Introduction to WS700

Spot/Seam control,monitor and machine sequencer
for 50/60Hz resistance welding.

For s/w version 1.45

Document revision 0

Manufacturers of advanced welding controls

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- Welding controls.

- Thyristors and power supplies

- Power Inverters.

- Meters and Monitors.
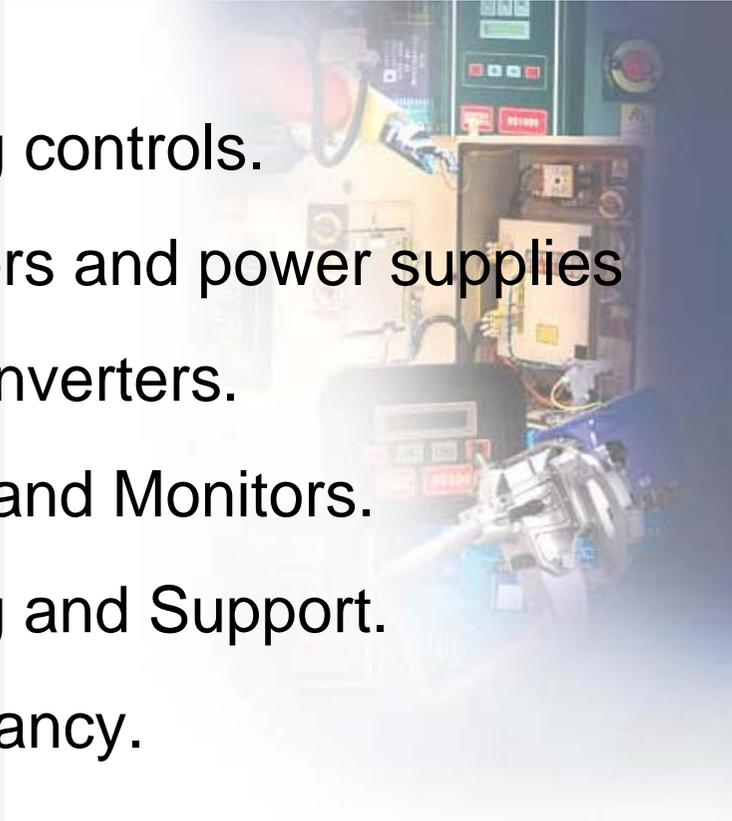
- Training and Support.

- Consultancy.

Table of contents

Functions

- Spot / Repeat / Roll-spot / Seam(dual heat)/Seam(pre-heat)/ half-cycle welding.
- Dual weld intervals plus pulsation, upslope and downslope.
- Constant current regulation.
- 64 programmes (internal or external selection).
- Current monitoring (high/low/pre limits), programmable blocking.
- Proportional valve controller (0..10V). Selectable units (kN/lbf)
- Pressure monitoring (high/low limits).
- Programmable outputs (events).
- Machine sequencer logic.
- Programmes may be linked together for multiple spot sequences.
- Contactor timer.
- Retract/high-lift control.

…functions

- Head-lock function.

- Weld counter (programmable blocking).

- Heat stepper (programmable blocking).

- Pop-up current meter.

- Weld history log.

- Support for G.E. Schmidt NVS nut-welding system.

- Primary or Secondary feedback via Toroid or CT.

- Toroid, CT and PV calibration functions.

- Toroid test function.

- Disable edit function.

- Large backlit 4x20 lcd display.

- RS232 port, for PC communications and print out of weld data.

Users connections

P1 OUTPUTS

EXTERNAL POWER SUPPLY 24V DC

Pin	Signal	AWS J1 DESIGNATION*
1	+24V	FSC
2	0V	SVC / POC
3	OUTPUT 8	SV8 / PO8
4	READY / OUTPUT 7	SV7 / PO7
5	CONTACTOR / OUTPUT 6	MC1 / PO6
6	COUNTER / OUTPUT 5	SV5 / PO5
7	FAULT / OUTPUT 4	FT1 / PO4
8	EOS / OUTPUT 3	EH1 / PO3
9	HAV / OUTPUT 2	RV1 / PO2
10	WAV / OUTPUT 1	SV1 / PO1

WAV AND HAV OUTPUTS RATED 500mA @ 24V DC.
ALL OTHER OUTPUTS RATED 100mA @ 24V DC

P2 INPUTS   24V

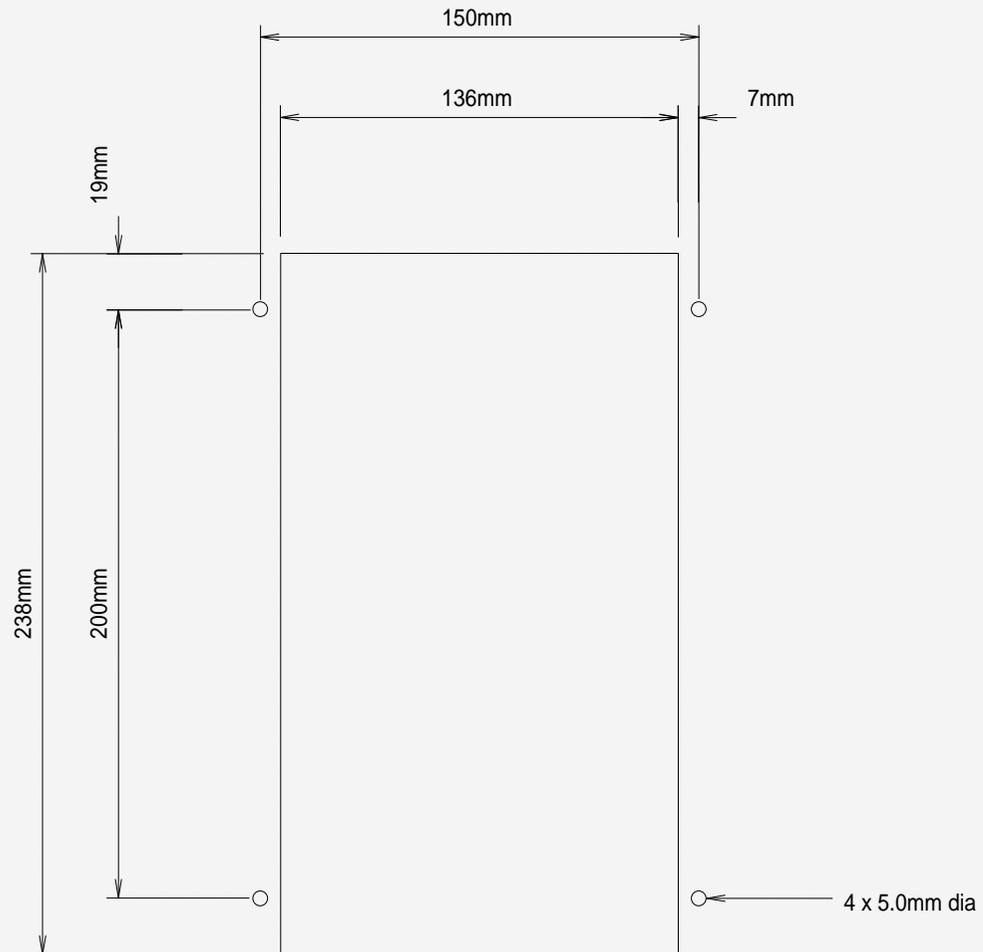| Pin	Signal	AWS J1 DESIGNATION *
1	START / INPUT 01	INIT / PI1
2	**WELD ON / INPUT 02	NW1 / PI2
3	**2nd STAGE / INPUT 03	PS1 / PI3
4	RETRACT / INPUT 04	RT1 / PI4
5	RESET FAULT / INPUT 05	FR1 / PI5
6	RESET COUNTER&STEPPER / INPUT 06	SR1 / PI6
7	PROG 1 / INPUT 07	BP1 / PI7
8	PROG 2 / INPUT 08	BP2 / PI8
9	PROG 4 / INPUT 09	BP4 / PI9
10	PROG 8 / INPUT 10	BP8 / PI10
11	PROG 16 / INPUT 11	BP16 / PI11
12	PROG 32 / INPUT 12	BP32 / PI12
13	STOP/AIR OK***/INPUT 13/NVS L1	ES1 / PI13
14	THERMAL/WATER OK***/INPUT 14/NVS L2	TS1 / PI14
15	INPUT 15/NVS L3	IN15 / PI15
16	EDIT DISABLE / INPUT 16	IN16 / PI16

P4 RS232

Pin	Signal
1	24V
2	TX
3	RX
4	CTS
5	COM
6	
7	
8	DTR
9	0V

NOTE:
24V(pin 1) and 0V(pin 9) are connected to P1 (pins 1 and 2), and are isolated from the RS232 signals.

NOTES:

* AWS J1 designations are used when configured for ENGLISH(US).

** These inputs must be linked out if not used.

*** Air and water switch inputs are available on V1.27 onward. Stop and thermal functions are available on V1.36 onwards.

NVS function inputs are available on V1.34 onward.

Fit EITHER a toroid OR a CT.
Use Toroid for secondary currents(2...60kA), connected to pins 1&3.
Use CT for primary currents (0.1...4kA), connected to pins 2&3.

CT

TOROID (100-2000mV/kA)

TOROID

SYNCHRONISING SIGNAL TRANSFORMER >6VA

24V AC

PULSE TRANSFORMER

Transducer (e.g. pressure sensor)

Proportional Valve

P3 SENSORS

Pin	Signal
1	TOROID
2	CT
3	TOROID/CT COMMON
4	GND
5	SYNC
6	SYNC
7	THYRISTOR FIRING CIRCUIT
8	0V
9	INPUT (0..10V)/ Analog Input A1
10	0V
11	GND
12	OUTPUT (0..10V)
13	0V
14	GND

Note that if the timer is supplied fitted into a case, some connections will have been pre-wired by BF Entron. See the case wiring diagram for details.

Dimensions

BF
ENTRON

WS700

RS232

P2

P1

P3

38mm

172mm

135mm

292mm 235mm

35mm

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Mounting

To mount a WS700 timer into a panel, you will need to cut an aperture and drill holes as shown here:

150mm

136mm

7mm

19mm

238mm

200mm

4 x 5.0mm dia

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Global parameters

Configuration

- Sequence
    - Spot / Roll-spot / Seam(2-heat/pre-heat) / ½-cycle(alt/+/-)
- Retract:
    (Simple / Hi-lift+ / Hi-lift-)
- Frequency (50/60 Hz)
- Contactor time (0..200 s)
- Blanking (On/Off)
- Await Pressure (On/Off)
- Toroid test (On/Off)
- Sensor (Toroid/CT)
- Heat range(Wide/High/Low)
- Head-lock/Stop/Continue on fault
- Sequencer (On/Off)
- Test inputs (Off/Air&Water/Air&Water-latched/Stop&thermal)
- NVS System (On/Off)
- Language (UK/US)

Stepper

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

Calibration

- Toroid sensitivity(100..2000 mV/kA)
- Toroid attenuation factor (1..4)
- CT S/P ratio (1:1..199:1)
- CT S/P offset (-1kA..+1kA)
- Seam CCR gain
- Pressure (2 points, kN/V or lbf/V)
- Analog input gain (0.9..2.5)
- Analog input offset(-9.99..+9.99 V)

Counter

- Actual count (0..9999).
- Terminal count(0..9999).
- Stop at end/continue at end.
- Synchronise with log (Yes/No)

Output Map

- Normal/Event/Sequencer (x8)

Input Map

- Normal/Sequencer (x16)

Sequencer

- Up to 250 statements

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Program parameters (x64)

Weld program

- Pre-squeeze (0..99 cycles)
- Squeeze (0..99 cycles)
- Weld1 (0..99 cycles)
- Cool1(0..99 cycles)
- Weld2(0..99 cycles)
- Cool2(0..99 cycles)
- Pulses(0..9)
- Upslope(0..99 cycles)
- Downslope (0..99 cycles)
- Hold(0..99 cycles)
- Off(0..99 cycles)
- Pressure (0..10V)
- Heat 1(0..99.9%)
- Heat 2(0..99.9%)
- Current 1 (0..60kA)
- Current 2 (0..60kA)
- Balance (seam only)
- Normal/Link program

Monitor limits

- Current monitor On/Off
- Current low limit,weld1 (0..99%)
- Current high limit,weld1 (0..99%)
- Current pre-limit,weld1 (0..99%)
- Current low limit,weld2 (0..99%)
- Current high limit,weld2 (0..99%)
- Current pre-limit,weld2 (0..99%)
- Pre-limit count (0..99)
- Pressure monitor On/Off
- Pressure low limit (0..99%)
- Pressure high limit (0..99%)

Events

- 4 x 4 trigger points

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Keypad and indicators

LED Indicators

Program running
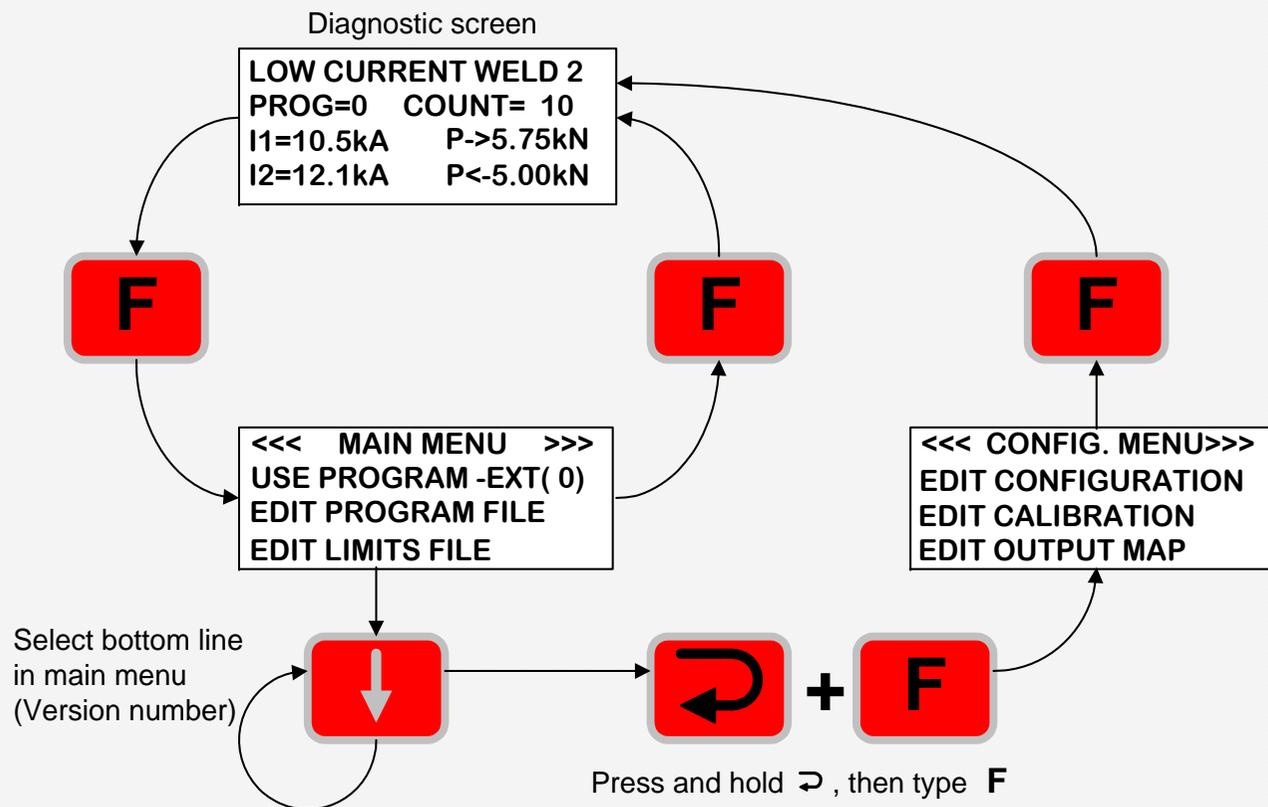
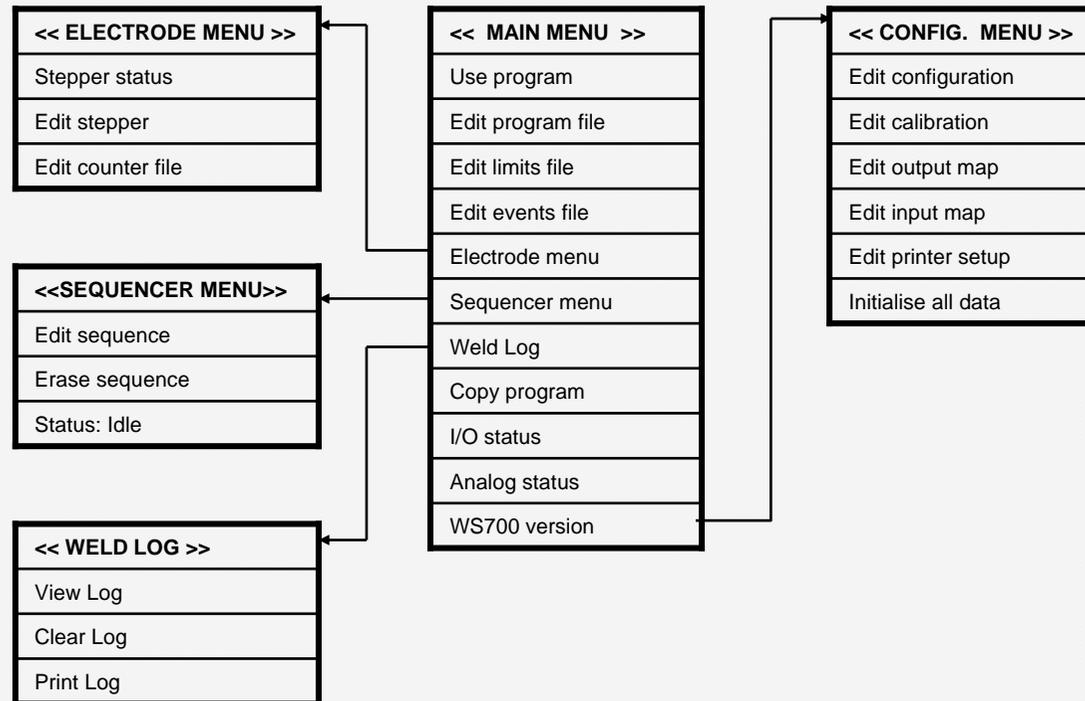Welding   Timer ready
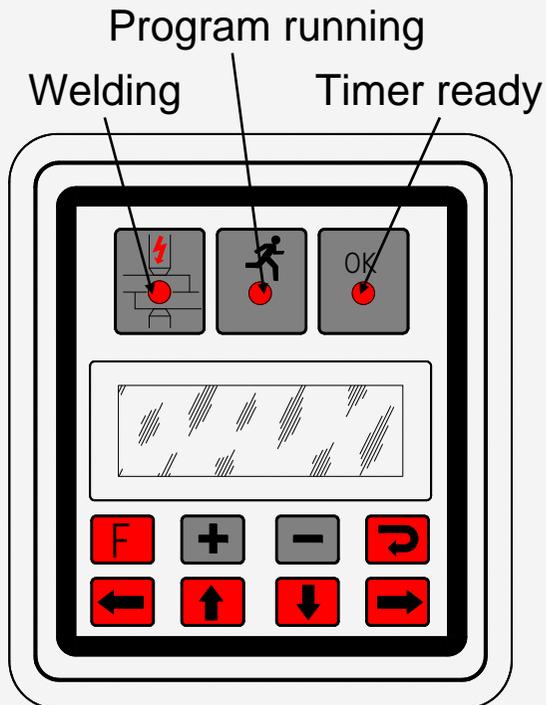
Using the keypad

• Press the **F** (function) key to return to the previous screen, or to move between menu screens (see menus).

• The selected function or parameter will flash.

• Use the ⬅ ⬆⬇ ➡ keys to select a different function or parameter. The visible window will scroll when required.

• Press the ⤴ key to access the selected function.

• Press the **+** or **-** keys to alter the selected parameter. Press **+** and **–** together to set a parameter to 0 or its minimum value.

• On some screens, certain keys can have a special function. These are noted on the page describing that screen.

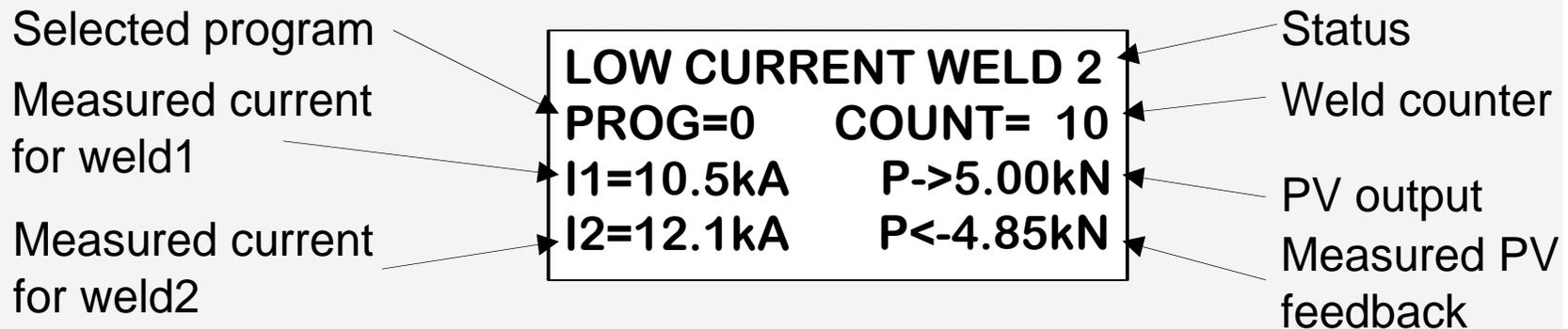WS700 V1.45

Menus

The various functions of the timer are arranged into a set of menus and screens. The diagrams below shows how these are organized and accessed:

Diagnostic screen

```
LOW CURRENT WELD 2
PROG=0    COUNT=  10
I1=10.5kA        P->5.75kN
I2=12.1kA        P<-5.00kN
```

F

F

F

```
<<<    MAIN MENU    >>>
USE PROGRAM -EXT( 0)
EDIT PROGRAM FILE
EDIT LIMITS FILE
```

```
<<<  CONFIG. MENU>>>
EDIT CONFIGURATION
EDIT CALIBRATION
EDIT OUTPUT MAP
```

Select bottom line in main menu (Version number)

↓

�averaging + **F**

Press and hold ↩ , then type **F**

..menus

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

<< MAIN MENU >>
Use program
Edit program file
Edit limits file
Edit events file
Electrode menu
Sequencer menu
Weld Log
Copy program
I/O status
Analog status
WS700 version

<< CONFIG. MENU >>
Edit configuration
Edit calibration
Edit output map
Edit input map
Edit printer setup
Initialise all data

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

<< WELD LOG >>
View Log
Clear Log
Print Log

13

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Diagnostic display

Selected program

Measured current for weld1

Measured current for weld2

```
LOW CURRENT WELD 2
PROG=0      COUNT= 10
I1=10.5kA       P->5.00kN
I2=12.1kA       P<-4.85kN
```

Status

Weld counter

PV output

Measured PV feedback

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

Status: diagnostic error messages. If more than one exists, these are flashed sequentially.
Selected program: this is the program no. that is presently selected.
Measured current: the RMS current measured during the last weld.
Weld counter: the present value in the counter (updates after each weld)
Stepper %complete:shows the progress along the stepping curve.
PV output: The output from the PV controller is determined by the pressure parameter in the selected program.
Measured PV feedback: the dynamic value measured from the feedback channel.

- Press the **F** key to move to the Main menu screen.
- Press ⮌ to reset faults (same action as external input).

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Status messages

The description (abbreviated) appears on the top line of the diagnostic screen.

To reset faults, select the diagnostic screen then press ↻ , or activate the external input.

Description	Advice
Configuration error	Edit the configuration file
No sync (50/60Hz)	Check 27V AC sync. signal source / Check frequency in configuration file
Counter end	Reset counter
Retract not ready	Operate retract input
Data error	Edit program
Weld off	Close Weld-on switch
No current (weld 1)	Check secondary circuit / check toroid connection
No current (weld 2)	Check secondary circuit / check toroid connection
Low current (weld 1)	Check secondary circuit or adjust parameters
Low current (weld 2)	Check secondary circuit or adjust parameters
Pre-alarm (weld 1)	Check secondary circuit or adjust parameters
Pre-alarm (weld 2)	Check secondary circuit or adjust parameters
High current (weld 1)	Check secondary circuit or adjust parameters
High current (weld 2)	Check secondary circuit or adjust parameters
Low pressure	Check air system or adjust parameters
High pressure	Check air system or adjust parameters
Toroid overrange	Reduce current, or use an external signal attenuator
Toroid short circuit	Inspect toroid connection
Toroid open circuit	Inspect toroid connection
Sequencer error	Edit sequencer program
Headlocked	Operate reset fault input
No Air	Check air sensor or other circuit on Input 13. Reset faults.
No Water	Check water sensor or other circuit on Input 14. Reset faults.
Stepper prewarning	Advance warning of elctrode service required
End of Stepper	Service electrodes and reset stepper
Lost Sync	Synchronisation was lost during welding. Check mains waveform.
NVS:Pin not extended	Check locator pin on nut-welder
NVS:bad setup	Check dispenser on nut-welder. Reset faults.
NVS:bad setdown	Check weld condition on nut-welder. Reset faults.
STOP	Check STOP signal on Input 13
No thermal	Check signal on input 14.

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Main menu

USE PROGRAM -EXT(0)
EDIT PROGRAM FILE
EDIT LIMITS FILE
EDIT EVENTS FILE
 EDIT COUNTER FILE
 WELD LOG
 SEQUENCER MENU
 COPY PROGRAM
 I/O STATUS
 ANALOG STATUS
 WS700 VERSION 1.22

Visible window

Change this parameter to select which program will be run when a start input is given. Set this parameter to **EXT** if you wish to select programmes via the external inputs (the external value will be shown in brackets).

For information only

•Press the **F** key to return to the diagnostic screen.

Note: To access the **Configuration menu**, select the 'version' line on the main menu (last line), hold down the ⟳ key, then press the **F** key.

Configuration menu

EDIT CONFIGURATION
EDIT CALIBRATION
EDIT OUTPUT MAP
EDIT INPUT MAP

Visible
window

EDIT PRINTER SETUP
INITIALISE ALL DATA

•Press the **F** key to return to the diagnostic screen.

Note: To access the **Configuration menu**, select the 'version' line on the **main menu** (last line), hold down the ⊃ key then press the **F** key.

Edit configuration

```
<<<CONFIGURATION>>>
SEQUENCE:SPOT
SIMPLE RETRACT
FREQUENCY 50Hz
CONTACTOR TIME  10 s
BLANKING Off
AWAIT PRESSURE On
TOROID TEST On
SENSOR TOROID
HEAT RANGE  HIGH
STOP ON FAULT
SEQUENCER   On
TEST = AIR / WATER
NVS SYSTEM   Off
LANGUAGE :ENGLISH(UK)
```

Visible window

• Sequence:**Spot / Roll-spot / Seam(2-heat) / Seam(pre-heat)/ ½-cycle alternating /**
•½-cycle positive/ ½-cycle negative.

• Retract:**Simple / Hi-lift+ / Hi-lift-**. Set to **Simple** if not required.

• Frequency:**50 Hz / 60Hz** : Set to the frequency of your mains supply.

• Contactor time (**0..200 s**): this is the delay (in seconds) after a weld, before the contactor output is turned off. Set to 0 if not required.

• Blanking (**0..99 cycles**): the first n cycles of weld current will be excluded from the measurement and limit testing process.

..edit configuration

- Await Pressure (**On/Off**): When set to **On**, the sequence will pause between end of squeeze and start of weld1, until the pressure feedback lies within the pressure limits.

- Toroid test (**On/Off**): When set to **On**, the resistance of the toroid is tested while the timer is idle. The resistance must lie between 10 and 100 Ohms. Values outside this range will prevent the timer from starting.

- Sensor:**Toroid / CT** : Select the type of feedback sensor which you are using. Usually, a toroid will be used for sensing on the secondary, and a CT is used for sensing on the primary. Most British Federal equipment has a CT built into the control, avoiding the need for an external sensor.

- Heat range **(Wide/High/Low)**:Wide corresponds to a control range of 30-150'. High corresponds to a control range of 30-130'. Low corresponds to a control range of 50-150'. Select the LOW range for machines with a poor power factor, or when exceptionally low currents are required. Select WIDE range for machines that need to produce both very high and very low currents.

- Stop on fault **(Head-lock/Stop/Continue)** :If **Head-lock** is selected, then when a weld fault is detected, the weld air-valve signal is held on and no further welds are permitted, until a fault reset is given. If **Stop** is selected, then when a weld fault is detected, the weld air-valve opens as normal, but no further welds are permitted, until a fault reset is given. If **Continue** is selected, then further welds will be permitted, regardless of the status of the previous weld.

….edit configuration

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

• Test: selects the function of inputs 13 and 14.

> **Off**: Inputs are ignored.
>
> **Air/Water**: Both inputs must be on to enable welding to begin. Seam welds will be aborted if either input is lost. Conditions will clear when inputs are restored.
>
> **Air/Water-latched**: As for the Air/Water option above. A fault reset signal is required to clear these conditions.
>
> **Stop/thermal**: Input 13 is a STOP signal. Any weld will be aborted if the STOP signal is lost. Input 14 is for a thermal monitor circuit. Seam welds will be aborted if input 14 is lost. Both inputs must be on to enable welding to begin. Conditions will clear when inputs are restored.

NVS system (see below) must be set to **Off**.

•NVS System **(On/Off):** If **On** is selected, then Inputs 13,14,15 are allocated to the NVS L1,2,3 outputs from the G.E. Schmidt NVS system, so that the WS700 can provide diagnostic information. Test (see above) must be set to **Off**. Further information about the NVS system can be found at:

> http://geschmidt.com/quality-nut-verification-system.html

•Language**(UK/US):** Selects terminology used on display.

Edit calibration

```
<<< CALIBRATION >>>
TOROID:   150 mV/kA
TOROID FACTOR  x1
S/P RATIO  50:1
S/P OFFSET     0 A
CCR GAIN (SEAM)   10
PRESSURE:  UNITS=kN
Pt1: 9.99kN @ 10.0V
Pt2: 0.00kN @ 0.00V
AN. IN GAIN  x1.000
AN. IN OFFSET +1.00 V
```

Visible window

- **Toroid:** sensitivity of the measuring coil (toroid), expressed in mV/kA.
- **Toroid Factor:** the ratio of the external attenuator which is required to measure currents>60kA
- **S/P ratio & Offset:** See next page for details.
- **Seam gain**: Adjusts the constant-current response time when seam welding (10 = fastest, 1= slowest).
- **Pressure:** relationship between the PV controller output voltage and actual tip force. This is expressed by entering two 'test' point values (Pt1, Pt2), which then define a straight-line relationship. The units are selectable (kN or lbf).
- **An.in gain:** value by which the voltage at the analog input is multiplied. Use to fine trim the reading, or to match a 5V sensor with the 10V input scale.
- **An.in offset:** value of the voltage at the analog input for a zero reading.

…calibration

• If the sensor (Toroid or CT) is measuring the primary current, the timer can display secondary values. It does this by calculation based on the **S**econdary to **P**rimary ratio (**S/P ratio**) and offset (**S/P offset**) parameters.

• To determine the correct values,

do the following:
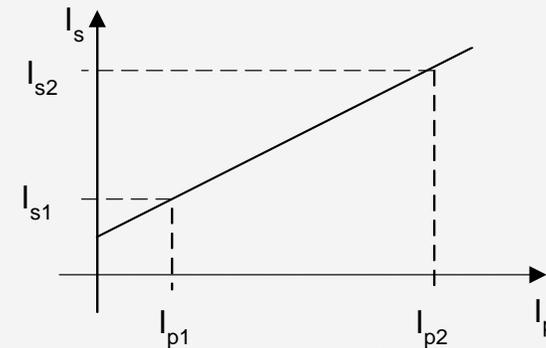
- Set the S/P ratio to 1:1 in the calibration.
- Set the S/P offset to 0 in the calibration.
- Do a short circuit weld at a low heat in PHA mode, and measure the secondary current (I_{s1})with a meter. Note the corresponding value (I_{p1}) on the timer status screen.
- Do a short circuit weld at a high heat in PHA mode, and measure the secondary current (I_{s2})with a meter. Note the corresponding value (I_{p2}) on the timer status screen.
- Calculate and enter S/P ratio = (I_{s2} - I_{s1}) / (I_{p2} - I_{p1})
- Calculate and enter S/P offset = I_{s2} - (I_{p2} x S/P ratio)

……calibration

• If you do not have a suitable meter, or you do not wish to do the calculations, you can still use primary feedback by doing the following:

1. Set the S/P ratio = **transformer turns ratio** in the calibration.
2. Set the S/P offset to 0 in the calibration.

• If you do not know the **transformer turns ratio,** then use a value of 50:1 as many welding transformers will be approximately this figure.

• The current readings on the timer will be shown in kA, and the timer will regulate (in CCR mode) to these figures, but they will not tie-up with a meter (i.e. the numbers are not absolute, but in 'scaled' Amps).

If you require precise and absolute settings then you must either:
- •Do the procedure and calculations (see previous page)
   OR
- •Use secondary feedback from a toroid, and set the sensitivity correctly.

Edit Output Map

```
<<<  OUTPUT MAP  >>>
Output Q1: WAV
Output Q2: HAV
Output Q3: EOS
Output Q4: FAULT
Output Q5: COUNTER
Output Q6: CONTACTOR
Output Q7: READY
Output Q8: LFAV
```

Visible window

Each output may be independently set up as
either:

- the standard function assigned (see users connections).

or

- as an EVENT output.

or

- as a SEQUENCER output.

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

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

Edit Input Map

```
<<<   INPUT MAP   >>>
Input I01: START
Input I02: WELD ON
Input I03: 2nd STAGE
```
Visible window

Input I04: RETRACT
Input I05: RES.FAULT
Input I06: RES.COUNT
Input I07: PROG 1
Input I08: PROG 2
Input I09: PROG 4
Input I10: PROG 8
Input I11: PROG 16
Input I12: PROG 32
Input I13: TEST 1
Input I14: TEST 2
Input I15: GAPSWITCH
Input I16: EDIT DIS.

Each input may be independently set up as
either:

- the standard function assigned (see users connections).

or

- as a SEQUENCER input.

When an input is mapped to 'sequencer', it may be used as part of the sequencer program.
Note that inputs I01 and I02 have special functions, and may only be mapped to standard.

Edit Printer setup

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

• Note that the *Print weld log* function will operate independently of the settings made here.

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

• **LINES PER PAGE:** set this to the number of lines which your printer can produce on each sheet of paper . Set to zero to suppress TABLE header.

• **FORMAT:**
    TABLE: tabulated output, suitable for driving a printer.
    ASCII-HEX: fixed length message suitable for data logging etc. on a PC
    ASCII-DEC: fixed length message suitable for data logging etc. on a PC

…print format :table

After each weld, the timer sends out a line of text, as shown in the example below. Additionally, a heading will be printed every n lines, where n is the value set for *lines per page.* Set *lines per page* to zero to suppress the heading.

COUNT	PROG	I1	I2	FORCE	ERROR
1	0	10.5kA	15.5kA	5.45kN	LOW CURRENT WELD 2
2	5	7.65kA	10.4kA	4.05kN	
3	10	0 A	12.5kA	5.05kN	
4	0	0 A	0 A	5.40kN	WELD OFF
5	5	7.50kA	10.8kA	4.00kN	
6	10	0 A	12.5kA	5.10kN	
7	0	10.5kA	16.5kA	5.40kN	HIGH CURRENT WELD2
8	5	7.50kA	10.8kA	4.00kN	
9	10	0 A	12.5kA	5.15kN	
10	0	10.5kA	16.0kA	5.45kN	

…print format :ASCII-HEX

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

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

where

COUNT=value in counter after weld (4 characters).
PROG=program number used for weld (2 characters).
CURRENT1=current measured during weld1 interval (4 characters). Units = Amps.
CURRENT2= current measured during weld2 interval (4 characters). Units = Amps
PRESSURE=pressure measured at end of weld (4 characters). Units = 0.01 kN / 1 lbf
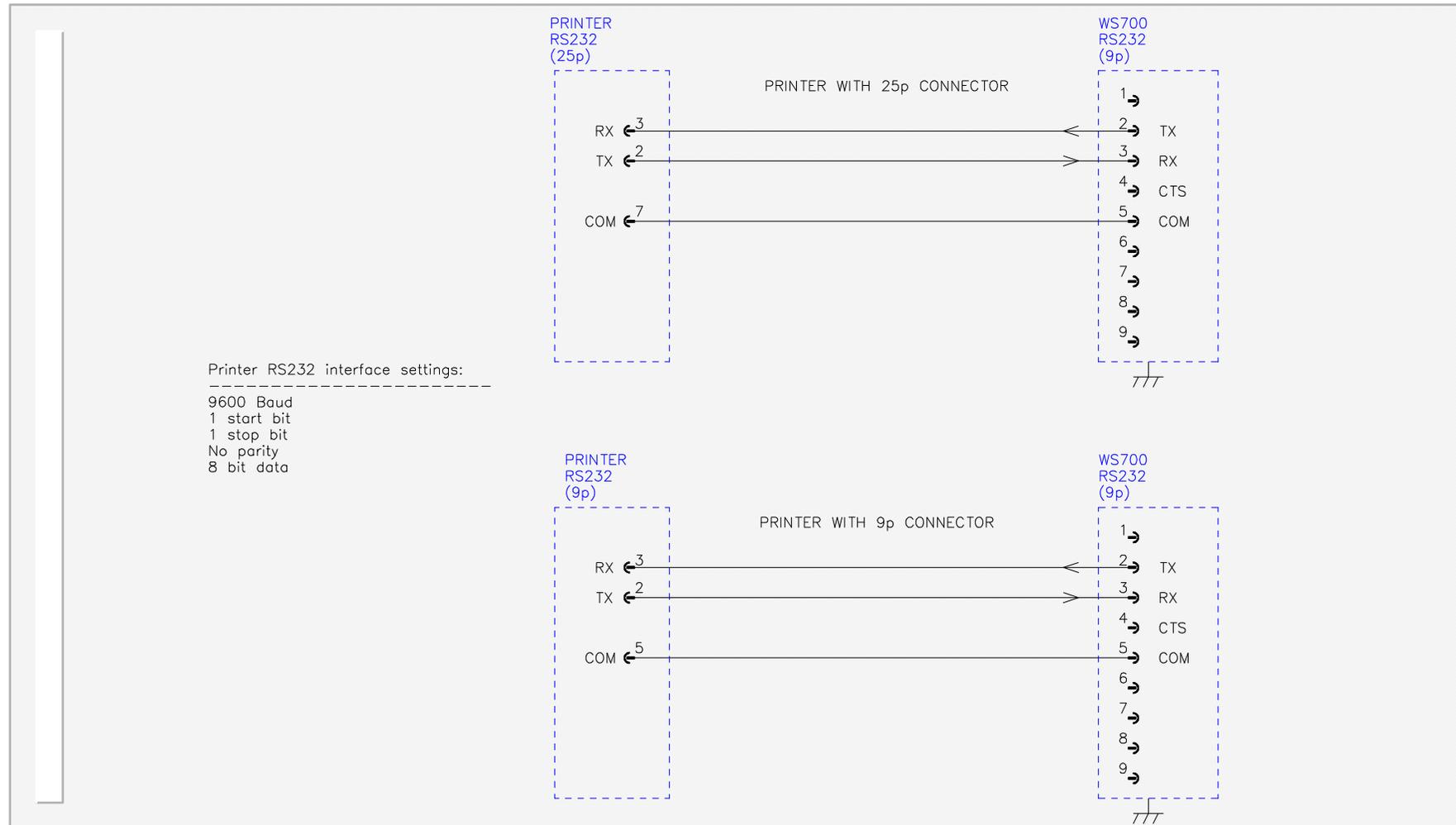STATUS=8 characters.
CR= Carriage return (hex 0D).

All data is leading zero padded, to ensure a fixed-length message (27 characters, including CR).
All data is sent most significant digit first, and in ASCII-HEX format.

i.e.　　　data=2003 (decimal) =07D3(hex)
characters sent= [0][7][D][3]
ASCII equiv.=[hex 30][hex 37][hex 45][hex33]

The STATUS field is a 32-bit bit array of 1-bit flags, encoded as follows:

Bit #	Description	Bit #	Description	Bit #	Description	Bit #	Description
0	Configuration error	8	No current (weld 1)	16	Low pressure	24	Sequencer error
1	No synchronising signal	9	No current (weld 2)	17	High pressure	25	Head locked
2	Counter end	10	Low current (weld 1)	18	Toroid overrange	26	No Air
3	Counter blocking	11	Low current (weld 2)	19	Toroid short circuit	27	No Water
4	Timer not ready	12	Pre-alarm (weld 1)	20	Toroid open circuit	28	Stepper prewarning
5	Retract not ready	13	Pre-alarm (weld 2)	21		29	End of stepper
6	Data error	14	High current (weld 1)	22		30	Stepper blocking
7	Weld off	15	High current (weld 2)	23		31	Lost Sync

…print format :ASCII-DEC

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

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

where

        COUNT=value in counter after weld (5 characters).

        PROG=program number used for weld (3 characters).

        CURRENT1=current measured during weld1 interval (5 characters). Units = Amps.

        CURRENT2= current measured during weld2 interval (5 characters). Units = Amps

        PRESSURE=pressure measured at end of weld (5 characters). Units = 0.01 kN / 1 lbf

        STATUS=8 characters (ASCII-HEX format).

        CR= Carriage return (hex 0D).

All data is leading zero padded, to ensure a fixed-length message (32 characters, including CR).

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

i.e.   data=2003 (decimal) = 02003

          characters sent= [0][2][0][0][3]

          ASCII equiv.=[hex 30][hex 37][hex 45][hex 45][hex33]

The STATUS field is a 32 bit array of 1-bit flags, encoded as shown on the previous page. Note that this field is sent in ASCII-HEX format.

…printer connections

PRINTER
RS232
(25p)

WS700
RS232
(9p)

PRINTER WITH 25p CONNECTOR

RX ⟵3 ——————————————————⟵ 2→ TX

TX ⟵2 ——————————————————⟶ 3→ RX

4→ CTS

COM ⟵7 ——————————————————— 5→ COM

1→

6→

7→

8→

9→

Printer RS232 interface settings:
————————————————————————
9600 Baud
1 start bit
1 stop bit
No parity
8 bit data

PRINTER
RS232
(9p)

WS700
RS232
(9p)

PRINTER WITH 9p CONNECTOR

RX ⟵3 ——————————————————⟵ 2→ TX

TX ⟵2 ——————————————————⟶ 3→ RX

4→ CTS

COM ⟵5 ——————————————————— 5→ COM

1→

6→

7→

8→

9→

Initialise all data

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

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

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

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Edit program

```
<<<   PROGRAM  0  >>>
I1=7.50kA   25.0%   PHA
I2=10.0kA   50.0%   CCR
PV=5.00kN@5.00V  NORM
PSQ= 0      SQZ= 10
W1 = 0     C1   =  0
W2 = 10    C2   =  0
Pulses(W2-C2)  =  1
UPS=  3    DWN = 0
HLD= 10    OFF =  0
```

Visible window

PHA=Phase angle mode. The current and heat parameters are independently adjustable. No current regulation takes place.

CCR=Constant current regulation mode. The current parameter is adjustable, but the heat is automatically determined by the timer, as it regulates the current to the set level.

UPS= Upslope time, **DWN**= Downslope time

..edit program

```
<<<   PROGRAM  0  >>>
I1=7.50kA   25.0%   PHA
I2=10.0kA   50.0%   CCR
PV=5.00kN@5.00V  NORM
PSQ= 0      SQZ= 10
W1 = 0      C1   =  0
W2 = 10     C2   =  0
Pulses(W2-C2)  = 1
HLD= 10     OFF =  0
```

Visible window

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

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

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

….edit program(seam)
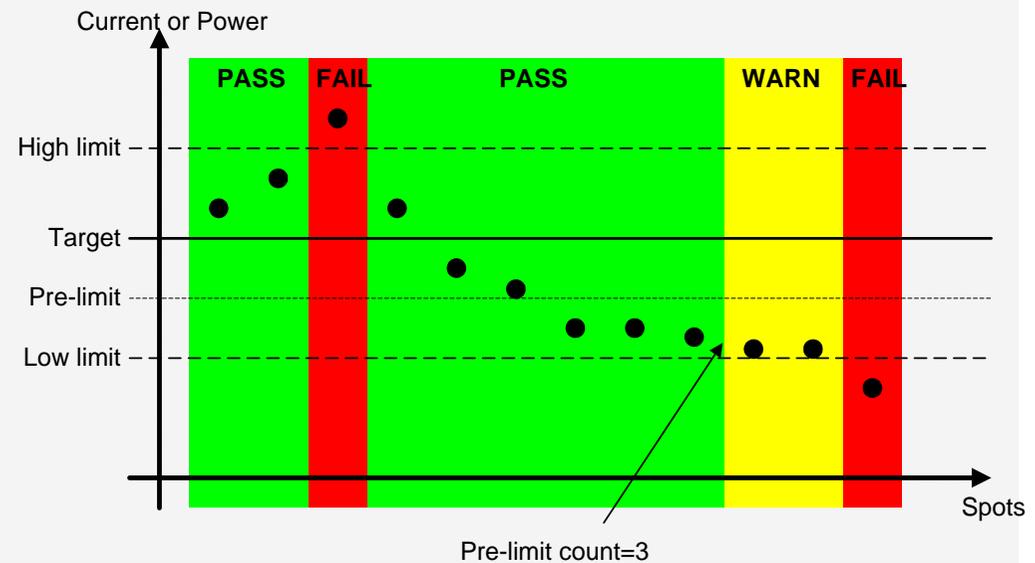
```
<<<   PROGRAM  0  >>>
I1=7.50kA   25.0%   PHA
I2=10.0kA   50.0%   CCR
BALANCE  = 4.5%
```

Visible window

```
PV=5.00kN@5.00V
PSQ= 0      SQZ= 10
W1 = 0      C1  =  0
W2 = 10     C2  =  0
UPS=  3     DWN = 0
HLD= 10
```

BALANCE : This control is used to balance the current when using pulsed seam welding. It may be adjusted dynamically (i.e. while the machine is running).

If the timer is configured for seam welding, then the program screen changes as shown above, in order to present only the relevant parameters..

……edit program(½-cycle)

```
<<<   PROGRAM  0  >>>
I1=7.50kA   25.0%
I2=10.0kA   50.0%
PV=5.00kN@5.00V
```

Visible window

 PSQ= 0   SQZ= 10
 W1 = 0   C1 = 0
 W2 = ½
 HLD= 10   OFF = 0

½-cycle welding: Weld times may be set to 0 or to one ½-cycle only. Constant current regulation (CCR) and program linking are not available.

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

If the timer is configured for ½-cycle welding, then the program screen changes as shown above, in order to present only the relevant parameters.

Edit limits

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

Visible window

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

Current or Power

| PASS | FAIL | PASS | WARN | FAIL |

High limit

Target

Pre-limit

Low limit

Spots

Pre-limit count=3

Edit Events

```
<<< EVENTS PROG  0 >>>
Ev1: 1=on  @SQZ +  2
Ev2: 1=off @HLD +  5
Ev3: 6=on  @W1  +  5
Ev4: 6=off @W2  +  3
```

Visible window

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

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

- Each event can turn one output on or off.

- To disable an event, set it's output to '?'.

Note:The outputs used must be mapped to 'EVENT' for correct operation.
(see *Edit Output Map*)

Electrode menu

```
<< ELECTRODE  MENU >>
STEPPER STATUS
EDIT STEPPER
EDIT COUNTER FILE
```

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

Electrode management is provided via a combination of stepper and counter functions. The stepper and counter share a common output and input.

The stepper provides a means of gradually increasing the current, to compensate for electrode wear.

Current or Heat

dH_9/dI_9
dH_4/dI_4
dH_3/dI_3
dH_2/dI_2
dH_1/dI_1
dH_0/dI_0

Spots

Step 0 · Step 1 · Step 2 · Step 3 · Step 4 · Step 5 · Step 6 · Step 7 · Step 8 · Step 9

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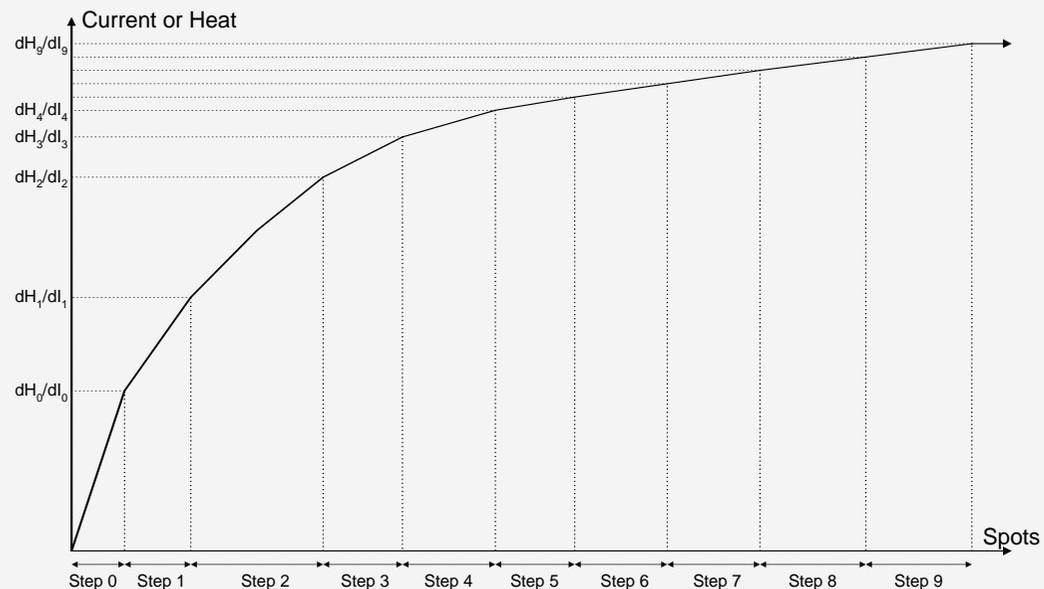
Stepper status

<STATUS ELECTRODE 1>
SPOTS DONE=   45

[RESET]   12%

dH= 2.5%   dI= 5.0%

Visible window

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

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

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

dH = % of programmed heat being added
dI = % of programmed current being added.

Outputs:

Output 'Counter/End of stepper' comes on at the end of the last step.

A 'Prewarning' message is given for the duration of step 9.

Edit stepper

```
<<<   STEPPER  1 on  >>>
CONTINUE AT END
SPOTS  +HEAT  +AMPS
0:   10    1.0%    2.5%
1:   50    1.5%    5.0%
2:  100    2.0%    7.5%
3:  100    2.5%   10.0%
4:  100    3.0%   12.5%
5:  100    3.5%   15.0%
6:  100    4.0%   17.5%
7:  100    4.5%   20.0%
8:  150    5.0%   22.5%
9:  200    5.5%   25.0%
[PRESET #1]
```

Visible window

Enable or disable the stepper.
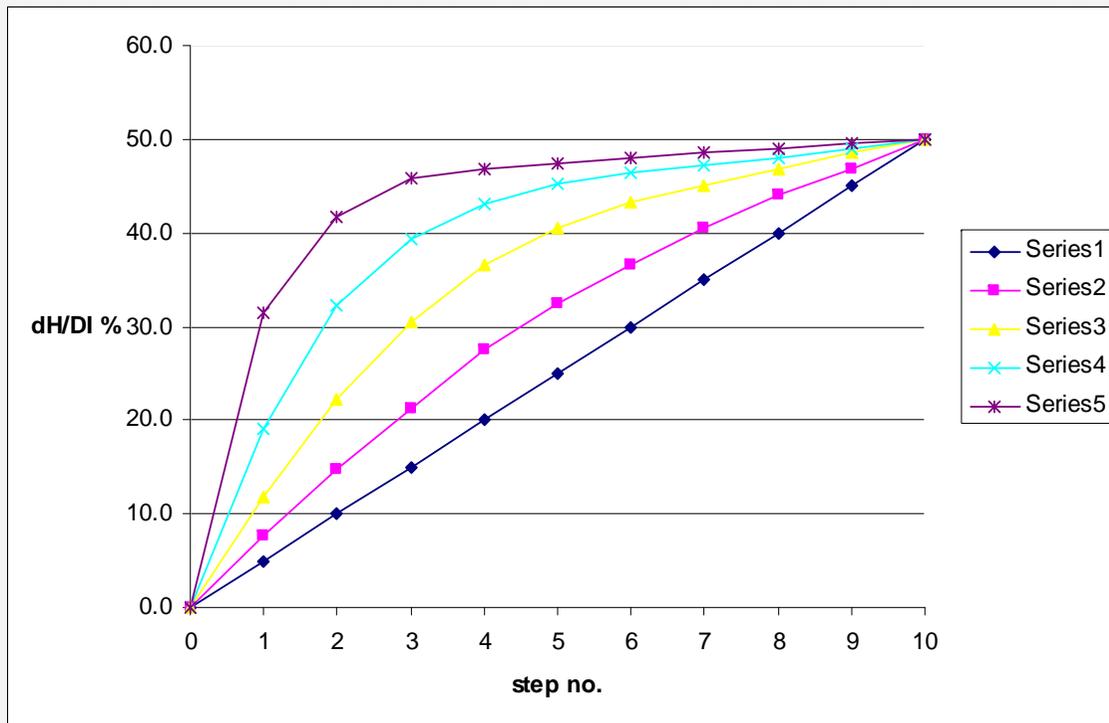**Be aware!** The counter and the heat stepper share a common input and output.

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

Quick set-up: Enter values in step 9 only, to define the finishing point, select the PRESET field, edit the preset number(see next page), and then press ↻ to load this stepper with a preset curve.

Note: PHA mode will make use of both the +HEAT(dH) and +AMPS(dI) parameters. CCR mode uses only the +AMPS(dI) parameter, as the heat is self-adjusting.

Stepper presets

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

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

Edit counter

```
<<<        COUNTER       >>>
COUNT NOW = 431
COUNT UP TO   500
STOP AT END
SYNC. WITH LOG   Yes
```

Be aware!

The counter and the heat stepper share a common input and output.

Set *count up to* to zero, to disable the counter.

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

If *stop at end* is selected, then no further welding may take place until a counter reset is given.
If *continue at end* is selected, then further welding can take place as normal, but the counter output will remain on.

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

Sync with log: If set to *Yes*, then the log will be cleared when the counter is reset. If set to *No*, then the log and counter are independent.

Weld log

```
<<<   WELD LOG   >>>
  64 welds in log
VIEW LOG
CLEAR LOG
```
PRINT LOG

Visible window

The number of welds presently held in the log.

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

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

The log can be cleared (emptied) by using the CLEAR LOG function. See also counter *sync with log* function.

The PRINT LOG function will send the entire log contents to the RS232 (printer) port.

View log

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

Status for this weld

Value in the counter for this weld

Program used for this weld

```
<LOG 1>   W2 FAIL
PROG= 0  COUNT=  10
I1=  6.54kA   ( 6.50kA)
I2=  7.29kA   ( 8.50kA)
```
Page 1

```
<LOG 1>   W2 FAIL
PROG= 0  COUNT=  10
P->5.40Kn   P<-5.35kN
```
Page 2

Actual current measured

Target current (from program)

PV output (from program)

Pressure input (from feedback)

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

•Press ⬅ ⬆ ⬇ ➡ to switch between pages.

Sequencer

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

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

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

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

The following resources are available:

Statements(lines)		Up to 249 max.
Outputs	8	Q1 to Q8
Inputs	16	I01 to I16
Memory	8	M1 to M8 (non-volatile)
Counters	8	C1 to C8 (non-volatile)
Analog inputs	1	A1

Non-volatile values are retained, even if power is lost.
Note that the inputs and outputs are shared with the welding controller and event timer
(see Input map and Output map).

Sequencer Menu

EDIT SEQUENCE
ERASE SEQUENCE
PRINT SEQUENCE
STATUS: IDLE

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

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

List the sequence on a printer (or a PC running a program such as 'Hyperterminal') connected to the RS232 port.
(see printer connections).

For information only:
Off: the sequencer is turned off (see edit configuration)
Idle:the sequencer is turned on, and waiting for the START input.
Line n: the sequence is running and is executing line n.

…edit sequence

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

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

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

When parameter only is flashing:
- Press the **+** or **-** keys to alter the selected parameter.
- Press **+** and **−** together to set 0 or minimum value.

Sequencer statements

The following table lists the available logic statement types:

Statement	Range	Function
Line nnn	1..249	Line number within sequencer file (has no effect)
----- STEP nnn -----	1..999	Has no effect, but serves as the target for a JUMP or GOSUB statement, or as a logical divider in the program
AWAIT INPUT Inn ON	1..16	Waits for Input nn to be ON
AWAIT INPUT Inn OFF	1..16	Waits for Input nn to be OFF
OUTPUT Qn ON	1..8	Turns ON Output n
OUTPUT Qn OFF	1..8	Turns OFF Output n
MEMORY Mn ON	1..8	Sets Memory bit n (non-volatile)
MEMORY Mn OFF	1..8	Clears Memory bit n (non-volatile)
DELAY nn.n s	0.1..99.9 s	Waits for specified time
JUMP nnn	1..999	Program continues at specified STEP number.
GOSUB nnn	1..999	Program continues with the subroutine at the specified STEP number. (Note maximum of 8 nesting levels)
RETURN		Return from subroutine
COUNTER Cn = xxx	n=1..8, x=1..999	Loads Counter n with the value xxx (non-volatile)
DECREMENT COUNTER Cn	1..8	The value in Counter n is reduced by 1 (non-volatile)
IF Cn>ZERO, JUMP xxx	n=1..8, x=1..999	If the value in Counter n is <u>not</u> zero, then continue at STEP xxx. If the value in Counter n <u>is</u> zero, then continue at the next statement
IF Qn ON, JUMP xxx	n=1..8, x=1..999	If Output Qn is <u>ON</u>, then continue at STEP xxx. If Output Qn is OFF, then continue at the next statement
IF Qn OFF, JUMP xxx	n=1..8, x=1..999	If Output Qn is <u>OFF</u>, then continue at STEP xxx. If Output Qn is ON, then continue at the next statement
IF Mn ON, JUMP xxx	n=1..8, x=1..999	If Memory Mn is <u>ON</u>, then continue at STEP xxx. If Memory Mn is OFF, then continue at the next statement
IF Mn OFF, JUMP xxx	n=1..8, x=1..999	If Memory Mn is <u>OFF</u>, then continue at STEP xxx. If Memory Mn is ON, then continue at the next statement
IF Inn ON, JUMP xxx	n=1..16, x=1..999	If Input Inn is <u>ON</u>, then continue at STEP xxx. If Input Inn is OFF, then continue at the next statement
IF Inn OFF, JUMP xxx	n=1..16, x=1..999	If Input Inn is <u>OFF</u> then continue at STEP xxx. If Input Inn is <u>ON</u>, then continue at the next statement
WELD (Prog=nn)	nn=0..63, EXT	Execute weld sequence. The program number is determined by the parameter nn. If nn=EXT, then the program number will be read from the external selection inputs. The sequencer

Example sequence

Statement	Range	Function
AWAIT ANALOG n<mm V	n=1 0.0<=mm<=10.0	Waits for Analog input n to be less than mm Volts.
AWAIT ANALOG n>mm V	n=1 0.0<=mm<=10.0	Waits for Analog input n to be greater than mm Volts.
IF ANALOG n<mm V, JUMP xxx	n=1 0.0<=mm<=10.0	If Analog input n is less than mm Volts, then continue at STEP xxx, otherwise continue with the next statement.
IF ANALOG n>mm V, JUMP xxx	n=1 0.0<=mm<=10.0	If Analog input n is greater than mm Volts, then continue at STEP xxx, otherwise continue with the next statement.

A short example program:

----- STEP 1 -----	
AWAIT INPUT I03 ON	Part detector
----- STEP 2 -----	
OUTPUT Q8 ON	Clamp ON
DELAY 0.5	Pause
----- STEP 3 -----	
WELD (Prog=1)	Weld operation using program 1
OUTPUT Q8 OFF	Clamp off
----- STEP 4 -----	
OUTPUT Q7 ON	Signal job done by flashing output until START released
DELAY 0.4	Flash 'On' time
OUTPUT Q7 OFF	
DELAY 0.2	Flash 'Off' time
JUMP 4	Loop back to create flashing effect

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Copy program

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

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

•The *TO* parameter can be set to *ALL* if required (i.e. copy 1 program to all others).

•Select the last line (**GO**), then press the ⮐ key to execute the copy function. This line will briefly show *COPY DONE*, when the function is complete.

I/O Status

```
<<<   I/O STATUS    >>>
I01:START            Off
I02:WELD ON           On
I03:SEQUENCER         On
I04:EVENT            Off
I05:RES.FAULT        Off
I06:RES.COUNT        Off
....
....
etc.
```

Visible window

This screen can be used to observe the status of all the discrete inputs and outputs.
Each input or output is labeled to show how it is mapped.
i.e. standard function / event / sequencer.
(see edit input map and edit output map)

Analog Status

```
<<< ANALOG STATUS  >>>
 Channel 1 = 0.00 V
 TOROID R =  20 Ω
```

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

- **Analog input channel**: the dynamic voltage at the analog input.

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

Disabling edits

Normally, a user can access the parameters via the keypad on the front of the timer, and make any changes, as required. Under some circumstances, it may be desirable to prevent such general access.

The timer provides an input called 'EDIT DISABLE', which can be used to block all parameter edits. With this input on, it will still be possible to view parameters, but no changes are permitted via the keypad.

If edits are attempted, the display will briefly show

** EDITS DISABLED **

and the edit will be blocked.

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

Typical connections to Timer

+24V

P2 INPUTS

16 EDIT DISABLE

Normally–closed contact.
Key withdraws in normal position.
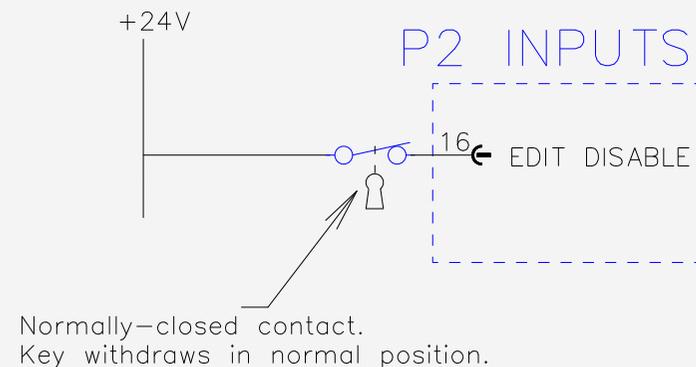
If this feature is not required, simply leave this input unconnected.

Pop-up current meter

The timer will measure the current on both the weld1 and weld 2 intervals, and this is displayed on the diagnostic screen.

Often, when programming the timer, you will need to refer to these current measurements. In order to avoid having to switch between screens, there is a convenient pop-up current meter window, which allows you to view the measured currents without leaving the screen you are on.
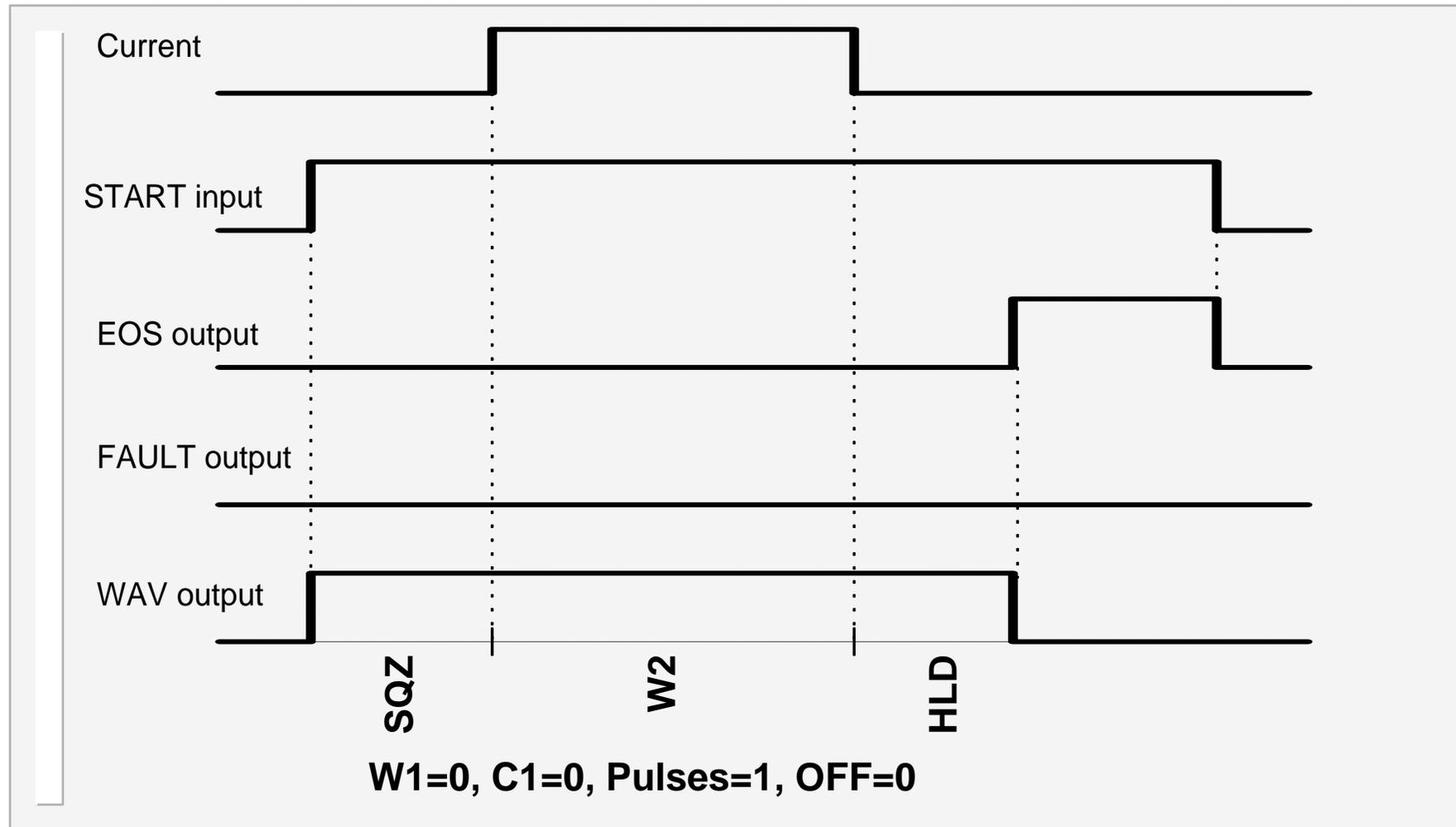
The pop-up meter is activated by pressing the ⊃ key. To close the pop-up window, press the ⊃ key again.

```
<<< CALIBRA
TOROID:  15    I1=6.06kA
TOROID FAC    I2=8.45kA
S/P RATIO  5
```
Pop-up window
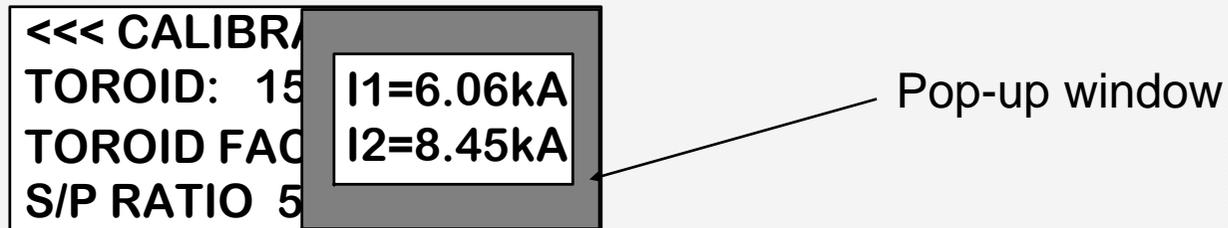
Note that the window may not show both weld1 and weld2, if either interval was not used.

Some screens use the ⊃ key for another purpose (such as selecting an item from a list). In this case, the pop-up meter is not available from that screen.

Operation: basic spot weld – no weld faults

Current

START input

EOS output

FAULT output

WAV output

SQZ   W2   HLD

W1=0, C1=0, Pulses=1, OFF=0

Operation: basic spot weld – weld fault

Current

START input

EOS output

FAULT output

WAV output

SQZ   **W2**   **HLD**

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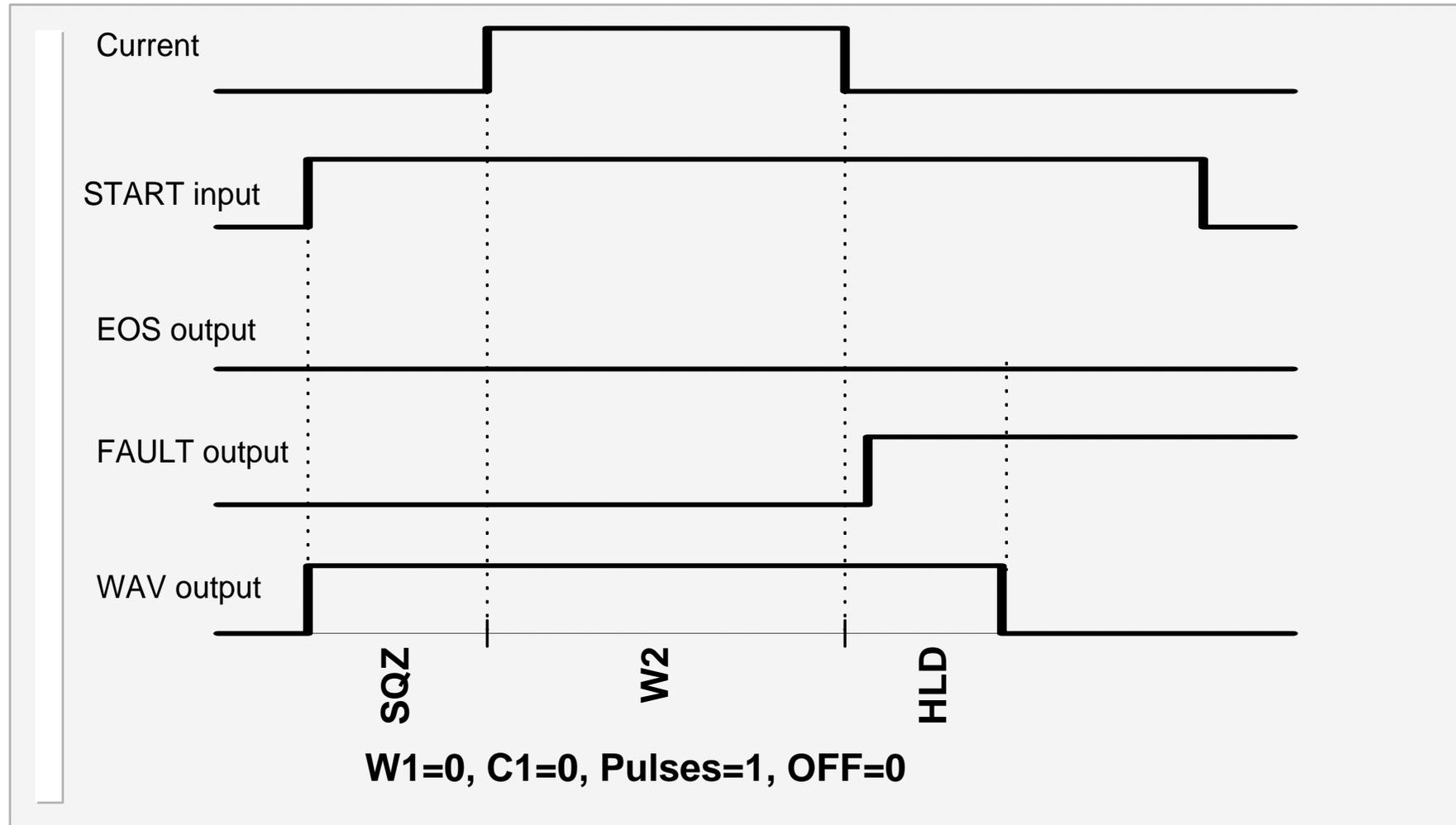
Operation: repeat spot weld

W1=0, C1=0, Pulses=1

Operation: pulsation spot weld

Current

START input

EOS output

FAULT output

WAV output

SQZ W2 C2 W2 C2 W2 C2 HLD

W1=0, C1=0, Pulses=3, OFF=0

Operation: Upslope and Downslope

Spot

Current

START input

Upslope time   Downslope time

WAV output
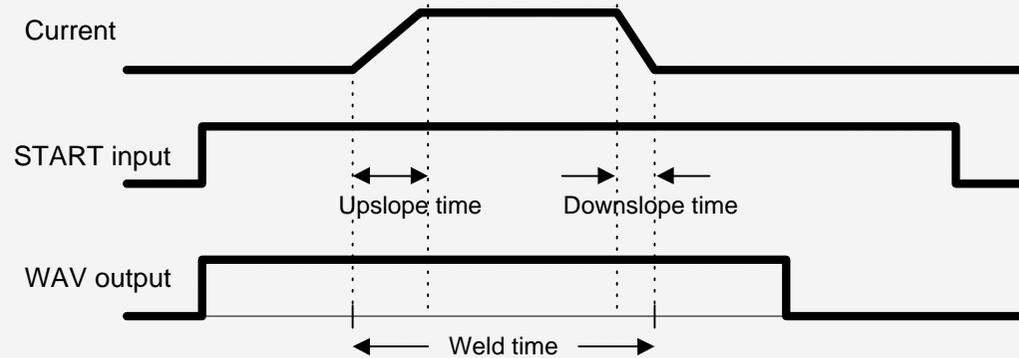
Weld time

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

Seam

Current

START input

Downslope time

Upslope time

WAV output
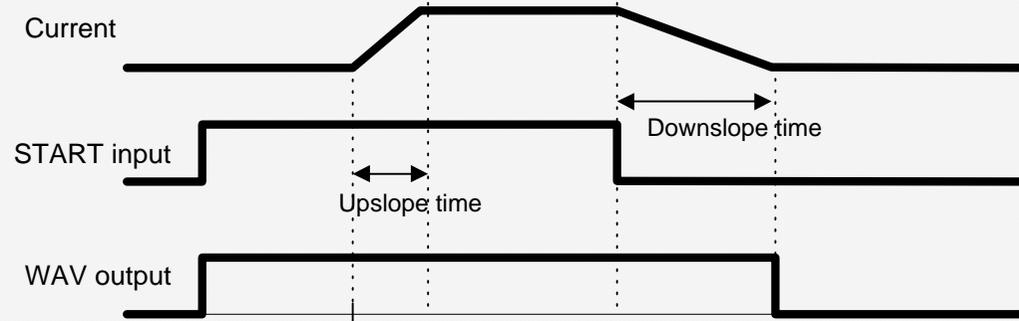
Note that for seam welds, the downslope time begins when the initiation input turns off.

Operation: Upslope and Downslope

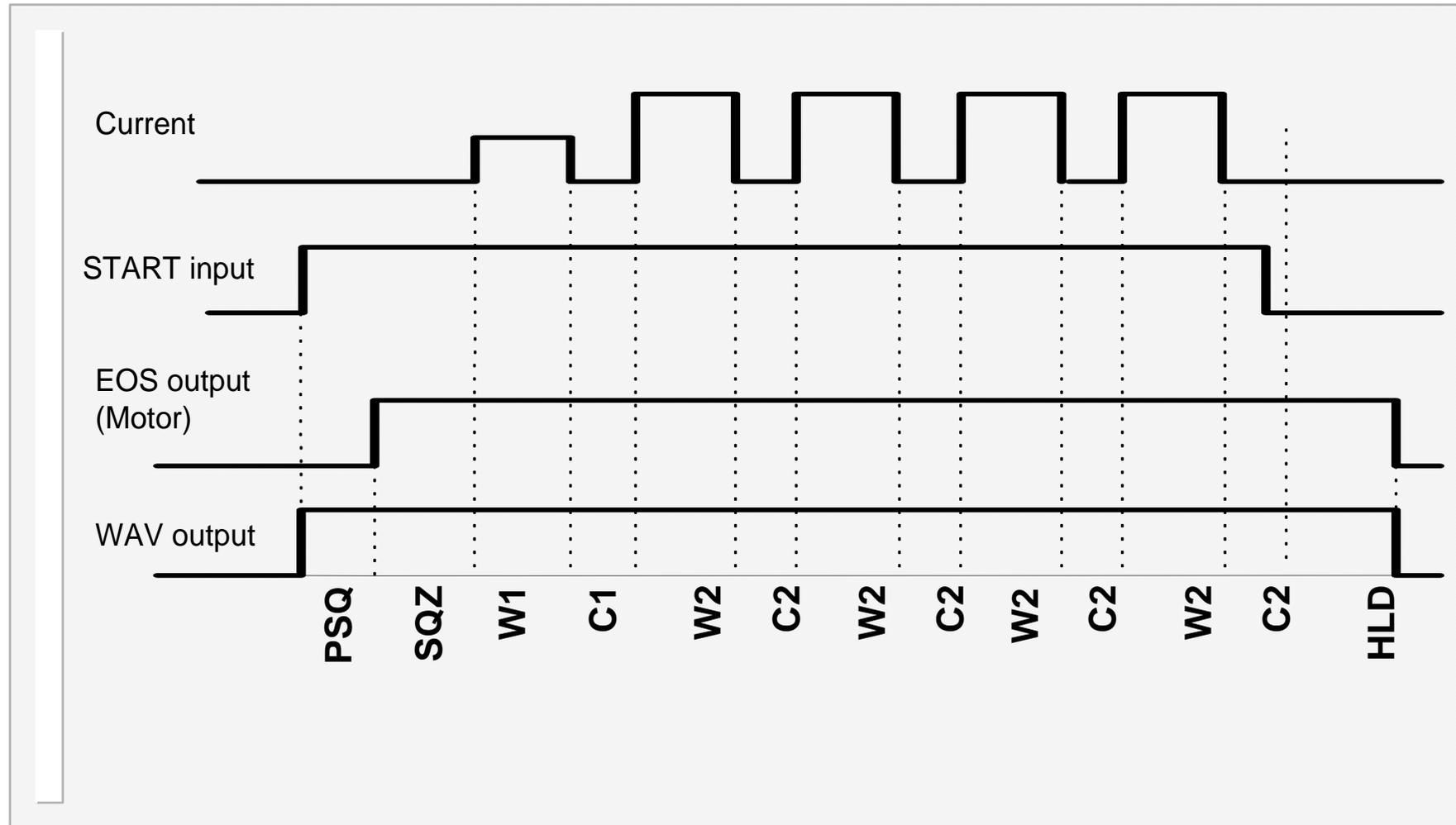Upslope and downslope times will be distributed across more than one pulse, when necessary.
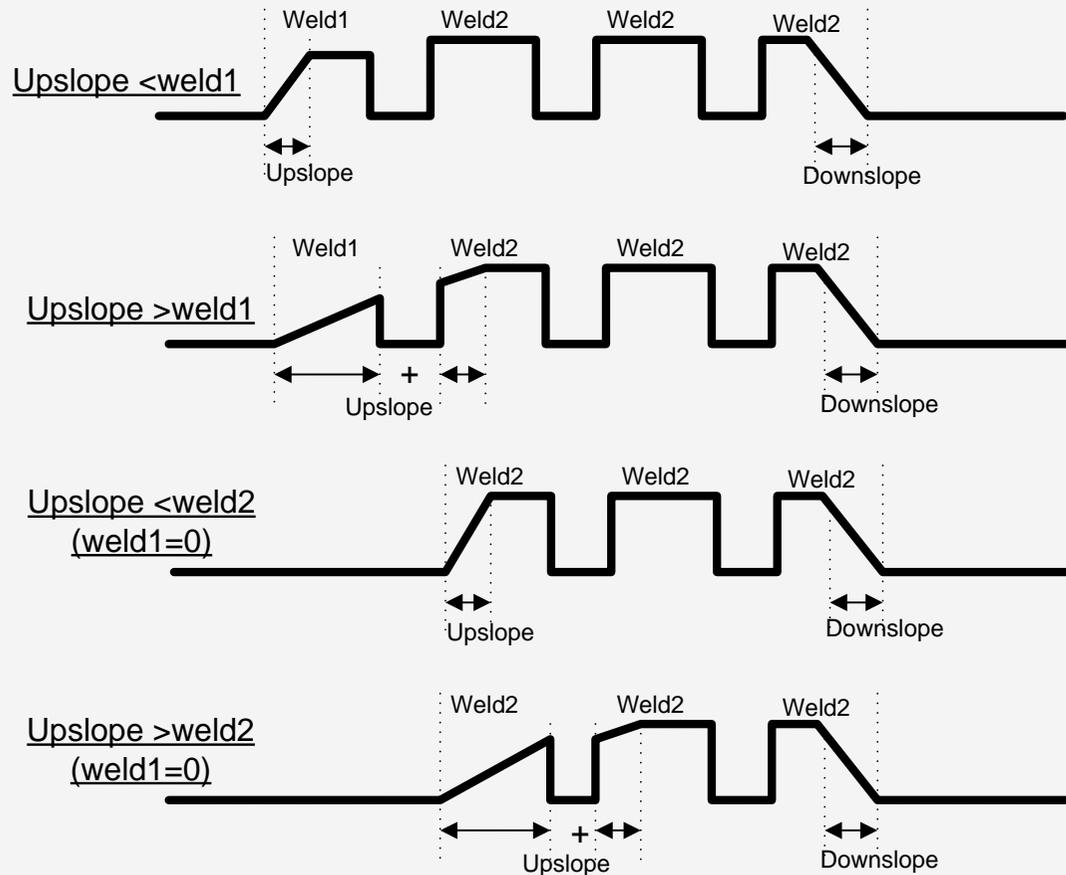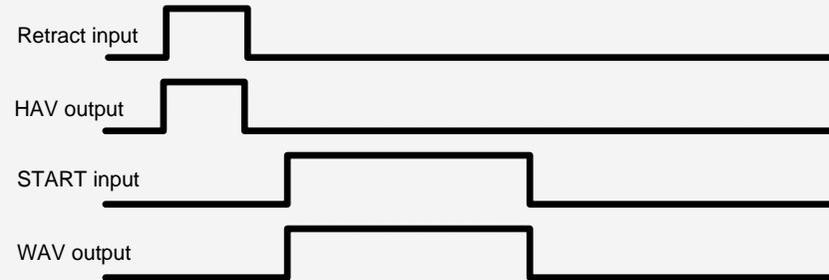
Operation: roll-spot welding

W1=0, C1=0, C2=0, Pulses=1

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Operation: seam welding (dual heat)

Current

START input

EOS output
(Motor)

WAV output

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

C1=0, C2=0
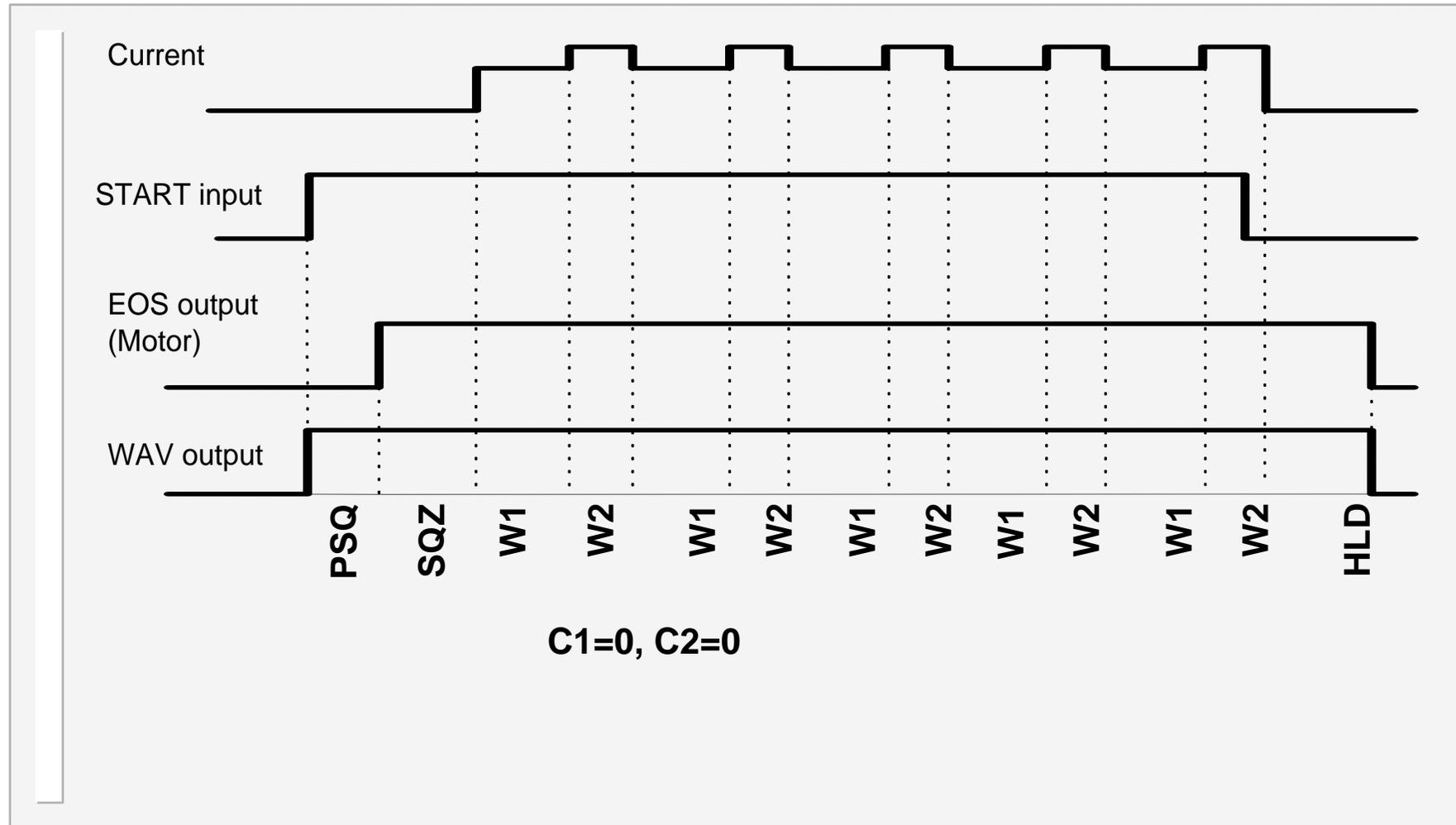
Operation: seam welding (pre-heat)

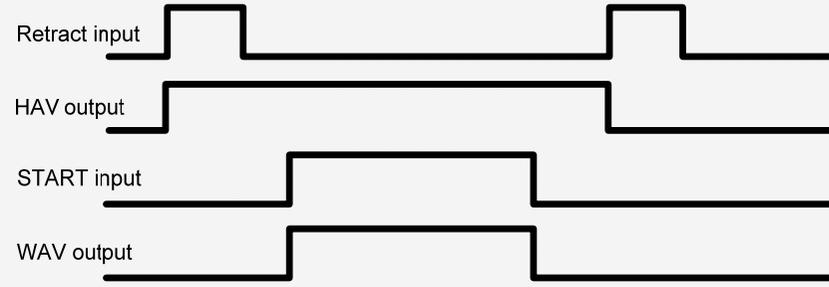# Operation: Retract/Hi-lift

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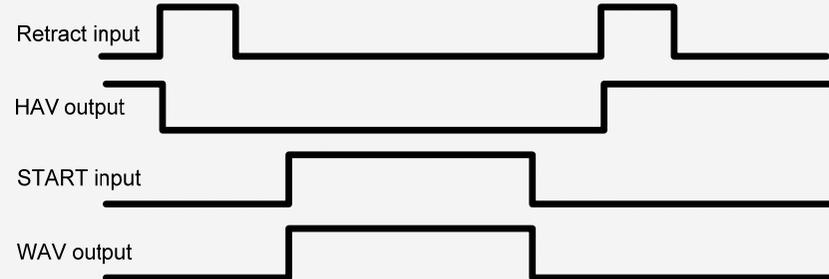

Simple
- Retract input
- HAV output
- START input
- WAV output

Hi-lift+
- Retract input
- HAV output
- START input
- WAV output

Hi-lift-
- Retract input
- HAV output
- START input
- WAV output

WS98-700 PC software

WS98-700 PC software is available for use with the WS700 timer. This offers the user the ability to program and monitor the welding control, and to back-up all of the programmed data on a PC.

WS98-700 is available on CDROM, and works with all versions of Microsoft Windows™ (98 onwards). Contact BF Entron for more details.