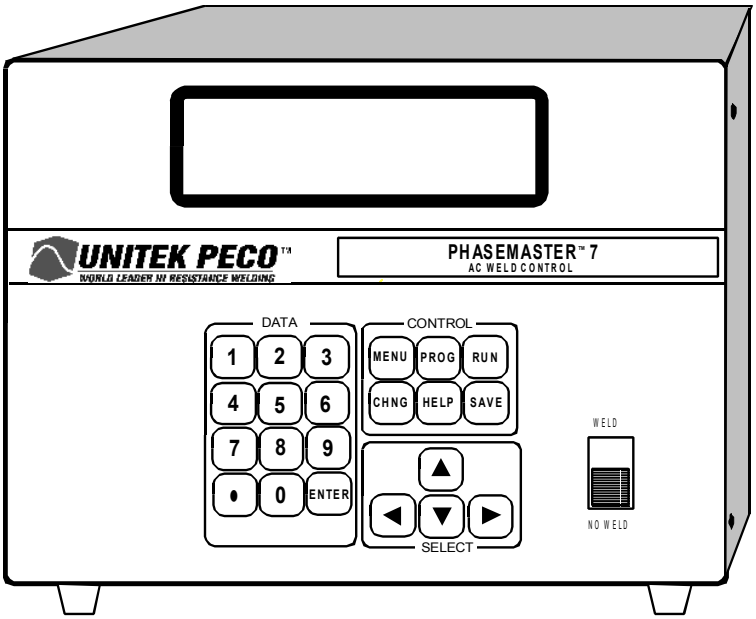
USER'S MANUAL
No. 990-084
Revision E, January 2002

UNITEK PECO™
WORLD LEADER IN RESISTANCE WELDING

PHASEMASTER™ 7
DIRECT ENERGY WELDING CONTROL

Model	Stock No.	Model	Stock No.
PM7	1-239-XX	PM7S	1-241-XX
PM7/115	1-239-XX-01	PM7S/115	1-241-XX-01
PM7/208	1-239-XX-02	PM7S/208	1-241-XX-02
PM7/100	1-239-XX-03	PM7S/100	1-241-XX-03
PM7/460	1-240-XX	PM7S/460	1-242-XX



Notice: Units with the built-in Weld Sentry Option also require User's Manual No. 990-291.

Revision Record

Revision	EO	Date	Basis of Revision
A	ENRG-RLSE	-	Original release
B	17273	3/98	Bind Addendum 995-084, Rev E, into Rev A manual
C	17417	4/98	Rewrite, reorganize and correct manual per Addendum 995-084, Rev E
D	18063	1/00	Correct interconnection pin numbers
E	19146	1/02	1. Change name to Unitek Peco™ 2. Update manual

FOREWORD

Thank you for purchasing a Unitek Peco™ Phasemaster™ 7 Direct Energy 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 Unitek Miyachi Corporation at:

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 and maintenance personnel with the information needed to properly and safely operate and maintain Phasemaster™ 7 Direct Energy 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 Corporation is not responsible for any loss due to improper use of this product.

SAFETY NOTES

This instruction manual describes how to operate, maintain and service the Phasemaster™ 7 Direct Energy Welding Control, and provides instructions relating to its SAFE use. Procedures described in this manual MUST be performed, as detailed, by QUALIFIED and TRAINED personnel.

For SAFETY, and to effectively take advantage of the full capabilities of the tester, please read these instruction manuals before attempting to use the workstation.

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 tester.

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.

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ILLUSTRATIONS

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UNITEK MIYACHI CORPORATION

Declaration of Conformity

Directive(s)	EMC, LOW VOLTAGE
Type of Equipment:	Resistance Welding Transformers
Applied Standards:	EN-50081-2,EN50082-1,EN55011,IEC 801-2,IEC 801-3,IEC 801-3, IEC 801-4,EN-60204-1,EN-50063
Model Nos:	X2/115,X2/115RF,X2/230,X2/230RP,X5/115HV,X8/230,X8/230HV X16/230,X16/230HV,X16/280,X16/460,X35/230 when used with PM4,PM5,PM7 Resistance Welding Power Supplies

Authorized Representative Within European Community:	Weld Equip Sales BV Engelseweg 217 Postbus 164 5700 AD Helmond HOLLAND
Manufacturer's Name and Address:	UNITEK MIYACHI CORPORATION 1820 South Myrtle Avenue Monrovia, CA 91017 U.S.A.

Based on the Declaration of Conformity Certificates issued by the test laboratories, I declare that the equipment specified above conforms to the listed directive and standards.

Place: Monrovia, CA

Date: December 16, 1996

Robert J. Wallish
Signature

Mark G. Rodighiero
Signature

Robert J. Wallish
Full Name

Mark G. Rodighiero
Full Name

Director of Quality Assurance
Title

Vice President, Engineering
Title

UNITEK MIYACHI CORPORATION

Declaration of Conformity

Directive(s)	EMC, LOW VOLTAGE, MACHINERY
Type of Equipment:	Resistance Welding Power Supply Equipment
Applied Standards:	EN-50081-2,EN-50082-1,EN-55011,IEC 801-2, IEC 801-3, IEC 801-4, EN-60204-1,EN-50063
Model Nos.:	PM7, PM7/100,PM7/208,PM7/115,PM7S, PM7S/100,PM7S/208,PM7S/115

Authorized Representative Within European Community:	Weld Equip Sales BV Engelseweg 217 Postbus 164 5700 AD Helmond HOLLAND
Manufacturer's Name and Address:	UNITEK MIYACHI CORPORATION 1820 South Myrtle Avenue Monrovia, CA 91017 U.S.A.

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Full Name

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Full Name

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Title

Vice President, Engineering
Title

CHAPTER 1
SYSTEM DESCRIPTION

Applications

The Phasemaster™ 7 (PM7) (figure 1-1) is a versatile, single-phase, sequence welding control which can effectively solve most precision, small parts resistance welding problems. Its context-sensitive user help screens quickly guides you through even the most complex program.

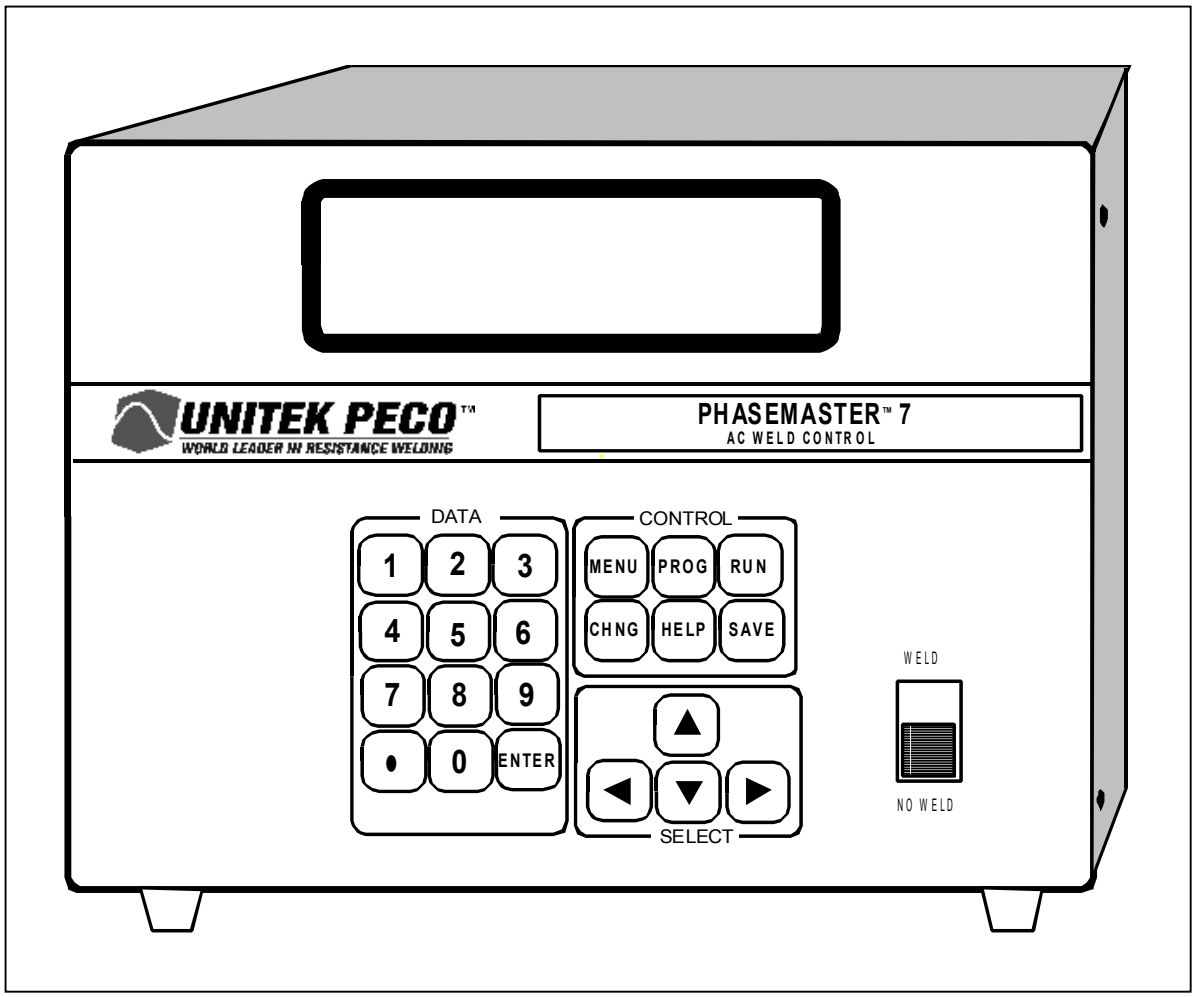


Figure 1-1. PM7 Direct Energy Welding Control

The PM7 can be used with manual, user-actuated, or air actuated weld heads. It is compatible with Unitek Peco's exclusive UNIPULSE Transformer series, which guarantees repeat-able output energy even during half-cycle operation. UNIPULSE Transformers will operate at a 50% duty cycle when the weld period is an integral number of cycles. In unipolar, half-cycle operation, UNIPULSE Transformers can be used at rates up to five welds per second.

You can program up to 128 weld schedules and save them in battery backup memory. A built-in schedule protection feature protects weld schedules from unauthorized or inadvertent changes. Schedule 0 serves as a scratch pad which anyone can use to perform occasional jobs without jeopardizing the integrity of the production line. The remote schedule selection feature allows you to reliably select weld schedules in automated applications.

The PM7 is a multi-voltage unit designed for operation in the standard line voltage ranges of 90-110, 110-120, 200-220, 220-240, 380-400, or 440-480 VAC, 50/60 Hz. The automatic line voltage compensation feature ensures that the weld quality will not be affected by normal fluctuations in line voltage, one of the major causes of defective welds. The unit is supplied with a line cord, and a 30-amp combined circuit breaker/power ON/OFF switch. The 460-volt unit requires a user-supplied circuit breaker, disconnect and input wiring.

Features

- Multi-function microprocessor control provides repeatable process control and is compatible with air or manually actuated weld heads.
- User friendly, context-sensitive help screens guide you through work set-up and operation.
- Digital display allows you to set welding current accurately and quickly.
- Half-cycle welding capability is critical for the welding of small parts.
- Automatic line voltage compensation compensates for up to ±13% changes in line voltage, which eliminates the major electrical cause of inconsistent weld quality.
- 128 discrete weld schedules facilitate multiple applications at one work station.
- Weld schedule protection feature protects 127 weld schedules from being changed by unauthorized personnel.
- Remote weld schedule selection simplifies use in automated systems.
- Chain schedule feature with automatic step function allows automation of simple tasks.
- Ten unique weld functions provide solutions for the most complex welding applications.

- Automatic power factor correction improves weld quality.
- Air head capability is a standard feature which allows the unit to control single or dual air actuated weld heads, using separate weld schedules for controlling VALVE DRIVER 1 and VALVE DRIVER 2.
- Unit is protected from radio frequency and electromagnetic interference to ensure reliable operation, even in high electrical noise environments.
- Can operate on multiple line voltages: 90-110, 110-120, 200-220, 220-240, 340-400, or 440-480 VAC, 50/60 Hz.

CHAPTER 2
INSTALLATION

Location

Install the PM7 in a well-ventilated area that is free from dirt and moisture. Allow sufficient clearance around the sides and rear of the unit so that cooling air may flow properly. Position the PM7 as close as is practical to the weld head.

Power Line

CAUTION: Do not connect the line cord at this time.

This power supply was wired for the specific input line voltage marked on the line cord at the factory. The standard PM7 is wired for 230 VAC. Reconnection for operation at another voltage may be made by a qualified technician. Refer to Chapter 7 under *Modifications and Calibration.*

Welding Cables

Position the PM7 on the work bench approximately 5 inches behind the weld head. Use the cables furnished with the weld head to connect the terminals on the back of the weld head to the appropriate terminals on the welding transformer. Refer to Appendix A for welding transformer specifications. Convention is to connect the lower electrode of the weld head or handpiece to the (+) output terminal and the upper electrode to the (-) output terminal of the PM7. To reduce energy losses, follow these recommendations:

- Use No. 2 AWG welding cables, or No. 00 AWG welding cables if the cables are more than 12 inches long. The diameter of the cables should be as large as practical.
- Use the shortest possible welding cables. It is not uncommon to have losses up to 50% per foot for No. 6 cable and 20% for No. 2 cable.
- Route cables so that they do not surround magnetic materials such as air solenoids, tooling, or steel weld heads (see figure 2-1).

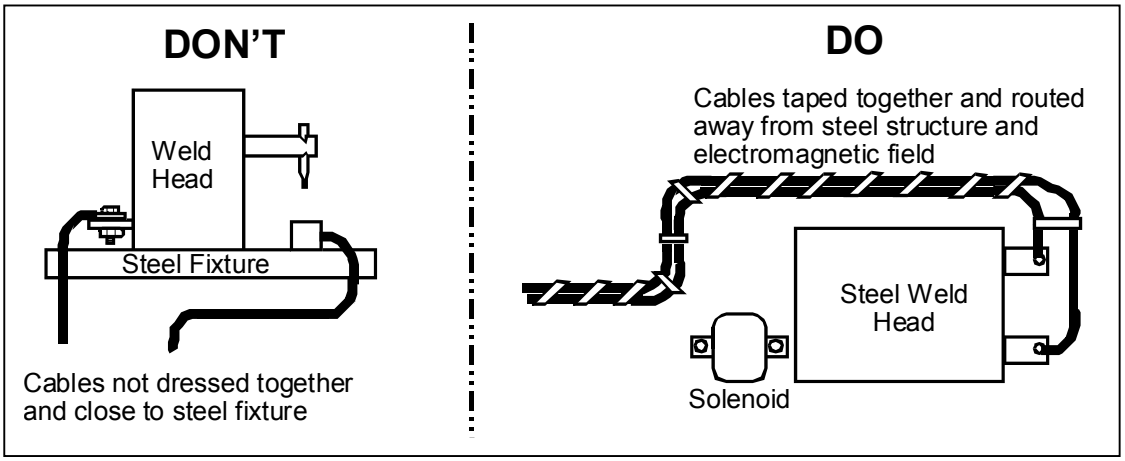


Figure 2-1. Cable Routing Examples

- Bolt connections directly together. Do not place washers between the terminals of the PM7 and the terminals of the cables. Tighten connections securely, they must be free from oxidation, dirt and/or grease (see figure 2-2).

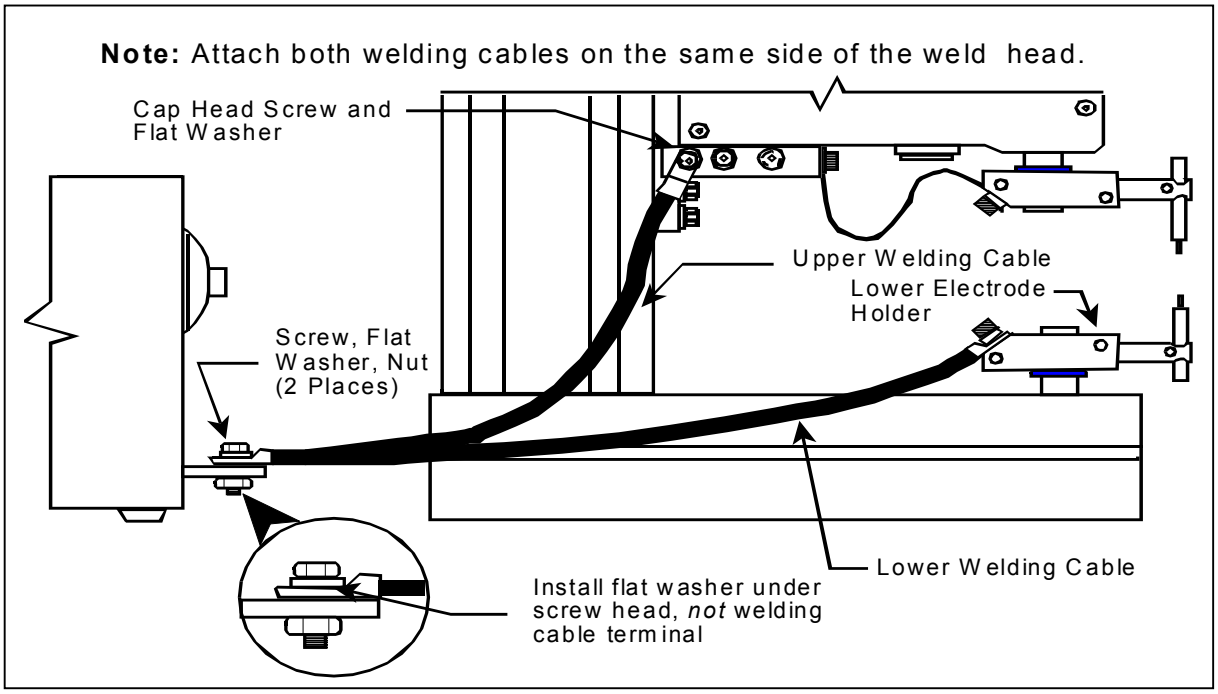


Figure 2-2. Terminal Connection Examples

- Tape cables together to minimize the inductive losses. A separation of weld cables surrounding an area of one square foot could result in losses of up to 65%.

Rear Panel Components

The input and output connections located on the rear panel of the PM7 (figure 2-3) are listed below.

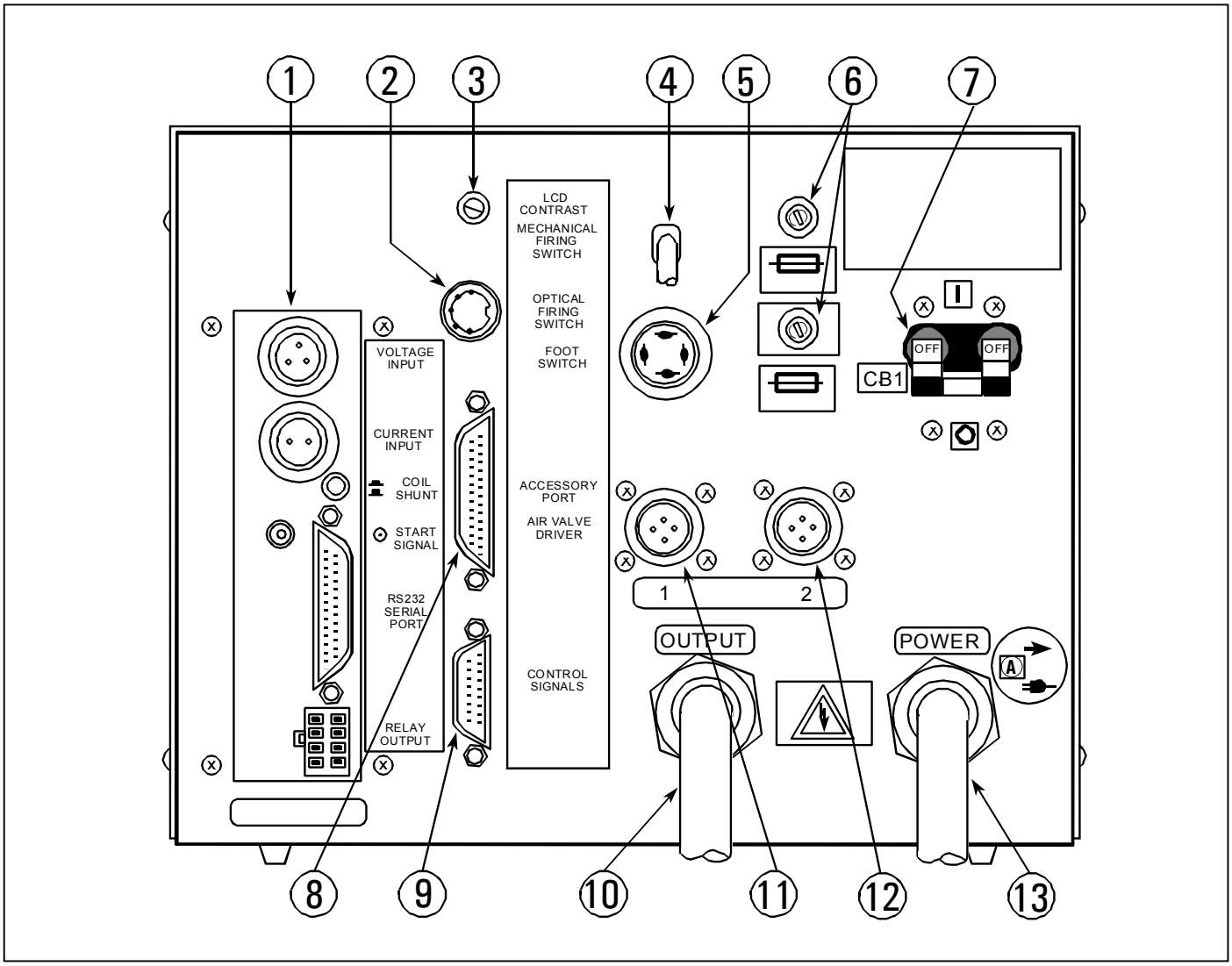


Figure 2-3. PM7 Rear Panel Components

1 WELD SENTRY CONTROL CLUSTER - Controls for PM7 models incorporating the Weld Sentry.

2 OPTICAL FIRING SWITCH - 5-pin receptacle is used to connect the PM7 to Weld Heads with either a 3-wire Firing Switch or an Optical Switch.

3 LCD CONTRAST - Allows the user to adjust the contrast of the LCD Display for optimum viewing.

4 MECHANICAL FIRING SWITCH - 6-foot cable is used to connect the PM7 to the Force Firing Switch in all Unitek Peco Weld Heads and Handpieces.

5 FOOTSWITCH RECEPTACLE - Used to connect either a 1-Level or 2-Level Unitek Peco Footswitch. Footswitches are used only with air or electrically actuated weld heads.

6 FUSES F1,F2 - Used to protect the internal Control Boards and the Valve Driver Circuits. The following table defines the fuse ratings:

Line Voltage	Fuse Type	Rating
100	3AG	250V, 1/2A Slo-Blo
120	3AG	250V, 1/2A Slo-Blo
208	3AG	250V, 1/4A Slo-Blo
240	3AG	250V, 1/4A Slo-Blo
400/480	3AG	440V, 1/4A Slo-Blo

7 CIRCUIT BREAKER - Used as a circuit breaker and a power ON/OFF switch.

8 ACCESSORY PORT - 25-pin, sub-miniature “D” connector used to interface the PM7 with other Unitek Peco devices.

9 CONTROL SIGNALS - 15-pin, subminiature “D” connector used for Remote Schedule Selection, Emergency Stop, and Process Inhibit and Relay Outputs. See Appendix A.

10 OUTPUT CABLE - 5-foot cable used to connect the PM7 to any Unitek Peco AC Welding Transformer.

11 AIR VALVE DRIVER 1 - Provides either 24 or 120 VAC to Unitek Peco Air Actuated Weld Heads.

12 AIR VALVE DRIVER 2 - Provides only 24 VAC to Unitek Peco Air Actuated Weld Heads.

13 POWER CABLE - 5-foot cable. 120-volt model terminated with the appropriate 120-volt plug.

Firing Switch Connections

Connect the weld head or handpiece to the appropriate firing cable or switch located on the rear panel of the PM7.

Mechanical Firing Switch

Unitek Peco weld heads and handpieces are force fired and have two-pin firing switch connectors which can be connected directly to the mating connector of the MECHANICAL FIRING SWITCH located on the rear panel of the PM7.

Users of manually actuated weld heads which do not have force firing switches must connect the two pins in the mechanical firing switch to an external switch in order to initiate the PM7.

Air actuated weld heads which do not have force firing switches rely on the squeeze time to ensure that the weld head has time to close and apply the proper force to the workpieces. Use the squeeze time option and select NO FIRING SWITCH from the Options Menu (refer to Chapter 3).

Optical Firing Switch

Users of weld heads with pressure switches using a 3-wire switch or an optical device should use the OPTICAL FIRING SWITCH receptacle located on the rear panel of the PM7 (refer to Appendix A under *Initiation Switch).*

3-Wire Firing Switches

Users of weld heads with single pole, double throw, 3-wire pressure switches should also use the OPTICAL FIRING SWITCH connector located on the rear panel of the PM7. The PM7 will automatically detect that the system is using a 3-wire switch if Pin 2 is low at power-up.

Air Actuated Weld Head Connections

Solenoid valve/regulator assemblies which are not mounted on the weld head should be located as close as possible to the weld head. Use the *shortest* air lines possible to obtain the fastest mechanical response.

Connect the inlet port on the air valve (solenoid) to a *properly filtered air supply* (65 psig maximum). Use 0.25-inch OD by 0.17-inch ID plastic hose with a rated burst pressure of 250 psi to connect the outlet ports of the solenoid/regulator assembly to the flow controls on the air cylinders. Figure 2-4 illustrates a typical single regulator installation for a Unitek Peco Series 80 Weld Head. Turn the regulator(s) fully counter-clockwise to ensure minimum air pressure. Turn on the air supply. Repair leaks if necessary.

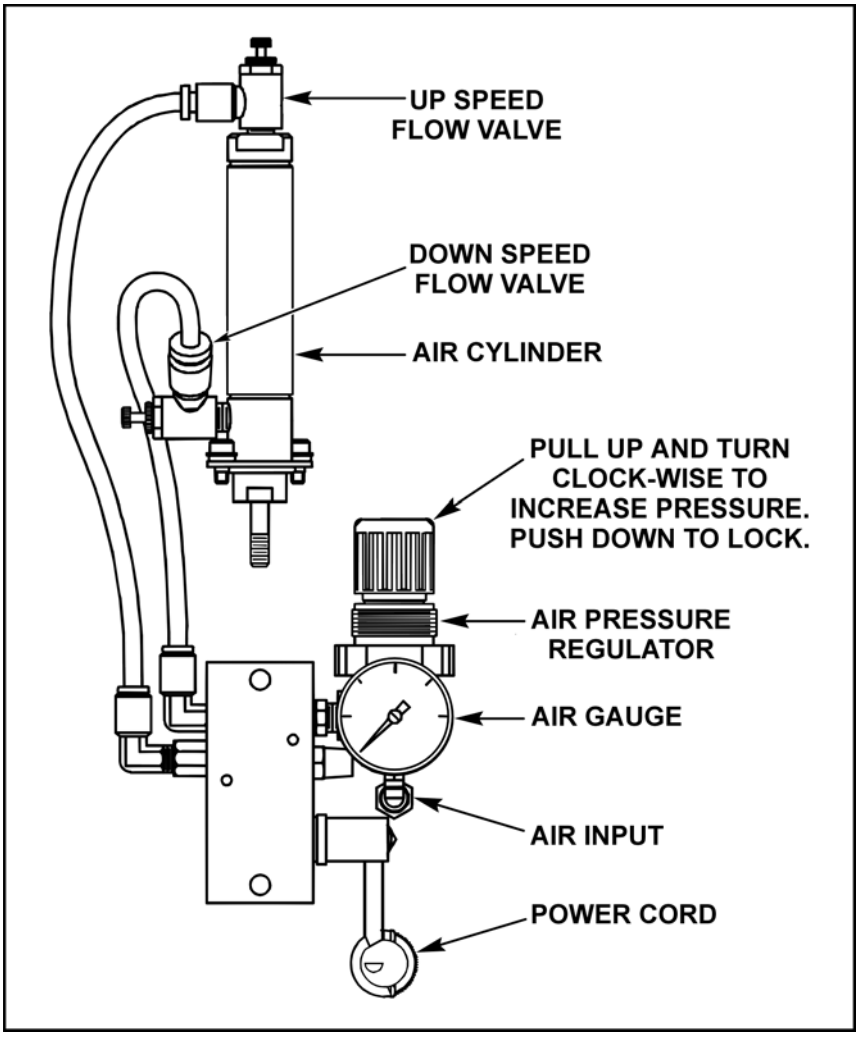


Figure 2-4. Typical Solenoid Air Valve Assembly with a Single Regulator

All Thinline weld heads are capable of cycling at a rate of 1 weld per second, *provided that the tubing between pressure regulators and the air cylinder is kept as short as possible.* Increasing the length of the tubing produces very sluggish mechanical motion. *Do not use lubrication on the input air line* because, as the internal seals on the air cylinder wear, lubricating oil will leak past these seals and contaminate the electrode and the workpiece with a fine oil mist. Once every six months or every 1 million operations, whichever occurs first, remove the top flow control valve and place two drops of light machine oil in the top of the air cylinder(s).

Air Valve Drivers

Connect the Air Valve (Solenoid) to the VALVE DRIVER Receptacle (or both air valves and VALVE DRIVER receptacles for a dual air actuated weld head) located on the rear panel of the PM7. Figure 2-5 shows the connections for a typical Unitek dual air actuated weld head system. Weld heads with 4-pin 24/120 VAC connectors can be plugged directly into the AIR VALVE 1 connector. Weld Heads with standard 120 volt plugs (NEMA 5-15P) require an adapter, Unitek Peco *Model VDAC, Valve Driver Adapter Cable.* When the connection has been made, the PM7 will automatically recognize that an Air Head has been connected.

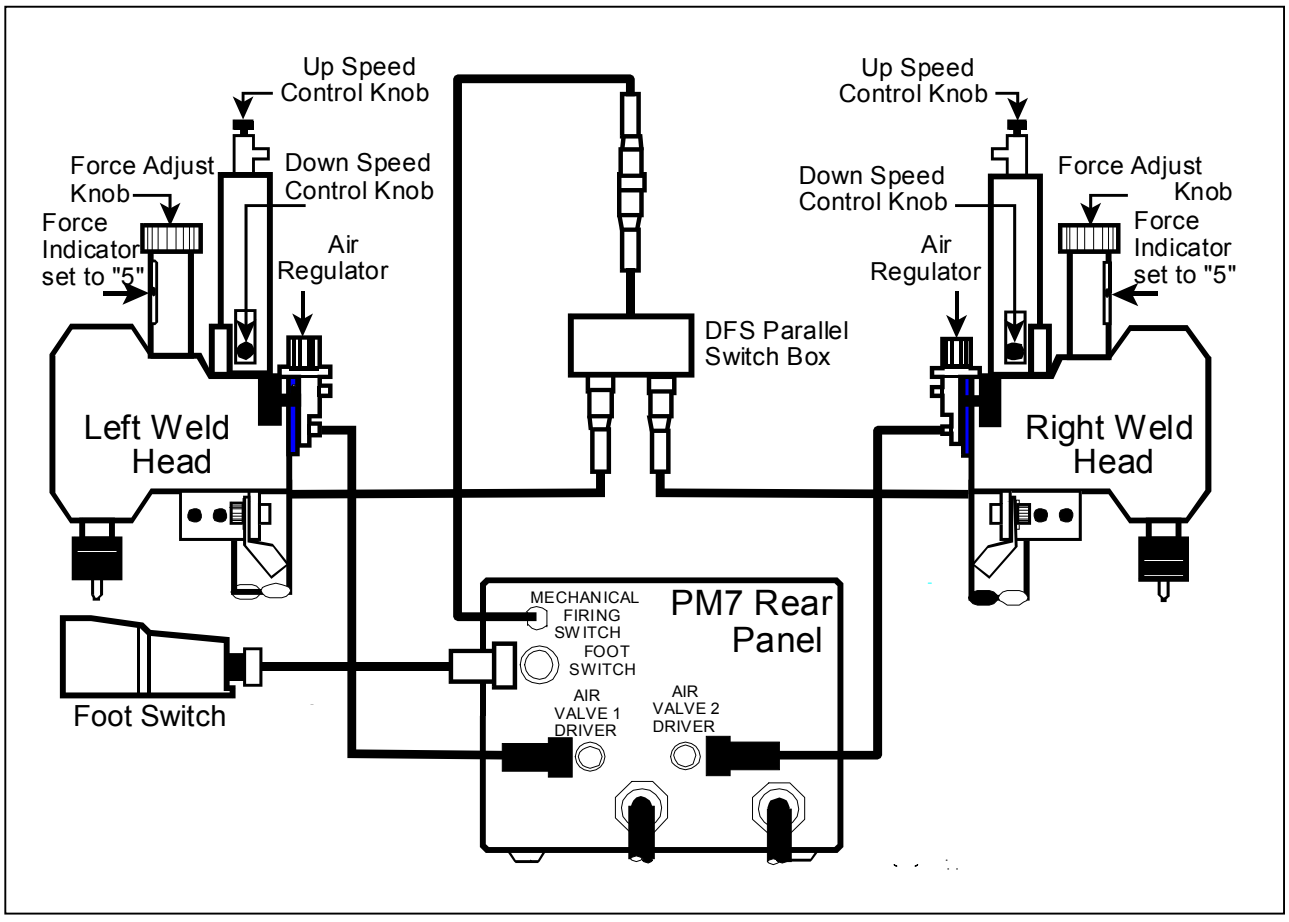


Figure 2-5. Cable Connections for a Typical Dual Air Actuated Air Head System

Non Unitek Peco Air Actuated Weld Heads

Users of air actuated weld heads not manufactured by Unitek Peco should connect the air solenoid valve on the head or regulator valve assembly to either the appropriate 24 volt or 115 volt pins of the receptacle on the rear of the PM7. Refer to Appendix A under *Control Signals* for detailed information.

Air Actuated Weld Heads without Force Firing Switches

Users of air actuated weld heads not having force firing switches must use sufficient squeeze time to allow the head to close and to apply the proper force to the workpieces.

Second Air Head

Connect the solenoid air valve of a second air actuated Unitek Peco weld head to the AIR VALVE DRIVER 2 receptacle. *Only weld heads with 4-pin 24 VAC connectors can be plugged directly into this connector.*

Footswitch

Connect either a 1-Level or 2-Level Footswitch to the FOOTSWITCH receptacle located on the rear panel. The PM7 will automatically recognize which type Unitek Peco Footswitch has been connected.

1-Level Footswitch

When the operator fully depresses the 1-level footswitch, the PM7 will energize the air valve on the weld head. The upper electrode will close and apply force to the workpiece. If the operator releases the footswitch before the weld head applies the preset firing force, the PM7 will remove the voltage from the air valve and the upper electrode will return to the open position.

If the FOOTSWITCH WELD ABORT option has been set to ON by changing the status on the OPTIONS menu, the welding sequence will be terminated if the footswitch is released before the welding sequence is completed.

If the FOOTSWITCH WELD ABORT option has been set to OFF, the welding process will continue to its conclusion, regardless of the position of the footswitch, once the preset firing force has been applied to the workpiece by the upper electrode of the weld head.

2-Level Footswitch

When a 2-level footswitch is pressed to the first level, the weld head will close and apply force to the workpiece. At this point, if the operator does not press further (harder) and actuate the second level, the footswitch can be released so that the workpiece can be re-positioned. Once the second level has been actuated, a 2-level footswitch will operate in the same manner as a 1-level footswitch.

Dual Weld Head Installation

For dual weld head operation, the PM7 must be reconfigured.

Internal Reconfiguration

Two jumpers on the PC board must be reconfigured for dual weld head operation.

CAUTION: Unplug the PM7 before proceeding with this procedure.

1 Remove the PM7 cover and locate the two yellow jumper headers, labeled E1 and E2, in the lower left area of the PC board. In the shipped positions, shown as "Before Change" in figure 2-6, the jumper headers are installed for the operation of such devices as enunciators, automated lines, and alarms via relays.

2 Reinstall the jumper headers in the "After Change" positions shown in figure 2-6.

3 Replace the PM7 cover and reconnect PM7 power.

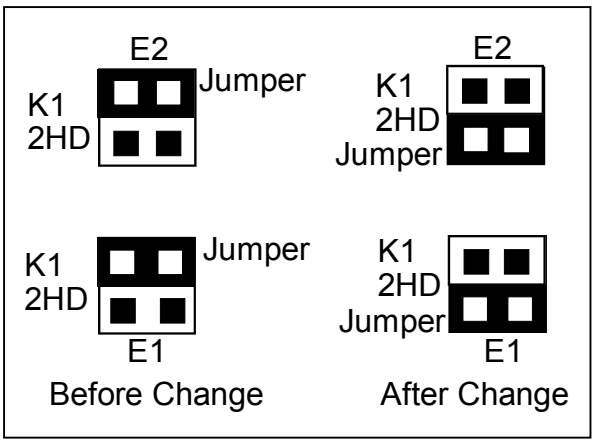


Figure 2-6. Jumper Reconfiguration for Dual Weld Head Operation

External Reconfiguration

Connect the weld cables to the transformer as shown in figure 2-7. Refer to figure 2-8. Connect the air valve drivers for weld head 1 and weld head 2 to their respective ports on the back of the PM7. Note that the Air Valve Driver 2 port supplies 24 VAC power, so a 115 VAC weld head cannot be used. Set each weld head for the proper force, psi, and flow control speed. A Model DFS Switch Box must be used to connect both weld head firing cables to the PM7 firing connector. Connect a foot switch which will activate both heads.

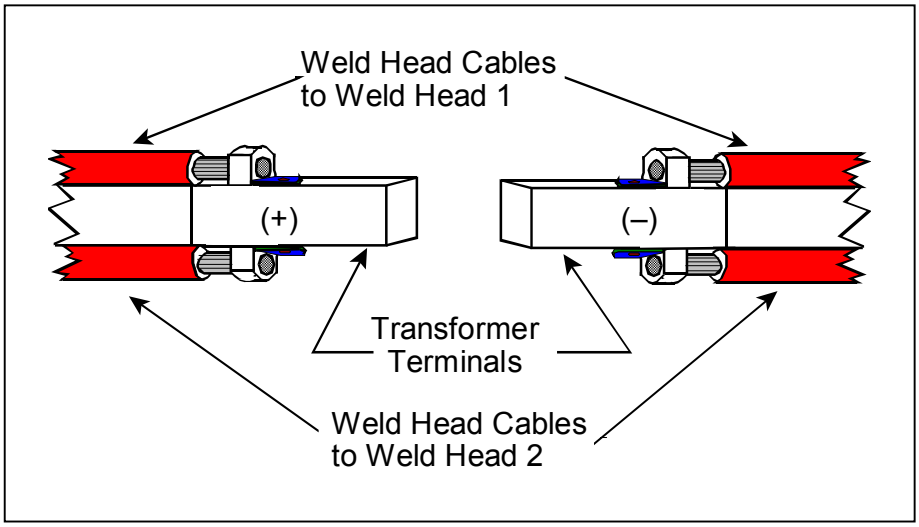


Figure 2-7. Weld Cable Installation for Dual Head Operation

Remote Schedule Selection

A 15-pin, subminiature D-type CONTROL SIGNALS connector, located on the rear panel, is provided for nine single-pole inputs which are used to:

- Remotely select Weld Schedules 1 through 127 in a binary sequence.
- Remotely inhibit (prevent) the flow of weld current, which is the same function provided by the front panel WELD/NO WELD Switch.
- Remotely reset and alarm.
- Invoke the emergency stop condition, which abruptly terminates the welding sequence. Refer to Appendix A, under *Control Signals,* for detailed connector information.

Relay Outputs

Two output relays can be used to provide status (timing) signals to external devices. Relay 1 can also be used to control a second 24 VAC air actuated weld head or to signal an alarm condition. Relay 2 can control a 5 to 50 VDC signal. When used for status signals, these relays can be independently programmed to close when:

- The PM7 is initiated
- Any portion of the welding sequence is completed

- The firing switch opens
- The PM7 is waiting for the welding sequence to start. Refer to Appendix A, under *Control Signals* and *Relay Outputs,* for more detailed information.

Interconnection Diagram

Refer to figure 2-8 for a wiring diagram of the PM7 that shows its interconnections with external equipment.

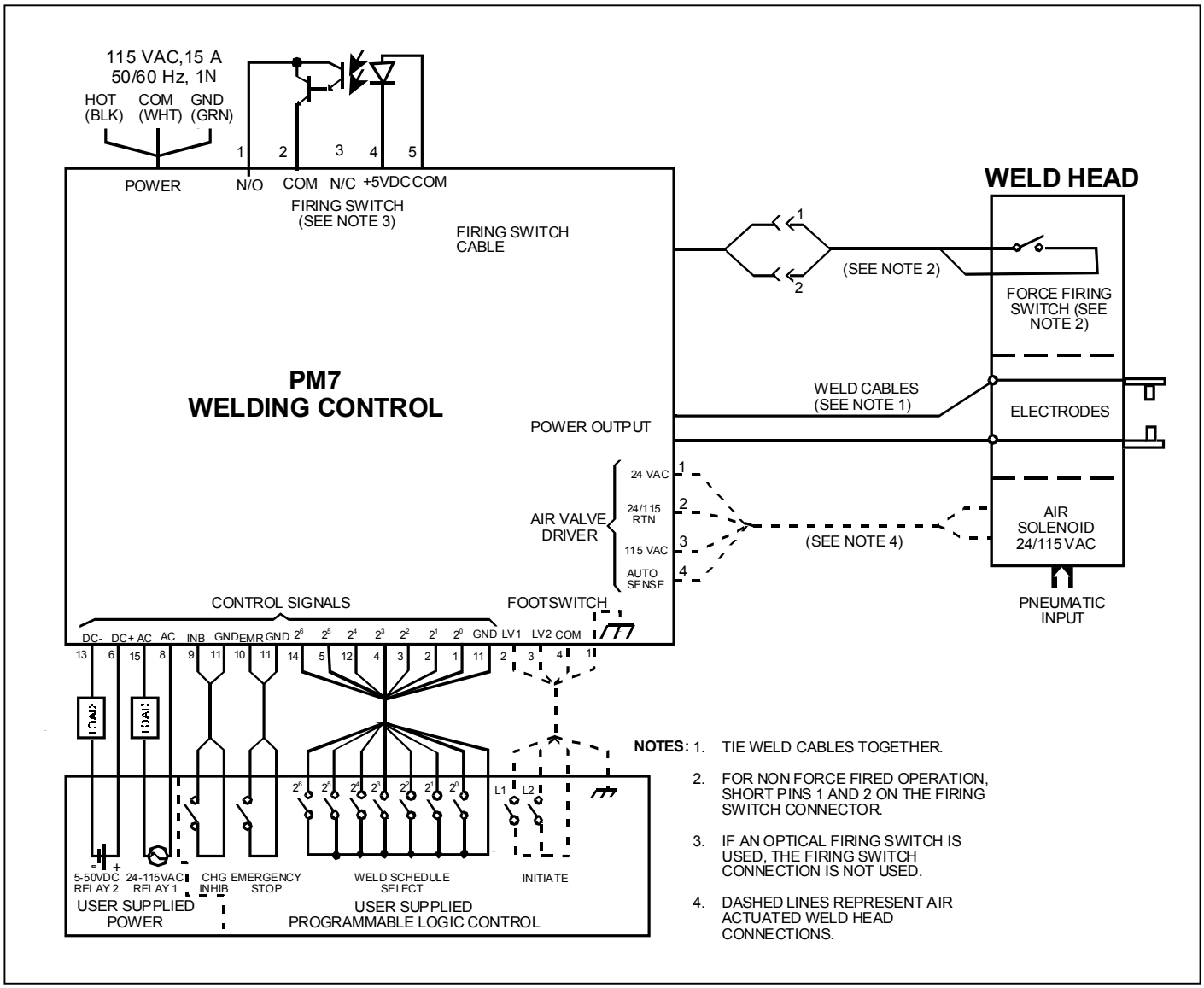


Figure 2-8. PM7 Equipment Interconnection Diagram

CHAPTER 3
OPERATING CONTROLS AND SCREENS

Operating Controls

Figure 3-1 illustrates the layout of the operating controls on the front panel of the PM7.

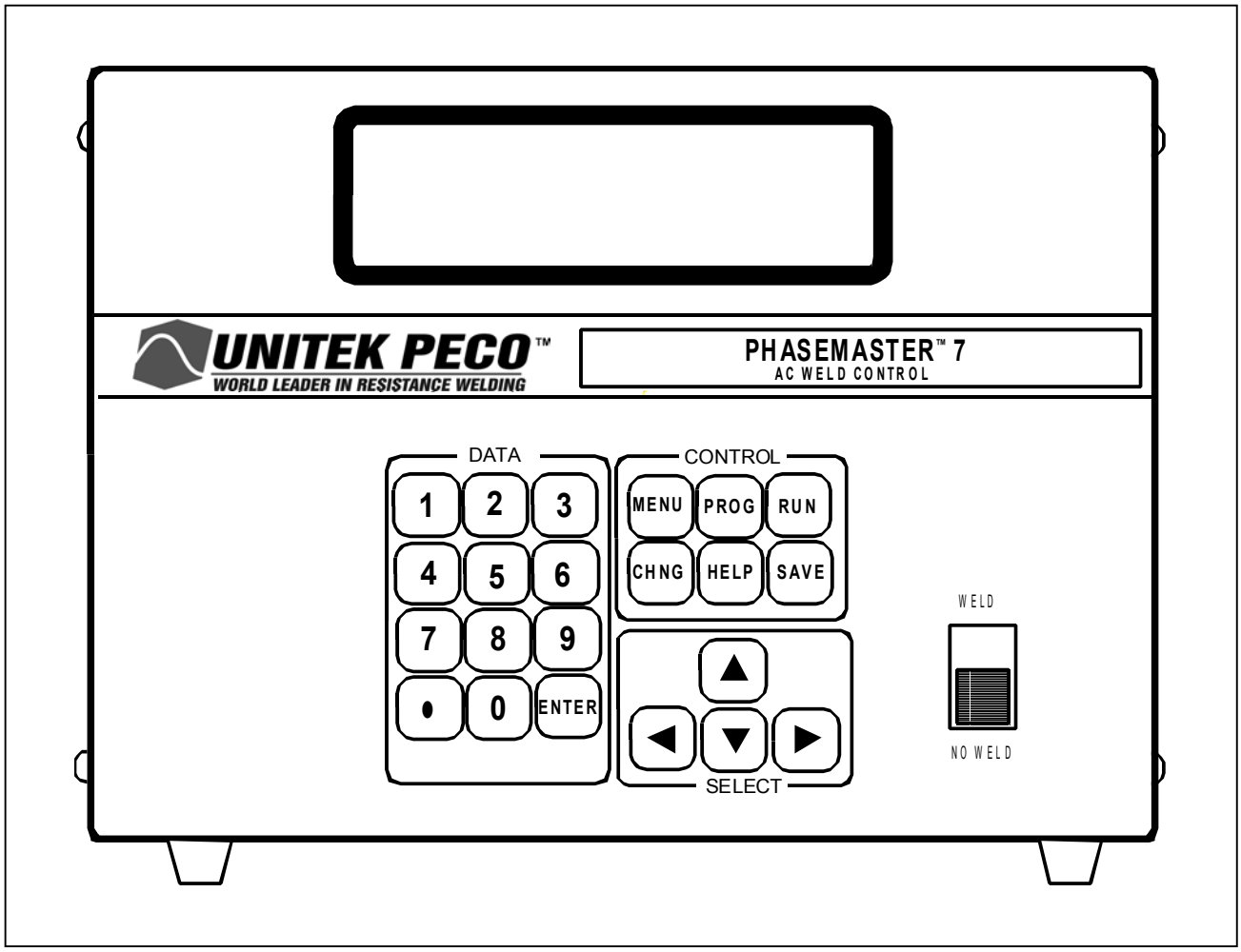


Figure 3-1. Front Panel Controls

The controls on the front panel are identified as follows:

NOTE: Instructions in the manual to "press [ ]" means that you are to press the key or button described inside the brackets. For example, "Press [PROG]" means that you should press the key labeled PROG on the front panel. "Press [?/>]" means that you should press either the ? SELECT or the > SELECT key, whichever is appropriate.

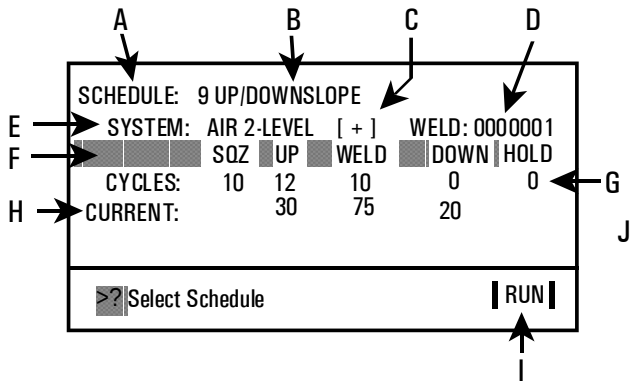
KEY	DESCRIPTION
DATA [KEYPAD]	Use the 10 numeric keys to enter numeric information. [.] is used to enter decimal values. Use the [ENTER] key to signify that the data entry you have entered using the keypad is complete.
[> ?]	In the run state, these keys changes ([>] increases and [?] decreases) the schedule number displayed. In program and menu states, the [>] and [?] SELECT keys are used to move up and down on the screen to select fields.
[< =]	In the program and menu states, these keys are used to select the parameter to the right (<) or left (=) of the parameter which is highlighted. In the run state, these keys are used to display weld sentry program lines A through E if the Weld Sentry is installed.
[PROG]	Causes the PM7 to enter the program state so that you can make changes to Schedules 0 through 127. If a Weld Sentry is installed, when [PROG] is pressed a second time, you can make changes to the Weld Sentry programs related to each weld schedule. Press [PROG] to return to the PROGRAM screen (refer to *Screen Formats* next in this chapter).
[RUN]	Causes the PM7 to exit the program state without saving the changed schedule. The changed schedule will become Schedule 0 and will *not* be written to permanent memory. If no changes are made to the schedule or the Weld Sentry program, then it will not be transferred to Schedule 0. Welding is done in the run state.
[SAVE]	In the program state, pressing this key saves (writes) any schedule and its related Weld Sentry programs to permanent memory. The PM7 will then exit the program state and return to the run state. This key has no function in the run state.

KEY	DESCRIPTION
[MENU]	In either the run or program state, [MENU] will provide you with a menu which allows you to select or change options which are common to all schedules.
[HELP]	The PM7 contains a built-in operation manual. Press this key whenever you need *HELP* or additional information from the built-in manual. Press this key a second time to return to the original state.
[CHNG]	Changes the contents of alphanumeric fields in the program or menu state. Changes the format of the RUN screen in the run state.
WELD / NO WELD SWITCH	Welding current will not flow when this switch is in the NO WELD position. However, the control will actuate the weld head and execute the welding sequence (Squeeze, Weld and Hold). This switch must be in the WELD position in order to make a weld.

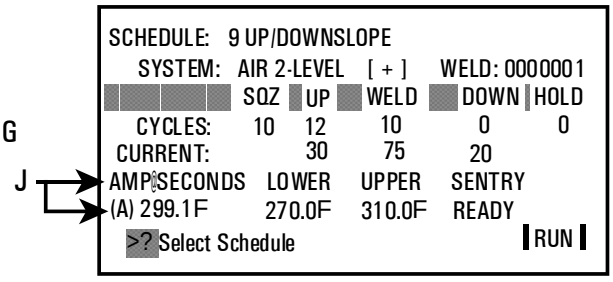
Screen Formats

Illustrated below is the information displayed in RUN, PROGRAM, NO WELD, HELP and MAIN MENU screens. Note that the PM7 operational state is displayed at the bottom right corner of the operation screens. Refer to figure 3-2 for the organization of the screen menus.

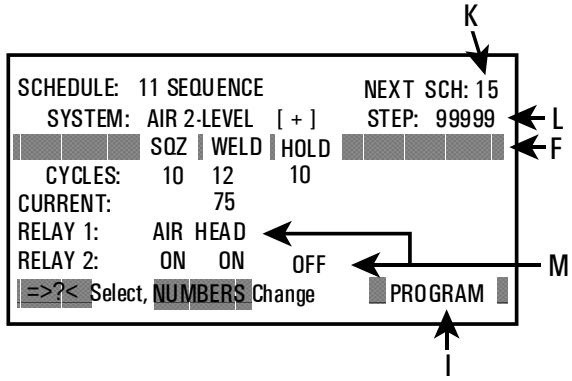
RUN Screen



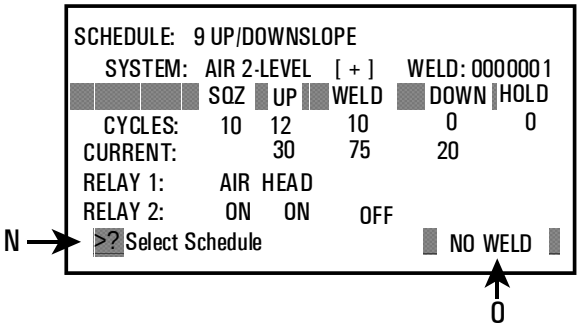
RUN Screen With Weld Sentry



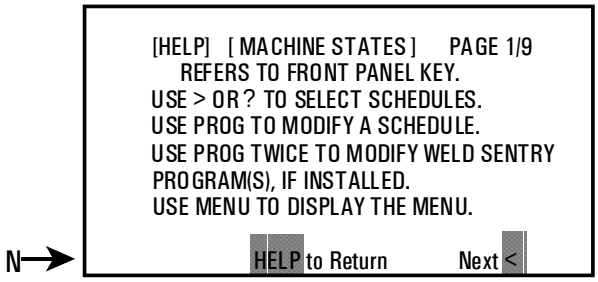
PROGRAM Screen



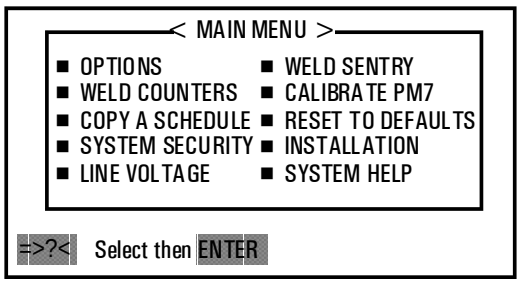
NO WELD Screen



HELP Screen



MAIN MENU Screen



A	Schedule number (0 – 127)	J	Weld sentry program lines if Weld Sentry is Installed. Program (A – E), results of last weld, Measurement unit, upper and lower limits, and Weld sentry status.
B	Weld function		
C	Polarity of weld current		
D	Weld counter		
E	Type of weld head and foot switch	K	Next schedule number (1 – 127) in chain
F	Periods associated with weld function	L	Step count for next schedule
G	User set time, in cycles, for each period	M	Switching status of output relays
H	User set welding current in % of maximum	N	Typical multipage help screen
I	Current state	O	Run state with NO WELD switch ON

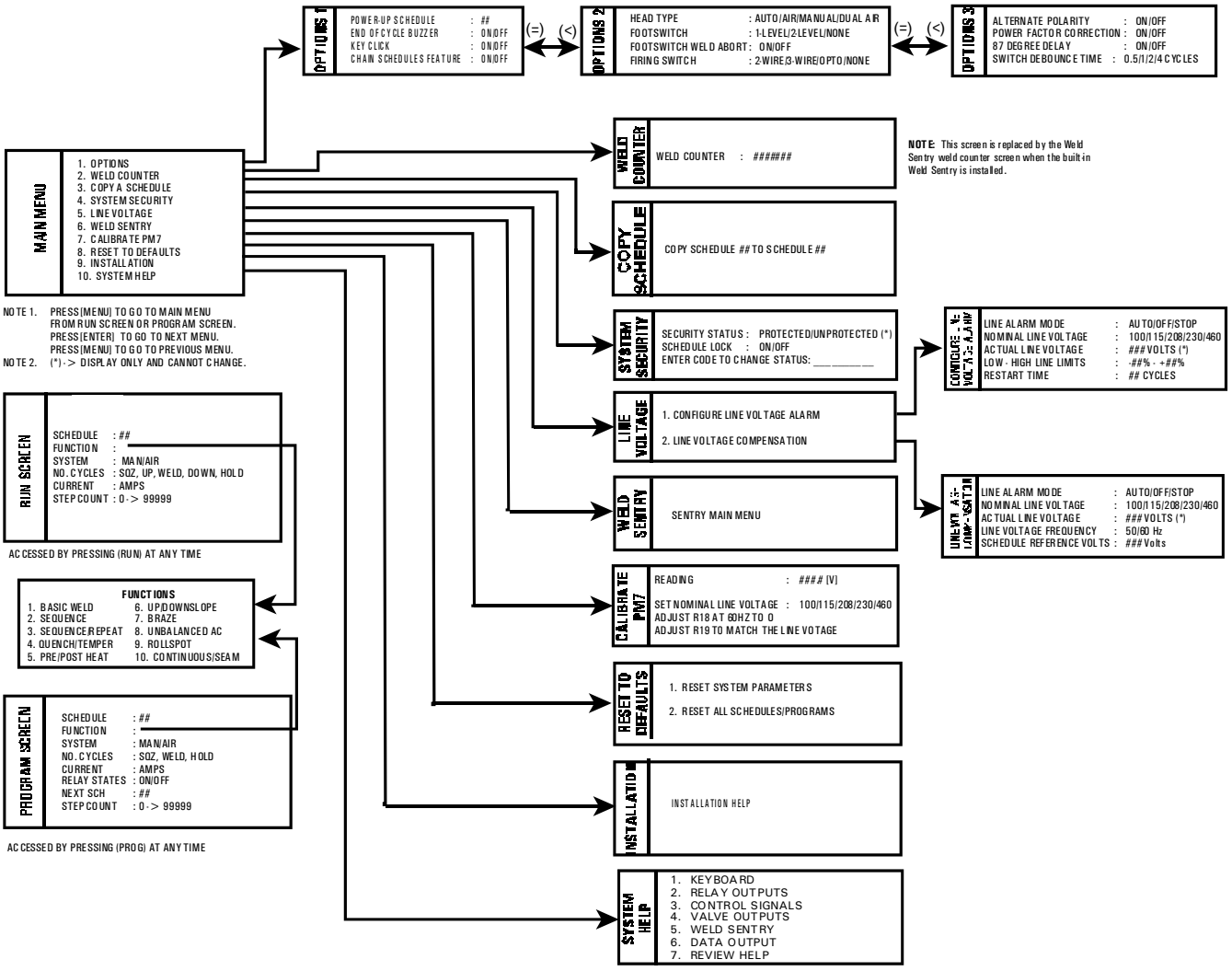


Figure 3-2. Screen Flow Chart

CHAPTER 4
GETTING STARTED

Powering Up

1 To prevent the PM7 from firing until you are ready to weld, select [NO WELD].

2 Set the welding transformer tap switch to its lowest tap position. This is Tap 1 on UNIPULSE transformers.

3 Set the rear panel circuit breaker/ power switch to ON. The title and copyright screens will be displayed, followed by the run screen.

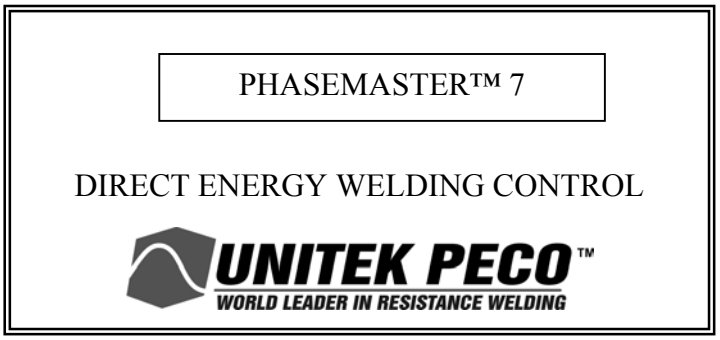
4 Press [>/?] to change the weld schedule number.

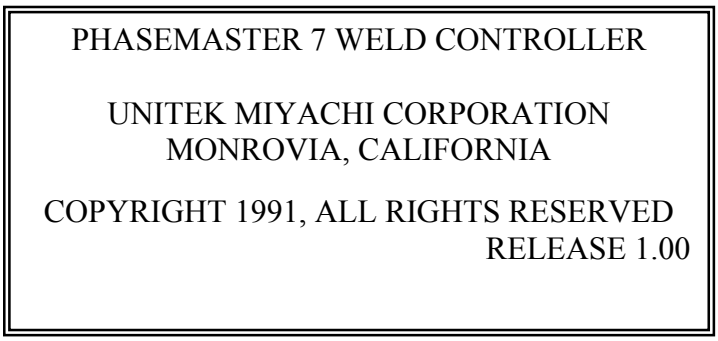
5 Press [CHNG] to change the format of the RUN state screen.

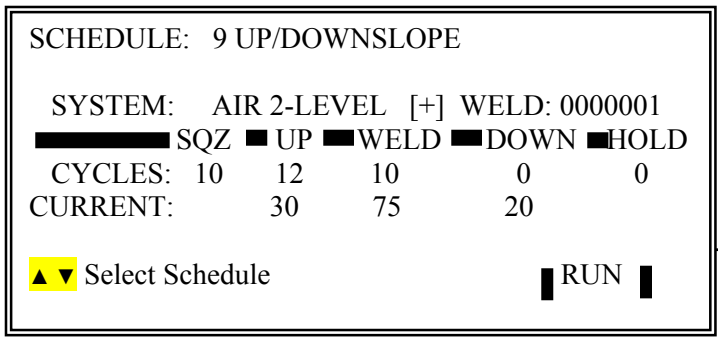
6 Press [HELP] to obtain help.

7 Press [MENU] to change any of the system options or to use any of the PM7 utilities.

8 Press [PROG] to make changes to weld schedules 0 to 127. Schedules 1 through 127 cannot be changed when the system security is PROTECTED. If SCHEDULE LOCK is also ON, only the schedule displayed can be used to weld. To change system security and/or turn OFF SCHEDULE LOCK, press [MENU] and select SYSTEM SECURITY.







NOTE: To override the security code, refer to Appendix A under *Weld Schedules.*

9 If appropriate, change the output relay configuration with the PROGRAM screen.

Adjusting an Air Actuated Weld Head

NOTE: If an alarm occurs, press [RUN] to silence the alarm, then press [HELP] to receive an explanation. Alarm messages will be erased from the display as soon as the alarm condition is corrected or when [PROG] is pressed. Refer to Appendix A under *Control Signals* to remotely clear alarms.

1 Refer to the appropriate weld head manual instructions on how to install the welding electrodes.

2 To adjust the pressure regulators and flow controls, refer to the following instructions or those which are printed on the side of the weld head.

3 To prevent the PM7 from firing until you are ready to weld, select [NO WELD]. Remove the workpiece from between or beneath the electrodes.

4 Set the force indicator on all Unitek weld heads to 3. For more detailed information on setting up each specific weld head, refer to their respective manuals. See figures 4-1 and 4-2 for illustrations of typical air actuated systems.

5 Unlock the regulator(s) by pulling the red ring up. Set the air gauge(s) for 10 psig. Fully open both flow controls.

6 The operational sequence with an air head is as follows:

The first level of a 2-Level foot switch actuates the weld head, moving the electrodes together. The weld period cannot begin until the second level of the foot switch *and* the force firing switch in the weld head close. The PM7 will enter a standby state until these conditions are met. When the firing force is reached, the weld period will start. Assuming that an alarm does not occur, the welding sequence will continue to completion and the weld head will rise at the end of the hold period. If FOOT SWITCH WELD ABORT is ON, releasing the foot switch at any time during the welding sequence will terminate the sequence.

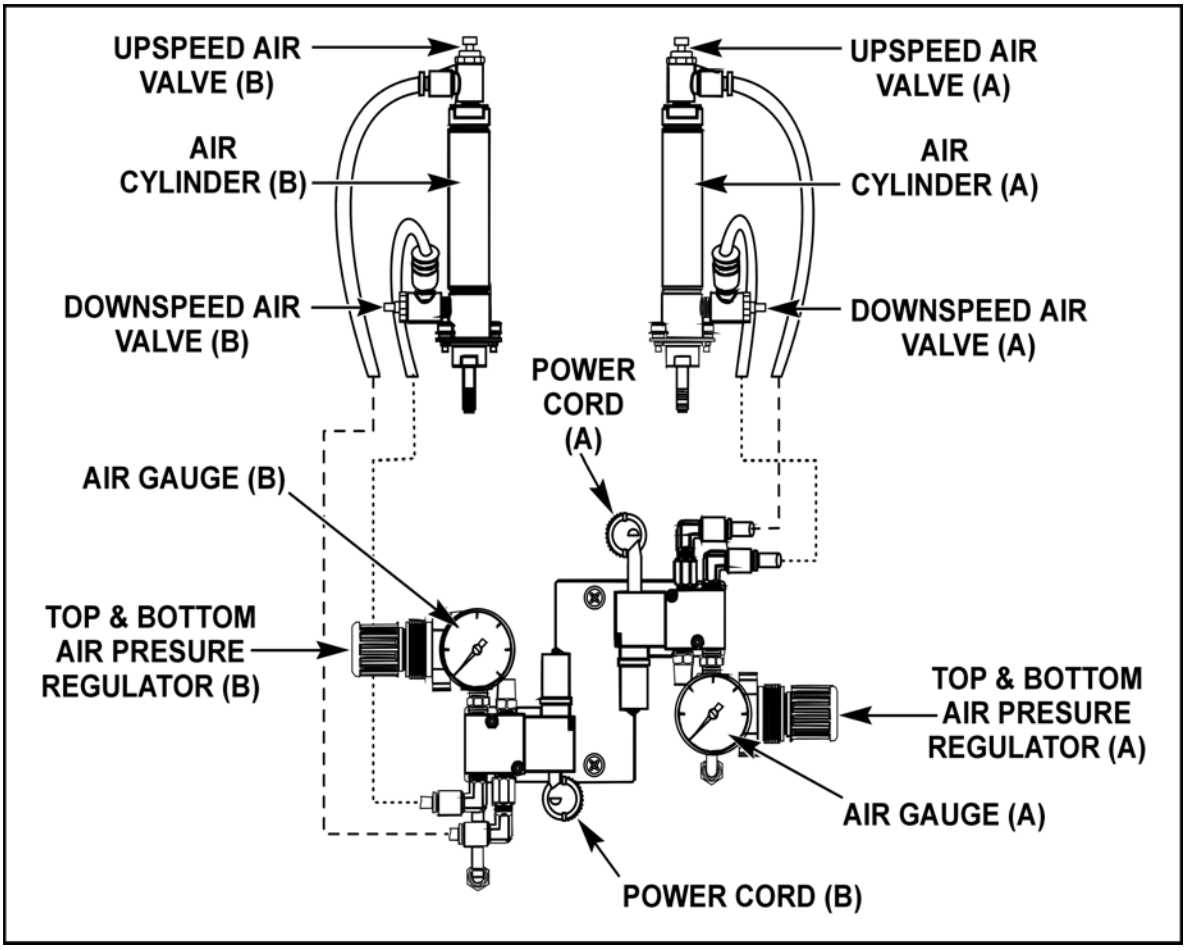


Figure 4-1. Typical Solenoid Air Valve System with Dual Regulators

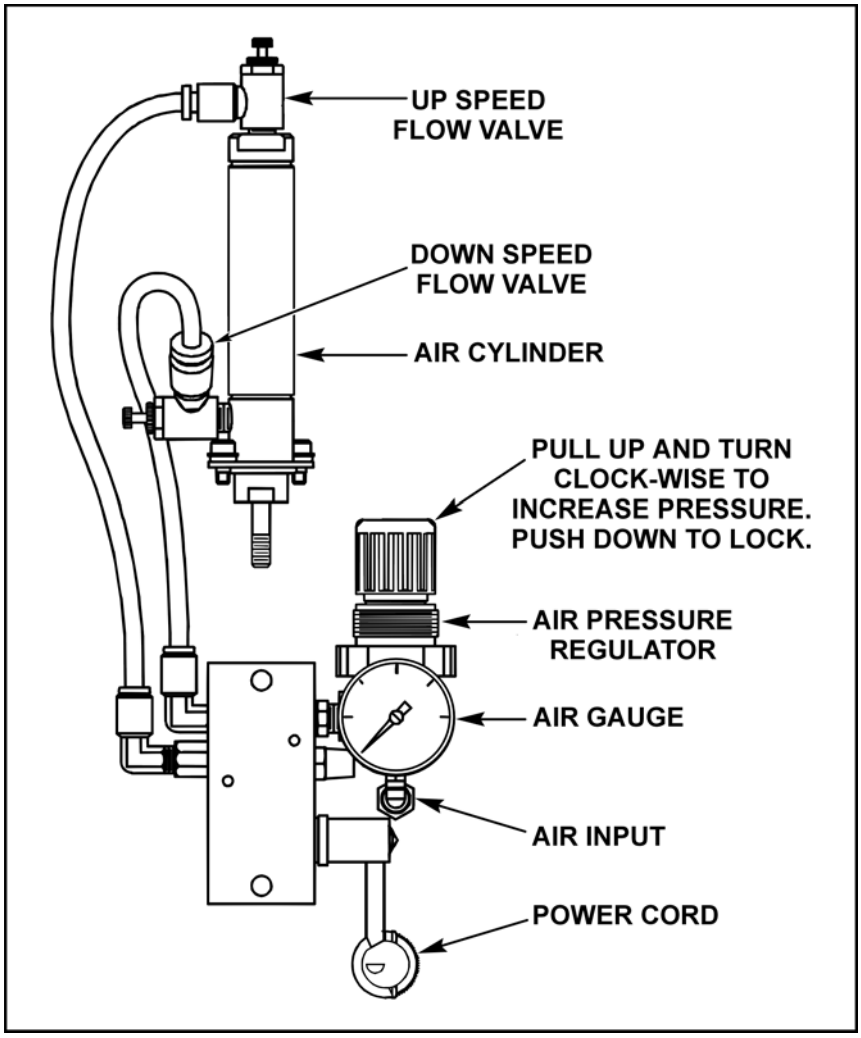


Figure 4-2. Typical Solenoid Air Valve System with a Single Regulator

7 Adjust the upspeed flow control on the top of the cylinder so that the upper arm of the weld head moves at a reasonable rate but does not slam against the upstop. This adjustment is made by pressing, then quickly releasing, the foot switch.

8 Adjust the regulator that controls the air pressure on the top of the cylinder to obtain the desired welding force. Place the workpiece in position between the electrodes. Close the downspeed flow control located on the bottom of the cylinder.

9 Press the foot switch. Adjust the downspeed flow control so that the upper electrode moves at a reasonable rate and does not impact the workpiece hard enough to damage either the electrode or the workpiece. If the flow controls interact, readjust the air pressure which controls the pressure on the

bottom of the cylinder so that it is identical to that set on the other regulator. Then adjust the flow control so that the upper electrode does not slam against the bottom electrode or the downstop.

10 Adjust the pressure regulator, which controls the air pressure on the top of the air cylinder so that it is *just sufficient* to cause the Force Firing Switch in the head to close (see figure 4-3). *When the Force Firing Switch in the head closes, the screen on the PM7 will no longer display* STANDBY. Re-adjust both flow controls, as necessary.

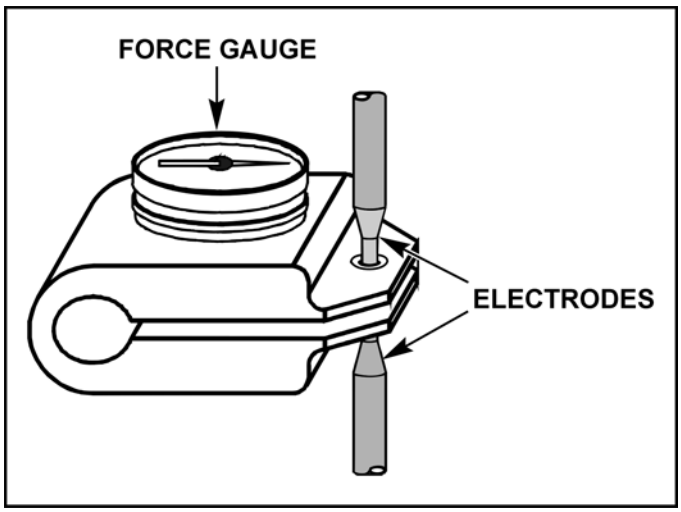


Figure 4-3. Measuring Preset Firing Force of the Weld Head with a Force Gauge

CAUTION: Resist the temptation to increase the downspeed by increasing the regulator setting since this increases the force applied to the workpiece by the electrodes (see figure 4-4). Illustration (a) in figure 4-4 shows the correct air pressure adjustment – the *actual* force equals the firing force setting. Illustration (b) shows the result of excessive air pressure – the *actual* force is much greater than the firing force setting. Excessive air pressure causes the electrodes to mushroom as well as wear faster.

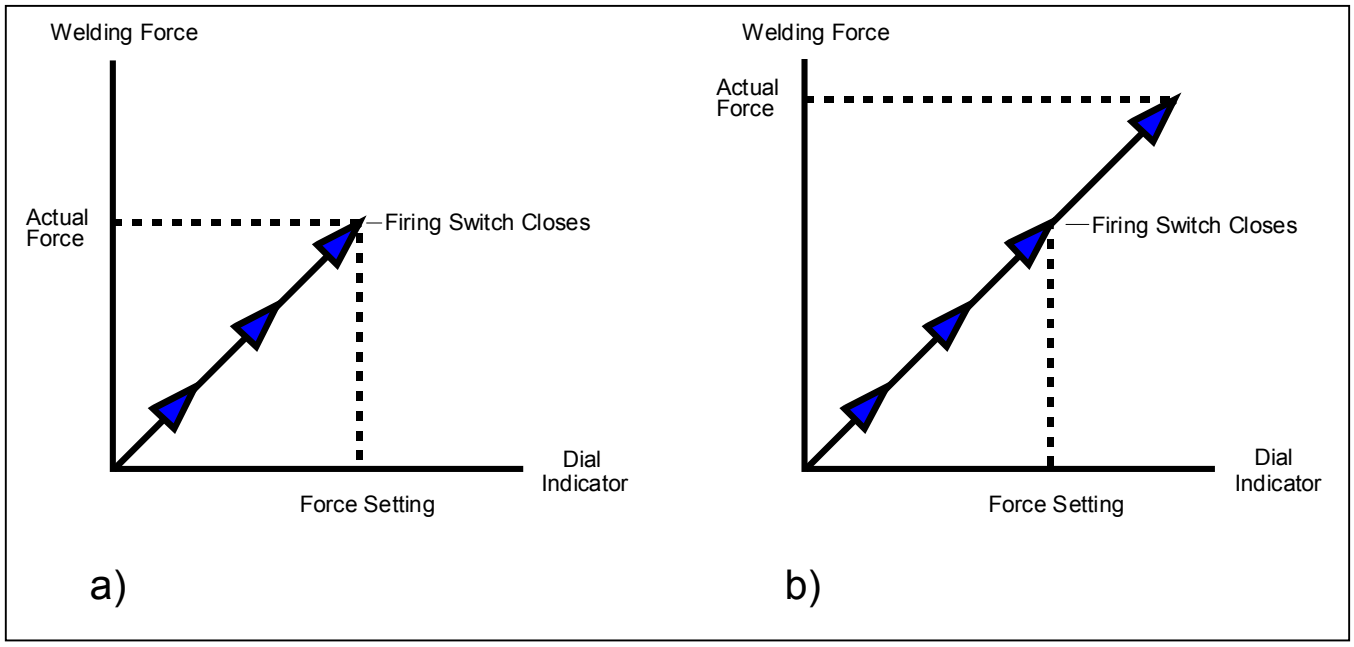


Figure 4-4. Results of Excessive Air Pressure

11 If a higher welding force is necessary, reset the force indicator on the weld head to a *larger* number, then repeat Steps 9 and 10.

12 If a lower welding force is necessary, reset the force indicator on the weld head to a *smaller* number, *reduce* the pressure regulator, which controls the air pressure on the top of the air cylinder, then repeat Steps 9 and 10.

13 If appropriate, configure the Weld Sentry. Press [MENU], select WELD SENTRY followed by SYSTEM SETUP.

14 If appropriate, configure the Weld Sentry print options, relay outputs, and communications options. Set the Weld Sentry clock for the correct time and date.

15 If appropriate, modify the Weld Sentry program. To develop a Weld Sentry program, use the Weld Sentry basic setup option, which is accessed by pressing [MENU] and selecting WELD SENTRY followed by BASIC SETUP.

16 If you want to see a graphical representation of a weld schedule, select DISPLAY GRAPH OF LAST WELD from the Weld Sentry print utility menu.

17 If you are using a second air actuated weld head:

a Connect the second air head to the AIR VALVE DRIVER 2 connector on the rear panel.

b There are two jumper headers, E1 and E2, located on the lower right hand area of the control printed circuit board. Re-jumper the headers to the dual air configuration as shown in figure 4-5. (refer to Chapter 2 under Dual Weld head Installation for the procedure).

c Press [MENU] and select OPTIONS.

d Change the weld head type to DUAL AIR.

e Press [PROG] and move the cursor to the RELAY 1 field.

f Press [CHNG] until AIR HEAD 2 is displayed.

g Press [SAVE] to store the changes.

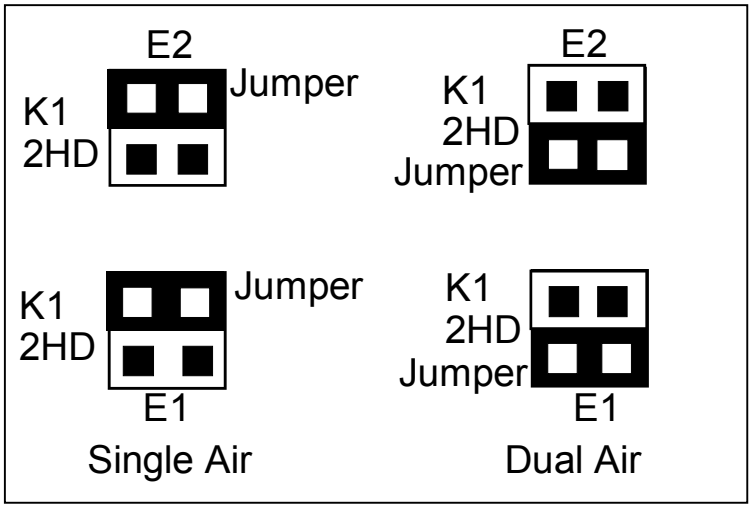


Figure 4-5. Weld Head Configuration Jumper Selection

CHAPTER 5
OPERATING INSTRUCTIONS

Successful Welding

This chapter is a guide to be used in establishing the parameters required to make a successful weld, then making and evaluating a weld. The development of an optimum weld schedule will aid in achieving a repeatable, reliable process. You will find additional useful information in the *Fundamentals of Resistance Welding* data sheet, Part No. 991-140.

Resistance Welding Parameters

The three basic welding parameters are heat, time, and pressure. These welding parameters are controlled by:

Parameter	Controlling Factors
Heat	1. %CURRENT selected during the weld period(s) on PM7. 2. Primary tap setting of the welding transformer. 3. Secondary tap connections of the welding transformer.
Time	Weld cycle selected during the weld periods(s) on the PM7.
Pressure	1. Electrode firing force set on weld head. 2. Surface area of electrode faces.

The effects of excessive or insufficient heat, time and pressure on a weld are illustrated in figure 5-1. You should consider the interaction between these basic welding parameters when developing a weld schedule.

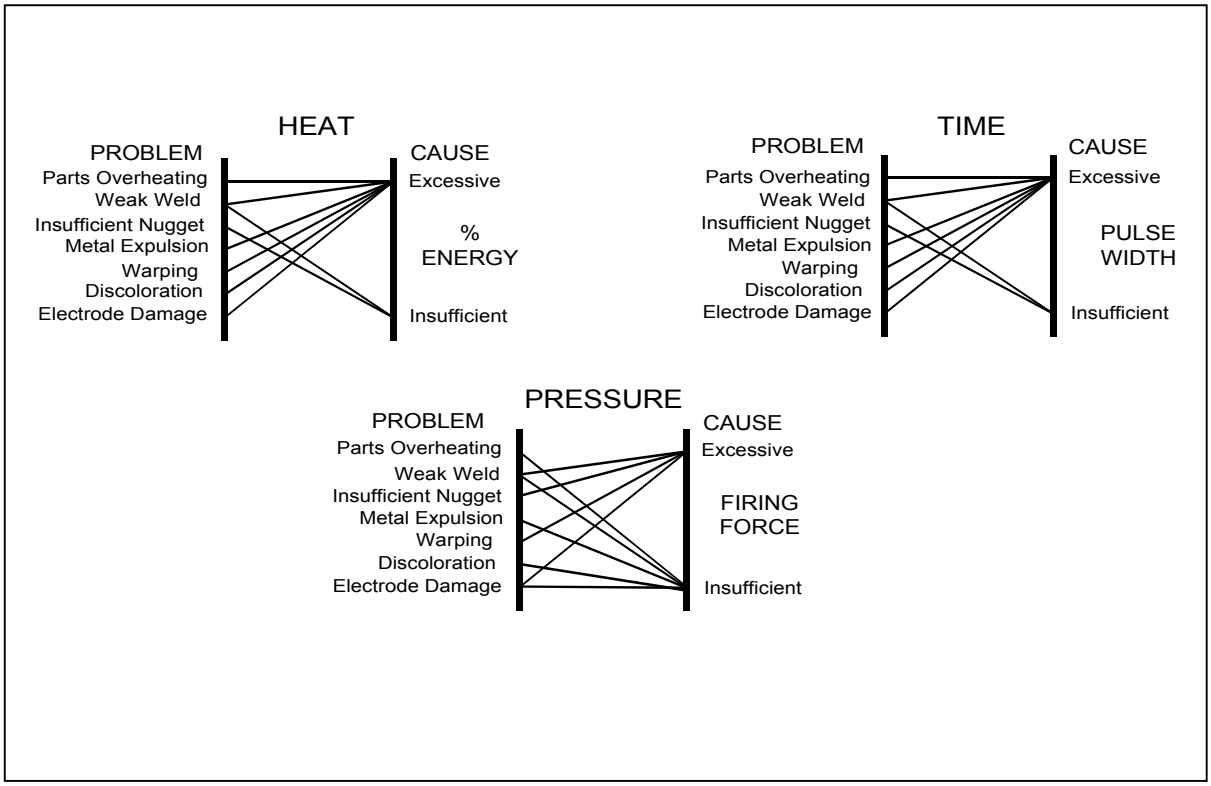


Figure 5-1. Effects of Excessive or Insufficient Heat, Time and Pressure

Using the Run, Program and HELP States

Run and Program State Selection

Welding is done in the run state and programming is done in the program state. These states are described in greater detail in Chapter 6. Press the [RUN] key to enter the run state, which is signified by the RUN legend in the lower right hand corner of the screen. Press the [PROG] key to enter the program state, which is signified by the PROGRAM legend in the lower right hand corner of the screen.

Help State Selection

The help state provides on-line instructions for programming the PM7. Press [HELP] to enter the help mode. When you wish to return to the programming mode, press [HELP] again.

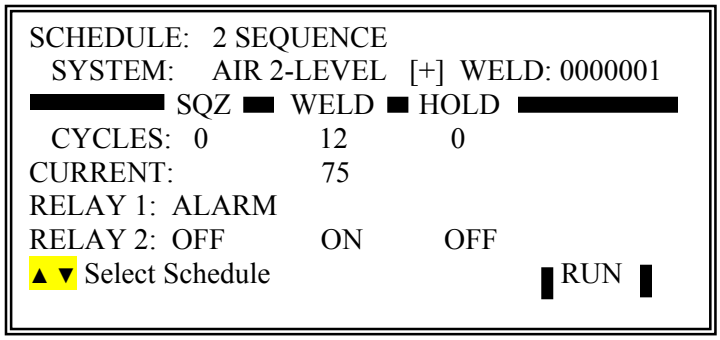
Selecting a Schedule

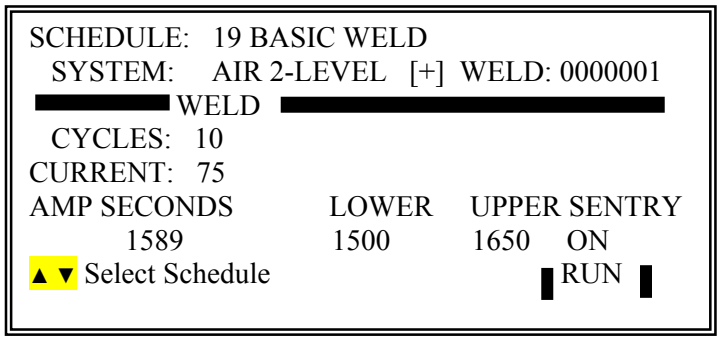
Press [>/?] or [NUMBERS] to select any schedule number from 0 to 127. Each schedule will be displayed, together with the configuration of the system. If you hear a beep (audible tone) in response to your selection, it means that no schedule has been defined for that schedule number.

Changing the Display Format

Press [CHNG] to add the status of the output relays, Relay 1 and Relay 2, to the RUN screen.

Press [CHNG] again to substitute the optional weld sentry information for relay information. The weld sentry information includes the measurement parameter (AMP SECONDS 1589), the preset upper and lower limits (1500 and 1650 respectively), the weld sentry status (ON), and the weld sentry schedule number and mode (19 BASIC WELD).





Changing Schedule Parameters

Use the [>/?] keys to select a schedule. You can change Schedule 0 whenever the PM7 is in the program state. You can change Schedules 1 through 127 only if the system security feature is OFF.

Press [PROG] to select the program state. The data or value field that was last changed will start to flash. Use the [=>?<] keys to move the flashing cursor to the field that you wish to change. The bottom line of the screen will advise you whether to use the [CHNG] key or the [NUMBERS] keys to change the contents of the flashing field.

Changing Output Relay States

Use the [>/?] keys to move to either of the RELAY fields. Use [<] to move the cursor to the first field located to the right of the colon (:). Pressing [CHNG] will cause this field change from ON to OFF to ALRM to AIR HEAD and back to ON.

Relay 1 is an AC relay capable of controlling any external function which requires up to 250 milliamps of current at 12 to 120 VAC. When a dual air head is used, you can program Relay 1 to control the 24 VAC VALVE DRIVER 2 connector.

Relay 2 is a DC relay that can switch up to 250 milliamps of current at 3 to 50 VDC.

ON and OFF means that the relay will be switched ON and OFF during the portion of the weld sequence noted on Line 3 of the screen (SQZ, WELD, HOLD). If the programmed application does not have a SQZ, HOLD or OFF period, there will be no entry for that column. If you select NO for all of the available fields, the relay will be switched to ON during the run state.

ALARM means that the relay will be switched ON for any alarm condition. The alarms are:

- Emergency Stop
- Shorted SCR
- Input Switch
- Line Voltage Out Of Limits

AIR HEAD 2 means that Relay 2 will control the 24 VAC VALVE DRIVER 2 connector. This feature allows the PM7 to control two air actuated weld heads. The second air head will be actuated in any schedule in which Relay 1 is defined as AIR HEAD 2. The standard air head will be actuated in any schedule in which Relay 1 is defined as ON, OFF or ALARM.

Saving Weld Schedules

When you have selected the appropriate parameters for a weld schedule, you have two ways of saving them to the weld schedule:

- Press [SAVE]. All of the selected parameters will be saved to the selected weld schedule in permanent memory. Then, you press [RUN] to go to the run state. Or,

- Press [RUN]. All of the selected parameters will be saved to Schedule 0 in temporary memory, and the PM7 will automatically go to the run state.

An example of the **permanent** save procedure option follows:

1. Switch the circuit breaker on the rear panel to OFF, then ON.
2. Use [>/?] to select Schedule 1.
3. Press [PROG].
4. Use [>/?] to move to the weld function field.
5. Use [CHNG] to select SEQUENCE.
6. Press [?] to move to the SQZ field.
7. Use [NUMBERS] to change the number of squeeze cycles to 5.
8. Press [SAVE].
9. Switch the circuit breaker to OFF, then ON. Notice that Schedule 1 has been permanently modified to contain the new parameters.

An example of the **temporary** save procedure option follows:

1. Use [>/?] to select Schedule 1.
2. Press [PROG].
3. Use [>/?] to move to the weld function field.
4. Use [NUMBERS] to change the number of squeeze cycles to 5.
5. Press [RUN]. Notice that the modified Schedule 1 has been transferred to Schedule 0 because you used [RUN] instead of [SAVE] to exit the program state.

Schedule 0 is a scratch pad into which any schedule that is changed but not saved is transferred. In practice, you could now make a weld with the modified schedule.

Configuring the Weld Sentry

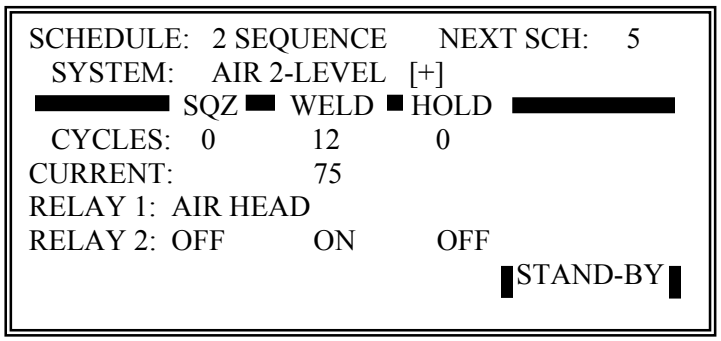
You configure the Weld Sentry from the MAIN MENU. Each PM7 weld schedule can have five related sentry programs, A through E. For example, for PM7 Weld Schedule 10, the related sentry programs are 10A through 10E. To configure a sentry schedule:

1. While in the run state, Press [MENU].

2. Select WELD SENTRY and follow the instructions given by the help screens or the weld sentry User's Manual.

Handling Alarm Conditions

An alarm condition, as exemplified by the standby alarm, is indicated in the lower right hand corner of the screen. There are four alarm messages.



SCR Alarm

The output SCRs, which control the flow of current to the welding transformer, are defective. They must be replaced by a qualified technician.

Emergency Stop

An emergency stop signal was received from external user's equipment.

Input Switch Alarm

The foot switch or force firing switch in the weld head closed before the PM7 went to the run state. You must release, then actuate, the foot switch or foot pedal to correct this condition.

Standby Alarm

The force firing switch in the weld head did not close within 10 seconds after the 1-level foot switch, or the second level of the 2-level footswitch, closed. This condition is normally caused by the head hitting the downstop before sufficient force has been applied to the work piece to actuate the force firing switch. Either adjust the downstop or increase the length of the upper electrode.

Sometimes this condition is caused by insufficient air pressure. In this case, increase air pressure slightly.

Using the Help Screen for Diagnosis

To determine the cause and remedy for an alarm, press [PROG] to silence the alarm. Then press [RUN] to return to the run state. Now, press [HELP] to bring up the HELP screen. As shown on the HELP screen for the standby alarm, the condition resulted from waiting for the force firing switch to close.

[HELP] [STANDBY FIRING SWITCH]
WAITING FOR FIRING SWITCH ON AIR HEAD TO CLOSE. OPEN FLOW CONTROL ON BOTTOM OF AIR CYLINDER; OR USE AIR REGULATOR TO INCREASE AIR PRESSURE; OR USE TURN FORCE ADJUSTMENT KNOB TO REDUCE FIRING FORCE.

HELP to Return

Weld Schedule Development

Developing a weld schedule is a methodical procedure consisting of making sample welds and evaluating the results. You should make the first weld at low energy settings. Then, you make adjustments to each of the parameters ***one at a time*** until a successful weld is made.

Weld Head Parameters

There are two critical weld head parameters that you must pay particular attention to: electrode force and electrode face area.

Electrode Force: 1 Install the correct electrodes in the electrode holders on the weld head. Refer to table 5-1 for electrode material recommendations.

2 Set the force adjustment knob on the weld head to set the firing force. Start at a moderate force setting, 3 on a Unitek Peco Weld Head. Figure 5-1 illustrates the effect of electrode force on the work piece.

3 Adjust the air pressure for air operated weld heads (refer to Chapter 4 under *Adjusting an Air Actuated Weld Head* for the procedure).

Table 5-1. Recommended Electrode Materials

Material	Electrode RWMA Type	Material	Electrode RWMA Type	Material	Electrode RWMA Type	Material	Electrode RWMA Type
Alumel	2	Evanohm	14	Kulgrid	2	Palladium	14
Aluminum	1	Gold	11	Magnesium	2	Rhenium	2
Aluminum Alloys	1	Gold Plated Dumet	2	Manganin	2	Silver	11
Beryllium Copper	2	Gold Plated Kovar	2	Molybdenum	2	Stainless Steel	2
Brass	2, 11	Hastalloy X	2	Nichrome	2	Tantalum	2
Bronze	2	Inconel	2	Nickel	2	Tinned Brass	14
Chromel	2	Invar	2	Nickel Alloy	2	Tinned Copper	14
Consil	11	Iridium	2	Niobium	2	Titanium	2
Constantan	2	Iron	2	NiSpan C	2	Tungsten	2
Copper	14	Karma	2	Platinum	2	Zinc	14
Dumet	2	Kovar	2	Paliney 7	2		

Electrode Face: Use a flat electrode face for most applications. Use a "domed" face if surface oxides are a problem. If either of the work pieces is a wire, the diameter of the electrode face should be equal to or greater than the diameter of the wire. If both work pieces are flat, the face should be at least one-half the diameter of the electrodes. *Pencil point* electrodes reduce the overall quality of the welding process, and are not recommended.

Welding Transformer Parameters

Set the primary tap and the secondary tap (if appropriate) as follows:

Primary Tap: No. 1, the lowest tap on the Unitek Peco transformers.
Secondary Tap: Lowest.

PM7 Control Parameters

You can develop weld schedules using Schedule 0, then copy it to any other schedule number. Use the sequence welding function, which is an appropriate function for 80% of the PM7 applications (refer to Chapter 6 under *Weld Functions*). Switch the Line Voltage Compensation to OFF (refer to Chapter 6 under *Line Voltage Compensation*). Set the parameters as follows:

- WELD CYCLES: 0.5
- SQUEEZE and HOLD (air head only): 0
- %CURRENT: 60%

Making a Weld

CAUTION: Always observe safety precautions when welding. Wear your safety glasses.

In making a weld, the objective is to obtain a consistent weld with the shortest possible weld time and a %CURRENT setting between 60 and 90%.

1 Select [RUN] and [WELD] on the PM7.

2 Position the parts between the electrodes.

3 Press the footpedal or footswitch to initiate the welding sequence. When weld current flows, the red pilot light on the UNIPULSE Transformer will light. (It may be difficult to see where the %CURRENT is less than 50% and/or WELD CYCLES is set to 0.5).

4 Assuming no weld occurred, increase the tap switch setting until the parts begin to weld. If you reach the highest primary tap and, if applicable, the highest secondary tap without obtaining a weld, increase the weld period from 0.5 to 1 cycle.

5 Use the %CURRENT to refine the characteristics of the weld.

Evaluating the Weld

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. Electrode sticking and/or "spitting" should define a weld as unsatisfactory.

Weak Weld

If the parts pull apart easily, or there is little or no residual material pulled, the weld is weak. Increase the %ENERGY in increments of 1% to 2%. The actual weld strength is a user defined specification.

Electrode Sticking

Electrode sticking includes burning, sparking, and "blown welds." These problems indicate that either the %ENERGY is too high or the electrode force is too low. Refer to figure 5-1.

Examine the electrode face. Resurface it if it is pitted, contaminated or burned. See *Electrode Maintenance* later in this chapter. Increase electrode force and/or decrease %ENERGY and save it to the weld schedule you are using.

Causes of Imperfect Welds

Table 5-2 lists the effects of the basic welding parameters on weld quality.

Table 5-2. Causes of Imperfect Welds

Problem	Energy	Electrode		Time
		Force	Size	
Weak Weld	Too Low	Too High	Too Large	Too Short
Blow Holes. Expulsion.	Too High	Too Low	Too Small	Too Long
Burned, Pitted or Cracked Electrodes	Too High	Too Low. Requires Maintenance	Poor Maintenance	Too Short

Electrode Force and %ENERGY

The heat of resistance welding is produced, in part, by the resistance of the interface between the work pieces to the flow of electricity (the contact resistance).

Sufficient electrode 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 energy to produce the heat required to form a weld.

The higher the electrode force, the greater the energy (current and/or time) required to produce a given weld. Low force usually results in lower bond strength. Increased force requires higher energy but usually results in a stronger bond. Energy is proportional to time and the square of the welding current.

Polarity

Users of half-cycle welders have found that the direction of 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.
- Identical materials with thickness ratios greater than 4 to 1.

Since polarity can be an important consideration in resistance welding of some material combinations, be sure to check the weld schedule results using both positive and negative polarity. Polarity can be changed in the PROGRAM state. The general rule is that the more resistive material, or the thinner material, should be placed against the negative (-) electrode.

Weld Strength Profiles

Weld strength profiles are graphic presentations of the varying effects of %CURRENT, electrode force and weld strength. To make a weld strength profile, start at an initial energy setting, make four or five welds, and perform pull tests for each weld. Calculate the average pull strength. Increase the %CURRENT and repeat the procedure. Continue to increase the %CURRENT until any unfavorable characteristic occurs, such as sticking or spitting.

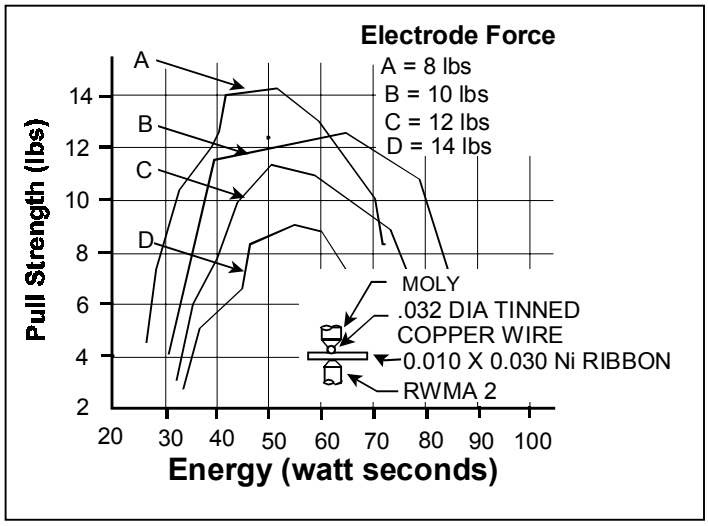


Figure 5-2. Typical Weld Strength Profile

Perform pull tests and plot the results of %CURRENT versus Pull Strength (see figure 5-2). Repeat this procedure for different forces and plot a separate curve for each electrode force.

Repeat this procedure using the longer pulse width.

In figure 5-2, Curve C shows the highest pull strengths but the lowest tolerance to changes in weld energy. Curve B shows a small reduction in strength but considerably more tolerance to changes in weld energy.

Weld energy/current will vary as a result of material variations and electrode wear. Curve B is preferred since it shows more tolerance to changes in weld energy and has nearly the same bond strength as Curve C. 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.

Destructive Testing

Destructive Testing can be performed on the actual work piece or on test specimens. For small, inexpensive parts, actual production samples, taken on a random basis, should be used. 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.

Electrode Maintenance

Depending on use, periodic tip resurfacing is required to remove oxides and welding debris from electrodes. On the production line, you should use No.400-600 grit electrode polishing disks. For less critical applications, you can use a file to clean a badly damaged tip. After filing, however, use polishing disks to ensure that the electrode faces are smooth and parallel. If you don't, the rough surface of the electrode face will have a tendency to stick to the work piece; or, if the faces are not parallel, energy will be concentrated at the point of contact and a blowout will result.

To dress the electrode tip:

1 Select [NO WELD].

2 On air actuated weld heads, reduce the air pressure to a value just sufficient to lower the upper electrode arm.

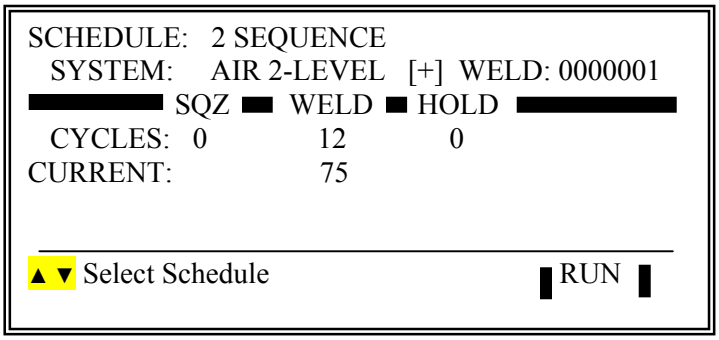
3 Place the polishing disks between the electrodes and actuate the footpedal or footswitch to bring the electrodes into light contact with the polishing disk. Move the polishing disk in a rotary motion.

CHAPTER 6
PROCESS DEFINITIONS AND WELD FUNCTIONS

PM7 States

The PM7 has seven states: RUN, NO WELD, PROGRAM, MENU, HELP, STANDBY and WELD. The [MENU], [RUN], and [PROG] keys cause the PM7 to change to the state defined by that key.

RUN State

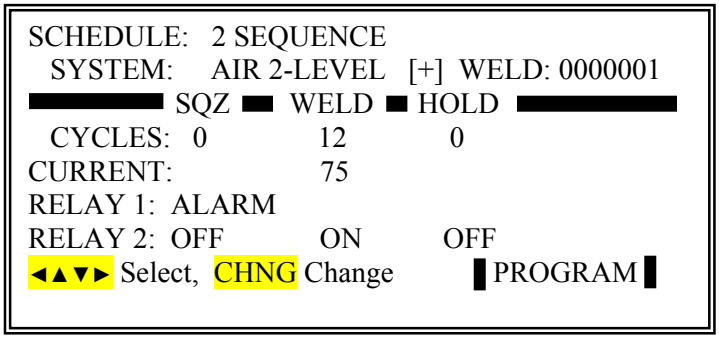


In this state, the PM7 is ready to make a weld. You can select, but not change, any weld schedule by using the ▲ or ▼ keys on the front panel. You can also change weld schedules by keying in the appropriate schedule number, 000 through 127. The run screen is showing that Schedule 2 is selected. In this schedule, the sequence function is programmed, and the system is an air actuated weld head with a 2-level footswitch. The weld period is preset for 12 cycles, and the weld current is preset for 75% of maximum.

NO WELD State

When you set the WELD/NO WELD switch to the NO WELD position, the legend RUN in the lower right hand corner of the run screen will be replaced by NO WELD. The PM7 will execute any weld schedule, but will not deliver welding current to the weld head.

PROGRAM State



In this state, the PM7 will allow you to change and save (write to permanent memory) any weld schedule. Press [PROG] to enter the PROGRAM state, which is signified by the legend PROGRAM in the lower right-hand corner of the screen. In those units

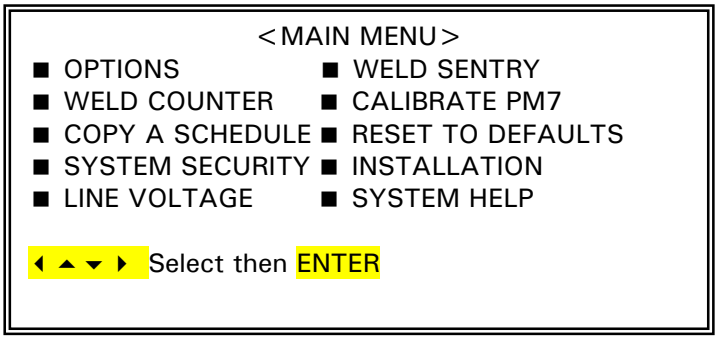
which include the Weld Sentry option, the PROGRAM state also allows you to change the measurement unit, the limits related to the Weld Sentry program, and the other parameters associated with the Weld Sentry.

Use the cursor to move to the field you wish to change. After you have made the changes, press [SAVE] to exit to the RUN state and save the changes.

MENU State

In this state, the PM7 will display a menu which allows you to select options which are common to all weld schedules, to access the Weld Sentry option, and obtain general information.

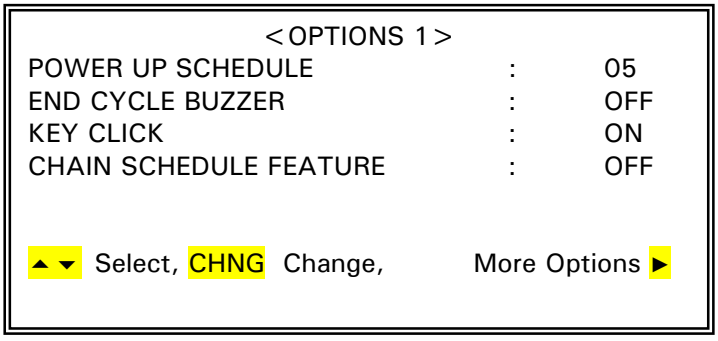
Press [MENU] to select the menu state. The MAIN MENU screen will be displayed.



■**OPTIONS:** Use the [>/?] keys to move the cursor to OPTIONS on the MAIN MENU screen. Then press ENTER to select OPTIONS.

There are three screens (pages) associated with the OPTIONS selection. The first time that you select OPTIONS, the OPTIONS 1 screen will appear. After you have made selections from the OPTIONS 1 screen, you can proceed directly to the OPTIONS 2 screen, and from there to the OPTIONS 3 screen; or, you may return from any of the three OPTIONS screens to the MAIN MENU.

OPTIONS 1: The OPTIONS 1 screen has four options.

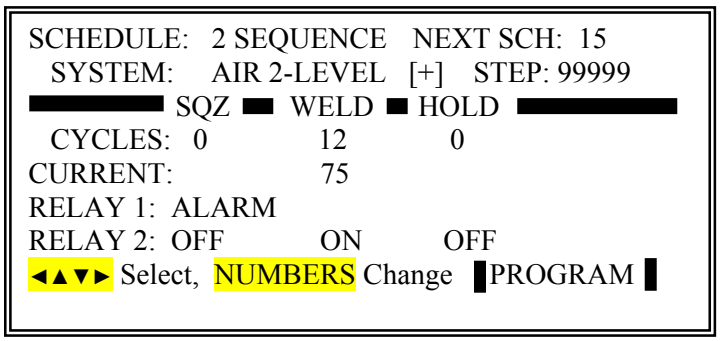


- POWER-UP SCHEDULE: This option determines which schedule number will come up when the PM7 is switched on. Use the keypad to enter any number between 0 and 127. To power up in the last schedule that was displayed when power was switched off, enter [.].

- END CYCLE BUZZER: This option is usually used for manual weld heads. An ON selection means that an audible signal will be given at the end of each weld sequence as a signal to the operator to release the foot pedal. Use the [CHNG] key to select ON or OFF.

- KEY CLICK: An ON selection means that, whenever a key is pressed, the operator will hear a key "click" sound. OFF means that no sound will be heard. Use the [CHNG] key to select ON or OFF.

- CHAIN SCHEDULES ON: An ON selection means that the schedule will automatically advance to another specified schedule after a specified number of welds have occurred. With this feature, a limited degree of automation can be achieved with minimum user investment.



When the CHAIN SCHEDULE FEATURE is ON, the RUN screen for each schedule will display a NXT SCH field and a STEP field. When CHAIN SCHEDULES FEATURE is first switched ON, the PM7 will automatically set NEXT SCH for each schedule as its own schedule number. Press [PROG] to specify A STEP count and a NEXT SCHedule to advance to after the count has expired.

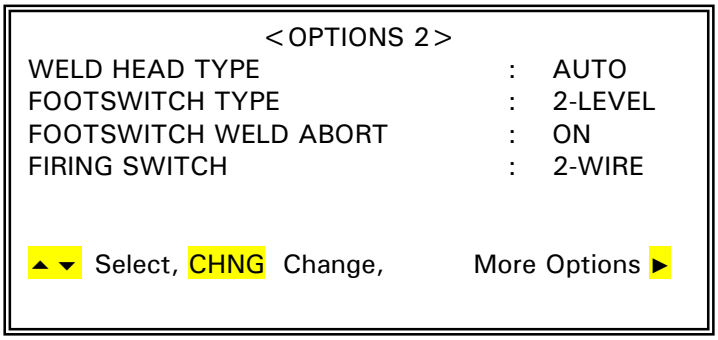
NOTE: You cannot use Schedule 0 in a chain of schedules. Schedule 0 is reserved for scratch-pad work.

For example, if the NEXT SCH number for Schedule 1 is 5 and the STEP count for Schedule 1 is 100, the PM7 will use Schedule 1 to make 100 welds, the automatically advance to Schedule 5. If the NEXT SCH number for Schedule 5 is 5, the PM7 will not advance and will continue to make welds using Schedule 5.

When you enter [.] for NEXT SCH, it means "stop". For example, if the NEXT SCH number for Schedule 6 is 9 and the NEXT SCH number for Schedule 9 is a period (.), the schedules will sequence from 9 to 6. After Schedule 6 is completed, the PM7 will enter the standby state and wait for you to enter a new schedule number.

OPTIONS 2: The OPTIONS 2 screen has four options.

- WELD HEAD TYPE: You have four selections within this option, as follows:



  - ► AUTO: Select AUTO when a Unitek Peco air or manually actuated weld head is connected to one of the AIR VALVE DRIVER connectors on the rear panel. The PM7 will automatically sense which type is connected. The PM7 will assume that a manual head is connected unless it senses a Unitek Peco air head.

  - ► DUAL AIR: Activates the 24 VAC AIR VALVE DRIVER 2 connector to drive the Second air head.

- ► MANUAL: Select MANUAL when a non-Unitek Peco manual head is connected. Also use this selection when an externally controlled air head is used and the air solenoid is not connected to one of the AIR VALVE DRIVER connectors.

- ► AIR: Select AIR when an air head controlled by a foot switch is connected to the PM7.

- FOOTSWITCH TYPE: You have three selections within this option.

  - ► With the AUTO selection, the PM7 will automatically recognize whether a Unitek Peco 1-level or 2-level foot switch is connected to it. When a user-supplied foot switch is connected to the PM7, select either 1-LEVEL or 2-LEVEL, as appropriate.

  - ► 1-LEVEL: When the foot switch closes, the PM7 will energize the air valve on the weld head. The upper electrode will then close, applying force to the work piece. If the operator releases the foot switch before the weld head applies the preset firing force, the PM7 will remove the voltage from the air valve. The upper electrode will then return to the open position.

  - ► 2-LEVEL: When the operator presses a 2-level foot switch to the first level, the weld head will close and apply force to the work pieces. At this point, if the operator does not press further down (harder) and actuate the second level, the operator can release the foot switch to reposition the work pieces.

  - ► When the operator has actuated the second level, a 2-level foot switch will operate just like a 1-level foot switch.

    A 2-level foot switch is recommended if the operator will be required to reposition the work pieces. It will also allow the operator to actuate an air head without initiating the weld cycle. This is because both the force firing switch and the second level of the foot switch must close before the weld portion of the sequence can begin.

- FOOTSWITCH WELD ABORT: Make this selection when the connected foot switch is being used with an air actuated weld head. You have two selections with this option as follows:

  - ► ON: This selection means that, if the operator releases the foot switch (or foot pedal) during the weld sequence, the sequence will terminate immediately. It may be a safety requirement for non-tooled systems. Always use this feature when a manual head is being used. This way, the welding sequence will terminate if the force firing switch in the weld head opens, usually as a result of the operator releasing the foot switch prematurely during the welding sequence.

  - ► OFF: This selection means that once the operator presses a 1-level foot switch, or the second level of a 2-level footswitch, and the preset firing force has been applied to the work pieces, the operator cannot terminate the welding sequence.

- FIRING SWITCH: You have four selections with this option. Make the selection according to the type of firing switch connected to the PM7.

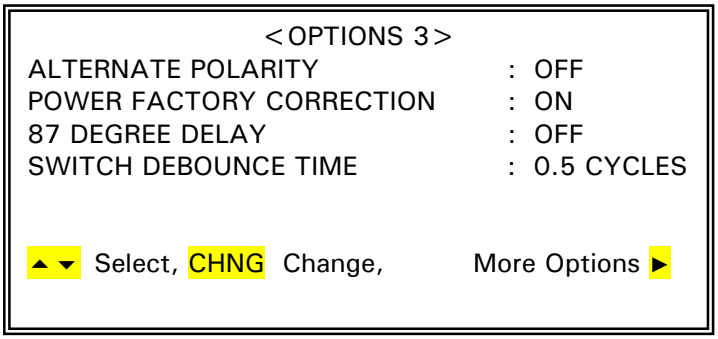
  - 2-WIRE: Make this selection when the firing switch connected to the MECHANICAL FIRING SWITCH connector on the rear panel is a single-pole, single-throw ON/OFF switch. This type of switch is used in a standard, force-fired Unitek Peco weld head.

  - 3-WIRE: Make this selection when the firing switch connected to the OPTICAL FIRING SWITCH connector on the rear panel is a single-pole, double-throw switch. This type of switch is used where weld rates exceed 1800 welds per hour.

  - OPTO SWITCH: Make this selection when the firing switch connected to the OPTICAL FIRING SWITCH connector on the rear panel is an optically coupled firing switch.

  - NONE: Make this selection when no firing switch is connected. Typically, this would be the case where an externally controlled air actuated weld head, and squeeze time, are being used.

OPTIONS 3: The OPTIONS 3 screen has four options.



- ALTERNATE POLARITY: An ON selection means that the polarity of the first half cycle of output will change with each weld. This feature can be used to prevent non-Unitek Peco welding transformers from saturating.

  Use the OFF selection if you are using Unitek Peco welding transformers since they do not use Hypersoil cores.

- POWER FACTOR CORRECTION: Select ON when the PM7 is used with a Unitek Peco welding transformer. This selection will ensure that the welding current is independent of the welding load power factor.

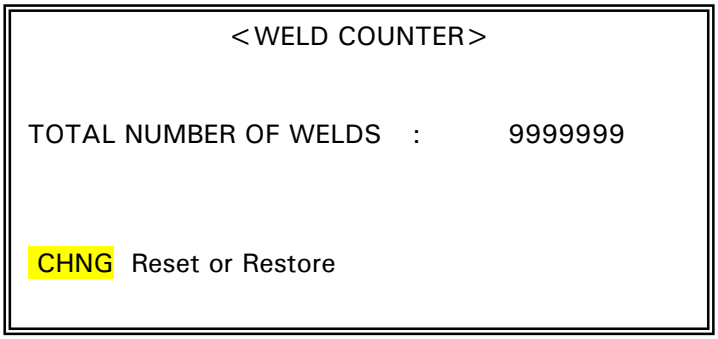
  Select OFF if you are using non-Unitek Peco welding transformers and welding times exceeding 5 cycles.

- 87 DEGREE DELAY: Select ON when using wound-core welding transformers and/or welding transformers with water-cooled secondary windings. Select OFF for Unitek Peco welding transformers.

- SWITCH DEBOUNCE TIME: The contacts of single-pole switches "bounce" as they close. The debounce feature will avoid resulting false initiations by requiring the firing switch to remain closed 0.5, 1, 2 or 4 cycles before initiating the weld.

  For operation at speeds below 0.5 welds per second, or with 3-wire firing switches, select 0.5. If the PM7 is not being initiated reliably, first try 1, then 2, then 4 cycles. If none of these selections is successful, use a single-pole, double-three (3-wire) firing switch.

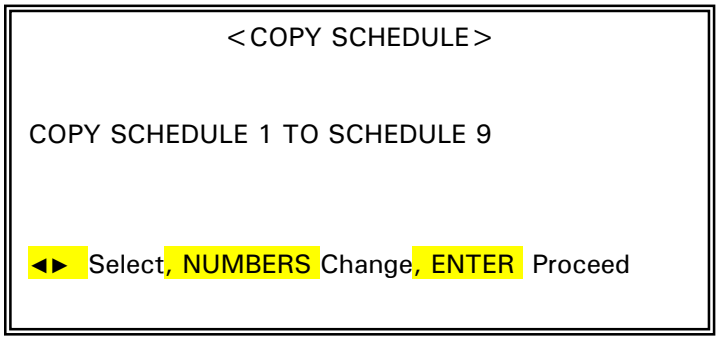
■**WELD COUNTER:** Select this option to display and reset the weld counter to zero. Use the [=><] keys to select WELD COUNTER on the MAIN MENU screen and press [ENTER] to access the WELD COUNTER screen.



The total number of welds increments each time a weld is made in any schedule. The value displayed on this screen corresponds to the weld count displayed in the run state. When the chain schedules feature is on, the step count is displayed instead.

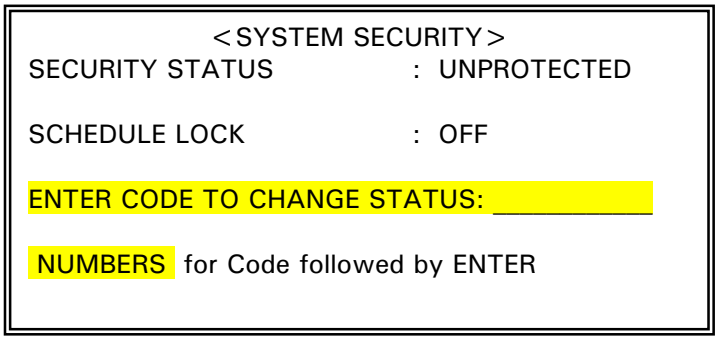
If the Weld Sentry is installed, three counters are added to the WELD COUNTER screen: Reject Hi, Reject Lo, and Accept. Refer to the Weld Sentry user's manual for details about these counters.

■**COPY A SCHEDULE:** Select this option to save one weld schedule to another weld schedule. Use the [=><] keys to select COPY A SCHEDULE on the MAIN MENU screen and press [ENTER] to access the COPY SCHEDULE screen.



Use [NUMBERS] to enter the number of the schedule to be copied. Then use [<] and [NUMBERS] to enter the number of the schedule to be changed. In the COPY SCHEDULE screen shown, Schedule 1 and Schedule 9 will be identical and the date previously in Schedule 9 will be lost.

■**SYSTEM SECURITY:** Select this option to protect all weld schedule data except Schedule 0 from changes by unauthorized persons. Use the [=><] keys to select SYSTEM SECURITY on the MAIN MENU screen and press [ENTER] to access the SYSTEM SECURITY screen.



SECURITY STATUS: You can change security status to protected when you enter a user-selected security code. To change to protected, enter your security code on the bottom line of the SYSTEM SECURITY screen and press [ENTER]. The SECURITY STATUS line on the SYSTEM SECURITY screen will now display PROTECTED. Your security code may be any seven-digit number from 1 to 9,999,999.

If you forget the security code, you may change status back to unprotected with the override key combination. Set the WELD/NO WELD switch to the NO WELD position. Press the [=] key, then the [SAVE] key. The system will now be unprotected and the SECURITY STATUS line on the SYSTEM SECURITY screen will now display UNPROTECTED again.

SCHEDULE LOCK: This selection prevents you from changing weld schedules. You may use only the currently selected schedule. All other schedules are locked out and cannot be used to weld. Use the [>?] keys to select SCHEDULE LOCK and press [CHNG] to select ON. Then, change SECURITY STATUS to PROTECTED.

NOTE: If the security status is unprotected, SCHEDULE LOCK will automatically change to OFF.

■LINE VOLTAGE: Select this option to program either the line voltage alarm or line voltage compensation. Use the [>?] keys to select LINE VOLTAGE ALARM or LINE VOLTAGE COMPENSATION, then press [ENTER].

```
<LINE VOLTAGE>

■LINE VOLTAGE ALARM
■LINE VOLTAGE COMPENSATION

◄▲▼► Select then ENTER
```

LINE VOLTAGE ALARM: Line voltage is measured during the half-cycle before a weld is made. You can set the line voltage alarm whenever the actual line voltage deviates from the nominal voltage by more than the programmed high/low limits.

When you select LINE VOLTAGE ALARM, the PM7 LINE VOLTAGE ALARM screen will be displayed.

LINE ALARM MODE: Use [CHNG] to select either OFF, STOP or AUTO. OFF means ignore the condition and make a weld. STOP means stop and initiate a VOLTAGE ALARM; press [RUN] to clear the alarm. AUTO means initiate a voltage standby; a voltage standby will cause the PM7 to wait until the line voltage returns to within limits for the duration of the restart time. (AUTO does not affect operation of the line voltage compensation option).

```
<PM7 LINE VOLTAGE ALARM>
LINE ALARM MODE          : AUTO
NOMINAL LINE VOLTAGE     : 240
ACTUAL LINE VOLTAGE      : 238.5
LOW – HIGH LINE LIMITS   : -05% - +05%
RESTART TIME             : 20 CYCLES

▲▼ Select, NUMBERS to Change
```

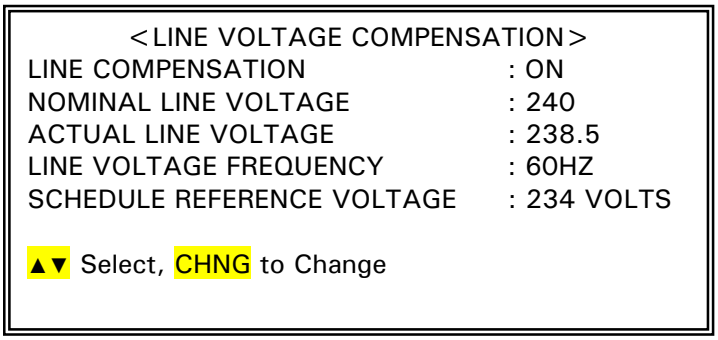
NOMINAL LINE VOLTAGE: Use [CHNG] to select the wired line voltage range of the PM7: 90-110, 110-120, 200-220, 220-240, 380-400, or 440-480. Nominal line voltage ranges can be selected from three different line voltage screens: PM7 LINE VOLTAGE ALARM, LINE VOLTAGE COMPENSATION, and PM7 CALIBRATION. When nominal line voltage information is changed on one screen, the PM7 will automatically change the other two screens.

ACTUAL LINE VOLTAGE: This selection displays the measured value of input line voltage. As with any meter, it is normal for the value to fluctuate slightly to reflect the true condition of the AC line.

LOW-HIGH LINE LIMITS: With this selection, you may choose the amount of deviation which will signal the line voltage alarm. You set the limits as percentages of the nominal line voltage; the low limit between -13% and -5%, and the high limit between 5% and 13%. If you set the limits at -13% -13%, the line voltage alarm would be signaled whenever the actual line voltage was less than 13% below the normal line voltage or more than 13% above the normal line voltage.

RESTART TIME: You use this selection only when LINE ALARM MODE is set for AUTO. When the line voltage goes outside the programmed limits, the PM7 will initiate a voltage standby. The voltage standby will be cleared when the line remains within limits for the duration of the RESTART TIME. Use [NUMBERS] to enter from 1 to 60 cycles.

LINE VOLTAGE COMPENSATION: Selection of LINE VOLTAGE COMPENSATION will bring up the LINE VOLTAGE COMPENSATION screen. You can set the PM7 to automatically compensate for deviations in the line voltage. For each 1% decrease in line voltage, the PM7 will increase %current by 1%. For each 1% increase in line voltage the PM7 will decrease %current by 1%.



NOTE: The PM7 will not compensate for more than a ±13% change in line voltage from the rated nominal line voltage (100, 120, 208, 240, 380 or 480 volts). Select OFF when the PM7 is used to develop weld schedules.

LINE COMPENSATION: Select ON to configure the PM7 to compensate for changes in line voltage, as described previously under *LINE VOLTAGE COMPENSATION.*

NOTE: If you do not use line compensation, the heating energy programmed in weld schedules will not be repeatable from one location to another.

NOMINAL LINE VOLTAGE: Use [CHNG] to select the input line voltage of the PM7: 90-110, 110-120, 200-220, 220-240, 380-400, or 440-480 volts. You can select nominal line voltage from three different line voltage screens: LINE VOLTAGE COMPENSATION, PM7 LINE VOLTAGE ALARM or PM7 CALIBRATION. When you change nominal line voltage on one of the screens, the PM7 will automatically change the other two screens.

ACTUAL LINE VOLTAGE: This line displays the measured value of the PM7 line voltage. As with any meter, it is normal for the value to fluctuate slightly to reflect the true condition of the AC line.

LINE VOLTAGE FREQUENCY: The PM7 will automatically determine the frequency of the line voltage and display either 50 Hz or 60 Hz.

SCHEDULED REFERENCE VOLTAGE: Use this selection when LINE COMPENSATION is ON. Use [NUMBERS] to enter the actual line voltage experienced when an original weld schedule was established. The line voltage compensation function will use this value, along with the nominal voltage, to provide correct heating energy.

■**WELD SENTRY:** Use this option to access the Weld Sentry module if it is installed. Refer to the Weld Sentry User's manual for operating instructions.

■**CALIBRATE PM7:** Use this option to calibrate the PM7. Refer to Chapter 7 for instructions.

■**RESET TO DEFAULTS:** From the MAIN MENU screen, select RESET TO DEFAULTS with the [=>?<] keys and press the [ENTER] key to bring up the RESET DEFAULTS screen.

RESET SYSTEM PARAMETERS: Use the [CHNG] key to select YES or NO. If you select YES, all system parameters will be set to factory defaults (see table 6-1).

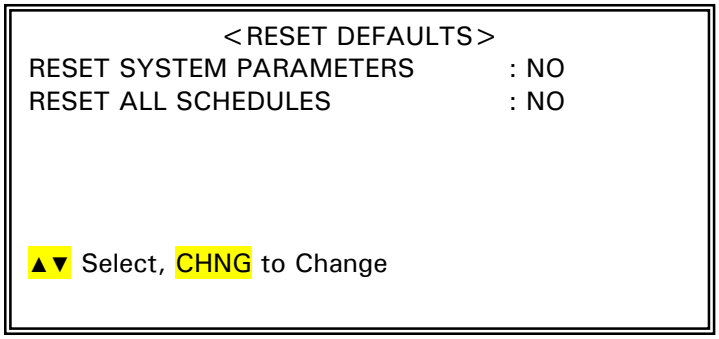


Table 6-1. Factory Default Settings

Default	Setting	Default	Setting
Power Up Schedule	Last	87 Degree Delay	Off
End Cycle Buzzer	Off	Switch Debounce Time	0.5 cycles
Key Click	On	System Security	Unprotected
Chain Schedules Feature	Off	Relay 1 and Relay 2	Off
Weld Head Type	Auto	Step Count	00001
Footswitch Type	Auto	Line Voltage Alarm	Auto
Footswitch Weld Abort	On	Nominal Line Voltage	240
Firing Switch Type	2-Wire	Scheduled Ref Voltage	240
Alternate Polarity	Off	Line Volt. Compensation	Off
Power Factor Correction	On		

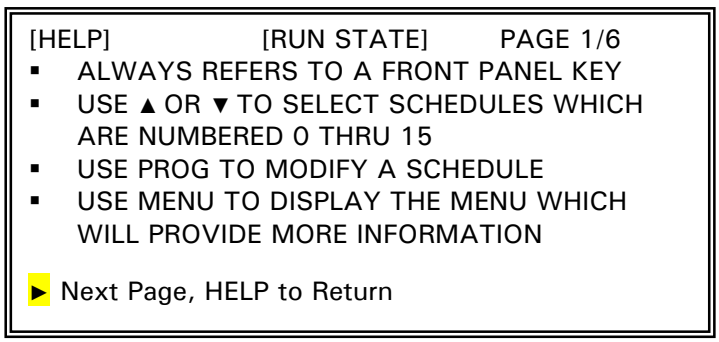
RESET ALL SCHEDULES: Use [CHNG] to select either YES or NO. If you select YES, all schedules will be reset to factory defaults. If the Weld Sentry option is installed, all related programs will be reset to factory defaults.

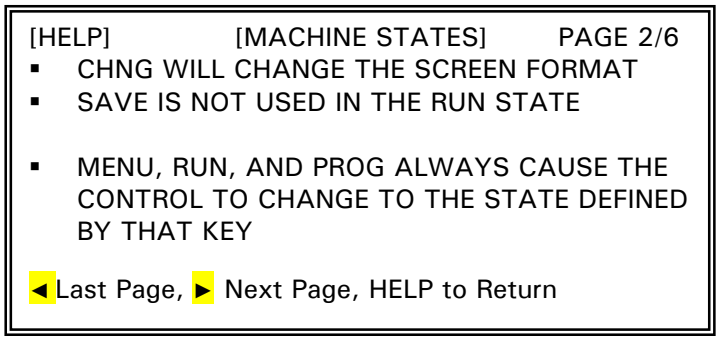
■**INSTALLATION:** This option consists of help screens containing installation information. Refer to Chapter 2 for more installation information.

■**SYSTEM HELP:** This option consists of all of the HELP screens.

HELP State

The PM7 offers you context sensitive help when running or programming. Press [HELP] whenever you have a question. Press [HELP] again to return to the original screen. For example, if you press [HELP] from the RUN state, information on the function of the PM7 keys will be displayed as illustrated below:





If there is more than one page of HELP screens, the current page number and number of pages will be displayed in the upper right hand corner. Use [◄►] to move from page to page. Press [HELP] (or the key defined on the bottom line) to return to the run state.

STANDBY State. The PM7 is waiting for a mandatory event to occur such as:

- The force firing switch in an air head to close, or
- The schedule number information to be placed on the terminals of the CONTROL SIGNALS connector, or
- Waiting to be reset to another schedule after a stop command in a chained schedule.

This state is essentially an alarm condition. For details on how to deal with it, refer to Chapter 5 under *Alarms*.

WELD State. The firing switch in the weld head has closed and the welding sequence is proceeding.

Programming a Dual Weld Head

General Program Requirements

To prepare the dual weld head program:

1 Configure Jumpers E2 and E3 on the PC board for dual weld head operation (refer to Chapter 2).

2 Go to the OPTIONS 2 menu and select WELD HEAD TYPE.

3 Configure the PM7 for WELD HEAD TYPE: DUAL AIR and FOOT SWITCH TYPE: 1 LEVEL or 2 LEVEL, depending on the type of foot switch.

4 Go to the OPTIONS 2 menu and select CHAIN SCHEDULE FEATURE: ON.

NOTE: The Chain Schedule Feature is not needed to operate Dual Weld Heads. However, using the Chain Schedule Feature can facilitate weld head selection by automatically switching between weld heads after a pre-programmed number of weld process cycles (STEPS). Press the [PROGRAM] key to return to the PROGRAM screen.

Weld Head 1 Weld Schedule Parameters

To select the Weld Head 1 parameters:

1 Select Schedule 001 and input the correct weld schedule parameters for Weld Head 1.

2 Program the Chain Schedule Feature for NEXT SCH: 002. Program STEP COUNT = for the number of welds that Weld Head 1 should make before switching to Weld Head 2.

3 While still in the program state, scroll down to the Relay 1/Relay 2 information with the [▼] key. Make sure that, for Schedule 1, Relay 1 reads NOT USED (the default reading) and Relay 2 reads OFF across all of the weld functions.

4 Press the [SAVE] key to save the Schedule 1 parameters.

Weld Head 2 Weld Schedule Parameters

To select the Weld Head 2 parameters:

1 Select Schedule 2 and input the correct weld schedule parameters for Weld Head 2.

2 Program the Chain Schedule Feature for NEXT SCH: 001. Program STEP COUNT = for the number of welds that Weld Head 2 should make before switching to Weld Head 1.

3 While still in the program state, scroll down to the Relay 1/Relay 2 information with the down arrow [▼] key. Change Relay 1 to read AIR HEAD 2. By doing so, the air valve driver will be turned on for the duration of the weld cycle for Weld Schedule 2, and Weld Head 2 until the chaining feature returns to Weld Schedule 1. Relay 2 should still read OFF across all of the weld functions.

4 Press the [SAVE] key to save the Schedule 2 parameters, then return the PM7 to Schedule 1.

Weld Functions

The PM7 allows you program 128 weld schedules. Each weld schedule contains all of the information required to execute a specific weld function. Typical timing of a weld function is shown in figure 6-1.

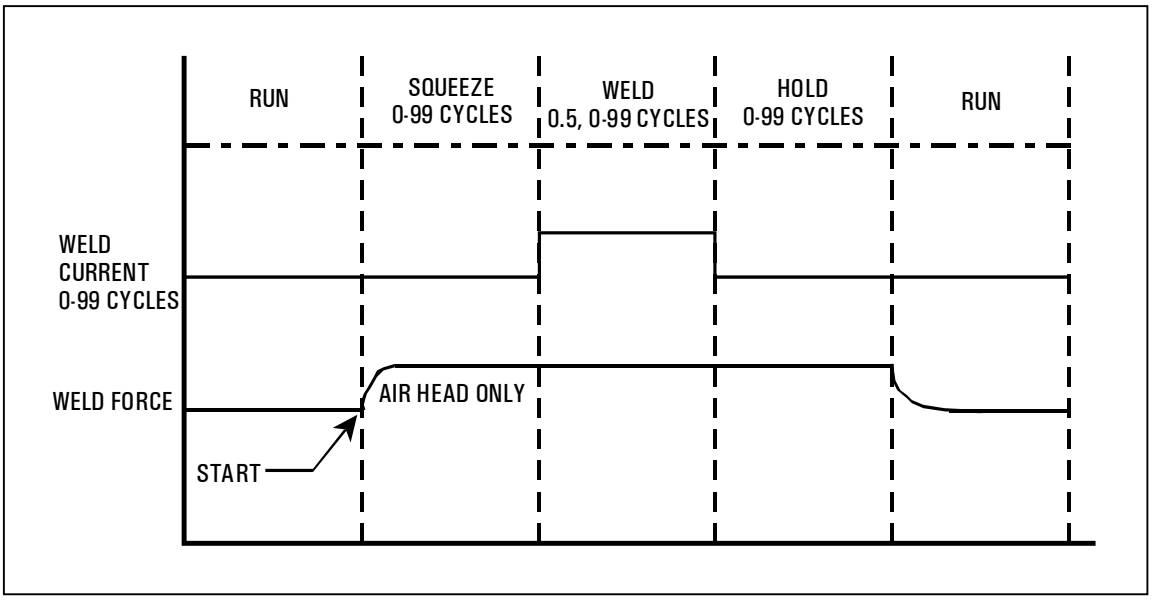


Figure 6-1. Typical Weld Function Timing

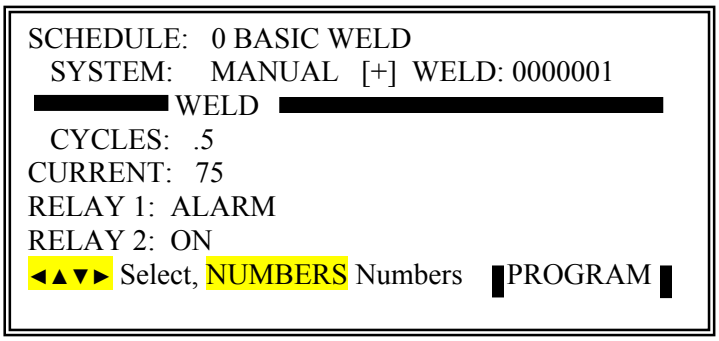
There are two versions of most functions: one for an air actuated weld head and the other for a manually actuated weld head. However, the basic weld function applies only to a manual weld head; the sequence function applies only to an air head.

Basic Function

This function makes a simple spot weld. It provides the solution for the majority of the resistance welding applications involving the use of manually actuated weld heads. When the force firing switch

in the weld head closes, current will flow and the weld will be executed. The next weld will be executed when the firing switch opens and closes again.

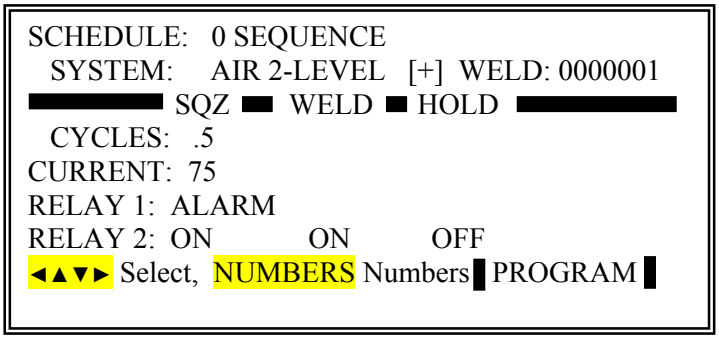
As shown in the example program screen to the right, the schedule number and name of the weld function appear in the first line of the display. The weld period is preset for 0.5 cycle and the weld current is preset for 75%. Relay 1 would be switched to ON in the event of an alarm and Relay 2 is switched to ON during the weld period.



Sequence Function

Sequence function is a term used in the welding industry to describe the basic welding function as it is used with air heads. It provides the solution for the majority of the resistance welding applications using air actuated weld heads.

A typical program screen for the sequence function is shown to the right. It is similar to the basic weld program screen, except that squeeze and hold periods are included.



Squeeze. The squeeze period (SQZ) is used with non-force fired heads. It has no meaning with manually actuated heads. Set SQZ to 0 for Unitek Peco Heads. With non-force fired heads, or if the electrodes are used to form the work pieces, SQZ must be set so that it allows sufficient time for the head to apply the proper force to the work pieces. The first level of a 2-level foot switch is used to start the SQZ period. The weld period cannot start until the SQZ period ends, and the second level of the foot switch and the force firing switch in the head both close.

Weld. The weld period is measured as the number of cycles of the AC power source during which welding current flows. The weld period starts after three events have transpired: The SQZ period has expired, the second level of the foot switch has closed, and the firing switch in the weld had has closed. You can set weld time for 0.5 cycle, or from 1 to 999 cycles in 1-cycle increments.

Hold. The hold period is measured as the number of AC cycles of the AC power source after the weld period. The period can be set from 0 to 99 cycles, in 1-cycle increments. It has no meaning when used with a manual weld head.

An air actuated weld head will continue to apply force to the work pieces during the hold period. In resistance brazing or soldering applications, the hold period provides time for the brazing alloy or solder to solidify.

Hold time is seldom used in welding applications where the electrodes are not water-cooled and/or where the weld time is less than 5 or 10 cycles. In these applications, hold time allows the electrodes to cool the work pieces.

Weld Current. The weld current (CURRENT) is measured as a percentage of the maximum welding current that could flow during each half-cycle of the weld period. The welding current is controlled by circuit that proportions current over time to obtain the required heating effect. For example, ignoring losses, if the %CURRENT is increased from 80 to 90%, the welding energy will increase from 64% to 81% of the maximum.

You can set %CURRENT from 20 to 99%, in 1% increments. Weld quality should improve if you set %CURRENT between 65% and 85%.

Output Relays. Two output relays, Relay 1 and Relay 2, can be used to supply status signals to external devices. Relay 1 can also be used to control a second air actuated weld head or to signal an alarm condition. The status of each relay is shown on screen Lines 6 and 7. You set the relay conditions in the program state and confirm them, in real time, in the run state.

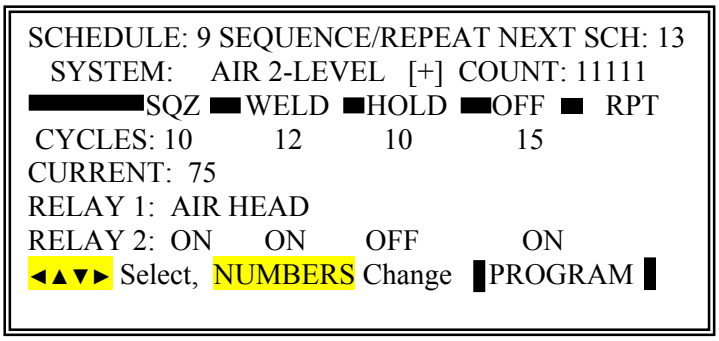
When used for status signals, you can program the relay states to close when:

- The PM7 is initiated
- Any portion of the welding sequence is completed
- The firing switch opens
- The PM7 is waiting for the welding sequence to start.

Sequence/Repeat Function

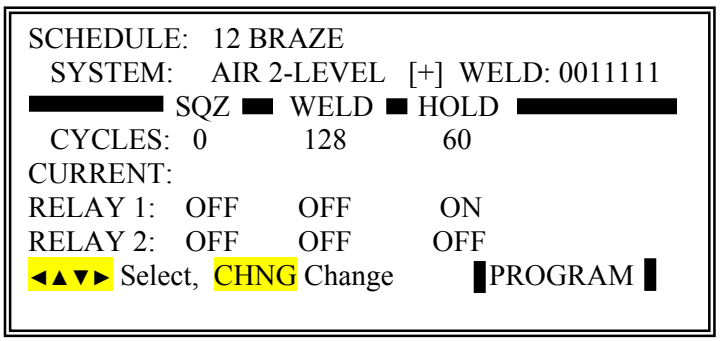
This function provides a repeat capability for simple automated air actuated applications. It is ideal for volume production requiring a single weld schedule. Note that, it can be used only with air actuated weld heads.

The typical program screen for the sequence/ repeat function shows two additional periods: OFF and RPT. During the OFF period, the PM7 releases the solenoid on the air actuated weld head for sufficient time for the electrodes to open and allow the parts to be repositioned before the entire welding sequence repeats (RPT) .



Braze Function

The braze function is ideal for both brazing and some non-critical reflow soldering applications. To ensure complete solidification of the brazing alloy, the electrodes, which are water-cooled in these applications, cool the work pieces during the hold period.

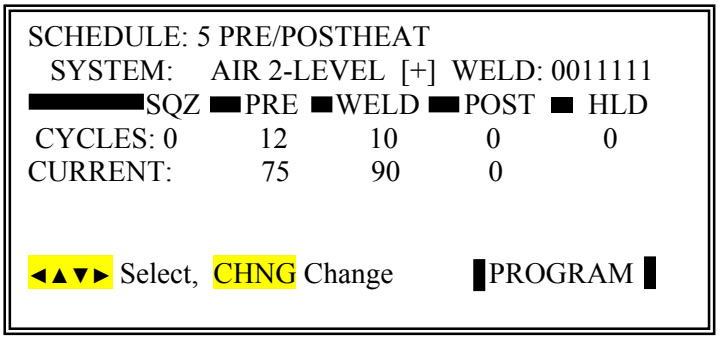


During the hold period, the weld head continues to apply force to the work pieces. The example program screen shows that 60 cycles was preset for the hold period, and that Relay 1 was programmed for ON to control the flow of cooling water to the electrodes.

Pre/Post Heat Function

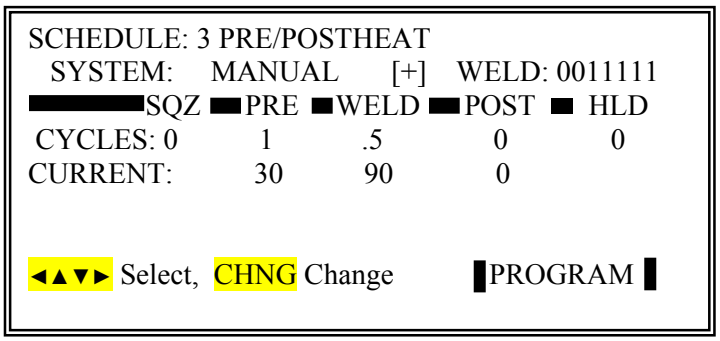
This function is the most versatile of the PM7 functions.

A complete preheat/postheat weld function for an air head system is shown at the right. The PREheat current raises the temperature of the work pieces during the PREheat period; it raises it to a level which stabilizes their surface condition so that the welds are more consistent. PREheat also allows time for the electrodes to seat firmly against the work pieces and force them into intimate contact with each other.



The weld is performed during the weld period by the welding current. The POSTheat CYCLES and POSTheat CURRENT are used to anneal the work pieces. In this example, POSTheat was set to 0 because small parts do not need annealing.

In the example program screen shown at the right, the pre/postheat function was used to weld a nickel tab to a plated steel battery case. The 1 cycle PREheat pulse provided sufficient heat to allow the electrodes to force the plating out of the weld area. The 0.5 cycle weld pulse welded the nickel tab to the steel case.



Up/Downslope Function

SCHEDULE: 6 UP/DOWNSLOPE			NEXT SCH: 11	
SYSTEM: AIR 2-LEVEL		[-]	WELD: 0011111	
SQZ	UP	WELD	DOWN	HLD
CYCLES: 10	12	10	15	19
CURRENT:	25	90	60	
RELAY 1: OFF	OFF	OFF	OFF	OFF
RELAY 2: ON	ON	OFF	ON	OFF
◄▲▼► Select, CHNG Change			PROGRAM	

The upslope function facilitates welding material combinations such as aluminum-to-aluminum or platinum-to-tungsten. Since the current during the first cycle is low, upslope allows a reduction in electrode force. The reduced force reduces electrode indentation, material pickup and electrode deformation. Upslope can also be used to displace plating or oxides, reduce flashing or spitting, and reduce thermal shock when welding parts containing metal-to-glass seals.

The downslope function assists in the grain refinements of certain heat-treatable steels. It also prevents cracking in aluminum and certain other materials by reducing the cooling rate. The current slope is linearly reduced from the weld current to the down current during the downslope period. The PM7 automatically calculates the rate of change, and will not allow a rate greater than 50% per cycle or less than 1% per cycle.

Quench/Temper Function

This function controls grain refinement in the parts. The weld current welds the parts together. During the quench (COOL) period, the parts are cooled by the electrodes, which are frequently water-cooled. The TEMPer CURRENT , which flows for the duration of the TEMPer period, must generate sufficient heat to achieve the desired grain alignment. Type 410 stainless steel is one of the materials that must be heat-treated (annealed) in order to eliminate the brittle, crystalline structure caused by the weld current.

SCHEDULE: 7 QUENCH TEMPER			NEXT SCH: 12	
SYSTEM: AIR 2-LEVEL		[-]	COUNT: 00099	
SQZ	WELD	COOL	TEMP	HLD
CYCLES: 10	12	10	15	19
CURRENT:	75		60	
RELAY 1: AIR HEAD				
RELAY 2: ON	ON	OFF	OFF	ON
◄▲▼► Select, NUMBERS Change			PROGRAM	

The quench/temper sequence for parts that are smaller than those just described is programmed differently. The program more commonly used is shown at the right. It is showing a program for welding a tungsten filament to a molybdenum ribbon. The WELD CURRENT is used to force the oxides out of the weld zone. The parts cool during the COOL period and are welded during the TEMPer period.

The WELD CURRENT is set so that it 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 then allows time to dissipate the heat generated during the WELD period. The structural weld is made during the TEMPer period by the TEMPer CURRENT. In this instance, the TEMPer CURRENT should be greater than the WELD CURRENT by a factor of 2 or 3.

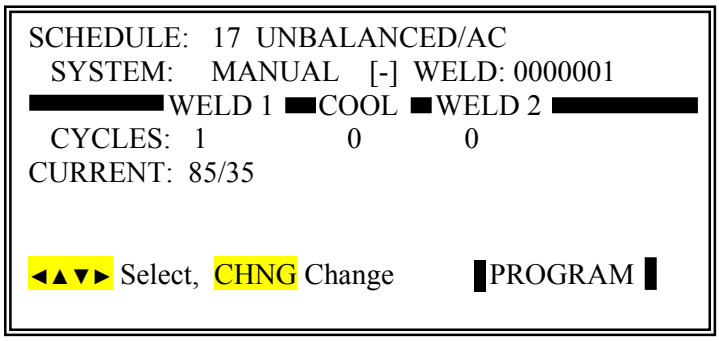
Unbalanced AC Function

This function is used in those applications where the heating at the interface between the work pieces is dependent on the direction of the current flow. This dependency occurs with identical materials whose thickness ratio is greater than 4:1, and with dissimilar material combinations such as copper and nickel.

CAUTION: This function can introduce heavy transients into the AC power line. These transients could affect the operation of other equipment connect to the same power line.

In some applications, the electrode material that would normally be selected cannot be used without it contaminating the work pieces. When the geometry of the work pieces requires that one electrode be significantly smaller than the other, the unbalance AC function has been used successfully with some material combinations to reduce the temperature of the small electrode and thus increase its life.

In the example program shown to the right, two cycles were required to produce a satisfactory weld. WELD CURRENT is preset to 85% during the positive half-cycle and 35% during the negative half-cycle. The heat generated during the two positive half-cycles was sufficient to form a weld.

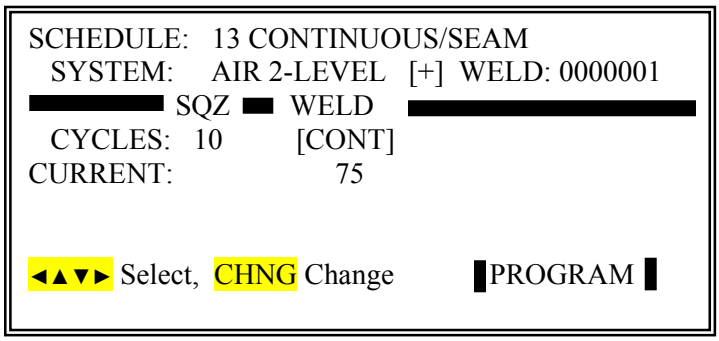


The heat generated during the two negative half-cycles was just sufficient to prevent the work pieces from cooling.

The COOL and WELD2 periods could be used in the same manner as illustrated in the previous quench/temper example. Unbalanced AC can be combined with the quench/temper function by reducing WELD1 CURRENT, setting the COOL period to greater than 0, and making the WELD2 CURRENT significantly larger than the WELD1 CURRENT.

Continuous Function

This function can be used for seam welding or brazing. Weld current flows as long as the initiation switch remains closed. A typical program is shown at the right.

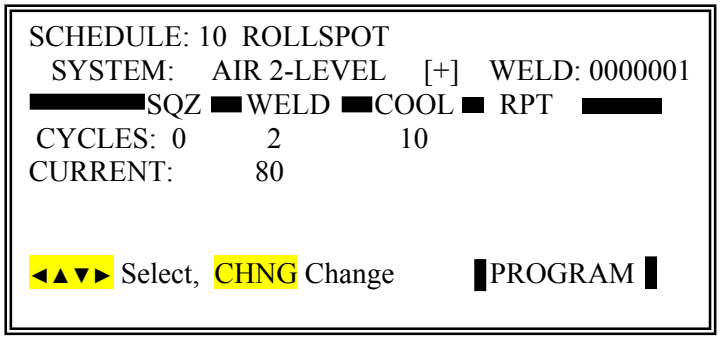


CAUTION: Do not exceed the duty cycle rating of both the PM7 and the Unipulse welding transformers, as listed in Appendix A.

Rollspot Function

This function is a special form of seam welding. Assuming that the rotational speed of the wheel is fixed, the WELD period controls the length of the spot. The COOL period controls the distance between the spots. Assuming a reasonable wheel speed, the COOL period could be reduced so that the spots would overlap.

As shown in the rollspot program to the right, the welds would not overlap since the WELD period is considerably shorter than the COOL period. The RPT legend in the program screen for rollspot indicates that the rollspot welding will continue for as long as the firing switch and the foot switch (air weld head) remain closed.



CAUTION: Do not exceed the duty cycle rating of both the PM7 and the Unipulse welding transformers, as listed in Appendix A.

CHAPTER 7
MAINTENANCE

Modification and Calibration

Unless you are a skilled technician, we suggest you telephone our Repair Department at the telephone number shown in the Foreword of this manual for advice before attempting calibration and/or modification.

WARNING: Contact with voltages present in this welding control may cause serious or fatal injuries.

Cover Removal

It will be necessary to remove the outside cover to perform calibration or modifications. Use the following procedure:

1 Set the rear panel circuit breaker/power switch to OFF.

2 Disconnect the PM7 from its power source.

3 Remove the top two screws on each side of the cover.

4 Loosen the bottom two screws on each side and lift the cover straight upwards.

Line Voltage Changes

You may reconnect the PM7 to operate at different line voltages: 90-110, 110-120, 200-220, 220-240, 340-400 or 440-480 VAC, 50/60 Hz. You may reconnect the PM7/380 to operate at 480 VAC. In order to operate the PM7, PM7/100, PM7/120 or the PM7/208 at 480 VAC, a factory modification is required. To reconfigure the line power input circuitry, proceed as follows:

1 Set the rear panel circuit breaker/power switch to OFF.

2 Remove the cover.

3 Refer to figure 7-1. Reconfigure the power transformer primary connections according to your line voltage input.

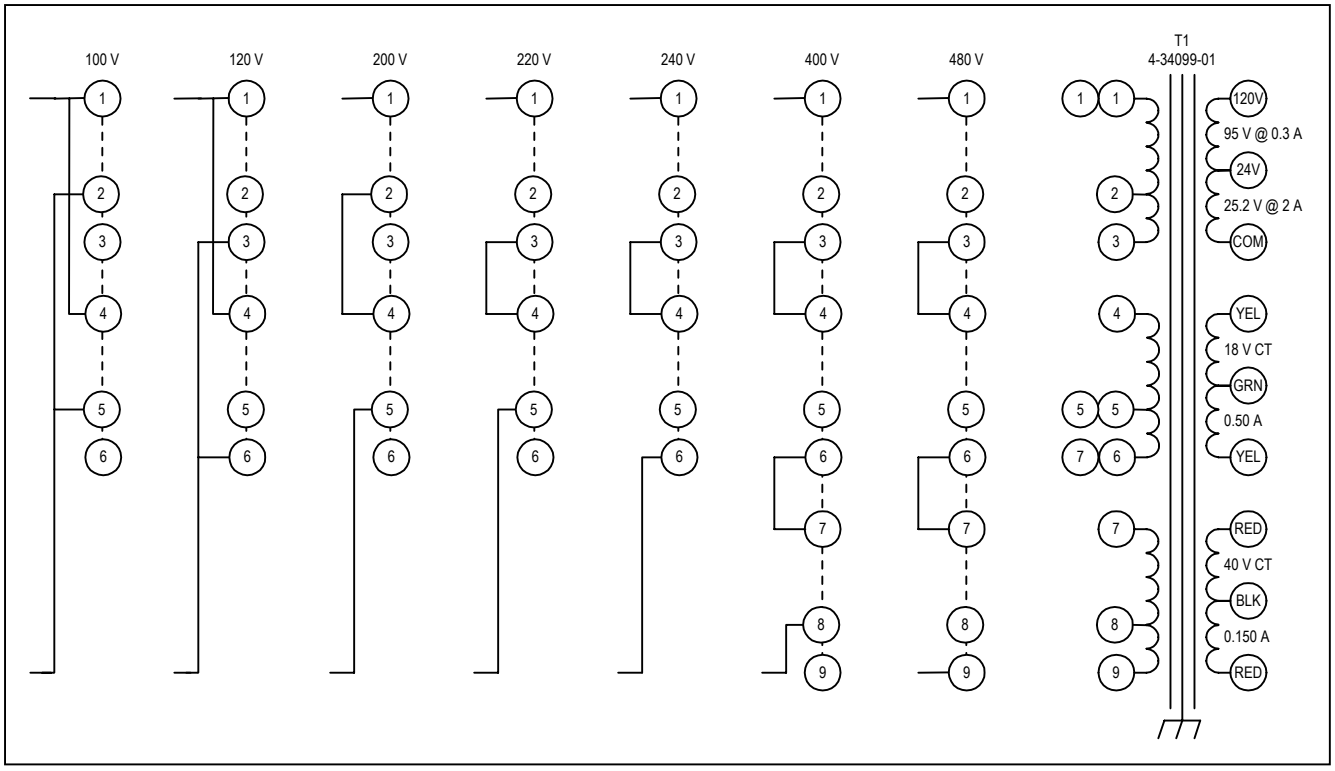


Figure 7-1. Connection Diagram for Standard AC Voltage Ranges

4 Install the correct circuit breaker. Refer to Appendix A under *Input/Output Cable Connections and Fusing.*

5 Install the line cord plug appropriate to your line voltage supply.

6 Change all labels and tags so that they indicate the correct line voltage.

7 Replace the cover.

Calibration

Calibration should be performed only by a qualified technician. Do not hesitate to call our Repair Department at the telephone number shown in the Foreword of this manual

The PM7 should not require any regular adjustments. Calibration consists only of adjusting two potentiometers on the control PCB. The only test equipment required is a digital AC voltmeter.

NOTE: PM7 power should be on for at least 5 minutes before attempting calibration.

1 Switch power OFF.

2 Remove the cover.

CAUTION: Exercise static protection procedures so that no IC chips are damaged.

3 Switch power ON.

4 Press the [MENU] key to access the menu mode and select the CALIBRATE PM7 screen.

5 Select the SET NOMINAL LINE VOLTAGE option and use [CHNG] to select the input line voltage of the PM7.

```
<CALIBRATE PM7>
READING                          : 000.5[-]

SET NOMINAL LINE VOLTAGE         : 240
 ▪ ADJUST R18 at 60 Hz to 0
 ▪ ADJUST R19 TO MATCH LINE VOLTAGE


▲▼ Select, CHNG to Change
```

NOTE: You can select the nominal line voltage on any one of three screens. When you select the nominal line voltage on one of the screens, the other two reflect the change.

6 With the [▲▼] keys, position the cursor next to either R18 or R22. The PM7 will automatically determine the correct line frequency and display the appropriate potentiometer (R18 or R22) for you to adjust. For 60 Hz units, R18 will be displayed. For 50 Hz units, R22 will be displayed. If the READING on Line 1 of the display is not 0, ±5, adjust R18 (60 Hz filter adjustment) or R22 (50 Hz filter adjustment) until the READING is 0, ±5.

7 With the [▲▼] keys, position the cursor next to ADJUST R19 TO MATCH THE LINE VOLTAGE. The READING line on the screen will now indicate the actual line voltage.

8 Using a digital AC voltmeter, measure the voltage across TB1 and TB2 on the control PCB. The meter reading and the screen READING line should compare within ±1 volt. If they do not, adjust R19 until they do.

9 Set power to OFF.

10 Replace the cover and top screws. Securely tighten all screws.

Repair Service

Telephone Service

Call our Repair Department at the telephone number shown in the Foreword of this manual. Before calling, please obtain the model number and serial number from the identification plate on the rear panel.

Factory Service Repair

Unitek Miyachi provides a repair service for both warranty and non-warranty repairs. Call the Customer Service Department at the telephone number shown in the Foreword of this manual for a Return Material Authorization number. All equipment to be returned for repair must be shipped PREPAID.

Please include information concerning the type of problem you are experiencing. Include with the shipping information the name and telephone number of the person whom we should call with the estimated cost of repairs.

APPENDIX A
TECHNICAL SPECIFICATIONS

Type of Control

NEMA Type BS2HX synchronous welding control, capable of operating with air actuated or manually actuated weld heads. Compatible with 1-level and 2-level foot switches. It can sense single pole, double pole or optical firing (pressure) switches.

Input Power

Line Voltage

The PM7 may be connected to any 100, 120, 208 or 240 volt outlet that is capable of supplying 30 amps. The voltage drop at the outlet during the weld sequence should be less than 5%.

Frequency

The PM7 is a dual-frequency device whose microprocessor automatically compensates for 50 or 60 Hz operation. The PM7 automatically determines and displays the frequency of the power line when it is placed in the calibrate mode.

Circuit Breakers and Fuses

The PM7 is supplied with a combination 30 amp circuit breaker/power switch, located on the rear panel. It protects both legs of the incoming power line at any of the specified voltages. The Model PM7/460 requires a user-supplied circuit breaker, disconnect and input power cable.

The control PCB and valve driver circuits are protected by a fuse, F1, located on the rear panel. The rating of the fuse is as follows:

Line Voltage	Fuse Type	Rating
100	3AG	250V, 1/2A Slo-Blo
120	3AG	250V, 1/2A Slo-Blo
208	3AG	250V, 1/4A Slo-Blo
240	3AG	250V, 1/4A Slo-Blo
400/480	3AG	440V, 1/4A Slo-Blo

POWER and OUTPUT CABLES

These cables are 5 feet long, with stranded wire leads. The standard POWER connector is a NEMA L6-30P (Unitek PN 520-093), 240 volt, 3 pronged, twist-lock plug rated for 250 volts, 30 amps. The OUTPUT connector is a Meltric 63-13045-480V-LCE172 (Unitek PN 520-124). The output connector is wired as follows:

PIN	DESCRIPTION
1	Output from SCR to H1 side of output transformer
N	L2 side of input power line and H2 side of output transformer
G	Chassis ground

Output Current

The maximum output current capability as a function of duty cycle is:

Duty Cycle (%)	Current (Amps)
100	20
50	28
8	70
1	200

Output current can be set from 20 to 99% of the maximum current that could flow during any half-cycle. Accuracy is ±3% of setting.

Duty cycle is defined as the percentage of time during which the weld current flows in a 1-minute interval. There are two extreme conditions for 50% duty cycle: ON for every other cycle, or ON for 30 seconds.

Current flow is controlled by SCRs rated at 50 amps, 280 volts, 50/60 cycles. The PM7 380/460 uses 50 amp, 480 volt SCRs.

Weld Schedules

You can save (write) 128 different weld schedules in *permanent memory*.

Weld Schedule Numbering System

Weld schedules are numbered 1 through 127. They can be protected from unauthorized or inadvertent changes by Unitek's system security feature. When the system security state is “protected”, Schedule 0 can still be modified and used as a “scratchpad”. When schedule lock is also turned ON, no other schedules can be displayed or used to weld except the currently displayed schedule.

NOTE: If the security code is lost: Select SYSTEM SECURITY from the main menu. Switch the WELD SWITCH to NO WELD, press [SAVE] and the press [◄]. The status will change to UNPROTECTED.

Schedule Number at Power-Up

This feature determines which schedule will be used when the PM7 is switched to ON. The option will be either Schedule Number 0 - 127 or the schedule which was selected just before the power was switched to OFF.

Weld Schedule Data

The contents of a weld schedule is as follows:

- Schedule number (0 - 127)
- Weld function
- Weld head type
- Foot switch type (system parameter)
- Weld polarity
- Alternate polarity status (system parameter)
- Next chained schedule
- Names of the weld function periods (for example, squeeze, upslope, weld, hold)
- Cycle length of the weld function periods
- Weld current flow during the weld function periods in percentage of maximum current
- Output Relay 1 status
- Output Relay 2 status
- System status (for example, run, standby, weld, hold, emergency stop)
- Weld sentry status (optional)

Weld Functions

The PM7 offers ten weld functions, as follows:

Basic (manual head only)	Upslope/downslope
Sequence (air head only)	Braze
Sequence/repeat (air head only)	Unbalanced AC
Quench Temper	Rollspot
Preheat/postheat	Continuous/seam

Half Cycle Operation

Half-cycle operation is possible with these weld functions: basic weld, sequence, sequence/repeat, preheat/postheat, upslope/downslope and rollspot.

Time Period Durations

The duration of the time periods and the corresponding welding currents are as follows:

Period	Cycles	Current
Squeeze	0 - 99	None
Upslope	0 - 99	Adjustable from 1% to 50%/cycle
Weld 1	0 - 99	20 - 99%
Quench	0 - 99	None
Weld 2	½, 0 - 99	20 - 99%
Downslope	0 - 99	Adjustable from 1% to 50%/cycle
Cool	0 - 99	None
Hold	0 - 99	None
Off	0 - 999	None

Accuracy

Linearity of the %CURRENT is ±3% of setting at 50 or 60 Hz.

Weld Sentry

The Weld Sentry can be installed in the PM7 as an option. The self-contained unit is installed inside the PM7 chassis, and is mounted on the rear panel with four captive screws. The option, which is configured from the front panel, includes a voltage sensing cable and a current pickup. When the option is installed, the Sentry Menu provides the following options and utilities:

a. Basic Setup
b. Print Utilities
c. Print Options
d. Relay Output
e. SPC
f. Set Time and Date
g. System Setup
h. Calibrate Sentry
I. Communications

Head Type

The PM7 can be used with a manual, user actuated weld head; or a single or dual air-actuated weld head. Air actuation means that the PM7 will provide a 24 or 120 VAC output which can be used to control an air valve (solenoid) on an air actuated weld head. When the dual head function is used, Output Relay 1 can be used to control the 24 VAC AIR VALVE DRIVER 2 connector. The PM7 can automatically detect the presence of a Unitek Peco air actuated weld head.

You can indicate the presence of a user-supplied non-Unitek air head by jumpering Pin 4 to Pin 2 on the AIR VALVE DRIVER connector. If Pin 4 is not connected to Pin 2, the PM7 assumes that a manual head is being used. The options menu can be programmed to override the automatic selection feature.

Footswitch Type

The PM7 requires the use of a 1-level or 2-level footswitch in order to control an air actuated weld head. The PM7 will automatically detect whether a Unitek 1-level or 2-level footswitch is connected to the FOOTSWITCH connector located on the rear panel.

The PM7 assumes that a 1-level footswitch is used if the input to the 2nd level is continuously closed. The PM7 determines whether it is connected to a 1-level or 2-level footswitch whenever it enters the RUN state. The options menu can be used to override the automatic selection feature.

Manual Head Initiation Switch

If the PM7 is connected to a manual weld head, the initiation switch is the force firing switch in the weld head.

Air Head Initiation Switch

If the PM7 is connected to an air-actuated weld head, the initiation switch is the foot switch. The first level of a 2-level foot switch instructs the PM7 to:

- Switch the valve driver ON. This causes the upper electrode of the weld head to apply force to the work pieces. The amount of force is determined by the air regulator on the weld head air cylinder.
- Start the squeeze period.

The second level of the foot switch initiates the start of the weld period provided that the force firing switch has closed and the squeeze period has ended.

A 1-level foot switch combines the functions of both levels of a 2-level foot switch.

Foot Switch Connector

The FOOTSWITCH connector is a 4-pin Amphenol 91-PC4F (Unitek PN 550-006) that mates with an Amphenol 91-MC4M (Unitek PN 520-009). Connect Pin 2 to Pin 3 on a user supplied 1-level footswitch. This connector is wired as follows:

Pin	Description
1	Chassis Ground
2	Footswitch Level 1 or Single Level Footswitch
3	Footswitch Level 2
4	Common

Footswitch Weld Abort Feature

The footswitch weld abort feature is controlled from the options menu.

Footswitch Weld Abort On

With FOOTSWITCH WELD ABORT ON selected, the welding sequence is initiated by the closure of the initiation switch, and continues to its conclusion as long as the initiation switch remains closed. If the initiation switch or the force firing switch open during the welding sequence, the sequence will terminate within one cycle after the switch opens. FOOTSWITCH WELD ABORT ON is preferred since it allows the operator to abort the welding sequence by releasing the footswitch, or footpedal in the case of a manual head.

Footswitch Weld Abort Off

With FOOTSWITCH WELD ABORT OFF selected, the welding sequence is initiated by a single, momentary, closure of the initiation switch. Opening the initiation switch during the welding sequence will *not* terminate the welding sequence. The initiation switch must open and re-close in order to start the next sequence. FOOTSWITCH WELD ABORT OFF is used in automated process control systems where operator intervention is not an issue.

Firing Switch Type

The PM7 can use as an input signal either a:

- Single pole, single throw switch
- Double pole, double throw (3-wire) switch, or an
- Optical switch.

The input signal will indicate when the weld head has applied the proper force to the workpiece. Weld heads with single pole firing switches should be connected to the MECHANICAL FIRING SWITCH connector. A 3-wire switch or optical firing switch, either of which should be connected to the OPTICAL FIRING SWITCH connector, eliminates switch bounce (which causes false triggering), and should be used when the welding speed exceeds 1.5 welds per second.

Firing Circuit

The firing circuit requires external contact closure or low logic level for firing. Internal filtering prevents premature firing due to radio frequency interference. The PM7 will automatically detect that the system is using a 3-wire switch whenever it enters the RUN state if Pin 1 is shorted to Pin 2.

Switch Debounce Time

Single pole mechanical firing switch contacts 'bounce' when they close. The switch debounce time feature allows you to specify that the firing switch must remain closed for 0.5, 1 or 2 cycles before the weld period can be initiated. The PM7 will automatically set the switch debounce time to 0 milliseconds whenever a 3-wire or optical switch is selected.

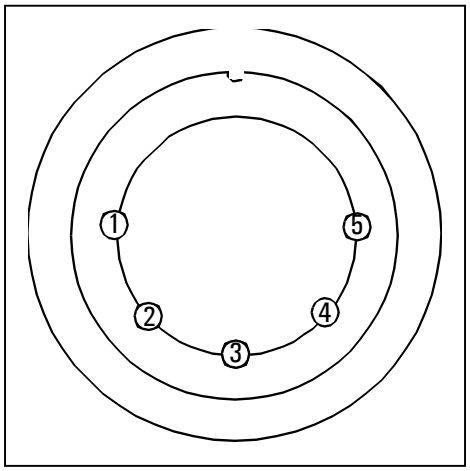
Mechanical Firing Switch Cable

This cable is 5 feet long. It is a Type 2/C, 600 volt cable containing two shielded, twisted 22 AWG conductors of high-flex stranded wire. The firing switch connector is a 2-pin Amphenol 80-MC2FI (Unitek PN 520-008), with strain relief. It mates with an Amphenol 80-MC2M (Unitek PN 520-001). Pin 2 is ground.

Optical Firing Switch Connector

This connector is a 5-pin AMP 212044-1 (Unitek PN 150-064) located on the rear panel. It mates with an AMP Assembly consisting of an AMP 212437-3 Plug, 212435-7 Ferrule and 212800-1 Strain Relief. The connector is wired as follows:

Pin	Description
Shell	Shield
1	Switch Normally Closed
2	Switch Common
3	Switch Normally Open
4	+5 VDC
5	Switch Common



Pin Numbers as Viewed from the Rear Panel

Initiation Switch

Manual Head Operation

If the PM7 is connected to a manual head, the initiation switch is the force firing switch located in the weld head.

Air Head Operation

If the PM7 is connected to an air actuated head, the initiation switch is the footswitch. The first level of a 2-level footswitch instructs the PM7 to:

- Switch the valve driver to ON, which causes the upper electrode of the weld head to apply force, as determined by the air regulator connected to the top of the air cylinder on the weld head, to the workpiece.
- Start the squeeze period.

The 2nd level initiates the start of the weld period, provided that the force firing switch has closed *and* the squeeze period has ended. A 1-level footswitch combines the functions of both levels of a 2-level footswitch.

Polarity Selection

Polarity sets the initial direction of weld current flow through the work pieces. Direction may be either positive (+), negative (-) or alternate (±). This feature is useful for some types of half-cycle welding applications. These are applications involving dissimilar materials or materials with thickness ratios greater than 4:1.

Alternate polarity means that the polarity of the first half cycle of output changes with each weld. Alternate polarity can also be used to prevent Hypersil welding transformers from saturating.

NOTE: Unitek Peco welding transformers do not use Hypersil cores. Alternate polarity overrides the positive or negative polarity selection on all weld schedules, and is controlled from the Special Options menu.

Positive and negative polarity are controlled by the individual weld schedules.

Power Factor Correction

Microprocessor controlled automatic power factor correction ensures that the actual welding current percentage is within ±3% of the value selected, regardless of the load power factor. Without this feature,

the welding current would be dependent, in part, on the position of the cables and the position of any magnet work piece placed between the electrodes.

Automatic Line Voltage Compensation

When switched ON, this feature increases the %CURRENT by 1 for each 1% decrease in line voltage from the rated nominal line voltage. Compensation is limited to maximum voltage changes of 13%. The PM7 cannot compensate for more than a 13% decrease in line voltage when the %CURRENT is set above 86%. It cannot compensate for more than a 13% increase in line voltage when the %CURRENT is set below 33%.

The amount of compensation is calculated immediately before the weld period starts. The feature, which is controlled from the Special Options menu, should be switched OFF when the PM7 is being used to develop weld schedules.

The line voltage monitor measures line voltage during the half cycle before a weld is made. You can program the percent deviation that will trigger the line voltage alarm. You can configure the PM7 to:

- Ignore the condition and make a weld
- Stop and initiate a voltage alarm
- Initiate a voltage standby and wait until the line voltage returns within limits for the duration of the programmed restart time (1 to 60 consecutive cycles). This selection does not affect operation of the Line Voltage Compensation feature.

87º Delayed Half-Cycle Firing

This feature delays the first half-cycle of the weld period by 87E if the weld current is greater than 73%. The feature prevents the buildup of a DC component in weld transformers using Hypersil core materials. The delay reduces the maximum energy that can be delivered during the first half-cycle.

NOTE: Unitek Peco transformers do not require the delay.

Chain Schedules Feature

The chain schedules feature is used to automatically change the weld schedule in use to another specified schedule. Chain schedules is a system feature, and is turned ON using the options menu. When chain schedules is turned ON, the RUN screen and PROGRAM screen for each schedule will have additional fields for both STEP COUNT and NEXT SCHEDULE. STEP COUNT and NEXT SCHEDULE are used to chain schedules together.

Step Count

STEP COUNT is a weld counter which counts down to 0. Any number from 00001 to 99999 can be entered as a step count. When the step count reaches 0, the schedule will change as specified by the NEXT SCHEDULE. If a weld sequence is not completed and/or the WELD/NO WELD switch is set to NO WELD, the step counter will *not* count down.

Next Schedule

NEXT SCHEDULE is the number of the weld schedule to be used when the step count reaches zero. Any schedule number from 001 to 127 can be used and any number of schedules can be chained together, with some exceptions as follows:

- Next Schedule = 0: Can only be used at the beginning of a chain.
- Next Schedule = Current Schedule: Prevents chaining. When the step count reaches 0, it will reset and the current schedule will remain in use.
- Next Schedule = [.] period: Causes the PM7 to stop after the step count has reached 0 and issue a standby stop command alarm.
- Weld Function = Rollspot: Can only be used as the last schedule in a chain.

Audible Buzzer

During alarm conditions, an audible tone (buzzer) is generated for 5 seconds. It can be immediately silenced by pressing [RUN]. It is also used to signal the operator of an incorrect keyboard entry. The volume can be adjusted with a potentiometer on the control printed circuit board. The potentiometer is accessible for adjustment through a hole in the upper, front, right hand corner of the cover.

End Of Cycle Buzzer ON/OFF

This feature is normally used with manual heads. ON means that an audible signal will be given at the end of each weld sequence as a signal to the operator to release the footpedal. The end of cycle buzzer is controlled from the options menu.

Key Click

Whenever a key is pressed, a click sound is generated.

Weld Counter

An eight-digit weld counter automatically increments after each complete weld sequence. You can display the full count by selecting the Weld Counter menu. This counter can be reset back to 0 at any time unless the system security is in the protected state.

The Weld Sentry option allows you to set upper and lower limits for each Weld Sentry program. To implement this feature, there are three additional counters which keep track of the number of welds: under the lower limit (999,999), over the upper limit (999,999), and within these limits (9,999,999). These counters can be independently reset to 0 at any time, unless system security is in the protected state.

Note that all counters retain their counts when the input power is interrupted, because the contents of these counters are stored in battery-backed-up memory.

Calibration Check

The PM7 monitors both the input line frequency and the line voltage. The Calibration menu allows you to verify the actual frequency and voltage level. The information on this menu confirms that the PM7 is correctly configured and properly calibrated.

Alarms

The PM7 issues three alarms. All alarms terminate or inhibit the welding sequence. To clear an alarm, press [RUN] or toggle the remote process inhibit line. Alarm conditions are processed in a priority order corresponding to the following list:

1 SCR ALARM: The output SCR devices are defective. The output SCR devices control the flow of current to the welding transformer. The PM7 has detected that the output SCR devices conducted current during restricted time periods for four consecutive cycles. Repair by a qualified technician is required.

2 EMERGENCY STOP: An emergency stop signal was received via the CONTROL SIGNALS connector from external equipment.

3 INPUT SWITCH: The force firing switch in the weld head or the footswitch closed before the PM7 was in the RUN state.

4 STAND BY: Waiting for the force firing switch in the weld head and/or the second level of the footswitch to close.

Air Valve Drivers

The air valve drivers provide power to control the solenoid of an air actuated weld head. The PM7 can sequentially operate two separate air actuated weld heads using two receptacles on the rear panel, AIR VALVE DRIVER 1 and AIR VALVE DRIVER 2.

Air Valve Driver 1

The output from the AIR VALVE DRIVER 1 receptacle is 12 volt-amps at 24 or 115 volts AC. This circuit is fused, together with the control printed circuit board, by Fuse F1 located on the control printed circuit board. The receptacle is wired so that either 115 or 24 volts are available. Air Valve Driver 1 is configured through the options menu, WELD HEAD TYPE, and selecting either AIR or AUTO.

Air Valve Driver 2

The output of the AIR VALVE DRIVER 2 receptacle provides 24 VAC to power a second air actuated weld head. Jumpers E1 and E2, located near the lower right hand corner of the control board must be moved to the correct positions, as shown in figure A-1.

Air valve driver 2 is wired only for 24 VAC through receptacle Pins 1 and 2. Pins 3 and 4 are not provided. To provide power to Air valve driver 2, move Jumpers E1 and E2 and program WELD HEAD TYPE to DUAL AIR.

NOTE: When air valve driver 2 is used, Relay 1 cannot be used.

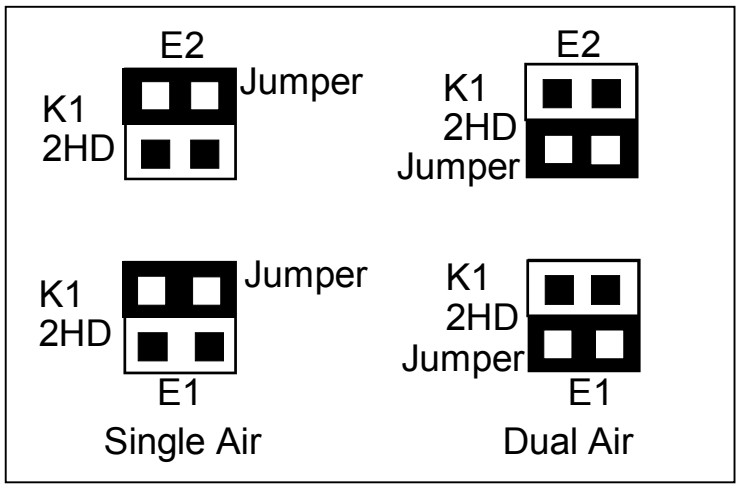


Figure A-1. Jumper Selection for Air Valve Driver Control

Air Valve Driver Receptacles

The 4-pin receptacles located on the rear panel are AMP P/N 206430-1 (Unitek PN 550-062). The mating plug is an AMP 206429-1 (Unitek PN 520-107), which uses a cable clamp, Amp 206358-2 (Unitek PN 245-084). Air Valve Driver 1 is wired as follows:

Pin	Description
1	24 VAC
2	115 and 24 VAC return
3	115 VAC
5	Air head sensing - externally connected to Pin 2

NOTE: Connect Pin 2 to Pin 4 on a non-Unitek Peco air actuated weld head.

CONTROL SIGNALS Connector

A 15-pin, sub-miniature D-type CONTROL SIGNALS connector, located on the rear panel, is provided for the two relays and nine single pole inputs. The relays and switch inputs are used to:

- Remotely select Weld Schedules 1 through 127
- Remotely inhibit the flow of weld current
- Invoke an emergency stop condition to abruptly terminate the welding sequence.

The CONTROL SIGNALS connector (figure A-2) is a Viking DMRST15RA05CG (Unitek PN 250-195). The mating connector, which included in the shipping kit, is a TRW Cinch Connector comprised of a DA-15P (Unitek PN 250-199) male connector and a DE-51210-1 (Unitek PN 250-200) plastic junction shell. The pin assignments are listed below:

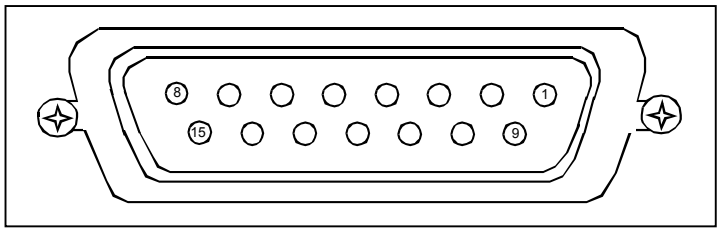


Figure A-2. CONTROL SIGNALS Connector

Pin	Function
1	Remote Weld Schedule Selection, Control Line 2^0
2	Remote Weld Schedule Selection, Control Line 2^1
3	Remote Weld Schedule Selection, Control Line 2^2
4	Remote Weld Schedule Selection, Control Line 2^3
5	Remote Weld Schedule Selection, Control Line 2^5
6	Relay 2 Input
7	Remote Weld Schedule Selection, Control Line 2^6
8	Relay 1 Input
9	Process Inhibit
10	Emergency Stop
11	Signal and Chassis Ground
12	Remote Weld Schedule Selection, Control Line 2^4
13	RELAY 2 Return
14	Spare
15	RELAY 1 Return

Emergency Stop

Emergency stop, or any other external function that should abort the welding sequence, can be implemented by continuously shorting Pin 10 to Pin 11 of the CONTROL SIGNALS connector. If either Pulse 1 or Pulse 2 has been initiated before the emergency stop signal occurs, that pulse will not be interrupted. After that, no further operation can be initiated until the short has been removed.

Process Inhibit

Shorting Pin 9 to Pin 11 will close the process inhibit line and inhibit weld current. The function is the same as the WELD/NOT WELD switch on the front panel. All other function continue to operate normally.

Remote Weld Schedule Selection

Refer to figure A-3. To use this feature, connect the seven control lines from a user supplied, normally open contact (open collector or TTL logic levels can also be used) to mating CONTROL SIGNALS connector Pins 1, 2, 3, 4, 12, 5, and 7. Connecting any one of these inputs to Pin 11 will cause the PM7 to load the weld schedule defined by the corresponding pin combination, immediately after the initiation switch closes. Weld schedules are selected according to the binary coded decimal pattern shown in the table A-1.

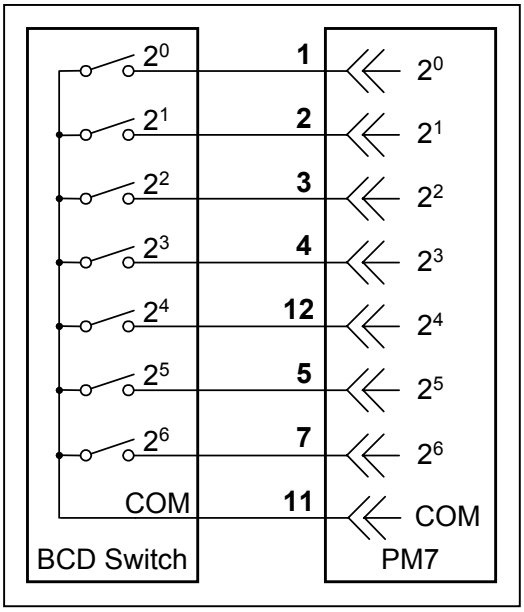


Figure A-3. Remote Schedule Selection with a Remote Binary Switch

Table A-1. Binary Codes for Remote Weld Schedule Selection

Schedule Panel Control Number	Input Pin and Bit Numbers (1 = Switch Closed)						
	Pin 1 (2^0)	Pin 2 (2^1)	Pin 3 (2^2)	Pin 4 (2^3)	Pin 12 (2^4)	Pin 5 (2^5)	Pin 7 (2^6)
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	1	1	0	0	0	0	0
4	0	0	1	0	0	0	0
5-126	Binary progression from 5 to 126						
127	1	1	1	1	1	1	1

Binary Schedule Selection Code

To select a schedule, connect the pin(s) corresponding to the schedule number to Pin 11. The schedules listed below are selected using the pin indicated by the 1 marked under the pin number. To select any other schedule number, select the schedule numbers whose sum equals the desired schedule, then connect all of the corresponding pins.

For example, to select Schedule 127, connect the pins that correspond to the numbers totaling 127.

Schedule 127 = 1 + 2 + 4 + 8 + 16 + 32 + 64

Connect Pins 1, 2, 3 , 4, 12, 5 and 7 to Pin 11 (ground)

When all input pins are open, control of the power supply remains at the front panel. When any one of the pins is shorted, the front panel controls are disabled.

Alarm stop conditions can also be cleared remotely by toggling the process inhibit line.

Relay Outputs

There are two output relays which can be used to provide status (timing) signals to external devices. Relay 1 can also be used to control a second 24 VAC air actuated weld head as part of a dual air head system, or to signal an alarm condition. Relay 2 can provide a 5 to 50 VDC signal. When used for status signals, these relays can be independently programmed to close when either:

- Any portion of the welding sequence is completed
- The firing switch opens, or
- The PM7 is waiting for the weld sequence to start.

Either relay is capable of switching up to 250 milliamps. The power source is user-supplied in each case.

Accessory Port

A 25-pin, sub-miniature D-type connector, located on the rear panel, is provided to control other devices contemplated for the future.

Front Panel Switches

There are 22 electrostatically shielded membrane switches which are integral to the front panel. The function of each key is defined in Chapter 4.

Microprocessor CPU

The PM7 uses a Motorola M68HC11A1 CPU with an 8.0 MHz clock, 8K bytes of random access memory, 512 bytes of electrically programmable read only memory and 128K bytes of ultra-violet erasable and programmable read only memory.

Display

This is an electrostatically shielded, 8 row by 40 column, rear lit liquid crystal cold cathode display. A contrast level adjustment potentiometer can be accessed through a hole in the rear panel.

Cooling

Cooling within the housing is provided by a muffin-type fan that operates on 115VAC, 50/60 Hz power. The air inlet is underneath the unit, and exhaust is through the rear panel. No restriction to air flow should be closer than 2 inches to the sides and rear of the PM7. Do not place the PM7 on a soft pad, or on any other surface, which could block the air inlets on the bottom of the housing. Do not allow the PM7 to sit on surfaces that are covered with heavy dirt or dust.

Physical Characteristics

- Length: 12 7/8 in. (32.7 cm)
- Width: 11 5/8 in. (29.6 cm)
- Height: 8 3/8 in. (21.3 cm)
- Weight: 20 lbs (9 kg)

Unipulse Transformers

Unipulse transformer designs guarantee repeatable output energy, even during half-cycle operation. They are convection-cooled. However, their performance and duty cycle can be increased with optional fan cooling.

The four models illustrated in Figure A-4 include a primary tap switch. The red pilot lamp on the front of the Unipulse transformer lights when voltage is applied to the transformer primary. Refer to Table A-4 for Unipulse transformer specifications.

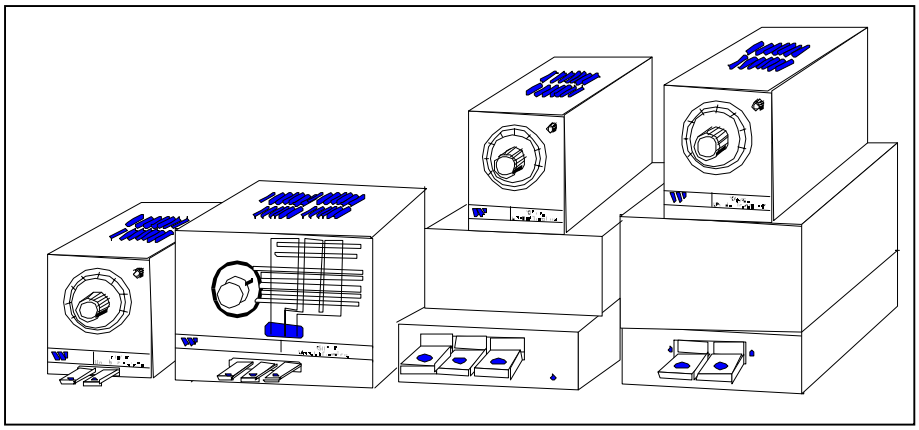


Figure A-4. Unipulse Welding Transformers

Table A-2 Unipulse Welding Transformer Specifications

Model	Pri. Volts	Input KVA Duty Cycle			Taps		Output Voltage (rms)	Short Ckt I (A)	Height (in./cm)	Width In./cm)	Depth (In./cm)	Weight (lbs/kg)
		3%	8%	50%	Pri.	Sec.						
X2/115RF	115	3.1	1.9	0.75	4	0	3.8, 2.4, 1.5, 1.0	2400	6.5/16.5	6.5/16.5	11.0/27.9	20/9
X2/230RF	230	3.1	1.9	0.75	4	0	3.8, 2.4, 1.5, 1.0	2400	6.5/16.5	6.5/16.5	11.0/27.9	20/9
X2/115	115	2.5	2.5	1.0	4	0	3.2, 2.7, 2.4, 2.0	2300	6.5/16.5	6.5/16.5	11.0/27.9	20/9
X2/230	230	2.5	2.5	1.0	4	0	3.2, 2.7, 2.4, 2.0	2300	6.5/16.5	6.5/16.5	11.0/27.9	20/9
X5/115HV	115	9.8	4.5	1.8	4	2	14 to 1.8 in 12 steps	1800	8.3/21.1	6.6/16.8	9.6/24.4	60/27
X5/230HV	230	9.8	4.5	1.8	4	2	14 to 3.5 in 12 steps	1800	8.3/21.1	6.6/16.8	9.6/24.4	60/27
X8/230	230	13.0	8.0	3.2	8	0	5.8, 5.3, 4.8, 4.4, 4.0, 3.6, 3.3, 3.0		13.0/33.0	7.0/17.8	14.0/35.6	90/41
X16/230	230	26.0	16.0	6.4	3	2	5.6, 4.9, 92004.3 (HI-COM) 3.6, 3. 3, 2.9 (LO-COM) 1.9, 1.6, 1.4 (HI-LO)	16000	13.0/33.0	7.5/19.1	14.0/35.6	95/43
X16/480	480	26.0	16.0	6.4	3	2	5.6, 4.9, 4.3 (HI-COM) 3.6, 3.3, 2.9 (LO-COM) 1.9, 1.6, 1.4 (HI-LO)	16000	13.0/33.0	7.5/19.1	14.0/35.6	95/43

Input Connector

The INPUT connector is an Amphenol Type 97-3102A-22-9P (Unitek PN 520-071). The mating connector, which is supplied with the PM7, is an Amphenol Type 97-3106A-222-9S (Unitek PN 520-072).

Forced Air Option

Unipulse welding transformers can be modified for fan cooling. A 4-inch muffin-type or boxer-type fan, which includes a filter and grill, may be mounted on top of the transformer. The corner screws for the fan assembly can be inserted through the slotted louvers. CAUTION: Air flow must be downward through the transformer; at is, in the top and out the front, next to the output terminals.

Maximum Repetition Rate

Unipulse transformers will operate at a 50% duty cycle when the weld period is an integral number of cycles. In unipolar, half-cycle operation, Unipulse transformers can be used at a rate of 5 welds per second. The duty cycle for unipolar, half-cycle operation should no exceed 4.2% at full output, which translates to one weld cycle at 99% heat during a 12-cycle period.

Insulation.

Unipulse transformer insulation is Class 130, rated at 180□C.

Transformer Tap Switch

The TAP switch, located on the front of the transformer, selects the output voltage. Tap 1 selects the lowest voltage on all transformers. For example, the rms open circuit output voltage of an X2/230 transformer is 2.0 volts on Tap 1, and 3.2 volts on Tap 4. The open circuit secondary voltages specified in Table A-4 are within ±5% of the values listed when measured with the specified rated voltage applied to the primary winding of the transformer.

Duty Cycle

To obtain the thermal rating at duty cycles other than those specified in Table A-4, multiply the KVA rating at 50% by the rating factor listed below. The averaging period is 1 minute.

Duty Cycle (%)	Rating Factor	Duty Cycle (%)	Rating Factor
1	7.08	20	1.58
2	5.00	30	1.29
3	4.07	50	1.00
5	3.15	70	0.845
8	2.5	80	0.790
10	2.23	100	0.707