PSI 6XXX.350 L1
Technical Information

Edition 101

PSI 6000 Description of Timer and I/O Level

PSI 6XXX.350 L1
Technical Information

1070 080 067-101 (2001.03) GB

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Your notes:

Safety instructions and reader's information

Please read this documentation before working with the **W**eld **T**imer (WT) PSI 6XXX.350 L1 for the first time.

Store this manual in a place to which all users have access at all times!

The products described have been developed, manufactured, tested and documented in compliance with the fundamental safety requirements of the EU Machinery Directive.

Nevertheless, there is some residual risk!

The present manual describes the following functions:

- timer module PSI 6XXX.350 L1
- I/O level

Explanation of pictographs and symbols

The following warnings and notes may be attached to the individual hardware components which are designed to inform the user of certain circumstances.

Warning of dangerous electrical voltage!

Components sensitive to electrostatic discharge!

Disconnect from mains before opening!

Pin for connecting PE conductor only!

Connection of shield conductor only!

There is a certain **hierarchy of warnings** in **this manual**. The warnings are printed in **bold letters** and marked by a warning sign at the margin.

The hierarchy of the warnings is as follows:

1. WARNING
2. CAUTION
3. NOTE

WARNING!

The term **WARNING** will be used wherever **danger is imminent.**
The possible consequences may be death or severe injury (personal injury).

CAUTION!

The term **CAUTION** will be used wherever a **dangerous situation is possible.**
The possible consequences include death, severe or light injury (personal injury) damage to property (destruction of modules) or environmental hazards.
In any case, the failure to observe/comply with these instructions will result in the loss of guaranty.

NOTE

*The term **NOTE** will be used for making **recommendations on the use.** These sections contain additional information, recommendations, hints and tips.*
Non-compliance with these recommendations may result in damage to property, e.g. to the machine or the workpiece.

Typographic conventions

General listing	-	Example:	-	The message is displayed on the screen.
Action	●	Example:	●	Insert floppy
			●	Read value
Screen displays, messages, displays	*Italics*	Example:		*Battery-Low* *Tip dress request*
(Welding) parameters	[in brackets]	Example:		[Weld time], [Schedule].
Interface signals, keys, command fields.	**<key>**	Example:		Press **<F8>**
Inputs: Values, texts	CAPITAL LETTERS			

NOTE

Note concerning this manual: Black bars in the margin of a page indicate modifications compared to the previous edition.

Proper use

The present manual contains information on the proper use of the weld timer type PSI 6XXX.350 L1.

In connection with the intended power supply and the specified welding equipment, the weld timer type PSI 6XXX.350 L1

- **serves for resistance welding of metals**
- **is suitable for operation in industrial environments in accordance with DIN EN 50082-2 and DIN EN 50081-2 concerning electromagnetic compatibility (EMC).**

The timer is not intended for any other use!

CAUTION!

The use for purposes other than the intended use may result in personal damage to the user or third persons or damage to the equipment, the workpiece to be welded or environmental hazards.
Therefore, our products should only be used for their intended purpose!

Warning of magnetic fields

In the environment of resistance welding systems magnetic field strengths have to be expected which usually are below the limits specified in VDE 0848 Part 4; in cases of doubt, the field strength must be measured.
Dangers, if any, may arise from alternating magnetic fields (critical frequency: 1.6 Hz).

WARNING!

When using manual welding guns, the limit values may be exceeded for the extremities. In this case, additional work protection measures must be taken.
So far, no problems have been reported. Nevertheless, the possible influences are lower with medium-frequency welding than with AC welding.

NOTE

The strong magnetic fields arising in connection with resistance welding may cause lasting damages to wrist watches, pocket watches, or cards with magnetic stripes (e.g. EC cards).
Therefore, you should not carry any such items on you when working in the direct vicinity of the welding equipment.

Not permitted for persons with cardiac pacemakers

WARNING for persons with cardiac pacemakers!

Warning signs should be posted for protecting persons with cardiac pacemakers because the function of these devices may be disturbed (impulse failure, total failure) and a negative influence on the pacemaker programming or even a total program destruction may occur !!!

We recommend posting a warning of the type shown below at all entrances to factory halls containing resistance welding equipment:

No entry for persons with cardiac pacemakers!
Danger!

DIN 40023

Qualified personnel

This manual is designed for welding technicians and engineers with special training and specific knowledge of the welding technology.
They require profound knowledge of the

- weld timers (WT)
- MF inverters (PSI)
- welding transformers and/or welding rectifier-transformers (PSG)

The term qualified personnel refers to

- engineering personnel familiar with the safety standards of the electrical and automation technology.
- commissioning personnel entitled to commission, earth and label electrical circuits and equipment/systems in compliance with the standards of safety technology.
- operating personnel who have been instructed in operating installations in resistance welding technology and who know the contents of the present documentation as far as operation is concerned.

WARNING!

An exception are persons with cardiac pacemakers!
Due to the strong magnetic fields arising from resistance welding, the function of cardiac pacemakers may be disturbed. This may cause the death or considerable health damages to the persons concerned!
Therefore, these persons should avoid the welding system.

Please note our comprehensive range of training courses. More information is available from our **training center** (Phone: +49 (0)6062 / 78258).

Storage and Transport

NOTE

Please note the environmental conditions given in the Technical data section to avoid damages.
Static discharges may destroy components of the weld timer. Therefore, the original packaging should be used for storage and transport. The equipment must be protected against humidity.

NOTE

CDs and floppies must be protected against negative external influences of dust or moisture by suitable packaging. They must never be exposed to the influence of magnetic fields.

Installation and assembly

CAUTION!

- Please observe all applicable safety and accident prevention regulations! The recognized rules of electrical engineering must be observed!
- Danger of injury or of damage to property due to inappropriate fastening!
  The place of installation and the fastening method for the modules must be in compliance with our specifications!
- Danger of injury on sharp metal edges!
  Please wear protective gloves.
- Danger of damage to property through short-circuits!
  When drilling or sawing out openings within switch cabinets, metal burr may get inside modules that have already been installed. The possibility of short-circuits and a destruction of the units cannot be entirely ruled out.
  Therefore, the modules should be well partitioned prior to any additional work! No liability is accepted in the event of non-compliance.
- Danger of life and of damage to property through insufficient protection type!
  The protection type of the PSI 6XXX.350 L1 modules is IP 20. The modules shall be installed together with a power supply as a single unit in a housing with a sufficient degree of protection (at least IP54).
- Danger of injury and of damage to property through incorrect installation!
  The weld timer, and especially the operating elements, must be installed so as to be sufficiently protected against unintentional operation or contact.
- Danger of injury and of damage to property when operating the units outside a switch cabinet!
  The units are designed to be installed in housings or switch cabinets and may only be operated in such housings or cabinets with the door closed!
- Danger of damages through static discharge!
  Elements or components of the weld timer may be damaged by static discharge. Do not touch any components or printed circuits with your hands. Installing and configuring the system is reserved to qualified personnel.

NOTE

Connecting lines and signal lines must be laid so as to avoid negative effects on the function of the units through capacitive or inductive interference and in compliance with the requirements on electromagnetic compatibility (EMC), cf. also section 7 as well as general information contained in the Bosch EMC manual for resistance welding components.

Electrical connection

The PSI 6XXX.350 L1 are supplied with 24 V DC. This power supply must provide safety separation in accordance with the Low-Voltage Directive (72/23/EEC, 93/68/EEC and 93/44/EEC).

WARNING!

- Considerable dangers are associated with the mains connection of the power unit!

- The possible consequences of inappropriate handling include death, severe bodily injury and damage to property.
- Therefore, the electrical connection may only be made by a skilled electrician who observes the valid safety regulations, the mains voltage and the maximum current consumption of the modules.
- The mains voltage must be identical with the nominal voltage indicated on the nameplate of the product!
- The mains system must be appropriately fused!
- Danger of life through electrical voltage!
- Suitable protective measures in accordance with DIN EN 50063 or DIN VDE 0545, Part 1 must be installed (e.g. by grounding the welding gun) on the welding hardware!

Operation

WARNING!

During operation of the welding equipment welding splashes are to be expected! The consequence may be injuries to the eyes or burns.
Therefore:

- wear protective goggles
- wear protective gloves
- wear flame-retardant clothes

Danger of injury at sheet metal edges and danger of getting burnt at the parts to be welded!
Therefore:

- wear protective gloves

CAUTION!

- Danger of injury and of damage to property when operating the units outside a switch cabinet or for purposes other than the intended use!
  The units are designed to be installed in housings or switch cabinets and may only be operated in such housings or cabinets with the door closed. The recognized rules of electrical engineering must be observed.
- Danger of injury and of damage to property through missing or false interpretation of fault messages!
- Danger of bruises through electrode movement!
  All users, line designers, welding machine manufacturers and welding gun producers are obliged to connect the output signal of the Bosch weld timer which initiates the electrode movement so that the applicable safety regulations are complied with.
  The risk of accidents can be considerably reduced by means of, e.g.,
  - two-handed start
  - fences
  - light barriers etc.
- Systems without **<Monitor contact>** MC
  (not available in all weld timers)
  If **<Monitor contact>** MC is connected to +24 VDC, the [squeeze times] must be selected long enough to permit optimal contact of the part to be welded prior to the [weld time]. If the [squeeze times] are too short, the electrodes close during [weld time]. This will cause strong welding splashes, resulting in damages to the electrodes and the part to be welded!

- Simulate start
  In remote-controlled systems, program execution may begin which may result in dangerous machine movements. Therefore, before remote starting, it must be ensured that nobody is in the dangerous area of the welding machine!

CAUTION!

Damage to property through excessive welding current!
The maximum welding current of the welding hardware used must not be exceeded. No liability is accepted in the event of non-compliance.

Retrofits and modifications by the user

The PSI 6XXX.350 L1 has been designed and manufactured by us as a safe unit.

WARNING!

Retrofits or modifications may have negative effects on the safety of the unit!
The possible consequences include death, severe or light bodily injury (personal injury), damage to property or environmental hazards.
Therefore, please contact us prior to retrofits or modifications to the PSI 6XXX.350 L1 using third-party equipment. This is the only way to determine whether these parts are suitable for use with our product.

Maintenance and repair

WARNING!

- Danger of life through electrical voltage of power units!
  Prior to any maintenance work - unless described otherwise - the system must always be switched off! In the event of necessary measurement or test procedures on the active system, the applicable safety and accident prevention regulations must be strictly observed. In any case, suitable insulated tools must be used!
- Danger of life through inappropriate EMERGENCY-STOP facilities!
  EMERGENCY-STOP facilities must be operative in all modes of the system. Releasing the EMERGENCY-STOP facility must by no means result in an uncontrolled restart of the system!
- Danger of explosion of batteries!
  Do not forcefully open batteries, do not attempt to charge, solder or incinerate the battery.
  Empty batteries should always be replaced by new ones!

CAUTION!

- The right to perform repair/maintenance work on the PSI 6XXX.350 L1 components is reserved to the Bosch service department or to repair/maintenance units authorized by Bosch!
- Only use spare parts/replacement parts approved by Bosch!
- The applicable regulations on the disposal of empty batteries or accumulators must be observed.

Your notes:

1 System

1.1 General

Welding **T**imers (WT) of the PSI 6XXX.350 L1 series are suitable for spot, projection and roller seam welding, as well as for other welding processes.

The welding system consists of

- Welding hardware (welding gun, robot or multi point ...)
- Timer module PSI 6XXX.350 L1
- MF inverter PSI
- welding tansformer
- A programming terminal with BOS-5000 software for data entry, operation and monitoring

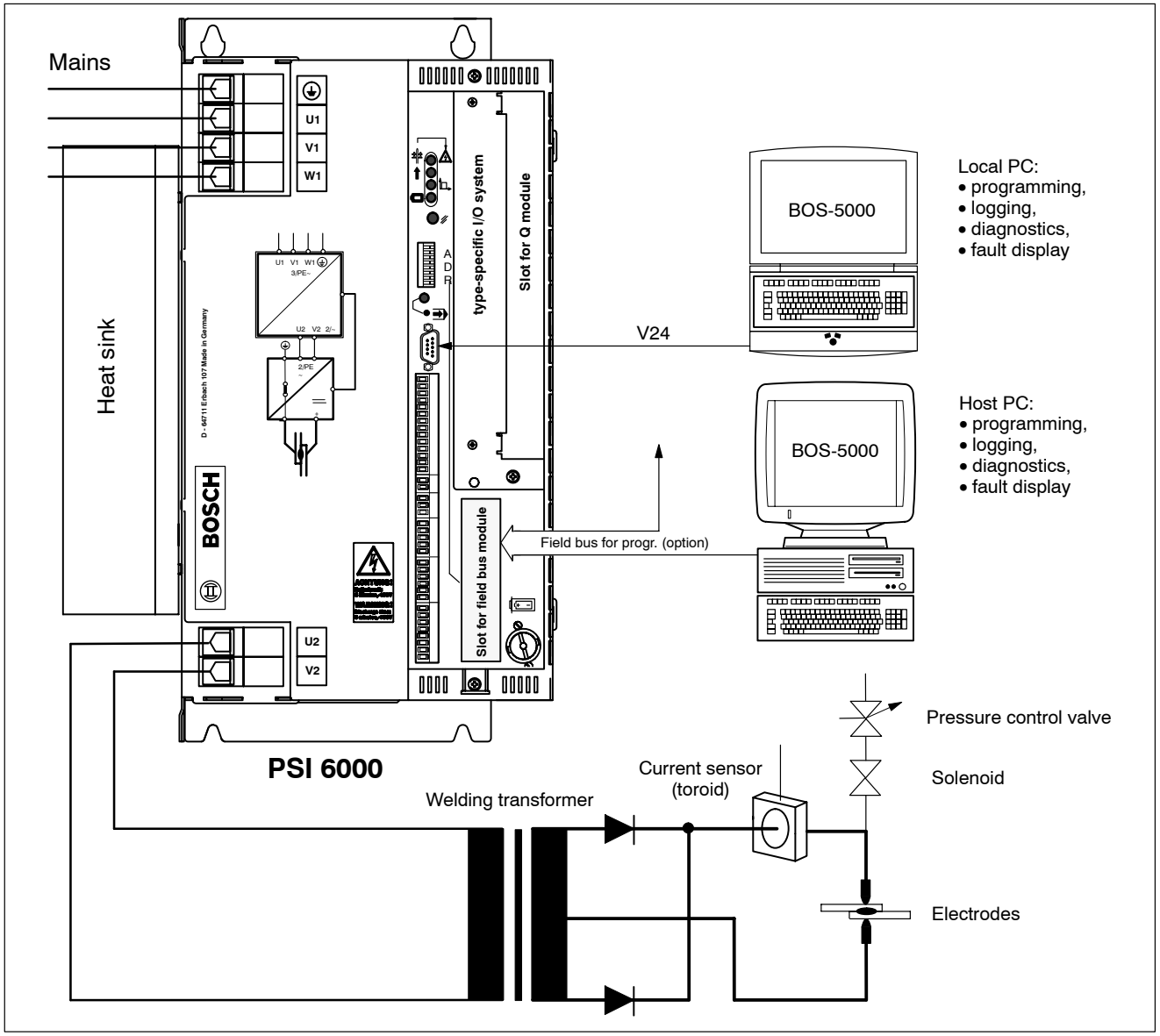

Figure 1: Welding system

Up to 256 welding programs can be programmed and called up. Single spot (SING), repeat mode (REPT) or seam operation can be selected.
The welding parameters are stored in a RAM memory. The RAM memory has battery backup to prevent loss of data. The condition of the battery and the data is being monitored.

The PSI 6XXX.350 L1 is an open system timer. You can select control functions from a variety of selections by entering or modifying the *Basic Setup* or the *Welding Parameters*.

You can configure your control by selecting various *Basic Setup* options and *Programming* the *Welding Parameters*.

This means for you:

- You need to set the parameters of a timer type only once and can
- transfer these parameter settings to all your timers.

Functional principle

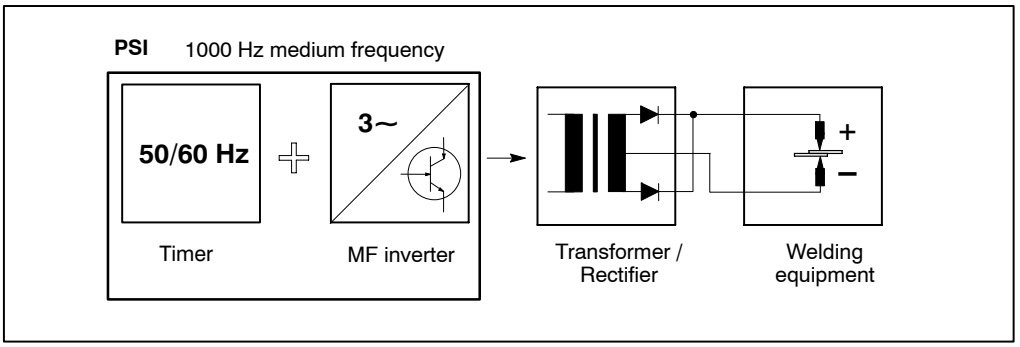

Figure 2: Basic functional diagram

Welding current

The Bosch medium-frequency welding system uses DC current for welding. The duration of the welding current is programmed in milliseconds (ms). Because welds turn out to be more uniform than at 50 Hz, a higher output of correct welds is obtained.

The medium-frequency welding current is clocked at 1000 Hz. The constant-current regulation system is faster and more precise compared to 50 Hz welding.

Upon delivery, the PSI 6XXX.350L1 is set to primary current monitoring.

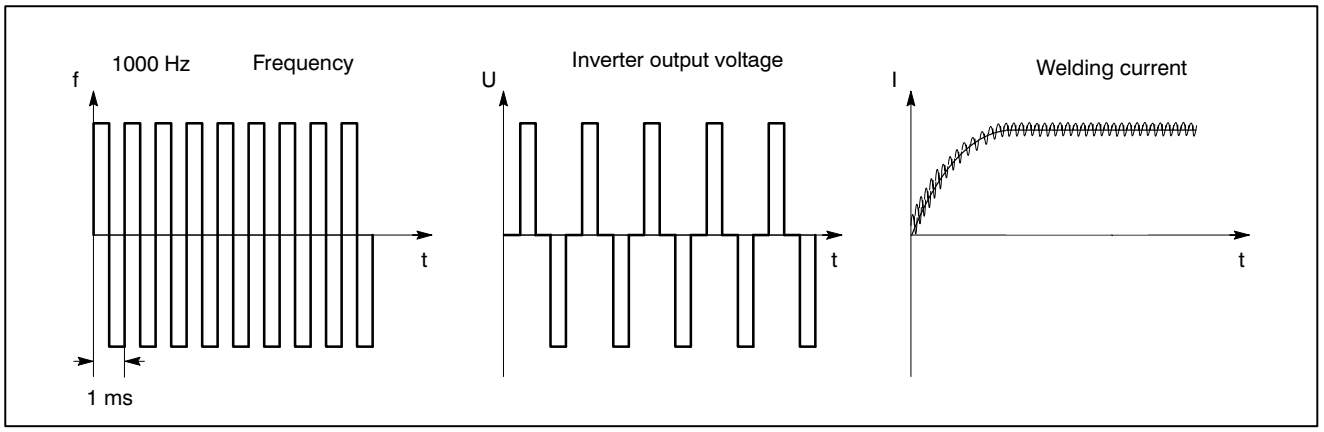

Figure 3: 1000 Hz welding

1.2 Programming and operating the timer

The following components are required for *Operation* and *Programming* of the timer:

- Programming terminal with one of the following operating systems:
  - Windows 3.1x
  - Windows 95
  - Windows 98
  - Windows NT3.x / NT4.0
- Software BOS-5000
- Technical documentation:
  - Operating and programming instructions, volume 1, part no. 1070 078 217
  - Operating and programming instructions, volume 2, part no. 1070 078 218
- V24 interface cable, see section 7.1.1, suitable installation for field bus interfaces.

2 Technical data

2.1 Welding timer

Degree of protection	IP20 when installed in power unit
Operating voltage	+24 VDC (min. 19VDC, max. 30VDC i.a.w. EN61131-2) optional internal supply or external supply to logic
Rated current (w/o I/Os) at 24V	approx. 1.5 A
Making current	approx. 2 A for 10 ms
Switchgear cubicle basic power dissipation	approx. 70 W
Environmental conditions - Operation - Storage - Transport - Air pressure - Humidity	 0 °C to +55 °C -25 °C . . . . to +70 °C -25 °C . . . . to +70 °C 0 to 2000 m above sea level No dew point excursion allowed
Number of programs	256, access to each individually from spot selection
Load cell input	Analog input, 0 to 5V (1V equivalent to 1 kN)
Load cell reset output	+24VDC
I/O bus	INTERBUS-S (optical waveguide)
Field bus for programming	in combination with I/O bus
Proportional control valve	8 bits, equivalent to 0 through 10 bar
Programming with BOS-5000 via laptop computer, Bosch BT operating terminal or INTERBUS-S interface	via internal V24 / RS232 interface, isolated Connection: 9-pin Cannon connector
Operational software	in flash memory, can be loaded through V24/RS232 or field bus
Program memory	RAM memory (battery-buffered)

Backup battery	Lithium battery Typ AA/S to buffer RAM data and internal clock during power loss. Battery life approx. 2 years.
Current sensor input	for toroid coils for secondary current measurement
Stop function (stop circuit)	via floating contact, stops schedule
Fan connection	+24VDC

2.2 Power unit

Overview of technical data of power unit

	PSI 6XXX.350 L1
System voltage	400 V -20 % to 480 V +10 % 3-phase
System frequency	50 / 60 Hz
Clock frequency	1000 Hz
DC link voltage	550 V DC to 680 V DC (nominal voltage)
Overvoltage protection	MOV
Temperature monitoring	heat sink
Cooling	air, max. 45 °C
Nominal current (system side) (max. thermal continuous current)	depending on type of power unit
Switching current	see load diagram in power unit description
Mains connection	U1, V1, W1, potential earth frame terminals conductor area depending on type of power unit
Transformer connection	U2, V2 frame terminals conductor area depending on type of power unit

Your notes:

3 Hardware

3.1 Structure

The PSI 6XXX.350 L1 comprises the following functional units:

- CPU with centralized control function
- I/O interfaces
  - serial I/O interface (INTERBUS-S), optical waveguide
- Quality module (slot prepared for subsequent retrofit)

All settings required for operation can be made on the front panel or from a connected programming terminal.

3.2 Module front panel without type-specific I/O system

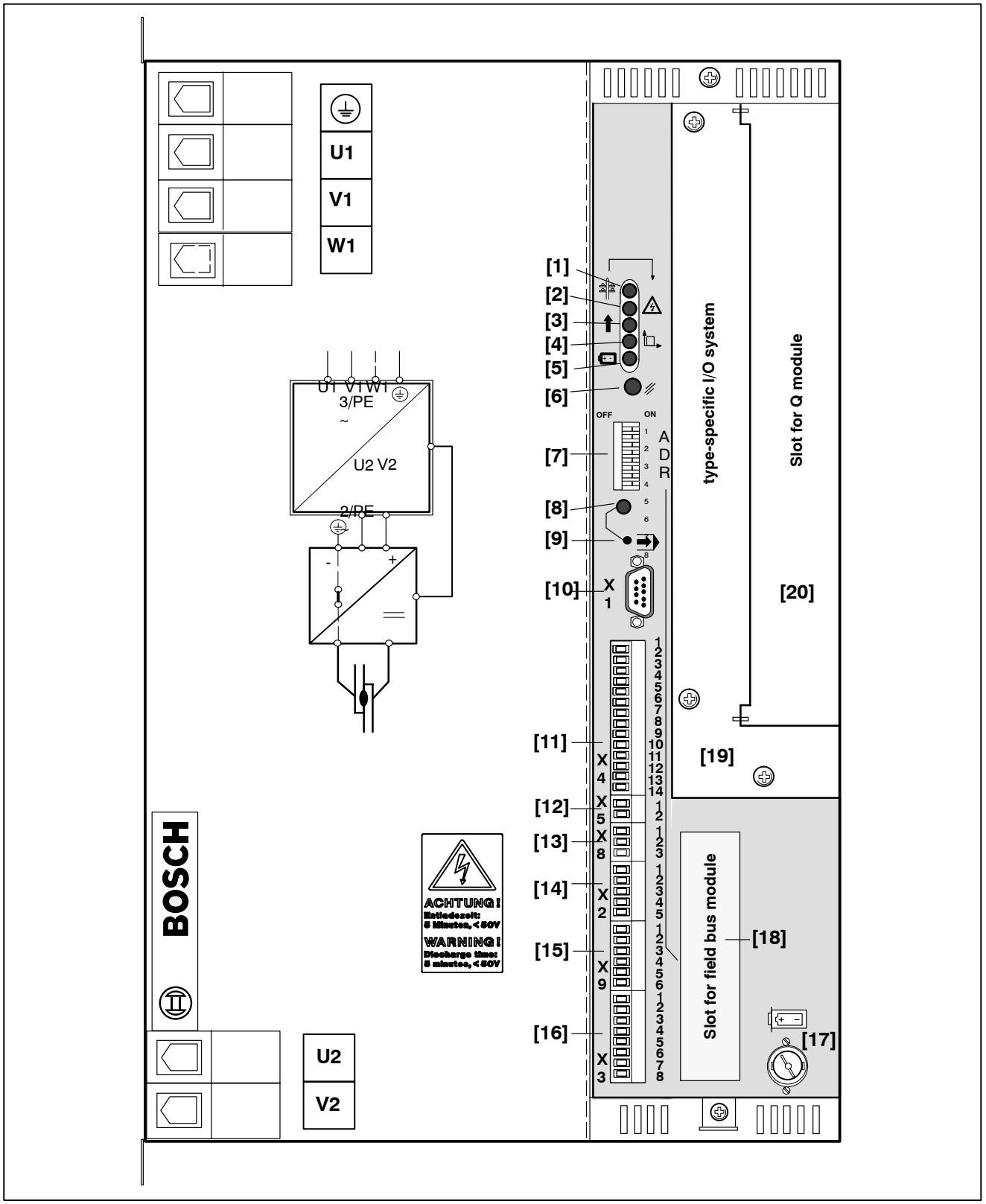

Figure 4: Front panel

[1] LED green, logics supply is ON.

[2] LED red, mains voltage and logics supply are ON.

[3] Ready LED
Timer ready goes out if
- an internal fault occurs, e.g. ”Battery low”, or
- a sequence fault occurs, e.g. ”No current”.

[4] Firing LED, Control signal for thyristor unit active

[5] Battery fault LED, backup battery voltage too low

[6] Reset push button, clears pending fault messages, returns timer to ready state.

[7] DIL switch, to set up address of field bus interface (no function with INTERBUS PMS).

[8] LED red, operating mode timer processor:
- On : timer stopped processing commands
  timer is in boot mode.
- Off : timer is in operating mode.

[9] Recessed key, switching from operating mode to boot mode.

- Pressing this key turns the system to boot mode.

You should only turn to boot mode for loading a new operating program (firmware).

CAUTION!

This key may only be operated by authorized personnel.
Never operate this key during a welding operation.
Program execution will be stopped and all control outputs set to zero.

[10] 9-pin D shell plug, V24 interface (programming terminal).

[11] 14-pin plug-in terminal - power supply:
- +24 V supply
  - external
  - standby
- stop circuit
- +24 V supply I/O

[12] 2-pin plug-in terminal for power supply of external device.

[13] 3-pin plug-in terminal (no function).

[14] 5-pin plug-in terminal analog pressure output, voltage from 0 V to +10 VDC, max. 20 mA (drives pressure regulating valve).

[15] 6-pin plug-in terminal: load cell
-/Operate, 24VDC Reset signal ≥ +2V
zero voltage, voltage supply of load cell
0 V through 5 V analog signal, load cell, 1 V equivalent to 1 kN
zero voltage, ext. signal GND

[16] 8-pin plug-in terminal for measuring system, connection for current sensor (toroid).

[17] Battery compartment; use only batteries with Bosch P/N 1070 914 446.

[18] Blanking plate on slot for field bus module.

[19] Elements of type-specific I/O system.

[20] Blanking plate on slot for retrofitting a quality module.

3.3 Module front panel type-specific I/Os

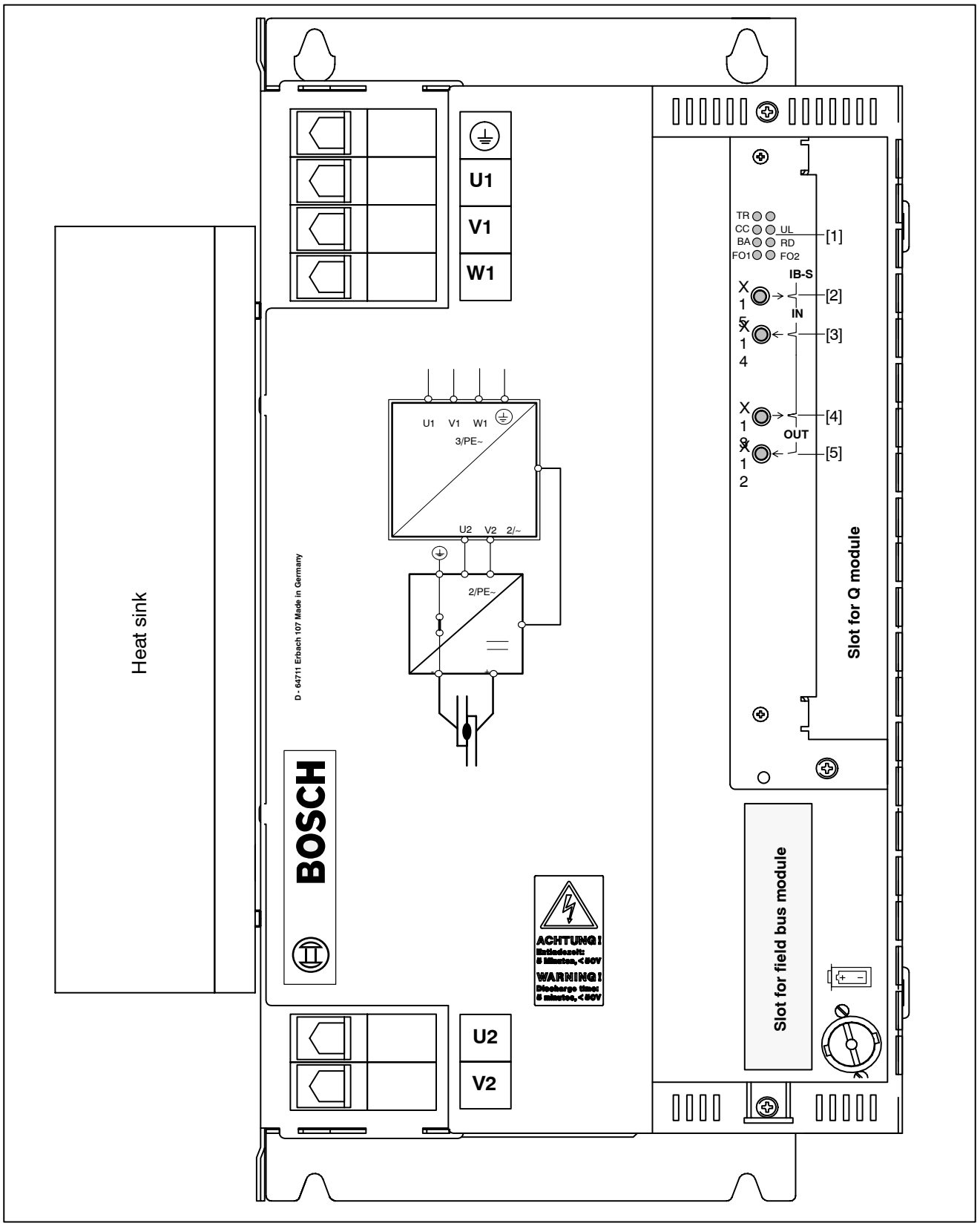

Figure 5: Type-specific I/Os

[1] Diagnostics messages of INTERBUS-S:

- TR
  Transmit/Receive, shows PCP communication.
- CC
  Cable Check, the green LED indicates that the optical waveguide is properly connected to the input. When the INTERBUS-S master module is reset, the LED goes off.
- BA
  Bus Active, the green LED indicates that INTERBUS-S data transmission is active.
- FO1
  Message “F01 IN Interface o.k.” Yellow LED.
- UL
  Unit Supply, the green LED indicates that the supply voltage is available at the bus drop.
- RD
  Remote Disable, the red LED indicates that the downstream optical waveguide has been switched off.
- FO2
  Message “F02 OUT Interface o.k.” Yellow LED.

[2] Connection of optical waveguide IB-S-IN
(output from timer)

[3] Connection of optical waveguide IB-S-IN
(input to timer)

[4] Connection of optical waveguide IB-S-OUT
(output from timer)

[5] Connection of optical waveguide IB-S-OUT
(input to timer)

4 Installation

CAUTION!

- Danger of life and of damage to property through insufficient protection class!
  The protection class of the CPU and the I/O modules of the PSI 6XXX.350 L1 is IP 20. The modules must be installed in a suitable housing.
- Danger of injury and of damage to property through incorrect installation!
  The units, and especially the operating elements, must be installed so as to be sufficiently protected against unintentional operation or contact.
- Danger of injury or of damage to property due to inappropriate fastening!
  The place for installing the modules, and their method of fastening, must be suitable for their weight!
- Danger of damage to property through short-circuits!
  When drilling or sawing out openings within switch cabinets, metal burr may get inside modules that have already been installed. It is also possible that water may emerge during the installation of the cooling water lines and may enter the modules.
  The possibility of short-circuits and a destruction of the units cannot be entirely ruled out.
  Therefore, the modules should be well partitioned prior to any additional work! No liability is accepted in the event of non-compliance.

NOTE

- Connecting lines and signal lines must be laid so as to avoid negative effects on the function of the units through capacitive or inductive interference!
- Optical waveguides must be laid in accordance with INTERBUS-S specifications (bending radiuses, fixing instructions, etc.).
- Interference is frequently coupled and de-coupled in long cables. Therefore, inverter cables and control cables must be routed separately. The influence of interfering cables on cables susceptible to interference can be minimized by keeping the following distances:
- > 100 mm with parallel connection of cables < 10 m
- > 250 mm with parallel connection of cables > 10 m.

Your notes:

5 Cables

Cables and cable lengths.

Interface	Cable	Cross section/max. length
X1, (V 24) - programming terminal - welding current meter for scaling	shielded cable	min. 0.2 mm^2 up to 20 m e.g. 3 x 2 x 0.2 mm^2 LifYCY (Metrofunk) capacitance max. 2.5 nF
X3, current sensor	shielded cable	0.75 mm^2 up to 100 m 2 x 2 x 0.75 mm^2 LiYCY corresponding to Bosch part number 1070 913 494
X4, power supply	unshielded cable, VDE 0281, 0812 z. B. Ölflex	0.75 mm^2 up to 10 m 1.5 mm^2 up to 75 m
X5, load cell X9, load cell	shielded cable,	min. 0.2 mm^2 e.g. 3x2x0.2 mm^2 LifYCY Metrofunk
X12/X13, IBS-OUT	optical waveguide IAW INTERBUS-S specification	IAW INTERBUS-S specification
X14/X15, IBS-IN	optical waveguide IAW INTERBUS-S specification	IAW INTERBUS-S specification

Your notes:

6 Suppression of RF noise

Means of noise suppression are required to prevent radiation of radio frequency noise. Such noise is caused by transients peaks, which are transmitted by the power supply line.

Noise should be neutralized at the source. If this is not practical, the noise suppression devices must be placed as close as possible to the source.

All inductive devices such as valves, solenoids and other switching elements (or their connecting wires), which are situated in the vicinity of the timer require noise suppression.

Because of inherent vibrations of the machine, the mounting of all noise suppression devices must be resistant to fracture.

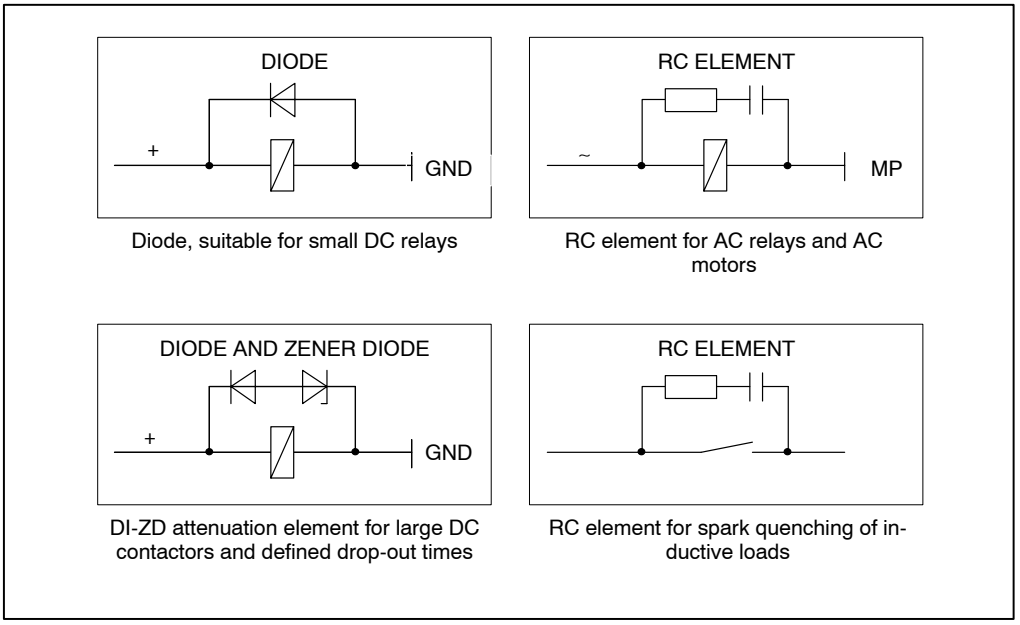

Figure 6: Examples of noise suppression

Voltage	Resistor	Capacitor	Diode
24 VDC	-	-	1 N 5060/ZL 12
48 VDC	-	-	1 N 5060/ZL 22
110 VAC	220 Ω/1 W	0.5 µF 400/600 V	
220 VAC	220 Ω/5 W	0.1 µF 500 V	
440 VAC	220 Ω/5 W	0.1 µF 1000 V	

This table serves only as an example. The actual component values depend on the specific load conditions.

Your notes:

7 Electrical connection

In this section, you will find a description of the CPU ports and various connection options for power supply.

WARNING!

- Working with system voltage may result in death, severe bodily injury or considerable damage to property unless the appropriate precautionary measures are taken.
  Therefore, you should carefully read the safety instructions at the beginning of this manual where you will find a description of a number of features to be strictly observed! The system voltage is associated with considerable dangers!

- The possible consequences of inappropriate handling include death or most severe injuries (personal injuries) and damage to property.
  For this reason, the electrical connection must always be made by an electrical expert in compliance with the valid safety regulations.
  The equipment must be appropriately fused at the mains side!
- Danger of life through electrical voltage!
  When working at the mains system or making connections involving the welding plant it must be ensured that the inverter has been safely isolated from the supply for at least 5 minutes (capacitor discharge time).
- Suitable insulated tools must be used for all electrical connection work!

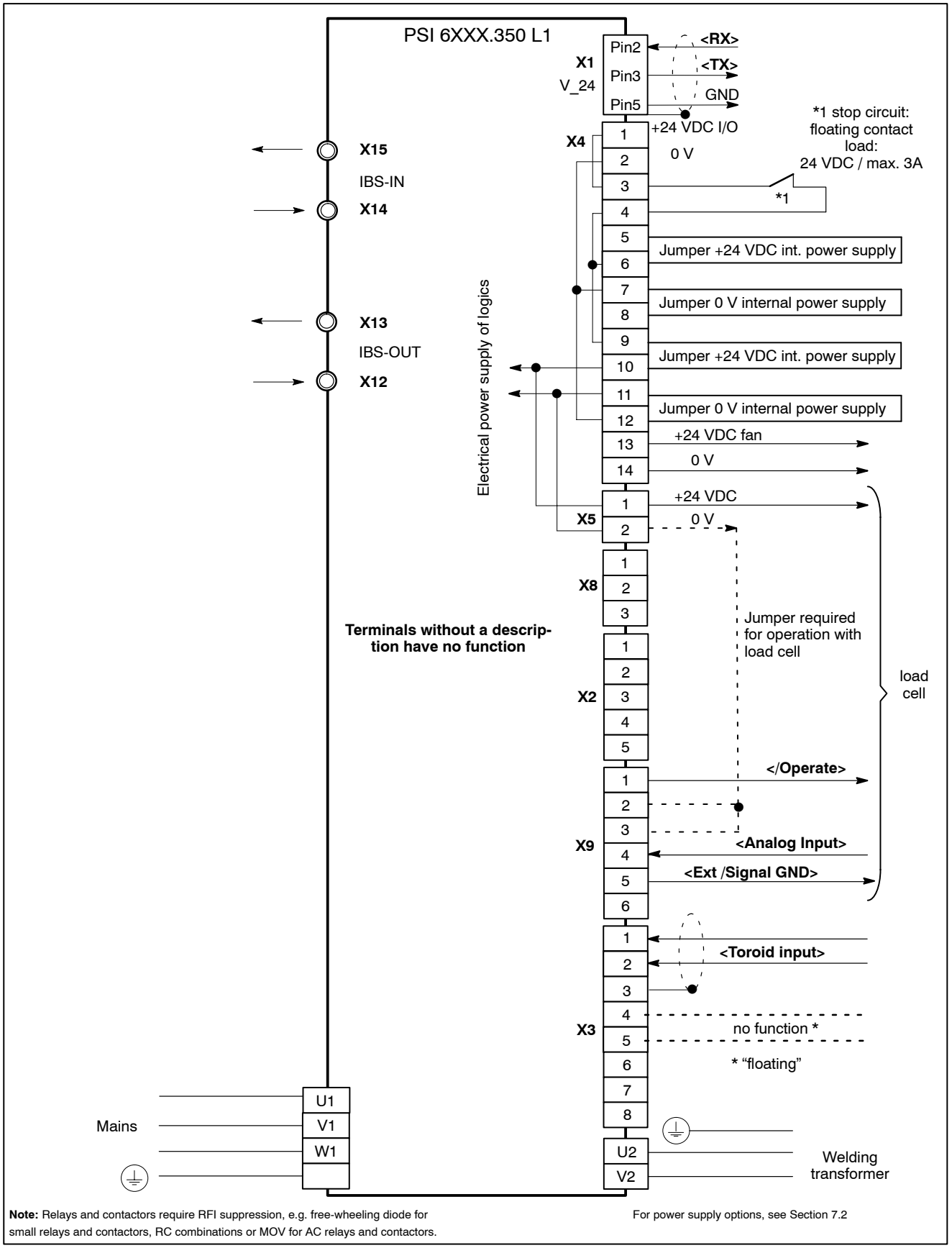

Figure 7: Connection diagram

7.1 Interfaces

7.1.1 X1 V24 interface with programming terminal or welding current meter for current scaling.

For the cable type and the maximum cable length, please refer to the cable table, Section 5.

Both ends of the shield conductor must be connected to the conductive connector shell. The connector should be screwed to the unit to improve the shielding efficiency.

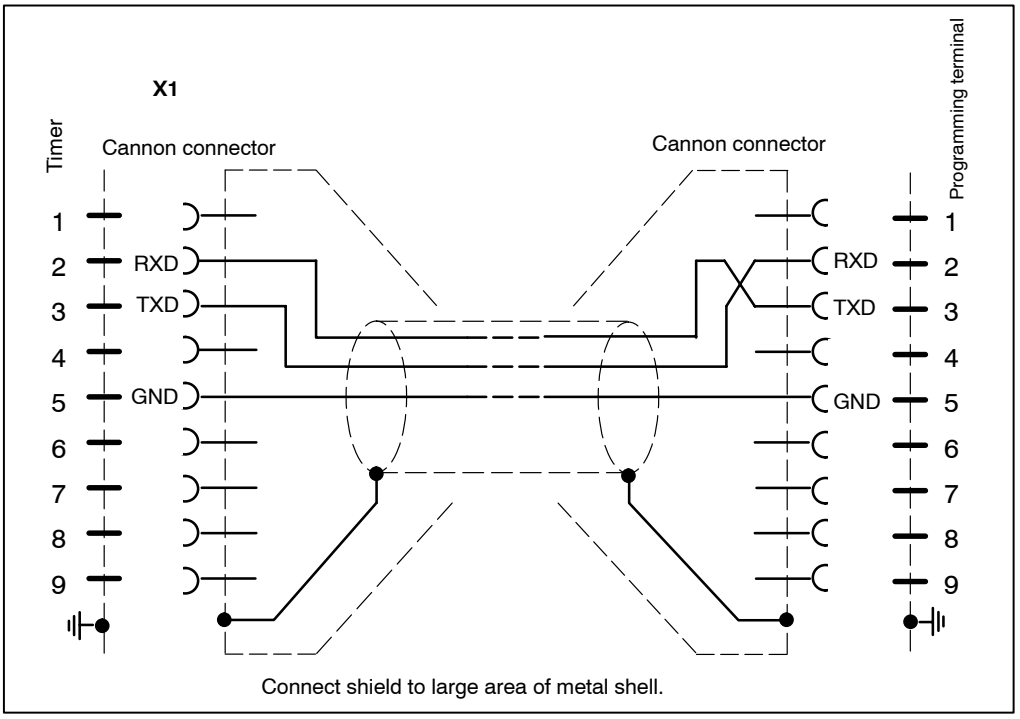

Figure 8: Connection of the V24/RS232 interface

7.1.2 Current sensor X3 (Toroid) for current scaling

For cable type and maximum cable length, please refer to the cable table, Section 5.

The KSR sensor (weld current sensor) must be installed in the monitoring device.

As the actual installation is concerned, remember that improper placement of the KSR sensor may lead to measuring faults.

In order to keep these faults as small as possible, the following cautions must be observed:

- The current carrying conductors must be run through the KSR sensor as straight and as centrally oriented as possible. The sensor should be mounted as far away from current carrying bus bars and high current carrying conductors as possible in order to prevent noise effects of external fields.
- No metal parts that can be magnetized should be used to mount the KSR sensor. Copper and brass are to be preferred.
- To be able to assess possible measuring fault, calibration measurements (scalings) should be made in each case, using a suitable welding current meter.
- The maximum cable length between the KSR sensor and the PSI 6XXX.350 L1 is 100 meters. This limit must not be exceeded.
- The connection between the KSR sensor and the PSI 6XXX.350 L1 consists of a shielded cable. The shield must be connected to X3/3 of the PSI 6XXX.350 L1. The shield at the sensor end is left unconnected.

The KSR cable value (ohmic resistance of KSR sensor, cable and connector) can be measured by a measuring circuit test during the last half-wave of [SQZ] (*Basic Setup - Sequence Setup* in the BOS-5000).

The measuring circuit test is evaluated for the following events:

- ohmic resistance less than 7 Ω = *Measuring circuit shorted*,
- ohmic resistance between 12 and 950 Ω = *Measuring circuit o.k.*,
- ohmic resistance higher than 1100 Ω = *Measuring circuit open*.

Measuring circuit values in the intermediate ranges lead to an ambiguous evaluation of the measurement.

In the use of KSR sensors with robots or similar devices, certain cable segments are subject to severe mechanical stress. This must be kept in mind when selecting the cables and the design of the cable connection.

7.1.3 Power supply X4

see Section 7.2.

7.1.4 X5 and X9 load cell

- +24 V DC supply voltage for feeding the load cell
- /Operate (reset signal) required before measuring event, ≥ +2 Volt
- analog ram force input signal, calibrated, 1 V being equivalent to 1 kN
- shielding

7.1.5 INTERBUS-S interfaces X12, X13, X14, X15

Signal communication of

- I/O signals, see Section 7.3
- programming data

7.1.6 Stop circuit

A fault in the stop circuit or the 24VDC power supply is automatically reset when corrected.

7.1.7 DC link voltage

The DC link voltage is permanently monitored. A fault in the DC link voltage is automatically reset when it has been corrected.

Your notes:

7.2 Power supply

7.2.1 Internal power supply

Configuration A

The power supply to PSI 6XXX.350 L1 is completely provided by the power unit (internal supply).

PSI 6XXX.350 L1 is internally supplied with 24 V DC (derived from the mains voltage). Several jumpers have to be positioned to enable the internal power supply.

- When the welding network is switched off, the 24 V DC supply is interrupted:
  - no communication via I/O interfaces possible
  - no communication between the timer and the programming terminal, e.g. programming and visualization.
- Preferably used with stand-alone systems, e.g. suspended welding stations.
- The **Stop function** is ensured by means of a **floating contact** which is to be connected to terminals X4/3 and X4/4.

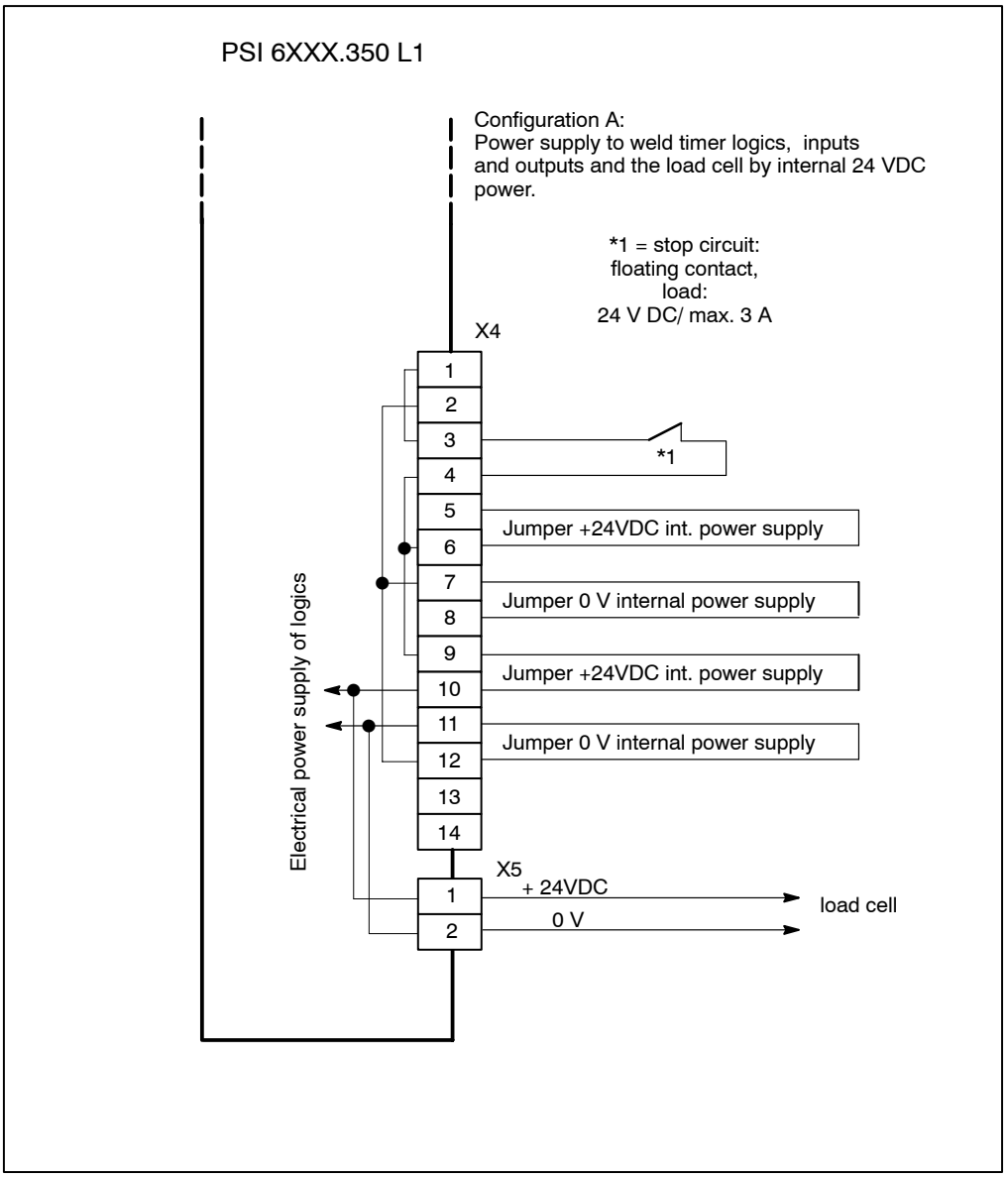

Figure 9: Internal power supply

7.2.2 External power supply

Configuration B

The power supply to PSI 6XXX.350 L1 is provided by an external unit (external supply). Several jumpers have to be positioned to enable the external power supply.

The power supply to the timer is thus independent of the welding network.

For configuration B, the external power supply must satisfy the following requirements:

- Maximum ripple <5 %, tolerance -15 % / +20 %.
  - Making current: approx. 2.0 A, duration approx. 10 ms, plus the current of the load cell connected to X5.
  - continuous current: approx. 1.5 A, plus the current of the inputs and outputs and the current of the load cell connected to X5.

NOTE

For determining the power supply rating, sum up the individual loads required.

Functions:

- No interfaces are interrupted when the welding network is switched off:
  - communication via I/O interfaces is possible
  - communication between the timer and the programming terminal, e.g. programming and visualization is possible.
- Preferably used in networked systems
  - only one non-floating 24 V DC supply for the entire system
- The **Stop function** is ensured by means of a **floating contact** which is to be connected to terminals X4/3 and X4/4.

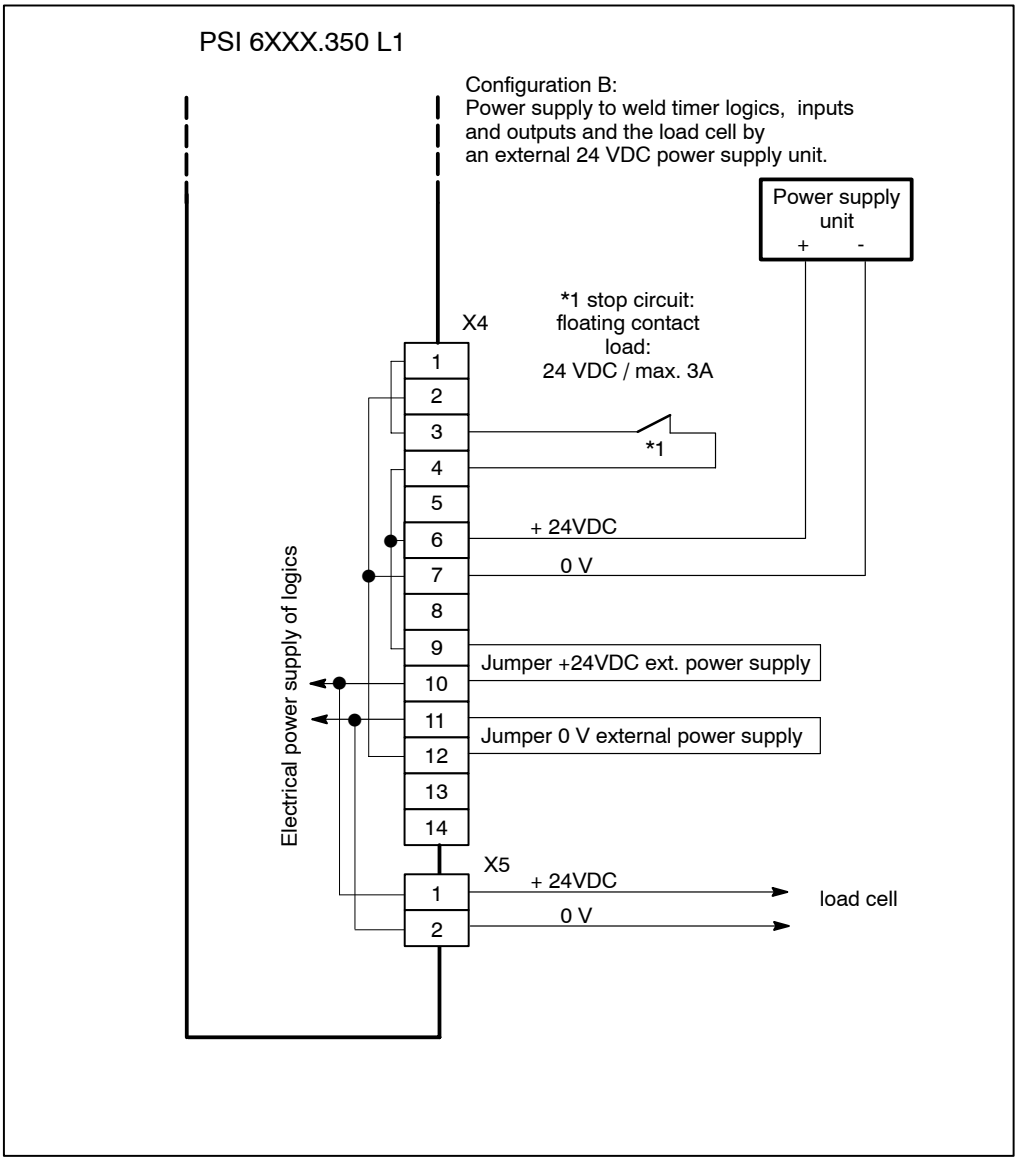

Figure 10: External power supply

7.3 I/O functions

NOTE

Electromagnetically activated switching and positioning devices require noise suppression (see section 6).

The selection of cables and the cable lengths are subject to the ”Cables” table in section 5.

The timer has an INTERBUS interface for I/O signal and programming data communication via the very same bus system (IB-S and PCP). Optical waveguides are used as transmission media.

The INTERBUS-S port of the timer operates according to profile specification C0 with specific enhancements.

Inputs

All inputs are served by the INTERBUS-S interface.

Outputs

All outputs are served by the INTERBUS-S interface.

7.3.1 Serial inputs

The inputs are driven via the serial INTERBUS-S interface. Its configuration is as follows

Bit	Serial input/output field via INTERBUS-S
0	**<Start_1>**
1	**<Tip dressed>**
2	**<Request electrode condition >**
3	**<Acknowledge Tip change>**
4	**<Reset fault>**
5	**<Fault reset with weld complete>**
6	**<Fault reset with Reweld>**
7	**<External Weld ON>** (with welding current)
8	**<Current Scaling>**
9	**<Current Scaling, Primary>**
10	**<Reduced current scaling>**
11	**<Current check>**
12	**<Pressure calibration>**
13	**<Pressure check>**
14	**<not used>**
	to
23	**<not used>**
24	**<Type ID (bit 0)>**
	to
27	**<Type ID (bit 3)>**
28	**<Spot selection (bit 0)>**
	to
47	**<Spot selection (bit 19)>**

Example of inputs (applies correspondingly to outputs)

Word	Low byte	High byte
0	I07 ... I00	I15 ... I08
1	I23 ... I16	I31 ... I24
2	I39 ... I32	I47 ... I40

< Series designation, 0 through 15, and spot number, 0 through 1048576 >

To select a welding program from the robotic control, use **<Series designation and spot number>**. By programming the BOS-5000, each spot number has been assigned a program number (0 through 255) and an electrode number (0 through 31).

<Series> range of values: 0 through 15 (4-bit selection: 0 through hex F)

<Spot number> range of values: 0 through 1048576 (20-bit selection: 0 through hex FFFFF)

<Program number> range of values: 0 through 255

The **<Spot selection>** function basically has three different effects:

- When **<Start_1>** becomes active in connection with the specified **<Spot selection>**, the welding program (0 through 255) assigned to the selected spot starts to weld this spot.
- When - in connection with the specified **<Spot selection>** (now electrode no. 0 through 31 assigned by the least significant bits of **<Spot selection>**) -
  - the **<Tip dressed>** signal becomes active, this will have an effect on the wear and tipdress counters of either all electrodes (if **<Spot selection>** = 0) or just one specific electrode (if **<Spot selection>** = electrode no. 1 through 31). The wear counters will be reset and the tip dress counters will be incremented by 1.
  - the **<Acknowledge Tip change>** signal becomes active, this will have an effect on the wear and tip dress counters of either all electrodes (if **<Spot selection>** = 0) or just one specific electrode (if **<Spot selection>** = electrode no. 1 through 31). The wear and tip dress counters will be reset to 0.
- When the **<Request electrode condition>** signal becomes active in connection with the specified **<Spot selection>** (now electrode no. 0 through 31 assigned by the least significant bits of **<Spot selection>**), the **<Initial (Start) tipdress request>**, **<Tipdress request>**, **<Prewarning>** and **<End of Stepper>** electrode signals are output, see p. 7-45

NOTE

Before you can make a **<Spot selection>** *from the coordinating control,* **<Spot reference>** *must be downloaded into the WT.*

- Create **<Spot reference>**
- *Operation - Services - Spot Table -> WT*

Before you can work with the timer, you must enter a spot number in the Spot Designation field in **<Spot reference>**.
Spot number entries are limited to 48 freely selectable characters as a maximum. The first sequence of digits is interpreted as the ident code (indicating the series designation) while the second sequence of digits is taken to be the spot number. These sequences of digits must be separated by a character other than a digit.

Finally, the spot table must be transmitted to the WT via *Services - Spot Table -> WT*.

To select a weld spot from the robotic control, you must use its respective spot number assigned to it in this table.

NOTE

If you set the ident code to 0 and a spot number smaller than 256 on the I/Os, the respective program from 0 through 255 will be selected directly. This way you can work with the timer without having to roll in a spot table first.

Now as before, the BOS function *Start Simulation* requires the selection of program numbers!

<Spot selection> will activate the proportional control valve at its programmed pressure value.

If **<Spot selection>** cannot find a spot because it is not listed in the spot table, the pressure value assigned to the spot that was active last will be read out. This is to avoid high pressure fluctuations between welding events if selection = 0 which would tend to reduce the life of pressure valves considerably.

Logs are recorded and error messages are displayed under the respective **<Spot selection>** number.

Influencing the counters via the input signals:

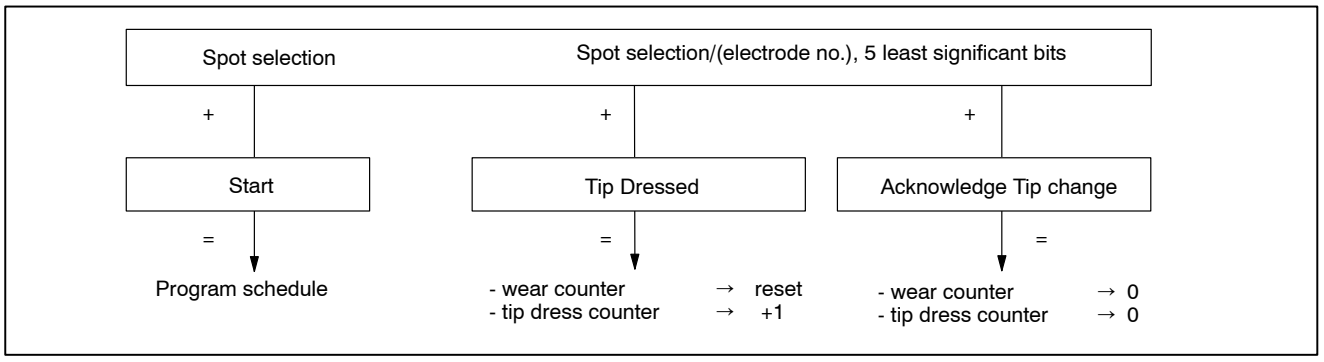

Figure 11: Spot selection and counters

NOTE

If electrode number 0 is selected with the **<Spot selection>** *signals and an* **<Acknowledge Tip change>** *signal becomes high, the tip dress and wear counters of* ***all electrodes*** *are reset.*

If an electrode number 1 through n (n = maximum number of electrodes) is selected with the **<Spot selection>** *signals and an* **<Acknowledge Tip change>** *signal becomes high, the tip dress and wear counters of the electrode selected with the signals for* **<Spot selection>** *are reset.*

If electrode number 0 is selected with the **<Spot selection>** *signals and a* **<Tip dressed>** *signal becomes high, the tip dress counters of* ***all electrodes*** *are incremented and the wear counters are set to a defined value.*

If an electrode number 1 through n (n = maximum number of electrodes) is selected with the **<Spot selection>** *signals and a* **<Tip dressed>** *signal becomes high, the tip dress counter is incremented by 1 and the wear counter is set to a defined value for the electrode selected by the number of the* **<Spot selection>** *signals.*

<Start_1>

Activating **<Start_1>** will start the [Sequence] in the timer, the respective **<Spot selection>** data are transmitted, and the pre-squeeze time [1. SQZ] beings to run. **<Start_1>** can still be cleared during [1. SQZ] and [SQZ] to interrupt the started [Sequence]. The [Sequence] becomes modal only upon the beginning of the [1. WLD] (with the exception of seam operations, which are non-modal).

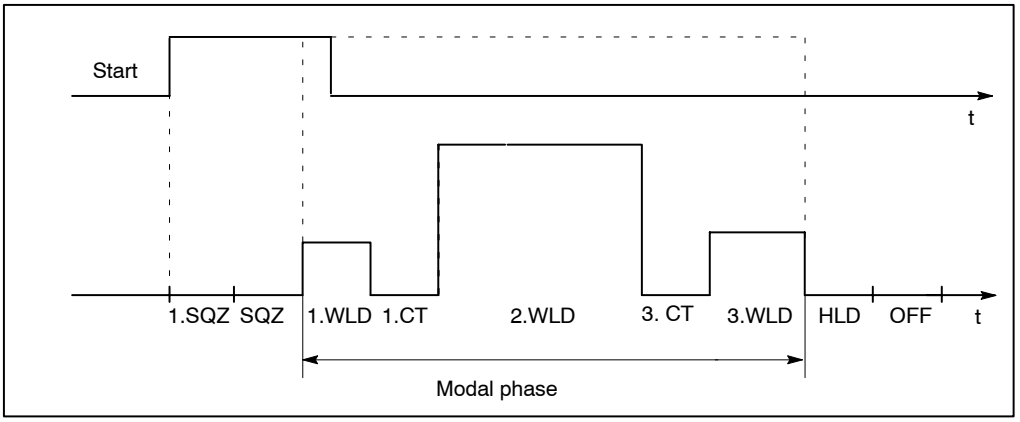

Figure 12: Modal phase of program execution in the case of single spot mode and repeat mode

A [Sequence] can be started with or without firing:

- Start with firing turned on : [Sequence] with welding current
- Start without firing turned on : [Sequence] without welding current

<Weld/No weld external>

This signal allows to disable the firing of the weld timer, which may be required for set-up operations, e.g. ([Sequence] without current).

Apart from the **<Weld/No weld external>** signal, firing may be controlled by the setting of Weld/No weld internal relating to all programs and a Weld/No weld setting relating to a specific program.

These three firing settings are linked by ”AND”.

With firing deactivated, the [Sequence] of the started program in terms of its timing is the same as with firing activated. However, no welding operation is performed because there is no weld current.

- **<Weld/No weld external>** :
  0 signal ⇒ external firing **switched ON** via I/O interface.
- **<Weld/No weld external>** :
  1 signal ⇒ external firing **switched OFF** via I/O interface.

For all timers		Program-specific firing	Program-specific sequence
<Weld/No weld external>	Weld internal		
off	off	off	Sequence **without** welding current
off	off	on	Sequence **without** welding current
off	on	off	Sequence **without** welding current
off	on	on	Sequence **without** welding current
on	off	off	Sequence **without** welding current
on	off	on	Sequence **without** welding current
on	on	off	Sequence **without [1]** welding current
on	on	on	Sequence **w i t h** welding current

[1] Caution: Program-specific firing may be active for other programs

Figure 13: Firing settings

<Reset fault>

Faults must be reset whenever a fault prevents any further welding [sequences] in the timer.

Pending faults are reset by

- pushing the green reset button on the front panel of the PSI 6XXX.350 L1 see front panel on page 3-2 or
- one of the following input signals

<Reset fault>

This signal resets the displayed fault. The cause of the fault must be cleared first. The **<Weld complete> (WC)** will not be output and the welding timer is switched to ready state. If the **<Start_1>** signal is active, it must first be cleared and then set again in order to start a new [sequence].

<Fault reset with weld complete>

This signal resets the displayed fault. The cause of the fault must be cleared first. If the **<Start_1>** signal is active, the **<Weld complete>** (WC) signal is output and the welding timer is switched to ready state.

<Fault reset with reweld>

This signal is required if the fault was caused by insufficient welding current. The spot is rewelded.
This signal resets the displayed fault. The cause of the fault must be cleared first. If the **<Start_1>** signal is active, the welding timer is switched to ready state and the respective spot is rewelded.

WARNING!

If the **<Start_1>** signal is active during **<Fault reset with reweld>**, the PSI 6XXX.350 L1 will start immediately to execute the [sequence]. This may result in dangerous machine motions. Before the **<Fault reset with reweld>** signal is set, always make sure that all individuals stay clear of the danger zone of the welding gun or the robot.

<Tip dressed>

For welding operations during which the electrodes need to be dressed once or repeatedly, tip dressing must be included in the programming. When the *Stepper* function is active (*Programming - Welding Parameters - Stepper*) the **<Tipdress request>** signal indicates that the electrodes need to be dressed. This signal is reset as soon as a **<Tip dressed>** signal indicates and acknowledges the completion of electrode dressing.

NOTE

If electrode number 0 is selected with the **<Spot selection>** *signals and a* **<Tip dressed>** *signal becomes high, the tip dress counters of* ***all electrodes*** *will be incremented and the wear counters will be set to a defined value.*

If electrode number 1 through n (n = maximum number of electrodes) is selected with the **<Spot selection>** *signals and a* **<Tip dressed>** *signal becomes high, the tip dress counter is incremented by 1 and the wear counter is set to a defined value for the electrode selected by the number of the* **<Spot selection>** *signals.*

Setting the wear and tip dress counters via input signals:

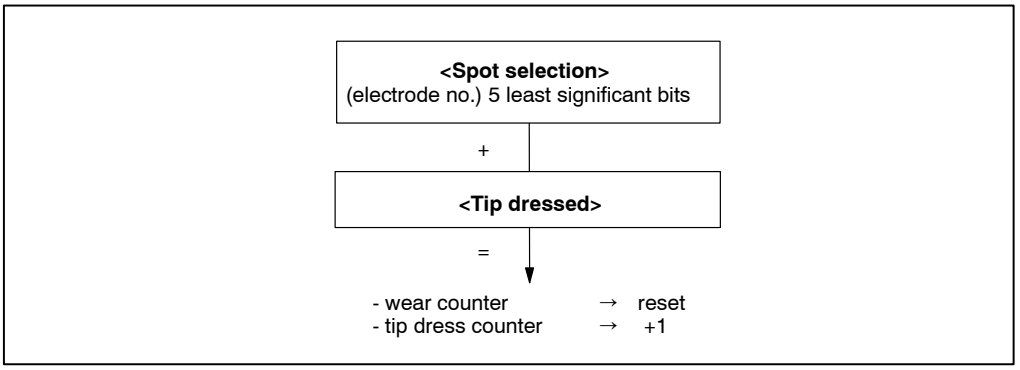

Figure 14: Setting the wear and tip dress counters by the **<Tip dressed>** *signal*

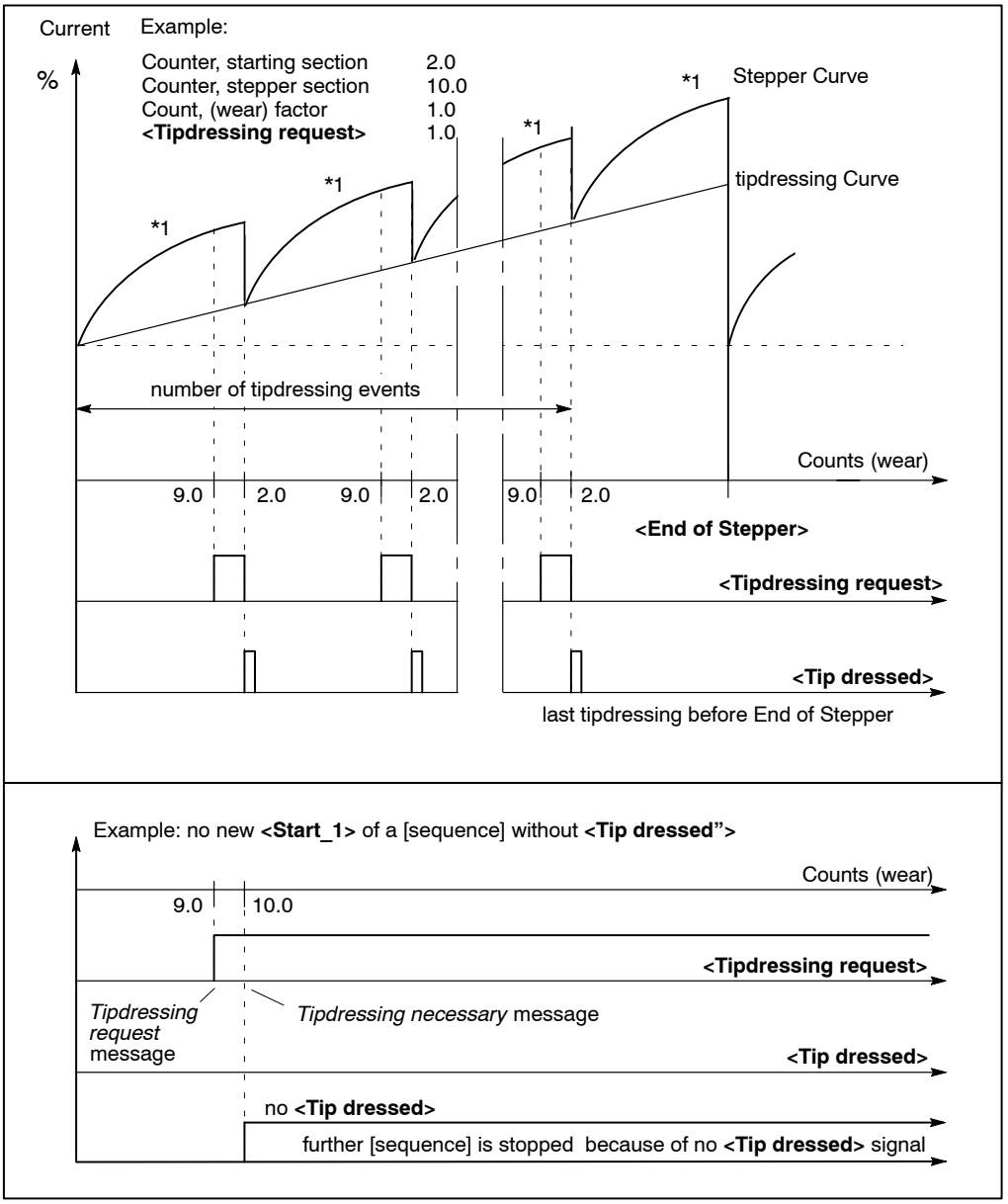

Figure 15: Example Tipdressing

NOTE

In the BOS-5000 software, the tip dress counter can be directly influenced by means of an input, e.g. if a used electrode is fitted.

<Acknowledge Tip change>

The timer signals the **<End of Stepper>**. Any further [sequences] can be disabled in the timer.

NOTE

A stop in the timer of any further sequence must be programmed in Basic Setup - Global Stepper Setup.

The **<End of Stepper>** signal is reset by the **<Acknowledge Tip change>** signal.

NOTE

If electrode number 0 is selected with the **<Spot selection>** *signals and an* **<Acknowledge Tip change>** *signal becomes high, the tip dress and wear counters of* ***all electrodes*** *are reset.*

If an electrode number 1 through n (n = maximum number of electrodes) is selected with the **<Spot selection>** *signals and an* **<Acknowledge Tip change>** *signal becomes high, the tip dress and wear counters of the electrode selected with the signals for* **<Spot selection>** *are reset.*

Setting the wear and tip dress counters via input signals:

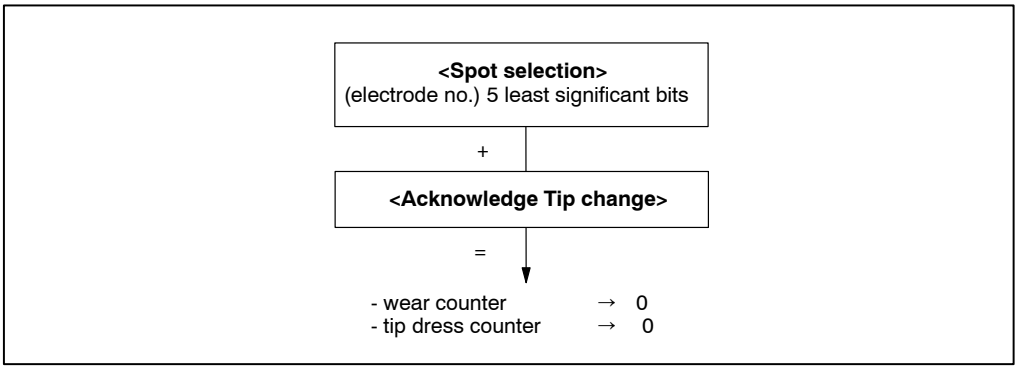

Figure 16: Setting the wear and tip dress counters by the **<Acknowledge Tip change>** *signal*

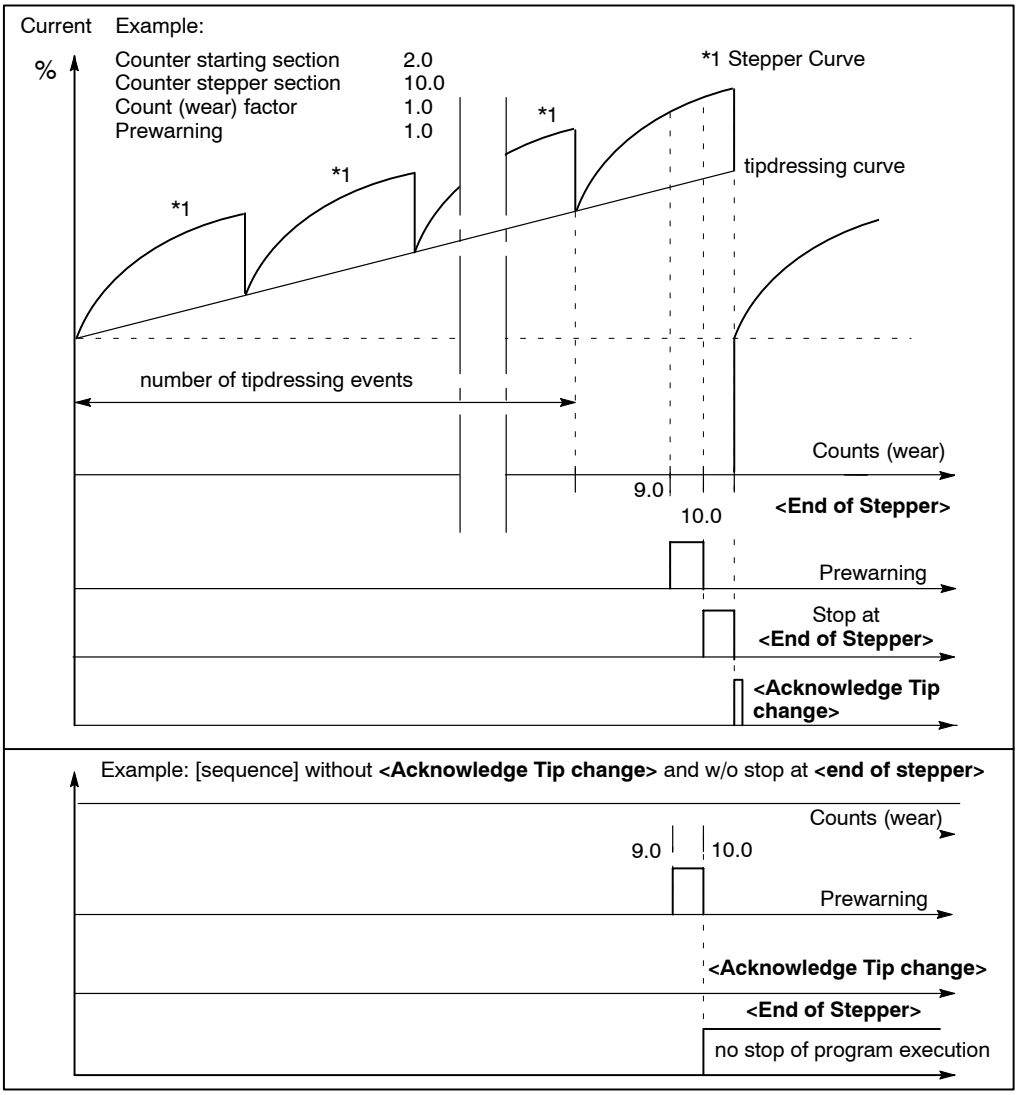

Figure 17: Example of electrode replacement

NOTE

The desired weld timer response (stop or continued program execution) when the max. number of welds (end of stepper) is reached must be programmed in Global Stepper Setup under Basic Setup.

NOTE

You may also program the BOS-5000 software so as to send an acknowledgement that the electrodes have been replaced.

<Request electrode condition>

With this signal the following electrode conditions can be requested:

- **<Initial (Start) Tipdress request>**
- **<Tipdress request>**
- **<Prewarning>**
- **<End of Stepper>**

This signal must be active before electrode selection/**<Spot selection>** becomes active. The **<Request electrode condition>** signal inhibits the **<Start_1>** signal.

Requesting the electrode condition:

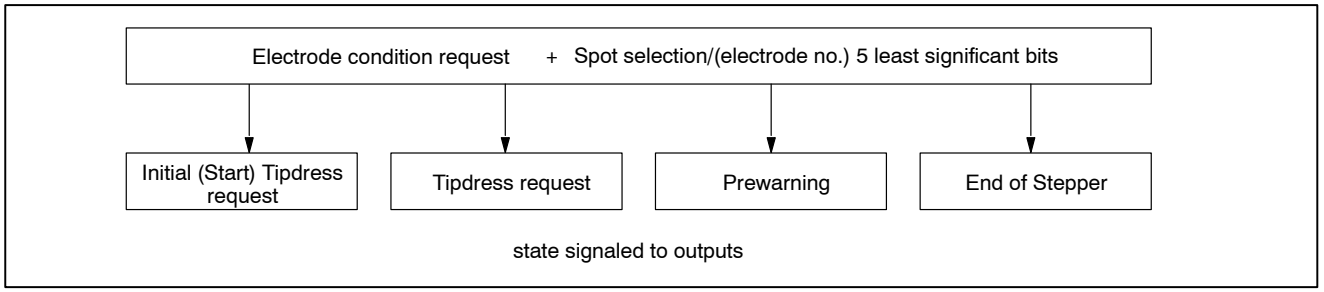

Figure 18: Signaling of electrode conditions to outputs

NOTE

If electrode number 0 is selected with the **<Spot selection>** *signals and a* **<Request electrode condition>** *signal becomes high, the states of* ***all electrodes*** *are requested (group signal) and signaled through the respective outputs.*

If an electrode number 1 through n (n = maximum number of electrodes) is selected with the **<Spot selection>** *signals and a* **<Request electrode condition>** *signal becomes high, the state of the selected electrode is requested and signaled through the respective outputs.*

If a **<Request electrode condition>** signal is active for a specific electrode, the specific electrode selection/**<Spot selection>** made allows the robot to scan the state of this electrode and acknowledge the signal.

<Current scaling>

<Current scaling> is designed to compensate for variations in the values measured for current check and control. **<Current scaling>** must be performed whenever a system component (WT, electrode holder, etc.) has been replaced.

The following components are required:

- welding gun monitoring unit with current sensor S_{chk}
- reference current meter

NOTE

A current meter is required to measure the reference current.

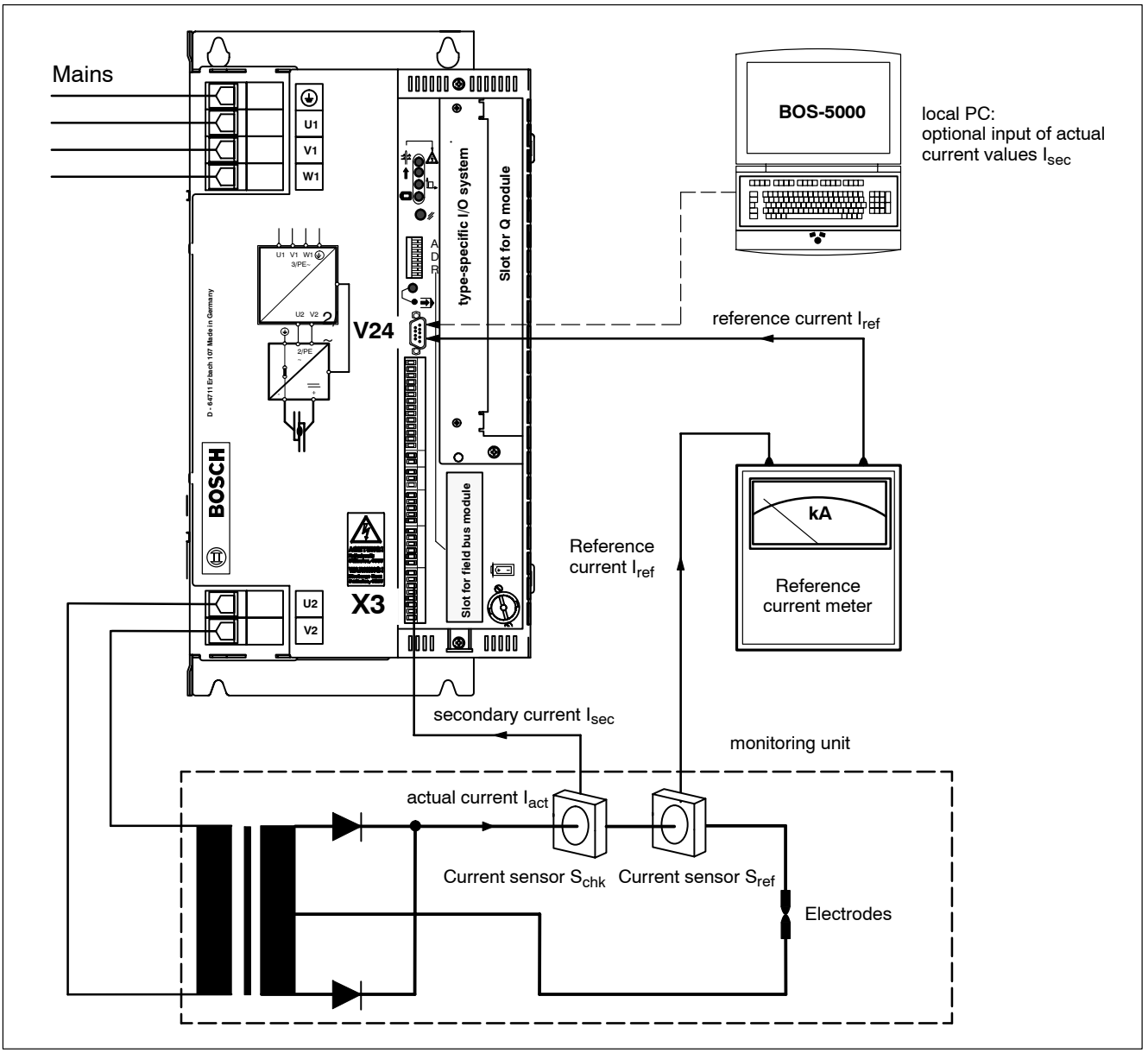

Figure 19: Current scaling setup

Program 255 is used for **<Current scaling>**. This program cannot be used for normal operation in production because Start-Inhibit is permanently ON. The program defaults allow automatic **<Current scaling>** in most cases. However, they must be reviewed by the operator prior to performing **<Current scaling>**. The fade-out time is 40 ms and trail current measurement is disabled.

It is an essential prerequisite for creating a weld program for **<Current scaling>** on the basis of the weld programs entered previously and assigned to an electrode that all those weld programs have been entered correctly. Any weld programs currently not in use and containing incorrect data will corrupt **<Current scaling>**.

NOTE

<Current scaling> *alters the toroid sensitivity. Afterwards the toroid sensitivity must not be altered by another input.*

CAUTION!

Make sure that the electrode gun is properly closed. Otherwise, there is danger of welding splashes!

Automatic **<Current scaling>** sequence without base metal:

Prerequisites:

- The external weld current meter must be connected to the V24 interface.
- The secondary current meter must be connected.

Sequence:

- The electrode to be selected must be entered in the I/O field
- The respective welding gun must be closed.
- The current scaling input signal must be set.
- The V24 log is switched over to the welding current meter log.

Now, the timer is in current scaling mode. No start commands or program selections entered in the I/O field are accepted.

The program in the timer assigned to current scaling is program 255 where significant parameters, e.g. run times, Weld/No weld internal ON, Start-Inhibit OFF, have been preset. With this setting, the operator can now carry out a current scaling operation. However, to ensure scaling accuracy, reviewing such values values/parameter settings as Weld Time, Measuring Time Window (fade-out time) and Differential Current Measurement (trail current) and scaling them to the external weld current meter is crucial.

- The electrode number selected is now automatically assigned to program 255.
- Next, program 255 is started automatically by the software, without any action required on the part of the operator, and the welding operations necessary to carry out current scaling are executed.

2 spots (upper and lower current value) must be selected at which current scaling is performed. Scaling is dependent on the value of the upper current limit (as set in the Electrode Parameter Menu). The lower value should be 40% of the upper current limit and the upper value should be 80% of the configured upper current limit .
Example: max. current 20 kA, lower current value: 8 kA, upper current value: 16 kA

Consequently, scaling should be performed at 8 kA and 16 kA, if possible. However, at least 2 test welding operations are to be performed to verify whether the respective electrode is suitable for welding with these desired current values. First, a welding operation must be performed at the lower current value. On the basis of the required phase angle, you can now determine whether the upper command current value can actually be achieved at a phase angle of up to 80%. If this is not the case, the lower command current value must be lowered until it can be ensured that also the upper command current value can be reached. Please note that the upper command current value must always be twice the value of the lower one.

When this has been verified, the actual current scaling process follows. During two welding operations, each, which must be performed at the upper and the lower command current values, the primary and secondary currents are measured. The reference current is read in through the 24V interface of the external weld current meter.

- The 24V log is switched back from the weld current meter.
- Upon correct completion of the scaling operation, the **<Current scaling** / **check finished>** signal becomes high and is held until the **<Current scaling>** signal is reset.

Current scaling involves the re-determination of 2 values:

1) Toroid sensitivity: Scaling of the primary current to the external weld current meter.
2) 2nd toroid sensitivity: Scaling of the secondary current to the external weld current meter.
These values are shown under *Basic Setup - Electrode Setup* in the BOS.

You can view the results of the last scaling operation for the respective electrode in the ”Scaling Results” window under the ”*Electrode Setup*” window in the BOS. No **<Weld complete>** signal is output during scaling.

If an error occurs:

If an error of any type occurs during scaling, the scaling operation will be aborted, the **<Ready>** signal reset and an error message transmitted. The error message transmitted will always relate to a weld fault. If the abort was caused by some other type of error, also a welding process error message will be transmitted nevertheless. No **<Current scaling**/ **check finished>** signal will be transmitted. What is unusual here is the way in which a fault is reset. The **< Fault reset with WC>** signal indicates that the fault is reset. Subsequently, however, the signal that is actually output is not the **<WC>** signal but instead the **<Current scaling**/**check finished>** signal. If the **<Fault reset with reweld>** signal is output while the **<Current scaling>** signal is still high, another current scaling operation will be started right away. Otherwise, the timer will now be in normal ”Weld timer ready” state.

Typical errors as they may occur during current scaling operations are described under ”Error Messages”.

NOTE

If you cannot use the automatic current scaling function described above, the former scaling function in the BOS is still available.

<Current Check>

<Current Check> verifies whether the measured value of the primary current I_{prim} matches the secondary current I_{sec} measured by current sensor S_{chk}.

It runs cyclically in the monitoring unit during the production process and serves to monitor the measured values of the primary current I_{prim} and to detect shunts in the secondary gun circuit.

In the event of any mismatch between the primary and the secondary currents that go beyond a specified tolerance band (BOS scaling mask), an error message is generated. This error must be reset just like any other error.

A few new parameters have been introduced for the current check function:

<Current Check Tolerance Band> (command current)

<Program Number, Previous Check> (actual current)

Secondary Current, Previous Check> (actual current)

Primary Current, Previous Check> (actual current)

CAUTION!

Make sure that the electrode gun is properly closed. Otherwise, there is a danger of welding splashes!

Prerequisites:

- Standard current scaling for the respective electrode must have been performed previously.
- The spot table must have been saved in the weld timer and the respective programs must have been configured.

Sequence:

- A spot must be selected in the I/O field.
- The gun assigned to the selected spot must be closed.
- The **<Current Check>** input signal must be set.

Now, the timer is in **<Current Check>** mode. No starts or program selections entered in the I/O field will be accepted.
The program assigned to the selected spot number is started. Primary and secondary currents are measured. Subsequently, the primary current is checked for any deviation beyond a specified limit (stated in %) from the secondary current (which is the reference current in this case). If the primary current exceeds the tolerance limit, an error message is transmitted.

- Upon correct completion of the **<Current Check>**, the **<Current scaling/ check finished>** signal becomes high and is held until the **<Current Check>** input signal is reset.

No WC signal is output during a current check.

If an error occurs:

The notes under ”Current Scaling” apply correspondingly.

<Reduced Current Scaling>

With this process, the primary current is scaled (adjusted) in the timer to the secondary current.

The process may be initiated e.g. following the replacement of electrodes by the RC control setting the **<Reduced Current Scaling>** signal.

Sequence of Reduced Current Scaling:

Prerequisites:

- Automatic current scaling for the respective electrode must have been performed previously.

Sequence:

- The electrode must be selected in the I/O field.
- The gun assigned must be closed.
- The **<Reduced Current Scaling>** input signal must be set.
  Now, the timer is in **<Reduced Current Scaling>** mode. No starts or program selections entered in the I/O field will be accepted.
  This sequence is the same as the sequence of standard current scaling. However, there is no external weld current meter required because only the primary and the secondary currents are measured. In this case, the secondary current is the reference current to which the primary current is scaled.
- Upon correct completion of the reduced current scaling process, the **<Current scaling/check finished>** signal becomes high and is held until the **<Reduced Current Scaling>** input signal is reset.

Current scaling involves the re-determination of 1 value.
Toroid sensitivity: Scaling of the primary current to the secondary current scaled previously. This value is shown under *Basic Setup - Electrode Setup* in the BOS.

You can view the results of the last scaling operation for the respective electrode in the ”Scaling Results” window under the ”*Electrode Setup*” window in the BOS. Standard scaling results will be overwritten.

No WC signal is output during a reduced current scaling operation.

If an error occurs:

The notes under ”Current Scaling” apply correspondingly.

<Current Scaling, Primary>

This function is designed to allow a simplified current scaling process.
With this function, only the primary current is scaled to an external current meter. Unlike the ”standard” current scaling function, the secondary current is not taken into account here. The automated sequence corresponds to ”standard” current scaling. A new **<Current Scaling, Primary>** input has been provided in the I/O assignments for this function.

Prerequisites:

- Standard current scaling for the respective electrode must have been performed previously.
- The external weld current meter must have been connected to the 24V interface.

Sequence:

- The electrode must be selected in the I/O field.
- The gun assigned must be closed.
- The **<Current Scaling, Primary>** input signal must be set.
  Now, the timer is in **<Current Scaling, Primary>** mode. No starts or program selections entered in the I/O field will be accepted.
  This sequence is the same as the sequence of standard current scaling. However, only the primary and secondary currents are measured with the weld current meter. The current of the weld current meter is used as the reference current to which the primary current is scaled.
- Upon correct completion of the primary current scaling process, the **<Current scaling/check finished>** signal becomes high and is held until the **<Current Scaling, Primary>** input signal is reset.

Primary current scaling involves the re-determination of 1 value.
Toroid sensitivity: Scaling of the primary current to the external weld current meter. This value is shown under *Basic Setup - Electrode Setup* in the BOS.

You can view the results of the last primary current scaling operation for the respective electrode in the ”Scaling Results” window under the ”*Electrode Setup*” window in the BOS. Standard scaling results will be overwritten.
No WC signal is output during a reduced current scaling operation.

If an error occurs:

The notes under ”Current Scaling” apply correspondingly.

<Pressure calibration>

Various pressure setpoints (P_{com}) are entered in the pressure regulator with this procedure. The force F_{act} between the electrode caps is measured with the LC_{mon} load cell. The measured force F_{act} (= value analog to the output voltage of the load cell) is used in the timer for power calibration.
The objective of this procedure is to adjust the pressure to pressure regulator with the effect that the programmed force F_{com} in kN (= F_{act}) is applied at the weld gun.

NOTE

A calibrated load-sensing device is required to provide reference load values.

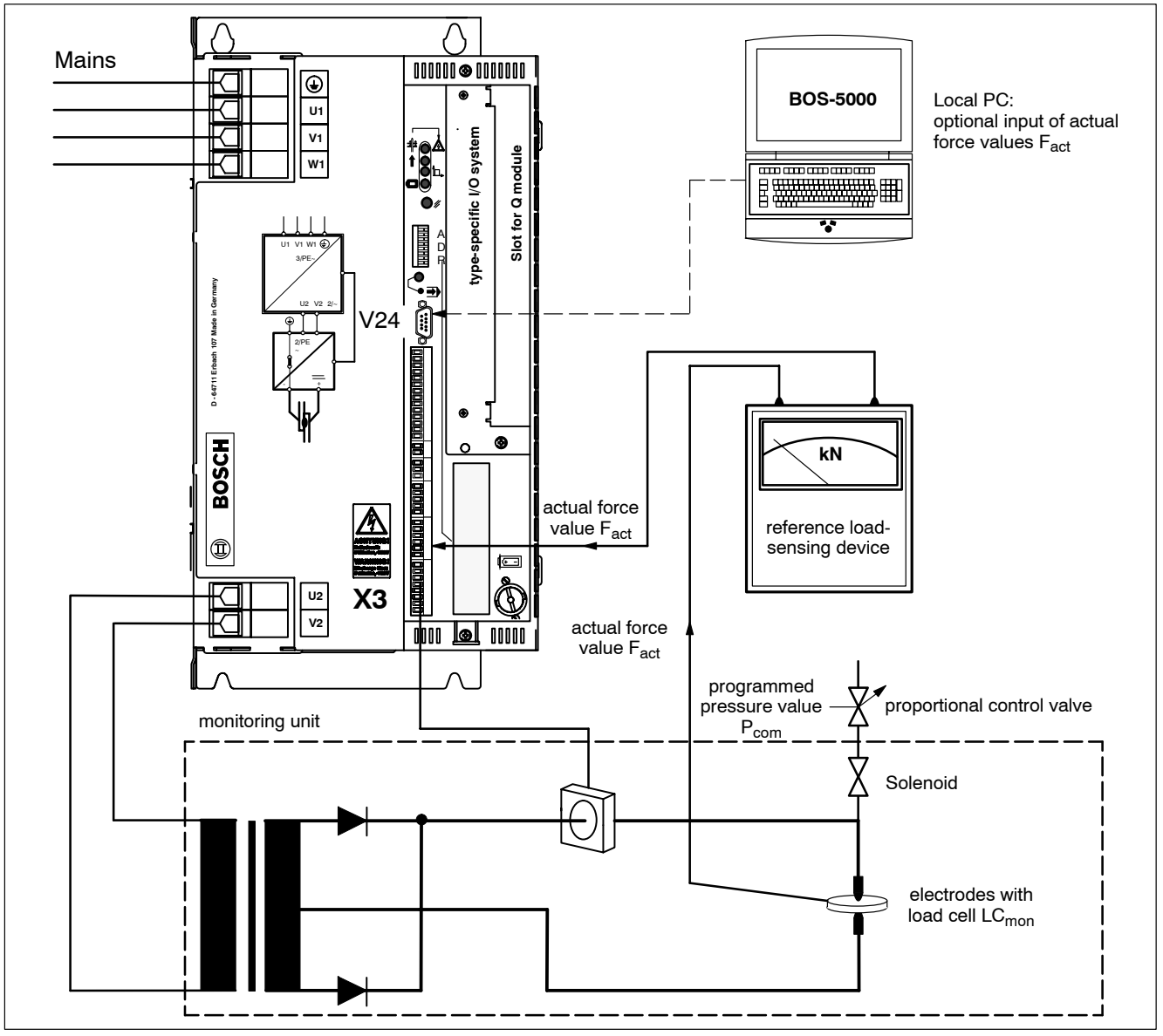

Figure 20: Setup for pressure calibration

Procedure for **<Pressure calibration>**

CAUTION!

Make sure that all individuals stay clear of the immediate operating range of the weld gun.
Only input calibration values which generate pressure values the electrode gun can support mechanicallybecause otherwise there is a risk of personal injury and/or damage to the machine.
If you do not know the behavior of the electrode gun, use low values in the beginning of calibration and increase these values step by step in individual calibration operations until the required working pressure is reached.

Prerequisite:

- The load-sensing device must be connected to the assigned terminals (see terminal connection diagram).

Sequence:

- The electrode to be selected must be entered in the I/O field
- The **<Pressure calibration>** input signal must be set.

Now, the timer is in **<Pressure calibration>** *mode. No start commands or program selections entered in the entry field are accepted.*

- The timer waits until the start signal level equals 0 (essential for error handling).
- The lower command pressure value is output. Subsequently, the **<Operate>** signal becomes high and the timer waits for the **<Start>** signal.
- The robot sets the **<Start>** input signal and simultaneously closes the weld gun.
- The timer waits for two seconds. Then the load is measured and the value obtained is saved. The **<Operate>** signal is reset.
- The **<WC>** signal becomes high.
- The robot resets the **<Start>** signal.
- The upper command pressure value is output and the **<Operate>** signal becomes high. Again, the timer waits for the **<Start>** signal.
- The robot sets the **<Start>** input signal and simultaneously closes the weld gun.
- The timer waits for two seconds. Then the load is measured and saved. The **<Operate>** signal is reset.
- Upon correct completion of the pressure calibration process, the **<Pressure calibration/check finished>** signal becomes high and is held until the **<Pressure calibration>** input signal is reset. In this case, also the **<Start>** signal must be reset.

NOTE

Please make sure that the electrode pressure is stable during measurement.

NOTE

A **<Pressure calibration>** *operation will change the value of the conversion factor entered previously. Do not change the new value by any subsequent data entry.*

NOTE

A **<Pressure calibration>** *operation will change the value of the zero adjust entered previously. Do not change the new value by any subsequent data entry.*

<Pressure calibration> involves the re-determination of 3 values: maximum pressure, conversion factor and zero adjust. These values are shown in the *Basic Setup - Electrode Setup* window in the BOS.

You can view the results of the last scaling operation for the respective electrode in the "*Scaling Results*" window under "*Electrode Setup*" in the BOS.

The lower and the upper command pressure values are entered as a percentage of 10V, or, respectively, as a digital value of 255 (8 bits). Their default values are 40% and 80%. You can change these values only by some intermediate programming. Go to the BOS interface and select **<Pressure calibration>**. Next, some proposed command values are displayed. You can overwrite them and save your entries. Now you may cancel **<Pressure calibration>** "manually". The command values you have just entered for the respective electrode are saved.

If an error occurs:

If an error of any type occurs during **<Pressure calibration>**, the calibration operation will be aborted, the **<Ready>** signal reset and an error message transmitted. The error message transmitted will always relate to a weld fault. If the abort was caused by some other type of error, also a welding process error message will be transmitted nevertheless. No **<Pressure calibration/check finished>** signal will be transmitted. What is unusual here is the way in which a fault is reset. The **<Fault reset with WC>** signal indicates that the fault is reset. Subsequently, however, the signal that is actually output is not the **<WC>** signal but instead the **<Pressure calibration/check finished>** signal. If the **<Fault reset with reweld >** signal is output while the **<Pressure calibration>** signal is still high, the **<WC>** signal is set and another pressure calibration operation will be started right away. Otherwise, the timer will now be in normal "Weld timer ready" state. Typical errors as they may occur during pressure calibration operations are described under "Error Messages".

<Pressure check>

This function allows you to verify whether the programmed actual force value F_{act} in kN is reached at the electrodes.

Additionally, a check is performed as to whether the electrodes reach the programmed pressure threshold value at the specified command pressure P_{com} within a specified time. This allows to identify any mechanical changes that may have occurred in the weld gun.

If the pressure threshold is not reached in the scheduled time, a warning or error message is displayed on the BOS-5000 weld operator interface.

If a deviation from the tolerance band programmed in the BOS-5000 occurs, an error message is generated and the **<Ready>** state of the timer is reset.

Various new parameters have been introduced for this function:

<Pressure check tolerance band> (command value)
<Pressure check before weld time> (command value)
<Program number of last check> (actual value)
<Command pressure> (command value)
<Final value of output pressure> (actual value)
<Time to pressure> (actual value)

Additionally: Graphical pressure profile of last pressure check.

CAUTION!

Please make sure that all individuals stay clear of the danger zone of the welding gun.

NOTE

Please make sure that the electrode pressure is stable during measurement.

Sequence of automatic **<Pressure check>**:

Prerequisite:

- The pressure gauge must be connected to the assigned terminals.

Sequence:

- The spot to be selected must be entered in the I/O field
- The **<Pressure check>** input signal must be set.

Now, the timer is in power check mode. No start commands or program selections entered in the I/O field are accepted.

- The timer waits until the start signal level equals 0 (essential for error handling).
- The base pressure value of the program assigned to the selected spot is set and the **<Operate>** signal is output.
- The timer waits for the **<Start>** signal.

- The robot sets the **<Start>** input signal and simultaneously closes the weld gun.
- For the specified period, the pressure is measured at intervals of 10 ms and the values obtained are saved. The specified period equals the pre-squeeze time plus the squeeze time plus 500 ms as configured in the program assigned to the selected spot. However, the maximum measuring time is 2 sec. When the specified period has elapsed, the **<Operate>** signal is reset.

During the sequence of the program, the pressure is measured every 10 ms and the obtained values are saved. Measurements are taken until the end of the **<Hold Time>***, or for 2 seconds at the most. Consequently, 200 measured pressure values are recorded. These measures are queried from the last one up. The point in time where a deviation of more than -10% from the command value is found is defined as the beginning of the* **<Time to pressure>***. The* **<Final value of output pressure>** *is then defined as the mean of the measured values from the end up to the* **<Time to pressure>***. If the desired pressure is not reached, an error message is transmitted, just like if the* **<Time to pressure>** *is too long or to short. The lower time limit is the pre-squeeze time, the upper time limit is the pre-squeeze time plus the squeeze time minus the pressure check before the end of squeeze time.*

- Upon correct completion of the pressure calibration process, the **<Pressure calibration/check finished>** signal becomes high and is held until the **<Pressure check>** input signal is reset.
- The robot must reset the **<Start>** signal.

You can view the results of the last checking of the respective electrode in the ”Scaling Results” window under ”*Electrode Setup*” in the BOS.

After each pressure check, the pressure profile together with the date, time program number, time to pressure and final value of output pressure are written to a log file and can be saved in the BOS. An independent Bosch program is available for the visual display of these pressure profiles.

If an error occurs:

The notes under ”Current Scaling” apply correspondingly.

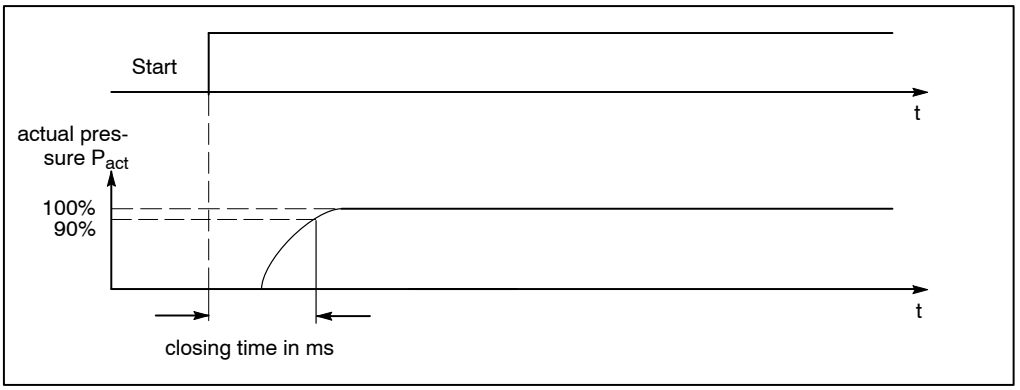

Figure 21: Pressure gauging

Pressure gauging:

You can initiate pressure gauging by setting the parameter **<Export pressure value>**. First, the **<Operate>** signal is set. Every time, the **<Actual pressure>** parameter is accessed, the pressure is measured. When the **<Export pressure value>** parameter is reset, the **<Operate signal>** is reset and pressure gauging is terminated. The normal end of a program sequence or a pressure check/calibration will also terminate the gauging routine.

7.3.2 Serial outputs

The outputs are driven via the serial INTERBUS-S interface. The setup is as follows:

Bit	Outputs of the PSI 6XXX.350 L1 according to the enhanced C0 profile by Bosch
0	**<Weld complete>**
1	**<Tipdress request>** (tip dress inquiry)
2	**<Prewarning>**
3	**<End of Stepper>** reached
4	**<Control ready>**
5	**<Welding fault>**
6	**<Without weld process monitoring>** or without stepper values
7	**<Weld/No weld>** (with welding current)
8	**<Proportional control valve selection_1>**
9	**<Proportional control valve selection_2>**
10	**<Proportional control valve selection_4>**
11	**<Proportional control valve selection_8>**
12	**<Proportional control valve selection_16>**
13	**<Proportional control valve selection_32>**
14	**<Proportional control valve selection_64>**
15	**<Proportional control valve selection_128>**
16	**<Initial (Start) Tipdress request>**
17	**<Current scaling/check finished>**
18	**<Pressure calibration/check finished>**
19	**-**
-	
27	**-**
-	
47	**-**

Example of outputs

Word	Low byte	High byte
0	O07 ... O00	O15 ... O08
1	O23 ... O16	O31 ... O24
2	O39 ... O32	O47 ... O40

<Control ready>

The **<Control ready>** signal indicates the ready status of the weld timer. At the same time, the green LED ⇑ lights up. This signal is cleared in the event of a fault, e.g. with:

- E-STOP circuit open
- a fault in the [Sequence] or a non-permitted deviation in a monitored value that has been defined as a fault in the *Fault Allocation* in the *Basic Setup* menu.
- a battery fault that has been defined as a fault in the *Fault Allocation* in the *Basic Setup* menu, etc.
  Cf. page 10-3: Messages concerning the timer status, page 10-4: Messages concerning *current* and *time monitoring*.

NOTE

The programming terminal signals the cause of the fault in the Timer Status Message window. Detailed information is displayed by calling up diagnostics for I/Os or timer diagnostics.

When the cause of the fault has been cleared, the ready state is restored by:

- the **<Reset Fault>** signal, cf. page 7-18
- the **<Fault reset with WC>** signal, cf. page 7-18
- the **<Fault reset with reweld>** signal, cf. page 7-18
- an operation in the BOS-5000 software, e.g. in the *Diagnostics - Timer* window.
- using the reset push button on the front panel, cf. page 3-2.

<Weld/No weld>

If the sum of all firing settings (logical AND operation) is switched on when a **<Spot selection>** is active, the **<Weld/No weld>** signal is output.

- **<Weld/No weld>** signal ON:
  All firing settings for the selected via **<Spot selection>** program of the timer are active. The [Sequence] is performed **with** welding current.
- **<Weld/No weld>** signal OFF:
  One of the firing settings is inactive, or no **<Spot selection>** has been activated. The [Sequence] is performed **without** welding current.

If **<Weld/No weld external>** has been switched off, a timer status message is displayed at the programming terminal.

Firing settings:

- **<Weld/No weld external>** signal
- Programming of weld/no weld internal for all programs in the menu *Programming - Basic Setup - Sequence Setup.*
- Programming of program-specific firing for one program in the menu *Programming - Basic Setup - Sequence Setup*.

For all timers		Program-specific firing	Program-specific sequence
<Weld/No weld external>	Weld internal		
off	off	off	Sequence **without** welding current
off	off	on	Sequence **without** welding current
off	on	off	Sequence **without** welding current
off	on	on	Sequence **without** welding current
on	off	off	Sequence **without** welding current
on	off	on	Sequence **without** welding current
on	on	off	Sequence **without [1]** welding current
on	on	on	Sequence **w i t h** welding current

[1] Caution: Program-specific firing may be active for other programs

Figure 22: Firing settings

<Without weld process monitoring>

This signal indicates that welding is performed without *current monitoring*.

If *current monitoring* is switched off, deviations from the tolerance band in *current monitoring* are not detected. This may lead to weld quality impairment.

NOTE

When weld process monitoring has been deactivated, you should always check the quality of your welds.

Current monitoring	Monitoring **stopped** for all timers	Weld process monitoring function
off	on	on: **without** monitoring
off	off	on: **without** monitoring
on	on	on: **without** monitoring
on	off	off: **with** monitoring

Figure 23: Monitoring

NOTE

Monitoring stopped is activated and deactivated for all timers (for all programs of the selected timer) in the Basic Setup, in the menu Sequence Setup.
Current monitoring is activated and deactivated for specific programs with the Welding Parameters option in the Current Monitoring window.

<Proportional valve selection, 1 through 128>

The pressure control value is output in digital form (8 bit resolution) via the serial outputs. Thus, the 0 through 100% setting range is subdivided into 256 segments.

The digitized pressure value is output with **<Spot selection>**. If **<Spot selection>** = 0, the digital value that was output previously is retained.

<Current scaling/check finished>

Successful completion of a **<Current scaling>** operation is indicated at the output level by a **<Current scaling/check finished>** signal, which stays high until the **<Current scaling>** input signal is reset. Cf. **<Current scaling>**, page 7-24.

Successful completion of a **<Current check>** operation is indicated at the output level by a **<Current scaling/check finished>** signal, which stays high until the **<Current check>** input signal is reset. No **<WC>** signal is output during a **<Current check>**. Cf. **<Current check>**, page 7-27.

<Pressure calibration/check finished>

Successful completion of a **<Pressure calibration>** operation is indicated at the output level by a **<Pressure calibration/check finished>** signal, which stays high until the **<Pressure calibration>** input signal is reset. Cf. **<Pressure calibration>**, page 7-31.

Successful completion of a **<Pressure check>** operation is indicated at the output level by a **<Pressure calibration/check finished>** signal, which stays high until the **<Pressure check>** input signal is reset. A **<WC>** signal is output during **<Pressure calibration / Pressure check>**. Cf. **<Pressure check>**, page 7-34.

<Weld complete> (WC)

If the welding operation of a single spot is properly completed by the end of the last [weld time], the signal **<Weld complete>** is output for as long as the **<Start_1>** signal is true, or, if the **<Start_1>** signal has been cleared, for the programmed number of milliseconds.
The **<Weld complete>** signal becomes high in single spot mode after each weld operation and in repeat mode after every spot. In seam mode, this signal indicates that a seam has been completed without any fault.

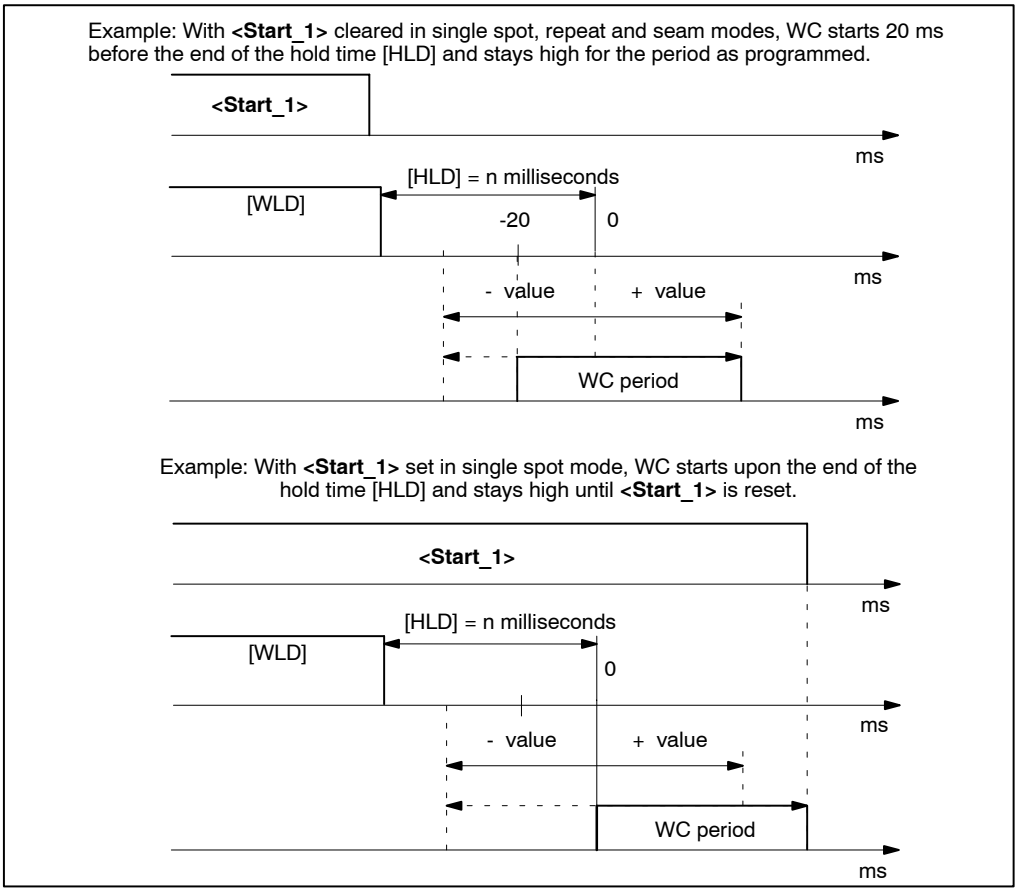

Figure 24: **<Weld complete>** *(WC) programming example*

”Quick robot communication”

If the **<Weld complete>** (WC) signal is used as a start signal for the welding robot, e.g., delays in signal processing by the robot and its drives can be accounted for by programming a negative value for the WC.

Any such delays can be eliminated at least in part by scheduling in the WC so as to start already in the hold time [HLD].

CAUTION!

In this case, the negative time value should be selected so as to ensure that the electrodes are already open when the robot drives are started.

NOTE

The earliest WC start time that may be programmed is as follows:
number of milliseconds [HLD] *minus 1 ms,*
but no earlier than 1000 ms before the end of the hold time [HLD].

An output of the **<Weld complete>** (WC) signal in the event of a welding fault can be programmed in *I/O Parameters* under *Basic Setup*.

The **<Weld complete>** signal can be output manually in the *Diagnostics - Simulate* menu under *Operation*.

<Tipdress request>

Whenever electrode maintenance is required, **<Tipdress request>** (electrode tip dressing) becomes high. This signal is reset when the **<Tip dressed>** acknowledgment signal indicates that tip dressing has been completed.

If **<Tipdress request>** is not acknowledged in time by **<Tip dressed>**, the message *Dressing* is displayed at the programming terminal.

No new [sequence] can be started before the *Dressing message* has been acknowledged by the **<Tip dressed>** signal.

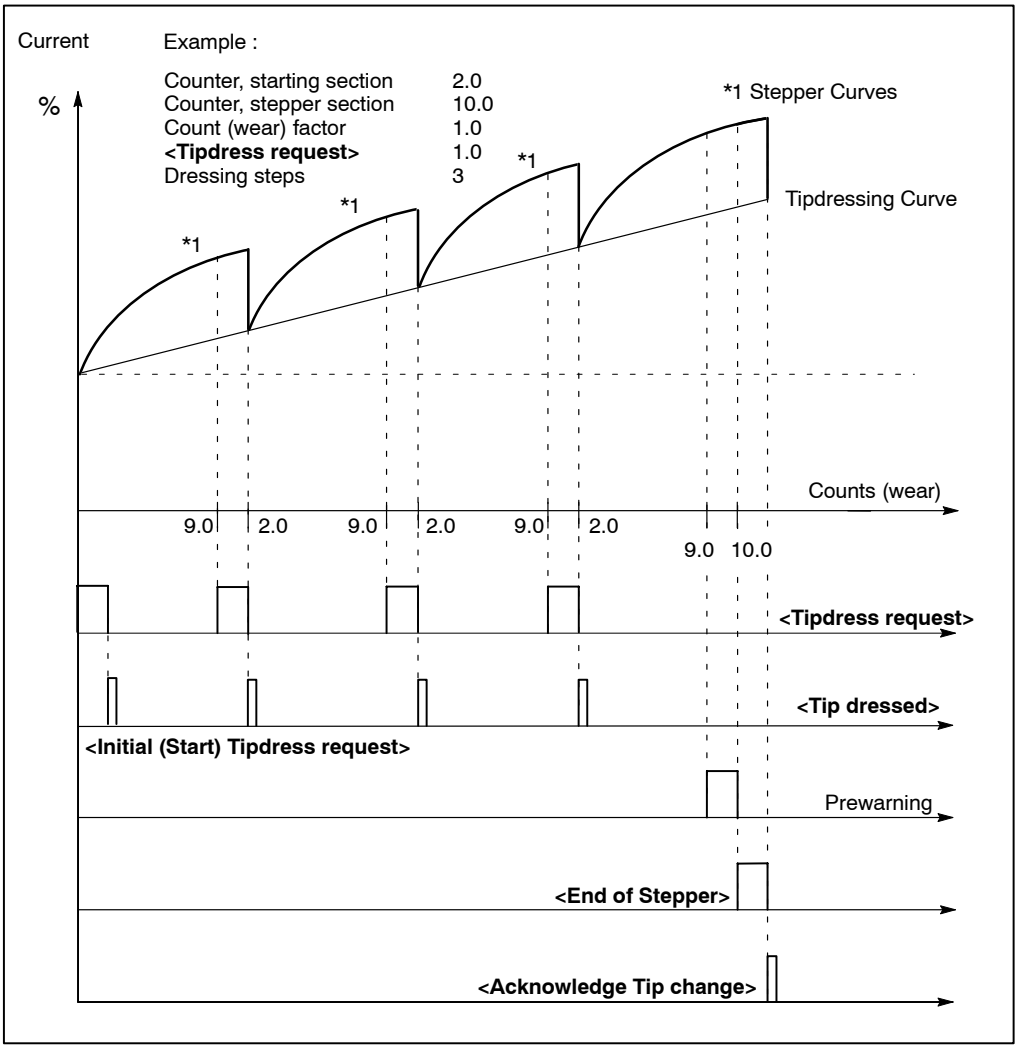

Figure 25: Example **<Tipdress request>**

The **<Tipdress request>** signal may also be output on request by the **<Request electrode condition>** signal, cf. page 7-23.

<Initial (Start) Tipdress request>

The **<Acknowledge Tip change>** (see page 7-21) signal is followed by the **<Initial (Start) Tipdress request>** signal .
The ensuing tip dressing enhances the proper fit of newly installed electrodes.

The tip dressing operation must be acknowledged with the **<Tip dressed>** signal.

The **<Initial (Start) Tipdress request>** signal may also be output on request by the **<Request electrode condition>** signal.

<Prewarning>

The **<Prewarning>** signal is set when the electrodes are worn down to a limit that has been programmed in the [Sequence]. This signal indicates that the **<End of Stepper>** (maximum electrode life) will soon be reached. The signal is reset when the **<End of Stepper>** is actually reached.

NOTE

The wear limit may be programmed in the Stepper window of the Welding Parameters menu.

The **<Prewarning>** signal may also be output on request by the **<Request electrode condition>** signal.

<End of Stepper>

This signal indicates that the **<End of Stepper>** (maximum electrode wear) has been reached. Any further [sequence] may be disabled by appropriate programming. The signal is reset when the **<Acknowledge Tip change>** signal becomes high.

NOTE

A "Stop at end of the stepper (Yes/No)" may be programmed in the Basic-Setup in the Global Stepper Setup window.

The **<End of Stepper>** signal may also be output on request by the **<Request electrode condition>** signal.

<Welding fault>

This signal is output in the event of a fault in the [Sequence] or a non-permitted deviation in a monitored value that has been defined as a fault. The ready state (**<Control ready>**) of the timer is cleared. Any further [Sequence] is disabled until the timer receives a signal that the fault has been cleared.

When the cause of the fault has been cleared, the ready state is restored by:

- the **<Reset fault>** signal, cf. page 7-18
- the **<Fault reset with WC>** signal, cf. page 7-18
- the **<Fault reset with reweld>** signal, cf. page 7-18
- an operation in the BOS-5000 software, e.g. in the *Diagnostics -Timer* window, or
- using the reset push button on the front panel, cf. page 3-2.

See also the **<Control ready>** signal description, page 7-38.

This signal is output in

- single spot mode:
  when the spot has been welded. A fault reset signal is required before any other spot can be welded.
- repeat mode:
  upon completion of the spot where a welding fault has been found. Welding the remaining spots in repeat mode is stopped and cannot be continued before a fault reset signal is set.
- seam mode:
  upon completion of the seam. A fault reset signal is required before any other seam can be welded.

NOTE

To define an event as a fault, use the Fault Allocation feature in the Basic Setup menu.

8 Control diagrams

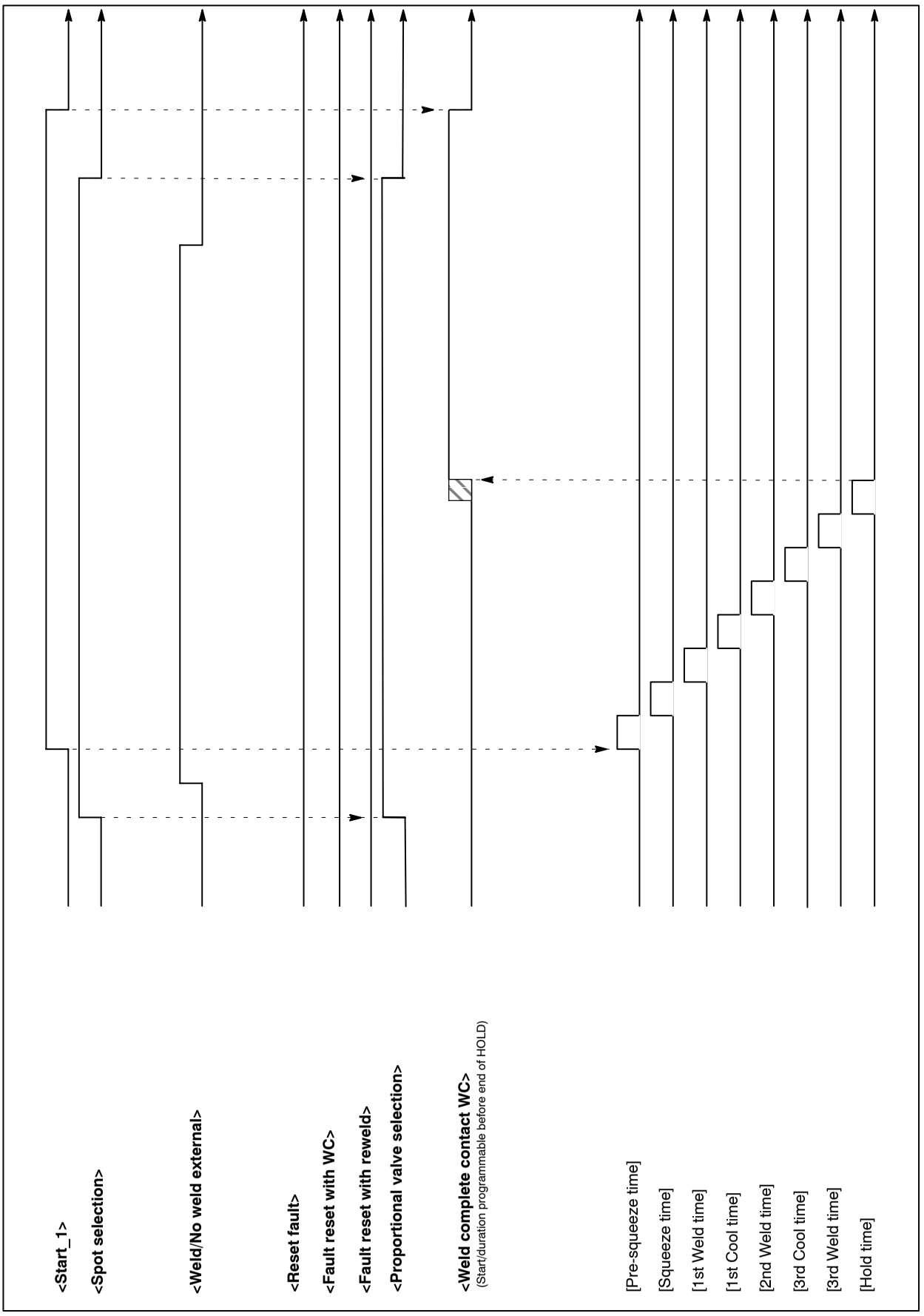

Figure 26: Example of a normal schedule (sequence), single spot

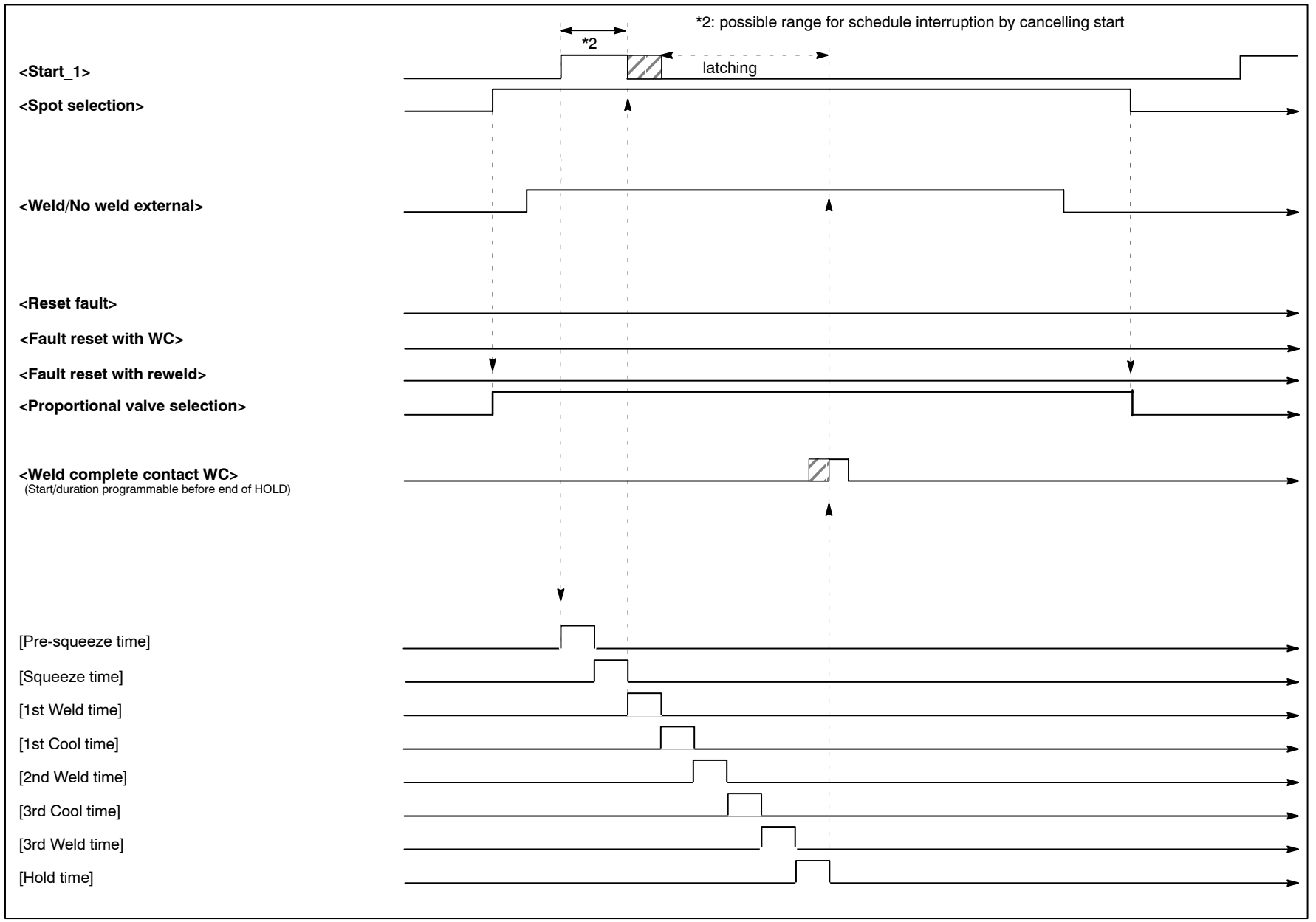

Figure 27: Example of possible range for schedule (sequence) interruption, single spot

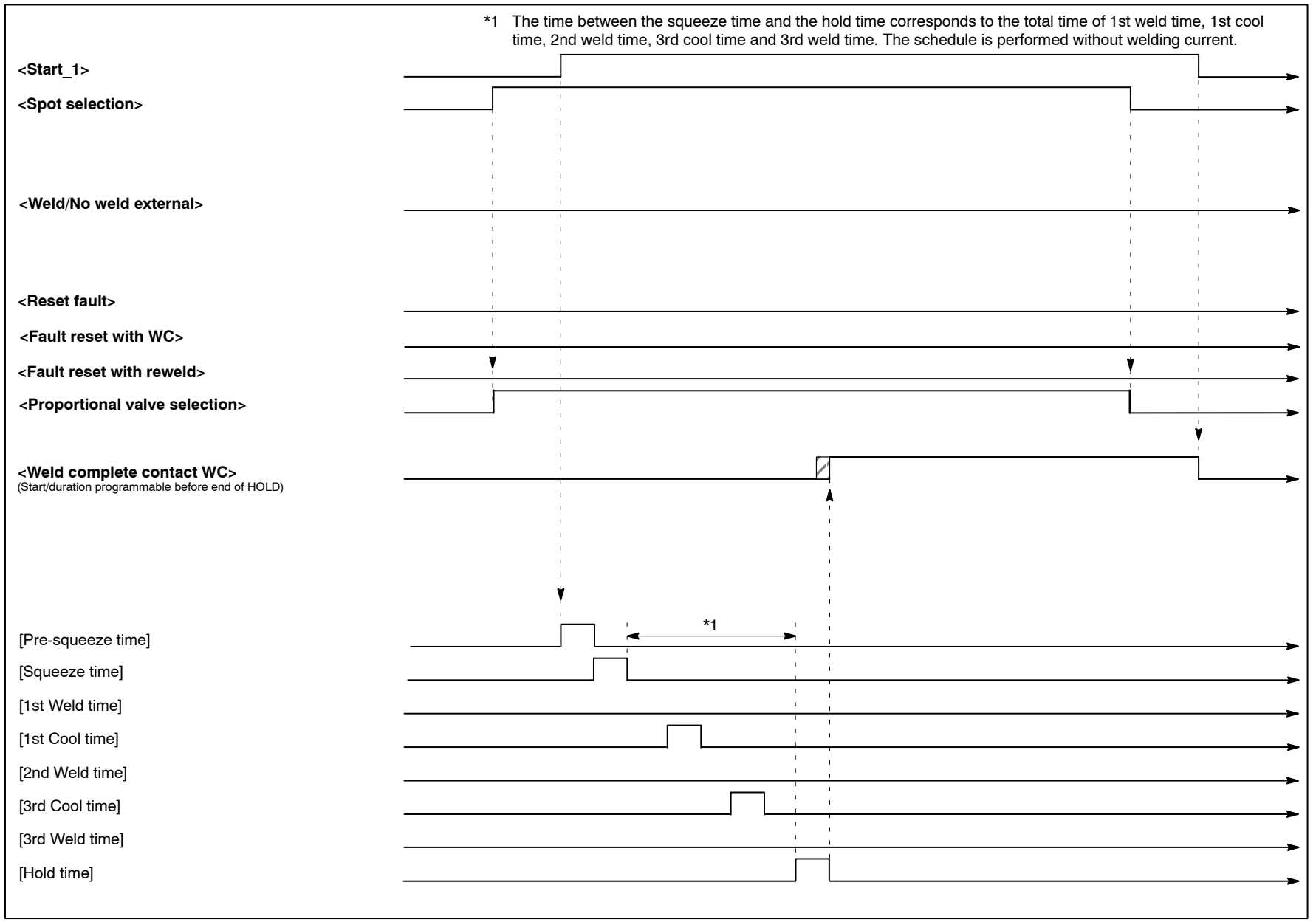

Figure 28: Example of no weld schedule, single spot

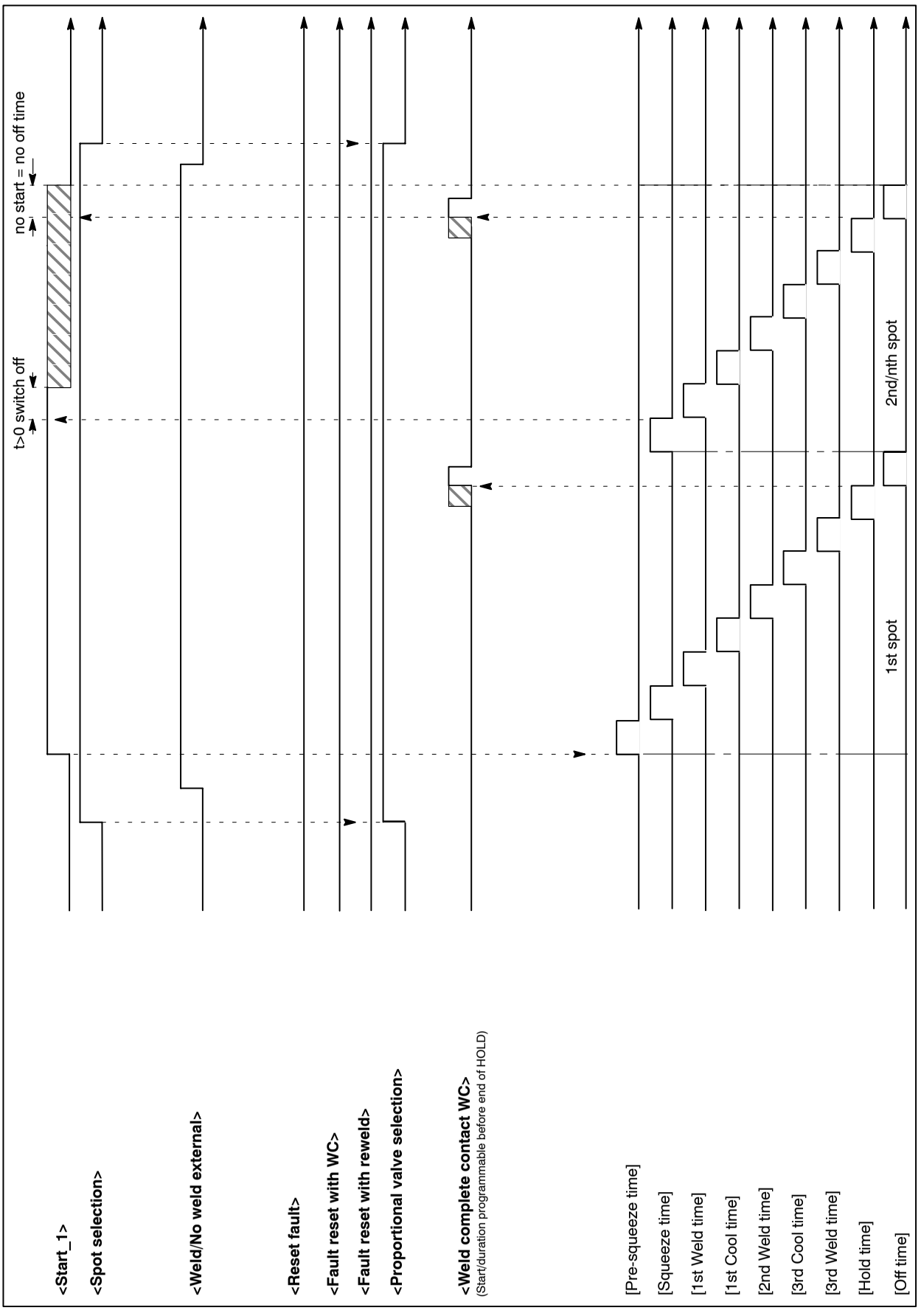

Figure 29: Example of normal schedule (sequence), repeat mode

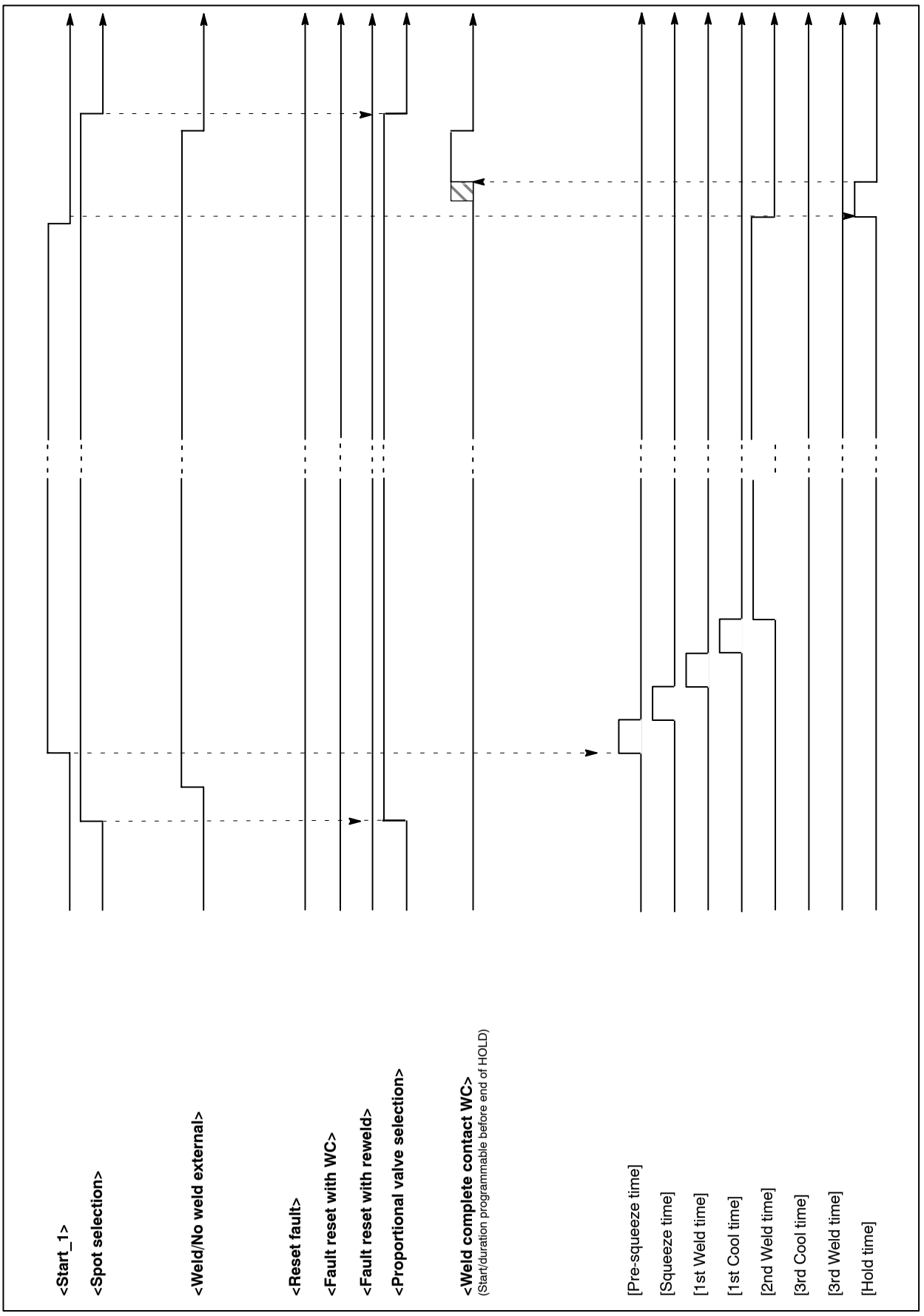

Figure 30: Example of normal schedule (sequence), seam

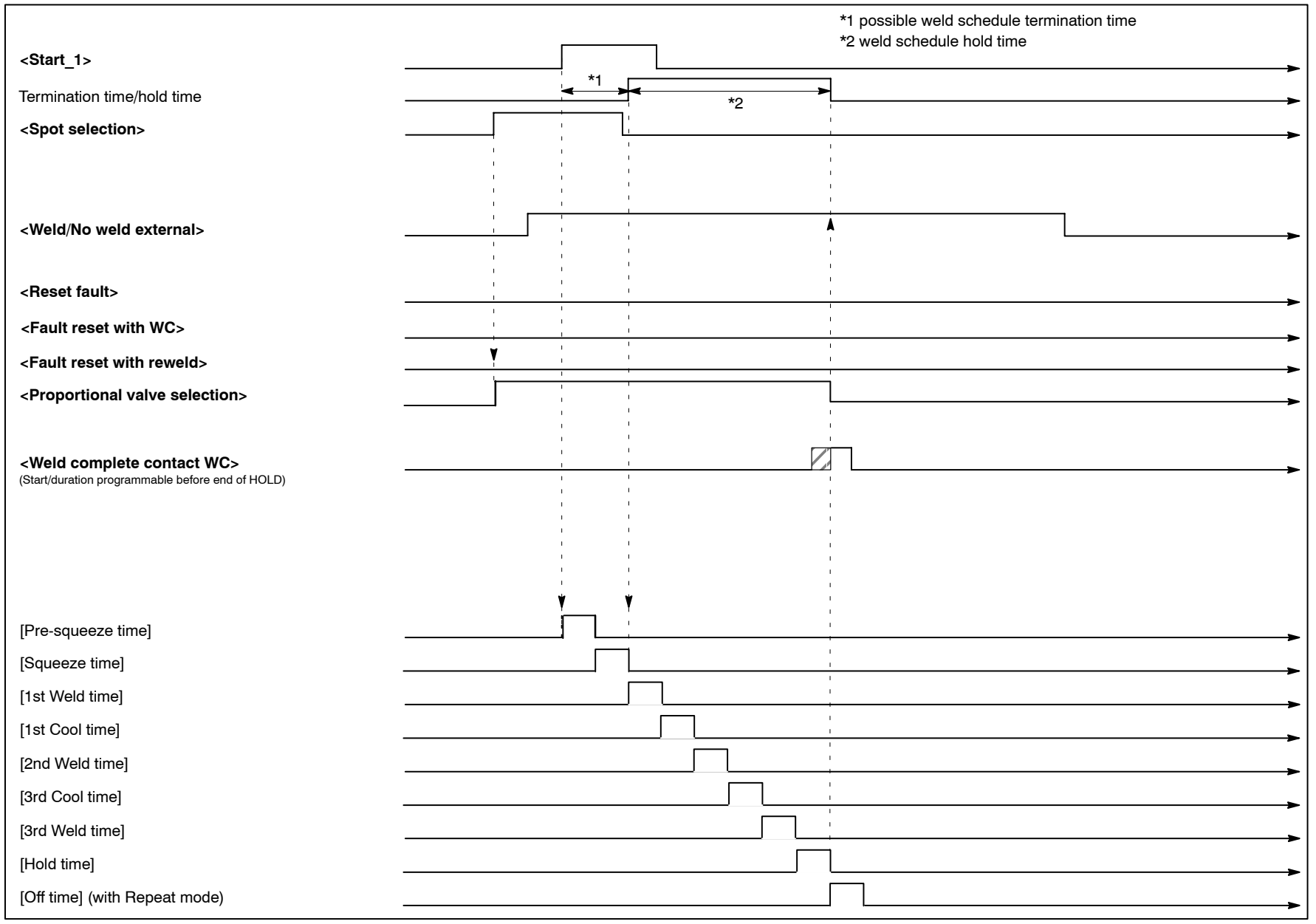

Figure 31: Example of possible termination time/hold time between program selection and start

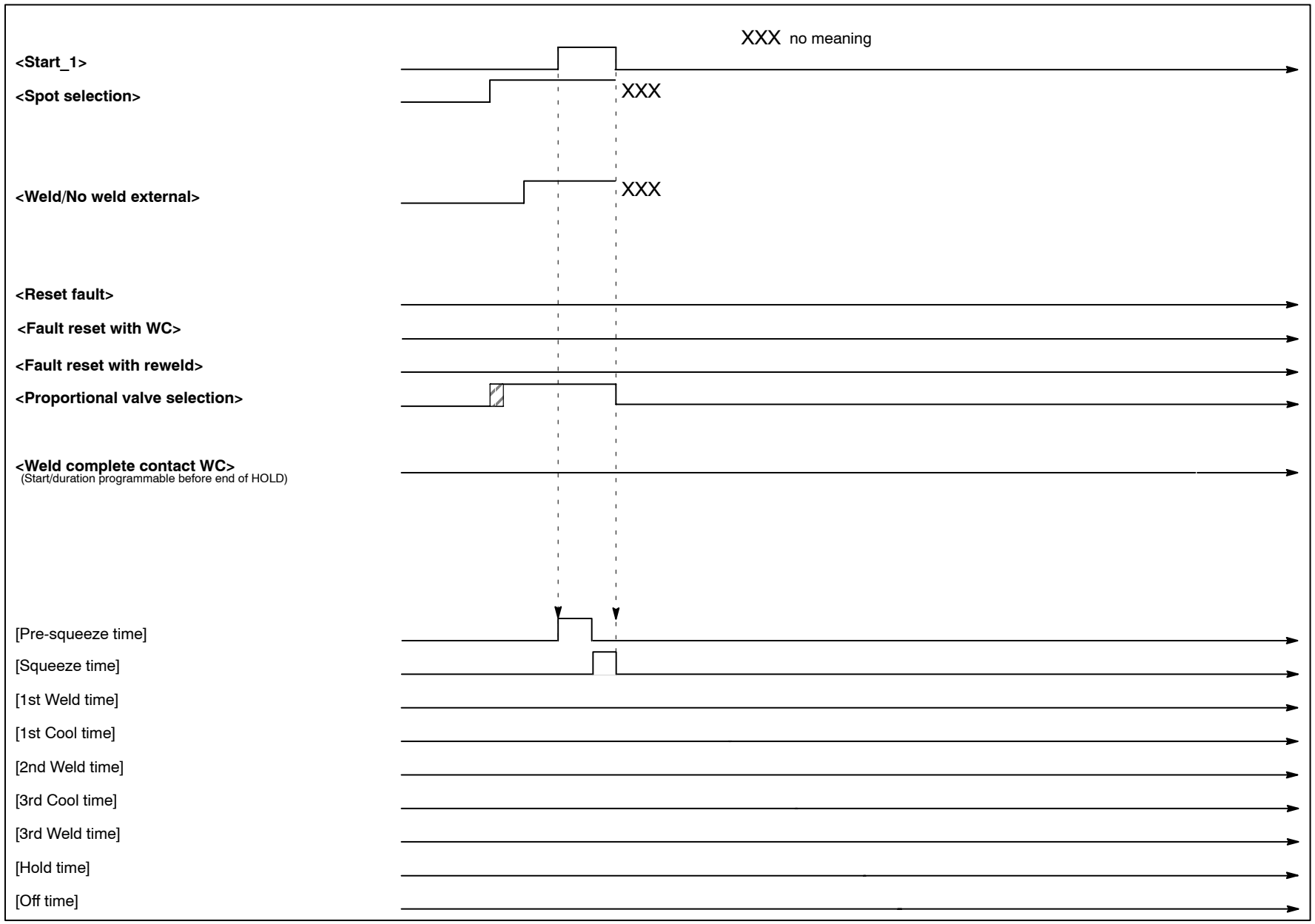

Figure 32: Example of schedule (sequence) cancellation during squeeze times (1.SQZ, SQZ), before latching

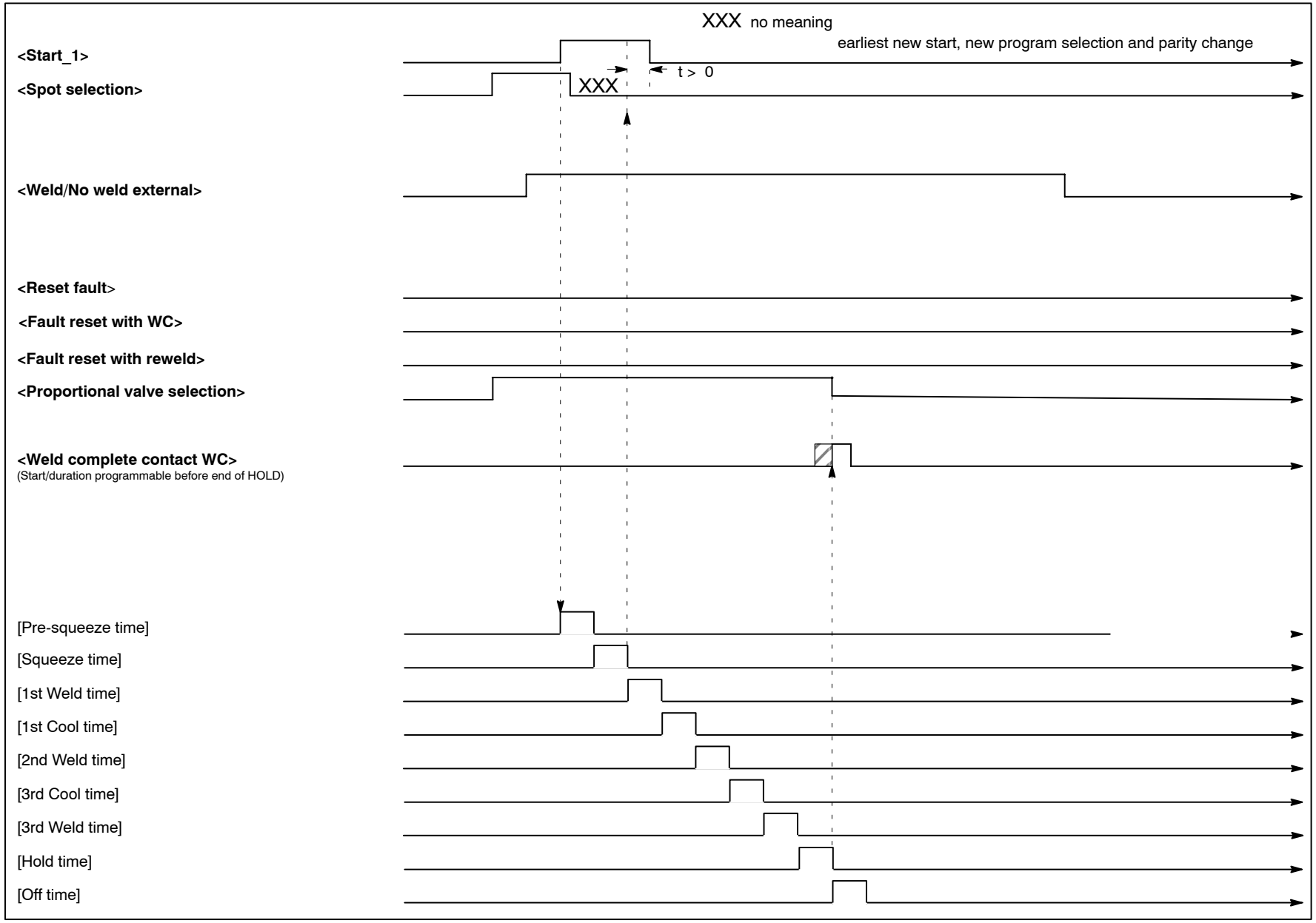

Figure 33: Example of schedule (sequence) interruption during latching

9 Commissioning

NOTE

For commissioning, please note the safety instructions, the technical data and the electrical wiring diagrams.
The following sections contain suggestions on how to proceed during commissioning. Acceptance of these suggestions will depend on the specific circumstances and will be the responsibility of the commissioning personnel.
Concerning the status messages of the timers, please refer to the BOS-5000 software and to section 10, Messages.

The following components are necessary for commissioning:

- programming terminal with V24 interface and Windows operating system, suitable interface boards in the programming terminal and the weld timers if field bus installations are used.
- BOS-5000 software
- V24 interface cable, cf. section 7.1.1, suitable field bus cables for field bus installations.

Communication between the programming terminal and the timers is via the V24, the I/O interface as the programming terminal interface or via the field bus interfaces (e.g. Profibus). In Online mode, all *Welding Parameters* are saved to the timer.
You can save the *Welding Parameters* in the programming terminal in preparation of commissioning (offline timer).

- The BOS-5000 software must be switched to online mode, and the terminal must be connected to the timer or the networked timers.
  Prerequisite:
  - *Timer Reference* has been performed.

For more information on these issues, please refer to the following documentation brochures:

- Operating and Programming Manual BOS-5000, volume 1, part no. 1070 078 217
- Operating and Programming Manual BOS-5000, volume 2, part no. 1070 078 218

NOTE

If any welding parameters have already been programmed in the timer, you should first save these parameters with the Upload (Backup) function.
Select Operation - Services - Upload (Backup).

9.1 Preparations

- Connect and turn on the timer according to the wiring diagrams and safety instructions.
- Deactivate the **<Weld/No weld external>** signal for as long as you do not need any welding current for commissioning.
- Start the BOS-5000 software and enter your user group and user password.
- Select *Operation*.
- Check in the plant layout whether there is a link (V24 -> timer or field bus interface board -> timer) between the programming terminal and the timer.
  - If the timer is not linked to the programming terminal (gray timer symbol in plant layout), check the connection cable or the address settings (with Profibus installations, also check the circuitry of the terminating resistors), the Timer Reference and the power supply to the timers.
- Select the timer and program for commissioning in the BOS-5000 software.

9.2 Testing the welding program

A welding program can be executed with or without firing (with or without welding current). For this purpose, weld internal or the **<Weld/No weld external>** function can be turned on or off.
In a [Sequence] without welding current, for example, one can first examine the I/O signal exchange with the higher-level control unit and the positioning of robot electrode guns.

- Select welding program.

CAUTION!

Before you start:
Always make sure beforehand that there is no person in the danger zone of the robot's electrode gun.

- Start the welding program.

NOTE

If the [sequence] *is not completed, or if it is aborted, messages will be displayed in the Operation - Diagnostics - I/Os or Timer window.*

9.2.1 Suggestions for a welding test

- Check whether the power unit type used has been programmed in *Basic-Setup - Thyristor (Power) Unit Setup*, and change it if necessary.
- Perform the first test weld without firing (Weld/No weld internal ”off” or **<Weld/No weld external>** ”off”).
- Then change to *Quick-Programming* and enter the following test parameters:

Parameter	Setting
Start Inhibit (T)	off
Weld/No weld internal (T)	off
Control Stopped	on
Start Inhibit (P)	off
Weld/No weld internal (P)	off
Sequence	Single Spot
Regulation	Standard
Regulation Mode	Phase angle
Stepper	off
Slope	off
Pre-Squeeze Time [1. SQZ]	60 ms
Squeeze Time [SQZ]	340 ms
1st Weld Time [1. WLD]	Without
1st Cool Time [1. CT]	Without
2nd Weld Time [2. WLD]	100 ms
Number of impulses	1 impulse
3rd Cool Time [3. CT]	Without
3rd Weld Time [3. WLD]	Without
Hold Time [HLD]	100 ms
OFF Time [OFF]	Not used for single spot.

- Check whether the welding cycle is carried out.
- Perform more test welds with firing (Weld/No weld internal ”on” and **<Weld/No weld external>** signal ”on”)
- Change the [weld times], [%I], [number of impulses], etc. for the parts to be welded.

9.3 *Basic-Setup*

If the timer has already been programmed, the *Quick-Programming* will give you a good overview of the most important *Welding Parameters*.

- Use function key **<F9>** to change from *Operation* to *Programming*.
- Check the *Basic-Setup* of all programs used.
  - *Safe Delete (Delete Memory)*
  - Find out whether the protocol memories, Actual values and Welding Parameters can be deleted.
    After deletion, the timer will use default values for as long as you have not transferred any other *Basic-Setup* and *Welding Parameters*.

NOTE

The "All Welding Parameters" memory area contains the entire programming. If you delete this memory, all Welding parameters have to be transferred again.

- *Fault-Allocation*
  Used to determine the timer response to events within the [Sequence].
  - Fault : Timer will lose its ready status.
  - Warning : Timer will **not** lose its ready status.
- Check the programmed values for the duration and start time of the **<Weld Complete contact>** (WC), or adjust them to the higher-level control unit.
- *Thyristor (Power) Unit Setup/Weld Transformer Selection*
- Compare the entries and settings to your network data and the power unit used.
- *Global Electrode (Stepper) Setup*
  Stop at **<End of Stepper>** and admissible correction limits for subsequent Operation.
  These settings can be entered when commissioning has been completed.
- *Stepper Curves/Tipdress Curves*
  These programmed values are necessary later on during operation in order to compensate for the electrode wear. The inputs are experimental values and may be entered when commissioning has otherwise been completed.

NOTE

If you have access to weld timers which already contain the stepper curves you want to use, you may load them to the programming terminal and then to your weld timer.

- *Electrode Setup*

- Check the *Electrode Setup* or adjust it to the hardware components of your welding equipment.
  The input concerning the toroid sensitivity and the [Pressure] should be adjusted to the real conditions later on by performing the *Scaling* procedure.

- *Sequence Setup*

  Suggestion concerning the settings for all programs:

- Deactivate Start Inhibit.
  Firing setting depending on the requirements of the commissioning work (with/without welding current).

CAUTION!

When Weld/No weld external has been activated and Weld internal has been switched on, [Sequences] can be performed with welding current.

- Check and/or adjust maximum Weld Time for [1st Weld Time], [2nd Weld Time] and [3rd Weld Time].

- Deactivate Control Stopped for KSR mode.

- Set maximum number of repeats. This number will only be active in those programs in which spot repetition (reweld) has been activated.

  Suggestion concerning the settings for the selected program:

- Deactivate Start Inhibit.

- Check the assignment of the electrode to the program.

- Set the Regulation Mode and the Standard monitoring mode.
  When commissioning has been completed, these values can be adjusted to higher requirements of the production process (Mixed mode).

- Deactivate spot repetition (reweld).

- Select single spot mode for the sequence.

NOTE

When working with several comparable weld timers, you should perform an Upload (Backup) for the Basic-Setup and transfer this data later on to the other weld timers using the Download (Restore) function.

9.4 *Welding Parameters*

If the timer has already been programmed, the *Quick-Programming* will give you a good overview of the most important *Welding Parameters*.

- Use function key **<F9>** to change from *Operation* to *Programming*.
- Check the *Welding Parameters* of all programs used.
  - *Sequence*
    - Check the sequence parameters, in particular, the [Weld Times] and the [%I] values (%I or kA).
  - *Stepper, Monitor Stepper*
    Recommendation: First use a simple [Sequence] without electrode maintenance (stepping). The *Steppers* can be programmed towards the end of commissioning.
  - *Current* and *Time Monitoring*
    - Turn *Current* and *Time Monitoring* on. For as long as you do not know the real conditions, you should use fairly large tolerances initially.

NOTE

For the subsequent production process, you should define smaller tolerances for monitoring in order to assure the quality of your products.

- *Pressure and Pressure Stepper*
  Recommendation: You should first use a simple [Sequence] without *Pressure* and *Pressure Stepper*. These values can be programmed towards the end of commissioning.

9.5 *Scaling* process

For quality assurance, you should adjust your welding equipment to your real conditions by means of *Scaling*.

The following parameters will be adjusted through *Scaling*:

- toroid sensitivity
- conversion factor for pressure output
- zero shift for pressure output

Scaling by manual entry:

- Select *Scaling* on the first screen, e.g.

- For automatic scaling/calibration, see pages 7-24 and 7-31.

9.6 Adjusting the program to your welding task

- Check the quality of your spot welds.

The actual current values of the spots welded are displayed in various windows, e.g. in the *Programming - Sequence - Actual Values* window.

- If necessary, adjust the following programmed values to your requirements:
  - [%I] and [Weld Time]
  - Type and number of [Weld Times]
  - Current upslope and downslope times [Slope]

9.7 Activating *Stepper* (electrode maintenance)

The [%I] *Stepper* refers to the [Amount of current] and the [Pressure]. The stepper values are experimental values, it may not be possible to enter these values before having closely monitored the electrode lives.

Procedure for setting the *Stepper* functions:

- Program the *Stepper* and *Tipdress Curves* in the *Basic-Setup.*
- Activate *Stepper* in the *Programming - Stepper* window.
- Enter the electrode parameters for calculating the wear.
- Select a *Stepper Curve* and a *Tipdress Curve.*
- Enter the number of dressings.
- Program the *Stepper* for the new electrode, stepper and tipdressing areas.
- Program the Pressure Stepper values.

9.8 Activating monitoring

For quality assurance, *Current* and/or *Time Monitoring* should always be switched on, and the appropriate tolerance bands should be entered.
The Actual Values are displayed and can be accepted as setpoints.

- Activating monitoring
  Select *Programming - Basic-Setup - Sequence Setup.*

- Enter *Current Monitoring* and the tolerance band
  Select *Programming - Welding Parameters - Current Monitoring.*
  To facilitate the definition of the reference current and tolerance band, this window shows an *Actual value* display.

- Activate *Time Monitoring*
  Select *Programming - Welding Parameters - Time Monitoring.*
  To facilitate the definition of the reference time and the admissible time tolerance, this window shows an *Actual value* display.

- Program *Monitor Stepper*
  Select *Programming - Welding Parameters - Monitor Stepper* and enter the monitoring values.

9.9 Other adjustments and programs

When commissioning has been completed, you may protect access to the BOS-5000 software in order to restrict changing the *Welding Parameters* and the *Basic-Setup* by defining user levels. A systems disk is needed for this purpose.

- Use the *BOS-5000 Set-up* in the *System* menu for this purpose.

Other adjustments:

- Maximum admissible limits for [%I] and [Pressure] correction by the user.
- Regulation and monitoring mode
- Creation of spot allocation tables

Other programs with slightly different parameters can be generated by copying.

- Copying programs:
  Select *Operation - Services - Copy.*
- Adjusting the Stepper Reference in the copied program.

9.10 Saving the Welding Parameters

When commissioning has been completed, you should backup your programs with the *Upload (Backup)* function.

- Create *Upload (Backup)*:
  Select *Operation - Services - Upload (Backup).*

NOTE

Existing Upload (Backup) files will be replaced. You may enter a new file name for the new Upload (Backup) file using the File Reference function.

When the *Upload (Backup)* has been completed, we recommend using the *Compare* function in order to check whether the saved *Welding Parameters* and *Basic-Setup* are identical with the timer values.

- Performing *Compare*:
  Select *Operation - Services - Compare: File -> Timer.*

NOTE

When using the Compare function, you should always make sure that you selected the proper timer and restore data.

10 Messages

10.1 Fault and Status Messages

Messages

- **Warnings** : The ready status of the timer remains, further [sequences] are not inhibited.
- **Faults** : The timer is no longer ready, further [sequences] are inhibited.

NOTE

Internally the timer works with coded numbers. All messages are output on the programming unit in text format.

10.2 Ranges of Messages

[A] Messages concerning the connection WT → Programming terminal (communication messages)
[B] Messages concerning the stepper (electrode) status (Pre*warning*, *End of Stepper reached*, etc.).
[C] Messages concerning the timer status (*battery low*, *no +24V* etc.).
[D] Messages from active monitoring (*Weld-time exceeded*).
[E] Messages concerning automatic scaling/monitoring

10.2.1 [A] - Communication Messages

Code	Explanation
-93	
-94	
-95	
-96	*Communication with weld timer cannot be established*
-97	*Communication with weld timer was disconnected*
-98	*Upload (Backup) or Download (Restore) active in timer*
-99	*Access to objects denied*
-100	*Incorrect timer type (wrong timer in Ref. Table)*
-146	*Fatal error layer 8*
	Error when starting the status message (possibly not enough RAM memory. Close other applications).
-193	*Error during checking of parameters*
-194	*Timer name not found*
-195	*Timer not found*
-196	*Driver not found*
-197	*Station not found or driver not loaded*
-198	*Object not found*
-199	*Service not found*
-200	*Parameter call error*

10.2.2 [B] - Electrode (Stepper) Messages

Code	Explanation	Additional code
31*	*End of Stepper*	Electrode no.
32*	*Prewarning*	Electrode no.
33*	*Tip dress request*	Electrode no.
34*	*Tip dress necessary*	Electrode no.
40*	*%I (Current) Prewarning*	Electrode no.
41*	*Maximum current*	Electrode no.

10.2.3 [C] - Messages Concerning the Timer Status

Code	Explanation	Additional code
80	*Stop Open circuit / no +24V*	-
83	*Thyristor unit not ready*	-
84	*Battery low*	-
85	*Memory deleted = RAM checksum error*	-
86	*Data Restore active*	-
87	*No weld program = invalid parameter*	Program no.
88	*Hardware fault*	H/W fault bitcode
89	*I/O-bus fault (only for WT with serial I/O bus)*	-
90		-
91	*Main switch tripped*	-
93	*Synchronization fault*	-
94	*Sequence inhibited*	Program no.
96		-
97		-
98		-
99	*Welding process*, cf. [D], [E], [F]	Monitoring code
100	*Supply voltage fault*	-
102	*No weld external*	-
103	*No weld internal*	-

10.2.4 [D] - Messages for Current and Weld Time Monitoring

Code	Explanation
1001	*Current measurement loop open*
1002	*Current measurement loop shorted*
1003	*No voltage 1. HW*
1004	*Primary voltage measurement fault*
1010	*No current* (standard mode)
1011	*No current 1. WLD* (mixed mode)
1012	*No current 2. WLD* (mixed mode)
1013	*No current 3. WLD* (mixed mode)
1020	*Current too low* (standard mode)
1021	*Current too low 1. WLD* (mixed mode)
1022	*Current too low 2. WLD* (mixed mode)
1023	*Current too low 3. WLD* (mixed mode)
1030	*Current too high* (standard mode)
1031	*Current too high 1. WLD* (mixed mode)
1032	*Current too high 2. WLD* (mixed mode)
1033	*Current too high 3. WLD* (mixed mode)
1040	*Series of welds below lower threshold* (standard mode)
1041	*Series of welds below lower threshold 1. WLD* (mixed mode)
1042	*Series of welds below lower threshold 2. WLD* (mixed mode)
1043	*Series of welds below lower threshold 3. WLD* (mixed mode)
1050	*Current measuring range exceeded* (standard mode)
1051	*Current measuring range exceeded 1. WLD* (mixed mode)
1052	*Current measuring range exceeded 2. WLD* (mixed mode)
1053	*Current measuring range exceeded 3. WLD* (mixed mode)
1060	*Weld time too short*
1070	*Weld time too long*

10.2.5 [E] - Messages concerning automatic scaling/monitoring

Explanation
Communication error Error in the communication with the external current meter.
Measured value received is invalid An inconsistent measured value has been received in communication with the external current meter.
No measured value received No measured value has been received in communication with the external current meter. The load cell could not pick up any voltage during the pressure calibration process.
Log error An error occurred when changing from the Bosch log to the 24V log of the reference current meter.
Incorrect mode The monitoring mode is set to ”secondary” for current scaling. Therefore, current scaling is aborted.
Sequence aborted An error has occurred in a sequence, which results in a program abort (Emergency-Stop, e.g.). Additionally, a welding fault message is displayed with the additional code ”Scaling aborted”.
Current out of range The deviation of the primary or secondary current is more than 30% from the command value.
Difference primary/secondary current too large Current monitoring shows that the difference between the primary and the secondary current is outside the programmed tolerance band.
Result invalid Processing of the force values measured for pressure calibration leads to inconsistent results.
Time too long The time to pressure is more than the total of pre-squeeze time plus squeeze time minus pressure check before squeeze time.
Time too short The time to pressure is less than the pre-squeeze time
Pressure too high The final value of output pressure that has been determined exceeds the pressure command value by more than 10%.
Pressure too low The final value of output pressure that has been determined falls short of the pressure command value by more than 10%.

11 Maintenance

WARNING!

- Danger of life through electrical voltage!
  Prior to any maintenance work - unless described otherwise - the system must always be switched off! If the system had been active shortly before, wait until the system is totally de-energized before starting the maintenance work (e.g. because of charged capacitors, etc.). For the duration of the maintenance work the system must always be protected against re-closing.
  In the event of necessary measurement or test procedures at the active system, the applicable safety and accident prevention regulations must be strictly observed. In any case, suitable insulated tools must be used!
- Danger of life through inappropriate EMERGENCY-STOP facilities!
  EMERGENCY-STOP facilities must be operative in all modes of the system. Releasing the EMERGENCY-STOP facility must by no means result in an uncontrolled restart of the system!

CAUTION!

- The right to perform repair/maintenance work on the timer components is reserved to the Bosch service department or to repair/maintenance units authorized by Bosch!
- Only use spare parts/replacement parts approved by Bosch!
- Spent batteries or accumulators must be disposed of as hazardous waste.

The connections and termination points of all connecting cables must be checked in regular intervals for firm sit. Check all cables for damages.

11.1 Changing batteries

NOTE

Data buffering is assured for about 30 hours, without internal or external 24 VDC supply voltage and after removing the battery.

A 3.6 V Lithium battery is installed in the PSI 6XXX.350 L1 to provide data backup power. This battery supplies the RAM memory and the internal clock in the power down state. Battery life is approx. 2 years.

If the battery voltage drops so far, that data buffering is no longer assured, the welding timer will sense this state. The reaction to this event depends on the *Fault Allocation* in the menu *Basic Setup.*

- If a low battery is defined as a fault, the control prevents the next start and the Ready message turns off. The [Sequence] can resume after changing the battery and resetting the fault.
- If a low battery is defined as warning, the control will issue the appropriate message, but [Sequence] will not be disabled.

To change the battery, first remove the cover to the battery compartment with CCW motion and remove the old battery. Then insert the new battery, while observing the correct polarity (see illustration on front cover).

NOTE

To prevent loss of data, a bi-annual battery change is recommended as part of preventive maintenance procedures.

CAUTION!

To prevent environmental harm, observe the currently valid disposal regulations for batteries in effect.

CAUTION!

Danger of explosion: Never expose the battery to temperatures above 85 °C. Do not attempt to charge, solder or incinerate the battery. Do not short circuit or disassemble the battery.

12 Ordering

Spare parts

Designation	Part no.
PCB I/O level	1070 075 808

Included in shipment (STKK plug-in terminal)		Part no.
[X]	please refer to section 3.2	
[10]	Power supply, X4: STKK 14-pin (3.5 mm)	1070 916 914
[11]	Load cell, X5: STKK 2-pin (3.5 mm)	1070 914 564
[12]	no function, X8: STKK 3-pin (3.5 mm)	1070 916 798
[13]	no function, X2: STKK 5-pin (3.5 mm)	1070 916 910
[14]	Analog output, load cell X9: STKK 6-pin (3.5 mm)	1070 916 554
[15]	Current sensor, X3: STKK 8-pin (3.5 mm)	1070 916 553

Not included in shipment		Part no.
[X]	please refer to section 3.2	
[9]	V24, X1: 9-pin female D shell connector	1070 912 981
[9]	V24, X1: 9-pin female D shell connector housing	1070 313 723
	finished cable V24, X1: for connecting PC to timer; length 1.5 meter	1070 066 749
	shielded cable 2 x 2 x 0.75 mm^2 LiYCY	1070 913 494
[16]	Battery compartment with cover	1070 917 004
[16]	Battery	1070 914 446

Your notes:

A Annex

A.1 Abbreviations, Terms

2.WLD	2nd Weld time: main weld time, can consist of a block comprising individual impulses, only the 2.WLD can have upslope and downslope
CT COOL	Cool time: time between the current pulses/blocks (1., 2., 3. COOL (CT))
Current	Current measured in %I (scale units) or kA (same as HEAT).
DST	Down Slope Time: until the end of 2. WT current is reduced gradually.
EA (EO)	Electronic output: in this case +24V through transistor
EOS	End-of-Sequence contact: signal is output when the spot has been completed
Ext	External, e.g. +24V: voltages for signal transmitters (switches) and actuators (valves) external to the timer
Firing (Ignition)	Weld on/Weld off: enabling and disabling of the firing (ignition) impulses for activating the power unit.
HEAT	Heat in %Ht or kA (same as current)
HLD HOLD	Hold time: last time of the welding schedule; time following the last weld time, during which the parts just welded are allowed to cool down
HSA	Main switch trip
IMP	Number of pulses forming the 2.WLD
LT	Power Unit (thyristor or inverter)
NBS	Mains load limitation control: for monitoring and influencing the mains load
OFF	Off time: time between 2 spot welds during which the solenoid valve is not activated. Available only in REPEAT mode.
PG	Programming unit/welding computer
Post-Heating Time	Also called 3. WLD.
Pressure (Monitor) Contact (MC)	Monitor Contact: e.g. monitoring of the pressure in the cylinder that closes the electrodes, or monitoring of the electrode position; gun closed.
PSG	Transformer rectifier unit for the PSU inverter
PSI	Inverter power unit (1000 Hz)
PSL	PS power unit
PSP	PS programming module
PSS	PS timer
PST	Thyristor power unit (50/60 Hz)
PSU	Weld current inverter (medium frequency)
RA (RO)	Relay output, +24V are output via a contact
REPEAT	Repeat mode: for manually operated systems only
SING	Single spot mode for automatic welding machines and manual systems

Slope	Current increase (or decrease) from an initial to a final current.
Solenoid valve	Activates the cylinders to close the electrodes.
SQZ	Squeeze time that elapses before the weld time. The electrodes squeeze the parts to be welded together.
Stepper	Current (heat) stepping for compensating for electrode wear
Temp	Temperature
UST	Upslope Time; time during which the Current (HEAT) stops after beginning of 2.WLD
WC	Weld Complete contact: signal is output when the spot has been completed
WLD	Weld time
WT	Weld timer, also called resistance weld timer

A.2 Regulation terms

%Ht	Specification of heat in %Ht: represents the electrical phase angle (same as %I)
%I	Specification of current in %I: represents the electrical phase angle (same as %Ht)
kA	kilo Amperes
KSR	Constant current regulation: the current in the secondary circuit is maintained constant by regulation
KUR	Constant voltage regulation: compensation for mains voltage fluctuations
PHA	Phase angle (shift) regulation
SKT (SKV)	Scale Units; correspond to an electrical phase angle.

A.3 Index

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