WELDING CONTROLLER

SERRATRON 1B

Version 1.2 (5th Ed) - 2009/05

IMPORTANT

This User's Manual must be read and understood before carrying out any operation with the SERRATRON 1B

Serra Soldadura, S.A.
Polígono Industrial Zona Franca
Calle D, nº 29
08040 BARCELONA (Spain)

Telephone: +34 93 261 71 00
Internet: http://www.serrasold.com
Discharges: http://serratron.serrasold.com

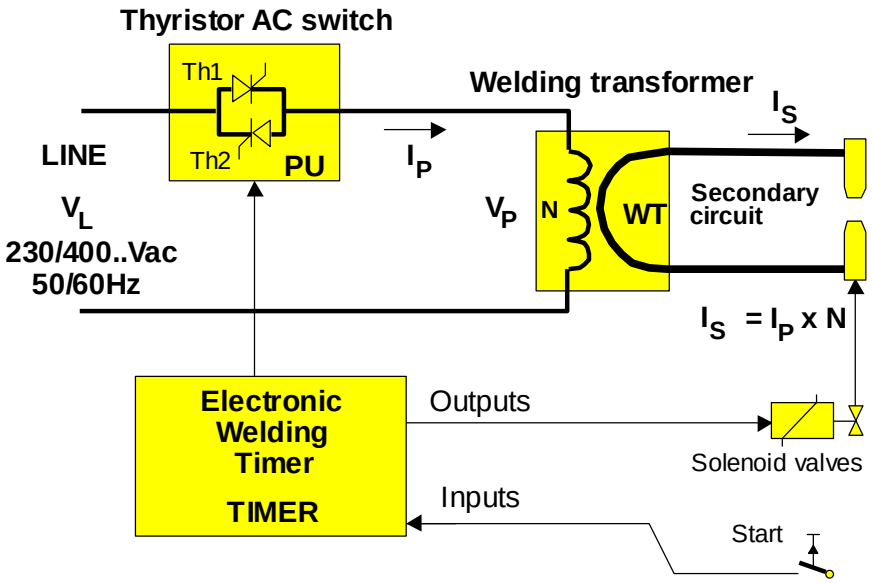
Version 1.2 (5th Edition) – Barcelona (Spain), May 2009

INDEX

Chapter 1
INTRODUCTION

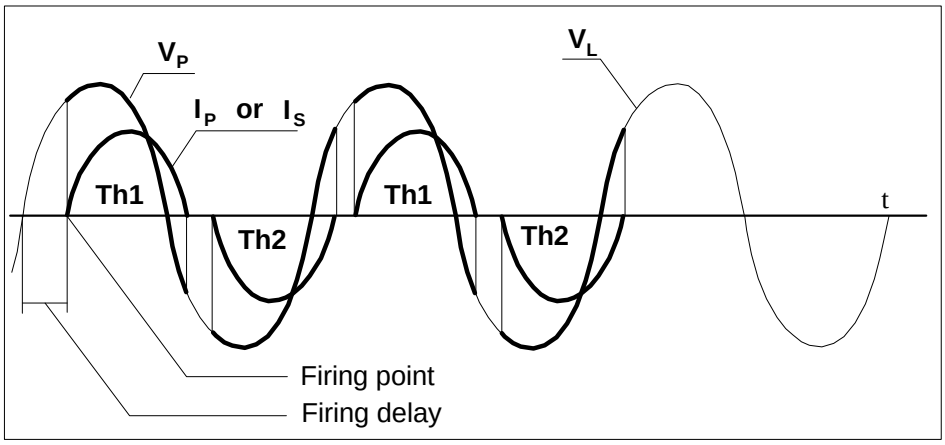
The basics about a resistance welding machine

The electrical part of a resistance welding machine is made up of three basic units:



- **Welding transformer** (**WT**)
  It provides the low voltages and high rates of current needed for welding.

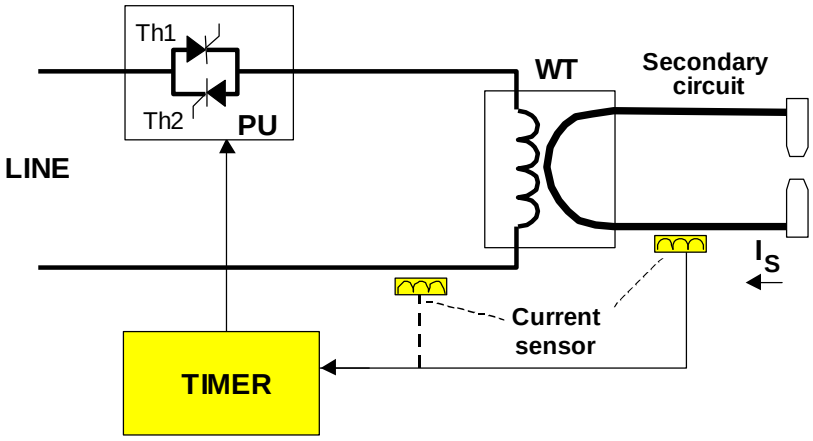
- **Power unit (PU)**
  It is connected to the primary side of the **WT** and is formed by two thyristors connected in antiparallel. The unit, also known as **Thyristor AC switch**, regulates the voltage applied to the primary of the **WT** by means of the procedure called 'Phase shifting' (see figure below): This is accomplished by an accurate control of the delay between the zero crossing of the voltage wave and the instant where the thyristors are triggered (firing point). The total amount of energy is controlled by the exact determination of the time that voltage will be applied to the **WT**. This time is counted in number of cycles of the AC power line (2 cycles in the figure).



Phase shifting power regulation

- **Welding timer (TIMER)**.
  The welding timer (a.k.a. welding control, control or just timer throughout this manual) controls not only the main variables, *Phase shifting* (power) and *time* of the current flow, but all the timings involved in the *welding process* (or welding sequence) as well, i.e. the squeeze, hold and off times that are related to the electrodes.

Besides other useful operations, the **SERRATRON 1B** incorporates the **constant current** feature. It provides the means of programming the aimed weld current directly in kA, calculating the fitted firing delay to achieve the programmed current, measuring the actual weld current and dynamically adjusting the firing delay along the weld time to compensate for deviations from the target weld current value. Thus, the true 'rms' value of the weld current along the whole weld time becomes unaffected by variations of all the magnitudes involved: mains voltage, resistance of the secondary cables or magnetic inductance of the secondary circuit.



Measurement probe of secondary current

The only external item needed by the constant current feature is a sensor coil placed around any conductor through which flows the welding current. Such coil may be an external device or be integrated in the **WT**.

Welding control SERRATRON 1B

The **SERRATRON 1B** is a Welding Resistance Control unit that regulates the energy supplied to a welding spot by the suitable control of the Power Unit (in time and phase). Auxiliary functions needed for the welding process, like the closing and opening of the electrodes, etc. can also be fully controlled.

Applications of the **SERRATRON 1B**:

- Spot welding
- Projection welding
- Seam welding

Type of machines where the **SERRATRON 1B** is applicable:

- Hanging or portable units with single or double gun
- Robots
- Pedestal machines

The **SERRATRON 1B** is mounted on a compact box which is easy to install and maintain.

The high performance of the **SERRATRON 1B** is obtained thanks to the use of a powerful microcontroller. The firmware is stored in a high capacity reprogrammable flash-memory, which allows it to be up-dated very quickly (via Ethernet port) without having to disassemble the control. The programmed parameters are stored in a non-volatile memory which makes them immune to alterations.

Summary of essential points

Two operating modes:

MAN = Portable welding machines
STA = Robots or Pedestal machines

127 x Welding Programs or Sequences
Sequences with additional features: Chained and Successive modes
Welding sequences with three independent weld times
Programmable weld pulsations (repetitions of 2nd Weld time)
Programmable up- and down-slope during Weld Time 2
Operation in Phase shifting, Monitoring or Constant Current mode
Weld current measurement through secondary or primary
Electrodes wear compensation by predefined curves
Optimized Electrode Tip-Dressing functions
Ethernet 10/100 base T + TCP/IP port for centralized programming
1 x Proportional Valve output: 0-10 V / 4-20 mA / 0-20 mA (configurable)
1/2 cycle welding time feature
Line frequency 50/60Hz with automatic detection & change-over
Data logging of the last 512 faults events & 512 weld sequences
SERRAstick card port for special purposes

●●●

Chapter 2
TECHNICAL DATA

Versions and optional modules

- **SERRATRON 1B** Standard model.
- **SERRATRON 1B5** Special model. Direct replacement for SERRATRON 5006 / 7000.

Accessories

● Programming software package	**CPC-connect**
● Memory module	**SERRAstik**
● Ø 50 mm Flexible Sensor Coil	**BCF-5**
● Ø 120 mm Flexible Sensor Coil	**BCF-12**
● Ø 180 mm Flexible Sensor Coil	**BCF-18**
● Wiring connectors pack	**X3Cb**
● Cable 1.5 m + Cb1 terminal	**XM-Cb1**
● Cable 1.5 m + Cb2 terminal	**XM-Cb2**
● Cable 1.5 m + Cb3 terminal	**XM-Cb3**

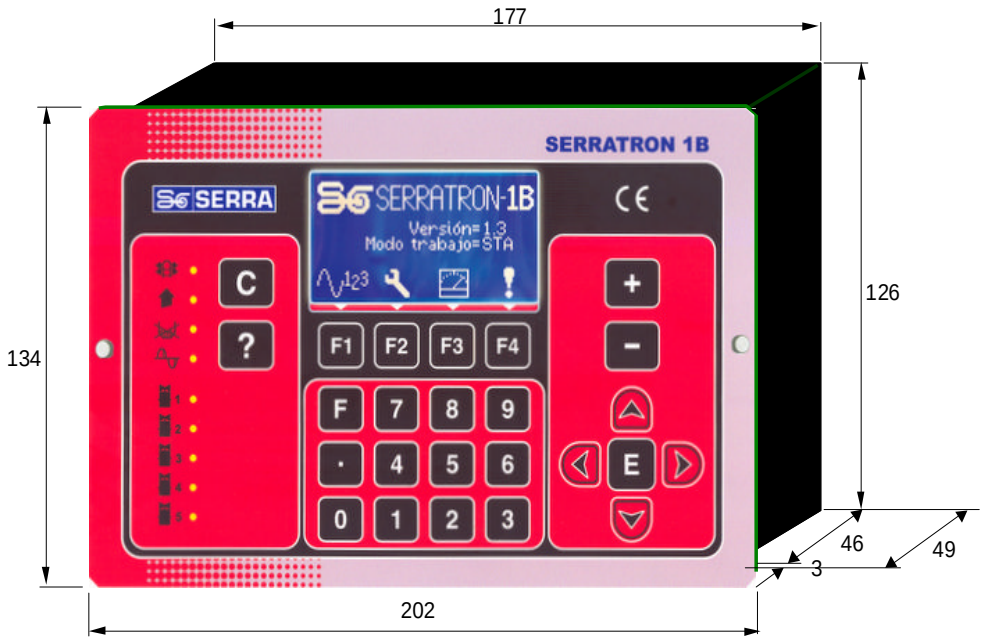
Specifications

Connections	Sub-D connectors (37, 15, 9-pins)
Temperatures	Storage conditions: -25 to +70 ºC / -13 to +158 ºF Operating conditions: 0 to 50 ºC / 32 to 122 ºF
Humidity	Class F according to DIN 40040. Condensation is not permitted
Protection class	General: IP20.
Operating voltage	24 VDC (± 5% ripple) maximum voltage 30 V (instantaneous voltage) minimum voltage 19 V (instantaneous voltage) Operating load (without I/Os): ~5 W
Synchronization voltage	24 Vac ± 25% Frequency: 50/60 Hz (automatic recognition & change-over)
Programming network	Ethernet 10/100 base T with protocol TCP/IP. Central programming system software package **CPC-connect**
Discrete input/outputs	19 inputs & 8 outputs Inputs 24 Vdc 10 mA 'on' ≥ 14 V 'off' = -1 VDC to 12 VDC or open circuit All Outputs: 24 Vdc / 700 mA (individual short circuit protection)
SCR firing output	1 A output (with LED indication) Isolator relay & short circuit protection: 0.8 A resettable fuse 5 kHz impulses ('on'=50 µs 'off'=150 µs)
Current image (optional)	24 Vac analogue input, supplied by transformer, derived from the voltage across the thyristor unit. Used by the thyristor supervision function.
1 x Weld current sensor	Analogue input (secondary or primary) Input sensitivity: 20...2300 mV/kA (R_L = 1 kΩ) Absolute maximum voltage: ± 45 V
1 x Proportional valve	Analogue 4-20 mA / 0-20 mA / 0-10 V output, programmable in kN 24 Vdc / 500 mA power supply for the PV
Buffering of weld parameters	Permanent. No battery required for this purpose.
Real Time Clock	Built-in real time clock.
Date/Time retention	Typical: 10 days.
Weight	1.0 kg (30.75 oz)
Dimensions	202 x 134 x 49 mm 7.95 x 5.28 x 1.93 inches

●●●

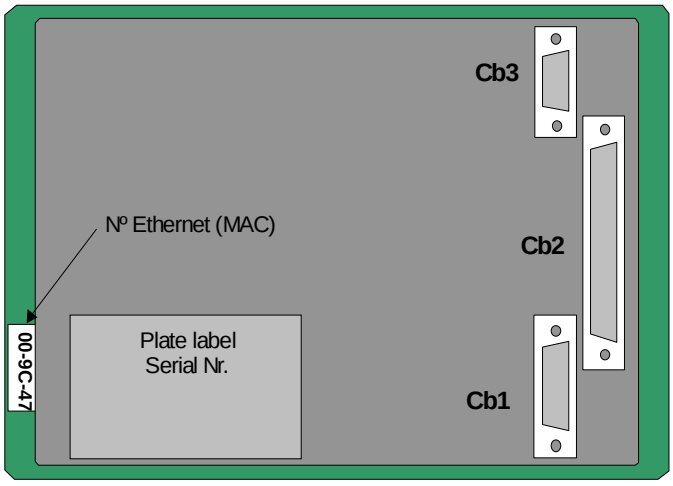
Chapter 3
GENERAL DESCRIPTION

SERRATRON 1B module



All dimensions in mm

Rear view



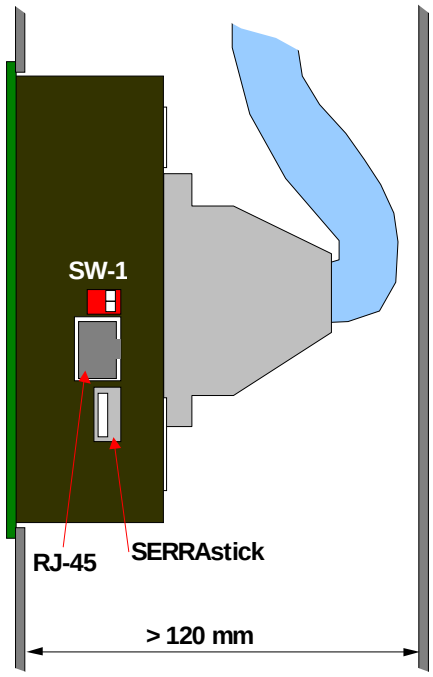
Connectors

Cb1 15 poles-male: 24 Vdc power supply, mains synchronization, firing circuit

Cb2 35 poles-female: 24 Vdc Inputs/Outputs 24, Proportional Valve

Cb3 9 poles-male: Measuring current sensor/coil

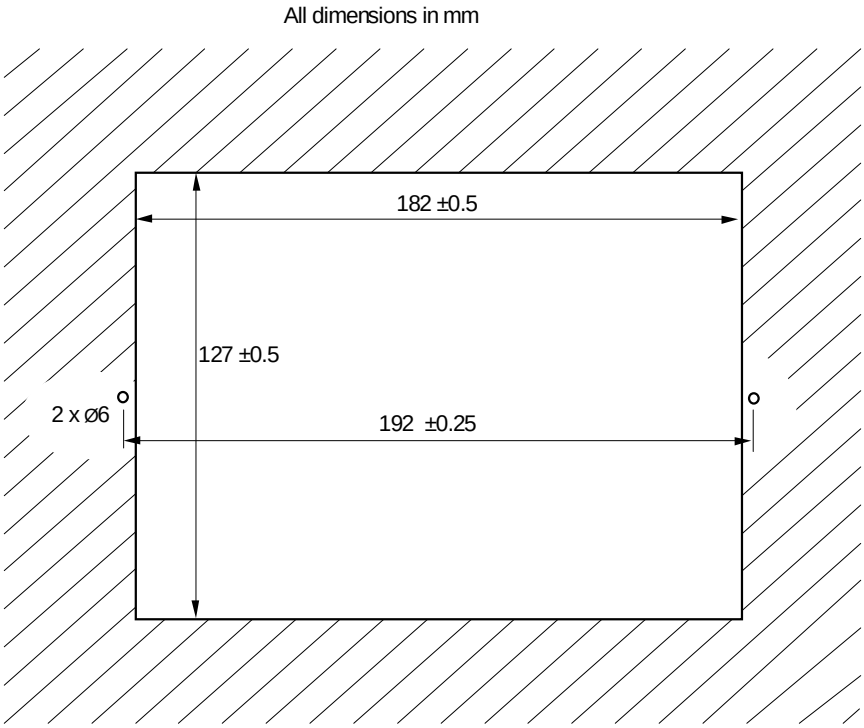
Side view



Side panel connectors

SW-1	Working mode (see page 3-3)
RJ-45	Ethernet connector
SERRAstik	External memory (SERRAstik) connector (see page 7-22)

Dimensiones de la ventana de montaje



Working modes of the SERRATRON 1B

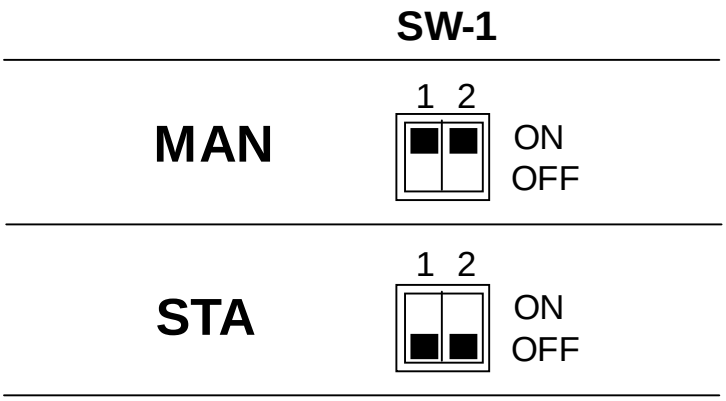
Depending on the welding application this control is destined for, we can choose between two different operating modes or **Working modes**:

- **MAN** For hanging or portable welding machines
- **STA** For pedestal machines, Robots, etc.

The Working mode is a **programmable** parameter.

Changing the Mode does not mean losing or deleting any of the programmed parameters, apart from the logical fact that some of them may become useless in the new Working mode.

The double switch –**SW-1**– on the right side of the SERRATRON 1B must match with the chosen working mode, otherwise several fault messages will be eventually displayed. Next figure shows the fitting positions.



Chapter 4 provides detailed information about the way the Inputs/Outputs operate.

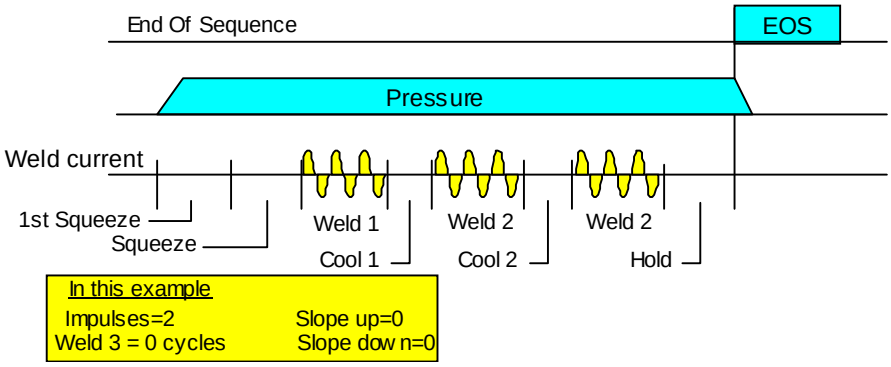
Weld program (also called 'weld schedule'): set of all programmable numeric values related to the variables involved in a weld sequence

Welding sequences

A welding sequence is the set of operations carried out by the control in order to make a weld. Each individual operation has a duration which can be adjusted by the user and this is why welding controls are also called *Timers*.
The welding sequences carried out by the **SERRATRON 1B** are described in the diagram in page 5-1 and the following ones. For a detailed explanation of each parameter (times, powers,..) see Chapter 5 *PARAMETERS AND FUNCTIONS.*

Single spot

It has this name because after each time the Start is activated just one welding sequence is carried out independently from the duration of that activation. To execute another welding sequence, Start must be de-activated and then be activated again.
This is the most employed **sequence mode**.



Some basic rules to follow when driving a welding timer from a PLC or Robot:

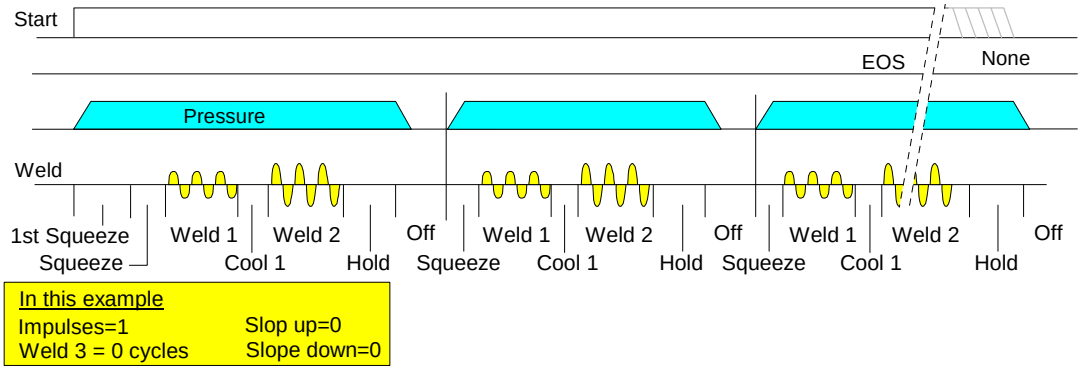
- 1 Program selection must be done prior or simultaneously to the activation of Start.
- 2 Do not activate Start if the timer has its output End of Sequence (EOS) still ON.
- 3 Start should be kept ON until the timer activates its output End Of Sequence. To resume a halted sequence due to a weld fault, there are two choices: retry the failed weld sequence in the hope of success this time, or simulate the EOS manually.

If the EOS output is triggered being Start still activated, EOS will remain ON until Start was released. On the other hand, if Start is released during the weld times but before the activation of EOS, EOS will be ON during a fixed delay (0.15 s).

WARNING: In case of a welding fault, the EOS signal is not activated, except in the case of excessive weld current faults. The aim of this exception is to prevent the unsuitable choice of a weld retry after a fault of this kind. Further weld sequences will be prevented to start until an acknowledgement is given (Fault Reset command).

See also *Start & End of Sequence (EOS)* at page 9-4.

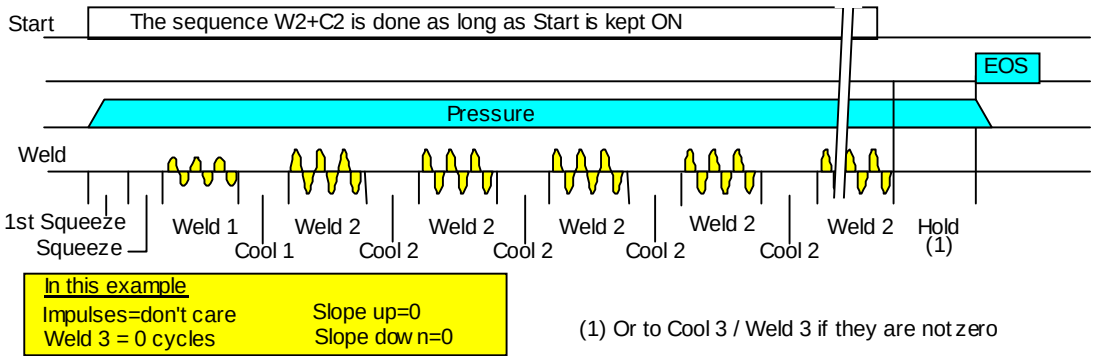
Repeated spot



The timer keeps performing welding sequences for as long as Start input is kept ON. During the brief opening time of the electrodes -Off time- the part can move, or rather the welding gun, with the outcome of welding at another position. Obviously, this **sequence mode** is only used in manual welding applications, portable guns or static machines, but never in automatic installations.

Seam welding sequence

Requires the use of special welding heads where the electrodes are rotary wheels (rollers), allowing them to roll over the parts to be welded, or the parts are dragged along by the rollers. The sequence of times W2+C2 is performed as long as Start remains activated. During Weld 2 the weld current flows and during Cool 2 not; thus modulating the rate of energy transmission to the welding parts. If Cool 2 is zero the current flow is *continuous*.



If Start is deactivated during a 1st Squeeze or Squeeze time the sequence ends immediately.
If Start is deactivated during a Weld Time 2, it is completed and the sequence skips to Cool 3 / Weld 3 / Hold time.
If Start is deactivated during a Cool Time 2 the sequence goes on directly to Cool 3 / Weld 3 / Hold time.

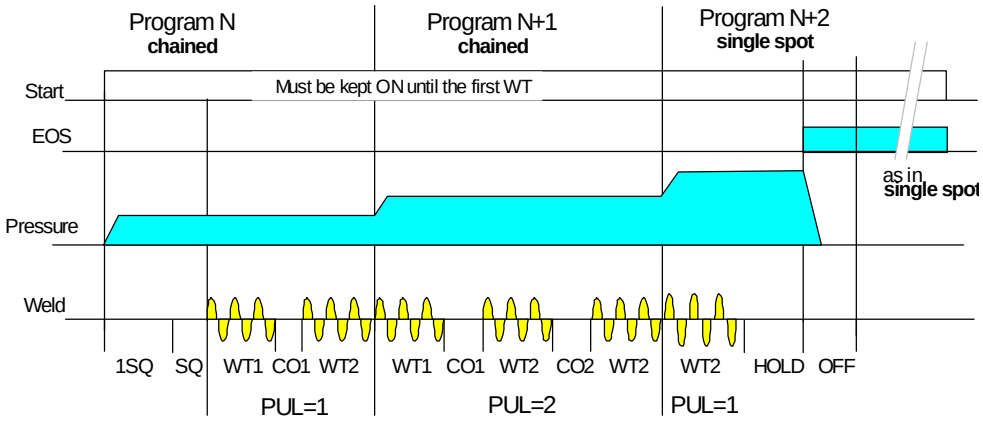
The EOS output is activated for 0.15 seconds at the end of Hold, if no welding fault is reported, or if the welding fault has been an excessive current fault.

If a welding fault happens during a seam sequence, the control reports on the fault but the weld process is not interrupted as long as Start remains activated. Once the Start is removed and the sequence ends, another welding sequence cannot be initiated until the fault has been acknowledged by a *Fault Reset* command.

Chained sequence (only in STA mode)

This allows complex welding sequences or with a varible profile to be made. When a program is executed in **chained** mode, if the Start signal remains activated at the end of HOLD time, the sequence goes on to execute the following Program, and so on successively until a Program in **single spot**, **repeated spot** or **seam welding** mode is reached, where the **chained sequence** will end.

Next figure shows an example of a complex sequence made up of two **chained** Programs and one Program in **single spot**.



Example of a CHAINED sequence

In this example, at the end of **WT2** of the Program N, the sequence goes directly on to **WT1** of the Program N+1, and the same happens at the end of the last **WT2** of this Program, moving on to **WT2** of N+2.

Behaviour rules of the sequence in chained sequences

It depends on the intermediate time values between the weld times (WTs) of a **chained** program N (WTs[n]) and the WTs of N+1 (WTs[n+1]); that is HOLD[n], OFF[n] and SQ[n+1] (1SQ[n+1] doesn't matter).

- **HOLD[n]=1, OFF[n]=0 and SQ[n+1]=1**
  The sequence goes **directly** from weld times in Program N to weld times in Programa N+1.
  It is not necessary to keep Start ON, for welds chained in this way are considered as just one weld.
- **HOLD[n]>0 or OFF[n]>1 or SQ[n+1]>1**
  A) If start is kept activated the sequence goes on from N to N+1 as follows:

  WTs[n] + HOLD[n] + OFF[n] + **SQ[n+1]** + WTs[n+1]...

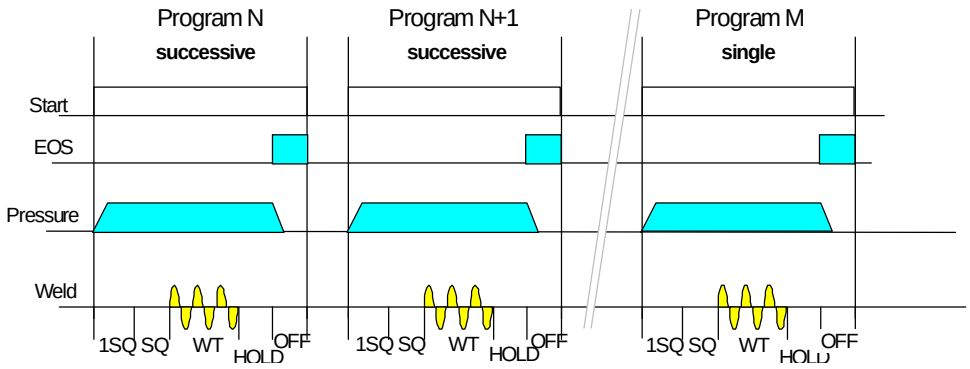
  B) If Start is NOT kept activated, the sequence continues until the end of N and stops there. Then, there are two possibilities:
  1) By activating Start the sequence will continue **1SQ[n+1]** + SQ[n+1] + WTs[n+1]...
  2) By activating *Sequence Reset* before activating Start.
     In this case the sequence will start from the first program in the series of **chained** which make up the Program N, or from the Program actually selected by the selection inputs.

  In the event of a welding fault the cycle stops at the end of the welding time in which it was produced. In order to continue, all you have to do is to give a *Fault reset* command.

If a sequence of chained programs ends with a Program in repeated mode and the Start signal is kept activated indefinitely, the behaviour is similar to that described in the **Repeated mode**, but considering all the chained programs as just one welding sequence. Therefore, in the case shown in the figure in page 3-5, at the end of OFF time in the Program N+2 the sequence will skip to **SQ** in Program N and repeat the sequence from then onwards.

Successive mode (only in STA mode)

The behaviour of a Program in **Successive** mode is exactly the same as in the case of the **Single spot** mode, the difference being that when a Program has been executed (e.g nr. N) the control is ready to run Program N+1 when Start was activated again.



Example of a SUCCESSIVE sequence

The series of **successive** programs ends when a program in **single** mode is reached and executed. The control is then ready to start again with the first of the **successive** programs, or with the Program determined by the Program selection inputs (page 4-6).

In the example in Example of a SUCCESSIVE sequence, after executing Program M, the control will become ready to start from Program N at the following activation of Start.

When the control is in the middle of a sequence of successive programs, a *Sequence Reset* command can be carried out in order to force a return to the beginning of that sequence (Pr. N).

●●●

Chapter 4
INPUTS & OUTPUTS

The following sections describe the operating mode of all the input or output signals. See the terminals wiring in chapter *SERRATRON 1B external connections*.

All the outputs have individual short-circuit protection. When the protecting device is triggered by overload or a short-circuit on the load, the output voltage falls near 0 V and remains at this level until the cause of the fault is removed.

Summary of Inputs/Outputs according Working Mode

MAN

INP	Cb2	Cfg	DESCRIPTION	OUT	Cb2	Cfg	DESCRIPTION
I0	12		Start 1 Gun 1	O0	13		Gun 1 (welding stroke)
I1	8	C	Weld ON (15/SW-3)	O1	34		Gun 2 (welding stroke)
I2	22		Faults Reset	O2	33		Gun 1 retract
I3	3		Counters Reset	O3	35		Gun 2 retract
I4	14		Retract Gun 1	O4	11	C	EOS / TD-Request (2/SW-2)
I5	7		Retract Gun 2	O5	15	C	Electrode alarm
I6	27	C	Weld Time Enabled (1/SW-2)	O6	10	C	WTR / TD-Request (3/SW-2)
I7	26		Tip-Dressing Acknowledge	O7	16	C	Control ready / Main Switch (4-5/SW-2)
I8	4		Start 1 Gun 2				
I9	23		Start 2 Gun 1	(WTR=Weld Time Request)			
I10	5		Start 2 Gun 2				
I11	24		Program selection 8				
I12	6		Program selection 16				
I13	25		Program selection 32				
I14	21		Program selection 64				
I15	2	C	Pressure switch (6/SW-2)				
I16	20		Operation enabled				
I17	1		Transformer Thermostat (9/SW-2) (Note 1)				
I18	32		Program selection 4				

STA

INP	Cb2	Cfg	DESCRIPTION	OUT	Cb2	Cfg	DESCRIPTION
I0	12		Start	O0	13	C	Solenoid valve 1 -SV1- (Note 2)
I1	8	C	Weld ON (15/SW-3)	O1	34	C	SV2
I2	22		Faults Reset	O2	33	C	SV3
I3	3		Counters Reset	O3	35	C	SV4 / Gun retract (0/SW-2)
I4	14	C	Retract Gun (Note 3) (0/SW-2)	O4	11	C	EOS / TD-Request (2/SW-2)
I5	7		Sequence Reset	O5	15	C	Electrode alarm
I6	27	C	Weld Time Enabled (1/SW-2)	O6	10	C	WTR / TD-Request (3/SW-2)
I7	26		Tip-Dressing Acknowledge	O7	16	C	Control ready / Main Switch (4-5/SW-2)
I8	4		Program selection 1				
I9	23		Program selection 2				
I10	5		Program selection 4				
I11	24		Program selection 8				
I12	6		Program selection 16				
I13	25		Program selection 32				
I14	21		Program selection 64				
I15	2	C	Pressure switch (6/SW-2)				
I16	20		Operation enabled				
I17	1		Transformer Thermostat (9/SW-2) (Note 1)				
I18	32	C	Program change / Weld time break (7-8/SW-2)				

Cfg=C Configurable
Note 1: The alternative use of Input I17 as Programming ON/OFF input is a factory setting choice.
Note 2: For the activation of SV1-SV2-SV3-SV4 see page 5-3
Note 3: Needs an external diode to activate I0 (See text box in I4 input, page 4-2).

Inputs description

This Chapter describes the operating mode of all the 24Vdc inputs according the Working Mode: MAN-STA.

I0	**Cb2/12**	**MAN**
Start 1 of Gun 1		Selects Gun 1 (output O0) and welding Program **1**. This input activates the internal safety relay of the O0 and O2 outputs. It remains interlocked from the beginning of **Weld Time 1**. This relay may also be activated by the I4 and I9 inputs.
		STA
Start		The activation of Start initiates a welding sequence with the Program whose number is being codified by the *Program Selection* inputs. Please see *Welding sequences*Chapter 0 (page 3-4) for the operation of the Start signal according the **Sequence Mode**. This input activates the internal safety relays of the O0..O3 outputs. These relays remain interlocked from the beginning of welding times.

The dip-switch **SW1** allows, in **MAN** Mode, the activation of the safety relays from other inputs apart from I0. **SW1** must be set to the correct position according to the **Working mode** chosen. If that was not done, the attempts to perform welding sequences would generate some error codes, described in Chapter 8 TECHNICAL SERVICE

I1	**Cb2/8**	**MAN-STA**
Weld ON		With this input inactive welding sequences can be carried out without ignition impulses being sent to the thyristors and consequently without current flow between the electrodes. This possibility is necessary during the set up of the machine or electrodes.

Bit **15** of **SW-3** (page 5-8) lets configure this input as the opposite: Weld OFF. In Weld OFF mode, the weld is enabled when this input remains deactivated.

I2	**Cb2/22**	**MAN-STA**
Fault reset		This generates a *Fault reset* command which clears the active error code. If the cause of the fault has not disappeared, the error will reappear. Input **I2** causes a single *Fault reset* every time it is activated, no matter how long it has been activated.

I3	**Cb2/3**	**MAN**
Counter reset		Sets to zero the Counter of the Program of the last sequence used.
		STA
Counter reset		Sets to zero the Counter of the Program selected by the inputs I8...I14 (see page 4-6). See also the description of output **O5**.

I4	**Cb2/14**	**MAN**
Retract Gun 1		**I4** activates the output **O2** (SV3): solenoid valve that opens the Gun 1. In the gun open position it is not possible to make weld sequences with Gun 1. Inputs I0 and I9 are left inoperative.
		STA
0/SW2 = **0**		Input not used
0/SW2 = **1**		**Retract Gun** **I4** activates the output **O3** (**SV4**) that drives the opening valve of the single gun available in this mode. In the open position it is not possible to perform weld sequences.

When **I4** is used as Retract Gun input, the input **I0** must be activated at the same time as I4, by means of a diode (anode: I4, cathode: I0) to enable the activation of the output **O3** (**SV4**).
Yet, the activation of I0 and I4 at the same time prevents the initiation of a weld sequence.

I5	**Cb2/7**	**MAN**
Retract Gun 2		I5 activates the output **O3** (SV4): solenoid valve that opens the Gun 2. In the gun open position it is not possible to make weld sequences with Gun 2. Inputs I8 and I10 are left inoperative.
		STA
Sequence Reset		This input is only operative when using the **chained** or **successive** sequence modes. It resets the **chained** or **successive** sequence being executed. Then, when Start (I0) was activated again, the sequence will begin with the Program actually selected by the inputs I8...I14 (page 4-6).

I6	**Cb2/27**	**MAN-STA**
Weld time enable		A welding sequence having reached the end of **Squeeze** time can go through the **Weld** times only if this input is activated. Otherwise, the sequence will remain at that point, waiting for this input, as long as the Start input was held ON. If this input is activated when the squeeze times have already ended, the weld times will begin immediately. There is not restriction due to I6 in a not welding sequence. The operation of I6 depends on bit 1/SW2 (page 5-8).
1/SW2 = **0**		Weld time enable input disabled. The activation of I6 is no more necessary to allow the sequence go through the weld times.
1/SW2 = **1**		I6 operates as Weld time enable input.

The I6 inputs and the O6 outputs of several timers (in *WTR-Weld time request* mode), connected to an external PLC, may let this one to limit the number of machines welding simultaneously.

I7	**Cb2/26**	**MAN-STA**
Tip-dressing acknowledge		This input must be activated after an electrode tip-dressing operation. This command increments the Tip-dressing counter of the selected electrode and modifies its Weld Spots counter in the way described in *Tip-dressing operation* (page 5-11).

I8	**Cb2/4**	**MAN**
Start 1 Gun 2		Selects Gun 2 (output **O1**) and Program **2**. This input activates the safety relay of the outputs O1 and O3, which will remain interlocked from the start of the weld times. This relay can also be activated by the inputs I5 and I10.
		STA
Selection of Program 1		Combined with I9...I14, it contributes with **1** on selecting the welding Program to be used when *Start* is activated (see page 4-6).

I9	**Cb2/23**	**MAN**
Start 2 Gun 1		This input selects **Gun 1** (output **O2**) and Program **3**. See also Input I0.
		STA
Selection of Program 2		Contributes with **2** on selecting the welding Program.

I10	**Cb2/5**	**MAN**
Start 2 Gun 2		This input selects **Gun 2** (output **O1**) and Program **4**. See also Input I8.
		STA
Selection of Program 4		Contributes with **4** on selecting the welding Program.

I11	**Cb2/24**	**MAN-STA**
Selection of Program 8		Contributes with **8** on selecting the welding Program.

I12	**Cb2/6**	**MAN-STA**
Selection of Program 16		Contributes with **16** on selecting the welding Program.

I13	**Cb2/25**	**MAN-STA**
Selection of Program 32		Contributes with **32** on selecting the welding Program.

I14	**Cb2/21**	**MAN-STA**
Selection of Program 64		Contributes with **64** on selecting the welding Program.

I15	**Cb2/2**	**MAN-STA**
Pressure switch		This input inactive avoids counting the (2nd) Squeeze time. A Pressure switch is any device which certifies that the electrodes are in close contact with the parts to be welded. If the *Start* signal is released before the activation of I15, the welding sequence will be ended immediately. If this input remains inactive at the end of the Squeeze times, prevents the weld times to begin and eventually generates Error **23**. Its behaviour depends on bit **6** of **SW-2** (page 5-8).
6/SW2 = **0**		I15 works as **Pressure switch** input.
6/SW2 = **1**		I15 disabled as Pressure switch.

I16	**Cb2/20**	**MAN-STA**
Operation enable		Contact normally closed. When it opens during a sequence, the sequence ends in the normal way but further sequences are disabled. This situation generates Error **80**. The deactivation of the Main circuit breaker, if any, should be done by means of a second contact in the Emergency stop push-button.

I17	**Cb2/1**	**MAN-STA**
		This input has two operating modes depending on a factory setting. This is the default mode
Transformer thermostat		It is a normally closed contact which opens in the event of excessive temperature in the welding transformer, producing the Error **82**. If the Transformer thermostat is not used, its functionality may be disabled by setting the bit **9**/**SW2** (see page 5-8).
9/SW2 = **0**		Input used as **Transformer thermostat**.
9/SW2 = **1**		Input disabled.
		Next mode will be supplied under special order only!
Programming enable		**I17**=**0** → Disables programming with the user interface. **I17**=**1** → Enables free programming. Suggested use: A locking-key switch connected to this input may prevent the use of the user interface by unauthorized personnel.

I18	**Cb2/32**	**MAN**
Selection of Program 4		Contributes with **4** on selecting the welding Program.
		STA
		Its behaviour depends on bits **7-8** of **SW-2** (page 5-8).
7/SW2 = **0**		Input **I18** not used.
7/SW2 = **1**		Input **I18** as determined by bit 8/SW2.
8/SW2 = **0**	**Swapping program**	(This input is only operative in **seam welding** mode) When this input is activated during the execution of Program N the Weld time 2 and Cool time 2 parameters (times and powers) swap to the ones of Program N+1 **or** to the ones in *Swapping program* (see page 5-7). When this input goes off the sequence returns to Program N. If the *Start* is released while in Program N+1, the sequence goes back to Program N and finishes in the normal way.
8/SW2 = **1**	**Weld time break**	(This input is independent of the sequence mode) If this input is activated during a **Weld Time 2** forces the immediate termination (in a synchronous way) of this weld time, and the end of the sequence in the normal way. Yet, the **Weld Time 3** will also be executed if it is not zero.

Program selection

MAN mode

The program selection is carried out directly at the activation if the *Start* push-buttons of the welding guns: two buttons on each gun. In this way Programs 1, 2, 3 and 4 are selected automatically. Nevertheless, program numbers above 4 can be used and thus take advantage of the fact that the **SERRATRON 1B** has 127 programs (1...127). All we have to do is to program the **starting Program** with the values 4, 8 or 12, etc.

In this way we can operate with the 127 programs available, but in groups of 4. On activating the *Start* buttons of the welding guns the intermediate programs will be selected automatically: e.g. 5-6-7-8, 9-10-11-12, 13-14-15-16 and so on.

STA mode

Next table shows all the combinations of the inputs I8...I14 and the program number selected when Working mode is **STA**.

For Programs 64 to 127 look at the table for the program value equal to Program – 64, but setting bit 64 to 1 (I14).

PROGRAM SELECTION (only in STA mode)

127 Programs

Input	I14	I13	I12	I11	I10	I9	I8	Input	I14	I13	I12	I11	I10	I9	I8
Program	**64**	**32**	**16**	**8**	**4**	**2**	**1**	**Program**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
0 (*)	0	0	0	0	0	0	0	32	0	1	0	0	0	0	0
1	0	0	0	0	0	0	1	33	0	1	0	0	0	0	1
2	0	0	0	0	0	1	0	34	0	1	0	0	0	1	0
3	0	0	0	0	0	1	1	35	0	1	0	0	0	1	1
4	0	0	0	0	1	0	0	36	0	1	0	0	1	0	0
5	0	0	0	0	1	0	1	37	0	1	0	0	1	0	1
6	0	0	0	0	1	1	0	38	0	1	0	0	1	1	0
7	0	0	0	0	1	1	1	39	0	1	0	0	1	1	1
8	0	0	0	1	0	0	0	40	0	1	0	1	0	0	0
9	0	0	0	1	0	0	1	41	0	1	0	1	0	0	1
10	0	0	0	1	0	1	0	42	0	1	0	1	0	1	0
11	0	0	0	1	0	1	1	43	0	1	0	1	0	1	1
12	0	0	0	1	1	0	0	44	0	1	0	1	1	0	0
13	0	0	0	1	1	0	1	45	0	1	0	1	1	0	1
14	0	0	0	1	1	1	0	46	0	1	0	1	1	1	0
15	0	0	0	1	1	1	1	47	0	1	0	1	1	1	1
16	0	0	1	0	0	0	0	48	0	1	1	0	0	0	0
17	0	0	1	0	0	0	1	49	0	1	1	0	0	0	1
18	0	0	1	0	0	1	0	50	0	1	1	0	0	1	0
19	0	0	1	0	0	1	1	51	0	1	1	0	0	1	1
20	0	0	1	0	1	0	0	52	0	1	1	0	1	0	0
21	0	0	1	0	1	0	1	53	0	1	1	0	1	0	1
22	0	0	1	0	1	1	0	54	0	1	1	0	1	1	0
23	0	0	1	0	1	1	1	55	0	1	1	0	1	1	1
24	0	0	1	1	0	0	0	56	0	1	1	1	0	0	0
25	0	0	1	1	0	0	1	57	0	1	1	1	0	0	1
26	0	0	1	1	0	1	0	58	0	1	1	1	0	1	0
27	0	0	1	1	0	1	1	59	0	1	1	1	0	1	1
28	0	0	1	1	1	0	0	60	0	1	1	1	1	0	0
29	0	0	1	1	1	0	1	61	0	1	1	1	1	0	1
30	0	0	1	1	1	1	0	62	0	1	1	1	1	1	0
31	0	0	1	1	1	1	1	63	0	1	1	1	1	1	1

(*) The Program actually selected at the activation of Start, will be given by the parameter **Starting Program** (page 5-6).

Outputs description

O0 Cb2/13	**MAN**
Welding Gun 1	This output activates (closes) welding gun **1** from the beginning of **1st Squeeze** time until the end of **Hold** time.
	STA
Solenoid valve SV1	See on page 5-3 the activating conditions of the outputs O0...O3 (SV1...SV4).

O1 Cb2/34	**MAN**
Welding Gun 2	This output activates (closes) welding gun from the beginning of **1st Squeeze** time until the end of **Hold** time.
	STA
Solenoid valve SV2	See on page 5-3 the activating conditions of the outputs O0...O3 (SV1...SV4).

O2 Cb2/33	**MAN**
Retract Gun 1	**O2** (**SV3**) drives the solenoid valve which opens the **Gun 1** and remains ON as long as the input **I4** is held ON.

NOTE: The bi-stable option for the retract function, that was available in older **SERRATRON** timers, is no longer available for safety reasons.

	STA
Solenoid valve SV3	See on page 5-3 the activating conditions of the outputs O0...O3 (SV1...SV4).

O3 Cb2/35	**MAN**
Retract Gun 2	**O3** (**SV4**) drives the solenoid valve which opens the **Gun 2** and remains ON as long as the input **I5** is held ON.
	STA
	Its behaviour depends on bit **0** of **SW2** (page 5-8).

0/SW2 = **0** **Solenoid valve SV4**.
See on page 5-3 the activating conditions of the outputs O0...O3 (SV1...SV4).

0/SW2 = **1** **Retract Gun**
O3 (**SV4**) drives the solenoid valve which opens the single welding gun available in this working mode and remains ON as long as the input **I4** is held ON.

When **I4/O3** are used for the Retract Gun function, the input **I0** must be activated at the same time as **I4**, by means of a diode (anode: I4, cathode: I0) to enable the activation of the output **O3** (**SV4**).
Yet, the activation of I0 and I4 at the same time prevents the initiation of a weld sequence.

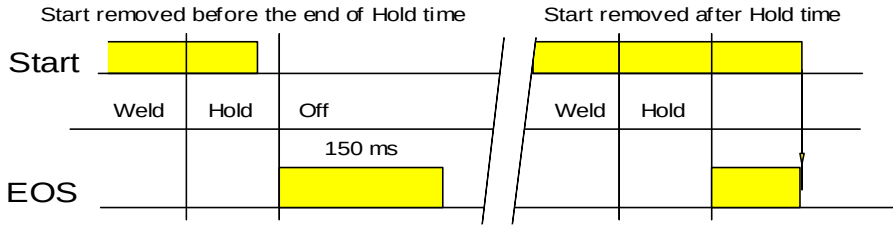
O4 Cb2/11 MAN-STA

Its behaviour depends on bit **2** of **SW2** (page 5-8).

2/SW2 = 0 End of sequence (EOS)

EOS is activated at the end of the **Hold** time in single spot and seam sequences, whether the sequence is with or without welding (see pages 3-4 and 9-4). If there has been a 'low current' kind of welding fault, the EOS output will not be activated.

Once activated, EOS stays ON until Start is deactivated. Otherwise, if at the end of **Hold** time the Start signal is already inactive, End of sequence is activated during 0.15 s.



2/SW2 = 1 Tip-dressing request

This output is activated when the electrode assigned to the selected program requires a Tip-dressing operation.

> In MAN mode the program selection becomes effective at the activation of one of the four available Start inputs.

This output will be reset by one of the following causes:

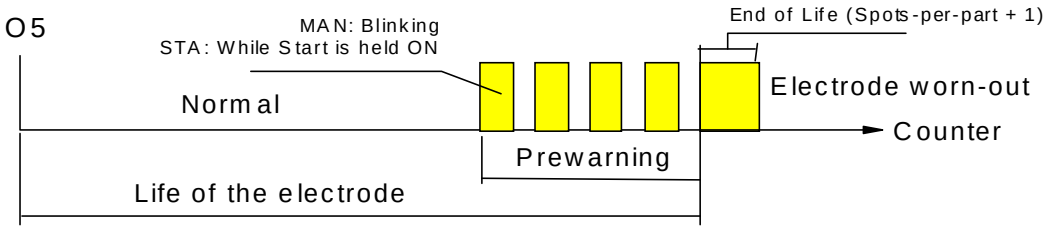
- A *Tip-dressing acknowledge* command (page 5-13)
- By selecting a (non blocked) program whose electrode was not in TD-Request condition.
- A *Counter reset* command (page 5-13)

O5 Cb2/15 MAN-STA

Electrode alarm Depends on the current wearing phase of the electrode used in the last weld sequence:

Normal	Remains inactive.
Prewarning	**MAN**: Remains blinking until the next weld sequence. **STA**: Remains activated, at the end of the sequence, as long as Start is held activated.
End of life	Remains permanently activated until the next weld sequence.
Electrode worn out	Remains permanently activated and the control blocked until a *Counter reset* command (page 5-13).

> The wearing phase of an electrode is evaluated at the end of the weld sequence but before the eventual EOS activation (see timing diagrams in page 9-4), according to the ratio between the current state of the **counter** and the programmed **Life** of the electrode.
>
> The **End of life** phase lasts for one spot more than the 'Spots per part' parameter



O6 Cb2/10 MAN-STA

Its behaviour depends on bit **3** of **SW2** (page 5-8).

3/SW2 = **0** **WTR-Weld time request**

O6 is activated, in welding sequences, at the end of **Squeeze** time and remains ON until the beginning of **Hold** time.
I6 and O6 of several timers, connected to an external PLC, may let this one to limit the number of machines welding simultaneously.

3/SW2 = **1** **Tip-dressing request**.

See output O4.

O7 Cb2/16 MAN-STA

Its behaviour depends on bits **4** & **5** of **SW2** (page 5-8)

4/SW2 = **0** **Control Ready / Control Not ready**.

5/SW2 = **0** **Control Ready**

This signal indicates that the control is ready to initiate a weld sequence. If there is, anyway, an error active, it must be a non-blocking fault: that is, a fault of little importance for the welding process or simply a warning message.

5/SW2 = **1** **Control Not ready**

Not Ready means that there is a fault preventing the initiation of welding sequences.
This is the set up recommended in **MAN** mode. In its simplest use this output can drive the pilot light on a Fault reset push-button connected to the input **I2**.

4/SW2 = **1** **Circuit breaker**

This output is driven by the **Circuit breaker** function, which is activated in the following cases:

- Detection of Thyristors triggered (Error **81**) and
- Time-out of the Circuit breaker delay time (see page 5-6)

The Main switch must have a circuit breaker of *Shunt trip coil* type: the Main Switch opens at the activation of this coil. In case of an *Undervoltage trip coil* an external relay must be used.

Other inputs & outputs

See wiring diagrams in Chapter 9.

Cb1 / 1-9	**INPUT 24 Vac**

Line synchronization voltage

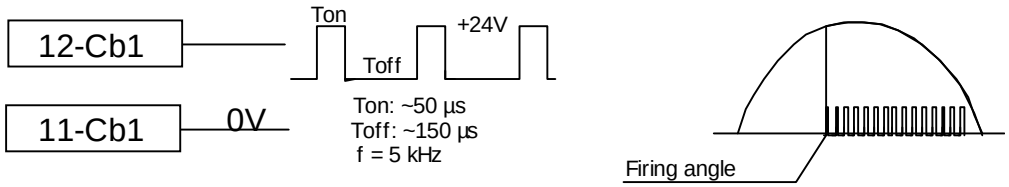
A voltage of 24 Vac must be applied to those terminals derived from the same line as the Thyristors AC switch and the welding Transformer.

Primary voltage: the line volage (400, 500, etc.)
Secondary voltage: 24 V ±5%
Power rating: 10 VA

It is needed for the time counting (in line cycles) and for the *Phase shifting* of the Thyristor ignition. The lack of this voltage does not prevent the programming operations and the set up of the **SERRATRON 1B** unless we try to carry out weld sequences in Weld ON condition: this will generate a fault (Error **43**).

Cb1 / 6	**INPUT 24 Vdc**
Thyristors thermostat	It is a normally closed contact which opens in the event of excessive temperature in the Thyristor group, producing the Error **83**. The running sequence will end in the normal way, but the initiation of a new weld sequence will be blocked until this contact was closed again.

Cb1 / 11-12	**OUTPUT 24 Vdc**
Thyristor ignition	On each welding half-cycle, the ignition impulses start according to the power parameter used, and end a few degrees before the end of the half-cycle



Cb1 / 7-14	**INPUT 24 Vac**
Thyristors fired detection	This input signal may come from two different sources, depending on the Thyristor-group actually used (page 9-1) and must be configured accordingly by means of the bits **14** & **15** of **SW2** (page 5-8).

14/SW2 = **0** **Thyristor fired detection enabled**

15/SW2 = **0** Thyristors of type **BTS-1200** (SERRA).

15/SW2 = **1** Thyristors of type **CNOMO** (supplies the **Current Image** signal).

The lack of this signal means that there is no power at the thyristor terminals which may come from various causes:

- Thyristors fired out of the welding times: Error **81**
- Firing circuit damaged: Error **34**
- Thyristors fired while welding: does not produce a fault.
- Zero voltage crossing, twice per line cycle: does not produce a fault.

14/SW2 = **1** **Thyristor fired detection disabled**

Cb1 / 3 - 8 - 15	**INPUT 24 Vdc**
Main power supply	This voltage lets make all the programming tasks as well as the simulation of welding sequences in Weld OFF condition. Voltage: 24 Vdc / 5 A Terminal **3** Earth connection Terminal **8** Negative (-) pole Terminal **15** Positive (+) pole

Cb3 / 2 - 3	**ANALOGUE INPUT**

Weld current sensor coil

Current sensor coil with the following characteristics:

- Sensitivity: 20..2300 mV / kA with 50 Hz sinusoidal wave (typical value 150 mV/kA)
- Internal resistance: between 7 and 470 Ω
- Load resistance 1000 Ω (Weld timer input resistance)

Use always screened cable to connect the sensor coil.

> Note: The sensors do not have to be changed for use in 60 Hz power lines
>
> The only thing to bear in mind when verifying the sensors is that the sensitivity of a sensor changes with the frequency.
>
> For instance: a 150 mV/kA @ 50Hz sensor coil would give a sensitivity of 180 mV/kA when measured in a 60 Hz line.

Proportional valve

See wiring diagram in page 9-3 (Connector **Cb2**).

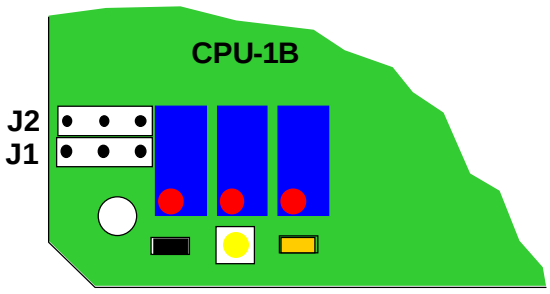
Cb2 / 17-19	**PROPORTIONAL VALVE**
PV power supply	**24 Vdc / 0.8 A**. (1 A resettable fuse protection).

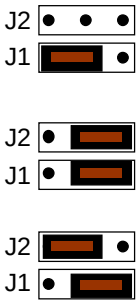
Cb2 / 18-36-37	**PROPORTIONAL VALVE**

4-20 mA / 0-20 mA / 0-10 V

Analogue output. Its actual level depends always on the pressure/force parameter of the last program selected. Therefore, this output will be updated as soon as a new non blocked program number is selected.

> The choice of output type is done by means of jumpers J1 & J2 in the CPU-1B printed circuit board





●●●

Chapter 5
PARAMETERS AND FUNCTIONS

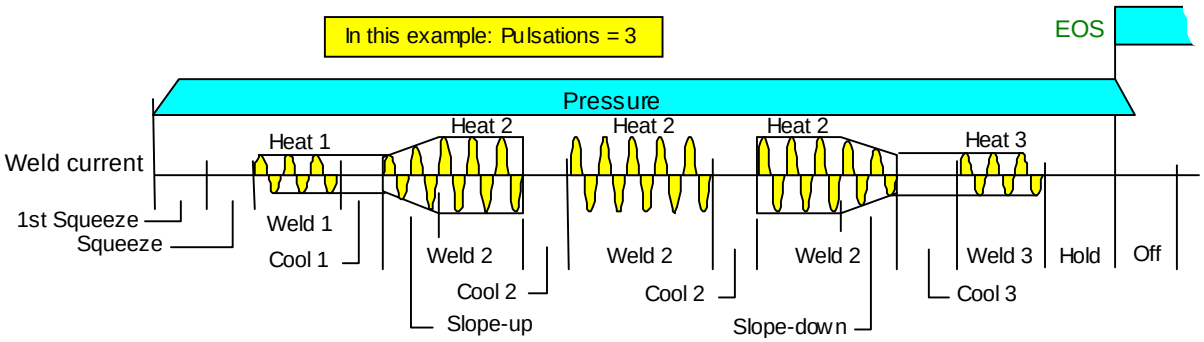
Welding program parameters

The time delays in a weld sequence are always counted in units of electric power line cycles:

@ 50 Hz : 1 second = 50 cycles 1 cycle = 20 ms

@ 60 Hz : 1 second = 60 cycles 1 cycle = 16.666 ms

Next figure shows all the steps (times) involved in the weld sequence managed by this timer.



To use more simple weld sequences it is enough to reset the unwanted 'times'.

Blocked sequence This parameter prevents the use of a Program.
0=Program enabled **1**=Program disabled

Sequence mode This parameter is not a 'time' but determines directly the way in which the times of a welding sequence occur. There are **5 modes**:

0 = **Single spot** Independently of how long Start was activated, only one welding sequence will be carried out.

1 = **Repeated spot** While Start remains activated welding sequences will be carried out with successive closings and openings of the electrodes, thus allowing the movement of the part to be welded or the welding gun.

2 = **Seam** sequence While Start is kept activated the sequence alternates Weld 2 and Cool 2 times indefinitely.
When Start is deactivated the current Weld time will be completed and then the sequence will go on to Hold time (or Cool 3 if Weld 3 > 0).
If Start is deactivated while the sequence is in a Cool time, it will go on to the Hold (or Cool 3) time immediately.

3 = **Chained** seq. (Only in **STA** mode, page 3-5) The sequence continues to carry out the following Program as if it were a single welding sequence, and successively until it reaches a program in **single** or **repeated** spot mode.

4 = **Successive** seq. (Only in **STA** mode, page 3-6) After carrying out this program the same way as in **single spot** mode the control is ready to carry out the following program, no matter the current state of the selection inputs.

1st Squeeze time Begins to count as soon as Start is pressed and is interrupted if Start is deactivated. At the end of this time the sequence moves to Squeeze time.
Range of values: 0 to 99.

Squeeze time Ends immediately if Start is removed. At the end of this time the sequence passes to Weld Time 1. Range of values: 1 to 99.

Weld Time 1 From this time on the sequence will remain interlocked even though Start was removed. The sequence will be cancelled only by Stop activation. During this time, ignition impulses are applied to the Thyristors. If this time is zero the sequence jumps directly from Squeeze to Weld Time 2.
Range of values: 0 to 99.

Cool Time 1 During this time the pressure in the electrodes is maintained but there is no welding current flow. If this time is zero the sequence jumps from Weld Time 1 to Weld Time 2 without any loss of cycles of weld current.
Range of values: 0 to 99.

Weld Time 2 The Weld Time 2 is carried out as many times as specified by the Pulsation parameter. Slope-up & -down times are available during the first and last Weld Time 2 pulses respectively. The last Weld Time 2 is followed by the Cool Time 3. Range of values: 1 to 99.

Pulsations This parameter is not a time. It determines the number of times the Weld Time 2 will be passed through, without the electrode opening, alternating with Cool Time 2's. This parameter has no significance in Seam Welding mode.
Range of values: 1 to 9.

Slope-up time This parameter means the time in cycles the power takes to rise -in the first Weld Time 2 pulsation- from an initial level (Heat 1) to its final level (Heat 2).
If this parameter is zero no ramp is generated.
If the Constant Current feature is used, it will operate only during the remaining cycles between the end of the Slope-up and the end of Weld 2, provided that was longer than 2 cycles. Range of values: 0 to 99.

Slope-down time This parameter means the time in cycles the power takes to fall -in the last Weld Time 2 pulsation- from the normal level (Heat 2) to its final low level (Heat 3). If this parameter is zero no ramp is generated.
If the Constant Current feature is used, it will operate only during the remaining cycles between the beginning of the last Weld Time 2 and the beginning of the Slope-down, provided that was longer than 2 cycles.
Range of values: 0 to 99.

Cool Time 2 This is a cool time -no welding current flow- between each two Weld Time 2 if the Pulsation parameter is higher than 1 or the sequence mode is seam welding. Range of values: 0 to 99.

Cool Time 3 There is no welding current flow. It follows the last Weld Time 2 provided that Weld Time 3 is not zero. Range of values: 0 to 99.

Weld Time 3 The Weld Time 3 is carried out only once. If this time is zero the sequence jumps directly from Weld Time 2 to Hold time, skipping Cool Time 3 as well.
Range of values: 0 to 99.

Hold time During this time the electrodes are kept under pressure -but without current flow- with the aim that the welding spot will cool and harden.
Range of values: 1 to 99.

Off time It is the time of opening the electrodes. The welded part is released. This time only has an application in **repeated** sequence, as at the end of this time, if the *Start* input is still kept activated the sequence skips to the Squeeze time and the electrodes close again.
Range of values: 0 to 99.

Activation of Solenoid valves (only in STA working mode)

Value	O0 SV1	O1 SV2	O2 SV3	O3 SV4	Activation times
0	●				**1st Squeeze...Hold** = SV1
1		●			**1st Squeeze...Hold** = SV2
2	●	(1)			**1st Squeeze...Hold** = SV1 & **Weld Time 1...Hold** = SV2
3	●	(2)			**1st Squeeze...Hold** = SV1 & **Hold** = SV2
4			●		**1st Squeeze...Hold** = SV3
5	●		●		**1st Squeeze...Hold** = SV1 & SV3
6		●	●		**1st Squeeze...Hold** = SV2 & SV3
7					None activated
8				●	**1st Squeeze...Hold** = SV4
9	●			●	**1st Squeeze...Hold** = SV1 & SV4
10		●		●	**1st Squeeze...Hold** = SV2 & SV4
11	●	●		●	**1st Squeeze...Hold** = SV1 & SV2 & SV4
12			●	●	**1st Squeeze...Hold** = SV3 & SV4
13	●		●	●	**1st Squeeze...Hold** = SV1 & SV3 & SV4
14		●	●	●	**1st Squeeze...Hold** = SV2 & SV3 & SV4
15	●	●	●	●	**1st Squeeze...Hold** = SV1 & SV2 & SV3 & SV4
16	●	(3)			**1st Squeeze...Hold** = SV1 & **Weld Time 2…Hold**=SV2
17	●	(4)			**1st Squeeze...Hold** = SV1 & **Weld Time 3…Hold**=SV2

● Activated output

1st Squeeze…Hold: Activated since the beginning of the sequence until the end of **Hold** time

(1) 2nd pressure: From the beginning of **Weld Time 1** until the end of **HOLD** time

(2) 2nd pressure: Activated during **HOLD** time

(3) 2nd pressure: From the beginning of **Weld Time 2** until the end of **HOLD** time

(4) 2nd pressure: From the beginning of **Weld Time 3** until the end of **HOLD** time

Note 3: For users acquainted with the SERRATRON 5000 timers, the codes 0..15 in the above table are the same as those used to program the air valve outputs of the SERRATRON 5006

Power parameters

Power parameters are those that may be used in the determination of the Thyristors ignition angle during the weld times. Unless otherwise explained, these parameters depend on the weld program.

On the **SERRATRON 1B** there are two kinds of power parameters: **degrees** and **kA**.

The ranges of values allowed in all of the **power** parameters are:

Degrees Available range: 0 to 99
00 equals an ignition angle of 130 electrical degrees
99 equals an ignition angle of 31 electrical degrees

kA Available range: 0.5 to 99.9. Programmable in steps of 0.1 kA
The Measurement system uses two scales:
- From 0.5 to 25.5 kA with a resolution of 0.1 kA
- I > 25.5 kA with a resolution of 0.1 kA

The power values in **degrees** do not mean percentages of the maximum power that the machine can supply, rather that they correspond to fixed ignition angles. As can be derived, each unit of the Power values is equivalent to a phase shifting of one degree of the ignition point (the lower the ignition angle, the higher the power).

Weld regulation mode There are three possibilities:

0 = **Phase control** The power is programmed in Degrees (from 0 to 99).
There is no control of the actual welding current. Faults are not generated neither by excess or lack of current, nor by sensor coil fault.

1 = **Monitoring** Both power parameters must be programmed:
The ignition angle of the Thyristors is determined by the parameter in degrees and remains constant along the welding time. The resulting current, measured by the control, is compared with the parameter in kA and the corresponding fault warning is generated if the error (in %) surpasses the programmed tolerance ranges.

2 =**Constant current** Only the desired current in **kA** needs to be programmed (although the power parameter in degrees helps during the 'learning' phase). The weld timer calculates the fitted ignition angle to obtain that current, corrects it -if necessary- in a dynamic way along the weld time, and at the end compares the programmed and measured currents, giving an fault code in case of being out of the tolerance ranges.

Base Heat /Currents Are the parameters used when the *Electrode* wear compensation function is disabled or an electrode has just been replaced.

Base Heat 1 Heat in degrees for Weld Time 1. See above note on 'degrees'.
Base Current 1 The target current for Weld Time 1.
Base Heat 2 Heat in degrees for Weld Time 2.
Base Current 2 The target current for Weld Time 2.
Base Heat 3 Heat in degrees for Weld Time 3.
Base Current 3 The target current for Weld Time 3.

End Heat /Currents Are the parameters to use when the *Electrode* wear compensation function is enabled and the electrode is completely worn out, reaching its End of life.

> Along the useful life of an electrode the actual Heat & Current target levels are intermediate values -between base and end values- calculated as shown in page 5-9.
> If the end value is lower than the base value, only the base value will be used.

End Heat 1 Heat in degrees for Weld Time 1.
End Current 1 The target current for Weld Time 1.
End Heat 2 Heat in degrees for Weld Time 2.
End Current 2 The target current for Weld Time 2.
End Heat 3 Heat in degrees for Weld Time 3.
End Current 3 The target current for Weld Time 3.

Thyristors group 0=No welding program (possible use: Tip-dressing timing program)
1=Welding program (as determined by the Weld ON input).

Other parameters depending on the program

Tolerances The deviation (in %) between the programmed (Ip) and measured (Im) welding currents is calculated as follows:

error (%) = (Im - Ip) x 100 / Ip

Upper limit +T% If the **error** value calculated is positive and greater than T% the timer will be blocked, generating a current too high error.
Range of programmable values: 1 to 30 %.

Lower limit –T% If the **error** value is negative and its absolute value is greater than this lower limit -T% the timer will be blocked, generating a current too low error.
Range of programmable values: 1 to 30%.

Minimum firing angle in 1st half-wave after a cool time

In the beginning of the first weld time found in a sequence, the firing angle of the first half-wave must be limited to a minimum value, i.e. a maximum initial heat. Its purpose is to prevent the magnetic saturation of the welding transformer and the resulting very high primary currents, capable of damaging the transformer and/or the Thyristors group. In the SERRATRON 1B, this minimum value is a fixed value (not programmable) of 72 degrees (87 @ 60Hz).

In the beginning of any other weld time following a cool time, the firing angle of the first half-wave must be limited to a minimum value for the same reasons explained above. In these cases, it is programmable parameter and must be specially attended, mainly in seam welding, when the used heat -in %- is greater than 58.
Range of values: 31 to 90 degrees (equivalent to 40 to 99 in Heat values).

Recommended default values: 72 degrees at 50 Hz and 87 degrees a 60 Hz
This angle is in fact a time delay due to the magnetic nature of the welding transformers core: both parameters, 72 degrees @ 50 HZ and 87 @ 60 Hz, mean the same time delay = 4 ms.

Proportional valve The same as with the heat values, the proportional valve outputs must be readjusted according to the stepping curve of the electrode.

Base Force The value used when the *Electrode* wear compensation function is disabled or a new electrode has just been placed.
Range of values: 0.000 to 65.000 kN.

End Force The value to use when the *Electrode* wear compensation function is enabled and the electrode is completely worn out, reaching its End of life.
Range of values: 0.000 to 65.000 kN.

Configuration parameters

Here are described all those parameters that affect the operation of the **SERRATRON 1B** in a general way, but that are not directly related to the welding programs. Normally, they should be the first to be programmed after the installation of a control.

IP number

This is a 24 bit address number that identifies each weld timer inserted in a communications network.
IP stands for Internet Protocol. The actual IP number to use should be assigned by the general Ethernet network manager, if the weld timers network has to be eventually accessed from any PC connected to the general network.
The IP number is given as four 0 to 255 values, e.g. 165.23.12.28.

Language

Selects the language used in the Programming units in order to display the messages coming from the **SERRATRON 1B**. Languages currently available:

0=Spanish **1**=French **2**=English **3**=German **4**=Portuguese **5**=Russian **6**=Turkish

Working mode

Selects among the available options (see *page 3-3*):

0 = **MAN** **1** = **STA**

First Tip-Dressing ON/OFF

It is a general enable/disable parameter used in the context of the *Tip-dressing operation* function (see page 5-11).
0=Disabled **1**=Enabled.

Type of current sensor

0 = Secondary coil (20.0 to 2300.0 mV/kA, standard value=150.0 mV/kA)
1 = Primary sensor (typical values -for the primary side- >= 1.5 V/kA)
2 = Primary current transformer (signal proportional to the line current)

In all cases the programmed currents are the weld currents (secondary circuit).
Characteristics of the sensors to apply in cases 1 and 2 may vary, depending on the turn's ratio of the welding transformer those changes with the line voltage and/or the power rating.
Typical use: Transformer 800:1 loaded with R=15 ohm.

1/2 Wave welding

This feature lets have weld times as short as a half-cycle. By firing only **one** thyristor, the weld current flows during (part of) a single half-cycle.
The aim is special welding applications where usually a capacitor discharge system was used: a single pulse of high energy in a short time (<10 ms). The difference, now, is that the welding transformer may be a normal (or smaller than normal) AC welding transformer.
To prevent the magnetic saturation of the welding transformer core, it is of main importance that every new weld sequence was welded with current of different polarity; the timer keeps track of the last polarity used, even in case of power off.
To use this feature, it is also necessary to have the following sequence parameters: Weld time 1=**0**, **Weld time 2**=**1**, Weld time 3=**0**, Pulsations=**1**.
0=Disabled **1**=Enabled

Circuit breaker trip delay

The **SERRATRON 1B** incorporates a delay feature intended for the activation of the Circuit-breaker trip coil after a period of inactivity. Possible use: avoid leaving the machine connected during the whole night or a whole weekend.
Any work sequence done reinitiates the delay time count. If this time elapses without any sequence being executed, the Circuit-breaker output is activated. That time is adjustable in minutes.
Range of values: 0 to 99 minutes (0=circuit breaker timing disabled).

Starting program

It is the Program used when at the activation of Start all Program selection inputs remain inactive.

Possible applications of this parameter:

- In simple machines make unnecessary the use of external program selectors.
- To select a 'special' program which will generate a fault code if executed, in order to detect the cases in which the Program selection inputs have not been activated before the Start.

See an effective way to use this parameter, in **MAN** mode, in page 4-6.

Swapping program In **seam welding** mode and with the input **I18** configured as *Swapping program* (page 4-5) the parameters of Weld Time 2 / Cool Time 2 of this program (if it is not 0) are used as long as **I18** remains activated.
When this input goes off the sequence returns to the selected program.
If this parameter is 0 the program used at the activation of **I18** is the next to the selected program.

Current and force calibration parameters

WARNING: It is advisable to do next calibrations first, before adjusting the welding parameters

Current sensor calibration

This parameter lets the timer manage weld current values matching with the measurements given by a portable meter used as calibration device.
There are as many current sensor calibration parameters as electrodes.
Range of values: 20.0 to 2300.0 mV/kA.

ATTENTION: Working in KSR mode, this adjustment modifies the actual amount of weld current in such a way that the calibrating device eventually ends up displaying the same current as the timer.

Therefore, if the quality of the weldings carried out was already optimum before the adjustment, after doing it all the kA parameters of all the programs using the same electrode must be revised.

Example: Ical=9.2 kA Im=10.5 kA (programmed and measured), optimum weld quality.

After the sensor adjustment, following a weld sequence, both values will be equal: 10.5 kA. To get 9.2 kA (the true best weld quality level), 9.2 kA should be actually programmed as power parameter instead of the previous value of 10.5 kA.

NOTE: To help during the calibration process, all the user has to do is to edit the value displayed by the calibration device (**Ical** above) in the target current numeric field (see page 7-14).

Calibration of force This parameter lets the timer manage weld force values in N (not in bar) matching with the measurements given by a portable meter used as calibration device.
There are as many force calibration parameters as electrodes.
Range of values: 0.01 to 6.5 kN/V.

NOTE: All the notes given for current calibration apply to the force as well

Other configuration parameters related to electrodes

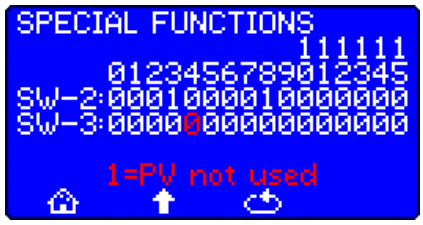
Heat Level 1 The purpose of this (and next) parameter is to get a warning signal of wearied welding cables reaching their end of life.
If during a weld time the heat setting reaches this level a warning message '*Heat Level 1*' will be displayed (see Fault **78**).
Range of values: 40..99.

Heat Level 2 If during a weld time the heat setting reaches this level a fault message '*Heat Level 2*' will be displayed (see Fault **79**).
Range of values: 40..99.

Special functions selectors SW-2 & SW-3

There are two parameters whose numeric value has significance only if it is interpreted bit by bit, and this is how they are always displayed. These parameters with denominations SW-2 and SW-3 have 16 bits.

Each bit has a particular significance and conditions the weld timer operation. In the descriptions that follow, if not explicitly indicated, it is to be understood that the described is accomplished when the bit is **1** and the opposite when it is **0**.

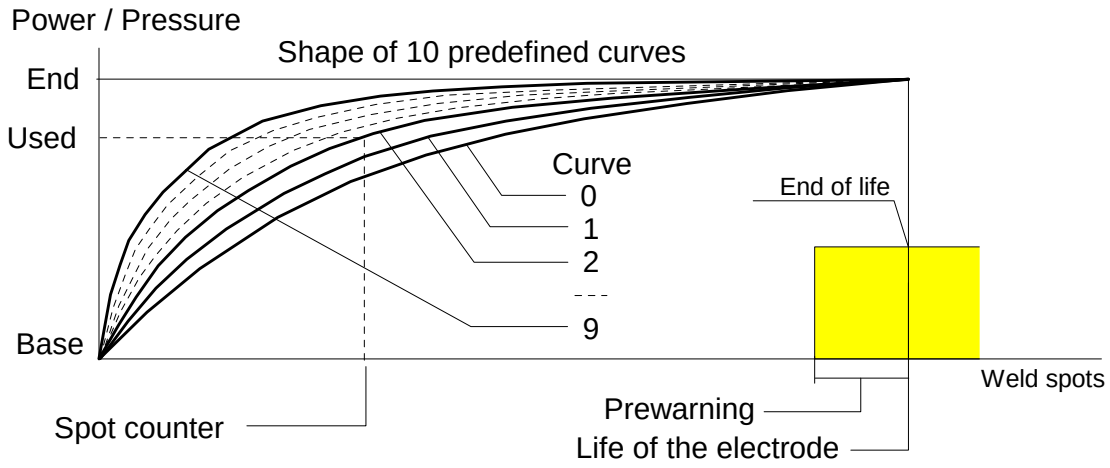


Bit	Description	SW-2	
0	Input **I4** / Output **O3** (In STA mode only):		
		0 = Input **I4**: disabled / Output **O3**: Solenoid valve SV4	
		1 = Input **I4** / Output **O3**: Retract gun	
1	Input **I6**:	**0**=Input disabled	**1**=Weld Time Enable input (Error **21**, page 8-1)
2	Output **O4**:	**0**=End of Sequence (EOS)	**1**=TD-Request
3	Output **O6**:	**0**=Weld Time Enable Request	**1**=TD-Request
4	Output **O7**:	**0**=Control READY	**1**=Main Circuit Breaker
5	Ready output mode:	**0**=Control READY	**1**=Control NOT READY (fault)
6	Input **I15**:	**0**=Pressure switch OK	**1**=Pressure switch disabled
7	Input **I18** (in **STA** mode):	**0**=Not used	**1**=According to bit **8**
8	Input **I18** (in **STA** mode):	**0**=Program swapping	**1**=Weld time break
9	Input **I17**:	**0**=Transformer Thermostat	**1**=Thermostat disabled (**I17**=don't care)
10	Not used		
11	Not used		
12	Not used		
13	Not used		
14	Thyristors fired detection (page 4-10):	**0**=Enabled	**1**=Disabled
15	Thyristors unit type (see page 4-10):	**0**=BTS-1200 (SERRA)	**1**=CNOMO

Bit	Description		SW-3
0	Weld Time 1:	**0**=In use	**1**=Disabled (hidden)
1	Weld Time 3:	**0**=In use	**1**=Disabled (hidden)
2	Slope Up Time:	**0**=In use	**1**=Disabled (hidden)
3	Slope Down Time:	**0**=In use	**1**=Disabled (hidden)
4	Proportional Valve:	**0**=In use	**1**=Disabled (hidden)
5	Display light:	**0**=30 s	**1**=Always ON
6	Not used		
7	Not used		
8	Not used		
9	Not used		
10	Not used		
11	Not used		
12	Not used		
13	Not used		
14	Not used		
15	Input **I1**:	**0**=Weld ON	**1**=Weld OFF / See Error **20** (page 8-1)

Electrode wear compensation

This function is also known as **'stepping'** function.
The electrode wear compensation is based on the use of predefined wearing curves. The powers used in each weld time will depend on the initial and final programmed values, as well as on the wear curve chosen and the number of welding spots done since a new electrode was set, in relation to the maximum number of foreseen spots.



Stepper function procedure

a) Set some general -or **configuration**- parameters (once).
b) Assign to each welding **program**, as a parameter, the number of the electrode to be used during the weld sequence.
c) Edit the curve of each welding **program** whose shape will drive the stepper process.
d) Enter the **stepper** parameters: heat & pressure values.
e) Check and eventually modify the state of the **counters** associated with each electrode in use.

Parameters depending on the program number

Electrode number	Is the number of the electrode to be used when welding with this program. Range of values: 1 to 15
Shape of the curve	A curve is defined by ten X and Y intermediate values. Normally the curve shapes will be downloaded from a curves library using the **CPC-connect** software package.
Base Heat/Current 1/2/3	Are the values needed to weld with a new electrode. *See Power parameters (page 5-4)*.
End Heat/Current 1/2/3	Are the maximum values allowed to weld with when the electrode becomes completely used and should be replaced by a new one.
Base Pressure	Is the pressure needed to weld with a new electrode.
End Pressure	Is the maximum pressure needed when the electrode is near its end of life.

Parameters depending on the electrode (Stepper parameters)

Stepper function **0**=Disabled **1**=Enabled.

The *Stepper function* for a particular electrode may also be disabled by programming **Life**=**0**

Life of the electrode Is the expected life of the electrode expressed as a number of weld spots. Initially the programmed value will be based upon previous experience with similar welds. Later the value will be adjusted according to the results achieved.
When an electrode has done as many weld spots as programmed under this parameter, the timer is blocked preventing new weld sequences, even with different programs.
Range of values: 0 to 65535.

NOTE: After reaching the End-of-Life condition, the effective blocking of the control unit, preventing the initiation of new weld sequences, will actually happen after a number of **additional** weld sequences equal to the parameter **Spots per part** + 1

Prewarning It establishes the moment when the *Prewarning* output will be activated before the electrode used reaches its *End of life* condition.
It is specified as a number of welded parts and has to be used in conjunction with the *Spots per part* parameter.
Range of values: 0 to 999 parts.

Spots per part Number of spot welds on each part, for use in conjunction with the *Prewarning* parameter. Range of values: 0 to 999.

Counters related to the electrodes

Spot counter A counter associated to each electrode enables the weld timer to keep track of the spots made with it, with the goal of making the adequate adjustments of pressure and weld current throughout the life of the electrode until its total wear.
This counter is increased after each welding carried out with any program having the same electrode number associated to it.
Range of values of these counters: 0 to 65535.

Total Spot counter See page 5-12.

There are other parameters and counters related to the electrodes, but they are only used in the context of the **tip dressing** function, that will be explained later on.

Any of the above parameters which is modified will affect the pressure/power used on the following weld, as rescaling is automatic. The power level actually used during the welding process is calculated continuously (not in steps) between the base and end values.

Tip-dressing operation

The purpose of Tip-dressing (TD) is to increase the useful life of the electrode, while still keeping constant the physical characteristics of the weld spots during the whole electrode life. For the tip-dressing operation an external tool -involving a small I/O interface- is required, as well as some special parameters.

I/Os involved

TD Request (Output). To warn the robot, PLC or operator that the electrode of the selected program needs a normal TD.

TD Acknowledge (Input). To confirm the timer that a TD operation has just been done. The counters of the selected electrode are modified as described later.

TD Parameters

First TD function (FTD)

It is a configuration (single) parameter to enable/disable the 1st TD-Request function, consisting in the activation of the TD-Request output following a *Counter reset* command, after an electrode replacement.
1st TD operation: **0**=Disabled **1**=Enabled.

The following parameters depend only on the Electrode Number:

Allowed TDs Is the number of times a TD Acknowledge command will be allowed by the weld timer. If this parameter is zero no TD will be done on this electrode. Range of values: 0 to 9999.

TD Interval This parameter can also be called TD delay or TD cadence.
It defines how often TD's are done on a particular electrode.
This value also corresponds to the width of the so-called TD Window: starting at the value '**I**' of the *Spot counter* and finishing at the value '**F**' of that same spot counter. '**I**' is the value to which the spot counter has been reset after the latest tip-dressing. '**F**' is the value at which the next TD Request will be generated by the weld timer. The values 'I' and 'F' change along the electrode's life, but they remain at a constant distance 'F-I'.
Range of values: 0 to 65535.

Start of 1st TD-Window

This value, in number of weld spots, is where the counter of the first TD-Interval starts. Therefore, it is also the start-position of the first TD-Window.
Range of values: 0 to 9999.

TD-Window shift after TD's

After each TD-Acknowledge command (TDA), the counter of the selected electrode lowers, not to zero, but to a value higher than the previous one, and therefore shifting the TD-Window upwards, each time a TDA command is executed. This way, after each TD, the base Heat/Current and pressure of the welding process will commence somewhat higher than after the previous TD. The displacement of the TD-Window, in number of spots, is defined by this value. The absolute maximum limit to which the window can reach is *End of Life*.
Range of values: 0 to 999.

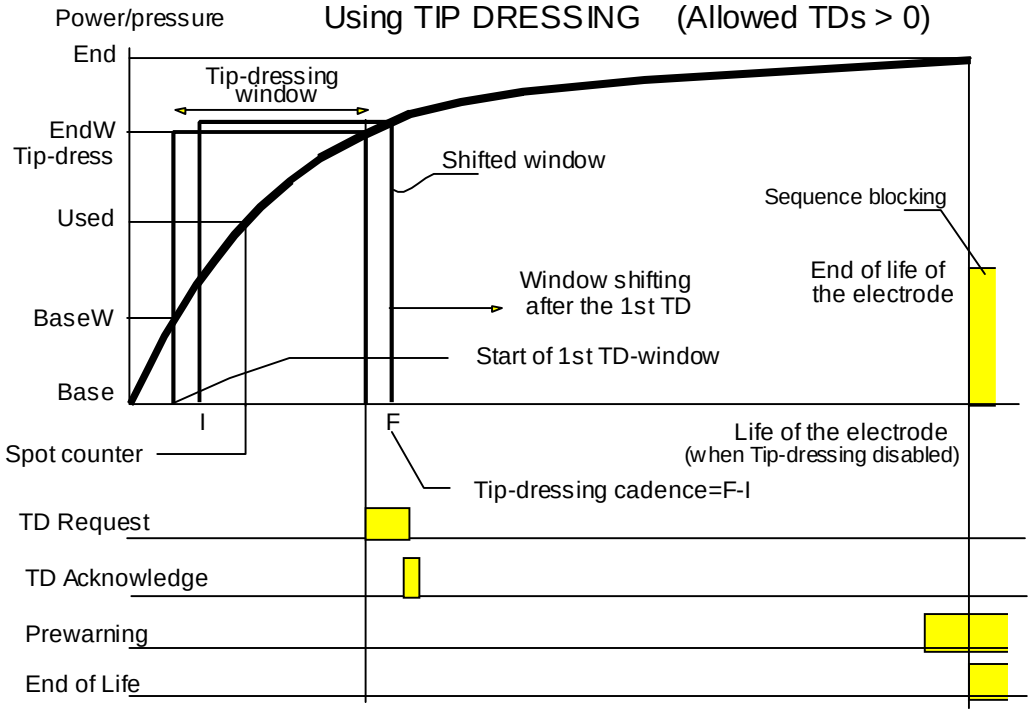
Counters

TD Counter For each Electrode there is a TD counter, which counts the tip dressings done and which increases one unit each time the TDA input is activated. The maximum value this counter can reach is that of the parameter *allowed TDs*.

Total Spot Counter (TSC)

Each electrode has this additional spot counter to keep track of the total amount of weld spots done after the last *Counter Reset* command. Do not confuse the TSC with the normal *Spot Counter* used by the stepper function and the TD window.
This counter can't be modified (edited) by the user. It can be reset only by a *Counter Reset* command.
Range of values: 0 to 16.000.000+ (24 bits).

The TD-Request output is activated when the welding spots counter reaches the final ('F') limit of the current TD window, provided the TD-Counter has not yet reached the Allowed-TDs value, in which case the End of life function would be activated instead.



The TD-Request output (TDR) remains activated until the activation of the TD-Acknowledge input. If more weld sequences are done, the TDR output remains activated and the timer does not block, but rather continues its path along the curve, eventually until the End of Life of that electrode. In this case, that 'end-of-life' may happen earlier than indicated by the End of Life parameter, if the number of already performed tip-dressings was near the maximum number allowed.

In case of unattended TD-Request, the End-of-life will happen when the welding counter reaches a value equal to **the lowest** of the two following values.

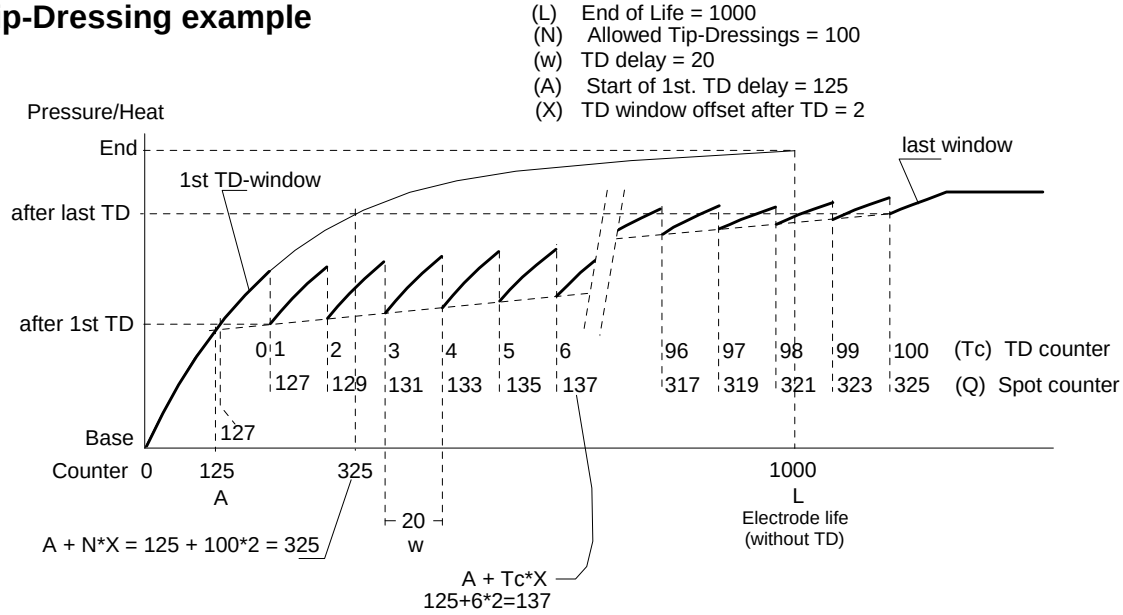
- The parameter Electrode Life, or
- The sum: F (current) + Remaining Tip-dressings x Tip-dressings Interval

Actually, the unattended TD-Request status is reached Spots-per-part welds past the 'F' point. Starting at 'F' point, during Spots-per-part welds the remaining 'life' is calculated having into account the remaining TDs. That lets to delay the TD operation until the completion of the part being welded, yet preventing an eventual End of life fault.

Once the electrode has been tip-dressed, the TD-Acknowledge input should be activated a short time, to indicate this fact to the weld timer. The response of the timer will be to shift the TD-Window in the manner described above, to put the weld spots counter at the initial (I) value of that new TD-window and to increment the TD-Counter.

A TD-Request is assumed to have been 'unattended' when the spot counter goes **Spots-per-part** (of such electrode) **above** the end of the current TD-Window. This feature lets the robot/user wait for attending the TD-Request until the part being welded is finished, without incurring in an early Prewarning or End-of-life fault.

Tip-Dressing example



Once the number of tip dressings actually done is equal to the Allowed TDs value, the TD-Request output is not activated anymore, and now the End-of-Life condition will arrive at the current 'F' point; that is, after a last TD-window run. Counter Reset will be the only command attended at the end of this run.

Counter reset

A *Counter reset* command may be done at any phase in the life of the electrodes.

Sources of the *Counter reset* command

- At the rising edge of the Counter Reset input activation
  The electrode affected by this action will be the electrode assigned to the program actually selected.
  The PLC or Robot may 'remember' the program to be selected by having previously 'stored' the program that was in use when, at the end of a weld sequence, the Prewarning or End of life outputs were activated (see also pages 9-4 and 9-5).

NOTE: Selecting Program **0** resets all electrodes.

- From the programming software **CPC-connect**, choosing the **Counter Reset** command in the **Timer** menu.

Effects of the *Counter reset* command

- Resets all the counters of the selected electrode: spot counter, total spot counter and TD-counter
- Deactivates all the electrode-related outputs: Prewarning, End of life and TD-Request.
- Activates the 1st-TD-Request function of this electrode (provided the FTD function is enabled).

Tip-dressing acknowledge (TDA)

Sources of a *TD-Acknowledge* command

- (Only) the rising edge of the TD-Acknowledge input activation.
  The electrode affected by this action will be the electrode of the selected program.
  The PLC or Robot may 'remember' the program to be selected by having previously 'stored' the program that was using when, at the end of a weld sequence, the TD-Request output was activated.

Effects of the *TDA* command

- Increments by one the TD-Counter of the selected electrode -provided it was lower than the Allowed TD parameter-, and modifies the spot counter in the way explained in the *Tip-dressing operation* paragraph.
- Deactivates TD-Request output.

Other *TDA* command features:

- It may be done at any point in a TD-Window except for the initial point.

Summary of programmable parameters

This is a list of the parameters or values that can be displayed on the **SERRATRON 1B**.

Type Type of parameter:
- **B** ..... When it is a basic parameter for a welding sequence
- **C** ..... When it is a configuration parameter
- **o**..... Optional use
- *..... Display function (not a parameter)

Ind Number of numerical values of each parameter according to the following characters:
- **P**..... one numerical value for each Program
- **E**..... one numerical value for each Electrode

Func.	Type	Name	Ind	Limits
1	B	Sequence Mode	P	0=Single 1=Repeated 2=Seam 3=Chained 4=Suc.
2	B	1st. Squeeze	P	0...99
3	B	Squeeze	P	1...99
4	o	Weld Time 1	P	0...99
5	o	Cool Time 1	P	0...99
6	B	Weld Time 2	P	1...99
7	o	Cool Time 2	P	0...99
8	o	Cool Time 3	P	0...99
9	o	Weld Time 3	P	0...99
10	B	Hold time	P	1...99
11	B	Off time	P	0...99
12	B	Pulsations	P	1...9
13	o	Electrode	P	1...15
14	o	Spots per part	E	1...99
15	o	Pre-warning	E	0...999
16	o	Min. firing angle after cool time	P	31...90 (Recommended=72)
17	o	Electrode Wear function	E	0=off 1=on
21	C	Working mode	1	0=MAN 1=STA
22	B	Weld regulation mode	P	0=Phase control 1=Weld monitor 2=Const. Cur.
23	o	Tolerance +T% (upper limit)	P	1...30
24	o	Tolerance -T% (lower limit)	P	1...30
26	C	Sensor adjustment	E	20.0...2300.0 mV/kA
27	*	I measurement in 1WT	-	result in kA (resolution 0.1kA)
28	*	I measurement in 2WT	-	id.
29	*	I measurement in 3WT	-	id.
30	*	I maximum available	-	id.
33	B	Thyristor group	P	0=No weld 1=Thyristors in use
36	C	Heat Level 1	1	40..99
37	C	Heat Level 2	1	40..99 (always > HL1)
38	o	Starting program	1	0…127 (0=none)
39	*	Total Welds counter	E	0...16.000.000+
40	*	Weld spots counter	E	0...65535
41	o	Electrode Life	E	0...65535

.../...

Func.	Type	Name	Ind	Limits
43	o	Base Heat 1 (degrees)	P	0...99
44	o	End Heat 1 (degrees)	P	0...99
45	*	Used Heat 1 (degrees)	-	interpolated result depending on curve
46	o	Base Current 1 (kA)	P	0.5...99.9 kA
47	o	End Current 1 (kA)	P	0.5...99.9 kA
48	*	Used Current 1 (kA)	-	interpolated result depending on curve
49	B	Base Heat 2 (degrees)	P	0...99
50	o	End Heat 2 (degrees)	P	0...99
51	*	Used Heat 2 (degrees)	-	interpolated result depending on curve
52	B	Base Current 2 (kA)	P	0.5...99.9 kA
53	o	End Current 2 (kA)	P	0.5...99.9 kA
54	*	Used Current 2 (kA)	-	interpolated result depending on curve
55	o	Base Heat 3 (degrees)	P	0...99
56	o	End Heat 3 (degrees)	P	0...99
57	*	Used Heat 3 (degrees)	-	interpolated result depending on curve
58	o	Base Current 3 (kA)	P	0.5...99.9 kA
59	o	End Current 3 (kA)	P	0.5...99.9 kA
60	*	Used Current 3 (kA)	-	interpolated result depending on curve
61	C	PV force: scale factor	E	0.01...6.5 kN/V
62	o	Base pressure (PV)	P	< 65kN
63	o	End pressure (PV)	P	< 65kN
64	*	Used pressure (PV)	P	< 65kN
65	o	Allowed Tip dressings	E	0...9999 TD-Acknowledge commands
66	o	TD-Interval	E	0...65535 weld spots
67	o	Start of 1st TD-Window	E	0...9999 weld spots
68	o	Offset after all TD's	E	0...999 weld spots
69	*	TD counter	E	Tip-Dressings performed
73	C	Blocked sequence	P	0=Program enabled 1=Program blocked
76	C	Circuit-breaker fall time	1	0...99 min (0=∞)
81	o	Up slope time	P	0...99 cycles
82	o	Down slope time	P	0...99 cycles
87	C	Tip-dressing function	E	0=Disabled 1=Enabled
88	o	Solenoid valve mode (STA)	P	0…17 (see page 5-3)
90	C	**Language**	1	0=Spanish 1=French 2=English 3=German…
92	C	First Tip-dressing	1	0=Disabled 1=Enabled
94	C	Swapping program (Seam welding)	1	0…127 (0=Next program)
95	C	1/2 cycle Welding	T	0=off 1=Weld time 2 is 1/2cycle
97	C	Current Sensor selection	1	0=Secondary 1-2=Primary
98	*	Real 1WT power (degrees)	P	0...99 (displays a result)
99	*	Real 2WT power (degrees)	P	id.
100	*	Real 3WT power (degrees)	P	id.

●●●

Chapter 6
INSTALLATION

Power

See Cb1 connector in diagrams at page 9-1.

The total load, including all the external outputs, proportional valve and firing circuit could rise above 5 A. Therefore, the choice of a suitable power supply is of main importance.

Connection of discrete Inputs and Outputs

Connect the inputs and outputs needed for a particular application according to the diagrams in *SERRATRON 1B external connections*.
Connecting two wires to the same terminal is forbidden. Use external terminals when necessary.

Commissioning

Use the next checklist as a basic guide for the commissioning of the weld timer **SERRATRON 1B**.

Before switching power on

- 1 **Power supply**:
  Main power supply: 24 Vdc external applied to terminals 15 (+) and 8 (-) in Cb1 connector.
  It powers up the internal logic as well as 24 Vdc inputs/outputs: all programming & communication functions are enabled.
- 2 **Synchronization voltage**: 24 Vac external applied to terminals 1 & 9 in Cb1 connector.
  This voltage must be in phase with the line voltage of the Thyristors group controlled by this timer.

  NOTE: This voltage must be isolated from earth as well as any other potentials. Safety requirements of the synchronization transformer must be fulfilled by suitable isolation voltage and the use of an electrostatic screen, between primary and secondary windings, connected to earth.
- 3 **Earth connection**: Must be connected to pin 3 in Cb1 connector.
- 4 **Operation enable**: +24 Vdc (taken from the main power supply -31/Cb2-) in terminal 20 of Cb2 connector. If not used, a bridge must be made.
- 5 **Circuit breaker**: The output O7 (configured for this purpose) may directly drive a circuit breaker coil of '*Shunt trip coil*' type. To drive an '*Undervoltage trip coil*' an external relay should be used.
- 6 **Thyristors ignition**:
  - Ignitions: terminals 11 (-) and 12 (+) in Cb1 connector.
  - Thyristors thermostat: terminals 5 and 6 in Cb1 connector.
  - Transformer thermostat: see Cb2 connector on page 9-3.
  - Detection of thyristors fired: signal connected to the terminals 14 & 7 in Cb1 connector, coming from the firing circuits (see page 9-1). If the firing board can't provide the **Thyristors off** signal (page 4-10) the generation of Fault **81** (*Thyristors fired without control*) may be disabled by setting bit 14 of SW-2 parameter (page 5-8).

  The ignition and thermostat connections must be as short as possible. If the weld timer is not installed near the Thyristors AC switch, the ignition cables must be properly protected and separated from all other cables, especially the power lines.
- 7 **Measurement probes**: terminals 2 and 3 in Cb3 connector (page 9-2).
  Shielded and twisted cable must be used, with the shield grounded only on the control side (Cb3 connector ground).
- 8 **Digital Inputs/Outputs**:
  Cb2 connector. Check mainly:
  - Start
  - Program selections
  - Weld ON
  - Fault reset, Counter reset, etc..
  - Solenoid valves
  - End of sequence, etc.

  The current state of the all the inputs and outputs is shown in the DIAGNOSTICS menus.

After switching power on, but before activating Start

- 1 **Check power supplies**:
  - 24 Vdc power supply
  - 24 Vac Synchronization voltage
- 2 **Clearing all programmed parameters** (prior to the first use):
  - User interface: By means of the sequence of keys **F-5 7** while in **programming** and in the WARNING & FAULTS menu.
    (F-5 : Press key F and without releasing it press and release key 5).
  - CPC-connect: **Timer** menu. **Delete parameters** command.

  The timer will issue a Fault **85** code if the command is successfully executed.
  This step is not necessary when loading data from a disk file or from a **SERRAstik** memory.
- 3 **Programming the configuration parameters**:
  - SERRATRON 1B user interface (display/keyboard)
  - CPC-connect
- 4 **Programming welding parameters**:
  - SERRATRON 1B user interface (display/keyboard)
  - CPC-connect

  Welding parameters recommended for a first test:
  Pulsations=1, Weld Time 2=5, Power 2 (degrees)=5, Stepping=0.

Performing a welding sequence

There are some faults that are only produced or detected after the start of a welding sequence (unexisting program or with incorrect data, pressure faults, lack of synchronization, fault in the current sensor coils, etc.), or even at the end of a weld sequence (welding faults, worn electrode, etc.).
In all those cases carefully consult Chapter 8 *TECHNICAL SERVICE* and follow its instructions.

- 1 **Perform welding sequences (with parts or with short circuited electrodes)**:
  The currents measured, as well as the maximum calculated will give an idea of the minimum and maximum currents which the machine can supply in the test welding conditions with the parameters suggested above. Make several welding sequences in order to confirm the results.
  If there is no sensor coil or the measured value is less than 0.5 kA, '<<' will be displayed and '>>' if the value is more than the maximum range.
  If the measured current display does not change in spite of having the sensor installed and clearly marking that there is welding current (heating of the part, clearly audible noise, vibration of the power transformer and secondary cables, etc.) it must be verified:
  - Whether the sensor is correctly connected.
  - Whether the welding current is really flowing across the sensor.
  - Whether there is continuity in the sensor and its connecting cables.
    This will be detected passing to ●2: when attempting to weld it will give a sensor fault.
- 2 **Test in kA and constant current**:
  - Program a Power 2 in kA at least a 10% higher to that measured in ●1.
  - Programming tolerances: +T% and -T% = 5.
  - Select Power Mode in **constant current** CC=2 and make a new welding sequence (with the parts to be welded or test metal plates): the measured current must be equal to the one programmed (+/- 0.1 kA). If so, the machine is ready to be programmed with the ultimate values.

●●●

Chapter 7
PROGRAMMING

Programming is the process of editing and storing in the internal memory of the control all the necessary parameters for its correct function as a welding controller.

There are two programming means:

- **Direct programming by using the built-in keyboard and display**
  - All parameters can be displayed and programmed.
  - Use of 'menus' of easy interpretation and learning.
- **CPC-connect software**
  - **Central computer type PC** running the programming package **CPC-connect** connected to the weld timer via the Ethernet 10/100 base T (TCP/IP protocol).
  - Centralized Programming of multiple controls.
  - Main features:
    - Modify all the weld timer parameters from the screen and computer keyboard and send them to the corresponding control without having to walk around or having to manipulate the controls in any way.
    - Display the state of the weld timer inputs and outputs, to detect possible errors in the external connection.
    - Store on the computer the parameters of all the controls, avoiding the loss of data in the event of breakdown and replacement of any control.
    - Fault data logging of all the errors detected in the weld timers, with an indication of day and time.
    - Monitoring of critical weldings and storing the values of the measured currents, for statistical analysis or quality control.
    - Advanced prewarning for electrode change.
    - Print the stored data.

There are two types of parameters:

- **Configuration parameters**
  They deal with single or a limited number of parameters, that affect the behaviour of the control in a general way and must be the first ones to be programmed during the start-up phase. Nevertheless, they may be modified at any given moment.
- **Parameters which depend on the welding programs**
  They have as many programmable values as available welding **programs**.
  Some parameters, nevertheless, are related to the welding programs through the parameter **Electrode number**.

This Chapter is specially dedicated to explain the **direct programming** issue

Direct programming from the built-in user interface

Graphic display and HOME menu

The programming of the **SERRATRON 1B** is based upon the simultaneous display of as many function-related parameters as possible. The blinking one (cursor) may be modified (edited).

The groups of parameters which are shown at the same time are called menus.

The built-in display is a monochrome graphic display. Next figure shows the appearance of the screen as it appears after switching on the **SERRATRON 1B**.

- SERRATRON 1B .....Welding controller model.
- Version=**x**.**y**: .....Firmware version number (x.y). See page 7-14.
- Working mode selected = **STA** .....MAN / STA

Backlight. Special cautions

The **SERRATRON 1B** display automatically turns the light on whenever a key is pressed or when a warning/fault is activated, and turns the light off after 30 s of inactivity if no fault is being displayed.

The bit **5** of **SW-3** (page 5-8) lets disable the automatic light-off of the display.

Being the LCD display the weakest part of the **SERRATRON 1B** some basic cautions should be followed:

- Do not operate or store it exposed directly to sunshine or high temperature/humidity.
- Avoid strong shock and drop from a height.
- SERRA recommends the use of the automatic light-off option (bit **5**/SW-3 = **0**).

Keyboard

The keys **F1**, **F2**, **F3** and **F4** (**Function keys**) allow us to move among menus.
The target menu is the menu suggested by the icons displayed just above those four keys, or the menu explicitly indicated in the displayed menu.

The **arrow keys** allow us to change the position of the blinking numerical field (cursor) inside a Menu.
The keys'**+**' and '**-**' increase/decrease the value of the cursor by one unit.
The numerical keys '**0**'...'**9**' modify the value of the numerical field of the cursor when this is permitted (**Programming ON**).

The '**C**' key operates in two modes:
- In **Programming ON** mode clears the cursor if the 0 value is allowed.
- In **Programming OFF** mode
  - If the cursor is in the WARNINGS & FAULTS menu generates a *Fault reset* command.
  - If the cursor is in another menu and there is an Error active (⇧ LED off or blinking) produces a direct jump to the WARNINGS & FAULTS menu.

The '**E**' key is used to validate the numerical value existing in the current position of the cursor when the control is in **Programming ON**. The edited value remains stored in the memory of the control permanently.
The '**F**' key is used for special functions, always in combination with other keys:

- F-? .....Language change (rolling across all languages available)
- F-F1 .....Activates programming (**Programming ON**)
- F-F2 .....Deactivates programming (**Programming OFF**)

> The indication of the form **F-F1** means that we must press and release key **F1** while key **F** is kept pressed.

- **Programming ON / Programming OFF**:
  In order to be able to modify parameters, the welding control must be in **Programming ON** mode. This mode does not affect the functioning of the control, but the way in which it deals with the information shown on the display. In the **Programming ON** mode, the previously edited Program number remains unchanged, while in **Programming OFF** mode it is updated as welding sequences are carried out.

Graphic symbols used in menus

In the next pages there is a detailed description of all **SERRATRON 1B** available menus and the key-stroke sequence to reach them.

In some menus the next to the last line shows a (blinking) text message concerning the blinking numerical field (cursor).

As a general rule, the last line shows graphic icons allusive to the target menu when the function key just below is pressed: F1…F4.

The most important icons are the following ones:

Go to the general PARAMETERS PROGRAMMING menus (Programs & Electrodes)

Go to CONFIGURATIONS menus

General information & diagnostic menus: counters, measured values, I/O status...

Go to DIRECT COMMANDS menu

Return to the HOME menu

Return to the former menu

Go to additional menus of the same subject or, in the WARNING & FAULTS menu, go back to the former menu without issuing a *Fault Reset* command.

Go to the next menu of the same level

Go to the preceding menu of the same level

Rotate (forwards) among menus of the same level

Short-cut to the Program or Electrode menus from a Graphic menu. The target menu depends on the context of the starting menu.

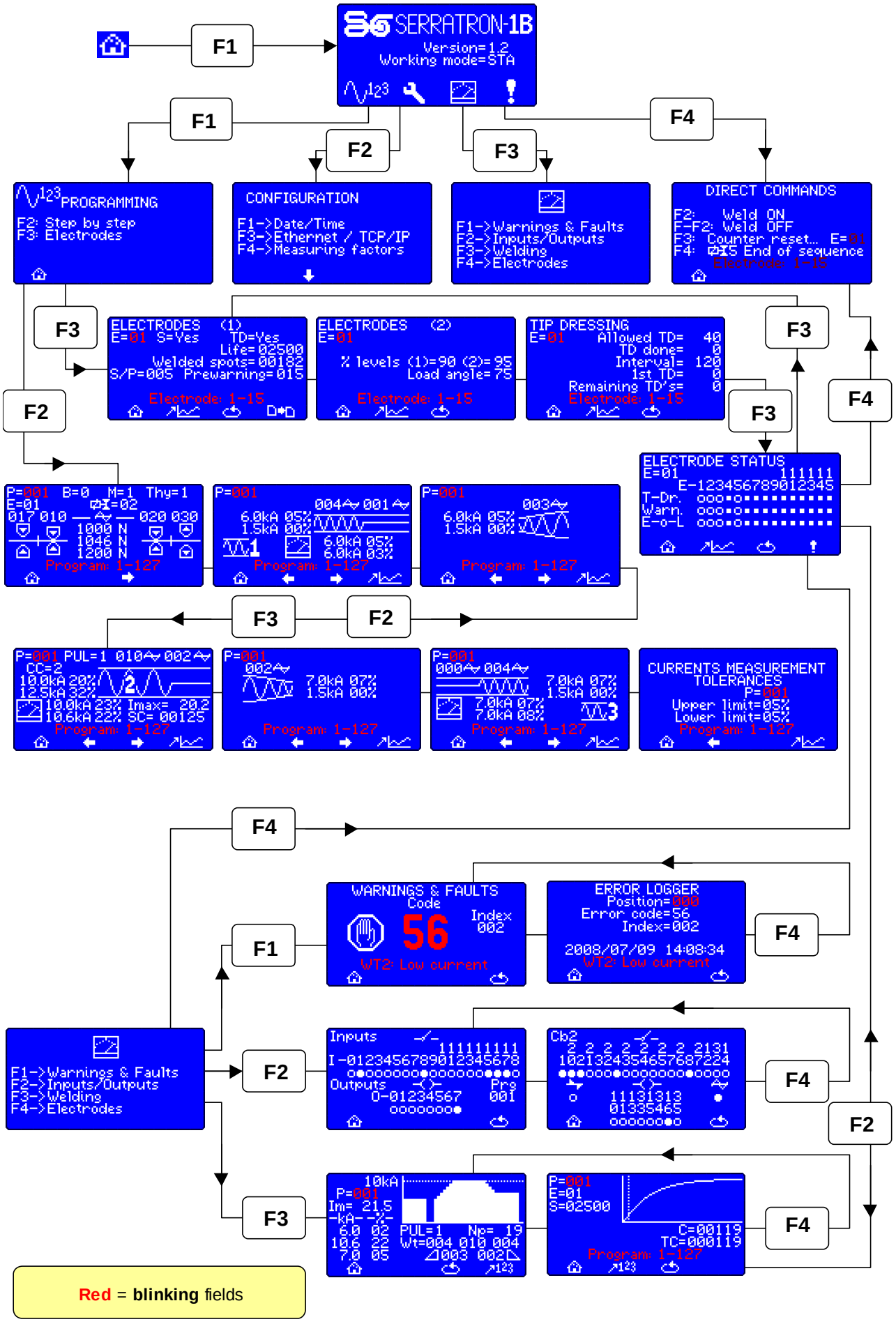
Short-cut to the Graphics menus from a Programs or Electrodes menu. The target menu depends on the context of the starting menu.

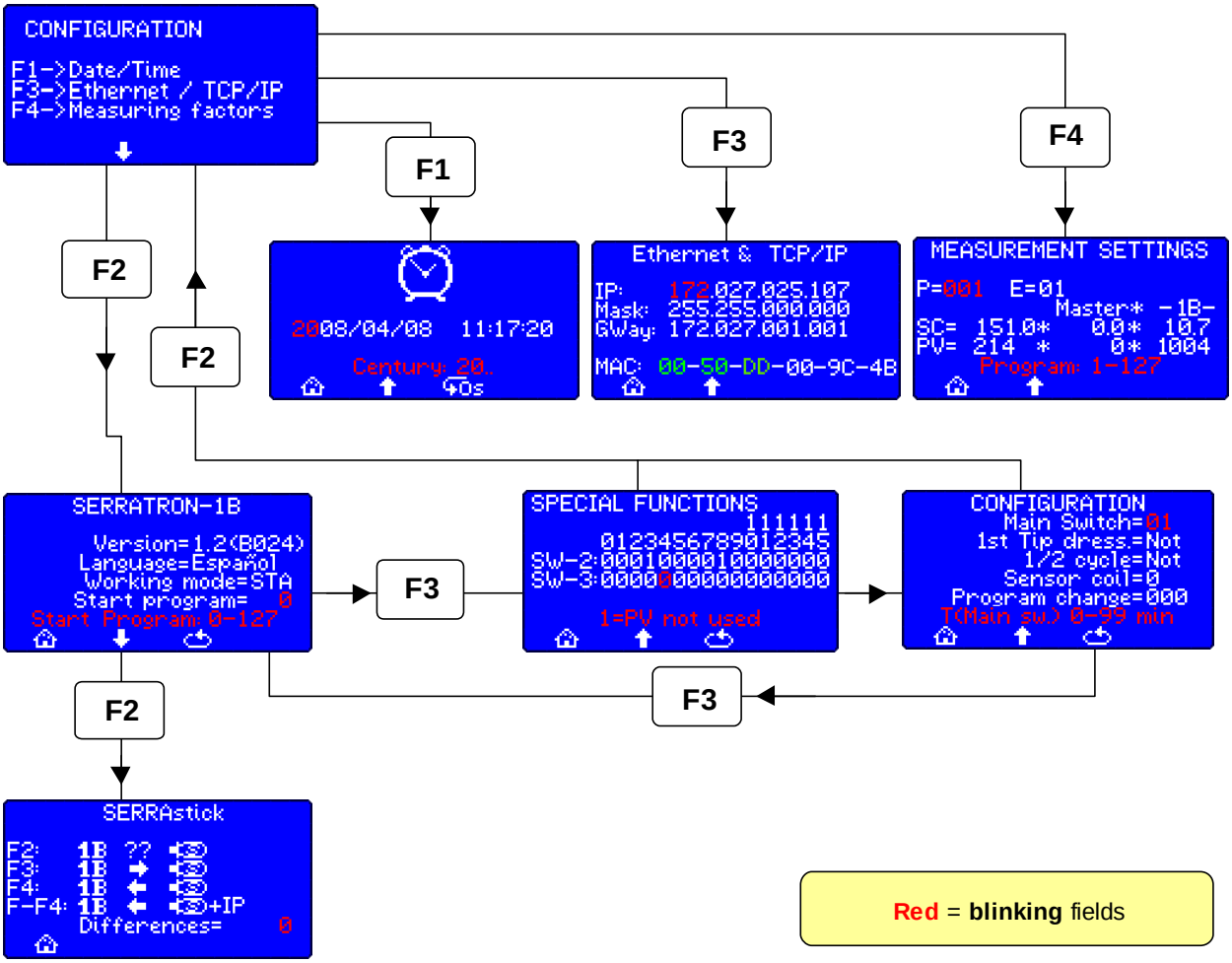
Copy / Paste parameters either of a Program or an Electrode. The choice depends on the menu context where this icon is shown.

Copy = F4 The parameters of the displayed Program or Electrode are marked as the source of parameters to be copied.

Paste = F – F4 The parameters of the Program or Electrode marked in the last 'copy' command are copied into the Program or Electrode being displayed in the current menu.

Summary of the SERRATRON 1B menus




CONFIGURATION
F1->Date/Time
F3->Ethernet / TCP/IP
F4->Measuring factors
F1
F2
F3
F4
2008/04/08 11:17:20
Century: 20.
Ethernet & TCP/IP
IP: 172.027.025.107
Mask: 255.255.000.000
GWay: 172.027.001.001
MAC: 00-50-DD-00-9C-4B
MEASUREMENT SETTINGS
P=001 E=01
Master* -1B-
SC= 151.0* 0.0* 10.7
PV= 214 * 0* 1004
Program: 1-127
SERRATRON-1B
Version=1.2(B024)
Language=Español
Working mode=STA
Start program= 0
Start Program: 0-127
SPECIAL FUNCTIONS
111111
012345678901234 5
SW-2:000100001000000 0
SW-3:00000000000000 0
1=PV not used
CONFIGURATION
Main Switch=01
1st Tip dress.=Not
1/2 cycle=Not
Sensor coil=0
Program change=000
T(Main sw.) 0-99 min
SERRAstick
F2: 1B ??
F3: 1B
F4: 1B
F-F4: 1B +IP
Differences= 0
Red = blinking fields

Automatic cursor positioning (ACP)

If the **E**-key is pressed with the control in **Programming ON** and the cursor in certain numerical fields, a process of **automatic cursor positioning** (**ACP**) begins, which will allow all the necessary parameters to be run through, without having to use other keys than the numerical keys and the validation '**E**'-key.

Furthermore, as long as the ACP function is ON, all non-programmable or irrelevant numerical fields are hidden from the active menus, leaving visible only the applicable ones.

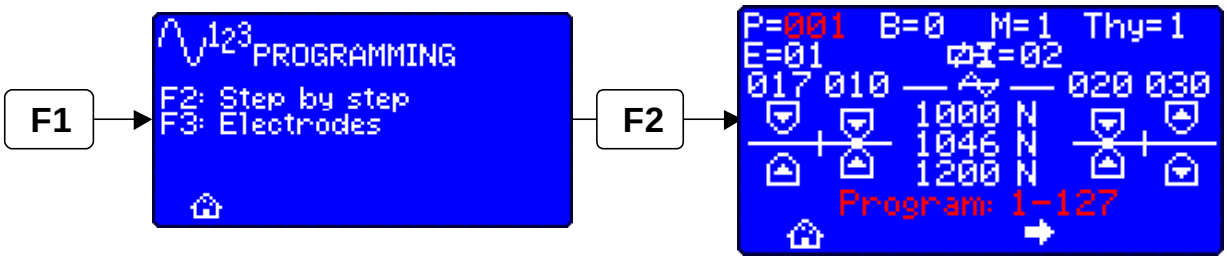
The **ACP** function is interrupted by changing to another menu using a function key or when changing to **Programming OFF**.

The starting fields of the **ACP** function are **P=xxx** or **E=xx** in the **parameters** menus.

Program parameter menus

These are several menus, arranged in a row, concerning all program parameters.
The first of these menus is reached by pushing **F1** ⇨ **F2** from the HOME menu.
The function keys **F2** & **F3** move backwards & forwards, respectively, along such row of menus

SEQUENCE TIMES



P=xxx	Welding program to which belong all other parameters in this menu.
B=x	B=1 -> Blocked program. To use a program it must be released by setting B=0 (see page 5-1).
M=x	Sequence mode (page 5-1).
Thy=x	For a normal weld sequence: Thy=1 (Thy=0 ⇨ Weld OFF sequence)
E=xx	Electrode linked to this program P=xxx. At the end of a weld sequence with this program the weld spot counters of this electrode will be incremented.
	Solenoid Valve mode (see page 5-3). This parameter is used (and displayed) in STA working mode only.
Times line	1st Squeeze - Squeeze - Hold - Off times. Times are expressed in line cycles ( )
xxxxx N	Base force (see page 5-5)
yyyyy N	Used force (according to the wearing curves, it is not a parameter)
zzzzz N	End force
F3	Moves to the next enabled program menu (check bits **0** and **2** of SW-3, page 5-8)
F4	(In Programming ON only) Marks current program P=xxx as **program to be copied**.
F – F4	(In Programming ON only) Copies the last program marked as '**to be copied**', if any, into the current program P=xxx.

WELD TIME 1

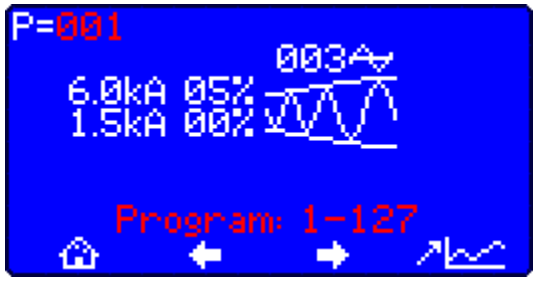
P=xxx	Welding program
xxx~ yyy~	xxx=Weld Time 1 / yyy=Cool Time 1
xx.xkA xx%	xx.x = Base Current in kA / xx% = Base Heat in degrees (new electrode).
yy.ykA yy%	yy.y = End Current in kA / yy% = End Heat in degrees (worn out electrode).

Numerical fields near the measuring icon (hidden while in ACP programming mode)

vv.vkA vv%	vv.v = **Target** current in kA / vv% = **Target** heat in degrees (according wearing curves).
zz.zkA zz%	zz.z = **Measured** current in kA / zz% = **Used** Heat in degrees.

F2	Moves backwards to the **Sequence times** menu
F3	Moves forwards to the next menu (check bit **2** of SW-3, page 5-8)
F4	Jumps to the graphics menus (from where to return by pushing again F4).

UP-SLOPE TIME

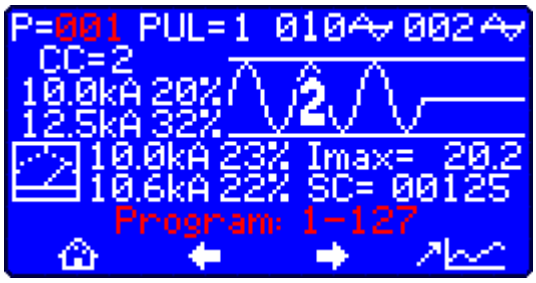


P=xxx	Welding program
xxx~	xxx=Up-slope time (the time needed to reach current/heat levels of Weld Time 2).
xx.xkA xx%	xx.x = Base Current in kA / xx% = Base Heat in degrees (new electrode).
yy.ykA yy%	yy.y = End Current in kA / yy% = End Heat in degrees (worn out electrode).

These current & heat levels correspond to the Weld Time 1 parameters and fix the levels used at the beginning of the Up-slope time, was the Weld Time 1 actually used or not.

F2	Moves backwards to the former menu (depends on bit **0** of SW-3, page 5-8)
F3	Moves forwards to the next menu
F4	Jumps to the graphics menus (from where to return by pushing again F4).

WELD TIME 2 (The main Weld time)



P=xxx	Welding program
PUL=x	Pulsations (times the Weld Time 2 is done, alternating with Cool Time 2).
xxx~ yyy~	xxx=Weld Time 2 / yyy=Cool Time 2.
CC=x	Power mode (see page 5-4) 0 = Phase control / in degrees 1 = Monitoring 2 = Constant current

Programmable current & heat values

xx.xkA xx%	xx.x = Base Current in kA / xx% = Base Heat in degrees (new electrode).
yy.ykA yy%	yy.y = End Current in kA / yy% = End Heat in degrees (worn out electrode).

Numerical fields near the measuring icon (hidden while in ACP programming mode)

vv.vkA vv%	vv.v = **Target** current in kA / vv% = **Target** heat in degrees (according wearing curves). These are the **target** current & heat levels. They are calculated according the Wearing curve used, the programmed electrode Life and current state of the spot counter, in a continuous form (not by steps) between the programmed **base** and **end** values. The target values must lie between these two. If the **end** value is lower than the **base** value, the **base** value will prevail. The target values are updated at each weld sequence.
zz.zkA zz%	zz.z = **Measured** current in kA / zz% = **Used** Heat in degrees. **zz**% is the used heat in the last weld done with the displayed Program. In constant current mode, this is the value to use as heat parameter to help getting successful welds since the very first one, during the 'learning phase' after power-up.
Imax=xx.x	xx.x = Maximum available current (kA) calculated by the timer. Result of a calculation made by the timer, based on the current conditions of the power line as well as the load (line voltage, transformer, secondary cables, fixture and welded parts).
SC=xxxxx	Spots counter. It counts the weld spots done by the electrode linked to this Program.

F2	Moves backwards to the former menu (depends on bits **0** and **2** of SW-3, page 5-8)
F3	Moves forwards to the next menu (depends on bits **1** and **3** of SW-3)
F4	Jumps to the graphics menus (from where to return by pushing again F4).

DOWN SLOPE TIME

P=xxx	Welding program
xxx~	xxx=Down-slope time (the time needed to reach current/heat levels of Weld Time 3).
xx.xkA xx%	xx.x = Base Current in kA / xx% = Base Heat in degrees (new electrode).
yy.ykA yy%	yy.y = End Current in kA / yy% = End Heat in degrees (worn out electrode).

These current & heat levels correspond to the Weld Time 3 parameters and fix the levels to be reached at the end of the Down-slope time, was the Weld Time 3 actually used or not.
The starting levels are Weld Time 2 ones.

F2	Moves backwards to the former menu (depends on bit **0** of SW-3, page 5-8)
F3	Moves forwards to the next menu
F4	Jumps to the graphics menus (from where to return by pushing again F4).

WELD TIME 3

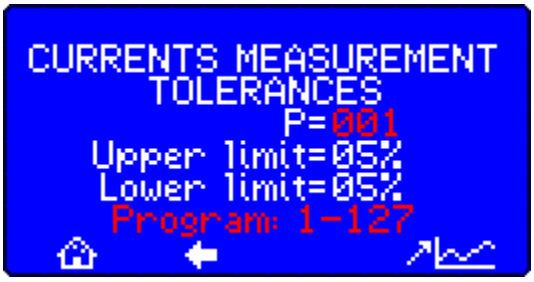
P=xxx	Welding program
xxx~ yyy~	xxx=Cool Time 3 yyy=Weld Time 3
xx.xkA xx%	xx.x = Base Current in kA / xx% = Base Heat in degrees (new electrode).
yy.ykA yy%	yy.y = End Current in kA / yy% = End Heat in degrees (worn out electrode).

Numerical fields near the measuring icon (hidden while in ACP programming mode)

vv.vkA vv%	vv.v = **Target** current in kA / vv% = **Target** heat in degrees (according wearing curves).
zz.zkA zz%	zz.z = **Measured** current in kA / zz% = **Used** Heat in degrees.

F2	Moves backwards to the former menu (depends on bit **3** of SW-3, page 5-8)
F3	Moves forwards to the next menu
F4	Jumps to the graphics menus (from where to return by pushing again F4).

TOLERANCES



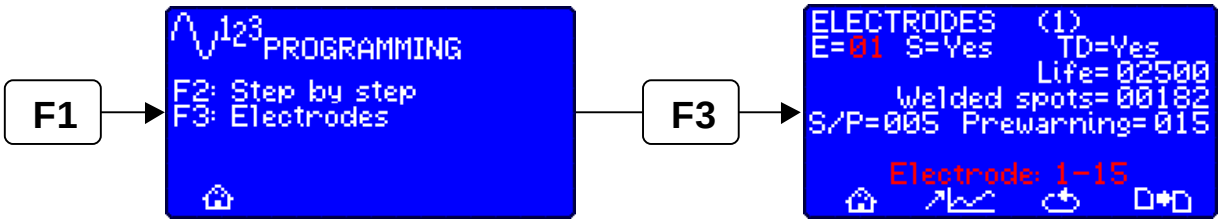
P=xxx	Welding program
Upper limit=xx%	
Lower limit=yy%	See Tolerances in page 5-5.

F2	Moves backwards to the former menu (depends on bits **1** and **3** of SW-3, page 5-8)
F4	Jumps to the graphics menus (from where to return by pushing again F4).

Electrode parameters menus

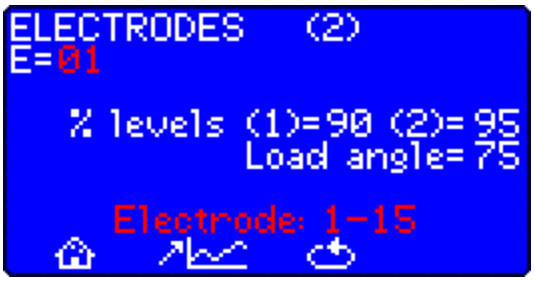
These are several menus, arranged in a row, concerning the electrode parameters.
The first of these menus is reached by pushing **F1** ⇨ **F3** from the HOME menu.
The function key **F3** rotates forwards along such row of menus

ELECTRODES MENU 1



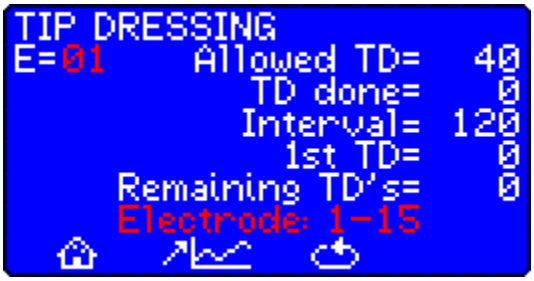
E=xx	Electrode to which belong all other parameters in this menu.
S=x	x=Yes: **Stepping** function for this electrode enabled. x=Not: **Stepping** function disabled. The remaining parameters become useless.
TD=x	Tip-dressing Yes/not. If **TD=Not** all TD menu parameters become useless.
Life=xxxxx	Foreseen electrode life, measured in number of welded spots.
Welded..=xxxxx	Spot counter linked to this electrode. It is not a parameter, yet it is editable.
S/P=xxx	Spots per Part: Number of spots in a single welded part.
Prewarning=xxx	Number of parts before the end of life of the electrode where a warning message & signal is generated (Error **29**).
F2	Jumps to the graphics menus (from where to return by pushing again F2).
F3	Moves forwards to the next rotating menu
F4	(In Programming ON only) Marks current electrode E=xx as **electrode to be copied**.
F – F4	(In Programming ON only) Copies the last electrode marked as '**to be copied**', if any, into the current electrode E=xx.

ELECTRODES MENU 2



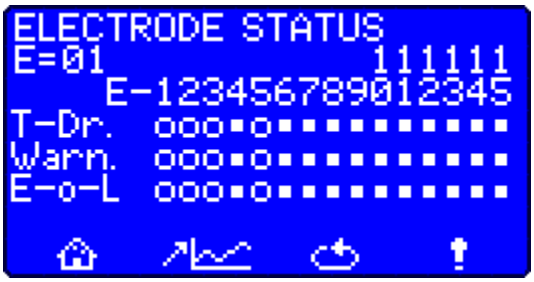
E=xx	Electrode to which belong all other parameters in this menu.
% levels	Heat levels.
(1)=xx	Warning level (see page 5-7 & Error **78**).
(2)=yy	Fault level (see page 5-7 & Error **79**).
Load angle=xx	Minimum load angle (see page 5-5).
F2	Jumps to the graphics menus (from where to return by pushing again F2).
F3	Moves forwards to the next rotating menu.

TIP DRESSING (See § *Tip-dressing operation* in page 5-11)



E=xx	Electrode.
Allowed TD=xxxx	Allowed Tip-dressings for this electrode (see page 5-11).
TD done=xxxx	Tip-dressings counter. It is not a parameter, yet it is editable.
Interval=xxxx	Tip-dressings interval.
1st TD=xxxx	Beginning of the 1st Tip-dressing window.
Remaining TD's=xxxx	TD-Window shift after any TD-Acknowledge command.
F2	Jumps to the graphics menus (from where to return by pushing again F2).
F3	Moves forwards to the next rotating menu.

ELECTRODE STATUS



E=xx	Electrode of the <u>selected</u> program or <u>last welding</u> program.
E-123456…	Electrodes available: 1 to 15.
■	Electrode not linked to any Program (not used).
○ (empty circle)	Normal state. Alarm **off**.
● (full circle)	Alarm **on**.

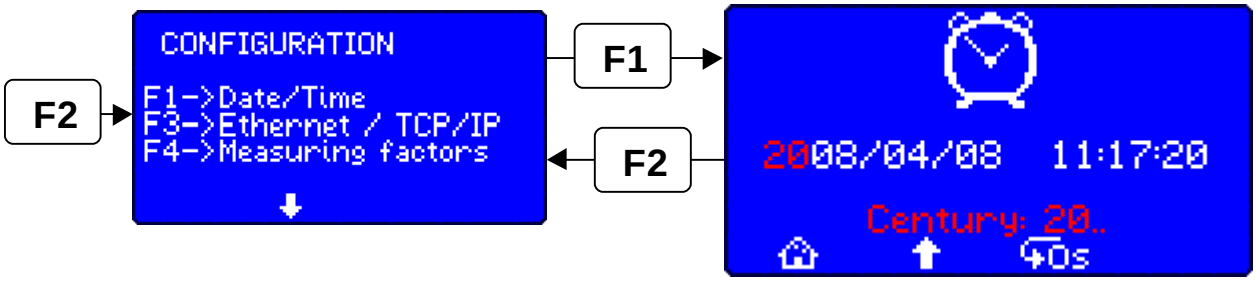
<u>Electrode states shown</u>

T-Dr.	Electrode in TD-Request state: Error **28**.
Warn.	Electrode in Prewarning state: Error **29**.
E-o-L	Electrode in End of Life state. Electrode worn out: Error **30**.
F2	Jumps to the graphics menus (from where to return by pushing again F2).
F3	Moves to the next rotating menu (the first in the row).
F4	Jumps to the Direct Commands menu (fro where to return by a Counter Reset command or by pushing F1).

Configuration menus

DATE / TIME

This menu is reached by pushing **F2** ⇨ **F1** from the HOME menu.

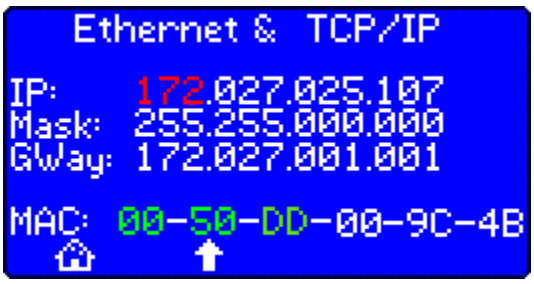


Date **20xx/yy/zz** Editable in the form of Century (20) / Year (xx) / Month (yy) / Day (zz)
Hour **hh:mm:ss** Hour (hh) : minute (mm) : second (ss)

F3 Synchronization: Sets the seconds (ss) to zero and rounds the minutes (mm) to the nearest value. If ss >= 30 the value of minutes is incremented by one.

Ethernet / TCP/IP

This menu is reached by pushing **F2** ⇨ **F3** from the HOME menu.



IP: **vvv.xxx.yyy.zzz** IP number (see page 5-6).
Mask: **vvv.xxx.yyy.zzz** Recommended: 255.255.255.0 (in special cases 255.255.0.0).
GWay: **vvv.xxx.yyy.zzz** Gateway. Number to be assigned by the network administrator.
MAC: **00-50-DD-xx-yy-zz** MAC number / Ethernet.
00-50-DD Number property of SERRA soldadura, S.A. (OUI number).
xx-yy-zz Welding controller serial number.

Calibrations menu

This menu is reached by pushing **F2** ⇨ **F4** from the HOME menu.

P=xxx Welding program to which belong the measurements shown under **-1B-**.

E=xx Electrode linked to the above program.

SC=**xxxx.x** * **yy.y** *zz.z Values linked to the measuring sensor coil (SC).

xxxx.x Calibration parameter of the sensor current linked to the above electrode (mv/kA).

yy.y Master value: Enter here the value measured by an external **master** current meter.

zz.z It is the welding current **measured** by the SERRATRON 1B in the last weld done by the above program, during the Weld Time 2 (the only WT to be used for calibration).

PV= **xxxxx** * **yyyyy** *zzzzz Values linked to the Proportional Valve (PV)

xxxxx Calibration parameter of the Proportional Valve linked to the above electrode (N -Newton-).

yyyyy Master value: Enter here the value given by an external **master** force meter.

zzzzz Target force **used** by the SERRATRON 1B in the last weld done by the above program.

This menu lets the user make an easy calibration of the current sensor coil and the proportional valve. At the end of a weld sequence, P=xxx and E=xx show the used Program and Electrode, respectively. All the user has to do is enter the current measured by an external master meter in **yy.y**, the force given by a dynamometer in **yyyyy**, and push the 'E' key (Programming ON) in both cases: the respective calibration parameters, **xxxx.x** and **xxxxx** will be automatically calculated by the timer.

> The Errors **76** and **77** disappear, for a given electrode, after doing the explained procedure with the sensor coil and the proportional valve, respectively.

BASIC DATA menu

Menu reached by pushing **F2** ⇨ **F2** from the HOME menu.

Version=**x.y**(**zzzz**)

x.y Firmware version number

zzzz 'Checksum' of the current firmware version. It will change at every new firmware release. However, the version number **x.y** will not change in case of modifications made with the aim of fixing a minor software bug.

Language=xxxx May be sequentially changed from any other menu by pushing **F-?**

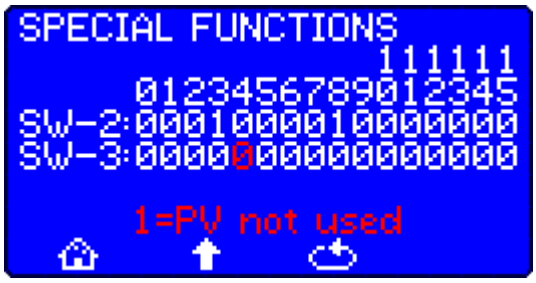
Working mode=xxx MAN/STA. Dip-switch SW-1 must fit with the working mode chosen (page 3-3).

Start program=xxx See page 5-6.

F3 Rotates to the next 'configuration' menu.

Special Functions Menu

Menu reached by pushing **F2** ⇨ **F2** ⇨ **F3** from the HOME menu.



In Programming ON mode blinks a single digit (bit) and the next to last line shows a descriptive message of this bit (*§ Special functions selectors SW-2 & SW-3*, page 5-8).
The **arrow-up** / **arrow-down** keys move to the above / below lines respectively (SW-2 / SW-3).
The **+** / **-** keys move the blinking bit to the right / left respectively along the current line.
The **0** / **1** keys let us modify the blinking bit.
The **E** key stores the current value of the whole line, SW-2 or SW-3.

F3 Rotates to the next 'configuration' menu.

Other Configuration parameters

Menu reached by pushing **F2** ⇨ **F2** ⇨ **F3** ⇨ **F3** from the HOME menu.

Main Switch=xx	See page 5-6.
1st Tip dressing=Not/Yes	See page 5-11.
1/2 cycle=Not/Yes	See page 5-6.
Sensor coil=x	See page 5-6.
Program change=xxx	See page 5-7.

F3 Rotates to the first 'configuration' menu (Basic Data)

SERRAstik memory

Menu reached by pushing **F2** ⇨ **F2** ⇨ **F2** from the HOME menu.

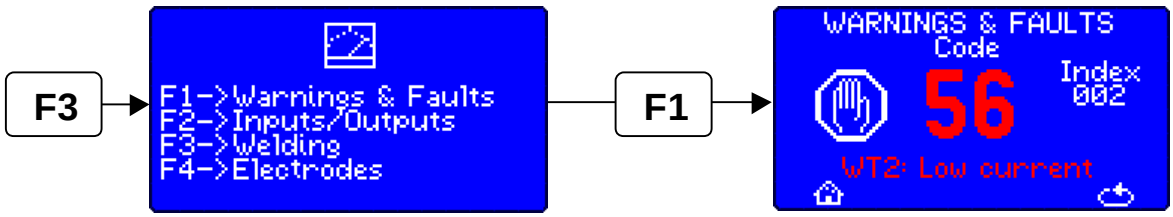
F2:	Performs a comparison of all parameters between the SERRATRON 1B and the SERRAstik module.
F3:	(In Programming ON mode only). Transfers all the SERRATRON 1B parameters to the SERRAstik memory (including the IP number).
F4:	(In Programming ON mode only). Transfers all the parameters from the SERRAstick module to the SERRATRON 1B memory (with the exception of the IP number).
F - F4:	(In Programming ON mode only). Transfers all the parameters from the SERRAstick module to the SERRATRON 1B memory (including the IP number). This option is useful in case of a SERRATRON 1B replacement.
Differences=xxxxx	It is the number of differences found, between the SERRATRON 1B and the SERRAstik module, at the end of any of the above commands.

DIAGNOSTICS Menus

These menus are reached by pushing **F3** from the HOME menu.

Warnings & Faults menu

This menu is reached either by pushing **F3** ⇨ **F1** from the HOME menu or automatically when a warning or fault is produced. In the last case, the activation of the **F3** key moves back to the earlier menu without performing any *Fault Reset* command.
The **F4** key swaps among the **Warnings & Faults** menu and the **Error logger** menu.
The **C** key 'clears' the warning or fault (*Fault Reset* command) if it is allowed, depending on the fault.



Code It is the warning or fault code, as described in Chapter 8 TECHNICAL SERVICE. The next to last line shows a message describing the active error.
Index=xxx This field, if any, indicates the Program or Electrode involved in the displayed error.

Fault: The initiation of further weld sequences is prevented.

Warning: It does not prevent new weld sequences, yet some user action may be necessary.

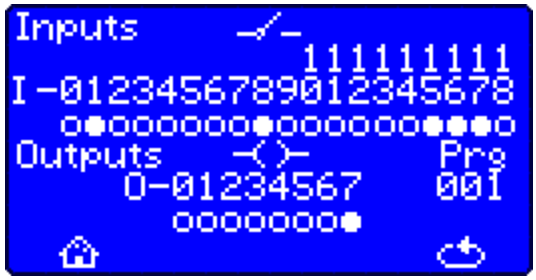
Error logger menu

Menu reached by pushing **F3** ⇨ **F1** ⇨ **F4** from the HOME menu.
The **F4** key swaps among the **Warnings & Faults** menu and the **Error logger** menu.

Position=xxx x=000…511 is the ordinal number of an error among the last 512 registered ones.
000 Is the current error.
001 Is the newest registered error (warning or fault)
511 Is the oldest registered error.
Error code=xxx Is the numerical code of the displayed error.
Index=xxx This field, if any, indicates the Program or Electrode involved in the displayed error.
yyyy/mm/dd hh:mm.ss Date & time when the displayed error was generated.
Next to last line Message describing the displayed error.

Inputs / Outputs

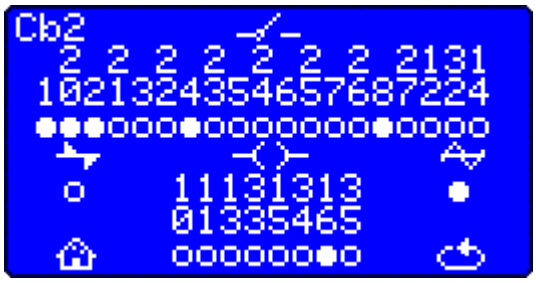
Menu reached by pushing **F3** ⇨ **F2** from the HOME menu.
The **F4** key swaps among the **Inputs/Outputs** menu and the **Cb2 connector** menu.



I-012..	Inputs 0…18
O-012..	Outputs 0…7
○ (empty circle)	I/O inactive (OFF).
● (full circle)	I/O active (ON)
Prg	Program being currently selected

Cb2 connector

Menu reached by pushing **F3** ⇨ **F2** ⇨ **F4** from the HOME menu.
The **F4** key swaps among the **Inputs/Outputs** menu and the **Cb2 connector** menu.



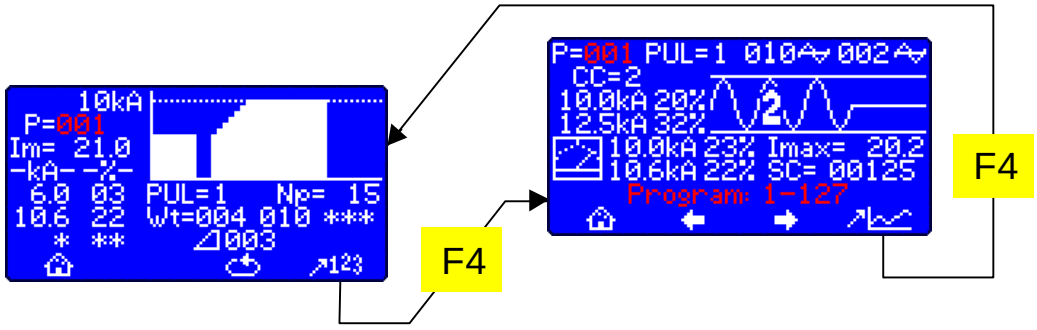
○ (empty circle)	I/O pin in the Cb2 connector inactive (OFF).
● (full circle)	I/O pin in the Cb2 connector active (ON)
(not shown)	Current state of the Thyristors group in the Cb1 connector (page 9-1).
	Current state of the synchronization signal in the Cb1 connector (page 9-1).

Welding Currents Graphic Waveform

Menu reached by pushing **F3** ⇨ **F3** from the HOME menu.
The **F3** key swaps among the **Welding currents** menu and the **Wearing curves** menu.

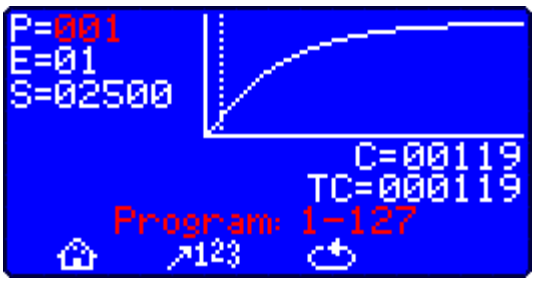
P=xxx	Welding program to which belong all other parameters in this menu.
Im=xxx.x	Maximum available current (kA).
-kA- -%-	(For the unused times the values are replaced by *****).
pp.p pp	kA and Heat (in degrees) respectively of Weld Time 1
qq.q qq	kA and Heat (in degrees) respectively of Weld Time 2
rr.r rr	kA and Heat (in degrees) respectively of Weld Time 3
PUL=x	Pulsations number
Np=xxx	Total welding times cycles (including cool times).
Wt=xxx yyy zzz	(The unused times the are replaced by *****)
xxx	Weld Time 1
yyy	Weld Time 2
zzz	Weld Time 3
◢ xxx	(Field hidden when not in use). Slope-up time.
yyy ◣	(Field hidden when not in use). Slope-down time.

The **F4** key swaps among the **Weld sequence parameters** menus and this **Welding currents** menu.



Wearing curves of the electrodes

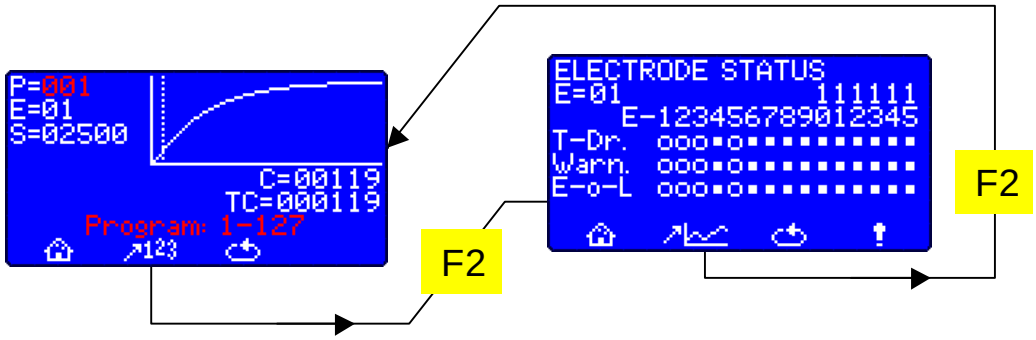
Menu reached by pushing **F3** ⇨ **F3** ⇨ **F3** from the HOME menu.
The **F3** key swaps among the **Welding currents** menu and the **Wearing curves** menu.



P=xxx	Welding program to which belong all other parameters in this menu.
E=xx ** y	Electrode and Curve number linked to the above Program.
S=xxxxx	Electrode life of this electrode (page 5-10).
C=xxxxx	Weld spots counter of this electrode.
TC=xxxxxx	Total weld spots counter of this electrode (page 5-12).

The shape of the displayed curve corresponds to the **Curve number** '**y**'. Curves **1** to **9** have predefined shapes, but the Curve **0** may be edited using the software package **CPC-connect**.
The vertical dotted line shows the current state of the displayed electrode.

The **F2** key swaps among the **Electrodes parameters** menus and this **Wearing curves** menu.



Direct commands menu

Menu reached by pushing **F4** from the HOME menu.

F2: Weld ON — Resumes next command (F-F2)

F-F2: Weld OFF — Sets the timer in **Weld OFF** mode, regardless of the I1 input state, until a F2 command was issued.
This situation produces the warning Error **20** Índex=**3**.

This mode is kept unchanged even after a shutdown of the power supply

F3: Counter reset.. E=**XX** — Resets the counter of Electrode **XX** and the display jumps to the Electrodes menu (page. 7-11) which will show the selected counter.

To change the **XX** value use the **+** or **-** keys, or enter the wished value with the numeric keys and push the **E** key to validate it

F4: End of sequence — Activates the **End of sequence** output during 150 ms.

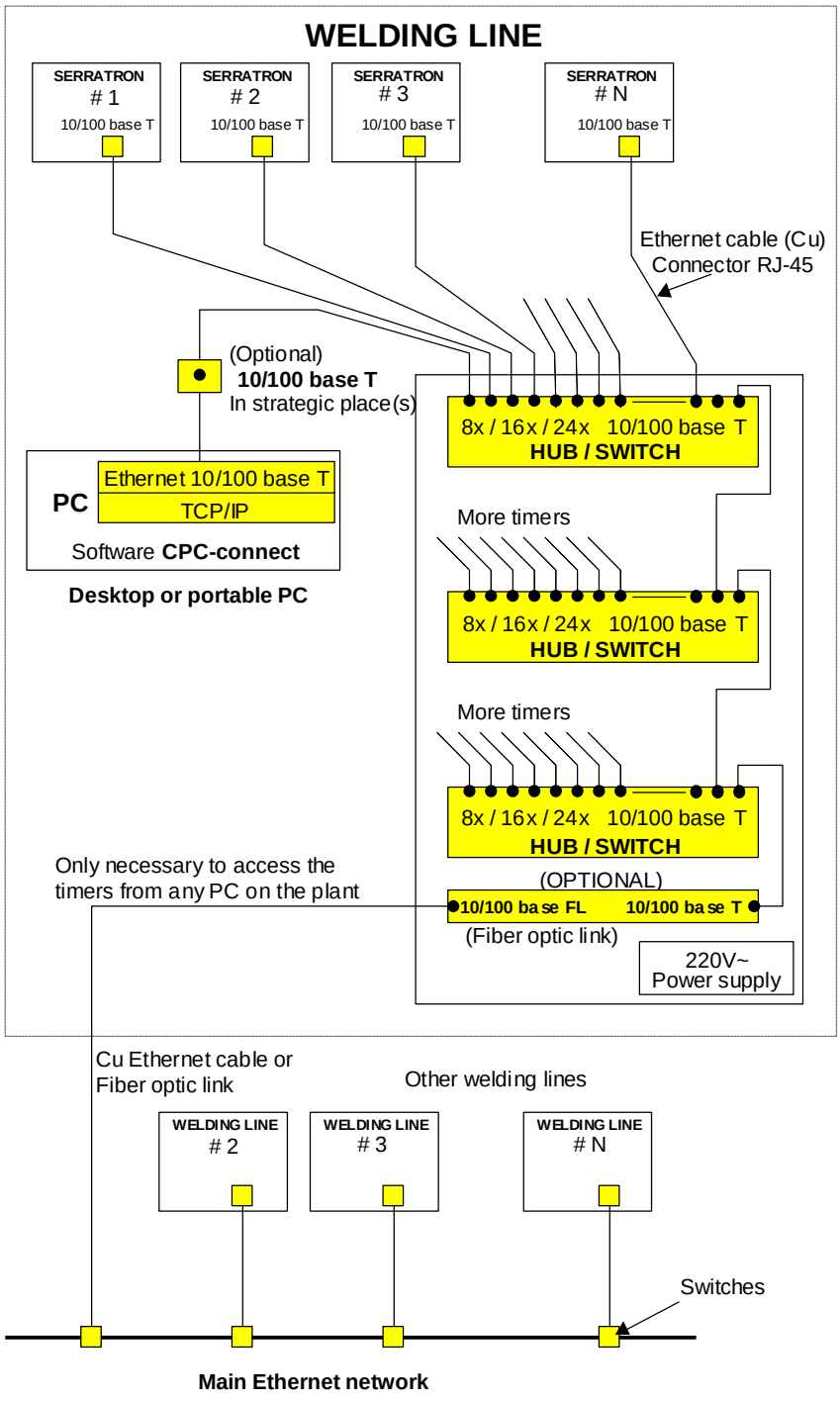
Centralized communications network: Ethernet 10/100 base T

The installation of a network is made up of two parts:

- 1 **Central computer and its accessories**, including its network card (Ethernet 10/100 base T)
  The network installation is out of the scope of this Manual. Any state-of-the-art Ethernet 10/100 Mbaud network may be used. The type of connectors used is RJ-45.
  The installation of the **CPC-connect** software on the Central computer is also straightforward under Windows-95, Windows-98, Windows-NT or Vista.
- 2 **Connection of all the SERRATRON 1B**
  Use the built-in Ethernet 10/100 base T to link the RJ-45 cable connector to the nearest network hub.

Example of an Ethernet network

Consult your factory network service staff for proper IP address assignation, in case the welding network should be eventually connected to the main factory network. This would allow free access to any timer from any PC in the plant.



External memory module SERRAstik

This external memory device lets the user store all programmable parameters of a **SERRATRON 1B** for safety purposes or with the aim of being transferred to other controllers.

See § SERRAstik memory (page 7-15).

NOTE: Although it looks like a USB device for the type of connector used, it is not at all a USB device.

Therefore, do not try to connect it into a USB port of a PC: no harm should happen either to the PC or to the SERRAstik module, but SERRA will not be responsible of eventual failures or damages under such circumstances.

●●●

Chapter 8
TECHNICAL SERVICE

These are the *Fault codes* relating to a **SERRATRON 1B** which may appear in the *Fault window* of the software package **CPC-connect**, or in the WARNING & FAULTS menu.

Fault codes

Next table gives a description of all available warning & fault codes, including possible causes and its corresponding solutions.

The Type column highlights the kind of reaction every error produces.

- **a** Shuts LED ☊ off (☊=Ready LED)
- **b** Blinks LED ☊
- **c** Electrode LED blinks slowly
- **d** Electrode LED blinks fast
- **e** Electrode LED permanent ON
- **A** Disables Ready output
- **B** Prevents the initiation of further welding sequences or halts the current sequence
- **F** Prevents EOS activation (only in faults produced during or after weld times)
- **M** Trips down Main Switch
- **Z** All 24Vdc outputs are forced to the OFF state

Index column:

- **P** Program producing the fault
- **E** Electrode involved in the current fault

WARNING: Any ***Fault Reset command*** is a user's voluntary action. It implies the user **acknowledges** the fault being displayed **and removes the blocking condition** produced by this fault

Error	Index	Type	Description
20		**b**	**Weld OFF**
	1		The Weld ON input remains inactive (OFF) ● Activate the **I1** input (pin 8/Cb2). Working mode for I1 input has been changed (Weld ON <-> Weld OFF) ● Configure properly the **15** of **SW-3** (page 5-8).
	2		The Thyristor used parameter is **0** and a weld sequence has been initiated. ● Select Thyristor group=1 if this program is a weld program and not just a 'timing' program (i.e. Tip-dressing).
	3		Weld OFF has been selected in the **Direct Commands** menu: (HOME) ⇒ F4 ⇒ F-F2 ● Select Weld ON with the keyboard: (HOME) ⇒ F4 ⇒ F2.
21	**-**	**b** **B**	**Weld not enabled** (prevents entering the weld times) **I6** input (27/Cb2) inactive (at the end of **Squeeze** time) ● Activate **I6** or reset bit **1** of the Special functions parameter **SW-2** (page 5-8).
23	**1**	**b** **B**	**Incorrect pressure in Proportional Valve** (during **Squeeze** time) The feedback Pressure-OK contact from the PV remains open ● If this input is not used disable it either by shunting the **I15** input or setting the bit **6** of **SW-2** (page 5-8). Programmed pressure excessive or **full range value** not fitted to the **Proportional Valve** ● Reprogram values: full range value must be equal to the maximum work pressure. The programmed pressures should always be below this value. Proportional Valve regulator damaged ● Check it. See manufacturer's Service manual of that module. Check its configuration dip-switch if available.

Error	Index	Type	Description
24 **25** **26**	**P**	**-**	**Full load reached in one Weld time 1/2/3 respectively** Indicates that there is not much more available welding current above the current level. The power required is near the maximum the machine can supply ● Increase the position of the power transformer tap switch by one step. If it is already at the maximum step and the welding current is still clearly insufficient, a greater transformer should be installed. ● It is not a fault, but in Constant Current mode may presage imminent faults like 'Low current' or 'Maximum available current'
27	**E**	**c**	**First Tip-dressing Request of an Electrode** It is a warning that the electrode whose number is being displayed must be tip-dressed for the first time after an electrode change ● Tip-dress the electrode and activate the input Reset after Tip-dressing.
28	**E**	**c**	**Tip-dressing Request of an Electrode** It is a warning that the electrode whose number is being displayed must be tip-dressed in the normal way ● Tip-dress the electrode and activate the input Reset after Tip-dressing.
29	**E**	**d**	**Electrode in Prewarning** The number of weldings allowed before the blocking of the control by End of Life is lower than the **Prewarning** parameter ● Replace the electrode for a new one as soon as possible and give a *Counter Reset* command before the blocking of the control. The purpose of the **Prewarning** function is to prevent the control from being blocked in the middle of welding a part.
30	**E**	**e** **(B)**	**End of Life of the Electrode or Electrode Worn out** Reached or overrun the maximum number of weld spots programmed for this electrode ● Replace the electrode with a new one and give a C*ounter Reset* command for this electrode.
32	**1, 2**	**a** **AB**	**Gun open** The *Start* input is activated while the displayed Gun remains open. It is not a fault but in this condition welding sequences are not permitted ● Deactivate the Retract input that keeps the gun open. NOTE: This fault is normal in STA mode, if an external diode is used to activate the I0 input whenever the Retract Gun input is activated (See Note 3 in page 4-1).
34	**1, 2**	**a** **AB** **F**	**Fault in thyristor ignition** The Thyristors ignition was not detected during the weld time 2. Possibly attempted to weld with a non-existing or damaged power unit (PU) ● Check that the PU receives the weld impulses. Verify the firing cable connections. Eventually, exchange the damaged PU. This alarm can be disabled with the bit **14** of SW-2 or by properly selecting the type of firing detection device with bit **15** of **SW-2** (page 5-8).
35	**1, 2**	**a** **AB**	**Safety relay activated** The relay indicated (K1 or K2) is activated when it **should not** ● Verify that the Start and Retract Gun inputs are OFF. Give a *Fault Reset* command. Eventually switch the control off and on again. If the fault persists replace the timer. ● Check SW-1 dip-switch position, § *Working modes of the SERRATRON 1B* (page 3-3). ● See text box in Error 36
36	**1, 2** **3** **4**	**a** **AB**	**Safety relay not activated** The relay indicated (K1 or K2) is **not** activated when it **should** be ● Verify that the Start and Retract Gun inputs are OFF. Give a *Fault Reset* command. Eventually switch the control off and on again. If the fault persists replace the timer. ● Check SW-1 dip-switch position, § *Working modes of the SERRATRON 1B* (page 3-3). In STA mode, this fault may be due to a missing external diode between the Retract Gun and the I0 inputs ● Install a diode according to the text box in the I4 input description (page 4-2) Relay **1** went OFF during a welding sequence Relay **2** went OFF during a welding sequence ● Damaged timer. It may be kept operational, provided the Start was kept ON until the activation of the EOS signal (pages 3-4, 4-8). In STA mode, Errors 35 & 36 are produced only when the selected program activates a solenoid valve protected by the faulty relay (see page 5-3). Relay K1 ⇨ Outputs S0 & S2 Relay K2 ⇨ Outputs S1 & S3

Error	Index	Type	Description
41	**…**	**b**	**Ethernet & TCP/IP port fault** Network cable not connected, loose or unfitted ● Verify all connections involved. Check carefully the type of cable used: normal, crossover.. Fault in the Ethernet interface ● Give a Fault Reset command. Eventually, switch power off/on. If the fault persists, write down the Index number of this fault code and consult SERRA Technical Service.
43	**1,2,3, 4,5**	**a AB F**	**Line synchronization fault** There is no line synchronization voltage and a welding is attempted ● Check it. Verify external synchronization transformer fuses. Switch on circuit-breaker. If the fault persists, write down the Index number of this fault code and consult SERRA Technical Service.
46	-	**a AB**	**Working Mode modified** The Timer mode **MAN-STA** has just been changed ● It is a warning message when the mode is modified. No parameters are changed. Give a Fault Reset command.
50	**E**	**a AB F**	**Current sensor circuit open** (at Start activation or at the end of a sequence) Sensor coil or sensor cable cut or loose ● Total resistance of cable+sensor must be less than 470 Ω
51	**E**	**a AB F**	**Current sensor circuit short-circuited** (same conditions as Error 50) Short-circuit in cable or sensor coil ● Check it: the total resistance of cable+sensor must be greater than 7 Ω
53	**P**	**a AB F**	**No welding current or it was lower than 0.5 kA** The ignition LED ◓◒ don't light up during the welding times ● Hardware fault. Replace timer. The impulses don't reach the ignition card in the power units ● Check ignition cable continuity. There are ignition impulses but the power unit doesn't emit any noise ● Check line voltage, electrical continuity of primary and secondary power cables, as well as the primary switch (could be in position **0**). The Thyristors aren't triggered ● Check connections between Thyristors and ignition cards. The electrodes don't make contact with the part to be welded or there are insulation particles ● Check the state of the electrodes and the parts, correct air pressure, oxidized parts, chunks of paper or plastic, etc.. Measuring current sensor or cable damaged during the weld sequence ● Check it, If a new weld is tried, Error 50 or 51 should appear.
55 **56** **57**	**P**	**a AB F**	**Weak current in Weld Time 1/2/3 respectively** Tolerance **-T%** too small ● Increase it one point. Suggested value: 5%. Optimum value under two different points of view: weld quality and good timer performances.
58 **59** **60**	**P**	**a AB**	**Too high current in Weld Time 1/2/3 respectively** Tolerance **+T%** too small ● The same as Faults 55/56/57
61 **62** **63**	**P**	**a AB**	**Minimum possible current in Weld Time 1/2/3 respectively** The aimed current would require programming a power in degrees less than 00 ● Reduce by one point the position of the primary switch, or install a smaller transformer.
64 **65** **66**	**P**	**a AB F**	**Maximum available current in Weld Time 1/2/3 respectively** The aimed current would require programming a power in degrees greater than 99 ● Increase by one point the primary switch position, or install a bigger transformer.

Error	Index	Type	Description
70		**b**	**Hardware warning** Hardware fault of low priority has been detected. The timer may still perform weld sequences. If the fault remains after a *Fault Reset* command or comes back in a short time, write down the Index number that goes with this Error code and consult SERRA Technical Service
	1		Real Time Clock. The date-time used to mark the error events will be invalid. After the second *Fault Reset* command this error will remain disabled for several hours. ● Replace the timer.
	2, 3, 4		Offset voltage in measuring current input ● Check sensor coil isolation & shielding. ● Eventually, replace the timer.
71	**P**	**a** **AB** **F**	**Fault in current measurement range** The currents measurement system saturates or overflows ● If the sensor coil has not been adjusted, do it. ● If the Weld regulation mode is **Phase control** or **Monitoring**, raise the current programmed in kA in that same Program to above the measured current, or as default, above 26 kA. This makes the weld timer use the high scale range reaching up to 99.9 kA.
72	**P**	**a** **AB** **F**	**Abnormal welding conditions** Weak or irregular contact between electrodes and parts ● Check if there is an excess of sparks or expelled material, or parts improperly placed. Secondary connections too thin and very long, or flexible connections almost cut ● Check them. Check also possible weak contacts in the secondary circuit (in the primary side it is quite less possible)
73	**1, 2**	**a** **AB**	**Hardware failure** Non volatile memory fault ● Push Fault Reset. If the fault remains or reappears in a short time write down the Index number of this fault code, replace the timer and consult SERRA Technical Service.
75	**-**	**a** **AB**	**Line frequency fault** Bad line frequency setting ● Push Fault Reset. The Timer will change it automatically
76	**E**	**b**	**Proportional Valve output of an electrode is not adjusted** The proportionality factor (kN/V) for the output force assigned to the selected Program has yet to be adjusted ● Adjust it using the Adjusting Menus in § Chapter 7 or the **CPC-connect** programming software. NOTE: There are as many factors as electrodes.
77	**E**	**b**	**Current sensor proportionality factor of an electrode is not adjusted** The proportionality factor for the current sensor assigned the electrode linked to the selected Program has yet to be adjusted ● See Error 76
78	**P**	**b**	**Heat Level 1 reached** During the last weld the Heat parameter (in degrees) has risen above **Heat Level 1** ● Verify the consistency between Heat parameters in **degrees** and current parameters in **kA** of this Program (in Constant Current mode). ● Check the wearing state of the welding cables, the welding conditions or any circumstance that could contribute to increase the impedance of the secondary circuit.
79	**P**	**a** **AB**	**Heat Level 2 overridden** During the last weld the Heat parameter (in degrees) has risen above **Heat Level 2** ● The same as in Error 78. Eventually replace the welding cables. ● These errors may be disabled by setting them to 99.

Error	Index	Type	Description
80	**-**	**a** **AB**	**Timer operation not enabled** Operation enable input open ● Close contact or tie terminal **20**/**Cb2** to +24V (**31/Cb2**). Terminal **31** of **Cb2** connector does not supply +24Vdc ● If the 24Vdc power supply is properly connected to **15-8/Cb1**, this event may be due to a short-circuit somewhere in the external devices connected to the terminal **31/Cb2** (internally protected by a 1A auto-resettable fuse). Verify it.
81	**1** **2**	**a** **AB** **M** **F**	**Thyristors fired without command** Power unit without Thyristors fired detection circuit (or detection circuit damaged) ● Use a suitable power unit (SERRA or CNOMO). Eventually this alarm may be disabled with the bit **14** of **SW-2** (page 5-8). No voltage across the power unit has been detected during 3 consecutive line cycles (out of the weld times) ● Thyristors short-circuited, bad gate-cathode connections or damaged ignition card. Unidirectional current detected in the Thyristor group during a weld time ● Thyristor damaged or bad gate-cathode connections. Replace Thyristor unit.
82	**-**	**a** **AB**	**Welding transformer overheated** Fault of welding Transformer cooling ● Check water flow and its temperature If this thermostat is not used ● Shunt the **I17** input. ● Disable this fault by setting the bit **9** of **SW-2** (page 5-8).
83	**-**	**a** **AB**	**Excessive Thyristor temperature** Fault of Thyristor cooling ● Check water flow and its temperature. Wait for cooling. Thyristor thermostat open ● Check continuity in the thermostats between terminals **5** and **6** of the **Cb1** connector.
85	**-**	**a** **AB**	**Data in RAM with minimum values** The command to erase data in RAM was executed from programming units ● It is not a fault!! This is a confirmation that the erase command has been executed.
86	**P**	**a** **AB**	**Program blocked** The selected Program is blocked ● Unblock it or select the fitted Program. This fault is auto-reset when the *Start* is removed.
87	**P**	**a** **AB**	**There is no valid Program when *Start* signal is activated** The selected program is 0 or above 127 ● Select a valid Program. Squeeze and Hold times have their minimum values (default values after a parameter erase command) ● Check whether the actually selected Program was the aimed one. If so, enter the correct parameters. Heat parameters of used Weld times out of limits: $0.5 \leq kA \leq 99.9$ / Degrees > 99 ● Check them. If stepping is used, check both the Base and End values. The assigned electrode nr. is 0 or above 15 ● Check it. Slope times too long ● WT2 must be 3 cycles higher than the Slope times. Bad weld times with **1/2 wave** welding time selected ● Check settings: Weld time 1 & 3=0, Weld time 2=1, Sequence mode<>Seam and Pulses=1
89	**-**	**a** **AB**	**Defect in RAM Memory** Faulty memory ● Replace the Timer. Consult SERRA Technical Service.

Faults 86 & 87 are automatically removed when the Start is de-activated

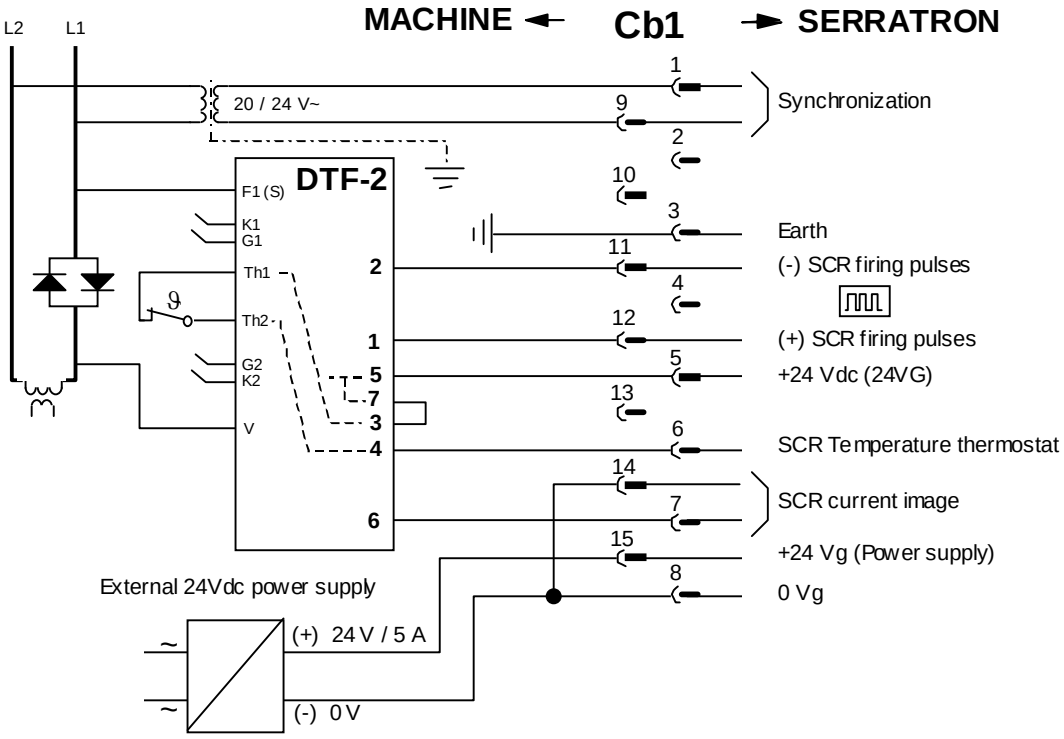
●●●

Chapter 9

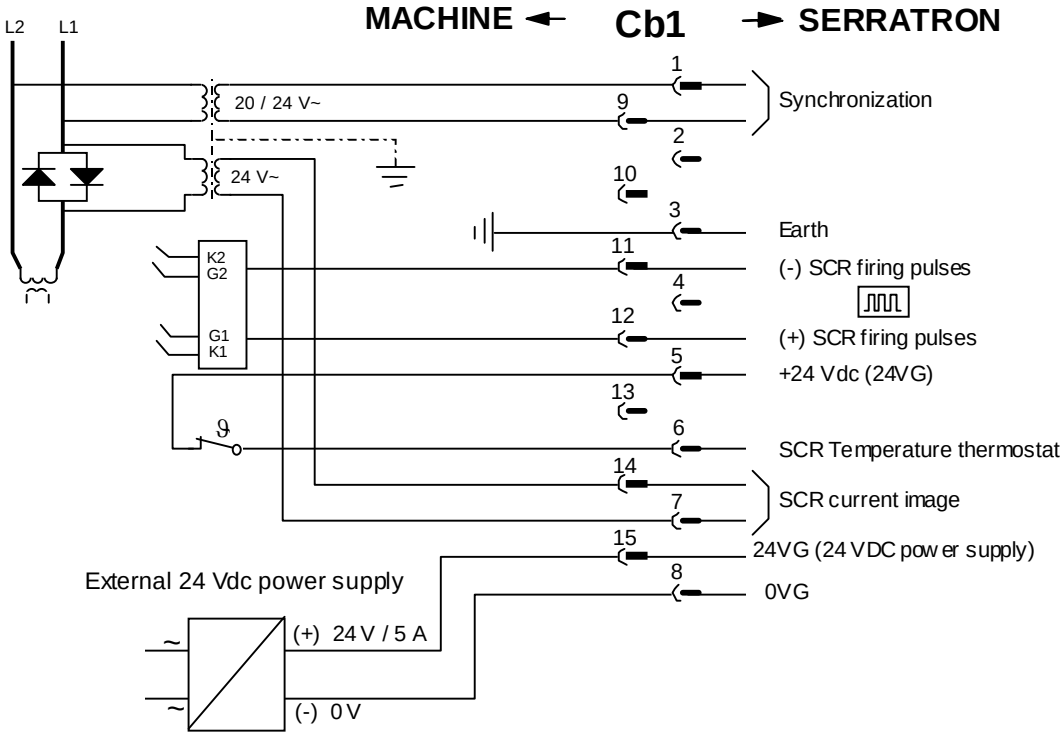
SERRATRON 1B external connections

Cb1 connector: Power supply & Thyristors control

SERRA Thyristor group



CNOMO Thyristor group



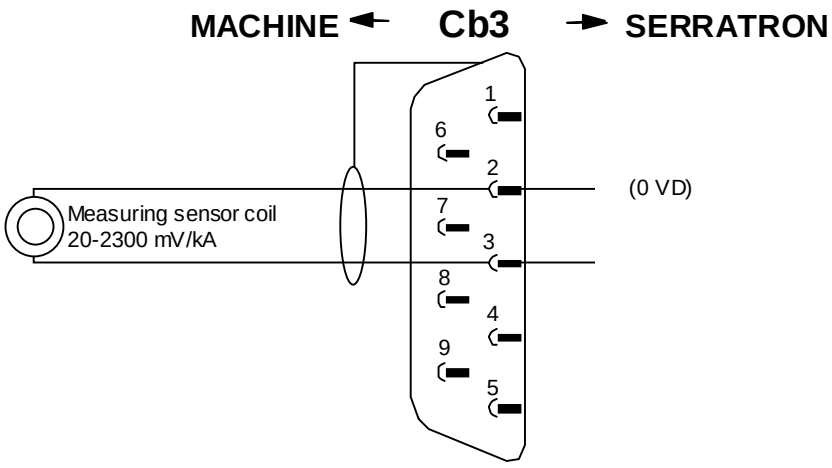
Remarks:

1) The external **Synchronization** and **Current Image** signals must be potential free and not be grounded to the earth potential on either of his poles. The grounding of both transformers (for safety purposes) may be assured by means of electrostatic screens placed between the primary and secondary windings and safely connected to earth (as shown in the above diagram).
2) The negative pole (0 V) of the external 24 Vdc power supply may be grounded to earth, provided this is done in one single point.
3) All the terminals, except 8 and 15, are compatibles with the old timers SERRATRON 5006 & 7000.

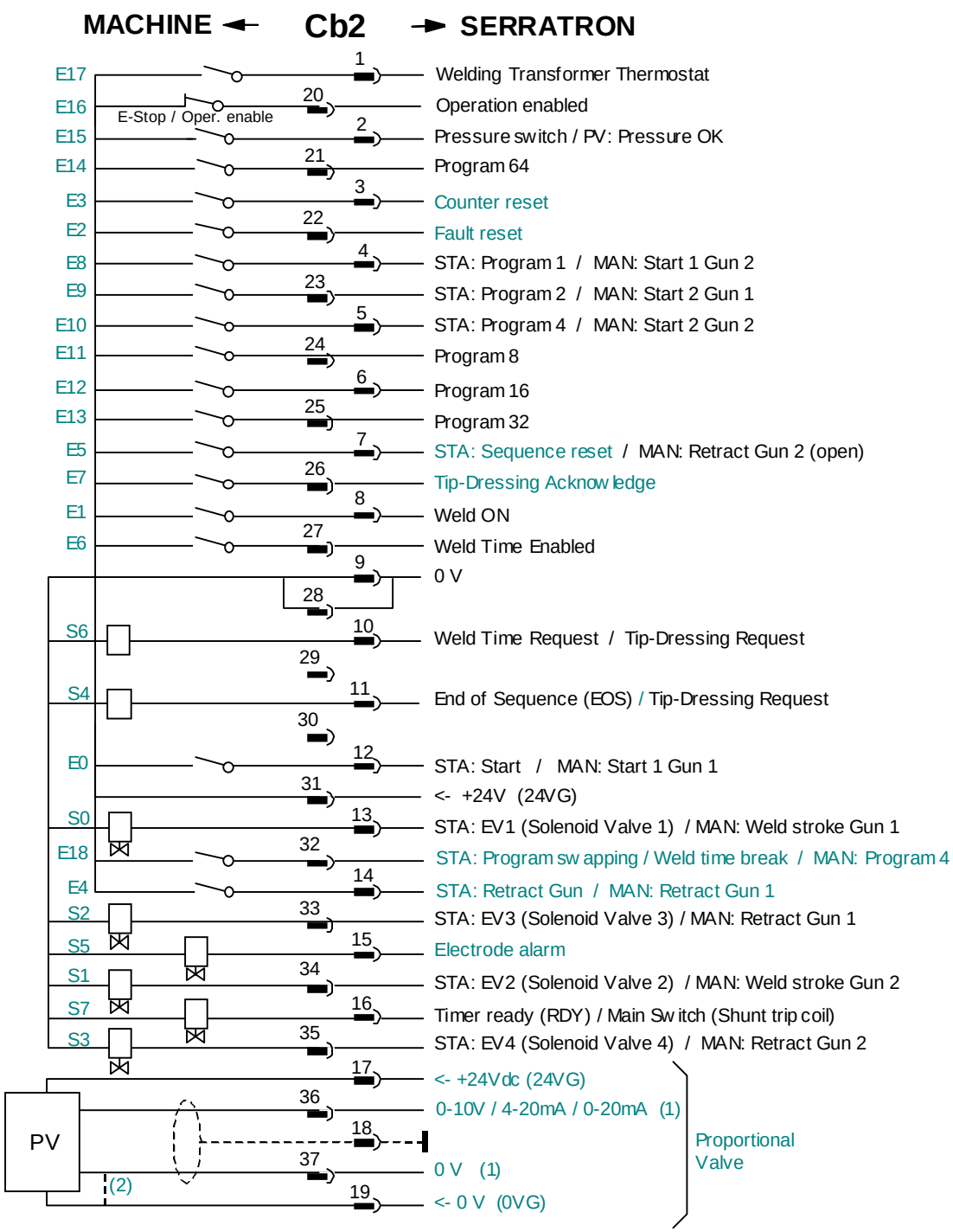
Cb1 variations with respect to old timers

Cb1	SERRATRON 1B	SERRATRON 5006	SERRATRON 7000
4	-	SCR Group 2 firing	-
12	-	SCR Group 3 firing	-
8	24Vdc power supply: (+) pole	-	-
15	24Vdc power supply: (-) pole	-	-

Cb3 connector: Sensor coil



Cb2 connector: Inputs, outputs & proportional valve

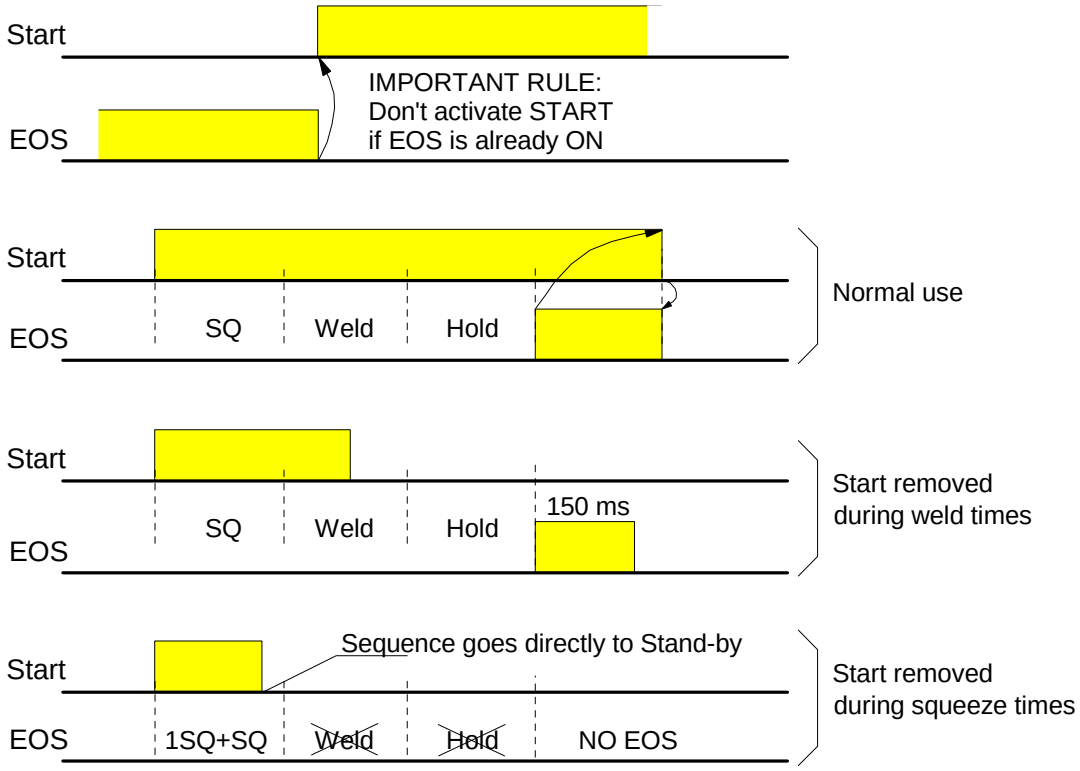


(1) Potential free analogue signal output.
(2) Optional link (recommended). See data sheets of the PV used.

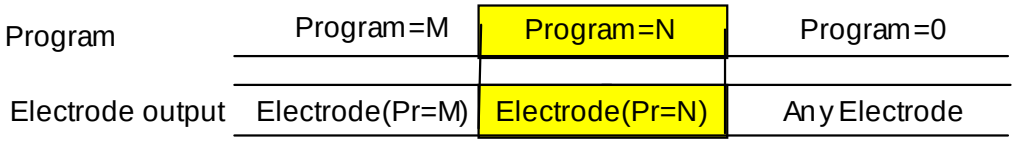
Summary of Timer & PLC/Robot handshake diagrams

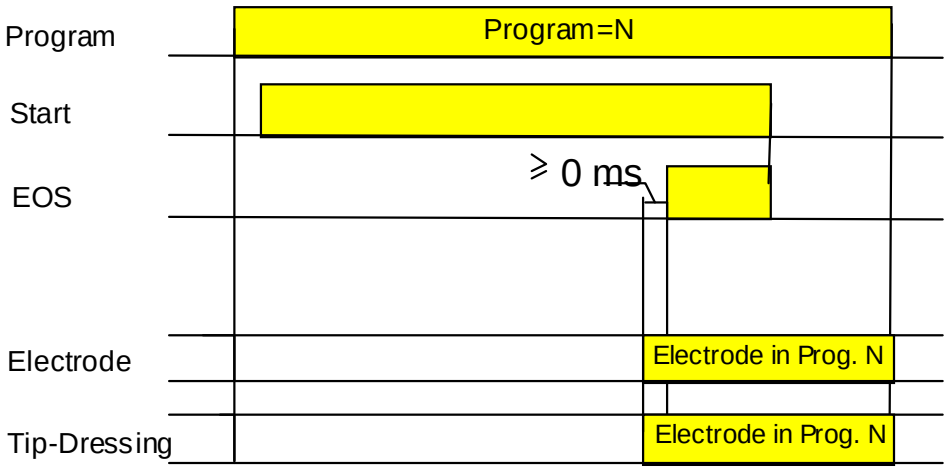
The following diagrams are a summary of all standard procedures needed to interface a SERRATRON 1B to a PLC or Robot.

Start & End of Sequence (EOS)

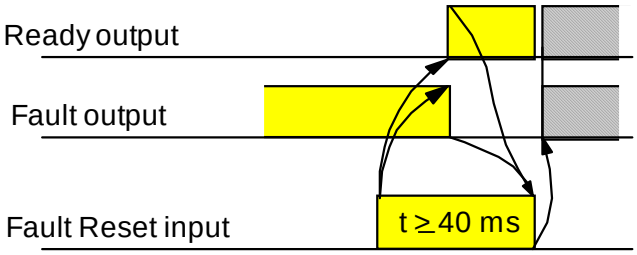


Program selection, EOS and Electrode status outputs

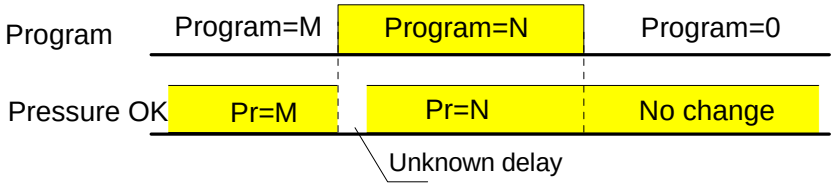


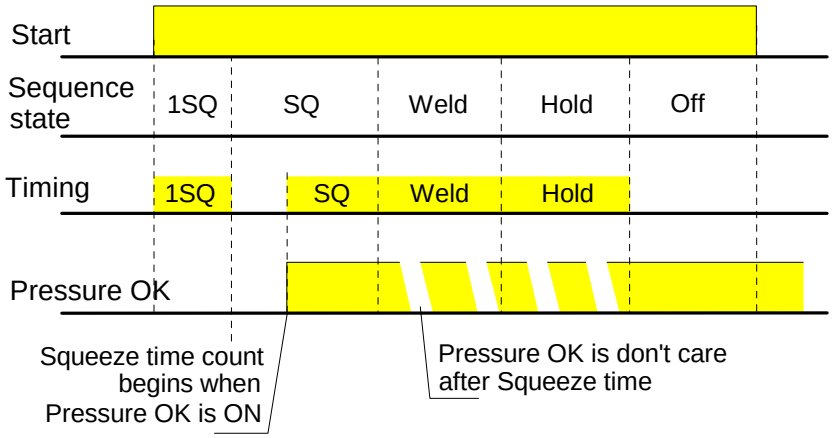


Fault Reset input, Ready (or Fault) output

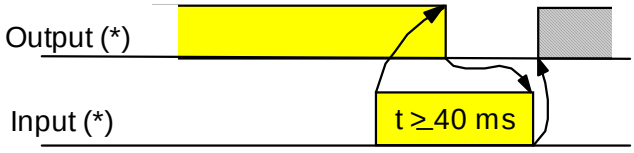


Sequence and Pressure OK input

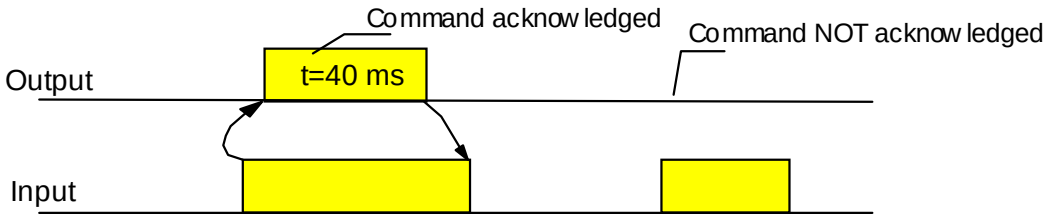




Counter Reset and Tip-dressing Acknowledge commands



(*) I/O pairs allowed:
Counter reset & End of Life
TD-Acknowledge & TD-Request



Replacing a SERRATRON 5006 welding timer

1) Cb1 Connector, pins 8 and 15: Connect a suitable 24 Vdc power supply. The negative pole (0 V) may be grounded to earth.
2) Check next table for compatibility around Cb2 connector pins.
3) Replacement not applicable if the Thyristor selection inputs are used.

Replacing a SERRATRON 7000 welding timer

1) Cb1 Connector, pins 8 and 15: Connect a suitable 24 Vdc power supply. The negative pole (0 V) may be grounded to earth.
2) Check next table for compatibility around Cb2 connector pins.
3) RS-485 serial channel not available in SERRATRON 1B.
4) The SV codes are only 5 and operate in a different way as in SERRATRON 1B / 5006

Cb2 variations with respect to old timers

Cb2	I/O	SERRATRON 1B	SERRATRON 5006	SERRATRON 7000
1	I	Thermostats in series (1)	Transformer thermostat	Transformer thermostat
21	I	Program 64	Transformer thermostat	Transformer thermostat
3	I	Counter Reset	Thyristor 1 selection	Counter Reset
22	I	Fault Reset	Thyristor 2 selection	Fault Reset
7	I	Sequence Reset / Retract Gun 2	Start 2	Start 2
26	I	Tip-Dressing Acknowledge	Back-step	Weld Time Enable
27	I	Weld Time Enable	Weld Time Enable	-
10	O	WTR(2) (O24(3)) / TD-Request	(-) WTR (PFop(4))	(-) WTR (PFop)
29	O	-	(+) WTR (PFop)	(+) WTR (PFop)
11	O	End of sequence (O24) / TD-Request	End of sequence (PFrc(5))	End of sequence (PFrc)
30	O	-	End of sequence (PFrc)	End of sequence (PFrc)
32	I	Program swapping / Program 4	-	-
14	I	Retract Gun / Retract Gun 1	-	-
15	O	Electrode alarm	-	-
35	O	SV4 / Retract Gun 2	SV4	Electrode alarm
17	-	+24V / 0.5A para VP	-	-
36	(O)	PV Regulation: 0-10V	-	-
18	-	PV electrostatic screen	-	-
37	-	PV Regulation: 0V	-	-
19	-	0V for PV	-	-

(1) The opposite side must be connected to +24 V
(2) WTR: Weld Time Enable Request
(3) O24: 24V 0,7 A output
(4) PFop: Free potential contact (polarized)
(5) PFrc: Free potential relay contact (without polarity).

●●●

Chapter 10
Modifications

Text modifications			
Date	**Version**	**Issue**	**Pages**
Dec. 2007	1.0	Initial version of this Manual	
Jan. 2008	1.0	Cb1 connector vs. Thyristor group type	9-1
July 2008	1.2	Ethernet operative	1-3, 7-21, 8-3
		Wearing curve number parameter removed (F-42)	5-5, 5-14, 7-7, 7-19
		I/O menu: SCR group status displayed	7-17
Dec. 2008	1.2	Error 38 removed (now managed by Errors 35 & 36)	8-2
May 2009 5th Ed.		Improved menus display format	

Correction of misprints	
Date	**Page**
July 2008	3-6, 4-1, 5-3, 5-6, 8-1, 8-2, 8-2, 8-3, 9-5
July 2008 2nd Ed.	4-3, 5-8, 8-1
Dec. 2008 3rd & 4th Ed.	2-2, 5-3, 8-1, 8-2
May 2009 5th Ed.	7-20

●●●