Copyright © 2013 - 2017 Amada Miyachi America

The engineering designs, drawings and data contained herein are the proprietary work of Amada Miyachi America and may not be reproduced, copied, exhibited or otherwise used without the written authorization of Amada Miyachi America.

Printed in the United States of America.

Revision Record

<table>
<thead>
<tr>
<th>Revision</th>
<th>EO</th>
<th>Date</th>
<th>Basis of Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>42477</td>
<td>02/13</td>
<td>None. Original edition.</td>
</tr>
<tr>
<td>B</td>
<td>42665</td>
<td>06/13</td>
<td>Updated technical information.</td>
</tr>
<tr>
<td>C</td>
<td>42736</td>
<td>08/13</td>
<td>Updated Repetition rates.</td>
</tr>
<tr>
<td>D</td>
<td>42903</td>
<td>10/13</td>
<td>Updated technical information.</td>
</tr>
<tr>
<td>E</td>
<td>42953</td>
<td>11/13</td>
<td>Updated to Miyachi America name and logo.</td>
</tr>
<tr>
<td>F</td>
<td>43199</td>
<td>05/14</td>
<td>Updated technical information.</td>
</tr>
<tr>
<td>G</td>
<td>43228</td>
<td>05/14</td>
<td>Updated technical information.</td>
</tr>
<tr>
<td>H</td>
<td>43482</td>
<td>12/14</td>
<td>Updated to Amada Miyachi America name and logo.</td>
</tr>
<tr>
<td>J</td>
<td>43838</td>
<td>08/15</td>
<td>Updated to Amanda Miyachi America format.</td>
</tr>
<tr>
<td>K</td>
<td>44031</td>
<td>01/16</td>
<td>Added UB29A</td>
</tr>
<tr>
<td>L</td>
<td>44137</td>
<td>03/16</td>
<td>Updated UB29A specifications</td>
</tr>
<tr>
<td>M</td>
<td>44362</td>
<td>08/16</td>
<td>Updated UB29A specifications</td>
</tr>
<tr>
<td>N</td>
<td>44640</td>
<td>05/17</td>
<td>See ECO for detailed changes</td>
</tr>
</tbody>
</table>
## CONTENTS

| Revision Record                                                                 | ii          |
| Contact Us                                                                       | viii        |
| Safety Notes                                                                     | ix          |
| Declaration of Conformity                                                         | xv          |
| Warranty                                                                         | xvii        |

### Chapter 1. Description

| Section I: Introduction                                                             | 1-1         |
| Features                                                                          | 1-1         |
| Applications                                                                      | 1-2         |

| Section II: Description                                                            | 1-3         |
| Overview                                                                          | 1-4         |
| LCD Display Screens                                                               | 1-4         |
| Menu Screens                                                                      | 1-5         |
| Data Screens                                                                      | 1-5         |
| Alphanumeric Data                                                                 | 1-5         |
| Operational States                                                               | 1-5         |
| Graphed Data                                                                      | 1-7         |

| Section III: Controls and Indicators                                              | 1-8         |
| Introduction                                                                      | 1-8         |
| Liquid Crystal Display and Weld Selector Keys                                    | 1-8         |
| Numeric Keypad and Operational Controls                                          | 1-10        |

### Chapter 2. Installation And Setup

| Section I: Planning for Installation                                             | 2-1         |
| Space Requirements                                                                | 2-1         |
| Utilities                                                                         | 2-1         |

| Section II: Unpacking                                                             | 2-2         |

| Section III: Electrical and Data Connections                                     | 2-3         |
| DC29 Rear Panel Connections                                                       | 2-3         |

| Section IV: Setup                                                                 | 2-5         |
| Manual Weld Head Connections                                                       | 2-5         |
| Air-Actuated Weld Head Connections                                                 | 2-7         |
Chapter 3. Using Welding and Monitoring Functions

Section I: Introduction

Section II: Weld Schedules
- Definition
- Weld Sequence Timing
- Welding Applications
- Weld Head Applicability
- Single-Pulse Weld Profile
  - Applications
  - Description
- Upslope/Downslope Weld Profile
  - Applications
  - Description
- Dual-Pulse Weld Profile
  - Applications
  - Description

Section III: Programmable Feedback Modes
- Introduction
- Current Mode
  - Application
  - Description
- Voltage Mode
  - Application
  - Description
- Power Mode
  - Application
  - Description
- Combo Mode (V-A Mode)
  - Application
  - Description
  - RUN Screen With Combo Feedback Mode

Section IV: Weld Monitor
- Introduction
- Active Part Conditioner (APC)
  - Application
  - Description
  - How It Works
  - Instructions
- Energy Limits
  - Applications
  - Description
Chapter 4. Operating Instructions

Section I: Introduction .................................................................................................................. 4-1

Section II: Initial Setup ................................................................................................................ 4-2
  Pre-Operational Checks .............................................................................................................. 4-2
  Connections ................................................................................................................................. 4-2
  Power ......................................................................................................................................... 4-2
  Compressed Air .......................................................................................................................... 4-2
  Initial Setup Instructions ........................................................................................................... 4-2

Section III: Programming Weld Schedules ................................................................................... 4-3
  Introduction ................................................................................................................................. 4-3
  Select A Weld Schedule .............................................................................................................. 4-3
  Enter New Values ......................................................................................................................... 4-3
  Single-Pulse Weld Schedule (For Current, Voltage, and Power Feedback Modes) ................. 4-4
  Upslope/Downslope Weld Schedule (For Current, Voltage, and Power Feedback Modes) ...... 4-6
  Dual-Pulse Weld Schedule (For Current, Voltage, and Power Feedback Modes) .................. 4-8
  Combo Mode (V-A) Single-Pulse and Dual-Pulse Weld Schedules: Combo (V-A) Feedback Mode ................................................................................................................................. 4-10

Section IV: Programming the Weld Monitor .................................................................................. 4-12

Section V: Programming for Active Part Conditioning ................................................................. 4-16

Section VI: Operation ................................................................................................................... 4-18
  General Operator Safety .............................................................................................................. 4-18
  Manual Welding ........................................................................................................................... 4-18
  Operation .................................................................................................................................. 4-18
  Normal STOP .............................................................................................................................. 4-18
  Automated Welding ..................................................................................................................... 4-18
  Operation .................................................................................................................................. 4-18
  Normal STOP .............................................................................................................................. 4-18
  EMERGENCY STOP .................................................................................................................. 4-19
  Re-Set After EMERGENCY STOP .............................................................................................. 4-19

Chapter 5. Software Setup

Section I: Introduction .................................................................................................................. 5-1

Section II: How to Use Menu Screens .......................................................................................... 5-2
  Main Menu .................................................................................................................................. 5-2
  Setup Menus ............................................................................................................................... 5-2
CONTENTS (Continued)

Section III: System Settings and Operator Preferences ................................................................. 5-4
  Footswitch Weld Abort ............................................................................................................... 5-4
  End Of Cycle Buzzer ............................................................................................................. 5-4
  Buzzer On Weld Stop ............................................................................................................ 5-5
  Update Graph After Weld ...................................................................................................... 5-5
  All Screen Updates .............................................................................................................. 5-6
  Display Contrast .................................................................................................................. 5-6
  Buzzer Loudness .................................................................................................................. 5-7
  Switch Debounce Time ....................................................................................................... 5-7
  Firing Switch ....................................................................................................................... 5-8
  Save System ......................................................................................................................... 5-8

Section IV: Functions .................................................................................................................. 5-9
  Waveform Check ................................................................................................................ 5-9
    Waveform Check ON/OFF ............................................................................................... 5-9
    Weld Fire Lockout Charge % Setting ............................................................................... 5-10
    Energy Capacity Limits ................................................................................................. 5-10
  Weld Counters .................................................................................................................... 5-10
  Copy A Schedule ............................................................................................................... 5-11
  System Security ................................................................................................................ 5-12
  Calibration ......................................................................................................................... 5-13
  Reset Defaults ................................................................................................................... 5-13
  Reset System Parameters ................................................................................................. 5-15
  Reset All Schedules ......................................................................................................... 5-15
  Reset Schedule Limits ...................................................................................................... 5-16
  Chain Schedules ................................................................................................................ 5-16

Section V. Communication and Data ............................................................................................. 5-19
  Requirements ...................................................................................................................... 5-19
  Communication .................................................................................................................. 5-19
    I.D. Number .................................................................................................................... 5-19
    Baud Rate ....................................................................................................................... 5-19
  Communication Role ......................................................................................................... 5-20
  Communication Role ......................................................................................................... 5-20

Section VI. Relay Settings ........................................................................................................... 5-21
  Function ............................................................................................................................. 5-21
  Programming Instructions ................................................................................................. 5-21
CONTACT US

Thank you for purchasing a Miyachi Unitek™ DC29/UB29/UB29A Linear DC Resistance Welding Controls.

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 Miyachi America
1820 South Myrtle Avenue
P.O. Box 5033
Monrovia, CA 91016-7133
Telephone: (626) 303-5676
FAX: (626) 358-8048
e-mail: info@amadamiyachi.com

The purpose of this manual is to provide the information required for proper and safe operation and maintenance of the Miyachi Unitek™ DC29/UB29/UB29A Linear DC Resistance Welding Controls.

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

Amada Miyachi America is not responsible for any loss or injury due to improper use of this product.
SAFETY PRECAUTIONS

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

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

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

NOTE: For the rest of this manual the DC29, UB29, and UB29A Linear DC Resistance Welding Controls will simply be referred to as “the Control,” except in specific instances where unique descriptions are required such as specifications, connections, etc. In those instances the DC29, UB29, or UB29A will be specified.

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 Miyachi America.

HIGH VOLTAGE is used in the operation of this equipment.

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

WHEN WELDING always wear safety glasses.
Before using this equipment, read the SAFETY PRECAUTIONS carefully to understand the correct usage of the equipment.

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

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

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

---

**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 Miyachi America 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 Miyachi America or your distributor for help.

People with pacemakers MUST stay away from the Control.
When the Control is operating, it generates a magnetic field, which adversely affects pacemakers. People who use a pacemaker must not approach the Control, or walk around the welding shop while the Control 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.
CAUTION! This symbol designates an operation which requires a qualified technician and User’s Manual

1. Install power supply system

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

Operator Guide – Miyachi Unitek power supplies

Bedieningshandleding - Voedingsbronnen voor Miyachi Unitek.
Användarhandledning - Kraftaggregat för Miyachi Unitek.
Käyttöopas - Miyachi Unitek tehonlaitteet.
Guide d'utilisation - Alimentation de électrique Miyachi Unitek.
Bedienungsanleitung - Energieversorgung für Miyachi Unitek.
Guida dell’operatore - Alimentazioni di corrente delle apparecchiature Miyachi Unitek.
Guía del Operador - Componentes eléctricos da Miyachi Unitek.
Guía del operador - Fuentes de alimentación de Miyachi Unitek.

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

1. Install power supply system

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

Alle programma- of instellingswijzigingen moeten door een gekwalificeerd technicus. Hänvisa alla program- och inställningsändringar till en kvalificerad tekniker.
na kaikki ohjelman tai asetusen muutokset asiantuntevan tekniikon suoritettaviksi.
Confier toutes les modifications de programme ou de réglages à un technicien qualifié.
Sämtliche Programm- oder Einstellungsänderungen müssen einem qualifizierten Techniker überlassen werden.
Rivolgersi ad un tecnico qualificato per tutti i cambiamenti di programma di impostazione.
Consulte um técnico qualificado quanto a qualquer alteração de programa ou ajuste.
3. **Use eye protection**

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

4. **Examine weld terminals**

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

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

   - Bedieningshandleiding - Voedingsbronnen voor Miyachi Unitek.  
   - Användarhandledning - Kraftaggregat för Miyachi Unitek.  
   - Käyttöopas - Miyachi Unitek tehonlähteet.  
   - Guide d'utilisation - Alimentation de électrique Miyachi Unitek.  
   - Bedienungsanleitung - Energieversorgung für Miyachi Unitek.  
   - Guida dell’operatore - Alimentazioni di corrente delle apparecchiature Miyachi Unitek.  
   - Guia do Operador - Componentes elétricos da Miyachi Unitek.  
   - Guía del operador - Fuentes de alimentación de Miyachi Unitek.

---

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

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


Standards To Which Conformity Is Declared:

- EN61326-1: 2006
- EN65011 Class A Group 1
- EN61000-4-2
- EN61000-4-3
- EN61000-4-4
- EN61000-4-5
- EN61000-4-6
- EN61000-4-8
- EN61000-4-11

Manufacturer's Name: Miyachi Unitek

Manufacturer's Address: 1820 S. Myrtle Avenue
Manrovia, CA 91016
626-303-5676

Equipment Description: Power Supply

Equipment Class: Electrical Equipment Measurement, Control & Laboratory Use - Industrial

Model Numbers: DC29 (INCL UB29 UB29A)

I, the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s).

Place: Monrovia, CA USA
Signature: [Signature]
Full Name: David Cielinski
Position: V.P. Standard Product Development
DECLARATION OF CONFORMITY


Standards to which conformity is declared: EN61010-1:2010

Manufacturer’s Name: Miyachi Unitek, Inc.

Manufacturer’s Address: 1820 S. Myrtle Avenue
Monrovia, CA 91016

Equipment Description: Power Supply

Equipment Class: Class I

Model Number: DC29 (INCL UB29 UB29A)

I the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place: Monrovia, CA USA
Signature: [Signature]
Full Name: [Full Name]
Position: U.P. STD PRODUCT DEVELOPMENT

DC29/UB29/UB29A LINEAR DC RESISTANCE WELDING CONTROLS

xvi 990-919
LIMITED WARRANTY

1. (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 1 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 Products.”)

(c) EXCEPT FOR THE WARRANTY SET FORTH IN SECTION 1(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 1(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 1(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 91016 or 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 1(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 1(e) and Section 1(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 1(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 1(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.
Limited Warranty

EXCEPT FOR THE WARRANTY SET FORTH BELOW IN THIS EXHIBIT 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.

Warranty Period: The Warranty Period for Specialty Products is for one (1) year, and the Warranty Period for laser welders and laser markers is two (2) years (unlimited hours), and the Warranty Period for the laser pump diodes or modules is two (2) years or 10,000 clock hours, whichever occurs first (as applicable, the “Warranty Period”). The Warranty Period begins as follows: (i) on orders for Goods purchased directly by Buyer, upon installation at Buyer’s site or thirty (30) days after the date of shipment, whichever occurs first; or (ii) on equipment purchased by a Buyer that is an OEM or systems integrators, upon installation at the end user’s site or six (6) months after the date of shipment, whichever occurs first.

Acceptance Tests: Acceptance Tests (when required) shall be conducted at Amada Miyachi America, Inc., Monrovia, CA, USA (the “Testing Site”) unless otherwise mutually agreed in writing prior to issuance or acceptance of the Acknowledgement. Acceptance Tests shall consist of a final visual inspection and a functional test of all laser, workstation, enclosure, motion and accessory hardware. Acceptance Tests shall include electrical, mechanical, optical, beam delivery, and software items deliverable under the terms of the Acknowledgement. Terms and conditions for Additional Acceptance Tests either at Seller’s or Buyer’s facility shall be mutually agreed in writing prior to issuance or acceptance of the Acknowledgement.

Performance Warranty: The system is warranted to pass the identical performance criteria at Buyer’s site as demonstrated during final Acceptance Testing at the Testing Site during the Warranty Period, as provided in the Acknowledgement. Seller explicitly disclaims any responsibility for the process results of the laser processing (welding, marking, drilling, cutting, etc.) operations.

Exclusions: Seller makes no warranty, express or implied, with respect to the design or operation of any system in which any Seller’s product sold hereunder is a component.

Limitations: The limited warranty set forth on this Exhibit A does not cover loss, damage, or defects resulting from transportation to Buyer’s facility, improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment, or improper site preparation and maintenance. This warranty also does not cover damage from misuse, accident, fire or other casualties of failures caused by modifications to any part of the equipment or unauthorized entry to those portions of the laser which are stated. Furthermore, Seller shall not be liable for a breach of the warranty set forth in this Exhibit 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.
Seller further warrants that all Services performed by Seller’s employees will be performed in a good and workmanlike manner. Seller’s sole liability under the foregoing warranty is limited to the obligation to re-perform, at Seller’s cost, any such Services not so performed, within a reasonable amount of time following receipt of written notice from Buyer of such breach, provided that Buyer must inform Seller of any such breach within ten (10) days of the date of performance of such Services.

Seller shall not be liable for a breach of the warranty set forth in this Exhibit A unless: (i) Buyer gives written notice of the defect or non-compliance covered by the warranty, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect or non-compliance 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 and (a) Buyer returns such Goods to Seller’s place of business at Buyer’s cost (prepaid and insured); or (b) in the case of custom systems, Seller dispatches a field service provider to Buyer’s location at Buyer’s expense, for the examination to take place there; and (iii) Seller reasonably verifies Buyer’s claim that the Goods are defective or non-compliant and the defect or non-compliance developed under normal and proper use.

All consumable, optical fibers, and 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.

No warranty made hereunder shall extend to any product whose serial number is altered, defaced, or removed.

**Remedies:** With respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: repair such Goods (or the defective part). **THE REMEDIES SET FORTH IN THE FOREGOING SENTENCE SHALL BE BUYER’S SOLE AND EXCLUSIVE REMEDY AND SELLER’S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN THIS EXHIBIT 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.

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 this Exhibit 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.
CHAPTER 1
DESCRIPTION

Section I: Introduction

Features

The DC29, UB29, and UB29A Linear DC Welding Controls are Resistance Welding Controls. These models have the same functionality except the UB29 has a maximum weld current output of 500 Amps, the UB29A has a maximum weld current output of 1500 Amps, and the DC29 has a maximum current output of 4000 amps. The design of the UB29 and UB29A, with their lower maximum current level, provides greater accuracy at lower weld current settings.

For the rest of this manual all three models will simply be referred to as “the Control,” except in specific instances where unique descriptions are required such as specifications, connections, etc. In those instances the DC29, UB29, or UB29A will be specified.

- Programming of time in 100 µsec increments (minimum) provides shorter weld times, less part deformation, longer electrode life, and greater weld strength with more part ductility.
- Built-in Liquid Crystal Display (LCD) shows a graphical "trace" of weld current, voltage, power and resistance, plus alphanumeric peak and average values.
- Up to 99 individual Weld Schedules (sometimes referred to as weld profiles) can be programmed and stored. Weld schedules can be used individually or in sequence with others using the "chain schedules" function.
- Easy-to-set limits establish process window for acceptable quality.
- Weld limits and user programmable relays can be used in conjunction with visual and audible signals for operators and automation interface.
- Able to abort process if process parameter moves outside of user set limits.
- Digital inputs for process automation include schedule selection, weld inhibit, and alarm reset.
- Five programmable relay outputs
CHAPTER 1: DESCRIPTION

- Rear-mounted RS-232 connector allows for remote programming, weld schedule selection, and data logging for SPC purposes.
- Side-mounted weld terminals (bus bars) on the left side of the Control give you a less cluttered workspace in front or behind of the Control.
- Calibration traceable to NIST standards.
- Password protection provides process security.

Applications

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

The Control requires only single-phase input power. The UB29, UB29A, and DC29 can respectively supply weld current up to 500 amps, 1500 amps, and 4,000 amps. The advanced linear control circuit provides instantaneous update of the welding pulse in response to changes in the resistance of the work piece during the weld. This level of control is essential to achieve consistent welds in applications where the resistance changes dramatically.

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

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

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

Complete technical specifications for the Control are listed in Appendix A, Technical Specifications. Connector pin identification and specifications are listed in Appendix B, Electrical And Data Connectors.
CHAPTER 1: DESCRIPTION

Overview

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

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

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

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

LCD Display Screens

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

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

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

Data Screens

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

Alphanumeric Data

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

Operational States

Each Data Screen displays the current operational state of the Control in the Top Line of data (left side). Menu Screens do not display the operational state, but the menu itself indicates the Control is in the MENU state. The following table describes each of the Control’s operational states.
### DC29/UB29/UB29A Operational States

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

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

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

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

Introduction

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

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

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

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

Liquid Crystal Display and Weld Selector Keys

![LCD and Weld Selector Keys](image)

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

<table>
<thead>
<tr>
<th>KEY</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="SCHEDULE" /></td>
<td>Press to view and select a <em>Weld Schedule</em>. After pressing the <strong>SCHEDULE</strong> key, you can use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys on the front panel to scroll through the 99 stored <em>Weld Schedules</em>, <strong>or</strong> use the numeric keypad to enter the two-digit number of the desired schedule.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>Press to enter the squeeze time before the weld. To select the value, use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers. The squeeze time will start after a firing signal is given to the Control. <strong>NOTE:</strong> In addition to the debounce time, there is a delay of no greater than 5 ms before the start signal is recognized by the Control.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>A group of 3 individual keys used to program the <em>time</em> and <em>energy</em> for Pulse 1. Each key is described below.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>Press to enter the amount of <em>time</em> Weld Pulse 1 upslope. To select the value, use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>This switch toggles between the <strong>middle</strong> and <strong>bottom</strong> data lines on the LCD. To enter weld <strong>energy</strong> values (energy level and feedback mode), press the switch to highlight the <strong>middle</strong> line. To enter weld <strong>time</strong> values [in milliseconds], press the <strong>WELD</strong> switch again to highlight the <strong>bottom</strong> line. To select <strong>energy</strong> and <strong>time</strong> values, use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers and decimal point. To select <strong>feedback mode</strong>, press the <strong>kA, V, kW</strong> or <strong>COMBO</strong> key when the <strong>energy</strong> value is highlighted.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>Press to enter the amount of time for Weld Pulse 1 downslope. To select the value, use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers and decimal point.</td>
</tr>
<tr>
<td><img src="image" alt="UP WELD PULSE 1 DOWN" /></td>
<td>Press to enter the amount of time for the cool period. To select the value, use <strong>either</strong> the ( \uparrow \downarrow ) (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers and decimal point.</td>
</tr>
</tbody>
</table>
### KEY

<table>
<thead>
<tr>
<th>KEY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="up_down_up_weld_down.png" alt="Image" /></td>
<td>A group of three individual keys that program Pulse 2. These keys have the exact same function as the Pulse 1 Keys.</td>
</tr>
<tr>
<td><img src="hold_period.png" alt="Image" /></td>
<td>Press to enter the amount of time for the hold period after the weld. To select the value, use <strong>either</strong> the 🝂 (up/down) keys, <strong>or</strong> use the numeric keypad to enter the numbers.</td>
</tr>
</tbody>
</table>

**Numeric Keypad and Operational Controls**

![Image](numeric_keypad.png)

**Numeric Keypad and Operational Controls**
<table>
<thead>
<tr>
<th>KEY</th>
<th>FUNCTION</th>
</tr>
</thead>
</table>
| ![Numeric Keypad] | **Numeric Keypad**  
  - Enter or modify weld period time and energy values.  
  - Enter or modify monitor and limit values.  
  - Directly recall a specific weld schedule.  
  - Select menu items when MENU screens are displayed. |
| ![Decimal Point] | Press to insert a decimal point into the time and energy values you enter. |
| ![Increment/Decrement] | Press to:  
  - **Increment** (increase) or **decrement** (decrease) numeric values on the display  
  - **Scroll** the weld schedule numbers up and down. |
| ![WELD/NO WELD] | Press to switch Control between WELD and NO WELD modes. The LED above will be green when in WELD mode and dark when in NO WELD mode.  
  **WELD** position -- when a weld is initiated, the Control delivers energy to the weld head.  
  **NO WELD** -- allows the Control to execute a complete weld sequence but does not deliver energy to the weld head. This function is useful for testing and adjusting the weld head before operation, and when cleaning electrodes. |
| ![RUN] | Press to return to the RUN state or to clear alarms. When using any MENU screen, press this key to exit the menu. |
| ![MENU] | Press to display the MENU screen. *Chapter 4, Operating Instructions* describes how to use the different MENU options.
**CHAPTER 1: DESCRIPTION**

<table>
<thead>
<tr>
<th>KEY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONITOR</strong></td>
<td>This state allows you to view waveforms of weld voltage, current, power, and resistance. Press the MONITOR key to go to the MONITOR state. The LCD will show the actual trace of energy of the last weld performed. You can also view the peak or average energy value for each weld pulse as selected by pressing the PEAK/AVERAGE key. If a start signal is received while in the MONITOR state, the Control will execute the programmed weld schedule and the waveform trace will update with the new weld data. The operational state will then read RUN, and the LCD screen will show the monitored data.</td>
</tr>
<tr>
<td><strong>Ω</strong></td>
<td>Pressing the Ω key displays the resistance monitor. This screen shows the results of the most recent weld. This screen also allows the operator to set limits that automatically interrupt the weld when they are reached. You can also program the power monitor to output an alarm when the limits are exceeded.</td>
</tr>
</tbody>
</table>

**NOTE:** The kA, A, V, and kW keys are used to:
- Set the feedback mode for Pulse 1 and Pulse 2 in the weld schedule.
- Set the feedback parameters for upper and lower monitor limits.
- Select the monitor mode to be viewed on the LCD display.

| **kA** | When PROGRAM is displayed, this key is used to set current as the feedback mode for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired output level with the numeric keypad, then press the kA key to change the feedback mode to current. Note: UB29 models display “A” instead of “kA” |
| **V** | When in the MONITOR state, this key is used to set current as the limit parameter for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the kA key to change the limit parameter to current. When RUN is displayed in the MONITOR state, press the kA key to view the current graph on the LCD display. |

| **PROGRAM** | When PROGRAM is displayed, this key is used to set voltage as the feedback mode for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired output level with the numeric keypad, and then press the V key to change the feedback mode to voltage. |
| **MONITOR** | When in the MONITOR state, this key is used to set voltage as the limit parameter for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the V key to view the voltage graph on the LCD display. |
CHAPTER 1: DESCRIPTION

<table>
<thead>
<tr>
<th>KEY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>keypad, and then press the V key to change the limit parameter to voltage. When RUN is displayed in the MONITOR state, press the V key to view the voltage graph on the LCD display.</td>
<td></td>
</tr>
</tbody>
</table>

When PROGRAM is displayed, this key is used to set power as the feedback mode for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired output level with the numeric keypad, and then press the kW key to change the feedback mode to power. When in the MONITOR state, this key is used to set power as the limit parameter for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the kW key to change the limit parameter to power. When RUN is displayed in the MONITOR state, press the kW key to view the power graph on the LCD display. |

The COMBO key is used to set the feedback mode for Pulse 1 in the weld schedule. If the present schedule is in Current, Voltage or Power mode and are either on the RUN screen or have a time or energy parameter highlighted for editing, press the COMBO key to change to COMBO mode. If the present schedule is in COMBO mode, pressing the COMBO key while either on the RUN screen or when the time or energy parameters are highlighted for editing, will change the schedule to Current mode and change the screen to the RUN screen. For more information on COMBO mode, refer to Chapter 3, Using Welding and Monitor Functions |

Switches the display between the peak welding energy and the average welding energy readings. Data is displayed in the top data line on the LCD. |

This is the input power switch. Press in up position to turn the Control ON and press in down position to turn the Control OFF. |
Section IV: Emergency Stop Switch and I/O Connections

The Control is shipped with two single row 16-pin mating plugs. These need to be installed on the two I/O connectors on the rear panel of the Control. These two plugs, connected to I/O Connector J1A and I/O Connector J1B. These two mating plugs are pre-wired with a typical wiring installation configuration. On I/O Connectors J1A, Pins 4 (F3 Pullup) and 5 (+24V) will be jumpered and pins 7 (I/O Common) and 8 (+24V) will also be jumpered. These jumpers configure the Control for negative logic. On I/O Connector J1B, pins 19 and 20 (Emergency Stop) will have approximately 3” (75mm) lengths of wire installed with a label attached to wires providing E-stop connection instructions. For connector pin identification and specifications, see Appendix B, Electrical and Data Connectors.

NOTE: The Control will not function without these minimum connections.

NOTE: For clarity, the tag attached to the shorting wires containing instructions in several languages is not shown here. The tag (with the complete text) is shown in Appendix B, Electrical and Data Connectors.

You may operate the Control with or without an Operator Emergency Stop Switch. For operation without an Emergency Stop Switch, short the two emergency stop wires together and secure with wire nut(closing the circuit).

J1B Mating Plug showing Emergency Stop Wires
To operate with an Emergency Stop Switch, connect a normally closed, Emergency Stop Switch across the two wires of the emergency stop leads. This switch, when actuated (opening the circuit), will immediately stop the weld cycle and retract the weld head. This emergency stop does not require the intervention of the microprocessor.

**CAUTION**

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

To restart the Control after an emergency stop, press the **RUN** key on the front panel or switch the **ALARM RESET** digital input. Verify that the desired schedule is still displayed on the front panel, and then resume welding.
CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning for Installation

Space Requirements

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

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

Utilities

The power input requirement is:

88 – 264 VAC, 47 – 63 Hz
Single Phase

The power cable for the Controller is equipped with a connector for the Control Rear Panel AC INPUT plug. The input power wiring diagram is in Appendix B, Electrical and Data Connectors.

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

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

The available accessories for the Control are:

- **2 Level Footswitch** (with wire leads to be connected to Mating Plug J1A)
- **Weld Cables**
- **Valve Drive Cable** (with weldhead connector on one end and wire leads to be connected to Mating Plug J1B)
- **Firing Switch adapter cable** (with firing switch connector on one end and wire leads to be connected to mating Plug J1A)
- **Adapter Cable for Footswitches FS1L and FS2L** (with footswitch connector on one end and wire leads to be connected to Mating Plug J1A on the other)
- **Pre-wired Adapter Box.** Mounts to the back of the Control (Contains Weld Head, Firing Switch, and Footswitch connectors)

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

**NOTE:** Save the packing material. Carefully place the packing materials back in the packing boxes and store for future shipping.
Section III: Electrical and Data Connections

All connections between the Control, switches, the weld head, and external equipment, such as PLC and data collection systems, are made on the rear panel.

Rear Panel Connections

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

- The Control is shipped with two 16-pin mating plugs in the ship kit. These are to be installed on the two I/O connectors, J1A and J1B on the rear panel. The Control will not function if these plugs are not installed. These two mating plugs contain some preset jumper wires for a typical basic I/O connection. User can configure I/O connections for a particular application as required. For details, see Appendix B.

- Wiring of cables and connectors going to the Control should only be done by qualified service personnel. Connector pin identification and specifications for the rear panel connectors are located in Appendix B. Electrical and Data Connectors.

- For clarity, illustrations in the rest of this manual do not show the power cable connected to the Control, even though the power cable must be connected in order to operate the Control.
Section IV: Setup

Manual Weld Head Connections

1. Connect one end of a weld cable to the negative (−) weld terminal on the Control.
2. Connect one end of the second weld cable to the positive (+) weld terminal on the Control.
3. Connect the other end of the two weld cables to the weld head.
4. Dress the weld cables together with cable ties to minimize induction losses.
5. Attach the voltage sensing cable connector to the **VOLTAGE SENSE INPUT** connector.
6. Install electrodes in the weld head electrode holders.
7. Attach voltage sensing cables to the screws on the electrode holders as shown.

**ENSURE THAT THE ELECTRODE CONNECTED TO THE “+” TERMINAL IS CONNECTED TO THE RED TERMINAL OF THE VOLTAGE SENSING CABLE**

1. Using a cable tie as a strain relieve, attach each voltage sensing lead to its corresponding electrode holder so that the lead terminals will not break away under heavy production operating conditions.
2. Connect the Firing Switch cable connector from the weld head to the back panel I/O connector. See *Appendix B, Electrical and Data Connections* for details.
3. Connect other I/O connections to J1A and J1B, along with the serial port as needed for your application.
Air-Actuated Weld Head Connections

1. In addition to the connections needed for a manual head, you also need to connect a Model FS1L or FS2L Foot Switch cable to Connector J1A. See Appendix B, Electrical and Data Connections for details.

2. Connect the weld head Air Valve and Emergency Stop cables to Connector J1B.

   NOTE: This Control connector provides 24 VDC power only. It will not drive 115 VAC or 24 VAC air valves. Refer to the weld head manufacturer’s manual.
CHAPTER 3
USING WELDING AND MONITORING FUNCTIONS

Section I: Introduction

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

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

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

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

Definition

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

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

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

Weld Sequence Timing

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

![Sample Weld Sequence (Dual-Pulse)]
Welding Applications

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

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

**Weld Head Applicability**

The Control is best used with Miyachi Unitek force-fired, manual weld heads, Miyachi Unitek low force programmable electronic weld heads, or force fired air actuated weld heads.

**Manual Weld Heads**

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

**Force Fired Air Actuated Weld Heads**

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

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

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

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

- **d)** After FS1, FS2, and fire switches have been closed the state of the footswitch weld abort now matters. If footswitch weld abort is ON, then opening FS1, FS2, or fire switches will terminate the welding sequence. If footswitch weld abort is OFF then opening FS1, FS2, or fire will NOT terminate the welding sequence.
CHAPTER 3: USING WELDING AND MONITORING FUNCTIONS

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

Single-Pulse Weld Profile

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

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

Upslope/Downslope Weld Profile

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

Description
Upslope allows a gradual application of weld energy which permits the parts to come into better contact with each other reducing the electrode-to-part contact resistances. Upslope can allow a lighter electrode force to be used, resulting in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation. It can also be used to displace plating and/or oxides, reduce flashing and spitting, or reduce thermal shock when welding parts containing glass-to-metal seals.
**Downslope** (annealing) assists in the grain refinement of certain heat-treatable steels, and prevents cracking in aluminum and other materials by reducing the cooling rate. Annealing is not typically used for welding small parts.

![Upslope / Downslope Weld Profile](image)

**Dual-Pulse Weld Profile**

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

**Description**

Adding upslope to the front of both weld periods allows a reduction in electrode force. This results in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation.
**Upslope** will also help to displace plating and/or oxides, reduce flashing and spitting, and reduce thermal shock when welding parts containing glass-to-metal seals. In the normal application of dual-pulse, the Pulse 1 weld period provides sufficient heat to displace the plating or oxides, seat the electrodes against the base metals, and force the parts into intimate contact. The cool period allows time to dissipate the heat generated during Pulse 1.

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

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

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

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

Introduction

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

Current Mode

Application

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

Description

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

Voltage Mode

Application

- Ideal for welding round or non-flat parts.

Description

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

Power Mode

Application

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

Description

This mode precisely varies the weld current and voltage to supply consistent weld energy to the parts. The power mode has been shown to extend electrode life in automated applications.
Combo Mode (V-A Mode)

Application

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

Description

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

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

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

---

**Set voltage** waveform

**Controlled Current** waveform

- $T_c$: Constant current control time period (milliseconds)
- $T_v$: Maximum allowable time for Voltage Ramp up (milliseconds)
- $V$: Maximum allowable voltage during Voltage Ramp up (volts)
- $I$: Constant current control level (amperes)
**CHAPTER 3: USING WELDING AND MONITORING FUNCTIONS**

\[ T_d \] Current downslope period (milliseconds)

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

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

**RUN SCREEN WITH COMBO FEEDBACK MODE**

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

A typical Weld Schedule is shown on the right.

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

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

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

The actual time of the voltage control portion of Pulse 1 will typically be less than the user set time, \( T_v \), for the voltage ramp up time.
Since the Control immediately switches to the **Current Feedback** Control portion of Pulse 1 as soon as the Current ramps up to the user set current level, the Control positions the actual ramp up in current on the screen adjacent to the **Current Feedback** Control shaded region.

In the screen shown on the right, the actual time for the current to ramp up was 1.1 mseconds as compared to the user set maximum allowable time, $T_v$, of 4 mseconds.
Section IV: Weld Monitor

Introduction

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

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

Active Part Conditioner (APC)

Application

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

Description

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

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

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

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

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

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

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

The use of a current limit monitor for the first pulse enables the pulse to be terminated when a predetermined amount of current flow is achieved. The rise of the current waveform is proof positive that the oxide is breaking down and the parts are fitting up together, ready to weld. The first pulse, therefore, should be programmed to be much longer than generally required. The power supply will terminate the pulse based on the reading of current in the power supply’s monitor.
CHAPTER 3: USING WELDING AND MONITORING FUNCTIONS

Instructions

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

Energy Limits

Applications

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

Energy Limits can be used in two different ways:

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

Description

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

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

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

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

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

Pre-Weld Check

Application
- Detect Misaligned or Missing parts.

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

Pre-Weld Check is similar to Energy Limits, however in this case Pulse 1 should be very short (1-2 milliseconds), and the current should be low, about 10% of the Pulse 2 current. Pulse 1 should be used as a measurement pulse and should not perform a weld.
Example: To detect misaligned parts, use constant current and set upper and lower voltage limits for Pulse 1. If parts are misaligned, the work piece resistance will be higher, so the voltage will be higher. If parts are missing, voltage will be lower. In either case, the Pulse 1 upper or lower limits will be exceeded, and Pulse 1 can be inhibited.

NOTE: You must have upslope programmed into the pulse in order to set a lower limit. In addition to inhibiting the weld, the Control has five programmable relay outputs which can be used to trigger alarms to signal operators of weld faults or signal automation equipment to perform pre-programmed actions, such as stopping the assembly line so the faulty weld piece can be removed.
CHAPTER 4
OPERATING INSTRUCTIONS

Section I: Introduction

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

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

Before operating the Control, you must be familiar with the following:

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

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

Pre-Operational Checks
Always perform these checks \textit{before} attempting to operate the Control.

Connections
Verify that the Control has been connected to a manual or air-actuated weld head as described in \textit{Chapter 2} of this manual. Verify that the Emergency Stop Switch shorting wires are connected \textit{or} verify that an Emergency Stop Switch is connected properly.

Power
Verify that power is connected as described in \textit{Chapter 2} of this manual.

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

Initial Setup Instructions
1. Adjust the weld head force adjustment knob for a force appropriate for your welding application. A good starting point is the mid-point in the range of the weld head force.
2. Set the \texttt{WELD/NO WELD} switch on the Control front panel to the \texttt{NO WELD} status. In this position, the Control will operate the weld head \textit{without} producing weld energy.
   \textbf{NOTE:} When you are ready to perform a weld, be sure to set the status back to the \texttt{WELD} status.
3. Turn the \texttt{ON/OFF} switch on the front panel of the Control to the \texttt{ON} position. The default \texttt{RUN} screen will be displayed. You will use this screen to enter welding parameters.

\begin{center}
\textbf{Default RUN Screen}
\end{center}
Section III: Programming Weld Schedules

Introduction

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

The process of Programming a weld schedule consists of:

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

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

Select A Weld Schedule

1. To select weld schedules, first make sure that the **RUN** state is displayed on the LCD. If not, press the **RUN** button on the front of the Control.
2. Press the **SCHEDULE** button on the right of the Control.
3. Use **either** of the methods below to select a schedule:
   - Use the **στ** (Up/Down) buttons to scroll through the list.
   - **OR**
   - Use the numeric keypad to enter the two-digit number of the schedule you want.

Enter New Values

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

**NOTE:** If the same energy parameters entered for Pulse 1 and Pulse 2, such as both Pulse 1 and Pulse 2 are both set to current feedback mode, the Control can be set to 0 ms Cool Time. If different energy parameters are entered for Pulse 1 and Pulse 2, the Control will require a minimum of 1.0 ms Cool Time. If a Cool Time is set lower than 1.0 ms, but not zero, the Control will default to 1.0 ms Cool Time.
CHAPTER 4: OPERATING INSTRUCTIONS

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

1. Press the SCHEDULE button, then select a Weld Schedule using either the ♦♦ arrows or the numeric keypad.

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

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

4. Press the PULSE 1 WELD key to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the ♦♦ arrows. The Control output ranges are:
   - Current: from 0.200 → 4.000 kA for DC29, 0.015 → 1.500 kA for UB29A or 5 → 500 amps for UB29.
   - Voltage: from 0.100 → 9.9 volts for all models
   - Power: from 0.100 → 25.00 kW for DC29, 0.070 → 9.999 kW for DC29 or 0.050 – 4.99 kilowatts for UB29.

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

6. Perform one of the following:
   - Press the kA key to program current as the feedback mode.
   - Press the V key to program voltage as the feedback mode.
   - Press the kW key to program power as the feedback mode.
CHAPTER 4: OPERATING INSTRUCTIONS

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

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

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

10. Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad or the ⬆️ arrows. Enter a time between 0 and 999 ms. We recommend at least 50 ms as weld strength is formed in the hold time.
Upslope/Downslope Weld Schedule (For Current, Voltage, and Power Feedback Modes)

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

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

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

4. Press the PULSE 1 WELD key to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the ▼◆ arrows. The Control output ranges are:
   - **Current:** from 0.200 → 4.000 kA for DC29, 0.015 → 1.500 kA for UB29A or 5 → 500 amps for UB29.
   - **Voltage:** from 0.100 → 9.9 volts for all models
   - **Power:** from 0.100 → 25.00 kW for DC29, 0.070 → 9.999 kW for DC29 or 0.050 – 4.99 kilowatts for UB29.

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

6. Perform one of the following:
   - Press the kA key to program current as the feedback mode.
   - Press the V key to program voltage as the feedback mode.
   - Press the kW key to program power as the feedback mode.
CHAPTER 4: OPERATING INSTRUCTIONS

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

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

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

10. Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad or the ♦♦ arrows. Enter a time between 0 and 999 ms. We recommend at least 50 ms as weld strength is formed in the hold time.
CHAPTER 4: OPERATING INSTRUCTIONS

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

1. Press the SCHEDULE button, then select a Weld Schedule using either the ◊◊ arrows or the numeric keypad.

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

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

4. Press the PULSE 1 WELD key to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the ◊◊ arrows. The Control output ranges are:
   - **Current:** from 0.200 → 4.000 kA for DC29, 0.015 → 1.500 kA for UB29A or 5 → 500 amps for UB29.
   - **Voltage:** from 0.100 → 9.9 volts for all models
   - **Power:** from 0.100 → 25.00 kW for DC29, 0.070 → 9.999 kW for DC29 or 0.050 → 4.99 kilowatts for UB29.

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

6. Perform one of the following to program the Pulse 1 feedback mode:
   - Press the kA key to program current as the feedback mode.
   - Press the V key to program voltage as the feedback mode.
   - Press the kW key to program power as the feedback mode.

7. Press the PULSE 1 DOWNSLOPE key to enter the amount of time for the Weld Pulse 1 downslope. Use the numeric keypad to enter the time or use the ◊◊ arrows. Enter a time between 0 and 99 ms.
8. Press the **COOL** key to enter the amount of time between Pulse 1 and Pulse 2. Use the numeric keypad to enter the time or use the † ‡ arrows. Enter a time between 0 and 99 ms. We recommend at least 2 ms.

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

10. Press the **HOLD** key to enter the amount of time for the hold period after the weld. Use the numeric keypad to enter the time or use the † ‡ arrows. Enter a time between 0 and 999 ms. We recommend at least 50 ms.
CHAPTER 4: OPERATING INSTRUCTIONS

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

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

1. Press the SCHEDULE button, then select a Weld Schedule using either the ↑↓ arrows or the numeric keypad.

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

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

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

5. Press the PULSE 1 WELD key to highlight the Current Setpoint (I) on the middle line of the LCD. Use the numeric keypad to enter the current level or use the ↑↓ arrows. The Control output range is:
   - Current: from 0.200 → 4.000 kilo amps. (DC29)

6. Press the PULSE 1 WELD key again to highlight the Voltage Setpoint (V) on the middle line of the LCD to enter the weld time. Use the numeric keypad to enter the voltage level or use the ↑↓ arrows. The Control output range is:
   - Voltage: from 0.100 → 9.9 volts.

7. Press the PULSE 1 WELD key again to highlight the bottom line of the LCD to enter the current weld time (Tc). Use the numeric keypad to enter the time or use the ↑↓ arrows. Enter a time between 0 and 99 ms.
8. Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the ♦♦ arrows. Enter 0 ms.

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

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

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

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

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

3. Perform a weld and view the trace of the weld parameter, use the key to view the desired waveform.

4. Toggle the Pulse 1 weld time/energy selector key to select the upper limit field for the weld period. Use the numeric keypad or the arrow keys to enter the upper limit value for the Pulse 1 weld period. The Control can monitor:
   - **Current:** from 0.200 → 4.000 kA for DC29, 0.05 → 1.500 kA for UB29A, or 5 → 500 amps for UB29.
   - **Voltage:** from 0.100 → 9.9 volts for all models
   - **Power:** from 0.100 → 25.00 kW for DC29, 0.070 → 9.999 kW for DC29, or 0.050 → 4.99 kilowatts for UB29.

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

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

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

The lower limit mode (current, voltage, or power) will automatically be the same as the upper limit mode programmed in Step 5.
CHAPTER 4: OPERATING INSTRUCTIONS

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

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

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

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

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

10. Use the numeric keypad to make another choice or press the **MONITOR** key to view the **MONITOR** screen. The dashed lines on the monitor screen will reflect the changes you made to the limits.
11. Press the COOL weld period key. This will bring up the PULSE 1 OUT OF LIMITS ACTION screen. This screen allows you to select the action that the Control will take if the Pulse 1 upper or lower limits are exceeded.

You have four choices:

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

**NOTES:**

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

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

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

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

14. Press the HOLD period key. This will bring up the PULSE 2 OUT OF LIMITS ACTION screen. This screen allows you to select the action that the Control will take if the Pulse 2 upper or lower limits are exceeded. You
have two choices:

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

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

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

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

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

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

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

1. Press the SCHEDULE button, and then select a Weld Schedule using either the 👈 arrows or the numeric keypad.

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

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

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

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

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

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

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

NOTE: You can toggle between peak and average readings by pressing the PEAK/AVERAGE button.
CHAPTER 4: OPERATING INSTRUCTIONS

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

<table>
<thead>
<tr>
<th>PULSE 1 OUT OF LIMITS ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. NONE</td>
</tr>
<tr>
<td>2. STOP WELD</td>
</tr>
<tr>
<td>3. INHIBIT PULSE 2</td>
</tr>
<tr>
<td>4. PART CONDITIONER (STOP PULSE 1)</td>
</tr>
</tbody>
</table>

NUMBER: Select, MENU: Previous menu


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

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

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

13. Program your second welding pulse as normal to achieve a strong weld. Constant voltage is recommended for round parts and constant current for flat parts. An upslope may be required to restrict the current flow early in the second pulse and avoid weld splash.
CHAPTER 4: OPERATING INSTRUCTIONS

Section VI: Operation

General Operator Safety

**WARNING**

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

Manual Welding

Operation

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

Normal STOP

When finished welding, turn the Control OFF.

Automated Welding

Operation

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

Normal STOP

1. When finished welding, follow the Turn Off/Power Down procedures established for your automated welding system.

2. Turn the Control OFF unless the procedures for your automated welding system require leaving it ON.

EMERGENCY STOP

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

1. Push the Operator Emergency Stop Switch any time necessary to prevent injury to personnel or damage to weld pieces or the welding system.

2. Clear the condition that caused the operator to hit the Operator Emergency Stop Switch.

Re-Set After EMERGENCY STOP

1. Clear the condition that caused the EMERGENCY STOP condition (whether initiated by an Operator or by a programmed action from the PLC).

2. Inspect the electrodes, weld head, and weld cables to make sure there are no shorts or damage that could prevent normal welding.

3. Inspect the production area to verify it is ready to continue welding.

4. Press the RUN key on the front of the Control to clear the Emergency Stop message and verify the desired weld schedule is displayed on the LCD.

5. Continue to weld following normal automation procedures.
CHAPTER 5
SOFTWARE SETUP

Section I: Introduction

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

This chapter is divided into the following sections:

How to Use Menu Screens
- Main Menu
- Setup Menus

System Settings & Operator Preferences
- Footswitch Weld Abort
- End Of Cycle Buzzer
- Buzzer On Weld Stop
- Update Graph After Weld
- All Screen Updates
- Display Contrast
- Buzzer Loudness
- Switch Debounce Time
- Firing Switch
- Save System

Functions
- Waveform Check
- Weld Counters
- Copy A Schedule
- System Security
- Calibration
- Reset Defaults
- Chain Schedules

Communication and Data
- Requirements
- Communication
- I.D. Number
- Baud Rate

Relay Settings
- Function
- Programming Instructions

Before programming the Control, you must be familiar with the location and function of the display and front panel controls. If you need more information, see Chapter 1 of this manual.
Section II: How to Use Menu Screens

Main Menu

All of the Control's programming functions are accessed through the **MAIN MENU**. To go to the **MAIN MENU**, press the **MENU** key on the front of the Control.

Each menu screen lists several choices, with some offering additional screens (sub-menus) listing more choices.

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

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

**Setup Menus**

**SETUP** menus are accessed in sequence:

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

---

**MAIN MENU**

<table>
<thead>
<tr>
<th>0. WAVEFORM CHECK</th>
<th>5. COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SETUP</td>
<td>6. RELAY</td>
</tr>
<tr>
<td>2. WELD COUNTERS</td>
<td>7. CALIBRATION</td>
</tr>
<tr>
<td>3. COPY A SCHEDULE</td>
<td>8. RESET Defaults</td>
</tr>
<tr>
<td>4. SYSTEM SECURITY</td>
<td>9. CHAIN SCHEDULES</td>
</tr>
</tbody>
</table>

**SETUP 1, page 1 of 2**

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

**NUMBER** Select, ▼ Page, **RUN** or **MENU**
NOTE: The SETUP 2 menu is only available through the SETUP 1 menu.

3. To scroll back to the SETUP 1 menu, press the * (UP) key.

4. When you have finished programming the desired functions, press the MENU key on the front panel to return to the MAIN MENU.

<table>
<thead>
<tr>
<th>SETUP 2, Page 2 of 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DISPLAY CONTRAST  : 50</td>
</tr>
<tr>
<td>2. BUZZER LOUDNESS   : 40</td>
</tr>
<tr>
<td>3. SWITCH DEBOUNCE TIME : 20 ms</td>
</tr>
<tr>
<td>4. FIRING SWITCH      : AUTO</td>
</tr>
<tr>
<td>5. SAVE SYSTEM DATA</td>
</tr>
</tbody>
</table>

NUMBER  Select,  Page,  RUN or  MENU
CHAPTER 5: SOFTWARE SETUP

Section III: System Settings and Operator Preferences

Footswitch Weld Abort

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

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

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

End Of Cycle Buzzer

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

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

3. Press the MENU key to return to the MAIN MENU.
CHAPTER 5: SOFTWARE SETUP

Buzzer On Weld Stop

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

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

<table>
<thead>
<tr>
<th>SETUP 1, page 1 of 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOTSWITCH WELD ABORT</td>
</tr>
<tr>
<td>END OF CYCLE BUZZER</td>
</tr>
<tr>
<td>BUZZER ON WELD STOP</td>
</tr>
<tr>
<td>UPDATE GRAPH AFTER WELD</td>
</tr>
<tr>
<td>ALL SCREEN UPDATES</td>
</tr>
</tbody>
</table>

NOTE: ON means that an audible signal will be given when a limit is reached.

Update Graph After Weld

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

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

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

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

<table>
<thead>
<tr>
<th>SETUP 1, page 1 of 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOTSWITCH WELD ABORT</td>
</tr>
<tr>
<td>END OF CYCLE BUZZER</td>
</tr>
<tr>
<td>BUZZER ON WELD STOP</td>
</tr>
<tr>
<td>UPDATE GRAPH AFTER WELD</td>
</tr>
<tr>
<td>ALL SCREEN UPDATES</td>
</tr>
</tbody>
</table>

NUMBER Select, V Page, RUN or MENU
CHAPTER 5: SOFTWARE SETUP

All Screen Updates

1. Go to the SETUP 1 menu.
2. Press the 5 key to toggle the update function ON or OFF.

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

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

Display Contrast

1. Go to the SETUP 2 menu.
2. Press the 1 key to access the DISPLAY CONTRAST adjustment screen.
3. Use the ♦ ♦ keys to adjust the screen contrast for comfortable viewing for your ambient lighting conditions.
4. Press the MENU key to return to the MAIN MENU.
**CHAPTER 5: SOFTWARE SETUP**

**DC29/UB29 LINEAR DC RESISTANCE WELDING CONTROLS**

**Buzzer Loudness**

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

**Switch Debounce Time**

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

**NOTE:** The factory default debounce time is 10 ms.

1. Go to the **SETUP 2** screen.
2. Press the 3 key to access the **SWITCH DEBOUNCE TIME** menu.
3. Select the required debounce time by pressing the 1, 2, 3, or 4 key. The display will automatically return to the **SETUP 2** screen and the **SWITCH DEBOUNCE TIME** line will now reflect your time selection.
4. If you wish to exit the screen, press the **MENU** key to return to the **MAIN MENU**.
CHAPTER 5: SOFTWARE SETUP

Firing Switch

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

NOTES:

- AUTO accepts a single pole, double pole, or optical firing switch input, typically from a Miyachi Unitek weld head. Firing switch activation indicates that the weld head has reached the set weld force and is ready for the weld energy sequence (including squeeze time) to start.
- NONE is used when welding with a non force-fired weld head. With NONE selected, a footswitch closure activates the 24 Vac Air Valve Driver and initiates the weld energy sequence (including squeeze time). Sufficient squeeze time must be programmed in the weld schedule to allow the weld head to close and the weld force to stabilize before the weld current starts. In addition to the debounce time, there is a delay of no greater than 2.5 ms before the start signal is recognized by the Control.
- REMOTE can be used in automated applications or when using a PLC to control the weld head. The weld energy sequence is initiated via the Remote Schedule Select input lines, which also select the weld schedule number. (Refer to Appendix B, Electrical And Data Connectors, for I/O connector pin connections and specifications.)

Save System

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

1. Go to the SETUP 2 screen.
2. Press the 3 key to access the SAVE SYSTEM PARAMETERS menu.
3. Press the 2 key to save all System Parameters. Press the 1 key if you wish to exit this screen without saving.
4. Press the MENU key to return to the MAIN MENU.
Section IV: Functions

Waveform Check

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

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

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

Waveform Check ON/OFF

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

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

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

On Line 3, the actual energy capacity % for Pulse 1 and Pulse 2 will be displayed to the right of the set point.
CHAPTER 5: SOFTWARE SETUP

Weld Fire Lockout Charge % Setting

1. From the WAVEFORM CHECK menu, press the 2 key to access the WELD FIRE LOCKOUT CHRG setting screen.

2. Use the numeric keypad to enter the required amount of energy in the capacitor bank before the next weld is allowed. The settable range is 70% 8 90%.

3. Press MENU to return to the MAIN MENU.

<table>
<thead>
<tr>
<th>WELD FIRE LOCKOUT CHRG</th>
<th>WELD FIRE LOCKOUT CHRG% : 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER Select, Page, RUN or MENU</td>
<td></td>
</tr>
</tbody>
</table>

Energy Capacity Limits

1. From the WAVEFORM CHECK menu, press the 3 key to access the ENERGY CAPACITY LIMITS setting screen.

2. Use the numeric keypad to enter the minimum amount of energy in the capacitor bank that should be allowed after a weld. The settable range is 0% 8 50%.

3. Press MENU to return to the MAIN MENU.

<table>
<thead>
<tr>
<th>ENERGY CAPACITY %</th>
<th>ENERGY CAPACITY % LIMIT : 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER Select, Page, RUN or MENU</td>
<td></td>
</tr>
</tbody>
</table>

Weld Counters

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

2. Press the 1 or 2 key to select the desired weld counter.

<table>
<thead>
<tr>
<th>WELD COUNTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TOTAL WELDS : 0000010</td>
</tr>
<tr>
<td>2. GOOD WELDS : 0000008</td>
</tr>
<tr>
<td>3. COUNTER LIMIT : 0000000</td>
</tr>
</tbody>
</table>

| NUMBER Select, MENU Previous menu |
CHAPTER 5: SOFTWARE SETUP

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

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

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

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

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

Copy A Schedule

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

NOTE: There are two fields in the COPY SCHEDULE screen. These fields determine which schedule will be copied (source) and which schedule will be overwritten (destination). The number of the schedule most recently displayed initially appears in the source schedule and the next consecutive schedule appears in the destination schedule.
2. Use the numeric keypad to enter the number of the **source** schedule.
3. Press the schedule key to select the **destination** schedule number field.
4. Use the numeric keypad to enter the number of the **destination** schedule.
5. Press the schedule key. The contents of the source schedule will be copied to the destination schedule, overwriting the previous contents of the destination schedule.

   **NOTE:** All monitor settings and limits are also copied.

### System Security

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

<table>
<thead>
<tr>
<th>SYSTEM SECURITY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SCHEDULE LOCK: OFF</td>
<td></td>
</tr>
<tr>
<td>2. SYSTEM LOCK: OFF</td>
<td></td>
</tr>
<tr>
<td>3. CALIBRATION LOCK: OFF</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

3. Enter a 7-digit number, from 0000001 to 9999999, in the code field, then enter a period. This will bring up the **SYSTEM SECURITY** menu screen, this time with **SCHEDULE LOCK: ON**. With **ON** selected, all other weld schedules are locked out and cannot be modified or used for welding.

4. To unlock the Control from security protection, return to the **CHANGE STATUS** screen and enter the code that you entered in Step 3. This will bring up the **SYSTEM SECURITY** menu screen, this time with **SCHEDULE LOCK: OFF**.
5. If you forget the security code and wish to unlock the Control from security protection:
   a) Return to the **CHANGE STATUS** screen.
   b) Enter a security code of **414**, followed by a period.
6. Keep pressing the **MENU** key to return to the **MAIN MENU**.

**Calibration**

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

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

---

*** CAUTION ***

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

---

**Reset Defaults**

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

### Defaults for Setup Menu 1

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot Switch Weld Abort</td>
<td>OFF</td>
</tr>
<tr>
<td>END OF CYCLE BUZZER</td>
<td>OFF</td>
</tr>
<tr>
<td>BUZZER ON WELD STOP</td>
<td>OFF</td>
</tr>
<tr>
<td>UPDATE GRAPH AFTER WELD</td>
<td>ON</td>
</tr>
<tr>
<td>ALL SCREEN UPDATES</td>
<td>ON</td>
</tr>
</tbody>
</table>
### Defaults for Setup Menu 2

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Contrast</td>
<td>080%</td>
</tr>
<tr>
<td>Buzzer Loudness</td>
<td>030%</td>
</tr>
<tr>
<td>Switch Debounce Time</td>
<td>10 ms</td>
</tr>
<tr>
<td>Firing Switch</td>
<td>AUTO</td>
</tr>
</tbody>
</table>

### Defaults for Waveform Check

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Fire Lockout</td>
<td>OFF</td>
</tr>
<tr>
<td>Weld Fire Lockout Charge</td>
<td>90 %</td>
</tr>
</tbody>
</table>

### Defaults for Communication Menu

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Role</td>
<td>SLAVE</td>
</tr>
<tr>
<td>RS 485 ID Number</td>
<td>01</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>19.2</td>
</tr>
</tbody>
</table>

### Defaults for Chain Schedules Menu

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chain Schedules</td>
<td>OFF</td>
</tr>
</tbody>
</table>

### Defaults for Relay Menu

<table>
<thead>
<tr>
<th>SYSTEM PARAMETER</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relays 1 through 4</td>
<td>ON WHEN ALARM</td>
</tr>
</tbody>
</table>
It is common to change system and schedule settings when you customize the Control for specific welding needs. If you wish to reset the Control to the original default settings, go to the MAIN MENU, then press the 8 key to get the RESET TO DEFAULTS menu. This menu allows you to reset all system programmed parameters, all weld schedules and all schedule limits to the original factory default settings.

**Reset System Parameters**

1. From the MAIN MENU, press the 8 key to go to the RESET DEFAULTS menu.

2. From RESET DEFAULTS, press the 1 key to go to the RESET SYSTEM PARAMETERS menu.

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

4. Press MENU to return to the MAIN MENU.

**Reset All Schedules**

1. From the RESET DEFAULTS menu, press the 2 key to get to the RESET ALL SCHEDULES menu.
CHAPTER 5: SOFTWARE SETUP

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

3. Press MENU to return to the MAIN MENU.

Reset Schedule Limits

1. From the RESET DEFAULTS menu, press the 2 key to get to the RESET SCHEDULE LIMITS menu.

2. Enter the number of the schedule whose limits you want to delete. Then press the down ▼ arrow to reset the limits for this schedule.

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

Chain Schedules

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

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

In this case you would program a sequence, or "chain," that looks like this: Schedule 01 [2 times] Schedule 02 [1 time] Schedule 03 [1 time] Schedule 01. This sequence will repeat, or "loop," until you turn Chain Schedules OFF.

- Some applications require a lower current for a number of welds after the electrodes have been replaced or resurfaced. Once the electrodes have been “seasoned”, the current can be increased as required. If the electrodes require 100 welds to “season”, Schedule 01 can be programmed
with a lower current and Schedule 02 can be programmed with a higher current. The chain would look like this: **Schedule 01** [100 times] **Schedule 02** [1 time] **Schedule 02** [1 time].

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

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

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

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

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

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

4. Use the ✿ (Up/Down) keys on the front panel to scroll vertically through the Schedules 1 to 99 to highlight the weld count for the schedule you want to chain.
5. Use the numeric keypad to enter the number of times you want this schedule to weld before going to the next schedule.

6. Use the SCHEDULE key to move the highlight horizontally to select NEXT.

7. Use the numeric keypad to enter the number of the next schedule in the chain.

8. Use the SCHEDULE key to move the highlight horizontally back to the WELD COUNT column. Repeat Steps 4 through 8 to program the rest of the chain.

9. When you finish programming the chain, press the MENU key to return to the MAIN menu.

10. Return to the CHAIN SCHEDULES menu to turn the Chain Schedules feature ON or OFF as needed by pressing the 1 key.

11. Press the RUN key on the front panel, then use the * (Up/Down) keys to select the first weld schedule in the chain you want to use. The Control will now weld in the "chain" mode until you turn the CHAIN SCHEDULES feature OFF.

12. NOTE: When CHAIN SCHEDULES is turned ON, the display changes to show the chain information on the right side of the screen.

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

Requirements

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

Communication

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

<table>
<thead>
<tr>
<th>COMMUNICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ID NUMBER</td>
</tr>
<tr>
<td>2. BAUD RATE</td>
</tr>
<tr>
<td>3. COMMUNICATION ROLE</td>
</tr>
</tbody>
</table>

NUMBER Select, MENU Previous menu

I.D. Number

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

1. From the MAIN MENU, press the 5 key to go to the COMMUNICATIONS MENU.
2. From the COMMUNICATIONS MENU screen, press the 1 key to get the I.D. NUMBER entry screen.
3. Enter a two-digit number, from 01 to 99, in the I.D. NUMBER field.
4. Press the up arrow key to save the I.D. number and return to the COMMUNICATION menu screen. This time the I.D. NUMBER line will display your I.D. number entry. You can also press MENU key to save the I.D. number and to return to the MAIN MENU.
CHAPTER 5: SOFTWARE SETUP

Baud Rate

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

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

Communication Role

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

- In the MASTER role, the Control will output the weld data on the RS-232 port after each weld operation. This setup may be useful for:
  - Collection of weld data by a host computer.
  - Printing of weld data to a serial printer, providing a printout of the average voltage and current values for each weld, generating a “paper history” of welds performed.
- In the SLAVE role, the Control will send weld data only when requested by the host computer.
Section VI. Relay Settings

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

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

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

2. From the RELAY menu, press the 1, 2, 3, 4 or 5 key to select a relay menu.

3. Press the 1 key to toggle the relay contact signal state: ON (closed) or OFF (open).

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

NOTE: There are two Relay When screens that are accessed by using the ♦ ♦ keys.
5. Use the numeric keypad to select when the relay will energize. The display screen automatically returns to the WHEN menu.

### WHEN 2, page 2 of 2

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>P1 or 2 HIGH I</td>
</tr>
<tr>
<td>2.</td>
<td>P1 or 2 LOW I</td>
</tr>
<tr>
<td>3.</td>
<td>P1 or 2 HIGH V</td>
</tr>
<tr>
<td>4.</td>
<td>P1 or 2 LOW V</td>
</tr>
<tr>
<td>5.</td>
<td>NO WELD SWITCH</td>
</tr>
<tr>
<td>6.</td>
<td>P1 or 2 HIGH P</td>
</tr>
<tr>
<td>7.</td>
<td>P1 or 2 LOW P</td>
</tr>
<tr>
<td>8.</td>
<td>P1 or 2 HIGH R</td>
</tr>
<tr>
<td>9.</td>
<td>P1 or 2 LOW R</td>
</tr>
<tr>
<td>0.</td>
<td>WELD COUNTER</td>
</tr>
</tbody>
</table>

#### WHEN

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

- **END OF WELD**
  - When welding, the relay output signal will start 0-10 ms after the end of the **HOLD** period and will stay energized for 650-850 ms. If another weld is initiated within this time, the **END OF WELD** relay will be reset at the start of the next weld. The relay will still close in the event of an aborted weld.

- **ALARM**
  - The relay output signal will start when the Control senses certain **ALARM** conditions (with the **exception** of **OUT OF LIMITS** alarms) and will stay energized until the **ALARM** state is cleared by pressing the **RUN** button (refer to Appendix D, LCD Display Messages).

- **OUT OF LIMITS**
  - The relay will switch when the Control senses any **OUT OF LIMITS** condition. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

- **V-A TIME OUT**
  - The relay will switch if the actual time exceeds the user set time for Tv for a Pulse using the **Combo** (V-A) feedback mode. It will start 0-5 ms after the end of **Pulse 1** is aborted and will stay energized until the **V-A TIME OUT** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

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

- **P1 HIGH LIMIT**
  - The relay signal will switch when the Control senses that the Pulse 1 energy is higher than the programmed upper limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

- **P1 LOW LIMIT**
  - The relay signal will switch when the Control senses that the Pulse 1 energy is lower than the programmed lower limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).
• **P2 HIGH LIMIT**  
  The relay signal will switch when the Control senses that the Pulse 2 energy is higher than the programmed upper limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P2 LOW LIMIT**  
  The relay signal will switch when the Control senses that the Pulse 2 energy is lower than the programmed lower limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P1 or 2 HIGH I**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 current is higher than the programmed upper limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P1 or 2 LOW I**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 current is lower than the programmed lower limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P1 or 2 HIGH V**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 voltage is higher than the programmed upper limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P1 or 2 LOW V**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 voltage is lower than the programmed lower limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **NO WELD SWITCH**  
  The relay signal with switch when **WELD/NO WELD** button on the front panel is pressed. It will switch within 0-5ms after the button is pressed.

• **P1 or 2 HIGH P**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 power is higher than the programmed upper limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

• **P1 or 2 LOW P**  
  The relay signal will switch when the Control senses that the Pulse 1 or 2 power is lower than the programmed lower limit. It will start 0-5 ms after the end of **HOLD** and will stay energized until the **OUT OF LIMITS** alarm state is cleared by pressing the **RUN** button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).
CHAPTER 5: SOFTWARE SETUP

- **P1 or 2 HIGH R**  The relay signal will switch when the Control senses that the Pulse 1 or 2 resistance is higher than the programmed upper limit. It will start 0-5 ms after the end of HOLD and will stay energized until the OUT OF LIMITS alarm state is cleared by pressing the RUN button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

- **P1 or 2 LOW R**  The relay signal will switch when the Control senses that the Pulse 1 or 2 resistance is lower than the programmed lower limit. It will start 0-5 ms after the end of HOLD and will stay energized until the OUT OF LIMITS alarm state is cleared by pressing the RUN button, or at the start of the next weld (refer to Appendix D, LCD Display Messages).

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

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

Section I: Precautions

General Operator Safety

_ALWAYS_ wear safety goggles and other appropriate safety equipment when you are _performing a_ welding operation.

Section II: Operator Maintenance

The Control does not require any Operator Maintenance other than calibration. To ensure consistently accurate welds, Amada Miyachi America recommends that you calibrate the Control at least once a year. For calibration instructions, please refer to Chapter 7, Calibration.

Section III: Troubleshooting

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

General Kinds of Problems

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

Soft

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

- Correct force is set at the weld head
- Correct weld energy and time is set at the Control
- The equipment is set up properly
- All electrical connections are tight
- Electrode alignment allows flush contact with the weld pieces
- Electrodes are properly dressed
CHAPTER 6: USER MAINTENANCE

Hard

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

In either case, you may telephone the Amada Miyachi America Applications Laboratory for assistance by calling the telephone number listed in the Foreword and asking for the Applications Laboratory.

Alarm Messages

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

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

Troubleshooting

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

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

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

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CAUSE (In Order of Probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCD is operational, the Control will attempt to fire, but no energy is provided to the weld and the graphs in the <strong>RUN</strong> screen will not fill in.</td>
<td>Possible open circuit in the secondary circuit. Electrodes did not close properly. Possible failed Capacitor Charging Power Supply. Contact Amada Miyachi America for support.</td>
</tr>
</tbody>
</table>
Troubleshooting Chart

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CAUSE (In Order of Probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Piece Warping.</td>
<td>Excessive weld time set at the Control.</td>
</tr>
<tr>
<td></td>
<td>Excessive weld head force.</td>
</tr>
<tr>
<td></td>
<td>Incompatible weld piece projection design.</td>
</tr>
<tr>
<td></td>
<td>Incompatible weld piece materials.</td>
</tr>
<tr>
<td></td>
<td>Wrong electrode tip shape.</td>
</tr>
<tr>
<td></td>
<td>Excessive current/energy set at the Control.</td>
</tr>
</tbody>
</table>

Technical Assistance

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

Electrode Maintenance

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

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

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

WARNING

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

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

<table>
<thead>
<tr>
<th>Fuse</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 10 Amp, 250 VAC, 5 x 20mm</td>
<td>Rear Panel</td>
</tr>
</tbody>
</table>
CHAPTER 7
CALIBRATION

Section I: Introduction

Overview

CAUTION

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

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

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

Calibration Equipment Required

This equipment is required for calibration:

- 2 weld cables, No. 2/0, 1 ft (30 cm) long, PN 2/0 BB12
- Calibration Kit, PN 10-390-01
  - Voltage Connection Calibration Cable, PN 4-35913-01
  - Standard BNC Cable, PN 205-157
  - BNC "T-Connector", PN 250-486
  - Firing Switch Calibration Cable, PN 4-39179-01
- Digital oscilloscope, Agilent MSO6034A or equivalent
- DC Power Supply Agilent 3630A or equivalent
CHAPTER 7: CALIBRATION

Calibration Equipment (Continued)

For DC29
- 2.500 milliohm coaxial shunt resistor accurate to ± 0.5%
  (T&M Research Products Model K-2000-4, 150 Watts, Mod .0025)

For UB29
- 10 milliohm coaxial resistor accurate to ± 0.5%
  (T&M Research Products Model K-500-1, 150 Watts, Mod .0100)

For UB29A
- 4 milliohm coaxial resistor accurate to ± 0.5%
  (T&M Research Products Model K-1000-2, 150 Watts, Mod .0040)

Source for shunt resistors:
T & M Research Products, Inc. Telephone: (505) 268-0316
139 Rhode Island Street NE E-Mail: www.tandmresearch.com
Albuquerque, New Mexico 87108
Section II: Calibration Equipment Setup

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

Calibration Setup for Current, Voltage and Power

NOTES:

- The ground of the oscilloscope should be isolated from the ground of the electrical "live" by an isolation transformer or other means.
- The filter in the Calibration Kit goes between the BNC cable and the oscilloscope input.
Calibration Setup for Verification of Voltage Measurement After Calibration
Section III: Calibration Procedure for Current and Power

The Control uses a two point calibration for both current and power. The values used for calibration are shown in the following table. The screens shown in this section are the DC29 screens. The UB29/UB29A screens are the same as the DC29 except the low and high calibration point values shown on the screens are different.

The DC/UB29 use a test waveform for calibration that consists of a 0.5ms upslope followed by a 2.0ms pulse. All measurements for calibration are to be done during the last 1ms of the 2ms pulse.

<table>
<thead>
<tr>
<th>Calibration Point</th>
<th>UB29</th>
<th>UB29A</th>
<th>DC29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Value Voltage</td>
<td>1.00V</td>
<td>0.50V</td>
<td>1.00V</td>
</tr>
<tr>
<td>High Value Voltage</td>
<td>4.00V</td>
<td>5.00V</td>
<td>6.00V</td>
</tr>
<tr>
<td>Low Value Current</td>
<td>50 Amps</td>
<td>0.10 kAmps</td>
<td>0.40 kAmps</td>
</tr>
<tr>
<td>High Value Current</td>
<td>400 Amps</td>
<td>1.00 kAmps</td>
<td>2.50 kAmps</td>
</tr>
<tr>
<td>Low Value Power</td>
<td>0.100 kWatts</td>
<td>0.10 kWatts</td>
<td>0.40 kWatts</td>
</tr>
<tr>
<td>High Value Power</td>
<td>2.0 kWatts</td>
<td>6.50 kWatts</td>
<td>15.0 kWatts</td>
</tr>
</tbody>
</table>

SHUNT LOAD RESISTANCE FOR UB29: 10mΩ
SHUNT LOAD RESISTANCE FOR UB29A: 4mΩ
SHUNT LOAD RESISTANCE FOR DC29: 2.5mΩ

Pre-Calibration Procedure
1. Verify that the equipment is connected as shown in Section II in the Calibration Setup diagram.

2. Turn the Control ON.

3. Press the MENU key to bring up the MAIN MENU screen.

4. Press the 7 key to select CALIBRATION.

<table>
<thead>
<tr>
<th>MAIN MENU</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. WAVEFORM CHECK</td>
</tr>
<tr>
<td>1. SETUP</td>
</tr>
<tr>
<td>2. WELD COUNTERS</td>
</tr>
<tr>
<td>3. COPY A SCHEDULE</td>
</tr>
<tr>
<td>4. SYSTEM SECURITY</td>
</tr>
<tr>
<td>5. COMMUNICATIONS</td>
</tr>
<tr>
<td>6. RELAY</td>
</tr>
<tr>
<td>7. CALIBRATION</td>
</tr>
<tr>
<td>8. RESET DEFAULTS</td>
</tr>
<tr>
<td>9. CHAIN SCHEDULES</td>
</tr>
</tbody>
</table>

**Number Select an item**

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

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

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

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

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

<table>
<thead>
<tr>
<th>CALIBRATION LOAD SHUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTER LOAD VALUE : 2.445 mΩ</td>
</tr>
</tbody>
</table>

**Number Select, Page, Run or Menu**
Current Calibration (DC29 Screens Shown)

The 2.5KA CALIBRATE D/A screen is used to calibrate the upper calibration point for Current. This screen for the DC29 is shown below. When this screen is displayed, fire the Control and look at the current waveform output on the oscilloscope. For correct calibration the upper part of the waveform shown on the oscilloscope should be at the voltage reading listed on this screen of the unit under test in the area outlined at the beginning of this section. Verify that the voltage reading on the oscilloscope is within tolerance.

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

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

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

9. Repeat the calibration process for the lower calibration point. Press the . key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.

10. When complete, press the **MENU** key to go to the next calibration screen.

**VOLTAGE CALIBRATION (DC29 Screens Shown)**

The **6.00V CALIBRATE D/A** screen is used to calibrate the upper calibration point for **Voltage**. This screen for the DC29 is shown below. When this screen is displayed, fire the Control and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down Arrow key. Adjust values within ±1.0% of expected.

2. Fire the Control again and observe the output on the oscilloscope. Repeat as needed.

3. When the top of the waveform is at the proper level press the . key to go to the next calibration screen.

The **1.00V CALIBRATE D/A** screen is used to calibrate the lower calibration point for **Voltage**. This screen for the DC29 is shown below. When this screen is displayed, fire the Control and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.
CHAPTER 7: CALIBRATION

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down Arrow key. Adjust values within ±1.0% of expected.

2. Fire the Control again and observe the output on the oscilloscope. Repeat as needed.

3. When the top of the waveform is at the proper level, press the key to go to the next calibration screen.

The previous 6.00V CALIBRATE D/A screen will be displayed. The previous calibration for the upper calibration point may have moved due to the calibration of the lower calibration point.

4. Repeat the calibration process for the upper calibration point.

5. Repeat the calibration process for the lower calibration point. Press the key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.

6. When complete, press the MENU key to go to the next calibration screen.

POWER CALIBRATION (DC29 Screens Shown)

The 15.00KW CALIBRATE D/A screen is used to calibrate the upper calibration point for Power. This screen for the DC29 is shown below. When this screen is displayed, fire the Control and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down Arrow key. Adjust values within ±3.0% of expected.

2. Fire the Control again and observe the output on the oscilloscope. Repeat as needed.

3. When the top of the waveform is at the proper level, press the key to go to the next calibration screen.

100 is a reference value for the calibration adjustment for the high calibration point. This value is incremented or decremented by one for each press of the ▲▼ keys.
CHAPTER 7: CALIBRATION

The 400W CALIBRATE D/A screen is used to calibrate the lower calibration point for Power. This screen for the DC29 is shown below. When this screen is displayed, fire the Control and look at the voltage waveform output on the oscilloscope. For correct calibration the upper part of the waveform during the specified interval should be at the voltage reading listed on this screen of the unit under test.

1. If the waveform is too low, press the Up arrow key. If the waveform is too high, press the Down Arrow key. Adjust values within ±3.0% of expected.

2. Fire the Control again and observe the output on the oscilloscope. Repeat as needed.

3. When the top of the waveform is at the proper level, press the key to go to the next calibration screen.

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

4. Repeat the calibration process for the upper calibration point.

5. Repeat the calibration process for the lower calibration point. Press the key to switch between the High and Low calibration screens. After a few iterations of this process, the upper and lower calibration points will measure as required without additional adjustment.

6. When complete, press the MENU key to exit calibration.

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

   3. END OF CALIBRATION
   HAVE A NICE DAY!!!
   I D/A = 20 + 103  I A/D = 100 + 101
   V D/A = 103 + 97  V A/D = 100 + 97
   P D/A = 112 + 89  P A/D = 100 + 100

   Press MENU to exit calibration

DC29/UB29/UB29A LINEAR DC RESISTANCE WELDING CONTROLS
7-10 990-919
Section IV: Verification Check for Voltage

1. Verify that the equipment is connected as shown in Section II in the Setup for Verification of Voltage Measurement After Calibration diagram. Turn the DC Power Supply ON and set to 1.00 Volt output.

2. Turn the Control ON.

3. Press the MENU key to bring up the MAIN MENU screen.

4. Press the 7 key to select CALIBRATION.

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

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

The VERIFY VOLTAGE screen displays the voltage level measured by the Control. In the screen shown on the right, this value is 1.01 volts. This reading should be within the specification for the Control. If it is not, please consult Amada Miyachi America.

You can change the output of the DC Power Supply from 0 to 9.9 Volts. DO NOT EXCEED 10 VOLTS. Too high a voltage may damage the Control. Press RUN or MENU to exit this screen.
Section V: Reset Calibration

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

1. Turn the Control **ON**.
2. Press the **MENU** key to bring up the **MAIN MENU** screen.
3. Press the **7** key to select **CALIBRATION**.
4. From the first calibration screen, press the keypad down (down) key to go to the **PRE-CALIBRATION** screen.

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

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

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

   *** WARNING ***
   THIS RESETS CALIBRATION TO DEFAULT AND MAY DESTROY CALIBRATION SETTINGS.

   **ARE YOU SURE TO RESET CALIBRATION?**
   1. **NO**
   2. **YES**
If the 2 key was pressed on the previous screen, the PRE-CALIBRATION screen will be displayed with a message confirming the values were reset to default values.

8. Press RUN or MENU to exit this screen.

PRE-CALIBRATION

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

CALIBRATION VALUES RESET TO DEFAULT

NUMBER Select, Page, RUN or MENU
APPENDIX A
TECHNICAL SPECIFICATIONS

General

The DC29 and UB29 are linear DC resistance welding power supplies that send energy directly into a weld without the use of a welding transformer. They are capable of executing any weld function at low current, voltage or power levels with high stability and good control.

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

<table>
<thead>
<tr>
<th>Physical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions: See Illustration:</td>
</tr>
<tr>
<td>Weight: 49 Pounds (22 Kg)</td>
</tr>
</tbody>
</table>

NOTE: In the following table, Values are for both DC29 and UB29 unless noted otherwise

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Line Voltage (1 phase):</td>
<td>Standard nominal voltages and suggested breaker ratings: 88-264 VAC, 47 – 63Hz</td>
</tr>
<tr>
<td>Input kVA: (max demand):</td>
<td>1.5 kVA</td>
</tr>
<tr>
<td>Output Capability: (max available to load):</td>
<td>Based on load</td>
</tr>
</tbody>
</table>
**APPENDIX A: TECHNICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Current/Steps:</strong> (Programmable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB29</td>
<td>5-500 Amps, 1 Amp/step</td>
<td>Actual achievable output based on load.</td>
</tr>
<tr>
<td>UB29A</td>
<td>15-1500 Amps, 1 Amp/step</td>
<td>Note: Limit detection occurs within ±4A of programmed limit value for DC29, ±3A of programmed limit value for UB29A, and ±2A of programmed limit value for UB29.</td>
</tr>
<tr>
<td>DC29</td>
<td>200-4000 Amps, 10 Amps/step</td>
<td></td>
</tr>
<tr>
<td><strong>Output Voltage/Steps:</strong> (Programmable)</td>
<td>0.10 – 9.99V (10mV steps)</td>
<td>Actual achievable output based on load.</td>
</tr>
<tr>
<td><strong>Output Power/Steps:</strong> (Programmable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB29</td>
<td>0.05 – 4.99kW, 10 watts/step</td>
<td>Actual achievable output based on load.</td>
</tr>
<tr>
<td>UB29A</td>
<td>0.1 – 9.99kW, 10 watts/step</td>
<td>Note: Limit detection occurs within ±5% of programmed limit value.</td>
</tr>
<tr>
<td>DC29</td>
<td>0.1 – 25.00kW, 10 watts/step</td>
<td></td>
</tr>
<tr>
<td><strong>Resistance Monitoring Limits</strong></td>
<td>---</td>
<td>Note: Limit detection occurs within ±5% of programmed limit value.</td>
</tr>
<tr>
<td><strong>Weld Period:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squeeze</td>
<td>0 – 999ms, 1.0ms / step</td>
<td>Note: If downslope is greater than 0ms, then upslope or weld pulse must be greater than 0ms.</td>
</tr>
<tr>
<td>First/Second Pulse</td>
<td>0 – 99ms, 0.1ms/step</td>
<td></td>
</tr>
<tr>
<td>Up/Downslope</td>
<td>0 – 99ms, 0.1ms/step</td>
<td></td>
</tr>
<tr>
<td>Cool</td>
<td>0 – 99ms, 0.1ms/step</td>
<td></td>
</tr>
<tr>
<td>Hold</td>
<td>0 – 99ms, 0.1ms/step</td>
<td></td>
</tr>
<tr>
<td><strong>Duty Cycle:</strong></td>
<td>Based on load</td>
<td>See Repetition Rates</td>
</tr>
<tr>
<td><strong>Weld Control:</strong></td>
<td>Weld Current, Voltage, or Power with simultaneous limits on one unregulated parameter for each pulse</td>
<td>---</td>
</tr>
<tr>
<td>(Average values are regulated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Regulation During Load Resistance Fluctuation:</strong></td>
<td>Current: +/-2% of setting +/- 10A</td>
<td>Load variation from 0.5 to 10 milliohms, exclusive of ripple. After weld time of 2ms.</td>
</tr>
<tr>
<td></td>
<td>Voltage: +/-2% of setting +/- 0.05V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power: +/-5% of setting +/-50W</td>
<td></td>
</tr>
<tr>
<td><strong>Steady State Regulation During Line Fluctuations:</strong></td>
<td>Output: +/- 2% of reading</td>
<td>Line voltage within input range</td>
</tr>
</tbody>
</table>
## APPENDIX A: TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Range and Accuracy:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current UB29</td>
<td>5 – 500 Amps, ± 2% of setting or ± 2.5A whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Current UB29A</td>
<td>15-1500 Amps, ±2% of setting or ±7.0A whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Current DC29</td>
<td>200 – 4000 Amps, ± 2% of setting or ±10A whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>0.1 – 9.99 Volts, ± 2% of setting or ±0.05V whichever is greater</td>
<td>Measurements are taken during the last 1ms of a test pulse with 0.5ms rise time and 2ms pulse width using standard test configuration.</td>
</tr>
<tr>
<td>Power UB29</td>
<td>0.050 – 4.99 kWatts, ± 5% of setting or ±12W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Power UB29A</td>
<td>0.070 – 9.999 kWatts, ± 5% of setting or ±40W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Power DC29</td>
<td>0.100 – 25.00 kWatts, ± 5% of setting or ±50W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Measurement Range and Accuracy:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current UB29</td>
<td>0 – 500 Amperes, ± 2% of actual value or 5A whichever is greater.</td>
<td>User selectable limits on peak values of one of three parameters: current, voltage, or power. When a parameter goes outside of limits, the unit can be set to report the error, terminate the weld, or inhibit a second pulse.</td>
</tr>
<tr>
<td>Current UB29A</td>
<td>0 – 1500 Amperes, ± 2% of actual value or 10A whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Current DC29</td>
<td>0 – 4000 Amperes, ± 2% of actual value or 20A whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>0 – 9.99 Volts, ± 2% of actual value or 50 mV whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Power UB29</td>
<td>0 – 4.99 kW, ± 5% of actual value or 10W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Power UB29A</td>
<td>0 – 4.99 kW, ± 5% of actual value or 10W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Power DC29</td>
<td>0 – 25.00 kW, ± 5% of actual value or 50W whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Rise Time:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current, Voltage and Power Control Modes</td>
<td>Limited by External secondary circuit</td>
<td></td>
</tr>
<tr>
<td>V-A Control Mode</td>
<td>500A/ms maximum</td>
<td></td>
</tr>
<tr>
<td>Weld Schedules:</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>Data Communications:</td>
<td>Remote capability to upload / download weld schedule; monitor welds; set up parameters; select schedule; and read weld results buffer</td>
<td></td>
</tr>
</tbody>
</table>
## Environmental Characteristics

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Ambient Air Temperature:</td>
<td>0 - 40 degrees C</td>
<td>---</td>
</tr>
<tr>
<td>Operating Humidity:</td>
<td>10 - 95% Relative Humidity</td>
<td>(Non-condensing)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Inputs</td>
<td>24 VDC 5 mA typical, 2500 Vrms optically isolated</td>
</tr>
<tr>
<td>Digital Outputs</td>
<td>30 VAC or VDC 0.5 amps, optically isolated solid state relays</td>
</tr>
<tr>
<td>Fire, Footswitch, Alarm, Alarm Reset, Schedule Selection, Weld Inhibit Signal Inputs</td>
<td>24VDC inputs, 5 mA, hardware selectable for positive or negative logic.</td>
</tr>
<tr>
<td>Emergency Stop Input</td>
<td>External Emergency Stop Switch rated for 24VDC, 2 amps</td>
</tr>
<tr>
<td>Voltage Sense Input</td>
<td>15 VDC, 0.1A maximum</td>
</tr>
<tr>
<td>Head Valve Driver</td>
<td>24 VDC, 0.5A maximum</td>
</tr>
<tr>
<td>Programmable Relays</td>
<td>Contact rating: 0.5A at 30 VAC or 30 VDC maximum</td>
</tr>
</tbody>
</table>
APPENDIX B
ELECTRICAL AND DATA CONNECTIONS

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

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

Voltage Sense Input

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>SIGNAL NAME</th>
<th>SIGNAL TYPE</th>
<th>MAX VOLTAGE</th>
<th>MAX CURRENT</th>
<th>I/O</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
<td></td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>Input #1 V+</td>
<td>Pulse</td>
<td>15V</td>
<td>0.1A</td>
<td>I</td>
<td>Note: Polarity of Pins 1 and 2 must be set correctly.</td>
</tr>
<tr>
<td>3</td>
<td>Input #2 V-</td>
<td>Pulse</td>
<td>15V</td>
<td>0.1A</td>
<td>I</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: ELECTRICAL AND DATA CONNECTIONS

RS 232

RS 232 CONNECTOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>DESCRIPTION</th>
<th>PIN TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TX (Transmit Data)</td>
<td>RS-232 Driver</td>
</tr>
<tr>
<td>3</td>
<td>RX (Receive Data)</td>
<td>RS-232 Receiver</td>
</tr>
<tr>
<td>4</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Signal Ground</td>
<td>Analog Ground (ISOGND1)</td>
</tr>
<tr>
<td>6</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Not Used</td>
<td></td>
</tr>
</tbody>
</table>
## I/O Signal Interface J1A and J1B

### I/O SIGNAL INTERFACE A CONNECTOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>PIN #</th>
<th>NAME</th>
<th>I/O</th>
<th>VOLTAGE (Max.)</th>
<th>CURRENT (Max.)</th>
<th>SIGNAL TYPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1A-1</td>
<td>FS1</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Foot Switch 1 input</td>
</tr>
<tr>
<td>J1A-2</td>
<td>FS2</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Foot Switch 2 input</td>
</tr>
<tr>
<td>J1A-3</td>
<td>Fire</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Firing Switch input</td>
</tr>
<tr>
<td>J1A-4</td>
<td>F3 Pullup</td>
<td>I</td>
<td>+ 24V dc</td>
<td>15 mA</td>
<td>voltage signal</td>
<td>Jumper to pin no. 5 or 6, as appropriate, to receive FS1, FS2, and Fire switch input circuit excitation</td>
</tr>
<tr>
<td>J1A-5</td>
<td>24V +</td>
<td>O</td>
<td></td>
<td></td>
<td>24V _I/O DC Power Supply</td>
<td>Provide FS1, FS2, and Fire switch input circuit excitation</td>
</tr>
<tr>
<td>J1A-6</td>
<td>24V -</td>
<td>O</td>
<td></td>
<td></td>
<td>24V _I/O DC Power Supply</td>
<td>Provide FS1, FS2, and Fire switch input circuit excitation</td>
</tr>
<tr>
<td>J1A-7</td>
<td>I/O Common</td>
<td>I</td>
<td>+ 24V dc</td>
<td>45 mA</td>
<td>voltage signal</td>
<td>Jumper to pin no. 8 or 9, as appropriate, to receive input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs</td>
</tr>
<tr>
<td>J1A-8</td>
<td>24V +</td>
<td>O</td>
<td></td>
<td></td>
<td>24V _I/O DC Power Supply</td>
<td>Provide input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs</td>
</tr>
<tr>
<td>J1A-9</td>
<td>24V -</td>
<td>O</td>
<td></td>
<td></td>
<td>24V _I/O DC Power Supply</td>
<td>Provide input circuit excitation for Binary 0 to Binary 6, Weld Inhibit, and Reset Alarm inputs</td>
</tr>
<tr>
<td>J1A-10</td>
<td>Binary 0</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-11</td>
<td>Binary 1</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-12</td>
<td>Binary 2</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-13</td>
<td>Binary 3</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-14</td>
<td>Binary 4</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-15</td>
<td>Binary 5</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1A-16</td>
<td>Binary 6</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Binary Schedule Inputs</td>
</tr>
<tr>
<td>J1B-17</td>
<td>Weld Inhibit</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Prevent Weld Pulse</td>
</tr>
<tr>
<td>J1B-18</td>
<td>Reset Alarm</td>
<td>I</td>
<td>+ 24V dc</td>
<td>5 mA</td>
<td>voltage signal</td>
<td>Reset Alarms and Relay Outputs</td>
</tr>
</tbody>
</table>
## I/O SIGNAL INTERFACE A CONNECTOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>PIN #</th>
<th>NAME</th>
<th>I/O</th>
<th>VOLTAGE (Max.)</th>
<th>CURRENT (MAX.)</th>
<th>SIGNAL TYPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1B-19</td>
<td>EMO1</td>
<td>O</td>
<td>+24 V dc</td>
<td></td>
<td></td>
<td>Emergency Stop (EMO) Switch terminal 1</td>
</tr>
<tr>
<td>J1B-20</td>
<td>EMO2</td>
<td>I</td>
<td></td>
<td>2 A</td>
<td></td>
<td>Emergency Stop (EMO) Switch terminal 2</td>
</tr>
<tr>
<td>J1B-21</td>
<td>RELAY1N</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 1 Negative</td>
</tr>
<tr>
<td>J1B-22</td>
<td>RELAY1P</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 1 Positive</td>
</tr>
<tr>
<td>J1B-23</td>
<td>RELAY2N</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 2 Negative</td>
</tr>
<tr>
<td>J1B-24</td>
<td>RELAY2P</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 2 Positive</td>
</tr>
<tr>
<td>J1B-25</td>
<td>RELAY3N</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 3 Negative</td>
</tr>
<tr>
<td>J1B-26</td>
<td>RELAY3P</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 3 Positive</td>
</tr>
<tr>
<td>J1B-27</td>
<td>RELAY4N</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 4 Negative</td>
</tr>
<tr>
<td>J1B-28</td>
<td>RELAY4P</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 4 Positive</td>
</tr>
<tr>
<td>J1B-29</td>
<td>RELAY5N</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 5 Negative</td>
</tr>
<tr>
<td>J1B-30</td>
<td>RELAY5P</td>
<td>O</td>
<td>30Vac OR 30Vdc</td>
<td>0.5 A</td>
<td>relay contact</td>
<td>Relay output 5 Positive</td>
</tr>
<tr>
<td>J1B-31</td>
<td>VALVE+</td>
<td>O</td>
<td>+24 V dc</td>
<td>0.5 A</td>
<td>voltage signal</td>
<td>Valve Driver +</td>
</tr>
<tr>
<td>J1B-32</td>
<td>VALVE-</td>
<td>O</td>
<td></td>
<td>0.5 A</td>
<td>voltage signal</td>
<td>Valve Driver -</td>
</tr>
</tbody>
</table>
APPENDIX B: ELECTRICAL AND DATA CONNECTIONS

I/O Wiring Diagram

UNIT SIDE  USER SIDE

NEGATIVE LOGIC CONFIGURATION

POSITIVE LOGIC CONFIGURATION

FS1/FS2/FIRE AND OTHER I/O MAY BE CONFIGURED FOR DIFFERENT LOGIC POLARITY
INPUT SWITCHES MAY BE CONTACTS OR TRANSISTOR WITH ATTENTION TO PROPER POLARITY

RELAYS RATED 30 VDC/VAC 0.5AMP MAX

HEAD VALVE

DC29/UB29/UB29A LINEAR DC RESISTANCE WELDING CONTROL

990-919
APPENDIX B: ELECTRICAL AND DATA CONNECTIONS

Configuration for Common Input Connections:

16-Pin Mating Plug J1A Connector
This connector is included in the Ship Kit supplied with the Control. It should be attached to I/O Connector J1A during installation. This connector as supplied has an internal jumper between pins 4 and 5 (Foot switch and Fire switch circuit excitation voltage +24V) as well as an internal jumper between pins 4 and 5 (Digital Inputs circuit excitation voltage +24V).

NOTE: In order to operate, mating plug must be attached to the I/O connector
This connector is included in the Ship Kit supplied with the Control. It should be attached to I/O Connector J1B during installation. This connector as supplied has Pins 19 & 20 connected to the shorting wires (see illustration below) for the Emergency Stop Input. The external wires are provided so the user can connect to an Emergency Stop Switch. Opening the connection will cause the Control to initiate an Emergency Stop. The display will show **Emergency Stop - Operator Activated** and a beep will sound. An Emergency Stop will disable all power outputs.

To reset the condition, the switch connection must be closed, and the **RUN** key must be pushed on the front panel, or the **RESET DIGITAL INPUT** must be set to **ACTIVE** in order to reset the Control. Users should verify that the weld Schedule is correct. If not, reset to the correct schedule if necessary.

An instruction tag is attached to the shorting wires with a cable tie. Instructions are printed on the front and back of the tag in several languages (full text below).

---

**Emergency Stop Switch Instruction Tag**

---

**- EMERGENCY STOP-**
Open electrical circuit to retract weld head.

**- DESCONEXION DE EMERGENCIA -**
Abra el circuito eléctrico para retraer la cabeza de soldadura.

**- PARADA DE EMERGÊNCIA -**
Abrir o circuito elétrico para tirar a cabeça da máquina.

**- ARRESTO D'EMERGENZA-**
Interrompere l'alimentazione per risalita testa.

**- HÄTÄKYTKIN POIS -**
Ava virtapiiri vetääksesi hitsauspääkin takaisin.

---

**- ARRET D'URGENCE -**
Ouvrez le circuit électrique pour retirer la tête de soudure.

**- NOODSTOP -**
Open het elektrische circuit om de laskop terug te trekken.

**- NÖDSTOPP -**
Öppna den elektriska kretsen för att dra tillbaka svetstråden.

**- NOT AUSSCHALTER -**
Würd den elektrischen Kreis öffen, der Schweßkopf würd zurück gezogen.
APPENDIX B: ELECTRICAL AND DATA CONNECTIONS

AC Input Power Connection

AC INPUT POWER CONNECTION SPECIFICATIONS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TERMINAL</th>
<th>MAXIMUM VOLTAGE</th>
<th>MAXIMUM CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC29/UB29</td>
<td>Hot</td>
<td>85 - 264 volts</td>
<td>10 amps</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Ground</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
### DC29 WELD TERMINAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>TERMINAL</th>
<th>MAXIMUM VOLTAGE</th>
<th>MAXIMUM CURRENT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>9.9 volts</td>
<td>5,000 amps</td>
<td>Variable</td>
</tr>
<tr>
<td>-</td>
<td>--</td>
<td>--</td>
<td>Return</td>
</tr>
</tbody>
</table>

### UB29 WELD TERMINAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>TERMINAL</th>
<th>MAXIMUM VOLTAGE</th>
<th>MAXIMUM CURRENT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>9.9 volts</td>
<td>500 amps</td>
<td>Variable</td>
</tr>
<tr>
<td>-</td>
<td>--</td>
<td>--</td>
<td>Return</td>
</tr>
</tbody>
</table>

### UB29A WELD TERMINAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>TERMINAL</th>
<th>MAXIMUM VOLTAGE</th>
<th>MAXIMUM CURRENT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>9.9 volts</td>
<td>1500 amps</td>
<td>Variable</td>
</tr>
<tr>
<td>-</td>
<td>--</td>
<td>--</td>
<td>Return</td>
</tr>
</tbody>
</table>
APPENDIX C
RELAY TIMING DIAGRAMS

Introduction

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

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

The following diagrams show the timing sequence for each relay WHEN state.
When welding, the relay output signal will start within ± 5 milliseconds of the start of SQUEEZE and will stay energized for 0-150 milliseconds after the end of the HOLD period.

**END OF WELD**

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

* If another weld is initiated within this time, the END OF WELD relay will be reset at the start of the next weld.
APPENDIX C: RELAY TIMING DIAGRAMS

ALARM

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

OUT OF LIMITS

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

UNIT READY

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

WELD COUNTER

The relay signal will switch when the TOTAL WELD COUNTER value reaches the user set value for COUNTER LIMIT. It will start 0-5 ms after the end of HOLD and will stay energized until the user changes the TOTAL WELDS or COUNTER LIMIT on the WELD COUNTERS Setup screen.
The relay will switch when the Control determined that V-A ramp-up time was exceeded. It will start 0-5 milliseconds after the weld is aborted and will stay energized until the V-A TIME OUT alarm is cleared by pressing the RUN button, or at the start of the next weld.
APPENDIX D
LCD DISPLAY MESSAGES

Introduction

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

- Alarm
- Out of Limits
- General Status

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

Relay Activation

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

Clearing Alarm Conditions to Resume Operation

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

1. Take the Corrective Action shown next to the Alarm message in the list of messages.
2. Clear the Alarm condition on the Control in order to resume operation:
   - Press the RUN key on the front panel of the Control.
   - Momentarily close the Reset Alarm Inhibit input on I/O Connector J1B on the rear panel.
3. Repeat until all alarms are cleared

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

List of Messages

The following pages list LCD display messages in alphabetical order.
## LCD Display Messages

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

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK VOLTAGE CABLE</td>
<td>No electrode voltage measurement was made.</td>
<td>Verify that the Voltage Sense Cable is properly connected to the electrodes or electrode holder. NOTE: Polarity is important for the cable connection.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>COOL TIME ADDED, DIFFERENT FEEDBACK</td>
<td>The Control automatically added Cool Time to the schedule because Pulse 1 and Pulse 2 feedback modes are different, or Pulse 1 and Pulse 2 energy levels are different.</td>
<td>Normal operation.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>CURRENT 1 GREATER THAN UPPER LIMIT</td>
<td>Actual weld current is greater than the user set Upper Limit value for Pulse 1.</td>
<td>Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>CURRENT 1 LOWER THAN LOWER LIMIT</td>
<td>Actual weld current is less than the user set Lower Limit value for Pulse 1.</td>
<td>Determine the cause of the low current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>CURRENT 2 GREATER THAN UPPER LIMIT</td>
<td>Actual weld current is greater than the user set Upper Limit value for Pulse 2.</td>
<td>Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>MESSAGE</td>
<td>DESCRIPTION</td>
<td>CORRECTIVE ACTION (IF REQUIRED)</td>
<td>TYPE OF MESSAGE</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>CURRENT 2 LOWER THAN</td>
<td>Actual weld current is less than the user set Lower Limit value for Pulse 2.</td>
<td>Determine the cause of the low current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>LOWER LOWER LIMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CURRENT IS AT MAXIMUM</td>
<td>The Control is providing the maximum current possible.</td>
<td>Determine the cause of the high current output. Changes to the welding setup or process can affect the energy delivered.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>EMERGENCY STOP - OPERATOR</td>
<td>The Operator Emergency Stop switch has been activated. All power outputs are disabled.</td>
<td>Remove any unsafe operating conditions at the welding electrodes. Reset the Operator Emergency Stop switch. Press RUN to reset, verify that correct weld schedule is selected.</td>
<td>ALARM</td>
</tr>
<tr>
<td>ACTIVATED</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIRING SWITCH BEFORE FOOT</td>
<td>The Firing Switch input has been activated before the Foot Switch has been activated.</td>
<td>Check the weld head for an improperly adjusted firing switch. Automation Only - Check the timing on the PLC control lines to the Firing Switch and Foot Switch inputs.</td>
<td>ALARM</td>
</tr>
<tr>
<td>SWITCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIRING SWITCH DIDN’T CLOSE</td>
<td>The Firing Switch input was not activated within 10 seconds after the Foot Switch was closed.</td>
<td>Press RUN to clear alarm. Check air pressure setting on weld head. Check Firing Switch connection.</td>
<td>ALARM</td>
</tr>
<tr>
<td>IN 10 SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ILLEGAL SECURITY CODE</td>
<td>The wrong security code was entered to de-activate the System, Schedule, or Calibration Lock protection features.</td>
<td>Press MENU, select System Security, then enter the correct access code to turn off System, Schedule, or Calibration Lock protection features. NOTE: Entering a security code of 414 will always unlock the system.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>ENTERED</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INHIBIT 2ND PULSE</td>
<td>A monitor action is programmed to inhibit the second pulse and the first pulse energy limit was reached.</td>
<td>Normal operation if this function is used. See Chapter 4, Operating Instructions.</td>
<td>OUT OF LIMITS</td>
</tr>
</tbody>
</table>
## LCD Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INHIBIT Control SIGNALS ACTIVATED</td>
<td>The Inhibit input control signal is activated, preventing the Control from continuing to operate. <strong>NOTE:</strong> Activating the Inhibit input terminates only future operations. It does NOT terminate any present Control operation.</td>
<td>Remove the Inhibit signal condition preventing further the Control operation. <strong>NOTE:</strong> The correct removal action depends on how the control signal I/O logic was programmed by the user.</td>
<td>ALARM</td>
</tr>
<tr>
<td>INPUT TOO LARGE</td>
<td>The user has attempted to program a weld energy or time that exceeds the capability of the Control.</td>
<td>Re-program welding parameters to be within the capability of the Control.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>INPUT TOO SMALL</td>
<td>The user has attempted to program a weld energy or time that is below the capability of the Control.</td>
<td>Re-program welding parameters to be within the capability of the Control.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>INVALID ERROR</td>
<td>An internal software error occurred</td>
<td>Consult factory</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>IT MODE RISE TIME TOO SMALL 500A/ms</td>
<td>Control calculated that user setpoint for time is too short to reach current setpoint for Combo Mode</td>
<td>Increase time or decrease current setpoints</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>LOWER LIMIT ADJUSTED</td>
<td>The user has attempted to program a lower or upper limit delay, which results in a limit time of less than 0.5 milliseconds.</td>
<td>Verify that the automatic correction by the Control is acceptable. Reprogram if necessary.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>LOWER LIMIT GREATER THAN UPPER LIMIT</td>
<td>The user has tried to program a Lower Limit value that is greater than the Upper Limit value for Pulse 1 or Pulse 2 time periods.</td>
<td>Re-program the invalid Lower Limit value.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>NO CURRENT READING</td>
<td>No current measurement was made. Possible open circuit.</td>
<td>Check that a closed secondary circuit is present when the Control fires. If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact Amada Miyachi America for support.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>NO VOLTAGE READING</td>
<td>No voltage measurement was made. Possible open circuit or possible voltage lead connection problem.</td>
<td>Check that a closed secondary circuit is present when the Control fires. Check voltage cable connection. If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact Amada Miyachi America for support.</td>
<td>OUT OF LIMITS</td>
</tr>
</tbody>
</table>
## APPENDIX D: LCD DISPLAY MESSAGES

### LCD Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO WELD</strong></td>
<td>User has tried to activate the Control with the <strong>WELD/NO WELD</strong> Switch in the No Weld Position. <strong>INOWELD</strong> signal might have been activated.</td>
<td>Set the <strong>WELD/NO WELD</strong> switch to the Weld position. Deactivate <strong>INOWELD</strong>.</td>
<td><strong>OUT OF LIMITS</strong></td>
</tr>
<tr>
<td><strong>OVER TEMPERATURE</strong></td>
<td>One of the internal thermal switches reaches its switching temperature indicating internal unit temperatures are too high.</td>
<td>Check that cooling fan on rear panel and internal power supply are functioning.</td>
<td><strong>GENERAL STATUS</strong></td>
</tr>
<tr>
<td><strong>P1 STOPPED - LIMIT REACHED</strong></td>
<td>When in <strong>APC</strong> mode, the user set Upper Limit value has been reached, and the weld energy has been terminated for Pulse 1.</td>
<td>Normal operation if this function is used. See Chapter 4, Operating Instructions for information on Pulse 1 <strong>OUT OF LIMITS ACTION</strong> for PART CONDITIONER..</td>
<td><strong>OUT OF LIMITS</strong></td>
</tr>
<tr>
<td><strong>POWER 1 GREATER THAN UPPER LIMIT</strong></td>
<td>Actual weld power is greater than the user set Upper Limit value for Pulse 1.</td>
<td>Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified personnel and are designed to identify process variations.</td>
<td><strong>OUT OF LIMITS</strong></td>
</tr>
<tr>
<td><strong>POWER 1 LOWER THAN LOWER LIMIT</strong></td>
<td>Actual weld power is less than the user set Lower Limit value for Pulse 1.</td>
<td>Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified personnel and are designed to identify process variations.</td>
<td><strong>OUT OF LIMITS</strong></td>
</tr>
<tr>
<td><strong>POWER 2 GREATER THAN UPPER LIMIT</strong></td>
<td>Actual weld power is greater than the user set Upper Limit value for Pulse 2.</td>
<td>Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified personnel and are designed to identify process variations.</td>
<td><strong>OUT OF LIMITS</strong></td>
</tr>
</tbody>
</table>
## LCD Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POWER 2 LOWER THAN LOWER LIMIT</strong></td>
<td>Actual weld power is less than the user set Lower Limit value for Pulse 2.</td>
<td>Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>RESISTANCE 1 GREATER THAN UPPER LIMIT</strong></td>
<td>Actual weld resistance is greater than the user set Upper Limit value for Pulse 1.</td>
<td>Determine the cause of the high resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>RESISTANCE 1 LOWER THAN LOWER LIMIT</strong></td>
<td>Actual weld resistance is less than the user set Lower Limit value for Pulse 1.</td>
<td>Determine the cause of the low resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>RESISTANCE 2 GREATER THAN LOWER LIMIT</strong></td>
<td>Actual weld resistance is greater than the user set Upper Limit value for Pulse 2.</td>
<td>Determine the cause of the high resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>RESISTANCE 2 LOWER THAN LOWER LIMIT</strong></td>
<td>Actual weld resistance is less than the user set Lower Limit value for Pulse 2.</td>
<td>Determine the cause of the low resistance. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
</tbody>
</table>
# APPENDIX D: LCD DISPLAY MESSAGES

## LCD Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHEDULES ARE RESET</td>
<td>User programmed the Control to automatically reset all weld schedules to their factory set default values.</td>
<td><strong>CAUTION:</strong> Be careful when using the <strong>MENU</strong> default features. There is no way to undo a reset to defaults action.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>SCREEN UPDATES ARE OFF</td>
<td>This message is displayed when the user goes to the <strong>RUN</strong> screen or changes the schedule while on the <strong>RUN</strong> screen when <strong>SCREEN UPDATES</strong> have been set to OFF.</td>
<td>None needed. This is a reference message only.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>SYSTEM &amp; SCHEDULE RESET TO DEFAULTS</td>
<td>During power-up, if the Control detects that internal memory is corrupt, the Control resets memory to defaults.</td>
<td>Re-enter user settings. Consult the factory if this message reoccurs.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>SYSTEM PARAMETERS ARE RESET</td>
<td>User programmed the Control to automatically reset all I/O and other system parameters to their factory set default values.</td>
<td><strong>CAUTION:</strong> Be careful when using the <strong>MENU</strong> default features. There is no way to undo a reset to defaults action.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>UPSLOPE REQUIRED FOR LOWER LIMIT</td>
<td>User has attempted to program a Lower Limit value for Weld 1 or Weld 2 periods without using an upslope period.</td>
<td>Delete the Weld 1 or Weld 2 Lower Limit value. Add an upslope period before Weld 1 or Weld 2 if a Lower Limit value is desired.</td>
<td>GENERAL STATUS</td>
</tr>
<tr>
<td>V-A TIME OUT</td>
<td>Weld current did not reach current setting within the user set time for <strong>Tv</strong> for a Pulse using the <strong>Combo</strong> (<strong>V-A</strong>) feedback mode.</td>
<td>Refer to Combo Mode description in Chapter 3 and change current and/or <strong>Tv</strong>.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>VOLTAGE 1 GREATER THAN UPPER LIMIT</td>
<td>Actual weld voltage is greater than the user set Upper Limit value for Pulse 1.</td>
<td>Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td>VOLTAGE 1 LOWER THAN LOWER LIMIT</td>
<td>Actual weld voltage is less than the user set Lower Limit value for Pulse 1.</td>
<td>Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
</tbody>
</table>
## LCD Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION (IF REQUIRED)</th>
<th>TYPE OF MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLTAGE 2 GREATER THAN UPPER LIMIT</strong></td>
<td>Actual weld voltage is greater than the user set Upper Limit value for Pulse 2.</td>
<td>Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>VOLTAGE 2 LOWER THAN LOWER LIMIT</strong></td>
<td>Actual weld voltage is less than the user set Lower Limit value for Pulse 2.</td>
<td>Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting information in Chapter 6. Limits should be set by qualified personnel and are designed to identify process variations.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>VOLTAGE IS AT MAXIMUM</strong></td>
<td>The Control is providing the maximum voltage possible.</td>
<td>Determine the cause of the high current output. Changes to the welding setup or process can affect the energy delivered.</td>
<td>OUT OF LIMITS</td>
</tr>
<tr>
<td><strong>WELD FIRE LOCKOUT – CAP BANK TOO LOW</strong></td>
<td>A weld was initiated before the capacitor bank charge reached the required level as programmed in the WAVEFORM CHECK menu. Default value for WELD FIRE LOCKOUT is 90% charge. Reducing this value with high energy levels or longer weld times could exceed the capacity of the Control.</td>
<td>Reduce the repetition rate. See Chapter 5 for programming information. See Appendix F for Repetition Rate and Control capability details.</td>
<td>ALARM</td>
</tr>
<tr>
<td><strong>WELD TIME TOO SMALL</strong></td>
<td>The user has attempted to program zero for all upslope, weld, and downslope time periods.</td>
<td>Re-program the welding parameters to be within the capability of the Control.</td>
<td>GENERAL STATUS</td>
</tr>
</tbody>
</table>
APPENDIX E
RS-232 CONNECTIONS

Section I. RS-232 Connections

Overview

The DC29/UB29 Linear DC Weld Control has an RS-232 Serial Port connector that is used to transmit commands and weld data to/from a Personal Computer (PC) / host computer or other serial communications device.

Interface Protocol

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud Rate</td>
<td>6.2k, 19.2k, 38.4k or 56.0k bits/second</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>None</td>
</tr>
</tbody>
</table>

RS-232 Serial Port Connections

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

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>TxD (transmit)</td>
</tr>
<tr>
<td>3</td>
<td>RxD (receive)</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Connect a standard RS-232 cable between your host computer COM port and the DC29/UB29 Control serial data port or build your own cable with a standard DB9-M connector (AMYA # 250-193) and backshell (AMYA # 250-194).
Section II. Command Format

Remote Data Collection and Programming

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

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

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

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

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

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

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

```
#01 REPORT OLD 10 <cr><lf>
```
The weld data counter in the Control is decremented by 10. The corresponding Control with ID #1 responses with:

    #1 REPORT 10 <crlf>
    1,1,0,0,0,0551,552,908,920,410,835,89,123,0,0,931,1246,1250,1941,1476,2427,122,15,9 <crlf>
    1,1,0,0,0,0551,550,908,920,409,835,89,123,0,0,932,1248,1250,1941,1478,2427,122,15,10 <crlf>
    1,1,0,0,0,0551,550,912,914,410,829,89,121,0,0,932,1249,1250,1941,1479,2427,124,16,11 <crlf>
    1,1,0,0,0,0550,550,912,914,409,833,89,119,0,0,931,1246,1250,1941,1476,2427,122,16,12 <crlf>
    1,1,0,0,0,0551,552,912,914,410,833,89,121,0,0,932,1249,1250,1945,1480,2431,123,15,13 <crlf>
    1,1,0,0,0,0551,554,912,933,411,842,89,122,0,0,931,1248,1250,1948,1478,2435,123,15,14 <crlf>
    1,1,0,0,0,0551,554,908,927,412,839,89,120,0,0,932,1249,1250,1941,1480,2427,123,15,15 <crlf>
</lf>

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

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

**Command Format**

    #ID  KEYWORD  parameters <crlf><lf>

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

    COMMAND KEYWORDS:  BOLD.

    VARIABLE:  italics.

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

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

    REQUIRED/OPTIONAL PARAMETERS:  [enclosed in brackets] (one or more allowed, used in the SET parameter)(zero allowed in the READ parameter).
RANGE OF PARAMETERS: \textit{low\_end - high\_end} (separated by hyphen).

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

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

Each unit identifier, command keyword, and parameters must be separated by one or more spaces except the termination of command \texttt{<lf>} must follow the end of parameter terminator \texttt{<crlf>} immediately. I. E. “\texttt{<crlf><lf>}”

Communication examples:

1. COUNTER:

   Example 1:

   \begin{verbatim}
   Send:   #01 COUNTER READ\langle crlf\rangle\langle lf\rangle
   \end{verbatim}

   Receive: #01 COUNTER
   TOTAL XX
   GOOD XX
   LIMIT XX

   Example 2:

   \begin{verbatim}
   Send:   #01 COUNTER SET\langle crlf\rangle
   TOTAL XX\langle crlf\rangle
   GOOD XX\langle crlf\rangle
   LIMIT XX\langle crlf\rangle\langle lf\rangle
   \end{verbatim}

   Receive: Nothing
APPENDIX E: RS-232 CONNECTIONS

2. ALARM:

   Example 1:
   Send: #01 ALARM CLEAR<cr><lf>
   Receive: Nothing

   Example 2:
   Send: #01 ALARM READ<cr><lf>
   Receive: #01 ALARM NONE

3. SECURITY:

   Example 1:
   Send: #01 SECURITY READ<cr><lf>
   Receive: #01 SECURITY
   SCHEDULE OFF (or ON)
   SYSTEM OFF (or ON)
   CALIBRATION OFF (or ON)

   Example 2:
   Send: #01 SECURITY {OFF|SCHEDULE|SYSTEM|CALIBRATION}<cr><lf>
   (OFF sets all security to OFF, SCHEDULE sets security to ON, SYSTEM sets security to ON, CALIBRATION sets security to ON)
   Receive: Nothing
Section III. Control Communication Codes

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

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

1. For a host “read” command, e.g. read profile data, the host must timeout if the unit does not send a complete response within a reasonable amount of time. Host can also check the number of bytes received against the expected number for that message, range check the received data, or do whatever else is thought necessary to have confidence in the received data.

2. Following a host “set” command, the host must subsequently read the data just “set” and make sure the data “set” matches data “read.” For example, if a “set schedule 1” command is sent, the unit must then do a “read schedule 1” and compare the set data against the read data.

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

1. This parameter must be set to MASTER under normal running conditions to turn on the “Read Report” command which sends the results of the latest weld to the host automatically.

2. When the parameter is set to SLAVE, this reporting will be turned off and the unit will accept both “Read” and “Set” from the host.

3. When in MASTER, the unit will not accept any commands from the host. This avoids potential collisions between these commands and the automatic reporting of reflow results.

4. MASTER or SLAVE must be set at the Control panel by pressing the MENU key and selecting option 5: COMMUNICATIONS.
## Host Originated Commands

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

<table>
<thead>
<tr>
<th>Command</th>
<th>STATUS&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to report the status of the weld data buffer. Control returns STATUS with either “OK” or “OVERRUN.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>TYPE&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to return the type of welder, release number, and revision letters.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>COUNT&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to report the number of weld data accumulated since the last data collection. Control returns the COUNT even if there is no weld data available.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>ERASE&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to erase all the weld reports. Note: The Control does not send back any reply for this command, if it was successful.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>SYNC&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Provides synchronization of the commands. The Control returns SYNC command back to the host computer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>CURRENT&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to report the sampled Current data of the last weld. Control shall return with CURRENT report. See CURRENT command under Control Originating Commands section.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>VOLTAGE&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Requests the Control to report the sampled Current data of the last weld. Control shall return with VOLTAGE report. See VOLTAGE command under Control Originating Commands section.</td>
</tr>
</tbody>
</table>
**APPENDIX E: RS-232 CONNECTIONS**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER&lt;crlf&gt;&lt;lf&gt;</td>
<td>Requests the Control to report the sampled Current data of the last weld. Control shall return with POWER report. See POWER command under Control Originating Commands section.</td>
</tr>
<tr>
<td>OHMS&lt;crlf&gt;&lt;lf&gt;</td>
<td>Requests the Control to report the sampled Current data of the last weld. Control shall return with RESISTANCE report. See OHMS command under Control Originating Commands section.</td>
</tr>
</tbody>
</table>
| IT { READ | SET }<crlf><lf> | Provides control over the Control schedule parameters related specifically only the Combo mode. When used with the "READ" keyword, the specific Combo mode parameters pertaining to the currently loaded schedule are returned (see SCHEDULE under Control ORIGINATED COMMANDS). When the "SET" keyword is used, the host may set (change) the value of the Combo specific parameters pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter_name and value variables.  
**ENABLE**  { ON | OFF } enable Combo (V-A) Mode  
**VOLT1**  { weld_energy } maximum allowable voltage for ramp  
**CURRENT1**  { weld_energy } constant current control level  
Note: The Control does not send back any reply for the IT SET command, if it was successful. |
| COUNTER READ<crlf><lf> | Requests the Control to return the Control weld counter contents.  
**TOTAL** returns the total number of weld counter.  
**GOOD** returns the within limits counter.  
**LIMIT** returns the limit set point. |
| REPORT {OLD | NEW | ERASE} number <crlf><lf> | Requests the Control to send the weld report.  
**OLD**: requests to send the number of oldest weld reports since the last data collection.  
**NEW**: requests to send the number of newest weld reports and then erases them from the buffer.  
**ERASE**: will erase the number of oldest weld reports.  
**number**: the quantity of weld data to be sent or erased.  
If the number is greater than the number of weld data in the buffer, than the number of welds stored will be sent. **NOTE**: There must be a space between two fields.
**APPENDIX E: RS-232 CONNECTIONS**

<table>
<thead>
<tr>
<th>Command</th>
<th>Control State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>Any</td>
<td>Commands the Control to identify its current state (see STATE under CONTROL ORIGINATED COMMANDS section) or go to either RUN state or PROGRAM state.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> The MONITOR is only available on the DC 25 and UB 25.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Control State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOAD</td>
<td>RUN state</td>
<td>Selects the schedule_number as the currently loaded schedule. schedule_number may be any number from 1 to 99. There must be a space between LOAD and schedule_number.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The Control does not send back any reply for this command, if it was successful.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Control State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPY</td>
<td>Any</td>
<td>Allows one schedule to be copied to another schedule number. From_schedule_number and to_schedule_number may be any number from 1 to 99. Copying a schedule to itself has no effect.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The Control does not send back any reply for this command, if it was successful.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Control State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHEDULE</td>
<td>Any state except while welding.</td>
<td>Requests the Control to return the currently selected schedule number.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Control State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHEDULE</td>
<td>RUN state.</td>
<td>Provides control over the Control schedule parameters. When used with the &quot;READ&quot; keyword, all parameters pertaining to the currently loaded schedule are returned (see SCHEDULE under Control ORIGINATED COMMANDS). When the &quot;SET&quot; keyword is used, the host may set (change) the value of one or more of the parameters pertaining to the currently loaded schedule. The following is a list of valid literal substitutions for the parameter name and value variables:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>parameter</th>
<th>value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG1</td>
<td>{weld energy}</td>
<td>energy amount for pulse 1</td>
</tr>
<tr>
<td>FEEDBACK1</td>
<td>{KA</td>
<td>V</td>
</tr>
<tr>
<td>ENG2</td>
<td>{weld energy}</td>
<td>energy amount for pulse 2</td>
</tr>
<tr>
<td>FEEDBACK2</td>
<td>{KA</td>
<td>V</td>
</tr>
<tr>
<td>SQUEEZE</td>
<td>{squeeze_time}</td>
<td>squeeze time</td>
</tr>
<tr>
<td>UP1</td>
<td>{weld_time}</td>
<td>up slope time of pulse 1</td>
</tr>
<tr>
<td>WELD1</td>
<td>{weld_time}</td>
<td>weld time of pulse 1</td>
</tr>
<tr>
<td>DOWN1</td>
<td>{weld_time}</td>
<td>down slope time of pulse 1</td>
</tr>
<tr>
<td>COOL</td>
<td>{weld_time}</td>
<td>cool time</td>
</tr>
<tr>
<td>UP2</td>
<td>{weld_time}</td>
<td>up slope time of pulse 2</td>
</tr>
<tr>
<td>WELD2</td>
<td>{weld_time}</td>
<td>weld time of pulse 2</td>
</tr>
<tr>
<td>DOWN2</td>
<td>{weld_time}</td>
<td>down slope time of pulse 2</td>
</tr>
</tbody>
</table>
HOLD { weld time } hold time

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

**Command** MONITOR {READ | SET}<crlf><lf>

[parameter_name value]<crlf>, where value is an integer.

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

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

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

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

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

Note: The Control does not send back any reply for the MONITOR SET command, if it was successful.
## APPENDIX E: RS-232 CONNECTIONS

### Command: RELAY \{READ | SET\}<cr><lf> [parameter_name value]<cr>, where value is an integer.

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

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

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

condition_value is:

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

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

### Command: CHECK \{READ | SET\}<cr><lf> [parameter_name value]<cr>, where value is an integer.

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

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

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

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

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

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

Note: The Control does not send back any reply for the CHECK SET command, if it was successful.
## APPENDIX E: RS-232 CONNECTIONS

| Command     | SYSTEM {READ | SET}<crlf><lf> [parameter_name value]<crlf>, where value is an integer. |
|-------------|-----------------------------------------------------------------------------------|
| Control State | Any                                                                                     |
| Description | Provides control over the Control's system parameters. When used with the "READ" keyword, all system parameters are returned (see SYSTEM under CONTROL ORIGINATED COMMANDS). When used with the "SET" keyword, the host may set (change) the value of one or more of the system parameters. The following is a list of valid literal substitutions for the parameter_name and value variables: |
|             | WELDABORT { OFF | ON } Footswitch weld abort |
|             | BUZZER { OFF | ON } end of cycle buzzer |
|             | BUZSTOP { OFF | ON } buzzer at weld stop |
|             | GRAPH { OFF | ON } Update Graph |
|             | UPDATE { OFF | ON } Update all screens |
|             | LIGHT { light_value } LCD contrast |
|             | LOUDNESS { loudness_value } Buzzer Loudness |
|             | DEBOUNCE { NONE | 10 | 20 | 30 } Switch debounce time in ms |
|             | FIRESW { AUTO | REMOTE | NONE } Firing Switch Type |
|             | DISPLAY { PEAK | AVG } Display mode |

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

light_value is a number 0 to 100 for brightness of the LCD. 0 is dark and 100 is the brightest.  

loudness_value is a number 0 to 100 for buzzer loudness. 0 is off and 100 is the loudest.  

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

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

Note: The Control does not send back any reply for the ALARM CLEAR or ALARM SET command, if it was successful.
### Command Security

| Command       | SECURITY {OFF | READ | SCHEDULE | SYSTEM | CALIBRATION} <cr><lf> |
|---------------|--------------------------------------------------|
| Control State | Any                                              |
| Description   | Allows control of the system security mode.     |
|               | “OFF” sets all security status Control to “OFF.” |
|               | “SCHEDULE” sets the schedule lock to “ON.”       |
|               | “SYSTEM” sets the system lock to “ON.”           |
|               | “CALIBRATION” sets the calibration lock to “ON.”  |
|               | “READ” requests the Control to return the present condition of the above four parameters. |

Note: The Control does not send back any reply for this command, if it was successful.
APPENDIX E: RS-232 CONNECTIONS

Control Originated Commands

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

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Identifies the current status of the weld data buffer. May be in response with “OK” or “OVERRUN.” “OK” means that the Control weld buffer did not over-run since the last data collection and all the data are intact. “OVERRUN” means that the Control weld buffer did over-run since the last data collection and only the latest 1200 weld data are available to report.</td>
</tr>
<tr>
<td>TYPE</td>
<td>Returns software version.</td>
</tr>
<tr>
<td>COUNT</td>
<td>Returns the number of weld data available in Control. The total number of weld data that the Control holds in the buffer is 1,024.</td>
</tr>
<tr>
<td>SCHEDULE</td>
<td>Returns the current schedule number to the host. schedule_number may be any number from 1 to 99.</td>
</tr>
<tr>
<td>REPORT</td>
<td>Returns the requested number of weld reports. First field is the number of reports to be sent. Then follows the packets of report. One report pack hold all the information about a weld. Each report packet is separated by &lt;crlf&gt; and this Command ends with &lt;crlf&gt;.</td>
</tr>
</tbody>
</table>

**number_of_reports**: This is the number of reports that shall be included in this command. If the host computer requests more weld data than is available in the weld data buffer, the Control sends only the weld reports in the weld buffer and the number_of_reports is the number of weld reports available in the weld data buffer. After the report is sent to the host computer, the Control erases the weld data sent to the host from the weld data buffer.

**report**: 
- unit_number
- schedule_number
- weld_error1
- weld_error2
- weld_error3
- weld_error4
- average_current_1
- peak_current_1
- average_voltage_1
- peak_voltage_1
- average_power_1
- peak_power_1
- average_resistance_1
- peak_resistance_1
- energy_capacity_1
- average_current_2
- peak_current_2
- average_voltage_2
- peak_voltage_2
- average_power_2
- peak_power_2
- average_resistance_2
- peak_resistance_2
- energy_capacity_2
- weld_count
The fields in the report packet are separated with a comma and all fields are in integer format. There are always 25 fields in a report packet.

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

<table>
<thead>
<tr>
<th>Command</th>
<th>STATE state_name&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Identifies the current state of operation of the Control. May be in response to the STATE READ Command sent by the host, or may be sent as a result of a state change from the Control front panel. <em>state_name</em> may be &quot;RUN&quot;, &quot;MENU&quot;, &quot;PROGRAM&quot;, &quot;MONITOR&quot; &quot;WELD&quot;, &quot;CALIBRATION&quot;, &quot;TEST&quot;, or &quot;ALARM&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>COUNTER number&lt;crlf&gt;&lt;lf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control State</td>
<td>Any</td>
</tr>
<tr>
<td>Description</td>
<td>Returns the requested current Control weld counter number.</td>
</tr>
</tbody>
</table>
### APPENDIX E: RS-232 CONNECTIONS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| **CURRENT** |  *
| *number_of_data*<crlf><lf>
| *data*<crlf>*data* <crlf> . . . . *data* <crlf><lf> | Returns the Current reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. |
| **number_of_data** | This is the number of data that shall be included in this command. The Control samples current every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: \( \text{total weld time} \div 50 \ \mu s \). This number will be always less than 2000. |
| **data** | an integer number in unit of A. |

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| **VOLTAGE** |  *
| *number_of_data*<crlf><lf>
| *data*<crlf>*data* <crlf> . . . . *data* <crlf><lf> | Returns the Voltage reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. |
| **number_of_data** | This is the number of data that shall be included in this command. The Control samples Voltage every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: \( \text{total weld time} \div 50 \ \mu s \). This number will be always less than 2000. |
| **data** | An integer number in unit of mV. |

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| **POWER** |  *
| *number_of_data*<crlf><lf>
| *data*<crlf>*data* <crlf> . . . . *data* <crlf><lf> | Returns the Power reading of the last weld. First field is the number of data to be sent. Then follows the packets of data. Each data is separated by <crlf> and this command ends with <crlf><lf>. |
| **number_of_data** | This is the number of data that shall be included in this Command. The Control samples Current and Voltage every 50 μs. For a weld less than 100 ms weld time, the number of data will be approximately: \( \text{total weld time} \div 50 \ \mu s \). This number will be always less than 2000. |
| **data** | An integer number in unit of W. |
### Command: OHMS

**Number of Data**: This is the number of data that shall be included in this Command. The Control samples Current and Voltage every 50 $\mu$s. For a weld less than 100 ms weld time, the number of data will be approximately: $\text{total weld time} \div 50 \mu$s. This number will be always less than 2000.

**Data**: An integer number in unit of $\Omega$ (10$^{-5}$).

### Command: IT

**Enable**: enable Combo (V-A) Mode

**VOLT1**: maximum allowable voltage for ramp

**CURRENT1**: constant current control level

### Command: SCHEDULE

**Schedule Number**: variable identifies which schedule is currently loaded, and may be any value from 1 to 99.

**Squeeze Time** and **Hold Time** are the parameter that defines the time for the given period in 1 msec. Valid range is from 0 to 999.

**Weld Time** is the parameter that defines the time for the given period in 0.01 msec. For the UB25, the valid range is from 0 to 9900 (0 to 99.00ms).
APPENDIX E: RS-232 CONNECTIONS

<table>
<thead>
<tr>
<th>HOST</th>
<th>CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increments</td>
<td>Range</td>
</tr>
<tr>
<td>1</td>
<td>0-100</td>
</tr>
<tr>
<td>10</td>
<td>110-1000</td>
</tr>
<tr>
<td>100</td>
<td>1100-9900</td>
</tr>
</tbody>
</table>

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

- **Current Feedback** mode: the **weld_energy** range for the UB29 is from 5 to 500A (5-500). For the DC29, the range is from 100-4,000A (100-4000). For the UB29A the range is from 50-1500A (50-1500)

- **Voltage Feedback** mode: **weld_energy** for the UB29 is in units of 0.01V, and the range is from 0.1 to 9.9V (100 to 9900). For the DC29, the range is from 0.1 to 9.9V (100 to 9900) for the DC29.

- **Power Feedback** mode: **weld_energy** for the UB29 is in units of 10W, and the range for the UB29 is from 10 to 4900W (10-4900). For the DC29, the range is from 100W to 9900W (100-9900). For the UB29A the range is from 100 to 4900W

**pid gain:** is the PID gain of the last weld

---

Command

| Command | IT number<crlf>|<lf> |
|---------|----------------|
| ENABLE  | { ON | OFF }<crlf> enable Combo (V-A) Mode |
| VOLT1   | { weld_energy }<crlf> maximum allowable voltage for ramp |
| CURRENT1| { weld_energy }<crlf> constant current control level |

**Control State** Any

**Description** Reports the Combo mode specific settings of the currently loaded Control schedule parameters. The **schedule_number**: variable identifies which schedule is currently loaded, and may be any value from 1 to 99.

---

Command

<table>
<thead>
<tr>
<th>Command</th>
<th>CHECK&lt;crlf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENABLE</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CHARGE</td>
<td>capacity_value&lt;crlf&gt;</td>
</tr>
<tr>
<td>CAPACITY</td>
<td>capacity_value&lt;crlf&gt;</td>
</tr>
</tbody>
</table>

**Control State** Any except while welding

**Description** Returns the parameters for the waveform check.

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

**capacity_value** is the capacity % limit. This limit is the % below the set point the energy is allowed to be at the end of the weld pulse.
## APPENDIX E: RS-232 CONNECTIONS

### Command RELAY

<table>
<thead>
<tr>
<th>Command</th>
<th>RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVE1</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CONDITION1</td>
<td>\text{condition value}</td>
</tr>
<tr>
<td>ACTIVE2</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CONDITION2</td>
<td>\text{condition value}</td>
</tr>
<tr>
<td>ACTIVE3</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CONDITION3</td>
<td>\text{condition value}</td>
</tr>
<tr>
<td>ACTIVE4</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CONDITION4</td>
<td>\text{condition value}</td>
</tr>
<tr>
<td>ACTIVE5</td>
<td>{ OFF</td>
</tr>
<tr>
<td>CONDITION5</td>
<td>\text{condition value}</td>
</tr>
</tbody>
</table>

**Control State** Any  
**Description** Reports the relay settings.

### Command MONITOR

<table>
<thead>
<tr>
<th>Command</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>schedule_number</td>
<td></td>
</tr>
<tr>
<td>TYPE1</td>
<td>{ KA</td>
</tr>
<tr>
<td>ACTION1</td>
<td>{ none</td>
</tr>
<tr>
<td>UPPER1</td>
<td>{ limit_value }</td>
</tr>
<tr>
<td>LOWER1</td>
<td>{ limit_value }</td>
</tr>
<tr>
<td>TYPE2</td>
<td>{ KA</td>
</tr>
<tr>
<td>ACTION2</td>
<td>{ none</td>
</tr>
<tr>
<td>UPPER2</td>
<td>{ limit_value }</td>
</tr>
<tr>
<td>LOWER2</td>
<td>{ limit_value }</td>
</tr>
</tbody>
</table>

**Control State** Any  
**Description** Reports the settings of the weld monitor of the currently loaded Control schedule. The `schedule_number` variable identifies which schedule is currently loaded, and may be any value from 1 to 99. The possible value for all variables listed after their parameter name correspond to the values listed under MONITOR in Host Originated Commands of this manual.

### Command SYSTEM

<table>
<thead>
<tr>
<th>Command</th>
<th>SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>WELDABORT</td>
<td>{ OFF</td>
</tr>
<tr>
<td>BUZZER</td>
<td>{ OFF</td>
</tr>
<tr>
<td>BUZSTOP</td>
<td>{ OFF</td>
</tr>
<tr>
<td>GRAPH</td>
<td>{ OFF</td>
</tr>
<tr>
<td>UPDATE</td>
<td>{ OFF</td>
</tr>
<tr>
<td>LIGHT</td>
<td>{ light_value }</td>
</tr>
<tr>
<td>LOUDNESS</td>
<td>{ loudness_value }</td>
</tr>
<tr>
<td>DEBOUNCE</td>
<td>{NONE</td>
</tr>
<tr>
<td>FIRESW</td>
<td>{ AUTO</td>
</tr>
<tr>
<td>DISPLAY</td>
<td>{ PEAK</td>
</tr>
</tbody>
</table>

**Control State** Any  
**Description** Reports the current settings of the Control system parameters.  

- **light_value** is a number 0 to 99 for brightness of the LCD. 0 is dark and 100 is the brightest.  
- **loudness_value** is a number 0 to 99 for buzzer loudness. 0 is off and 100 is the loudest.
### Section IV. RS-232 Error Codes

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERRNONE</td>
<td>0 // No Error occurred</td>
</tr>
<tr>
<td>ALSWITCH</td>
<td>1 // Switch Input Error</td>
</tr>
<tr>
<td>ALCFIRESW</td>
<td>2 // FIRING SWITCH BEFORE FOOT SWITCH</td>
</tr>
<tr>
<td>ALEMGSTOP</td>
<td>3 // Emergency STOP</td>
</tr>
<tr>
<td>ALNFIRESW</td>
<td>4 // FSW didn’t closed in 10 sec</td>
</tr>
<tr>
<td>ALTFHEAT</td>
<td>5 // Unit Over Heated</td>
</tr>
<tr>
<td>ALINHIBIT</td>
<td>6 // INHIBIT CONTROL SIGNALS ACTIVATED</td>
</tr>
<tr>
<td>ALMAXCURR</td>
<td>7 // CURRENT IS AT MAXIMUM</td>
</tr>
<tr>
<td>ALMAXVOLT</td>
<td>8 // Voltage is at Maximum</td>
</tr>
<tr>
<td>ALNOCURR</td>
<td>9 // No Current</td>
</tr>
<tr>
<td>ALNOVOLT</td>
<td>10 // No Voltage</td>
</tr>
<tr>
<td>ALNOWELD</td>
<td>11 // WELD SWITCH IN NO WELD POSITION</td>
</tr>
<tr>
<td>ERCHKVOLT</td>
<td>12 // Check Voltage Cable</td>
</tr>
<tr>
<td>IT_RISETIME</td>
<td>13 // Combo Mode Rise Time too Small 500A/ms</td>
</tr>
<tr>
<td>ERLIMIT</td>
<td>14 // Limit Error</td>
</tr>
<tr>
<td>ERCOOLADD</td>
<td>15 // Cool Time Added for feedback</td>
</tr>
<tr>
<td>ERDEFAULT</td>
<td>16 // System and Schedule Reset</td>
</tr>
<tr>
<td>ERCHAIN</td>
<td>17 // Chained to next schedule</td>
</tr>
<tr>
<td>ERP1LLIM</td>
<td>18 // Invalid lower limit delays for Pulse 1</td>
</tr>
<tr>
<td>ERP1ULIM</td>
<td>19 // Invalid upper limit delays for Pulse 1</td>
</tr>
<tr>
<td>ERP2LLIM</td>
<td>20 // Invalid lower limit delays for Pulse 2</td>
</tr>
<tr>
<td>ERP2ULIM</td>
<td>21 // Invalid upper limit delays for Pulse 2</td>
</tr>
<tr>
<td>ERNOUPSLOPE</td>
<td>22 // Upslope required for lower limit</td>
</tr>
<tr>
<td>ERBIG</td>
<td>23 // Input too large</td>
</tr>
<tr>
<td>ERSMAALL</td>
<td>24 // Input too small</td>
</tr>
<tr>
<td>ERNOTREADY</td>
<td>25 // Press RUN before weld</td>
</tr>
<tr>
<td>ERSCHLOC</td>
<td>26 // Schedule Lock Error</td>
</tr>
<tr>
<td>ERLIMDLYS</td>
<td>27 // Limit delays adjusted</td>
</tr>
<tr>
<td>ERPOT</td>
<td>28 // System is protected</td>
</tr>
<tr>
<td>EROVERCUR1</td>
<td>29 // Over Current 1</td>
</tr>
<tr>
<td>EROLowCUR1</td>
<td>30 // Low Current 1</td>
</tr>
<tr>
<td>EROVERVOL1</td>
<td>31 // Over Voltage 1</td>
</tr>
<tr>
<td>EROLowVOL1</td>
<td>32 // Low Voltage 1</td>
</tr>
<tr>
<td>EROVERPWR1</td>
<td>33 // Over Power 1</td>
</tr>
<tr>
<td>EROLowPWR1</td>
<td>34 // Low Power 1</td>
</tr>
<tr>
<td>EROVERRES1</td>
<td>35 // Over Resistance 1</td>
</tr>
<tr>
<td>EROLowRES1</td>
<td>36 // Low Resistance 1</td>
</tr>
<tr>
<td>EROVERCUR2</td>
<td>37 // Over Current 2</td>
</tr>
<tr>
<td>EROLowCUR2</td>
<td>38 // Low Current 2</td>
</tr>
<tr>
<td>EROVERVOL2</td>
<td>39 // Over Voltage 2</td>
</tr>
<tr>
<td>EROLowVOL2</td>
<td>40 // Low Voltage 2</td>
</tr>
<tr>
<td>EROVERPWR2</td>
<td>41 // Over Power 2</td>
</tr>
<tr>
<td>EROLowPWR2</td>
<td>42 // Low Power 2</td>
</tr>
<tr>
<td>EROVERRES2</td>
<td>43 // Over Resistance 2</td>
</tr>
<tr>
<td>EROLowRES2</td>
<td>44 // Low Resistance 2</td>
</tr>
<tr>
<td>ERINHIBIT</td>
<td>45 // Inhibit 2nd pulse out of limit</td>
</tr>
<tr>
<td>Error Code</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>ERWSTOP</td>
<td>46 // weld stop after P1 or P2 reached limit</td>
</tr>
<tr>
<td>ERRSTSCH</td>
<td>47 // Schedules are reset to default</td>
</tr>
<tr>
<td>ERRSTSYS</td>
<td>48 // System Parameters are reset to default</td>
</tr>
<tr>
<td>ERTSMALL</td>
<td>49 // Total weld time is too small</td>
</tr>
<tr>
<td>ERCAPBANK</td>
<td>50 // Test weld cap charge level too low</td>
</tr>
<tr>
<td>ALCAPCHG</td>
<td>51 // Capacitor charge level low</td>
</tr>
<tr>
<td>ERNOUNPDATES</td>
<td>52 // Screen updates turned off</td>
</tr>
<tr>
<td>ER_IT_NOI</td>
<td>53 // IT MODE - NO CURRENT SET POINT REACHED</td>
</tr>
<tr>
<td>ER_AD_FAIL</td>
<td>54 // A/D Failure to Convert</td>
</tr>
<tr>
<td>ERCOUNTLIMIT</td>
<td>55 // Counter has reached its limit</td>
</tr>
<tr>
<td>ERBADFLASH</td>
<td>56 // Weld Time required for lower limit</td>
</tr>
<tr>
<td>ALPOWERLOSS</td>
<td>58 // POWER LOSS DETECTED - SHUTTING DOWN</td>
</tr>
<tr>
<td>DISPLAYERROR</td>
<td>59 // Display Timeout</td>
</tr>
</tbody>
</table>

DC29/UB29/UB29A LINEAR DC RESISTANCE WELDING CONTROL
APPENDIX F
REPETITION RATES

Section I. Introduction

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

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

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

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

It is possible that longer durations may be provided by the control (depending upon the details of the secondary circuit) but the stability of the waveform may decrease. In this circumstance, a reduction of the secondary circuit resistance and/or inductance will be beneficial. (Shorten weld cables and/or tie them together.) Testing with the actual secondary circuit to be used will be required in this case.
Section II. DC29 Repetition Rates

![Graph showing supported repeat weld width (ms) vs. current (A) for 1 mΩ load at 3pps, 2pps, and 1pps repetition rates.](image)
APPENDIX F: REPETITION RATES

2.5 mΩ load

![Graph showing supported repeat weld width (ms) vs. current (A) for different repetition rates: 3pps, 2pps, and 1pps. The graph illustrates the decrease in supported repeat weld width with increasing current at each repetition rate.]
Section III. UB29 Repetition Rates
UB29A Repetition Rates

1 mΩ, 2.5 mΩ, 4 mΩ loads

Current (A)

Supported Repeat Weld Width (ms)

3pps
2pps
1pps
APPENDIX G
THE BASICS OF RESISTANCE WELDING

Resistence Welding Parameters

Resistance welding heat is produced by passing electrical current through the parts for a fixed time period. The welding heat generated is a function of the magnitude of the weld current, the electrical resistance of the parts, the contact resistance between the parts, and the weld force applied to the parts. Sufficient weld force is required to contain the molten material produced during the weld. However, as the force is increased, the contact resistance decreases. Lower contact resistance requires additional weld current, voltage, or power to produce the heat required to form a weld.

The higher the weld force, the greater the weld current, voltage, power, or time required to produce a given weld. The formula for amount of heat generated is \( I^2RT \) -- the square of the weld current \( I \) times the workpiece resistance \( R \) times the weld time \( T \).

Welding Parameter Interaction
Electrode Selection

Correct electrode selection strongly influences how weld heat is generated in the weld area. In general, use conductive electrodes such as a RWMA-2 (Copper alloy) when welding electrically resistive parts such as nickel or steel so that the weld heat is generated by the electrical resistance of the parts and the contact resistance between the parts. Use resistive electrodes such as RWMA-13 (Tungsten) and RWMA-14 (Molybdenum) to weld conductive parts such as copper and gold because conductive parts do not generate much internal heat so the electrodes must provide external heat. Use the following Electrode Selection Table for selecting the proper electrode materials.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>-2</td>
<td>Alumel -2</td>
<td>-2</td>
</tr>
<tr>
<td>Alumel</td>
<td>-2</td>
<td>Chromel -2</td>
<td>-2</td>
</tr>
<tr>
<td>Alumel</td>
<td>-2</td>
<td>Dumet -2</td>
<td>-2</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Aluminum -1</td>
<td>-1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Aluminum Alloys</td>
<td>-1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Cadmium Plating</td>
<td>-1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Tinned Brass</td>
<td>-14</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Gold Plated Dumet</td>
<td>-2</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Gold Plated Kovar</td>
<td>-2</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Kovar</td>
<td>-2</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Magnesium</td>
<td>-1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-1</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Beryllium Copper</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Brass</td>
<td>-2, -14</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Nickel</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Nickel</td>
<td>-2</td>
</tr>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beryllium Copper</td>
<td>-2</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Brass</td>
<td>-2, -14</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Tinned Brass</td>
<td>-14</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Consil</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Constantan</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Dumet</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Nichrome</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Nickel</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>NiSpan C</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Paliney 7</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Silver</td>
<td>-11, -14</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Brass</td>
<td>-2, -14</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Bronze</td>
<td>-2, -11</td>
<td>Bronze</td>
<td>-2, -11</td>
</tr>
<tr>
<td>Bronze</td>
<td>-2, -11</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Bronze</td>
<td>-2, -11</td>
<td>Iron</td>
<td>-2</td>
</tr>
<tr>
<td>Bronze</td>
<td>-2, -11</td>
<td>Nichrome</td>
<td>-2</td>
</tr>
<tr>
<td>Bronze</td>
<td>-2, -11</td>
<td>Nickel</td>
<td>-2</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Chromel</td>
<td>-2</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Constantan</td>
<td>-2</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Copel</td>
<td>-2</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Tinned Copper</td>
<td>-14</td>
</tr>
<tr>
<td>Chromel</td>
<td>-2</td>
<td>Dumet</td>
<td>-2</td>
</tr>
</tbody>
</table>
### MATERIAL | ELECT RWMA TYPE | MATERIAL | ELECT RWMA TYPE
--- | --- | --- | ---
Chromel | -2 | Nichrome | -2
Chromel | -2 | Cold Rolled Steel | -2
Consil | -2 | Consil | -2
Consil | -2 | Tinned Copper | -14
Consil | -2 | Dumet | -2
Constantan | -2 | Constantan | -2
Constantan | -2 | Copper | -14
Constantan | -2 | Tinned Copper | -14
Constantan | -2 | Iron | -2
Constantan | -2 | Nichrome | -2
Constantan | -2 | Nickel | -2
Copper | -14 | Copper | -14
Copper | -14 | Dumet | -2
Copper | -14 | Invar | -2
Copper | -14 | Karm | -2
Copper | -14 | Manganin | -2
Copper | -14 | Nichrome | -2
Copper | -14 | Nickel | -2
Copper | -14 | Paliney 7 | -2
Copper | -14 | Silver | -11, -14
Copper | -14 | Cold Rolled Steel | -2
Copper | -14 | Stainless Steel | -2
Dumet | -2 | Dumet | -2
Dumet | -2 | Nickel | -2
Dumet | -2 | Platinum | -2
Dumet | -2 | Cold Rolled Steel | -2
Evanohm | -14 | Copper | -14
Gold | -14 | Gold | -14
Gold | -14 | Kovar | -2
Hastalloy | -2 | Titanium | -2
Inconel | -2 | Inconel | -2
Inconel | -2 | Kulgrid | -2
Invar | -2 | Invar | -2
Iridium | -2 | Iridium | -2
Iridium | -2 | Platinum | -2

### MATERIAL | ELECT RWMA TYPE | MATERIAL | ELECT RWMA TYPE
--- | --- | --- | ---
Iron | -2 | Iron | -2
Karma | -2 | Karma | -2
Karma | -2 | Nickel | -2
Karma | -2 | Platinum | -2
Kovar, Gold Plate | -2 | Kovar, Gold Plate | -2
Kovar, Gold Plate | -2 | Kulgrid | -2
Kovar, Gold Plate | -2 | Nickel | -2
Kovar, Gold Plate | -2 | Silver | -11, -14
Kovar, Gold Plate | -2 | Stainless Steel | -2
Magnesium | -1 | Magnesium | -1
Molybdenum | -2 | Molybdenum | -2
Molybdenum | -2 | Nickel | -2
Molybdenum | -2 | Tungsten | -2
Nichrome | -2 | Nichrome | -2
Nichrome | -2 | Nickel | -2
Nichrome | -2 | Cold Rolled Steel | -2
Nichrome | -2 | Stainless Steel | -2
Nickel | -2 | Nickel | -2
Nickel | -2 | Cold Rolled Steel | -2
Nickel | -2 | Stainless Steel | -2
Nickel | -2 | Tantalum | -2
Nickel | -2 | Tungsten | -2
Nickel Alloy | -2 | Nickel Alloy | -2
Nickel Alloy | -2 | Tinned Brass | -14
Nickel Alloy | -2 | Beryllium Copper | -2
Nickel Alloy | -2 | Consil | -2
Nickel Alloy | -2 | Tinned Copper | -14
Nickel Alloy | -2 | Nichrome | -2
Nickel Alloy | -2 | Nickel | -2
Nickel Alloy | -2 | Cold Rolled Steel | -2
NiSpan C | -2 | NiSpan C | -2
NiSpan C | -2 | Cold Rolled Steel | -2
NiSpan C | -2 | Stainless Steel | -2
APPENDIX G: THE BASICS OF RESISTANCE WELDING

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niobium</td>
<td>-2</td>
<td>Niobium</td>
<td>-2</td>
</tr>
<tr>
<td>Platinum</td>
<td>-2</td>
<td>Platinum</td>
<td>-2</td>
</tr>
<tr>
<td>Paliney 7</td>
<td>-2</td>
<td>Paliney 7</td>
<td>-2</td>
</tr>
<tr>
<td>Silver</td>
<td>-11, -14</td>
<td>Silver</td>
<td>-11, -14</td>
</tr>
<tr>
<td>Silver</td>
<td>-11, -14</td>
<td>Cadmium</td>
<td>-13</td>
</tr>
<tr>
<td>Silver</td>
<td>-11, -14</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Cold Rolled Steel</td>
<td>-2</td>
<td>Cold Rolled Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Cold Rolled Steel</td>
<td>-2</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
<th>MATERIAL</th>
<th>ELECT RWMA TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Rolled Steel</td>
<td>-2</td>
<td>Tantalum</td>
<td>-2</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>-2</td>
<td>Stainless Steel</td>
<td>-2</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>-2</td>
<td>Tungsten</td>
<td>-2</td>
</tr>
<tr>
<td>Tantalum</td>
<td>-2</td>
<td>Tantalum</td>
<td>-2</td>
</tr>
<tr>
<td>Titanium</td>
<td>-2</td>
<td>Titanium</td>
<td>-2</td>
</tr>
<tr>
<td>Tungsten</td>
<td>-2</td>
<td>Tungsten</td>
<td>-2</td>
</tr>
<tr>
<td>Tungsten</td>
<td>-2</td>
<td>Rhenium</td>
<td>-2</td>
</tr>
<tr>
<td>Zinc</td>
<td>-14</td>
<td>Zinc</td>
<td>-14</td>
</tr>
</tbody>
</table>

Electrode Maintenance

Depending on use, periodic tip resurfacing is required to remove oxides and welding debris from electrodes. Cleaning of electrodes on production line should be limited to use of #400-600 grit electrode polishing disks. For less critical applications, a file can be used to clean a badly damaged tip. However, after filing, polishing disks should then be used to ensure that the electrode faces are smooth. If this is not done, the rough surface of the electrode face will have a tendency to stick to the work piece.

Weld Schedule Development

Developing a weld schedule is a methodical procedure, which consists of making sample welds and evaluating the results. The first weld should be made at low energy settings. Adjustments are then made to each of the welding parameters one at a time until a successful weld is made.

1. Install the correct electrodes in the electrode holders on the Weld Head. See the preceding Table for electrode material recommendations.

2. Use a flat electrode face for most applications. Use a "domed" face if surface oxides are a problem. If either of the parts is a wire, the diameter of the electrode face should be equal to or greater than the diameter of the wire. If both parts are flat, the face should be at least one-half the diameter of the electrodes. Pencil point electrodes cause severe electrode sticking to the parts, unexplained explosions, and increase the weld heat substantially because of the reduced electrode-to-part contact area.

3. Use the Force Adjustment Knob on the Weld Head to set the Firing Force and adjust an Air Actuated Weld Head.

4. Program a weld schedule, then make your first weld. Always observe safety precautions when welding and wear safety glasses. For a complete procedure on making welds, refer to Chapter 4, Operating Instructions.
5 Use pliers to peel the welded materials apart. A satisfactory weld will show residual material pulled from one material to the other. Tearing of base material around the weld nugget indicates a material failure NOT a weld failure. Excessive electrode sticking and/or "spitting" should define a weld as unsatisfactory and indicates that too much weld current, voltage, power, or time has been used.

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

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

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

**Weld Strength Testing**

Destructive tests should be performed on a random basis using actual manufacturing parts. Destructive tests made on spot welds include tension, tension-shear, peel, impact, twist, hardness, and macro-etch tests. Fatigue tests and radiography have also been used. Of these methods torsional shear is preferred for round wire and a 45-degree peel test for sheet stock.

**Weld Strength Profiles**

Creating a weld strength profile offers the user a scientific approach to determining the optimum set of welding parameters and then displaying these parameters in a graphical form.

1 Start at a low weld current, voltage, or power, making five or more welds, then perform pull tests for each weld. Calculate the average pull strength. Increase weld current, voltage, or power and repeat this procedure. Do not change the weld time, weld force, or electrode area.

2 Continue increasing weld current, voltage, or power until any unfavorable characteristic occurs, such as sticking or spitting.

3 Repeat steps 1 through 3 for different weld forces, then create a plot of part pull strength versus weld current, voltage, or power for different weld forces as shown in the illustration on the next page, *Typical Weld Strength Profile.*
APPENDIX G: THE BASICS OF RESISTANCE WELDING

Typical Weld Strength Profile

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

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

A comparison of weld schedules for several different applications might show that they could be consolidated into one or two weld schedules. This would have obvious manufacturing advantages.
APPENDIX H
QUALITY RESISTANCE WELDING SOLUTIONS:
DEFINING THE OPTIMUM PROCESS

Introduction

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

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

Resistance Welding -- A Material World

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

There are four main types of structural materials:

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

Of these, only metals can be resistance welded because they are electrically conductive, soften on heating, and can be forged together without breaking.
Alloys are a mixture of two or more metals. An alloy is normally harder, less conductive, and more brittle than the parent metal which has bearing on the type of joint one can expect when resistance welding a combination of different metals.

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

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

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

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

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

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

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

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

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

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

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

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

Group III – Refractory Metals

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

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

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Copper)</td>
<td>• Solid-State • W/Mo electrodes</td>
<td>• Solid-State • Projection on Group I</td>
</tr>
<tr>
<td>Group II (Steel)</td>
<td>• Solid-State or Fusion</td>
<td>• Solid-state or braze of II on III • Projection on III</td>
</tr>
<tr>
<td>Group III (Moly)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Basic Principles

The figure above shows the key resistances in a typical opposed resistance weld and the relationship between contact resistances and bulk resistances over time, during a typical resistance weld:
**R1 & R7** The electrode resistances affect the conduction of energy and weld heat to the parts and the rate of heat sinking from the parts at the end of the weld.

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

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

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

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

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

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

The contact resistances present at the weld when the power supply is fired have a great impact on the heat balance of a weld and, therefore, the heat affected zone.
The figure below shows a weld that is fired early on in the weld sequence when the contact resistance is still quite high. The figure shows a weld that is initiated when the contact resistance is lower; in this example, we are using bulk resistance to generate our weld heat.

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

The following figure shows the three stages of heat generation for resistive materials in a fusion weld. In the first stage, the heat is focused in the part-to-part and electrode-to-part contact areas, since contact resistance is high relative to bulk resistance. In the second stage, contact resistance decreases as the electrodes seat better to the parts. Less heat is generated in the electrode-to-part contact areas, and a greater amount of heat is generated in the parts as the bulk resistance increases. In the third stage, the bulk resistance becomes the dominant heat-generating factor and the parts can reach their bonding temperature at the part-to-part interface. The stages of heat generation for conductive materials will be similar to that of resistive materials, but there will be less heat generated in the bulk resistance due to the conductivity of the materials.

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

The basic welding profile (or schedule) consists of a controlled application of energy and force over time. Precision power supplies control the energy and time and therefore heating rate of the parts. The weld head applies force from the start to finish of the welding process.

The figure on the right shows a typical welding sequence where the force is applied to the parts; a squeeze time is initiated which allows the force to stabilize before the current is fired. Squeeze time also allows time for the contact resistances to reduce as the materials start to come into closer contact at their interface. A hold time is initiated after current flows to allow the parts to cool under pressure before the electrodes are retracted from the parts. Hold time is important as weld strength develops in this period. This basic form of weld profile is sufficient for the majority of small part resistance welding applications.

Power supply technology selection is based on the requirements of both the application and process. In general, closed loop power supply technologies are the best choice for consistent, controlled output and fast response to changes in resistance during the weld (for further details comparison see the Miyachi Unitek “slide rule” tool).
APPENDIX H: DEFINING THE OPTIMUM PROCESS

Approach to Weld Development

The first stage in developing a quality welding process is to fix as many of the variables as possible in the welding equipment set up. The welding variables can be grouped in the following categories:

- **Material Variables**
  - Base material
  - Plating
  - Size
  - Shape

- **Weld Head & Mechanical Variables**
  - Force, squeeze, hold
  - Actuation method
  - Electrode material and shape

- **Power Supply Variables**
  - Energy
  - Time (squeeze, weld, hold)

- **Process Variables**
  - Tooling, level of automation
  - Repetition rate
  - Part positioning
  - Maintenance, electrode cleaning

- **Quality Requirements**
  - Pull strength
  - Visual criteria
  - Test method, other weld joint requirements

The first stage in developing a quality welding process is to fix as many of the variables as possible in the welding equipment set up. Welding variables can be grouped in the following categories:

**Initial Welding Trials -- The “Look See” Tests**

“Look see” welding tests are a series of mini welding experiments designed to provide a starting point for further statistical development of the welding parameters. The user should adjust the key welding variables (energy, force, time) in order to identify the likely good “weld window.” Close visual inspection of the weld parts will promote better understanding of the heating characteristics of the application.

The mini-experiments should also be used to understand the weld characteristics from both application and process perspective. Key factors in this understanding are as follows:

**Application Perspective**
- Materials: Resistivity, melting point, thermal mass, shape, hardness, surface properties.
- Heat balance: Electrode materials, shape, Polarity, heating rate (upslope).
- Observation: visual criteria, cross section, and impact of variables on heat balance.
APPENDIX H: DEFINING THE OPTIMUM PROCESS

Process Perspective

- What are the likely variables in a production process?
- How will operators handle and align the parts?
- What tooling or automation will be required?
- How will operators maintain and change the electrodes?
- What other parameters will operators be able to adjust?
- What are the quality and inspection requirements?
- What are the relevant production testing methods and test equipment?
- Do we have adequate control over the quality of the materials?

Common Problems

During this stage of process development, it is important to understand that the majority of process problems are related to either materials variation, or part-to-electrode positioning. Some examples are shown below.

The changes detailed above generally result in a change in contact resistance and always affect the heat balance of the weld. During weld development these common problems must be carefully monitored so as not to mislead the course and productivity of the welding experiments.

In summary, the “look see” welding experiments should be used to fix further variables from an application and process perspective and also to establish a “weld window” for energy, time and force. This part of weld development is critical in order to proceed to a statistical method of evaluation (Design of Experiments or “DOEs”). Random explosions or unexpected variables will skew statistical data and waste valuable time.
Common welding problems can often be identified in the basic setup of the force, energy, and time welding profile shown above. These problems can lead to weld splash, inconsistency, and variation (contact Amada Miyachi America for further information and support).

**What are Screening DOE’S?**

The purpose of a Screening DOE is to establish the impact that welding and process parameters have on the quality of the weld. Quality measurement criteria should be selected based on the requirements of the application. A Screening DOE will establish a relative quality measurement for the parameters tested and the variation in the welded result. This is important, as identifying variation in process is critical in establishing the best production settings. Typically, welded assemblies are assessed for strength of joint and variation in strength.

A Screening DOE tests the high, low settings of a parameter, and will help establish the impact of a parameter on the process. A Screening DOE is a tool that allows the user to establish the impact of a particular parameter by carrying out the minimum number of experiments to gain the information. A five-factor screening DOE can be accomplished in as few as 24 welds, with three welds completed for each of 8 tests. By comparison, it would take 96 welds to test every combination. The DOE promotes understanding of many variables in a single experiment and allows the user to interpret results, thus narrowing the variables for the next level of statistical analysis. If many variables are still not understood, multiple Screening DOE’s may be required. Amada Miyachi America provides a simple Screening DOE tool that is run in Excel® and is sufficient for the majority of possible applications (contact Amada Miyachi America for details). Sophisticated software is also available from other vendors designed specifically for this purpose.
Criteria for Success

Before running the series of experiments, the user must establish an acceptable window for energy, time, and force, thus preventing voided results. It is common practice to include one or all of the above variables in a Screening DOE. This is only recommended if sufficient understanding has been established for the other application and process variables that can impact quality. Users should first try to screen out all common application and process variables that require further exploration from the results of the “look see” mini experiments and then include the three key welding variables (energy, force, and time). Several Screening DOE’s may be required.

Results should be interpreted carefully. Typically, one would look for the highest result in terms of quality with the least variation. A Screening DOE provides only a measurement that indicates the relative importance of a parameter and not the ideal setting. Factorial DOE’s should be used to establish the correct or best setting for a parameter once many of the other variables have been screened and fixed. This is also the time to assess the measurement accuracy and consistency of the test method and procedure. Variation in test method can invalidate the test and lead to misinterpretation of results.

What are Factorial DOE’s?

The purpose of a Factorial DOE is to narrow in on the optimal setting for a particular parameter. This method is generally used when the critical or main key variables have been identified, and we need to establish the best settings for the process. A factorial DOE may also give an indication as to how wide the acceptable weld window is in relation to quality requirements. We recommend data be gathered from a monitoring perspective so that this can provide a starting point for establishing a relationship between quality and the monitored measurement parameter.

Criteria for Success

Critical parameters should be identified from the list of unfixed variables left from the Screening DOE’s. A mini-experiment may be required establishing reasonable bounds for the combination of parameters to be tested. This will prevent void data and wasted time. At this stage, it is useful to record multiple relevant quality measurement or inspection criteria so that a balanced decision can be reached. For example, if part marking and pull strength are the relevant criteria, a compromise in ideal setting may be required.

As with all experiments, the test method should be carefully assessed as a potential source of variation and inconsistency. Once the optimum parameters have been established in this series of experiments, a validation study can be run which looks at the consistency of results over time. It is good practice to build in variables such as electrode changes and cleaning, as well as equipment set up by different personnel. This will ensure that the solution is one that can run in a real production environment. Welded assemblies should be tested over time and under real use conditions to ensure that all functional criteria will be met. Validation testing is usually required to prove the robustness of the process under production conditions.
APPENDIX H: DEFINING THE OPTIMUM PROCESS

Conclusion

The resistance welding process can deliver a reliable and repeatable joining solution for a wide range of metal joining applications. Defining the optimum welding process and best production settings can be achieved through a methodical and statistical approach. Time spent up front in weld development will ensure a stable welding process and provide a substantial return in quality and long term consistency. Welding problems can more easily be identified and solved if sufficient experimental work is carried out to identify the impact of common variables on the quality and variation of the welded assembly. Amada Miyachi America frequently uses the Screening DOE tool to establish the impact of key variables and to assist customers with troubleshooting. Often, the testing described above will provide the information and understanding to predict common failure modes and causes. A troubleshooting guide can be requested in the form of a slide rule, to assist users in identification of welding problems and likely causes.