USER'S MANUAL No. 990-665, Revision C January 2002





Copyright © 2002 Unitek Miyachi Corporation

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

Printed in the United States of America.

Revision	EO	Date	Basis of Revision
А	18653	5/01	Original Release.
В	18860	5/01	Technical changes.
С	19146	2/02	Technical changes.

REVISION RECORD

FOREWORD

Thank you for purchasing a Unitek Peco® UB25 Linear DC Welding Control.

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:

> Unitek Miyachi 1820 South Myrtle Avenue P.O. Box 5033 Monrovia, CA 91017-7133 Telephone: (626) 303-5676 FAX: (626) 358-8048 e-mail: info@unitekmiyachi.com

The purpose of this manual is to supply operating, maintenance and service personnel with the information needed to properly and safely operate, maintain and service the UB25 Linear DC Welding Control.

We have made every effort to ensure that the information in this manual is accurate and adequate. Should questions arise, or if you have suggestions for improvement of this manual, please contact us at the above location/numbers.

Unitek Miyachi is not responsible for any loss due to improper use of this product.

SAFETY NOTES

This instruction manual describes how to operate and maintain the UB25 Linear DC Welding Control and provides instructions relating to its SAFE use. Procedures described herein MUST be performed, as detailed, by QUALIFIED and TRAINED personnel.

For SAFETY, and to effectively take advantage of the full capabilities of the workstation, please read this instruction manual before attempting to use the UB25 Linear DC Welding Control.

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

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

Please note the following conventions used in this manual:

WARNING: Comments marked this way warn the reader of actions which, if not followed, might result in immediate death or serious injury.

CAUTION: Comments marked this way warn the reader of actions which, if not followed, might result in either damage to the equipment, or injury to the individual if subject to long-term exposure to the indicated hazard.

Table of Contents

	Page
Chapter 1. Description	1-1
Section I. Introduction	
Features	
Applications	
Section II. Description	
Section III. Overview	
Introduction	
LCD Screens	
Menu Screens	
Data Screens	
Alphanumeric Data	
Operational States	
Graphed Data	
Section IV. Controls And Indicators	
Introduction	
Liquid Crystal Display (LCD) And Weld Selector Keys	
Numeric Keypad And Operational Controls	
Section V. Emergency Stop Switch And 24v Jumpers	
Section VI. Related Publications	
Chapter 2 Getting Started	2-1
Section I: Planning For Installation	2-1
Space Requirements	
Utilities	
Section II: Unpacking	
Section III: Electrical And Data Connections	
Section IV. Setup	
Manual Weld Head Connections	
Air-Actuated Weld Head Connections	
Relay, Data, And Communication Connections	
Chapter 3. Using UB25 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	 ł
Description	 ł

Table of Contents (Continued)

Page

Upslope/Downslope Weld Profile Applications	
Applications	
Description	
Dual-Pulse Weld Profile	
Applications	
Description	
Section III. Programmable Feedback Modes	
Introduction	
Current Mode	
Applications	
Description	
Voltage Mode	
Applications	
Description	
Power Mode	
Applications	
Description	
Section IV. Weld Monitor	
Introduction	
Active Part Conditioner (APC)	
Applications	
Description	
How It Works	
Instructions	
Energy Limits	
Applications	
Description	
Pre-Weld Check	
Application	
Function	
Chapter 4, Operating Instructions	
Section I: Introduction	4-1
Section II: Initial Setup	
Pre-Operational Checks	
Connections	
Power	
Compressed Air	
Initial Setup Instructions	
Section III. Programming Weld Schedules	

Page

Introduction	
Select A Weld Schedule	
Enter New Values	
Single-Pulse Weld Schedule	
Upslope/Downslope Weld Schedule	
Dual-Pulse Weld Schedule	
Section IV. Programming The Weld Monitor	
Section V. Programming For Active Part Conditioning	
Section VI. Operation	
General Operator Safety	
Manual Welding	
Operation	
Normal Stop	
Automated Welding	
Operation	
Normal Stop	
Emergency Stop	
Re-Set After Emergency Stop	
Chapter 5, Setup Software	
Section I: Introduction	
Overview	
Section II. How To Use Menu Screens	
Main Menu	
Setup Menus	
Section III. Operator Preferences	
Display Contrast	
Buzzer Loudness	
End Of Cycle Buzzer	
Update Graph After Weld	
Buzzer On Weld Stop	
Section IV. System Settings	
Waveform Check And Weld Fire Lockout	
Waveform Check ON/OFF	
Stability Check % Limit Setting	
Stability Check Delay Setting	
Energy Capacity % Limit Setting	
Weld Fire Lockout Charge % Setting	
Footswitch Weld Abort	
Switch Debounce Time	
Firing Switch	

Table of Contents (Continued)

Page

Input Switch Select	
Mechanical Selection	
OPTO Selection	
PLC Selection	
Control Signals Select	
Weld Counter Functions	
System Security	
Calibration	
Chain Schedules	
Section V. PID Test Weld Setup	
Overview	
Do Test Weld Options	
Ignore First/Last	
Section VI. Relay Settings	
Function	
Programming Instructions	
Section VII. Special Functions	
Copy A Schedule	
Reset Defaults	
Reset System Parameters	
Reset All Schedules	
Section VIII. Communication And Data	
Requirements	
Communication	
I.D. Number	
Baud Rate	
Chapter 6. User Maintenance	
Section I. Precautions	6-1
Section II. Operator Maintenance	
Section III. Troubleshooting	
General Kinds of Problems	6-1
Alarm Messages	
Troubleshooting	
Technical Assistance	
Electrode Maintenance	
Parts Replacement	

Page

Chapter 7. Calibration	7-1
Section L Introduction	7-1
Overview	7-1
Calibration Equipment Required	7-1
Calibration Points	7-2
Section II Calibration Equipment Setun	7_3
Section III. Calibration Procedure	
Appendix A. Technical Specifications	A-1
General	Δ_1
Mechanical Characteristics	
Environmental Characteristics	A-3
Environmental Characteristics	A-3
Einerrace Signals	A-3
Fimiware	A-3
Appendix B. Electrical And Data Connectors	B-1
Introduction	B-1
Voltage Sense Input	B-1
RS 485-In And RS 485-Out	B-2
RS 232	B-3
I/O Signal Interface A	B-4
I/O Signal Interface B	B-6
25-Pin Mating Plug With Emergency Stop Shorting Wires For I/O Connector A	B-8
25-Pin Mating Plug With Internal Jumpers For I/O Connector B	B-8
Air Valve Driver 24v	B-9
Firing Switch B-9	,
Foot Switch	B-10
AC Input Power Connection	B-11
Weld Terminals	B-12
Appendix C. The Basics Of Resistance Welding	C-1
Resistance Welding Parameters	C-1
Welding Parameter Interaction	C-1
Electrode Selection	C-2
Electrode Maintenance	C-4
Weld Schedule Development	C-4
Weld Strength Testing	
Weld Strength Profiles	
σ	

Typical Weld Strength Profile

Table of Contents (Continued)

	Page
Appendix D. Quality Resistance Welding Solutions Defining The Optin	mum Process D-1
Introduction	D-1
Resistance Welding - A Material World	D-1
A Solder or Braze Joint	
A Solid-State Joint	
A Fusion Joint	
Consider the Material Properties	D-3
Group I – Conductive Metals	D-3
Group II – Resistive Metals	D-4
Group III – Refractory Metals	D-4
Basic Principles	D-4
Weld Profiles	D-6
Approach to Weld Development	D-7
Initial Welding Trials The "Look See" Tests	D-8
Application Perspective	D-8
Process Perspective	D-8
Common Problems	D-9
What are Screening DOE'S?	D-10
Criteria for Success	D-10
What are Factorial DOE'S?	D-11
Criteria for Success	D-11
Conclusion	D-11
Appendix E. LCD Display Messages	E-1
Introduction	E-1
Relay Activation	E-1
Clearing Alarm Conditions to Resume Operation	E-1
List of Messages	E-1
Appendix F. Relay Timing Diagrams	F-1
Introduction	F-1
Weld	F-1
End Of Weld	F-2
Alarm	F-2
Out Of Limits	F-3
Appendix G. Repetition Rates	G-1

Introduction		G- 1
Maximum We	d Pulse Duration As A Function Of Weld Current	G-2

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

OPGELET! Dit symbool duidt een bediening aan waarvoor een gekwalificeerde technicus en de gebruikershandleiding vereist zijn VARNING! Denna symbol indikerar ett arbetsmoment som b r utf ras av en kvalificerad tekniker med hj lp av Anv ndarhandledningen VAARA! T m merkki osoittaa toimenpiteen, jossa tarvitaan asiantuntevaa teknikkoa sek k ytt k sikirjaa ATTENTION! Ce symbole d isigne une op ration exigeant un technicien qualifi et le Manuel d'utilisation Dieses Symbol kennzeichnet einen Arbeitsgang, f r den ein qualifizierter Techniker und ein Benutzerhandbuch erforderlich sind ATTENZIONE! Questo simbolo indica un'operazione che richiede un tecnico qualificato ed il manuale dell'utente ¡CUIDADO! Este s mbolo indica uma opera o que requer um t cnico qualificado e o Manual do Usu rio ¡PRECAUCI N! Este s mbolo designa una operaci n que requiere un t cnico competente y el Manual del usuario



Install power supply system

Installeer het voedingssysteem Installera kraftaggregatsystemet Asenna voimanl hdej rjestelm Installer le syst me d'alimentation lectrique Das Elektroenergieversorgungssystem installieren Installazione del sistema d'alimentazione elettrico Instale o sistema de fonte de aliment o Instale el sistema de fuente de alimentaci n

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

Augenschutz verwenden

Usare occhiali di protezione

Use culos de prote o

Use protecci n para los ojos

Alle programma- of instellingswijzigingen moeten door een gekwalificeerd technicus H nvisa alla program- och inst llnings ndringar till en kvalificerad tekniker Anna kaikki ohjelman tai asetusten muutokset asiantuntevan teknikon suoritettaviksi Confier toutes les modifications de programme ou de r glages un technicien qualifi S mtliche Programm - oder Einstellungs nderungen m ssen einem qualifizierten Techniker berlassen werden

Rivolgersi ad un tecnico qualificato per tutti i cambiamenti di programma di impostazione Consuite um t cnico qualificado quanto a qualquer altera o de programa ou ajuste Comfiele a un t cnico competente todos los cambios de programas o ajustes

3. Use eye protection

Oogbescherming dragen Anv nd skyddsglas gon K yt silm suojaimia Porter une protection oculaire





Unitek Miyachi Corporation 1820 South Myrtle Avenue • Monrovia CA 91017 Tel: 626-303-5676 • FAX: 626-358-8048

4. Examine weld terminals

Kijk de lasterminals na Inspektera svetsterminalerna Tarkista hitsausterminaalit Examiner les bornes de soudure Schwei verbindungen pr fen Esaminare i terminali di saldatura Examine os terminals de soldagem Examine las terminales soldadas



5.

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

Gebruik de schakelaar WELD/NO WELD om de lasstroom te stoppen

Anv nd omkopplaren WELD/NO WELD f $\mbox{ r}$ att koppla fr $\mbox{ n}$ svetsstr $\mbox{ mmen}$

Katkaise hitsausvirta WELD/NO WELD - kytkimest

Utiliser l'interrupteur WELD/NO WELD pour arr ter le passage du courant de soudure

Der Schwei stromflu wird mit dem Schalter WELD/NO WELD angehalten

Usare l'interruttore WELD/NO WELD per interrompere il flusso della corrente di saldatura

Use a chave WELD/NO WELD para interromper o fluxo da corrente de soldagem

Utilice el interruptor de WELD/NO WELD para cortar el flujo de la corriente de soldar

EMERGENCY STOP - Open electrical circuit to retract weld head

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

N DSTOPP - ppna den elektriska kretsen f r att dra tillbaka svetstr den.

H T KYTKIN POIS - Avaa virtapiiri vet ksesi hitsausp n takaisin.

ARRET D'URGENCE - Ouvrez le circuit lectrique pour retirer la t te de soudure.

NOT AUSSCHALTER - W rd den elektrischen Kreis ffnen, der Schwei kopf w rd zur ck gezogen.

EMERGENZA DISINSERITA - Aprire il circuito elettrico per ritrarre la testa della saldatura. DESCONE O DE EMERG NCIA - Abra o circuito el trico para retrair a cabe a da soldadura.

DESCONECCION DE EMERGENCIA - Abra el circuito el ctrico para retraer la cabeza de soldadura.



Unitek Miyachi Corporation 1820 South Myrtle Avenue • Monrovia CA 91017 Tel: 626-303-5676 • FAX: 626-358-8048







DECLARATION OF CONFORMITY

Application of Council Directive: 72/23/EEC

Standards to which conformity is declared:	EN 61010-1:1993
Manufacturer's Name:	Unitek Miyachi
Manufacturer's Address:	1820 S. Myrtle Ave
	Monrovia, CA 91017
Equipment Description:	Linear DC Welder
Equipment Class:	1
Model Number:	UB25

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

Place	Monroup	Galifornia
Signature:	Kin Au	·
Full Name:	Keum Gi	unning
Position:	Director,	R+D.



CHAPTER 1 DESCRIPTION

Section I. Introduction

Features

The **UB25 Linear DC Welding Control** is a Resistance Welding Control. For the rest of this manual, the UB25 will be referred to simply as the *Control*. The Control has the following features:

- Programming of time in 10 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. You can also use schedule #00 as a "scratch pad" for developing schedules.
- 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.
- Active Part Conditioning (APC) compensates for varying part conditions and oxide layers.
- Rear-mounted RS-232 and RS-485 connectors allow for remote programming, weld schedule selection, and data logging for SPC purposes.
- Calibration traceable to NIST standards.
- Optional *DC25/UB25 Advanced Serial Datacom Communications Interface* kit, commonly called "the Datacom kit," available for process logging.
- 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. *Chapter 3, Using UB25 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 and can supply weld power up to 1,000 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.





UB25 Front Panel

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*.

All electrical connectors, data connectors, and the **ON / OFF** switch 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.

Section III. Overview

Introduction

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 LCD 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 LCD displays 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 Screens



LCD Display Screens

The LCD displays 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 is used to select choices from the menu.

Data Screens

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

Alphanumeric Data



Alphanumeric Data

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

Operational States

Each **Data Screen** displays the current operational state of the 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.

UB25 Operational States

STATE	DESCRIPTION		
RUN	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.		
NO WELD	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 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 WELD SWITCH IN NO WELD POSITION alarm. The WELD/NO WELD switch toggles the Control between the WELD and NO WELD states.		
PROGRAM	In this state, the weld time and energy values can be modified and new schedules can be selected. From the RUN state, press any one of the WELD SELECTOR KEYS to put the Control in the PROGRAM state.		
TEST	When a weld schedule is changed, the Control has the capability of performing a TEST weld in order to optimize the feedback control loop and produce the fastest rise-time, minimum-overshoot weld pulse. The Control can be programmed to ALWAYS do a test weld after a schedule is changed, ASK to do a test weld after a schedule is changed, or only IF REQUIRED , do a test weld after a schedule is changed.		
STANDBY	When an air actuated weld head is being used, the Control will go to the STANDBY state when the footswitch is pressed.		
SQUEEZE	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 milliseconds. NOTE: In addition to the debounce time, there is a delay of no greater than 2.5ms before the start signal is recognized by the Control.		
WELD	The WELD period begins after SQUEEZE time has ended and includes both weld pulses as well as the Cool time between Pulse 1 and Pulse 2.		
HOLD	The HOLD period begins after the WELD period ends and lasts for the duration programmed in the schedule. An adequate amount of hold time should be programmed to allow the electrodes to sink the heat away from the welded parts. The default HOLD time is 50 milliseconds. It is during the HOLD time that the weld strength is formed.		
END	The Control will enter the END state after the HOLD period if the firing switch or footswitch has not yet been released.		
MONITOR	This state allows you to view waveforms of weld voltage , current , power , and resistance . Press the ENERGY 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		

UB25 Operational States

STATE	DESCRIPTION	
	will update with the new weld data. The operational state will then read RUN , and the LCD screen will show the monitored data.	
ALARM	The Control automatically goes into an alarm state when it recognizes any alarm condition (these are described in detail in <i>Appendix E</i> , <i>LCD Display Messages</i>).	
MENU	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 <i>Chapter 4, Operating Instructions</i>).	

Graphed Data



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 1: DESCRIPTION

Chapter 3, Using UB25 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 IV. 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 (LCD) And Weld Selector Keys



LCD and Weld Selector Keys

KEY	FUNCTION
SCHEDULE	Press to view and select a <i>Weld Schedule</i> . After pressing the SCHEDULE key, you can use either the $\frac{1}{3} \Leftrightarrow$ (up/down) keys on the front panel to scroll through the 99 stored <i>Weld Schedules</i> , or use the numeric keypad to enter the two-digit number of the desired schedule.
	Weld Selector Keys. A group of nine keys used to program the time periods and energy levels for each complete weld schedule.

CHAPTER 1: DESCRIPTION

KEY	FUNCTION
SQUEEZE	Press to enter the squeeze time before the weld. To select the value, use either the $\frac{1}{2} \Rightarrow$ (up/down) keys, or use the numeric keypad to enter the numbers. The squeeze time will start after a firing signal is given to the Control.
	NOTE: In addition to the debounce time, there is a delay of no greater than 2.5ms before the start signal is recognized by the Control.
UP WELD DOWN PULSE 1	A group of 3 individual keys used to program the time and energy for Pulse 1. Each key is described below.
UP	Press to enter the amount of time Weld Pulse 1 upslope. To select the value, use either the $\frac{1}{3} \Leftrightarrow (up/down)$ keys, or use the numeric keypad to enter the numbers.
WELD	This switch toggles between the middle and bottom data lines on the LCD. To enter weld energy values (energy level and feedback mode), press the switch to highlight the middle line. To enter weld time values [in milliseconds], press the WELD switch again to highlight the bottom line. To select energy and time values, use either the $\frac{1}{2} \Leftrightarrow$ (up/down) keys, or use the numeric keypad to enter the numbers and decimal point. To select feedback mode , press the kA , V , or kW key.
DOWN	Press to enter the amount of time for Weld Pulse 1 downslope. To select the value, use either the $\mathcal{F} \mathrel{\bullet} (up/down)$ keys, or use the numeric keypad to enter the numbers and decimal point.
COOL	Press to enter the amount of time for the cool period. To select the value, use either the $\frac{1}{2} \Leftrightarrow (up/down)$ keys, or use the numeric keypad to enter the numbers and decimal point.
UP WELD DOWN PULSE 2	A group of three individual keys that program Pulse 2. These keys have the exact same function as the Pulse 1 Keys.

KEY	FUNCTION
HOLD	Press to enter the amount of time for the hold period after the weld. To select the value, use either the $\frac{1}{3} \Rightarrow (up/down)$ keys, or use the numeric keypad to enter the numbers.

Numeric Keypad and Operational Controls



Numeric Keypad and Operational Controls

KEY	FUNCTION
	Monitor/Limits a group of two keys that allows you to view monitor data and set limits of welding parameters. If the weld exceeds pre-set limits, the Control can be programmed to initiate alarms and/or interrupt welds.
ENERGY	Displays the energy limits monitor allowing you to view the graphic waveform trace of the selected parameter. Welding in the MONITOR state allows you to watch and verify welds as they are being made. Welding can be automatically interrupted when the programmed limit value of current , voltage or power has been reached. Using the RELAY MENU screens, you can also program relays to provide an output alarm signal when limits are exceeded.
	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.
	 Press to: Increment (increase) or decrement (decrease) numeric values on the display Scroll the weld schedule numbers up and down.

CHAPTER 1: DESCRIPTION

KEY	FUNCTION	
1 2 3 4 5 6 7 8 9 • 0 i	 Numeric Keypad Enter or modify weld period time and energy values. Enter or modify monitor and limit values. Directly recall a specific weld schedule. Select menu items when MENU screens are displayed. 	
	Press to insert a decimal point into the time and energy values you enter.	
	Press to display the version number of the Control software and other pertinent information about the Control.	
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. <i>Chapter 4, Operating Instructions</i> describes how to use the different MENU options.	
	When in the MONITOR state, press to view the resistance waveform of the last weld. The resistance waveform and values are provided as a reference and are designed to provide an illustration of the resistance change during the weld.	
 NOTE: The kA, 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 .	
	When MONITOR or RUN is displayed 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	

CHAPTER 1: DESCRIPTION

KEY	FUNCTION	
	parameter to current.	
kA	(Continued) When MONITOR or RUN is displayed in the MONITOR state, press the kA key to view the current graph on the LCD display.	
V	When PROGRAM is displayed, this key is used to set voltage as the feedback mode for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired output level with the numeric keypad, and then press the V key to change the feedback mode to voltage .	
	When MONITOR or RUN is displayed in the MONITOR state, this key is used to set voltage as the limit parameter for Pulse 1 or Pulse 2. First, use the WELD key to highlight the energy field, then enter the desired limit level with the numeric keypad, and then press the V key to change the limit parameter to voltage .	
	When MONITOR or RUN is displayed in the MONITOR state, press the V key to view the voltage graph on the LCD display.	
kW	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 MONITOR or RUN is displayed 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 MONITOR or RUN is displayed in the MONITOR state, press the kW key to view the power graph on the LCD display.	
WELD	WELD position when a weld is initiated, the Control delivers energy to the weld head.	
NO WELD	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	

KEY	FUNCTION	
	electrodes.	

Section V. Emergency Stop Switch and 24V Jumpers

The Control is shipped with two 25-pin mating plugs installed on the two I/O connectors on the rear panel of the Control. These two plugs, connected to I/O Connector A and I/O Connector B are pre-wired with two jumpers for the **24V Power** signals and a shorted two-wire lead for the **Emergency Stop Switch** connection. For connector pin identification and specifications, including the 24V Power signals, see *Appendix B*, *Electrical and Data Connectors*.

NOTE: The Control will not function if these plugs are not installed.

The plug connected to **I/O Connector A** is pre-wired with a two-wire lead for the *Emergency Stop Switch*. The lead wires are shorted together [normally closed] and secured with a wire nut.



Emergency Stop Switch Shorting Wires

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, leave the two wires of the emergency stop lead shorted together (closing the circuit).

To operate *with* an Emergency Stop Switch, connect a normally closed, emergency stop switch across the two wires of the emergency stop lead. 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.

To restart the Control after an emergency stop, press the **RUN** key on the front panel. Verify that the desired schedule is still displayed on the front panel, and then resume welding.

For user convenience, pins 9 and 13 of **I/O Connector B** have an additional input to stop the functioning of the unit. This input will stop weld current and raise the weldhead. This input requires the microprocessor to be operational and is not the emergency stop for the unit.

Section VI. Related Publications

Related publications, which you may wish to obtain from Unitek Peco, are:

- DC25/UB25 Advanced Serial Datacom Communications Interface, No. 990-661
- Series 300 Fast Response Weld Head System, No. 990-115

Please consult your **Unitek Peco** representative to obtain this information. In addition, check the **Unitek Peco** website listed in the *Foreword* of this manual to see the latest technical update information, called *Nuggets*.

CHAPTER 2 GETTING STARTED

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.

Dimensions and weight are:

Height:	12.75 in.	(324 mm)
Width:	9.25 in.	(235 mm)
Depth:	23.5 in.	(597 mm)
Weight:	52 lbs	(24 kg)

Utilities

Power requirements will vary depending on your configuration.

Model UB25:	115 volts AC, 15 amps
Model UB25/230:	230 volts, AC, 10 amps

The power cable for the 230-volt version of the Controller the (Model UB25/230) is not supplied with a wall connector due to the variety of connectors used by different countries. You will need to install the appropriate connector to the Controller power cable before installation and setup. 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 Control is shipped to you completely assembled and ready-to-use. The available accessories for the Control are:

- 2-Level Foot Switch
- DC25/UB25 Advanced Serial Datacom Communications Interface Kit
- Weld Head appropriate for the welding application
- Input/Output Mating Connectors (For use on cables connecting the Control to external equipment)

Verify that the equipment shows no signs of damage. If you see any damage, please contact the carrier. Also, contact Unitek Peco immediately by telephone, FAX, or the postal or e-mail address shown in the Foreword 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, are made on the rear panel.



UB25 Rear Panel Connections

NOTE: The Control is shipped with **two** 25-pin mating plugs installed on the two I/O connectors on the rear panel (the plug for Connector B is not shown for clarity). The Control will *not* function if these plugs are not installed. The plug connected to I/O Connector A is pre-wired with a two-wire lead for the *Emergency Stop Switch*. For details, see *Chapter 1, Section V, Emergency Stop Switch And 24V Jumpers*.

NOTE: 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*.

NOTE: 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



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.



Voltage Sensing Cable Installation

- 8 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.
- 9 Connect the Firing Switch cable connector from the Control to the firing switch cable connector from the weld head.

Air-Actuated Weld Head Connections

If you are using an air-actuated weld head, you will need to make the following two connections in addition to the manual weld head connections.



Air Head Connections

- 1 Connect the Model FS1L or FS2L Foot Switch cable connector to the Control connector marked **FOOT SWITCH**.
- 2 Connect the weld head air valve solenoid cable connector to the Control connector marked **AIR VALVE DRIVER 24V**.

NOTE: This connector provides 24 Vac power only. It will not drive 115 V ac air valves. Refer to the weld head manufacturer's manual.

Relay, Data, And Communication 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*.

Chapter 3 Using UB25 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 preprogrammed 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 $01 \rightarrow 99$. A weld profile is the graphic representation [or *waveform*] of the numeric weld-time and weld-energy values. **NOTE**: There is an additional weld schedule numbered **00**, which can be used as a "scratch pad" to develop new weld schedules.

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**, or **power** 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** is what displays on the LCD when you schedule a weld profile.



Sample Weld Sequence (Dual-Pulse)

Welding Applications

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

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

Weld Head Applicability

The Control is best used with Unitek Peco force-fired, manual weld heads or air actuated weld heads. For manually actuated weld heads, the weld sequence begins when the force-firing switch closes. 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.

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.



Single-Pulse Weld Profile

Upslope/Downslope Weld Profile

Applications

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

Description

Upslope allows a gradual application of weld energy which permits the parts to come into better contact with each other reducing the electrode to part contact resistances. Upslope can allow a smaller electrode force to be used, resulting in a cleaner appearance by reducing electrode indentation, material pickup and electrode deformation. It can also be used to displace plating and/or oxides, reduce flashing and spitting, or reduce thermal shock when welding parts containing glass-to-metal seals.

Downslope (annealing) assists in the grain refinement of certain heat-treatable steels, and prevents cracking in aluminum and other materials by reducing the cooling rate. Annealing is not typically used for welding small parts.



Upslope / Downslope Weld Profile

Dual-Pulse Weld Profile

Applications

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

Description

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



CHAPTER 3: USING UB25 WELDING FUNCTIONS

Upslope will also help to displace plating and/or oxides, reduce flashing and spitting, or 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 2 weld current by a factor of 3 as the first pulse significantly reduces the resistance of the interface between the parts. The only use for the downslope period following the Pulse 1 or Pulse weld period 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 0.050 kA [or less] 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.

Section III. Programmable Feedback Modes

Introduction

The feedback mode (**current**, **voltage**, **power**) 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.

NOTE: In a Dual-Pulse weld profile, a different feedback mode can be used for each pulse. For example, a constant power first pulse can be used to break through plating in combination with a constant current second (welding) pulse.

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

How It Works

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

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



Constant Power Waveform With Corresponding Voltage And Current Waveforms

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



Active Part Conditioning Waveform

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

Instructions

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

Energy Limits

Applications

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

Energy Limits can be used in two different ways:

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

Description

This function terminates the weld energy during the welding process if pre-set weld **current**, **voltage**, or **power** limits are exceeded. In addition to inhibiting the weld, the 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: Energy Limit Weld Termination

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



Example 2: Sufficient Current Level

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

Pre-Weld Check

Application

• Detect Misaligned or Missing parts.

Function

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

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

CHAPTER 3: USING UB25 WELDING FUNCTIONS



Pre-Weld Check Waveform

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

NOTE: You must have **upslope** programmed into the pulse in order to set a lower limit.

In addition to inhibiting the weld, the 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 assembly line so the faulty weld piece can be removed.

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 UB25 Welding And Monitoring Functions*.
- The principles of resistance welding and the use of programmed weld schedules. For more information, see *Appendix C, The Basics of Resistance Welding*.

For additional information on the welding process, see *Appendix D*, *Quality Resistance Welding Solutions*, *Defining the Optimum Process*.

Section II: Initial Setup

Pre-Operational Checks

Always perform these checks *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 *Chapter* 2 of this manual. Verify that the Emergency Stop Switch shorting wires are connected *or* verify that an Emergency Stop Switch is connected properly.

Power

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

Compressed Air

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

Initial Setup Instructions

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

NOTE: When you are ready to perform a weld, be sure to set this switch back to the **WELD** position.

3 Turn the **ON/OFF** switch on the rear panel of the Control to the **ON** position. The default **RUN** screen will be displayed. You will use this screen to enter welding parameters.



Default RUN Screen

Section III. Programming Weld Schedules

Introduction

The 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 UB25 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 $\blacktriangle \nabla$ (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 drastically different energy values are entered for Pulse 1 and Pulse 2, the Control will require a minimum of 0.5 ms Cool Time. If different feedback modes are programmed for a dual pulse weld, the Control will require a minimum of 0.5 ms Cool Time. If a Cool Time is set lower than 0.5 ms, but not zero, the Control will default to 0.5 ms Cool Time.

Single-Pulse Weld Schedule



- Press the **SCHEDULE** button, then select a Weld Schedule using **either** the \blacktriangle arrows or the numeric keypad.
 - 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** milliseconds. **NOTE**: We recommend 150 milliseconds.
- 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 $\blacktriangle \forall$ arrows. Enter **0** milliseconds.
- Press the **PULSE 1 WELD** key to highlight the bottom line of the LCD to enter the weld time. Use the numeric keypad to enter the time or use the $\blacktriangle \nabla$ arrows. Enter a time between **0** and **99** milliseconds.

Press the **PULSE 1 WELD** key again to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the $\blacktriangle \nabla$ arrows. The Control output ranges are:

- **Current:** from $0.005 \rightarrow 1.000$ kiloamps.
- Voltage: from $0.100 \rightarrow 4.900$ volts.
- **Power:** from $0.050 \rightarrow 4.900$ kilowatts.
- 6 Perform *one* of the following:
 - Press the **kA** key to program **current** as the feedback mode.
 - Press the V key to program voltage as the feedback mode.
 - Press the **kW** key to program **power** as the feedback mode.
- 7

8

10

1

2

3

4

5

- Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the $\blacktriangle \nabla$ arrows. Enter **0** milliseconds.
 - 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 $\blacktriangle \nabla$ arrows. Enter **0.5** milliseconds.
- 9 Program Pulse 2 by repeating Steps 3 through 7 above using the keys for Pulse 2, entering the value0 in each step.



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

Upslope/Downslope Weld Schedule



Press the **SCHEDULE** button, then select a Weld Schedule using **either** the $\blacktriangle \lor$ arrows **or** the numeric keypad.

Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the $\blacktriangle \forall$ arrows. We recommend 150ms.

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 milliseconds. A good starting point is 5 milliseconds.



Press the **PULSE 1 WELD** key again to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the $\blacktriangle \forall$ arrows. The Control output ranges are:

- **Current:** from $0.005 \rightarrow 1.000$ kiloamps.
- Voltage: from $0.100 \rightarrow 4.900$ volts.
- **Power:** from $0.050 \rightarrow 4.900$ kilowatts.
- 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.
 - **I** Press the **kW** key to program **power** as the feedback mode.
 - Press the **PULSE 1 DOWNSLOPE** key to enter the amount of time for the Weld Pulse 1 **downslope**. Use the numeric keypad or the $\blacktriangle \lor$ arrows to enter the time. Enter a time between **0** and **99** milliseconds. A good starting point is **5** milliseconds.
- 8

7

1

2

3

4

5

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 $\Delta \nabla$ arrows. Enter **0.5** milliseconds.

9 Program Pulse 2 by repeating Steps 3 through 7 above using the keys for Pulse 2, entering the value0 in each step.



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

Dual-Pulse Weld Schedule



- Press the **SCHEDULE** button, then select a Weld Schedule using either the \blacktriangle arrows or the numeric keypad.
 - Press the **SQUEEZE** button to enter the squeeze time before the weld. Use the numeric keypad to enter the time or use the $\blacktriangle \nabla$ arrows. We recommend 150ms.
 - 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 **99** milliseconds.



Press the **PULSE 1 WELD** key again to highlight the middle line of the LCD to enter weld energy. Use the numeric keypad to enter the energy level or use the $\blacktriangle \nabla$ arrows. The Control output ranges are:

- Current: from $0.005 \rightarrow 1.000$ kiloamps.
- Voltage: from $0.100 \rightarrow 4.900$ volts.
- **Power:** from $0.050 \rightarrow 4.900$ kilowatts.
- 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.
 - 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 $\blacktriangle \forall$ arrows. Enter a time between **0** and **99** milliseconds.

8

7

1

2

3

4

5

UP

•

COOL

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 $\blacktriangle \nabla$ arrows. Enter a time between 0 and 99 milliseconds. We recommend at least 2 milliseconds.

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



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 $\blacktriangle \lor$ arrows. Enter a time between 0 and 999 milliseconds. We recommend at least 50 milliseconds.

Section IV. Programming the Weld Monitor

- Press the **SCHEDULE** button, then select a Weld Schedule using **either** the $\frac{1}{2}$ \Rightarrow arrows **or** the numeric keypad. Fire the welder and view the output waveform (shaded graph) on the display.
- 2 **ENERGY** Press the **ENERGY** key to access the **MONITOR** screen.
- 3 Perform a weld and view the trace of the weld parameter, use the



kA

- Ω key to view the desired waveform.
- 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 *\science* arrows to enter the upper limit value for the Pulse 1 weld period. The Control can monitor:
 - **Current** from $0 \rightarrow 1.2$ kiloamps.
 - Voltage from $0 \rightarrow 6.5$ volts.
 - **Power** from $0 \rightarrow 8.0$ kilowatts.
- 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.



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.



6

1

4

kW

or

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 DURING PULSE 1** 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.
- **APC: STOP PULSE 1/ALLOW PULSE 2** stops Pulse 1 immediately after upper or • lower energy limits are exceeded, but allows Pulse 2 to fire. This function will not operate if both pulses are joined *without* a cool time.

NOTE: See "Active Part Conditioner" in *Chapter 3*.

- 8 After making your selection the display will automatically return to the monitor screen.
- 9 Program the upper and lower limits for Pulse 2 by repeating Steps 4 through 6 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.



Press the **HOLD** period key. This will bring up the **PULSE 2 OUT HOLD** 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 DURING PULSE 2** stops **PULSE 2** immediately after upper or lower energy limits are exceeded.
- 14 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 UB25 Welding And Monitoring Functions
- Chapter 4, Section III, Programming Weld Schedules
- Chapter 4, Section IV, Programming The Weld Monitor
- Press the **SCHEDULE** button, then select a Weld Schedule using **either** the \blacktriangle 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.
- 4 Push the **ENERGY** button to monitor the waveforms for **voltage**, **resistance**, **current**, and **power**.
- 5 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.
 - 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.
- 6 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.

7 Push the **ENERGY** 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.



1

5



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

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

- 10 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 ...
- Try welds with varying oxide (clean and dirty). The power supply terminates the first pulse when your 11 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.
- 12 Program your second welding pulse as normal to achieve a strong weld. Constant voltage is recommended for round parts and constant current for flat parts. An upslope may be required to restrict the current flow early in the second pulse and avoid weld splash.



Section VI. Operation

General Operator Safety

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.

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 and verify the desired weld schedule is displayed on the LCD.
- 5 Continue to weld following normal automation procedures.

CHAPTER 5 SETUP SOFTWARE

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, 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
Operator Preferences	Display ContrastBuzzer LoudnessEnd Of Cycle Buzzer	Update Graph After WeldBuzzer On Weld Stop
System Settings	 Waveform Check Footswitch Weld Abort Switch Debounce Time Firing Switch Input Switch Select 	 Control Signals Select Weld Counter Functions System Security Calibration Chain Schedules
PID Test Weld Setup	 Overview Do Test Weld Options	Ignore First/Last
Relay Settings	• Function	Programming Instructions
Special Functions	Copy A Schedule	 Reset Defaults Reset System Parameters Reset All Schedules
Communication and Data	RequirementsCommunication	I.D. NumberBaud Rate

Before programming the Control, you must be familiar with the **location** and **function** of the LCD 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.

MAIN MENU				
0. WAVEFORM CHECK	5. COMMUNICATION			
1. SETUP	6. RELAY			
2. WELD COUNTER	7. CALIBRATION			
3. COPY A SCHEDULE	8. RESET TO DEFAULTS			
4. SYSTEM SECURITY	9. CHAIN SCHEDULES			
NUMBER Select an item				

Always look at the prompt at the bottom of each menu screen. These prompts vary from screen to screen, but 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 **AV** which means that you should use the UP or DOWN keys on the front panel to take the next action. Other prompts may **highlight** a specific key, which means you should press the key indicated to take the next action.

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

Setup Menus

SETUP menus are accessed in sequence: **MAIN MENU** \rightarrow **SETUP 1** \rightarrow **SETUP 2** \rightarrow **SETUP 3**.

- 1 From the **MAIN MENU**, press **1** to go to the **SETUP 1** menu.
- 2 To go to the **SETUP 2** menu, press the $\mathbf{\nabla}$ (down) key.

SETUP 1				
1. FOOTSWITCH WELD ABORT	: OFF			
2. SWITCH DEBOUNCE TIME	: 10ms			
3. FIRING SWITCH	: AUTO			
4. INPUT SWITCH SELECT	: MECH OPEN			
5. CONTROL SIGNALS SELECT	: MECH OPEN			
NUMBER Select, MENU Main menu, ▼ Page 2				
NOTE: The SETUP 2 menu is *only* available through the SETUP 1 or SETUP 3 menus.

3 To go to the **SETUP 3** menu, press the $\mathbf{\nabla}$ (down) key.

SETUP 2			
1. DISPLAY CONTRAST	: 080%		
2. BUZZER LOUDNESS	: 030%		
3. END OF CYCLE BUZZER	: OFF		
4. UPDATE GRAPH AFTER WELD	: ON		
5. BUZZER ON WELD STOP	: OFF		
NUMBER Select MENII Main men			

NOTE: The **SETUP 3** menu is *only* available through the **SETUP 2** menu.

4 To scroll back through **SETUP 2** and **SETUP 1** menus, press the \blacktriangle (UP) key.

SETUP 3 PID TEST WELD			
1. DO TEST WELD	: ALWAYS		
2. IGNORE FIRST/LAST	: 0.2 ms		
	_		
NUMBER Soloct MENII Ma	in menu 🔺 Page 🤈		

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

Section III. Operator Preferences

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 in the shop environment and different ambient lighting conditions.



4 Press **MENU** to return to the previous screen, *or* keep pressing the **MENU** key to return to the **MAIN MENU**.

Buzzer Loudness

- 1 Go to the **SETUP 2** menu.
- 2 Press the **2** key to access the **BUZZER LOUDNESS** adjustment screen.
- 3 Use the up ▲ and ▼ keys to adjust the buzzer tone so that it can be heard against shop background noise.

BUZZER LOUDNESS BUZZER LOUDNESS : 30%									
0 10	20 djust,	30 MENL	 40 Prev	 50 vious	 60 men	 70 u	 80	 90	I

4 Press **MENU** to return to the previous screen, *or* keep pressing the **MENU** key to return to the **MAIN MENU**.

End Of Cycle Buzzer

- 1 Go to the **SETUP 2** menu.
- 2 Press the **3** key to toggle the end of cycle buzzer **ON** or **OFF**.

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

SETUP 2			
1. DISPLAY CONTRAST	: 080%		
2. BUZZER LOUDNESS	: 030%		
3. END OF CYCLE BUZZER	: OFF		
4. UPDATE GRAPH AFTER WELD	: ON		
5. BUZZER ON WELD STOP	: OFF		
NUMBER Select MENU Main menu			

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

Update Graph After Weld

- 1 Go to the **SETUP 2** 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 LCD 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 (multiple welds per second) for automated welding because the control processor does *not* have to redraw the screen.

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

Buzzer On Weld Stop

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

- 1 Go to the **SETUP 2** menu.
- 2 Press the **5** key to toggle the buzzer function **ON** or **OFF**.
- 3 Keep pressing the **MENU** key on the front panel to return to the **MAIN MENU**.

SETUP 2			
1. DISPLAY CONTRAST	: 080%		
2. BUZZER LOUDNESS	: 030%		
3. END OF CYCLE BUZZER	: OFF		
4. UPDATE GRAPH AFTER WELD) : ON		
5. BUZZER ON WELD STOP	: OFF		
NUMBER Select MENU Main mer			

NOTE: After setting Operator Preferences, press the RUN button on the front panel to perform welding.

Section IV. System Settings

Waveform Check and Weld Fire Lockout

Even though the Control optimizes the output pulse, misaligning parts or operating at the outer edges of the Control's operational range may degrade the waveform. The **WAVEFORM CHECK** feature, which includes **STABILITY CHECK** and **ENERGY CAPACITY LIMIT**, can be used to confirm that the proper waveform was produced.

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.

These features are 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 Press the **1** key to toggle **WAVEFORM CHECK ON** or **OFF**.

Stability Check % Limit Setting

- From the WAVEFORM CHECK menu, press the 2 key to access the STABILITY CHECK % LIMIT screen.
- 2 Use the numeric keypad to enter the % limit. This limit is the allowable average deviation from the set point for the weld pulse after the delay period.
- 3 Press **MENU** to return to the **WAVEFORM CHECK** menu. The **STABILITY CHECK % LIMIT** line will display your programmed setting along with deviation readings from the Pulse 1 and Pulse 2 of the most recent weld.



WAVEFORM CHECK

2. STABILITY CHECK % LIMIT : Ø7 % Ø/ Ø

5. WELD FIRE LOCKOUT CHRG% : 95 % Ø

3. STABILITY CHECK DLY(ms) : 1.Ø msec 4. ENERGY CAPACITY % LIMIT : Ø5 % Ø/ Ø

NUMBER Select. MENU Main menu

: <mark>ON</mark>

1. WAVEFORM CHECK

Stability Check Delay Setting

 From the WAVEFORM CHECK menu, press the 3 key to access the STABILITY CHECK DLY (ms) screen.

Use the numeric keypad to enter the delay period, in milliseconds. This period, at the start of the pulse, will not be used when the average deviation is calculated.

2 Press **MENU** to return to the **WAVEFORM CHECK** menu.

Energy Capacity % Limit Setting

- 1 From the WAVEFORM CHECK menu, press the 4 key to access the ENERGY CAPACITY % LIMIT screen.
- 2 Use the numeric keypad to enter the capacity % limit. This limit is the % below the set point the energy is allowed to be at the end of the weld pulse.
- 3 Press MENU to return to the WAVEFORM CHECK menu. The ENERGY CAPACITY % LIMIT line will display your programmed setting along with the Pulse 1 and Pulse 2 ENERGY CAPACITY readings from the most recent weld.



ENERGY CAPACITY %	LIMIT
ENERGY CAPACITY % LIMIT:	<mark>Ø5</mark>
NUMBER Change, MENU Previous me	enu

Weld Fire Lockout Charge % Setting

- From the WAVEFORM CHECK menu, press the 5 key to access the WELD
 FIRE LOCKOUT screen.
- 2 Use the numeric keypad to enter the required amount of energy in the capacitor bank before the next weld is allowed.
- 3 Press MENU to return to the WAVEFORM CHECK menu. The WELD FIRE LOCKOUT CHRG% line will display your programmed setting along with the actual % CHARGE from the most recent weld.



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

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

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

UB25 LINEAR DC RESISTANCE WELDING CONTROL

WELD FIRE LOCKOUT CHRG%
WELD FIRE LOCKOUT CHRG%: 90
NUMBER Change, MENU Previous 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 milliseconds 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 2.5ms before the start signal is recognized by the Control.

NOTE: The factory default debounce time is 10 milliseconds (ms).

- 1 Go to the **SETUP 1** screen.
- 2 Press the **2** key to access the **SWITCH DE-BOUNCE TIME** menu.

	SWITCH DEBOUNCE TIME
1. NONE	
2. 10ms	
3. 20ms	
4. 30ms	
NUMBER Sala	nt MENH Previous menu

3 Select the required debounce time by pressing the **1**, **2**, **3**, or **4** key. The LCD will automatically return to the **SETUP 1** screen and the **SWITCH DEBOUNCE TIME** line will now reflect your time selection.

NOTE: NONE represents a debounce time of **0** msec. Use **NONE** for interfacing with the Unitek Peco Model 350C Electronic Weld Force Control.

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

Firing Switch

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



NUMBER Select, MENU Previous menu

NOTE:

• **AUTO** accepts a single pole, double pole, or optical firing switch input, typically from a Unitek Peco 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.

NOTE: In addition to the debounce time, there is a delay of no greater than 2.5ms before the start signal is recognized by the 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.)
- 3 Press **MENU** to return to the **MAIN MENU**.

Input Switch Select

Selects the type of external switch to be used by the **Firing Switch** and **Foot Switch** inputs, and how these switches are activated.

- 1 Go to the **SETUP 1** menu.
- 2 Press 4 for the INPUT SWITCH SELECT menu.

INPUT SELECT SWITCH 1. MECHANICAL 2. OPTO 3. PLC

NUMBER Select, MENU Previous menu

Mechanical Selection

This selection accepts dry contact, single, or double pole switch or reed relay devices. This is the factory default setting and will run Unitek Peco weld heads.

- 1 From the **INPUT SWITCH SELECT** menu, press **1** for the mechanical switch select menu.
- 2 Press the **1** or **2** key to select how the input mechanical switches will initiate the Control. The display automatically returns to the **SETUP 1** menu.



- Mechanical Switch Normal Open: Initiate the Control by closing the mechanical switches.
- **Mechanical Switch Normal Closed:** Initiate the Control by opening the mechanical switches

CHAPTER 5: SETUP SOFTWARE

NOTE: You will get an **INPUT SWITCH ALARM** *unless* you close the **Firing Switch** and **Foot Switch** inputs before selecting the Normal Closed option.

OPTO Selection

This selection accepts an opto coupler switch for eliminating switch debounce problems.

- 1 From the **INPUT SWITCH SELECT** menu, press **2** to display the opto switch select menu.
- 2 Press the **1** or **2** key to select how the input opto switches will initiate the Control. The display automatically returns to the **SETUP 1** menu.



- **OPTO SWITCH NORMAL OPEN**: Turn **ON** the open collector output transistor of the opto isolator to initiate the Control.
- **OPTO SWITCH NORMAL CLOSED**: Turn the open collector output transistor of the opto isolator **OFF** to initiate the Control.

NOTE: You will get an **INPUT SWITCH ALARM** *unless* you close the **Firing Switch** and **Foot Switch** inputs before selecting the Normal Closed option.

PLC Selection

This option is used only if you are using an automated welding system. This selection accepts +24 Vdc from a PLC as a source for activating the **Firing Switch** and **Foot Switch** inputs. For detailed electrical interface information on these input switch selections, see *Appendix B*, *Electrical And Data Connectors*.

 From the INPUT SWITCH SELECT menu, press the 3 key to display the PLC select menu.

NOTE: PLC 0VDC TURN ON

initiates the Control from a PLC source by changing the PLC voltage from +24 Vdc to 0 Vdc.

INPUT SWITCH SELECT 1. PLC 0VDC TURN ON 2. PLC +24VDC TURN ON

NUMBER Select MENIL Previous Menu

PLC +24VDC TURN ON initiates the Control from a PLC source by changing the PLC voltage from 0 Vdc to +24 Vdc.

NOTE: You will get an **INPUT SWITCH ALARM** *unless* you have 0 Vdc on the Firing **Switch** and **Foot Switch** inputs before selecting the +24 Vdc Turn On option.

2 Press the **1** or **2** key to select how the PLC input switches will initiate the Control. The display automatically returns to the **SETUP 1** menu.

Control Signals Select

This option selects the type of external switch to be used by the **Schedule Selection**, **Process Inhibit**, and **ISTOP** inputs and how these switches are activated.

1. MECHANICAL

2. **OPTO**

3. PLC

- 1 From the **SETUP 1** menu, press **5** for the **CONTROL SIGNALS SELECT** menu.
- 2 Follow the **INPUT SWITCH SELECT** instructions on *the previous two pages*, the procedures are identical for **CONTROL SIGNALS SELECT**.
- 4 Press **MENU** to return to the **MAIN MENU**.

Weld Counter Functions

- 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**, **2**, **3** or **4** key to select the desired weld counter.

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

3 To reset the counter, press **0** on the numeric keypad. To input a preset number, use the numeric keypad.

WELD COUNTERS
1. TOTAL WELDS : 0000000
2. OUT OF LIMITS HIGH : 0000000
3. OUT LIMITS LOW : 0000000
4. WITHIN LIMITS : 0000000

CONTROL SIGNALS SELECT

NUMBER Select, MENU Previous menu

TOTAL WELDS	WELD COUNTER : 0017429
NUMBER Change,	•Restore, MENU Menu

NOTE: If you accidentally reset the wrong counter, press the • (period/decimal point) key. The original count will reappear.

- 4 Press the **MENU** 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**.

System Security

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

SYSTEM	I SECURITY	
1. SCHEDULE LOCK	: OFF	
2. SYSTEM LOCK	: OFF	
3. CALIBRATION LOCK	: OFF	
NUMBERS Select, MENU Pr	evious menu	

NOTE:

- **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.

NOTE: 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.

PASSWORD	CHANGE STATUS :
NUMBERS for co	de followed by <mark>PERIOD</mark>

- 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 2. 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.

🕶 Novt MENII monu

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] \rightarrow Schedule 02 [1 time] \rightarrow Schedule 03 [1 time] \rightarrow 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 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.

CHAIN SCHE	DULES
1. CHAIN SCHEDULE	:OFF
2. SETUP CHAIN SCHEDULES	

NUMBER Select, MENU Previous menu

CHAIN SCHEDULE SETUP			
SCHEDULE NUMBER	WELD COUNT	NEXT	
Ø1	<mark>ØØØ1</mark>	Ø1	
Ø2	ØØØ1	Ø2	
Ø3	ØØØ1	Ø3	
Ø4	ØØØ1	Ø4	
▲▼ scroll, <mark>SCHEDULE</mark> select, MENU menu			

CHAIN SCHEDULE SETUP			
SCHEDULE NUMBER	WELD COUNT	NEXT	
Ø4	ØØØ1	Ø4	
Ø5	<mark>ØØØ1</mark>	Ø5	
Ø6	ØØØ1	Ø6	
Ø7	ØØØ1	Ø7	
▲▼ scroll, <mark>SCHEDUI</mark>	<mark>_E</mark> select, <mark>MENU</mark> r	menu	

CHAIN SCHEDULE SETUP			
SCHEDULE NUMBER	WELD COUNT	NEXT	
Ø4	ØØØ1	Ø4	
Ø5	ØØØ2	Ø5	
Ø6	ØØØ1	Ø6	
Ø7	ØØØ1	Ø7	
▲▼ scroll, SCHEDULE select, MENU menu			

CHAIN SCHEDULE SETUP			
SCHEDULE NUMBER	WELD COUNT	NEXT	
Ø4	ØØØ1	Ø4	
Ø5	ØØØ2	<mark>Ø5</mark>	
Ø6	ØØØ1	Ø6	
Ø7	ØØØ1	Ø7	
▲▼ scroll, SCHEDULE select, MENU menu			

- 9 When you finish programming the chain, press the **MENU** key to return to the **CHAIN SCHEDULES** menu.
- 10 Press the **1** key to toggle between **ON** or **OFF**.

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**.

NOTE: When **Chain Schedules** is turned **ON**, the LCD screen 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.

CHAPTER 5: SETUP SOFTWARE

Section V. PID Test Weld Setup

Overview

The Control is designed to "learn" the load of specific pieces to be welded by performing a test weld. Once it has "learned" the load (resistance), it can automatically adjust itself to deliver the optimum output waveform: the fastest rise time without overshoot, and the smoothest waveform possible. To do this, the Control does a **Test Weld** of the actual pieces you want to weld during production. The Test Weld is done on the first weld performed after a change to the weld schedule has been made. Test Welds are *only* done for schedules programmed for **voltage (V)** and/or **power (kW)** feedback. Test Welds are not done for schedules programmed for only **current (kA)** feedback.

The Control allows you to set the conditions for when the Test Welds will be done and also allows you to specify the length of time at the beginning and end of the weld pulse to be ignored by the Test Weld when calculating the load resistance.

- 1 From the **MAIN MENU**, press **1** to access the **SETUP 1** screen.
- 2 Press the down arrow key to access the SETUP 3 PID TEST WELD menu screen.



Do Test Weld Options

The **DO TEST WELD** menu screen allows you choose *when* the Control performs Test Welds.

The three options for **DO TEST WELD** are:

- If Required
- Ask
- Always

Regardless of the option chosen, a **TEST WELD** will be performed any time the schedule's feedback mode is changed to **voltage** or **power**. If the V or **kW** keys are pressed when the energy level field is selected (highlighted) in the **PROGRAM** state, the Control will treat this as if the feedback mode was changed and do a **TEST WELD**, whether the feedback mode was actually changed or not. Changes to monitor settings, such as energy limits and actions, do not cause the Control to perform a **TEST WELD**.

The **DO TEST WELD** options are:

IF REQUIRED The Control will only do a Test Weld when the feedback mode is changed to **voltage** or **power** as described above.

ASK The Control will do a Test Weld when the feedback mode is changed to voltage or power as described above. The Control will also prompt the operator if a Test Weld should be done (TEST WELD? [MENU]=NO, [RUN]=YES) when time values, voltage levels, or power levels are changed on the schedule.

ALWAYS The Control will do a Test Weld when the feedback mode is changed to voltage or power as described above. The Control will also do a Test Weld when time values, voltage levels, or power levels are changed on the schedule.

- From the SETUP 3 menu screen, press the 1 key to access the DO TEST WELD screen.
- 2 Press the **1**, **2**, **or 3** key to select the desired option.
- 3 The display will automatically return to the **SETUP 3** menu screen.

Ignore First/Last

- From the SETUP 3 menu screen, press the 2 key to access the IGNORE FIRST/LAST screen.
- 2 Use the numeric keypad to enter the time in milliseconds that the Control ignores when calculating the load resistance during the PID Test Weld. The delay time prevents the Control from measuring noise early in the test weld and allows for more accurate load resistance to be measured.
- 3 Press **MENU** to return to the **SETUP 3** menu screen.

IGNORE FIRST/LAST	
IGNORE FIRST/LAST : Ø.2ms	
NUMBER Change, MENU Previous menu	

UB25 LINEAR DC RESISTANCE WELDING CONTROL

DO TEST WELD 1. IF REQD 2. ASK 3. ALWAYS

NUMBER Select, MENU Previous menu

Section VI. Relay Settings

Function

The Control's four relays can be programmed to activate outputs under eight user-programmed conditions. Relay connections are made through the 25-pin connector I/O Signal Interface A on the rear of the Control. See Appendix B, Electrical And Data Connectors for pin connections. Appendix F, 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 , or 4 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.
- 5 Use the numeric keypad to select when the relay will energize. The display screen automatically returns to the WHEN menu.

1. RELAY 1 2. RELAY 2 3. RELAY 3 4. RELAY 4	RELAY : ON WHEN ALARM : ON WHEN ALARM : ON WHEN ALARM : ON WHEN ALARM
NUMBER Select, M	ENU Previous menu

RELAY 1

: ON

: ALARM

NUMBER Select, MENU Previous menu WHEN 1. WELD 2. END OF WELD 3. ALARM 4. OUT OF LIMITS

1. SET RELAY TO

2. WHEN

6. P1 LOW LIMIT 7. P2 HIGH LIMIT 8. P2 LOW LIMIT

5. P1 HIGH LIMIT NUMBER Select, MENU Previous menu

•	WELD	When welding, the relay output signal will start within 5 milliseconds after 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 0-150 milliseconds after the end of the HOLD period and will stay energized for 350-450 milliseconds. 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 <i>exception</i> of OUT OF LIMITS alarms) and will stay energized until the ALARM state is cleared by pressing the RUN button (refer to <i>Appendix E, LCD Display Messages</i>).
•	OUT OF LIMITS	The relay will switch when the Control senses any OUT OF LIMITS condition. It will start 0-150 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 (refer to <i>Appendix E, LCD Display Messages</i>).
•	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 0-150 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 (refer to <i>Appendix E, LCD Display Messages</i>).
•	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 0-150 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 (refer to <i>Appendix E, LCD Display Messages</i>).
•	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 0-150 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 (refer to <i>Appendix E, LCD Display Messages</i>).
•	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 0-150 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 (refer to <i>Appendix E, LCD Display Messages</i>).

- 5 Use the numeric keypad to enter the number of your choice.
- 6 Press the **MENU** key two times to return to the **RELAY** screen.

CHAPTER 5: SETUP SOFTWARE

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

Section VII. Special Functions

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**). Both fields initially contain the number of the schedule most recently displayed.

- 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.

Reset Defaults

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

SYSTEM PARAMETER	DEFAULT SETTING
Foot Switch Weld Abort	OFF
Switch Debounce Time	10 ms
Firing Switch	AUTO
Input Switch Select	MECH OPEN
Control Signals Select	MECH OPEN

Defaults for Setup Menu 1

SYSTEM PARAMETER	DEFAULT SETTING
Display Contrast	080%
Buzzer Loudness	030%
End of Cycle Buzzer	OFF
Update Graph After Weld	ON
Buzzer On Weld Stop	OFF

Defaults for Setup Menu 2

Defaults for Setup Menu 3

SYSTEM PARAMETER	DEFAULT SETTING
Do Test Weld	ALWAYS
Ignore First/Last	0.2ms

Defaults for Waveform Check and Weld Fire Lockout

SYSTEM PARAMETER	DEFAULT SETTING
Waveform Check	ON
Stability Check % Limit	Ø7 % Ø/ Ø
Stability Check Delay	2.Ø ms
Energy Capacity % Limit:	Ø5 % Ø/ Ø
Weld Fire Lockout Charge	90 %

Defaults for Communication Menu

SYSTEM PARAMETER	DEFAULT SETTING
Communication Role	SLAVE
RS 485 ID Number	01
Baud Rate	9600

Defaults for Chain Schedules Menu

SYSTEM PARAMETER	DEFAULT SETTING		
Chain Schedules	OFF		

Defaults for Relay Menu

SYSTEM PARAMETER	DEFAULT SETTING
Relays 1 through 4	ON WHEN ALARM

It is common to change system and schedule settings when you customize the 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 DEFAULTS** menu.

This menu allows you to reset all system programmed parameters and all weld schedules 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.
- From RESET DEFAULTS, press the
 1 key to go to the RESET SYSTEM
 PARAMETERS? menu.

RE	SET SYSTEM PARAMETERS?
1. NO	
2. YES	
NUMBER Select	MENII Previous menu

RESET DEFAULTS

1. RESET SYSTEM PARAMETERS

EPROM DATE: XX-XX-XX XX:XX VX.XX

NUMBER Salact MENII Providus monu

2. RESET ALL SCHEDULES

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

Reset All Schedules

- 1 From the **RESET DEFAULTS** menu, press the **2** key to get to the **RESET ALL SCHEDULES?** menu.
- 2 Press the 2 key to select YES. This will automatically reset all weld schedule parameters to the factory defaults and return the display to the RESET DEFAULTS? screen.

RESET ALL SCHEDULES?

<mark>1. NO</mark> 2. YES

ALL WELD SCHEDULES ARE RESET

3 Press MENU to return to the MAIN MENU.

Section VIII. Communication and Data

Requirements

The following menu screens tell you how to set the Control's communication and data options. However, to enable the Control to perform these functions, you must install the software from the optional *DC25/UB25 Advanced Serial Datacom Communications Interface Kit*, commonly referred to as "the Datacom kit," in a host computer.

The Datacom Operator Manual describes cables, connections, RS-232 operation, RS-485 operation, sample weld reports, data collection, and how to use remote commands. The manual also lists all of the commands that the Control will respond to, and instructions on how to format commands sent to the Control so it will respond properly.

Communication

- 1 From the **MAIN MENU**, press the **5** key to go to the **COMMUNICATION** menu (shown with default settings).
- From the COMMUNICATION menu, toggle the 1 key to select MASTER or SLAVE. The COMMUNICATION ROLE line will now reflect your role selection.

	In the	MAS	ΓER	role	the	Control	will
-	III uit			1010,	uic	Condor	vv 111.

- Send weld data to the host computer after each weld operation.
- Send text 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.

NOTE: For weld data collection and host computer control information, refer to the Datacom Operator Manual, which describes how to use the **MASTER** and **SLAVE** options.

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

COMMUNICATION				
1. COMMUNICATION ROLE	: SLAVE			
2. I.D. NUMBER	: 01			
3. BAUD RATE	: 9600			

NUMBER Select, MENU Previous menu

I.D. Number

The host computer may be used to talk with multiple Controls using a single RS-485 communications line. Each Control sharing that line *must* have 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.
- From the COMMUNICATIONS
 MENU screen, press the 2 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 **MENU** key to get the **COMMUNICATION** menu screen. This time the **I.D. NUMBER** line will display your I.D. number entry.
- 5 Press **MENU** to return to the **MAIN MENU**.

Baud Rate

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

- From the COMMUNICATION menu, press the 3 key to get the BAUD RATE selection screen.
- 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.
- BAUD RATE

 1. 1200
 6. 19.2K

 2. 2400
 7. 28.8K

 3. 4800
 4. 9600

 4. 14.4K
 NUMBER Change MENU Previous menu
- 3 Press **MENU** to return to the **MAIN MENU**.

CHAPTER 6 USER 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, Unitek Peco 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 Unitek Peco 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 E*, *LCD Display Messages*.

Troubleshooting

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

Troubleshooting Chart			
PROBLEM	CAUSE (In Order of Probability)		
Air-operated weld head will not close.	Air valve driver cable not connected. (Check that the Control switches to STANDBY state when footswitch is activated.)		
	Blown fuse located on the Rear Panel. (Valve Driver Fuse: 3-A, 125-V, Slow-Blow)		
	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		
PROBLEM	CAUSE (In Order of Probability)	
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	
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	
EMERGENCY STOP message is displayed on the LCD, and fans all stop, but the Emergency Stop Switch is not activated.	Blown fuse located on internal Power Distribution & Fan Controller Board. Contact Unitek Peco for support.	

CHAPTER 6: USER MAINTENANCE

Troubleshooting Chart			
PROBLEM	CAUSE (In Order of Probability)		
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, fans are still operational.	Blown fuse located on internal Bias Power Supply. Contact Unitek Peco for support.		
LCD is operational, the Control will attempt to fire, but no energy is provided to the weld and the graphs in the RUN screen will not fill in.	Possible open circuit in the secondary circuit. Electrodes did not close properly. Possible blown fuse located on internal Capacitor Charging Power Supply. Contact Unitek Peco for support.		
Metal Expulsion	Excessive current/energy set at the Control Insufficient weld head force Misaligned parts Slow weld head follow-up Incompatible weld piece projection design Contaminated weld piece surface/ plating Incompatible weld piece materials Contaminated electrode surface. Wrong electrode tip shape No cover gas on weld piece Excessive weld time set at the Control Misaligned parts		

Troubleshooting Chart			
PROBLEM	CAUSE (In Order of Probability)		
Weld Piece Discoloration	Excessive weld time set at the Control No cover gas on weld piece Excessive current/energy set at the Control Insufficient weld head force Contaminated weld piece surface/ plating Wrong electrode material/tip shape Contaminated electrode surface		
Weld Piece Over-heating	Excessive weld time set at the Control Excessive current/energy set at the Control Misaligned parts Insufficient weld head force Incompatible weld piece materials Wrong electrode material/tip shape Contaminated electrode surface		
Weld Piece Warping	Excessive weld time set at the Control Excessive weld head force Incompatible weld piece projection design Incompatible weld piece materials Wrong electrode tip shape Excessive current/energy set at the Control		

Technical Assistance

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

CHAPTER 6: USER MAINTENANCE

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

There are no replaceable parts for the Control, other than the protection fuse for the 24-volt Air Valve Driver.

DESCRIPTION	LOCATION
3-A, 125-V, Slow-Blow	Rear Panel

Fuse

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.

CHAPTER 7 CALIBRATION

Section I. Introduction

Overview

Calibration instructions are displayed on the series of screens displayed on the Control's LCD. There are only two Calibrations *setups*, or equipment connections. After you connect the Control to the calibration equipment as instructed, follow the instructions shown on each LCD screen. While some of the instructions may appear slightly different, the procedures are essentially the same.

It takes approximately one hour to calibrate the Control if working by yourself, faster with an assistant. 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 RAM, where they will be used as standards for the operational welding parameters.

NOTE: Only authorized personnel should perform this procedure.

Calibration Equipment Required

This equipment is required for calibration:

- 2 weld cables, No. 2/0, 1 ft (30 cm) long, PN 2/0 BB12
- 4,000 micro-ohm coaxial shunt resistor accurate to $\pm 0.5\%$.

Source for shunt resistor (Model K-1000-2, 150 Watts, Mod .004):

T & M Research Products, Inc.	Telephone:	(505) 268-0316
139 Rhode Island Street NE	E-Mail:	www.tandmresearch.com
Albuquerque, New Mexico 87108		

- Calibration Kit, PN 4-35914-01
 - Filter
 - Special Calibration Cable, PN 4-35913-01
 - Standard BNC Cable
 - BNC "T-Connector"
- Digital oscilloscope, Tektronix 724C or equivalent
- 2-wire, normally open switch for weld initiation, mating connector PN 520-011

The waveforms displayed on the oscilloscope screen will vary from pulse to pulse. To calibrate the Control, adjust the energy output to the *average* value of each pulse displayed on the oscilloscope.

Calibration Points

The term *Calibration Points* refers to the various values that need to be calibrated in order for the Control to operate and monitor accurately. There are 12 *Calibration Points*. The instructions in *Section II, Calibration Procedure* tell you how to perform the procedures, the illustration below gives a quick overview of the process.



Calibration Points

Section II. Calibration Equipment Setup

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



Calibration Setup

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.

Section III. Calibration Procedure

- 1 Verify that the equipment is connected as shown in Calibration Setup.
- 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 the **PRE-CALIBRATION** screen.
- 6 From the **PRE-CALIBRATION** screen, press the **3** key to **RESET CALIBRATION** *before* performing the following procedures.
- 7 At the screen prompt, press the 2 key for **YES** to confirm that you want to reset calibration.

```
MAIN MENU

0. WAVEFORM CHECK 5. COMMUNICATION

1. SETUP 6. RELAY

2. WELD COUNTER 7. CALIBRATION

3. COPY A SCHEDULE 8. RESET DEFAULTS?

4. SYSTEM SECURITY 9. CHAIN SCHEDULES
```

NUMBER Select an item

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

▼Next, <mark>MENU</mark> menu

PRE-CALIBRATION 1. TEST UB25 (T-232 REQUIRED) 2. CALIBRATE UB25 3. RESET CALIBRATION 4. TEST SERIAL PORT

▼ NUMBER Select, MENU Previous menu

- 8 From the **PRE-CALIBRATION** screen, press the **2** key to start the sequence of on-screen calibration instructions.
- 9 The next screen is **CALIBRATION SHUNT**, which requires you to enter the actual value of the 4,000 micro-ohm shunt (the value is printed on the exterior of the shunt). Enter the value using the numeric keypad, then go to the next screen.

NOTE: The prompts at the *bottom* of the screen that tell you how to go to the next screen may vary from screen to screen. To go to the next screen, press the key indicated by the prompt.

10 Follow the instructions on the calibration screens. Each screen will show you the desired energy output value for that calibration step. Use the oscilloscope to measure the output, then use the ▲▼ keys to adjust the Control output to the correct *average* value.


Oscilloscope Display of Average Output

NOTE: Some screens will tell you to fire the Control 5 times when setting the Monitor, others will tell you to keep firing until the desired value is reached. You *must* wait a **minimum of 2 seconds** between firing pulses for calibration to be accurate.

- 11 Continue to follow the instructions on the LCD screens.
- 12 When calibration is complete, keep pressing the **MENU** button on the front of the Control until the **MAIN MENU** is displayed on the LCD.
- 13 Disconnect the Control from the "Calibration Setup," then re-connect the Control as required for your welding system.
- 14 Press the **RUN** button to return to normal operation.

APPENDIX A TECHNICAL SPECIFICATIONS

General

The UB25 is a linear DC resistance welding power supply that sends energy directly into a weld without the use of a welding transformer. It is 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.

DESCRIPTION	VALUE	NOTES
Input Line Voltage (1 phase) Model UB25/115 Model UB25/230	Standard nominal voltages 115 Vac, 15 A 230 Vac, 10 A	
Line Voltage Tolerance (referred to nominal)	115 + 15% / -10% 230 + 15% / -10%	All functions perform normally All functions perform normally
Input kVA (max demand)	UB25: 1.5 kVA UB25/230: 1.5 kVA	To be used for sizing ac input power service
Output Capability (max available to load)	Based on load	See Appendix G, Repetition Rates
Output Current/Steps (Programmable)	0.005 – 1.000 kA 1 A steps	Actual achievable output based on load. See Appendix G, Repetition Rates
Output Voltage/Steps (Programmable)	0.100 – 4.90V 1 mV steps	Actual achievable output based on load. See Appendix G, Repetition Rates
Output Power/Steps (Programmable)	0.050 – 4.9kW 1 W steps	Actual achievable output based on load. See Appendix G, Repetition Rates
Weld Periods	0-99 ms	For each of the upslope, downslope and weld periods in each of the two dual pulses.
Duty Cycle	Based on load	See Appendix G, Repetition Rates
Weld Control (Average values are regulated)	Weld Current, Voltage, or Power with simultaneous limits on one unregulated parameter	
Weld Control Ripple (At power line frequency)	2% of energy setting, peak to peak	Worst case

APPENDIX A: TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE	NOTES
Steady State Regulation During Line Fluctuations	Output: +/- 2% of reading	Line voltage within + 15% / -10% tolerance.
Regulation During Load Resistance Fluctuation	Current: $\pm 2\%$ of setting $\pm 2A$ Voltage: $\pm 2\%$ of setting $\pm 0.05V$ Power: $\pm 5\%$ of setting $\pm 20W$	Load variation from 0.5 to 10 milliohms, exclusive of ripple. After weld time of 2 ms.
Steady state Control Accuracy	Current: $\pm 2\%$ of setting $\pm 2A$ Voltage: $\pm 2\%$ of setting $\pm 0.05V$ Power: $\pm 5\%$ of setting $\pm 20W$	After weld time of 2 ms.
Initial Control Accuracy (Maximum transients)	Current: \pm 5% of setting \pm 2AVoltage: \pm 5% of setting \pm 0.05VPower: \pm 10% of setting \pm 20W	During first 2 ms with load resistance greater than 2 milliohms.
Current, Voltage, Power Repeatability:	All modes: ±2%	Weld to weld repeatability with fixed load resistance and input line voltage, steady state.
Rise Time:	Limited by external secondary circuit	
Data Communications	Remote capability to upload / download weld schedule; monitor welds; set up parameters; select schedule; and read weld results buffer	
Weld Monitor:	Range: Current from 0 to 1.2 kiloamps Voltage from 0 to 6.5 volts Power from 0 to 8.0 kilowatts	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. APC functionality also included.
Current Monitoring Accuracy	The sum of $\pm 2\%$ of setting and $\pm 2A$ Reference is actual current delivered.	Average value after settling time.
Voltage Monitoring Accuracy	The sum of $\pm 2\%$ of setting and ± 0.05 V at values greater than 0.1 V Reference is actual voltage delivered.	Average value after settling time. Voltage monitoring is not guaranteed below 0.1 V.
Power Monitoring Accuracy	The sum of \pm 5% of setting and \pm 20W Reference is actual power delivered	Average value after settling time.

Mechanical Characteristics						
DESCRIPTION VALUE NOTES						
Size	12.75" H x 9.25" W x 23.5"L (324 mm H x 235 mm W x 597 mm L)					
Weight	52 lbs (24 kg)	Weight less shipping kit or shipping materials				

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

Interface Signals									
DESCRIPTION	VALUE	NOTES							
Input / Output	24 V ac/dc inputs and outputs, 2500 V rms optically isolated, hardware selectable positive or negative logic. Fail-safe emergency power off input.	RS-232 and RS-485 communications included							
	External or internal power supplied to inputs. Inputs to be current sourcing or sinking.								
	Dedicated connectors for 24 V air head, 2-wire force firing switch, voltage sense cable, computer interface, foot switch.								
	Additional connections for weld head, schedule selection, process inhibit, emergency stop. Four general purpose programmable relays.								

Firmware

Firmware is subject to change without prior notice. Contact Unitek Peco for latest version.

APPENDIX B ELECTRICAL AND DATA CONNECTORS

Introduction

This Appendix describes the electrical and data connectors located on the rear panel of the DC25. 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 DC25, starting at the top left.

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

Voltage Sense Input



VOLTAGE SENSE INPUT CONNECTOR SPECIFICATIONS							
PIN NO.	SIGNA	MAX MAX	MAX	COMMENTO			
	NAME	TYPE	VOLTAGE	CURRENT	1/0		
1	AGND					Analog Ground	
2	Input #1	Pulse	15V	0.1A	Ι	Signal is differential between Input #1	
3	Input #2	Pulse	15V	0.1A	Ι	and Input #2 (polarity is not important).	

RS 485-IN and RS 485-OUT





RS 485 IN/OUT CONNECTOR SPECIFICATIONS						
PIN NO.	DESCRIPTION	PIN TYPE				
1	Signal Ground	Isolated ground (1kV dc Isolation)				
2	Not used					
3	Not used					
4	Transmit +	RS-485 Driver +				
5	Transmit -	RS-485 Driver -				
6	Not used					
7	Not used					
8	Receive +	RS-485 Receiver +				
9	Receive -	RS-485 Receiver -				

RS 232



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

I/O Signal Interface A



Specification Table on next page.

APPENDIX B: ELECTRICAL AND DATA CONNECTORS

I/O SIGNAL INTERFACE A CONNECTOR SPECIFICATIONS							
PIN NO.	NAME	VOLTAGE	CURRENT	I/O	COMMENTS		
1	RELAY1N	230V ac or 30V dc	3A	0	Relay output 1 Negative		
2	RELAY1P	230V ac or 30V dc	3A	0	Relay output 1 Positive		
3	RELAY2N	230V ac or 30V dc	3A	0	Relay output 2 Negative		
4	RELAY2P	230V ac or 30V dc	3A	0	Relay output 2 Positive		
5	RELAY3N	230V ac or 30V dc	3A	0	Relay output 3 Negative		
6	RELAY3P	230V ac or 30V dc	3A	0	Relay output 3 Positive		
7	RELAY4N	230V ac or 30V dc	3A	0	Relay output 4 Negative		
8	RELAY4P	230V ac or 30V dc	3A	0	Relay output 4 Positive		
9	CGND	CGND			Chassis ground		
10	+24VGND	GND			+24V dc GND		
11	O-UNUSED				Not used		
12	I-UNUSED				Not used		
13	INOWELD	+24V	10mA	Ι	No weld input Switch normally open		
14	24VGND	GND			+24V dc GND		
15	SPOWER	24V dc	20mA	Ι	Power can be from internal or external source for Schedule Select, Process Inhibit, Istop		
16	24VOUT	+24V dc (open circuit)	48mA at < 24Vdc	0	+24V dc out through 200 ohm		
17	Not used						
18	Not used						
19	Not used						
20	Not used						
21	Not used						
22	HEAD+	24V ac	3A	0	24V ac Valve Driver		
23	24V acRET	24V ac Return	3A	0	24V ac Valve Driver Return		
24	ESON	24V ac	3A	Ι	Emergency Stop		
25	24V ac	24V ac	3A	0	Internal 24V ac		

I/O Signal Interface B



Specification Table on next page.

I/O SIGNAL INTERFACE B CONNECTOR SPECIFICATIONS							
PIN NO.	NAME	VOLTAGE	CURRENT	I/O	COMMENTS		
1	ISCH0	+24V dc	10 mA	Ι	Remote Schedule Select 2 ⁰		
2	ISCH1	+24V dc	10mA	Ι	Remote Schedule Select 2 ¹		
3	ISCH2	+24V dc	10mA	Ι	Remote Schedule Select 2 ²		
4	ISCH3	+24V dc	10mA	Ι	Remote Schedule Select 2 ³		
5	ISCH4	+24V dc	10mA	Ι	Remote Schedule Select 2 ⁴		
6	ISCH5	+24V dc	10mA	Ι	Remote Schedule Select 2 ⁵		
7	ISCH6	+24V dc	10mA	Ι	Remote Schedule Select 2 ⁶		
8	IINHIBIT	+24V dc	10 mA	Ι	Stop next weld pulse		
9	ISTOP	+24V dc	10 mA	Ι	User convenience stop function.		
10	IFIRE	+24V	10 mA	Ι	Firing switch normally open		
11	24VOUT	+24V dc	48mA at < 24Vdc	0	+24V dc out through 200 ohm		
12	FPOWER	+24V dc	20mA	Ι	Power can from internal or external source for Footswitch, Firing Switch, INOWELD.		
13	24VGND	GND			+24V dc GND		
14	Not used						
15	Not used						
16	Not used						
17	Not used						
18	Not used						
19	Not used						
20	Not used						
21	Not used						
22	Not used						
23	IFOOT1	+24V	10 mA	Ι	Foot switch normally open, Level 1		
24	IFOOT2	+24V	10 mA	Ι	Foot switch normally open, Level 2		
25	CGND	CGND			Chassis ground		

25-Pin Mating Plug with EMERGENCY STOP Shorting Wires for I/O Connector A.

This connector should be attached to I/O Connector A when it is shipped from the factory. Pins 24 & 25 are connected to the shorting wires (see illustration below) for the Emergency Stop Input, pins 15 and 16 (SPOWER) have an internal jumper between them. 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 LCD will display **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 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-

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

Avaa virtapiiri vetääksesi hitsauspään takaisin.

- ARRET D'URGENCE -

Ouvrez le circuit électrique pour retirer la tête de soudure. - NOODSTOP -

Open het elektrische circuit om de laskop terug te trekken.

- NÖDSTOPP -

Öppna den elektriska kretsen för att dra tillbaka svetstråden.

- NOT AUSSCHALTER -

Würd den elektrischen Kreis öffen, der Schweißkopf würd zurück gezogen.

Emergency Stop Switch Instruction Tag

25-Pin Mating Plug With Internal Jumper For I/O Connector B.

This connector should be attached to I/O Connector B when it is shipped from the factory. This plug has an *internal* jumper between pins **11** and **12** (FPOWER).

NOTE: In order to operate, *both* mating plugs *must* be attached to the I/O connectors, *or* I/O cables wired for the proper jumpers *must* be attached to the Control.

APPENDIX B: ELECTRICAL AND DATA CONNECTORS

Air Valve Driver 24V

PIN #2 -- 24V ac RETURN PIN #1 -- HEAD + PIN #4 --NOT USED PIN #3 --NOT USED

AIR VALVE DRIVER CONNECTOR SPECIFICATIONS							
PIN NO.	SIGNA	L	MAX VOLTAGE	MAX CURRENT	I/O	COMMENTS	
	NAME	TYPE					
1	HEAD+	AC.	24V ac	3A	0	Air valve drive	
2	24V acRET	AC	24V ac	3A	0	Air valve drive return	
3	Not Used						
4	Not Used						

Firing Switch

PIN #2 -- IFIRE

PIN #1 -- 24VGND



FIRING SWITCH CONNECTOR SPECIFICATIONS							
	SIGNA	L	MAX MA VOLTAGE CURF	МАХ	I/O	COMMENTS	
PIN NO.	NAME	TYPE		CURRENT			
1	24VGND	Digital.	SGND	20mA		Firing Switch signal ground.	
2	IFIRE	Digital	+24V	10mA	Ι	Firing Switch normally open.	
SHIELD	CGND		CGND			Chassis ground.	

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

APPENDIX B: ELECTRICAL AND DATA CONNECTORS

Foot Switch



FOOT SWITCH CONNECTOR SPECIFICATIONS								
PIN NO.	SIGNAL		VOLTAGE	MAX CURRENT	I/O	COMMENTS		
	NAME	TYPE						
1	CGND					Chassis ground		
2	IFOOT1	Digital	+24V	10mA	Ι	Foot switch SW1 (Level 1) normally open		
3	IFOOT2	Digital	+24V	10mA	Ι	Foot switch SW2 (Level 2) normally open		
4	24V GROUND	Digital	SGND	20mA	Ι	Foot switch signal ground		

AC Input Power Connection



AC INPUT POWER CONNECTION SPECIFICATIONS							
MODEL TERMINAL MAXIMUM VOLTAGE MAXIMUM CURR							
	Hot	132 volts	15 amps				
UB25	Neutral						
	Ground						
	Hot	265 volts	10 amps				
UB25/230	Neutral						
	Ground						

APPENDIX B: ELECTRICAL AND DATA CONNECTORS

Weld Terminals



WELD TERMINAL SPECIFICATIONS								
TERMINAL MAXIMUM VOLTAGE MAXIMUM CURRENT COMMENTS								
+	9.9 volts	1,300 amps	Variable					
-	Return							

Resistance Welding Parameters

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

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



Welding Parameter Interaction

Interaction of Welding Parameters

Electrode Selection

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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Alumel	-2	Alumel	-2
Alumel	-2	Chromel	-2
Alumel	-2	Dumet	-2
Aluminum	-1	Aluminum	-1
Aluminum	-1	Aluminum Alloys	-1
Aluminum	-1	Cadmium Plating	-1
Aluminum	-1	Tinned Brass	-14
Aluminum	-1	Tinned Copper	-14
Aluminum	-1	Gold Plated Dumet	-2
Aluminum	-1	Gold Plated Kovar	-2
Aluminum	-1	Kovar	-2
Aluminum	-1	Magnesium	-1
Aluminum	-1	Cold Rolled Steel	-2
Aluminum	-1	Stainless Steel	-2
Beryllium Copper	-2	Beryllium Copper	-2
Beryllium Copper	-2	Brass	-2, -14
Beryllium Copper	-2	Copper	-14
Beryllium Copper	-2	Tinned Copper	-14

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Beryllium Copper	-2	Nickel	-2
Beryllium Copper	-2	Cold Rolled Steel	-2
Beryllium Copper	-2	Stainless Steel	-2
Brass	-2, -14	Brass	-2, -14
Brass	-2, -14	Tinned Brass	-14
Brass	-2, -14	Consil	-2
Brass	-2, -14	Constantan	-2
Brass	-2, -14	Copper	-14
Brass	-2, -14	Tinned Copper	-14
Brass	-2, -14	Dumet	-2
Brass	-2, -14	Nichrome	-2
Brass	-2, -14	Nickel	-2
Brass	-2, -14	NiSpan C	-2
Brass	-2, -14	Paliney 7	-2
Brass	-2, -14	Silver	-11, -14
Brass	-2, -14	Cold Rolled Steel	-2
Brass	-2, -14	Stainless Steel	-2
Bronze	-2, -11	Bronze	-2, -11
Bronze	-2, -11	Tinned Copper	-14
Bronze	-2, -11	Iron	-2
Bronze	-2, -11	Nichrome	-2
Bronze	-2, -11	Nickel	-2
Chromel	-2	Chromel	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Chromel	-2	Constantan	-2
Chromel	-2	Copel	-2
Chromel	-2	Copper	-14
Chromel	-2	Tinned Copper	-14
Chromel	-2	Dumet	-2
Chromel	-2	Nichrome	-2
Chromel	-2	Cold Rolled Steel	-2
Consil	-2	Consil	-2
Consil	-2	Tinned Copper	-14
Consil	-2	Dumet	-2
Constantan	-2	Constantan	
Constantan	-2	Copper	-14
Constantan	-2	Tinned Copper	-14
Constantan	-2	Iron	-2
Constantan	-2	Nichrome	-2
Constantan	-2	Nickel	-2
Copper	-14	Copper	-14
Copper	-14	Dumet	-2
Copper	-14	Invar	-2
Copper	-14	Karme	-2
Copper	-14	Manganin	-2
Copper	-14	Nichrome	-2
Copper	-14	Nickel	-2
Copper	-14	Paliney 7	-2
Copper	-14	Silver	-11, -14
Copper	-14	Cold Rolled Steel	-2
Copper	-14	Stainless Steel	-2
Dumet	-2	Dumet	-2
Dumet	-2	Nichrome	-2
Dumet	-2	Nickel	-2
Dumet	-2	Platinum	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
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

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
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
Niobium	-2	Niobium	-2
Platinum	-2	Platinum	-2
Paliney 7	-2	Paliney 7	-2

MATERIAL	ELECT RWMA TYPE	MATERIAL	ELECT RWMA TYPE
Silver	-11, -14	Silver	-11, -14
Silver	-11, -14	Cadmium	-13
Silver	-11, -14	Cold Rolled Steel	-2
Silver	-11, -14	Stainless Steel	-2
Cold Rolled Steel	-2	Cold Rolled Steel	-2
Cold Rolled Steel	-2	Stainless Steel	-2
Cold Rolled Steel	-2	Tantalum	-2
Stainless Steel	-2	Stainless Steel	-2
Stainless Steel	-2	Tungsten	-2
Tantalum	-2	Tantalum	-2
Titanium	-2	Titanium	-2
Tungsten	-2	Tungsten	-2
Tungsten	-2	henium	-2
Zinc	-14	Zinc	-14

Electrode Maintenance

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

Weld Schedule Development

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

- 1 Install the correct electrodes in the electrode holders on the Weld Head. See the preceding Table for electrode material recommendations.
- 2 Use a flat electrode face for most applications. Use a "domed" face if surface oxides are a problem. If either of the parts is a wire, the diameter of the electrode face should be equal to or greater than the

diameter of the wire. If both parts are flat, the face should be at least one-half the diameter of the electrodes. Pencil point electrodes cause severe electrode sticking to the parts, unexplained explosions, and increase the weld heat substantially because of the reduced electrode-to-part contact area.

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

- 4 Program a weld schedule, then make your first weld. Always observe safety precautions when welding and wear safety glasses. For a complete procedure on making welds, refer to *Chapter 4, Operating Instructions*.
- 5 Use pliers to peel the welded materials apart. A satisfactory weld will show residual material pulled from one material to the other. Tearing of base material around the weld nugget indicates a material failure NOT a weld failure. Excessive electrode sticking and/or "spitting" should define a weld as unsatisfactory and indicates that too much weld current, voltage, power, or time has been used.
- 6 If the parts pull apart easily or there is little or no residual material pulled, the weld is weak. Increase the weld time in 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*.
- 4 Repeat steps 1 through 3 using a different but fixed weld time.

Typical Weld Strength Profile

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

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

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



Typical Weld Strength Profile

APPENDIX D

Quality Resistance Welding Solutions Defining the Optimum Process

Introduction

A quality resistance welding solution can be defined as one that meets the application objectives and produces stable, repeatable results in a production environment. In order to define the optimum process the user must approach the application in a methodical way and many variables must be considered. 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 stage in designing a quality welding solution is to consider the properties of the materials to be joined and also the quality requirements of the desired welded joint. When considering these properties it is worthwhile to review the way the resistance welding process works and the likely outcome when the parts are resistance welded.

There are four main types of structural materials:

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

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 as shown on the right. Alloys are normally harder, less conductive, and more brittle than the parent metal. This has bearing on the type of joint one can expect when resistance-welding a combination of different metals.



Metals atoms are naturally attracted to other metal atoms even in different parent materials. Metals and alloys will bond together once surface contaminants such as dirt grease and oxides are removed. Resistance welding generates heat at the material interface that decomposes the dirt and grease and helps to break up the oxide film. The heat generated 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 the joint cools and a new structure is formed.

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

• A 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.

• A Solid-State Joint

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

• A 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 point, electrical conductivity, and hardness. A solid-state joint can be an ideal solution for these difficult joining challenges. 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. In a solid-state joint the metals are only heated to 70-80% of their respective melting points. This means that the materials are less thermally stressed 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 as follows:

- Electrical and thermal conductivity
- Melting point
- Hardness

It is also important to consider the surface properties of each material such as plating, coatings, and oxides.

The figure below gives an idea of the variance in resistivity and melting point for some of the more common materials used today in micro resistance welding. The materials can be grouped into three common catagories.



• • • • •

The types of joints achievable within each of the main groups are as follows:

• Group I – Conductive Metals

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

additional heating.

• Group II – Resistive Metals

It is easier to generate heat and trap heat at the interface of resistive metals and therefore it is possible to form both solid state and fusion welds depending on the 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.



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 also 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 (see below). Conductive materials can be welded by using high contact resistance and fast heating as their bulk resistance is not high and cannot be relied upon for heat generation.

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

If a weld is initiated when both parts and electrodes are fitted up correctly as show on the right, 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 resistance present at the weld when the power supply is fired has a great impact on the heat balance of a weld and therefore also 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 below shows a weld that is initiated when the contact resistance is lower and in this example we are using bulk resistance to generate our weld heat.



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

In general conductive materials benefit from a faster heating rate, as the higher contact resistances assist heat generation in the weld. Resistive materials benefit from slower heating rates that allow the contact resistances to reduce significantly thus bulk resistances become the major source for heat generation.

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, time, and therefore heating rate of the parts. The weld head applies force from the start to finish of the welding process.



to come into closer contact at their interface. A hold time is the 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 of time. This basic form of weld profile is sufficient for the majority of small part resistance welding applications.

Power supply technology selection is based on both the requirements of the application and process. In general, closed loop power supply technologies are the best choice for their consistent, controlled output and fast response to changes in resistance during the weld (for further details, see the Unitek Peco "slide rule").

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

APPENDIX D: DEFINING THE OPTIMUM PROCESS

At this stage, it is good practice to document the welding set up so that it can be referred to later (request Unitek Peco "Process Audit Worksheet" for an example). Once the equipment set up has been documented the next stage is to fix as many of the process and material variables as possible to reduce variation in the subsequent welding trials. The main welding parameters such as energy, force, and time cannot be fixed at this stage but many of the other variables such as repeatable part positioning should be fixed.

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".

The mini experiments should also be used to understand the weld characteristics from both application and process perspective. Key factors in this understanding are listed on the next page.

Application Perspective

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

Process Perspective

- What are the likely variables in a production process?
- How will operators handle and align the parts?
- What tooling or automation will be required?
- How will operators maintain and change the electrodes?
- What other parameters will operators are 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 (Design of Experiments) method of evaluation. Random explosions or unexpected variables will skew statistical data and waste valuable time.



The figure above shows common welding problems that can often be identified in the basic set up of the force, energy and time welding profile. These problems can lead to weld splash and inconsistency and variation (contact Unitek Peco for further information and support).

What are Screening DOE'S?

The purpose of a Screening DOE (Design of Experiments) 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 also the variation in the welded result. This is important, as variation in process is critical in establishing the best production settings.

Typical welded assemblies are assessed for strength of joint and variation in strength. A Screening DOE tests the high and low settings for 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. It promotes understanding of many variables in a single experiment and allows the user to interpret results and thus narrow the variables for the next level of statistical analysis. If many variables are still not understood, multiple Screening DOE'S may be required. Unitek Peco provides a simple Screening DOE tool that is run in excel and is sufficient for the majority of applications (contact us for details). Bespoke 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. This will prevent 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 maybe 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 the time to also assess the measurement accuracy and consistency of the test method and procedure. Variation in test method can invalidate the test and can 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 maybe 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 maybe 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 to ensure that the solution is one that can run in a real production environment. Welded assemblies should be tested over time an under real use conditions to ensure that all functionality criteria will be met. Validation testing is usually required to prove the robustness of the process under production conditions.

Conclusion

The resistance welding process can deliver a reliable and repeatable joining solution for a wide range of metal joining applications. Defining the optimum welding process and best production settings is not a "black art" and 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. Unitek Peco will frequently use the Screening DOE tool to establish the impact of key variables and also to assist customers with troubleshooting. Often the testing as 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.

APPENDIX E 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.

Relay Activation

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

Clearing Alarm Conditions to Resume Operation

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

- 1 Take the **Corrective Action** shown next to the **Alarm** message in the list of messages.
- 2 Clear the **Alarm** condition on the Control in order to resume operation:
 - Press the **RUN** key on the front panel of the Control.

OR

• Momentarily close the Process Inhibit input on I/O Connector B on the rear panel.

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.

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE	
ACCESS DENIED! SCHEDULE LOCK ON	Operator tried to change a weld schedule or individual weld parameters.	Press MENU , select System Security, then enter your access code to turn off Schedule Lock.	GENERAL	
		NOTE: Entering a security code of 414 will always unlock the system.		
ACCESS DENIED! SYSTEM SECURITY ON	Operator tried to change parameters of an individual weld schedule, I/O switch functions, or calibration parameters.	Press MENU , select System Security, then enter the correct access code to turn off the System or Calibration Lock protection features.	GENERAL STATUS	
		NOTE: Entering a security code of 414 will always unlock the system.		
CALIBRATION RESET TO DEFAULT	User entered calibration values have been reset to factory default values.	Execute the built-in calibration procedure to get the correct setting. See Calibration section in manual.GEN ST.		
CAPACITY LIMIT EXCEEDED P1	Pulse 1 is below the % limit at the end of the waveform.	Shorten weld time, lower energy setting, or reduce repetition rate. See Chapter 5 for programming instructions.	OUT OF LIMITS	
CAPACITY LIMIT EXCEEDED P2	Pulse 2 is below the % limit at the end of the waveform.	Shorten weld time, lower energy setting, or reduce repetition rate. See Chapter 5 for programming instructions.	OUT OF LIMITS	
CHAINED TO NEXT SCHEDULE	Chain Schedules function is active. Schedule has been incremented.	Normal operation. See Chapter 5 for more information.	GENERAL STATUS	
CHECK CONTROL SIGNALS INPUT STATUS	One or more of the I/O input control signals (Schedule Selection, Process Inhibit, or ISTOP) is preventing the Control	Remove the I/O input control signal condition preventing further Control operation. For more information see Chapter 5.	ALARM	
	nom continuing to operate.	NOTE: The correct removal action depends on how the control signal select in the Setup 1 menu was programmed by the user.		
CHECK INPUT SWITCH STATUS	One or more of the Firing or Foot Switch input signals is preventing the Control from continuing to	Remove the I/O input control signal condition preventing further Control operation.	ALARM	
	operate.	NOTE: The correct removal action depends on how the INPUT SWITCH SELECT in the Setup 1 menu was programmed by the user.		

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE	
CHK VOLTAGE CABLE &	No electrode voltage measurement was made. Possible open circuit.	Check that a closed secondary circuit is present when the Control fires.	t	
SECONDARY CKT		Verify that the Voltage Sense Cable is properly connected to the electrodes or electrode holder.		
		NOTE: Polarity is not important for the cable connection.		
		If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact Unitek Peco for support.		
COOL TIME ADDED FOR DIFFERENT FEEDBACK	The Control automatically added Cool Time to the schedule because Pulse 1 and Pulse 2 feedback modes are different, or Pulse 1 and Pulse 2 energy levels are different.	Normal operation.	GENERAL STATUS	
COOL TIME MINIMUM	The operator programmed a cool time smaller than required.	Increase setting.	GENERAL STATUS	
CURRENT 1 GREATER THAN UPPER LIMIT	Actual weld current is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS	
CURRENT 1 LOWER THAN LOWER LIMIT	Actual weld current is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS	
CURRENT 2 GREATER THAN UPPER LIMIT	Actual weld current is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high current. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS	

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

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE	
INPUT TOO LARGE	The user has attempted to program a weld energy or time that exceeds the capability of the Control.	Re-program welding parameters to be within the capability of the Control.	GENERAL STATUS	
INPUT TOO SMALL	The user has attempted to program a weld energy or time that is below the capability of the Control.	Re-program welding parameters to be within the capability of the Control.	GENERAL STATUS	
LOWER LIMIT GREATER THAN UPPER LIMIT	The user has tried to program a Lower Limit value that is greater than the Upper Limit value for Pulse 1 or Pulse 2 time periods.	Re-program the invalid Lower Limit value.	GENERAL STATUS	
NO CURRENT READING	No current measurement was made. Possible open circuit.	Check that a closed secondary circuit is present when the Control fires.		
		If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact Unitek Peco for support.	OUT OF LIMITS	
NO VOLTAGE READING	No voltage measurement was made. Possible open circuit or possible voltage lead connectionCheck that a closed secondary circuit is present when the Control fires.		OUT OF	
	problem.	Check voltage cable connection.	LIMITS	
		If message persists, possible blown internal fuse on Capacitor Charging Power Supply, contact Unitek Peco for support.		
POWER 1 GREATER THAN UPPER LIMIT	Actual weld power is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS	
POWER 1 LOWER THAN LOWER LIMIT	Actual weld power is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS	

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
POWER 2 GREATER THAN UPPER LIMIT	Actual weld power is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
POWER 2 LOWER THAN LOWER LIMIT	Actual weld power is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low power. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
POWER TRANSISTOR OVERHEATED	The power dissipated by the power transistors has exceeded the Control specified capability.	Reduce duty cycle. Reduce weld time.	ALARM
SCHEDULES ARE RESET	User programmed the Control to automatically reset all 100 weld schedules to their factory set default values.	CAUTION: Be careful when using the MENU default features. There is no way to undo a reset to defaults action.	GENERAL STATUS
STABILITY LIMIT EXCEEDED P1	The average deviation of Pulse 1 is beyond the allowable amount programmed in the Stability Check function. The default value for the % limit is 7%. The default value for the delay at the start of the pulse is 2 milliseconds.	See Chapter 5 for programming instructions. Decide whether to adjust the % limit, delay, or schedule settings. NOTE : The WAVEFORM CHECK function can be turned OFF if desired.	OUT OF LIMITS
STABILITY LIMIT EXCEEDED P2	The average deviation of Pulse 2 is beyond the allowable amount programmed in the Stability Check function. The default value for the % limit is 7%. The default value for the delay at the start of the pulse is 2 milliseconds.	See Chapter 5 for programming instructions. Decide whether to adjust the % limit, delay, or schedule settings. NOTE: The WAVEFORM CHECK function can be turned OFF if desired.	OUT OF LIMITS
STOP ON CONTROL SIGNALS INPUT	The ISTOP function has been activated. Welding has been inhibited.	Remove any unsafe operating conditions at the welding electrodes. Reset the input to the ISTOP. See Appendix B for details.	ALARM

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
SYSTEM PARAMETERS ARE RESET	User programmed the Control to automatically reset all I/O and other system parameters to their factory set default values.	CAUTION: Be careful when using the MENU default features. There is no way to undo a reset to defaults action.	GENERAL STATUS
TEST WELD? [MENU]=NO [RUN]=YES	The ASK test weld function is programmed in the SETUP 3 MENU screen. This is the prompt to the operator whether to do a test weld or not.	Normal Operation. Press MENU to skip the test weld. Press RUN to perform the test weld. See Chapter 5 for programming information.	GENERAL STATUS
UPSLOPE REQUIRED FOR LOWER LIMIT	User has attempted to program a Lower Limit value for Weld 1 or Weld 2 periods without using an upslope period.	Delete the Weld 1 or Weld 2 Lower Limit value. Add an upslope period before Weld 1 or Weld 2 if a Lower Limit value is desired.	GENERAL STATUS
VOLTAGE 1 GREATER THAN UPPER LIMIT	Actual weld voltage is greater than the user set Upper Limit value for Pulse 1.	Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
VOLTAGE 1 LOWER THAN LOWER LIMIT	Actual weld voltage is less than the user set Lower Limit value for Pulse 1.	Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
VOLTAGE 2 GREATER THAN UPPER LIMIT	Actual weld voltage is greater than the user set Upper Limit value for Pulse 2.	Determine the cause of the high voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS

MESSAGE	DESCRIPTION	CORRECTIVE ACTION (IF REQUIRED)	TYPE OF MESSAGE
VOLTAGE 2 LOWER THAN LOWER LIMIT	Actual weld voltage is less than the user set Lower Limit value for Pulse 2.	Determine the cause of the low voltage. Changes to the welding setup or process can affect the energy delivered. Refer to the Troubleshooting Chart in Chapter 6. Limits should be set by qualified by personnel and are designed to identify process variations.	OUT OF LIMITS
WELD FIRE LOCKOUT	A weld was initiated before the capacitor bank charge reached the required level as programmed in the WAVEFORM CHECK menu. Default value for WELD FIRE LOCKOUT is 90% charge. Reducing this value with high energy levels or longer weld times could exceed the capacity of the Control.	Reduce the repetition rate. See Chapter 5 for programming information. See Appendix G for Repetition Rate and Control capability details.	ALARM
WELD STOP - LIMIT REACHED	The user set Upper Limit value has been reached, and the weld energy has been terminated.	Normal operation if this function is used. See Chapter 4, Operating Instructions for information on WELD STOP.	OUT OF LIMITS
WELD SWITCH IN NO WELD POSITION	User has tried to activate the Control with the WELD/NO WELD Switch in the No Weld Position.	Set the WELD/NO WELD switch to the Weld position.	
WELD TIME TOO SMALL	The user has attempted to program zero for all upslope, weld, and downslope time periods.	Re-program the welding parameters to be within the capability of the Control.	GENERAL STATUS

APPENDIX F RELAY TIMING DIAGRAMS

Introduction

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

- WELD
- END OF WELD
- ALARM
 - OUT OF LIMITS
 - P1 HIGH LIMIT
 - P1 LOW LIMIT
 - P2 HIGH LIMIT
 - P2 LOW LIMIT

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

WELD



When welding, the relay output signal will start within 5 milliseconds after 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 0-150 milliseconds after the end of the **HOLD** period and will stay energized for 350-450 milliseconds.* The relay will still close in case of an aborted weld.

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

ALARM



The relay output signal will start when the Control senses 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 E, LCD Display Messages*).

OUT OF LIMITS

- P1 HIGH LIMIT
- P1 LOW LIMIT
- P2 HIGH LIMIT
- P2 LOW LIMIT



The relay will switch when the Control senses any **OUT OF LIMITS** condition. It will start 0-150 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.

- **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 0-150 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.
- **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 0-150 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.
- **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 0-150 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.
- **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 0-150 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 G REPETITION RATES

Introduction

The term repetition rate refers to how often weld pulses can be repeated based on the Control's recharging time. The UB25 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 graph is divided into sections by the graphed lines. The portion of the graph below the lines is labeled *Acceptable Durations*; the area at the top-right is labeled *Durations Too Long*.

Weld pulses that fall below the lines in the *Acceptable Durations* section 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 $\frac{1}{2}$ the periods of upslope and downslope, if any. For dual-pulse welding, the sum of both pulses must be compared to the chart. This graph requires the total resistance of the secondary circuit to be between 0.5 milliohms and 10 milliohms. Certain combinations of weld currents, durations and repetition rates in the top-right portion of the graph may be possible. This depends upon the secondary load and resistance. For assistance, contact the Unitek Peco Applications Lab.

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.



Maximum Weld Pulse Duration as a Function of Weld Current

INDEX

A

Active Part Conditioner (APC)	
Air-Actuated Weld Head Connections	
Alarm Messages	6-2, E-1
Alarm	1-7, E-1
Out Of Limits	E-1
Alphanumeric Data	
Applications	
Automated Welding	

B

Baud Rate	5-25
Buzzer Loudness	
Buzzer on Weld Stop	
Basics of Resistance Welding	C-1
Electrode Maintenance	C-4
Electrode Selection	C-2
Resistance Welding Parameters	C-1
Typical Weld Strength Profile	C-6
Weld Schedule Development	C-4
Weld Strength Profiles	C-5
Weld Strength Testing	C-5
Welding Parameter Interaction	C-1

С

Calibration	7-1
Calibration Points	7-2
Equipment Required	7-1
Equipment Setup	
Overview	7-1
Procedure	7-4
Chain Schedules	
Common Problems	D-9
Communication and Data	

Control Signals Select	. 5-12
Controls and Indicators	1-8
Liquid Crystal Display (LCD)	
and Weld Selector Keys	1-8
Numeric Keypad and	
Operational Controls	.1-10
Copy A Schedule	. 5-21
Current Mode	3-7

D

Data Screens	
Datacom Kit1-1, 1-14, 2-2,	5-24
Description	1-1
Alphanumeric Data	1-5
Applications	1-2
Data Screens	1-5
Features	1-1
Graphed Data	1-7
LCD Screens	1-4
Menu Screens	1-5
Operational States	1-5
Display Contrast	5-4
Do Test Weld Options	5-17
Dual-Pulse Weld Profile	3-5
Dual-Pulse Weld Schedule	4-6

E

B-1
B-8
B-8

E (Continued

AC Input Power Connection	B-11
Air Valve Driver 24v	B-9
Firing Switch	B-9
Foot Switch	B-10
I/O Signal Interface A	B-4
I/O Signal Interface B	B-6
RS 232	B-3
RS 485 (In and Out)	В-2
Voltage Sense Input	B-1
Weld Terminals	B-12
Electrode Maintenance	6-6, C-4
Electrode Selection	C-2
Emergency Stop	
Emergency Stop Switch	
and 24v Jumpers	1-13
End Of Cycle Buzzer	
End Of Weld Relay	F-2
Energy Capacity % Limit Setting	
Energy Limits	
Enter New Values	
Environmental Characteristics	A-3

F

Features	1-1	
Firing Switch	5-9, B-9	
Firmware		
Foot Switch		B-10
Footswitch W	eld Abort	

G

General Kinds of Problems	6-1
General Operator Safety	4-11
Getting Started	2-1
Installation	2-1
Space Requirements	2-1
Unpacking	2-2
Utility Requirements	2-1
Graphed Data	1-7

H

How It Works	
How to Use Menu Screens	

Ι

I.D. Number	
I/O Signal Interface A	B-4
I/O Signal Interface B	B-6
Initial Setup	
Input Switch Select	
Installation	
L	

LCD Screens	1-4
Liquid Crystal Display (LCD) and	
Weld Selector Keys	1-8

Μ

Main Menu	5-2
Manual Weld Head Connections	2-4
Manual Welding	4-11
Mechanical Characteristics	A-3
Mechanical Switch Selection	5-10
Menu Screens	1-5

Ν

Normal Stop 4-11	
Numeric Keypad and Operational Controls	1-10
Nuggets (Unitek Peco Website)	iii

0

Operating Instructions	4-1
Initial Setup	4-1
Compressed Air	
Connections	
Initial Setup Instructions	
Power	

Pre-Operational Checks	
------------------------	--

O (Continued)

Р

Parts Replacement	6-6
PID Test Weld Setup	
PLC Switch Selection	
Power Mode	
Precautions	6-1
Precautions, CE	v
Pre-Operational Checks	
Pre-Weld Check	
Programmable Feedback Modes	
Current Mode	
Applications	

INDEX

Power Mode	3-7
Applications	3-7
Description	3-7
Voltage Mode	3-7
Applications	3-7
Description	3-7
Programming for Active	
Part Conditioning	4-9
Programming Instructions	5-19
Programming the Weld Monitor	4-7
Programming Weld Schedules	

Q

Quality Resistance Welding Solutions,	
Defining the Optimum Process D)-1

R

RS 232 Connector	B-3
RS 485 Connectors (In and Out)	B-2
Relay Settings	5-19
Relay Timing Diagrams	F-1
Alarm	F-2
End Of Weld	F-2
Introduction	F-1
Out Of Limits	F-3
Weld	F-1
Relay, Data, and Communication	
Connections	2-7
Repetition Rates	G-1
Introduction	G-1
Maximum Weld Pulse Duration As	
A Function of Weld Current	G-2
Re-Set After Emergency Stop	4-12
Reset All Schedules	5-23
Reset Defaults	5-21
Reset System Parameters	5-23
Resistance Welding Parameters	C-1
Revision Record	ii

S

$Q_{-1} \rightarrow A_{-1} Q_{-1} = 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1$
Select A weld Schedule
Setup2-4
Air-Actuated Weld Head Connections 2-6
Manual Weld Head Connections2-4
Relay, Data, and
Communication Connections2-7
Setup Menus 5-2
Setup Software
Communication and Data5-24
Baud Rate 5-25
Single-Pulse Weld Profile
Communication
I.D. Number 5-25
Requirements 5-24
Setup Software (Continued)
How to Use Menu Screens
Main Menu5-2
Setup Menus5-2
Operator Preferences
Display Contrast5-4
Buzzer Loudness5-4
End Of Cycle Buzzer5-4
Update Graph After Weld5-5
Buzzer On Weld Stop5-5
Overview
PID Test Weld Setup 5-17
Do Test Weld Options5-17
Always 5-18
Ask5-18
If Required5-18
Ignore First/Last5-18
Overview
Relay Settings
Function
Programming Instructions
Special Functions
Copy A Schedule
Reset Defaults
Reset All Schedules5-23

System Settings 5-6
Calibration 5-14
Chain Schedules5-17
Control Signals Select 5-12
Firing Switch5-9
Footswitch Weld Abort5-8
Input Switch Select 5-10
Mechanical Selection5-10
OPTO Selection5-11
PLC Selection5-11
Switch Debounce Time5-9
System Security 5-13
Waveform Check and
Weld Counter Functions 5-12
Energy Capacity %
Stability Check %
Limit Setting5-6
Stability Check Delay Setting 5-7
Waveform Check ON/OFF 5-6
Weld Fire Lockout
Charge % Setting5-8
Weld Fire Lockout5-6
Limit Setting5-7
Single-Pulse Weld Schedule
Space Requirements2-1
Special Functions
Stability Check % Limit Setting5-6
Stability Check Delay Setting
Switch Debounce Time
System Security
System Settings

Т

Technical Assistance	6-5
Technical Specifications	A-1
Environmental Characteristics	A-3
Firmware	A-3
Interface Signals	A-3
Mechanical Characteristics	A-3
Troubleshooting	6-1
Typical Weld Strength Profile	C-6

U

Unitek Peco Contact Information	iii
Unpacking	2-2
Update Graph After Weld	5-5
Upslope/Downslope Weld Profile	
Applications	3-4
Upslope/Downslope Weld Schedule	4-5

V

User Maintenance	6-1
Precautions	6-1
Operator Maintenance	6-1
Troubleshooting	6-1
Alarm Messages	6-2
Electrode Maintenance	6-6
General Kinds of Problems	6-1
Hard	6-2
Soft	6-1
Parts Replacement	6-6
Technical Assistance	6-6
Troubleshooting	6-2
Utility Requirements	2-1
Voltage Mode	3-7
Voltage Sense Input	B-1

W

Waveform Check and Weld Fire Lockout	t 5-6
Waveform Check ON/OFF	
Weld Counter Functions	5-12
Weld Fire Lockout Charge % Setting	5-8
Weld Head Applicability	

INDEX

Weld Monitor
Active Part Conditioner (APC)
Applications
Description
How It Works
Energy Limits
Applications
Description
Instructions
Introduction
Pre-Weld Check
Application3-11
Function
Weld Schedules
Definition
Dual-Pulse Weld Profile
Applications
Description
Single-Pulse Weld Profile
Applications
Description
Upslope/Downslope Weld Profile
Applications
Description
Welding Applications
Weld Head Applicability
Weld Sequence Timing
Weld Selector Keys 1-8
Weld Sequence Timing
Weld Strength Profiles
Weld Strength Testing
Weld TerminalsB-12
Welding Applications
Welding Parameter Interaction