SOLUTION-2 #9280

TABLE OF CONTENTS

STANDARD WELDING FUNCTIONS
WARRANTY
INSTALLATION

SPECIAL OPTIONS
DIRECTIONS FOR USE

INITIAL SET-UP PROCEDURE

DIRECTIONS FOR USE

TABLE OF CONTENTS (continued)

SAMPLE PROGRAM CHAINS

SERVICE INFORMATION

SOLUTION #9280
RESISTANCE WELDING CONTROL SYSTEM

SOLUTION-2 FEATURES:

Up to **45** LINKS (function sets) **per chain**
Up to **15** separate **CHAINS** (of 45 LINKS each for a total of 675 LINKS)
Up to **75** direct access **PROGRAMS** using **BINARY SELECT**
NO CODES TO LEARN, EVER!
Can **BRANCH** from CHAIN to CHAIN for almost unlimited sequences
DOES NOT USE LADDER LOGIC PROGRAMMING
75 <u>complete</u> NEMA weld program memory; Does **not** require complex linking
Ability to use the **same** weld PROGRAM at **multiple locations** in a CHAIN
AVC Automatic Line Voltage Compensation; +/-2% output for +/-10% line voltage input
Can insert **time delay** (dwell) and **stop** sequences at any point of the chain
Uses a simple **14 button keypad** similar to a touch tone phone
Full **32** character alpha/numeric readout in **PLAIN ENGLISH; NO CODES**
26 (optional 38) 1/O:
>   **7** initiation inputs (discrete, binary or BCD) dry contact or **PNP**
>   **4** (upgradable to **16**) programmable 115V valve outputs
>   **INIT.** Input for reading binary code, dry contact or **PNP**
>   **5** assignable proximity switch inputs, dry contact or **PNP**
>   **WATER SAVER** 115V valve output (remains **ON** 1 minute after last weld)
>   **3 ASSIGNABLE FAULT OR ACCEPT OUTPUTS,** dry contact (**NO** or **NC**)
>   **EHR,** End of Hold Relay (sequence completion), dry contact (**NO** or **NC**)
>   **ES,** Emergency Stop input, dry contact or **PNP**
>   **NO WELD,** external dry contact or **PNP**, and also on keypad
>   Transformer overtemperature input, dry contact or **PNP**
>   **SCR** overtemperature input, dry contact or **PNP**

Valve outputs (4 to 16) can be independently designated in **any** program to:
>   a.   Turn **on** or **off** at the **start** of any link
>   b.   Turn **on** or **off** at the **end** of any link (for between link functions)
>   c.   Turn **on** at a time delay after the start of any link (**FORGE DELAY**)
>   d.   Turn **on** with time delay and then start welding sequence (**INTENSIFIER**)

Includes **ANTI-TIEDOWN, ANTI REPEAT,** and **2 STAGE INITIATION** functions
Can control up to **15** SCR contactors (**multi-SCR option**)
Can read up to **16** optional Differential Pressure Transducers (option)
KEYBOARD KEYLOCK is **standard**
Counter computes **individual welds** or **finished parts**
Can be **initiated** in **4** different ways:
>   a.   **Single** switch closure to select any of **7** CHAINS
>   b.   **Two level** switch closure to select any of **3** CHAINS
>   c.   **BCD** switch input to select any of **15** chains
>   d.   **Binary** switch input to directly select any of the **75 PROGRAMS**

Chain steps can be run in **3** different modes:
>   a.   Sequence **one step** of the chain for **each** switch closure (**JOG** mode, to verify sequence)
>   b.   Run the **entire** chain after a switch has been closed **momentarily (NON-BEAT** mode, for automatic or PLC operated systems)
>   c.   Operate successive steps with a **maintained** switch closure, **stop** each time switch **opens** (BEAT mode, for use on manually operated welders).

SOLUTION #9280

RESISTANCE WELDING CONTROL SYSTEM

STANDARD WELDING FUNCTIONS IN EACH OF 75 PROGRAMS

NAME	OPERATION	RANGE	APPLICATION
SQUEEZE	DWELL BEFORE FIRING	0-99 CY	ALLOWS TIPS TO FULLY CLOSE BEFORE WELDING .
WELD	MAIN HEAT & WELD TIME	0-99 CY 0.99% HEAT	MAIN HEAT IN ALL PROGRAMS .
SEAM WELD	CONTINUOUS OR INTER-MITTENT SEAM WELDING	-	SEAM WELDING .
PREHT. COOL1	DELAY ATER PREHEAT	0-99 CY	GALVANIZED WELDING .
HOLD	DWELL AFTER WELDING	0-99 CY.	ALLOWS NUGGET TO COOL
COOL-1	DELAY AFTER PREHEAT	0-99 CY.	GALVANIZED WELDING
PREHEAT	SETTING BEFORE UPSLOPE	0-99 CY. 0-99% HEAT	TO PREHEAT PARTS FOR FIT-UP PROBLEMS
UPSLOPE	RAMPS CURRENT UPWARD TO WELD HEAT %	0-99 CY. 0-99 INIT. %	GALVANIZED AND COATED METAL; PROJECTIONS
DOWNSLOPE	RAMPS CURRENT DOWNWARD FROM WELD HEAT %	0-99 CY. 0-99 FINAL %	ALUMINUM; HIGH CARBON STEEL
POSTHEAT	SETTING AFTER DOWNSLOPE	0-99 CY. 0-99% HEAT	REDEFINES GRAIN STRUC-TURE IN STEEL
PULSATION	REPEATS WELD SEQUENCE WITHOUT OPENING TIPS	0-99 PULSES 0-99 INTERPULSE	HEAVY METAL WELDING AND GALVANIZED METAL
COOL-2	DELAY TIME BTWEEN PULS.	0-99 CY.	PULSATION WELDING
QUENCH & TEMPER	COOL AND REHEAT AT END OF WELDING CYCLES	0-99 CY. HEAT 0-99% HEAT 0.99 CY. COOL	REDUCES BRITTLENESS IN HIGH CARBON STEELS
DWELL BETWEEN	TIME BETWEEN LINKS IN A CHAIN	0-99 CY.	TIME TO ALLOW FOR PART OR WELD HEAD MOVEMENT

OPTIONAL FUNCTIONS

NAME	OPERATION	RANGE	APPLICATION
PRESSURE TRANSDUCER	STARTS WELD WHEN PRESSURE IS REACHED	1-99 psi. KEYPAD SET	PRECISION TIP PRESSURE FOR CONSISTENT WELDS
CURRENT MONITOR	MONITORS AND SETS UPPER / LOWER LIMITS	0-100 KA	CONTINUOUS PRODUCTION CONTROL
PRINTER	RECORDS WELD SCHEDULE WELD CURRENT / FORCE	0-100 KA 0-9, 000 LBS	PRODUCTION CONTROL
PRINTER PORT	EXPORTS WELD DATA TO PRINTER	RS-232, RS-485	PRODUCTION CONTROL & QUALITY CONTROL
HEAT STEPPER	MODIFY WELD HEAT	UP TO 16	COATED METALS

ELECTRICAL SPECIFICATIONS

VOLTAGE RANGE = 208, 230, 380, 460, 575.   FREQUENCY = 50 / 60 Hz.

INSTALLATION

Most welding control problems are traced to installation errors. Please take the time to read over the entire installation direction section FIRST before starting any steps. You will thank us for this!

If at any time during the installation you have a question or are unsure of a step, pick up the phone and call the Unitrol Service Department. They will be more than delighted to walk you through any problems.

We at Unitrol are proud of this product and want to be sure that it performs properly the first time. Thank you for taking this extra step.

Carefully unpack system and inspect for damage. Report any problems to the factory at once. If damage is obvious from outside of carton, report to carrier immediately. If this is a control supplied with **SCR** contactor(s) already installed, skip to step 2.

+ +
FOR INSTALLATION OF <u>RETROFIT</u> CONTROLS #9280-SOO, #9280-GOO (supplied without contactor or cabinet), #9280-SCO, #9280-GCO (supplied <u>without</u> contactor but in an enclosure)

1a.   Mark the four gate/cathode wires from the existing SCR(s) to the existing control with **K1, G1, K2, G2** to match the existing control's terminal markings. If these are not marked with the above nomenclature, contact the Unitrol Service Department for assistance.

1b.   Remove all existing components from the old control leaving only the **SCR** contactor(s). The new control contains all power supplies and **SCR** firing boards.

1c.   **If this retrofit control has been supplied complete with a white metal cabinet,** mount the cabinet as close as possible to the existing control enclosure. It is often convenient to mount the new box with one side bolted to a side of the existing enclosure. In this case, holes can be drilled through the "common" wall and grometed for clean wire passage between the two enclosures. **Skip to step 1j below.**

1d.   Mount the new power supply in the existing cabinet near the top using the mounting bracket supplied.

SOLUTION-2 #9280
INSTALLATION INSTRUCTION

PAGE 1-2

1e.   Punch or drill a 1-3/4" dia (1-1/4" electrical **KO**) hole in the existing cabinet to allow the control cable to be connected to the power supply. Locate the hole at the top of the cabinet near the power supply installed in step 1d. **IT IS IMPORTANT THAT NO METAL CHIPS ENTER ANY OF THE ELECTRONIC COMPONENTS IN THE CABINET! PROTECT POWER SUPPLY AND CONTACTOR DURING THESE DRILLING AND INSTALLATION OPERATIONS. WHEN COMPLETE, REMOVE ALL CHIPS FROM THIS CABINET BEFORE APPLYING POWER.**

1f.   Because the plug shell is too large to pass through the hole made in step 1e., carefully remove two screws holding the black plug shell together on the cable end that is on the thread side of the large silver connector and remove the two cover halves. Note that the two jack screws in this plug will come free when the shells are removed.

1g.   Pass this end of the plug through the cabinet hole and install the tooth nut on the inside.

1h.   Carefully install the two black plug shells back on the plug, being sure that the two jack screws are installed and free.

1i.   Pull enough cable through to comfortably plug into the upper rear of the power supply. Hand tighten the two jack screws on this plug.

1j.   Connect the gate/cathode wires from the existing **SCR** contactor to the G1/K1 and G2/K2 terminals on the power supply (wires marked in step 1a.).

   For **multi-SCR contactor** systems, note that these wires go to the K1/G1, K2/G2 terminals marked SCR-1, SCR-2, etc. as shown on the hook-up diagram. **It is <u>critical</u> that the K1 connection on each of the SCRs traces to the same side of each SCR contactor that goes to L1 of the incoming power (as shown on the hook-up diagram). Check the Unitrol hook-up diagram to be sure the SCR contactors are connected correctly. If in doubt, contact the Unitrol Service Department.**

1k.   Skip to step 6 below.
* *
2.   Select location for power supply cabinet, being sure that the cabinet door will clear all welder components when open. It is usually an advantage to locate this cabinet as close to eye level as possible for easy installation and servicing.

3.   Drill welder to match the four mounting holes in the cabinet. Install cabinet.

4.   Drill or punch power cable hole either through the back, side or bottom of the cabinet. Drill or punch a second hole to handle the return cable to the welder transformer. **IT IS IMPORTANT THAT NO METAL CHIPS ENTER ANY OF THE ELECTRONIC COMPONENTS IN THE CABINET! PROTECT POWER SUPPLY AND CONTACTOR**

5. Drill or punch an access hole to handle the foot pedal, palm buttons, valve outputs, and machine control input/output wires at a convenient location in the bottom of the cabinet. **OBSERVE THE CAUTIONS IN THE STEP ABOVE.** After cleaning interior of all chips, install liquid tight or rigid conduit at all locations. Consult local codes for proper wire size. Wire should be sized for a maximum of 50% duty cycle load.

6. Connect power wires as shown in the WIRING HOOK-UP DIAGRAM. Be sure that all connections are cleaned prior to insertion, and that all connectors are fully tightened. **Loose connections will cause heating problems in the control, and eventually create intermittent welds.**

7. Connect weld transformer(s) as shown on the WIRING HOOK-UP DIAGRAM. Try to route these large current conducting cables so that they are not near any of the control lines (input/output lines). This will eliminate the possibility for inductive "cross talk".

   If this is a multiple **SCR** contactor control that will operate multiple transformers, it is good practice to be sure that the connection from the **SCR** terminal be connected to the transformer input terminal marked either + or with a dot. This will help on multiple transformer systems to reduce "recirculating current loop" problems.

8. Connect foot pedal, palm buttons, valves, and machine control input wires per WIRING HOOK-UP DIAGRAM. Note that this control can be used in a large variety of input schemes. Proper attention to the WIRING HOOK-UP DIAGRAM will save problems. Note that is is **not** necessary to put a jumper on any of the PS (pressure/proximity switch) inputs (terminals 17 – 21) when they are not being used. The system will take care of this later. **Be sure that all control input/output lines are routed away from heavy current carrying cables. Control cables should <u>never</u> be run in the same raceway as heavy current carrying cables.**
   NOTE: If the control is being mounted on a **manually operated welder**, you should consider adding another operator button to allow REPEAT LAST WELD operation. When pushed, the control steps back to the link just used and allows repeat after the initiation switch (foot or hand) has been pushed. This is useful in cases where a spot has missed the proper location.
   If you are installing the REPEAT LAST WELD switch, connect to the INIT. terminal as shown on the WIRING HOOK-UP DIAGRAM. Note that this switch **cannot** be used if the system is set for BINARY initiation.

9. If the weld transformer(s) uses a high temperature thermal switch, connect the Normally Closed (opens on high temperature) switch wires to terminals 23 and 24. **If no transformer thermal switch exists, jump these terminals.**

10. If system uses water cooled SCR contactors, connect water hoses to fittings on side of cabinet. In/out direction of water is not important unless the system has been supplied with the #9181-28 water flow switch. The SCR high temperature thermal switch has been factory connected on systems supplied with an SCR contactor. For retrofit systems

supplied **without** an SCR, either wire the Normally Closed SCR contactor thermal switch wires to terminals 22 and 23, **or jump these terminals.**

SOLUTION-2 #9280
INSTALLATION INSTRUCTION

PAGE 1-4

If this control is a MODEL #9280 (with remote data input console), **skip** to step 15 below.

* *

If this control is a MODEL #9280M, #9280L, or #9280D (all components in one enclosure) do the following:

11. **If** the control is **mounted in the door (9280D)** of the cabinet, **skip** to step 12. If it is mounted on either side of the enclosure ((9280M, 9280L), remove the four outer screws on the control face plate. Carefully rotate the front panel from the top to expose the wiring terminals. A bracket is provided to prevent the panel from going more than 90o.

12. Connect the YELLOW wire at upper right of power supply chassis board to a terminal that most closely matches your supply. **CAUTION: IF THE ACTUAL LINE VOLTAGE IS MORE THAN 25% HIGHER THAN THE TERMINAL MARKING, PERMANENT DAMAGE CAN OCCUR TO THE SYSTEM.**

13. Connect line power as shown on the HOOK-UP diagram. Locate terminal on SCR. marked **L1.** If this control has high speed fuse, the connection marked **L1** will be on the fuse tag. Connect one side of the line to this point. The second side, as shown on the drawing, is a light blue color wire marked **L2**. Connect as shown to the other side of the power line.

14. If control was rotated out of cabinet in step 11, carefully rotate back into cabinet, being sure that terminal at top clears cabinet. Replace screws.

SKIP TO STEP 20 BELOW

* * * * * * * * * * ** *

15. Select appropriate location for the SOLUTION-2 control remote console. Be sure that the console face is clear of the worst anticipated location of parts to be welded, and is not in the direct path of weld flash. Use the supplied swivel bracket.

16. Carefully plug control cable into the rear of console. After pushing plug all the way inward, fasten with the two jack screws on the cable plug. **HAND TIGHTEN ONLY. DO NOT USE A SCREWDRIVER. DO NOT USE EXCESSIVE FORCE ON THESE JACK SCREWS SINCE THEY BREAK EASILY WHEN OVER STRESSED.**

17. Route the cable to the power supply cabinet and push the excess cable into the large compression fitting supplied on the cabinet top. Be sure that there is enough of a loop at the console to allow full movement of the console. Tighten fitting. Remote cable extensions are available at time of purchase or can be field added to allow up to 25 feet distance between the console and the power cabinet. **Be sure that this control cable is routed away from any high current carrying cables and is not routed in the same trough with such heavy cables.**

18. Secure all wires inside power supply cabinet and check to be sure that connections are made correctly and that no loose strands of wire are at any terminal point.

19. Locate wire at lower edge of the power supply chassis circuit board that is marked "**F1"** and connect to voltage terminal that most closely matches your supply. **Check this one more time to be sure this terminal is correct. Connection to a lower voltage terminal will cause permanent damage that will** <u>not</u> **be covered by the Unitrol warranty in any way.**

20. If a factory installed CIRCUIT BREAKER is in this system, locate adjustment setting on breaker and set to the closest or higher range calculated from the following formula:

$$\text{SETTING } = \text{ (KVA - Line voltage) X 3,000}$$

   Where **KVA** is that shown on the welder nameplate.

   As an example: **KVA = 75**
   Line voltage = 460

$$\text{SETTING } = \text{ (75 - 460) X 3,000} = .163 \text{ X 3,000} = 489.13$$

   The circuit breaker should be set to the nearest higher level. Note that this circuit breaker has a MAGNETIC mechanism <u>only</u> to protect the **SCR** contactor against very fast and high current surges.

21. Take a moment to inspect all connections one more time. Be sure that all terminals are tight, and that no stray strands of wire are visible.

22. Turn power on and check the control module.   If the system is working correctly, the control will go through the diagnostic program and finish with the read-out showing **"PROGRAM #   "** if the memory was cleared at the factory or previous installation, or will display, "PROGRAM # # READY" if program was left in the memory. If no display is present, check that line voltage is present and matches that selected in step 15. If some other phrase is displayed, check page 10 in **DIRECTIONS FOR USE** to find the problem. Consult factory service department if difficulty is encountered at this point. Do not attempt to service control without proper information.

23. System should now be ready for operation.

SPECIAL OPTIONS

INITIAL SET-UP PROCEDURE

SUCCESS WITH THE MINIMUM OF PAIN

The SOLUTION-2 control is an extremely advanced piece of Engineering. It allows the user to specify simple or complex welding and automation sequences using the simplest possible programming steps.

The design team at Unitrol **STRONGLY** recommend the following sequence for first time users:

1. Read the entire direction book cover to cover **FIRST** before attempting to operate this system.

2. Then start back at page SU-2 and follow the directions step by step. In this way you will be sure that all original configuration settings in the **SOLUTION-2** are correct, and that the system will respond properly to your input commands.

3. If at any time during this process you have a question or find a problem, please contact the Service Department at Unitrol for assistance at 847-480-0115. Our regular business hours are 8:30 AM to 5:00 PM CST, Monday to Friday. While personnel are often available at other times and days, a message left on our 24 hour answering system will get a response at the start of the next business day.

INITIAL SET-UP PROCEDURE

Before proceeding further, be sure that all steps of the installation section, pages 1-1 through 1-5, have been completed.

A WORD ON THE OVERALL OPERATION LOGIC OF THE SOLUTION-2 SYSTEM

This SOLUTION-2, like all SOLUTION controls, uses a **very simple format** of entry:

A1.   A line will come up on the display with a value or mode shown.

A2.   If this line is part of an **initial configuration setting** in the system, the following display will then be alternately shown:

CHANGE 1 = YES, 0 = NO

This says that if you want to **CHANGE** the number or mode shown on the display, press **1** ("YES", change). If you **do not** want to change the value or mode shown, press **0** ("NO", do not change)

A3.   If the line is a **NUMBER**, just enter the new number and then press **ENTER** to go to the next question.

If the line is a **MODE** and there are only **two** MODES from which to choose, the new MODE will appear and then the system will automatically advance to the next question. For example using PROGRAM 90:

HOLDING MODE

CHANGE 1 = YES, 0 = NO

Press 1 ("YES, CHANGE")

MOMENTARY MODE

and then will step to the next question or exit automatically

A4.   If the line is a **MODE** and there are **more than two MODES** from which to choose, the choices will now be displayed one at a time with a number following each as in this example from PROGRAM 79:

3-CHAIN, 2 – STAGE

or other initiation mode

CHANGE 1 = YES, 0 = NO

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

Press **1**, and the display will show:

3-CHAIN, 2 STAGE = 1

7-CHAIN, 1 STAGE = 2

15-CHAIN – BIN. = 3

75-PROG, BINNARY = 4

KEYPAD PRG. SEL = 5

At this time, by pressing the numbers 1 to 5, the chosen mode will be chosen for messages that will appear during normal welding sequences.

A5.   **ENTRY ERRORS:** If a number is entered that does **not** match one of the choices shown on the display (for example, the number 8 in the LANGUAGE example above), the display will show:

INCORRECT ENTRY

and then display the original question again. Pressing of the **ENTRY** button at this time will set the SOLUTION-2 **back** to the original mode or number without making any change.

THAT'S ALL THERE IS TO UNDERSTANDING SOLUTION-2 ENTRY PROCEDURES!

SOLUTION-2 #9280
INITIAL SET-UP PROCEDURE

DIRECT ACCESS SET-UP NUMBERS

The SOLUTION-2 control has a large variety of functions that can be performed for various types of welding situations. The pages that follow in the INITIAL SET-UP PROCEDURE and DIRECTIONS FOR USE will show how to locate and make entry into these locations to customize your SOLUTION-2.
* *

IMPORTANT NOTE:

ALL functions listed as "standard function" should be set for all systems.

Functions **not** listed as "standard function" are **OPTIONS** and only require setting if the option is installed on this control.
* *

The following is a master list of these **DIRECT ACCESS NUMBERS** used on the following pages to set your SOLUTION-2 for desired functions and values.

There are two ways to get to any of these setting programs:

A.   If you know the program number of the function to be set (see table below), press: **PROGRAM, ##, ENTER** where # # is the PROGRAM NUMBER listed in the table. On numbers that are listed as **97 / ##,** press: **PROGRAM, 87, ENTER, ##.**

B.   If you do **not** have the table available, you can go to the master directory by pressing: **PROGRAM, 0, ENTER.** By continuing to press the **STEP** button, the display will show the same setting programs in order as shown in the table.

         To use the setting program displayed, press the **PROGRAM** button and answer the questions on the display. After making entry into that program, the system will bring you back to the next setting program. If you want to exit this master directory, press **SINGLE, NO WELD,** or **REPEAT.**

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-5

DIRECT ACCESS SET-UP NUMBERS

PROGRAM NUMBER	FUNCTION	USED WITH OPTION	PAGE
76	ASSIGN TRANSDUCER TO VALVES	#9181-05 MULTIPLE PRESSURE TRANSDUCER OPTION	SU-13
77	PRINT PROGRAMS DATA	#9181-22A/B PRINTER OPTIONS	SU-22
78	TRANSDUCER SET-UP	#9181-05 PRESSURE TRANSDUCER	SU-13
79	CHOOSE TYPE OF CHAIN	STANDARD FUNCTION	SU-9
80	CHAIN SETUP	STANDARD FUNCTION	U-9
81	PRINT FAULTS / WELDS	#9181-21A/B PRINTER & PORT	SU-22
82	MAN/AUTO FAULT RESET	#9181-22A/B CURRENT MONITOR 9181-O5C TRANSD. HIGH/LOW #9181-06A AVC HIGH/LOW	OP-4
83	CURRENT BLANKING	#9181-22A/B CURRENT MONITOR	SU-21
84	I-READ / REACT / OFF	#9181-22A/B CURRENT MONITOR	0P-1 .
85	I-CALIBRATION	#9181-22A/B CURRENT MONITOR	SU-16
86	SOFTWARE VERSION	standard function	SU-23
86	PRINTS SYSTEM SETUP	#9181-21/A PRINTER OPTIONS	SU-23
87/01	INIT. CONFIGURATION (SV, SCRs, PS, ETC.)	standard function	SU-6 .
87/90	FAULT & EHR RELAY **ON** TIME; CHAIN SPEED SET	STANDARD OR HIGH SPEED. TIME RELAYS STAY CLOSED	SU-27
87/92	CURRENT RANGES	#9181-22B CURRENT MONITOR	SU-20
87/96	KEYLOCK SECURITY	Sets keyboard lock mode	SU-39
87/93	LIGHT CURTAIN	standard function	SU-28
87/97	SET TYPE OF PRINTER	#9181-21A/B PRINTER	SU-22
87/98	LOAD CELL MULTIPLIER	#9181-05D LOAD CELL	SU-23
87/99	PRI / SEC. CURRENT SEL	#9181-22A/B CURRENT MONITOR	SU-17 /18
88	HEAT STEPPER SETUP	#9281-15 MULTI HEAT STEPPER	SU-8
89	AVC VOLTAGE SETUP	standard function	SU-14
90	MOM./ HOLDING INIT.	standard function	SU-10A
91	WELD / PART COUNTER	standard function	SU-24
93	FULL / HALF CY. COUNT	standard function	SU-26
94	+ / - FIRST ½ CYCLE	standard function	SU-26
95	0-99 or 0-999 CY TIME	standard function	SU-27
96	TRANSDUCER PROGRAM	$9181-05 PRESSURE TRANSDUCER	OP-11
97	MAJOR / MINOR / SPECIAL FAULT OUTPUT	select relay output for various fault conditions	SU-30
98	AVC ON / OFF	standard function	SU-14
-	AVC HIGH / LOW	#9181-06A	SU-14
99	CLEAR MEMORY PROGRAM	standard function	

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-6

B. INITIAL CONFIGURATION OF SOLUTION-2

Each SOLUTION-2 is shipped from the factory ready to handle a large range of I/O functions. When the following configuration steps are followed, the control will eliminate any unwanted lines in each of the 75 programs to make data entry faster and easier.

Note: All memory is stored in the **EEPROM** chip that resides within the SOLUTION-2's computer. If the computer board or **EEPROM** chip is replaced at a future date, this same procedure must be repeated. In addition, all program data will also require reinstallation under the same circumstances.

B1.   Turn power on control. The display should show the following or similar sequence:

<div align="center">

DIAGNOSTIC TEST

UNITROL SOLUTION

*   *   * **(flash 3 times)**

TEST COMPLETED

3-CHAIN, 2-STAGE

HOLDING MODE

PROGRAM NO. ___ ___

</div>

This display will be shown every time the SOLUTION-2 control is turned on. It gives an overall indication of the **MODE** and condition settings on the SOLUTION-2. Also, if during the **DIAGNOSTIC** test portion the system stops or gives another display, the control is telling the operator that the computer is not setting properly and will not proceed any further. In this case, contact the Unitrol Service Department for assistance.

B2.   Press: **PROGRAM, 87, ENTER, 01.** The display will show:

<div align="center">

TOTAL VALVES = ##

CHANGE 1 = YES, 0 = NO

SOLUTION-2 #9280
INITIAL SET-UP PROCEDURE
PAGE SU-7

</div>

The SOLUTION-2 will support up to 16 total controlled valve outputs (SV1 through SV16). The first four (SV1 through SV4) are standard equipment for all controls. The next four SV outputs must be ordered in groups of 4. The balance can be ordered separately as required. They can also be field added should you want to expand the system's capability.

Note: Pressing **STEP** after any display is shown will skip to the next question without changing the value or mode shown.

B3. This number should have been set at the factory to match the quantity of outputs ordered with the system.

    a.   If you wish to **reduce** the number of SV lines in each of the 75 programs, press **1** to allow the change, and then enter this number. Note that this number can always be returned to the maximum in the future without affecting programs previously entered. Also, if you choose a number **higher** than the quantity of SV output circuits installed on the control, the control will allow entry for these SV outputs in each program even though no output circuit exists. After entry of a number, press **ENTER**.

    b.   If you do not want to change this number, press **O**.

B4. The display will now alternately show:

<p align="center">TOT. PS INPUT = #</p>

<p align="center">CHANGE 1 = YES, - = NO</p>

All SOLUTION-2 controls have the hardware capacity to monitor the condition of up to five proximity of mechanical switches during the start of each program **LINK** (to be explained later). Press **1** ("**YES**", change), and then enter the quantity of proximity / limit / pressure switches that have been connected to terminals **PS1** through **PS5**.

IMPORTANT NOTE: If you are going to use either the **LOOP IF PS5 ON** or **PS5 OFF, NEXT** mode (see pages U-8 through U-11), select a **maximum** of four PS switches (i.e., **TOT. PS INPUT = 1, TOT. PS INPUT = 2, TOT. PS INPUT = 3,** or **TOT. PS INPUT = 4**).

B5. Press **ENTER** and the display will alternately show:

<p align="center">TOTAL TRANSD. = ##</p>

<p align="center">CHANGE 1 = YES, 0 = NO</p>

This number should have been entered at the factory to match the hardware (transducer options) installed.

a. If this control does **not** have a #9181-05 **DIFFERENTIAL PRESSURE TRANSDUCER** option, the number should be **00**. If **another** number is shown, press: **1** ("YES", change), **00, ENTER.** If it **is** correct, press **STEP**.

<p align="center">SOLUTION-2 #9280</p>

<p align="center">INITIAL SET-UP PROCEDURE</p>

b. If this control **has** a **single** #9181-05 DIFFERENTIAL PRESSURE TRANSDUCER installed, the number should be **01.**
    If another number is shown, press **1** ("YES", change), **01, ENTER**.
    If it **is** correct, press **STEP.**

c. If this control has **more than one** #9181-05 DIFFERENTIAL PRESSURE

TRANSDUCER installed, this number should match that quantity even if all will not be used for a particular setup.
  If an **incorrect** number is shown, press the proper number, and then **ENTER**.
  If it **is** correct, press **STEP**.

B6.   The display will now show:

TOTAL SCRS = ##

CHANGE 1 = YES, 0 = NO

The SOLUTION-2 control can support up to 15 SCR contactors. The correct number should have been set at the factory.

c.   If this control **has a single** SCR contactor installed, the number should be **01**.
    If **another** number is shown, press **1, 01, ENTER.**
    If it **is** correct, press **STEP.**

c.   If this control has **more than one** SCR contactor installed, this number should match that quantity even if all will not be used for a particular setup.
    If an **incorrect** number is shown, press **1,** the proper number, **ENTER.**
    If it **is** correct, press **STEP.**

B7.   If your control has been purchased with the #9281-15 **HEAT STEPPER** option, the display will now show:

TOT. STEPPERS = ##

CHANGE = YES, 0 = NO

The SOLUTION-2 control can support up to 16 **HEAT STEPPERS.**   Press **1** (to change) and install the number of steppers that will be used. This number can be changed at any time in the future and should represent the maximum number you feel will be used at this time. Now press **STEP.**

B8.   The display will now show:

READY TO WELD

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-9

C.   **HOW DO YOU WANT WELDER INITIATION TO OPERATE?**

This control can be initiated in various ways. Since the software is universal, it is now necessary to tell the control what initiation mode is to be used. The five choices are:

C1.   **SELECTION OF UP TO <u>3 CHAINS</u> USING <u>DOUBLE STAGE FOOT SWITCHES</u> AND/OR DUAL <u>ANTI-TIEDOWN HAND SWITCHES:</u>** (3-CHAIN, 2-STAGE)

This initiation mode is typically used for two types of welders:

1.   Single transformer pedestal welders with **one or more** solenoid valves. In this case, SOLUTION-2 set in this initiation mode will allow up to **45** welds to be made in a CHAIN to provide the proper weld schedule for each location. It can also be used to operate an automatic retract system if the welder has retract hardware.

2.   Multiple transformer, multiple valve welding systems that will be manually initiated by an operator (typical manual load/unload systems). This initiation mode allows selection of up to **three** separate CHAINS that each can have up to **45 LINKS.**

      If more than 45 LINKS are needed, two or more CHAINS can be connected.

IMPORTANT: Set jumper on upper left corner of power supply to the <u>FS</u> position.

C2.   **SELECT UP TO <u>7 CHAINS</u> USING <u>SINGLE STAGE SWITCHES</u>:** (7-CHAIN, 1-STAGE)

This initiation mode is typically used for **single or multiple transformer**, multiple valve welding systems that are being operated from a **PLC** or other **external control system.** The weld area is normally protected by light curtains or mechanical barriers.

Initiation is done by **seven** separate **single contact** switches or **solid state PNP** switches. Selection can also be done through a single pole multi-point selector switch. This provides up to **seven** CHAINS that each can have up to **45 LINKS** of sequence. If more than 45 LINKS are needed, two or more CHAINS can be connected.

IMPORTANT: Set jumper on upper left corner of power supply to the <u>FS</u> position.

C3.   **<u>BINARY</u> SELECTION OF UP TO <u>15 CHAINS</u>:** (15-CHAIN-BIN)

This mode is typically used in automatic systems that require more than 7 CHAINS. Initiation uses **four** data inputs driven by dry contacts or solid state **PNP** switches in a **PLC** or other external control system to select one of 15 CHAINS (01-75) using **BINARY** code. This can also be accomplished using a thumbwheel switch or a single pole switch with diodes.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-10

Fifteen CHAINS (01 to 15) that each can have up to **45 LINKS** of sequence can be randomly selected in this mode. If more than 45 LINKS are needed, two or more CHAINS can be connected. While **BINARY PROGRAM** totally eliminates any restrictions of the maximum quantity of steps that can be used, time for hand shakes makes it slower than a CHAIN mode.

Note that BINARY 0 is **not** a legal selection and will generate a **LOGICAL ERROR** message if used.

IMPORTANT: When using BINARY mode, set jumper on upper left corner of power supply to the <u>BP</u> position. If it is in the FS position, the system will initiate as soon as any binary code input switch has been closed. This will cause races in reading the binary code and can result in selection of random programs!

C4.   <u>BINARY</u> **SELECTION OF UP TO <u>75 PROGRAMS</u>:** (75-PROG, BINARY)

This initiation mode is typically used for **single or multiple transformer,** multiple valve welding systems that are being operated from a **PLC** or other **external control system** where the SOLUTION-2 is basically a **slave**. In this case, the PLC or other external control system operates the majority of valve functions, and the SOLUTION-2 is used more for control of weld schedules and transformer firing.

Initiation is done by **seven** separate **single contact** switches or **solid state PNP** switches using **BINARY** code 01-75. This provides up to **seventy-five** PROGRAMS that can be BINARY selected in a **NON-CHAIN** MODE. Note that BINARY 0 is **not** a legal selection and will generate a **LOGICAL ERROR** message if used. This allows the **PLC** or other switch selection system to "call" any PROGRAM and have that program operated when the **INIT** input is closed. After the selected PROGRAM has been finished, the EHR relay will close for the time set in PROGRAM 87/90 to "tell" the PLC that this PROGRAM has been complete.

INPORTANT: When using BINARY mode, set jumper on upper left corner of power supply to the <u>BP</u> position. If it is in the FS position, the system will initiate as soon as any binary code input switch has been closed. This will cause races in reading the binary code and can result in selection of random programs!

C5.   **KEYPAD PROGRAM SELECT:** (KEYPAD PRG. SEL)

This initiation mode is typically used for manual welding stations where it is desired to weld with the **last PROGRAM entered.** In this mode, the welding control will **not** use the CHAIN sequence. Note that if this is a multi-SCR system, the selected PROGRAM must specify the SCR being fired. If the REPEAT button is pushed, the PROGRAM will be repeated with off time between each weld as set in the DWELL BETWEEN line,.

IMPORTANT: Set jumper on upper left corner of power supply to the <u>FS</u> position.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-10A

SELECTING DESIRED INITIATION MODE

To select one of the above INITIATION MODES, press: **PROGAM, 79, ENTER.** The display will alternately show:

3-CHAIN, 2-STAGE

or other initiation mode

CHANGE 1 = YES, 0 = NO

Press **1**, and select the number that matches the desired initiation mode:

3-CHAIN, 2 STAGE = 1

7-CHAIN, 1 STAGE = 2

15-CHAIN – BIN. = 3

75 – PROG, BINARY = 4

KEYPAD PRG. SEL = 5

C6.   SELECTING MOMENTARY OR HOLDING INITIATION MODE

1.   In **MOMENTARY** mode, initiating the control for any time over 50 ms. will start the sequence. This is used in systems where either the electrodes are spaced less than ¼" apart, or guarding **is** present (light curtain, mechanical gate, etc.) to prevent the operator from placing any body part between the electrodes.

2.   In **HOLDING** mode, if the initiation switch is opened **before** the first weld cycle has started, the system will go back to all conditions at the start of this particular LINK. This function happens for every LINK of the CHAIN. **HOLDING mode <u>MUST BE USED</u> for all situations where electrode spacing is more than ¼" and the electrode area is <u>not</u> guarded (i.e., no light curtain or mechanical guard).** HOLDING MODE will only operate **if** you have selected **MANUAL CHAIN** in PROGRAM 80.

Press: PROGRAM 90, ENTER, and choose the desired mode.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-11

D.   SETTING TIP FORCE CALCULATOR

The SOLUTION-2 control converts **TIP FORCE** numbers that you enter in each program into required **air psi.** (pounds per square inch) that should be set on the air regulator(s) of the welder. Even if the #9181-05 DIFFERENTIAL PRESSURE TRANSDUCER option is not installed, this TIP FORCE CALCULATOR system is still in place.

When installing a new control, a value called **LB/PSI** must be calculated and entered into the SOLUTION-2. This value, when multiplied by the psi setting of the air supplied to the welding cylinder, will yield the **TIP FORCE** that will be created between the electrode and the metal being welded.

* *

The formula for **TIP FORCE** is written as:

TIP FORCE = AIR psi X lb / PSI

* *

To find the LB/PSI number of your welder, follow the one step below that matches your welder's cylinder system:

D1.   For use on welding systems that use **DOUBLE** or **TRIPLE PISTON** air cylinders ("gun" cylinders), check manufacturers data sheet for the correct effective total cylinder area. This number is normally part of the model number stamped on each double or triple piston cylinder. For example:

On Grossel cylinders, a model **2-GA-765-1.5** means that **LB/PSI = 7.65** (7.65 in 2 effective area).

On Savair cylinders, a model **A-G-436-6A** means that the **LB/PSI = 4.36** (4.36 in 2 effective area).

On an **OHMA** intensifier type cylinder, a model **8716-RH-.25-12A** means that the **LB/PSI = 16** (16in 2 effective area). Note that on an intensifier cylinder, the air pressure must be measured at the **INTENSIFIER** port located furthest away from the piston end of the cylinder.

Now **go to step D5** below for entry of this LB/PSI value into the SOLUTION-2.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-12

D. SETTING TIP FORCE CALCULATOR (Cont.)

D2.   Some **SINGLE CYLINDER PEDESTAL WELDERS** list the **WELD FORCE RATIO** on the name plate. This number, when multiplied by air pressure, will yield the actual force between the welding electrodes (tips). If this **is** shown, the value will be the **LB/PSI** to be entered into the SOLUTION-2.

If this ratio is **not** shown, but a chart showing tip force for various air pressure settings is on the welder, calculate **LB/PSI** as follows:

$$\text{LB/PSI} = \frac{\text{TiP FORCE AT 50 PSI}}{50}$$

Now **go to step D5** below for entry of this **LB/PSI** value into the SOLUTION-2.

D3.   On all other **PRESS** and **PROJECTION** (non-rocker arm type) welders, the LB/PSI value can be calculated using the following formula:

LB/PSI = CYLINDER DIAMETER X CYLINDER DIAMETER X .785

Where CYLINDER DIAMETER is the **inside** dimension across the cylinder. This is typically about 1/8" smaller than the outside cylinder diameter. Most cylinders installed on U.S. made welders use ½" increments in size.

The following are areas of common cylinder sizes:

INSIDE CYLINDER DIAMETER	LB/PSI (AREA)
3 in	7.1 in
3-1/2 in	9.6 in
4 in	12.6 in
4.5 in	15.9 in
5 in	19.6 in
6 in	28.3 in
8 in	50.2 in
10 in	78.5 in

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-13

D. SETTING TIP FORCE CALCULATOR (Cont.)

D4.   If you are operating a **ROCKER ARM WELDER,** you must first calculate the machine **ARM LEVERAGE** as follows:

ARM LEVERAGE = (A - B)

A = distance from the weld cylinder rod to the weld arm pivot
B = distance from the weld arm pivot to the weld tip

As an example, on a **ROCKER ARM WELDER** with a 5" diameter cylinder that measures 18" from the cylinder rod to the weld arm pivot ("A"), and 24" from the weld arm pivot to the welding tip ("B"):

ARM LEVERAGE   =   18 - 24
=   .75

LB/PSI   =   ARM LEVERAGE X CYLINDER AREA
=   .75 X 19.6
=   14.7

Note: This LB/PSI number will change on a **ROCKER ARM WELDER** every time the length of the welding arm is changed (moved inward or outward).

Now **go to step D5** below for entry of this LB/PSI value into the SOLUTION-2.

D5.   **ENTRY OF THE LB/PSI VALUE:** The value from one of the above steps must now be entered into the SOLUTION-2 so that it can calculate the required air psi needed for each TIP FORCE value. To do this, press: **PROGRAM, 78, ENTER.** The display will now show:

TRANSDUCER SETUP

then alternately:

TRI = ##.# LB/PSI

CHANGE 1 = YES, 0 = NO

If this control has either **no** DIFFERENTIAL PRESSURE TRANSDUCER (option #9181-05) or only **one** TRANSDUCER installed, press **1** and enter the LB/PSI value. If the number of 0 or 1 was installed in step B5 earlier, the display will now show:

READY TO WELD

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-14

D. SETTING TIP FORCE CALCULATOR (cont.)

If this control has **more than one** DIFFERENTIAL PRESSURE TRANSDUCER (option #9181-05) installed, a separate value must be installed for each one **even if they are all the same.** To do this, enter the LB/PSI value that matches the cylinder plumbed to TRANSDUCER 01 in the SOLUTION-2 cabinet, press **STEP,** and the display will alternately show:

TR2 = ##.# LB/PSI

CHANGE 1 = YES, 0 = NO

Continue to enter the values for each cylinder connected to a transducer. If the correct quantity of transducers was entered during step B5 earlier, the program will have the following display when the **ENTER** button is pushed after the last value has been entered:

READY TO WELD

You can review these values by again pressing: **PROGRAM, 78, ENTER** and push the **STEP** button once for each line.

D6.   **ASSIGN TRANSDUCERS TO VALVES:** If the system has **more than one** transducer, press: **PROGRAM, 76, ENTER** and the display will ask for a valve (SV) number to be assigned for each transducer. This is used in **PROGRAM 96** when checking the operation of each transducer. In this way, when the **CHECK TIP FORCE** or **CHECK AIR PSI?** tests are made in Program 96, the valve assigned here will energize so that values can be read. This valve assignment will **not** be used in any way during normal operation of control sequences.

SOLUTION-2 #9280
INITIAL SET-UP PROCEDURE
PAGE SU-15

E. INITIAL SET-UP OF AVC AUTOMATIC VOLTAGE COMPENSATION

This control contains a system that continuously monitors the incoming line voltage, compares it to a reference voltage, and then modifies the firing angle (% HEAT) of each half cycle of weld to maintain the welder voltage within a + / - 2% window. When a new control has been installed, or when a new control pendant is installed, the system must be set to measure and store the reference "zero line" voltage.

To do this:
E1.   Press: **PROGRAM, 89, ENTER.** The display will show:

VOLT CALIBRATION

SYSTEM VOLT. = - - -

E2.   Using a digital or analog voltage meter, carefully measure the **actual** incoming line voltage. Enter this number. Then press **ENTER**. The display will show:

READING VOLTAGE

For the next 20 seconds, the SOLUTION-2 will make hundreds of line voltage readings, convert these into digital numbers for the internal computer, then average these numbers to arrive at an "average" line voltage. This will be displayed as:

SYSTEM VOLT. = ###

E3.   The reference voltage is now set. At this time, the **AVC** circuitry is turned **OFF.** To turn it on, press: **PROGRAM, 98, ENTER.** The display will show:

VOLTCOMP. IS OFF

CHANGE 1 = YES, 0 = NO

E4.   Press **1**, and the display will show:

VOLTCOMP. IS ON

E5.   The control is now set to operate with **VOLTAGE COMPENSATION** operative.

* *

AVC HI/LOW OPTION

If your control has been purchased with the #9181-06A **AVC HI/LOW OPTION**, the system will check to see if the line voltage has gone more than 10% above or below the **"BASELINE"** as learned above (or during the constant current setup procedure). If this happens, the display will show the voltage and indicate **HIGH** or **LOW.** This fault can also be sent to one of the **FAULT RELAYS** by assigning it in **PROGRAM 97.**

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-16

F. SETTING CURRENT READING SYSTEM, PRIMARY COIL

If your control does not have a CURRENT MONITOR system option, <u>skip</u> to page SU-23.

If this control uses the #9181-22B CURRENT MONITOR / LIMITER with **SECONDARY** current coil, <u>skip</u> to page SU-18.

F1.   **BEING SURE THE SOLUTION-2 IS IN <u>PRIMARY CURRENT MODE</u>**: It is first important to check and see if the SOLUTION-2 has been set to read **PRIMARY** current. To do this, press: **PROGRAM, 87, ENTER, 99.** The display will alternately show:

PRIME 1 SYSTEM   or   **SECOND 1 SYSTEM**

CHANGE 1 = YES, 0 = NO

If **PRIME 1 SYSTEM** is shown on the readout, press **0** to <u>not</u> change, otherwise, **0**. The display will now alternately show:

1   COIL CODE = ####

CHANGE 1 = YES, 0 = NO

This value represents the current transformer **size** that was factory installed. This **COIL CODE** should have been set at Unitrol before shipment and noted in the first page of this direction book. For example, a 400:5 current transformer will require a **COIL CODE = 0400.**

If the maximum **PRIMARY** current developed through this **CT** during a weld **exceeds** the current transformer maximum rating (400 amps in the above example), the display will show:

CURRENT OVERFLOW

In this case, contact Unitrol to obtain the correct current transformer to match your application.

F2.   If your control has the #9181-22**A CURRENT MONITOR**/**LIMITER** option, a single current transformer (**CT**) has been factory installed around line **L1** inside the white control box. This **CT** converts current passing through the center of the coil into a proportional current in the coil. A voltage is now sent to the SOLUTION-2 computer to represent the primary current.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-17

F. SETTING CURRENT READING SYSTEM, PRIMARY COIL(cont.)

F3.   **TURNS RATIO:** Voltage sent from the CT represents the **PRIMARY CURRENT.** This value must be multiplied by the SOLUTION-2 computer to <u>calculate</u> **SECONDARY CURRENT.** This multiplier is called the **TURNS RATIO.**

As an example, for a 220 volt rated transformer having a 3.2 volt secondary (on the tap setting being used), the calculation to find the **TURNS RATIO** would be:

$$\textbf{TURNS RATIO} = \frac{\textbf{LINE VOLTAGE}}{\textbf{SECONDARY VOLTAGE}} = \frac{220}{3.2} = 68.7$$

Rounded upward, **TURNS RATIO = 69.**

F4.   If the welding transformer has a **TAP SWITCH**, the **SECONDARY VOLTAGE** will be different for each **TAP SWITCH** position. The welding transformer nameplate will typically contain the **HIGH SECONDARY VOLTAGE** and **LOW SECONDARY VOLTAGE** values.

You need first to calculate the voltage steps created by each tap switch position. To do this, use the following formula:

$$\text{VOLTS PER STEP} = \frac{\text{(HIGH SECONDARY VOLTAGE – LOW SECONDARY VOLTAGE)}}{\text{(NUMBER OF TAP POSITIONS - 1}}$$

For example, on a transformer that has **LOW SECONDARY VOLTAGE** = 6.9V, a **HIGH SECONDARY VOLTAGE** = 9.0V, and four tap switch positions:

$$\text{VOLTS PER STEP} = \frac{(9.0 - 6.9)}{(4 - 1)} = \frac{2.1}{3} = .7 \text{ VOLTS PER STEP}$$

SECONDARY VOLTAGE on any particular **TAP SWITCH** position is:

SECONDARY VOLTAGE = LOW SECONDARY + (VOLTS PER STEP X (TAP #-1)

As an example, the **SECONDARY VOLTAGE** of the above transformer with the tap switch on position **#3** is:

TAP #3 SEC. VOLTAGE = 6.9 + (.7 X (3-1) = 6.9 + (.7 x 2) = 6.9 + 1.4 = 8.3V

FOR CONTROLS WITH ONLY <u>ONE</u> SCR CONTACTOR
SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-18

F. SETTING CURRENT READING SYSTEM, PRIMARY COIL (cont.)

F5.   **FOR CONTROLS WITH ONLY <u>ONE</u> SCR CONTACTOR:**

If your control has only <u>ONE</u> SCR contactor (as selected in PROGRAM 87/01), press **PROGRAM 85, ENTER.** The display will alternately show:

TURNS RATIO   00

CHANGE 1 = YES, 0 = NO

Press **1** to change, and then enter the TURNS RATIO for the **tap switch position being used** as shown in section F3 or F4 on the previous page.

FOR CONTROLS WITH <u>MORE THAN ONE</u> SCR CONTACTOR

If, in PROGRAM 87/01, this control has been configured with more than one(1) SCR, the calibration number for <u>each</u> transformer will have to be calculated. **After PROGRAM 85, ENTER** has been pushed, the display will show:

<div align="center">

TURN R = 00, XMR #01

CHANGE 1 = YES, 0 = NO

</div>

Press **1** to change. Enter the TURNS RATIO, as calculated in section F3, for the **tap switch position being used** on the transformer <u>wired to SCR #1</u>. Press **STEP** and the display will request the TURNS RATIO for each additional SCR.

 *

IMPORTANT NOTE: If in the future a transformer tap switch is changed on any transformer, the new TURNS RATIO must be entered into the SOLUTION-2 for the system to calculate secondary current properly!

* *

<div align="center">

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-19

G. SETTING CURRENT READING SYSTEM, SECONDARY COIL

</div>

G1.   If your control has the #9181-22**B** CURRENT MONITOR/LIMITER option installed, it is only necessary to set the control for the desired **CURRENT RANGE.** The system has been factory calibrated to Unitrol standards in **PROGRAM 97/91.** The calibration numbers are shown on the serial number page in front of this book.

If it is desired to check or change this calibration (ZERO and SPAN), press: **PROGRAM, 97, ENTER, 91.** The display will show first if the **ZERO** is being added (+) or subtracted (-) from the reading. The second display will show the **ZERO** value, and the third will show the **SPAN.**

It is not normally necessary to change this calibration. However, if you desire to calibrate the system to another standard, contact the Unitrol Service Department at 847-480-0115 for assistance.

G2. **SETTING THE MAXIMUM CURRENT RANGE.**   The SOLUTION-2 system should be set to a MAXIMUM CURRENT RANGE that is the **first one above** the **maximum** possible value of secondary current that can be produced by your welder.

If the range chosen is too **low,** a **CURRENT OVERFLOW** fault will be displayed during each welding sequence.

If the range chosen is too **high**, readings will be **less accurate** (greater steps during the reading process).

If the system is set correctly, readings should be within ½% maximum error.

TWO STEPS are now required in setting this range. Note that both steps **must match** or the values displayed by the system will be **completely wrong.**

<div align="center">

STEP #1

</div>

Now select the **MAXIMUM CURRENT** to be read by pressing: **PROGRAM, 87, ENTER, 99.** The display should alternately show:

<div align="center">

SECOND. 1 SYSTEM

CHANGE 1 = YES, 0 = NO

</div>

(Note: If **PRIMARY 1 SYSTEM** is displayed, press 1 to change to SECONDARY 1.)

<div align="center">

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-20

H. SETTING CURRENT READING SYSTEM, SECONDARY COIL (cont.)

STEP #17

</div>

G1.   Press **0** (to leave at SECONDARY 1 SYSTEM). The display will now alternately show:

<div align="center">

1 MAX 50 KA = 2

CHANGE 1 = YES, 0 = NO

</div>

G2.   To select the correct range, press **1**, and the display will show:

<div align="center">

1 MAX 100 KA = 1   (100,000 amp. maximum)

</div>

$$1\ \textbf{MAX 50 KA}\ =\ 2 \qquad (50{,}000\ \text{amp. maximum})$$

$$1\ \textbf{MAX 25 KA}\ =\ 3 \qquad (25{,}000\ \text{amp. maximum})$$

$$1\ \textbf{MAX 10 KA}\ =\ 4 \qquad (10{,}000\ \text{amp. maximum})$$

G3.   Press the number that is the **first one above** the highest current output possible from your welding system.

STEP #2

ON #9280 SERIES SOLUTION-2 WITH <u>REMOTE</u> KEYPAD CONSOLES:

G4.   Open the back of the SOLUTION-2 control pendant and locate the four segment **DIP** switch on the lower right corner of that circuit board. Push the switch **down** next to the correct range value as selected in STEP #1 above (100 = 100,000A, etc.). Set the remaining three switches **down** on the side **away** from the numbers.

```
                               _____      100
                               _____       50
PUSH 3 DOWN ON THIS SIDE       _____       25    SELECT ONE ONLY ON THIS SIDE
                               _____       10
```

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-21

G. SETTING CURRENT READING SYSTEM, SECONDARY COIL (cont.)

G5.   Remove the four outer screws on the white keypad plate and rotate control forward. Locate the four section **DIP** switch on top of the front circuit board. The switches are hanging over the edge of the circuit board.

G6.   Push the switch that matches the current range set in **STEP #1** above **towards** the **front** white plate (50 = 50,000a, etc.). Be sure that the other three switches are pushed **away** from the white plate.

Push only one switch towards white front plate on this side to select range

_____10_____25_____50_____100_____

_____

Pull the other three switches **away** from the white front plate on this side.

G7.   Note that on older SOLUTION-2 controls manufactured before 9/97, the range is 7,500A, 15,000A, and 60,000A. If the numbers on the **DIP** switch are 7.5, 15, 30, 60, the hardware is set for this range group. The system must recognize this in **PROGRAM 87/92**. In this case, be sure this range is selected.

**SOLUTION-2 #9280
INITIAL SET-UP PROCEDURE
PAGE SU-22**

H. SETTING CURRENT BLANKING

At the beginning of each weld, a few half cycles of time are normally required before the electrode has fully made contact with the metal and current flow is stabilized. For this reason, these first few half cycles are often ignored or **BLANKED** so that the readings over the entire weld will be more stable. This is done in measurements coming from both a primary and secondary coil system.

H1.   To enter a **CURRENT BLANKING,** press: **PROGRAM, 83, ENTER.** The display will show:

BLANK 00 HALF CY

H2,   Now enter the desired number of HALF cycles at the beginning of the WELD portion only that will not be measured. Obviously for welds of ½ or 1 cycle duration, no blanking should be made. **Note: If the number of BLANK cycles equals or exceeds the number of WELD cycles, no current will be read!**

H3.   For welds of up to 12 cycles, blanking of two(2) half cycles will work well.
For welds over 12 cycles, blanking of 4 half cycles is typical.

H4.	Press **ENTER** when the desired number has been inserted.

1. SELECTING "FAULT RESET " MODE

11. The SOLUTION-2 use various **options** to monitor various parameters during each weld. They are:

   A. **CURENT FAULT (options #9181-22A and #9181-22B):** current out of HIGH 1/LOW 1 window

   B. **FORCE FAULT (option #9181-05C)**: Computed electrode force is above or below program variation

   C. **LINE VOLTAGE FAULT (option #9181-06A):** Measured line voltage is out of +/- 10% window from baseline

12. When any of these errors is detected, the system has two possible modes of response:

   1. **MANUAL RESET:** Stop the weld sequence and keep the electrodes closed. The initiation switch must be **opened** and **closed again** to release the electrodes. Welding will continue when the initiation switch has been closed one additional time. This mode is typically used on **manually operated welders** where the operator is operating the foot or hand switches.

   2. **AUTOMATIC RESET:** Allow the sequence to continue without the need to close the initiation switch. This mode is typically used on **automatic systems** where the FAULT RELAYS are being monitored for action by a **PLC** or other external system.

For either **MANUAL** or **AUTOMATIC RESET** modes, you can assign output relays to communicate **FAULTS** or **ACCEPTABLE** conditions to an external system (i.e., **PLC,** etc.). See page SU-30 for assignment instructions.

SOLUTION-2 #9280
INITIAL SET-UP PROCEDURE
PAGE SU-23

K. SETTING PRINTER FUNCTIONS

TYPE OF PRINTER
K1.	Skip to SU-24 if system does not have a printer option installed. If this control has the #9181-22A printer port, or #9181-22B built-in printer option installed, it will be necessary to set the correct type of printer that will be operated. To do this, press: **PROGRAM, 87, ENTER, 97.** The display will alternately show:

BUILT-IN PRINTER
or

"EPSON" PRINTER

CHANGE 1 = YES, 0 = NO

K2.	If this control has been supplied with the #9181-22B built-in 2-1/4" printer, the **BUILT-IN-PRINTER** is the correct setting (should have been set at the factory).

If this control has been supplied without a printer to drive your external serial printer, **"EPSON" PRINTER** is the correct setting.

K3.   If the type printer shown on the display **is** correct, press **0** to exit without changing.

If the type printer shown on the display is **not** correct, press **1** to change to the other type. The new type printer will be displayed, and then the system will exit this program.

SELECTING WHAT WILL BE PRINTED

K4.   The SOLUTION-2 can print in two modes:

PRINT ALL WELDS: This printing mode will print lines of data for **every** weld made even if all functions measured are within proper range.

PRINT FAULTS ONLY: This mode will print only welds that have at least one out of range measurement. This can be **CURRENT** (with option #9181-22A or #9181-22B), **TIP FORCE** (with option #9181-05), or **LINE VOLTAGE** (with option #9181-06A).

K5.   To select the desired printing mode, press: **PROGRAM, 81, ENTER.** The display will alternately show:

<div align="center">

PRINT FAULT ONLY

or

PRINT ALL WELDS

CHANGE 1 = YES, 0 = NO
</div>

K6.   If the correct printing mode is being displayed, press **0**. If the display is not correct, press **1**. The new printing mode will now be displayed. **SEE SECTION 0P-17 FOR PRINTER OPTION OPERATION.**

<div align="center">

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-24
</div>

M4.   **PRINTING BASIC SYSTEM SETTINGS:** By pressing: **PROGRAM, 86, ENTER,** you will display the software version. If a printer option is installed in this control, the printer will now record control system settings. These are the same settings shown when the control is first being powered **ON.**

<div align="center">

L. SELECTING LOAD CELL RANGE
</div>

If your control does not have the #9181-05C **LOAD CELL** option installed, skip to page SU-25.

The SOLUTION-2 control can measure **TIP FORCE** with one of two optional devices: **A DIFFERENTIAL PRESSURE TRANSDUCER,** or a **DIRECT READING LOAD CELL.** The control must be set for the correct device for all readings to be accurate.

L1.   To check the **TIP FORCE** device and setting, press: **PROGRAM, 87, ENTER, 98.** The display will show:

<div align="center">

SCALE MULT. = ##.#
</div>

L2.   If this control utilizes the #9181-05 **DIFFERENTIAL PRESSURE TRANSDUCER** option, it should have been factory set at a value of 00.0. If this is not on the display, enter **000, ENTER**. The system will now be ready for operation.

L3.   If this utilizes the #9181-05D **LOAD CELL** option, it should have been set at the factory at a value to match the full load range of the load cell. This number should be the range shown on the load cell divided by 100.

      For example, for a 0-250 LB load cell, the **SCALE MULT.** should be 02.5. If the number on the display is not correct, make the proper entry and then press **ENTER**. The system will now be ready for operation.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-25

M. SETTING COUNTER FUNCTION

M1.   The SOLUTION-2 incorporates a multi function counter system. It will allow counting of individual welds or complete parts. To use this system, press: **PROGRAM, 91, ENTER,** and the display will show:

PARTS MADE   or   **##### WELDS MADE**

Then alternately display:

RESET COUNTER ?

PRESS: 1 = YES, 0 = NO

M2.   If you want to set the counter to zero, press **1**. Otherwise to leave the count press **0**.

Now the display will alternately show:

COUNTER IS ON

CHANGE 1 = YES, 0 = NO

M3. If the counter is to be turned OFF so that welds will not be counted, press **1**. In this case, when each **LINK** has been completed, the display will continue to show the welding sequence just used(i.e., **S, W, H,** etc.) rather than the count. In this way you know that if the counter **is** being displayed, it is turned on and operating. To leave the counter **ON**, press **0**.

M4. **COUNTING PARTS WHEN USING CHAINS**

The display will now give choices on counting **PARTS** or **WELDS.**

If the control has been set to use any of the three CHAIN modes (PROGRAM 79 set to: **3-CHAIN, 2-STAGE** or **7-CHAIN, 1 STAGE** or **15-CHAIN-BIN**.), the display will be:

CHAINS / PART ###

If a part is to be completed using one CHAIN (any number of LINKS) and you want to count **COMPLETED PARTS** either **00000** or **00001** will work. In this case, the display will show:

PARTS MADE
at the end of every CHAIN.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-26

M. SETTING COUNTER FUNCTION(continued)

Note that if the control has been set to loop chains and/or use a string of chains (any mode in PROGRAM 80 **except** ONE CHAIN ONLY), the displayed count will be made at the **end** of the **last** CHAIN no matter how many were used or how many times they were looped. In this way, the **PARTS MADE** count should represent the actual number of weldments produced.

In some cases, welding will be done on one part of a component, the component moved, and then **the same exact pattern repeated at another place on the same part.** In this case, enter the number of chains required for completion. Note that if you are looping and/or using strings of chains (any mode in PROGRAM 80 **except** ONE CHAIN ONLY), a "CHAIN" count will be the entire group.

In this case, enter the number of total CHAINS (or complete CHAIN groups) required to complete the part. Every time that number has been completed, the counter will index **one** number to actually represent the finished PARTS produced.

M5. **COUNTING WELDS OR PARTS WHEN NOT USING CHAINS**

If the control is in **BINARY PROGRAM SELECT** mode (PROGRAM 79 set to: 75-PROG-BINARY), the SOLUTION-2 does **not** know how many welds are required to

produce a finished part. Therefore, in this case, the display of PROGRAM 91 will automatically change to:

WELDS / PART ###

If **00000** or **00001** is entered, the counter will assume that you want to count WELDS **only**, and after each weld, the indexed number **one** will display:

WELDS MADE

If **00002** or greater is entered, the counter will assume that you want to count **PARTS.** After this number of welds have been completed, the display will be indexed by **one** and display:

PARTS MADE

IMPORTANT NOTE: If a particular PROGRAM does **not** have any welding functions (i.e., only valve and time dwells), the system will **not** count that operation as a WELD. For example, if the PLC chooses fifteen different PROGRAMS to complete a part and only three have weld heat functions, the counter will see this as **3 WELDS** and count accordingly.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-27

N. SELECTING FULL CYCLE OR HALF CYCLE COUNT TIMING

N1.   This control has the ability to use ½ cycle of weld heat, or even an odd number of ½ cycles. This is useful for welding very thin materials.

To use, press: **PROGRAM, 93, ENTER.** The display will show:

FULL CYCLE COUNT

CHANGE 1 = YES, 0 = NO

If it is desired to use ½ cycle count for the WELD portion only, press **1** (to change). If this is done, the display will show:

HALF CYCLE COUNT

If you are **not** welding with ½ cycle of weld heat, skip to N3.

N2.   If using ½ cycle of weld on thin materials, the direction of this ½ cycle of weld heat (positive or negative) often has a noticeable effect on the weld strength. Since the actual direction of this current is a combination of control signal and transformer wiring, the direction when first connected is a "coin toss".

Therefore make a weld with the system in the default **POSITIVE** direction, then one in the **NEGATIVE** direction. Set the control in the direction that makes the best weld.

To set the direction, press: **PROGRAM, 94, ENTER.** The display will show:

POSITIVE START

CHANGE 1 = YES, 0 = NO

To change direction, press **1**. The display will now show:

NEGATIVE START

N3.   Normal spot welding is done with a maximum of 99 cycles of weld time. However, if you are using this system for **RESISTANCE BRAZING** or **RESISTANCE ANNEALING** processes, 99 cycles of time (1.65 seconds) is probably not long enough.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-28

N. SELECTING FULL CYCLE OR HALF CYCLE COUNT TIMING(cont.)

To change the system to a maximum of 999 cycles of time (16.5 seconds), press: **PROGRAM, 95, ENTER.** The display will show:

0-99 CYCL. WELD

CHANGE 1 = YES, 0 = NO

To change, press **1**, and the display will show:

0-999 CYCLE WELD

When the system is in this extended time, three digits will be available in each weld program for data entry.

O. SELECTING CHAIN SPEED

If this control contains only one SCR, skip to the next section on page U-1.

If this control uses **more than one SCR** and will fire many transformers **in cascade**, the time between firing of each SCR can have a noticeable effect on the overall time required to run a large part. This is particularly important in cross wire or other pass-through welders that have many SCR firings per row and many rows per part.

Under normal operation, the upper row of display on the **SOLUTION** console shows the CHAIN being operated and the last LINK just performed. This is useful for diagnostic purposes. However, this display routine takes computer time. Elimination of this feature will gain approximately 2 line cycles between each SCR firing. Therefore, in a welder that has 8 SCRs fired in cascade, the display between welds will add extra time of 7 X 2 cycles or 14 line cycles of time per row of welds. In 20 rows of welding, this will account for 280 line cycles or 4.7 seconds of time.

If saving of this time is important, press **PROGRAM, 87, ENTER, 90.** The display will show:

<div align="center">

STD. SPEED RUN   standard speed

CHANGE 1 = YES, 0 = NO

</div>

To eliminate the upper row display during the chain, press **1**. The display will show:

<div align="center">

HIGH SPEED RUN

</div>

Note that in this mode, if the **SINGLE** button has been pushed (to operate the CHAIN one link at a time), the upper row display will appear to aid in trouble shooting.

<div align="center">

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-29

P. CHOOSING LIGHT CURTAIN FUNCTION

</div>

P1.   The SOLUTION-2 has a special function available to monitor a LIGHT CURTAIN input. The function uses the PS-4 input port and eliminates PS-4 response in all programs.

P2.   If you **are** using a LIGHT CURTAIN, set the SOLUTION-2 for this function by pressing: **PROGRAM, 87, ENTER, 93.** The display will show:

<div align="center">

PS4 = PROX. SWITCH

CHANGE 1 = YES, 0 = NO

</div>

P3.   At this time, the control is set to use **PS4** input as a normal proximity switch port. That is, it will monitor the requested condition in each LINK and wait until that condition (TO BE OPEN, TO BE CLOSED, or TO BE EITHER) has been satisfied before moving forward. To change this to act as a **LIGHT CURTAIN** function input, press **1** and the display will show:

<div align="center">

PS4 = LIGHT CURTAIN

</div>

P4.   **LIGHT CURTAIN OPERATION**

Your LIGHT CURTAIN should be set so that breaking of the beam will **open** the circuit connected to PS4 on the SOLUTION-2. If the beam is clear, the circuit will **close**.

The sequence of operation is as follows:

CONDITION 1: Light Curtain beam is **already broken** when initiation is tried.

RESPONSE:

a.   The display will show:

LIGHT CURTAIN OPN

and the control will not start operation.

b.   If, while initiation is **still closed** the light beam is cleared, the display will show:

RELEASE INITIAT.

and no operation will be started.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-30

P. CHOOSING LIGHT CURTAIN FUNCTION(cont.)

d. Once the initiation has been released, the display will show:

PLEASE INITIATE

and wait for the initiation switch to be closed before the operation begins.

CONDITION 2: Curtain is broken when system is **anywhere** in a LINK.

RESPONSE:

a.   The display will show:

LIGHT CURTAIN OPN

b.   Even if weld heat has started to flow, welding will stop and all valves that came in at the **start** of **that** LINK will be released. If any of the valves were already on from the previous LINK (i.e., previous link had either SV# **ON , END ON,** or **SV# OFF, END ON**), these valves will remain in the **ON** condition.

c.   If the light curtain has been cleared but the initiation is still closed, the display will show:

RELEASE INITIAT.

and no operation will be started.

d.   With the light curtain cleared, once the initiation has been released, the display will show:

PLEASE INITIATE

and wait for the initiation switch to be closed before the operation begins. The sequence will start at the **beginning** of the LINK where the light curtain was opened.

e.   If Emergency Stop is pushed (even if the curtain is still broken), the **CHAIN** will be reset, and all valves will be opened.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-31

Q. ASSIGNING FAULT AND ACCEPT RELAY OUTPUTS

Q1.   The SOLUTION-2 monitors various conditions during the welding sequence. These include:

a.   WELDING CURRENT (0ption #9181-22A or #9181-22B)
b.   ELECTRODE FORCE out of range (Option #9181-05C)
c.   LINE VOLTAGE out of range (Option #9181-06A)
d.   HEAT STEPPER exhausted (Option #9281-15)

Q2.   In each of these functions, you can decide which of three relays you want to transfer and (except for the HEAT STEPPER) if you want the assigned relay transfer for a FAULT or for an ACCEPT sequence. To assign functions to relays, press: **PROGRAM, 97, ENTER**. The display will show:

CURRENT TEST FOR
NOT ASSIGNED = 7

CHANGE 1 = YES, 0 = NO

This means that **if Option #9181-22A or #9181-22B is in this control** and an out of current condition is detected, no output relay will be operated.

Q3.   If **1** is pressed, the display will show the following one after the other:

CURRENT TEST FOR   Current out of range will cause
REJECT – MAJOR = 1   the **MAJOR** relay to close

CURRENT TEST FOR **ACCEPT – MAJOR = 2**	Current within range will cause the **MAJOR** relay to close
CURRENT TEST FOR **REJECT – MINOR = 3**	Current out of range will cause the **MINOR** relay to close
CURRENT TEST FOR **ACCEPT – MINOR = 4**	Current within range will cause the **MINOR** relay to close
CURRENT TEST FOR **REJECT – SPECIAL = 5**	Current out of range will cause the **SPECIAL** relay to close
CURRENT TEST FOR **ACCEPT – SPECIAL = 6**	Current within range will cause the **SPECIAL** relay to close
CURRENT TEST FOR **NOT ASSIGNED = 7**	No relay will close for either Current within or out of range

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-32

Q. ASSIGNING FAULT AND ACCEPT RELAY OUTPUTS(cont.)

Q4. Press the number that matches your desired response. In this way an external system (i.e., PLC, etc.) can monitor either FAULTS or GOOD conditions for each weld.

Q5. The display will now show:

> **FORCE TEST FOR**
> **NOT ASSIGNED = 7**
>
> **CHANGE 1 = YES, 0 = NO**

This means that **if option #9181-05C is in this control,** and the Electrode Force is above or below the selected window, no relay will be operated.

Q6. If **1** is pushed, the following will be displayed:

FORCE TEST FOR **REJECT – MAJOR = 1**	Force out of range will cause the **MAJOR** relay to close
FORCE TEST FOR **ACCEPT – MAJOR = 2**	Force within range will cause the **MAJOR** relay to close
FORCE TEST FOR **REJECT – MINOR = 3**	Force out of range will cause the **MINOR** relay to close
FORCE TEST FOR	Force within range will cause

ACCE[T – MINOR = 4	the **MINOR** relay to close
FORCE TEST FOR REJECT – SPECIAL = 5	Force out of range will cause the **SPECIAL** relay to close
FORCE TEST FOR ACCEPT – SPECIAL = 6	Force within range will cause the **SPECIAL** relay to close
FORCE TEST FOR NOT ASSIGNED = 7	No relay will close for either Force within or out of range

Q7. Press the number that matches your desired response. In this way an external system (i.e., PLC, etc.) can monitor either FAULTS or GOOD conditions for each weld.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-33

Q. ASSIGNING FAULT AND ACCEPT RELAY OUTPUTS(cont.)

Q8. The display will now show:

> **VOLTAGE TEST FOR**
> **NOT ASSIGNED = 7**
>
> **CHANGE 1 = YES, 0 = N0**

This means that **if option #9181-06A is in this control** and if the LINE VOLTAGE is more than + / -10% from the original setting made in PROGRAM 89 (during original setup procedure), the control will not cause any relays to close.

Q9. If **1** is pushed, the following will be displayed:

VOLTAGE TEST FOR REJECT – MAJOR = 1	Voltage out of range will cause the **MAJOR** relay to close
VOLTAGE TEST FOR ACCEPT – MAJOR = 2	Voltage within range will cause the **MAJOR** relay to close
VOLTAGE TEST FOR REJECT – MINOR = 3	Voltage out of range will cause the **MINOR** relay to close
VOLTAGE TEST FOR ACCEPT – MINOR = 4	Voltage within range will cause the **MINOR** relay to close
VOLTAGE TEST FOR REJECT – SPECIAL = 5	Voltage out of range will cause the **SPECIAL** relay to close

VOLTAGE TEST FOR **ACCEPT – SPECIAL = 6**	Voltage within range will cause the **SPECIAL** relay to close
VOLTAGE TEST FOR **NOT ASSIGNED = 7**	No relay will close for either Voltage within or out of range

Q10. Press the number that matches your desired response. In this way an external system (i.e., PLC, etc.) can monitor either **FAULTS** or **GOOD** conditions for each weld.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

Q. ASSIGNING FAULT AND ACCEPT RELAY OUTPUTS(cont.)

Q11. The display will now show:

> **EXPIRED STEPPER**
> **NOT ASSIGNED = 4**
>
> **CHANGE 1 = YES, 0 = NO**

This means that **if option #9182-15 is in this control,** and one or more **HEAT STEPPER** has expired, no relay will be operated.

Q12. If **1** is pushed, the following will be displayed:

EXPIRED STEPPER **A MAJOR OUTPUT = 1**	An expired stepper will cause the **MAJOR** relay to close
EXPIRED STEPPER **A MINOR OUTPUT = 2**	An expired stepper will cause the **MINOR** relay to close
EXPIRED STEPPER **A SPEC. OUTPUT = 3**	An expired stepper will cause the **SPECIAL** relay to close
EXPIRED STEPPER **NOT ASSIGNED = 4**	An expired stepper will not cause any relay to close

Q13. Press the number that matches your desired response. In this way an external system (i.e., PLC, etc.) can monitor when one or more stepper has expired.

R. SETTING TIME FOR FAULT AND EHR (END OF HOLD) RELAY TO REMAIN CLOSED

R1.   For any of the above fault or accept conditions, the assigned relay(s) will close. If **no** fault is detected, the EHR relay will close. The time of all relay closings is determined by a setting you install.

R2.   To set this time delay, press: **PROGRAM, 87, ENTER, 90.** The display will show:

FLT / EHR RELAY = ##   CHANGE 1 = YES, 0 = NO

R3.   Enter the amount of time, in line cycles, for the relay(s) to close. For example, ¼ second closure = 15 cycles (15/60 sec.). If there are more than one fault detected on a weld, **all** fault relays will close **at the same time** and release at the same time. If this happens in the last **LINK** of a **CHAIN,** the EHR relay will close **after** the fault relays have been released.

SOLUTION-2 #9280

INITIAL SET-UP PROCEDURE

PAGE SU-35

S. KEYBOARD SECURITY LOCK SYSTEM

The SOLUTION-2 control has a two level security lock system. There are two levels of security:

1. **STANDARD KEYLOCK:** This mode is a typical security level used for most **manually operated welders.** It allows the ability to view programs, view chains, but will not allow any changes to be made.

2. **TOTAL KEYLOCK:** This mode is typically used on **automatic welding systems where absolutely no change is allowed.**

If the key switch is in the **locked** position, and a change to any locked function is attempted, the control will refuse to make such a change, and the display will show **"KEYBOARD LOCKED".**

To select the desired KEYBOARD SECURITY LOCK mode:

1.   Press: PROGRAM, 87, ENTER, 96. The display will show:

KEYBOARD LOCK IS   or   **KEYBOARD LOCK IS**
STANDARD KEYLOCK   **TOTAL KEYLOCK**

CHANGE 1 = YES, 0 = NO

Select the desired keylock mode by pushing **1** to change the display as shown, or **0** to keep the mode as shown. Note that when the control is first turned on, the **KEYLOCK** mode will be one of the phrases displayed during the diagnostic test.

DIRECTIONS FOR USE

SIMPLE - LOGICAL - POWERFUL

Think of the SOLUTION-2 programming as connecting a series of LINKS in a CHAIN. Each LINK of the CHAIN contains a PROGRAM.

Each **PROGRAM** consists of a complete set of instructions that you enter to operate valves, check inputs, and, if desired, do a complete weld sequence (SQUEEZE, WELD, HOLD, ETC.). There is space for **75 complete PROGRAMS** in the **SOLUTION-2** memory.

Notice that since the same **PROGRAM** can be used in any number of **LINKS**, it is only necessary to enter repetitive operations one time.

The **SOLUTION-2** then performs the selected **PROGRAMS** one LINK at a time. By selecting various operating modes, this sequence can be continuous, or can be interrupted at various points and continued as desired.

The **SOLUTION-2** comes with the ability to store and use up to **7 different CHAINS**.

Each **CHAIN** can have up to **45 LINKS**.

Each **LINK** can select from **75 PROGRAMS** in the control's electronic memory bank.

SOLUTION –2 #9280

DIRECTIONS FOR USE

PAGE U-2

SOLUTION-2 FLOW SEQUENCE

Think of the SOLUTION-2 as a logical **CHAIN**. Once you have initiated the **CHAIN** (by closing a switch), the SOLUTION-2 control performs the instructions of the first **LINK** of this **CHAIN**, then the next **LINK** of the **CHAIN**, and so forth until all **LINKS** of this **CHAIN** have been completed.

You assign a **PROGRAM** (one of 75 in memory) to each **LINK**.

Each **PROGRAM** contains lines that direct how valve outputs, proximity switch inputs, and welding functions will function.

_____

SETS BEGINNING VALVE CONDITIONS

If   SV# - **ON**, END OFF   or   SV# - **ON**, END ON   turns **ON** valve #

If   SV# = **OFF**, END OFF   or   SV# = **OFF**, END ON   turns **OFF** valve #

This sets conditions for all valve (SV#) outputs (4 to 16).
_____

then

_____

CHECKS TIP FORCE (#9181-05 OPTION)

If this option is in system, reads DIFFERENTIAL PRESSURE TRANSDUCER and displays **WAIT: TIP FORCE** until the selected TIP FORCE has been reached.

If system has **more** than **one** PRESSURE TRANSDUCER, control monitors transducer per line: **USE TRANSDUCER ##**

_____

then

_____

INTERROGATES PROXIMITY SWITCH INPUTS

If line in PROGRAM is: PS# TO BE **EITHER**

does not sample this PS# input and continues to the next line.

If line in PROGRAM is: PS# TO BE **CLOSED**

waits until input PS# goes **high** before going to the next line. While waiting, control displays: **CLOSE PS#** until satisfied.

If line in PROGRAM is: PS# TO BE **OPEN**

waits until input PS# goes to **0** before going to the next line. While waiting, control displays: **OPEN PS#** until satisfied.

The control checks PS1 first, then each successive PS (up to 5) and will not continue to the next function until all conditions have been satisfied.

NOTE: If the PS4=LIGHT CURTAIN has been chosen in PROGRAM 87 / 93 the control will ignore anything entered on the PS4 line.

_____

then
_____

WAITS FOR SQUEEZE/DWELL TIME
Waits for the number of cycles in PROGRAM line:
SQUEEZE / DWELL = ##.

Each cycle is 1/60 second.
_____
then
_____

PERFORMS WELDING SEQUENCE

Fires welding transformer with the SCR contactor, from **PREHEAT**

through **HOLD TIME**, as directed by values you have entered in this PROGRAM.

If control has **more** than one SCR, SCR firing signal will be sent to SCR specified in line: **SCR NUMBER = ##**

_____

SOLUTION-2 FLOW SEQUENCE (cont)

_____

SETS <u>FINAL</u> VALVE CONDITIONS FOR PERIOD OF TIME BEFORE NEXT LINK

All valves will now be set for the **END** condition during the time specified in this PROGRAM as: **DWELL BETWEEN = ##.**

If   SV# = ON, **END OFF**   or   SV# = OFF, **END OFF**   turns **OFF** valve #

If   SV# = ON, **END ON**   or   SV# = OFF, **END ON**   turns **on** valve #

If a valve is controlling a component such as a clamp that is to **remain closed** for the entire process, set that valve using the **SV# = ON, END ON** instruction.

If a valve is being used to index the system between LINKS, or to eject a part between LINKS, use **SV# = OFF, END ON.**

_____

then

_____
STOPS OR CONTINUES PROGRAM

If program line is: **PROGRAM STOP = NO** control **will exit this LINK . .**

If program line is: **PROGRAM STOP = YES,** control **will stop** at this point and **wait** for a new initiation. If the initiation input is still closed, it must be released and closed again.

While waiting for a new initiation, the display will show: **PROGRAM STOP**

_____

then goes to the next LINK

ASSEMBLE THE CHAIN

You "assemble" the **CHAIN** in **PROGRAM 80** by assigning a **PROGRAM** to **LINK 01**, another to **LINK 02,** etc. A **CHAIN** can have up to 45 **LINKS**.

Note that you can assign a particular **PROGRAM** to more than one **LINK** if the exact sequence within this **PROGRAM** is needed more than one time within the **CHAIN. PROGRAMS** do not need to be used in any particular order. This allows changing of sequences, or inserting functions between sequences without having to rewrite existing **PROGRAMS.**
* *

THAT'S ALL THERE IS TO UNDERSTANDING THE OPERATION OF THE **SOLUTION-2!**

SOLUTION-2 #9280
DIRECTIONS FOR USE

PAGE U-5

THREE SIMPLE STEPS TO MAKE A CHAIN

Setting information into the SOLUTION-2 is done in a very logical and simple procedure using the following three steps for each **CHAIN:**

* *

STEP 1: DEFINING THE TASK

Write out the overall **TASK** to be accomplished in a simple **"START TO FINISH"** sequence.

For example:
a.   Operator places channels and hinges on panel using a drop-in fixture.
b.   With the foot pedal held down, 12 welds are made along top edge joining top angle to panel.
c.   After operator rotates part, three hinges are welded along one long edge using 3 spots per hinge.
d.   After operator rotates part, last 9 welds are made along bottom edge to join bottom angle to panel.

* *

STEP 2: ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION

2.1   Write, step by step, the exact condition of INPUTS and OUTPUTS and desired WELDING PROGRAM (if any) for each **LINK** of the **CHAIN** for operation as shown in the FLOW SEQUENCE on the previous pages. Keep in mind that a program used in **one LINK** can contain both INPUT/OUTPUT instructions as well as welding data.

2.2   Select a **PROGRAM** number for **each** unique combination of valve operations, input monitoring, and welding sequence (if any). This **PROGRAM NUMBER** can be random, or can be some scheme that makes sense within your product mix.

        For example, an operation loaded into a **single PROGRAM** can be:

OPERATION #1 (welding of angles to panel)

a.   Bring weld head down using SV1.
b.   Check to be sure that PS1 proximity switch is closed.
c.   Weld using the following schedule:

                TIP FORCE = 550 POUNDS

<div align="center">

WELD = 12 CYCLES at 76%
HOLD TIME = 5 CYCLES

</div>

d.   After the end of HOLD TIME, release SV1 to bring weld head UP.
e.   Wait for 35 cycles
f.   Put above information in PROGRAM 6 as follows:

<div align="center">

SOLUTION-2 #9280
DIRECTIONS FOR USE
PAGE U-6
THREE SIMPLE STEPS TO MAKE A CHAIN
ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION(cont.)

PROGRAM 06

SV1 ON, END OFF
PSI TO BE CLOSED
WELD TIME   12
WELD HEAT   76%
HOLD TIME   05
DWELL BETWEEN = 35
TIP FORCE 0550LB

</div>

2.3   Enter the desired functions for each unique group of functions from above by pressing:
        PROGRAM, ##, ENTER, where ## is a number you select between 01 and 75. The
        display will now show, line by line, the information as shown in the chart shown on page
        U-7.
2.4   Enter the desired values and conditions on each line and then press **ENTER** to step to
        the next line.

<div align="center">

STEPPING THROUGH A PROGRAM

</div>

Each time the **STEP** button is pushed momentarily , the next line will appear.

If the **STEP** button is pushed and **held down**, lines in the PROGRAM that either contain data
(01-99), have CLOSED selected (limit switches), or have ON selected (valves) will be shown for
½ second each. If the **STEP** button is released, the last line will remain.

Each time the **BLOCK** button is pushed, the next block of data will be shown. These blocks are
shown on page U-7 between lines.

If you go to a line that is **past** the one desired, push the **BACK** button one time for each
backstep.
2.5   On lines that have space for a number (i.e., WELD TIME, etc.), enter the number using
        the appropriate key strokes.
2.6   On lines that show a condition (i.e., SV1, PS1 etc,) press **any** of the numbered buttons
        on the keypad to change the display.
2.7   For the Proximity Switch condition lines, one of three conditions (i.e., PS1 TO BE
        EITHER, PS1 TO BE OPEN, PS1 TO BE CLOSED) can be selected by pushing any
        numbered button on the keypad. Each push will show the next state and will start from
        the top after the last one has been displayed.
        If four states can be used (i.e., SV1 OFF, END OFF; SV1 ON, END OFF; SV1 ON, END
        ON, SV1 OFF, END ON), each button push will go to the next state. Then the series will
        start over again.
2.8   Remember that even though this combination will be repeated many times, it only has

to be entered **one** time.
2.9   The displays will be shown in the following order. If, in the SET-UP procedure in
        PROGRAM 87/01, less than the full quantity of SV (valve outputs) and PS (proximity
        switch inputs) are chosen, extra lines will be eliminated in each table.

THREE SIMPLE STEPS TO MAKE A CHAIN
ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION(cont.)

75 PROGRAMS EACH CONTAIN THE FOLLOWING LINES
THAT ARE USED PER THE FLOW SEQUENCE ON PAGES U-2 THROUGH U-4

SV1 OFF(or ON), END = OFF(or ON)	Turns indicated valve output ON or
SV2 OFF(or ON), END = OFF(or ON)	OFF at the <u>start</u> of this program,
SV3 OFF(or ON), END = OFF(or ON)	then turns the valve ON or OFF at
SV4 OFF(or ON), END = OFF(or ON)	the <u>end</u> of this program
SV5 OFF(or ON), END = OFF(or 0N)	
To	Same function as above for optional
SV16 OFF(or ON), END = OFF(or ON)	valve outputs SV5 – SV16
PS1 TO BE OPEN/CLOSED/EITHER	condition of PS1 input before continuing)
PS2 TO BE OPEN/CLOSED/EITHER	condition of PS2 input before continuing)
PS3 TO BE OPEN/CLOSED/EITHER	condition of PS3 input before continuing)
PS4 TO BE OPEN/CLOSED/EITHER	condition of PS4 input before continuing)
PS5 TO BE OPEN/CLOSED/EITHER	condition of PS5 input before continuing)

SQUEEZE/DWELL TIME (time before current flow, or just a dwell time)
WELD TIME
WELD HEAT %
HOLD TIME
TRANSFORMER TAP NUMBER (records transformer tap switch position)
DWELL BETWEEN (dwell time between links)
INITIAL SQUEEZE TIME (in continuous welding, SQUEEZE for first weld only)
NUMBER OF PULSES
PULSAT. COOL 2 (cool cycles between pulses when in PULSATION)
PREHEAT TIME
PREHEAT %
PREHEAT COOL 1 (cool time between PREHEAT and WELD. For galvanized)
UPSLOPE INITIAL %
UPSLOPE TIME
DOWNSLOPE TIME
DOWNSLOPE FINAL %
POSTHEAT TIME
POSTHEAT %
QUENCH TIME
TEMPER TIME
TEMPER HEAT
PROGRAM STOP YES/NO stops sequence **after** HOLD, starts on re-initiation)
TIP FORCE (differential pressure transducer/load cell option)
READ TRANSD. #   (option: selects pressure transducer being used
HIGH CURRENT LIMIT (optional, current monitor)
LOW CURRENT LIMIT   (optional, current monitor

SCR NUMBER   optional, for up to 15 SCR contactor systems)
STEPPER NUMBER   optional, selects HEAT STEPPER 1 to 16)
SEAM/PS3 CL.   (Used to do SEAM WELDING in a LINK. See page U-8.

SOLUTION-2 #9280
DIRECTIONS FOR USE
PAGE U-8
SEAM WELDING IN A LINK

2.10 **SEAM WELDING** can be done in any LINK of the CHAIN. To do this, go to the last line in the desired PROGRAM. It will show:

SEAM / PS3 CL. = NO   **CHANGE 1 = YES, 0 = N0**

Press **1** to change. If **CONTINUOUS SEAM** operation is desired, set WELD TIME to 4 and WELD HEAT to desired value. If **INTERMITTENT SEAM** is desired, set **WELD TIME** to the number of ON cycles desired, and **PULSAT.COOL 2** time to the desired number of OFF cycles. When you enter the LINK that contains this PROGRAM, the control will make one WELD pulse and then check to see if **PS3** is still **CLOSED.** If it is **CLOSED,** it will continue. Seam will stop when **PS3** has been **OPENED.**

2.11 When this program is used for one or more links, the system will use this data as shown in the FLOW SEQUENCE on pages U-2 through U-4.

2.12 **NOTE ON INTENSIFIER VALVE FUNCTIONS:** If you are operating INTENSIFIER TYPE welding cylinders, assign the FLUID TANK air line to one SV output and the INTENSIFIER line to a second SV output.

If your system **uses** a PRESSURE SWITCH on the INTENSIFIER air line, connect this to one of the PS inputs. Set the FLUID TANK SV output as an <u>ON, END = ON</u> in one LINK. In the **next** LINK of the CHAIN, select <u>ON, END = OFF</u> for both this SV as well as the SV used on the INTENSIFIER line.

If your system does **not** use a PRESSURE SWITCH on the INTENSIFIER air line, set the FLUID TANK SV output as an <u>ON, END = ON</u> and enter a DWELL TIME long enough to allow electrode closing (typically 15-25 cycles). In the **next** LINK select <u>ON, END = OFF</u> for both this SV as well as the SV used on the INTENSIFIER line.

In either case, if your control has been supplied with a **DIFFERENTIAL PRESSURE TRANSDUCER** option, connect the HIGH (red) tubing to the INTENSIFIER port of the cylinder and the LOW (green) tubing to the RETURN port of the cylinder.

2.12.1 **NOTE ON MULTIPLE SCR OPERATION:** If more than one SCR contactor is being used, enter the desired **SCR NUMBER** to be fired in this link. If **no** welding will occur during this link, set the **SCR NUMBER = 0.**

2.12.2 **MPORTANT <u>SAFETY</u> NOTE ON VALVE PROTECTION CHOICE:** Valve outputs are protected against operation before a hard input switch has been closed. This is done through use of an electromechanical relay that only allows 115V. to the valve solid state input chips when an input switch has been closed.

A plug jumper is provided for each valve (SV) output channel. **Always place the jumper plug in the <u>SPURIOUS OPERATION SAFETY-ON</u> position for any SV output that operates a welding cylinder or any device that can injure personnel.**

The jumper plug can be installed in the <u>SPURIOUS OPERATION SAFETY-OFF</u> position <u>ONLY IF</u> operation of this output cannot cause injury to the operator. This can allow an output to stay ON after the last LINK has been performed.

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-9

THREE SIMPLE STEPS TO MAKE A CHAIN

STEP 3: ASSEMBLING THE CHAIN

It is now time to "assemble" the **LINKS** of the **CHAIN.**

3.1.1   The control has to know how many **CHAINS** will be used and how many **LINKS** will be in each chain. To make things simple the first time around, let's only work with **one** chain.

3.1.2   To this, press: **PROGRAM, 80, ENTER.** The display will now show:

CHAIN SETUP

TOTAL CHAINS # =

3,.3   For this first time, enter **1, ENTER.** The display will now show:

CHAIN #1

NO. OF LINKS = 00

3.4.1   Enter the desired number of **LINKS** for this part. You can come back later and change this number if the sequence is shorter or longer than originally planned.

Remember that each **LINK** will use the **PROGRAMS** set in STEP #2 on the previous pages. Even if the same **PROGRAM** is used many times in the chain, you must count every time it is used as <u>**one** LINK.</u>

3.4.2   Now press **ENTER** and the display will show:

CHAIN #1

LINK 01 = PROG. –

3.61.1 Enter the **PROGRAM** number that contains desired operational instructions to be used just after the initiation switch has been closed. This will form the **first LINK** in the **CHAIN.**

3/7   When this has been done, press **ENTER** and the display will show:

CHAIN #1

LINK 02 = PROG. --

THREE SIMPLE STEPS TO MAKE A CHAIN

STEP 3: ASSEMBLING THE CHAIN(continued)

3.8.1   As with the first **LINK,** enter the **PROGRAM** that will do the desired operation during the second sequence after initiation.

3.9 Continue in this manner until the last **LINK** has been assigned (the number of links is set in step 3.4 on the previous page). After you enter the last **LINK** and press **ENTER**, the display will show:

<div align="center">

CHAIN #1

ONE CHAIN ONLY = 1

CHAIN #1

CHANGE 1 = YES, 0 = NO
</div>

BACKSTEP: If you press the BACK button on the keypad while in the middle of a **CHAIN,** the control will go to the previous line. This can only be done if you are working on a **CHAIN** that has already been programmed.

BLOCK KEY: If you press the BLOCK button, the control will step forward to the next **CHAIN.** The number of the current chain will always be shown at the top of the display.

DWELL BETWEEN: A time delay can be inserted after one **LINK** and before the next **LINK** using this line in the **PROGRAM** before the desired delay. This can be used to allow tooling to move out of the way between **LINKS.**

HOW CHAINS CAN BE USED

At this time, you can choose to operate this CHAIN #1 in one of six ways:

   a. **ONE CHAIN ONLY:** In this mode, the chain, as just assembled, will operate one time after initiation and then stop after the last link has been run.

   The sequence looks like:

<div align="center">

START CHAIN

RUN LINK 1

RUN LINK 2

RUN LASK LINK

STOP
</div>

THREE SIMPLE STEPS TO MAKE A CHAIN

STEP 3: ASSEMBLING THE CHAIN (continued)

b. **LOOP IF PS5 ON:** In this mode, the chain, as just assembled, will operate through the end of the last link. When this last link has been run, the control will sample the PS-5 proximity/limit switch input. If the PS-5 switch is **CLOSED** at that time, the **entire** chain will be run again from **link 1.**

This continues until PS-5 is read as **open** after running the last link. At this time, the system stops operation.

APPLICATION: This sequence is useful for operating a weld sequence that repeats many times as a part is being indexed or rotated. When the last weld operation has been performed, indexing will **open** a proximity/limit switch wired to PS-5 on the control, and all operations stop.

LOGIC SEQUENCE

INITIATE CHAIN

RUN LINK 1

RUN LINK 2
.
.
RUN LAST LINK

YES
IS PS-5 CLOSED?

NO

STOP

IMPORTANT NOTE: If you are using this mode, be sure that no more than four PS switches have been selected during the set-up procedure on page S-7. Otherwise any PS-5 condition instructions will be honored in each **PROGRAM.**

STEP 3: ASSEMBLING THE CHAIN (continued)

c. **PS5 OFF, NEXT:** In this mode, the chain, as just assembled, will operate through the end of the last link. When this last link has been run, the control will sample the PS-5 proximity/limit switch input. If the PS-5 switch is **CLOSED** at that time, the **entire** chain will be run again from LINK 1.

This continues until PS-5 is read as **open** after running the last link. At this time, the system starts operation of the **next** CHAIN. This continues until the last chain has been run.

APPLICATION: Like the **LOOP IF PS5 ON** mode above, this sequence is useful for operating a weld sequence that repeats many times as a part is being indexed or rotated. When the last weld operation has been performed, indexing will **open** a proximity/limit switch wired to PS-5 on the control. The control will now go to the next **CHAIN** that might be an eject procedure, a part rotation, or a pick-and-place sequence for loading other components into the fixture. This might then lead to the next chain that welds these new parts, or might just exit out.

You can even group chains in sets. For example, CHAIN 1 & CHAIN 2 might weld the left hand weldment with CHAIN 2 set as ONE CHAIN ONLY. Then CHAIN 3 & CHAIN 4 might be set to weld the right hand weldment with CHAIN 4 set for ONE CHAIN ONLY.

LOGIC SEQUENCE: In the following example, CHAIN 5 has been set for **PS5 OFF, NEXT** mode, and CHAIN 6 has been set for **ONE CHAIN ONLY** mode.

INITIATE CHAIN 3	**GO TO CHAIN 4**
RUN LINK 1	**RUN LINK 1**
RUN LINK 2	**RUN LINK 2**
.	**.**
.	**.**
RUN LAST LINK	**RUN LAST LINK**
YES	**STOP**

IS PS-5 CLOSED?

NO

IMPORTANT NOTE: If you are using this mode, be sure that a maximum of four PS switches has been selected during the set-up procedure on page SU-7.

SOLUTION-2 $9280

STEP 3: ASSEMBLING THE CHAIN (continued)\

d.   **DO NEXT CHAIN:** In this mode, the existing chain is completed and then the next starts.

APPLICATION: If the 45 LINKS of a chain are not enough to do the desired sequence, this **DO NEXT CHAIN** mode will allow operation of one chain after another. This can extend to the total 15 CHAINS of 45 LINKS each to give a total of 675 possible LINKS. Also note that in this mode, you can start from the middle of a group of CHAINS for test purposes (i.e., If CHAIN 2 and CHAIN 3 are connected, closing initiation for CHAIN 2 will operate both in sequence, but closing initiation for CHAIN 3 will only run CHAIN 3.

LOGIC SEQUENCE

INITIATE CHAIN 2	**GO TO CHAIN 3**
RUN LINK 1	**RUN LINK 1**
RUN LINK 2	**RUN LINK 2**
.	**.**
.	**.**
RUN LAST LINK	**RUN LAST LINK**
	STOP

In this mode, the chain, as just assembled, will operate through the end of the last link and then **repeat** for up to 99 times as chosen in the line **## REPEAT LOOPS.** After the last link of the last loop has been completed, the **next** CHAIN will start.

APPLICATION: This sequence is useful for operating a weld sequence that repeats many times as a part is being indexed or rotated. At the end of the last loop, the next CHAIN can be used to index the part and do another operation, or it can be used to eject the part.

LOGIC SEQUENCE

e.   **LOOP, NXT CHAIN:**

.   **INITIATE CHAIN 5**   **GO TO CHAIN 6**

              RUN LINK 1   **RUN LINK 1**

              RUN LINK 2   **RUN LINK 2**
                    .   .
                    .   .

              RUN LAST LINK   **RUN LAST LINK**

                            YES   **STOP**
              ANY LOOPS LEFT?

                          NOI

f.   **LOOP, THEN STOP:** In this mode, the chain, as just assembled, will operate through the end of the last link and then **repeat** for up to 99 times as chosen in the program line ## **REPEAT LOOPS.** After the last link of the last loop has been completed, the sequence stops.

      APPLICATION: This sequence is useful for operating a weld sequence that repeats many times as a part is being indexed or rotated.

LOGIC SEQUENCE

INITIATE CHAIN

RUN LINK 1

RUN LINK 2
.
.
RUN LAST LINK

                  YES
ANY LOOPS LEFT?

NO

STOP
SOLUTION-2 #9280
DIRECTIONS FOR USE

SELECTING CHAIN MODE

If the desired mode is already on the readout, press **0** (to not change), and skip to 3.10 below:

If it is desired to change the displayed mode, press **1** (to change), and the display will show:

CHAIN #1

ONE CHAIN ONLY = 1

CHAIN #1

LOOP IF PS5 ON = 2

CHAIN #1

PS5 OFF, NEXT = 3

CHAIN #1

DO NEXT CHAIN = 4

CHAIN #1

LOOP, NXT CHAIN = 5

CHAIN #1

LOOP, THEN STOP = 6

Press 1 – 6 to select the desired mode. Than press **ENTER.**

If either **LOOP, NXT CHAIN** or **LOOP, THEN STOP** is chosen, a new line will be shown on the display:

CHAIN #1

REPEAT LOOPS

Enter the **number of times** you want to **repeat** this CHAIN (01 – 99 times).

SOLUTION-2 #9280

DIRECTIONS FOR USE

SELECTING MANUAL OR AUTOMATIC CHAIN

3.10   The display will now show:

CHAIN #1

MANUAL CHAIN

or

CHAIN #1

AUTOMATIC CHAIN

CHAIN #1

CHANGE 1 = YES, 0 = NO

1. **AUTOMATIC CHAIN.** This mode is typically used with **PLC** controlled systems. In this mode. the initiation switches are closed only **one time** to start a chain into operation. Opening of the switch at any point in the chain will **not** stop the chain. Only opening of the EMERGENCY STOP switch will stop and reset a chain with this mode.

2. **MANUAL CHAIN:** This mode is typically used with a manually operated welder to allow stopping of a sequence at any point in the CHAIN. In this mode, opening of the initiation switches will **stop** the chain after the contents of the current link have been performed. **Closing** of the initiation switch **again** will continue the chain from this point. This can be done as many times as desired during a single chain.

If the mode shown on the display is not the one desired, press **1** to change to the alternate mode. If it **is** correct, press **0** to exit this program without making a change.

* *

THAT'S ALL THERE IS TO IT! YOU ARE NOW READY TO RUN PRODUCTION.

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-17

TESTING CHAIN

4.1.1   After the **CHAIN** has been assembled, press the **NO WELD** button **once.** The NO WELD and SINGLE LEDs will light. This will allow you to **STEP** through the entire **CHAIN** one link at a time **without welding** as you go through the following steps.

4.1.2   Now close the initiation switch to start **CHAIN #1** (see hook-up diagram for type of initiation mode being used), and the **SOLUTION-2** will display:

<div align="center">

1 / LINK = 01, PRG = ##
CLOSE PS1

</div>

The **upper** display shows that **CHAIN #1** is being used, **LINK 01** is being performed, and that this **LINK 01** is using **PROGRAM ##.**

The **lower** display shows that, in this example, the SOLUTION-2 is waiting for proximity switch connected to PS1 to **close.**

4.1.3   At the same time, the red window at the left corner of the main display will show which SV valve output is on at that time. Note that this will only show **SV1** through **SV8**. The balance are shown on indicator lights inside the main power enclosure. For example, if the display shows:

<div align="center">

1 2 4   7

</div>

this indicates that SV1, SV2, SV4, and SV7 are on at this time.

4.4   If all proximity switch (PS) conditions were met, this display would then show first:

<div align="center">

WAIT: TIP FORCE

</div>

If the #9181-05 **DIFFERENTIAL PRESSURE TRANSDUCER** option is installed. Then when the **TIP FORCE** matches that in the program, and if this **LINK** has welding data, the display will show:

<div align="center">

S   W   H

</div>

or other letters to indicate from left to right: **S**queeze time, **P**reheat, **C**ool time, **U**pslope, **W**eld, **D**ownslope, **P**ostheat, **Q**uench time, **T**emper, and **H**old time.

4.5   Each time the initiation switch is closed, the **LINK** number will increment by one, and the **PROGRAM** number will show that chosen during the **CHAIN ASSEMBLY** in Step #3. If at any time you want to stop this step-by-step process, press any button on the

4.6   keypad or press the external EMERGENCY STOP button, and the unit will reset.

<div align="center">

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-18

TESTING CHAIN (continued)

</div>

4.7   After you are satisfied that the **CHAIN** sequence is correct, press the **NO WELD** button **two times.** The NO WELD and REPEAT LEDs will light. Initiate the control as before.

4.7   The SOLUTION-2 will now go through all **LINKS** in the **CHAIN** without stopping but **will not weld**. Check pages SU-11 and SU-12 to see various ways that the initiation switch input will affect the operation of this **CHAIN.**

4.8   After the functions within the last **link** have been performed, the EHR relay will close for a period set in PROGRAM 87/90, the control beeper will sound briefly, and the control will reset. Even if the initiation switch is closed at this time, a new **CHAIN** will not start.

4.9   Now test this **CHAIN** one step at a time but **with** welding by pressing the **SINGLE** button and repeat the steps starting at 4.2.

4.7.1   If any changes are required, press: **PROGRAM, ##, ENTER** for each **PROGRAM** requiring data modification. This can be done at any point in the **CHAIN**, and the system will reset automatically.

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-19

RUNNING PRODUCTION

5.1   After you are satisfied that the **CHAIN** is correct, press the **RUN** button and the RUN LED will light. Initiate the control as before.

5.2   The SOLUTION-2 will now go through all **LINKS** in the **CHAIN** without stopping and weld as directed. Check pages SU-9 and SU-10 to see various ways that the initiation switch input will affect the operation of this **CHAIN**. If it is desired to go through the entire **CHAIN** <u>without</u> welding, press the **NO WELD** button until both the NO WELD and RUN LEDs are on.

5.3   After the functions within the last **LINK** have been performed, the **EHR** relay will close for the time set in PROGRAM 87/90, the control beeper will sound briefly, and the control will reset. Even if the initiation switch is closed at this time, a new **CHAIN** will not start.

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-20

LIGHT CURTAIN FEATURE

The SOLUTION-2 can be operated with a LIGHT CURTAIN or GUARD GATE safety system that closes a switch when clear. **To use LIGHT CURTAIN function, follow directions on page SU-28 to assign PS4 as a LIGHT CURTAIN input port.**

If the SOLUTION-2 has been set for **LIGHT CURTAIN** operation, it will function as follows:

6.1   If the LIGHT CURTAIN beam has been broken (input **PS4 is OPEN**) when initiation is attempted, no action will occur and the display will show:

LIGHTCURTAIN OPN

If the LIGHT CURTAIN beam is then cleared (PS4 closed) while the initiation is **still** closed, no action will occur and the display will show:

RELEASE INITIAT.

requesting that the initiation be released (opened).

After the **LIGHT CURTAIN** beam has been cleared (**PS4 closed**), closing the initiation again will start the sequence.

6.2   If the **LIGHT CURTAIN** beam has been broken (input **PS4 is OPEN**) at any point within a **LINK**

a.   All valves that came **ON** at the beginning of **that LINK** will be reset to the condition they were in at the end of the **previous LINK.**

b.   If the control was in the middle of a weld, that weld sequence will stop.

d.   The display will show:

LIGHTCURTAIN OPN

6.3   Once the **LIGHT CURTAIN** input **PS4** has been closed, the display will show:

PLEASE INITIATE

Alternately, if the **LIGHT CURTAIN** input is closed while the initiation **is still closed,** no action will occur and the display will show:

RELEASE INITIATE

requesting that the initiation be opened.

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE U-21

LIGHT CURTAIN FEATURE (continued)

SELECTING LIGHT CURTAIN FEATURE:

6.3 (continued)

After the **LIGHT CURTAIN** has been cleared (**PS4** closed), closing the initiation again will run the entire interrupted **LINK** again.

6.4 To select **LIGHT CURTAIN** operation, press: **PROGRAM, 87, ENTER, 93.** The display will show:

PS4 = PROX. SWITCH

CHANGE 1 = YES, 0 = NO

6.5 If you want to use **PS4** as a **LIGHT CURTAIN** input port, press **1** to change displayed function. The display will now show:

PS4 = LIGHTCURTAIN

6.6 While the SOLUTION-2 is using the **PS4 = LIGHT CURTAIN** mode, the system will ignore the **PS4** line in all **PROGRAMS.**

6.7 If it is ever desired to return **PS4** as a normal proximity input port, **press: PROGRAM 87, ENTER, 93.** The display will show:

PS4 = LIGHTCURTAIN

CHANGE 1 = YES, 0 = NO

Press 1 and **PS4** will now show:

PS4 = PROX. SWITCH

and return to normal proximity switch function.

SOLUTION-2 #9280

DIRECTIONS FOR USE PAGE U-22

WARNING CODES

DISPLAY	POSSIBLE CAUSE	RECOMMENDED ACTION
TRANSFORMER OVERTEMP	THERMOSTAT ON WELDER TRANSFORMER TRIPPED	CHECK WATER FLOW IN TRANSFORMER
SCR OVERTEMP	THERMOSTAT ON SCR	CHECK WATER FLOW IN SCR
	EMERGENCY STOP PUSHED	RELEASE SWITCH

EMERGENCY STOP	LINE VOLTAGE IS LOW	CHECK LINE VOLTS
CHOOSE MODE	NO MODE HAS BEEN SELECTED	PUSH **SINGLE, N0-WELD OR REPEAT**
OPEN INITIATION!	INITIATION CLOSED ON POWER UP	CHECK AND OPEN SWITCHES
PB RELEASED EARLY	INITIATION RELEASED BEFORE WELD SEQUENCE	HOLD BUTTONS TO END OF SQUEEZE
KEYBOARD LOCKED	KEY SWITCH IN **LOCKED** POSITION	INSERT KEY AND ROTATE TO OPEN
PLEASE PROGRAM	TRYING TO WELD WITHOUT SPECIFYING PROGRAM	ENTER DESIRED PROGRAM NUMBER
CHECK SCR/Z-CROSS	NO ZERO CROSS SIGNAL	WELD TRANSFORMER SWITCH SET TO OFF
	SCR IS SHORTED	CHECK, REPLACE
LOGICAL ERROR	CHAIN INITIATED IS NOT PROGRAMMED	GO TO PROGRAM 80 AND ENTER CHAIN
PLEASE INITIATE	WAITING FOR INITIATION WHEN USING PROGRAM 96 TO CHECK TIP FORCE	CLOSE FOOT SWITCH OR HAND BUTTONS TO MEASURE FORCE
WAIT: TIP FORCE	PRESSURE TRANSDUCER NOT SATISFIED (OPTION 9181-05)	INCREASE AIR SETTING ON AIR REGULATOR
LIGHTCURTAIN OPN	SYSTEM SET FOR LIGHT CURTAIN: PS4 IS OPEN	CLEAR LIGHT CURTAIN
CURRENT OVERFLOW	VOLTAGE FROM CURRENT INPUT DEVICE EXCEEDS SYSTEM MAXIMUM VALUE	PRI. CURRENT: CHANGE CT. OR CT. RESISTER SEC. CURRENT: CHANGE CURENT RANGE & DIP SW
OPEN PS#	PS INPUT THAT, IN THE LINK, HAS BEEN PROGRAM-MED: **PS# TO BE OPEN** IS STILL CLOSED	CHECK TO SEE WHY SWITCH IS CLOSED. CHANGE LINK OR REPLACE SWITCH
CLOSE PS#	PS INPUT THAT, IN THE LINK, HAS BEEN PROGRAM-MED: **PS# TO BE CLOSED** IS STILL OPEN	CHECK TO SEE WHY SWITCH IS OPEN. CHANGE LINK OR REPLACE SWITCH

USING OPTIONS

SOLUTION-2 #9280

USING OPTIONS

PAGE OP-1

CURRENT MONITORING OPTION #9181-22A/B

CONCEPT

 Current measurement options in the SOLUTION-2 control all produce direct measured (#9181-22B) or computed (#9181-22A) secondary current. This current is measured **only** during the **WELD** portion of each welding sequence. No measurement is made during any of the other welding sequences (i.e., UPSLOPE, PREHEAT, POSTHEAT, DOWNSLOPE, TEMPER). In this way, the readings recorded in the control will match those on welding schedule sheets.

It also means that if any of the other welding sequences are included in the weld program, a reading made with an external current monitor (that reads the entire heat envelope) will be lower than that read by the SOLUTION-2. The advantage of having internal reading by the weld control is that it can be selective in its reading and provide more useful numbers.

GETTING STARTED

Before proceeding further, be sure that all setup steps have been completed as shown starting on page **SU-16.** Without making the proper original steps, nothing of the following will work!

SETTING CURRENT LIMITS

Each program has a setting for UPPER and LOWER current limits. Do the following for each welding schedule that is being used:

6.1   To set the control for reading current, press: **PROGRAM, 84, ENTER**

If the display shows:

1 – READ ONLY = 1

CHANGE 1 = YES, 0 = NO

Press **0** (to not change setting).

If another phrase is on the readout or if it is desired to check the available options, press #1 to display the following:

1 – READ ONLY = 1   read and display current only

1 – READ & REACT = 2   compare reading to limits

1 – READ OFF = 3   no reading or reaction
SOLUTION-2 #9280

USING OPTIONS

PAGE OP-2

CURRENT MONITORING OPTION #9181-22A/B(continued)

Now select **I-READ ONLY** by pressing 1.

6.2   Set the desired welding schedule and make welds on coupons until an acceptable weld has been achieved. Ignore the lines in the program that show HIGH 1 and LOW 1 settings. Do this by selecting one of the PROGRAMS that fires the desired welding program and weld cylinder or SCR, and placing it in PROGRAM 80 as a chain with ONE link. In this way, every time you close the initiation switch, only this desired weld head or transformer will operate.

6.3   The average RMS current of the weld will be displayed on the upper readout after each sequence has been completed. Make several welds to be sure that this number is reasonably constant.

6.4   Decide on the limits of current above and below that observed in step #2 above. To do this, make welds as you continue to **LOWER** the % HEAT setting in 1% steps until the weld has **fallen below** minimum desired strength. **Increase** the displayed current value slightly and write down this number as the **LOW 1** (low current) number in that program.

Now go back to the original % HEAT and start **RAISING** it in 1% steps until metal **expulsion** has started. **Lower** this value slightly and write down this number as **HIGH 1** (high current) in the program.

On REGULAR CURRENT MEASURING systems (low current range welding) (under 10,000 amps), a variation of + / - 400 amps is reasonable. On higher current welding, a range of + / - 700 amps is a typical setting.

On LOW CURENT MEASURING systems, a variation of + / - 50 to 100 amps is reasonable.

6.5   Now press the STEP button until the display shows:

HIGH 1 = 00000 A

Enter the HIGH 1 value from the above step. Note that the right hand **O** will not change. Be sure that the number displayed is as desired.

6.6   Now press the STEP button one more time and the display will show:

LOW 1 = 00000 A

Enter the LOW 1 value from step #4.

6.7   Repeat the above steps for every welding spot in the part being made.

SOLUTION-2 #9280

USING OPTIONS

PAGE OP-3

CURRENT MONITORING OPTION #9181-22A/B(continued)

MEASURING CURRENT DURING PRODUCTION

Follow the following procedure to utilize the current comparison QC system during production.

6.8   Press: **PROGRAM, 84, ENTER**

and the display will show:

1 – READ ONLY = 1

CHANGE 1 = YES, 0 = NO

Press **1** to change this current reading mode. The display will now show:

1 – READ ONLY = 1

read and display current only

1 – READ & REACT = 2

compare reading to limits

1 – READ OFF = 3

no reading or reaction

Now select **1 – READ & REACT** by pressing **2**.

6.9   Now enter the weld schedule used earlier and start welding. As each weld is made, the system will show the current as averaged over the WELD portion of each sequence.

NOTE: When the READ & REACT function is active in the SOLUTION, an "*****" will show on the upper right corner of the display. IF THIS "*****" IS <u>NOT</u> SHOWN BUT CURRENT READINGS ARE SHOWN, THE SYSTEM IS IN **READ ONLY MODE** AND **<u>NO FAULT INDICATION WILL BE MADE UNDER ANY CIRCUMSTANCES.</u>**

SOLUTION-2 #9280

USING OPTIONS
PAGE OP-4

CURRENT MONITORING OPTION #9181-22A/B(continued)

6.10.1 If the current, as shown on the upper display, is **ABOVE** or **BELOW** that in the weld schedule, one of two fault conditions will occur depending on the setup of the SOLUTION-2.

A.   If PROGRAM 82 is set to **MANUAL RESET**, the system will stay in the present LINK and display on the upper row the current being measured and an "**E**" to show that an error has occurred.

To go to the next LINK, close the initiation switch once to reset the fault. Then close a second **time** to continue the chain from that point.

B.   If PROGRAM 82 is set to **AUTOMATIC RESET**, the system will **not** stop and the next LINK will operate.

FAULT OR ACCEPT RELAY OUTPUT: See page SU-30 for action of selectable output relays.

6.11   If it is desired to turn the current reading system **OFF**, press:

PROGRAM 84
ENTER

The display will now show:

1 – READ & REACT = 2

CHANGE 1 = YES, 0 = NO

Press **1** to change this current reading mode. The display will now show:

1 – READ ONLY = 1

read and display current only

1 – READ & REACT = 2

compare reading to limits

1 – READ OFF = 3

no reading or reaction

Now select **1-READ OFF** by pressing **3**.

In this condition, no current will be displayed, and no current comparison will be made during any welding sequence.

SOLUTION-2 #9280
USING OPTIONS
PAGE OP-5

HEAT STEPPER OPTION #9281-15

* *

NOTE: When a control has been ordered with **CONSTANT CURRENT** software, the **HEAT STEPPER OPTION** is **not available.**

* *

When welding galvanized or other coated metals, electrode pick-up is unavoidable. In galvanized metal, for example, zinc from the galvanized coating alloys with the copper electrode to form **BRASS**. This does two things.

First, this coating effectively increases the contact diameter of the electrode. Because of this, the AMPS PER SQUARE INCH within the weld zone will be **DECREASED**. For example, if the contact area of an electrode increases from .250" diameter to .275" diameter (an increase of 10% in contact diameter), this will cause a 21% **decrease** of AMPS PER SQUARE INCH and a proportional decrease of weld strength.

Second, the new coating (brass in this example) will have a higher resistance value than the original copper electrode. While this is not as important as changes in contact area, the effect will still be seen in the weld strength.

This leaves only two choices.

Choice #1: Dress the electrodes every 25 to 50 welds to maintain electrode contact area.

Choice #2: Increase the % heat to compensate for the change in electrode contact area.

The **HEAT STEPPER** accomplishes Choice #2.

In the traditional heat stepper, the user enters the number of welds for each step and the increase in % heat for that step. In this way a progressive change will be made over the desired maximum number of welds prior to dressing of tips.

The Unitrol concept differs from the traditional in that the SOLUTION computer chip is programmed with a classic heat stepper curve. Therefore, it is only necessary to enter the maximum number of welds to be made and the maximum % heat increase to be accomplished during the last weld.

The computerized curve will increase the % heat the greatest amount during the early welds, and less as the stepper approaches the maximum quantity of welds. Unlike the traditional stepper systems, these steps are done **continuously.**

When the last weld has been made in the stepper, the SOLUTION display will instruct the operator and also sound the beep tone.

Since the SOLUTION-2 HEAT STEPPER option comes with the ability to operate as many as 16 heat steppers, the system is designed to allow easy assignment and operation of these separate steppers. One stepper can be assigned to each welding program, or the same stepper can be shared by several programs.

HEAT STEPPER OPTION #9281-15(continued)

INITIAL CONFIGURATION OF STEPPERS

7.1.1 The HEAT STEPPER function is an option in the SOLUTION-2 system. It can be ordered with the original control or added later. If the **HEAT STEPPER** option is in this control, the letter H will be included in the option codes at the end of the model number of the system.

Install the desired maximum number of **HEAT STEPPERS** you think will be used following step B7 in the **SET-UP** section of these directions.

7.1.2 Now it is necessary to set each of the desired heat steppers for maximum number of welds and maximum % heat increase. To do this, press: **PROGRAM, 88, ENTER,** and the display will show:

HEAT STEPPER #01
WELDS LEFT = ####

If **#### = 0000,** skip[to 7.4. If **####** is not 0000, the display will show:

HEAT STEPPER #01
RESET STEPPER?

HEAT STEPPER #01
PRESS: 1 = YES, 0 = N0

7.3 If you are in the middle of a heat stepper run and are installing new electrodes (or have decided to address the existing ones),you can reset the stepper at this point by pressing **1.** Otherwise, press **0** and the stepper will **not** reset.

SOLUTION-2 #9280

USING OPTIONS

PAGE OP-7

HEAT STEPPER OPTION #9281-15(continued)

7.4 The display will now show:

HEAT STEPPER #01
HEAT STEPPER ON

or

HEAT STEPPER #01
HEAT STEPPER OFF

HEAT STEPPER #01
CHANGE 1 = YES, 0 = NO

If the heat stepper is **ON** and you want to turn it off, press **1**. Otherwise press **0**.

Or if the heat stepper is **OFF** and you want to torn it **ON**, press **1**. Otherwise press **0**.

7.5　　The display will now show:

> **HEAT STEPPER #01**
> **TOTAL WELDS   = ####**

> **HEAT STEPPER #01**
> **CHANGE 1 = YES, 0 = NO**

If the number shown is correct, press **0**. Otherwise press **1** and enter the maximum number of welds to be made on this stepper. For typical galvanized welding, a number of 700 to 1,500 is common. Some companies try for as high as 3,000 with reasonable results. Start with a lower number and increase as experience dictates. Remember that a greater number of welds made between tip dressing means that there will be more material to remove from the electrodes.

7,6　　Now press: **STEP** and the display will show:

> **HEAT STEPPER #01**
> **MAX. INCREASE = ##%**

> **HEAT STEPPER #01**
> **CHANGE 1 = YES, 0 = NO**

SOLUTION-2 #9280

USING OPTIONS

PAGE OP-8

HEAT STEPPER OPTION #9281-15(continued)

This is the % heat **increase** over the initial % heat of the program(s) assigned to this stepper. This will occur near the end of the number of welds chosen in 7.5 above. This % increase will be used for all heat functions (i.e., **PREHEAT, UPSLOPE, WELD, DOWNSLOPE, POSTHEAT, TEMPER**). Press **1** to change this number and then enter the desired % heat increase. Typical numbers are 04% to 10%.

If this is the first time you are making this entry for a particular metal combination, this % increase number is found as follows:

a.　　With the heat stepper **OFF**, make a weld on a single dressed electrode and adjust the program parameters until a successful weld has been accomplished.

b.　　Continue to make welds on this same electrode and increase the % heat as necessary to maintain the desired weld quality on each weld. If various heat

functions are being used, increase all functions by the same % each time.

    c.   Continue this process until the maximum desired number of welds has been made.

    d.   Note this weld count along with the **increase** in % heat from the original (step a above) to the last weld. For example, if you started with 83% and made the last weld with 87%, the **MAX. INCREASE** = **04%.**

    e.   Install these numbers in 7.5 and 7.6 above. Make a record of the numbers for future use on this combination of metals.

7.7.1 Press **STEP** and the same data for **HEAT STEPPER #2** will be shown.

7.7.2 Continue in this manner until all desired steppers have been loaded. Note that the number of steppers that will be available in **PROGRAM 88** will match that chosen in step B7 of the SETUP section in these directions.

7.9   **OVERALL OPERATING NOTE:** If you want to go to a particular heat stepper without walking through others, press **PROGRAM** in step 7.3 until the desired heat stepper is shown on the upper display. Then proceed at step 7.3. If you are finished with heat stepper data entry and you are not in the last heat stepper, press **SINGLE, NO WELD,** or **REPEAT** to exit at that point.

<div align="center">

SOLUTION-2 #9280

USING OPTIONS

PAGE OP-9

HEAT STEPPER OPTION #9281-15(continued)

ASSIGNING HEAT STEPPERS TO WELDING PROGRAMS

</div>

If the **HEAT STEPPER** option is installed, each of the **75 PROGRAMS** will have a line that displays:

<div align="center">

HEAT STEPPER = #--

</div>

If **00** is entered, no heat stepper will be used during any **LINK** that this **PROGRAM** has been assigned.

If a number is entered in this line that matches one of the heat steppers as set up in the above steps, this stepper number will be used every time this **PROGRAM** is being performed in a **LINK**.

MULTIPLE PROGRAMS USING A SINGLE HEAT STEPPER: It is possible to use the **same** heat stepper in **more than one** PROGRAM. This might be useful if the electrode(s) is being used more than one time on a part (part index, etc.). In this case, the total number of welds used by this stepper will be used for the stepper's counting and increase functions.

HEAT STEPPER REACHES MAXIMUM NUMBER OF WELDS

If during a CHAIN one or more heat steppers has reached the MAXIMUM WELDS number, one of two things will happen:
* *

CONTROL IN "AUTO FAULT RESET "

7.10.1 If in PROGRAM 82 the system has been set in the **AUTO FAULT RESET** mode, the display at the **end** of the chain will show:

RESET STEPPER = 88

This directs the operator to go to **PROGRAM 88 (PROGRAM, 88, ENTER).**

EXPIRED RELAY OUTPUT: See page SU-33 for instruction on assigning an output relay to transfer when one or more heat steppers has expired.

7.10.2 If it is desired to complete a run of parts **before** dressing any electrodes, just continue welding without making any keypad entries. The heat stepper(s) that has been run to the maximum number of welds will remain at the **last** % heat increase level no matter how many more welds are made. The FAULT indication will still come on and the assigned FAULT OUTPUT will continue to momentarily close at the end of each CHAIN.

SOLUTION-2 #9280
USING OPTIONS

PAGE OP-10
HEAT STEPPER OPTION #9281-15(continued)

7.10.3 If it **is** desired to reset an expired heat stepper and dress the electrodes, press: **PROGRAM, 88, ENTER**. The display will show:

RESET STEPPER?
PRESS: 1 = YES, 0 = NO

7.13.1 If you want to only check condition of all steppers, go to 7.15 below. If you **do** want to reset **all** exhausted steppers, Press **1** and the display will show:

HEAT STEPPER #--
DRESS TIP - - RESET

This is the lowest number heat stepper that has reached the maximum number of welds. Press **STEP** and the heat stepper number displayed on the upper row of the display will be reset.

7.13.2 If this is the only heat stepper that has been exhausted, the **SOLUTION** will return to the welding program. However, if **more than one** heat stepper has been exhausted during this **CHAIN**, the next exhausted heat stepper will be displayed as in 7.13. By pressing **STEP**, each successive heat stepper will be reset. The system will return to the welding program after the last heat stepper has been reset.

7.13.3 If it is just desired to check the condition of all heat steppers at this point **without automatically resetting** any or all of them, press **0** and the control will go through the same sequence as shown starting in step **7.2** for all steppers. You can, then, just not condition of a particular stepper or reset it.

NOTE: If you change either the TOTAL WELDS or MAX. INCREASE % in a heat stepper that is not expired, the system will **automatically reset** that heat stepper.

* *

CONTROL IN "MAN. FAULT RESET"

7.16.1 If in PROGRAM 82 the system has been set in the **MAN. FAULT RESET** mode and a particular LINK contains a heat stepper that has expired, welding in the CHAIN will stop, the beep tone will sound continuously, and the display will show:

HEAT STEPPER # - -
DRESS TIP - - RESET

Press **STEP** and the heat stepper number displayed on the upper row of the display will be reset.

EXPIRED RELAY OUTPUT: See page SU-33 for instruction on assigning an output relay to transfer when one or more heat steppers has expired.

* *

SOLUTION-2 #9280 / #9181-09

USING OPTIONS

PAGE OP-11

PRESSURE TRANSDUCER OPTION #9181-05 & -05C

THEORY:

A major variable in the resistance welding process is tip force. Since the electrical resistance between parts being joined **decreases** as force between the welding electrodes **increases**, the heat generated during the weld changes accordingly.

Additionally, since the tip force also acts as a **forge** in the nugget development process, variations will greatly affect weld strength and ductility.

Lastly, if current starts to flow before proper tip force has been reached, metal expulsion (flash) will occur causing part indentation, tip pick-up of metal, and potential danger to the operator and others in the area of the welder.

_____

Welding before proper tip force has been reached DRASTICALLY lowers the quantity of welds possible between tip dressing, and REDUCES overall weld strength, consistency, and appearance.

_____

APPLICATION:

This **SOLUTION** option is designed to start current flow in the welder at the **EXACT** tip force desired. As shown in the graph on the next page, air pressure in the welding cylinder, as measured by the **DOUBLE SIDED** (differential) **PRESSURE TRANSDUCER** supplied with this option changes in three steps:

1.   As the welder head starts to move, and before the electrode touches the electrode, volume in the upper half of the cylinder starts to **INCREASE**. Therefore, during this same time, air pressure in the **VARIABLE** volume cylinder builds only slightly as required to overcome friction and inertia. This varies depending on air temperature, viscosity, oil content in air, temperature of welder bearings, etc. The **SOLUTION** read-out will show: **WAIT: TIP FORCE** during this time.

3.   When the weld electrode touches the work piece, the cylinder stops moving, and the now **FIXED** volume of the cylinder causes each additional amount of air to increase pressure. This continues until the pressure inside the cylinder has reached that of the welder's pressure regulator. **THIS IS THE EXACT POINT THAT WELD CURRENT FLOW SHOULD BE STARTED,** and the **TIP FORCE IS LOW** readout will be turned off.

4.   This level now remains as long as the welder's solenoid is on.

SOLUTION-2 #9280 / #9181-09
USING OPTIONS
PAGE OP-12

PRESSURE TRANSDUCER OPTION #9181-05 & -05C(continued)

TIP FORCE (in pounds), as shown in the graph, remains at zero (0) until the electrode touches the work piece. Then the tip force increases in direct proportion to the change in air pressure.

The #9181-05 **DIFFERENTIAL PRESSURE TRANSDUCER** option connects to the weld cylinder as shown in the diagram below. Note that the hose connected to the **UPPER** (forward) port of the weld cylinder connects to the SOLUTION cabinet bulkhead fitting marked H (high), and that the hose connected to the **LOWER** (return) port of the weld cylinder connects to the fitting marked L (low). If these are reversed, the system will not work.

* *

BE SURE THAT THE TRANSDUCER CONNECTIONS ARE INSTALLED <u>BEFORE</u> THE FLOW CONTROLS AS SHOWN. OTHERWISE, THE SYSTEM WILL BE RESPONDING TO THE SETTING OF THE FLOW CONTROLS <u>RATHER</u> THAN TO THE ACTUAL WELDING CYLINDER RESPONSE.

The transducer, provided in the option, subtracts the air pressure on the underside of the cylinder piston from that of the top. The resultant is the exact air pressure acting on the cylinder rod. Note that the pressure measurement is taken **BEFORE** any flow control devices.

Use of a **DIFFERENTIAL** type transducer eliminates error and false signals caused by changes in **welder head advance speed** as set by flow controls in the air system. Also, unlike mechanical pressure switches, this device is accurate to better than ½ psi. and will not change even under large temperature swings and changes in air density and composition.

Use of this option will present the **SAME EXACT FORCE CONDITIONS** every time that the weld has started. Because of this, the inter resistance of the parts being joined will be constant and, therefore, reproduce weld strength and ductility throughout the production run.

LEGEND

AIR CYLINDER PRESSURE _____
TIP FORCE _____

SOLUTION-2 #9280 / 9181-09

USING OPTIONS

PAGE OP-13

PRESSURE TRANSDUCER OPTION #9181-05 & -05c(continued)

* ** *

1.	See page **SU-13** for assigning a solenoid valve for each transducer.

2.	On systems with **more than one** transducer, there will be a separate line for measuring TIP FORCE and INPUT (air PSI) for **each** transducer in the system. See page **SU-7** for installing the desired number of transducers.

* *

TO CHECK TIP FORCE AND AIR PRESSURE READINGS:

1.	Press: **PROGRAM 96, ENTER**

	If the readout will show:

			TRANSDUCER ON		or	**TRANSDUCER OFF**

CHANGE 1 = YES, 0 = NO

If TRANSDUCER OFF is shown, press **1** to turn it on.
If TRANSDUCER ON is shown, press **0** to leave this way.

2.   The display will now show:

TRANSD. 01, SV - ##
CHECK TIP FORCE?

PRESS: 1 = YES, 0 = N0

The SV-## matches the assignment made on page **SU-13**

3.   Press **1** to check the TIP FORCE on this transducer. The display will show:

PLEASE INITIATE

and wait for you to close the foot switch or hand buttons of any initiation input.

4.   Once you have done this, the output for SV## shown on the upper row of the display will turn on and turn on the solenoid valve wired to that SV output terminal. This output will remain on without the need to keep the initiation switch closed. Also, no actual welding will occur.

SOLUTION-2 #9280 / #9181-09

USING OPTIONS

PAGE OP-14

PRESSURE TRANSDUCER OPTION #9181-05 & -05VC(continued)

5. The display will now show:

TRANSD. 01, SV - ##
TIP FORCE = ####LB

Note that, while the display shows readings every ½ second, the computer is updating continuously.

The value shown will be calculated as:

TIP FORCE = (AIR PSI) X (LBS / PSI)

You can now adjust the welder's air regulator to reach the desired TIP FORCE. Note that it is always desirable to have this setting slightly above the desired value since the system will wait a long time for the last "drop" of air to enter the cylinder each weld sequence if the actual TIP FORCE and the program TIP FORCE are equal.

To release, press **STEP**.

6. **TO CHECK CALIBRATION ON YOUR PRESSURE GAGE:**

    After the above step, the readout will show:

    TRANSD. 01, SV - ##
    CHECK INPUT?

    PRESS: 1 = YES, 0 = N0

    The SV-## matches the assignment made on page **SU-13.**

7. Press **1** to check the DIFFERENTIAL AIR PRESSURE as read by the transducer. The display will show:

    PLEASE INITIATE

    and wait for you to again close the foot switch or hand buttons of any initiation input.

8. Once you have done this, the output for SV## shown on the upper row of the display will again turn on and turn on the solenoid valve wired to that SV output terminal. This output will remain on without the need to keep the initiation switch closed. Also, no actual welding will occur.

SOLUTION-2 #9280 / #9181-09

USING OPTIONS

PAGE OP-15

PRESSURE TRANSDUCER OPTION #9181-05 & -05C(Continued)

9. The display will now show:

    TRANSD. 02, SV - ##
    AIR PRES. = ##PSI

    Note that, while the display shows readings every ½ second, the computer is updating continuously.

    To release, press **STEP**.

10. If your control has more than one transducer installed, the display will show:

    TRANSD. 02, SV - ##
    CHECK TIP FORCE?

    PRESS: 1 = YES, 0 = NO

The SV-## matches the assignment made on page **SU-13**. By repeating steps 2-9 above, the system will check each transducer one at a time for **TIP FORCE** and **AIR PSI**.

USING TRANSDUCER OPTION IN PRODUCTION

1.   With the desired CHAIN entered, press **SINGLE, NO WELD, or RUN** as desired to set the control for welding.

2.   As shown on page U-2, when the foot pedal or hand switches are closed, and before the selected tip force has been reached within any **LINK**, the readout will show:

<div align="center">

WAIT: TIP FORCE

</div>

and welding will not start. Once the differential air pressure meets or exceeds the setting, the rest of this **LINK** will be performed.

Note that if you are in **MOMENTARY** initiation (program 90) and the air pressure is below the required setting, the system will not release when the foot or hand switch has been opened.

3.   **TO RELEASE** at this point, either increase air pressure, press **EMERGENCY STOP**, or press any button on the keypad.

<div align="center">

SOLUTION-2 #9280 / #9181-09
USING OPTIONS
PAGE OP-16

PRESSURE TRANSDUCER OPTION #9181-05 & -05C(Continued)

</div>

#9181-05C HIGH / LOW PRESSURE TRANSDUCER OPTION:

If the correct TIP FORCE is reached at the start of the weld, but the air regulator is set much higher than necessary, the TIP FORCE will be much higher than desirable at some point during the weld. This will **reduce** the electrical resistance between the parts being welded to **reduce** heat created by the weld current. This will greatly **reduce** weld strength and nugget penetration.

Conversely, if the air pressure sags below the desired point during the weld, excessive metal expulsion will cause poor surface appearance of the weld nugget and can greatly reduce electrode life.

If your control has the #9181-05C HIGH / LOW TRANSDUCER option, it will first operate the same as STEPS 1 and 2. This option adds a **second** measurement **after** the weld has been completed to see if the TIP FORCE has gone ABOVE or BELOW the **PSI VARIATION** that has been entered into the system.

This value is entered by pressing: **PROGRAM, 96, ENTER**. The display will show:

<div align="center">

PSI VARIATION ----

</div>

Enter the largest variation of air pressure (**PSI**) that will **not** affect the weld quality. Typically this value is 4-5psi.

NOTE: If you do **not** want to use this feature, set **PSI VARIATION = 00.**

With this function operational, a reading above or below the air pressure displayed each time you exit a **PROGRAM** will cause a fault condition.

If the welder has been set in MANUAL FAULT RESET mode (**PROGRAM 82**), this FAULT will stop at the end of this LINK and the air pressure measured at the **end** of the LINK will now be displayed. At the same time, an output relay can be assigned to communicate a fault or accept condition to an external control (i.e., **PLC**, etc.). See page SU-31 for information on assigning these relays. To continue the sequence (next LINK in the chain), close the initiation switch.

If the welder has been set in **AUTOMATIC FAULT RESET** mode (**PROGRAM 82**), the sequence will continue without the need for closure of the initiation. As with the MANUAL FAULT RESET mode above, an output relay can be assigned to communicate a fault or accept condition to an external control (i.e., PLC, etc). See page SU-31 for information on assigning these relays.

In either **MANUAL** or **AUTOMATIC FAULT RESET** mode, if a PRINTER PORT or PRINTER option is installed in this control, the last value measured will be printed, and the work F-FLT will show at the end of the line.

SOLUTION-2 #9280 / #9181-09

USING OPTIONS

PAGE OP-17

AVC HIGH / LOW MONITOR OPTION #9181-06A

This option will continuously check to see if the line voltage is more than 10% above or below the value measured during the original setup of AVC (page SU-4, line E2).

If this option is installed, the average line voltage for each weld being made will be shown on the printout of options #9181-21A or #9181-21B.

Since the AVC function can only compensate within the + / - 10% range, anything over this range will have no compensation. For example, if the line voltage drops 12%, the AVC system will compensate for the first 10%, but the output will now be 2% - 3% low. This option will cause a relay to transfer every time a weld is being made and the system is out of the + / - 10% range. See page SU-32 for information on assigning this relay. The function operates continuously as long as AVC is turned on in **PROGRAM 98**, and does not require any keypad input to activate.

SAMPLE PROGRAMS

SOLUTION-2 #9280
DIRECTIONS FOR USE

PAGE E-1

SAMPLE PROGRAM CHAINS

Read through the following examples to see how the three steps shown on the previous pages are actually put to practice.

SAMPLE WELD CHAIN #1

EQUIPMENT SETUP:

a.   Rocker Arm welder
b.   Double pressure regulator system with a solenoid valve to provide higher pressure
c.   A single foot switch, 2 stage
d.   Manual load/unload and manual movement
e.   SOLUTION control is set for 3-CHAIN, 2-STAGE mode
f.   SOLUTION control contains PRESSURE TRANSDUCER option
* *

STEP #1: THE TASK

a.   Operator places channels and hinges on panel using a drop-in fixture
b.   With the foot pedal held down, 12 welds are made along top edge joining top angle to panel.
c.   After operator rotates part, three hinges are welded along one long edge using 3 spots per hinge.
d.   After operator rotates part, last 9 welds are made along bottom edge to join bottom angle to panel.
* *
STEP #2: ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION

OPERATION #1 (welding of angles to panel):

a..   Bring weld head down using SV1.
b.   Weld using the following schedule:
             TIP FORCE = 550 POUNDS
             WELD = 12 cycles AT 76%
             HOLD TIME = 5 CYCLES

c.   After the end of HOLD TIME, release **SV1** to bring weld head **UP**
d.   Wait for 35 cycles
e.   Put above information in **PROGRAM 6** as follows:

                  PROGRAM 06
                  SV1 ON, END OFF
                  WELD TIME   12
                  WELD HEAT   76%
                  HOLD TIME   05

All other lines in **PROGRAM 06** are to be set to **00** or **OFF,** or **OPEN**

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-2

SAMPLE PROGRAM CHAINS (Continued)

SAMPLE WELD CHAIN #1 (Continued)

OPERATION #2 (welding hinges to panel):
a.   Bring weld head down with **SV1** using high pressure selected by SV2.
b.   Weld using the following schedule:

             TIP FORCE = 690 POUNDS
             WELD = 17 CYCLES at 84%
             HOLD TIME = 6 CYCLES

c.   After the end of HOLD TIME, release **SV1** to bring weld head UP
d.   Wait for 15 cycles
e,   Put above information in **PROGRAM 7** as follows:

                    PROGRAM 07
                    SV1 ON, END OFF
                    SV2 ON, END ON
                    WELD TIME   17
                    WELD HEAT   84%
                    HOLD TIME   06
                    DWELL BETWEEN = 15
                    TIP FORCE 0690LB

All other lines in **PROGRAM 07** are to be set to **00, off,** or **OPEN**

* *

STEP #3: ASSEMBLING THE CHAIN

All that remains is to tell the SOLUTION-2 control

a.   There are **30 LINKS** in the chain
b.   **LINK 1** through **LINK 12 = PROGRAM 6**
c.   **LINK 13 THROUGH LINK 21 = PROGRAM 7**
d.   **LINK 22 THROUGH LINK 30 = PROGRAM 6**
e.   **ONE CHAIN ONLY**
f.   **MANUAL CHAIN** or **AUTOMATIC CHAIN**

* *

THAT'S IT! YOU ARE NOW READY FOR PRODUCTION

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-3

SAMPLE PROGRAM CHAINS (Continued)

SAMPLE WELD CHAIN #2

EQUIPMENT SETUP:

a.   A-Frame welder
b.   One welding transformer
c.   Two welding cylinders, separate solenoid valve for each
d.   Table shuttle cylinder
e.   Part clamp
f.   Manual load/unload, automatic movement
g.   **SOLUTION** control is set for **3-CHAIN, 2-STAGE** mode
h.   **SOLUTION** control contains **PRESSURE TRANSDUCER** option

* *

STEP #1: THE TASK

Clamp part, shuttle table with fixture to bring part under two weld heads, weld first one head then the other, retract fixture, open clamp.

* *

STEP #2: ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION

OPERATION #1:

a. Clamp part in weld nest using **SV3.**
b. Wait until the clamp proximity switch connected to **PS1** closes
c. Check to be sure that both welding heads are **UP** using limit switch on first head connected to **PS3** and on second head connected to **PS4**
d. Pub above information in **PROGRAM 3** as follows:

<div align="center">

PROGRAM 03
SV3   ON, END ON
PS1 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED

</div>

All other lines in **PROGRAM 03** are to be set to **00, OFF,** or **OPEN**

<div align="center">

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E – 4

SAMPLE PROGRAM CHAINS(Continued)

SAMPLE WELD CHAIN #2 (Continued)

</div>

OPERATION #2:
a. Shuttle table with fixture under weld head using **SV2**
b. Wait until the table limit switch connected to **PS2** closes
c. Put information in **PROGRAM 17** as follows:

<div align="center">

PROGRAM 17
SV2 ON, END ON
SV3 ON, END ON
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED

</div>

All other lines in **PROGRAM 17** are to be set to **00, OFF,** or **OPEN**

OPERATION #3:
a. Bring the first **WELD HEAD** down by turning on **SV1**.
b. Weld with the following schedule:

> **TIP FORCE = 550 POUNDS**
> **UPSLOPE = 6 CYCLES** starting at **35%**
> **WELD = 12 CYCLES AT 83%**
> **HOLD TIME = 7 CYCLES**

c. After **HOLD TIME** has been completed, return the first **WELD HEAD** to the **UP** position

d .   Put information in **PROGRAM 4** as follows:

> **PROGRAM 04**
> **SV1 ON, END OFF**
> **SV2 ON, END ON**
> **SV4 ON, END ON**
> **PS1 TO BE CLOSED**
> **PS2 TO BE CLOSED**
> **WELD TIME   12**
> **WELD HEAT   83%**
> **HOLD TIME   07**
> **TIP FORCE   0550LB**
> **UPSLOPE INIT   35%**
> **UPSLOPE TIME   06**

All other lines in **PROGRAM 04** are to be set to **00, off,** or **OPEN**

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-5

SAMPLE PROGRAM CHAINS(Continued)

SAMPLE WELD CHAIN #2

OPERATION #4:

a.   Bring the second **WELD HEAD** down by turning **SV4** on
b.   Weld with the following schedule:

> **TIP FORCE = 560 POUNDS**
> **UPSLOPE = 6 CYCLES** starting at **42%**
> **WELD = 15 CYCLES** at **89%**
> **PULSATION = 2** with **5 CYCLES COOL TIME**
> **HOLD TIME = 7 CYCLES**

c.   After **HOLD TIME** has been completed, return the second **WELD HEAD** to the **UP** position by releasing **SV4.**
d.   Put information in **PROGRAM 2** as follows:

> **PROGRAM 02**
> **SV2 ON, END ON**
> **SV3 ON, END ON**
> **SV4 0N, END OFF**
> **PS1 TO BE CLOSED**
> **PS2 TO BE CLOSED**
> **PS3 TO BE CLOSED**
> **WELD TIME   15**
> **WELD HEAT   89%**

```
HOLD TIME        07
TIP FORCE    0550LB
NO. OF PULSES   02
PULSAT COOL  2=05
```

All other lines in **PROGRAM 02** are to be set to **00, OFF,** or **OPEN.**

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-6

SAMPLE PROGRAM CHAINS(Continued)

SAMPLE WELD CHAIN #2 (Continued)

OPERATION #5:
a.   Wait until both weld head **LIMIT SWITCHES** are closed to verify that both **WELD HEADS** are **UP.**
b.   Wait an additional ½ second for security that **WELD HEADS** are fully clear of **WELDING FIXTURE.**
c.   Put information in **PROGRAM 15** as follows:

```
PROGRAM 15
SV2  ON,  END ON
SV3  ON,  END ON
PS1  TO BE CLOSED
PS2  TO BE CLOSED
PS3  TO BE CLOSED
PS4  TO BE CLOSED
SQUEEZE/DWELL 30
```

All other lines in **PROGRAM 15** are to be set to **00, OFF,** or **OPEN**

OPERATION #6:
a.   Bring the **TABLE WITH FIXTURE** back to the **HOME POSITION** by turning **SV2 OFF.**
b.   Wait until the **TABLE IN POSITION LIMIT SWITCH** connected to **PS2** has opened.
c.   Wait for **1** second to allow table to travel to home position.
d.   Release **CLAMP** by turning **SV3 OFF.**
e.   Put information in **PROGRAM 7** as follows:

PROGRAM 01
SV3 ON, END OFF
PS1 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED
SQUEEZE/DWELL 60

All other lines in **PROGRAM 01** are to be set to **00, OFF,** or **OPEN.**

* *

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-7

SAMPLE PROGRAM CHAINS(Continued)

SAMPLE WELD CHAIN #2

SAMPLE WELD CHAIN #2(Continued)

STEP #3: ASSEMBLING THE CHAIN

All that remains is to tell the **SOLUTION-2** control that there are **6 LINKS** in the chain, and that::

a.   **LINK 1 = PROGRAM 03**
b.   **LINK 2   =   PROGRAM 17**
c.   **LINK 3 = PROGRAM 04**
d.   **LINK 4 = PROGRAM 02**
e.   **LINK 5 = PROGRAM 15**
f.   **LINK 6 = PROGRAM 01**
g   **ONE CHAIN ONLY**
h.   **MANUAL CHAIN** or **AUTOMATIC CHAIN**.

* *

THAT'S IT! YOU ARE NOW READY FOR PRODUCTION.

SAMPLE PROGRAM CHAINS(continued)
SAMPLE WELD CHAIN #3

EQUIPMENT SETUP:

a.   Three weld heads (cylinders), one welding transformer
b.   Two button **ANTI-TIEDOWN** initiation
c.   Air operated shuttle for part with an **IN** limit switch
d.   Manual load / unload
e.   A limit switch is installed on each of the three weld heads for **UP** position verification.
f.   A limit switch is installed on each of the three weld heads for **DOWN** position verification. All three are wired in parallel.
g.   **SOLUTION** control is set for **2-LEVEL, 2 CHAIN** mode.
* *

STEP #1: THE TASK

After operator closes two hand buttons (**ANTI-TIEDOWN**), one flange on a center rein-forcement "hat" section is welded with three spots. Part is indexed to place the electrodes over the other flange, and the last three spots are made.

* *

STEP #2: ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION

OPERATION #1 (bringing weld head #1 down and weld):
a.   Weld head #1 goes down using **SV1**
b.   Check to be sure that heads #2 and #3 are **UP** using **PS2** and **PS3**
c.   Weld with the following program:
       SQUEEZE TIME = 15 CYCLES
       WELD = 09 CYCLES at **71%**
       HOLD TIME = 5 CYCLES

d.   After **HOLD TIME**, return head #1 by releasing **SV1**.
e.   Put the above information in **PROGRAM 9** as follows:

PROGRAM 09
SV1 ON, END OFF
PS2 TO BE CLOSED
PS3 TO BE CLOSED
SQUEEZE/DWELL 15
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

SOLUTION-2 #9280
DIRECTIONS FOR USE

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #3(continued)

OPERATION #2 (bring weld head #2 down and weld):
a.   Weld head #2 goes down using **SV2**
b.   Check to be sure that head #1 and #3 are **UP** using **PS1** and **PS3**
c.   Weld with the following program
SQUEEZE TIME = 15 CYCLES
WELD = 09 CYCLES at **71%**
HOLD TIME = 5 CYCLES

d.   After **HOLD TIME**, return head #2 by releasing **SV2**.
e.   Put the above information in **PROGRAM 10** as follows:

PROGRAM 10
SV2 ON, END OFF
PS1 TO BE CLOSED
PS3 TO BE CLOSED
SQUEEZE/DWELL   15
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05

All other lines in **PROGRAM 10** are to be set to **00,** or **OFF,** or **OPEN**

OPERATION #3 (bring weld head #3 down and weld):
a.   Weld head #3 goes down using **SV3**
b.   Check to be sure that heads #1 and #2 are **UP** using **PS1** and **PS2**
c.   Weld with the following program

SQUEEZE TIME = 15 CYCLES
WELD = 09 CYCLES at **71%**
HOLD TIME = 5 CYCLES

d.   Put the above information in **PROGRAM 11** as follows:

PROGRAM 11
SV3 ON, END OFF
PS1 TO BE CLOSED
PS2 TO BE CLOSED
SQUEEZE/DWELL   15
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05

All other lines in **PROGRAM 11** are to be set to **00** or **OFF** or **OPEN**

SOLUTION-2 #9280
DIRECTIONS FOR USE

PAGE E-10

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #3(continued)

OPERATION #4 (check to see that all heads are UP:

a.   Check to be sure that heads are **UP** using **PS1, PS2,** and **PS3**
b.   Time delay after all heads are **UP** for 15 cycles for security.
c.   Put this information into **PROGRAM 20** as follows:

PROGRAM 20
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
DWELL BETWEEN = 15

All other lines in **PROGRAM 20** are to be set to **00,** or **OFF,** or **OPEN**

OPERATION #5 (index part)

a.   Index part using **SV4**
b.   Check to be sure table is all the way forward using **PS4**
c.   Delay for 10 cycles for security
d.   Put this information in **PROGRAM 21** as follows:

PROGRAM 21
SV4 ON, END ON
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED
DWELL BETWEEN = 10

All other lines in **PROGRAM 21** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #6 (bringing weld head #1 down and weld):

a.   Weld head #1 goes down using **SV1**
b.   Check to be sure that heads #2 and #3 are **UP** using **PS2** and **PS3**
c.   Weld with the following program:

SQUEEZE TIME = 15 CYCLES
WELD = 09 CYCLES at 71%
HOLD TIME = 5 CYCLES

d.   After **HOLD TIME,** return head #1 by releasing **SV1**.

SOLUTION-2 #9280
DIRECTIONS FOR USE
PAGE E-11

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #3(continued)

e.   Put the above information in **PROGRAM 22** as follows:

PROGRAM 22
SV1 ON,   END OFF
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED
SQUEEZE/DWELL   15
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05

All other lines in **PROGRAM 22** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #7 (bring weld head #2 down and weld):
a.   Weld head #2 goes down using **SV2**
b.   Check to be sure that head #1 and #3 are **UP** using **PS1** and **PS3**
c.   Weld with the following program
      SQUEEZE TIME = 15 CYCLES
      WELD = 09 CYCLES at 71%
      HOLD TIME = 5 CYCLES
d.   After **HOLD TIME**, return head #2 by releasing **SV2**.
e.   Put the above information in **PROGRAM 23** as follows:

PROGRAM 23
SV2 ON,   END OFF
PS1 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED
SQUEEZE/DWELL   15
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05

All other lines in **PROGRAM 23** are to be set to **00** or **OFF**, or **OPEN**

OPERATION #8 (bring weld head #3 down and weld):
a.   Weld head #3 goes down using **SV3**
b.   Check to be sure that heads #1 and #2 are **UP** using **PS1** and **PS2**
c.   Weld with the following program
        SQUEEZE TIME = 15 CYCLES
        WELD = 09 CYCLES at 71%
        HOLD TIME = 5 CYCLES

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-12

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #3(continued)

d.   Put the above information in **PROGRAM 24** as follows:

```
                    PROGRAM 24
              SV3  ON,  END OFF
              PS1  TO BE CLOSED
              PS2  TO BE CLOSED
              PS4  TO BE CLOSED
              SQUEEZE/DWELL   15
              WELD TIME          09
              WELD HEAT          71%
              HOLD TIME          05
```

All other lines in **PROGRAM 24** are to be set to **00** or **OFF,** or **OPEN**

* *

STEP #3: ASSEMBLING THE CHAIN

All that remains is to tell the **SOLUTION-2** control

a.   There are **8 LINKS** in the chain
b.   **LINK 1 = PROGRAM 9**
c.   **LINK 2 = PROGRAM 10**
d.   **LINK 3 = PROGRAM 11**
e.   **LINK 4 = PROGRAM 20**
f.   **LINK 5 = PROGRAM 21**
g.   **LINK 6 = PROGRAM 22**
h.   **LINK 7 = PROGRAM 23**
i.   **LINK 8 = PROGRAM 24**
j.   **ONE CHAIN ONLY**
k.   **MANUAL CHAIN** or **AUTOMATIC CHAIN**

* *

THAT'S IT! YOU ARE NOW READY FOR PRODUCTION.

SOLUTION-2 #9280
DIRECTIONS FOR USE

PAGE E-13

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #4

EQUIPMENT SETUP:

a.   Three weld heads (cylinders) on **SV1,** three welding transformers
b.   Two button **ANTI-TIEDOWN** initiation
c.   Air operated shuttle (**SV2**) for part with an **IN** limit switch **PS4**
d.   Manual load/unload
e.   A limit switch is installed on each of the three weld heads for **UP** position verification
      (PS1, PS2, PS3)
f.   **SOLUTION** control is set for **3-CHAIN, 2 STAGE** mode

* *
STEP #1: THE TASK

After operator closes two hand buttons (**ANTI-TIEDOWN**), one flange on a center reinforcement "hat" section is welded with three spots. Part is indexed to place the electrodes over the other flange, and the last three spots are made.

* *

STEP #2: ENTERING PROGRAMS WITH THE DESIRED SEQUENCE OF OPERATION

OPERATION #1 (bringing all three heads down, weld with SCR1):

a.   All three welding heads go down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2** and **PS3**
c.   Allow ½ second (30 cycles) for cylinders to move and pressurize
d.   Weld with the following program on **SCR1**
      SQUEEZE TIME = 30 CYCLES
      WELD = 09 CYCLES at 71%
e.   Put the above information in **PROGRAM 9** as follows:

PROGRAM 09
SV1 ON, END ON
PS1 TO BE OPEN
PS2 TO BE OPEN
PS3 TO BE OPEN

<div align="center">

SQUEEZE TIME   30
WELD TIME   09
WELD HEAT   71%
SCR NUMBER =   1

</div>

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **open**

<div align="center">

SOLUTION-2 #9280
DIRECTIONS FOR USE

PAGE E-14

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #4(continued)

</div>

OPERAION #2 (with heads still down, weld with SCR2):
a.   All three welding heads remain down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2** and **PS3**
c.   Weld with the following program on **SCR2**
        WELD = 09 CYCLES at **71%**

d.   Put the above information in **PROGRAM 20** as follows:

<div align="center">

PROGRAM 20
SV1 ON,   END ON
SV2 OFF, END OFF
PS1 TO BE OPEN
PS2 TO BE OPEN
PS3 TO BE OPEN
WELD TIME   09
WELD HEAT   71%
SCR NUMBER = 2

</div>

All other lines in **PROGRAM 10** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #3 (with heads still down, weld with SCR3):
a.   All three welding heads remain down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2 AND PS3**
c.   Weld with the following program on **SCR3**
        WELD = 09 CYCLES at 71%
        HOLD TIME = 5 CYCLES

d.   Put the above information in **PROGRAM 23** as follows:

<div align="center">

PROGRAM 23
SV1 ON,   END OFF
SV2 OFF, END OFF
PS1 TO BE OPEN
PS2 TO BE OPEN
PS3 TO BE OPEN
PS4 TO BE OPEN
WELD TIME   09

</div>

WELD HEAT   71%
HOLD TIME   05
SCR NUMBER = 3

All other lines in **PROGRAM 10** are to be set to **00** or **OFF,** or **OPEN**
SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-15

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #4(continued)

OPERATION #4 (check weld heads before shuttle of table)

a.   Be sure that all weld heads are retracted by using **PS1, PS2** and **PS3**
b.   Put the above information in **PROGRAM 25** as follows:

PROGRAM 25
SV1 OFF, END OFF
SV2 ON,   END ON
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #5 (shuttle table and be sure that it is in position)

a.   Move table using **SV2**
b.   Be sure that the table is in position using **PS4**
c.   Put the above information in **PROGRAM 28**

PROGRAM 28
SV1   OFF, END OFF
SV2   ON,   END ON
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #6 (bring all welding heads down, weld with SCR1):

a.   All three welding heads go down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2 and PS3**
c.   Check to be sure table is still in shuttle position using **PS4**
d.   Allow ½ second (30 cycles) for all heads to go forward and pressurize
e.   Weld with the following program on **SCR1**

SQUEEZE TIME = 30 CYCLES
WELD = 09 CYCLES AT 71%

SOLUTION-2 #9280

DIRECTIONS FOR USE

SAMPLE PROGRAM CHAINS(continued)

d.   Put the above information in **PROGRAM 29** as follows:

> **PROGRAM 29**
> **SV1 ON,   END ON**
> **SV2 ON,   END ON**
> **PS1 TO BE OPEN**
> **PS2 TO BE OPEN**
> **PS3 TO BE OPEN**
> **PS4 TO BE CLOSED**
> **SQUEEZE/DWELL   30**
> **WELD TIME   09**
> **WELD HEAT   71%**
> **SCR NUMBER   =   1**

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #7 (bring all welding heads down, weld with SCR2):

a.   All three welding heads go down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2** and **PS3**
c.   Check to be sure table is still in shuttle position using **PS4**
d.   Weld with the following program on **SCR2**

   WELD = 09 CYCLES at 71%

e.   Put the above information in **PROGRAM 44** as follows:

> **PROGRAM 44**
> **SV1 ON,   END ON**
> **SV2 ON,   END ON**
> **PS1 TO BE OPEN**
> **PS2 TO BE OPEN**
> **PS3 TO BE OPEN**
> **PS4 TO BE CLOSED**
> **WELD TIME   09**
> **WELD HEAT   71%**
> **SCR NUMBER =   2**

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

SAMPLE PROGRAM CHAINS(continued)
SAMPLE WELD CHAIN #4(continued)

OPERATION #8 (bring all welding heads down, weld with SCR3):

a.   All three welding heads go down using **SV1**
b.   Check to be sure that heads are not up using **PS1, PS2** and **PS3**
c.   Check to be sure table is still in shuttle position using **PS4**
d.   Weld with the following program on **SCR3**
e.   Release the welding heads

   WELD = 09 CYCLES at 71%
   HOLD TIME = 05 CYCLES

f.   Put the above information in **PROGRAM 49** as follows:

PROGRAM 49
SV1 ON, END OFF
SV2 ON, END ON
PS1 TO BE OPEN
PS2 TO BE OPEN
PS3 TO BE OPEN
PS4 TO BE CLOSED
WELD TIME   09
WELD HEAT   71%
HOLD TIME   05
SCR NUMBER =   3

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

OPERATION #9 (check to be sure all welding heads are up)

a.   Check to be sure that heads are up using **PS1, PS2** and **PS3**
b.   Check to be sure table is still in shuttle position using **PS4**
c.   After heads are up, dwell for ½ second (30 cycles)
d.   Put the above information in **PROGRAM 16** as follows:

PROGRAM 16
SV1 OFF, END OFF
SV2 ON,   END ON
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED

All other lines in **PROGRAM 09** are to be set to **00** or **OFF,** or **OPEN**

SOLUTION-2 #9280

DIRECTIONS FOR USE

PAGE E-18

SAMPLE PROGRAM CHAINS(continued)

SAMPLE WELD CHAIN #4(continued)

OPERATION #10 (return table to unloading position):

a. Release table solenoid valve using **SV2**
b. Wait until table limit switch **PS4** opens
c. Put the above information in **PROGRAM 33** as follows:

PROGRAM 33
SV1 OFF, END OFF
SV2 OFF, END OFF
PS1 TO BE CLOSED
PS2 TO BE CLOSED
PS3 TO BE CLOSED
PS4 TO BE CLOSED

All other lines in **PROGRAM 10** are to be set to **00** or **OFF,** or **OPEN**

* *

STEP #3: ASSEMBLING THE CHAIN

All that remains is to tell the **SOLUTION-2** control

a. There are **10 LINKS** in the chain
b. **LINK 1 = PROGRAM 9**
c. **LINK 2 = PROGRAM 20**
d. **LINK 3 = PROGRAM 23**.
e. **LINK 4 = PROGRAM 25**
f. **LINK 5 = PROGRAM 28**
g. **LINK 6 = PROGRAM 29**
h **LINK 7 = PROGRAM 44**
l. **LINK 8 = PROGRAM 49**
j. **LINK 9 = PROGRAM 16**
k. **LINK 10 = PROGRAM 33**
l. **ONE CHAIN ONLY**
m. **MANUAL CHAIN** or **AUTOMATIC CHAIN**

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THAT'S IT! YOU ARE NOW READY FOR PRODUCTION

SERVICE INFORMATION