INSTRUCTION MANUAL
700221J

EN6021 SERIES CONTROLS

MICROPROCESSOR BASED
Weld Sequence Controls
With
Solid State Thyristor Contactors

Wiring Diagram 421505 “N” Cabinet

Communication Specifications – Instruction Manual 700222

Intended for use with firmware version 2.00 and higher
THIS PAGE IS INTENTIONALLY BLANK
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!

WARNING

HAZARDOUS VOLTAGE FROM ONE OR MORE SOURCES
Turn off all voltage sources before entering cabinet. Electrical shock or flash may cause severe injury or death.

Do not remove or cover this sign.

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.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of this control for purposes other than intended use may result in injury to user or others or damage to equipment.</td>
</tr>
<tr>
<td>This control should only be used for its intended purpose!</td>
</tr>
</tbody>
</table>

RETROFITS AND MODIFICATIONS BY USER

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
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.

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.

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.
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.

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.

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.
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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.

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.
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, momentary and 2-palm
- 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 / 2-Palm [CLEAR default=Off]
- On Error: Head lock / Continue / Stop [CLEAR default=Continue]
- Schedule Select: Internal / External [CLEAR default=Internal]
- 2-Palm Mode: On / Off [CLEAR default=Off]
- 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]
- Retract Open: 0 to 99 cycles (Mode 2) [CLEAR default=0]
- Retract Close: 0 to 99 cycles (Mode 2) [CLEAR default=0]
- 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 / Retract open / Retract prox. / Retract PB1 /
  Retract PB2 / Retraction / Schedule Select / 2nd stage / Sequencer /
  Stepper reset / Tip dress input / 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 / Retract exhaust / Retract force / Retract return / Retraction /
  Sequencer / Stepper end / Tip dress / 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection type</td>
<td>NEMA 12 Enclosure</td>
</tr>
<tr>
<td>CPU operating voltage (without I/O) (no active inputs or outputs)</td>
<td>24 VDC ±5% with maximum ±2% ripple at 220 mA</td>
</tr>
<tr>
<td>Rated current (without I/O) at 24V</td>
<td>approximately 500 mA – SV1–SV3</td>
</tr>
<tr>
<td></td>
<td>approximately 500 mA – PO1–PO32</td>
</tr>
<tr>
<td>Environmental conditions:</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>0°C to 60°C</td>
</tr>
<tr>
<td>Storage/Transport</td>
<td>-25°C to 70°C</td>
</tr>
<tr>
<td>Air pressure</td>
<td>0 to 2000m above sea level</td>
</tr>
<tr>
<td>Humidity</td>
<td>no dew point excursion allowed</td>
</tr>
<tr>
<td>Number of schedules</td>
<td>100</td>
</tr>
<tr>
<td>Discrete I/O:</td>
<td></td>
</tr>
<tr>
<td>Inputs</td>
<td>logic ‘1’ – +24V ±15%; logic ‘0’ – 1V to +2V or open</td>
</tr>
<tr>
<td>Outputs</td>
<td>24VDC maximum 0.5A; 120VAC maximum 1A</td>
</tr>
<tr>
<td>Supply I/O signals</td>
<td>24 VDC ±5% with maximum ±2% ripple</td>
</tr>
<tr>
<td>Programming</td>
<td>RPP2 pendant, internal USB-interface or Ethernet</td>
</tr>
<tr>
<td>Operating system</td>
<td>in Flash Memory; reloadable from USB flash drive</td>
</tr>
<tr>
<td>Program memory</td>
<td>RAM memory</td>
</tr>
<tr>
<td>Backup battery</td>
<td>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</td>
</tr>
<tr>
<td>RPP2</td>
<td>24 VDC ±5% with maximum ±2% ripple at 50 mA</td>
</tr>
<tr>
<td>Analog I/O</td>
<td>4–20 mA ±5% or 0–10V ±10%</td>
</tr>
<tr>
<td>Pressure Sense</td>
<td>4–20 mA ±5%</td>
</tr>
<tr>
<td>Pressure Control</td>
<td>4–20 mA ±5%</td>
</tr>
<tr>
<td>Stack-up Sense</td>
<td>4–20 mA ±0.5%</td>
</tr>
</tbody>
</table>
1.6 CPU LAYOUT

P14
AC Out – see Figure 1-4

Bootloader Reset
(see Appendix B)

P11
Optional Programmable Inputs
(see Section 1.6.8)

P10
Optional Programmable Outputs
(see Section 1.6.7)

P3
Programmable Inputs
(see Section 1.6.3)

P12
ENTRON use only; connection between CPU and Power Supply

P11
Programmable Inputs
(see Section 1.6.8)

P10
Programmable Outputs
(see Section 1.6.7)

P9
Weld Control
(see Section 1.6.1)

P8
Ethernet
(see Section 1.6.6)

P7
Analog Control
(see Figure 1-5)

P6
See Figure 1-4

Figure 1-3. CPU layout – Front
1.6 CPU LAYOUT (cont.)

**NOTICE**

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

**BOTTOM**

- **P7 ANALOG CONTROL**
  - 24VDC
  - IN1+
  - IN2+
  - IN1-
  - IN2-
  - 0VDC
  - VIN1
  - VIN2
  - VIOUT1
  - VIOUT2
  - 0VDC
  - 0VDC
  - COIL
  - COIL

**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**

**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.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-1</td>
<td>SVC &amp; 5</td>
<td>24 VDC negative return wire (/ solenoid valve common) — serves as common point for SV1, SV2, and SV3. Also internally connected to 0VDC.</td>
</tr>
</tbody>
</table>

Figure 1-6. P1 connections

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-2</td>
<td>SV1</td>
<td>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).</td>
</tr>
<tr>
<td>P1-3</td>
<td>SV2</td>
<td>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).</td>
</tr>
<tr>
<td>P1-4</td>
<td>SV3</td>
<td>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).</td>
</tr>
<tr>
<td>P1-6,9, 12,15 &amp; 18</td>
<td>FSC Input Common connection (/foot switch common) — serves as common point for FS1–FS4, ES1, TC1, NW1 and PS1. Internally connected to 24VDC.</td>
<td></td>
</tr>
<tr>
<td>P1-7</td>
<td>FS1</td>
<td>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.</td>
</tr>
<tr>
<td>P1-8</td>
<td>FS2</td>
<td>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.</td>
</tr>
<tr>
<td>P1-10</td>
<td>FS3</td>
<td>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.</td>
</tr>
<tr>
<td>P1-11</td>
<td>FS4</td>
<td>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.</td>
</tr>
</tbody>
</table>
1.6.1 P1 (WELD CONTROL) CONNECTIONS (cont.)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-13</td>
<td>ES1</td>
<td>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.</td>
</tr>
<tr>
<td>P1-14</td>
<td>TC1</td>
<td>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.</td>
</tr>
<tr>
<td>P1-16</td>
<td>NW1</td>
<td>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.</td>
</tr>
<tr>
<td>P1-17</td>
<td>PS1</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

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

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

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.

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

**Figure 1-7. P2 connections**
1.6.2 P2 (PROGRAMMABLE OUTPUT) CONNECTIONS (cont.)

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

**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 02VDC or 24VDC 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.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3-1</td>
<td>PI1</td>
<td>Programmable Input 1 – used as multi-purpose programmable input. Via programming, may be used as <strong>Retraction</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-2</td>
<td>PI2</td>
<td>Programmable Input 2 – used as multi-purpose programmable input. Via programming, may be used as <strong>Parts Counter Reset</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-3</td>
<td>PI3</td>
<td>Programmable Input 3 – used as multi-purpose programmable input. Via programming, may be used as <strong>Error Reset</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-4</td>
<td>PI4</td>
<td>Programmable Input 4 – used as multi-purpose programmable input. Via programming, may be used as <strong>TT1</strong> (Temperature Transformer) or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-5</td>
<td>PI5</td>
<td>Programmable Input 5 – used as multi-purpose programmable input. Via programming, may be used as <strong>Interlock</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-6</td>
<td>PI6</td>
<td>Programmable Input 6 – used as multi-purpose programmable input. Via programming, may be used as <strong>Edit Lock</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-7</td>
<td>PI7</td>
<td>Programmable Input 7 – used as multi-purpose programmable input. Via programming, may be used as <strong>Escape</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-8</td>
<td>PI8</td>
<td>Programmable Input 8 – used as multi-purpose programmable input. Via programming, may be used as <strong>Back Step</strong> or Sequencer input. When connected to APIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P3-11</td>
<td>PI9</td>
<td>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.</td>
</tr>
</tbody>
</table>
### 1.6.3 P3 (PROGRAMMABLE INPUT) CONNECTIONS (cont.)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3-12</td>
<td>PI10</td>
<td>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.</td>
</tr>
<tr>
<td>P3-13</td>
<td>PI11</td>
<td>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.</td>
</tr>
<tr>
<td>P3-14</td>
<td>PI12</td>
<td>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.</td>
</tr>
<tr>
<td>P3-15</td>
<td>PI13</td>
<td>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.</td>
</tr>
<tr>
<td>P3-16</td>
<td>PI14</td>
<td>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.</td>
</tr>
<tr>
<td>P3-17</td>
<td>PI15</td>
<td>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.</td>
</tr>
<tr>
<td>P3-18</td>
<td>PI16</td>
<td>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.</td>
</tr>
</tbody>
</table>
1.6.4 P4, P5, P6, & P14 CONNECTIONS

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

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

**P14 AC OUT**

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P14-1</td>
<td>PO33</td>
<td>Valve 1 AC Output.</td>
</tr>
<tr>
<td>P14-2</td>
<td>cPOC 4,6 &amp; 8</td>
<td>Programmable Output Common c – Common return connection for PO33-36. Internally connected to cVACX2 (pin P14-12).</td>
</tr>
<tr>
<td>P14-3</td>
<td>PO34</td>
<td>Valve 2 AC Output.</td>
</tr>
<tr>
<td>P14-5</td>
<td>PO35</td>
<td>Valve 3 AC Output.</td>
</tr>
<tr>
<td>P14-7</td>
<td>PO36</td>
<td>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.</td>
</tr>
<tr>
<td>P14-9</td>
<td>CR  &amp; 10</td>
<td>Control Relay Common – Safe 120 VAC output.</td>
</tr>
<tr>
<td>P14-11</td>
<td>cVACX1</td>
<td>Connect to External AC Power Supply (T1-X1). For 120 VAC monitoring errors, see Section 1.6.9.</td>
</tr>
<tr>
<td>P14-12</td>
<td>cVACX2</td>
<td>Connect to External AC Power Supply (T1-X2). Internally connected to cPOC.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7-1</td>
<td>24VDC</td>
<td>24VDC terminal for Proportional Valve. Internally connected to 24VDC on PS1.</td>
</tr>
<tr>
<td>P7-2</td>
<td>24VDC</td>
<td>24VDC terminal for Analog devices. Internally connected to 24VDC on PS1.</td>
</tr>
<tr>
<td>P7-3</td>
<td>IN1+</td>
<td>4-20 mA Input 1 positive</td>
</tr>
<tr>
<td>P7-4</td>
<td>IN2+</td>
<td>4-20 mA Input 2 positive</td>
</tr>
<tr>
<td>P7-5</td>
<td>IN1–</td>
<td>4-20 mA Input 1 negative</td>
</tr>
<tr>
<td>P7-6</td>
<td>IN2–</td>
<td>4-20 mA Input 2 negative</td>
</tr>
<tr>
<td>P7-7</td>
<td>0VDC</td>
<td>0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.</td>
</tr>
<tr>
<td>P7-8</td>
<td>0VDC</td>
<td>0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.</td>
</tr>
<tr>
<td>P7-9</td>
<td>VIN1</td>
<td>0-10V Input 1</td>
</tr>
<tr>
<td>P7-10</td>
<td>VIN2</td>
<td>0-10V Input 2</td>
</tr>
<tr>
<td>P7-11</td>
<td>VIOUT1</td>
<td>0-10V or 4-20 mA Output 1</td>
</tr>
<tr>
<td>P7-12</td>
<td>VIOUT2</td>
<td>0-10V or 4-20 mA Output 2</td>
</tr>
<tr>
<td>P7-13</td>
<td>0VDC</td>
<td>0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.</td>
</tr>
<tr>
<td>P7-14</td>
<td>0VDC</td>
<td>0VDC terminal for Analog devices. Internally connected to 0VDC on PS1.</td>
</tr>
<tr>
<td>P7-15</td>
<td>0VDC</td>
<td>0VDC terminal for Rogowski Coil. Internally connected to 0VDC on PS1.</td>
</tr>
<tr>
<td>P7-16 &amp; 17</td>
<td>COIL</td>
<td>Rogowski Coil connection. Primary Coil 1400 mV/kA @ 60Hz; Secondary Coil 180 mV/kA @ 60Hz. <strong>NOTE:</strong> Temperature and position of Rogowski Coil can affect control accuracy.</td>
</tr>
</tbody>
</table>

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

Serial Port Interface (P8)

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

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Direction</th>
<th>Contact</th>
<th>Primary Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS232 RXD</td>
<td>In</td>
<td>2</td>
<td>Receive pin for RS232</td>
</tr>
<tr>
<td>RS232 TXD</td>
<td>Out</td>
<td>3</td>
<td>Transmit pin for RS232</td>
</tr>
<tr>
<td>RS485 A</td>
<td>In/Out</td>
<td>4</td>
<td>Pin A for RS485</td>
</tr>
<tr>
<td>RS485 B</td>
<td>In/Out</td>
<td>8</td>
<td>Pin B for RS485</td>
</tr>
<tr>
<td>COM GND</td>
<td>GND</td>
<td>5,9</td>
<td>Ground for communication</td>
</tr>
</tbody>
</table>

Ethernet Interface (P9)

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

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Direction</th>
<th>Contact</th>
<th>Primary Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX+</td>
<td>Out</td>
<td>1</td>
<td>Differential Ethernet transmit data +</td>
</tr>
<tr>
<td>TX–</td>
<td>Out</td>
<td>2</td>
<td>Differential Ethernet transmit data –</td>
</tr>
<tr>
<td>RX+</td>
<td>In</td>
<td>3</td>
<td>Differential Ethernet receive data +</td>
</tr>
<tr>
<td>RX–</td>
<td>In</td>
<td>6</td>
<td>Differential Ethernet receive data –</td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td>4</td>
<td>Terminated</td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td>5</td>
<td>Terminated</td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td>7</td>
<td>Terminated</td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td>8</td>
<td>Terminated</td>
</tr>
<tr>
<td>SHIELD</td>
<td></td>
<td></td>
<td>Chassis ground</td>
</tr>
</tbody>
</table>

Ethernet Status LEDs

**Table 1-3. Ethernet connector LED functions**

<table>
<thead>
<tr>
<th>Color</th>
<th>Link LED (Left)</th>
<th>Activity LED (Right)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>No Link</td>
<td>No Activity</td>
</tr>
<tr>
<td>Amber</td>
<td>10 Mbps</td>
<td>Half Duplex</td>
</tr>
<tr>
<td>Green</td>
<td>100 Mbps</td>
<td>Full Duplex</td>
</tr>
</tbody>
</table>

Figure 1-11. P8 and P9 connections

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.

<table>
<thead>
<tr>
<th>Connector #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P8</td>
<td>N/A</td>
<td>NOT FUNCTIONAL AT THIS TIME</td>
</tr>
<tr>
<td>P9</td>
<td>ETHERNET</td>
<td>10/100 BASE-T Ethernet connection</td>
</tr>
</tbody>
</table>

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.

Table 1-4. Status indicator LED functions

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

Figure 1-13. Status indicator LEDs
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.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P10-1</td>
<td>PO17</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-2</td>
<td>PO18</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-3</td>
<td>PO19</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-4</td>
<td>PO20</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-5</td>
<td>PO21</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-6</td>
<td>PO22</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-7</td>
<td>PO23</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-8</td>
<td>PO24</td>
<td>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 BPOC.</td>
</tr>
<tr>
<td>P10-9</td>
<td>BPOC &amp; 18</td>
<td>Programmable Output Common B – Common return connection for PO17-32. Internally connected to B0VDC (pin P10-19).</td>
</tr>
</tbody>
</table>
### 1.6.7 P10 (Programmable Output) CONNECTIONS (Optional) (cont.)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P10-10</td>
<td>PO25</td>
<td>Programmable Output 25 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-11</td>
<td>PO26</td>
<td>Programmable Output 26 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-12</td>
<td>PO27</td>
<td>Programmable Output 27 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-13</td>
<td>PO28</td>
<td>Programmable Output 28 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-14</td>
<td>PO29</td>
<td>Programmable Output 29 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-15</td>
<td>PO30</td>
<td>Programmable Output 30 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-16</td>
<td>PO31</td>
<td>Programmable Output 31 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-17</td>
<td>PO32</td>
<td>Programmable Output 32 – 24 VDC output rated at 0.5 A maximum. Via programming, can be used for <strong>Error Map</strong>, Event, Sequencer, or PLC output. Not isolated via Control Relay. Supplies 24 VDC when active. Connect other side of load to bPOC.</td>
</tr>
<tr>
<td>P10-19</td>
<td>b0VDC</td>
<td>Connect to External Power Supply b0VDC. Internally connected to bPOC.</td>
</tr>
<tr>
<td>P10-20</td>
<td>b24VDC</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P11-1</td>
<td>PI17</td>
<td>Programmable Input 17 – used as multi-purpose programmable input. Via programming, may be used as Stepper Reset or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-2</td>
<td>PI18</td>
<td>Programmable Input 18 – used as multi-purpose programmable input. May be programmed as Weld Counter Reset or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-3</td>
<td>PI19</td>
<td>Programmable Input 19 – used as multi-purpose programmable input. May be programmed as Retract Palm Button 1 or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-4</td>
<td>PI20</td>
<td>Programmable Input 20 – used as multi-purpose programmable input. May be programmed as Retract Palm Button 2 or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-5</td>
<td>PI21</td>
<td>Programmable Input 21 – used as multi-purpose programmable input. May be programmed as Tip Dress Input or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-6</td>
<td>PI22</td>
<td>Programmable Input 22 – used as multi-purpose programmable input. May be programmed as Retract Prox. or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-7</td>
<td>PI23</td>
<td>Programmable Input 23 – used as multi-purpose programmable input. May be programmed as Retract Open or Sequencer input. When connected to bPIC, will be active and draw 10 mA.</td>
</tr>
<tr>
<td>P11-8</td>
<td>PI24</td>
<td>Programmable Input 24 – 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.</td>
</tr>
<tr>
<td>P11-10</td>
<td>PI25</td>
<td>Programmable Input 25 – 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.</td>
</tr>
</tbody>
</table>

Figure 1-15. P11 connections
### 1.6.8 P11 (Programmable Input) CONNECTIONS (Optional) (cont.)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P11-11 PI26</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-12 PI27</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-13 PI28</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-14 PI29</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-15 PI30</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-16 PI31</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>P11-17 PI32</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>! WARNING !</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Relay for AC outputs will not be monitored when Jumper 2 is used.</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Dimension</th>
<th>CPU</th>
<th>PS1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.50</td>
<td>4.80</td>
</tr>
<tr>
<td>B</td>
<td>17.50</td>
<td>12.00</td>
</tr>
<tr>
<td>C</td>
<td>15.00</td>
<td>9.50</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
<td>1.25</td>
</tr>
<tr>
<td>E</td>
<td>1.00</td>
<td>1.15</td>
</tr>
<tr>
<td>F</td>
<td>1.50</td>
<td>2.50</td>
</tr>
<tr>
<td>G</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>H</td>
<td>16.50</td>
<td>11.00</td>
</tr>
<tr>
<td>I</td>
<td>6.50</td>
<td>6.50</td>
</tr>
</tbody>
</table>

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

3.1 FUSING AND SAFE OPERATION

POWER HARNESS FUSES
Three 1-1/4A fuses (FNQ-R-1-1/4 – 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 5A 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.

<table>
<thead>
<tr>
<th>Current Draw:</th>
<th>CPU</th>
<th>500 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Weld input</td>
<td>300 mA</td>
</tr>
<tr>
<td></td>
<td>Other inputs</td>
<td>10 mA</td>
</tr>
<tr>
<td></td>
<td>RPP2</td>
<td>50 mA</td>
</tr>
</tbody>
</table>

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 a 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).

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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 Maximum Chloride content of 20 PPM.
.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.

\[
\text{Transformer KVA} \times \frac{1000}{\text{AC Line Voltage}} \times 3 = \text{Maximum Current Demand}
\]

**Example 1:** Using 75 KVA transformer at 230 VAC:

\[
\text{Maximum Current Demand} = \frac{75 \times 1000}{230} \times 3 = 978 \text{ Amperes}
\]

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

\[
\text{Maximum Current Demand} = \frac{250 \times 1000}{460} \times 3 = 1630 \text{ Amperes}
\]

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:

\[
\% \text{ Duty Cycle} = \frac{\text{Weld Time (in Cycles)} \times \text{Number of welds per minute}}{36}
\]
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.
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 1mm².

- 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.

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.

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.**

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.

<table>
<thead>
<tr>
<th>Current Draw</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>500 mA</td>
</tr>
<tr>
<td>No Weld input</td>
<td>300 mA</td>
</tr>
<tr>
<td>Other inputs</td>
<td>10 mA</td>
</tr>
<tr>
<td>RPP2</td>
<td>50 mA</td>
</tr>
</tbody>
</table>

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 connected to H1

---

**Figure 4-2. Power Supply connectors**
4.2 POWER SUPPLY CONNECTORS (cont.)

<table>
<thead>
<tr>
<th>Pin#</th>
<th>Function</th>
<th>Table 4-1. P17 pin designations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>0 VDC</td>
<td></td>
</tr>
<tr>
<td>3 &amp; 4</td>
<td>24 VDC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pin#</th>
<th>Color</th>
<th>SCR Connection</th>
<th>Table 4-2. P5 &amp; P6 pin designations</th>
</tr>
</thead>
<tbody>
<tr>
<td>P5-1</td>
<td>YEL</td>
<td>SCR1 Gate</td>
<td></td>
</tr>
<tr>
<td>P5-2</td>
<td>ORG</td>
<td>SCR1 Cathode</td>
<td></td>
</tr>
<tr>
<td>P6-1</td>
<td>WHT</td>
<td>SCR2 Gate</td>
<td></td>
</tr>
<tr>
<td>P6-2</td>
<td>RED</td>
<td>SCR2 Cathode</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-3. Power Supply schematic
### 4.3 WIRING DIAGRAMS

#### 4.3.1 BILL OF MATERIALS

<table>
<thead>
<tr>
<th>QTY</th>
<th>Part #</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>510308</td>
<td>Cabinet, NEMA 12 &quot;N&quot;</td>
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<tr>
<td></td>
<td></td>
<td><strong>Rear Panel</strong></td>
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<tr>
<td></td>
<td></td>
<td>as needed</td>
</tr>
<tr>
<td>1</td>
<td>600755</td>
<td>Assembly, CPU</td>
</tr>
<tr>
<td>1</td>
<td>331208</td>
<td>Insertion Bridge Jumper</td>
</tr>
<tr>
<td>1</td>
<td>600756</td>
<td>Assembly, Power Supply</td>
</tr>
<tr>
<td>2</td>
<td>225016</td>
<td>Surge Resistor, 100W, 500 ohm, 10%</td>
</tr>
<tr>
<td>3</td>
<td>307025</td>
<td>Fuse, 1-1/4A</td>
</tr>
<tr>
<td>3</td>
<td>308010</td>
<td>Fuseholder, One Pole</td>
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<tr>
<td>1</td>
<td>322568</td>
<td>Assembly, P12 Harness, 26 Conductor Ribbon</td>
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<td>322569</td>
<td>Harness Assembly, 24 VDC</td>
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<tr>
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<td>322570</td>
<td>Harness Assembly, Power</td>
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<td>460143</td>
<td>Label, Danger, Voltage/Flash Hazard</td>
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<td>3</td>
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<td>Label, Fuse, FNQ-R-1 1/4 or KLDR-1 1/4</td>
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<td></td>
<td></td>
<td><strong>Ground Lug</strong></td>
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<td>346004</td>
<td>Lug, 5/16&quot; Bolt to 2/0 Wire</td>
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<td>460144</td>
<td>Label, Danger, Voltage Hazard Earth GND</td>
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<td></td>
<td><strong>RPP2 Bulkhead</strong></td>
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<tr>
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<td>326063</td>
<td>Cable Assembly, 6', DB9 Male to Male, 1:1</td>
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<tr>
<td>2</td>
<td>331193</td>
<td>Jack Screw, 433</td>
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<td>1</td>
<td>331194</td>
<td>Adapter, DB9 Female/Female</td>
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<td>1</td>
<td>460416</td>
<td>Label, RPP2 Connector</td>
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<tr>
<td></td>
<td></td>
<td><strong>Drain/Vent Insulator</strong></td>
</tr>
<tr>
<td>1</td>
<td>341055</td>
<td>Insulator, Drain/Vent for &quot;N&quot; Cabinet</td>
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<tr>
<td>4</td>
<td>557067</td>
<td>1/2-13 Hex Nut, Brite</td>
</tr>
<tr>
<td>4</td>
<td>557050</td>
<td>5/16-18x1-1/4 Carriage Bolt, Brite</td>
</tr>
<tr>
<td>4</td>
<td>557125</td>
<td>5/16-18 Hex Nylon Lock Nut with Washer</td>
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<tr>
<td></td>
<td></td>
<td><strong>Labels, Left Side</strong></td>
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<tr>
<td>1</td>
<td>460103</td>
<td>Label, For Service Contact</td>
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<td>460170</td>
<td>Label, Caution, Do Not Pinch Wire</td>
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<tr>
<td></td>
<td></td>
<td><strong>Door</strong></td>
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<tr>
<td>3</td>
<td>565015</td>
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<td>Label, Warning, Hazardous Voltage</td>
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<tr>
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<td>460342</td>
<td>Label, Warning, Programmed Control Devices</td>
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<tr>
<td>1</td>
<td>460335</td>
<td>Label, ENTRON Logo</td>
</tr>
<tr>
<td>1</td>
<td>460393</td>
<td>Label, EN6021</td>
</tr>
<tr>
<td>1</td>
<td>700221</td>
<td>EN6021 Manual</td>
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### CIRCUIT BREAKER PARTS LIST

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<tr>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>510249</td>
<td>Cover Plate Assem., CB Operator Opening</td>
</tr>
<tr>
<td>1</td>
<td>309001-006</td>
<td>Circuit Breaker, 2 pole, 600V, 200A</td>
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<tr>
<td>1</td>
<td>309018-006</td>
<td>Flange Operator, C/B, 200A — Consisting of:</td>
</tr>
<tr>
<td></td>
<td>P/N 309066</td>
<td>Cable Operator Handle (qty. 1)</td>
</tr>
<tr>
<td></td>
<td>P/N 309071</td>
<td>Flange Operator (qty. 1)</td>
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<tr>
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<td>309002-002</td>
<td>Circuit Breaker, 2 pole, 600V, 400A</td>
</tr>
<tr>
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<td>309019-002</td>
<td>Flange Operator, C/B, 400A — Consisting of:</td>
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<tr>
<td></td>
<td>P/N 309066</td>
<td>Cable Operator Handle (qty. 1)</td>
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<tr>
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<td>No ENTRON P/N — Flange Operator (qty. 1)</td>
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### CONTACTOR PARTS LIST

#### 1200A Contactor Mounting

<table>
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<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>600598-007</td>
<td>Assembly, 1200A Contactor, Heat Sink w/90° Hose Barbs</td>
</tr>
<tr>
<td>1</td>
<td>525136</td>
<td>Mounting Bracket for 1200A Contactor</td>
</tr>
<tr>
<td>1</td>
<td>900080</td>
<td>Cable, #4/0 AWG, Copper, 600V</td>
</tr>
<tr>
<td>2</td>
<td>600179</td>
<td>Assembly, Water Fitting, 3/8&quot; Hose</td>
</tr>
<tr>
<td>4</td>
<td>566010</td>
<td>Hose Clamps, 9/16 min ID x 1-1/16 max OD</td>
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<tr>
<td>4</td>
<td>900045</td>
<td>Hose, 3/8 ID x .70 max OD</td>
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#### 1800/2200/3200A Contactor Mounting

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<td>600533-005</td>
<td>Assembly, 1800A SCR Contactor</td>
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<tr>
<td>1 or</td>
<td>600533-003</td>
<td>Assembly, 2200A SCR Contactor</td>
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<td>1</td>
<td>600533-014</td>
<td>Assembly, 3200A SCR Contactor</td>
</tr>
<tr>
<td>1</td>
<td>525136</td>
<td>Mounting Bracket for 1800/2200/3200A Contactor</td>
</tr>
<tr>
<td>1 ft.</td>
<td>900114</td>
<td>Cable, 350 MCM, Copper, 600V for 1800A Contactor</td>
</tr>
<tr>
<td>1 ft.</td>
<td>900100</td>
<td>Cable, 500 MCM, Copper, 600V for 2200A Contactor</td>
</tr>
<tr>
<td>2 ft.</td>
<td>900114</td>
<td>Cable, 350 MCM, Copper, 600V for 3200A Contactor</td>
</tr>
<tr>
<td>2</td>
<td>600179</td>
<td>Assembly, Water Fitting, 3/8&quot; Hose</td>
</tr>
<tr>
<td>4</td>
<td>566010</td>
<td>Hose Clamps, 9/16 min ID x 1-1/16 max OD</td>
</tr>
<tr>
<td>4</td>
<td>900045</td>
<td>Hose, 3/8 ID x .70 max OD</td>
</tr>
</tbody>
</table>

#### 150/300A Contactor Mounting

<table>
<thead>
<tr>
<th>QTY</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or</td>
<td>600613</td>
<td>Assembly, 150A SCR Contactor</td>
</tr>
<tr>
<td>1</td>
<td>600520</td>
<td>Assembly, 300A SCR Contactor</td>
</tr>
<tr>
<td>1</td>
<td>525035-001</td>
<td>Mounting Bracket for 150/300A Contactor</td>
</tr>
<tr>
<td>1 ft.</td>
<td>900009</td>
<td>Cable, #4 AWG, Copper, 600V for 150A Contactor</td>
</tr>
<tr>
<td>1 ft.</td>
<td>900050</td>
<td>Cable, #4 AWG, Copper, 600V for 300A Contactor</td>
</tr>
<tr>
<td>2</td>
<td>565001</td>
<td>Hole Plug, 1&quot; diam., Black</td>
</tr>
</tbody>
</table>

#### External SCR Contactor

<table>
<thead>
<tr>
<th>QTY</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>565001</td>
<td>Hole Plug, 1&quot; diam., Black</td>
</tr>
</tbody>
</table>
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.

![Diagram of noise suppression devices](image)

**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!

---

**DANGER**

HAZARDOUS VOLTAGE FROM ONE OR MORE SOURCES
Turn off all voltage sources before touching any components. Electrical shock or flash will cause severe injury or death.

VOLTAGE HAZARD FLASH HAZARD
Turn off all voltage sources before removing or replacing fuse. Electrical shock or flash will cause severe injury or death.

Hazardous Voltage
Electrical shock will cause severe injury or death.

---

4.4.1 WHEN CONTACITOR 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.

**NOTE:** Temperature and position of Rogowski Coil can affect control accuracy.
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.

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4.4.3 USER CONNECTIONS (cont.)

SPECIFICATIONS:

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

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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.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Option</th>
<th>Description</th>
<th>Drawing Applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>73005-005</td>
<td>PS</td>
<td>Integrated Pressure Sense Only, Single Input Sensor</td>
<td></td>
</tr>
<tr>
<td>73005-008</td>
<td>PSD</td>
<td>Integrated Pressure Sense Only, Differential Sensor</td>
<td></td>
</tr>
<tr>
<td>73005-007</td>
<td>IPC2</td>
<td>Integrated Pressure Control Only, 1/2&quot; NPT Valve</td>
<td></td>
</tr>
<tr>
<td>73005-006</td>
<td>IPC5</td>
<td>Integrated Pressure Control Only, 1-1/4&quot; NPT Valve</td>
<td></td>
</tr>
<tr>
<td>73005-015</td>
<td>IPC2</td>
<td>Integrated Pressure Sense and Control, Single Input Sensor &amp; 1/2&quot; NPT Valve</td>
<td></td>
</tr>
<tr>
<td>73005-016</td>
<td>IPC2</td>
<td>Integrated Pressure Sense and Control, Single Input Sensor &amp; 1-1/4&quot; NPT Valve</td>
<td></td>
</tr>
<tr>
<td>73005-017</td>
<td>IPCD2</td>
<td>Integrated Pressure Sense and Control, Differential Sensor &amp; 1/2&quot; NPT Valve</td>
<td></td>
</tr>
<tr>
<td>73005-018</td>
<td>IPCD5</td>
<td>Integrated Pressure Sense and Control, Differential Sensor &amp; 1-1/4&quot; NPT Valve</td>
<td></td>
</tr>
</tbody>
</table>
4.4.4 PRESSURE SENSE AND CONTROL (cont.)

PROPORTIONAL VALVE CONNECTIONS

Use this Pressure Control Wiring Diagram for all Pressure Control Systems with "C" (Control) in Option Description — see chart below.

Chart:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Drawing Applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>730005-005</td>
<td>IPS Integrated Pressure Sense Only, Single Input Sensor</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-008</td>
<td>IPSD Integrated Pressure Sense Only, Differential Sensor</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-007</td>
<td>IPC Integrated Pressure Control Only, 1/2&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-006</td>
<td>IPC5 Integrated Pressure Control Only, 1-1/4&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-015</td>
<td>IPSC2 Integrated Pressure Sense and Control, Single Input Sensor &amp; 1/2&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-016</td>
<td>IPSC5 Integrated Pressure Sense and Control, Single Input Sensor &amp; 1-1/4&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-017</td>
<td>IPSCD2 Integrated Pressure Sense and Control, Differential Sensor &amp; 1/2&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
<tr>
<td>730005-018</td>
<td>IPSCD5 Integrated Pressure Sense and Control, Differential Sensor &amp; 1-1/4&quot; NPT Valve</td>
<td>6/14/13</td>
</tr>
</tbody>
</table>
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 evaluated 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).

![Single two-stage foot switches connection diagram](image-url)

**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.

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 to 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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Status Page 1</th>
<th>Status Page 2</th>
<th>Status Page 3</th>
<th>Status Page 4</th>
<th>Status Page 5</th>
<th>Status Page 6</th>
<th>Status Page 7</th>
<th>Status Page 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-page 1 – Inputs PI1-PI16</td>
<td>Sub-page 2 – Inputs PI17-PI32</td>
<td>Sub-page 3 – Outputs PO1-PO16</td>
<td>Sub-page 4 – Outputs PO17-PO32</td>
<td>Sub-page 5 – Analog</td>
<td>Sub-page 6 – Flags 01-16</td>
<td>Sub-page 7 – Flags 17-32</td>
<td>Sub-page 8 – Counter</td>
</tr>
<tr>
<td>Sub-page 1 – Main Control</td>
<td>Sub-page 2 – Inputs PI1-PI16</td>
<td>Sub-page 3 – Inputs PI17-PI32</td>
<td>Sub-page 4 – Outputs PO1-PO16</td>
<td>Sub-page 5 – Outputs PO17-PO32</td>
<td>Sub-page 6 – Analog</td>
<td>Sub-page 7 – PLC Inputs 1-16</td>
<td>Sub-page 8 – PLC Inputs 17-32</td>
</tr>
<tr>
<td>Sub-page 1 – Schedule/Event/Counter/Stepper/Sequencer</td>
<td>Sub-page 2 – Config/Calibration/IO Map/Use schedule</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Joystick functions:
- **F1** – switch to previous Status Page
- **F2** – return to Main Menu
- **F3** – switch to next Status Page
- **DOWN** – toggle WELD/NO WELD setting
- **+ADJUST** – switch to next Sub-page
- **–ADJUST** – switch to previous Sub-page
- **ENTER** – switch to Use Schedule page

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 5-5. 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

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
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 ($I_1$), Weld1 Heat ($PW_1$), Weld2 Current ($I_2$) and Weld2 Heat ($PW_2$), 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](image)

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

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](image)

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
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 00000 and On state is indicated by 11111. For line labeled PI1-4: in Figure 5-9, first 11111 indicates Input PI1 is On, second 00000 indicates Input PI2 is Off, third 00000 indicates Input PI3 is Off, and fourth 00000 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).

![Sequencer Analog Inputs and Outputs](image)

**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).

![Sequencer Counters](image)

**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](image)

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](image)

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).

![Analog Inputs and Outputs Measurement]

**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

F1 + ADJUST – switch to next sub-page
F2 – 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.

SUB-PAGE 2
This screen displays the total amount of invalid parameters for Configuration, Calibration, I/O Map and Use Schedule menus.
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:

\[ \text{Displacement} = (\text{Stack-up thickness at end of HOLD}) - (\text{Stack-up thickness at end of SQUEEZE}) \]

![Stack-up Status Page](image)

Displacement Thickness

Stack-up Thickness

Schedule number and state

SCH: 40-End

ESC

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

Figure 5-17. Stack-up Status Page
5.4 USE SCHEDULE PAGE

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

![Use Schedule page](image)

**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:

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.

Joystick functions for Main Menu:

F1 – select previous menu
F2 – return to Status pages
F3 – select next menu
DOWN – toggle Weld/No Weld state

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.)

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.
**VALVE SELECTION**

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

<table>
<thead>
<tr>
<th>Programming values:</th>
<th>None</th>
<th>No cylinder valve selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Valve 1 selected</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Valve 2 selected</td>
</tr>
<tr>
<td></td>
<td>1+2</td>
<td>Valve 1 &amp; Valve 2 selected</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Valve 3 selected</td>
</tr>
<tr>
<td></td>
<td>1+3</td>
<td>Valve 1 &amp; Valve 3 selected</td>
</tr>
<tr>
<td></td>
<td>2+3</td>
<td>Valve 2 &amp; Valve 3 selected</td>
</tr>
<tr>
<td></td>
<td>1+2+3</td>
<td>Valve 1 &amp; Valve 2 &amp; Valve 3 selected</td>
</tr>
</tbody>
</table>

**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

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 the 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.

<table>
<thead>
<tr>
<th>Programmable values:</th>
<th>Off</th>
<th>PRESSURE/FORCE MONITOR function not active</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On</td>
<td>PRESSURE/FORCE MONITOR function is active</td>
</tr>
</tbody>
</table>

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.)

**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:
\[ \text{PRE-HIGH LIMIT} = \text{HIGH LIMIT} \times (1 - \text{PRE-LIMIT OFFSET}) \]

PRESSURE/FORCE PRE-LOW LIMIT value is calculated using following equation:
\[ \text{PRE-LOW LIMIT} = \text{LOW LIMIT} \times (1 + \text{PRE-LIMIT OFFSET}) \]

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 \times (1 - .10) = 1800 Lb
FORCE PRE-LOW LIMIT = 1000 \times (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).
5.5.1 SCHEDULE MENU (cont.)

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.

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

Programmable values:  
- **Off**  
- **On**

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.
5.5.1 SCHEDULE MENU (cont.)

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.

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.

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.)

**CURRENT MONITORING FOR WELD1**

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

**Programming values:**
- Off: WELD1 CURRENT MONITOR function not active
- On: WELD1 CURRENT MONITOR function 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:

\[ \text{PRE-HIGH LIMIT} = \text{HIGH LIMIT} \times (1 - \text{PRE-LIMIT OFFSET}) \]

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

\[ \text{PRE-LOW LIMIT} = \text{LOW LIMIT} \times (1 + \text{PRE-LIMIT OFFSET}) \]
5.5.1 SCHEDULE MENU (cont.)

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.

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](image)

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

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.
5.5.1 SCHEDULE MENU (cont.)

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:
\[
\text{PRE-HIGH LIMIT} = \text{HIGH LIMIT} \times (1 - \text{PRE-LIMIT OFFSET})
\]

WELD2 CURRENT PRE-LOW LIMIT value is calculated using following equation:
\[
\text{PRE-LOW LIMIT} = \text{LOW LIMIT} \times (1 + \text{PRE-LIMIT OFFSET})
\]

HIGH LIMIT value is set in \text{High parameter} and LOW LIMIT value is set in \text{Low parameter} when WELD2 CURRENT MONITORING is On. PRE-LIMIT OFFSET value is set in \text{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.
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 to HIGH 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.)

**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.

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

<table>
<thead>
<tr>
<th>Schedule number</th>
<th>Event number</th>
<th>Status</th>
<th>Delay setting</th>
<th>Output mapped for Event1</th>
<th>Output mapped for Event2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule= 0</td>
<td>1: Output= PO 1</td>
<td>Status: On</td>
<td>Inter:Squeeze delay</td>
<td>Delay: 0</td>
<td>2: Output= PO 2</td>
</tr>
</tbody>
</table>

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 Mode 1 or 2 in Configure Menu) Squeeze / Intensify (Air-over-oil set to Mode 1 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 +ADJUST – increase value of parameter
F2 – return to Main Menu –ADJUST – decrease value of parameter
F3 – switch to next parameter ENTER – accept/save new value
DOWN – toggle ADJUST gain setting

<table>
<thead>
<tr>
<th>Counter</th>
<th>Part count done= 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weld count done= 0</td>
</tr>
<tr>
<td>Counter: Enable</td>
<td></td>
</tr>
<tr>
<td>Max part count</td>
<td>= 60000</td>
</tr>
<tr>
<td>Max weld count</td>
<td>= 1</td>
</tr>
<tr>
<td>RST Counter</td>
<td>None</td>
</tr>
</tbody>
</table>

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 sets MAXIMUM COUNT allowed for WELD COUNTER. Range of programmable values for this parameter is 1 – 9999. When WELD COUNT DONE value equals MAX WELD COUNT, control will report Counter End Error (ER25).

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.

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 5-37. Heat/Current Stepper Curve

Figure 5-38. Pressure/Force Stepper Curve

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 P17 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

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.

Figure 5-40. STEPPER settings

Stepper number

Stepper01 settings

Count value

Heat+ setting

Current+ setting

Force- setting

Stepper

01: Count = 0
  > Heat+  0 %
  > Current+ 0.00 kA
  > Force-  0 %

02: Count = 0
  > Heat+  0 %

Figure 5-40. STEPPER settings
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:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements (lines)</td>
<td>Up to 200 maximum</td>
</tr>
<tr>
<td>Outputs</td>
<td>32 PO1 to PO32</td>
</tr>
<tr>
<td>Inputs</td>
<td>32 PI1 to PI32</td>
</tr>
<tr>
<td>Flags</td>
<td>32 Flag1 to Flag32</td>
</tr>
<tr>
<td>Counters</td>
<td>8 C1 to C8</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>2 Ain1 and Ain2</td>
</tr>
<tr>
<td>Analog outputs</td>
<td>2 Aout1 and Aout2</td>
</tr>
</tbody>
</table>

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**

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** – scroll forward through operation codes
-**ADJUST** – scroll backward through operation codes

**ENTER** – accept/save new operation code

**OR** access parameter of current operation code

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 **P** indicating operation code selection.

![Figure 5-41. Initial Sequencer Menu](image)
**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.

The following operation codes are available for programming SEQUENCER.

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

<table>
<thead>
<tr>
<th>OPERATION CODE (cont.)</th>
<th>RANGE</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>N/A</td>
<td>End of Sequence</td>
</tr>
<tr>
<td>If Errxx = On, JP yyy</td>
<td>x=1-96 or Any, y=1-200</td>
<td>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</td>
</tr>
<tr>
<td>If Errxx = Off, JP yyy</td>
<td>x=1-96 or All, y=1-200</td>
<td>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</td>
</tr>
<tr>
<td>Seam-weld with Sch xxx</td>
<td>x=0-99</td>
<td>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. Stop seam weld sequence.</td>
</tr>
</tbody>
</table>

Seam-weld end N/A

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

---

**Sequencer 001A**

Step 1
Await PI 3 = On
Step 2
Set PO 8 = On
Delay 0.5 Second
Step 3
Seam-weld end

**Sequencer 007A**

Spot-weld with Sch 1
Set PO 8 = Off
Step 4
Set PO 7 = On
Delay 0.4 Second
Set PO 7 = Off

**Sequencer 013A**

Delay 0.2 Second
Jump to step 4
End
Blank
Blank
Blank

---

**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

---

**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.

**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.

---

**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.
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, Momentary, and 2-Palm. 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.

2-Palm – Similar to standard operation of retraction with addition of dual palm buttons, a prox indicating “pre-weld” position, dual coil/action retract valve, and special weld control logic.

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).
5.5.6 CONFIGURE MENU (cont.)

2-PALM MODE
This parameter activates 2-PALM MODE where Initiation Start3 and Start4 will be used as input to initiate selected SCHEDULE which is assigned to Start1 when Start3 and Start4 are closed within 0.5 seconds of each other (see Section 9.10).

Programmable values:  Off  2-PALM function not active  
                      On   2-PALM function is active

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>When 2-PALM MODE is On, initiating Start1 can still be used to initiate selected SCHEDULE or Start2 can still be used to initiate SCHEDULE 20.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please note that industrial products designed for requirements such as this include many more safeguards to ensure correct operation. Please review designs carefully to ensure that failures do not cause undesirable results!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-PALM MODE is implemented by the single processor in control and does not have built-in redundancies.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
5.5.6 CONFIGURE MENU (cont.)

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 **Integrated 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.
5.5.6 CONFIGURE MENU (cont.)

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  

<table>
<thead>
<tr>
<th>AVCC config</th>
<th>Settings</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVC: Max 1%</td>
<td>Voltage monitor= On</td>
<td>AVC Nominal setting</td>
</tr>
<tr>
<td>AVC Nom.= 480 V</td>
<td>High= 700 V</td>
<td>High line voltage limit</td>
</tr>
<tr>
<td>Voltage monitor= On</td>
<td>Low= 300 V</td>
<td>Maximum Current Offset</td>
</tr>
<tr>
<td>Max I offset= 0 %</td>
<td>Max I offset= 0 %</td>
<td></td>
</tr>
</tbody>
</table>
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.

**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.)

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.)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label Printing</td>
<td>Select RS232 port to implement Label Printing function</td>
</tr>
<tr>
<td>EIP+MB Ethernet</td>
<td>Select Ethernet port to implement EtherNet/IP and Modbus Ethernet communication function</td>
</tr>
</tbody>
</table>

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](image)

**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.

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.

5.5.6 CONFIGURE MENU (cont.)

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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
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
- **+ADJUST** – increase value of parameter
- **F2** – return to Main Menu
- **–ADJUST** – decrease value of parameter
- **F3** – switch to next parameter
- **ENTER** – accept/save new value or
- **DOWN** – toggle ADJUST gain setting

**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).

<table>
<thead>
<tr>
<th>Programmable values</th>
<th>Firmware version</th>
<th>Previous firmware versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Feedback</td>
<td>1.00 and higher</td>
<td>1260 – 1540 mV/kA</td>
</tr>
<tr>
<td>Secondary Feedback</td>
<td>1190 – 1610 mV/kA</td>
<td>135 – 165 mV/kA</td>
</tr>
<tr>
<td>Secondary Feedback with Primary Coil</td>
<td>1190 – 1610 mV/kA</td>
<td>Not available</td>
</tr>
</tbody>
</table>

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:

\[ \text{Secondary Current} = \text{Primary Current} \times \text{TURNS Ratio of transformer} \]

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
to 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.
   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.

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.

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.
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**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Additional Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1 current</td>
<td>3.0 mA</td>
<td>19.9 mA</td>
<td>PT2 current &gt; PT1 current</td>
</tr>
<tr>
<td>PT2 current</td>
<td>4.1 mA</td>
<td>21.0 mA</td>
<td></td>
</tr>
<tr>
<td>PT2 thickness</td>
<td>1 mil</td>
<td>10500 mil</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

**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.

### Table 5-2. Programable values for INPUTS

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PROGRAMMABLE VALUES</th>
<th>INPUT</th>
<th>PROGRAMMABLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI1</td>
<td>Retraction or Sequencer</td>
<td>PI17</td>
<td>Stepper reset or Sequencer</td>
</tr>
<tr>
<td>PI2</td>
<td>Parts counter reset or Sequencer</td>
<td>PI18</td>
<td>Weld counter reset or Sequencer</td>
</tr>
<tr>
<td>PI3</td>
<td>Error reset or Sequencer</td>
<td>PI19</td>
<td>Retract PB1 or Sequencer</td>
</tr>
<tr>
<td>PI4</td>
<td>TT1 or Sequencer</td>
<td>PI20</td>
<td>Retract PB2 or Sequencer</td>
</tr>
<tr>
<td>PI5</td>
<td>Interlock or Sequencer</td>
<td>PI21</td>
<td>Tip dress input or Sequencer</td>
</tr>
<tr>
<td>PI6</td>
<td>Edit lock or Sequencer</td>
<td>PI22</td>
<td>Retract prox. or Sequencer</td>
</tr>
<tr>
<td>PI7</td>
<td>Escape or Sequencer</td>
<td>PI23</td>
<td>Retract open or Sequencer</td>
</tr>
<tr>
<td>PI8</td>
<td>Back step or Sequencer</td>
<td>PI24</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI9</td>
<td>2nd stage or Sequencer</td>
<td>PI25</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI10</td>
<td>SchSelect1 or Sequencer</td>
<td>PI26</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI11</td>
<td>SchSelect2 or Sequencer</td>
<td>PI27</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI12</td>
<td>SchSelect3 or Sequencer</td>
<td>PI28</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI13</td>
<td>SchSelect4 or Sequencer</td>
<td>PI29</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI14</td>
<td>SchSelect5 or Sequencer</td>
<td>PI30</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI15</td>
<td>SchSelect6 or Sequencer</td>
<td>PI31</td>
<td>Not used or Sequencer</td>
</tr>
<tr>
<td>PI16</td>
<td>SchSelect7 or Sequencer</td>
<td>PI32</td>
<td>Not used or Sequencer</td>
</tr>
</tbody>
</table>
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.

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.

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

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

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.

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.

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

Figure 5-60. Error Map sub-menu

Figure 5-61. Analog Map sub-menu
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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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).</td>
</tr>
</tbody>
</table>

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.

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

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

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.
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.

- **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.

- **File**: EN6021<sub>xx</sub> – unique File name (<sub>xx</sub>=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.

- **File**: EN6021<sub>xx</sub> – unique File name (<sub>xx</sub>=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.

File: WDLOGxxx – 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.

File: ERLOGxxx – 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.

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.

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: xxxx** – 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.

**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: \textit{x.xx} – indicates version of Firmware.
SN: \textit{xxxxxxxxxxx} – indicates ten-digit Serial Number of control (CPU unit).

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 5-72. About Menu](image)

![Figure 5-73. Setup Page access](image)
6.0 OPERATING INSTRUCTIONS

<table>
<thead>
<tr>
<th>! CAUTION !</th>
</tr>
</thead>
<tbody>
<tr>
<td>READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL OR OPERATE THIS CONTROL.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>! CAUTION !</th>
</tr>
</thead>
<tbody>
<tr>
<td>High voltage and low voltage inputs <strong>must be</strong> arranged to avoid negative effects on weld control through capacitive or inductive interference. Isolate high voltage and low voltage initiations as much as possible.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>! WARNING !</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance welding can create splashes and flash. <strong>Proper eye protection must be used!</strong> Gloves can also protect users from burns or hot parts.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAMAGE TO PROPERTY THROUGH EXCESSIVE WELDING CURRENT!</td>
</tr>
<tr>
<td>The maximum welding current of transformer and fixturing used must not be exceeded.</td>
</tr>
</tbody>
</table>

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](image1)

![Figure 9-2. Basic Spot Weld—Weld Fault](image2)

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](image3)

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](image4)
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.

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.
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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>40</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>35</td>
<td>60</td>
<td>0</td>
<td>35</td>
<td>10</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>4</td>
<td>00</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>40</td>
<td>0</td>
<td>20</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>40</td>
<td>1</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>45</td>
<td>85</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>40</td>
<td>1</td>
<td>45</td>
<td>85</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

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

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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>40</td>
<td>1</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>35</td>
<td>80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>80</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

**Figure 9-11. UPSLOPE**

**Figure 9-12. DOWNSLOPE**

**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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>1+2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>50</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>1+2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>95</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

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 PULSATON 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.

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 9-16. Forge Delay Weld using Events](image)

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

Figure 9-17. Forge Delay using Events
9.2 SEAM MODE EXAMPLES

9.2.1 SEAM1 MODES

CONTINUOUS SEAM MODE

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).

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>40</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

Figure 9-18. Continuous Seam Weld

Figure 9-19. Continuous Seam mode

INTERMITTENT SEAM MODE

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).

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

Figure 9-20. Intermittent Seam Weld

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).

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>10</td>
<td>1</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

Approximate Pressure Curve

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.

<table>
<thead>
<tr>
<th>INIT</th>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS1</td>
<td>17</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>20</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
<tr>
<td>FS2</td>
<td>20</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>40</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
<tr>
<td>FS3</td>
<td>40</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>60</td>
<td>0</td>
<td>10</td>
<td>10</td>
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<td>Non-repeat</td>
</tr>
<tr>
<td>FS4</td>
<td>60</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>80</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>
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.

NOTICE

If 2-PALM MODE is used with Seam2 mode, FS1 will start Seam weld or FS3 and FS4 using 2-button Palm Mode. FS2 will then be only Spot mode available.
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:

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>1</td>
<td>70</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>70</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>70</td>
<td>60</td>
<td>0</td>
<td>0</td>
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<td>90</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Chained</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>65</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

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 P19 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](image-url)
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](image)
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. 2-Palm Retraction is also available.

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.

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 9-27. Momentary Retraction](image)

![Figure 9-28. Momentary Retraction connections](image)
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.

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 9-29. Maintained Retraction](image)

![Figure 9-30. Maintained Retraction connections](image)
9.5.3 2-PALM RETRACTION

This mode of retraction may be used on press, projection or similar stationary welding applications. In cases such as these, operators may have the ability to have hands between closing electrodes from “total open” position to the closer 1/4” “pre-weld” position.

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P11-3 &amp; P119 &amp;</td>
<td>Dual Palm Buttons</td>
<td>used to enter “ready to weld” or “return from ready to weld” must be closed together within 0.5 seconds of each other before operation. When in weld sequence, control will not respond to these inputs – see Error Codes 89, 90 and 91. See also Retract Open Foot Switch.</td>
</tr>
<tr>
<td>P11-4 P120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P11-5 P121</td>
<td>Tip Dress Switch</td>
<td>closes electrodes only in “pre-weld” position when closed. Opens electrodes when opened. Weld sequence is blocked when closed.</td>
</tr>
<tr>
<td>P11-6 P122</td>
<td>Prox Input</td>
<td>used to monitor that weld cylinder has travelled to “pre-weld” position after closure of dual palm buttons. If input is lost in weld sequence, control will return to power on (reset state) and indicate Error Code 40.</td>
</tr>
<tr>
<td>P11-7 P123</td>
<td>Retract Open Foot Switch</td>
<td>is an alternate way to fully open electrodes from “ready to weld” position. See also Dual Palm Buttons.</td>
</tr>
<tr>
<td>P2-12 &amp; PO10 &amp; P2-13 PO11</td>
<td>Dual Coil Retract Valve – PO10 is used to supply retract piston; PO11 is used to exhaust retract piston.</td>
<td></td>
</tr>
<tr>
<td>P2-14 PO12</td>
<td>Return Valve</td>
<td>used to keep the head up in “pre-weld” position and completely open in the “at rest” position.</td>
</tr>
<tr>
<td>P1-2 Valve 1</td>
<td>Weld Valve</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9-31. 2-Palm Retraction connections
9.5.3 2-PALM RETRACTION (cont.)

ERROR CODES & MESSAGES
40  Prox input lost during weld sequence.
41  2-palm selected in Configure Menu but PI19-PI23 and PO10-PO12 not mapped to this mode.
42  Error to indicate “in tip dress” if in “pre-weld” position; PI22 prox is on and PI21 retract tip dress is on.
43  If electrodes are moving from “total open” position to “pre-weld” position but prox input is not closed within 15 seconds, control will report this error.
89  Retract Open input closed more than 10 seconds.
90  Retract palm not ready; palm buttons not closed together within 0.5 seconds.
91  Retract palm closed too long; PI19 and PI20 closed longer than 15 seconds.

BASIC OPERATION

The operation of this special mode is similar to more standard operation of retraction cylinders with the addition of dual palm buttons, a prox indicating “pre-weld” position, dual coil/action retract valve, and special weld control logic.

AT REST/POWER ON/AFTER ESTOP    POWER OFF/ESTOP

When power is first applied or control is returned from Emergency Stop, all outputs are off. Due to use of dual coil/action retract valve, little movement should be seen. Similar action when power off or Emergency Stop is applied. Return air valve is not energized and allows air to bottom of retract cylinder, keeping head up. Control initiation is blocked in this position.

![Retract cylinder block diagram](image)

Figure 9-32. Retract cylinder block diagram
9.5.3 2-PALM RETRACTION (cont.)

GO TO PRE-WELD POSITION
The control waits for dual palm buttons to close within 0.5 seconds of each other. If this timing is not achieved, Error Codes 89, 90 and 91 are activated. When palm button inputs are satisfied, return air to bottom of cylinder is turned off (valve activated), retract air to top of cylinder is turned on, and cylinder begins to move to “pre-weld” position. Mechanically, retract piston is stopped at the adjustable 1/4“ “pre-weld” position and a prox limit switch is met and turned on. Once prox is on, return air is then turned off, via spring return single action valve, to hold bottom cylinder of retract cylinder up in “pre-weld” position. If prox is not met within 15 seconds, Error Code 43 will be activated and returned to at rest state.

While in “pre-weld” position, control may be initiated using first and second stage initiations. The prox will be checked and, if in “pre-weld” position, control will go through weld sequence, turning on weld valve, actuating retraction cylinder weld piston (weld force will be achieved as configured as retract pressure is higher) and turning on return valve for weld sequence. When in off, weld valve and return valve will turn off. This can be done repeatedly.

While in “pre-weld” position, retract cylinder may be returned to at rest/power on/after estop “total open” position via closing palm buttons within 0.5 seconds of each other or momentarily closing retract open.

While in “pre-weld” position, tip dress input may be closed and weld valve will be turned on and return valve is turned on. While in this tip dress mode, control is blocked from weld initiation.

While in “pre-weld” position and power is removed or Emergency Stop is activated, cylinder should not shift. When power is reapplied or Emergency Stop closed, cylinder should not shift.

While in “pre-weld” position, if air leaks across seals internal to retraction cylinder, retraction cylinder may shift, causing prox to open which then will return to “total open” (at rest/power on/after estop) position and errors will be reported when control is asked to weld.

2-Palm Retraction is implemented by the single processor in control and does not have built-in redundancies.

It is important to note that this system is entirely under single processor software support and thus is subject to program alteration and single point failure. It is not a simply hardware/hard-wired system and precautions should be taken accordingly. No built-in redundancies are offered besides the control relay on weld valve output.

Please note that industrial products designed for requirements such as this include many more safeguards to ensure correct operation. Please review designs carefully to ensure that failures do not cause undesirable results!

Any use of this option must be reviewed before implementation.
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.

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.
### 9.7.2 MULTIPLE SCHEDULE OPERATION WITH EXTERNAL SCHEDULE SELECT (cont.)

#### Table 9-1. Binary External SCHEDULE SELECT

<table>
<thead>
<tr>
<th>DECIMAL (SCHEDULE)</th>
<th>TO BINARY SS1 (PI10) through SS7 (PI16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCH SS1 SS2 SS3 SS4 SS5 SS6 SS7</td>
<td>SCH SS1 SS2 SS3 SS4 SS5 SS6 SS7</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>0</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>1 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>0 1 0 0 0 0 0 0</td>
</tr>
<tr>
<td>3</td>
<td>1 1 0 0 0 0 0 0</td>
</tr>
<tr>
<td>4</td>
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<tr>
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<td>6</td>
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<td>24</td>
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<td>7 1 0 1 1 1 0 0</td>
</tr>
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<td>9 1 0 1 1 1 0 0</td>
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</tr>
<tr>
<td>31</td>
<td>11 0 1 1 1 0 0 0</td>
</tr>
<tr>
<td>32</td>
<td>12 0 0 0 0 0 1 0</td>
</tr>
<tr>
<td>33</td>
<td>13 0 0 0 0 0 1 0</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Valve 1 and/or 2 and/or 3</th>
<th>P1-SV1/SV2/SV3</th>
<th>Connects to Valve 1 and/or 2 and/or 3 for Electrodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation Contactor</td>
<td>P2-PO9</td>
<td>Connects to R1 to drive Magnetic Isolation Contactor</td>
</tr>
<tr>
<td>Alarm Output</td>
<td>P2-PO6</td>
<td>Connects to Alarm Output</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>ALSO</td>
</tr>
<tr>
<td>Be certain valve power supply can supply sufficient power for valves and contactor used.</td>
</tr>
</tbody>
</table>

| ! 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).

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>When using PI3 or PI7, these INPUTS must be mapped in I/O Map Menu (see Section 5.5.8).</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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).

\[ \text{Figure 9-36. Control input connection} \]

\[ \text{Figure 9-37. Multiple valve connection} \]
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.
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).

C. Map OUTPUTS PO9 through PO12 to Event on Input/Output Map page (Figure 9-41).
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](image)

![Figure 9-43. EVENT settings for SCHEDULE 1](image)

![Figure 9-44. EVENT settings for SCHEDULE 2](image)

![Figure 9-45. EVENT settings for SCHEDULE 3](image)
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.

![](image1.png)

Figure 9-46. Edit SCHEDULE 0

B. Enable SEQUENCER function on Configuration page (Figure 9-47).

![](image2.png)

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).

D. Enter SEQUENCER program on Sequencer page as shown in Figure 9-49.
9.10 2-PALM CONTROL

9.10.1 2-PALM MODE USING CONFIGURE MENU

The EN6021 Control offers a 2-PALM MODE which is similar to Anti-tie Down, but it is not designed internally the same. Purchased Anti-tie Down controls typically have built-in redundancies and meet standards that 2-PALM MODE will not meet. Any use of this function must be reviewed before implementation.

| WARNING |

Please note that industrial products designed for requirements such as this include many more safeguards to ensure correct operation. Please review designs carefully to ensure that failures do not cause undesirable results!

The 2-PALM MODE function uses FS3 (pin P1-10) and FS4 (pin P1-11) as inputs from normally open push buttons. The internal logic requires that both FS3 and FS4 be closed within 0.5 seconds of each other and be held closed until end of SQUEEZE. The logic also prevents Repeat initiations if held closed through end of SCHEDULE. Any SCHEDULE executed which activates a new valve (Chained mode) requires operator to keep both hands on switches until after SQUEEZE time of last SCHEDULE which adds any new valves.

To perform this function, follow these steps:
1. Enable 2-PALM MODE by setting this parameter to On in Configure Menu (see Section 5.5.6).
2. Connect the initiation switches SW1 and SW2 to P1 connector as shown in Figure 9-50.
3. Initiate weld with switches SW1 and SW2.

When 2-PALM MODE is enabled, FS1 and FS2 operate normally and use the same SCHEDULE as FS1 which is set in Use Schedule page (see Section 5.4).

| NOTICE |

2-PALM MODE is implemented by the single processor in control and does not have built-in redundancies.

To provide both 2-PALM MODE and single stage initiations, a key switch (SW3) may be placed in series with FS1 and FS2 (SW4 and SW5).

| NOTICE |

The 2-PALM MODE affects Chained SCHEDULES. It is required that operator’s two hands be on two palm buttons while electrodes are closing on parts to be welded. Palm buttons must be held until end of last programmed SQUEEZE time. Otherwise electrodes will retract prematurely.
9.10.2 2-PALM MODE USING SEQUENCER

The following application shows how to use the SEQUENCER function to accomplish a 2-Palm Button control function.

! WARNING !

This programming of the internal SEQUENCER for 2-Palm Button control is an example only. Please note that industrial products designed for requirements such as this include many more safeguards to ensure correct operation. Please review designs carefully to ensure that failures do not cause undesirable results!

For this example, switches PB1 and PB2 are used as initiation switches; RELAY1 on OUTPUT PO10 (pin P2-12) is used to indicate fault when one initiation switch is closed and the other switch is not closed within 0.5 seconds; RELAY2 on OUTPUT PO12 (pin P2-14) is used to indicate END OF SEQUENCE.

This function requires both PB1 and PB2 be closed within 0.5 seconds of each other before the weld sequence will start. Two relay outputs indicate status of the sequence and are not required.

To perform this function, follow these steps:

1. Connect the initiation switches PB1 and PB2 to P1 connector as shown in Figure 9-51.
2. Connect diodes to P1 & P3 connectors as shown in Figure 9-51 (D1 and D2 are 1N4002 – ENTRON P/N 170001).
3. Connect the indication relays RELAY1 and RELAY2 to P2 connector as shown in Figure 9-51 (if required).
4. 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).
5. Initiate the weld with switches PB1 and PB2.

Figure 9-51.
Connections for initiation switches and indication relays
9.10.2 2-PALM MODE USING SEQUENCER (cont.)

Step 4 – Programming with ENLINK

A. Edit SCHEDULE 0 as shown in Figure 9-52.

![Figure 9-52. Edit SCHEDULE 0](image)

B. Enable SEQUENCER function on Configuration page (Figure 9-53).

![Figure 9-53. Configuration page](image)
9.10.2 2-PALM MODE USING SEQUENCER (cont.)

Step 4 – Programming with ENLINK (cont.)

C. Map INPUT PI11, INPUT PI12, OUTPUT PO10 and OUTPUT PO11 to Sequencer on Input/Output Map page (Figure 9-54).

D. Enter SEQUENCER program on Sequencer page as shown in Figure 9-55.

Figure 9-54. Input/Output Map page

Figure 9-55. Sequencer page
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.

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).

![Block diagram of IPSC and Control with Regulator and Sensor](image)

**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.

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.

<table>
<thead>
<tr>
<th>Notice</th>
</tr>
</thead>
<tbody>
<tr>
<td>If modes are changed, data in SCHEDULES is no longer valid.</td>
</tr>
</tbody>
</table>

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.

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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1 cannot be below 3 mA and PT2 cannot be over 21.0 mA. Maximum force cannot exceed 8284.5.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1 cannot be below 3 mA and PT2 cannot be over 21.0 mA.</td>
</tr>
<tr>
<td>Maximum force cannot exceed 8284.5.</td>
</tr>
</tbody>
</table>
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](image)
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.

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.

Figure 9-62. IPS System with Sensor
9.12.6 PRESSURE SENSOR (cont.)

DIFFERENTIAL PRESSURE SENSOR

The IPSC system can be ordered with a Differential Pressure Sensor (Figure 9-63).

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).
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 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-END 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

* 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.

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)
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.

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.

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**Figure 9-68.**
Sourcing Sensor Wiring Logic

**Figure 9-69.**
Sinking Sensor Wiring Logic

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**SINKING/SOURCING BLOCK DIAGRAM**

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**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.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>POSSIBLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control will not change pressure.</td>
<td>1. Programming error.</td>
<td>1. Follow programming instructions.</td>
</tr>
<tr>
<td></td>
<td>2. Clogged filter.</td>
<td>2. Clean filter.</td>
</tr>
<tr>
<td></td>
<td>2. Pressure Sensor connected incorrectly.</td>
<td>2. Review wiring or check for open circuit.</td>
</tr>
<tr>
<td>Sensor input display always maximum value.</td>
<td>1. Pressure Sensor connected incorrectly.</td>
<td>1. Review wiring or check for open circuit.</td>
</tr>
<tr>
<td>Cylinder falls at the end of sequence or stays down (Pressure Control Option).</td>
<td>1. No Background (Return) Pressure Setting</td>
<td>1. Program Background value in the control.</td>
</tr>
<tr>
<td></td>
<td>2. Background (Return) pressure not high enough to lift the cylinder.</td>
<td>2. Change Background value.</td>
</tr>
<tr>
<td>Valve will not shuttle.</td>
<td>1. Pressure too low to operate valve.</td>
<td>1. Increase pressure or change to pilot assist type valve.</td>
</tr>
<tr>
<td></td>
<td>2. Solenoid valve not programmed in schedule.</td>
<td>2. Program a valve in the schedule.</td>
</tr>
<tr>
<td>Welding control initiates and valve actuates, but electrodes do not close.</td>
<td>1. Solenoid valve mis-wired.</td>
<td>1. Check all solenoid terminals for proper wiring or open connections.</td>
</tr>
<tr>
<td></td>
<td>2. Clogged filter.</td>
<td>2. Clean filter.</td>
</tr>
</tbody>
</table>

⚠️ WARNING ⚠️

TURN PRESSURE OFF AND BLEED SYSTEM BEFORE ATTEMPTING TO INSTALL OR SERVICE THIS CONTROL! BLOCK ALL MOVING DEVICES BEFORE INSTALLATION OR SERVICING!
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.

Figure 9-71 may be useful in understanding Pressure Sense and Control operation and aid in troubleshooting.
9.12.8 TROUBLESHOOTING (cont.)

Table 9-2. Relationship of mA to PSI for 4-20 mA=0-100 PSI Sensors and Proportional Valves

<table>
<thead>
<tr>
<th>mA</th>
<th>PSI</th>
<th>mA</th>
<th>PSI</th>
<th>mA</th>
<th>PSI</th>
<th>mA</th>
<th>PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00</td>
<td>0.00</td>
<td>8.00</td>
<td>25.00</td>
<td>12.00</td>
<td>50.00</td>
<td>16.00</td>
<td>75.00</td>
</tr>
<tr>
<td>4.50</td>
<td>3.13</td>
<td>8.50</td>
<td>28.13</td>
<td>12.50</td>
<td>53.13</td>
<td>16.50</td>
<td>78.13</td>
</tr>
<tr>
<td>5.00</td>
<td>6.25</td>
<td>9.00</td>
<td>31.25</td>
<td>13.00</td>
<td>56.25</td>
<td>17.00</td>
<td>81.25</td>
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<tr>
<td>5.50</td>
<td>9.38</td>
<td>9.50</td>
<td>34.38</td>
<td>13.50</td>
<td>59.38</td>
<td>17.50</td>
<td>84.38</td>
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<tr>
<td>6.00</td>
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<td>37.50</td>
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<td>6.50</td>
<td>15.63</td>
<td>10.50</td>
<td>40.63</td>
<td>14.50</td>
<td>65.63</td>
<td>18.50</td>
<td>90.63</td>
</tr>
<tr>
<td>7.00</td>
<td>18.75</td>
<td>11.00</td>
<td>43.75</td>
<td>15.00</td>
<td>68.75</td>
<td>19.00</td>
<td>93.75</td>
</tr>
<tr>
<td>7.50</td>
<td>21.88</td>
<td>11.50</td>
<td>46.88</td>
<td>15.50</td>
<td>71.88</td>
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<td>20.00</td>
<td>100.00</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

9.12.9 IPSC RETROFIT KIT BILL OF MATERIAL

<table>
<thead>
<tr>
<th>EN6021 CONTROLS</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPS</td>
<td>730005-005</td>
<td>600633 Assembly, Pressure Sense</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-008</td>
<td>571004 Differential Pressure Sensor</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-007</td>
<td>326039 Cable Assembly, PCS Ctrl to Proportional Valve</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-006</td>
<td>571002 Proportional Valve, 1-1/4 NPT</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-015</td>
<td>571001 Proportional Valve, 1/2 NPT</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-016</td>
<td>326053 Cable Assembly, Differential Pressure Sensor</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-017</td>
<td>326039 Cable Assembly, PCS Ctrl to Proportional Valve</td>
</tr>
<tr>
<td>IPS</td>
<td>730005-018</td>
<td>571002 Proportional Valve, 1-1/4 NPT</td>
</tr>
</tbody>
</table>

ALL CABINET STYLES
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](image)

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](image)
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 (P18 – 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

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

This CYCLE MODE has been implemented to satisfy additional requirements for more complicated machine sequencing.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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).</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>SCH</th>
<th>SQUEEZE</th>
<th>VALVE</th>
<th>WELD1</th>
<th>HEAT1</th>
<th>COOL1</th>
<th>SLOPE</th>
<th>WELD2</th>
<th>HEAT2</th>
<th>COOL2</th>
<th>HOLD</th>
<th>OFF</th>
<th>IMPULSES</th>
<th>CYCLE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>30</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Successive</td>
</tr>
<tr>
<td>21</td>
<td>20</td>
<td>1+2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>99</td>
<td>0</td>
<td>1</td>
<td>Wait-here</td>
</tr>
<tr>
<td>40</td>
<td>30</td>
<td>1+2+3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>99</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Wait-here</td>
</tr>
<tr>
<td>60</td>
<td>10</td>
<td>1+2+3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Non-repeat</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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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. |

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 transformer primary connection and has 1.75” inside diameter. Primary Coil range is 0.2–5.0 kA.

**SECONDARY COILS**
The Secondary Coils are available in diameters of 5” (S5 option) or 8” (S8 option). Secondary Coil range is 10–100 kA.

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.
10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

EXTERNAL USB & ETHERNET CONNECTIONS

See Control Assembly Drawings for Harness Routing for specific controls.

NOTE:

Drawings show "N" Cabinet. Actual usage of cable tie wraps and holders may be different on other Cabinet sizes but routing is similar.

CHG'D ITEM 2 P/N TO 326067; RMV'D QTY OF P/N 342024; CHG'D ROUTING OF ITEM 2; ADDED NOTE FOR CABLE TIE WRAPS & HOLDERS; DRWG FOR EN6000 SERIES CTRLS.
10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.5 PROGRAM LOCKOUT KEY SWITCH (PLS)

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)

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)

* Included in final Control Assembly.

Add Cable Ties as needed. Use Item 4 to terminate all wires on all ends.

REF: 440498 for Switch Assembly

WIRING DIAGRAM

TYPICAL HARNESS ROUTING

drawing shows "L" Cab.

PARTS LIST

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<thead>
<tr>
<th>ITEM NO.</th>
<th>QTY</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td>302019</td>
<td>Switch, Mounting Base Section (part of Assembly)</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>302020</td>
<td>Switch, N/C Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>302021</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>302022</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>302023</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>302024</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>302025</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>302026</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>302027</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
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<td>1</td>
<td>302028</td>
<td>Spare/Replacement Keys (2)</td>
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<tr>
<td>11</td>
<td>2</td>
<td>342002</td>
<td>Cable Tie, 1/2&quot; diameter</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>342024</td>
<td>Cable Tie Holder, Push Mount</td>
</tr>
</tbody>
</table>

* Included in final Control Assembly.

Add Cable Ties as needed. Use Item 4 to terminate all wires on all ends.

REF: 440498 for Switch Assembly

WIRING DIAGRAM

TYPICAL HARNESS ROUTING

drawing shows "L" Cab.

PARTS LIST

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>QTY</th>
<th>Part #</th>
<th>Description</th>
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<tr>
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</tr>
<tr>
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<td>Switch, N/C Contact Section (part of Assembly)</td>
</tr>
<tr>
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<td>302021</td>
<td>Switch, N/O Contact Section (part of Assembly)</td>
</tr>
<tr>
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<tr>
<td>6</td>
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<td>12</td>
<td>3</td>
<td>342024</td>
<td>Cable Tie Holder, Push Mount</td>
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</table>

* Included in final Control Assembly.

Add Cable Ties as needed. Use Item 4 to terminate all wires on all ends.

REF: 440498 for Switch Assembly

WIRING DIAGRAM

TYPICAL HARNESS ROUTING

drawing shows "L" Cab.

PARTS LIST

<table>
<thead>
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<th>Description</th>
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<td>Spare/Replacement Keys (2)</td>
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<td>342002</td>
<td>Cable Tie, 1/2&quot; diameter</td>
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<tr>
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<td>3</td>
<td>342024</td>
<td>Cable Tie Holder, Push Mount</td>
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* Included in final Control Assembly.

Add Cable Ties as needed. Use Item 4 to terminate all wires on all ends.

REF: 440498 for Switch Assembly
## 10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

**OPERATION MODE KEY SWITCH (OMS)**

**PARTS LIST**

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<th>PART #</th>
<th>DESCRIPTION</th>
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<td>3</td>
<td>1</td>
<td>302021</td>
<td>Switch, L1 &amp; L2 Contact Section (part of Assem 302027)</td>
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<tr>
<td>4</td>
<td>1</td>
<td>302022</td>
<td>Switch, L1 &amp; L2 Contact Section (part of Assem 302027)</td>
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<tr>
<td>5</td>
<td>1</td>
<td>302023</td>
<td>Switch, L1 &amp; L2 Contact Section (part of Assem 302027)</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>302024</td>
<td>Switch, L1 &amp; L2 Contact Section (part of Assem 302027)</td>
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<td>60&quot;</td>
<td>900169</td>
<td>Wire, #18, Blue White</td>
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<td>8</td>
<td>60&quot;</td>
<td>900170</td>
<td>Wire, #18, Violet White</td>
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<td>60&quot;</td>
<td>900028</td>
<td>Wire, #18, Red</td>
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<td>0</td>
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<td>Spare/Replacement Keys (2)</td>
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</tbody>
</table>

* Included in final Control Assembly.

---

* Included in final Control Assembly.

Add Cable Ties as needed.
Use Item 4 to terminate all wires on all ends.

REF: 440498 for Switch Assembly

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**ADD-ON, OMS, EN6000 SERIES**

**ɨ**

**SCHEMATICS**

**WIRING DIAGRAM**

See Harness Routing Diagram for typical installation.

**TYPICAL HARNESS ROUTING**

(drawing shows “L” Cab.)

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**OPERATION MODE KEY SWITCH (OMS)**

---

**ENTRON**

Drawing 730014-004
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).

**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. This card supports regular direct Ethernet cable and crossover
Ethernet cable.

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.

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.
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.

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.

Available Configurations

<table>
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<tr>
<th>Part Number</th>
<th>Option</th>
<th>Description</th>
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</thead>
<tbody>
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<td>IPS</td>
<td>Integrated Pressure Sense Only, Single Input Sensor</td>
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<tr>
<td>730005-008</td>
<td>IPSD</td>
<td>Integrated Pressure Sense Only, Differential Sensor</td>
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<tr>
<td>730005-007</td>
<td>IPC2</td>
<td>Integrated Pressure Control Only, 1/2&quot; NPT Valve</td>
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<td>730005-006</td>
<td>IPC5</td>
<td>Integrated Pressure Control Only, 1-1/4&quot; NPT Valve</td>
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<td>730005-015</td>
<td>IPSC2</td>
<td>Integrated Pressure Sense and Control, Single Input Sensor &amp; 1/2&quot; NPT Valve</td>
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<td>730005-016</td>
<td>IPSC5</td>
<td>Integrated Pressure Sense and Control, Single Input Sensor &amp; 1-1/4&quot; NPT Valve</td>
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<td>730005-017</td>
<td>IPSCD2</td>
<td>Integrated Pressure Sense and Control, Differential Sensor &amp; 1/2&quot; NPT Valve</td>
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<tr>
<td>730005-018</td>
<td>IPSCD5</td>
<td>Integrated Pressure Sense and Control, Differential Sensor &amp; 1-1/4&quot; NPT Valve</td>
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</tbody>
</table>
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.

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.

10.13 GFI FOR PORTABLE GUNS
IN DEVELOPMENT

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.

<p>| EN6021 KIT PARTS LIST (P/N 730014-031) |
|-----------------|-----------------|-----------------|</p>
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10.0 OPTIONS FOR EN6021 SERIES CONTROLS (cont.)

10.15 LINEAR DISPLACEMENT TRANSDUCER

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

| Connector 5-pin 12mm Euro Micro |
| Displacement 1" to 72" in 1" increments |
| 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 Ripple 1 mV maximum
Current Output Maximum Load Resistance 500 Ohms
Update Time 1ms

Resolution
- Internal .00006"
- Output 16-bit

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)
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)

* Included in final Control Assembly. Add Cable Ties as needed. Use Item 4 to terminate all wires on all ends.

REF:

440498 for Switch Assembly

WIRING DIAGRAM

See Harness Routing Diagram for typical installation.

TYPICAL HARNESS ROUTING

(drawing shows "L" Cab.)

ITEM NO. QTY Part # Description

1 1 302019 Switch, Mounting Base Section (part of Assembly 302032)
2 1 302022 Switch, N/O Contact Section (part of Assembly 302032)
3 1 302021 Switch, N/C Contact Section (part of Assembly 302032)
4 1 900165 Wire, #18, Red White
5 60" 900169 Wire, #18, Blue White
6 0 302028 Spare/Replacement Keys (2)
7 1 342001 Cable Tie, 1/2" diameter
8 0 342024 Cable Tie Holder, Push Mount

PARTS LIST

561026-001 Bus Bar

H2-3
H2-2
H2-1
H1-3
H1-2
H1-1

EN6041 1200A ROUTING

NON-FUSED HIGH VOLTAGE
FUSED HIGH VOLTAGE
EXTERNAL HARNESS
CUSTOMER/24 VDC/LOW
GATE LEADS
RPP2
GROUND

TYPICAL ASSEMBLY

(notes actual picture)

Drawing 730014-015
10.17 WELD CONTROL WITH OPTIONS

- Sense Transformer
- Control Transformer
- Power Supply & SCR Firing Board
- I/O Expansion Card
- 16 DC Inputs
- 16 DC Outputs

- Primary Sensor
- Secondary Sensor
- Opto isolation
- Micro-controller

- Communication Cards
- RS232 Printer

- EN6021 CPU
- 4 AC Outputs
- 4 DC Outputs
- 4 DC Inputs

- Primary Sensor
- Secondary Sensor
- Opto isolation
- Micro-controller

- Communication Cards
- RS232 Printer

- USB Memory Stick

- LDT
- RPP2
- ENLINK
- 6021

- IPC
- 730014-007
- 730014-006

- IPS
- 571005
- 571004

- ERS
- 730014-015

- PLS
- 730014-009

- OMS
- 730014-004

- 313022

- 410380

- 730014-011

- 730014-003

- 410381

- 730014-013

- 730014-014

- 730014-015

- 730014-051

- 730014-012

- 730014-010
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.

<table>
<thead>
<tr>
<th>ERROR CODE</th>
<th>DESCRIPTION</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Configuration error</td>
<td>Edit Configure Menu (see Section 5.5.6)</td>
</tr>
<tr>
<td>2</td>
<td>Calibration error</td>
<td>Check parameters in Calibration Menu (see Section 5.5.7)</td>
</tr>
<tr>
<td>3</td>
<td>Schedule error</td>
<td>Check parameters in Schedule Menu (see Section 5.5.1)</td>
</tr>
<tr>
<td>4</td>
<td>Sequencer error</td>
<td>Check parameters in Sequencer Menu (see Section 5.5.5)</td>
</tr>
<tr>
<td>5</td>
<td>Event error</td>
<td>Check parameters in Event Menu (see Section 5.5.2)</td>
</tr>
<tr>
<td>6</td>
<td>Counter error</td>
<td>Check parameters in Counter Menu (see Section 5.5.3)</td>
</tr>
<tr>
<td>7</td>
<td>Stepper error</td>
<td>Check parameters in Stepper Menu (see Section 5.5.4)</td>
</tr>
<tr>
<td>8</td>
<td>I/O Map error</td>
<td>Check parameters in I/O Map Menu (see Section 5.5.8)</td>
</tr>
<tr>
<td>9</td>
<td>Emergency Stop error</td>
<td>Check ES1 (pin P1-13) contacts (see Section 1.6.1)</td>
</tr>
<tr>
<td>10</td>
<td>TC1 error</td>
<td>Check TC1 (pin P1-14) contacts (see Section 1.6.1)</td>
</tr>
<tr>
<td>11</td>
<td>No Weld (P1-NW1)</td>
<td>Check NW1 (pin P1-16) contacts (see Section 1.6.1)</td>
</tr>
<tr>
<td>12</td>
<td>PS1 error</td>
<td>Check PS1 (pin P1-17) contacts (see Section 1.6.1)</td>
</tr>
<tr>
<td>13</td>
<td>SCR short</td>
<td>Check SCR or weld transformer</td>
</tr>
<tr>
<td>14</td>
<td>Second Stage error</td>
<td>Check 2nd Stage input (P19 – pin P3-11)</td>
</tr>
<tr>
<td>15</td>
<td>Proportional Valve error</td>
<td>Check Proportional Valve</td>
</tr>
<tr>
<td>16</td>
<td>Interlock Error</td>
<td>Check Interlock input (P15 – pin P3-5)</td>
</tr>
<tr>
<td>17</td>
<td>High Pressure</td>
<td>Check operation of Proportional Valve / Check inlet pressure</td>
</tr>
<tr>
<td>18</td>
<td>Low Pressure</td>
<td>Check operation of Proportional Valve / Check inlet pressure</td>
</tr>
<tr>
<td>19</td>
<td>High Current 1</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>20</td>
<td>Low Current 1</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>21</td>
<td>High Current 2</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>22</td>
<td>Low Current 2</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>23</td>
<td>High Voltage</td>
<td>Check inlet AC line voltage or adjust parameters</td>
</tr>
<tr>
<td>24</td>
<td>Low Voltage</td>
<td>Check inlet AC line voltage or adjust parameters</td>
</tr>
<tr>
<td>25</td>
<td>Counter end</td>
<td>Reset Counter</td>
</tr>
<tr>
<td>26</td>
<td>Stepper end</td>
<td>Reset Stepper</td>
</tr>
<tr>
<td>27</td>
<td>High Pulse Width1</td>
<td>Check transformer or secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>28</td>
<td>Low Pulse Width1</td>
<td>Check transformer or secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>29</td>
<td>High Pulse Width2</td>
<td>Check transformer or secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>30</td>
<td>Low Pulse Width2</td>
<td>Check transformer or secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>31</td>
<td>Tip dress prewarn</td>
<td>Dress tip</td>
</tr>
<tr>
<td>32</td>
<td>AVC error</td>
<td>Check inlet AC line voltage or adjust parameters</td>
</tr>
<tr>
<td>33</td>
<td>Power on w/STARTs closed</td>
<td>Check FS1–FS4 and Retract input</td>
</tr>
<tr>
<td>34</td>
<td>2-palm error</td>
<td>Operate 2-palm buttons within 0.5 seconds</td>
</tr>
<tr>
<td>35</td>
<td>Pendant NO WELD</td>
<td>Toggle RPP2 pendant Weld/No Weld</td>
</tr>
<tr>
<td>36</td>
<td>TLS-2 error</td>
<td>Check PI4 (pin P3-4) transformer over temperature switch</td>
</tr>
<tr>
<td>37</td>
<td>Safety Relay error</td>
<td>Firmware detected control relay error (see Section 3.2)</td>
</tr>
<tr>
<td>38</td>
<td>No 24V for CPU I/O ports</td>
<td>Check fuse in CPU / Check inlet 24V voltage</td>
</tr>
<tr>
<td>39</td>
<td>No 24V for Expansion Cd.</td>
<td>Check fuse in I/O Expansion Card / Check inlet 24V voltage</td>
</tr>
<tr>
<td>40</td>
<td>Prox lost during weld</td>
<td>Check Prox signal; check air pressure and valves</td>
</tr>
<tr>
<td>41</td>
<td>2-Palm Retract ports error</td>
<td>Check if ports PI19-23 and PO10-12 are mapped to mode</td>
</tr>
<tr>
<td>42</td>
<td>Tip Dress mode</td>
<td>Shows that PI21 is closed and control is in Tip Dress mode</td>
</tr>
<tr>
<td>43</td>
<td>Prox not met</td>
<td>Prox not met within 15 seconds; cylinder not in “pre-weld” within 15 seconds</td>
</tr>
</tbody>
</table>
## 11.0 ERROR CODES (cont.)

<table>
<thead>
<tr>
<th>ERROR CODE</th>
<th>DESCRIPTION</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>AC 120V Safety Relay error</td>
<td>Firmware detected control relay error (see Section 3.2)</td>
</tr>
<tr>
<td>47</td>
<td>No AC 120V for Expansion Cd.</td>
<td>Check fuse in I/O Expansion Card / Check inlet AC 120V</td>
</tr>
<tr>
<td>49</td>
<td>High Pressure pre-limit</td>
<td>Check operation of Proportional Valve / Check inlet pressure</td>
</tr>
<tr>
<td>50</td>
<td>Low Pressure pre-limit</td>
<td>Check operation of Proportional Valve / Check inlet pressure</td>
</tr>
<tr>
<td>51</td>
<td>High Current 1 pre-limit</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>52</td>
<td>Low Current 1 pre-limit</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>53</td>
<td>High Current 2 pre-limit</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>54</td>
<td>Low Current 2 pre-limit</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>55</td>
<td>High Stack-up</td>
<td>Check calibration / Check part or adjust parameters</td>
</tr>
<tr>
<td>56</td>
<td>Low Stack-up</td>
<td>Check calibration / Check part or adjust parameters</td>
</tr>
<tr>
<td>65</td>
<td>Battery Low</td>
<td>Replace battery (see Section 12.1)</td>
</tr>
<tr>
<td>66</td>
<td>Use Schedule error</td>
<td>Check parameters in <strong>Use Schedule</strong> page (see Section 5.4)</td>
</tr>
<tr>
<td>73</td>
<td>Weld Log full</td>
<td>Copy Weld Log if necessary, then reset Weld Log</td>
</tr>
<tr>
<td>74</td>
<td>Weld Log warn (80% full)</td>
<td>Copy Weld Log if necessary, then ready to reset Weld Log</td>
</tr>
<tr>
<td>75</td>
<td>Error Log full</td>
<td>Copy Error Log if necessary, then reset Error Log</td>
</tr>
<tr>
<td>76</td>
<td>Error Log warn (80% full)</td>
<td>Copy Error Log if necessary, then ready to reset Error Log</td>
</tr>
<tr>
<td>77</td>
<td>Flash RAM error</td>
<td>Data flash memory error, contact factory</td>
</tr>
<tr>
<td>89</td>
<td>Retract Open error</td>
<td>Open Retract Open input within 10 seconds</td>
</tr>
<tr>
<td>90</td>
<td>Retract 2-Palm error</td>
<td>Retract palms not ready; palm buttons not closed together within 0.5 seconds</td>
</tr>
<tr>
<td>91</td>
<td>Retract inputs closed</td>
<td>Retract palms closed too long; PI19 and PI20 closed longer than 15 seconds</td>
</tr>
<tr>
<td>92</td>
<td>Pressure Sensor not ready</td>
<td>Pressure Sensor not ready, normal operation status</td>
</tr>
<tr>
<td>93</td>
<td>Retract not ready</td>
<td>Operate Retract input (PI1 – pin P3-1)</td>
</tr>
<tr>
<td>94</td>
<td>Second Stage not ready</td>
<td>Operate 2nd Stage input (PI9 – pin P3-11)</td>
</tr>
<tr>
<td>95</td>
<td>Proportional Valve not ready</td>
<td>Proportional Valve signal not ready, normal operation status</td>
</tr>
<tr>
<td>96</td>
<td>Interlock not ready</td>
<td>External Interlock not responding; check PI5 (pin P3-5)</td>
</tr>
</tbody>
</table>
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 airborne 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 StopStopStopStopStop, 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 StopStopStopStopStop, 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.)

<table>
<thead>
<tr>
<th>WARNING</th>
<th>! WARNING !</th>
</tr>
</thead>
<tbody>
<tr>
<td>To prevent environmental harm, observe local disposal regulations for batteries.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DANGER</th>
<th>! DANGER !</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>! CAUTION !</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

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

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

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

**USE OF OUT OF WARRANTY REPAIR SERVICE:**
To obtain service for any printed circuit board assembly or welding control after the warranty period, send assembly or control, prepaid, to ENTRON Controls, LLC., and ENTRON will repair printed circuit board assembly or control and return it to you without further warranty. Additional service charges will be invoiced at time of shipment.

Your ENTRON Controls, LLC., Original Equipment Manufacturers (OEMs), Dealers and Distributors are your first response contact to secure technical assistance on control or welding problems. Should they be unable to assist you, please contact your ENTRON sales representative or the factory directly. Contact the factory at 864-416-0190.
APPENDIX A  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.
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.
5. Complete assembly by installing provided labels on all connectors as shown in Figure A-2.

NOTICE
Connector can be assembled with cable exiting to either side.

Figure A-1. RS232 Connector wiring

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.

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.

**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

---

#### 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
  - □ Constant Current
  
  - **WELD1 HEAT** _______ %
  - **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
  - □ Constant Current
  
  - **WELD2 HEAT** _______ %
  - **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.)
## APPENDIX C PROGRAMMING WORKSHEETS (cont.)

### EVENT WORKSHEET

#### SCHEDULE # ______

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APPENDIX C  PROGRAMMING WORKSHEETS (cont.)
APPENDIX C  PROGRAMMING WORKSHEETS (cont.)

COUNTER WORKSHEET

COUNTER ENABLE  □ Enable

MAX PART COUNT  ________  WELDS PER PART  ________

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.
APPENDIX C PROGRAMMING WORKSHEETS (cont.)

WELD MODE □ Spot □ Seam1 □ Seam2
RETRACTION MODE □ Off □ Momentary □ Maintained □ 2-Palm
ON ERROR OUTPUT 17 □ Continue □ Stop on fault □ Head lock on fault
SCHEDULE SELECT □ Internal □ External
2-PALM MODE □ Off □ On
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
PRESSURE CONTROL MODE □ None □ P Sensing □ P Control □ P Sensing + Control
FORCE UNITS □ PSI □ Lb □ mA □ Calibrated Lb
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.)

ENLINK 6021 CONFIGURE WORKSHEET

- Encircled parameters are programmable only if enabled.
- LOG RECORDING MODE
  - "Change recording mode" must be checked to enable editing of this parameter.

Encircled parameters are programmable only if enabled.
APPENDIX C PROGRAMMING WORKSHEETS (cont.)

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**Bold function** indicates default value
# APPENDIX C PROGRAMMING WORKSHEETS (cont.)

## P1 WELD CONTROL

<table>
<thead>
<tr>
<th>IN/OUT</th>
<th>FUNCTION</th>
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<td>SV1 P1-2</td>
<td>Solenoid Valve 1</td>
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<td>SV2 P1-3</td>
<td>Solenoid Valve 2</td>
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<td>SV3 P1-4</td>
<td>Solenoid Valve 3</td>
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<td>FS1 P1-7</td>
<td>Foot Switch 1</td>
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<td>FS2 P1-8</td>
<td>Foot Switch 2</td>
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<td>FS3 P1-10</td>
<td>Foot Switch 3</td>
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<td>FS4 P1-11</td>
<td>Foot Switch 4</td>
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<tr>
<td>ES1 P1-13</td>
<td>Emergency Stop*</td>
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<tr>
<td>TC1 P1-14</td>
<td>Temperature Limit Switch Contactor*</td>
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<tr>
<td>NW1 P1-16</td>
<td>External Weld/No Weld Input*</td>
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<td>PS1 P1-17</td>
<td>Pressure Switch*</td>
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## P7 ANALOG I/O

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<td>IN2 P7-10</td>
<td>Stack-up Sequencer</td>
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<td>OUT1 P7-11</td>
<td>PV Sequencer</td>
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## P14 AC OUT

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<td>PO34 P14-3</td>
<td>Valve 2 AC Output</td>
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<td>PO35 P14-5</td>
<td>Valve 3 AC Output</td>
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<td>PO36 P14-7</td>
<td>EOS Not Ready</td>
<td>Tip Dress</td>
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<td>Retraction</td>
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<td>Error</td>
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<tr>
<td></td>
<td>Interlock</td>
<td>Water Saver</td>
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* Jumper when not used.

**Bold function** indicates default value
### ERROR MAP WORKSHEET

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* NOTE: Control can stop on Error 17 if set in Configuration Menu.
## APPENDIX C PROGRAMMING WORKSHEETS (cont.)

### ENLINK 6021 ERROR WORKSHEET

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<td>2. Calibration error</td>
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<td>3. Schedule error</td>
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<td>5. Event error</td>
<td>No output</td>
<td>6. Counter error</td>
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<td>7. Stepper error</td>
<td>No output</td>
<td>8. UO map error</td>
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<td>10. TC1 (Contactor) error</td>
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<td>31. Tip dress Pre-steam</td>
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<td>32. AVC error</td>
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<td>33. Power on with START is closed</td>
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<td>35. PHY (Pinch Point Normal)</td>
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<td>36. T1 (Transformer) error</td>
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<td>No output</td>
<td>86. Reserved</td>
<td>No output</td>
</tr>
<tr>
<td>87. Reserved</td>
<td>No output</td>
<td>88. Reserved</td>
<td>No output</td>
</tr>
<tr>
<td>89. Retract open error</td>
<td>No output</td>
<td>90. Retract 2 PALM not ready</td>
<td>No output</td>
</tr>
<tr>
<td>91. Retract input closed</td>
<td>No output</td>
<td>92. PS not ready</td>
<td>No output</td>
</tr>
<tr>
<td>93. Retract not ready</td>
<td>No output</td>
<td>94. 2 stage not ready</td>
<td>No output</td>
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<tr>
<td>95. P-sense not ready</td>
<td>No output</td>
<td>96. Interlock not ready</td>
<td>No output</td>
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## APPENDIX C PROGRAMMING WORKSHEETS (cont.)

### SEQUENCER WORKSHEET

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<th>RANGE</th>
<th>FUNCTION</th>
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<tr>
<td>Blank</td>
<td>N/A</td>
<td>Not programmed (has no effect)</td>
</tr>
<tr>
<td>Step xxx</td>
<td>1 to 100</td>
<td>Has no effect, but serves as target for Jump statement or as logical divider in program</td>
</tr>
<tr>
<td>Sub xxx</td>
<td>1 to 100</td>
<td>Has no effect, but serves as target for Call SUB statement or as logical divider in program</td>
</tr>
<tr>
<td>Await PI xx = On</td>
<td>1 to 32</td>
<td>Waits for Input PI xx to be On</td>
</tr>
<tr>
<td>Await PI xx = Off</td>
<td>1 to 32</td>
<td>Waits for Input PI xx to be Off</td>
</tr>
<tr>
<td>Set PO xx = On</td>
<td>1 to 32</td>
<td>Turns On Output PO xx</td>
</tr>
<tr>
<td>Set PO xx = Off</td>
<td>1 to 32</td>
<td>Turns Off Output PO xx</td>
</tr>
<tr>
<td>Set Flag xx = On</td>
<td>1 to 32</td>
<td>Sets Flag xx On</td>
</tr>
<tr>
<td>Set Flag xx = Off</td>
<td>1 to 32</td>
<td>Sets Flag xx Off</td>
</tr>
<tr>
<td>Delay xx.x Second</td>
<td>0.1–99.9 seconds</td>
<td>Waits for specified time</td>
</tr>
<tr>
<td>Jump to step xxx</td>
<td>1 to 200</td>
<td>Program continues at specified Step number</td>
</tr>
<tr>
<td>Call SUB xxx</td>
<td>1 to 100</td>
<td>Program continues with subroutine at specified SUB number (maximum of 8 nesting levels)</td>
</tr>
<tr>
<td>Return</td>
<td>N/A</td>
<td>Return from subroutine</td>
</tr>
<tr>
<td>Set Counter x = yyy</td>
<td>x=1-8, y=1-999</td>
<td>Loads Counter x with value yyy (non-volatile)</td>
</tr>
<tr>
<td>Decrease Counter x</td>
<td>1 to 8</td>
<td>Value in Counter x is reduced by 1 (non-volatile)</td>
</tr>
<tr>
<td>If Counter x &gt; 0, JP yyy</td>
<td>x=1-8, y=1-200</td>
<td>If value in Counter x is greater than 0, jump to Step yyy</td>
</tr>
<tr>
<td>If PO xx = On, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Output PO xx is On, jump to Step yyy</td>
</tr>
<tr>
<td>If PO xx = Off, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Output PO xx is Off, jump to Step yyy</td>
</tr>
<tr>
<td>If Flag xx = On, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Flag xx is On, jump to Step yyy</td>
</tr>
<tr>
<td>If Flag xx = Off, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Flag xx is Off, jump to Step yyy</td>
</tr>
<tr>
<td>If PI xx = On, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Input PI xx is On, jump to Step yyy</td>
</tr>
<tr>
<td>If PI xx = Off, JP yyy</td>
<td>x=1-32, y=1-200</td>
<td>If Input PI xx is Off, jump to Step yyy</td>
</tr>
<tr>
<td>Spot-weld with Sch xxx</td>
<td>x=0-100</td>
<td>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.</td>
</tr>
<tr>
<td>Set Aout x = yyy mA / V</td>
<td>x=1 or 2, y=4.0-20.0mA</td>
<td>Set Analog Output 1 or 2 to specific current/voltage (set in Configure Menu)</td>
</tr>
<tr>
<td>If Ain1 &gt; xx.x mA, JP yyy</td>
<td>x=4.0-20.0, y=1-200</td>
<td>If Analog Input 1 is greater than xx.x mA, jump to Step yyy</td>
</tr>
<tr>
<td>If Ain1 &lt; xx.x mA, JP yyy</td>
<td>x=4.0-20.0, y=1-200</td>
<td>If Analog Input 1 is less than xx.x mA, jump to Step yyy</td>
</tr>
<tr>
<td>If Ain2 &gt; xx.x mA, JP yyy</td>
<td>x=4.0-20.0, y=1-200</td>
<td>If Analog Input 2 is greater than xx.x mA, jump to Step yyy</td>
</tr>
<tr>
<td>If Ain2 &lt; xx.x mA, JP yyy</td>
<td>x=4.0-20.0, y=1-200</td>
<td>If Analog Input 2 is less than xx.x mA, jump to Step yyy</td>
</tr>
<tr>
<td>End</td>
<td>N/A</td>
<td>End of Sequence</td>
</tr>
<tr>
<td>If Err xx = On, JP yyy</td>
<td>x=1-96 or Any, y=1-200</td>
<td>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</td>
</tr>
<tr>
<td>If Err xx = Off, JP yyy</td>
<td>x=1-96 or All, y=1-200</td>
<td>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</td>
</tr>
<tr>
<td>Seam-weld with Sch xxx</td>
<td>x=0-99</td>
<td>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.</td>
</tr>
<tr>
<td>Seam-weld end</td>
<td>N/A</td>
<td>Stop seam weld sequence</td>
</tr>
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See previous page for complete list of operation codes and parameters which can be used in programming Sequencer statements.

Maximum of 200 statement lines are available in Sequencer.
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