iPAK2
User Guide

Welding control for MFDC spot, projection, roll-spot, seam and multi-welding applications.

For firmware version 2.10

Document change record

Issue	Date	Comment
2.00	27-02-19	Initial release
2.00.01	13-06-19	Minor errata corrected
2.00.02	19-06-19	Corrected weld program time range.
2.01	08-08-19	Added Presqueeze to all modes
2.02	19-09-19	Added programable blanking. Added C-Monitor
2.03	27-02-20	Includes iPAK2v2. Modified Seam sequence. Modified Analog control. Added Retry feature.
2.04	16-09-20	Changed description of 2nd-stage Once/Every configuration parameter
2.06	27-07-21	Added section on RS485 via COM2
2.10	10-03-22	Added Aux Valve delay function

IMPORTANT SAFETY INSTRUCTIONS

READ ALL INSTRUCTIONS BEFORE USING THE iPAK2

WARNING

DO NOT DISASSEMBLE, REPAIR, OR MODIFY THE iPAK2. These actions can cause electric shock and fire.

- Use only as described in this manual. Use only ENTRON recommended accessories and replacement parts.
- Stop operation if any problems occur. If the equipment is not working as it should, has been dropped, damaged, left outdoors, or been in contact with water, contact ENTRON.
- Only apply the specified power. Application of a voltage or current beyond the specified range can cause electric shock or fire.
- Do not use damaged plugs or connecting cables.
- Keep water and water containers away from the iPAK2. Water ingress can cause a short circuit, electric shock, or fire.
- Do not insert objects into openings. Do not use with any opening blocked; keep free of dust and debris.
- Do not install the iPAK2 in any of the following environments
    - damp environments where humidity is 90% or higher.
    - dusty environments.
    - environments where chemicals are handled.
    - environments near a high-frequency noise source.
    - hot or cold environments where temperatures are above 40°C or below 0°C, or environments where water will condense.

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1. Introduction

The iPAK2 and iPAK2v2 controllers are suitable for MFDC spot, projection, roll-spot, seam and multi-welding applications.

The controller supports:

- pre-heat, main heat and post-heat intervals
- force profiles
- multi-air valve applications
- multi-electrode applications

Multiple communication and control options are supported by a number of programming methods. The Ethernet port supports simultaneous programming and control connection via a single physical cable. iPAK2v2 includes integrated EtherNet/IP. For iPAK2, EtherNet/IP can be provided via an optional plug-in adapter board.

Short-circuit proof outputs and a guided-contact pilot relay provides enhanced safety. Connection to the power system is via a single ribbon cable. Analog inputs and outputs can be used to drive a proportional air regulator valve for force control.

Operation in Standard mode provides a basic set of features for simple applications. Extended mode adds advanced features for more demanding applications. Choose between Standard or Extended features (See **Configuration section**). iPAK2 must be restarted after changing this setting.

1.1. Part numbers

Model	Part number
iPAK2	01-70-27
iPAK2v2	01-70-28

1.2. Features

NetFlash programming	✓
WSP3 programming	✓
Ethernet [1]	✓
EtherNet/IP [2]	✓
RS232	✓
RS485	✓
MODBUS TCP/IP	✓
MODBUS RTU	✓
Analogue inputs [3]	2
Analogue outputs [3]	1
Discrete inputs	16
Discrete outputs [4]	16
Weld programmes	256
Pre-heat	✓
Main heat	✓
Post-heat [6]	✓
Slope	✓
Constant current	✓
Cascade/Mux [6]	8
Multi air valve [5,6]	8
Aux valves	7
Force profile [5]	✓
Electrodes	8
Real-time clock	✓
Data log (spot welds)	6000
Expansion slot	✓
Analog control mode [6]	✓

[1] Two simultaneous connections
[2] Standard on v2 model, otherwise requires plug-in adapter board.
[3] 0 to 10 V
[4] 24 V dc, short-circuit proof, monitored
[5] Guided contact safety relay, monitored
[6] Extended feature

The symbol **Extended** is used throughout this manual to indicate that the feature is available when the configuration parameter ***Features*** is set to ***extended***.

1.3. Weld schedule parameters

Presqueeze	✓
Squeeze	✓
Pre-heat	✓
Cool1	✓
Upslope	✓
Main heat	✓
Cool2	✓
Downslope	✓
Pulses	✓
Post-heat [1]	✓
Hold	✓
Off	✓
WAV selection [1]	✓
Aux valve control	✓
Retract/Hi-lift	✓
Electrode selection [1]	✓
Force profile [1]	✓
SCR selection [1]	✓
Current monitor	✓
Conduction monitor [1]	✓
Force monitor	✓
Spot weld	✓
Roll-spot weld [1]	✓
Seam weld [1]	✓

[1] Extended feature

The **extended features** option can be enabled for greater flexibility or more demanding applications.

1.4. Programming options

1.4.1. NetFlash

This PC-compatible program displays and allows editing of all welding parameters and status information.

In addition to programming, NetFlash provides backup/restore functions for control data, live data logging to a file and a utility for updating the firmware in the iPAK2.

1.4.2. WSP3 Pendant

iPAK2 works with the same WSP3 pendant that is used with EN7000, iPAK and WS2003. Access to all parameters is provided, plus diagnostic indication.

1.4.3. EtherNet/IP

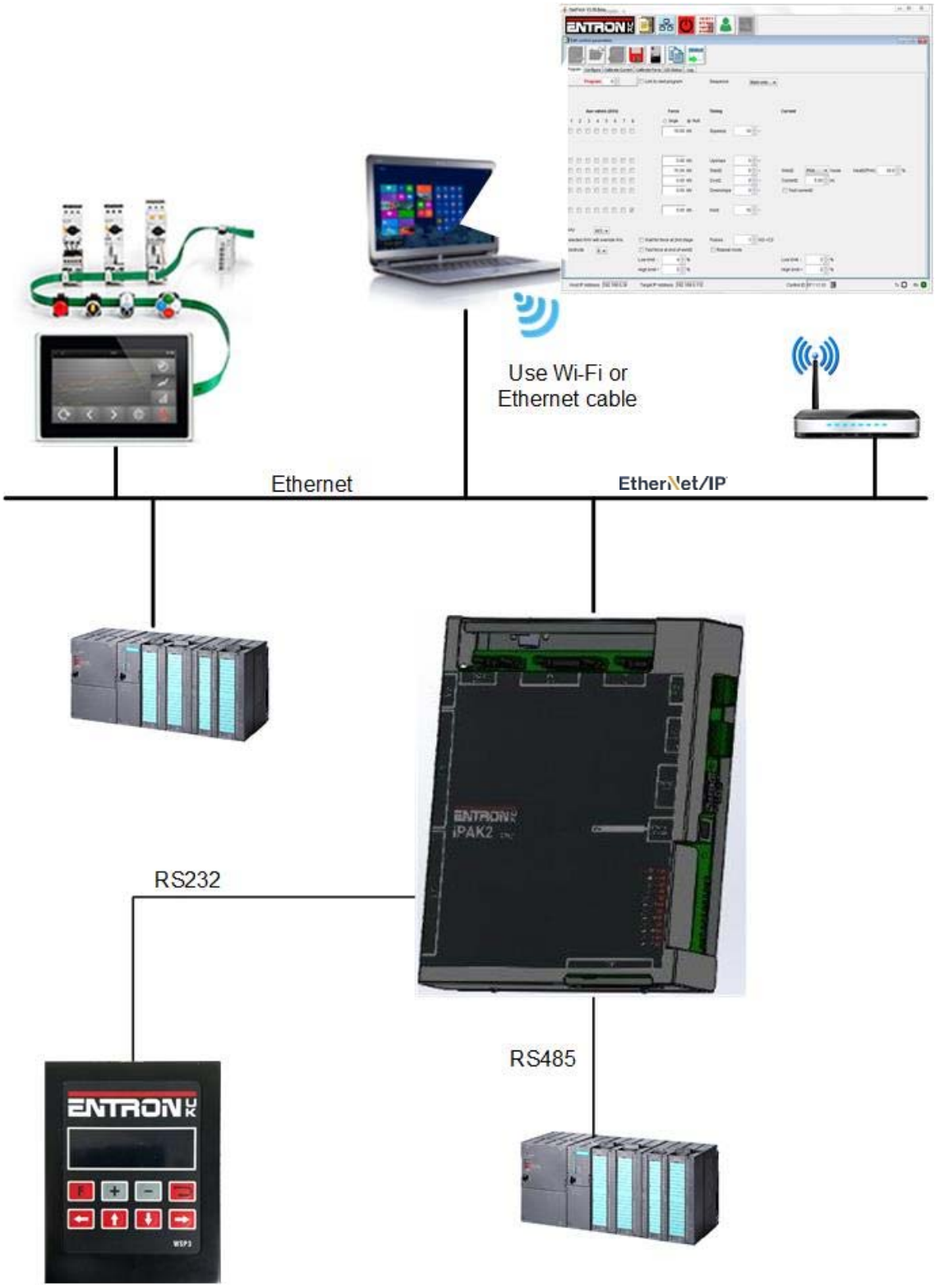
EtherNet/IP

On v2 models, EtherNet/IP is integrated as standard. On other models, an optional adapter card can be fitted to the expansion port, providing full data access via the EtherNet/IP protocol.

1.4.4. Modbus

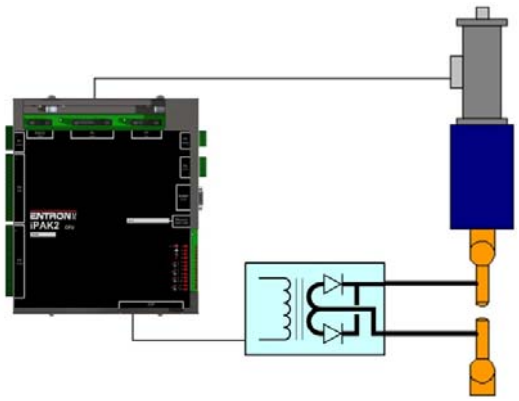
A PLC or HMI MODBUS master can be used to program, control and monitor iPAK2s. All parameters are directly mapped to MODBUS registers for easy access. Both MODBUS-TCP/IP (Ethernet) and MODBUS-RTU (RS485) protocols are supported.

1.5. Communications

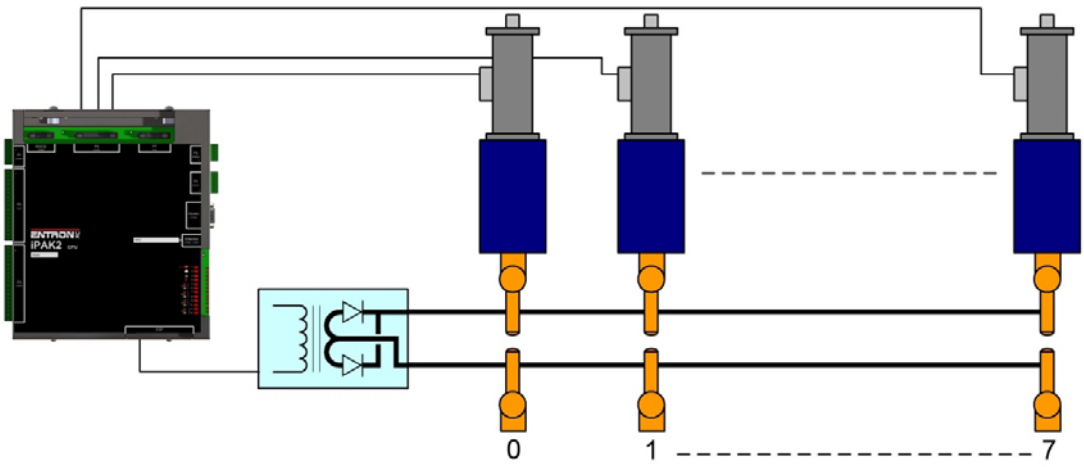


1.6. Applications

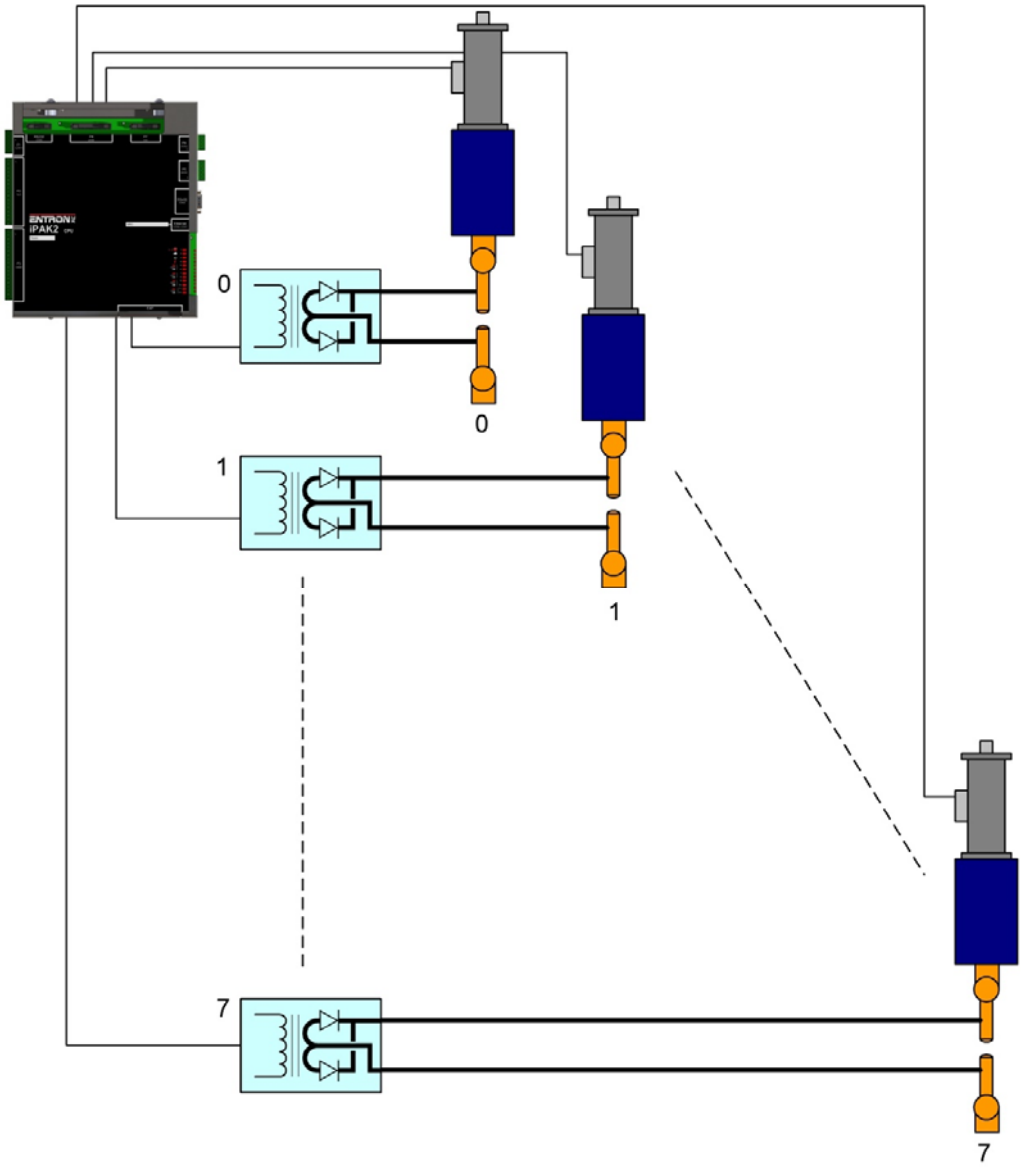
Standard machines, portable/manual guns, robot guns, multi-welders and seam welders.



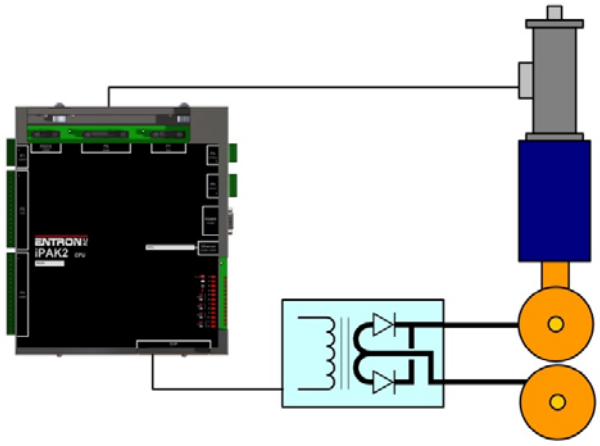
Standard machine.



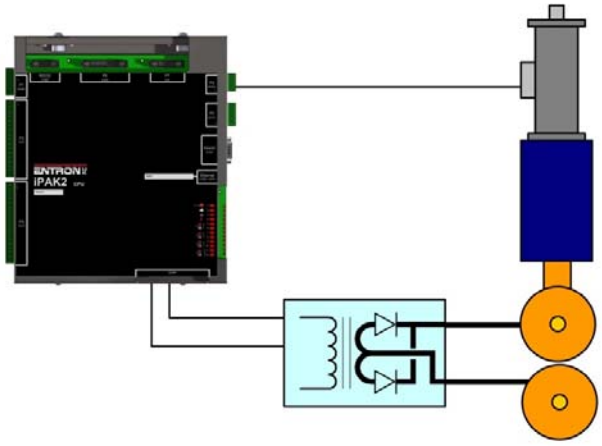
Multi-head machine. Up to eight cylinders. Cascade or independent firing.



Multi-welder. Up to 8 transformers and cylinders. Cascade or independent firing.



Seam welder with one transformer.



Seam welder with a multi-tap transformer.

2. Weld Control

iPAK2 controls the weld sequence by using the I/O in conjunction with the welding parameters. The parameters are stored in programs so that different materials and machine sequences can be used. There are 256 weld programs.

2.1. Sequence timing

Parameter	Units	Range	Description
Presqueeze	ms	0 - 1999	The time for the electrodes to close onto the work piece.
Squeeze	ms	0 - 1999	The time between the initial application of the electrode force and the first application of welding current
Pre-heat[1]	ms	0 - 1999	The pre-heat welding current is applied
Cool1[1]	ms	0 - 1999	The material is allowed to cool with electrode force applied
Upslope	ms	0 - 1999	Welding current is increased during this time
Main heat	ms	0 - 1999	The main welding current is applied
Cool2[2]	ms	0 - 1999	The material is allowed to cool with electrode force applied
Downslope	ms	0 - 1999	Welding current is decreased during this time
Post-heat[3]	ms	0 - 1999	The post-heat welding current is applied
Hold	ms	0 - 1999	Electrode force continues after the welding current has finished
Off[4]	ms	0 - 1999	Electrode force is released until the next sequence begins

[1] Pre-heat program option must be enabled to use this feature
[2] Pulsations program option must be greater than 1 to use this feature
[3] Post-heat program option must be enabled to use this extended feature
[4] Repeat mode or Roll-spot program option must be enabled to use this feature

Upslope can be used on hard, irregular shaped, oxidized and aluminium materials
Downslope can be used to reduce marking and embrittlement
Pre-heat and Post-heat can be used on hard or heat resistant metals

2.2. Program options

Each weld program has a number of optional features.

Parameter	Range	Description
Pre-heat	on/off	Enables or disables the Pre-heat parameters
Post-heat [2]	on/off	Enables or disables the Post-heat parameters
Pulsations	1 - 99	The number of times the Main heat – Cool2 interval is repeated
Link [2]	on/off	The next welding program will be started automatically if the input signals are maintained
Repeat	on/off	The welding program will be repeated if the input signals are maintained
Force profile	on/off	Use multiple force values during the weld
Inhibit [1]	on/off	An inhibited program will not run
C-Monitor shunt [2]	on/off	The measured conduction will be checked against the C-Monitor shunt limit
C-Monitor wear [2]	on/off	The measured conduction will be checked against the C-Monitor wear limit
Retry [2]	On/off	Weld schedule will re-run if a Low Main Current is detected – spot welds only.

[1] If an inhibited program is not linked then attempting to run it will produce an error message. If the program is linked, then the program will be skipped and the next linked program will run. This feature may be used to temporarily disable a program in a cascade.

[2] Extended mode must be set in ***Configuration*** to use this feature

Pulsations can be used to temper the material, control nugget growth and reduce electrode wear.
The START signal must be maintained for the full duration of the sequence if pulsations are set to 10 or more, otherwise the sequence will terminate after 10 pulses.

2.3. Current control

The weld programs contain the following current control parameters.

Parameter	Units	Range	Description
Pre-mode[1]		PW/CCu/CCC	Operating mode of the Pre-heat interval
Pre-heat[1]	%	0.0 – 99.9	The % heat used during the Pre-heat interval in PHA mode
Pre-current[1]	kA	0 – 500	The current used during the Pre-heat interval in CCC mode. Set point for monitoring.
Main mode		PW/CCu/CCC	Operating mode of the Main heat interval
Main heat	%	0.0 – 99.9	The % heat used during the Main heat interval in PHA mode
Main current	kA	0 – 500	The current used during the Main heat interval in CCC mode. Set point for monitoring.
Post mode[2]		PW/CCu/CCC	Operating mode of the Post-heat interval
Post heat[2]	%	0.0 – 99.9	The % heat used during the Post-heat interval in PHA mode
Post current[2]	kA	0 – 500	The current used during the Post-heat interval in CCC mode. Set point for monitoring.
Test current		on/off	Each current can be tested between limits
High limit	%	0 - 99	Current high limit
Low limit	%	0 - 99	Current low limit

[1] Pre-heat program option must be enabled to use this feature
[2] Post-heat program option must be enabled to use this extended feature.

2.3.1. PW mode

PW (Pulse-width) mode. The heat adjusts the output pulse-width. No current regulation takes place. The current parameter is used for monitoring only

2.3.2. CCu mode

CCu (Constant Current, uncalibrated) mode. The heat adjusts the output current within the range set by the configuration parameter ***Ip limit***. Current is regulated but the current parameter is used for monitoring only.

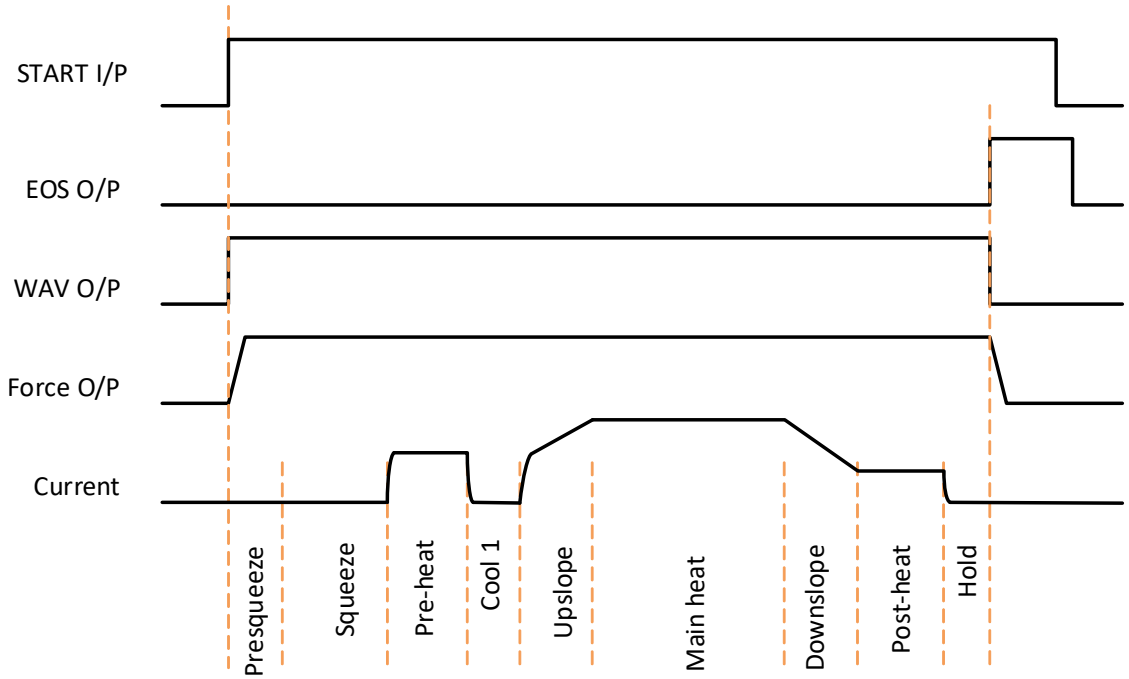
2.3.3. CCC mode

CCC (Constant Current, calibrated) mode. The current parameter sets the output current directly (in kA). Current is regulated. The current parameter is also used for monitoring. See ***Electrode management – CCC calibration***.

2.4. Timing diagrams

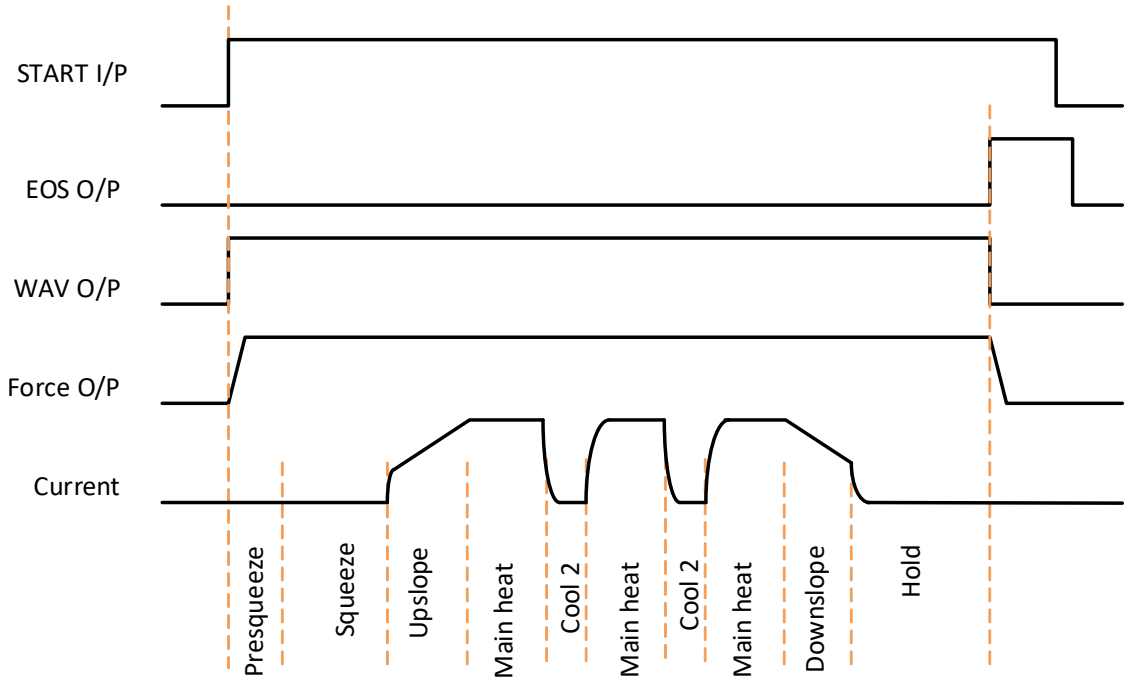
2.4.1. Spot weld

Pulsations = 1, Force profile = Off.



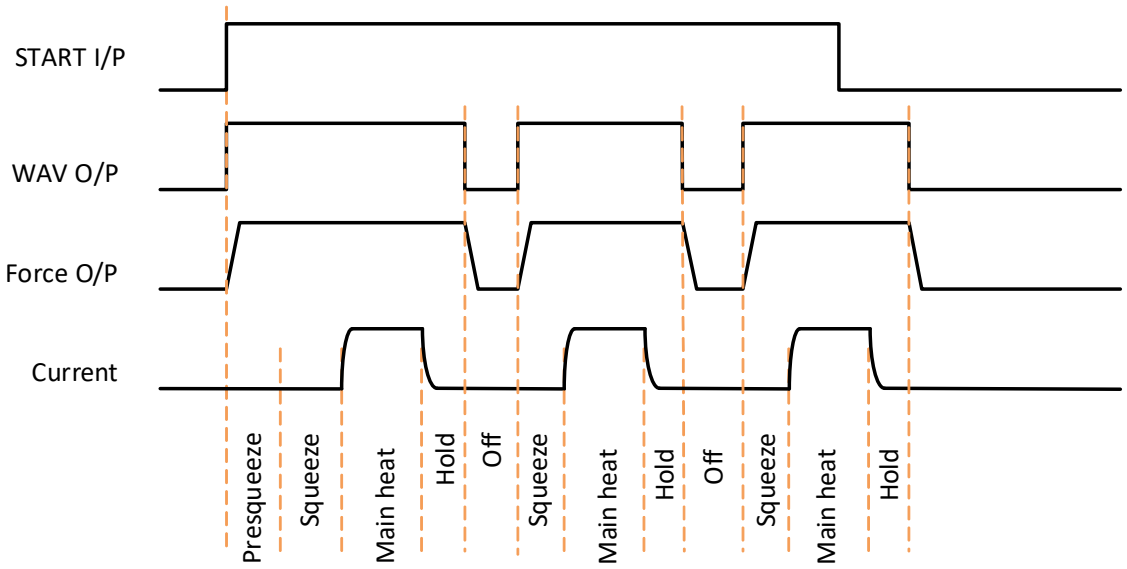
2.4.2. Spot pulsation

Pre-heat = 0, Cool1 = 0, Post-heat = 0, Pulsations = 3, Force profile = off.



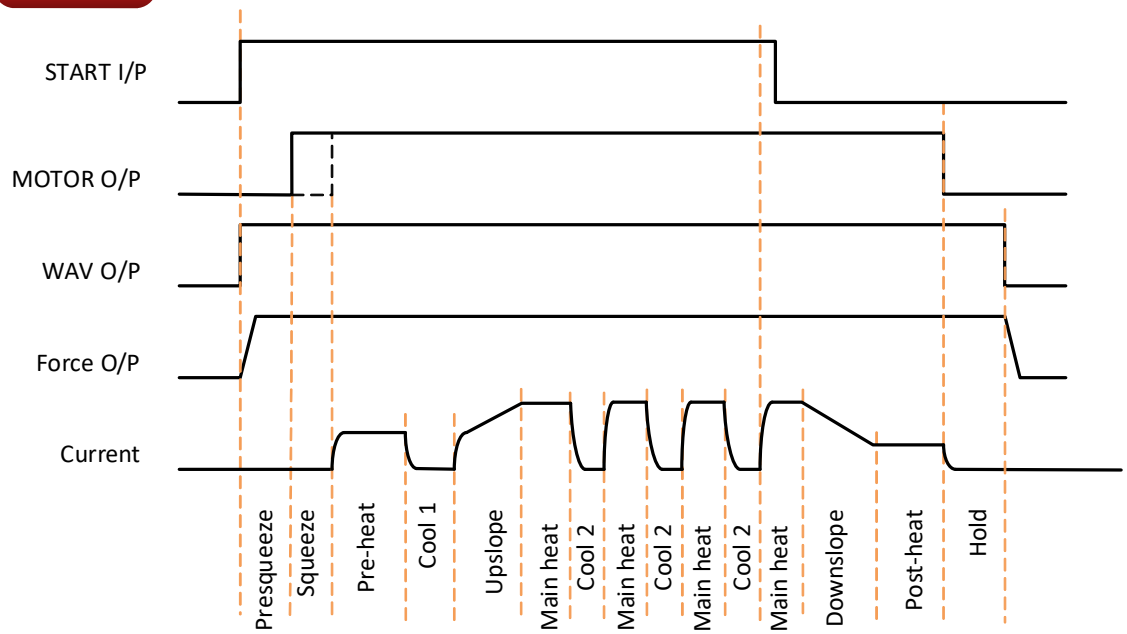
2.4.3. Spot repeat

Pre-heat = 0, Cool1 = 0, Upslope = 0, Downslope = 0, Post-heat = 0, Pulsations = 1, Force profile = Off.



2.4.4. Seam

Extended



The position of rising edge of the MOTOR output depends on the selection of the ***Second Stage*** configuration parameter.

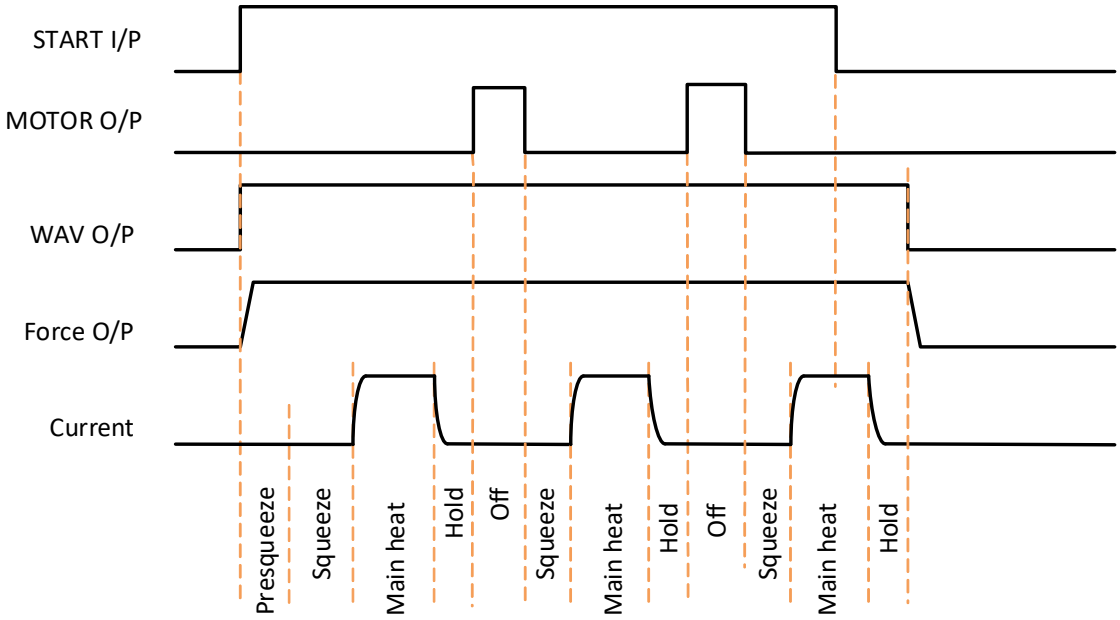
Continuous seam operation is obtained when Cool 2 = 0.

A spot weld (in Seam mode) can be produced by using the pre-heat with Main heat = 0.

2.4.5. Roll-spot

Extended

Pre-heat = 0, Cool1 = 0, Upslope = 0, Downslope = 0, Post-heat = 0, Pulsations = 1, Force profile = off.



To use Roll-Spot, set ***Seam*** welding in ***configuration***, then select the ***Roll-Spot*** option in the ***weld program***.

2.4.6. Second stage

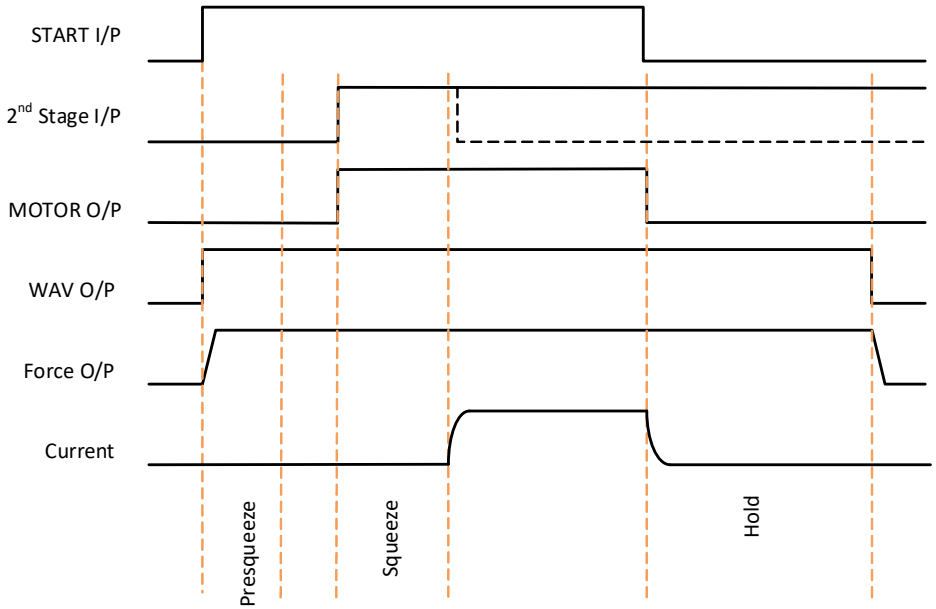
The second stage configuration parameter allows the user to select where in the sequence the second-stage test is to be performed.

Second Stage = Off

The input is not used. The MOTOR output will not be driven.

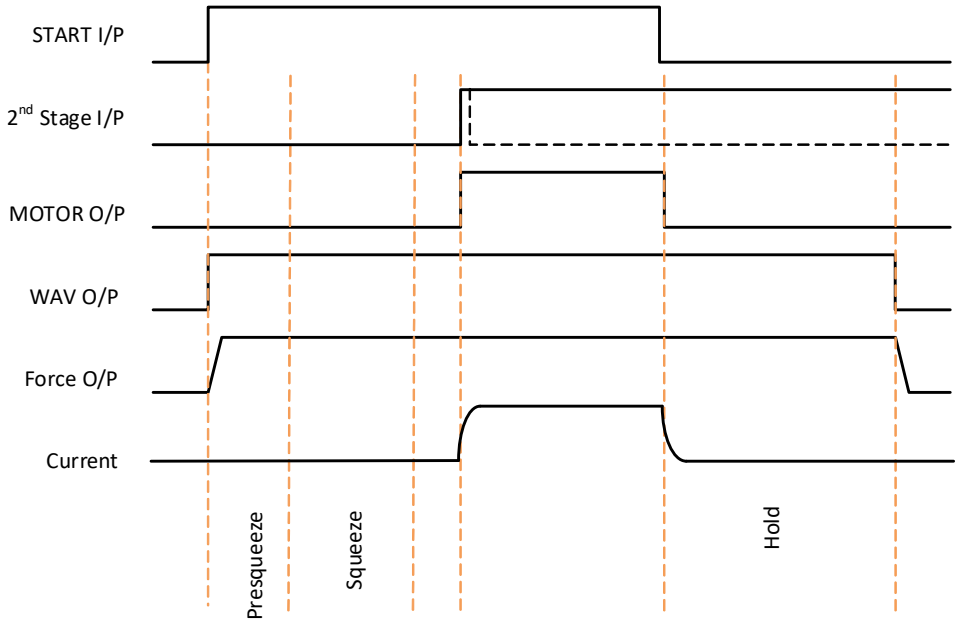
Second Stage = Before Squeeze

The input is checked before the squeeze time runs.



Second Stage = After Squeeze

The input is checked after the squeeze time runs.



2.4.7. Retract

The Retract function allows the welding head to open in two stages.

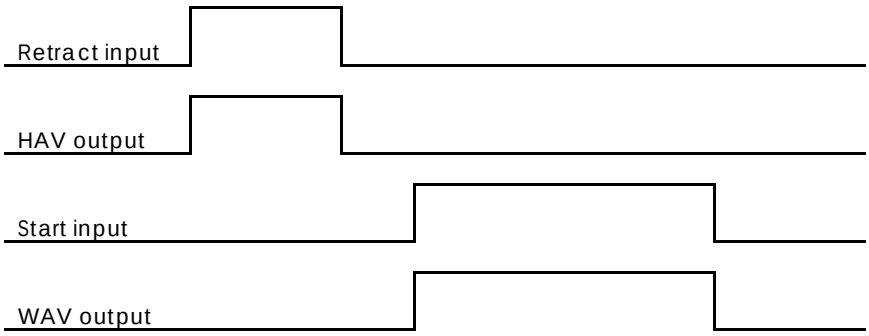
- The fully open position allows the work piece to be positioned between the electrodes.
- The middle position allows the electrodes to close onto the work piece in order to weld.

iPAK2 has four Retract modes that can be used depending on the application. The mode is selected in the Configuration settings. Use the ***Simple*** setting if no Retract function is required.

Simple

When the Retract Input is switched off, the Retract Air Valve switches off and the electrodes close to the mid position. Welding can proceed in this case.

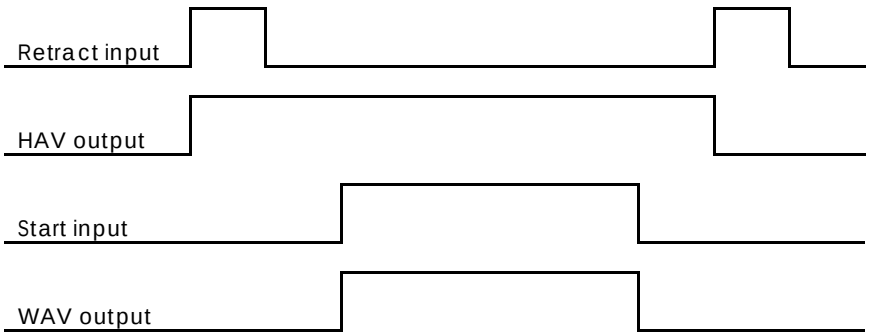
When the Retract Input is switched on, the Retract Air Valve switches on and the electrodes open fully. Welding cannot proceed in this case.



Hi-lift+

A pulse on the Retract Input causes the High Lift Air Valve to switch on and close the electrodes to the mid position. Welding can proceed in this case.

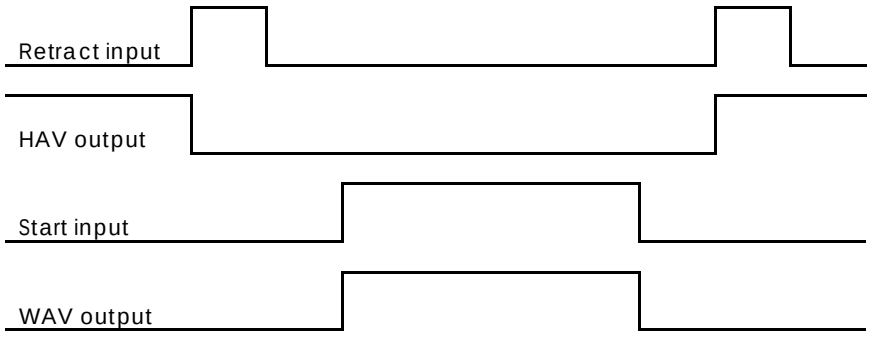
Whilst the High Lift Air Valve is on, a pulse on the Retract Input causes the valve to switch off and the electrodes go to the fully open position. Welding cannot proceed in this case.



Hi-lift-

A pulse on the Retract Input causes the High Lift Air Valve to switch off and close the electrodes to the mid position. Welding can proceed in this case.

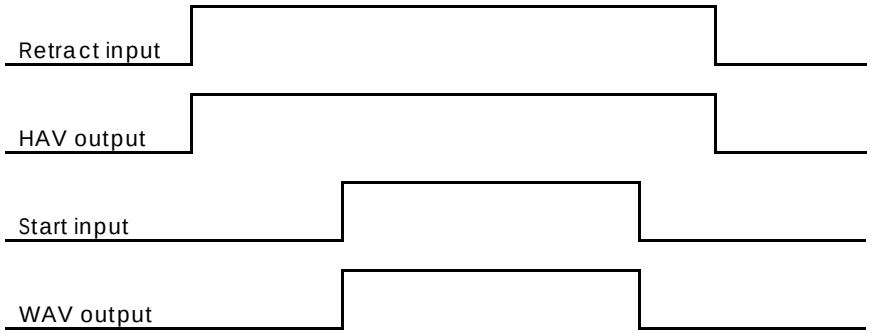
Whilst the High Lift Air Valve is off, a pulse on the Retract Input causes the valve to switch on and the electrodes go to the fully open position. Welding cannot proceed in this case.



Maintained

When the Retract Input is switched on, the High Lift Air Valve switches on and the electrodes close to the mid position. Welding can proceed in this case.

When the Retract Input is switched off, the High Lift Air Valve switches off and the electrodes open fully. Welding cannot proceed in this case.



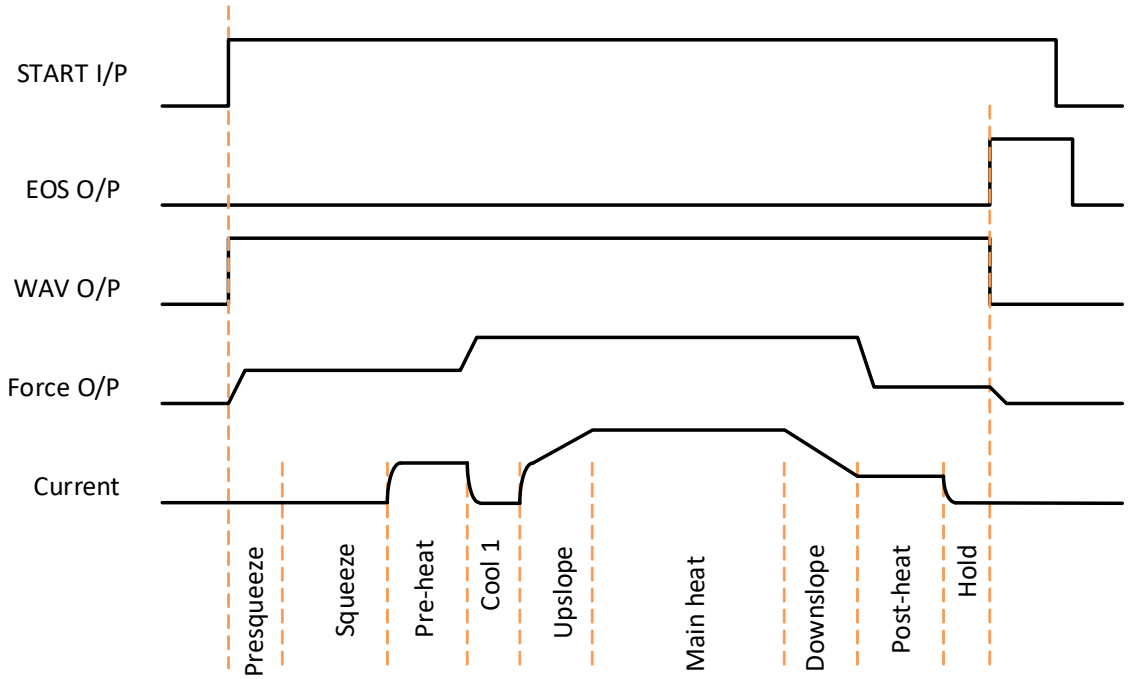
2.5. Force control

The weld programs contain the following force control parameters.

Parameter	Units	Range	Description
Squeeze[1]	kN/lbf	variable	Force used from the start of the Squeeze interval
Pre-heat[1]	kN/lbf	variable	Force used from the start the Pre-heat interval
Cool1[1]	kN/lbf	variable	Force used from the start the Cool1 interval
Upslope[1]	kN/lbf	variable	Force used from the start the Upslope interval
Main heat	kN/lbf	variable	Force used from the start of the Main heat interval
Cool2	kN/lbf	variable	Force used from the start of the Cool2 interval
Downslope[1]	kN/lbf	variable	Force used from the start of the Downslope interval
Post-heat[1]	kN/lbf	variable	Force used from the start the Post-heat interval
Hold[1]	kN/lbf	variable	Force used from the start the Hold interval
Wait for force[2]		on/off	Wait until the applied force has been reached
Test force		on/off	Test the applied force at the end of the Main interval
High limit	%	0 - 99	Force high limit
Low limit	%	0 - 99	Force low limit

[1] Force profile program option must be enabled to use this extended feature. If the force profile option is disabled the Main heat force is used for the duration of the weld.
[2] Occurs at the same time as 2nd stage. If Wait for force is required without 2nd stage, select 2nd stage Before or After Squeeze (See Configuration section) and permanently assert the 2nd stage input.
The Force profile option allows users to dynamically change the force to a different setting for each interval in the weld sequence.

e.g. spot weld with force profile active:



2.6. Valve control

iPAK2 has eight discrete outputs (AV1 – AV8) that can be operated independently during a weld sequence. The valves are categorised as WAV, MOTOR[1] or AUX valves.

- A WAV valve turns on at start of sequence and turns off at the end of the Hold interval.
- A MOTOR valve turns on after the 2nd stage test (see Configuration section), and turns off at the start of the Hold interval.
- An AUX valve may be programmed to come on during any interval of the weld sequence, including the Off time in repeat or roll-spot mode.

iPAK2 features parameter	Configuration	WAV function	MOTOR function	Description
Standard	All	AV1	n/a	AV1 is automatically selected
Extended (spot)	Single electrode	AV1	n/a	AV1 is automatically selected
	Multi-electrode	AV1 – AV8	n/a	Any combination of AV1 to AV8 may be selected
Extended (seam)	Single electrode	AV1	AV2	AV1 and AV2 are automatically selected
	Multi-electrode	AV1 – AV8	AV1 – AV8	Any combination of AV1 to AV8 may be selected

Valves not being used for the WAV or MOTOR function may be used as AUX valves. WAV/MOTOR settings always override any corresponding AUX settings.

The weld programs contain the following valve control parameters.

Parameter	Units	Range	Description
WAV		AV1 – AV8	WAV output
Motor [1]		AV1 – AV8	Motor output
Squeeze	AV1 – AV8	on/off	Valve states during the Squeeze interval
Pre-heat	AV1 – AV8	on/off	Valve states during the Pre-heat interval
Cool1	AV1 – AV8	on/off	Valve states during the Cool1 interval
Upslope	AV1 – AV8	on/off	Valve states during the Upslope interval
Main heat	AV1 – AV8	on/off	Valve states during the Main heat interval
Cool2	AV1 – AV8	on/off	Valve states during the Cool2 interval
Downslope	AV1 – AV8	on/off	Valve states during the Downslope interval
Post-heat	AV1 – AV8	on/off	Valve states during the Post-heat interval
Hold	AV1 – AV8	on/off	Valve states during the Hold interval
Off [2]	AV1 – AV8	on/off	Valve states during the Off interval

[1] Seam mode only.
[2] Repeat mode or Roll-Spot program option must be enabled to use this feature.

2.6.1. Valve delays

An on-delay may be applied to any of the AUX valves. The delay is triggered when a valve is programmed to turn on at the start of any interval. The actual turn-on time is delayed by the time value entered in the appropriate delay parameter.

- If a valve is programmed to turn off, then the delay is reset.
- All delays are reset at the end of the HOLD time.
- If a valve has been selected to operate as a WAV or MOTOR function, then the delay for that valve is not used.

See tutorials section for examples

Each weld program has a corresponding extension. Each weld program extension contains the following parameters:

Parameter	Units	Range	Description
AV1 Delay	ms	0..9999	Delay on for AV1
AV2 Delay	ms	0..9999	Delay on for AV2
AV3 Delay	ms	0..9999	Delay on for AV3
AV4 Delay	ms	0..9999	Delay on for AV4
AV5 Delay	ms	0..9999	Delay on for AV5
AV6 Delay	ms	0..9999	Delay on for AV6
AV7 Delay	ms	0..9999	Delay on for AV7
AV8 Delay	ms	0..9999	Delay on for AV8

2.7. Multi-Electrode operation

Extended

Each welding program can be assigned an electrode:

Parameter	Units	Range	Description
Electrode		0 - 7	The electrode number

When a program is run, the iPAK2 will automatically trigger the correct transformer by referencing the electrode/transformer assignment. In addition, the electrode number is also used to access the appropriate stepper, counter and calibration information

2.8. Program selection

There are options for setting the way in which weld programs can be selected.

2.8.1. Internal program selection.

If the '***Program select***' configuration parameter is set to '***Internal***', then the program to be used is taken from the '***Use program***' configuration parameter. This can be set by programming, either manually or via a communications interface.

2.8.2. External program selection

If the '***Program select***' configuration parameter is set to '***External***', then the program to be used is read from the interface set in the '***I/O source***' configuration parameter. Note that the Discrete interface can only select programs 0 to 127. The Bus interfaces can select programs 0 to 255.

2.8.3. Program selection for Spot welding

The program select inputs are scanned at the same time as the START signal. The inputs be changed after the program begins without affecting the weld in progress.

2.8.4. Program selecting for seam welding

Extended

The program select inputs are scanned at the same time as the START signal. The inputs may be changed during welding and the control will switch to the newly selected program.

2.9. Analog control

Extended

If the '***Analog control'*** configuration parameter is set to '***ON***', then the output current can be controlled by applying a 0 to 10 Volt signal to P4 pins 1(+) and 2(-). The program will track the analog input, allowing the user to create custom current profiles.

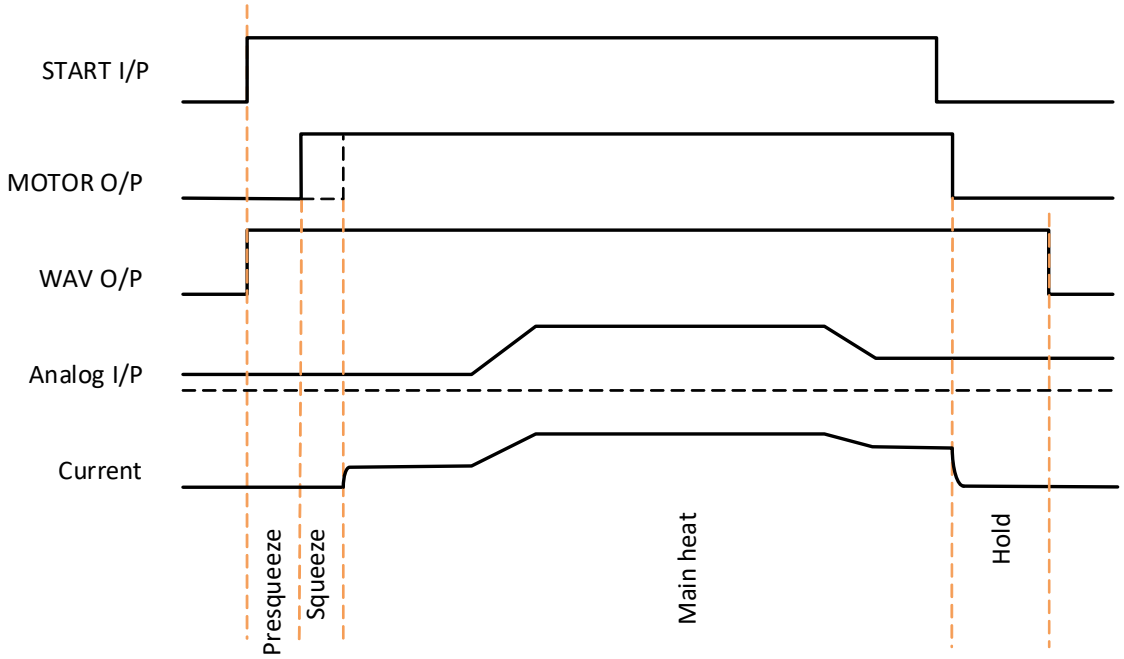
Note:

- Pre-heat and post-heat are not available
- Force feedback is not available

The input signal will control a different parameter depending on the mode set in the selected weld program:

Main mode	0 to 10 V input signal controls
PW	0 to 100% pulse-width
CCu	0 to 100% heat (configured current)
CCC	0 to 100% calibrated current.

e.g. Seam weld, Cool 2 = 0.



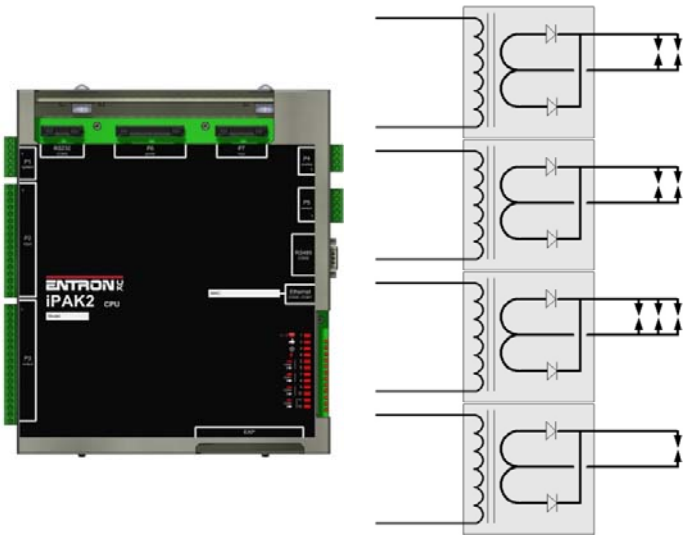
3. Multi-weld operation

Extended

There are two methods available for multi-welding:

- Multi-Electrode operation allows each welding program to be triggered independently but allows for selection of a transformer and electrode.
- Cascade operation allows welding programs to be linked together and triggered from a single start command. The programs then ripple through with minimal time between them, selecting transformers and electrodes on the fly. The linked programs are known as a cascade.

Up to eight transformers can be directly connected.



Up to 8 electrodes can be assigned to the welding transformers

The electrode number is assigned in the weld program:

Weld program parameter	Units	Range	Description
Electrode		0 - 7	The electrode number

Each electrode is assigned to a transformer:

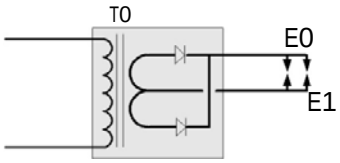
Electrode parameter	Units	Range	Description
Transformer		0 - 7	The transformer that the electrode is connected to

The weld programs may be linked together to create cascade sequences of programs, each using a different SCR/Transformer/Electrode combination.

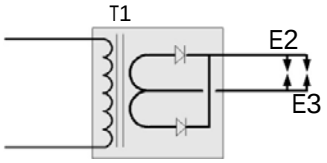
Weld program parameter	Units	Range	Description
Linked program		0 - 255	The next program in the cascade sequence
Link		Off/On	

Example: the diagram below shows how the electrodes can be assigned to transformers/SCRs

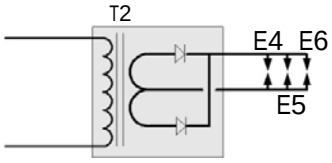
Electrodes 0 and 1 are assigned to transformer/SCR 0



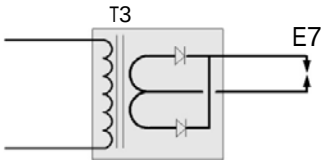
Electrodes 2 and 3 are assigned to transformer/SCR 1



Electrodes 4, 5 and 6 are assigned to transformer/SCR 2

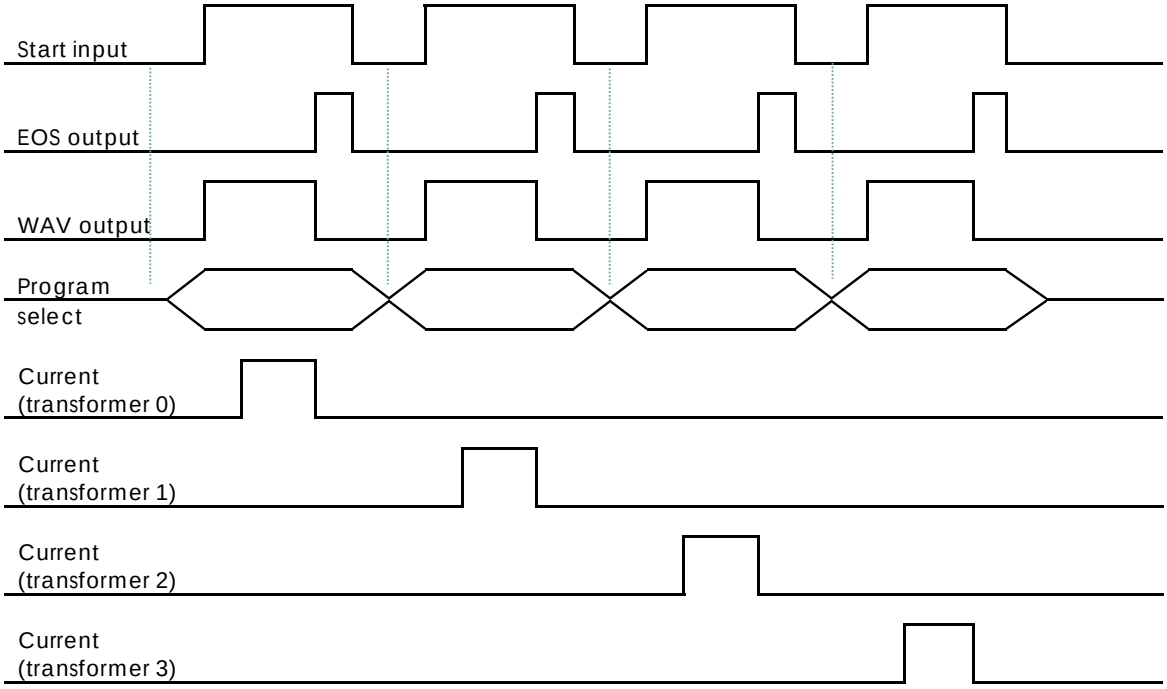


Electrode 7 is assigned to transformer/SCR 3



3.1. Multi-Electrode operation

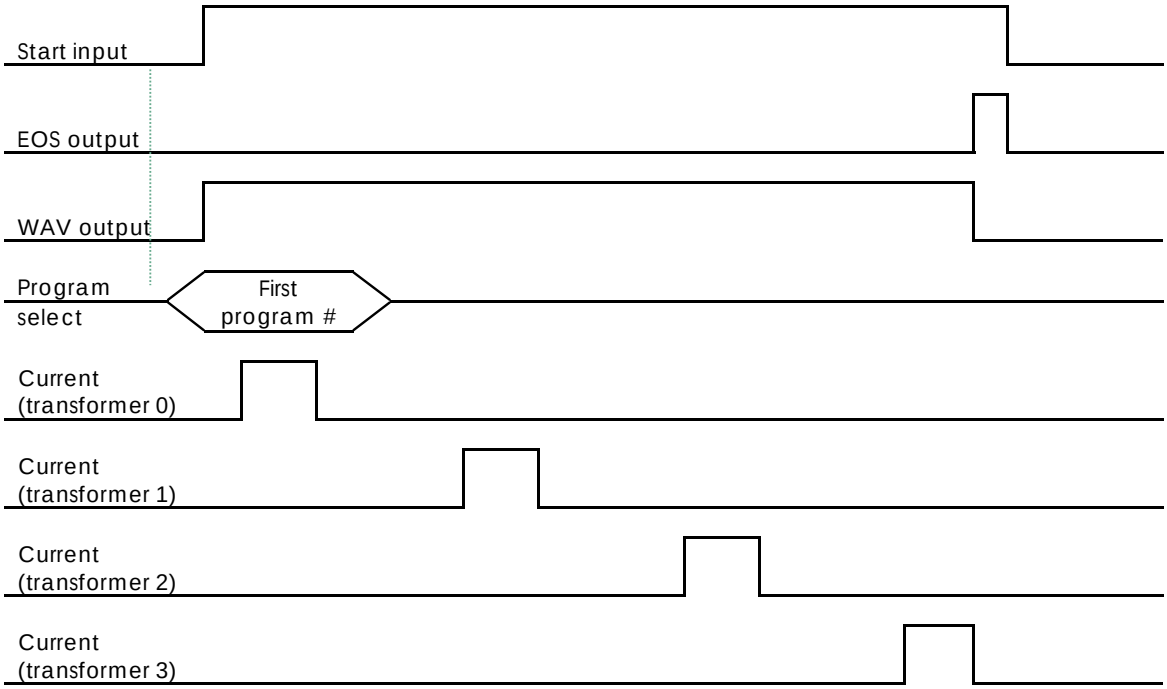
Each welding program is started independently but different electrodes and transformers can be selected.



The WAV signal can use a different output for each program

3.2. Cascade operation

Different electrodes and transformers can still be selected but the welding programs are linked together and started by a single Start command. Cancelling the Start command at any time will abort the cascade sequence.



In cascade operation, the program select inputs determine the first program in the cascade. The Link program parameter specifies the next program in the cascade. The cascade ends when a program runs with its Link option set to Off.

If a fault occurs during a cascade sequence:

Configuration parameter '***Stop on fault***'	Description
Off	Cascade will continue. Fault output will remain on only until next weld.
On	Cascade will pause. Cascade will continue when the fault is reset.

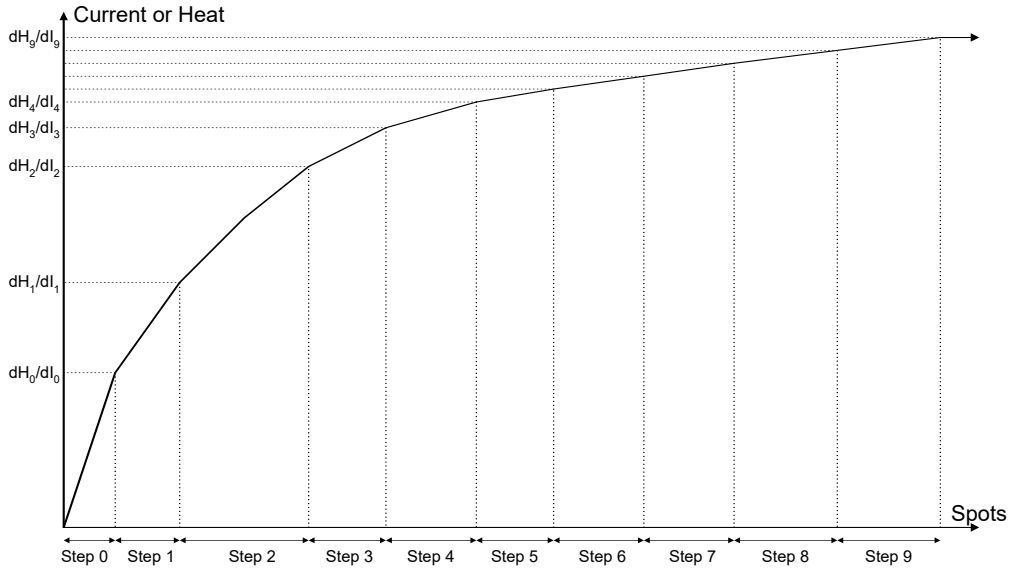
4. Electrode management

Electrode management is provided via a combination of stepper, counter and calibration functions. The stepper provides a means of gradually increasing the current to compensate for electrode wear. The counter counts the number of welds that the electrode has done and allows the electrode to be dressed a number of times before it is replaced.

If configured for extended features, eight steppers and counters can be assigned to up to eight transformers. When a program is run, the iPAK2 will automatically trigger the correct transformer by referencing the electrode/transformer assignment. In addition, the electrode number is also used to access the appropriate stepper, counter and calibration information.

4.1. Steppers

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



Parameter	Units	Range	Description
Step		0 - 9	The step number
Spots	welds	0 - 9999	The number of welds in the step
+Heat	%	0.0 - 50.0	The increase in heat during the step
+Current	%	0.0 - 50.0	The increase in current during the step
Preset		1 - 5	Apply predefined values to the stepper curve
Enable stepper		on/off	Enables or disables the stepper
Stop at end		on/off	iPAK2 can inhibit welding at the end of the last step
Spots done	welds	0 - 99999	The number of welds that have been done since the last reset

P/W and CCu modes will make use of both the +Heat and +Current parameters. CCC mode uses only the +Current parameters.

The Stepper output is active at the end of the last step. The Prewarn output is active during the last step.

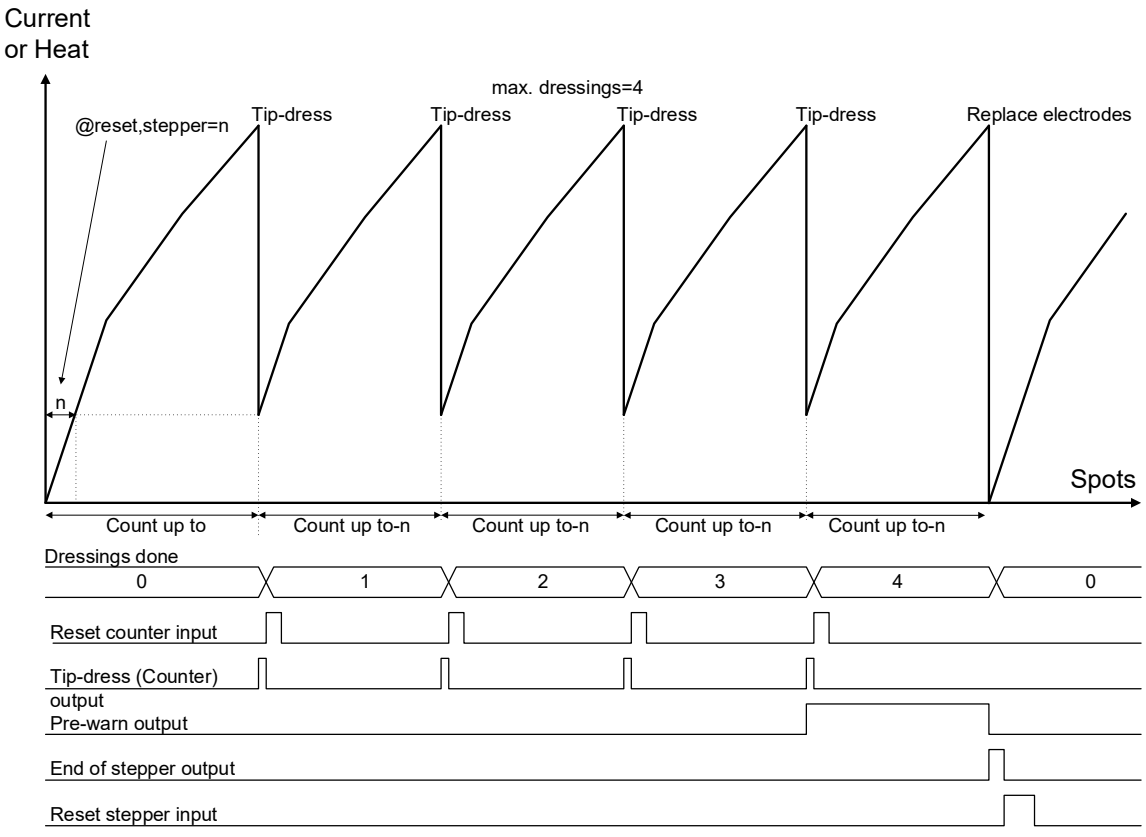
To get started enter the values for Step 9 then select a Preset to load the intermediate values

4.2. Counters

A counter is programmed by entering values related to the electrode maintenance and lifetime.

Parameter	Units	Range	Description
Enable counter		on/off	Enables or disables the counter
Count	welds	0 - 9999	The number of welds that have been done since the last reset
End count	welds	0 - 99999	The maximum number of welds that can be done
Stop at end		on/off	iPAK2 can inhibit welding until the counter is reset
Enable tip dress		on/off	Enables or disables the tip dressing feature
Dressings done		0 - 9999	The number of times the electrodes have been dressed
Max dressings		0 - 9999	The maximum number of times the electrodes can be dressed
Reset to	welds	0 - 9999	The weld count following a tip dress operation

If tip dressing is enabled iPAK2 will activate the Tip Dress Request output when the Count value is reached.



4.3. Current calibration

Current is measured by one of two methods:

1. Primary current is measured by the iPAK2 built-in CT.
2. Secondary current can be measured via an externally connected Toroid (spot weld modes only).

The method is selected by the Configuration parameter ***Measure***.

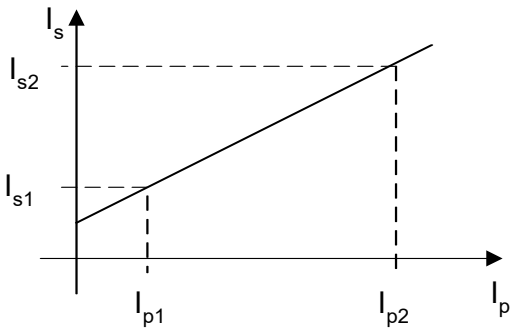
4.3.1. Maximum Primary Current

The inverter chassis has a maximum output current specification dependant on the inverter size. The iPAK2 detects this value on power-up and sets it as an absolute maximum. The output current can be set below this maximum value. It is important to do this before attempting any of the following calibration procedures (see ***Configuration*** section).

4.3.2. Current measurement by built-in CT

In order to display secondary current, there are two methods provided for conversion:

1. Turns ratio: The turns ratio may be obtained from the welding transformer data. The displayed secondary current will be the measured primary current multiplied by this value. This method does not allow for losses in the transformer but will provide reasonable accuracy.
2. Points 1&2: This is the more accurate method and also calibrates the iPAK2 to match an external current meter. Two test welds establish the relationship between primary current (as measured by the CT) and secondary current measured using the external meter as follows:
   - Initially, select the turns-ratio method and set the turn ratio to 1:1 so that the iPAK2 measures and displays primary current.
   - Produce a short circuit weld at a low heat in CCu mode and note the primary current (Ip1) from the iPAK2 and the corresponding secondary current (Is1) using an external weld current meter.
   - Repeat the short circuit weld at a higher heat and note again the primary current (Ip2) and secondary current (Is2).
   - Now select the Points 1&2 method and enter the four measurements (Ip1, Is1 and Ip2, Is2).



The iPAK2 uses the characteristic to calculate the secondary current from the measured primary current.

4.3.3. Current measurement by external toroid (spot weld only)

A toroid (Rogowski coil) is connected around the welding transformer secondary. Most such coils have a nominal output of 150 mV/kA. The iPAK2 provides a sensitivity parameter which may be adjusted to provide for absolute matching with an external current meter.

At the nominal 150 mV/kA, iPAK2 will handle signals corresponding to about 50 kA. If the current is expected to exceed 50 kA then it is necessary to use an attenuator device such as a TAM/1 between the toroid and iPAK2. The attenuator will have options for x1, x2, x3, x4 etc. The factor selected should be entered into the iPAK2 so that it is able to calculate the actual current from the (attenuated) measured current.

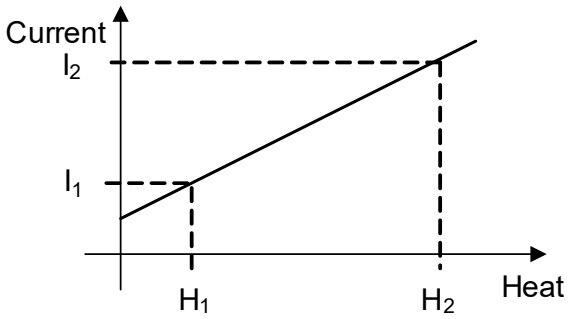
In multi-electrode or multi-transformer (cascade) systems it may be difficult to arrange toroids for multiple secondary circuits. The toroids need to be switched in and out of circuit at the appropriate moment in the sequence or errors will occur. In these circumstances use the CT measurement method. The CT method has the advantage of not requiring an external toroid.

Parameter	Units	Range	Description
Max. primary current	A	0 - max	Limits maximum output
Conversion method		points/ratio	Method used to convert primary current to secondary current
Turns ratio		1 - 999	The turns ratio of the welding transformer
Point 1 (primary)	kA	0 - 32.0	The measured value of primary current at a low heat (Ip1)
Point 1 (secondary)	kA	0 - 500.0	The measured value of secondary current at a low heat (Is1)
Point 2 (primary)	kA	0 - 32.0	The measured value of primary current at a high heat (Ip2)
Point 2 (secondary)	kA	0 - 500.0	The measured value of secondary current at a high heat (Is2)
Toroid	mV/kA	100 - 60000	The sensitivity of the toroid
Toroid factor		1 - 10	The ratio of the external attenuator (1 if no attenuator fitted)
Blanking time	ms	0 - 99	Initial section of a spot weld NOT included in current measurement. Default value = 40 ms.

4.4. CCC calibration

The current must be calibrated (See 4.3) before carrying out the following procedure.
When operating in CCu mode the inverter uses the Heat parameter to determine the output current. In order to be able to control the output current directly in amps it is necessary to establish the relationship between Heat and Current as follows:

- Produce a short circuit weld at a low heat in CCu mode and note the heat setting (H1) from the iPAK2 and the corresponding measured current (I1).
- Repeat the short circuit weld at a higher heat and note Heat (H2) and Current (I2).
- Enter these values as the 'Points 1&2' parameters in CCC calibration.



The iPAK2 will use these values to determine the relationship between Heat and Current. CCC mode can now be selected in the welding schedules and required current programmed directly in amps. The Heat parameter is no longer required.

This calibration also assists the iPAK2 to produce a rapid rise-time to the desired current without causing any significant transient conditions.

Parameter	Units	Range	Description
Point 1 (heat)	%	0 – 99.9	The set value of low heat (H1)
Point 1 (current)	kA	0 - 500.0	The measured value of current at a low heat (I1)
Point 2 (heat)	%	0 – 99.9	The set value of high heat (H2)
Point 2 (current)	kA	0 - 500.0	The measured value of current at a high heat (I2)

In multi-electrode systems there are separate calibration files for each electrode. Each electrode must be calibrated before being used.

4.5. Force calibration

The analog input and analog output can be used for force control in terms of kN or lbf when they have been calibrated.

Parameter	Units	Range	Description
OUT Point 1	mV	0 - 10000	Analog output (point 1)
OUT Point 1	kN/lbf		Measured output force (point 1)
OUT Point 2	mV	0 - 10000	Analog output (point 2)
OUT Point 2	kN/lbf		Measured output force (point 2)
IN Point 1	mV	0 - 10000	Analog input (point 1)
IN Point 1	kN/lbf		Measured input force (point 1)
IN Point 2	mV	0 - 10000	Analog input (point 2)
IN Point 2	kN/lbf		Measured input force (point 2)

The relationship between the analog input and output and the electrode force can be determined by measuring the values at two points. The values define a linear relationship between mV and kN/lbf.

The force can be independently calibrated for each electrode.

5. Input/Output (I/O)

Inputs and output signals which are used to operate the control can be taken from a number of sources:

- Discrete connections
- Modbus messages
- EtherNet/IP

The ***I/O Source*** configuration parameter selects which interface is active.

5.1. Inputs

Input	AWS designation	Description
Start	FS1	When this input is activated a weld sequence begins. If the input is removed during the Squeeze interval the sequence is aborted. If the input is maintained through the Squeeze interval but switched off subsequently, the sequence terminates normally.
Weld on [1]	NW1	This input enables the weld current. If this input is inactive a weld sequence will not produce any current.
Stop [1]	ES1	Sequencing is inhibited or aborted if this input is not active.
Thermal [2]	TT1	This input is usually connected to a normally closed thermal contact attached to the weld transformer. Sequencing is inhibited if this input is not active.
2nd stage	PS1	If enabled, iPAK2 checks that the 2nd Stage signal is present before proceeding to weld. The checking is programmable to take place either before or after the Squeeze interval. If the signal is not present iPAK2 waits for the signal before it proceeds. If the Start signal is removed while waiting, the sequence is aborted.
Retract	RT1	This input is used to control the Retract function.
Reset fault	FR1	This input resets the Fault output and clears the status messages. Only momentary application is required (minimum time 40ms).
Reset counter / tip dress acknowledge [3]		Used to reset the counter(s) or acknowledge a tip dress request.
Reset stepper [4]	SR1	Used to reset the stepper(s).
P1	BP1	Program select inputs. Weld program selection is made by applying the binary code for the required program. Programs 0 to 127 can be selected via the discrete interface. Programs 0 to 255 can be selected internally, via Modbus or via EtherNet/IP. If the 'key-switch' security option is selected, then input P64 (on the discrete interface only) is not available. In this case, programs 0 to 63 can be selected (programs 64 to 255 can still be selected internally or via the fieldbus).
P2	BP2	
P4	BP4	
P8	BP8	
P16	BP16	
P32	BP32	
P64 / Edit enable [5]	BP64	
P128	BP128	

[1] The discrete connection for this input is always required, even when the I/O source is Modbus or EtherNet/IP.

[2] The signal from the discrete interface is always used, even when the I/O source is Modbus or EtherNet/IP where there is no equivalent signal.

[3] Momentary operation will reset all expired counters. If maintained for more than 5 seconds all counters will be reset, regardless of status.

[4] Momentary operation will reset all expired steppers. If maintained for more than 5 seconds all steppers will be reset, regardless of status.

[5] The Edit enable function is only available on the Discrete interface. This bit is always P128 on other interfaces.

5.2. Outputs

Output	AWS designation	Description
EOS	EH1	This output switches on to indicate the end of the weld sequence.
HAV	RV1	Used in conjunction with the Retract input to control the welding head.
Fault	FT1	This output indicates a fault condition.
Ready [1]		This output is active if iPAK2 is ready to weld. The output switches off under some fault conditions.
Contactor	MC1	This output can be used to control an isolation contactor.
Counter / tip dress request		This output indicates that the counter has reached its limit or that a tip dressing operation is required.
Stepper		This output indicates that the stepper has reached its limit.
Pre-warn		This output indicates that the stepper is close to its limit.
AV8		Additional outputs that can be used during the weld sequence to control valves etc.
AV7		
AV6		
AV5		
AV4		
AV3		
AV2		
AV1		

[1] If iPAK (v1) mode is selected (see **Configuration**)

- the sense of the READY output is reversed and it signifies NOT READY
- outputs AV4, 5, and 6 are used for MUX selection and are not available

5.3. Softstart

Some configurations offer a ***Softstart*** feature. This works by sending a software command to start a weld program. Be aware that if the hardware ***START*** input is not closed, then AV1-8 cannot operate and hence anything connected to these outputs will not work. Examples include:

- Any air-valve including WAV.
- Transformer selection using an external decoder in iPAKv1 mode.

5.4. Analog signals

Signal	P4 pin
Analog Input Ch1 (0...10V)	1
0V	2
Analog Output (0...10V)	3
Ground (screen)	4

Signal	P5 pin
Analog Input Ch2 (0...10V)	1
Analog Input Ch2 (0...10V)	2
Toroid	3
Toroid	4
Ground (screen)	5

5.4.1. Analog input Ch1

0 to 10 V analog input.

Analog control Configuration parameter set to ***Off***: Used to monitor a proportional air regulator valve output or other sensor for force control and monitoring. Scaling is set in Force calibration.

Analog control Configuration parameter set to ***On***: Used as the current control input (see configuration section).

5.4.2. Analog output

0 to 10 V analog output.

Analog Out Configuration parameter set to ***Force***: Outputs the force control signal to drive a proportional air regulator valve. Scaling is set in Force calibration.

Analog Out Configuration parameter set to ***Current***: Outputs a signal representing the measured current. Scaling must be set in the ***Waveform 10V=*** configuration parameter.

5.4.3. Analog input Ch2

0 to 10 V analog input.

5.4.4. Toroid

Spot welds only. A toroid (Rogowski coil) may be used for measuring the current (normally on the secondary side of the power transformer). Sensitivity may be set in current calibration (see Current calibration section).

If the ***Toroid test*** configuration parameter is set to ***On***, then the resistance must be in the range 10 to 300 Ohms.

5.5. Discrete interface

24V DC only. Do **not** connect to 110V AC!

5.5.1. Inputs

Current sinking. Connect input to 24V DC to activate.

Input	P1 pin
Stop	3
Thermal	4
Weld on	5

Input	P2 pin
24 VDC output	1
Start	2
P1	6
P2	7
P4	8
P8	9
P16	10
P32	11
Reset stepper	12
Reset counter / tip dress acknowledge	13
Retract	14
Reset fault	15
2nd stage	16
P64 / Edit enable	17

5.5.2. Outputs

Current sourcing. Connect load between output and 0V.

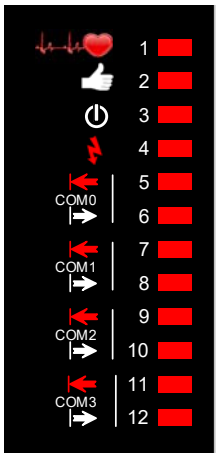
Output	P3 pin
AV1	1
AV2	2
AV3	3
HAV	4
Counter / tip dress request	6
Stepper	7
Pre-warn	8
AV4	9
AV5	10
AV6	11
AV7	12
AV8	13
EOS	14
Fault	15
Ready	16
Contactor	17
0V (SVC)	18

5.6. LED indicators

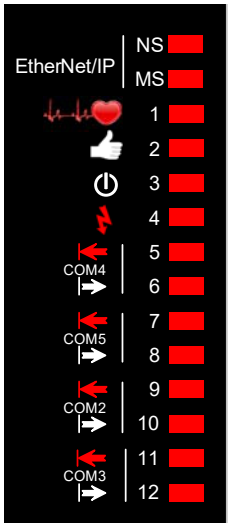
An array of LEDs, visible on the side of the control indicate activity:

LED	FUNCTION
MS [1]	EtherNet/IP module status
NS [1]	EtherNet/IP network status
1	Heartbeat (Flashes at 1 Hz)
2	Ready (Flashes at 1Hz)
3	Sequence initiated
4	Weld current
5	Data receive COM0/4
6	Data send COM0/4
7	Data receive COM1/5
8	Data send COM1/5
9	Data receive COM2
10	Data send COM2
11	Data receive COM3
12	Data send COM3

[1] On v2 model only. This same indicator is visible on the adapter board (if fitted) on non-v2 model.



iPAK2



iPAK2v2

5.6.1. Heartbeat LED (1)

This LED should always be flashing at 1Hz. The duty indicates:

- Long ON, short OFF: The control is in BIOS only mode. Use NetFlash to install an application.
- Short ON, long OFF: The control is running an application.

5.6.2. Ready LED (2)

- Flashing at 1 Hz: The control is ready for use.
- Off: The control is not Ready. Check status messages.

5.6.3. Sequence LED (3)

The control has accepted a START signal and is running a weld program

5.6.4. Weld LED (4)

Lights when the control turns on the welding current.

5.6.5. Data Send/Receive LEDs (5...12)

Indicates activity on this COM port.

5.6.6. NS/MS LEDs

See EtherNet/IP section.

6. Modbus

Modbus is an open system and full details are freely available at www.modbus.org.

Both MODBUS TCP/IP (Ethernet) and MODBUS RTU (RS485) protocols are supported. Modbus TCP/IP uses port 502.

To have the Modbus connection activate the inputs to the welding control, access the control configuration parameters (using WSP3, touch- screen or NetFlash) and select

I/O SOURCE: COMn

where n = desired port (see table below).

Protocol	Cable connected to	Port
MODBUS-TCP/IP	RJ45 on iPAK2 (-TS)	COM1
	RJ45 on EtherNet/IP adapter card	COM5
	RJ45 on iPAK2v2 (-TS)	COM5
MODBUS-RTU	DSUB9 (RS485)	COM2

Restart the control.

This setting only affects the inputs and outputs. Parameter access is always available, even if ***I/O Source*** is set to something other than a Modbus port.

6.1. Using discrete outputs AV1 to AV8

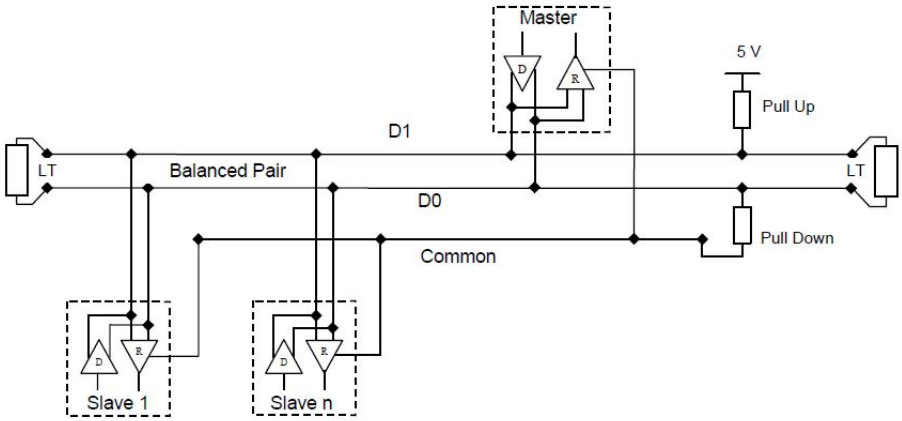
Output signals are fed to both the fieldbus and discrete outputs. However, discrete outputs AV1 to AV8 will only pass a signal if the discrete **START** input is closed. To use these outputs when controlling the system via a fieldbus, link the discrete **START** input to +24V.

6.2. Using Modbus-RTU on RS485 via COM2

The COM2 port on the control is a female D-Sub 9-way connector. The control is configured as a Modbus slave I/O device and uses half-duplex RS485 signalling (2-wire topology). The table below shows the pin-out at the COM2 connector: Note that your bus master may have a different pin-out.

Pin	Signal	Note
1	0V	Connect to common wire
2		Do not connect
3		Do not connect
4		Do not connect
5	Tx+ / Rx+	Connect to Tx+ / Rx+ wire
6		Do not connect
7	120R from pin 5	Connect to pin 9 if at end of cable, otherwise do not connect[1]
8		Do not connect
9	Tx- / Rx-	Connect to Tx- / Rx- wire

Note[1]: The 120R resistor at pin 7 is provided for the purposes of line termination (LT), to prevent signal reflections on the cable. Connect pin 7 to pin 9 ONLY at the ends of the cable.



6.2.1. Configuring the RS485 port

The controls may be configured by using one of the following tools:

WSP3 pendant connected to COM3 on the control.

Access the Configuration menu then scroll down to COM2 and press the RETURN button.

NetFlash software on a connected PC.

Connect to the control then access the Configuration tab.

In both cases, set the following parameters:

Address: This is the Modbus address for the control. Each control must have a unique address, in the range 1 to 247.

Baud-rate:Each control on the cable should have the same baud-rate, and this must match the setting on the bus-master. Values of 9600, 19200, 38400 and 57600 are available.

You may also need to set the ***I/O source*** parameter (on the WSP3 pendant and the touch-screen, return to the Configuration menu and scroll to find this parameter).

If you intend to perform control functions (such as starting the control) via the Modbus connection, then set the ***I/O source*** parameter to COM2 (programming and monitoring is still possible with this setting). If the Modbus channel is only for programming and monitoring purposes, and not for control, then set the ***I/O source*** parameter to DISCRETE, or any other COM interface, as appropriate to the application.

Parity: This is a fixed setting in the controls. They require that no parity is sent. Make sure that the bus master is set for no-parity. The controls will not communicate if even-parity or odd-parity is used.

6.3. Access types

Write inputs or parameters using MODBUS function code 16

Read outputs or parameters using MODBUS function code 3

Only Modbus functions 3 (read registers) and 16 (write registers) are implemented. Attempting to use any other function code will return a Modbus exception.

The control appears to the master as a set of I/O registers. The register addresses can be found in the user manual for the control.

Control registers: two words input to the control, 24 words output from the control. These registers are used for initiating the control (if **COM2** has been selected as the **I/O source**) and for checking its status. See sections **Inputs** and **Outputs**.

Parameter registers: every user parameter (e.g. weld time, current etc) is mapped to a Modbus register. See section **parameter mapping**. Users may freely read and write these registers. Take care when doing this, so as not to unintentionally change any welding which may be in progress!

6.4. Inputs to iPAK2

Variable	Channel	Address	Type	Description
	Write inputs	%QW0	WORD ARRAY [0..1]	Write multiple registers
	Write inputs [0]	%QW0	WORD	WRITE 16#8000 (= 32768)
Start	Bit 0	%QX0.0	BOOL	
Weld on	Bit 1	%QX0.1	BOOL	
Stop	Bit 2	%QX0.2	BOOL	
Transformer thermal	Bit 3	%QX0.3	BOOL	
2nd stage	Bit 4	%QX0.4	BOOL	
Retract	Bit 5	%QX0.5	BOOL	
Reset fault	Bit 6	%QX0.6	BOOL	
Reset counter	Bit 7	%QX0.7	BOOL	
Reset stepper	Bit 8	%QX1.0	BOOL	
Reserved	Bit 9	%QX1.1	BOOL	
Reserved	Bit 10	%QX1.2	BOOL	
Reserved	Bit 11	%QX1.3	BOOL	
Reserved	Bit 12	%QX1.4	BOOL	
Reserved	Bit 13	%QX1.5	BOOL	
Reserved	Bit 14	%QX1.6	BOOL	
Reserved	Bit 15	%QX1.7	BOOL	
	Write inputs [1]	%QW2	WORD	WRITE 16#8001 (= 32769)
P1	Bit 0	%QX2.0	BOOL	
P2	Bit 1	%QX2.1	BOOL	
P4	Bit 2	%QX2.2	BOOL	
P8	Bit 3	%QX2.3	BOOL	
P16	Bit 4	%QX2.4	BOOL	
P32	Bit 5	%QX2.5	BOOL	
P64	Bit 6	%QX2.6	BOOL	
P128	Bit 7	%QX2.7	BOOL	
Reserved	Bit 8	%QX3.0	BOOL	
Reserved	Bit 9	%QX3.1	BOOL	
Reserved	Bit 10	%QX3.2	BOOL	
Reserved	Bit 11	%QX3.3	BOOL	
Reserved	Bit 12	%QX3.4	BOOL	
Reserved	Bit 13	%QX3.5	BOOL	
Reserved	Bit 14	%QX3.6	BOOL	
Reserved	Bit 15	%QX3.7	BOOL	

6.5. Outputs from iPAK2

Variable	Channel	Address	Type	Description
	Read outputs	%IW0	WORD ARRAY [0..23]	Read holding registers
	Read outputs [0]	%IW0	WORD	READ 16#9000 (= 36864)
EOS	Bit 0	%IX0.0	BOOL	
HAV	Bit 1	%IX0.1	BOOL	
Fault	Bit 2	%IX0.2	BOOL	
Ready	Bit 3	%IX0.3	BOOL	
Contactor	Bit 4	%IX0.4	BOOL	
Counter	Bit 5	%IX0.5	BOOL	
Stepper	Bit 6	%IX0.6	BOOL	
Pre-warn	Bit 7	%IX0.7	BOOL	
AV8	Bit 8	%IX1.0	BOOL	
AV7	Bit 9	%IX1.1	BOOL	
AV6	Bit 10	%IX1.2	BOOL	
AV5	Bit 11	%IX1.3	BOOL	
AV4	Bit 12	%IX1.4	BOOL	
AV3	Bit 13	%IX1.5	BOOL	
AV2	Bit 14	%IX1.6	BOOL	
AV1	Bit 15	%IX1.7	BOOL	
	Read outputs [1]	%IW2	WORD	READ 16#9001 (= 36865)
Start	Bit 0	%IX2.0	BOOL	≙ %QX0.0
Weld on	Bit 1	%IX2.1	BOOL	≙ %QX0.1
Stop	Bit 2	%IX2.2	BOOL	≙ %QX0.2
Transformer thermal	Bit 3	%IX2.3	BOOL	≙%QX0.3
2nd stage	Bit 4	%IX2.4	BOOL	≙ %QX0.4
Retract	Bit 5	%IX2.5	BOOL	≙ %QX0.5
Reset fault	Bit 6	%IX2.6	BOOL	≙ %QX0.6
Reset counter	Bit 7	%IX2.7	BOOL	≙ %QX0.7
Reset stepper	Bit 8	%IX3.0	BOOL	≙ %QX1.0
Reserved	Bit 9	%IX3.1	BOOL	
Reserved	Bit 10	%IX3.2	BOOL	
Reserved	Bit 11	%IX3.3	BOOL	
Reserved	Bit 12	%IX3.4	BOOL	
Reserved	Bit 13	%IX3.5	BOOL	
Reserved	Bit 14	%IX3.6	BOOL	
Reserved	Bit 15	%IX3.7	BOOL	
	Read outputs [2]	%IW4	WORD	READ 16#9002 (= 36866)
Start	Bit 0	%IX4.0	BOOL	≙ discrete input Start
Weld on	Bit 1	%IX4.1	BOOL	≙ discrete input Weld on
Stop	Bit 2	%IX4.2	BOOL	≙ discrete input Stop
Thermal	Bit 3	%IX4.3	BOOL	≙ discrete input Thermal
2nd stage	Bit 4	%IX4.4	BOOL	≙ discrete input 2nd stage
Retract	Bit 5	%IX4.5	BOOL	≙ discrete input Retract
Reset fault	Bit 6	%IX4.6	BOOL	≙ discrete input Reset fault
Reset counter	Bit 7	%IX4.7	BOOL	≙ discrete input Reset counter
Reset stepper	Bit 8	%IX5.0	BOOL	≙ discrete input Reset stepper
Reserved	Bit 9	%IX5.1	BOOL	
Reserved	Bit 10	%IX5.2	BOOL	
Reserved	Bit 11	%IX5.3	BOOL	
Reserved	Bit 12	%IX5.4	BOOL	
Reserved	Bit 13	%IX5.5	BOOL	
Reserved	Bit 14	%IX5.6	BOOL	
Reserved	Bit 15	%IX5.7	BOOL	

Variable	Channel	Address	Type	Description
Analog input (mV)	Read outputs [3]	%IW6	WORD	READ 16#9003 (= 36867)
Analog output(mV)	Read outputs [4]	%IW8	WORD	READ 16#9004 (= 36868)
% pulse width	Read outputs [5]	%IW10	WORD	READ 16#9005 (= 36869)
Reserved	Read outputs [6]	%IW12	WORD	READ 16#9006 (= 36870)
Reserved	Read outputs [7]	%IW14	WORD	READ 16#9007 (= 36871)
Status register 0	Read outputs [8]	%IW16	WORD	READ 16#9008 (= 36872)
Stop	Bit 0	%IX16.0	BOOL	Bit 0
Reserved	Bit 1	%IX16.1	BOOL	
Retract not ready	Bit 2	%IX16.2	BOOL	Bit 2
Inverter hot	Bit 3	%IX16.3	BOOL	Bit 3
Transformer hot	Bit 4	%IX16.4	BOOL	Bit 4
Pilot fault	Bit 5	%IX16.5	BOOL	Bit 5
Restart required	Bit 6	%IX16.6	BOOL	Bit 6
Headlock	Bit 7	%IX16.7	BOOL	Bit 7
Reserved	Bit 8	%IX17.0	BOOL	
Reserved	Bit 9	%IX17.1	BOOL	
Reserved	Bit 10	%IX17.2	BOOL	
Reserved	Bit 11	%IX17.3	BOOL	
Reserved	Bit 12	%IX17.4	BOOL	
Reserved	Bit 13	%IX17.5	BOOL	
Reserved	Bit 14	%IX17.6	BOOL	
Test mode	Bit 15	%IX17.7	BOOL	Bit 15
Status register 1	Read outputs [9]	%IW18	WORD	READ 16#9009 (= 36873)
Start on	Bit 0	%IX18.0	BOOL	Bit 16
Weld off	Bit 1	%IX18.1	BOOL	Bit 17
Program inhibited	Bit 2	%IX18.2	BOOL	Bit 18
Output fault	Bit 3	%IX18.3	BOOL	Bit 19
Reserved	Bit 4	%IX18.4	BOOL	
Too many links	Bit 5	%IX18.5	BOOL	Bit 21
Bad link	Bit 6	%IX18.6	BOOL	Bit 22
Maximum current	Bit 7	%IX18.7	BOOL	Bit 23
Toroid over range	Bit 8	%IX19.0	BOOL	Bit 24
CT over range	Bit 9	%IX19.1	BOOL	Bit 25
Maximum pulse width	Bit 10	%IX19.2	BOOL	
Calibration error	Bit 11	%IX19.3	BOOL	
Reserved	Bit 12	%IX19.4	BOOL	
Reserved	Bit 13	%IX19.5	BOOL	
Reserved	Bit 14	%IX19.6	BOOL	
Reserved	Bit 15	%IX19.7	BOOL	
Status register 2	Read outputs [10]	%IW20	WORD	READ 16#900A (= 36874)
Low force	Bit 0	%IX20.0	BOOL	Bit 32
High force	Bit 1	%IX20.1	BOOL	Bit 33
Low pre-current	Bit 2	%IX20.2	BOOL	Bit 34
High pre-current	Bit 3	%IX20.3	BOOL	Bit 35
Low main current	Bit 4	%IX20.4	BOOL	Bit 36
High main current	Bit 5	%IX20.5	BOOL	Bit 37
Low post-current	Bit 6	%IX20.6	BOOL	Bit 38
High post-current	Bit 7	%IX20.7	BOOL	Bit 39
No 2nd stage	Bit 8	%IX21.0	BOOL	Bit 40
No force	Bit 9	%IX21.1	BOOL	Bit 41
Low conduction(shunt)	Bit 10	%IX21.2	BOOL	Bit 42
High conduction(wear)	Bit 11	%IX21.3	BOOL	Bit 43
Reserved	Bit 12	%IX21.4	BOOL	
Reserved	Bit 13	%IX21.5	BOOL	
Reserved	Bit 14	%IX21.6	BOOL	
Reserved	Bit 15	%IX21.7	BOOL	

Variable	Channel	Address	Type	Description
Status register 3	Read outputs [11]	%IW22	WORD	READ 16#900B (= 36875)
End of count 0	Bit 0	%IX22.0	BOOL	Bit 48
End of count 1	Bit 1	%IX22.1	BOOL	Bit 49
End of count 2	Bit 2	%IX22.2	BOOL	Bit 50
End of count 3	Bit 3	%IX22.3	BOOL	Bit 51
End of count 4	Bit 4	%IX22.4	BOOL	Bit 52
End of count 5	Bit 5	%IX22.5	BOOL	Bit 53
End of count 6	Bit 6	%IX22.6	BOOL	Bit 54
End of count 7	Bit 7	%IX22.7	BOOL	Bit 55
Reserved	Bit 8	%IX23.0	BOOL	
Reserved	Bit 9	%IX23.1	BOOL	
Reserved	Bit 10	%IX23.2	BOOL	
Reserved	Bit 11	%IX23.3	BOOL	
Reserved	Bit 12	%IX23.4	BOOL	
Reserved	Bit 13	%IX23.5	BOOL	
Reserved	Bit 14	%IX23.6	BOOL	
Reserved	Bit 15	%IX23.7	BOOL	
Status register 4	Read outputs [12]	%IW24	WORD	READ 16#900C (= 36876)
End of electrode 0	Bit 0	%IX24.0	BOOL	Bit 64
End of electrode 1	Bit 1	%IX24.1	BOOL	Bit 65
End of electrode 2	Bit 2	%IX24.2	BOOL	Bit 66
End of electrode 3	Bit 3	%IX24.3	BOOL	Bit 67
End of electrode 4	Bit 4	%IX24.4	BOOL	Bit 68
End of electrode 5	Bit 5	%IX24.5	BOOL	Bit 69
End of electrode 6	Bit 6	%IX24.6	BOOL	Bit 70
End of electrode 7	Bit 7	%IX24.7	BOOL	Bit 71
Reserved	Bit 8	%IX25.0	BOOL	
Reserved	Bit 9	%IX25.1	BOOL	
Reserved	Bit 10	%IX25.2	BOOL	
Reserved	Bit 11	%IX25.3	BOOL	
Reserved	Bit 12	%IX25.4	BOOL	
Reserved	Bit 13	%IX25.5	BOOL	
Reserved	Bit 14	%IX25.6	BOOL	
Reserved	Bit 15	%IX25.7	BOOL	
Status register 5	Read outputs [13]	%IW26	WORD	READ 16#900D (= 36877)
Tip dress 0	Bit 0	%IX26.0	BOOL	Bit 80
Tip dress 1	Bit 1	%IX26.1	BOOL	Bit 81
Tip dress 2	Bit 2	%IX26.2	BOOL	Bit 82
Tip dress 3	Bit 3	%IX26.3	BOOL	Bit 83
Tip dress 4	Bit 4	%IX26.4	BOOL	Bit 84
Tip dress 5	Bit 5	%IX26.5	BOOL	Bit 85
Tip dress 6	Bit 6	%IX26.6	BOOL	Bit 86
Tip dress 7	Bit 7	%IX26.7	BOOL	Bit 87
Reserved	Bit 8	%IX27.0	BOOL	
Reserved	Bit 9	%IX27.1	BOOL	
Reserved	Bit 10	%IX27.2	BOOL	
Reserved	Bit 11	%IX27.3	BOOL	
Reserved	Bit 12	%IX27.4	BOOL	
Reserved	Bit 13	%IX27.5	BOOL	
Reserved	Bit 14	%IX27.6	BOOL	
Reserved	Bit 15	%IX27.7	BOOL	

Variable	Channel	Address	Type	Description
Status register 6	Read outputs [14]	%IW28	WORD	READ 16#900E (= 36878)
Prewarn 0	Bit 0	%IX28.0	BOOL	Bit 96
Prewarn 1	Bit 1	%IX28.1	BOOL	Bit 97
Prewarn 2	Bit 2	%IX28.2	BOOL	Bit 98
Prewarn 3	Bit 3	%IX28.3	BOOL	Bit 99
Prewarn 4	Bit 4	%IX28.4	BOOL	Bit 100
Prewarn 5	Bit 5	%IX28.5	BOOL	Bit 101
Prewarn 6	Bit 6	%IX28.6	BOOL	Bit 102
Prewarn 7	Bit 7	%IX28.7	BOOL	Bit 103
Reserved	Bit 8	%IX29.0	BOOL	
Reserved	Bit 9	%IX29.1	BOOL	
Reserved	Bit 10	%IX29.2	BOOL	
Reserved	Bit 11	%IX29.3	BOOL	
Reserved	Bit 12	%IX29.4	BOOL	
Reserved	Bit 13	%IX29.5	BOOL	
Reserved	Bit 14	%IX29.6	BOOL	
Reserved	Bit 15	%IX29.7	BOOL	
Status register 7	Read outputs [15]	%IW30	WORD	READ 16#900F (= 36879)
Inverter DC BUS failure	Bit 0	%IX30.0	BOOL	
Inverter short circuit	Bit 1	%IX30.1	BOOL	
Inverter fan failure	Bit 2	%IX30.2	BOOL	
Inverter not ready	Bit 3	%IX30.3	BOOL	
LMI config error	Bit 4	%IX30.4	BOOL	
LMI error	Bit 5	%IX30.5	BOOL	
Duty cycle limit	Bit 6	%IX30.6	BOOL	
Reserved	Bit 7	%IX30.7	BOOL	
Reserved	Bit 8	%IX31.0	BOOL	
Reserved	Bit 9	%IX31.1	BOOL	
Reserved	Bit 10	%IX31.2	BOOL	
Reserved	Bit 11	%IX31.3	BOOL	
Reserved	Bit 12	%IX31.4	BOOL	
Reserved	Bit 13	%IX31.5	BOOL	
Reserved	Bit 14	%IX31.6	BOOL	
Reserved	Bit 15	%IX31.7	BOOL	
Pre-heat current (A)	Read outputs [16]	%IW32	DWORD	READ 16#9010 (= 36880)
Main current (A)	Read outputs [18]	%IW36	DWORD	READ 16#9012 (= 36882)
Post-heat current (A)	Read outputs [20]	%IW40	DWORD	READ 16#9014 (= 36884)
Program number	Read outputs [22]	%IW44	WORD	READ 16#9016 (= 36886)
Force[1]	Read outputs [23]	%IW46	WORD	READ 16#9017 (= 36887)

[1] value is multiplied by the scale factor (898.88 for kN or 4 for lbf)

Read outputs[15...8] correspond to the status messages - see section ***status messages***.

6.6. Parameter mapping

Variable	Address	Type	Description
Weld programs			256 x 64 WORDS
Weld program 0	16#0000 (= 0)	WORD ARRAY [0..63]	
Weld program 1	16#0040 (= 64)	WORD ARRAY [0..63]	
Weld program 2	16#0080 (= 128)	WORD ARRAY [0..63]	
Weld program 3	16#00C0 (= 192)	WORD ARRAY [0..63]	
...	...	...	
Weld program 254	16#3F80 (= 16256)	WORD ARRAY [0..63]	
Weld program 255	16#3FC0 (= 16320)	WORD ARRAY [0..63]	
Weld program extensions			256 x 16 WORDS
Weld program 0 extension	16#7000 (= 28672)	WORD ARRAY [0..15]	
Weld program 1 extension	16#7010 (= 28688)	WORD ARRAY [0..15]	
Weld program 2 extension	16#7020 (= 28704)	WORD ARRAY [0..15]	
Weld program 3 extension	16#7030 (= 28720)	WORD ARRAY [0..15]	
...	...	...	
Weld program 254 extension	16#7FE0 (= 32736)	WORD ARRAY [0..15]	
Weld program 255 extension	16#7FF0 (= 32752)	WORD ARRAY [0..15]	
Electrodes			8 x 64 WORDS
Electrode 0	16#4000 (= 16384)	WORD ARRAY [0..63]	
Electrode 1	16#4040 (= 16448)	WORD ARRAY [0..63]	
Electrode 2	16#4080 (= 16512)	WORD ARRAY [0..63]	
Electrode 3	16#40C0 (= 16576)	WORD ARRAY [0..63]	
Electrode 4	16#4100 (= 16640)	WORD ARRAY [0..63]	
Electrode 5	16#4140 (= 16704)	WORD ARRAY [0..63]	
Electrode 6	16#4180 (= 16768)	WORD ARRAY [0..63]	
Electrode 7	16#41C0 (= 16834)	WORD ARRAY [0..63]	
Calibration			8 x 64 WORDS
Calibration 0	16#5000 (= 20480)	WORD ARRAY [0..63]	
Calibration 1	16#5040 (= 20544)	WORD ARRAY [0..63]	
Calibration 2	16#5080 (= 20608)	WORD ARRAY [0..63]	
Calibration 3	16#50C0 (= 20672)	WORD ARRAY [0..63]	
Calibration 4	16#5100 (= 20736)	WORD ARRAY [0..63]	
Calibration 5	16#5140 (= 20800)	WORD ARRAY [0..63]	
Calibration 6	16#5180 (= 20864)	WORD ARRAY [0..63]	
Calibration 7	16#51C0 (= 20928)	WORD ARRAY [0..63]	
Configuration			1 x 64 WORDS
Configuration	16#6000 (= 24576)	WORD ARRAY [0..63]	

6.6.1. Weld program parameters

Variable	Channel	Address offset	Type	Description
Weld program		%IW0	WORD ARRAY [0..63]	
Attributes	Weld program [0]	%IW0	WORD	
Pre heat	Bit 0	%IX0.0	BOOL	0 = off, 1 = on
Post heat	Bit 1	%IX0.1	BOOL	0 = off, 1 = on
Pre-mode	Bit 2	%IX0.2	BOOL	00 = PW mode 01 = CCu mode 10 = CCC mode
	Bit 3	%IX0.3	BOOL	
Main mode	Bit 4	%IX0.4	BOOL	00 = PW mode 01 = CCu mode 10 = CCC mode
	Bit 5	%IX0.5	BOOL	
Post-mode	Bit 6	%IX0.6	BOOL	00 = PW mode 01 = CCu mode 10 = CCC mode
	Bit 7	%IX0.7	BOOL	
Link mode	Bit 8	%IX1.0	BOOL	0 = off, 1 = on
Repeat / Roll-spot mode	Bit 9	%IX1.1	BOOL	0 = off, 1 = on
Wait force	Bit 10	%IX1.2	BOOL	0 = off, 1 = on
Force profile	Bit 11	%IX1.3	BOOL	0 = off, 1 = on
Test force	Bit 12	%IX1.4	BOOL	0 = off, 1 = on
Test pre-current	Bit 13	%IX1.5	BOOL	0 = off, 1 = on
Test main current	Bit 14	%IX1.6	BOOL	0 = off, 1 = on
Test post-current	Bit 15	%IX1.7	BOOL	0 = off, 1 = on
Presqueeze time	Weld program [1]	%IW1	WORD	0 – 1999
Squeeze time	Weld program [2]	%IW2	WORD	0 – 1999
Pre-heat time	Weld program [3]	%IW3	WORD	0 –1999
Pre-heat	Weld program [4]	%IW4	WORD	0 – 999 (x10)
Reserved	Weld program [5]	%IW5	WORD	
Pre-current	Weld program [6]	%IW6	DWORD	0 – 500000
Cool1 time	Weld program [8]	%IW8	WORD	0 – 1999
Main heat time	Weld program [9]	%IW9	WORD	0 – 1999
Main heat	Weld program [10]	%IW10	WORD	0 – 999 (x10)
Reserved	Weld program [11]	%IW11	WORD	
Main current	Weld program [12]	%IW12	DWORD	0 – 500000
Cool2 time	Weld program [14]	%IW14	WORD	0 – 1999
Pulsations	Weld program [15]	%IW15	WORD	1 – 99
Post-heat time	Weld program [16]	%IW16	WORD	0 – 1999
Post-heat	Weld program [17]	%IW17	WORD	0 – 999 (x10)

Reserved	Weld program [18]	%IW18	WORD	
Post-current	Weld program [19]	%IW19	DWORD	0 – 500000
Hold time	Weld program [21]	%IW21	WORD	0 – 1999
Off time	Weld program [22]	%IW22	WORD	0 – 1999
Upslope time	Weld program [23]	%IW23	WORD	0 – 1999
Downslope time	Weld program [24]	%IW24	WORD	0 – 1999
Squeeze valves[1]	Weld program [25]	%IW25	WORD	
Pre-heat valves[1]	Weld program [26]	%IW26	WORD	
Cool1 valves[1]	Weld program [27]	%IW27	WORD	
Upslope valves[1]	Weld program [28]	%IW28	WORD	
Main heat valves[1]	Weld program [29]	%IW29	WORD	
Cool2 valves[1]	Weld program [30]	%IW30	WORD	
Downslope valves[1]	Weld program [31]	%IW31	WORD	
Post-heat valves[1]	Weld program [32]	%IW32	WORD	
Hold valves[1]	Weld program [33]	%IW33	WORD	
Off valves[1]	Weld program [34]	%IW34	WORD	

[1]	Weld program [nn]	%IXnn.0.0	BOOL	AV1 state 1 = ON
	Weld program [nn]	%IXnn.0.1	BOOL	AV2 state 1 = ON
	Weld program [nn]	%IXnn.0.2	BOOL	AV3 state 1 = ON
	Weld program [nn]	%IXnn.0.3	BOOL	AV4 state 1 = ON
	Weld program [nn]	%IXnn.0.4	BOOL	AV5 state 1 = ON
	Weld program [nn]	%IXnn.0.5	BOOL	AV6 state 1 = ON
	Weld program [nn]	%IXnn.0.6	BOOL	AV7 state 1 = ON
	Weld program [nn]	%IXnn.0.7	BOOL	AV8 state 1 = ON

Squeeze force	Weld program [35]	%IW35	WORD	0 – 32767[2]
Pre-heat force	Weld program [36]	%IW36	WORD	0 – 32767[2]
Cool1 force	Weld program [37]	%IW37	WORD	0 – 32767[2]
Upslope force	Weld program [38]	%IW38	WORD	0 – 32767[2]
Main heat force	Weld program [39]	%IW39	WORD	0 – 32767[2]

Cool2 force	Weld program [40]	%IW40	WORD	0 – 32767[2]
Downslope force	Weld program [41]	%IW41	WORD	0 – 32767[2]
Post-heat force	Weld program [42]	%IW42	WORD	0 – 32767[2]
Hold force	Weld program [43]	%IW43	WORD	0 – 32767[2]
Off force	Weld program [44]	%IW44	WORD	0 – 32767[2]
Force low limit	Weld program [45]	%IW45	WORD	0 – 99
Force high limit	Weld program [46]	%IW46	WORD	0 – 99
Selected WAV	Weld program [47]	%IW47	WORD	0 – 7
Current low limit	Weld program [48]	%IW48	WORD	0 – 99
Current high limit	Weld program [49]	%IW49	WORD	0 – 99
Selected electrode	Weld program [50]	%IW50	WORD	0 – 7
Linked program	Weld program [51]	%IW51	WORD	0 – 255
Reserved	Weld program [52]	%IW52	WORD	
Reserved	Weld program [53]	%IW53	WORD	
Reserved	Weld program [54]	%IW54	WORD	
Reserved	Weld program [55]	%IW55	WORD	
Reserved	Weld program [56]	%IW56	WORD	
Reserved	Weld program [57]	%IW57	WORD	
C-Monitor Shunt limit	Weld program [58]	%IW58	WORD	0 – 99 %
C-Monitor Wear limit	Weld program [59]	%IW59	WORD	0 – 99 %
Reserved	Weld program [60]	%IW60	WORD	
Attributes2	Weld program [61]	%IW61	WORD	
Inhibited	Bit 0	%IX61.0	BOOL	0 = enable,1 = inhibit
C-Monitor Shunt enable	Bit 1	%IX61.1	BOOL	0 = off, 1 = on
C-Monitor Wear enable	Bit 2	%IX61.2	BOOL	0 = off, 1 = on
Retry enable	Bit 3	%IX61.3	BOOL	0 = off, 1 = on
Motor valves[1]	Weld program [62]	%IW62	WORD	
Reserved	Weld program [63]	%IW63	WORD	

[2] Divide value by 898.99 for kN. Divide value by 4 for lbf.

6.6.2. Weld program extension parameters

Variable	Channel	Address offset	Type	Description
Weld program extension		%IW0	WORD ARRAY [0..15]	
AV1 delay time	Weld program extension[0]	%IW0	WORD	0 – 9999
AV2 delay time	Weld program extension[1]	%IW1	WORD	0 – 9999
AV3 delay time	Weld program extension[2]	%IW2	WORD	0 – 9999
AV4 delay time	Weld program extension[3]	%IW3	WORD	0 – 9999
AV5 delay time	Weld program extension[4]	%IW4	WORD	0 – 9999
AV6 delay time	Weld program extension[5]	%IW5	WORD	0 – 9999
AV7 delay time	Weld program extension[6]	%IW6	WORD	0 – 9999
AV8 delay time	Weld program extension[7]	%IW7	WORD	0 – 9999
Reserved	Weld program extension[8]-[15]			

6.6.3. Electrode parameters

Variable	Channel	Address offset	Type	Description
Electrode		%IW0	WORD ARRAY [0..63]	
Attributes	Electrode [0]	%IW0	WORD	
Enable counter	Bit 0	%IX0.0	BOOL	0 = off, 1 = on
Enable tipdress	Bit 1	%IX0.1	BOOL	0 = off, 1 = on
Enable stepper	Bit 2	%IX0.2	BOOL	0 = off, 1 = on
Stop at endcount	Bit 3	%IX0.3	BOOL	0 = off, 1 = on
Stop at endstep	Bit 4	%IX0.4	BOOL	0 = off, 1 = on
Transformer	Electrode [1]	%IW1	WORD	0 – 7
Counter	Electrode [2]	%IW2	WORD	0 – 9999
Endcount	Electrode [3]	%IW3	WORD	0 – 9999
Dressings done	Electrode [4]	%IW4	WORD	0 – 9999
Max dressings	Electrode [5]	%IW5	WORD	0 – 9999
Stepper spots done	Electrode [6]	%IW6	DWORD	Read only
Stepper % done	Electrode [8]	%IW8	WORD	Read only
Stepper reset to	Electrode [9]	%IW9	WORD	0 – 9999
Stepper spots	Electrode [10..19]	%IW10..19	WORD	0 – 9999
Stepper delta H	Electrode [20..29]	%IW20..29	WORD	0 – 500 (% x 10)
Stepper delta l	Electrode [30..39]	%IW30..39	WORD	0 – 500 (% x 10)
Reserved	Electrode [40]-[63]			

6.6.4. Calibration parameters

Variable	Channel	Address offset	Type	Description
Calibration		%IW0	WORD ARRAY [0..63]	
Ip max	Calibration [0]	%IW0	WORD	0 – inverter specific
A out X1	Calibration [1]	%IW1	WORD	0 – 10000 mV
A out Y1	Calibration [2]	%IW2	WORD	0 – 32767
A out X2	Calibration [3]	%IW3	WORD	0 – 10000 mV
A out Y2	Calibration [4]	%IW4	WORD	0 – 32767
A in X1	Calibration [5]	%IW5	WORD	0 – 10000 mV
A in Y1	Calibration [6]	%IW6	WORD	0 – 32767
A in X2	Calibration [7]	%IW7	WORD	0 – 10000 mV
A in Y2	Calibration [8]	%IW8	WORD	0 – 32767
Reserved	Calibration [9]	%IW9	WORD	
Toroid sensitivity	Calibration [10]	%IW10	WORD	1 – 60000 mV/kA
Convert CT	Calibration [11]	%IW11	WORD	0 = use 2-points 1 = use turns ratio
CT X1	Calibration [12]	%IW12	DWORD	0 – 32000
CT Y1	Calibration [14]	%IW14	DWORD	0 – 500000
CT X2	Calibration [16]	%IW16	DWORD	0 – 32000
CT Y2	Calibration [18]	%IW18	DWORD	0 – 500000
CT max	Calibration [20]	%IW20	DWORD	Read only
Turns ratio	Calibration [22]	%IW22	WORD	1 – 999
Reserved	Calibration [23]	%IW23	WORD	
CCC X1	Calibration [24]	%IW24	WORD	0 – 999
CCC Y1	Calibration [25]	%IW25	DWORD	0 – 500000
CCC X2	Calibration [27]	%IW27	WORD	0 – 999
CCC Y2	Calibration [28]	%IW28	DWORD	0 – 500000
Toroid factor	Calibration [30]	%IW30	WORD	1 – 10
Blanking	Calibration[31]	%IW31	WORD	0 – 99 ms
Reserved	Calibration[32]-[63]			

6.6.5. Configuration parameters

Variable	Channel	Address offset	Type	Description
Configuration		%IW0	WORD ARRAY [0..63]	
Weld type	Configuration[0]	%IW0	WORD	0 = spot 1 = seam
Second stage	Configuration[1]	%IW1	WORD	
	Bit 0 Bit 1	%IX1.0 %IX1.1	BOOL BOOL	00 = none 01 =before Squeeze 10 = after Squeeze
	Bit 2	%IX1.2	BOOL	Reserved
	Bit 3	%IX1.3	BOOL	0 = check first program 1 = check every program
Retract	Configuration[2]	%IW2	WORD	0 = simple 1 = hilift plus 2 = hilift minus 3 = maintained
Measure	Configuration[3]	%IW3	WORD	0 = primary 1 = secondary
Ip limit	Configuration[4]	%IW4	WORD	0 – inverter specific
Units	Configuration[5]	%IW5	WORD	0 = metric 1 = imperial
Electrodes	Configuration[6]	%IW6	WORD	0 = single, 1 = multi
Fault	Configuration[7]	%IW7	WORD	
Stop	Bit 0	%IX7.0	BOOL	1 = stop on fault
EOS	Bit 1	%IX7.1	BOOL	1 = EOS on fault
Headlock	Bit 2	%IX7.2	BOOL	1 = headlock on fault
iPAK(v1)	Bit 3	%IX7.3	BOOL	1 = use NOT READY sense
Contactor	Configuration[8]	%IW8	WORD	1 - 99 seconds 0 = off
Program select	Configuration[9]	%IW9	WORD	0 = external 1 = internal
Internal prog	Configuration[10]	%IW10	WORD	0 - 255
I/O source	Configuration[11]	%IW11	WORD	0 = discrete 1 = MODBUS COM0 2 = MODBUS COM1 3 = MODBUS COM2 4 = n/a 5 = MODBUS COM4 6 = MODBUS COM5 7 = EtherNet/IP COM7
Regulation	Configuration[12]	%IW12	WORD	0 = primary 1 = secondary
COM2 address	Configuration[13]	%IW13	WORD	1 - 247
COM2 baud rate	Configuration[14]	%IW14	WORD	0 = 9600 1 = 19200 2 = 38400 3 = 57600
Bus Monitor	Configuration[15]	%IW15	WORD	0 = iPAK(v1) inverter 1 = iPAKv2 inverter

Adapter code	Configuration[16]	%IW16	WORD	
Analog output function	Configuration[17]	%IW17	WORD	0 = force 1 = waveform
Analog output scale (10 V =)	Configuration[18]	%IW18	DWORD	0 – 500 kA
Security [2]	Configuration[20]	%IW20	WORD	0 = off 1 = key-switch 2 = PIN on WSP3
Security timeout [2]	Configuration[21]	%IW21	WORD	0 – 10 minutes
Security PIN0 [2]	Configuration[22]	%IW22	WORD	1000 - 9999
Security PIN1 [2]	Configuration[23]	%IW23	WORD	1000 - 9999
Security PIN2 [2]	Configuration[24]	%IW24	WORD	1000 - 9999
Security PIN3 [2]	Configuration[25]	%IW25	WORD	1000 - 9999
Security PIN4 [2]	Configuration[26]	%IW26	WORD	1000 - 9999
IP address (msb) [1]	Configuration[27]	%IW27	WORD	0 - 255
IP address[1]	Configuration[28]	%IW28	WORD	0 - 255
IP address[1]	Configuration[29]	%IW29	WORD	0 - 255
IP address (lsb)[1]	Configuration[30]	%IW30	WORD	0 - 255
Sub-net mask(msb)[1]	Configuration[31]	%IW31	WORD	0 - 255
Sub-net mask[1]	Configuration[32]	%IW32	WORD	0 - 255
Sub-net mask[1]	Configuration[33]	%IW33	WORD	0 - 255
Sub-net mask (lsb)	Configuration[34]	%IW34	WORD	0 - 255
Gateway (msb) [1]	Configuration[35]	%IW35	WORD	0 - 255
Gateway[1]	Configuration[36]	%IW36	WORD	0 - 255
Gateway[1]	Configuration[37]	%IW37	WORD	0 - 255
Gateway (lsb) [1]	Configuration[38]	%IW38	WORD	0 - 255
Features	Configuration[39]	%IW39	WORD	0 = standard 1 = extended
Toroid test	Configuration[40]	%IW40	WORD	0 = off, 1 = on
Analog control	Configuration[41]	%IW41	WORD	0 = off, 1 = on
Reserved	Configuration [42]-[63]			

[1] Applies to COM4, COM5 and COM6 only.

[2] Not accessible on WSP3.

7. EtherNet/IP

iPAK2v2 includes integrated EtherNet/IP. For iPAK2, EtherNet/IP can be provided via an optional plug-in adapter board.

7.1. Using discrete outputs AV1 to AV8

Output signals are fed to both the fieldbus and discrete outputs. However, discrete outputs AV1 to AV8 will only pass a signal if the discrete START input is closed. To use these outputs when controlling the system via a fieldbus, link the discrete START input to +24V.

7.2. Functionality

- Cyclic I/O control using EtherNet/IP implicit messaging (class 1 connection).
- Parameter programming using EtherNet/IP explicit messaging.

7.3. Ports

TCP	44818	Explicit
UDP	44818	Explicit
UDP-IO	2222	Implicit: Cyclic I/O

7.4. Status LEDs (MS & NS)

On power-up the LEDs perform the following sequence, as defined by the EtherNet/IP specification:

LE1/MS	LE2/NS	Duration s
Green	Off	0.25
Red	Off	0.25
Off	Green	0.25
Off	Red	0.25

After the power-up sequence, the LEDs indicate as follows:

LE1/MS: EtherNet/IP module status:

GREEN	OK
RED	Fault

LE2/NS: network status:

GREEN flashing	Ready, no EtherNet/IP connection.
GREEN solid	EtherNet/IP class 1 connection.
RED flashing	EtherNet/IP class 1 connection lost.

7.5. Cyclic I/O (class 1 connection)

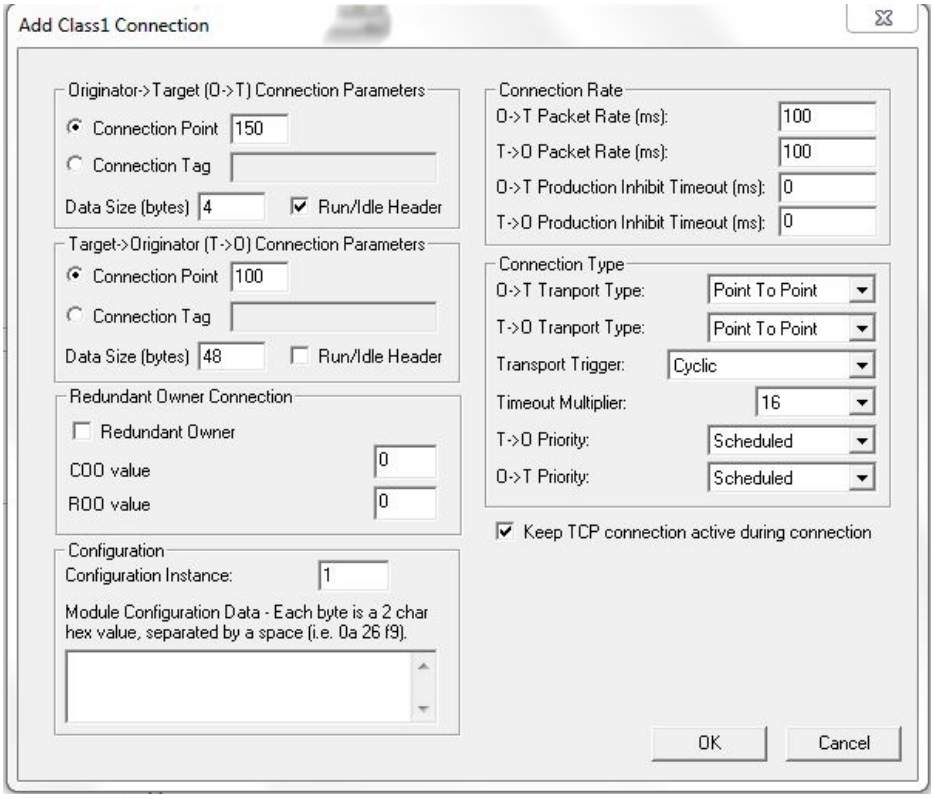
To have the EtherNet/IP connection activate the inputs to the welding control, access the control configuration parameters (using WSP3, touch- screen or NetFlash) and select

I/O SOURCE: COM6-E/IP

then restart the control.

This setting only affects the inputs and outputs. Parameter access is always available, even if ***I/O Source*** is set to something other than COM6.

The controlling device (usually a plc) must then be set up to initiate the connection. The following screen-shot shows the required parameters:



As can be seen above, the control accepts 4 bytes of input information and produces 48 bytes of output. This should be interpreted as 2 16-bit words (input) and 24 16-bit words (output) in little-endian format (lsb sent first). The definition of these words can be found in this manual, in the Modbus section.

7.6. Parameter programming

This is achieved through the use of the EtherNet/IP explicit messaging service.

The following services are implemented:

Service	Code
Get attribute single	0E (hex)
Set attribute single	10 (hex)

With each of these services, the following objects are available:

Parameters	Class ID	Instance	Attribute ID	Size
Weld program extension	95 (hex)	1	0 to FF (hex)	32 bytes
Weld program	96 (hex)	1	0 to FF (hex)	128 bytes
Electrode	97 (hex)	1	0 to 7	128 bytes
Calibration	98 (hex)	1	0 to 7	128 bytes
Configuration	99 (hex)	1	0	128 bytes

Data should be interpreted as 16-bit words, in little-endian format (lsb sent first). The definition of these words can be found in the Modbus section of this manual.

For example, to modify a weld parameter in program p (0 to 255):

1. Get the weld program from the control by sending the explicit message:

Service	Class ID	Instance	Attribute ID	Data
0E (hex)	96 (hex)	1	p	none

This returns the 64-word (128 bytes) program structure.

2. Modify the parameter(s) as required.
3. Send the modified program back to the control with the explicit message:

Service	Class ID	Instance	Attribute ID	Data
10 (hex)	96 (hex)	1	p	128 bytes

7.7. Interfacing with a PLC

A separate document is available which details an example on how to interface with a PLC.

8. Configuration

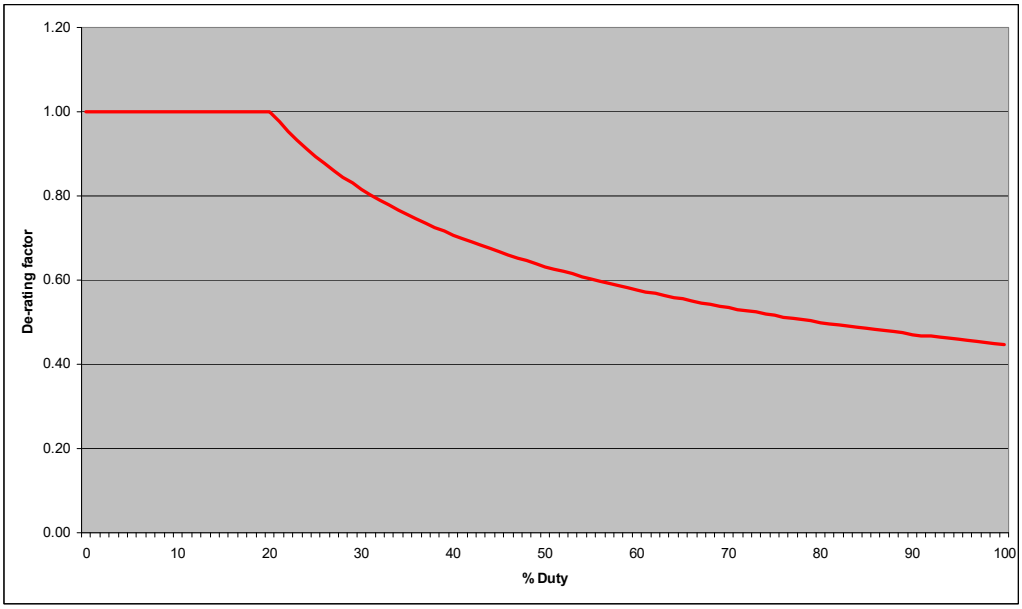
Parameter	Value	Description
Features	Standard	Selects standard features.
	Extended	Selects extended features.
Weld type	Spot	Selects spot welding features.
	Seam	Selects seam welding features.
Measure	Primary	Measure primary welding current
	Secondary	Measure secondary welding current
Regulation	Primary	Regulate primary welding current
	Secondary	Regulate secondary welding current
Units	Metric	Force in KN.
	Imperial	Force in lbf.
Program select	External	The Program Select inputs select the weld program.
	Internal	The ***Use Program*** parameter selects the weld program.
Use program	0 - 255	The weld program that will be used if ***Internal*** program select is set
Electrodes	Single	Use one electrode for the weld programs.
	Multi	Use up to 8 electrodes for the weld programs.
iPAK(v1) mode	Yes/No	Changes the sense of the READY output to NOT READY. AV4, 5 and 6 are used for MUX selection.
Ip limit	0 – inverter specific	Sets an upper limit on the inverter output current [3]
2nd stage	Off	Selects the second stage function. See Welding control – timing diagrams section.
	Before Squeeze	
	After Squeeze	
2nd stage	Once	The 2nd stage input is checked only at the start of the first spot in a sequence. Applies to spot-repeat, cascade and roll-spot modes but not seam.
	Every	The 2nd stage input is checked at the start of every spot within a sequence. Applies to spot-repeat, cascade and roll-spot modes but not seam.
Retract	Simple	Selects the Retract function. See Welding control – timing diagrams section.
	Hilift +	
	Hilift -	
	Maintained	
Stop on fault	No	In the event of a fault further welds will be permitted.
	Yes	In the event of a fault, a ***fault reset*** is required before further welds will be permitted.
EOS on fault	No	In the event of a fault the EOS output will not be activated.
	Yes	In the event of a fault the EOS output will be activated.
Headlock on fault	No	In the event of a fault the welding head will not be locked.
	Yes	In the event of a fault the welding head will be locked.
I/O source	Discrete	Use the discrete inputs and outputs.
	COM0	Use MODBUS TCP/IP (Ethernet) on COM0[1]
	COM1	Use MODBUS TCP/IP (Ethernet) on COM1[1]
	COM2	Use MODBUS RTU (RS485) on COM2
	COM3	Use RS232 on COM3
	COM4	Use MODBUS TCP/IP (Ethernet) on COM4 [2]
	COM5	Use MODBUS TCP/IP (Ethernet) on COM5 [2]
	COM6	Use EtherNet/IP on COM6 [2]
Analog output	Force	The analog output is used to control force.
	Current	The analog output corresponds to the measured weld current.
Waveform	10V = 0 – 500kA	Sets the analog output scaling for the measured current option.
Contactor	0 – 99 seconds	The contactor output is sustained for this time following a weld
Toroid test	Off / On	The connection to an external toroid will be tested. The measured resistance must lie within the range 10 to 300 Ohms.
Analog control	Off / On	The heat or current can be controlled via the analog input.

[1] iPAK2 only.
[2] iPAK2 fitted with EtherNet/IP adapter, or iPAK2v2.

[3] See Duty cycle limiter

9. Duty cycle limiter

Duty is calculated over a 2 second averaging time. The inverter rating applies at up to 20% duty. At higher duties the maximum output current must be de-rated as shown by the curve below:



The iPAK2 protects against weld sequences that would exceed the allowable duty cycle. In this event the inverter will

- Stop at the end of a spot weld
- Stop immediately in a seam weld

The READY signal will be de-asserted and an error message given. Further initiation is prohibited. Perform a 'RESET FAULT' operation to clear.

10. Status messages

NetFlash and WSP3 show these status messages. They are also available on the bus outputs – See Modbus and EtherNet/IP sections.

Code	Condition	Action
0	Normal	
1	Stop	Check the Stop input
2	Reserved	
3	Retract not ready	Operate the Retract input
4	Inverter hot	Check inverter cooling
5	Transformer hot	Check weld transformer cooling
6	Pilot fault	Safety relay fault. Do not use the iPAK2 and return it for service.
7	Restart required	Restart the iPAK2
8	Headlocked	The welding head is locked because of a fault condition
9	Toroid short circuit	Connection to Toroid (secondary feedback coil) is short-circuit
10	Toroid open circuit	Connection to Toroid (secondary feedback coil) is open-circuit
16	Test mode	For service use only
17	Start on	The Start input is on following a weld sequence or stop/power-up condition
18	Weld off	Check the Weld On input
19	Program inhibited	The selected weld program is inhibited
20	Output fault	One or more outputs have failed
22	Too many links	Too many weld programs are linked together
23	Bad link	A link has been made to a weld program that cannot be used
24	Max. current	Check secondary circuit. Reduce heat/current.
25	Toroid overrange	Reduce current or use an external signal attenuator
26	CT overrange	Check calibration parameters
27	Max. pulse width	Check secondary circuit. Reduce heat/current.
28	Calibration error	Check parameters in calibration program
33	Low force	Check the analog input and output circuits and/or adjust force parameters
34	High force	Check the analog input and output circuits and/or adjust force parameters
35	Low pre-current	Check CT/toroid feedback and/or adjust Pre-heat parameters
36	High pre-current	Check CT/toroid feedback and/or adjust Pre-heat parameters
37	Low main current	Check CT/toroid feedback and/or adjust Main heat parameters
38	High main current	Check CT/toroid feedback and/or adjust Main heat parameters
39	Low post-current	Check CT/toroid feedback and/or adjust Post-heat parameters
40	High post-current	Check CT/toroid feedback and/or adjust Post-heat parameters
41	No 2nd stage	Check the 2nd Stage input
42	No force	Check analog input circuit
43	Low conduction (Shunt)	There may be a shunt condition on the weld transformer secondary circuit
44	High conduction (wear)	The weld transformer secondary circuit may have degraded.
49	End of count 0	Reset counter 0
50	End of count 1	Reset counter 1
51	End of count 2	Reset counter 2
52	End of count 3	Reset counter 3
53	End of count 4	Reset counter 4
54	End of count 5	Reset counter 5
55	End of count 6	Reset counter 6
56	End of count 7	Reset counter 8
65	End of electrode 0	Reset stepper 0
66	End of electrode 1	Reset stepper 1
67	End of electrode 2	Reset stepper 2
68	End of electrode 3	Reset stepper 3

69	End of electrode 4	Reset stepper 4
70	End of electrode 5	Reset stepper 5
71	End of electrode 6	Reset stepper 6
72	End of electrode 7	Reset stepper 7
81	Tip dress 0	Dress the electrodes and then reset counter 0
82	Tip dress 1	Dress the electrodes and then reset counter 1
83	Tip dress 2	Dress the electrodes and then reset counter 2
84	Tip dress 3	Dress the electrodes and then reset counter 3
85	Tip dress 4	Dress the electrodes and then reset counter 4
86	Tip dress 5	Dress the electrodes and then reset counter 5
87	Tip dress 6	Dress the electrodes and then reset counter 6
88	Tip dress 7	Dress the electrodes and then reset counter 7
97	Prewarn 0	Stepper 0 has completed its 9th step
98	Prewarn 1	Stepper 1 has completed its 9th step
99	Prewarn 2	Stepper 2 has completed its 9th step
100	Prewarn 3	Stepper 3 has completed its 9th step
101	Prewarn 4	Stepper 4 has completed its 9th step
102	Prewarn 5	Stepper 5 has completed its 9th step
103	Prewarn 6	Stepper 6 has completed its 9th step
104	Prewarn 7	Stepper 7 has completed its 9th step
113	Inverter DC BUS error	Check inverter
114	Inverter short circuit	Check inverter
115	Inverter fan failure	Check inverter
116	Inverter not ready	Wait for inverter to charge
117	Inverter config error	LMI units only
118	LMI error	Check indication on LMI module
119	Duty cycle limit	Reduce duty and/or current

Codes not listed are reserved for future use.

11. History log

iPAK2 stores the results of the last 6000 **spot welds** in a history log. Each record contains the following information:

Parameter	Description
Time and date	The time and date when the weld was made
Program	The weld program used
Pre-current	The current measured during the Pre-heat interval
Main current	The current measured during the Main heat interval
Post-current	The current measured during the Post-heat interval
Force	The force measured during the weld
Pulse width	The conduction measured during the weld

The log can be viewed or reset as required via WSP3 or NetFlash. When using NetFlash, this log can be downloaded to the screen and stored in a file. Subsequent welds are also displayed and stored.

12. Programming

iPAK2 supports several programming methods:

- NetFlash PC program (Ethernet)
- WSP3 pendant (RS232)
- MODBUS (Ethernet or RS485)
- EtherNet/IP (Integrated on iPAK2v2/iPAK2v2-TS, via optional adapter card on iPAK2/iPAK2-TS)

12.1. Security

There are two features which can be configured to protect access:

12.1.1. PIN codes

Up to five PIN codes can be stored in each control. Users must then enter their code before being granted access permission to edit parameters. All parameters remain viewable (read-only). This feature can be configured to be applied to the WSP3. After initially gaining access, edit permission remains granted for a configurable time-out period.

12.1.2. Edit switch

Use of an external switch connected to the P64 input pin. Users are only granted access permission to edit parameters when the switch is activated. By using a key-switch, only the key-holders will be able to make edits. All parameters remain viewable (read-only). When configured, this feature applies to the WSP3.

Note that if this feature is used, then the P64 (program select bit 64) is no longer available on the discrete signal interface and thus external selection of programs is restricted to the range 0 to 63. This is not normally a problem on manual installations which is typically where security features are required. The full range of programmes (0 to 255) is still available through manual selection or via a network connection.

The above features are configured via the use of NetFlash software. NetFlash itself also has a security feature which can be used to tailor access rights. Users can be allocated usernames, passwords and access levels which restrict users to editing none, some or all parameters, as required. Thus, an administrator can pass copies of NetFlash to various personnel, each having individually permission levels.

Access via network protocols is not restricted as this will generally be via automation systems.

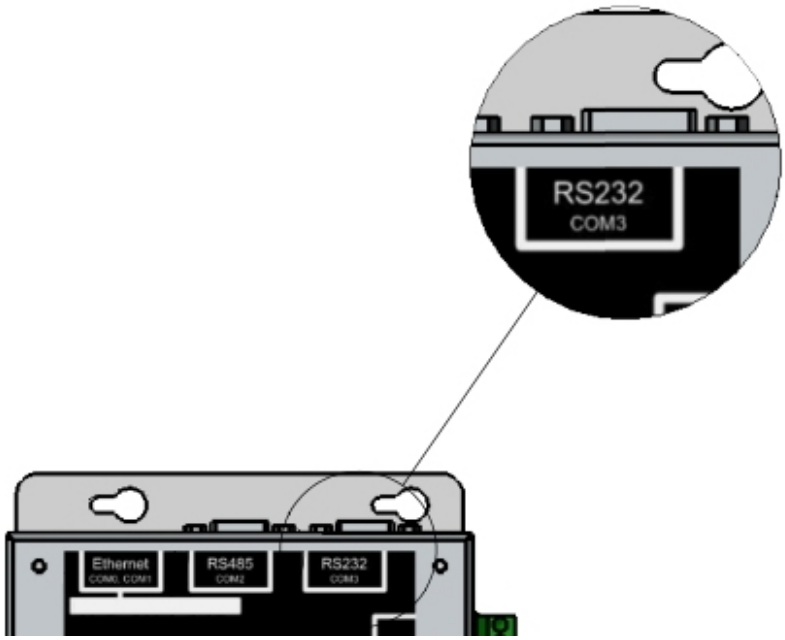
12.2. Programming with WSP3 pendant

When parameters are changed by the WSP3 they are changed immediately in the iPAK2.

The WSP3 is a hand-held programming pendant with a 20x4 character display and a sealed keypad.

The WSP3 can be used to access diagnostic information in addition to all parameters.

The WSP3 uses RS232 to communicate with the iPAK2 and should be connected to COM3:



12.2.1. Keypad

F	Return to the previous screen or move between menu screens.
← ↑ ↓ →	Select a different function or parameter. The selected function or parameter will flash and the visible window will scroll if required.
↵	Return. Access the selected function.
+ −	Alter the selected parameter. Press both keys together to set the parameter to 0 or to its minimum value.

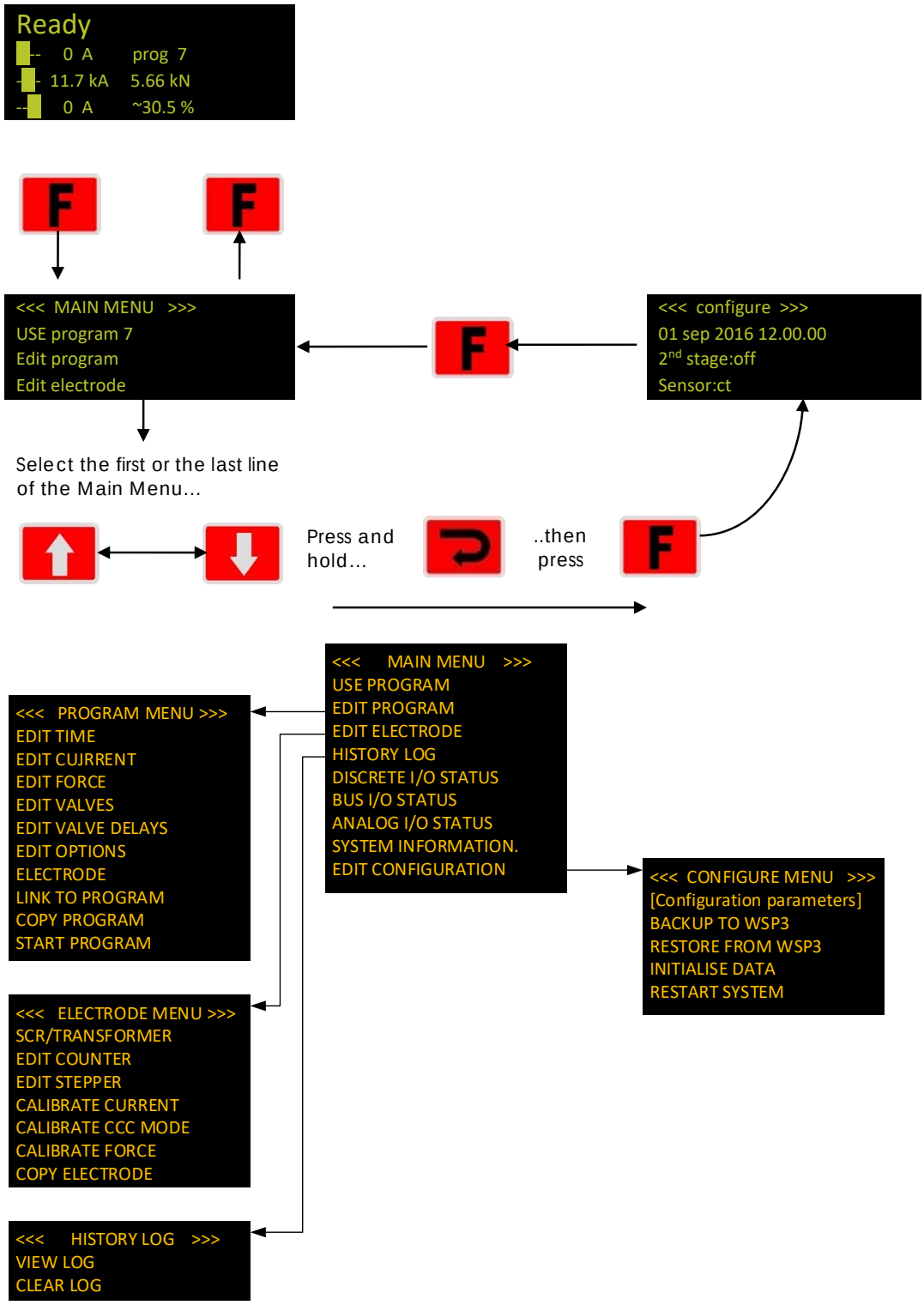
12.2.2. Diagnostic or Status screen

Tip: When editing parameters, you can quickly switch to the diagnostic screen by pressing the *Return* key, then switch back again by pressing *F.*

12.2.3. Menus

The functions of the iPAK2 are arranged into a set of menus and screens as follows:

Diagnostic screen



12.2.4. Backup/Restore

The WSP3 allows the data in one iPAK2 to be transferred to another by using the Backup and Restore functions.

- Use the Backup function to make a copy of all the iPAK2's settings. The copy is held within the WSP3. The data in the iPAK2 is unchanged. Note that only one backup can be stored in the WSP3 and that this is overwritten each time the backup function is used.

- Use the Restore function to restore all of the settings in the iPAK2 from a backup stored in the WSP3 pendant. Note that this operation will overwrite all data which was previously stored in the iPAK2. After the restore operation the backup remains in the WSP3.

12.2.5. Initialise data

The Initialise function sets all of the parameters in the iPAK2 to predefined values.

The Initialise function will overwrite all previously stored data in the iPAK2. After an initialise operation, review the configuration and calibration settings and ensure they are appropriate for the application. Also review the welding programs that will be used.

12.3. Programming with NetFlash

NetFlash is a PC-compatible program which provides a graphical user interface to program and monitor one or more iPAK2s. In addition, NetFlash provides backup/restore functions for control data, live data logging to a file and a utility for updating the firmware in the iPAK2.

Please see the separate ***NetFlash User Guide*** document.

12.4. Programming with MODBUS

Please see the Modbus section of this manual.

12.5. Programming with EtherNet/IP

Please see the EtherNet/IP section of this manual.

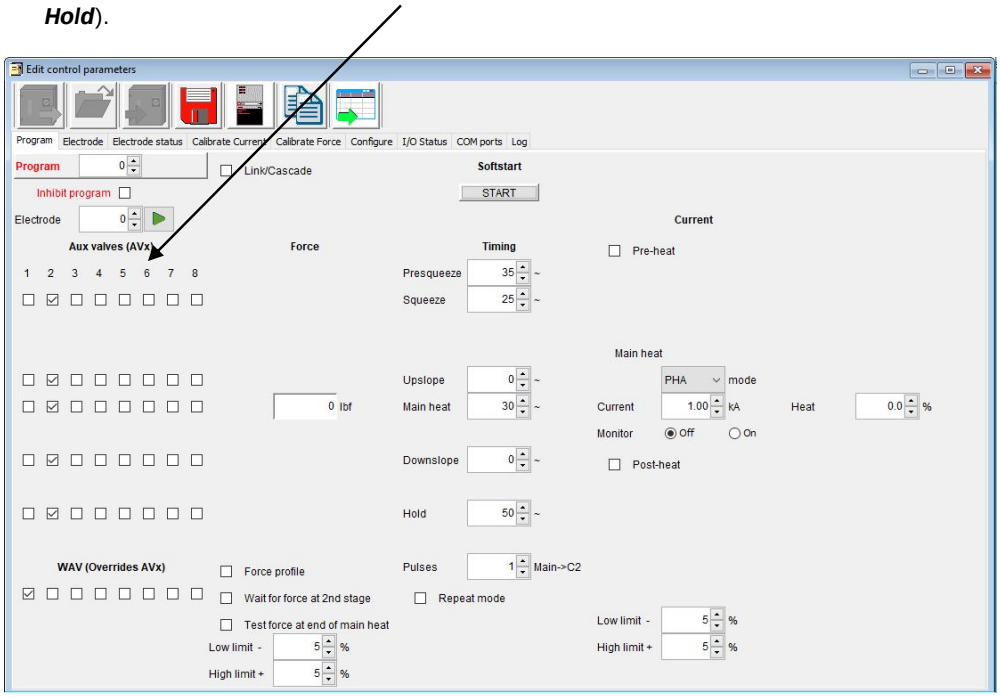
13. Tutorials

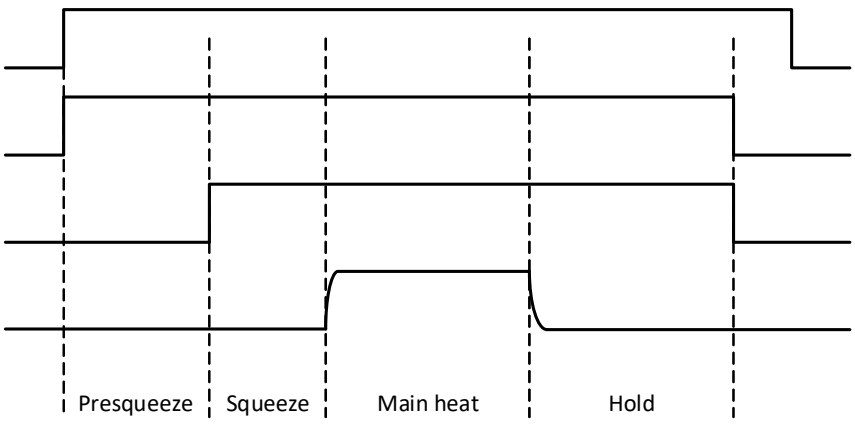
This section is a series of application notes which discuss some specific topics in detail.

13.1. Controlling an *Air over Oil* system

An 'Air over Oil' system (also referred to as OHMA) uses compressed air to open and close the electrodes plus a hydraulic intensifier to apply the weld force. This type of system can easily be controlled by the iPAK2 by making use of the programmable AUX valves feature.

1. Connect the air solenoid (ADVANCE) to the AV1(SV1) output (or whichever output you have programmed to provide the WAV function).
2. Connect the hydraulic solenoid (INTENSIFY) to the AV2(SV2) output (or whichever AUX output you wish to use).
3. In your welding schedule(s), set the ***Presqueeze time*** to suit the gun closure, and the ***Squeeze time*** to apply the force pre-weld. Now program the AUX valve chosen in step 2 to come on during all of the intervals which you are using (e.g. ***Squeeze, Main heat, Hold***).





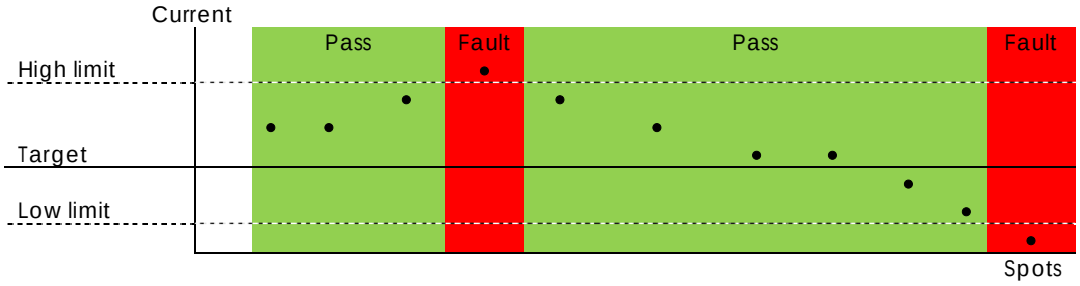
13.2. Testing the weld current

13.2.1. Current monitor

The current for each weld can be tested against upper and lower limits.

1. In the weld program, enable the Test current option for each weld to be tested.
2. Set the Low limit and High limits appropriately. The limits correspond to a percentage of the required current.

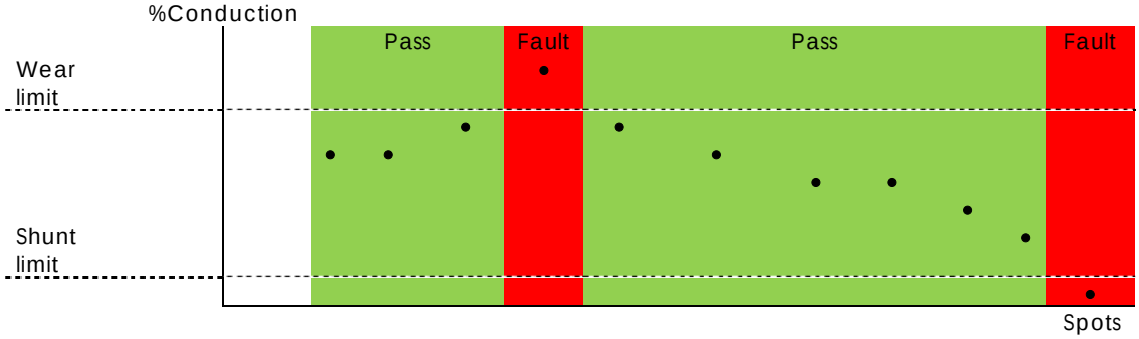
If the weld current falls outside the limits, iPAK2 will signal a fault.



13.2.2. Conduction monitor (C-Monitor)

Extended

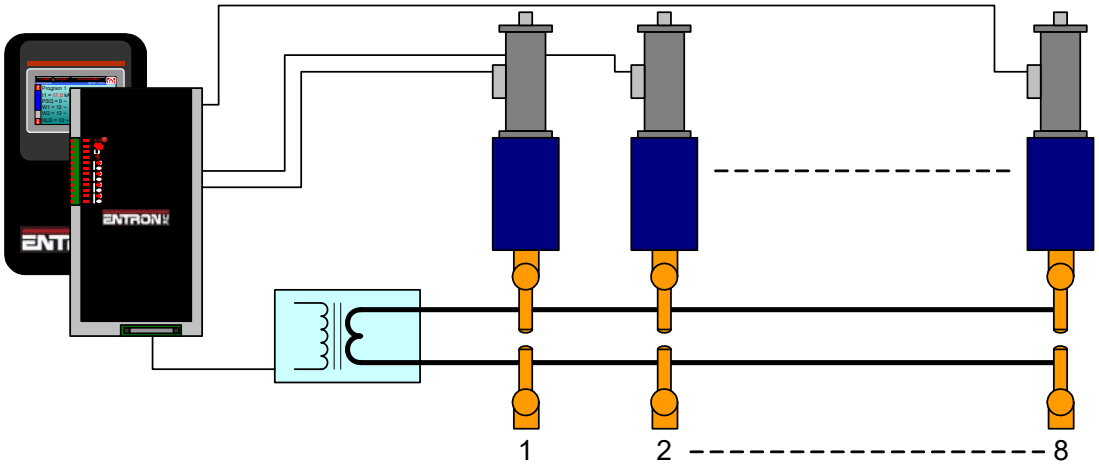
The control measures the percentage conduction of the **Main-heat** interval. The user may set low (shunt) and high(wear) limits, thus setting an acceptance window. These limits are absolute values (they are not percentages of the measurement). If the measured conduction is found to be outside of these limits, the iPAK2 will signal a fault.



When using constant current, the conduction will vary as the control applies compensation. Low conduction can be indicative of a shunt condition on the welding transformer secondary circuit. High conduction can be indicative of secondary circuit wear. Be sure to use CCR mode for the main heat

13.3. Using the Valves to control a multi-head machine

iPAK2 can be used with welding machines that have multiple welding heads. By assigning one of the iPAK2s AV outputs, each head can be operated individually.



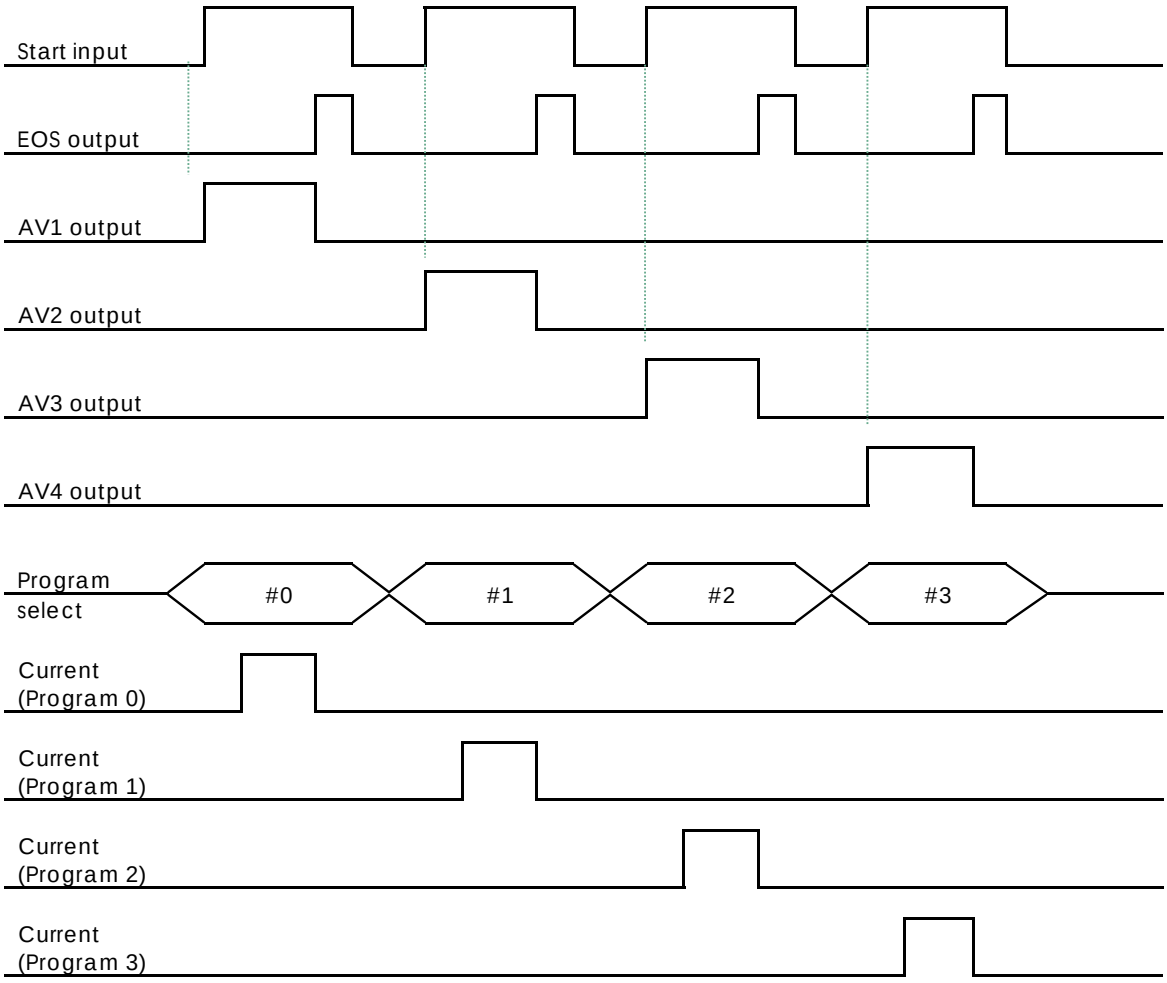
The weld air valve or WAV output is determined by the weld program.

1. In the weld program, use the Valve parameters to select an output that will be used as the WAV
2. The WAV will become active when the Start input is active and will remain active until the end of the weld sequence unless programmed otherwise.

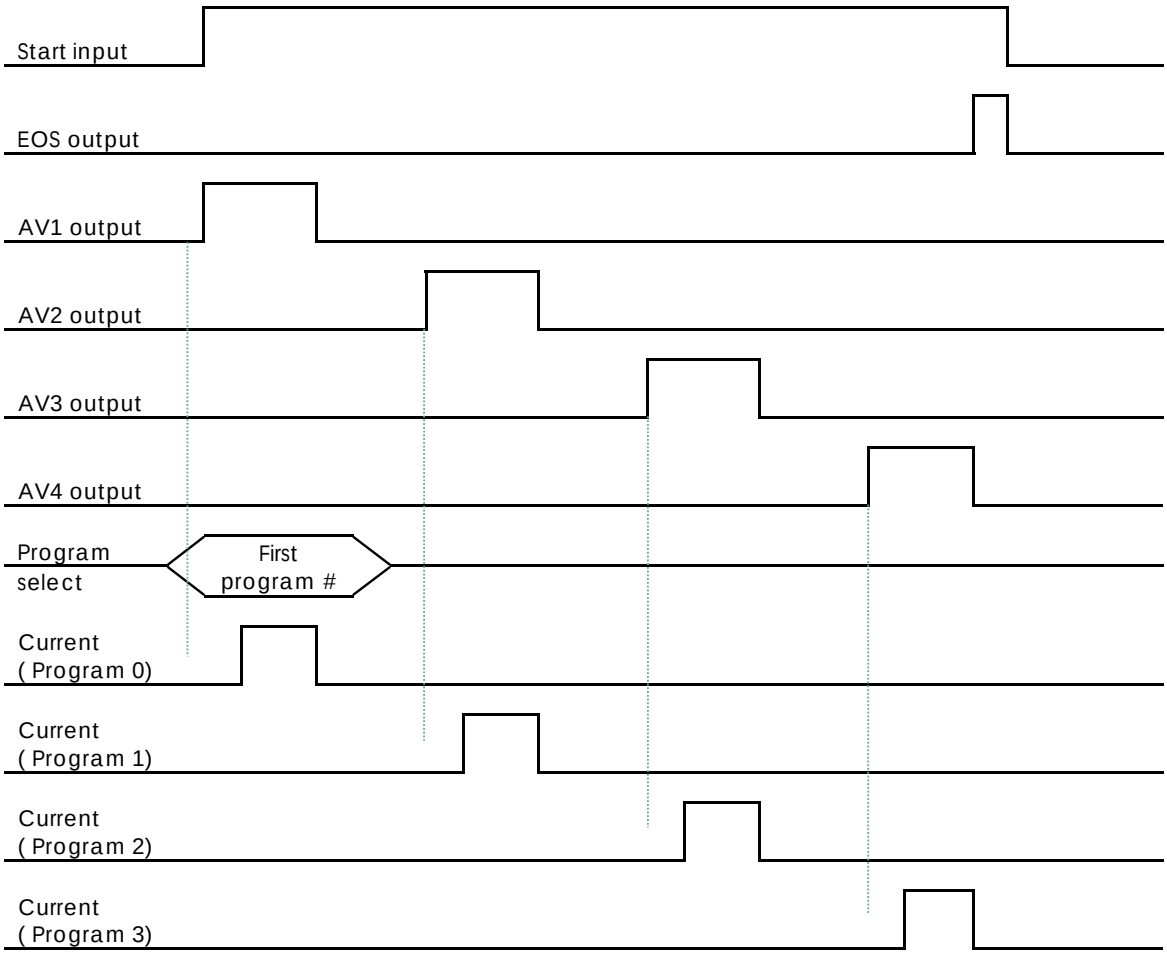
For example:

Program	WAV	Description
0	AV1	Program 0 uses AV1 as the WAV
1	AV2	Program 1 uses AV2 as the WAV
2	AV3	Program 2 uses AV3 as the WAV
3	AV4	Program 3 uses AV4 as the WAV

The diagram shows the operation in multi-gun mode:



The operation is similar when the programs are linked together in multi-gun cascade mode:

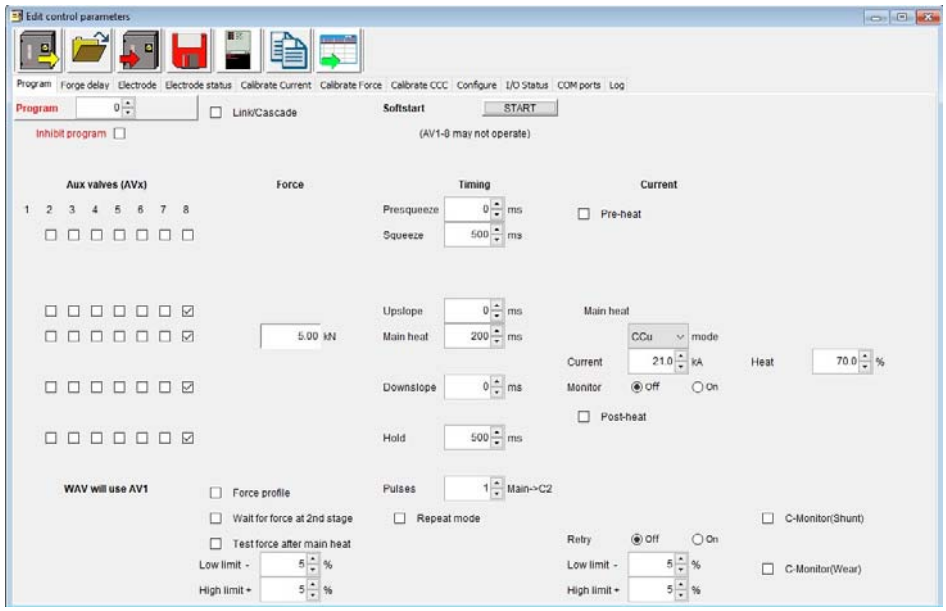


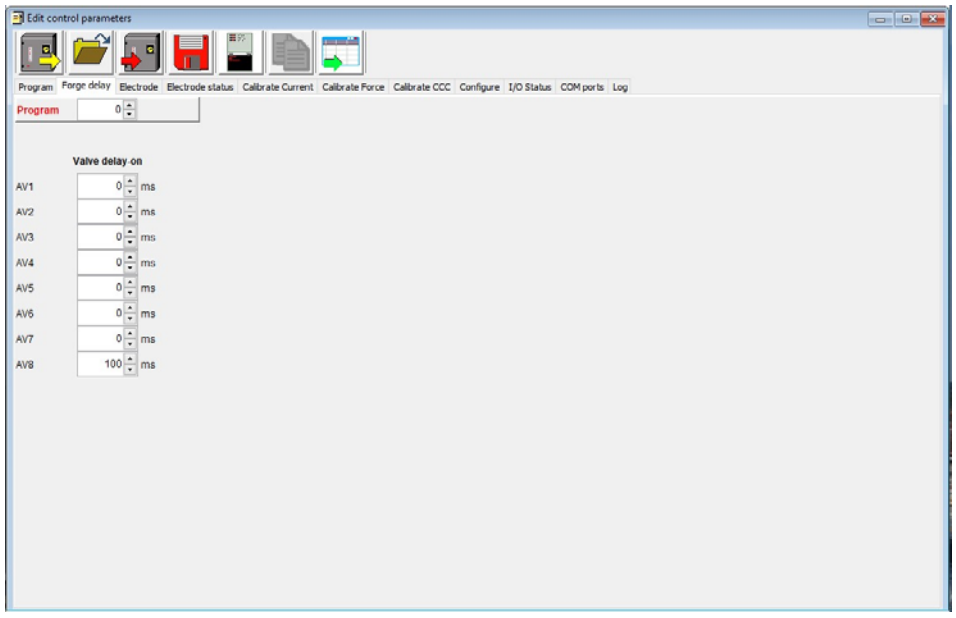
The program select inputs select the first program in the cascade (0 in this example).

13.4. Using Valve delay parameters

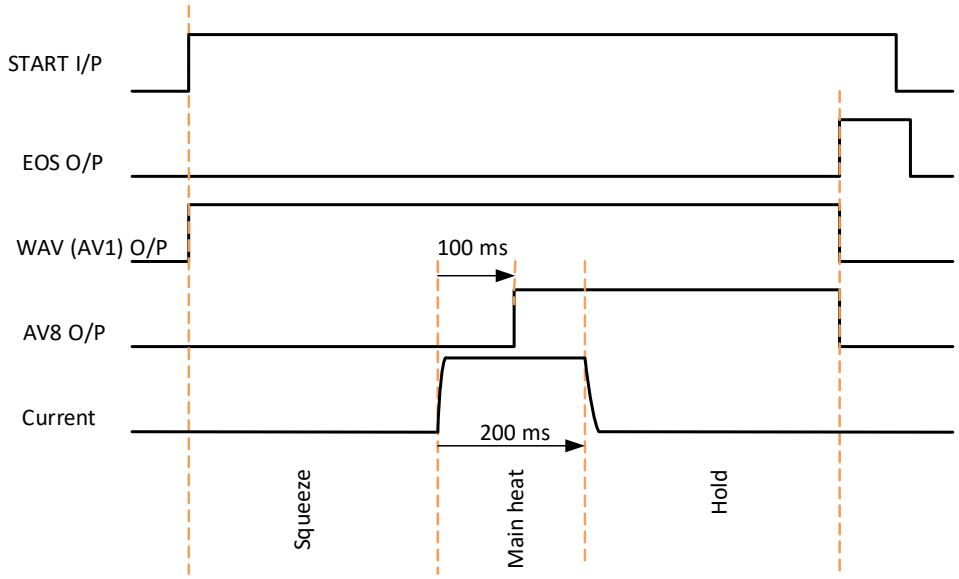
Example 1:

The AUX valve outputs can be programmed to activate after the start of any interval. In this example, NetFlash is used to program AV8 to come on 100 ms after the start of the main heat interval:





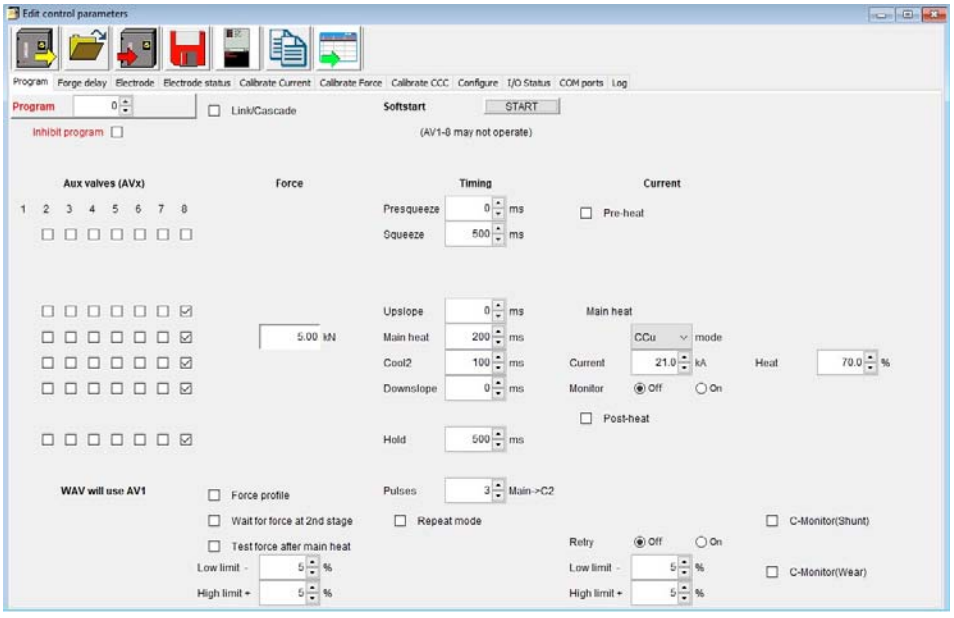
The resulting output is shown below:

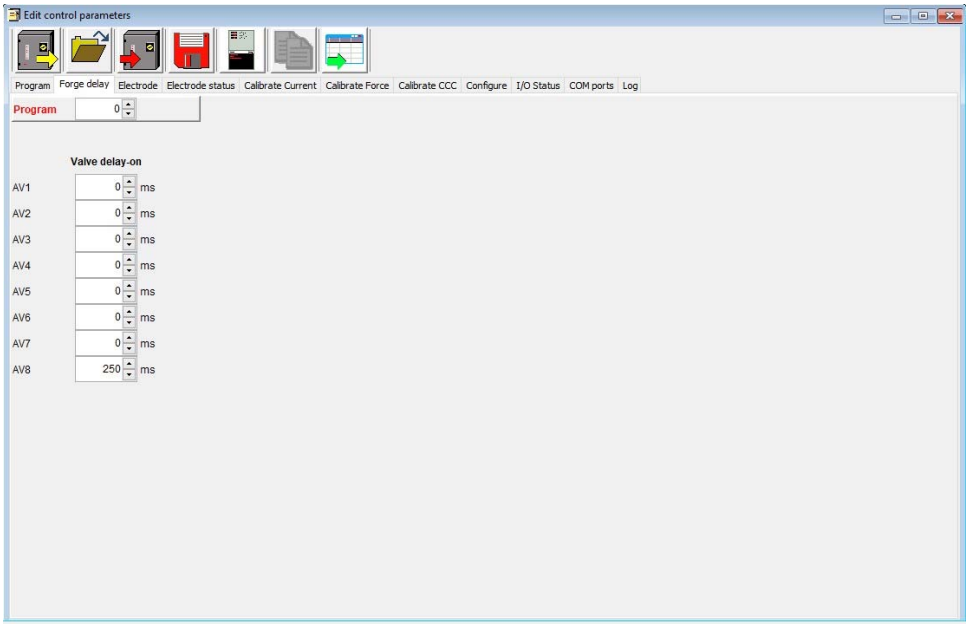


Example 2:

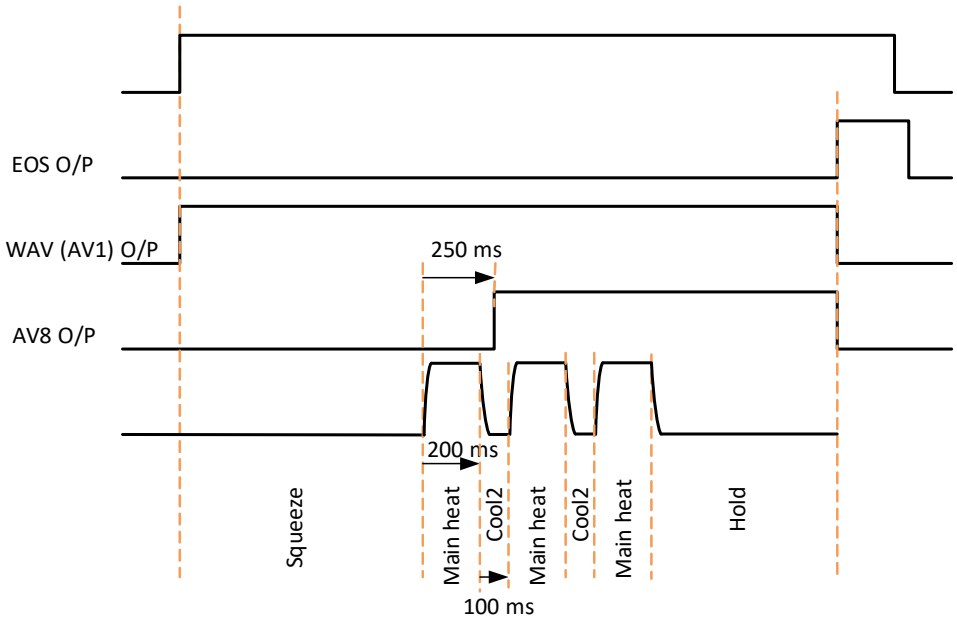
Extra care should be taken when using pulsation welding, as the program schedule contains a loop (Main-heat->Cool2->Main heat-> Cool2 etc). If the valve turn-on point lies within the loop, be sure to select all intervals in the loop and trigger the delay at the start of the Main heat interval.

In this example, AV8 is turned on in the first COOL2 period:



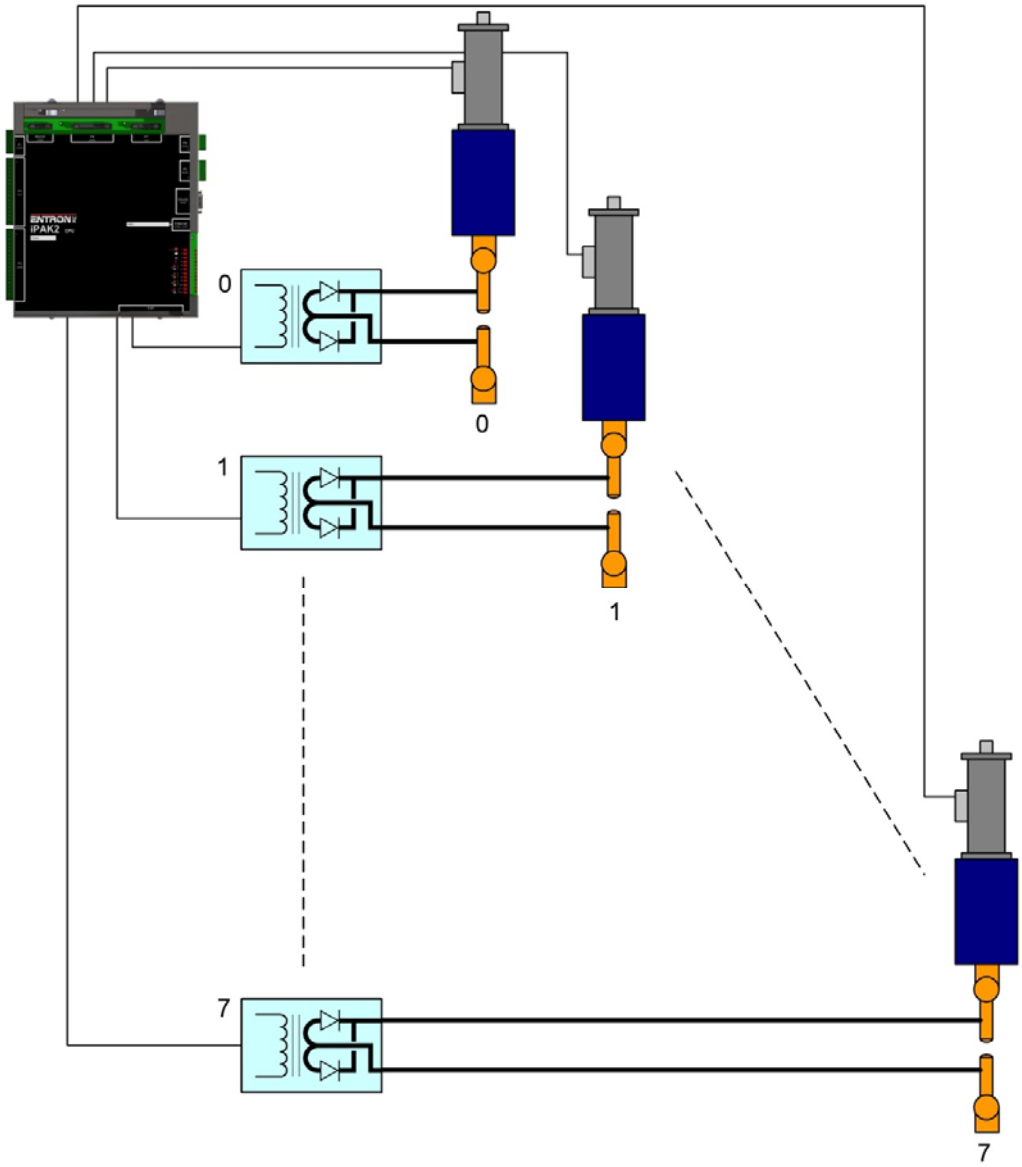


The resulting output is shown below:



13.5. Controlling a multi-welder

A multi-welder can use different transformers for each welding head.



The welding heads can be controlled as described in the previous tutorial.

1. Choose the transformers that will be assigned to the electrodes. The procedure is described in the Multi-welding section.

2. Choose the weld programs that will be using the electrodes.

For example:

Electrode	Transformer	Description
0	0	Electrodes 0, 1 and 2 are assigned to transformer 0
1	0	
2	0	
3	1	Electrodes 3 and 4 are assigned to transformer 1
4	1	
5	2	Electrode 5 is assigned to transformer 2
6	3	Electrodes 6 and 7 are assigned to transformer 3
7	3	

The electrodes can then be assigned to weld programs:

Weld program	Electrode	Description
0	0	Weld programs 0 and 1 are assigned to Electrode 0
1	0	
2	1	Weld programs 2 and 3 are assigned to Electrode 1
3	1	
4	2	Weld programs 4 and 5 are assigned to Electrode 2
5	2	
6	3	Weld programs 6 and 7 are assigned to Electrode 3
7	3	
8	4	Weld programs 8 and 9 are assigned to Electrode 4
9	4	
10	5	Weld programs 10 and 11 are assigned to Electrode 5
11	5	
12	6	Weld programs 12 and 13 are assigned to Electrode 6
13	6	
14	7	Weld programs 14 and 15 are assigned to Electrode 7
15	7	

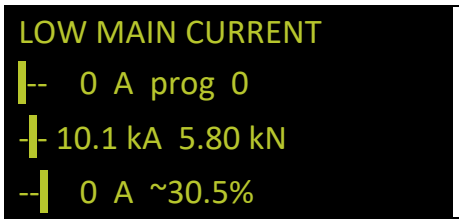
By implication the transformers are used as follows:

Transformer	Weld programs	Description
0	0, 1, 2, 3, 4, 5	Transformer 0 is used by weld programs 0, 1, 2, 3, 4, and 5
1	6, 7, 8, 9	Transformer 1 is used by weld programs 6, 7, 8 and 9
2	10, 11	Transformer 2 is used by weld programs 10 and 11
3	12, 13, 14,15	Transformer 3 is used by weld programs 12, 13, 14 and 15

13.6. Resetting Faults

Fault conditions and error messages can be reset in several ways.

13.6.1. WSP3



From the Diagnostic screen press 

13.6.2. NetFlash

Use  to select the Metrics window then select the reset button 

13.6.3. Discrete input

Input	Pin number	Description
Reset fault	P2.15	This input resets the Fault output and clears the status messages. Only momentary application is required (minimum time 40ms).

The discrete I/O is described in the I/O section.

13.6.4. Bus input

Input	Channel	Address	Description
Reset fault	Bit 6	%QX0.6	This input resets the Fault output and clears the status messages. Only momentary application is required (minimum time 40ms).

The bus I/O is described in the Modbus section.

13.7. Setting the IP address

13.7.1. iPAK2v2

This model has an integrated Ethernet sub-system for Ethernet and EtherNet/IP communications on COM4, COM5 and COM6. The IP address may be set in the configuration with NetFlash or WSP3.

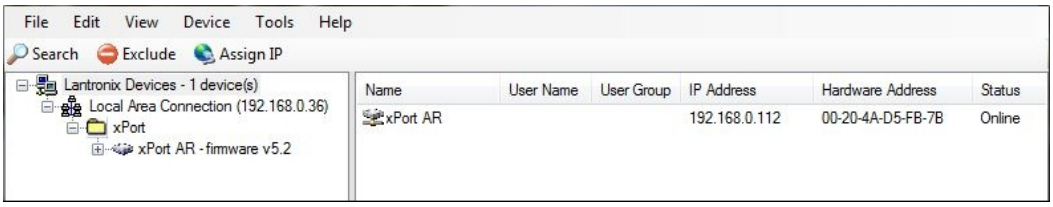
13.7.2. iPAK2

If an EtherNet/IP adapter board has been fitted, then this has its own IP address (for COM4, COM5 and COM6) which can be set as shown above for the iPAK2v2.

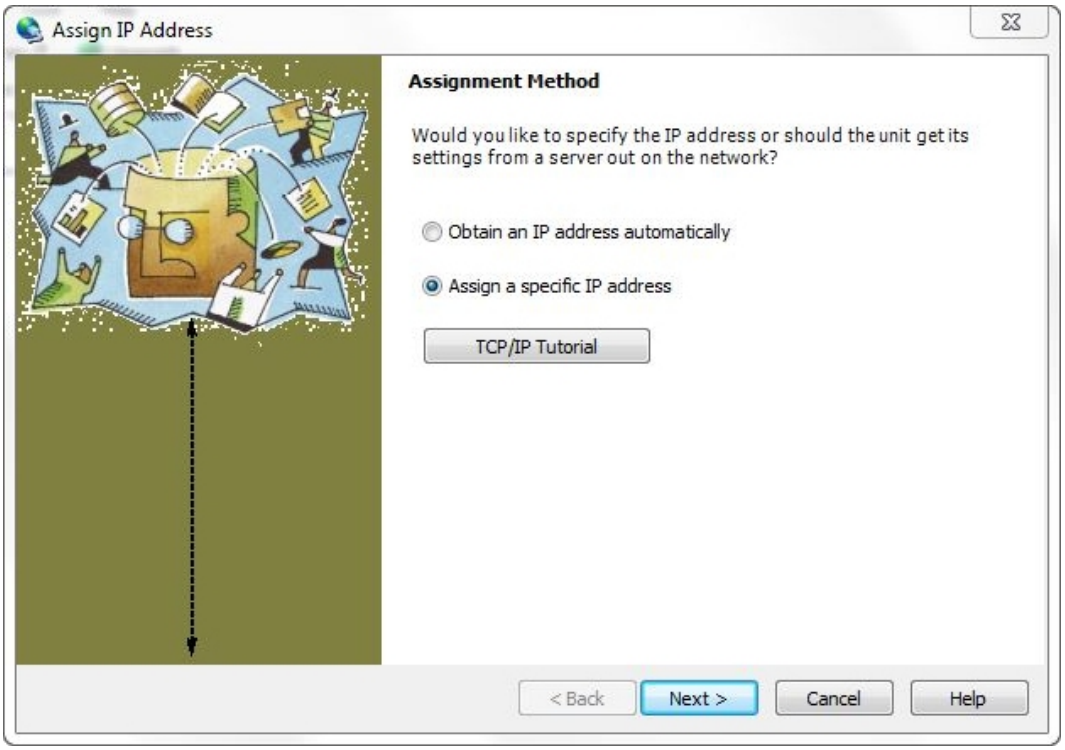
The port on the main board uses a device server for Ethernet communications on COM0 and COM1. The device server is an xPort AR device, manufactured by Lantronix. To set the IP address of the main board port on iPAK2, use Lantronix DeviceInstaller software www.lantronix.com/products/deviceinstaller/

Note: This method also works for the EtherNet/IP adapter board (if fitted) and iPAK2v2.

- Download the documentation and Device Installer software. Install the software.
- Follow the instructions in the documentation to search for all Lantronix devices on your network. Device Installer will show the iPAK2 device server in the device list. The example shows an iPAK2/xPort AR with a hardware address of 00-20-4A-D5-FB-7B:

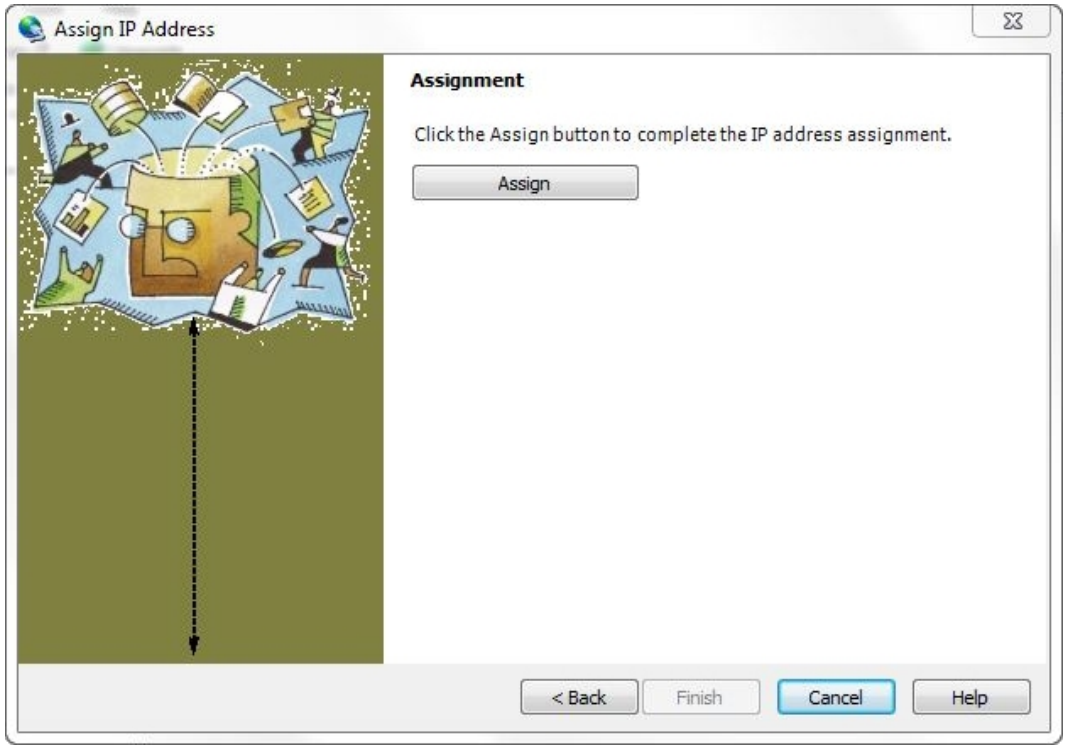


- Select the iPAK2/xPort AR device then select Assign IP:

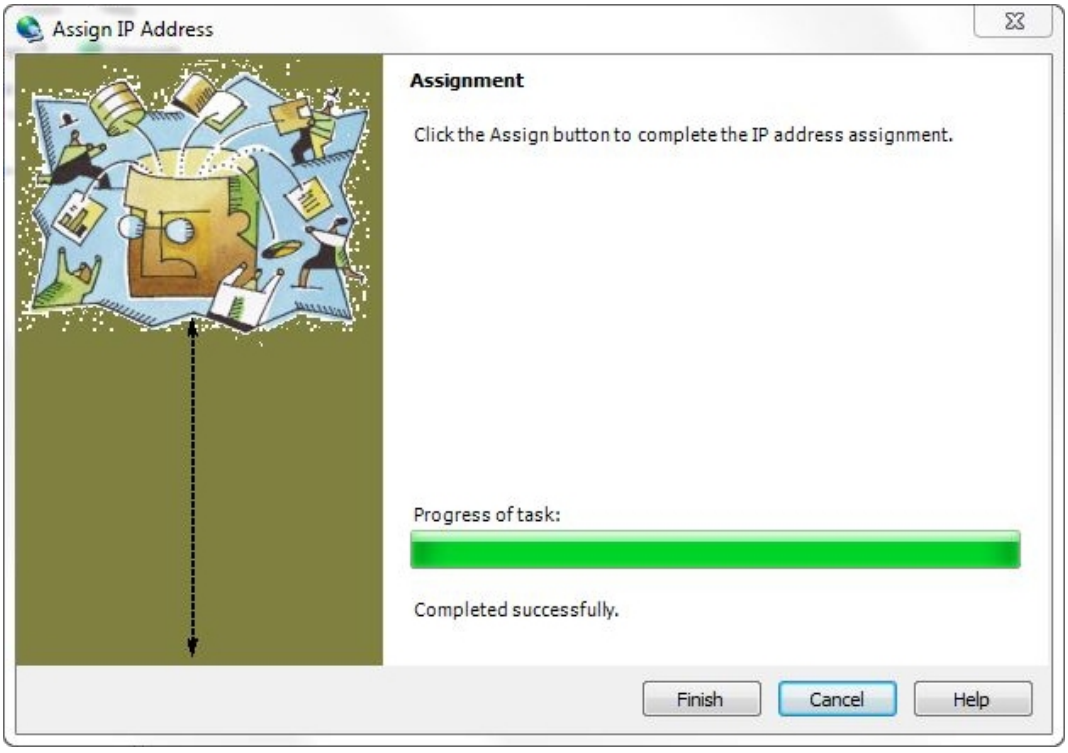


- Select 'Assign a specific IP address' and then select Next:

- Enter the IP address, subnet mask and gateway then select Next:



- Select Assign to complete the assignment. Device Installer will show the progress of the operation.



- Select Finish to return to the main screen.

13.8. Updating the firmware

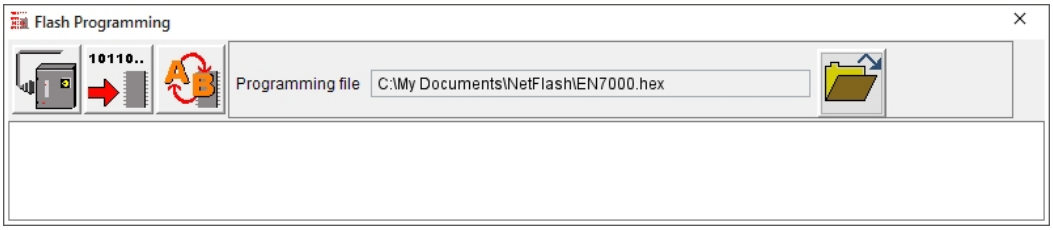
The functionality of iPAK2 is determined by firmware stored in reprogrammable memory. iPAK2 has three memories:

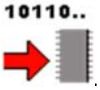
Memory	Description
A	Memory A
B	Memory B
BIOS	BIOS memory

The firmware can be transferred to one or more of the memories and then activated when iPAK2 starts. In this way it is possible to retain different firmwares and activate them without having to reprogram iPAK2. When new features become available NetFlash is used to update the firmware.

- Initialise NetFlash and select the target iPAK2 as described in the Tutorial section setting the IP address.
- Select the Flash Programming tool 

. The following screen is shown:



- Select the flash file  . This will be a file with a .hex extension supplied by ENTRON.
- Select connect to the iPAK2  . NetFlash will connect to the target control and report the current firmware status.
- Select transfer to the iPAK2 

. Select a memory to re-program and NetFlash will transfer the flash file to the iPAK2.
- If required, select change the active memory  . NetFlash will mark the selected memory as active. When iPAK2 restarts, the selected memory is copied internally and becomes active.

14. Terminology

Term	Description
Constant current	Closed loop control of weld current resulting in the weld current being regulated to a programmed value.
CT	See Current transformer.
Current transformer	A coil of wire wound on a circular core. This is used to measure the current in a cable passing through the circular core. iPAK2 can use a CT to measure primary current.
Cool time	The time between weld pulses.
Downslope	A linear decrease in current from the Main heat value to a final value.
Downslope time	Time taken for the welding current to decrease from the Main heat value to a final value. Expressed in mains cycles.
End of sequence	An output that switches on as the electrodes open on completion of a weld. The output indicates the end of the weld sequence.
EOS	See End of sequence.
HAV	Hi-lift Air Valve. See also Retract.
Heat	A measure of power put into a phase angle controlled (non- constant current) weld. The Heat relates directly to the firing angle on the mains voltage waveform. Expressed as a percentage.
Hold	The time between the last application of current and the electrodes opening. This interval allows the molten material created by the weld process to solidify.
Hold time	The time period following the last weld pulse prior to the electrodes opening. This period allows the molten material to solidify. Expressed in mains cycles.
IP address	Internet Protocol address. A unique address used by devices on an Ethernet network.
Initiation signal	The signal that starts the weld sequence. See also Start signal
kA	Kilo amp (1000 amps).
kVA	Unit of power (1000 volt amps).
mA	Milliamp (1/1000 amp).
mV	Millivolt (1/1000 volt).
Off time	In a Repeated weld sequence this is the time between sequences. Expressed in mains cycles.
PHA	See Phase angle control.
Pulse width (PW) control	Open loop control of weld current using Heat setting. The welding current is not regulated and can be influenced by external parameters such as mains voltage and cable lengths.
Post-heat	The application of current to prevent the weld cooling too quickly.
Pre-heat	The application of current prior to welding for the purpose of burning through plating or surface contamination.
Presqueeze	The time interval in a weld sequence for the electrodes to close onto the work piece.
Presqueeze time	The time allowed for the welding electrodes to close onto the components to be welded. Expressed in mains cycles.
Primary current	The current in the primary winding of the weld transformer which is the current drawn from the mains whilst welding.
Program select	A group of inputs representing the binary value of the weld program to be used.
Proportional valve	A device for regulating air-line pressure. Controlled by 0 to10 V dc signal.
Pulsations	The number of times the Main heat interval is repeated during the sequence. Successive applications of Main heat are separated by Cool2 time.
Retract	The electrodes have two open positions: fully open to move the weld gun to and from the work piece, and a working position for welding.
Retract air valve	For use on a gun where the electrodes can be opened and closed in two stages. This is an electrically operated valve for admitting air to the air cylinder that controls the electrode movement.
2nd stage	A signal required to allow the weld sequence to proceed.
Secondary current	The current in the secondary winding of the weld transformer which is the weld current.

Squeeze	The time interval in a weld sequence for the electrodes to exert full welding force on the work piece.
Squeeze time	The time allowed for the welding electrodes to build up full pressure on the components to be welded. Expressed in mains cycles.
Start signal	The signal that starts the weld sequence.
Stepper	A program of parameters required for stepping.
Stepping	A technique of progressively increasing the weld current over the course of a large number of welds in order to compensate for the effects of electrode wear.
Thermostat	A switch device that operates at a certain temperature.
Tip dress acknowledge	An input to acknowledge that the electrodes have been dressed.
Tip dress request	An output to indicate that the electrodes require dressing.
Tip dressing	Filing or machining worn electrodes to restore their original shape and dimensions.
Toroid	A device used for sensing current in a cable. The current carrying cable must pass through the toroid.
Upslope	A linear increase in current from an initial value to the Main heat value.
Upslope time	Time taken for current to increase from an initial value to the Main heat value. Expressed in mains cycles.
VA	Volt amp
WAV	See Weld air valve.
Weld air valve	Electrically controlled valve for admitting air to the air cylinder responsible for forcing the weld electrodes together.
Weld current	High current passed from one electrode to the other, through the components being welded. The current must be large enough to generate sufficient heat to melt the metal and produce a weld.
Weld transformer	Electrical component for converting mains voltage input to low voltage, high current output.

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