INSTRUCTION MANUAL

700150D

EN1500 SERIES
SEAM WELDING CONTROLS

MICROPROCESSOR BASED
Weld Sequence Controls
With
Solid State Thyristor Contactors

Wiring Diagrams	421362	FP Cabinet (Flat Plate)
	421373	S Cabinet
	421391	E Cabinet
	421359	T/D/LS/LF Cabinet

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RWMA® MEMBER

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ENTRON Controls, LLC.

MICROPROCESSOR BASED WELDING CONTROLS
WITH SOLID STATE THYRISTOR CONTACTORS

INSTALLATION AND OPERATION MANUAL FOR:
Model Series EN1500

! CAUTION !
READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL OR OPERATE THIS CONTROL

ENTRON Controls, LLC., reserves the right to alter the contents of this manual without previous notice.

ENTRON Controls, LLC.
Greer, South Carolina 29650

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1.0 GENERAL DESCRIPTION

The EN1500 Control is a microprocessor-based resistance welding control. It has been designed specifically for seam welding applications. This control allows programming of PREHEAT, UPSLOPE, WELD heat, DOWNSLOPE and POSTHEAT when necessary. Parameters programmed with values of **00** are omitted. One outstanding feature of the EN1500 Control is its ability to allow the operator concurrent adjustment of WELD heat intensity during an initiated sequence (this feature is optional). The EN1500 can store weld sequence parameters in each of 50 unique schedules. Weld schedule parameters are held in non-volatile memory for storage. Pilot initiations trigger specific sequences tailored to the intended application. Despite the need for complex weld schedules to provide different heats at specific times, the EN1500 is automatically preprogrammed to execute a chain of events making the control simple to program and operate.

CONTROL SEQUENCE

The EN1500 Control is also preprogrammed for BEAT DURING SQUEEZE operation. This feature allows the sequence to be cancelled if the initiation switch is opened before a weld has been started. The control cannot be re-initiated until the previous sequence is completed or the sequence has been terminated (interrupted) using Emergency Stop.

Continued closure will keep the control in the weld state until opening the initiation pilot switch. The control will then advance to DOWNSLOPE, POSTHEAT, and HOLD to end the sequence (see Figure 1-1 and Appendix A).

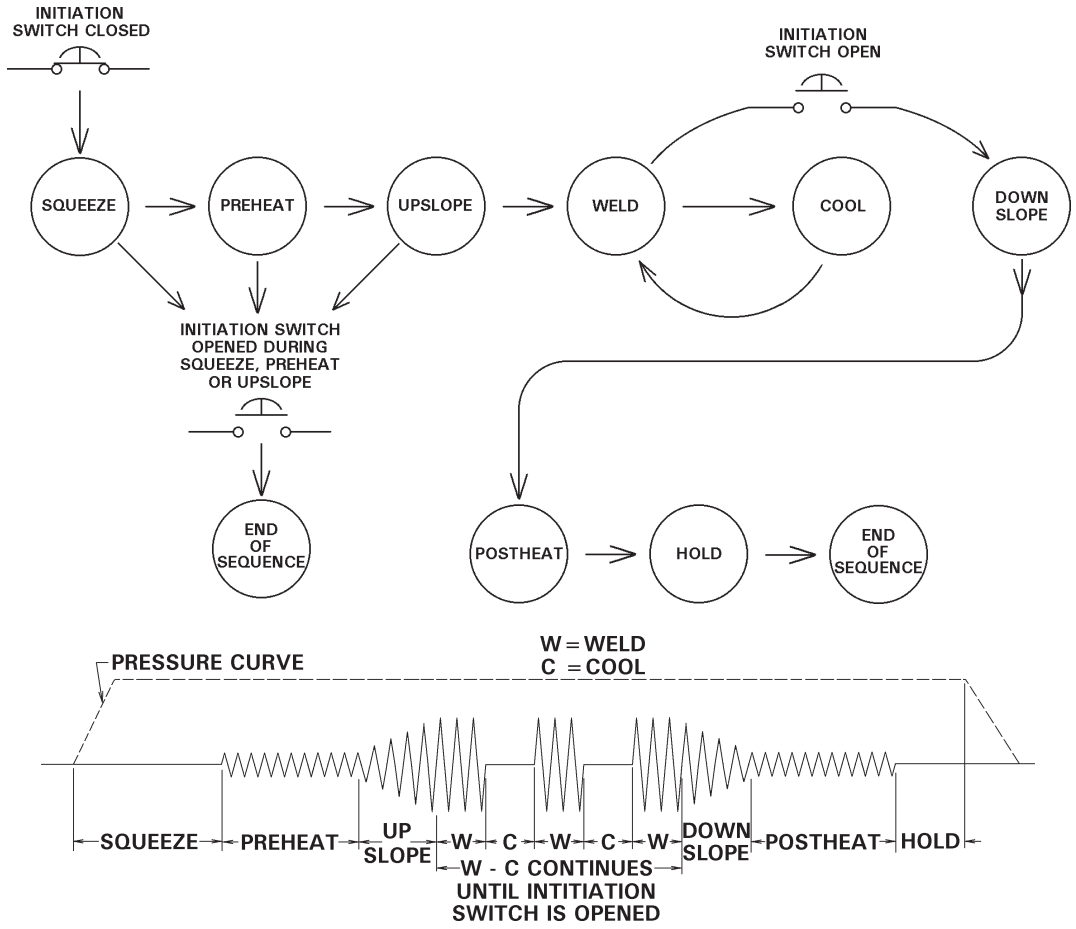


Figure 1-1. *Control Sequence*

1.0 GENERAL DESCRIPTION (cont.)

The EN1500 is a seam welding control which is able to perform seam or roll-spot welds. If any value is entered into COOL, a roll-spot (non gas-tight) weld will occur by alternating between the number of WELD and COOL cycles programmed in the initiated schedule.

PILOT OPERATION

FS3, FS7 and FS11 are weighted initiation inputs allowing the control to automatically jump to the WELD time of the chosen, higher order, initiation pilot. Release of the higher order switch will automatically revert to the lower order pilot if it is still closed.

Initiation on FS3

Closure of a switch between FS3 and GND will always initiate the schedule shown on the control display.

Initiation on FS7

Closure of a switch between FS7 and GND will initiate schedule 10.

Initiation on FS11

Closure of a switch between FS11 and GND will initiate schedule 20.

1.1 STANDARD FEATURES

DIGITAL CURRENT CONTROL is possible via microprocessor-driven circuitry allowing precise firing on each half cycle of alternating current being delivered to the welding transformer. Accurate phase shift firing makes this control adjustable in 1% increments of available current.

FUNCTION TIMING of sequence parameters relates to all programmed parameters except WELD which is a function of how long the pilot initiation is held closed.

Cycle timing is achieved by counting each cycle of the line current directly. This method of timing allows this control to be used on either 60 or 50 Hz operation without special adjustments.

PRESSURE SWITCH FIRING is a Terminal Strip connection which allows the control to be initiated from a Pressure Switch closure. Remove the jumper from TS1-PS1 and TS1-GND and connect Pressure Switch leads. Pressure Switch is not furnished with control.

87° DELAY OF FIRST CYCLE FIRING – The purpose of the 87° DELAY firing of each weld sequence is to prevent the build-up of a DC component in the welding transformer. This feature is most widely used in conjunction with wound core transformers.

ADJUSTABLE HEAT (Optional) – A knob located on the Control Display Panel can adjust the WELD % CURRENT while the control is idle and during a weld. The new value of PERCENT CURRENT is automatically stored in memory in the schedule being executed during adjustment.

OPERATING CONDITIONS – Temperature Range: 0°C to 70°C (32°F to 158°F).

2.0 CONTROL PANEL LAYOUT

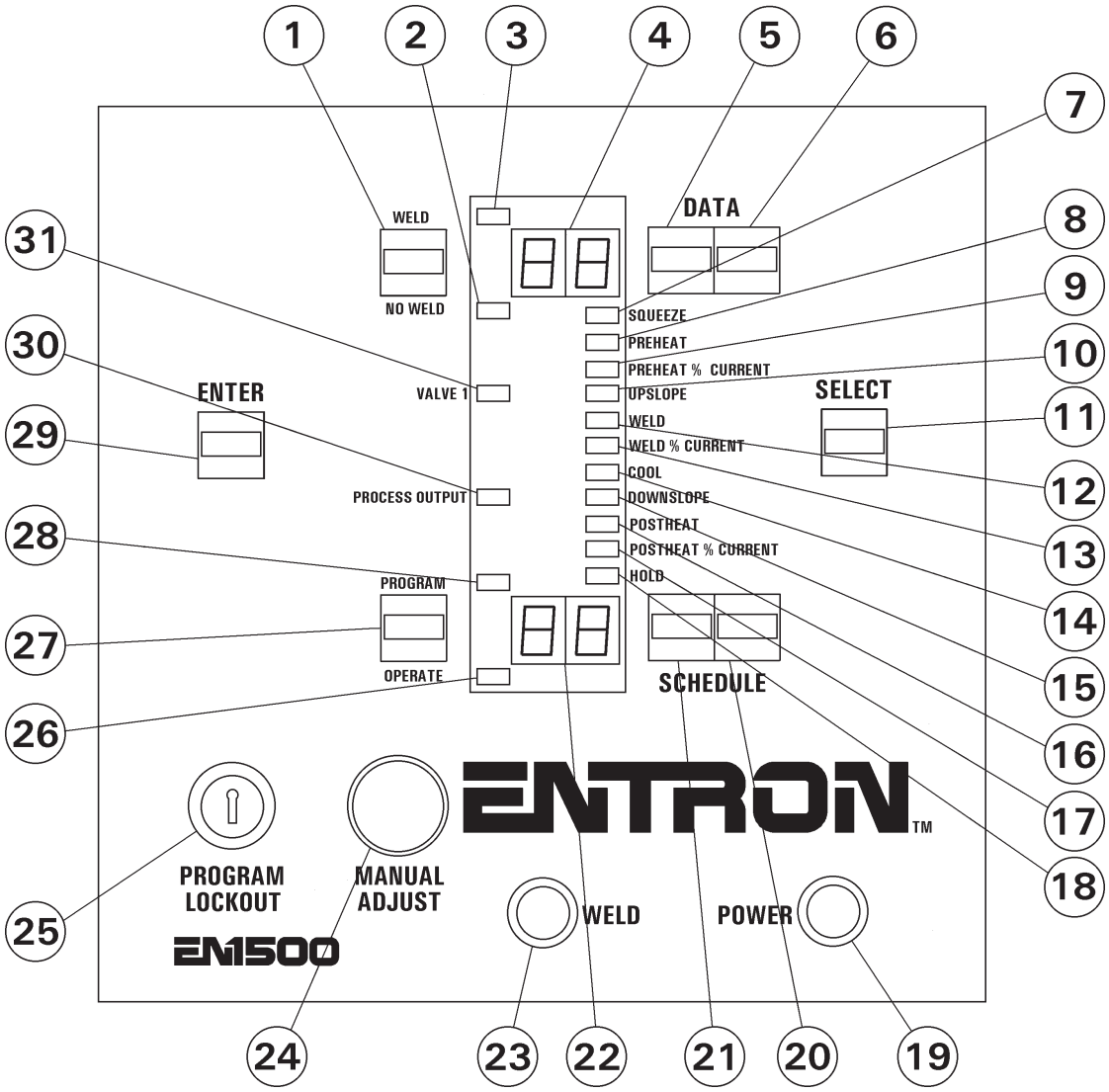


Figure 2-1. *Control Panel layout*

1 - WELD/NO WELD push button
2 - NO WELD mode indicator LED
3 - WELD mode indicator LED
4 - DATA display
5 - DATA 10s push button
6 - DATA 1s push button
7 - SQUEEZE function indicator LED
8 - PREHEAT function indicator LED
9 - PREHEAT % CURRENT function indicator LED
10 - UPSLOPE function indicator LED
11 - SELECT push button
12 - WELD function indicator LED
13 - WELD % CURRENT function indicator LED
14 - COOL function indicator LED
15 - DOWNSLOPE function indicator LED
16 - POSTHEAT function indicator LED
17 - POSTHEAT % CURRENT function indicator LED
18 - HOLD function indicator LED
19 - POWER light (red)
20 - SCHEDULE 1s push button
21 - SCHEDULE 10s push button
22 - SCHEDULE display
23 - WELD light (white)
24 - MANUAL ADJUST knob
25 - PROGRAM LOCKOUT key switch
26 - OPERATE mode indicator LED
27 - PROGRAM/OPERATE push button
28 - PROGRAM mode indicator LED
29 - ENTER push button
30 - PROCESS OUTPUT indicator LED
31 - VALVE 1 indicator LED

2.1 CONTROL FUNCTIONS – See Figure 2-1. *Control Panel layout*

WELD/NO WELD PUSH BUTTON (1) – This push button is active at all times. It puts the control in WELD mode (enables the contactor to fire) or NO WELD mode (disables firing). This function is accessible while in OPERATE mode or while welding with few exceptions (generally during error conditions).

WELD (3)**/NO WELD** (2) **INDICATOR LEDs** – These LEDs indicate the active status of the control. The LEDs toggle whenever the WELD/NO WELD push button is pressed.

DATA PUSH BUTTONS (5) & (6) – The right button increments or decrements the DATA display (4) by one, and the left button increments or decrements DATA by ten. When either digit reaches the maximum, it resets to zero. Pressing either DATA push button for more than one second will decrement rather than increment the data viewed on the numeric display. These push buttons are only active in PROGRAM mode.

NOTICE
Press and release of either push button will increment the data (7, 8, 9, 0, etc.). Hold and release of either push button will decrement the data (2, 1, 0, etc.).

FUNCTION INDICATOR LEDs (7-10 & 12-18) – The LED adjacent to each programmable function will light when the chosen function is displayed in DATA display. When in PROGRAM mode, the indicator LED will light to highlight which active function is being edited.

SELECT PUSH BUTTON (11) – Use the SELECT push button in PROGRAM mode to choose any programmable function. When selecting a function, the indicator LED will light to indicate the selected function. Data pertaining to the selected function will appear in the DATA display. Tapping the SELECT push button will select the function below the one currently being displayed. Pressing the SELECT push button for more than one second will cause function indicator LEDs to change direction and select the previously displayed function.

EXTENDED FUNCTIONS – Section of memory dedicated as a second layer of parameters that apply to all the schedules, and can modify the way the control operates. This section of memory can be found by pressing the SELECT push button and paging through the functions until ***EF*** appears in the DATA display.

POWER LIGHT (19) – The red POWER lamp indicates when power is applied to the control.

SCHEDULE DISPLAY (22) – The SCHEDULE display shows the number of the active schedule. The EN1500 can store up to 50 schedules numbered from 00 to 49.

SCHEDULE PUSH BUTTONS (20) & (21) – The right button increments or decrements the schedule by one, and the left button increments or decrements the schedule by ten. When either digit reaches the maximum, it resets to zero. Press and release of either SCHEDULE push button will increment the SCHEDULE display to the next integer. Press and hold of either SCHEDULE push button will decrement the SCHEDULE display to the previous integer, selecting a lower schedule. SCHEDULE push buttons are active in both PROGRAM and OPERATE modes.

2.1 CONTROL FUNCTIONS (cont.) – See Figure 2-1. *Control Panel layout*

WELD LIGHT (23) – The white WELD lamp is connected directly across the welding transformer primary and will light when voltage is present at the welding transformer. The brilliance of this light is an indication of the programmed PERCENT CURRENT and therefore provides a visual indication of the percent of RMS voltage supplied to the welding transformer.

PROGRAM/OPERATE PUSH BUTTON (27) – This push button will put the control in PROGRAM or OPERATE mode. PROGRAM (28) and OPERATE (26) indicator LEDs indicate which mode control is in:

PROGRAM mode is the mode in which the individual schedules can be entered or modified. Welding parameters (times, valves, etc.) can only be changed in PROGRAM mode. If the control is fitted with a MANUAL ADJUST knob, PERCENT CURRENT parameter can be adjusted in PROGRAM mode or via the MANUAL ADJUST knob (24).

OPERATE mode is the normal operating mode for the control. This is the only mode in which the control can initiate a weld. When the control is in OPERATE mode, the control is in a Ready (to initiate) state.

PROGRAM LOCKOUT KEY SWITCH (25) (Optional) – Allows the operator to lock the control in OPERATE mode only. A key is necessary to place the control in PROGRAM mode.

To put the control in PROGRAM mode using the PROGRAM LOCKOUT key switch:

1. Rotate the key 45 degrees clockwise.
2. Hold the key in this position and press PROGRAM/OPERATE push button.
3. Release PROGRAM/OPERATE push button and release the key. The OPERATE LED will now turn off and the PROGRAM LED will turn on, indicating programmability of all functions.

To put the control back in OPERATE mode:

Press PROGRAM/OPERATE push button again. The control will return to OPERATE mode without rotating the key.

ENTER PUSH BUTTON (29) – The ENTER push button is used to **store** the data shown **from** the DATA display **into** the non-volatile **memory** which retains data with the power off.

NOTICE
If the ENTER push button is not pressed before other data is viewed (by pressing the SELECT push button) or before returning to OPERATE mode, the new data will **not** be stored and the previous data will be retained.

PROCESS OUTPUT INDICATOR LED (30) – When the control is in OPERATE mode, this LED is momentarily lit when indicating the initiation sequence has ended.

VALVE 1 INDICATOR LED (31) – When the control is in OPERATE mode, this LED is lit when the valve output is active.

SQUEEZE INDICATOR LED (7) – When the control is in OPERATE mode, this LED is lit indicating the valve is energized for the time interval entered in this parameter. In PROGRAM mode, the same LED is lit indicating a value may be entered or changed in the selected schedule.

2.1 CONTROL FUNCTIONS (cont.) – See Figure 2-1. *Control Panel layout*

PREHEAT INDICATOR LED (8) – When the control is in OPERATE mode, this LED is lit indicating PREHEAT CURRENT is passing through the welding transformer for the time interval entered in this parameter. When the control is in PROGRAM mode, this LED is lit indicating a value may be entered or changed in the selected schedule.

PREHEAT % CURRENT INDICATOR LED (9) – When the control is in PROGRAM mode, this LED is lit indicating a value representing the percentage of available current may be entered or changed in the selected schedule. This magnitude of CURRENT will be present during PREHEAT time.

UPSLOPE INDICATOR LED (10) – When the control is in OPERATE mode, this LED is lit indicating UPSLOPE time is elapsing for the programmed time interval. In PROGRAM mode, the same LED is lit indicating a value may be entered or changed in the selected schedule.

WELD INDICATOR LED (12) – When the control is in OPERATE mode, this LED is lit indicating the Contactor (SCR) is activated. In PROGRAM mode, the same LED is lit indicating a value may be entered or changed to determine the WELD time in a roll-spot weld in the selected schedule.

WELD % CURRENT INDICATOR LED (13) – When the control is in PROGRAM mode, this indicator is lit indicating a value representing the percentage of available current is being entered or changed in the selected schedule. This magnitude of CURRENT is present during WELD time.

COOL INDICATOR LED (14) – When the control is in OPERATE mode, this LED is lit indicating an impulse sequence is elapsing time in a roll-spot weld in the selected schedule. In PROGRAM mode, the same LED is lit indicating a value of COOL (OFF) cycles is being entered or changed in the selected schedule.

DOWNSLOPE INDICATOR LED (15) – When the control is in OPERATE mode, this LED is lit indicating DOWNSLOPE time is elapsing. In PROGRAM mode, the same LED is lit indicating a value of DOWNSLOPE cycles is being entered or changed in the selected schedule.

POSTHEAT INDICATOR LED (16) – When the control is in OPERATE mode, this LED is lit indicating POSTHEAT time is elapsing. In PROGRAM mode, the same LED is lit indicating a value of HEAT cycles is being entered or changed in the selected schedule.

POSTHEAT % CURRENT INDICATOR LED (17) – When the control is in OPERATE mode, this LED is lit indicating POSTHEAT CURRENT is passing through the welding transformer for the time interval entered in this parameter. When the control is in PROGRAM mode, this LED is lit indicating a value representing the percentage of available current is being entered or changed in the selected schedule.

HOLD INDICATOR LED (18) – When the control is in OPERATE mode, this LED is lit indicating HOLD time is elapsing. In PROGRAM mode, this LED is lit indicating a value representing the time the cylinder is activated after POSTHEAT is being entered or changed in the selected schedule.

2.1 CONTROL FUNCTIONS (cont.) – See Figure 2-1. *Control Panel layout*

MANUAL ADJUST KNOB (24) (Optional) – Allows the increase or decrease of PERCENT CURRENT in both PROGRAM and OPERATE modes. This knob is not functional with the PROGRAM LOCKOUT key switch option.

3.0 WELD PARAMETERS

WELD* (BEAT OPERATION)..... BEAT operation (On with initiation switch closed)
ALL OTHER PARAMETERS ..... 0 to 99 cycles (1 cycle = 1/60 sec.)

SQUEEZE – The number of cycles that the cylinder will be energized prior to the PREHEAT portion of the sequence.

PREHEAT – The number of cycles that current will be transferred to the weld transformer at the PREHEAT % CURRENT.

PREHEAT PERCENT CURRENT – The amount of current that will be transferred to the weld transformer for the programmed number of PREHEAT cycles.

WELD TIME (SEAM) – One (1) cycle programmed into this parameter will produce continuous weld current (**Note: No value stored in COOL time**) while the pilot initiation is held closed.

WELD TIME (ROLL-SPOT) **–** A value programmed into this parameter, with a value stored in COOL time, will produce a roll-spot seam weld by alternating WELD and COOL as long as the initiation pilot is held closed.

WELD PERCENT CURRENT – The amount of current that will be transferred to the weld transformer for the programmed number of WELD cycles.

UPSLOPE – The number of cycles that will occur after PREHEAT causing a gradual increase in HEAT until reaching the programmed WELD % CURRENT.

Beginning with PROM firmware version 619028-001**D**, control will execute a gradual increase (UPSLOPE) or gradual decrease (real DOWNSLOPE) depending on programmed values for PREHEAT % CURRENT and WELD % CURRENT.

Setting Upslope and Downslope Bottom Current – UPSLOPE will begin at the percent current stored in PREHEAT % CURRENT and DOWNSLOPE will stop at the percent current stored in POSTHEAT % CURRENT.

COOL – The OFF time during a roll-spot seam weld sequence. WELD and COOL time will alternate while the pilot initiation is held closed. If no value is stored in this parameter, the seam weld will be continuous.

DOWNSLOPE – The number of WELD cycles that will occur immediately after WELD time. The percent of current decreases from the programmed WELD % CURRENT to the level of current stored in POSTHEAT.

* WELD time in a roll-spot weld is in cycles (1 cycle = 1/60 sec.).

3.0 WELD PARAMETERS (cont.)

Beginning with PROM firmware version 619028-001**D**, control will execute a gradual decrease (DOWNSLOPE) or increase (real UPSLOPE) depending on programmed values for WELD % CURRENT and POSTHEAT % CURRENT.

POSTHEAT – The number of cycles that current will be transferred to the weld transformer at the POSTHEAT % CURRENT.

POSTHEAT % CURRENT – The amount of current that will be transferred to the weld transformer for the programmed number of POSTHEAT cycles.

HOLD – The number of cycles that the cylinder will stay active after WELD or a WELD/COOL sequence has elapsed.

4.0 INITIATION PILOT INPUTS

TWO STAGE INITIATION

STAGE 1 INITIATION (FS1) – Connect a normally open Pilot Switch between TS1-FS1 and TS1-GND. Closure of this switch will energize the valve output on the Terminal Strip/Firing Board (SV1 and SV2).

STAGE 2 INITIATION (FS3 or FS7 or FS11 to GND) – Same functionality as Single Stage initiation – see following description.

SINGLE STAGE INITIATION

Connect a normally open Pilot Switch between TS1-FS3 or FS7 or FS11 and TS1-GND. **DO NOT connect TS1-GND to earth ground.** Closure of this switch will execute a welding schedule as follows:

FS3 initiates the schedule shown in the SCHEDULE display.
FS7 initiates schedule 10.
FS11 initiates schedule 20.

Initiation of this control is very versatile in that it may allow several individual heat levels to be introduced to the parts being welded depending on what parameters are stored in schedules 10 and 20 and the manner in which the FS initiation switches are operated.

This flexibility can be very useful when welding complex shapes or multiple layers. Imagine a roll-spot seam weld which begins welding two layers of steel, then at some point in the weld a third layer of steel is added, then a fourth layer, back down to three layers, then back down to only two layers, all on the same part. This can be done easily in one setup using limit switches and the EN1500 by programming the control to use three separate initiations at different times during the sequence to compensate for the varying layers of steel.

For further clarification on various heat initiation, refer to Appendix A.

4.1 OTHER CHARACTERISTICS

CONTACTOR TEMPERATURE LIMIT SWITCH – This feature is used **inhibit** welding if the temperature of the Contactor is above the rated operating temperature (149°F). If the Temperature Limit Switch is open (over temperature), the control cannot be initiated until the Temperature Limit Switch cools (resets/closes). If the Temperature Limit Switch becomes open during a weld, the firing pulses to the Contactor will continue until end of WELD time. A new sequence cannot be initiated until the Temperature Limit Switch cools and resets (closes).

In either of the above cases, the DATA display will show ERROR CODE **01** until the Temperature Limit Switch recovers its normally closed state; then, the control will return to normal operation.

NOTICE
If the Temperature Limit Switch is not used, place a jumper between PCB2-TLS1/AUX1 and GND. Temperature Limit Switches are standard on **all** supplied Contactors.

PRESSURE SWITCH – This feature is used to make the control **wait** if the required pressure has not been reached while in the SQUEEZE interval as follows:

After initiation, the control advances through SQUEEZE. If the Pressure Switch is open (pressure not sufficient), the control waits, and the SQUEEZE LED flashes at the end of SQUEEZE. When the Pressure Switch closes (pressure is sufficient), the flashing stops and the control continues the sequence.

If the Pressure Switch interrupts the sequence for an extended period, the display will flash ERROR CODE **15**. This error will not terminate the sequence. Once the Pressure Switch closes, the sequence will continue on through PREHEAT and UPSLOPE to WELD and then complete the sequence (see Section 5.3).

NOTICE
If a Pressure Switch is not used, place a jumper (factory installed) between TS1-PS1 and TS1-GND. Pressure Switch is not furnished with the control.

WATER FLOW SWITCH (Optional) **–** This feature is used to **inhibit** welding if water flow is not sufficient for proper cooling of the Contactors as follows:

The Water Flow Switch (normally closed) contact can be connected to TS1-NW1 and TS1-GND. If the Water Flow Switch is open because of insufficient flow, the control will not allow weld current to pass to the welding transformer until there is sufficient water flow to close the switch. See Section 5.5 for Contactor cooling requirements.

EMERGENCY STOP SWITCH – When the Emergency Stop Switch is open, the control **stops any and all processes (all valves and contactor).** While in the Emergency Stop condition, the control will flash ERROR CODE **E.S.** on the DATA display until the condition has been cleared. If the execution of a schedule was interrupted by means of the Emergency Stop Switch, the control cannot be re-initiated automatically (after the Emergency Stop condition is removed). Upon release of the switch, it must be re-initiated by closing the Pilot Switch.

NOTICE
If the Emergency Stop Switch is not used, place a jumper (factory installed) between TS1-ES1 and TS1-GND. Emergency Stop Switch is not supplied with the control.

4.2 NON-VOLATILE MEMORY ERROR

The EN1500 Series Controls make extensive use of non-volatile memory devices. These devices are sometimes susceptible to corruption due to electrical noise present in some systems.

To detect effects of electrical noise on the control, upon power up or return from Emergency Stop, the control executes a diagnostic test that reads all memory locations within the schedule storage areas. If the microcontroller finds invalid data, it displays ERROR CODE **14** alternated with the schedule number where the invalid data is stored. The invalid data may also be found in the EXTENDED FUNCTIONS' memory area; in this case, the alternate flash displays **EF**.

Physically isolating high voltage wires from low voltage wires will avoid the introduction of electrical noise into the control.

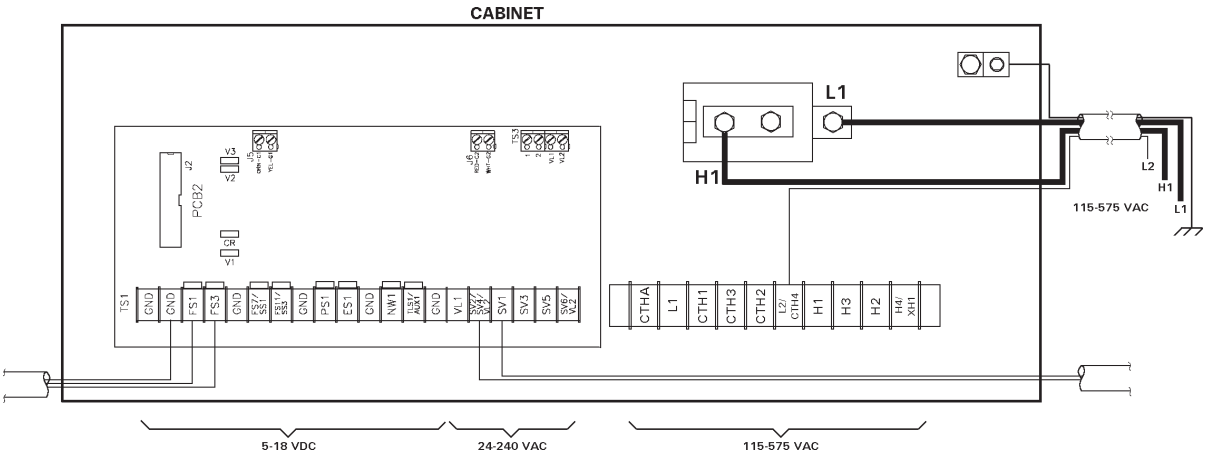


Figure 4-1. *Recommended low and high voltages conduit wiring and routing*

If ERROR CODE **14** occurs, the following procedure should be performed to clear this condition:

1. Press the SELECT push button to stop the flashing.
2. Using the PROGRAM/OPERATE push button, place the control in PROGRAM mode.
3. The operator can use SELECT to find the invalid parameter in the schedule displayed during the flashing.
4. Use the DATA push buttons to correct the data.
5. Press ENTER.
6. Return the control to OPERATE mode.

If more than one location has been affected, it may be necessary to use the CLEAR ALL command in the EXTENDED FUNCTIONS to erase all the memory locations and restore the default settings (factory settings).

NOTICE

If **E.r.=14** persists, you may need to isolate high voltage (valve outputs, etc.) from low voltage (initiation inputs) wires. Re-routing each type of wire to a separate grounded conduit may restore the control to normal operation.

NOTICE

If **E.r.=14** is NOT flashing or appears in PROGRAM mode, the Main Control Board may need repair.

5.0 VOLTAGE PROGRAMMING

! CAUTION !

This welding control and/or welding machine was shipped configured for a specific voltage. A tag attached to the control terminal block specifies this voltage.

! WARNING !

THE EN1500 IS A MULTI-VOLTAGE UNIT WHICH CAN BE CHANGED FROM ONE VOLTAGE TO ANOTHER BY RE-ARRANGING JUMPERS ON THE TERMINAL STRIP INSIDE THE UNIT. OPERATING THE CONTROL AT A VOLTAGE OTHER THAN THAT PRESCRIBED BY THE VOLTAGE CONFIGURATION JUMPERS MAY CAUSE SERIOUS DAMAGE.

This control can be configured to operate at 208, 240, 380, 480, and 575 VAC. If operation at 380 or 575 VAC is required, please consult the factory.

Control Transformer

Jumpers on TS1-L2/CTH4, CTH2, CTH3, and L1/CTH1 must be configured to match the line voltage. Refer to the Wiring Diagram shipped with the control.

Sense Transformer

Jumpers on TS1-H4, TS1-H2, TS1-H3, and TS1-H1 must be configured to match the line voltage. Refer to the Wiring Diagram shipped with the control.

5.1 FUSING

CONTROL FUSE — This fuse, an FNQ-R-1/4 or KLDR-1/4, is used to protect the control circuits.

VALVE FUSE — These fuses, a 2AG 1 AMP, are used to protect the valve circuits. The fuses are located on Terminal Strip PCB2 (A/N 410319 or 410319-001).

! CAUTION !

INSTALL PROPERLY SIZED FUSES IN SERVICE DISCONNECT SWITCH. CHECK WELDING MACHINE MANUFACTURER'S RECOMMENDATIONS.

! DANGER !

VOLTAGES PRESENT IN THIS CONTROL CAN CAUSE SEVERE OR FATAL INJURY.
DO NOT CHANGE FUSES WITH THE POWER ON.
USE ONLY THE TYPE OF FUSE SPECIFIED TO MAINTAIN SAFE OPERATION.

5.2 TERMINAL STRIP DIAGRAMS

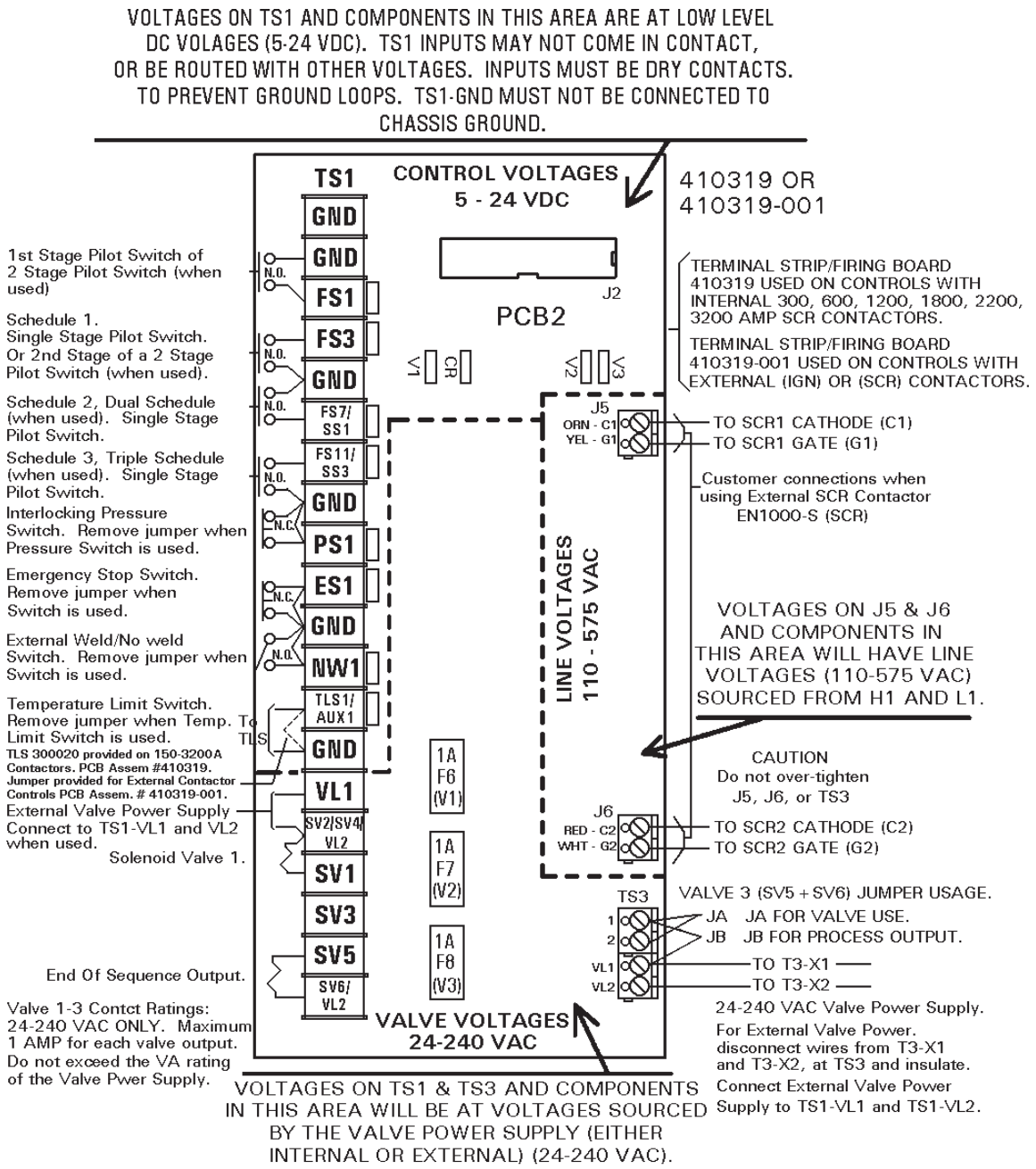


Figure 5-1. *Terminal Strip/Firing Board (before June 2004)*

5.2 TERMINAL STRIP DIAGRAMS (cont.)

Since June 2004, a new tape layout revision of Terminal Strip/Firing Board A/N 410319 is shipped with new controls. Beside new layout of the components on the Board, it now includes optional manufacture of assembly with 24 VDC Valves. For more information about 24 VDC Valve Option, see Application Note 700189.

Valve load resistors have also been omitted. Internal leakage on solid state relays can cause voltages to be seen across unloaded valve outputs. When Valve Terminals are loaded, these voltages will disappear.

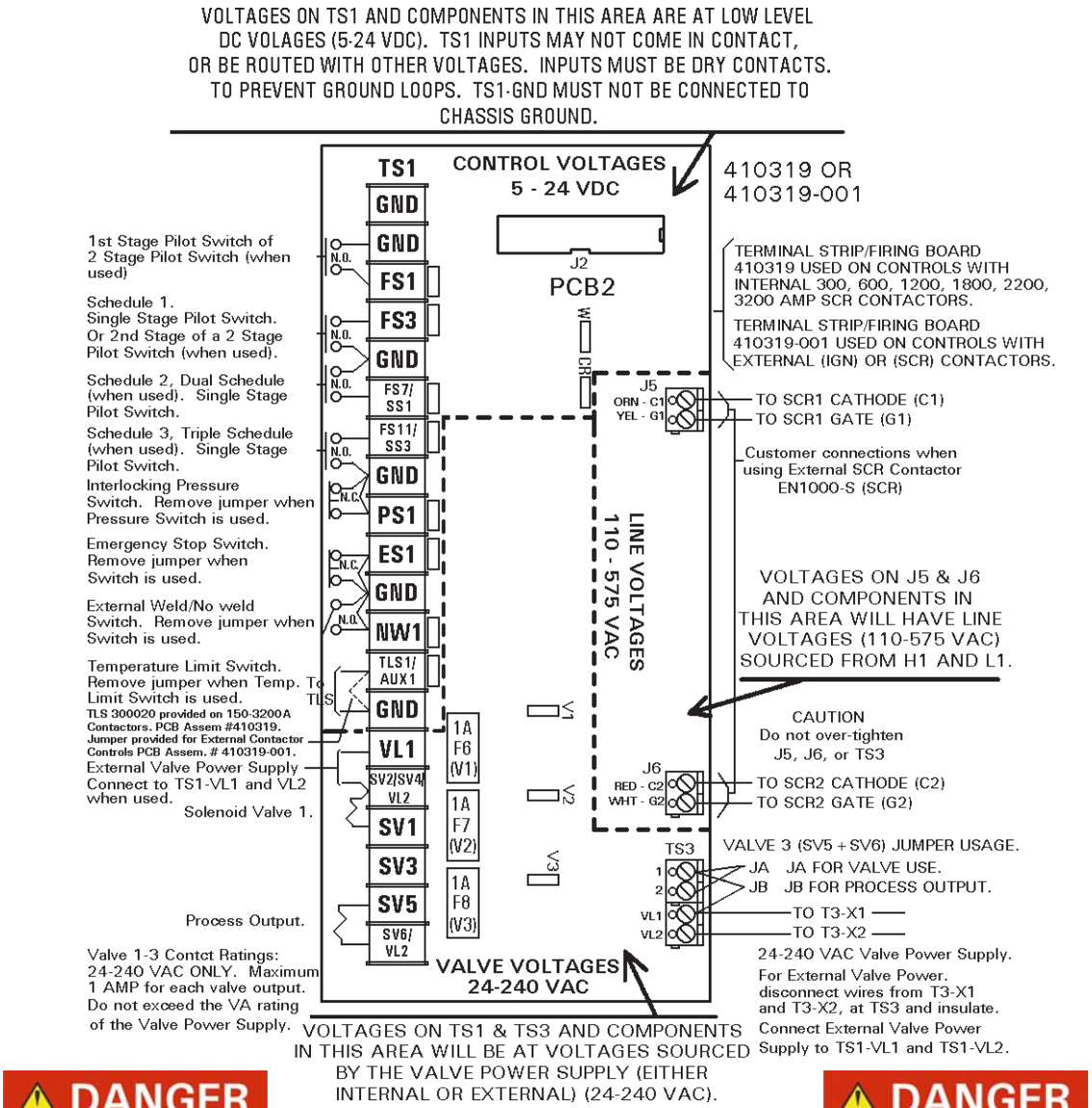
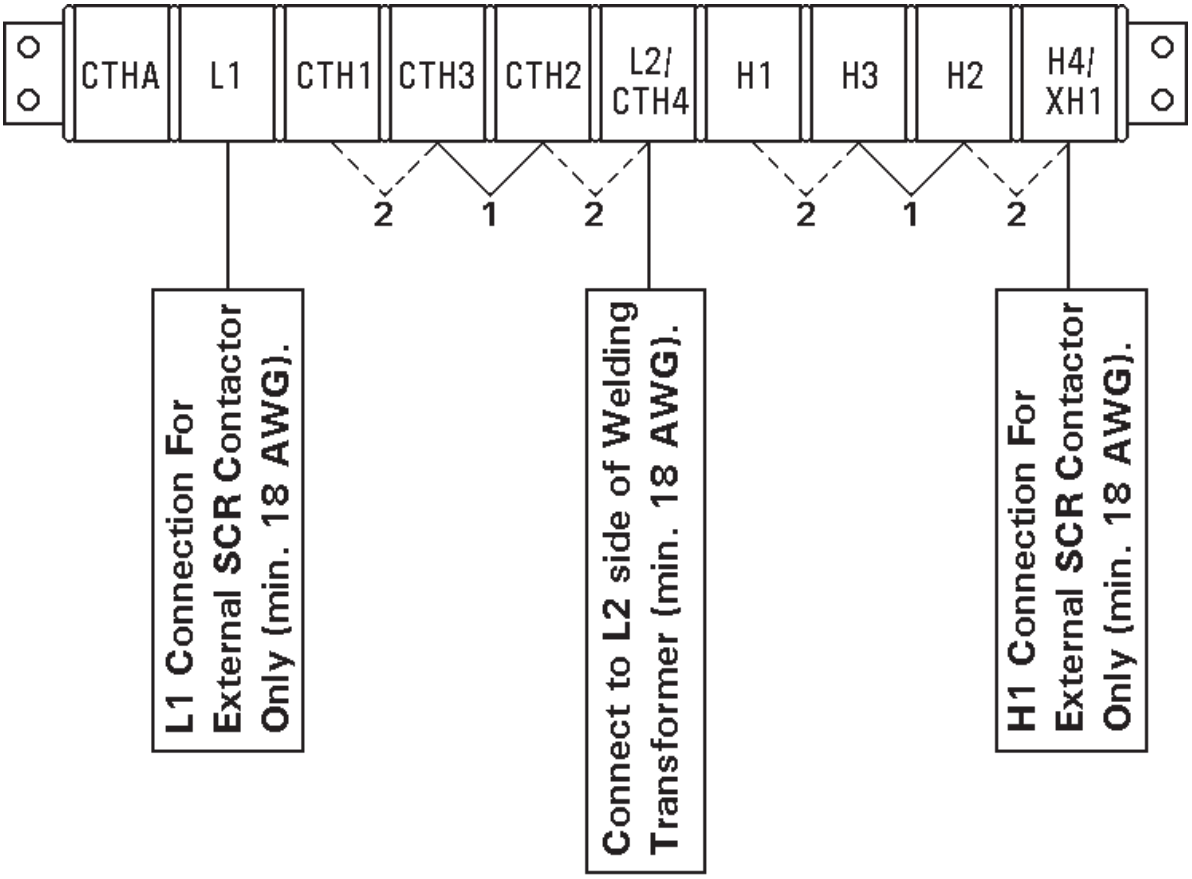


Figure 5-2. *Terminal Strip/Firing Board (since June 2004)*

5.2.1 TERMINAL STRIP TS1

See front page for appropriate Wiring Diagram.



For 480 VAC Operation – Use Jumpers #1
For 240 VAC Operation – Use Jumpers #2
For 208 VAC Operation – Use Jumpers #2
For 380 VAC Operation – Consult Factory

For 575 VAC Operation – **FACTORY WIRED ONLY**

NO CALIBRATION OR CHANGE REQUIRED FOR OPERATION ON EITHER 50 OR 60 Hz.

Figure 5-3. *Voltage operation jumpers settings*

5.3 TERMINAL STRIP CONNECTIONS – See Section 5.2

TS1-GND Used as the **common connection/return path** for initiation connection. There are six GND terminals provided on TS1 (**Not Earth or Power Ground**).

TS1-FS1 Used to connect one side of the **First Stage of a Two Stage Pilot**. Connect a Single Stage Pilot between TS1-FS1 and TS1-GND terminals. Use a single pole, normally open, momentary type switch.

TS1-FS3 Used to connect one side of a **Single Stage Pilot.** Connect a Single Stage Pilot between TS1-FS3 and TS1-GND terminals. Use a single pole, normally open, momentary type switch.

NOTICE

When initiated via any initiation, the initiation switch MUST remain closed beyond the UPSLOPE time of the scheduled sequence for seam weld current to flow. Upon release of the switch, the control will automatically proceed to DOWNSLOPE, etc.

TS1-FS7 Used to connect one side of a **Single Stage Pilot** for direct initiation of schedule 10. Connect a Single Stage Pilot between TS1-FS7 and TS1-GND terminals. Use a single pole, normally open, momentary type switch.

TS1-FS11 Used to connect one side of a **Single Stage Pilot** for direct initiation of schedule 20. Connect a Single Stage Pilot between TS1-FS11 and TS1-GND terminals. Use a single pole, normally open, momentary type switch.

TS1-PS1 Used to connect one side of a **Pressure Limit Switch.** When used, remove jumper and install a single pole, normally open Pressure Limit Switch between TS1-PS1 and TS1-GND terminals.

TS1-ES1 Used to connect one side of a **Emergency Stop Switch.** When used, remove jumper and install a single pole, normally closed Emergency Stop Switch between TS1-ES1 and TS1-GND terminals.

TS1-NW1 Used to connect one side of an **External No Weld Switch.** When used, remove jumper and install a single pole, normally open switch between TS1-NW1 and TS1-GND terminals.

TS1-TLS1 Used to connect one side of a **Temperature Limit Switch.** When used, remove jumper and install a single pole, normally closed Temperature Limit Switch between TS1-TLS1/AUX1 and TS1-GND terminals.

TS1-VL1 External valve power input. This terminal is one side of an external power. External power is supplied between TS1-VL1 and TS1-SV2/SV4/VL2.

5.3 TERMINAL STRIP CONNECTIONS (cont.) – See Section 5.2

TS1-SV2/ SV4/VL2 — One side of Solenoid Valve #1 output power. External input power neutral.

TS1-SV1 — Valve output. This output is active during any schedule for which VALVE 1 has been programmed (SQUEEZE time, HOLD time, etc.).
Switched side of Solenoid Valve #1 power output.

TS1-SV3 — Not used on this assembly. No connection is necessary to this terminal.

TS1-SV5 — Switched side of the **End Of Process** output power.

TS1-SV6/VL2 — Other side of **End Of Process** output power.

! CAUTION !

When external valve power is used (24-240VAC), valve transformer must be disconnected at TS3-VL1 and TS3-VL2. Caution must be used to properly insulate the wires from T3-X1 and T3-X2 leads after removing them from TS3.

5.3.1 TERMINAL STRIP TS1 CONNECTIONS – See Figure 5-3

TS1-CTHA,L1,CTH1, CTH3,CTH2,CTH4/L2 — Used to properly jumper for input voltages to the Control Transformer. L1 is internally connected to control fuse F1.

For 208/240 VAC operation – Jumper CTH1 to CTH3 and CTH2 to CTH4/L2.

For 480 VAC operation – Jumper CTH3 to CTH2 only.

Used also for connections to external SCR Contactors. When required, connect wire (minimum 18 AWG) L1 to L1 side of external Contactor.

TS1-CTH4/L2 — Used to provide control power. Connect wire (minimum 18 AWG) from one side of line common to the L2 welding transformer lead. On controls furnished with integrally installed isolation switch or circuit breaker, L2 is factory installed.

TS1-H1,TS1-H3, TS1-H2,TS1-H4/XH1 — Used to properly jumper input voltage to the Sense Transformer.

For 208/240 VAC operation – Jumper H1 To H3 and H2 to H4.

For 480 VAC operation – Jumper H3 to H2 only.

Used also for connections to external SCR Contactors. When required, connect wire (minimum 18 AWG) H4/XH1 to H1 side of external Contactor.

5.4 PRIMARY WIRING TO WELDING CONTACTOR

For your convenience, many electrical and mechanical connections are performed at the factory. Check **ALL** electrical connections to insure integrity. Connections may loosen during shipping.

! DANGER !

WHEN POWER IS ON, ALL EXTERIOR SURFACES OF THE IGNITRON TUBES AND SCRs CARRY HAZARDOUS VOLTAGES.
CONTACT WITH THESE DEVICES MAY CAUSE SERIOUS OR FATAL INJURIES.

Connect the L1 lead from incoming power to L1 connection located on contactor assembly. Connect the H1 lead from welding transformer to H1 connection located on contactor assembly.

Connect an 18 AWG wire from L2/CTH4 to the H2 side of welding transformer primary.

5.5 COOLING REQUIREMENTS FOR CONTACTORS

SOLID STATE MANUFACTURER'S COOLING RECOMMENDATIONS

600 AMP SCR Solid State Contactor
1200 AMP SCR Solid State Contactor
1800/2200 AMP SCR Solid State Contactor

1 GPM at 104°F (40°C) maximum inlet temperature.

Be sure power to an electronic Contactor is turned off when water is turned off.

With a voltage applied, most water will ionize and begin to conduct current between points of high differential voltages. This current is sufficient to heat the water past the boiling point, creating steam and possibly causing the rubber hose to burst. The water spraying over the high voltage circuit can cause considerable damage to the Contactor and, most likely, the control circuitry as well. Never use metallic or other conductive tubing to plumb a water-cooled resistance welding Contactor. Heater hose has a very high carbon content and should not be used for Contactor plumbing. A low carbon, reinforced hose (such as the hose originally supplied with the unit), no less than 18" long, must be used to connect the Heatsinks to each other and to the bulkhead fitting on the inside wall of the cabinet (see plumbing instructions on Wiring Diagram).

The 600 and 1200 Ampere water-cooled Contactors are electrically isolated from the electrical circuit within the Contactor. No minimum length of water hose is required for electrical isolation of the Contactor. It is still recommended to turn power off when the control is not in use.

WATER OFF – POWER OFF
POWER ON – WATER ON

For all water-cooled Contactors, be sure water is turned ON before placing welder in operation. An open drain is recommended for best operation. If a closed return system is used, be sure return line is properly sized so that back pressure will not reduce water flow below recommendations. A sight flow indicator is recommended.

5.6 INSTALLATION DIAGRAM – 11x11 FLAT PLATE

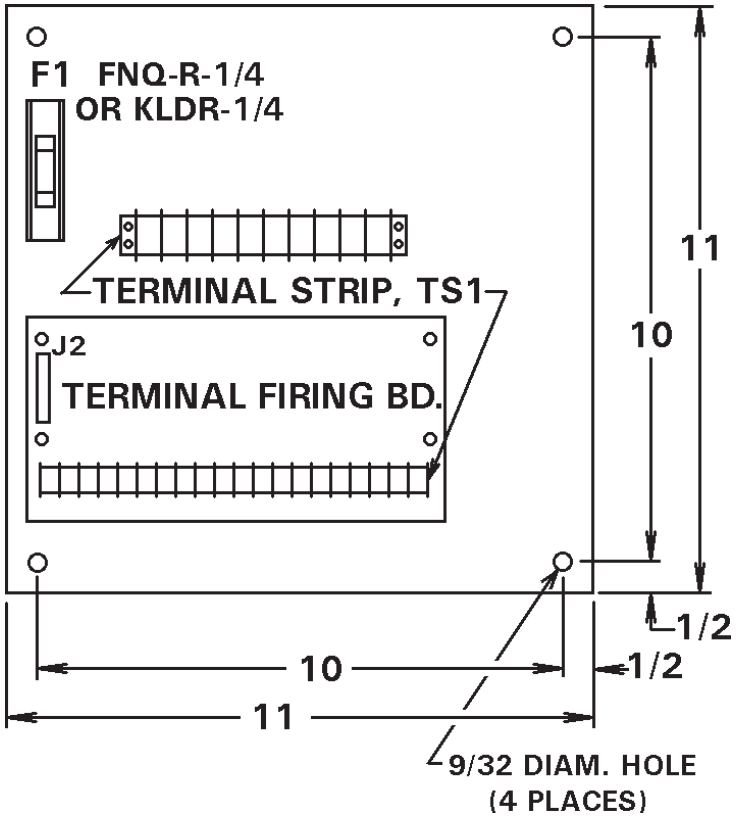


Figure 5-4. *11x11 Flat Plate Installation*

5.7 INSTALLATION DIAGRAMS – “S” CABINET

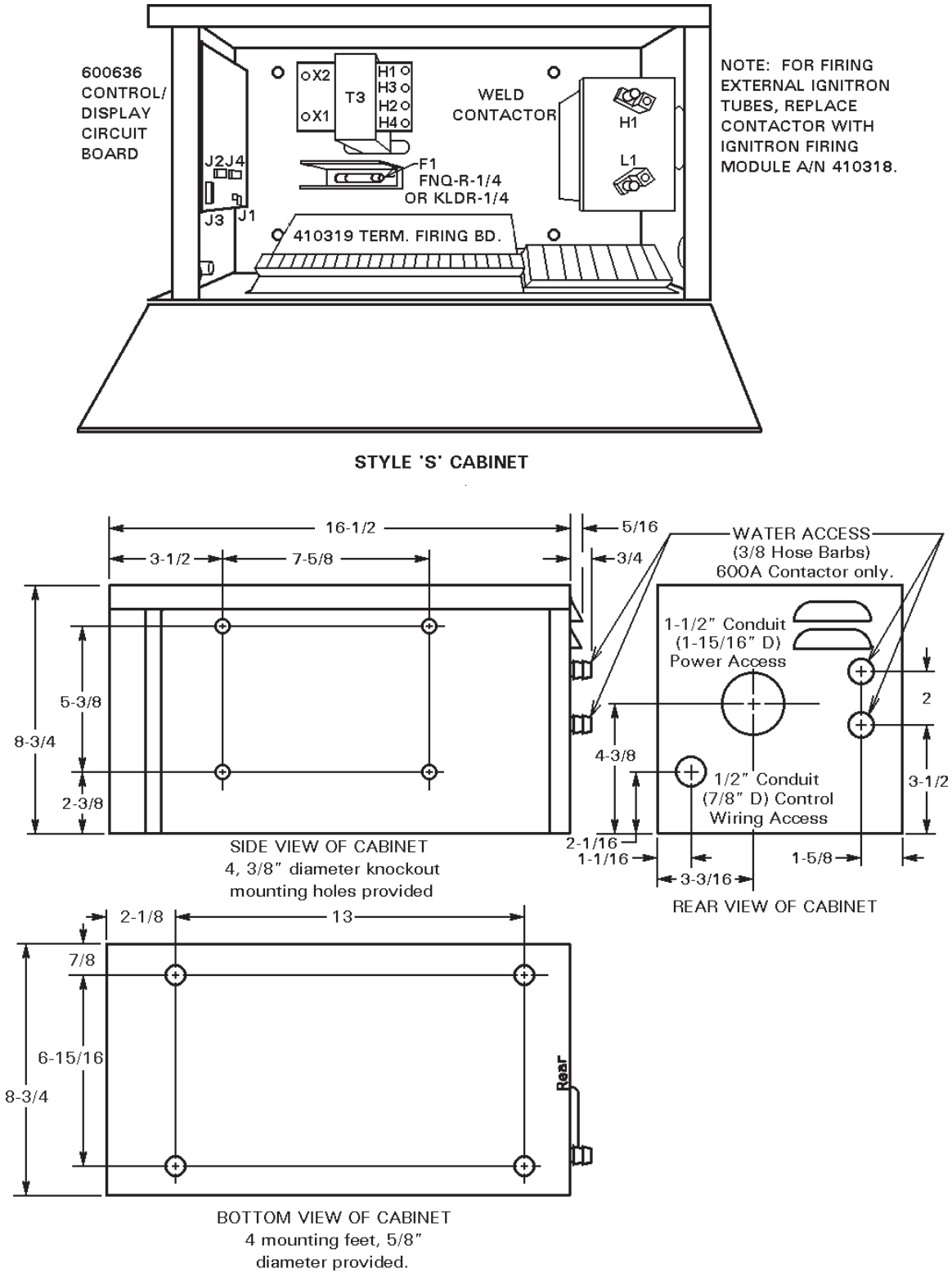


Figure 5-5. *“S” Cabinet Installation*

5.8 INSTALLATION DIAGRAMS – “E” CABINET

See Figure 5-10 for mounting information.

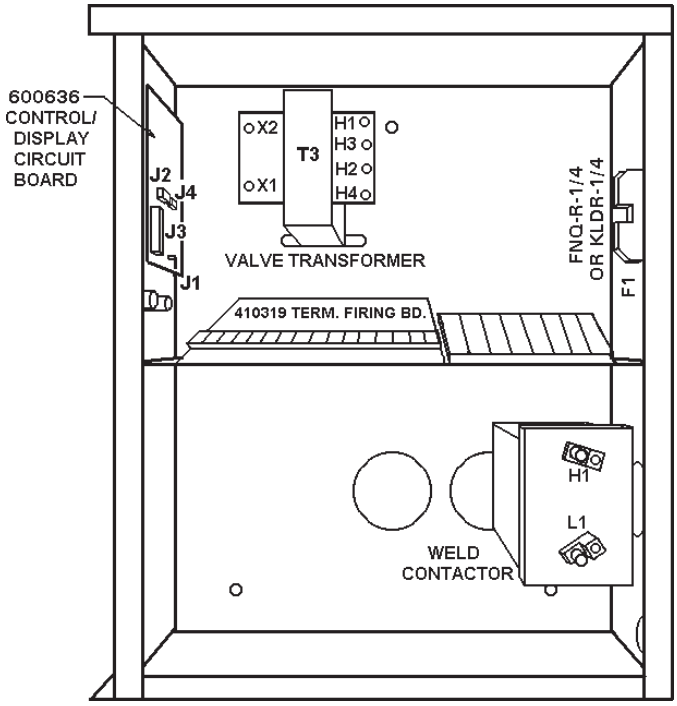


Figure 5-6. *“E” Cabinet – 300/600/1200A Contactor*

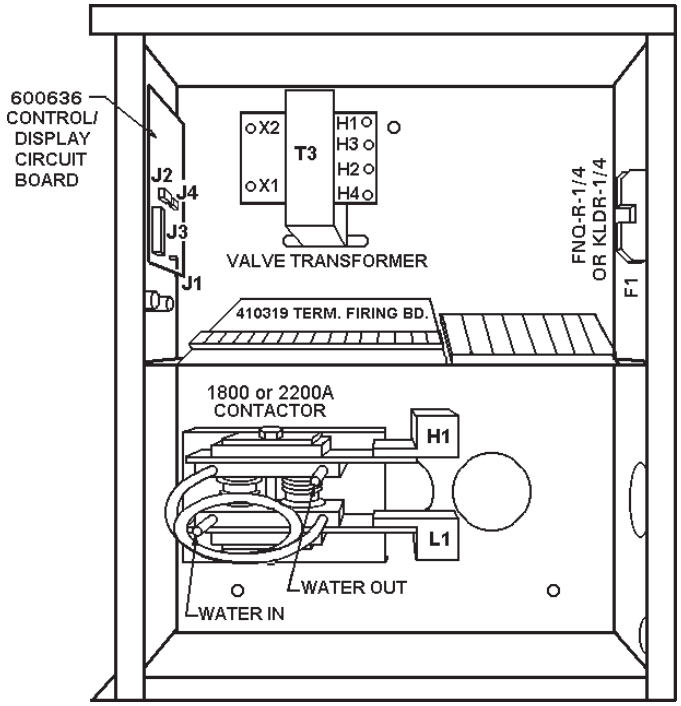


Figure 5-7. *“E” Cabinet – 1800/2200A Contactor*

5.9 INSTALLATION DIAGRAMS – "T/D" AND "L" CABINETS

See Figure 5-11 for mounting information.

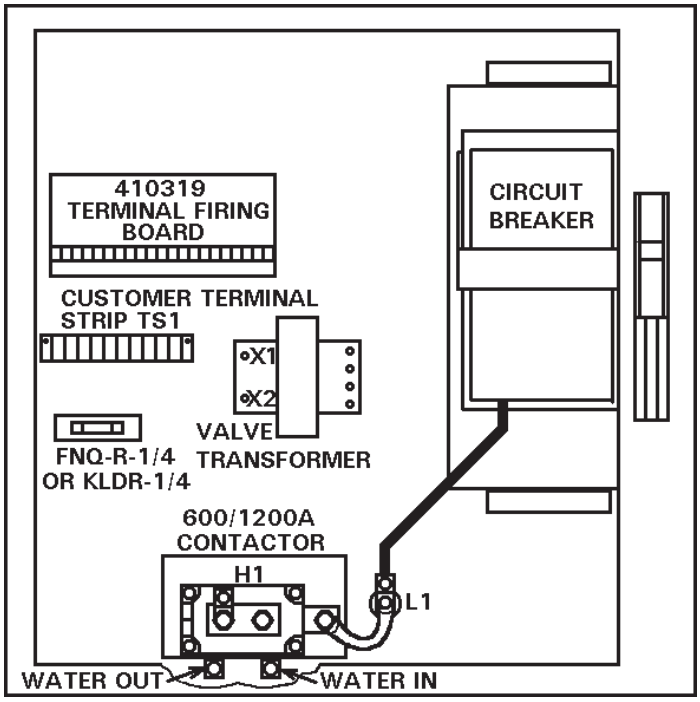


Figure 5-8. *"T/D" and "L" Cabinets – 600/1200A Contactor*

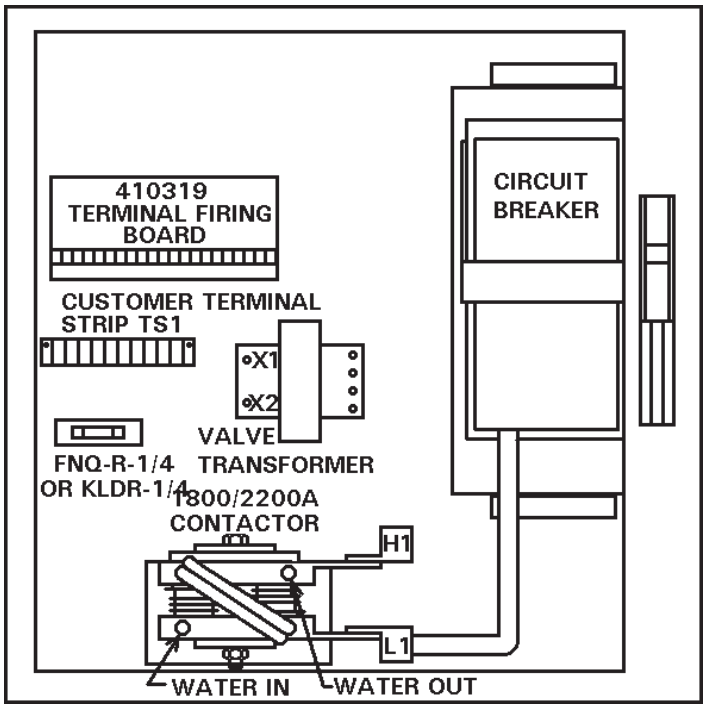


Figure 5-9. *"T/D" and "L" Cabinets – 1800/2200A Contactor*

5.10 MECHANICAL MOUNTING DIAGRAMS

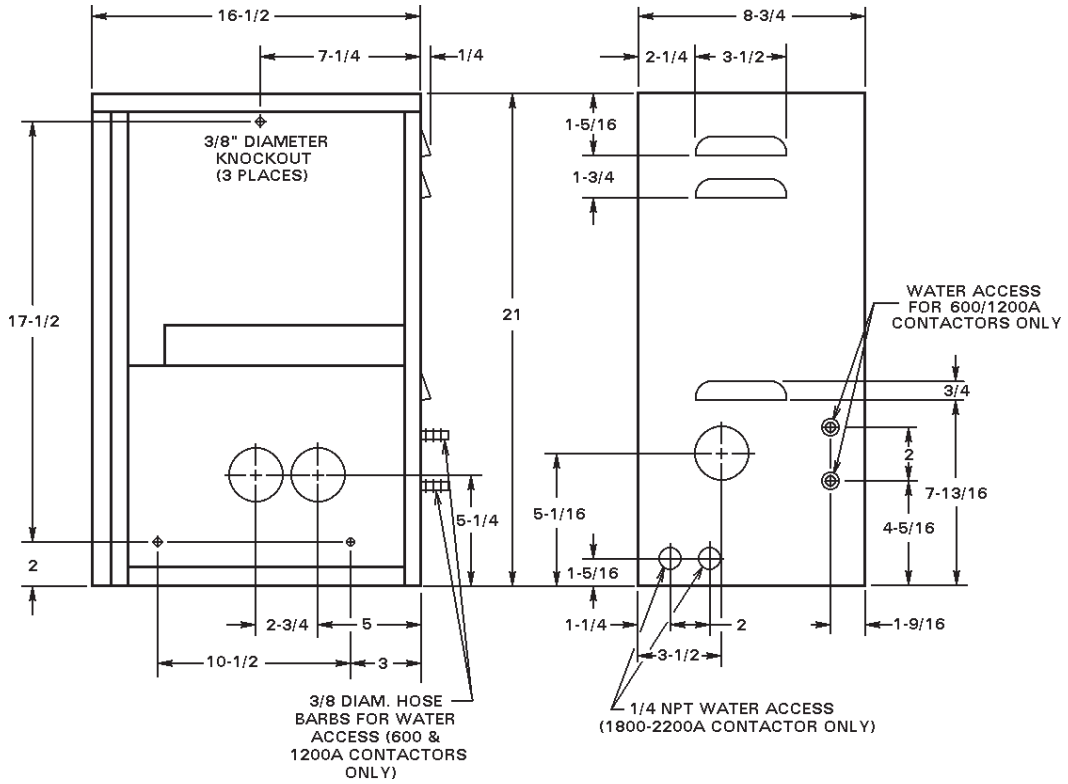


Figure 5-10. *"E" Cabinet mounting*

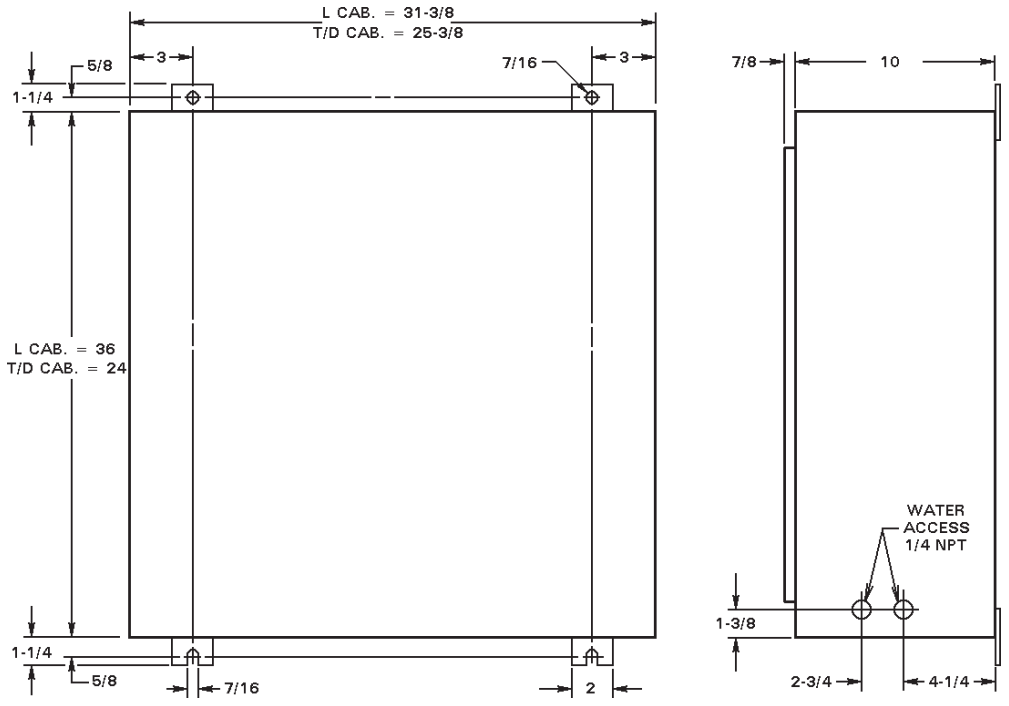


Figure 5-11. *"T/D" and "L" Cabinets mounting*

6.0 EXTENDED FUNCTIONS

To change settings of the EXTENDED FUNCTIONS, put the control in PROGRAM mode. Use the SELECT push button to step once past HOLD. All function indicator LEDs will turn off and the DATA display will read **EF**. This indicates that the control is in the EXTENDED FUNCTION mode. EXTENDED FUNCTIONS can now be viewed or altered.

To view all of the EXTENDED FUNCTIONS, press the SCHEDULE push buttons and step through the available EXTENDED FUNCTIONS in either direction. When a desired function is shown in the SCHEDULE display, the DATA display will read the current value programmed for that function. To exit the EXTENDED FUNCTIONS mode, press SELECT once to advance the function indicator LED one more time. Other parameters appear as you move through the EXTENDED FUNCTIONS. Only parameters that are programmable are covered in this section.

The available EXTENDED FUNCTIONS are listed below and described in the indicated sections.

DESIGNATION	DESCRIPTION	SECTION
S.E.	Seam Mode	6.1
C.C.	AVC	6.2
C.A.	Clear All Functions	6.3
8.7.	87° Delay	6.4
P.P.	Manual Power Factor Programming	6.5

6.1 SEAM MODE – S.E.

Since PROM firmware version 619028-001**C**, the EN1500 has two SEAM modes available – **S.E.**=**01** or **02** (See Section 7.0 for more details). Other values are reserved for future applications.

6.2 AVC – C.C.

The EN1500 Controls are shipped with the AUTOMATIC VOLTAGE COMPENSATION feature disabled. Under conditions of poor line voltage regulation, AVC will allow for consistently good quality welds in spite of varying line voltage.

To enable AVC:

1. Put the control in PROGRAM mode.
2. Use SELECT to find **EF**.
3. Use the SCHEDULE push buttons and find **C.C.**
4. Use the DATA push buttons to enter the desired value of **C.C.** from Table 6-1 based on the working voltage of your control.
5. Press the ENTER push button.

Table 6-1. *AVC parameter values*

C.C. Value	Nominal Line Voltage
00	AVC disabled
01	120
02	240
03	380
04	480
05	575

NOTICE

The AVC must be enabled at a time when the line voltage is nominal. Also, when using AVC, select a PERCENT CURRENT not higher than 85% to allow the AVC circuit operating space.

6.3 CLEAR ALL FUNCTIONS – *C.A.*

It is sometimes desirable to CLEAR ALL previous SCHEDULES and EXTENDED FUNCTIONS from memory and return programmed control parameters to factory defaults.

To use the CLEAR ALL feature:

1. Put the control in PROGRAM mode.
2. Use SELECT to find ***EF***.
3. Use the SCHEDULE push buttons to find ***C.A.***
4. Enter a value for ***C.A.*** of ***01*** or ***02*** into the DATA display using the DATA push buttons,
   where*:** ***C.A.*=*01 Clears all SCHEDULE data
   C.A.*=*02 Clears all EXTENDED FUNCTION data
5. Press the ENTER push button.

NOTICE
ONCE THE CLEAR ALL FUNCTION IS EXECUTED, ERASED DATA *CANNOT* BE RESTORED.

6.4 87° DELAY – *8.7.*

The 87° DELAY helps to prevent the build-up of a DC component in the welding transformer. A DC component may be damaging. To program this function:

1. Put the control in PROGRAM mode.
2. Use SELECT to find ***EF***.
3. Use the SCHEDULE push buttons to find ***8.7.***
4. Use the DATA push buttons and make ***8.7.*=*00*** or ***01***,
   where*:** ***8.7.*=*00 87° DELAY is disabled
   8.7.*=*01 87° DELAY is enabled (factory default setting)
5. Press ENTER.

6.5 MANUAL POWER FACTOR PROGRAMMING – *P.P.*

If required, the EN1500 Control can be placed in the MANUAL POWER FACTOR mode as follows:

1. Place the control in PROGRAM mode.
2. Use SELECT and find ***EF***.
3. Use the SCHEDULE push buttons to find ***P.P.***
4. Use the DATA push buttons to enter the machine's POWER FACTOR,
   where*:** ***P.P.*=*00 The control is in AUTOMATIC POWER FACTOR mode
   P.P.*=[*xx*]** If ***xx is not ***00***, the control is in MANUAL POWER FACTOR mode and the programmed POWER FACTOR is ***xx***
5. Press ENTER.

7.0 APPLICATIONS

The following applications are available on EN1500 Controls with PROM firmware version 619028-001**C** or later.

7.1 BRAZING (BEAT/RESUME)

Brazing operations require long heating times. This is because large areas must be raised to the temperature required for brazing. Depending on the parts to be brazed, this time may vary in the order of seconds. Because of the many variables in the process, the heating period is typically controlled manually by the operator.

The EN1500 Control was originally designed as a dedicated seam welding control. The EN1500 Series Controls can be operated in brazing mode by connecting a Two Stage foot switch to the Terminal Strip Input board. The First Stage is connected between FS1 and GND. The Second Stage is connected to FS3, FS7, or FS11. The FS3 closure will always start any sequence shown on the Front Panel display. FS7 will only initiate the sequence programmed in schedule 10. FS11 will only initiate the sequence shown on schedule 20.

7.1.1 BRAZING WORKS IN SEAM MODES – S.E.=01 OR S.E.=02

To program a brazing operation (BEAT operation):

1. Put the control in PROGRAM mode.
2. Program required amounts of the following, pressing ENTER after each parameter change:

   SQUEEZE
   WELD **(01 to 99)**
   WELD % CURRENT
   HOLD

COOL time may be programmed if intermittent heat pulses are required during brazing. Whenever a schedule has a non-zero value programmed for WELD, the operation is BEAT if the initiation input is opened at any point of the sequence (FS3, FS7, or FS11). However, keeping the First Stage closed (FS1) will maintain the solenoid valve active (electrodes closed) to permit a resumption of weld current by re-closing the Second Stage (FS3, FS7, or FS11). In SEAM mode **01** (default value), if the value of WELD is **00**, the control will skip this part of the sequence and execute any other programmed schedule parameter in BEAT mode. However, in SEAM mode **02**, the control will execute other programmed schedule parameters in a NON-BEAT mode (see Section 7.2).

7.2 SPOT (NON-BEAT)

Sometimes, an application requires the use of the same welding equipment to perform seam, brazing or spot welding. In these cases, it is convenient to allow multiple operations without reprogramming the weld control every time a different operation is required. The SEAM mode **02** is available to accomodate this need.

7.2.1 SPOT WORKS ONLY IN SEAM MODE S.E.=02

To program a SPOT welding sequence:

1. Click SELECT push button until EF is shown in the DATA display.
2. Click SCHEDULE push buttons to find S.E.
3. Put the control in PROGRAM mode and change S.E. data value to 02 and press ENTER.
4. Use SELECT push button to return to SCHEDULE display.
5. Program **WELD=00** in the SPOT weld schedule used.
6. Program required amounts of the following, pressing ENTER after each parameter change:

SQUEEZE
PREHEAT or POSTHEAT
PREHEAT % CURRENT or POSTHEAT % CURRENT
HOLD

7.2.2 SPOT WITH PULSATION WORKS ONLY IN SEAM MODE S.E.=02

To program a SPOT welding sequence with pulsation:

1. Click SELECT push button until EF is shown in the DATA display.
2. Click SCHEDULE push buttons to find S.E.
3. Put the control in PROGRAM mode and change S.E. data value to 02 and press ENTER.
4. Use SELECT push button to return to SCHEDULE display.
5. Program required amounts of the following, pressing ENTER after each parameter change:

SQUEEZE	**00 to 99 cycles**
PREHEAT (Pulse Count)	**00 to 99 pulses**
PREHEAT % CURRENT	**Must be 00**
WELD	**01 to 99 cycles**
WELD % CURRENT	**00 to 99 %**
COOL	**00 to 99 cycles**
HOLD	**00 to 99 cycles**

! CAUTION !

In this mode, the control will initiate in NON-BEAT mode. Once the initiation is closed, the weld control will energize the solenoid and complete the weld sequence even if the initiation is momentary.

NOTICE

NOTE on BRAZING and SPOT: Using S.E.=02, the two operations may be done with the same control without the necessity of reprogramming the control between operations. For example, simply connect the spot welding foot switch to FS7 and program schedule 10 with required data. Connect the brazing foot switch to FS11 and program schedule 20 with the required brazing data. Alternatively, FS3 may initiate any schedule shown on the display. All three inputs work with a common First Stage (FS1).

8.0 ERROR CODES

ERROR	POSSIBLE CAUSE	REMEDY
Data/Schedule Display E.r.=01	Error Code #01 Temperature Limit Switch open or overheated.	Wait for Temperature Limit Switch to cool or check for open circuit. **See Section 4.1, 5.2 and 5.3**.
Data/Schedule Display E.r.=02	Error Code #02 FS1 AND FS7 both closed.	Remove any connection to FS1. **See Section 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=03	Error Code #03 FS1 AND FS11 both closed.	Remove any connection to FS1. **See Section 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=04	Error Code #04 Attempt to weld in PROGRAM mode.	Return to OPERATE mode. **See Section 2.1.**
Data/Schedule Display E.r.=05	Error Code #05 FS1,FS3,FS7,FS11 closed to GND before power on.	All initiations must be open at power on. **See Section 2.1, 5.2 and 5.3.**
Data/Schedule Display E.r.=07	Error Code #07 FS1 initiated while another seq. active.	Remove any connection to FS1. **See Section 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=08	Error Code #08 FS3 initiated while another seq. active.	Open TS1-FS3. **See Section 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=09	Error Code #09 FS7 initiated while another seq. active.	Open TS1-FS7. **See Section 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=10	Error Code #10 Termination of sequence – FS11-GND.	Open TS1-FS11. **See Section 1.0, 4.0, 5.2 and 5.3.**
Data/Schedule Display E.r.=11	Error Code #11 Control Board. Control Relay problem.	Replace Control Board.
Data/Schedule Display E.r.=12	Error Code #12 Control Board. Hardware error.	Replace Control Board.
Data/Schedule Display E.r.=13	Error Code #13 Full conduction detected.	Change to higher welding transformer tap.
Data/Schedule Display E.r.=14 (Flashing)	Error Code #14 Flashing EEPROM error. Possible electrical noise causing invalid data storage.	Follow procedure in Section 4.2 and 6.3.
Data/Schedule Display E.r.=14 (NON-Flashing)	Error Code #14 NON-Flashing EERAM memory failure.	Replace Control Board. **See Section 4.2 and 6.3.**
Data/Schedule Display E.r.=26	Error Code #26 Contactor short detected.	1. Check Contactor for short. 2. Check Firing Module 410319. 3. Check L1 and L2 reversed or L2 missing.

For list of all Error Codes, refer to Appendix C (Application Note 700158).

8.1 TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	REMEDY
POWER light will not light.	1. Fuse F1, type FNQ-R-1/4 or KLDR-1/4, control fuse blown.	1. Check that control is wired for proper input line voltage (H1, H2, H3 and H4 and CTH1, CTH2, CTH3 and CTH4 jumpers on Terminal Strip).
	2. Defective POWER light.	2. Replace POWER light.
	3. Main welder disconnect open.	3. Check that fuse or circuit breaker is of sufficient size for KVA demand of welding transformer.
	4. L2 wire to Terminal Strip missing.	4. Add L2 wire.
Control will not initiate.	1. Initiation switch(es) defective.	1. Replace switch(es).
	2. Loose or broken wire(s) at initiation switch(es).	2. Check for loose or broken wire(s) at initiation switch(es) and at Terminal Strip (FS3, FS7, etc.).
	3. Defective Control/Display.	3. Replace board with another board stamped with same A/N.
Half cycle during WELD time.	1. Defective thyristor.	1. Check thyristor for open. Replace.
	2. Defective Terminal Strip/Firing PCB.	2. Replace board. See Wiring Diagram for correct A/N.
Control sequences but will not weld.	1. WELD/NO WELD push button on Front Panel of control.	1. Check to see that control is in WELD.
	2. Open Temperature Limit Switch.	2a) Contactor overheated, causing Limit Switch to open. 2b) Defective Limit Switch. Replace. 2c) Connect jumper across TLS1 and GND if TLS is not used.
	3. Welding transformer tap switch in OFF position.	3. Set to ON or at one of the tap positions.
	4. Welding transformer secondary open (WELD light may light).	4. Check corroded or open connections. Be sure welding electrodes close on work.
	5. Defective Terminal Strip/Firing PCB.	5. Replace board. See Wiring Diagram for correct A/N.
	6. Defective Control/Display PCB.	6. Replace board with another board stamped with same A/N.

8.1 TROUBLESHOOTING (cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Weld too cool or too small.	1. Line voltage drop. 2. Excessive force at electrodes. 3. Weld transformer set low. 4. WELD count too short. 5. PERCENT CURRENT too low. 6. Electrode face too small. 7. Excessive electrode wear.	1. KVA demand for welding transformer too high for input power line. 2. Check force supply. 3. Increase transformer tap setting. 4. Increase WELD count duration. 5. Increase PERCENT CURRENT. 6. Select correct electrode face diameter. 7. Properly dress electrodes.
"HOT" Welds	1. Low force. 2. Weld transformer set high. 3. WELD count set too high. 4. PERCENT CURRENT set too high. 5. Electrode face too small.	1. Check force at electrodes. 2. Reset tap to lower setting. 3. Reduce WELD count duration. 4. Decrease PERCENT CURRENT. 5. Dress or replace electrode with proper size.
Inconsistent Welds	1. Work not square with electrodes. 2. Poor part fit-up. 3. Dirty material to be welded.	1. Check welding fixtures setup or electrode alignment. 2. Check parts for proper fit-up. 3. Work should be free from excessive dirt, paint and oxides.

9.0 ENTRON LIMITED WARRANTY AND FACTORY SERVICE

ENTRON Controls, LLC., warrants that all ENTRON control panels, **EXCEPT** Mid-frequency Inverter controls, silicon controlled rectifiers (SCRs), insulated gate bipolar transistors (IGBTs), SCR and IGBT assemblies, circuit breakers, and electro-mechanical contactors, are free of manufacturing defects for a period of **TWO YEARS** from the date of original purchase and, in the event of a manufacturing defect, ENTRON will repair or replace, at its discretion, the defective part without any cost for parts or labor.

All silicon controlled rectifiers, SCR and IGBT assemblies, circuit breakers, and electro-mechanical contactors in ENTRON control panels are covered by **a limited warranty from the original manufacturer**. If these parts fail because of a manufacturing defect, they will not be repaired or replaced by ENTRON, but will be returned by ENTRON to the original manufacturer in accordance with said manufacturer's warranty.

ENTRON Controls, LLC., warrants that all Mid-frequency Inverter controls are free of manufacturing defects for a period of **ONE YEAR** from the date of original purchase and, in the event of a manufacturing defect, ENTRON will repair or replace, at its discretion, the defective part without any cost for parts or labor.

To obtain repairs or replacement parts under this warranty, the defective part must be returned, prepaid, to ENTRON Controls, LLC., 1402 S. Batesville Road, Greer, SC 29650. Please send your repair to the attention of "Service" with a description of the problem you are experiencing, contact person, and phone number.

EXCLUSIONS: This warranty does not cover damage by accident, misuse, unauthorized repair or modification to any control assembly by the customer.

IMPORTANT NOTE: The warranty period is considered from the date of shipment and is tracked by a serial number code.

Use of Out of Warranty Repair Service:
To obtain service for any printed circuit board assembly or welding control after the warranty period, send the assembly or control, prepaid, to ENTRON Controls, LLC., and ENTRON will repair the printed circuit board assembly or control and return it to you without further warranty. Additional service charges will be invoiced at time of shipment.

Your ENTRON Controls, LLC., Original Equipment Manufacturers (OEMs), Dealers and Distributors are your first response contact to secure technical assistance on control or welding problems. Should they be unable to assist you, please contact your ENTRON sales representative or the factory directly. Contact the factory at 864-416-0190.

APPENDIX A

INITIATION COMBINATIONS

The control will initiate a programmed schedule when any of three initiation inputs – FS3, FS7, and FS11 – is switched to GND. When closed, FS3 will initiate whatever schedule is shown on the Control Display. When closed, FS7 will initiate schedule 10. When closed, FS11 will initiate schedule 20. All initiations will perform the sequence shown in Figure 1-1.

Within the software of the control, these inputs are weighted (prioritized). By this we mean if a higher order switch initiation is closed, the switches weighted lower will be ignored. If all three switches are closed in succession, the control will initiate schedule 20 – FS11 which is the highest order initiation.

There may be applications that require several heats being introduced to the material as the weld progresses. An outstanding feature of the EN1500 is that the next higher schedule can interrupt and replace a lower numbered initiation during the programmed WELD/COOL time. FS3 can be interrupted by FS7 or FS11; likewise FS7 can be interrupted by FS11. Release of a higher order switch, while the lower order switch is still closed, will revert back to the lower order initiation's WELD/COOL time.

EXAMPLE:
If after FS3 has been initiated and has reached the WELD/COOL portion of its program, FS7 or FS11 initiation switch is closed, the control will immediately jump to the WELD/COOL portion of schedule 10 (in the case of FS7 initiation) or schedule 20 (in the case of FS11 initiation).

If FS3 switch is opened once FS7 or FS11 is engaged, the control will continue through the newly chosen schedule. If FS3 switch is held closed, the control will cycle through the WELD/COOL portion of the newly chosen schedule until that switch is opened, at which time the control will revert to FS3 schedule and complete it.

If after FS3 has been initiated and has reached the WELD/COOL portion of its program, and FS7 initiation is engaged, the control will jump to and begin the WELD/COOL portion of schedule 10.

If while the control is engaged in the WELD/COOL portion of schedule 10 and FS11 initiation is engaged, the control will immediately jump to the WELD/COOL portion of the schedule 20 program. The control will continue to maintain the WELD/COOL portion of FS11 (schedule 20) until one of two things happens:

A. FS11 initiation switch is opened, causing the control to revert to FS7 (as long as that initiation switch is being held closed) or FS3 (if FS3 initiation switch is held closed and FS7 initiation switch has been released).
B. Both FS3 and FS7 initiation switches are opened, and FS11 switch is opened, allowing the control to complete schedule 20.

This flexibility can be very useful when welding conditions vary. Imagine a long seam weld where metal is entering the throat of the machine as the weld progresses. Since the efficiency of the welder is dropping, a second and eventually third heat may be necessary to maintain a good weld. This can be accomplished using limit switches and by simply programming the EN1500 control's three separate initiations to compensate for the varying power loss.

The flow chart in Figure A1 may assist in better understanding the capabilities of the control when an application dictates the need for more than one heat.

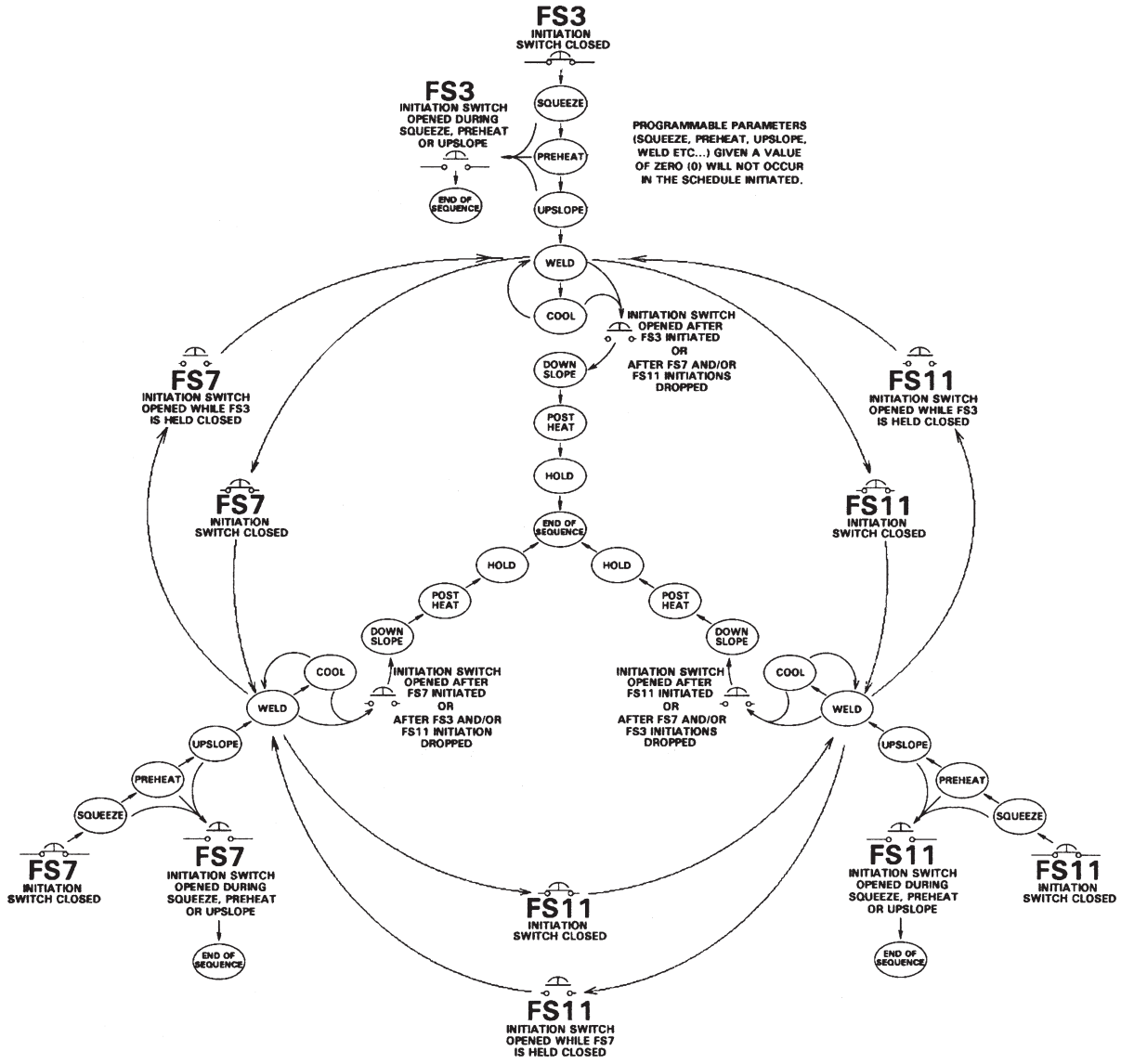


Figure A1. *Initiation Combinations (before PROM firmware version 619028-001**D**)*

APPENDIX A (cont.)

NOTICE
As of PROM firmware version 619028-001**D**, initiation combinations have been changed.

As of PROM firmware version 619028-001**D**, if sequence is started with FS3, and if, during WELD time, new initiation FS7 or FS11 is activated, the control will jump to the PREHEAT time of schedule 10 (FS7) or schedule 20 (FS11). Before this software change, the jump was back to the WELD time part of the sequence. Also, if FS7 is released and FS3 is still held closed, the control will execute DOWNSLOPE and POSTHEAT on schedule 10, then jump back to the WELD time on FS3. If FS11 is released after control has started its weld sequence with either FS3 or FS7, the control will execute DOWNSLOPE on schedule 20, then jump back to WELD on schedule 10 if FS7 is held closed or to default schedule if FS3 is still closed.

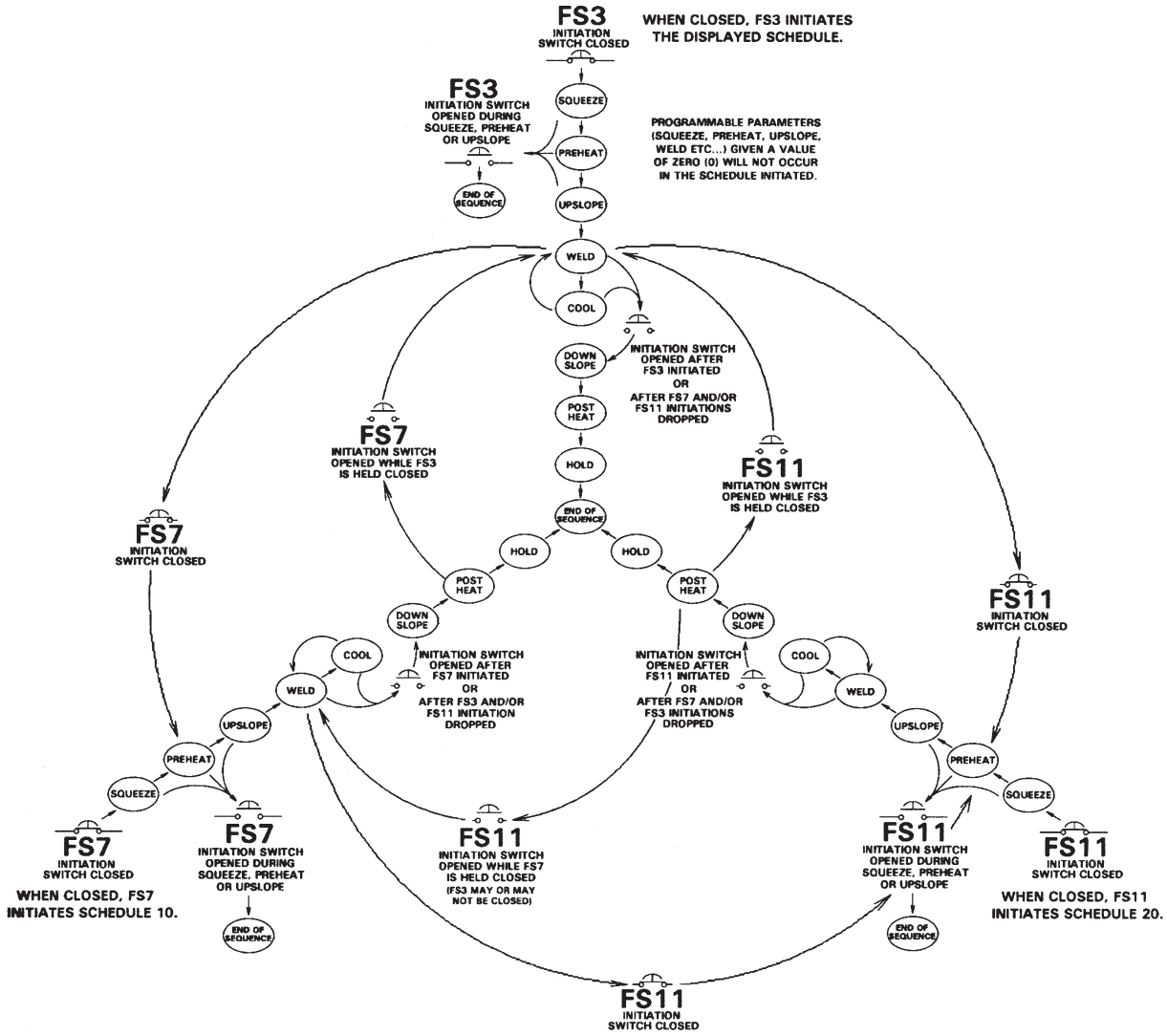


Figure A2. *Initiation Combinations (since PROM firmware version 619028-001**D**)*

APPENDIX B

ISOLATION CIRCUITRY DESCRIPTION

The EN1500 Series Controls are microprocessor-based resistance welding controls that incorporate circuitry designed to prevent any output from the control due to spurious conditions or failure of circuit components. The intent of this Appendix is to explain how the circuitry accomplishes this isolation.

The main isolation is provided by electro-mechanical control relay contacts that are in series with the solenoid valve voltage supply and the contactor firing circuitry. In a non-initiated state, the relay contacts are open and no outputs from these circuits are possible. When the control is initiated by the physical closure of a normally open set of external contacts (commonly a foot switch) across the initiation circuit, the relays are energized and their contacts close and complete the circuits to the solenoid valve and the contactor. The outputs are not actually energized, however, until the microprocessor reaches the point in the sequence at which the valve or contactor outputs are to be activated.

There is no way to guarantee that any control circuit will be free of any component failure. It is always necessary to take personal safety precautions when operating any machinery.

In addition to the relay contacts mentioned above, there are other levels of isolation. The initiation signals first pass through a circuit comprised of opto-isolators before being passed to the input circuitry of the microprocessor. The valve outputs are further isolated by the use of optically coupled triac (solid state) outputs and the weld pulses are isolated by a pulse transformer.

NOTICE
Valve 3 (SV5/SV6) will not be isolated if jumper B is used on TS3 – see Figure B1.

APPENDIX B (cont.)

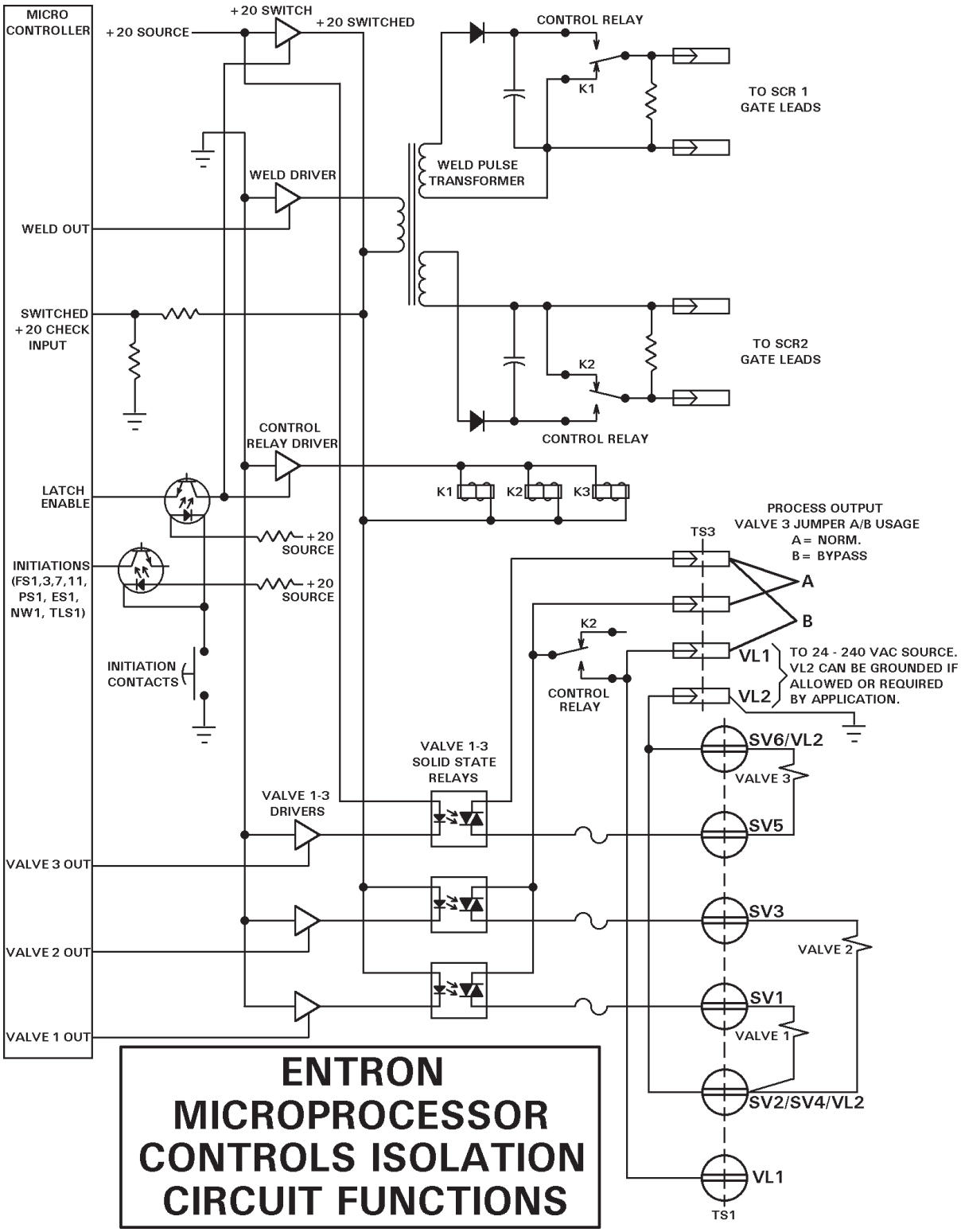


Figure B1. *Isolation Circuitry diagram*

APPENDIX C

ERROR CODES*
APPLICATION NOTE 700158L

ERROR CODE	Reason or Cause
01	Temperature limit exceeded (TLS open). / Incorrect **b.S.** or **P.O.** programmed.
02	FS1 & FS7 are both active.
03	FS1 & FS11 are both active.
04	Weld initiated while in PROGRAM mode.
05	FS1, FS3, FS7, or FS11 is active upon power up.
06	BACK-STEP is active too long. / Input switch closed. / Incorrect **b.S.** or **P.O.** programmed.
07	FS1 still active after weld.
08	FS3 still active after weld.
09	FS7 still active after weld.
10	FS11 still active after weld.
11	Control Relay still active after weld.
12	Hardware error is detected.
13	Full conduction is detected.
14	EEPROM error is detected (refer to Application Note 700127).
14 - **flashing**	Invalid data in EEPROM (refer to Application Note 700127).
15	Pressure Switch is open too long.
16	Emergency Stop is active.
17	Nominal AVC reading is too low.
18	Nominal AVC reading is too high.
19	AVC reading is too low.
20	AVC reading is too high.
21	+5 VDC is out of range.
22	+18 VDC is out of range.
23	Maximum firing angle exceeded during AVC correction.
24	Minimum firing angle exceeded during AVC correction.
25	Power factor measured as zero.
26	Sense input active while not welding. / Shorted SCRs. / Incorrect wiring or missing L2.
27	Retraction not active upon initiation.
28	Front Panel NO WELD switch is active for **P.O.**=**10** or for *EN1000/EN1001 Cascade only* **P.O.**=**33**.
29	Schedule out of range for **S.S.**=**03** when using S49 or S99 option.
30	Over current (*EN1200 and EN1201 only*).
31	IIC Error.
32 - **flashing**	Invalid data in EEPROM (refer to Application Note 700127).
33	MM2 is not found. Memory Module required.
34	Downloading data from MM2 Checksum Error.
35	Copy data to MM2 Checksum Error.
36	Pressure Sense input is too low or too high.
37	Calibration data out of range (*EN1001 only*).
38	DC bus voltage is too low (*EN1200 and EN1201 only*).
39	DC bus voltage is too high (*EN1200 and EN1201 only*).
40	Control with programmed ID not found on the RS485 network (*RT4 only*).
41	Message is not received from the control (*RT4 only*).
42	Communication Error (*RT4 only*).
43	Checksum Error in data bytes (*RT4 only*).
44	DC bus voltage is too high. Send signal to Circuit Breaker Shunt Trip (*EN1200 and EN1201 only*).
45	One or two of the three phases are missing (*EN1200 and EN1201 only*).
46	Setup failed. Control failed to adjust for signal level *(EN1001/EN1001 Cascade only).*
47	Over current from Primary Current Sensor (*EN1200 and EN1201 only*).
48	SCR's Firing Board is not ready for weld (*EN1200 and EN1201 only*).
90	Error Output from control to ENLINK, High.
91	Error Output from control to ENLINK, Low.
d.o.u.n.	VCC power supply voltage below safe operating range.
H. i. or L.o.	Flashing on DATA display if control is unable to correct and maintain constant current during weld. Generally shown after weld for **P.O.**=**12**, **13**, **14**, **22**, **23**, **24** or **25** (*EN1001 and EN1201 only*).
E.S. - **flashing**	Emergency Stop is active.

*These ERROR CODES affect controls in Series EN1000, EN1001, EN1000B, EN1003, EN1000/EN1001 Cascade, EN1200, EN1201, EN1280, TW1280, EN1380, EN1500 and EN1501.