DC Spot Welding Power Supply

DCxx13-T and M31xx-T

Resistance Welders

SOFTWARE MANUAL

961-00061 rev10

Annex:
- Safety regulations
- General references on resistance welding
- Contact addresses

Versions		
Version	**Date**	**Basis of Version**
1.08	2019-01	Conversion to new layout
1.09	2019-07	Add access configuration feature
1.10	2020-03	Overhaul to ensure screens match latest version
1.11	2020-10	Encoder and name changes

Table of Contents

1 General Information

Information about safety regulations, symbols, copyrights, protection rights, usage location conditions can be found in the back section of these operating instructions.

Please read this information carefully before using these operating instructions.

These operating instructions should help you familiarize yourself with the system and take advantage of its application possibilities when used as directed.

It contains important notes to help operate the unit safely, properly, and economically.

Observing the notes will help avoid risks, decrease repair costs and down times, and enhance reliability and the service life of the unit.

Warning

It is a rule: **Safety first!**

Danger

Incorrect or inappropriate configuration, installation, settings, handling or use can cause mechanical, electrical or thermal hazards, which may result in serious damage or injury.

Ensure the correct execution of these points and follow the respective notes in the operating instructions.

Do not put the system into operation before you have read the **operating instructions**!

Danger

Persons with **cardiac pacemakers** and **metallic implants** are prohibited from approaching to within a radius of **at least 5 m** of welding equipment!

Warning

Crushing Hazard
There is a risk of crushing during the adjustment movement due to closing electrodes, stops for limiting adjustment or stroke movement and the stop on the basic pincers unit for limiting floating movement.

Warning

This **Class A welding equipment** is not supposed to be used in living quarters, where the power supply is carried out by a public low voltage supply.

There it can be difficult to ensure electromagnetic compatibility because of conducted or radiated disturbances.

2 Technical Description

2.1 Introduction

Thank you for purchasing this Amada Weld Tech resistance welding power source.

This manual is designed to help the new user to understand and operate the equipment quickly and safely. Please take a few moments to become familiar with the equipment and this manual before attempting to use the equipment.

The following information covers the model you have purchased and others in the range and should be kept for reference. This will also help you identify model specific features mentioned in this manual.

All DC-xx13-Ts are comprised of a linear DC power unit controlled by a microprocessor and colour touch screen interface.

It is the user's responsibility to ensure that their installation is safe both electrically and mechanically.

The DC-xx13-T allows you to program the delivery of electrical energy into a weld by allowing adjustment of time and amplitude. Typically, energy into the weld is gradually ramped up, held at a peak and then reduced. The amount of energy will depend on the length of these times together with the value of the peak amplitude achieved. In some cases it is beneficial to use 2 pulses in a weld, usually with the first pulse acting as a means of pre-conditioning the parts.

A weld profile that is used to make a satisfactory weld can be saved as a PROFILE in the unit's memory.

2.2 Technical Specification

For technical specifications of the DC-xx13 and M31xx machine ranges, please see the latest version of the associated hardware manual (961-00060).

3 Commissioning

3.1 Electrical Connections

Caution

DO **Use a properly rated Mains Service Supply**
An identification plate on the rear panel specifies the input mains voltage requirement.

DO **Provide Proper Ventilation**

DO **Use Lifting Gear to Move the Unit**

DO NOT **Operate Machine Without Covers**

DO NOT **Operate With Suspected Failures**

DO NOT **Operate in an Explosive Atmosphere**

DO NOT **Operate in Wet/Damp Conditions**

IF IN DOUBT, CONTACT YOUR DISTRIBUTOR

Inspect the unit for any shipping damage prior to connecting to the mains supply.

Ensure you use green safety goggles when operating unit.

This product MUST be connected to the correct mains supply voltage. Refer to the identification plate located on the rear panel.

Single-Phase

Cable Colour:	
Brown	Live
Blue	Neutral
Yellow/Green	Safety Earth / Ground

3-Phase

Cable Colour:	
Black	Line 1
Black	Line 2
Black	Line 3
Yellow/Green	Safety Earth / Ground

Ensure a good earth / ground connection is provided for operator safety. The internal electrical circuits are floating, so an additional earth / ground connection can be made to one output lug or on one side of the weld head. The unit will not operate with both the positive and negative outputs grounded.

4 Main Operating Screen

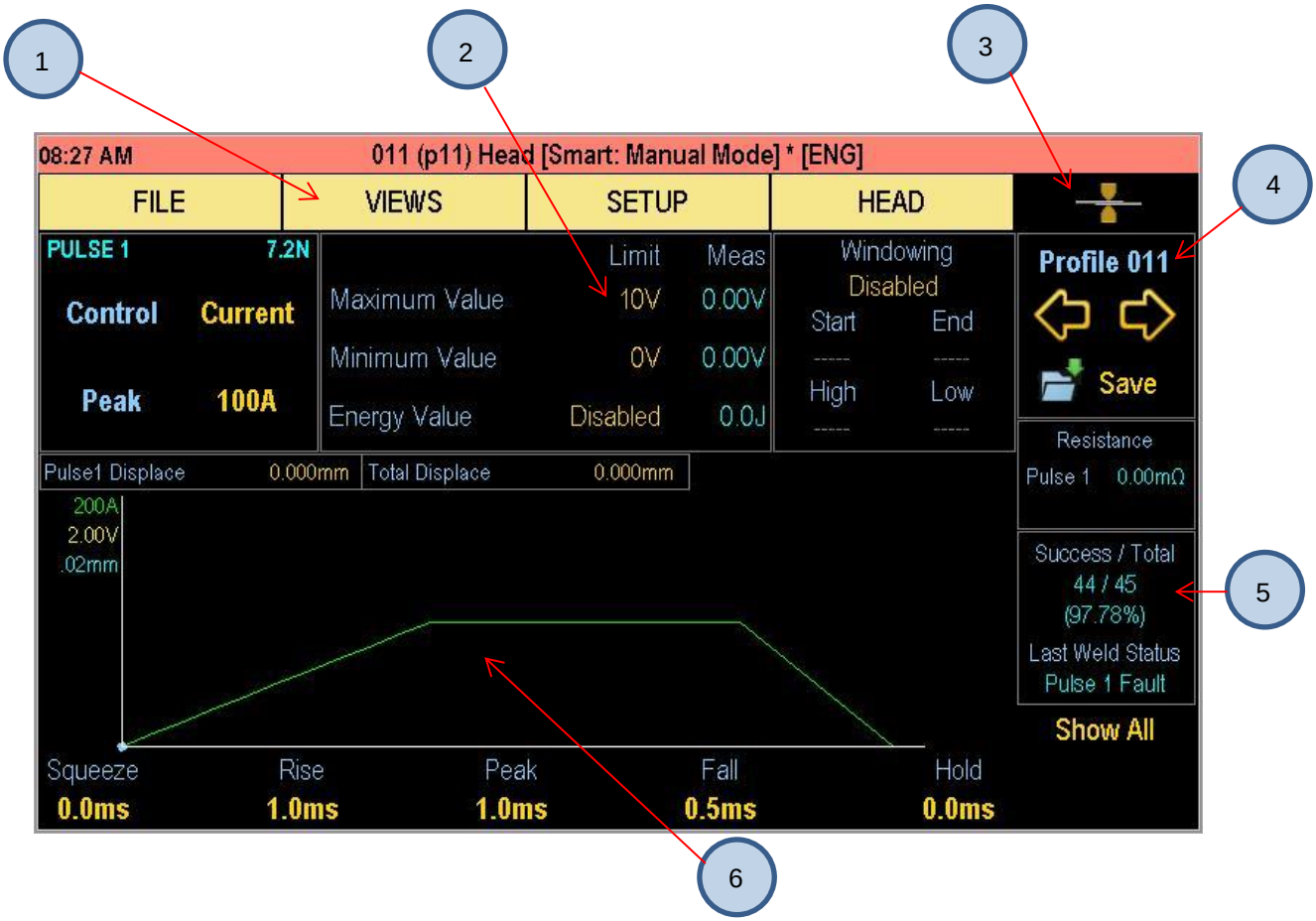
4.1 Overview

The main operating screen, shown here with a single pulse weld, can be considered as a series of control or display sections.

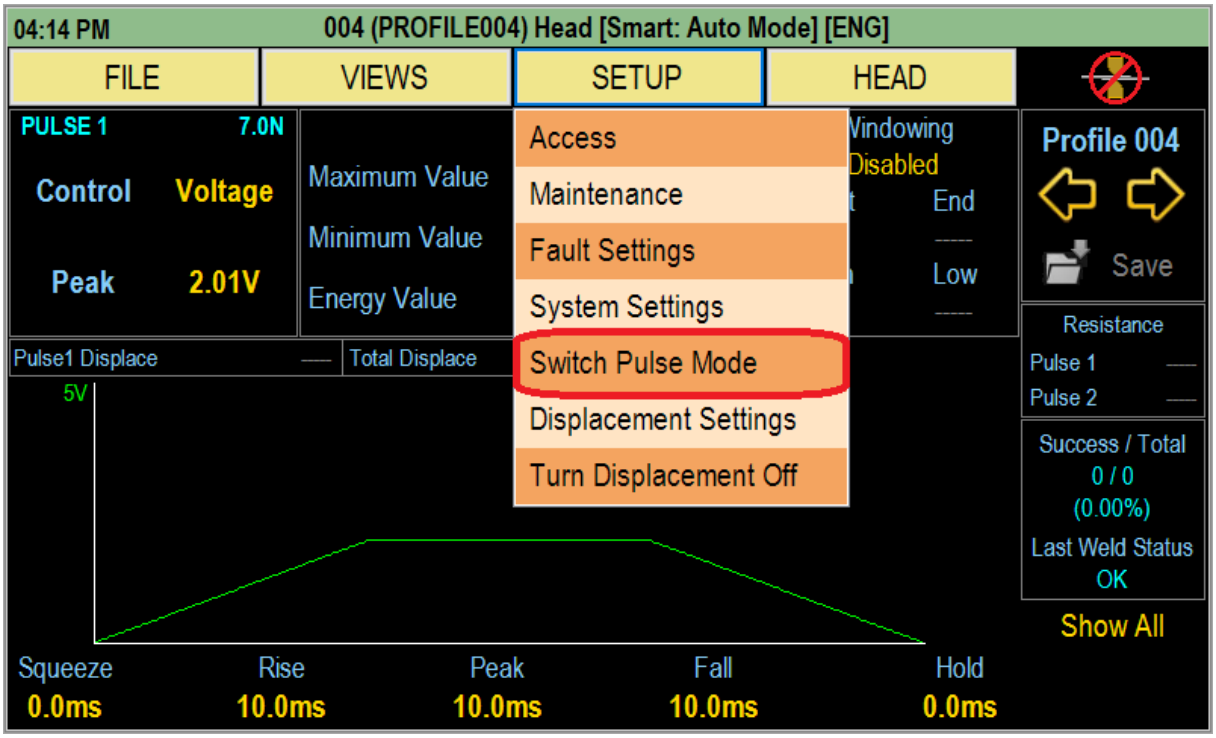
1. Along the top are up to four context related drop-down menu structures.
2. Underneath the drop-down menus are three key parameter display areas which show the primary set and measured values
3. Top right is a weld inhibit button and indicator.
4. Below this is the current profile name, along with two left/right scroll arrows to facilitate quick recall of profiles.
5. Below this is a separate box section showing basic weld statistic data.
6. The main section, middle left, shows a graphical representation of the desired and programmed welding profile.

A welding profile is defined in terms of discrete time sections in which the closed loop power supply will output either a constant current, constant voltage or constant power in accordance with the times set and the peak value.

Adjustable values are shown in yellow and will change to red once they have been changed but not saved.

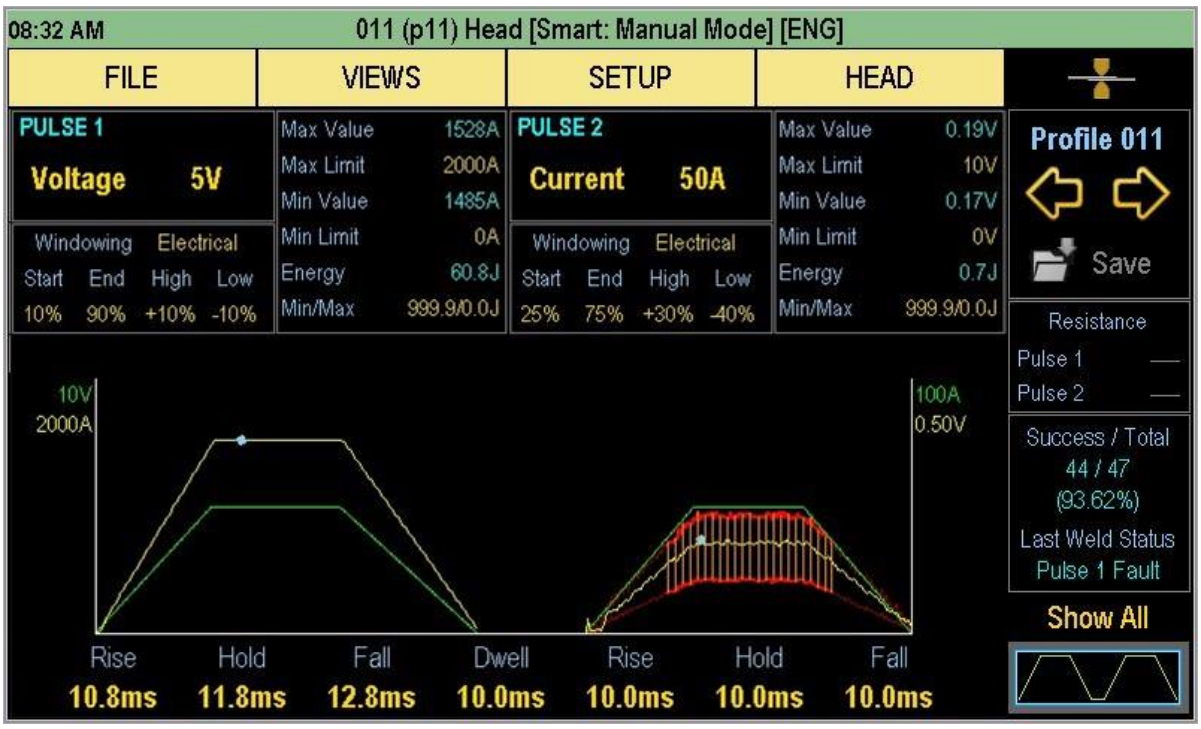


The general principle for setting up a single pulse profile is duplicated when using a double pulse profile. To activate double pulse mode, press **SETUP** and then select **SWITCH PULSE MODE.** Once selected, the double pulse icon appears in the lower right hand corner.



Double pulse mode follows the same scheme as for single pulse. Adjustable variables are shown in yellow. Non-adjustable values are shown in cyan.

The screen shot below shows a double pulse weld with window tolerancing applied to the second pulse. Note that each pulse can be defined with its own operating mode (voltage, current or power) and that limits and measurements are separate for each pulse.

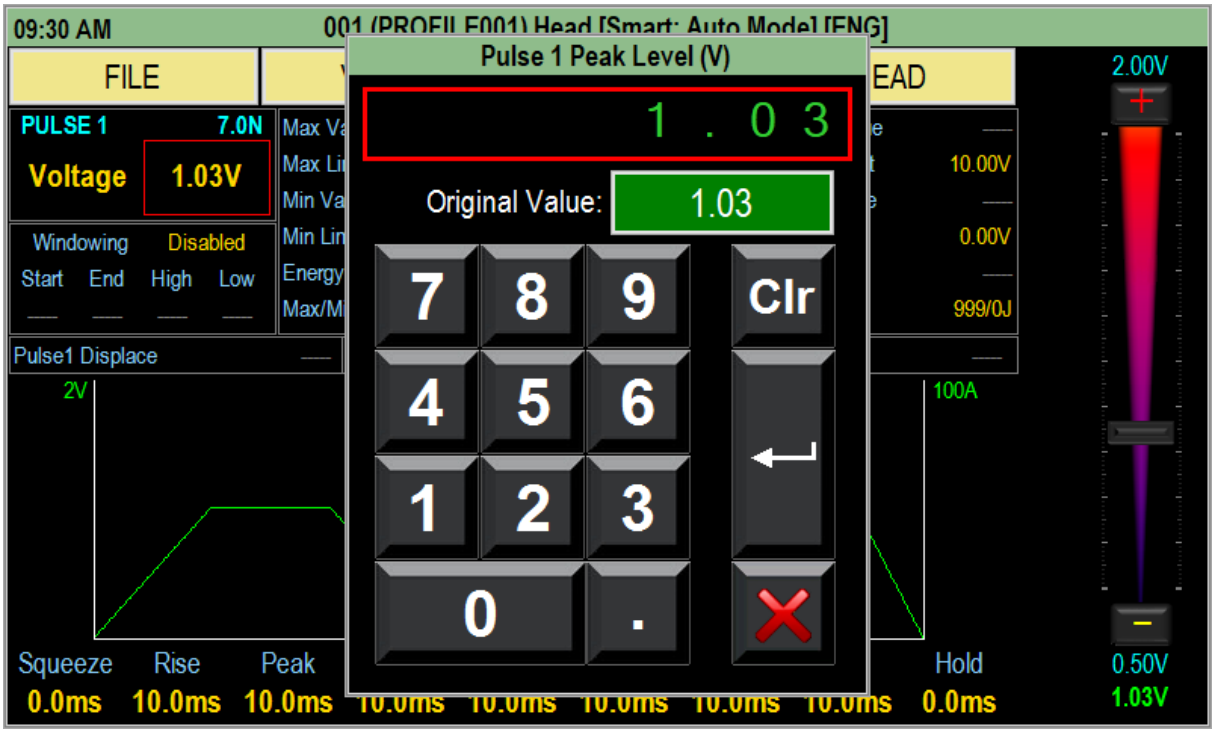


4.2 Making Adjustments

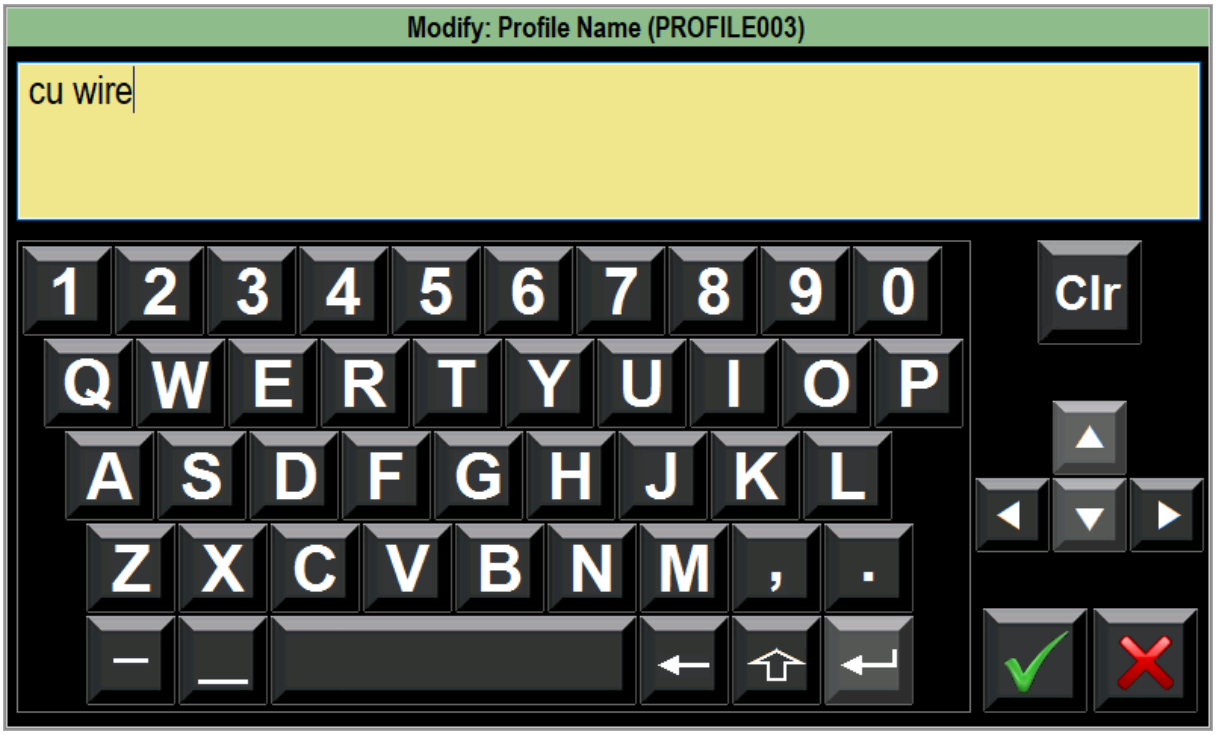
Adjustable parameters are shown in yellow (turning red when modified but not saved). These can be further highlighted with outline boxes under the system settings menu (see 'Parameter Boxes').

Upon touching a numeric parameter for modification, a context based numeric keypad will pop up. There is also a touch slider control. Both items allow the parameter to be changed within the limits of the machine.

Note that the control displays the original value prior to change as a reference to the user. To restore the original value, simply press on the original value number in the green box.



Alphanumeric values, such as a profile name, will cause a full keyboard to appear on screen to facilitate the data entry.

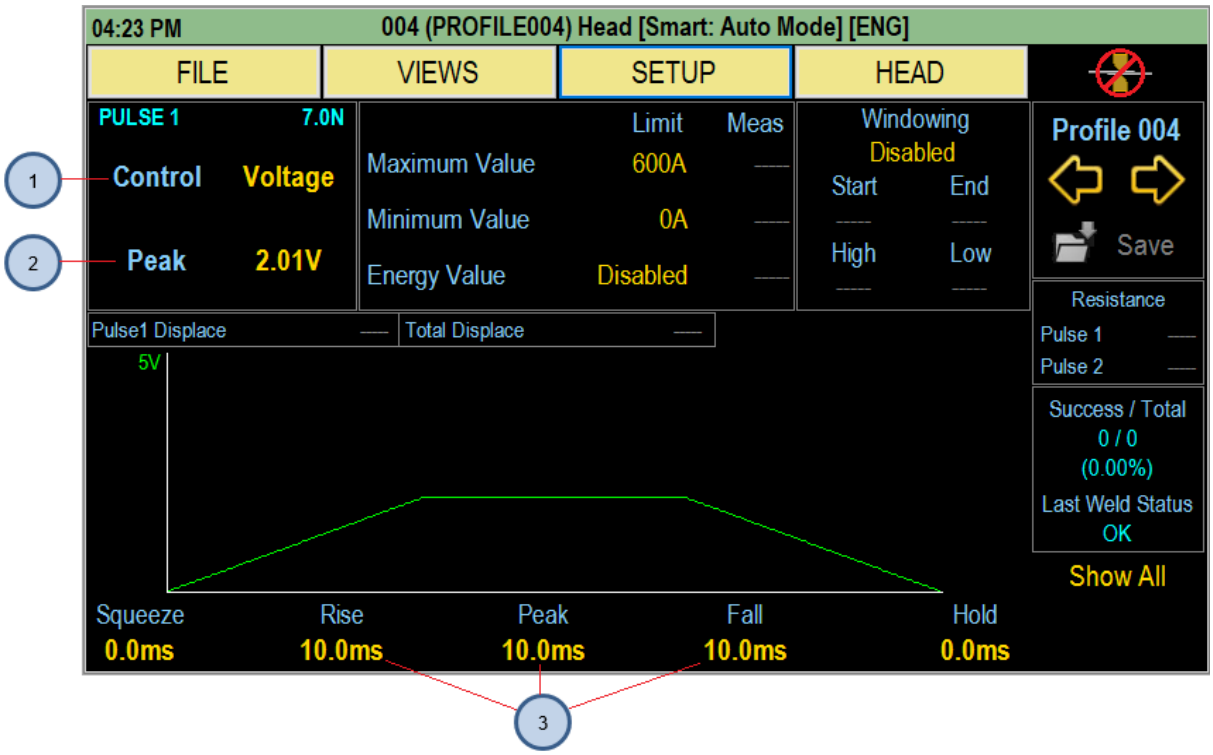


4.3 Getting Started

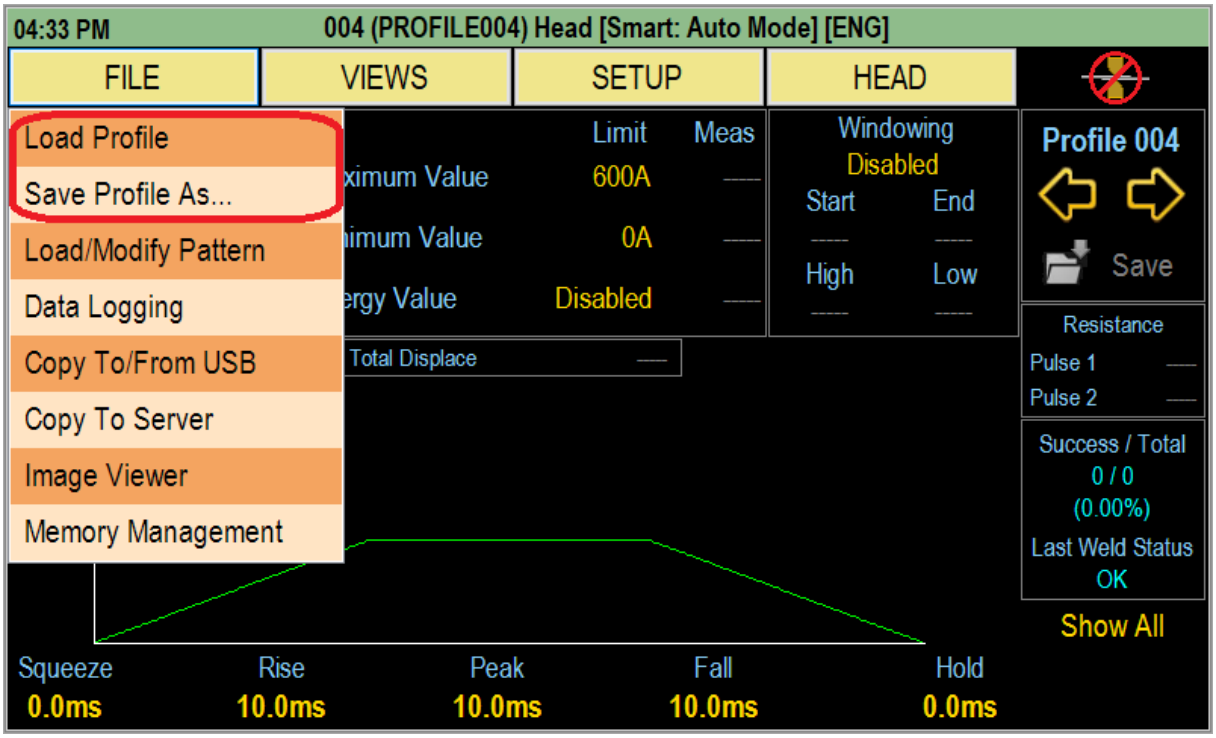
This section shows how to get started with a simple welding profile.The screen below shows a single pulse weld running in voltage control.

To set this up, the user would select:

1. The control mode (voltage, current or power)
2. The peak level for the electrical profile (weld).
3. The rise time, the peak time and the fall time for the electrical profile (weld).



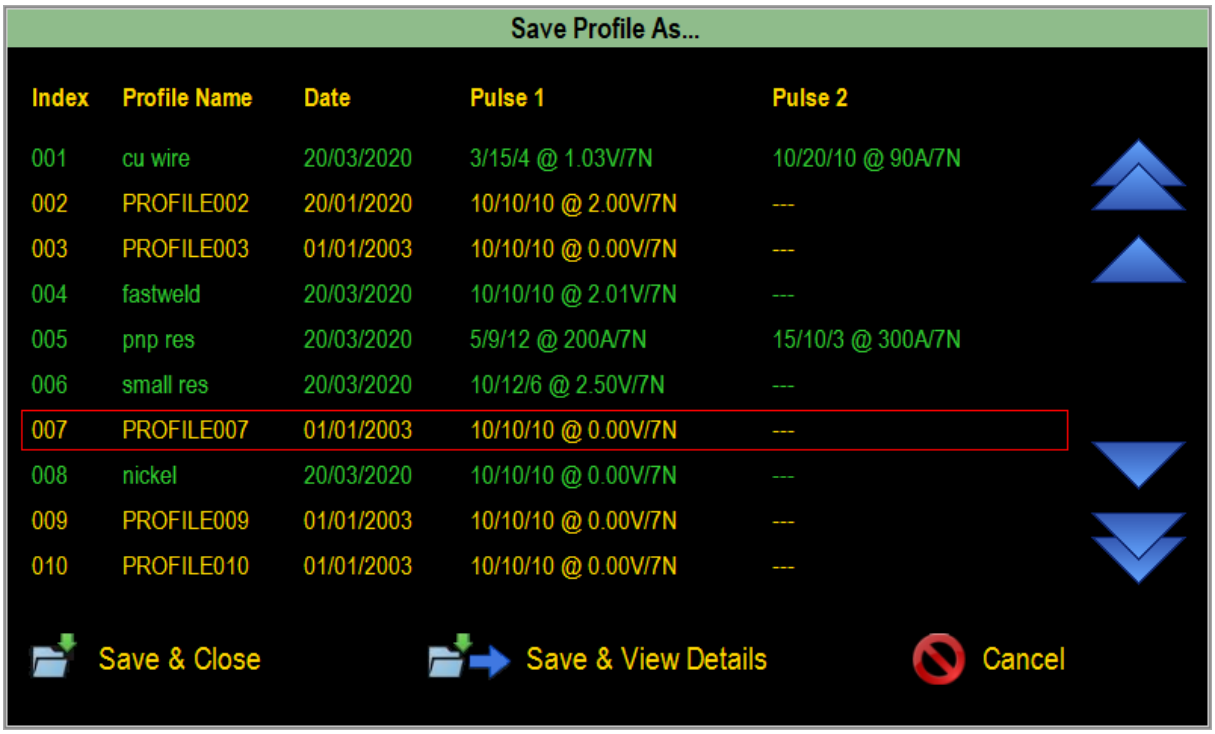
Once the desired parameters have been set, the profile can be saved via the Save button on the top right of the screen or alternatively, the **FILE** drop down menu, selecting **Save Profile As…**. To load the saved profile, use the **Load Profile** under the **FILE** drop down menu.



The profile save screen provides a view of the most recently modified profile names, along with basic setup details. Scroll arrows to the right of the screen allow other pages to be displayed.

To select a profile memory location, simply press the appropriate line.

If you want to edit the default profile name, select **Save & View Details** and then edit the profile name. If you are simply saving over the top of a previously stored profile, then select **Save & Close.**



5 Menus

5.1 Profile Data Definition

As the screen above shows, a welding profile is the definition of the desired output with respect to time. These basic settings are shown against each profile in the memory listing.

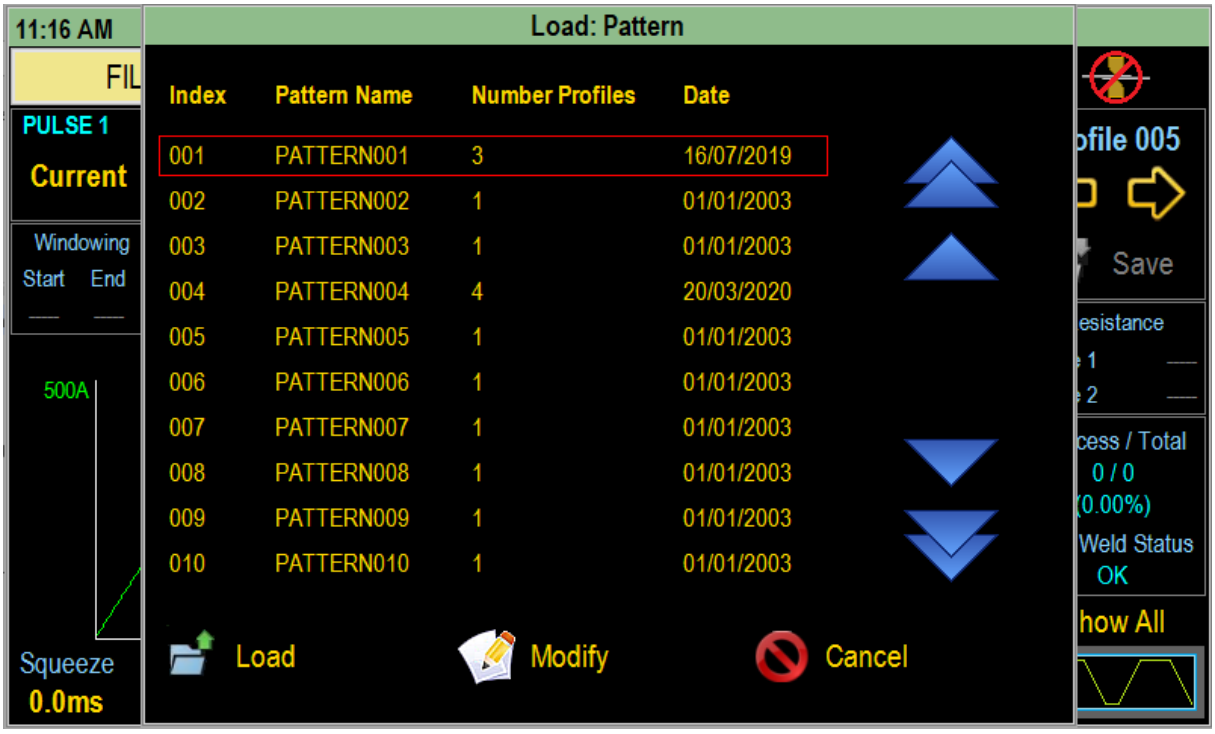
Profiles are stored in memory and are conveniently given a numeric index number in the range 1 – 99 (as shown in the left-hand column). By default, the machine profile names are also numbered according to the matching index number e.g. PROFILE003 above. Typically, once a production profile has been established, it will be renamed to something more relevant.

The numeric profile index is also used as the default weld head number (up to head 6). Head numbers are only relevant when the power supply is interfaced with distribution and can be modified from their default values to suit the application. (See the distribution section.)

The profile definition will also contain all limit data and recorded limit traces; hence a profile forms a complete definition of the electrical process required as well as the expected limits. Furthermore, it is possible to associate relevant documents to a profile so that external data can be referenced simply from the weld profile. (See the profile details section).

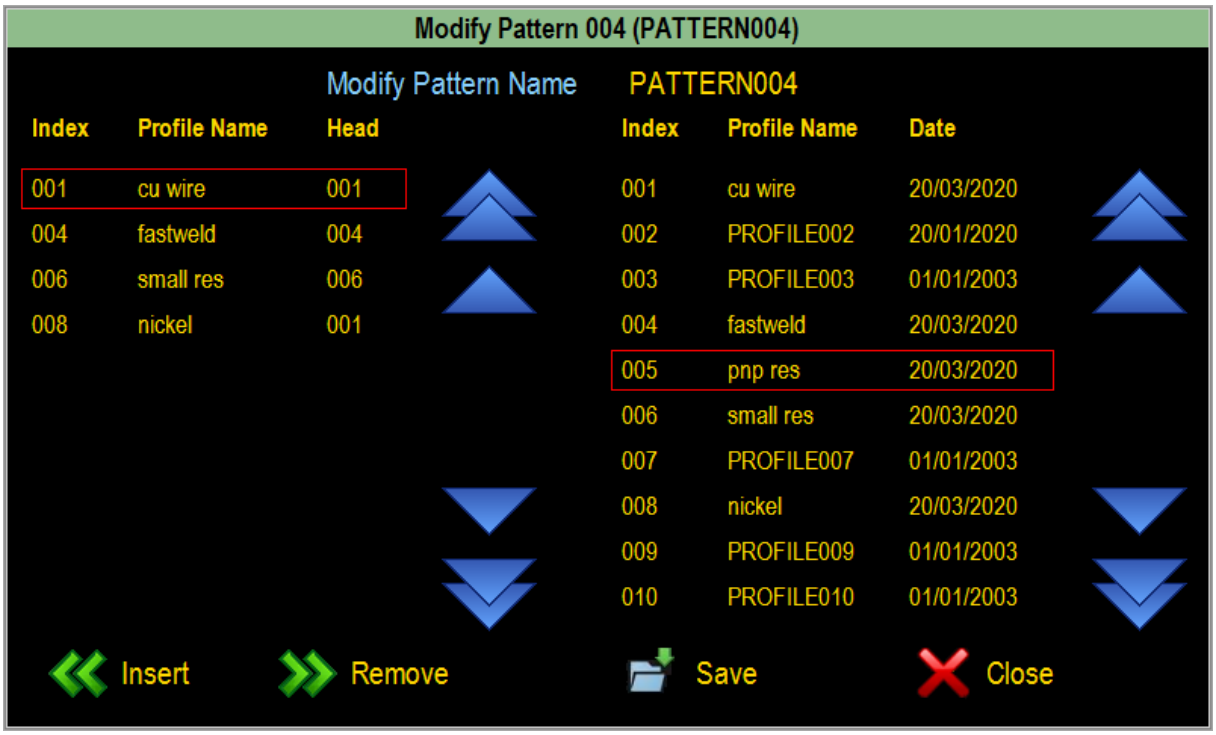
5.2 Pattern Data Definition

In the same way that Profile memories default with a numeric index, there are also 100 pattern memories.



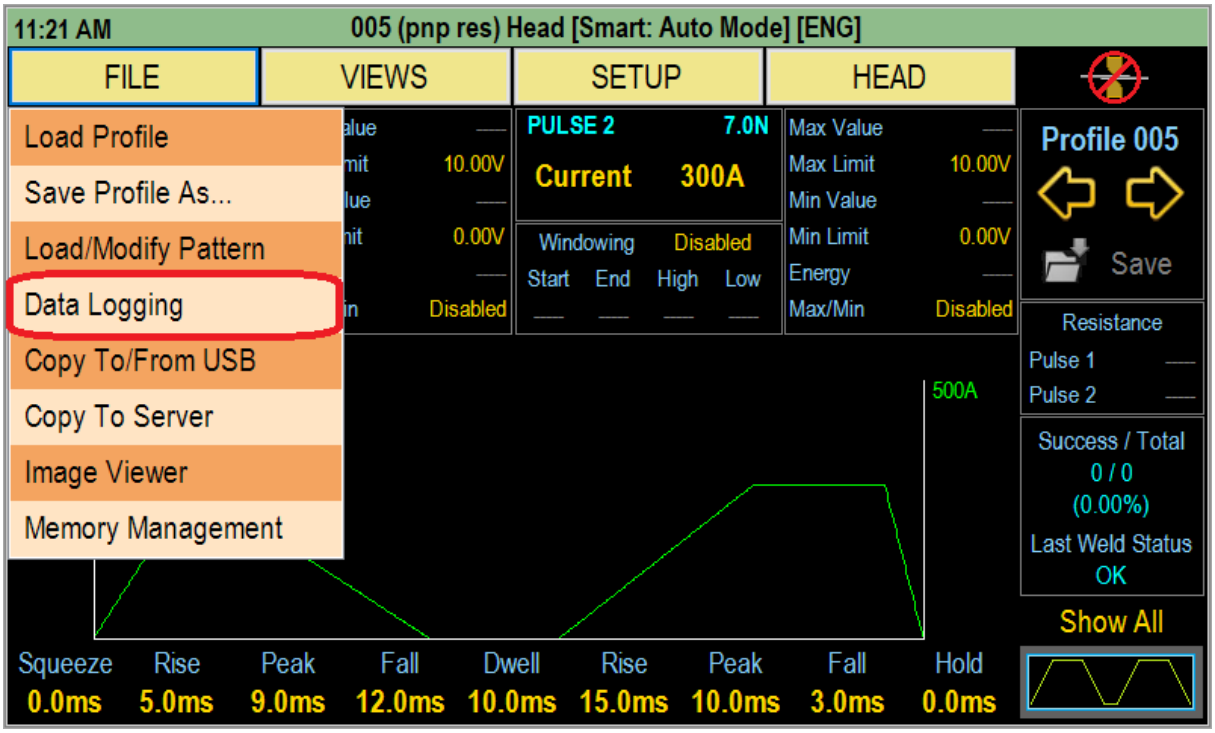
A pattern is simply a sequential collection of profiles and is most often used in automation when there is a fixed sequence of different profile welding required. Each time the machine is triggered to weld, the next profile in the list is selected and executed.

Once a pattern list of profiles is selected, profiles can be added to or subtracted from the pattern list. Similarly, the order of the list can be modified.



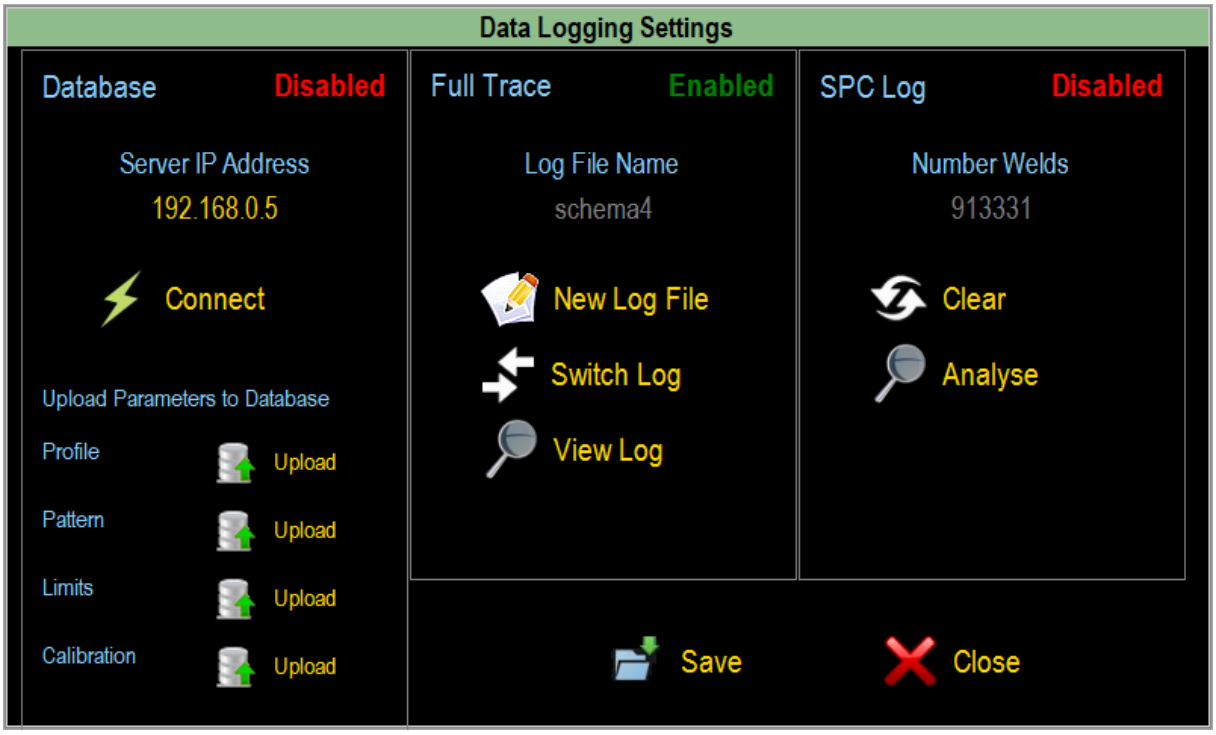
5.3 Data Logging

Under the FILE menu is the ‘Data Logging‘ option. Selecting ‘this provides a number of options by which process data can be recorded.



The unit itself has significant internal memory which may be used to capture process data. This data can also be analysed on screen.

For greater capacity and longer periods of logging, it is recommended that the unit be connected directly onto a network in order to stream data directly into a database.



Database: Enable to stream log information directly to a network database at a specified IP address. Quick buttons enable parameter settings to be uploaded quickly to sync and save the welder setups to the database.

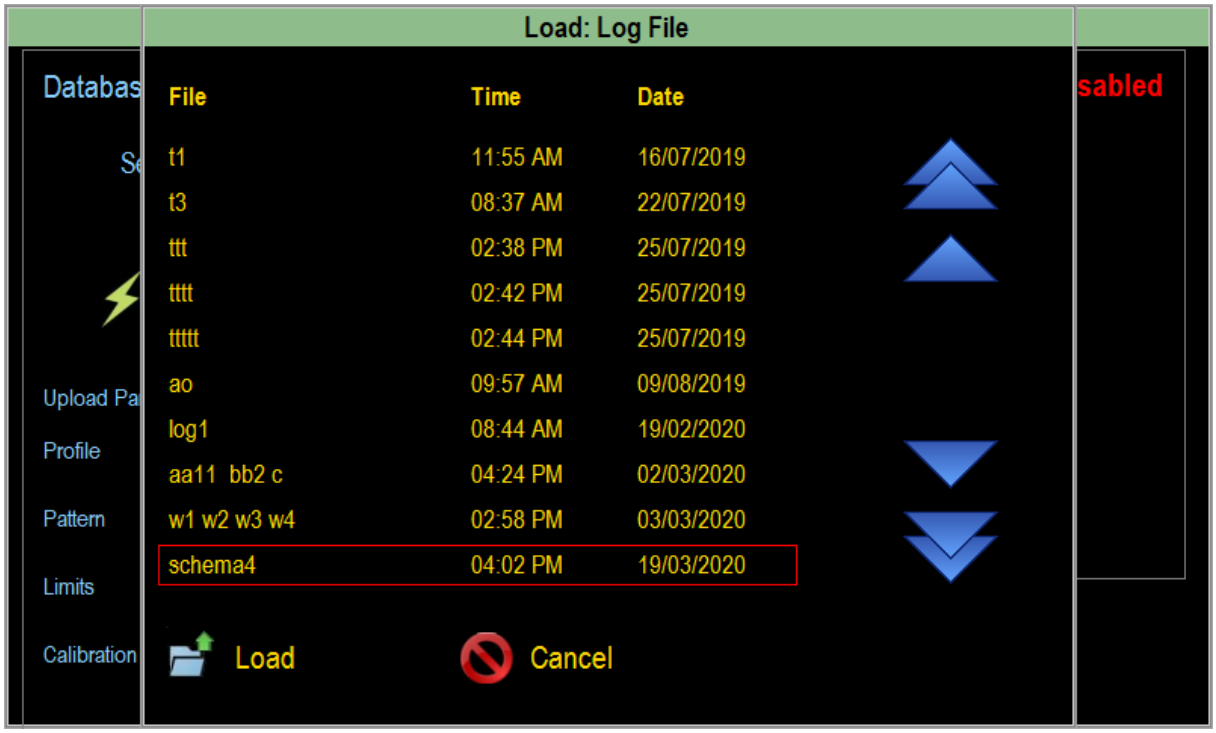
Full Log: Enable to create / select a detailed log file which comprises all available weld information including a graphical trace.

SPC Log: Also known as a ‘minimal’ log, this is a reduced log which only stores basic time stamped weld information.

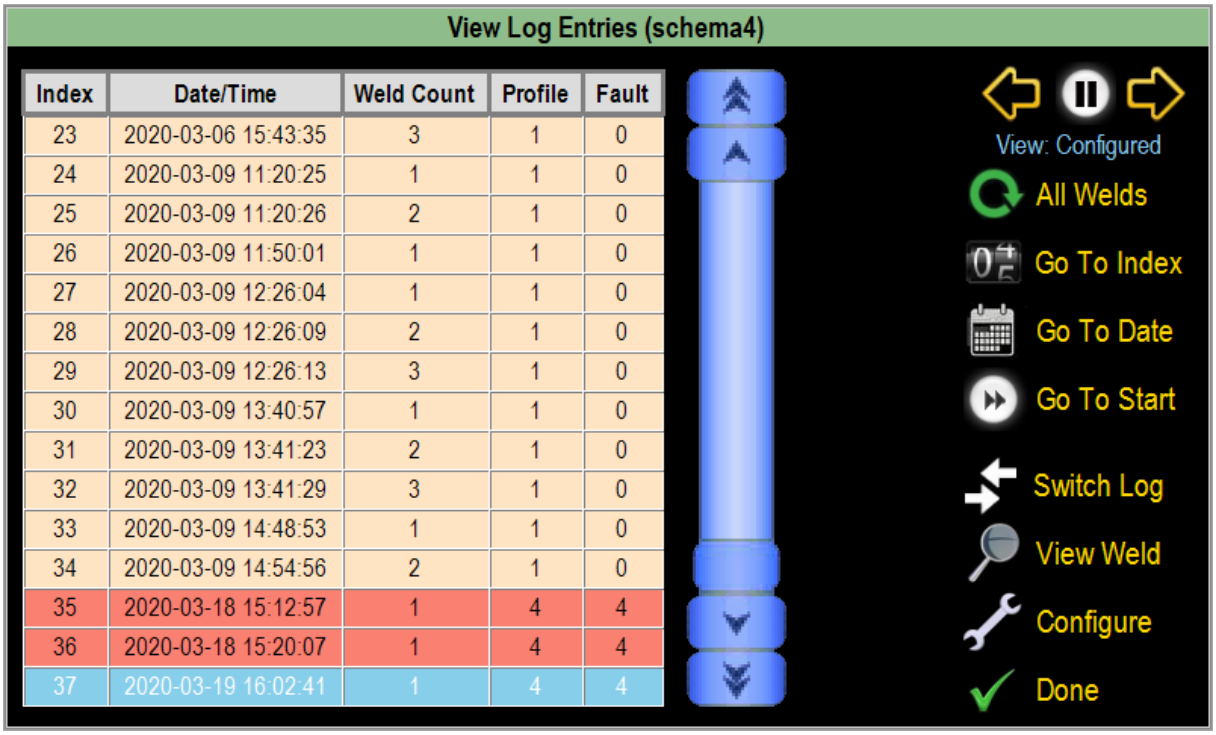
5.3.1 Full Log

Full log files are relatively memory intensive due to recording all weld data. As such, it is possible to use all of the available space on the disk (worst case, with double pulse welding and displacement enabled, after about 300,000 welds). To counteract this, the log file will eventually wrap around and overwrite the oldest entries. However, to preserve performance it is recommended not to run close to memory capacity. Log files can be copied to USB/server and deleted where required.

Separately named files can be created and viewed for batch analysis work. The following screen is shown when either the ‘Switch Log’ or ‘View Log’ button is pressed

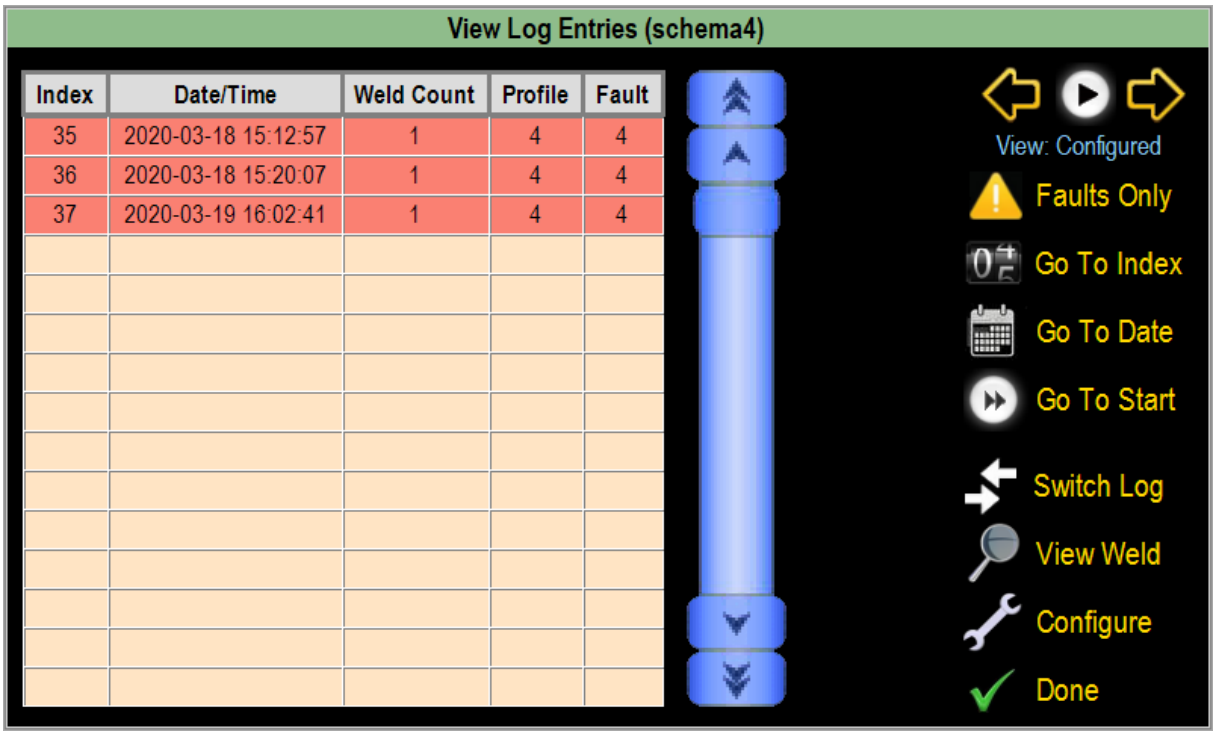


When choosing to view a log file, this will bring up the log view screen



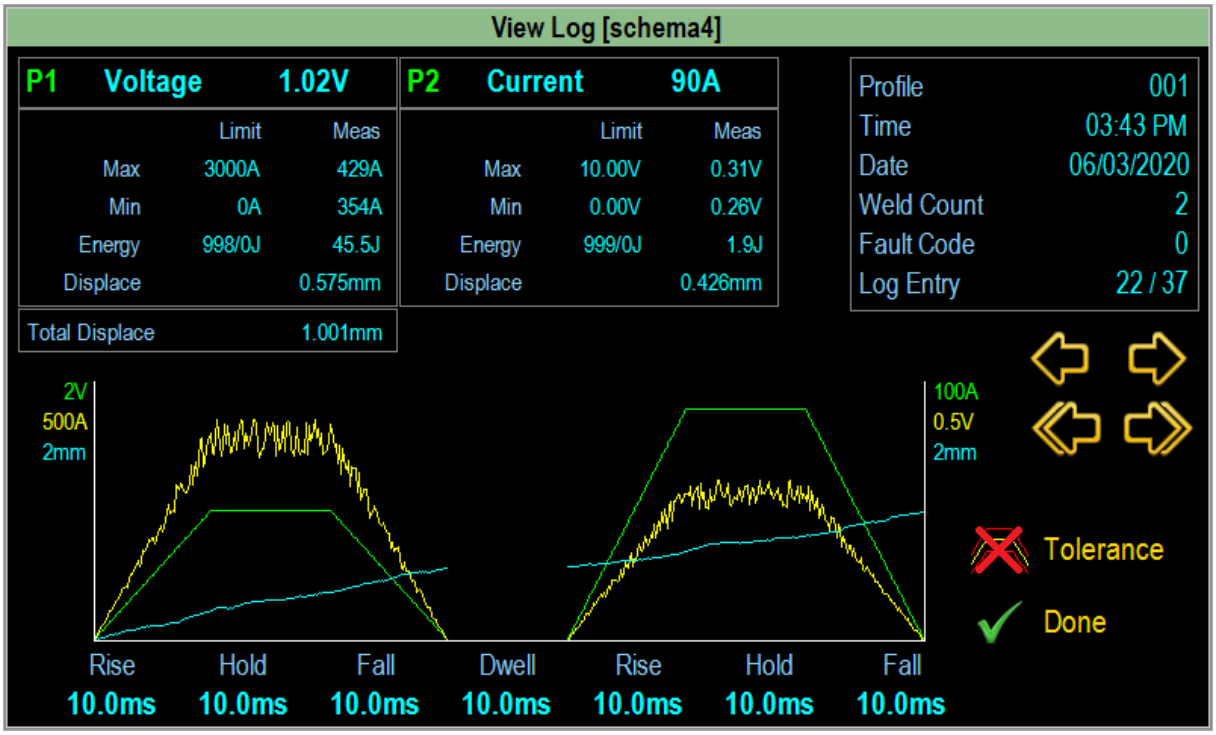
Log file data can be configured and viewed in tabular form with real time updates. Double tap a row to show the associated graph data. Note: The log file can be downloaded from the machine to a USB stick, under the FILE menu Copy to/From USB.

Pressing the ‘All Welds’ button will cause the screen to reload showing only welds that raised a fault.



The ‘Go To Index’ button can be used to specify which weld to show based on the index (first column) in the list. The ‘Go To Date’ button can be used to navigate to welds performed at a specific date or time. The ‘Go To End’ button navigates to the most recent weld logged. The ‘Switch Log’ button can be used to change to a different log file.

The ‘View Weld’ button will show details of the selected weld in a similar fashion to the main screen, as follows:



Once the view weld screen is showing, the other welds in the log file can be viewed using the arrow keys.

5.3.2 SPC Log

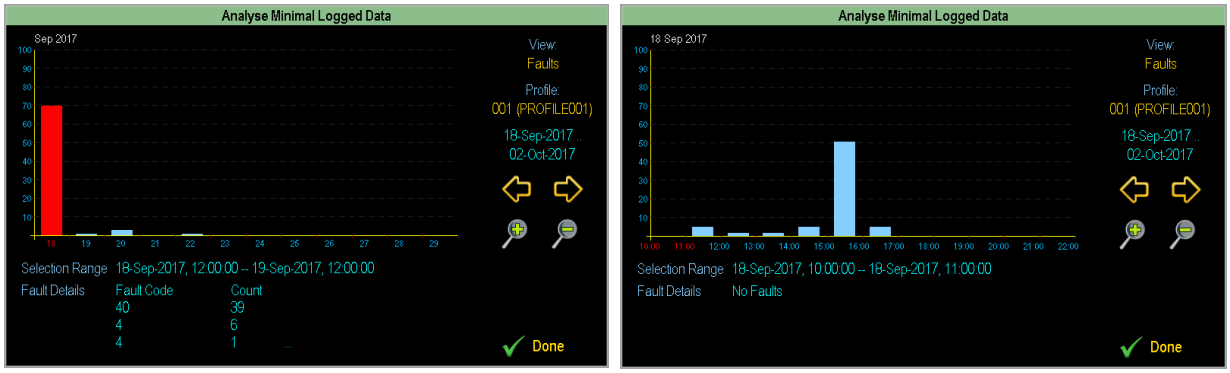
The SPC log (or minimal log) stores a small set of values per weld. These are: peak electrical values, total energy, fault status information, displacement values (where configured) and SPC values (where configured). An SPC value is defined as the recorded value (electrical or displacement) at a specific point during a weld. See the SPC Point section for more details.

Each of the values stored in SPC logs can be analysed in detail to produce statistical process control data as follows using the histogram view:

Any of the SPC values (Cp, Cpk, Yield, Fallout, Upper/Lower Spec Limit) can be changed to the desired values. The remaining values will automatically be adjusted to match. An analysis of Statistical Process Control (SPC) methodology is beyond the scope of this document, so please refer elsewhere for more details.

It is also possible to view all of the stored data over time using the ‘Trace’ view:

Finally, fault analysis can be performed using the ‘Fault’ view:



Each of the above views is shown on a pre-profile basis. The profile chosen to view can be changed by pressing on the profile text:

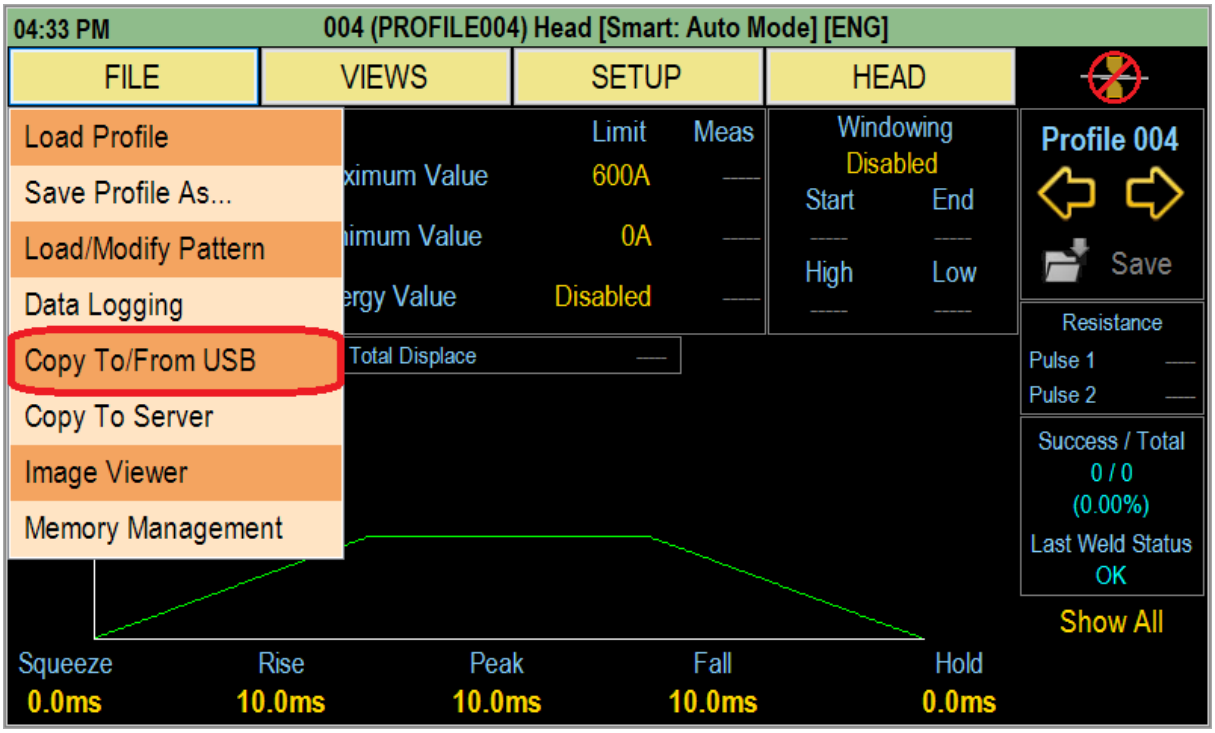
For more details on SPC analysis, see section 6.5.

5.3.3 Database Logging

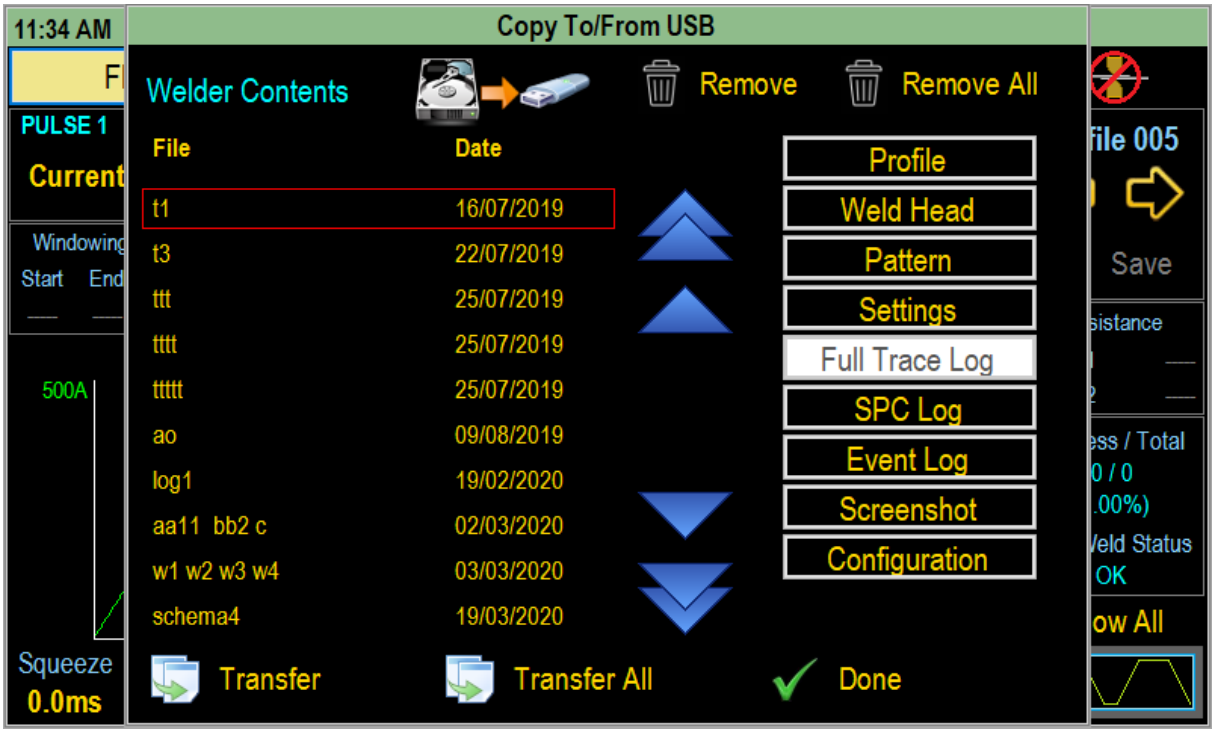
If database logging is enabled, the server IP address must be entered and connected to. Connection is made automatically on subsequent power cycles when database logging is enabled.

5.4 Copy To/From USB

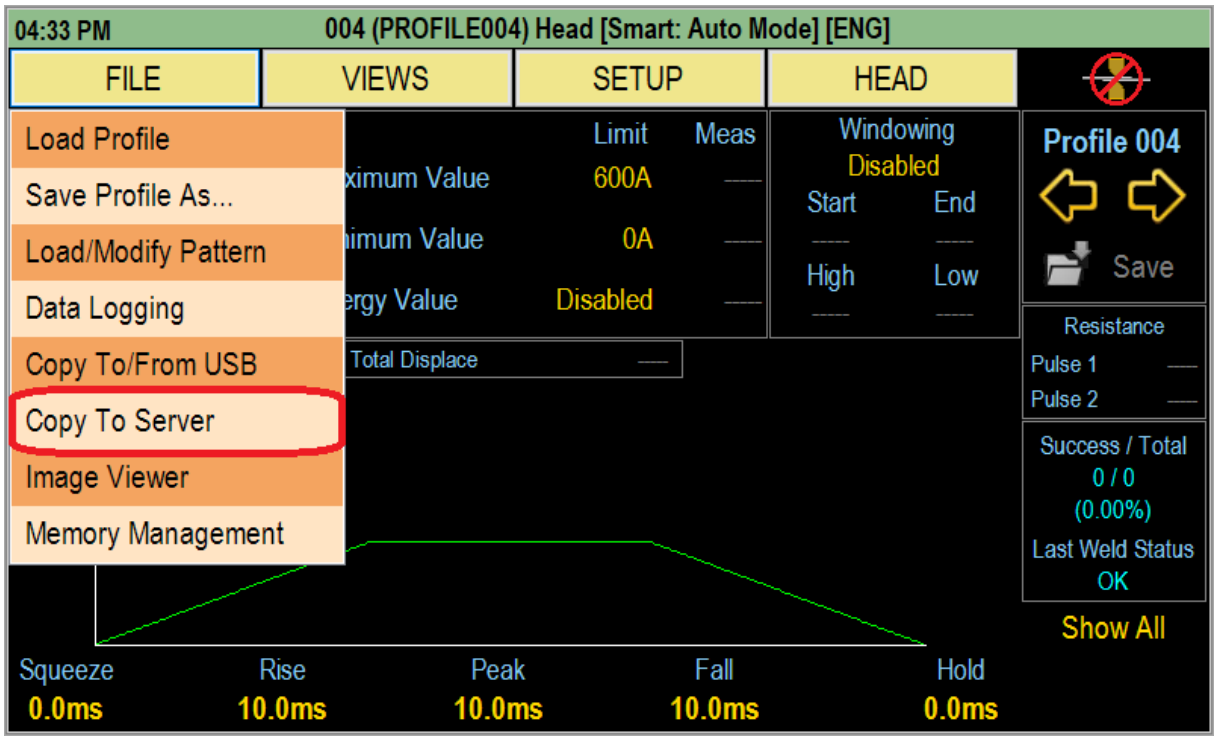
Under the FILE drop down menu is the Copy To/From USB option.



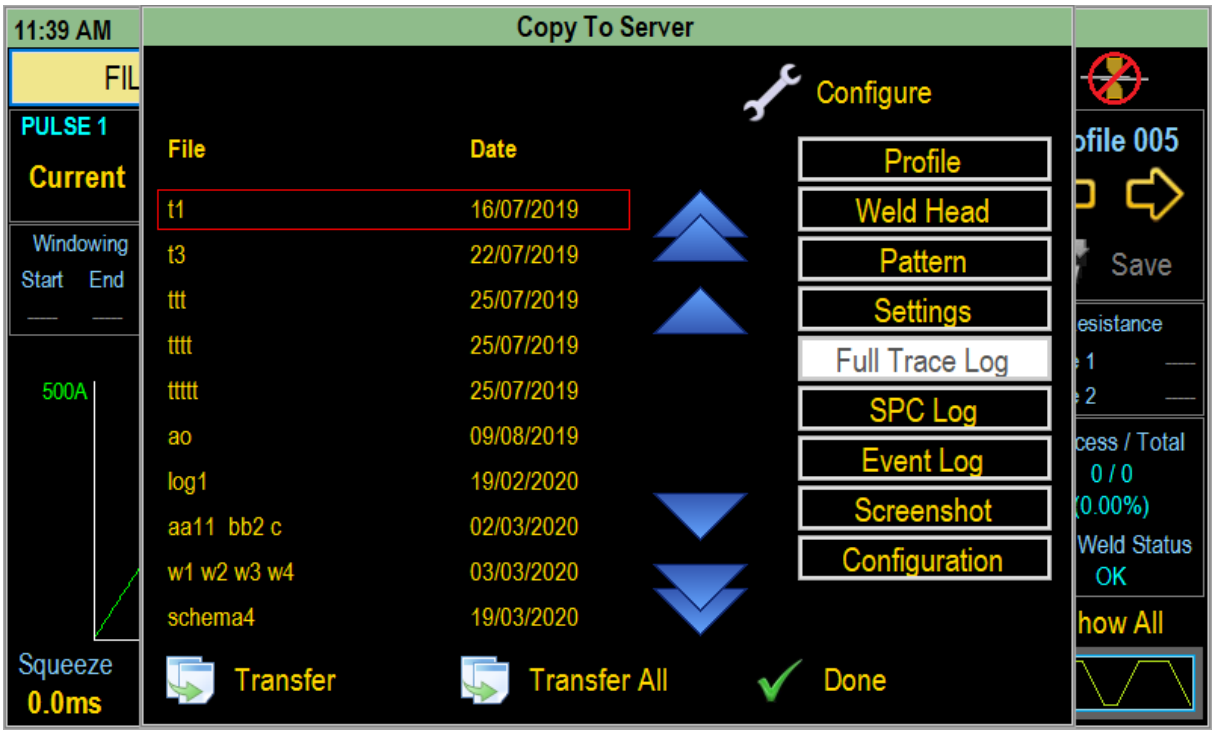
Using this option, the operator can choose to copy or retrieve a number of different types of data via a USB memory device, as shown above. Copying can be done from the machine to USB, or vice versa (by pressing the drive icon).



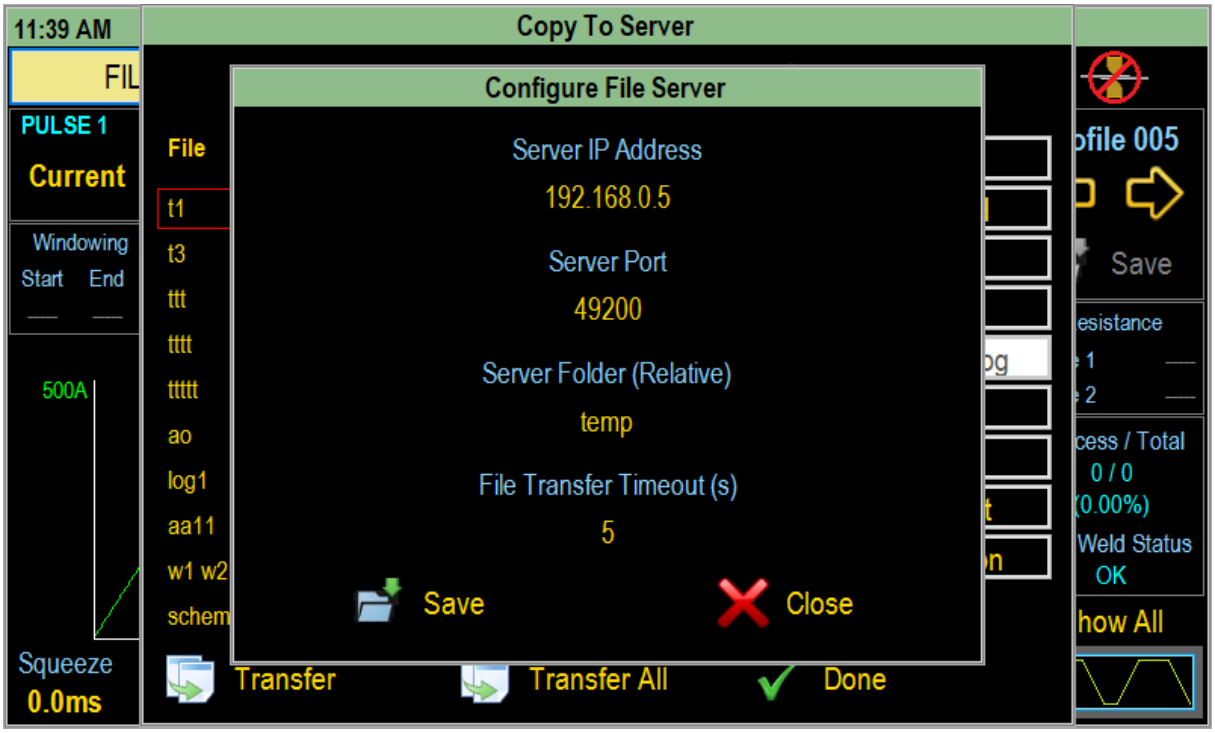
5.5 Copy To Server



Under the FILE drop down menu is the Copy To Server option. Use of this option requires a remote PC to be running the MWSFileServer program. The primary usage is the ability to upload log files to a server to preserve disk space. Choosing this brings up the following screen:

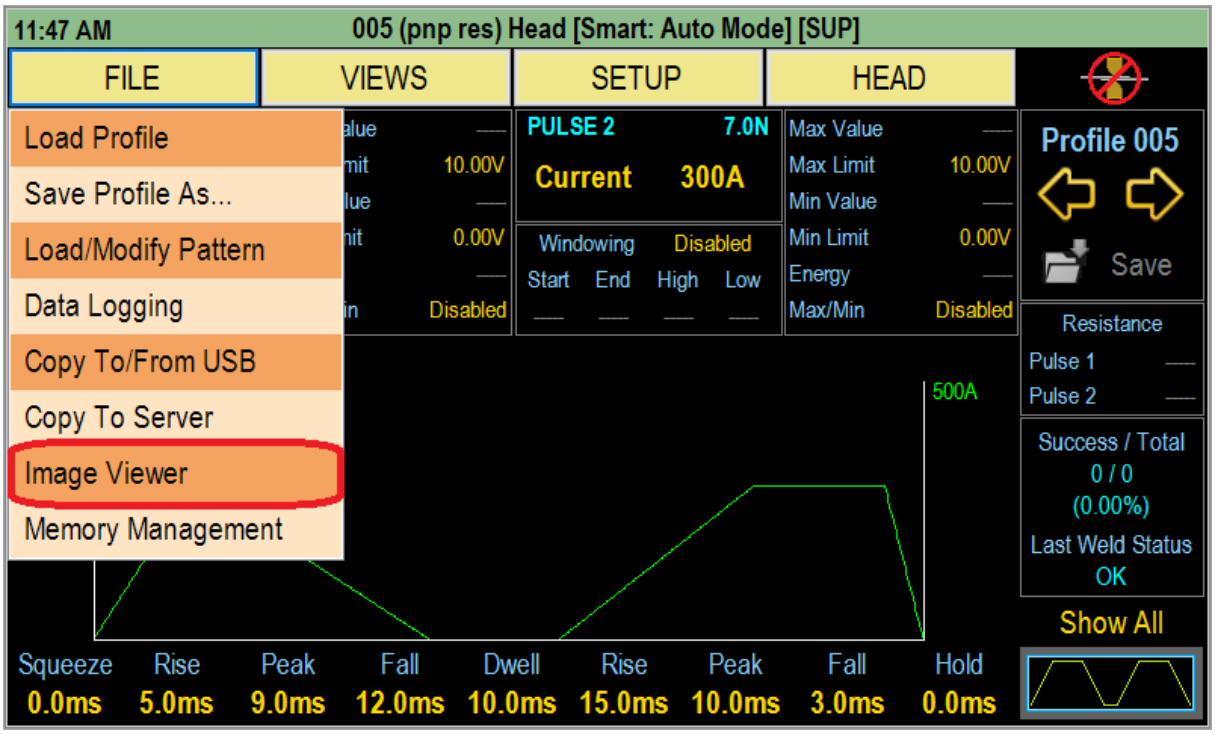


Press the ‘Configure’ button to set up the welder connection. The IP address is that of the remote PC. If the default port number (49200) is changed then this must also be changed on the remote PC. The server folder allows a relative path to the default location on the remote PC. A timeout can be set that allows the process to be aborted if it is taking too long.

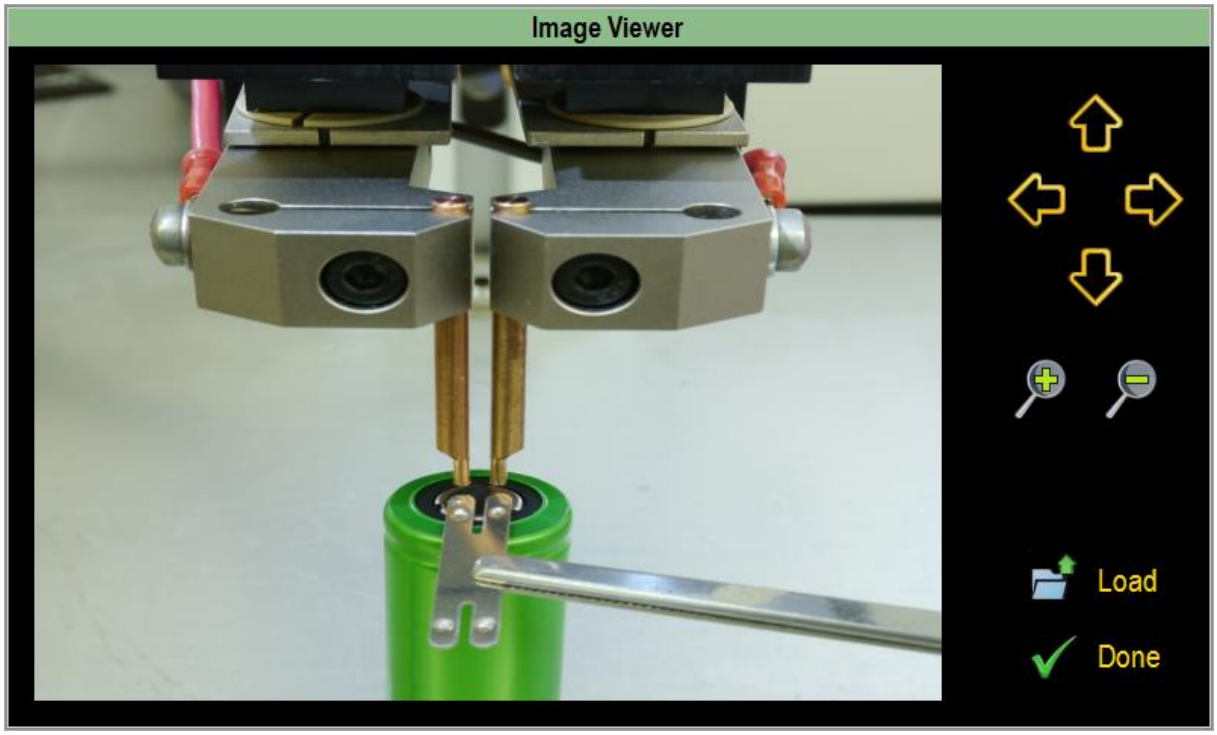


5.6 Image Viewer

Under the FILE drop down menu, is the Image Viewer option. Under this option, the operator can preview image files on a USB stick in readiness for association with profiles. Additionally, the system holds in memory the last image that was viewed.



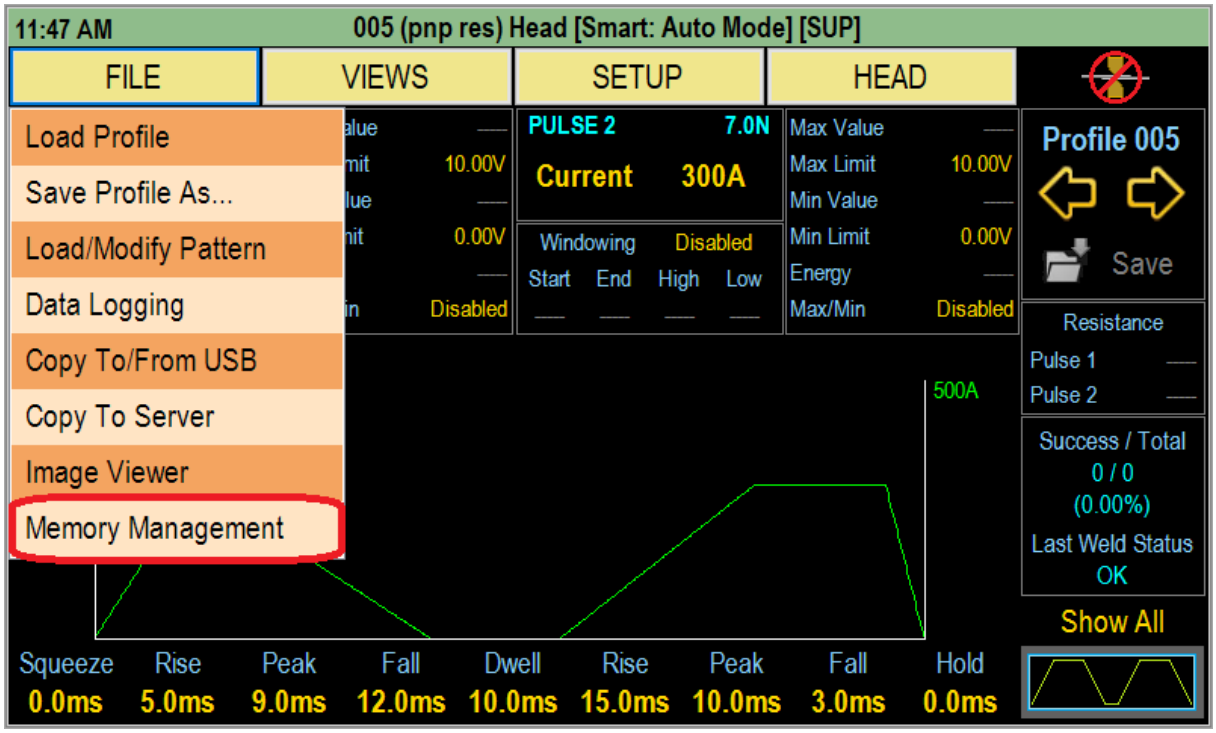
Selecting an image from files on USB brings up the following screen (with the relevant image shown):



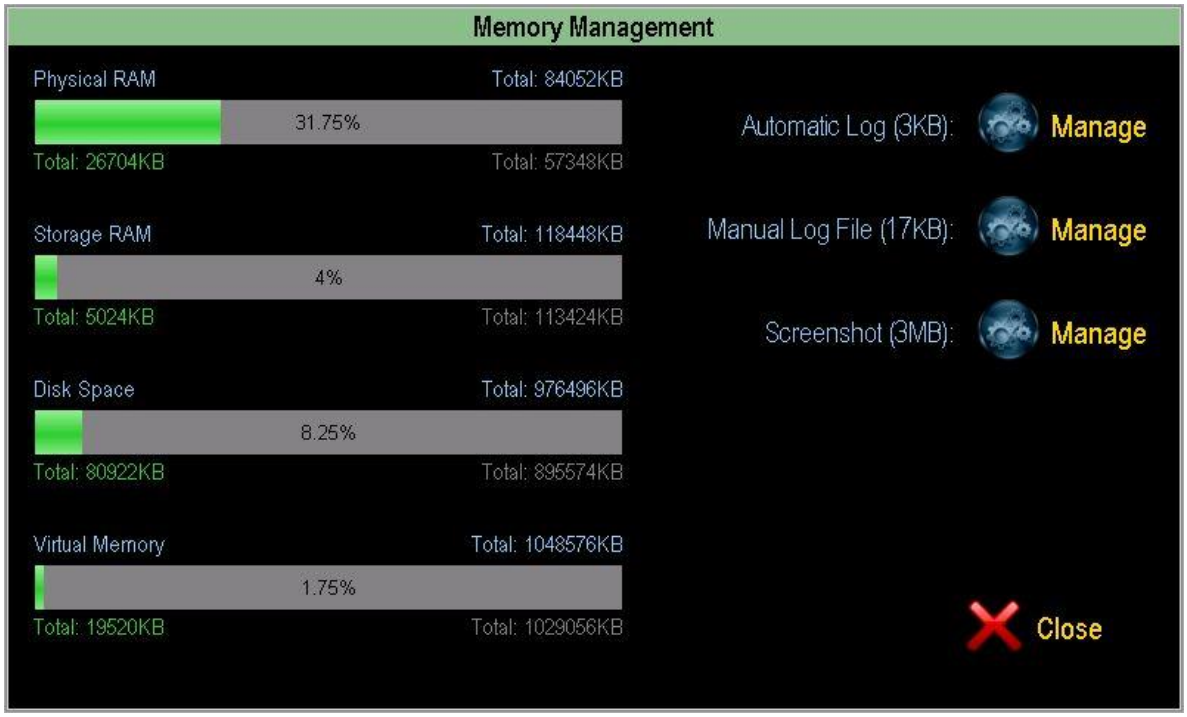
The user can zoom in and out, and pan left/right/up/down using the buttons provided.

5.7 Memory Management

Under the FILE drop down menu, is the memory management option. The machine will automatically manage the system memory by overwriting old files as the memory starts to fill up. Typical memory uses are for data logging and document association.

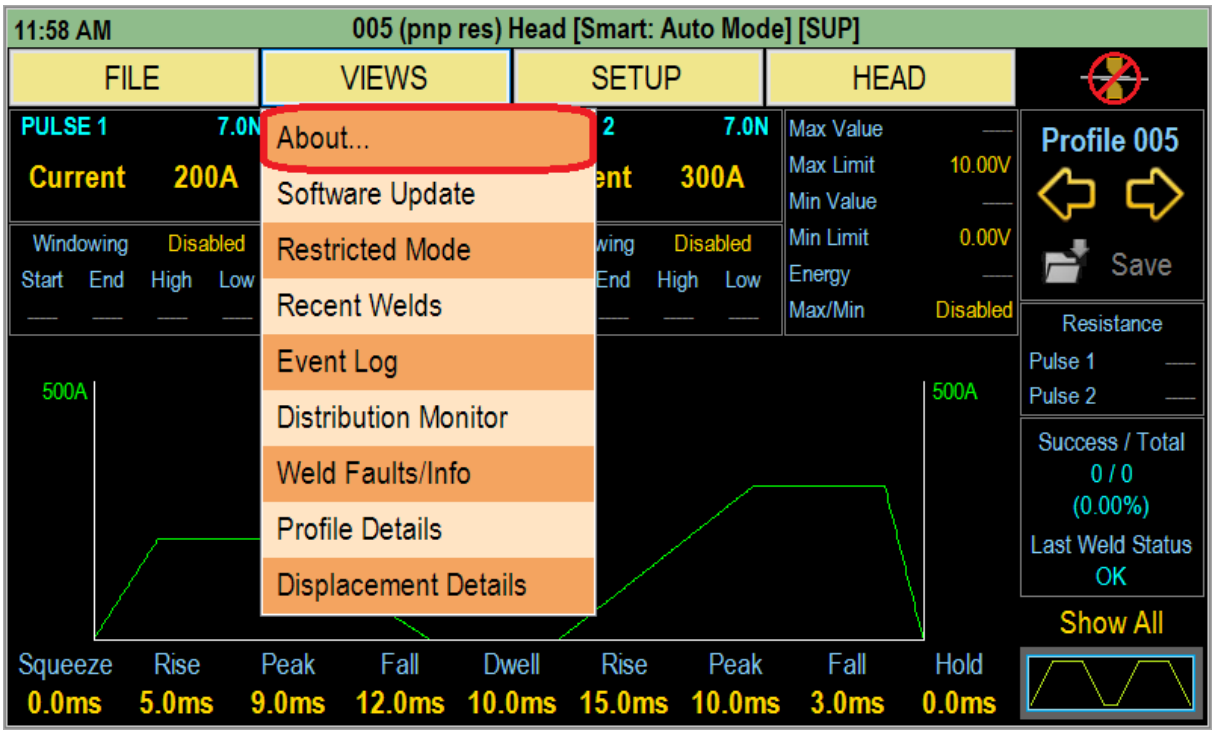


The memory management feature provides an element of manual intervention with respect to data log file and provides a quick overview of the memory status.

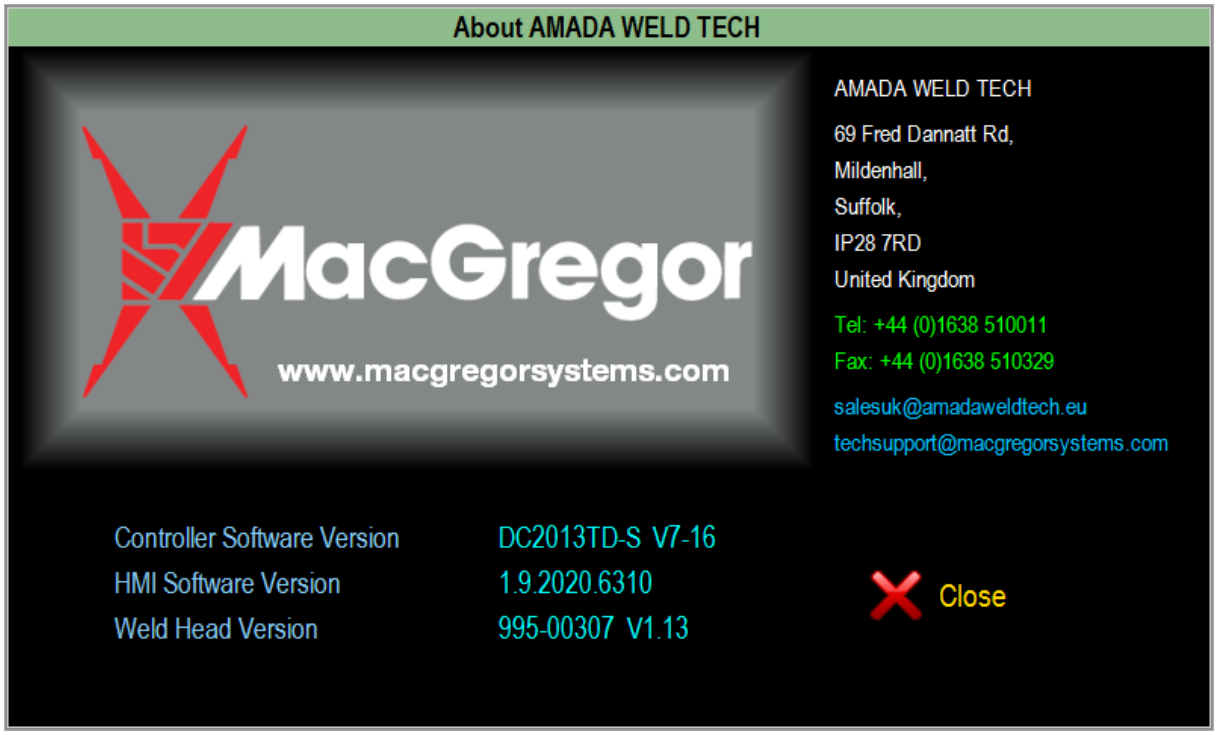


5.8 About Screen

Under the VIEWS drop down menu is the About... option.

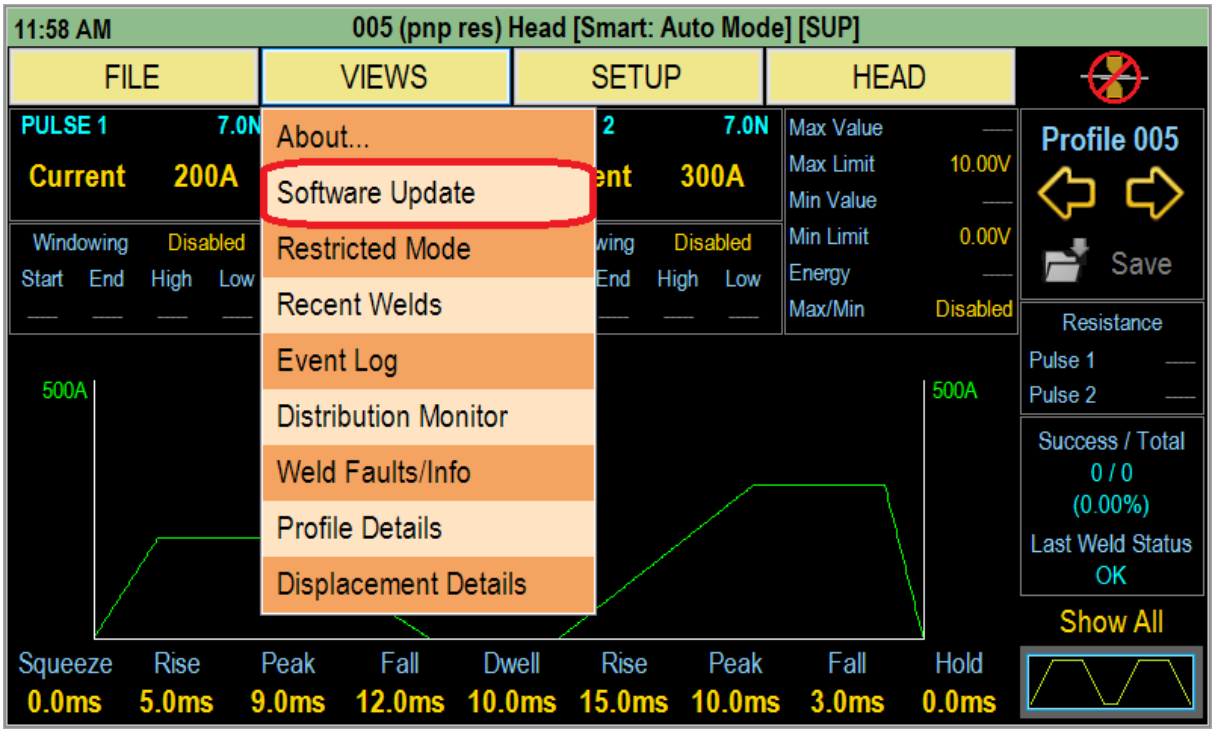


On pressing this, the following screen is displayed as information for sales and technical contact points.

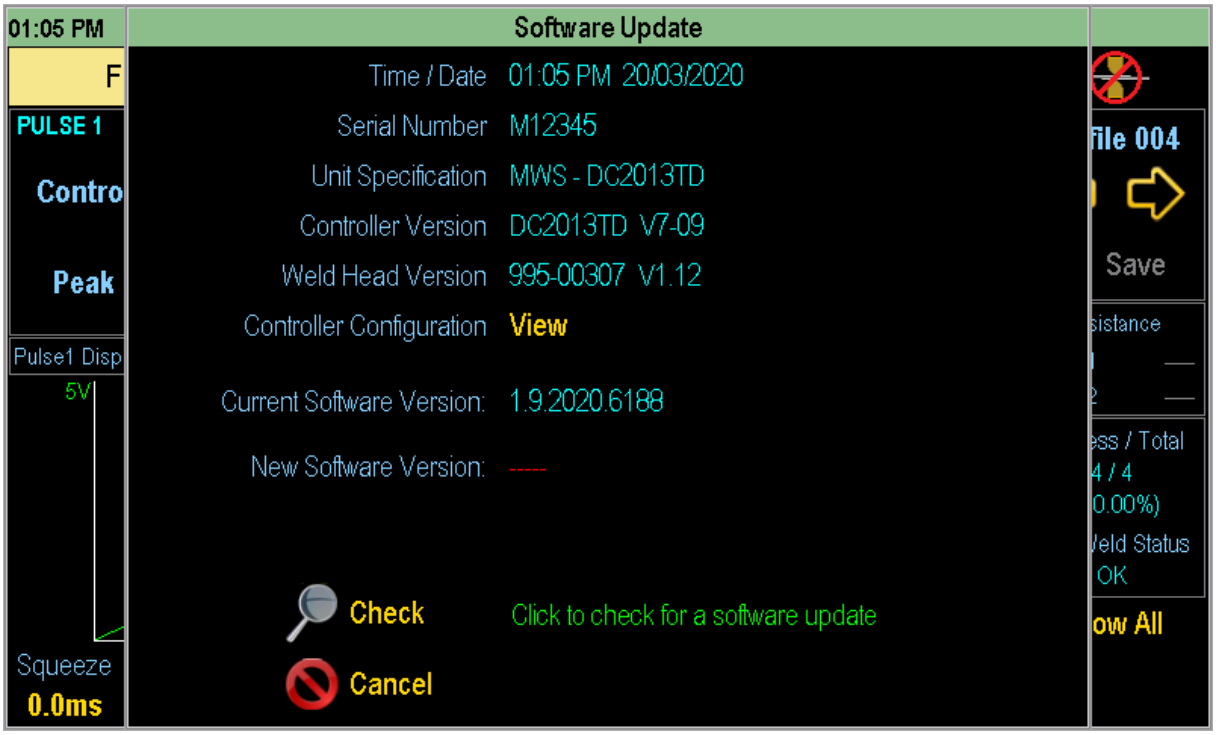


5.9 Software Update

Under the VIEWS drop down menu is the option to update the HMI software.



Software updates are performed with a USB memory device. Upon selecting a software update, the present machine software status is displayed.

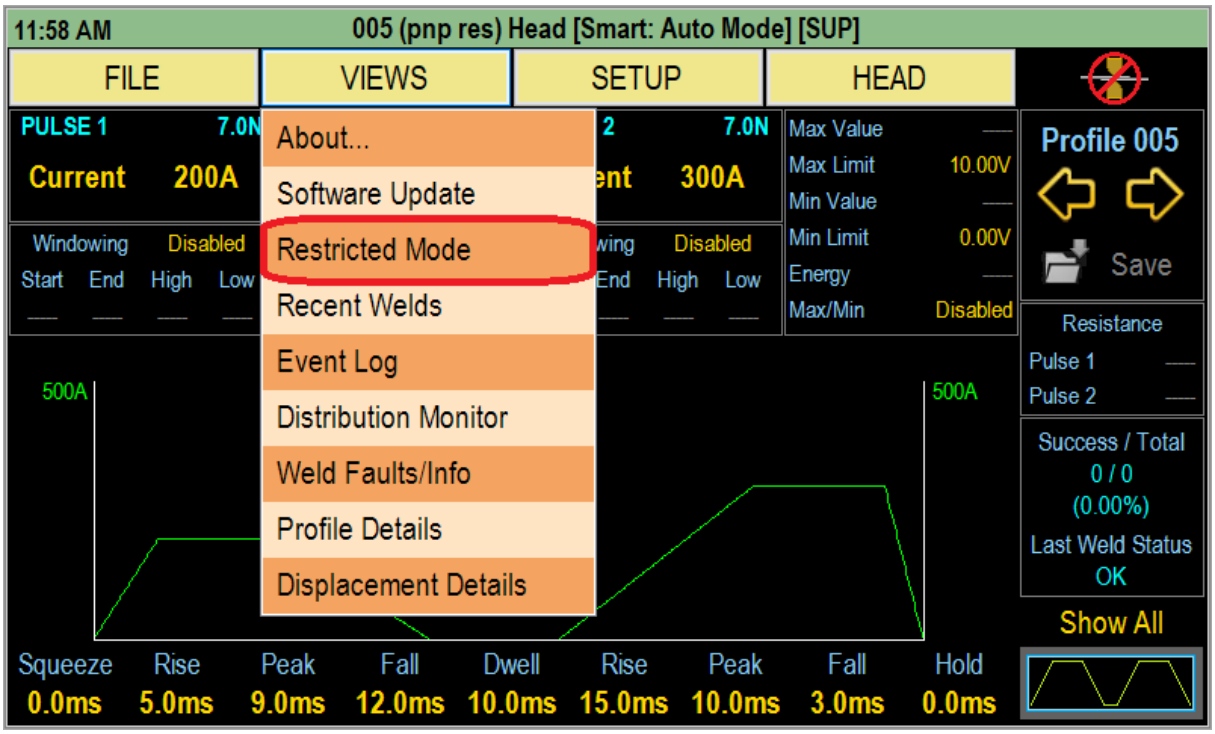


It is advisable to contact Amada Weld Tech UK Ltd Technical Support prior to an upgrade in order to verify compatibility. You will usually need to report the controller configuration.

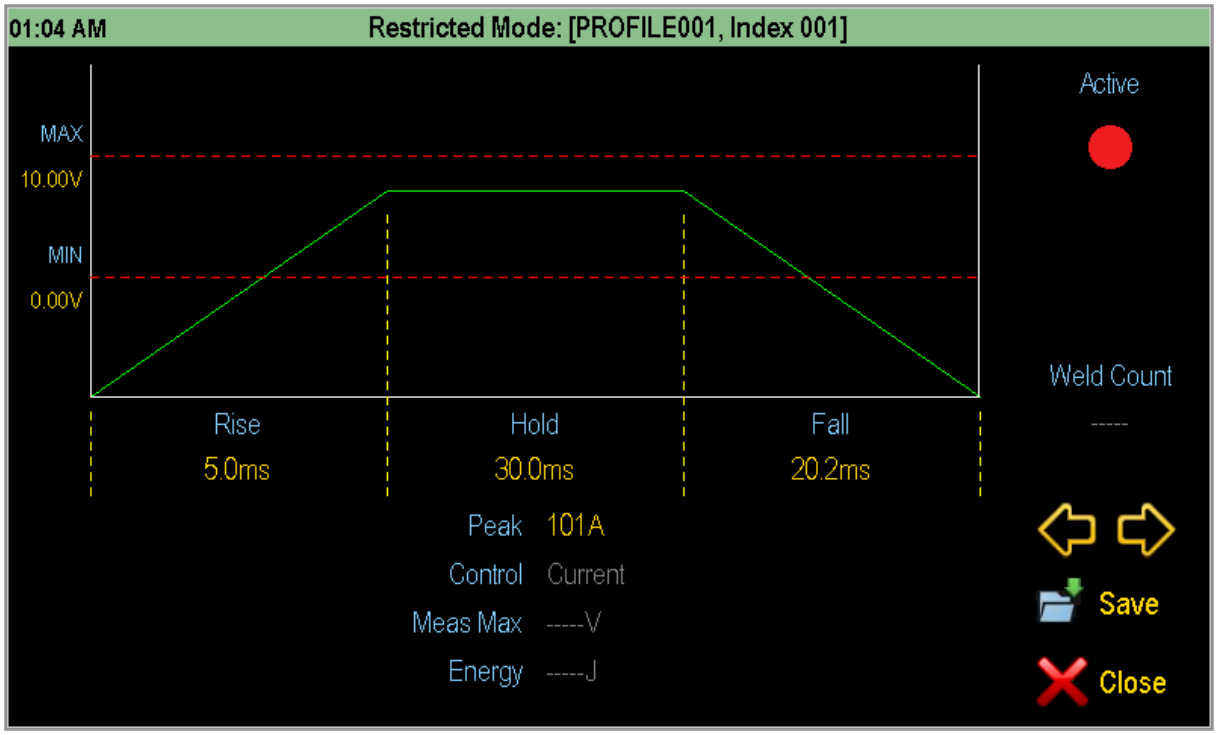
To start an update, press the check icon to verify the new version is on the USB stick. The process is then automatic with instructions.

5.10 Restricted Mode

Restricted Mode is a limited function basic display, designed to restrict operators to a subset of the main system variables in order to limit the scope of available adjustments. In order to activate restricted mode, a supervisory password is required. The default password is 'supervisor'.

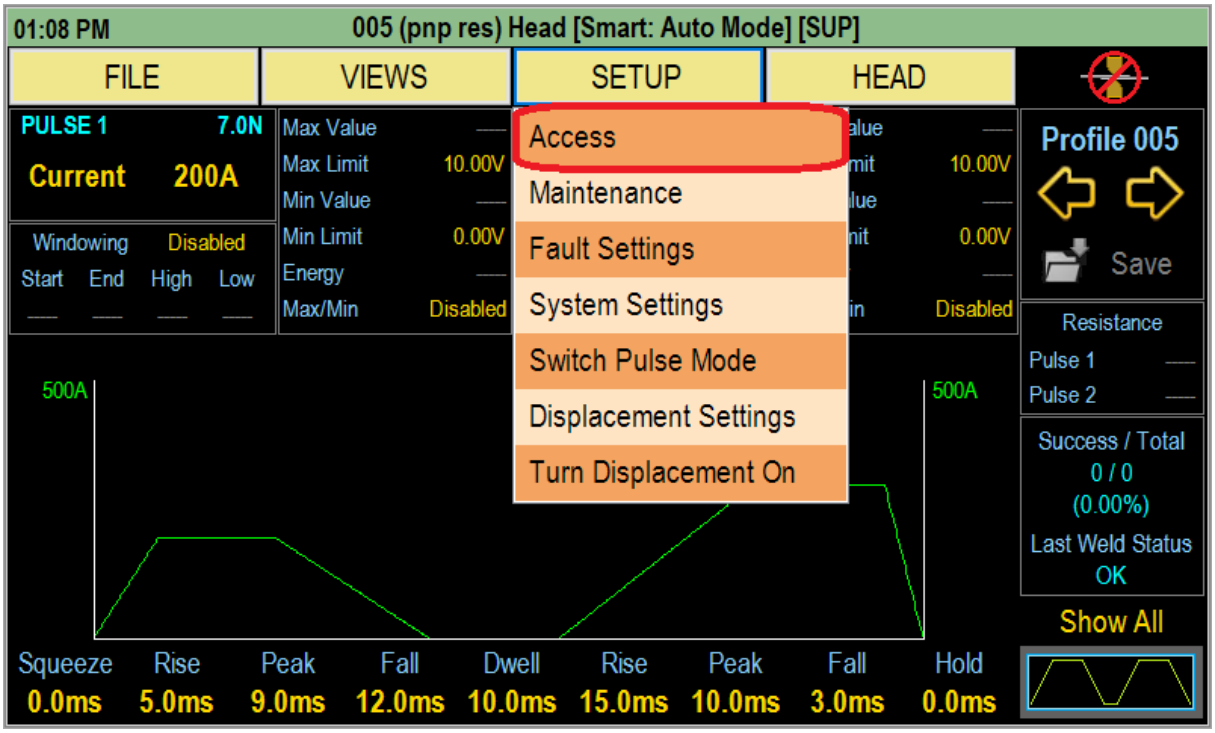


The restricted mode screen is shown below. The Left/Right arrows allow the operator to scroll through the available weld profiles that have been allocated to them.

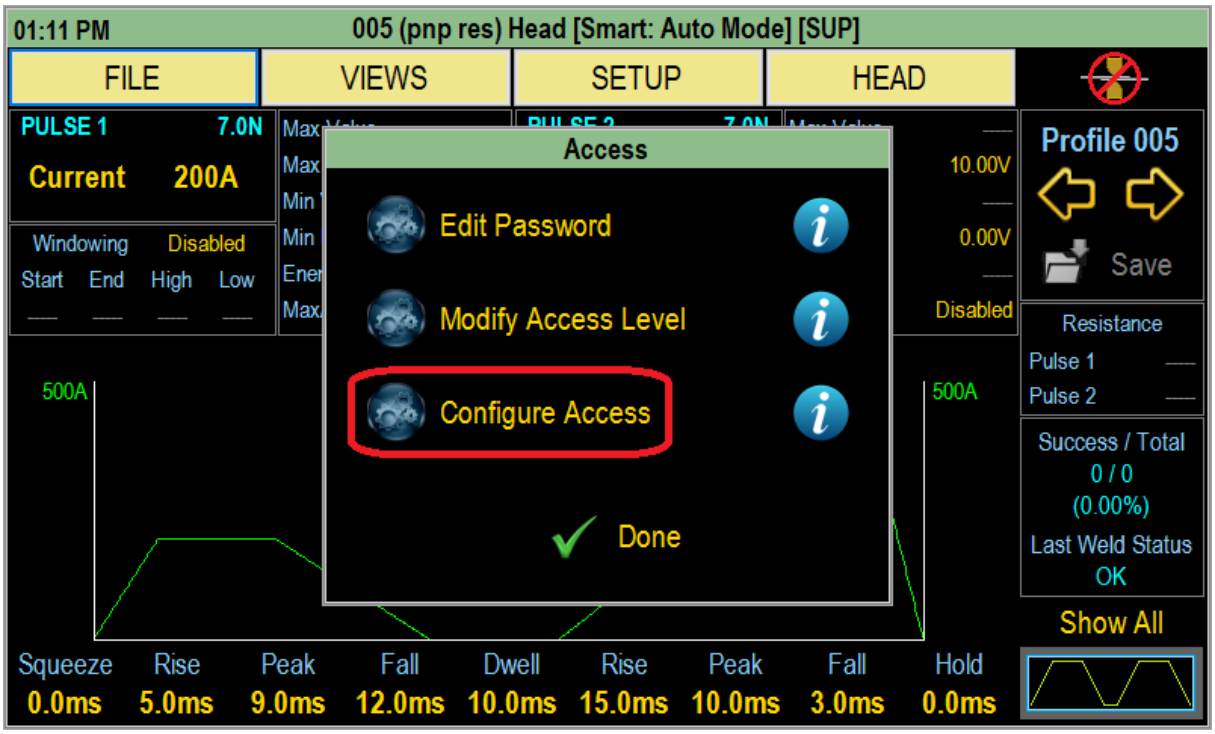


To exit restricted mode, select close. (The supervisor password is required in order to exit.)

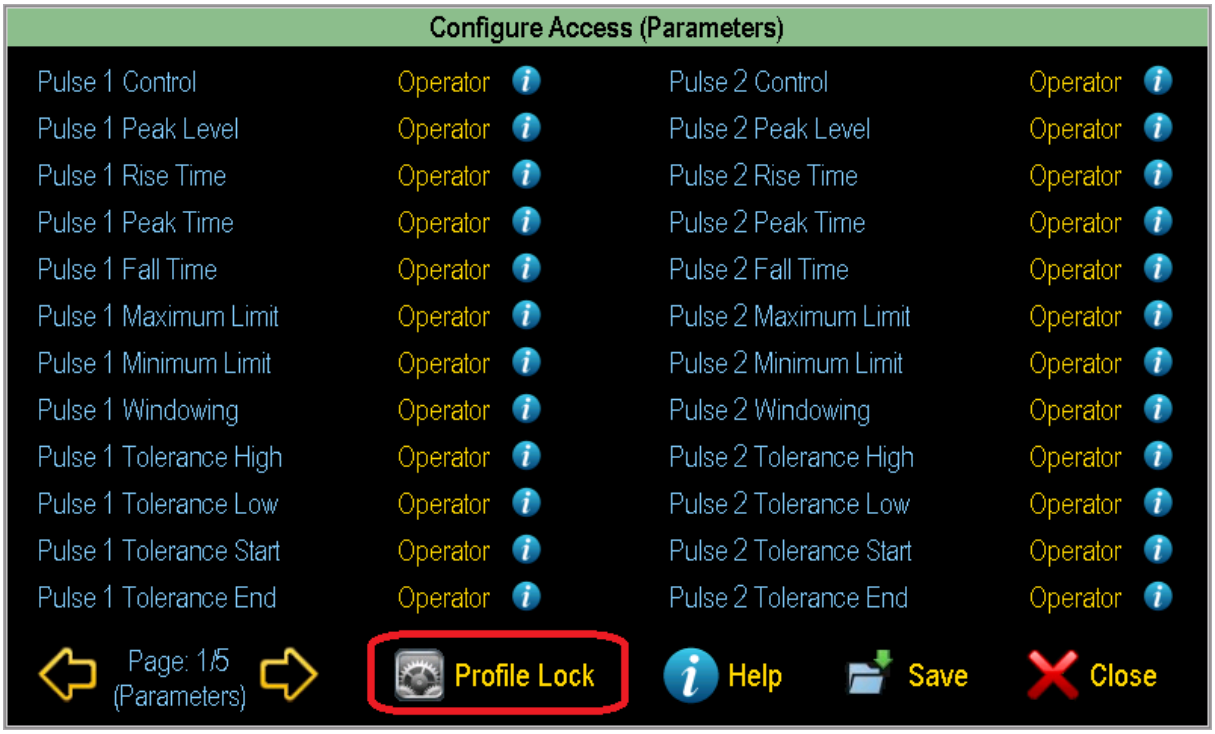
Restricted Mode is setup from the 'Access' option on the SETUP drop down menu (see also the 'Access Configuration' section)



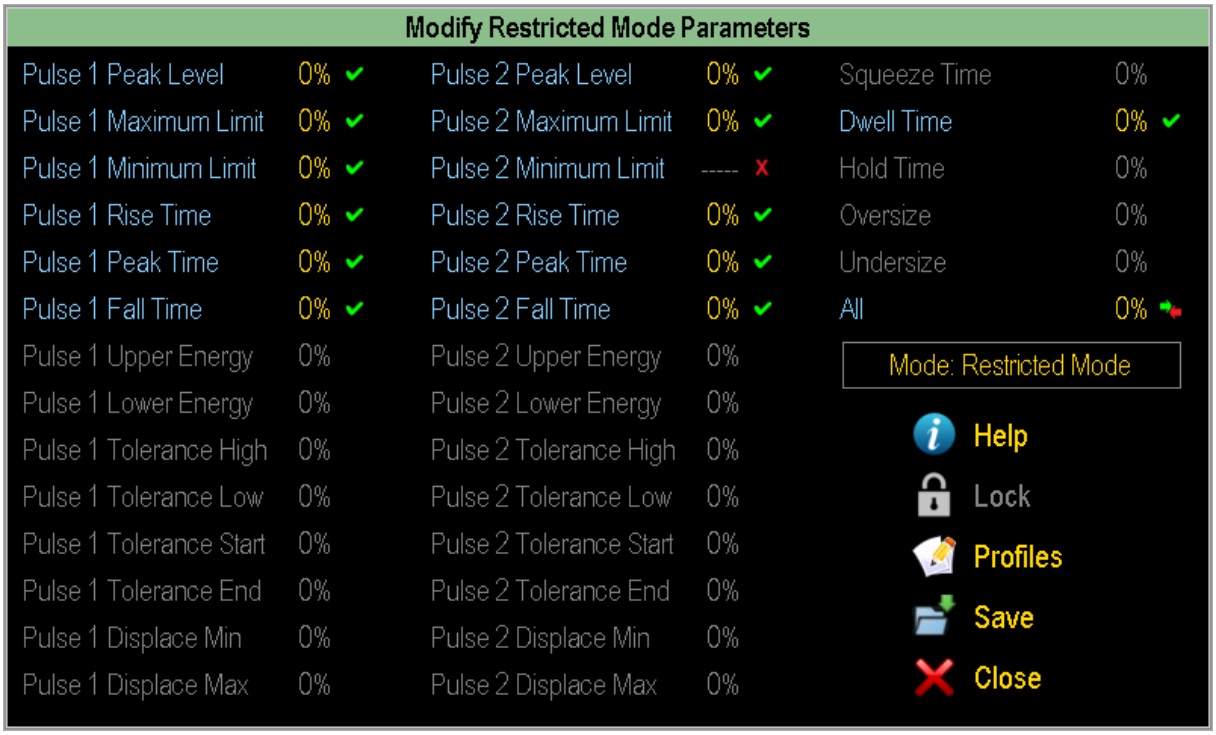
Then press the 'Configure Access' button:



Then press the 'Profile Lock' button:

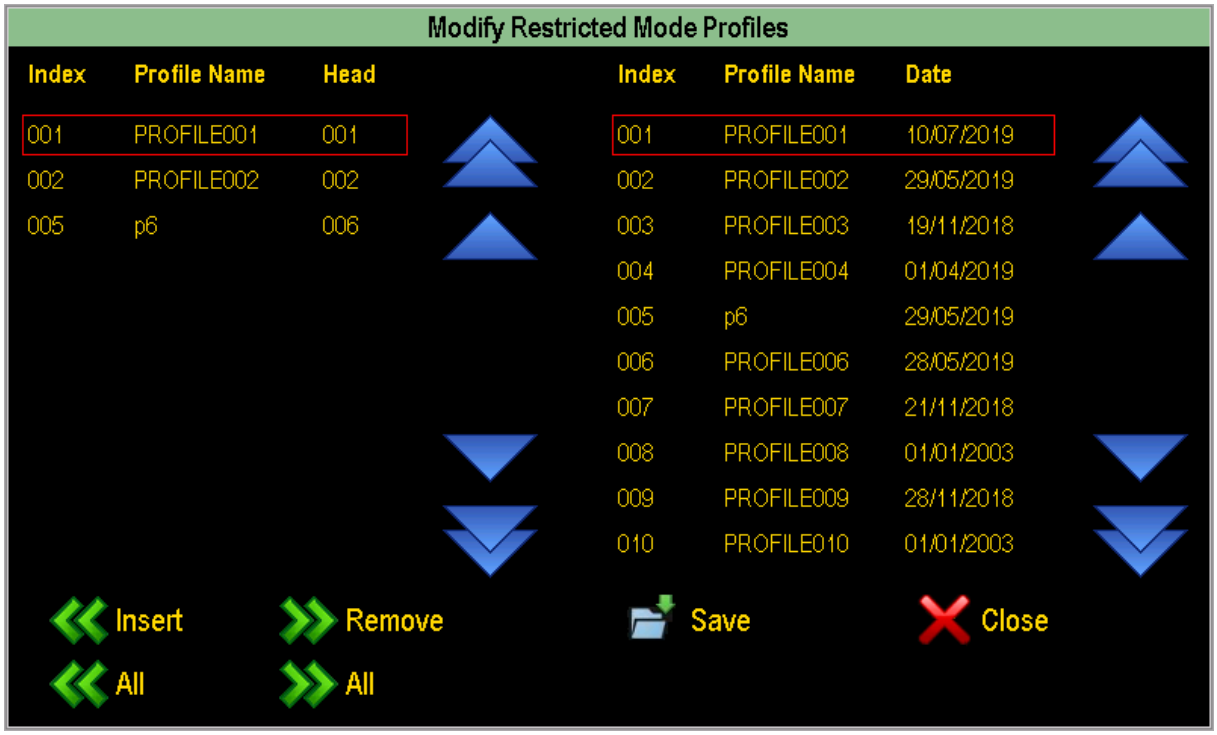


Then press the mode button switch between 'Profile Lock' mode and 'Restricted' mode:



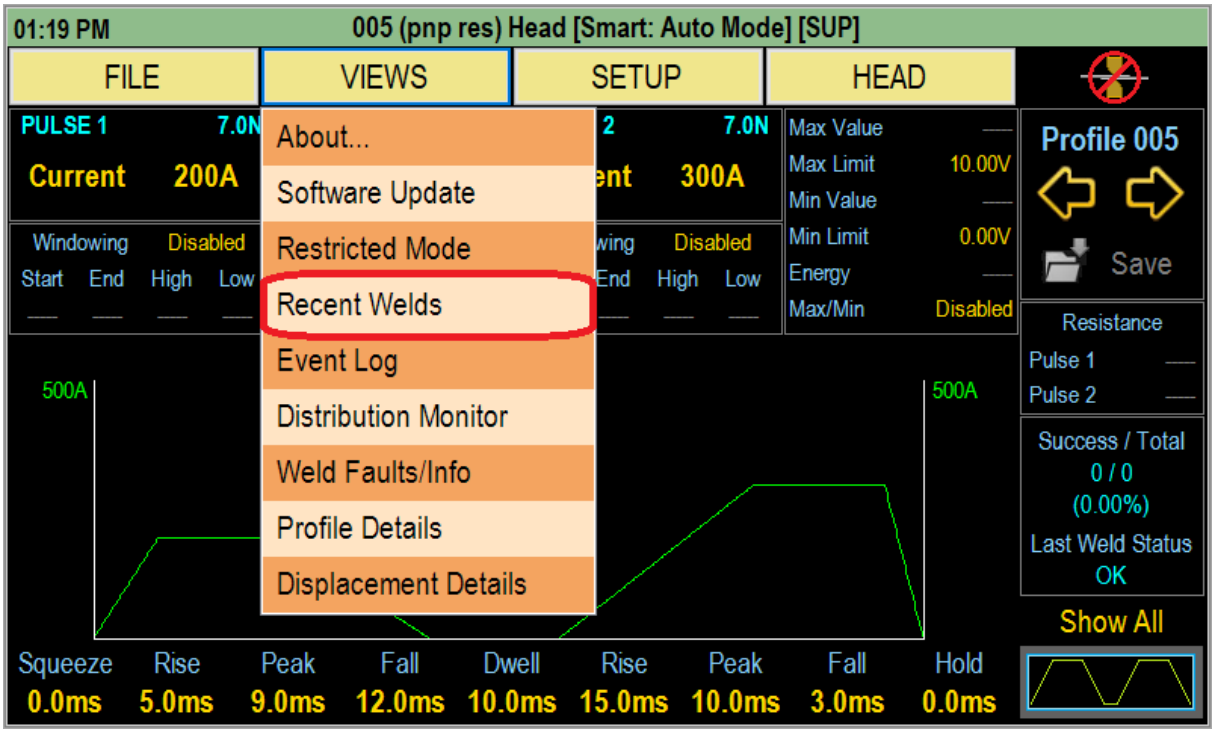
This screen shows which parameters the operator has access to when on the restricted mode screen. Each of the parameters has an upper percentage tolerance for how much the operator is allowed to change them. A value of 0% means that no changes are allowed. If the green tick button is pressed it will change to a red cross, meaning that limiting is not applied to that parameter.

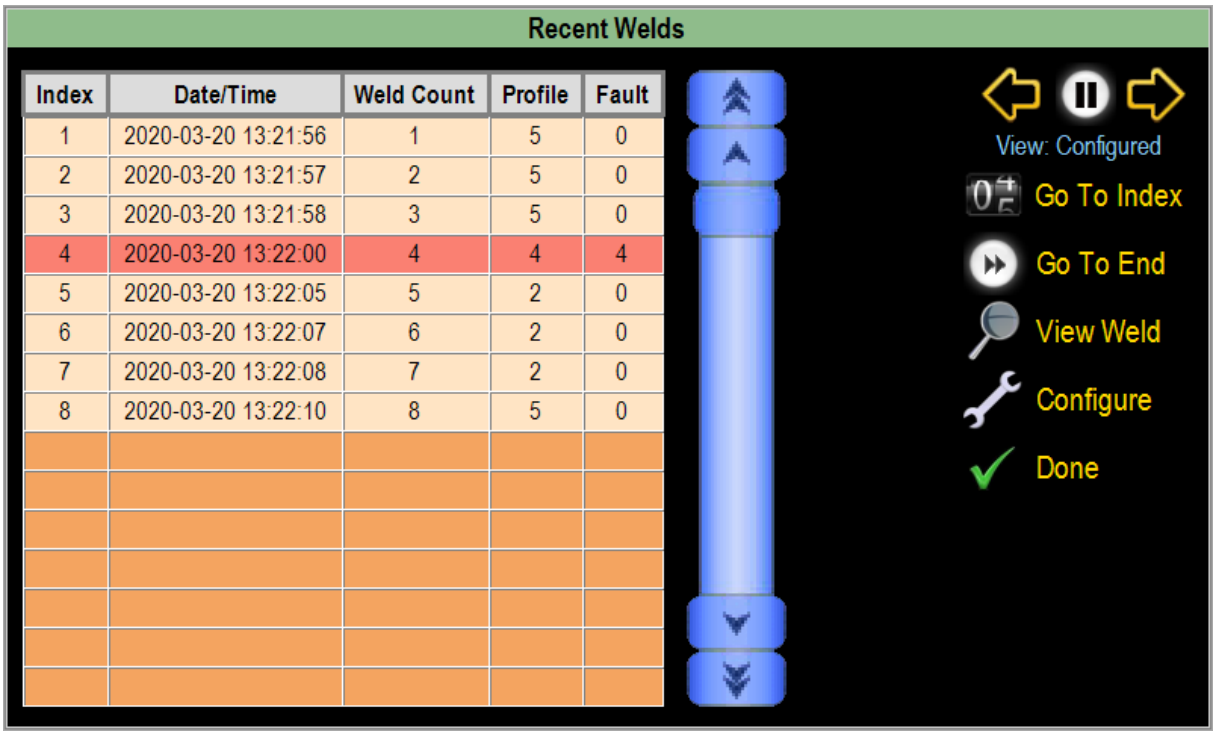
The profiles which the operator is allowed to view and switch between can also be set here. Pressing the 'Profiles' button brings up the following screen, which allows viewable profiles to added or removed from the list on the left. The right hand list shows all of the profile memories in the machine.



5.11 Recent Welds

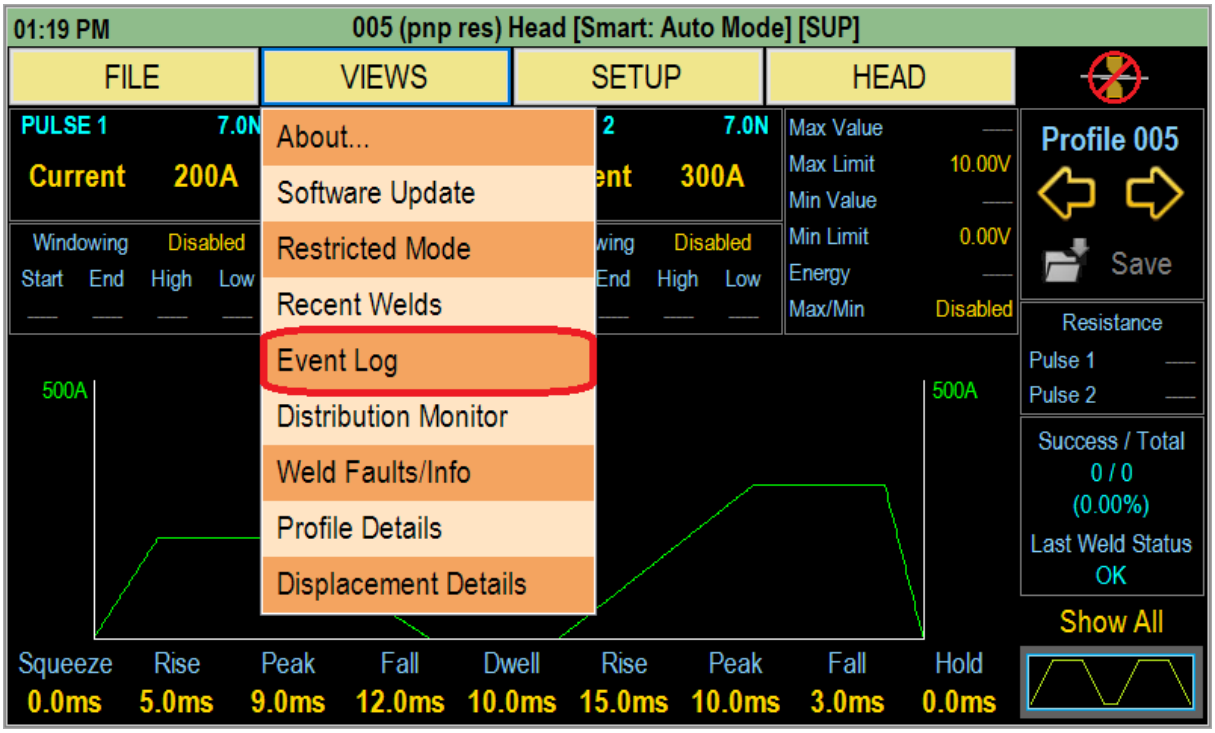
The Recent Welds screen allows the user to view the 20 most recent welds without requiring logging to be enabled. The screen shows up to 20 welds, and only shows welds which have occurred on the existing power cycle.



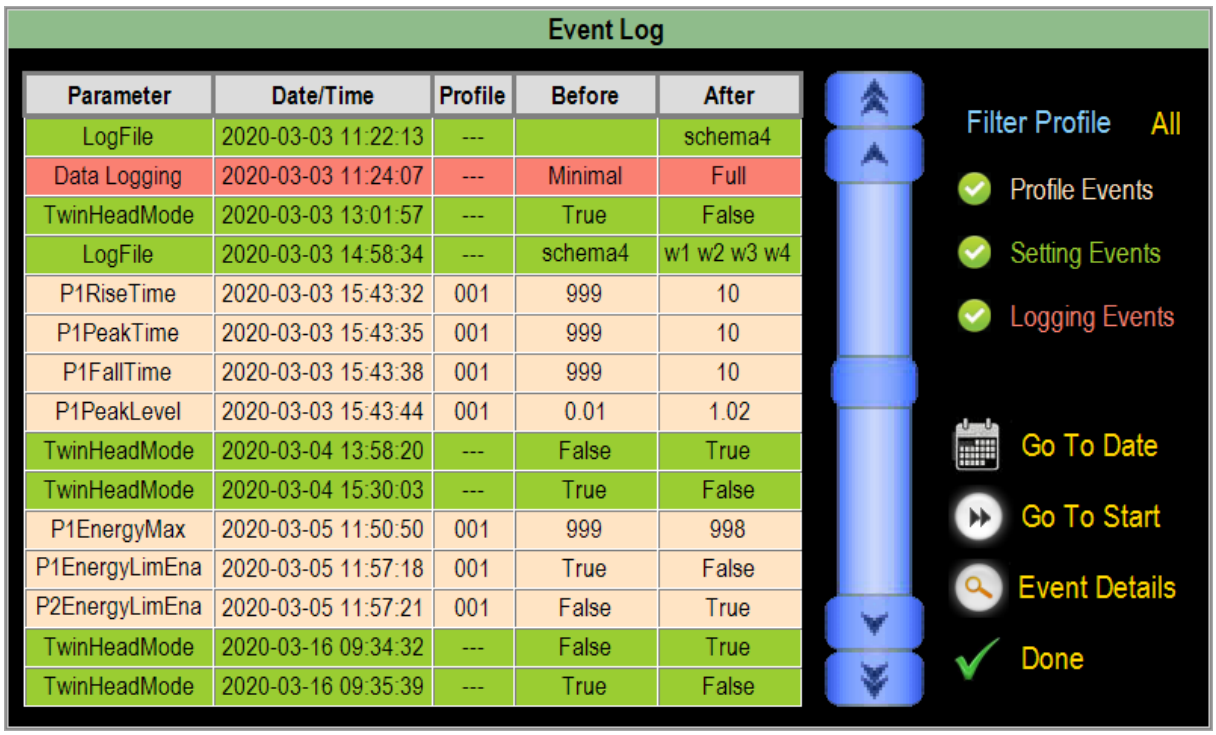


5.12 Event Log

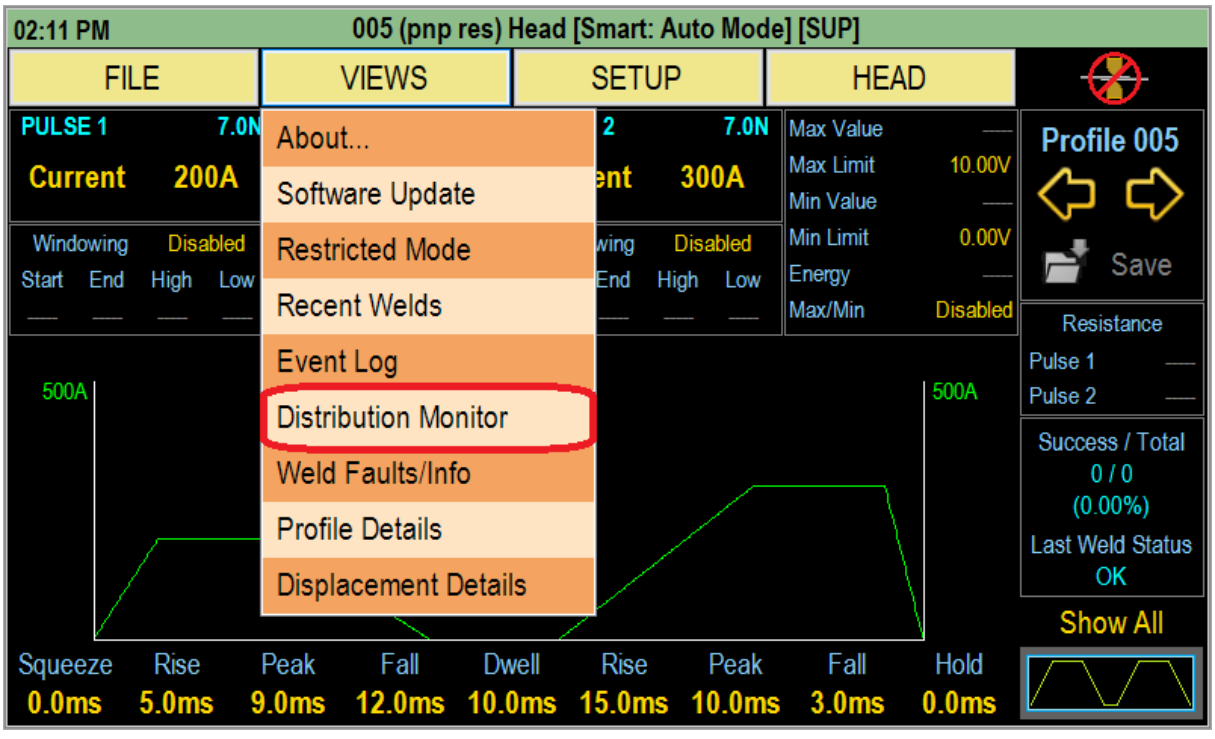
The Event Log tracks changes made to the welder settings.



The data shown can be filtered to show any combination of changes to any profile, changes to system settings, and changes to the way logging is performed.



5.13 Distribution Monitor

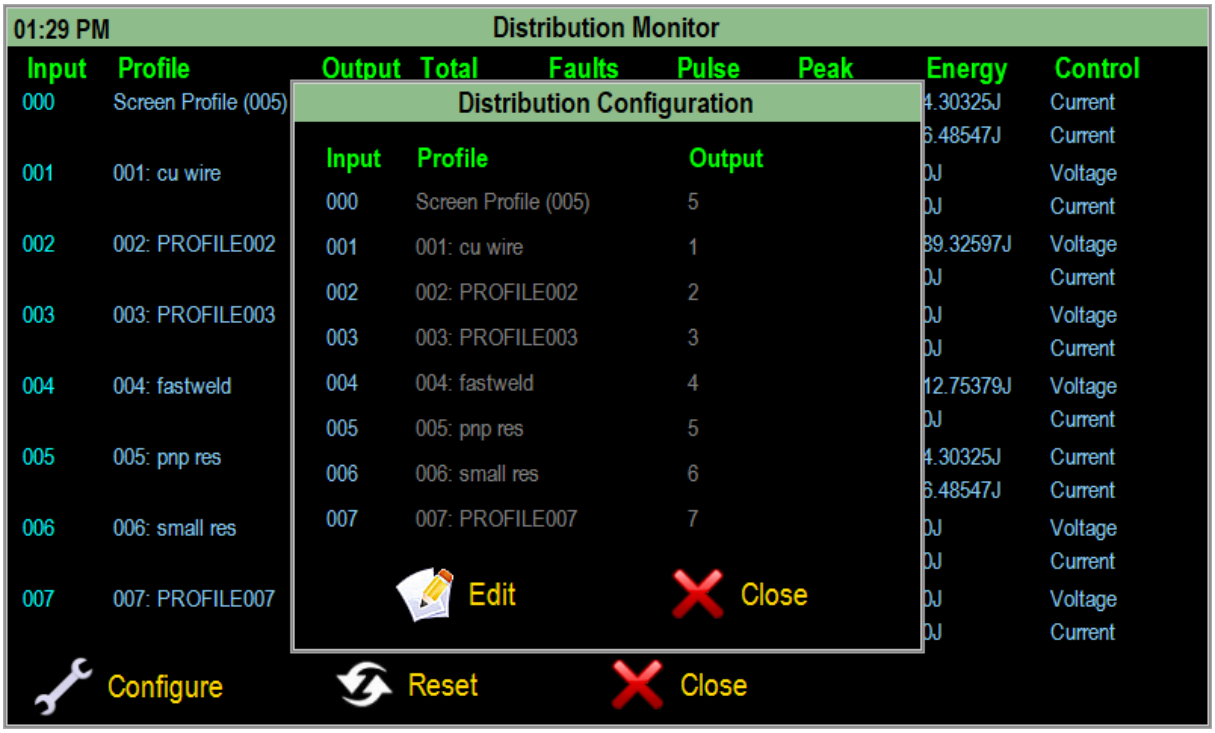


Distribution systems are additional welding products that provide electronic switching of the welding current from a single power supply to many weld heads. In order to setup such switching systems, Weld Head numbers are assigned and used in each welding profile which are then mapped to corresponding input trigger signals.

In multiple output systems using distribution, it is convenient to visualise and adjust the signal mapping between input trigger signals and output.

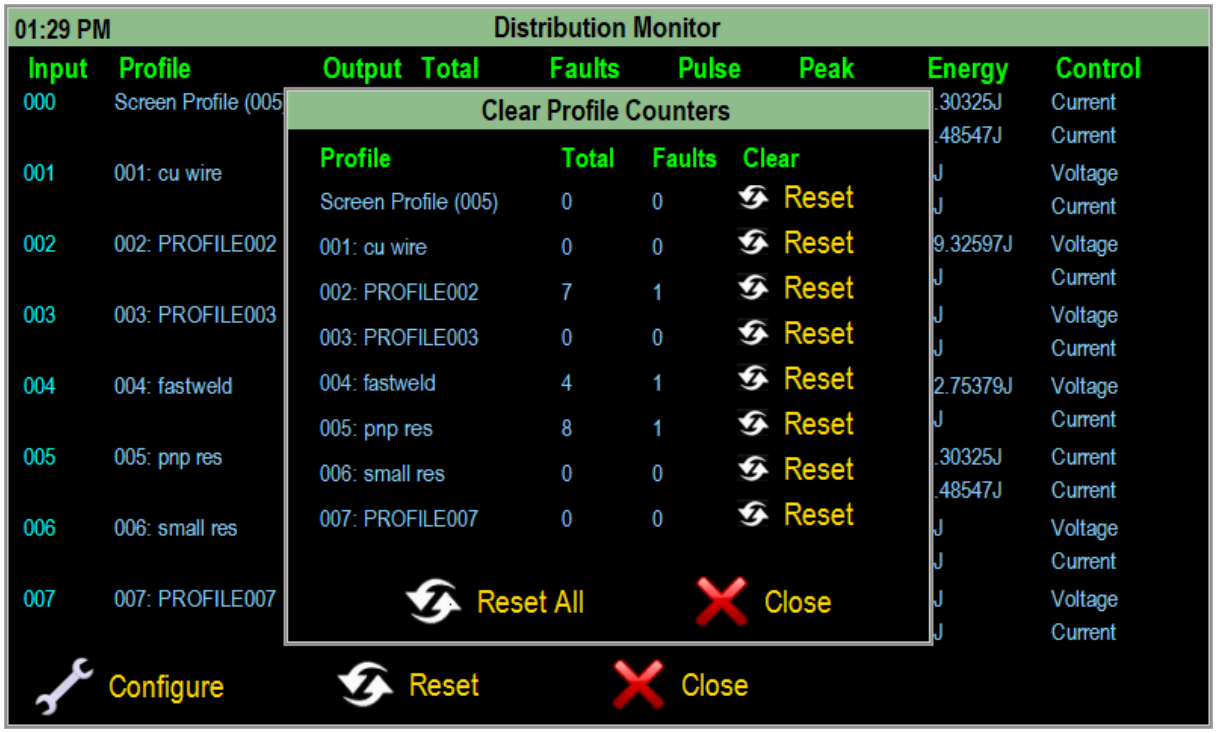
The distribution monitor shows from left to right, the input trigger signal, the profile it will recall and the output channel (weld head) to which the welding current will be switched, when the input is triggered. The monitor also shows the peak values measured last time the profile was triggered along with an overview of the total welds and total faults.

Edits can be made using the configure button.



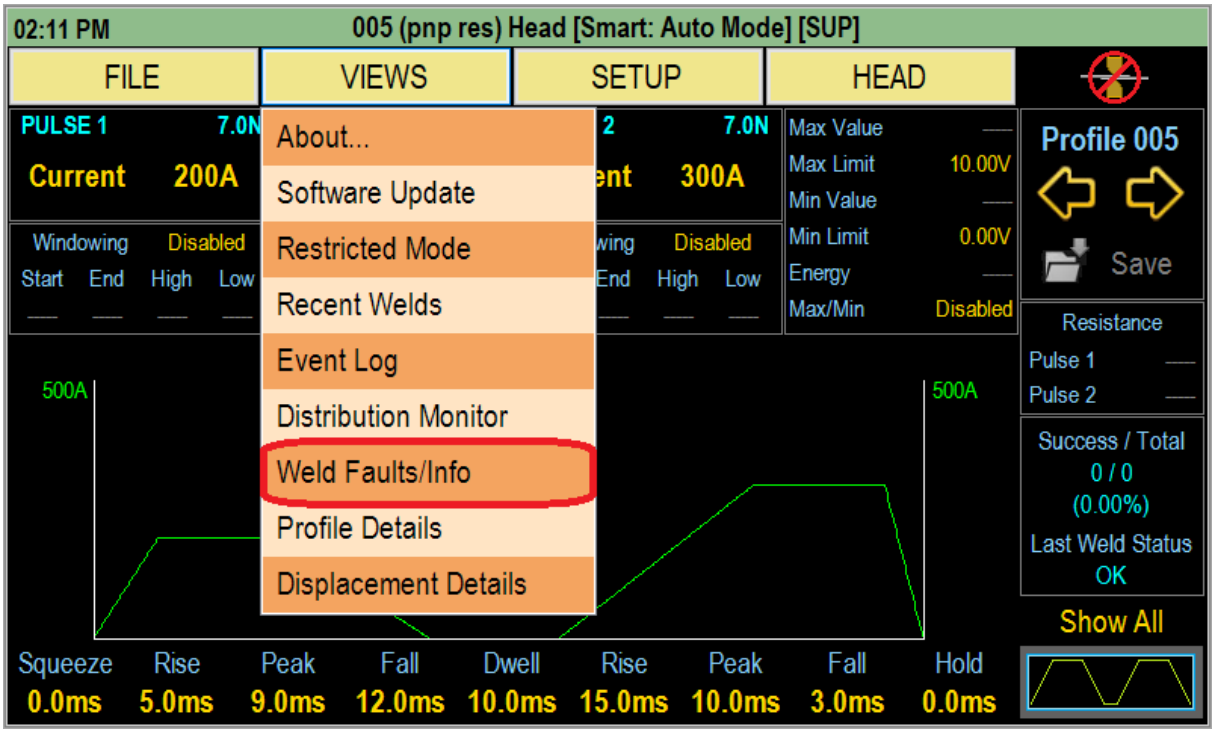
Configuring the distribution setup means mapping the 8 available inputs from the 37Way rear panel PLC interface to the desired profile. The profile information contains the destination head number, which is automatically mapped to the output number. Thus, anything up to 6 heads can be programmed with anything up to 8 different profiles (see the hardware manual for more details).

The weld- and fault- counts for each channel can be cleared using the Reset button.

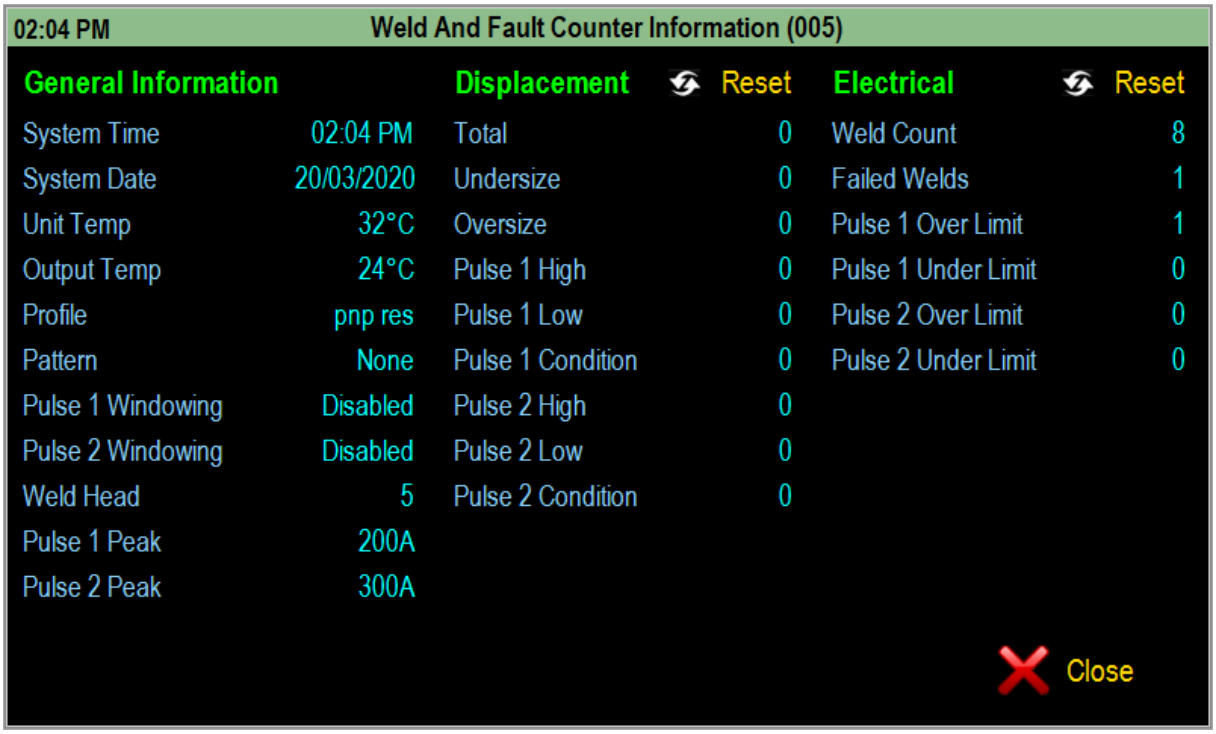


5.14 Weld Faults/Info

Under the VIEWS drop down menu is the Weld Faults/Info screen.

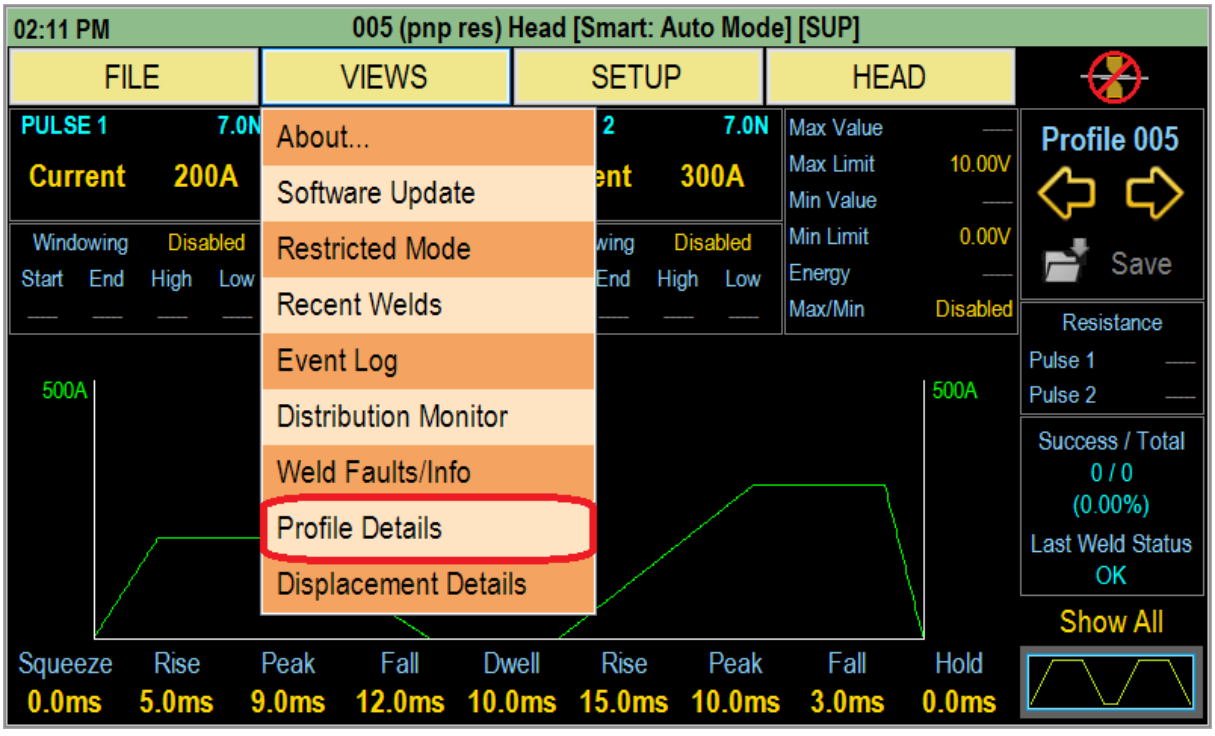


This provides information to summarise the total faults associated with the currently loaded profile. From this screen, the counters can be cleared.

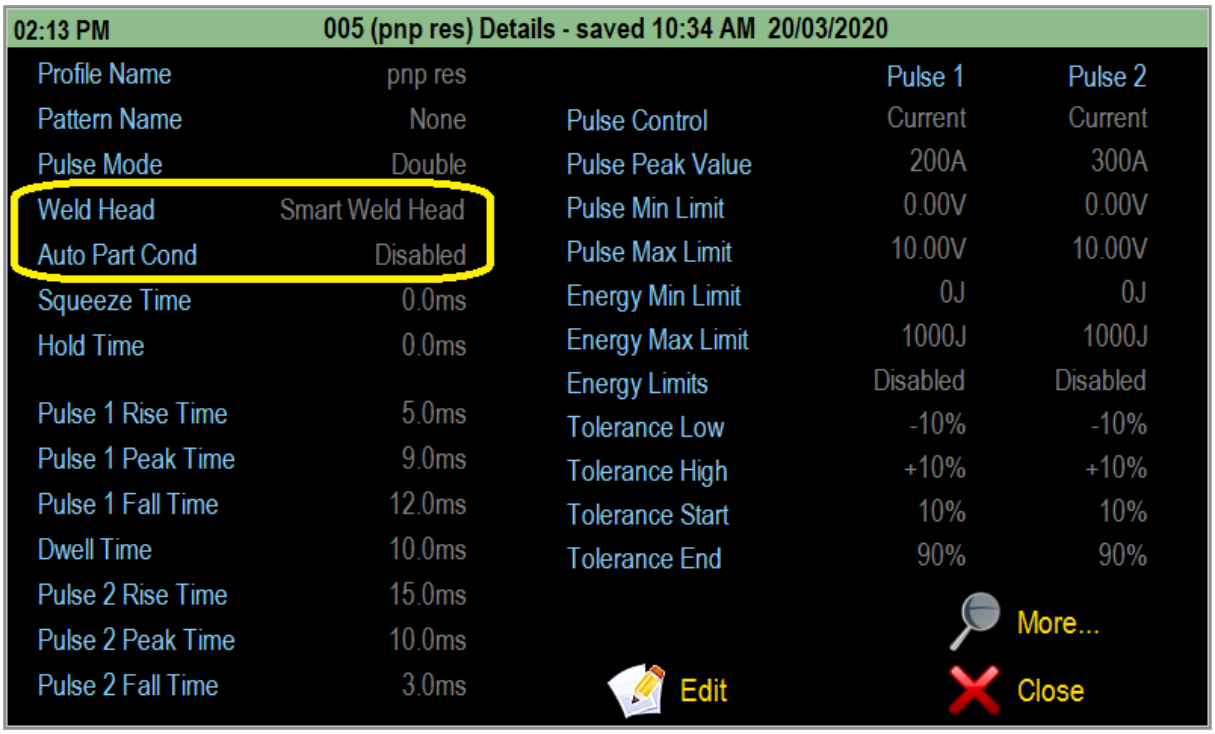


5.15 Profile Details

Generally, profile data is manipulated from the main screen in its graphical format. This provides access to the primary adjustable parameters for setting up a welding profile. A welding profile can also contain additional setup information, which would otherwise complicate the graphical screen, so a text-based profile summary is provided. This is accessed from the VIEWS drop down menu under Profile Details.

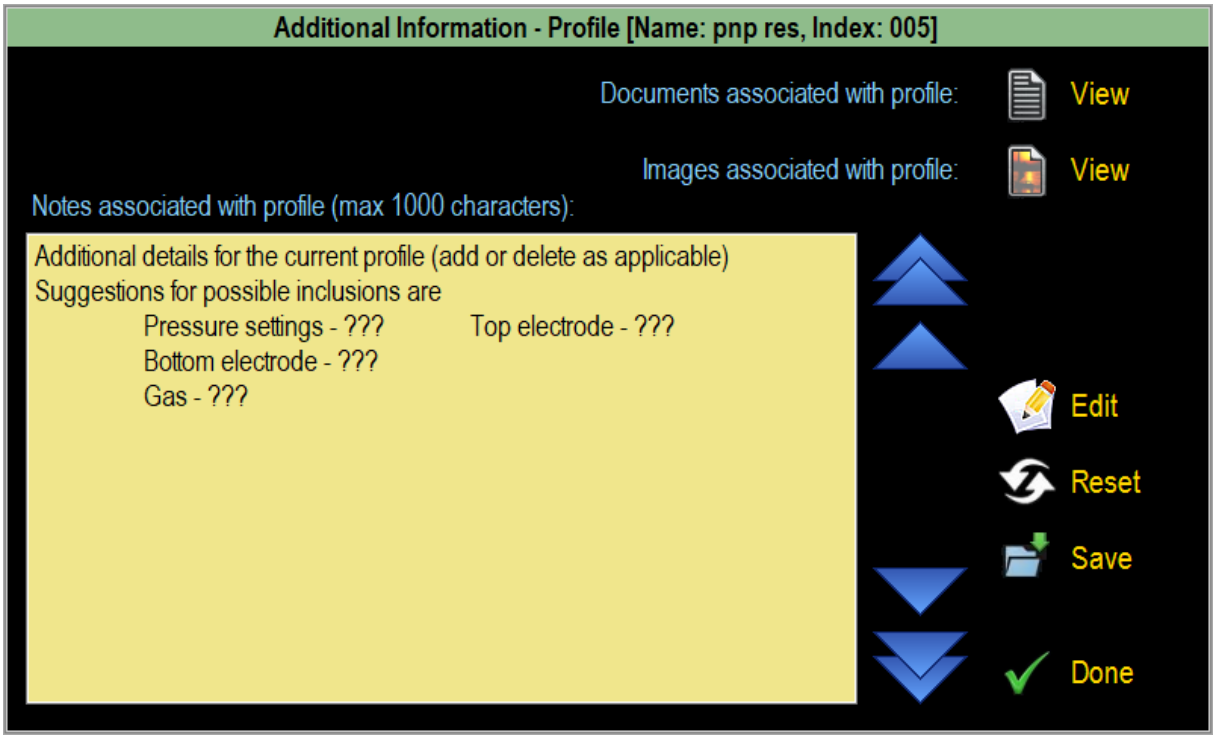


In the Profile details screen, all of the graphical data is shown textually. In addition, variables such as the weld head number, and auto part conditioning are also shown.



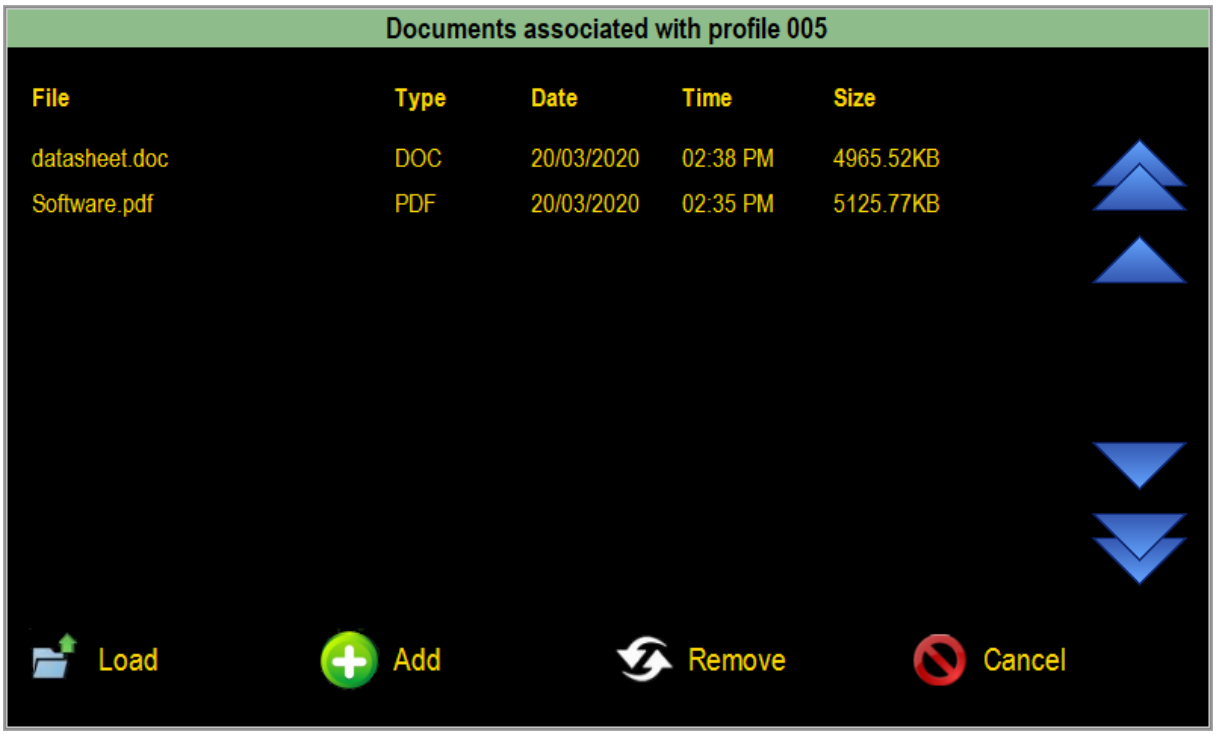
To make changes, simply press the Edit button.

The ‘More…’ button takes the user to the ‘additional information’ screen. Here, the user is free to enter textual notes giving extra information on the profile and select to images or documents to associate with the profile. This can be useful for recording production notes, expected visual appearances and so on.



5.15.1 Profile Associated Documents

In the additional information screen, if the ‘view associated documents’ or ‘view associated images’ button is pressed then a list of the corresponding files is shown:

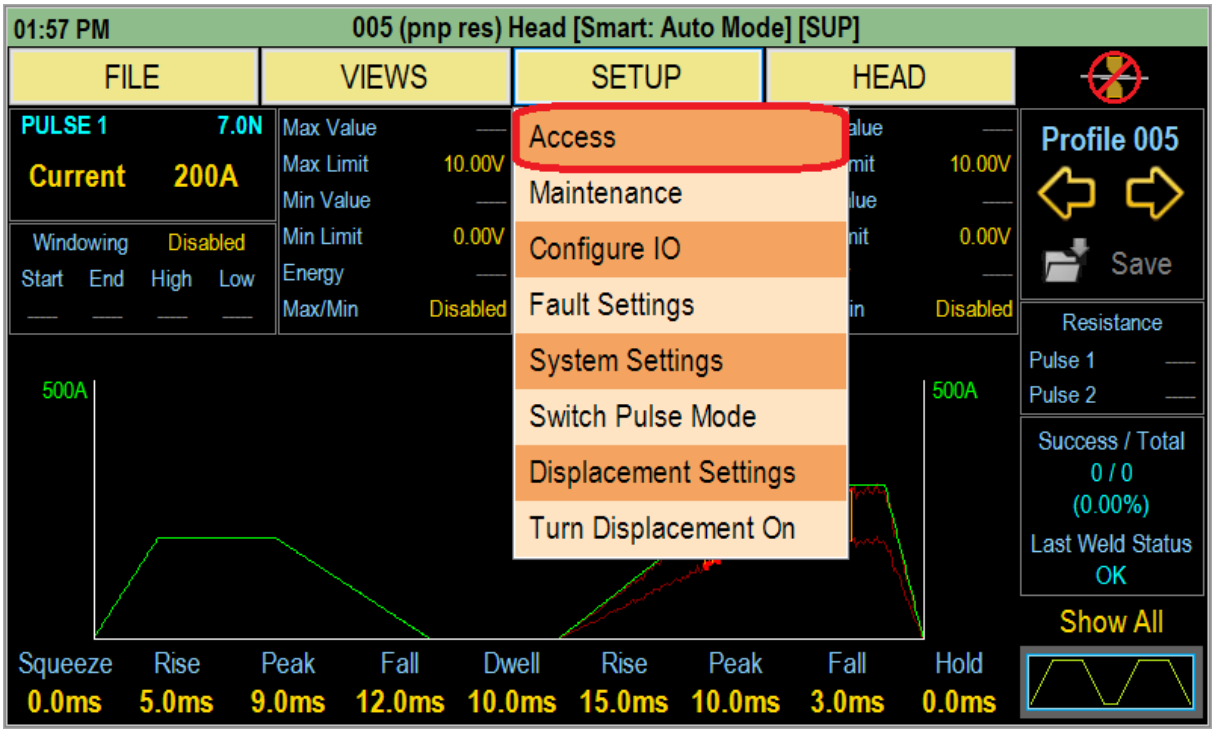


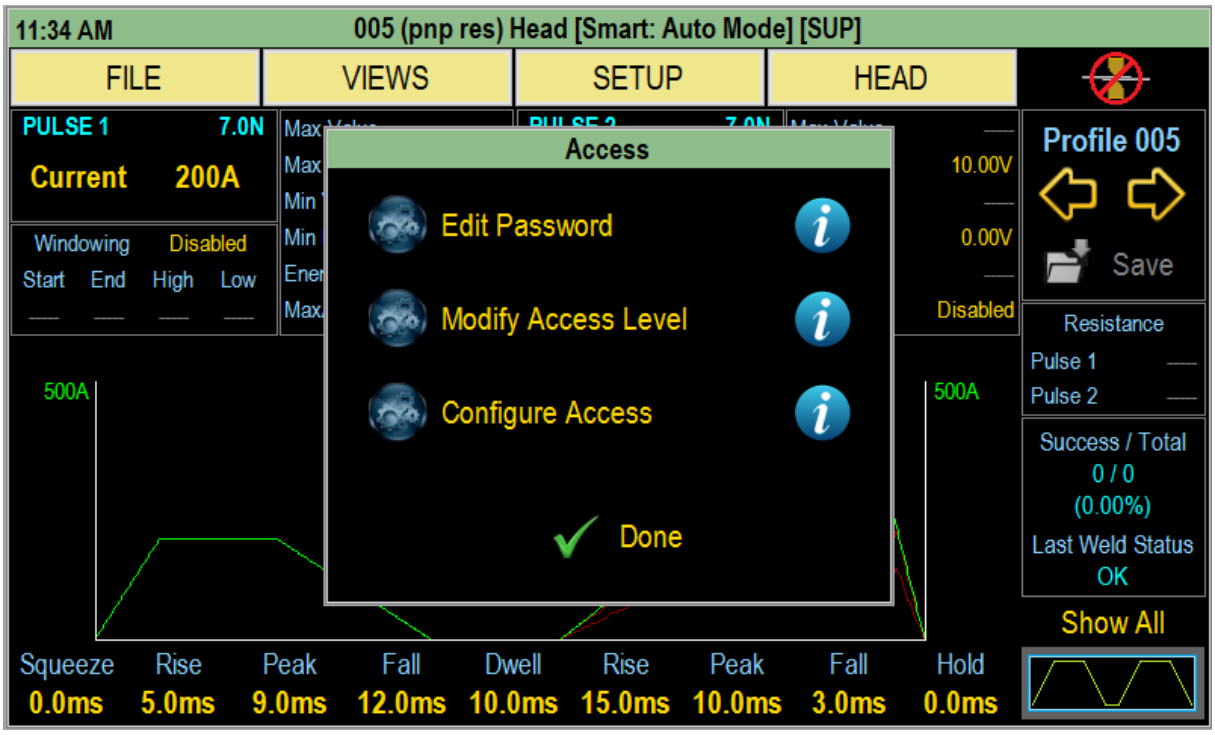
If the 'Profile Switch Show' setting is enabled (see the 'Setup – System Settings' section) a list of all of the available documents, images and notes can be automatically shown when the profile is selected. This will appear as follows.

If the 'Profile Switch Item' setting is also enabled (see the 'Setup – System Settings' section) it is then possible to use the 'Select' button to choose one of these documents to be automatically displayed in detail instead of the full list.

5.16 Passwords / Access

Under the SETUP drop down menu is the ‘Access’ option. This covers all items regarding access or restrictions to various parts of the HMI.





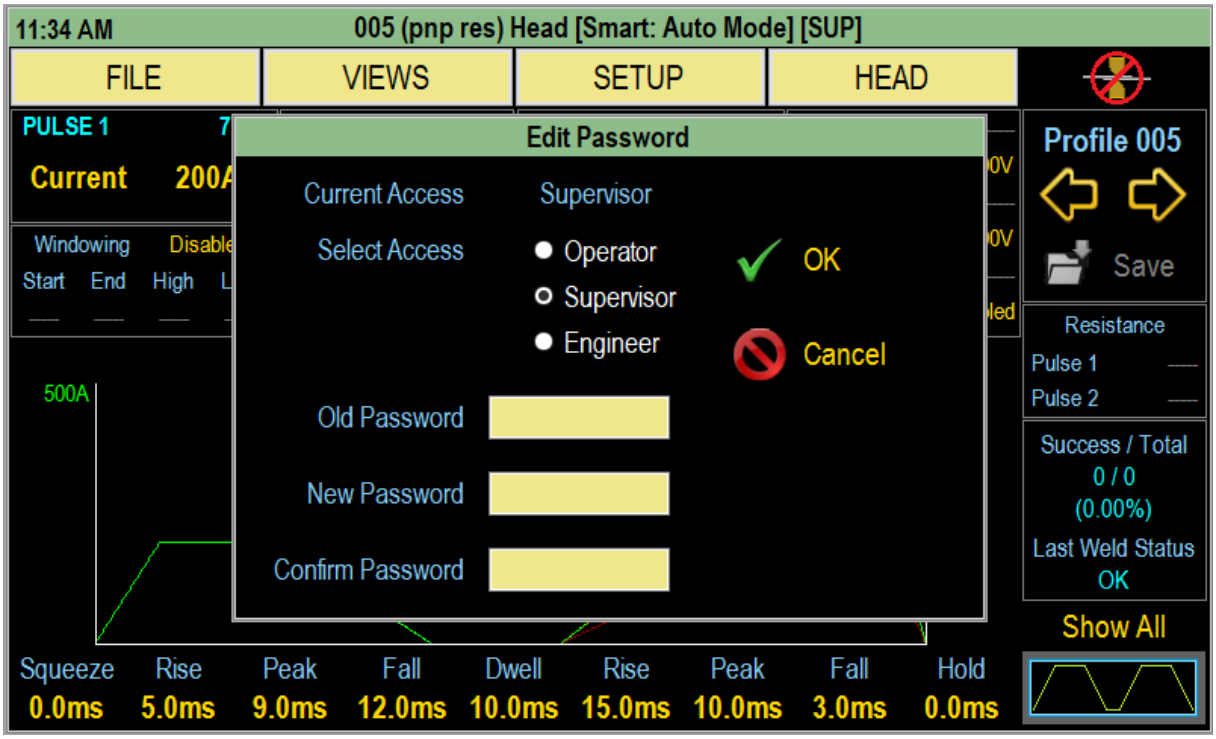
5.16.1 Passwords

There are three levels, namely Operator, Supervisor and Engineer. By default, these provide the following functionality:

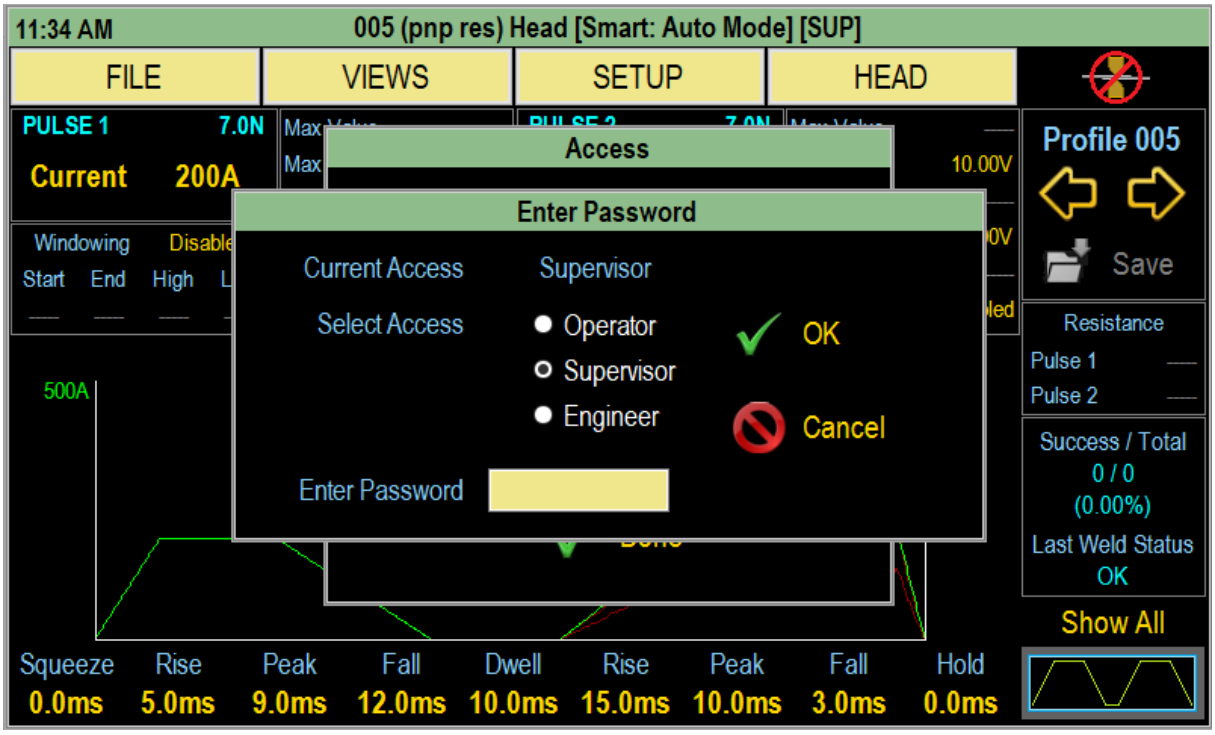
- The Operator level is restricted to a minimal range of adjustment and of course, the operator menu.
- The Supervisor level gives access to everything except the factory set calibration data.
- The Engineer level permits changes to everything.

Note that the title bar shows the current access level (OPR / SUP / ENG).

The ‘Edit Password’ screen provides the ability to set new passwords.



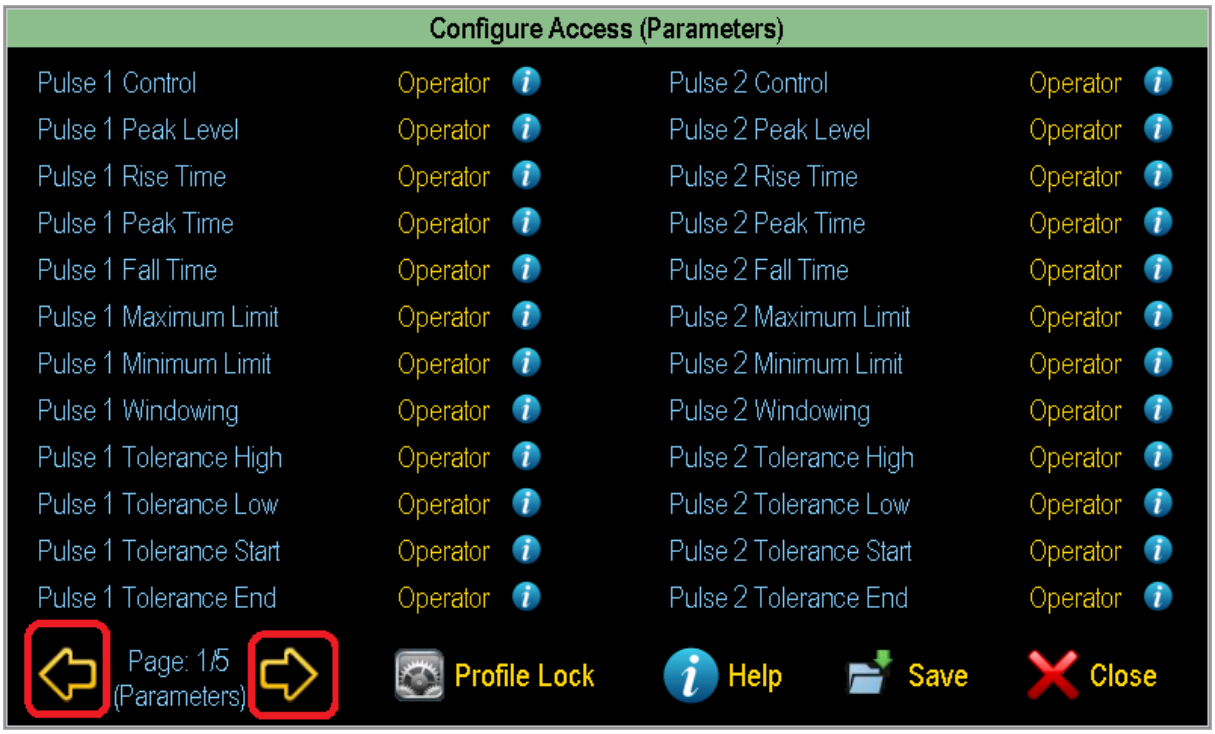
The ‘Modify Access Level’ screen provides the ability to set the current access level.

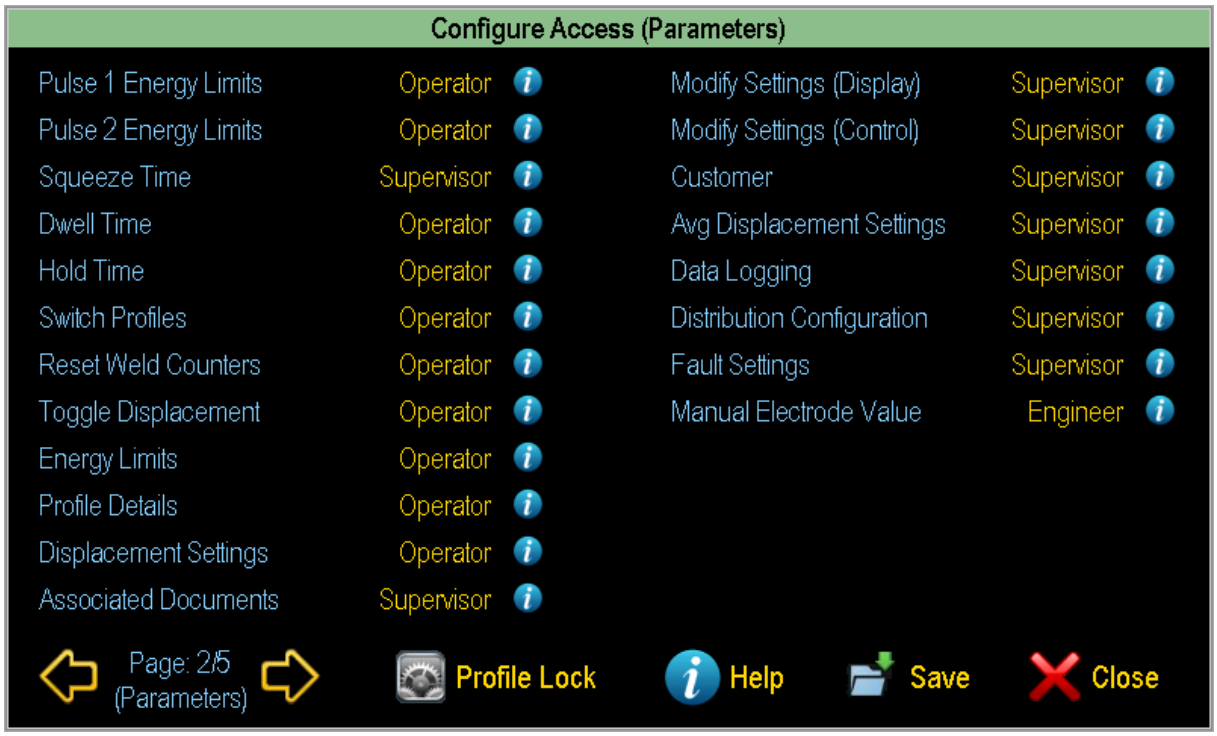


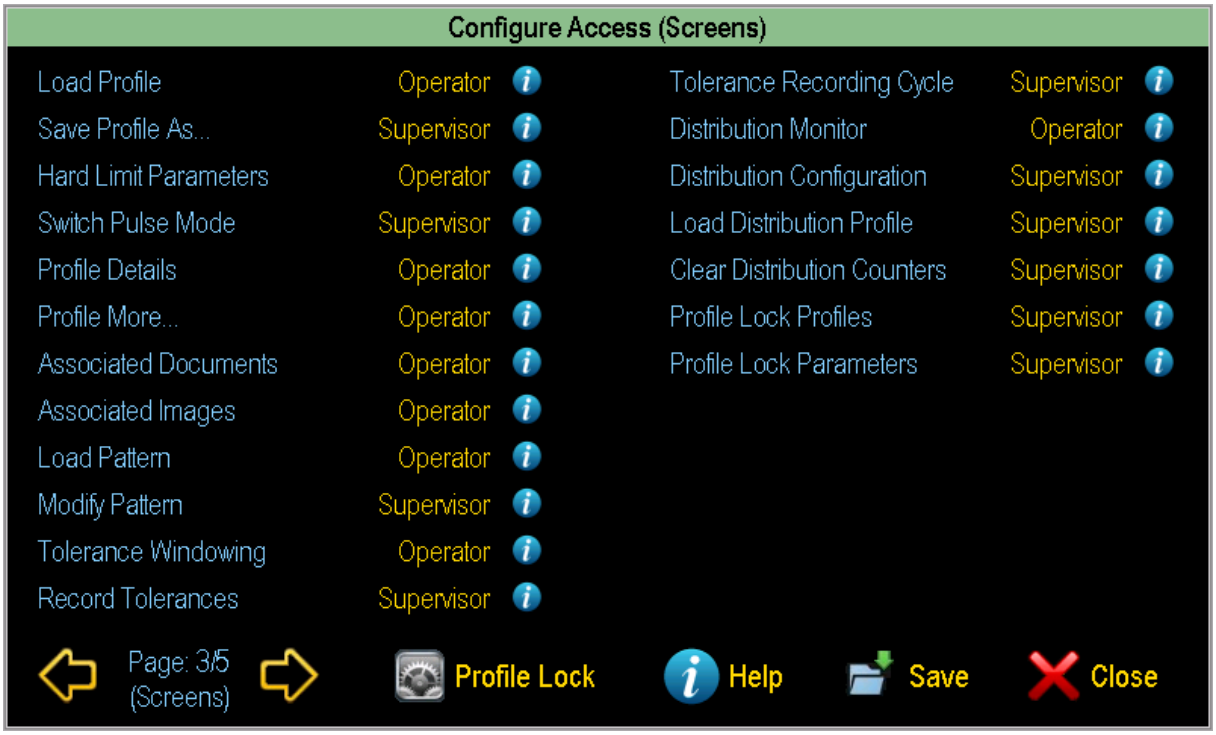
5.16.2 Access Configuration

The ‘Configure Access‘ screen provides the ability to fully control the minimum login level (operator / supervisor / engineer) required to access any part of the HMI.

The configurable items are split into two main groups: parameters (or associated actions) and screens. The full list of available items can be seen by using the arrow buttons to change page.


Configure Access (Parameters)
Pulse 1 Control Operator
Pulse 1 Peak Level Operator
Pulse 1 Rise Time Operator
Pulse 1 Peak Time Operator
Pulse 1 Fall Time Operator
Pulse 1 Maximum Limit Operator
Pulse 1 Minimum Limit Operator
Pulse 1 Windowing Operator
Pulse 1 Tolerance High Operator
Pulse 1 Tolerance Low Operator
Pulse 1 Tolerance Start Operator
Pulse 1 Tolerance End Operator
Pulse 2 Control Operator
Pulse 2 Peak Level Operator
Pulse 2 Rise Time Operator
Pulse 2 Peak Time Operator
Pulse 2 Fall Time Operator
Pulse 2 Maximum Limit Operator
Pulse 2 Minimum Limit Operator
Pulse 2 Windowing Operator
Pulse 2 Tolerance High Operator
Pulse 2 Tolerance Low Operator
Pulse 2 Tolerance Start Operator
Pulse 2 Tolerance End Operator
Page: 1/5
(Parameters)
Profile Lock
Help
Save
Close


Configure Access (Parameters)
Pulse 1 Energy Limits Operator
Pulse 2 Energy Limits Operator
Squeeze Time Supervisor
Dwell Time Operator
Hold Time Operator
Switch Profiles Operator
Reset Weld Counters Operator
Toggle Displacement Operator
Energy Limits Operator
Profile Details Operator
Displacement Settings Operator
Associated Documents Supervisor
Modify Settings (Display) Supervisor
Modify Settings (Control) Supervisor
Customer Supervisor
Avg Displacement Settings Supervisor
Data Logging Supervisor
Distribution Configuration Supervisor
Fault Settings Supervisor
Manual Electrode Value Engineer
Page: 2/5
(Parameters)
Profile Lock
Help
Save
Close

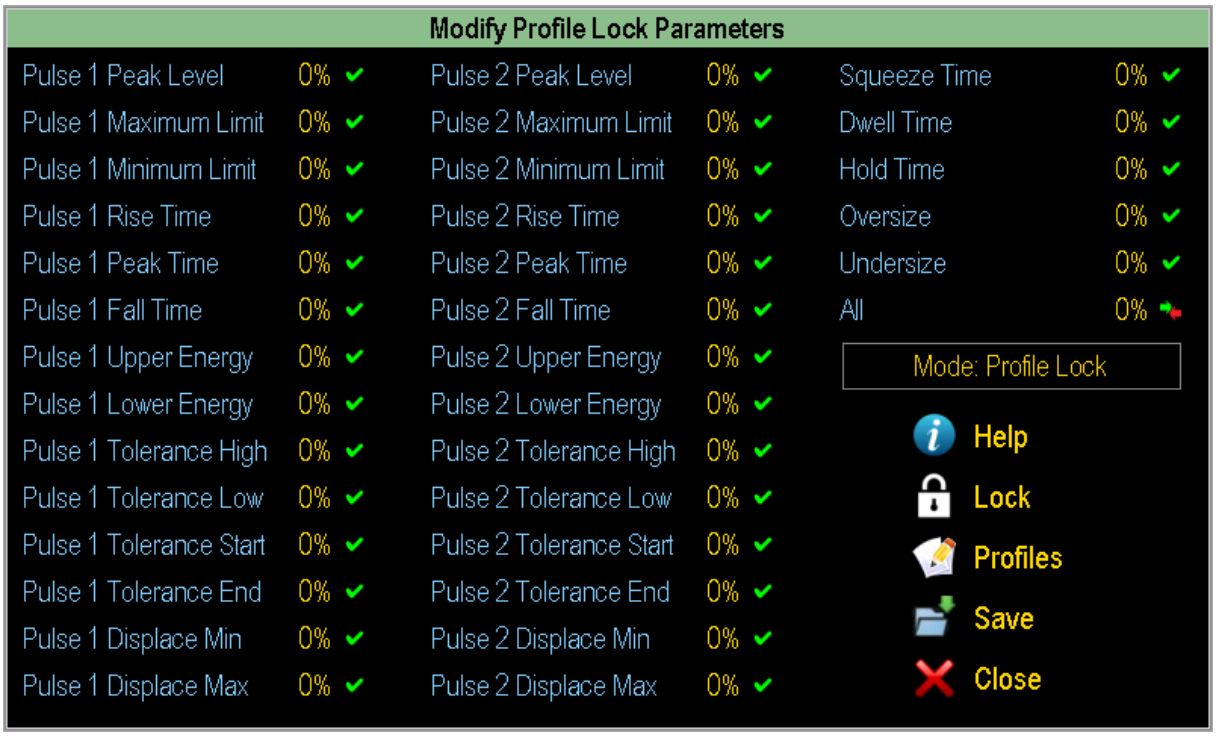


And so on. Each of the items has a help button associated with it (the 'i' icons) providing information to allow the user to determine the appropriate access level for the item. The minimum access level is changed by pressing on the current access which will cycle through the available values. Some items have an inbuilt minimum level that cannot be changed. For instance, the calibration screen cannot be set below 'Engineer' level.

When the configuration is as desired, pressing the save button will not only save the configuration, but will also change the 'Customer' system setting to 'Manual'. This indicates that the access levels set in this screen are then in use for the entire HMI. The access can later be returned to default values, if desired, by changing the Customer system setting back to 'Standard'.

5.16.3 Profile Lock

The 'Profile Lock' feature duplicates and extends the feature that was previously called 'Operator Mode' (now 'Restricted Mode'). This allows a supervisor to set limits on how much an operator can change profile parameters. The following is shown on first entering the screen:



The allowed percentage change that can be applied to each parameter can be specified by pressing the relevant value. If the green 'enabled' tick is pressed it will change to a red 'disabled' cross, indicating that the parameter has no limits applied to it.

The value and enable/disable button attached to the 'All' item allows all of the values to be set simultaneously.

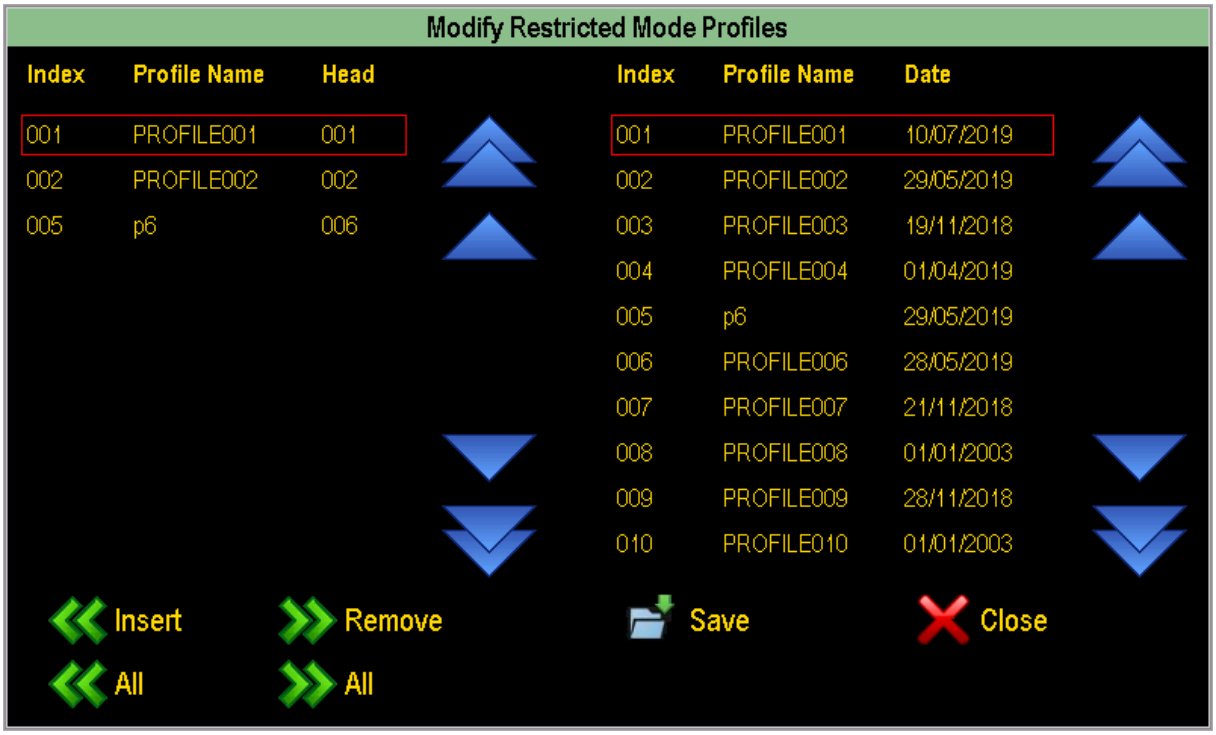
When the parameters are set as desired, the settings are retained by pressing the 'Save' button.

Pressing the 'Lock' button 'locks' all stored profiles at their current values. This forms a baseline against which the allowed parameter changes are measured. Even if the operator subsequently makes a change to a profile, the original locked values are still used to limit further changes.

The 'Mode' button switches between the view shown above (profile lock mode) where all profile parameters can be changed and restricted mode (see the Restricted Mode section).

Note that the display will be slightly different if the welder is not configured with displacement capability.

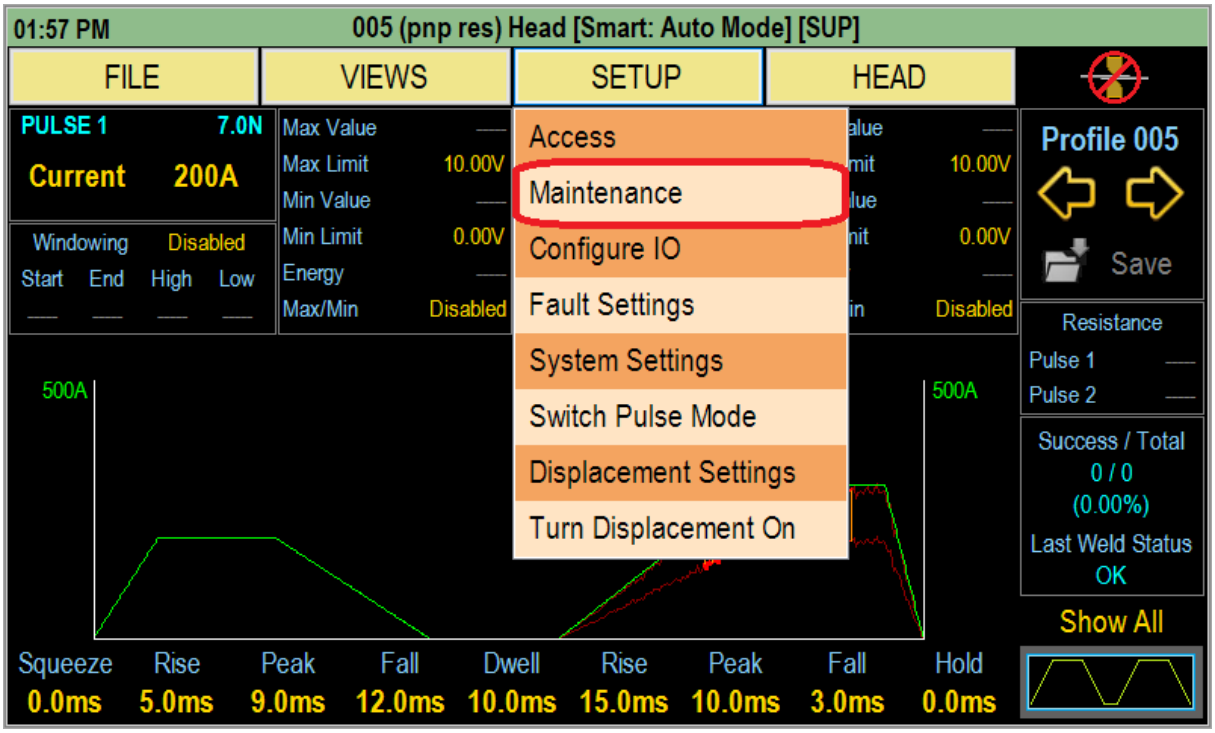
The profiles that an operator has access to can be specified by pressing the 'Profiles' button, which brings up the following screen:

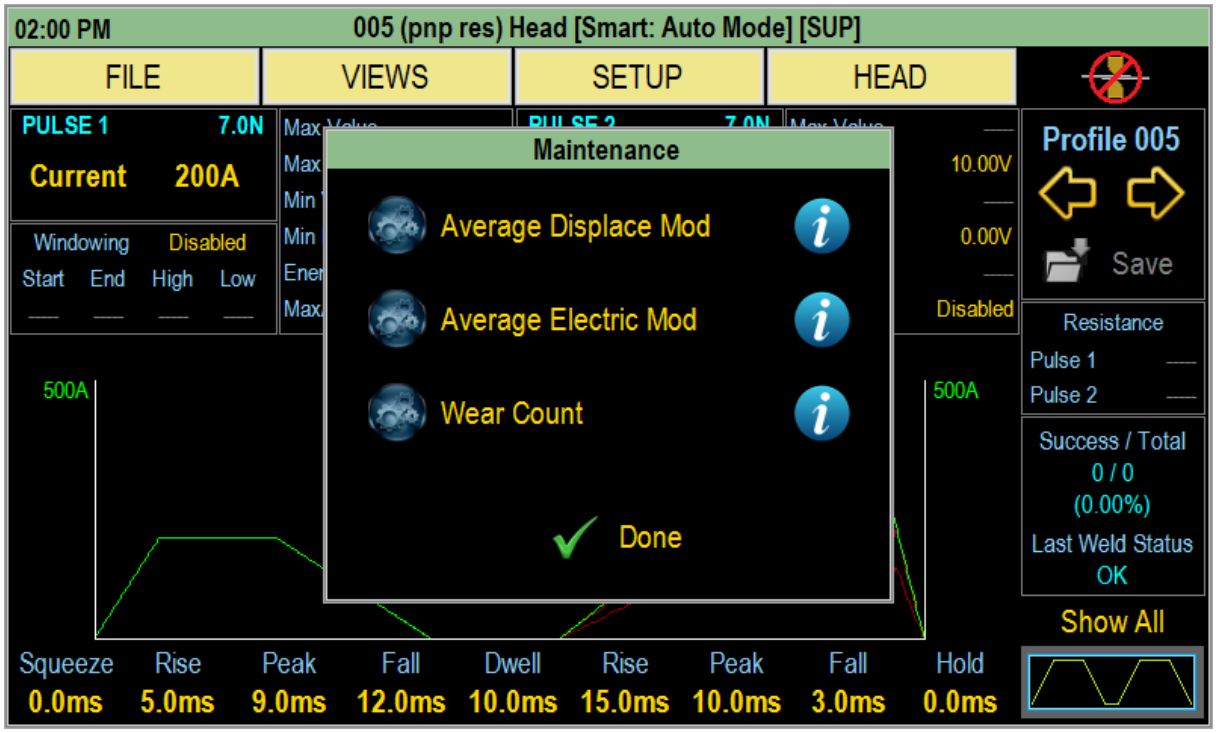


Here all of the profiles that the operator is allowed access to should be added to the list on the left using the 'Insert' button (or 'Insert All' button if all are to be available). Profiles can also be removed using the 'Remove' or 'Remove All' buttons. Note that if remove all is selected, Profile 001 will be retained by default since the operator will always have access to at least one profile.

5.17 Maintenance

Under the SETUP drop down menu is the ‘Maintenance’ option. This covers features relating to pre-emptive maintenance of the welder, in particular with regard to electrode lifetime.



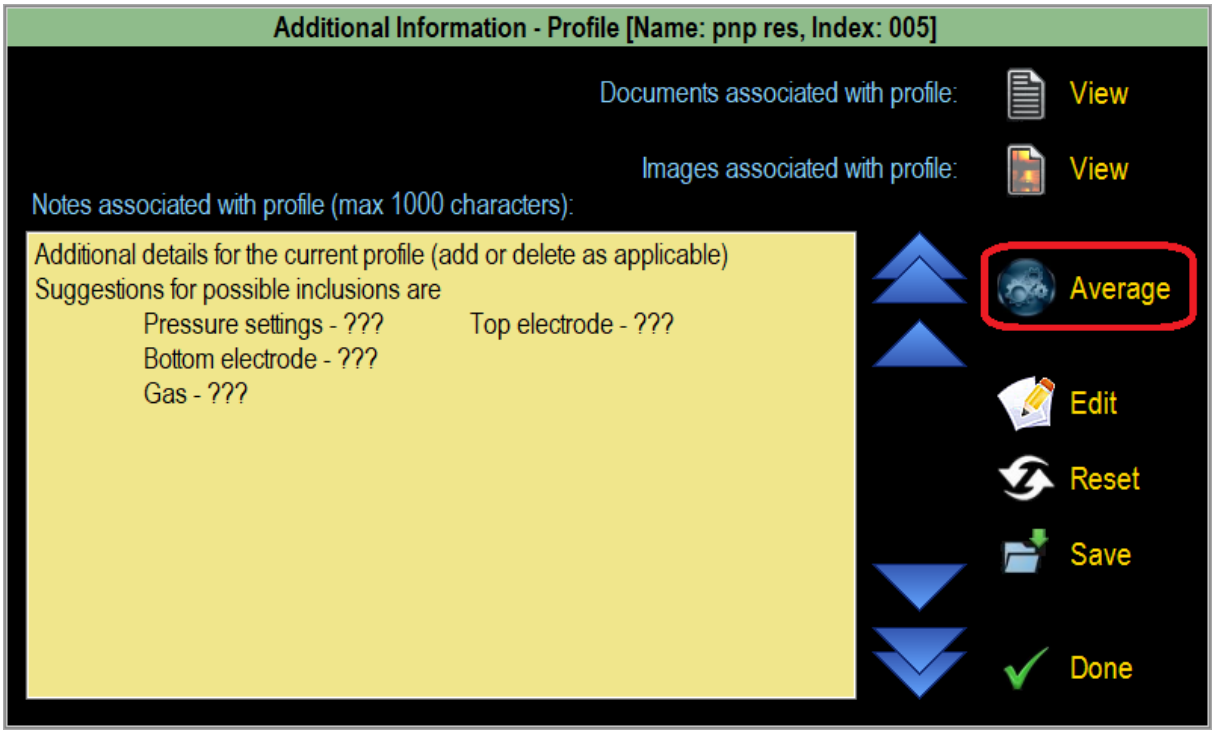


5.17.1 Average Displacement

The ‘Average Displacement Modification’ feature is detailed as part of the Displacement Option in Section 7.2 below.

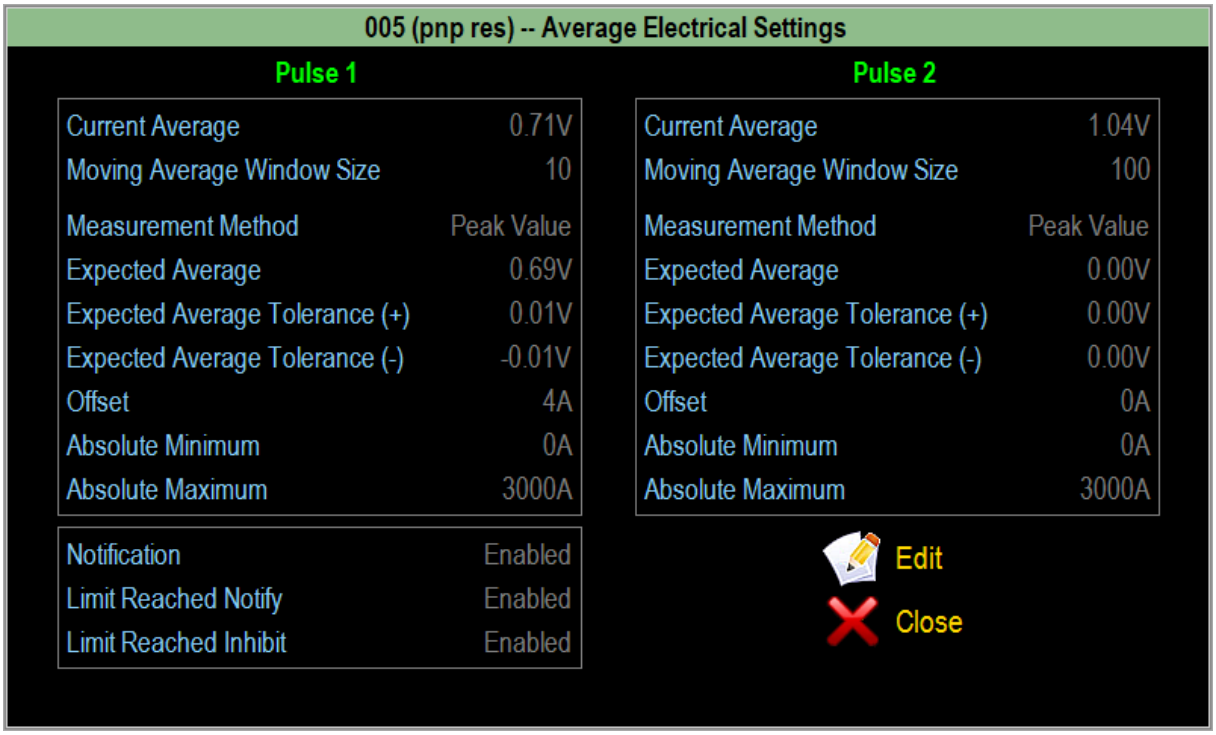
5.17.2 Average Electric Modification

To be able to use the ‘Average Electric Modification’ feature, the ‘Average Electric Mod’ setting must be enabled (see System Settings). When enabled, an additional button (Average) is shown on the Additional Profile Information screen.



The feature is unconditionally accessible via the SETUP Maintenance menu option.

Selecting via one of the above methods shows the Average Electrical Settings screen:



The average values are calculated separately for each profile and with separate settings. The average ('Current Average') is calculated over the number of welds specified in the 'Moving Average Window Size' setting. The average is compared against the 'Expected Average' setting, with the positive and negative tolerances applied.

If the average is out of range, the peak demand of the corresponding profile is modified by the offsets specified. **Only** the peak demand in the active control mode (voltage, current, power) is affected. The offsets for both pulses are applied simultaneously, if applicable.

The direction that the peak demand is modified is with the intention of bringing the average displacement back into line. Therefore, the following calculations apply:

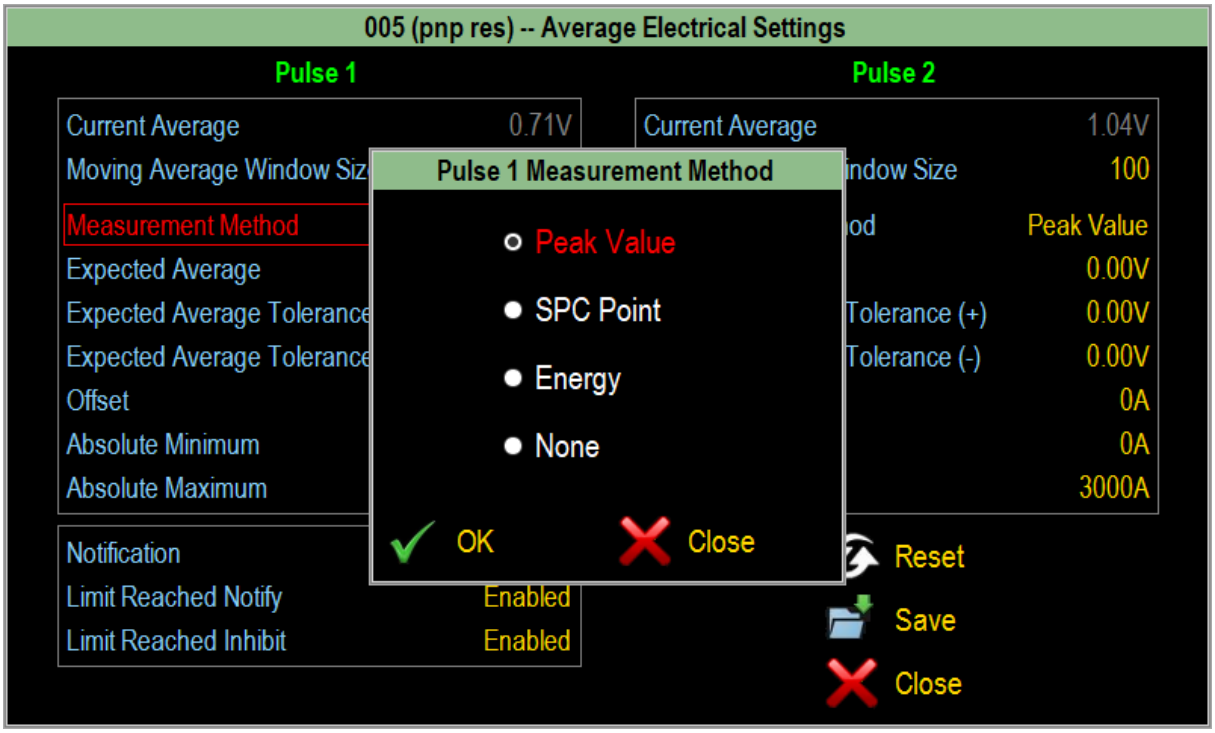
IF 'current average' > ('expected average' + positive tolerance)
THEN peak demand = peak demand – offset

IF 'current average' < ('expected average' - negative tolerance)
THEN peak demand = peak demand + offset

The offsets are signed values, so it is possible to change the demand in the opposite direction. For example, with a negative offset the demand would be increased if the positive tolerance was exceeded.

The measurement that is averaged can be set to one of the following:

- Peak Value – this is the maximum peak value seen during the pulse. When pulse control is in current mode this is the maximum voltage, otherwise it is the maximum current.
- SPC Point – this is a user-defined part of the electrical feedback (see Section 6.6.1)
- Energy – this is the total energy of the pulse.
- None – the feature is disabled for this pulse



The ‘Absolute Minimum’ and ‘Absolute Maximum’ settings indicate the extreme limits that the demand can be modified to.

The ‘Notification’ setting indicates whether a message is shown on screen when the demand is modified.

The ‘Limit Reached Notify’ setting indicates whether a message is shown on screen when the demand reaches the absolute minimum or maximum.

The ‘Limit Reached Inhibit’ setting indicates whether the welder should be inhibited when the demand reaches the absolute minimum or maximum.

The ‘Reset’ button will reset the average electrical calculation (both pulses).

After the calculation is reset or the demand has been modified, the number of welds that must occur before modification can happen must be equal to or greater than the ‘Moving Average Window Size’. This avoids the possibility of multiple consecutive demand modifications.

5.17.3 Wear Count

The ‘Wear Count’ feature provides the ability to set actions to occur when a set number of welds has occurred. The functionality is primarily to show when the expected lifetime of electrodes has expired and they need changing.

The feature can operate in two modes. Normal operation uses the separate weld counts in place for each profile (see the ‘Profile Settings’ panel). If the 'Use Total' setting is enabled, a single count is implemented for all of the profiles combined (see the ‘Use Total Settings’ panel). In both modes a maximum count is defined, which is disabled when set to zero.

When the maximum is reached a warning is displayed, and an option is given for the corresponding weld count to be reset to 0. If this option is NOT selected the warning will continue to be shown after each further weld.

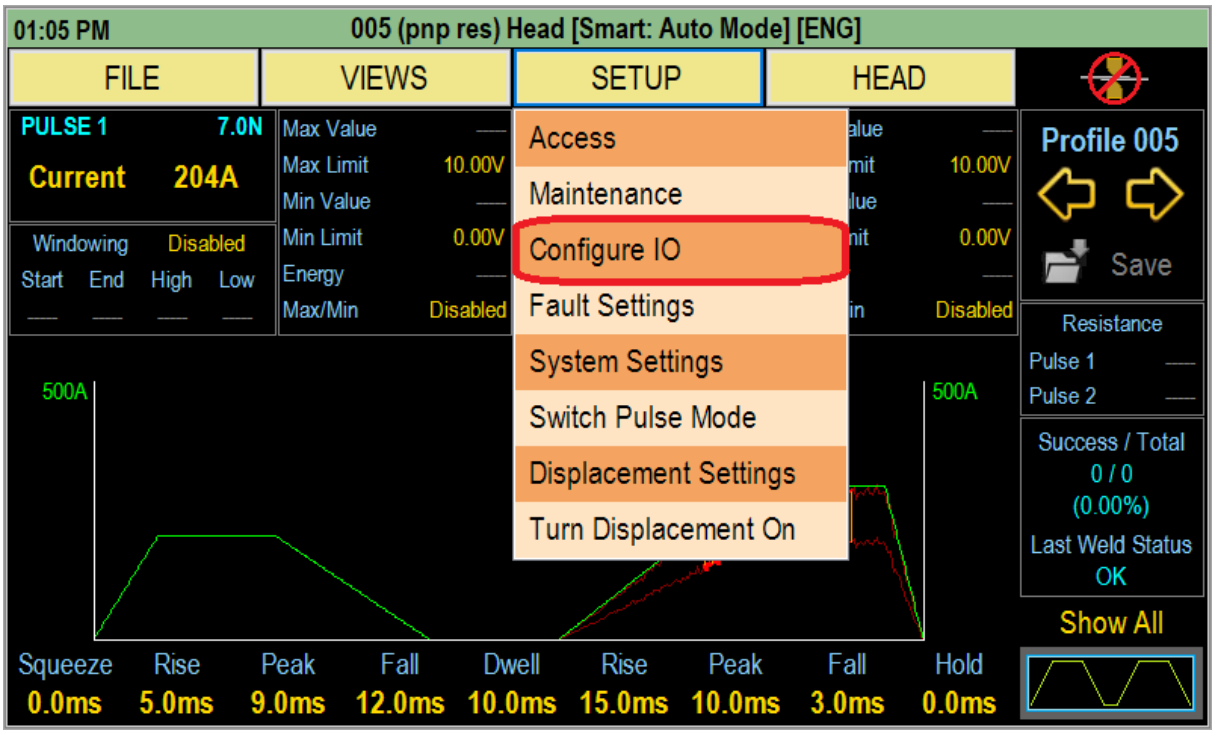
In addition to the warning, the welder can also be inhibited automatically at the point the limit is exceeded by enabling the 'Inhibit On Exceed' setting.

An earlier pre-warning can be shown by setting ‘Pre-Warn Count' to a non-zero value. This specifies the number of welds before the maximum count is reached that the pre-warning is displayed. Setting this to zero disables the pre-warning.

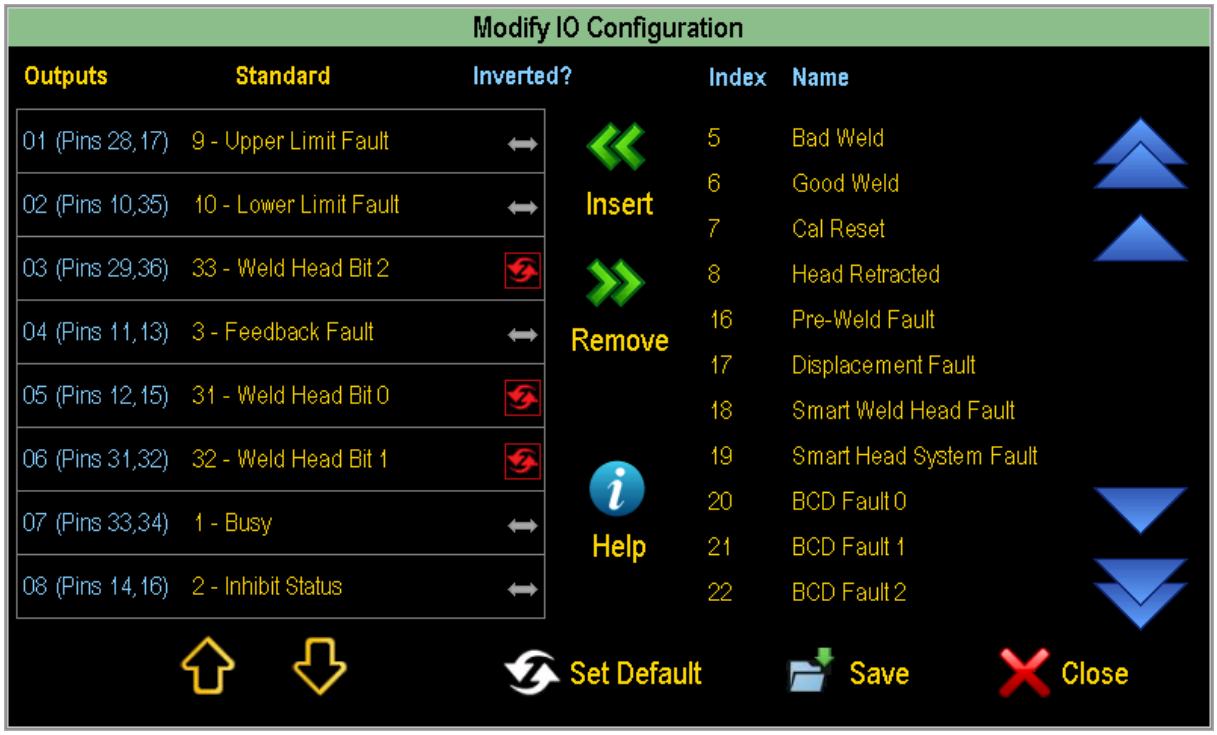
The feature is globally activated or deactivated using the 'Enable / Disable' setting.

5.18 Configure IO

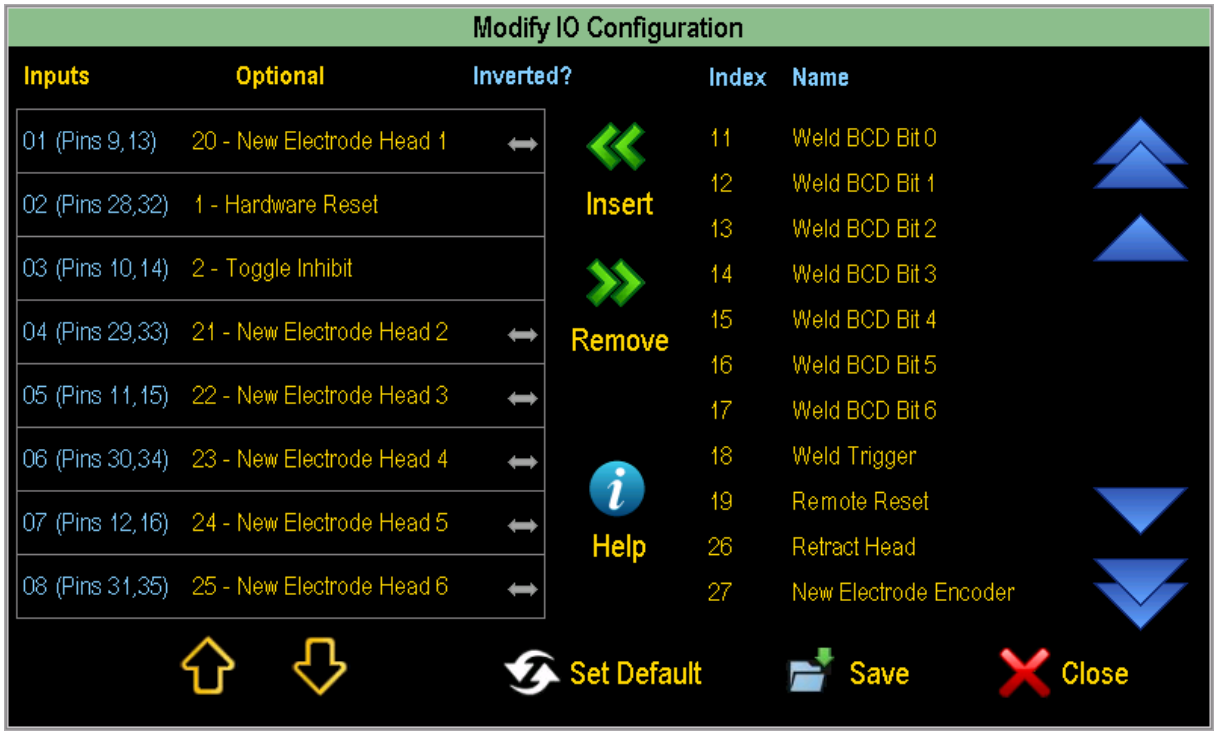
Under the SETUP menu is the 'Configure IO' option. Selecting this allows the ability to modify the inputs and outputs of the welder. Using this feature should be done in conjunction with the hardware manual 'Rear Panel Connections' section.



Selecting this menu option brings up a similar screen to the following, depending on the configuration of the originally ordered welder:



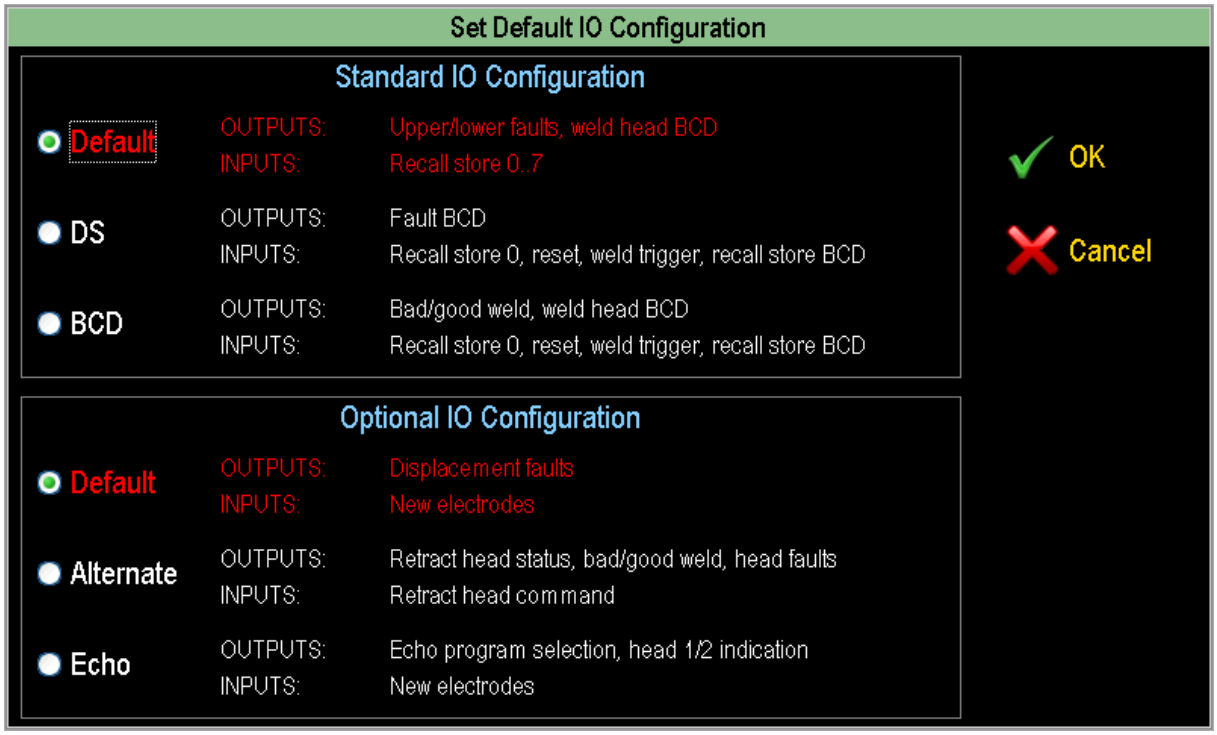
The left-hand list shows the actual outputs, together with the relevant pins on the 37-way and the currently assigned action. The default display shows the standard outputs (see above), but the headings can be pressed to change between outputs/inputs and standard/optional IO. For example:



The right-hand list shows the potential actions that can be assigned to an input or output. Actions can be inserted into the existing list using the ‘Insert’ button if there is an available slot. Actions can be removed from the existing list by selecting and then using the ‘Remove’ button. The arrow buttons allow actions to be moved to different input/output locations.

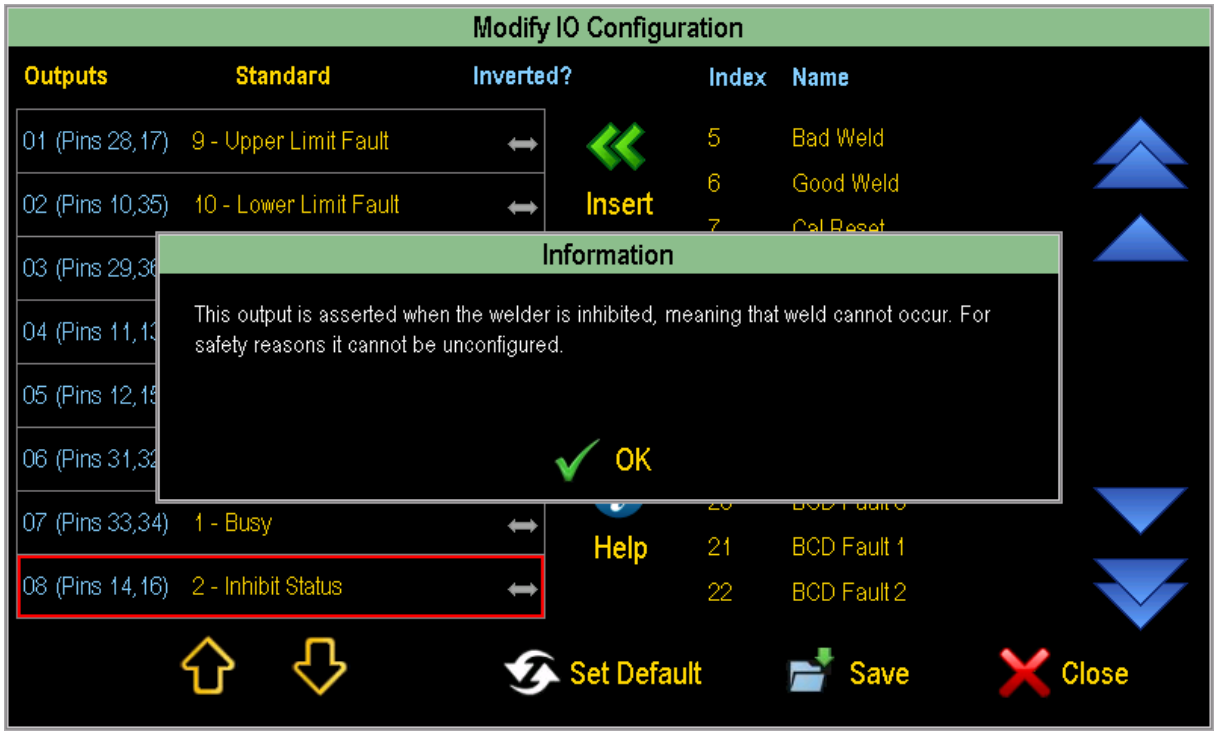
Note that some IO items cannot be removed or relocated.

Pressing the ‘Set Default’ button shows a screen that allows one of a set of default configurations to be loaded. In general, these options match the IO options shown in the hardware manual.



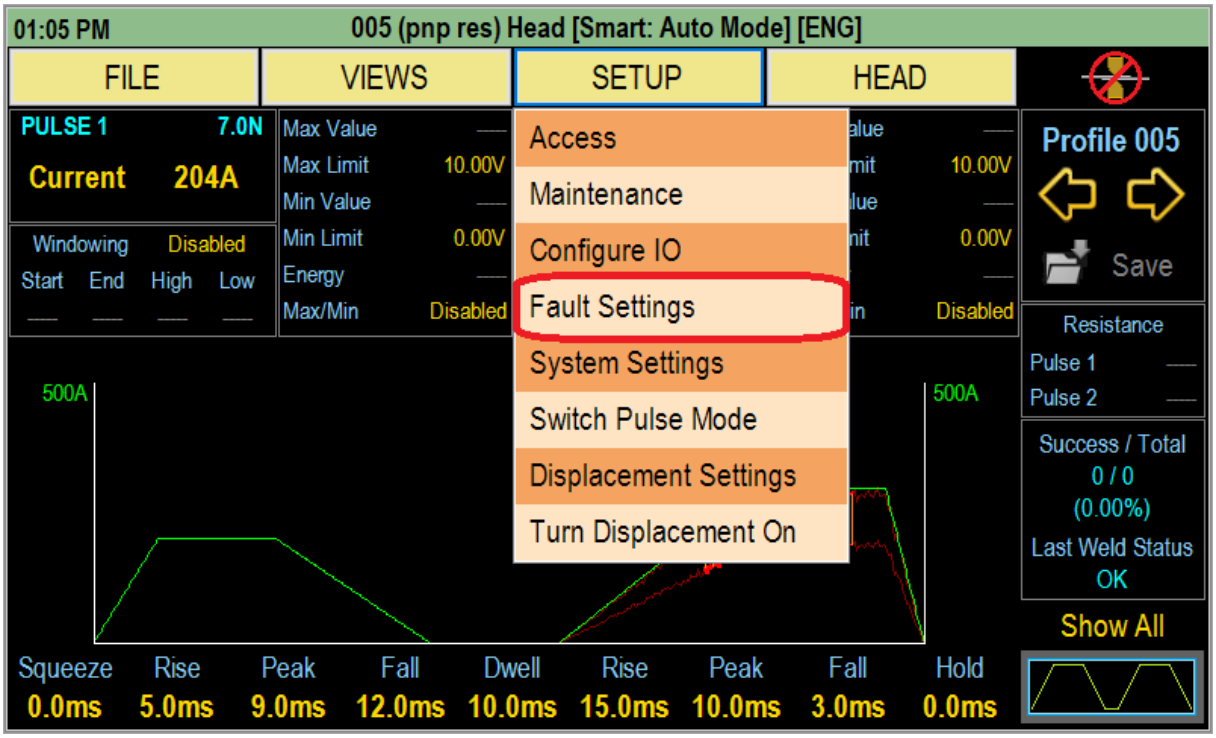
When the desired configuration has been loaded (including if one of the default configurations has been chosen) the data needs to be saved to the real time controller using the ‘Save’ button.

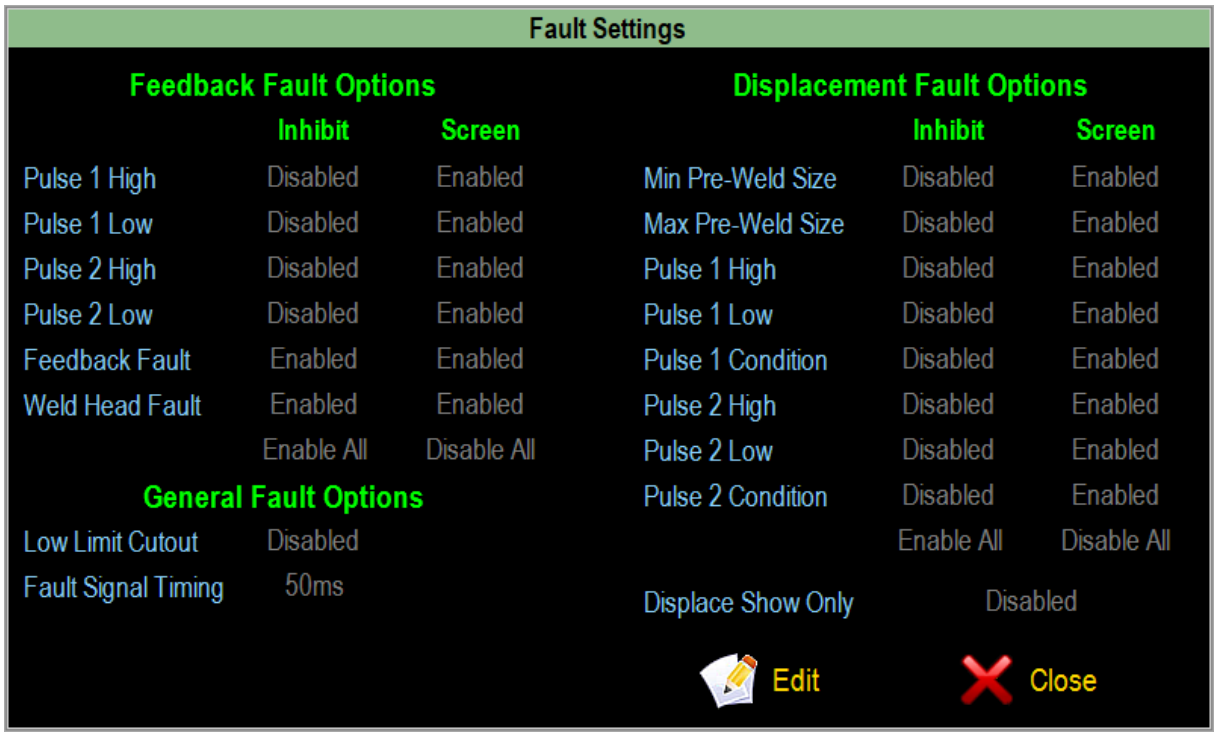
Information on any of the output/input actions can be shown by selecting it and then pressing the ‘Help’ button. The same information is also shown if any of the actions is double tapped.



5.19 Fault Settings

Under the SETUP drop down is the Fault Settings menu. Here the user can configure how the machine should behave when a fault has been detected. Options include forcing the machine to inhibit on a fault and thus force the user to interact to clear the fault. The user can also chose whether or not the fault is displayed on the screen.

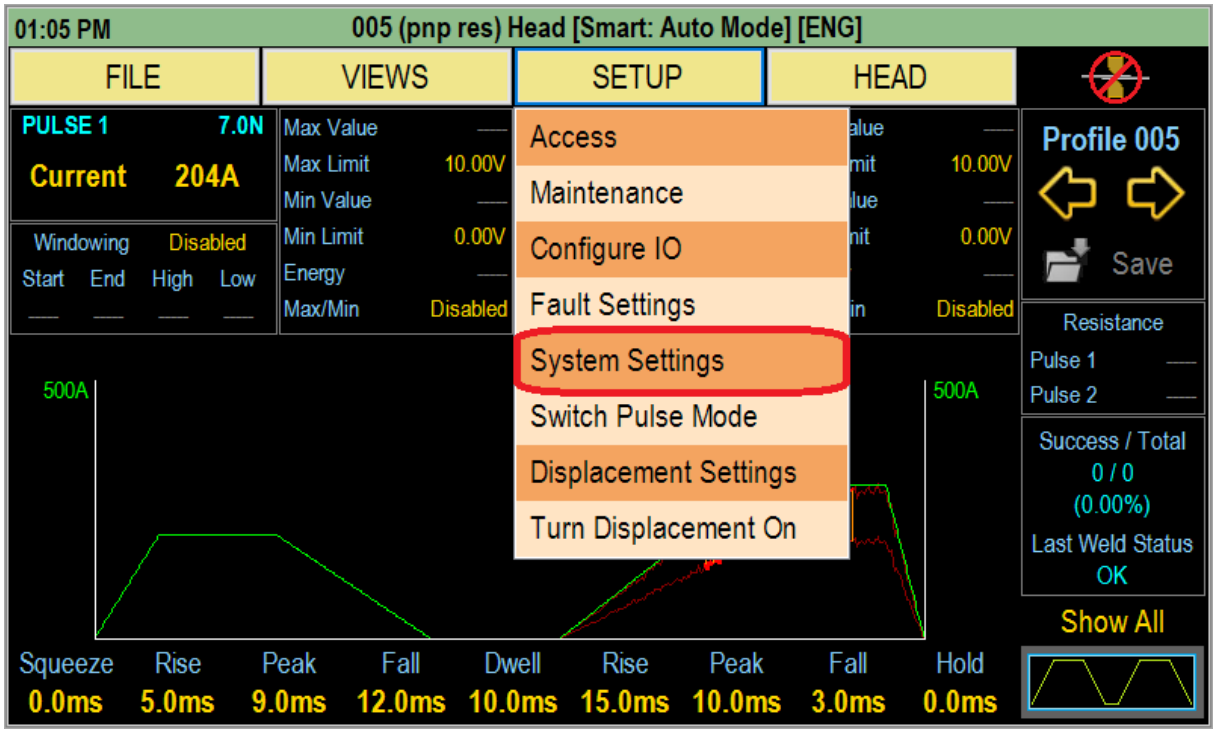




Fault signal timing determines how long a fault signal output is asserted. The timing is triggered from the end of the weld. In the case of a high limit fault, the end of the weld occurs when the fault occurs as the weld is terminated.

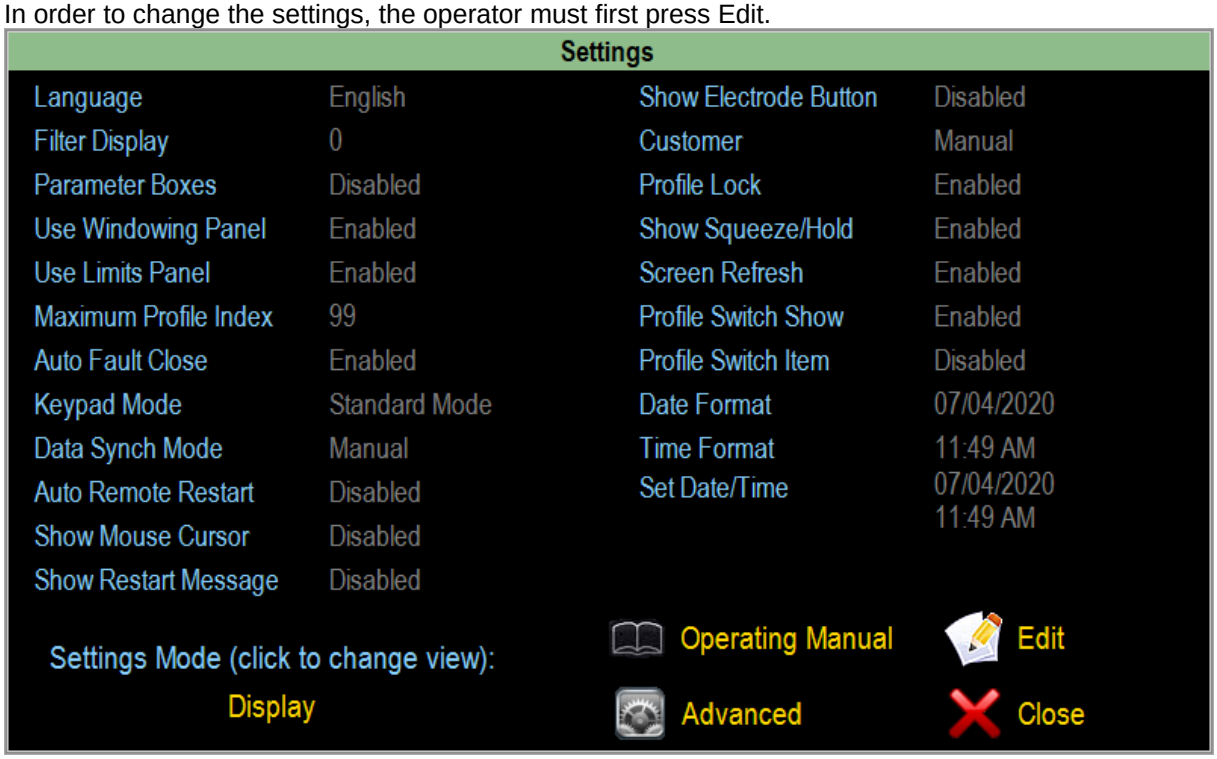
5.20 System Settings

Under the SETUP drop down is the System Settings menu. Here the user can configure global settings for the machine.



5.20.1 Display Settings

In order to change the settings, the operator must first press Edit.

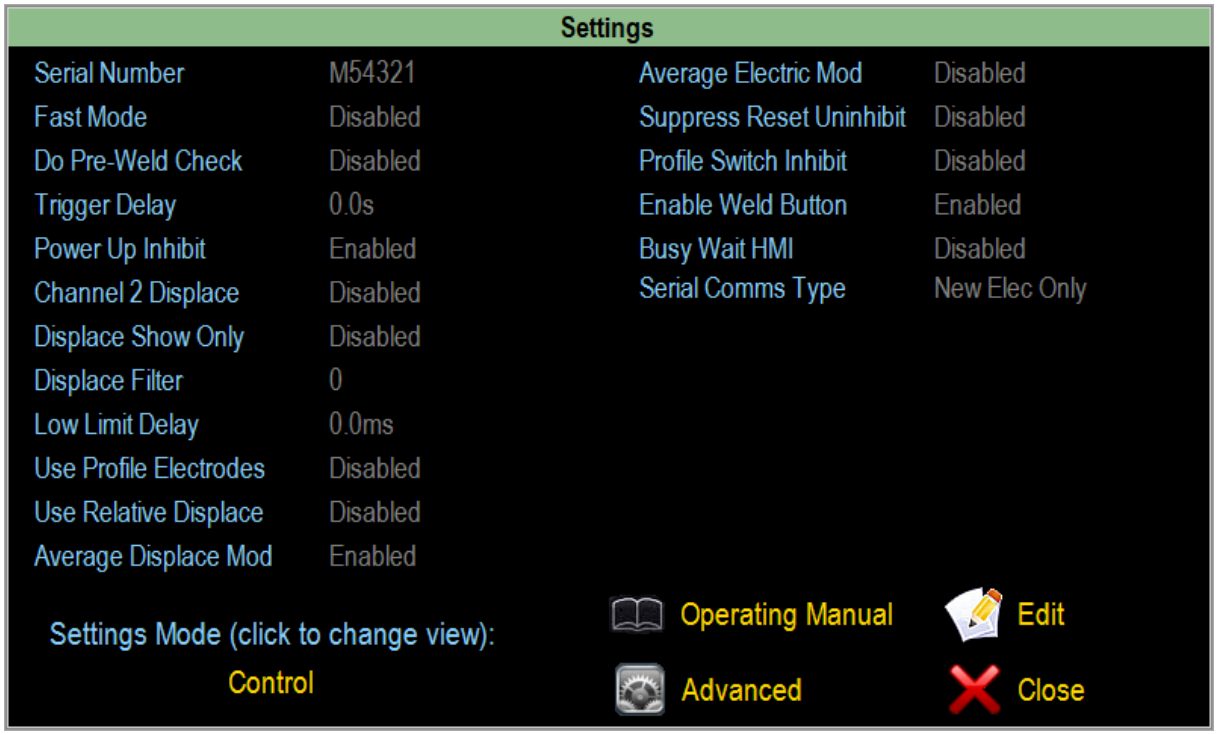


Language	Select the preferred language for menus.
Filter Display	This is a sampling average number which is applied to the real-time feedback trace on the graphical display during welding. The number can be between 0 and 20 and determines the number of samples used for each trace point. This has the effect of significantly smoothing out the trace.
Parameter Boxes	Toggles highlight boxes on/off around the key adjustable parameters.
Use Windowing Panel	This enables/disables touch sensitivity throughout the windowing panel. When disabled, only the yellow text is sensitive. When enabled a separate window is shown.

Use Limits Panel	This enables/disables touch sensitivity throughout the limit parameters. When disabled, only the yellow text is sensitive. When enabled a separate window is shown.
Maximum Profile Index	This number simply restricts the scrollable memories available from the two arrow keys on the profile select area. Upon reaching the number, the scroll feature will wrap around. The maximum value is 99.
Auto Fault Close	When enable, this will automatically clear any fault screens upon execution of a faultless weld.
Keypad Mode	Toggles between standard calculator style numeric entry or right-justified numeric entry.
Data Synch Mode	This is a setting that allows the bypassing of the data synchronisation screen (transfer from controller to display or the opposite direction). In normal running this is set to manual, meaning that the user has to choose which action to take. However, this setting allows the user to choose which direction the transfer occurs automatically, so the screen with the choice is not shown.
Auto Remote Restart	Toggles whether the remote display program restarts itself periodically.
Show Mouse Cursor	Toggles whether the mouse cursor/pointer is shown or hidden.
Show Restart Message	This setting allows a message to be displayed showing the most recent restarts of the HMI. This also causes an RS232 message to be sent out by the controller.
Show Electrode Button	This setting allows the user to show the capture electrode button on the recent welds screen (displacement machines only).
Customer	This setting allows configuration of access levels for menu or window items. See the ‘Customer Configuration Files’ section for details.
Profile Lock	This setting enables constraints on which values/screens operators can access or modify. This is an extension of what was previously termed ‘Operator Mode’. See section 5.16.3 for more detail.
Show Squeeze/Hold	This setting either shows (enabled) or hides (disabled) the squeeze and hold time settings on the main screen.
Screen Refresh	Toggles the screen refresh function upon welding. Redrawing the screen with the last set of weld data information takes around 200ms. For some high-speed manufacturing lines, this time can be critical. Turning off screen refresh stops the screen from redrawing if the profile used to weld is different from the one being shown. This allows the machine to be triggered at a faster rate.
Profile Switch Show	When this setting is enabled, every time the profile is switched a list is shown of associated documents, images and notes. This gives the user the ability to ensure that the operator is reminded of important information when the switch is made. Any item from the list can be viewed in detail.
Profile Switch Item	When this setting is enabled, then instead of a list of associated documents a single item is shown when the profile is switched. The specific item can be chosen from the list shown when the ‘Profile Switch Show’ setting is enabled.
Date format	Changes the date format
Time format	Changes the time format
Set Date/Time	Allows the system date and time to be set.

5.20.2 Controller Settings

Pressing the 'Display‘ setting changes to the controller-specific page.

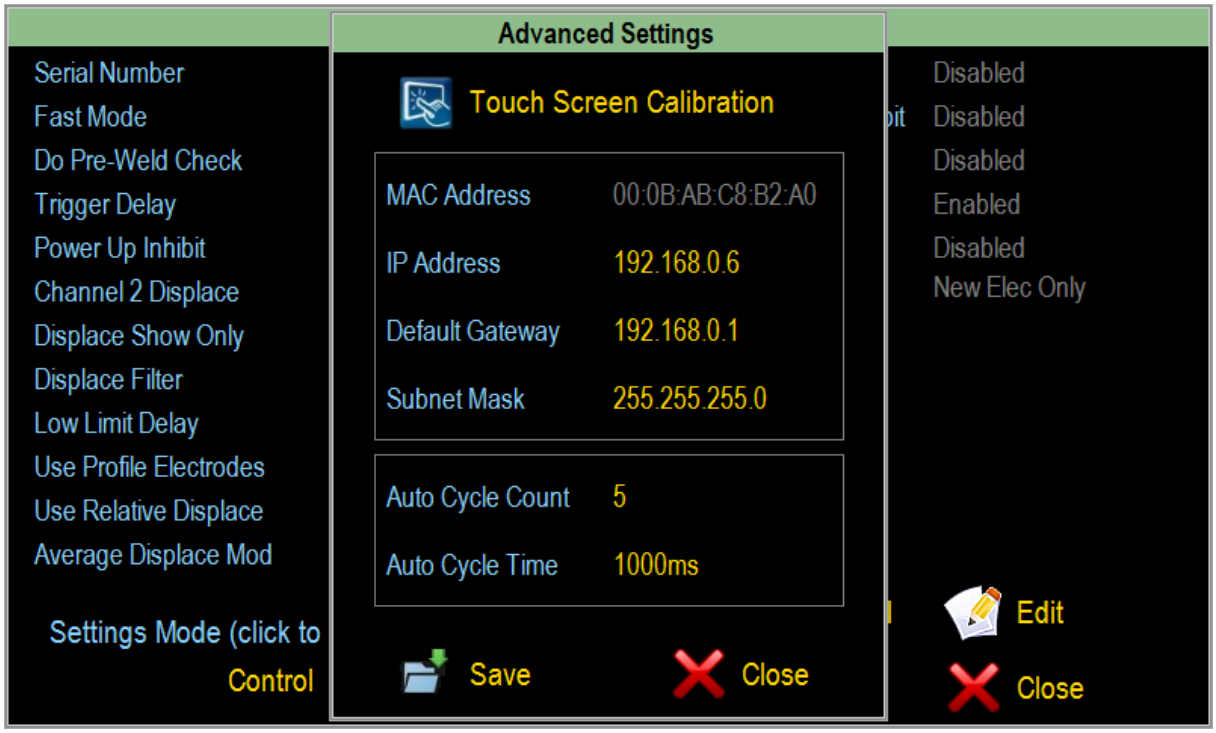


Serial Number	On this screen the serial number is shown as a read only value.
Fast Mode	This disables all weld feedback reporting from the controller when welding. This saves some processing time which can be critical in very high-speed automation applications.
Do Pre-Weld Check	This function checks that the voltage sensing leads are in place prior to welding. When enabled, an error is given if the leads are not detected.
Trigger Delay	Applies a delay in seconds between a weld trigger and the actual initiation of the weld profile.
Power Up Inhibit	When enabled, the unit will always power up with Weld Inhibit on. Usually for automation, this will be disabled.
Channel 2 Displace	This allows the addition of a second channel of displacement, so a single weld is actually sent simultaneously to two heads with feedback from two separate encoders.
Displace Show Only	This is a setting that allows all displacement faults (pre-weld and mid-weld) on all profiles to be ignored. If enabled, it only remains active for the current power cycle then is automatically set back to disabled. Note: this should only be used for testing scenarios.
Displace Filter	This is a signal smoothing filter applied to the displacement trace. It is applied to the source signal within the controller.
Low Limit Delay	The low limit electrical fault is checked for over the duration of the peak period during a weld pulse. This setting adds a delay at the start of the peak period before the fault is checked for. If the setting is non-zero, then the measured minimum value on the main screen is shown in red instead of blue.
Use Profile Electrodes	If this is enabled, then the electrode values are set on a per-profile basis (i.e. one electrode setting per profile). If this is disabled, then the electrode values are on a per-weld head basis (i.e. one electrode setting per head). The maximum number of different weld heads is 6, but the maximum number of profiles is 100.
Use Relative Displace	If enabled then displacement feedback in log files shows values relative to the electrode value rather than absolute.
Average Displace Mod	If enabled, then the average total displacement is monitored and if it goes out of range the peak demand is automatically modified. See Average Displacement Modification (section 5.17.1) for more details.

Average Electric Mod	If enabled, then the average electrical signal is monitored and if it goes out of range the peak demand is automatically modified. See Average Electrical Modification (section 5.17.2) for more details.
Suppress Reset Un…	If this setting is enabled, then asserting the remote reset input will not affect the welder inhibit status. If disabled, remote reset uninhibits (turns OFF inhibit) as normal.
Profile Switch Inhibit	If enabled, then the welder is inhibited when changing profile.
Enable Weld Button	If this setting is disabled, then the hard weld button is also disabled. If enabled, the weld button works as normal.
Busy Wait HMI	If this setting is enabled, the real time controller will hold the busy signal on until the HMI has fully started (main screen shown).
Serial Comms Type	The unit supports various RS232 data formats which have evolved historically. Each format contains different amounts of weld profile and weld feedback information. Choice sometimes depends on data transfer time. Contact technical support at Amada Weld Tech UK Ltd for more details.

5.20.3 Advanced Settings

Pressing the Advanced button on the settings screen provides a number of further options as shown below.



Here the touch panel calibration can be set using a simple program. This ensures screen presses are accurate. After pressing the target a few times, wait until the program timeout and returns back to this menu.

This screen also makes provision to setup/change the machine IP address on an Ethernet network, and shows the MAC address of the Ethernet device on the welder.

The auto cycle system is accessible at the bottom of the window. This feature should be used with caution as setting a rapid auto cycle could damage the unit. The two user adjustable variables are Count and Time.

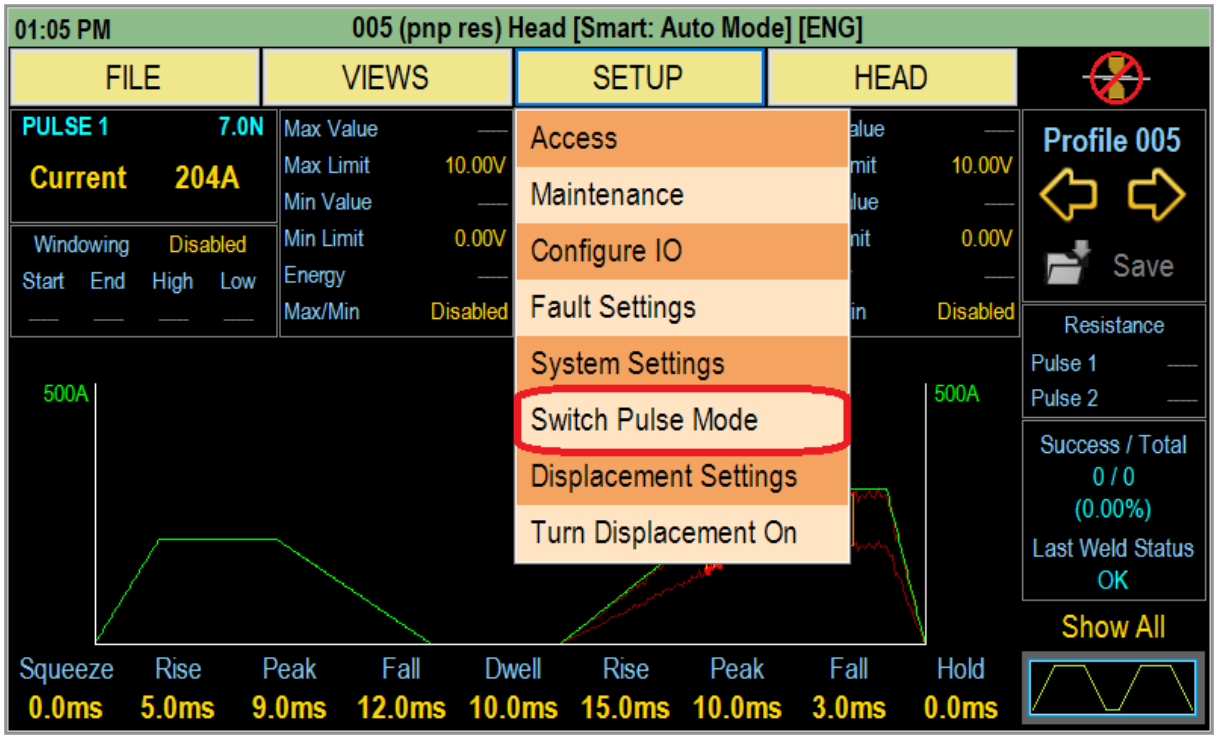
The Count specifies the number of automatically triggered welds that should be performed.

The Auto Cycle Time is the auto trigger rate in milliseconds.

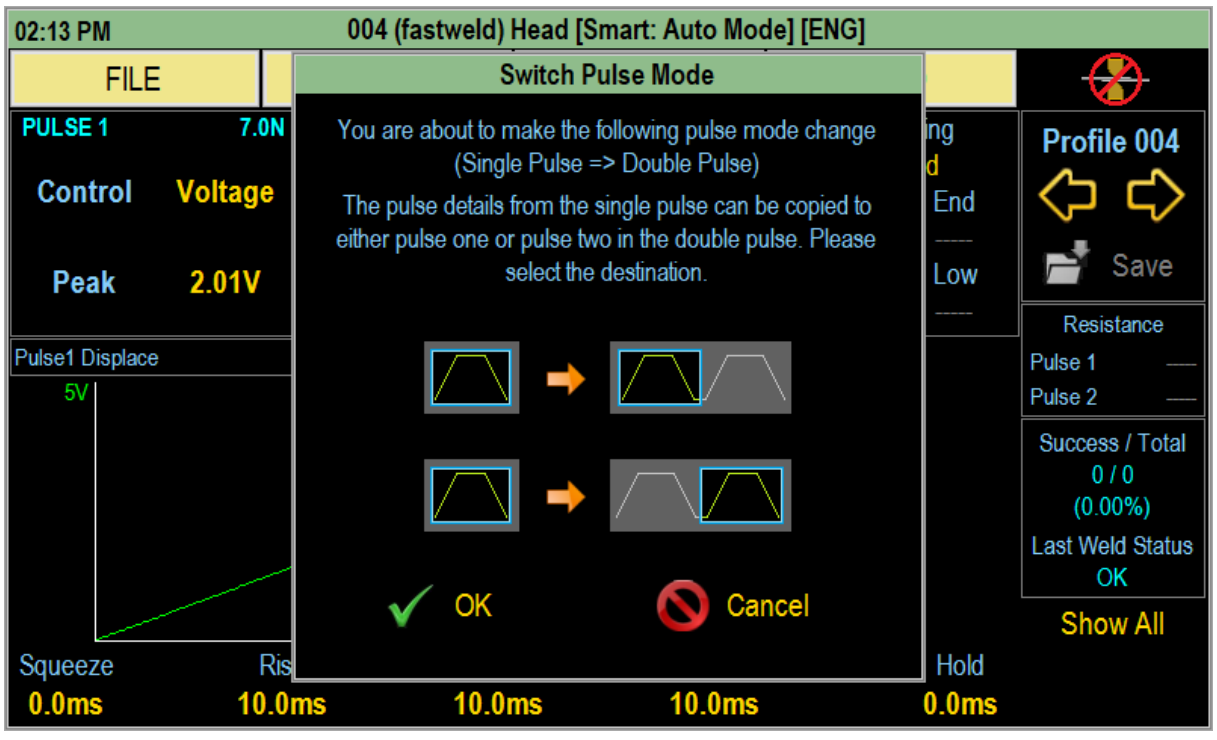
With the Cycle count set to anything above zero, the machine will begin auto triggering upon receipt of the first trigger, either from the rear panel OR the weld button. Making any further change causes auto cycle to stop. (Inhibiting also stops auto cycle.)

5.21 Switch Pulse Mode

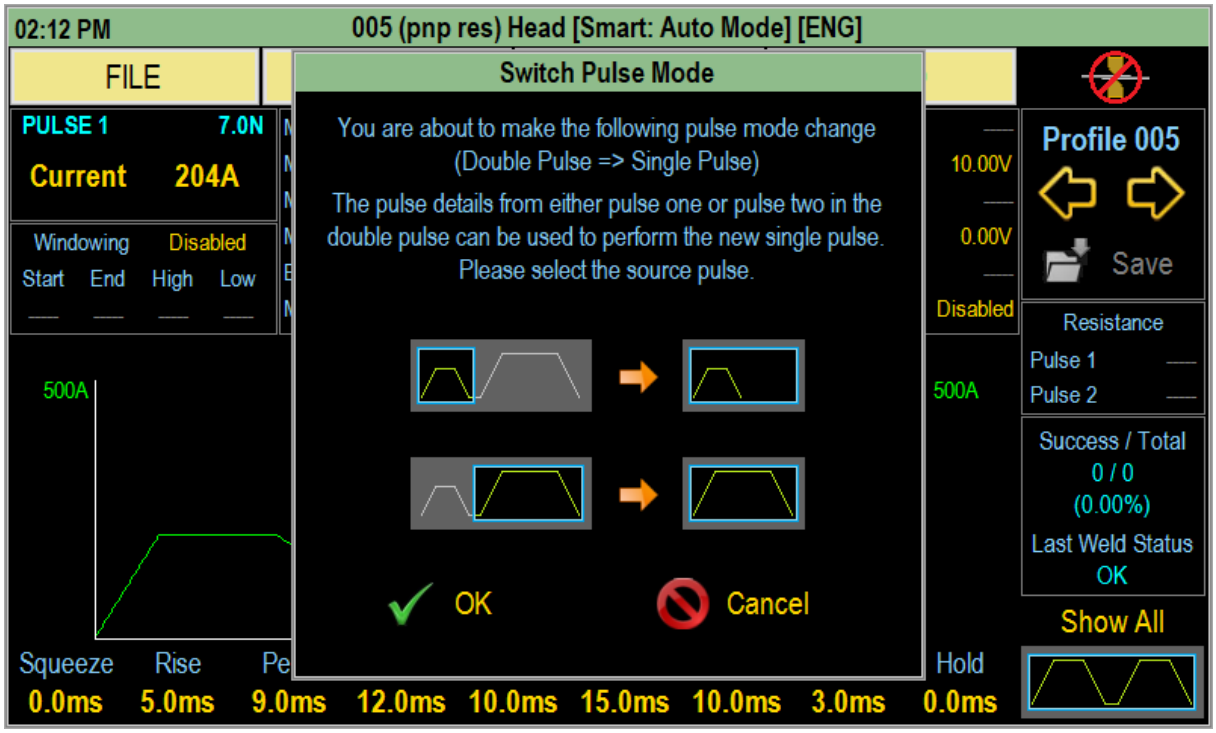
Under the SETUP menu is the ‘Switch Pulse Mode‘ option. Selecting this button reveals the single pulse or double pulse options screen.



When changing from single to double pulse mode, the user is offered the option of where the existing pulse data will be used.



Conversely, when changing from double to single pulse, the user determines which existing pulse data will be used in the single pulse. This is useful when assessing the benefits of a one or two pulse weld, since the primary welding pulse information can remain available.



6 Configuration

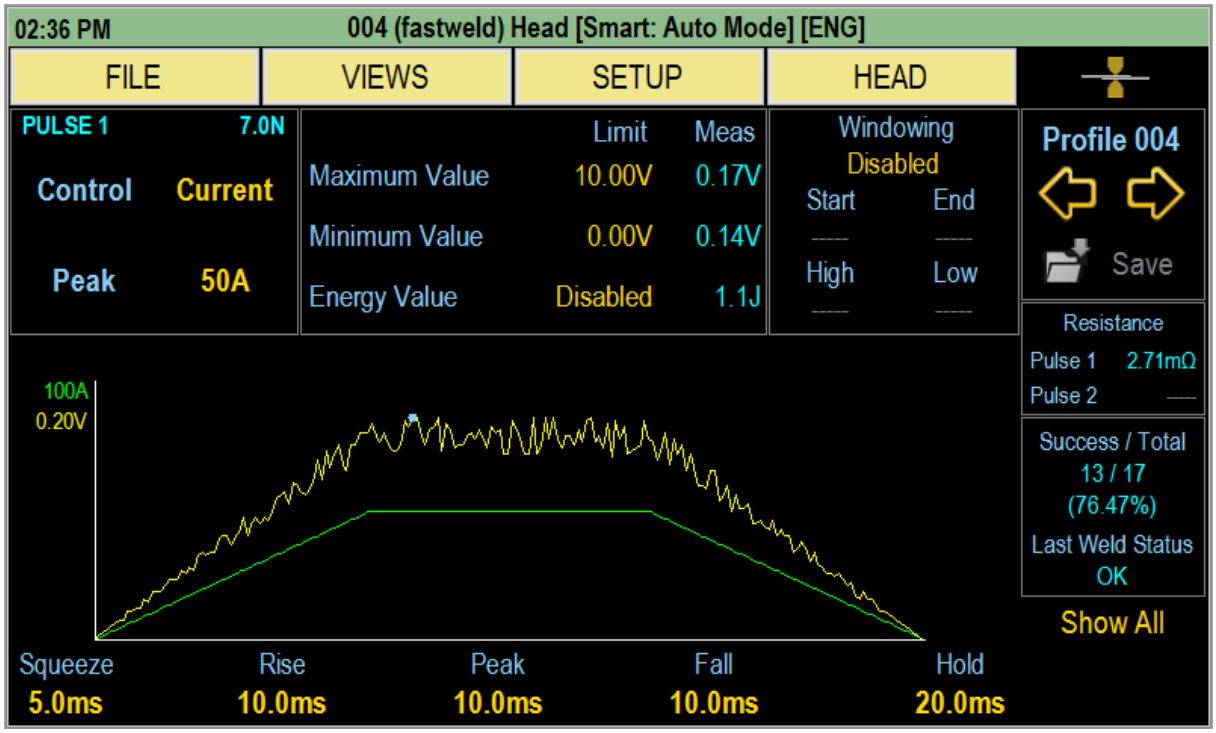
6.1 Welding Profiles

Welding profiles are most easily defined through the graphical interface. Once the desired profile settings of pulse mode, demand level and time parameters have been set, the profile should be saved. In the process of saving, it is advantageous to rename the profile to something with application meaning.

If required, additional welding profile information such as application use or external settings can be added to the profile. This is done using the text summary under Views | Profile Details | More.

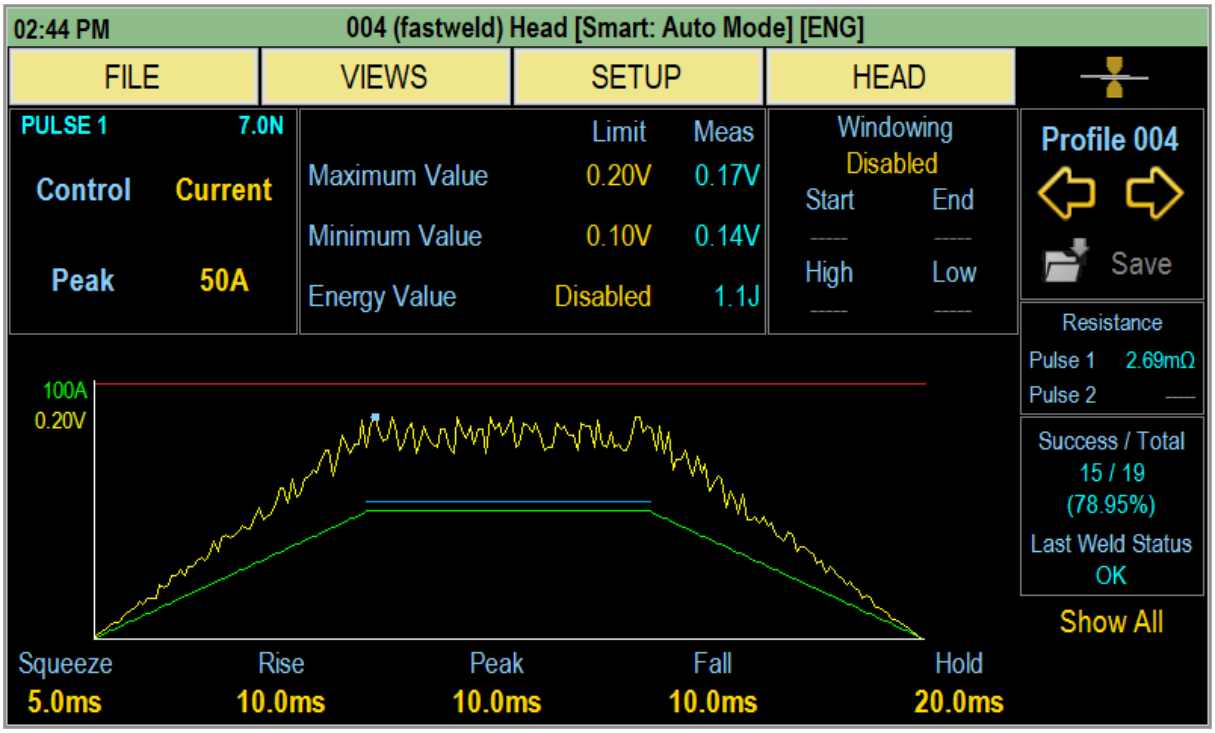
Establishing a new welding profile is generally an iterative process of trial and error, with the aim of finding settings that will be broadly tolerant of process variables, such as electrode wear.

The graphical screen provides an intuitive way to visualise the welding process in electrical terms. The image below shows a basic setup running at 50 amps. The power supply will control its output so that the current rises to 50 amps in 10ms, holds steady for 10ms and then ramps down for 50A to zero, in 10ms. While this controlled process occurs, the uncontrolled electrical parameter (in this case voltage) is free to change in accordance with the circuit resistance and the controlled current. This is the trace shown in yellow, and is generally referred to as ‘feedback’. The peak point on the trace (0.17V) is highlighted using a blue dot. The lowest voltage during the ‘peak‘ time is 0.14V, and the total energy dispensed was 1.1J.



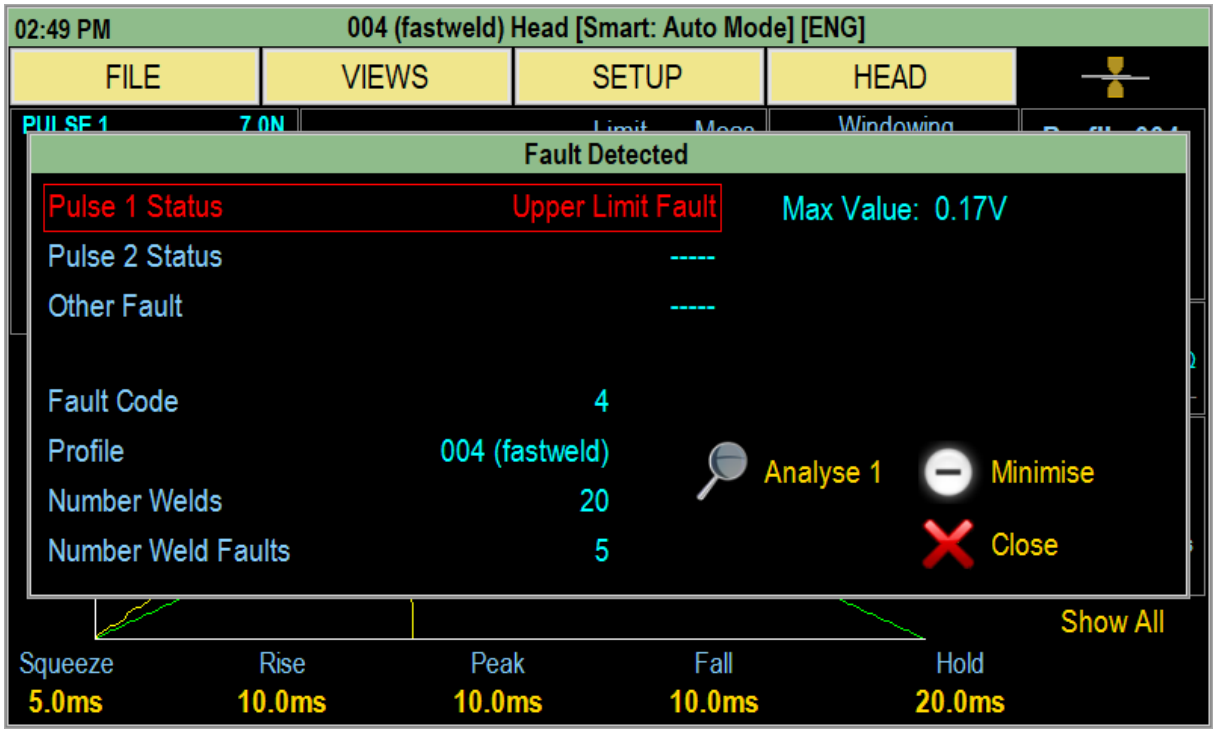
6.2 Basic Process Limits

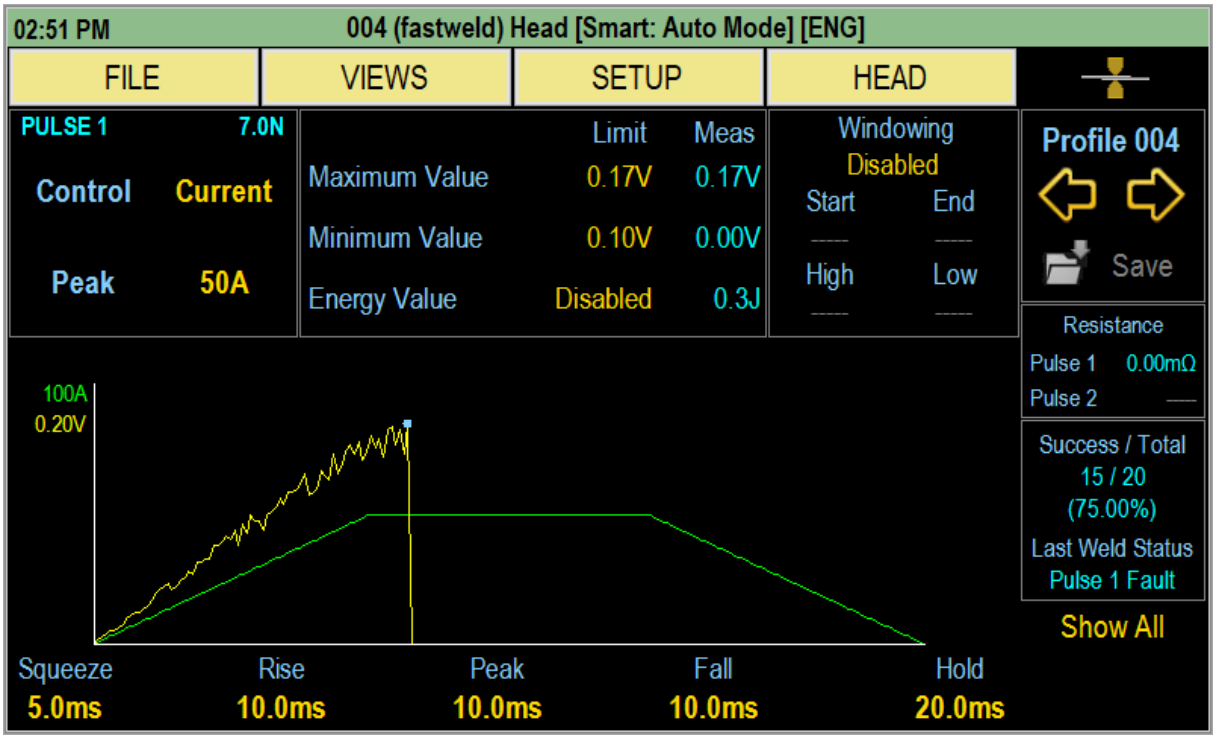
From the above screenshot, we can see the basic limits for the process are set to an upper value of 10V and a lower value of 0V. Given that the process is measuring around 0.15V, we can consider applying some more meaningful process limits based on these measurements.



The high level limit is now set to 0.2V and will apply for the entire duration of the weld pulse (shown in Red). The low level limit of 0.1V is applied only during the Peak time of the weld, shown in Blue. Using the Fault Settings screen, we can force the machine to detect and flag excursions beyond these basic limits.

The following images show what happens if the process limits are too close to the actual values. Here the upper limit is now set to 100A with the weld being performed in voltage mode. When the limit fault occurs, the machine shuts down the output in order to prevent electrode or product damage. The first image shows the fault being reported; the second is the same but with the fault report closed and shows where the weld was terminated.

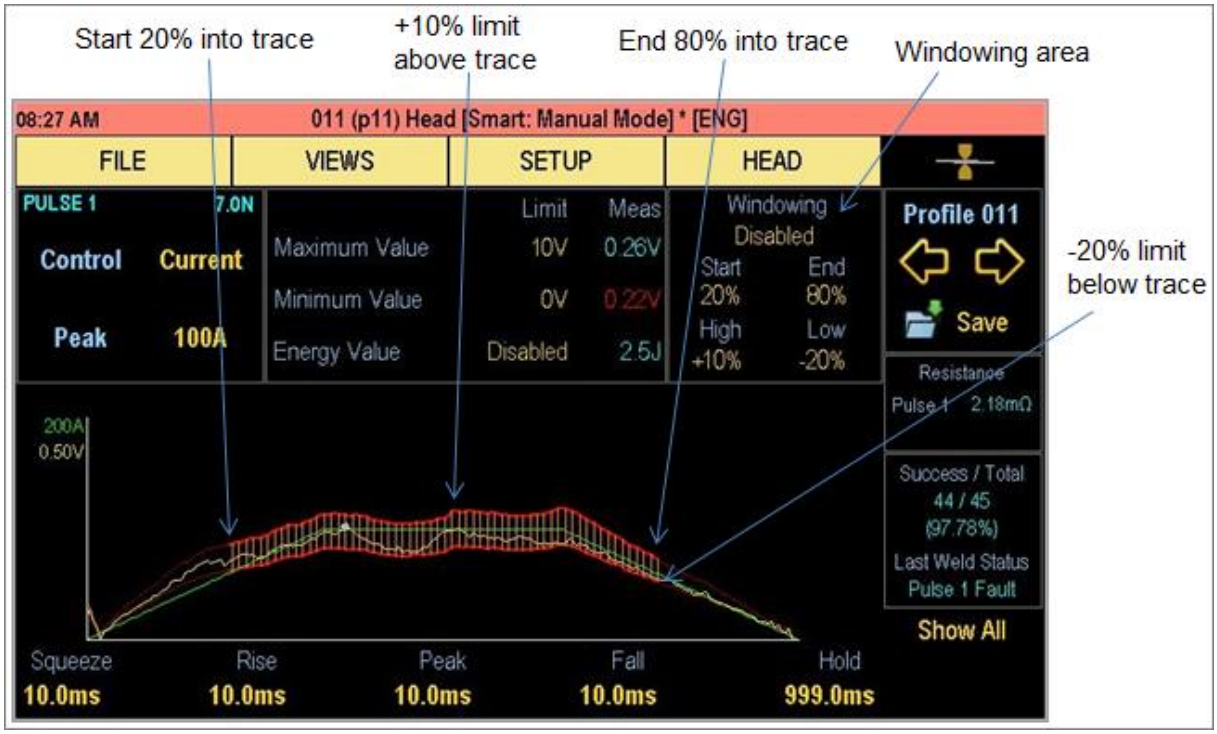




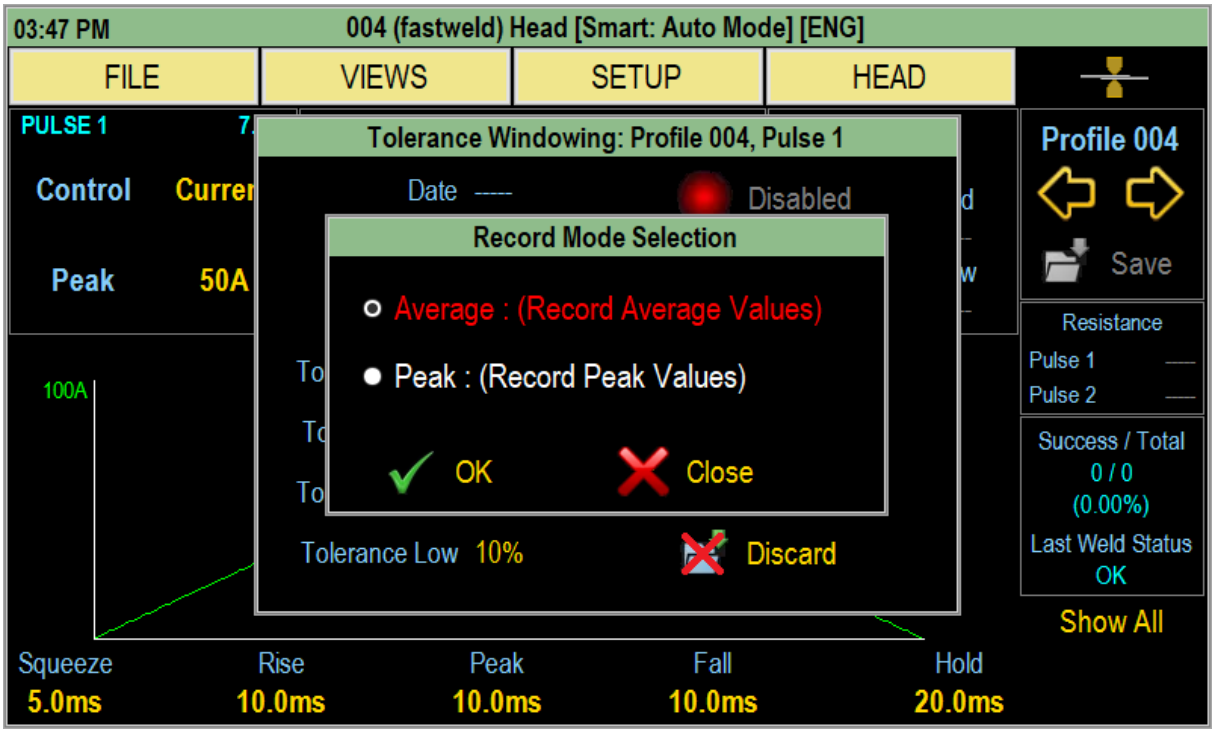
6.3 Windowing Process Limits

A more advanced method of process limiting is through windowing, also referred to as tolerances. With this method, a typical feedback trace is recorded and stored against the profile. This data is used as a template against which to judge further weld feedback traces.

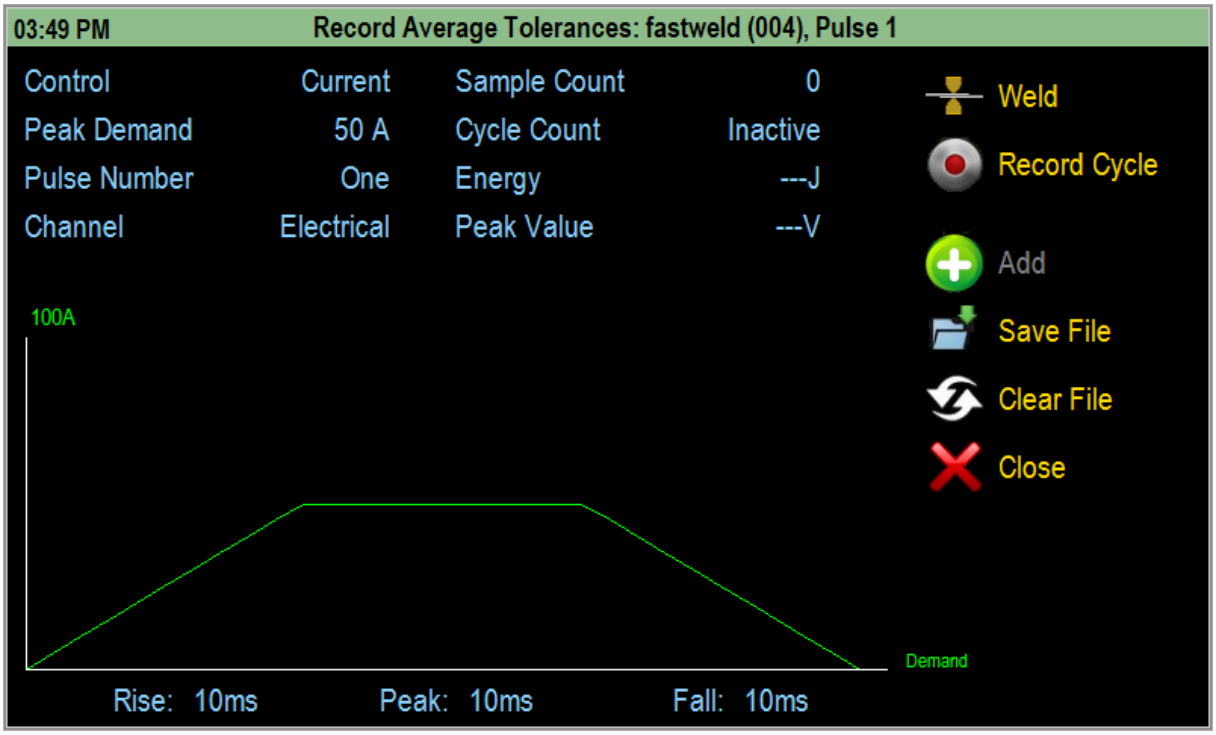
An allowed tolerance above and below the typical trace is specified, together with a start and end point through the trace. These are shown in the image below.



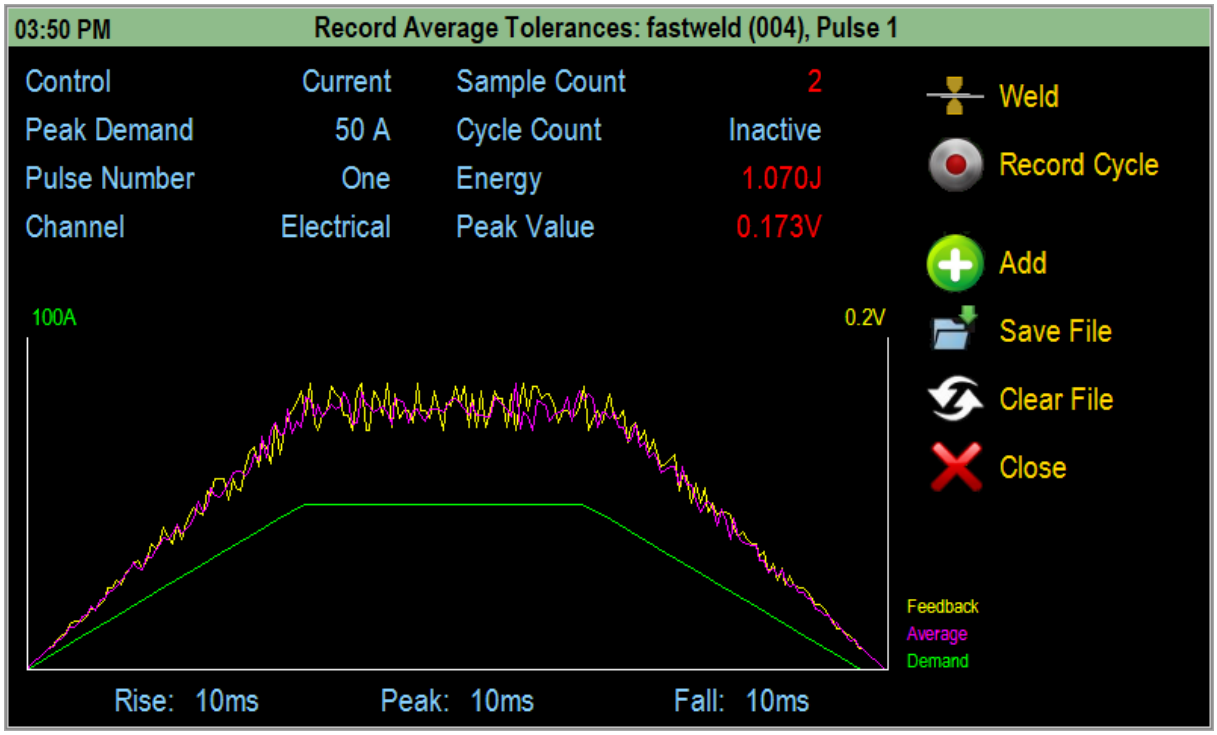
In order to setup windowing such as this, we must first record the typical process trace. To do this, press the windowing area in yellow, then press Record.



Typically, limits are recorded as an average although it is possible to select peak recordings only. Having chosen the recording method, average or peak, the screen below is shown.

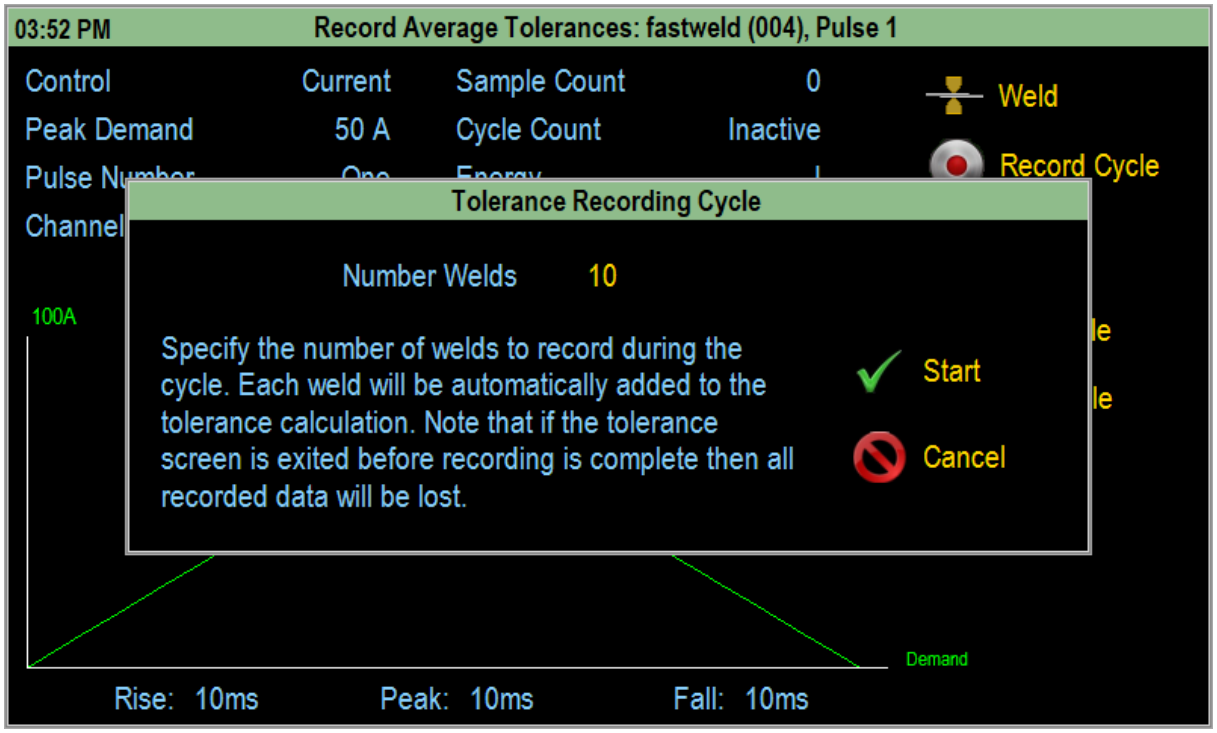


To start recording, simply start welding. As each weld takes place, the trace is shown and assuming there are no errors, the trace can be added to the average by pressing the Add button. As waveforms are added, an internal file is generated which is associated with the profile.



Once sufficient samples have been taken, press Save File and then Close the window, by pressing Close.

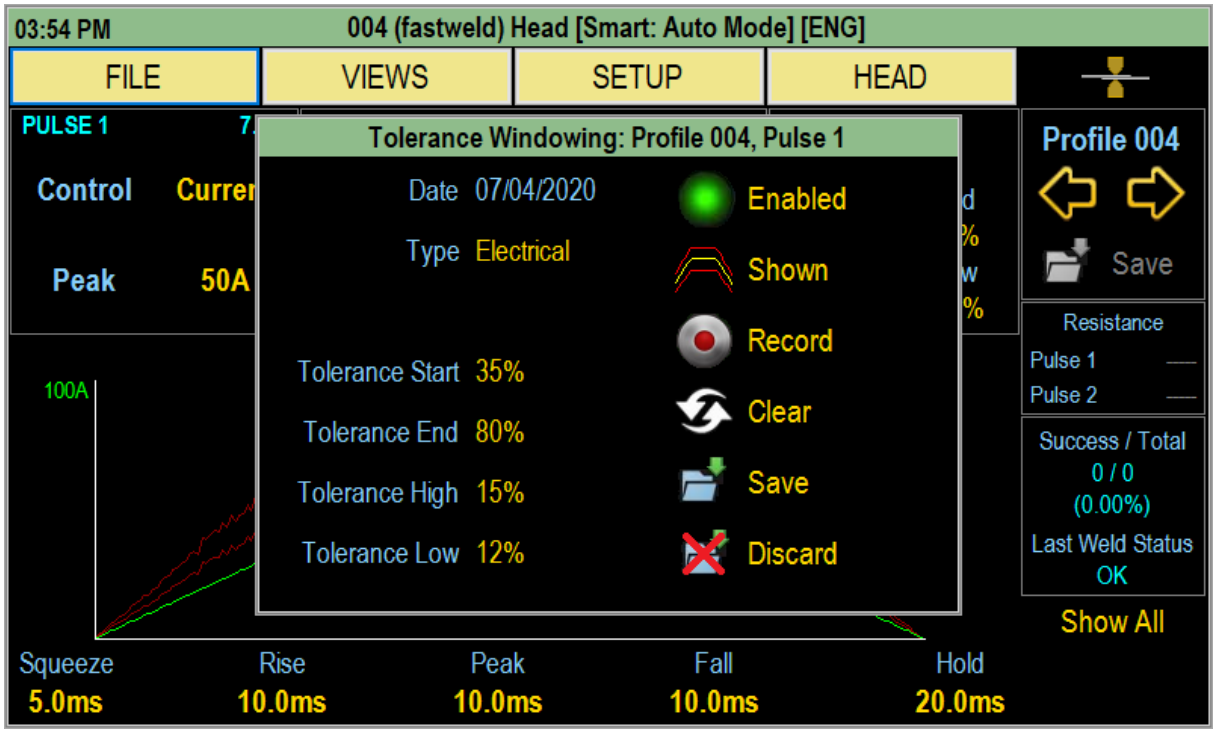
The unit can automatically record a series of welds when in automatic triggering mode by specifying the number of welds for a given recording cycle. This assumes that all the welds will be of sufficient quality to add. To initiate this, press the 'Record Cycle‘ button:

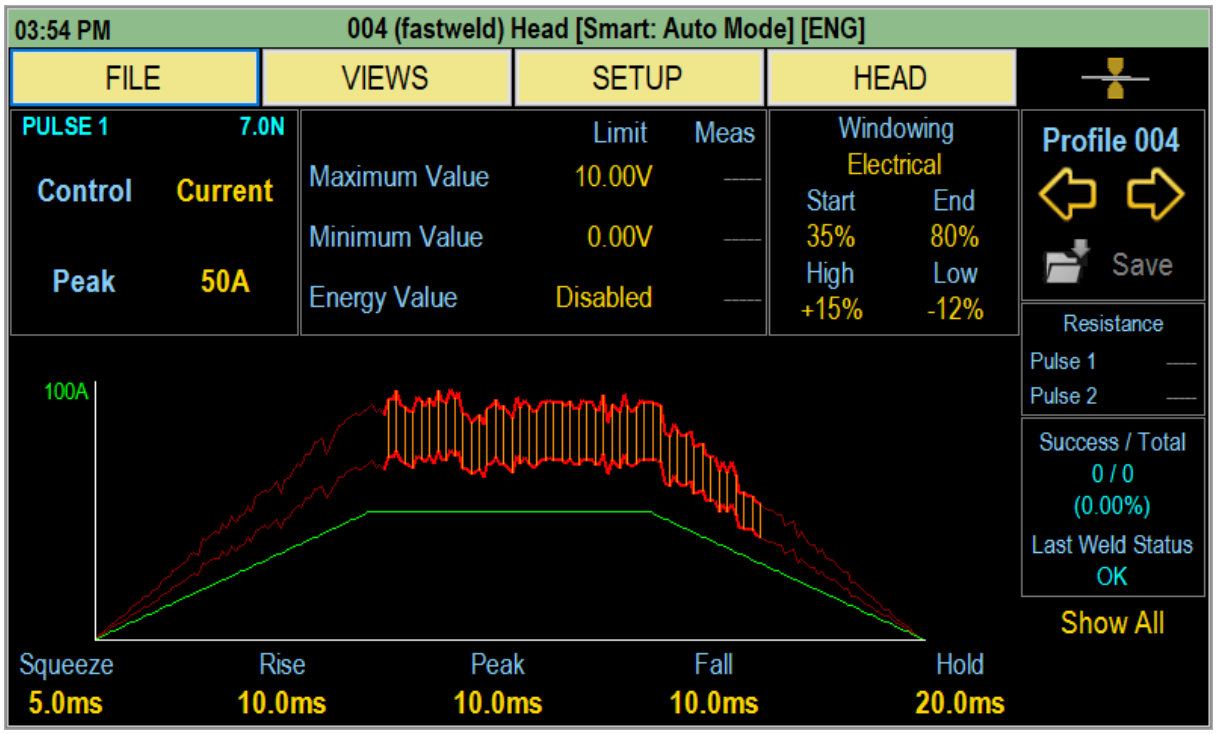


Once the process trace has been recorded and the screen closed, the Tolerance Windowing screen allows the user to define how that data is applied to the profile in real time using the following settings:

- **Enabled/Disabled** – This determines whether or not an excursion outside of the limits actually signals a fault

- **Shown/Hidden** – This setting toggles whether or not the limits are shown on the display graph. The limit information can be shown on the screen as a reference only, by Disabling Limits and Showing the trace.
- **Clear** – Clears the recorded limit data
- **Save** – Saves the limit setup (and profile) and closes the screen
- **Discard** – Discards any changes and closes the screen
- **Type** – If the machine is configured with displacement, windowing can be setup to operate on either the electrical or displacement feedback. This setting changes between the two modes.
- **Start/End/High/Low** – adjustable parameters as shown above



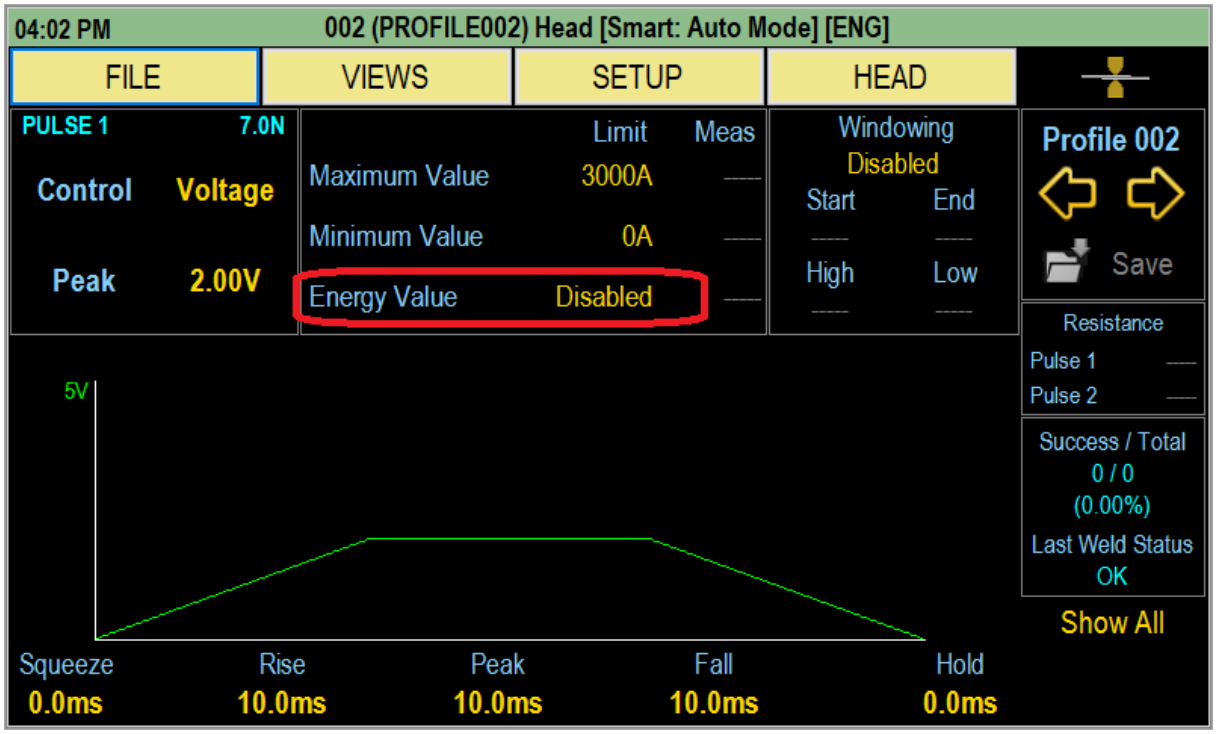


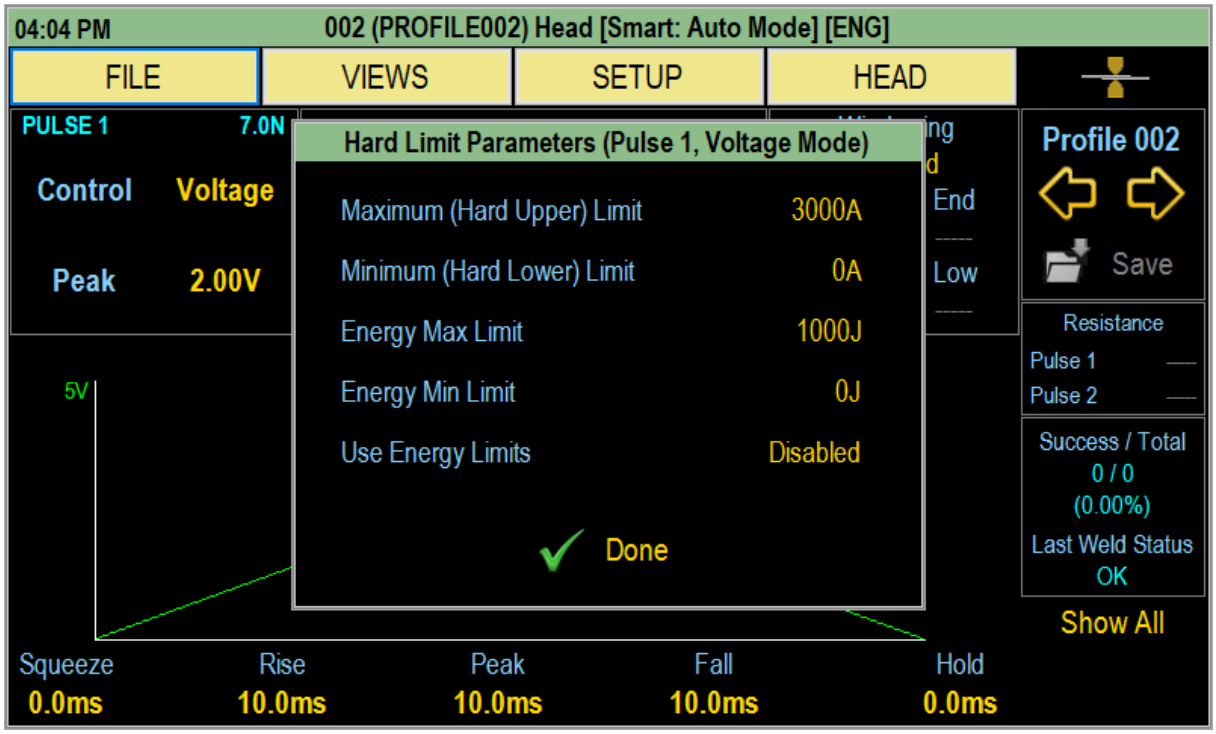
The windowing process control feature is best implemented once a stable process has been established so as to avoid nuisance tripping. In all cases, the maximum and minimum hard limits will prevail.

A useful feature of the system is that windowing traces can be recorded and displayed, but not used to trip on error. This therefore provides a useful reference comparison against a live trace.

6.4 Energy Process Limits

The welding machine measures overall welding energy. With a stable process, this energy level should also be stable. Since energy is related to time, the energy value is available post weld and can be used as a further process parameter by which the machine can signal a potential process problem. Energy limits are turned on and off by the 'energy limit' touch area and can be assigned minimum and maximum values:





6.5 Statistical Process Control

The application of process limits and their tolerance band is very much dependent upon the individual process and quality assurance protocol. It is important to study the process over time and collate sufficient information to make an informed decision.

A great tool in understanding the process variation is Statistical Process Control (SPC). This mathematical process takes process values and calculates the statistical variation effects upon a normalised production process. From this, figures for likely limit excursions can be determined and hence, the probability of potential reject.

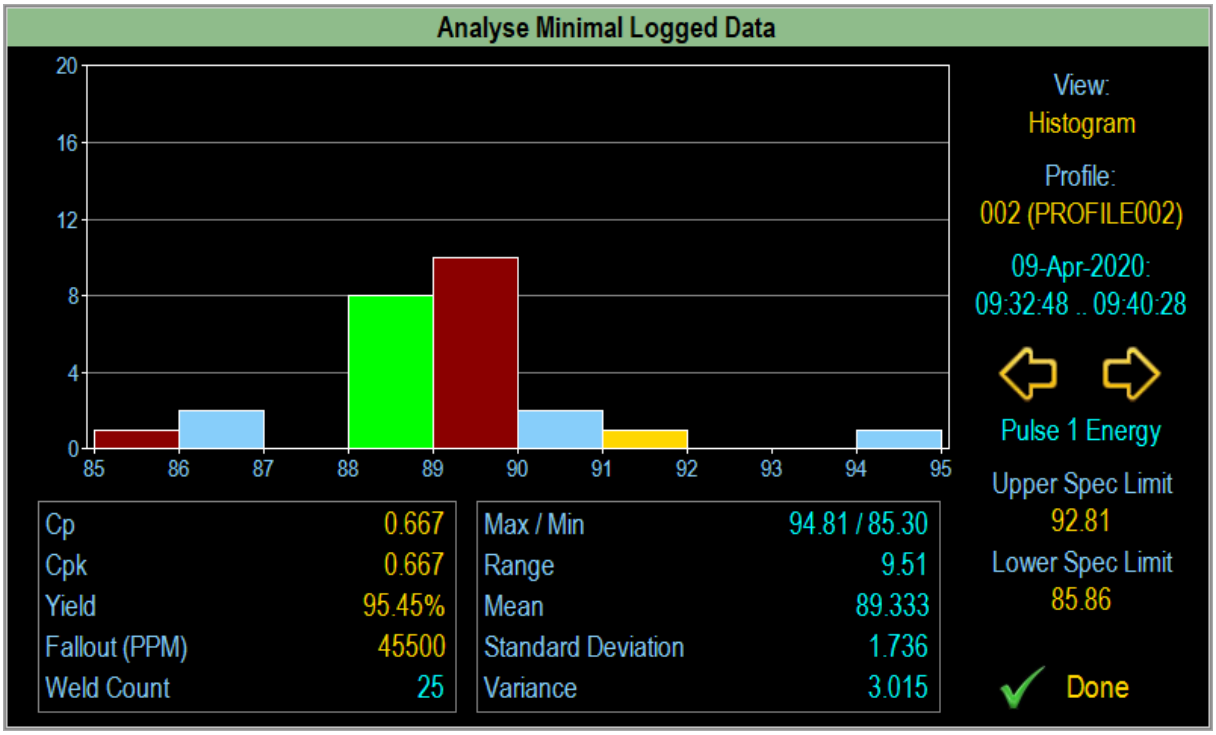
This powerful tool enables the process engineer a method to determine appropriate process limits under ideal or normal conditions. Thus, if fault outside of the predicted norm become prevalent, the system will flag a potential problem with the production process.

Detailed analysis of SPC data across a number of machines is best done using values stored in a centralised database. Such a database is available from Amada Weld Tech UK Ltd. Individual machines contain a subset of full analysis software and may be exercised to determine individual weld station variance.

To exercise SPC analysis, firstly SPC data logging must be turned on, welds performed, and then the SPC log analysed (see the SPC Log section).

6.5.1 Histogram View

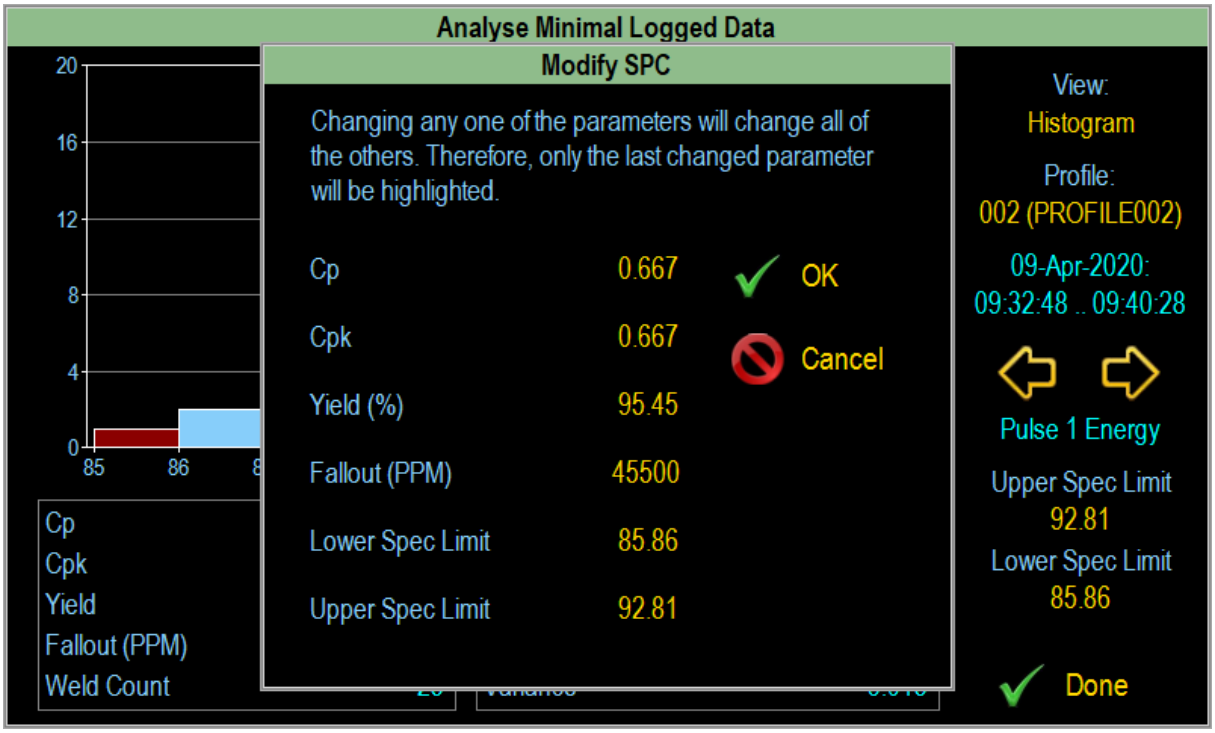
The example below shows the SPC analysis screen in histogram mode (default) for total pulse 1 energy with twenty-five data samples.



This provides the user with a full range SPC values and variables which are mathematically linked using SPC calculation criteria. By default, the histogram assumes upper and lower limits based on two standard deviations and computes the other information accordingly.

Crudely, based on the sample shown, the statistical analysis is suggesting that given an upper limit of 94.8J and a lower limit of 85.3 J, the yield will be 95.45%. Changing any of the variables will result in refreshed calculation, hence the operator is able to start making informed judgements as to how to setup the process limits.

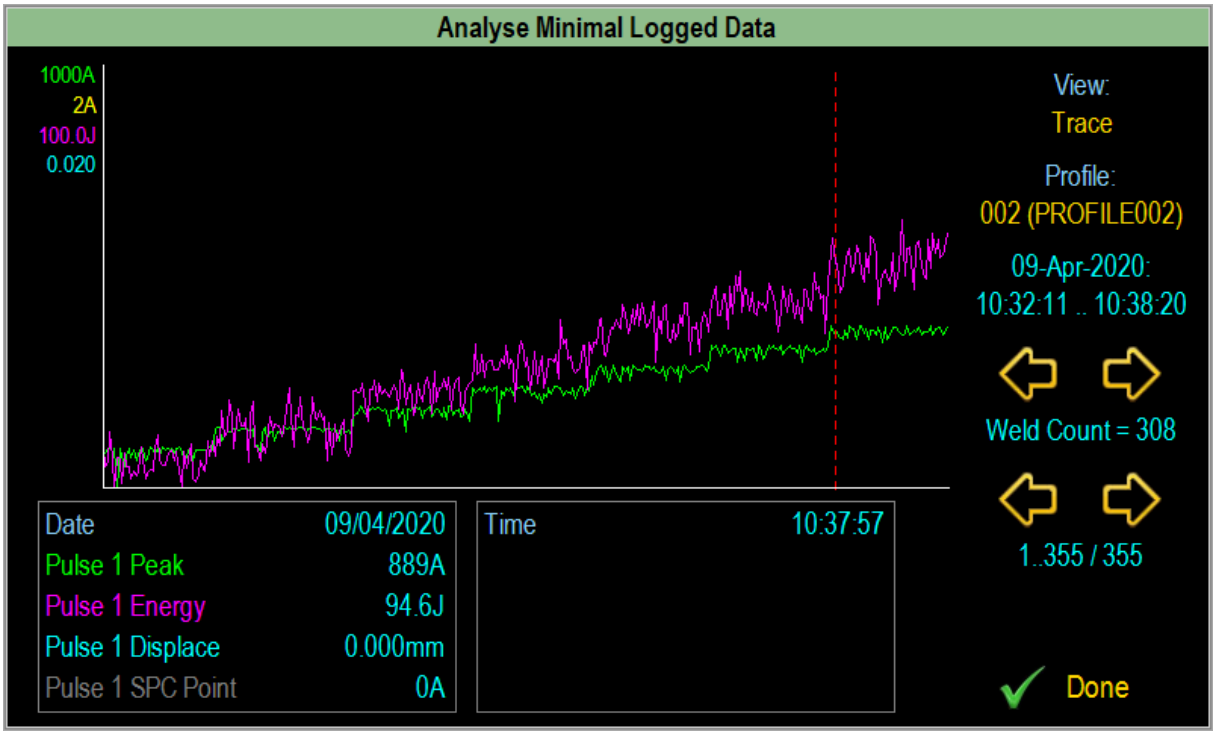
Since the aim is generally to derive appropriate process limits, the user is free to experiment with all variable values (shown in yellow) in order to see the effect on these limits. Tapping any of these shows the following screen:



Using the process variable arrow buttons, other process source information can be displayed.

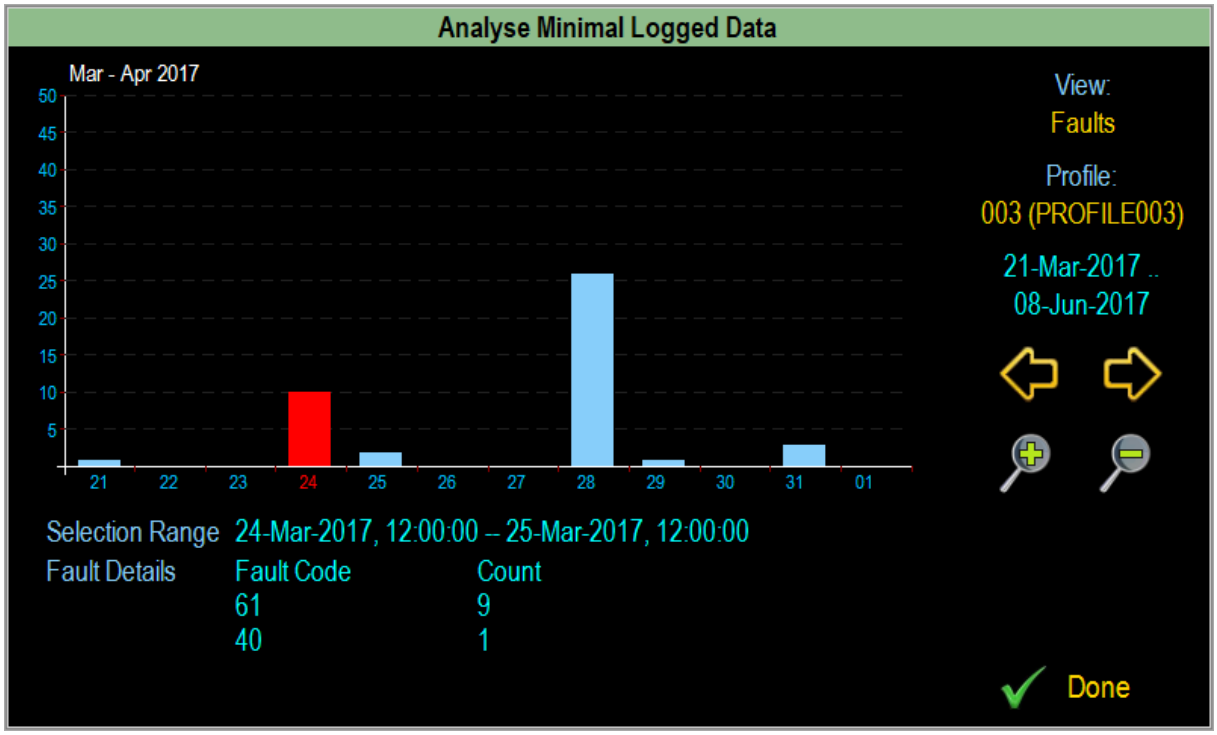
6.5.2 Trace View

In trace mode, the data points are shown collectively over time. This provides a graphical view of the general chronological trend of the data which can be useful in identifying when a process may have started to change.



6.5.3 Fault View

In fault mode, an analysis of when and where faults are occurring can be made.



It is possible to zoom in (and show faults per hour, minute or second) or to zoom out (and show faults per month or year).

All of data logged internally in the machine is also available as an output data stream via the RS232 and Ethernet ports. In addition, these data streams can also contain the profile setup information and the full weld trace data.

Amada Weld Tech power supplies operate as calibrated closed loop units with true process monitoring built in. As such, they can be considered as an accurate, calibrated measuring tool as well as a welding power supply.

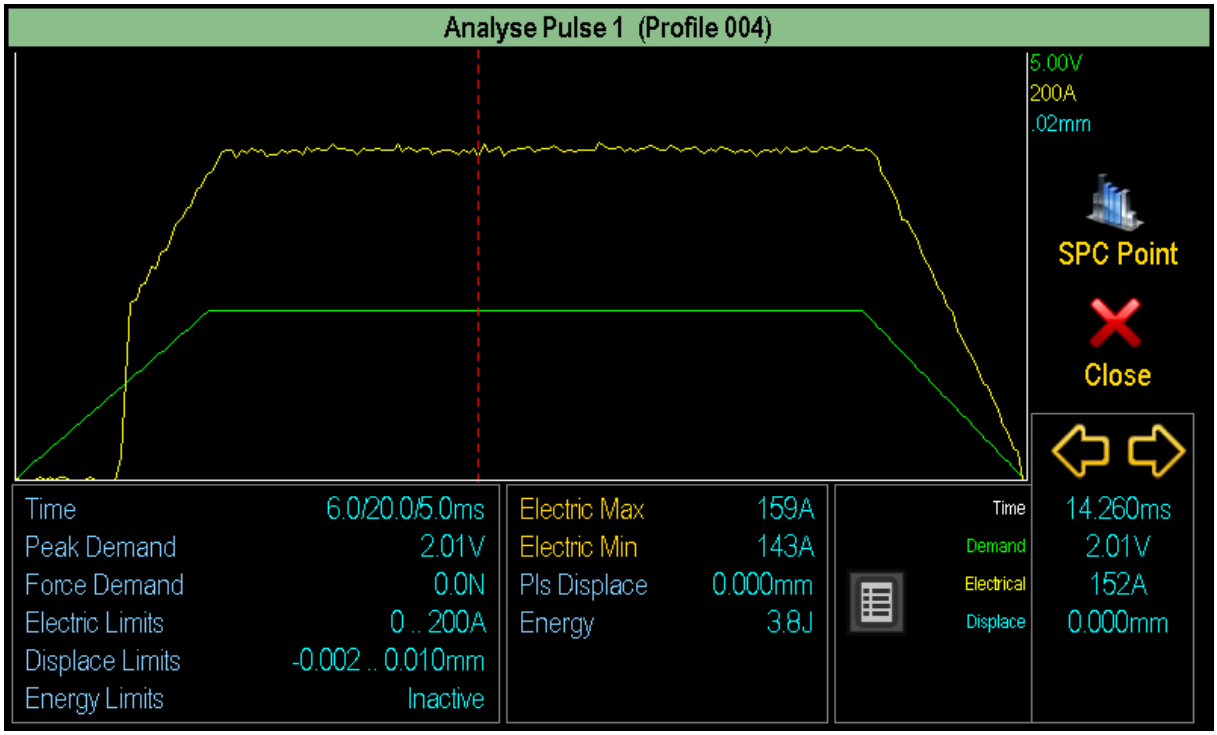
Using the remote-control features, it is possible to identify a wandering process and if needs be to make remote adjustments to the welding parameters to compensate.

Statistical process control is common place in the production arena and most companies adopt their own individual limits and methods when assessing process criteria. In a multi machine setup, the ability to compare and contrast SPC data from station to station can be particularly useful when trying to determine the point in a production line of greatest variation. The calculations and theory behind SPC are widely documented and are outside the scope of this document. Try https://www.moresteam.com/toolbox/statistical-process-control-spc.cfm

Amada Weld Tech UK Ltd provide a database collection system, providing the ability to manipulate large quantities of data as well as providing the central collection point for multiple machines. This is backward compatible for the Amada Weld Tech range, thereby facilitating SPC analysis on both old and new equipment. For more information contact Amada Weld Tech UK Ltd.

6.6 Pulse Analysis

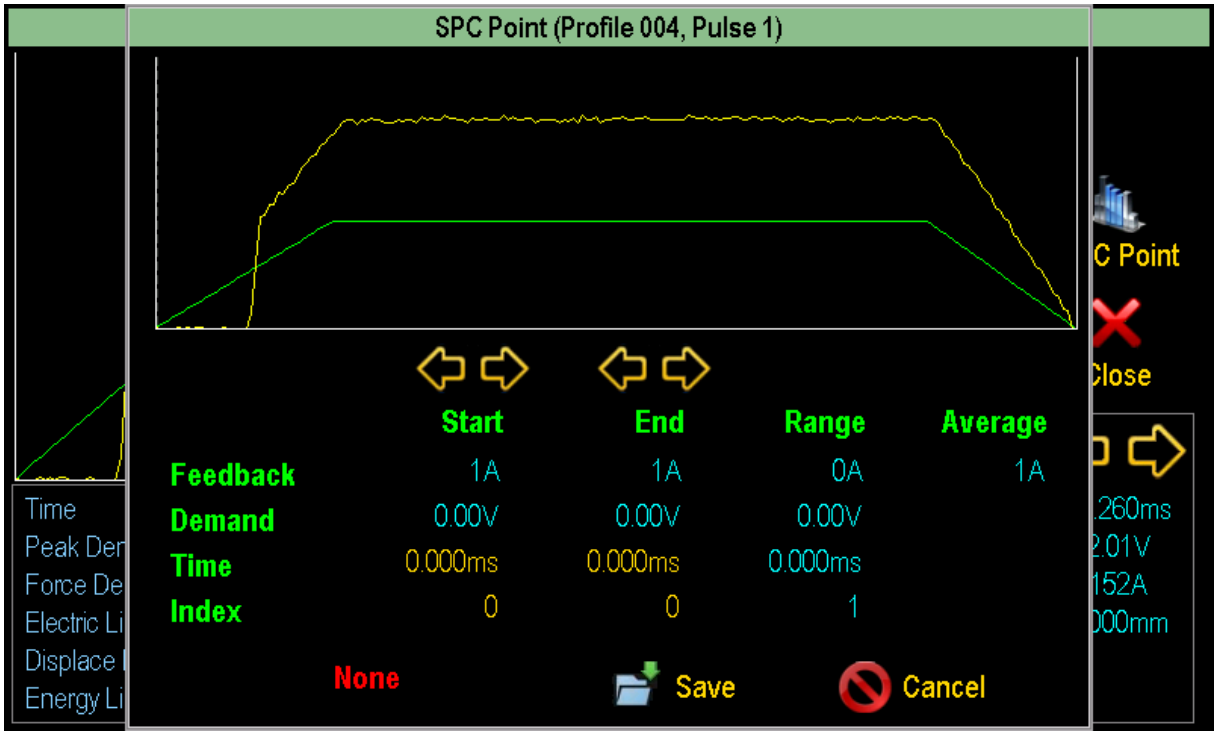
Following a weld, or when viewing a weld in the log file, double tapping the screen takes the user into an analysis screen which provides a larger trace and more information. Using the cursor keys or by tapping on the trace, measurements are shown for any recorded values at any point along the trace.



If required, a screenshot such as this can be recorded directly to internal memory OR directly onto a USB stick.

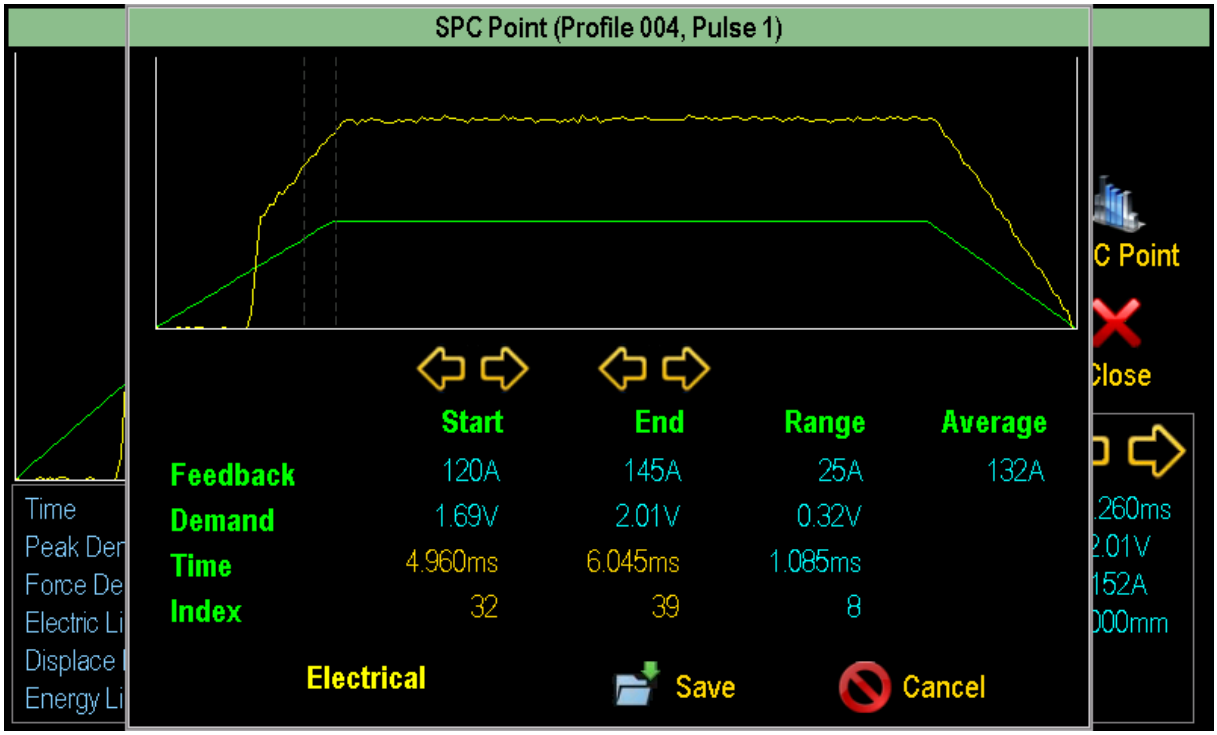
6.6.1 SPC Point

If the ‘SPC Point’ is pressed on the analyse screen above, the following screen is shown:



This gives the user the option of specifying a point, or range of points on the electrical or displacement feedback trace, that is of particular interest. If such a point/range is defined, then the relevant values are stored in the SPC log for each weld.

To enable such a point or range, first press the channel indicator (showing ‘None’ in the image above) to select either ‘Electrical’ or ‘Displacement’. This then allows the user to set the start and end point of the values to log. For example:



Here, the range of points of interest have been defined as starting at index 32 (out of 200) and ending at 39. The start and end times are calculated and shown, along with the values at these points. If a range is defined as above, the average of the values over the range is calculated.

6.7 Screenshots

Screenshots of the HMI can be captured at any time. Press and hold down the HELP key until the Image Viewer pops up (this will take around 5 seconds). This will indicate that the screenshot has been taken and will show a copy on the screen. Screenshots are always in JPEG format.

The location of the screenshot is dependent on whether a USB device is connected. If so, then the image will be save to USB. If not, the image will be saved in on-board memory automatically. Such images can be copied to a USB device at a later point.

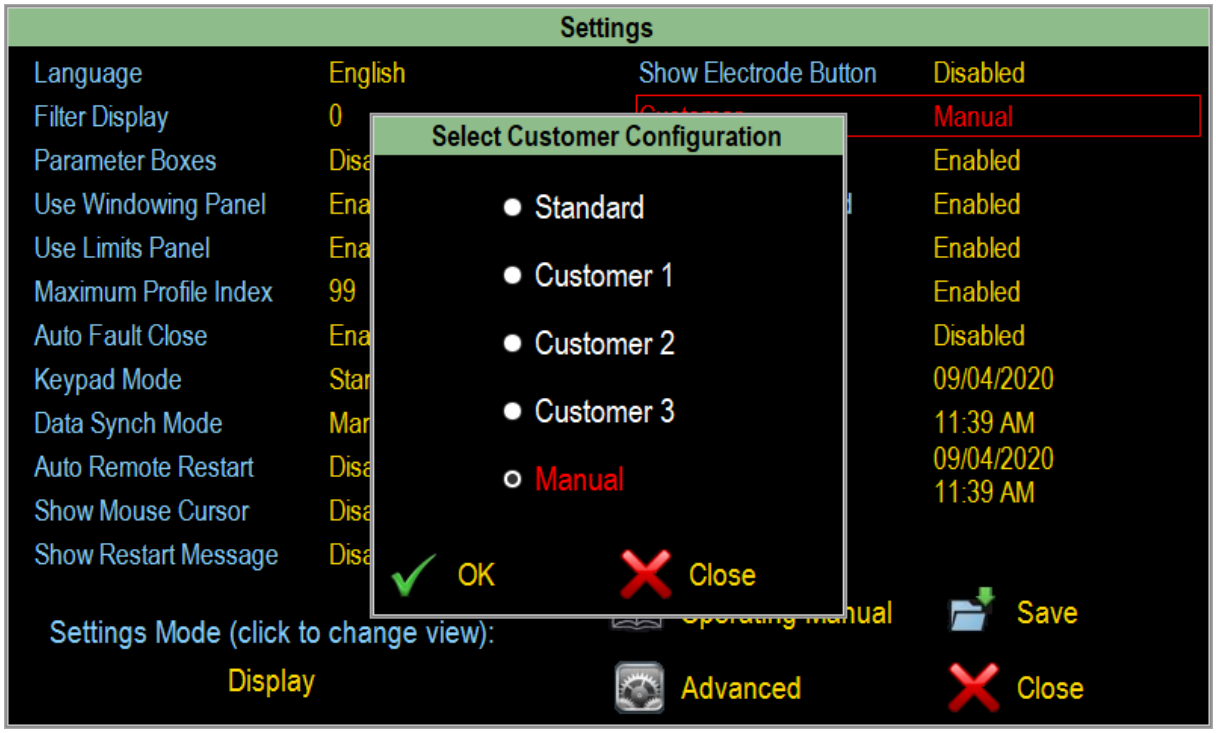
6.8 Customer Files

Customer configuration files can be used to limit what actions a user is able to perform. The minimum required access level (operator, supervisor, engineer) is defined for each screen in the application, and also individually for key parameters/settings.

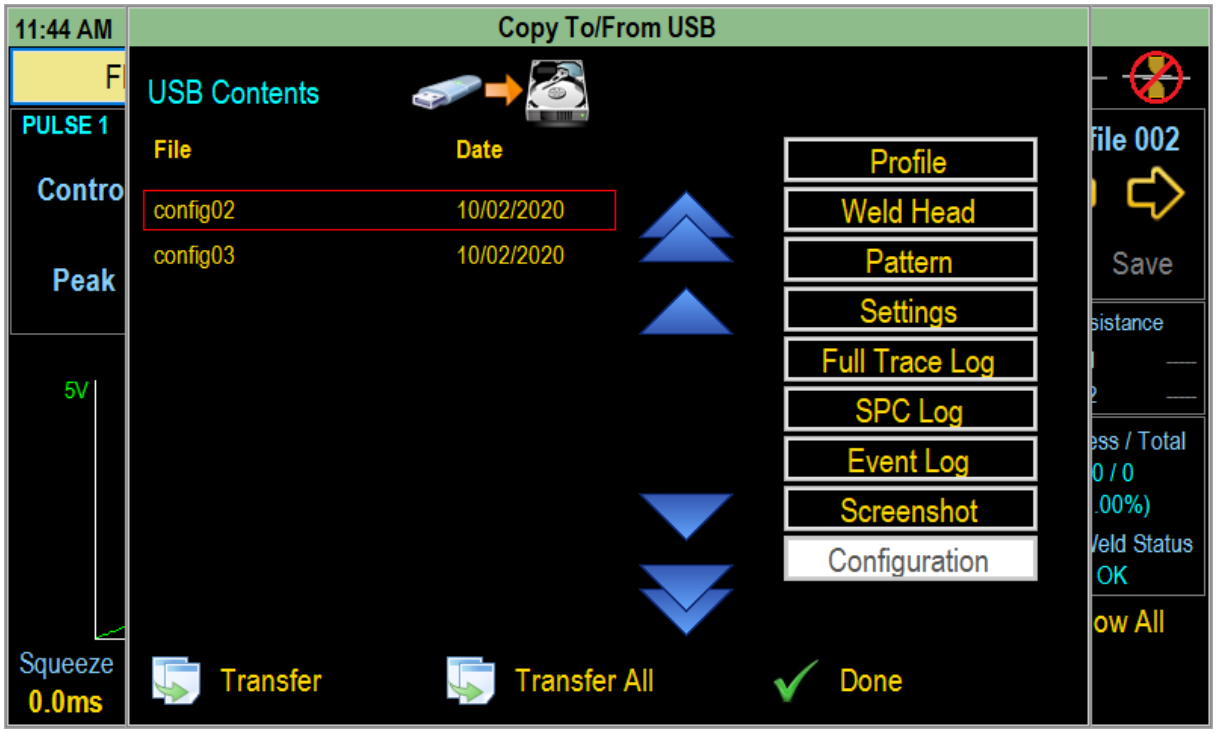
A welder comes with two pre-defined configuration files: ‘Standard’ and ‘Customer 1’. These cannot be changed, but alternative configurations can be defined and selected for use with the ‘Customer 2’ or ‘Customer 3’ settings. The ‘Manual' configuration is set via the ‘Access Configuration’ screen (see Section 5.16.2).

If one of the other settings is selected without a new configuration file, the default (‘Standard’) settings are used.

The customer setting is available from the ‘System Settings’ display tab (see Display Settings’).



Additional configuration files, which are simple text files, can be created and loaded into place via the Copy To/From USB screen.



A sample configuration file is given below in Appendix A. The settings in this sample match the default ('Standard') settings. They can be adjusted accordingly for the required usage in a new file.

Any such file **must** be named either 'config02.txt' or 'config03.txt''. These match the Customer 2 or 3 setting options correspondingly.

Customer configuration files follow a strict format. Each file is split into three sections. Each of these sections must be enclosed within start/end labels. The sections are as follows:

- Screens (StartAccessLevels .. EndAccessLevels) - This is the access level required to enter each of the screens in the application.

- Primary profile parameters (StartParameterAccessLevels .. EndParameterAccessLevels) - These are the most important parameters required to define a welding profile, providing more detailed access control. These settings apply wherever the parameters can be changed, including the home screen.
- Additional parameters (StartMiscAccessLevels .. EndMiscAccessLevels) - These are further individual settings or actions that may require specific access levels. See below

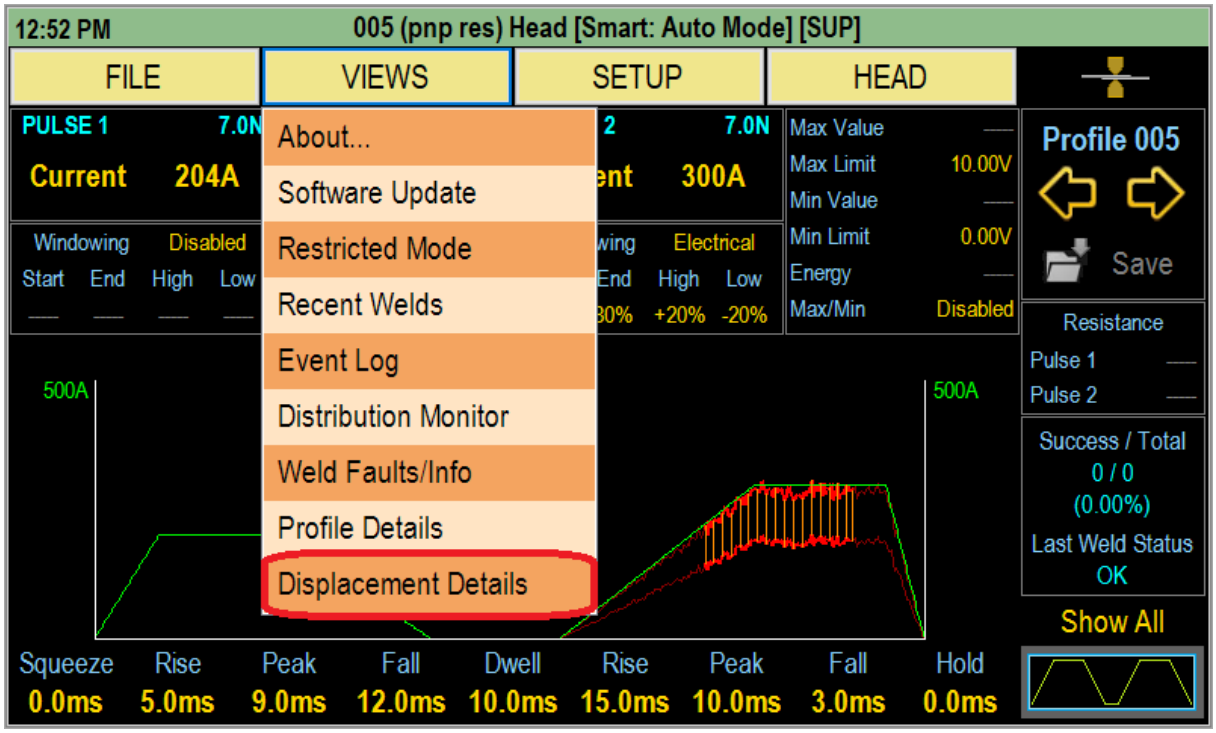
The additional parameters apply to the following items:

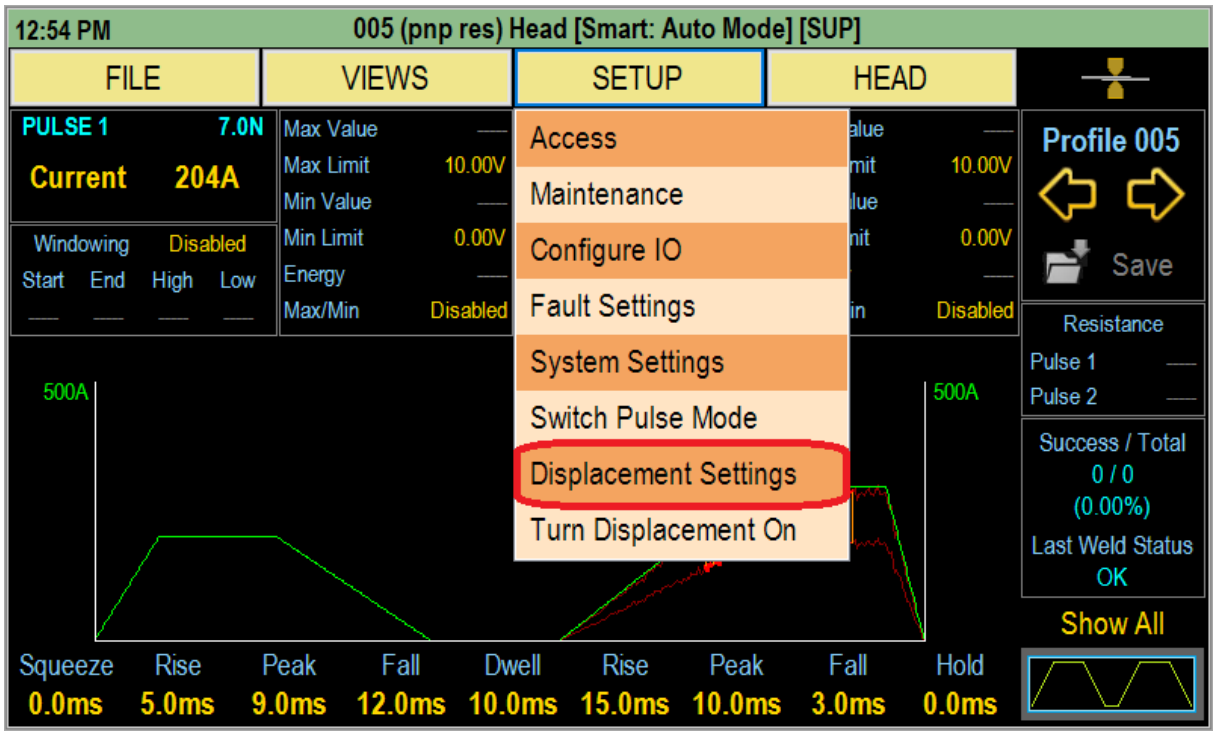
- Squeeze = squeeze time (time just before welding)
- Hold = hold time (time just after welding)
- ProfileSwitch = the ability to load a different profile
- ResetCounts = the ability to reset weld and fault counters
- ToggleDisplacement = the ability to turn displacement on/off
- AssociatedModify = the ability to add associated files/images on the additional profile details screen
- SettingsModify = the ability to make changes to the display page parameters on the system settings screen
- ManualElectrode = the ability to manually enter an electrode value
- AverageDisplaceModify = the ability to make changes to average displacement modification parameters
- AverageElectricModify = the ability to make changes to average electrical modification parameters
- AverageLimitsModify = the ability to make changes to the absolute limits in both the average displacement and average electrical modification features
- DataLoggingModify = the ability to change data logging settings
- DisplaceSettingsModify = the ability to change general displacement settings
- DistributionConfigModify = the ability to change distribution system configuration
- FaultOptionsModify = the ability to change the fault action settings
- EnergyLimits = the ability to change energy limit settings
- PulseDetailsModify = the ability to change profile parameters not covered by the primary parameter group. This comprises the profile name and auto part conditioning.
- SettingsControlModify = the ability to make changes to the control page parameters on the system settings screen
- CustomerConfig = the ability to make changes to the customer configuration

7 Displacement Option

Displacement measurement and monitoring is a cost option with most Amada Weld Tech power supplies. It is generally required either for process monitoring or simply as a secondary means to determine that a mechanical weld has taken place. Essentially, the power supply monitors in real time a displacement sensor attached to the weld head and records the weld head position and travel before and after a weld.

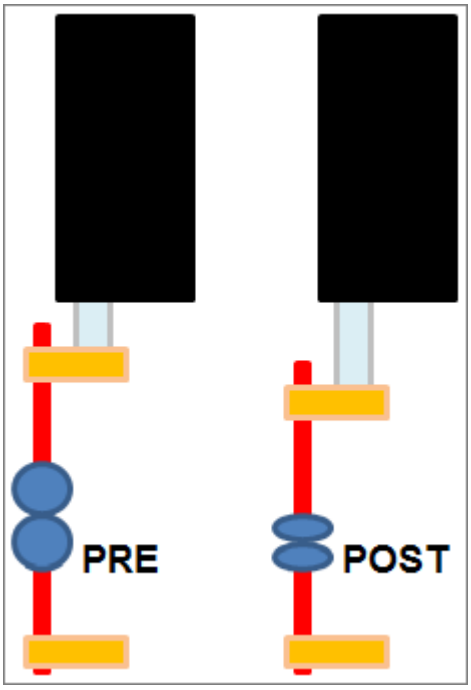
As with electrical process parameters, real time displacement traces can be recorded and analysed and limits set around them. If the displacement option is installed, then the menu items under the VIEWS and SETUP drop downs will be available as below.





7.1 Setup

To use displacement monitoring, it is important to understand how the system is designed to operate in order to setup the variables associated with the monitoring. Without this understanding, displacement monitoring can cause nuisance fault tripping. Consider the diagrams below which show exaggerated pre- and post-weld conditions.

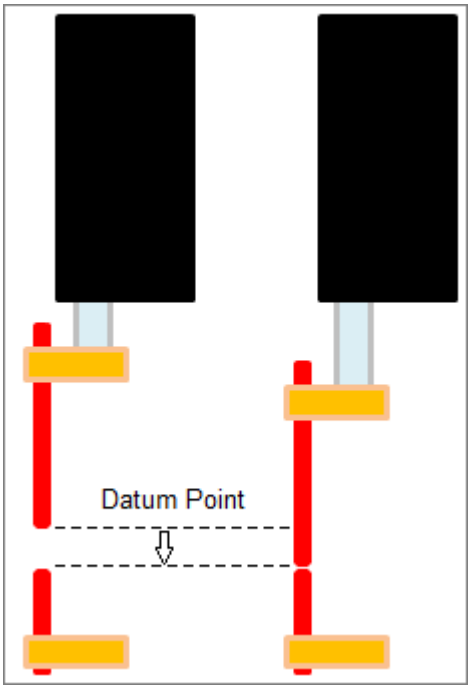


Displacement measurement can also be used to check that the correct parts are in place before welding. To enable this, the first step of setup required is to determine a mechanical datum point.

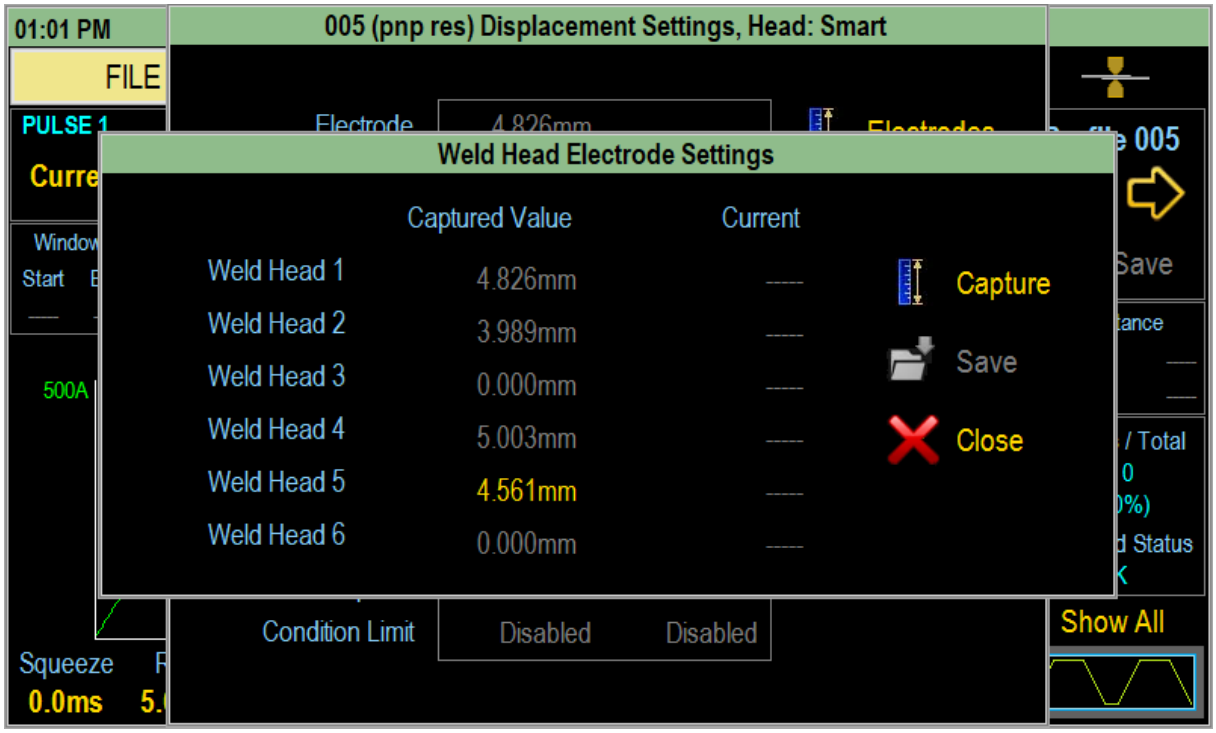
7.1.1 Setting Datum

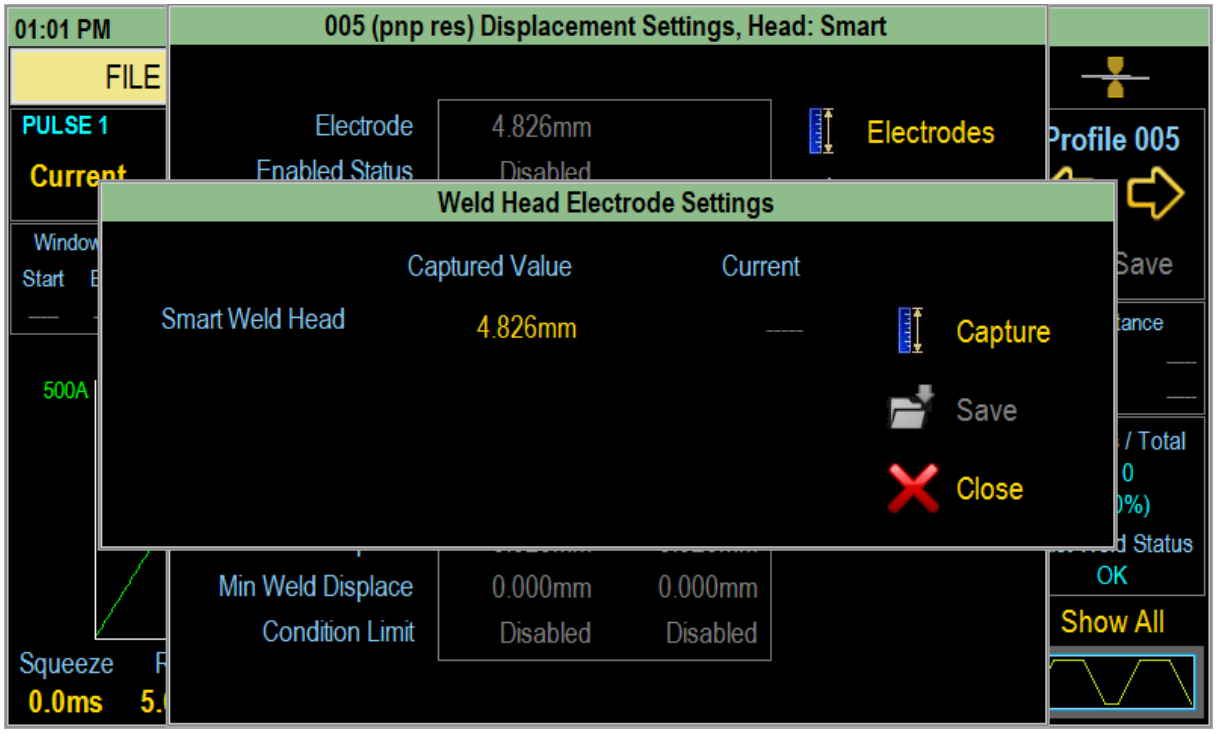
In all cases, the most accurate datum point (also referred to as the ‘Electrode Value’) will be achieved by closing freshly cleaned and polished electrodes. This must be done every time electrodes are cleaned or replaced since the overall length of the electrode is likely to change subtly.

Close the electrodes together with no product in place:



Select SETUP | Displacement Settings | Electrodes. This will bring up a screen similar to one of the ones below (dependent upon machine configuration) which shows a live reading for the selected weld head (weld head numbers are found under Profile Details).





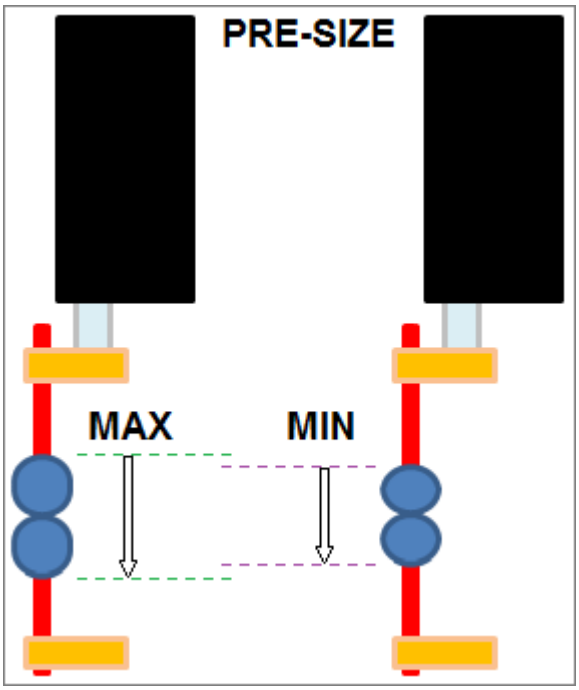
Pressing ‘Capture’ causes the live displacement reading to be captured and stored against the weld head number. The active weld head field is editable, so alternately a value can be entered manually.

The electrode value can also be captured automatically without first entering the electrode screen. This is done by selecting ‘Auto Capture’ on the displacement settings screen.

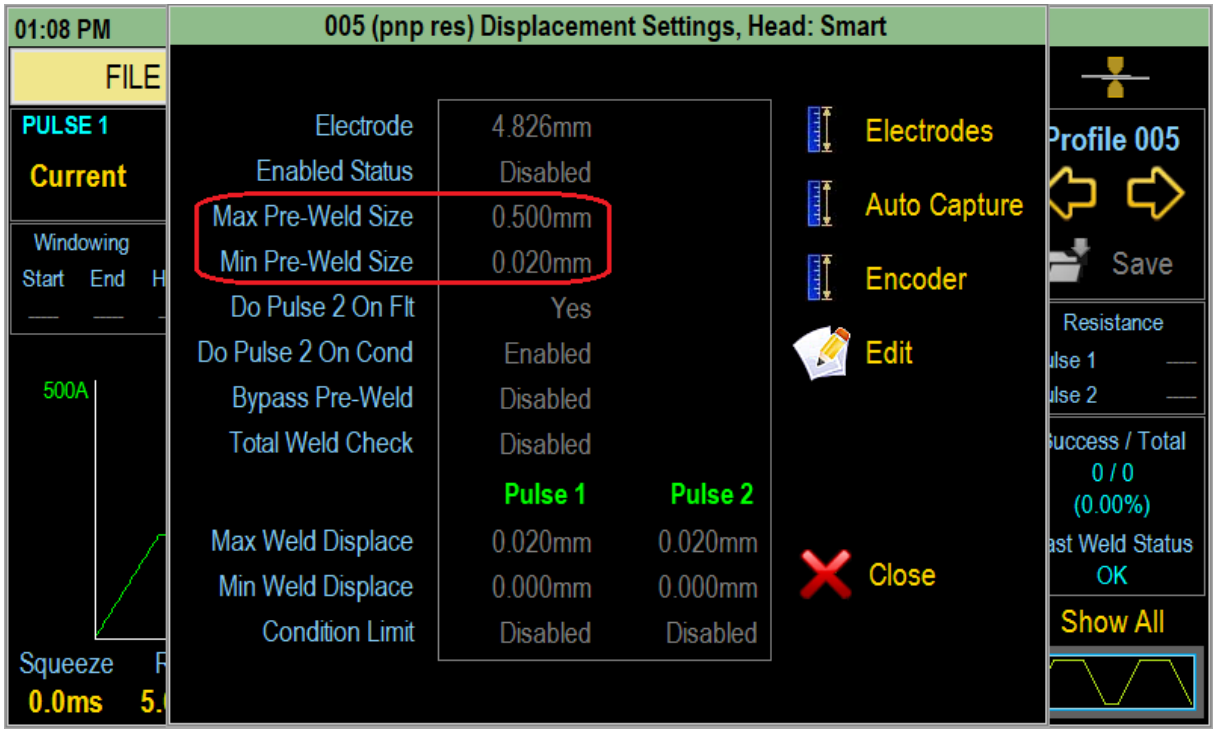
7.1.2 Pre-Weld Checks

Once a datum has been established, the user can enter details of the component size to perform pre-weld size checking. Before setting this, it is important to understand the likely mechanical tolerance of the parts to be welded.

For example, if two components to be welded are 1mm in size +/- 0.1mm, then the exact minimum combined pre-weld size would be 0.9mm + 0.9mm = 1.8mm. Similarly, the exact maximum pre-weld size would be 1.1mm + 1.1mm = 2.2mm.



These values are referred to in the HMI as Min Pre-Weld Size and Max Pre-Weld Size and can be found in the displacement settings (SETUP | Displacement Settings):

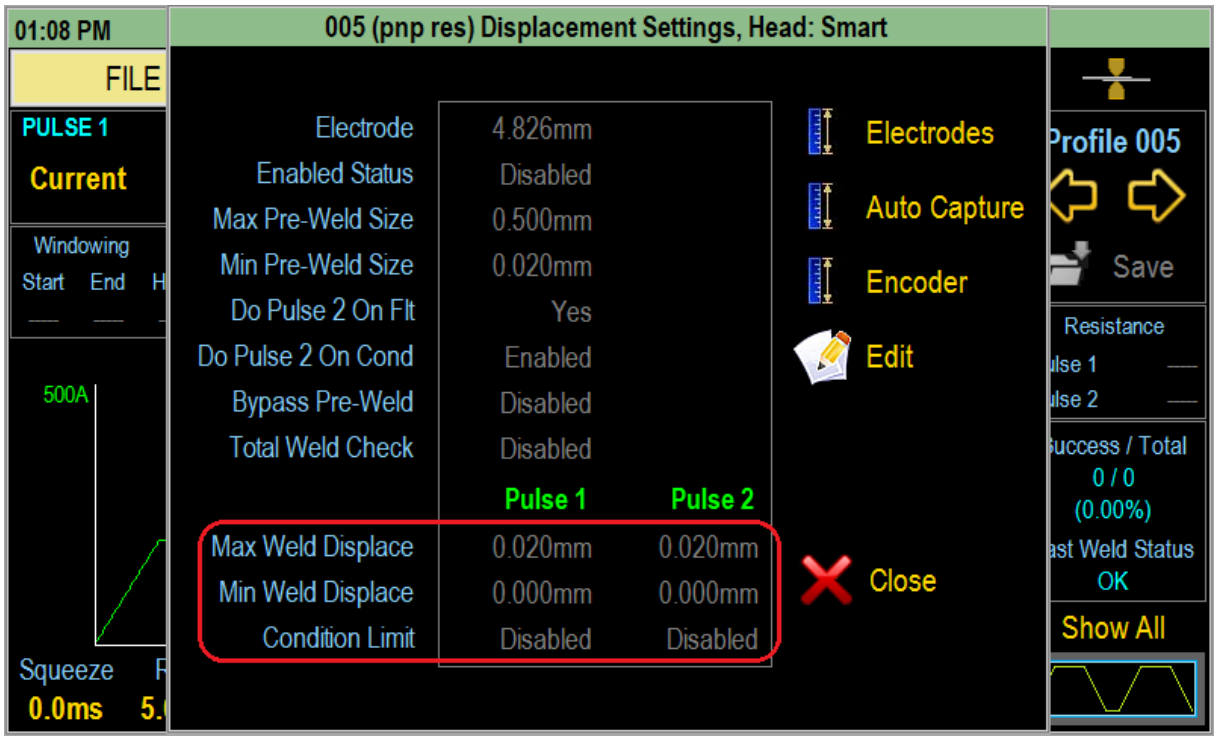


In this way, the machine can potentially be made to detect incorrect, missing or superfluous parts:

In addition to the component size spread, it is also worth noting that the measurement will take into account electrode wear. Hence the setup can be used to additionally factor in or out the tolerable wear back on the electrodes. To accommodate electrode wear on the example given above, a minimum pre-weld value of 1.6mm might be chosen to allow 0.2mm wear back.

7.1.3 Displacement Checks

With the pre-weld conditions and datum set, typical process displacement tolerances (the maximum and minimum allowed displacement) can now be applied.



The programmed maximum weld displacement limit is used to detect excessive displacement during and after the weld. The value is measured from the pre-weld displacement reading (Start Value). Throughout the weld and when the weld is completed, the displacement is compared to the maximum weld displacement value. If the total weld displacement (Total Value = Final Reading – Start Value) exceeds the maximum weld displacement, then a fault will be indicated. If the maximum weld displacement limit is violated before the end of the weld then the welding power supply output will be terminated.

The programmed minimum weld displacement limit is used to detect too little displacement by the end of the weld. The value is measured from the pre-weld displacement reading (Start Value). After the weld is completed, the final displacement value is compared to the minimum weld displacement limit. If the total weld displacement (Total Value = Final Reading – Start Value) is less than the programmed minimum weld displacement limit then a fault will be indicated.

The unit is also able to terminate a weld upon reaching a specified condition limit. This is useful in dynamic part conditioning and weld displacement targeting as this allows the weld current to cease while simultaneously allowing the weld collapse to continue to move within the specified limits. With condition limiting enabled, the weld stops as soon as the maximum weld displacement is reached.

When using a double pulse, condition limiting can be applied to each pulse. As such, it is possible to define which parts of the welding are subject to the condition check.

As with pre-weld checks, maximum/minimum/condition transgressions can be used to trigger fault events which are enable/disabled under the Fault Settings Screen.

7.1.4 Changing Electrodes

Since all displacement checks reference the closed electrode position with no parts, it is obviously important to make sure that a new electrode datum value is acquired every time the electrodes are moved or changed.

In an automation system with one or more displacement measuring channels, a new electrode datum can also be acquired by supplying a signal to the Expanded I/O connector (See the Hardware Manual). There is a unique signal input corresponding to each of the six possible electrodes. When a signal is supplied, the corresponding channel status LED on the front panel momentarily shows a green light. As described above, the weld head should be closed and inhibit set before supplying the signal.

7.1.5 Displacement Tolerances

As with electrical process information, the real time displacement trace information can be stored against a profile and window tolerances applied. This can be useful when looking for characteristic weld collapse patterns.

7.1.6 Displacement Faults

In summary, the available displacement faults/scenarios are as follows:

- **(Start Value < Datum – Max Pre-Weld Size) => Max Pre-Weld Size Fault**
- **(Start Value > Datum – Min Pre-Weld Size) => Min Pre-Weld Size Fault**
- **(Total Value < Start Value + Min Weld Displace) => Min Displace Fault**

With condition limit disabled:

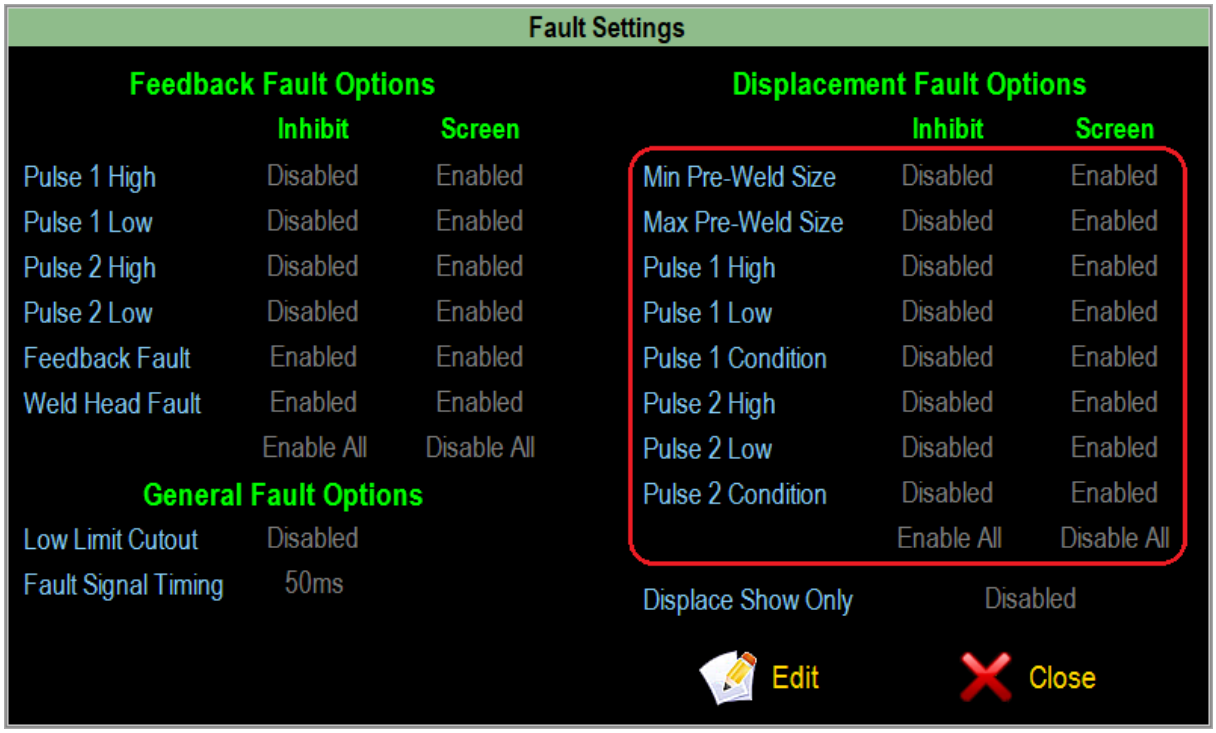
- **(Current Value > Start Value + Max Weld Displace) => Max Displace Fault**
- **(Total Value > Start Value + Max Weld Displace) => Max Displace Fault**

With condition limit enabled

- **(Current Value > Start Value + Max Weld Displace) => stop weld, no fault**
- **(Total Value < Start Value + Max Weld Displace) => Condition Fault**

7.1.7 Fault Settings

Via the fault settings menu option (SETUP | Fault Settings), the machine can be made to indicate a violation of displacement faults:

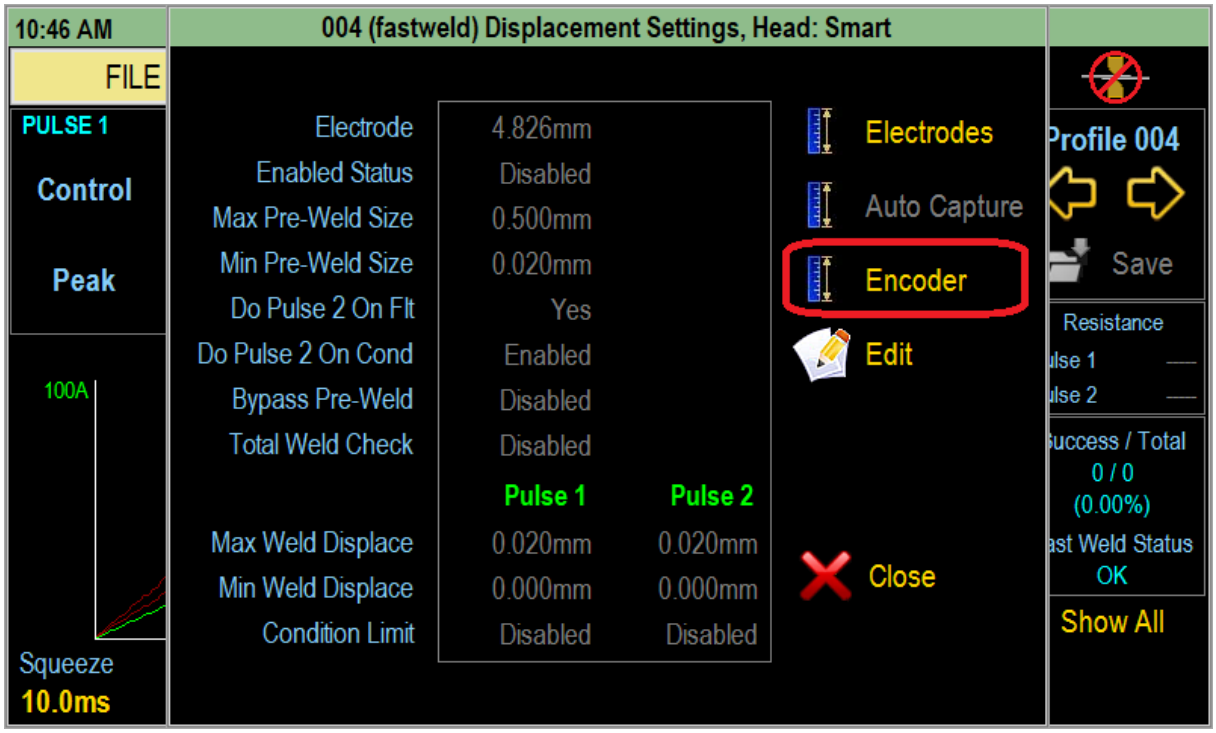


On this screen ‘Low’ and ‘High’ correlate respectively with ‘Min’ and ‘Max’ weld displacement.

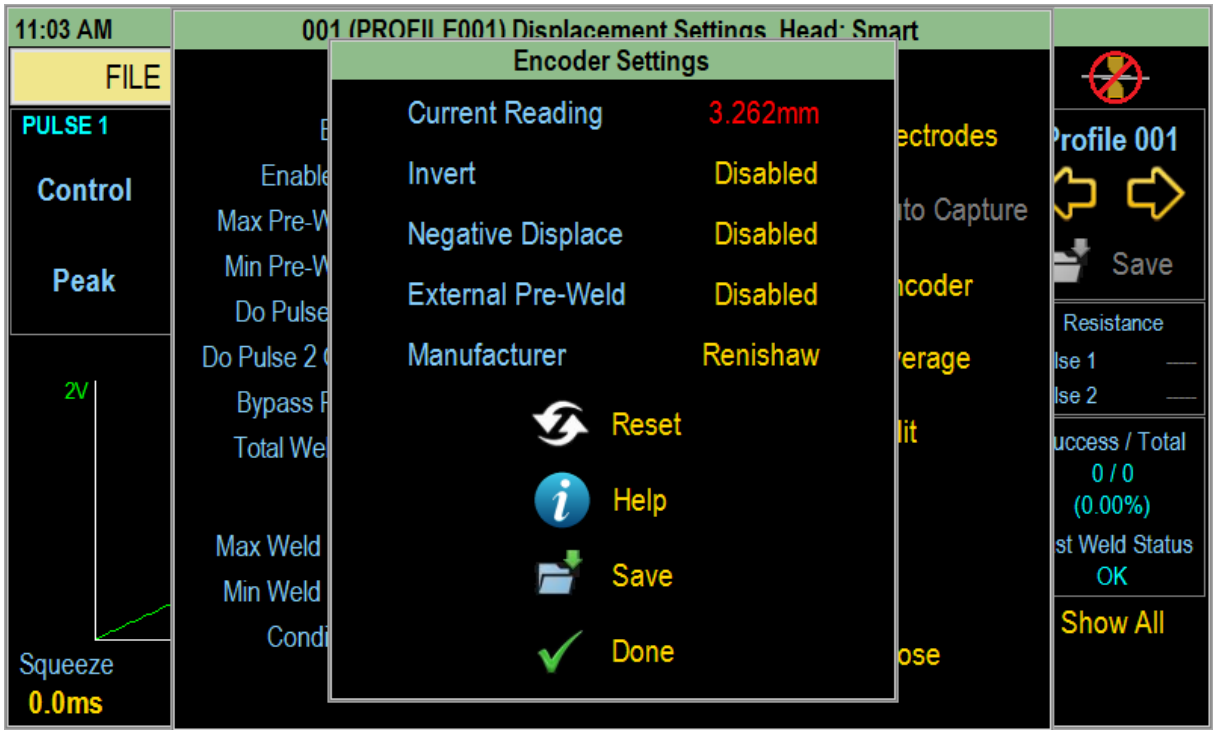
The ‘Displace Show Only’ setting is the same as the one detailed in the System Settings (see Section 5.20.1).

7.2 Encoder Settings

If displacement is measured using an encoder (currently this only applies to systems with a smart head installed) then the displacement settings screen contains an additional button to modify the encoder settings, as shown below.



Selecting the encoder button shows the following screen (or similar):



The 'Current Reading' field shows the instantaneous displacement, and this is updated once a second.

The 'Invert' setting provides the ability to reverse the direction of reading the encoder travel. This may be necessary on some systems if the encoder is fitted upside down due to design constraints.

The ‘Negative Displace’ setting provides the ability to monitor in-weld displacement properly when this occurs in the opposite direction to the general travel of the weld head. Again, this is dependent on welder and weld head configuration.

The ‘External Pre-Weld’ setting provides the ability to use the smart weld head positional encoder for pre-weld monitoring. On most systems the positional and displacement encoders are fitted to the same part of the weld head, meaning that they measure the same at all times. However, on some

systems the encoders are fitted to different parts of the assembly. Using the positional encoder provides correct measurement of the position immediately prior to the weld. In such a case, the setting should be enabled. Note that it is also used for taking electrode readings, so must enabled at all times.

The 'Manufacturer' field is provided to change between encoder manufacturers. Currently Renishaw and Heidenhain encoders are supported.

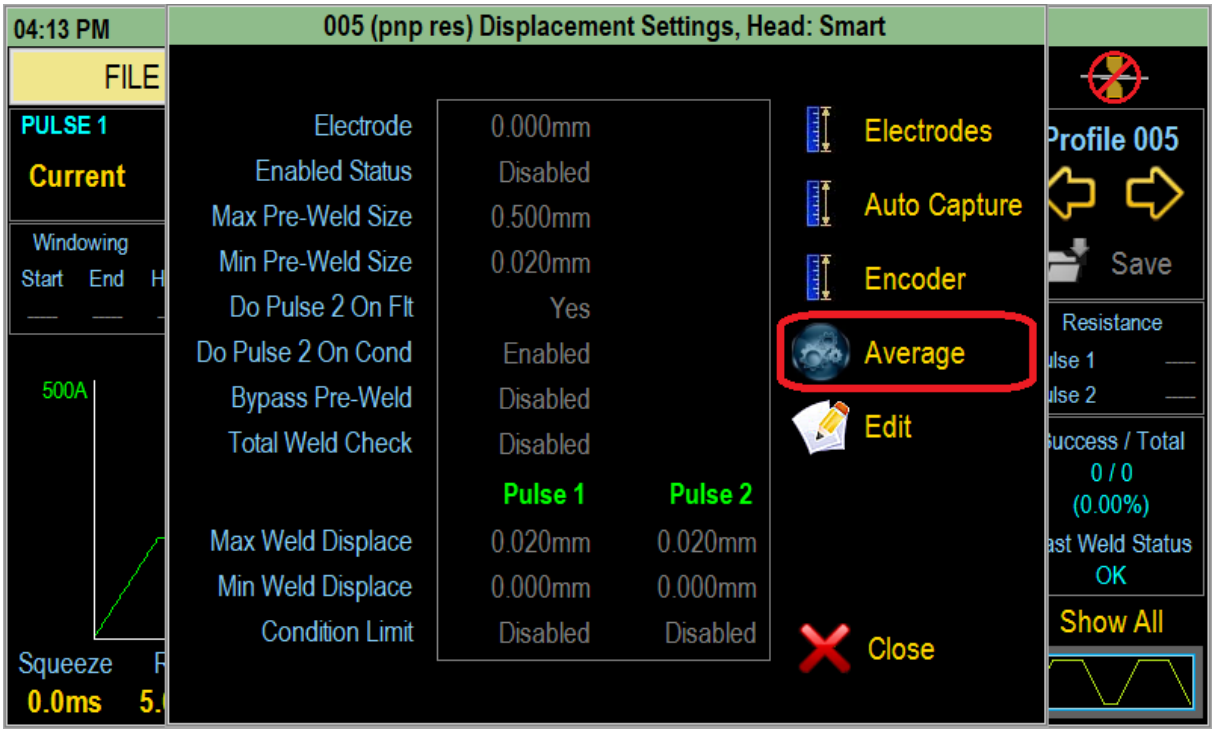
Encoders have a ‘zero point’, from which their readings are derived. On a smart head system, this is normally set when the head has finished its ‘homing’ routine. The 'Reset' button provides the user the ability to set the zero point at a position of their choosing. Note that the current displacement reading will show negative values if the zero point has a higher displacement than the instantaneous position.

The 'Help' button shows a condensed version of this section in the manual.

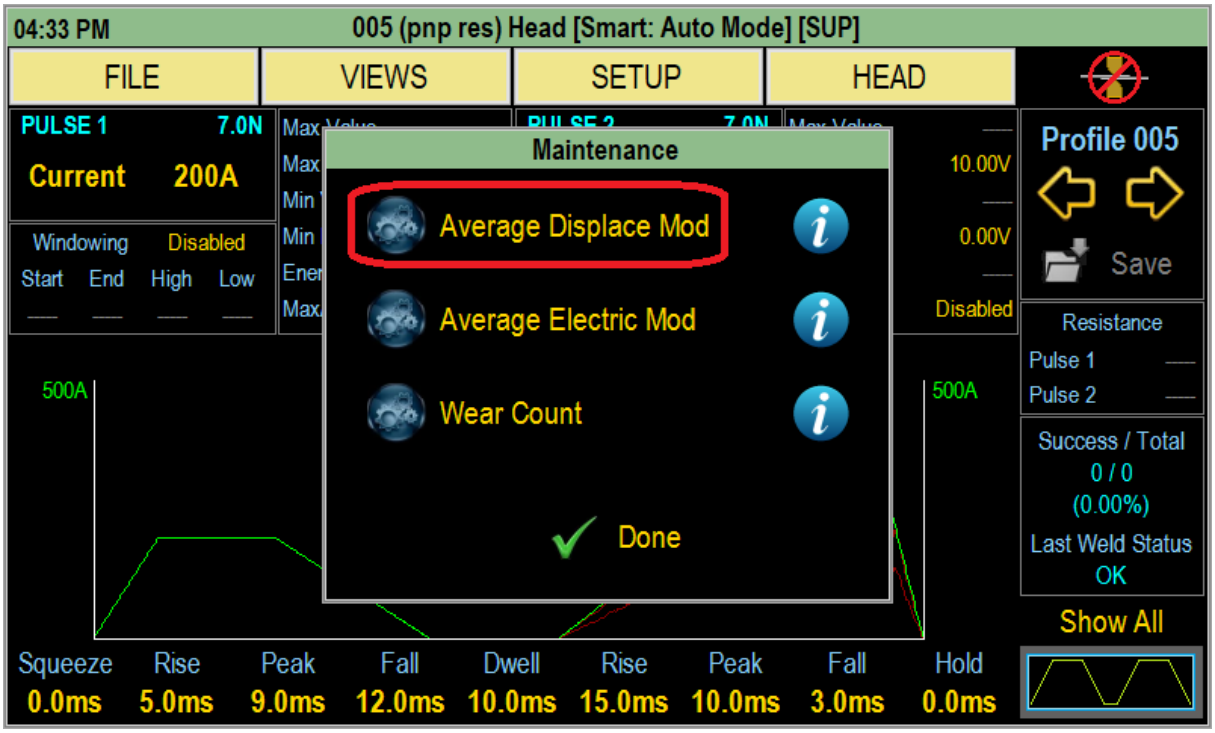
The 'Save' button saves any changes to the invert or manufacturer fields.

7.3 Average Displacement Modification

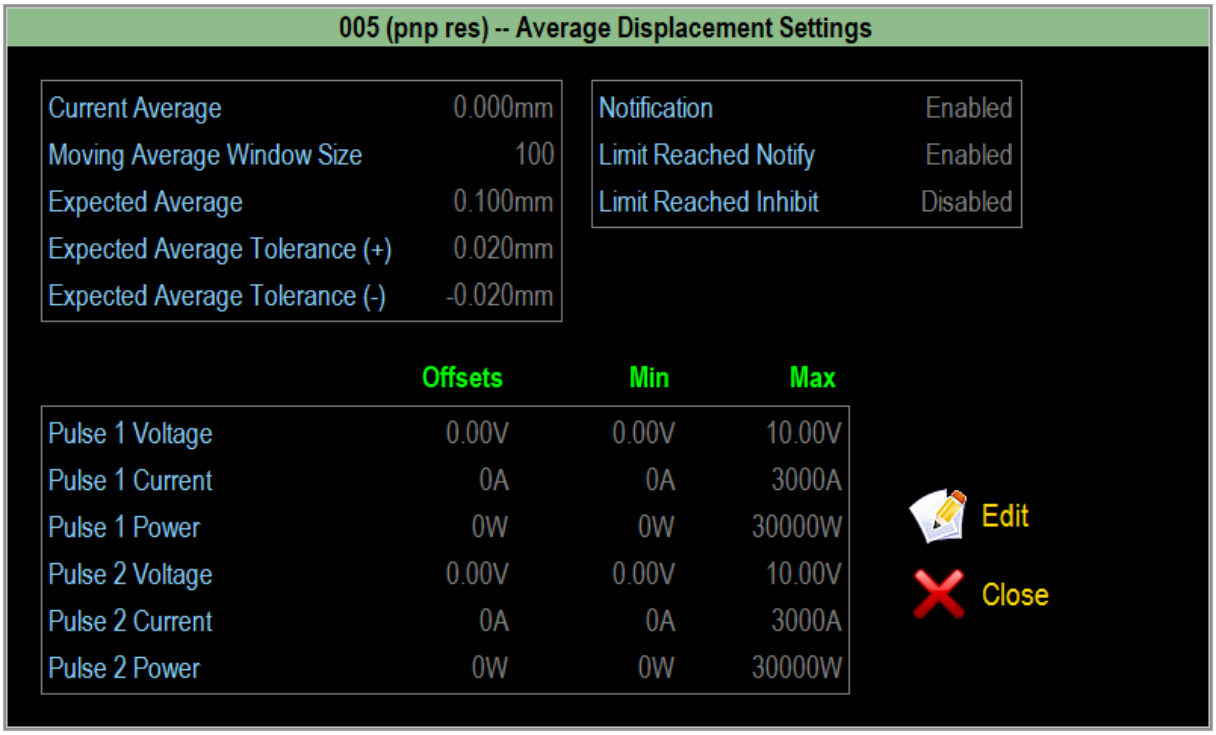
To be able to use the average displacement modification feature, the ‘Average Displace Mod’ setting must be enabled (see System Settings). When enabled, an additional button (Average) is shown on the Displacement Settings screen.



Also, the feature is available via the SETUP Maintenance menu option.



Selecting via one of the above methods shows the Average Displacement Settings screen:



The average total displacement is performed separately for each profile and with separate settings. The average (‘Current Average’) is calculated over the number of welds specified in the ‘Moving Average Window Size’ setting. The average is compared against the ‘Expected Average’ setting, with the positive and negative tolerances applied.

If the average is out of range, the peak demand of the corresponding profile is modified by the offsets specified. **Only** the peak demand in the active control mode (voltage, current, power) is affected. The offsets for both pulses are applied simultaneously.

The direction that the peak demand is modified is with the intention of bringing the average displacement back into line. Therefore, the following calculations apply:

IF ‘current average’ > (‘expected average’ + positive tolerance)
THEN peak demand = peak demand – offset

IF ‘current average’ < (‘expected average’ - negative tolerance)
THEN peak demand = peak demand + offset

The offsets are signed values, so it is possible to change the demand in the opposite direction. For example, with a negative offset the demand would be increased if the positive tolerance was exceeded.

The ‘Min’ and ‘Max’ settings indicate the extreme limits that the demand can be modified to in each mode.

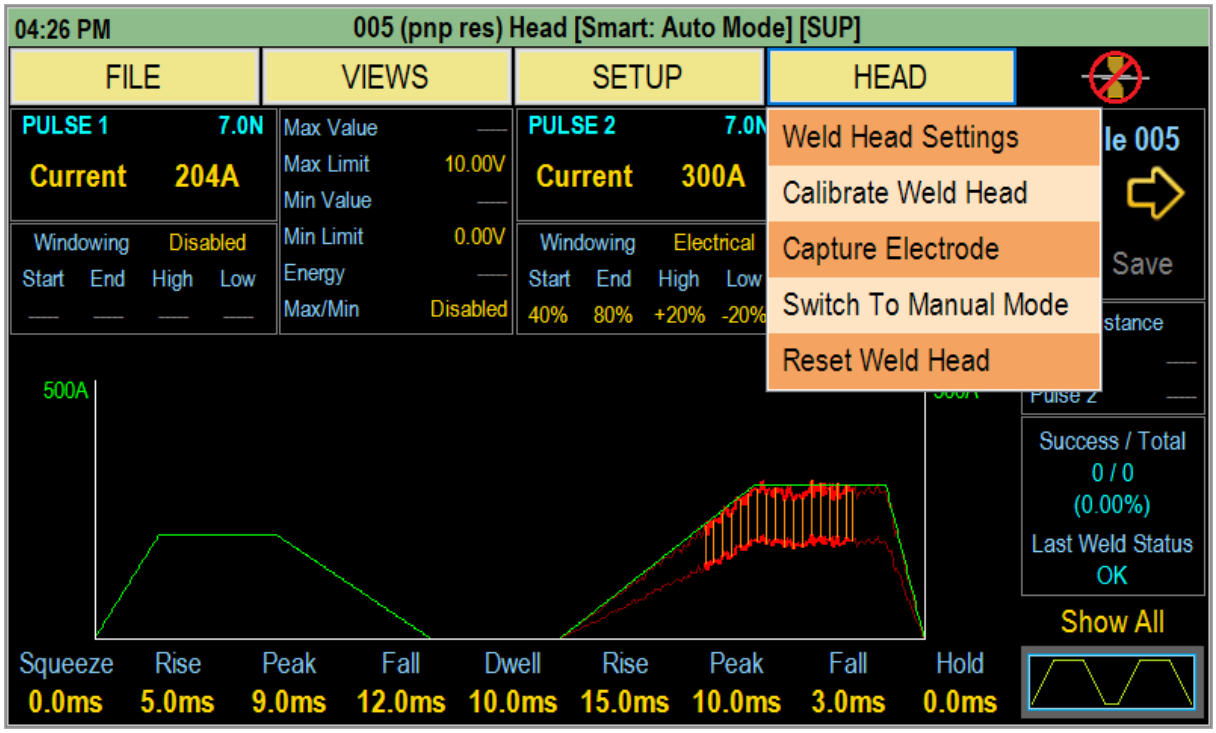
The ‘Notification’ setting indicates whether a message is shown on screen when the demand is modified.

The ‘Reset’ button will reset the average displacement calculation.

After the calculation is reset or the demand has been modified, the number of welds that must occur before modification can happen must be equal to or greater than the ‘Moving Average Window Size’. This avoids the possibility of multiple consecutive demand modifications.

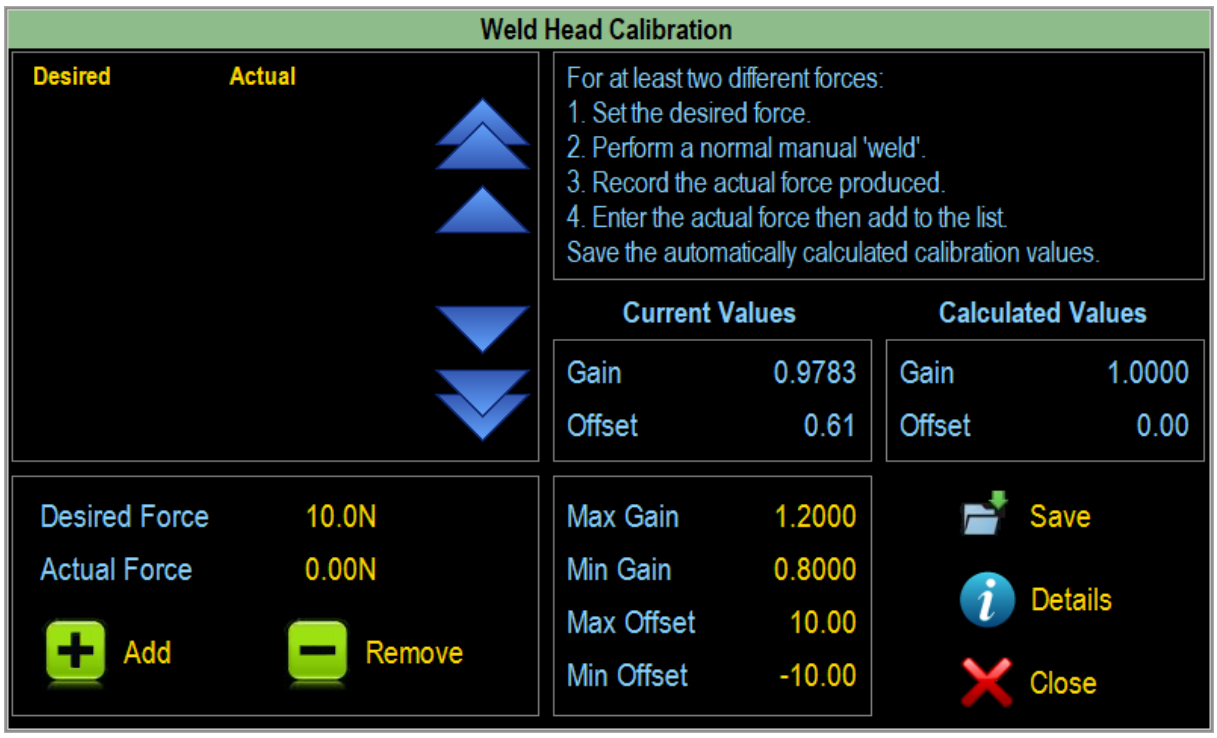
8 Smart Weld Head Option

Machines with SMART weld head interfaces are equipped with an additional drop down “HEAD” menu, which provides the means to setup and calibrate an attached servo weld head. There are also menu options to quickly switch between manual and auto mode, and to reset the smart head.



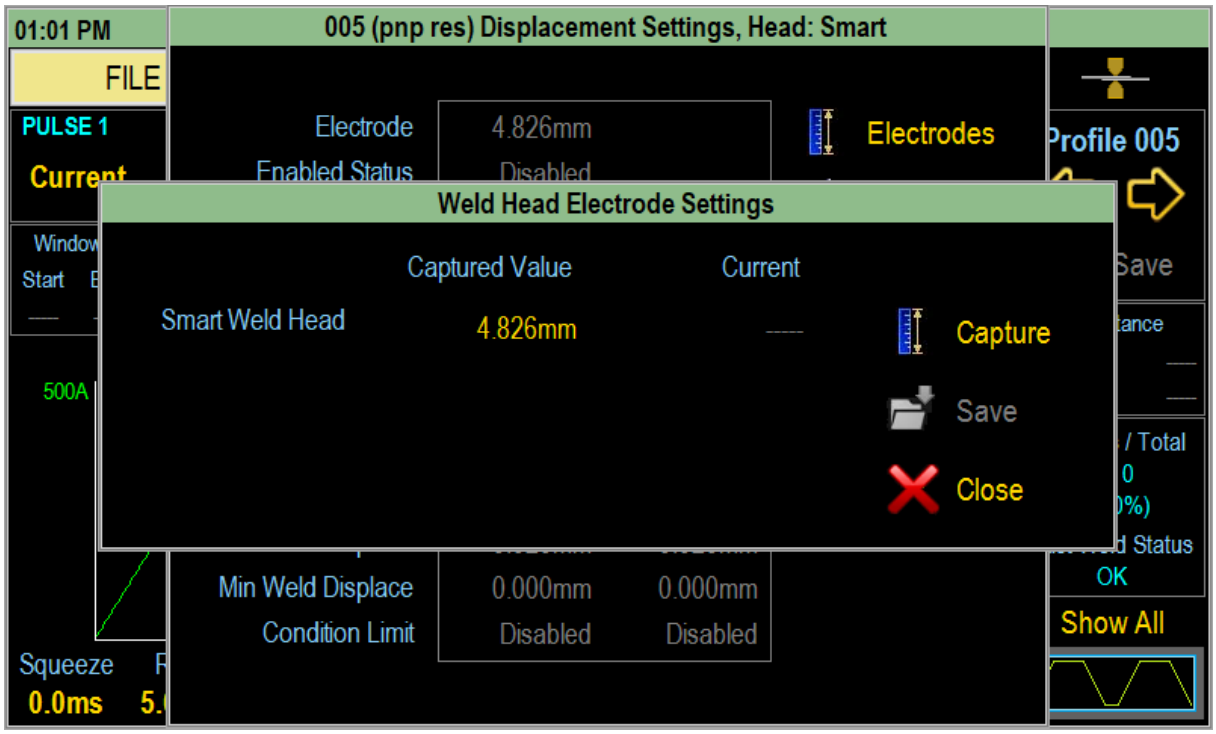
8.1 Weld Head Calibration

Weld head calibration is password protected (unless in Engineering mode) and requires external measurements to be made and entered against the existing preset values in the machine. As shown below, the calibration method involves entering a list of actual forces (externally measured) against desired forces (those programmed). From these values, gain and offset calibration values are automatically calculated and can be saved back to the weld head.



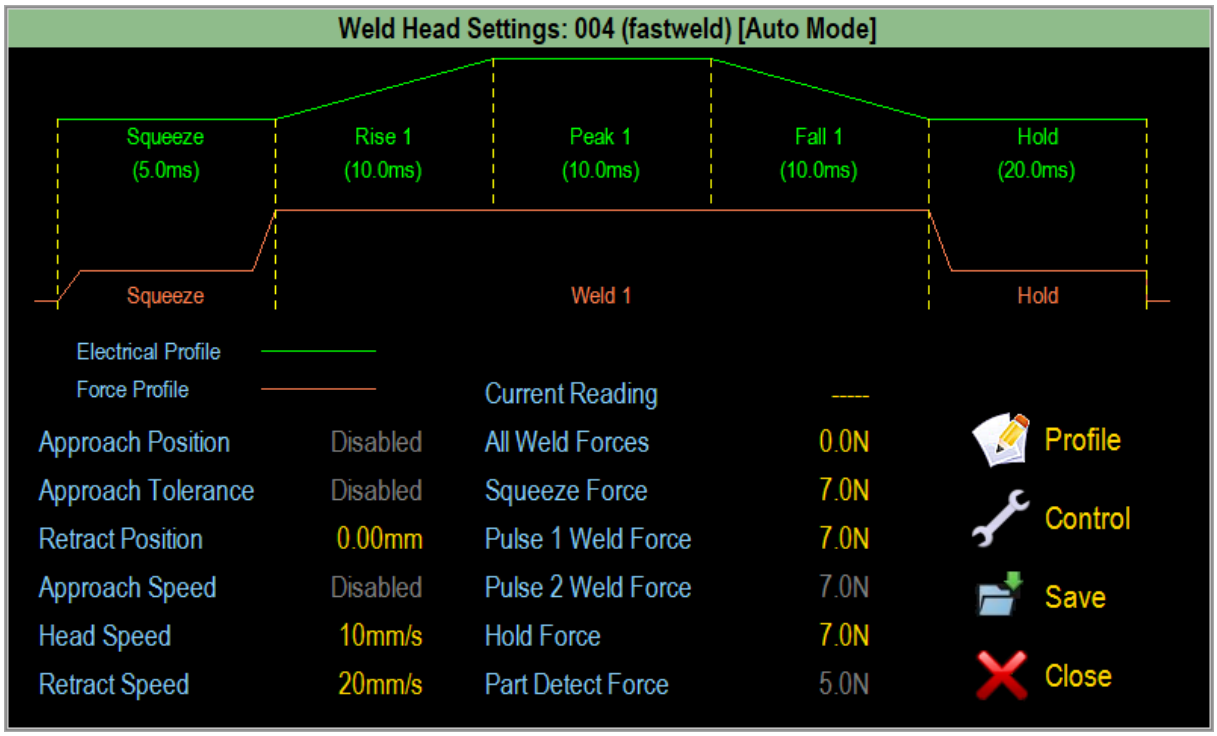
8.2 Electrode Capture

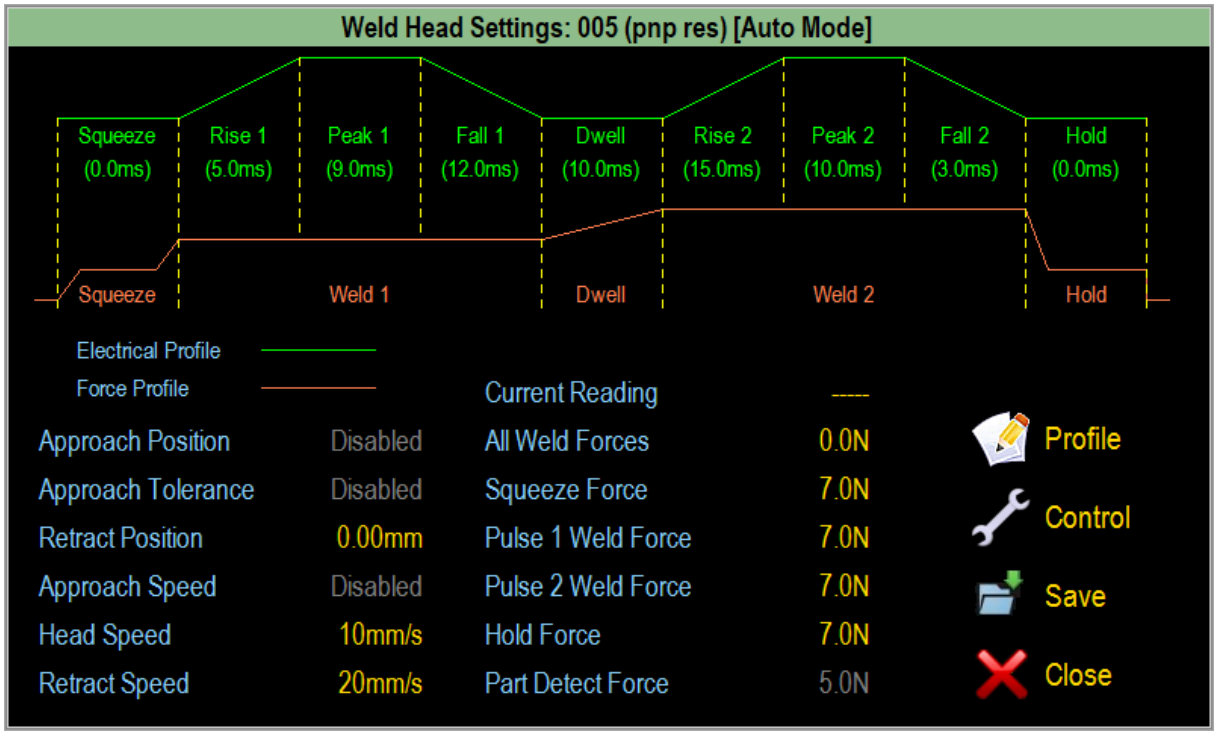
The electrode value can be captured using the ‘Capture Electrode’ menu option in the same way as for other displacement options (see the ‘Changing Electrodes’ section). The display is different to account for the different weld head operation.



8.3 Weld Head Settings

The settings menu allows the welding speed and force profile to be defined.





In double pulse mode, separate force settings can be used for each pulse. In practical terms, the welder will wait until the head has achieved the position and force requirements before triggering. Hence a ‘double force’ profile could be defined for the same part.

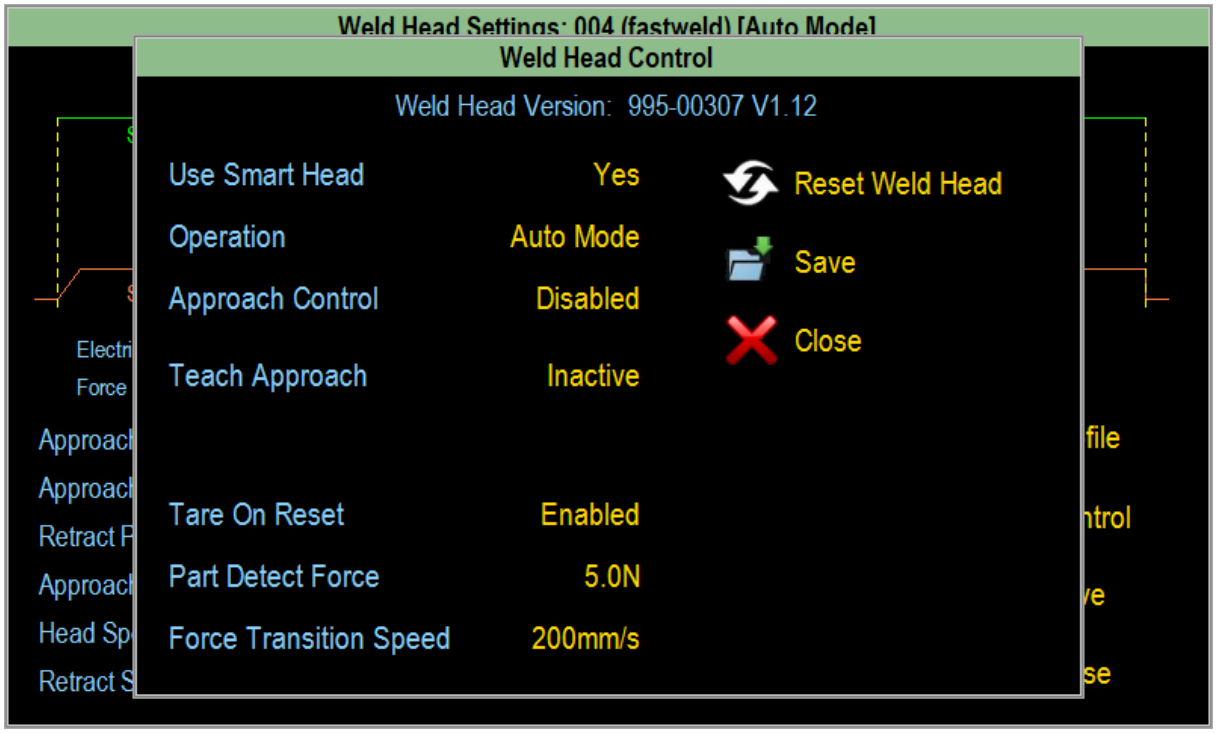
The ‘Retract Position is a programmable upper arm rest position after each weld.

The 'All Weld Forces‘ can be used to ensure that all forces during the weld profile are the same.

Pressing the ‘Profile’ button takes the user directly to the details for the currently loaded profile.

Pressing the ‘Control’ button brings up the weld head control screen, which allow overall (non-profile-specific) weld head settings to be made.

8.4 Weld Head Control Screen



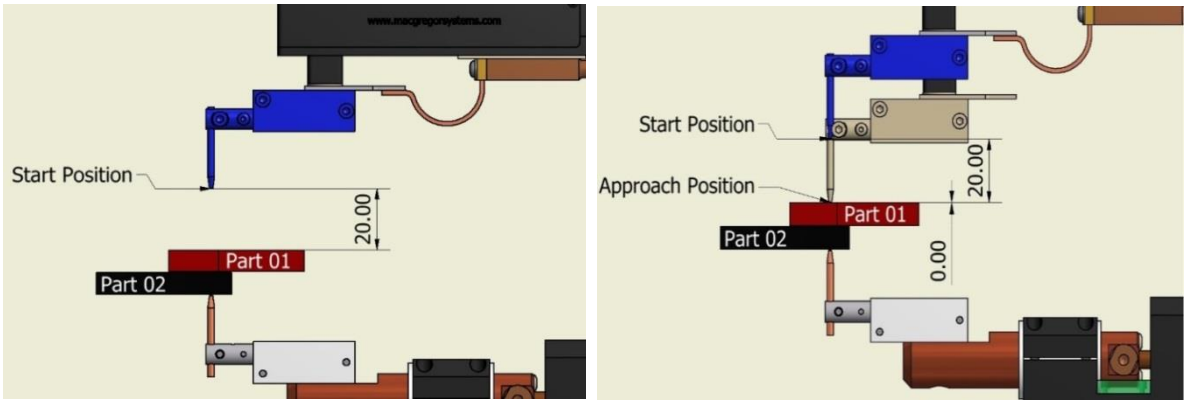
The control screen provides another method to switch between manual (weld head position controlled using a pedal or equivalent) and auto (weld head position controlled by the weld head motor) modes.

The 'Part Detect Force‘ is the force used by the equipment whilst locating the part to be welded (while approaching at Part Detect Speed). Part detection occurs immediately after the approach phase and is usually set to a slower speed and lighter force for maximum sensitivity. After part detection, the unit applies the Squeeze, Weld and Hold forces as programmed in the profile-specific settings.

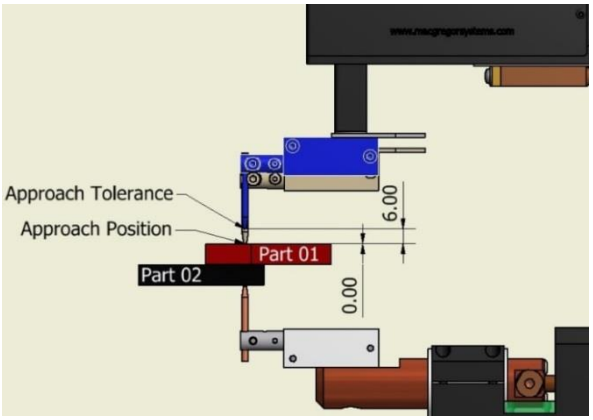
A tare value is stored in the unit representing the weight of the electrode holder and mechanism. The unit can be programmed to remeasure the Tare upon every reset, by toggling the 'Tare On Reset‘ option. If disabled, the current tare value remains in the memory. Therefore, when changing an electrode holder or fitting a new head to the controller, a new Tare operation is required to ensure calibration is maintained.

8.5 Approach Variables

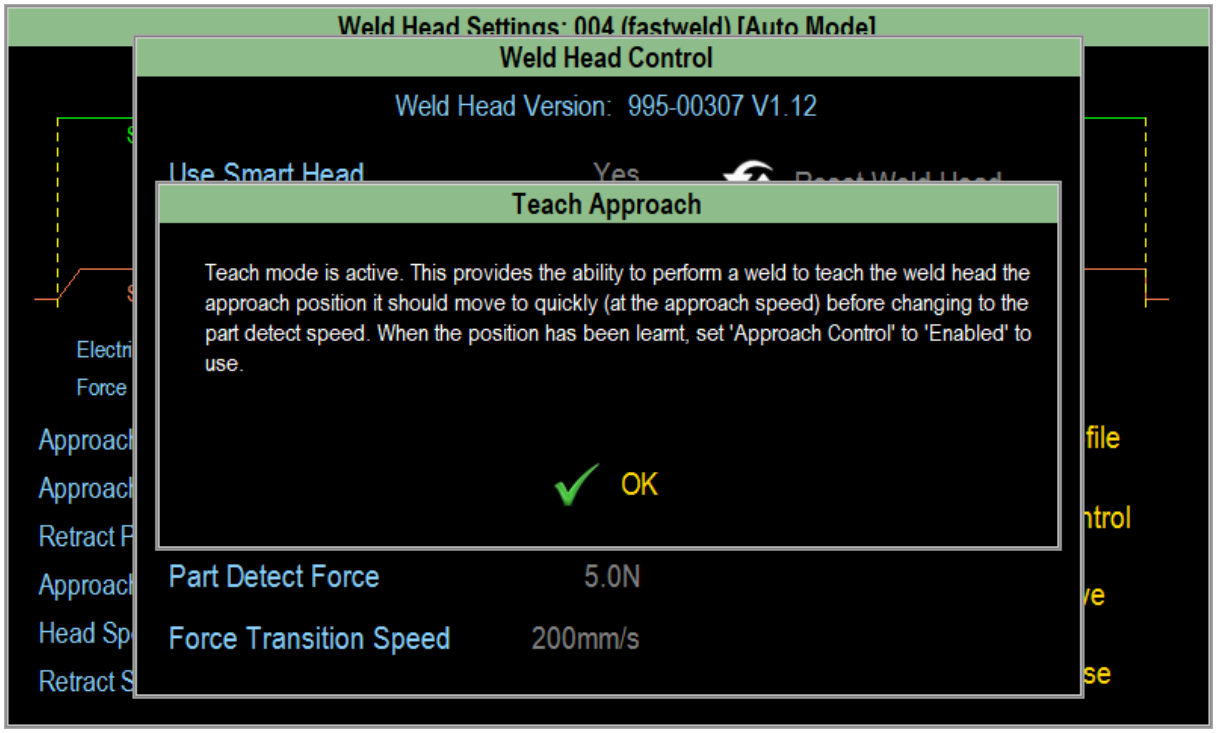
These are used to define a high speed actuation zone that moves the weld head from its home (up) positions to (down) just above the part to be welded. This down position can be taught using Teach Approach. When teaching, the electrodes grip the part at low force. Upon contact, the positional information is stored as 'Approach Position‘.



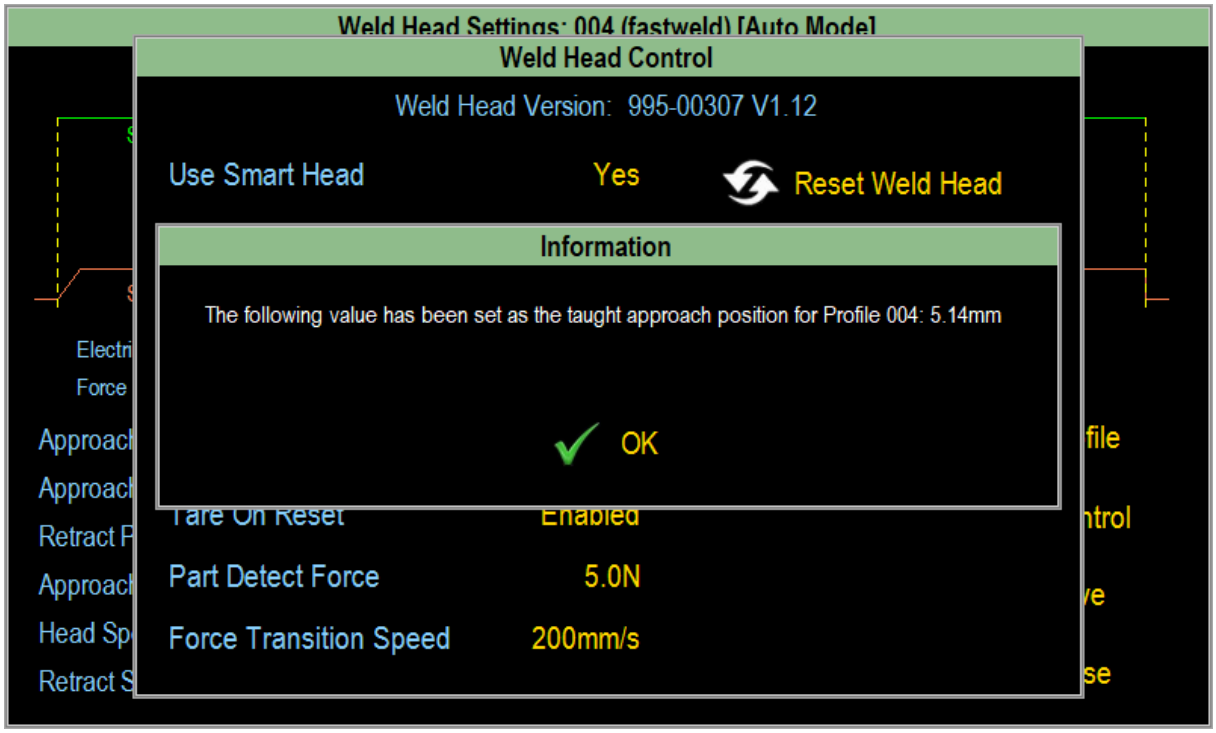
The 'Approach Tolerance‘ is a negative offset value from the Approach Position. If the head has been taught against a part, this value represents the desired gap between the electrode and the part prior to moving slowly for part detection.



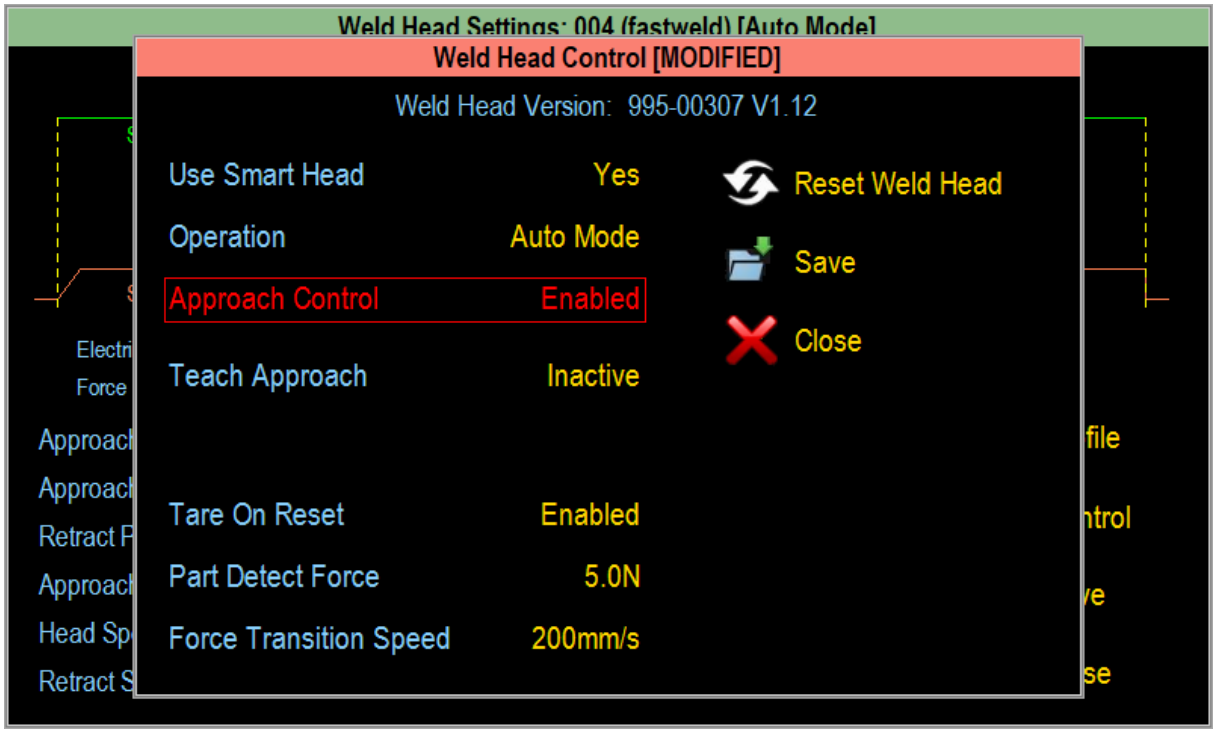
To activate ‘Teach Approach’ select it on the weld head control screen. Note that the Smart Weld Head must be enabled and in auto mode. The following window will appear.



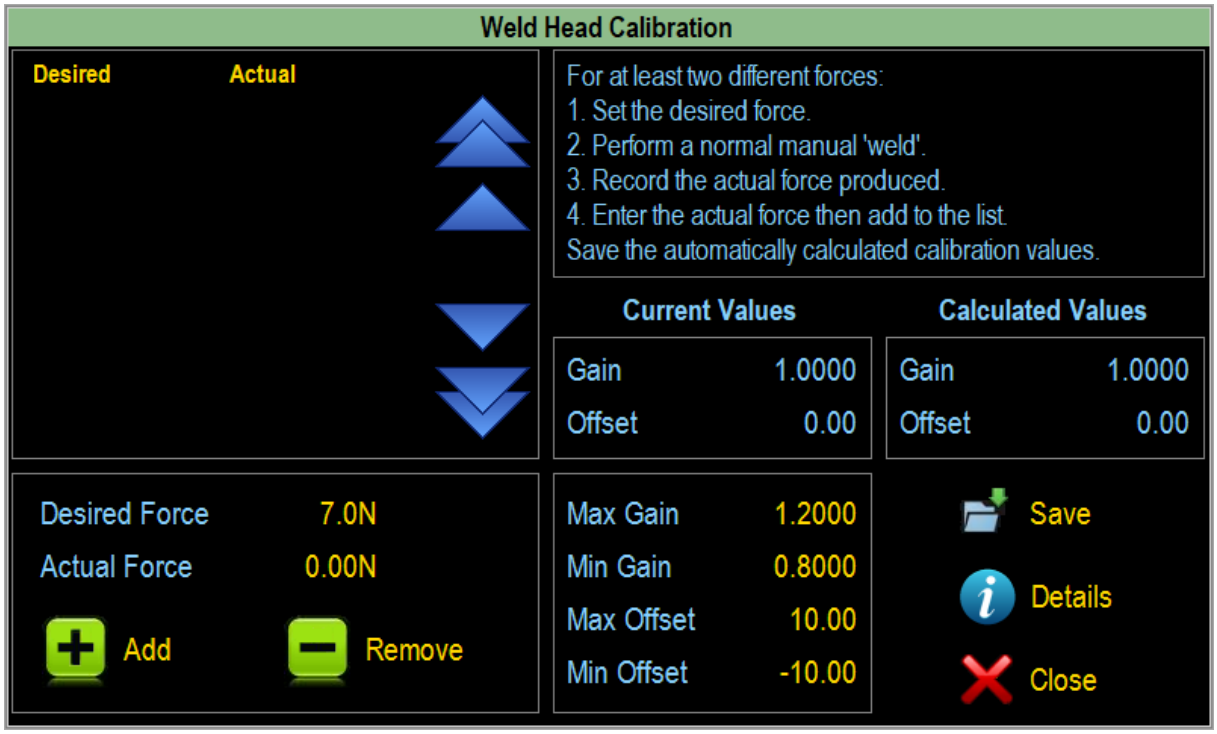
Place a part between the electrodes and perform a ‘weld’. The electrodes will make contact at low force. Upon contact, the positional information is stored as Approach Position.



Now ‘Approach Control’ can be enabled.



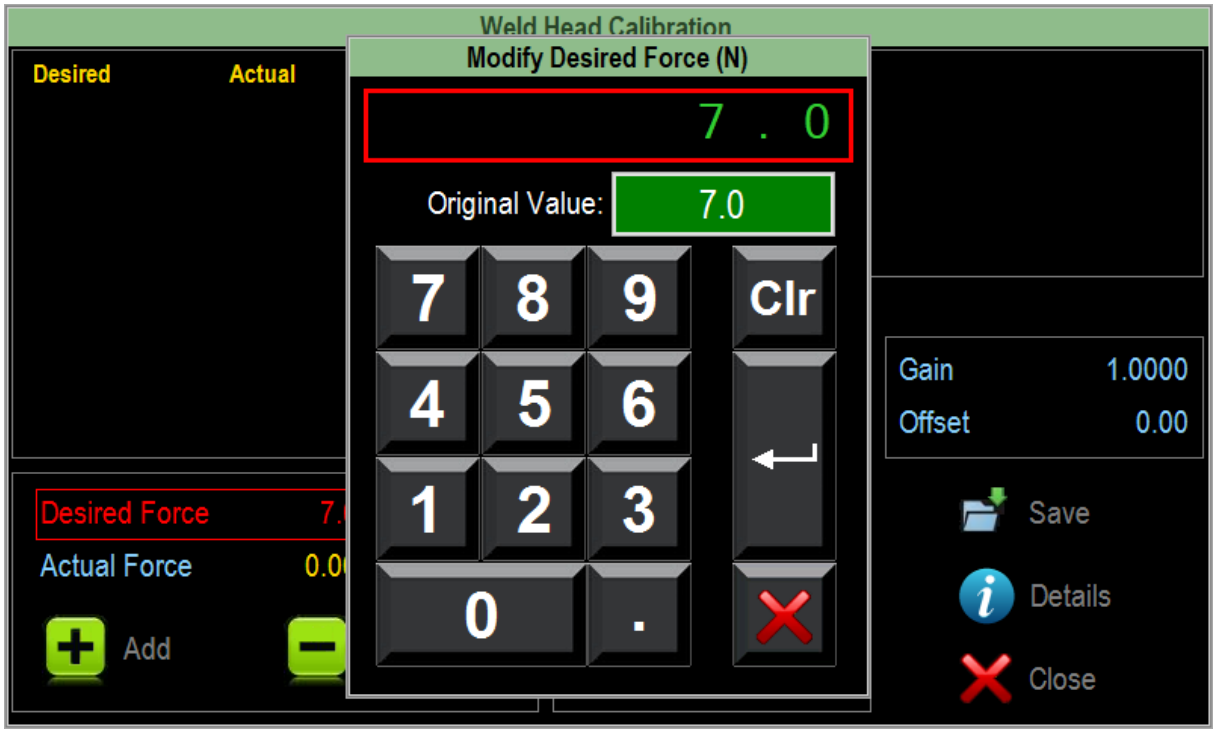
8.6 Calibrating Head



The above screen (or similar) appears when the ‘Calibrate Weld Head’ menu option is selected. The default gain and offset values for the calibration are 1 and 0 respectively. If the head has already been calibrated then different values may be shown on entry.

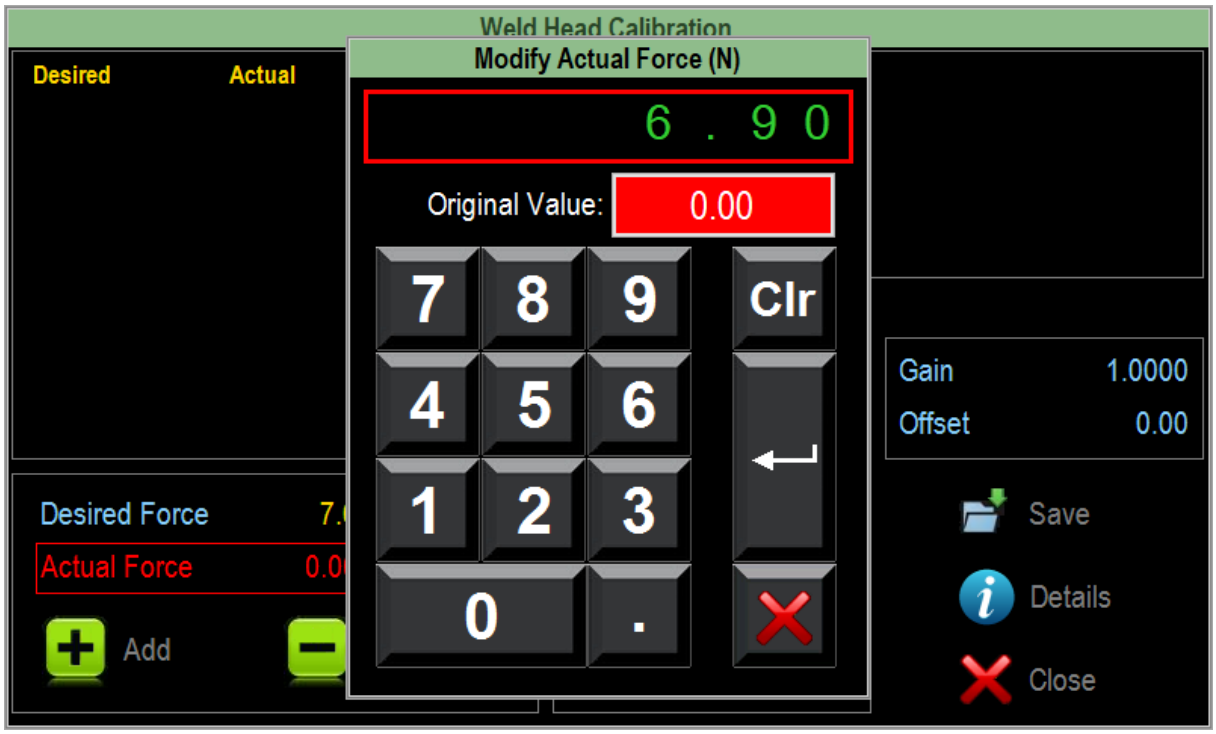
It is recommended to calibrate the head over a range of values, preferably comprising the range of forces that will be used when welding. When at least 2 different values have been entered, new gain and offset values are automatically calculated using a line of best fit.

To create a new desired/actual force pairing, select the ‘Desired Force’ field as follows:



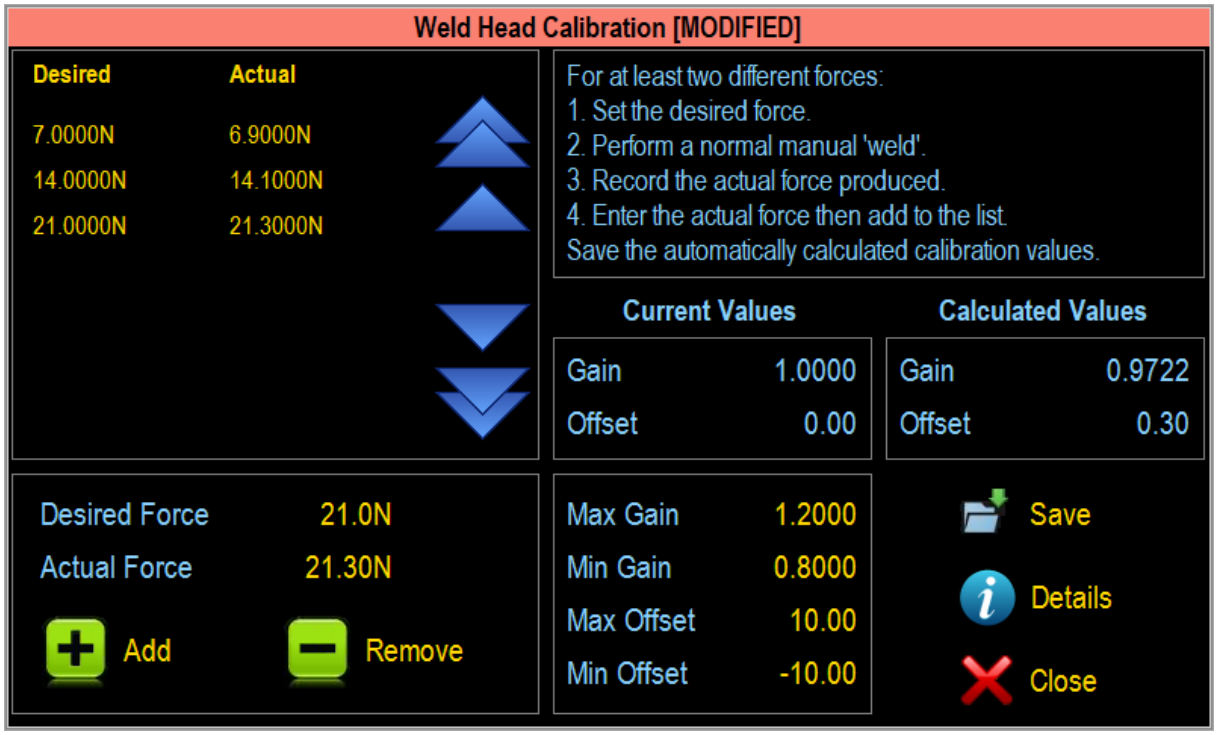
The actual force then needs to be measured with a suitable force gauge. (Such a gauge is available from Amada Weld Tech if required.) To do this, a 'weld' needs to be performed by closing the weld head. When using a pedal, the head will remain closed the first time that the pedal is released. Note that no electrical current will be passed during this process.

The measured value should then be entered by selecting the 'Actual Force' field as follows:

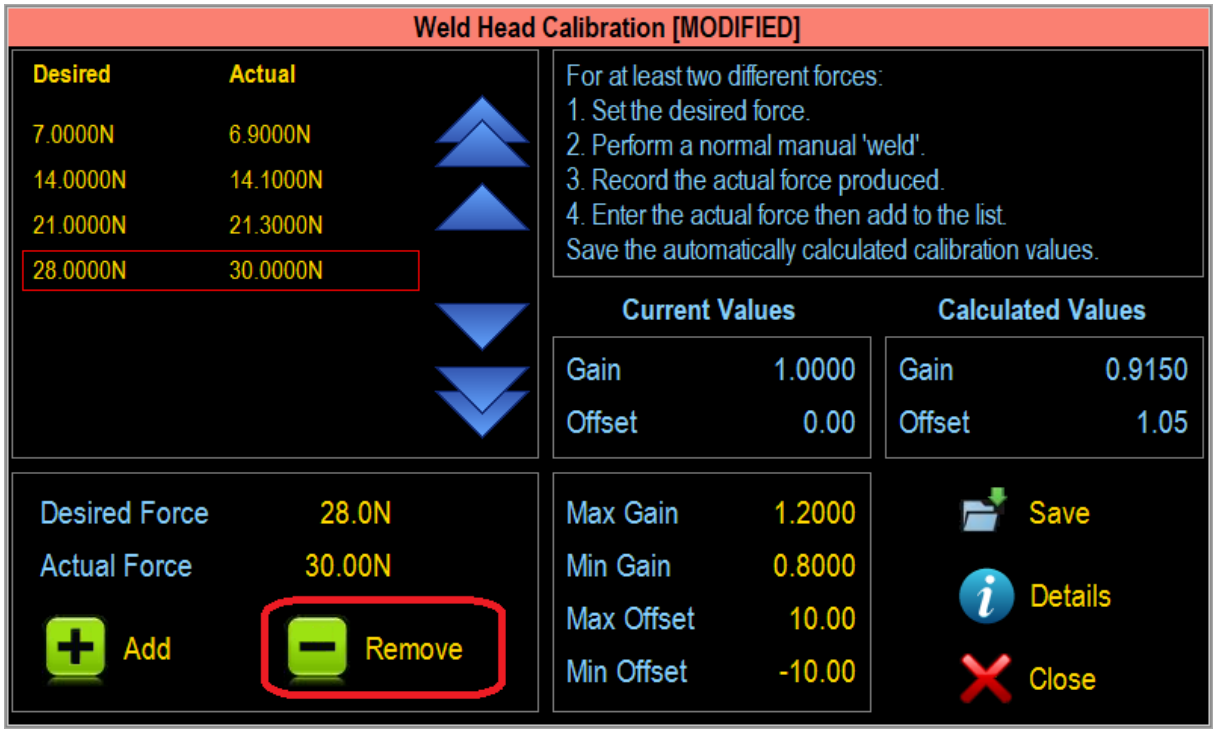


The weld head can then be released by pressing and releasing the pedal again. If the desired/actual force pairing is deemed to be accurate, the pair can be added to the list by pressing the 'Add' button.

This process should be repeated over the required range of forces. As can be seen below, the calculated values have been updated accordingly:



At any time, unwanted desired/actual force pairings can be deleted by selecting them and then using the ‘Remove’ button:

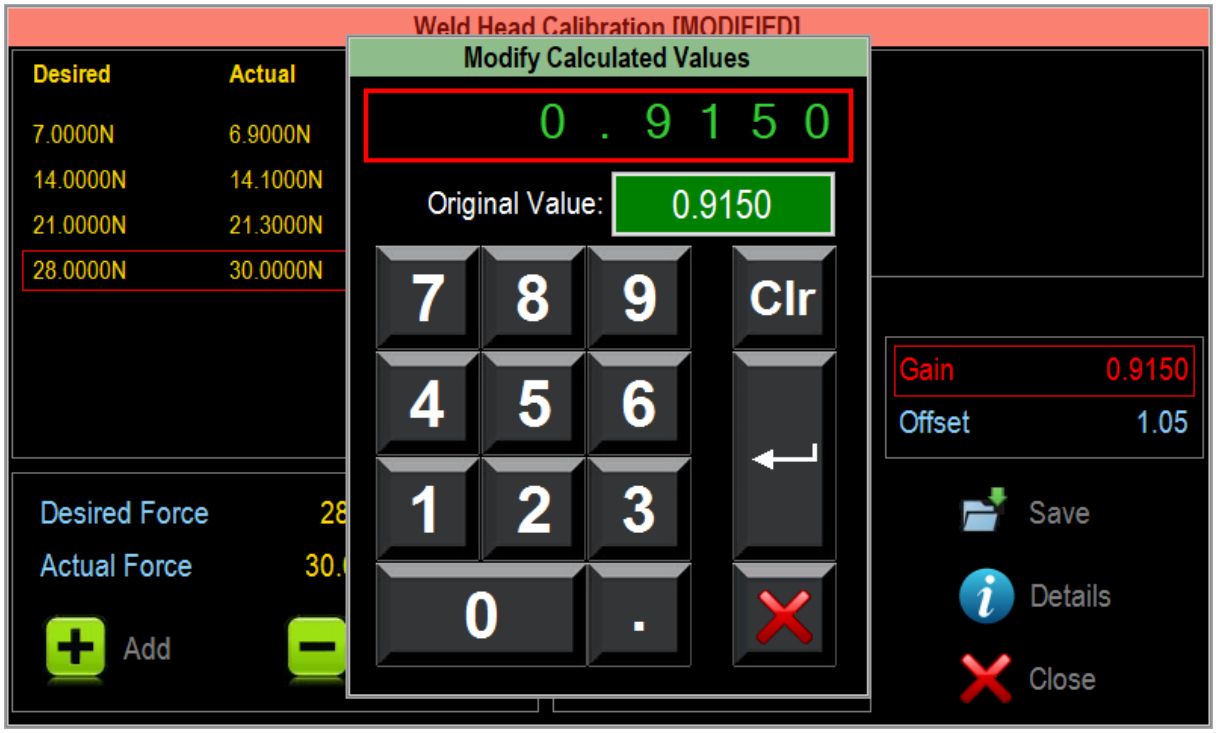


Further explanation of the calibration process is available on the welder by pressing the ‘Details’ button.

When the measurements are complete, the newly calculated calibration values can be saved by pressing the ‘Save’ button. The current values will then be updated with the new values.

The maximum and minimum gain and offset values can be adjusted if these prevent accurate calibration from being performed. It is unlikely, however, that the gain and offset will be very far from the defaults of 1 and 0, unless there is a problem with the system.

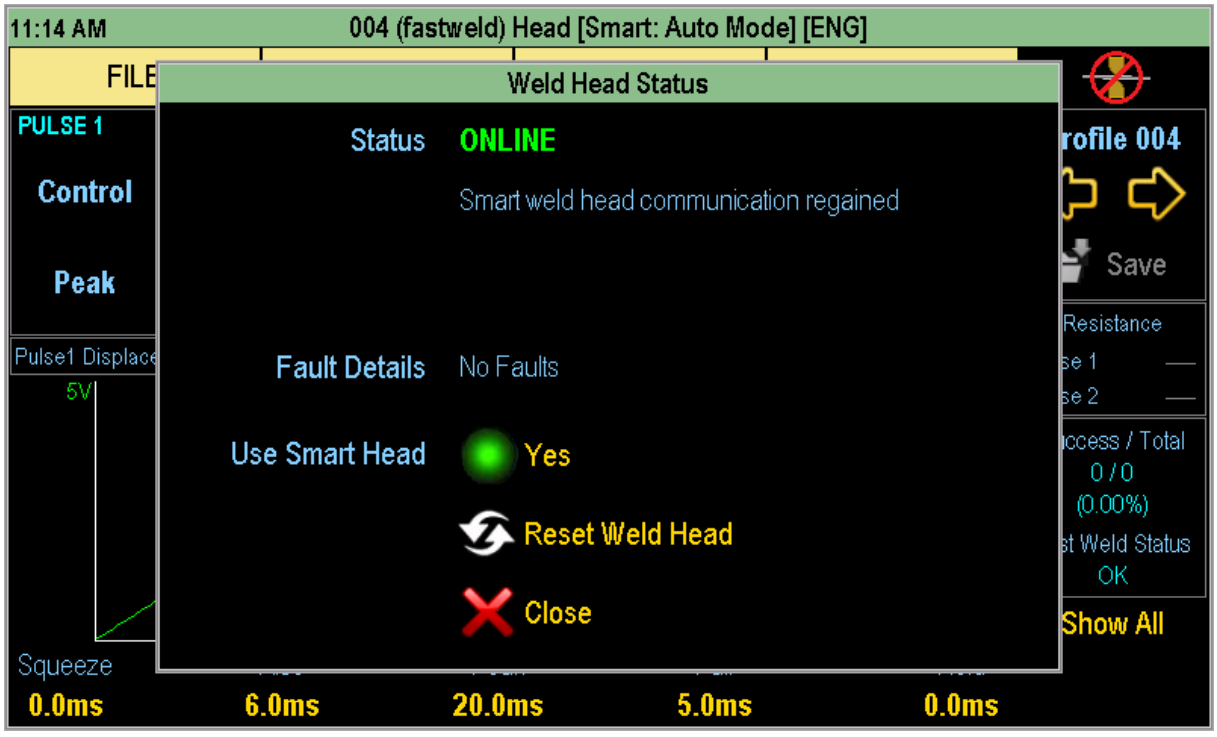
The option is also available to manually enter calibration values by pressing the Calculated Values gain and offset fields. However, this is not recommended as any such values are unlikely to be accurate.



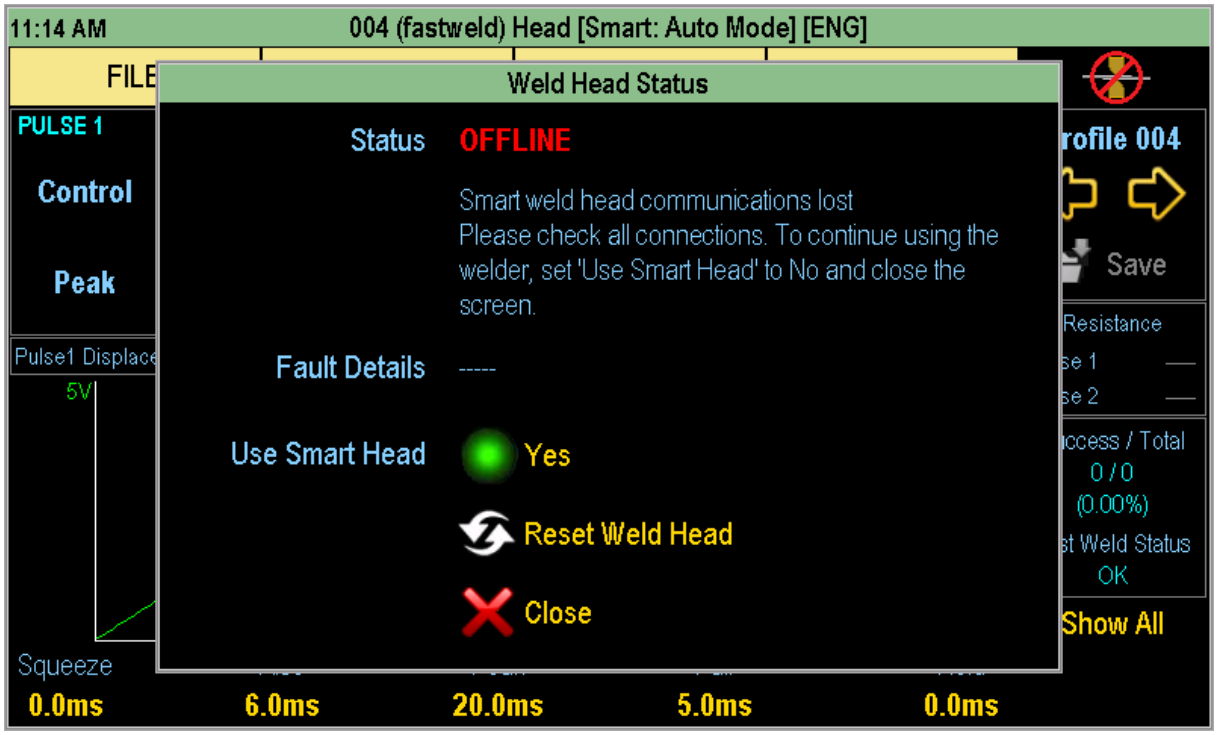
Please be aware that certain weld head and welder settings are changed when the calibration screen is active. These are returned to their previous values when the screen is closed. If the power supply or the weld head controller are powered down whilst the screen is active, then these values will be retained and may affect operation.

8.7 Weld Head Status Screens

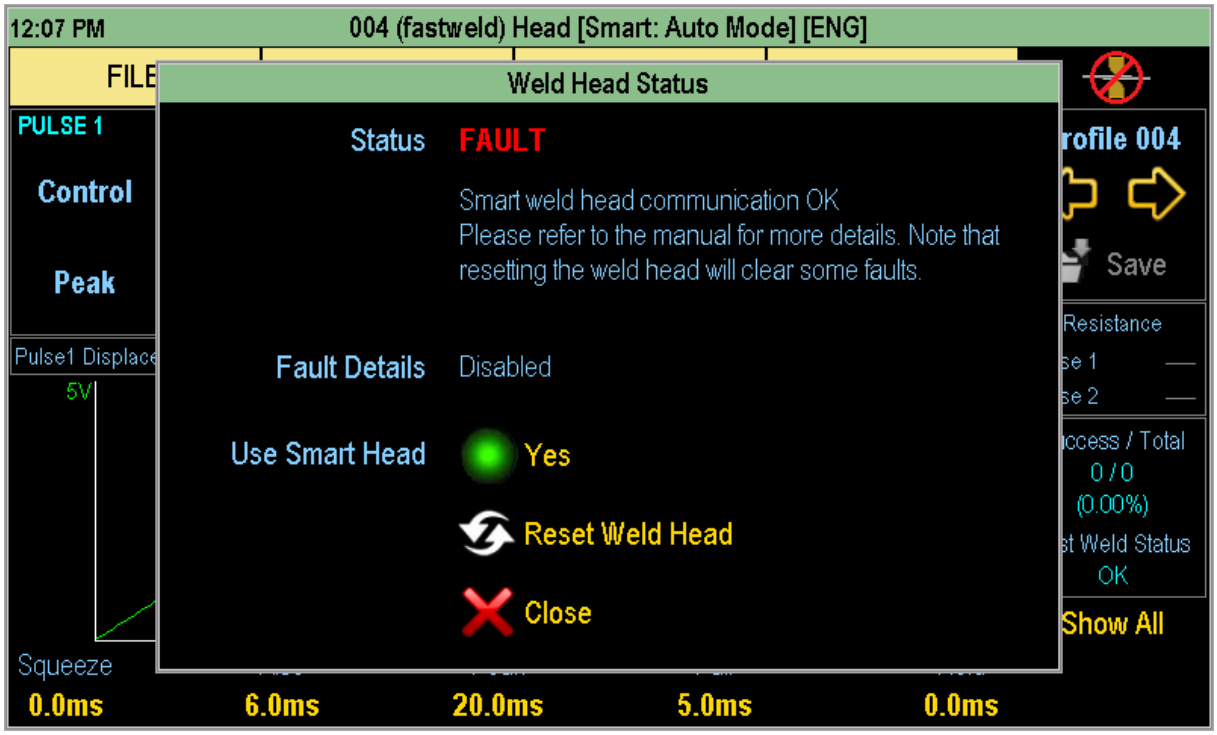
The weld head status screen gives information about the communication status between the welder and the weld head. The window will open automatically when information needs to be shown or action needs to be taken. Instructions are given where necessary, and the weld head can be reset, disabled, or enabled and the status window can be closed.



The above screen is shown when the weld head has come online (from an offline status). The window can be closed and welding can be continued.



The above screen is shown when the weld head has gone offline. If the weld head is no longer needed then it should be disabled by changing the ‘Use Smart Head’ setting to ‘No’. If the weld head needs to continue to be used then connections should be checked. If the connections are correct but the status is still offline then power should be cycled on the weld head controller.



The above screen is shown when an internal weld head controller fault has been detected. Any actions to be taken are dependent upon the actual fault. These are listed in the table below.

Fault Name	Details	Actions
Disabled	Check the status of the enable link on the rear panel and the enable/disable switch on the front panel. Both must be enabled to clear the fault. Afterwards, the head must be reset	Enable Reset head
Command	Internal command error. Head must be reset	Reset head
Under voltage	Indicates motor supply problem. Switch the system on and off. If the fault does not clear, please contact Amada Weld Tech.	Power cycle
Over voltage	Indicates motor supply problem. Switch the system on and off. If the fault does not clear, please contact Amada Weld Tech.	Power cycle
Over temperature (drive)	Do not operate, switch the weld head controller off and wait for the unit to cool down.	Power down Allow to cool
Over temperature (motor)	Do not operate, switch the weld head controller off and wait for the unit to cool down.	Power down Allow to cool
I2T	Indicates an over duty cycle error. Reset the weld head and increase the delay between welds.	Reset head Increase delay
Over current	Motor has exceeded the internal current limit. Head must be reset	Reset head
Short circuit	Output from motor to drive has a short circuit. Switch of the system and check the connections.	Power down Check connections
Position wrap	Internal position calculation error. Reset the weld head	Reset head
General control	Internal error	Reset head
Invalid setup	Motor data file is missing. Reset the weld head to reload the data file.	Reset head
Closure disabled	This error only applies to MK1 weld heads with the 5-pin black motor cable. Check that the closure / enable switch on the front panel of the weld head controller is in the ‘enable’ position then reset the weld head.	Check enable Reset head

9 Index

9.1 Headword Index

10 Appendix A: Sample Configuration File

```
StartAccessLevels

AboutScreen = Operator
AccessScreen = Operator
AccessConfigScreen = Supervisor
AdvancedSettingsScreen = Supervisor
AnalyseChannelScreen = Operator
AnalyseScreen = Operator
AverageDisplacementScreen = Operator
AverageElectricScreen = Operator
CalibrationScreen = Engineer
CalMoreScreen = Engineer
DataLogScreen = Supervisor
DisplacementDetailsScreen = Operator
DisplacementSettingsScreen = Operator
DistributionClearScreen = Supervisor
DistributionConfigureScreen = Supervisor
DistributionMonitorScreen = Operator
ElectrodeScreen = Operator
EncoderScreen = Supervisor
EnterPasswordScreen = Operator
EventEntryScreen = Supervisor
EventLogViewScreen = Supervisor
FaultOptionsScreen = Operator
FaultReportScreen = Operator
HardLimitsScreen = Operator
ImageScreen = Operator
IOConfigScreen = Engineer
IODefaultScreen = Engineer
IoTestScreen = Engineer
KeyboardScreen = Operator
LoadScreen = Operator
LoadAssociatedDoc = Operator
LoadAssociatedImage = Operator
LoadDeleteLog = Supervisor
LoadDeleteScreenshot = Supervisor
LoadForce = Supervisor
LoadForceSave = Supervisor
LoadLog = Supervisor
LoadLogProfile = Supervisor
LoadPattern = Operator
LoadProfile = Operator
LoadProfileOperator = Operator
LoadProfileSave = Supervisor
LoadProfileSelect = Supervisor
LoadServer = Supervisor
LoadUsb = Supervisor
LogAnalyseScreen = Supervisor
LogConfigureScreen = Supervisor
LogListScreen = Supervisor
LogViewScreen = Supervisor
MacweldSelectionScreen = Operator
MainScreen = Operator
MaintenanceScreen = Operator
ManageAutoLogScreen = Supervisor
MemoryManagementScreen = Supervisor
MessageBoxScreen = Operator
NumberKeyPad = Operator
OperatorModifyScreen = Supervisor
OperatorScreen = Supervisor
PasswordScreen = Operator
PatternOperator = Supervisor
PatternPattern = Supervisor
```

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PatternProfilesScreen = Supervisor
PersonaliseScreen = Engineer
ProfileSwitchScreen = Operator
PulseDetailsScreen = Operator
PulseSwitchScreen = Supervisor
RecentWeldScreen = Operator
RecordCycleScreen = Supervisor
RecordToleranceScreen = Supervisor
ResetRamScreen = Engineer
ScratchPadScreen = Operator
ServerConfigureScreen = Supervisor
SetDateTimeScreen = Operator
SettingsScreen = Operator
SoftwareUpdateScreen = Supervisor
SpcParameterScreen = Supervisor
SpcPointScreen = Supervisor
StartOptionsScreen = Operator
TimestampSelectionScreen = Supervisor
TolerancesScreen = Operator
UsbExplorerScreen = Supervisor
WearCountScreen = Operator
WeldHeadCalibrationScreen = Supervisor
WeldHeadControlScreen = Supervisor
WeldHeadSettingsScreen = Supervisor
WeldHeadStatusScreen = Operator
WeldInfoScreen = Operator

EndAccessLevels

StartParameterAccessLevels

Pulse1Control = Operator
Pulse1Max = Operator
Pulse1Min = Operator
Pulse1Fall = Operator
Pulse1Hold = Operator
Pulse1Peak = Operator
Pulse1Rise = Operator
Pulse1Limits = Operator
Pulse1TolHigh = Operator
Pulse1TolLow = Operator
Pulse1WinHigh = Operator
Pulse1WinLow = Operator
Pulse1EnergyLim = Operator
DwellTime = Operator
Pulse2TolHigh = Operator
Pulse2TolLow = Operator
Pulse2WinHigh = Operator
Pulse2WinLow = Operator
Pulse2Control = Operator
Pulse2Max = Operator
Pulse2Min = Operator
Pulse2Fall = Operator
Pulse2Hold = Operator
Pulse2Peak = Operator
Pulse2Rise = Operator
Pulse2Limits = Operator
Pulse2EnergyLim = Operator

EndParameterAccessLevels

StartMiscAccessLevels

Squeeze = Operator
```

```
Hold = Operator
ProfileSwitch = Operator
ResetCounts = Operator
ToggleDisplacement = Operator
AssociatedModify = Supervisor
SettingsModify = Supervisor
ManualElectrode = Engineer
AverageDisplaceModify = Supervisor
AverageElectricModify = Supervisor
AverageLimitsModify = Engineer
DataLoggingModify = Supervisor
DisplaceSettingsModify = Operator
DistributionConfigModify = Supervisor
FaultOptionsModify = Supervisor
EnergyLimits = Supervisor
PulseDetailsModify = Operator
SettingsControlModify = Supervisor
CustomerConfig = Supervisor

EndMiscAccessLevels
```