the 2ND STAGE signal input. Next, when the 2ND STAGE signal is input, the welding sequence with the selected schedule number starts. After the welding sequence starts, the valve signal is output until the sequence ends even if the 1ST STAGE signal is turned OFF.

T: DELAY START SET (1 to 20 ms)
TW: 2ND STAGE signal input wait time (uncertain)



When the 2ND STAGE signal is input, the valve signal (SOL1 or SOL2) with the selected schedule number is output. After the welding sequence starts, the valve signal is output until the sequence ends even if the 2ND STAGE is turned OFF.

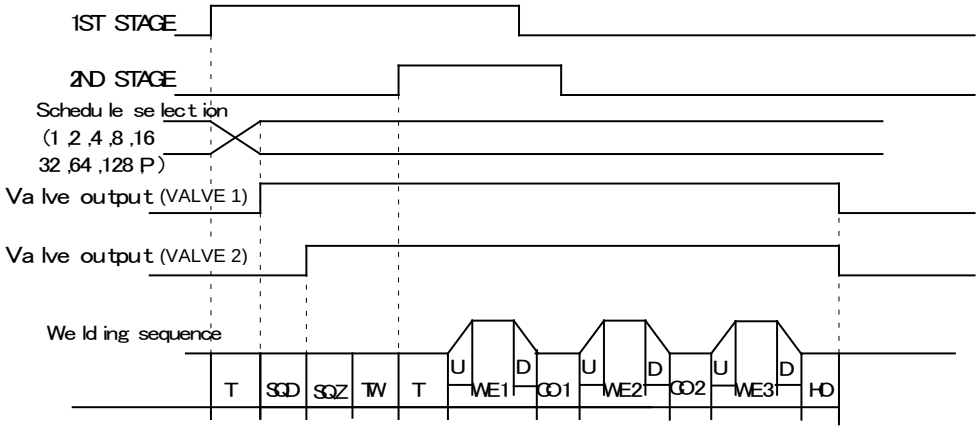


When **2 VALVE** is selected

2 valve signals (VALVE 1, 2) are output in a sequence.
When VALVE 1 is used, the weld force position can be adjusted by the 1ST STAGE signal output timing of VALVE 2 to the start of SQZ.
After the welding sequence starts, the valve signal is output until the sequence ends even if the 1ST STAGE signal is turned OFF. When VALVE MODE is set to 2 VALVE, the following functions become disabled.

- OFF (repeated operation)
- STEPPER (step-up (-down) operation)

When the 1ST STAGE signal is input, VALVE 1 is output, and then SOL2 is output after SQD. After SQD and SQZ, the sequence waits for the 2ND STAGE signal input. Next, when the 2ND STAGE signal is input, the welding sequence after WELD1 starts.



n. MONITOR DISP MODE

Sets the monitor display. This function is invalid when the Program Unit is disconnected.

NORMAL	The monitor display is updated each time. It takes monitored value computing time + display time (ms). Used when the part cycle time is relatively slow. * Communicated with the Program Unit each time welding is complete.
LAST	The monitor display is not updated. When the MONITOR screen is updated, the last measured value is displayed. Used when the part cycle time is relatively fast. Errors are also displayed only when updated (communicated with the Program Unit). * Not communicated with the Program Unit automatically.

o. RE-WELD

Select whether or not to supply welding current again at the same location if the monitored current is lower than the lower limit. The second welding current will be 5% greater than the setting value.

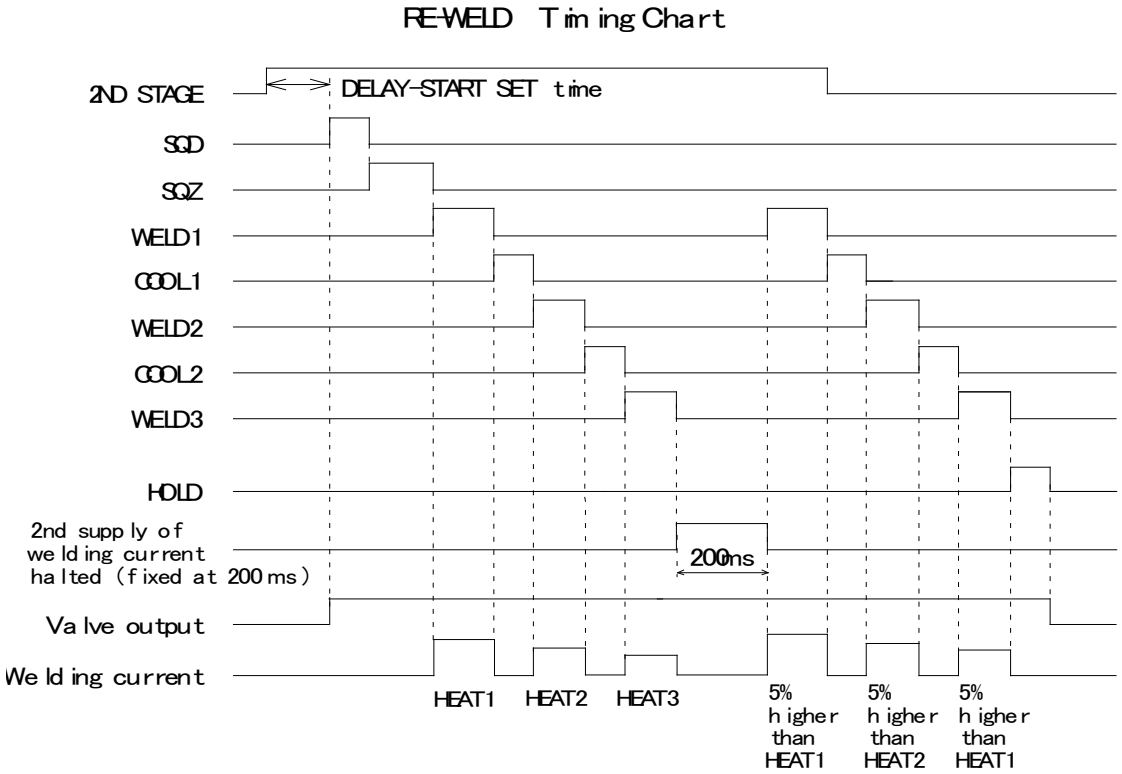
ON	Welding current will be supplied again.
OFF	Welding current will not be supplied again.

Even when the welding current is supplied twice with RE-ELD, each count-up is done only once.

TOTAL, **WELD/WORK**, and **STEPPER** → Once

GOOD → None (below the lower limit setting for the second time). Once (The lower limit setting or more for the second time). This cannot be used in combination with the off time (OFF).

When the off time is set, **RE-WELD** works as **OFF** even if **ON**. When **RE-WELD** is combined with **STEPPER**, the welding current will be 5% greater than the value set for **STEPPER**.



p. COUNTER

Sets the mode of counter. There are three modes (**TOTAL/GOOD/WORK**). The counter value returns to "0" at the time the setting is changed. Count-up is done in all cases only when **WELD** is **ON**.

TOTAL: Count-up (increment of +1) is done despite the result of the upper/lower limit judgment in monitoring when the current is supplied. In case of errors other than upper/lower limit monitor and counter error (device error, setting error, no-current error (**ERROR/CAUTION**), work piece error (**ERROR/CAUTION**)), count-up is not done. When the welding is interrupted, count-up is not done.

Judgment in Monitor		Counting Manner
GOOD (normal)		Count-up
Upper/lower limit monitor	**CAUTION**	
	ERROR	
Error/Interrupt		No Count-up

GOOD: Count-up is done if the judgment is **GOOD** in current-supplied monitoring.
In case of errors other than the counter error, count-up is not done. Also, when the welding is interrupted, count-up is not done.

Judgment in Monitor		Counting Manner
GOOD (normal)		Count-up
Upper/lower limit monitor	CAUTION	No Count-up
	ERROR	
Error/Interrupt		

WORK: Count-up is not done if the judgment is **ERROR** in current-supplied monitoring.

Judgment in Monitor		Counting Manner
GOOD (normal)		WELD Counter counts-up. WORK Counter counts-up (increment of+1) when WELD Count reached the set value.
Upper/lower limit monitor	CAUTION	
	ERROR	WELD Counter does not count-up. WELD Counter is reset to 0 (zero) when NG is reset. WORK Counter does not count-up.
Error		
Interrupt		WELD Counter does not count-up. Since an error does not occur, the error reset is not received.

q. SCAN MODE

Cannot be used. Select OFF.

r. COMM CONTROL

Selects a communication function.

OFF	No communication
→	One-way communication
↔	Both-way communication

s. COMM MODE

Selects a communication mode.

RS-485 (optional)	Communication by RS-485
RS-232C	Communication by RS-232C

t. COMM SPEED

Selects a communication speed.

9.6k	Communication at 9,600 bps
19.2k	Communication at 19,200 bps
38.4k	Communication at 38,400 bps

For details of the external communication, see **External Communication Function**.

u. DISPLC SENSOR STEP

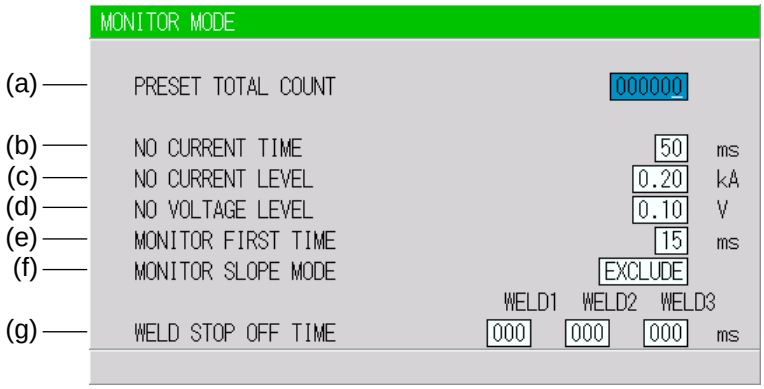
Sets the resolution of displacement sensor.

(Example) **LGK-110**: 1.0 μm

v. REV

When the cursor () is displayed, pressing the **ENTER** key will change the display to the MODE SELECT (1) screen.

10. MONITOR MODE Screen

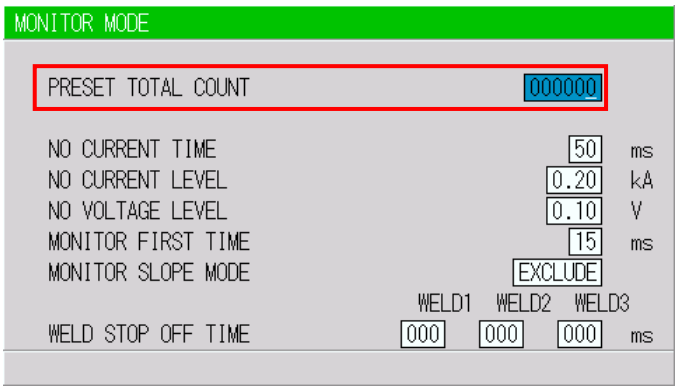


NOTE: This screen shows initial settings. The display surrounded with frame changes depending on the setting of **WELD2 STOP/WELD COUNT** and **COUNTER** on the **MODE SELECT** screen.

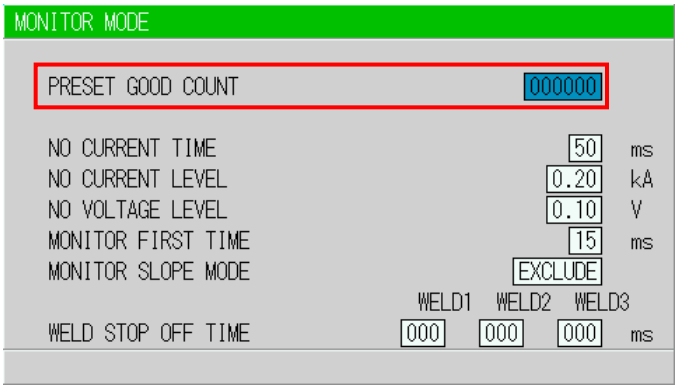
a. PRESET TOTAL COUNT

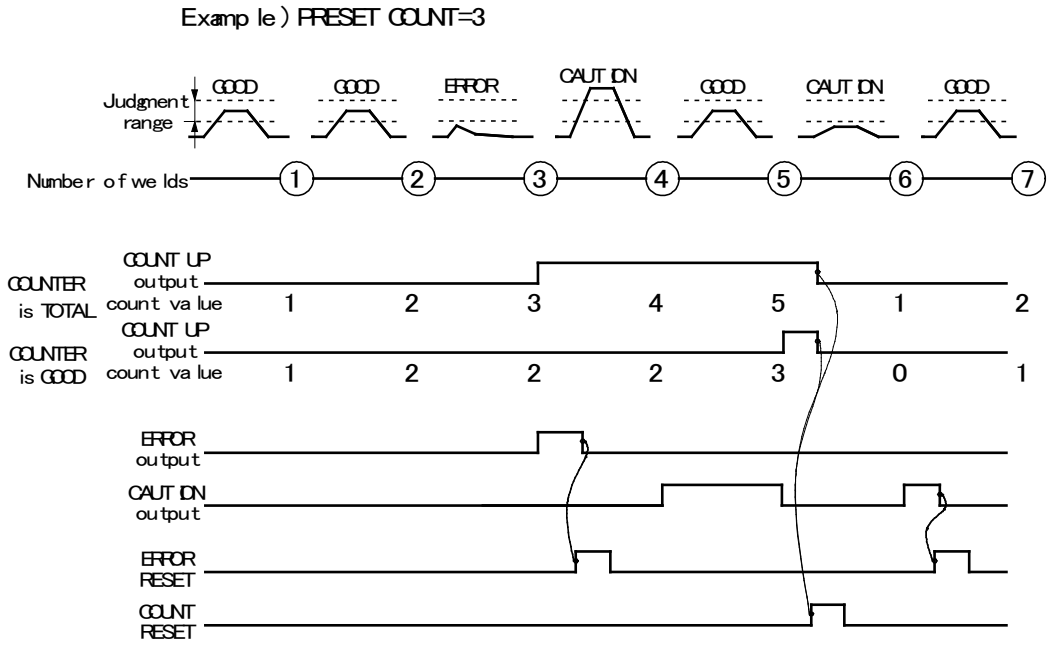
The display changes depending on the setting of WELD2 STOP/WELD COUNT and COUNTER on the MODE SELECT screen. The preset count is the count value set in advance. When each count reaches the set value, E-28 (Count-up) is displayed and the **COUNT UP** signal is output.

When WELD2 STOP/WELD COUNT is WELD2 STOP and COUNTER is TOTAL, the PRESET TOTAL COUNT is displayed.



When WELD2 STOP/WELD COUNT is WELD2 STOP and COUNTER is GOOD, the PRESET GOOD COUNT is displayed.



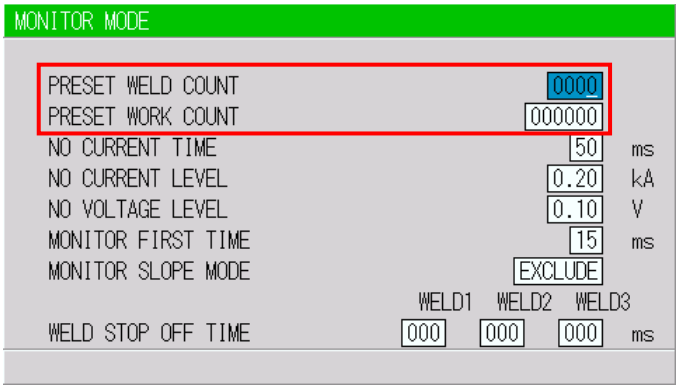


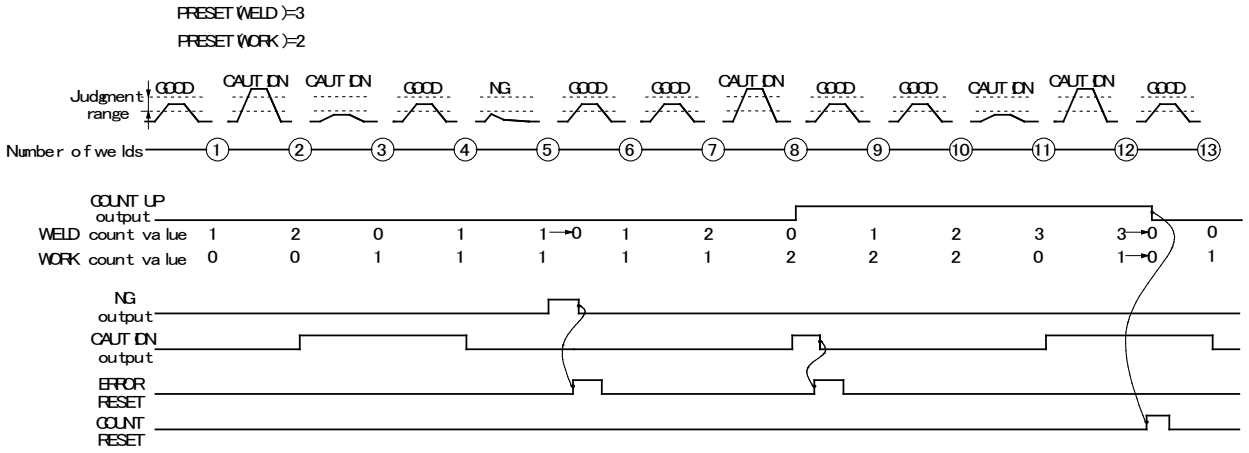
NOTES:

- When ERROR RESET is input, display of **MA-660A**, **TROUBLE** lamp on panel and ERROR/CAUTION output are turned OFF, but COUNT UP output is not turned OFF.
- When COUNT RESET is input, display of **MA-660A**, **TROUBLE** lamp on panel and COUNT UP output are turned OFF, but CAUTION output is not turned OFF.
- The chart above represents the occasion where ERROR/CAUTION output is set to N.O. (NORMAL OPEN): Open at normal / Closed at error.

WELD2 STOP/WELD COUNT is WELD2 STOP and COUNTER is WORK

Set WELD COUNT and WORK COUNT. When PRESET WELD COUNT is set to 0, the weld count is not incremented. Also, when the PRESET WORK COUNT is set to 0, count-up is not done.

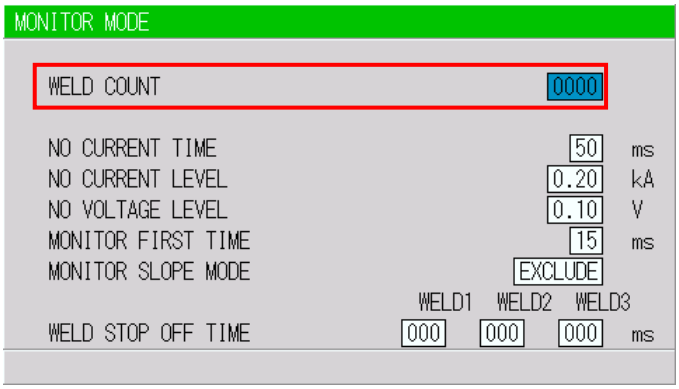




NOTES:

- The **WELD** count becomes "0" at the same time as the **WORK** count is increased by +1, not "3" (**PRESET COUNT** value).
- When **ERROR RESET** is input, display of MA-660A, **TROUBLE** lamp on panel and **NG/CAUTION** output are turned **OFF**, but **COUNT UP** output is not turned **OFF**.
- When **COUNT RESET** is input, display of MA-660A, **TROUBLE** lamp on panel and **COUNT UP** output are turned **OFF**, but **CAUTION** output is not turned **OFF**.
- The chart above represents the occasion where **NG/CAUTION** output is set to **N.O. (NORMAL OPEN)**: Open at normal / Closed at error.

WELD2 STOP/WELD COUNT is WELD COUNT

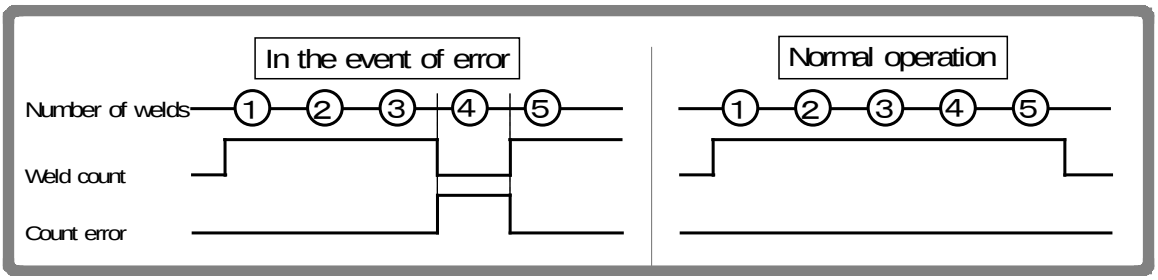


A count error signal is output if the number of welds deposited while the external weld count signal is input is smaller than the value set for **PRESET COUNT** (weld count signal is turned off before the number of welds set for **PRESET COUNT** is not deposited). See the following diagram.

For example, if you set the number of welds to 5 from the programmable logic controller, select "**5**" for **PRESET COUNT** as well.

This function can be turned on or off through **WELD2 STOP/WELD COUNT** on the **MODE SELECT** screen. To clear the count error signal, you need to input the weld count signal again or add required number of welds to make up for insufficiency. The count error signal is not cleared if the error reset signal is input. Also, when required number of welds are added to make up for insufficiency, the count error signal is output until the insufficient number of welds is complete.

NOTE: OFF/Off time and **WELD COUNT** do not work simultaneously. When **WELD COUNT** is set, OFF is invalid.



b. NO CURRENT TIME

The absence of welding current will not be detected as a no-current or no-voltage error (see *Chapter 5, Troubleshooting*) as long as the absence lasts for a period within the time set here.

For example, if you select 3 ms, the absence of current will not be detected as an error as long as it lasts no more than 3 ms. An absence of current will be detected as an error if it lasts for 4 ms or more.

At this time, the **TROUBLE** lamp lights up. When the program unit is connected, the fault code is displayed on the monitor. **COOL**, **HOLD**, **OFF**, and **INT** times are not included in the time for the no-current to be detected.

c. NO CURRENT LEVEL
d. NO VOLTAGE LEVEL

Set the current or voltage level for determining the absence of current or voltage as a no-current or no-voltage error. The **TROUBLE** lamp will light up, and operation will stop if the monitored current or voltage falls below the level set here.

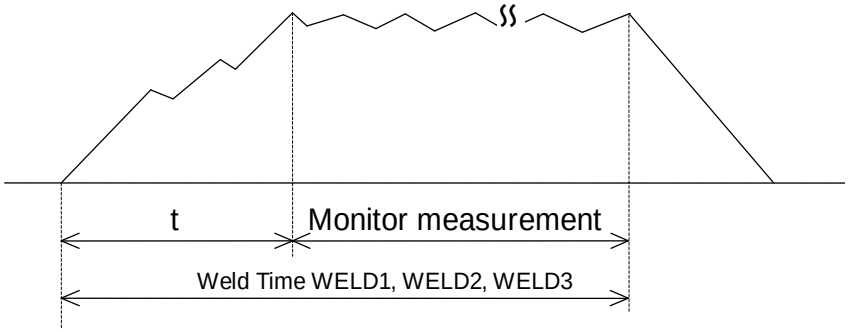
In the case of primary current control, supplying current with the welding transformer's secondary side open will cause an excitation current to flow through the primary side. Set the current level slightly higher than the monitored current.

NOTE: No judgment as to no-current or no-voltage error will be made if you select **00.0kA/0.00 V**. If the toroidal coil and the voltage detecting cable are disconnected in the second control, excessive current may flow.

e. MONITOR FIRST TIME

Use this setting to specify the start time to measure the monitored value (current, voltage, power, pulse width). The start time can be set in a range from 0 to 15 ms. Use this setting to exclude the initial rise of current from measurement.

The monitored value will not be displayed if the weld time is shorter than **MONITOR FIRST TIME**. The monitored value will not be also checked against the upper and lower tolerance limits.



t = MONITOR FIRST TIME

f. MONITOR SLOPE MODE

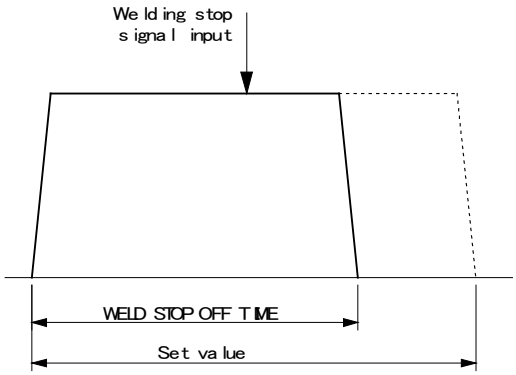
Select whether or not to include a slope period in the monitored value to be displayed.

EXCLUDE	Slope period will not be included.
INCLUDE	Slope period will be included.

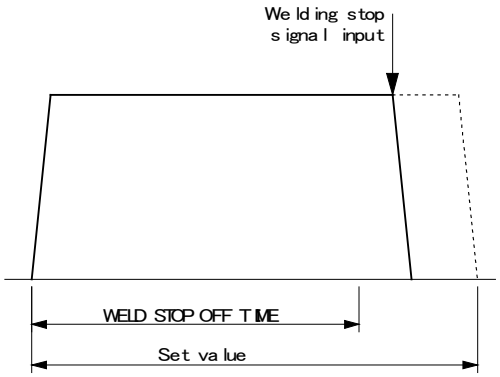
g. WELD STOP OFF TIME

Sets the neglecting time of the welding stop signal for each of **WELD1**, **WELD2**and **WELD3**. Even if the welding stop signal is input during welding, the current is supplied for the set time and the sequence will switch to the next.

When the welding stop signal is input within WELD STOP OFF TIME
The welding is stopped at the end of WELD STOP OFF TIME.

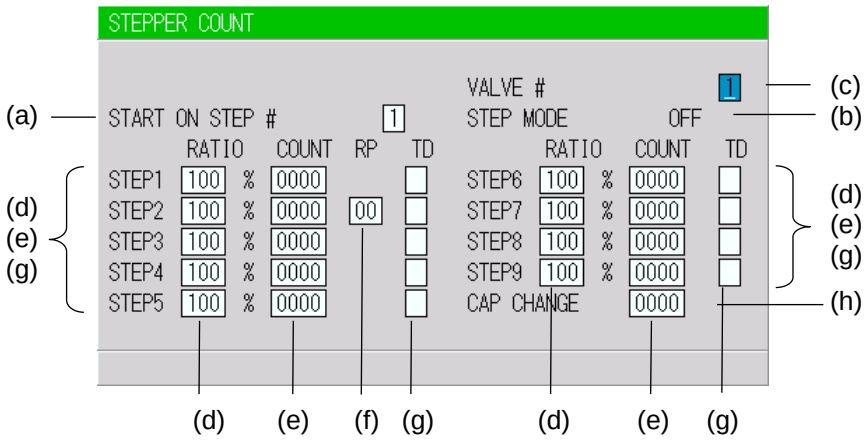


When the welding stop signal is input after WELD STOP OFF TIME
The welding is stopped when the welding stop signal is input.



11. STEPPER COUNT Screen

The Power Supply can change the level of the welding current depending on the welding conditions. The function to increase the welding current is called the “step-up” function, and that to decrease the welding current is called the “step-down” function. Set the step-up or step-down timing based on the number of welds. When the set number of welds is complete, the step end signal (**STEP END**) is output.



a. START ON STEP

The counting of welds starts from the **STEP** set here.

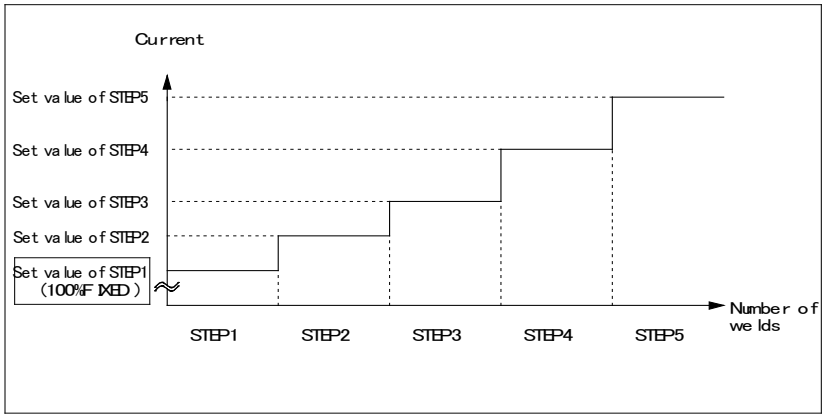
If, for example, you select **START ON STEP #3** as shown above, welds will be counted from the first weld in **STEP3**, even if welding for the first time. Further, the welding current will be increased (or reduced) by the extent you have set this value for **STEP3**.

Set the desired **STEP** No. 1–9 for **VALVE1** and **VALVE2, or SOL 1 – 4,** respectively, depending on the valve mode selection.

b. STEP MODE

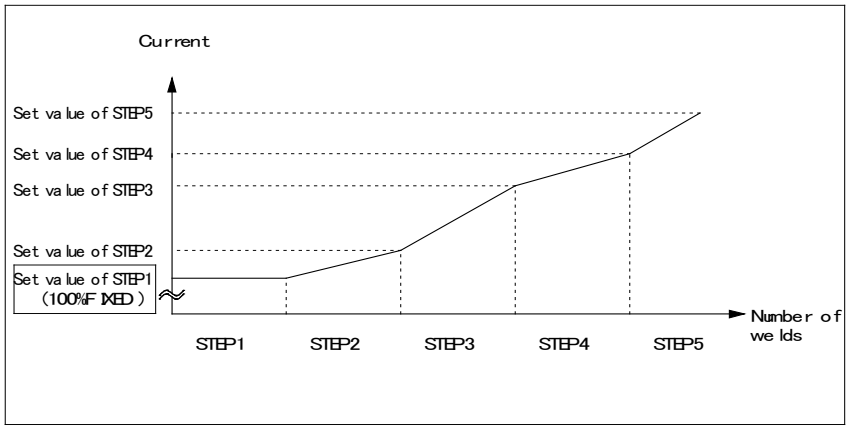
There are two types for step-up (step-down), stepwise (**FIXED**) and linear (**LINER**). When step-up (step-down) is not used, **OFF** is displayed. The setting is made on the **MODE SELECT** screen.

FIXED



As shown in the above figure, the current is stepped up or down to the value for **STEP2** following completion of the specified number of welds for **STEP1**. Similarly, the current is stepped up or down to the value for **STEP3** following completion of the specified number of welds for **STEP2**.

LINER



As shown in the above figure, the current is stepped up or down to the value for **STEP2** with the specified number of welds for **STEP2** following completion of the specified number of welds for **STEP1**. Similarly, the current is stepped up or down to the value for STEP3 the specified number of welds for **STEP3** following completion of the specified number of welds for STEP2.

For example, the settings are **COUNT: 2** for **STEP1, RATIO: 200%** and **COUNT: 4** for **STEP2**, and 2 kA for current, the current is stepped up in a stepwise manner from Weld 3 to Weld 6 as shown below.

```
Weld 1:2 kA Weld 2:2 kA     Weld 3:2.5 kA Weld 4:3.0 kA Weld 5:3.5 kA Weld 6:4.0 kA
<--------- STEP1---------->  <---------------------------- STEP2 ---------------------------->
```

START ON STEP #

The counting of welds starts from the **STEP** set here. For example, if you select **START ON STEP #3** as shown above, welds will be counted from the first weld in **STEP3**, even if welding for the first time. Further, the welding current will be increased (or reduced) by the extent you have set this value for **STEP3**. Set the desired **STEP** number. 1–9 for **VALVE1** and **VALVE2** respectively.

STEP 1–9. Set the welding current step-up ratio (**RATIO**) and the number of welds (**COUNT**) for each **STEP**. The sequence will proceed to the next **STEP** when the set number of welds is reached.

VALVE # Make settings for (a) and (b) above for each valve number. Change the number to set the schedule for each valve.

NOTE: Upper/Lower limit judgment value when STEPPER MODE is set to ON
The upper/lower limit judgment value set here is for the current when a welding is performed, not for the initial setting. Therefore, when STEPPER MODE is set to ON to perform step-up (step-down) for the initial setting, the upper/lower limit judgment value is stepped up or down automatically.

RATIO has an effect on **HEAT** only. Fixed for **UF/DL**. When the **HEAT** value multiplied by **RATIO** falls below the **UF/DL** value, an error occurs.

Example: When the current is set to **2 kA, H; 2.2 kA, L; 1.8 kA**. When the step becomes **150%**, **H** and **L** become as follows.

H: 2.2 x 1.5 = 3.3 kA
L: 1.8 x 1.5 = 2.7 kA

c. VALVE

Make settings for (a) and (b) above for each valve number. Change the number to set the schedule for each valve.

NOTE: Upper/Lower limit judgment value when **STEPPER MODE** is not OFF. The upper/lower limit judgment value set here is for the current when a welding is performed, not for the initial setting.

Therefore, when **STEPPER MODE** is not OFF to perform step-up (-down) for the initial setting, the upper/lower limit judgment value is stepped up or down automatically.

RATIO has an effect on HEAT only. Fixed for UF/DL.
When the HEAT value multiplied by RATIO falls below the UF/DL value, an error occurs.

Example: When the current is set to 2 kA, HIGH; 2.2 kA, LOW; 1.8 kA.

When the step becomes 150%, HIGH and LOW become as follows.

HIGH: 2.2 x 1.5 = 3.3 kA
LOW: 1.8 x 1.5 = 2.7 kA

d. STEP 1–9

Set the welding current up (-down) ratio (**RATIO**) for each **STEP**.

e. COUNT 1–9

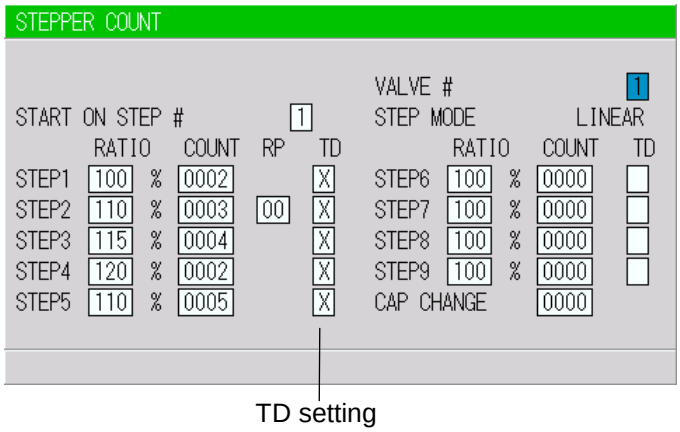
Set the number of welds (**COUNT**) for each **STEP**.
The sequence will proceed to the next **STEP** following completion of the specified number of welds.

f. RP2

Set the number of repetition (**COUNT**) for **STEP2**.
The sequence will proceed to the next **STEP3** following completion of the specified number of welds. **STEP2** is repeated the set number of times, and the sequence will proceed to the next **STEP3**.

g. TD 1–9

Set the chip dress for each **STEP**. When TD is set, X is displayed.
For **STEP** with the tip dress setting, the tip dress error occurs following completion of the specified number of welds.



h. CAP CHANGE

Set the cap change (**COUNT**) for **STEP9**.

The cap change error occurs following completion of the specified number of welds for **STEP9**.

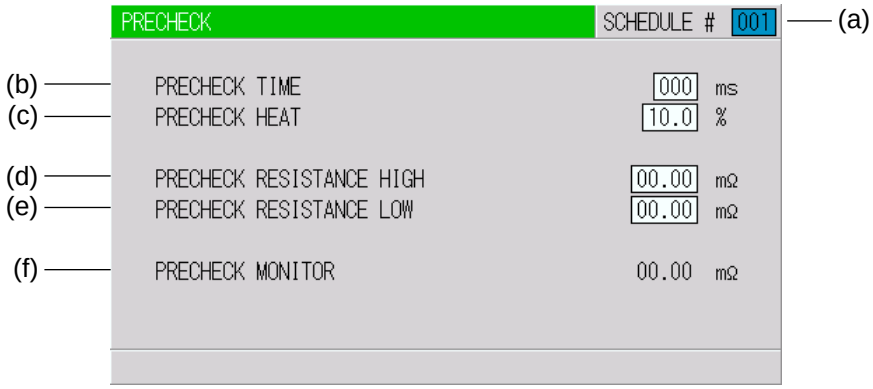
When the number of welds is set in **CAP CHANGE**, prior notice for cap change will be given before the cap change error occurs.

Specify the number of welds to give prior notice how many numbers before the number of welds (**STEP9 COUNT**) that the cap change error occurs.

For example, when **STEP9 COUNT** is 1000 (the number of welds that the cap change error occurs) and **CAP CHANGE** is 10, prior notice is given when the stepper count is 990.

12. PRECHECK Screen

Screen for setting the weld time and pulse width for resistance pre-check welding. The resistance pre-check welding is a function to apply a small current under constant voltage control before regular welding to confirm that the part to weld is set correctly by means of the measured current value. To use the pre-check function, the secondary current (voltage) needs to be monitored.



a. SCHEDULE

Select from #1 to #255 to set the **SCHEDULE**. Normally select #1 first, then select additional schedules in sequential order.

b. PRECHECK TIME

Set the weld time. Pre-check is not performed at 0 ms.

c. PRECHECK HEAT

Set the welding pulse width.

d. PRECHECK RESISTANCE HIGH

Set the upper limit of resistance value for pre-check.

e. PRECHECK RESISTANCE LOW

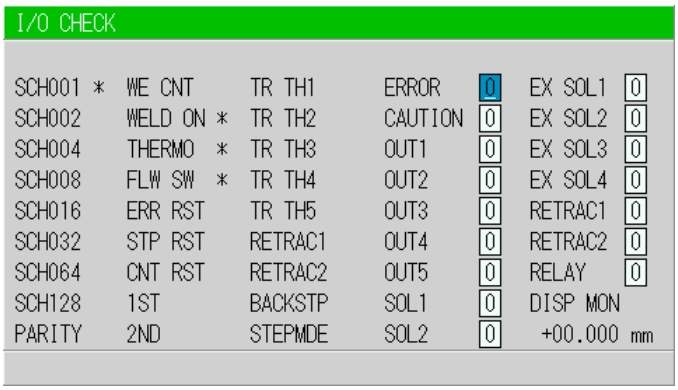
Set the lower limit of resistance value for pre-check.

f. PRECHECK MONITOR

Displays the monitor resistance value at the pre-check welding.

13. I/O CHECK Screen

This screen is used to check the status of the external I/O signals. The "*" symbol appears when the corresponding input signal is ON. The asterisk disappears if the signal is OFF. Set the cursor reading to "0" to turn OFF the output signal, and "1" to turn it ON. Reception of an input signal while this screen is showing will not activate the corresponding function. You cannot move to another screen while the 1ST or 2NDSTAGE signal is input.



I/O Terminal Board (see Appendix B for user accessible I/O's)

Input signal

SCHEDULE 1	SCHEDULE 128	ERROR RESET
SCHEDULE 2	PARITY	STEP RESET
SCHEDULE 4	WELD COUNT	COUNT RESET
SCHEDULE 8	WELD CONT	STAGE 1
SCHEDULE 16	THERMOSTAT	STAGE 2
SCHEDULE 32	FLOW SWITCH	RETRACTION 1
SCHEDULE 64	BACK STEP	RETRACTION 2
	STEP MODE	

Output signal

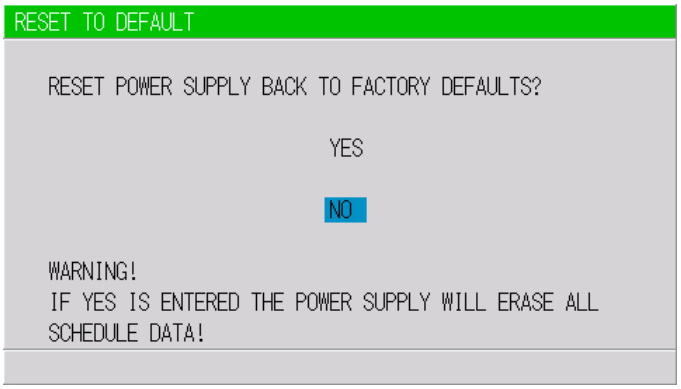
NG1 OUT (ERROR)	VALVE1 (SOL1)
NG2 OUT (CAUTION)	VALVE2 (SOL2)
OUT1	EX VALVE1 (EX SOL1)
OUT2	EX VALVE2 (EX SOL2)
OUT3	EX VALVE3 (EX SOL3)
OUT4	EX VALVE4 (EX SOL4)
OUT5	RET VALVE1 (RET SOL1)
	RET VALVE2 (RET SOL2)
	VALVE RELAY (SOL RELAY)

Displacement sensor

DISP MON: The displacement gauge operation can be viewed.

14. RESET TO DEFAULT Screen

This screen is used to initialize the Power Supply's memory (i.e., to restore the initial settings). Initialization will not clear the memory of the MA-660A. To initialize, move the cursor over **YES** or **NO** and press the **ENTER** key.



(a) YES	Initializes the Power Supply memory (restores the initial settings). After initialization, the screen will reflect the settings shown in this chapter.
(b) NO	Returns the display to the **MENU** screen without initializing the Power Supply memory.

15. PROGRAM PROTECT MODE Screen

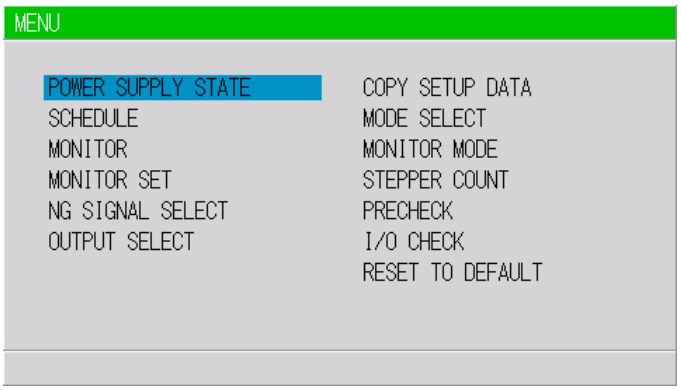
When this function is used, set values cannot be changed by any person other than the supervisor. **PROGRAM PROTECT** is usually set to OFF. When it is set to ON, set values cannot be changed until **PROGRAM PROTECT** is set to OFF again.

Follow the procedure below to change the setting of **PROGRAM PROTECT**.

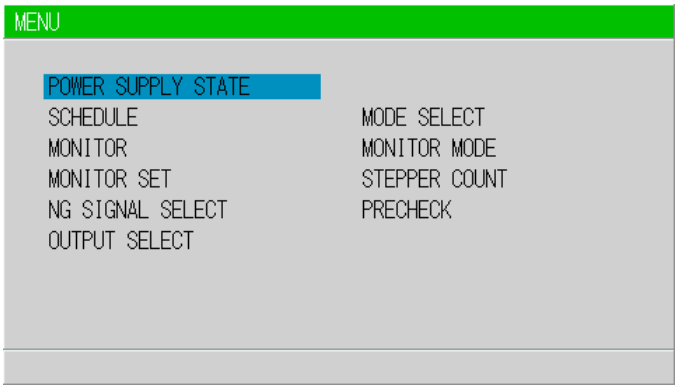
1. Turn the power supply ON using the ▼ key pressed or connect the MA-660A to the circuit cable with the power supply turned ON. The following screen is displayed:

2. When the **ENTER** key is pressed after the **+ON** key is pressed, **ON** is displayed. You cannot go to other screens from this screen. Also, the external signals cannot be received.
3. Turn off the power supply and turn on it again, or disconnect the MA-660A with the power supply turned on and connect to the circuit cable again. When **PROGRAM PROTECT** is ON, the display of the **MENU** screen changes. **COPY SETUP DATA, I/O CHECK** and **RESET TO DEFAULT** are not displayed. On the other screens, the cursor can be moved and the settings can be checked, but the settings cannot be changed.

<When the PROGRAM PROTECT is OFF>

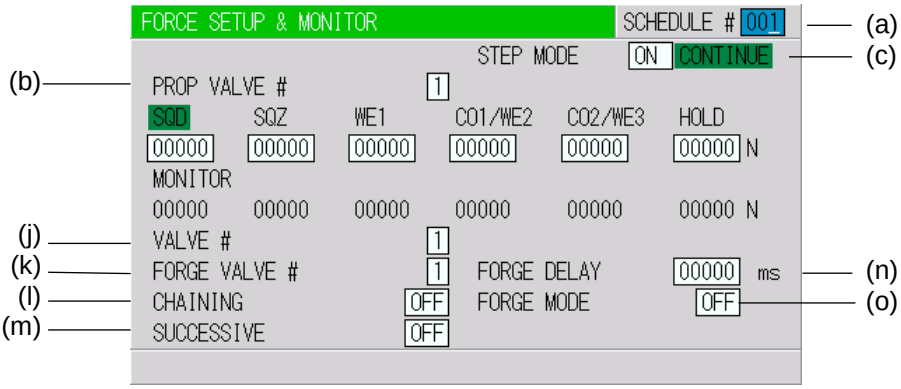


When the PROGRAM PROTECT is ON>



16. FORCE SETUP & MONITOR Screen

This screen is used to set and monitor the force of the electro pneumatic proportional valve. Two electro pneumatic proportional valves can be used. The ANALOG OUT output terminal (voltage output proportional to force) for electro pneumatic proportional valve and the ANALOG IN input terminal (voltage input proportional to force) for force measurement have two channels, respectively. Also, chaining, successive and forge force functions can be set.



a. SCHEDULE

Select from #001 to #255 to set the **SCHEDULE**.
Normally select #001 first, then select additional schedules in sequential order.

b. PROP VALVE

Two electro pneumatic proportional valves can be connected.
Select an electro pneumatic proportional valve to use.

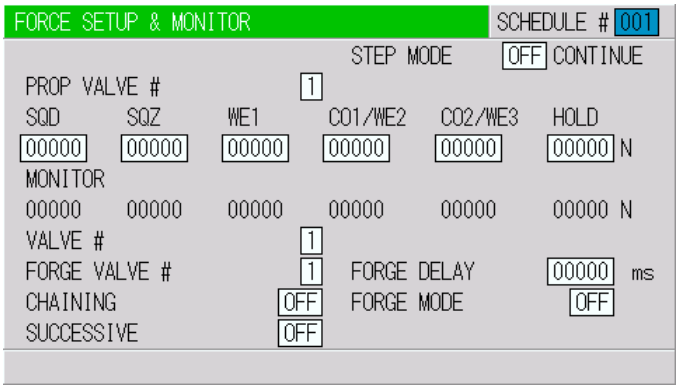
c. STEP MODE

This is the mode to check the force operation of the electro pneumatic proportional valve.
In this mode, the force operation can be checked without flowing the welding current. The sequence proceeds to the next in order of SQD, SQZ, WE1, CO/WE2, CO2/WE3, and HOLD by pressing the ENTER key or input the STEP MODE signal.
Do not move the cursor from STEP MODE during this mode. Settings cannot be changed.
Valid only when FORCE CONTROL MODE on the PRESSURE REGULATOR screen is not 0.

Turning on the step operation mode
Set STEP MODE to ON.

SQD

Closes the 1ST signal. When the 1ST signal is input, the force set in SQD is output to the electro-pneumatic proportional valve (ANALOG OUT), and SQD and CONTINUE blink.
The measured value input in the force input (ANALOG IN) is displayed at the monitor of SQD.



SQZ

The sequence proceeds from SQD to SQZ by press the ENTER key or input STEP MODE signal. The force set in SQZ is output to the electro pneumatic proportional valve (ANALOG OUT), and SQZ and CONTINUE blink. The measured value input in the force input (ANALOG IN) is displayed at the monitor of SQZ.

WE1

The sequence proceeds from SQZ to WE1 by pressing the ENTER key or input the STEP MODE signal. The force set in WE1 is output to the electro pneumatic proportional valve (ANALOG OUT), and WE1 and CONTINUE blink. The measured value input in the force input (ANALOG IN) is displayed at the monitor of WE1.

CO1/WE2

The sequence proceeds from WE1 to CO1/WE2 by pressing the ENTER key or input the STEP MODE signal. The force set in CO1/WE2 is output to the electro pneumatic proportional valve

(ANALOG OUT), and CO1/WE2 and CONTINUE blink. The measured value input in the force input (ANALOG IN) is displayed at the monitor of CO1/WE2.

CO2/WE3

The sequence proceeds from CO1/WE2 to CO2/WE3 by pressing the ENTER key or input the STEP MODE signal. The force set in CO2/WE3 is output to the electro pneumatic proportional valve (ANALOG OUT), and CO2/WE3 and CONTINUE blink. The measured value input in the force input (ANALOG IN) is displayed at the monitor of CO2/WE3.

HOLD

The sequence proceeds from CO2/WE3 to HOLD by pressing the ENTER key or input the STEP MODE signal. The force set in HOLD is output to the electro pneumatic proportional valve (ANALOG OUT), and HOLD and CONTINUE blink. The measured value input in the force input (ANALOG IN) is displayed at the monitor of HOLD.

Turning off the step operation mode

The step operation mode ends by pressing the **ENTER** key or input the **STEP MODE** signal. Open the 1ST signal. The force output to the electro pneumatic proportional valve (ANALOG OUT) becomes the setting on the setting on the PRESSURE REGULATOR screen, and **HOLD** and **CONTINUE** stops blinking.

d. SQD

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during SQD.

e. SQZ

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during SQZ.

f. WE1

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during WE1.

g. CO1/WE2

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during CO1/WE2.

h. CO2/WE3

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during CO2/WE3.

i. HOLD

Set the force of the electro pneumatic proportional valve (ANALOG OUT) output during HOLD.

j. VALVE

Two or four valves (welding heads) can be connected to the Power Supply. Use this setting to select which of the two valves to use.
Operation differs according to the VALVE MODE setting on the MODE SELECT screen.

When VALVE MODE is 1 VALVE

Set the valve # in the range of 1 to 4.
EX SOL1 to EX SOL4 on the I/O terminal block.
VALVE #1: EX SOL1 VALVE #3: EX SOL3
VALVE #2: EX SOL2 VALVE #4: EX SOL4

When VALVE MODE is 2 VALVE

Set the valve # in the range of 1 to 2.
SOL1 and SOL2, and EX SOL1 to EX SOL2 on the I/O terminal block are used for valve output.
VALVE #1: SOL1, SOL2
VALVE #2: EX SOL1, EX SOL2

k. FORGE VALVE

The forge force function can be used.
The forge valve can be used at the given timing (the head force can be changed) except the valve selected in **VALVE #**.
Select a valve to output the forge force.
Operation differs according to the VALVE MODE setting on the MODE SELECT screen.

When VALVE MODE is 1 VALVE

The forge valve No. is set in the range of 1 to 4.
Do not set the same number as that used for the valve No.
EX SOL1 to EX SOL4 on the I/O terminal block are used for valve output.
FORGE VALVE #1: EX SOL1 FORGE VALVE #3: EX SOL3
FORGE VALVE #2: EX SOL2 FORGE VALVE #4: EX SOL4

When VALVE MODE is 2 VALVE

FORGE VALVE # is fixed to 4.
EX SOL4 on the I/O terminal block is used for valve output.

Valid only when FORGE MODE is ON.

l. CHAINING

Used for the chaining function.
The welding is performed with SCHEDULEs with the chaining setting in order while the start signal (1ST and 2ND) is input.

All values of the chained schedules must be entered, especially the turns ratio, to ensure proper weld output.

For example, when CHAINING for SCHEDULE 1, 2, 5, and 6 are ON, the welding is performed sequentially in order of SCHEDULE 1 → SCHEDULE 2 → SCHEDULE 5 → SCHEDULE 6 by the start signal (1ST and 2ND) input.

m. SUCCESSIVE

Used for the successive function.
The welding is performed with SCHEDULEs with the successive setting in order each time the start signal (1ST and 2ND) is input.

For example, when SUCCESSIVE for SCHEDULE 1, 2, 5, and 6 are ON, the welding is performed singly in order of SCHEDULE 1 → SCHEDULE 2 → SCHEDULE 5 → SCHEDULE 6 each time the start signal (1ST and 2ND) is input.

The CHAINING setting has a priority to the SUCCESSIVE setting.

n. FORGE DELAY

The forge force function can be used.
The forge valve can be used at the given timing (the head force can be changed) except the valve selected in **VALVE #**.
Set the timing to output the forge force.
Operation differs according to the VALVE MODE setting on the MODE SELECT screen.

When VALVE MODE is 1 VALVE
The forge valve operates from the end of SQD through the forge delay time elapses.

When VALVE MODE is 2 VALVE

The forge valve operates from the beginning of WE1 through the forge delay time elapses.

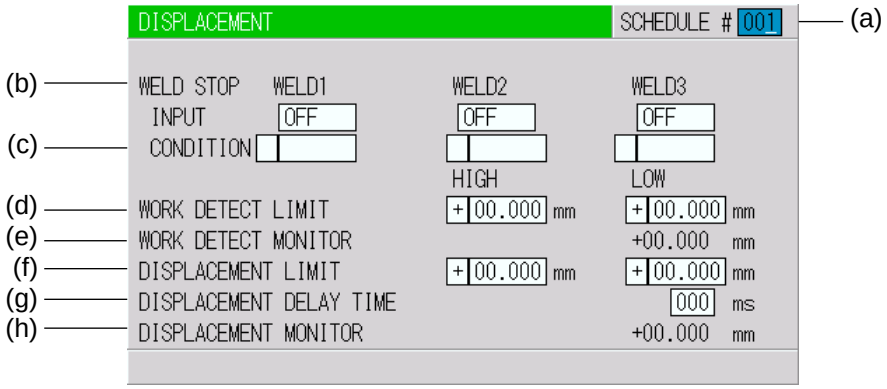
Valid only when FORGE MODE is set to ON.

o. FORGE MODE

The forge force function can be used.
The forge valve can be used at the given timing (the head force can be changed) except the valve selected in **VALVE #**.
Set whether or not to use the forge force.

17. DISPLACEMENT Screen

This screen is used to make a measurement using a displacement gauge and set the weld stop function.



a. SCHEDULE

Select from #001 to #255 to set the **SCHEDULE**.
Normally select #001 first, then select additional schedules in sequential order.

b. WELD STOP INPUT

Select items for weld stop.
OFF: External Input, **WE1** to **WE3**Stop Input are effective.
DISPLC: Weld Stop works at the set displacement value.
CURR: Weld Stop works at the set current value.
VOLT: Weld Stop works at the set voltage value.
POWER: Weld Stop works at the set power value.
PULSE: Weld Stop works at the set pulse width.

c. WELD STOP CONDITION

Set values for items selected in **WELD STOP INPUT**.
OFF: Not displayed.
DISPLC: Set the value of displacement.
CURR: Set current value.
VOLT: Set voltage value.
POWER: Set power value.
PULSE: Set pulse width.

d. WORK DETECT LIMIT

e. WORK DETECT MONITOR

The presence or absence of work piece can be detected by measuring the head travel distance from the beginning of SQD through the end of SQZ. The presence or absence and overlapping of work piece can be detected.

In **WORK DETECT LIMIT**, set the upper limit (HIGH) and the lower limit (LOW) in consideration of the difference between the head travel distance from the beginning of SQD through the end of SQZ and the presence or absence of a work piece to detect.

In **WORK DETECT MONITOR**, the measured value of the head travel distance from the beginning of SQD through the end of SQZ at welding is displayed.

In **WORK DETECT LIMIT**, you can set a value checking the measured value of work piece detection when the head is actually operated.
To use the work piece detection function, the used displacement gauge should be ready at any time to measure the displacement from force releasing to force applying (the measurement range of the displacement gauge is larger than distance between electrodes at force releasing). Otherwise, the work piece detection will not be done properly.

f. DISPLACEMENT LIMIT

g. DISPLACEMENT DELAY TIME

h. DISPLACEMENT MONITOR

Measures the degree of work piece collapse by measuring the head travel distance from the pre-check start to the displacement delay time elapses.
The degree of collapse in fusing welding can be controlled.

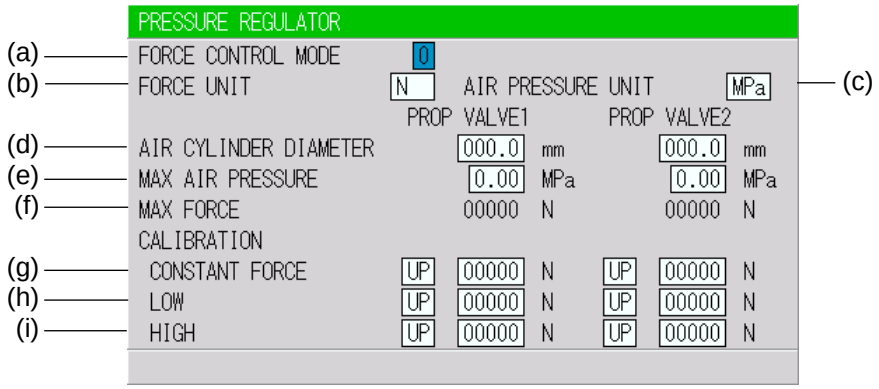
In **DISPLACEMENT LIMIT**, set the upper limit (HIGH) and the lower limit (LOW) to control the head travel distance (the degree of work piece collapse) from the pre-check start to the displacement delay time elapses.

In **DISPLACEMENT DELAY TIME**, set the delay time from the end of WE3 to the displacement measurement. Since the degree of work piece collapse changes by remaining heat of electrode even after welding, set the time in consideration of the timing to make a displacement measurement. Up to the time set in HOLD can be set.

In **DISPLACEMENT MONITOR**, the head travel distance (the degree of work piece collapse) from the pre-check start to the displacement delay time elapses is displayed.

18. PRESSURE REGULATOR Screen

This screen is used to set the units of force and air pressure, set the maximum force, and calibrate force.



a. FORCE CONTROL MODE

Sets the control mode of the electro pneumatic proportional valve.

0: Mode not using the electro pneumatic proportional valve. The electro pneumatic proportional valve (ANALOG OUT) is not output.

1: Mode using the electro pneumatic proportional valve. The electro pneumatic proportional valve (ANALOG OUT) is output.

- At the operation of welding sequence, SQD, SQZ, WE1, CO1/WE2, CO2/WE3, and HOLD settings are output to the electro pneumatic proportional valve (ANALOG OUT).
- After the completion of welding sequence, the CALIBRATION CONSTANT FORCE setting is output to the electro pneumatic proportional valve (ANALOG OUT).
- Set AIR CYLINDER DIAMETER and MAX AIR PRESSURE to set the maximum force. (CALIBRATION LOW and HIGH settings are not used.)
- Check the force before using this.

2: Mode using the electro pneumatic proportional valve. The electro pneumatic proportional valve (ANALOG OUT) is output.

- At the operation of welding sequence, SQD, SQZ, WE1, CO1/WE2, CO2/WE3, and HOLD settings are output to the electro pneumatic proportional valve (ANALOG OUT).
- After the completion of welding sequence, the HOLD setting is output to the electro pneumatic proportional valve (ANALOG OUT).
- Set AIR CYLINDER DIAMETER and MAX AIR PRESSURE to set the maximum force. (CALIBRATION LOW and HIGH settings are not used.)
- Check the force before using this.

3: Mode using the electro pneumatic proportional valve. The electro pneumatic proportional valve (ANALOG OUT) is output.

- Regardless of welding sequence operation, the CALIBRATION CONSTANT FORCE setting is output to the electro pneumatic proportional valve (ANALOG OUT).
- Set AIR CYLINDER DIAMETER and MAX AIR PRESSURE to set the maximum force. (CALIBRATION LOW and HIGH settings are not used.)
  Check the force before using this.

4: Mode using the electro pneumatic proportional valve. The electro pneumatic proportional valve (ANALOG OUT) is output.

- At the operation of welding sequence, SQD, SQZ, WE1, CO1/WE2, CO2/WE3, and HOLD settings are output to the electro pneumatic proportional valve (ANALOG OUT).
- After the completion of welding sequence, the CALIBRATION CONSTANT FORCE setting is output to the electro pneumatic proportional valve (ANALOG OUT).
- Set CALIBRATION LOW and HIGH to set the maximum force. (AIR CYLINDER DIAMETER, MAX AIR PRESSURE and AIR PRESSURE UNIT settings are not used.)
  Check the force before using this.

b. FORCE UNIT

Select the unit of force among N, kgf and lbf.

c. AIR PRESSURE UNIT

Select the unit of pneumatic pressure among Mpa, bar and psi.

d. AIR CYLINDER DIAMATER

Used when FORCE CONTROL MODE is 1 to 3.
Set the diameter of pneumatic cylinder.

e. MAX AIR PRESSURE

Used when FORCE CONTROL MODE is 1 to 3.
Set the maximum pneumatic pressure supplied to the electro pneumatic proportional valve.

f. MAX FORCE

Displays the maximum force of the set electro pneumatic proportional valve.

g. CALIBRATION CONSTANT FORCE

Used when FORCE CONTROL MODE is 1, 3 or 4.

FORCE CONTROL MODE is 1 or 4:

Set the force output to the electro pneumatic proportional valve (ANALOG OUT) after the completion of welding sequence.

FORCE CONTROL MODE is 3:

Set the force output to the electro pneumatic proportional valve (ANALOG OUT) Regardless of welding sequence operation.

UP and DW at the left side of CALIBRATION CONSTANT FORCE can be used when FORCE CONTROL MODE is 3.

The force can be checked with this setting when FORCE CONTROL MODE is 3.

Set AIR CYLINDER DIAMETER and MAX AIR PRESSURE.

Set the force used to CALIBRATION CONSTANT FORCE.

The force is applied by changing UP on the left side of CALIBRATION CONSTANT FORCE into DW and released by returning the setting to UP.

The force setting and the force can be checked by measuring the force while the force is applied.

When there is difference between the set value and the measured value, adjust either AIR CYLINDER DIAMETER or MAX AIR PRESSURE so that the set value and the measured value become the same.

h. CALIBRATION LOW

i. CALIBRATION HIGH

Used when FORCE CONTROL MODE is 4.

Set CALIBRATION LOW and HIGH to set the maximum force.

UP and DW on the left side of CALIBRATION LOW and HIGH can be used when FORCE CONTROL MODE is 4.

The force can be checked with these settings when FORCE CONTROL MODE is 4.

The force is applied by changing UP on the left side of CALIBRATION LOW into DW and released by returning the setting to UP. About 30% of the maximum force is applied.

Measure the force while the force is applied, and input the measured value in CALIBRATION LOW.

The force is applied by changing UP on the left side of CALIBRATION HIGH into DW and released by returning the setting to UP. About 80% of the maximum force is applied.

Measure the force while the force is applied, and input the measured value in CALIBRATION HIGH.

CHAPTER 4
OPERATING INSTRUCTIONS

Section I: Introduction

Operator Safety

WARNING

- DEATH ON CONTACT may result if personnel fail to observe the safety precautions labeled on the equipment and noted in this manual. **HIGH VOLTAGE** is used in the operation of this equipment.
- To prevent blindness or eye injury, ***wear safety goggles at all times during welding***.
- ***Be careful of moving parts.*** You can be injured by moving parts during welding.
- Do ***not*** wear loose clothing or jewelry around moving parts. They could get caught and cause injury.

Before You Start

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

- The principles of resistance welding and the use of programmed weld schedules.
- The location and function of Controls and Indicators (see *Chapter 1*).
- How to select and use the Power Supply functions for your specific welding applications. For more information (see *Chapter 3*).
- Check that the display screen and lamps are turned on normally.

Preparing for Operation

Verify that the electrical and water supplies meet the electrical and cooling (water) requirements, as shown in *Appendix A, Technical Specifications*. The electrical and water supplies must also meet all applicable local, state, and federal safety standards.

Section II: Operation

CAUTION

If no secondary toroidal coil is connected, make sure that the Power Supply mode is set to **PRIMARY RMS** or **PRIMARY LIMIT** or you may damage the Power Supply.

Starting Welding Operation

1. Turn the cooling water supply ON at the temperature and flow rate shown in *Chapter 2*.
2. Turn the input power ON.
   IS-2200CA: close door and turn handle to ON.
   IS-4500CA: close door, Charge the breaker spring by pulling on the charge spring until the handle will not move anymore. Then push the ON button of the breaker.
   Observe that the red **WELD POWER** lamp lights and green **READY** lamp blinks for 7 seconds, then goes off.
3. Press the **MENU** key on the Pendant to see the **MENU** screen.
4. Move the cursor to **SCHEDULE MODE** and press the **ENTER** key.
5. Set each item as described in *Chapter 3*.
6. Again press the **MENU** key to bring back the Menu screen.
7. Move the cursor to **SCHEDULE** and press the **ENTER** key.
8. Set each item as described in *Chapter* 3.

   NOTE: For initial set-up, current settings should be a little lower than predicted to prevent damage from excessive settings.
9. Re-set the schedule so that the work piece will be welded adequately.
10. When welding plural work pieces according to plural schedules, change **SCHEDULE #** and set new time and welding current.
11. Set the upper and lower limits on **MONITORSET** screen for each **SCHEDULE#.**

Check the Valve Sequence

1. Press and hold the Power Supply **WELD ON/OFF** switch until the green LED goes out.
2. Initiate a start signal while the **READY** lamp is ***not*** on, and check each sequential operation.

   WARNING: When confirming the operation, check that the Squeeze time (SQZ) is sufficient. If the welding current begins before the welding electrodes have reached sufficient force, expulsion is produced.

If no error is detected in Step 2, ensure that the three **READY** requirements are met:

- The Power Supply **WELD ON/OFF LED** must be ON.
- The **ON/OFF** setting of the Pendant must be set to ON.
- An external **WELD ON/OFF** signal must be present at the I/O terminal block.

3. Check that the Power Supply green **READY** lamp is lit
4. Start the weld sequence and confirm that the welding current is flowing normally by checking the red **WELD** lamp and the Monitor screen.
5. Make any necessary adjustments to the schedule so that the work piece will be properly welded.
6. When welding multiple work pieces according to multiple schedules, change the **SCHEDULE #** and set new time and welding current.
7. Set the upper and lower limits on the Pendant **MONITOR SET** screen for each **SCHEDULE #.**
8. Begin welding following normal procedures. Adjust the **SCHEDULE** settings as necessary.

Section III: Shutdown

CAUTION

DO NOT power ON the unit while the door is open. Touching anything inside the cabinet with power ON may cause death.

Turn the Power Supply OFF

The IS-2200CA requires to turn the power handle to OFF to open the cabinet. This will trip the breaker, cut power to the inside of the cabinet and discharge the capacitors within 30 seconds.

Push the OFF button on the circuit breaker to power the system down.

Note: The IS-4500CA has an interlock system. As soon as anyone opens the door, the breaker will trip, cutting power to the inside of the cabinet and automatically discharge the capacitors within 30 seconds.

Wait 10 minutes before conducting any work inside the cabinet AFTER power is turned off.

CHAPTER 5
MAINTENANCE
Section I: Troubleshooting

The table below lists the **ERROR** messages that may be displayed on the Pendant and what those messages mean, and corrective actions you can take.

FAULT CODE	CONTENTS	CAUSE	MEASURES
E-01	SYSTEM ERROR	Error has been detected in the **IS-2200CA/4500CA**	Re-cycle the power. If the **E-01** SYSTEM ERROR is displayed again, repair is required. Contact AMADA WELD TECH.
E-02	MEMORY ERROR	The welding schedule data is different than the programmed schedule.	Check all the settings. If the data in memory is corrupt, the possible causes are: Abnormal Power Supply voltage from power surge or electrostatic discharge Flash memory's rewrite limit has been exceeded If the error occurs again after initialization, the Power Supply will need repair. Contact AMADA WELD TECH.
E-03	MEMORY TROUBLE		
E-04	PARITY ERROR	Input "Start" signal cable is open/broken, and a parity check error is detected.	Check start signal input cable.
E-05	TRIP OF EXTERNAL THERMO	Welding transformer temperature rises and opens the external thermostat input circuit.	Lower transformer temperature. When using a water-cooled transformer, properly adjust the temperature and flow rate of the cooling water.
		External signal input power is not connected.	Check external input signal for proper connection.
E-06	TRIP OF INTERNAL THERMO	High equipment temperature causing the power transistor thermostat to open.	Ensure that the duty cycle does not exceed the specified value.
E-07	NO CURRENT	Squeeze of welding electrode is not sufficient.	Adjust the squeeze of welding electrode.
		SQD or **SQZ** time is too short.	Check the setting of the **SQD** or **SQZ** time to determine whether it is too short. (Note: Set the **SQD** or **SQZ** time to a period longer than the stroke time of the electrode).
		NO CURRENT LEVEL is high.	Set a lower **NO CURRENT LEVEL**.
		Fuse inside the equipment is blown.	The fuse needs replacement. Contact AMADA WELD TECH.
		Toroidal coil is not connected.	Connect the toroidal coil.
E-08	OUT LIMIT OF CURRENT ERROR	Welding current is out of **CURRENT** setting range on the **MONITOR SET** screen.	Check for stained welding electrode or loose cable connection.

FAULT CODE	CONTENTS	CAUSE	MEASURES
E-09	OUT LIMIT OF PULSE WIDTH ERROR	Welding Current pulse width is out of **PULSE HI** setting range on **MONITOR SET** screen.	Check that the transformer capacity is sufficient. Check workpiece and welding electrode.
E-10	SET ERROR	Primary current of turn ratio is out of range of the following formula: $\mathbf{X} \leq \left(\frac{\textbf{HEAT setting}}{\textbf{TURNS RATIO}} \right) \leq \mathbf{Y}$ **IS-2200CA**: X = 45, Y = 2200 **IS-4500CA**: X = 90, Y = 4500	Correct each setting
		The **WELD1**, **WELD2**, and **WELD3** values are all "0."	
		The total time of **UP SLOPE** and **DOWN SLOPE** is longer than the **WELD** time.	
		HEAT setting, including **RATIO** setting is equal to or lower than UF or DL setting.	
		Although STEPPER MODE is set to LINER or FIXED, STEPPER COUNT of STEP number set for START ON STEP# are all "0."	
		The series of welding currents in WELDs without COOL are different than the consecutive UP/DOWN settings.	
		UP/DOWN is set in the consecutive portion of a series of WELDs without COOL and the portion meets specific conditions.	
		On ADVANCED Power Supply models the transformer weld frequency was set greater than 1,000 Hz	
E-11	SET OVER	**HEAT** setting (including **RATIO** setting) is equal to or lower than UF or DL setting.	Correct each setting
		HEAT setting (including **RATIO** setting) is larger than the maximum current, voltage, or power setting.	
		HEAT setting (including **RATIO** setting) is lower than the minimum value of current, voltage, or power setting.	

FAULT CODE	CONTENTS	CAUSE	MEASURES
E-12	STOP	External STOP input circuit is open.	Rectify cause of the STOP, and then close the STOP circuit.
		Power supply for external input is not connected.	Check the external input signal for proper connection.
E-13	OVER CURRENT	Primary current above the limit is detected.	Check for welding transformer and welding electrode problems.
			Check that the toroidal coil or the voltage detection cable is connected in the secondary control.
E-14	SHORT WITH GROUND	The output cable between the welding transformer and the power supply is grounded.	Check the output cable.
E-15	LACK OF COOLING WATER	Cooling water flow is low.	Increase cooling water flow rate to meet specifications.
		Power supply for external input is not connected.	Check external input signal for proper connection.
E-16	START ERROR	Schedule signal has not been entered when the external start signal is present.	Input the schedule before the start signal.
E-17	AC 50/60 FREQUENCY FAILURE	Frequency of incoming power supply is not stable, and equipment cannot determine whether it is at 50 Hz or 60 Hz.	Check power source.
E-18	OUT LIMIT OF VOLTAGE ERROR	Secondary voltage is out of the **VOLT** setting range on the **MONITOR SET** screen.	Check for stained welding electrodes and low electrode force.
E-19	OUT LIMIT OF POWER ERROR	Welding power is out of the **POWER** setting range on the **MONITOR SET** screen.	
E-20	INTERRUPT ERROR	The current shutoff signal is present before the start signal.	Check interrupt input signal.
E-21	NO VOLTAGE	No detection of the voltage across welding electrodes.	Make sure that the cable detecting the voltage across welding electrodes is connected.
		NO VOLTAGE LEVEL is too high.	Set a lower **NO VOLTAGE LEVEL**.
E-22	OVER CURRENT (DC 24 V)	Built-in 24 VDC power supply on the rear panel is shorted and overloaded.	Turn off the power and check the I/O connection on the rear panel.
E-23	SHORT CIRCUIT	The output cable is shorted.	Check the output cable.
E-24	PRECHECK ERROR	Current is outside of the upper / lower limit setting on the **PRECHECK** screen (when the PRECHECK Current Supply is used).	Check for contamination on the weld pickup electrodes, electrodes and workpieces. Check range set on the PRECHECK Screen.

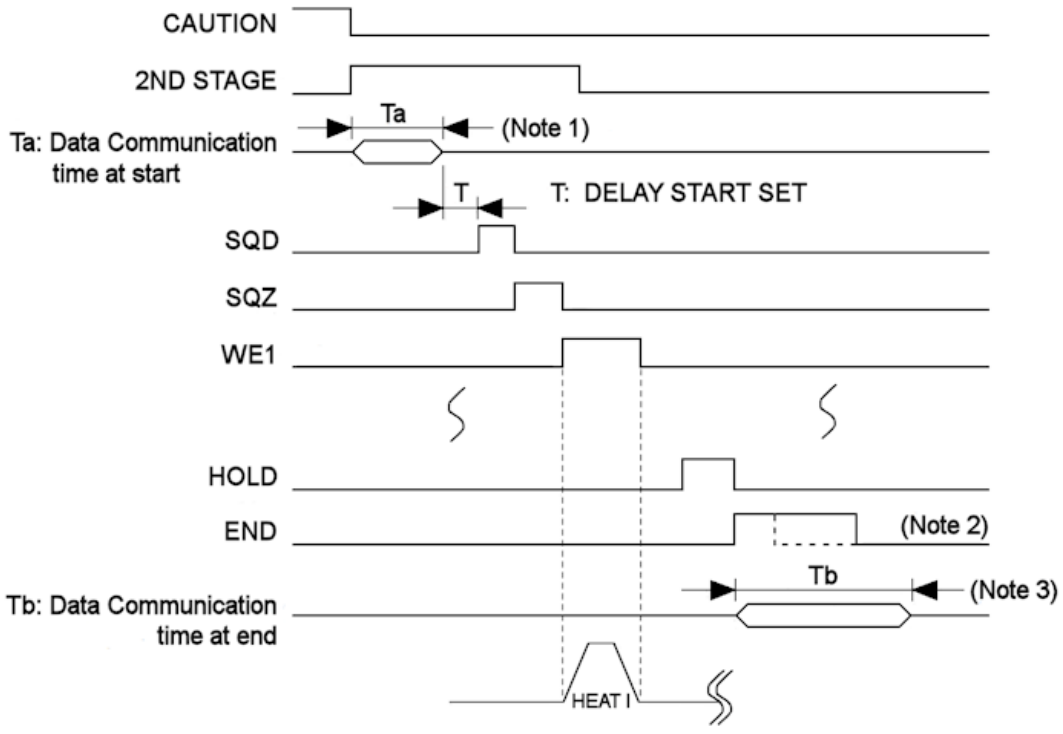
FAULT CODE	CONTENTS	CAUSE	MEASURES
E-25	RAM MEMORY ERROR	Count data or schedule number data stored in memory is corrupt.	Memory was erased because the period for retaining memory of the count data elapsed over the specified period. Count data memory is retained up to 10 days after the power supply is turned off.
E-26	LACK OF WELD COUNT	The counted number of welds is less than the **WELD COUNT** setting.	Add more welds to equal the **WELD COUNT** setting.
E-27	END OF STEP	The **STEPPER COUNT** has completed its final step.	Dress or replace the tip, then reset the step.
E-28	COUNT UP	The total weld count is equal to the preset count value.	Reset the counter.
E-29	PHASE MISSING	A welding power supply error is present.	Confirm that the welding power supply is connected correctly.
E-30	POWER FAILURE	The power was out during welding.	Check for the cause of the instantaneous power failure.
E-31	OUT LIMIT OF TIME ERROR	Weld time is out of the **TIME** setting range on the **MONITOR SET** screen.	Check the welding stop input of the external interface.
E-32	COMM SETTING ERROR	The bi-directional data write (in external communications), is either out of the range or data format is wrong.	Check the write data.
E-33	SUCCESSIVE BACK STEP ERROR	The first SCHEDULE is selected. SCHEDULE cannot be returned any more.	Check the back step input. Check that SCHEDULE is returned to the first one.
E-34	TIP DRESS REQUIRED	Counting has arrived at the tip dress setting value. This occurs when the tip dress is set for stepper.	Dress the tip, then reset it.
E-35	APPROACHING CAP CHANGE	Capacitor change count is approaching the change setting value.	The time for capacitor change is approaching. Check and reset it.
E-36	CAP CHANGE REQUIRED	STEPPER COUNT has completed final step.	Dress or replace the tip, then reset step.
E-37	OUT LIMIT OF DISPLACEMENT ERROR	The displacement is out of the DISPLACEMENT LIMIT setting range on the DISPLACEMENT screen.	Check work pieces, welder and welding power supply voltage. Check range set at DISPLACEMENT LIMIT.

FAULT CODE	CONTENTS	CAUSE	MEASURES
E-38	WORK DETECTERROR	The workpiece detection is out of the WORK DETECT LIMIT setting range on the DISPLACEMENT screen.	Check work piece setting and positioning. Check range set at WORK DETECT LIMIT.
E-39	WITHOUT EXTENSION BOARD	The optional extension board is not connected.	Recycle power. If the E-39 error WITHOUT EXTENSION BOARD is displayed again, repair is required. Contact AMADA WELD TECH

When Welding Does not Start, Even if the Start Signal is Present

When welding does not start even if the Start signal **2ND STAGE** signal is present, the following causes may be occurring:

- The Welder is not ready as indicated by the READY light.
- Start signal is shorter than DELAY START SET time setting.
- Start signal is input while the END signal is output.
- Start signal is input during communicating with the Pendant.



NOTES:

- When the next start signal is received while the monitor error is displayed on the Pendant, the **CAUTION** signal is turned OFF and the previous screen is displayed. At this time, the data is transferred to the Pendant from the Power Supply. The start signal is not received while the data is transferred. (Ta: 40 ms max. in the figure above.) When the monitor error is displayed, input the start signal more than (Ta) time.
- When the sequence ends, the **END** signal is output after **HOLD**. To make the cycle time faster, lower the output time of END signal. (can be set in 10 ms increment. The minimum value is 10 ms.)
- When the **MONITOR** screen is displayed, the monitor data is transferred to the Pendant simultaneously with the **END** signal output (transmission time Tb1). The monitor data is not transferred when the screen other than **MONITOR** screen is displayed.

  The next Start signal is not received while the monitor data is transferred. Also, on every screen, the data is transferred to the Pendant from the Power Supply to display the monitor error when the monitor data is beyond/below the upper/lower limit (data communication time Tb2). The data communication time at end "Tb" is shown in the table below.

	MONITOR ERROR OCCURS	**MONITOR ERROR DOES NOT OCCUR**
MONITOR screen	Tb1: 164 ms max.	Tb1+Tb2+α: 280 (438) ms max.
Screens other than MONITOR screen	0 ms	Tb2: 113 (144) ms max.

* Time in ( ) is the time with RS-232C communication.

- When the RS-232C external communication function is set to the single-directional communication mode (**MODE SELECT** Screen), the monitor data is transferred to the host computer after the completion of welding (transmission time **Tc1**).

  Also, when the monitored value is outside the upper/lower limit on the **MONITOR SET** screen, the monitor error code is transferred to the host computer (transmission time **Tc2**). The Start signal is not received while during transmitting.

  To make start time faster, set the external communication function to OFF. Shown below is the data transmission time **Tc1** and **Tc2** when the communication speed is 9,600 bps. When the communication speed is 19,200bps or 38,400bps, the transmission time will be short.
- Data transmission time when the communication speed is 9,600 bps

Tc1	132 ms max.
Tc2	42 ms max.

Section II. Before You Start

IS-2200CA / IS-4500CA Cleaning

CAUTION

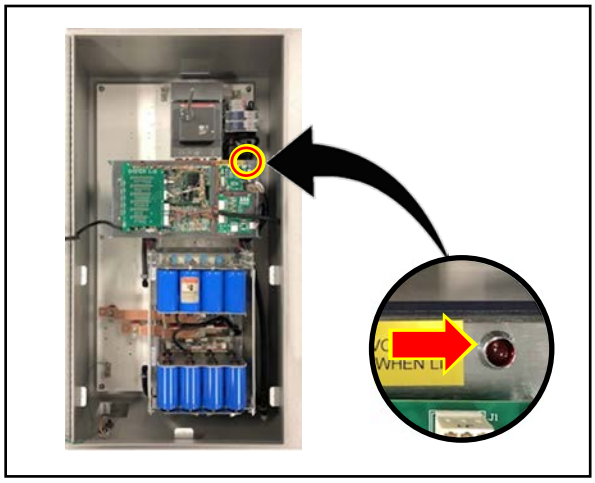
When cleaning the exterior of the Power Supply, do ***not*** use paint thinner, benzene, or acetone. These chemicals can damage the surface finish on the Power Supply. Use a dry cloth or, if it is heavily soiled, use a cloth moistened with a mild detergent or alcohol.

IS-2200CA Service Safety Precautions

DANGER

DEATH ON CONTACT may result if you fail to observe all safety precautions. ***Lethal voltages*** are present in the Power Supply. Perform the following steps to eliminate electrical shock hazard. Make sure external power is turned OFF before performing any maintenance procedures.

1. Turn the power to the IS-2200CA Power Supply to the off position by rotating the handle located on the front door to the OFF position.
2. Open the front door by turning the three quarter-turn screws.
3. The capacitors will automatically discharge in about 30 seconds. If the Charge Indicator is lit (see illustration to the right), then the IS-2200CA contains lethal voltages. DO NOT service until the lamp is off and at least 30 seconds of time have lapsed.



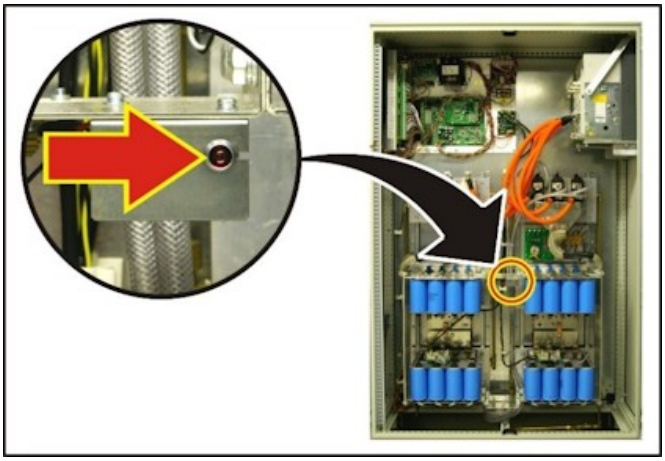
NOTE: If necessary for maintenance, remove the Safety Shields by removing the five screws used to secure the Capacitor cover or the four screws used to secure the Circuit Breaker cover.

IS-4500CA Service Safety Precautions

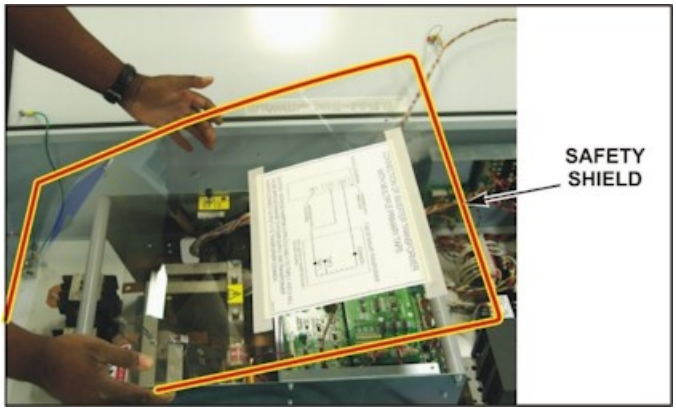
DANGER

DEATH ON CONTACT may result if you fail to observe all safety precautions. ***Lethal voltages*** are present in the Power Supply. Perform the following steps to eliminate electrical shock hazard. Make sure external power is turned OFF before performing any maintenance procedures.

1. Turn the power to the IS-4500CA Power Supply OFF by pressing the OFF button on the circuit breaker located on the right side of the IS-4500CA.
2. Open the front door.
3. The capacitors will automatically discharge in about 30 seconds. If the Charge Indicator is lit (see illustration to the right), then the IS-4500CA contains lethal voltages. DO NOT service until the lamp is off and at least 30 seconds of time have lapsed.



NOTE: If necessary for maintenance, remove the Safety Shields by removing the four securing screws. The Safety Shield (below) is highlighted for clarity.



Section III: Fuse Failure and Replacement

Lethal Voltages exist in the IS-2200CA / IS-4500CA Power Supply. The information in this Section is provided to give the end user an overview of the protection devices that are installed in the Power Supply.

If the Power Supply stops functioning and a fuse opens, it is important to identify and fix the problem before replacing the fuse and reapplying power to the Power Supply.

CAUTION

Do ***not*** attempt to replace any fuses other than those described below. All other fuses in the Power Supply should ***only*** be serviced by factory-authorized technicians or serious damage to the Power Supply could result.

Whenever a fuse needs to be replaced, the following steps should always be followed:

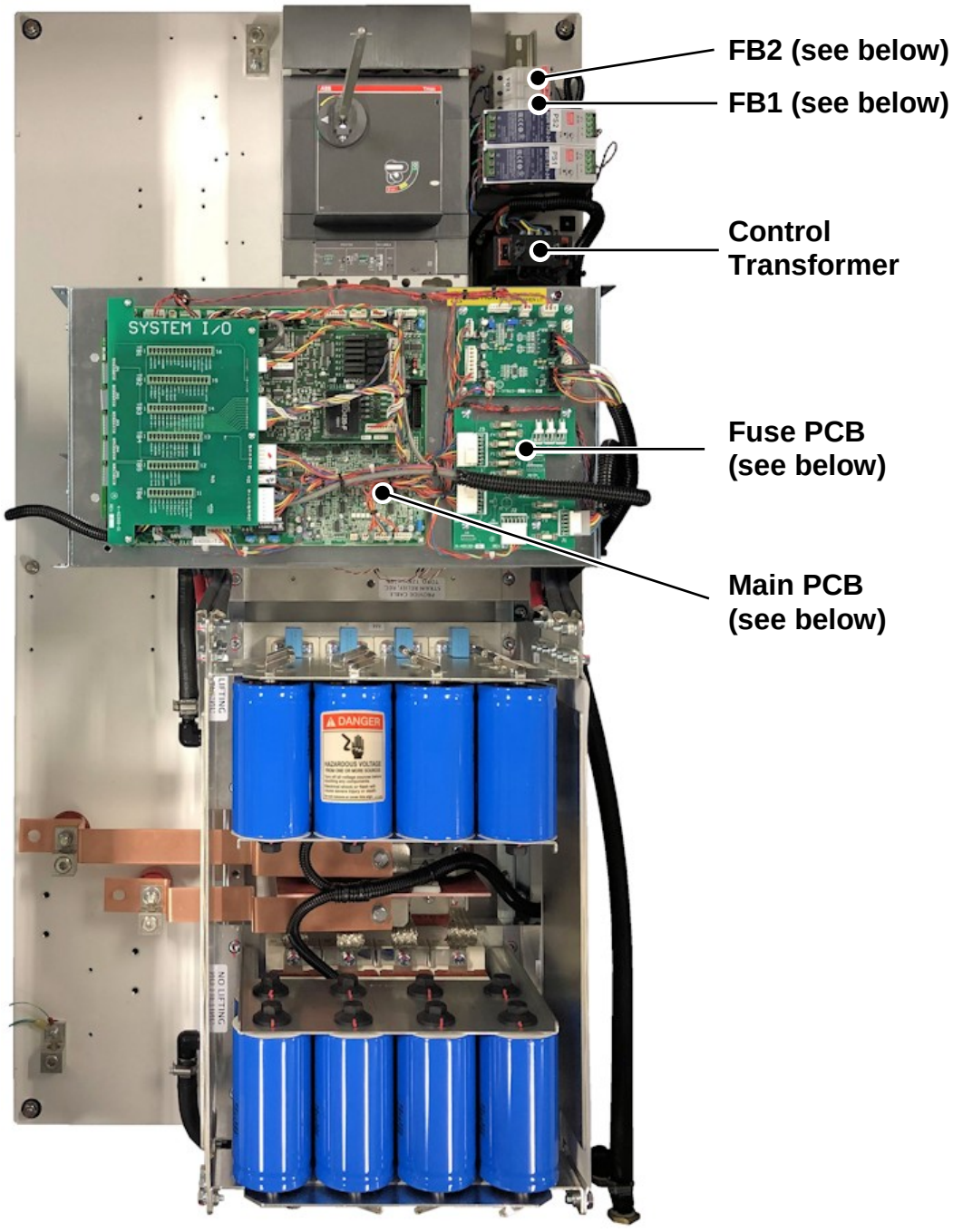
1. Turn OFF the Main A.C. Power to the IS Power Supply (external breaker used to supply power to the Power Supply).
2. Turn OFF the Main Power Switch on the IS Power Supply.
3. Allow a minimum of 5 minutes for the capacitors to discharge before opening the front door of the IS Power Supply and then open the front door.
4. Depending on the Fuse that needs to be replaced, the Safety Shield may need to be removed as described in *Section I, Before You Start*.
5. Identify the source of problem and repair.
6. Replace the damaged fuse.
7. Assemble in the reverse order and re-test.

The IS-2200CA and IS-4500CA have a similar system architecture. The location of the system components will vary depending on the power supply, date of manufacture and installed options. Refer to the appropriate section below for your power supply.

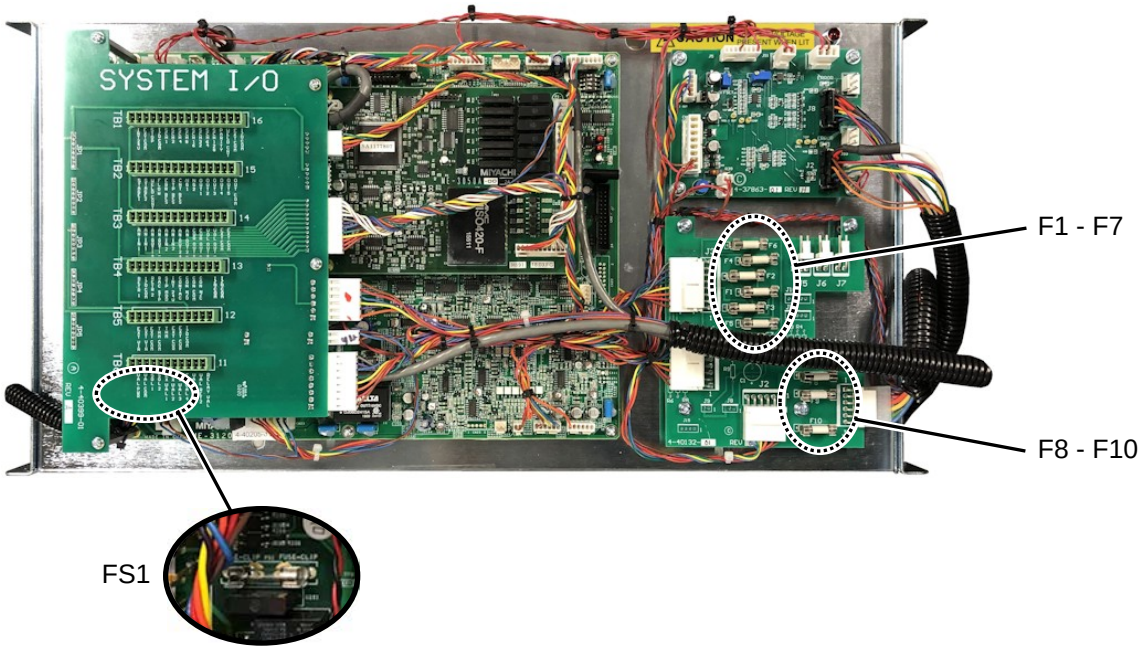
IS-2200CA Power Supply

Fuse / Component Locations

See next page for fuse descriptions, values and replacement part numbers.



IS-2200CA – Main PCB + Fuse PCB



Main PCB (P/N 4-40205-03)

The Main PCB contains a redundant Valve Fuse FS1 and is located under the System I/O PCB as shown above.

Fuse Board (P/N 4-40132-01)

The Fuse Board contains ten fuses, seven for the various valve functions and three for the Main PCB power.

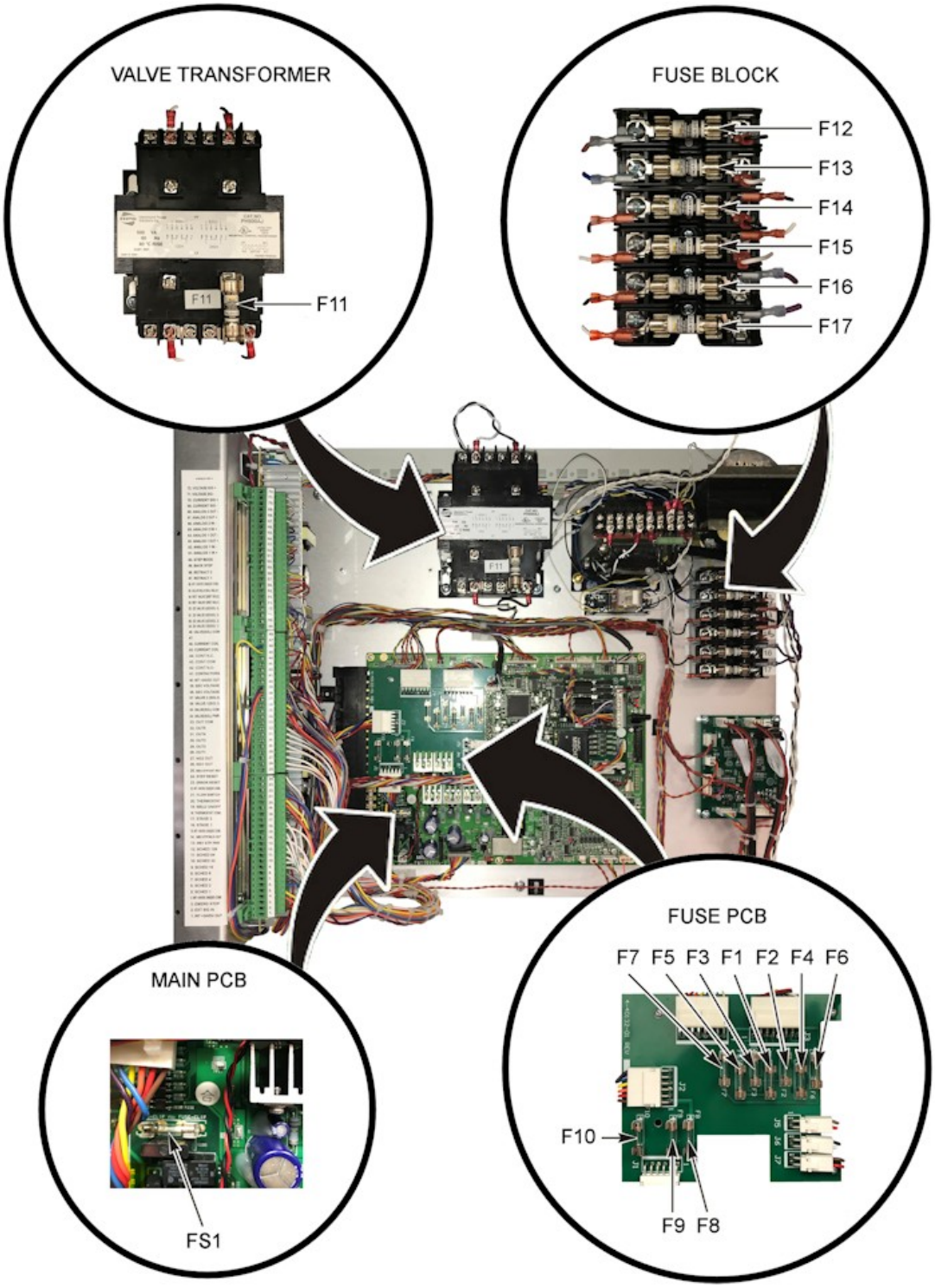
FUSE	DESCRIPTION	FUSE TYPE	AMADA WELD TECH PART NUMBER
FS1	Main Board, Valve Fuse	5 x 20 mm, 1 A, 250 VAC, slow blow	330-182

F1 – F7	Valve Output Fuses	5 x 20 mm, 1/2 A, 250 VAC, slow blow	330-135
F8 – F10	Main PCB Fuses	5 x 20 mm, 2 A, 250 VAC, slow blow	330-137

FB1	Control Transformer Fuses	FNQ-R 1-1/2, 1.5A, 600V slow blow	330-120
FB2	Semikron Power Supply Fuses	FNQ-R 3/4, 3/4A, 600V slow blow	330-175

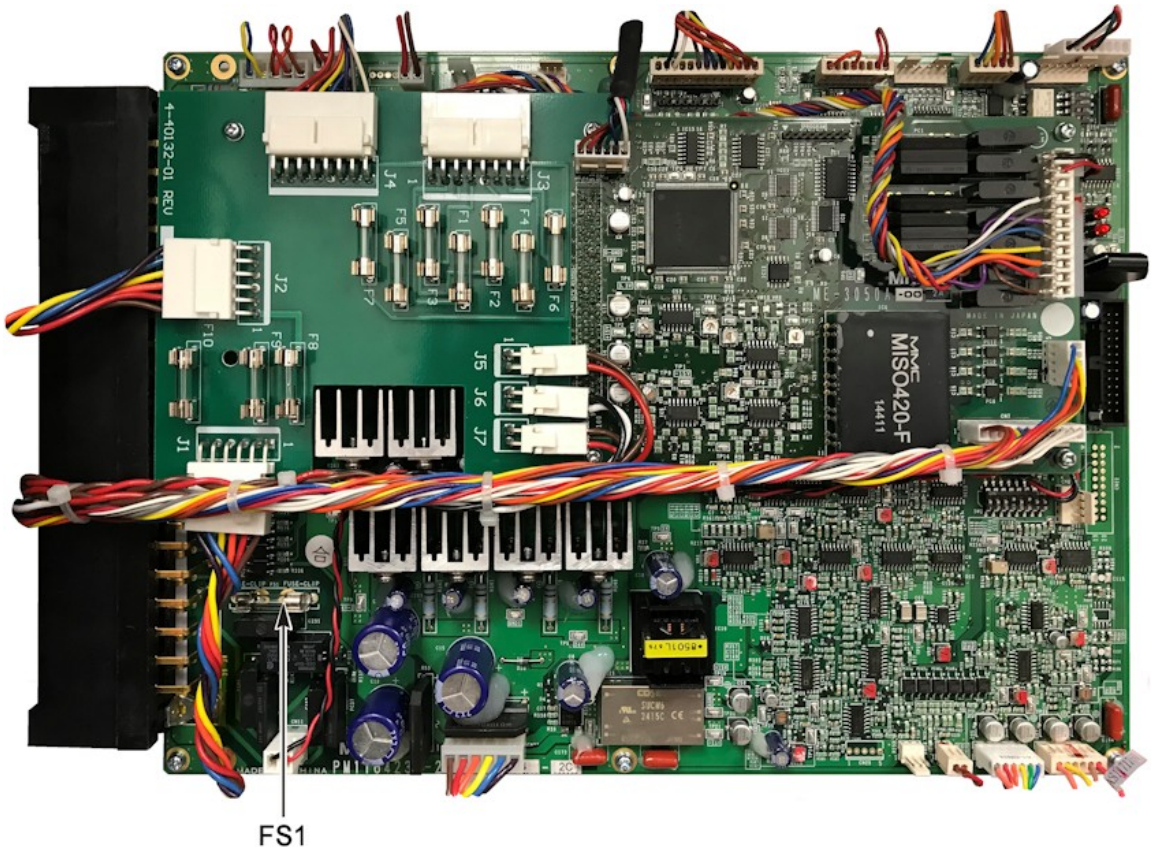
IS-4500CA Power Supply

Fuse / Component Locations



Main PCB (P/N 4-40205-03)

The Main PCB contains a redundant Valve Fuse FS1 and is shown below.



FUSE	DESCRIPTION	FUSE TYPE	AMADA WELD TECH PART NUMBER
FS1	Main board fuse	5 x 20 mm, 1 A, slow blow 250 VAC	330-182

Fuse Board (P/N 4-40132-01)

The Fuse Board contains ten fuses, seven for the various valve functions and three for the Main PCB power.

FUSE	DESCRIPTION	TYPE	AMADA WELD TECH PART NUMBER
F1 – F7	Valve output fuses	5 x 20 mm, 1/2 A, 250 VAC, slow blow	330-135
F8 – F10	Main PCB fuses	5 x 20 mm, 2 A, 250 VAC, slow blow	330-137

Power Supply

The Power Supply contains fuses, mounted on the load side of the Valve Transformer and the Power Transformer.

Valve Transformer

FUSE	DESCRIPTION	UNIT VOLTAGE	FUSE TYPE	AMADA WELD TECH PART NUMBER
F11	Valve Transformer Fuse	480 VAC	FNQ-R 4½ , slow blow, 4.5 A, 600 VAC	330-204

Fuse Block

FUSE	DESCRIPTION	UNIT VOLTAGE	TYPE	AMADA WELD TECH PART NUMBER
F12 – F13 F16 – F17	Fuse block fuses, primary	480 VAC	FNQ-R 3/4 slow blow, ¾ A, 600 VAC	330-175
F14 – F15	Fuse block fuses, primary	480 VAC	FNQ-R 1-6/10 slow blow, 1.6 A, 600 VAC	330-176

Section IV: Maintenance Procedures

Cooling Maintenance

Perform the following maintenance on the cooling system:

- **Monthly** – Check the water hoses to assure there is no leakage.
- **Any time there is a chance that the water might freeze –** Drain the water.
- **Any time you believe that there is a build-up of sediment that might decrease the water flow and cause the Power Supply to overheat –** Drain and flush the hoses and heat sink/IGBT cooling chamber.

Checking Water Hoses

1. Disconnect power to the Power Supply then wait for 20 minutes after the power is removed before maintenance.
2. Check the input/output hoses on the right side of the Power Module and the interconnecting hoses on the left side for any sign of water leakage.
3. Turn off the water supply and squeeze the hoses to check for brittleness. Restore water flow.
4. Re-install the plastic high voltage protective cover with the four screws that secure it.
5. Close the Power Supply door and secure it with the two quarter-turn screws.
6. Reconnect power to the Power Supply, then set the circuit breaker to ON.

Draining Water Hoses

1. Turn off and tag the Power Supply circuit breaker, so the Power Supply cannot be operated while the water is drained.
2. Turn off the water source, wherever convenient.

   NOTE: Be sure to have a bucket or other receptacle handy to collect the drained water.
3. Disconnect both hoses at the bottom of the Power Supply and allow the water to drain into the bucket.
4. Allow the input and output hoses to drain into the bucket.
5. Leave the hoses disconnected until danger from freezing has passed.

Flushing Water Hoses and Cooling Chambers

1. Turn off and tag the Power Supply circuit breaker, so the Power Supply cannot be operated during flushing.
2. Turn off the water source, wherever convenient.

   NOTE: Be sure to have a bucket or other receptacle handy to collect the drained water.

3. Disconnect one of the hoses at the bottom of the Power Supply and allow the water to drain into the bucket.
4. Turn the water back on slightly, but enough to flush the system. When the water is running clean, turn the water OFF.
5. Reconnect the hose back onto the Power Supply and restore power and water.
6. Close the Power Supply door and secure it with the two quarter-turn screws.

   NOTE: To reduce damage to the Power Supply, should there be an external problem, reconnect external power to the Power Supply before turning the circuit breaker ON.
7. Turn the circuit breaker ON.

Section V: Repair Service, Storage, Shipment

Repair Service

If you have problems with your Control that you cannot resolve, please contact our service department at the address, phone number, or e-mail address indicated in the Foreword of this manual.

Preparation for Storage or Shipment

1. Disconnect power to the Power Supply then wait 20 minutes after power is removed before the following procedures.
2. Turn off water source and disconnect the water hoses to the Power Supply. Using shop air, dry out the hoses.
3. Remove the circuit breaker line terminal cover and disconnect all line wires. Replace cover.
4. Disconnect all load wires.
5. Disconnect all signal wires.
6. Remove any conduits from the top and bottom of the Power Supply as necessary.
7. If a secondary current sensor is used, disconnect the signal cable from the connector on the bottom of the Power Supply.
8. Replace the plastic cover and secure it with the four mounting screws.
9. Remove the Power Supply from its mounting location.
10. Repack the Power Supply into the original packing materials and packing box in which you originally received the Power Supply.

APPENDIX A
TECHNICAL SPECIFICATIONS

Specifications

Parameter		IS-2200CA	IS-4500CA
Dimensions: inches **(W x H x D)** (mm) *(see isometric images on page 2-1)*		31.4” x 55.0” x 15.0” (797 mm x 1,397 mm x 381 mm)	47.2” x 79.0” x 19.7” (1,200 mm x 2,005 mm x 500 mm)
Weight		340 lb. (160 kg)	500 lb. (227 kg)
Max. input voltage (voltage level is factory set and is not field selectable)		3-phase, 380 – 480 VAC ±10% (50/60 Hz)	3-phase, 380 – 480 V AC ±10% (50/60 Hz)
Max. output current		2200 A (peak value)	4500 A (peak value)
Average max. duty cycle	Output current [() indicates duty cycle] (at 40 °C, 1 kHz of welding frequency)	2,200 A (12%) (350 ms/weld max) 1,800 A (20%) 1,400 A (50%) 1,000 A (100%)	4,500 A (12%) (350 ms/weld max) 3,600 A (20%) 2,800 A (50%) 2,000 A (100%)
Number of schedules		255	
Control method *		Primary constant-current effective value control Secondary constant-current effective value control Secondary constant-power effective value control Primary constant-current peak value control Secondary constant-voltage effective value control Constant-phase control	
Timer setting range *	SQD / squeeze delay time	0000 – 9999 (ms) / 0000 – 9999 (CYC)	
	SQZ / squeeze time	0000 – 9999 (ms) / 0000 – 9999 (CYC)	
	U1 / upslope 1 time	000 – 999 (ms) / 00 – 50 (CYC)	
	WE1 / weld 1 time	000 – 999 (ms) / 00 – 50 (CYC)	
	D1 / downslope 1 time	000 – 999 (ms) / 00 – 50 (CYC)	
	COOL1 / cooling 1 time	0000 – 9999 (ms) / 0000 – 0999 (CYC)	
	U2 / upslope 2 time	000 – 999 (ms) / 00 – 50 (CYC)	
	WE2 / weld 2 time	000 – 999 (ms) / 00 – 50 (CYC)	
	D2 / downslope 2 time	000 – 999 (ms) / 00 – 50 (CYC)	
	COOL2 / cooling 2 time	0000 – 9999 (ms) / 0000 – 0999 (CYC)	
	U3 / upslope 3 time	000 – 999 (ms) / 00 – 50 (CYC)	
	WE3 / weld 3 time	000 – 999 (ms) / 00 – 50 (CYC)	
	D3 / downslope 3 time	000 – 999 (ms) / 00 – 50 (CYC)	
	HOLD / hold time	00000 – 20000 (ms) / 00000 – 00999 (CYC)	
	OFF / off time (*Note 1*)	0 or 0010 – 9990 (ms) / 0000 – 0099 (CYC)	
Transformer turns ratio * **(TURN RATIO)**		1.0 – 199.9	

APPENDIX A. TECHNICAL SPECIFICATIONS

Parameter			IS-2200CA	IS-4500CA
Transformer frequency * (WELD TRANS FREQ)			600 – 1,000 Hz (in units of 100 Hz)	
Pulsation setting * (PULSATION)			01 – 19 (settable for WELD1 to WELD 3, respectively)	
Valve setting * (VALVE)			2 valves (VALVEx (SOLx), 1 and 2; BASIC unit 8 valves (VALVEx (SOLx), 1 and 2; EX VALVEx (EX SOLx), 1 thru 4; RET VALVEx (RET SOLx); VALVE RELAY (SOL RELAY) ADVANCED unit	
Control gain * (GAIN)			1 – 9	
Setting Range * (HEAT)	Constant Current Control	160/320 kA range	16.0 – 160.0 kA	32.0 – 320.0 kA
		80/160 kA range	8.0 – 80.0 kA	32.0 – 160.0 kA
		40/80 kA range	4.0 – 40.0 kA	32.0 – 80.0 kA
		20 kA range	2.0 – 20.0 kA	N/A
		10 kA range	2.0 – 9.99 kA	N/A
Setting Range * (HEAT)	Constant Power Control	160/320 kA range	16.0 – 240.0 kW	32.0 – 480.0 kW
		80/160 kA range	8.0 – 120.0 kW	32.0 – 240.0 kW
		40/80 kA range	4.0 – 60.0 kW	32.0 – 120.0 kW
		20 kA range	2.0 – 30.0 kW	N/A
		10 kA range	2.0 – 9.99 kW	N/A
	Constant voltage control		0.20 – 9.99V	
	Constant phase control		10.0 – 99.9%	
Current monitor * (CURRENT H/L)			0.0 – 999.9 kA 0.0 – 9.99 kA	

Parameter		IS-2200CA	IS-4500CA
Power monitor * **(POWER H/L)**		000.0 – 999.9 kW 00.00 – 99.99 kW	
Voltage monitor * **(VOLT H/L)**		0.00 V – 9.99 V	
Pulse width monitor * **(PULSE H)**		010.0 – 100.0%	
Step-up/-down **(STEPPER COUNT)**	STEP Up (down) ratio (RATIO) Counter setting (COUNT)	1 – 9 (9 steps) 50 – 200% 0000 – 9999 } Selectable for each valve	
Weld count monitor **(PRESET COUNT)**		0000 – 9999	
State indicator LED		[WELD POWER] lamp [READY] lamp [START] lamp [WELD] lamp [TROUBLE] lamp [WELD ON/OFF] lamp	
Cooling method		Water cooled for IGBT's and power components. • Flow Rate: 6 liters/minute minimum. • Water Temperature: 35 °C maximum. • Water Pressure: 40 psi maximum. • Fittings: 1/2" FNPT	
Operating environment	Ambient temperature Humidity Altitude Pollution degree	+5 to +40 °C 90% max. (no condensation) 1000 m max. 3	
Transport and storage conditions	Ambient temperature Humidity	-10 to +55 °C 90% max. (no condensation)	
Heat-resistant class		E	
Case protection		IP20	
Setting accuracy (Note 3)		Within ± 1.5% of full scale	
Repetition accuracy (Note 3)		Within 2% of full scale	
FORCE Monitor Accuracy		Within 2% of full scale	

Parameter		IS-2200CA	IS-4500CA
Error conditions	No-current	Power is turned off in the following cases: a. When a secondary current is not detected in Secondary constant-current effective value control, Secondary constant-power effective value control, or Constant-phase control. b. When a primary	
	No-voltage	Under Secondary constant-voltage effective value control or Secondary constant-power effective value control, the supply of current is stopped when a secondary voltage cannot be detected.	
	Temperature	Overheating of power unit of inverter and welding transformer are detected.	
	Self-diagnostic error	Setting dates (e.g., schedule settings) are diagnosed.	
CURRENT Calibration Adjustment	Percentage of setting	–24 to +24	

*: selectable for all 255 schedules

NOTES:

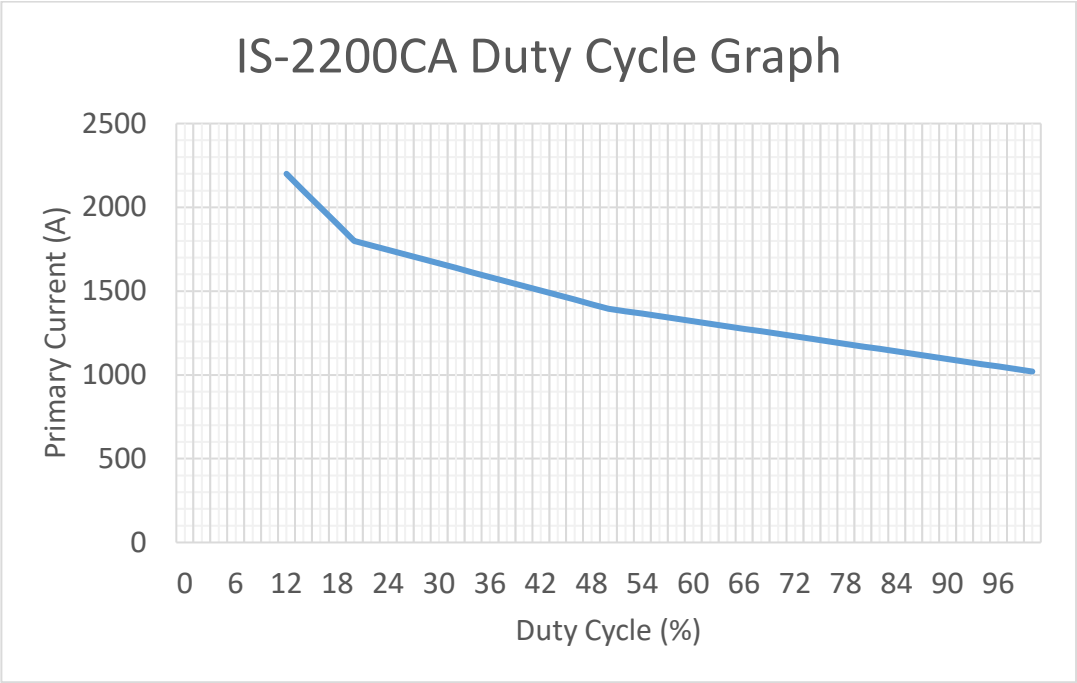
1. No repetitive operation will be performed if "0" is selected for OFF (off time).
2. Primary current can be set up to 2,200A for **IS-2200CA** and 4,500A for **IS-4500CA**.
3. Using the fixed load and the specified transformer
   - The weld time is 100 ms. The measurement range is from 60 ms to 100 ms.
   - The voltage may be out of the range due to the induced electromotive force.

Accessories (optional)

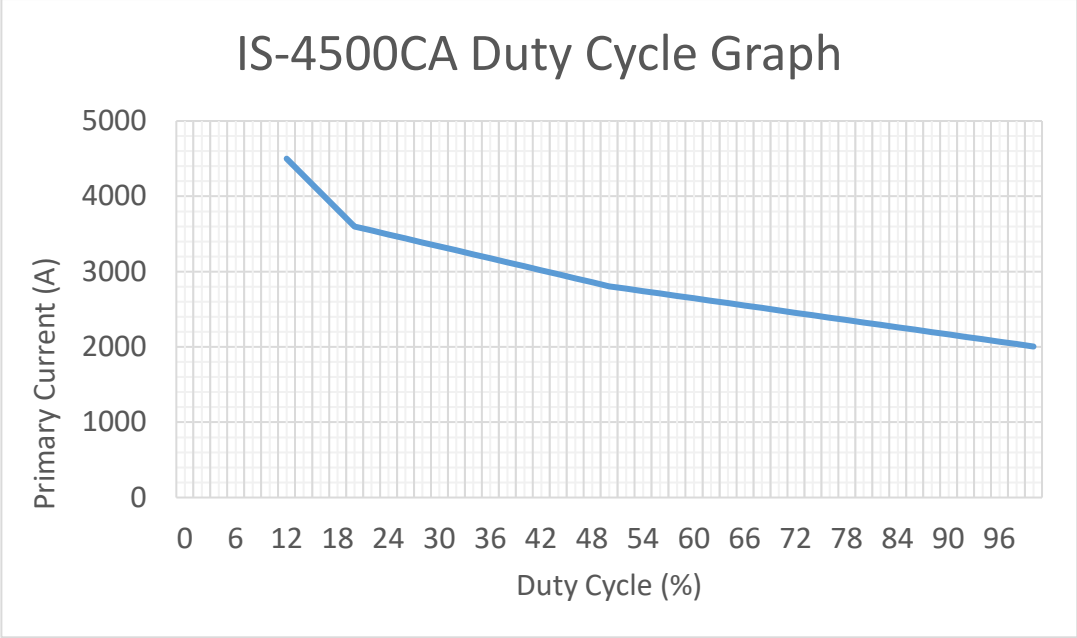
Option	Model No.	Length
Pendant Cable	18-047-01-02	2 ft
	18-047-01-05	5 ft
	18-047-01-10	10 ft
	18-047-01-15	15 ft
	18-047-01-20	20 ft
	18-047-01-33	33 ft
	18-047-01-50	50 ft
	18-047-01-66	66 ft
Secondary Sensing Toroidal coil	MB-400L (Belt, 1.54 ft approx.)	Cable, 9.2 ft
	MB-800L (Belt, 2.92 ft approx.)	

Duty Cycles

IS-2200CA

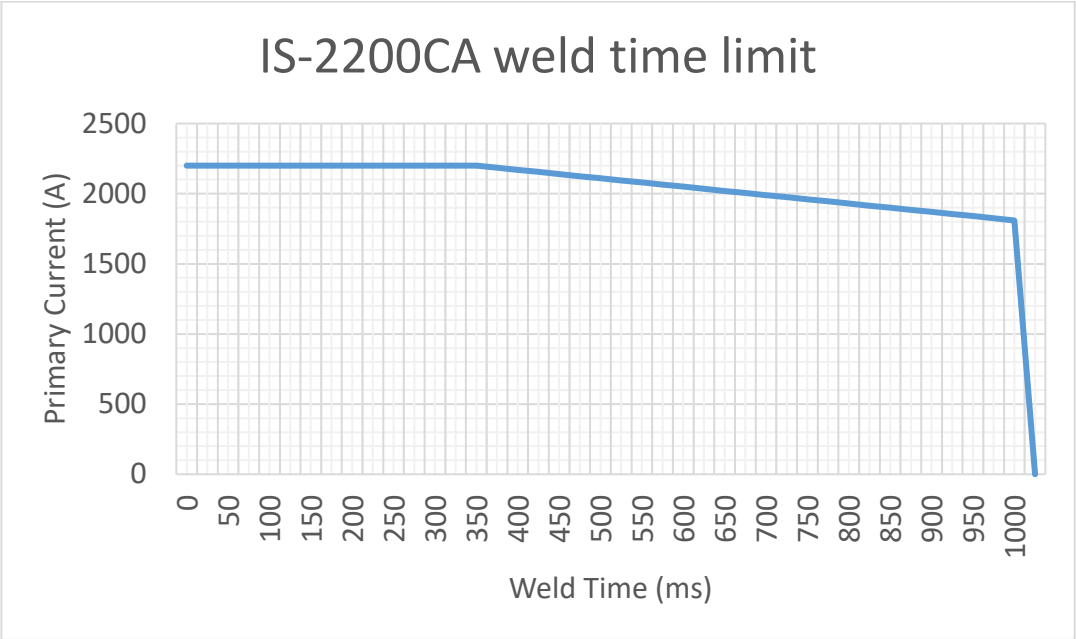


IS-4500CA

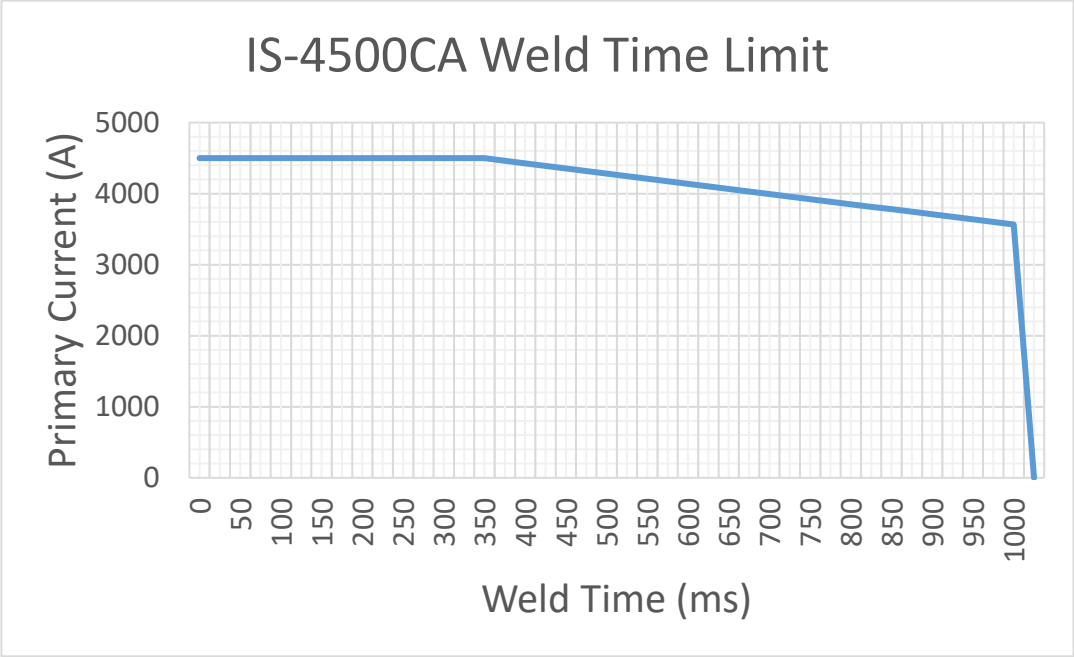


Weld Time Limit

IS-2200CA



IS-4500CA



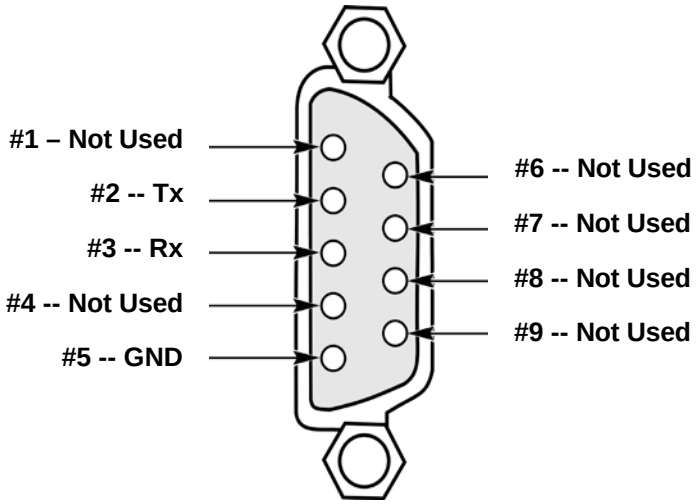
APPENDIX B
ELECTRICAL AND DATA CONNECTIONS

CAUTION
Use the shielded cable for the external input/output signals and connect the shielded part to the ground.

Section I: Data and Signal Connectors

RS-232 (standard)

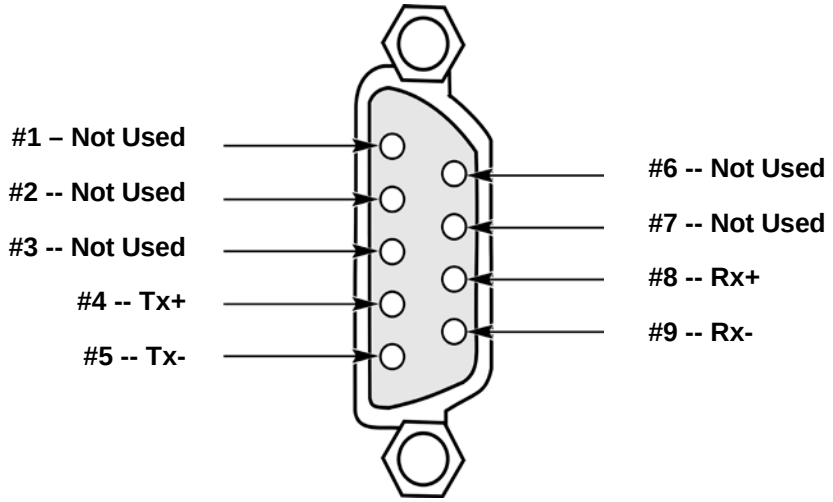
One DB-9 (female) connector wired as follows:



RS-232 only allows one Power Supply at a time to be connected to a host.

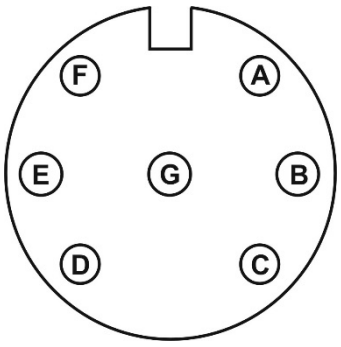
RS-485 (optional)

Two DB-9 (female) connector wired as follows:



RS-485 allows multiple Power Supplies to be daisy chained to a host.

TRANSFORMER SENSING CONNECTOR



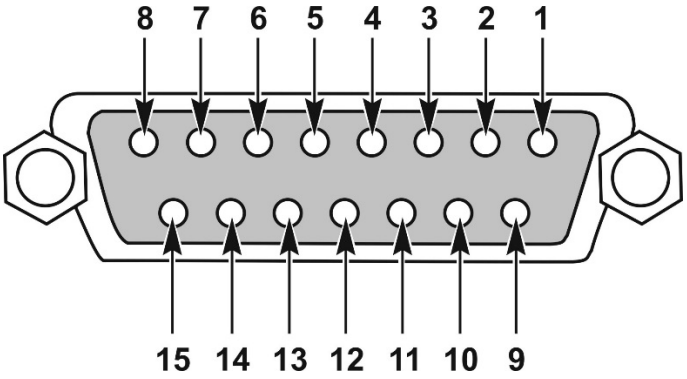
FRONT VIEW

PIN	DESCRIPTION
A	Common (Thermostat)
B	Thermostat
C	Voltage
D	Current
E	Current
F	Voltage
G	Ground

DISPLACEMENT SENSOR CONNECTOR (ADVANCED Models ONLY)

Recommended Displacement Sensor: Heidenhain St3078

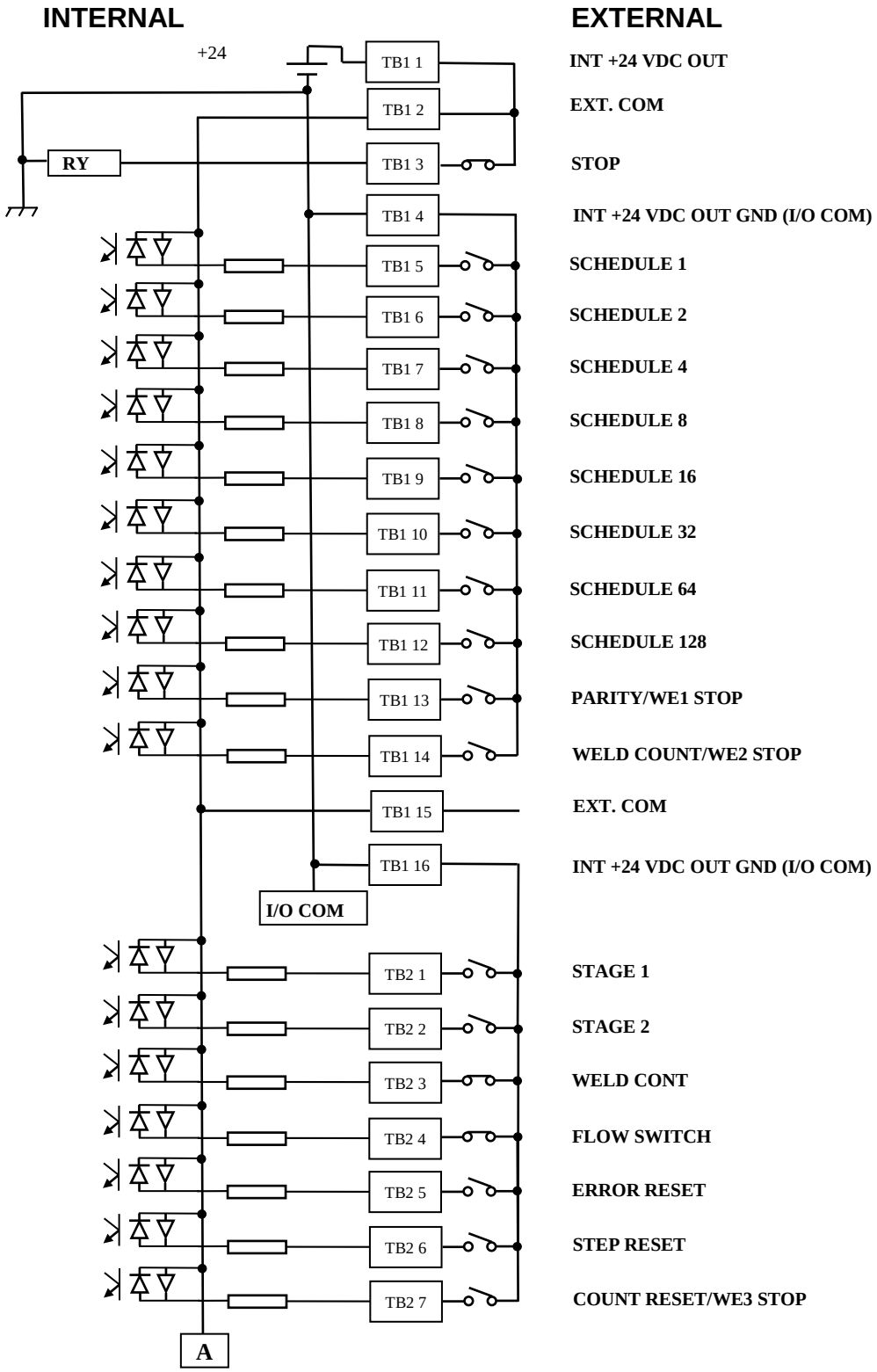
15-pin D-sub (female)

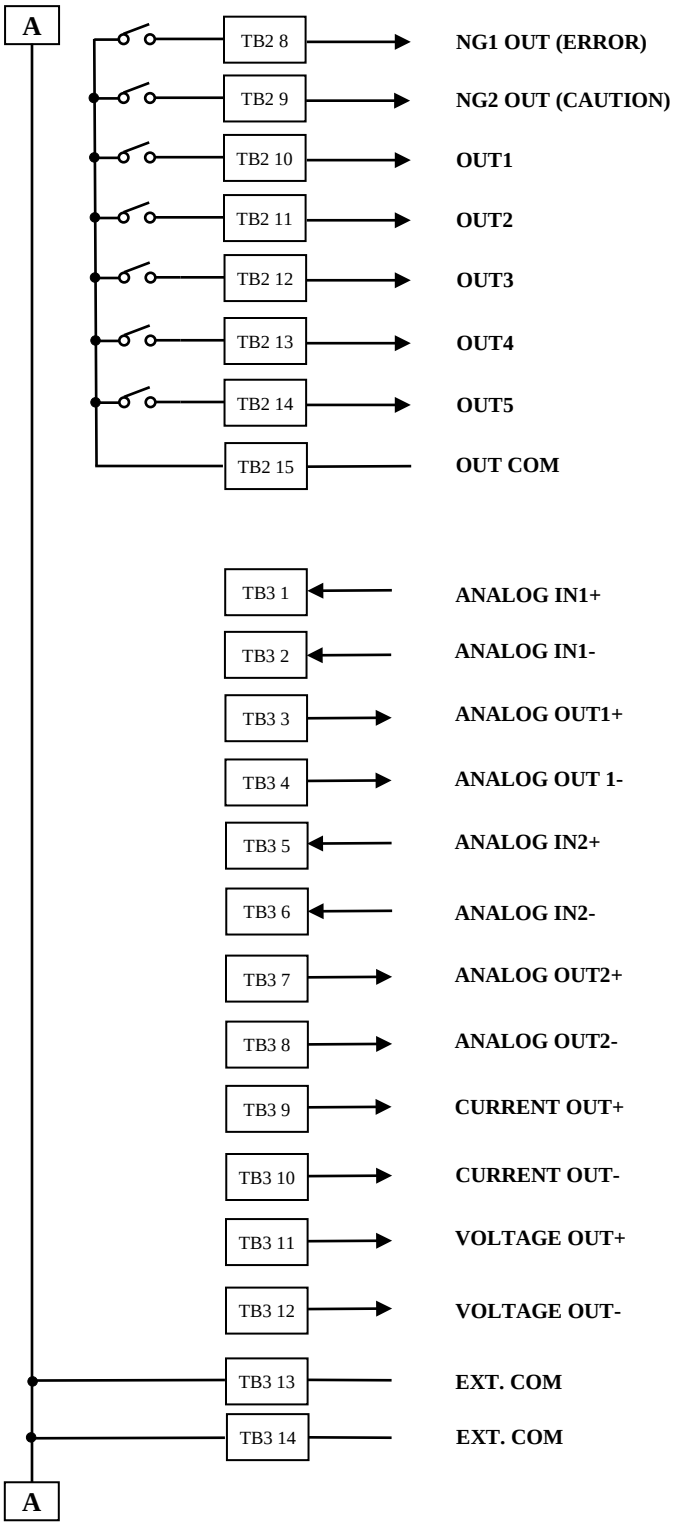


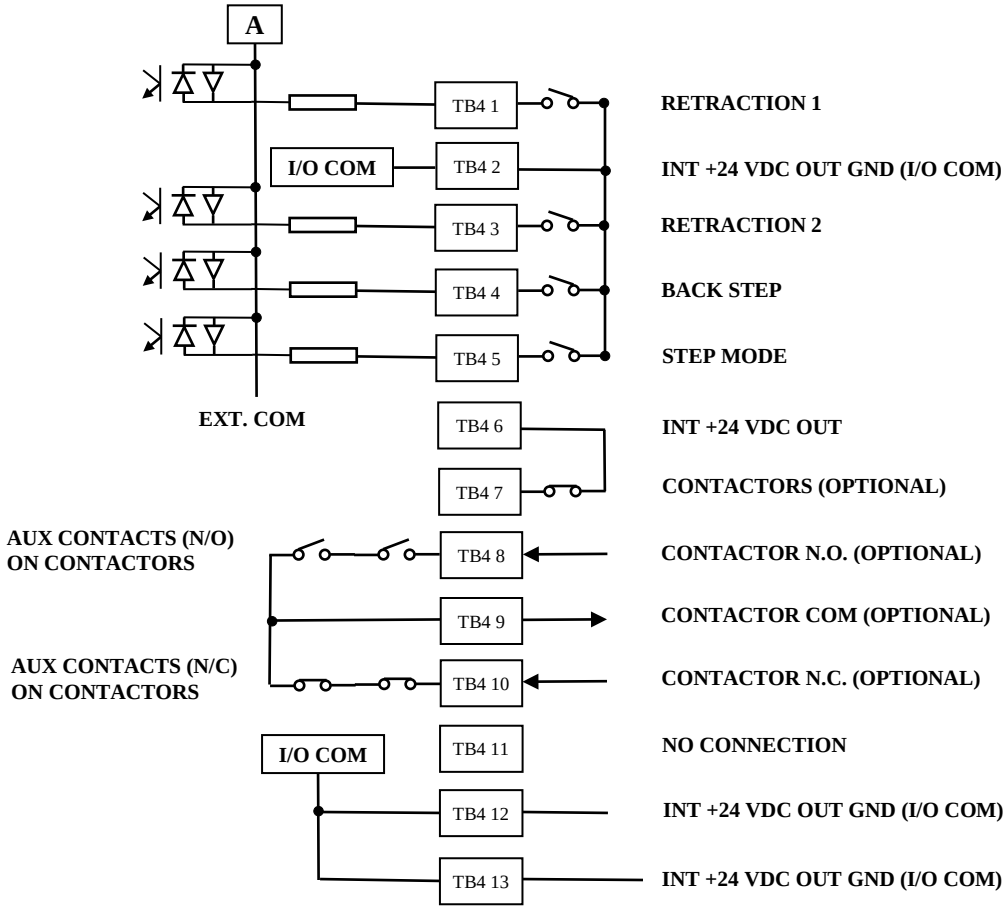
PIN	DESCRIPTION
1	A_{sig}
2	GROUND
3	B_{sig}
4	5 VOLT
5-8	UNUSED
9	A'_{sig}
10	GROUND
11	B'_{sig}
12	5 VOLT
13-15	UNUSED

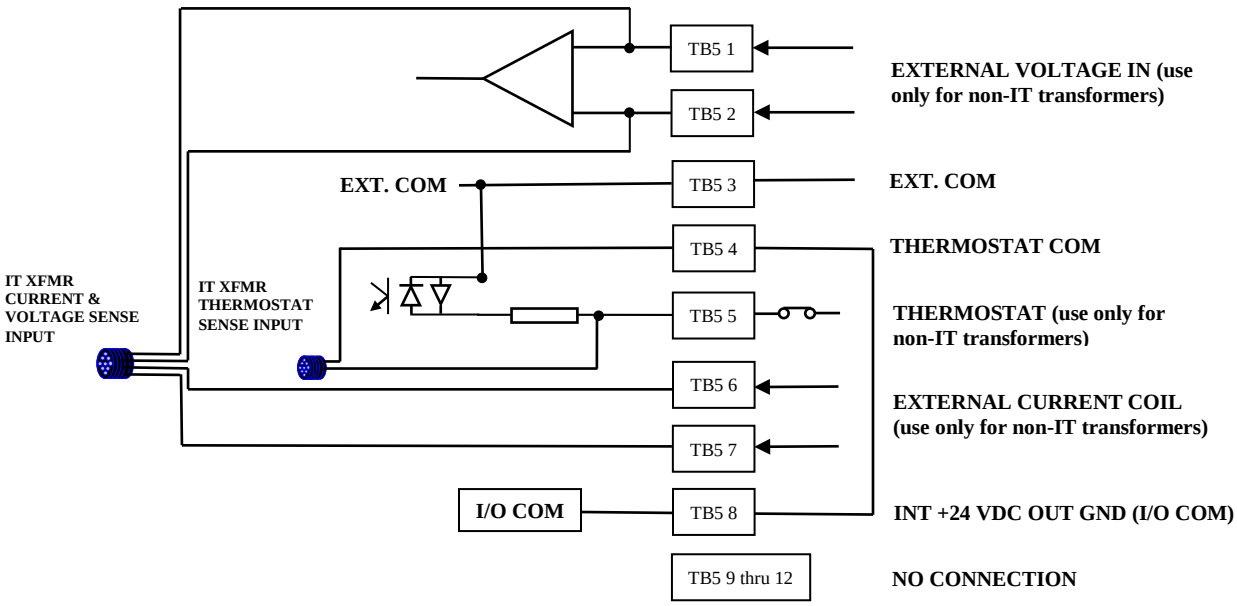
Section II: I/O Terminal Block for IS-2200CA

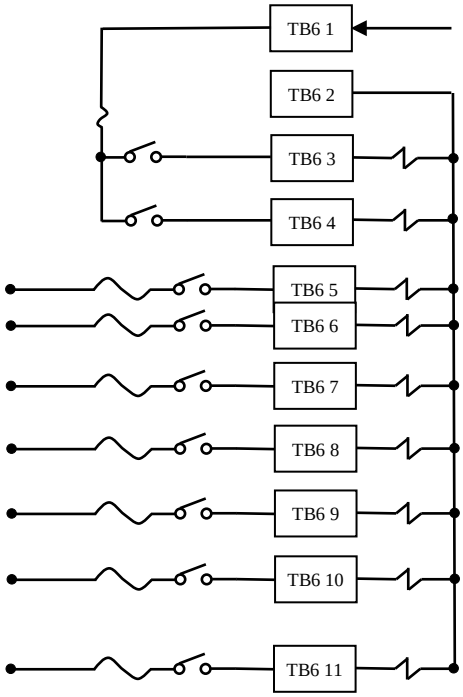
(INTERNAL SINK MODE SHOWN)




A
TB2 8
NG1 OUT (ERROR)
TB2 9
NG2 OUT (CAUTION)
TB2 10
OUT1
TB2 11
OUT2
TB2 12
OUT3
TB2 13
OUT4
TB2 14
OUT5
TB2 15
OUT COM
TB3 1
ANALOG IN1+
TB3 2
ANALOG IN1-
TB3 3
ANALOG OUT1+
TB3 4
ANALOG OUT 1-
TB3 5
ANALOG IN2+
TB3 6
ANALOG IN2-
TB3 7
ANALOG OUT2+
TB3 8
ANALOG OUT2-
TB3 9
CURRENT OUT+
TB3 10
CURRENT OUT-
TB3 11
VOLTAGE OUT+
TB3 12
VOLTAGE OUT-
TB3 13
EXT. COM
TB3 14
EXT. COM
A


A
TB4 1
RETRACTION 1
I/O COM
TB4 2
INT +24 VDC OUT GND (I/O COM)
TB4 3
RETRACTION 2
TB4 4
BACK STEP
TB4 5
STEP MODE
EXT. COM
TB4 6
INT +24 VDC OUT
TB4 7
CONTACTORS (OPTIONAL)
AUX CONTACTS (N/O)
ON CONTACTORS
TB4 8
CONTACTOR N.O. (OPTIONAL)
TB4 9
CONTACTOR COM (OPTIONAL)
AUX CONTACTS (N/C)
ON CONTACTORS
TB4 10
CONTACTOR N.C. (OPTIONAL)
I/O COM
TB4 11
NO CONNECTION
TB4 12
INT +24 VDC OUT GND (I/O COM)
TB4 13
INT +24 VDC OUT GND (I/O COM)


TB5 1
EXTERNAL VOLTAGE IN (use only for non-IT transformers)
TB5 2
EXT. COM
TB5 3
EXT. COM
TB5 4
THERMOSTAT COM
IT XFMR CURRENT & VOLTAGE SENSE INPUT
IT XFMR THERMOSTAT SENSE INPUT
TB5 5
THERMOSTAT (use only for non-IT transformers)
TB5 6
EXTERNAL CURRENT COIL (use only for non-IT transformers)
TB5 7
I/O COM
TB5 8
INT +24 VDC OUT GND (I/O COM)
TB5 9 thru 12
NO CONNECTION



VALVE POWER (SOL)

VALVE COM (SOL)

VALVE1 (SOL1)

VALVE2 (SOL2)

These valves are only active in 2 valve mode (See page 3-33) Use EXT valves 1-4 (TB6 5-6) for normal valve operation

EX VALVE1 (EX SOL1)

EX VALVE2 (EX SOL2)

EX VALVE3 (EX SOL3)

EX VALVE4 (EX SOL4)

RET VALVE1 (RET SOL1)

RET VALVE2 (RET SOL2)

VALVE RELAY (SOL RELAY)

External I/O Signals for IS-2200CA

PIN	NAME	DESCRIPTION
TB1-1	INT +24VDC OUT	**NOTE:** Do not use pin 1 unless connecting it to pin 2 or 3. Failure to observe this precaution will result in malfunction. **MAX CURRENT DRAW:** 100 mA
TB1-2	EXT. COM	For internal Sink (pull down) Connect to pin 1. For Internal Source (push up) Connect to pin 4. To activate input in Sink Mode, connect inputs to INT +24 VDC GND (I/O COM) To activate input in Source Mode, connect inputs to INT +24 VDC For External Sink attach PLC +24 V. For External Source, attach PLC COM
TB1-3	STOP	Must be jumpered to Pin 1 to operate. Use relay to provide switch closure if required
TB1-4	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the internal +24 VDC GND. NOTE: DO NOT CONNECT TO PIN 1 (INT +24 VDC OUT)
TB1-5 **TB1-6** **TB1-7** **TB1-8** **TB1-9** **TB1-10** **TB1-11** **TB1-12**	SCHEDULE 1 SCHEDULE 2 SCHEDULE 4 SCHEDULE 8 SCHEDULE 16 SCHEDULE 32 SCHEDULE 64 SCHEDULE 128	Schedule input pins: 5: Schedule 1 6: Schedule 2 7: Schedule 4 8: Schedule 8 9: Schedule 16 10: Schedule 32 11: Schedule 64 12: Schedule 128
TB1-13	PARITY/WE1 STOP	WE1 stop input or Parity input pin. <u>When WE1 STOP is selected</u> Closing this pin during the WELD1 sequence will switch the sequence to COOL1. The interrupt error occurs when the WELD1 STOP signal is input before the start signal is input. When this pin is closed before WELD1 welding start after startup, the current is supplied for at least a control cycle and WELD1 is stopped to switch the sequence to COOL1. <u>When PARITY CHECK is selected</u> This pin allows for detection of failure resulting from a wire break in the schedule selection signal lines. Be sure that the total number of closed schedule selection and parity signal lines is always odd.

PIN	NAME	DESCRIPTION
TB1-14	WELD COUNT/WE2 STOP	WE2 stop input or Weld count input pin. When WE2 STOP is selected Closing this pin during the WELD2 sequence will switch the sequence to COOL2. Closing this pin in the sequence other than WELD2 is neglected. The sequence will switch to COOL2 if this signal is closed during the WELD2 sequence operation. When this pin is closed before WELD2 welding start after startup, the current is supplied for at least a control cycle and WELD2 is stopped to switch the sequence to COOL2. When WELD COUNT is selected This pin allows you to determine whether or not the number of deposited welds has reached the WELD COUNT setting. 20 ms or more is required for receiving the WELD COUNT input signal.
TB1-15	EXT. COM	For internal Sink (pull down) Connect to pin 1. For Internal Source (push up) Connect to pin 4. To activate input in Sink Mode, connect inputs to INT +24 VDC GND (I/O COM) To activate input in Source Mode, connect inputs to INT +24 VDC For External Sink attach PLC +24 V. For External Source, attach PLC COM
TB1-16	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND

TB2-1	STAGE1	1ST STAGE input pin. Closing this pin will activate the selected Valve. Since the welding sequence does not start, you can adjust or check the position. When the 2ND STAGE pin is closed the Weld sequence will be performed.
TB2-2	STAGE2	2ND STAGE input pin. Closing this pin will start the Weld sequence.
TB2-3	WELD CONT	Weld Control pin. Close this pin to turn ON the WELD ON/OFF signal, and open it to turn it OFF. Leaving this pin open will shut off welding current even when the sequence operation is performed. Use this pin, for example, to start the sequence experimentally.
TB2-4	FLOW SWITCH	Flow switch input pin. Opening this pin will result in a flow rate error.
TB2-5	ERROR RESET	Error/caution reset input pin. After eliminating the cause of an error or caution, close this pin to reset the error or caution indication. 20 ms or more is required for receiving the input signal.
TB2-6	STEP RESET	Step reset input pin. Closing this pin while the STEPPER is ON will reset the STEP number to 1. 20 ms or more is required for receiving the input signal.

PIN	NAME	DESCRIPTION
TB2-7	COUNT RESET/WE3 STOP	WE3 stop input or Count reset input pin. When WE3 STOP is selected Closing this pin during the WELD3 sequence will switch the sequence to HOLD. The interrupt error occurs when the WELD3 STOP signal is input before the start signal is input. When this pin is closed before WELD3 welding start after startup, the current is supplied for at least a control cycle and WELD3 is stopped to switch the sequence to HOLD. When COUNT RESET is selected Closing this pin allows you to reset the counter. 20 ms or more is required for receiving the COUNT RESET input signal.
TB2-8	NG1 OUT (ERROR)	Error signal output pin. This signal is output upon completion of the welding sequence in the event of an operational error. If an error occurs, operation will halt until the reset signal is input. In NORMAL CLOSE, the pin is closed with the power turned on, but becomes open with an error occurring. In NORMAL OPEN, the pin is open with the power turned on, but becomes closed with an error occurring. The contact is rated at 24 VDC at 20 mA (semiconductor switch).
TB2-9	NG2 OUT (CAUTION)	Caution signal output pin. This pin is closed upon completion of the welding sequence if the measured value is outside the range set on the MONITOR SET screen. (In the case CAUTION is set, the status will be "ERROR" depending on the NG SIGNAL SELECT setting.) You can continue with your welding task even if a caution signal is activated. To cancel this caution output, input the reset or start signal. The contact is rated at 24 VDC at 20 mA (semiconductor switch). In the case the off time (OFF) is set, when CAUTION is output, the signal is maintained until the next welding result is obtained. (*1)
TB2-10	OUT1	Contact output pins. (semiconductor switch. The contact is rated at 24 VDC at 20 mA.) The contact is open or closed corresponding to the function. Can be assigned to each pin. END,COUNT ERROR,READY,STEP END,WELD SIGNAL,GOOD,COUNT UP,OUT I,OUT II
TB2-11	OUT2	
TB2-12	OUT3	
TB2-13	OUT4	
TB2-14	OUT5	
TB2-15	OUT COM	Common pin for output pins. This pin is the common pin for the NG1, NG2, OUT 1, OUT 2, OUT 3, OUT 4 and OUT 5.

TB3-1 **TB3-2**	ANALOG IN1+ ANALOG IN1-	0 – 10 VDC Analog input 1

PIN	NAME	DESCRIPTION
TB3-3 **TB3-4**	ANALOG OUT1+ ANALOG OUT1-	0 - 10VDC Analog output 1*[2]
TB3-5 **TB3-6**	ANALOG IN2+ ANALOG IN2-	0 - 10VDC Analog input 2
TB3-7 **TB3-8**	ANALOG OUT2+ ANALOG OUT2-	0 - 10VDC Analog output 2*[2]
TB3-9 **TB3-10**	CURRENT OUT+ CURRENT OUT-	Current output (0 - 10 VDC)*[2] $V_{OUT} = I_{OUT} / 5000$
TB3-11 **TB3-12**	VOLTAGE OUT+ VOLTAGE OUT-	Voltage output (0 - 10 VDC)*[2] $V_{OUT} = V_{FEEDBACK} / 2$
TB3-13 **TB3-14**	EXT. COM	For internal Sink (pull down) Connect to pin 1. For Internal Source (push up) Connect to pin 4. To activate input in Sink Mode, connect inputs to INT +24 VDC GND (I/O COM) To activate input in Source Mode, connect inputs to INT +24 VDC For External Sink attach PLC +24 V. For External Source, attach PLC COM

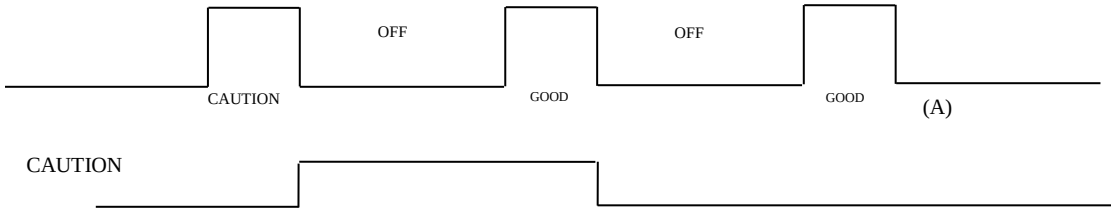
TB4-1	RETRACTION 1	Control pin for Retraction 1 Valve
TB4-2	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND
TB4-3	RETRACTION 2	Control pin for Retraction 2 Valve
TB4-4	BACK STEP	Input terminal for the back step. When the signal is input with the successive function, the SCHEDULE No. returns to the previous one. Also, when the signal is input over 1.5 seconds, the SCHEDULE No. returns to the first one.
TB4-5	STEP MODE	Input terminal. Each time closed on the FORCE SETUP & MONITOR screen, the sequence proceeds to the next step.
TB4-6	INT +24VDC OUT	**NOTE:** Do not use pin 1 unless connecting it to pin 2 or 3. Failure to observe this precaution will result in malfunction. **MAX CURRENT DRAW:** 100 mA
TB4-7	CONTACTORS	Switch closure between Pin 40 and Pin 41 will engage the optional contactor.
TB4-8	CONTACTOR N.O.	Detect position of contactors between pin 42 and 43: contactors normally open (optional)
TB4-9	CONTACTOR COM	Contactor Aux contact common (optional)
TB4-10	CONTACTOR N.C.	Detect position of contactors between pin 44 and 43: contactors normally closed (optional)
TB4-11	NO CONNECTION	
TB4-12	INT +24VDC GND	I/O COM pin. This pin is internally connected to the +24 VDC GND
TB4-13	INT +24VDC GND	I/O COM pin. This pin is internally connected to the +24 VDC GND

PIN	NAME	DESCRIPTION
TB5-1 **TB5-2**	EXTERNAL VOLTAGE	Secondary voltage input pins. Internally connected to the IT XFMR sense connector. If IT XFMR sense cable not used may be connected directly to electrodes.
TB5-3	EXT. COM	For internal Sink (pull down) Connect to pin 1. For Internal Source (push up) Connect to pin 4. To activate input in Sink Mode, connect inputs to INT +24 VDC GND (I/O COM) To activate input in Source Mode, connect inputs to INT +24 VDC For External Sink attach PLC +24 V. For External Source, attach PLC COM
TB5-4	THERMOSTAT COM	Common input for Transformer Thermostat through the XFMR Sense connector For Internal Sink operation, connect to INT +24 VDC GND (I/O Com) For internal Source operation, connect to INT+24 VDC For External Sink, connect to PLC COM. For External source, connect to PLC +24 V
TB5-5	THERMOSTAT	If the XFMR Sense connector is not used, this pin should be connected to the appropriate voltage (Sink or Source) If the XFMR Sense connector is used this pin should be left open.
TB5-6 **TB5-7**	EXTERNAL CURRENT COIL	Current coil input, used for secondary current feedback. Internally connected to the IT XFMR sense connector. If ITXFMR sense cable is not used, may be connected to external current coil.
TB5-8	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND
TB5-9 **to** **TB5-12**	NO CONNECTION	

TB6-1	VALVE POWER (SOL)	Power input pins to drive the solenoid valve. Input 120 VAC or 24 VDC power.
TB6-2	VALVE COM (SOL)	COM pin for the solenoid valve.
TB6-3 **TB6-4**	VALVE1 (SOL1) VALVE2 (SOL2)	Solenoid valve output pins. 36: VALVE1 (SOL1); 37: VALVE2 (SOL2) These pins are closed for the duration of the STAGE 2 input. Output between SQD and HOLD. When the off time (OFF) is set, this pin is output between SQZ and HOLD after the second sequence. The contacts are rated at 120 VAC or 24 VAC/DC at 0.5 A (semiconductor switches). Use a solenoid valve with a current capacity of 0.5 A or less. NOTE: when using DC solenoid see note *3

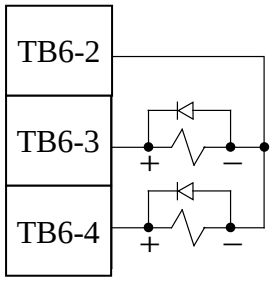
PIN	NAME	DESCRIPTION
TB6-5	EX VALVE1 (EX SOL1)	Solenoid valve output pins. TB6 5: EX VALVE1 (EX SOL1); TB6 6: EX VALVE2 (EX SOL2); TB6 7: EX VALVE (EX SOL3); TB6 8: EX VALVE4 (EX SOL4) TB6 9: RETRACTION VALVE1 (RET SOL1); TB6 10: RETRACTION VALVE2 (RET SOL2); TB6 11: VALVE RELAY (SOL RELAY) The contacts are rated at 120 VAC or 24 VAC/DC at 0.5 A (semiconductor switches). Use a solenoid valve with a current capacity of 0.5 A or less.
TB6-6	EX VALVE2 (EX SOL2)	
TB6-7	EX VALVE3 (EX SOL3)	
TB6-8	EX VALVE4 (EX SOL4)	
TB6-9	RET VALVE1 (RET SOL1)	
TB6-10	RET VALVE2 (RET SOL2)	
TB6-11	VALVE RELAY (SOL RELAY)	Retraction Solenoid valve output pins. NOTE: when using DC solenoid see note *3

*1 When the sequence is stopped at (A), error (CAUTION) is not displayed. It's because the contents when stopped is displayed on the program unit.



*2 Maximum combined current draw from all analog outputs: 75 mA

*3 When using 24 VDC solenoid, install diodes across the solenoid coils to prevent spike (see example below).



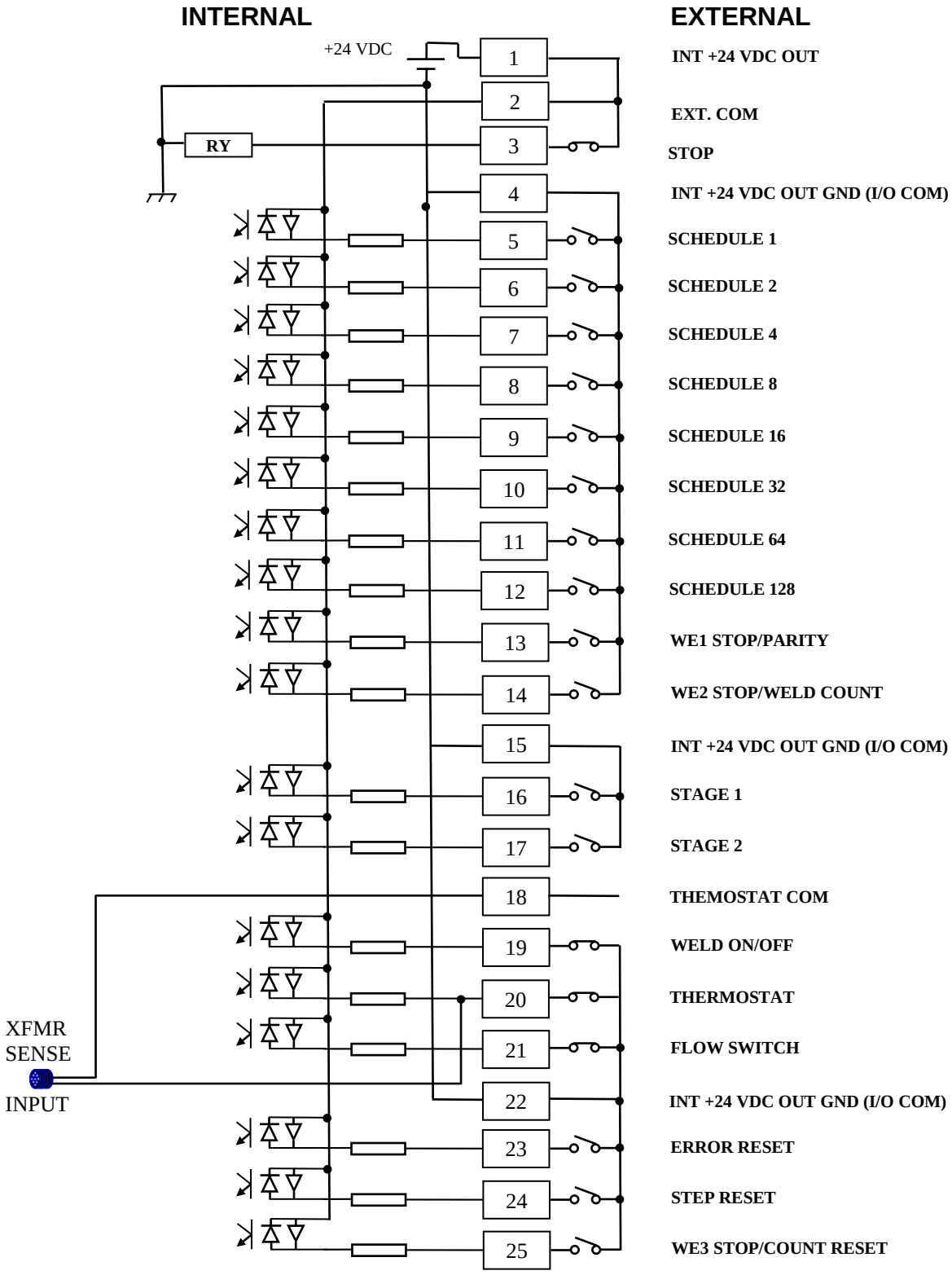
External Output Signals

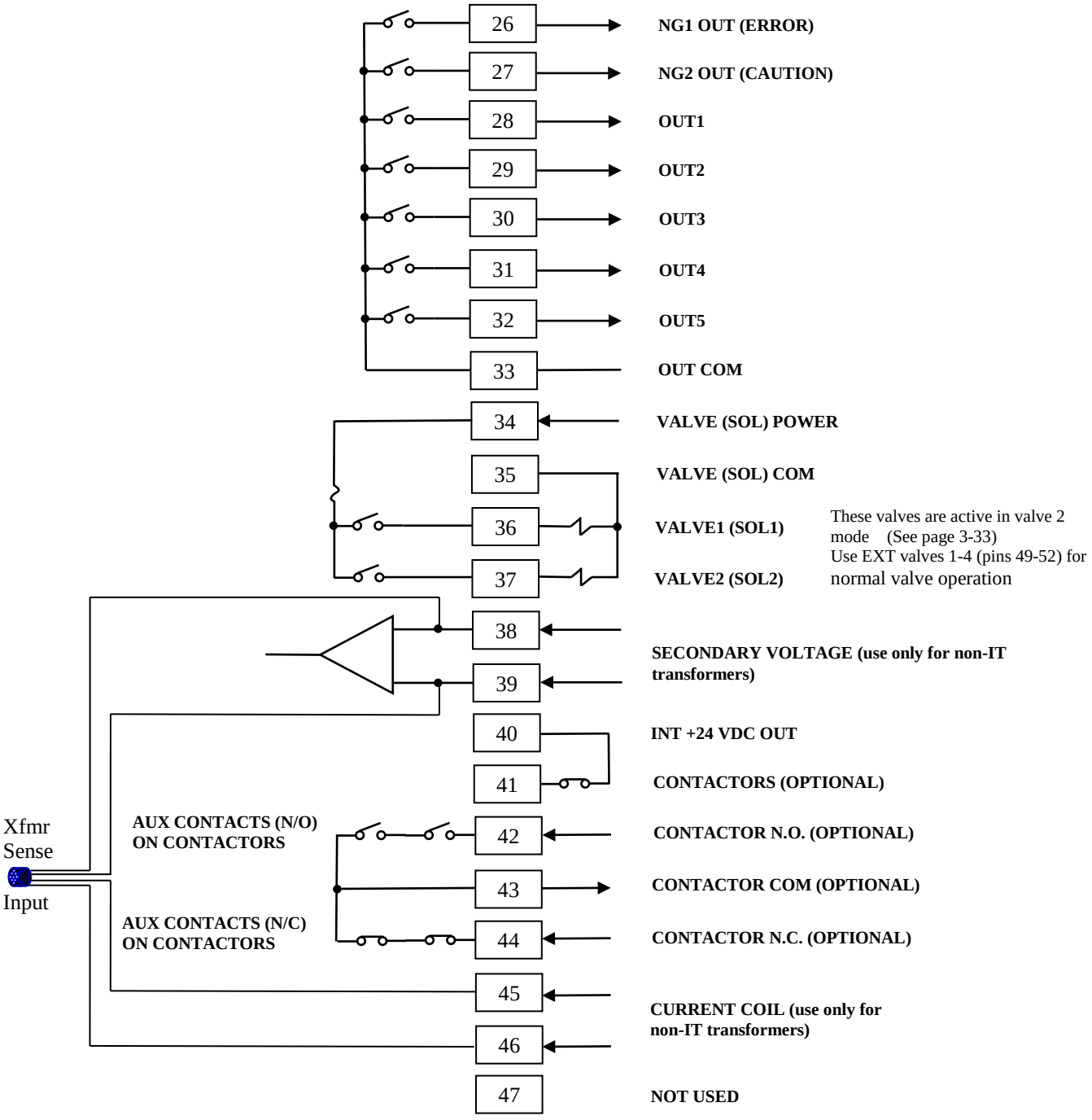
The following signals can be assigned to output pins TB2-10 to TB2-14 (OUT 1 to 5) on the **OUTPUT SELECT Screen**.

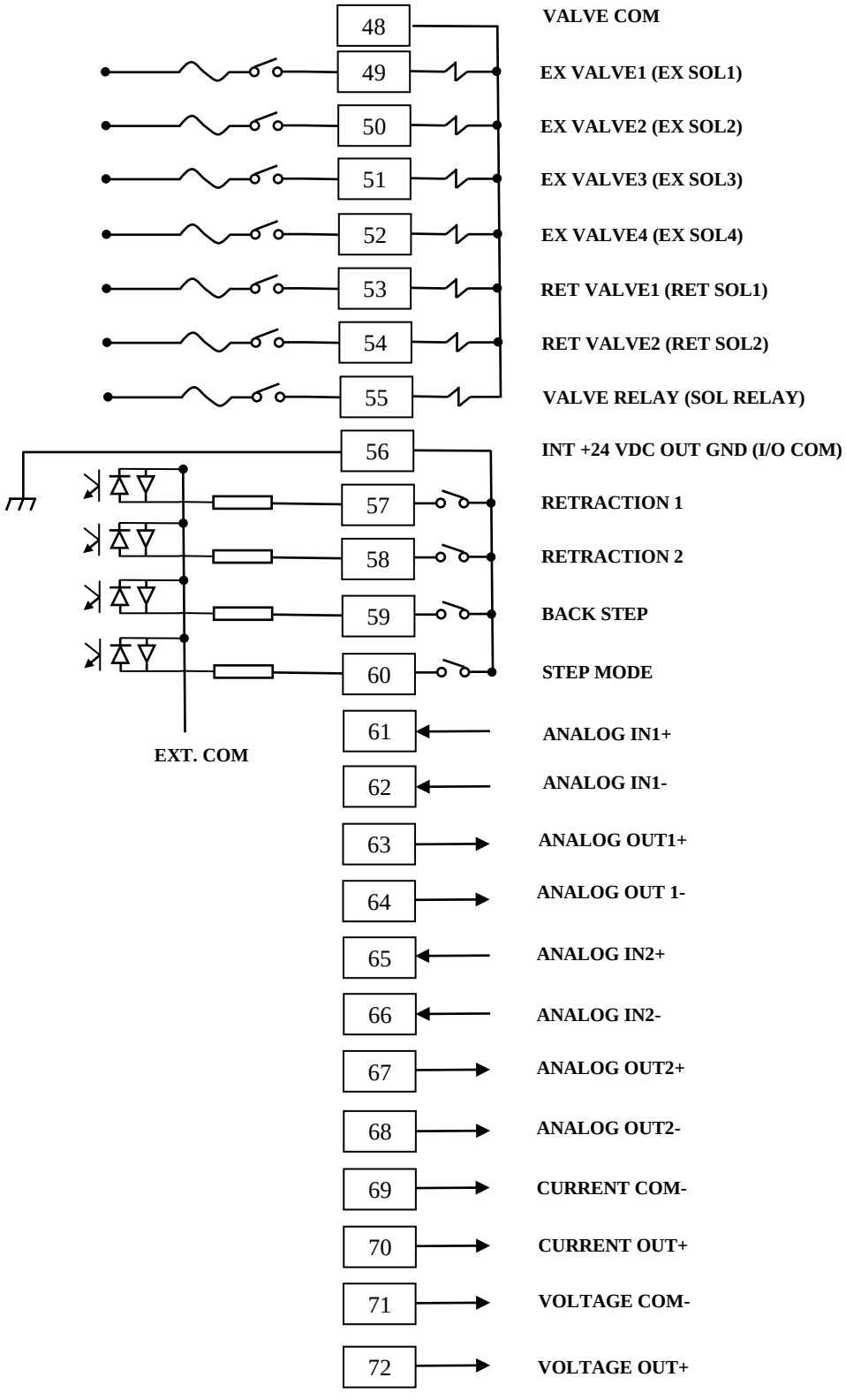
NAME	DESCRIPTION
END	Closed each time the sequence is complete and output the END signal. Output time selection (10 to 200 ms, HOLD) When the off time (OFF) is set and the END signal time is set to time longer than OFF time, the END signal time will be equal to OFF time
COUNT ERROR	Weld count error output. In the case WELD COUNT is ON, this signal is closed when the weld count terminal is open before the set number of welds is not deposited. This signal is also closed when the weld count terminal is open before welds are counted. When the weld count is larger than the set number of welds, this signal is not output. To clear the count error signal, you need to input the weld count signal again or add required number of welds to make up for insufficiency. The count error signal is not cleared if the error reset signal is input. Also, when required number of welds are added to make up for insufficiency, the count error signal is output until the insufficient number of welds is complete.
READY	Closed when no error occurs and the WELD ON/OFF is ON.
STEP END	Closed when the last step ends in step-up operation. Closed until the step reset signal is input or the step setting (value) is changed. Even if VALVE1 and VALVE 2 are switched, the signal remains closed when the either one reaches the set number of welds. The error is displayed only when the VALVE where the current is supplied has reached (reaches) the set number of welds.
WELD SIGNAL	Welding timing signal. Closed during welding. Not output at COOL. Closed even if start with the WELD OFF state (with time set and HEAT not set).
GOOD	Closed when the measured value is judged to be within the range set on the MONITOR SET screen after the completion of welding sequence. Output time selection: 10 to 200 ms, 0ms (Hold)
COUNT UP	Closed when the count reaches the preset counter value. To cancel the count up output, input the reset signal to the count reset pin.
OUT I	WELD1 welding end output. Closed between the WELD1 welding end and the beginning of HOLD.
OUT II	WELD2 welding end output. Closed between the WELD2 welding end and the beginning of HOLD.

Section III: I/O Terminal Block for IS-4500CA

INTERNAL SINK MODE SHOWN




26
NG1 OUT (ERROR)
27
NG2 OUT (CAUTION)
28
OUT1
29
OUT2
30
OUT3
31
OUT4
32
OUT5
33
OUT COM
34
VALVE (SOL) POWER
35
VALVE (SOL) COM
36
VALVE1 (SOL1)
37
VALVE2 (SOL2)
These valves are active in valve 2 mode (See page 3-33)
Use EXT valves 1-4 (pins 49-52) for normal valve operation
38
39
SECONDARY VOLTAGE (use only for non-IT transformers)
40
INT +24 VDC OUT
41
CONTACTORS (OPTIONAL)
Xfmr Sense Input
AUX CONTACTS (N/O) ON CONTACTORS
42
CONTACTOR N.O. (OPTIONAL)
43
CONTACTOR COM (OPTIONAL)
AUX CONTACTS (N/C) ON CONTACTORS
44
CONTACTOR N.C. (OPTIONAL)
45
CURRENT COIL (use only for non-IT transformers)
46
47
NOT USED


48
VALVE COM
49
EX VALVE1 (EX SOL1)
50
EX VALVE2 (EX SOL2)
51
EX VALVE3 (EX SOL3)
52
EX VALVE4 (EX SOL4)
53
RET VALVE1 (RET SOL1)
54
RET VALVE2 (RET SOL2)
55
VALVE RELAY (SOL RELAY)
56
INT +24 VDC OUT GND (I/O COM)
57
RETRACTION 1
58
RETRACTION 2
59
BACK STEP
60
STEP MODE
EXT. COM
61
ANALOG IN1+
62
ANALOG IN1-
63
ANALOG OUT1+
64
ANALOG OUT 1-
65
ANALOG IN2+
66
ANALOG IN2-
67
ANALOG OUT2+
68
ANALOG OUT2-
69
CURRENT COM-
70
CURRENT OUT+
71
VOLTAGE COM-
72
VOLTAGE OUT+

External I/O Signals for IS-4500CA

PIN	NAME	DESCRIPTION
1	INT +24VDC OUT	**NOTE:** Do not use pin 1 unless connecting it to pin 2 or 3. Failure to observe this precaution will result in malfunction. **MAX CURRENT DRAW:** 100 mA
2	EXT. COM	For internal Sink (pull down) Connect to pin 1. For Internal Source (push up) Connect to pin 4. To activate input in Sink Mode, connect inputs to INT +24 VDC GND (I/O COM) To activate input in Source Mode, connect inputs to INT +24 VDC For External Sink attach PLC +24 V. For External Source, attach PLC COM
3	STOP	Must be jumpered to Pin 1 to operate. Use relay to provide switch closure if required
4	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the internal +24 VDC GND. NOTE: DO NOT CONNECT TO PIN 1 (INT +24 VDC OUT)
5 **6** **7** **8** **9** **10** **11** **12**	SCHEDULE 1 SCHEDULE 2 SCHEDULE 4 SCHEDULE 8 SCHEDULE 16 SCHEDULE 32 SCHEDULE 64 SCHEDULE 128	Schedule input pins. 5: Schedule 1 6: Schedule 2 7: Schedule 4 8: Schedule 8 9: Schedule 16 10: Schedule 32 11: Schedule 64 12: Schedule 128
13	WE1 STOP/ PARITY	WE1 stop input or Parity input pin. <u>When WE1 STOP is selected</u> Closing this pin during the WELD1 sequence will switch the sequence to COOL1. The interrupt error occurs when the WELD1 STOP signal is input before the start signal is input. When this pin is closed before WELD1 welding start after startup, the current is supplied for at least a control cycle and WELD1 is stopped to switch the sequence to COOL1. <u>When PARITY CHECK is selected</u> This pin allows for detection of failure resulting from a wire break in the schedule selection signal lines. Be sure that the total number of closed schedule selection and parity signal lines is always odd.

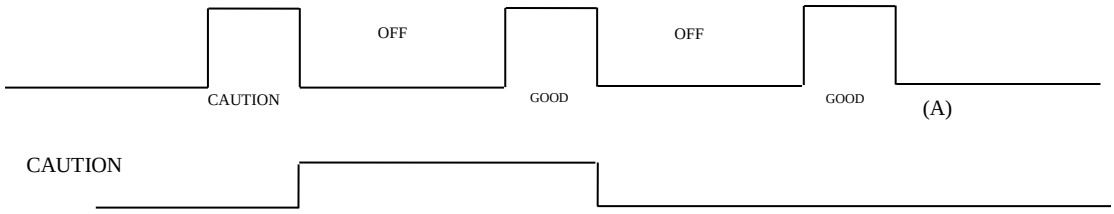
PIN	NAME	DESCRIPTION
14	WE2 STOP/ WELD COUNT	WE2 stop input or Weld count input pin. When WE2 STOP is selected Closing this pin during the WELD2 sequence will switch the sequence to COOL2. Closing this pin in the sequence other than WELD2 is neglected. The sequence will switch to COOL2 if this signal is closed during the WELD2 sequence operation. When this pin is closed before WELD2 welding start after startup, the current is supplied for at least a control cycle and WELD2 is stopped to switch the sequence to COOL2. When WELD COUNT is selected This pin allows you to determine whether or not the number of deposited welds has reached the WELD COUNT setting. 20 ms or more is required for receiving the WELD COUNT input signal.
15	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND
16	STAGE1	1ST STAGE input pin. Closing this pin will close SOL1 of pin 36 or SOL2 of pin 37. Since the welding sequence does not start, you can adjust or check the position. When the 2ND STAGE pin is closed after this, a welding can be done.
17	STAGE2	2ND STAGE input pin. Closing this pin will start the sequence.
18	THERMOSTAT COM	Common input for Transformer Thermostat through the XFMR Sense connector For Internal Sink operation, connect to INT +24 VDC GND (I/O Com) For internal Source operation, connect to INT+24 VDC For External Sink, connect to PLC COM For External source, connect to PLC +24V
19	WELD ON/OFF	Weld ON pin. Close this pin to turn ON the WELD ON/OFF signal, and open it to turn it OFF. Leaving this pin open will shut off welding current even when the sequence operation is performed. Use this pin, for example, to start the sequence experimentally.
20	THERMOSTAT	If the XFMR Sense connector is not used, this pin should be connected to the appropriate voltage (Sink or Source). If the Sense connector is used this pin should be left open.
21	FLOWSWITCH	Flow switch input pin. Opening this pin will result in a flow rate error.
22	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND.
23	ERROR RESET	Error/caution reset input pin. Eliminate the cause of error or caution and close this pin to reset the error or caution indication. 20 ms or more is required for receiving the input signal.
24	STEP RESET	Step reset input pin. Closing this pin while the STEPPER is ON will reset the STEP number to 1. 20 ms or more is required for receiving the input signal.

PIN	NAME	DESCRIPTION
25	WE3 STOP/ COUNT RESET	WE3 stop input or Count reset input pin. When WE3 STOP is selected Closing this pin during the WELD3 sequence will switch the sequence to HOLD. The interrupt error occurs when the WELD3 STOP signal is input before the start signal is input. When this pin is closed before WELD3 welding start after startup, the current is supplied for at least a control cycle and WELD3 is stopped to switch the sequence to HOLD. When COUNT RESET is selected Closing this pin allows you to reset the counter. 20 ms or more is required for receiving the COUNT RESET input signal.
26	NG1 OUT (ERROR)	Error signal output pin. This signal is output upon completion of the welding sequence in the event of an operational error. If an error occurs, operation will halt until the reset signal is input. In NORMAL CLOSE, the pin is closed with the power turned on, but becomes open with an error occurring. In NORMAL OPEN, the pin is open with the power turned on, but becomes closed with an error occurring. The contact is rated at 24 VDC at 20 mA (semiconductor switch).
27	NG2 OUT (CAUTION)	Caution signal output pin. This pin is closed upon completion of the welding sequence if the measured value is outside the range set on the MONITOR SET screen. (In the case CAUTION is set, the status will be "ERROR" depending on the NG SIGNAL SELECT setting.) You can continue with your welding task even if a caution signal is activated. To cancel this caution output, input the reset or start signal. The contact is rated at 24 VDC at 20 mA (semiconductor switch). In the case the off time (OFF) is set, when CAUTION is output, the signal is maintained until the next welding result is obtained. (*1)
28	OUT1	Contact output pins. (semiconductor switch. The contact is rated at 24 VDC at 20 mA.) The contact is open or closed corresponding to the function. Can be assigned to each pin. END,COUNT ERROR, READY, STEP END, WELD SIGNAL, GOOD, COUNT UP, OUT I, OUT II.
29	OUT2	
30	OUT3	
31	OUT4	
32	OUT5	
33	OUT COM	Common pin for output pins. This pin is the common pin for the NG, CAUTION, END, COUNT ERROR, READY, STEP END, and WELD ON pins.
34	VALVE (SOL) POWER	Power input pins to drive the solenoid valve. Input 120 VAC or 24 VDC power.
35	VALVE (SOL) COM	COM pin for the solenoid valve.

PIN	NAME	DESCRIPTION
36 **37**	VALVE1 (SOL1) VALVE2 (SOL2)	Solenoid valve output pins. 36: VALVE1 (SOL1); 37: VALVE2 (SOL2) These pins are closed for the duration of the STAGE 2 input. Output between SQD and HOLD. When the off time (OFF) is set, this pin is output between SQZ and HOLD after the second sequence. The contacts are rated at 120 VAC or 24 VAC/DC at 0.5 A (semiconductor switches). Use a solenoid valve with a current capacity of 0.5 A or less.
38 **39**	SECONDARY VOLTAGE	Secondary voltage input pins. Internally connected to the IT XFMR sense connector. If IT XFMR sense cable not used may be connected directly to electrodes.
40	INT +24VDC OUT	Jumpered from Pin1 to provide drive voltage to Contactor Solid State Relay
41	CONTACTORS	Switch closure between Pin 40 and Pin 41 will engage the optional contactor
42	CONTACTOR N.O.	Detect position of contactors between pin 42 and 43: contactors normally open (optional)
43	CONTACTOR COM	Contactor Aux contact common (optional)
44	CONTACTOR N.C.	Detect position of contactors between pin 44 and 43: contactors normally closed (optional)
45 **46**	CURRENT COIL	Current coil input, used for secondary current feedback. Internally connected to the IT XFMR sense connector. If XFMR sense cable not used may be connected external current coil.
47	N/A	UNUSED
48	VALVE COM	COMMON for all valves
49 **50** **51** **52** **53** **54** **55**	EX VALVE1 (EX SOL1) EX VALVE2 (EX SOL2) EX VALVE3 (EX SOL3) EX VALVE4 (EX SOL4) RET VALVE1 (RET SOL1) RET VALVE2 (RET SOL2) VALVE RELAY (SOL RELAY)	Solenoid valve output pins. 49: EX VALVE1 (EX SOL1); 50: EX VALVE2 (EX SOL2); 51: EX VALVE (EX SOL3); 52: EX VALVE4 (EX SOL4) Retraction Solenoid valve output pins. 53: RET VALVE1 (RET SOL1); 54: RET VALVE2 (RET SOL2); 55: VALVE RELAY (SOL RELAY) The contacts are rated at 120 VAC or 24 VAC/DC at 0.5 A (semiconductor switches). Use a solenoid valve with a current capacity of 0.5 A or less.
56	INT +24VDC GND (I/O COM)	COM pin. This pin is internally connected to the +24 VDC GND

PIN	NAME	DESCRIPTION
57 **58** **59** **60**	RETRACTION 1 RETRACTION 2 BACK STEP STEP MODE	I/O Inputs
61 **62**	ANALOG IN1+ ANALOG IN1-	0 - 10VDC Analog input 1
63 **64**	ANALOG OUT1+ ANALOG OUT1-	0 - 10VDC Analog output 1*[2]
65 **66**	ANALOG IN2- ANALOG IN2-	0 - 10VDC Analog input 2
67 **68**	ANALOG OUT2+ ANALOG OUT2-	0 - 10VDC Analog output 2*[2]
69 **70**	CURRENT COM- CURRENT OUT+	Current output (0 - 10 VDC)*[2] $V_{OUT} = I_{OUT} / 5000$
71 **72**	VOLTAGE COM- VOLTAGE OUT+	Voltage output (0 - 10 VDC)*[2] $V_{OUT} = V_{FEEDBACK} / 2$

*[1] When the sequence is stopped at (A), error (CAUTION) is not displayed. It's because the contents when stopped is displayed on the program unit.



*[2] Maximum combined current draw from all analog outputs: 75 mA

External Output Signals

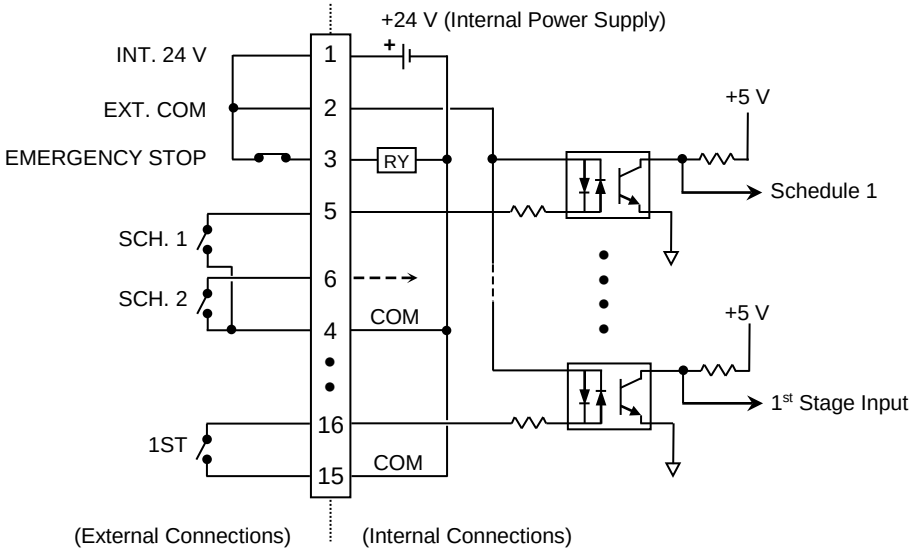
The following signals can be assigned on the **OUTPUT SELECT** screen to output pins 28 to 32 (OUT 1 to 5)

NAME	DESCRIPTION
END	Closed each time the sequence is complete and output the END signal. Output time selection (10 to 200 ms, HOLD) When the off time (OFF) is set and the END signal time is set to time longer than OFF time, the END signal time will be equal to OFF time.
COUNT ERROR	Weld count error output. In the case WELD COUNT is ON, this signal is closed when the weld count terminal is open before the set number of welds is not deposited. This signal is also closed when the weld count terminal is open before welds are counted. When the weld count is larger than the set number of welds, this signal is not output. To clear the count error signal, you need to input the weld count signal again or add required number of welds to make up for insufficiency. The count error signal is not cleared if the error reset signal is input. Also, when required number of welds are added to make up for insufficiency, the count error signal is output until the insufficient number of welds is complete.
READY	Closed when no error occurs and the WELD ON/OFF is ON.
STEP END	Closed when the last step ends in step-up operation. Closed until the step reset signal is input or the step setting (value) is changed. Even if VALVE1 and VALVE 2 are switched, the signal remains closed when the either one reaches the set number of welds. The error is displayed only when the VALVE where the current is supplied has reached (reaches) the set number of welds.
WELD SIGNAL	Welding timing signal. Closed during welding. Not output at COOL. Closed even if start with the WELD OFF state (with time set and HEAT not set).
GOOD	Closed when the measured value is judged to be within the range set on the MONITOR SET screen after the completion of welding sequence. Output time selection: 10 to 200 ms, 0 ms (Hold)
COUNT UP	Closed when the count reaches the preset counter value. To cancel the count up output, input the reset signal to the count reset pin.
OUT I	WELD1 weld end output. Closed between the WELD1 weld end and the beginning of HOLD.
OUT II	WELD2 weld end output. Closed between the WELD2 weld end and the beginning of HOLD.

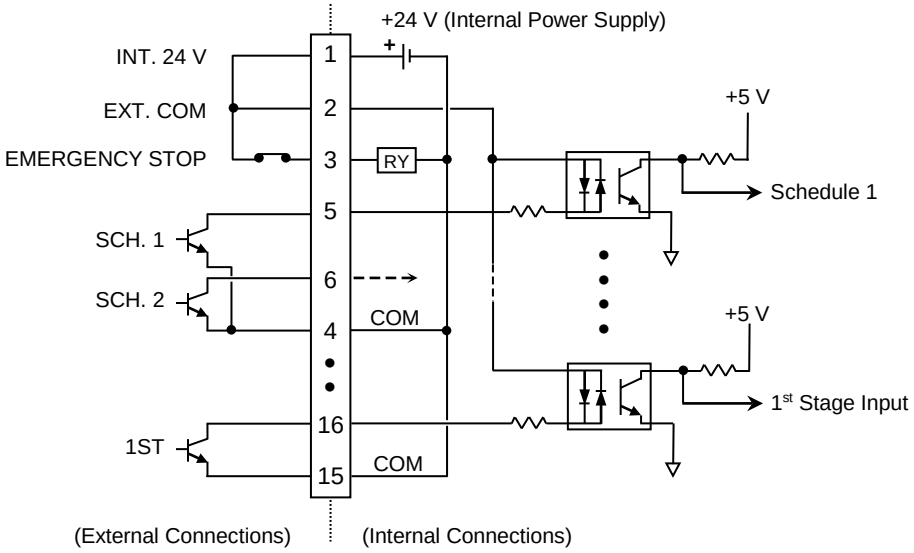
Section IV: Input Connection Examples (All models)

Input Signal Connections

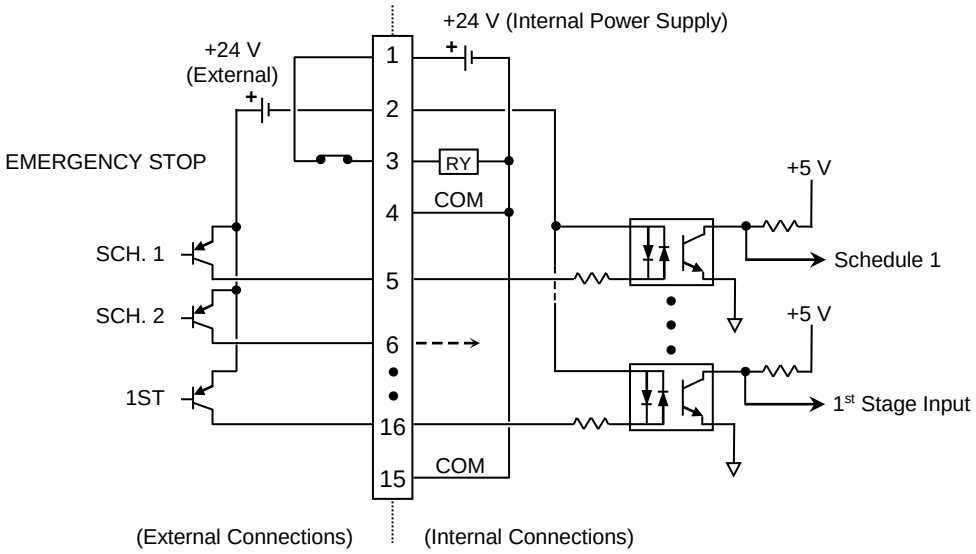
1. Connection with equipment having a contact input. Connect pins 1 and 2.



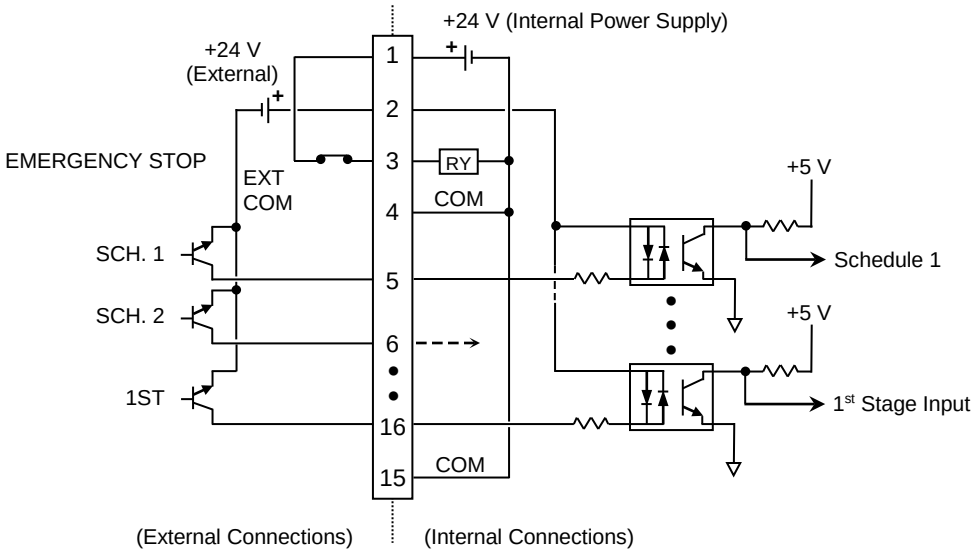
2. Connection with equipment featuring NPN (sink) open collector output using internal +24 VDC power supply. Connect pins 1 and 2.



3. Connection with equipment featuring PNP (source) current output using external power supply. Connect the negative side of an external 24 VDC power supply to pin 2.



4. Connection with equipment featuring NPN (sink) open collector output using external power supply. Connect the positive side of an external 24 VDC power supply to pin 2.



APPENDIX C
SYSTEM TIMING

Input and Output Timing Signals

The following illustrations show the timing signals for different functions of the Power Supply.

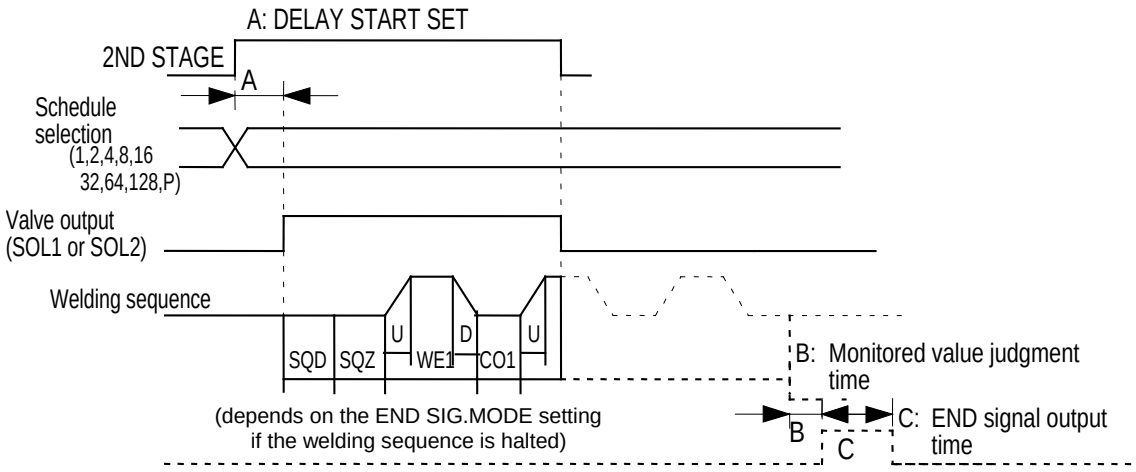
Start Signal Input

Weld sequence operation varies by the setting of **START SIG. MODE** on the Mode Select screen.

Maintained Mode

If the 2ND STAGE signal stops halfway through the welding sequence (from the beginning of initial squeeze delay time through the end of hold time), the welding sequence will halt at that point.

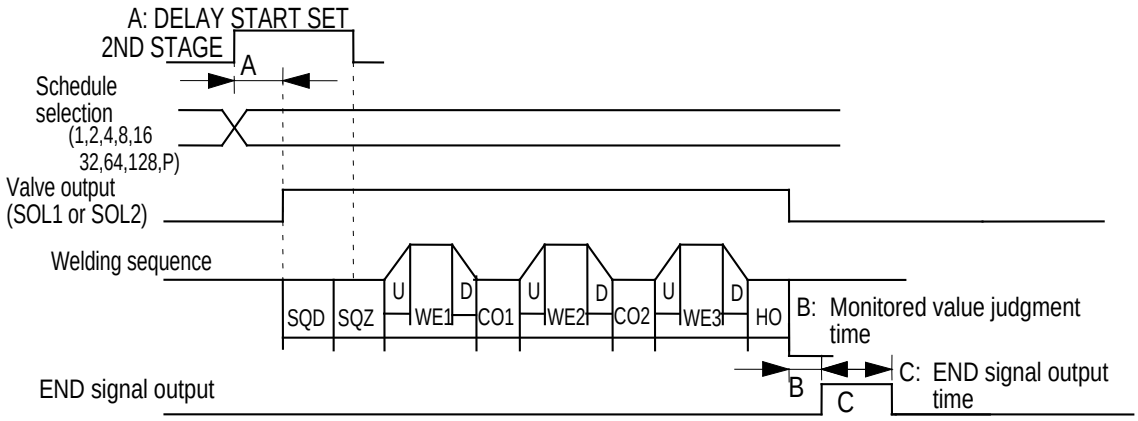
Note that the **END** signal depends on the **END SIG.MODE** setting.



Start Signal Input in Maintained Mode

Pulsed Mode

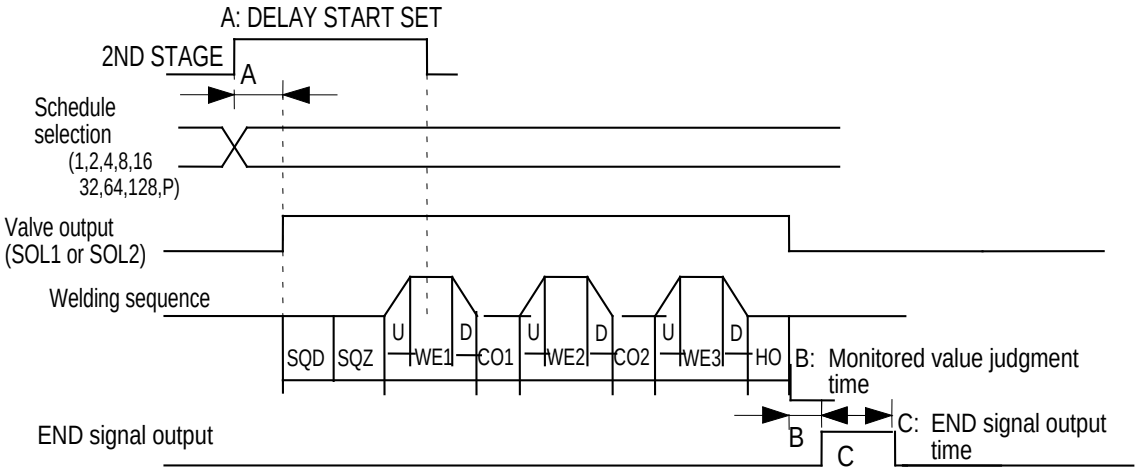
When the 2ND STAGE signal is input for more than the time set through DELAY START SET and then stops, the welding sequence will proceed to completion.



Start Signal Input in Pulsed Mode

Latched Mode

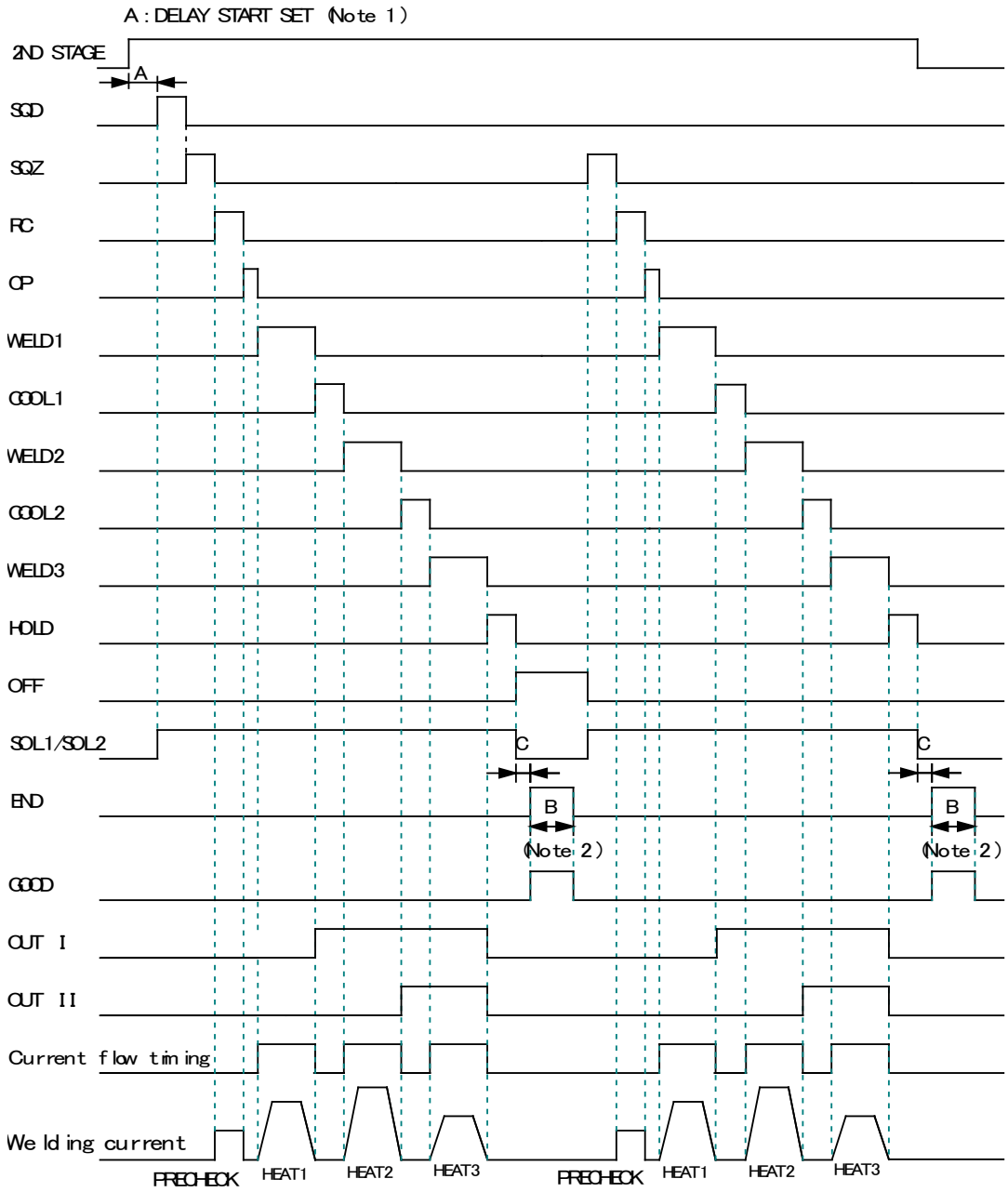
- The welding sequence halts if the 2ND STAGE signal stops during squeeze time (**SQZ**).
- The welding sequence proceeds to completion when the 2ND STAGE signal stops during Weld 1 time (**WE1**) or later.



Start Signal Input in Latched Mode

One-Stage Start

Stage 2 signal will begin the welding sequence with the selected Schedule #.



SQD: Squeeze delay time
SQZ: Squeeze time
RC: Resistance pre-check time
CP: Resistance judgment time (2ms)
WELD1: 1st weld time
COOL1: Cooling time 1
WELD2: 2nd weld time
COOL2: Cooling time 2
WELD3: 3rd weld time
HOLD: Hold time
OFF: Off time

A: DELAY START SET setting + Welding preparation time

The welding preparation time changes depending on the WELD TRANS FREQ (frequency) setting.

Frequency [Hz]	Welding preparation time [ms]	Frequency [Hz]	Welding preparation time [ms]
600	1.1	1000 to 1200	0.7
700	1.0	1300 to 1600	0.6
800	0.9	1700 to 2400	0.5
900	0.8	2500 to 3000	0.4

B: END SIGNAL TIME setting

The output time changes depending on the OFF time. See *Chapter 3: Using Programming Functions, Section 10: Mode Select Screen, Sub-section c: End Signal Mode*.

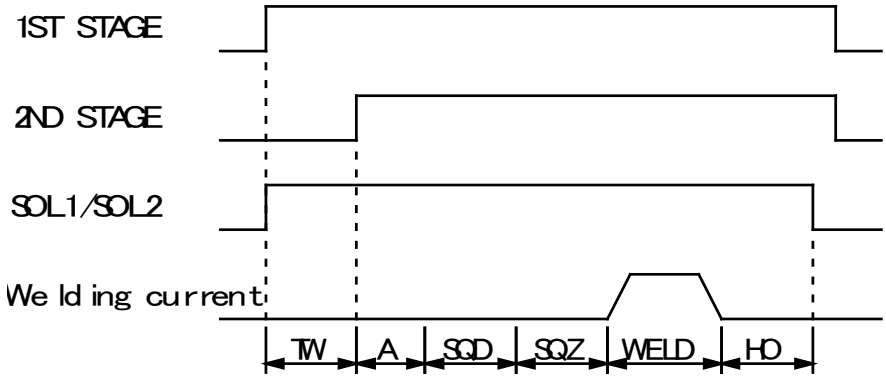
C: Monitored value judgment time 200 μs max.

(Note 1) To stop the sequence during **SQD** or **SQZ** (possible only when LATCHED or MAINTAINED is selected for **START SIG. MODE**; see *Chapter 3: Using Programming Functions, Section 10: Mode Select Screen, Sub-section b: Start Signal Mode*, stop the 2ND STAGE input for a period longer than that set for **DELAYSTART SET**.

(Note 2) When the current gets out of the range of upper/lower limit judgment (ERROR) in a sequence, repetition operation ends even if the OFF time is set.

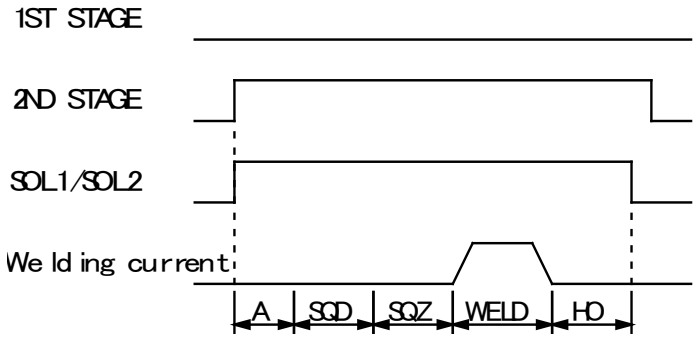
Two-Stage Start

When the 1ST STAGE is input, the solenoid valve output (SOL1 or SOL2) is turned ON and goes in to the standby state of the 2ND STAGE input. When the 2ND STAGE is input, welding sequence starts.



TW: 2ND STAGE input standby state.
A: DELAY START SET setting + Welding preparation time.

When the 2ND STAGE is input before the 1ST STAGE input, welding sequence starts. When welding sequence starts, 1ST STAGE signal is not received until welding sequence ends.

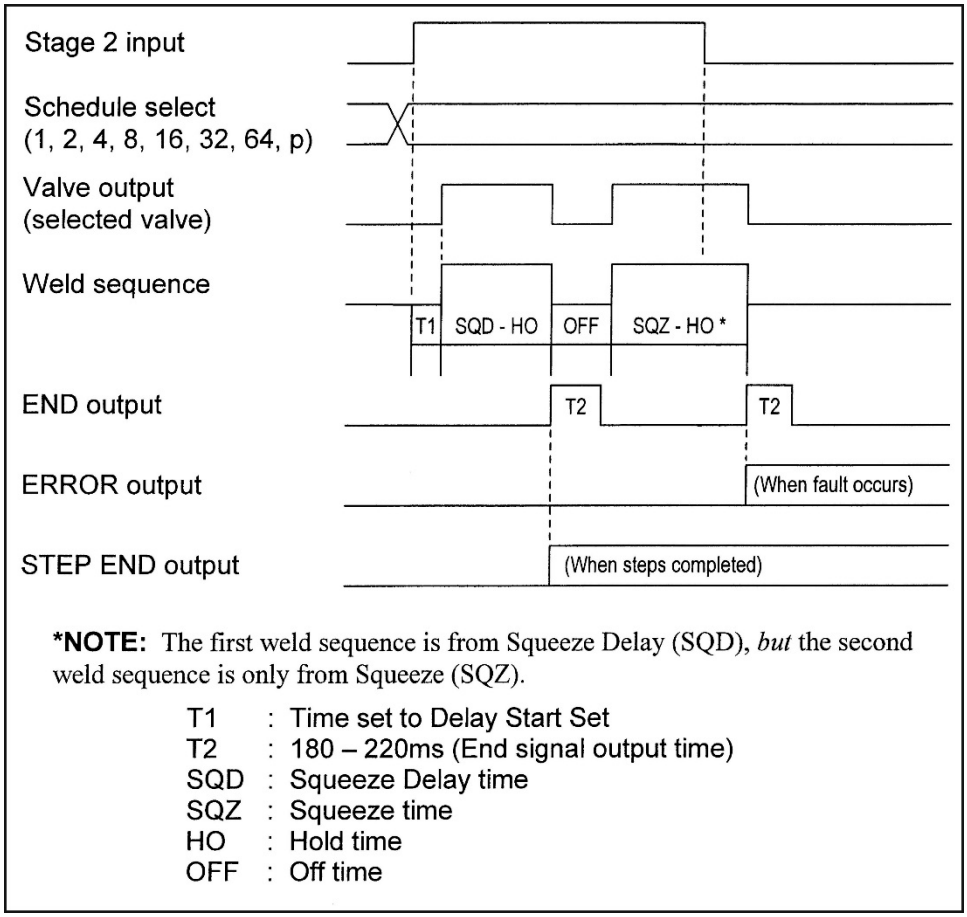


A: DELAY START SET setting + Welding preparation time.

Two-Stage Start

Repeat Operation

Repeat operation will occur whenever the Off time is set to any value other than zero (0).



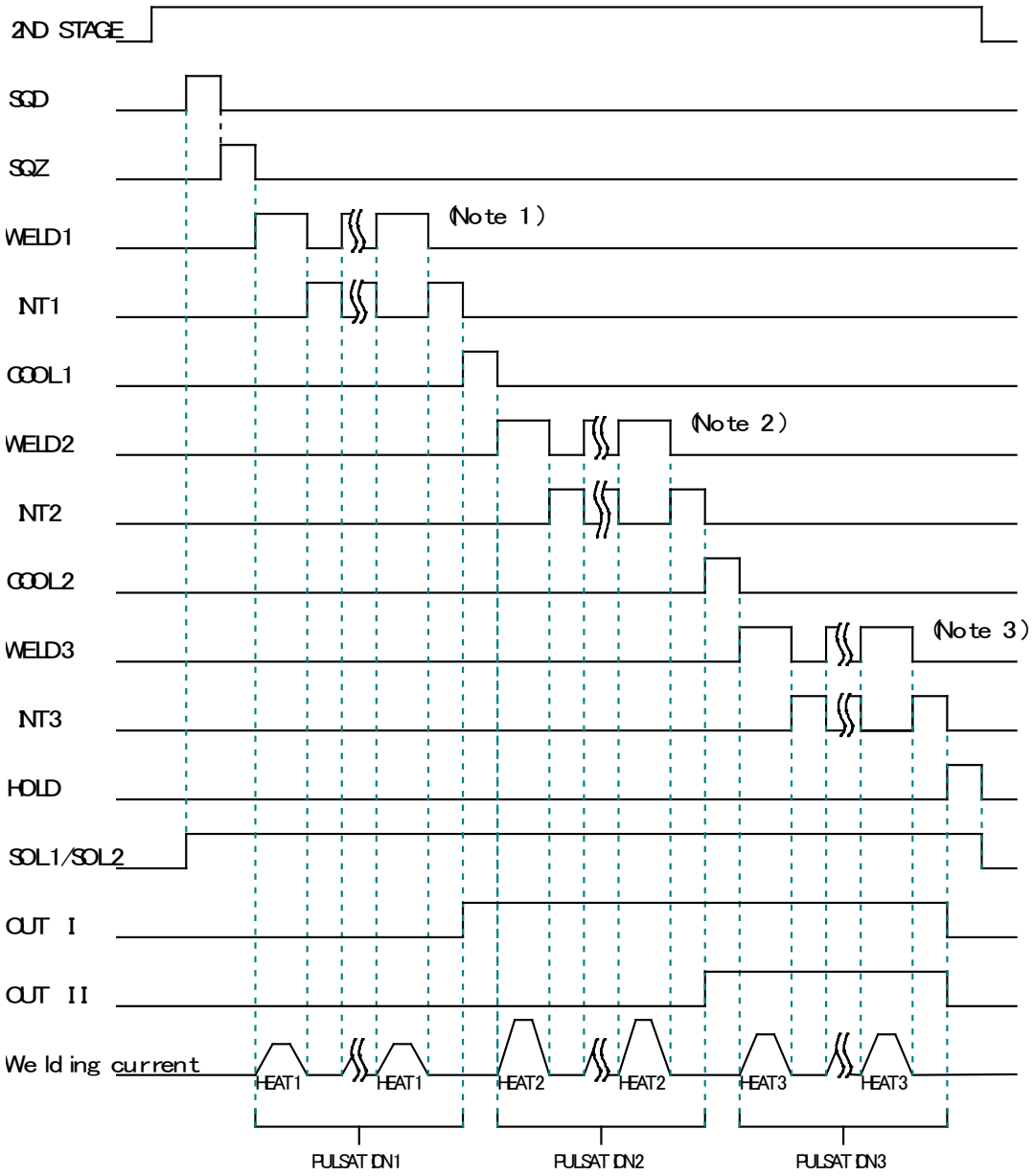
***NOTE:** The first weld sequence is from Squeeze Delay (SQD), *but* the second weld sequence is only from Squeeze (SQZ).

T1 : Time set to Delay Start Set
T2 : 180 – 220ms (End signal output time)
SQD : Squeeze Delay time
SQZ : Squeeze time
HO : Hold time
OFF : Off time

Repeat Operation

Pulsation

Operation is repeated in **WELD** and **INT** set times.



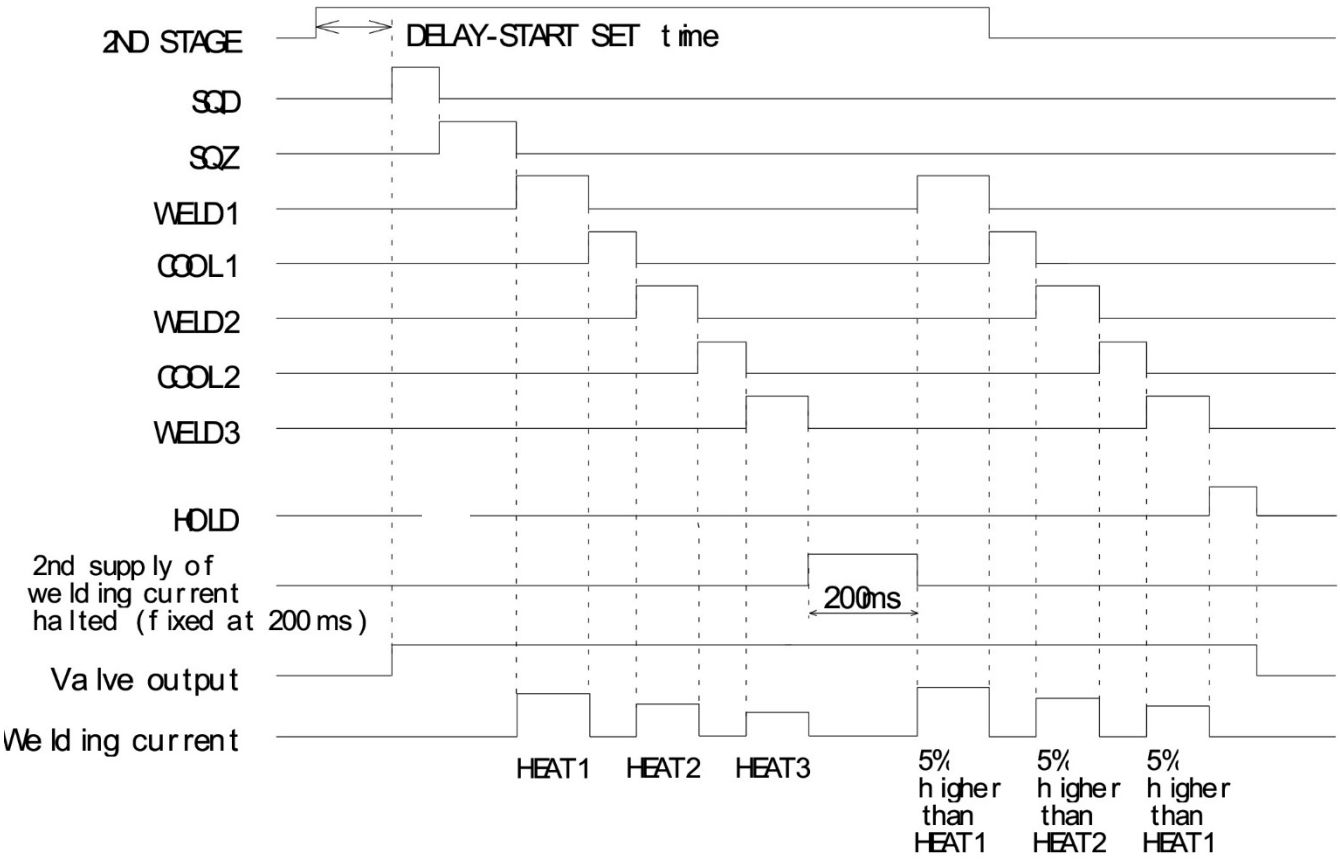
(Note 1) Repeat operation times set for PULSATION1 in WELD1 and INT1 set times. When PULSATION is set to 3, WELD to INT are repeated 3 times as follows; SQZ→WELD1→ INT1→ WELD1→ INT1→ WELD1→ INT1→ WELD2

(Note 2) Repeat operation times set for PULSATION2 in WELD2 and INT2 set times.

(Note 3) Repeat operation times set for PULSATION3 in WELD3 and INT3 set times.

Re-Weld

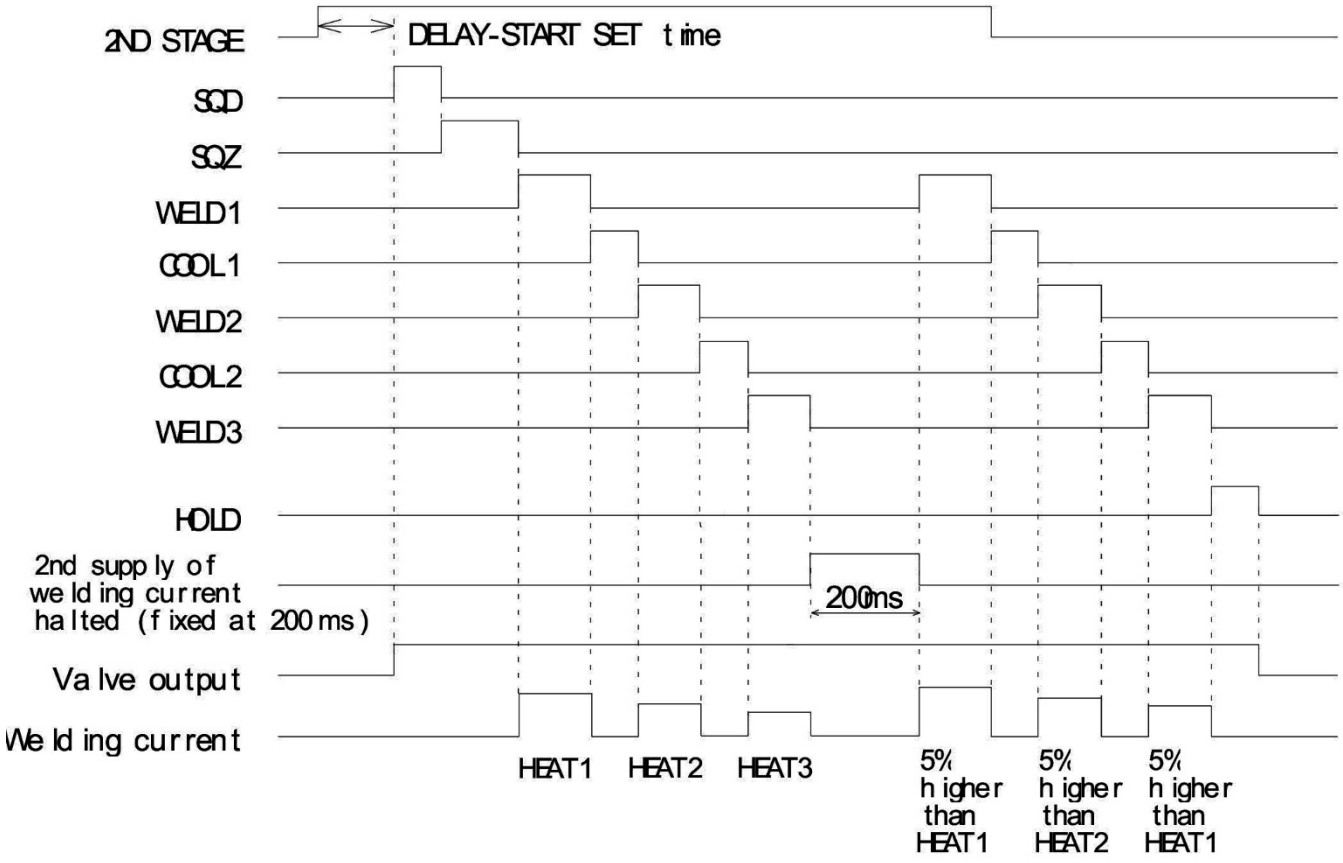
Re-weld will occur when Re-Weld is set On (Mode Select screen), and a current monitor error occurs as a low weld current shown below. Under that circumstance, a re-weld will occur with a 5% increase in weld current.



Re-Weld

Interrupt

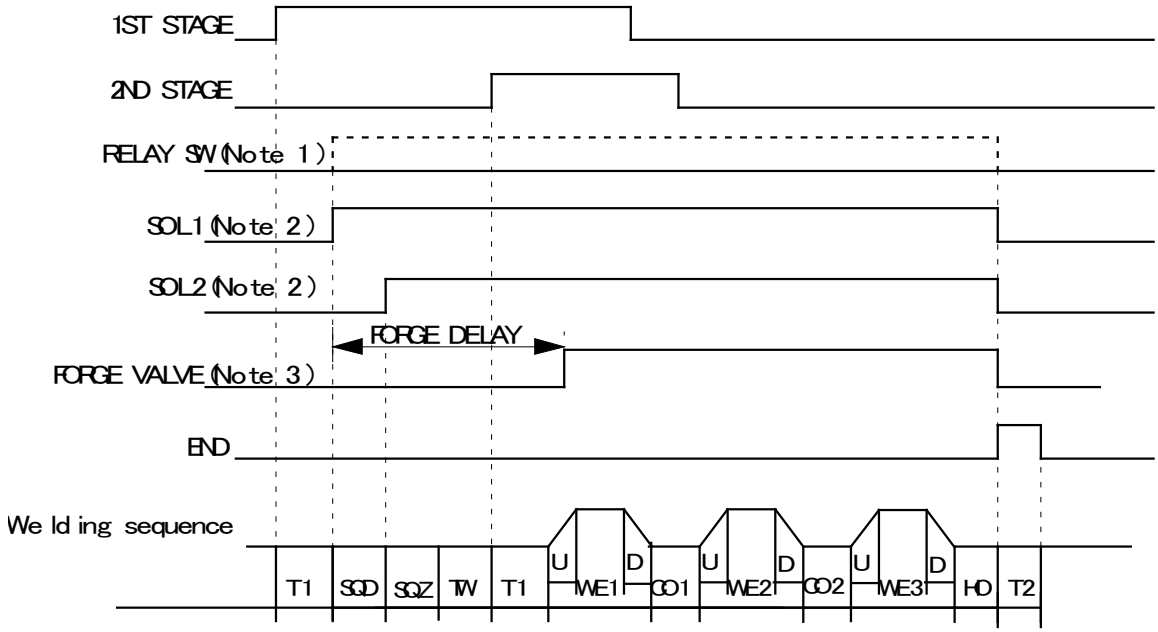
Interrupt will occur when Interrupt is set On (Mode Select screen), and an Interrupt signal is applied during a weld sequence. The weld cycle is immediately stopped and shifted to Hold (HO).



Interrupt

VALVE MODE- specific difference in sequence

When VALVE MODE is changed to “2 VALVE” from “1 VALVE”, two valve signals (SOL1 and SOL2) are output in a sequence. In this case, the settable VALVE No. is 1 or 2.



(Note 1) The RELAY SW signal is not output when VALVE# is set to “1”. It is output from SQD to HOLD only when VALVE# is set to “2”.

(Note 2) When VALVE# is set to “1”, the output signal No. of SOL1 is 36 and that of SOL2 is 37 on the 39-pin terminal strip. When VALVE# is set to “2”, the output signal No. of SOL1 is 2 (EX SOL1) and that of SOL2 is 3 (EX SOL2) on the 25-pin D-Sub connector.

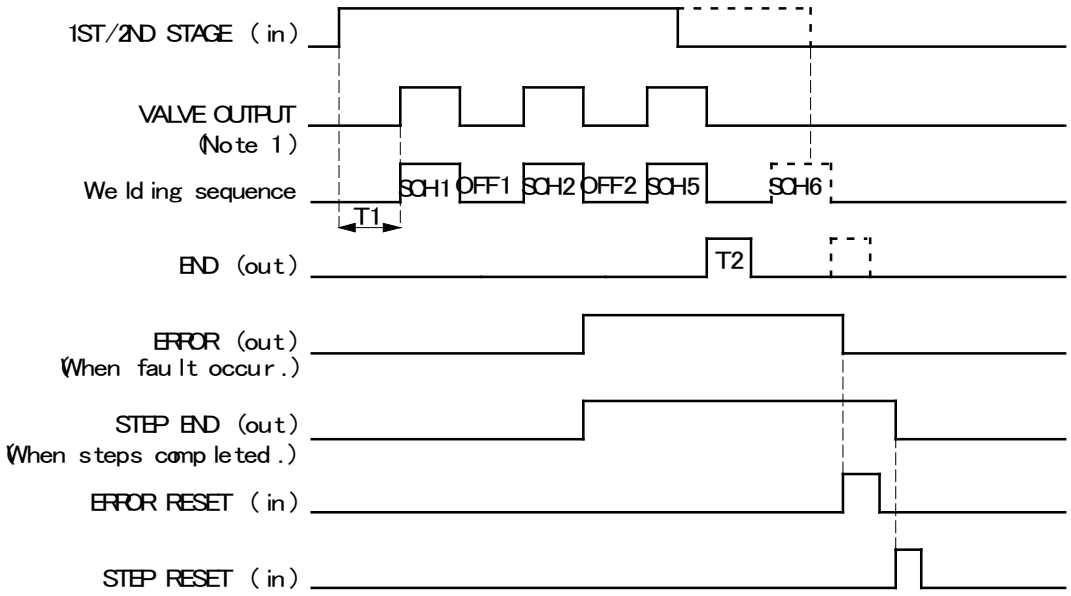
(Note 3) The output signal No. of FORGE VALVE is 4 (EX SOL3) when VALVE# is set to “1”, and 5 (EX SOL4) on the 25-pin D-Sub connector when VALVE# is set to “2”.

CHAINING Function

This function can call up welding multiple SCHEDULEs in order to perform them while the 1ST STAGE signal and the 2ND STAGE signal are input.
The SCHEDULE used in the chaining function is set in CHAINING on the FORCE SETUP & MONITOR screen. For details, *Chapter 3: Using Programming Functions, Section 17: Force Setup & Monitor Screen*.
Even if start is maintained, the sequence executes the final SCHEDULE and ends.

[Example] At 1-stage start operation

(For 2-stage start, the start method is different, but the operation after start is the same.)
In this example, the CHAINING settings for SCHEDULE1, 2, 5, and 6 are ON, and those for other SCHEDULEs are OFF.
Since the 2ND STAGE signal is OFF when the sequence of SCHEDULE5 ends, SCHEDULE6 is not executed.
Next, when the 2ND STAGE signal is input, the sequence starts from the first SCHEDULE1.



T1 : Time set by [DELAY START SET]
T2 : Duration of END output signal
OFF1 : OFF time set by [SCHEDULE1]
OFF2 : OFF time set by [SCHEDULE2]

(Note 1) When the VALVE MODE setting is 1 VALVE, the valve selected from EXSOL1to4 is output.

Successive and Back Step Function

This function can switch welding multiple SCHEDULEs in order to perform them each time the 1ST STAGE signal and the 2ND STAGE signal are input.

The SCHEDULE used in the successive function is set in SUCCESSIVE on the FORCE SETUP & MONITOR screen. For details, see *Chapter 3: Using Programming Functions, Section 17: Force Setup & Monitor Screen.*

When the back step signal is input, SCHEDULE returns to the previous one.

Also, when the back step signal is input over 1.5 seconds, SCHEDULE returns to the first one.

The END signal is output at the end of each SCHEDULE.

[Example] At 1-stage start operation

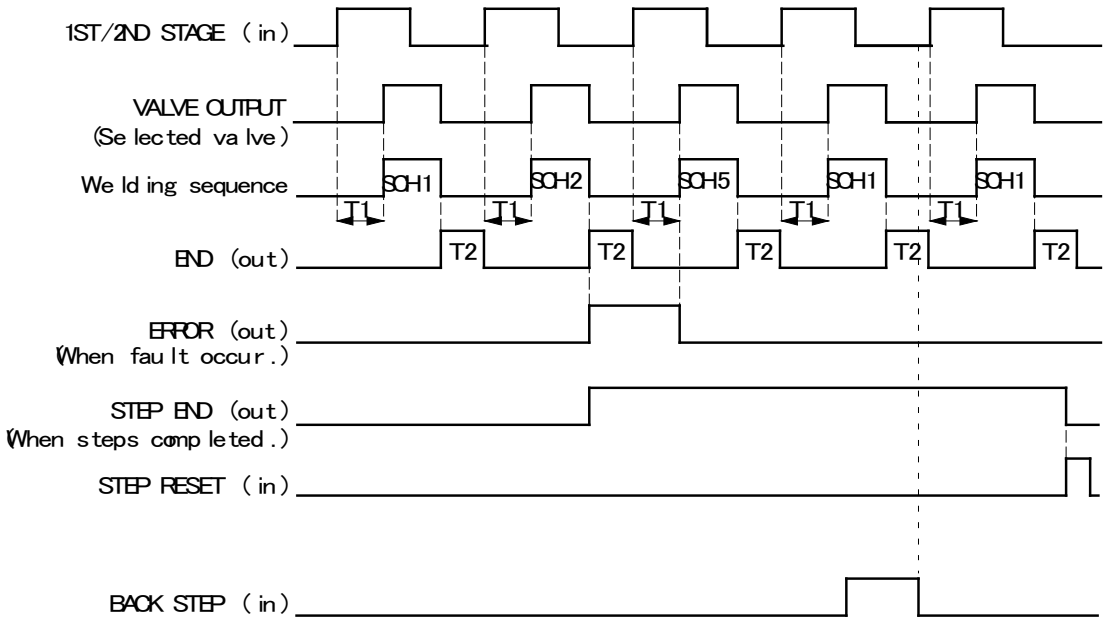
(For 2-stage start, the start method is different, but the operation after start is the same.)

In this example, the SUCCESSIVE settings for SCHEDULE1, 2 and 5 are ON, and those for other SCHEDULEs are OFF.

SCHEDULE1 comes after SCHEDULE5.

Next, when the 2ND STAGE signal is input, the sequence starts from the first SCHEDULE1.

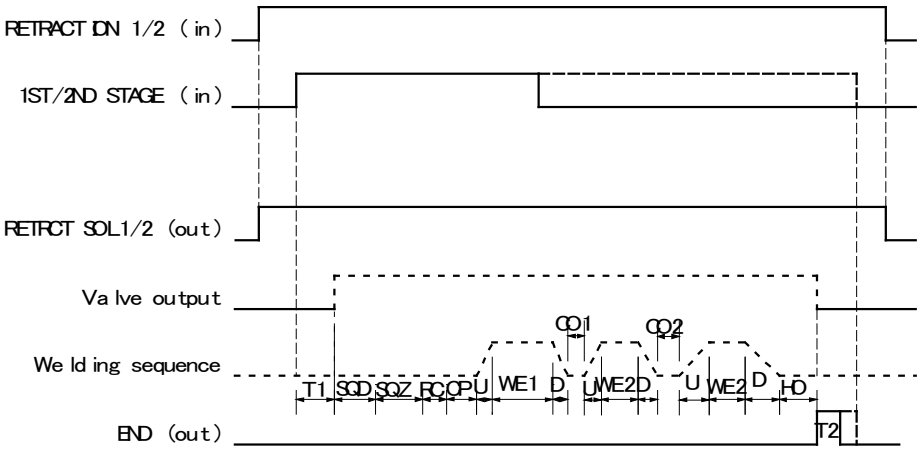
The sequence also starts from SCHEDULE1 once the power supply is turned off.



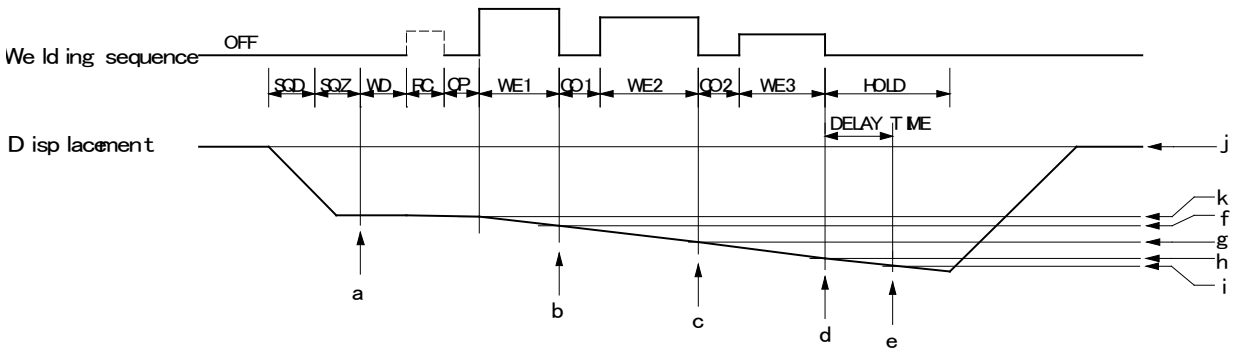
T1 : Time set by [DELAY START SET]
T2 : Duration of END output signal

Retraction Function

This function can output the retraction valve signal while the retraction signal is input. Since the electrode opening can be temporarily extended during welding, the direction of workpiece can be easily changed. However, the retraction valve signal cannot be turned ON/OFF during welding sequence.



T1 : Time set by [DELAY START SET]
T2 : Duration of END output signal



WD : Work detect time
RC : Resistance precheck time
CP : Resistance judgment time

a: Work detection — When the work detection is set on the DISPLACEMENT screen, the workpiece detection is done after the end of SQZ. When ± 00.00 mm is set, the work detection is not done.

b: Weld1 stop (WE1) — When the displacement weld stop (DISPLC) is set to the weld1 stop on the DISPLACEMENT screen and the displacement sensor arrives at the set displacement (f at the above figure), the weld1 stop is stopped to make the sequence move to the next cool time (CO1).

c: Weld2 stop (WE2) When the displacement weld stop (DISPLC) is set to the weld2 stop on the DISPLACEMENT screen and the displacement sensor arrives at the set displacement (g at the above figure), the weld2 stop is stopped to make the sequence move to the next cool time (CO2).

d: Weld3 stop (WE3) When the displacement weld stop (DISPLC) is set to the weld3 stop on the DISPLACEMENT screen and the displacement sensor arrives at the set displacement (h at the above figure), the weld3 stop is stopped to make the sequence move to HOLD.

e: Delay time When the delay time is set on the DISPLACEMENT screen, the displacement (i at the above figure) after the delay time elapses is measured.

(Notes)

- The displacement of work detection is set as 0 mm (reference point) at “j” (right before SQD).
- “k” at the end of work detection is set as 0 mm (reference point) of weld stop and the final displacement (0 mm for work detection and 0 mm for the final displacement monitor are different.)
- The displacement between “k” and “j” is the monitor displacement (WORK DETECT MONITOR) for work detection.
- The displacement between “j” and “i” is the monitored value of the final displacement (DISPLACEMENT MONITOR).

APPENDIX D
WIRE GAUGE SELECTION AND CIRCUIT BREAKER SETTING

Sizing Power Input Lines and Transformer Input Lines

Due to the many possible combinations of transformer ratios, total secondary resistance and weld voltages, all which have a direct relationship for cable sizing, this section assumes that the secondary current is at its maximum peak current during the weld.

Wire gauges for the AC Mains and Output lines to the transformer must meet the following criteria:

a. For the 480 VAC or 380 VAC, 3 phase lines, the voltage drop must be less than 5%. Note also, that if the input source drops by 1% then the cable allowance is reduced to 4% maximum. A table is provided that gives the maximum length for the gauge selected (calculation is linear). Ampacity must be equal to, or larger than the effective current based on NEC table 310-16.

b. For the Output lines to the transformer it is recommended that voltage loss does not exceed 1%. A table is provided that gives the maximum length for the gauge selected (calculation is linear). Ampacity must be larger than the effective current based on NEC table 310-16.

In general:

Size all cables for the maximum secondary current anticipated for your installation. Preferred would be at full capability of 100 amps at 100% duty cycle.

Minimize cable length as much as possible.

If in doubt use a larger gauge cable.

Use the minimum number of connections as possible.

Insure that all connections are tight.

Formulas used:

I_{EFF} = Output current times the square root of the duty cycle.

I_{PH} = Resultant (I_{EFF} x 0.817) current in each phase of the 3-phase input source.

Example:

Using the table below:

- If a 100 amp output current at 100% duty cycle is required, the I_{EFF} is 100 amps.
- For the Transformer lines: use a 3/0 cable with a maximum length of 80 feet.
- For the AC lines: use 1/0 cable with a maximum length of 282 feet.

PRIMARY CURRENT VS WELD DUTY CYCLE				CABLE TO OUTPUT TRANSFORMER		CABLE TO UNIT (480 VAC INPUT)	
Output Current	**Weld Duty Cycle (%)**	**I_{EFF}**	**I_{PH}**	**AWG @ I_{EFF} Amps**	**1% Drop (feet)**	**AWG @ I_{PH}**	**5% Drop (feet)**
*500	15	194	158	3/0	80	1/0	282
*400	24	196	160	3/0	80	1/0	282
*280	50	198	162	3/0	80	1/0	282
*200	100	200	163	3/0	80	1/0	282
150	100	150	123	1	40	2	170
100	100	100	82	3	25	4	110
50	100	50	41	8	8	8	45

* Maximum output current at rated duty cycle.

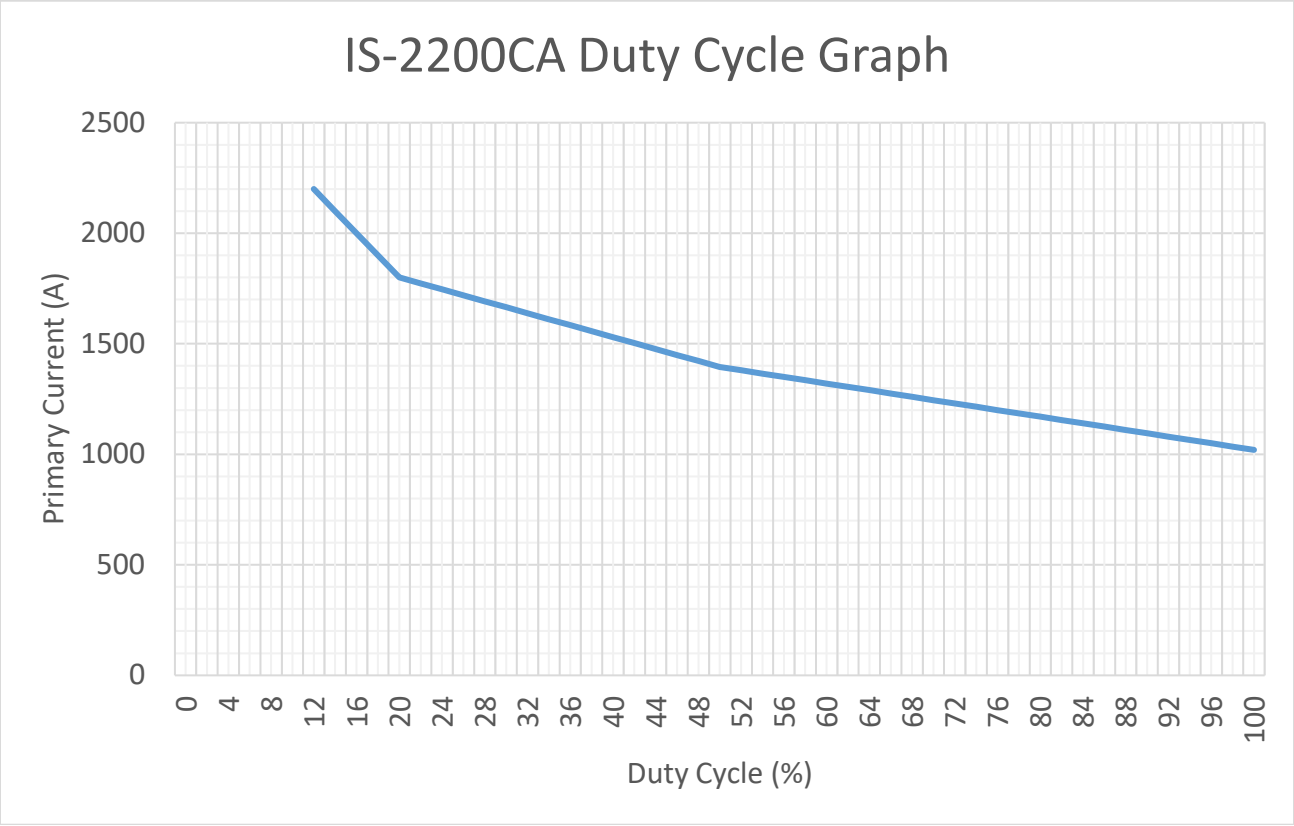
* Rated capacity at 25 °C.

NOTES:

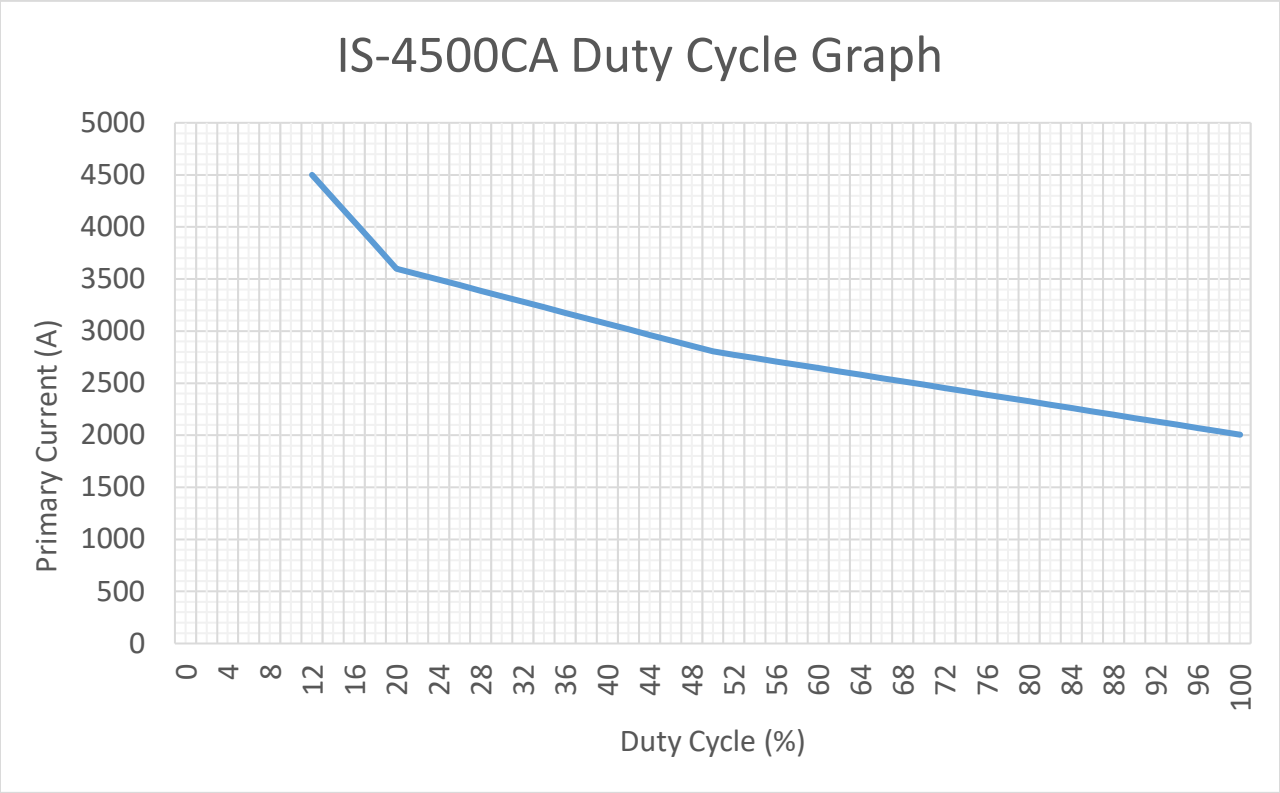
- For other output currents see the table on the next page.
- For other output currents at different duty cycles, apply the above formula to find the new I_{EFF}, the use the following table for cable sizes and maximum lengths.
- If I_{EFF} is not in the table, use the next higher current.

Duty Cycles

IS-2200CA



IS-4500CA


IS-4500CA Duty Cycle Graph
Primary Current (A)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92 96 100
Duty Cycle (%)

CABLE TO OUTPUT TRANSFORMER		
I_{EFF}	AWG @ I_{EFF} amps	1% drop (feet)
410	500 MCM	77
350	500 MCM	80
200	3/0	80
190	2/0	62
180	2/0	62
170	1/0	50
155	1/0	50
150	1	40
135	1	40
130	2	31
115	2	31
110	3	25
105 ⋮ 100	3 ⋮ 3	25 ⋮ 25
95	4	20
90	4	20
75	6	13
55	8	8

CABLE TO UNIT (480 VAC INPUT)		
I_{PH}	AWG @ I_{PH}	5% drop (feet)
335	300 MCM	380
286	300 MCM	449
163	1/0	282
155	1/0	282
147	1	211
139	1	211
127	2	170
123	2	170
110	3	135
106	3	135
94	4	110
90	4	110
86 ⋮ 82	4 ⋮ 4	110 ⋮ 110
78	4	110
74	6	70
61	6	70
45	8	45

Circuit Breaker Settings

The dipswitches referred to in his section are located on the ABB circuit breaker, ***not*** on the IS motherboard. The dipswitches are clearly labeled on the circuit breaker. Please refer to this manual if you need more information on the circuit breaker.

The circuit breaker has three adjustments:

ADJUSTMENT	TRIP FUNCTION	RANGE	INDIVIDUAL SETTINGS
L	Long time pick-up	0.4 - 1.0	0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 1.0 x I_n
t1	Long time delay	3.0 - 18 sec	A = 3, B = 6, C = 12, D = 18 seconds
I	Instantaneous trip	1.5 - 12.0	1.5, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0 x I_n

I_n = 800 Amps for IS-2200CA

I_n = 1,200 Amps for IS-4500CA

*See circuit breaker front panel for dipswitch settings.

Setting L

Calculate the breaker rated current using the Effective secondary current and duty cycle of the weld schedule.

$$\text{Circuit Breaker setting} = \text{Output Current} \times \sqrt{DC/100} \times 0.817$$

DC is the duty cycle of the weld schedule in percent.

Example: Output current is 500 amps @ a duty cycle of 15%.
Breaker should be set at 114 amps or more.
Set the L dipswitch to 125 amps (0.5) or 150 amps (0.6).

Example: Output current is 350 amps @ a duty cycle of 20%.
Breaker should be set at 128 amps or more.
Set the L dipswitch to 150 amps (0.6) or 175 amps (0.7).

Setting t1 Set to 3 seconds (A). This setting should require no further adjustment.

Setting I Set to 4.0 as the maximum peak current is 1000 amps.

NOTE: If circuit breaker nuisance trips, set L higher or set I to 6.

APPENDIX E
Communications

Section I. Description

Overview

The standard communication is RS-232C.
RS-485 is a hardware option (pendant needs to be set to RS-232C)

Remote Programming

Advanced users may wish to perform programming for custom welding applications. The codes needed to perform remote programming are listed in *Section II. External Communication Function*. Using these codes, users can write customized software for controlling all functions of the welding control and interfacing the unit to automation control systems.

Section II. External Communication Function

Introduction

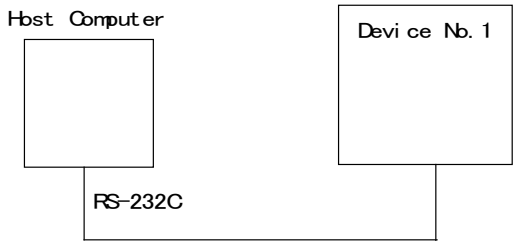
The **IS-2200CA/4500CA** can be used to set schedules from an externally-connected personal computer (abbreviated as PC) or to read monitored data and several kind of status data.

Data Transmission

ITEM	CONTENT
Transmission Mode	Select only one mode on the MODE SELECT screen: RS-232C (RS-485 requires factory installed RS-485 option) See *Chapter 3: Using Programming Functions, Section 10: Mode Select Screen, Sub-section S: Comm Mode*
Communication Control	Select either “one-way” (RS-232) or “Both-way” (RS-485) communication.
Transmission Rate	Select either of the followings at MODE SELECT screen: 9,600, 19,200, 38,400 bps See *Chapter 3: Using Programming Functions, Section 10: Mode Select Screen, Sub-section T: Comm Speed*
Data Format	Start bit: 1, Data bit: 8, Stop bit: 1, Parity bit: Even
Character Code	ASCII
Checksum Data	None
Connector	D-Sub 9 pins Pin Position RS-232C, 2: RXD, 3: TXD, 5: SG, 7: RTS (RS-485 requires factory installed RS-485 option)

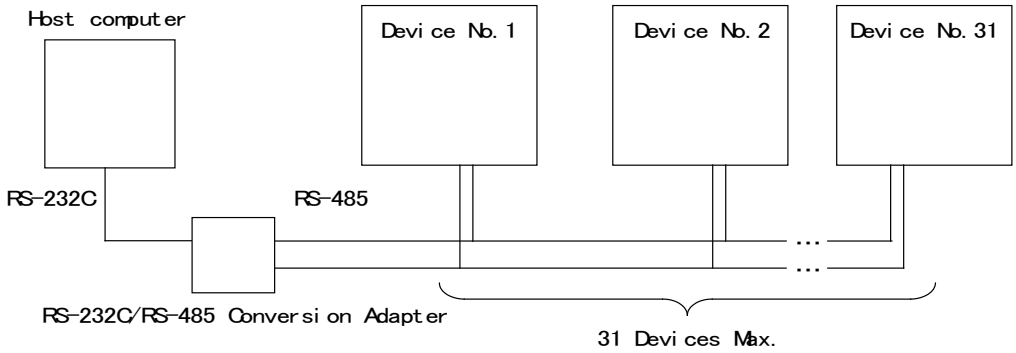
Configuration

① RS-232C



Only a device can be connected.

② RS-485



(Note 1) When controlling two or more devices with one host computer, register the device No. (**CONTROL#**) for each device. Set the device No. on the **POWER SUPPLY STATE Screen**, See *Chapter 3: Using Programming Functions, Section 2: Power Supply State Screen.*

(Note 2) Do not assign one number to more than one device. Do not send data simultaneously from two or more devices in the single-directional communication mode, otherwise, data collision and inappropriate system operations may result.

(Note 3) The RS-232C / RS-485 conversion adapter is not included in the accessories. The customer preferred adapter must be obtained at the point of installation.

Protocol

Single-directional Communication Mode
(When **-->** is selected at **COMM CONTROL** in **MODE SELECT Screen**)

1) Monitor Data

IS-2200CA / 4500CA BASIC Data strings:

```
!01 001 :m, 120,1.20, 0.50, 00.60,20.0, 200,2.00, 1.50, 03.00,40.0,300, 2.50,
 A   B  C    D   E     F      G     H     I    J     K     L     M    N    O
```

Continued on next line

```
2.00, 05.00,50.0,2, 0010,5,0100, 2222,555555[CR][LF]
  P     Q     R  S    T  U  V     W      X
```

IS-1200CA / 4500CA ADVANCED Data strings:

```
!01 001 :m, 120,01.20,0.50, 00.60,20.0, 200,02.00,1.50, 03.00,40.0,300, 02.50,
 A   B  C    D   E     F      G     H     I    J     K     L     M    N    O
```

Continued on next line

```
2.00, 05.00,50.0,2, 0010,5,0100, 1, 0000,1,0000, 01, 100,0100,2222,555555,
  P     Q     R  S    T  U  V    W   X   Y   Z   AA   AB  AC   AD    AE
```

Continued on next line

```
05000, 05000, 05000, 05000, 05000, 05000, +00.100, +01.120, [CR][LF]
  AF     AG     AH     AI     AJ     AK      AL       AM
```

A	Device No.	Fixed to 2 digits (01 to 31)
B	Schedule No.	Fixed to 3 digits (001 to 255)
C	Unit of monitor time	m: ms C: CYC
D	Monitor time of WE1	Fixed to 3 digits (000 to 999) (ms) Fixed to 3 digits (000 to 050) (CYC)
E	Monitor current of WE1	Fixed to 4 digits (0.00 to 9.99) (kA) Fixed to 4 digits (00.0 to 99.9) (kA)
F	Monitor voltage of WE1	Fixed to 4 digits (0.00 to 9.99) (V)
G	Monitor power of WE1	Fixed to 5 digits (00.00 to 09.99) (kW) Fixed to 5 digits (000.0 to 999.9) (kW)
H	Monitor pulse width of WE1	Fixed to 4 digits (10.0 to 99.9) (%)
I	Monitor time of WE2	Fixed to 3 digits (000 to 999) (ms) Fixed to 3 digits (000 to 050) (CYC)
J	Monitor current of WE2	Fixed to 4 digits (0.00 to 9.99) (kA) Fixed to 4 digits (00.0 to 99.9) (kA)
K	Monitor voltage of WE2	Fixed to 4 digits (0.00 to 9.99) (V)
L	Monitor power of WE2	Fixed to 5 digits (00.00 to 09.99) (kW) Fixed to 5 digits (000.0 to 999.9) (kW)
M	Monitor pulse width of WE2	Fixed to 4 digits (10.0 to 99.9) (%)
N	Monitor time of WE3	Fixed to 3 digits (000 to 999) (ms) Fixed to 3 digits (000 to 050) (CYC)
O	Monitor current of WE3	Fixed to 4 digits (0.00 to 9.99) (kA) Fixed to 4 digits (00.0 to 99.9) (kA)

P	Monitor voltage of WE3	Fixed to 4 digits (0.00 to 9.99) (V)
Q	Monitor power of WE3	Fixed to 5 digits (00.00 to 09.99) (kW) Fixed to 5 digits (000.0 to 999.9) (kW)
R	Monitor pulse width of WE3	Fixed to 4 digits (10.0 to 99.9) (%)
S	STEP No. of VALVE1	Fixed to 1 digit (1 to 9)
T	STEP COUNT of VALVE1	Fixed to 4 digits (0000 to 9999)
U	STEP No. of VALVE2	Fixed to 1 digit (1 to 9)
V	STEP COUNT of VALVE2	Fixed to 4 digits (0000 to 9999)
W	COUNTER (WELD/WELD COUNT of WORK)	Fixed to 4 digits (0000 to 9999)
X	COUNTER (WORK of TOTAL/GOOD/WORK)	Fixed to 6 digits (000000 to 999999)
Y	STEP No. of VALVE4	Fixed to 1 digit (1 to 9)
Z	STEP COUNT of VALVE4	Fixed to 4 digits (0000 to 9999)
AA	STEP2 REPEAT	Fixed to 2 digits (01 to 99)
AB	STEP RATIO	Fixed to 3 digits (050 to 200)
AC	CAP CHANGE	Fixed to 4 digits (0000 to 9999)
AD	COUNTER (WELD/WELD COUNT of WORK)	Fixed to 4 digits (0000 to 9999)
AE	COUNTER (WORK of TOTAL/GOOD/WORK)	Fixed to 6 digits (000000 to 999999)
AF	FORCE of SQD	Fixed to 5 digits [00000 to 35000 (N), 00000 to 03569 (kgf), and 00000 to 07868 (lbf)]
AG	FORCE of SQZ	
AH	FORCE of WELD1	
AI	FORCE of COOL1/WELD1	
AJ	FORCE of COOL2/WELD3	
AK	FORCE of HOLD	
AL	WORK DETECT	Fixed to 7 digits (-99.999 to +99.999 (mm))
AM	DISPLACEMENT	

2) Error Data

IS-2200CA/4500CA Data strings:

!01 000:E03,04,12,15,17,19, 22, 26[CR][LF]
A B C D E F G H I J

A	Device No.	Fixed to 2 digits (01 to 31)
B	Schedule No.	Fixed to 3 digits (001 to 255)
C*1	Error code 1	Fixed to 3 digits (E01 to E39)
D*1	Error code 2	Fixed to 2 digits (01 to 39)
E*1	Error code 3	Fixed to 2 digits (01 to 39)
F*1	Error code 4	Fixed to 2 digits (01 to 39)
G*1	Error code 5	Fixed to 2 digits (01 to 39)
H*1	Error code 6	Fixed to 2 digits (01 to 39)
I*1	Error code 7	Fixed to 2 digits (01 to 39)
J*1	Error code 8	Fixed to 2 digits (01 to 39)

*1 The maximum number of Error Codes is 8. In the case of only one error code, errors D through J are omitted.
For Error Codes, see *Chapter 5: Maintenance*, *Section I: Troubleshooting*

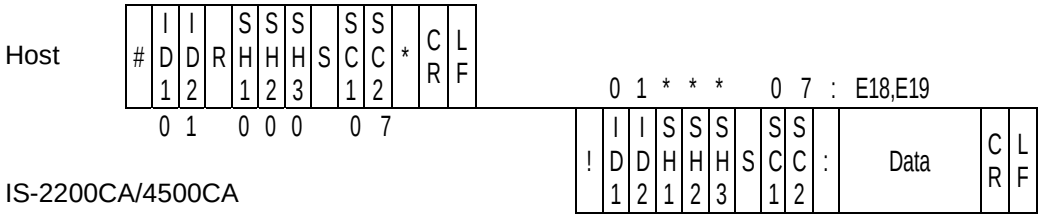
*2 Error codes are transmitted when errors are detected.
For the monitored value error and counter error, however, the error is transmitted after the monitored data is transmitted.

3) Bi-directional Communication Mode

(When <--> is selected at **COMM CONTROL** in **MODE SELECT Screen**)

Reading of Trouble	Code: # Device No. R Schedule No. Screen No. *

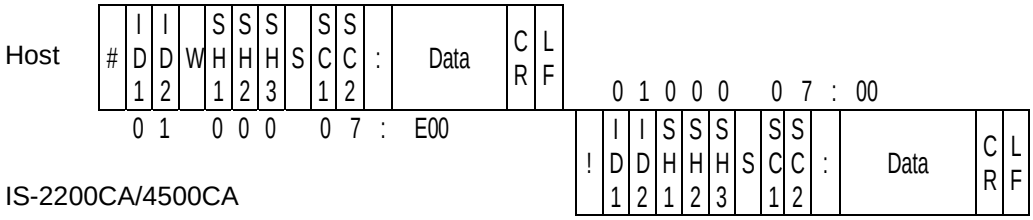
Example: Read all troubled data in the specified device, No. 01. (Schedule No. is "008" and Voltage error and Electric power error are occurring.)



1) Schedule numbers, SH1, SH2 and SH3 are fixed to 000.
   However, schedule numbers are sent from the Power Supply when "E06: Current error", "E18: Voltage error", "E19: Electric power error" and "E07: Pulse width error" occurs.
2) Screen numbers, SC1 and SC2 are fixed to 07.
3) If there is no error, data of "00" returned.

Error Reset	Code: # Device No. W Schedule No. Screen No. Data

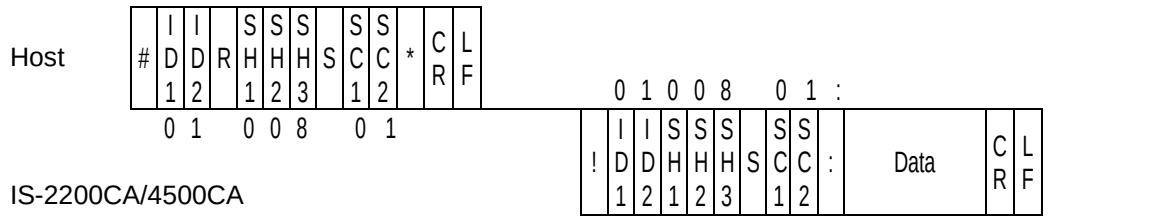
Example: Resets the trouble of the specified device, No. 01.



1) Schedule Nos, SH1, SH2 and SH3 are fixed to 000.
2) Screen Nos, SC1 and SC2 are fixed to 07.
3) "00" (no trouble) is returned as a confirmation data

Reading of Data	Code: # Device No. Screen No. R Schedule No. *

Example: Read all data of Screen No. "01" of Schedule No. "008" of the specified device No. 01.



Insert [,] between data for a schedule.

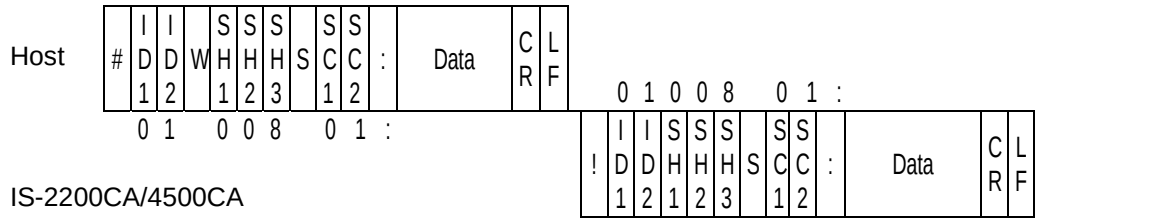
1) SH1, SH2 and SH3 are schedule numbers.
   Fixed to 3 digits (SH1=Hundred's place, SH2=Ten's place, SH3=One's place)
   However, screen 03, 05 and 07 are fixed to the schedule No. 000.

2) SC1 and SC2 are screen numbers.
   Fixed to 2 digits (SC1=Ten's place, SC2=One's place)

3) For the data order for a schedule of each screen No., see the **Data Code List** below.

Setting of Data	Code: # Device No. W Schedule No. Screen No. Data

Example: Write data for a schedule of Screen No "01" of Schedule No. "008" of the specified device No. 01.



Insert [,] between data for a schedule.

1) SH1, SH2 and SH3 are schedule numbers.
   Fixed to 3 digits (SH1=Hundred's place, SH2=Ten's place, SH3=One's place)
   However, screen 03, 05 and 07 are fixed to 000 of schedule No.

2) SC1 and SC2 are screen numbers.
   Fixed to 2 digits (SC1=Ten's place, SC2=One's place)
   (Note) Screen 04 and 07 (1) are read only and cannot be written.

3) For the data order for a schedule and the screen No., see the **Data Code List** below.

4) The set data is returned as a confirmation data. When data which is outside the range is set, previous data is returned.

5) It takes about 1 second at most to save data into the internal memory (READY is turned off during saving). Be careful when writing continuously.

Data Code Table

Screen 01 (SCHEDULE data) Specific data in accordance with Schedule No. (001 to 255)

Example of data writing:
#01W001S01:0,0,0,m,0000,0000,000,000,000,0000,000,000,000,0000,000,000,000,00000,0000,1,00.50,00.50,00.50,00.50,00.50,00.50,00.50,00.50,01,000,01,000,01,000,1000,01,1,001.0,0,000,99.9,99.9,99.9,010,1[CR][LF]

Item	Contents	Character String	Range
1	Control mode of WELD1	n,	0: Primary constant-current effective value control 1: Secondary constant-current effective value control 2: Secondary constant-power effective value control 3: Primary constant-current peak value control 4: Secondary constant-voltage effective value control 5: Constant-phase control
2	Control mode of WELD2	n,	
3	Control mode of WELD3	n,	
4	Unit of time *1	n,	m: ms C: CYC
5	SQD / Squeeze delay time	nnnn,	0000 to 9999 (ms mode) 0000 to 0999 (CYC mode)
6	SQZ/ Squeeze time	nnnn,	0000 to 9999 (ms mode) 0000 to 0999 (CYC mode)
7	UP1 / Upslope 1 time	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
8	WELD1 / Weld 1 time	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
9	DOWN1 / Downslope 1 time	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
10	COOL1 / Cooling 1 time	nnnn,	0000 to 9999(ms mode) 0000 to 0999(CYC mode)
11	UP2 / Upslope 2 time	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
12	WELD2 / Weld 2 time	nnn,	000 to 999(ms mode) 000 to 050 (CYC mode)
13	DOWN2 / Downslope 2 time	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
14	COOL2 / Cooling 2 time	nnnn,	0000 to 9999 (ms mode) 0000 to 0999 (CYC mode)
15	UP3 / Upslope 3 time	nnn,	000 to 999(ms mode) 000 to 050 (CYC mode)
16	WELD3 / Weld 3 time	nnn,	000 to 999(ms mode) 000 to 050 (CYC mode)
17	DOWN3 / Downslope 3 time	nnn,	000 to 999(ms mode) 000 to 050 (CYC mode)
18	HOLD / Hold time	nnnnn,	00000 to 20000 (ms mode) 00000 to 00999 (CYC mode)
19	OFF / Off time	nnnn,	0000 to 9990 (ms mode) 0000 to 0099 (CYC mode)

Item	Contents	Character String	Range
20	CURR RANGE / Current range	n,	0: 05 1: 10 2: 20 3: 40 4: 80 (kA)
21	UF1 / Initial heat 1 of upslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
22	HEAT1 / Heat 1	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
23	DL1 / End heat 1 of downslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
24	UF2 / Initial heat 2 of upslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
25	HEAT2 / Heat 2	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
26	DL2 / End heat 2 of downslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)

Item	Contents	Character String	Range
27	UF3 / Initial heat 3 of upslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
28	HEAT3 / Heat 3	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
29	DL3 / End heat 3 of downslope	nnn.n,	004.0 to 120.0 (kW)
		nn.n,	04.0 to 80.0 (kA) 02.0 to 40.0 (kA) 04.0 to 60.0 (kW) 01.0 to 20.0 (kA, kW) 10.0 to 99.9 (%)
		n.nn,	0.50 to 9.99 / 0.05 to 5.00 (kA, kW) 0.20 to 9.99 (V)
30	PULSATION of WE1 / WE1 repetition	nn,	00 to 19
31	INT1 / Interval 1	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
32	PULSATION of WE2 / WE2 repetition	nn,	00 to 19
33	INT2 / Interval 2	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
34	PULSATION of WE3 / WE3 repetition	nn,	00 to 19
35	INT3 / Interval 3	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
36	WELD TRANS FREQ / Welding transformer frequency	nnnn,	0600 to 1,000 (Hz) Note: The last 2 digits are fixed to 00.
37	GAIN	nn,	1 to 9
38	VALVE	n,	1 to 2
39	TURN RATIO	nnn.n,	001.0 to 199.9
40	WELD ON/OF	n,	0: OFF 1: ON
41	VOLT COMP	nnn,	Fixed to 3 digits (000 to 100) (%)
42	PULSE LIM of WE1	nn.n,	Fixed to 4 digits (10.0 to 99.9) (%)
43	PULSE LIM of WE2	nn.n,	Fixed to 4 digits (10.0 to 99.9) (%)
44	PULSE LIM of WE3	nn.n	Fixed to 4 digits (10.0 to 99.9) (%)
45	MAX CURRENT	nnn,	005 to 80 (kA)
46	TRANS#	n	1

*1 The setting of ms/CYC cannot be changed. You can change it via Screen 05 (SYSTEM data).

Screen 02 (MONITOR SET data) Specific data in accordance with Schedule No. (001 to 255)

Example: #01W001S02:999,000,99.99,00.00,9.99,0.00,99.99,00.00,100.0,999,000,99.99,00.00,9.99, 0.00,99.99,00.00,100.0,999,000,99.99,00.00,9.99,0.00,99.99,00.00,100.0[CR][LF]

Item	Contents	Character String	Range
1	TIME H of WE1 (upper limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
2	TIME L of WE1 (lower limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
3	CURRENT H of WE1 (upper limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
4	CURRENT L of WE1 (lower limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
5	VOLT H of WE1 (upper limit)	n.nn,	0.00 to 9.99 (V)
6	VOLT L of WE1 (lower limit)	n.nn,	0.00 to 9.99 (V)
7	POWER H of WE1 (upper limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
8	POWER L of WE1 (lower limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
9	PULSE H of WE1 (upper limit)	nnn.n,	010 to 100 (%)
10	TIME H of WE2 (upper limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
11	TIME L of WE2 (lower limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
12	CURRENT H of WE2 (upper limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
13	CURRENT L of WE2 (lower limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
14	VOLT H of WE2 (upper limit)	n.nn,	0.00 to 9.99 (V)
15	VOLT L of WE2 (lower limit)	n.nn,	0.00 to 9.99 (V)
16	POWER H of WE2 (upper limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
17	POWER L of WE2 (lower limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
18	PULSE H of WE2 (upper limit)	nnn.n,	010 to 100 (%)
19	TIME H of WE3 (upper limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
20	TIME L of WE3 (lower limit)	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
21	CURRENT H of WE3 (upper limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
22	CURRENT L of WE3 (lower limit)	n.nn,	0.00 to 9.99 (kA)
		nn.n,	00.0 to 99.9 (kA)
23	VOLT H of WE3 (upper limit)	n.nn,	0.00 to 9.99 (V)
24	VOLT L of WE3 (lower limit)	n.nn,	0.00 to 9.99 (V)
25	POWER H of WE3 (upper limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
26	POWER L of WE3 (lower limit)	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
27	PULSE H of WE3 (upper limit)	nnn.n	010 to 100 (%)

Screen 03 (STEPPER data) Common data (Valve No.: 001 to 004)

Example of data writing:
#01W001S03:1,0000,0,0000,100,0,0000,100,0,0000,100,0,0000,100,0,0000,100,0,0000,100,0,0000,100,0,0000,100,0,01,0000[CR][LF]

Item	Contents	Character String	Range
1	START ON STEP #	n,	1 to 9
2	COUNT of STEP1	nnnn,	0000 to 9999
3	TIP DRESS of STEP1	n,	0: OFF 1: ON(X)
4	COUNT of STEP2	nnnn,	0000 to 9999
5	RATIO of STEP2	nnn,	050 to 200(%)
6	TIP DRESS of STEP2	n,	0: OFF 1: ON(X)
7	COUNT of STEP3	nnnn,	0000 to 9999
8	RATIO of STEP3	nnn,	050 to 200(%)
9	TIP DRESS of STEP3	n,	0: OFF 1: ON(X)
10	COUNT of STEP4	nnnn,	0000 to 9999
11	RATIO of STEP4	nnn,	050 to 200(%)
12	TIP DRESS of STEP4	n,	0: OFF 1: ON(X)
13	COUNT of STEP5	nnnn,	0000 to 9999
14	RATIO of STEP5	nnn,	050 to 200(%)
15	TIP DRESS of STEP5	n,	0: OFF 1: ON(X)
16	COUNT of STEP6	nnnn,	0000 to 9999
17	RATIO of STEP6	nnn,	050 to 200(%)
18	TIP DRESS of STEP6	n,	0: OFF 1: ON(X)
19	COUNT of STEP7	nnnn,	0000 to 9999
20	RATIO of STEP7	nnn,	050 to 200(%)
21	TIP DRESS of STEP7	n,	0: OFF 1: ON(X)
22	COUNT of STEP8	nnnn,	0000 to 9999
23	RATIO of STEP8	nnn,	050 to 200(%)
24	TIP DRESS of STEP8	n,	0: OFF 1: ON(X)
25	COUNT of STEP9	nnnn,	0000 to 9999
26	RATIO of STEP9	nnn,	050 to 200(%)
27	TIP DRESS of STEP9	n,	0: OFF 1: ON(X)
28	STEP2 REPEAT	nn,	01 to 99
29	CAP CHANGE	nnnn	0000 to 9999

Screen 04 (MONITOR data) (Data reading only) Specific data in accordance with Schedule No. (Schedule No.: 001 to 255)

Item	Contents	Character String	Range
1	Unit of time	n,	m: ms C: CYC
2	TIME of WELD1	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
3	CURRENT of WELD1	nn.nn,	00.00 to 9.999 (kA)
		nnn.n,	000.0 to 999.9 (kA)
4	VOLT of WELD1	n.nn,	0.00 to 9.99 (V)
5	POWER of WELD1	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
6	PULSE of WELD1	nn.n,	00.0 to 99.9 (%)
7	TIME of WELD2	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
8	CURRENT of WELD2	nn.nn,	00.00 to 9.999 (kA)
		nnn.n,	000.0 to 999.9 (kA)
9	VOLT of WELD2	n.nn,	0.00 to 9.99 (V)
10	POWER of WELD2	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
11	PULSE of WELD2	nn.n,	00.0 to 99.9 (%)
12	TIME of WELD3	nnn,	000 to 999 (ms mode) 000 to 050 (CYC mode)
13	CURRENT of WELD3	nn.nn,	00.00 to 9.999 (kA)
		nnn.n,	000.0 to 999.9 (kA)
14	VOLT of WELD3	n.nn,	0.00 to 9.99 (V)
15	POWER of WELD3	nn.nn,	00.00 to 99.99 (kW)
		nnn.n,	000.0 to 999.9 (kW)
16	PULSE of WELD3	nn.n,	00.0 to 99.9 (%)
17	STEP # of VALVE1	n,	1 to 9
18	STEPPER COUNT of VALVE1	nnnn,	0000 to 9999
19	STEP # of VALVE2	n,	1 to 9
20	STEPPER COUNT of VALVE2	nnnn,	0000 to 9999
21	STEP # of VALVE3	n,	1 to 9
22	STEPPER COUNT of VALVE3	nnnn,	0000 to 9999
23	STEP # of VALVE4	n,	1 to 9
24	STEPPER COUNT of VALVE4	nnnn,	0000 to 9999
25	STEP2 REPAT	nn,	01 to 99
26	STEP RATIO	nnn,	050 to 200(%)
27	CAP CHANGE	nnnn,	0000 to 9999
28	COUNTER (WELD/WELD COUNT of WORK)	nnnn,	0000 to 9999
29	COUNTER (WORK of TOTAL/GOOD/WORK)	nnnnnn	000000 to 999999
30	SQD FORCE	nnnnn,	00000 to 35000(N) 00000 to 03569(kgf) 00000 to 07868(lbf)
31	SQZ FORCE	nnnnn,	
32	WE1 FORCE	nnnnn,	
33	COOL1/WELD1 FORCE	nnnnn,	
34	COOL2/WELD3 FORCE	nnnnn,	
35	HOLD FORCE	nnnnn,	
36	WORK DETECT	+nn.nnn, -nn.nnn,	-99.999 to +99.999(mm)
37	DISPLACEMENT	+nn.nnn, -nn.nnn,	

Screen 05 (PRE-CHECK data) Specific data in accordance with Schedule No. (001 to 255)

Item	Contents	Character String	Range
1	PRECHECK TIME	nnn,	000 to 100 (ms)
2	PRECHECK HEAT	nn.n,	10.0 to 99.9 (%)
3	PRECHECK RESISTANCE HIGH	nn.nn,	00.00 to 99.99 (mΩ)
4	PRECHECK RESISTANCE LOW	nn.nn,	00.00 to 99.99 (mΩ)
5*1	PRECHECK MONITOR	nn.nn	00.00 to 99.99 (mΩ)

*1 Items inhibited from setting (When setting data, omit these items.)

Screen 06 (SYSTEM data) Common data (Schedule No.: 000)

Example of data writing:
#01W000S06:20,0,200,0,0,0,0,0,0,0,0,0,0,000000,0000,000000,0000,50,0.00,0.00,15,0,000,000,000,0,1,1,1,1,1,0,0,0,1,2014,02,27,0,0,0,0,1,2,3,4,1.0[CR][LF]

Item	Contents	Character String	Range
1*1	POWER SOURCE FREQUENCY	nn,	50 or 60 (Hz)
2*1	Model name	nnnnnnnn,	IS-2200CA or IS-4500CA
3*1	ROM VERSION	Vnn-nnn,	V00-00A to
4	DELAY START SET	nn,	01 to 20 (ms)
5	START SIGNAL MODE	n,	0: LATCHED 1: PULSED 2: MAINTAINED
6	END SIGNAL TIME	nnn,	000, 010 to 200 (ms)
7	END SIGNAL MODE	n,	0, 1, 2
8	WELD1 STOP/PARITY CHECK	n,	0: WELD1 STOP 1: PARITY CHECK
9	WELD2 STOP/WELD COUNT	n,	0: WELD2 STOP 1: WELD COUNT
10	WELD3 STOP/COUNT RESET	n,	0: WELD3 STOP 1: COUNT RESET
11	WELD TIME	n,	0: ms 1: CYC
12	RE-WELD	n,	0: OFF 1: ON
13	SCHEDULE	n,	0: EXT 1: INT
14	STEPPER MODE	n,	0: OFF 1: FIXED 2: LINER
15	COUNTER	n,	0: TOTAL 1: GOOD 2: WORK
16	COMM CONTROL	n,	0: OFF 1: ---> 2: <--->
17	COMM SPEED	n,	0: 9.6k 1: 19.2k 2: 38.4k
18	COMM MODE	n,	0: RS-485 1: RS-232C
19	MONI DISP MODE	n,	0: NORMAL 1: LAST
20	PRESET COUNT	n,	0: TOTAL/GOOD 1: WELD/WORK
21	TOTAL/GOOD of PRESET COUNT	nnnnnn,	000000 to 999999
22	WELD of WELD/WORK, PRESET COUNT	nnnn,	0000 to 9999

Item	Contents	Character String	Range
23	WORK of WELD/WORK, PRESET COUNT	nnnnnn,	000000 to 999999
24	NO CURRENT TIME	nn,	01 to 99 (ms)
25	NO CURRENT LEVEL	n.nn,	0.00 to 9.99 (kA)
26	NO VOLTAGE LEVEL	n.nn,	0.00 to 9.99 (V)
27	MONITOR FIRST TIME	nn,	00 to 15 (ms)
28	MONITOR SLOPE MODE	n,	0: EXCLUDE 1: INCLUDE
29	WELD STOP OFF TIME of WELD1	nnn,	000 to 999(ms)
30	WELD STOP OFF TIME of WELD2	nnn,	000 to 999(ms)
31	WELD STOP OFF TIME of WELD3	nnn,	000 to 999(ms)
32	OUTPUT MODE of NG SIGNAL SELECT	n,	0:N.C. 1:N.O.
33	TIME-OVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
34	CURR-OVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
35	VOLT-OVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
36	POWER-OVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
37	PULSE-OVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
38	NO CURR of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
39	WRK ERR of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
40	WORK OVER of NG SIGNAL SELECT	N,	0: ERROR 1: CAUTION
41	DISPLOVER of NG SIGNAL SELECT	n,	0: ERROR 1: CAUTION
42*1	PROGRAM PROTECT	n	0: OFF 1: ON
43*1	CONTRAST	n,	0 to 9
44*1	CONTROL#	nn,	01 to 31
45	PROGRAMD DATE YEAR	nnnn,	2000 to 2099
46	PROGRAMD DATE MONTH	nn,	01 to 12
47	PROGRAMD DATE DAY	nn,	01 to 31
48	LANGUAGE	n,	0: ENGLISH 1: JAPANESE
49	FLOW SWITCH/PRG PROTECT	n,	0: FLOW SWITCH 1: PRG PROTECT
50	VALVEMODE	n,	0: 1 VALVE 1: 2 VALVE
51	SCANMODE	n,	0: OFF
52	OUTPUT1	n,	0: END 1: COUNTERROR 2: READY 3: STEPEND 4: WELDSIGNAL
53	OUTPUT2	n,	
54	OUTPUT3	n,	
55	OUTPUT4	n,	

Item	Contents	Character String	Range
56	OUTPUT5	n,	5: GOOD 6: COUNTUP 7: OUTI 8: OUTII
57	DISPL SENSOR STEP	n.n	0.5 to 5.0 (um)

*1 Items inhibited from setting (When setting data, omit these items.)
“,” is not transmitted, too.

Screen 07 (Error data) Common data (Schedule No.: 000)

- Error data confirmation (Data reading only)

Item	Contents	Character String	Range
1	Error code 1	nnn,	E01 to E39
2	Error code 2	nn,	01 to 39
3	Error code 3	nn,	01 to 39
4	Error code 4	nn,	01 to 39
5	Error code 5	nn,	01 to 39
6	Error code 6	nn,	01 to 39
7	Error code 7	nn,	01 to 39
8	Error code 8	nn	01 to 39

The number of error codes is of eight max. In the case of only one error code, the items 2 to 8 are omitted. For error codes, see *Chapter 5: Maintenance, Section I: Troubleshooting*.

- Error reset (Data setting only)

Item	Contents	Character String	Range
1	Error reset	nnn	E00

Screen 08 FORCE SETUP screen Specific data in accordance with Schedule No. (001 to 255)

Example of data writing:
#01W001S08:1,02000,02100,02200,02300,02400,02500,1,0,0,00000,0[CR][LF]

Item	Contents	Character String	Range
1*1	STEP MODE	n,	0: OFF 1: ON
2	PROPVALVE#	n,	1 to 2
3	SQD FORCE	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
4	SQZ FORCE	nnnnn,	
5	WELD1 FORCE	nnnnn,	
6	COOL1/WELD2 FORCE	nnnnn,	

7	COOL2/WELD3 FORCE	nnnnn,	
8	HOLD FORCE	nnnnn,	
9*1	VALVE#	n,	1 to 4
10	FORGE VALVE#	n,	1 to 2
11	CHAINING	n,	0: OFF 1: ON
12	SUCCESSIVE	n,	0: OFF 1: ON
13	FORGE DELAY	nnnnn,	00000 to 30000 (ms)
14	FORGE MODE	n	0: OFF 1: ON

*1 Items inhibited from setting (When setting data, omit these items.)
“,” is not transmitted, too.

Screen 09 DISPLACEMENT screen Specific data in accordance with Schedule No. (001 to 255)

Example of data writing:
#01W001S09:0,0,0,0000000,0000000,0000000,+00.000,+00.000,+00.000,+00.000,000[CR][LF]

Item	Contents	Character String	Range
1	WELD1STOP INPUT	n,	0: OFF 1: DISPLC 2: CURR 3: VOLT 4: POWER 5: PULSE
2	WELD2STOP INPUT	n,	
3	WELD3STOP INPUT	n,	
4	WELD1CONDITION	nnnnnnn, +nn.nnn, -nn.nnn, nnnn.nn, nnnnn.n,	WELD STOP INPUT: OFF 0000000 WELD STOP INPUT: DISPLC -99.999 to +99.999(mm) WELD STOP INPUT: CURR 0000.05 to 0005.00(kA) 5kA range 0000.50 to 0009.99(kA) 10kA range 00001.0 to 00020.0(kA) 20kA range 00002.0 to 00040.0(kA) 40kA range 00004.0 to 00080.0(kA) 80kA range*1 WELD STOP INPUT: VOLT 0000.20 to 0009.99(V) WELD STOP INPUT: POWER 0000.05 to 0005.00(kW) 5kA range 0000.50 to 0009.99(kW) 10kA range 00001.0 to 00020.0(kW) 20kA range 00002.0 to 00060.0(kW) 40kA range 00004.0 to 00120.0(kW) 80kA range*1 WELD STOP INPUT: PULSE 00010.0 to 00099.9(%)
5	WELD2CONDITION	nnnnnnn, +nn.nnn, -nn.nnn, nnnn.nn, nnnnn.n,	
6	WELD3CONDITION	nnnnnnn, +nn.nnn, -nn.nnn, nnnn.nn, nnnnn.n,	
7	WORKDETECTLIMIT HIGH	+nn.nnn, -nn.nnn,	-99.999 to +99.999 (mm)
8	WORKDETECTLIMIT LOW	+nn.nnn, -nn.nnn,	-99.999 to +99.999 (mm)
9	DISPLACEMENT LIMIT HIGH	+nn.nnn, -nn.nnn,	-99.999 to +99.999 (mm)
10	DISPLACEMENT LIMIT HIGH	+nn.nnn, -nn.nnn,	-99.999 to +99.999 (mm)
11	DISPLACEMENT DELAY TIME	nnn	000 to 999 (ms)

Screen 10 PRESSURE REGULATOR screen Common data (Schedule No.: 000)

Example of data writing:
#01W000S10:1,0,0,200.0,0.40,00000,00000,00000,000.0,0.00,00000,00000,00000[CR][LF]

Item	Contents	Character String	Range
1	FORCE CONTROL MODE	n,	1 to 4
2	FORCE UNIT	n,	0: N 1: kgf 2: lbf
3	AIR PRESSURE UNIT	n,	0: Mpa 1: bar 2: psi
4	AIR CYLINDER DIAMETER of VALVE1	nnn.n,	000.0 to 500.0 (mm)
5	MAX AIR PRESSURE of VALVE1	n.nn, nn.n, nnnn,	0.00 to 1.00 (Mpa) 00.0 to 10.0 (bar) 0000 to 0145 (psi)
6*1	MAXFORCE of VALVE1	nnnnn,	00000 to 99999 (N) 00000 to 99999 (kgf) 00000 to 99999 (lbf)
7*1	CONSTANT FORCE UP/DW of VALVE1	n,	0: UP 1: DOWN
8	CONSTANT FORCE of VALVE1	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
9*1	CONSTANT LOW UP/DW of VALVE1	n,	0: UP 1: DOWN
10	CONSTANT LOW of VALVE1	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
11*1	CONSTANT HIGH UP/DW of VALVE1	n,	0: UP 1: DOWN
12	CONSTANT HIGH of VALVE1	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
13	AIR CYLINDER DIAMETER of VALVE2	nnn.n,	000.0 to 500.0 (mm)
14	MAX AIR PRESSURE of VALVE2	n,nn, nn.n, nnnn,	0.00 to 1.00 (Mpa) 00.0 to 10.0 (bar) 0000 to 0145 (psi)
15*1	MAX FORCE of VALVE2	nnnnn,	00000 to 99999 (N) 00000 to 99999 (kgf) 00000 to 99999 (lbf)
16*1	CONSTANT FORCE UP/DW of VALVE2	n,	0: UP 1: DOWN
17	CONSTANT FORCE of VALVE2	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
18*1	CONSTANT LOW UP/DW of VALVE2	n,	0: UP 1: DOWN
19	CONSTANT LOW of VALVE2	nnnnn,	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)
20*1	CONSTANT HIGH UP/DW of VALVE2	n,	0: UP 1: DOWN
21	CONSTANT HIGH of VALVE2	nnnnn	00000 to 35000 (N) 00000 to 03569 (kgf) 00000 to 07868 (lbf)

*1 Items inhibited from setting (When setting data, omit these items.) “,” is not transmitted, too.

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