Introduction to iPAK

Medium-frequency resistance welding power source, with integrated control, monitor and machine sequencer.
Manufacturers of advanced welding controls

BF Entron Ltd.
Castle Mill Works,
Birmingham new road,
Dudley,
West Midlands,
DY1 4DA
England.

Tel: +44 (0)1384 455401
Fax: +44 (0)1384 455551
Email: sales@bfentron.co.uk

Web site: www.bfentron.co.uk

• Welding controls.
• Thyristors and power supplies
• Power Inverters.
• Meters and Monitors.
• Training and Support.
• Consultancy.
# Table of contents

4. iPAK System  
5. ...iPAK system  
6. Introduction and overview  
7. Functions  
8. ...functions  
9. Global parameters  
10. Program parameters (x64)  
11. Connectors(power)  
12. Connectors(control)  
13. Users connections (discrete)  
14. ...users connections  
15. Getting started.  
16. Operation with a fieldbus  
17. ...operation with a fieldbus  
18. Keypad  
19. Menus  
20. ...menus  
21. Diagnostic screen 1  
22. Diagnostic screen 2  
23. Diagnostic screen 3  
24. Status / error codes  
25. ...status/ error codes  
26. LMI diagnostics  
27. Configuration menu  
28. Edit configuration  
29. ...edit configuration  
30. .....edit configuration  
31. Edit calibration  
32. ...calibration  
33. ...calibration error  
34. Edit output map  
35. Edit Input Map  
36. Set-up Adapters  
37. Backup/Restore  
38. Initialise all data  
39. Edit printer set-up  
40. ...print format: table  
41. ...print format: ASCII-HEX  
42. ...printer connections  
43. System set-up menu  
44. Main menu  
45. Edit program  
46. ...edit program  
47. ...edit program(seam)  
48. Edit limits  
49. Edit Events  
50. Edit counter  
51. ...edit counter(tip dressing)  
52. Stepper menu  
53. Stepper status  
54. Edit stepper  
55. Stepper presets  
56. Sequencer  
57. Sequencer Menu  
58. ...edit sequence  
59. .....edit sequence  
60. ...example sequence  
61. Weld log  
62. View log (screen 1)  
63. View log (screen 2)  
64. View log (screen 3)  
65. View log (screen 4)  
66. Copy program  
67. I/O status  
68. Fieldbus input status  
69. Analog status  
70. Program selection  
71. OHMA (Air over Oil) system  
72. ...OHMA system  
73. Disabling edits  
74. Pop-up meter  
75. Operation: basic spot weld – no weld faults  
76. Operation: basic spot weld – weld fault  
77. Operation: repeat spot weld  
78. Operation: pulsation spot weld  
79. Operation: upslope and downslope  
80. Operation: roll-spot welding  
81. Operation: seam welding (dual heat)  
82. Operation: seam welding (pre-heat)  
83. Operation: EOS signal  
84. Operation: Retract  
85. Operation: Hi-lift  
86. iPAK / iPAK-MPX  
87. Configuring iPAK for multiwelding  
88. ...users connections  
89. ...multi-gun operation  
90. ...multi-gun cascade operation  
91. ......multi-gun cascade operation  
92. ...electrode/Transformer assignment  
93. ...assigning a weld program  
94. ...operation with a fieldbus  
95. WS98-iPAK PC software
iPAK System
The standard iPAK family is available in the following sizes (maximum permitted primary current):
• 150A
• 360A
• 600A
• 1000A

The standard iPAK family operates with a supply voltage in the range 380-480V AC.

For lower voltages (190-290V AC), use iPAK-LV.

For higher voltages (up to 580V AC), iPAK-HV is available.

Drive up to eight transformers with additional MUX switch.

For higher current applications, iPAK-LMI modules can be connected together to provide the required output:
• 1500A (1 module)
• 3000A (2 modules)
• 4500A (3 modules)
• 6000A (4 modules)
Introduction and overview

This manual details the features of the iPAK cpu, and shows how to program the system using the WSP3 programmer.

iPAK is an integrated timer/controller/inverter system for MF resistance welding. The control section is housed in a cassette type casing, which simply mounts onto the power pack for ease of maintenance.

A programming pendant, type WSP3 is available, and provides a large multi-line display, making programming easy.

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

A plug-in option board provides a 10/100Base-T Ethernet connection. Units may then be networked to a PC running WS98-iPAK software for programming and monitoring purposes.

Fieldbus operation (Profibus, Interbus, DeviceNet etc.) is supported via plug-in option boards.
Functions

- Spot / Repeat / Roll-spot / Seam(dual heat)/Seam(pre-heat) welding.
- Single, or dual gun operation.
- OHMA (Air over Oil) gun operation.
- Dual weld intervals plus pulsation, upslope and downslope.
- Constant current regulation.
- Constant voltage regulation (requires external isolation amplifier).
- Constant power regulation (requires external isolation amplifier).
- Up to 64 programmes (internal or external selection).
- Current/power monitoring (high/low/pre limits), programmable blocking.
- Measurements log keeps history of recent welds.
- Proportional valve controller (0..10V or 4..20mA).
- Up to 3 analog inputs ( 2 x 0..10V, plus 1 x 0..10V / 4..20mA).
- Pressure monitoring (high/low limits).
- Programmable outputs (events).
- Machine sequencer logic.
- Welding programmes may be linked together for multiple spot sequences.
...functions

- Retract/high-lift control.
- Contactor timer.
- Head-lock function.
- Electrode management functions, including stepping, counting and tip-dressing, with programmable blocking and preset curves.
- All inputs and outputs 24V DC.
- Toroid and PV calibration functions.
- Toroid test function.
- Analog output of current waveform.
- Disable edit (keyswitch) function.
- External plug-in programming pendant with large backlit 4x20 lcd display, and data backup facility.
- RS232 port, for PC communications and data logging.
- Expandable via plug-in option cards (Ethernet, Profibus, DeviceNet etc).
Global parameters

### Configuration
- Sequence (Spot / Roll-spot / Seam(2-heat) / Seam(pre-heat))
- Regulation (primary/secondary)
- Measurement (primary/secondary)
- Single gun / Dual gun / OHMA gun
- Discrete/Fieldbus I/O
- Retract (x2):
  - (Simple / Hi-lift+ / Hi-lift- / Maintained / OHMA)
- Start/Program select (Binary / 1-of-4)
- Second stage pre/post squeeze
- Contactor time (0..200 s)
- Blanking (On/Off)
- Toroid test (On/Off)
- On Fault (Continue/Stop/Head-lock/EOS/No EOS)
- Sequencer (On/Off)
- Toroid attenuation factor (1..10)
- Sync counter with log (On/Off)
- Units (Metric/Imperial)
- Analog output (PV/Current)

### Calibration (x2)
- Toroid sensitivity (100..2000 mV/kA)
- Maximum primary current (0..5000A)
- CT ratio (100…10000)
- S/P ratio (1:1..199:1)
- S/P Trim (-50..+50%)
- S/P offset (-5000..+5000 A)
- Inverter (2 points, kA / kW / %heat)
- Pressure (2 points, kN/V)
- Analog output scale (0..60kA)
- Analog input (ch3) gain (0.9..10.0)
- Analog input (ch3) offset (-9.99..+9.99)

### Output Map
- Normal/Event/Sequencer/Fieldbus (x16)

### Input Map
- Normal/Sequencer (x16)

### Stepper (x2)
- Stepper on/off
- Stop /continue at end
- Curve (10 point, interpolated)

### Counter (x2)
- Actual count (0..9999)
- Terminal count (0..9999)
- Stop/continue at end
- Tip-dressing (On/Off)
- Maximum dressings (0..9999)
- Dressings done (0..9999)
- Reset stepper to (0..9999)

### Sequencer
- Up to 250 statements

### Printer
- Print Off / All / Passes / Fails
- Lines per page (10..99)
- Format Table / ASCII-HEX
## Program parameters (x64)

### Weld program
- Pre-squeeze (0..1999 ms)
- Squeeze (0..1999 ms)
- Weld1 (0..999 ms)
- Cool1 (0..999 ms)
- Weld2 (0..999 ms)
- Cool2 (0..999 ms)
- Pulses (0..9)
- Hold (0..999 ms)
- Off (0..999 ms)
- Upslope (0..999 ms)
- Downslope (0..999 ms)
- Pressure (0..100%)
- Heat 1 (0..99.9%)
- Heat 2 (0..99.9%)
- Current 1 (0..60kA)
- Current 2 (0..60kA)
- Power 1 (0..130kW)
- Power 2 (0..130kW)
- Normal/Link program
- Mode 1 (P/W, CCu, CCC, CV, POW)
- Mode 2 (P/W, CCu, CCC, CV, POW)

### Monitor limits
- Current/Power monitor On/Off
- Low limit, weld1 (0..99%)
- High limit, weld1 (0..99%)
- Pre-limit, weld1 (0..99%)
- Low limit, weld2 (0..99%)
- High limit, weld2 (0..99%)
- Pre-limit, weld2 (0..99%)
- Pre-limit count (0..99)
- Pressure monitor On/Off
- Pressure low limit (0..99%)
- Pressure high limit (0..99%)

### Events
- 4 x 4 trigger points

### OHMA gun
- Gun open (0..999 ms)
- Gun close (0..999 ms)
- Retract open (0..999 ms)
- Retract delay (0..999 ms)
- Retract close (0..999 ms)
Connectors P1, P2, P3, P4 and P5 are two-part terminals, for use with wires up to 1mm².

Connectors P6 is used internally to connect to the inverter power pack, and is not used for users connections.

Connector P7 is the RS232 port, for the connection of the WSP3 programming pendant, or a PC. A ribbon cable assembly is available for converting to the standard 9-way D-sub style of connector.
Connectors (power)

A 3-phase supply, via a suitable protective device (such as a circuit breaker) should be connected to the inverter as shown (Terminals L1, L2, L3, PE).

A suitable MF welding transformer/rectifier should be connected to the inverter at terminals H1, H2. The transformer must also be connected to the protective earth (PE).

Additional earthing and/or a protective device is required for the secondary circuit, depending on the application.

! These tasks must only be carried out by qualified personnel.
Users connections (discrete)
...users connections
Getting started

1. Make the basic connections as shown here. Note that you may require additional connections (see users connections), depending on your installation requirements, but the connection shown here are the most basic which are required in order to run the equipment.

2. Make sure that you have sufficient air pressure, and cooling water where necessary.

3. Switch on, then use the ‘Initialise all data’ function, to clear the iPAK’s memory.

4. Edit the configuration file: set ‘Regulation=primary’ and ‘Blanking=ON’.

5. Edit the calibration file: set the the ‘Max.primary amps’ and ‘S/P ratio’ parameters to suit your equipment (see edit calibration).

6. Edit program 0 to set up a basic weld sequence e.g. SQZ=500ms, W2=200ms, CCu mode, HLD=500ms, Pulses=1, all other intervals=0.

7. You should now be able to perform a welding operation. Begin by using the gun short-circuit (i.e. without metal to be welded). The timer should report the measured current on the diagnostic display.

8. Perform the calibration operation for the toroid sensitivity. Observe the current with an external meter. Set the program heat to give a typical value of welding current on the meter. Adjust the toroid sensitivity (in the calibration file) until the iPAK measurement agrees with the meter.

9. Perform the calibration operations for the inverter current (see edit calibration).

10. You can now proceed to make any other adjustments which may be required, and to set up programmes for welding.
Operation with a fieldbus

iPAK can be operated on a fieldbus, instead of through the discrete I/O connections.

An optional adapter card is required to interface to the required fieldbus. Adapter cards are available for all popular fieldbus types: (Profibus-DP, Interbus-S, DeviceNet, Ethernet TCP/IP/MODBUS, etc.)

The diagram opposite shows, schematically, how the I/O is arranged. Selection between Discrete or Fieldbus operation is via the iPAK configuration.

The tables on the next page show the fieldbus bit assignments for both single-gun and dual-gun operation.
...operation with a fieldbus

### Single gun

<table>
<thead>
<tr>
<th>INPUT from bus to timer</th>
<th>OUTPUT from bus to timer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit No.</td>
<td>Function</td>
</tr>
<tr>
<td>0</td>
<td>START 1</td>
</tr>
<tr>
<td>1</td>
<td>START 2</td>
</tr>
<tr>
<td>2</td>
<td>START 3</td>
</tr>
<tr>
<td>3</td>
<td>START 4</td>
</tr>
<tr>
<td>4</td>
<td>2nd Stage</td>
</tr>
<tr>
<td>5</td>
<td>Weld on*</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>8</td>
<td>Reset counter 1</td>
</tr>
<tr>
<td>9</td>
<td>Reset stepper 1</td>
</tr>
<tr>
<td>10</td>
<td>Retract 1</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
</tr>
<tr>
<td>12</td>
<td>Reserved</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
</tr>
<tr>
<td>15</td>
<td>Reset fault</td>
</tr>
<tr>
<td>16</td>
<td>Program bit 1</td>
</tr>
<tr>
<td>17</td>
<td>Program bit 2</td>
</tr>
<tr>
<td>18</td>
<td>Program bit 4</td>
</tr>
<tr>
<td>19</td>
<td>Program bit 8</td>
</tr>
<tr>
<td>20</td>
<td>Program bit 16</td>
</tr>
<tr>
<td>21</td>
<td>Program bit 32</td>
</tr>
<tr>
<td>22</td>
<td>Reserved</td>
</tr>
<tr>
<td>23</td>
<td>Reserved</td>
</tr>
<tr>
<td>24</td>
<td>Discrete output Q09</td>
</tr>
<tr>
<td>25</td>
<td>Discrete output Q10</td>
</tr>
<tr>
<td>26</td>
<td>Discrete output Q11</td>
</tr>
<tr>
<td>27</td>
<td>Discrete output Q12</td>
</tr>
<tr>
<td>28</td>
<td>Discrete output Q13</td>
</tr>
<tr>
<td>29</td>
<td>Discrete output Q14</td>
</tr>
<tr>
<td>30</td>
<td>Discrete output Q15</td>
</tr>
<tr>
<td>31</td>
<td>Discrete output Q16</td>
</tr>
</tbody>
</table>

### Dual gun

<table>
<thead>
<tr>
<th>INPUT from bus to timer</th>
<th>OUTPUT from bus to timer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit No.</td>
<td>Function</td>
</tr>
<tr>
<td>0</td>
<td>START 1</td>
</tr>
<tr>
<td>1</td>
<td>START 2</td>
</tr>
<tr>
<td>2</td>
<td>Start 3</td>
</tr>
<tr>
<td>3</td>
<td>START 4</td>
</tr>
<tr>
<td>4</td>
<td>2nd Stage</td>
</tr>
<tr>
<td>5</td>
<td>Weld on*</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>8</td>
<td>End of stepper 2</td>
</tr>
<tr>
<td>9</td>
<td>Reserved</td>
</tr>
<tr>
<td>10</td>
<td>Discrete input I7</td>
</tr>
<tr>
<td>11</td>
<td>Discrete input I8</td>
</tr>
<tr>
<td>12</td>
<td>End of sequence (EOS)</td>
</tr>
<tr>
<td>13</td>
<td>Fault</td>
</tr>
<tr>
<td>14</td>
<td>Not ready</td>
</tr>
<tr>
<td>15</td>
<td>Reset fault</td>
</tr>
<tr>
<td>16</td>
<td>Program bit 1</td>
</tr>
<tr>
<td>17</td>
<td>Program bit 2</td>
</tr>
<tr>
<td>18</td>
<td>Program bit 4</td>
</tr>
<tr>
<td>19</td>
<td>Program bit 8</td>
</tr>
<tr>
<td>20</td>
<td>Program bit 16</td>
</tr>
<tr>
<td>21</td>
<td>Program bit 32</td>
</tr>
<tr>
<td>22</td>
<td>Reserved</td>
</tr>
<tr>
<td>23</td>
<td>Reserved</td>
</tr>
<tr>
<td>24</td>
<td>Pressure bit 1</td>
</tr>
<tr>
<td>25</td>
<td>Pressure bit 2</td>
</tr>
<tr>
<td>26</td>
<td>Pressure bit 4</td>
</tr>
<tr>
<td>27</td>
<td>Pressure bit 8</td>
</tr>
<tr>
<td>28</td>
<td>Pressure bit 16</td>
</tr>
<tr>
<td>29</td>
<td>Pressure bit 32</td>
</tr>
<tr>
<td>30</td>
<td>Pressure bit 64</td>
</tr>
<tr>
<td>31</td>
<td>Pressure bit 128</td>
</tr>
</tbody>
</table>

*The discrete Weld on input must also be on to enable welding.*
Using the keypad

- Press the F (function) key to return to the previous screen, or to move between menu screens (see menus).
- The selected function or parameter will flash.
- Use the ← ↑ ↓ → keys to select a different function or parameter. The visible window will scroll when required.
- Press the → key to access the selected function.
- Press the + or - keys to alter the selected parameter. Press + and – together to set a parameter to 0 or its minimum value.
- On some screens, certain keys can have a special function. These are noted on the page describing that screen.
The various functions of the iPAK are arranged into a set of menus and screens. This diagram shows how these are organized and accessed:

Press and hold , then type F

Select bottom line in main menu (Version number)
..menus

<< ELECTRODE MENU >>
- Stepper status
- Edit stepper
- Edit counter

<< SEQUENCER MENU >>
- Edit sequence
- Erase sequence
- Status: Idle

<< WELD LOG >>
- View log
- Clear log

<< MAIN MENU >>
- Use program
- Edit program file
- Edit limits file
- Edit events file
- Electrode menu
- Sequencer menu
- Weld log
- Copy program
- I/O status
- Fieldbus inputs
- Analog status
- iPAK version

<< CONFIG. MENU >>
- Edit configuration
- Edit calibration
- Edit output map
- Edit input map
- Setup adapters
- Backup all data
- Restore all data
- Initialise all data
- Edit Printer setup
- Edit system setup

<< SYSTEM SETUP >>
- Show system files
- Select active file
- Restart system
Diagnostic screen 1

Note that some elements may not be visible, if that feature is not being used.

**Status:** diagnostic error messages. If more than one exists, these are flashed sequentially.

**Program used:** this is the program number that was last used.

**Pulse-width:** the inverter output pulse width, as a percentage of maximum, measured during the last weld.

**Measured current:** the RMS current measured during the last weld.

**Measured voltage:** the RMS voltage measured during the last weld.

**Measured power:** the RMS power measured during the last weld.

- Press to reset faults (same action as external input). The counters will also be reset if they have reached the end of count.
- Press to change to diagnostic screen 2, or to change to diagnostic screen 3.
Diagnostic screen 2

**Weld counter**: the present value in the counter (updates after each weld)

**Stepper % complete**: shows the progress along the stepping curve.

**PV output**: The output from the PV controller is determined by the pressure parameter in the selected program.

**Measured PV feedback**: the dynamic value measured from the feedback channel.

- Press ➡️ to reset faults (same action as external input). The counters will also be reset if they have reached the end of count.
- Press ⬅️ ⬆️ ⬇️ ➡️ to change to diagnostic screen 1.
Diagnostic screen 3

Program used
Measured power and voltage for weld 1
Measured power and voltage for weld 2

LOW CURRENT WELD 2
PROG=0  P/W = 10.5%
W1=15.3kW  1.25 V
W2=18.6kW  1.65 V

Status
Inverter pulse-width

Note that some elements may not be visible, if that feature is not being used.

**Status:** diagnostic error messages. If more than one exists, these are flashed sequentially.

**Program used:** this is the program number that was last used.

**Pulse-width:** the inverter output pulse width, as a percentage of maximum, measured during the last weld.

**Measured voltage:** the RMS voltage measured during the last weld.

**Measured power:** the RMS power measured during the last weld.

This screen is particularly useful when performing the inverter calibration, as it shows the recorded values which will be used (see edit calibration).

- Press ➩ to reset faults (same action as external input). The counters will also be reset if they have reached the end of count.
- Press ← ↑ ↓ → to change to diagnostic screen 1.
The description (abbreviated) appears on the top line of the diagnostic screen.

Error codes are sent to the fieldbus (if fitted).

<table>
<thead>
<tr>
<th>Error code</th>
<th>Description</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No errors</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Configuration error</td>
<td>Edit the configuration file</td>
</tr>
<tr>
<td>2</td>
<td>Calibration error</td>
<td>Check parameters in calibration file</td>
</tr>
<tr>
<td>3</td>
<td>LMI configuration error</td>
<td>Check connections on LMI modules</td>
</tr>
<tr>
<td>4</td>
<td>LMI error</td>
<td>See indicator panel on LMI modules</td>
</tr>
<tr>
<td>5</td>
<td>Retract not ready</td>
<td>Operate retract input</td>
</tr>
<tr>
<td>6</td>
<td>Data error</td>
<td>Edit program</td>
</tr>
<tr>
<td>7</td>
<td>Weld off</td>
<td>Close Weld-on switch</td>
</tr>
<tr>
<td>8</td>
<td>No current (weld 1)</td>
<td>Check secondary circuit / check toroid connection</td>
</tr>
<tr>
<td>9</td>
<td>No current (weld 2)</td>
<td>Check secondary circuit / check toroid connection</td>
</tr>
<tr>
<td>10</td>
<td>Low current (weld 1)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>11</td>
<td>Low current (weld 2)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>12</td>
<td>Pre-alarm (weld 1)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>13</td>
<td>Pre-alarm (weld 2)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>14</td>
<td>High current (weld 1)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>15</td>
<td>High current (weld 2)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>16</td>
<td>Config. Changed</td>
<td>Restart the timer (power off/on)</td>
</tr>
<tr>
<td>17</td>
<td>No 2nd stage</td>
<td>Check the 2nd stage input</td>
</tr>
<tr>
<td>18</td>
<td>Toroid overrange</td>
<td>Reduce current, or use an external signal attenuator</td>
</tr>
<tr>
<td>19</td>
<td>Toroid open circuit</td>
<td>Inspect toroid connection</td>
</tr>
<tr>
<td>20</td>
<td>Toroid short circuit</td>
<td>Inspect toroid connection</td>
</tr>
<tr>
<td>21</td>
<td>Sequencer error</td>
<td>Edit sequencer program</td>
</tr>
<tr>
<td>22</td>
<td>Power-Pak hot</td>
<td>Check inverter cooling (air/water). Reduce duty.</td>
</tr>
<tr>
<td>23</td>
<td>No 24V supply</td>
<td>Check fuse in timer</td>
</tr>
<tr>
<td>24</td>
<td>Headlocked</td>
<td>Operate reset fault input</td>
</tr>
<tr>
<td>25</td>
<td>No adapter</td>
<td>Fit adapter or change configuration</td>
</tr>
<tr>
<td>26</td>
<td>Fieldbus inactive</td>
<td>Check fieldbus connections / check bus master</td>
</tr>
<tr>
<td>27</td>
<td>Headlocked</td>
<td>Operate reset fault input</td>
</tr>
<tr>
<td>28</td>
<td>No adapter</td>
<td>Fit adapter or change configuration</td>
</tr>
<tr>
<td>29</td>
<td>Fieldbus inactive</td>
<td>Check fieldbus connections / check bus master</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error code</th>
<th>Description</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>Low pressure</td>
<td>Check operation of PV. Check inlet pressure.</td>
</tr>
<tr>
<td>34</td>
<td>High pressure</td>
<td>Check operation of PV. Check inlet pressure.</td>
</tr>
<tr>
<td>35</td>
<td>Transformer hot</td>
<td>Check flow to welding transformer / Reduce duty</td>
</tr>
<tr>
<td>36</td>
<td>Stop</td>
<td>Close the external Stop circuit</td>
</tr>
<tr>
<td>37</td>
<td>Fan fail</td>
<td>Check inverter fans</td>
</tr>
<tr>
<td>38</td>
<td>Waiting for pressure</td>
<td>Check operation of PV. Check inlet pressure.</td>
</tr>
<tr>
<td>39</td>
<td>Switch off START</td>
<td>START must be off after a STOP or power-up condition</td>
</tr>
<tr>
<td>40</td>
<td>No current(weld off)</td>
<td>Close Weld-on switch</td>
</tr>
<tr>
<td>41</td>
<td>Max. pulse width</td>
<td>Check secondary circuit / Reduce heat/current</td>
</tr>
<tr>
<td>42</td>
<td>Max. current</td>
<td>Check secondary circuit / Reduce heat/current</td>
</tr>
<tr>
<td>43</td>
<td>Short circuit</td>
<td>Check cables from inverter to welding transformer/ Check transformer</td>
</tr>
<tr>
<td>44</td>
<td>DC bus failure</td>
<td>Check mains supply to inverter</td>
</tr>
<tr>
<td>45</td>
<td>Power-pak not ready</td>
<td>Check control connections to inverter OR wait for power-on delay</td>
</tr>
<tr>
<td>46</td>
<td>No voltage signal</td>
<td>Check connections to electrodes and isolation amp.</td>
</tr>
<tr>
<td>47</td>
<td>Low power (weld 1)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>48</td>
<td>Low power (weld 2)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>49</td>
<td>High power (weld 1)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>50</td>
<td>High power (weld 2)</td>
<td>Check secondary circuit or adjust parameters</td>
</tr>
<tr>
<td>51</td>
<td>Headlocked</td>
<td>Operate reset fault input</td>
</tr>
<tr>
<td>52</td>
<td>No adapter</td>
<td>Fit adapter or change configuration</td>
</tr>
<tr>
<td>53</td>
<td>Fieldbus inactive</td>
<td>Check fieldbus connections / check bus master</td>
</tr>
</tbody>
</table>
## Status / Error Codes

<table>
<thead>
<tr>
<th>Error code</th>
<th>Description</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>Stepper 1 end</td>
<td>Reset stepper 1</td>
</tr>
<tr>
<td>66</td>
<td>Stepper 2 end</td>
<td>Reset stepper 2</td>
</tr>
<tr>
<td>67</td>
<td>Stepper 3 end</td>
<td>Reset stepper 3</td>
</tr>
<tr>
<td>68</td>
<td>Stepper 4 end</td>
<td>Reset stepper 4</td>
</tr>
<tr>
<td>69</td>
<td>Stepper 5 end</td>
<td>Reset stepper 5</td>
</tr>
<tr>
<td>70</td>
<td>Stepper 6 end</td>
<td>Reset stepper 6</td>
</tr>
<tr>
<td>71</td>
<td>Stepper 7 end</td>
<td>Reset stepper 7</td>
</tr>
<tr>
<td>72</td>
<td>Stepper 8 end</td>
<td>Reset stepper 8</td>
</tr>
<tr>
<td>73</td>
<td>Stepper 1 prewarn</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Stepper 2 prewarn</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Stepper 3 prewarn</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Stepper 4 prewarn</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Stepper 5 prewarn</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Stepper 6 prewarn</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Stepper 7 prewarn</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Stepper 8 prewarn</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Counter 1 end</td>
<td>Reset counter 1</td>
</tr>
<tr>
<td>82</td>
<td>Counter 2 end</td>
<td>Reset counter 2</td>
</tr>
<tr>
<td>83</td>
<td>Counter 3 end</td>
<td>Reset counter 3</td>
</tr>
<tr>
<td>84</td>
<td>Counter 4 end</td>
<td>Reset counter 4</td>
</tr>
<tr>
<td>85</td>
<td>Counter 5 end</td>
<td>Reset counter 5</td>
</tr>
<tr>
<td>86</td>
<td>Counter 6 end</td>
<td>Reset counter 6</td>
</tr>
<tr>
<td>87</td>
<td>Counter 7 end</td>
<td>Reset counter 7</td>
</tr>
<tr>
<td>88</td>
<td>Counter 8 end</td>
<td>Reset counter 8</td>
</tr>
<tr>
<td>89</td>
<td>Tip dress 1</td>
<td>Dress gun 1 and activate reset counter input</td>
</tr>
<tr>
<td>90</td>
<td>Tip dress 2</td>
<td>Dress gun 2 and activate reset counter input</td>
</tr>
<tr>
<td>91</td>
<td>Tip dress 3</td>
<td>Dress gun 3 and activate reset counter input</td>
</tr>
<tr>
<td>92</td>
<td>Tip dress 4</td>
<td>Dress gun 4 and activate reset counter input</td>
</tr>
<tr>
<td>93</td>
<td>Tip dress 5</td>
<td>Dress gun 5 and activate reset counter input</td>
</tr>
<tr>
<td>94</td>
<td>Tip dress 6</td>
<td>Dress gun 6 and activate reset counter input</td>
</tr>
<tr>
<td>95</td>
<td>Tip dress 7</td>
<td>Dress gun 7 and activate reset counter input</td>
</tr>
<tr>
<td>96</td>
<td>Tip dress 8</td>
<td>Dress gun 8 and activate reset counter input</td>
</tr>
</tbody>
</table>
LMI diagnostics

LMI modules each have their own diagnostic indicators. When an iPAK CPU registers an LMI error, refer to the red LED indicators on the modules for a more details. During normal operation, only the +24V (green) LED will be on.

<table>
<thead>
<tr>
<th>Diagnostic Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESET(ON)</td>
<td>The module is not initialised – check connections, check fuse in CPU unit. This LED will light during power-up and whenever a ‘fault reset’ is given.</td>
</tr>
<tr>
<td>RESET (flashing)</td>
<td>There is an error in another module, upstream of this one.</td>
</tr>
<tr>
<td>FAN</td>
<td>Check the operation of the fans in the module.</td>
</tr>
<tr>
<td>THERMAL</td>
<td>The module is too hot. Check the supply of cooling water.</td>
</tr>
<tr>
<td>BUS VOLTAGE</td>
<td>There is insufficient DC bus voltage. Check mains supply.</td>
</tr>
<tr>
<td>SHORT CIRCUIT</td>
<td>Check cables from inverter to transformer. Check transformer.</td>
</tr>
<tr>
<td>MAX. CURRENT</td>
<td>Reduce heat/current demand in program.</td>
</tr>
<tr>
<td>+24V (green)</td>
<td>Always on – indicates status of internal power supply for module.</td>
</tr>
</tbody>
</table>

- Press ➔ to reset faults (same action as external input).
Configuration menu

Note: To access the Configuration menu, select the ‘version’ line on the main menu (last line), hold down the → key, then press the F key.

Note: after changing the configuration, you must restart the iPAK before your changes will take effect.

You can restart the iPAK by cycling the power, or via the system set-up menu.
Note: after changing the configuration, you must restart the iPAK before your changes will take effect.

The diagnostic message ‘CONFIG.CHANGED’ will appear, and further welding will not be permitted until the iPAK is restarted.

You can restart the iPAK by cycling the power, or via the system set-up menu.
...edit configuration

• Sequence type: **Spot / Roll-spot / Seam(2-heat) / Seam(pre-heat).**
• Regulation (**Primary/Secondary**): Specifies where the inverter closed loop control feedback is obtained from.
• Measure (**Primary/Secondary**): Specifies where the displayed current measurements are obtained from.
• Single gun / Dual gun / OHMA gun: the number/type of welding guns to be controlled.
• I/O Source: **Discrete / Fieldbus(map 1) / Fieldbus(map2).** Specifies how the iPAK obtains input signals (outputs are always written to both the discrete and fieldbus interfaces).
• Retract: **Simple / Hi-lift+ / Hi-lift- / Maintained / OHMA.** Set to **Simple** if not required. One Independent setting for each gun.
• Start: **Binary / 1-of-4.** Sets the method of start and program selection.
• 2nd stage: **Before SQZ/After SQZ.** Determines where in the sequence the 2nd stage input is checked.
• Contactor time (0..200 s): this is the delay (in seconds) after a weld, before the contactor output is turned off. Set to 0 if not required.
• Blanking (**On/Off**): When set to **On,** the first 50 ms of weld current will be excluded from the measurement and limit testing process.
• Toroid test (**On/Off**): When set to **On,** the resistance of the toroid is tested while the iPAK is idle. The resistance must lie between 10 and 300 Ohms. Values outside this range will prevent the iPAK from starting.
If fault (Continue/Stop/Head-lock/EOS/No EOS): If Head-lock is selected, then when a weld fault is detected, the weld air-valve signal is held on and no further welds are permitted, until a fault reset is given. If Stop is selected, then when a weld fault is detected, the weld air-valve opens as normal, but no further welds are permitted, until a fault reset is given. If Continue is selected, then further welds will be permitted, regardless of the status of the previous weld. If EOS is selected, then the EOS signal is always given. If No EOS is selected, then no EOS signal is given when there is a weld fault.

Sequencer (On/Off): If On is selected, then the sequencer is active, and welds are started via sequencer statements. If Off is selected, then the sequencer is disabled, and welds can be started via the START input.

Toroid Factor (1..10): the ratio of the external attenuator which is required to measure currents>60kA

Count/Log sync (Yes/No): If set to Yes, then the log will be cleared when a counter is reset. If set to No, then the log and counters are independent.

Units (METRIC/IMPERIAL): this selects the system of units displayed (kN/lbf, mm/inch etc).

Analog out (PV/Current): this selects the function on the analog output at P4. If PV is selected, then the output follows the setting of the PV parameter in the programmes. If Current is selected, then the output will be the measured current waveform. Scale factors for both functions are set in the calibration file. Note that the output is provided as 0..10V (pin 3) and 4..20mA (pin 4), but both pins have the same source function.
Edit calibration

<<< CALIBRATION 1 >>>
TOROID: 150 mV/kA
MAX.PRI.AMPS 600 A
S/P RATIO 50:1
S/P TRIM +03.5%
S/P OFFSET +55 A
Pt1: 15.1kA  20.5kW
  @80.0% [AUTO LOAD]
Pt2: 5.40kA  7.30kW
  @20.0% [AUTO LOAD]
Pt1: 10.0kN @ 100%
Pt2: 0.00kN @ 0.0%
ANALOG: 10V= 10kA
AN. IN GAIN x1.000
AN. IN OFFSET +0.00

Visible window

• **Toroid**: sensitivity of the measuring coil (toroid), expressed in mV/kA.
• **Important**: When calibrating the toroid sensitivity, configure for primary regulation and use CCu mode for welding.
• **Max.Pri.Amps**: this must be set to the maximum transformer primary current, or maximum inverter current, whichever is the smaller.
• **S/P ratio**: this must be set equal to the turns-ratio of the welding transformer.
• **S/P Trim & S/P Offset**: Use to calibrate primary current measurements.
• **Pt1/Pt2**: See next page for details.
• **Pt1/Pt2**: relationship between the PV controller output and actual tip force. This is expressed by entering two 'test' point values, which then define a straight-line relationship.
• **Analogue**: the value of current which corresponds to full scale (10V/20mA) from the analog output at P4.
• **An.in gain**: value by which the voltage at the analog input (ch 3 only) is multiplied. Use to fine trim the reading, or to match a 5V sensor with the 10V input scale.
• **An.in offset**: value of the voltage at the analog input (ch 3 only) for a zero reading.

Note: there are separate calibration files for each gun in a dual/multi-gun system.
...calibration

• **Pt1/Pt2:** the relationship between the %heat output and actual current/power is expressed by entering two ‘test’ point values, which then define straight-line relationships.

To calibrate the inverter, do the following procedure:

• Do a short-circuit weld at a low heat (H₁) in CCu mode. The iPAK measures the secondary current(I₁) and power(P₁). These values can be observed on the diagnostic screen, or via the pop-up meter window.

• Select [AUTO LOAD] for point 1 (Pt1) on the calibration screen, then press the key. This will automatically load the measured values into the calibration file.

• Repeat this procedure for point 2 (Pt2), this time using a high heat (H₂) in CCu mode. The iPAK measures the secondary current(I₂) and power(P₂). These values can be observed on the diagnostic screen, or via the pop-up meter window.

• Select [AUTO LOAD] for point 2 (Pt2) on the calibration screen, then press the key. This will automatically load the measured values into the calibration file.
Use the graphs to look up the maximum permitted primary current setting for any given turns ratio and scale factor.

**Important:** the 'scale factor' setting must match the external toroid attenuator (TAM/1) configuration.

The exact relationship (which must be satisfied in order to avoid a 'calibration error') is:

\[ I_{p,max} \times N \times T \leq S \times 9 \]

If this is set incorrectly, this will result in a ‘calibration error’ fault (error code E2).
Edit Output Map

<table>
<thead>
<tr>
<th>Q01</th>
<th>WAV1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q02</td>
<td>LFAV/MOTOR</td>
</tr>
<tr>
<td>Q03</td>
<td>HAV1</td>
</tr>
<tr>
<td>Q04</td>
<td>Reserved</td>
</tr>
<tr>
<td>Q05</td>
<td>COUNTER1</td>
</tr>
<tr>
<td>Q06</td>
<td>STEPPER1</td>
</tr>
<tr>
<td>Q07</td>
<td>PRE-WARN1</td>
</tr>
<tr>
<td>Q08</td>
<td>Reserved</td>
</tr>
<tr>
<td>Q09</td>
<td>FIELDBUS</td>
</tr>
<tr>
<td>Q10</td>
<td>FIELDBUS</td>
</tr>
<tr>
<td>Q11</td>
<td>EVENT</td>
</tr>
<tr>
<td>Q12</td>
<td>SEQUENCER</td>
</tr>
<tr>
<td>Q13</td>
<td>EOS</td>
</tr>
<tr>
<td>Q14</td>
<td>FAULT</td>
</tr>
<tr>
<td>Q15</td>
<td>SEQUENCER</td>
</tr>
<tr>
<td>Q16</td>
<td>CONTACTOR</td>
</tr>
</tbody>
</table>

Each output may be independently set up as either:

- the standard function assigned (see users connections).
- as an EVENT output.
- as a SEQUENCER output.
- as a FIELDBUS output (outputs 9-16 only).

When an output is mapped to ‘event’, it may be programmed to operate at any point in the welding sequence, via an event program.

When an output is mapped to ‘sequencer’, it may be programmed to operate under the control of the sequencer program.

When an output is mapped to ‘fieldbus’, it will be operated under the direct control of the fieldbus inputs.
Each input may be independently set up as either:

- the standard function assigned (see users connections).

or

- as a SEQUENCER input.

When an input is mapped to ‘sequencer’, it may be used as part of the sequencer program, or as a discrete input to the fieldbus.

Note that input I01 has a special function, and may only be mapped to standard.
Set-up Adapters

The iPAK CPU can be fitted with up to two adapter cards, to provide additional functions.

These are fitted into two positions, referred to as slot 1 and slot 2.

This screen can be used to:
• Show what type of adapter cards are fitted.
• Access any parameters required by that adapter.
Note that some adapters do not require any parameters.

<<< ADAPTERS >>>
S1 Ethernet 1.01
S2 Profibus-DP

View of CPU with cover removed and two adapter cards fitted.
The **Backup** and **Restore** functions provide a convenient means of transferring all of your settings from one iPAK to another.

**Backup:** Use this function to make a copy of all of your data. The copy is held within the WSP3 pendant. No data in the iPAK is changed. Note that only one backup can be stored in the WSP3, and that this is overwritten each time the backup function is used.

**Restore:** Use this function to restore all of your data in the iPAK, from a backup stored in the WSP3 pendant. Note that this operation will overwrite all data which was previously stored in the iPAK. After the restore operation, the backup remains in the WSP3.

Before the restore can proceed, a check is made to ensure that the backup data was recorded from the same type of timer (i.e. another iPAK).
Initialise all data

The **Initialise** function provides a convenient means of setting all of the data in the iPAK to a known initial state. This can be useful when first setting up a system.

**Caution:** When you use the **Initialise** function, you will loose all previously stored data in the iPAK.

After an **initialise** operation, you should edit the configuration files (configuration, calibration, mapping etc.), to suit your installation. You will then need to set-up any welding programmes etc. which you wish to use.
Edit Printer setup

<< PRINTER SETUP >>>
PRINT          ALL
LINES PER PAGE  68
FORMAT         TABLE

You can use this function to send measurements from each weld to a printer, PC or other data logging device. After setting the PRINT parameter, unplug the WSP3 pendant and connect the printer (otherwise you will see the print characters on the WSP3 screen). To use the WSP3 again, plug it back in, and press F.

- **PRINT**: select-
  - OFF (no printing).
  - ALL (print every weld).
  - FAILS (only print failed welds).
  - PASSES (only print good welds).

- **LINES PER PAGE**: set this to the number of lines which your printer can produce on each sheet of paper.

- **FORMAT**:
  - TABLE: tabulated output, suitable for driving a printer.
  - ASCII-HEX: fixed length message suitable for data logging etc. on a PC.
After each weld, the timer sends out a line of text, as shown in the example below. Additionally, a heading will be printed every n lines, where n is the value set for *lines per page*.

<table>
<thead>
<tr>
<th>COUNT</th>
<th>PROG</th>
<th>I1</th>
<th>I2</th>
<th>FORCE</th>
<th>ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>10.5kA</td>
<td>15.5kA</td>
<td>5.45kN</td>
<td>LOW CURRENT WELD 2</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7.65kA</td>
<td>10.4kA</td>
<td>4.05kN</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>0 A</td>
<td>12.5kA</td>
<td>5.05kN</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0 A</td>
<td>0 A</td>
<td>5.40kN</td>
<td>WELD OFF</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>7.50kA</td>
<td>10.8kA</td>
<td>4.00kN</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>0 A</td>
<td>12.5kA</td>
<td>5.10kN</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>10.5kA</td>
<td>16.5kA</td>
<td>5.40kN</td>
<td>HIGH CURRENT WELD2</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>7.50kA</td>
<td>10.8kA</td>
<td>4.00kN</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>0 A</td>
<td>12.5kA</td>
<td>5.15kN</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>10.5kA</td>
<td>16.0kA</td>
<td>5.45kN</td>
<td></td>
</tr>
</tbody>
</table>
...print format : ASCII-HEX

After each weld, the timer sends out the following message:

```
[COUNT][PROG][CURRENT1][CURRENT2][PRESSURE][STATUS][CR]
```

where

- **COUNT** = value in counter after weld (4 characters).
- **PROG** = program number used for weld (2 characters).
- **CURRENT1** = current measured during weld1 interval (4 characters). Units = Amps.
- **CURRENT2** = current measured during weld2 interval (4 characters). Units = Amps.
- **PRESSURE** = pressure measured at end of weld (4 characters). Units = 0.01 kN / 1 lbf.
- **STATUS** = 24 characters.
- **CR** = Carriage return (hex 0D).

All data is leading zero padded, to ensure a fixed-length message (43 characters, including CR).

All data is sent most significant digit first, and in ASCII-HEX format.

i.e. data=2003 (decimal) =07D3(hex)

characters sent= [0][7][D][3]

ASCII equiv.= [hex 30][hex 37][hex 45][hex 33]

The **STATUS** field is a 96 bit array of 1-bit flags, encoded as shown on page 24/24(status/error messages).
...printer connections

PC com port

Port settings:
19200 Baud
8 Data bits
1 Start bit
1 Stop bit
No parity
No handshake

iPAK

Printer
9 pin serial port

Printer
25 pin serial port
The *iPAK CPU* is equipped with two memories, which can be used to store two versions of the operating firmware files. The Edit system set-up menu provides a number of functions for examining and selecting these files.

**Caution:** These functions should only be used by trained and experienced personnel, as improper use could render the iPAK inoperable.

**Note:** The iPAK will not operate while this menu is selected.
Note: To access the Configuration menu, select the ‘version’ line on the main menu (last line), hold down the ➔ key, then press the F key.
**Edit program**

<<< PROGRAM 0 >>>
I1=7.50kA  25.0%  P/W.
I2=10.0kA  50.0%  CCC
PV=5.00kN@50.0%  NORM
PSQ= 0ms  SQZ= 10ms
W1 = 0ms  C1 = 0ms
W2 = 10ms  C2 = 0ms
Pulses(W2-C2) = 1
UP SLOPE = 3ms
DOWN SLOPE = 0ms
HOLD = 10ms
OFF = 0ms  (SINGLE)

P/W= Constant Pulse-Width mode. The current and heat parameters are independently adjustable. The inverter pulse-width is fixed. The current parameter is used for monitoring only.

CCu=Constant Current Uncalibrated mode. The current and heat parameters are independently adjustable. Actual current is determined by the inverter. The current parameter is used for monitoring only.

CCC=Constant Current Calibrated mode. The current parameter (in kA) is adjustable, but the heat is automatically determined by the iPAK from the calibration data.

CV*=Constant Voltage mode. The current parameter is replaced with the voltage parameter. Set up this mode by first using the P/W or CCu mode to determine the voltage required to weld (use the pop-up meter), then select CV and enter this value into the voltage parameter.

POW*=Constant Power mode. The power parameter (in kW) is adjustable, but the heat is automatically determined by the iPAK from the calibration data.

*External isolation amplifier is required for these modes.

IMPORTANT!
Set OFF time to 0 for single spot operation. If OFF time>0, then repeat operation will occur.
..edit program

<<< PROGRAM 0 >>>
I1=7.50kA  25.0%  P/W
I2=10.0kA  50.0%  CCC
PV=5.00kN @ 50.0%  NORM
PSQ= 0ms  SQZ= 10ms
W1 = 0ms  C1 = 0ms
W2 = 10ms  C2 = 0ms
Pulses(W2-C2) = 1
UPSLOPE = 3ms
DOWNLOPE = 0ms
HOLD = 10ms
OFF = 0ms (SINGLE)

NORM = normal spot weld operation. LINK = linked spot operation.

LINKed operation provides a means of chaining programmes together so that a single start signal generates a sequence of programmes. At the end of a linked program, the next program (numerically ascending) is automatically selected and run, and so on, until either a program set to NORMal, or the last program (63) is reached.

IMPORTANT!
Set OFF time to 0 for single spot operation. If OFF time > 0, then repeat operation will occur.

Note: If the low-force option is selected in the configuration, then the presqueeze (PSQ) parameter changes to low-force time (LF). See section 'low-force approach'.

If the OHMA system is selected, additional timing parameters will be shown.
If the iPAK is configured for seam welding, then the program screen changes as shown here, in order to present only the relevant parameters.

CAUTION! When using an an MF system for seam-welding, the duty is effectively 100%. Make sure that the transformer/rectifier are correctly specified for this duty.
Edit limits

The **PRE-LIMIT COUNT** is the number of successive welds which can fail the pre-limit level test, before a warning message is produced.

Visible window

```
<<< LIMITS PROG 0 >>>
kA/kW: MONITOR On
LOW1=15%  HIGH1=10%
PRE-LIMIT1= 5%
LOW2=10%  HIGH2= 8%
PRE-LIMIT2= 5%
PRE-LIMIT COUNT = 3
PRESSURE: MONITOR On
WAIT On
LOW=10%  HIGH= 10%
```

**Pressure: monitor** Pressure is checked to be within limits at the end of the weld.

**Pressure: wait** Pressure is checked to be within limits before weld is allowed to start.
Edit Events

• Each welding program may have up to 4 events defined.

• Each event can turn one output on or off.

• To disable an event, set its output to ‘?’. Note: The outputs used must be mapped to ‘EVENT’ for correct operation.

(see Edit Output Map)

e.g. Turn on output 6, 5 ms into the Weld 1 interval.

Note. Events cannot be used when seam welding.
Electrode menu

A stepper is programmed by means of a curve which will provide values of heat, current and power increments, related to the number of spots done. The curve is defined by a set of 10 points. The iPAK provides interpolation between these points.

Electrode management is provided via a combination of stepper and counter functions.

The stepper provides a means of gradually increasing the current, to compensate for electrode wear. Two steppers are provided, one per gun.
Electrode status

The number of spots made since the last reset. This may be changed to alter the working position on the curve.

The percentage done of the total number of spots, also shown as a bar-graph.

Select 1 for gun 1, or 2 for gun 2 (dual-gun mode only).

Visible window

Select this field and press to reset this stepper (same function as external input).

dH= additional % heat being applied (+HEAT from table).
dI= additional current being applied (+A from table).
dP= additional power being applied (+W from table).

Outputs:

Output ‘End of stepper’ comes on at the end of the last step.

Output ‘Prewarn’ comes on during the last step.

If tip-dressing is on, then the outputs behave differently (see edit counter).
## Edit stepper

<table>
<thead>
<tr>
<th>STEPPER</th>
<th>SPOTS</th>
<th>+HEAT</th>
<th>+A / W</th>
<th>Visible Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>1.0%</td>
<td>100 A</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>1.5%</td>
<td>200 A</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>2.0%</td>
<td>300 A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>2.5%</td>
<td>400 A</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>3.0%</td>
<td>500 A</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>3.5%</td>
<td>600 A</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>100</td>
<td>4.0%</td>
<td>700 A</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>4.5%</td>
<td>800 A</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>150</td>
<td>5.0%</td>
<td>900 A</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>200</td>
<td>5.5%</td>
<td>1000 A</td>
<td></td>
</tr>
</tbody>
</table>

### Enable or disable the stepper.

If **continue at end** is selected, then at the end of the last step, further welding can take place as normal, but the stepper output will remain on. There is no further increase in current. If **stop at end** is selected, then no further welding may take place until a stepper reset is given.

**Note:** P/W and CCu modes will make use of both the +HEAT(dH) and +AMPS(dI) parameters. CCC mode uses only the +A(dI) parameter, as the heat is self-adjusting. POW mode uses only the +W(dP) parameter, as the heat is self-adjusting.

### Quick set-up:

Enter values in step 9 only, to define the finishing point, select the PRESET field, edit the preset number (see next page), and then press ➤ to load this stepper with a preset curve.
Stepper presets

When a preset curve is loaded, the data is obtained from a table which holds the 5 curves shown.

The step sizes (spots) are all made the same as for step 9, and the +HEAT(dH), +A (dI) and +W(dP) parameters are obtained by applying the values in step 9 to the curve as a scaling factor.
**Edit counter**

<table>
<thead>
<tr>
<th>&lt;&lt;&lt; COUNTER 1 &gt;&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNT NOW = 431</td>
</tr>
<tr>
<td>COUNT UP TO 500</td>
</tr>
<tr>
<td>STOP AT END</td>
</tr>
<tr>
<td>TIP DRESSING On</td>
</tr>
<tr>
<td>MAX.DRESSINGS = 10</td>
</tr>
<tr>
<td>DRESSINGS DONE = 2</td>
</tr>
<tr>
<td>@RESET, STEPPER = 100</td>
</tr>
</tbody>
</table>

*Count now* is incremented after every weld. When *count up to* is reached, the counter output is activated.

If *stop at end* is selected, then no further welding may take place until a counter reset is given.

Set *count up to* = 0 to disable a counter.

If *continue at end* is selected, then further welding can take place as normal, but the counter output will remain on.

*Count now* is reset to zero by activating the counter reset input.

**Note:** Counter 1 is used by gun 1. Counter 2 is used by gun 2.
The counter can be used to control tip-dressing by setting the parameter ‘tip-dressing’ to On.
Sequencer

The sequencer provides a means of controlling a small machine, via a series of logic statements. The statements are executed sequentially in the order in which they appear.

The START1 input is used to trigger execution of the sequence, and must be maintained. On release of the START1 signal, the sequence is reset.

With the sequencer configured (see edit configuration), the START1 signal cannot be used to start a weld. Instead, welds are started via statements within the sequence.

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

The following resources are available:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements (lines)</td>
<td>Up to 249 max.</td>
</tr>
<tr>
<td>Outputs</td>
<td>16 Q1 to Q16</td>
</tr>
<tr>
<td>Inputs</td>
<td>16 I01 to I16</td>
</tr>
<tr>
<td>Memory</td>
<td>8 M1 to M8 (non-volatile)</td>
</tr>
<tr>
<td>Counters</td>
<td>8 C1 to C8 (non-volatile)</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>3 A1 to A3</td>
</tr>
</tbody>
</table>

Non-volatile values are retained, even if power is lost.
Note that the inputs and outputs are shared with the welding controller and event timer (see Input map and Output map).
For information only:
Off: the sequencer is turned off (see edit configuration)
Idle: the sequencer is turned on, and waiting for the START input.
Line n: the sequence is running and is executing line n.

<< SEQUENCER MENU >>
EDIT SEQUENCE
ERASE SEQUENCE
STATUS: IDLE

Enter new statements, parameters etc., or edit the existing sequence (see edit sequence).

Erase the entire sequence –use with caution!
You will be asked to confirm the operation before the erase takes place.
An erased sequence cannot be restored.
...edit sequence

On the edit sequence screen, the keys have the following functions:

At any time:
- Press the ↑ or ↓ keys to change the selected line. The entire line will flash. The screen will scroll when required.
- Press the → key to insert a new (blank) line. The line number will be shown.
- Press the F key to return to the sequencer menu screen.

When entire line is flashing:
- Press + and – together to delete the selected line
- Press the + or - keys to alter the selected statement type.
- Press the ← key to momentarily see the selected line number.
- Press the ← or → keys to select a parameter (parameter only will flash).

When parameter only is flashing:
- Press the + or - keys to alter the selected parameter.
- Press + and – together to set 0 or minimum value.
The following table lists the available logic statement types:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line nnn</td>
<td>1..249</td>
<td>Line number within sequencer file (has no effect)</td>
</tr>
<tr>
<td>----- STEP nnn -----</td>
<td>1..999</td>
<td>Has no effect, but serves as the target for a JUMP or GOSUB statement, or as a logical divider in the program</td>
</tr>
<tr>
<td>AWAIT INPUT Inn ON</td>
<td>1..14</td>
<td>Waits for Input nn to be ON</td>
</tr>
<tr>
<td>AWAIT INPUT Inn OFF</td>
<td>1..14</td>
<td>Waits for Input nn to be OFF</td>
</tr>
<tr>
<td>OUTPUT Qn ON</td>
<td>1..12</td>
<td>Turns ON Output n</td>
</tr>
<tr>
<td>OUTPUT Qn OFF</td>
<td>1..12</td>
<td>Turns OFF Output n</td>
</tr>
<tr>
<td>MEMORY Mn ON</td>
<td>1..8</td>
<td>Sets Memory bit n (non-volatile)</td>
</tr>
<tr>
<td>MEMORY Mn OFF</td>
<td>1..8</td>
<td>Clears Memory bit n (non-volatile)</td>
</tr>
<tr>
<td>DELAY nn.n s</td>
<td>0.1..99.9 s</td>
<td>Waits for specified time</td>
</tr>
<tr>
<td>JUMP nnn</td>
<td>1..999</td>
<td>Program continues at specified STEP number.</td>
</tr>
<tr>
<td>GOSUB nnn</td>
<td>1..999</td>
<td>Program continues with the subroutine at the specified STEP number. (Note maximum of 8 nesting levels)</td>
</tr>
<tr>
<td>RETURN</td>
<td></td>
<td>Return from subroutine</td>
</tr>
<tr>
<td>COUNTER Cn = xxx</td>
<td>n=1..8, x=1..999</td>
<td>Loads Counter n with the value xxx (non-volatile)</td>
</tr>
<tr>
<td>DECREMENT COUNTER Cn</td>
<td>1..8</td>
<td>The value in Counter n is reduced by 1 (non-volatile)</td>
</tr>
<tr>
<td>IF Cn&gt;ZERO, JUMP xxx</td>
<td>n=1..8, x=1..999</td>
<td>If the value in Counter n is not zero, then continue at STEP xxx.</td>
</tr>
<tr>
<td>IF Qn ON, JUMP xxx</td>
<td>n=1..12, x=1..999</td>
<td>If Output Qn is ON, then continue at STEP xxx.</td>
</tr>
<tr>
<td>IF Qn OFF, JUMP xxx</td>
<td>n=1..12, x=1..999</td>
<td>If Output Qn is OFF, then continue at the next statement</td>
</tr>
<tr>
<td>IF Mn ON, JUMP xxx</td>
<td>n=1..8, x=1..999</td>
<td>If Memory Mn is ON, then continue at STEP xxx.</td>
</tr>
<tr>
<td>IF Mn OFF, JUMP xxx</td>
<td>n=1..8, x=1..999</td>
<td>If Memory Mn is OFF, then continue at the next statement</td>
</tr>
<tr>
<td>IF Inn ON, JUMP xxx</td>
<td>n=1..14, x=1..999</td>
<td>If Input Inn is ON, then continue at STEP xxx.</td>
</tr>
<tr>
<td>IF Inn OFF, JUMP xxx</td>
<td>n=1..14, x=1..999</td>
<td>If Input Inn is OFF, then continue at the next statement</td>
</tr>
<tr>
<td>WELD (Prog=nn)</td>
<td>nn=0..63,EXT</td>
<td>Execute weld sequence using program nn. If nn=EXT, the read the program number from the external inputs. The sequencer will wait until the weld reaches 'End of sequence', before continuing with the next statement.</td>
</tr>
</tbody>
</table>
### Example sequence

#### Statement Range Function

<table>
<thead>
<tr>
<th>Statement</th>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWAIT ANALOG n&lt;mm V</td>
<td>n=1.3, 0.0&lt;=mm&lt;=10.0</td>
<td>Waits for Analog input n to be less than mm Volts.</td>
</tr>
<tr>
<td>AWAIT ANALOG n&gt;mm V</td>
<td>n=1.3, 0.0&lt;=mm&lt;=10.0</td>
<td>Waits for Analog input n to be greater than mm Volts.</td>
</tr>
<tr>
<td>IF ANALOG n&lt;mm V, JUMP xxx</td>
<td>n=1.3, 0.0&lt;=mm&lt;=10.0</td>
<td>If Analog input n is less than mm Volts, then continue at STEP xxx, otherwise continue with the next statement.</td>
</tr>
<tr>
<td>IF ANALOG n&gt;mm V, JUMP xxx</td>
<td>n=1.3, 0.0&lt;=mm&lt;=10.0</td>
<td>If Analog input n is greater than mm Volts, then continue at STEP xxx, otherwise continue with the next statement.</td>
</tr>
</tbody>
</table>

**A short example program:**

```
----- STEP 1 -----
AWAIT INPUT I03 ON Part detector

----- STEP 2 -----
OUTPUT Q8 ON Clamp ON
DELAY 0.5 Pause

----- STEP 3 -----
WELD (Prog= 01) Weld operation using program number 1
OUTPUT Q8 OFF Clamp off

----- STEP 4 -----
OUTPUT Q7 ON Signal job done by flashing output until START released
DELAY 0.4 Flash 'On' time
OUTPUT Q7 OFF
DELAY 0.2 Flash 'Off' time
JUMP 4 Loop back to create flashing effect
```
Weld log

The iPAK records the measurements from each weld into the weld log. The log can hold information from up to 64 welds (after this, the oldest record will be discarded).

To see the information for each weld, select the VIEW LOG function.

The log can be cleared (emptied) by using the CLEAR LOG function.

The weld log is not available when seam welding.

The number of welds presently held in the log.

64 welds in log
VIEW LOG
CLEAR LOG

The iPAK records the measurements from each weld into the weld log. The log can hold information from up to 64 welds (after this, the oldest record will be discarded).

To see the information for each weld, select the VIEW LOG function.

The log can be cleared (emptied) by using the CLEAR LOG function.

The weld log is not available when seam welding.
View log (screen 1)

Press the + or - keys to select the log record (1 = most recent weld, 64 = oldest weld).

Program used for this weld

Status for this weld

Inverter pulse-width used for this weld

Actual current measured

Target current, from program

Note that if either of I1 or I2 are not shown, then that interval was not used.

Press ← ↑ ↓ → to change between log screens 1/2/3/4.
View log (screen 2)

Press the + or - keys to select the log record (1 = most recent weld, 64 = oldest weld).

Program used for this weld

Status for this weld

Inverter pulse-width used for this weld

Actual voltage measured

Target voltage from program

Note that if either of V1 or V2 are not shown, then that interval was not used.

Press ← ↑ ↓ → to change between log screens 1/2/3/4.
View log (screen 3)

Press the + or - keys to select the log record (1 = most recent weld, 64 = oldest weld).

Program used for this weld

Status for this weld

Inverter pulse-width used for this weld

Actual power measured

Target power from program

<LOG 1>  W2 FAIL
PROG= 0  P/W= 25%
P1= 10.4 kW (10.5 kW)
P2= 12.8 kW (12.7 kW)

Note that if either of P1 or P2 are not shown, then that interval was not used.

*Press ↔ ↑ ↓ to change between log screens 1/2/3/4.*
View log (screen 4)

Press the + or - keys to select the log record ( 1 = most recent weld, 64 = oldest weld).

- Electrode used for this weld
- Status for this weld
- Value of the counter used for this weld
- PV output
- Measured PV feedback

<LOG 1> W2 FAIL
Elec= 1  COUNT= 99
P->5.00kN  P<-4.95kN

• Press to change between log screens 1/2/3/4.
Copy program

<<< COPY PROGRAM >>>
FROM: 0
TO: 1
GO

Copy a program (and associated limit and event files) to any other program, or to all other programmes.

• The TO parameter can be set to ALL if required (i.e. copy 1 program to all others).
• Select the last line (GO), then press the → key to execute the copy function. This line will briefly show COPY DONE, when the function is complete.
I/O Status

This screen can be used to observe the status of the discrete inputs and outputs. Each input or output is labeled to show how it is mapped.

i.e. standard function / event / sequencer/fieldbus.

(see edit input map and edit output map)
Fieldbus input status

This screen can be used to observe the status of the fieldbus inputs. Note that this screen is only available if the iPAK is configured for fieldbus operation.
Analog Status

- **Analog input channels**: the dynamic voltage at each of the analog inputs. This is shown for test calibration and information purposes only, and does not need to be adjusted by the user.

- **Toroid resistance**: the result of the toroid test, in Ohms. If a measurement > 750 Ohms is obtained then the (infinity) symbol is shown. If the toroid test is off, then ??? is shown.

### Visible window

<table>
<thead>
<tr>
<th>Channel</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00 V</td>
</tr>
<tr>
<td>2</td>
<td>2.34 V</td>
</tr>
<tr>
<td>3</td>
<td>9.55 V</td>
</tr>
</tbody>
</table>

TOROID R = 20 Ω

This screen can be used to observe the status of the analog inputs.
Program selection

Programmes can be selected in a variety of different ways, depending on the settings used.

Set these parameters in the configuration file.

X = don’t care, or not connected

Note: If 2-input binary is selected, then the inputs **START 1** and **2nd STAGE** must be activated within 0.3 s of each other.
The OHMA system uses three valves to control the opening and closing of the electrodes. If Retract is used, the timing of the valve operations is used to control the gap between the electrodes in their mid-position. To enable the OHMA system, you must make appropriate settings in the configuration file.

**Weld Stroke**

When a Start input is given to the weld control the Blocking valve is switched off and the Advance valve is switched on. This closes the electrodes onto the work-piece. At the end of the ‘Gun close’ time, the 2nd stage input and/or ‘wait for pressure’ function is/are checked, before the Intensify valve switches on to provide the electrode force required for welding.

The weld sequence proceeds in the usual way until the end of the Hold time when the Advance and Intensify valves switch off. The electrodes then start to open until the Blocking valve switches on and prevents further opening. The timing of the Blocking valve turning on (the Gun Open Time) sets the position to which the electrodes open. The End of Sequence output operates when the Blocking Valve switches on.
**Retract Stroke**

With the electrodes in the fully open position the control will not begin a weld sequence. A Retract input is required to move the electrodes to their mid-position.

When a Retract input is given, the Blocking valve is switched off and the Advance valve is switched on. This starts the electrodes moving towards their mid-position. After the Retract Close time the Advance valve is switched off. The Retract Close Delay time then begins and when complete, the Blocking valve is switched on, halting the movement of the electrodes. Hence, these times control the mid position of the electrodes. In this condition the timer is ready to weld.

When in this “ready” condition, if a Retract input is detected, the Blocking valve is switched off for the duration of the Retract Open time. This allows the electrodes to move to the full open position.

The following additional parameters will be shown on the programming screen, only if **OHMA retract** is selected:

- Retract close time
- Retract delay time
- Retract open time
Disabling edits

Normally, a user can access the parameters via the keypad on the WSP3 programming pendant, and make any changes, as required. Under some circumstances, it may be desirable to prevent such general access. The iPAK provides an input called ‘EDIT DISABLE’, which can be used to block all parameter edits. With this input on, it will still be possible to view parameters, but no changes are permitted via the keypad. If edits are attempted, the display will briefly show

** EDITS DISABLED **

and the edit will be blocked.

It is suggested that this input is controlled via a key-switch, such that only the key-holder is able to open the switch, and thus be able to edit parameters.

Typical connections to iPAK

Normally-closed contact. Key withdraws in normal position.

If this feature is not required, simply leave this input unconnected.
Pop-up meter

The iPAK will measure the current, voltage and power on both the weld1 and weld 2 intervals, and this is displayed on the diagnostic screen. Often, when programming the iPAK, you will need to refer to these measurements. In order to avoid having to switch between screens, there is a convenient pop-up meter window, which allows you to view the measurements without leaving the screen you are on. The pop-up meter is activated by pressing the ➤ key. To close the pop-up window, press the ➤ key again. Press + or - to access voltage and power measurements (V1, V2, P1 P2).

Note that the window may not show both weld1 and weld2, if either interval was not used. Some screens use the ➤ key for another purpose (such as selecting an item from a list). In this case, the pop-up meter is not available from that screen.
Operation: basic spot weld – no weld faults

W1=0, C1=0, Pulses=1, OFF=0
Operation: basic spot weld – weld fault

Current

START input

EOS output

FAULT output

WAV output

SQZ  W2  HLD

W1=0, C1=0, Pulses=1, OFF=0
Operation: repeat spot weld

W1=0, C1=0, C2=0, Pulses=1
Operation: pulsation spot weld

W1=0, C1=0, Pulses=3, OFF=0
Operation: Upslope and Downslope

Spot

The upslope and downslope times are part of the overall weld time – they **do not** add to the weld time.

Seam

Note that for seam welds, the downslope time begins when the initiation input turns off.
Operation: roll-spot welding

W1=0, C1=0, C2=0, Pulses=1
Operation: seam welding (dual heat)

Current

START input

MOTOR output

WAV output

PSQ SQZ W1 W2 W1 W2 W1 W2 W1 W2 W1 W2 HLD

C1=0, C2=0

iPAK V1.62
Operation: seam welding (pre-heat)
Operation: EOS signal

Handshake mode: The start signal remains on until EOS is given. When start is removed, EOS goes off, after 500ms. This is the recommended method of operation for automatic systems.

Pulsed mode: The start signal goes off before the end of the hold time. The EOS signal is a fixed pulse of 500ms.

In either mode, if a new start signal is given during the EOS pulse, then EOS will go off and a new sequence will start.
The retract operating mode (*Simple/Hi-lift+/Hi-lift-/Maintained*) is set in the configuration file.

**Operation: Retract**

- **No/ Simple**
  - Retract input
  - HAV output
  - START input
  - WAV output

- **Maintained**
  - Retract input
  - HAV output
  - START input
  - WAV output
Operation: Hi-lift

The retract operating mode *(Simple/Hi-lift+/Hi-lift-/Maintained)* is set in the configuration file.

Hi-lift+

Hi-lift-

Retract input

HAV output

START input

WAV output
## Multi-gun welding

There are two methods for driving more than one power transformer/gun with an iPAK:

- **By connecting to a standard iPAK via a power switch (MUX).**
  
  - Standard iPAK
  - Power switch
  - Up to 8 welding transformers

- **By connecting directly to a special type iPAK-MUX.**
  
  - iPAK-MPX
  - Up to 4 welding transformers

Up to 8 pairs of electrodes can be distributed randomly across welding transformers. Up to 8 electrode pairs can be closed at a time (4 on MPX types). Control can ripple-fire through up to 8 spots, or each spot can be individually triggered.
Configuring iPAK for multiwelding

There are two modes available for multiwelding: ‘MULTI-GUN’ and ‘MULTI-GUN CASCADE’.

**Multi-gun** mode allows each welding program to be triggered independently, in the traditional way, but allows for selection of a transformer and electrode.

In **multi-gun cascade** mode, up to eight welding programmes can be grouped together, and triggered from a single start command. The programmes then ripple through with minimal time between them, selecting transformers and electrodes on the fly. The group of programmes is referred to as a **cascade**.

Selection of these modes is made by selecting ‘EDIT CONFIGURATION’ from the config. Menu:

Operating mode selection: Press the + or – keys until the required selection is shown.

Note:
Multiwelding modes can be used on both standard and MPX type iPAKs.
users connections

**CONNECTIONS FOR MULTI GUN OR CASCADE**

**P1 SYSTEM**
- Do not connect
- 24V (internal)
- 24V for I/O
- STOP
- **TRANSFORMER THERMOSTAT**
- HEAT ON
- 3V
- EXTERNAL POWER SUPPLY 24V DC

**P2 INPUTS**
- 24V (from P1 pin 2)
- START1 / K1
- START2 / K2
- START3 / K3
- START4 / K4
- P1 / K5
- P2 / K6
- P3 / K7
- P4 / K8
- P5 / K9
- P6 / K10
- STOP / K11
- README / K12
- RESET STEPPER / K11
- RESET COUNTER / K12
- RESET ALL / K13
- RESET FAULT / K14
- 2ND STAGE / K15
- EDT CSC-REL / K16

**P3 OUTPUTS**
- WAVE / 001
- 002
- 003
- 004
- 005
- 006
- 007
- 008
- 009
- 010
- 011
- 012
- 013
- 014
- 015
- 016

**P4 VALVE**
- 24V
- OUTPUT (0-10V)
- OUTPUT (4-20mA)
- ANALOG INPUT CH1 (0-10V)
- ANALOG INPUT CH2 (4-20mA)
- INPUT 24V on/off

**P5 SENSORS**
- Optional required for constant voltage and constant power operation
- 5V
- 10V
- 20V
- 30V

**NOTES:**
- WAVE and HEAT outputs rated 500mA @ 24V DC
- All other outputs rated 100mA @ 24V DC
- **These inputs must be blanked out if not used.**

Inputs and Outputs are shared between the timer, events, sequence and feedback. Use the EDT INPUT HFP and EDT OUTPUT HFP functions to configure.
Multi-gun operation

*Multi-gun* mode allows each welding program to be triggered independently, in the traditional way, but allows for selection of a transformer and electrode.
Multi-gun cascade operation

In *multi-gun cascade* mode, up to eight welding programmes can be grouped together, and triggered from a single start command. The programmes then ripple through with minimal time between them, selecting transformers and electrodes on the fly. The group of programmes is referred to as a *cascade*. Up to 16 cascades may be programmed.

To set up a cascade, select ‘EDIT CASCADE’ from the main menu.

In the example shown here:

The cascade consists of 4 steps, using programmes 0, 1, 2 and 3. Note that the electrode and transformer numbers are automatically assigned, by reference to the electrode number in the selected weld program.

Note that in *multi-gun cascade* mode, the program selection inputs refer to a cascade, and not directly to a weld program.
...multi-gun cascade operation

Note that in *multi-gun cascade* mode, the SQUEEZE time from the first step and the HOLD time from the last step are used.
Electrode/Transformer assignment

The physical arrangement of the electrodes and welding transformers must be entered into the control.

1. From the config. menu, select ‘EDIT TRANSFORMERS’.

2. Assign each electrode to a transformer.

3. Each transformer has a separate calibration file. Perform the calibration procedure (see main manual) for each transformer connected.

In the example shown here:
Electrodes 1 and 2 are attached to Transformer 1.
Electrodes 3 and 4 are attached to Transformer 2.
Electrodes 5 and 6 are attached to Transformer 3.
Electrodes 7 and 8 are attached to Transformer 4.
Assigning a weld program to an electrode

Each weld program should be assigned to a particular electrode. This is done on the ‘EDIT PROGRAM’ screen, accessed from the main menu.

```
<<< PROGRAM 0 >>>
I1=7.50kA  25.0% P/W
I2=10.0kA  50.0% CCC
PV=5.00kN@50.0% NORM
PSQ= 0ms  SQZ=100ms
W1 = 0ms  C1 = 0ms
W2 =100ms  C2 = 0ms
Pulses(W2-C2) = 1
UPSLOPE = 30ms
DWONLOPE = 0ms
HOLD = 200ms
OFF = 0ms  (SINGLE)
ELECTRODE=1
```

In the example shown here: Weld program 0 is assigned to Electrode 1.

Whenever a program is run, the control will automatically trigger the correct transformer, by referencing the electrode/transformer assignment table, as shown on the previous page. In addition, the electrode number is also used to access the appropriate stepper, counter and calibration information.
## Operation with a fieldbus

### Multi-gun

<table>
<thead>
<tr>
<th>INPUT from bus to timer</th>
<th>OUTPUT from timer to bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit No.</td>
<td>Function</td>
</tr>
<tr>
<td>0</td>
<td>START 1</td>
</tr>
<tr>
<td>1</td>
<td>START 2</td>
</tr>
<tr>
<td>2</td>
<td>START 3</td>
</tr>
<tr>
<td>3</td>
<td>START 4</td>
</tr>
<tr>
<td>4</td>
<td>2nd Stage</td>
</tr>
<tr>
<td>5</td>
<td>Weld on*</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>8</td>
<td>Reset expired counters</td>
</tr>
<tr>
<td>9</td>
<td>Reset expired steppers</td>
</tr>
<tr>
<td>10</td>
<td>Reset All</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
</tr>
<tr>
<td>12</td>
<td>Reserved</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
</tr>
<tr>
<td>15</td>
<td>Reset fault</td>
</tr>
<tr>
<td>16</td>
<td>Program bit 1</td>
</tr>
<tr>
<td>17</td>
<td>Program bit 2</td>
</tr>
<tr>
<td>18</td>
<td>Program bit 4</td>
</tr>
<tr>
<td>19</td>
<td>Program bit 8</td>
</tr>
<tr>
<td>20</td>
<td>Program bit 16</td>
</tr>
<tr>
<td>21</td>
<td>Program bit 32</td>
</tr>
<tr>
<td>22</td>
<td>Reserved</td>
</tr>
<tr>
<td>23</td>
<td>Reserved</td>
</tr>
<tr>
<td>24</td>
<td>Discrete output Q09</td>
</tr>
<tr>
<td>25</td>
<td>Discrete output Q10</td>
</tr>
<tr>
<td>26</td>
<td>Discrete output Q11</td>
</tr>
<tr>
<td>27</td>
<td>Discrete output Q12</td>
</tr>
<tr>
<td>28</td>
<td>Discrete output Q13</td>
</tr>
<tr>
<td>29</td>
<td>Discrete output Q14</td>
</tr>
<tr>
<td>30</td>
<td>Discrete output Q15</td>
</tr>
<tr>
<td>31</td>
<td>Discrete output Q16</td>
</tr>
</tbody>
</table>

### Multi-gun Cascade

<table>
<thead>
<tr>
<th>INPUT from bus to timer</th>
<th>OUTPUT from timer to bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit No.</td>
<td>Function</td>
</tr>
<tr>
<td>0</td>
<td>START 1</td>
</tr>
<tr>
<td>1</td>
<td>START 2</td>
</tr>
<tr>
<td>2</td>
<td>START 3</td>
</tr>
<tr>
<td>3</td>
<td>START 4</td>
</tr>
<tr>
<td>4</td>
<td>2nd Stage</td>
</tr>
<tr>
<td>5</td>
<td>Weld on*</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>8</td>
<td>Reset expired counters</td>
</tr>
<tr>
<td>9</td>
<td>Reset expired steppers</td>
</tr>
<tr>
<td>10</td>
<td>Reset All</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
</tr>
<tr>
<td>12</td>
<td>Reserved</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
</tr>
<tr>
<td>15</td>
<td>Reset fault</td>
</tr>
<tr>
<td>16</td>
<td>Cascade Program bit 1</td>
</tr>
<tr>
<td>17</td>
<td>Cascade Program bit 2</td>
</tr>
<tr>
<td>18</td>
<td>Cascade Program bit 4</td>
</tr>
<tr>
<td>19</td>
<td>Cascade Program bit 8</td>
</tr>
<tr>
<td>20</td>
<td>Cascade Program bit 16</td>
</tr>
<tr>
<td>21</td>
<td>Cascade Program bit 32</td>
</tr>
<tr>
<td>22</td>
<td>Cascade Program bit 64</td>
</tr>
<tr>
<td>23</td>
<td>Cascade Program bit 128</td>
</tr>
<tr>
<td>24</td>
<td>Discrete output Q09</td>
</tr>
<tr>
<td>25</td>
<td>Discrete output Q10</td>
</tr>
<tr>
<td>26</td>
<td>Discrete output Q11</td>
</tr>
<tr>
<td>27</td>
<td>Discrete output Q12</td>
</tr>
<tr>
<td>28</td>
<td>Discrete output Q13</td>
</tr>
<tr>
<td>29</td>
<td>Discrete output Q14</td>
</tr>
<tr>
<td>30</td>
<td>Discrete output Q15</td>
</tr>
<tr>
<td>31</td>
<td>Discrete output Q16</td>
</tr>
</tbody>
</table>

*The discrete Weld on input must also be on to enable welding.*
WS98-iPAK PC software

WS98-iPAK PC software is available for use with the iPAK. This offers the user the ability to program and monitor the welding control, and to back-up all of the programmed data on a PC.

iPAKs may be connected to the PC via RS232 (1 iPAK only) or via Ethernet (multiple iPAKs on a network).

WS98-iPAK is available on CDROM, and works with all versions of Microsoft Windows™ (98 onwards). Contact BF Entron for more details.