INSTRUCTION MANUAL

700221M

EN6021 SERIES CONTROLS

MICROPROCESSOR BASED
Weld Sequence Controls
With
Solid State Thyristor Contactors

Wiring Diagram 421505 “N” & “L” Cabinet

Communication Specifications – Instruction Manual 700222

Intended for use with firmware version 2.00 and higher

ENTRON Controls, LLC.
1402 S. Batesville Road
Greer, South Carolina 29650
(864) 416-0190
FAX: (864) 416-0195
www.entroncontrols.com

RWMA® MEMBER

THIS PAGE IS INTENTIONALLY BLANK

ENTRON Controls, LLC.

MICROPROCESSOR BASED WELDING CONTROLS

INSTALLATION AND OPERATION MANUAL FOR:
Model Series EN6021

! CAUTION !

READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL OR OPERATE THIS CONTROL.
STORE THIS TECHNICAL INFORMATION IN A PLACE TO WHICH ALL USERS HAVE ACCESS AT ANY TIME!

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

ENTRON Controls, LLC.
Greer, South Carolina 29650

NORMAL USE

This manual contains all information concerning normal use of the ENTRON EN6021 Weld Control.

Together with designated welding hardware, the EN6021 Weld Control is intended to be used for **RESISTANCE WELDING**. It is not intended for any other use.

! CAUTION !
The use of this control for purposes other than intended use may result in injury to user or others or damage to equipment. **This control should only be used for its intended purpose!**

RETROFITS AND MODIFICATIONS BY USER

! WARNING !
Retrofits or modifications may have negative effects on the safety of unit! Consequences could include death, personal injury, or damage to property and loss of warranty. Please contact factory prior to retrofits or modifications to the EN6021 using third-party equipment. This is the only way to determine whether these parts can be used with this control.

QUALIFIED PERSONNEL

This manual is designed for welding technicians and engineering personnel with knowledge of installation and safety standards of electrical and automation technology. Specific knowledge of hardware and software components of EN6021 and related welding hardware is required. This manual must be read and understood by qualified personnel.

CARDIAC PACEMAKERS

! WARNING !
Due to strong magnetic fields arising from resistance welding, the function of cardiac pacemakers may be disturbed. This may cause death or considerable health damages to persons concerned! These persons should avoid the welding system.

EXPLANATION OF ADVISORY NOTATIONS

Throughout this manual, advisory notations are included to inform the user of certain circumstances which need to be emphasized. The hierarchy of these advisory notations is as follows:

1. DANGER
2. WARNING
3. CAUTION
4. NOTICE

! DANGER !

The signal word **DANGER** is used to call attention to immediate or imminent hazards which if not avoided ***will result*** in immediate, serious, or personal injury or loss of life. Examples are: exposed high voltage; exposed fan blades.

! WARNING !

The signal word **WARNING** is used to call attention to potential hazards which ***could result*** in personal injury or loss of life. Examples are: not using proper personal protection; removal of guards.

! CAUTION !

The signal word **CAUTION** is used to call attention to hazards which ***could result*** in non-life threatening personal injury or damage to equipment. **CAUTION** may also be used to alert against unsafe practices.

NOTICE

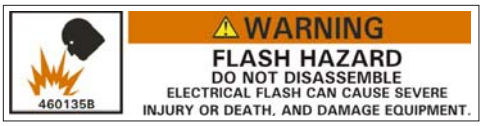
The term **NOTICE** is used for making recommendations on use, supplementary information, or helpful suggestions. Non-compliance with these recommendations ***may result*** in damage to control, welding machine, or workpiece.

PRECAUTIONARY LABELING

ENTRON Controls follows the practices of the RWMA for precautionary labeling. See RWMA Bulletins #1 and #5 for a complete description. Observe the WARNING, DANGER, and CAUTION labels affixed to control to maintain safe operation.

460103 – FOR SERVICE CONTACT
Placed on control to inform the user how to obtain service information.

PRECAUTIONARY LABELING (cont.)



460135 – FLASH HAZARD WARNING
Placed on items that should not be disassembled or remanufactured by non-qualified personnel – items such as circuit breakers and contactors that require expertise of original manufacturer when repairs are required; although these devices look simple in design, improper reassembly could result in dangerous conditions.

460142
HAZARDOUS VOLTAGE
DANGER
Placed on interior of control to advise weld control may be powered by more than one source.

460146
HAZARDOUS VOLTAGE
WARNING
Placed on exterior of control to advise weld control may be powered by more than one source.

460143
VOLTAGE/FLASH
HAZARD DANGER
Placed on interior of control to advise to remove power before changing fuses.

460144
HAZARDOUS VOLTAGE
GND/PE DANGER
Placed on interior of control at GROUND connection to advise control must be grounded and this is the point.

460145
WATER HOSE BURST
HAZARD
Placed on exterior of control. Hoses on **direct water-cooled** contactors connect points of differential voltage; water in hoses will allow some magnitude of current to conduct through them; if there is no water flow and power is left on, water will ionize and deteriorate interior of hose, resulting in hose bursting.

NOTE: 1200 amp Contactor (P/N 600763) is **indirectly water-cooled** and should not have voltages on water-cooling connections. Label is sometimes used on **indirectly water-cooled** contactors because operators cannot tell if contactor is directly or indirectly water-cooled. Also the "Water Off–Power Off/Power On–Water On" recommendation is used generically whether the contactor is directly or indirectly water-cooled.

PRECAUTIONARY LABELING (cont.)

460170
PINCH POINTS CAUTION
Placed on interior of control near points where wires can be pinched to advise pinching of wires can cause control damage.

460199
STORED ENERGY/ PRESSURE HAZARD
Used in drawings/manuals dealing with Pressure Sense and Control systems to advise of possible stored energy in these systems.

460342
PROGRAMMED CONTROL DEVICES WARNING
Placed on exterior of door of control with programmable control features to warn operators and designers of improperly programmed control devices.

PRECAUTIONARY LABELING (cont.)

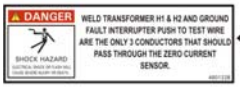
460118 - NOTICE SAFETY/INSTALLATION LABELS

Placed on door of GF series controls. Label sumerizes all labels used with GF controls.

NOTICE

SAFETY/INSTALLATION/OPERATION/MAINTENANCE NOTES

GROUND FAULT INTERRUPTER: This control is equipped with a ground fault and ground continuity operator protection system. For proper operation and operator protection, the following ***MUST*** be considered.



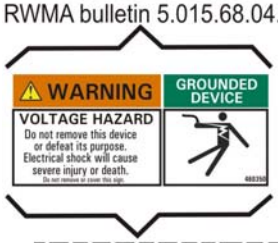
H1 & H2 Weld Transformer primary connections and Push To Test (SW2) lead are the ***ONLY*** 3 conductors that should pass through the Ground Fault Current Transformer (T5). The H1 and H2 wires should also be in close proximity to each other. Never pass a neutral or ground or shield or any other conductor other than the 3 wires listed above through the Ground Fault Current Transformer (T5).

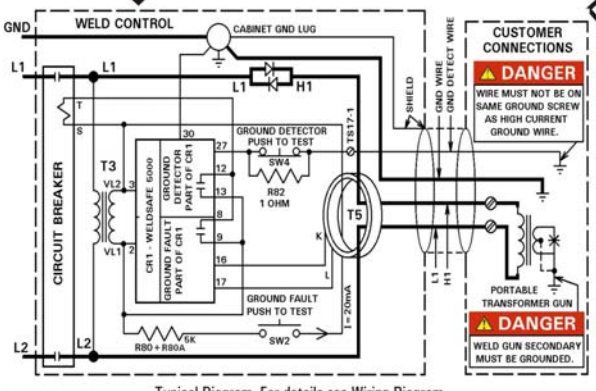
The ground fault interrupter test switch button and ground continuity switch button, (SW1 and SW2 Push to Test) should be used periodically to test the ground fault detection components. The TEST button on the current relay (CR1) need not be used.

Relay (CR1) ***MUST*** have S3 & S4 (located behind CR1 front plate) closed to put Relay in active mode.

Ground Detect wire ***MUST*** be connected to Gun Case (GND) at a point mechanically different from the High Current Protection Ground. See view below.

A Ground wire ***MUST*** be connected to the Weld Control Cabinet Ground. This ground wire must be able to pass high currents and trip up stream protection devices. See RWMA bulletin 5.015.68.04.





Typical Diagram. For details see Wiring Diagram

RWMA MEMBER

460118D

Cable from Weld Control to Transgun must comply with RWMA Bulletin 5.015.68.04.

ENTRON Controls, LLC.
1402 S. Batesville Road
Greer, SC 29650
(864) 416-0190
FAX (864) 416-0195
www.entroncontrols.com
e-mail: info@entroncontrols.com

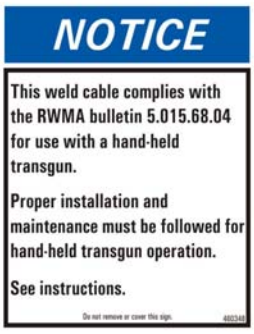


TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

APPENDICES

TABLES

1.0 INTRODUCTION AND OVERVIEW

This manual details the features of the EN6021 Control and shows how to program the system using RPP2 programming pendant.

The EN6021 Control is an integrated timer/controller. The CPU is housed in a chassis which simply mounts onto the control rear panel for ease of maintenance.

The CPU is powered by separate power supply/SCR firing assembly.

A RPP2 programming pendant (not required) is available and provides a large multi-line graphic display, making programming easy.

A powerful built-in logic sequencer program provides the EN6021 with a flexible means of fully controlling small machines or tooling arrangements, without the need for additional hardware.

A USB Connector provides a connection from a PC running ENLINK 6021 software to one EN6021 Control for programming and monitoring purposes. A second USB jack is provided for weld schedule and weld log storage.

Figure 1-1. *RPP2 programming pendant*

Optional 10/100BASE-T Ethernet/RS232/RS485 cards are available for networking multiple EN6021 Controls with ENLINK 6021. These Communication Cards allow control input/output to either become remote I/O for PLC or allows PLC to directly control weld control functions.

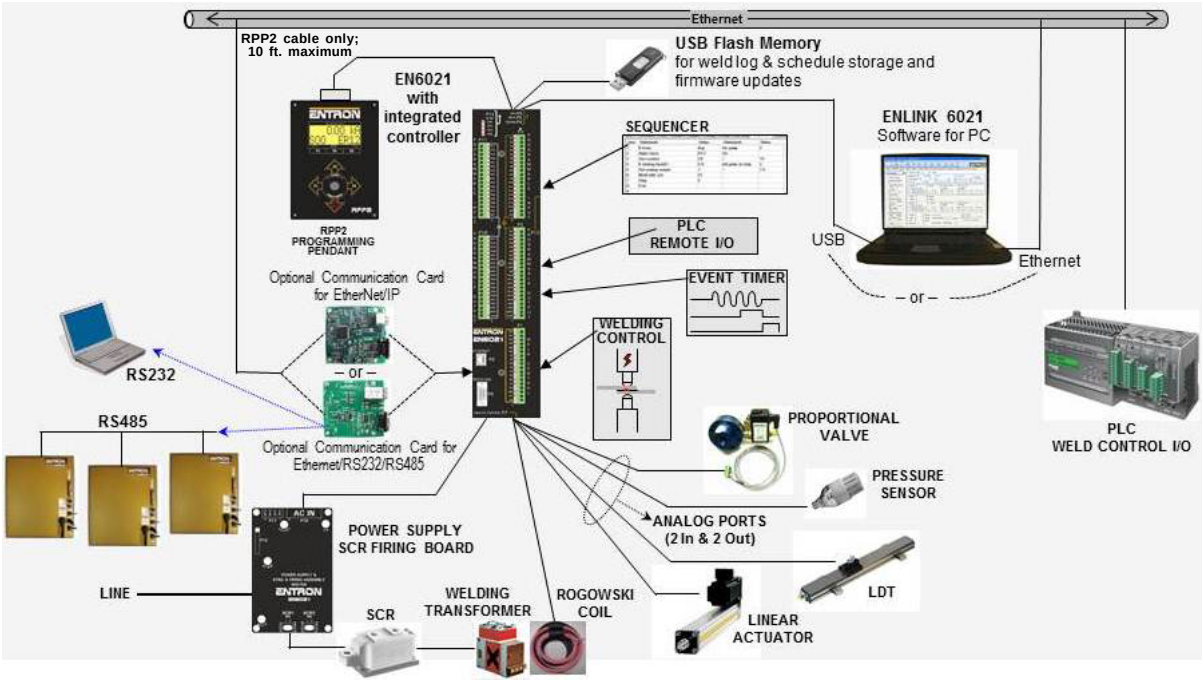


Figure 1-2. *EN6021 System*

1.1 FUNCTIONS

- Constant current regulation
- Primary or secondary feedback
- Current monitoring with high, low and pre-limits
- Up to 100 programs (internal or external selection)
- External plug-in programming pendant (RPP2) with backlit 128x64 (8 lines) LCD graphic display
- Sixteen (16) inputs and outputs with output protection on CPU
- Sixteen (16) additional 24 VDC inputs and 24 VDC outputs with output protection and four (4) 120 VAC outputs on I/O Expansion Card
- Electrode management functions, including stepping, current and force counting, tip-dressing and preset curves
- Weld (57,600 entries) and Error (1000 entries) logs with real-time clock keep history of recent welds
- Proportional valve controller and pressure sensor (uses 1 analog input and 1 analog output)
- Pressure monitoring (high/low limits)
- Machine sequencer logic
- Two (2) analog inputs and outputs (0–10V or 4–20 mA)
- Welding programs may be linked together for complex spot schedules (chained or successive)
- USB port for PC communications
- USB port for flash memory storage
- Refresh firmware through USB device
- Export weld log and error log data to USB device
- Load/export control settings from/to USB device
- Events (synchronize outputs to internal functions)
- Optional plug-in Ethernet/RS232/RS485 cards provides PLC compatibility via MODBUS and EtherNet/IP for remote I/O
- Label printing function
- AC 60/50 Hz welding supported
- Spot / Pulsation / Seam (quad heat) / Seam welding / Flash or Butt welding / Brazing
- Multiple weld intervals plus pulsation, upslope and downslope
- Air-over-oil gun operation
- Retraction – maintained and momentary
- Water Saver (contactor timer)
- Head lock function
- Program Lockout (key switch) function
- Operation Mode Switch (Program Lockout and Weld/No Weld)
- Error Reset Switch
- Stack-up and Displacement measurements and windows

1.2 TERMINAL STRIP FUNCTIONS

- 4 Pilot Switch Inputs
- Temperature Limit Switch Contactor
- Pressure Switch Input
- 16 Inputs – 24 VDC
- Optional 16 Inputs – 24 VDC
- 24 VDC Power Supply
- TS1 Voltage Programming (208, 240, 380, 480, 575)
- Emergency Stop Input
- No Weld Input
- 3 Valve Outputs with Control Relay
- 16 Outputs – 24 VDC
- Optional 16 Outputs – 24 VDC
- Optional 4 Outputs – 120 VAC

1.3 GLOBAL PARAMETERS

Configuration

- Weld Mode: Spot / Seam1 / Seam2 [CLEAR default=Spot]
- Retraction: Off / Maintained / Momentary [CLEAR default=Off]
- On Error: Head lock / Continue / Stop [CLEAR default=Continue]
- Schedule Select: Internal / External [CLEAR default=Internal]
- Current Feedback: Primary / Secondary / Secondary with Primary Coil [CLEAR default=Secondary]
- Air-over-oil: Off / Mode1 (without Retraction) / Mode 2 (with Retraction) [CLEAR default=Off]
- Pressure Control: Off / IPS / IPC / IPSC [CLEAR default=Off]
- Force/Pressure Units: Lb / mA / PSI / Calibrated Lb [CLEAR default=PSI]
- Cylinder Diameter: 1″ to 10″
- Background Pressure/Force: 0–100 PSI or 0–7850 Lb or 4.0–20.0 mA
- Sequencer: On / Off [CLEAR default=Off]
- Beat Mode: Non-Beat / Beat during Squeeze / Beat during Squeeze + Weld / Enable Wait-Here [CLEAR default=Non-Beat]
- Automatic Voltage Compensation: Disable / Maximum % (1–10) [CLEAR default=Disable]
- AVC Nominal Voltage: 187–633 V [CLEAR default=480V]
- Voltage Monitor: On / Off [CLEAR default=Off]
- High/Low Line Voltage Limits: 160–750 V
- Maximum Current Offset: 0% to 15% [CLEAR default=0]
- Water Saver: 0 to 199 seconds [CLEAR default=0]
- 87° Delay: On / Off [CLEAR default=On]
- Half Cycle: Off / + / - / AC [CLEAR default=Off]
- Power Factor: 0 to 99% [CLEAR default=0]
- Analog Inputs (2): Current / Voltage [CLEAR default=Current]
- Analog Outputs (2): Current / Voltage [CLEAR default=Current]
- ID Number: 1 – 99 [factory default=1]*
- Communication Cards: MB Ethernet / MB RS232 RTU / MB RS485 RTU / Label Printing / EIP+MB Ethernet [CLEAR default=MB Ethernet]
- Blanking: 0 to 99 cycles [CLEAR default=1]
- Display Return: 0 to 10 minutes [CLEAR default=0]
- Log Recording Mode: Stop when full / Rewrite when full [CLEAR default=Stop when full]

* This programmed value **is not reset** in CLEAR function.

1.3 GLOBAL PARAMETERS (cont.)

Calibration

- Toroid (Coil) Sensitivity – Primary: 1190 to 1610 mV/kA
  Secondary: 127 to 173 mV/kA [factory default=150]*
  Secondary with Primary Coil: 1190 to 1610 mV/kA
- Maximum Current: 5 to 100 kA [CLEAR default=35]
- Turns Ratio: 10:1 to 250:1 [factory default=50:1]*

Input/Output Map

- Input Functions (x32): Back step / Edit lock / Error reset / Escape / Interlock / Parts Counter reset / Retraction / Schedule Select / 2nd stage / Sequencer / Stepper reset / TT1 / Weld Counter reset [see Table 5-2 for CLEAR defaults]
- Input Source (x32): Local / PLC [CLEAR default=Local]
- Output Map (x32): Counter end / EOS / Error / Error map / Event / Not ready / PLC / Interlock / Retraction / Sequencer / Stepper end / Water Saver [see Table 5-3 for CLEAR defaults]
- Error Map (x96): No output / Output PO17 to Output PO32 [CLEAR default=No output]
- Analog Map – Input/Output 1: Proportional Valve / Sequencer [CLEAR default=PV]
  Input 2: Stack-up / Sequencer [CLEAR default=Stack-up]
  Output 2: Not used / Sequencer [CLEAR default=Sequencer]

Event (x4)

- Output: PO1 – PO32
- Status: On / Off [CLEAR default=Off]
- Interval: Squeeze delay or Advance / Squeeze or Intensify / 2nd stage / Weld1 / Cool1 / Slope / Weld2 / Cool2 / Hold
- Delay: 0 – 98 [CLEAR default=0]

Counter

- Counter: Enable / Disable [CLEAR default=Disable]
- Maximum Part Count: 0 – 60000 [CLEAR default=60000]
- Maximum Weld-per-Part Count: 1 – 9999 [CLEAR default=1]

Stepper

- Stepper: Disable / Heat / Force / Heat+Force [CLEAR default=Disable]
- Tip Dress: 0 – 9999 [CLEAR default=9000]
- Stepper 1 to 10 – Count: 0 – 9999 [CLEAR default=0]
  Heat+: 0% to 99% [CLEAR default=0]
  Current+: 0.00 to 99.99 kA [CLEAR default=0]
  Force-: 0% to 99% [CLEAR default=0]

Sequencer

- Up to 200 statements

* This programmed value **is not reset** in CLEAR function.

1.4 SCHEDULE PARAMETERS (x100)

Weld schedule

- Schedule Number: 0 – 99 [CLEAR default=0]
- Squeeze Delay: 0 to 99 cycles [CLEAR default=0]
- Squeeze: 0 to 99 cycles [CLEAR default=0]
- Valve Mode: None / Combinations of Valve 1, 2, and/or 3 [CLEAR default=None]
- Pressure/Force: 0–100 PSI or 0–7850 Lb or 4.0–20.0 mA [CLEAR default=0 PSI]
- Weld1: 0 to 99 cycles [CLEAR default=0]
- Weld1 Current Regulation Mode: Phase Shift / Constant Current [CLEAR default=Phase shift]
- Heat1: 0 to 99% [CLEAR default=0]
- Current1: 0 to 99.99 kA [CLEAR default=0]
- Cool1: 0 to 99 cycles [CLEAR default=0]
- Slope: 0 to 99 cycles [CLEAR default=0]
- Weld2: 0 to 99 cycles [CLEAR default=0]
- Weld2 Current Regulation Mode: Phase Shift / Constant Current [CLEAR default=Phase shift]
- Heat2: 0 to 99% [CLEAR default=0]
- Current2: 0 to 99.99 kA [CLEAR default=0]
- Cool2: 0 to 99 cycles [CLEAR default=0]
- Hold: 0 to 99 cycles [CLEAR default=0]
- Off: 0 to 99 cycles [CLEAR default=0]
- Impulses: 1 to 99 cycles [CLEAR default=1]
- Heat/Current Offset: -15% to +15% [CLEAR default=0]
- Cycle Mode: Non-repeat / Repeat / Chained / Successive / Wait-here [CLEAR default=Non-repeat]

Additional parameters for Air-over-oil operation

- Advance: 0 to 99 cycles (Mode 1 and 2) [CLEAR default=0]
- Intensify: 0 to 99 cycles (Mode 1 and 2) [CLEAR default=0]
- Block Delay: 0 to 99 cycles (Mode 2) [CLEAR default=0]

Monitor limits

- Pressure/Force Monitor: On / Off [CLEAR default=Off]
- Pressure/Force High Limit: 0–100 PSI or 0–7850 Lb or 4.0–20.0 mA [CLEAR default=0 PSI]
- Pressure/Force Low Limit: 0–100 PSI or 0–7850 Lb or 4.0–20.0 mA [CLEAR default=0 PSI]
- Pressure/Force Pre-limit: On / Off [CLEAR default=Off]
- Pressure/Force Pre-limit Offset: 0 to 99% [CLEAR default=0]
- Pressure/Force Sensing: Off / Rising edge / Falling edge [CLEAR default=Off]
- Pressure/Force Sensing Trigger Value: 0–100 PSI or 0–7850 Lb or 4.0–20.0 mA [CLEAR default=0 PSI]
- Stack-up Monitor: On / Off [CLEAR default=Off]
- Stack-up High Limit: 0 to 10000 mil [CLEAR default=0]
- Stack-up Low Limit: 0 to 10000 mil [CLEAR default=0]
- Current Monitor (Weld1 and/or Weld 2): On / Off [CLEAR default=Off]
- Current High Limit (Weld1 and/or Weld 2): 0 to 99.99 kA [CLEAR default=0]
- Current Low Limit (Weld1 and/or Weld 2): 0 to 99.99 kA [CLEAR default=0]
- Current Pre-limit (Weld1 and/or Weld 2): On / Off [CLEAR default=Off]
- Current Pre-limit Offset (Weld1 and/or Weld 2): 0 to 99% [CLEAR default=0]
- Pulse Width Monitor (Weld1 and/or Weld 2): On / Off [CLEAR default=Off]
- Pulse Width Monitor High Limit (Weld1 and/or Weld 2): 0 to 99% [CLEAR default=0]
- Pulse Width Monitor Low Limit (Weld1 and/or Weld 2): 0 to 99% [CLEAR default=0]

1.5 SPECIFICATIONS

Protection type	NEMA 12 Enclosure
CPU operating voltage (without I/O) (no active inputs or outputs)	24 VDC ±5% with maximum ±2% ripple at 220 mA
Rated current (without I/O) at 24V	approximately 500 mA – SV1–SV3 approximately 500 mA – PO1–PO32
Environmental conditions:	
Operation	0°C to 60°C
Storage/Transport	-25°C to 70°C
Air pressure	0 to 2000m above sea level
Humidity	no dew point excursion allowed
Number of schedules	100
Discrete I/O:	
Inputs	logic '1' – +24V ±15%; logic '0' – 1V to +2V or open
Outputs	24VDC maximum 0.5A; 120VAC maximum 1A
Supply I/O signals	24 VDC ±5% with maximum ±2% ripple
Programming	RPP2 pendant, internal USB-interface or Ethernet
Operating system	in Flash Memory; reloadable from USB flash drive
Program memory	RAM memory
Backup battery	Lithium-Battery Type CR2032 (P/N 140007) to buffer RAM data and internal clock during power loss; battery life approximately 2 years at 25°C
RPP2	24 VDC ±5% with maximum ±2% ripple at 50 mA
Analog I/O	4–20 mA ±5% or 0–10V ±10%
Pressure Sense	4–20 mA ±5%
Pressure Control	4–20 mA ±5%
Stack-up Sense	4–20 mA ±0.5%

1.6 CPU LAYOUT

P14
AC Out –
see Figure 1-4

P11
Optional
Programmable Inputs
(see Section 1.6.8)

P10
Optional
Programmable Outputs
(see Section 1.6.7)

P9
Ethernet
(see Section 1.6.6)

P8
RS232/485
(see Section 1.6.6)

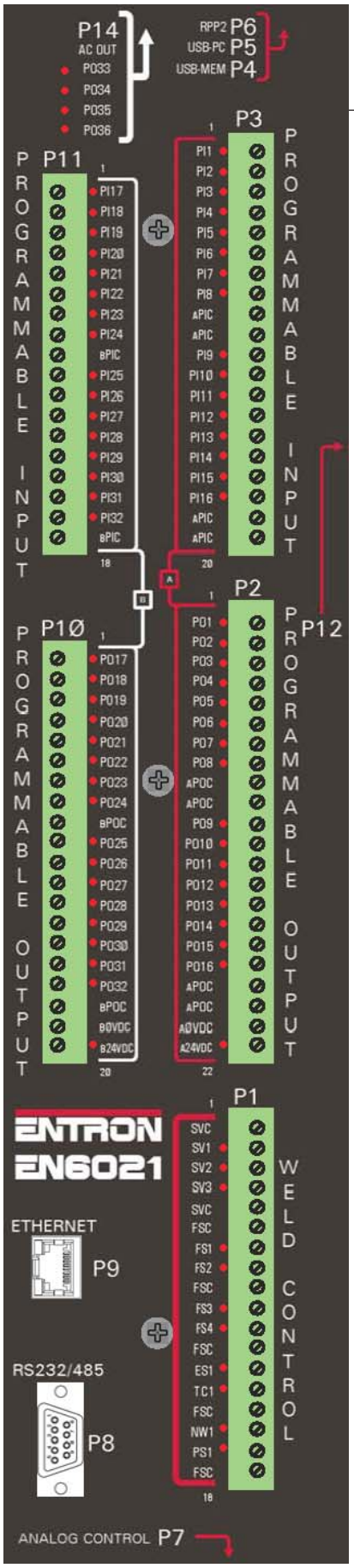


Figure 1-3. *CPU layout – Front*

P4, **P5**, **P6** – see Figure 1-4

Bootloader Reset
(see Appendix B)

P3
Programmable Inputs
(see Section 1.6.3)

P12
ENTRON use only;
connection between CPU
and Power Supply

P2
Programmable Outputs
(see Section 1.6.2)

P1
Weld Control
(see Section 1.6.1)

P7
Analog Control
(see Figure 1-5)

1.6 CPU LAYOUT (cont.)

! WARNING !

CONNECTOR P6 IS USED FOR RPP2 ONLY!
Voltages on this connection can damage devices other than RPP2 programming pendant.

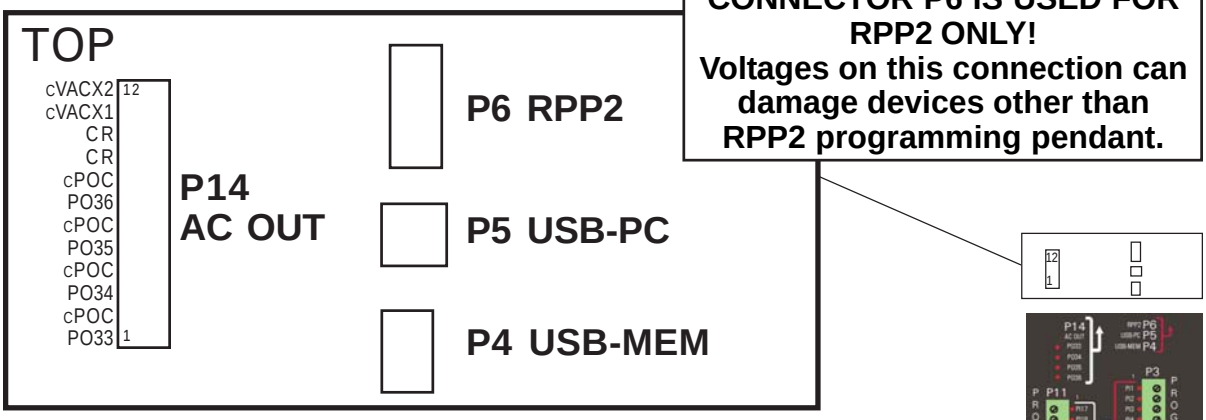


Figure 1-4. *CPU layout – Top*

NOTICE

P4, P5, P6 and P14 Connections are not labeled on CPU Top.
See Section 1.6.4 for detailed information about these connections.

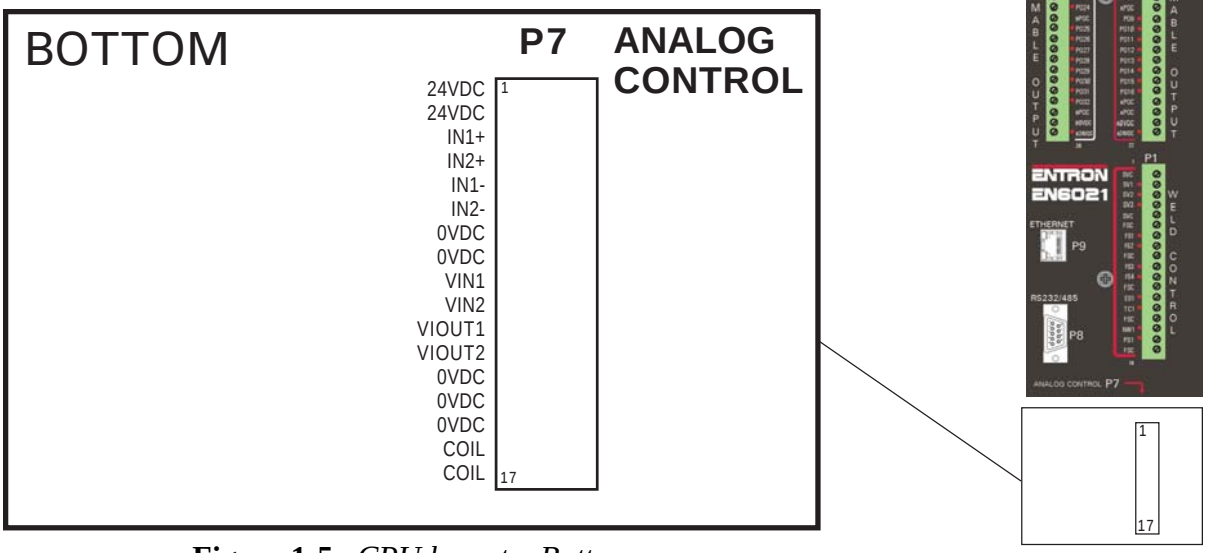


Figure 1-5. *CPU layout – Bottom*

NOTICE

P7 Connector is not labeled on CPU Bottom.
See Section 1.6.5 for detailed information about this connector.

1.6.1 P1 (WELD CONTROL) CONNECTIONS

Refer to Figure 1-6 for orientation of pin connections in following descriptions. See Appendix C for programming worksheets.

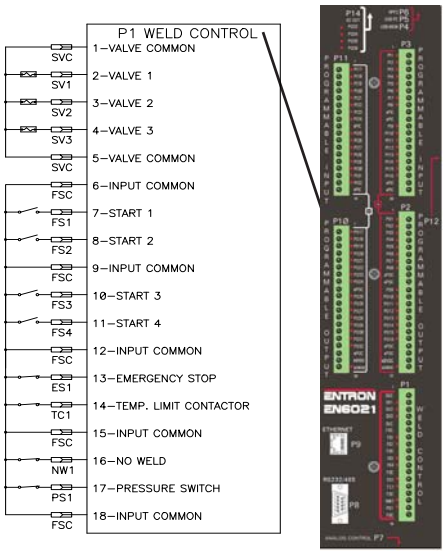


Figure 1-6. *P1 connections*

Pin #	Designation	Description
P1-1 & 5	SVC	24 VDC negative return wire(/ solenoid valve common) – serves as common point for SV1, SV2, and SV3. Also internally connected to 0VDC.
P1-2	SV1	Solenoid Valve 1 – 24 VDC output rated at 0.5 A maximum. Used for weld air valve. Supplies 24 VDC when active. Connect other side of load to SVC. Protected by Control Relay 1 (CR1).
P1-3	SV2	Solenoid Valve 2 – 24 VDC output rated at 0.5 A maximum. Used for weld air valve. Supplies 24 VDC when active. Connect other side of load to SVC. Protected by Control Relay 1 (CR1).
P1-4	SV3	Solenoid Valve 3 – 24 VDC output rated at 0.5 A maximum. Used for weld air valve. Supplies 24 VDC when active. Connect other side of load to SVC. Protected by Control Relay 1 (CR1).
P1-6,9, 12,15 & 18	FSC	Input Common connection(/foot switch common) – serves as common point for FS1–FS4, ES1, TC1, NW1 and PS1. Internally connected to 24VDC.
P1-7	FS1	Foot Switch 1 – used as start/initiation input for weld sequences. When connected to FSC, will be active and draw 10 mA. May be used alone as Single Stage Foot Switch or Stage 1 of 2-Stage Foot Switch. Activates Control Relay 1 (CR1) and Control Relay 1A (CR1A). For Two Stage operation, see Sections 1.6.3 (pin P3-11) and 4.4.5.
P1-8	FS2	Foot Switch 2 – used as start/initiation input for weld sequences. When connected to FSC, will be active and draw 10 mA. May be used alone as Single Stage Foot Switch or Stage 1 of 2-Stage Foot Switch. Activates Control Relay 1 (CR1) and Control Relay 1A (CR1A). For Two Stage operation, see Sections 1.6.3 (pin P3-11) and 4.4.5.
P1-10	FS3	Foot Switch 3 – used as start/initiation input for weld sequences. When connected to FSC, will be active and draw 10 mA. May be used alone as Single Stage Foot Switch or Stage 1 of 2-Stage Foot Switch. Activates Control Relay 1 (CR1) and Control Relay 1A (CR1A). For Two Stage operation, see Sections 1.6.3 (pin P3-11) and 4.4.5.
P1-11	FS4	Foot Switch 4 – used as start/initiation input for weld sequences. When connected to FSC, will be active and draw 10 mA. May be used alone as Single Stage Foot Switch or Stage 1 of 2-Stage Foot Switch. Activates Control Relay 1 (CR1) and Control Relay 1A (CR1A). For Two Stage operation, see Sections 1.6.3 (pin P3-11) and 4.4.5.

1.6.1 P1 (WELD CONTROL) CONNECTIONS (cont.)

Pin #	Designation	Description
P1-13	ES1	Emergency Stop – when open, control stops any and all processes (all valves and firing pulses turn off). While in Emergency Stop condition, **Status Page 1** will show Error Code 09 until condition has been cleared. If execution of a schedule was interrupted by means of this switch, control will not re-initiate automatically (after Emergency Stop condition is removed). Upon release of the switch, it must be re-initiated by closing pilot switch.

NOTICE

If Emergency Stop Switch is not used, place jumper between ES1 (pin P1-13) and FSC (pin P1-12).

P1-14	TC1	Temperature Limit Switch Contactor – used to inhibit welding if temperature of switching circuitry is above rated operating temperature (149° F). If this switch is open (over temperature), control cannot be initiated until it cools (resets/closes). If this switch becomes open during weld, weld interval will continue until end of WELD time; HOLD and OFF will execute normally but new sequence cannot be initiated until it cools and resets (closes). In either case, **Status Page 1** will show Error Code 10 until Temperature Limit Switch recovers its normally closed state; then control will return to normal operation.

NOTICE

If Temperature Limit Switch is not used, place jumper between TC1 (pin P1-13) and FSC (pin P1-15).

P1-16	NW1	No Weld – external Weld/No Weld input. Close for Weld; open for No Weld. When active, will draw 10 mA. When welding, will draw 300 mA. When open, no source voltage is provided to weld firing circuit.

NOTICE

If No Weld is not used, place a jumper between NW1 (pin P1-16) and FSC (pin P1-15).

P1-17	PS1	Pressure Switch – used to make control wait if required pressure has not been reached while in SQUEEZE interval. If this switch interrupts sequence for extended period, **Status Page 1** will show Error Code 92. This error will not terminate sequence. Once Pressure Switch closes, sequence will continue on to WELD and complete sequence. If Pressure Switch does not close within 1 minute, **Status Page 1** will show Error Code 12.

NOTICE

If Pressure Switch is not used, place a jumper between PS1 (pin P1-17) and FSC (pin P1-18).

! CAUTION !

P1 Connector and internal logic are connected internally to factory-provided Power Supply (PS1) 24VDC and 0VDC. FSC or SVC **may not** be connected or referenced to any other source. Also, SV1, SV2, SV3, FS1–FS4, ES1, TC1, NW1, PS1 **must have** return connection via SVC and FSC **only**.

1.6.2 P2 (PROGRAMMABLE OUTPUT) CONNECTIONS

Refer to Figure 1-7 for orientation of pin connections in the following descriptions. See Appendix C for programming worksheets.

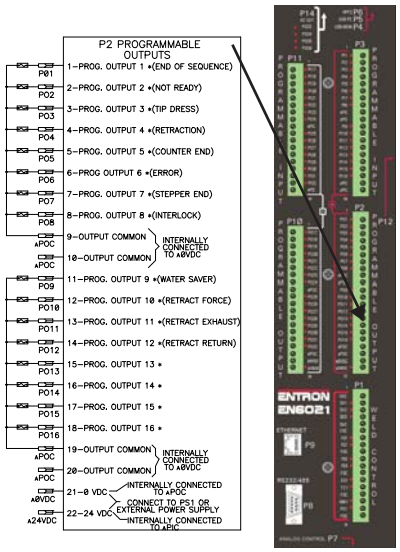


Figure 1-7. *P2 connections*

Pin #	Designation	Description
P2-1	PO1	Programmable Output 1 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **End of Sequence**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-2	PO2	Programmable Output 2 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Not Ready**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-3	PO3	Programmable Output 3 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Tip Dress**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-4	PO4	Programmable Output 4 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Retraction**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-5	PO5	Programmable Output 5 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Counter End**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-6	PO6	Programmable Output 6 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-7	PO7	Programmable Output 7 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Stepper End**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-8	PO8	Programmable Output 8 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Interlock**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-9, 10,19, & 20	APOC	Programmable Output Common A – Common return connection for PO1-16. Internally connected to A0VDC (P2-21).

1.6.2 P2 (PROGRAMMABLE OUTPUT) CONNECTIONS (cont.)

Pin #	Designation	Description
P2-11	PO9	Programmable Output 9 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Water Saver**, Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-12	PO10	Programmable Output 10 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-13	PO11	Programmable Output 11 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-14	PO12	Programmable Output 12 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-15	PO13	Programmable Output 13 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-16	PO14	Programmable Output 14 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-17	PO15	Programmable Output 15 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-18	PO16	Programmable Output 16 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for Event, Sequencer or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to APOC.
P2-21	A0VDC	Connect to External Power Supply A0VDC. Internally connected to APOC.
P2-22	A24VDC	Connect to External Power Supply A24VDC. Internally connected to APIC (P3-19,20).

NOTICE

This Power Supply (pins P2-21 and P2-22) may be connected to internal PS1 Power Supply if current requirements are sufficient. If not, external Power Supply may be used. This external Power Supply needs no reference to 0VDC and 24VDC or B0VDC or B24VDC and is completely isolated from them.

1.6.3 P3 (PROGRAMMABLE INPUT) CONNECTIONS

Refer to Figure 1-8 for orientation of pin connections in the following descriptions. See Appendix C for programming worksheets.

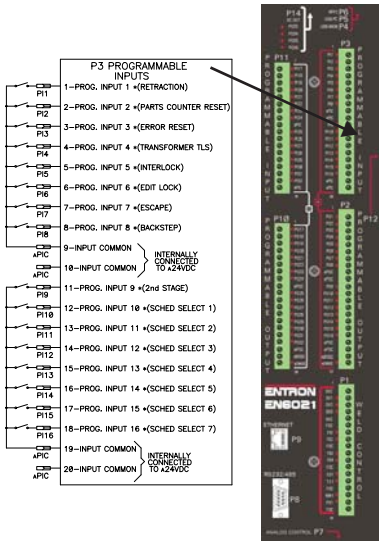


Figure 1-8. *P3 connections*

Pin #	Designation	Description
P3-1	PI1	Programmable Input 1 – used as multi-purpose programmable input. Via programming, may be used as **Retraction** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-2	PI2	Programmable Input 2 – used as multi-purpose programmable input. Via programming, may be used as **Parts Counter Reset** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-3	PI3	Programmable Input 3 – used as multi-purpose programmable input. Via programming, may be used as **Error Reset** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-4	PI4	Programmable Input 4 – used as multi-purpose programmable input. Via programming, may be used as **TT1** (Temperature Transformer) or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-5	PI5	Programmable Input 5 – used as multi-purpose programmable input. Via programming, may be used as Interlock or **Sequencer** input. When connected to APIC, will be active and draw 10 mA.
P3-6	PI6	Programmable Input 6 – used as multi-purpose programmable input. Via programming, may be used as **Edit Lock** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-7	PI7	Programmable Input 7 – used as multi-purpose programmable input. Via programming, may be used as **Escape** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-8	PI8	Programmable Input 8 – used as multi-purpose programmable input. Via programming, may be used as **Back Step** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-9, 10, 19 & 20	APIC	Programmable Input Common A – Common connection for PI1-16. Internally connected to A24VDC (pin P2-22).
P3-11	PI9	Programmable Input 9 – used as multi-purpose programmable input. Via programming, may be used as 2nd Stage or **Sequencer** input. When connected to APIC, will be active and draw 10 mA.

1.6.3 P3 (PROGRAMMABLE INPUT) CONNECTIONS (cont.)

Pin #	Designation	Description
P3-12	PI10	Programmable Input 10 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 1** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-13	PI11	Programmable Input 11 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 2** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-14	PI12	Programmable Input 12 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 3** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-15	PI13	Programmable Input 13 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 4** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-16	PI14	Programmable Input 14 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 5** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-17	PI15	Programmable Input 15 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 6** or Sequencer input. When connected to APIC, will be active and draw 10 mA.
P3-18	PI16	Programmable Input 16 – used as multi-purpose programmable input. Via programming, may be used as **Schedule Select 7** or Sequencer input. When connected to APIC, will be active and draw 10 mA.

1.6.4 P4, P5, P6, & P14 CONNECTIONS

Refer to Figure 1-9 for orientation of pin connections in the following descriptions.

Connector#	Designation	Description
P4	USB-MEM	USB Type A connection for use with USB flash drive.
P5	USB-PC	USB Type B connection to external computer for use with ENLINK 6021.
P6	RPP2	Connection to RPP2 programming pendant. **CONNECTOR P6 IS USED FOR RPP2 ONLY! Voltages on this connection can damage devices other than RPP2 programming pendant.**
P14	AC OUT	See below for individual pin designations and descriptions.

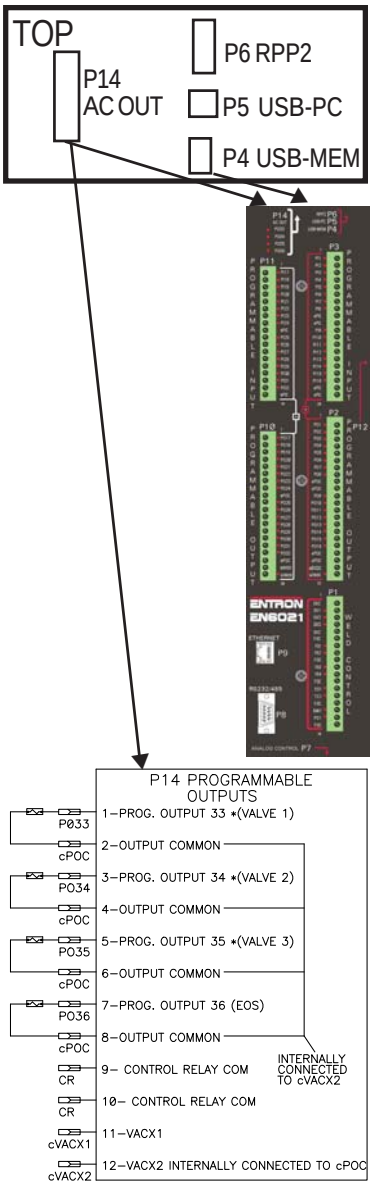


Figure 1-9.
P4, P5, P6, P14 connections

Pin #	Designation	Description
P14-1	PO33	Valve 1 AC Output.
P14-2 4,6 & 8	cPOC	Programmable Output Common C – Common return connection for PO33-36. Internally connected to cVACX2 (pin P14-12).
P14-3	PO34	Valve 2 AC Output.
P14-5	PO35	Valve 3 AC Output.
P14-7	PO36	Programmable Output 36 – May be programmed as **EOS**, Not Ready, Tip Dress count end, Retraction, Part count end, Error, Stepper End, Interlock and Water Saver.
P14-9 & 10	CR	Control Relay Common – Safe 120 VAC output.
P14-11	cVACX1	Connect to External AC Power Supply (T1-X1). For 120 VAC monitoring errors, see Section 1.6.9.
P14-12	cVACX2	Connect to External AC Power Supply (T1-X2). Internally connected to cPOC.

See Appendix C for programming worksheets for PO33-PO36.

1.6.5 P7 (ANALOG CONTROL) CONNECTIONS

Refer to Figure 1-10 for orientation of pin connections in the following descriptions.

Pin #	Designation	Description
P7-1	24VDC	24VDC terminal for Proportional Valve. Internally connected to 24VDC on PS1.
P7-2	24VDC	24VDC terminal for Analog devices. Internally connected to 24VDC on PS1.
P7-3	IN1+	4-20 mA Input 1 positive
P7-4	IN2+	4-20 mA Input 2 positive
P7-5	IN1–	4-20 mA Input 1 negative
P7-6	IN2–	4-20 mA Input 2 negative
P7-7	0VDC	0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.
P7-8	0VDC	0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.
P7-9	VIN1	0-10V Input 1
P7-10	VIN2	0-10V Input 2
P7-11	VIOUT1	0-10V or 4-20 mA Output 1
P7-12	VIOUT2	0-10V or 4-20 mA Output 2
P7-13	0VDC	0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.
P7-14	0VDC	0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.
P7-15	0VDC	0VDC terminal for Rogowski Coil. Internally connected to 0VDC on PS1. (Black wire for Primary and Secondary coils)
P7-16 &17	COIL	Rogowski Coil connection. Primary Coil 1400 mV/kA @ 60Hz; Secondary Coil 180 mV/kA @ 60Hz. **NOTE:** Temperature and position of Rogowski Coil can affect control accuracy. (Clear and Blue for Primary Coils and White and Brown for Secondary Coil)

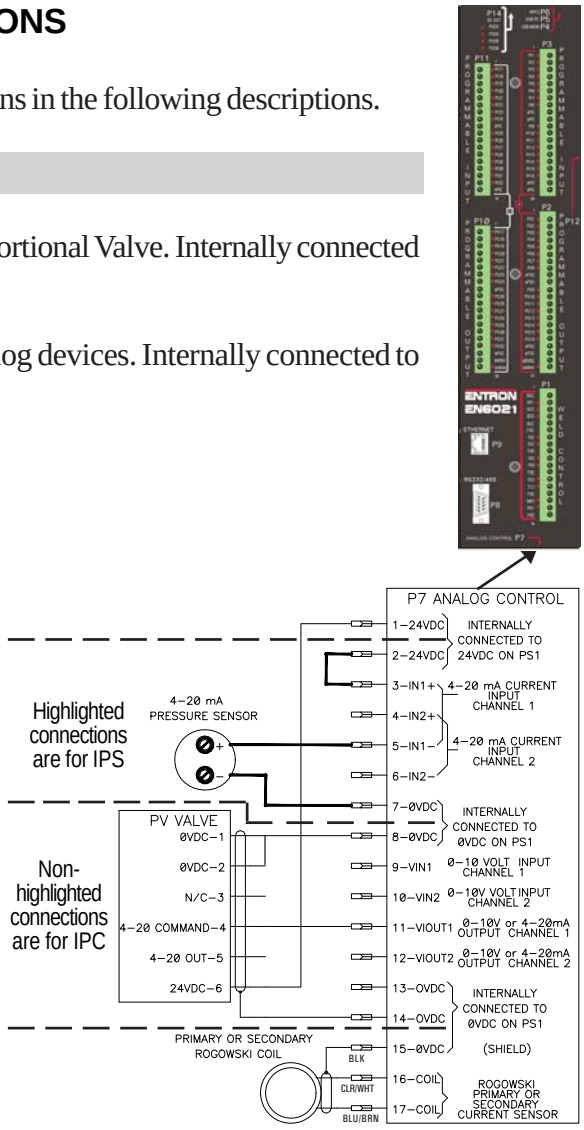


Figure 1-10. *P7 connections*
Connections shown are typical when using factory-provided IPS, IPC, or IPSC.

See Appendix C for programming worksheets for Analog Inputs and Outputs (P7-9, 10, 11, 12).

NOTICE
When using Pressure Sense and Control, see Section 9.12.7 for more details.

1.6.6 P8 & P9 CONNECTIONS (Optional)

Two types of Communication Cards – **MBTCP/RTU** and **EIP/MBTCP** – can be installed in CPU.

MBTCP/RTU COMMUNICATION CARD

Refer to Figure 1-11 for orientation of pin connections in the following descriptions.

Connector #	Designation	Description
P8	RS232/485	RS232 or RS485 connection
P9	ETHERNET	10/100 BASE-T Ethernet connection

Indicator #	Designation	Description
RXD	RS232/485	viewable with cover removed
TXD	RS232/485	viewable with cover removed

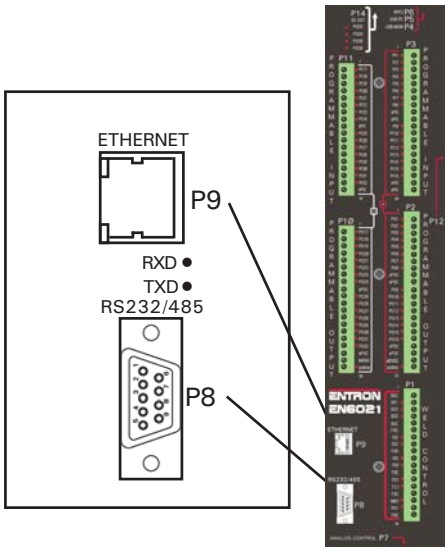


Figure 1-11.
P8 and P9 connections

Serial Port Interface (P8)

Table 1-1. *Serial port interface signals pin out*

Signal Name	Direction	Contact	Primary Function
RS232 RXD	In	2	Receive pin for RS232
RS232TXD	Out	3	Transmit pin for RS232
RS485 A	In/Out	4	Pin A for RS485
RS485 B	In/Out	8	Pin B for RS485
COM GND	GND	5,9	Ground for communication

Ethernet Interface (P9)

Table 1-2. *Ethernet interface signals pin out*

Signal Name	Direction	Contact	Primary Function
TX+	Out	1	Differential Ethernet transmit data +
TX–	Out	2	Differential Ethernet transmit data –
RX+	In	3	Differential Ethernet receive data +
RX–	In	6	Differential Ethernet receive data –
Not used		4	Terminated
Not used		5	Terminated
Not used		7	Terminated
Not used		8	Terminated
SHIELD			Chassis ground

Ethernet Status LEDs

Table 1-3. *Ethernet connector LED functions*

Color	Link LED (Left)	Activity LED (Right)
Off	No Link	No Activity
Amber	10 Mbps	Half Duplex
Green	100 Mbps	Full Duplex

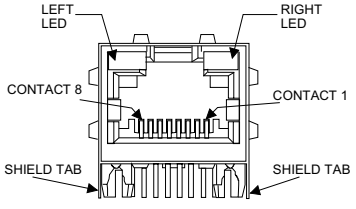


Figure 1-12.
Ethernet connector LEDs

1.6.6 P8 & P9 CONNECTIONS (Optional) (cont.)

EIP/MBTCP COMMUNICATION CARD

Refer to Figure 1-11 for orientation of pin connections in the following descriptions.

Connector #	Designation	Description
P8	N/A	NOT FUNCTIONAL AT THIS TIME
P9	ETHERNET	10/100 BASE-T Ethernet connection

Ethernet Interface (P9)

The Ethernet interface has same pin layout shown in Table 1-2.

Status Indicator LEDs

There are two status indicators LEDs on the Ethernet connector, shown in Figure 1-13. The status indicator LED functions are described in Table 1-4.

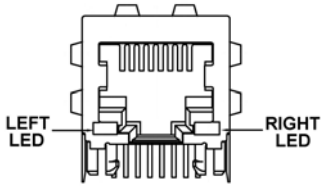


Figure 1-13.
Status indicator LEDs

Table 1-4. *Status indicator LED functions*

Color/Status	Module Status (Left)	Network Status (Right)
Steady Off	No power	No power
Flashing Amber	Control selects incorrect communication mode; communication card will not work	N/A
Flashing Green	N/A	No CIP connections are established
Steady Green	Control selects correct communication mode	At least one CIP connection is established

1.6.7 P10 (Programmable Output) CONNECTIONS (Optional)

Refer to Figure 1-14 for orientation of pin connections in the following descriptions. See Appendix C for programming worksheets.

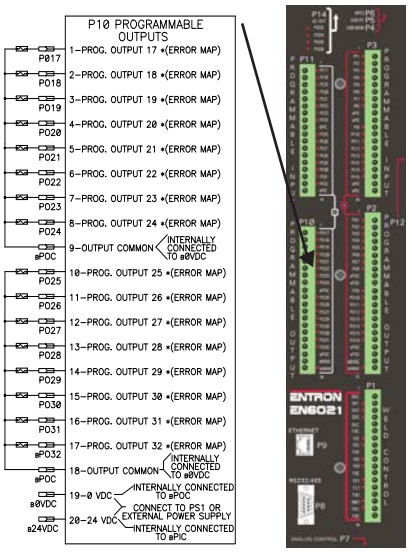


Figure 1-14. *P10 connections*

Pin #	Designation	Description
P10-1	PO17	Programmable Output 17 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-2	PO18	Programmable Output 18 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-3	PO19	Programmable Output 19 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-4	PO20	Programmable Output 20 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-5	PO21	Programmable Output 21 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-6	PO22	Programmable Output 22 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-7	PO23	Programmable Output 23 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-8	PO24	Programmable Output 24 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to ʙPOC.
P10-9 & 18	ʙPOC	Programmable Output Common ʙ – Common return connection for PO17-32. Internally connected to ʙ0VDC (pin P10-19).

1.6.7 P10 (Programmable Output) CONNECTIONS (Optional) (cont.)

Pin #	Designation	Description
P10-10	PO25	Programmable Output 25 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-11	PO26	Programmable Output 26 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-12	PO27	Programmable Output 27 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-13	PO28	Programmable Output 28 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-14	PO29	Programmable Output 29 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-15	PO30	Programmable Output 30 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-16	PO31	Programmable Output 31 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-17	PO32	Programmable Output 32 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for **Error Map**, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to BPOC.
P10-19	B0VDC	Connect to External Power Supply B0VDC. Internally connected to BPOC.
P10-20	B24VDC	Connect to External Power Supply B24VDC. Internally connected to BPIC (pins P11-9 and P11-18). For 24V monitoring errors, see Section 1.6.9.

NOTICE

This Power Supply (pins P10-19 and P10-20) may be connected to internal PS1 Power Supply if current requirements are sufficient. If not, external Power Supply may be used. This external Power Supply needs no reference to 0VDC and 24VDC or A0VDC or A24VDC and is completely isolated from them.

1.6.8 P11 (Programmable Input) CONNECTIONS (Optional)

Refer to Figure 1-15 for orientation of pin connections in the following descriptions. See Appendix C for programming worksheets.

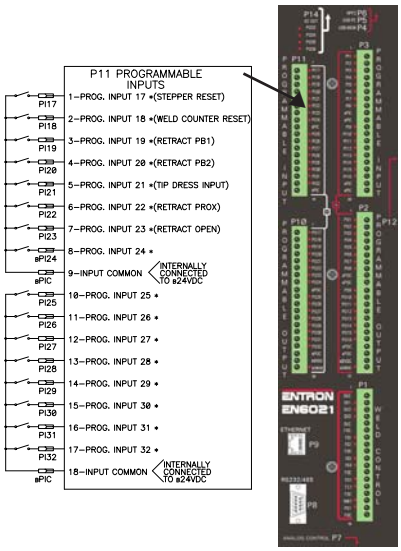


Figure 1-15. *P11 connections*

Pin #	Designation	Description
P11-1	PI17	Programmable Input 17 – used as multi-purpose programmable input. Via programming, may be used as **Stepper Reset** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-2	PI18	Programmable Input 18 – used as multi-purpose programmable input. May be programmed as **Weld Counter Reset** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-3	PI19	Programmable Input 19 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-4	PI20	Programmable Input 20 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-5	PI21	Programmable Input 21 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-6	PI22	Programmable Input 22 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-7	PI23	Programmable Input 23 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-8	PI24	Programmable Input 24 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.
P11-9 & 18	ʙPIC	Programmable Input Common ʙ – Common connection for PI17-32. Internally connected to ʙ24VDC on P10.
P11-10	PI25	Programmable Input 25 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to ʙPIC, will be active and draw 10 mA.

1.6.8 P11 (Programmable Input) CONNECTIONS (Optional) (cont.)

Pin #	Designation	Description
P11-11	PI26	Programmable Input 26 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-12	PI27	Programmable Input 27 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-13	PI28	Programmable Input 28 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-14	PI29	Programmable Input 29 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-15	PI30	Programmable Input 30 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-16	PI31	Programmable Input 31 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.
P11-17	PI32	Programmable Input 32 – used as multi-purpose programmable input. May be programmed as **Not used** or Sequencer input. When connected to BPIC, will be active and draw 10 mA.

NOTICE

For 24V monitoring errors, see Section 1.6.9.

1.6.9 I/O EXPANSION CARD JUMPERS

Voltage is monitored on I/O Expansion Card on 24V Connectors P10 and P11 on P10-20 (B24VDC) and on 120 VAC Connector P14-11 (CVACX1). Errors are recorded if these voltages are not present. If power supplies on these connections are not used, errors may be blocked or removed. Jumper 1 may be put on or closed to block B24VDC error and Jumper 2 may be used to block CVACX1 error. Control Relay for AC outputs will not be monitored when Jumper 2 is used. Remove Jumpers for error recording. Jumper is stored by placing on one pin of connector.

! WARNING !
Control Relay for AC outputs will not be monitored when Jumper 2 is used.

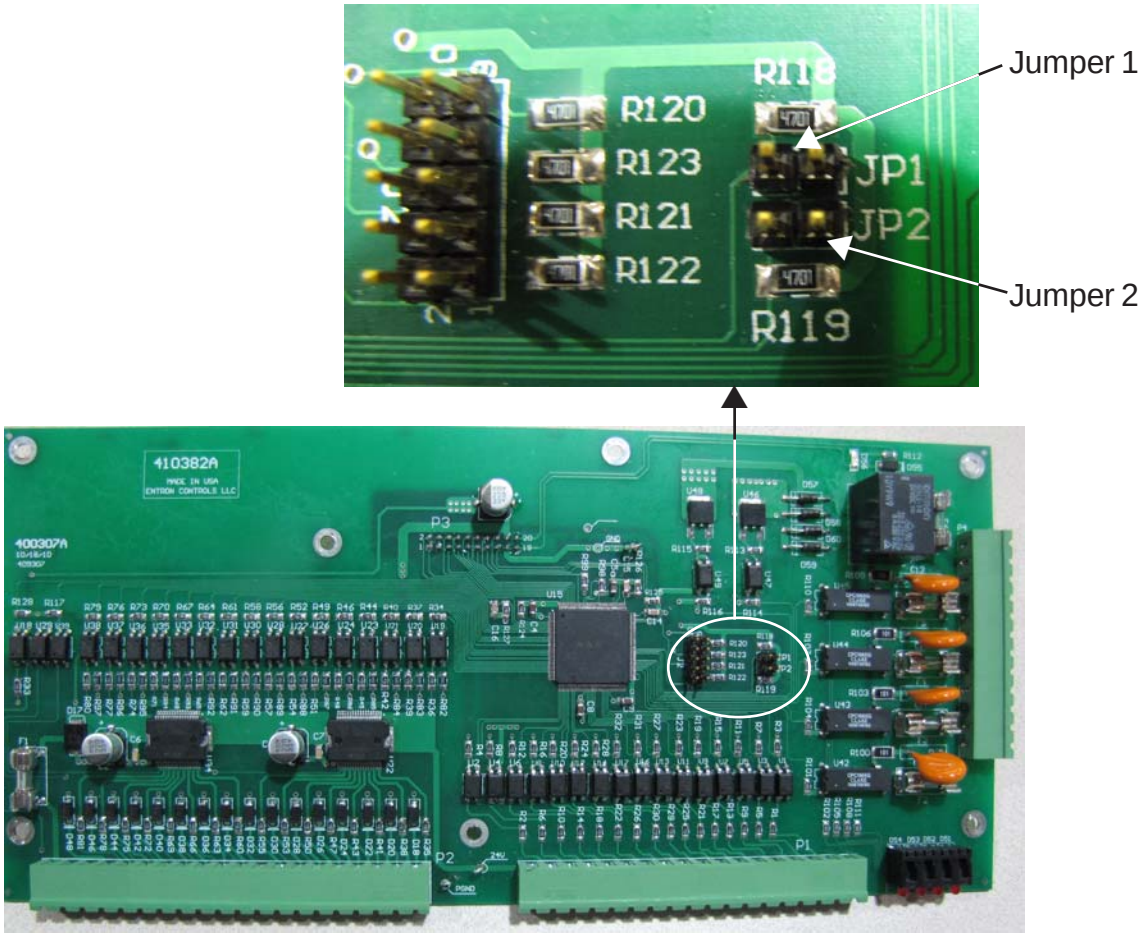


Figure 1-16. *Installation of I/O Expansion Card Jumpers (P/N 331139)*

2.0 MOUNTING DIAGRAMS

The EN6021 Control comes in a Style "N" Cabinet. The figures in this section present installation, mounting, and dimension information.

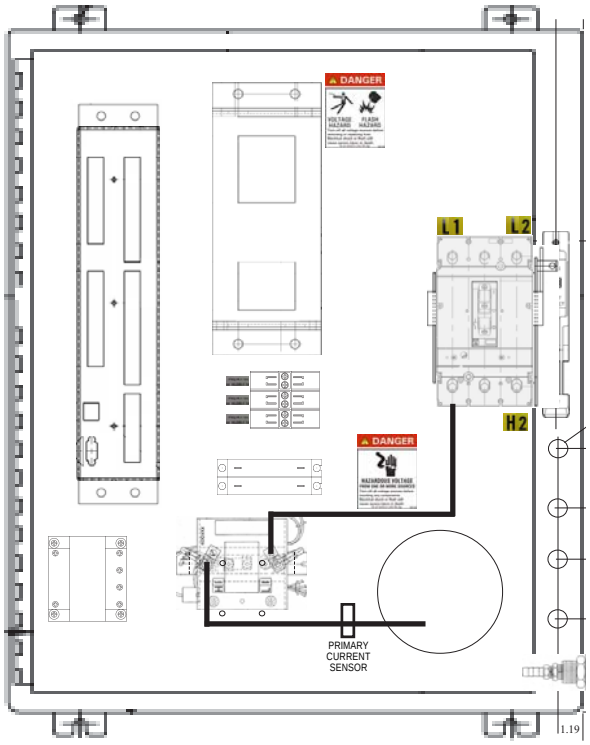


Figure 2-1. *Installation of Style "N" Cabinet – 150/300 Amp Contactor*

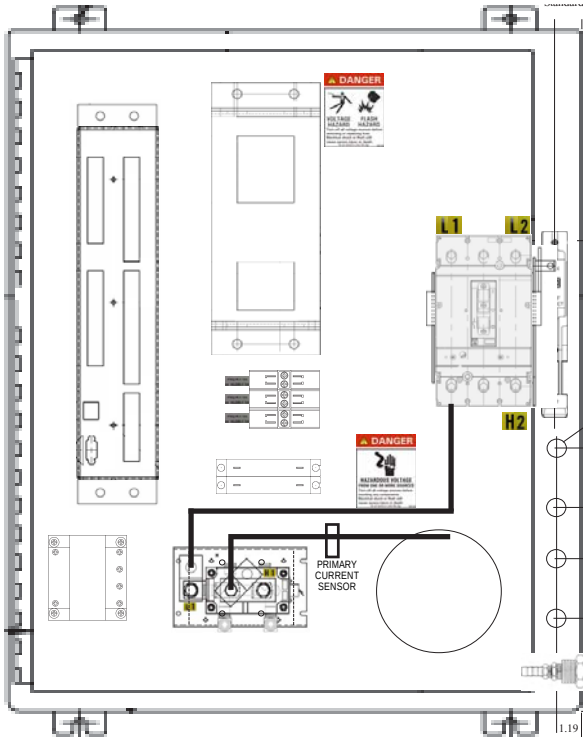


Figure 2-2. *Installation of Style "N" Cabinet – 1200 Amp Contactor*

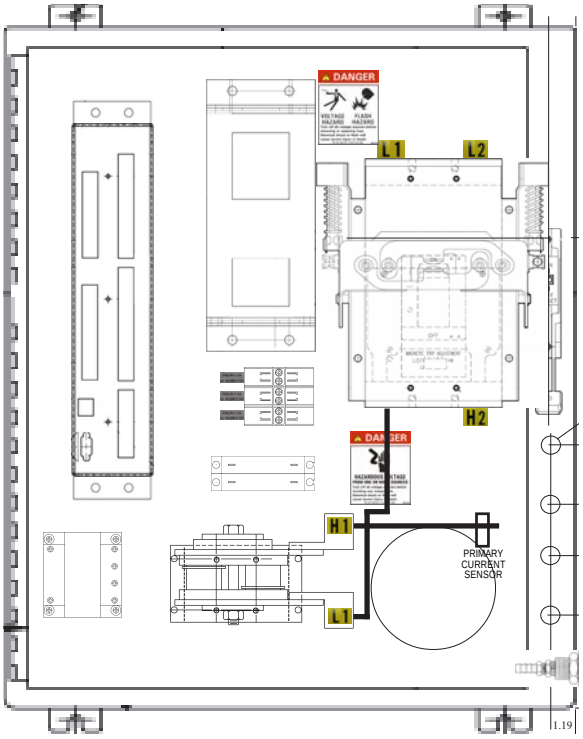


Figure 2-3. *Installation of Style "N" Cabinet – 1800/2200/3200 Amp Contactor*

2.0 MOUNTING DIAGRAMS (cont.)

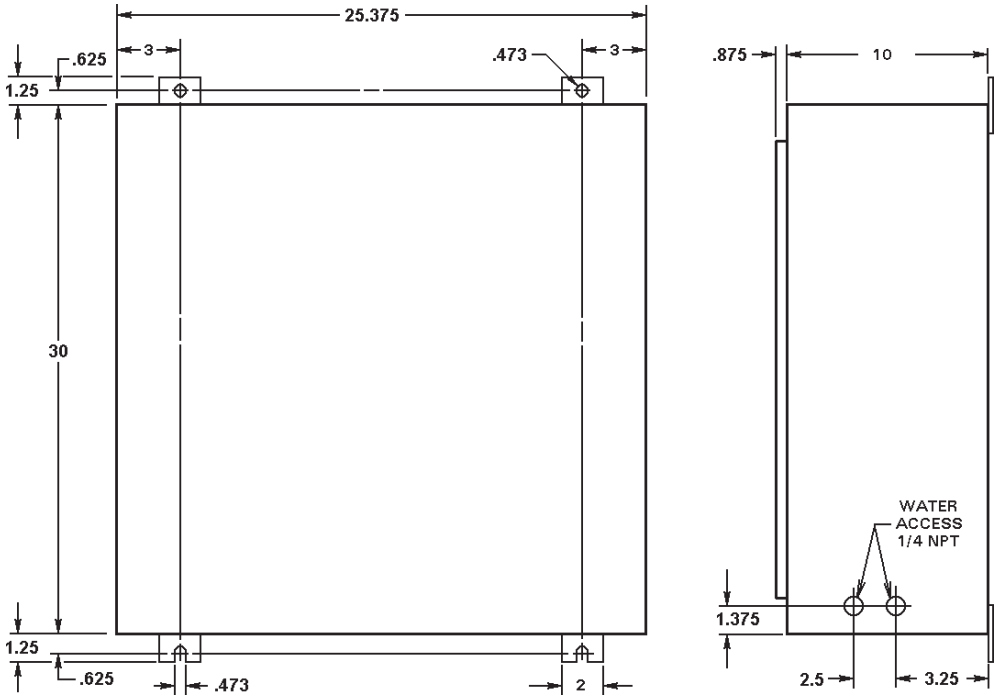


Figure 2-4. *Mechanical mounting diagram for* ***"N"*** *Cabinet*

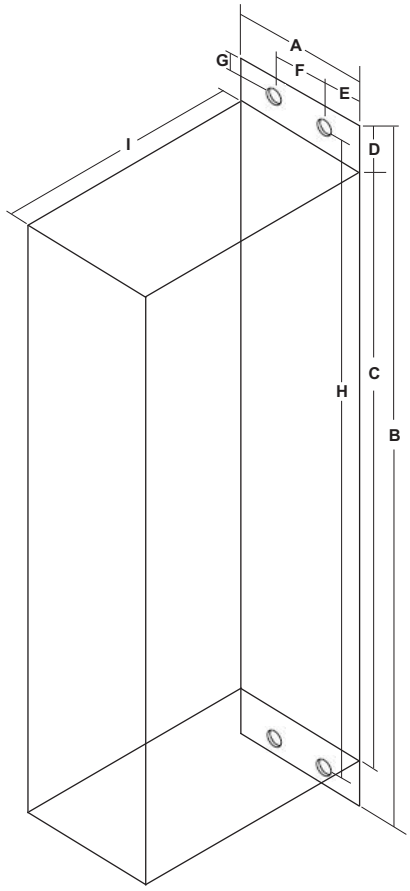


Figure 2-5.
Dimensions for CPU and Power Supply when supplied in kit form

Table 2-1. *Dimensions (in inches) of CPU and PS1 in Figure 2-5*

Dimension	CPU	PS1
A	3.50	4.80
B	17.50	12.00
C	15.00	9.50
D	1.00	1.25
E	1.00	1.15
F	1.50	2.50
G	0.50	0.50
H	16.50	11.00
I	6.50	6.50

3.0 GENERAL OPERATING REQUIREMENTS

3.1 FUSING AND SAFE OPERATION

POWER HARNESS FUSES	Three 1-1/4A fuses (FNQ-R-1-¼ – P/N 307025) are used to protect line voltage circuits. The fuse holders are located on rear panel.
CPU DC VALVE FUSE	One 3A fuse (F2) (3 amp 2AG 250V – P/N 307034) is used to protect the valve circuits on the CPU.
POWER SUPPLY FUSES	One 5A fuse (F1) (5 amp 2AG 250V – P/N 307035) is used to protect Power Supply primary for 24 DC Power Supply. This fuse is located on Power Supply PS1. Two 2A fuses (F2 & F3) (2 amp 2AG 250V – P/N 307037) are used to protect Control Transformer.
I/O EXP DC VALVE FUSE	One 3A fuse (F1) (3 amp 2AG 250V – P/N 307034) is used to protect the DC valve circuits on I/O Expansion Card.
I/O EXP AC VALVE FUSES	Four 1A fuses (F2–F5) (1 amp 2AG – P/N 307022) are used to protect 4 AC valve outputs (PO33-36) on I/O Expansion Card. One 5 A fuse (F6) (5 amp 2AG 250V – P/N 307035) protects valve power supply sensing circuits and PO33-36. It is located on I/O Expansion Card.

! CAUTION !

REPLACE FUSES WITH EXACT TYPE ONLY FOR CONTINUED PROTECTION!

! 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 SERVICE ANY COMPONENT WITH POWER ON. USE ONLY THE FUSE TYPE SPECIFIED TO MAINTAIN SAFE OPERATION. ONLY CHANGE FUSES WITH POWER OFF!

3.2 ISOLATION CIRCUITRY DESCRIPTION

The EN6021 Series Controls are microprocessor-based resistance welding controls that incorporate circuitry designed to prevent weld valve outputs from the control due to spurious or unexpected or false conditions or failure of circuit components. The intent of this section is to explain how the circuitry accomplishes this isolation.

3.2.1 24 VDC OUTPUTS

The isolation is provided by electro-mechanical control relay contacts that are in series with solenoid valve voltage supply for valve outputs (SV1, SV2, and SV3). In non-initiated state, relay contacts are open and no output from these circuits are possible. When control is initiated by physical closure of normally open set of external contacts (commonly a foot switch) across initiation circuit, relays are energized and their contacts close and complete circuits to solenoid valves. The outputs are not actually energized, however, until microprocessor reaches the point in the sequence at which valves are to be activated. Typical output circuitry can be seen in Figure 3-1. Output drivers are equipped with over temperature and over current protection.

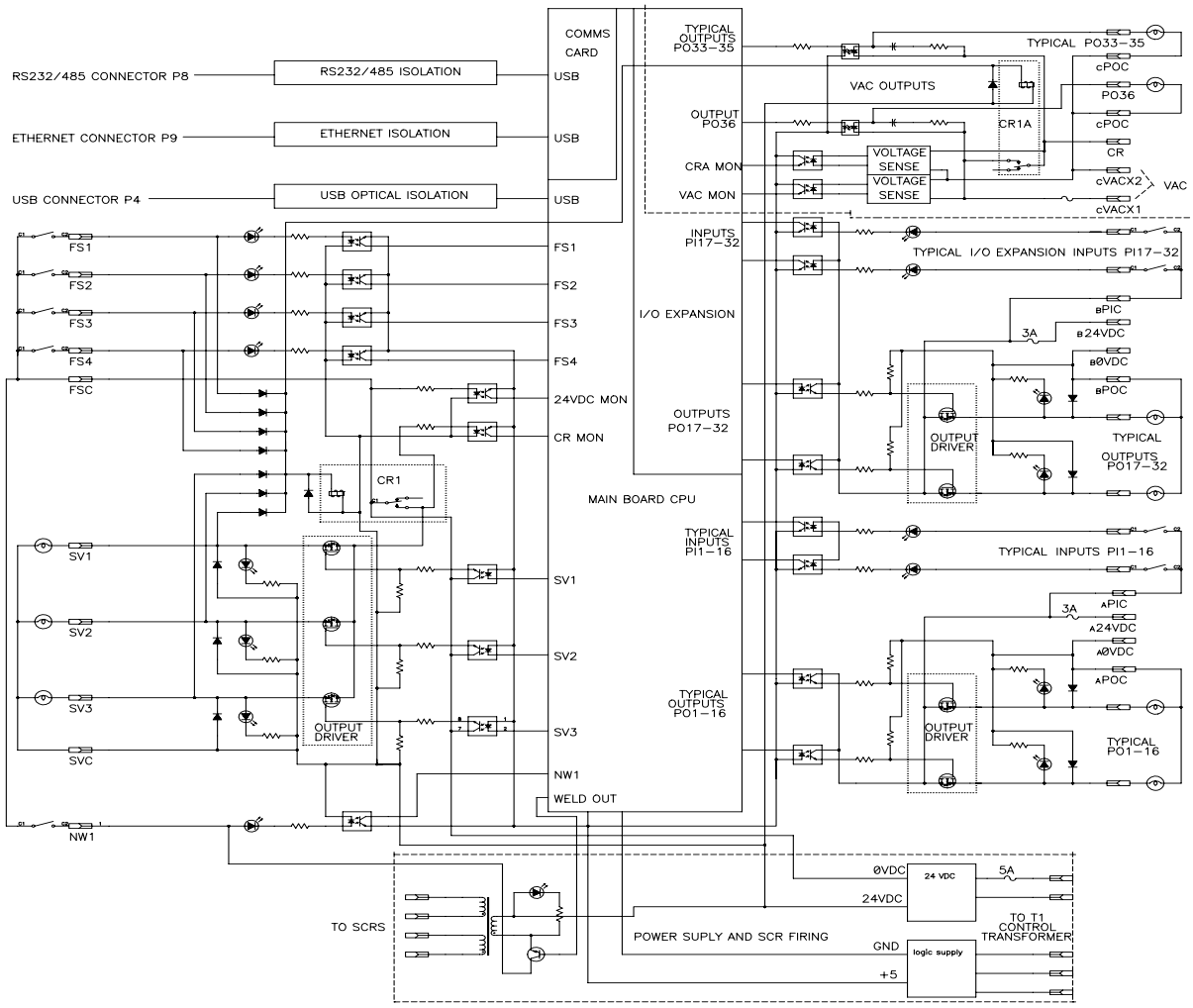


Figure 3-1. *Typical input and output schematic*

3.2.1 24 VDC OUTPUTS (cont.)

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. The system is designed so that it would take two non-associated circuits to fail before an unexpected output could occur.

In addition to relay contacts mentioned above, there are other levels of isolation. The valve outputs are further isolated by the use of optically isolated transistor (solid state) outputs.

NOTICE
The control is monitoring the status of contacts on Control Relay CR1 and CR1A. Therefore, if these contacts fail closed, relay isolation of SV1, SV2, and SV3 is revealed with error message. CR1A isolates PO33-35 and are monitored by the CPU.

NOTICE
Programmable Outputs PO1–PO32 and PO36 are **not** isolated through CR1 or CR1A.

Reference Figure 3-1.

3.2.2 24 VDC INPUTS

The initiation signals first pass through a circuit comprised of opto-isolators before being passed to the input circuitry of the microprocessor.

3.2.3 VALVE OUTPUTS

SV1–SV3 and PO1–PO32 are protected by Driver IC for over current, short circuit, under voltage, and over temperature. PO33-PO36 are protected by Fuses F2, F3, F4, and F5 on I/O Expansion Card.

3.2.4 WELD OUTPUT

Weld output is not isolated through any control relay outputs. To prevent spurious output, the power to weld driver is supplied by NW1. See Figure 3-1 for reference.

3.2.5 LOAD CALCULATIONS

SV1–SV3 and PO1–PO32 outputs are rated to switch 0.5 A at 24 VDC.

PO33-PO36 are rated at 1 A.

The PS1 Power Supply (P/N 600756) for the EN6021 Control will supply 2.5 amps continuously.

3.2.5 LOAD CALCULATIONS (cont.)

Be certain the summation of all loads to Power Supply will not exceed allotted 2.5 A. When calculating this load, note that, since this Power Supply also supplies input and output circuits and CPU, these loads must be added to get the maximum.

Current Draw:	CPU	500 mA
	No Weld input	300 mA
	Other inputs	10 mA
	RPP2	50 mA

3.3 COOLING REQUIREMENTS FOR SCR CONTACTOR

SOLID STATE COOLING RECOMMENDATIONS – Water cooled

EN6021-1200 amp EN6021-2200 amp
EN6021-1800 amp EN6021-3200 amp

1.5 GPM at 86°F (30°C) maximum inlet temperature.
Internal cabinet temperature not to exceed 130°F (55°C).
Maximum water pressure 90 PSI (6 bar).

Weld Controls follow recommendations of RWMA Bulletin 5. Sections 5-005.04 and 5-005.05 are reprinted in Figure 3-2 for reference.

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

The 1200 amp heatsink is electrically isolated from electrical circuit within the contactor section (indirect water cooled). No minimum length of water hose is required for electrical isolation of the contactor. It is still recommended to turn power off when control is not in use. The heatsink has an temperature limit switch that will prohibit operation at temperatures over 149°F.

TURN POWER OFF WHEN WATER OFF
TURN WATER ON WHEN POWER ON

For all water-cooled Heatsinks, 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.

NOTICE

Keep chilled water temperature from reaching temperatures that will cause condensation on heatsink and mains voltage electronic devices.

3.3 COOLING REQUIREMENTS FOR SCR CONTACTOR (cont.)

SOLID STATE COOLING RECOMMENDATIONS – Air cooled

EN6021-150 amp EN6021-300 amp

Ambient temperature is not to exceed 104°F (40°C).
Internal cabinet temperature not to exceed 130°F (55°C).

BULLETIN 5-005
Page 28
October 1995

RESISTANCE WELDER MANUFACTURERS' ASSOCIATION
WELDING CONTACTORS

BUL 5-005.04 SPECIFICATION FOR DIRECT WATER COOLED SCR CONTACTORS

See also RWMA Bulletin 16, section 1.6.4 for additional requirements of the cooling water.

.01 Water flow rate shall be 1.2 G..P.M. minimum. Some larger SCR contactors require greater flow rates.
.02 Maximum water pressure shall be 90 P.S.I.G.
.03 Resistivity greater than 2000 ohms/cm at 25°C (77°F).
.04 Power should be removed from the SCR in less than 10 minutes if the cooling water is not flowing and the resistivity of the water is less than 5000 ohms/cm. If the water circulation is stopped when the power is still on, current through the water will eventually heat the hose material and embed contamination resulting in destruction of the hose. The use of water savers for Contactor cooling are not recommended for the above reasons. If Isolation Contactors remove the power from the SCR module, hose destruction is eliminated as there is no current to cause damage.
.05 Hoses for directly water cooled SCRs should be a non-conductive type of 3/8" inside diameter. This hose must not be shorter than 18 inches in length.
.06 Cooling Water temperature should be no greater than 104°F (40°C), without derating the devices.
.07 To prevent condensation on the cooled components, water temperature should not be less than the existing dew point of the ambient air (approximately 70°F).
.08 Maintain a pH between 7.0 and 8.0.
.09 Maximum Chloride content of 20 PPM.
.10 Maximum Nitrate content of 10 PPM.
.11 Maximum Sulfate content of 100 PPM.
.12 Maximum solids content of 250 PPM.
.13 Maximum Calcium Carbonate content of 250 PPM.

BUL 5-005.05 SPECIFICATIONS FOR INDIRECT WATER COOLED SCR CONTACTORS

.01 Minimum water flow rate of 1.2 G..P.M.
.02 Maximum water pressure shall be 90 P.S.I.G.
.03 Water temperature no greater than 104°F (40°C).
.04 To prevent condensation on the cooled components, water temperature should not be less than the existing dew point of the ambient air (approximately 70°F).
.05 Maintain a pH between 7.0 and 8.0.
.06 Maximum Chloride content of 20 PPM.
.07 Maximum Nitrate content of 10 PPM.
.08 Maximum Sulfate content of 100 PPM.
.09 Maximum solids content of 250 PPM.
.10 Maximum Calcium Carbonate content of 250 PPM.

Figure 3-2. *RWMA recommended standards for water cooled SCRs*

3.4 SIZING CURVES

To help in selecting the proper SCR contactor size for application, use the following "rule of thumb" for sizing SCR contactors for various size transformers.

$$\frac{\text{Transformer KVA x 1000}}{\text{AC Line Voltage}} \text{ x 3 = Maximum Current Demand}$$

Example 1: Using 75 KVA transformer at 230 VAC:

$$\text{Maximum Current Demand} = \frac{75 \text{ x } 1000}{230} \text{ x 3 = } \mathbf{978} \text{ Amperes}$$

Example 2: Using 250 KVA transformer operating at 460 VAC:

$$\text{Maximum Current Demand} = \frac{250 \text{ x } 1000}{460} \text{ x 3 = } \mathbf{1630} \text{ Amperes}$$

The multiplier factor of 3 in this formula assumes a reasonable secondary configuration of an 8" x 12" throat to a secondary of 13" to 18", with a poor power factor of about 40%, having a necessary adjustment on the welding control of greater than 50 percent current.

A multiplier factor of 2.5 may be used when a machine's power factor is 45% or better. A multiplier factor of 5 or 8 may be required for machines with large secondaries with power factors of 30% or poorer.

When applying the above "rule of thumb", two other parameters must be considered. **Conduction Time –** the time the welding transformer is energized and the **Duty Cycle –** the ratio of Conduction Time to the complete cycle time (including part handling). These are factors that can substantially alter the selection of a contactor with regard to demand current.

The shorter the Conduction Time and Percent Duty Cycle, the greater the current switching capability of a contactor. Conversely, longer Conduction time and higher Duty Cycle reduce the current switch capability of the contactor.

Figure 3-3 shows suggested relationships for Current Demand, Duty Cycle and Conduction Times. All curves on chart are shown in 30 cycle (60 Hz) conduction time. Assuming maximum 30 cycle conduction time and using Figure 3-3, the following recommendations would be made for above examples:

Example 1: For 75 KVA transformer operating at 230 VAC, recommended contactor size would be 1200 amp SCR contactor for Percent Duty Cycle of approximately 14% or less.

Example 2: For 250 KVA transformer operating at 460 VAC, recommended contactor size would be 1200 amp SCR contactor for Percent Duty Cycle of approximately 20% or less.

DUTY CYCLE

Duty Cycle is the percent of the time the weld current is on. A convenient formula for calculating Duty Cycle is:

$$\text{\% Duty Cycle} = \frac{\text{Weld Time (in Cycles) x Number of welds per minute}}{36}$$

3.4 SIZING CURVES (cont.)

Consult machine manufacturer or local resistance welding supplier for assistance in selecting the proper contactor size that fits application.

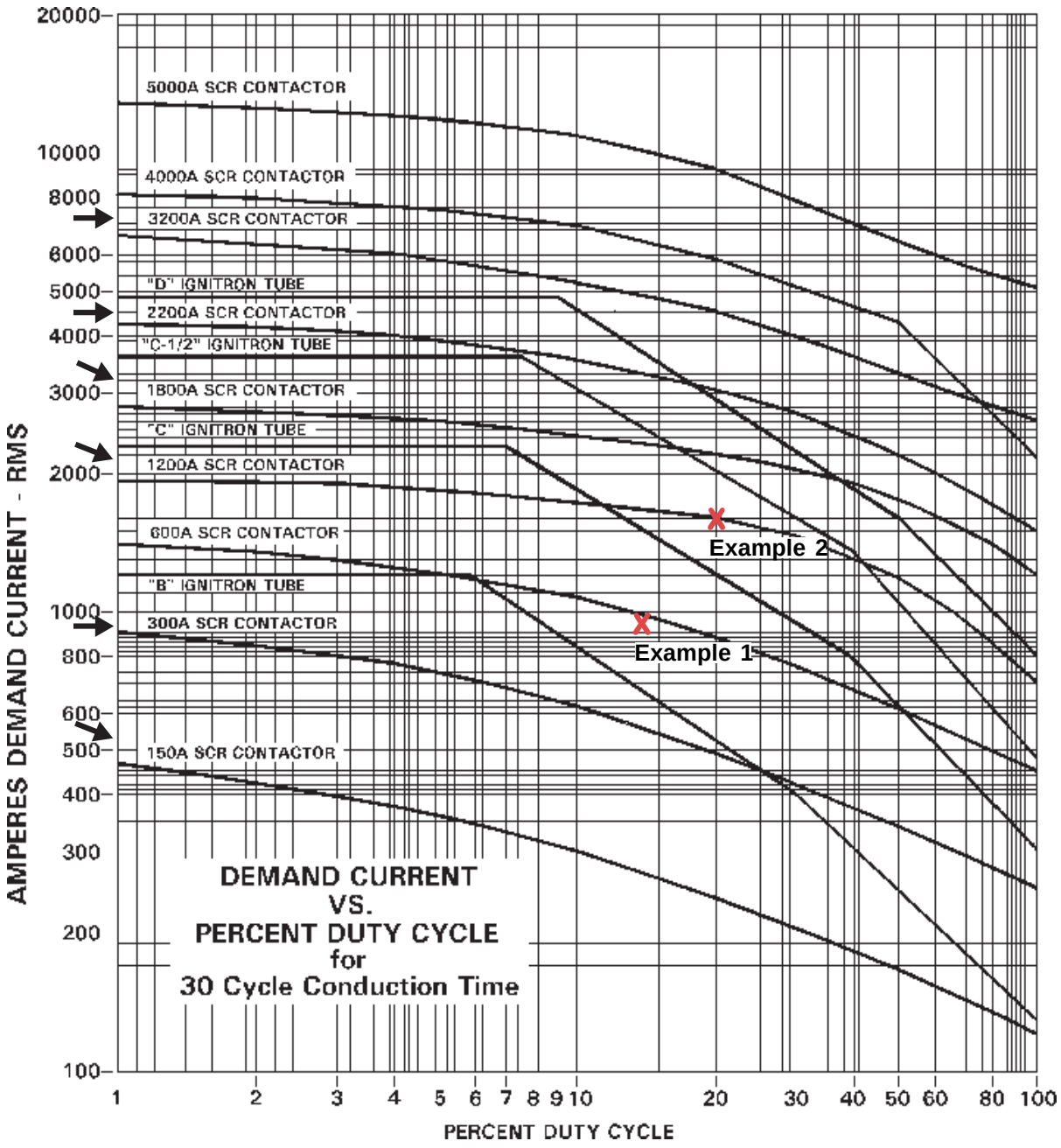


Figure 3-3. *Demand Current vs. Percent Duty Cycle*

NOTICE

Ignition tubes for reference only.
SCR Contactors available for EN6021 are: 150A, 300A, 1200A, 1800A, 2200A, and 3200A.

3.5 INITIATION RESPONSE TIME

The EN6021 will always fire on a positive half cycle. Delay from start initiation to when welding valve turns on and sequence starts can vary between a minimum of 0.0 ms and a maximum of 16.6 ms.

The FS1–FS4 signals need to be maintained until SV1–SV3 turn on, otherwise sequence is aborted. The best way to ensure this is to maintain FS1–FS4 until End of Sequence turns off, then open FS1–FS4.

3.6 GF – GROUND FAULT OPTION (HAND-HELD TRANSGUN)

The design of the optional GF (Ground Fault) circuit is meant to fulfill the recommended requirements of RWMA's Bulletin 5-015.68.04 (Figure 3-4) and AWS J1.1. (Figure 3-5) The recommended standard is typically called out to protect operators in hand-held transgun applications.

To understand the operation in more detail, see Wiring Diagram 421505 and the Weldsafe 5000 manual in Appendix A. Since CR1 (Weldsafe 5000) operation is discussed in Appendix A, its design will not be discussed further. The GF option monitors specifically the transformer load and the ground connection to it.

3.6.1 GROUND FAULT DETAILS

Weld transformer primary wires are passed through T5 (transformer/coil). Current will be summed by T5 and the difference sent to CR1. CR1 will monitor this current and will close a contact at the RWMA specification of 15 mA. These contacts pass 120 VAC, developed on the primary of PS1 (power supply 1), to the ST (shunt trip) on CB1 (circuit breaker 1). When the voltage is applied, the contacts of the breaker will open. Timing of this action will be within the RWMA recommendation of 60 ms.

A push-to-test circuit is composed of SW2 (push button switch 2) and R80 (10k resistor). When SW2 is closed, a current is developed from the primary voltage windings (120 VAC) of PS1, through R80 (approximately 20 mA), and is passed through T5.

3.6.2 GROUND DETECTOR

It is important that the control and gun be well grounded in the case of a high current fault to ground. This low impedance will allow properly designed upstream breakers to open before the voltage on the gun gets over 48 VAC. To insure a low resistance connection between the gun and control, CR1 (Weldsafe 5000) monitors the connection between the gun case and control ground via TS1-17. The detect wire is routed from the gun case through the transgun cable to TS17-1. From there, the signal is passed through SW4 and on to CR1. SW 4 is a push-to-test switch for the GND detection circuit. When pressed, R82 (1 ohm resistor) is inserted in series with this detect lead to perform the push-to-test feature.

When the CR1 measures 1 ohm or greater in the ground path, a separate set of contacts in CR1 relay will close. These contacts are in parallel with the EL and GF contacts and will pass 120 VAC from the primary windings of PS1 to the ST of the CB1 and remove voltage to the control within 60 ms.

RESISTANCE WELDER MANUFACTURERS' ASSOCIATION OCT. 1995

BULLETIN 5-015
SAFETY STANDARDS FOR CONSTRUCTION AND GUIDE FOR INSTALLATION AND OPERATION

BUL 5-015.68 GROUNDED CIRCUITS AND EQUIPMENT GROUNDING

.04 Special considerations for Portable Transguns

(a) *Portable Transguns* – shall be grounded per *Article 250 of the National Electrical Code* and require the use of (1),(2) and (3) listed below:

NOTE— Conduit or Raceways shall not be used as the grounding conductor.

NOTE— The intention of these requirements is to ensure that the grounding conductor to the transgun is sized correctly to allow sufficient ground fault current to flow for a time long enough to trip an upstream circuit breaker or other protection device. As a general guideline, the resistance of a grounding conductor should be maintained at a value to ensure the continuous and unrestricted flow of available ground fault short circuit current until the circuit protection device removes voltage from the equipment.

(1) *Grounding Integrity* – The welding gun transformer case and secondary shall be grounded and protected by fail safe circuitry designed to immediately disconnect line voltage from the transgun via a circuit breaker with shunt trip or a circuit breaker with undervoltage trip. The combined clearing time shall not exceed 60 mS. A sensed value of grounding conductor resistance in excess of one ohm by the ground integrity monitor would be considered an inadequate ground [referred to in paragraph 5-015.68.04(a)(2)]. A push-to-test circuit providing a 1 ohm resistance between the sense lead and ground will be included to verify the operation of the ground integrity circuit.

NOTE— The ground integrity monitor operation shall not depend on a programmable device.

(2) *Ground Fault Current Relay* – A sensitive, fail safe, ground fault relay with a maximum trip point of 15mA must be used to provide protection against differential ground fault leakage currents. The ground fault relay must immediately disconnect line voltage from the Portable Transgun via a circuit breaker with shunt trip or a circuit breaker with undervoltage trip. The combined clearing time shall not exceed 60 mS.

A push-to-test circuit supplying a test fault current, through the sense coil of 20mA maximum will be included to verify the operation of the ground fault relay.

Only three wires are allowed to pass through the ground fault relay current pickup transformer: two welding transformer primary conductors and the push-to-test circuit.

NOTE— The ground fault current relay operation shall not depend on a programmable device.

NOTE— If an Isolation Contactor is used, ground fault current will only be detected when this Isolation Contactor is closed.

NOTE— In (1) and (2) above, combined clearing time is the reaction time of the ground fault relay plus the clearing time of the shunt trip or undervoltage trip of circuit breaker.

(3) *Ground shielded cable* – The weld transformer primary cable conductors between the weld control and the Portable Transgun must be surrounded by grounded shield. This shield must be tied to an appropriate ground lug at the control. In addition to the two primary conductors, ground conductor and shield, a ground sense wire must be included with the cable.

NOTE— The grounded shield provides a current path should a metallic component cut through the shield to a power conductor within the cable. This current path will then cause the ground fault current relay to trip.

Reproduced from RWMA Bulletin 5 – Resistance Welding Control Standards, October 1995.

Figure 3-4. *RWMA recommended standards for grounded circuits*

3.6 GF – GROUND FAULT OPTION (HAND-HELD TRANSGUN) (cont.)

AWS J1.1M/J1.1:2013 Specification for Resistance Welding Controls
ANSI STANDARD

4.1.1 Manual Transgun Control

This control system employs additional devices necessary to ensure safe operation of manual transguns. Since the operating (line) voltage and ground wires connect to the transgun by means of a flexible power cable, supplemental systems within the welding control monitor the system for ground faults and ground circuit integrity. These supplemental systems provide an added level of operator protection in the event the ground connection is lost or there is an electrical

current leakage to ground. Such faults could indicate a component of the transgun is no longer adequately grounded or perhaps has become dangerously energized. A manual transgun control shall incorporate supplemental safety devices including a ground integrity monitor, ground fault detector, and a grounded-shield power cable.

4.1.1.1 Ground Integrity Monitor

A ground integrity monitor shall be provided in the manual transgun control system. This monitor senses the value of ground circuit resistance to identify conditions where there may be an inadequate bonding connection between the welding control and the transgun. In the event a fault is detected, the electrical supply shall be disconnected from the transgun in accordance with the performance specified in clause 7.9.1. A push–to-test circuit shall be included to enable verification of the ground integrity monitor operation.

4.1.1.2 Ground Fault Monitor

A sensitive, fail-safe, ground fault monitor shall be provided in the manual transgun control system. The earth-leakage detector, the most commonly applied system, uses a current coil surrounding supply and return conductors to detect differential current indicative of an undesired active path. In the event a fault is detected, the electrical supply shall be disconnected from the transgun in accordance with the performance specified in clause 7.9.2. The disconnecting means employed in 4.2.4.1 above also functions in this case. A push-to-test circuit supplying a test fault current, through the sense coil will be included to verify the operations of the ground fault monitor.

4.1.1.3 Grounded-Shield Power Cable

The weld transformer primary cable conductors between the weld control and the manual transgun shall be surrounded by a grounded conductive shield. This shield will provide a current path to ground within the cable should it be penetrated with something conductive. This shield shall be tied to an appropriate ground lug at the control. In addition to the two primary conductors, ground conductor and shield, a ground sense wire must be included within the cable to facilitate verification of the bonding connection between the resistance welding control and transformer.

Reproduced from **AWS J1.1M/J1.1:2013 Specification for Resistance Welding Controls**

Figure 3-5. *AWS WELD CONTROL STANDARD*

4.0 WIRING AND INSTALLATION

4.1 CPU CONNECTORS

Connectors P1, P2, P3, P7, P10, P11 and P14 are two-part connectors for use with wires up to 1mm^2.

P1	18-pin	P/N 331201
P2	22-pin	P/N 331203
P3	20-pin	P/N 331202
P7	17-pin	P/N 331209
P10	20-pin	P/N 331202
P11	18-pin	P/N 331201
P14	12-pin	P/N 331204

Connector P12 is used internally via ribbon cable assemblies and is not used for user connections.

Connector P4 is used to connect to external USB flash drive (USB Type A – P/N 730014-003).

Connector P5 is used to connect to external computer (USB Type B), allowing use of ENLINK 6021. Use optional external USB cable assembly to extend connection to an external connection (P/N 730014-002).

Connector P6 is used to connect to RPP2 programming pendant. This is standard 9-pin D-subminiature connector. It is connected via harness (P/N 326063) to bulkhead (P/N 331194) on cabinet wall. This connection is intended only for RPP2 communication. It is good practice to keep connections short. Cable from cabinet to RPP2 is 10′ (P/N 326061). It is not recommended to lengthen this cable. Lengthening this cable is not a supported option.

! WARNING !

CONNECTOR P6 IS USED FOR RPP2 ONLY!
Voltages on this connection can damage devices other than RPP2 programming pendant.

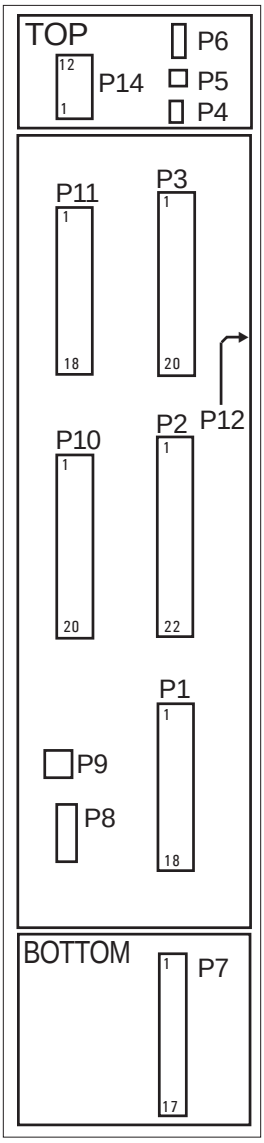


Figure 4-1.
CPU connectors

Connector P7 is the connection to Analog Inputs and Outputs (two each; may be used for Pressure Sense or Pressure Control) and Rogowski Coil.

Connectors P8 and P9 are used for optional Communication Cards. Connector P8 (standard 9-pin D-sub) is used to connect to remote RS232 or RS485 connection (currently not functional with EIP/MBTCP Card). Connector P9 (8-contact RJ45) is used to connect to 10/100BASE-T Ethernet networks.

Connector P14 is the AC Output Connector on the I/O Expansion Card that provides four (4) AC outputs for V1–V3 and EOS (default). See Section 1.6.4 for more information.

4.2 POWER SUPPLY CONNECTORS

Power for CPU input and output functions is supplied by an external 24 VDC 2.5 A power supply. This is an isolated power supply used for the logic/CPU and I/O functions of the control. Since this power supply is isolated, the 0 VDC terminal may be chassis grounded if required. Also when this control is integrated into larger systems, the 0 VDC terminal may be connected to the 0 VDC bus of the larger system. When needed, this power supply can be removed or disconnected and the power supply from the larger system can be used to power functions of the control.

! WARNING !

This same power supply provides power to the RPP2 through P6 Connector.
Do not use RPP2 cable (Harness A/N 326061) to connect to your computer.

! CAUTION !

Use of incorrect cables from weld control to computer inputs can allow 24 VDC to be applied incorrectly to connected devices.

The PS1 Power Supply (P/N 600756) for the EN6021 Control will supply 2.5 amps continuously.

Be certain the summation of all loads to Power Supply will not exceed alloted 2.5 A. When calculating this load, note that, since this Power Supply also supplies input and output circuits and CPU, these loads must be added to get the maximum.

Current Draw:	CPU	500 mA
	No Weld input	300 mA
	Other inputs	10 mA
	RPP2	50 mA

Power Supply PS1 (P/N 600756) uses the following connectors and terminal strip connections.

P18 — 10-pin connector (P/N 331071) receives power from Control Transformer T1 and Chassis Ground, wired by factory.

P17 — 4-pin connector (P/N 331067) which supplies 24 VDC. See Table 4-1 for specific pin designations. Factory supplies +24 VDC and 0 VDC Harness (P/N 322569) to CPU.

P5 & P6 — Gate and Cathode connections to SCR Contactor. See Table 4-2 for specific pin designations. Gate firing circuitry for External SCRs will provide 4 volts at 300 mA.

P12 — 26-pin ribbon connection to CPU; wired by factory.

FL1 — Previously fused connection to L1

FL2 — Previously fused connection to L2

FH1 — Previously fused connection to H1

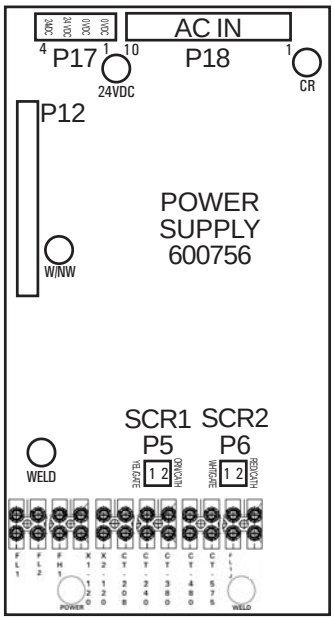


Figure 4-2. *Power Supply connectors*

4.2 POWER SUPPLY CONNECTORS (cont.)

Table 4-1. *P17 pin designations*

Pin#	Function
1 & 2	0 VDC
3 & 4	24 VDC

Table 4-2. *P5 & P6 pin designations*

Pin#	Color	SCR Connection
P5-1	YEL	SCR1 Gate
P5-2	ORG	SCR1 Cathode
P6-1	WHT	SCR2 Gate
P6-2	RED	SCR2 Cathode

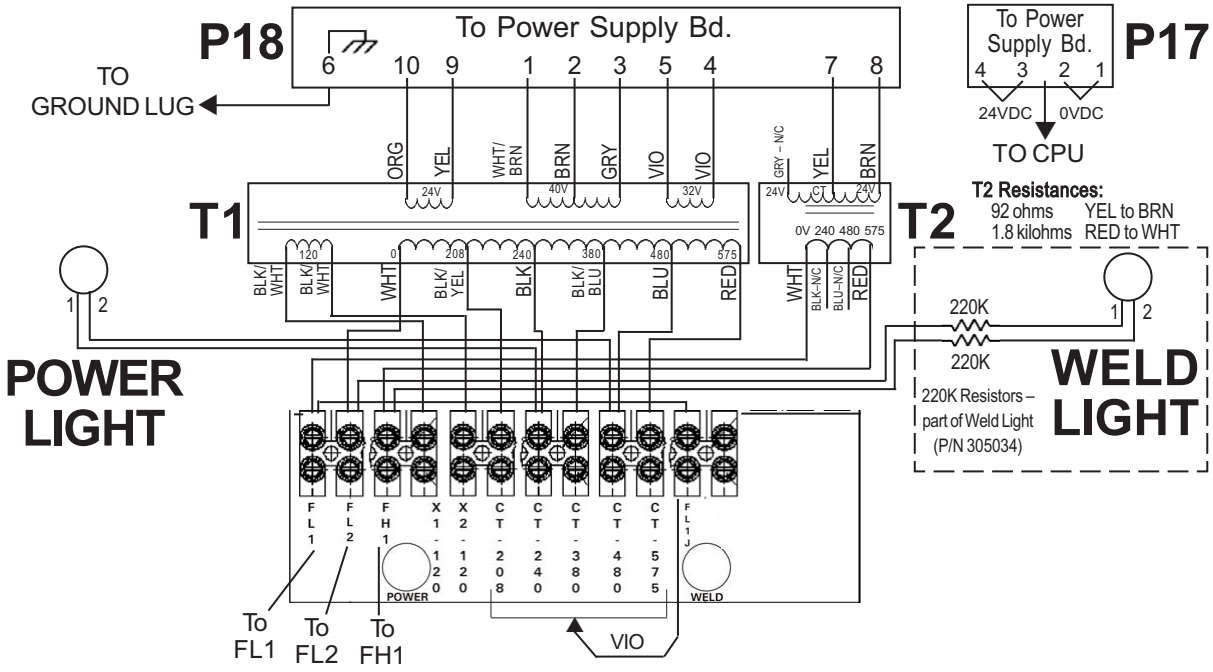


Figure 4-3. *Power Supply schematic*

4.3 WIRING DIAGRAMS

4.3.1 BILL OF MATERIALS

GROUND FAULT CONTROLS
ONLY AVAILABLE IN L CABINET
1200A SCR

QTY	Part #	Description
1	600695	Assembly, Ground Fault Relay, 60Hz, Weldsafe 5000
2	211035	Resistor, Carbon, 1W, 10%, 10K
1	210108	Resistor, Metal Oxide, 1W, 5%, 1 ohm
1	309514	Ground Fault Current Coil
1	335017	Terminal Block, 2 Pole, 20A
1	318001-002	5" of 318001 Din Rail
2	318030	End Stop, Din Rail
1	318033	Terminal Block, 30A, 600V, Din Rail Mount
1	341040	Insulator
4	346002	Screw Lug, 5/16 Bolt
1	600649	Assembly, Glastic/Insulator – Consisting of one each of: 341045 – Insulator, 1/8" Polyethylene 341040-001 – Insulator Standoff, made from 341040 557086 – Screw, 5/32 x 1/2 PHSTS
1	302024	Switch Assem, Oil Tight, Push Button, Red, N/O, 22mm Consists of: 302022, 302023, 302019
1	302025	Switch Assem, Oil Tight, Push Button, Red, N/C, 22mm Consists of: 302020, 302023, 302019

4.3.1 BILL OF MATERIALS (cont.)

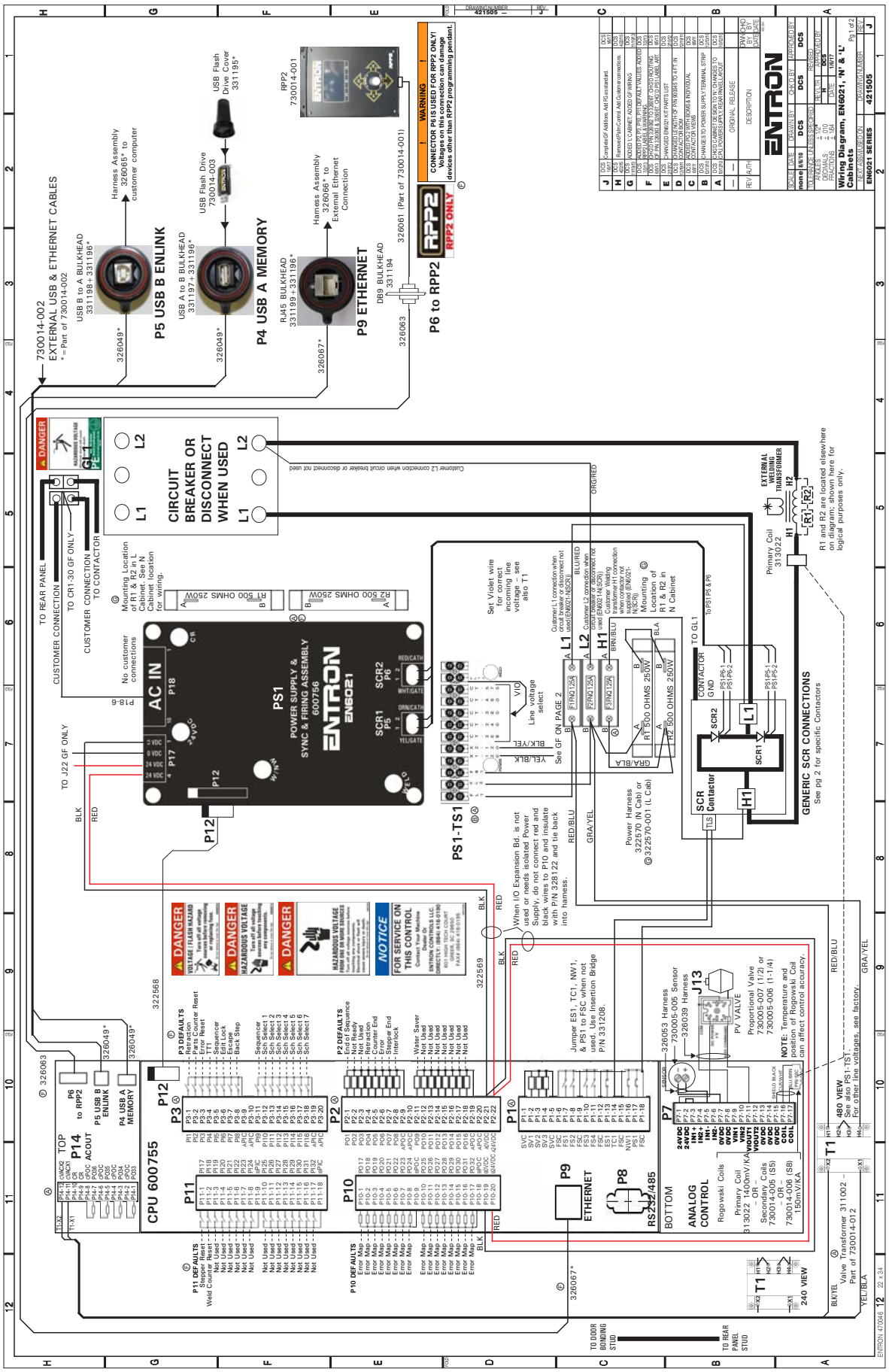
L CAB	N CAB	CONTROL PARTS LIST	
QTY	QTY	Part #	Description
1		510257	Cabinet, NEMA 12 "L"
	1	510308	Cabinet, NEMA 12 "N"
		Rear Panel	
1	1	600755	Assembly, CPU
4	4	331208	Insertion Bridge Jumper
1	1	600756	Assembly, Power Supply
2	2	225016	Surge Resistor, 100W, 500 ohm, 10%
3	3	307025	Fuse, 1-1/4A
3	3	308010	Fuseholder, One Pole
1	1	322568	Assembly, P12 Harness, 26 Conductor Ribbon
1	1	322569	Harness Assembly, 24 VDC
	1	322570	Harness Assembly, Power, N Cabinet
1		322570-001	Harness Assembly, Power, L Cabinet
1	1	460142	Label, Danger, Hazardous Voltage
1	1	460143	Label, Danger, Voltage/Flash Hazard
3	3	No P/N	Label, Fuse, FNQ-R-1 1/4 or KLDR-1 1/4
		Ground Lug	
1	1	346004	Lug, 5/16" Bolt to 2/0 Wire
1	1	460144	Label, Danger, Voltage Hazard Earth GND
		RPP2 Bulkhead	
1	1	326063	Cable Assembly, 6', DB9 Male to Male, 1:1
2	2	331193	Jack Screw, 433
1	1	331194	Adapter, DB9 Female/Female
1	1	460416	Label, RPP2 Connector
		Drain/Vent Insulator	
1	1	341055	Insulator, Drain/Vent for "N" Cabinet
4	4	557067	1/2-13 Hex Nut, Brite
4	4	557050	5/16-18x1 Carr. Bolt, Brite
4	4	557125	5/16-18 Hex Nylon Lock Nut w/Washer
		Labels, Left Side	
1	1	460103	Label, For Service Contact
1	1	460170	Label, Caution, Do Not Pinch Wire
		Door	
1	1	460145	Label, Caution, Water Hose Burst Hazard
1	1	460146	Label, Warning, Hazardous Voltage
1	1	460342	Label, Warning, Programmed Control Devices
1	1	460335	Label, ENTRON Logo
1	1	460393	Label, EN6021
3	3	565015	Hole Plug, 30 mm, Black
1	1	700221	EN6021 Manual

4.3.1 BILL OF MATERIALS (cont.)

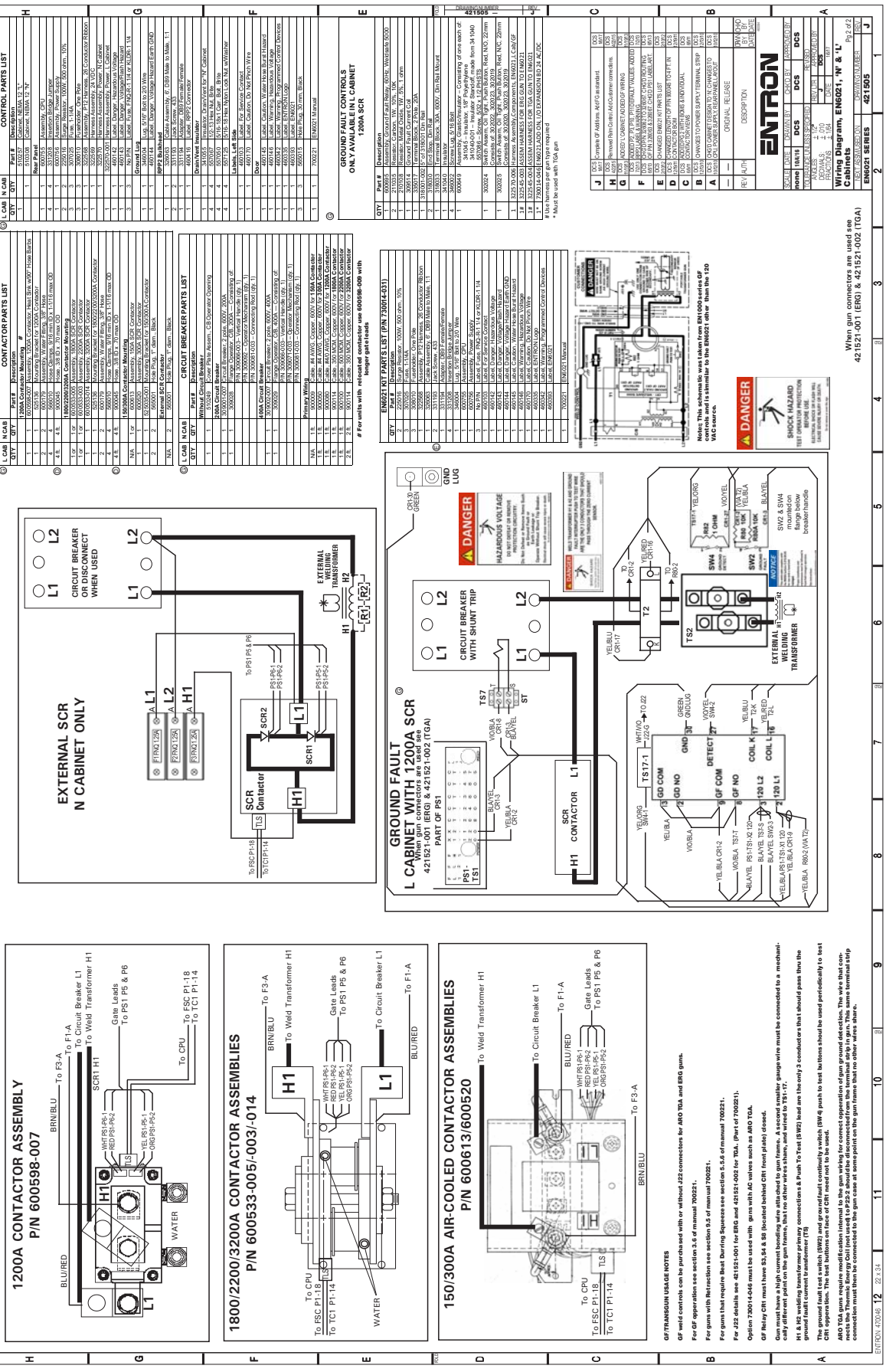
L CAB	N CAB	CIRCUIT BREAKER PARTS LIST	
QTY	QTY	Part #	Description
		Without Circuit Breaker	
1	1	510249	Cover Plate Assem., CB Operator Opening
		200A Circuit Breaker	
1	1	309001-007	Circuit Breaker, 2 pole, 600V, 200A
1	1	309028	Flange Operator, C/B, 200A — Consisting of:
			P/N 309066-003– Vertical Handle (qty. 1)
			P/N 309092 – Operator Mechanism (qty. 1)
			P/N 309081-003 – Connecting Rod (qty. 1)
		400A Circuit Breaker	
1	1	309002-007	Circuit Breaker, 2 pole, 600V, 400A
1	1	309029	Flange Operator, C/B, 400A — Consisting of:
			P/N 309066-003– Vertical Handle (qty. 1)
			P/N 309071-003 – Operator Mechanism (qty. 1)
			P/N 309081-003 – Connecting Rod (qty. 1)
		Primary Wiring	
N/A	1 ft.	900009	Cable, #4 AWG, Copper, 600V for **150A Contactor**
1 ft.	1 ft.	900050	Cable, #4 AWG, Copper, 600V for **300A Contactor**
1 ft.	1 ft.	900080	Cable, #4/0 AWG, Copper, 600V for **1200A Contactor**
1 ft.	1 ft.	900114	Cable, 350 MCM, Copper, 600V for **1800A Contactor**
1 ft.	1 ft.	900100	Cable, 500 MCM, Copper, 600V for **2200A Contactor**
2 ft.	2 ft.	900114	Cable, 350 MCM, Copper, 600V for **3200A Contactor**

L CAB	N CAB	CONTACTOR PARTS LIST	
QTY	QTY	Part #	Description
		1200A Contactor Mounting	
1	1	600598-007	Assembly, 1200A Contactor, Heat Sink w/90° Hose Barbs
1	1	525136	Mounting Bracket for 1200A Contactor
2	2	600179	Assembly, Water Fitting, 3/8" Hose
4	4	566010	Hose Clamps, 9/16 min ID x 1-1/16 max OD
4 ft.	4 ft.	900045	Hose, 3/8 ID x .70 max OD
		1800/2200/3200A Contactor Mounting	
1 or	1 or	600533-005	Assembly, 1800A SCR Contactor
1 or	1 or	600533-003	Assembly, 2200A SCR Contactor
1	1	600533-014	Assembly, 3200A SCR Contactor
1	1	525136	Mounting Bracket for 1800/2200/3200A Contactor
2	2	600179	Assembly, Water Fitting, 3/8" Hose
4	4	566010	Hose Clamps, 9/16 min ID x 1-1/16 max OD
4 ft.	4 ft.	900045	Hose, 3/8 ID x .70 max OD
		150/300A Contactor Mounting	
N/A	1 or	600613	Assembly, 150A SCR Contactor
1	1	600520	Assembly, 300A SCR Contactor
1	1	525035-001	Mounting Bracket for 150/300A Contactor
2	2	565001	Hole Plug, 1" diam., Black
		External SCR Contactor	
N/A	2	565001	Hole Plug, 1" diam., Black

4.3.2 WIRING DIAGRAM

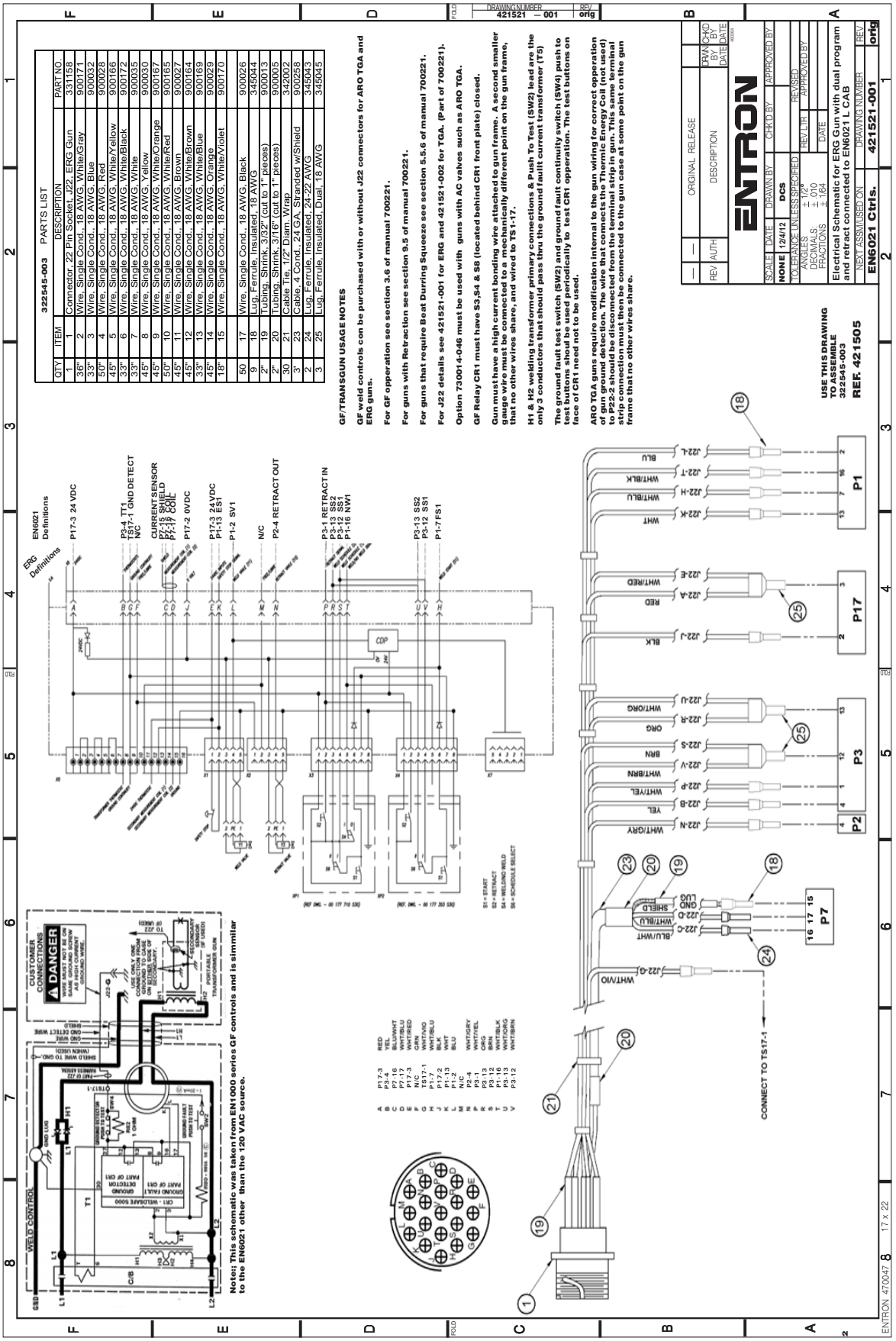


4.3.2 WIRING DIAGRAM (cont.)



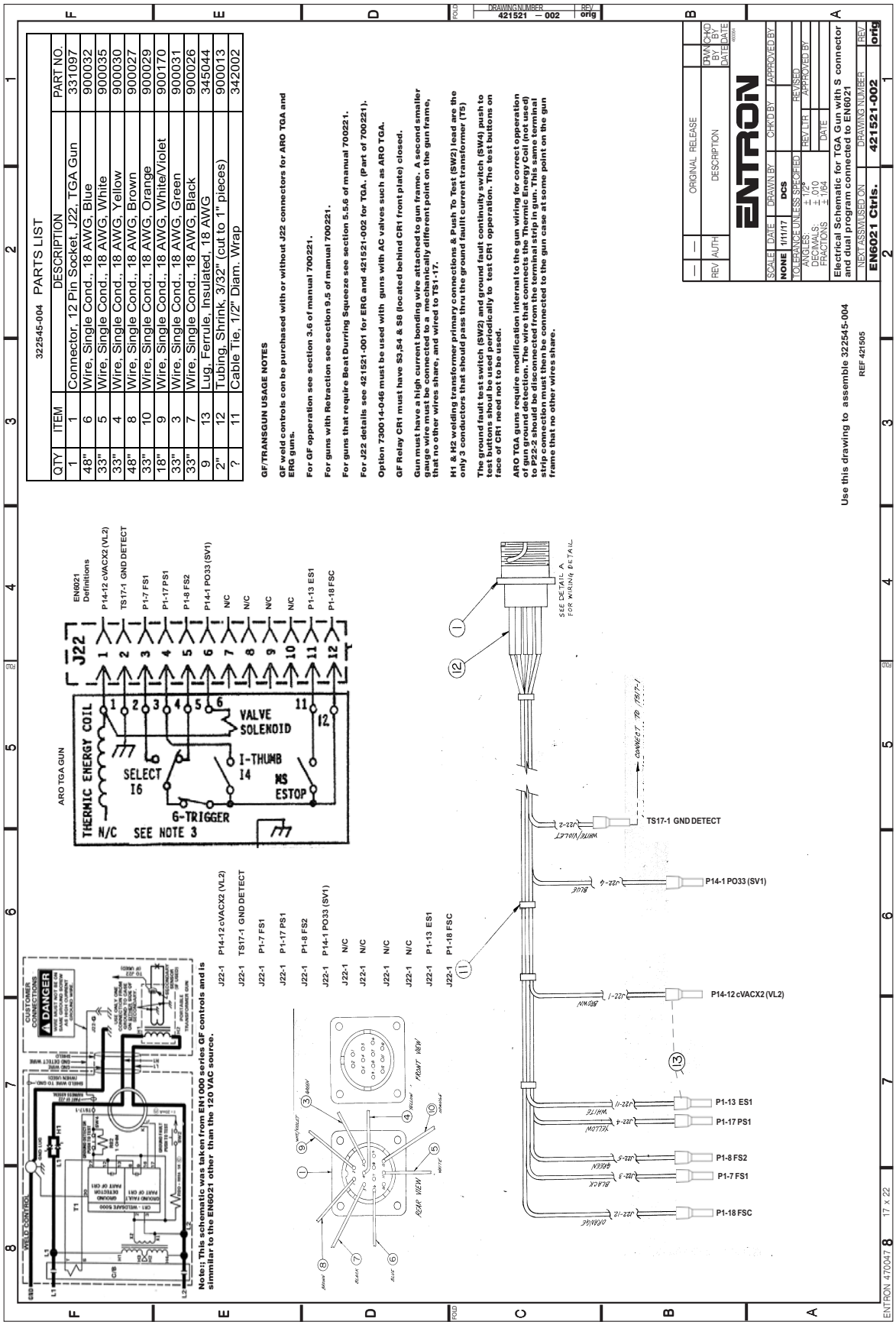
4.3.2 WIRING DIAGRAMS (cont.)

4.3.2 ERG GUN CONNECTED TO EN6021



4.3.2 WIRING DIAGRAMS (cont.)

4.3.2 TGA GUN CONNECTED TO EN6021



4.3.3 GROUNDING AND SHIELDING

The control cabinet must be grounded. Use ground lug on top right of cabinet for connecting grounding conductor (see Figure 4-4).

The grounding conductor wire size must comply with local codes and be able to trip upstream breaker in fault conditions. Conduit grounding is not permitted – see RWMA Bulletin #5.

Shielded cables should only be grounded at one point to prevent ground loops.

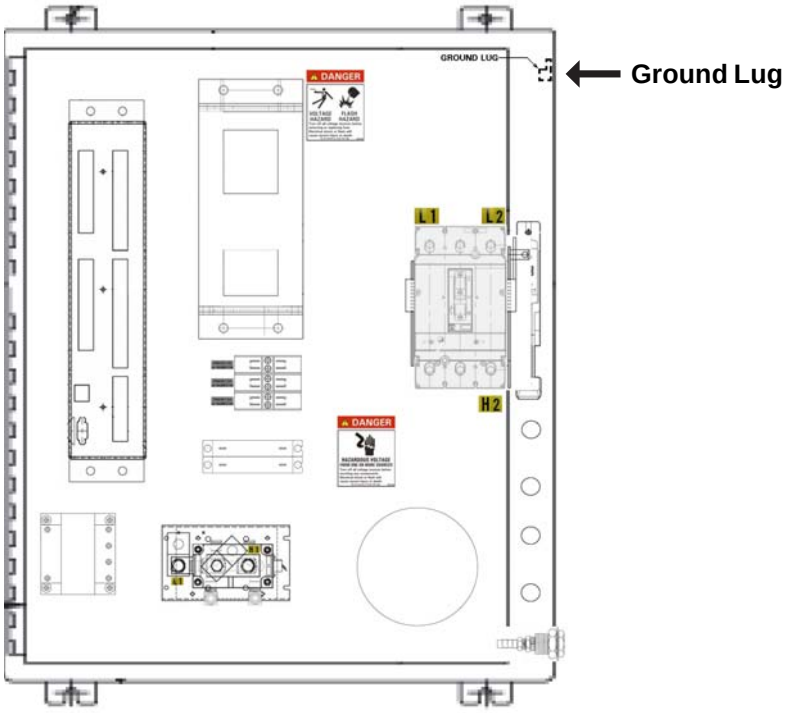


Figure 4-4. *Grounding and shielding*

4.3.4 NOISE SUPPRESSION

Means of noise suppression may be required to prevent radiation of RF noise. Such noise is caused by transients peaks, which are transmitted by AC line or valve outputs, motor controls, etc.

Noise should be removed at its source. If this is not reasonable, noise suppression devices must be placed as close as possible to device.

All inductive devices such as valves, solenoids and other switching elements (or their connecting wires), which are situated in the vicinity of control, require noise suppression or physical isolation with barriers.

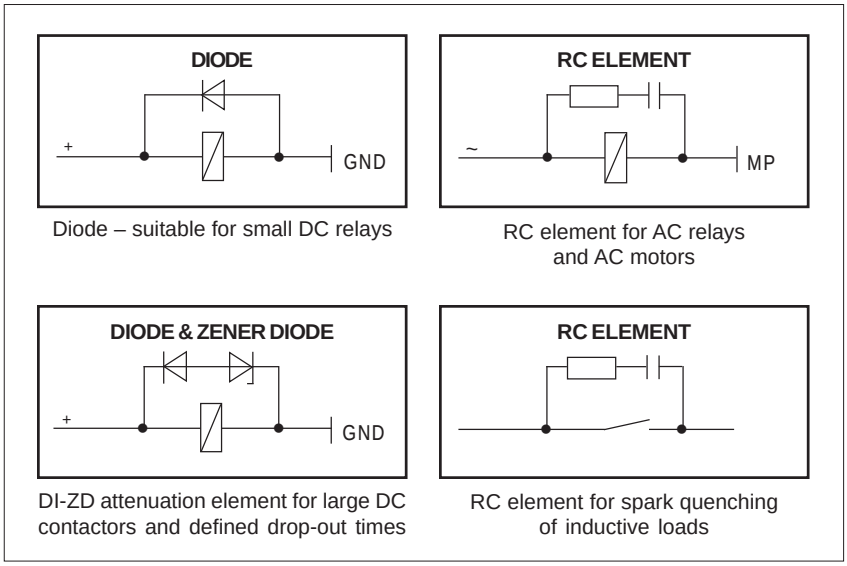


Figure 4-5. *Noise suppression examples*

4.3.5 LOW VOLTAGE WIRING

Appropriate low voltage wiring techniques should also be used, including:

1. Use of different color wire(s) for low voltage.
2. Avoid long parallel runs of high voltage and low voltage wires. When wires have to cross, do so at right angles. Separate high voltage from low voltage.
3. Label wire ends.
4. Avoid possibility of high voltage wires shorting or conducting to low voltage wires.
5. Keep high voltage/high current noise-producing wiring away from low voltage wiring and control assemblies.

4.4 LINE CONNECTIONS

The EN6021 Control is connected to main electrical supply.

! WARNING !

Significant dangers are associated with line connection of thyristor contactor! The possible consequences of inappropriate handling include death, severe bodily injury and damage to property.

Electrical connection may only be made by a skilled electrician who follows existing regulations. The line voltage must match the nominal voltage of control!

THE LINE MUST BE CORRECTLY FUSED!

4.4.1 WHEN CONTACTOR IS SUPPLIED

A single phase supply, via a suitable protective device (such as a circuit breaker), should be connected to the control as shown (Terminals L1, L2, GND).

A suitable welding transformer should be connected to the control at terminals H1 and H2. The transformer case MUST also be connected to ground (GND).

Additional earthing and/or protective device is required for the secondary circuit, depending on the application – see ANSI Z49-1.

! CAUTION !

THESE TASKS MUST ONLY BE CARRIED OUT BY QUALIFIED PERSONNEL.

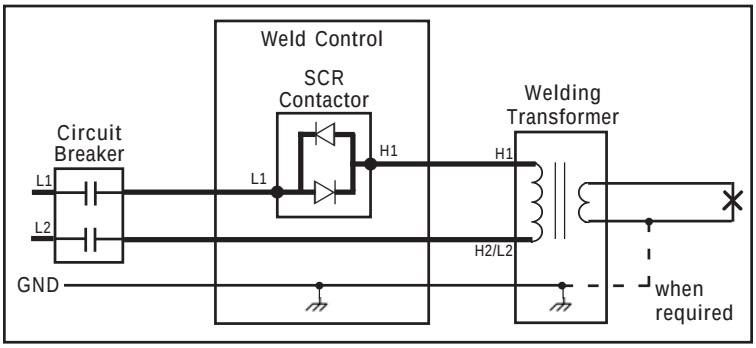


Figure 4-6. *Power connections*

4.4.2 EXTERNAL SCR CONTACTOR

EN6021 Weld Controls may be purchased to fire existing SCRs. When required, connect as shown. For External SCR requirements, see Section 4.2.

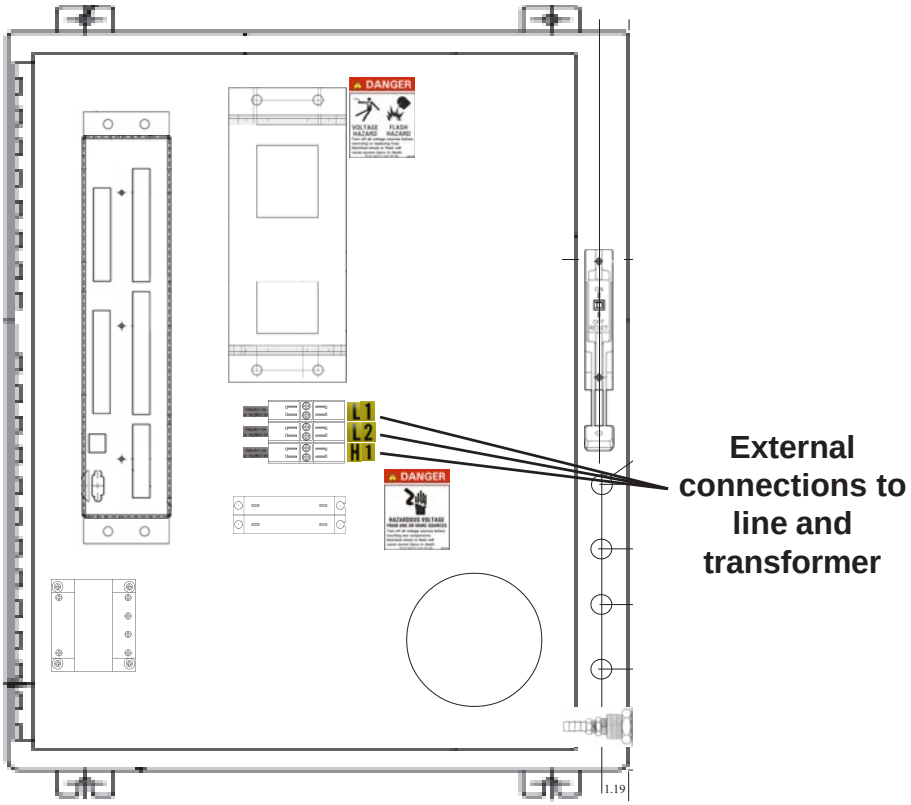


Figure 4-7. *Wiring Diagram for External SCR Contactor*

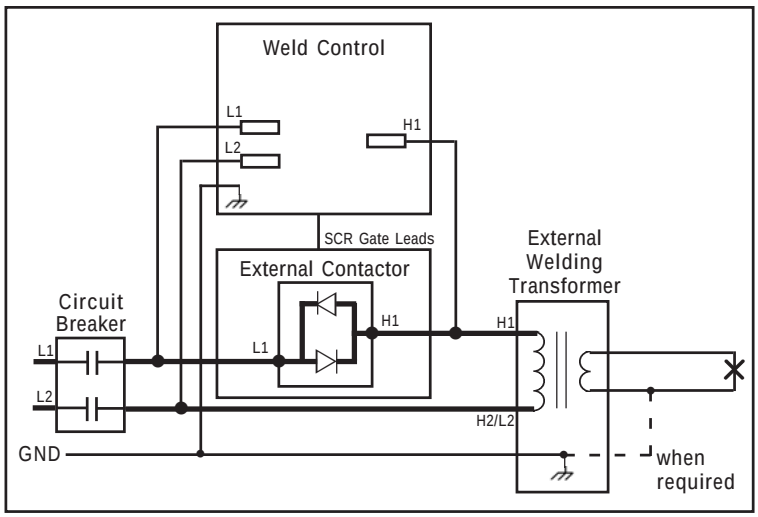


Figure 4-8. *Schematic for External SCR*

4.4.3 USER CONNECTIONS

SPECIFICATIONS:

SV1–SV3 and PO1–PO32 outputs rated 500 mA at 24 VDC.

P1 inputs typically consume 10 mA.

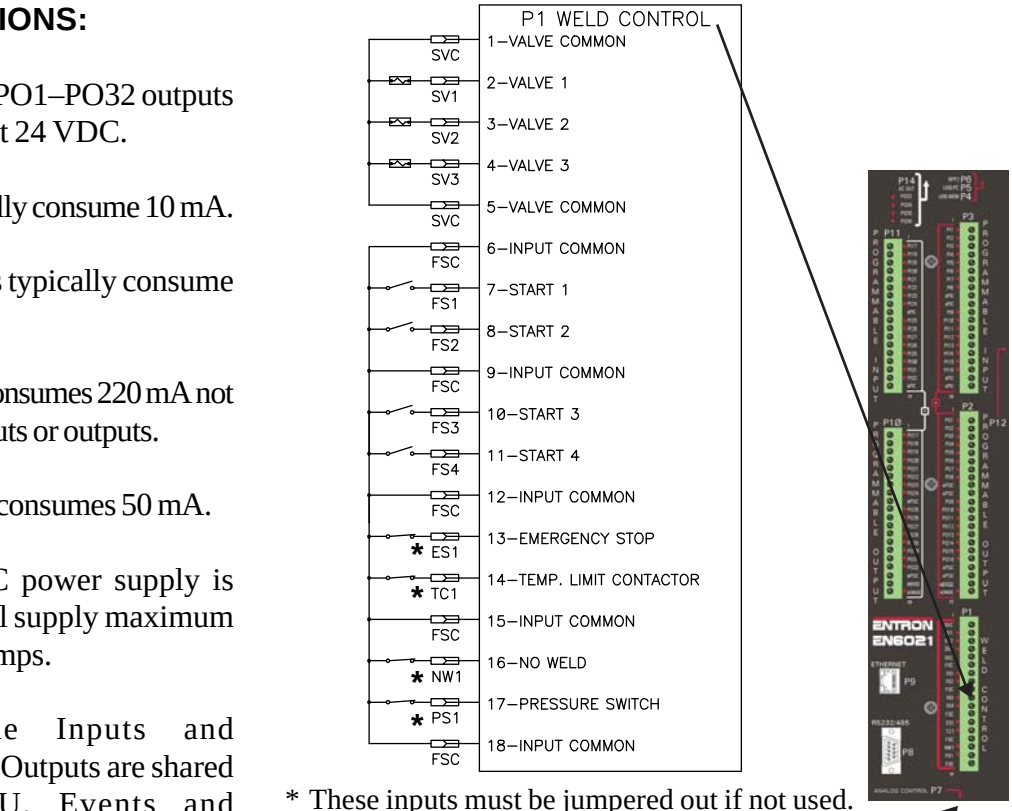
PI1-PI32 inputs typically consume 10 mA.

CPU typically consumes 220 mA not considering inputs or outputs.

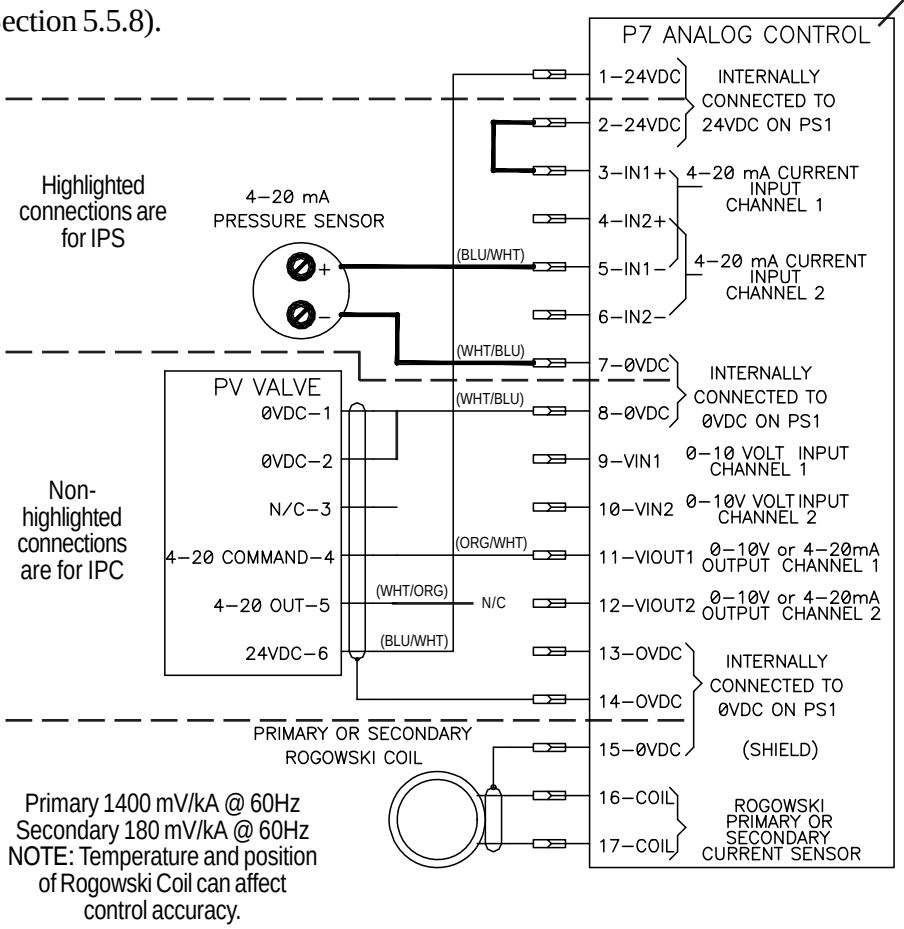
RPP2 typically consumes 50 mA.

When 24 VDC power supply is provided, it will supply maximum current of 2.5 amps.

Programmable Inputs and Programmable Outputs are shared between CPU, Events and Sequencer. Use **I/O Map Menu** to configure (see Section 5.5.8).



* These inputs must be jumpered out if not used.



4.4.3 USER CONNECTIONS (cont.)

SPECIFICATIONS:

SV1–SV3 and PO1–PO32 outputs rated 500 mA at 24 VDC.

P1 inputs typically consume 10 mA.

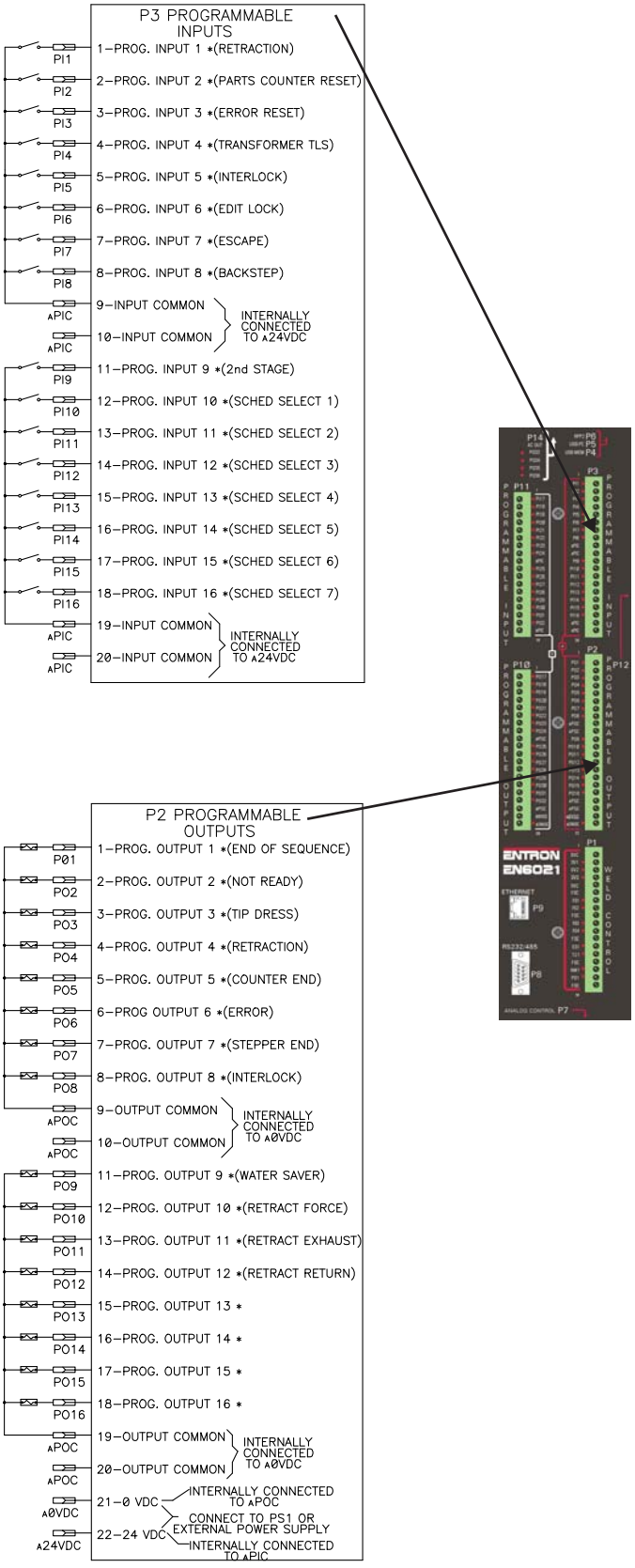
PI1-PI32 inputs typically consume 10 mA.

CPU typically consumes 220 mA not considering inputs or outputs.

RPP2 typically consumes 50 mA.

When 24 VDC power supply is provided, it will supply maximum current of 2.5 amps.

Programmable Inputs and Programmable Outputs are shared between CPU, Events and Sequencer. Use **I/O Map Menu** to configure (see Section 5.5.8).



4.4.3 USER CONNECTIONS (cont.)

SPECIFICATIONS:

SV1–SV3 and PO1–PO32 outputs rated 500 mA at 24 VDC.

P1 inputs typically consume 10 mA.

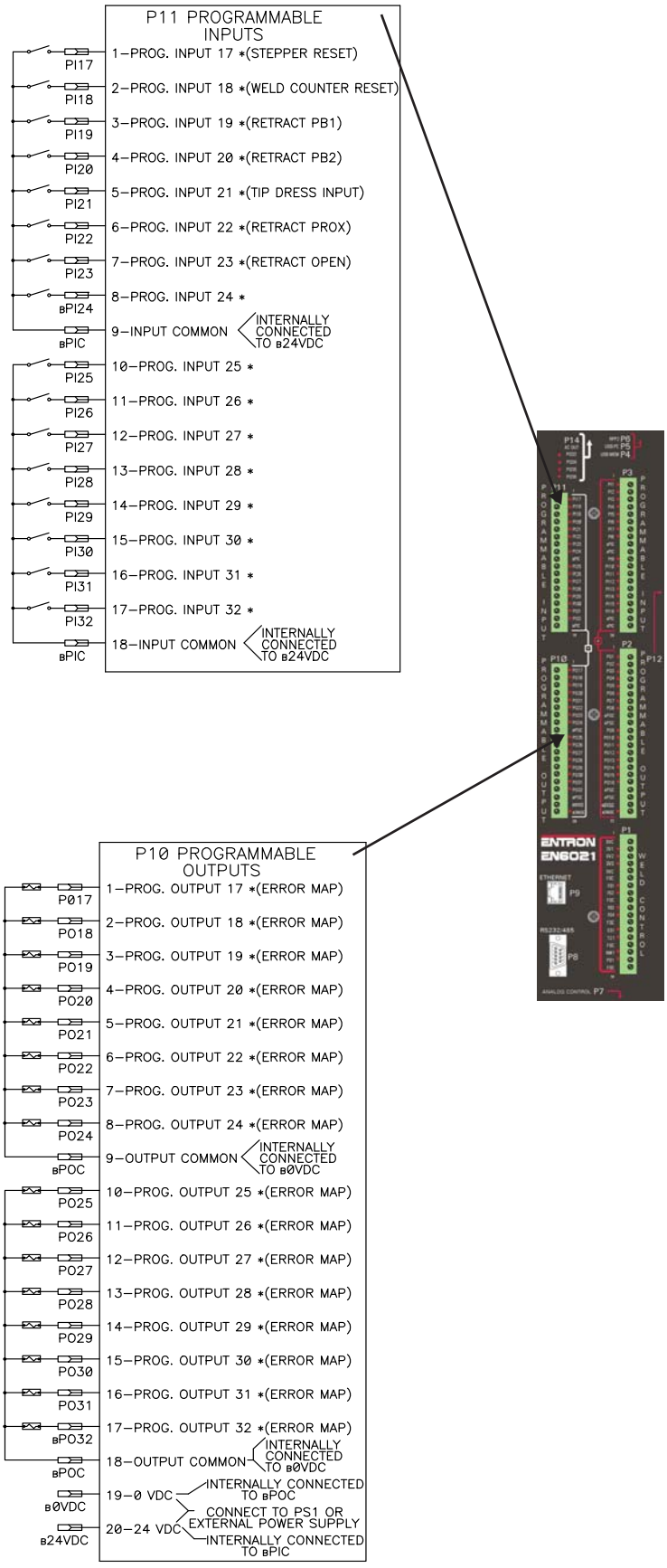
PI1-PI32 inputs typically consume 10 mA.

CPU typically consumes 220 mA not considering inputs or outputs.

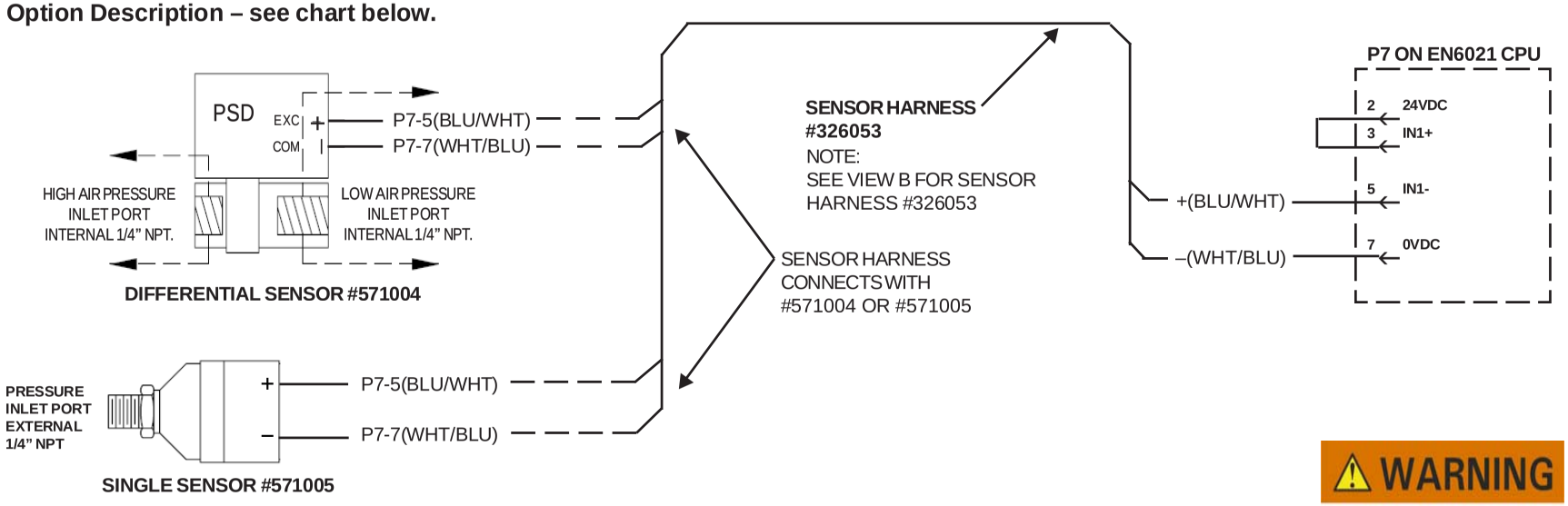
RPP2 typically consumes 50 mA.

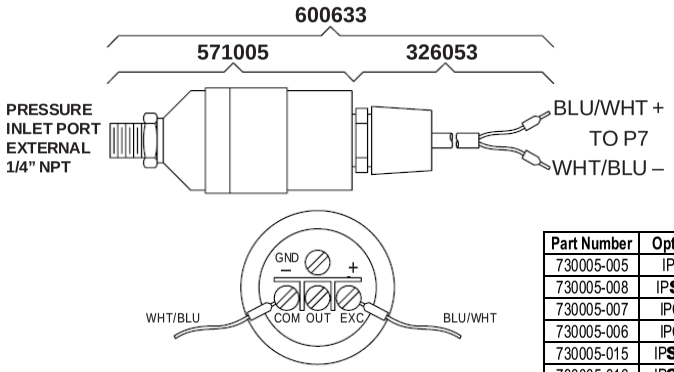
When 24 VDC power supply is provided, it will supply maximum current of 2.5 amps.

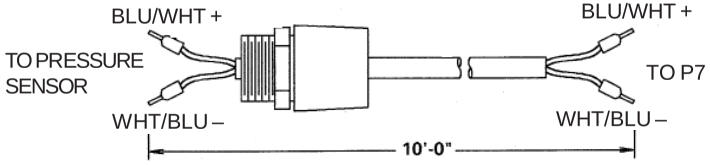
Programmable Inputs and Programmable Outputs are shared between CPU, Events and Sequencer. Use **I/O Map Menu** to configure (see Section 5.5.8).

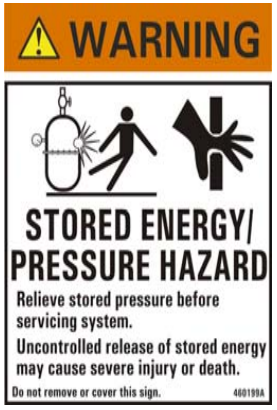


Use this Pressure Sensor Wiring Diagram for all Pressure Control Systems with "S" (Sense) in Option Description – see chart below.







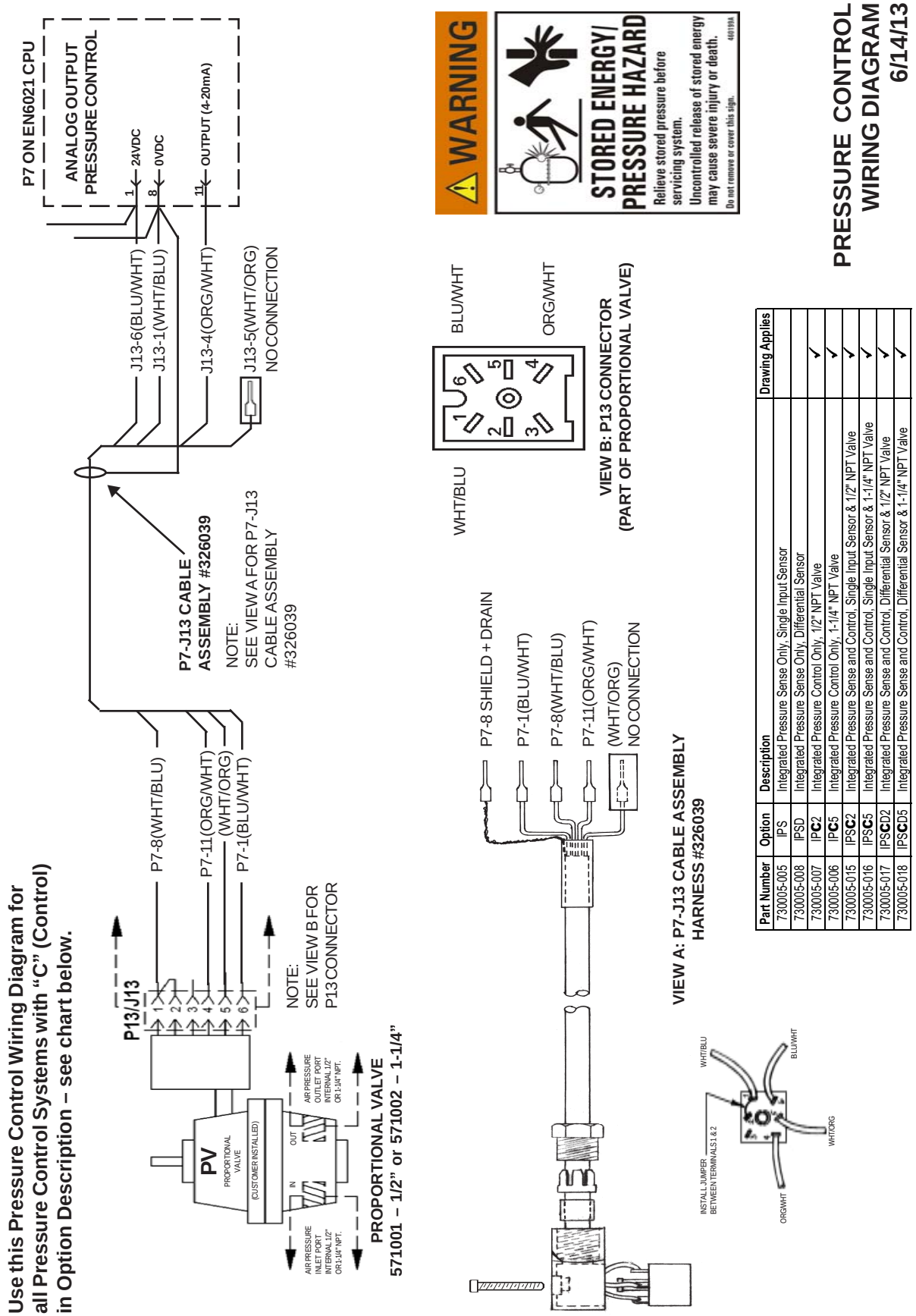


Part Number	Option	Description	Drawing Applies
730005-005	IP**S**	Integrated Pressure Sense Only, Single Input Sensor	✓
730005-008	IP**SD**	Integrated Pressure Sense Only, Differential Sensor	✓
730005-007	IPC2	Integrated Pressure Control Only, 1/2" NPT Valve	
730005-006	IPC5	Integrated Pressure Control Only, 1-1/4" NPT Valve	
730005-015	IP**S**C2	Integrated Pressure Sense and Control, Single Input Sensor & 1/2" NPT Valve	✓
730005-016	IP**S**C5	Integrated Pressure Sense and Control, Single Input Sensor & 1-1/4" NPT Valve	✓
730005-017	IP**S**C**D**2	Integrated Pressure Sense and Control, Differential Sensor & 1/2" NPT Valve	✓
730005-018	IP**S**C**D**5	Integrated Pressure Sense and Control, Differential Sensor & 1-1/4" NPT Valve	✓

PRESSURE SENSOR WIRING DIAGRAM
2/25/14

4.4.4 PRESSURE SENSE AND CONTROL (cont.)

PROPORTIONAL VALVE CONNECTIONS



Part Number	Option	Description	Drawing Applies
730005-005	IPS	Integrated Pressure Sense Only, Single Input Sensor	
730005-008	IPSD	Integrated Pressure Sense Only, Differential Sensor	
730005-007	IPS**C**2	Integrated Pressure Control Only, 1/2" NPT Valve	✓
730005-006	IPS**C**5	Integrated Pressure Control Only, 1-1/4" NPT Valve	✓
730005-015	IPS**C**2	Integrated Pressure Sense and Control, Single Input Sensor & 1/2" NPT Valve	✓
730005-016	IPS**C**5	Integrated Pressure Sense and Control, Single Input Sensor & 1-1/4" NPT Valve	✓
730005-017	IPS**C**D2	Integrated Pressure Sense and Control, Differential Sensor & 1/2" NPT Valve	✓
730005-018	IPS**C**D5	Integrated Pressure Sense and Control, Differential Sensor & 1-1/4" NPT Valve	✓

4.4.5 TWO-STAGE OPERATION

A typical two-stage foot switch uses 2 internal limit switches that open and close in sequence when foot pedal is closed. Two-Stage Operation is typically used on manual welders where an operator needs to check welding electrode position on the part before welding. The operator first depresses the pedal on foot switch part way down. This closes the first stage. The control will respond with programmed valves for the start input selected that was closed. The control will time through Pre-Squeeze and Squeeze and wait.

- If the pedal is released, valves will turn off, allowing operator to realign part if needed.
- If pedal is moved from first stage to second stage, PS1 is then evaluted and weld sequence is started.
- If foot pedal is operated such that first stage is closed and then immediately second stage is closed before Pre-Squeeze or Squeeze time elapses, the control will wait for Pre-Squeeze and Squeeze to complete before evaluating PS1 and going into weld sequences.
- If control is using Two-Stage Operation and the schedule initiated is a repeat schedule, the schedule will repeat only if first stage and second stage are closed.

SINGLE TWO-STAGE FOOT SWITCH OPERATION

When using Single Two-Stage Operation, START1–4 (pins P1-7,8,10,11) become First Stage initiations and Second Stage input is connected to PI9 (2nd STAGE) (pin P3-11).

1. Connect as shown in Figure 4-9. Activating foot switch SW1 will initiate welding sequence in SCHEDULE 0.
2. Map INPUT PI9 to 2nd Stage function in **Input Function** sub-menu of **I/O Map Menu** via RPP2 programming pendant (see Section 5.5.8).
3. Set Input Source of INPUT PI9 to Local mode in **Input Source** sub-menu of **I/O Map Menu** via RPP2 programming pendant (see Section 5.5.8).

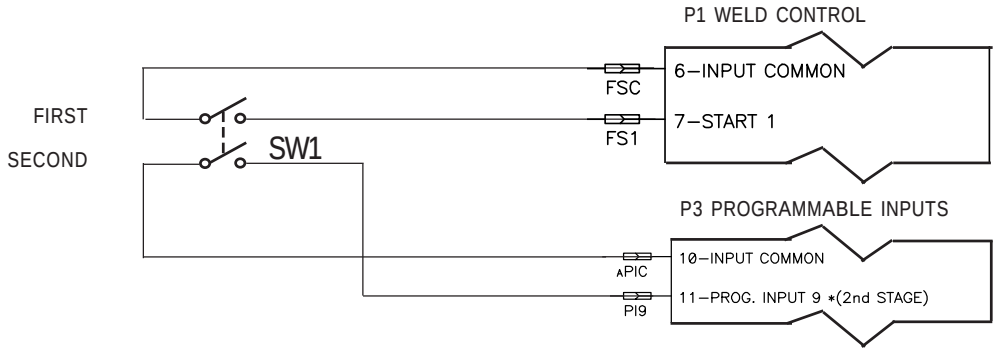


Figure 4-9. *Single two-stage foot switches connection diagram*

4.4.5 TWO-STAGE OPERATION (cont.)

MULTIPLE TWO-STAGE FOOT SWITCH OPERATION

The First Stage input FS1–FS4 (pins P1-7,8,10,11) and Second Stage input (pin P3-11) can be wired in parallel to allow initiations by means of multiple two-stage foot switches.

1. The foot switches are connected to connectors P1 and P3 of control as shown in Figure 4-10. One (1) to four (4) two-stage foot switches can be used. Activating foot switches SW1 through SW4 will initiate welding sequence in the SCHEDULE associated with activated switch.
2. Map INPUT PI9 to 2nd Stage function in **Input Function** sub-menu of **I/O Map Menu** via RPP2 programming pendant (see Section 5.5.8).
3. Set Input Source of INPUT PI9 to Local mode in **Input Source** sub-menu of **I/O Map Menu** via RPP2 programming pendant (see Section 5.5.8).
4. Initiate different weld schedule by initiating different foot switches. Initiating SW1 will trigger weld schedule selected in **Use Schedule** page or binary schedule select input (External SCHEDULE SELECT). Initiating SW2 will trigger SCHEDULE 20. Initiating SW3 will trigger SCHEDULE 40. Initiating SW4 will trigger SCHEDULE 60.

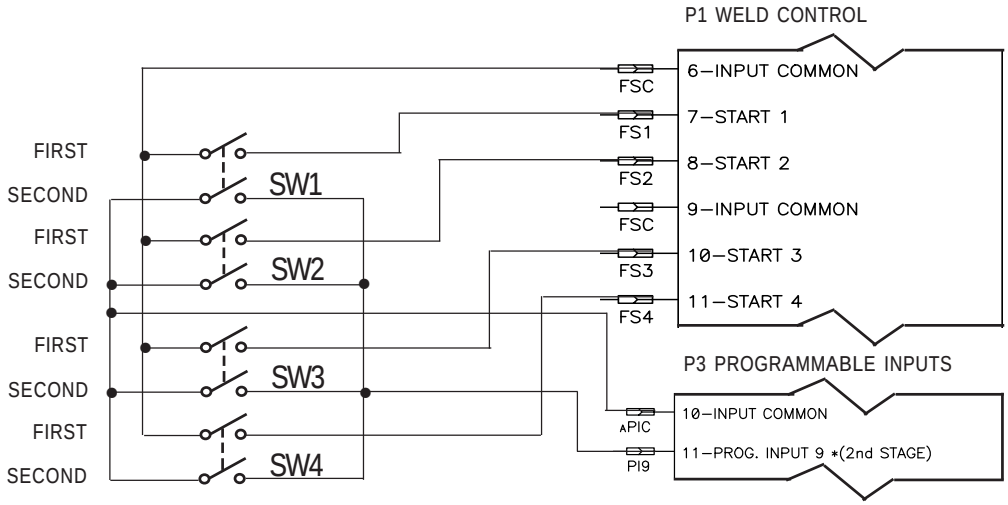


Figure 4-10. *Multiple two-stage foot switches connection diagram*

4.4.6 LINEAR DISPLACEMENT TRANSDUCER

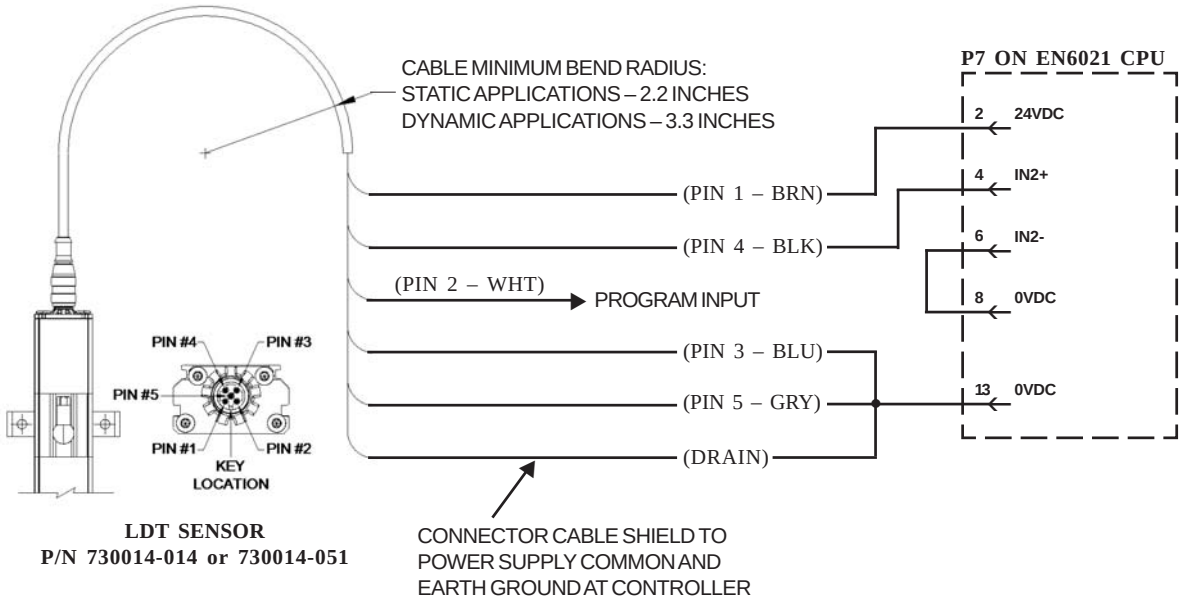


Figure 4-11. *Linear Displacement Transducer Sensor wiring diagram*

See Section 10.15 for more detailed information on LDT Sensor Option.

5.0 PROGRAMMING

The EN6021 Control is capable of storing and accessing up to 100 unique weld schedules. Programming allows the operator to enter and change parameters of weld schedules, along with configuring the control for appropriate application. The RPP2 programming pendant, which includes a large multi-line graphic display and joystick, is used for all programming and control configuration.

Basically, programming requires selecting appropriate menu, then selecting function/parameter to be programmed, entering and/or changing value, and saving desired settings.

Layout of display is shown in Figure 5-1. First line (Title Section) and last line (Help Section) are consistent on all screens. Title Section will display title of menu or sub-menu selected, along with Edit Lock function indicator (flashing LK shown when function is enabled – see Section 5.5.8) and ADJUST gain setting for joystick (see Section 5.1 for further explanation). Help Section defines use of F1, F2, and F3 (see Section 5.1). Main Display will show items for information and/or programming depending on menu, sub-menu, or page selected. Selected line/parameter will be indicated by inverted text.

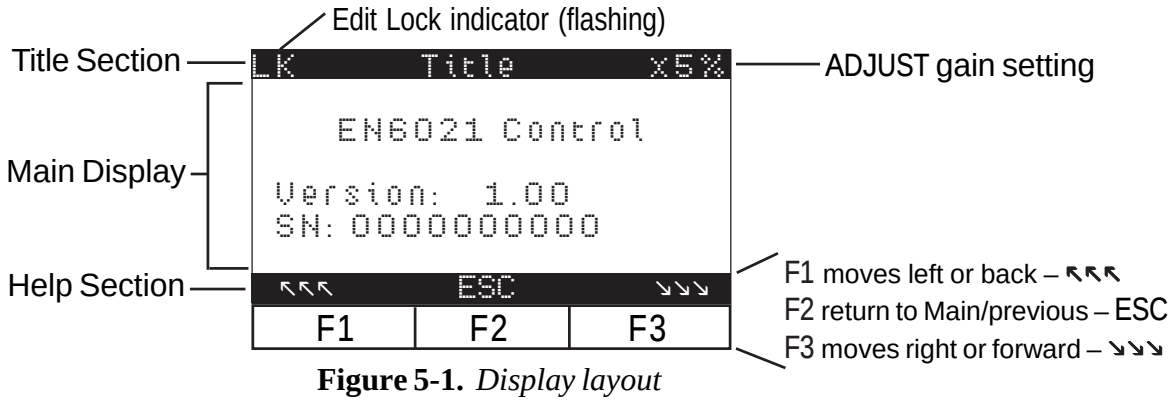


Figure 5-1. *Display layout*

5.1 JOYSTICK OPERATION

Joystick can be manipulated in three ways:

Toggled up, down, left, and right (F2, DOWN, F1, F3)
Rotated clockwise or counterclockwise (**+/–** ADJUST)
Pushed in (ENTER)

Some joystick functions may be redefined on various screens which will be noted in description of that screen. Generally, each joystick function will perform as follows:

F1 (left) – used to switch to or select previous parameter. If current parameter is first parameter in menu and F1 is triggered, Help Section will display First item !!! for three seconds.

F2 (up) – used to return display to **Main Menu** or previous menu when triggered in a sub-menu.

F3 (right) – used to switch to or select next parameter. If current parameter is last parameter in menu and F3 key is triggered, Help Section will display Last item !!! for three (3) seconds.

5.1 JOYSTICK OPERATION (cont.)

DOWN – has two distinct functions which depend on menu and/or parameter selected.

1. On some screens, DOWN is used toggle Weld/No Weld state. Weld state, which enables weld firing pulse, is indicated by red WELD in DOWN arrow area. No Weld state, which disables firing, is indicated by flashing red NO WELD in DOWN arrow area.
2. Where needed, DOWN is used to toggle gain setting of **+/–** ADJUST rotation among "+/- 1", "+/- 1%", and "+/- 5%" options. For parameters with large value ranges, changing gain setting will result in quicker increments/decrements to facilitate programming of those values. On display, right end of Title Section is used to indicate gain setting. If gain is set to default of "+/- 1", nothing will be displayed. If gain is set to "+/- 1%", end of line will flash x1%. If gain is set to "+/- 5%", end of line will flash x5%.

+ADJUST (clockwise) – used to increase the value of selected parameter. The default rotation increment is "+1", which increases value by 1 when **+**ADJUST is rotated one step clockwise. For some parameters, rotation increment is controlled by gain setting of **+**ADJUST. If gain setting is x1%, value will be increased by 1% of maximum value of parameter when **+**ADJUST is rotated one step clockwise. If gain setting is x5%, value will be increased by 5% of maximum value of parameter when **+**ADJUST is rotated one step clockwise. If parameter value is increased when displaying its maximum, value will roll over to its minimum value.

–ADJUST (counterclockwise) – used to decrease the value of selected parameter. The default rotation decrement is "–1", which decreases value by 1 when **–**ADJUST is rotated one step counterclockwise. For some parameters, rotation decrement is controlled by gain setting of **–**ADJUST. If gain setting is x1%, value will be decreased by 1% of maximum value of parameter when **–**ADJUST is rotated one step counterclockwise. If gain setting is x5%, value will be decreased by 5% of maximum value of parameter when **–**ADJUST is rotated one step counterclockwise. If parameter value is decreased when displaying its minimum, value will roll over to its maximum value.

ENTER – used to accept/save displayed value for parameter by pushing in joystick. When ENTER is triggered to accept displayed value, this new value will be saved for selected parameter and the cursor will automatically move to next parameter.

NOTICE

If value of selected parameter is modified by **+/–** ADJUST rotation and cursor is moved to another parameter using **F1** or **F3** before ENTER is triggered, the displayed value **will not be saved** – parameter will revert previous value.

5.2 MENUS

The various programming features of the EN6021 are arranged in menus and sub-menus. Also available are several **Status** pages which display useful information about control's status. Figure 5-2 illustrates organization of and access to these items.

5.2 MENUS (cont.)

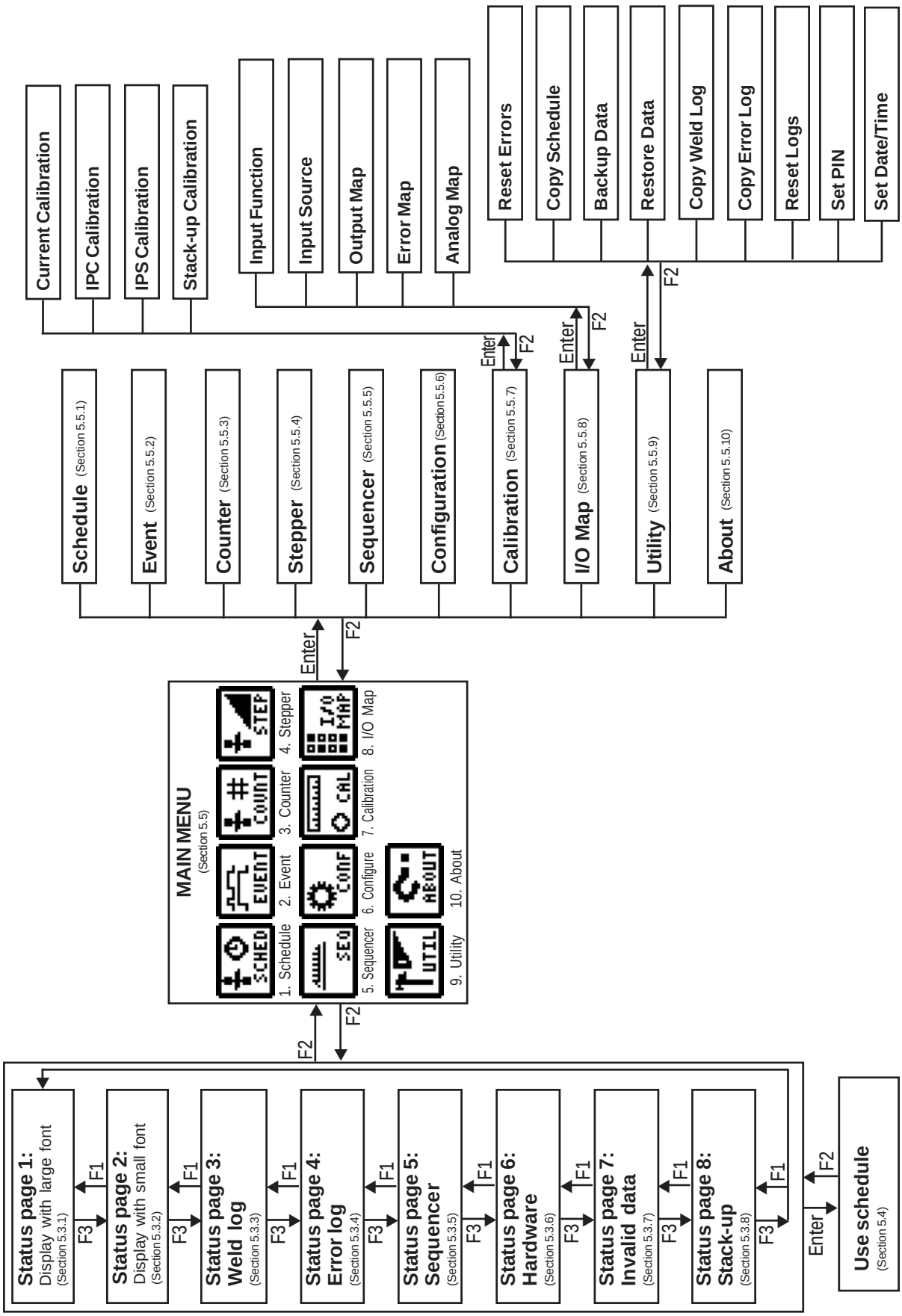


Figure 5-2. *Menu organization*

5.3 STATUS PAGES

The EN6021 has eight (8) **Status** pages. These pages display various information regarding status of control, measurements of weld parameters, and error notifications. No editing can be done on these pages, except to change record number of Weld and/or Error Log displayed.

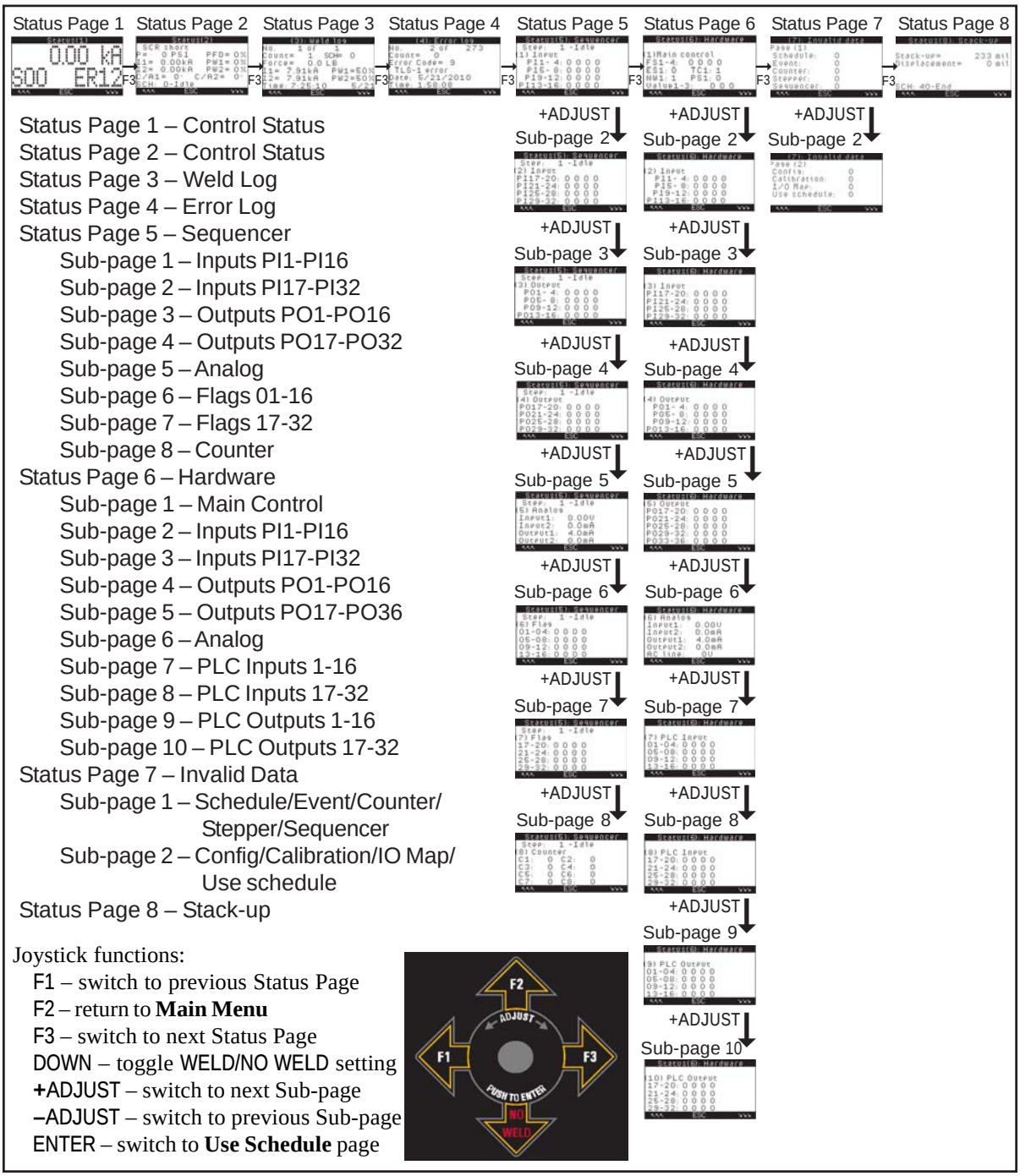


Figure 5-3. *Overview of Status Pages*

5.3.1 STATUS PAGE 1

When control is turned on, an initialization screen (Figure 5-4) will flash briefly, then **Status Page 1** will be displayed. This page displays Weld2 Current of last weld, Schedule number and Error Code(s). Error Code (ERxx) display area will be blank if no error occurs. If multiple errors occur, Error Codes will rotate continuously.

Figure 5-4. *Initialization screen*

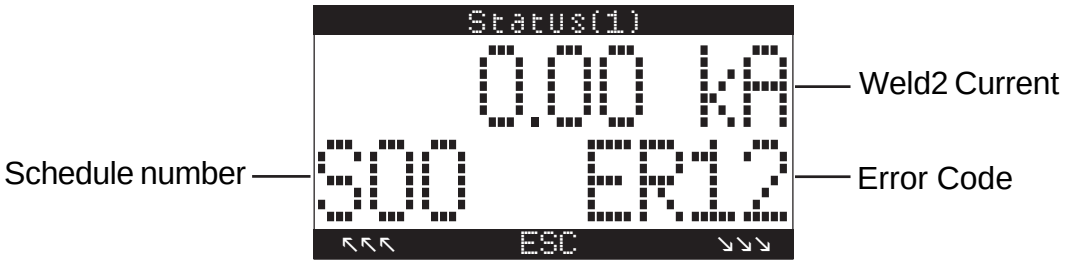


Figure 5-5. *Status Page 1*

Joystick functions for **Status Page 1**:

F1 – switch to **Status Page 8**
F2 – return to **Main Menu**
F3 – switch to **Status Page 2**
DOWN – toggle Weld/No Weld state
+ADJUST – not used on this page
–ADJUST – not used on this page
ENTER – switch to **Use Schedule** page

5.3.2 STATUS PAGE 2

Status Page 2 displays Error Code Message(s), Pressure/Force, Power Factor Delay (PFD), Weld1 Current (I1), Heat (PW1), and Conduction Angle (C/A1), Weld2 Current (I2), Heat (PW2) and Conduction Angle (C/A2) of last weld; Schedule number; and state of Schedule. Error Code Message will be blank if no error occurs. If multiple errors occur, Error Code Messages will rotate continuously.

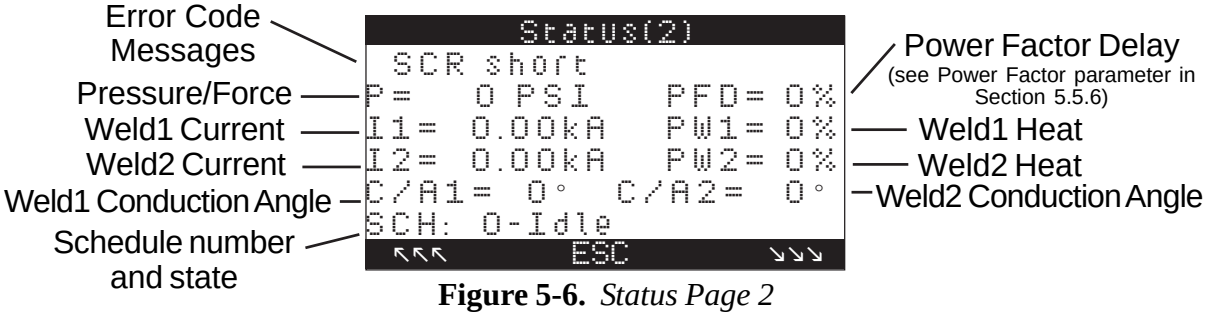


Figure 5-6. *Status Page 2*

Joystick functions for **Status Page 2**:

F1 – switch to **Status Page 1**
F2 – return to **Main Menu**
F3 – switch to **Status Page 3**
DOWN – toggle Weld/No Weld state
+ADJUST – not used on this page
–ADJUST – not used on this page
ENTER – switch to **Use Schedule** page

5.3.3 WELD LOG – STATUS PAGE 3

Status Page 3 displays one record of the **Weld Log** which includes: index number of record and total number of records in memory; Count number of Counter when weld was recorded; Schedule number; Pressure/Force value, Weld1 Current (I1), Weld1 Heat (PW1), Weld2 Current (I2) and Weld2 Heat (PW2), Time and Date of weld. If **Weld Log** memory does not have any records, this page will display No record. Use +/–ADJUST to change **Weld Log** record number displayed.

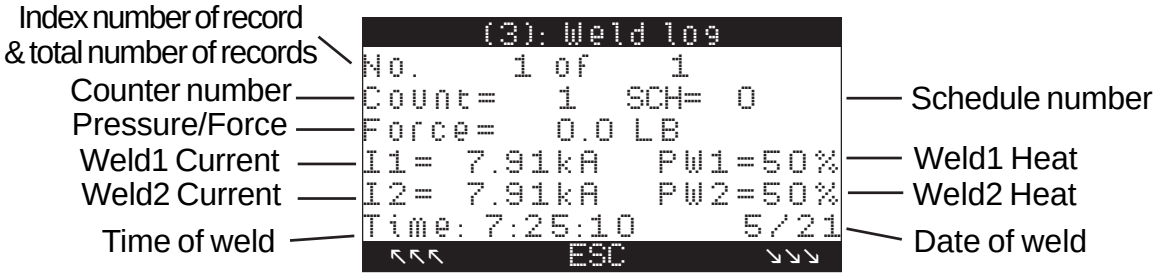


Figure 5-7. *Weld Log*

Joystick functions for **Weld Log**:

F1 – switch to **Status Page 2**
F2 – return to **Main Menu**
F3 – switch to **Status Page 4**
DOWN – toggle Weld/No Weld state
+ADJUST – select next record to display
–ADJUST – select previous record to display
ENTER – switch to **Use Schedule** page

5.3.4 ERROR LOG – STATUS PAGE 4

Status Page 4 displays one record of the **Error Log** which includes: index number of record and total number of records in memory; Count number of Counter when error was recorded; Error Code and Message, Date and Time of this error record. If **Error Log** memory does not have any records, this page will display No record. Use +/–ADJUST to change **Error Log** record number displayed.

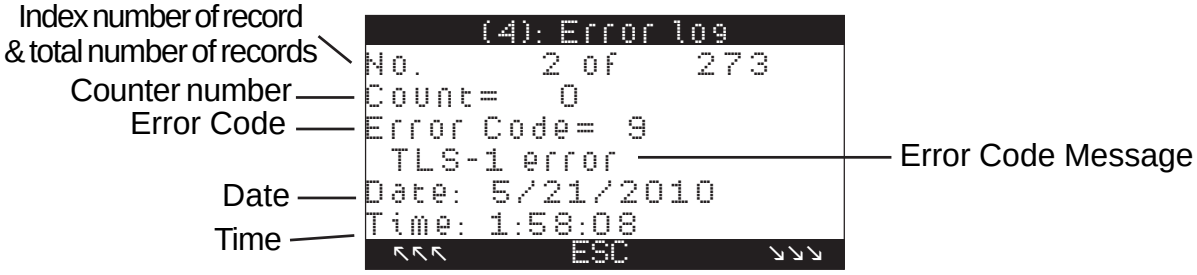


Figure 5-8. *Error Log*

Joystick functions for **Error Log**:

F1 – switch to **Status Page 3**
F2 – return to **Main Menu**
F3 – switch to **Status Page 5**
DOWN – toggle Weld/No Weld state
+ADJUST – select next record to display
–ADJUST – select previous record to display
ENTER – switch to **Use Schedule** page

5.3.5 SEQUENCER – STATUS PAGE 5

Status Page 5 displays status of **Sequencer** which includes: Step number and Sequencer state; state of Sequencer Inputs, Outputs, Analog Inputs and Outputs, and Flags; and value of Counters. Since all this information cannot be displayed on one screen, there are eight (8) sub-pages. Each sub-page displays Step number and Sequencer state (Idle, Running, End, Error) on first line of Main Display for reference, along with specific information.

Joystick functions for **Sequencer Status Page**:

F1 – switch to **Status Page 4**
F2 – return to **Main Menu**
F3 – switch to **Status Page 6**
DOWN – toggle Weld/No Weld state
+ADJUST – switch to next sub-page
–ADJUST – switch to previous sub-page
ENTER – switch to **Use Schedule** page

SUB-PAGE 1 – INPUTS PI1–PI16

This screen displays the state of Sequencer Inputs PI1 through PI16 in 4x4 grid format. Off state is indicated by **0** and On state is indicated by **1**. For line labeled **PI1-4**: in Figure 5-9, first **1** indicates Input PI1 is On, second **0** indicates Input PI2 is Off, third **0** indicates Input PI3 is Off, and fourth **0** indicates Input PI4 is Off.

Figure 5-9. *Sequencer Inputs*

SUB-PAGE 2 – INPUTS PI17–PI32

This screen displays the state of Sequencer Inputs PI17 through PI32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 1**.

SUB-PAGE 3 – OUTPUTS PO01–PO16

This screen displays the state of Sequencer Outputs PO1 through PO16 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 1**.

SUB-PAGE 4 – OUTPUTS PO17–PO32

This screen displays the state of Sequencer Outputs PO17 through PO32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 1**.

5.3.5 SEQUENCER – STATUS PAGE 5 (cont.)

SUB-PAGE 5 – ANALOG

This screen displays the state of Sequencer's two Analog Inputs and two Analog Outputs. Current and/or Voltage of each will be shown, depending on Analog Inputs/Outputs signal settings in **Configure Menu** (see Section 5.5.6).

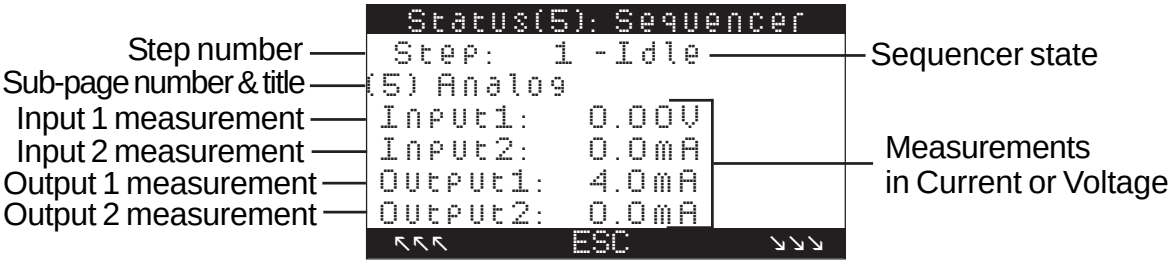


Figure 5-10. *Sequencer Analog Inputs and Outputs*

SUB-PAGE 6 – FLAGS 01–16

This screen displays the state of Sequencer Flags 01 through 16 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 1**.

SUB-PAGE 7 – FLAGS 17–32

This screen displays the state of Sequencer Flags 17 through 32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 1**.

SUB-PAGE 8 – COUNTER

This screen displays values of Sequencer Counters 1 through 8 (C1 – C8).

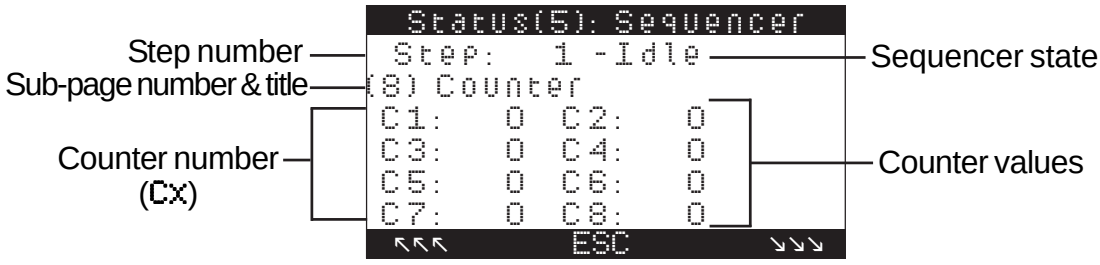


Figure 5-11. *Sequencer Counters*

5.3.6 HARDWARE – STATUS PAGE 6

Status Page 6 displays input/output status of **Hardware** ports and PLC which includes: Input state of main control signal; state of Hardware Inputs and Outputs; state of Analog Inputs and Outputs; and state of PLC Inputs and Outputs. Since all this information cannot be displayed on one screen, there are ten (10) sub-pages.

Joystick functions for **Hardware Status Page**:

F1 – switch to **Status Page 5**
F2 – return to **Main Menu**
F3 – switch to **Status Page 7**
DOWN – toggle Weld/No Weld state
+ADJUST – switch to next sub-page
–ADJUST – switch to previous sub-page
ENTER – switch to **Use Schedule** page

SUB-PAGE 1 – MAIN CONTROL

This screen displays main control signal which includes: state of FS1 through FS4, Emergency Stop (**ES1**), Temperature Limit Switch (**TC1**), Weld/No Weld (**NW1**), Pressure Switch (**PS1**) and Valves 1-3. Off state is indicated by **0** and On state is indicated by **1**.

Figure 5-12. *Main Control Status*

SUB-PAGE 2 – INPUTS PI1–PI16

This screen displays the state of Hardware Inputs PI1 through PI16 in 4x4 grid format. Off state is indicated by **0** and On state is indicated by **1**. For line labeled **PI1- 4**: in Figure 5-13, first **1** indicates Input PI1 is On, second **0** indicates Input PI2 is Off, third **0** indicates Input PI3 is Off, and fourth **0** indicates Input PI4 is Off.

Figure 5-13. *Hardware Inputs*

SUB-PAGE 3 – INPUTS PI17–32

This screen displays the state of Hardware Inputs PI17 through PI32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

5.3.6 HARDWARE – STATUS PAGE 6 (cont.)

SUB-PAGE 4 – OUTPUTS PO1–PO16

This screen displays the state of Hardware Outputs PO1 through PO16 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

SUB-PAGE 5 – OUTPUTS PO17–PO36

This screen displays the state of Hardware Outputs PO17 through PO36 in 4x5 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

SUB-PAGE 6 – ANALOG I/O AND AC LINE VOLTAGE

This screen displays the state of two Analog Inputs and two Analog Outputs. Current and/or Voltage of each will be shown, depending on Analog Inputs/Outputs signal settings in **Configure Menu** (see Section 5.5.6).

Figure 5-14. *Analog Inputs and Outputs*

SUB-PAGE 7 – PLC INPUTS 01–16

This screen displays the state of PLC Inputs 01 through 16 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

SUB-PAGE 8 – PLC INPUTS 17–32

This screen displays the state of PLC Inputs 17 through 32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

SUB-PAGE 9 – PLC OUTPUTS 01–16

This screen displays the state of PLC Outputs 01 through 16 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

SUB-PAGE 10 – PLC OUTPUTS 17–32

This screen displays the state of PLC Outputs 17 through 32 in 4x4 grid format. Appearance and description of this screen is similar to **Sub-page 2**.

5.3.7 INVALID DATA – STATUS PAGE 7

Status Page 7 displays the total amount of **invalid** parameters in each of the programming menus. Since not all menus cannot be displayed on one screen, there are two (2) sub-pages.

Joystick functions for **Invalid Data Status Page**:

F1 – switch to **Status Page 6**
F2 – return to **Main Menu**
F3 – switch to **Status Page 8**
DOWN – toggle Weld/No Weld state
+ADJUST – switch to next sub-page
–ADJUST – switch to previous sub-page
ENTER – switch to **Use Schedule** page

SUB-PAGE 1

This screen displays the total amount of invalid parameters for Schedule, Event, Counter, Stepper, and Sequencer menus.

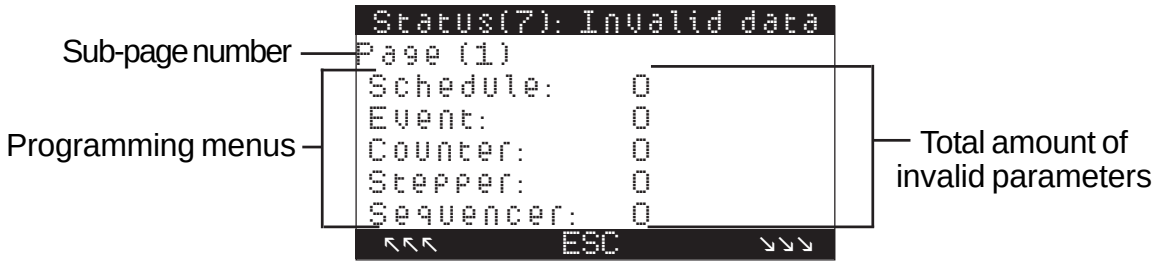


Figure 5-15. *Invalid Data Sub-page 1*

SUB-PAGE 2

This screen displays the total amount of invalid parameters for Configuration, Calibration, I/O Map and Use Schedule menus.

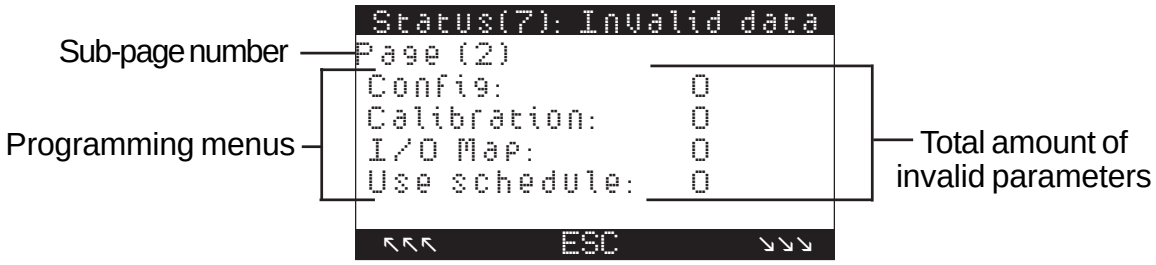


Figure 5-16. *Invalid Data Sub-page 2*

5.3.8 STACK-UP – STATUS PAGE 8

Status Page 8 displays **Stack-up** Thickness value and Displacement value after each weld. These values are measured when using LDT Sensor Option (see Section 10.15).

When control is in PRE-SQUEEZE or SQUEEZE step, Stack-up parameter displays the real-time stack-up thickness value. When control is past the end of SQUEEZE step, Stack-up parameter displays the thickness value at the end of SQUEEZE.

Displacement parameter displays the stack-up thickness difference between the end of HOLD time and the end of SQUEEZE time, as calculated by following equation:

Displacement = (Stack-up thickness at end of HOLD) – (Stack-up thickness at end of SQUEEZE)

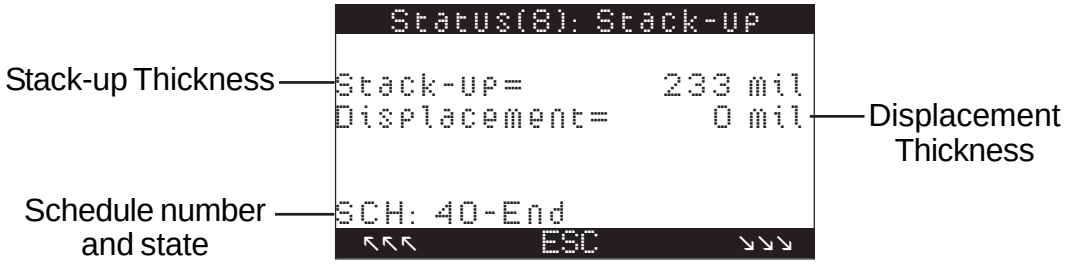


Figure 5-17. *Stack-up Status Page*

Joystick functions for **Stack-up Status Page**:

F1 – switch to **Status Page 7**
F2 – return to **Main Menu**
F3 – switch to **Status Page 1**
DOWN – toggle Weld/No Weld state
+ADJUST – switch to next sub-page
–ADJUST – switch to previous sub-page
ENTER – switch to **Use Schedule** page

5.4 USE SCHEDULE PAGE

The **Use Schedule** page is used to display and/or input SCHEDULE number assigned to Start 1 initiation.

Figure 5-18. *Use Schedule page*

Joystick functions for **Use Schedule Page**:

F1 – not used on this page
F2 – return to **Status** pages
F3 – not used on this page
DOWN – toggle Weld/No Weld state
+ADJUST – increase Schedule number
–ADJUST – decrease Schedule number
ENTER – accept/save Schedule number

There are two SCHEDULE SELECT modes – Internal and External – which are set in **Configure Menu** (see Section 5.5.6).

When SCHEDULE SELECT mode for Start 1 is Internal, SCHEDULE number selected for Start 1 is displayed on this page. Use **+/–ADJUST** to change to desired SCHEDULE number (0–99 SCHEDULES are available) and push ENTER to save new SCHEDULE number.

If SCHEDULE SELECT mode for Start 1 is External, External will be displayed in place of SCHEDULE number. This indicates that SCHEDULE number assigned for Start 1 will be input by binary Schedule Select Inputs 1–7 (pins P3-12 through P3-18) (see Section 9.7.2).

5.5 MAIN MENU

The **Main Menu** consists of 10 menus for programming various features/functions of the EN6021. These menus set and/or display the wide variety of parameters available with this control. Each menu is explained in detail in the following sections:

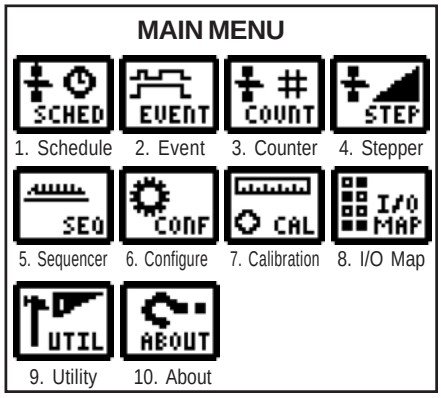


Figure 5-19. *Main Menu selections*

1.	Schedule	Section 5.5.1
2.	Event	Section 5.5.2
3.	Counter	Section 5.5.3
4.	Stepper	Section 5.5.4
5.	Sequencer	Section 5.5.5
6.	Configure	Section 5.5.6
7.	Calibration	Section 5.5.7
8.	I/O Map	Section 5.5.8
9.	Utility	Section 5.5.9
10.	About	Section 5.5.10

Each menu is displayed by an icon. Use F1 and F3 to select desired menu, then push ENTER to access selected menu. When menu is selected, its icon is inverted and Title Section displays selected menu's title.

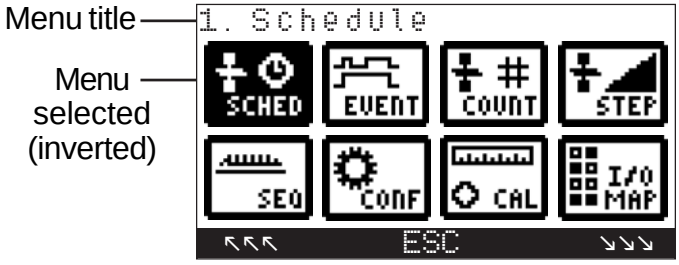


Figure 5-20. *Selecting Menus*

Joystick functions for **Main Menu**:

F1 – select previous menu
F2 – return to **Status** pages
F3 – select next menu
DOWN – toggle Weld/No Weld state
+ADJUST – not used on this page
–ADJUST – not used on this page
ENTER – access selected menu

5.5.1 SCHEDULE MENU

The EN6021 can store up to 100 schedules, numbered from 0 to 99. A weld sequence may include more than one schedule by chaining schedules together. The **Schedule Menu** is used to display and/or modify individual weld schedules, which include the parameters explained in this section. Some parameters are not displayed if their related functions are disabled. Main Display will show six (6) lines of menu at a time. As F1 and F3 are used to switch to parameters at top and bottom of display, previous/next parameters will disappear/appear from display.

Joystick functions for **Schedule Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

5.5.1 SCHEDULE MENU (cont.)

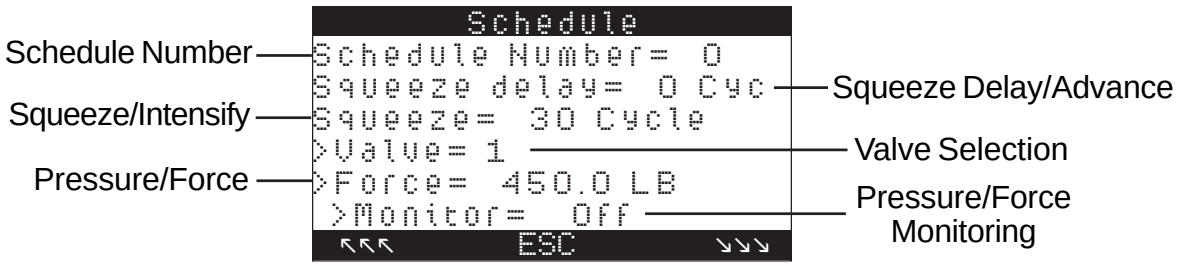


Figure 5-21. *Schedule Menu – Sample Display 1*

SCHEDULE NUMBER

SCHEDULE NUMBER indicates which weld schedule and its settings are currently displayed on screen. To load a different weld schedule for display or editing, change this number using **+/–**ADJUST and push ENTER to save new schedule and display its settings. Range of programmable values for this parameter is 0 – 99 schedules. If control is turned off or loses power, control memorizes selected SCHEDULE NUMBER and returns to that schedule when **Schedule Menu** is accessed after power is restored.

SQUEEZE DELAY / ADVANCE

This parameter is used for two different functions depending on configuration of valves (see Section 5.5.6). When control uses regular valves (Air-over-oil set to **Off**), **Squeeze Delay** will be displayed. If control is configured for Air-over-oil valve, **Advance** will be displayed. Range of programmable values for this parameter is 0 – 99 cycles.

The **SQUEEZE DELAY** function is a pre-squeeze which energizes desired valves for programmed interval of time in cycles (60 cycles = 1 second). It occurs **after** initiation and immediately **before** first SQUEEZE is executed (a form of retraction to position electrodes closer to the work in a Repeat sequence – see CYCLE MODE in this section).

NOTICE
SQUEEZE DELAY occurs only before the first SQUEEZE time when in Repeat mode.

If control is configured for Air-over-oil operation, this parameter indicates programmed interval of time (in cycles) for **ADVANCE** state.

SQUEEZE / INTENSIFY

SQUEEZE indicates programmed time interval (in cycles) for electrodes to close on part being welded and build up pressure before WELD time begins. Range of programmable values for this parameter is 0 – 99 cycles. There are several parameters associated with SQUEEZE function (indicated by **>** at beginning of subsequent display lines) – VALVE selection, PRESSURE/FORCE and related monitoring and sensing functions.

If control is configured for Air-over-oil operation, this parameter indicates programmed interval of time (in cycles) for **INTENSIFY** state.

5.5.1 SCHEDULE MENU (cont.)

VALVE SELECTION

The **VALVE** parameter indicates the combination of three (3) cylinder valves to be activated during SQUEEZE time.

Programming values:

None	No cylinder valve selected
1	Valve 1 selected
2	Valve 2 selected
1+2	Valve 1 & Valve 2 selected
3	Valve 3 selected
1+3	Valve 1 & Valve 3 selected
2+3	Valve 2 & Valve 3 selected
1+2+3	Valve 1 & Valve 2 & Valve 3 selected

PRESSURE/FORCE

The **PRESSURE/FORCE** parameter sets pressure or force for Proportional Valve during SQUEEZE time. The unit of this parameter will be PSI, Lb, or mA depending on FORCE UNIT setting in **Configure Menu** (see Section 5.5.6). If FORCE UNIT is set to **PSI** or **mA**, **Pressure** will be displayed. If FORCE UNIT is set to **Lb** or **Calibrated Lb**, **Force** will be displayed.

Range of programmable values:
- 0 – 100 PSI
- 0.0 – 7850.0 Lb (0.5 increments only)
- 4.0 – 20.0 mA

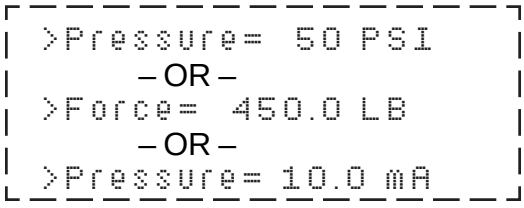


Figure 5-22. *PRESSURE/FORCE units sample values*

For further explanation of Pressure Sense and Control System, see Section 9.12. The EN6021 uses a 0–100 PSI Pressure Sensor for PRESSURE/FORCE SENSING. When Sensor senses 0–100 PSI pressure, it will output 4–20 mA current. The control calculates pressure value using following equation:

$$\text{Force} = \text{Pressure} \times \text{Area of cylinder} = \text{Pressure} \times \frac{\pi \times D^2}{4}$$

In the equation, D equals inside diameter of cylinder. The inside diameter of cylinder is programmed using CYLINDER DIAMETER parameter in **Configure Menu** (see Section 5.5.6). When inside diameter changes, maximum value of FORCE changes.

PRESSURE/FORCE MONITORING

This **MONITOR** parameter indicates if control will monitor **PRESSURE/FORCE** value.

Programmable values:
- Off — PRESSURE/FORCE MONITOR function not active
- On — PRESSURE/FORCE MONITOR function is active

If this parameter is set to On, at end of SQUEEZE time, control will compare PRESSURE/FORCE value with PRESSURE/FORCE HIGH LIMIT and LOW LIMIT settings. If PRESSURE/FORCE is larger than or equal to HIGH LIMIT, control will report High Pressure/Force Error (**ER17**). If PRESSURE/FORCE is smaller than or equal to LOW LIMIT, control will report Low Pressure/Force Error (**ER18**).

5.5.1 SCHEDULE MENU (cont.)

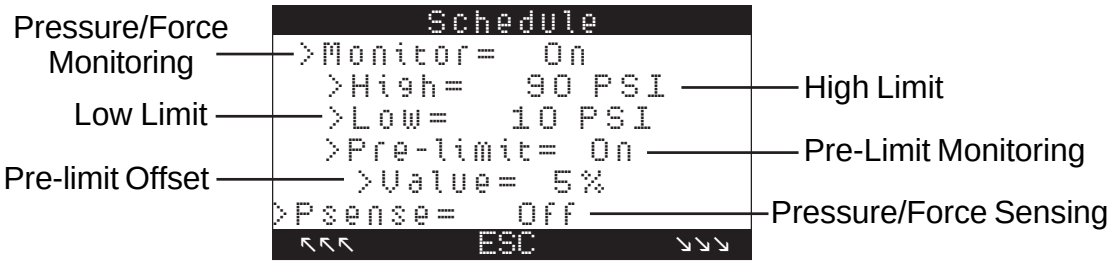


Figure 5-23. *PRESSURE/FORCE MONITORING*

HIGH LIMIT FOR PRESSURE/FORCE MONITORING

This parameter sets **HIGH LIMIT** value for **PRESSURE/FORCE MONITORING** function. Maximum value of this parameter depends on FORCE UNIT setting in **Configure Menu** and, if FORCE UNIT is Lb or Calibrated Lb, the inside cylinder diameter (see Section 5.5.6).

Range of programmable values: 0 – 100 PSI
0.0 – 7850.0 Lb (0.5 increments only)
4.0 – 20.0 mA

This option will be hidden if **PRESSURE/FORCE MONITORING** function is Off.

LOW LIMIT FOR PRESSURE/FORCE MONITORING

This parameter sets **LOW LIMIT** value for **PRESSURE/FORCE MONITORING** function. Maximum value of this parameter depends on FORCE UNIT setting in **Configure Menu** and, if FORCE UNIT is Lb or Calibrated Lb, the inside cylinder diameter (see Section 5.5.6).

Range of programmable values: 0 – 100 PSI
0.0 – 7850.0 Lb (0.5 increments only)
4.0 – 20.0 mA

This option will be hidden if **PRESSURE/FORCE MONITORING** function is Off.

PRESSURE/FORCE PRE-LIMIT MONITORING

This parameter indicates if control will monitor **PRESSURE/FORCE** value and compare it with **PRE-LIMIT** value.

Programmable values:	Off	PRESSURE/FORCE PRE-LIMIT function not active
	On	PRESSURE/FORCE PRE-LIMIT function is active

If both PRE-LIMIT and PRESSURE/FORCE MONITORING are On, at end of SQUEEZE time, control will compare PRESSURE/FORCE value with PRESSURE/FORCE PRE-HIGH LIMIT and PRE-LOW LIMIT setting. If PRESSURE/FORCE is larger than or equal to PRE-HIGH LIMIT, control will report High Pressure/Force Pre-limit Error (ER49). If PRESSURE/FORCE is smaller than or equal to PRE-LOW LIMIT, control will report Low Pressure/Force Pre-limit Error (ER50).

PRESSURE/FORCE PRE-LIMIT MONITORING (cont.)

PRESSURE/FORCE PRE-HIGH LIMIT value is calculated using following equation:

PRE-HIGH LIMIT = HIGH LIMIT x (1 – PRE-LIMIT OFFSET)

PRESSURE/FORCE PRE-LOW LIMIT value is calculated using following equation:

PRE-LOW LIMIT = LOW LIMIT x (1 + PRE-LIMIT OFFSET)

HIGH LIMIT value is set in **High** parameter and LOW LIMIT value is set in **Low** parameter when PRESSURE/FORCE MONITORING is On. PRE-LIMIT OFFSET value is set in **Value** parameter (see PRE-LIMIT OFFSET FOR PRESSURE/FORCE PRE-LIMIT MONITORING discussion below) when PRESSURE/FORCE PRE-LIMIT MONITORING is On.

Example: If – FORCE HIGH LIMIT = 2000 Lb and LOW LIMIT = 1000 Lb, and PRE-LIMIT OFFSET = 10%,
Then – FORCE PRE-HIGH LIMIT = 2000 x (1 – .10) = 1800 Lb
FORCE PRE-LOW LIMIT = 1000 x (1 + .10) = 1100 Lb

This parameter is hidden if **PRESSURE/FORCE MONITORING** function is Off.

PRE-LIMIT OFFSET FOR PRESSURE/FORCE PRE-LIMIT MONITORING (Value)

This parameter sets **PRE-LIMIT OFFSET** value (in %) for **PRESSURE/FORCE PRE-LIMIT MONITORING** function. Its use is described in **PRESSURE/FORCE PRE-LIMIT MONITORING** discussion. Range of programmable values for this parameter is 0 – 99%.

This parameter is hidden if **PRESSURE/FORCE MONITORING** function is Off or **PRESSURE/FORCE PRE-LIMIT MONITORING** is Off.

PRESSURE/FORCE SENSING (Psense)

This parameter indicates if control will compare Sensor output with **PRESSURE/FORCE TRIGGER** value (see **TRIGGER VALUE FOR PRESSURE/FORCE SENSING**).

Programming values:	Off	PRESSURE/FORCE SENSING function not active
	Rising edge	Sensor output value smaller than TRIGGER
	Falling edge	Sensor output value larger than TRIGGER

If PRESSURE/FORCE SENSING is set to **Off**, at end of SQUEEZE, control will not check Sensor output and jump directly to next step in current SCHEDULE.

If PRESSURE/FORCE SENSING is set to **Rising edge**, at end of SQUEEZE, control will compare Sensor output value with TRIGGER value. If value is larger than or equal to TRIGGER, control will jump to next step. If value is smaller than TRIGGER, control will wait for value to equal to TRIGGER and then jump to next step. During waiting period, control will report Proportional Valve not ready Flag (**ER95**). If waiting time is longer than 60 seconds, control will jump to OFF state and report Proportional Valve Error (**ER15**).

PRESSURE/FORCE SENSING (cont.)

If PRESSURE/FORCE SENSING is set to **Falling edge**, at end of SQUEEZE, control will compare Sensor output value with TRIGGER value. If value is smaller than or equal to TRIGGER, control will jump to next step. If value is larger than TRIGGER, control will wait for value to equal TRIGGER and then jump to next step. During waiting period, control will report Proportional Valve not ready Flag (**ER95**). If waiting time is longer than 60 seconds, control will jump to OFF state and report Proportional Valve Error (**ER15**).

TRIGGER VALUE FOR PRESSURE/FORCE SENSING (Value)

This parameter sets **TRIGGER** value for **PRESSURE/FORCE SENSING** function. Maximum value of this parameter depends on FORCE UNIT setting in **Configure Menu** and, if FORCE UNIT is Lb or Calibrated Lb, the inside cylinder diameter (see Section 5.5.6).

Range of Programming values:
- 0 – 100 PSI
- 0.0 – 7850.0 Lb (0.5 increments only)
- 4.0 – 20.0 mA

This option will be hidden if **PRESSURE/ FORCE SENSING** function is Off.

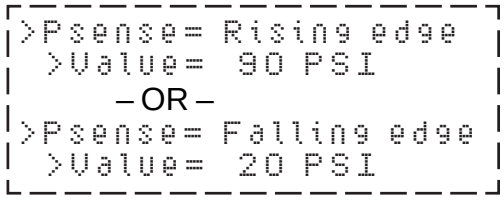


Figure 5-24.
PRESSURE/FORCE SENSING

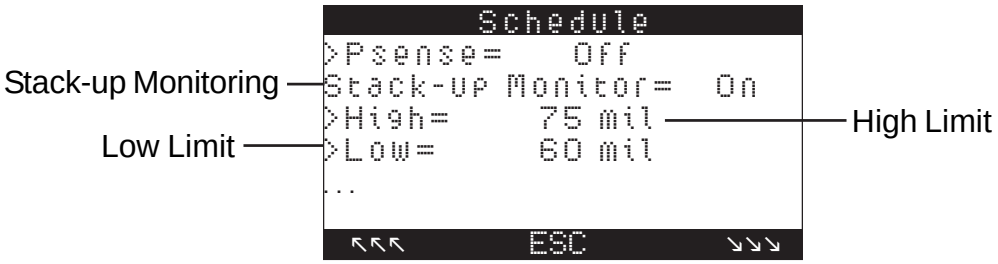


Figure 5-25. *STACK-UP MONITORING*

STACK-UP MONITORING

This **STACK-UP MONITOR** parameter indicates if control will monitor **STACK-UP** value.

Programmable values:	Off	STACK-UP MONITOR function not active
	On	STACK-UP MONITOR function is active

This parameter is used in conjunction with LDT Sensor Option (see Section 10.15). If this parameter is set to On, at end of SQUEEZE time, control will compare STACK-UP thickness value with STACK-UP HIGH LIMIT and LOW LIMIT settings. If STACK-UP thickness value is larger than or equal to HIGH LIMIT, control will report High Stack-up Error (**ER55**). If STACK-UP thickness value is smaller than or equal to LOW LIMIT, control will report Low Stack-up Error (**ER56**).

HIGH LIMIT FOR STACK-UP MONITORING

This parameter sets **HIGH LIMIT** value for **STACK-UP MONITORING** function. Range of programmable values for this parameter is 0 – 10000 mil. This option will be hidden if **STACK-UP MONITORING** function is Off.

LOW LIMIT FOR STACK-UP MONITORING

This parameter sets **LOW LIMIT** value for **STACK-UP MONITORING** function. Range of programmable values for this parameter is 0 – 10000 mil. This option will be hidden if **STACK-UP MONITORING** function is Off.

WELD 1

WELD1 indicates programmed time (in cycles) during which current will flow through welding transformer. Range of programmable values for this parameter is 0 – 99 cycles. There are several parameters associated with WELD1 function (indicated by > at beginning of subsequent display lines) – CURRENT REGULATION MODE, CURRENT and PULSE WIDTH MONITORING.

WELD1 CURRENT REGULATION MODE

This parameter sets **CURRENT REGULATION MODE** for **WELD1** function. There are two modes available – **Phase Shift** and **Constant Current**.

If this parameter is set to **Phase Shift** mode, control will output fixed pulse width for each cycle of WELD1 step. This value is set in **HEAT** parameter.

HEAT SETTING FOR WELD1

This parameter sets target pulse width value for WELD1 if **CURRENT REGULATION** is set to **Phase Shift**. Pulse width is percentage of maximum **HEAT** which control can output. Range of programmable values for this parameter is 0 – 99%. This parameter is hidden if **CURRENT REGULATION** is set to **Constant Current** mode.

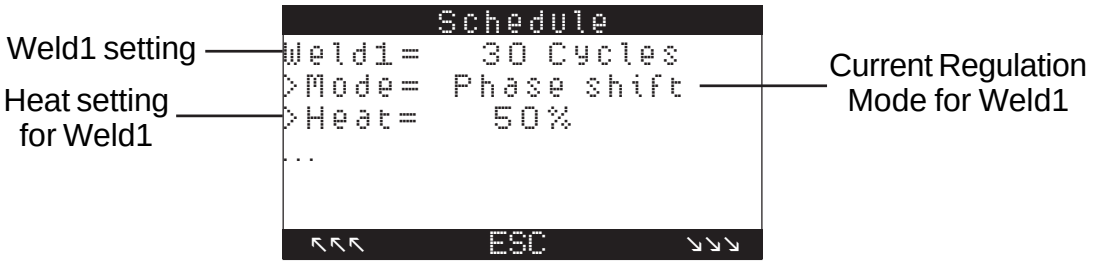


Figure 5-26. *WELD1 in Phase Shift mode*

If **CURRENT REGULATION MODE** is set to **Constant Current**, control will adjust pulse width of output current on each WELD1 cycle to maintain target constant current. This target current value is set in **CURRENT** parameter.

CURRENT SETTING FOR WELD1

This parameter sets target **CURRENT** value for WELD1 if **CURRENT REGULATION** is set to **Constant Current**. Range of programmable values is 0.00 – 99.99 kA. Parameter is hidden if **CURRENT REGULATION** is set to **Phase Shift** mode.

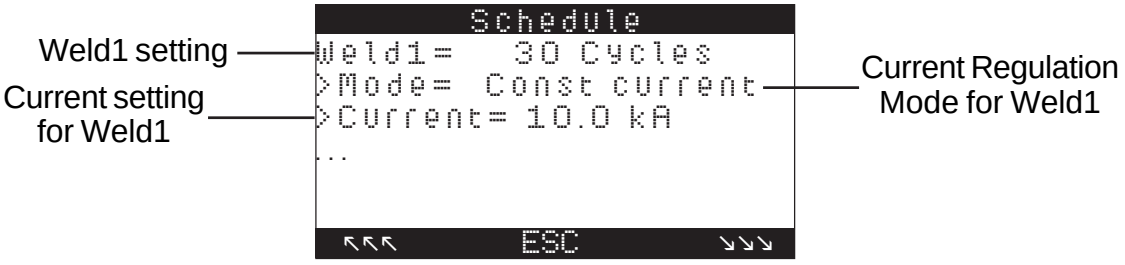


Figure 5-27. *WELD1 in Constant Current mode*

NOTICE

When cursor is on HEAT or CURRENT parameter for either WELD1 or WELD2 and initiation is held to end of weld, Help Section will display value of current for each weld (I1=***xx.x*** kA and I2=***xx.x*** kA). This function is useful for programming.

5.5.1 SCHEDULE MENU (cont.)

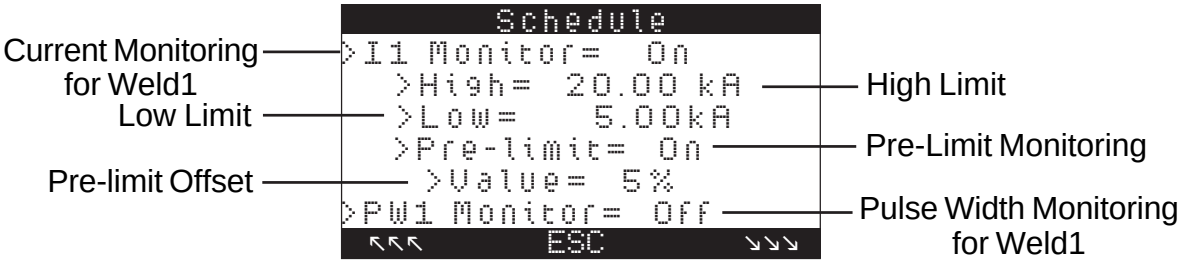


Figure 5-28. *CURRENT MONITORING for WELD1*

CURRENT MONITORING FOR WELD1 (I1 Monitor)

This parameter indicates if control will monitor average current for WELD1.

Programming values:	Off	WELD1 CURRENT MONITOR function not active
	On	WELD1 CURRENT MONITORfunction is active

If this parameter is On, at end of WELD1, control will compare average current of WELD1 with WELD1 HIGH LIMIT and LOW LIMIT settings. If average current is larger than or equal to HIGH LIMIT, control will report High Current 1 Error (ER19). If average current is smaller than or equal to LOW LIMIT, control will report Low Current 1 Error (ER20).

HIGH LIMIT FOR WELD1 CURRENT MONITORING

This parameter sets **HIGH LIMIT** value for **WELD1 CURRENT MONITORING** function. Range of programmable values for this parameter is 0.00 – 99.99 kA.

This option will be hidden if **WELD1 CURRENT MONITORING** function is Off.

LOW LIMIT FOR WELD1 CURRENT MONITORING

This parameter sets **LOW LIMIT** value for **WELD1 CURRENT MONITORING** function. Range of programmable values for this parameter is 0.00 – 99.99 kA.

This option will be hidden if **WELD1 CURRENT MONITORING** function is Off.

CURRENT PRE-LIMIT MONITORING FOR WELD1

This parameter indicates if control will monitor average current value for WELD1 and compare it with **PRE-LIMIT** value.

Programmable values:	Off	WELD1 CURRENT PRE-LIMIT function not active
	On	WELD1 CURRENT PRE-LIMIT function is active

If both PRE-LIMIT and WELD1 CURRENT MONITORING are On, at end of WELD1, control will compare average current value with WELD1 CURRENT PRE-HIGH LIMIT and PRE-LOW LIMIT settings. If average current is larger than or equal to PRE-HIGH LIMIT, control will report High Current 1 Pre-limit Error (ER51). If average current is smaller than or equal to PRE-LOW LIMIT, control will report Low Current 1 Pre-limit Error (ER52).

WELD1 CURRENT PRE-HIGH LIMIT value is calculated using following equation:

PRE-HIGH LIMIT = HIGH LIMIT x (1 – PRE-LIMIT OFFSET)

WELD1 CURRENT PRE-LOW LIMIT value is calculated using following equation:

PRE-LOW LIMIT = LOW LIMIT x (1 + PRE-LIMIT OFFSET)

CURRENT MONITORING FOR WELD1 (cont.)

HIGH LIMIT value is set in **High** parameter and LOW LIMIT value is set in **Low** parameter when WELD1 CURRENT MONITORING is On. PRE-LIMIT OFFSET value is set in **Value** parameter (see PRE-LIMIT OFFSET FOR WELD1 CURRENT PRE-LIMIT MONITORING discussion below) when WELD1 CURRENT PRE-LIMIT MONITORING is On.

Example: If – WELD1 CURRENT HIGH LIMIT=60.00 kA and LOW LIMIT=40.00 kA, and PRE-LIMIT OFFSET = 10%,
Then – WELD1 CURRENT PRE-HIGH LIMIT=60.00 x (1 – .10) = 54.00 kA
WELD1 CURRENT PRE-LOW LIMIT=40.00 x (1 + .10) = 44.00 kA

This parameter is hidden if **WELD1 CURRENT MONITORING** function is Off.

PRE-LIMIT OFFSET FOR WELD1 CURRENT PRE-LIMIT MONITORING

This parameter sets **PRE-LIMIT OFFSET** value (in %) for **WELD1 CURRENT PRE-LIMIT MONITORING** function. Its use is described in **CURRENT PRE-LIMIT MONITORING FOR WELD1** discussion. Range of programmable values for this parameter is 0 – 99%.

This parameter is hidden if **WELD1 CURRENT MONITORING** function is Off or **WELD1 CURRENT PRE-LIMIT MONITORING** is Off.

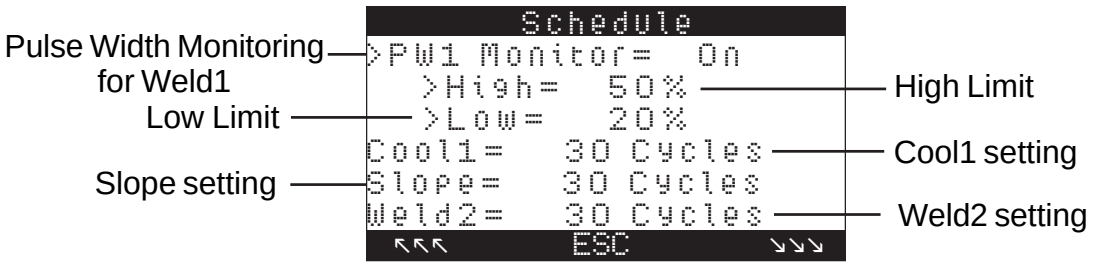


Figure 5-29. *PULSE WIDTH MONITORING for WELD1*

PULSE WIDTH MONITORING FOR WELD1 (PW1 Monitor)

This parameter indicates if control will monitor average pulse width for WELD1.

Programming values:	Off	WELD1 PULSE WIDTH MONITORING function not active
	On	WELD1 PULSE WIDTH MONITORING function is active

If this parameter is On, at end of WELD1, control will compare average pulse width of WELD1 with WELD1 HIGH LIMIT and LOW LIMIT settings. If average pulse width is larger than or equal to HIGH LIMIT, control will report High Pulse Width 1 Error (**ER27**). If average pulse width is smaller than or equal to LOW LIMIT, control will report Low Pulse Width 1 Error (**ER28**).

HIGH LIMIT FOR PULSE WIDTH MONITORING

This parameter sets **HIGH LIMIT** value for **WELD1 PULSE WIDTH MONITORING** function. Range of programmable values for this parameter is 0 – 99%.

This option will be hidden if **WELD1 PULSE WIDTH MONITORING** function is Off.

5.5.1 SCHEDULE MENU (cont.)

LOW LIMIT FOR PULSE WIDTH MONITORING

This parameter sets **LOW LIMIT** value for **WELD1 PULSE WIDTH MONITORING** function. Range of programmable values for this parameter is 0 – 99%.

This option will be hidden if **WELD1 PULSE WIDTH MONITORING** function is Off.

COOL 1

COOL1 indicates programmed time (in cycles) between heat impulses in multiple impulse welding for WELD1. Range of programmable values for this parameter is 0 – 99 cycles.

SLOPE

SLOPE indicates number of additional WELD1 cycles during which current increases or decreases to achieve SLOPE (gradual increase or decrease in current). Range of programmable values for this parameter is 0 – 99 cycles. See Section 9.1.4 for more details regarding SLOPE function.

WELD 2

WELD2 indicates programmed time (in cycles) during which current will flow through welding transformer. Range of programmable values for this parameter is 0 – 99 cycles. There are several parameters associated with WELD2 function (indicated by > at beginning of subsequent display lines) – CURRENT REGULATION MODE, CURRENT and PULSE WIDTH MONITORING.

WELD2 CURRENT REGULATION MODE

This parameter sets **CURRENT REGULATION MODE** for **WELD2** function. There are two modes available – **Phase Shift** and **Constant Current**.

If this parameter is set to **Phase Shift** mode, control will output fixed pulse width for each cycle of WELD2 step. This value is set in **HEAT** parameter.

HEAT SETTING FOR WELD2

This parameter sets target pulse width value for WELD2 if **CURRENT REGULATION** is set to **Phase Shift**. Pulse width is percentage of maximum **HEAT** which control can output. Range of programmable values for this parameter is 0 – 99%. This parameter is hidden if **CURRENT REGULATION** is set to **Constant Current** mode.

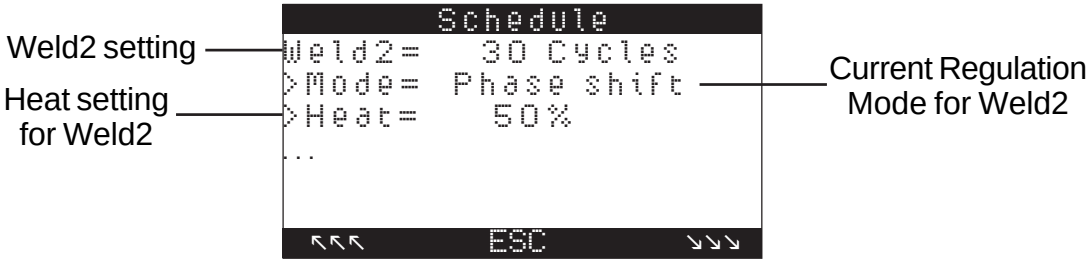


Figure 5-30. *WELD2 in Phase Shift mode*

If **CURRENT REGULATION MODE** is set to **Constant Current**, control will adjust pulse width of output current on each WELD2 cycle to maintain target constant current. This target current value is set in **CURRENT** parameter.

5.5.1 SCHEDULE MENU (cont.)

CURRENT SETTING FOR WELD2

This parameter sets target **CURRENT** value for WELD2 if **CURRENT REGULATION** is set to Constant Current. Range of programmable values for this parameter is 0.00 – 99.99 kA. This parameter is hidden if **CURRENT REGULATION** is set to Phase Shift mode.

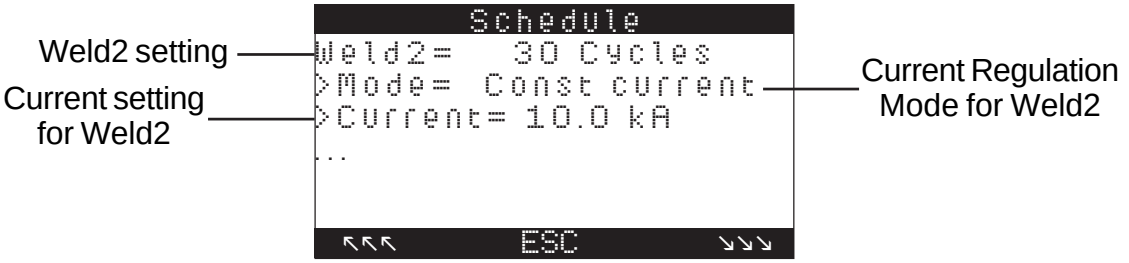


Figure 5-31. *WELD2 in Constant Current mode*

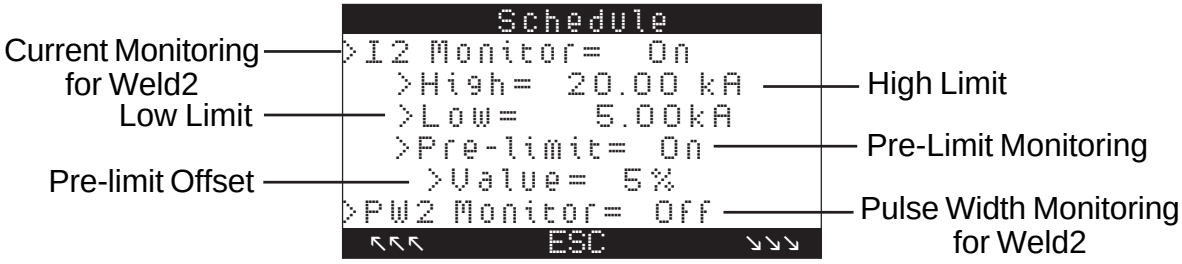


Figure 5-32. *CURRENT MONITORING for WELD2*

CURRENT MONITORING FOR WELD2 (I2 Monitor)

This parameter indicates if control will monitor average current for WELD2.

Programming values:	Off	WELD2 CURRENT MONITORING function not active
	On	WELD2 CURRENT MONITORING function is active

If this parameter is On, at end of WELD2, control will compare average current of WELD2 with WELD2 HIGH LIMIT and LOW LIMIT settings. If average current is larger than or equal to HIGH LIMIT, control will report High Current 2 Error (ER21). If average current is smaller than or equal to LOW LIMIT, control will report Low Current 2 Error (ER22).

HIGH LIMIT FOR WELD2 CURRENT MONITORING

This parameter sets **HIGH LIMIT** value for **WELD2 CURRENT MONITORING** function. Range of programmable values for this parameter is 0.00 – 99.99 kA.

This option will be hidden if **WELD2 CURRENT MONITORING** function is Off.

LOW LIMIT FOR WELD2 CURRENT MONITORING

This parameter sets **LOW LIMIT** value for **WELD2 CURRENT MONITORING** function. Range of programmable values for this parameter is 0.00 – 99.99 kA.

This option will be hidden if **WELD2 CURRENT MONITORING** function is Off.

CURRENT PRE-LIMIT MONITORING FOR WELD2

This parameter indicates if control will monitor average current value for WELD2 and compare it with **PRE-LIMIT** value.

Programmable values:	Off	WELD2 CURRENT PRE-LIMIT function not active
	On	WELD2 CURRENT PRE-LIMIT function is active

If both PRE-LIMIT and WELD2 CURRENT MONITORING are On, at end of WELD2, control will compare average current value with WELD2 CURRENT PRE-HIGH LIMIT and PRE-LOW LIMIT settings. If average current is larger than or equal to PRE-HIGH LIMIT, control will report High Current 2 Pre-limit Error (ER53). If average current is smaller than or equal to PRE-LOW LIMIT, control will report Low Current 2 Pre-limit Error (ER54).

WELD2 CURRENT PRE-HIGH LIMIT value is calculated using following equation:

PRE-HIGH LIMIT = HIGH LIMIT x (1 – PRE-LIMIT OFFSET)

WELD2 CURRENT PRE-LOW LIMIT value is calculated using following equation:

PRE-LOW LIMIT = LOW LIMIT x (1 + PRE-LIMIT OFFSET)

HIGH LIMIT value is set in High parameter and LOW LIMIT value is set in Low parameter when WELD2 CURRENT MONITORING is On. PRE-LIMIT OFFSET value is set in Value parameter (see PRE-LIMIT OFFSET for WELD2 CURRENT PRE-LIMIT MONITORING discussion below) when WELD2 CURRENT PRE-LIMIT MONITORING is On.

Example: If – WELD2 CURRENT HIGH LIMIT=60.00 kA and LOW LIMIT=40.00 kA, and PRE-LIMIT OFFSET = 10%,
Then – WELD2 CURRENT PRE-HIGH LIMIT=60.00 x (1 – .10) = 54.00 kA
WELD2 CURRENT PRE-LOW LIMIT=40.00 x (1 + .10) = 44.00 kA

This parameter is hidden if **WELD2 CURRENT MONITORING** function is Off.

PRE-LIMIT OFFSET FOR WELD2 CURRENT PRE-LIMIT MONITORING

This parameter sets **PRE-LIMIT OFFSET** value (in %) for **WELD2 CURRENT PRE-LIMIT MONITORING** function. Its use is described in **CURRENT PRE-LIMIT MONITORING FOR WELD2** discussion. Range of programmable values for this parameter is 0 – 99%.

This parameter is hidden if **WELD2 CURRENT MONITORING** function is Off or **WELD2 CURRENT PRE-LIMIT MONITORING** is Off.

5.5.1 SCHEDULE MENU (cont.)

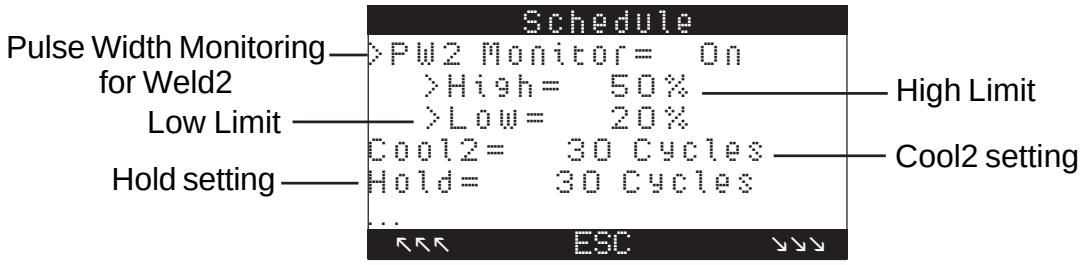


Figure 5-33. *PULSE WIDTH MONITORING for WELD2*

PULSE WIDTH MONITORING FOR WELD2 (PW1 Monitor)

This parameter indicates if control will monitor average pulse width for WELD2.

Programming values:	Off	WELD2 PULSE WIDTH MONITORING function not active
	On	WELD2 PULSE WIDTH MONITORING function is active

If this parameter is On, at end of WELD2, control will compare average pulse width of WELD2 with WELD2 HIGH LIMIT and LOW LIMIT settings. If average pulse width is larger than or equal toHIGH LIMIT, control will report High Pulse Width 2 Error (ER29). If average pulse width is smaller than or equal to LOW LIMIT, control will report Low Pulse Width 2 Error (ER30).

HIGH LIMIT FOR PULSE WIDTH MONITORING

This parameter sets **HIGH LIMIT** value for **WELD2 PULSE WIDTH MONITORING** function. Range of programmable values for this parameter is 0 – 99%.

This option will be hidden if **WELD2 PULSE WIDTH MONITORING** function is Off.

LOW LIMIT FOR PULSE WIDTH MONITORING

This parameter sets **LOW LIMIT** value for **WELD2 PULSE WIDTH MONITORING** function. Range of programmable values for this parameter is 0 – 99%.

This option will be hidden if **WELD2 PULSE WIDTH MONITORING** function is Off.

COOL 2

COOL2 indicates programmed time (in cycles) between heat impulses in multiple impulse welding for WELD2. Range of programmable values for this parameter is 0 – 99 cycles.

HOLD

HOLD indicates programmed time (in cycles) during which the electrodes will remain in contact with part being welded to allow weld nugget to congeal. Range of programmable values for this parameter is 0 – 99 cycles.

5.5.1 SCHEDULE MENU (cont.)

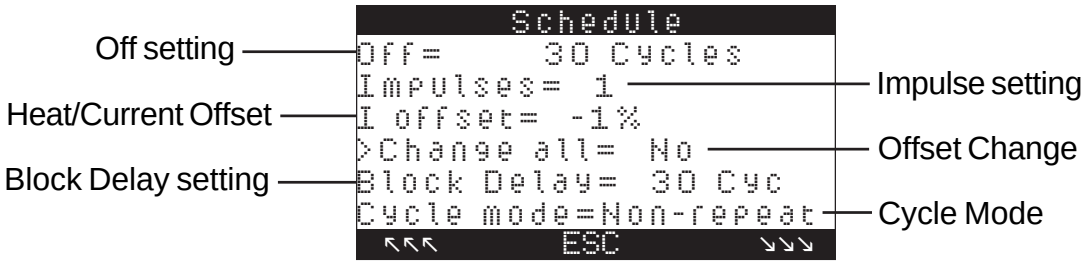


Figure 5-34. *Schedule Menu – Sample display 2*

OFF

OFF indicates programmed time (in cycles) between HOLD step and SQUEEZE step in Repeat CYCLE MODE to allow part being welded to be repositioned. Range of programmable values for this parameter is 0 – 99 cycles.

IMPULSES

IMPULSES indicates number of heat impulses that will occur in SCHEDULE. Range of programmable values for this parameter is 1 – 99 cycles.

The next two parameters – HEAT/CURRENT OFFSET and CHANGE ALL – will only be displayed when MAX HEAT/CURRENT OFFSET parameter in **Configure Menu** is set to value other than zero (0). These parameters will be hidden if MAX HEAT/CURRENT OFFSET is set to 0.

HEAT/CURRENT OFFSET (I offset)

This parameter specifies an OFFSET value of HEAT or CURRENT setting for WELD1 and WELD2.

This parameter is controlled by MAX HEAT/CURRENT OFFSET parameter in **Configure Menu**. MAX HEAT/CURRENT OFFSET is maximum value to which HEAT/CURRENT OFFSET can be set. If MAX HEAT/CURRENT OFFSET is set to 0, HEAT/CURRENT OFFSET function is disabled. See Section 5.5.6 for further information.

Range of programmable values: -15% to +15% based on MAX HEAT/CURRENT OFFSET setting

Example: If MAX HEAT/CURRENT OFFSET is set to 6% in **Configure Menu**, then programmable range of HEAT/CURRENT OFFSET will be -6% to +6%.

When Edit Lock function or PIN Lock function is enabled, the operator will be able to adjust HEAT/CURRENT OFFSET of the weld if this parameter is enabled (MAX HEAT/CURRENT OFFSET not set to 0).

OFFSET CHANGE (Change all)

This parameter determines which SCHEDULE(S) will be affected by HEAT/CURRENT OFFSET parameter. If No is selected, OFFSET will only affect selected SCHEDULE. If Yes, OFFSET will affect all SCHEDULES.

5.5.1 SCHEDULE MENU (cont.)

BLOCK DELAY

If control is configured to use AIR-OVER-OIL operation with retraction valve (Mode 2), this parameter indicates the **DELAY** time from end of HOLD to when the block valve is activated. Range of programmable values for this parameter is 0 – 99 cycles.

This parameter will not be displayed if AIR-OVER-OIL parameter in **Configure Menu** is set to Off or Mode 1.

CYCLE MODE

This parameter indicates action of control when schedule has been completed. The CYCLE MODE determines the manner in which control performs schedules. Each of 100 available SCHEDULES has a CYCLE MODE parameter which dictates the sequence of events that will follow an initiation. The following CYCLE MODES are available:

Non-repeat – Control can be initiated for only one sequence even if initiation remains closed.

Repeat – When sequence is complete, control will restart sequence if initiation is maintained closed.

Chained – Several schedules can be chained together so that several consecutive schedules can be sequenced from one initiation.

Successive – Several schedules can be sequenced successively upon separate initiations. To indicate Successive mode is in progress, SCHEDULE number on **Status Page 1** will be flashing.

Wait-here – After an initiation, wait either in SQUEEZE or WELD/COOL or HOLD step of sequence until control is re-initiated with a different initiation and selected SCHEDULE or SCHEDULE 20, 40 or 60 will be sequenced. In order to use this mode, BEAT MODE must be set to 3 in **Configure Menu** (see Section 5.5.6).

See Section 9.13 for detailed information about each of these CYCLE MODES.

5.5.2 EVENT MENU

The **Event Menu** is used to display and/or modify settings of EVENT function for individual SCHEDULES. Each SCHEDULE may have up to four (4) EVENTS defined. Each EVENT can turn one OUTPUT on or off. To disable an EVENT, set its OUTPUT to N/A.

NOTICE

For correct operation, desired OUTPUTS must be mapped to EVENT function using **I/O Map Menu** (see Section 5.5.8).

Main Display will show six (6) lines of menu at a time. As F1 and F3 are used to switch to parameters at top and bottom of display, previous/next parameters will disappear/appear from display.

Joystick functions for **Event Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

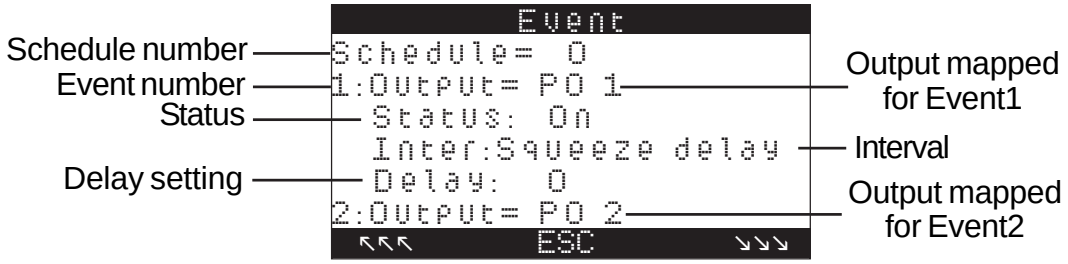


Figure 5-35. *Event Menu*

SCHEDULE

SCHEDULE indicates which weld SCHEDULE is currently displayed on screen. To load a different SCHEDULE for display or editing, change this number using +/–ADJUST and push ENTER to save new SCHEDULE and display EVENT settings. Range of programmable values for this parameter is 0 – 99 SCHEDULES. If control is turned off or loses power, control memorizes selected SCHEDULE and returns to that schedule when **Event Menu** is accessed after power is restored.

Each SCHEDULE can have up to four (4) EVENTS programmed. Each EVENT is identified by number in front of OUTPUT parameter. Each EVENT has four (4) parameters that can be programmed – OUTPUT, STATUS, INTERVAL, and DELAY – which are explained below.

OUTPUT

This parameter sets specific OUTPUT to which EVENT function will output. Range of programmable values for this parameter is PO1–PO32 outputs or N/A which disables EVENT function.

STATUS

This parameter indicates output STATUS for EVENT– either Off or On.

5.5.2 EVENT MENU (cont.)

INTERVAL

This parameter specifies state of SCHEDULE when EVENT will produce output.

Programmable values: Squeeze delay / Advance (**Air-over-oil** set to Mode1 or 2 in **Configure Menu**)
Squeeze / Intensify (**Air-over-oil** set to Mode1 or 2 in **Configure Menu**)
2nd stage
Weld1
Cool1
Slope
Weld2
Cool2
Hold

DELAY

This parameter indicates DELAY time (in cycles). Range of programmable values for this parameter is 0 – 98 cycles.

5.5.3 COUNTER MENU

The **Counter Menu** is used to display and/or modify settings of COUNTER function. To enable COUNTER functions, set COUNTER to Enable and push ENTER to save. When PART COUNTER function is enabled, control adds one (1) to PART COUNT DONE value during HOLD state of each weld. The PART or WELD COUNTER will not count the part when control is in No Weld mode. Control will report Counter End Error (ER25) when COUNT DONE value equals MAX COUNT setting. If there is more than one weld per part, MAX WELD COUNT may be set to amount of welds per part. Status of this COUNTER is seen in WELD COUNT DONE. The PART COUNTER is incremented when MAX WELD COUNT is met. PART or WELD COUNTER may be reset individually – see RST COUNTER parameter explanation.

Joystick functions for **Counter Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

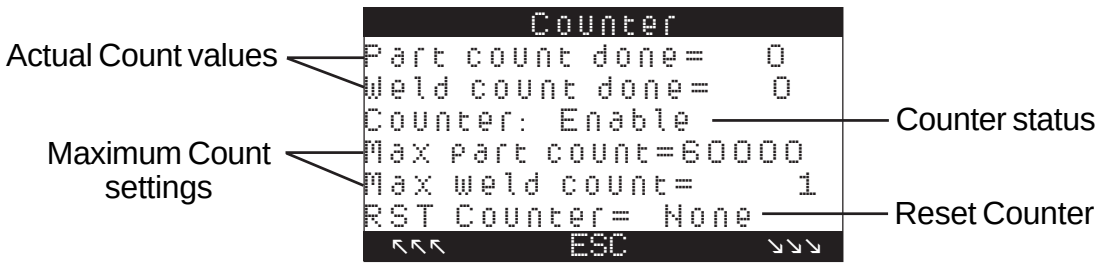


Figure 5-36. *Counter Menu*

5.5.3 COUNTER MENU (cont.)

PART COUNT DONE

This parameter displays actual **PART COUNT** since last reset. This value cannot be edited. It can be reset to zero (0) using RST COUNTER function in this menu or mapping Input PI2 to Reset Counter function in **I/O Map Menu** (see Section 5.5.8).

WELD COUNT DONE

This parameter displays actual welds per part **COUNT** since last reset. This value cannot be edited. It can be reset to zero (0) using RST COUNTER function in this menu or mapping Input PI2 to Reset Counter function in **I/O Map Menu** (see Section 5.5.8).

COUNTER

This parameter enables or disables **COUNTER** function.

Programmable values:	Disable	COUNTER function not active
	Enable	COUNTER function is active

MAXIMUM PART COUNT

This parameter sets **MAXIMUM COUNT** allowed for **PART COUNTER**. Range of programmable values for this parameter is 0 – 60,000. When PART COUNT DONE value equals MAX PART COUNT, control will report Counter End Error (ER25).

MAXIMUM WELD COUNT

This parameter determines the number of welds necessary to increment **PART COUNT DONE** by a factor of one. Range of programmable values for this parameter is 0 – 60,000.

RESET (RST) COUNTER

This parameter is used to **RESET** COUNT DONE value.

Programmable values:	None	COUNTER not reset
	PCTR	Reset PART COUNTER when ENTER is pushed
	WCTR	Reset WELD COUNTER when ENTER is pushed
	Both	Reset both PART and WELD COUNTER when ENTER is pushed

5.5.4 STEPPER MENU

The **Stepper Menu** is used to display and/or modify settings of STEPPER function. The STEPPER provides a means of gradually increasing heat/current and/or decreasing squeeze pressure setting to compensate for electrode wear according to STEPPER settings.

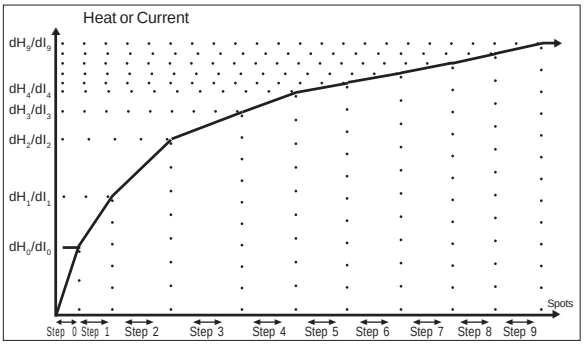


Figure 5-37. *Heat/Current Stepper Curve*

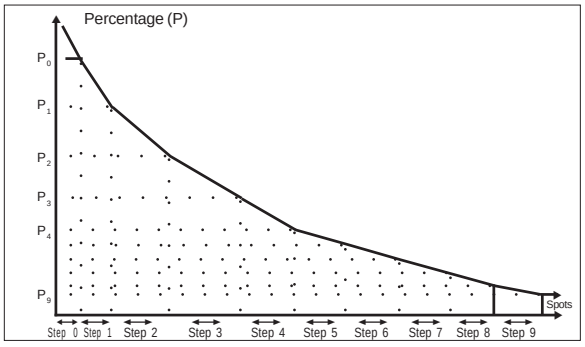


Figure 5-38. *Pressure/Force Stepper Curve*

Joystick functions for **Stepper Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

Figure 5-39. *Stepper Menu*

COUNT DONE

This parameter displays current **COUNT** since last reset. This value cannot be edited. It can be reset to zero (0) using RST STEPPER function in this menu or mapping Input PI17 to Reset Stepper function in **I/O Map Menu** (see Section 5.5.8).

STEPPER

This parameter enables or disables **STEPPER** function.

Programmable values:	Disable	STEPPER function not active
	Heat	Heat/Current compensation
	Force	Force/Pressure compensation
	Heat+Force	Heat/Current and Force/Pressure compensation

TIP DRESS

This parameter indicates count value for TIP DRESS error output. Range of programmable values for this parameter is 0 – 9999. When COUNT DONE value equals TIP DRESS value, control will report Tip Dress Error (**ER31**).

5.5.4 STEPPER MENU (cont.)

RESET (RST) STEPPER

This parameter is used to **RESET** COUNT DONE value for **STEPPER**.

Programmable values: Yes RESET COUNT DONE when ENTER is pushed
No COUNT DONE not reset

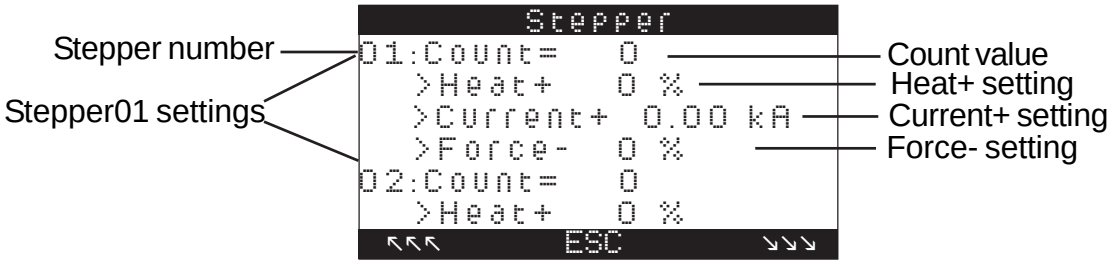


Figure 5-40. *STEPPER settings*

The EN6021 can have up to ten (10) STEPPERS programmed. Each STEPPER is identified by number in front of COUNT parameter. Each STEPPER has four (4) parameters that can be programmed – COUNT, HEAT+, CURRENT+, and FORCE- – which are explained below.

COUNT

This parameter indicates **COUNT** value for individual STEPPER. Range of programmable values for this parameter is 0 – 9999.

HEAT+

This parameter indicates **HEAT** increments for individual STEPPER. Range of programmable values for this parameter is 0 – 99%. When CURRENT REGULATION MODE is set to **Phase Shift** in **Schedule Menu** (see Section 5.5.1), STEPPER will use set value to compensate HEAT setting.

CURRENT+

This parameter indicates **CURRENT** increments for individual STEPPER. Range of programmable values for this parameter is 0.00 – 99.99 kA. When CURRENT REGULATION MODE is set to **Constant Current** in **Schedule Menu** (see Section 5.5.1), STEPPER will use set value to compensate CURRENT setting.

FORCE-

This parameter indicates **FORCE** decrements for individual STEPPER. Range of programmable values for this parameter is 0 – 99%. STEPPER will use set value to compensate FORCE/PRESSURE setting.

5.5.5 SEQUENCER MENU

The **Sequencer Menu** is used to display and/or modify settings of SEQUENCER function which provides a means of controlling a small machine via a series of operation code statements. The statements are executed sequentially in the order in which they appear in SEQUENCER display. The START1 input is used to trigger execution of SEQUENCER and must be maintained. On release of START1 signal, SEQUENCER is reset.

When SEQUENCER is set to On in **Configure Menu** (see Section 5.5.6), the START1 signal cannot be used to start a weld. Instead, welds are started via statements within SEQUENCER.

The operation codes available consist of various input, output, delay, counter and weld functions. It is also possible to program subroutines up to 8 levels deep.

The following resources are available:	Statements (lines)		Up to 200 maximum
	Outputs	32	PO1 to PO32
	Inputs	32	PI1 to PI32
	Flags	32	Flag1 to Flag32
	Counters	8	C1 to C8
	Analog inputs	2	Ain1 and Ain2
	Analog outputs	2	Aout1 and Aout2

NOTICE

Non-volatile values are retained, even if power is lost.
The INPUTS and OUTPUTS are shared with weld control and Events and set in **I/O Map Menu** (see Section 5.5.8).

Joystick functions for **Sequencer Menu** vary depending on status of line.

When entire line is flashing:

F1 – switch to previous line
F2 – return to **Main Menu**
F3 – switch to next line
DOWN – delete selected line if Blank **OR** insert new line if selected line is not Blank
+ADJUST – scroll forward through operation codes
–ADJUST – scroll backward through operation codes
ENTER – accept/save new operation code **OR** access parameter of current operation code

When parameter is flashing:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

Figure 5-41 shows non-programmed SEQUENCER display. Title Section indicates SEQUENCER line number (001–200) which is selected in Main Display. Selected line will be flashing and line number in Title Section will be followed by A indicating operation code selection.

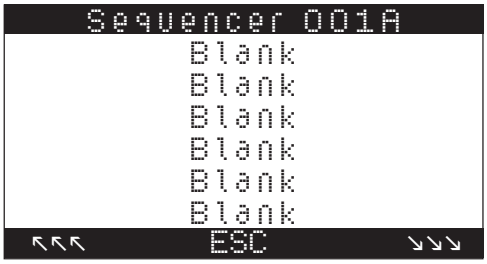


Figure 5-41. *Initial Sequencer Menu*

5.5.5 SEQUENCER MENU (cont.)

Use +/–ADJUST to scroll through available operation codes. To edit displayed operation code, push ENTER to access first parameter (parameter will flash and line number will be followed by **B** indicating 1st parameter selection). Use +/–ADJUST to find desired parameter value and push ENTER to save. If operation code has second parameter to be set, that parameter will be flashing and line number will be followed by **C** indicating 2nd parameter selection. Again use +/–ADJUST to find desired value and push ENTER to save.

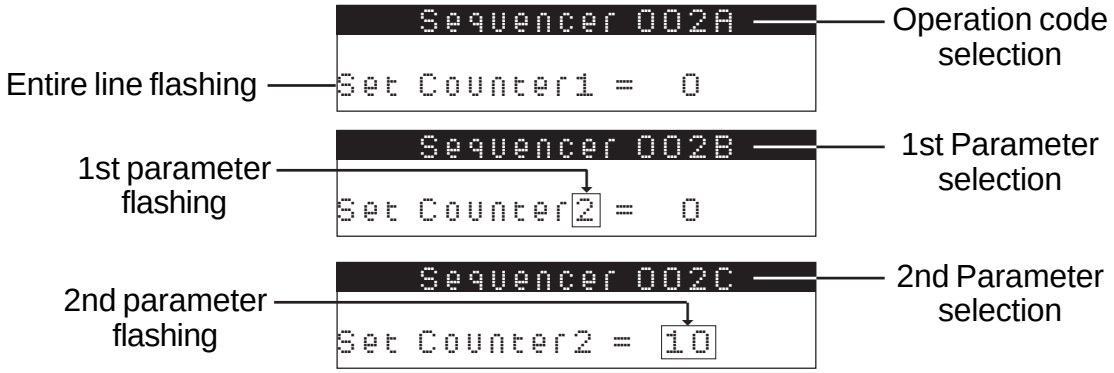


Figure 5-42. *SEQUENCER line number*

The following operation codes are available for programming SEQUENCER.

OPERATION CODE	RANGE	FUNCTION
Blank	N/A	Not programmed (has no effect)
Step *xxx*	1 to 100	Has no effect, but serves as target for Jump statement or as logical divider in program
Sub *xxx*	1 to 100	Has no effect, but serves as target for Call SUB statement or as logical divider in program
Await PI*xx* = On	1 to 32	Waits for Input PI*xx* to be On
Await PI*xx* = Off	1 to 32	Waits for Input PI*xx* to be Off
Set PO*xx* = On	1 to 32	Turns On Output PO*xx*
Set PO*xx* = Off	1 to 32	Turns Off Output PO*xx*
Set Flag*xx* = On	1 to 32	Sets Flag *xx* On
Set Flag*xx* = Off	1 to 32	Sets Flag *xx* Off
Delay *xx.x* Second	0.1–99.9 seconds	Waits for specified time
Jump to step *xxx*	1 to 200	Program continues at specified Step number
Call SUB *xxx*	1 to 100	Program continues with subroutine at specified SUB number (maximum of 8 nesting levels)
Return	N/A	Return from subroutine
Set Counter*x* = *yyy*	*x*=1-8, *y*=1-999	Loads Counter *x* with value *yyy* (non-volatile)
Decrease Counter*x*	1 to 8	Value in Counter *x* is reduced by 1 (non-volatile)
If Counter*x*>0, JP *yyy*	*x*=1-8, *y*=1-200	If value in Counter *x* is greater than 0, jump to Step yyy
If PO*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Output PO*xx* is On, jump to Step *yyy*
If PO*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Output PO*xx* is Off, jump to Step *yyy*
If Flag*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Flag *xx* is On, jump to Step *yyy*
If Flag*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Flag *xx* is Off, jump to Step *yyy*
If PI*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Input PI*xx* is On, jump to Step *yyy*
If PI*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Input PI*xx* is Off, jump to Step *yyy*
Spot-weld with Sch *xxx*	*x*=0-100	Execute spot weld sequence using Schedule *xxx* (0–99). SEQUENCER will wait until weld reaches End of Sequence before continuing with next statement. If *xxx* set to 100, starting schedule selected by Internal or External Select.
Set Aout*x* = *yy.y* mA / V	*x*=1 or 2, *y*=4.0-20.0mA or 0.0-10.0V	Set Analog Output 1 or 2 to specific current/voltage (set in Configure Menu)
If Ain1 > *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 1 is greater than *xx.x* mA, jump to Step *yyy*
If Ain1 < *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 1 is less than *xx.x* mA, jump to Step *yyy*
If Ain2 > *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 2 is greater than *xx.x* mA, jump to Step *yyy*
If Ain2 < *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 2 is less than *xx.x* mA, jump to Step *yyy*

5.5.5 SEQUENCER MENU (cont.)

OPERATION CODE (cont.)	RANGE	FUNCTION
End	N/A	End of Sequence
If Err*xx* = On, JP *yyy*	*x*=1-96 or Any, *y*=1-200	When *xx*=1-96, if Error *xx* is On, jump to Step *yyy* When *xx*=Any, if one or multiple Errors are On, jump to Step *yyy*
If Err*xx* = Off, JP *yyy*	*x*=1-96 or All, *y*=1-200	When *xx*=1-96, if Error *xx* is Off, jump to Step *yyy* When *xx*=All, if all Errors are Off, jump to Step *yyy*
Seam-weld with Sch *xxx*	*x*=0-99	Execute seam weld sequence using Schedule *xxx* (0–99). SEQUENCER will continue with next statement when seam weld sequence has been started. The sequence will be ended when SEQUENCER implements Seam-weld end statement or when Start1 initiation switch is released. When control is implementing seam weld sequence, SEQUENCER can implement one or multiple new Seam-weld with Sch *xxx* statements, and control will continue seam weld sequence with new weld schedule parameters. This allows SEQUENCER to change seam weld parameters, such as weld current, when application requires. A spot weld should not be implemented (SEQUENCER implements Spot-weld with Sch *xxx* statement) when control is implementing seam weld sequence, otherwise Sequencer Error will be triggered. If spot weld is required when seam weld sequence is running, SEQUENCER should implement Seam-weld end statement to stop seam weld, then implement Spot-weld with Sch *xxx* statement to initiate spot weld.
Seam-weld end	N/A	Stop seam weld sequence.

Figure 5-43 shows an example of a short SEQUENCE.

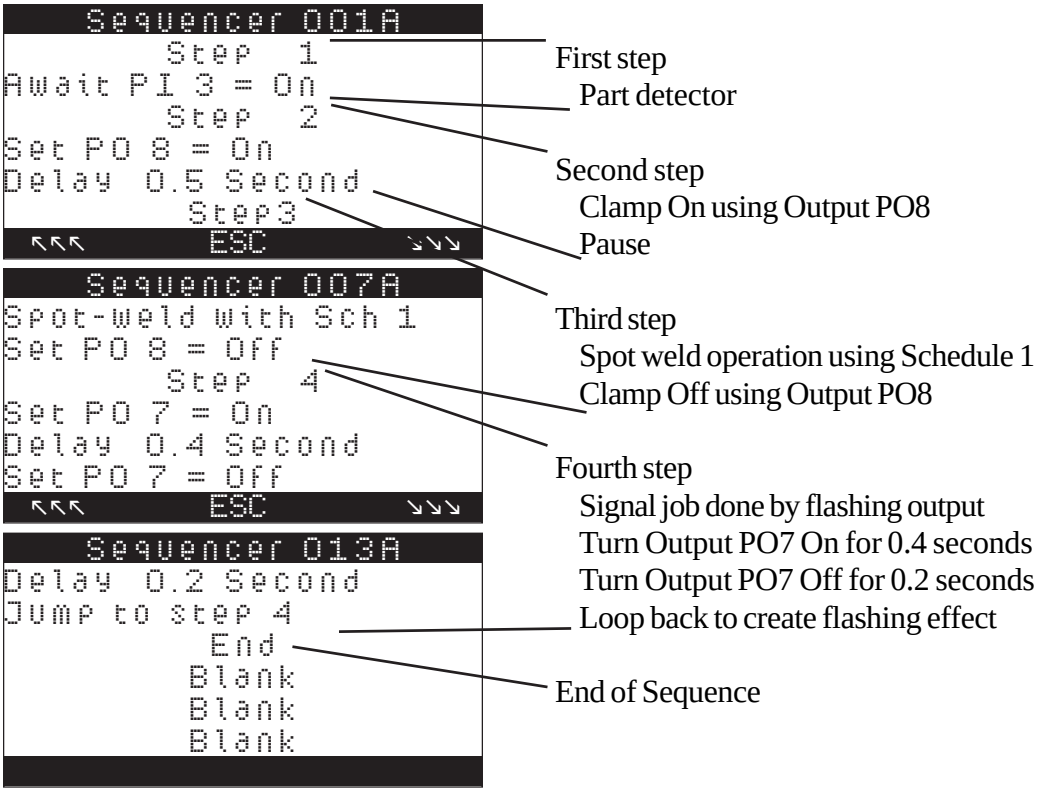


Figure 5-43. *SEQUENCER example*

5.5.6 CONFIGURE MENU

The **Configure Menu** is used to configure the basic operation of the EN6021. Main Display will show six (6) lines of menu at a time. As F1 and F3 are used to switch to parameters at top and bottom of display, previous/next parameters will disappear/appear from display.

Joystick functions for **Configure Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

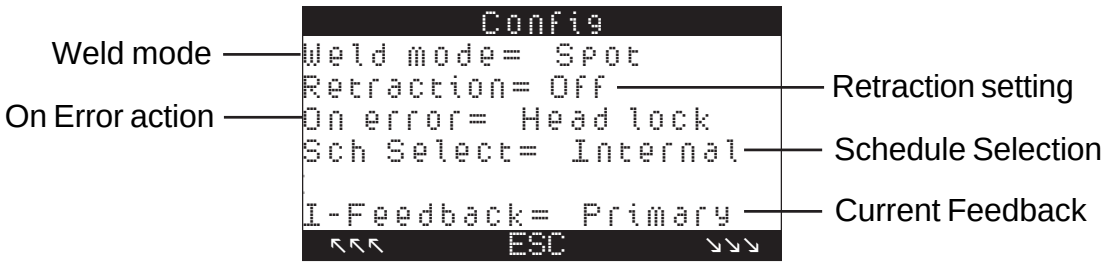


Figure 5-44. *Configure Menu – Sample Display 1*

WELD MODE

This parameter selects type of welding operation. There are three modes available – Spot, Seam1, and Seam2.

Spot – Standard Non-Beat SQUEEZE, WELD, HOLD and OFF sequence.

Seam1 – Regular Seam Mode – When Start input is initiated, control will run selected SCHEDULE from SQUEEZE DELAY through COOL2. If Start input is held, control will repeat WELD2 and COOL2. If Start input is dropped during WELD2 and BEAT MODE is set to Beat During Squeeze + Weld (Beat Mode=2), WELD2 ends immediately. For other BEAT MODES, WELD2 will end after cycles set in WELD2 setting.

NOTICE

In Seam1 mode, Start initiations can be changed during welding of a seam to provide different heat-cool pattern and/or different percent current. This feature is useful to compensate for possible machine power factor changes which may occur as a seam is being welded. For example, a seam may be started by closing Start1, then closing Start2, and finally closing Start3 as seam progresses. Highest Start number closed determines which SCHEDULE will be active. Schedule changes made during WELD2 or COOL2 become effective immediately. When in Seam1 mode, Start1 initiation will use selected SCHEDULE, Start2 will use SCHEDULE 20, Start3 will use SCHEDULE 40 and Start4 will use SCHEDULE 60.

Seam2 – Seam/Spot Combination – Start1 initiation implements same function as in Regular Seam Mode (Seam1). Initiation Start 2–4 and SCHEDULE 20, 40 and 60 will always be **Spot** sequence. **Seam** sequence can be initiate with Start1 in Regular Seam Mode; whenever initiation Start2 or 3 or 4 is closed, control will jump from **Seam** to **Spot** sequence on SCHEDULE 20, 40 or 60.

5.5.6 CONFIGURE MENU (cont.)

RETRACTION

This parameter sets **RETRACTION** mode used for welding guns and stationary machines with cylinders and valves configured for retraction operation. RETRACTION can be accomplished by de-energizing a valve solenoid, allowing electrode arms to separate further than normal to allow large parts to be placed between electrodes. The EN6021 has three RETRACTION modes – Maintained and Momentary. If RETRACTION is not needed, this parameter is set to `Off`.

Maintained – Retraction Output directly mimics Retraction Input. Retraction Output must be on for welding to proceed. If Retraction Output is off, the display will read `Retract Not Ready`.

Momentary – Impulse on Retraction Input changes state of Retraction Output. Retraction Output must be on for welding to take place. If Retraction Output is off, the display will read `Retract Not Ready`.

For further information on RETRACTION function, see Section 9.5.

ON ERROR

This parameter indicates how control will respond to ERROR condition which is assigned to Output PO17 (pin P10-1). The following programmable values are available:

Stop – When ERROR on Output PO17 is detected, weld air valve signal opens as normal, but no further welds are permitted until Error Reset is given.

Continue – Further welds permitted regardless of status of previous weld.

Head lock – When ERROR on Output PO17 is detected, weld air valve signal is held on and no further welds are permitted until Error Reset is given.

SCHEDULE SELECT (`Sch Select`)

This parameter sets source of initiation for Start1. There are two modes available – Internal or External.

Internal – SCHEDULE number assigned to Start1 initiation is determined by programmed SCHEDULE set in **Use Schedule** page (see Section 5.4).

External – SCHEDULE number assigned to Start1 initiation is determined by binary input status of Inputs PI10–PI16. The binary value of these inputs between 0–99 indicates SCHEDULE 0–99; a value larger than 99 will be considered as SCHEDULE 99. See Section 9.7.2 for more information.

NOTICE
For **External** mode, Input PI10 through Input PI16 should be mapped to **Schedule Select** function in **I/O Map Menu** (see Section 5.5.8).

CURRENT FEEDBACK (I-Feedback)

This parameter sets **CURRENT FEEDBACK** source for current measurement and Constant Current regulation.

Programmable values:	Primary	Current measurement signal from primary coil
	Secondary	Current measurement signal from secondary coil
	Sec.W.Pri	Secondary current measurement using primary coil

As of February 2014, **Sec.W.Pri** option has been added in firmware version **1.00** and higher to measure low secondary currents (for example, less than 5kA). With this option, a Primary Coil (P/N 313022) can be placed in the secondary loop to measure secondary current. This option is recommended when secondary current is no more than 10kA, especially when secondary current is less than 5kA.

! CAUTION !

Sec.W.Pri option with a primary coil should not be used when secondary current is larger than 10kA. If using a primary coil to measure secondary current which is much higher than 10kA, the primary coil will generate a high voltage signal and destroy the control's signal port.

5.5.6 CONFIGURE MENU (cont.)

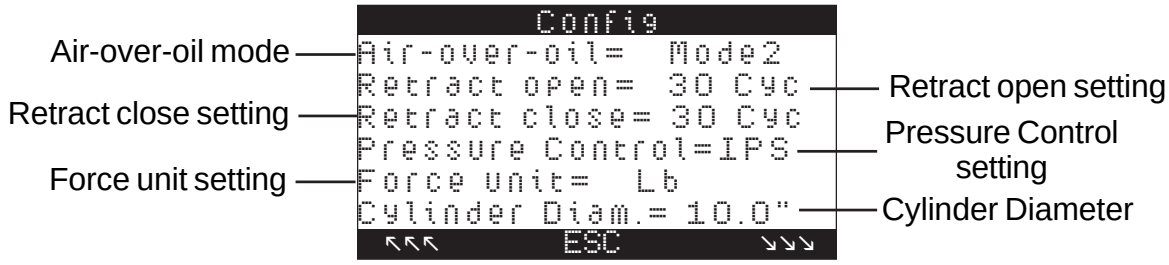


Figure 5-45. *Configure Menu – Sample Display 2*

AIR-OVER-OIL MODE

This parameter sets type of AIR-OVER-OIL operation.

Programmable values:	Off	AIR-OVER-OIL operation not active
	Mode1	AIR-OVER-OIL operation without Retraction
	Mode2	AIR-OVER-OIL operation with Retraction

If **AIR-OVER-OIL Mode2** is selected, two additional parameters – RETRACT OPEN and RETRACT CLOSE – will be displayed. If Off or Mode1 are selected, these parameters will be hidden.

RETRACT OPEN

RETRACT OPEN indicates programmed time (in cycles) gun travels from "pre-weld" position to "total open" position. Range of programmable values for this parameter is 0 – 99 cycles.

RETRACT CLOSE

RETRACT CLOSE indicates programmed time (in cycles) gun travels from "total open" position to "pre-weld" position. Range of programmable values for this parameter is 0 – 99 cycles.

PRESSURE CONTROL

This parameter enables desired configuration of **Intergrated Pressure Sense Control System**. See Section 9.12 for details of this system.

Programmable values:	OFF	PRESSURE CONTROL not active
	IPS	PRESSURE SENSE is active
	IPC	PRESSURE CONTROL is active
	IPSC	PRESSURE SENSE AND CONTROL are active

If this parameter is set to **OFF**, no additional parameters are shown. If this parameter is set to **IPS**, **IPC**, or **IPSC**, one additional parameter – FORCE UNIT – will be displayed.

FORCE UNIT

This parameter sets measurement **UNIT** for **PRESSURE/FORCE** for Proportional Valve (see Section 9.12). There are four modes which will determine programming of all related parameters in **Configure Menu** and **Schedule Menu** (see Section 5.5.1).

mA – Pressure measured in Current. All programming done in mA. This mode is used for force pound calibration, troubleshooting or non-standard devices.

Cal. Lb – Force measured in Calibrated Pounds. All programming done in pounds (Lb) of force. This mode works well for rocker arms or guns with fulcrums or mechanical gain or multiplication. A force gauge is used in a 2-point calibration procedure. Piston diameter or pivot point distances are not required to be known.

PSI – Pressure measured in PSI. All programming done in PSI. This mode works best with proportional valves and sensors that are set up so that 4 mA=0 PSI and 20 mA=100 PSI. This mode can be used for troubleshooting.

Lb – Force measured in Pounds. All programming done in pounds (Lb) of force. When this mode is chosen, CYLINDER DIAMETER becomes programmable parameter in **Configure Menu** and must be entered. No force gauge is required. This mode will not work with systems such as rocker arms.

NOTICE

If modes are changed, data in SCHEDULES is no longer valid.

If this parameter is set to **Lb**, one additional parameter – CYLINDER DIAMETER – will be displayed. If mA, PSI, or Cal. Lb are selected, this parameter will not be shown.

CYLINDER DIAMETER

This parameter sets inside **CYLINDER DIAMETER** which is used to calculate FORCE value from Pressure Sensor (see Section 9.12). Range of programmable values for this parameter is 1.0″ – 10.0″.

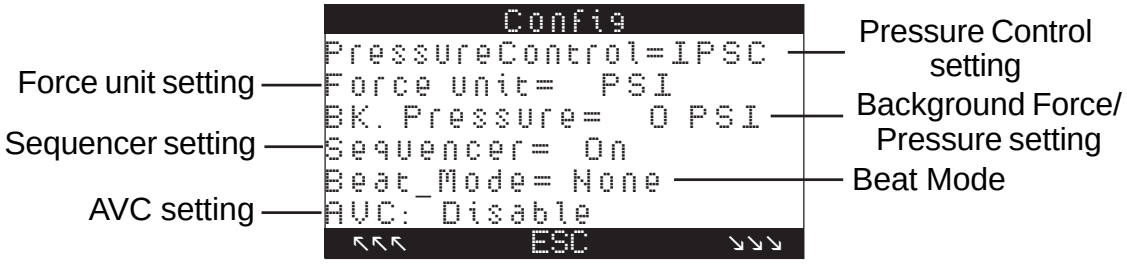


Figure 5-46. *Configure Menu – Sample Display 3*

If **PRESSURE CONTROL** is set to **IPC** or **IPSC**, one additional parameter – BACKGROUND FORCE/PRESSURE – will be displayed.

BACKGROUND FORCE/PRESSURE (BK. Force/Pressure)

This parameter sets **BACKGROUND FORCE/PRESSURE** for Proportional Valve output (see Section 9.12).

If **FORCE UNIT** is set to **Lb** or **Cal. Lb**, this parameter will be displayed as **BK. Force** and range of programmable values is 0.0 – 7850.0 pounds in 0.5 increments.

If **FORCE UNIT** is set to **mA** or **PSI**, this parameter will be displayed as **BK. Pressure**. Range of programmable values is 0 – 100 PSI if **FORCE UNIT** set to **PSI** or 4.0 – 20.0 mA if **FORCE UNIT** set to **mA**.

5.5.6 CONFIGURE MENU (cont.)

SEQUENCER

This parameter is used to enable use of **SEQUENCER**. See Section 5.5.5 for programming SEQUENCER.

Programmable values:	Off	SEQUENCER function not active
	On	SEQUENCER function is active

BEAT MODE

This parameter selects initiation mode to be used. The following modes are available on the EN6021:

Non-Beat (Beat Mode=None) – sequence initiated by momentary switch closure and stopped with open Emergency Stop.

Beat during Squeeze (Beat Mode=Squeeze) – typically used with transgun applications which may require that operator or external source terminate SQUEEZE time before entering WELD. This allows operator to check tip placement before welding. If placement is not correct, initiation can be interrupted and sequence terminated; operator can then reposition tip.

Beat during Squeeze + Weld (Beat Mode=SQZ.+Weld) – typically used for brazing applications. It provides same functions as **Beat during Squeeze**; in addition sequence can be terminated before WELD time has elapsed. If operator opens initiation during WELD, the WELD time is interrupted and control immediately advances to HOLD. However, if initiation switch remains closed, control will weld normally until end of selected SCHEDULE. This flexibility is necessary for brazing parts with differing characteristics which require different WELD times. The WELD time must be set for longest time required to bring parts to required brazing temperature. For more details about use of this mode, see Section 9.3.

Enable Wait-here CYCLE MODE (Beat Mode=Wait Here) – this mode must be set to allow programming of **Wait-here CYCLE MODE** in **Schedule Menu** (see Section 5.5.1). It does not affect initiation and control operates, after closing initiation, exactly the same as **Non-Beat** mode.

AUTOMATIC VOLTAGE COMPENSATION (AVC)

This parameter is used to set **AUTOMATIC VOLTAGE COMPENSATION** function. This function only works with SCHEDULES which use Phase Shift mode to regulate current (see Section 5.5.1). SCHEDULES using Constant Current mode will not be affected by AVC.

Programmable values:	Disable	AVC function not active
	Maximum %	Range from 1% to 10%; sets maximum compensation for AVC mode

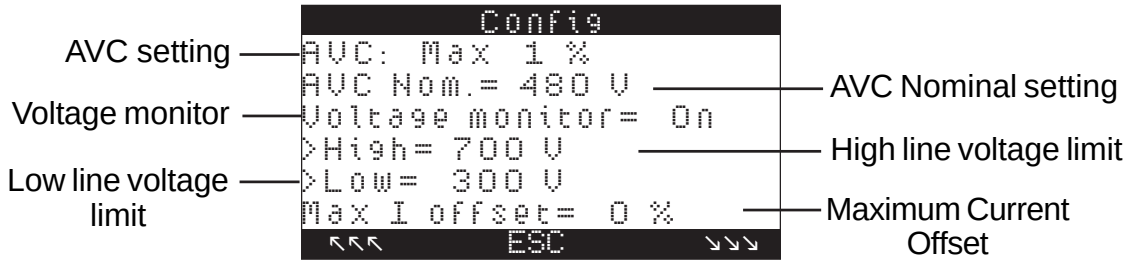


Figure 5-47. *Configure Menu – Sample Display 4*

5.5.6 CONFIGURE MENU (cont.)

If **AVC** is set to Max x%, one additional parameter – AVC NOMINAL – will be displayed. If **AVC** is disabled, this parameter will be hidden.

AVC NOMINAL

This parameter sets **NOMINAL** AC line voltage for AVC function. Control will compensate heat output when AC line voltage is offset from this value. Range of programmable values for this parameter is 187 – 633 volts (which is 208V-10% to 575V+10%).

VOLTAGE MONITOR

This parameter is used to set **VOLTAGE MONITOR** function for AC input line. When enabled, control will monitor AC input line voltage and report High Voltage Error (ER23) or Low Voltage Error (ER24) when AC line voltage is out of **HIGH/LOW LIMIT** range.

Programmable values:	Off	VOLTAGE MONITOR function not active
	On	VOLTAGE MONITOR function is active

If **VOLTAGE MONITOR** is set to On, two additional parameters – HIGH and LOW – will be displayed. If **VOLTAGE MONITOR** is set to Off, these parameters will be hidden.

HIGH LINE VOLTAGE LIMIT

This parameter sets **HIGH LINE VOLTAGE LIMIT** used in monitoring AC input line voltage. Range of programmable values for this parameter is 160 – 750 volts.

LOW LINE VOLTAGE LIMIT

This parameter sets **LOW LINE VOLTAGE LIMIT** used in monitoring AC input line voltage. Range of programmable values for this parameter is 160 – 750 volts.

MAXIMUM CURRENT OFFSET (Max I Offset)

This parameter sets **MAXIMUM CURRENT OFFSET** used to limit value of HEAT/CURRENT OFFSET parameter in **Schedule Menu**. Range of programmable values for this parameter is 0% through 15%. A value of 0% disables HEAT/CURRENT OFFSET function in **Schedule Menu**. See Section 5.5.1 for programming HEAT/CURRENT OFFSET parameter.

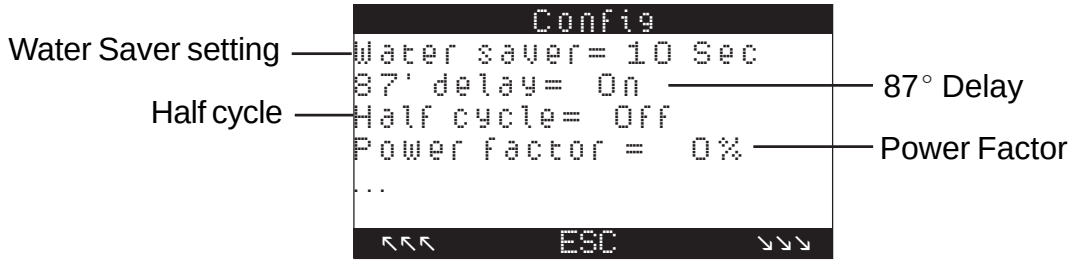


Figure 5-48. *Configure Menu – Sample Display 5*

WATER SAVER

This parameter sets the delay (in seconds) after a weld, before water saver output is turned off. Range of programmable values for this parameter is 0 – 199 seconds. If delay is not needed, set WATER SAVER to 0. This parameter can also be used for magnetic isolation contactor (see Section 9.8).

5.5.6 CONFIGURE MENU (cont.)

87° DELAY

This parameter sets 87° DELAY function for first half cycle. The 87° DELAY helps to prevent build-up of a DC component in welding transformer which may be damaging.

Programmable values:	Off	87° DELAY function not active
	On	87° DELAY function is active

HALF CYCLE

This parameter enables HALF CYCLE welding.

Programmable values:	Off	HALF CYCLE function not active
	+	Only output positive HALF CYCLE
	–	Only output negative HALF CYCLE
	AC	Alternate output positive and negative HALF CYCLE

POWER FACTOR

This parameter sets POWER FACTOR of control. Range of programmable values for this parameter is 0 – 99. For automatic POWER FACTOR, set to 0. EN6021 Control is in automatic mode when shipped from factory. Calibration of automatic power factor circuit is not required. This has two benefits:

1. It is not necessary to make manual adjustments when installing the control, to match its circuitry to the power factor of the welding machine;
2. It assures that maximum welding current, for any welding transformer tap switch setting, will occur when selected HEAT is 99%.

If required, EN6021 Control can be placed in manual POWER FACTOR mode by entering a value from 1 – 99 for POWER FACTOR. If this value is not known, it can be measured as described below.

NOTICE

When using EN6021 Control in CONSTANT CURRENT mode, automatic POWER FACTOR is disabled and Constant Current algorithms work in its place.

Power Factor Delay Measuring

If desired, for some applications, automatic mode can be disabled and machine POWER FACTOR can be set manually. Machine's POWER FACTOR can be determined when in automatic POWER FACTOR mode and viewing Power Factor Delay (PFD) value on **Status Page 2** (see Section 5.3.2).

NOTICE

When measuring the POWER FACTOR, the displayed POWER FACTOR corresponds to the last weld made by control.

5.5.6 CONFIGURE MENU (cont.)

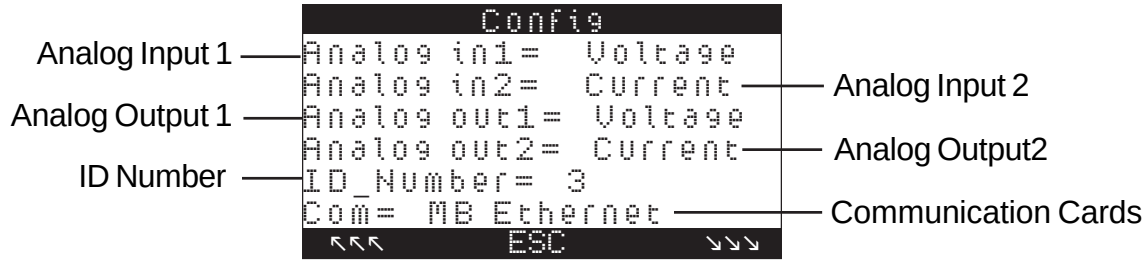


Figure 5-49. *Configure Menu – Sample Display 6*

ANALOG INPUT 1

This parameter sets signal type for **ANALOG INPUT 1** channel.

Programmable values:	Current	Allows 4–20 mA current input signal
	Voltage	Allows 0–10 volt input signal

ANALOG INPUT 2

This parameter sets signal type for **ANALOG INPUT 2** channel.

Programmable values:	Current	Allows 4–20 mA current input signal
	Voltage	Allows 0–10 volt input signal

ANALOG OUTPUT 1

This parameter sets signal type for **ANALOG OUTPUT 1** channel.

Programmable values:	Current	Allows 4–20 mA current output signal
	Voltage	Allows 0–10 volt output signal

ANALOG OUTPUT 2

This parameter sets signal type for **ANALOG OUTPUT 2** channel.

Programmable values:	Current	Allows 4–20 mA current output signal
	Voltage	Allows 0–10 volt output signal

ID NUMBER

This parameter allows setting of unique control **ID NUMBER** for RS485 communication. Range of programmable values for this parameter is 1 – 99.

COMMUNICATION CARDS (COM)

This parameter selects appropriate channel to implement one of five COMMUNICATION functions. See Section 10.7 for more details.

Programmable values:	MB Ethernet	Select Ethernet port to implement Modbus Ethernet communication function
	MB RS232 RTU	Select RS232 port to implement Modbus RS232 communication function
	MB RS485 RTU	Select RS485 port to implement Modbus RS485 communication function

5.5.6 CONFIGURE MENU (cont.)

COMMUNICATION CARDS (cont.)

Label Printing	Select RS232 port to implement Label Printing function
EIP+MB Ethernet	Select Ethernet port to implement EtherNet/IP and Modbus Ethernet communication function

When Label Print is selected, control will print informational label when spot weld is completed. See Section 10.8 for details regarding RS232 Printer Option.

NOTICE

Only one of these five channels can be selected at a time.
New setting of COMMUNICATION function will take effect after next control reset (power off then power on).

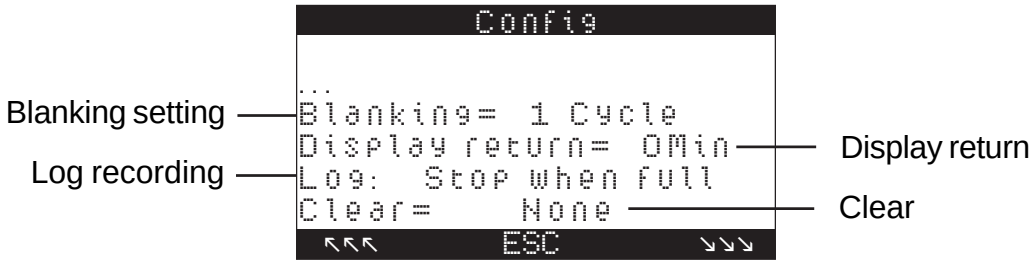


Figure 5-50. *Configure Menu – Sample Display 7*

BLANKING

This parameter sets the number of weld current cycles to exclude from measurement and limit testing process. Range of programmable values for this parameter is 0 – 99 cycles.

DISPLAY RETURN

This parameter performs automatic return of RPP2 display to **Status Page 1** when no activity has occurred within programmed **DISPLAY RETURN** time. Range of programmable values for this parameter is 0 – 10 minutes. Setting of **0** disables this function. Any setting between **1** and **10** enables this function.

LOG RECORDING MODE

As of February 2014, **LOG RECORDING MODE** parameter has been added in firmware version **1.00** and higher.

Programmable values:	Stop when full	When Weld or Error Log memory is full, control will not record new Weld or Error Log data. The log data in memory will be kept until control receives **RESET LOG** command (see Section 5.5.9).
	Rewrite when full	When Weld or Error Log memory is full and new Weld or Error Log data is generated, control will rewrite the memory which holds the oldest Weld or Error Log data. Using this option, the latest Weld and Error Log data will be recorded into memory, but the oldest data will be deleted.

If new setting for **LOG RECORDING MODE** has been input, an additional confirmation line will be displayed as shown in Figure 5-51. The operator needs to change confirmation value from No to Yes and press ENTER for control to accept the new setting.

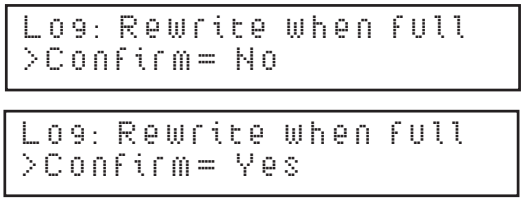


Figure 5-51. *LOG RECORDING MODE confirmation process*

LOG RECORDING MODE using ENLINK

If ENLINK software is used to modify **LOG RECORDING MODE** setting, "Change recording mode" box should be checked to enable editing of **LOG RECORDING MODE** setting.

In addition, when downloading data from ENLINK software to control, "Change recording mode" box **must be** checked. If it is not checked when data is downloaded, control will ignore **LOG RECORDING MODE** setting.

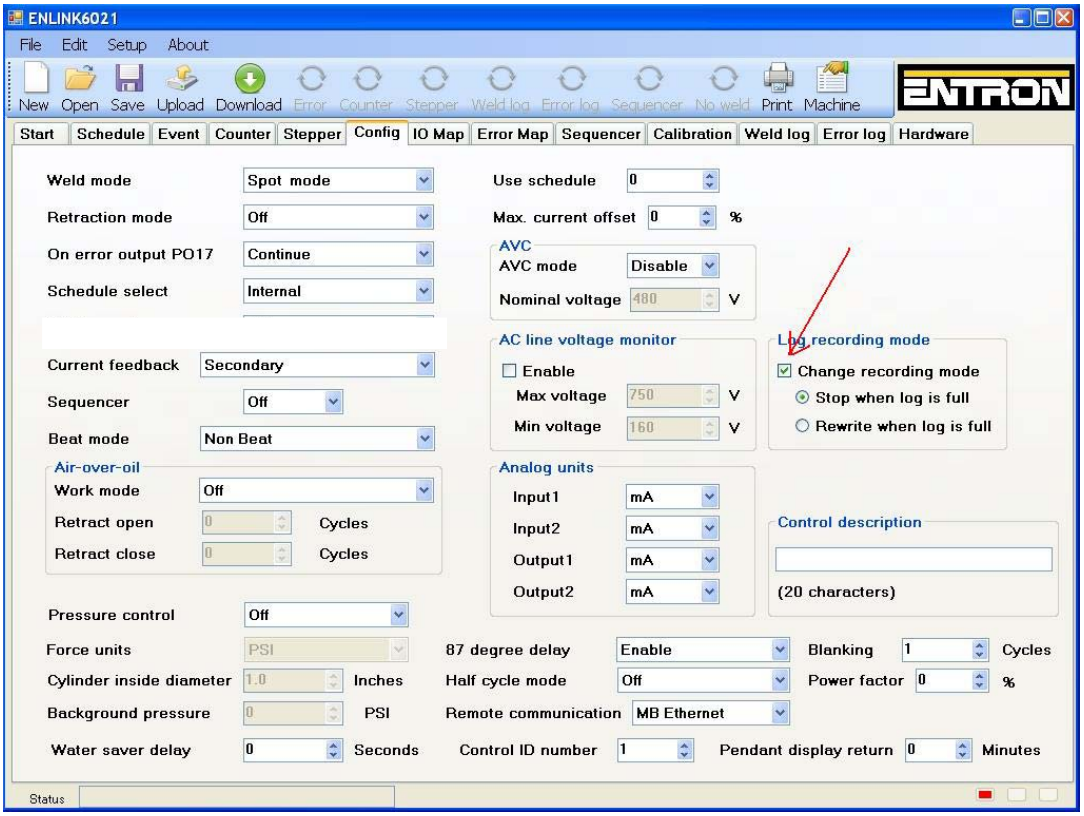


Figure 5-52. *LOG RECORDING MODE using ENLINK*

NOTICE

The **LOG RECORDING MODE** should be set correctly according to the need of application. Improper setting could cause lost data when Weld Log/Error Log memory is full:

- If "Stop when full" setting is selected, when Weld Log/Error Log memory is full, control will not record new data; the new Weld Log/Error Log will be discarded and lost.
- If "Rewrite when full" setting is selected, when Weld Log/Error Log memory is full and new data is generated, control will remove the oldest data out of memory to store new data; the oldest Weld Log/Error Log will be discarded and lost.

5.5.6 CONFIGURE MENU (cont.)

CLEAR

This parameter will reset all settings of control or selected menus to default values. Selecting None will have no effect on settings. To reset all settings of control, select All then press ENTER. To reset settings of individual menus, select appropriate menu name then press ENTER. Done!!! will appear in Help Section to confirm. The following menus can be reset individually: **Schedule**, **Event**, **Counter**, **Stepper**, **Sequencer**, **Configure**, **Calibration**, and **I/O Map**.

See Sections 1.3 and 1.4, along with Section 5.5.8, for CLEAR function default values.

NOTICE
Default values listed in Section 1.3 for **ID Number**, **Toroid Sensivity**, and **Turns Ratio** are ***factory*** defaults. Programmed values for these parameters **are not reset** with CLEAR function.

5.5.7 CALIBRATION MENU

The **Calibration Menu** is used to set parameters for current and force measurements.

Joystick functions for **Calibration Menu**:

F1 – switch to previous parameter
F2 – return to **Main Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value or access sub-menu

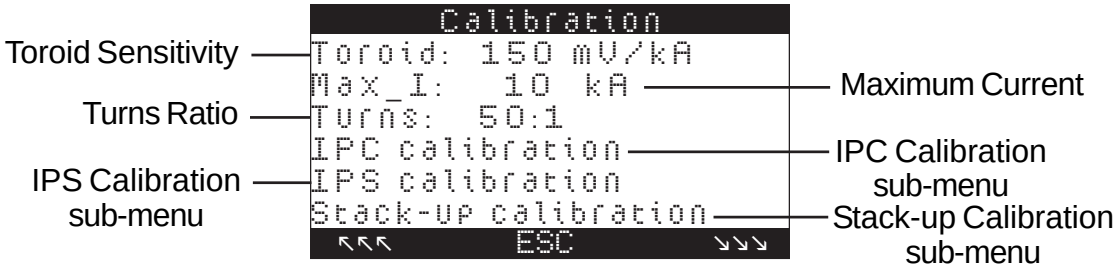


Figure 5-53. *Calibration Menu*

TOROID SENSITIVITY

This parameter sets **SENSITIVITY** of measuring coil/toroid, expressed in mV/kA. Range of programmable values is dependent on setting of CURRENT FEEDBACK in **Configure Menu** (see Section 5.5.6).

Programmable values	**Firmware version 1.00 and higher**	**Previous firmware versions**
Primary Feedback	1190 – 1610 mV/kA	1260 – 1540 mV/kA
Secondary Feedback	127 – 173 mV/kA	135 – 165 mV/kA
Secondary Feedback with Primary Coil	1190 – 1610 mV/kA	Not available

Typical sensitivity of Primary Coil is 1400 mV/kA @ 60Hz. Typical sensitivity of Secondary Coil is 180 mV/kA @ 60Hz. **NOTE**: Temperature and position of Rogowski Coil can affect control accuracy.

MAXIMUM CURRENT (Max I)

This parameter will determine amplifier gain for current measurement and maximum heat offset. Setting appropriate value will achieve the best current measurement accuracy and Constant Current regulation performance. For firmware version **1.00** and higher, range of programmable values for this parameter is 5 – 100 kA. For previous firmware versions, range of programmable values for this parameter is 10 – 100 kA. The CLEAR function will reset this parameter to default value of 35 kA (see Section 5.5.6).

TURNS RATIO

This parameter sets **TURNS RATIO** of transformer which is necessary when control is set to Primary CURRENT FEEDBACK mode (see Section 5.5.6). Range of programmable values for this parameter is 10:1 – 250:1. When control is set to Primary CURRENT FEEDBACK, it measures only primary current from sensor and then calculates secondary current using following equation:

Secondary Current = Primary Current x Turns Ratio of transformer

In addition to these three parameters, there are three sub-menus in **Calibration Menu** – IPC Calibration, IPS Calibration and Stack-up Calibration. Push ENTER to access each sub-menu and F2 to return to **Calibration Menu**.

5.5.7 CALIBRATION MENU (cont.)

IPC CALIBRATION

When using Calibrated Lb mode for IPC, pressure control must be calibrated using this sub-menu. The Calibrated Lb mode of operation requires a measured force value to be entered. This value is typically measured using force gauge. If force value cannot be determined, another mode must be chosen (mA, Lb, or PSI). Following steps are taken to calibrate pressure control.

1. Set FORCE UNIT to mA in **Configure Menu** (see Section 5.5.6). Previous Calibrated Lb values in **IPC Calibration** sub-menu will not be lost.
2. In **Schedule Menu**, two SCHEDULES will need to be programmed for calibration process in step 3. One SCHEDULE should be programmed with PRESSURE/FORCE parameter at approximately 20% of 4–20mA current range. Second SCHEDULE should be programmed at 20% of maximum 20mA current in that parameter.
3. In **Calibration Menu**, access **IPC Calibration** sub-menu.

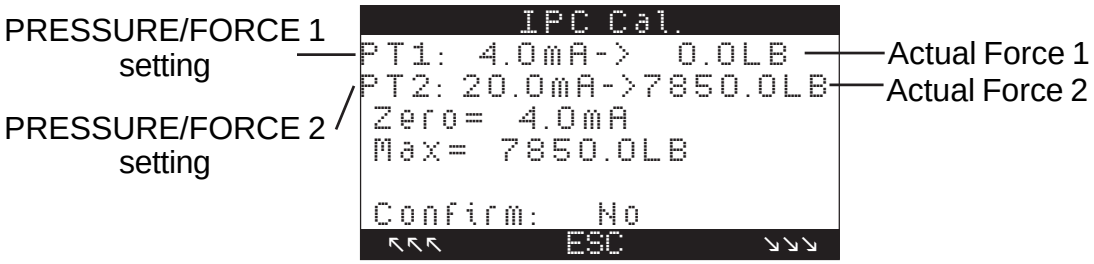


Figure 5-54. *IPC Calibration sub-menu*

   a. In No Weld, initiate low mA SCHEDULE with force gauge between electrodes. Control will fill in PT1 value with value programmed in initiated SCHEDULE. Push ENTER to accept this value.
   b. Control then indexes cursor to actual force value. Enter measured value from force gauge.
   c. Control will move cursor to PT2 parameter. In No Weld, initiate high mA SCHEDULE with force gauge between electrodes. Control will now load current value from initiated SCHEDULE into PT2. Push ENTER to accept this value.
   d. Control moves cursor to actual force value. Enter measured value from force gauge.
   e. To save these values, change Confirm parameter from No to Yes and push ENTER.
4. Control can now be changed back to Calibrated Lb in **Configure Menu** and force values may be entered in SCHEDULES.

NOTICE

Values for PT1 and PT2 in this sub-menu need not be filled in automatically by control when initiated. If values are recorded or known, they can be entered manually and confirmed.

5.5.7 CALIBRATION MENU (cont.)

IPS CALIBRATION

Appearance of **IPS Calibration** sub-menu is similar to **IPC Calibration** sub-menu in Figure 5-54. **IPS Calibration** function is very similar to **IPC Calibration**. The sensor must be temporarily placed or used to sense cylinder pressure. Two SCHEDULES are programmed in similar way as in IPC. FORCE can be set in SCHEDULE from IPC option if available. If IPC option is not available, manual regulator will need to be changed manually with SCHEDULES to approximately 20% greater than minimum and 20% less than maximum. A force gauge will be required to determine resultant force for measured mA value.

NOTICE

Values for PT1 and PT2 in this sub-menu need not be filled in automatically by control when initiated. If values are recorded or known, they can be entered manually and confirmed.

STACK-UP CALIBRATION

When using STACK-UP MONITORING function, control must be calibrated using this sub-menu. To calculate Stack-up thickness value from optional LDT Sensor's current signal (see Section 10.15), control needs to calibrate Zero-thickness current offset of sensor and current-thickness scale. When calibrating the scale, one known thickness sample is needed. The thickness of sample should be larger than maximum thickness of part which will be welded.

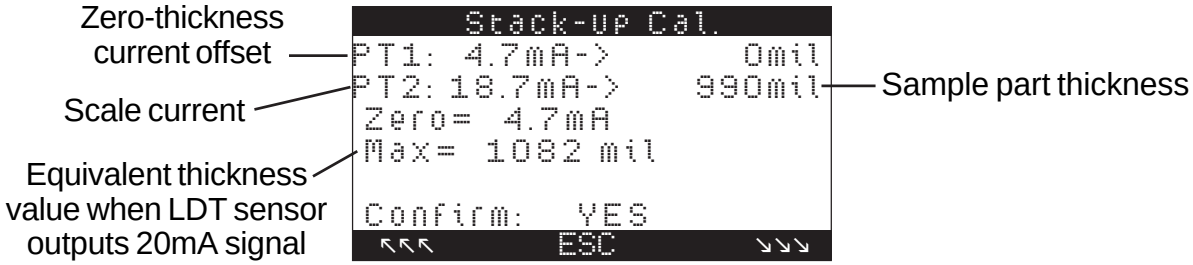


Figure 5-55. *Stack-up Calibration sub-menu*

The complete calibration operation should be implemented in NO WELD mode. Following steps are taken to calibrate STACK-UP MONITORING function.

1. In **Schedule Menu**, program one SCHEDULE for calibration process. The SCHEDULE should include enough SQUEEZE time for LDT sensor to read back correct/stable signal when electrodes squeeze.
2. In **Calibration Menu**, access **Stack-up Calibration** sub-menu.
   a. Calibrate Zero-thickness offset by placing cursor at PT1 current input position. Initiate control without anything between electrodes. Control will fill in PT1 current value with current signal from LDT sensor – this value is current feedback from LDT sensor when control sees 0 mil stack-up thickness. Push ENTER to accept this value.
   b. Calibrate Scale current by making sure, after pushing ENTER on previous step, cursor has moved to PT2 current input position. Place sample part between electrodes and initiate control. Control will fill in PT2 current value with current signal from LDT sensor. Push ENTER to accept this value.
   c. Control will move cursor to Sample part thickness value. Enter thickness value of sample part.
   d. To save these values, change Confirm parameter from No to Yes and push ENTER.

5.5.7 CALIBRATION MENU (cont.)

NOTICE

1. Control accepts parameter values as shown in Table 5-1. When cursor is moved to Confirm parameter, control will check input parameters and calculate Zero-thickness and Scale parameter for Stack-up thickness measurement. If values do not meet criteria, Cal. out of range! message will be displayed.

   Table 5-1. *Parameter range for Stack-up thickness calibration*

Parameter	Minimum	Maximum	Additional Requirement
PT1 current	3.0 mA	19.9 mA	PT2 current > PT1 current
PT2 current	4.1 mA	21.0 mA	
PT2 thickness	1 mil	10500 mil	

2. Values for PT1 and PT2 need not be filled in automatically by initiating control. If values are recorded or known, they can be entered manually and confirmed.

5.5.8 I/O MAP MENU

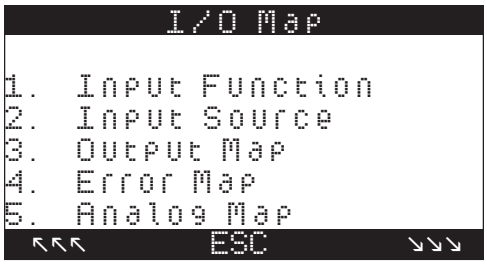


Figure 5-56. *I/O Map sub-menus*

The **I/O Map Menu** is used to map EN6021 inputs and outputs to specific functions. This menu has five (5) sub-menus which are accessed by using F1 and/or F3 to select desired sub-menu and pushing ENTER.

Joystick functions for **I/O Map Menu**:

F1 – switch to previous sub-menu
F2 – return to **Main Menu**
F3 – switch to next sub-menu
DOWN – toggle WELD/NO WELD setting
+ADJUST – not used on this page
–ADJUST – not used on this page
ENTER – access selected sub-menu

After selecting desired **sub-menu**, joystick functions are as follows:

F1 – switch to previous parameter
F2 – return to **I/O Map Menu**
F3 – switch to next parameter
DOWN – toggle WELD/NO WELD setting
+ADJUST – scroll forward through values
–ADJUST – scroll backward through values
ENTER – accept/save new value

INPUT FUNCTION SUB-MENU

Input ports on CPU unit and I/O Expansion Card can be used for primary function assigned to each port or Sequencer input. This menu maps each of control's 32 programmable INPUTS (indicated by number at beginning of line) to specific function. Main Display will show six (6) INPUTS at a time. As F1 and F3 are used to switch to various INPUTS at top and bottom of display, previous/next INPUT will disappear/appear from display. See Table 5-2 for programmable values for each INPUT. Appendix C includes Input Worksheet to facilitate programming.

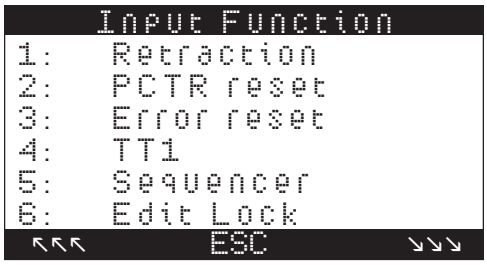


Figure 5-57.
Input Function sub-menu

Table 5-2. *Programmable values for INPUTS*

Bold indicates CLEAR function default

INPUT	PROGRAMMABLE VALUES	INPUT	PROGRAMMABLE VALUES
PI1	**Retraction** or Sequencer	PI17	**Stepper reset** or Sequencer
PI2	**Parts counter reset** or Sequencer	PI18	**Weld counter reset** or Sequencer
PI3	**Error reset** or Sequencer	PI19	Sequencer
PI4	**TT1** or Sequencer	PI20	Sequencer
PI5	Interlock or **Sequencer**	PI21	Sequencer
PI6	**Edit lock** or Sequencer	PI22	Sequencer
PI7	**Escape** or Sequencer	PI23	Sequencer
PI8	**Back step** or Sequencer	PI24	**Not used** or Sequencer
PI9	2nd stage or **Sequencer**	PI25	**Not used** or Sequencer
PI10	**SchSelect1** or Sequencer	PI26	**Not used** or Sequencer
PI11	**SchSelect2** or Sequencer	PI27	**Not used** or Sequencer
PI12	**SchSelect3** or Sequencer	PI28	**Not used** or Sequencer
PI13	**SchSelect4** or Sequencer	PI29	**Not used** or Sequencer
PI14	**SchSelect5** or Sequencer	PI30	**Not used** or Sequencer
PI15	**SchSelect6** or Sequencer	PI31	**Not used** or Sequencer
PI16	**SchSelect7** or Sequencer	PI32	**Not used** or Sequencer

5.5.8 I/O MAP MENU (cont.)

INPUT SOURCE SUB-MENU

This sub-menu sets signal source for programmable INPUTS PI1 through PI32 (indicated by number at beginning of line). Control can read signal from local Input ports on CPU unit and I/O Expansion Card or from PLC through optional Communication Card. Appendix C includes Input Worksheet to facilitate programming.

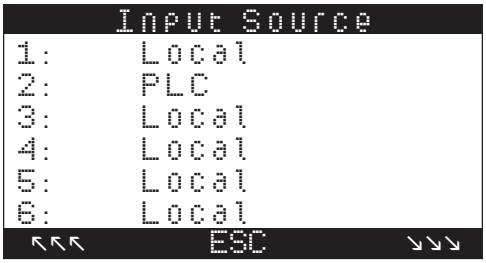


Figure 5-58.
Input Source sub-menu

Each line of Main Display allows Local or PLC option for programming input signal source. Main Display will show six (6) INPUTS at a time. As F1 and F3 are used to switch to various INPUTS at top and bottom of display, previous/next INPUT will disappear/appear from display.

Programmable values:

- Local – Control uses input signal from local Input ports – PI1-PI16 on P3 connector and PI17-PI32 on P11 connector.
- PLC – Control uses input signal from two 16-bit registers which are modified/written by PLC through Modbus function code 16. Modbus addresses of registers are:
  - For PI1-PI16 – Register 911 (Bit 0-15)
  - For PI17-PI32 – Register 912 (Bit 0-15)

OUTPUT MAP SUB-MENU

Output ports on CPU unit and I/O Expansion Card can output signal/status for primary function assigned to each port, Event, Sequencer, or PLC output through Communication Card. This menu maps each of control's 32 programmable OUTPUTS (indicated by number at beginning of line) to specific function.

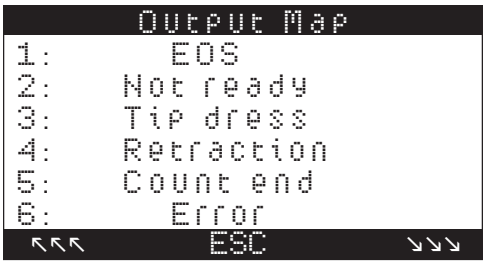


Figure 5-59.
Output Function sub-menu

Function:

- (Primary) – Ports will output primary function assigned to each. Primary function varies per specific OUTPUT – first programmable value listed in Table 5-3 is primary function.
- Event – Ports will output status set by EVENT function.
- Sequencer – Ports will output status set by SEQUENCER.
- PLC – Ports will output value from two 16-bit registers which are modified/written by PLC through Modbus function code 16. Modbus addresses of registers are:
  - For PO1-PO16 – Register 913 (Bit 0-15)
  - For PO17-PO32 – Register 914 (Bit 0-15)

Main Display will show six (6) OUTPUTS at a time. As F1 and F3 are used to switch to various OUTPUTS at top and bottom of display, previous/next OUTPUT will disappear/appear from display. See Table 5-3 for programmable values for each OUTPUT. Appendix C includes Output Worksheet to facilitate programming.

5.5.8 I/O MAP MENU (cont.)

OUTPUT MAP SUB-MENU (cont.)

Table 5-3. *Programmable values for OUTPUTS* Bold indicates CLEAR function default

OUTPUT	PROGRAMMABLE VALUES	OUTPUT	PROGRAMMABLE VALUES
PO1	**EOS** / Event / Sequencer / PLC	PO17	**Error map** / Event / Sequencer / PLC
PO2	**Not ready** / Event / Sequencer / PLC	PO18	**Error map** / Event / Sequencer / PLC
PO3	**Tip dress** / Event / Sequencer / PLC	PO19	**Error map** / Event / Sequencer / PLC
PO4	**Retraction** / Event / Sequencer / PLC	PO20	**Error map** / Event / Sequencer / PLC
PO5	**Count end** / Event / Sequencer / PLC	PO21	**Error map** / Event / Sequencer / PLC
PO6	**Error** / Event / Sequencer / PLC	PO22	**Error map** / Event / Sequencer / PLC
PO7	**Step end** / Event / Sequencer / PLC	PO23	**Error map** / Event / Sequencer / PLC
PO8	**Interlock** / Event / Sequencer / PLC	PO24	**Error map** / Event / Sequencer / PLC
PO9	**Water Saver** / Event / Sequencer / PLC	PO25	**Error map** / Event / Sequencer / PLC
PO10	**Retract force** / Event / Sequencer / PLC	PO26	**Error map** / Event / Sequencer / PLC
PO11	**Retract exhaust** / Event / Sequencer / PLC	PO27	**Error map** / Event / Sequencer / PLC
PO12	**Retract return** / Event / Sequencer / PLC	PO28	**Error map** / Event / Sequencer / PLC
PO13	**Not used** / Event / Sequencer / PLC	PO29	**Error map** / Event / Sequencer / PLC
PO14	**Not used** / Event / Sequencer / PLC	PO30	**Error map** / Event / Sequencer / PLC
PO15	**Not used** / Event / Sequencer / PLC	PO31	**Error map** / Event / Sequencer / PLC
PO16	**Not used** / Event / Sequencer / PLC	PO32	**Error map** / Event / Sequencer / PLC

ERROR MAP SUB-MENU

Control can set specific outputs to indicate status of Error Messages via OUTPUTS PO17 through PO32. This menu designates which OUTPUT (PO17–PO32) will be used for each of 96 available Error Messages (indicated by Er and two-digit number at beginning of line). Appendix C includes Error Map Worksheet to facilitate programming. Main Display will show six (6) Error Message OUTPUTS at a time. As F1 and F3 are used to switch to lines at top and bottom of display, previous/next Error Message OUTPUT will disappear/appear from display.

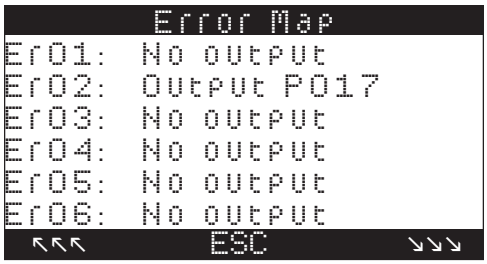


Figure 5-60. *Error Map sub-menu*

If no output is desired, set individual Error Message OUTPUT to **No output**. To output Error Message to specific OUTPUT, set individual Error Message OUTPUT to **Output POxx** (*xx* = 17–32). Designated OUTPUT must be mapped to Error map in **Output Map** sub-menu.

ANALOG MAP SUB-MENU

This sub-menu is used to define the function of two (2) ANALOG INPUTS and two (2) ANALOG OUTPUTS. Appendix C includes I/O Worksheet to facilitate programming.

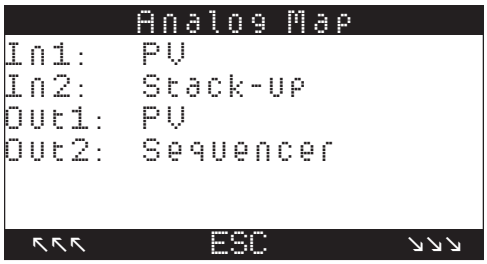


Figure 5-61.
Analog Map sub-menu

Programmable values:

- In1 Proportional Valve (PV) or Sequencer
- In2 Stack-up or Sequencer
- Out1 Proportional Valve (PV) or Sequencer
- Out2 Not used or Sequencer

5.5.8 I/O MAP MENU (cont.)

ANALOG MAP SUB-MENU (cont.)

The setting of ANALOG INPUT 2 affects the 13th and 14th data of each Weld Log record. When Weld Log data are created, in each weld record, if ANALOG INPUT 2 is mapped to Stack-up function, the 13th word stores Stack-up Thickness and 14th word stores Stack-up Displacement; if ANALOG INPUT 2 is mapped to Sequencer function, the 13th word stores ANALOG INPUT 2 raw value when control is at end of SQUEEZE step and 14th word stores ANALOG INPUT 2 raw value when control is at end of HOLD step.

NOTICE

To save the Stack-up Thickness and Displacement data into Weld Log in mil unit, ANALOG INPUT 2 **must be** mapped to Stack-up function (see Section 10.15 for LDT Sensor Option).

5.5.9 UTILITY MENU

The **Utility Menu** has nine (9) sub-menus which are accessed by using F1 and/or F3 to select desired sub-menu and pushing ENTER. Main Display will show six (6) sub-menus at a time. As F1 and F3 are used to scroll through sub-menus at top and bottom of display, previous/next sub-menus will disappear/appear from display.

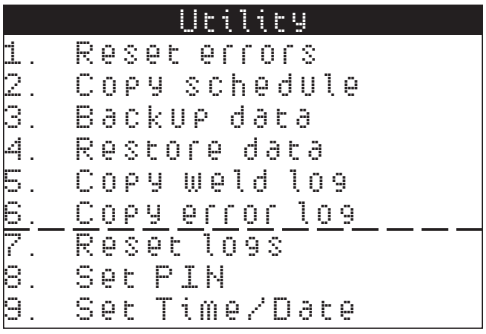


Figure 5-62. *Utility sub-menu*

Joystick functions for **Utility Menu**:

F1 – switch to previous sub-menu
F2 – return to **Main Menu**
F3 – switch to next sub-menu
DOWN – toggle WELD/NO WELD setting
+ADJUST – not used on this page
–ADJUST – not used on this page
ENTER – access selected sub-menu

After selecting desired **sub-menu**, joystick functions are as follows:

F1 – switch to previous parameter
F2 – return to **Utility Menu**
F3 – switch to next parameter
DOWN – toggle ADJUST gain setting
+ADJUST – increase value of parameter
–ADJUST – decrease value of parameter
ENTER – accept/save new value

RESET ERRORS SUB-MENU

This function is used to reset error conditions on control. **Confirm** setting must be changed from No to Yes using +/-ADJUST and ENTER must be pushed to execute this command.

Figure 5-63.
Reset Errors sub-menu

5.5.9 UTILITY MENU (cont.)

COPY SCHEDULE SUB-MENU

This function is used to copy all data from one SCHEDULE to any other SCHEDULE. The **COPY SCHEDULE** function facilitates programming multiple SCHEDULES which have similar settings.

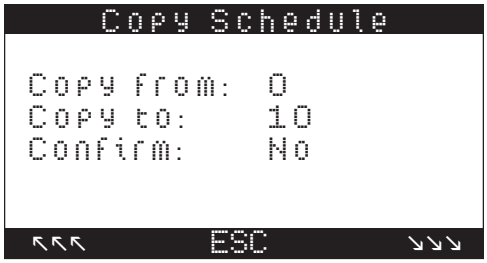


Figure 5-64.
Copy Schedule sub-menu

- **Copy from** – programmed SCHEDULE number (0–99) whose data is to be copied.
- **Copy to** – desired SCHEDULE number (0–99) to which data will be copied.
- **Confirm** – YES option must be selected using **+/–**ADJUST and ENTER must be pushed to execute this command.

BACKUP DATA SUB-MENU

This function is used to backup/save all data from internal settings to file on USB device. The **BACKUP DATA** function also provides a convenient means of transferring settings from one EN6021 Control to another.

Figure 5-65.
Backup Data sub-menu

- **File: EN6021*xx*** – unique File name (***xx***=00–99) whose data is to be saved; same File name will be used on USB device.
- **Confirm** – YES option must be selected using **+/–**ADJUST and ENTER must be pushed to execute this command.
- **USB** – displays status of USB device to determine if **BACKUP DATA** function can be completed.
  - Ready indicates USB device is connected to control's USB-A port and **BACKUP DATA** function can be completed.
  - Not ready indicates there is **no** USB device connected to control's USB-A port and **BACKUP DATA** function cannot be completed.

RESTORE DATA SUB-MENU

This function is used to restore/reload all data from file on USB device to control's internal memory. The **RESTORE DATA** function also provides a convenient means of transferring settings from one EN6021 Control to another.

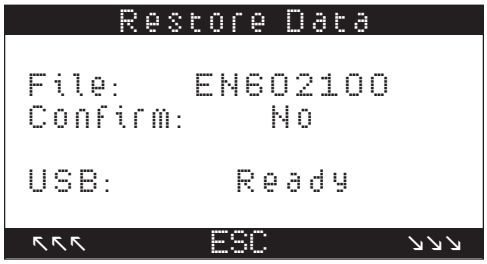


Figure 5-66.
Restore Data sub-menu

- **File: EN6021*xx*** – unique File name (***xx***=00–99) on USB device whose data is to be restored; same File name will be used on control.
- **Confirm** – YES option must be selected using **+/–** ADJUST and ENTER must be pushed to execute this command.
- **USB** – displays status of USB device to determine if **RESTORE DATA** function can be completed.
  - Ready indicates USB device is connected to control's USB-A port and **RESTORE DATA** function can be completed.
  - Not ready indicates there is **no** USB device connected to control's USB-A port and **RESTORE DATA** function cannot be completed.

5.5.9 UTILITY MENU (cont.)

COPY WELD LOG SUB-MENU

The **COPY WELD LOG** function is used to copy/export Weld Log data from control's internal memory to file on USB device. File format is .CSV which can be opened with Microsoft® Office Excel.

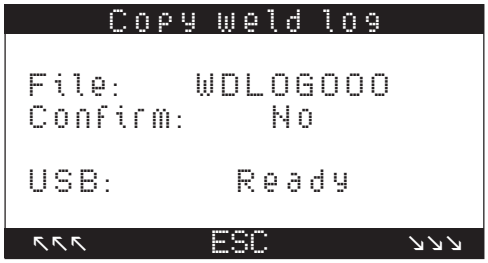


Figure 5-67.
Copy Weld Log sub-menu

File: WDLOG*xxx* – unique File name (***xxx***=000–255 indicates Index number of Weld Log) whose data is to be copied; same File name will be used on USB device.

Confirm – YES option must be selected using +/–ADJUST and ENTER must be pushed to execute this command.

USB – displays USB device status to determine if **COPY WELD LOG** function can be completed.

Ready indicates USB device is connected to control's USB-A port and **COPY WELD LOG** function can be completed.

Not ready indicates there is **no** USB device connected to control's USB-A port and **COPY WELD LOG** function cannot be completed.

COPY ERROR LOG SUB-MENU

The **COPY ERROR LOG** function is used to copy/export Error Log data from control's internal memory to file on USB device. File format is .CSV which can be opened with Microsoft® Office Excel.

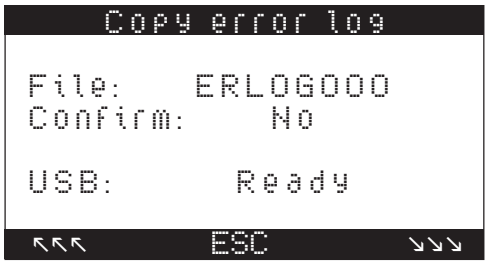


Figure 5-68.
Copy Error Log sub-menu

File: ERLOG*xxx* – unique File name (***xxx***=000–255 indicates Index number of Error Log) whose data is to be copied; same File name will be used on USB device.

Confirm – YES option must be selected using +/–ADJUST and ENTER must be pushed to execute this command.

USB – displays USB device status to determine if **COPY ERROR LOG** function can be completed.

Ready indicates USB device is connected to control's USB-A port and **COPY ERROR LOG** function can be completed.

Not ready indicates there is **no** USB device connected to control's USB-A port and **COPY ERROR LOG** function cannot be completed.

RESET LOGS SUB-MENU

This function is used to clear/delete Weld Log and Error Log records currently in memory. Weld Log will be reset independent of Error Log, allowing option of resetting only one or the other.

This function must be confirmed by selecting YES option using +/–ADJUST and ENTER must be pushed to execute **RESET LOGS** function.

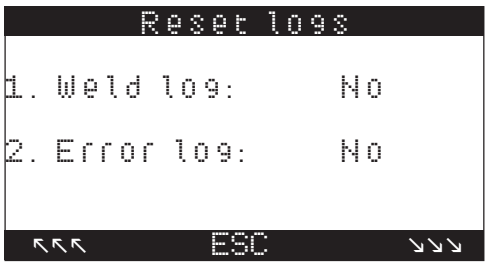


Figure 5-69.
Reset Logs sub-menu

If No is selected and ENTER pushed, specified log will **not** be reset.

5.5.9 UTILITY MENU (cont.)

SET PIN SUB-MENU

This function is used to set four-digit PIN number for control to prevent changes to programmed settings by unauthorized personnel.

Figure 5-70.
Set PIN sub-menu

Setting a non-zero PIN number locks **Main Menu** parameters to "read-only". When Edit Lock function is enabled, flashing LK is displayed on left end of Title Section.

PIN: x*xxx* – each digit (***x***) can be set from 0–9. Each digit is set separately, pushing ENTER after selecting chosen value for each.

Confirm – YES option must be selected using **+/–**ADJUST and ENTER must be pushed to execute this command.

When Edit Lock function is enabled and user attempts to access **Main Menu**, **PIN Input** page is displayed. User must input PIN number to access menus and modify parameters or use Program Lockout key switch to disable this function.

SET TIME/DATE SUB-MENU

This function allows user to set current time and date for control's real-time clock which is used for Weld and Error Log entries.

Figure 5-71.
Set Time/Date sub-menu

Time: Hr:Mi:Sc – displays current time setting.

Date: Mn/Dy/Yr – displays current date setting.

New: Hr:Mi:Sc – enter new time setting.

Hr = Hours (programmable values = 00-23)

Mi = Minutes (programmable values = 00-59)

Sc = Seconds (programmable values = 00-59)

Each digit is set separately, pushing ENTER after selecting current value for each.

New: Mn/Dy/Yr – enter new date setting.

Mn = Month (programmable values = 01-12)

Dy = Day (programmable values = 01-31)

Yr = Year (programmable values = 00-99 indicates last two digits of year)

Each digit is set separately, pushing ENTER after selecting current value for each.

Confirm – YES option must be selected using **+/–**ADJUST and ENTER must be pushed to execute this command.

5.5.10 ABOUT MENU

The **About Menu** displays important information about the EN6021 Control. No changes can be made on this menu. This information is useful when contacting factory for service.

Version: ***x.xx*** – indicates version of Firmware.
SN: ***xxxxxxxxxx*** – indicates ten-digit Serial Number of control (CPU unit).

Figure 5-72.
About Menu

Accessed from the **About Menu**, the **Setup Page** is for factory use only. If screen in Figure 5-73 is displayed, use F2 to return to **About Menu**.

Figure 5-73.
Setup Page access

6.0 OPERATING INSTRUCTIONS

! CAUTION !

READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL OR OPERATE THIS CONTROL.

6.1 OPERATING SAFETY INSTRUCTIONS

Please follow all applicable safety and accident prevention regulations. Appropriate engineering standards and codes must be followed.

Be sure **ALL** electrical connections are properly made and that all fittings are securely tightened. Loose electrical connections can cause faulty or erratic operation of the control or welding machine.

Mounting of control cabinet should be free from excessive vibrations.

Parts may have sharp edges – gloves may be required.

When enclosures are modified, metal filings may get inside electronic components. It is also possible that water may leak into electronic components. Customer should use practices to prevent short circuits that water and metal filings can cause. **ENTRON will not honor warranty claims due to these problems.**

Control cabinet style **must be** chosen for environment in which it will be used.

Control devices can fail or be programmed in an unsafe condition. Unless proper safeguards are incorporated by designer, malfunction or improper programming of these devices could lead to sudden equipment startup, shutdown, or latch-up. Failure can also be exhibited as erratic or unexpected operation. Such startup or shutdown or unexpected operation could result in death or serious injury to personnel and/or damage to equipment. If customer uses any programmable controls with equipment which requires operator or attendant, be aware that this potential safety hazard exists and take appropriate precautions.

Control **must be** operated only with door closed.

Danger of damages through static discharge! Components of the EN6021 may be damaged by static discharge. Do not touch any components or printed circuits with your hands without dissipating static charge.

! CAUTION !

High voltage and low voltage inputs **must be** arranged to avoid negative effects on weld control through capacitive or inductive interference. Isolate high voltage and low voltage initiations as much as possible.

! WARNING !

Resistance welding can create splashes and flash. **Proper eye protection must be used!** Gloves can also protect users from burns or hot parts.

6.1 OPERATING SAFETY INSTRUCTIONS (cont.)

Follow Error Code Messages on RPP2 and ENLINK and take appropriate measures to rectify (see Section 11.0).

Set electrode open spacing to 1/4″ or less. If this cannot be accomplished, be certain that guarding or other protection scheme is in place.

Weld Valve 1–3 (SV1, SV2, SV3) are protected by control relays (see Section 3.2). It is machine designer's responsibility to protect operators from electrode movement.

Excessive welding current can damage fixture and cause flash and burns. Be cautious when selecting schedules and programming parameters.

! WARNING !

DAMAGE TO PROPERTY THROUGH EXCESSIVE WELDING CURRENT!
The maximum welding current of transformer and fixturing used must not be exceeded.

6.2 GENERAL OPERATING INSTRUCTIONS

1. Make basic connections as shown in Figure 6-1. Additional connections (see Section 4.4.3) may be needed, depending on installation requirements, but connections shown are the most basic which are required in order to run equipment. For your convenience, many electrical and mechanical connections have been performed at the factory. Refer to Wiring Diagram for other connections.

2. If the machine is air operated, turn on the air supply to the machine. Set air pressure in accordance with the machine manufacturer's recommendations.

3. Make sure sufficient cooling water is turned on.

4. Be sure that the welding machine heads are fully retracted. Turn on main power. RPP2 will turn on.

5. Place the control in No Weld. Use either RPP2's WELD/NO WELD feature (see Section 5.1) or External Weld/No Weld Switch connected to Terminal Strip between NW1 and FSC (see Figure 6-1).

6. Use CLEAR function in **Configure Menu** to clear the EN6021's memory (see Section 5.5.6).

7. Edit **Calibration Menu** to set TOROID SENSITIVITY, MAXIMUM CURRENT, and TURNS RATIO parameters to suit equipment (see Section 5.5.7).

8. Program SCHEDULE 0 to set up basic weld sequence (see Section 6.3).

9. Perform a welding operation. Begin by using machine short-circuit (i.e., without metal to be welded). Control should report measured current on **Status Page 1** and **2**.

10. Make any other adjustments which may be required and set up SCHEDULE for welding.

6.2 GENERAL OPERATING INSTRUCTIONS (cont.)

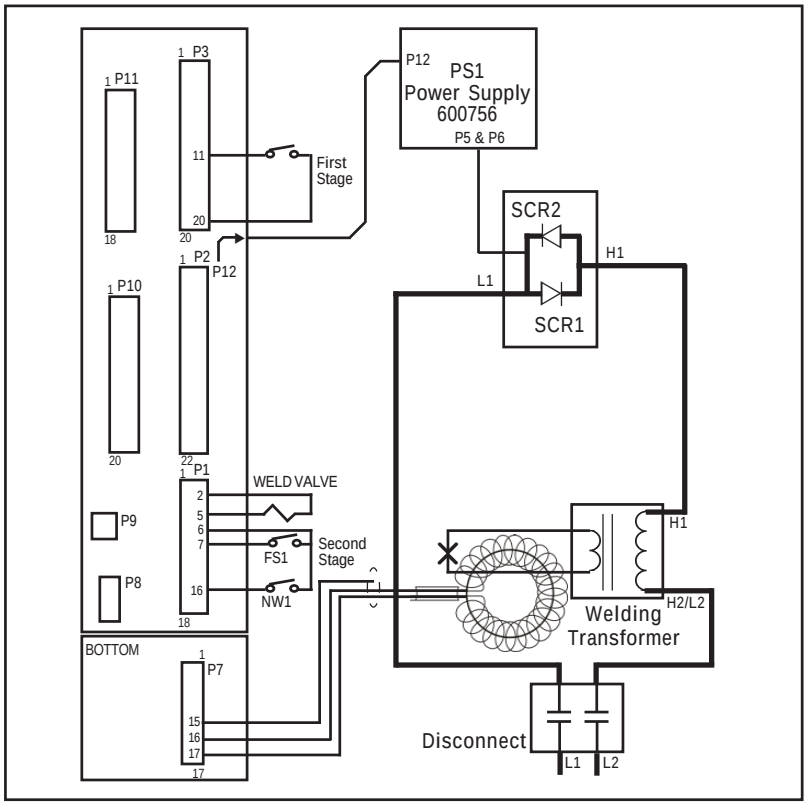


Figure 6-1. *Basic connections*

6.3 WELD SEQUENCE EXAMPLE

Program a simple single **Spot** SCHEDULE into the control as follows:

SQUEEZE time	30 to 60 cycles
VALVE	1 (Valve 1 only)
WELD1 time	12 to 25 cycles
MODE	Phase Shift
HEAT1	50 to 60% (Percent Current)
COOL1 time	0 cycles
SLOPE	0
HOLD time	10 to 15 cycles
OFF time	0 cycles
IMPULSES	1 (No Impulses)
CYCLE MODE	Non-repeat

1. Initiate the control. On installations with Two Stage Pilot switch, depress First Stage only. The programmed valve will activate. Control will not sequence through SQUEEZE, WELD, HOLD and OFF. Be sure that electrodes have closed together prior to depressing Second Stage.

2. The control will sequence but will not weld, and then head or arms will retract. On Single Stage operation, closure of Pilot switch will cause control to sequence. On foot-operated machines only, a switch on mechanical linkage of machine will initiate sequence.

! CAUTION !

KEEP HANDS, ARMS, OTHER PORTIONS OF THE BODY, CLOTHING, AND TOOLS AWAY FROM THE MOVING PARTS OF THE MACHINE.

3. Program SCHEDULE for part to be welded. Place part in machine and set Weld/No Weld switch (both on RPP2 and any External Weld/No Weld Switches) to Weld. The machine is ready to weld.

4. If no standards have been set, it is recommended to use a short WELD count for initial setup and welding. WELD count can be increased, HEAT can be adjusted, and welding transformer tap (if applicable) can be increased for the best weld. The most efficient use of control and welding machine will generally be made at lowest welding transformer tap, highest heat setting, and shortest weld count.

5. For Repeat operation, program CYCLE MODE to **Repeat**, and program OFF count to allow sufficient time to reposition part for subsequent welds.

8.0 ENLINK 6021 SOFTWARE

ENLINK 6021 software is available for use with the EN6021. This offers the user the ability to program and monitor the welding control and to backup all of the programmed data on a PC.

The EN6021 may be connected to the PC via RS232 (one control only) or via Ethernet (multiple controls on a network).

ENLINK 6021 is available on CDROM, and works with all versions of Microsoft Windows™ (XP onwards). Contact factory for more details.

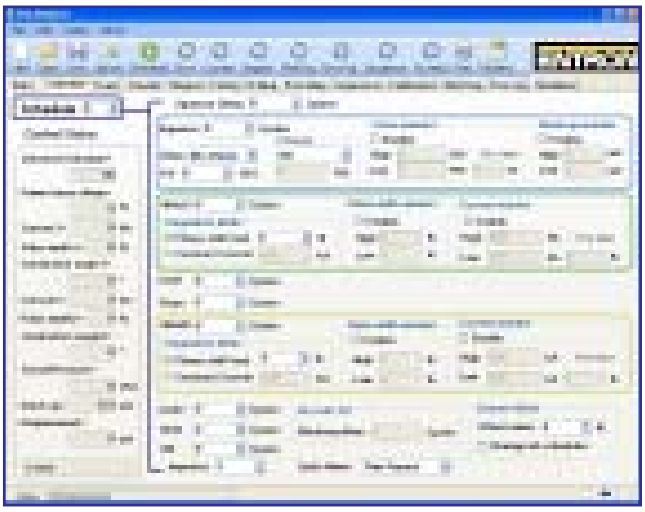


Figure 8-1. *ENLINK 6021 software*

9.0 APPLICATIONS AND PROGRAMMING EXAMPLES

The EN6021 Control can be programmed for numerous welding applications. A few of them are highlighted here to help understand control operation.

The schedules shown are for demonstration purposes. In order to easily follow visually the schedules as they progress, the individual times in each one have been made longer than they would be for an actual machine operation. Phase Shift mode is used for simplicity. Parameters used are functions which need to be changed after CLEAR function is performed.

9.1 SPOT MODE EXAMPLES

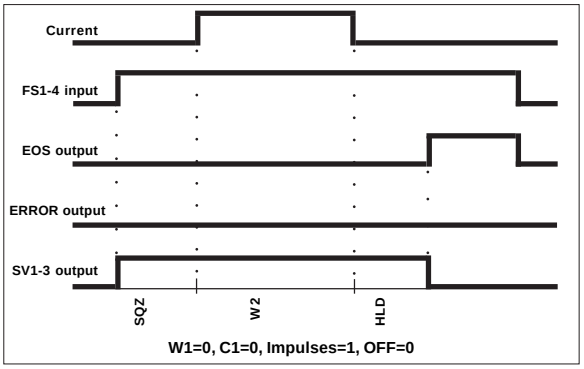


Figure 9-1. *Basic Spot Weld—No Weld Faults*

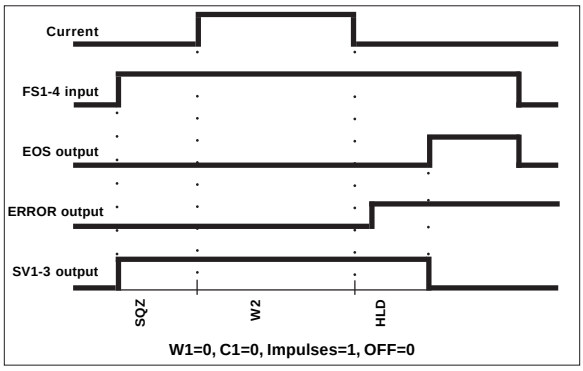


Figure 9-2. *Basic Spot Weld—Weld Fault*

EOS SIGNAL

In Spot operation, at the end of the weld sequence, the End of Sequence Output (EOS) switches on for 0.5 seconds.

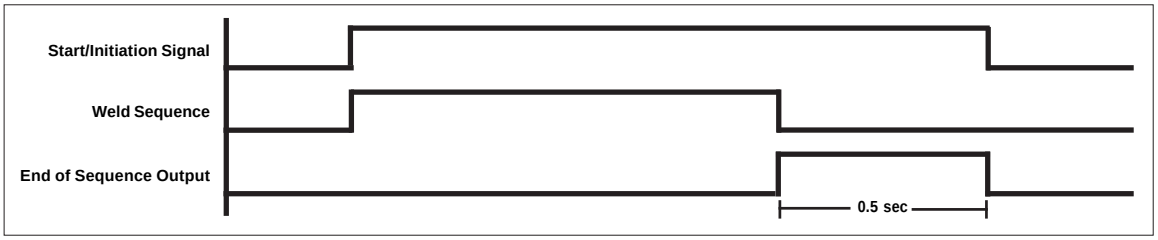


Figure 9-3. *End of Sequence in Spot operation*

If a new weld sequence is initiated during the time the EOS is on, the End of Sequence Output will be reset and switches off.

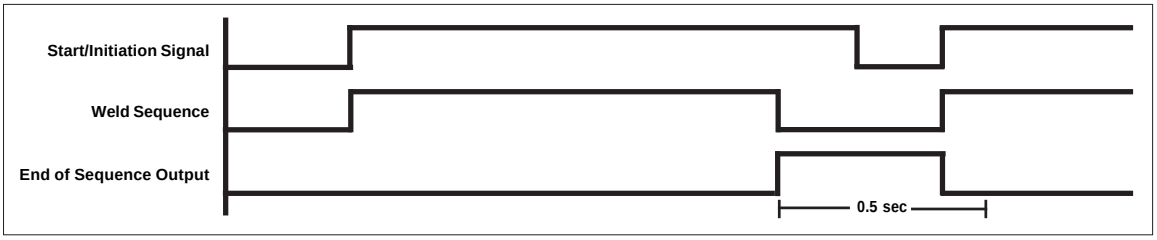


Figure 9-4. *End of Sequence with new start/initiation signal*

9.1.1 SPOT WITH REPEAT MODE

SCHEDULE 0 is a **Spot** sequence in **Repeat** CYCLE MODE. Momentary initiation results in one sequence only. If initiation is held closed, sequence will continue repeating. VALVE 2 output is used.

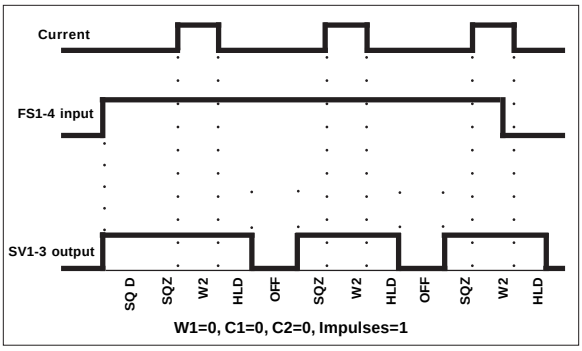


Figure 9-5. *Repeat Spot Weld*

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
0	40	2	0	0	0	0	30	60	0	10	15	1	Repeat

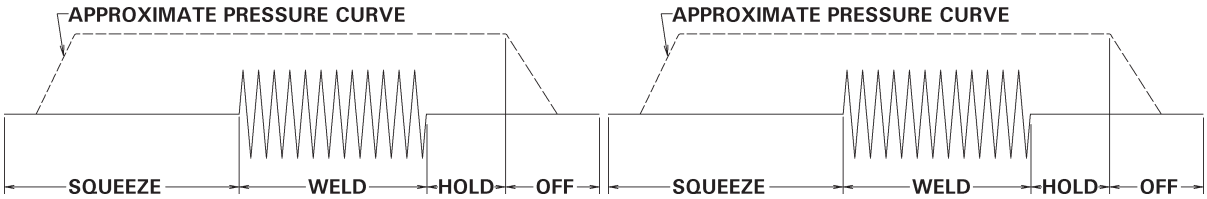


Figure 9-6. *Spot with Repeat CYCLE MODE*

9.1.2 PULSATION WITH SUCCESSIVE MODE

SCHEDULES 1 and 2 are **Pulsation** and **Spot** schedules combined in **Successive** CYCLE MODE. SCHEDULE 1 is initiated first. When SCHEDULE 1 is completed, SCHEDULE number will flash on **Status Page 1** on RPP2 to indicate that sequence is in Successive mode and ready to be initiated again. After sequence is completed, **Status Page 1** will display **S01**. SCHEDULE 1 uses VALVE 1, SCHEDULE 2 uses VALVE 2.

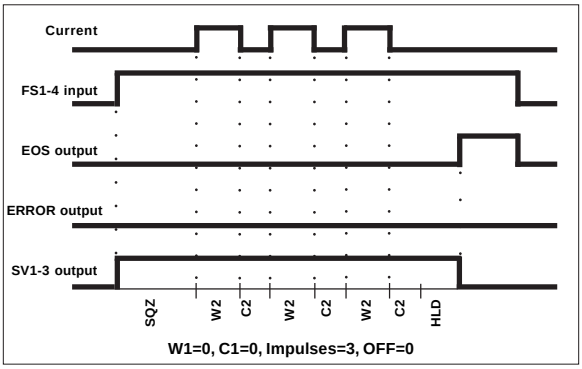


Figure 9-7. *Pulsation Spot Weld*

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
1	20	1	0	0	0	0	10	60	6	10	0	3	Successive
2	25	2	0	0	0	0	30	60	0	10	0	1	Non-repeat

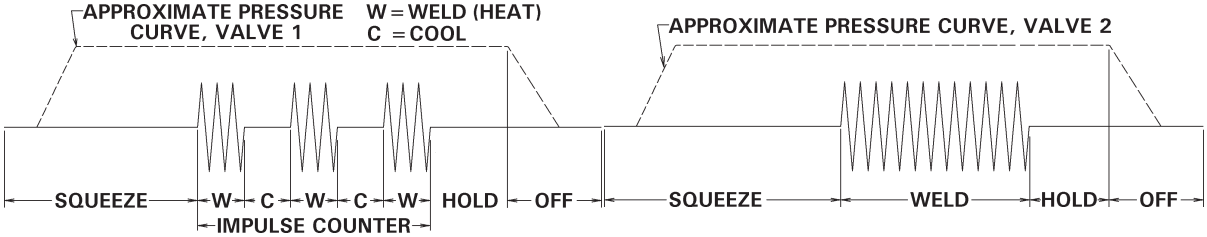


Figure 9-8. *Pulsation with Successive CYCLE MODE*

9.1.3 QUENCH-TEMPER WITH CHAINED MODE

SCHEDULES 3 and 4 are chained together to illustrate **Quench-Temper** operation. SCHEDULE 3 performs SQUEEZE, WELD and QUENCH functions (using HOLD for QUENCH), and SCHEDULE 4 performs TEMPER and HOLD functions (using WELD for TEMPER). VALVE 3 output is used.

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
3	40	3	0	0	0	0	35	60	0	35	10	1	Chained
4	00	3	0	0	0	0	30	40	0	20	10	1	Non-repeat

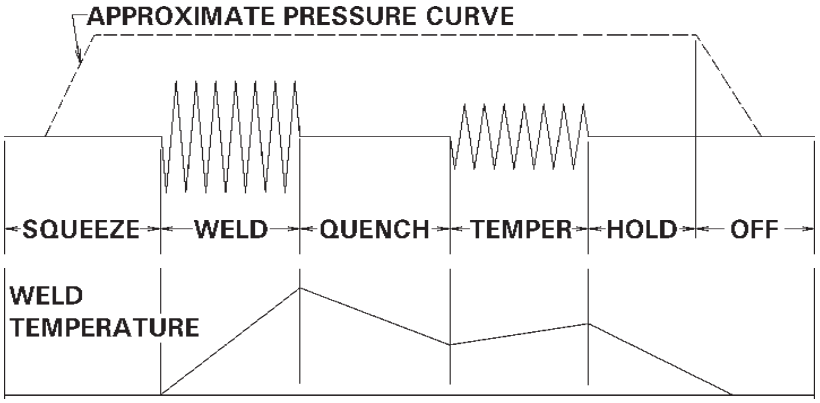


Figure 9-9. *Quench-Temper with Chained CYCLE MODE*

9.1.4 SLOPE OPERATION

SLOPE function is hard coded into firmware to occur between WELD1 and WELD2. The direction (Up or Down) is determined by settings in HEAT1 and HEAT2. If HEAT1 is lower than HEAT2, control will **slope up** from HEAT1 to HEAT2 – see SCHEDULE 5 and Figure 9-11. If HEAT1 is higher than HEAT2, control will **slope down** from HEAT1 to HEAT2 – see SCHEDULE 6 and Figure 9-12.

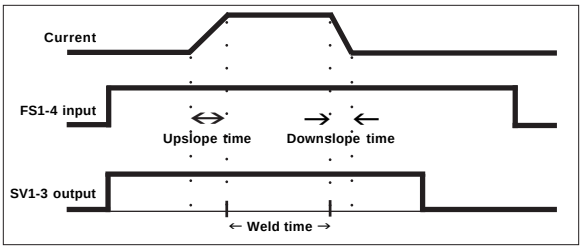


Figure 9-10. *SLOPE function in Spot Weld*

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
5	40	1	0	20	0	20	45	85	0	20	0	1	Non-repeat

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
6	40	1	45	85	0	20	0	20	0	20	0	1	Non-repeat

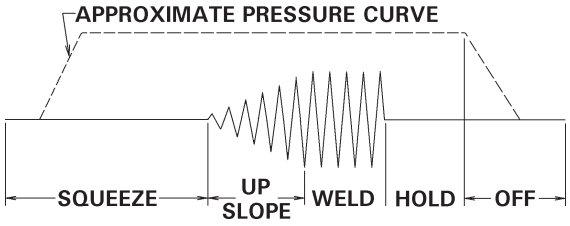


Figure 9-11. *UPSLOPE*

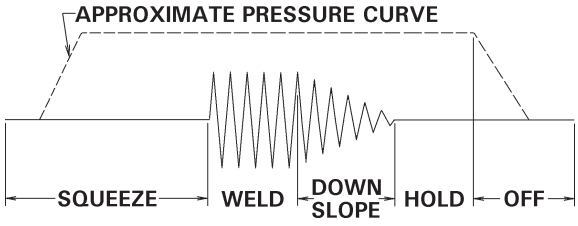


Figure 9-12. *DOWNSLOPE*

To combine UPSLOPE and DOWNSLOPE, at least two (2) Chained SCHEDULES are required. SCHEDULES 7 and 8 are chained together to illustrate SLOPE function. WELD2 of SCHEDULE 7 establishes HEAT at which UPSLOPE will begin (bottom current). SCHEDULE 8 sets DOWNSLOPE time and HEAT at which it will finish. WELD times (in example, SCHEDULE 7 WELD1) can be set to zero (0) to give control starting or ending points. VALVE 1 output is used for this example.

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
7	40	1	0	20	0	20	35	80	0	0	0	1	Chained
8	0	1	0	80	0	20	0	30	0	0	0	1	Non-repeat

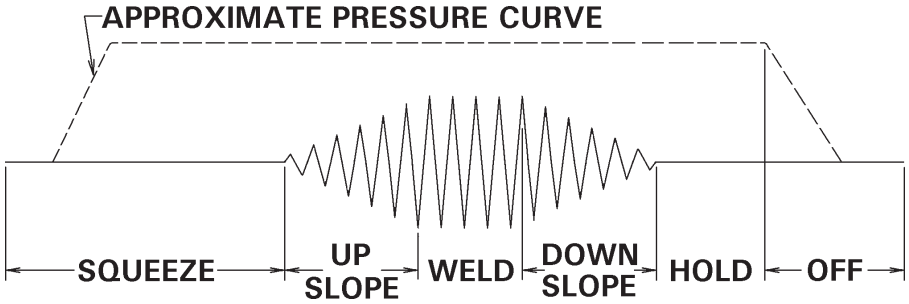


Figure 9-13. *SLOPE with Chained CYCLE MODE*

9.1.4 SLOPE OPERATION (cont.)

SLOPE operation is most easily understood and programmed as above in SCHEDULES using **only** Phase Shift mode or in SCHEDULES using **only** Constant Current mode. In SCHEDULES using **both** CURRENT REGULATION MODES, programming is not as simple and different from example above. When using **both** Phase Shift and Constant Current modes in Chained SCHEDULES, control needs to know current values to start from or end with. There must be some non-zero WELD1 or WELD2 time before SLOPE is started.

9.1.5 BUTT WELD WITH CHAINED MODE

SCHEDULES 9 and 10 are chained together to perform **Butt Weld** sequence. SCHEDULE 9 contains only SQUEEZE time with VALVE 1 output, and is used as the CLAMP function. SCHEDULE 10 follows the CLAMP function with a normal SQUEEZE, WELD, HOLD sequence with VALVE 2 output. Both VALVE outputs turn off at the end of HOLD time.

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
9	20	1	0	0	0	0	0	0	0	0	0	1	Chained
10	20	1+2	0	0	0	0	10	50	0	10	10	1	Non-repeat

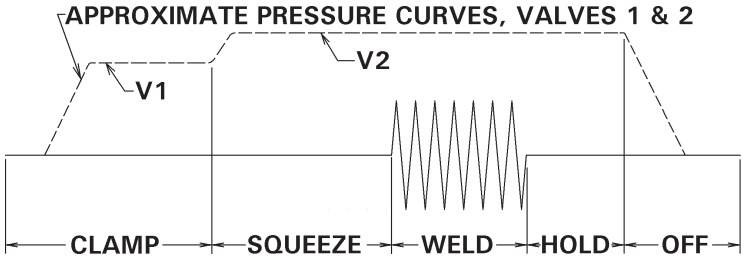


Figure 9-14. *Butt Weld with Chained CYCLE MODE*

9.1.6 FORGE DELAY WITH CHAINED MODE

The forging process is most often used when working with hard-to-weld materials such as aluminum. The weld is usually started at one force, followed by application of a higher force during weld or hold time. This action may refine the weld zone, and provide a more homogeneous weld nugget. Timing of application of forging force is critical. If applied too soon, welding current may be insufficient for higher force. If applied too late, weld will have solidified and forging force will do no good.

Forge Delay is defined as delay from beginning of WELD to activation of forging solenoid valve. To accomplish **Forge Delay** operation on EN6021 Control, it is necessary to chain together two or more schedules as outlined below.

1. Program first SCHEDULE with amount of WELD time desired before activation of forging valve. Use any one of three solenoid VALVE outputs.
2. For **Forge during WELD**, program second SCHEDULE with remaining WELD time and program an unused VALVE output. This second VALVE output activates forging valve.

NOTICE
For continuous current from first SCHEDULE to second SCHEDULE, do not program any HOLD time in first SCHEDULE or SQUEEZE time in second SCHEDULE.

3. For **Forge after WELD**, program number of cycles of time between WELD time and activation of forge valve in HOLD time of first SCHEDULE or in SQUEEZE time of second SCHEDULE.

In this example, VALVE 1 will be standard valve and VALVE 2 will be forging valve. Total WELD time is 15 cycles at 95 HEAT with forging valve activated after 10 cycles.

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
11	20	1	0	0	0	0	10	95	0	0	0	1	Chained
12	0	1+2	0	0	0	0	5	95	0	20	0	1	Non-repeat

For **Forge during WELD**, it is possible to select a HEAT for second SCHEDULE different from that of first SCHEDULE.

Other combinations of weld schedules may be combined to create other forging schedules. For example, it would be possible to use SLOPE in first sequence and PULSATION in second sequence.

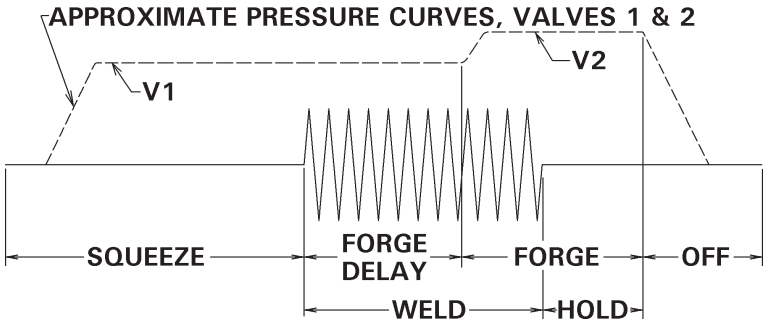


Figure 9-15. *Forge Delay with Chained CYCLE MODE*

9.1.7 FORGE DELAY USING EVENTS

Forge Delay can also be accomplished using Event function.

In this example, VALVE 1 will be standard valve and PO10 will be forging valve. Total WELD time is 15 cycles at 95 HEAT with forging valve activated after 10 cycles.

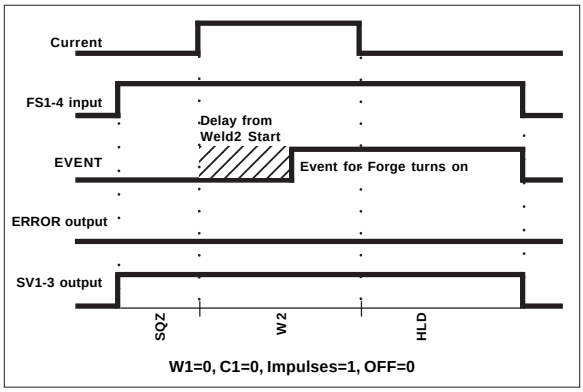


Figure 9-16. *Forge Delay Weld using Events*

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
13	20	1	0	0	0	0	15	95	0	0	0	1	Non-repeat

For **Forge during WELD**, it is possible to turn on an Event OUTPUT during WELD time.

An OUTPUT must be chosen and mapped to Event in **I/O Map Menu** – PO10=Event (see Section 5.5.8).

In **Event Menu**, this mapped OUTPUT (PO10) must be enabled and set to **On** status in **Weld2** INTERVAL with DELAY setting of **10** (see Section 5.5.2).

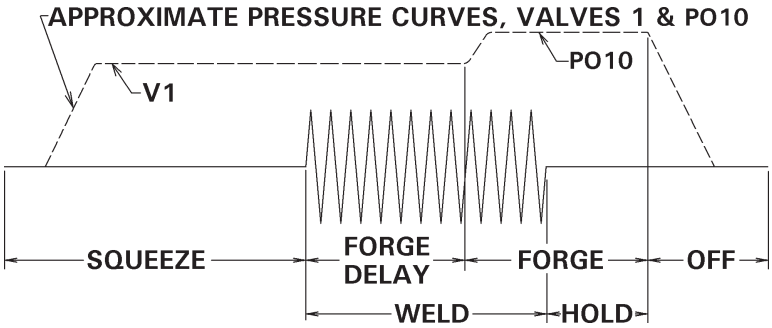


Figure 9-17. *Forge Delay using Events*

9.2 SEAM MODE EXAMPLES

9.2.1 SEAM1 MODES

CONTINUOUS SEAM MODE

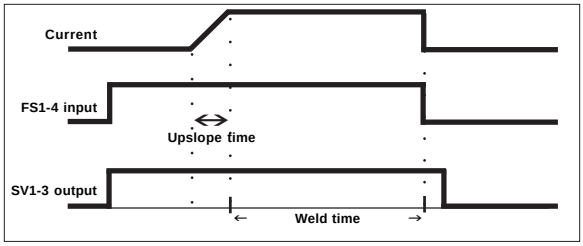


Figure 9-18. *Continuous Seam Weld*

SCHEDULE 14 is a **Continuous Seam** mode. The control is switched to **Seam** mode by programming WELD MODE to Seam1 in **Configure Menu** (see Section 5.5.6). Welding current starts when initiation contact is closed, and stays on as long as it is held closed. To switch control back to Spot mode, program WELD MODE to Spot in **Configure Menu** (see Section 5.5.6).

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
14	10	1	0	0	0	0	1	40	0	10	10	1	Non-repeat

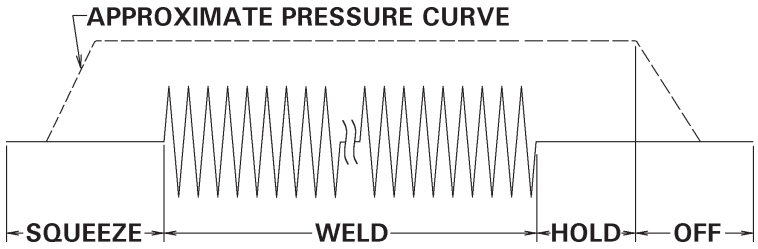


Figure 9-19. *Continuous Seam mode*

INTERMITTENT SEAM MODE

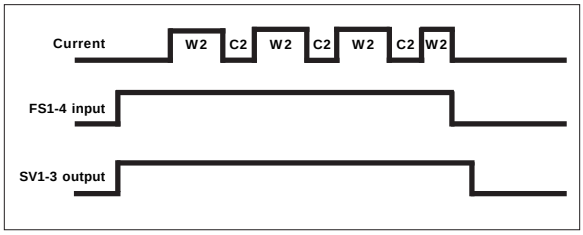


Figure 9-20. *Intermittent Seam Weld*

SCHEDULE 15 is an **Intermittent Seam** mode. The control is switched to **Seam** mode by programming WELD MODE to Seam1 in **Configure Menu** (see Section 5.5.6). Intermittent operation is accomplished by programming a value other than 0 (zero) for COOL2. To switch control back to Spot mode, program WELD MODE to Spot in **Configure Menu** (see Section 5.5.6).

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
15	10	1	0	0	0	0	20	40	5	10	10	1	Non-repeat

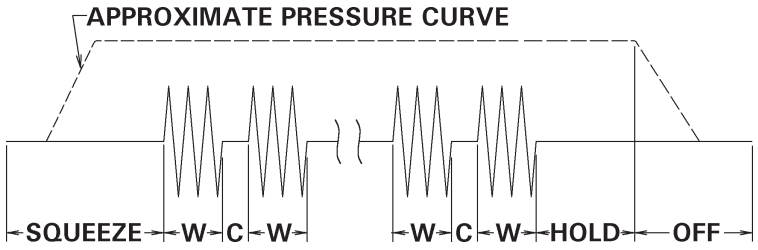


Figure 9-21. *Intermittent Seam mode*

9.2.1 SEAM1 MODES (cont.)

INTERMITTENT SEAM MODE WITH WELD1/COOL1

SCHEDULE 16 is an **Intermittent Seam** mode using WELD1 and COOL1. The control is switched to **Seam** mode by programming WELD MODE to **Seam1** in **Configure Menu** (see Section 5.5.6). This example shows how WELD1 and COOL1 are used in Seam mode. WELD1 and COOL1 are only used after SQUEEZE time once; while WELD2 and COOL2 are repeated as long as initiated. Intermittent operation is accomplished by programming a value other than 0 (zero) for COOL2. To switch control back to Spot mode, program WELD MODE to **Spot** in **Configure Menu** (see Section 5.5.6).

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
16	10	1	30	20	10	0	20	40	5	10	10	1	Non-repeat

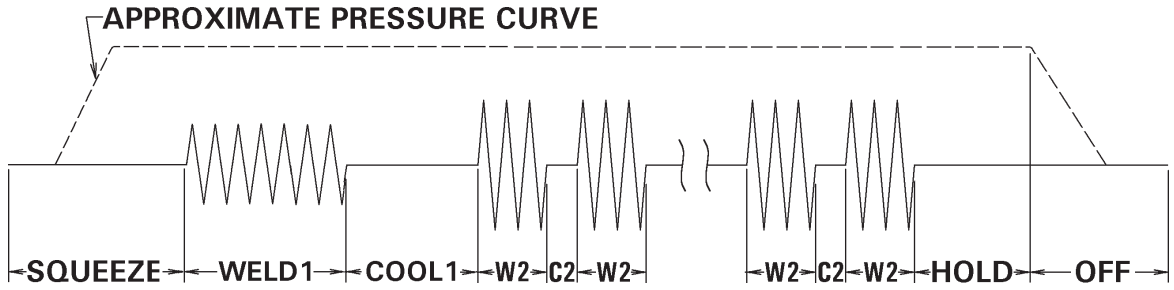


Figure 9-22. *Intermittent Seam mode using WELD1/COOL1*

SEAM MODE WITH MULTIPLE INITIATIONS

The four start initiations FS1–FS4 can be used in Seam mode and operate differently in Seam mode than in Spot mode. The SCHEDULES used for FS1–FS4 remain as Spot mode. FS1–FS4 use selected SCHEDULE, SCHEDULE 20, 40, 60 respectively. Multiple FS closures may be closed at the same time. The highest order initiation will be used by control. When that initiation is opened, the next highest order initiation will take over without any gap in current.

INI	SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
FS1	17	10	1	0	0	0	0	1	20	0	10	10	1	Non-repeat
FS2	20	10	1	0	0	0	0	1	40	0	10	10	1	Non-repeat
FS3	40	10	1	0	0	0	0	1	60	0	10	10	1	Non-repeat
FS4	60	10	1	0	0	0	0	1	80	0	10	10	1	Non-repeat

9.2.1 SEAM1 MODES (cont.)

SEAM MODE WITH MULTIPLE INITIATIONS (cont.)

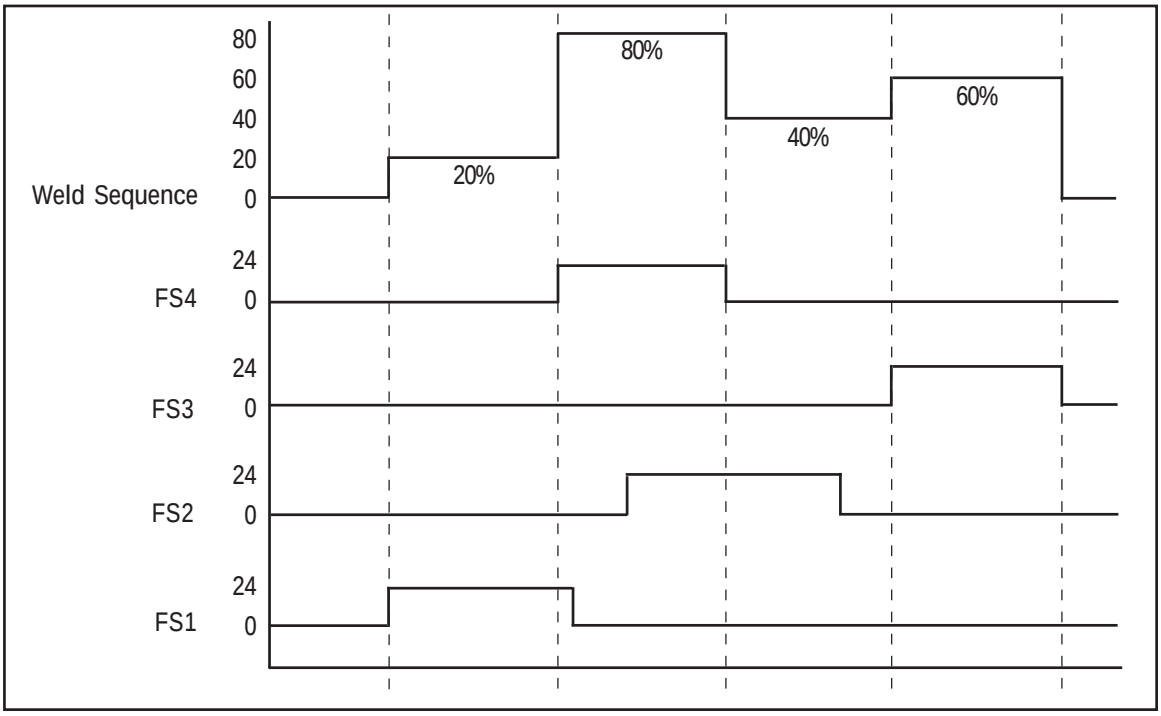


Figure 9-23. *Seam mode with multiple initiations*

9.2.2 SEAM2 MODE

Seam2 mode is used in cases where **Seam** (Beat mode) and **Spot** (Non-beat mode) need to be combined. The control is switched to **Seam2** mode by programming WELD MODE to Seam2 in **Configure Menu** (see Section 5.5.6).

In some applications, a non-timed initiation-controlled heat (Beat) is first required, then at some point a timed heat (Non-beat) is needed. An application which requires Seam2 mode would be flash upset welding. This type of resistance welding typically requires a weld (flash) at the start in which its timing is dependent on many variables, not just time. Then after weld (flash) cycle is complete, force is changed and a timed current is started (upset). In Seam2 mode, FS1 starts Seam (Beat) mode weld. FS2, FS3, and FS4 (SCHEDULES 20, 40, 60) will immediately start Spot (Non-beat) mode weld.

FS2, FS3, and FS4 do not need to be initiated simultaneously with FS1. FS2, FS3, and FS4 can be initiated independent of FS1 for machines that require both Seam and Spot modes.

9.2.3 SEAM MODE WITH TIMED HEATS (LONG CHAIN IN SPOT)

This mode was primarily designed as a **Non-Beat Seam** mode. It enables a user to execute a fixed time weld using a number of schedules in addition to using two heats within single schedule.

Set control to Spot mode by programming WELD MODE to **Spot** in **Configure Menu** (see Section 5.5.6).

NOTICE
By definition, Seam mode is a Beat mode operation. In normal Seam mode, Chained CYCLE MODE of welding schedules is not available. This is an example of Seam weld made in Spot mode (Non-Beat).

In order to obtain a long series of heat patterns, SCHEDULES can be chained as normal to execute a second, third or more subsequent SCHEDULE. For example:

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
1	20	1	70	50	0	0	50	70	0	0	0	1	Chained
2	0	1	70	50	0	0	50	80	0	0	0	1	Chained
3	0	1	70	60	0	0	50	90	0	0	0	1	Chained
4	0	1	50	10	0	0	50	65	0	0	0	1	Non-repeat

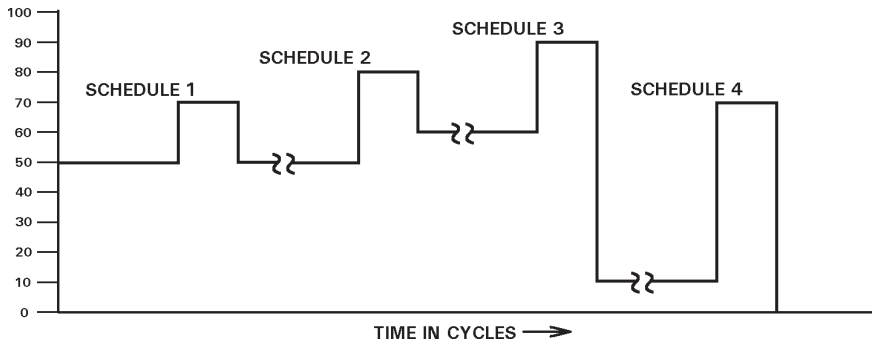


Figure 9-24. *Seam mode with timed heats*

9.2.4 SQUEEZE DELAY (WELD CURRENT DELAY)

When used in Seam mode, **SQUEEZE DELAY** is sometimes known as Weld Current Delay. This function provides a time delay and output to seam welding machine's solenoid valve circuit. When weld wheels are lowered, a delay before applying weld current is required to insure wheels are together and sufficient pressure is attained. SQUEEZE DELAY can be set for each SCHEDULE.

To add SQUEEZE DELAY to Seam sequence, program desired SQUEEZE DELAY time. If sequence is programmed for Intermittent Seam or Roll Spot, programmed SQUEEZE DELAY time will only be in effect upon initiation.

To return control back to Spot mode, WELD MODE must be programmed to **Spot** in **Configure Menu** (see Section 5.5.6).

9.3 BRAZING APPLICATION

Brazing operations differ from spot welding operations in that a much longer heating time may be required. This is because a much larger area must be raised to melting temperature of brazing material. Depending on the mass of parts to be brazed, this time may vary from several cycles to several seconds. The EN6021 Control can be operated in two **Brazing** modes: **Automatic** for short brazing times and **Manual** which is most useful for long brazing times.

9.3.1 AUTOMATIC BRAZING MODE

For **Automatic Brazing** mode, the EN6021 is initiated in the same manner as for Spot welding. However, it must be programmed for **Beat During Squeeze + Weld** (BEAT MODE=SQZ.+Weld) in BEAT MODE function in **Configure Menu**, in accordance with instructions in Section 5.5.6.

In this mode, initiation must be held closed for time required to bring parts to desired brazing temperature. If this time is longer than 99 cycles, two or more SCHEDULES must be chained together. If operator then opens initiation, brazing current turns off immediately and sequence advances to HOLD time, and after HOLD time, electrodes retract. Control will terminate weld sequence normally at end of programmed schedule if initiation switch remains closed.

9.3.2 MANUAL BRAZING MODE

For **Manual Brazing** mode, **Beat During Squeeze + Weld** is also programmed as above. In addition, set WELD, HEAT and IMPULSES to 99, and VALVE in accordance with job requirements, and all other parameters to default values. Initiation switches are connected to P1 as shown in Figure 9-25. Enable Second Stage operation by setting INPUT PI9 to 2nd Stage in **I/O Map Menu** (see Section 5.5.8).

Operation in this mode is as follows: When First Stage is closed, brazing electrodes close on the work. When Second Stage is closed, brazing current comes on. If Second Stage is opened, brazing current stops, but electrodes stay closed. Current may be turned on and off in this manner as many times as desired by operator. When First Stage is opened, electrodes retract.

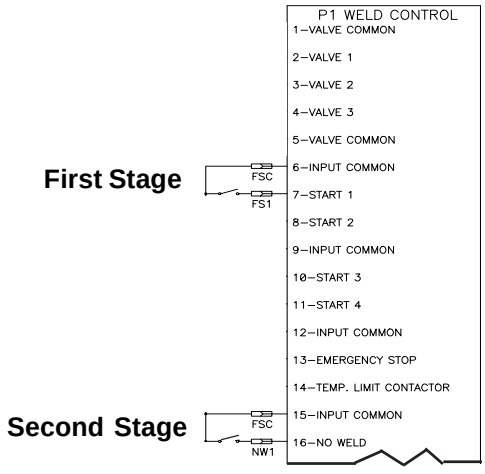


Figure 9-25. *Two Stage initiation in Brazing mode*

9.4 SQUEEZE DELAY APPLICATION

Some applications require the welder arms be opened wide to allow the electrodes to access areas to be welded. SQUEEZE DELAY was designed for use with welding guns and stationary machines incorporating standard air cylinders and valves without retraction features. The additional time provided by SQUEEZE DELAY will allow electrodes to travel a greater distance and simulate retraction function. SQUEEZE DELAY is only active in first SCHEDULE in Repeat sequence.

Each SCHEDULE has SQUEEZE DELAY parameter available for programming. Setting control for SQUEEZE DELAY will provide additional time before programmed SQUEEZE time in selected SCHEDULE. SQUEEZE DELAY time occurs only during first SQUEEZE of a series of repeated welding sequences (Repeat CYCLE MODE).

If not required, set SQUEEZE DELAY to 0 in **Schedule Menu** (see Section 5.5.1).

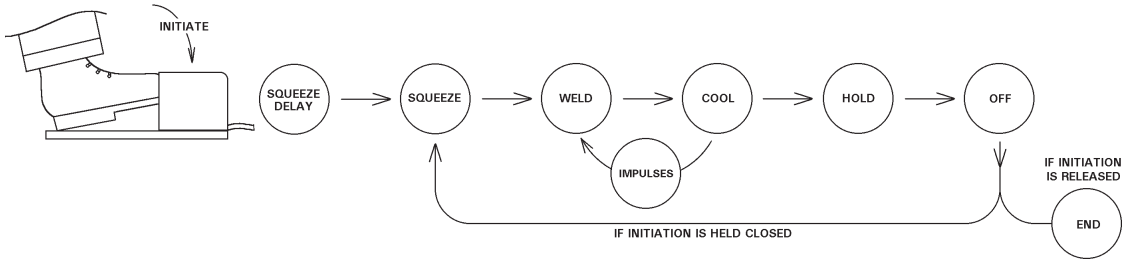


Figure 9-26. *SQUEEZE DELAY operation*

9.5 RETRACTION APPLICATION

Retraction is used for welding guns and stationary machines with cylinders and valves configured for retraction operation. Retraction can be accomplished by de-energizing a valve solenoid, allowing electrode arms to separate further than normal allowing large parts to be placed between welding electrodes. The EN6021 has three RETRACTION modes. The retraction valve can be activated by a ***Momentary*** switch closure that toggles electrodes between retracted and non-retracted state or a ***Maintained*** closure.

9.5.1 MOMENTARY CLOSURE

To program **Momentary Retraction**, set RETRACTION parameter to **Momentary** in **Configure Menu** (see Section 5.5.6). Assign INPUT PI1 to Retraction in **Input Map** sub-menu and OUTPUT PO4 to Retraction in **Output Map** sub-menu under **I/O Map Menu** (see Section 5.5.8).

A momentary closure from PI1 (pin P3-1) to APIC (pin P3-9) will toggle valve from On to Off state. These contacts are normally tied to momentary type switch that is independent from initiation switch. When valve is off and gun is in fully retracted state, control cannot initiate weld sequence and Error Code **ER93** will appear on display if initiation is attempted. Only when valve is on and electrodes are in pre-weld or extended position will initiations be enabled.

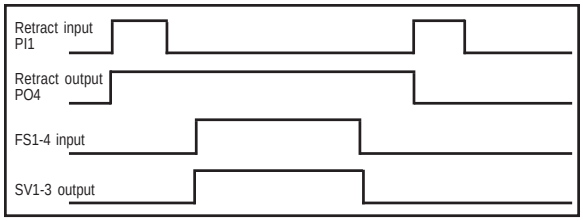


Figure 9-27. *Momentary Retraction*

Programmable output between PO4 (pin P2-4) and APOC (pin P2-9) is enabled by toggling the PI1 (pin P3-1) to APIC (pin P3-9) switch. This output remains on during and after a weld as long as switch is not activated again.

Successive SCHEDULES can be used with Momentary Retraction.

If PI1 (pin P3-1) input switch is held **closed** for a long period of time, **ER91** message will be displayed, but error condition is abandoned and valve output **will be toggled** upon opening of PI1 (pin P3-1) to APIC (pin P3-9).

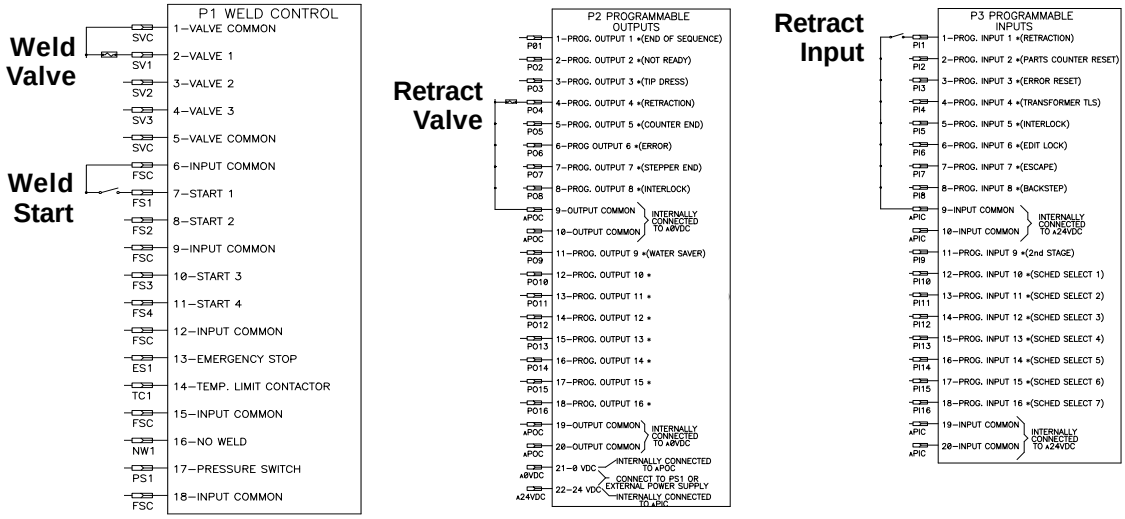


Figure 9-28. *Momentary Retraction connections*

9.5.2 MAINTAINED CLOSURE (THREE STAGE FOOT-SWITCH RETRACTION)

To program **Maintained Retraction**, set RETRACTION parameter to Maintained in **Configure Menu** (see Section 5.5.6). Assign INPUT PI1 to Retraction in **Input Map** and OUTPUT PO4 to Retraction in **Output Map** sub-menu under **I/O Map Menu** (see Section 5.5.8).

Maintained Retraction implementation is different from Momentary in that it uses one foot switch that has a maintained/latched contact which control uses to turn on retract valve. The firmware has a power-on interlock of retraction output to block retract valve from turning on with power on. This feature, simple as its operation may be, will help users implement this type of retraction without putting high voltage on one pole and/or in same conduit as low voltage foot switch wiring.

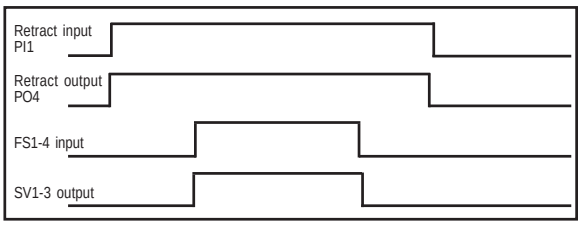


Figure 9-29. *Maintained Retraction*

Valve output between PO4 (pin P2-4) and APOC (pin P2-9) is enabled by closing the PI1 (pin P3-1) to APIC (pin P3-9) switch. This output remains on during and after a weld as long as switch remains closed.

Successive SCHEDULES can be used with Maintained Retraction.

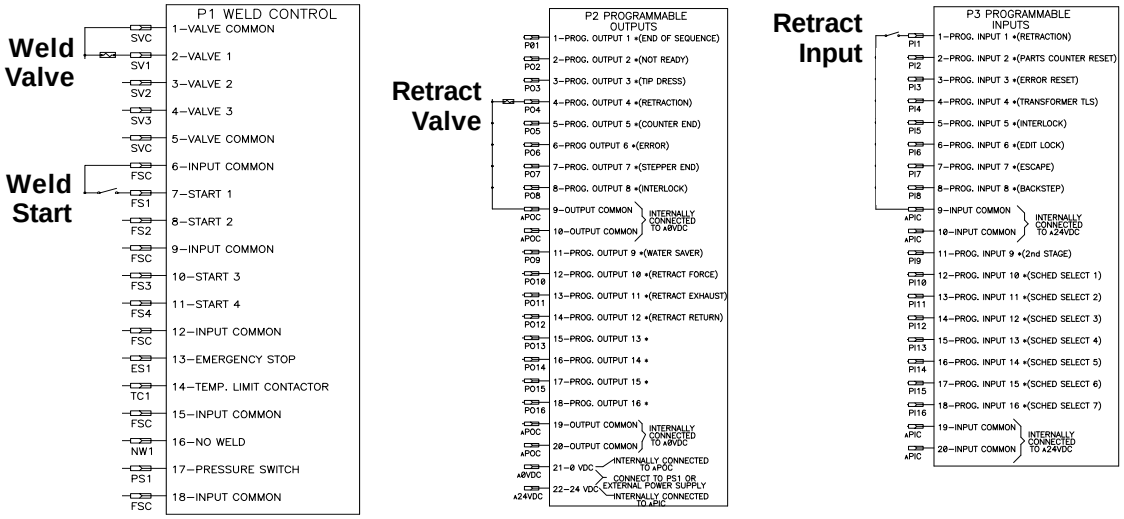


Figure 9-30. *Maintained Retraction connections*

9.7 MULTIPLE SCHEDULE OPERATION

Quad Count/Quad Current (4C/4C) also can be accomplished on the EN6021 Controls. The control is factory configured for Internal SCHEDULE SELECT mode or 4C/4C operation. See Section 5.5.6 for more information about SCHEDULE SELECT options.

9.7.1 MULTIPLE SCHEDULE OPERATION WITH INTERNAL SCHEDULE SELECT

SCHEDULE SELECT must be set to Internal mode in **Configure Menu** (see Section 5.5.6). In this mode:

1. A switch closure between FS1 (pin P1-7) and FSC (pin P1-6) will initiate SCHEDULE selected on **Use Schedule** page (see Section 5.4).
2. A switch closure between FS2 (pin P1-8) and FSC (pin P1-9) will initiate SCHEDULE 20.
3. A switch closure between FS3 (pin P1-10) and FSC (pin P1-9) will initiate SCHEDULE 40.
4. A switch closure between FS4 (pin P1-11) and FSC (pin P1-12) will initiate SCHEDULE 60.

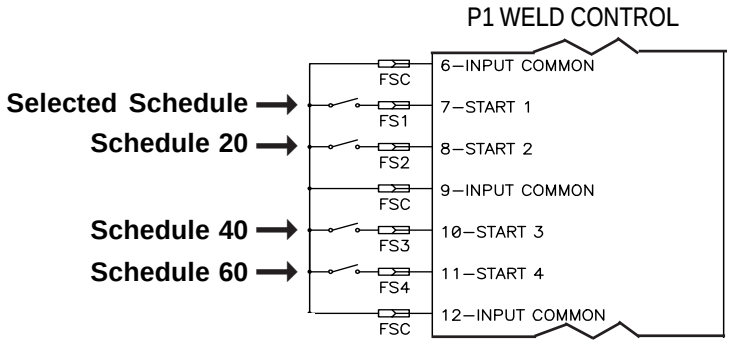


Figure 9-33. *Multiple Schedule operation with Internal SCHEDULE SELECT*

9.7.2 MULTIPLE SCHEDULE OPERATION WITH EXTERNAL SCHEDULE SELECT

SCHEDULES can be externally selected when SCHEDULE SELECT is set to External mode in **Configure Menu** (see Section 5.5.6). In this mode:

1. PI10 (pin P3-12) through PI16 (pin P3-18) become binary schedule selects, and can point to any SCHEDULE 0–99 (see Table 9-1 for binary equivalents).
2. The control is then initiated via FS1 (pin P1-7) for externally selected schedule.

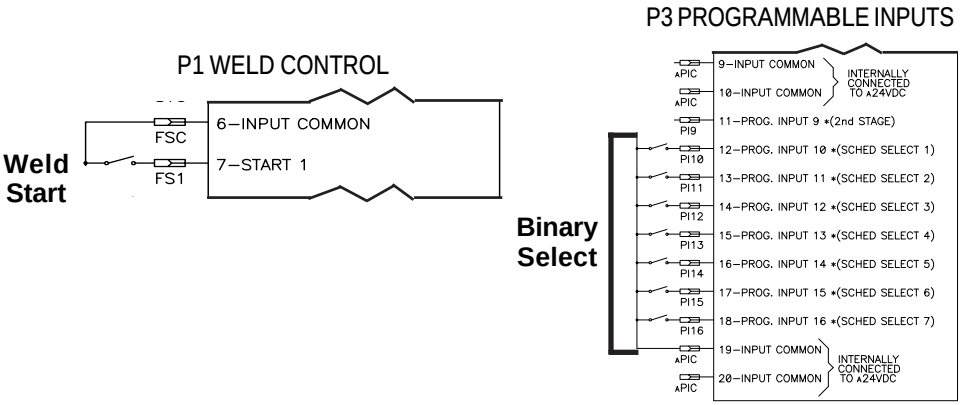


Figure 9-34. *Multiple Schedule Operation with External SCHEDULE SELECT*

9.7.2 MULTIPLE SCHEDULE OPERATION WITH EXTERNAL SCHEDULE SELECT (cont.)

Table 9-1. *Binary External SCHEDULE SELECT*

DECIMAL (SCHEDULE) TO BINARY SS1 (PI10) through SS7 (PI16)

SCH	SS1	SS2	SS3	SS4	SS5	SS6	SS7
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	1	1	0	0	0	0	0
4	0	0	1	0	0	0	0
5	1	0	1	0	0	0	0
6	0	1	1	0	0	0	0
7	1	1	1	0	0	0	0
8	0	0	0	1	0	0	0
9	1	0	0	1	0	0	0
10	0	1	0	1	0	0	0
11	1	1	0	1	0	0	0
12	0	0	1	1	0	0	0
13	1	0	1	1	0	0	0
14	0	1	1	1	0	0	0
15	1	1	1	1	0	0	0
16	0	0	0	0	1	0	0
17	1	0	0	0	1	0	0
18	0	1	0	0	1	0	0
19	1	1	0	0	1	0	0
20	0	0	1	0	1	0	0
21	1	0	1	0	1	0	0
22	0	1	1	0	1	0	0
23	1	1	1	0	1	0	0
24	0	0	0	1	1	0	0
25	1	0	0	1	1	0	0
26	0	1	0	1	1	0	0
27	1	1	0	1	1	0	0
28	0	0	1	1	1	0	0
29	1	0	1	1	1	0	0
30	0	1	1	1	1	0	0
31	1	1	1	1	1	0	0
32	0	0	0	0	0	1	0
33	1	0	0	0	0	1	0
34	0	1	0	0	0	1	0
35	1	1	0	0	0	1	0
36	0	0	1	0	0	1	0
37	1	0	1	0	0	1	0
38	0	1	1	0	0	1	0
39	1	1	1	0	0	1	0
40	0	0	0	1	0	1	0
41	1	0	0	1	0	1	0
42	0	1	0	1	0	1	0
43	1	1	0	1	0	1	0
44	0	0	1	1	0	1	0
45	1	0	1	1	0	1	0
46	0	1	1	1	0	1	0
47	1	1	1	1	0	1	0
48	0	0	0	0	1	1	0
49	1	0	0	0	1	1	0
50	0	1	0	0	1	1	0
51	1	1	0	0	1	1	0
52	0	0	1	0	1	1	0
53	1	0	1	0	1	1	0
54	0	1	1	0	1	1	0
55	1	1	1	0	1	1	0
56	0	0	0	1	1	1	0
57	1	0	0	1	1	1	0
58	0	1	0	1	1	1	0
59	1	1	0	1	1	1	0
60	0	0	1	1	1	1	0
61	1	0	1	1	1	1	0
62	0	1	1	1	1	1	0
63	1	1	1	1	1	1	0
64	0	0	0	0	0	0	1
65	1	0	0	0	0	0	1
66	0	1	0	0	0	0	1
67	1	1	0	0	0	0	1
68	0	0	1	0	0	0	1
69	1	0	1	0	0	0	1
70	0	1	1	0	0	0	1
71	1	1	1	0	0	0	1
72	0	0	0	1	0	0	1
73	1	0	0	1	0	0	1
74	0	1	0	1	0	0	1
75	1	1	0	1	0	0	1
76	0	0	1	1	0	0	1
77	1	0	1	1	0	0	1
78	0	1	1	1	0	0	1
79	1	1	1	1	0	0	1
80	0	0	0	0	1	0	1
81	1	0	0	0	1	0	1
82	0	1	0	0	1	0	1
83	1	1	0	0	1	0	1
84	0	0	1	0	1	0	1
85	1	0	1	0	1	0	1
86	0	1	1	0	1	0	1
87	1	1	1	0	1	0	1
88	0	0	0	1	1	0	1
89	1	0	0	1	1	0	1
90	0	1	0	1	1	0	1
91	1	1	0	1	1	0	1
92	0	0	1	1	1	0	1
93	1	0	1	1	1	0	1
94	0	1	1	1	1	0	1
95	1	1	1	1	1	0	1
96	0	0	0	0	0	1	1
97	1	0	0	0	0	1	1
98	0	1	0	0	0	1	1
99	1	1	0	0	0	1	1

1 = CLOSED 0 = OPEN

PI10 through PI16 require 24 VDC at 50 mA contacts

9.8 HEAD LOCK OPERATION
HOLD PART IN WELDER IF CURRENT OUT OF LIMIT RANGE

When ON ERROR parameter is set to Head Lock in **Configure Menu** (see Section 5.5.6), weld control (when wired to the machine as shown in Figure 9-35) will hold part just previously welded between electrodes, if measured current is not between programmed HIGH/LOW LIMIT range (see Section 5.5.1 for programming HIGH and LOW LIMITS for CURRENT MONITORING). The VALVE assignments must be as follows:

Valve 1 and/or 2 and/or 3	P1-SV1/SV2/SV3	Connects to Valve 1 and/or 2 and/or 3 for Electrodes
Isolation Contactor	P2-PO9	Connects to R1 to drive Magnetic Isolation Contactor
Alarm Output	P2-PO6	Connects to Alarm Output

NOTICE

On weld controls with Program Lockout key switch, key must be rotated and error cleared before part can be removed from welder.

9.8.1 VALVES 1 AND/OR 2 AND/OR 3 (Welding Head Solenoid Outputs for Electrodes)

Program desired SCHEDULE using VALVE 1 and/or 2 and/or 3 for SQUEEZE, WELD, and HOLD times.

NOTICE

Programmed VALVES will stay on after sequence is complete if current is out of programmed HIGH/LOW LIMIT range. If current is within LIMIT range, VALVES will turn off at end of HOLD.

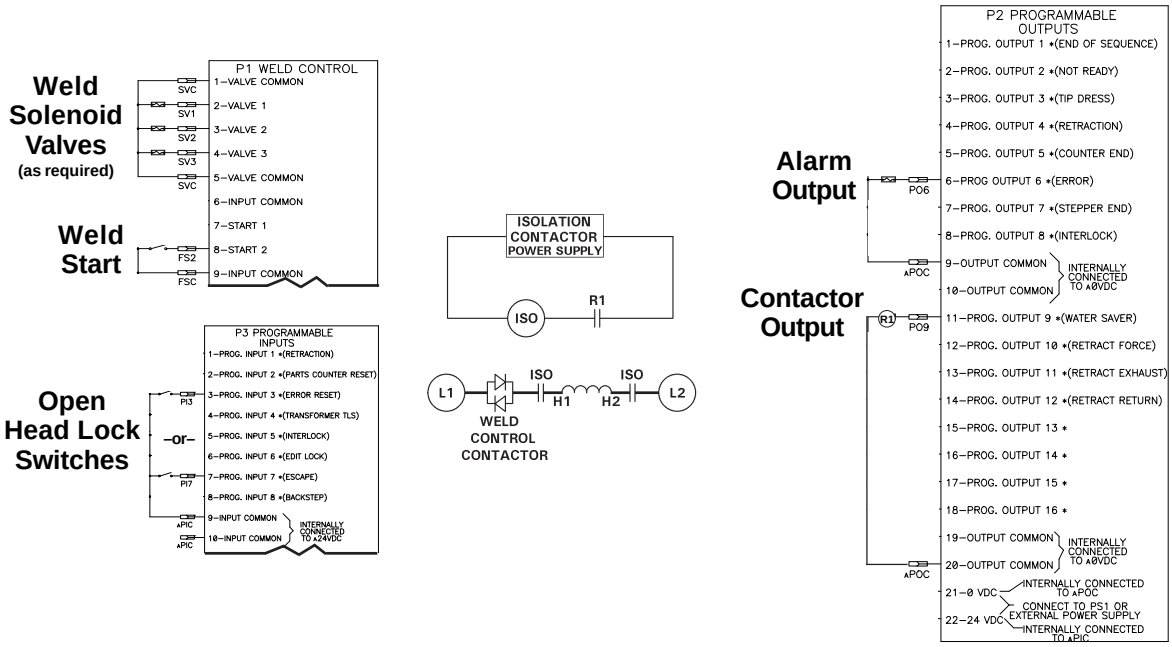


Figure 9-35. *Head Lock wiring*

9.8.2 ISOLATION CONTACTOR OUTPUT PO9 (R1)

The Magnetic Isolation Contactor's function is to isolate welding transformer from control in the possible case that weld control should malfunction. For example, an SCR could fail shorted during the time part was being held and maximum current could flow unrestricted.

Program desired SCHEDULE using VALVE 1 and/or 2 and/or 3 for SQUEEZE, WELD, and HOLD times. This VALVE (if programmed) will stay on only during weld sequence (SQUEEZE, WELD, and HOLD).

The Isolation Contactor can be supplied from factory at time of order. Contact ENTRON for further information.

NOTICE

VALVES 1-3 can only sink 500 mA of current. Check Isolation Contactor current draw. If current is too high, use Relay (R1) to buffer the Isolation Contactor as shown in Figure 9-35.

ALSO

Be certain valve power supply can supply sufficient power for valves and contactor used.

! WARNING !

THE ISOLATION CONTACTOR MUST BE CONTROLLED BY PO9 SO WELD TRANSFORMER IS ISOLATED FROM WELD CONTROL WHEN PART IS HELD IN WELDER.

IF ISOLATION CONTACTOR IS NOT USED, UNCONTROLLED WELD CURRENT MAY BE APPLIED TO HELD PART.

This is REQUIRED as Control Relays in weld control will be held in On state until the part is removed. SCRs can fail in shorted condition (see Figure 9-35).

9.8.3 ALARM OUTPUT PO6 (ALARM)

PO6 (pin P2-6) will turn on while part is being held in welder, for currents either over HIGH LIMIT or below LOW LIMIT. This output can be used to light a signal lamp or give error indication to a PLC.

When High or Low Error is present, VALVE 1 and/or 2 and/or 3 (Welding Head Solenoid Outputs) and Alarm Output PO6 will stay on until error is cleared. Isolation Contactor Output PO9 (R1) will turn off at end of HOLD time, removing power from welding transformer.

9.8.4 OPEN HEAD LOCK

Several ways are available to open electrodes after a fault has been detected – (1) Open Emergency Stop; (2) Close Error Reset PI3 (pin P3-3); (3) Close Escape PI7 (pin P3-7).

NOTICE

When using PI3 or PI7, these INPUTS must be mapped in **I/O Map Menu** (see Section 5.5.8).

When error is cleared, all valve outputs will turn off and control will go through Power On Reset.

9.9 MULTIPLE VALVE CONTROL

9.9.1 USING EVENTS FOR MULTIPLE VALVE CONTROL

One application of EVENT function is multiple valve control. The following example describes how to control four valves to use four guns with EVENT function.

! WARNING !

Only SV1, SV2, and SV3 outputs are protected via control relay contacts. All other outputs are not protected and should be considered during application design. See Section 3.2.

For this example, each gun will be programmed for following sequence:

SQUEEZE for 10 cycles
WELD for 20 cycles with 30% HEAT (Phase Shift CURRENT REGULATION MODE)
HOLD for 20 cycles

To perform multiple valve control using EVENT function, follow these steps:

1. Connect initiation switch SW1 to connector P1 as shown in Figure 9-36.
2. Connect four valves associated with Guns 1-4 to connector P2 as shown in Figure 9-37.
3. Program parameters using either RPP2 or ENLINK (example uses ENLINK to demonstrate programming on following pages; see Section 5.5 for programming instructions for RPP2).
4. Initiate a weld with initiation switch SW1 (FS1).

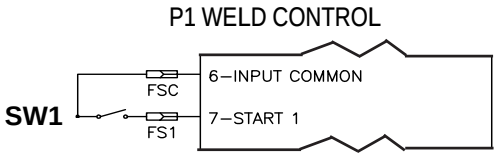


Figure 9-36. *Control input connection*

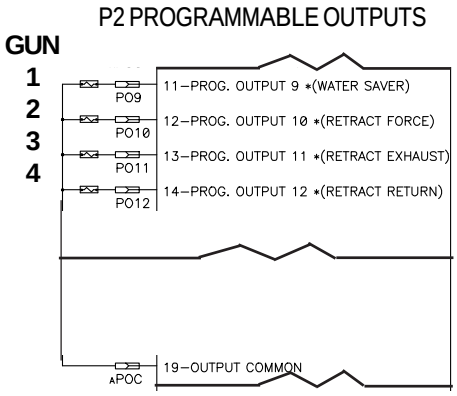


Figure 9-37. *Multiple valve connection*

9.9.1 USING EVENTS FOR MULTIPLE VALVE CONTROL (cont.)

Step 3 – Programming with ENLINK

A. Edit SCHEDULES 0 through 3 as shown in Figures 9-38 and 9-39. Make sure to set CYCLE MODE to Chained for SCHEDULES 0, 1, and 2 and set CYCLE MODE to Non-repeat for SCHEDULE 3.

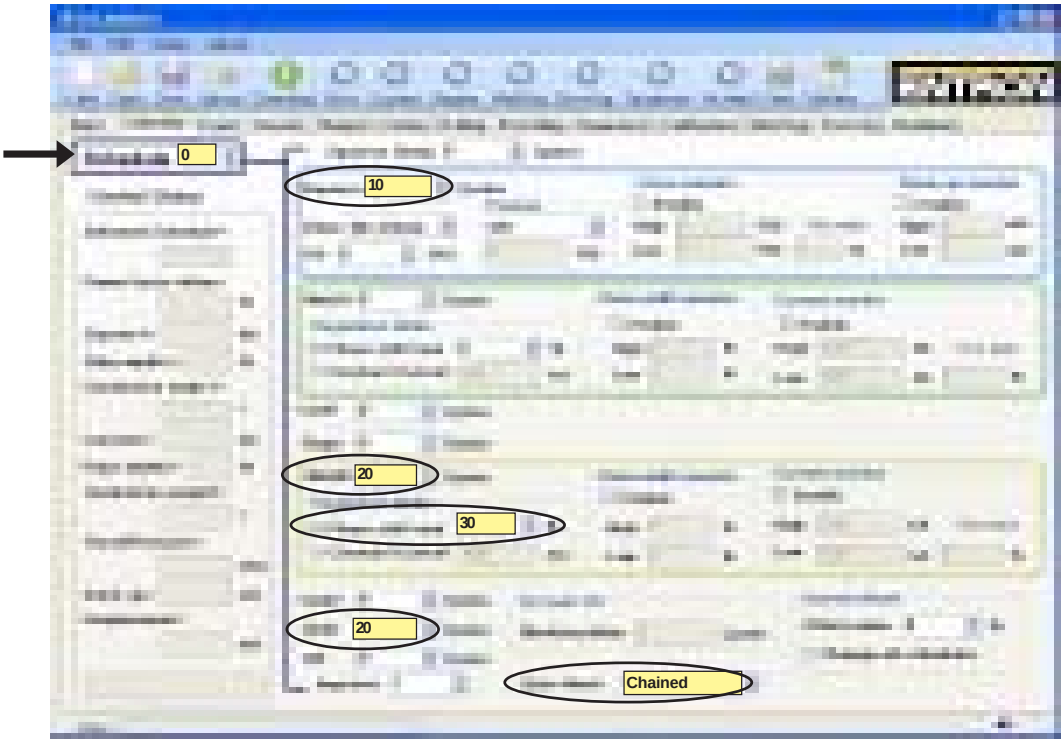


Figure 9-38. *Edit SCHEDULES 0 through 2*

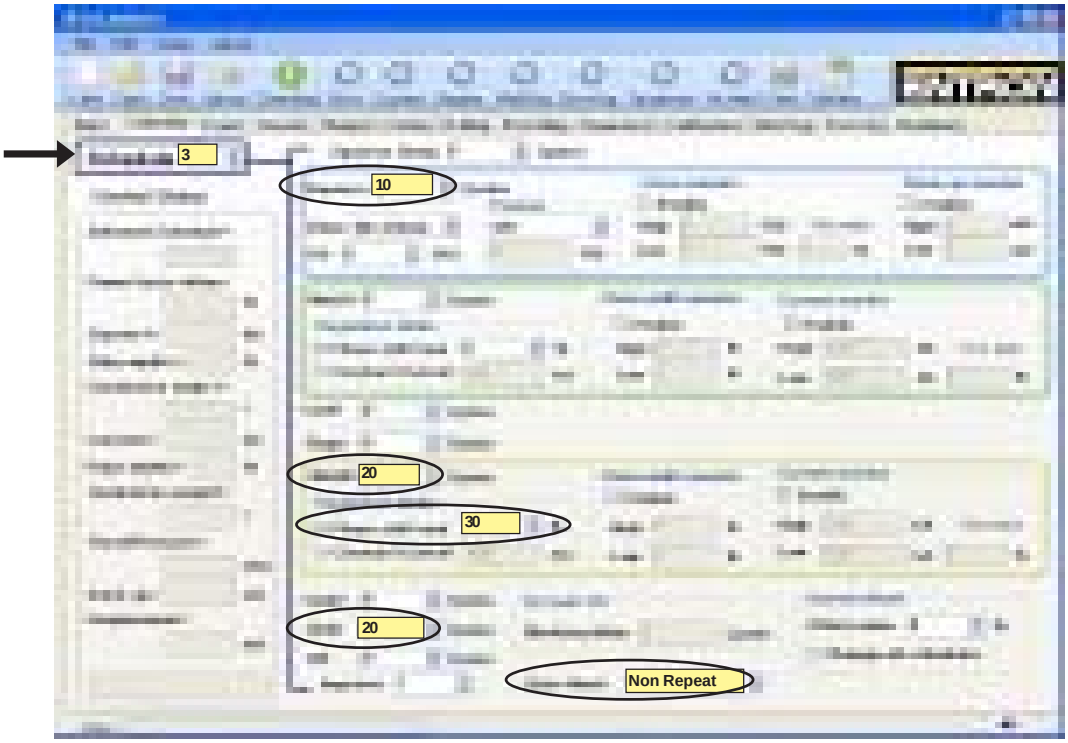


Figure 9-39. *Edit SCHEDULE 3*

9.9.1 USING EVENTS FOR MULTIPLE VALVE CONTROL (cont.)

Step 3 – Programming with ENLINK (cont.)

B. Make sure SEQUENCER function is Off on Configuration page (Figure 9-40).

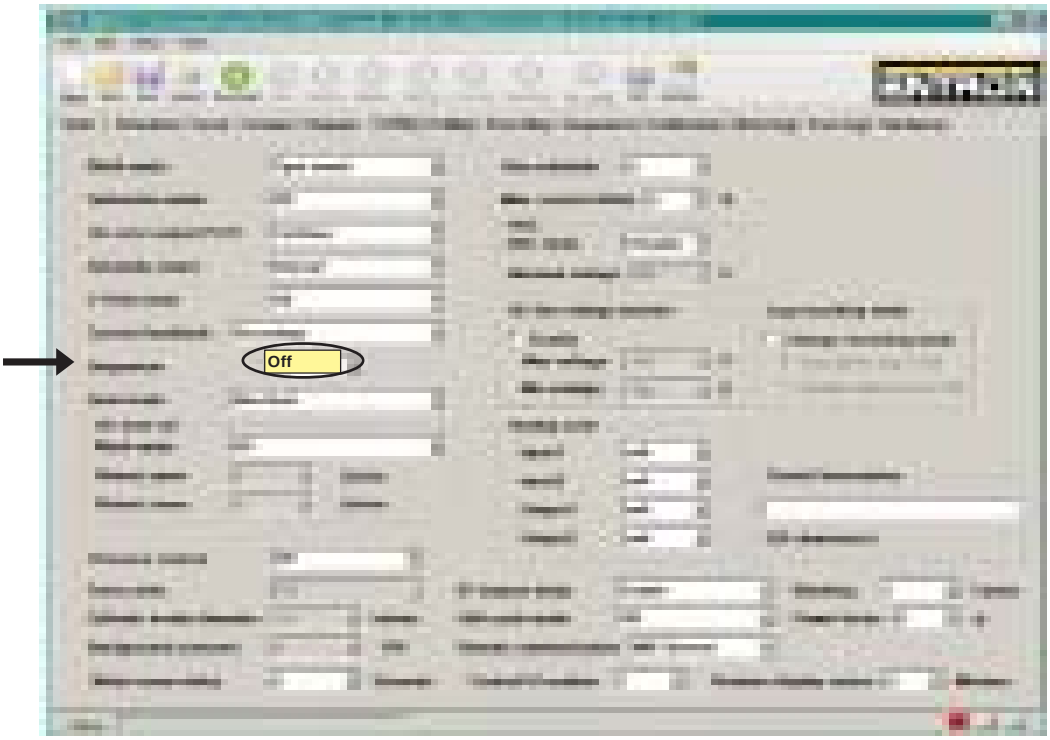


Figure 9-40. *Configuration page*

C. Map OUTPUTS PO9 through PO12 to Event on Input/Output Map page (Figure 9-41).

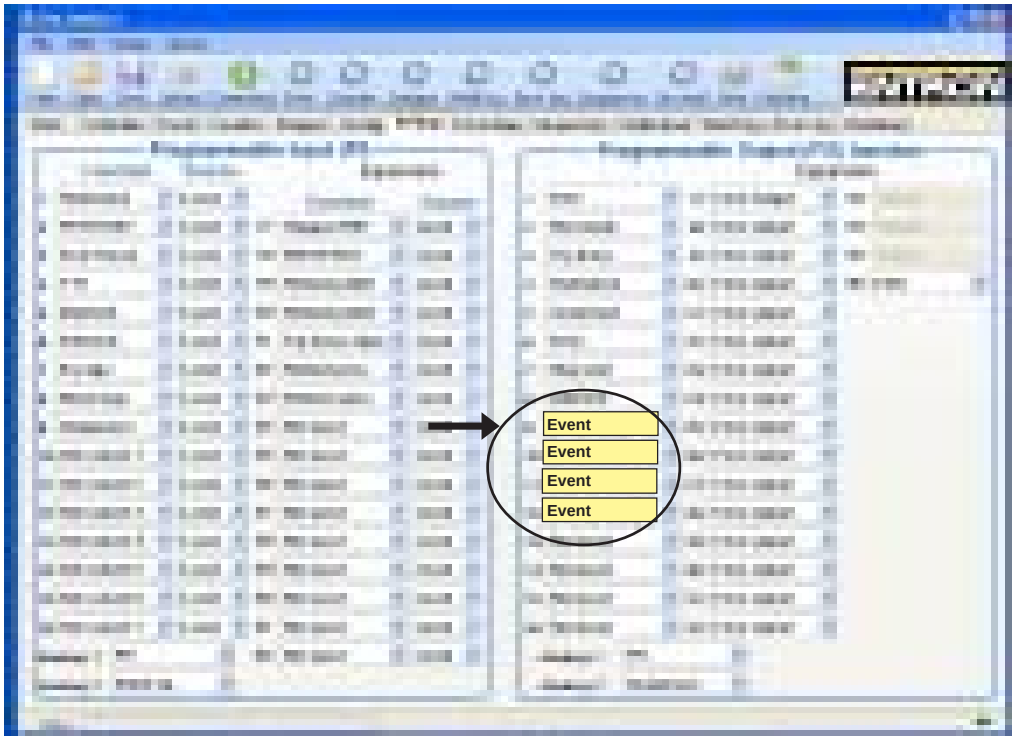


Figure 9-41. *Input/Output Map page*

9.9.1 USING EVENTS FOR MULTIPLE VALVE CONTROL (cont.)

Step 3 – Programming with ENLINK (cont.)

D. Go to EVENT configuration and edit settings for each SCHEDULE as shown in Figures 9-42, 9-43, 9-44, and 9-45.

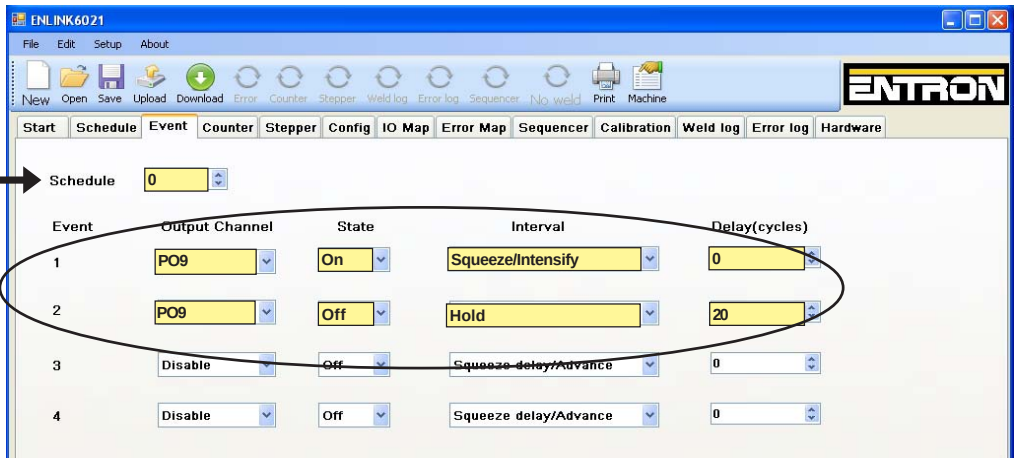


Figure 9-42. *EVENT settings for SCHEDULE 0*

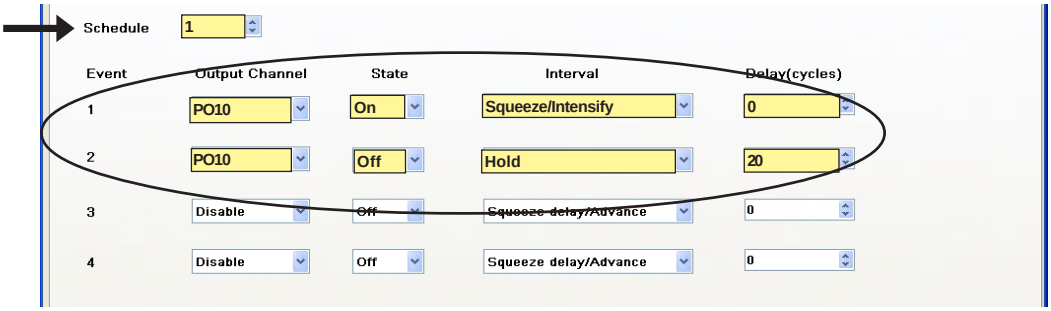


Figure 9-43. *EVENT settings for SCHEDULE 1*

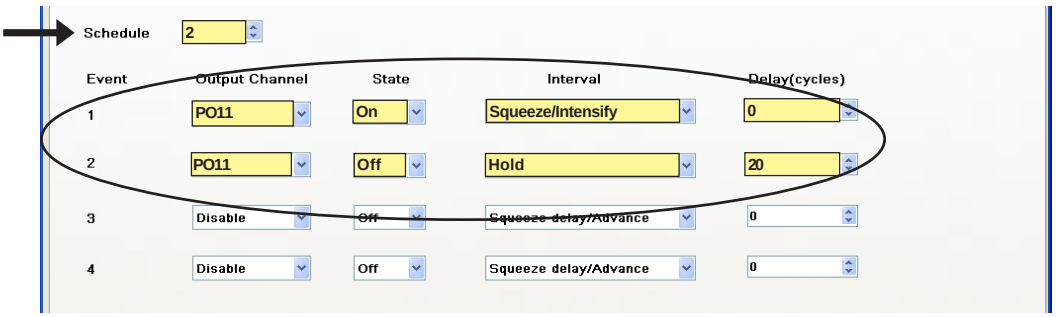


Figure 9-44. *EVENT settings for SCHEDULE 2*

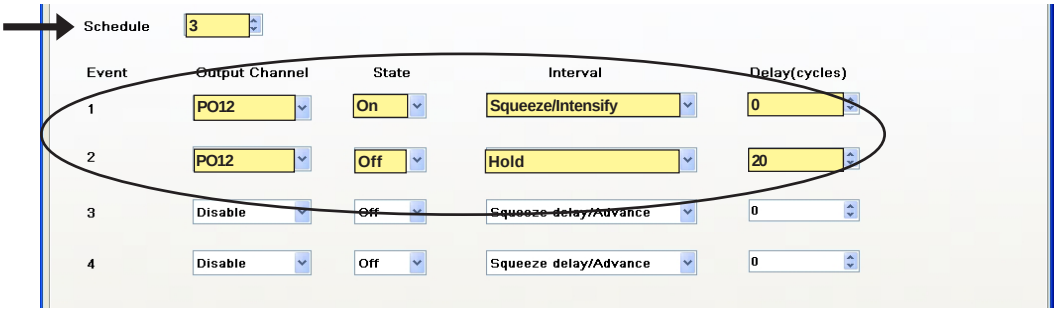


Figure 9-45. *EVENT settings for SCHEDULE 3*

9.9.2 USING SEQUENCER FOR MULTIPLE VALVE CONTROL

The following application shows how to use SEQUENCER function to accomplish multiple valve control.

! WARNING !
Only SV1, SV2, and SV3 outputs are protected via control relay contacts. All other outputs are not protected and should be considered during application design. See Section 3.2.

For this example, each gun will be programmed for following sequence:

SQUEEZE for 10 cycles
WELD for 20 cycles with 30% HEAT (Phase Shift CURRENT REGULATION MODE)
HOLD for 20 cycles

To perform multiple valve operation using SEQUENCER function, follow these steps:

1. Connect initiation switch SW1 to connector P1 as shown in Figure 9-36 (see Section 9.9.1).
2. Connect four valves associated with Guns 1-4 to connector P2 as shown in Figure 9-37 (see Section 9.9.1).
3. Program parameters using either RPP2 or ENLINK (example uses ENLINK to demonstrate programming on following pages; see Section 5.5 for programming instructions for RPP2).
4. Initiate a weld with initiation switch SW1 (FS1).

9.9.2 USING SEQUENCER FOR MULTIPLE VALVE CONTROL (cont.)

Step 3 – Programming with ENLINK

A. Edit SCHEDULE 0 as shown in Figure 9-46.

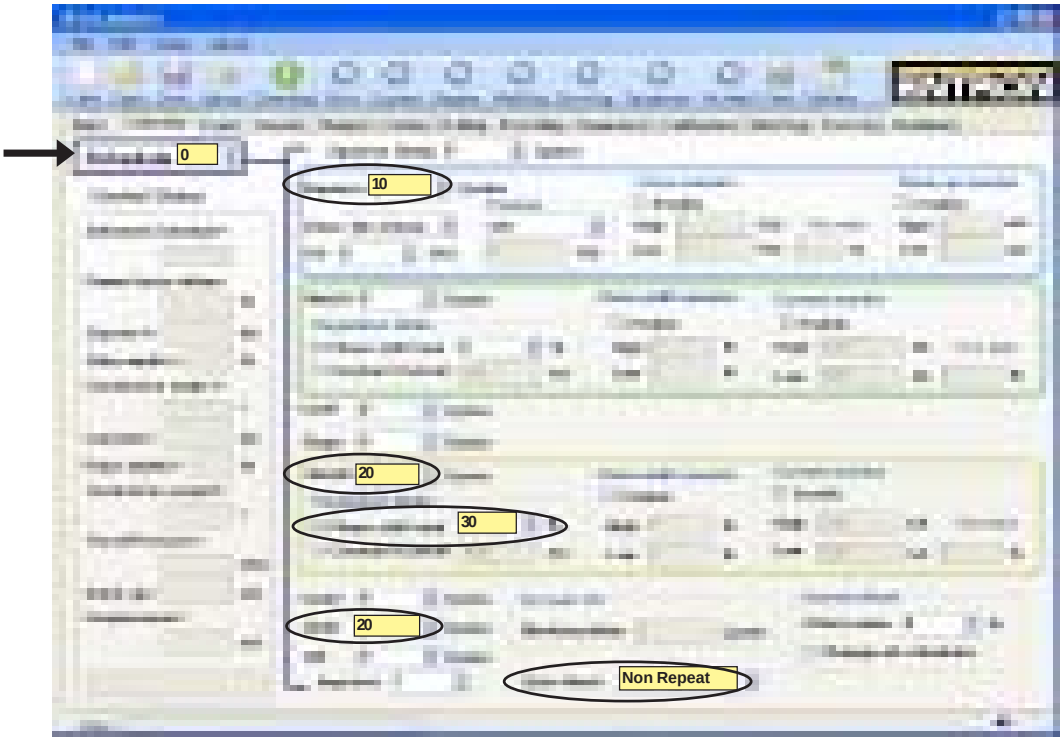


Figure 9-46. *Edit SCHEDULE 0*

B. Enable SEQUENCER function on Configuration page (Figure 9-47).

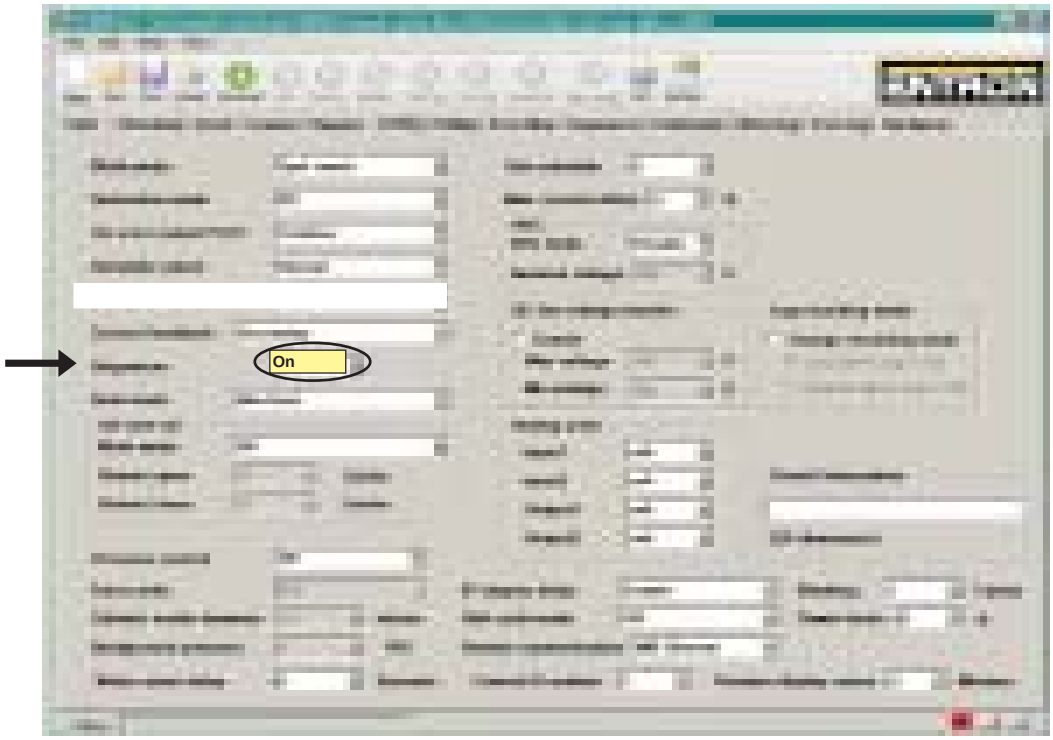


Figure 9-47. *Configuration page*

9.9.2 USING SEQUENCER FOR MULTIPLE VALVE CONTROL (cont.)

Step 3 – Programming with ENLINK (cont.)

C. Map OUTPUTS PO9 through PO12 to Sequencer on Input/Output Map page (Figure 9-48).

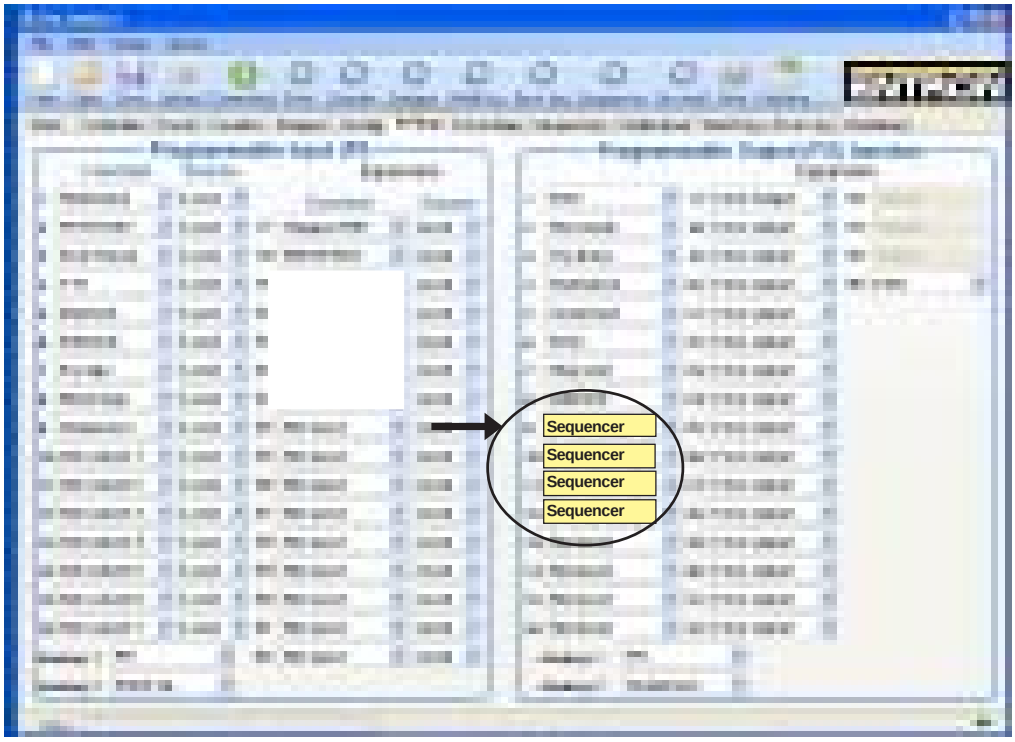


Figure 9-48. *Input/Output Map page*

D. Enter SEQUENCER program on Sequencer page as shown in Figure 9-49.

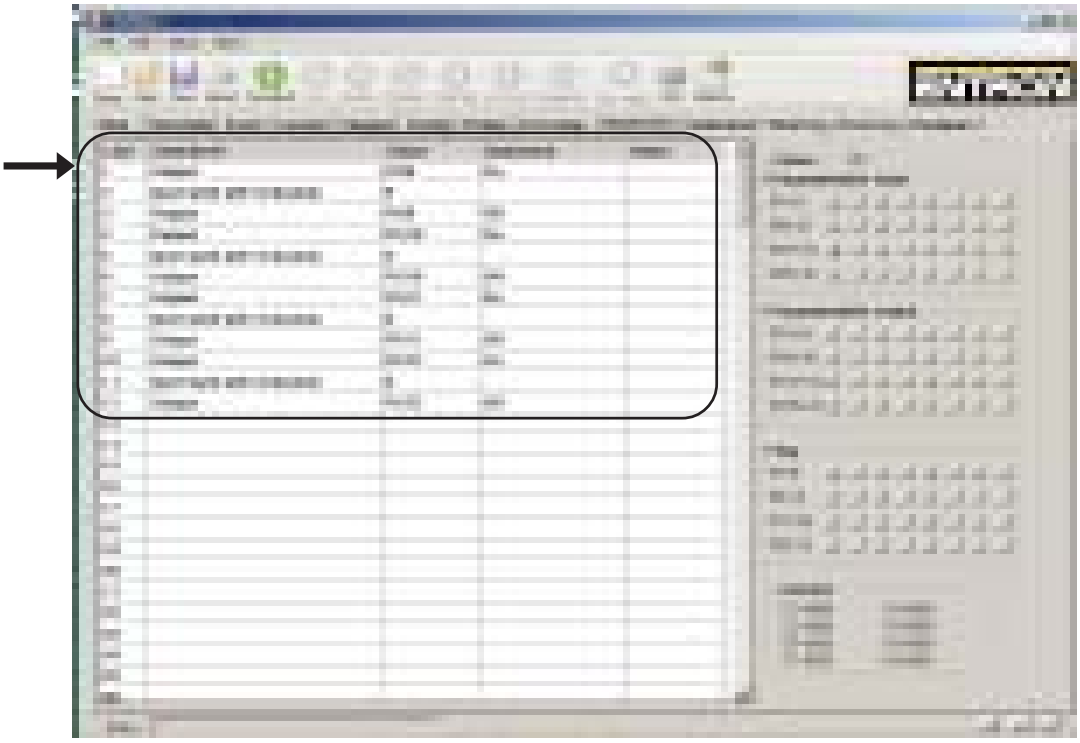


Figure 9-49. *Sequencer page*

THIS PAGE IS INTENTIONALLY BLANK

9.11 MULTIPLE CONTROLS USED WITH WELDER INTERLOCK

The following application shows how to use ENTRON Welder Interlock with the EN6021. The Relay Rack should use Option E shown on Wiring Diagram 420721 (see also Instruction Manual 700200 Section 4.0). The input relays should be white IDC5 relays (P/N 314026). The output relays should be red ODC5 relays (P/N 314025). Refer to Wiring Diagram 420721 and Instruction Manual 700200 for further Welder Interlock connections and operation details.

For this example, connections should be made as shown in Figure 9-56. Subsequent controls should be connected as Control 1, but on next available pair of relays in Interlock.

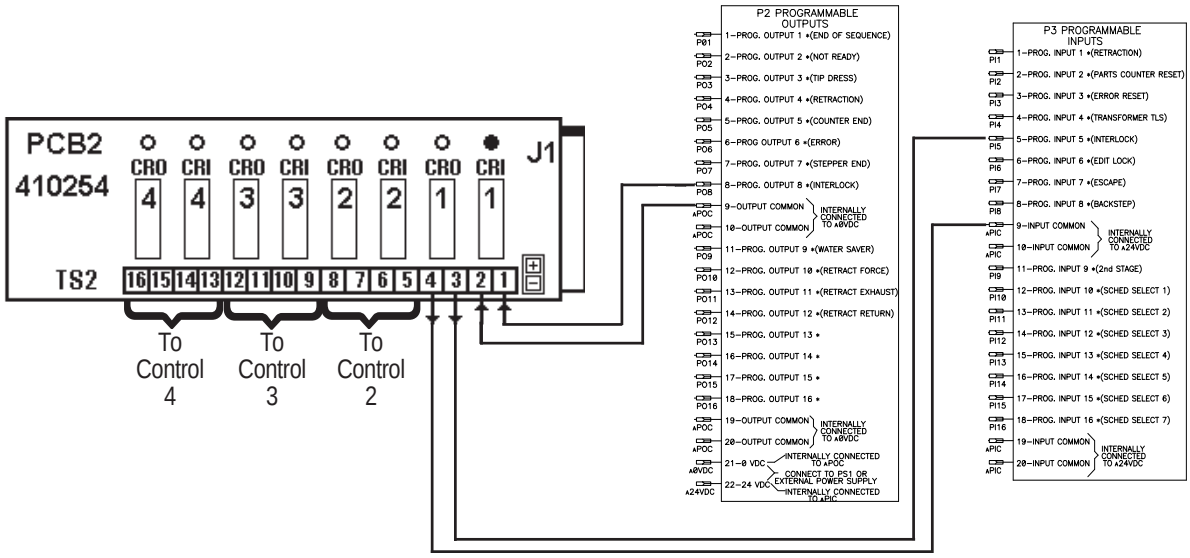


Figure 9-56. *Welder Interlock connections*

To enable this operation, two settings must be configured:

1. Set INPUT PI5 to `Interlock` in **Input Function** sub-menu and confirm that source for INPUT PI5 is set to `Local` in **Input Source** sub-menu of **I/O Map Menu** (see Section 5.5.8).
2. Set OUTPUT PO8 to `Interlock` in **Output Function** sub-menu of **I/O Map Menu** (see Section 5.5.8).

When this feature is used with Welder Interlock, best performance or minimal delays between welders will be optimized. Control will send a request to weld after SQUEEZE time on Output PO8 (pin P2-8) and wait until it receives grant to weld from Interlock on Input PI5 (pin P3-5). The added efficiency gained using INTERLOCK mode over using Pressure Switch is due to SQUEEZE time being completed in INTERLOCK mode.

9.12 INTEGRATED PRESSURE SENSE AND CONTROL

The electronics for an Integrated Pressure Sense Control (IPSC) System are included with all EN6021 Series Controls. The system is designed so that all programming is done within weld control using RPP2 pendant or ENLINK. No further analog input or output cards are required. When required, sensors and proportional valves are purchased as options (see Section 10.10).

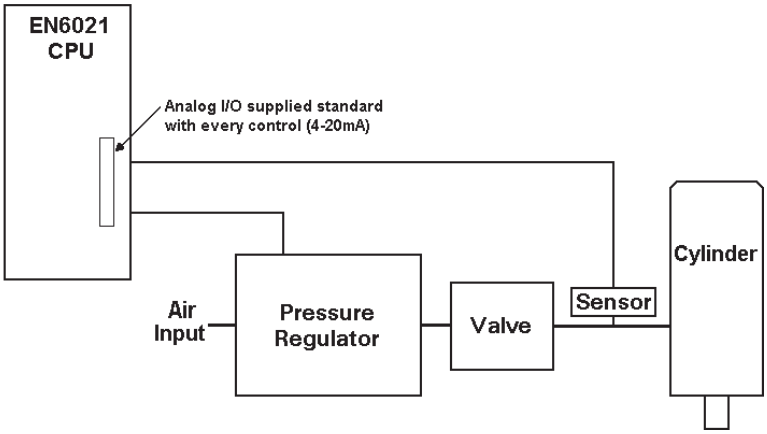


Figure 9-57. *Block diagram of IPSC and Control with Regulator and Sensor*

! WARNING !

TURN PRESSURE OFF AND BLEED SYSTEM BEFORE ATTEMPTING
TO INSTALL OR SERVICE THIS CONTROL!
BLOCK ALL MOVING DEVICES BEFORE INSTALLATION OR SERVICING!

The Integrated Pressure Sense Control System is designed for any application that requires automatic monitoring and/or selection of a pre-programmed pressure, or automatic switching between different pressure settings. Weld control schedules may be chained to obtain sequential pressure changes. The benefits of the system depend on the application. The ENTRON IPSC System allows for sequencing of multiple pressures with one initiation. The flexibility of operation is only limited by the number of weld schedules. An IPSC System may be used to remove worry of pressure settings from the operator. Also, the IPSC System may be used to reduce electrode wear by programming "soft set-down" during SQUEEZE. The IPSC System may eliminate multiple valves to simplify forging operations. Another application may serve to eliminate many valves when multiple pressures are required for selecting different pressure regulators. An IPS can be used to confirm force before welding.

There are three options:

- **IPSC** - Pressure Sense and Control
- **IPC** - Pressure Control
- **IPS*** - Pressure Sense

* Sensor can be provided as Single-ended or Differential type, see Section 9.12.6

9.12 INTEGRATED PRESSURE SENSE AND CONTROL (cont.)

For **IPSC** and **IPS** options, there are two programmable triggers to continue sequence after SQUEEZE:

- on rising edge
- on falling edge

There are four programmable modes for any of the three options:

- PRESSURE in mA – standard industrial input and/or output from 4.00 to 20.00 mA
- FORCE in Calibrated Lb – input and/or output from 0.0 to 7850.0 lb (in 0.5 increments)
- PRESSURE in PSI – input and/or output from 0 to 100 PSI
- FORCE in Lb – input and/or output from 0.0 to 7850.0 lb (in 0.5 increments)

Pressure Sensor (transducer) has a standard 4.00-20.00 mA output for 0-100 PSI. Proportional Valve (complete closed loop servo system) has a standard input 4.00-20.00 mA for 0-100 PSI. Similar devices may be substituted.

9.12.1 PRESSURE SENSOR* AND PROPORTIONAL VALVE

An ENTRON Integrated Pressure System may include a Pressure Transducer (Sensor) in **IPSC** and **IPS** options, and/or an electro-pneumatic servo valve (Proportional Valve) in **IPSC** and **IPC** options.

The Pressure Sensor accurately measures air pressure and converts the measurement to an electrical signal. Electrical output is a linear ratio of sensed pressure. The Sensor is connected to CPU through P7 connector using Cable Assembly 326053 (see Section 4.4.4). Signal from Sensor is converted by CPU Board.

The Proportional Valve with a filter and volume booster is installed in pneumatic system typically replacing manual regulator. It regulates air pressure based on programmed PRESSURE. Proportional Valve is electro-pneumatic closed loop servo system consisting of valves, manifold, housing and electronic components. Output pressure is controlled by electrical input signal. This device interfaces with CPU Board through P7 connector using Cable Assembly 326039 (see Section 4.4.4). Proportional Valve is equipped with internal feedback loop which compensates for variations of incoming pressure providing highly accurate pressure control.

Since Proportional Valve is a servo system with internal feedback loop, Sensor in **IPSC** and **IPS** Systems can be used to provide actual pressure values to control to confirm that command (required) pressure is available in one of three alternative locations for Pressure Sensor: incoming air line to machine, air line into cylinder, or exhaust side of cylinder.

The weld control including IPSC System with Sensor and Proportional Valve can be used for pressure sense and control in other non-resistance welding operations such as: dispensing, moving, checking vacuum on lifter, checking pressure in reservoir and water pressure, etc. When using these features along with Chained and Successive CYCLE MODE, special functions can be accomplished using standard controls.

* Sensor can be provided as Single-ended or Differential type, see Section 9.12.6

9.12.2 AVAILABLE CONFIGURATIONS

The ENTRON Integrated Pressure Sense Control Systems may be configured to allow great flexibility in many applications. Figure 9-58 shows all possible configurations along with specific examples of controls.

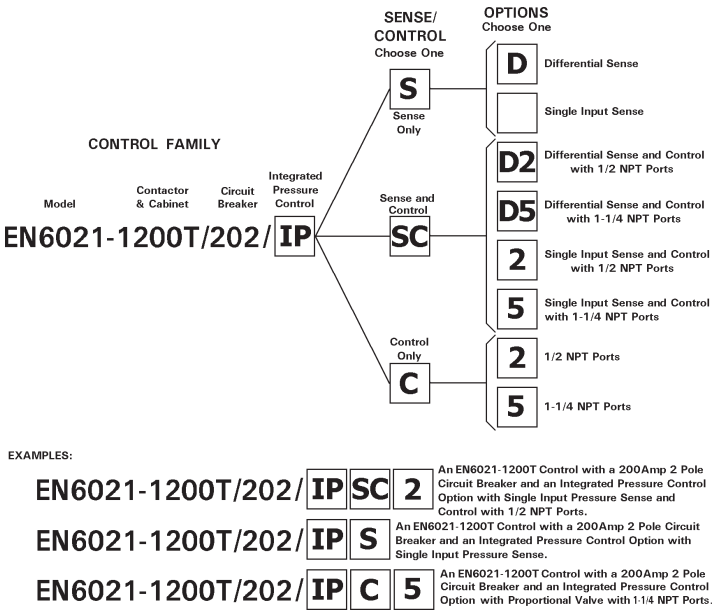


Figure 9-58. *IPSC configurations*

INTEGRATED PRESSURE SENSE* AND CONTROL

Allows programming of any PRESSURE/FORCE setting within any SCHEDULE of the weld control (see **IPC** explanation). In addition, it allows sensing or measuring PRESSURE/FORCE and display of measured values (see **IPS** explanation).

INTEGRATED PRESSURE CONTROL

Allows programming of any PRESSURE/FORCE setting within any SCHEDULE of weld control. The EN6021 can accept 100 different PRESSURE/FORCE settings (see Section 5.5.1). PRESSURE settings become active during execution of SQUEEZE time of SCHEDULE. The **IPC** System with Proportional Valve is a complete closed loop servo system with internal feedback. For normal operation it does not require a Pressure Sensor. Weld controls with this option provide only pressure control without pressure sense or display of measured values. May also be used with STEPPER.

INTEGRATED PRESSURE SENSE*

Allows sensing and display of separate, user defined, PRESSURE/FORCE. The **IPS** System can be configured to trigger on Rising or Falling Edge of PRESSURE. Rising or Falling PRESSURE TRIGGER is set independently for each SCHEDULE (see Section 5.5.1). The **IPS** with Pressure Sensor is an independent system and does not require Proportional Valve to operate. A weld control with this option provides only pressure sensing without pressure control.

Since sensed pressure is read directly by weld control, it is the basis for pressure triggering during sequence. Pressure Sense is commonly used to determine if programmed PRESSURE has been reached before WELD portion of weld sequence. It can be used to determine when to trigger a weld if pressure is reached during pressure transition. It can be used to emulate pressure switch used to trigger the weld upon reaching required pressure. In addition, pressure switch could also be used to determine whether exhaust side of cylinder is completely evacuated by allowing triggering on a lack of pressure (very low) or a low value of pressure.

* Sensor can be provided as Single-ended or Differential type, see Section 9.12.6

9.12.3 PROGRAMMING

The IPSC System has four modes of operation. Selected mode becomes operating mode for all SCHEDULES. Mode is set in FORCE UNIT parameter in **Configure Menu** (see Section 5.5.6).

1. **mA** – Standard industrial input and/or output from 4.00 to 20.00 mA. All RPP2/ENLINK programming is done in mA. This mode is used for troubleshooting or non-standard devices.
2. **Calibrated Lb** – Input and/or output from 0.0 to 7850.0 lb (in 0.5 increments). All RPP2/ENLINK programming is done in pounds of FORCE – see Calibration information in this section. This mode works well for rocker arms or guns with fulcrums or mechanical gain or multiplication. A force gauge is used in a 2-point calibration procedure. Piston diameter or pivot point distances are not required to be known.
3. **PSI** – Input and/or output from 0 to 100 PSI. All RPP2/ENLINK programming is done in PSI. This mode works best with proportional valves and sensors that are set up so that 4 mA=0 PSI and 20 mA=100 PSI. This mode can be used for troubleshooting.
4. **Lb** – Input and/or output from 0.0 to 7850.0 lb (in 0.5 increments). All RPP2/ENLINK programming is done in pounds of FORCE. When this mode is chosen, CYLINDER DIAMETER becomes a programmable parameter in **Configure Menu** and must be entered. No force gauge is required. This mode **will not** work with systems such as rocker arms.

NOTICE
If modes are changed, data in SCHEDULES is no longer valid.

Regardless on which mode is chosen, control allows programming of following parameters in units of mode chosen.

1. **BACKGROUND FORCE/PRESSURE** – set in **Configure Menu** for all SCHEDULES (see Section 5.5.6). This setting provides output signal to Proportional Valve when control is in idle modes between initiations. This will allow programmed FORCE/PRESSURE to return tips to open position between welds.
2. **PRESSURE/FORCE SENSING** – set in **Schedule Menu** for each SCHEDULE (see Section 5.5.1). Used with Pressure Sensor to hold welding until preset PRESSURE/FORCE TRIGGER has been reached. Programming options include **Rising Edge** or **Falling Edge**. These are used to determine if weld will be enabled on rising or falling edge of sensed input. This is helpful for looking at input (rising) or exhaust (falling) connection on a cylinder.

3a. **PRESSURE/FORCE MONITORING** – set in **Schedule Menu** for each SCHEDULE (see Section 5.5.1). Allows LIMIT window to be entered around sensed value. HIGH and LOW LIMIT values can be entered. This allows errors when values are measured outside of LIMIT window. See 3b for associated parameter.

3b. **PRESSURE/FORCE MONITORING PRE-LIMIT** – set in **Schedule Menu** for each SCHEDULE which has PRESSURE/FORCE MONITORING enabled (see Section 5.5.1). Allows indication of minor error before major Out of Limit Error occurs. This parameter is programmed as percentage of FORCE UNIT chosen.

9.12.3 PROGRAMMING (cont.)

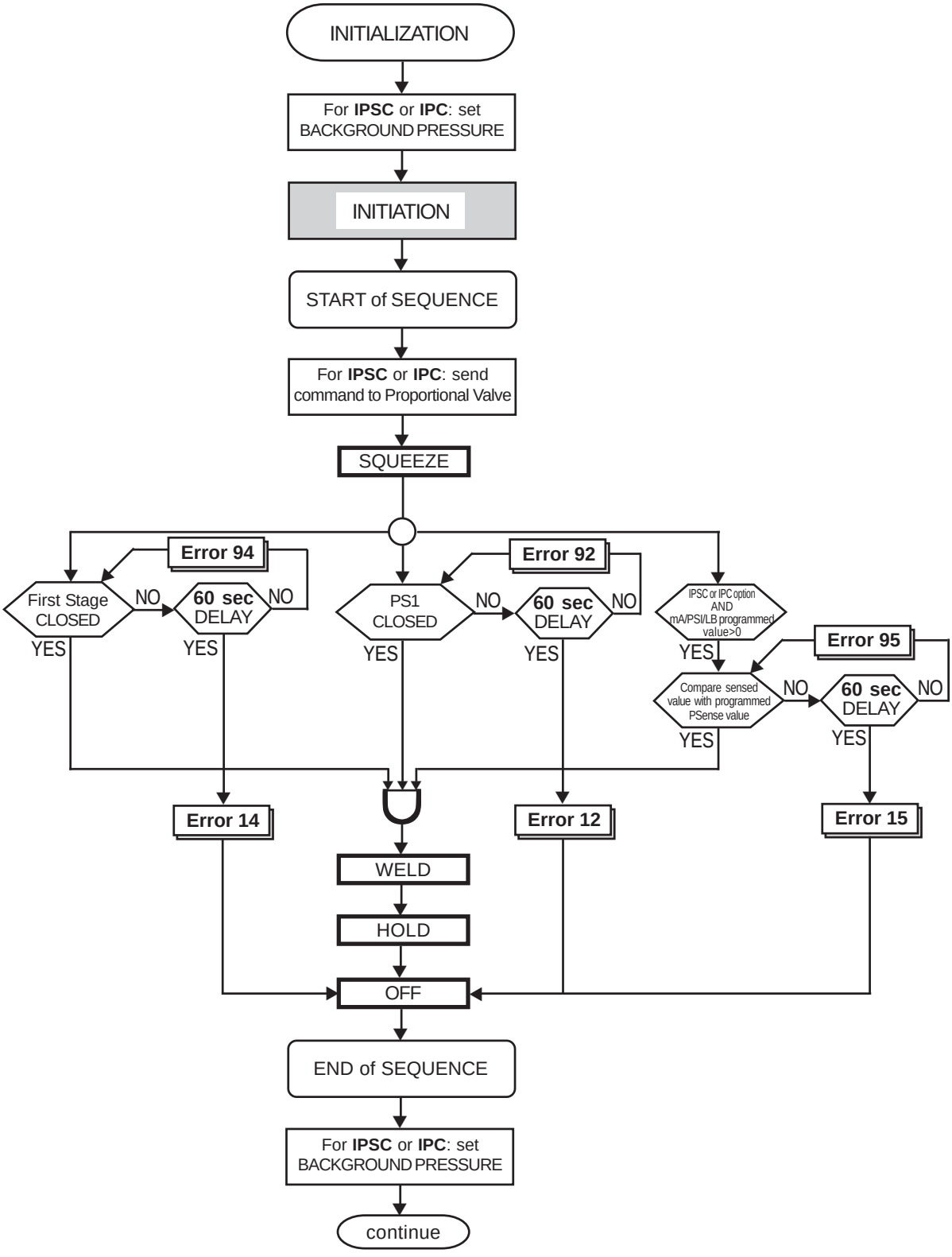


Figure 9-59. *Sequence flow chart*

9.12.3 PROGRAMMING (cont.)

CALIBRATION

When EN6021 is used in Calibrated Lb. mode, the control must be calibrated using an accurate force gauge. Pressure Sensor (transducer) has a standard 4.00-20.00 mA output for 0-100 PSI. Proportional Valve (complete closed loop servo system) has a standard 4.00-20.00 mA input for 0-100 PSI. These devices need to be accurate for IPSC to operate correctly. Because of the tolerances of these devices, a mode for aligning the range of Sensors and Proportional Valves to the range of the control is provided. Both are set independently using **Calibration Menu** in both RPP2 and ENLINK programming.

NOTICE
The following procedures assume correctly installed Proportional Valve on system that can support forces produced with maximum-supplied PSI.

IPC Calibration

Put control in **IPC** mode – see PRESSURE CONTROL parameter in **Configure Menu** Section 5.5.6.

Program control for **mA** mode – see FORCE UNIT parameter in **Configure Menu** Section 5.5.6.

Set up two SCHEDULES with low and high mA setting, using 6 mA for low and 16 mA for high set points.

Put control in No Weld. Set up SQUEEZE and HOLD to be long enough to measure force with force gauge.

Initiate low SCHEDULE and note actual force on force gauge.

In **Calibration Menu**, enter PT1 current setting (6 mA), then enter recorded force. In ENLINK, a shortcut is provided to copy last SCHEDULE used current into PT1.

Initiate high SCHEDULE and note actual force on force gauge.

In **Calibration Menu**, enter PT2 current setting (16 mA), then enter recorded force. In ENLINK, a shortcut is provided to copy last SCHEDULE used current into PT2.

The control will then calculate a line between the two points and display the zero point and maximum force available. Check to see if they look appropriate.

NOTICE
PT1 cannot be below 3 mA and PT2 cannot be over 21.0 mA. Maximum force cannot exceed 8284.5.

9.12.3 PROGRAMMING (cont.)

IPS Calibration

Put control in **IPS** mode – see PRESSURE CONTROL parameter in **Configure Menu** Section 5.5.6.

Program control for **mA** mode – see FORCE UNIT parameter in **Configure Menu** Section 5.5.6.

Provide a way to get a variable PSI to the Sensor. Try to get two points that can be set around 12 lbs. for a low set point and 75 lbs for a high set point. If IPC is available, two SCHEDULES may be set with the two mA settings.

Apply first low PSI setting.

From **Hardware Status Page**, record Analog Input 1 current reading and enter value into PT1 current setting, then enter resultant force. In ENLINK, a shortcut is provided to copy last SCHEDULE used current into PT1.

Apply second high PSI setting.

From **Hardware Status Page**, record Analog Input 1 current reading and enter value into PT2 current setting, then enter resultant force. In ENLINK, a shortcut is provided to copy last SCHEDULE used current into PT2.

The control will then calculate a line between the two points and display the zero point and maximum force available. Check to see if they look appropriate.

NOTICE
PT1 cannot be below 3 mA and PT2 cannot be over 21.0 mA. Maximum force cannot exceed 8284.5.

9.12.4 FIELD INSTALLATIONS

These options can be field installed.

POWER/FUSING

The IPSC (24 VDC) is powered by and fused via PS1 Power Supply.

9.12.5 PROPORTIONAL VALVE (SERVO CONTROL VALVE)

The Proportional Valve is electro-pneumatic closed loop servo system consisting of valves, manifold, housing and electronic components. The output pressure is controlled by electrical input signal. This device interfaces with CPU Board through P7/J13 Cable Assembly (P/N 326039). Data from CPU Board is received directly by Proportional Valve. It is equipped with an internal feedback loop which compensates for variations of incoming pressure providing highly accurate pressure regulation. A volume booster and filter are used also.

Programming PRESSURE parameters for Proportional Valve input and Sensor output display is performed on weld control through RPP2 pendant or ENLINK 6021 as shown in Figure 9-59.

PROPORTIONAL VALVE PLACEMENT

Since several configurations are possible, actual Proportional Valve placement in the system is left to system designer. The **IPC** System option with one of several possible configuration is shown in Figure 9-60. This system provides monitoring and accurate pressure control, even when variations of line pressure occur. Regulated air creates force used to press welding electrodes upon parts to be welded. A repeatable and constant electrode force during weld sequence helps achieve consistent weld quality. If Sense option is available, weld control may be used to monitor and display pressure, force, or mA by enabling PRESSURE/FORCE MONITORING and SENSING and associated parameters in **Schedule Menu** (see Section 5.5.1). The pressure reading depends on location of the Sensor. The **IPSC** System option with one of several possible configuration is shown in Figure 9-61.

NOTICE

When regulation is used on Cascade controls or weld controls with multiple valves, points A & B can be tied to more valves and cylinders.

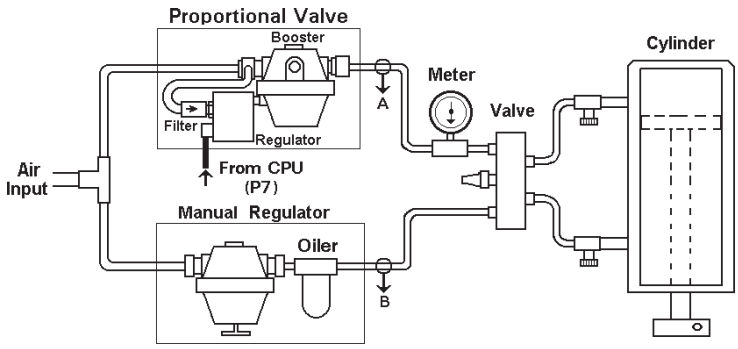


Figure 9-60. *IPC System with Proportional Valve and manual regulator*

9.12.5 PROPORTIONAL VALVE (SERVO CONTROL VALVE) (cont.)

However, in most applications, using a manual regulator is necessary to feed return chamber of air cylinder (Figure 9-60). The manual regulator is used to assure that weld head will stay in upper position at end of sequence even when power to control is off. In this case, background (return) pressure is controlled with manual regulator and value programmed in BACKGROUND FORCE/PRESSURE parameter will not have any effect on background (return) pressure.

In some resistance welding applications, the Proportional Valve may be placed to feed both top and bottom chamber of air cylinder (Figure 9-61). If Proportional Valve is placed so that it controls both top and bottom of cylinder as shown in Figure 9-61, background (return) pressure is controlled also with same Proportional Valve and value programmed in BACKGROUND FORCE/PRESSURE parameter in **Configure Menu**. While weld control power is on and control is not initiated, Proportional Valve maintains system pressure continuously based on programmed setting. If available line pressure drops below programmed BACKGROUND FORCE/PRESSURE, Proportional Valve cannot compensate. **See WARNING below.**

! WARNING !

Cylinders/Electrodes/Tooling may not stay up/open with Power Off (see Figure 9-61)

If Proportional Valve is used to return head after valve is turned off, a disruption in power to Proportional Valve could cause a change in regulated output pressure and gravity may cause cylinder to return to closed position.

Manual regulator should be used as shown in Figure 9-60 and 9-61 to supply return pressure to cylinder head after valves 1 and/or 2 are turned off.

OILER PLACEMENT RECOMMENDATIONS

The oiler is recommended to be placed after booster assembly or placed as shown in Figure 9-60. The oiler may be placed before Proportional Valve but oil must be kept clean and not allowed to saturate Proportional Valve.

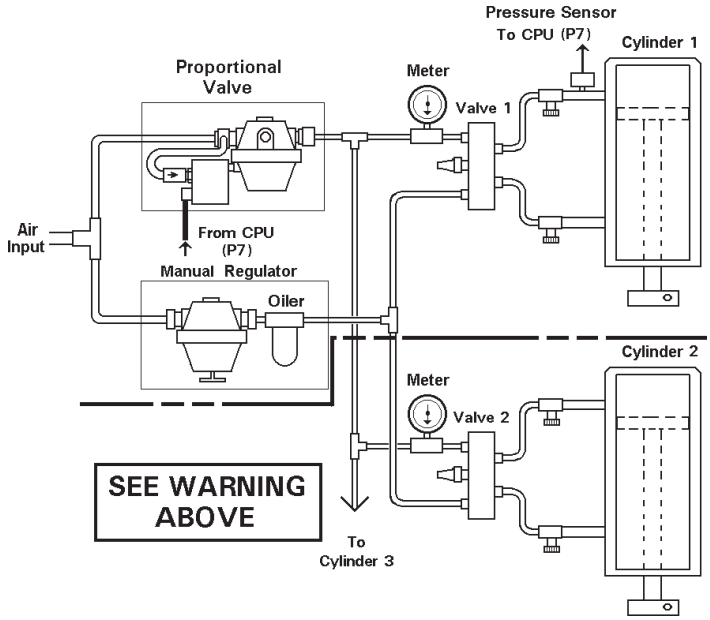


Figure 9-61. *IPSC System with Proportional Valve and Sensor in Single function or Cascade control*

9.12.6 PRESSURE SENSOR

The Pressure Sensor (transducer) accurately measures air pressure and converts measurement to an electrical signal. The electrical output is a linear ratio of the sensed pressure. The Sensor is connected to the CPU Board through P7.

The PRESSURE may be displayed on RPP2 pendant if **Status Page 2** is selected. The pressure reading depends on location of the Sensor.

SENSOR PLACEMENT

The IPSC pressure sensing element needs to be placed in system nearest area where pressure sensing is desired or is most critical. Since many configurations are possible, actual placement in system is left to system designer. The IPSC System option is shown in Figure 9-61 and IPS option in Figure 9-62. As shown in Figure 9-62, Pressure Sensor in a resistance welding application may be placed in at least three different locations.

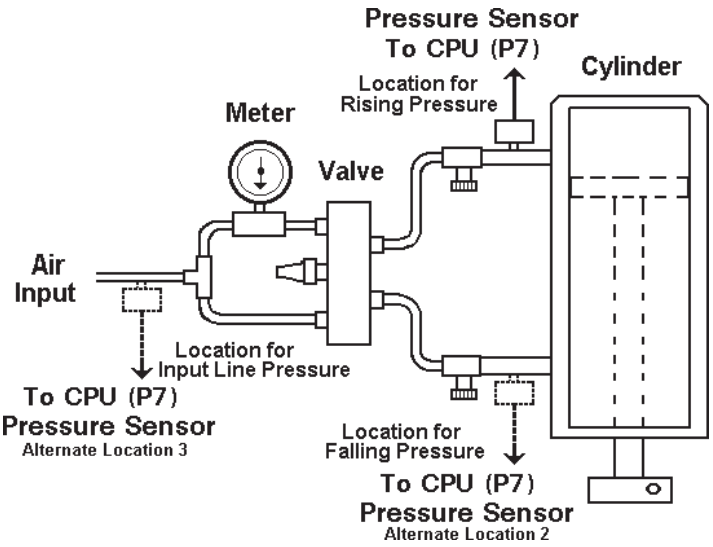


Figure 9-62. *IPS System with Sensor*

Sensor Placement At Top Of The Cylinder

The top (supply) side of cylinder is used as trigger for continuing sequence on a rising edge. In this position, Sensor output should match programmed value.

Sensor Placement At Bottom Of The Cylinder

Sensor can be placed on bottom (exhaust) side of cylinder, in order to trigger for continuing sequence on a falling edge. In this position, Sensor output should match programmed BACKGROUND FORCE/ PRESSURE value.

Sensor Placement On The Input Air Line

Sensor can also be placed on input line in order to trigger for continuing sequence on a rising edge. In this position, Sensor output should match supply pressure.

9.12.6 PRESSURE SENSOR (cont.)

DIFFERENTIAL PRESSURE SENSOR

The **IPSC** system can be ordered with a Differential Pressure Sensor (Figure 9-63).

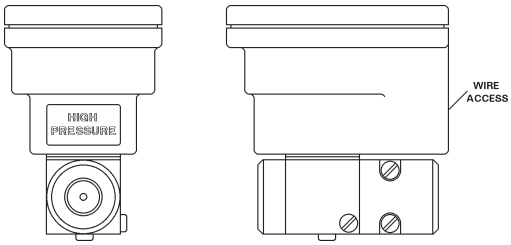


Figure 9-63. *Differential Pressure Sensor*

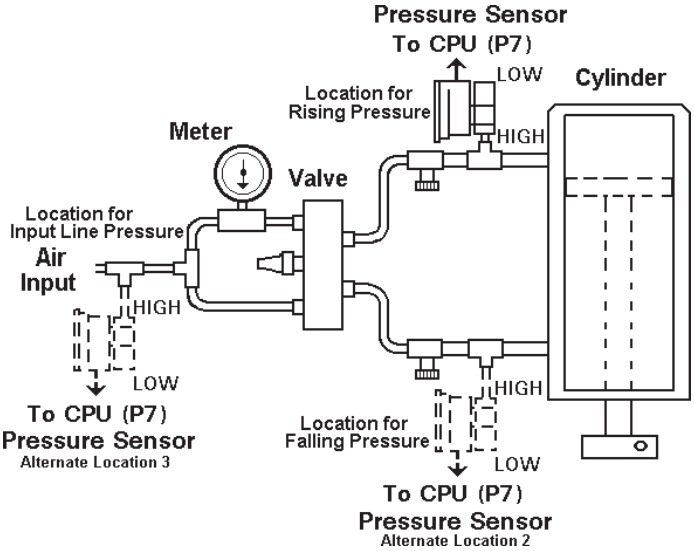


Figure 9-64. *IPS System with Differential Pressure Sensor*

The Differential Pressure Sensor has two connections, one high and one low. This sensor can be used as a single ended sensor by using only the high pressure port (Figure 9-64).

Using Differential Pressure Sensor as shown in Figure 9-65 provides a better indication of actual cylinder force. This Differential Sensor will subtract pressures on low side of Sensor from pressures on high side. This is useful to detect possible forces in exhaust side of cylinder, either intentional (forge operations) or unintentional (restricted exhaust).

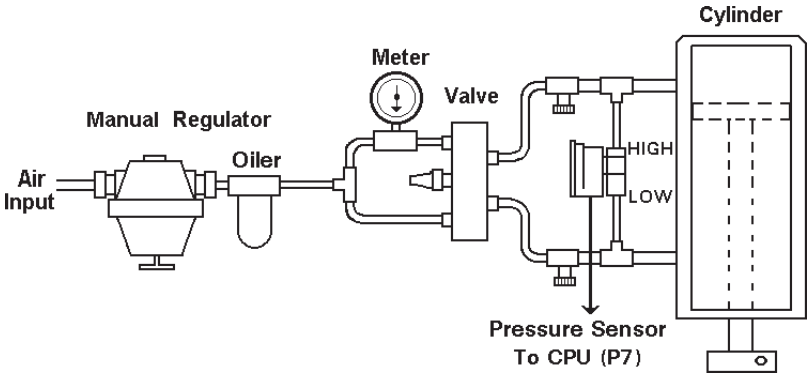
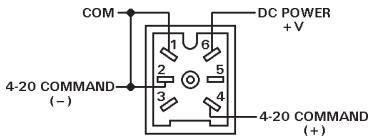


Figure 9-65. *Differential Pressure Sensor location to sense Cylinder position*

9.12.7 PRODUCT SPECIFICATIONS

The Proportional Valve is made by Proportion-Air. The Differential Pressure Sensor and Single Input Sensor without cable are made by Setra. Similar devices may be substituted.

PROPORTIONAL VALVE WITH VOLUME BOOSTER & FILTER



PROPORTIONAL VALVE
WIRING LOGIC

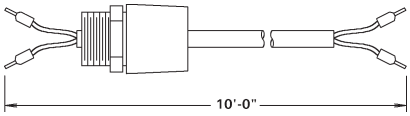
Proportional Valve, filter, volume booster with cable

Proportional Valve with Booster and Filter has P/N 571001 for Internal ½″ N.P.T., and P/N 571002 for Internal 1¼″ N.P.T. The Cable Assembly P7-J13 has P/N 326039.

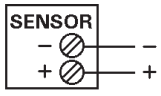
Operating Temperature: 0°C to 70°C (32°F to 158°F)
Accuracy: +/- 1% full scale
Repeatability: 0.1% full scale
* Operating Pressure: 125 PSI (max.)
Adjustment Resolution: 0-99 PSI in 1 PSI increments
Command Current: 4-20 mA at 100 ohms impedance
Port Size: Internal ½″ N.P.T. or 1¼″ N.P.T.
Filtration: 20 micron nominal
Response Time: 40-50 mS (typical)
Construction: Aluminum, Zinc, Acetal, Brass, Buna-n
Proportional Valve Type: Diaphragm
Flow Rate (High): 100 scfm at 80 PSI for ½″
250 scfm at 80 PSI for 1¼″

SINGLE-ENDED PRESSURE SENSOR

The Sensor without cable has P/N 571005. Sensor supplied with cable P/N 326053 has P/N 600633.
Operating Temperature: -40°C to 127°C (-40°F to 260°F)



Accuracy: +/- .25% full scale
Repeatability: 0.05% full scale
Adjustment Resolution: 0-99 PSI in 1 PSI increments
Output Current: 4-20 mA
Operating Pressure: 200 PSI maximum
Input Size: External ¼″ N.P.T.
Construction: Stainless Steel, Valox, 17-4 PH S.S.
Response Time: 5 mS (DC output)
Sensing Device Construction: Variable Capacitance



PRESSURE
SENSOR
WIRING LOGIC

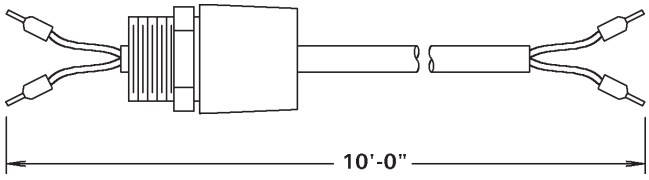
Single-ended Pressure Sensor

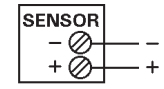
* Operating Pressure shown is for QB1 electronic Proportional Valve. Volume Booster can be operated alone with 400 PSI (max.). Contact factory for more information.

9.12.7 PRODUCT SPECIFICATIONS (cont.)

DIFFERENTIAL PRESSURE SENSOR

The Differential Pressure Sensor is P/N 571004.
Supplied with cable P/N 326053.





DIFFERENTIAL SENSOR WIRING LOGIC

Differential Sensor

Operating Temperature: -22°C to 80°C (0°F to 175°F)
Accuracy: +/- 1% full scale
Non-Repeatability: 0.05% full scale
Output Current: 4-20 mA
Operating Pressure: 250 PSI maximum
Input Size: Internal ¼″ N.P.T.
Construction: Aluminum, Stainless Steel, Viton
Response Time: 30-50 mS (DC output)

9.12.7 PRODUCT SPECIFICATIONS (cont.)

CUSTOMER PROVIDED HARDWARE WIRING

When customer provides Proportional Valve and/or Pressure Sensor, use information in Figure 9-66 to wire to IPSC Option to P7 with Standard Sensor and Proportional Valve.

On CPU P7, terminal 5 is sourcing input and terminal 11 (controller output) is sourcing output.

Sourcing inputs **must be** connected to sinking outputs and sinking inputs **must be** connected to sourcing outputs.

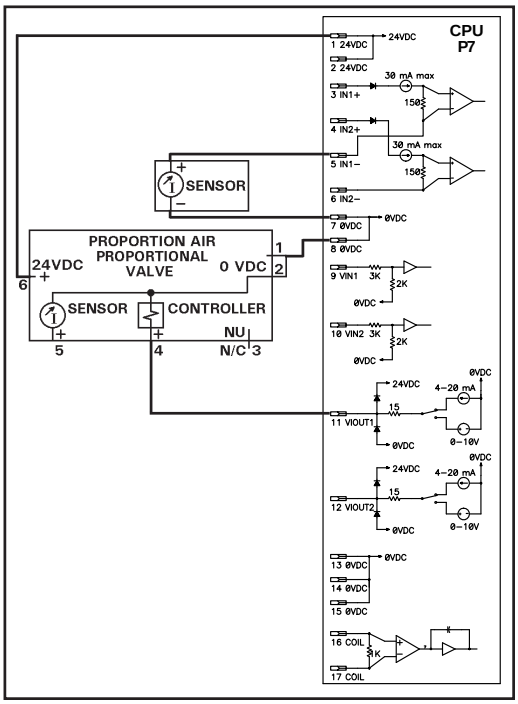


Figure 9-66. *IPSC Wiring Logic – Proportion-Air*

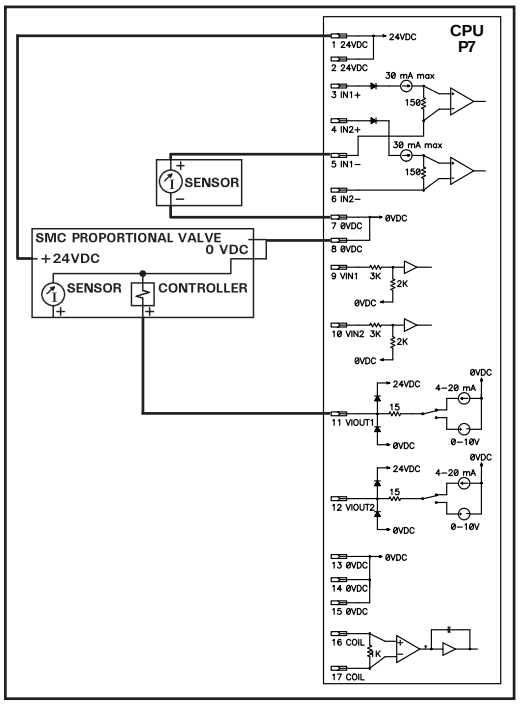


Figure 9-67. *IPSC Wiring Logic – SMC or other customer provided Proportional Valve*

When customer provides Proportional Valve and/or Pressure Sensor, use information in Figures 9-67, 9-68 and 9-69 to wire to IPSC Option to P7 with SMC or other customer provided Proportional Valve.

The valve used should have a sinking input.

On CPU P7, terminal 5 is sourcing input and terminal 11 (controller output) is sourcing output.

Sourcing inputs **must be** connected to sinking outputs and sinking inputs **must be** connected to sourcing outputs.

9.12.7 PRODUCT SPECIFICATIONS (cont.)

CUSTOMER PROVIDED HARDWARE WIRING

When customer provides a Sourcing Sensor, use information in Figure 9-68 to wire IPS Option to P7.

When customer provides a Sinking Sensor, use information in Figure 9-69 to wire IPS Option to P7.

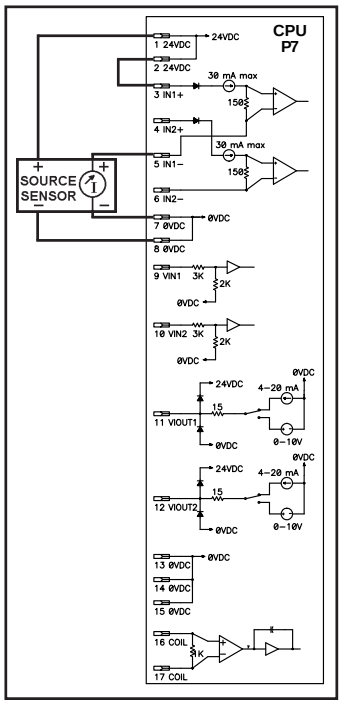


Figure 9-68.
Sourcing Sensor Wiring Logic

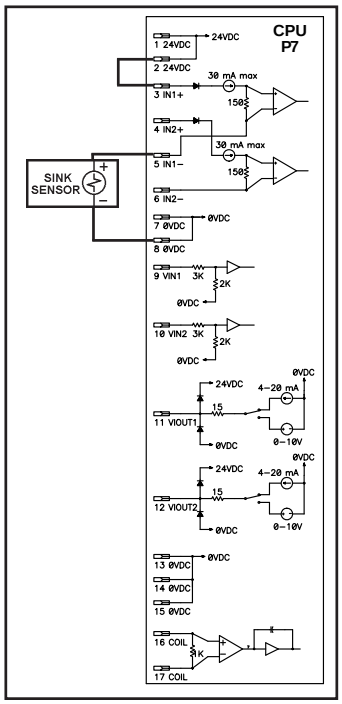


Figure 9-69.
Sinking Sensor Wiring Logic

SINKING/SOURCING BLOCK DIAGRAM

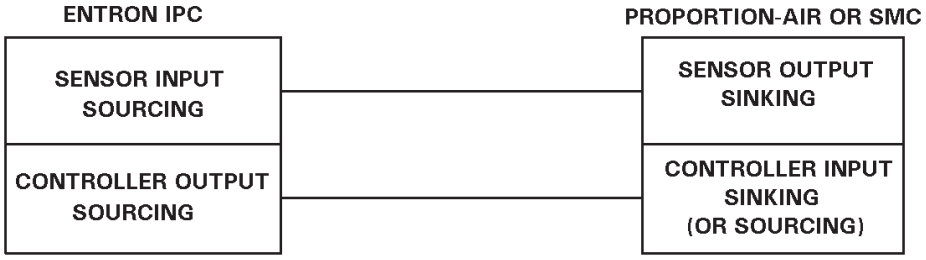


Figure 9-70. *Sinking/Sourcing Block Diagram*

9.12.8 TROUBLESHOOTING

Refer to Manual and Wiring Diagrams for location of fuses, terminal strips, etc. Refer to Wiring and Logic Diagrams for Bills of Material.

TROUBLE	POSSIBLE CAUSE	SOLUTION
Control will not change pressure.	1. Programming error. 2. Clogged filter.	1. Follow programming instructions. 2. Clean filter.
Error Code **15** (IPSC or IPS Option).	1. Not reaching actual preset point. 2. Pressure Sensor connected incorrectly.	1. Check parameters in control. Check line pressure. 2. Review wiring or check for open circuit.
Sensor input display always maximum value.	1. Pressure Sensor connected incorrectly.	1. Review wiring or check for open circuit.
Cylinder falls at the end of sequence or stays down (Pressure Control Option).	1. No Background (Return) Pressure Setting 2. Background (Return) pressure not high enough to lift the cylinder. 3. May need manual regulator.	1. Program Background value in the control. 2. Change Background value. 3. Install manual regulator.
Valve will not shuttle.	1. Pressure too low to operate valve. 2. Solenoid valve not programmed in schedule.	1. Increase pressure or change to pilot assist type valve. 2. Program a valve in the schedule.
Welding control initiates and valve actuates, but electrodes do not close.	1. Solenoid valve mis-wired. 2. Clogged filter.	1. Check all solenoid terminals for proper wiring or open connections. 2. Clean filter.

! WARNING !

TURN PRESSURE OFF AND BLEED SYSTEM BEFORE ATTEMPTING

TO INSTALL OR SERVICE THIS CONTROL!

BLOCK ALL MOVING DEVICES BEFORE INSTALLATION OR SERVICING!

9.12.8 TROUBLESHOOTING (cont.)

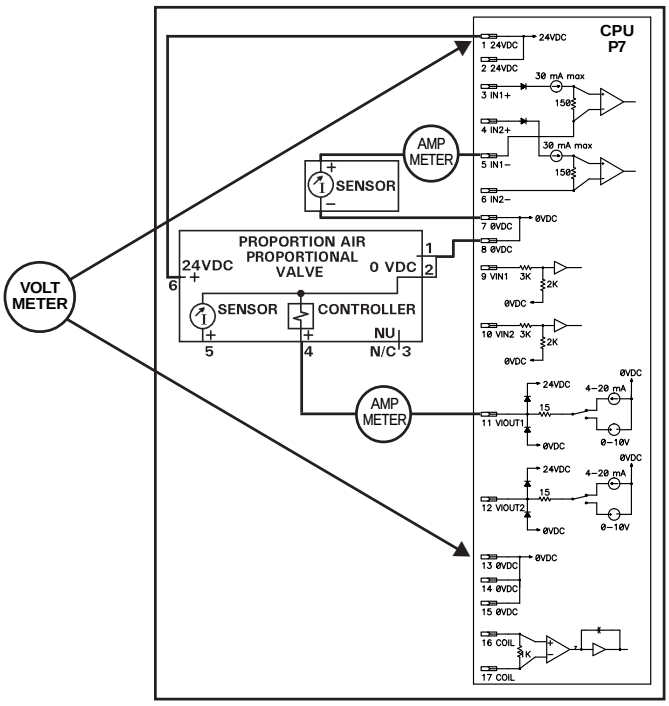


Figure 9-71. *IPSC block diagram*

Figure 9-71 may be useful in understanding Pressure Sense and Control operation and aid in troubleshooting.

When troubleshooting the Pressure Control operation:

1. A DC volt meter can check for 24VDC (approx. 24 VDC) between P7-1 and P7-13.
2. The weld control can be used to vary pressure output and an Amp meter can be placed in series with TS13-4 or VIOUT1 (P7-11) connection to check for current variations from 4 mA (0 PSI) to 20 mA (99 PSI). See Table 9-2 for mA to PSI relationship.
3. Control may be placed in mA mode and BACKGROUND parameter adjusted.

When troubleshooting the Pressure Sense operation:

1. A DC volt meter can check for 24VDC (approx. 24 VDC) between TS13-1 and TS13-6.
2. The source of pressure that is being monitored can be varied and an Amp meter be placed in series with the sensor at IN1- (P7-5) and the reading should change from 4 mA (0 PSI) to 20 mA (99 PSI). See Table 9-2 for mA to PSI relationship.
3. Control may be placed in mA mode and BACKGROUND parameter adjusted.

! WARNING !

TURN PRESSURE OFF AND BLEED SYSTEM BEFORE ATTEMPTING
TO INSTALL OR SERVICE THIS CONTROL!
BLOCK ALL MOVING DEVICES BEFORE INSTALLATION OR SERVICING!

9.12.8 TROUBLESHOOTING (cont.)

Table 9-2. *Relationship of mA to PSI for 4-20 mA=0-100 PSI Sensors and Proportional Valves*

mA	PSI	mA	PSI	mA	PSI	mA	PSI
4.00	0.00	8.00	25.00	12.00	50.00	16.00	75.00
4.50	3.13	8.50	28.13	12.50	53.13	16.50	78.13
5.00	6.25	9.00	31.25	13.00	56.25	17.00	81.25
5.50	9.38	9.50	34.38	13.50	59.38	17.50	84.38
6.00	12.50	10.00	37.50	14.00	62.50	18.00	87.50
6.50	15.63	10.50	40.63	14.50	65.63	18.50	90.63
7.00	18.75	11.00	43.75	15.00	68.75	19.00	93.75
7.50	21.88	11.50	46.88	15.50	71.88	19.50	96.88
						20.00	100.00

9.12.9 IPSC RETROFIT KIT BILL OF MATERIAL

EN6021 CONTROLS ALL CABINET STYLES									
IPS	IPSD	IPC2	IPC5	IPSC2	IPSC5	IPSCD2	IPSCD5		
730005-005	730005-008	730005-007	730005-006	730005-015	730005-016	730005-017	730005-018	PART NO.	DESCRIPTION
1				1	1			600633	Assembly, Pressure Sense
	1					1	1	571004	Differential Pressure Sensor
	1					1	1	326053	Cable Assembly, Differential Pressure Sensor
		1		1		1		571001	Proportional Valve, 1/2 NPT
		1	1	1	1	1	1	326039	Cable Assembly, PCS Ctrl to Proportional Valve
			1		1		1	571002	Proportional Valve, 1-1/4 NPT

9.13 CYCLE MODE EXAMPLES

The EN6021 can be programmed to operate in several CYCLE MODES. Each SCHEDULE has CYCLE MODE parameter that dictates the sequence of events that will follow an initiation (see Section 5.5.1).

9.13.1 NON-REPEAT CYCLE MODE

When any of 100 possible SCHEDULES, having CYCLE MODE set to **Non-repeat**, is initiated by pilot switch, the sequence executes as shown in Figure 9-72 (depending on programmed parameters).

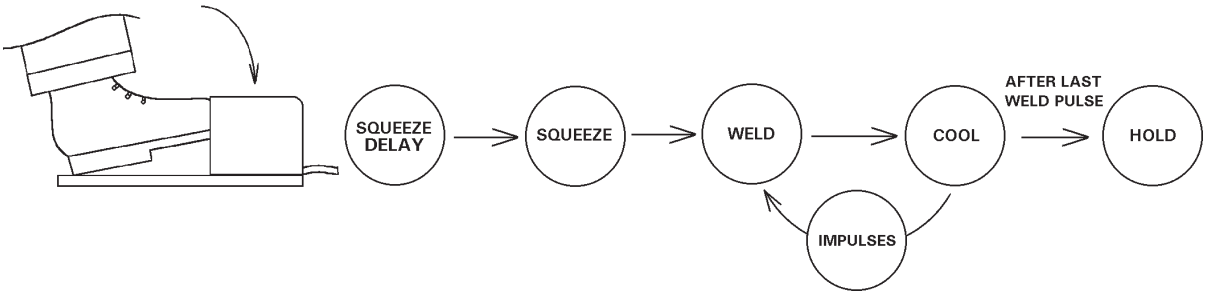


Figure 9-72. *Non-Repeat sequence*

Upon initiation, programmed valve is energized at beginning of SQUEEZE. If Pressure Switch is open, control counts through SQUEEZE time but does not begin counting WELD time until Pressure Switch closes. Once Pressure Switch closes, WELD time begins. Weld current is then supplied to the welding transformer at a value programmed by HEAT for a duration programmed in WELD.

In this example, PULSATION is shown after COOL, until number of IMPULSES has elapsed, then moving to HOLD. HOLD time is when electrodes are closed with no current present, but selected valve will still be energized. Since this is a Non-repeat sequence, there is no OFF time mentioned. The valve will automatically de-energize at end of programmed HOLD time.

9.13.2 REPEAT CYCLE MODE

When any of 100 possible SCHEDULES, having CYCLE MODE set to **Repeat**, is initiated by pilot switch, the sequence is as shown in Figure 9-73.

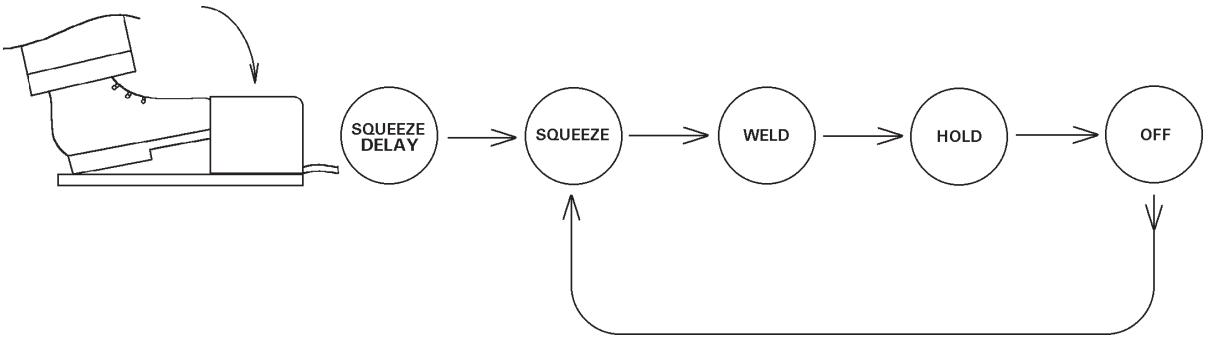


Figure 9-73. *Repeat sequence*

9.13.2 REPEAT CYCLE MODE (cont.)

In this example, sequence is much the same as previous example with exception of no IMPULSE welding. If initiation (foot switch) is held closed until after OFF time, control will move to beginning of SQUEEZE time and **repeat** scheduled sequence.

Each individual SCHEDULE intended to repeat must be programmed separately for **Repeat** CYCLE MODE to perform Repeat function.

9.13.3 CHAINED CYCLE MODE

Scheduled sequences may be chained, resulting in weld sequence made up of several schedules in length. A Chained sequence can be programmed by setting CYCLE MODE to **Chained**. Last SCHEDULE of sequence must be have CYCLE MODE value of Non-repeat, Repeat, or Successive.

If Chained CYCLE MODE is used in last SCHEDULE of Chained sequence, entire chain will be repeated if initiation is held closed.

The first SCHEDULE of Chained sequence can be any of 100 possible. In **Chained** CYCLE MODE, scheduled sequence is chained immediately to next numerical SCHEDULE. When initiated (foot switch), sequence takes place as shown in Figure 9-74. First SCHEDULE of Chained sequence is called *N*.

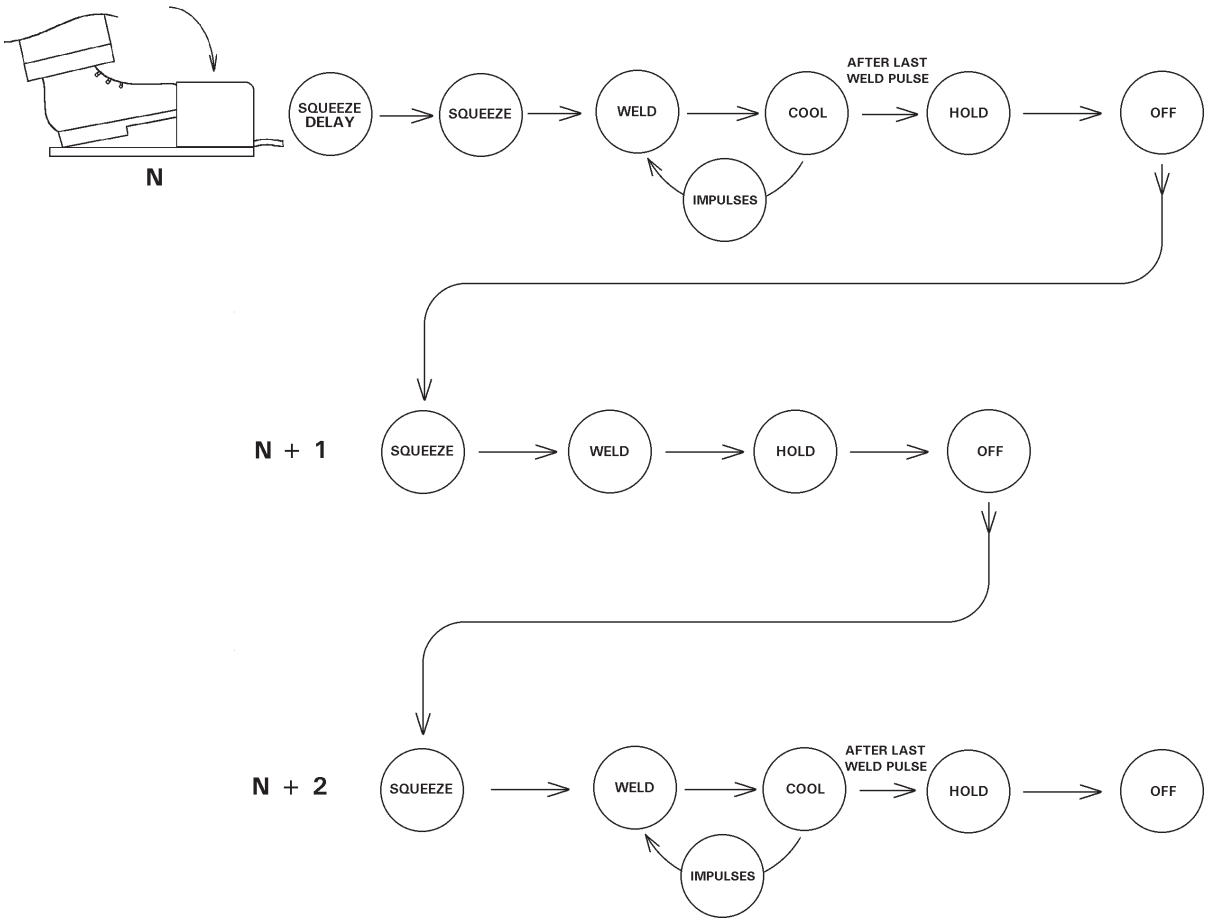


Figure 9-74. *Chained sequence*

9.13.3 CHAINED CYCLE MODE (cont.)

While SCHEDULE *N* is sequencing, times and parameters will be in accordance with those stored in SCHEDULE *N*. When SCHEDULE *N* has finished, sequence jumps to SCHEDULE *N*+1. SCHEDULE *N*+1 is then performed and so on until sequence encounters Non-repeat, Repeat, or Successive CYCLE MODE.

Within Chained sequence, control will encounter SCHEDULES programmed with following CYCLE MODES and will react as follows:

Non-repeat: Sequence will end in Non-repeat mode.

Repeat: Sequence will start over at initiated sequence and continue as explained in Chained mode.

Chained: SCHEDULE number displayed on **Status Page 1** will increment by one and continue as explained in Chained mode.

Successive: Sequence will end as if it were in Non-repeat mode. SCHEDULE number on **Status Page 1** would then be incremented by one to next SCHEDULE as in Successive mode but not start that sequence until next initiation. By using Successive mode at end of Chained sequences, extremely complicated sequences can be generated. **Status Page 1** will display SCHEDULE number of last SCHEDULE performed + 1.

Wait-here: Sequence will wait at parameter set to **99** for another initiation input.

When HOLD and OFF in first SCHEDULE of Chained sequence and SQUEEZE in second of Chained sequence are all programmed to 0 cycles, sequence will jump directly from end of WELD time of first SCHEDULE to beginning of WELD time in following SCHEDULE, without any interval between two WELD times (continuous weld current). This sequence allows two different weld currents to be introduced with one immediately following the other.

SCHEDULE number displayed on **Status Page 1** at end of Chained sequence depends on SCHEDULE SELECT parameter. If it was programmed in External mode, SCHEDULE number displayed will be controlled by combination of SS1–SS7 (see Section 9.7). If it was programmed to Internal mode, SCHEDULE number will be last number entered. The SCHEDULE number displayed need not be first number in sequence of Chained SCHEDULES. For example, if SCHEDULES 1, 2, 3 and 4 are chained together and SCHEDULE 2 is selected, after initiation sequence would be as follows: SCHEDULE 2, 3, 4 and, at completion of SCHEDULE 4, **Status Page 1** would read **S02**, and not **S01**. See Section 9.7 for more information about SCHEDULE SELECT function.

9.13.4 SUCCESSIVE CYCLE MODE

Successive mode can be thought of as a Chained SCHEDULE being initiated one link (or step) at a time. When first SCHEDULE of Successive series is initiated, it will sequence as in Non-repeat. At completion of SCHEDULE, SCHEDULE number on **Status Page 1** will be incremented by one and control will return to Ready state.

For example, if control is programmed with Successive series consisting of SCHEDULES 1, 2, and 3 (1 and 2 being programmed as Successive and 3 being programmed as Non-repeat) and SCHEDULE 1 is manually selected and control is initiated, sequence of events will be as follows: control will sequence through SCHEDULE 1 and then increment SCHEDULE number on **Status Page 1** to S02 (flashing) and wait for next initiation. An initiation at this point would start SCHEDULE 2. After SCHEDULE 2 was completed, SCHEDULE number would then increment to S03 (flashing). After next initiation, SCHEDULE 3 will be completed and SCHEDULE number displayed on **Status Page 1** will again show S01.

When SCHEDULE SELECT is programmed to External mode, Successive series will start with externally selected SCHEDULE and will automatically return to that SCHEDULE once series is completed (see Section 5.5.6).

The BACK-STEP function can be used to return to previous SCHEDULE *N*-1 without continuing through rest of Successive SCHEDULES. A momentary closure of Back-step switch (PI8 – pin P3-8) will cause control to return previous SCHEDULE. This can be repeated until first SCHEDULE of a series is reached. A maintained closure (approximately 1.5 seconds) will cause control to return first SCHEDULE in series.

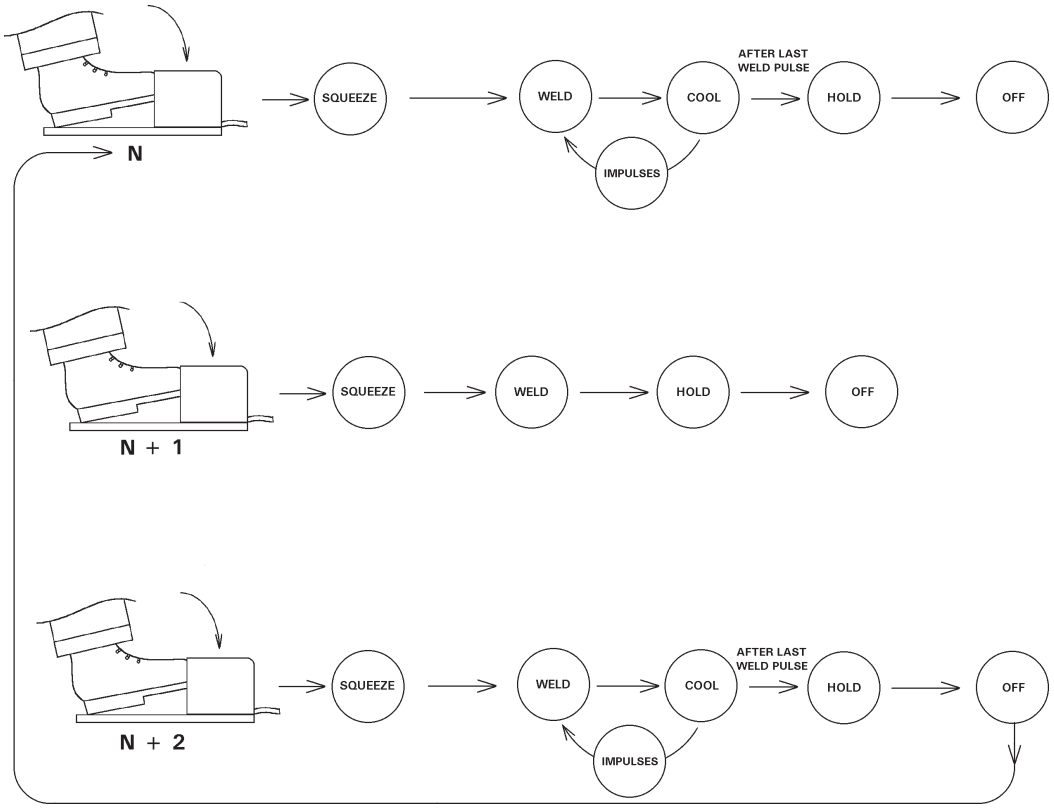


Figure 9-75. *Successive sequence*

9.13.5 WAIT-HERE CYCLE MODE

! CAUTION !

Only use Wait-here CYCLE MODE with full understanding of machine and control operation. Enabling of **BEAT MODE=3** has been added to help ensure this operation is **really** required.

This CYCLE MODE has been implemented to satisfy additional requirements for more complicated machine sequencing.

NOTICE

Control will allow programming of Wait-here CYCLE MODE ***only*** if BEAT MODE is already programmed to **3** in **Configure Menu** (see Section 5.5.6).

If SCHEDULE is programmed with Wait-here CYCLE MODE and, if initiated, control will execute sequence, wait either in SQUEEZE or WELD/COOL or HOLD part of sequence, depending on programmed data in given SCHEDULE, and maintain programmed valves and weld active indefinitely. At this point, Wait-here part of sequence can be stopped by activating Emergency Stop or Temperature Limit Switch input, or it can be continued with a different initiation. When another initiation input closes, control will continue by selecting displayed SCHEDULE or SCHEDULE 20, 40, or 60 respectively, and executing it as programmed whether it is Spot or Repeat or Chained sequence.

In order to determine where control will wait in Wait-here CYCLE MODE, corresponding SCHEDULE parameter must be programmed to **99**. Control will wait on SQUEEZE if SQUEEZE is programmed to **99**, WELD1 if WELD1 programmed to **99**, COOL1 if COOL1 programmed to **99**, WELD2 if WELD2 programmed to **99**, COOL2 if COOL2 programmed to **99**, or HOLD if HOLD is **99**.

The following sequence illustrates how to use this CYCLE MODE.

SCH	SQUEEZE	VALVE	WELD1	HEAT1	COOL1	SLOPE	WELD2	HEAT2	COOL2	HOLD	OFF	IMPULSES	CYCLE MODE
20	30	1	0	0	0	0	10	50	0	0	0	1	Successive
21	20	1+2	0	0	0	0	0	0	0	99	0	1	Wait-here
40	30	1+2+3	0	0	0	0	99	0	0	0	0	1	Wait-here
60	10	1+2+3	0	0	0	0	0	0	0	20	0	1	Non-repeat

After welding sequence is started with FS2, control will execute Successive cycle on SCHEDULE 20, wait for re-initiation on FS2 for SCHEDULE 21, execute Wait-here and turn on Valves 1 and 2 because CYCLE MODE=**Wait-here** and HOLD=**99**. Control will sequence until one of two conditions occur: 1) Emergency Stop or Temperature Limit Switch is open causing sequence to be stopped or 2) FS1, FS3 or FS4 is activated causing control to jump to selected SCHEDULE, SCHEDULE 20 or 40, respectively, and execute whatever sequence is programmed there. If FS3 is initiated, control will execute SCHEDULE 40. This is a Wait-here SCHEDULE with WELD2 time set to **99**. It will now weld until Emergency Stop or another SCHEDULE is initiated. If SCHEDULE 60 is initiated by FS4, control will go through to HOLD and stop.

! CAUTION !

Only use Wait-here CYCLE MODE with full understanding of machine and control operation. Enabling of **BEAT MODE=3** has been added to help ensure this operation is **really** required.

9.14 LDT STACK-UP THICKNESS SENSE AND MONITORING

The Stack-up Thickness Sense and Monitoring function can be used to measure the stack-up thickness of parts to be welded. With this feature, control is able to detect some errors such as the part is upside-down, or check the welding quality by the stack-up displacement after a weld.

The following steps are necessary to use this function:

1. **LDT Sensor Installation**
   An optional LDT Sensor (ENTRON P/N 730014-014 or 730014-051) is required. The sensor should be mounted on the welding machine. The moving magnet part of the sensor connects to the cylinder of electrodes, arm or any place where the sensor can detect the traveling distance of electrode.
   If a non-ENTRON-recommended LDT sensor is used, the sensor must output current signal in order to work with EN6021 control firmware. When in calibration process, the EN6021 accepts a signal range of 3.0–21.0 mA; when in normal operation mode, control accepts a signal range of 4.0–20.0 mA (± 0.5%).
2. **LDT Sensor Wiring**
   Connect sensor's cable to P7 Connector as shown in Figure 4-11 (see Section 4.4.6).
3. **Recalibration of Sensor Analog Output Signal** (if necessary)
   The control uses Analog Input 2 port to measure the current signal from LDT Sensor and, in 0–20 mA range, control current measurement accuracy is 0.5%. In some applications, where electrode travels a much longer distance than stack-up thickness value which control needs to detect, the 0.5% accuracy is not high enough.
   For example, electrode might travel 3 inches from total open position to totally closed on part. Accuracy of 0.5% for 3 inches will be 15 mil, but part to be welded may only have 100-150 mil thickness and control needs to detect less than 10 mil thickness difference. If sensor's moving part can travel more than 3 inches but only convert thickness range which control needs into 4–20mA, then above 0.5% will be enough for the application.
   This LDT Sensor offers analog signal programmability – the ability to rescale Zero and Span positions or invert the positions in the field. When sensor has been mounted on the welding machine, move the magnet part of sensor and rescale Zero and Span points, making sure Zero through Span range covers stack-up thickness range.
   See *Manual Setting ZERO & SPAN* information in Section 10.15 for rescaling procedure.
4. **Calibration of Stack-up Thickness Measurement**
   See **Calibration Menu** (Section 5.5.7) to calibrate Stack-up thickness measurement.
5. **Set up Weld Schedules**
   Program appropriate parameters of STACK-UP MONITORING in weld schedules (see Section 5.5.1).

When above steps are completed, Stack-up Monitoring function will be ready for use. Status Page 8 on RPP2 will display Stack-up Thickness and Displacement measurements (see Section 5.3.8).

NOTICE
To save Stack-up Thickness and Displacement data into Weld Log in mils, ANALOG INPUT 2 must be mapped to Stack-up function (see Section 5.5.8).

10.0 OPTIONS FOR EN6021 SERIES CONTROLS

The following optional devices can be used with EN6021 Controls. Consult factory or sales representatives for details.

10.1 RPP2 PROGRAMMING PENDANT

This detachable, hand-held pendant provides access to all programmable parameters and displays control status on a 128x64 dots (8 lines) graphic display. RPP2 Pendant has internal data backup and comes with 10′ cable.

! WARNING !

CONNECTOR P6 IS USED FOR RPP2 ONLY!
Voltages on this connection can damage devices other than RPP2 programming pendant.

RPP2
P/N 730014-001

10.2 EXTERNAL USB & ETHERNET CONNECTORS (P/N 730014-002)

In cases where end users need external access to USB and Ethernet connectors, this option may be used. This option extends these connections from CPU to external flange of cabinet, providing IPC 68 standard connectivity. Option comes complete with 16′ cables to connect to external devices. A cover for USB memory stick and caps to protect connectors when not in use are also provided. Installation information is shown in Drawing 730014-002.

10.3 ROGOWSKI COILS

Rogowski Coils are needed to measure primary and secondary currents.

PRIMARY COIL

The Primary Coil can be placed over a weld tranformer primary connection and has 1.75″ inside diameter. Primary Coil range is 0.2–5.0 kA.

Primary Coil
P/N 313022

SECONDARY COILS

The Secondary Coils are available in diameters of 5″ (S5 option) or 8″ (S8 option). Secondary Coil range is 10–100 kA.

Secondary Coils
S5 – P/N 730014-005
S8 – P/N 730014-006

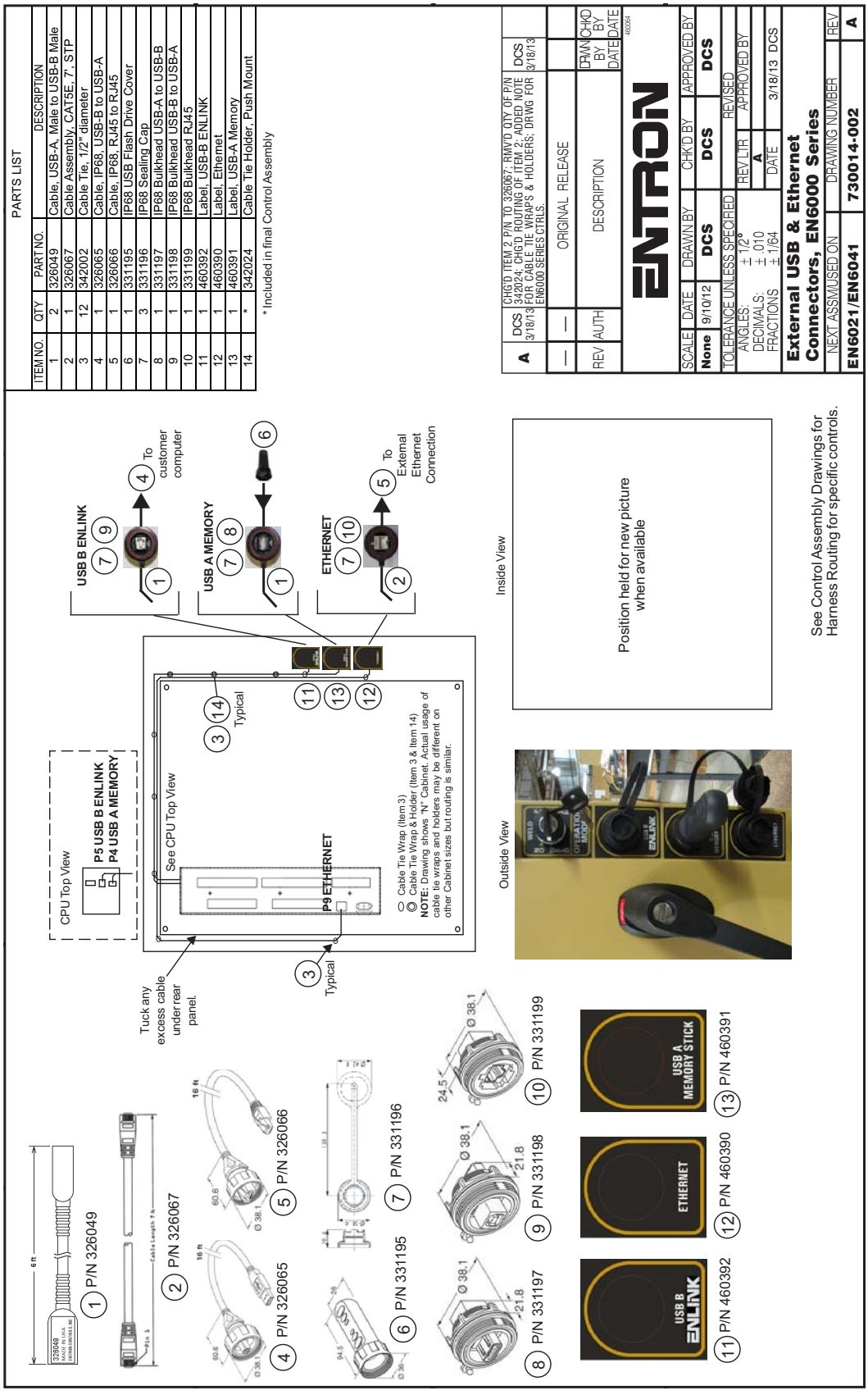
10.4 USB MEMORY STICK

This USB Memory Stick is used for Schedule storage, Weld Log and Error Log exports, backup purposes and firmware updates. See Section 5.5.9 and Appendix B for more information about memory stick functions.

USB Memory Stick
P/N 730014-003

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

EXTERNAL USB & ETHERNET CONNECTIONS



Drawing 730014-002

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.5 PROGRAM LOCKOUT KEY SWITCH (PLS)

PLS
P/N 730014-009

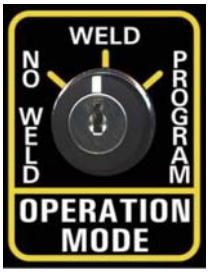
Normally, a user can access parameters via RPP2 programming pendant and make any changes as required. Under some circumstances, it may be desirable to prevent such general access. The EN6021 provides an option called Program Lockout key switch (PLS), which can be used to block all parameter edits. When Edit Lock function is enabled, flashing **LK** will be displayed on left end of Title Section (see Section 5.0).

If control is locked, the **PIN** page will be displayed when user attempts to access **Main Menu** from any **Status** page. The correct PIN number must be entered to unlock control. If incorrect PIN number is entered, **Main Menu** can be accessed. However, while viewing parameters is possible, no changes are permitted via RPP2. If edits are attempted, display will briefly show **Edits Disabled!!!** in Help Section and editing will be blocked.

It is suggested that this key switch be activated so only key-holder is able to open switch and edit parameters. INPUT PI6 needs to be mapped to Edit Lock in **Input Function** sub-menu of **I/O Map Menu** (see Section 5.5.8). If this feature is not required, simply leave this input unconnected or map this input to Sequencer function.

Weld controls can be ordered with this switch by ordering Program Lockout Switch (PLS – P/N 730014-009) option. This option can also be shipped separately and installed in field. Remove the key switch hole-plug from the cabinet and mount the switch using the nut and lock-washer provided. Connect the switch as shown in Drawing 730014-009.

10.6 OPERATON MODE KEY SWITCH (OMS)



OMS
P/N 730014-004

The Operation Mode Switch combines Program Lockout feature to lockout unauthorized users from modifying programmed parameters with the ability to place control in **No Weld** or **Weld** mode. **No Weld** mode is desirable when initiating a sequence as programmed without weld current for setup purposes.

See Program Lockout section for specific information about that feature.

The OMS option also provides an input for WELD ON. NW1 (pin P1-16) must be connected to FSC (pin P1-15) for a weld to be made in a sequence.

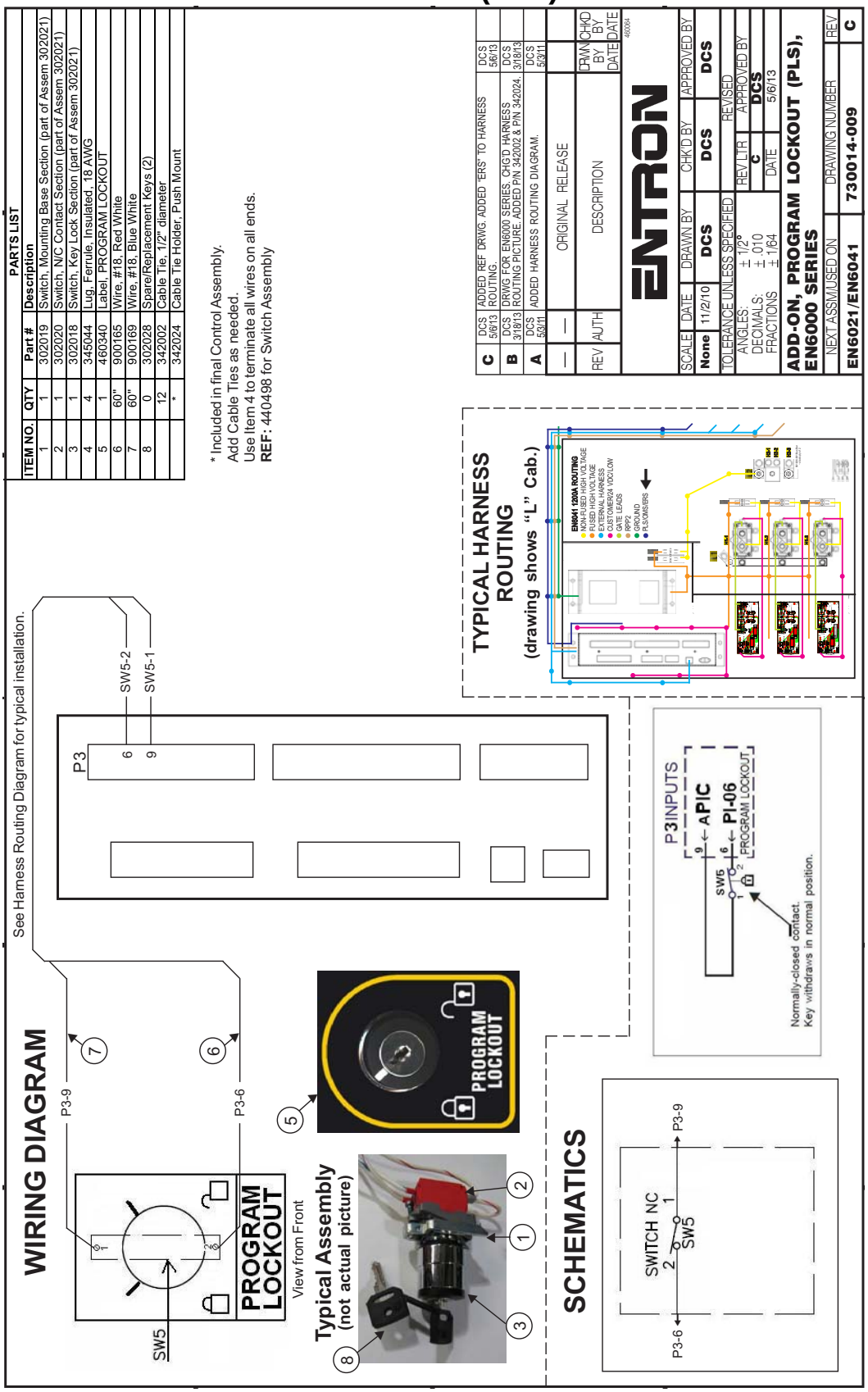
It is suggested that this key switch be activated so only key-holder is able to open switch and edit parameters. INPUT PI6 needs to be mapped to Edit Lock in **Input Function** sub-menu of **I/O Map Menu** (see Section 5.5.8). If this feature is not required, simply leave this input unconnected or map this input to Sequencer function.

When Program Lockout or No Weld are not required, simply leave INPUT PI6 (pin P3-6) unconnected. When Weld On is not required, simply jumper NW1 (pin P1-16) to FSC (pin P1-15).

Weld controls can be ordered with this switch by ordering Operation Mode Switch (OMS – P/N 730014-004) option. This option can also be shipped separately and installed in field. Remove the key switch hole-plug from the cabinet and mount the switch using the nut and lock-washer provided. Connect the switch as shown in Drawing 730014-004.

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

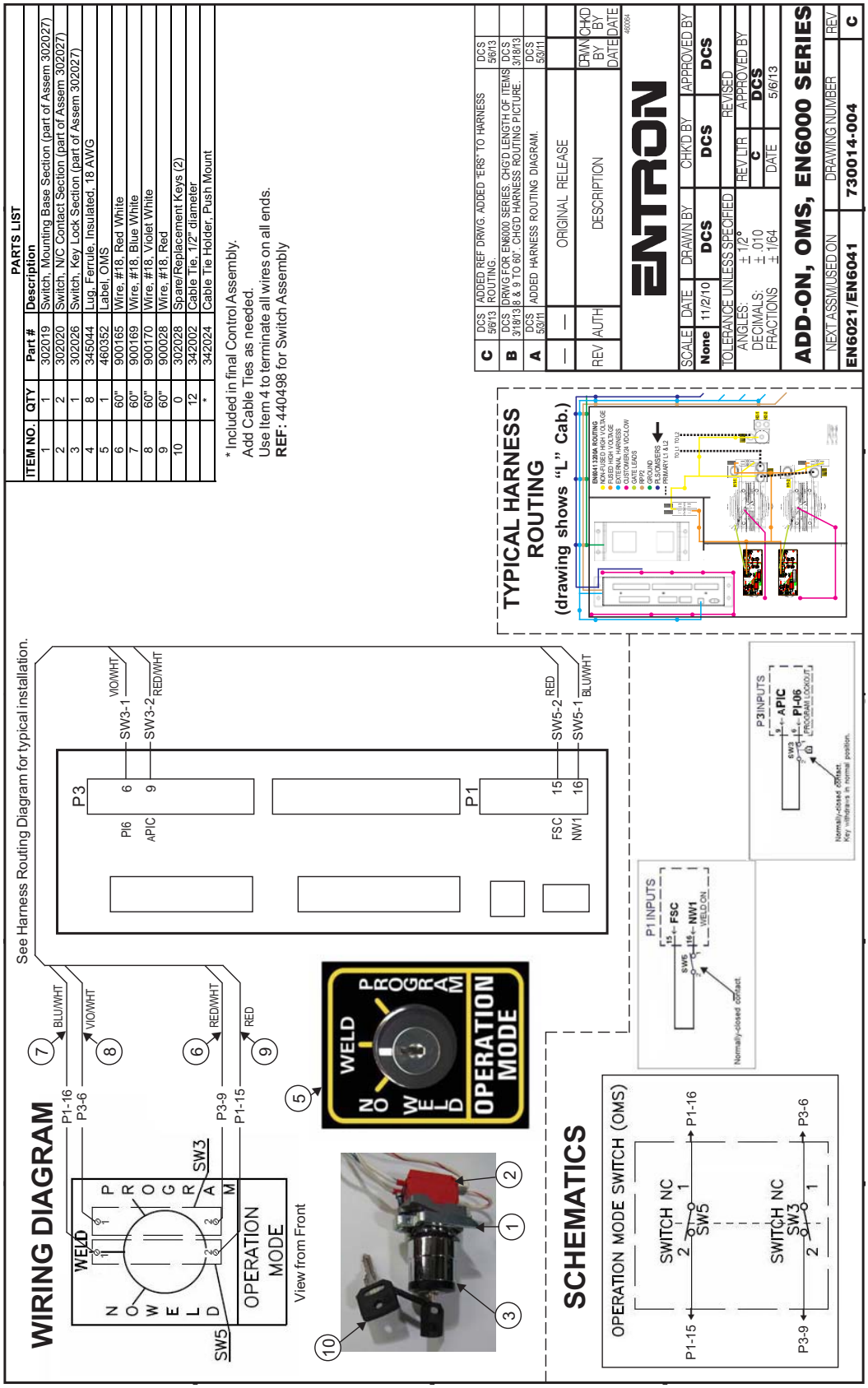
PROGRAM LOCKOUT KEY SWITCH (PLS)



Drawing 730014-009

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

OPERATION MODE KEY SWITCH (OMS)



Drawing 730014-004

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.7 COMMUNICATION CARDS

The EN6021 supports two types of Communication Cards:

MBTCP/RTU (P/N 730014-007) – implements Modbus/TCP communication over Ethernet networks or using serial RS232 or RS485 connections.

EIP/MBTCP (P/N 730014-013) – implements either EtherNet/IP or Modbus/TCP communication.

MBTCP/RTU COMMUNICATION CARD (P/N 730014-007)

This Communication Card provides ability to network multiple controls using ENLINK 6021, PLC or other devices which use Modbus protocol. This card also provides RS232 interface to serial printer to implement label printing function. Three connections are included – Ethernet, RS232 and RS485 – which are enabled in **Configure Menu** (see Section 5.5.6).

MBTCP/RTU Communication Card
P/N 730014-007

Ethernet port – Allows connection of multiple controls with ENLINK 6021, PLC and touch screens over Modbus-TCP/IP protocol. The default IP address is 192.168.0.100.

RS232 port – Connects to PLC, touch screens or other communication devices over Modbus over serial line protocol. When implementing Modbus over RS232 protocol, control works as Modbus server, using the following settings:

Baud Rate:	19200
Parity:	EVEN
Mode:	RTU
Coding system:	8-bit binary
Bits per byte:	1 start bit; 8 data bits, least significant bit sent first 1 bit for parity completion; 1 stop bit

RS232 port can also drive serial printer to implement weld label printing function over regular ASCII characters (see RS232 Printer Option). When implementing label printing function, RS232 uses the following settings:

Baud Rate:	9600
Word length:	8-bit
Parity:	No parity
Stop bit:	1 bit
Data flow control:	XON/XOFF

RS485 port – Allows connection of multiple controls with PLCs, touch screens and other communication devices over Modbus over serial line protocol. When implementing Modbus over RS485 protocol, controls works as Modbus server, using the following settings:

Control ID number:	1 through 99
Baud Rate:	19200
Parity:	EVEN
Mode:	RTU
Coding system:	8-bit binary
Bits per byte:	1 start bit; 8 data bits, least significant bit sent first 1 bit for parity completion; 1 stop bit

NOTICE

See Instruction Manual 700222 *Communication Specifications for EN6021 Series Controls* for more information.

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.7 COMMUNICATION CARDS (cont.)

EIP/MBTCP COMMUNICATION CARD (P/N 730014-013)

This Communication Card provides ability to network multiple controls using PLC or other devices which use Common Industrial Protocol (CIP™). This card also provides Modbus communication for devices which use Modbus/TCP protocol. Ths card supports regular direct Ethernet cable and crossover Ethernet cable.

EIP/MBTCP Communication Card
P/N 730014-013

EtherNet/IP port – Allows up to two TCP connections and one UDP connection over port number 44818 (0xAF12) with PLCs, touch screens and other EIP devices. ENTRON's ODVA Vendor ID is 1242. The default IP address is 192.168.0.100.

Modbus port – Supports one TCP connection over port number 502 for devices which use Modbus/TCP protocol.

RS232/RS485 port – Not functional at present time.

NOTICE
See Instruction Manual 700222 *Communication Specifications for EN6021 Series Controls* for more information.

10.8 RS232 PRINTER (P/N 730014-011)

The EN6021 has the ability to output weld data on RS232 port on Communication Card after each weld for printed log or label (sample label shown below) which can be attached to each part. This option is complete with Communication Card Option, printer and printer cable, along with one (1) roll of thermal labels.

To enable this feature, select Label Printing for COMMUNICATION CARD parameter in **Configure Menu** (see Section 5.5.6).

NOTICE
When this feature is enable, Ethernet or RS485 may not be used.

Since required cable lengths may be different depending on need, see Appendix A for cable assembly information.

Weld Log Number _____
Control I.D. __ TIME __:__:__ DATE __/__/__
Counter _____ Schedule __ Force _____
Weld 1 KA _____ Weld 2 KA _____
Pulse Width 1 __ Pulse Width 2 __
Analog Input 1 _____ Analog Input 2 _____

10.9 WATER FLOW SWITCH

The Water Flow Switch confirms water flow to water-cooled devices such as SCR contactors and will open a contact at low flow rates. See Application Note 700149 for more information.

Water Flow Switch
P/N 730005-009

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.10 INTEGRATED PRESSURE SENSE AND CONTROL SYSTEM

The EN6021 comes with Analog inputs and outputs and firmware for pressure control and sensing as standard. The actual sensors and proportional valves are optional and can be used together or separately. See Section 9.12 for further details regarding these options.

PRESSURE SENSOR (4-20 mA/0-10V Input)

The Pressure Sensors accurately measure air pressure and convert measurements to an electrical signal. The electrical output is a linear ratio of the sensed pressure. The Sensor is connected to CPU through P7. Single-ended or differential sensors are available.

IPS
Single-ended
Sensor
P/N 730005-005

IPSD
Differential
Sensor
P/N 730005-008

The pressure may be displayed by RPP2 or ENLINK Status screens. The pressure reading depends on location of the Sensor.

PRESSURE CONTROL (4-20 mA/0-10V Output)

The Integrated Pressure Sense Control System is designed for any application that requires automatic selection of a pre-programmed pressure or automatic switching between different pressure settings. Weld control schedules may be chained to obtain sequential pressure changes. Benefits of this system depend on application. Pressure Control System allows for sequencing of multiple pressures with one initiation. The flexibility of operation is only limited by number of weld schedules. Pressure Control System may be used to remove worry of pressure settings from operator. Also, it may be used to reduce electrode wear by programming "soft set-down" during SQUEEZE. The Pressure Control System may eliminate multiple valves to simplify forging operations. Another application may serve to eliminate many valves when multiple pressures are required for selecting different pressure regulators.

Proportional Valves
1/2″ port option – P/N 730005-007
1-1/4″ port option – P/N 730005-006

Available Configurations

Part Number	Option	Description
730005-005	IPS	Integrated Pressure Sense Only, Single Input Sensor
730005-008	IPSD	Integrated Pressure Sense Only, Differential Sensor
730005-007	IPC2	Integrated Pressure Control Only, 1/2" NPT Valve
730005-006	IPC5	Integrated Pressure Control Only, 1-1/4" NPT Valve
730005-015	IPSC2	Integrated Pressure Sense and Control, Single Input Sensor & 1/2" NPT Valve
730005-016	IPSC5	Integrated Pressure Sense and Control, Single Input Sensor & 1-1/4" NPT Valve
730005-017	IPSCD2	Integrated Pressure Sense and Control, Differential Sensor & 1/2" NPT Valve
730005-018	IPSCD5	Integrated Pressure Sense and Control, Differential Sensor & 1-1/4" NPT Valve

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.11 ISOLATION CONTACTOR FPI3–5

Isolation Contactors can be provided at most NEMA current ratings. ENTRON provides driver boards and power supplies to operate these higher current draw devices. Contact factory for availability and cabinet size.

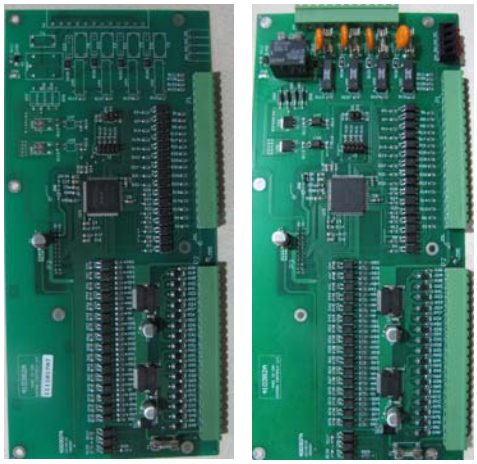
Isolation Contactor

10.12 I/O EXPANSION CARD

The **I/O Expansion Card DC** (P/N 730014-008; PCB 410382-001) provides additional 16 inputs and 16 outputs (24 VDC), equipped with 500 mA DC outputs. This card can be used with advanced error outputs to provide individual output for individual errors.

The **I/O Expansion Card AC&DC** (P/N 730014-012; PCB 410382) provides additional 16 inputs and 16 outputs (24 VDC), equipped with 500 mA DC outputs and four (4) 1 amp 120 VAC outputs, including 120 VAC, 150 VA Valve Power Supply. This card can be used with advanced error outputs to provide individual output for individual errors.

The **I/O Expansion Card AC&DC** (P/N 730014-046) is simmilar but comes with a 24 VAC transformer.



I/O Expansion Cards
P/N 730014-008 P/N 730014-012

10.13 GFI FOR PORTABLE GUNS (GF option)

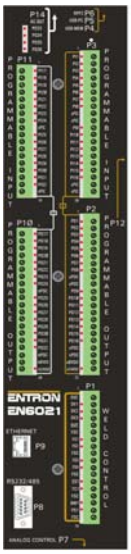
The EN6021 can be used with protable guns. Connjectors can be provided for the ARO ERG and TGA. Currently the control only supports Retraction with single valve coils.

10.14 EN6021 KIT (P/N 730014-031)

The EN6021 Kit option includes CPU, Power Supply, Fuses, Surge Resistors, Harness, Hardware, Labels, and documentation for use in customer-supplied cabinet.

EN6021 KIT PARTS LIST (P/N 730014-031)		
QTY	Part #	Description
2	225016	Surge Resistor, 100W, 500 ohm, 10%
3	307025	Fuse, 1-1/4A
3	308010	Fuseholder, One Pole
1	322568	Assembly, P12 Harness, 26 Conductor Ribbon
1	326063	Cable Assembly, 6', DB9 Male to Male, 1:1
2	331193	Jack Screw, 433
1	331194	Adapter, DB9 Female/Female
4	331208	Insertion Bridge Jumper
1	346004	Lug, 5/16" Bolt to 2/0 Wire
1	600755	Assembly, CPU
1	600756	Assembly, Power Supply
3	No P/N	Label, Fuse, FNQ-R-1 1/4 or KLDR-1 1/4
1	460103	Label, For Service Contact
1	460142	Label, Danger, Hazardous Voltage
1	460143	Label, Danger, Voltage/Flash Hazard
1	460144	Label, Danger, Voltage Hazard Earth GND
1	460145	Label, Caution, Water Hose Burst Hazard
1	460146	Label, Warning, Hazardous Voltage
1	460170	Label, Caution, Do Not Pinch Wire
1	460335	Label, ENTRON Logo
1	460342	Label, Warning, Programmed Control Devices
1	460393	Label, EN6021
1	700221	EN6021 Manual

Power Supply



CPU

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER

LDT
P/N 730014-014
or 730014-051

INTRODUCTION

The Linear Displacement Transducer (LDT) Option is designed to ensure proper stack-up of materials before weld and proper displacement after weld. For example, in nut welding, the correctly placed nut will have a correct stack-up dimension, but an upside-down nut may have an incorrect stack-up dimension. A second example highlighting displacement might be for a part with a projection that must be a certain stack-up before welding and also have a correct displacement after welding to ensure a proper weld. See Sections 4.4.6, 5.3.8, 5.5.1, 5.5.7, 5.5.8 and 9.14 for additional information.

This option comes with a cable and components to help assist in attaching Sensor to the weld head or cylinder. The operating span of the ENTRON-provided Sensor is 6" (P/N 730014-014) or 11" (P/N 730014-051) and can be set up to operate in spans less than 6" or 11" for better accuracy.

The LDT is an accurate programmable, auto-tuning, noncontact, linear displacement transducer in an economical, low profile package. The transducer utilizes field-proven Magnetostrictive technology to give absolute position, repeatable to 0.001% of the programmable sensing distance. The streamlined anodized aluminum extrusion houses the sensing element and electronics. The magnet moves over the sensing element that determines the position and converts it to an analog output. The transducer is equipped with a 4 to 20 mA output. All units are provided with a standard 5 pin 12mm Euro Micro connector.

ENTRON offers two standard units – P/N 318035 has span of 6 inches or P/N 318037 has span of 11 inches. Units can be ordered in span lengths up to 72 inches long in 1 inch increments. The optional slide magnet is designed to move effortlessly along the transducer in guide tracks, or the standard floating magnet assembly can be positioned up to 1/4" above the unit. A variety of hardware is available for attaching the magnet slide to the moving portion of the process.

The LDT has a few truly unique features. One feature is the LDT's auto-tuning capability, the ability to sense a magnet other than the standard slide magnet and adjust its signal strength accordingly. Another optional feature is that the analog output is programmable over the entire active stroke length. The active stroke area of the LDT lies between the Null and Dead zones.

The LDT offers a unique diagnostic capability. The normal analog output indicates the position of the magnet within the programmed Span. If the magnet moves beyond the programmed Zero & Span positions, the analog output will be either 3.9mA or 20.1mA for current models. If there is a loss of magnet, the output will be 3.8mA on current units.

MOUNTING

The transducer can be mounted vertically or horizontally using the supplied mounting brackets. The mounting brackets slide in the grooves on the lower part of the extrusion and clamp down when tightened. It is recommended to use one mounting bracket on each end and every three feet between.

Ferro-magnetic material, which is material readily magnetized, should be placed no closer than .25" from the sensing surface of the LDT.

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER (cont.)

MAGNET ASSEMBLY

Magnet choices are the Floating Magnet or Slide Magnet assemblies. When using the Floating Magnet assembly, the magnet should be installed within ¼" of the sensing surface. The magnet assembly should also be installed in such a manner that it remains an even distance from the aluminum extrusion throughout the entire stroke. Improperly installed magnets can result in output signal non-linearity, or loss of Magnet signal.

WIRING

Once the LDT has been installed, wiring connections can be made. The LDT uses an industry standard 5 pin 12mm Euro style cordset with a shield, tied to the coupling nut. To reduce electrical noise, the shield must be properly used. Connect the cable's shield to the controller system Ground. The cable shield is connected at the connector end. Always observe proper grounding techniques and isolate high voltage (i.e. 120/240VAC) from low voltage (24 VDC cables).

! WARNING !

Do not substitute molded cordsets with LEDs! USE ONLY P/N 318036!

It is preferable that the cable between the LDT and the interface device be one continuous run. If you are using a junction box, it is highly recommended that the splice junction box be free of AC and/or DC transient-producing lines. The shield should be carried through the splice and terminated at the interface device end.

NOTICE

When grounding the LDT, a single earth ground should be connected to the Power Supply Common (circuit ground). The LDT Power Supply Common should be connected to the Power Supply Common (-) terminal. The LDT power supply (+VDC) should be connected to the power supply positive terminal (+). The LDT cable shield should be tied to earth ground at the power supply. The LDT analog common should not be connected to earth ground and should be used for connection to interface devices only. See Wiring Diagram Section.

The power supply should be dedicated to the LDT to prevent noise and external loads from affecting it. When powering up more than one LDT on a single power supply, each unit will draw approximately 1.1 watts (44 mA at 24 VDC).

The LDT generates an analog output based on position. The LDT offers 16-Bits of resolution, and if the optional was ordered, is fully programmable over the entire active stroke length. Keep in mind that there is a 2.75" Null Zone at the connector end of the LDT and a 2.75" Dead Band at the other end of the LDT that the magnet must stay out of at all times. The units come fully programmed from the factory and do not require re-programming unless desired. The analog output is referenced to the analog common terminal and should not be referenced to any of the other common terminals.

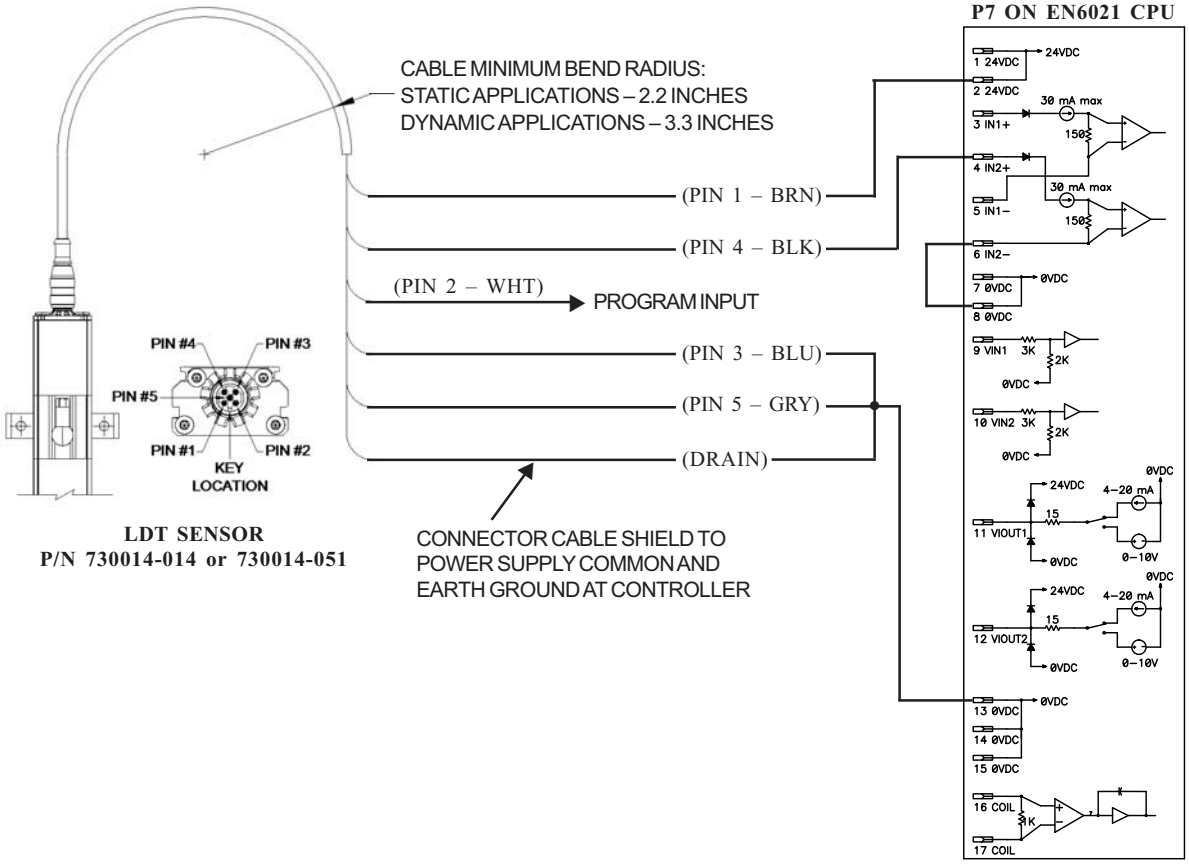
10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER (cont.)

TYPICAL WIRING

There are two common methods for wiring the LDT to a customer supplied interface device, such as a PLC or panel meter. The two different methods are commonly referred to as Single Ended Input or Differential Input. Differential Input is the preferred wiring method. With the Differential Input, the Analog Common wire is connected to the customer supplied input device and the Power Supply Common is wired separately to the customers supplied power source. When wired using the Differential method, the electrical noise and voltage offset errors produced by the currents running through the Power Supply Common are eliminated. The Power Supply Common and Analog Common are internally connected inside of the LDT.

WIRING DIAGRAM



AUTOMATIC GAIN CONTROL

The Automatic Gain Control feature will automatically search and find the magnet on power up. If power is applied without a magnet on the LDT, turn power off and place magnet within the active stroke area. Re-apply power. If using the Floating magnet option, the magnet should be placed within ¼" of the LDT's sensing surface, and must be within the active region of the LDT when power is applied.

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER (cont.)

SETTING ZERO & SPAN

The LDT is programmable over the entire active stroke length of the LDT. The unit can easily be changed in the field from a 4 to 20mA to a 20 to 4mA. Keep in mind that there is a 2.75" Null area at the connector end of the LDT and a 2.75" Dead band at the other end of the LDT that the magnet must stay out of at all times.

The units come fully programmed from the factory and do not require re-programming unless desired. The units are 100% absolute and will not lose programmed parameters on power loss. The Zero and Span points can be programmed in any order and anywhere within the LDT's active sensor area.

NOTICE
NOTE 1: Zero or Span can be adjusted individually without setting the other. **NOTE 2:** Zero = 4mA on 4-20mA units. There is a timing sequence that is used to unlock the probe for programming. This is to ensure that the Span cannot be accidentally re-programmed by someone in the field.

Before programming the Zero or Span, the program input must be connected to the Power Supply Common for a minimum of 2 seconds and no more than 6 seconds, and then released for 1 second. The LDT programming sequence is now unlocked and will remain an unlocked unit until either the Zero or Span is programmed or the 10 second programming sequence times out. During the unlock mode either the Zero or Span can be programmed by momentarily connecting the Program Input to either the Power Supply Common or Power Supply +. NOTE: The LDT must be unlocked to program the Zero and unlocked again to program the Span. Once either the Zero or Span is programmed, the LDT will go back into the locked mode. To program the Zero or Span, the program input must be connected to the Power Supply Common for 4 seconds, and then released for 1 second. Within the next 5 seconds, you can program either the Zero or the Span by momentarily connecting the Program Input to either the Power Supply Common or Power Supply +VDC.

! WARNING !
During normal operation, electrically insulate the White Program wire to prevent accidental setting of Span.

MANUAL SETTING ZERO & SPAN

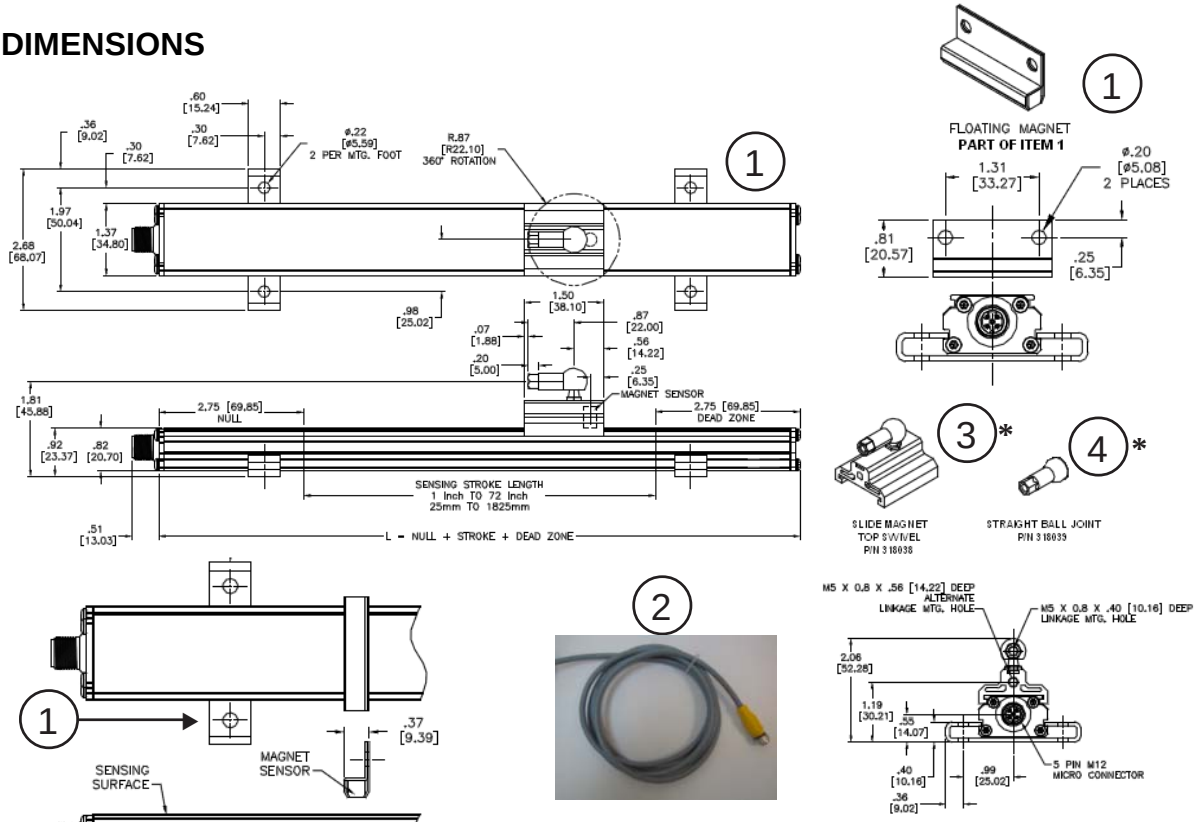
To set the Zero and Span position, follow these steps:

1. Apply power to the LDT.
2. Place magnet assembly where Zero is to be located, but within the active region of the probe.
3. Short the Program Input pin to the Power Supply Common for 4 seconds. Remove the short for 1 second. Within 5 seconds, short the Programming Input pin to the Power Supply Common. This completes the Zero programming process.
4. Place magnet assembly where Span is to be located, but within the active region of the probe.
5. Short the Program Input pin to the Power Supply Common for 4 seconds. Remove the short for 1 second. Within 5 seconds, short the Programming Input pin to the Power Supply +VDC. This completes the programming process.

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER (cont.)

DIMENSIONS



LDT ACCESSORIES		
Desig.	**Part #**	**Description**
1	318035	LDT Sensor, 6" Stroke - consisting of: qty 1 - Float Magnet qty 2 - Mounting Bracket
	318037	LDT Sensor, 11" Stroke - consisting of: qty 1 - Float Magnet qty 2 - Mounting Bracket
2	318036	12 ft. 5-pin Straight Cable
3	318038	Slide Magnet Top Swivel
4	318039	Straight Ball Joint*

* Ball Joint (Item 4) can be attached to the front of Slide Magnet (Item 3) when side mounting is preferred.

SPECIFICATIONS	
General Specifications	
Connector	5-pin 12mm Euro Micro
Displacement	1" to 72" in 1" Increments
Electrical Specifications	
Input Voltage	24 VDC ±20%
Current Draw	1.1W (44mA typical)
Dead Band	2.75"
Null Zone	2.75"
Non-linearity	less than ± 0.03% of stroke or ± 0.013", whichever is greater
Repeatability	0.001%
Hysteresis	less than 0.001"
Operating Temperature	-40°C to 85°C
Analog Output Specifications	
Analog Ripple	1 mV maximum
Current Output Maximum Load Resistance	500 Ohms
Update Time	1ms
Resolution	
Internal	.00006"
Output	16-bit
Output Type	
Current Output	4mA to 20mA, 20mA to 4mA
Enclosure Rating – IP-67	
Approvals – CE (EMC)	
Note: Specifications are based on a 48" stroke with floating magnet and 1/8" gap.	

10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.16 ERROR RESET KEY SWITCH (ERS)

ERS
P/N 730014-015

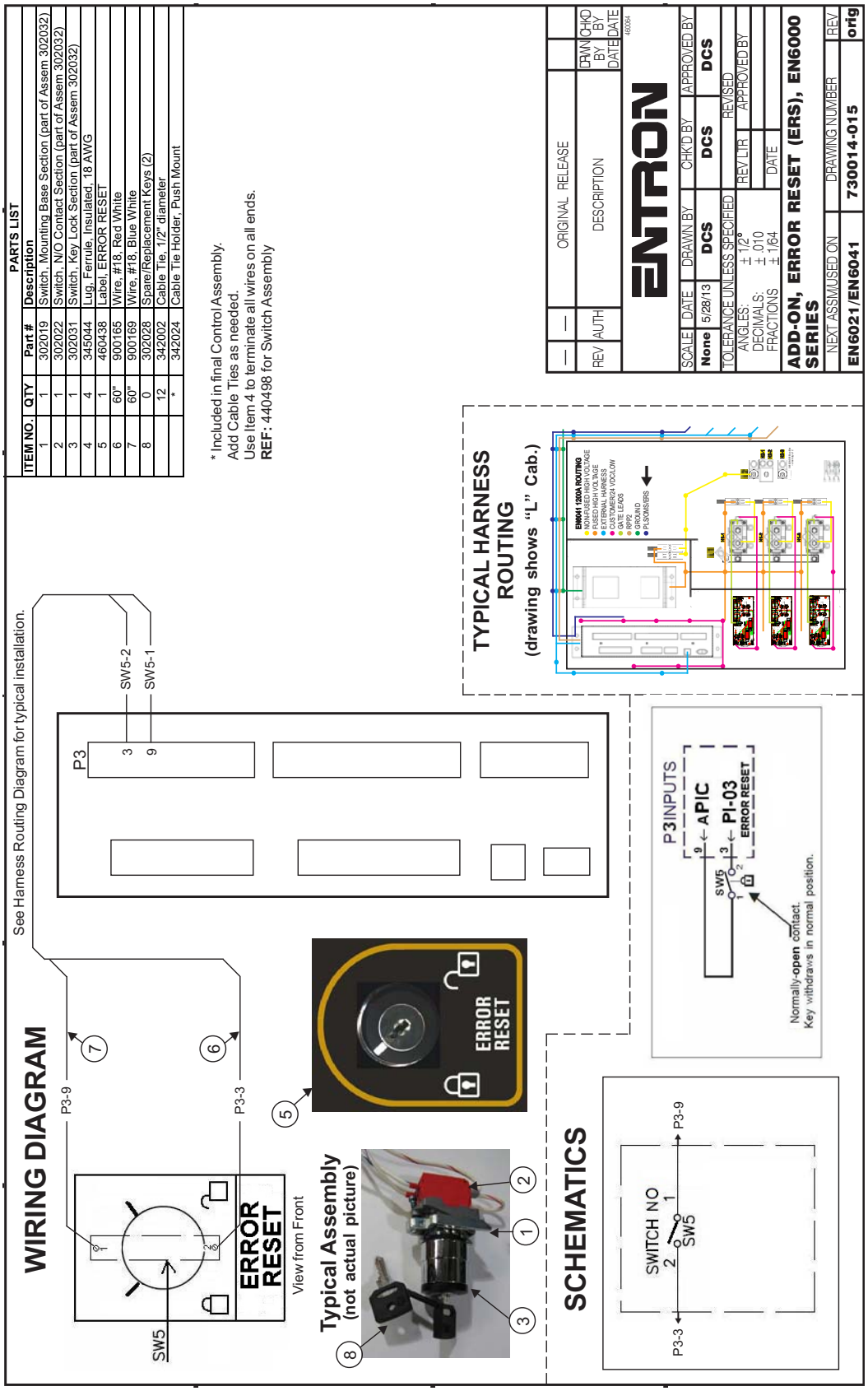
The Error Reset Switch is a two-position key switch which is used to reset errors. The reset position (clockwise) is a momentary position. The key may only be removed in the normal (counterclockwise) position.

To enable use of this switch, INPUT PI3 needs to be mapped to Error Reset in **Input Function** sub-menu of **I/O Map Menu** (see Section 5.5.8). If this feature is not required, simply leave this input unconnected or map this input to Sequencer function.

Weld controls can be ordered with this switch by ordering Error Reset Switch (ERS – P/N 730014-015) option. This option can also be shipped separately and installed in field. Remove the key switch hole-plug from the cabinet and mount the switch using the nut and lock-washer provided. Connect the switch as shown in Drawing 730014-015.

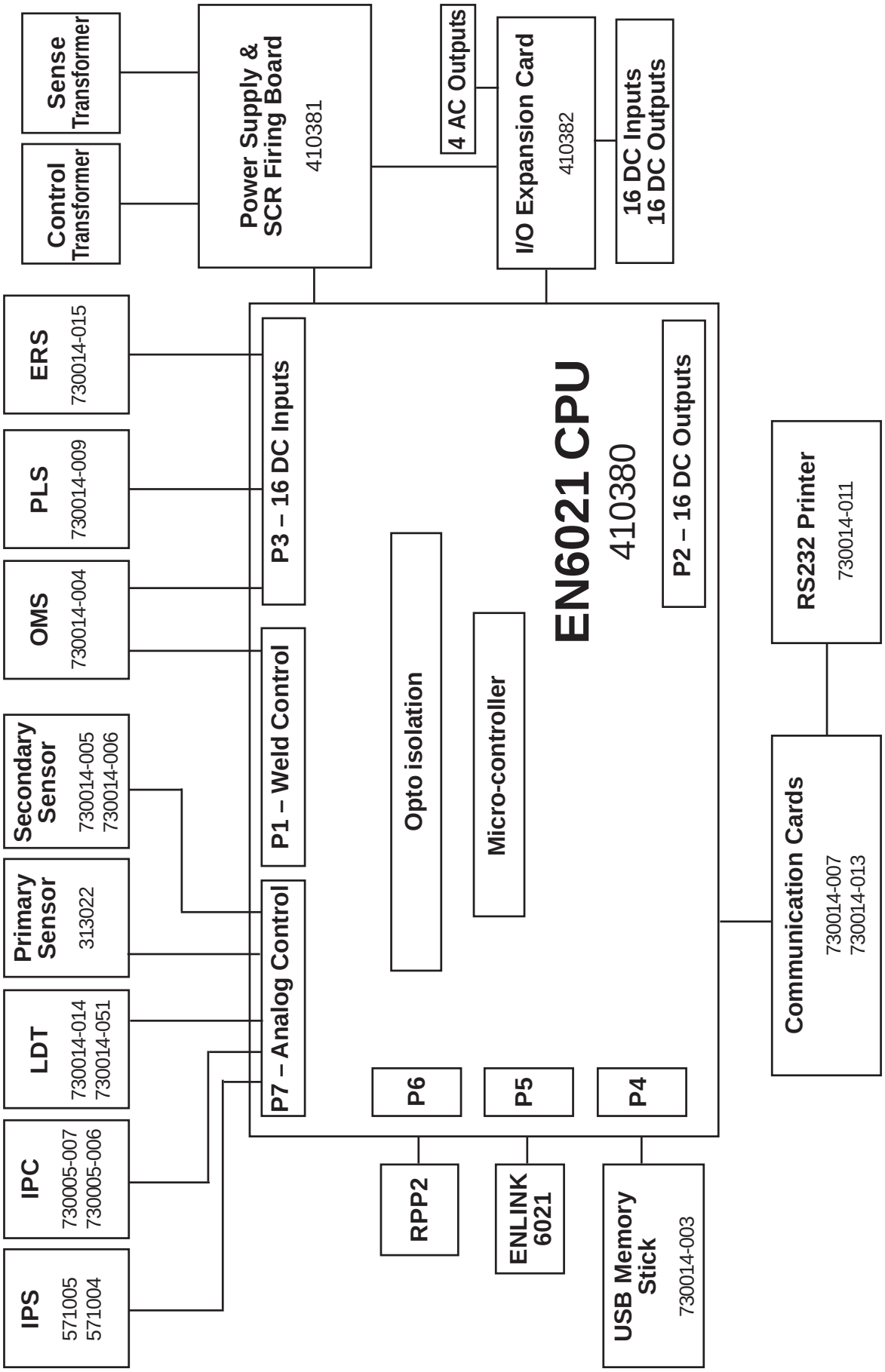
10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

ERROR RESET KEY SWITCH (ERS)



Drawing 730014-015

10.17 WELD CONTROL WITH OPTIONS



11.0 ERROR CODES

Error Codes are displayed on **Status Page 1** and Error Messages are displayed on **Status Page 2**. Detailed information about Error Codes can be found on **Error Log Status Page**.

ERROR CODE	DESCRIPTION	REMEDY
1	Configuration error	Edit **Configure Menu** (see Section 5.5.6)
2	Calibration error	Check parameters in **Calibration Menu** (see Section 5.5.7)
3	Schedule error	Check parameters in **Schedule Menu** (see Section 5.5.1)
4	Sequencer error	Check parameters in **Sequencer Menu** (see Section 5.5.5)
5	Event error	Check parameters in **Event Menu** (see Section 5.5.2)
6	Counter error	Check parameters in **Counter Menu** (see Section 5.5.3)
7	Stepper error	Check parameters in **Stepper Menu** (see Section 5.5.4)
8	I/O Map error	Check parameters in **I/O Map Menu** (see Section 5.5.8)
9	Emergency Stop error	Check ES1 (pin P1-13) contacts (see Section 1.6.1)
10	TC1 error	Check TC1 (pin P1-14) contacts (see Section 1.6.1)
11	No Weld (P1-NW1)	Check NW1 (pin P1-16) contacts (see Section 1.6.1)
12	PS1 error	Check PS1 (pin P1-17) contacts (see Section 1.6.1)
13	SCR short	Check SCR or weld transformer
14	Second Stage error	Check 2nd Stage input (PI9 – pin P3-11)
15	Proportional Valve error	Check Proportional Valve
16	Interlock Error	Check Interlock input (PI5 – pin P3-5)
17	High Pressure	Check operation of Proportional Valve / Check inlet pressure
18	Low Pressure	Check operation of Proportional Valve / Check inlet pressure
19	High Current 1	Check secondary circuit or adjust parameters
20	Low Current 1	Check secondary circuit or adjust parameters
21	High Current 2	Check secondary circuit or adjust parameters
22	Low Current 2	Check secondary circuit or adjust parameters
23	High Voltage	Check inlet AC line voltage or adjust parameters
24	Low Voltage	Check inlet AC line voltage or adjust parameters
25	Counter end	Reset Counter
26	Stepper end	Reset Stepper
27	High Pulse Width1	Check transformer or secondary circuit or adjust parameters
28	Low Pulse Width1	Check transformer or secondary circuit or adjust parameters
29	High Pulse Width2	Check transformer or secondary circuit or adjust parameters
30	Low Pulse Width2	Check transformer or secondary circuit or adjust parameters
31	Tip dress prewarn	Dress tip
32	AVC error	Check inlet AC line voltage or adjust parameters
33	Power on w/STARTs closed	Check FS1–FS4 and Retract input
34		
35	Pendant NO WELD	Toggle RPP2 pendant Weld/No Weld
36	TLS-2 error	Check PI4 (pin P3-4) transformer over temperature switch
37	Safety Relay error	Firmware detected control relay error (see Section 3.2)
38	No 24V for CPU I/O ports	Check fuse in CPU / Check inlet 24V voltage
39	No 24V for Expansion Cd.	Check fuse in I/O Expansion Card / Check inlet 24V voltage
40		
41		
42		
43		

11.0 ERROR CODES (cont.)

ERROR CODE	DESCRIPTION	REMEDY
45	AC 120V Safety Relay error	Firmware detected control relay error (see Section 3.2)
47	No AC 120V for Expansion Cd.	Check fuse in I/O Expansion Card / Check inlet AC 120V
49	High Pressure pre-limit	Check operation of Proportional Valve / Check inlet pressure
50	Low Pressure pre-limit	Check operation of Proportional Valve / Check inlet pressure
51	High Current 1 pre-limit	Check secondary circuit or adjust parameters
52	Low Current 1 pre-limit	Check secondary circuit or adjust parameters
53	High Current 2 pre-limit	Check secondary circuit or adjust parameters
54	Low Current 2 pre-limit	Check secondary circuit or adjust parameters
55	High Stack-up	Check calibration / Check part or adjust parameters
56	Low Stack-up	Check calibration / Check part or adjust parameters
65	Battery Low	Replace battery (see Section 12.1)
66	Use Schedule error	Check parameters in **Use Schedule** page (see Section 5.4)
73	Weld Log full	Copy Weld Log if necessary, then reset Weld Log
74	Weld Log warn (80% full)	Copy Weld Log if necessary, then ready to reset Weld Log
75	Error Log full	Copy Error Log if necessary, then reset Error Log
76	Error Log warn (80% full)	Copy Error Log if necessary, then ready to reset Error Log
77	Flash RAM error	Data flash memory error, contact factory
89	Retract Open error	Open Retract Open input within 10 seconds
90		
91		
92	Pressure Sensor not ready	Pressure Sensor not ready, normal operation status
93	Retract not ready	Operate Retract input (PI1 – pin P3-1)
94	Second Stage not ready	Operate 2nd Stage input (PI9 – pin P3-11)
95	Proportional Valve not ready	Proportional Valve signal not ready, normal operation status
96	Interlock not ready	External Interlock not responding; check PI5 (pin P3-5)

12.0 CONTROL MAINTENANCE

Control **must be powered off** before any work inside cabinet can be performed. Note that weld control sometimes has more than one source of power entering control. **All must be turned off**. Door **must be closed** before returning power to control.

If measurements must be taken with doors open, be certain to follow arc flash standards.

Keep control free from dirt and airborn contaminates.

Keep control free from water spray and condensation.

Contactors are not to be repaired except by factory and have no user replaceable parts.

Do not open cases on batteries or charge them or incinerate batteries. See Section 12.1. The local regulations on the disposal of discharged batteries must be observed.

NOTICE
Weld control circuit board component-level repair should be done by ENTRON Controls! **Only use spare parts/replacement parts approved by ENTRON Controls!**

12.1 BATTERIES

NOTICE
When battery is removed, Weld Log and Error Log will be lost! **Backup data before removing battery!** **Schedule data is not lost when battery fails or is removed.**

A 3.0 V Lithium battery (ENTRON P/N 140007) is installed to provide data backup power. This battery supplies RAM memory and internal clock in power down state. Battery life is two (2) years.

If battery voltage drops so far that data retention is no longer assured, control will sense this state. The reaction to this event depends on Error Output assignment in **I/O Map Menu** (see Section 5.5.8) and ON ERROR parameter setting in **Configure Menu** (see Section 5.5.6).

If a low battery error is assigned to OUTPUT PO17 and ON ERROR parameter is set to **Stop**, control prevents next start and Ready message turns off. Welding operation can resume after changing battery and resetting error.

If a low battery error is not assigned to OUTPUT PO17 or ON ERROR parameter is not set to **Stop**, control will issue appropriate message, but welding operations will not be disabled.

NOTICE
When battery is removed or fails, **Weld Log and Error Log data will be lost and real-time clock will reset**. To prevent loss of data, two-year battery change is recommended as part of preventive maintenance procedures. Schedule data is not lost when battery fails or is removed.

12.1 BATTERIES (cont.)

! WARNING !
To prevent environmental harm, observe local disposal regulations for batteries.

! DANGER !
DANGER OF EXPLOSION! **NEVER EXPOSE BATTERY TO TEMPERATURES ABOVE 85°C.** **DO NOT ATTEMPT TO CHARGE, SOLDER OR INCINERATE BATTERY.** **DO NOT SHORT CIRCUIT OR DISASSEMBLE BATTERY.**

! CAUTION !
Battery powers components on CPU PCB. If PCB is placed in conductive materials, battery may discharge or damage components on PCB. Remove or insulate battery before storage or shipping in conductive packaging or while handling board outside of CPU chassis.

To change battery, turn off all power sources to control, remove CPU cover and remove old battery. Then insert new battery while observing correct polarity. See Figure 12-1 for location and orientation.

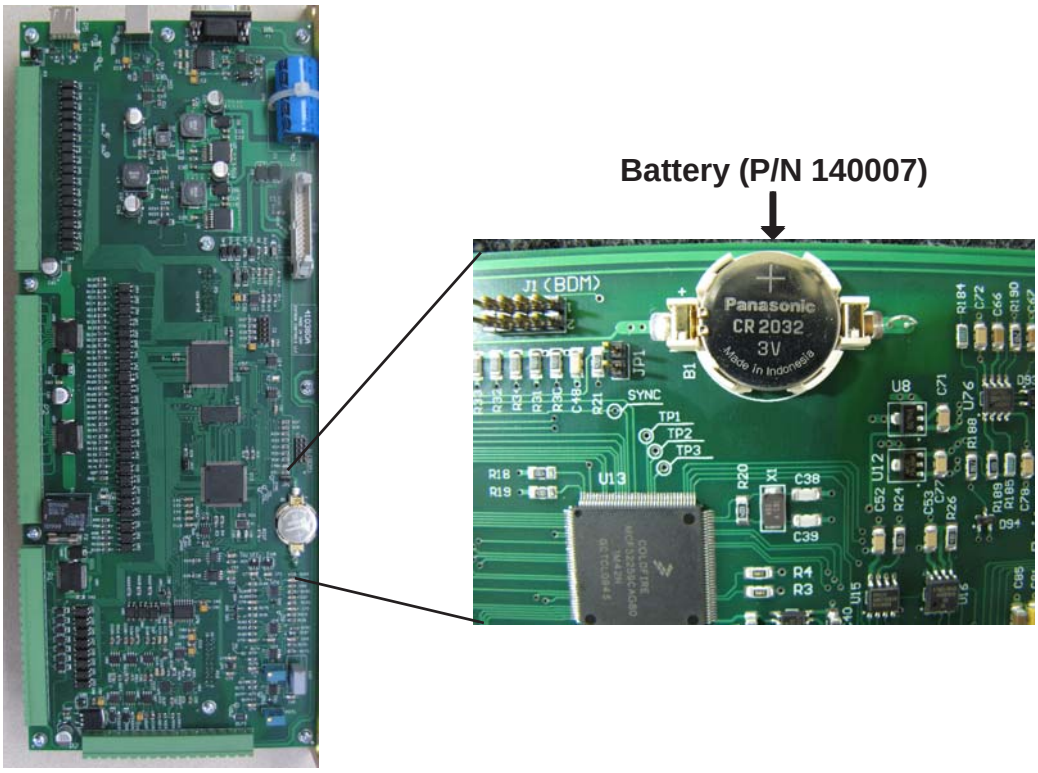


Figure 12-1. *Battery changing*

13.0 ENTRON LIMITED WARRANTY AND FACTORY SERVICE

ENTRON warrants that any equipment manufactured by it for the Purchaser (the "Product") will be free from defects in materials and workmanship and will comply with ENTRON's quoted specification and/or schematic design for the Product (the "Designed Use"). ENTRON further warrants that, if properly and normally used and maintained, the Product will be free of defects for the Warranty Period. The Warranty Period shall run from the date of original purchase of the Product to the earlier of (i) eighteen (18) months after the date of shipment from the ENTRON site or (ii) twelve (12) months after the Product is placed in service, whichever occurs first (the "Warranty Period"). The Warranty Period applies unless superseded by a different term that is expressly accepted by ENTRON in writing in ENTRON's order acknowledgement document. During the Warranty Period, ENTRON will remedy any such defects and will remedy any non-compliance with the quoted specification and/or schematic design by repair or replacement (at ENTRON's option) of the Product or parts to the Product.

Terms and Conditions of Warranty:

The warranty shall be limited to the warranty of materials and workmanship and compliance with ENTRON's Designed Use for the Product and ENTRON makes no other warranties. When the Product is sold to be used in combination with other equipment not of ENTRON's design or manufacture, the warranty is limited to the Product and not the other equipment.

EXCEPT FOR THE WARRANTY SET FORTH ABOVE IN THE FIRST PARAGRAPH, (A) NEITHER ENTRON NOR ANY PERSON ON ENTRON'S BEHALF HAS MADE OR MAKES ANY EXPRESS OR IMPLIED REPRESENTATION OR WARRANTY WHATSOEVER, EITHER ORAL OR WRITTEN, INCLUDING ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, OR NON-INFRINGEMENT OR PERFORMANCE OF PRODUCTS OR PRODUCTS TO STANDARDS SPECIFIC TO THE COUNTRY OF IMPORT, WHETHER ARISING BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, ALL OF WHICH ARE EXPRESSLY DISCLAIMED, AND (B) THE PURCHASER ACKNOWLEDGES THAT IT HAS NOT RELIED UPON ANY REPRESENTATION OR WARRANTY MADE BY ENTRON, OR ANY OTHER PERSON ON ENTRON'S BEHALF, EXCEPT AS SPECIFICALLY PROVIDED IN THE FIRST PARAGRAPH.

This warranty does not apply to any Product that (i) has been subjected to abuse, misuse, neglect, negligence, accident, improper testing, improper installation, improper storage, improper handling, abnormal physical stress, abnormal environmental conditions or use contrary to any instructions issued by ENTRON; (ii) has been reconstructed, repaired or altered by persons other than ENTRON or its authorized representative; (iii) has been used or integrated into any machine or equipment for any use other than a Designed Use; or (iv) has been used with any third-party products, hardware or product that has not been previously approved in writing by ENTRON.

For replacement parts supplied by ENTRON, the Warranty Period for said replacement parts is limited to the Warranty Period for the original Product in which said replacement parts are installed.

13.0 ENTRON LIMITED WARRANTY AND FACTORY SERVICE (cont.)

With respect to any of the equipment used within the Product, but not manufactured by ENTRON, ENTRON will transmit to the Purchaser the benefit of any warranties or conditions it receives from the manufacturer or supplier of said equipment which are capable of transmission. ENTRON itself gives no warranty hereunder in respect of any such equipment.

To obtain repairs or replacement parts under this warranty, the defective part must be returned, prepaid, to any ENTRON site (Mexico, United Kingdom or United States) prior to the end of the Warranty Period. Please send your repair to the attention of "Service" with a description of the problem you are experiencing, contact person and phone number.

Limitations of the Warranty:

The damages for which ENTRON is liable in respect of any one cause of action shall not exceed the sum equal to 100% of the purchase price specified in the equipment purchase agreement.

OTHER THAN ACTUAL DAMAGES AS LIMITED BY THE PRIOR PARAGRAPH, IN NO EVENT SHALL ENTRON OR ITS REPRESENTATIVES BE LIABLE FOR CONSEQUENTIAL, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, PUNITIVE OR ENHANCED DAMAGES, LOST PROFITS OR REVENUES OR DIMINUTION IN VALUE, ARISING OUT OF OR RELATING TO ANY CLAIMS RELATED TO THE PRODUCT, REGARDLESS OF (A) WHETHER SUCH DAMAGES WERE FORESEEABLE, (B) WHETHER OR NOT PURCHASER WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND (C) THE LEGAL OR EQUITABLE THEORY (CONTRACT, TORT OR OTHERWISE) UPON WHICH THE CLAIM IS BASED, AND NOTWITHSTANDING THE FAILURE OF ANY AGREED OR OTHER REMEDY OF ITS ESSENTIAL PURPOSE. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THE PURCHASER ASSUMES ALL RISK AND LIABILITY FOR THE RESULTS OBTAINED BY THE USE OF ANY PRODUCTS IN THE PRACTICE OF ANY PROCESS, WHETHER IN TERMS OF OPERATING COSTS, GENERAL EFFECTIVENESS, SUCCESS OR FAILURE, AND REGARDLESS OF ANY ORAL OR WRITTEN STATEMENTS MADE BY ENTRON OR ITS AUTHORIZED REPRESENTATIVE, BY WAY OF TECHNICAL ADVICE OR OTHERWISE, RELATED TO THE USE OF THE PRODUCT.

Warranty and Transferability of Software:

All software and/or software documentation (collectively, the "Software"), whether supplied to the Purchaser as a component of the Product or supplied as a stand-alone Product, shall be considered to be "licensed" rather than "sold" to the Purchaser, and the Purchaser shall be licensed to use the Software under the following terms unless superseded by a different term that is expressly accepted by ENTRON in writing in ENTRON's order acknowledgement document.

13.0 ENTRON LIMITED WARRANTY AND FACTORY SERVICE (cont.)

ENTRON or ENTRON's licensor retains ownership of the Software and applicable copyrights, patents and trade secrets.

- The Purchaser, as licensee, is granted a limited, non-exclusive, royalty-free license to use the Software during the term permitted by ENTRON in writing (and perpetually for any Software embedded into the Product).

- The Purchaser may not reverse engineer or modify the Software (except to customize the Product for the Purchaser's operations, as authorized by ENTRON in writing, provided that any such modifications are and shall remain the property of ENTRON), remove it from the Product, or install the Software into products other than the Product.

- The Purchaser may not sublicense the Software, and this license terminates upon transfer of the Product to any third party.

All rights in the Software not expressly granted hereunder are reserved to ENTRON. The rights granted herein may be terminated by ENTRON upon prior written notice to the Purchaser if the Purchaser is in default of these standard terms.

ENTRON Document 750003-0414

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 FIELD CONSTRUCTION OF RS232 HARNESS ASSEMBLY FOR EXTERNAL PRINTER

Cable assemblies will need to be constructed onsite after routing through conduits, holes, troughs, etc. All cables should be separated as much as possible from other high voltage wires connecting to solenoid valves, welding transformers, and the AC line. Pre-fabricated RS232 cable assemblies are not available. Printers are provided with cables and connectors as standard on controls with RS232 Printer Option. Cable is a 1-to-1 connection on pins 2,3,5. No other pins are required. No other pins should be used even if not required.

To create RS232 Harness, following parts are required (supplied with weld controls equipped with RS232 Printer Option):

2	331136	Connector, 9 Pin, Screw Terminal, "D" Style, Plug
25'	900258	Cable, 4 Conductor, 24 Ga. Stranded w/Shield
2	460397	Label, RS232

Additional Connectors, Cable and Labels are available at additional cost

ASSEMBLY INSTRUCTIONS:

1. Cut cable to length or route from source to destination. DO NOT route cable with or place cable in same conduit with wires carrying 120VAC or higher.
2. Strip outer insulation and foil shield at each end 1-1/2" and wire both ends as shown in Figure A-1.

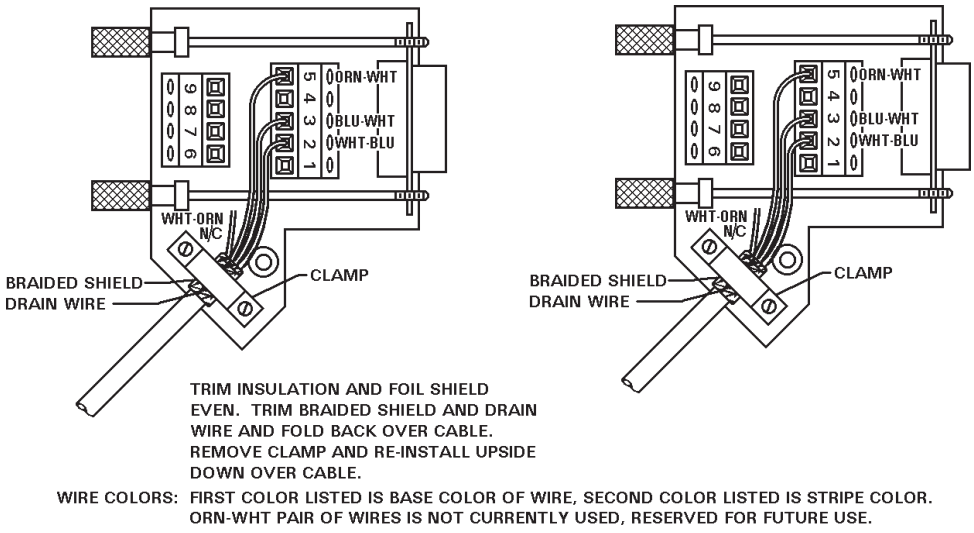


Figure A-1. *RS232 Connector wiring*

3. Inspect connections before proceeding to next step. Be aware that, in multiple connection installations, one wrong connection will stop ALL communication.
4. Assemble cover to plug assembly at both ends by snapping cover in place and using provided screw to secure assembly.

NOTICE
Connector can be assembled with cable exiting to either side.

5. Complete assembly by installing provided labels on all connectors as shown in Figure A-2.

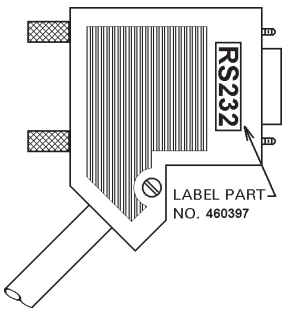


Figure A-2.
RS232 Connector labeling

APPENDIX B BOOTLOADER FUNCTION

Bootloader function is used to refresh control's firmware or reset PIN number.

There are two ways to access Bootloader function:

1. If control's firmware is corrupt for some reason, control will access Bootloader function automatically when powered on.

2. Push and hold Bootloader Reset button on CPU panel (see Figure B-1) and power on control. Display on RPP2 pendant will appear as in Figure B-2. Control will await release of button within 12 seconds. If button is released or pendant operated within 12 seconds, control will access Bootloader function; otherwise control will execute regular firmware function.

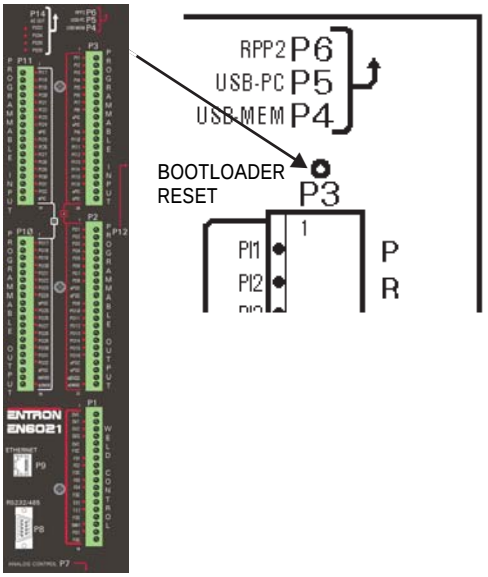


Figure B-1.
Bootloader Reset on CPU panel

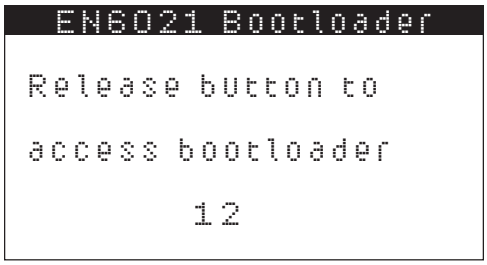


Figure B-2.
Initial Bootloader display

Bootloader has four (4) sub-functions:

1. Refresh Firmware
2. Execute Firmware
3. Unlock Control
4. About

REFRESH FIRMWARE

Refresh Firmware function is used to refresh/ upgrade control's firmware when necessary. Figure B-3 shows display of Refresh Firmware function.

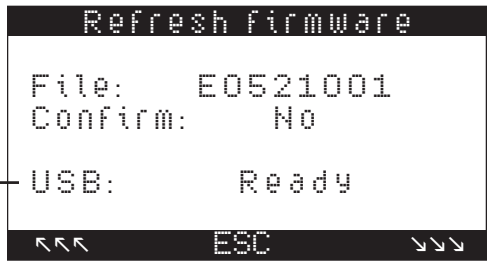


Figure B-3.
Refresh Firmware display

File: File name of firmware sent from factory. For EN6021 control, file name will start with "E052"; next digit is hardware revision number; last three digits is firmware version number.

Confirm: Set to **Yes** to execute Refresh Firmware function.

Status Line: Information for USB status, execution and error messages. This status line will display following messages:

USB: Not ready – USB memory stick is not connected to control
USB: Ready – USB memory stick is ready to be read
Open file error – Bootloader cannot find/open file on USB memory stick
Erasing page *xxx* – Bootloader is erasing memory page before programming

APPENDIX B BOOTLOADER FUNCTION (cont.)

REFRESH FIRMWARE (cont.)

Status Line: **Erase flash error** or **Blank check error** – Bootloader cannot erase memory (microcontroller's memory is damaged)
Programming page *xxx* – Bootloader is programming memory page
Program error – Bootloader cannot program memory (microcontroller's memory is damaged)
Program Succeeded – Programming is done successfully

To refresh firmware, follow these steps:

1. Plug USB memory stick containing firmware file into control's USB-A port (P4).
2. Turn on control and access Bootloader Refresh Firmware function.
3. Use +/- ADJUST to change file name and press ENTER to accept file name.
4. Use +/- ADJUST to set Confirm to Yes, then press ENTER to execute function.
5. Check Status Line message for execution information.

EXECUTE FIRMWARE

This function is used to execute firmware which is refreshed without rebooting control.

UNLOCK CONTROL

This function is used to allow first boot of control after entering Bootloader to not be protected by PLS/OMS or firmware PIN. This allows PIN to be reset or changed.

ABOUT

This function displays version numbers of Bootloader and CPU firmware, along with serial number of control.

APPENDIX C PROGRAMMING WORKSHEETS

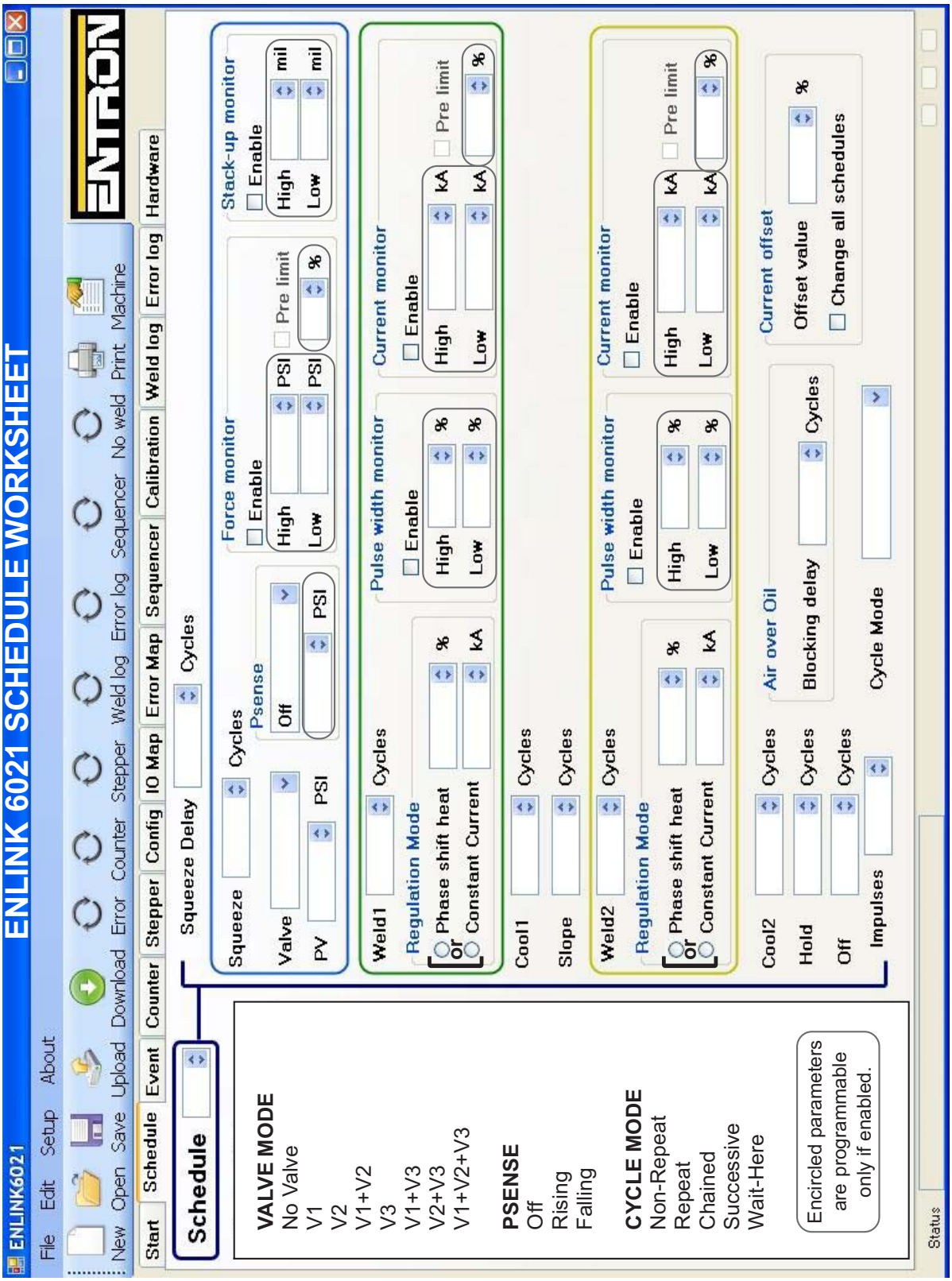
EN6021 SCHEDULE WORKSHEET

SCHEDULE # _____

SQUEEZE DELAY TIME _____ Cycles
SQUEEZE TIME _____ Cycles
VALVE MODE ☐ No Valve ☐ V1 ☐ V2 ☐ V1+V2 ☐ V3 ☐ V1+V3 ☐ V2+V3 ☐ V1+V2+V3
SQUEEZE PRESSURE/FORCE (PV) _____ PSI / Lb / mA
PRESSURE/FORCE SENSE MODE ☐ Off ☐ Rising ☐ Falling
P/F TRIGGER _____ PSI / Lb / mA
PRESSURE/FORCE MONITOR ☐ Enable P/F LIMIT HIGH _____ PSI / Lb / mA
P/F LIMIT LOW _____ PSI / Lb / mA
PRESSURE/FORCE PRE-LIMIT MONITOR ☐ Enable P/F PRE-LIMIT _____ %
STACK-UP MONITOR ☐ Enable STACK-UP LIMIT HIGH _____ mil
STACK-UP LIMIT LOW _____ mil
WELD1 TIME _____ Cycles
WELD1 REGULATION MODE ☐ Phase Shift WELD1 HEAT _____ %
– or – ☐ Constant Current WELD1 CURRENT _____ kA
WELD1 PULSE WIDTH MONITOR ☐ Enable PW1 HIGH _____ %
PW1 LOW _____ %
WELD1 CURRENT MONITOR ☐ Enable CURRENT1 LIMIT HIGH _____ kA
CURRENT1 LIMIT LOW _____ kA
CURRENT1 PRE-LIMIT MONITOR ☐ Enable CURRENT1 PRE-LIMIT _____ %
COOL1 TIME _____ Cycles
SLOPE TIME _____ Cycles
WELD2 TIME _____ Cycles
WELD2 REGULATION MODE ☐ Phase Shift WELD2 HEAT _____ %
– or – ☐ Constant Current WELD2 CURRENT _____ kA
WELD2 PULSE WIDTH MONITOR ☐ Enable PW2 HIGH _____ %
PW2 LOW _____ %
WELD2 CURRENT MONITOR ☐ Enable CURRENT2 LIMIT HIGH _____ kA
CURRENT2 LIMIT LOW _____ kA
CURRENT2 PRE-LIMIT MONITOR ☐ Enable CURRENT2 PRE-LIMIT _____ %
COOL2 TIME _____ Cycles
HOLD TIME _____ Cycles AIR OVER OIL BLOCKING DELAY _____ Cycles
OFF TIME _____ Cycles CURRENT OFFSET _____ % ☐ Change all schedules
IMPULSES _____
CYCLE MODE ☐ Non-Repeat ☐ Repeat ☐ Chained ☐ Successive ☐ Wait-Here

Highlighted Parameters are programmable only if enabled.

APPENDIX C PROGRAMMING WORKSHEETS (cont.)

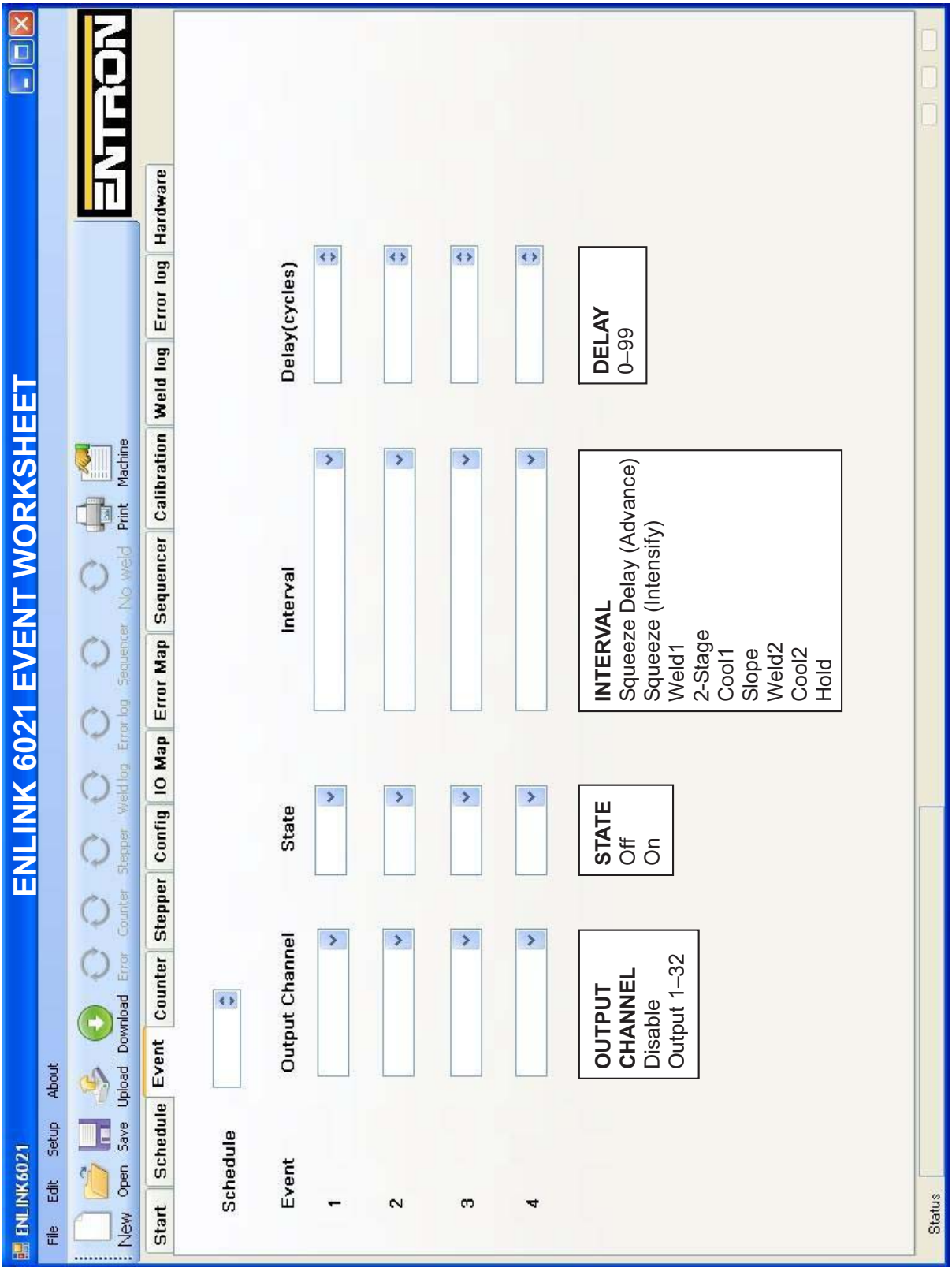


ENTRON EN6021 EVENT WORKSHEET

SCHEDULE # _____

EVENT 1	OUTPUT CHANNEL	☐ Disable	☐ Output # _____
	STATE	☐ Off	☐ On
	INTERVAL	☐ Squeeze Delay (Advance)	☐ Squeeze (Intensify)
		☐ Weld1	☐ 2-Stage
		☐ Cool1	☐ Slope
		☐ Weld2	☐ Cool2
		☐ Hold	
	DELAY	_____ Cycles	
EVENT 2	OUTPUT CHANNEL	☐ Disable	☐ Output # _____
	STATE	☐ Off	☐ On
	INTERVAL	☐ Squeeze Delay (Advance)	☐ Squeeze (Intensify)
		☐ Weld1	☐ 2-Stage
		☐ Cool1	☐ Slope
		☐ Weld2	☐ Cool2
		☐ Hold	
	DELAY	_____ Cycles	
EVENT 3	OUTPUT CHANNEL	☐ Disable	☐ Output # _____
	STATE	☐ Off	☐ On
	INTERVAL	☐ Squeeze Delay (Advance)	☐ Squeeze (Intensify)
		☐ Weld1	☐ 2-Stage
		☐ Cool1	☐ Slope
		☐ Weld2	☐ Cool2
		☐ Hold	
	DELAY	_____ Cycles	
EVENT 4	OUTPUT CHANNEL	☐ Disable	☐ Output # _____
	STATE	☐ Off	☐ On
	INTERVAL	☐ Squeeze Delay (Advance)	☐ Squeeze (Intensify)
		☐ Weld1	☐ 2-Stage
		☐ Cool1	☐ Slope
		☐ Weld2	☐ Cool2
		☐ Hold	
	DELAY	_____ Cycles	

APPENDIX C PROGRAMMING WORKSHEETS (cont.)



EN6021 COUNTER WORKSHEET

COUNTER ENABLE ☐ Enable

MAX PART COUNT _____ WELDS PER PART _____

EN6021 CALIBRATION WORKSHEET

TOROID SENSITIVITY _____ mV/kA

MAX SECONDARY CURRENT _____ kA

TURNS RATIO _____ : 1

IPC FORCE CALIBRATION: ☐ Enabled (using Configure Menu)

PT1: _____ mA → _____ LB

PT2: _____ mA → _____ LB

IPS FORCE CALIBRATION: ☐ Enabled (using Configure Menu)

PT1: _____ mA → _____ LB

PT2: _____ mA → _____ LB

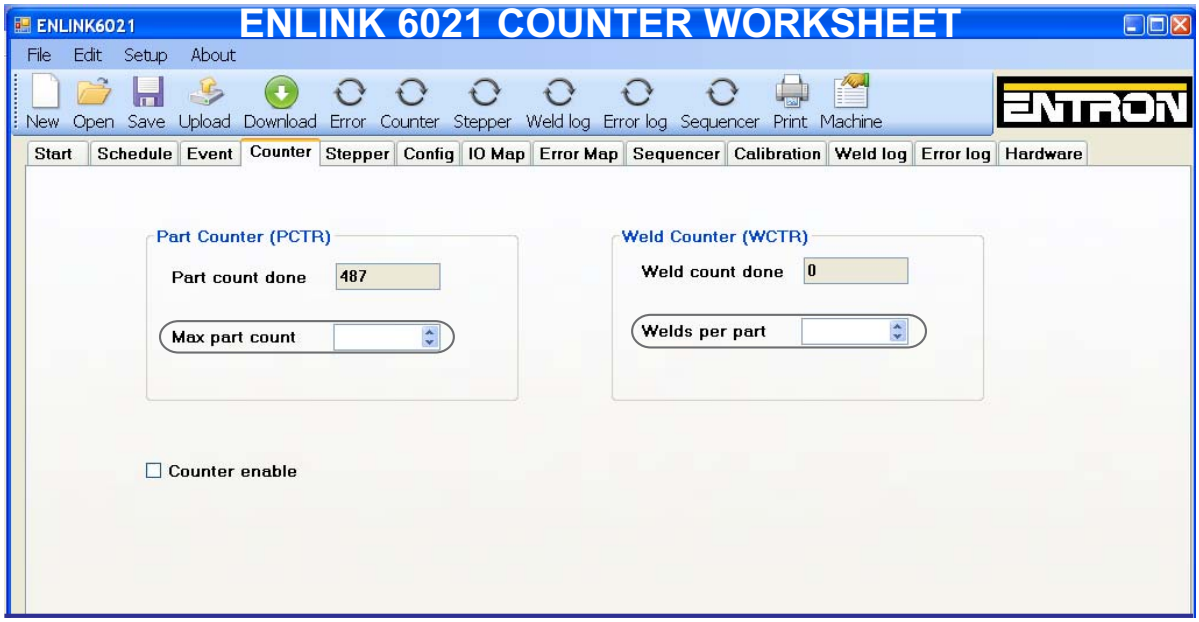
STACK-UP CALIBRATION:

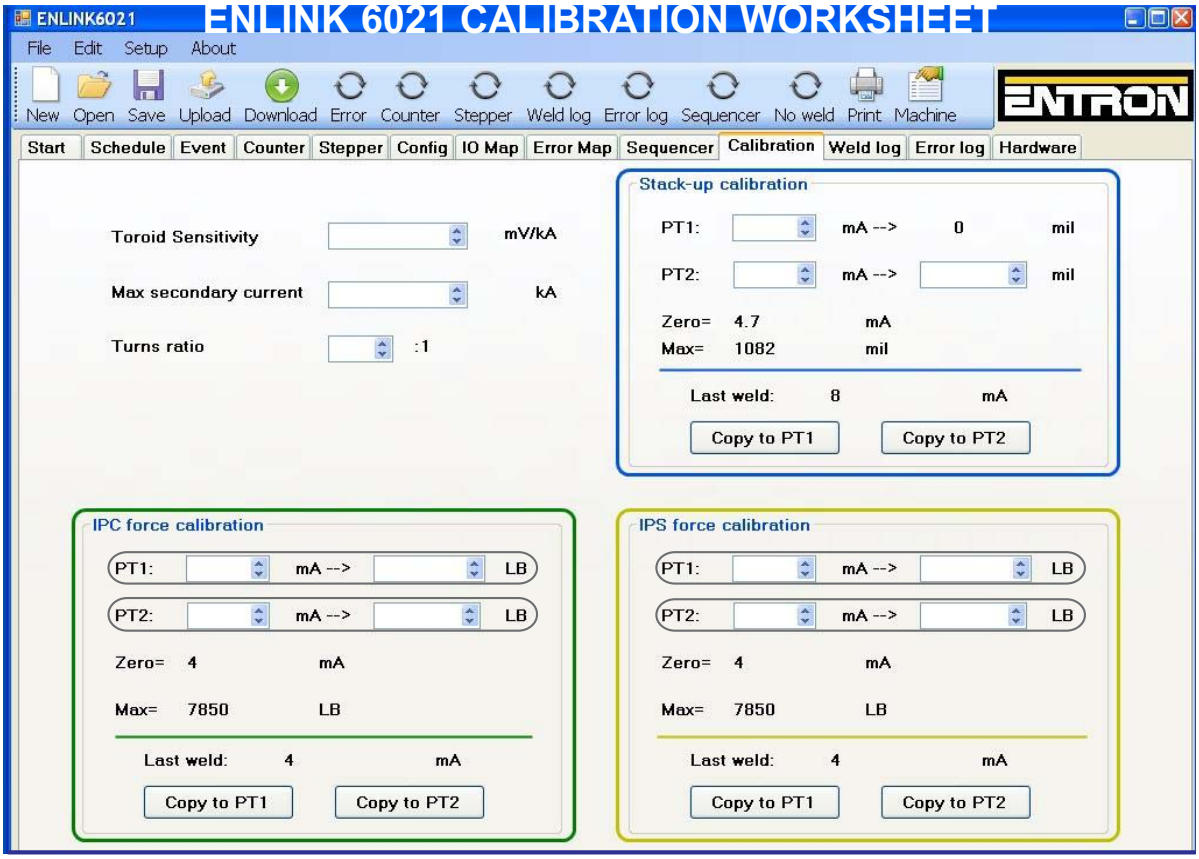
PT1: _____ mA → 0 mil

PT2: _____ mA → _____ mil

Highlighted Parameters are programmable only if enabled.

APPENDIX C PROGRAMMING WORKSHEETS (cont.)





Encircled parameters are programmable only if enabled.

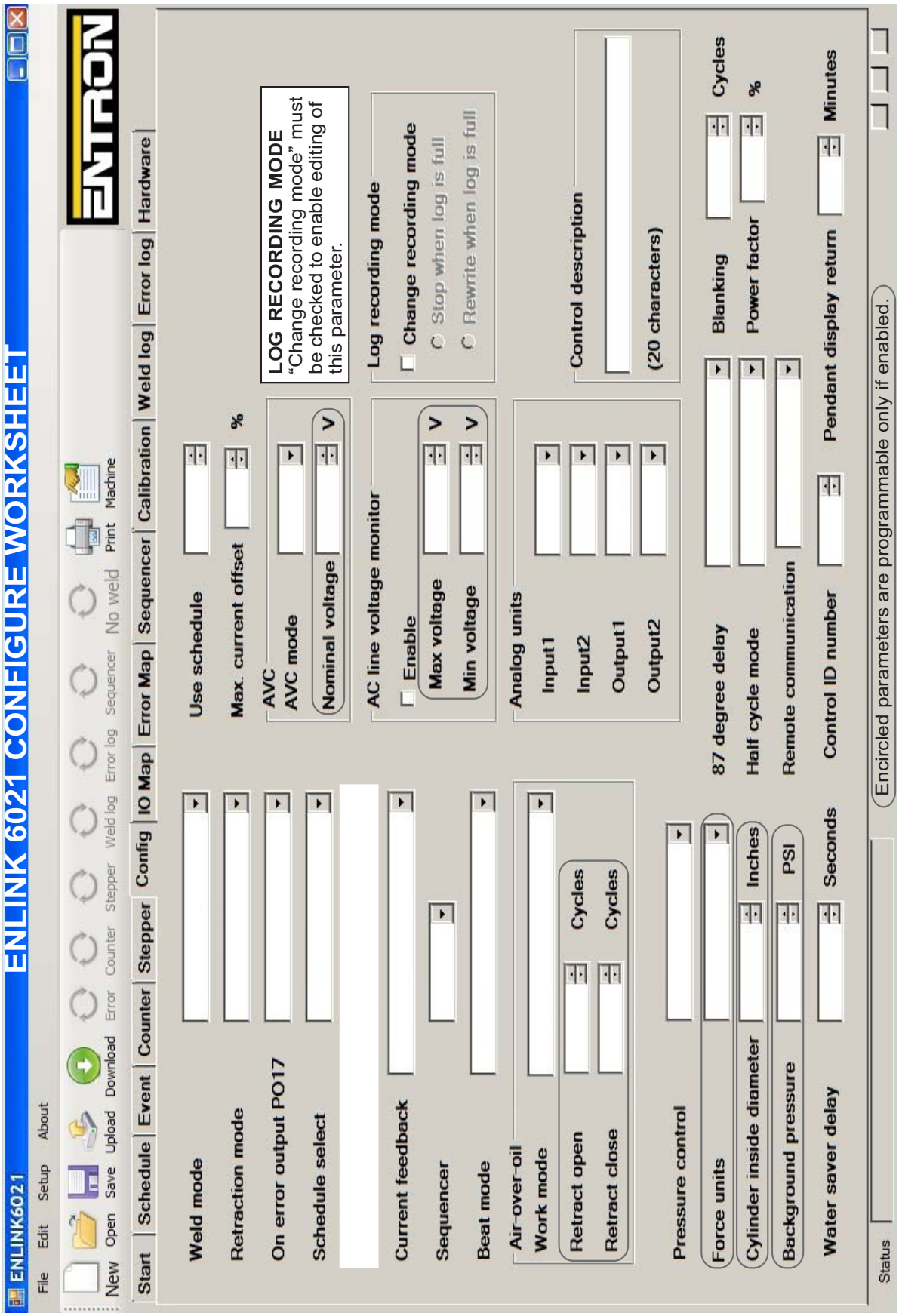
EN6021 CONFIGURE WORKSHEET

WELD MODE ☐ Spot ☐ Seam1 ☐ Seam2
RETRACTION MODE ☐ Off ☐ Momentary ☐ Maintained
ON ERROR OUTPUT 17 ☐ Continue ☐ Stop on fault ☐ Head lock on fault
SCHEDULE SELECT ☐ Internal ☐ External

CURRENT FEEDBACK ☐ Primary ☐ Secondary ☐ Secondary with Primary Coil
SEQUENCER ☐ Off ☐ On
BEAT MODE ☐ Non-Beat ☐ Beat during SQZ ☐ Beat during SQZ + WELD ☐ Enable Wait-Here
AIR-OVER-OIL MODE ☐ Off ☐ Without Retraction ☐ With Retraction
RETRACT OPEN _____ Cycles
RETRACT CLOSE _____ Cycles
PRESSURE CONTROL MODE ☐ None ☐ P Sensing ☐ P Control ☐ P Sensing + Control
FORCE UNITS ☐ PSI ☐ Lb ☐ mA ☐ Calibrated Lb
CYLINDER INSIDE DIAMETER _____ Inches
BACKGROUND PRESSURE _____ PSI / Lb
WATER SAVER DELAY _____ Seconds
USE SCHEDULE #_____
MAX CURRENT OFFSET _____ %
AVC MODE ☐ Disable ☐ Maximum _____ %
NOMINAL VOLTAGE _____ V
AC LINE VOLTAGE MONITOR ☐ Enable MAX VOLTAGE _____ V
MIN VOLTAGE _____ V
ANALOG UNITS INPUT1 ☐ V ☐ mA
INPUT2 ☐ V ☐ mA
OUTPUT1 ☐ V ☐ mA
OUTPUT2 ☐ V ☐ mA
87 DEGREE DELAY ☐ Off ☐ On
HALF CYCLE MODE ☐ Off ☐ + ☐ – ☐ AC
REMOTE COMMUNICATION ☐ MB Ethernet ☐ MB RS232 RTU ☐ MB RS485 RTU
☐ Label Printing ☐ EIP+MB Ethernet
CONTROL ID #_____
CONTROL DESCRIPTION _____
BLANKING _____ Cycles
POWER FACTOR _____ %
PENDANT DISPLAY RETURN _____ Minutes
LOG RECORDING MODE ☐ Stop when log is full ☐ Rewrite when log is full

Highlighted Parameters are programmable only if enabled.

APPENDIX C PROGRAMMING WORKSHEETS (cont.)



EN6021 P3 & P11 INPUTS WORKSHEET

INPUT	FUNCTION		SOURCE		USE
PI1	**Retraction**	☐	**Local**	☐	
P3-1	Sequencer	☐	PLC	☐	
PI2	**Parts Counter Reset**	☐	**Local**	☐	
P3-2	Sequencer	☐	PLC	☐	
PI3	**Error Reset**	☐	**Local**	☐	
P3-3	Sequencer	☐	PLC	☐	
PI4	**TT1**	☐	**Local**	☐	
P3-4	Sequencer	☐	PLC	☐	
PI5	Interlock	☐	**Local**	☐	
P3-5	**Sequencer**	☐	PLC	☐	
PI6	**Edit Lock**	☐	**Local**	☐	
P3-6	Sequencer	☐	PLC	☐	
PI7	**Escape**	☐	**Local**	☐	
P3-7	Sequencer	☐	PLC	☐	
PI8	**Back Step**	☐	**Local**	☐	
P3-8	Sequencer	☐	PLC	☐	
PI9	2nd Stage	☐	**Local**	☐	
P3-11	**Sequencer**	☐	PLC	☐	
PI10	**SchSelect1**	☐	**Local**	☐	
P3-12	Sequencer	☐	PLC	☐	
PI11	**SchSelect2**	☐	**Local**	☐	
P3-13	Sequencer	☐	PLC	☐	
PI12	**SchSelect3**	☐	**Local**	☐	
P3-14	Sequencer	☐	PLC	☐	
PI13	**SchSelect4**	☐	**Local**	☐	
P3-15	Sequencer	☐	PLC	☐	
PI14	**SchSelect5**	☐	**Local**	☐	
P3-16	Sequencer	☐	PLC	☐	
PI15	**SchSelect6**	☐	**Local**	☐	
P3-17	Sequencer	☐	PLC	☐	
PI16	**SchSelect7**	☐	**Local**	☐	
P3-18	Sequencer	☐	PLC	☐	
PI17	**Stepper Reset**	☐	**Local**	☐	
P11-1	Sequencer	☐	PLC	☐	
PI18	**Weld Counter Reset**	☐	**Local**	☐	
P11-2	Sequencer	☐	PLC	☐	
PI19		☐	**Local**	☐	
P11-3	Sequencer	☐	PLC	☐	
PI20		☐	**Local**	☐	
P11-4	Sequencer	☐	PLC	☐	
PI21		☐	**Local**	☐	
P11-5	Sequencer	☐	PLC	☐	
PI22		☐	**Local**	☐	
P11-6	Sequencer	☐	PLC	☐	
PI23		☐	**Local**	☐	
P11-7	Sequencer	☐	PLC	☐	
PI24	**Not used**	☐	**Local**	☐	
P11-8	Sequencer	☐	PLC	☐	
PI25	**Not used**	☐	**Local**	☐	
P11-10	Sequencer	☐	PLC	☐	
PI26	**Not used**	☐	**Local**	☐	
P11-11	Sequencer	☐	PLC	☐	
PI27	**Not used**	☐	**Local**	☐	
P11-12	Sequencer	☐	PLC	☐	
PI28	**Not used**	☐	**Local**	☐	
P11-13	Sequencer	☐	PLC	☐	
PI29	**Not used**	☐	**Local**	☐	
P11-14	Sequencer	☐	PLC	☐	
PI30	**Not used**	☐	**Local**	☐	
P11-15	Sequencer	☐	PLC	☐	
PI31	**Not used**	☐	**Local**	☐	
P11-16	Sequencer	☐	PLC	☐	
PI32	**Not used**	☐	**Local**	☐	
P11-17	Sequencer	☐	PLC	☐	

Bold function indicates default value

EN6021 P2 & P10 OUTPUTS WORKSHEET

OUTPUT	FUNCTION				USE
PO1 P2-1	**EOS** Sequencer	☐	Event PLC	☐ ☐	
PO2 P2-2	**Not Ready** Sequencer	☐	Event PLC	☐ ☐	
PO3 P2-3	**Tip Dress** Sequencer	☐	Event PLC	☐ ☐	
PO4 P2-4	**Retraction** Sequencer	☐	Event PLC	☐ ☐	
PO5 P2-5	**Count End** Sequencer	☐	Event PLC	☐ ☐	
PO6 P2-6	**Error** Sequencer	☐	Event PLC	☐ ☐	
PO7 P2-7	**Step End** Sequencer	☐	Event PLC	☐ ☐	
PO8 P2-8	**Interlock** Sequencer	☐	Event PLC	☐ ☐	
PO9 P2-11	**Water Saver** Sequencer	☐	Event PLC	☐ ☐	
PO10 P2-12	Sequencer	☐	Event PLC	☐ ☐	
PO11 P2-13	Sequencer	☐	Event PLC	☐ ☐	
PO12 P2-14	Sequencer	☐	Event PLC	☐ ☐	
PO13 P2-15	**Not used** Sequencer	☐	Event PLC	☐ ☐	
PO14 P2-16	**Not used** Sequencer	☐	Event PLC	☐ ☐	
PO15 P2-17	**Not used** Sequencer	☐	Event PLC	☐ ☐	
PO16 P2-18	**Not used** Sequencer	☐	Event PLC	☐ ☐	
PO17 P10-1	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO18 P10-2	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO19 P10-3	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO20 P10-4	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO21 P10-5	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO22 P10-6	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO23 P10-7	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO24 P10-8	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO25 P10-10	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO26 P10-11	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO27 P10-12	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO28 P10-13	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO29 P10-14	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO30 P10-15	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO31 P10-16	**Error Map** Sequencer	☐	Event PLC	☐ ☐	
PO32 P10-17	**Error Map** Sequencer	☐	Event PLC	☐ ☐	

Bold function indicates default value

ENTRON EN6021 OTHER INPUTS & OUTPUTS WORKSHEET

P1 WELD CONTROL		
IN/OUT	**FUNCTION**	**USE**
SV1 P1-2	**Solenoid Valve 1**	
SV2 P1-3	**Solenoid Valve 2**	
SV3 P1-4	**Solenoid Valve 3**	
FS1 P1-7	**Foot Switch 1**	
FS2 P1-8	**Foot Switch 2**	
FS3 P1-10	**Foot Switch 3**	
FS4 P1-11	**Foot Switch 4**	
ES1 P1-13	**Emergency Stop***	
TC1 P1-14	**Temperature Limit Switch Contactor***	
NW1 P1-16	**External Weld/ No Weld Input***	
PS1 P1-17	**Pressure Switch***	

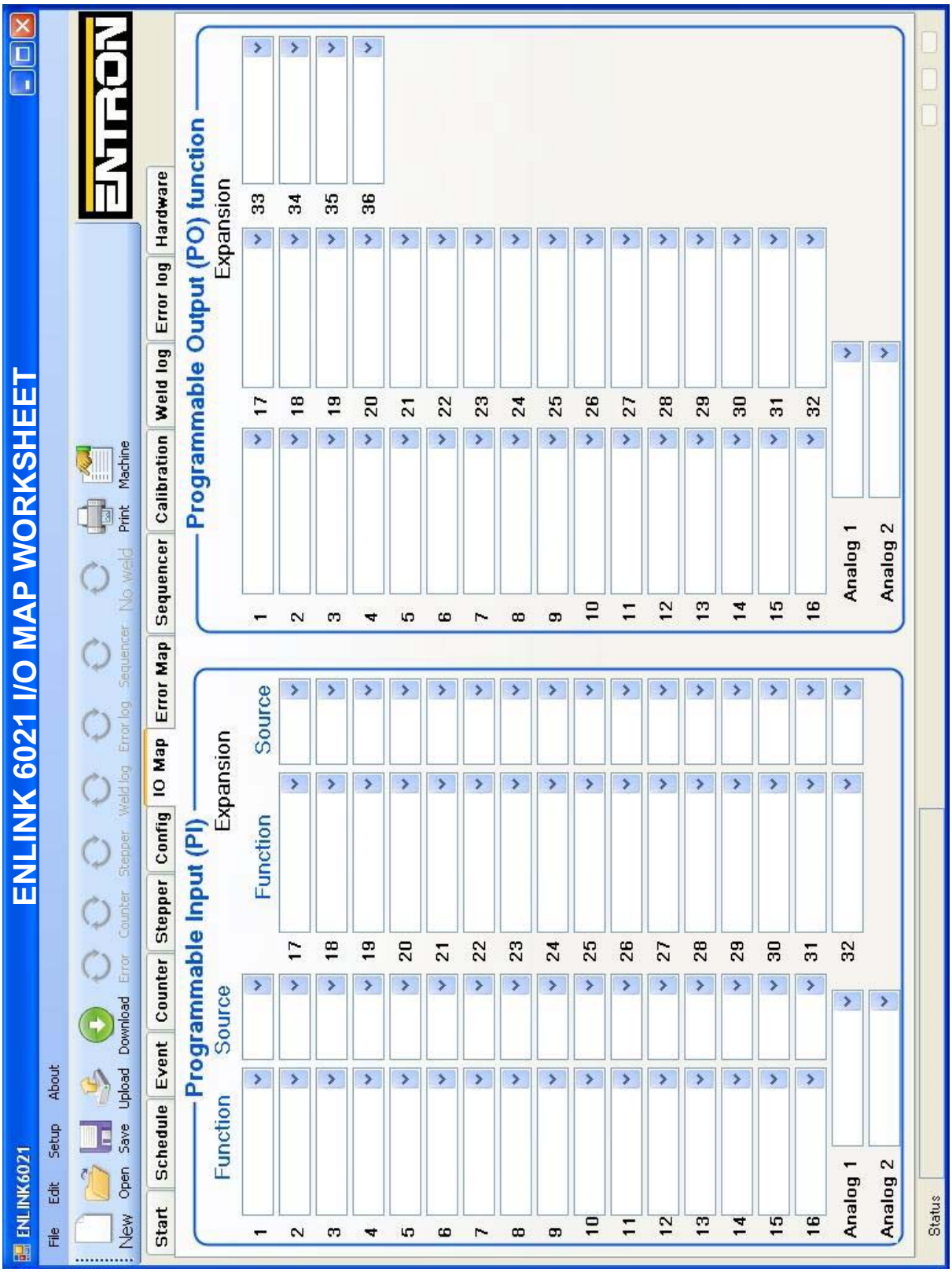
P7 ANALOG I/O		
IN/OUT	**FUNCTION**	**USE**
IN1 P7-9	**PV** ☐ Sequencer ☐	
IN2 P7-10	**Stack-up** ☐ Sequencer ☐	
OUT1 P7-11	**PV** ☐ Sequencer ☐	
OUT2 P7-12	**Sequencer** ☐ Not used ☐	

P14 AC OUT		
OUTPUT	**FUNCTION**	**USE**
PO33 P14-1	**Valve 1 AC Output**	
PO34 P14-3	**Valve 2 AC Output**	
PO35 P14-5	**Valve 3 AC Output**	
PO36 P14-7	**EOS** ☐ Not Ready ☐ Tip Dress ☐ Retraction ☐ Count End ☐ Error ☐ Step End ☐ Interlock ☐ Water Saver ☐	

* Jumper when not used.

Bold function indicates default value

APPENDIX C PROGRAMMING WORKSHEETS (cont.)



ENTRON

EN6021 ERROR MAP WORKSHEET

ERROR	OUTPUT 17-32*	DESCRIPTION	ERROR	OUTPUT 17-32*	DESCRIPTION
1		Configuration error	49		High force pre-warn
2		Calibration error	50		Low force pre-warn
3		Schedule error	51		High current 1 pre-warn
4		Sequencer error	52		Low current 1 pre-warn
5		Event error	53		High current 2 pre-warn
6		Counter error	54		Low current 2 pre-warn
7		Stepper error	55		High Stack-up
8		I/O Map error	56		Low Stack-up
9		E-stop error	57		Reserved
10		TC1 (Contactor) error	58		Reserved
11		P1-NW error	59		Reserved
12		PS error	60		Reserved
13		SCR short	61		Reserved
14		Second Stage error	62		Reserved
15		Pressure Sense error	63		Reserved
16		Interlock error	64		Reserved
17		High force	65		Battery low
18		Low force	66		Use Schedule error
19		High current 1	67		Reserved
20		Low current 1	68		Reserved
21		High current 2	69		Reserved
22		Low current 2	70		Reserved
23		High line voltage	71		Reserved
24		Low line voltage	72		Reserved
25		PCTR counter end	73		Weld Log full
26		Stepper end	74		Weld Log warn
27		High pulse width1	75		Error Log full
28		Low pulse width1	76		Error Log warn
29		High pulse width2	77		Flash RAM error
30		Low pulse width2	78		Reserved
31		Tip dress pre-warn	79		Reserved
32		AVC error	80		Reserved
33		Power on with STARTs closed	81		Reserved
34			82		Reserved
35		PNW (Pendant No-Weld)	83		Reserved
36		TT1 (Transformer) error	84		Reserved
37		Safety Relay error	85		Reserved
38		No 24V for CPU I/O ports	86		Reserved
39		No 24V for Expansion Board	87		Reserved
40			88		Reserved
41			89		
42			90		
43			91		Retraction input closed
44		Reserved	92		Pressure Sensor not ready
45		AC120V Safety Relay error	93		Retract not ready
46		Reserved	94		Second Stage not ready
47		No AC120V for Expansion Board	95		Pressure Sense not ready
48		Reserved	96		Interlock not ready

* NOTE: Control can stop on Error 17 if set in Configuration Menu.

APPENDIX C PROGRAMMING WORKSHEETS (cont.)

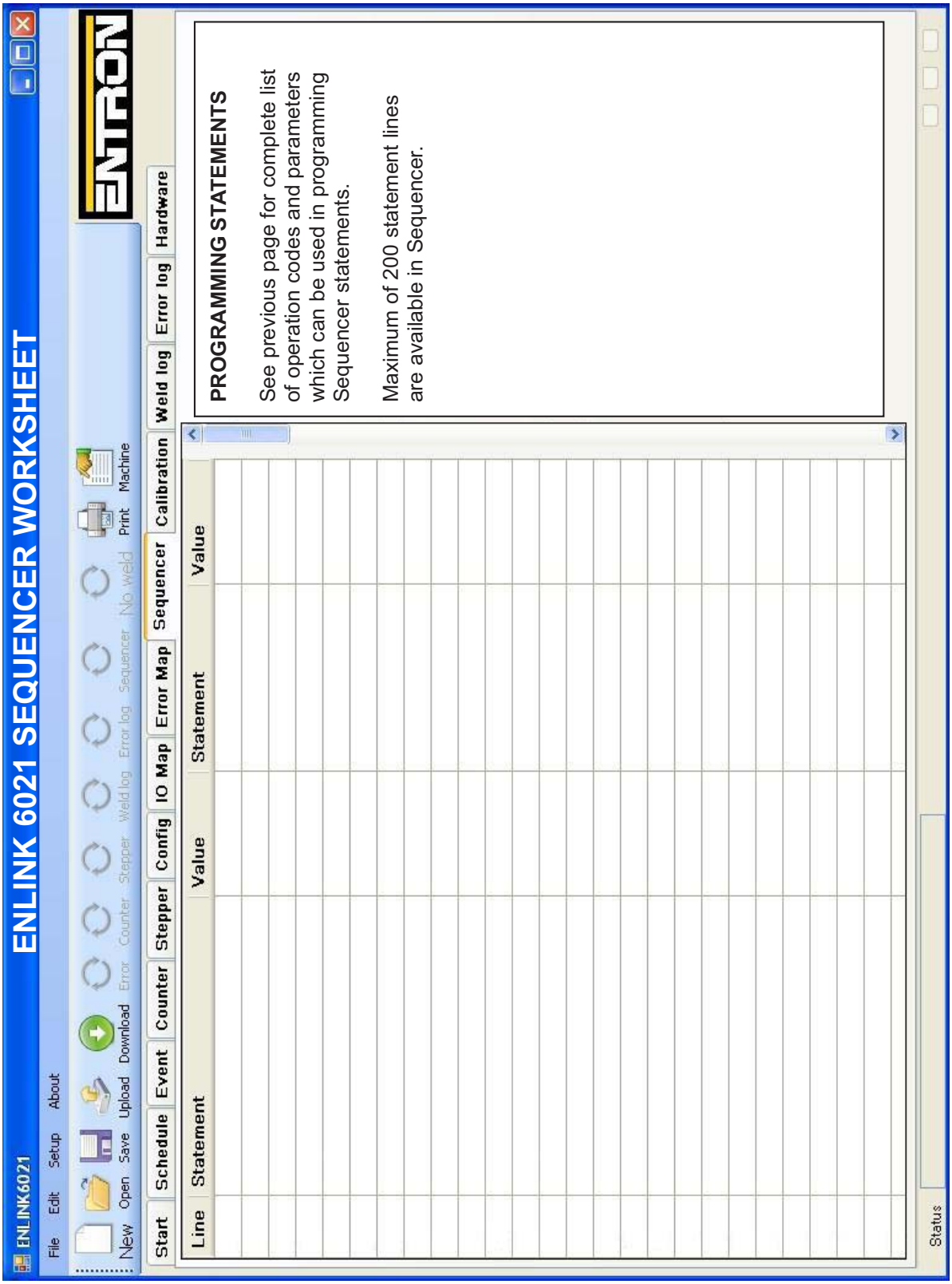
Error	Output port	Error	Output port
1: Configuration error	No output	2: Calibration error	No output
3: Schedule error	No output	4: Sequencer error	No output
5: Event error	No output	6: Counter error	No output
7: Stepper error	No output	8: I/O map error	No output
9: E-stop error	No output	10: TC1(Contactor) error	No output
11: P1-NW error	No output	12: PS error	No output
13: SCR short	No output	14: 2 stage error	No output
15: P sense error	No output	16: Interlock error	No output
17: High force	No output	18: Low force	No output
19: High current 1	No output	20: Low current 1	No output
21: High current 2	No output	22: Low current 2	No output
23: High line voltage	No output	24: Low line voltage	No output
25: PCTR counter end	No output	26: Stepper end	No output
27: High pulse width1	No output	28: Low pulse width1	No output
29: High pulse width2	No output	30: Low pulse width2	No output
31: Tip dress Pre-warn	No output	32: AVC error	No output
33: Power on with STARTs closed	No output	34:	No output
35: PNW(Pendant No-weld)	No output	36: TT1(Transformer) error	No output
37: Safety relay error	No output	38: No 24V for CPU I/O ports	No output
39: No 24V for expansion board	No output	40:	No output
41:	No output	42: Tip dress input on	No output
43:	No output	44: Reserved	No output
45: AC120V safety relay error	No output	46: Reserved	No output
47: No AC120V for expansion	No output	48: Reserved	No output
49: High force pre-warn	No output	50: Low force pre-warn	No output
51: High current 1 pre-warn	No output	52: Low current 1 pre-warn	No output
53: High current 2 pre-warn	No output	54: Low current 2 pre-warn	No output
55: High stack-up	No output	56: Low stack-up	No output
57: Reserved	No output	58: Reserved	No output
59: Reserved	No output	60: Reserved	No output
61: Reserved	No output	62: Reserved	No output
63: Reserved	No output	64: Reserved	No output
65: Battery low	No output	66: Use schedule error	No output
67: Reserved	No output	68: Reserved	No output
69: Reserved	No output	70: Reserved	No output
71: Reserved	No output	72: Reserved	No output
73: Weld log full	No output	74: Weld log warn	No output
75: Error log full	No output	76: Error log warn	No output
77: Flash RAM error	No output	78: Reserved	No output
79: Reserved	No output	80: Reserved	No output
81: Reserved	No output	82: Reserved	No output
83: Reserved	No output	84: Reserved	No output
85: Reserved	No output	86: Reserved	No output
87: Reserved	No output	88: Reserved	No output
89:	No output	90:	No output
91: Retraction input closed	No output	92: PS not ready	No output
93: Retract not ready	No output	94: 2-stage not ready	No output
95: P sense not ready	No output	96: Interlock not ready	No output

APPENDIX C PROGRAMMING WORKSHEETS (cont.)

EN6021 SEQUENCER WORKSHEET

OPERATION CODE	RANGE	FUNCTION
Blank	N/A	Not programmed (has no effect)
Step *xxx*	1 to 100	Has no effect, but serves as target for Jump statement or as logical divider in program
Sub *xxx*	1 to 100	Has no effect, but serves as target for Call SUB statement or as logical divider in program
Await PI*xx* = On	1 to 32	Waits for Input PI*xx* to be On
Await PI*xx* = Off	1 to 32	Waits for Input PI*xx* to be Off
Set PO*xx* = On	1 to 32	Turns On Output PO*xx*
Set PO*xx* = Off	1 to 32	Turns Off Output PO*xx*
Set Flag*xx* = On	1 to 32	Sets Flag *xx* On
Set Flag*xx* = Off	1 to 32	Sets Flag *xx* Off
Delay *xx.x* Second	0.1–99.9 seconds	Waits for specified time
Jump to step *xxx*	1 to 200	Program continues at specified Step number
Call SUB *xxx*	1 to 100	Program continues with subroutine at specified SUB number (maximum of 8 nesting levels)
Return	N/A	Return from subroutine
Set Counter*x* = *yyy*	*x*=1-8, *y*=1-999	Loads Counter *x* with value *yyy* (non-volatile)
Decrease Counter*x*	1 to 8	Value in Counter *x* is reduced by 1 (non-volatile)
If Counter*x*>0, JP *yyy*	*x*=1-8, *y*=1-200	If value in Counter *x* is greater than 0, jump to Step yyy
If PO*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Output PO*xx* is On, jump to Step *yyy*
If PO*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Output PO*xx* is Off, jump to Step *yyy*
If Flag*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Flag *xx* is On, jump to Step *yyy*
If Flag*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Flag *xx* is Off, jump to Step *yyy*
If PI*xx* = On, JP *yyy*	*x*=1-32, *y*=1-200	If Input PI*xx* is On, jump to Step *yyy*
If PI*xx* = Off, JP *yyy*	*x*=1-32, *y*=1-200	If Input PI*xx* is Off, jump to Step *yyy*
Spot-weld with Sch *xxx*	*x*=0-100	Execute spot weld sequence using Schedule *xxx* (0–99). SEQUENCER will wait until weld reaches End of Sequence before continuing with next statement. If *xxx* set to 100, starting schedule selected by Internal or External Select.
Set Aout*x* = *yy.y* mA / V	*x*=1 or 2, *y*=4.0-20.0mA or 0.0-10.0V	Set Analog Output 1 or 2 to specific current/ voltage (set in **Configure Menu**)
If Ain1 > *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 1 is greater than *xx.x* mA, jump to Step *yyy*
If Ain1 < *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 1 is less than *xx.x* mA, jump to Step *yyy*
If Ain2 > *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 2 is greater than *xx.x* mA, jump to Step *yyy*
If Ain2 < *xx.x* mA, JP *yyy*	*x*=4.0-20.0, *y*=1-200	If Analog Input 2 is less than *xx.x* mA, jump to Step *yyy*
End	N/A	End of Sequence
If Err*xx* = On, JP *yyy*	*x*=1-96 or Any, *y*=1-200	When *xx*=1-96, if Error *xx* is On, jump to Step *yyy* When *xx*=Any, if one or multiple Errors are On, jump to Step *yyy*
If Err*xx* = Off, JP *yyy*	*x*=1-96 or All, *y*=1-200	When *xx*=1-96, if Error *xx* is Off, jump to Step *yyy* When *xx*=All, if all Error are Off, jump to Step *yyy*
Seam-weld with Sch *xxx*	*x*=0-99	Execute seam weld sequence using Schedule *xxx* (0–99). SEQUENCER will continue with next statement when seam weld sequence has been started. Sequence will be ended when SEQUENCER implements **Seam-weld end** statement or when Start1 initiation switch is released.
Seam-weld end	N/A	Stop seam weld sequence.

APPENDIX C PROGRAMMING WORKSHEETS (cont.)



APPENDIX D WELDSAFE 5000

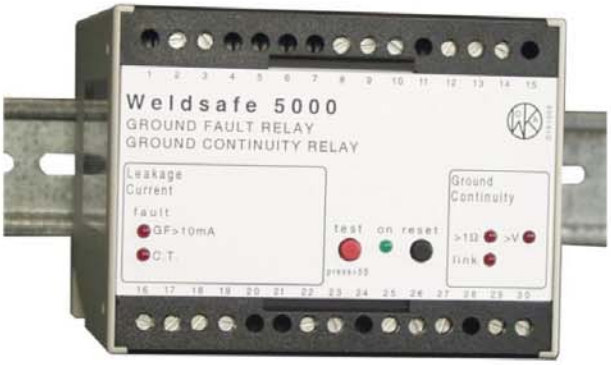
WoKa-Elektronik GmbH
Fulder Tor 30, D-36304 Alsfeld • Phone: +49 (0)6631-776040 • Fax: +49 (0)6631-7760499 • Mail: info@woka-elektronik.com

WELDSAFE 5000

combination ground fault sensing and ground checking relay for AC 50-60 Hz applications
manual transgun applications

Features

- 10 mA trip point setting for ground fault sensing
- C.T. loop monitoring
- 1 ohm single trip point for ground checking
- Voltage Build-up Detection
- Optional End-of-Line Resistor for crush fault detection
- Harmonic filtering



The Weldsafe 5000 combination ground fault current and ground check relay has been designed to provide sensitive ground fault protection and continuous ground checking for ac, 50-60 Hz manual transguns in accordance with RWMA Bulletin 5 standards.

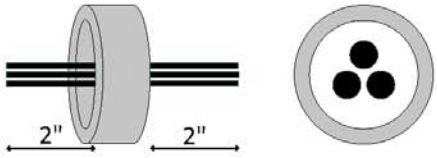
Ground Fault Sensing Operation

The Weldsafe 5000 protects operators and equipment from dangerous leakage currents that may occur when a circuit is energized. The device has harmonic filtering to prevent nuisance tripping and a pick-up response time of < 25ms.

Ground Fault Protection
The Weldsafe 5000 ground fault function has two ground fault settings which will typically correspond to the size of the manual transgun. Setting 1 is the factory setting. This setting should always be used whenever practicable. Generally, Setting 1 will work for transguns smaller than 100 KVA. For manual guns larger than 100 KVA or with very high amperages (>40,000A), Setting 2 can be selected. All settings meet or exceed current RWMA recommendations. To determine which setting is correct, consult with your service operator.

C.T. Loop Monitoring
The Weldsafe 5000 also continuously monitors the connection to the current transformer to ensure proper functioning of the ground fault sensing. If this connection is broken, the unit will immediately operate.

CT600/…/WKE Series Current Transformers
The ground fault protection function of the Weldsafe 5000 operates together with a CT600 series current transformer. There are different sizes available ranging from 1" to 5 1/8" depending upon the size of the load conductors passing through window. The C.T. is connected across terminals 16 and 17. Only the load carrying conductors pass through the C.T.. The ground wire must remain outside the C.T. core. It is also important that the cables passing through the C.T. be as straight as possible (see diagram) to minimize the possibility of core saturation.



CT600/60/2 for High Current Applications
In applications where very high current is present, as in the case of a very large hand-held welding gun (>100KVA, 40,000A), this high current may influence the operation of the CT and cause nuisance tripping. The mounting and location of the CT within the control panel is very important. In order to get optimum results from the CT, it is recommended that the CT be mounted on the output side. This reduces the influence of any internal leakage caused by components in the welding control. For systems above 100 KVA, it is advisable to use either coaxial cable or order the CT600/60/2. This CT has been specifically designed with a 6" metal core insert and provides the same shielding from the high current as the coaxial cable.

Ground Checking Operation

The Weldsafe 5000 has several protective methods to ensure proper grounding of fixed or portable equipment. If the unit senses any one of the following conditions, it activates the alarm relay (K2).

WoKa-Elektronik GmbH
Fulder Tor 30, D-36304 Alsfeld • Phone: +49 (0)6631-776040 • Fax: +49 (0)6631-7760499 • Mail: info@woka-elektronik.com

WELDSAFE 5000

combination ground fault sensing and ground checking relay for AC 50-60 Hz applications
manual transgun applications

Pilot Wire Ground Integrity Check
The Weldsafe 5000 monitors the resistance of the return path to ground via a ground connection from terminal 30 and a standard loop pilot wire going to the equipment from terminal 27. The unit continuously sends a measuring signal around the ground loop circuit. This circuit comprises the main equipment grounding conductor, a section of the equipment casing and a pilot conductor return path. When the Weldsafe 5000 detects a loop resistance in excess of 1 Ω, it will activate the output alarm relay (K2). The response time will vary depending upon the actual loop resistance value. The Weldsafe will react in < 30 ms for values approaching "open circuit" (see **table 1**).

Earth Voltage Build-up
The Weldsafe 5000 can also detect large ground fault currents that may cause unsafe voltage build-up on the ground path. If the unit senses a voltage >30 V ac on the ground path, it will immediately react to this condition.

Optional End-of-Line Resistor (EOL)
The Weldsafe 5000 ground checking operation has an additional protection feature. The unit can detect crush or parallel faults. This situation occurs when the cable ground wire becomes unintentionally connected to the equipment pilot wire. To sense this fault, a grounding resistor is connected at the end of the pilot wire from terminal 29. In this configuration, the Weldsafe 5000 will alarm if the ground wire ever comes into contact with the equipment pilot wire. This grounding resistor must have a value of 49.9 ohms with a high tolerance of +/- 0.1% to ensure proper function of the Weldsafe 5000. Circuit Savers can supply this resistor on request.
Please note: this end-of-line (EOL) will not affect the operation of the earth voltage build-up function.

Technical Information

Mounting and Wiring
The Weldsafe 5000 can be either DIN rail mounted (35mm) or screw-mounted by the 2 holes at the corners of the device. Terminals are clearly marked for connection.

Input Power Supply
The Weldsafe 5000 requires an auxiliary power supply of either 24Vdc, 24Vac, 120Vac or 230Vac 50-60 Hz. Customer must specify.

Trip/Alarm Output Relays
Two sets of changeover trip/alarm contacts (one for ground fault, one for ground check) are provided rated at 250 V, 5 A. These two relays can be set for tripping or remote indication. They can be configured for either failsafe or active operation, manual or auto reset. Factory settings are Failsafe and Auto Reset. To adjust relay for Failsafe/Active operation for either ground fault or ground check, open front cover. There is a small blue button in the left and right lower areas. The switch on the left changes the ground fault, the one on the right changes the ground check. For Hand reset close contacts between 18-19, open for Auto.

LEDs
In addition to the trip relays there are six LED indicators on the front cover. The green LED indicates POWER ON. There are two red LEDs for the ground fault function:

- "GF" indicates leakage in excess of present trip level
- "C.T." indicates C.T. connection broken
- There are three LEDs indicating different conditions on the ground check function
- "1Ω" indicates ground loop resistance in excess of 1 ohm
- "Link" indicates ground wire connected to pilot wire
- ">V" indicates voltage build-up in excess of 30 V AC

Test/Reset
The test facilities on the Weldsafe 5000 may be operated locally or remotely. They test both the ground fault sensing and the ground checking circuits. The test button, S1 is used to simulate a ground fault condition internally as a means of testing the relay function. An external test button can also be used to perform the same function test.

CT600 Current Transformers

CT600/25/WKE	1" internal diameter
CT600/60/WKE	2 1/3" internal diameter
CT600/95/WKE	3 3/4" internal diameter
CT600/130/WKE	5 1/8" internal diameter
CT600/60/2	2 1/3" internal diameter for high current applications, 6" metal insert

Power Supply Voltage Us	Order Number
DC24V	17007031
AC24V	17007041
AC120V	17007051

WoKa-Elektronik GmbH
Fulder Tor 30, D-36304 Alsfeld • Phone: +49 (0)6631-776040 • Fax: +49 (0)6631-7760499 • Mail: info@woka-elektronik.com

WELDSAFE 5000

combination ground fault sensing and ground checking relay for AC 50-60 Hz applications
manual transgun applications

Technical Data

Nominal AC insulation voltage ..... 500 V ac
Insulation group to UL 1053
and VDE 0110(01.83) ..... Dirty group 2
Test voltage ..... 3000 V ac
Operation class ..... Continuous
Input supply voltage ... 24V ac, 24V dc, 120V ac, 230V ac 50-60Hz
working range ..... +/- 15%
Maximum self-consumption ..... 10 VA
Alarm relay contacts ..... Volt-free NO/NC
Switching capacity ..... 1100 VA
Rated contact voltage 250V
Continuous current 5A
Breaking capacity
At: 240V ac, P.F.=0.4 ..... 3A
At: 110V dc, @L/R=0 ..... 0.3A
Adjustable function ..... Failsafe/Active
Relay alarm memory ..... Manual/Auto reset
Factory settings ..... Failsafe/Auto
Operating ambient temperature ..... -10° to +60° C
Storage ambient temperature ..... -40° to +70° C

Mounting
Terminal ..... M 2.5
Terminal capacity ..... 0.5 to 4 mm²
Weight ..... 575 g
Dimensions ..... 2.96"H x 3.94"W x 4.33

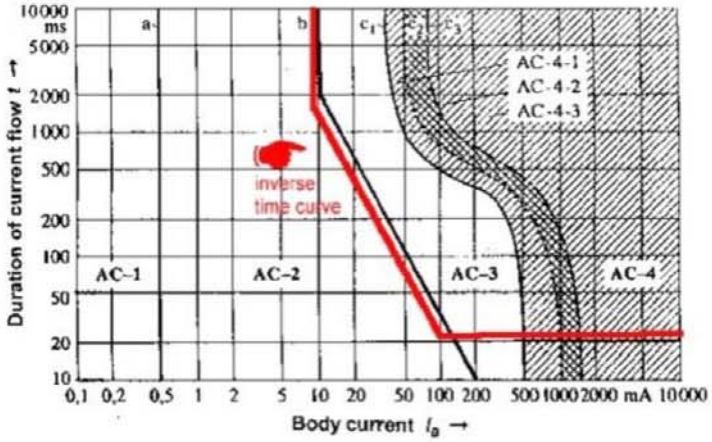
Ground fault function
Trip level
Setting 1 ..... factory setting
S8 closed ..... 10 mA, +0%/-15%, ac 50-60 Hz
Response time ..... 20 –25 ms Response time
Setting 2
S8 open ..... 10 mA, +0%/-15%, ac 50-60 Hz
Response time to current ..... inverse time curve
..... see below
Current transformer ..... CT600/…/WKE or CT600/60/2
Sizes ..... 1" – 5 1/8" internal diameter

Ground check function
Loop resistance measuring current ..... DC 20 mA
Trip Level ..... 1Ω, +/-15%
Stray voltage
(terminals 30-27 or 30-29) ..... Max. 300 V ac (<5 sec)
Response time
0.5Ω - open circuit ..... < 30 ms
response time curve ..... see table 1
Hysteresis ..... Approx. 2%
Voltage response ..... > 30 V ac

Industry Standards ..... RWMA 5-015.68.04

Response Time for Ground Loop value change 0.5Ω to RΩ	
0.5 Ω - 2 Ω	= 1.8 s
0.5 Ω - 5 Ω	= 1.8 s
0.5 Ω - 8 Ω	= 1.8 s
0.5 Ω - 10 Ω	= 1.8 s
0.5 Ω - 20 Ω	= 310 ms
0.5 Ω - 50 Ω	= 100 ms
0.5 Ω - 100 Ω	= 60 ms
0.5 Ω - 200 Ω	= 42 ms
0.5 Ω - Open	= 21 ms

Table 1



Weldsafe 5000 Ground Fault Setting 2 reaction time

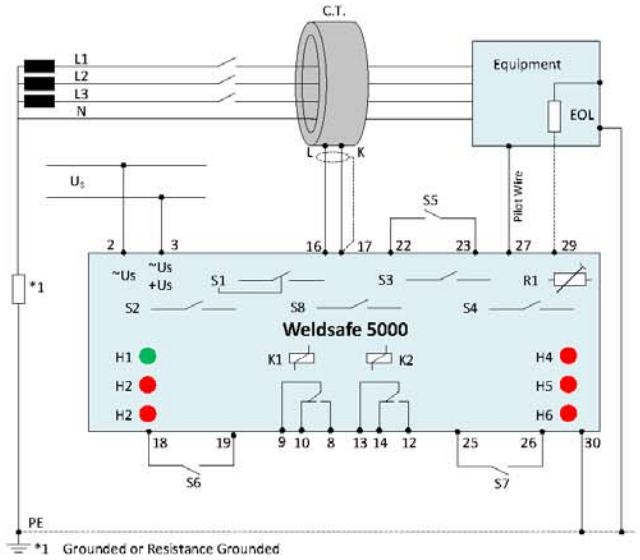
APPENDIX D WELDSAFE 5000 (cont.)

WoKa-Elektronik GmbH
Fulder Tor 30, D-36304 Alsfeld • Phone: +49 (0)6631-776040 • Fax: +49 (0)6631-7760499 • Mail: info@woka-elektronik.com

WELDSAFE 5000

combination ground fault sensing and ground checking relay for AC 50-60 Hz applications
manual transgun applications

Connection Diagram E699001-2



PLEASE NOTE:

TO CHECK UNIT FUNCTION DURING COMMISSIONING, WE RECOMMEND TESTING THE WELDSAFE 5000 UNDER TRUE FAULT CONDITIONS. FOR THE GROUND FAULT FUNCTION, A SMALL RESISTOR, (e.g. 30 KΩ AT 480V WILL GENERATE APPROX. 16 mA) CAN BE USED TO CREATE THIS CONDITION. FOR THE GROUND CHECKING FUNCTION, OPEN THE PILOT WIRE.

Legend

H1	LED green POWER ON
H2	LED red GROUND FAULT
H3	LED red CT FAULT
H4	LED red LOOP RESISTANCE > 1Ω
H5	LED red CRUSH FAULT
H6	LED red VOLTAGE BUILD-UP
K1	Ground fault alarm relay
K2	Ground check alarm relay
S1	Internal test button
S2	Internal reset button
S3	Switch for ground fault Failsafe/Active (behind front cover) Closed=active Open=failsafe
S4	Switch for ground check Failsafe/Active (behind front cover) Closed=active Open=failsafe
S5	External test button
S6	External reset button for ground fault sensing
S7	External reset button for ground checking
S8	Trip level adjustment (behind front cover) Closed = 10 mA fixed = factory setting Open = 10 mA inverse response
**R1	Loop resistance adjustment - see instructions

Terminals

2-3	Input power supply
8-9-10	Contact for K1 alarm relay – ground fault
12-13-14	Contact for K2 alarm relay – ground check
16-17	C.T. connection
18-19	Ground fault external reset, Hand=closed Auto=open
22-23	External test button (optional)
25-26	Ground check external reset, Hand=closed Auto=open
27	Pilot wire if using standard ground check monitoring
29	Pilot wire if using EOL monitoring
30	Ground connection
EOL	End-of-line resistor, 49.9Ω, +/-0.1

**R1 Loop Resistance Adjustment

This is an internal adjustment that must made when cable length is very long and the loop resistance is high (0.5..0.8Ω). Please check with manufacturer about your specific application.

APPENDIX D WELDSAFE 5000 (cont.)

WELDSAFE 5000 MODIFICATION NOTES