WS500 Manual

**For Timer firmware
Version 1.09 onwards**

BF ENTRON Ltd.
**The Pensnett Estate,
Building 80, Bay 1,
1 First Ave.,
Pensnett Trading Estate,
Kingswinford DY6 7FQ**

**Tel: 01384 455401
Fax: 01384 455551**

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Introduction

The WS500 welding control offers the reliability that ensues from simplicity. The WS500 is a compact, robust unit providing basic control for resistance welding. The membrane front panel provides a neat, water resistant finish and incorporates four push buttons and a display for programming purposes. Programming is quick and simple, as is operation of the control. Installation is also easy. The WS500 has four mounting studs and sixteen connections on a plug-in connector block.
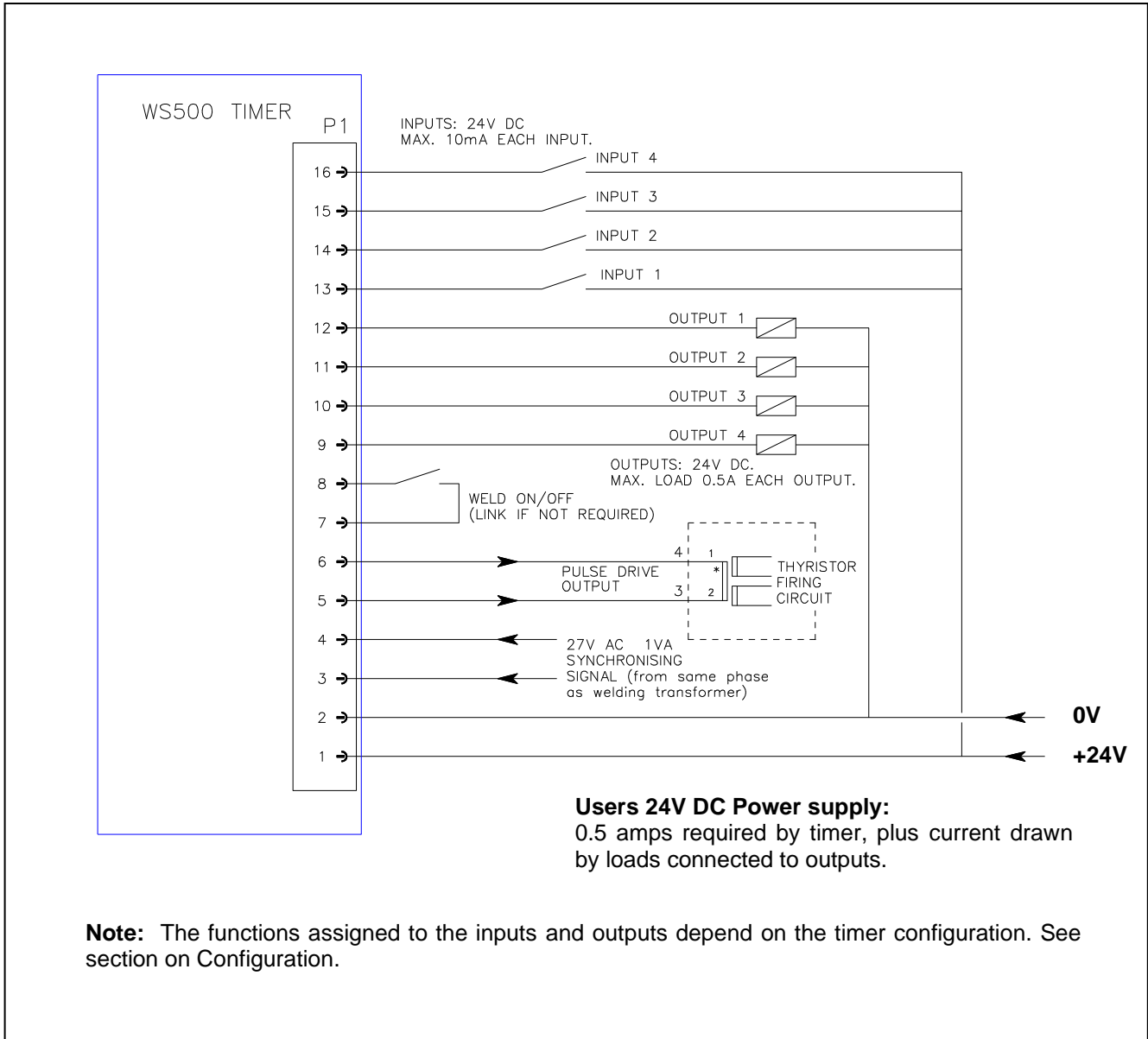
The principle features of the WS500 are:

- Operates from 24 volt DC supply

- 50 Hz or 60 Hz operation

- 4 inputs and 4 outputs plus weld on/off

- 1 to 8 programmes, depending on mode of operation

- Configurable for:
  - Single spot
  - Repeat spot
  - Half cycle
  - Roll spot
  - Seam

- Two weld intervals, upslope and pulsation

- Retract/High lift option

- Counter with configurable lock-out

- Cross-interlock facility (2 options)

- Built-in test routines

Specifications

Supply voltage:	24 V DC
Supply current:	< 500mA (no outputs on)
Synch. signal:	27 V AC @ 1 VA
Mains frequency:	50 or 60 Hz
Number of digital inputs:	4
Input requirement:	24 V DC, < 10mA
Number of digital outputs:	4
Digital output rating:	24 V DC, < 500mA
Pulse drive output:	5KHz, 1:10 mark/space. First pulse 24V, subsequent pulses >15V
Size:	160mm x 122mm x 35mm (50mm including connector)
Weight:	620gms

Connections

Users 24V DC Power supply:
0.5 amps required by timer, plus current drawn by loads connected to outputs.

Note: The functions assigned to the inputs and outputs depend on the timer configuration. See section on Configuration.

General Connection Diagram

Configuring the WS500

The WS500 has various configurations to tailor it for specific applications.

- Press ![F] until it the display reads **WS500 V1.10** (or earlier)

- Hold down ![↵] and then press ![F]. The display will read **CONFIGURE**.

- Press ![↵] The display will read, for example, **CONFIG TYPE 00** This is the first item in the list of configuration parameters.

    a) If you wish to change the parameter setting (in this case 00) use the ![+] or ![–]

       keys to make the required selection. Press ![↵] to enter the value. If you do not wish to change this parameter move directly to b).

    b) Press ![↵] to move to the next item in the configuration file.

- Repeat steps a) and b) until the configuration is complete, then press ![F].

Configuration Parameters

The items in the list of configuration parameters is shown below.

Parameter	Options
Config type	0 to 12
Retract	None Simple High Lift + High Lift -
Frequency	50 Hz or 60 Hz
Interlock	On or Off
Heat range	Low or High
X-lock type	External or Ring

Config Type

The WS500 has 13 modes of operation, numbered as "Types" 0 to 12. Each Type offers different features, different numbers of weld programmes and may use the input and output connections in different ways. The following table gives a brief description of what each Type does, and shows the number of weld programmes available for that option.

The table should be used in conjunction with the tables of Input and Output Allocations which show how the inputs and outputs are used for each configuration Type.

Config Type	WS500 Operation	No. of weld progs.
00	**Spot/repeat** Simple spot welding with single or repeated weld sequences and no other functions.	8
01	**Spot/repeat with cross interlock** Spot welding with single or repeated weld sequences giving an interlock output to prevent other timers welding at the same time.	4

02	**Spot/repeat with retract** Spot welding with single or repeated weld sequences with an input and output for controlling the "open" and "working" positions of the welding gun.	4
03	**Spot/repeat with counter** Spot welding with single or repeated weld sequences with a counter that gives an output when the programmed number of welds has been reached.	4
04	**Spot/repeat with cross interlock and retract** Spot welding with single or repeated weld sequences giving an interlock output to prevent other timers welding at the same time, and an input and output for controlling the "open" and "working" positions of the welding gun.	2
05	**Spot/repeat with counter and retract** Spot welding with single or repeated weld sequences with a counter that gives an output when the programmed number of welds has been reached and has an input and output for controlling the "open" and "working" positions of the welding gun.	2
06	**Spot/repeat with counter and cross interlock** Spot welding with single or repeated weld sequences with a counter that gives an output when the programmed number of welds has been reached and with an interlock output to prevent other timers welding at the same time.	2
07	**Spot/repeat with counter, cross interlock and retract** Spot welding with single or repeated weld sequences with a counter that gives an output when the programmed number of welds has been reached, also an interlock output to prevent other timers welding at the same time and with an input and output for controlling the "open" and "working" positions of the welding gun.	1
08	**Half cycle** Spot welding using only a half cycle of weld time.	8
09	**Half cycle with cross interlock** Spot welding using only a half cycle of weld time and giving an interlock output to prevent other timers welding at the same time.	4
10	**Half cycle with counter** Spot welding using only a half cycle of weld time also with a counter that gives an output when the programmed number of welds has been reached..	4
11	**Roll-spot** Spot welding with an output to operate motor-driven welding wheels during the OFF time between weld sequences.	8
12	**Seam** Uses seam wheels, a motor drive and continuous, or modulated current, to provide a seam weld.	8

Input Allocations

Config Type	Input 1 (Pin 13)	Input 2 (Pin 14)	Input 3 (Pin 15)	Input 4 (Pin 16)
0	Start	Prog. sel. bit 1	Prog. sel. bit 2	Prog. sel. bit 4
1	Start	Prog. sel. bit 1	Prog. sel. bit 2	2nd stage
2	Start	Prog. sel. bit 1	Prog. sel. bit 2	Retract
3	Start	Prog. sel. bit 1	Prog. sel. bit 2	Count reset
4	Start	Prog. sel. bit 1	Retract	2nd stage
5	Start	Prog. sel. bit 1	Count reset	Retract
6	Start	Prog. sel. bit 1	Count reset	2nd stage
7	Start	Retract	Count reset	2nd stage
8	Start	Prog. sel. bit 1	Prog. sel. bit 2	Prog. sel. bit 4
9	Start	Prog. sel. bit 1	Prog. sel. bit 2	2nd stage
10	Start	Prog. sel. bit 1	Prog. sel. bit 2	Count reset
11	Start	Prog. sel. bit 1	Prog. sel. bit 2	Prog. sel. bit 4
12	Start	Prog. sel. bit 1	Prog. sel. bit 2	Prog. sel. bit 4

Output Allocations

Config Type	Output 1 (Pin 12)	Output 2 (Pin 11)	Output 3 (Pin 10)	Output 4 (Pin 9)
0	Weld air valve	End of sequence	Not used	Not used
1	Weld air valve	End of sequence	Interlock	Not used
2	Weld air valve	End of sequence	Not used	Retract
3	Weld air valve	End of sequence	Counter	Not used
4	Weld air valve	End of sequence	Interlock	Retract
5	Weld air valve	End of sequence	Counter	Retract
6	Weld air valve	End of sequence	Counter	Interlock
7	Weld air valve	Interlock	Counter	Retract
8	Weld air valve	End of sequence	Not used	Not used
9	Weld air valve	End of sequence	Interlock	Not used
10	Weld air valve	End of sequence	Counter	Not used
11	Weld air valve	Motor	Not used	Not used
12	Weld air valve	Motor	Not used	Not used

Retract

Some operational modes provide a Retract facility. This feature is used when a welding gun has two "open" states, a wide open state for positioning the gun around a component, and a working state.
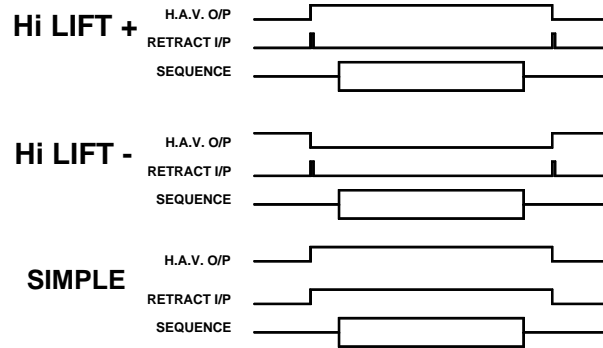
There are three modes of Retract operation:

Simple Retract   The Retract Output directly mimics the Retract Input. The Retract Output must be off for welding to proceed. If the Retract Output is on the display will read "Retract not ready".

Hi Lift +   With this mode of retract, an impulse on the Retract Input changes the state of the Retract Output. In this case the Retract Output must be on for welding to take place. If the Retract output is off, the display will read, "Retract not ready".

Hi Lift -   With this mode of retract, an impulse on the Retract Input changes the state
                         of the Retract Output. In this case the Retract Output must be off for welding
                         to take place. If the Retract output is on, the display will read, "Retract not
                         ready".

Hi LIFT +   H.A.V. O/P
                RETRACT I/P
                SEQUENCE

Hi LIFT -   H.A.V. O/P
                RETRACT I/P
                SEQUENCE

SIMPLE   H.A.V. O/P
                RETRACT I/P
                SEQUENCE

Frequency

Select frequency of mains supply.

Interlock

Select Interlock ON for machines where the electrodes are controlled by the WS500's weld air
valve output. In this mode, when a weld sequence has progressed beyond the Squeeze time, the
sequence continues to completion, regardless of the Start signal.

Select Interlock OFF for machines with no weld air valve, such as pedal spot welders and poke
welders. In this mode, the weld sequence is terminated if the Start signal is removed before the
sequence has completed.

Heat Range

Select Heat Range High for hotter heat settings. The use of this setting may result in "dead angle"
at higher heats. (After a certain point, increasing the heat no longer increases the current).

Select Heat Range Low for cooler heat settings. This should be used if low heat levels in the
"High" setting, produce too much current.

X-Interlock type

Select EXT if you are using an external cross-interlock unit.

Select RING if you have wired the WS500 for ring type cross-interlocking

See the section on cross-interlocking for a full explanation.

Programming the WS500

To programme the WS500 press the [F] key until the display reads
EDIT   PROGRAM 0

Use the [+] or [-] key to select the programme required. The display will flash. Press [↵] to enter the programme number. Press [↵] again to move the programmer to the

first parameter. With each parameter use the [+] and [-] keys to select the value, or

type. This will cause the display to flash. When the value is correct enter it by pressing [↵]

Then press [↵] again to move onto the next parameter. At any point [F] can be
pressed to exit programming weld parameters. If the WS500 is in a mode that uses a counter, the
display will read **COUNTER**. This is programmed in the same way.

The table below shows the welding parameters and the order in which they appear. It should be
noted that not all parameters are used in every mode.

Parameter		
Programmes	**Range of values**	**Applicable Config. Modes**
Mode	Single or Repeat	0 – 7
Heat 1	0 – 99	0 – 12
Heat 2	0 – 99	0 – 7, 11 – 12
Presqueeze	0 – 99	0 – 7, 11 – 12
Squeeze	0 – 99	0 – 12
Weld 1	0 – 99	0 – 7, 11 – 12
Cool 1	0 – 99	0 – 7, 11 – 12
Weld 2	0 – 99	0 – 7, 11 – 12
Cool 2	0 – 99	0 – 7, 11 – 12
Pulses	1 – 9	0 – 7, 11
Hold	0 – 99	0 – 12
Off	0 – 99	0 – 7, 11
Balance	0 – 60	12
Upslope	0 – 99	0 – 7, 11 – 12
Counter		
Counter now	0 – 9999	3, 5 – 7, 10
End count	0 – 9999	3, 5 – 7, 10
Stop at end	Stop at end/Continue at end	3, 5 – 7, 10

Programme parameters

Mode   Selects either Single Sequence or Repeat Sequence operation. Single Sequence operation performs one weld sequence when the timer is initiated. Repeat Sequence performs successive weld sequences for the duration of the Start signal.

Heat 1   Controls the heat of the first weld interval.

Heat 2   Controls the heat of the second weld interval.

Presqueeze   The time (in cycles) allowed for the electrodes to meet.

Squeeze   The time (in cycles) allowed for the electrodes to build up full welding pressure on the component.

Weld 1   The duration (in cycles) of the first weld interval.

Cool 1   The time (in cycles) between the first and second weld intervals.

Weld 2   The duration (in cycles) of the second weld interval.

Cool 2   (Only applicable when using pulsations) The time (in cycles) between pulses of Weld 2.

Pulses   The number of times pulses of Weld 2.

Hold   The time (in cycles) for which welding pressure is maintained on the weld after welding current has ceased.

Off   (Only applicable in Repeat mode). The time (in cycles) between successive weld sequences.

Balance   (Seam mode only) Adjusts the heat of the first half cycle of weld in a seam weld. The adjustment range is 0 to 60. A nominal setting for this is 45. To set it using a weld current meter, measure the current of the +ve half cycles, and the current of the –ve half cycles, then adjust the Balance to get the two readings to be the same. (The "grunt" from the transformer sounds smooth and even for a balanced weld.)

Upslope   The time (in cycles) during which the heat builds up from minimum to the set heat level. This time is **not** additional to the programmed weld times, but defines how much of the weld time is to be sloped.
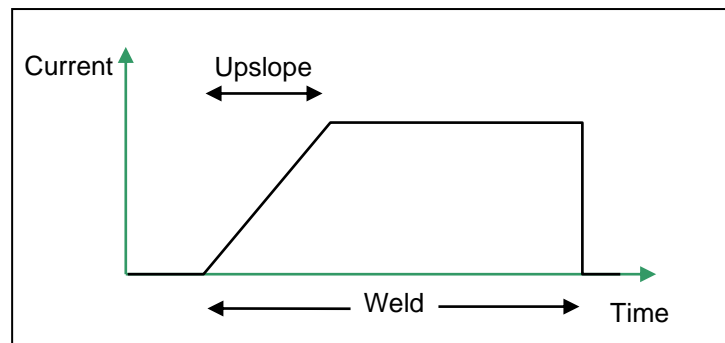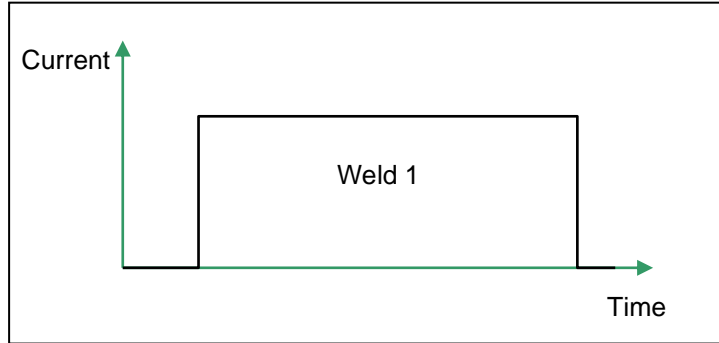
Seam Welding Current Profiles

In seam welding mode (Configuration mode 12) there are two weld pulses and two cool times available. These can be used to give a number of weld current profiles, as shown below.
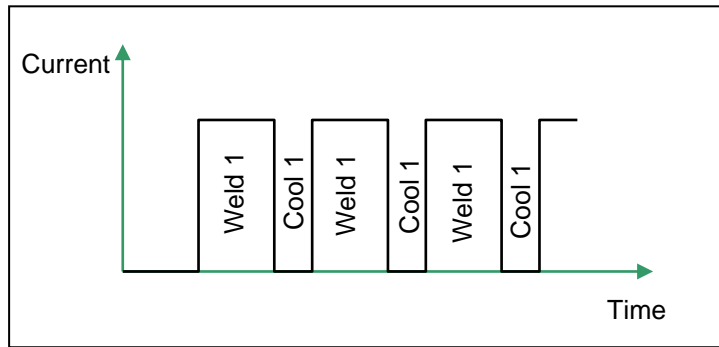
Seam Continuous

Example settings:

Weld 1 =   10
Cool 1 =   0
Weld 2 =   0
Cool 2 =   0
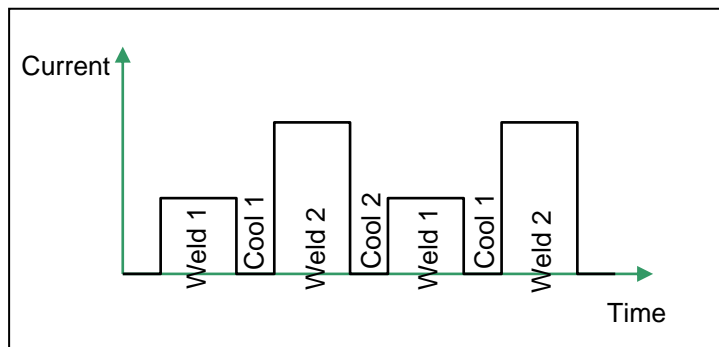Heat 1 =   40
Heat 2 =   0

Seam Pulsation

Example settings:

Weld 1 =   10
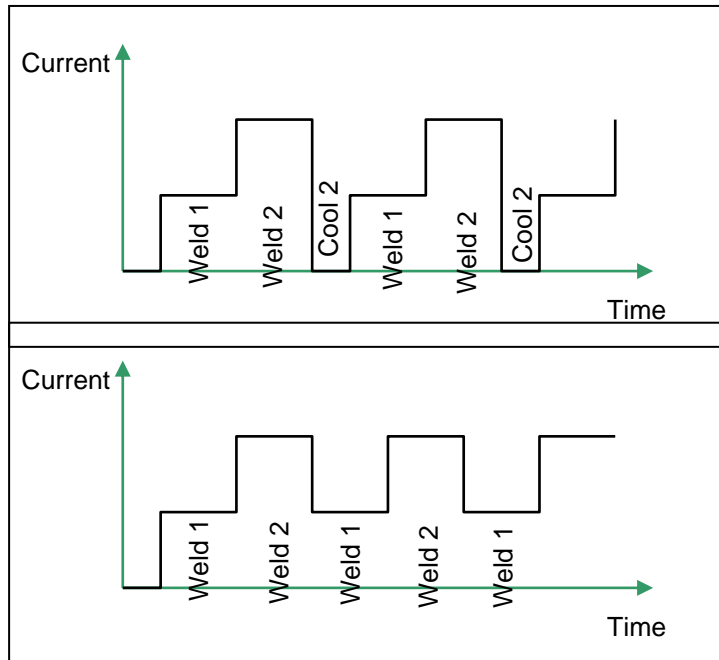Cool 1 =   5
Weld 2 =   0
Cool 2 =   0
Heat 1 =   40
Heat 2 =   0

Seam Modulation

Example settings:

Weld 1 =   10
Cool 1 =   5
Weld 2 =   10
Cool 2 =   5
Heat 1 =   30
Heat 2 =   70

Example settings:

    Weld 1 =   10
    Cool 1 =   0
    Weld 2 =   10
    Cool 2 =   5
    Heat 1 =   30
    Heat 2 =   70

Example settings:

    Weld 1 =   10
    Cool 1 =   0
    Weld 2 =   10
    Cool 2 =   0
    Heat 1 =   30
    Heat 2 =   70

Welding with the WS500

To weld, the WS500 needs to have been configured for your specific application. (See section on "Configuration"). Having been configured, the timer must be programmed with the weld parameters for the job in hand. Several sets of weld parameters can be held in the WS500. Each set of parameters is called a "Programme". (See section "Programming the WS500".)

Selecting a Weld Programme

Using Inputs

Refer to the timer connection drawing and the tables below.

For software versions v1.03 and higher
If WS500 has software version v1.03 or higher, external programme selection must be selected.

Press [**F**] until the WS500 displays READY.

Press [↩] . The display will show either a programme number or External Select.. If the timer

does not show External Select press [**+**] until it does, then press [↩] .

With the timer displaying External Select, press [**F**] to return to normal mode.

Depending on which configuration mode the timer is using, there can be 1, 2, 4 or 8 programmes available. The following tables show how to select programmes for each mode of configuration.

0 on an input means 0v present on input pin.
1 on an input means 24v present on an input.

Mode 7
Only operates on programme 0. No selection necessary.

Modes 4, 5 and 6

Prog. No.	Input 2
0	0
1	1

Modes 1, 2, 3, 9 and 10

Prog. No.	Input 2	Input 3
0	0	0
1	1	0
2	0	1
3	1	1

Modes 0, 8, 11 and 12

Prog. No.	Input 2	Input 3	Input 4
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

Using timer keypad

(only applicable to software versions v1.03 and higher)

Press **F** until the WS500 displays READY.

Press ⏎ . The display will show either a programme number or External Select.

Press either ➕ or ➖ to get the required programme number, then press ⏎ .

Press **F** to return to normal mode.

When the timer is initiated, it will weld using the programme selected by the previous operation, not a programme selected by inputs.

Starting a Weld

When the timer has been configured and programmed, welding can proceed. Select the programme to be used (see previous section) and operate the Start input (input 1). A weld sequence will begin.

The Start signal must be held on until the first weld period. If the Start signal is removed before this, the weld sequence will be aborted.

Second Stage Start

(Applicable only to modes 1, 4,6,7 and 9)

Some modes require a Second Stage Start. Where this is needed the timer checks input 4 when the weld sequence has reached the end of the Squeeze time. If the input has 24v on it, the sequence continues. If there is no voltage present on input 4, the sequence waits for the signal.
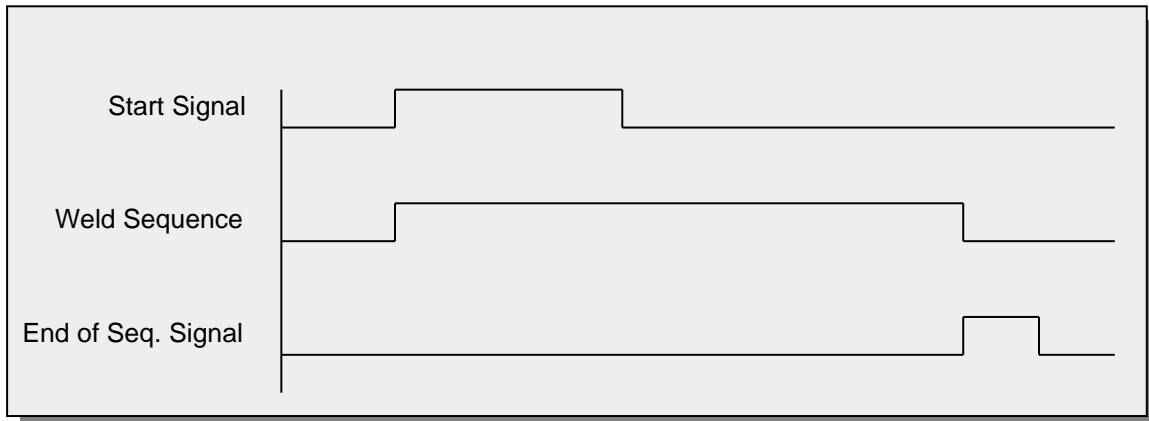
End of Sequence Output

(Applicable to all modes except 7, 11 and 12)

In Single Spot operation, at the end of the weld sequence the End of Sequence output switches on. If the Start signal is still present, the End of Sequence signal remains on until the Start signal is removed.
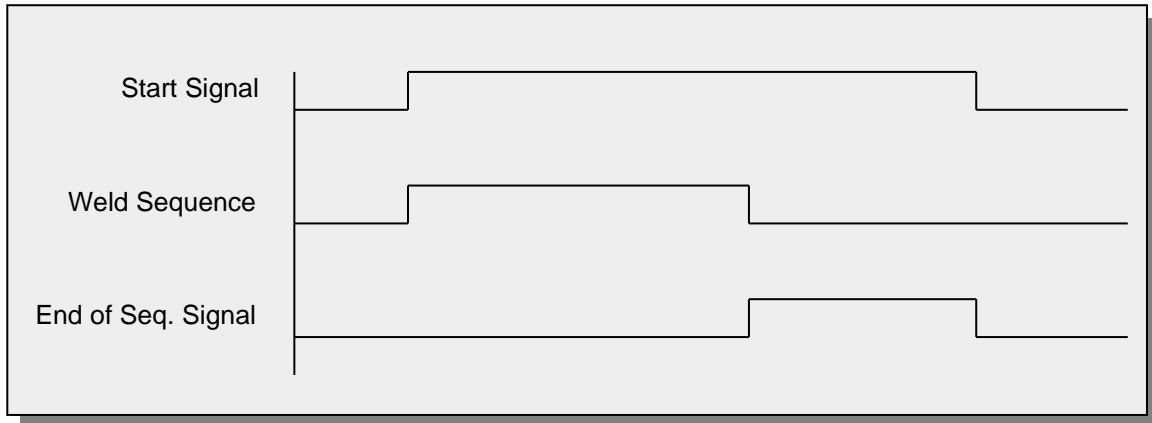
In Single Spot operation, at the end of the weld sequence the End of Sequence output switches on. If the Start signal is absent, the End of Sequence signal switches on for a time programmed as EOS Duration in the timer configuration.

In Repeat Spot operation the End of Sequence output switches on for the Off time between sequences, and for the time entered in the timer configuration as EOS Duration, after the final sequence.
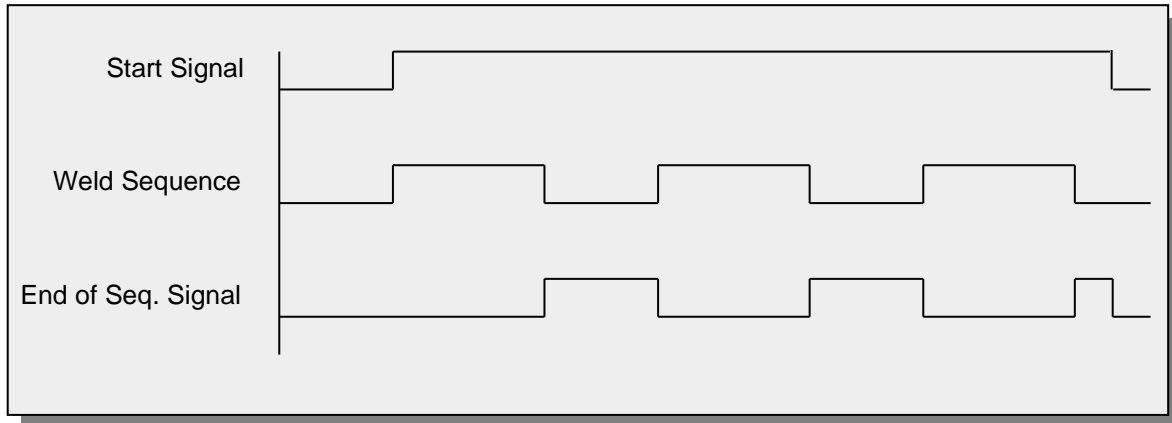
Further Functions

Counter

Certain modes of operation provide a counter facility. In this an "End Count" value is programmed into the WS500. A counter within the WS500 increments each time a weld sequence is completed. When the number of welds completed equals the number of welds programmed as "End Count" the Count Output switches on.

If "Stop at End" has been programmed, the WS500 will ignore Start inputs when this stage has been reached. If "Continue at End" has been programmed, welding will continue.

The counter and the Count Output can be cleared by applying a signal to the Reset input.

At any stage the progress of the counter can be observed, and changed if required. This is the value "Count Now", found in the programming section.

Counter parameters

Count Now   The number of weld sequences carried out since the counter was reset.

End Count   The number of welds after which the timer will switch on the Counter Output.

Stop/Continue at End   Selects whether or not the timer will initiate further weld sequences when the Counter Output has switched on.
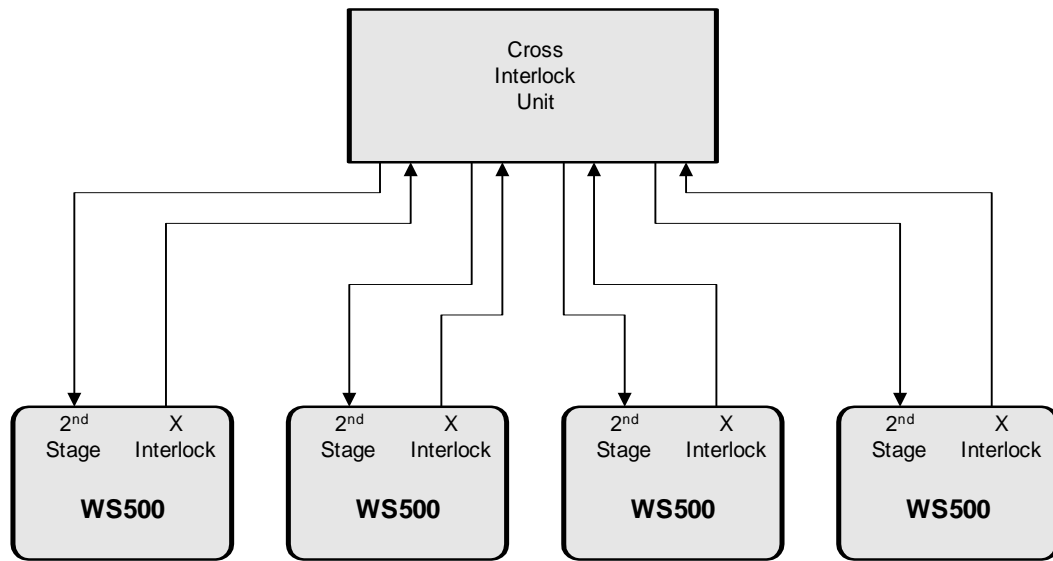
Cross Interlock

A cross interlock is an arrangement of welding controls that ensures no more than one control is welding at any time. This is to ensure that the mains supply is not over-loaded.

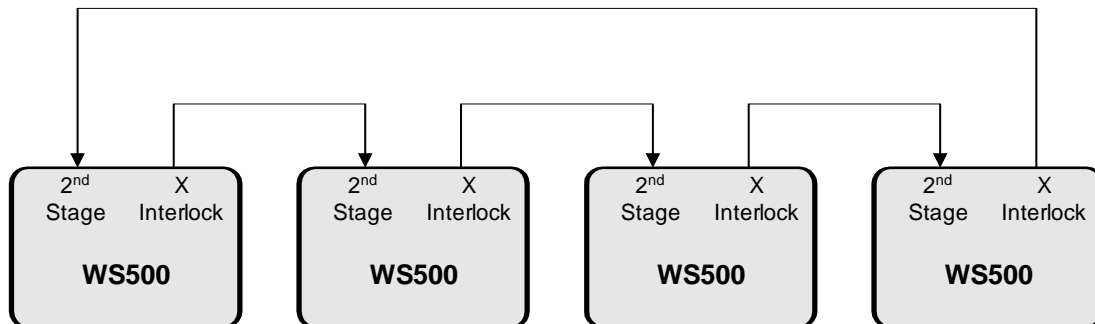WS500 offers a choice of two cross-interlocking schemes, called EXTernal and RING.

EXTernal cross-interlock.
This option requires an external cross-interlock unit. Interlocking is achieved by the Cross Interlock output from the timer switching on at the end of squeeze time and switching off at the beginning of the Hold time. Cross Interlock outputs from a number of timers are connected to the Cross Interlock Unit. This grants welding permission to one timer at a time by controlling the Second Stage Start inputs of the timers. The cross-interlock unit requires one channel for each connected timer.

**RING cross-interlock.**
This option requires no external hardware. Timers are simply wired in a ring configuration, with the cross interlock output from one timer feeding the second stage input of the next timer. Any number of timers may be connected in this way. Interlocking is achieved by an internal protocol which grants welding permission to one timer at a time.

Glossary of Terms

AVC	Automatic Voltage Compensation
CCR	Constant current regulation. See Constant Current
Const I	Constant current
Constant current	Closed loop control of weld current resulting in weld current being regulated to a programmed value. The current achieved by this method of control is independent of external influences.
ControlNet	A network for controlling a number devices (a device could be a weld timer).
Cool	The time interval, in a weld sequence, between applications of current.
Cool 1	The time period, within a weld sequence, between the end of Weld 1 pulse and the start of Weld 2 pulse.
Cool 2	The time period, within a weld sequence, between successive applications of the Weld 2 pulse (pulsations).
Cool 3	The time period, within a weld sequence, between the end of Weld 2 pulse and the start of Weld 3 pulse.
Cool time	A period of time, in a weld sequence, between applications of current. – Expressed in mains cycles.
CT	Current transformer
Current transformer	A coil of wire wound on a circular core. This is used to measure the current in a wire passing through the circular core. The weld timer uses this to measure primary current.
DeviceNet	A network for controlling a number stations (a station could be a weld timer).
Downslope	A linear decrease in current from the welding value to a final value, applied to the main weld pulse (Weld 2).
Downslope time	Time taken for current to decrease from the welding value to a final value. – Expressed in mains cycles.
End of sequence	An output that switches on as the electrodes open on completion of a weld. The output indicates completion of the weld sequence.
EOS	End of sequence.
Ethernet	A network for programming a number devices (a device could be a weld timer).
Fieldbus control	General term for control of timers over a network.
Heat	A measure of power put into a phase angle controlled (non- constant current) weld. The Heat relates directly to the firing angle in electrical degrees, on the mains voltage waveform. – Expressed as a percentage.
Heat 1	% Heat set for weld interval 1 (Weld interval 1 is sometimes referred to as "preheat").
Heat 2	% Heat set for weld interval 2. Weld interval 2 is usually programmed to provide the actual weld, unlike weld 1 – preheat, and weld 2 – post heat.
Heat 3	% Heat set for weld interval 3 (Weld interval 3 is sometimes referred to as "post heat").
Heat stepping	See Stepping.
Hold	The time, in a weld sequence, between the last application of

	current and the electrodes opening. This time allows the molten material created by the weld process, to solidify.
Hold time	The time period following the last weld pulse, prior to the electrodes opening. This period allows the molten material to solidify. – Expressed in mains cycles.
Hub	A component used with the Ethernet network for connecting a number of devices such that all data appears on all parts of the network.
I.P. address	Internet Protocol Address. A unique address used by devices on an Ethernet network.
IGBT	Insulated Gate Bipolar Transistor. A type of power transistor used in inverters.
Initiation signal	The signal that starts the weld sequence.
Interbus S	A network for controlling a number stations (a station could be a weld timer).
Inverter	See Medium Frequency Inverter
kA	Kilo amp. 1000 amps
KSR	German initials for constant current.
kVA	Unit of power. 1000 volt amps
LED	(Light Emitting Diode) An indicator that gives light when energised. There are different coloured types and some types can change colour.
mA	Milli-amp 1/1000 amp
Medium Frequency Inverter	A piece of equipment for powering a Medium Frequency welding transformer.
Medium frequency welding	System of welding using 1000 Hz or 1200 Hz instead of mains frequency.
MF	Medium frequency (welding)
mV	Milli-volt 1/1000 volt
Network adapter	An interface card for a computer giving it access to an Ethernet connection.
Off time	In a Repeated weld sequence, this is the time between sequences. – Expressed in mains cycles.
PC	Personal computer
PHA	Phase angle control.
Phase angle control	Open loop control of weld current using Heat setting. This method does not use Constant Current and the current achieved can be influenced by external parameters such as mains voltage, cable lengths, etc..
Ping	A diagnostic programme that tests if a station on an Ethernet network is responding.
Post heat	The application of current to prevent the weld (carried out by Weld 2) cooling too quickly. Sometimes called "Weld 3".
Pre heat	The application of current, in preparation for the actual weld current. This application of current is intended to burn through the plating or surface contamination of the work piece. Sometimes call "Weld 1".
Presqueeze	The time interval in a weld sequence for the electrodes to close onto the work piece.
Presqueeze time	The time allowed for the welding electrodes to close onto the components to be welded. – Expressed in mains cycles.
Primary current	The current in the primary winding of the weld transformer. – The current drawn from the mains whilst welding.
Profibus DP	A network for controlling a number devices (a device could be a weld timer).
Profibus FMS	A network for programming a number devices (a device could be a

	weld timer).
Prog Sel	See Programme Select i/p
Programme Select I/P	An input, usually one of several, giving a binary number to select the weld programme to be used.
Proportional valve	A device for regulating air-line pressure. Controlled by 0 – 10 v DC or 4 – 20 mA analogue signal.
Pulsations	The number of times the main weld interval (Weld 2) is applied. Successive applications of Weld 2 are separated by a Cool time.
Pulse Drive O/P	Timer output for driving thyristor firing circuit.
Retract	A system whereby the electrodes have two open positions: - Fully open to move the weld gun to and from the work piece, and an intermediate working position, for normal welding.
Retract air valve	For use on a gun where the electrodes can be opened and closed in two stages. This is an electrically controlled valve for admitting air to the air cylinder responsible for first stage of closing of the electrodes.
RS232	Serial communication system suitable only for short cables. This is the type of connection made via a COM socket on a computer.
Second Stage Initiation	A signal required to allow the weld sequence to proceed from the end of the Squeeze time to the beginning of the Weld interval. If the timer requires this signal, and it is absent, the sequence is halted until the signal is given. This input may be used to check electrode force has reached the correct value, or to make the sequence wait until another machine has finished it's weld.
Second Stage Start	See Second Stage Initiation
Secondary current	The current in the secondary winding of the weld transformer. – The weld current.
Squeeze	The time interval in a weld sequence for the electrodes to exert full welding force on the work piece.
Squeeze time	The time allowed for the welding electrodes to build up full pressure on the components to be welded. – Expressed in mains cycles.
Start 1	The signal that starts the weld sequence on Gun 1.
Start 2	The signal that starts the weld sequence on Gun 2.
Start signal	The signal that starts the weld sequence.
Stepper	A programme of parameters required for stepping.
Stepping	A technique of progressively increasing the weld current over the course of a large number of welds in order to compensate for the effects of electrode wear.
Switch	An Ethernet device for connecting other Ethernet devices together having the ability to direct packets of data to a specific destinations rather than the whole network.
Synchronisation	The actions of the weld timer are synchronised to the zero – voltage crossing points of the mains.
Thermostat	A switch device that operates at a certain temperature.
Thyristor	High power switch used for switching the mains supply to the weld transformer. Thyristors are controlled by a pulse drive.
Tip dress acknowledge	An input to a weld timer acknowledging that the electrodes have been dressed.
Tip dress request	An output given by a weld timer to indicate that the electrodes require dressing.
Tip dressing	Filing or machining worn electrodes to restore their original shape and dimensions. An adaptation of a Stepper to facilitate automatic dressing of electrodes.
Toroid	A device used for sensing current in a cable. The current carrying

	cable must pass through the toroid.
Upslope	A linear increase in current from an initial value to the welding value.
Upslope time	Time taken for current to increase from an initial value to the welding value. – Expressed in mains cycles.
VA	Volt Amp
WAV	Weld air valve.
Weld 1	A weld pulse intended to burn through surface coatings in preparation for the next weld pulse which will actually weld the components. Sometimes called Pre Heat. – Expressed in mains cycles.
Weld 2	The weld pulse that welds the components together. – Expressed in mains cycles.
Weld 3	A weld pulse following the pulse that welded the components together, included to slow the rate of cooling of the weld, sometimes called Post Heat. – Expressed in mains cycles.
Weld air valve	Electrically controlled valve for admitting air to the air cylinder responsible for forcing the weld electrodes together.
Weld current	High current passed from one electrode to the other, through the components being welded. The current must be large enough to generate sufficient heat to melt the metal and produce a weld.
Weld Transformer	Electrical component for converting mains voltage input to low voltage, welding current output.