Rexroth
Bosch Group

Rexroth PST 6xxE

AC Compact
Weld Timer / Power Supply Unit

Technical Information

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Edition 01

Title Rexroth PST 6xxE

AC Compact
Weld Timer / Power Supply Unit

Type of Documentation Technical Information

Document Typecode DOK-PS6000-AC-Compact*-FK01-EN-P

Purpose of Documentation The present manual contains information on

- the mechanical construction
- the electrical connection
- the functionality

of the PST 6xxE series compact weld timers.

Record of Revisions

Description	Release Date	Notes
DOK-PS6000-AC-Compact*-FK01-EN-P	12.2007	

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Contents

Contents

Contents

Contents

Contents

Safety Instructions

1 Safety Instructions

The products described in this manual were developed, manufactured and tested in compliance with the safety requirements of the EU machinery directive. This product poses no danger to persons or property if it is used in accordance with the handling stipulations and safety notes prescribed for its configuration, mounting, and proper operation.

Nevertheless, there still is some residual risk!

Therefore, you should read this manual before installing, connecting or commissioning the products or programming the welding system.
Store this manual in a place to which all users have access at any time!

The contents of this manual refer to

- the mechanical construction
- the electric connection and
- the functionality

of the PST 6xxE series compact weld timers.

1.1 Possible Safety Markings on the Product


Warning of dangerous electrical voltage!


Warning of hazards associated with batteries!


Electrostatically sensitive components!


Lug for connecting PE conductor only!


Function ground, ground with low parasitic voltage


Connection of shield conductor only

1.2 Safety Instructions in this Manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol is used to warn of a **dangerous electrical voltage**. The failure to observe the instructions in this manual in whole or in part may result in **personal injury**.

DANGER
This symbol is used wherever insufficient or lacking compliance with instructions may result in **personal injury**.

CAUTION
This symbol is used wherever insufficient or lacking compliance with instructions may result in **damage to equipment or data files**.

☞ This symbol is used to draw the user's attention to special circumstances.

★ This symbol is used if user activities are required.

Modifications in this manual as compared to a previous edition are marked by black vertical bars in the margin.

Safety Instructions

1.3 Proper use

The product described

- serves in connection with a welding transformer and the appropriate AC power unit for
  - resistance welding of metals

  and
- is suitable for operation in industrial environments (emission class A, group 2) in accordance with the following standards:
  - EN 50178
  - EN 50240
  - EN 60204-1

Any other application is deemed improper use!

DANGER
Risk of high-frequency interference!
This resistance welding equipment belongs to class A.
Class A resistance welding equipment is not intended for use in the public low-voltage network supplying, e.g., residential buildings, because it may interfere with other equipment in the environment.

DANGER
The consequences of an improper use include personal damages of the user or of third parties as well as damages to property – the technical equipment, the workpiece to be processed, or environmental hazards.
Therefore, you should only use our products for their intended purpose!

☞ **For operation in residential environments, in trade and commercial applications and small enterprises, an individual permit of the national authority or test institution is required; in Germany, please contact the Bundesnetzagentur (BNetzA) or its local branch offices.**

The faultless, safe functioning of the product requires proper transport, storage, erection and installation as well as careful operation.

Safety Instructions

1.4 Environmental protection, recovery of materials and re-use

Environmental protection

Our products do not contain any hazardous materials which may be released by their intended use. Therefore, no negative effects on the environment are to be expected under normal circumstances.

Recovery of materials

The products manufactured by us can be returned to us free of charge for proper disposal.

However, the following conditions have to be satisfied for this purpose:

- no deposits such as oil, grease or other contamination
- no inappropriate extraneous materials or third-party components included.

The packaging materials are made of cardboard, wood and polystyrene. For environmental reasons, please do not return any **empty** packagings to us. They can be easily recycled.

The products are to be sent postage prepaid to the following address:
Bosch Rexroth Electric Drives and Controls GmbH
Bürgermeister-Dr.-Nebel-Straße 2
D 97816 Lohr am Main

Recycling

Principal components of our electronic equipment:

- Steel, aluminum, copper, plastic materials.

Due to their high metal content, the most of the materials of our products can be recycled. In order to ensure optimum recovery of metals, the equipment has to be split into individual components.
The metals that are contained in the electric and electronic modules can also be recovered using special separating methods. The plastic materials recovered by this process can be disposed of thermally.

☞ **Batteries or accumulators must be removed prior to recycling and disposed of in an environmentally compatible manner!**

Safety Instructions

1.5 Qualified Personnel

The requirements as to qualified personnel depend on the qualification profiles described by ZVEI (Zentralverband Elektrotechnik und Elektronikindustrie – German Electrical and Electronic Manufacturers' Association) and the VDMA (Verband deutscher Maschinen– und Anlagenbau – German Engineering Federation) in:
Weiterbildung in der Automatisierungstechnik
edited by: ZVEI and VDMA
Maschinenbau Verlag
Postfach 71 08 64
D 60498 Frankfurt

This manual is designed for technicians and engineers with special welding training and skills. They must have a sound knowledge of the software and hardware components of the weld timer, the power supply used, and the welding transformer.

Project engineering, programming, start and operation as well as the modification of program parameters is reserved to properly trained personnel! This personnel must be able to judge potential hazards arising from programming, program changes and in general from the mechanical, electrical, or electronic equipment.

Interventions in the hardware and software of our products, unless described otherwise in this manual, are reserved to specialized personnel. Tampering with the hardware or software, ignoring warning signs attached to the components, or non-compliance with the warning notes given in this manual can result in serious bodily injury or property damage.

Only skilled persons as defined in IEV 826-09-01 (modified) who are familiar with the contents of this manual may install and service the products described.

Such personnel are

- those who, being well trained and experienced in their field and familiar with the relevant norms, are able to analyze the jobs being carried out and recognize any hazards which may have arisen.
- those who have acquired the same amount of expert knowledge through years of experience that would normally be acquired through formal technical training.

With regard to the foregoing, please also note our comprehensive range of training courses.
Please refer to **www.boschrexroth.com/training** for the latest information on training courses, teachware and training systems. Our Training Center will be pleased to provide you with information

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training.brc@boschrexroth.de

Safety Instructions

DANGER
Danger of life for 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!
Therefore, these persons should avoid the welding system.
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!

Safety Instructions

1.6 Installation and assembly

DANGEROUS ELECTRICAL VOLTAGE
Danger of life when performing assembly works on live systems!
Please ensure that all plant sections worked on in the course of the assembly have been safely isolated from supply and sufficiently protected against accidental reclosing!

DANGER
Possibility of damages to persons and to property in the event of inappropriate performance of installation or assembly works.
Therefore, you must observe the information provided in the ”Technical Data” (environmental conditions) applicable to the installation and assembly.
Installation and assembly are reserved to qualified personnel.

DANGER
Danger of life and damage to property through inadequate degree of protection!
The degree of protection of the products described is IP 20.
They must be installed in a switch cabinet satisfying at least degree of protection IP 54.

DANGER
Danger of injuries and damage to property through inappropriate installation!
When installing the devices and, in particular, the control elements it must be ensured that they are sufficiently protected against inadvertent operation or contact.

DANGER
Danger of injuries and damage to property through inappropriate fastening!
Select the place of installation and the method of fastening the modules according to their weight!

DANGER
Danger of injuries through lifting of excessive weights, bruises or sharp metal edges!
Installation and assembly are reserved to qualified personnel using proper hoisting equipment.

Safety Instructions

DANGER
The safety and accident prevention regulations as amended shall be observed!
Wear a protective helmet, safety shoes and gloves!

CAUTION
Short-circuits!
When drilling or cutting holes into switch cabinets, burr may get inside previously installed modules. Furthermore, when connecting cooling water lines water may leak into modules.
The possibility of short-circuits and destruction of the systems cannot be entirely ruled out.
Therefore, all affected modules should be well partitioned prior to all work! Non-compliance will result in the extinction of any warranty claims.

CAUTION
Heat accumulation!
An installation clearance of min. 100 mm must remain above and below the modules. If these clearances are not observed, there is a risk of heat accumulation which may cause the unit to fail.

CAUTION
Consequential damages due to leaks in the cooling water circuit!
In the event of a leak in the cooling water circuit, there is a risk of damaging the surrounding components by leaking cooling water.
Therefore, water-cooled modules must be installed so that the units inside the switch cabinet are sufficiently protected against leaking cooling water.

Safety Instructions

CAUTION
Damage to property due to poor water quality in the cooling water circuit, if applicable!
Deposits in the cooling system may restrict the water flow and thus reduce the performance of the cooling system with time.

Therefore, you must ensure that the cooling water used has the following properties:

- **pH value : 7 to 8.5**
- **Degree of hardness D_{max} : 10 German degrees = 12.5 British degrees = 10.5 US degrees = 18 French degrees**
- **Chlorides : max. 20 mg/l**
- **Nitrates : max. 10 mg/l**
- **Sulfates : max. 100 mg/l**
- **Insoluble components : max. 250 mg/l**

Tap water usually meets these conditions. However, an algaecide must be added to the water.

Safety Instructions

1.7 Electrical connection

DANGEROUS ELECTRICAL VOLTAGE
Considerable dangers are associated with the mains connection! 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!

Prior to connection, it is absolutely important to observe the following:

- **Power OFF**
- **Protection against reclosing**
- **Check for zero voltage**
- **Grounding and short circuit**
- **Cover or screen off live parts**

DANGEROUS ELECTRICAL VOLTAGE
Working with mains voltage may lead to death, severe injury or considerable damage to property unless appropriate precautionary measures are taken.

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.

Hazardous conditions of the system and function failure of electric modules can occur as a result of incorrect mains voltage! Therefore please note:

- **The mains voltage must be identical with the nominal voltage indicated on the nameplate of the product!**
- **Fluctuations deviations of the mains voltage from the nominal value must not exceed or fall below the specified tolerance limits (see Technical Data).**
- **The mains system must be appropriately fused!**
- **For all electrical connection work, suitable insulated tools must be used!**

DANGEROUS ELECTRICAL VOLTAGE
Danger of life through insufficient PE conductor system!
The products must be connected to the PE conductor system of the plant correctly. Make sure that the conductor cross-section of the PE conductor is of sufficient size. The complete connection of the PE conductor system must be verified in accordance with EN 60204 Part 1.

Safety Instructions

DANGEROUS ELECTRICAL VOLTAGE
Thyristor power units may only be connected to earthed systems. Exclusively permissible protective measure according to EN 50178 (DIN VDE 0160): TT protective system

DANGEROUS ELECTRICAL VOLTAGE
Operation at asymmetrical systems (one system phase grounded) is not admissible.

DANGER
Danger of injuries and damage to property through inappropriate or missing evaluation of error messages!
The closing of the transformer temperature contact (thermostatic switch, break contact) must e.g. inhibit the connected timer!
As regards fault analysis, also refer to section 12.

DANGER
Danger of life through inappropriate EMERGENCY-STOP devices! EMERGENCY-STOP devices must be active and within reach in all system modes. Releasing an EMERGENCY-STOP device must not result in an uncontrolled restart of the system! First check the EMERGENCY-STOP chain before switching on!

Safety Instructions

CAUTION
All connection or signal leads must be routed so as to prevent negative effects on device functions through capacitive or inductive interference!

In long cables, interference is frequently injected and removed. Power lines and control cables should be routed separately. The influence of interfering lines or lines susceptible to interference can be minimized by observing the following distances:

> 100 mm with parallel installation of cables < 10m,
> 250 mm with parallel installation of cables > 10m.

The product should be installed in close vicinity of the welding equipment in order to avoid cables > 25 m in length wherever possible.

CAUTION
Connecting cords can become detached and cause dangerous voltage at system parts!
Make sure that the cords are attached securely.

Safety Instructions

1.8 Operating the product

DANGER
One has to expect that magnetic fields are present in the vicinity of resistance welding systems, which are above the limits specified in VDE 0848 Part 4. In particular, the limits for extremities can be exceeded if manual guns are used.
In cases of doubt, please measure the field strength and provide additional measures to ensure health and safety at work. Please note the Instructions BGV B11, “Accident prevention regulation relating to electromagnetic fields” issued by the Berufsgenossenschaft (employers’ third party liability insurance association).

DANGER
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!
Therefore, these persons should avoid the welding system.
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!

DANGER
Danger of injuries and damage to property through operation of units outside their intended cabinets!
The units are designed to be installed in housings or switch cabinets and must not be operated unless they have been installed in such housings and with the cabinet door closed!

DANGER
Danger of bruises and of being caught by electrode and/or workpiece movements!
Any user, line supplier, welding machine manufacturer and welding gun provider is obligated to connect all output signals that cause electrode movements (e.g. solenoid valve and prelift) in compliance with the applicable safety regulations ensuring that danger to personnel is safely prevented.
Please note that, according to the safety instructions, electronic outputs are considered as ”not safe”! Therefore the welding gun control must be secured additionally via relay.
For example, ”two-handed start”, guards, light barriers, etc. can considerably reduce the risk of bruises.

CAUTION
Danger of overheating in the event of incorrect or insufficient cooling.
The temperature in the installation area must be within the specified limits.

Air-cooled equipment may only be operated with ”forced cooling”. Cooling by means of convection is not sufficient!

Water-cooled equipment may only be operated if the cooling water circuit has been activated! Condensation on the water-conducting components is not permitted.

1.9 Retrofits and modifications by the operator

DANGER
Any changes made to the product may endanger the safety of the unit!
The possible consequences include death, severe or light injury (personal injury), damage to property or environmental hazards.
Therefore, you should contact us before performing any intended changes. This is the only way to find out whether or not changes can be made safely.

Safety Instructions

1.10 Maintenance, repair

DANGEROUS ELECTRICAL VOLTAGE
Unless described otherwise, maintenance works must be performed on inactive systems that have been sufficiently protected against reclosing!
Measuring or test activities that might be necessary on the live system are reserved to qualified electrical personnel!

DANGER
Lithium batteries may cause causticization or explode if not handled properly!
Therefore, do not open batteries by force, do not recharge or heat them above 100 degrees Centigrade.

CAUTION
Only replacement/spare parts approved by us may be used!
Only use original replacement batteries! In any case, spent batteries and accumulators should be disposed of as hazardous waste!

CAUTION
Observe all precautions for ESD protection when handling modules and components! Avoid electrostatic discharge!

The following protective measures must be observed for modules and components sensitive to electrostatic discharge (ESD)!

- Personnel responsible for storage, transport and handling must have training in ESD protection.
- ESD-sensitive components must be stored and transported in the prescribed protective packaging.
- ESD-sensitive components may only be handled at special ESD-workplaces.
- Personnel, working surfaces, as well as all equipment and tools which may come into contact with ESD-sensitive components must have the same potential (e.g. by grounding).
- Wear an approved grounding bracelet. The grounding bracelet must be connected with the working surface through a cable with an integrated 1-MΩ resistor.
- ESD-sensitive components may by no means come into contact with chargeable objects, including most plastic materials.
- When inserting or removing ESD in/from other devices, the device must be safely disconnected from the supply.

Safety Instructions

1.11 Safe working practices

DANGER
Program start is immediately possible after fault reset!
If the start signal is present when an error is reset (acknowledged), the timer will start its program run immediately! This may result in dangerous machine movements!
Therefore, prior to error reset, make sure that there is no one in the hazard area of the welding equipment.

DANGER
Danger of welding splashes!
Welding splashes have to be expected during operation of the welding plant! This may result in eye injuries and burns. Therefore
– wear protective goggles
– wear safety gloves
– wear flame-retardant clothes

DANGER
Danger of injuries at sharp metal edges and danger of getting burnt by hot welded parts!
Therefore, you should wear safety gloves.

CAUTION
Strong magnetic fields!
Due to the strong magnetic fields arising from resistance welding, the function of wristwatches, pocket watches, floppy disks or magnetic stripe cards (e.g., EC cards) may be disturbed for ever. Therefore, you should not carry such items on you while working in the immediate vicinity of the welding system.

Safety Instructions

1.12 CE Marking

CAUTION
The CE mark (refer to Section 15) is applicable for use in industrial environments.
For other combinations/applications, the certificate must be derived from the above requirements, or a new certificate must be issued, if necessary. This is the responsibility of the line supplier/user.
The product described corresponds to an application variant which is not covered by the provisions concerning end user products, machines or systems based on its very nature. Therefore, it may only be operated as described above.
The evaluation of the electrical and mechanical safety, the environmental influences (foreign bodies, moisture) must be carried out on the final product in encased state.
When installed in an enclosure, the EMC properties of this product may be subject to change. For this reason, the final product (end-user device, machine, systems) should be subjected to a verification of its EMC characteristics by the end product manufacturer.

Safety Instructions

Notes:

2 Overview

Main features of the PST 6xxE series compact weld timers:

- Weld timer and AC power unit in a common compact enclosure
- Suitable for controlling AC welding transformers with a nominal power between 68 and 155 kVA (at 50% duty cycle)
- Integrated regulation and monitoring
- Separation between regulation and monitoring
- Primary current measurement, therefore external current sensor in the secondary circuit not required
- Functionality for optimizing the weld quality
- With integrated I/O field (discrete signals)
- Timer functions can be switched (for manual welding gun or machine applications)
- Different cooling systems (air, water) and stepped power classes are available.
  For information on rating and load, refer to section 2.2
- Ethernet link for programming and diagnostics (optional)
- Comfortable programming, operation and diagnostics via PC software (”BOS” user interface)

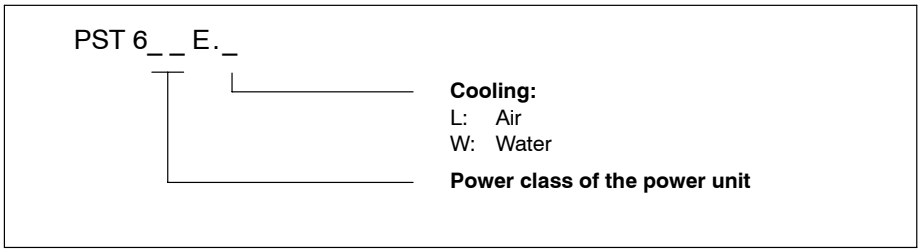
In section 2.2 you will find a more detailed list of the features.

The integrated weld timer is used to control the integrated power unit and is suitable for

- spot welding (e.g. with a robot)
- projection welding
- repeat welding (e.g. manual guns) and
- seam welding (e.g. roll seam).

2.1 Type designation

Provides information on the product variant:



Type designation

Overview

2.2 Features of the PST 6xxE series

- User interface for operation, programming and diagnostics:
  - completely via BOS graphic user interface;
    operative on PCs with Windows 2000 operating system and higher.
  - with limited scope of functions via operating and diagnostics terminal BT 6. Link BT6: via V24/RS232.
- optional access protection for operation/programming
  - through password
- Programming link to the PC (BOS)
  - Standard:
    for a single timer via V24/RS232
    (e.g. for programming on location)
  - Option:
    simultaneous connection of several timers through fieldbus interface Ethernet.
- I/O connection:
  - parallel (discrete I/O wiring)
  - I/O functionality can be switched to manual guns or machine applications.
- Number of programs:
  - for manual gun applications: 10 programs
    for machine applications: 64 programs
  - symbolic spot addressing possible.
- Programming of the times in mains cycles (AC technology)
- Universally adaptable welding schedule:
  - 3 programmable weld times (1.WLD: pre-heating weld time; 2.WLD: weld time; 3.WLD: post-heating weld time).
    The weld times can be operated together in one regulation mode (standard mode) as well as in different regulation modes (mixed mode).
  - 1.WLD and 3.WLD can be switched off
  - programmable impulse mode for 2.WLD
  - programmable slope (upslope/downslope time) for 2.WLD
- Welding modes:
  - single spot (e.g. for robot applications)
  - repeat (e.g. for manual gun applications)
  - roll seam
- Regulation modes:
  - PHA (phase angle)
  - KSR (constant current regulation)

  The required regulation mode can be adjusted separately for each weld time (mixed mode).

Overview

- Current monitoring:
  - reference currents can be programmed regardless of the regulation setpoint values
  - percentage tolerance band, can be programmed asymmetrically
  - the regulation mode can be adjusted separately for each weld time (mixed mode).
- automatic spot repetition when current too low
- Time monitoring
- Electrode management:
  - stepper function for %I (%I stepping)
  - tip dressing incl. initial dressing
  - stepper function for pressure (stepping of the electrode force)
  - prewarning table with graphic display of electrode wear
- Proportionate valve control:
  - output signal with program selection is active
  - analog pressure control
  - feedback through overpressure contact possible
  - electrode force in kN, programmable for each welding program
  - pressure scaling for adjustment to the valve characteristic
- Pressure profile:
  - up to 10 different electrode forces can be programmed during a program sequence
- Freely programmable output:

  up to 3 programmable switch-on/switch-off times during a program sequence. Is used, e.g. to control a counterpressure valve or generally to trigger further processes.
- Scaling:
  - for current (adjustment of the welding equipment to external reference current meter)
  - for force (adjustment of the electrode force to external reference force meter)
- Logging functions (ISO 9000):
  - fault log
  - weld fault log
  - data change log
  - current value log
- Integrated diagnostics memory
- Fault allocation:
  - events are definable as ”fault” or ”warning”
- Status display of the I/O signals in online operation
- %I correction:
  - for selected programs
  - for all programs
  - for selected electrode pairs

Overview

- Overview of plant image for e.g.
  - start-inhibit
  - weld on internal
  - time monitoring
  - current monitoring
  - 2. WLD in PHA / KSR
  - used electrodes
- Backup/auto-Backup (data backup)
- Restore (data restoration)
- Copying of welding programs
- Comparison between timers and/or backup files
- Timer change (module-global data backup and restoration incl. counter statuses und actual values)
- Start simulation:
  - program selection and schedule start can be initiated through user interface
- Languages currently available:
  - German
  - English
  - NA English
  - Spanish
  - French
  - Swedish
  - Portuguese
  - Italian
  - Hungarian
  - Russian
- Online and offline programming possible

Overview

2.3 Programming and operation

All necessary parameters are always kept in a battery-buffered RAM inside the timer.

Operation, programming and diagnostics are performed via the connected PC. For connection to the PC, it is possible to use

- the V24 interface of the weld timer (X3C) as well as
- the optionally available Ethernetfieldbus interface.

Whereas the V24 connection is only provided for access to one individual timer (e.g. programming on location), the fieldbus interface allows the simultaneous connection of several timers.

Conditions for programming and operation at the PC:

- PC with Windows 2000 operating system and higher
- BOS software (**B**edien**o**berfläche **S**chweißen – welding GUI)
- V24 connecting cord or, in case of fieldbus interface, the corresponding installation.

☞ **For detailed information on the BOS software, please refer to the BOS manual and the online help.**

☞ **With regard to programming, please observe:**

with mains frequency of 50 Hz:	**1 mains cycle corresponds to 20 ms**
with mains frequency of 60 Hz:	**1 mains cycle corresponds to 16.6 ms**

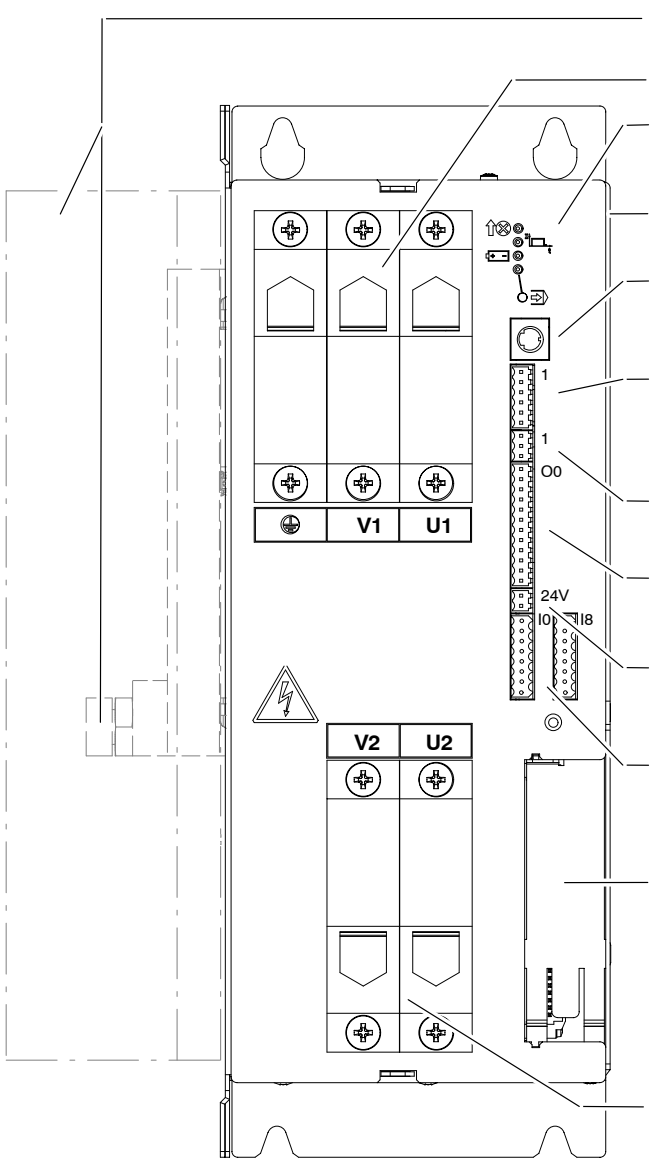
The weld timer can be programmed ”online” as well as ”offline”.

- offline:
  no active connection to timer required.
  Diagnostics and visualization are not possible.
  Programming is performed in the PC, where it is saved and can later be easily transferred to the timer.
- online:
  active connection to timer required.
  Diagnostics and visualization are possible.
  Programming is performed via PC. Each parameter is read from the timer and, after acknowledgment, written back to the timer. After acknowledgment, changed parameters will thus be effective at the latest with the next program start.

Overview

2.4 Front view (overview)

Weld timer and power supply unit are assembled in a common compact enclosure.



Heat sink / cooling water connections.
Refer to section 6.1 and 6.2.

Mains connection terminals (refer to page 7–4)

Display and operating elements. Refer to page 2–7.

right-hand side of enclosure: RAM buffer battery and timer functionality switch (manual gun/machine applications). Refer to page 2–8.

X3C: V24 connection for PC (for programming, logging, diagnostics, fault display via BOS). For pin assignment, refer to page 7–8.

X1S1: Supply input for
logic (refer to page 7–2),
fan control (refer to page 7–7),
supply I/O field (refer to page 7–3).

X2U: Pressure output (gun force).
For pin assignment, refer to page 7–5.

X2O: discrete outputs (O00 through O11).
For signal assignment, refer to section 7.8 from page 7–9.

X1S2: 24V output for power supply of X2I and 0V-reference potential for X2O
Refer to section 7.8 from page 7–9.

X2I: discrete inputs (I00 bis I15).
For signal assignment, refer to section 7.8 from page 7–9.

Slot for fieldbus module Ethernet.
For connection of several timers to a central PC (programming, logging, diagnostics, fault display via BOS).

Welding transformer connection terminals
(refer to page 7–4)

Front panel view: Here: PST 625E

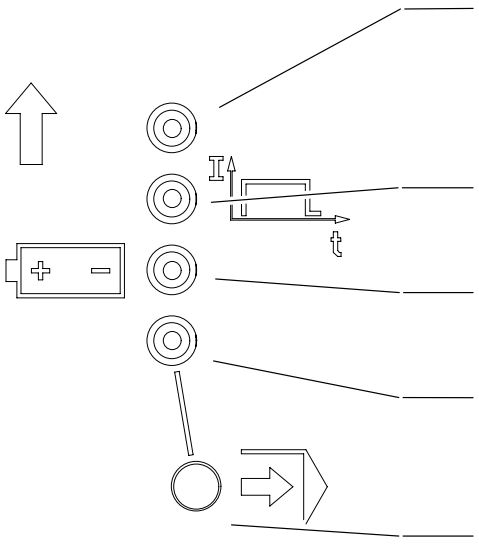
☞ **The dimensions and functional units for cooling depend on the output of the integrated power supply unit, therefore, they may differ from the example shown above. Refer to page 6–1.**

☞ **For technical data, refer to section 4.**

Overview

CAUTION
Possibility of malfunctions and damages!
The incorrect installation, improper connection or operation faults may lead to an unexpected or undesired unit response and thus to dangerous situations at the welding system.
Please note all the information provided in the present manual!

2.5 Display and operating elements



READY LED:
green: 24 V_{DC} (logic power supply) is available and no fault has occurred.
The unit is ready for welding.
red: error has occurred. The unit is not ready for welding.
off: 24 V_{DC} (logic power supply) not available

WELD TIME LED:
yellow: power unit is activated
off : power unit is not activated

BATTERY FAULT LED:
red: insert new battery
off: battery ok

BOOT LED:
red: timer is in Boot mode.
For explanations, please refer to Boot button.
off: normal status.

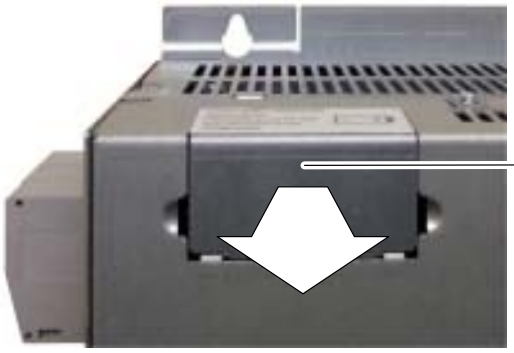
BOOT button (recessed):
For calling up the Boot mode.
Required for a firmware upgrade in connection with the "WinBlow" software. Welding is not possible in Boot mode.
Exiting Boot mode: Toggle 24 V logic voltage off / on.

LEDs and Boot button

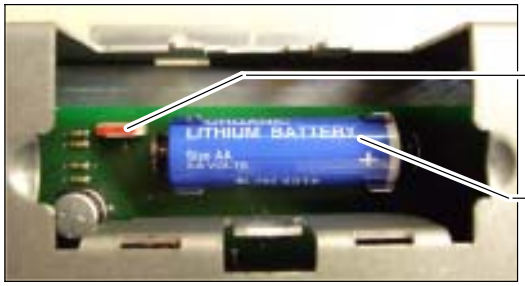
DANGEROUS ELECTRICAL VOLTAGE
Dangerous voltage may be present at the equipment even if no LED is on!
Before working on the equipment, always use appropriate measuring devices and measuring methods to check for zero voltage!

CAUTION
When the "Boot" button has been depressed, welding is immediately stopped! The timer interrupts program execution and resets all signal outputs and goes into "Boot" mode (for firmware upgrades). For this reason, this button
– must never be pressed while operation is running, and
– may only be pressed by authorized personnel.

Overview



for opening:
pull cover straight forward.



Timer function switch:
: for manual gun applications
: for machine applications (e.g. for robot)

Battery for buffering the unit's internal RAM.
For information on battery replacement, please refer to page 11–2.

Battery compartments and switch for timer functions

☞ **The setting of the switch for timer function is only taken over during the start-up of the timer!**

3 Control functions

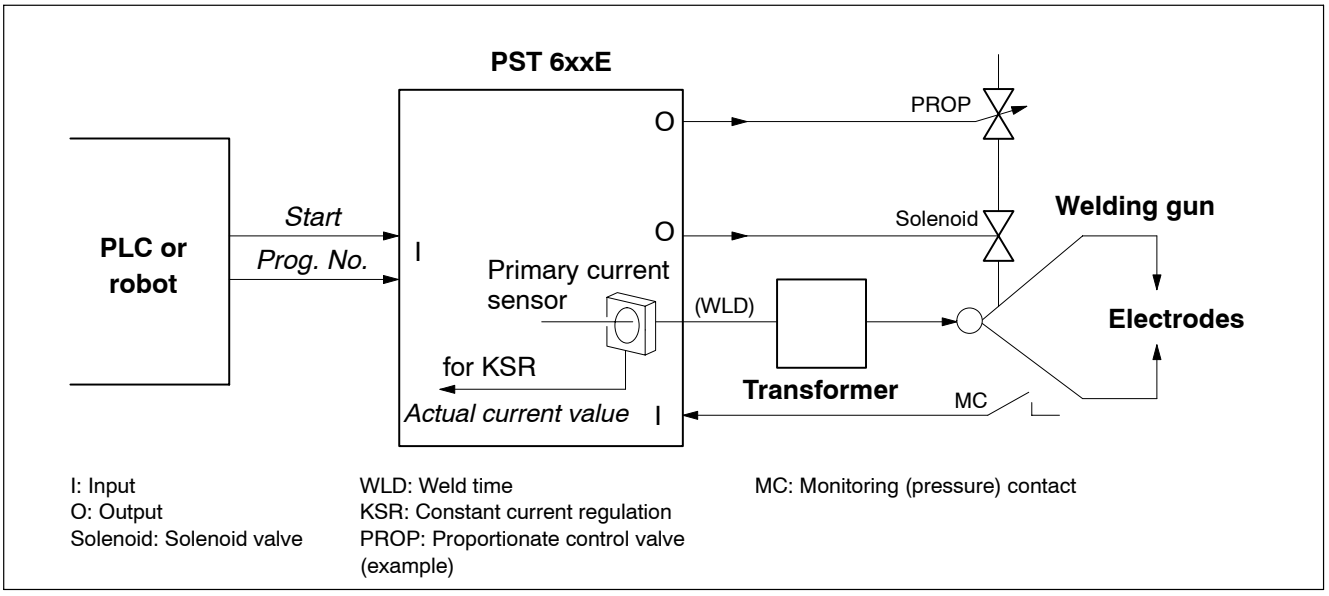
3.1 Main components of a welding station

Welding systems equipped with PST 6xxE series weld timers normally consist of the following main components:

- Weld timers with integrated AC power unit (AC: thyristor power unit)
- suitable welding transformer and
- pneumatically or electrically operated electrode gun and electrodes.

Furthermore, a higher-level controller is required that controls the entire manufacturing process of the part and also monitors its safety aspects. Suitable controllers include

- a programmable logic controller (PLC)
- robot controller
- manual controller (e.g. for manual guns) or also
- a combination of these possibilities.



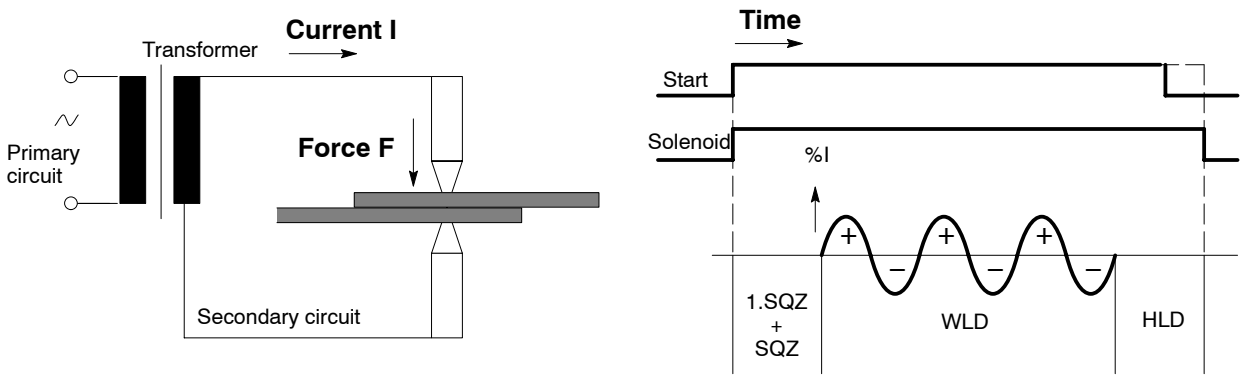
Main components of a welding station

The weld timer ensures the controlled performance of the actual welding process. For this purpose, it must provide open- and closed-loop control of many functions and physical quantities.
Its main tasks include, e.g.

- Communication with a higher-level PLC, or robot controller or (manual) gun electronic system via I/O signals.
- Controlling a solenoid valve for closing the welding gun.
- Controlling a proportionate control valve or a servo motor for influencing the electrode force.

Control functions

- Ensuring the proper schedule of various time intervals (e.g. squeeze, weld, hold time etc.).
- Controlling a power supply unit for generating the correct welding heat.
- Signalling a correct or defective weld at the end of the welding program schedule.



SQZ: Squeeze time (for more information, please refer to section. 3.3.4 from page 3–10)
WLD: Weld time (for more information, please refer to section 3.3.4 from page 3–7)
HLD: Hold time (for more information, please refer to section 3.3.4 from page 3–12)
Solenoid: Solenoid valve

Physical quantities for influencing the weld

Control functions

3.2 Welding modes

To run a welding process, the operator can address the weld timer automatically via PLC/robot or manually.

The PST 6xxE series compact weld timers are designed both

- for (suspended) systems with 2 guns (with 4 programs each) and
- for general machine applications (with 64 programs).

The required timer behavior and the corresponding characteristic of the respective I/O field can be adjusted using a switch (see figure on page 2–8).
The timer behavior is influenced additionally by the programmed welding mode.

Various welding modes are available:

- Single spot mode (Single)
- Repeat mode (Repeat)
- Seam mode (Seam)

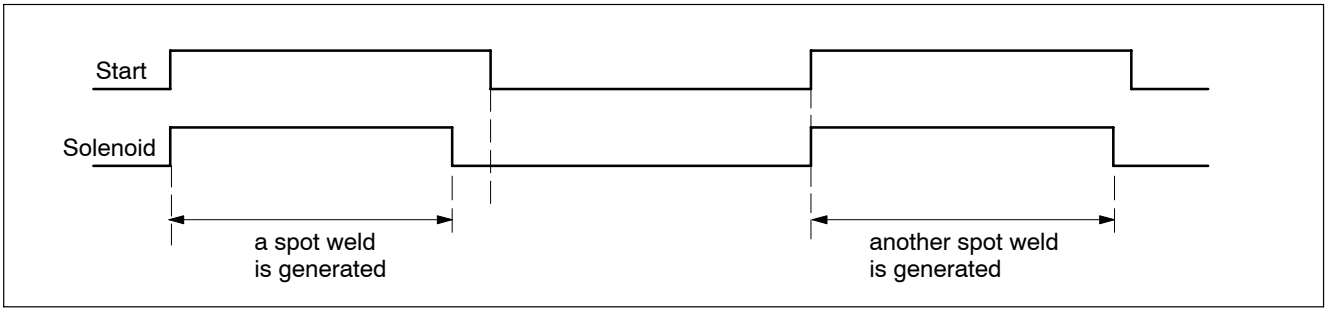
Parameter setting in BOS:

In ”Programming”, flag ”Schedule”, parameter ”Schedule”

3.2.1 Single spot

Suitable for use in connection with robots, welding machines, automatic welding equipment or manual welding guns, for spot welding, projection welding, butt welding.

A high level at the corresponding start input initiates the welding schedule (or welding program) exactly once, starting with the pre-squeeze time (1.SQZ).
For the next program start, the start signal has to be switched off and back on.



Single spot welding mode; signal sequence

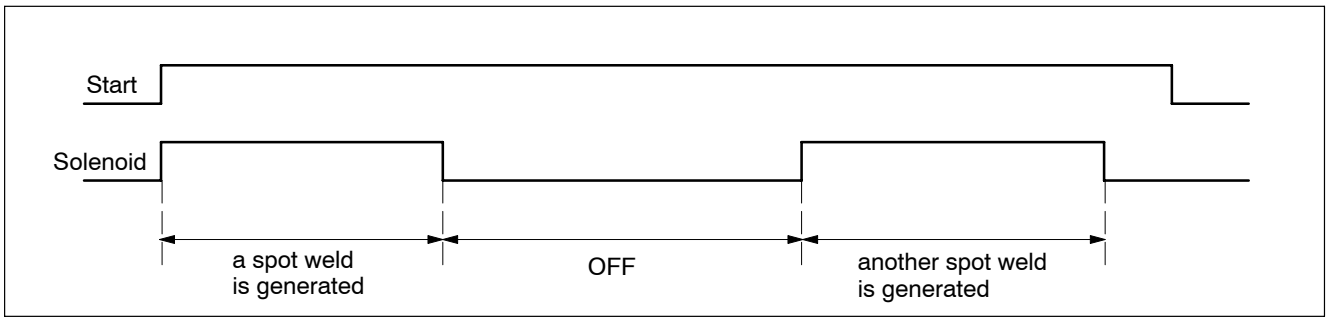
Control functions

3.2.2 Repeat

Suitable for manual welding guns and manually operated welding machines.

The weld timer initially responds to the start signal as in ”single spot” mode and starts the welding schedule.
If the high level signal is still present at the respective start input after the end of the hold time (HLD), the solenoid valve (Solenoid) will be switched off. The welding gun is opened.
The Off time (OFF) runs. During this time, the operator can pull on the welding gun towards the next spot.
After the end of the OFF time, the solenoid valve will be energized again, and the welding schedule will be restarted – this time beginning with the SQZ.

This schedule will be repeated for as long as the respective start input is high.



Repeat welding mode; signal sequence

3.2.3 Seam mode

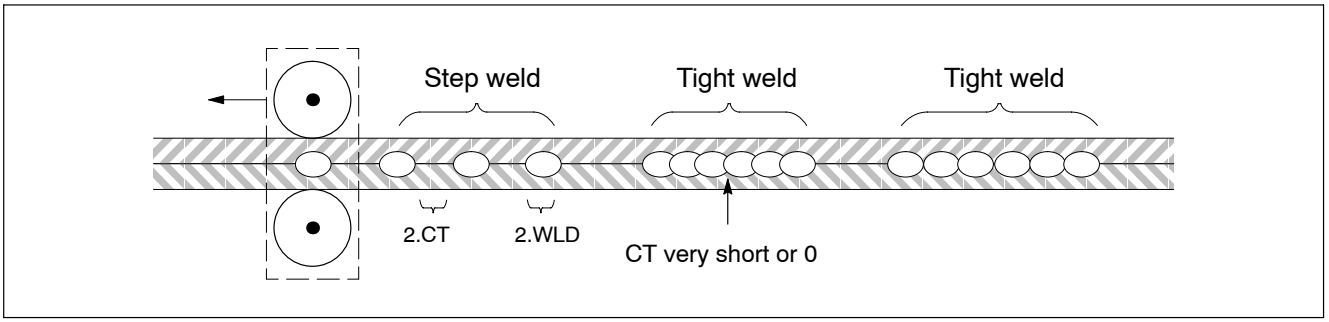
Suitable for roll seam systems.
The parts to be welded are joined by individual spot welds while rolling electrodes are moved along.

The weld timer initially responds to the start signal as in ”single spot” mode and starts the welding schedule.
The weld time (2.WLD) and a cool time (2.CT), if programmed, will be repeated for as long as the START input remains high.
When the start signal becomes low, the timer will cancel the actual current pulse and start the hold time (HLD).

The seam mode distinguishes between step weld and tight weld:

- Step weld:
  successive weld times are separated from each other by sufficiently long cool times, so that the resulting spot welds do not touch or overlap.
- Tight weld:
  the cool times are short, so that the resulting spot welds overlap.

Control functions



Principle of seam mode

Control functions

3.3 Program sequence

Using the inputs for program selection, the required program is first selected and then started via High level at the respective start input.

Each welding program includes all parameters which are necessary for the exact definition of a weld.
Basic parameters are, e.g.

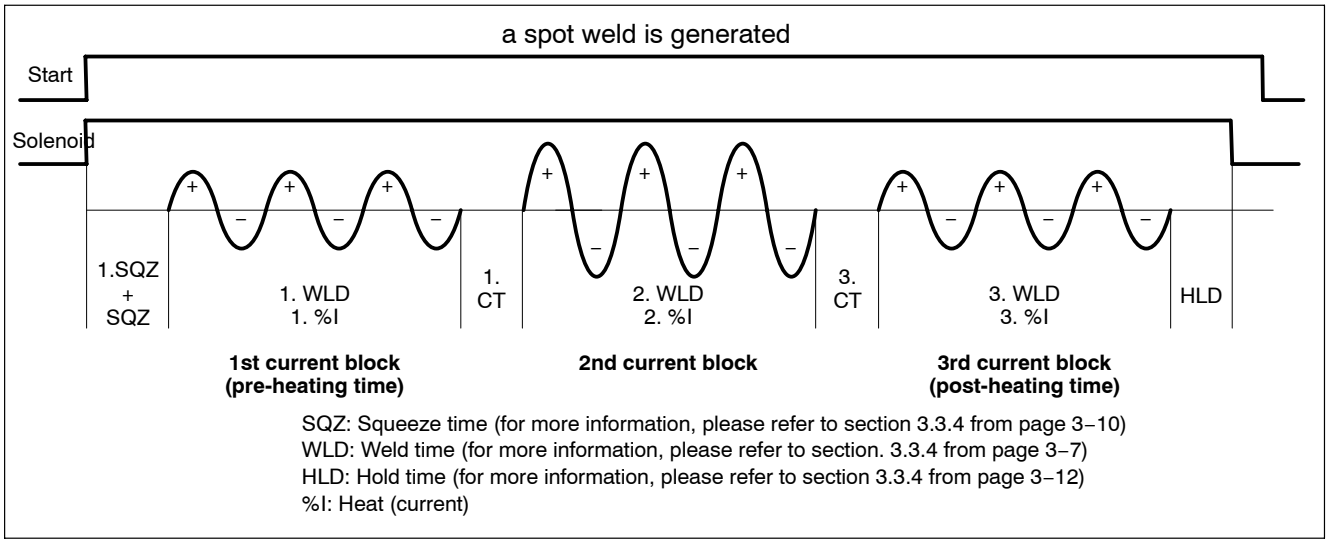
- %I values which should be active in different current blocks (refer to section 3.3.1)
- Times which should run after each other (refer to section 3.3.4 from page 3–10)
- Electrode force (for a description, refer to page 7–5).

3.3.1 Programmable current blocks

The process may require that the amount of heat needed for a single spot weld is provided in consecutive current blocks.
Therefore, a spot weld can be generated from max. three current blocks (1.WLD, 2.WLD, 3.WLD), where the time and %I of each individual block can be programmed separately.

☞ **Programming of the %I is dependent on the active regulation mode (refer to page 3–13):**
PHA (phase angle): in SCV (scale values)
KSR (constant current regulation) in kA

Cool times (1.CT, 3.CT) can be programmed between the blocks. Setting a cool time = 0, the respective 2 blocks will be positioned next to each seamlessly.



Available current blocks

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”.
Prerequisite for programming of the %I: parameter ”x.WLD” is greater than 0.

1.WLD (1st weld time / pre-heating time):

This current block can be used with a smaller %I value (1.%I) prior to the actual weld (in the 2nd current block) to pre-heat the metal and thus reduce e.g. welding splashes.
If you do not wish to use the 1.WLD, then simply program 1.WLD = 0.

2.WLD (2nd weld time / 2nd current block):

Carries out the actual welding of the spot with the setpoint %I value (2.%I).

- The 2nd weld time has to be programmed in all instances.
- Within the 2.WLD, the functions
  - ”Impulse mode” (refer to page 3–8) and
  - ”Slope” (refer to page 3–9) can be used.

3.WLD (3rd weld time / post-heating time):

This current block can be used with a smaller %I value (3.%I) after the actual weld (in the 2nd current block) to post-heat the metal.
This is used, for instance, to prevent the spot weld from being cooled down too quickly through electrode cooling. This will improve the joint between the parts to be welded and serves to balance stress.
If you do not wish to use the 3.WLD, then simply program 3.WLD = 0.

Control functions

3.3.2 Impulse mode

In addition to the option of providing the amount of heat needed for one single spot weld in 3 consecutive current blocks (refer to page 3–6), the **impulse mode** is available as well.

In the 2nd current block the required amount of heat can be applied to the spot weld via max. 9 consecutive impulses and thus also reduce welding splashes.
A 2.CT can be programmed between the impulses.
Setting the 2.CT = 0, all impulses will be positioned next to each seamlessly.

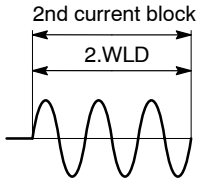
They influence the impulse mode through the ”Impulse” parameter.
It determines how often the 2.WLD is repeated, taking into account the programmed 2.CT.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”.
Prerequisite: parameter ”Impulse” is greater than 1.

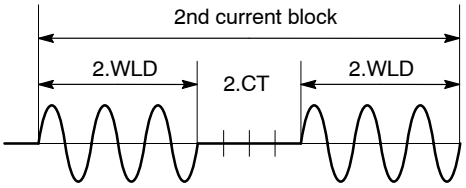
Example: Impulse mode OFF

IMP = 1
2.WLD = 3 periods (cycles)
2.CT (not relevant because only 1 impulse)



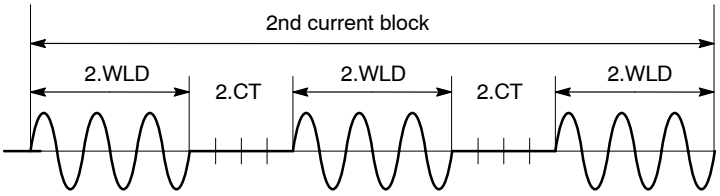
Example: 2 impulses

IMP = 2
2.WLD = 3 periods
2.CT = 2 periods



Example: 3 impulses

IMP = 3
2.WLD = 3 periods
2.CT = 2 periods



Programming examples for the impulse mode

Control functions

3.3.3 Slope (current slope)

With activated slope, the weld timer automatically generates a linear current increase/decrease **for the 2nd current block** within the programmable time period. This allows current peaks to be reduced and will thus protect the welding equipment.
For programming you use

- the **upslope time (UST)** to determine in what period of time the current is to be increased from ”upslope heat” to the current setpoint of the 2.WLD (2.%I) and/or
- the **downslope time (DST)** to determine in what period of time the setpoint current of the 2.WLD (2.%I) is to be reduced to the ”final %I value”.

Parameter setting in BOS:

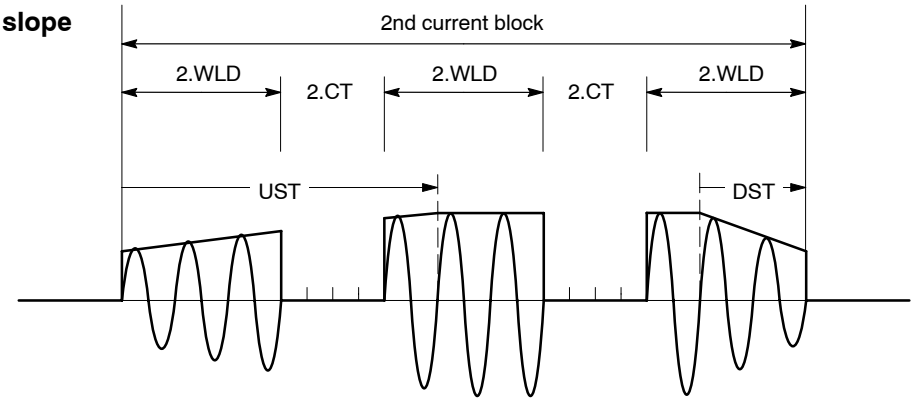
In ”Programming”, flag ”Schedule”.
Prerequisite: ”Slope” parameter is ON.

Please note:

- Current increase and decrease times are always positioned in the 2nd current block.
  The current increase time begins with the start of the 2nd current block.
  The current decrease time ends with the end of the 2nd current block.
- Current increase and decrease times are not influenced by an activated impulse mode and a programmed 2.CT, if applicable. This means, they will take place regardless of an existing 2.CT.
- If the total of UST and DST is greater than the 2nd current block, the setpoint %I in the 2nd current block (2.%I) will never be reached! This results in error messages such as ”Current too low”.
- Use the fade-out time in connection with the slope (refer to page 3–22).

Example: 3 impulses incl. slope

UST = 6 periods (cycles)
DST = 2 periods
IMP = 3
2.WLD = 3 periods
2.CT = 2 periods



Example: slope in connection with impulse mode

Control functions

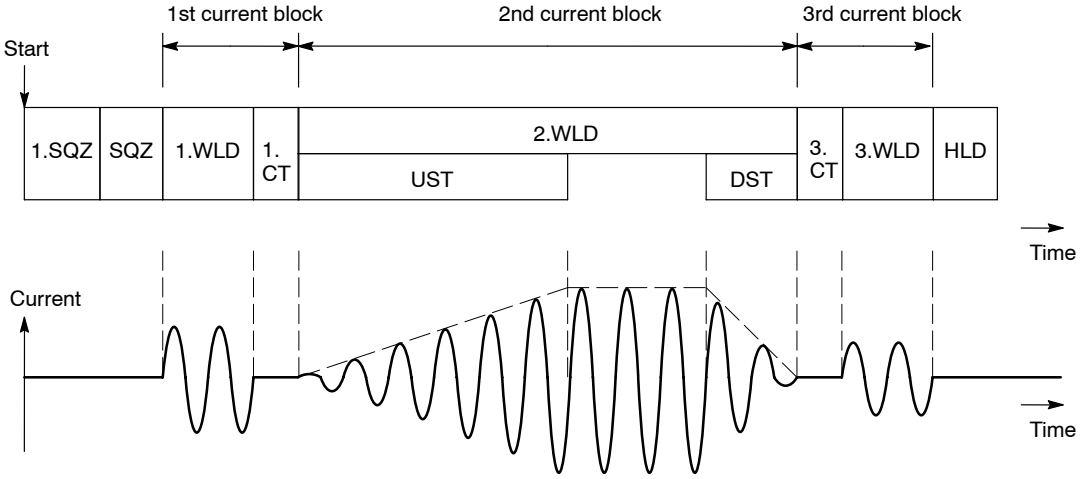
3.3.4 Programmable times

The sequence of a welding program is dependent on the use of different programmable periods of time. Each period of time serves a specific purpose within the program sequence.

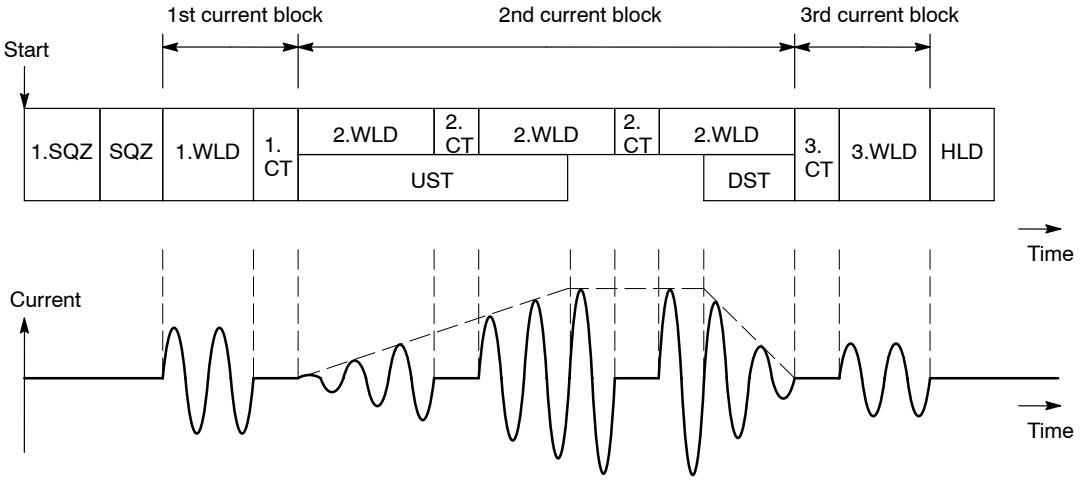
Parameter setting in BOS:
In ”Programming”, flag ”Schedule”.

★ Program all times in the unit ”mains cycles”.

Welding program schedule without impulse mode in the 2nd current block:



Welding program schedule with impulse mode in the 2nd current block (as example: impulses=3):



Examples for time diagrams with all programmable time periods

Control functions

☞ **The period of time is dependent on the mains frequency that is present:**
at 50 Hz: 1 mains cycle corresponds to 20 ms
at 60 Hz: 1 mains cycle corresponds to 16.6 ms

1. SQZ (Pre-squeeze time)

The welding gun should close completely during the 1.WLD. No current flows during this period of time.

The 1.SQZ is always processed immediately following the start in all three welding modes (single spot, repeat, and seam).

In the welding mode ”Repeat”, the 1.SQZ is only processed for the 1st spot weld of a series because the gun does not open that far anymore in the subsequent spot welds of the series, because the Off time (OFF) will mostly be fairly short.

SQZ (Squeeze time):

Is used to build up the working pressure of the electrodes. No current flows during this period of time.
The welding gun must be entirely closed at the beginning of SQZ (refer to 1.SQZ).

☞ **It is always necessary to program SQZ greater than 0.**
Shortest possible SQZ: 1mains cycle

The programmed SQZ will only start when the input signal PRESSURE CONTACT is high.

☞ **If the input is not high, the welding program will be selected and started (if programmed, 1.SQZ will be processed), but the further schedule will be delayed until the input signal PRESSURE CONTACT is switched to high.**

☞ **With the beginning of SQZ, the programmable sequence of the FREELY PROGRAMMABLE OUTPUT signal starts.**

1.WLD (1st weld time, pre-heating time)

Refer to page 3–7.

1.CT (1st cool time)

If programmed with a value greater than 0, it separates the first current block from the second current block. Serves to release stress in the parts to be welded.
Refer to page 3–6.

☞ **The 1.CT can only be programmed if 1.WLD is greater than 0.**

Control functions

2.WLD (2nd weld time)

Refer to page 3–7.

2.CT (2nd cool time)

If programmed with a value greater than 0, it separates the individual impulses in impulse mode. Serves to release stress in the parts to be welded.
Refer to page 3–8.

☞ **The 2.CT can only be programmed if impulse mode is activated (parameter ”Impulse” >1).**

UST (upslope time / time of current rise)

Refer to page 3–9.

DST (downslope time / current decrease time)

Refer to page 3–9.

3.WLD (3rd weld time; post-heating time)

Refer to page 3–7.

3.CT (3rd cool time)

If programmed with a value greater than 0, it separates the second current block from the third current block. Serves to release stress in the parts to be welded.
Refer to page 3–6.

☞ **The 3.CT can only be programmed if 3.WLD is greater than 0.**

HLD (Hold time)

Used to securely hold the parts to be welded during the cooling phase. No current flows during this period of time.
After HLD, the solenoid valve is switched off and the welding gun is opened. If no welding error is detected, the WELD COMPLETE (WC) output signal is generated.

OFF (Off time)

This time period is only relevant for the ”Repeat” welding mode. It is used to determine the period of time in which the welding gun is to remain open until the next SQZ. As a result, the manual gun cannot be pulled to the next welding position.

Control functions

3.4 Regulation modes

Different regulation modes are available in the weld timer:

- Phase angle (PHA) and
- Constant current regulation (KSR).

Program and regulation modes can be allocated in a very flexible manner. Therefore, we distinguish between the following regulation options:

- **Standard:**
  A regulation mode can be allocated to each welding program. The set regulation mode applies to all weld times of the program.
- **Mixed:**
  Different regulation modes can be allocated to all weld times of a program.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”, parameter ”Regulation”.

☞ **Regulation and monitoring are two independent functions! Therefore, the setpoint %I values for regulation and monitoring can be parametrized separately.**
Refer to section 3.6.1 from page 3–17.

3.4.1 Phase angle (PHA)

Special case.

In the PHA mode, there is no regulation of an actual value (e.g. current) but exclusively controlling of the power unit. If the thyristors are activated correspondingly during the sine half-cycle, this will influence the electrical weld angle in the range from 130 degrees to 30 degrees: the greater the weld angle, the less current will flow in the secondary circuit.

The weld angle is influenced by programming the unit ”scale values” (SCV). The following applies:

0 SCV: Thyristors are only switched at an electr. weld angle of 130 degrees.

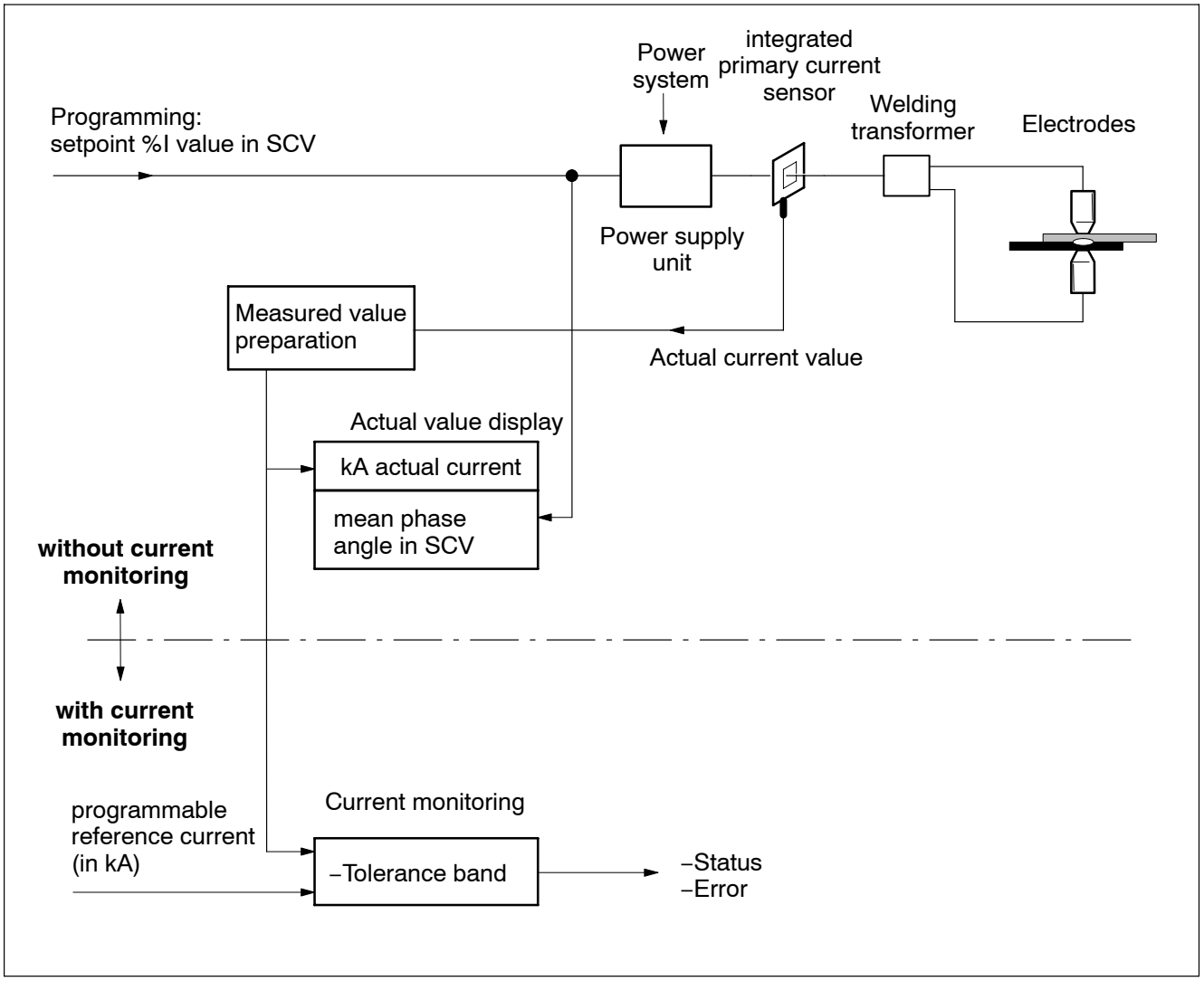
100 SCV: Thyristors are already switched at an electr. weld angle of 30 degrees.

PHA features:

- The %I values are programmed as scale divisions (SCV).
  Programmable range: 0.0 to 100.0 SCV.
  Programming resolution: 0.01 SCV
- No regulation takes place.
- The resulting amount of current in the secondary circuit depends on the transfer resistance between electrode and part to be welded.

Control functions

- A current or time monitoring can be activated in PHA mode.



Principle of open-loop PHA mode

Control functions

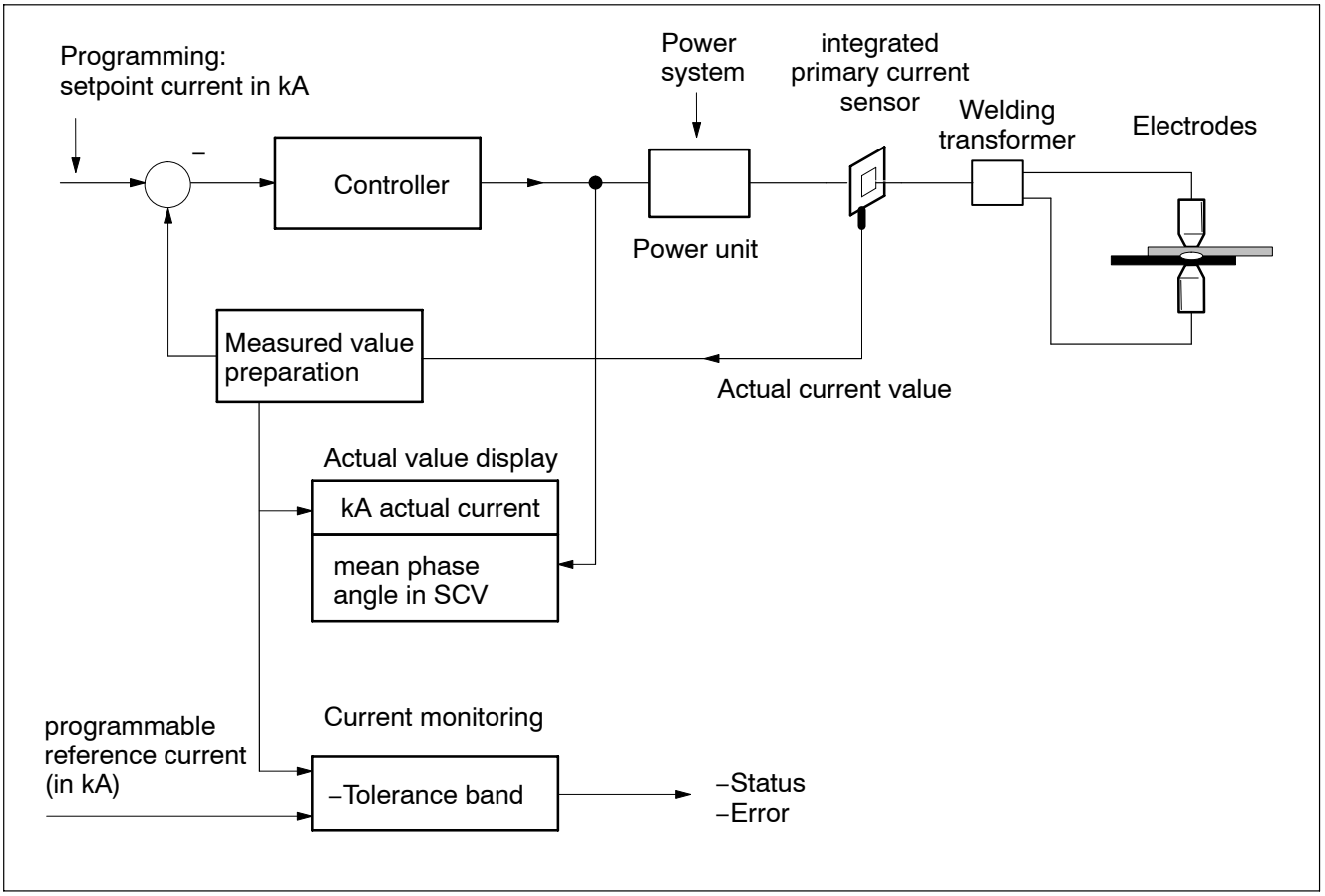
3.4.2 Constant current regulation KSR)

Standard case (e.g. robot guns)

Current regulation is activated in KSR mode. For this purpose, the actual current is scanned by the integrated primary current sensor , converted to secondary current using the transformer ratio and constantly compared with the programmed current setpoint. A downstream controller processes the setpoint/actual difference and controls the phase angle in the power unit so that the setpoint current is reached.

KSR features:

- The %I value is programmed in kiloamps kA).
  Programmable range: 0.5 to 250 kA
  (may be limited by parametrization and the power unit used).
  Programming resolution: 10 A
- The current flowing through the parts to be welded is regulated.
- Eliminates the influence of the electrical resistance in the secondary circuit on the weld (e.g. transfer resistance between electrode and part to be welded).



Principle of the KSR regulation mode

Control functions

3.5 %I prewarning and limitation

3.5.1 %I prewarning

The ”%I prewarning” parameter can be used to specify

- from which scale value on the message ”Phase angle prewarning reached” is to be displayed.

The timer is thus able, in the KSR mode, to call your attention to an imminent %I limitation resulting e.g. from cable losses in the secondary circuit.

Parameter setting in BOS:

In ”Programming”, flag ”Electrode”, parameter group ”Limitation”

☞ **The parameter value must be lower than the value for the %I limitation.**

3.5.2 %I limitation

☞ **Parametrize the %I prewarning first.**

☞ **The parameter value must be higher than the value for the %I prewarning.**

Using the ”%I limitation” parameter, you define the maximum permitted scale value. It limits

- the scale value specified to the power supply unit in KSR mode, and
- the possible programming input in PHA mode.

If the %I limitation is activated, the timer will output the message ”Maximum phase angle”.

Parameter setting in BOS:

In ”Programming”, flag ”Electrode”, parameter group ”Limitation”.

☞ **The input value for %I limitation is effective absolutely!**
The function ”%I correction” (refer to page 3–38) and ”%I stepping” (refer to page 3–30) can therefore lead to the activation of the %I limitation.

Control functions

3.6 Monitoring

The timer has the option to monitor the welds with regard to the following primary values:

- Current (refer to section 3.6.1)
- Time (refer to section 3.6.2 from page 3–24).

Both monitoring functions can be switched on or off separately.

Activated monitoring functions control the respective relevant actual value on the basis of programmable reference values and tolerance bands.

Since the current and time variables influence the amount of %I in the spot weld, correct setting of reference values and activation of monitoring functions are important measures and prerequisites for quality assurance.

☞ **The reference values used for current monitoring can be programmed irrespective of the regulation parameters. A modification of the setpoint regulation values thus does not influence the monitoring parameters!**
In connection with the respective access rights, the user can set new reference values manually or take over a measured actual value as new reference value.

Additional available monitoring functions:

- **Monitor stepper:**
  is effective in connection with current monitoring for active stepper/ dressing curves. Refer to page 3–24.

3.6.1 Current monitoring

Tolerance ranges

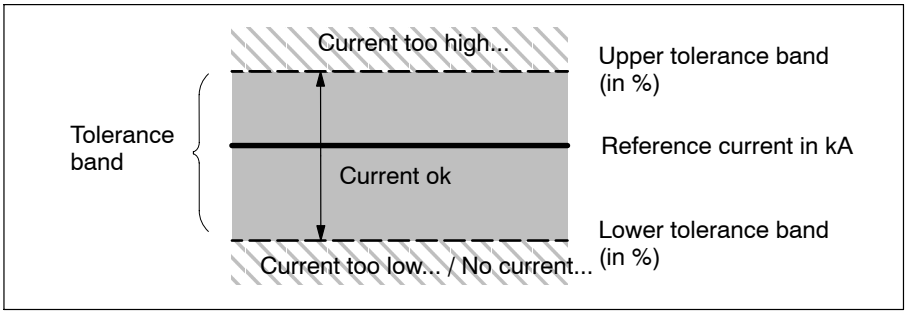
The current monitoring compares the actual current with the ”tolerance band” by means of effective value measurement.

Whether the timer interprets a measured actual current as ”good” depends on the programming of the tolerance band.
The following values are essential to the definition of the tolerance band:

- Reference current in kA
- Positive tolerance in % of the reference current
  (upper tolerance band).
  Actual values above this tolerance limit generate the message type ”Current too high”.
- Negative tolerance in % of the reference current
  (lower tolerance band).
  Actual values below this tolerance limit generate the message type ”Current too low...” or ”No current...”.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”.
Prerequisite: parameter ”Current monitoring” is ON.



Principle: tolerance band

Conditional tolerance range

In addition to determining whether the weld is ”good/bad”, it would be helpful to be informed in time about the tendency of the current actual values.
In this context, a steady accumulation of current actual values in the lower range of the tolerance band is of special interest: creeping faults in the system (e.g. slow increase in cable resistance in the measurement fault before a broken cable) can lead to such effects. If current reference values have not been set optimally, this can also result in current actual values in the lower range of the tolerance band.

For this reason, the following parameters are available additionally in context with the tolerance band:

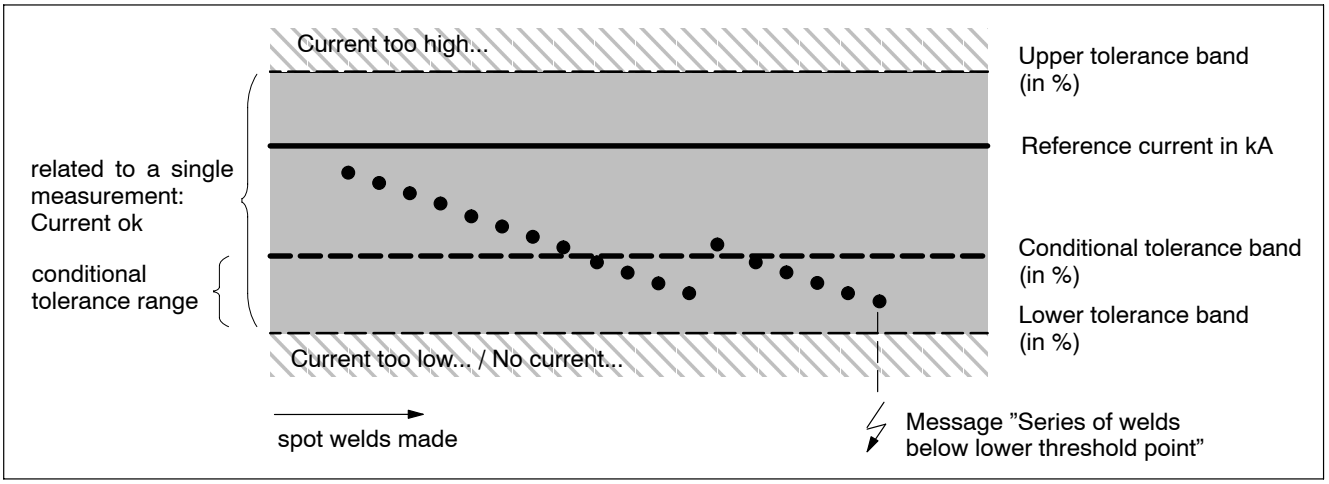
- ”conditional tolerance band” (in % of the reference current) and
- ”Repetition factor”.

The ”Conditional tolerance band” parameter determines the upper limit of the conditional tolerance range.
The lower limit is defined by the ”Lower tolerance band” parameter.
The ”Repetition factor” determines the number of **consecutive** welds that may be within the conditional tolerance range.
If several consecutive welds are in the conditional tolerance range, the message ”Series of welds below lower threshold point” will be displayed.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”.
Prerequisite: ”Current monitoring” parameter is ON.

Control functions



Example: principle of the conditional tolerance band with repetition factor = 4

☞ **Messages may optionally be defined as "Welding fault" or as "Warning". While an event defined as "Warning" does not cause a blocking of the timer, the occurrence of a "Welding fault" always requires a "Fault reset" (refer to page 12–1) in order to start the next welding schedule.**

Control functions

Current monitoring modes

Since a total of 3 independent current blocks can be programmed (refer to page 3–6), a flexible handling of current monitoring is required.

Therefore, a difference is made between the currentmonitoring modes ”Standard” and ”Mixed”.

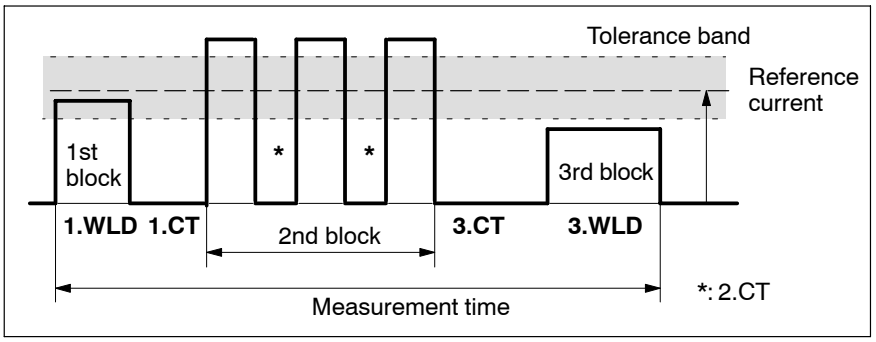
Parameter setting in BOS:

In ”Programming”, flag ”Schedule”, parameter ”Monitoring”.

- **Standard:**

  All current blocks including cool times aretaken into account in the effective value measurement.
  In this context, the entire current profile is repersented by a single actual value and monitored by a single tolerance band.
  This simple and in many cases sufficient monitoring mode keeps the amount of data to be processed low, but possibly existing cool times and different current amounts in the individual blocks change the measurement result.

  In this case, the reference current to be specified should be determined by means of test welds. If you only use the 2.WLD and no impulse mode, you may enter the current setpoint programmed for regulation as reference current, too.



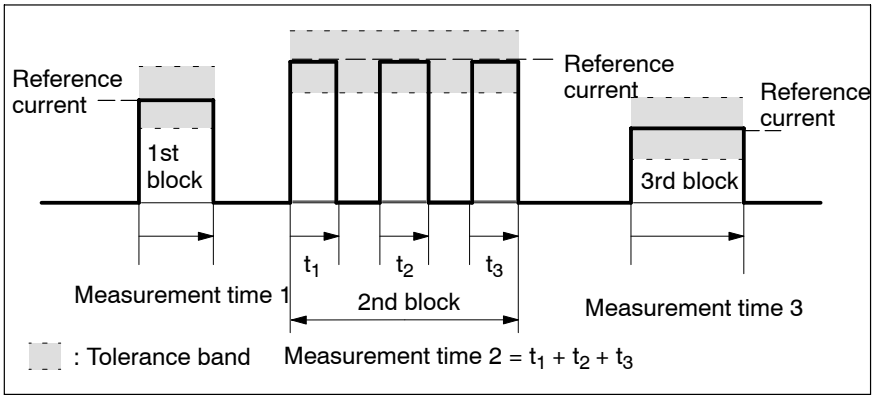
Principle current monitoring mode ”Standard”

- **Mixed:**

  The effective value is measured separately for each current block and monitored by separate tolerance bands . Programmed cool times do not influence the actual value generation of the individual current blocks.
  This results in a greater transparency of the the individual current blocks, but the amount of data to be processed is larger.

  In mixed mode, you may generally specify the current setpoints programmed for regulation as reference currents as well.

Control functions



Principle current monitoring mode "Mixed"

Fade-out time and trail current

In the explanations made until now, an ideal temporal characteristic of the current has been given (in rectangular form). However, current has a transient characteristic at the beginning and the end of a weld time. These effects in principle influence the effective value measurement. As a result it may be necessary to program different values for setpoint and reference current (in context with current monitoring).

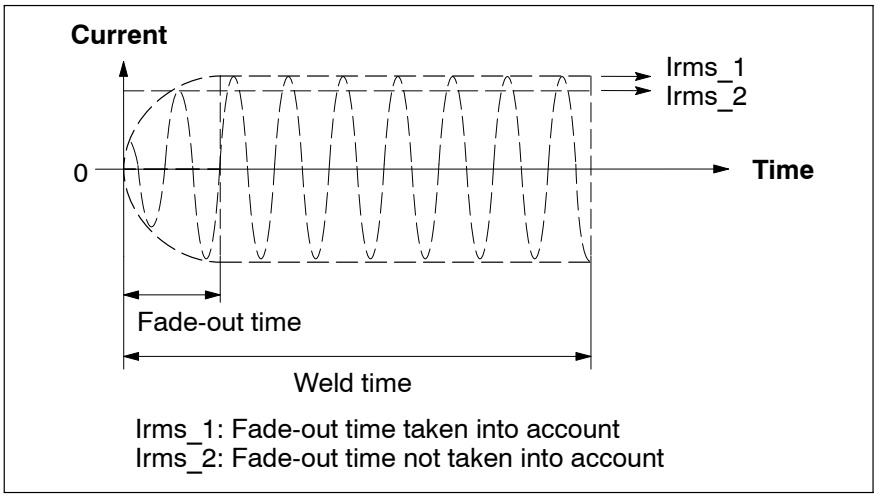
Using the ”Fade-out time” and ”Trail current” functions you can specifically influence the measurement sequence.

Parameter setting in BOS:

In ”Programming”, flag ”General”, parameter group ”Current measurement”.

- **Fade-out time:**

  specifies the period of time after the start of a weld time which is **not** to be used to calculate the effective value. If this is set correctly, the entire transient procedure can be faded out.



Irms_1: Fade-out time taken into account
Irms_2: Fade-out time not taken into account

Effect of the fade-out time

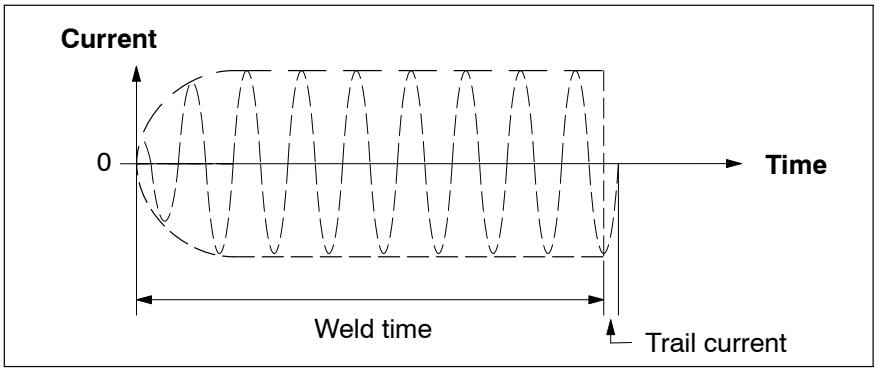
Use of fade-out time

- in connection with the ”Slope” function (refer to page 3–9). program the same value for the fade-out time as for the upslope time (UST).
- for welding high sheet thicknesses and great immersion depths (welding gun protrudes deeply into material).
- in connection with current calibration: reference welding current measurement devices also have a ”fade-out function” (e.g. Miyatchi: ”First Cycle”; specification, from which period of the weld time on the measured values are to be taken into account).

☞ **With respect to current calibration, make sure that the measuring device you use is set to the fade-out time currently parametrized in the timer.**

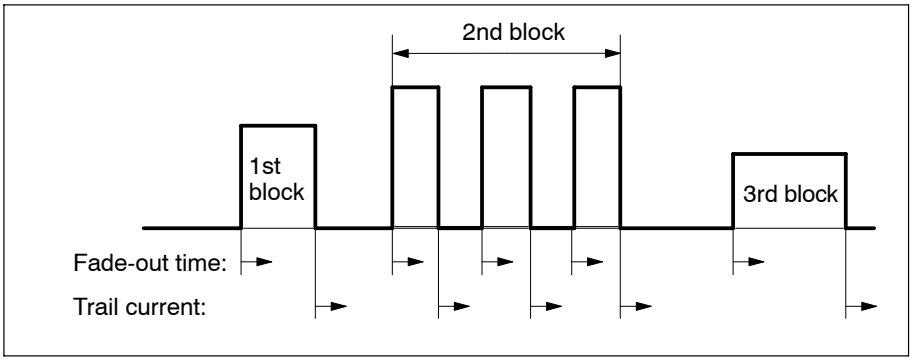
Control functions

- **Trail current:**
  specifies, whether the transient period after the end of a weld time is to be taken into account to calculate the effective value (trail current ON).
  If trail current is deactivated, the effective value measurement stops precisely at the end of the weld time.



Trail current

- A programmed fade-out time always starts at the beginning of a current block and at the beginning of an impulse.
- An activated trail current always starts at the end of a current block and at the end of an impulse.



Starting times of the fade-out time and the trail current

☞ **The programmed fade-out time is identical for all weld times and for all welding programs!**
Therefore, you should make sure that the fade-out time is always shorter than the shortest programmed weld time.

☞ **The activated trail current is identical for all weld times and for all welding programs!**

☞ **If the amount of heat applied to the spot weld is the exclusive quality criterion for your application (amount of heat: $Q \approx i^2 \times t \times R$), program the fade-out time with value ”0” and activate trail current ON.**

Control functions

3.6.2 Time monitoring

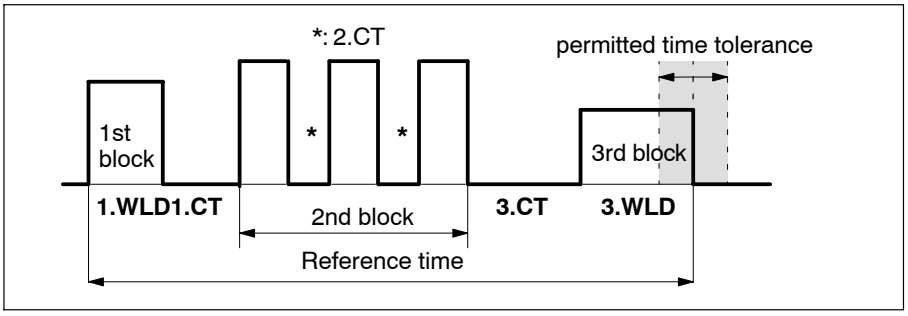
Time monitoring is separately adjustable to each program and compares the actual time required for the entire current profile with a programmed reference time.
Actual time is understood as the time period from the beginning of the first current block to the end of the last current block including any existing cool times.
It is thus possible to make sure that no excessive weld time changes can be made in the individual welding programs manually.

The following values are essential to the programming of time monitoring:

- Time monitoring ON/OFF
- Reference time
- Permitted time tolerance of the programmed reference time.
  Actual values above the permitted time tolerance generate the message type ”Time too long...”.
  Actual values below the permitted time tolerance generate the message type ”Time too short...”.

Parameter setting in BOS:

In ”Programming”, flag ”Seq. Pg.2”, parameter group ”Time monitoring”.



Principle of time monitoring

3.6.3 Monitor stepper

Usedfor electrode maintenance functions

- ”Stepper” (refer to page 3–30) and
- ”Tip dressing” (refer to page 3–30)

to monitor the programmed %I stepping.

-It is thus possible to make sure that no excessive changes can be made in the individual stepping or dressing curves manually.

In case of active stepper function, the timer modifies the programmed setpoint %I depending on the electrode wear.
The ”Monitor stepper” gives you the opportunity to program separate percentage stepper values for each individual stepping or dressing curves which are then used as reference values for monitoring.

Parameter setting in BOS:

In ”Programming”, flag ”Stepping”, parameter ”Ref. current”.

Control functions

3.7 Latching

When SQZ has elapsed, the timer goes into latching in the welding modes ”Single spot” and ”Repeat”. In the latching status, the 1. to 3.WLD including HLD will be executed even after reset of the corresponding start signal.

☞ **Latching can only be cancelled by opening the stop circuit (refer to page 7–3).**

☞ **Latching is not available in the ”Seam” welding mode. If the ”Start” input signal is reset during the weld time, the timer will end the period just started and continue with the hold time.**

For information on latching, also refer to ”Start” input signal.

3.8 1st Half-cycle limit

Control of the first half-cycle can be limited for protection of the welding transformer and the thyristor power unit.

Example: Input value 55 SCV means

- that the 1st half-cycle is not influenced in case of welds with lower setpoint %I (0 to 55 SCV).
- that the 1st half-cycle is limited to 55 SCV in case of higher setpoint %I (> 55 SCV).

Two parameters are available for programming:

- ”1.half-cycle limit”:
  Parameter effective for all modules.
  Only the first half-cycle of a weld will be limited.
- ”1. half-cycle after cool time”:
  Adjustable separately for each welding program.
  The first half-cycle of each weld time or each impulse will be limited if a cool time greater than 0 has been programmed previously.

Parameter setting in BOS:

In ”Programming”, flag ”Electrode”, parameter ”1.half-cycle limit”

In ”Programming”, flag ”Schedule”, parameter ”1.half-cycle after cool time”

Control functions

3.9 Automatic spot repetition

It is used for welding faults type ”Current too low...” or ”No current...”, which occur occasionally, to reduce the number of user intervention required.

Conditions:

- Current monitoring is activated **and**
- the function ”Inhibit monitoring” has been turned off.

Automatic spot repetition can be activated or deactivated separately for each welding program using the ”Reweld” parameter.

When automatic spot repetition is activated, the timer is able to automatically repeat a defective welding schedule 1x – starting with SQZ – when the messages ”Current too high...” or ”No current...” are output. In this case, the welding gun remains closed after the defective welding schedule, and the programmed squeeze time, weld time and hold time will run again.

If the repetition results in a correct weld, the welding system will continue its normal operation. If an error occurs again during the repetition, this will lead to the respective message (”Current to low...”, ”No current...”).

It is a problem that bad fits or improperly placed electrodes may, in extreme cases, provoke the repetition of each spot weld, if the spot repetition has been activated. Conclusion: the cycle time increases considerably, which may go unnoticed at first.

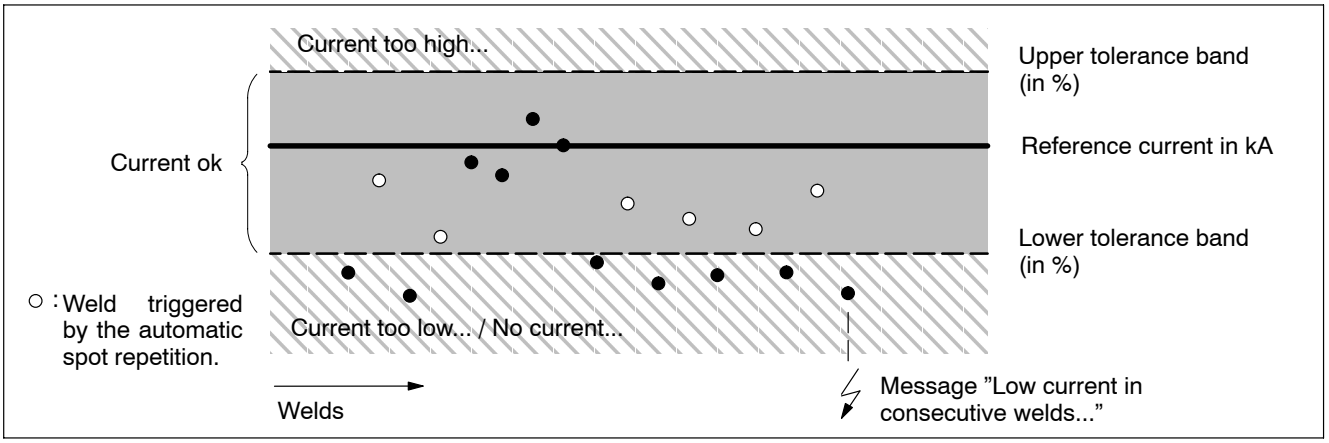
For this reason, the parameter ”Max. repetition” (max. permitted consecutive spot repetitions) is available.
An internal counter is always reset to 0 when a weld is successful the first time. In return, it is incremented whenever the ”Lower tolerance band” is not reached and automatic spot repetition is active at the same time.
The automatic spot repetition is only performed when the internal counter value is smaller than/equal to the parameter ”Max. repetitions”. If this is not the case, the timer will generate the message ”Series of welds below lower threshold point”.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”, parameter ”Reweld”

In ”Programming”, flag ”General”, parameter ”Max. repetitions”

Control functions



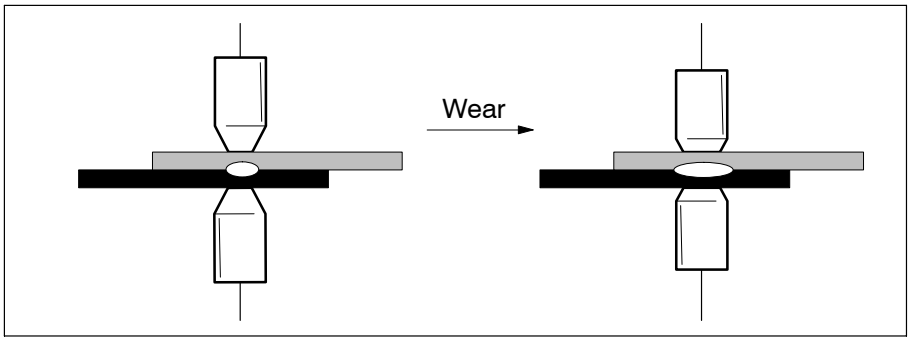
Example: Principle of automatic spot repetition with "Max. repetitions" =4

☞ **Messages may optionally be defined as "Fault" or as "Warning". While an event defined as "Warning" does not cause a blocking of the timer, the occurrence of a "Fault" always requires a "Fault reset" (refer to page 12–1) in order to start the next welding schedule.**

Control functions

3.10 Electrode maintenance

Electrodes are subject to process-related wear in the course of their life (for information on wear, refer to section3.10.1), and this becomes noticeable by an increase in the contact surface, among other things.



Increase of the contact surface due to electrode wear

To compensate this effect, the timer has

- automatic %I stepping (stepper; refer to page 3–30) and
- tip dressing (refer to page 3–30)

Both methods can be used separately as well as in combination.

3.10.1 Count factor and wear per component

Count factor

The wear of electrodes is dependent on different factors such as programmed %I value, thickness and material of the part to be welded.

As long as an electrode is used to make welds on one type of material with one thickness and using the same %I value, it is possible to predict after how many welds the electrode will be worn and in need of replacement based on the existing experimental values. In this case, electrode wear can be represented using a ”spot counter”. The spot counter is incremented by the value ”1” after each welding schedule performed.

If, however, an electrode is used for a mixture of materials or varying material thicknesses, its wear will not progress constantly per spot weld. A spot counter is not appropriate in this case.

That is why the wear of an electrode is monitored in the timer by a ”wear counter”.
In this instance, the timer increments the wear counter by the ”count factor” after each welding schedule. This means that the wear counter cannot only be incremented by the value ”1” (like the spot counter) but by random values.
The count factor that matches a spot weld can be specified for each individual program, thus ensuring that the electrode wear is recorded correctly.

Control functions

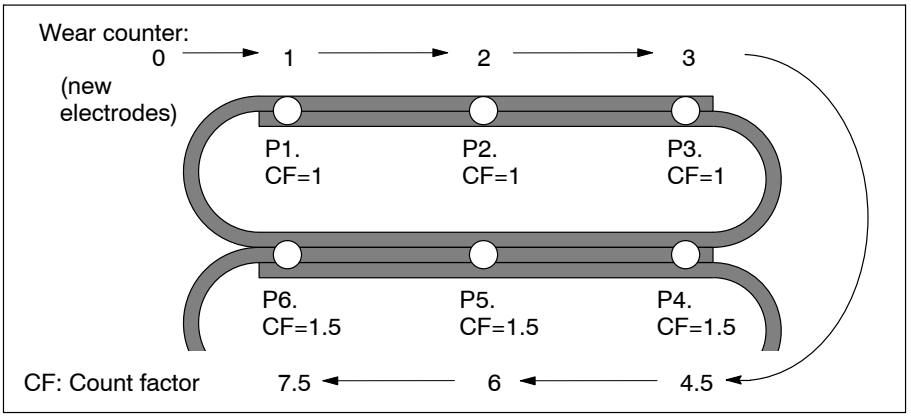
Wear per component

Using the parameter ”Wear/component”, it is possible to enter the electrode wear that occurs when a single part is welded. Based on this, the timer can calculate the number of parts that can be welded by an electrode until the maximum electrode life is reached. The number of these remaining parts are displayed in a ”Prewarning table” (refer to page 3–31).

Example:

Six welds have to be performed on a component.
Each spot weld (P1 to P6) is generated by a separate welding program (Prog1 to Prog6).
In case of the upper 3 spots (P1 to P3), 2 sheets have to be welded together, in case of the lower 3 spots (P4 to P6) 3 sheets have to be welded together.
As a result, the electrode wear is higher for spot welds P4 to P6 (greater thickness of material). Therefore, the program-specific count factor in Prog1 to Prog3 is programmed with value ”1” and in Prog4 to Prog6 with value 1.5.
The wear per component is 7.5.

☞ **The count factors mentioned above are just an example. In practice, the count factors are determined in advance for the materials and thicknesses in question.**



Example: recording of wear

Parameter setting in BOS:

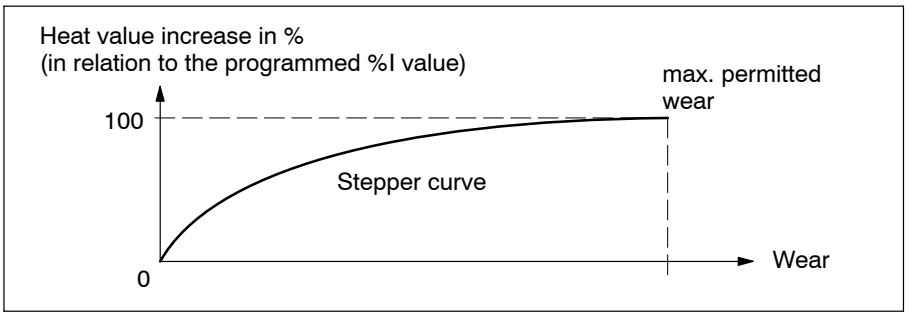
In ”Programming”, flag ”Stepping”, parameter ”Count factor”
In ”Programming”, flag ”Stepping”, parameter ”Wear/component”

Control functions

3.10.2 %I Stepper (Stepper)

In the course of the electrode life, the stepper maintains the current density in the gradually increasing spot weld.

For this purpose, separate stepping curves can be defined for up to 10 different electrode types. A stepper curve determines the percentage by which the programmed setpoint %I is to be increased automatically in dependence on the electrode wear.



Principle of stepping

Parameter setting in BOS:

In ”Programming”, flag ”Stepping”, parameter ”%I value...”

☞ **The resulting %I value changes can be monitored by the function ”Monitor stepper” (refer to page 3–24).**

3.10.3 Tip dressing

In the course of the electrode life, tip dressing periodically restores the required contact surface.

For this purpose, the electrodes have to undergo corresponding treatment at the tip dressing station after a specific wear.

With the output signal ”Tip-dress request” the timer asks for tip dressing.

The ability to define 10 different dressing curves as additional option provides optimum adjustability to the varying electrode types. A dressing curve determines the percentage by which the programmed setpoint %I is to be increased automatically in dependence on the electrode wear.

Parameter setting in BOS:

In ”Programming”, flag ”Stepping”, parameter ”Dressings”.

☞ **The resulting %I changes can be monitored by the function ”Monitor stepper” (refer to page 3–24).**

Control functions

☞ **Start dressing is activated via parameter ”Dress new electrodes”. When start dressing is active, the timer will demand an immediate tip dressing after an electrode replacement.**
With new electrodes, this serves to e.g.
– to establish a defined size of plug
– to establish a defined contact angle
– to remove a protective coating.

3.10.4 Warning and Maximum electrode life

When the maximum tolerable wear has been reached, new electrodes have to be installed.

In this context, the following output signals are available

- ”Warning cap change”
- ”Maximum cap life” or
- ”Request cap change”

These are only used when the electrode maintenance function is active (parameter ”Stepping”: ON).

Parameter setting in BOS:

In ”Programming”, flag ”Stepping”, parameters ”Warning wear” and ”Max. wear”.

3.10.5 Prewarning table

For electrodes with active electrode maintenance function, the prewarning table provides an overview giving quick access to all important information and operations:

- weld timers allocated to the individual electrodes,
- current wear (percentage, numerical and graphical).
  The graphic display is color-coded. Existing prewarnings, tip-dress requests or the reaching of maximum electrode life can thus be recognized quickly.
- remaining parts which can still be produced with the respective electrode,
- resetting of one or several wear counters after cap change.

Control functions

3.11 Electrode force

The electrode force used to press the parts to be welded together (in kilonewton: kN)) is part of each welding program:

Therefore, the timer generates a corresponding output signal on the basis of each programmed force value which can be used as manipulated variable for electrode force.

For the output of the force manipulated value,

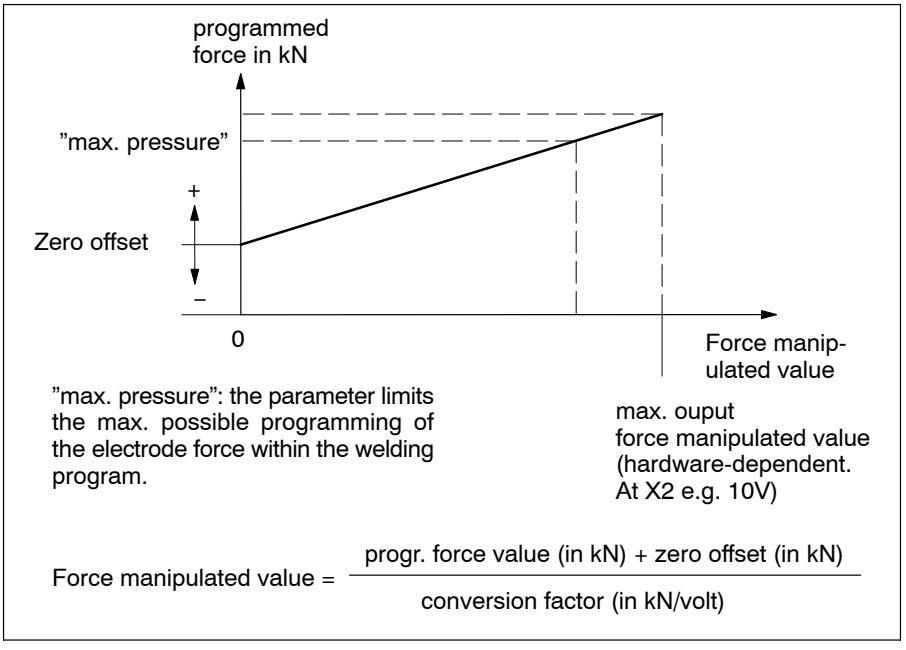
- an analog signal at X2U is available. For details, refer to page 7–5.

The internal characteristic can be created either

- automatically via force calibration (refer to section 3.12.1 from page 3–34),
  or
- manually via parameter ”Conversion factor” and ”Zero shift”

”Conversion factor” (in kN/volt):
The timer uses this factor to calculate the output value of the force manipulated value. Refer to figure.

”Zero offset” (in kN):
Offsets the zero crossing of the characteristic. Thus the characteristic can be adjusted to the working zero point of the actuators used. Refer to figure.



Characteristic for the output of force values

☞ **A properly adjusted characteristic is required to make sure that the programmed force actually has effect on the electrodes.**

Control functions

☞ **In the course of force calibration, the timer automatically calculates the required values for the parameters ”Conversion factor” and ”Zero offset”. Therefore, the parameters must not be changed manually after this!**

In addition to the programming of an electrode force that remains constant throughout the welding schedule, the timer offers the following functions:

- Pressure profile:
  ten different force values are programmable for each welding program which may be activated at specific times within the welding schedule.
- Pressure stepping:
  depending on the selected stepping or dressing curve, you can determine the percentage by which the programmed base pressure value is to be raised automatically in dependence on the electrode wear.

Parameter setting in BOS:

In ”Programming”, flag ”Schedule”, parameter ”Base pressure value”.

In ”Programming” flag ”General”, parameter ”Pressure output mode”.

In ”Programming”, flag ”Electrode”, parameter group ”Force”.

In ”Programming”, flag ”Seq. Pg.2”, parameter group ”Pressure profile”.

Control functions

3.12 Calibration

☞ **Always calibrate the pressure first, then the current!**

3.12.1 Pressure calibration

Using the ”Pressure calibration” function, you adjust all the components of the welding system involved in force build-up with your reference force meter (e.g. pressure dynamometer). This feature has the following advantages:

- Input of gun force in kilonewton (kN).
- exact reproducibility of logged force values (ISO 9000)
- The force values of all calibrated systems are comparable to each other and can be transferred to additional systems.
- Comparable documentation.

☞ **The weld timer in principle also works without pressure calibration. However, the advantages mentioned above can only be achieved after pressure calibration has been performed.**

CAUTION
Possible damage to welding guns!
If pressure calibration is not used, the timer cannot create the correct relation between programmed force and force manipulated value to be output (to control the welding gun force).
The actual force having effect on the welding gun can therefore deviate considerably from the programmed force.
Possible consequences are defective welds or even damage to the welding guns.
Without pressure calibration, it is therefore necessary to determine the base pressure to be programmed empirically – starting with the value ”0” – for each required electrode force and after each welding gun change!

Conditions for pressure calibration:

- Proportionate control valve, servo gun or other suitable equipment capable of converting the force manipulated value of the timer into mechanical force at the welding gun.
- External reference force meter with suitable measuring range.
- Linked programming device with BOS software (for operation and measuring value input).

Control functions

For pressure calibration, you specify 2 different values of forcemanipulated value in the unit % (related to the max. output value), measure the force resulting between the electrodes using the reference force meter and transmit the measured force values to the timer (in kN). The timer will then internally calculate all the data needed for the alignment.

With respect to pressure sclaing, pay attention to the following:

★ The following applies to the 2 force manipulated values used for pressure calibration:
the higher value should generate the max. force used for welding (upper limit of the force working range).
Both values should differ from each other by at least 20%.
The force required for tip dressing is not allocated to the normal working range (because it is mostly lower).
If you do not know which values have to be input for pressure calibration, perform test pressure calibrations using small values in order to see which force values act on the welding gun. That way you make sure that the welding gun is not overburdened or damaged during the pressure calibration. Then perform additional pressure calibrations with raised values until the higher input value generates the max. force you use for welding.

★ Use the same reference force meter for all similar welding systems.

★ Perform a pressure calibration for each gun of the welding system and after each change of welding guns.

★ Check the pressure calibration by using test welding programs and comparing the programmed base pressure values with the actual values present at the welding gun.
In this context, make sure that the test programs work **without current** and people will not be endangered during the measurement (e.g. by robot movement).

★ Perform a new pressure calibration whenever a component, which is actively involved in force generation, is replaced (weld timer, proportionate control valve, gun...).

☞ **Pressure calibration modifies the parameters ”Conversion factor” and ”Zero offset” (in electrode parametrization; also refer to page 3–32). Therefore, these parameters must not be changed manually after pressure calibration has been performed!**

Control functions

3.12.2 Current calibration

Using the function ”Current calibration”, you adjust the entire measurement and control circuit to your reference current meter. This feature has the following advantages:

- reproducible, selectable currents with a max. error of less than +/–2% (with respect to the real value of a reference current meter)
- exact reproducibility of logged current values (ISO 9000)
- the currents of all calibrated systems are comparable to each other and can be transferred to additional systems
- comparable documentation.

☞ **The weld timer also works without current calibration. However, the advantages mentioned above can only be achieved after current calibration has been performed.**

Conditions for current calibration:

- External reference current meter with suitable current sensor.
- Linked programming device with BOS software (for operation and measuring value input).

☞ **You should perform a pressure calibration prior to the current calibration (refer to page 3–34).**

For current calibration, you enter 2 different %I values in the unit SCV, measure the resulting currents in the secondary circuit using the reference current meter and input the measured current values into the timer. The timer will then internally calculate all the data needed for the adjustment.

With respect to current calibration, pay attention to the following:

★ The following applies to the 2 %I values (in SCV) used for current calibration:
the higher value should be at the upper end of the normal working range of your welding system.
Both values should differ from each other by at least 20 SCV.

★ Use the same reference current meter for all similar welding systems.

★ Adjust your reference current meter to the appropriate current type (”AC” for PST) and the suitable measuring range.

★ If fade-out times have been programmed or trail currents are active, this will influence the current calibration!
Therefore, check your reference current meter for the respective functions and for correct adjustment prior to performing the calibration procedure.

★ Always perform the calibration procedure without parts to be welded and with closed electrodes.

Control functions

- ★ Perform a pressure calibration for each gun of the welding system and after each change of welding guns.
- ★ Check the current calibration by performing a test weld and comparing the current displayed on the timer with the current displayed on the reference current meter.
- ★ Perform a new current calibration whenever a component, which is actively involved in the control circuit, is replaced (weld timer, transformer ...).

Control functions

3.13 Corrections

The correction function of the timer permits

- %I value and
- pressure change (electrode force).

Thus, process-related adjustments of the welding schedule can be made quickly without having to modify the original programmed schedule data. The corrections act in addition to the programmed base values.

You can activate both types of corrections

- for a specific electrode/gun (=Corr.(E) and
- for individual programs or individual program areas (=Corr.(P)).

☞ **When the %I correction is changed, the reference current to be monitored is also adjusted internally.**

☞ **The max. input correction values can be limited in the basic setup. The limitation is freely adjustable in a range of +/– 20%.**

Parameter setting in BOS:

In ”Correction”, flag ”Correction”.

In ”Programming”, flag ”General”, parameter group ”Global electrode parametrization”

Control functions

3.14 Welding transformer transmission ratio

In order to ensure the proper functioning of the power unit , the technical data of the welding transformer used must be known in the timer.

- ”Transformer transmission ratio”:
  Transmission ratio primary/secondary.

CAUTION
Incorrect current regulation is possible!
The ”Transformer transmission ratio” parameter is needed for the conversion between primary and secondary current in connection with the primary current regulation.
Incorrect settings result in a defective current regulation and thus in detrimental effects on the welding process and the welding system.
In caseof transformers with step switches, make sure that the new transformer transmission ratio is adjusted after each step switch change!

Parameter setting in BOS:

In ”Programming”, flag ”Electrode”, parameter group ”Transformer”.

Control functions

Notes:

Technical data

4 Technical data

☞ **For information on rating and load, refer to section 5!**

4.1 Type-independent data

Power supply	Logic (X1S1, pin 3/4)	+24 V_{DC} ; +20 %, −15 % max. +/−5 % ripple
	I/O field (X1S1, pin 1/2)	
	Power unit	400 V_{AC} −20% to 480 V_{AC} +10%; 50 / 60 Hz Connection to earthed TN or TT mains
Power input	Nominal current logic (at 24 V)	approx. 1.0 A (without fan cover) approx. 3 A (with fan cover)
	Making current logic	approx. 1.5 A for 10 ms
	I/O field	max. 3 A (depending on I/O circuitry)
	Power unit	Type-specific. Refer to section 4.2.
Power loss	Logic operation	10 VA
	I/O field	0.5 VA per active input 2.4 VA per active output
Discrete signals	16 inputs	+24 V_{DC}; 3 mA according to EN 61131-2 Type 3
	12 outputs (short-circuit-proof)	O00 to O03: +24 V_{DC}; max. 1 A (for solenoid and prelift valves). O4 to O11 +24 V_{DC}; max. 0.1 A
Degree of protection		IP 20; designed to be installed in housings or switch cabinets with at least IP 54
Ambient temperature	Operation	0 ... +55 degrees Centigrade
	Storage / transport	−25 ... +70 degrees Centigrade
Coolant temperature	Air	max. 45 degrees Centigrade
	Water	max. 30 degrees Centigrade
Air pressure		0 ... 2,000 m a.m.s.l.
Air humidity		Condensation is not permitted
Climatic category		3K3 according to EN 60721−3−3
Corrosion		The ambient air must be free from high levels of acids, lyes, corrosive materials, salt, metal vapors

Technical data

Number of programs	for machine applications	64; can be selected via input signals ”Program”.
	for manual gun applications	8 welding programs and 2 dressing programs; can be selected via input signals ”Program”.
Programming interfaces	V24 / RS232; for programming on location	Interface X3C, electrically isolated; Mini-DIN female connector
	Ethernet (optional); for linking of several timers	female RJ 45 connector
Operating software (Firmware)		stored in flash memory; can be reloaded via software (option) through interface X3C (V24): via SW ”WinBlow” Ethernet: via SW ”FWUpdate”
Program memory		RAM; buffered
Bufferbattery		Lithium battery type AA 3.6 V; buffers RAM and internal clock with deactivated power supply for logic. Battery life approx. 2 years
Output of programmed electrode force		Analog output (at X2U): 0 to +10 V, max. 20 mA
Electrodes	for machine applications	8 (electrode 0 to 7)
	for manual gun applications	2 Electrode 1: for prog. 1...4 Electrode 2: for prog. 6...9
Integrated power supply unit	Design	2-phase thyristor power supply unit
	Overvoltage protection	MOV (metal oxide varistor)

Technical data

4.2 Type-specific data

Terminal connectors (mains supply and transformer)	PST 610E L/W	Core area: Tightening torque:	max. 50 mm^2 6 to 8 Nm
	PST 625E L/W	Core area: Tightening torque:	max. 95 mm^2 15 to 20 Nm
Nominal current	PST 610E L	non-ventilated: with forced cooling:	max. 95 A_{rms} max. 130 A_{rms}
	PST 610E W		max. 130 A_{rms}
	PST 625E L	non-ventilated: with forced cooling:	max. 150 A_{rms} max. 200 A_{rms}
	PST 625E W		max. 230 A_{rms}
Primary output current (also refer to load diagrams, from page 5–3)	PST 610E L	non-ventilated: with forced cooling:	max. 300 A (at 10% duty cycle) max. 300 A (at 20% duty cycle)
	PST 610E W		max. 300 A (at 20% duty cycle)
	PST 625E L	non-ventilated: with forced cooling:	max. 389 A (at 15% duty cycle) max. 365 A (at 30% duty cycle)
	PST 625E W		max. 400 A (at 30% duty cycle)
Primary current measuring ranges	PST 610E L/W	Measuring range 11: Measuring range 12: Measuring range 13:	50 ... 300 A (default) 150 ... 1100 A 450 ... 2800 A
	PST 625E L/W	Measuring range 11: Measuring range 12: Measuring range 13:	50 ... 300 A 150 ... 1100 A (default) 450 ... 2800 A
operable transformer nominal power (at 50% duty cycle, 400 V_{AC} and 80% utilization)	PST 610E L	non-ventilated: with forced cooling:	68 kVA 95 kVA
	PST 610E W		95 kVA
	PST 625E L	non-ventilated: with forced cooling:	106 kVA 141 kVA
	PST 625E W		155 kVA
Duty cycle (also refer to load diagrams, from page 5–3)		max. 50% duty cycle) (independent on possible power unit switched currents; limited by the integrated 2.2 kOhm field discharge resistor).	
Weight	PST 610E L/W	approx. 8 kg	
	PST 625E L	approx. 12 kg	
	PST 625E W	approx. 8 kg	

Technical data

Notes:

Rating and load

5 Rating and load

5.1 Basics

In general, semi-conductors have an almost infinite life if they are used within their specifications.
As a result of thermal load, however, mechanical forces act on the semi-conductor chips, and this may influence their life depending on the component size.
For this reason, semi-conductor manufacturers normally provide life curves showing the number of temperature cycles until the calculated end of life – in dependence on the junction temperature rise. In this case, one temperature cycle corresponds to one spot weld.

These conditions were taken into account in the design of our systems. The calculated life takes into account the thermal rise which is influenced by the welding current, secondary resistance, weld time and ambient temperature, among others.

Our load diagrams are based on the following assumptions:

- a calculated life of 20 million spots
- at an ambient temperature of 45°C.

However, ambient temperatures of about 25°C are realistic, which results in an approximately three times longer life.

In principle, the life would have to increase in systems with the ”colder” water cooling as opposed to air cooling. Depending on the application, however, water cooling may lead to a bigger temperature drop after a spot weld (due to the higher cooling capacity of water during the cooling phase). This effect results in a bigger temperature rise and may thus reduce the life

5.2 Is the power unit overloaded?

The maximum load of the thyristor power units is generally specified by the assignment of types to specific maximum welding transformer sizes.

★ Make sure that your target application does not overload the unit!

CAUTION
Possible damage or reduction of the life of units due to overload!
Therefore, it is absolutely necessary to check the actual load of the units!
Damages due to overload will result in the extinction of any warranty claims.

This can be checked using load diagrams. They represent the

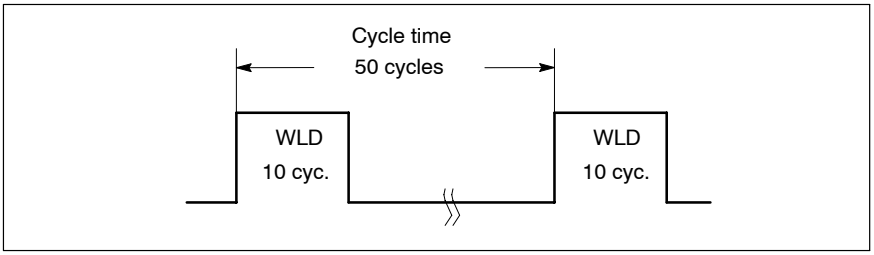
- primary output currents (I_{PRIM} in A) as a function of the
- duty cycle (in %) for an ambient temperature of 45°C refer to section 5.1) that can be switched by the thyristor power unit.

☞ **The resulting secondary currents (welding currents) can be calculated by multiplication by the respective transformer ratio.**

☞ **All load diagrams are shown in section 5.3 from page 5–3.**

Procedure for a check (example)

1. Calculate the max. duty cycle of the power unit.
   As a result of the low heat capacity of semi-conductors, the maximum permissible duty cycle is determined on the basis of the time ratio ”weld time / cycle time”.
   If different weld or cycle times occur within the application, use
   - the longest weld time and
   - the shortest cycle time to calculate the duty cycle.



   In this example, the following result is obtained for duty cycle ED:

$$\textbf{Duty cycle} = \frac{10\ \text{cyc.}}{50\ \text{cyc.}} \times 100\ \% = \textbf{20 \%}$$

2. Look for the type-specific load diagram in section 5.3 from page 5–3.
3. First draw the vertical at the previously calculated duty cycle of the transformer (refer to point 1.: duty cycle = 20 %).
4. Use the respective characteristics to determine the maximum permissible primary current.

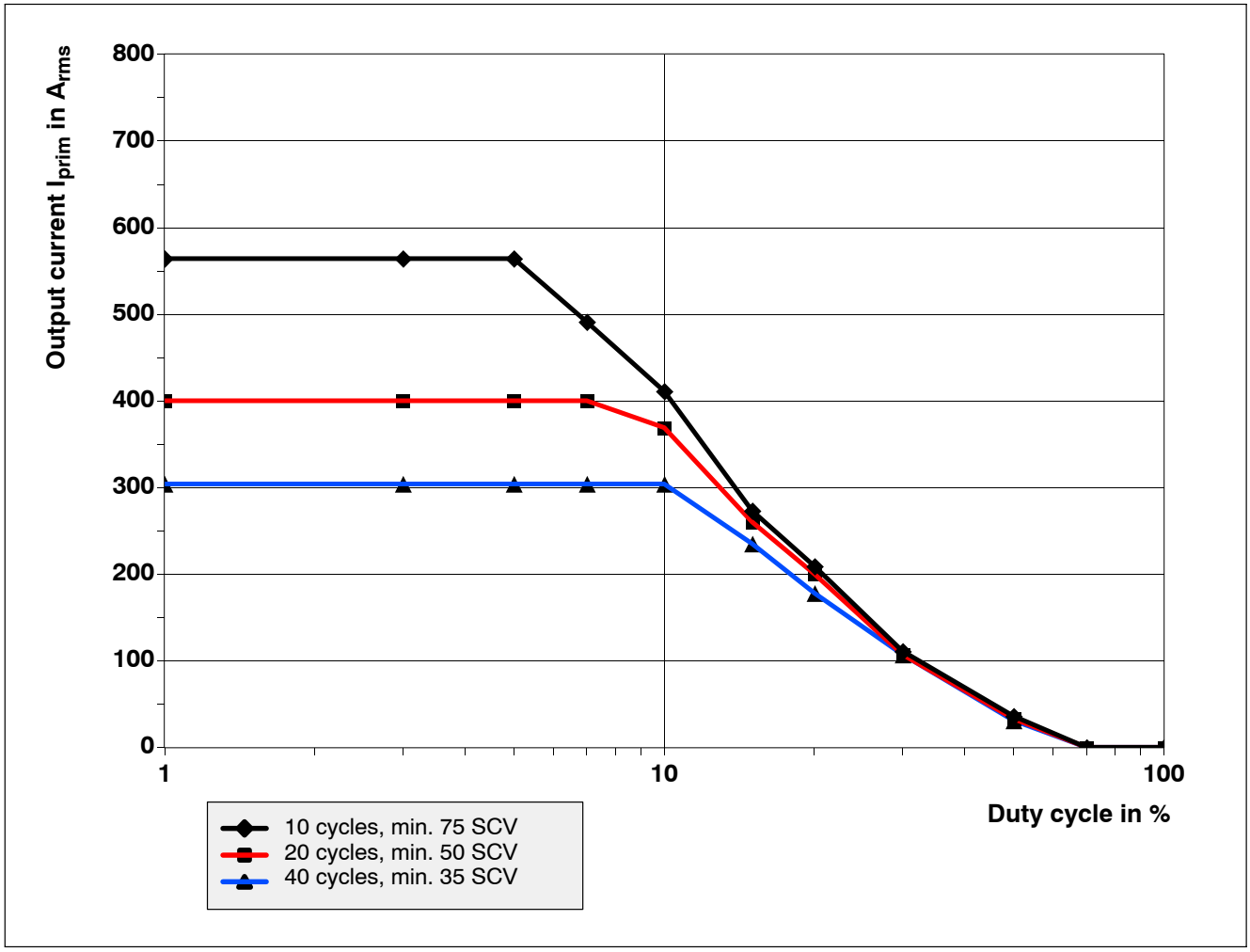
Rating and load

5.3 Load diagrams

5.3.1 PST 610E L without forced ventilation

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 610E L (without forced ventilation)

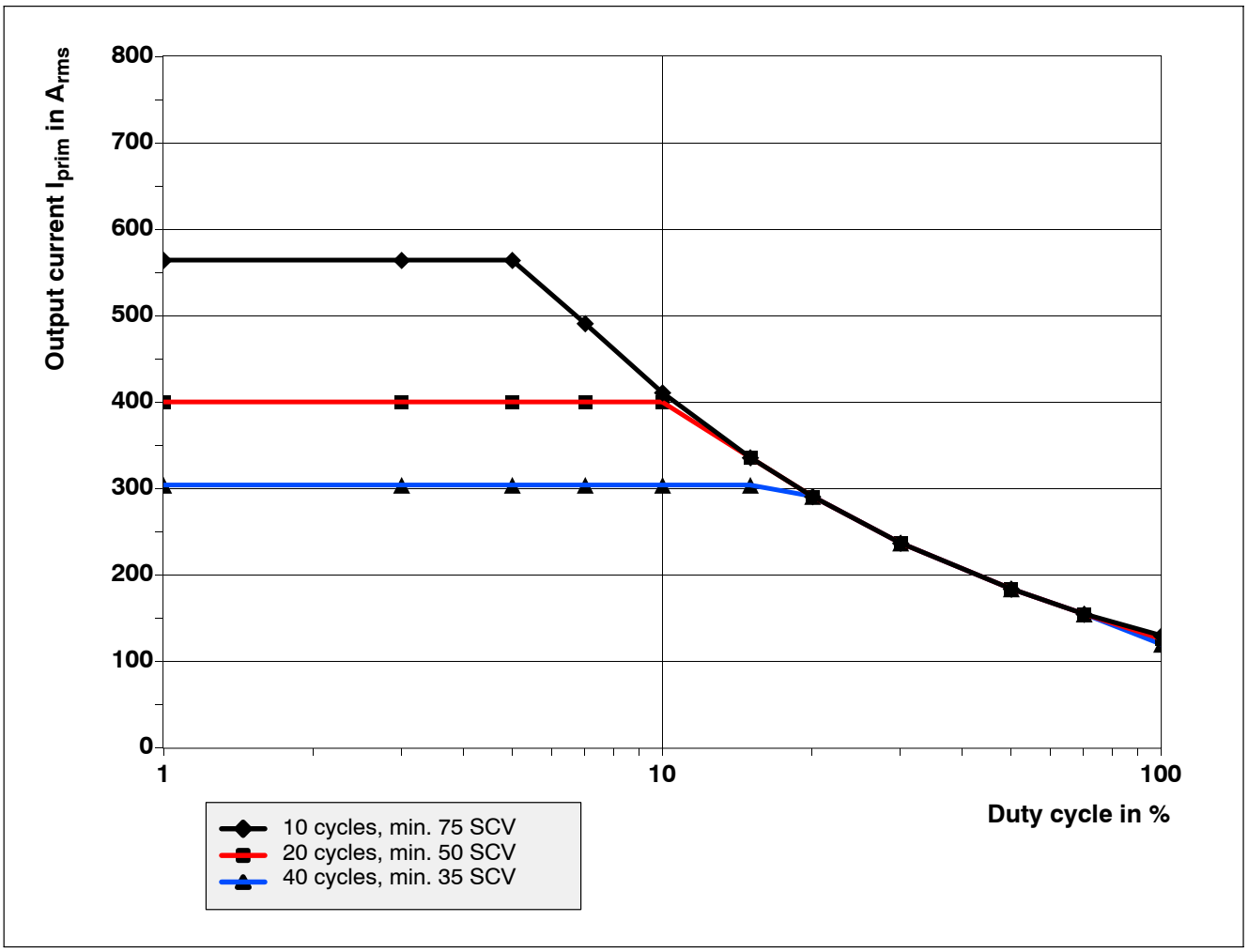
☞ **For descriptions on the load diagrams, refer to page 5–1.**

Rating and load

5.3.2 PST 610E L with forced ventilation

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 610E L (with forced ventilation)

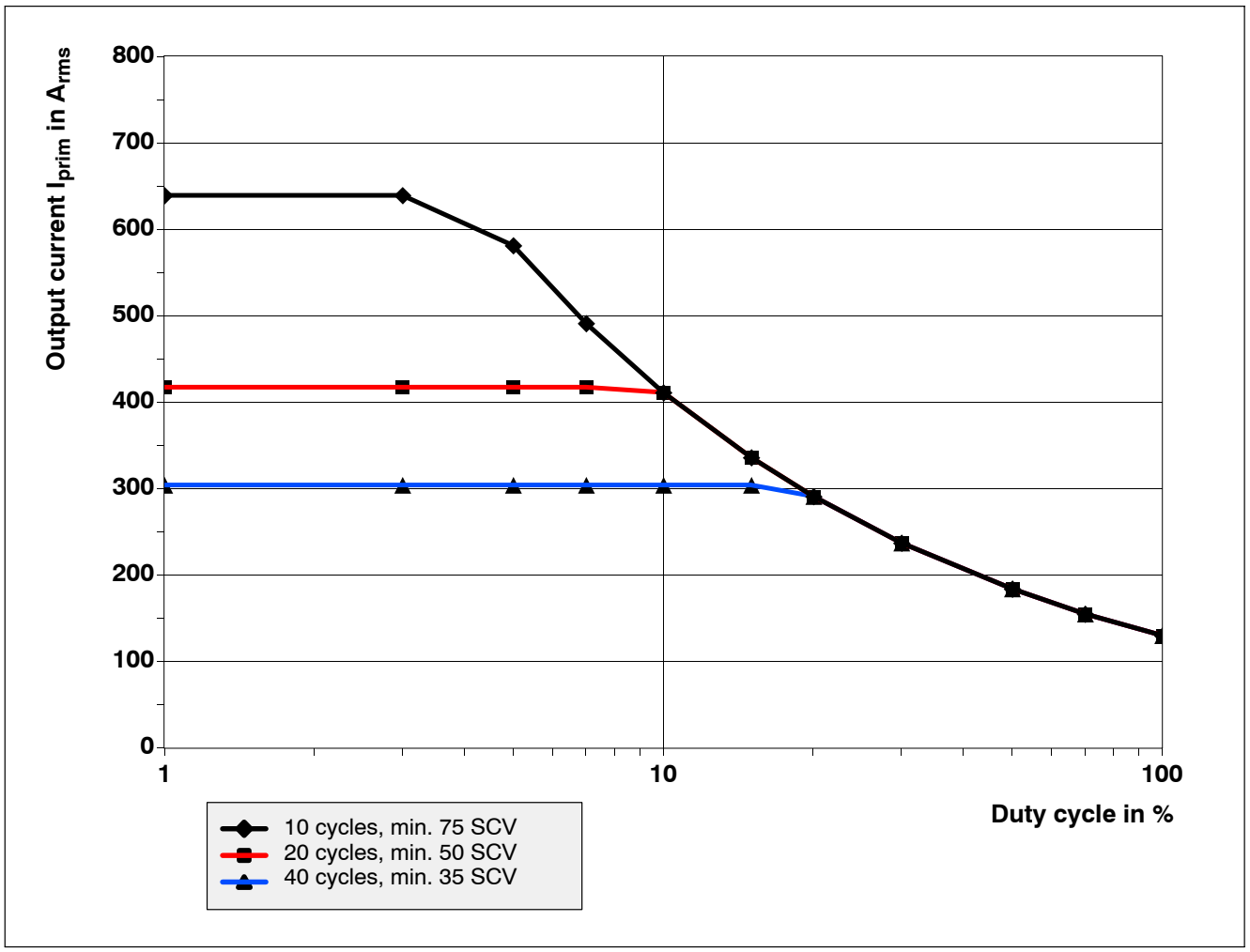
☞ **For descriptions on the load diagrams, refer to page 5–1.**

Rating and load

5.3.3 PST 610E W

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 610E W

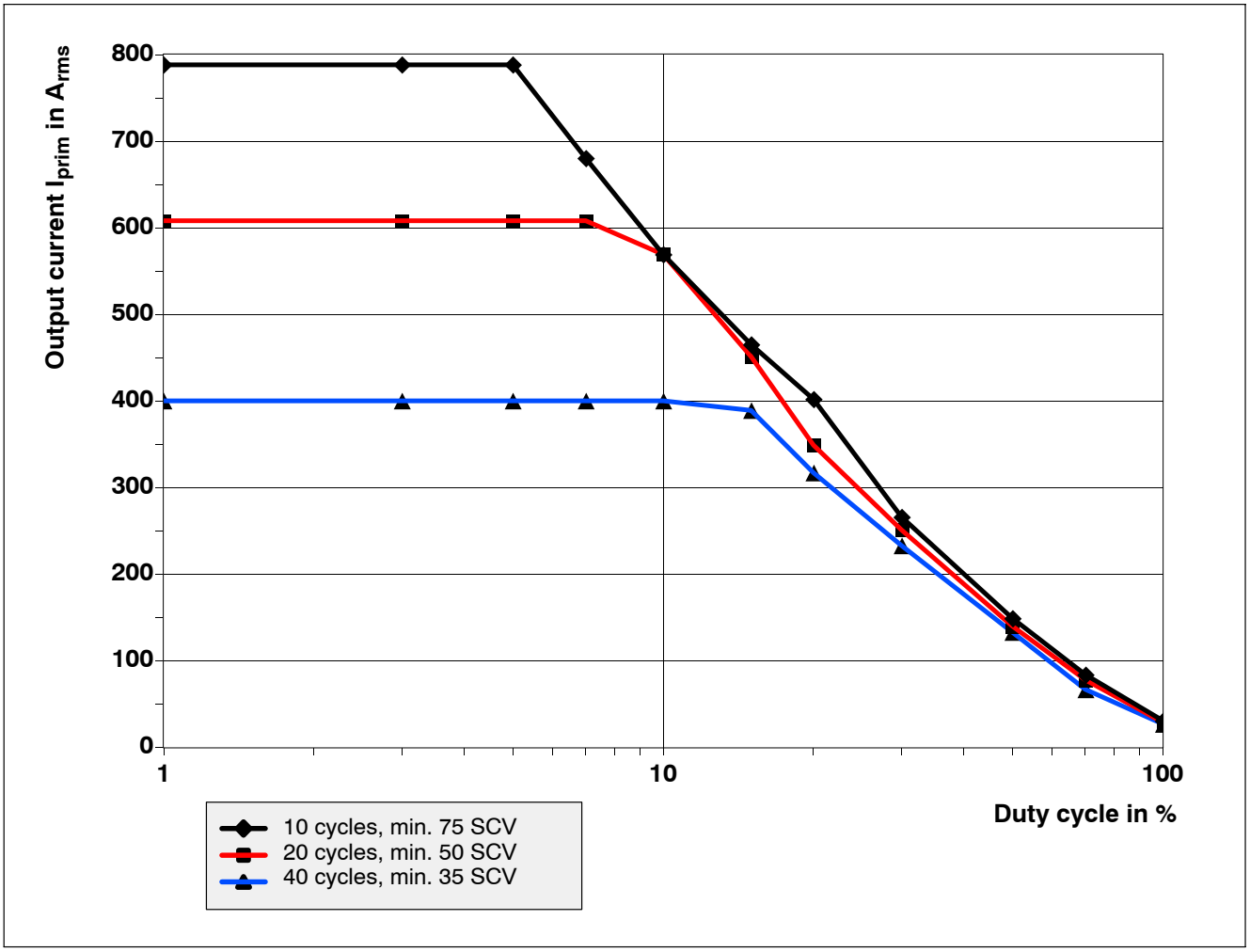
☞ **For descriptions on the load diagrams, refer to page 5–1.**

Rating and load

5.3.4 PST 625E L without forced ventilation

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 625E L (without forced ventilation)

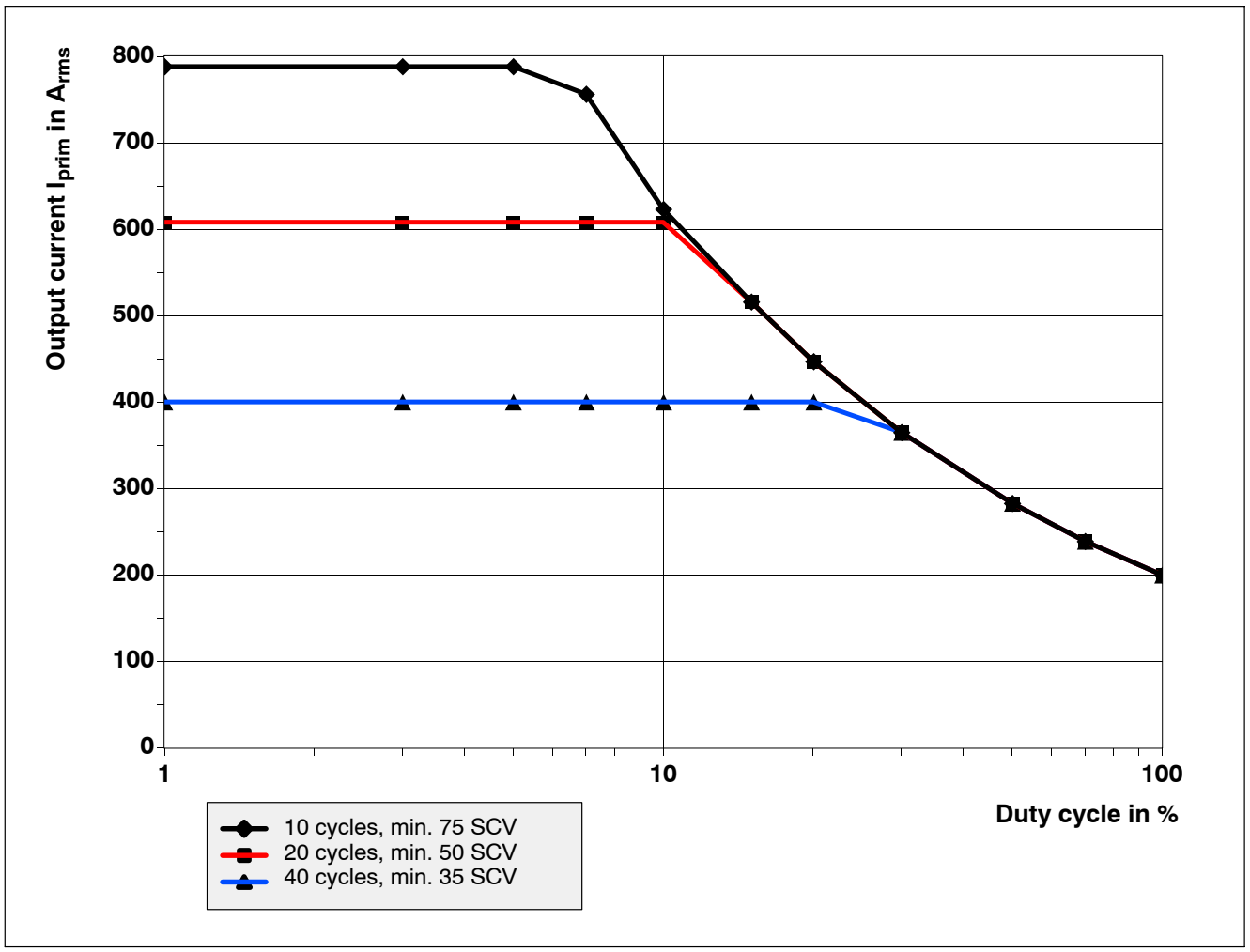
☞ **For descriptions on the load diagrams, refer to page 5–1.**

Rating and load

5.3.5 PST 625E L with forced ventilation

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 625E L (with forced ventilation)

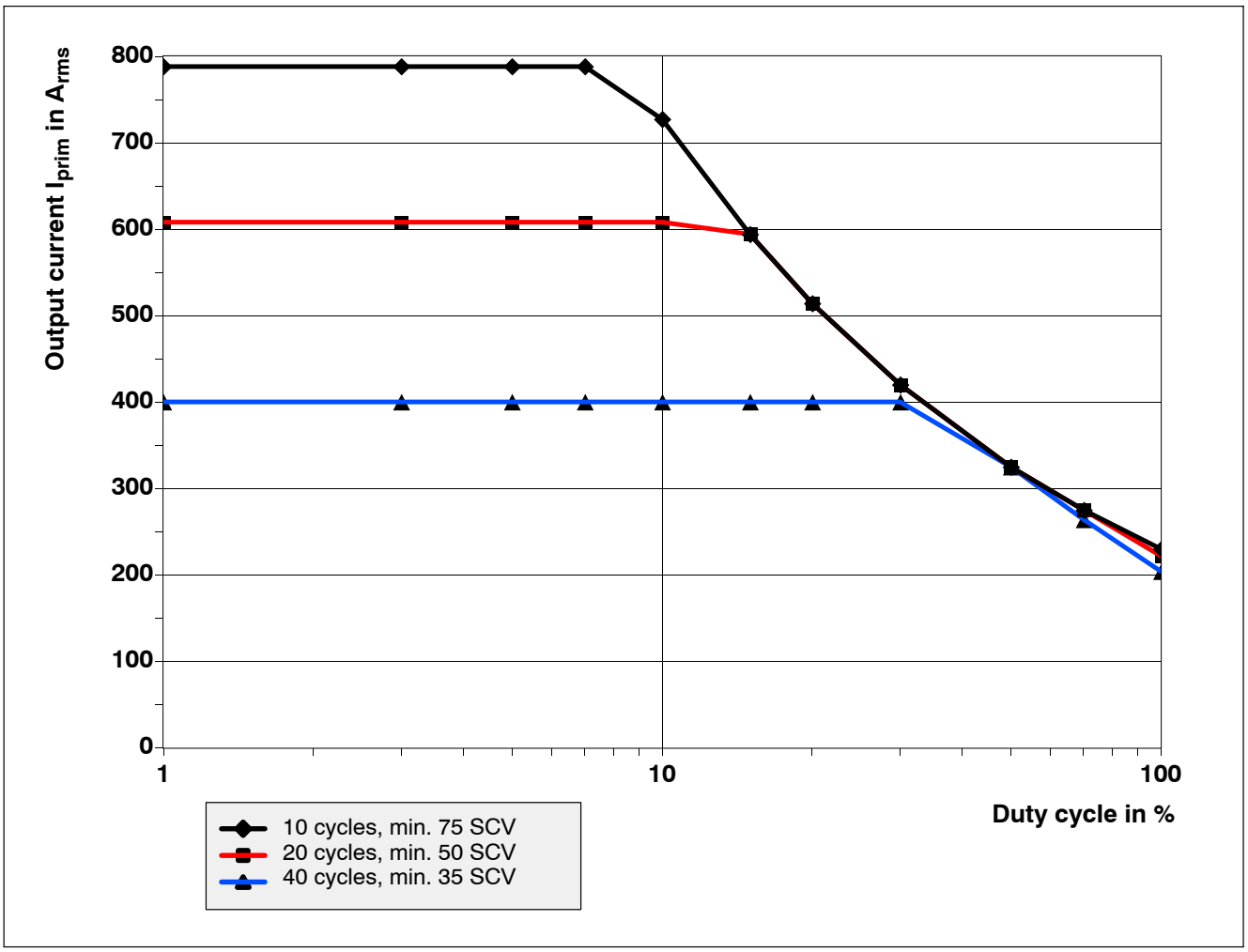
☞ **For descriptions on the load diagrams, refer to page 5–1.**

Rating and load

5.3.6 PST 625E W

Basis of the diagram:

- calculated life: 20 million spots
- ambient temperature: 45°C



Load diagram: PST 625E W

☞ **For descriptions on the load diagrams, refer to page 5–1.**

Assembly

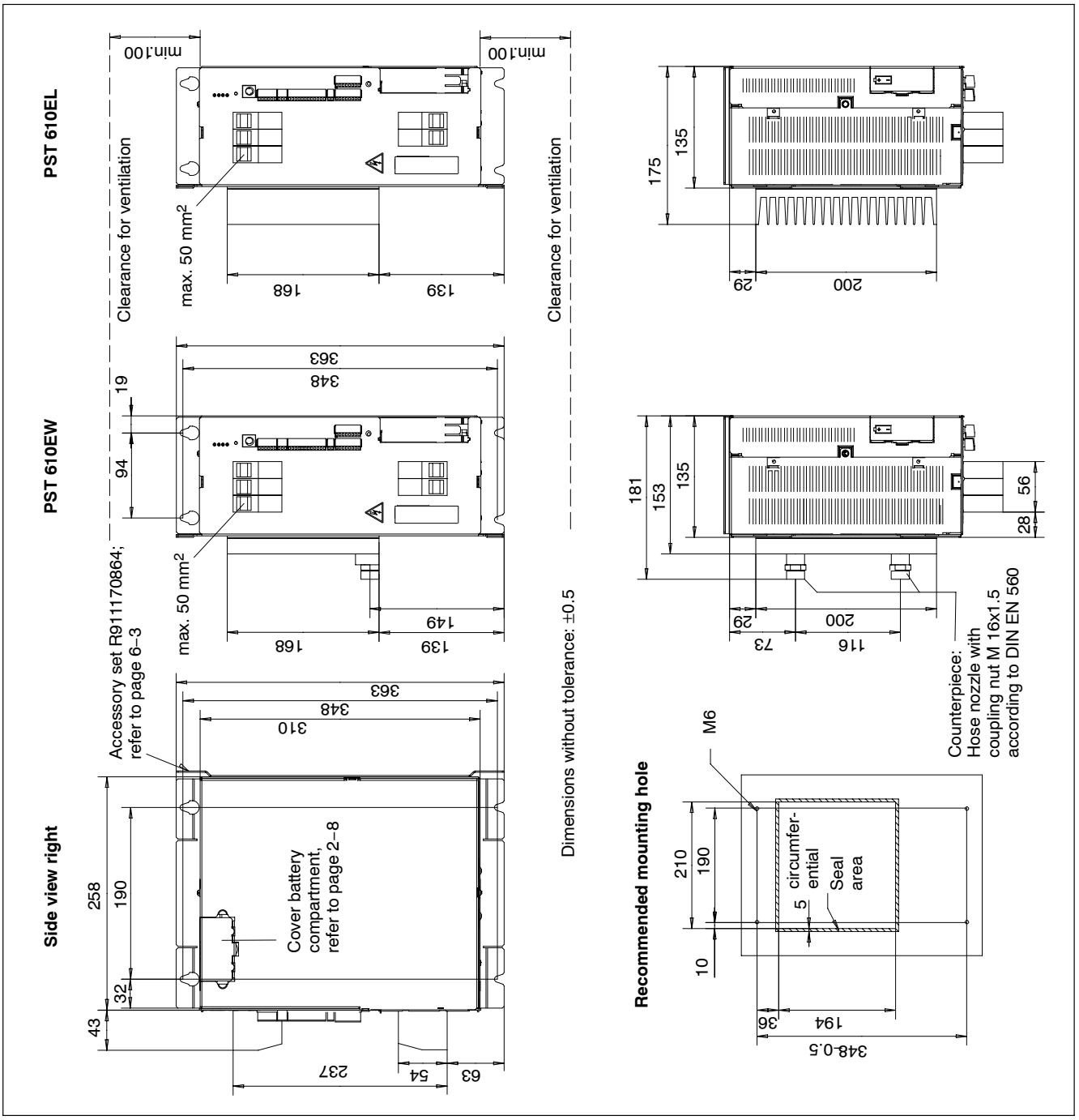
6 Assembly

★ Observe the safety notes for installation and assembly starting on page1–7 and the dimension values in section 6.1.

★ It is preferable to install the equipment vertically.

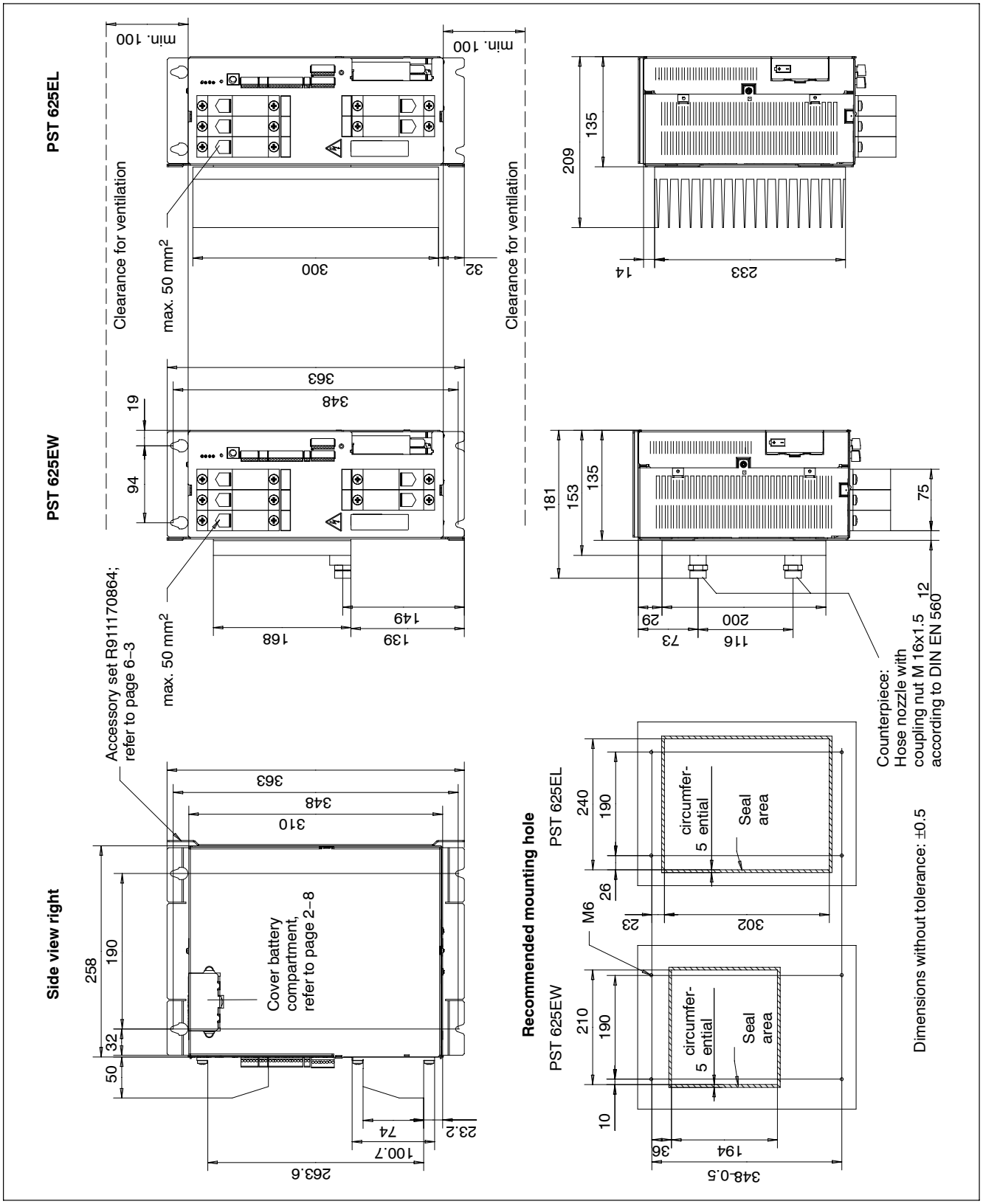
★ Please ensure that the cover of the battery compartment (refer to page 2–8) can be opened without any danger or problem after the installation.

6.1 Dimensioned drawings



Dimensioned drawings: PST 610EW (water cooling) and PST 610EL (air cooling)

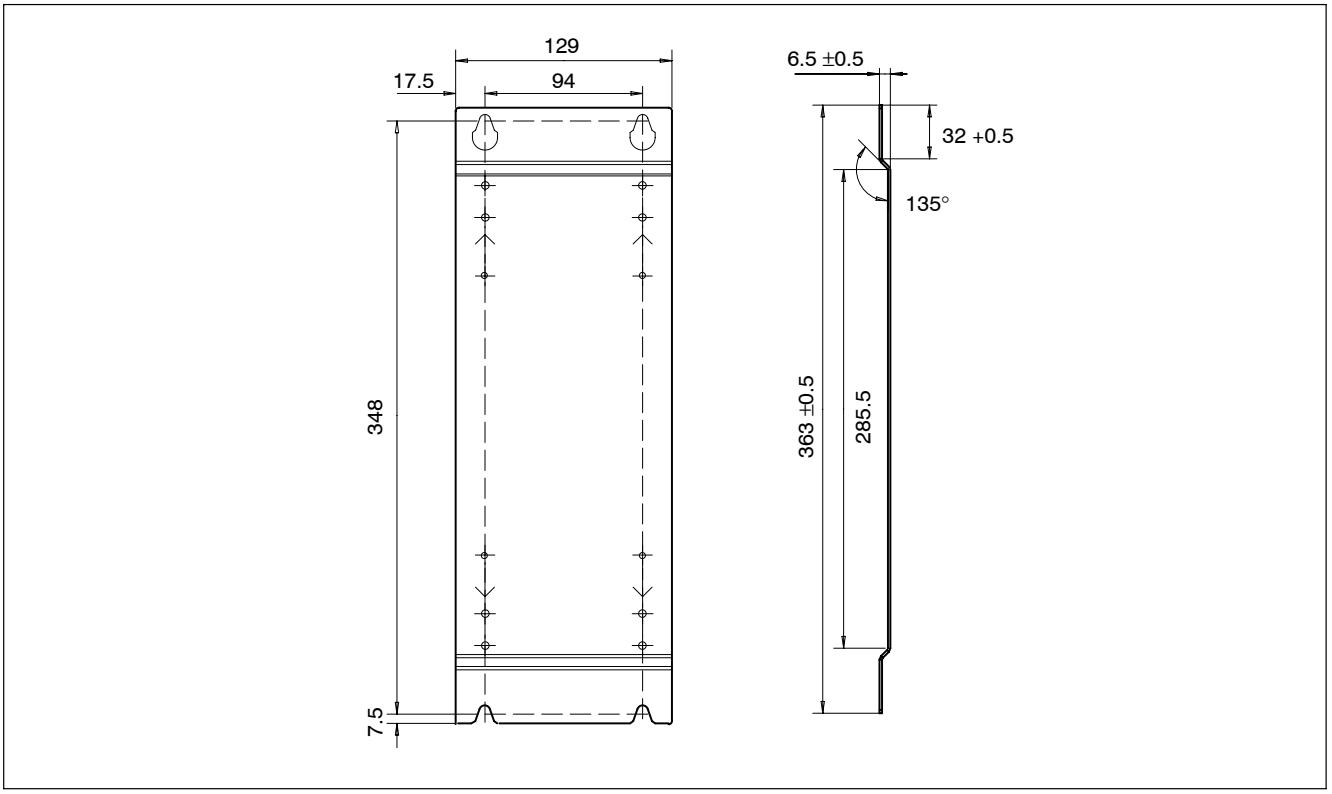
Assembly



Dimensioned drawings: PST 625EW (water cooling) and PST 625EL (air cooling)

Assembly

As a standard, the devices are mounted on the left side panel (seen from the front side). A mounting hole for the respective cooling unit is required for this purpose.
As an alternative, the device can be mounted to the rear panel using an accessory set.
For part numbers, refer to section 14.



Dimensioned drawing: Mounting plate 15 (accessory set R911 170 864)

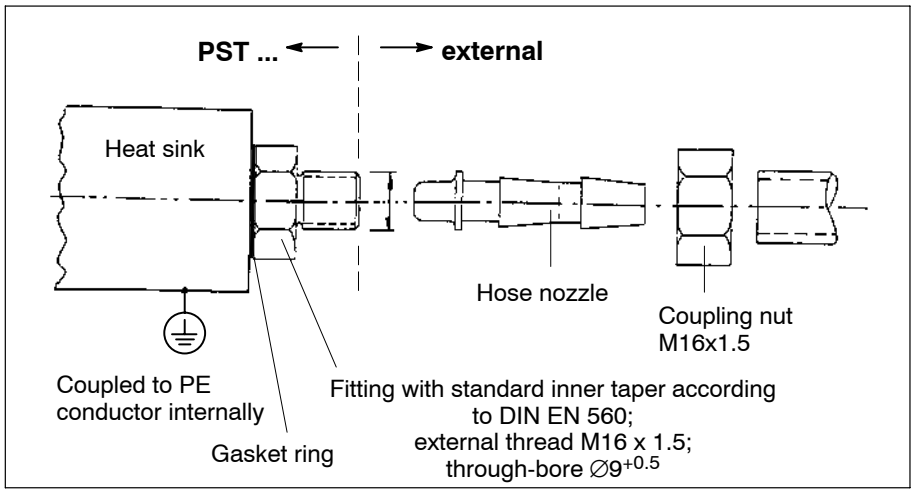
Assembly

6.2 Cooling water connection

★ Please note the requirements on cooling in the section ”Safety instructions”, section 1.6 and 1.8.

★ Make sure that the conditions required for cooling are actually complied with.
The respective information is provided in the technical data, starting on page 4–1.

☞ **The mechanical construction of the cooling water connection is identical for all PST types with water cooling. Only the position of the connections may be different.**
For further information, refer to section 6.1.



Example: Cooling water connection

★ DIN threads must be used in order to reach the necessary frictional connection.

Electrical connection

7 Electrical connection

☞ **For technical data, refer to section 4.**

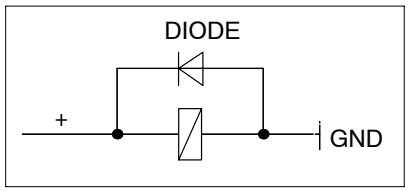
7.1 Noise suppression

Noise is caused by switching peaks and can interfere with the devices directly or through coupling with connecting lines. Therefore, measures must be taken to suppress noise.

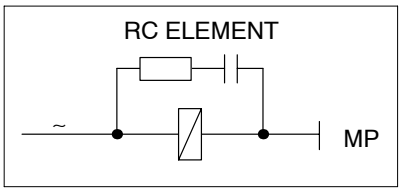
★ Eliminate all noise at its very source. Where this is not possible, the noise suppression elements must be attached as close as possible to the source of noise.

★ First make sure that proper noise suppression is available for all components containing inductive elements or switchgear.

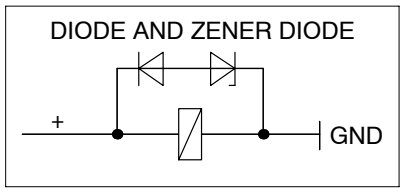
★ Noise suppression equipment must be installed resistant to fracture because strong vibration may occur on machines.



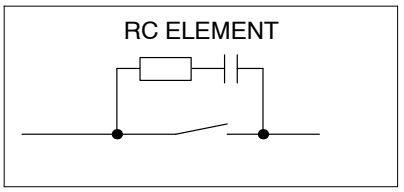
Diode, suitable for small DC voltage relays



RC element for AC voltage relays and AC motors



DI-ZD attenuation element for large DC voltage contactors and defined dropout times



RC element for spark quenching with inductive load

Noise suppression examples

☞ **The following table serves as an example only. The rating of the necessary components depends on the actual load situation.**

	Resistance	Capacitor	Diode
24 V_{DC}	–	–	1 N 5060/ZL 12
48 V_{DC}	–	–	1 N 5060/ZL 22
110 V_{AC}	220 ohms / 1 W	0.5 uF 400/600 V	
220 V_{AC}	220 ohms / 5 W	0.1 uF 500 V	
440 V_{AC}	220 ohms / 5 W	0.1 uF 1000 V	

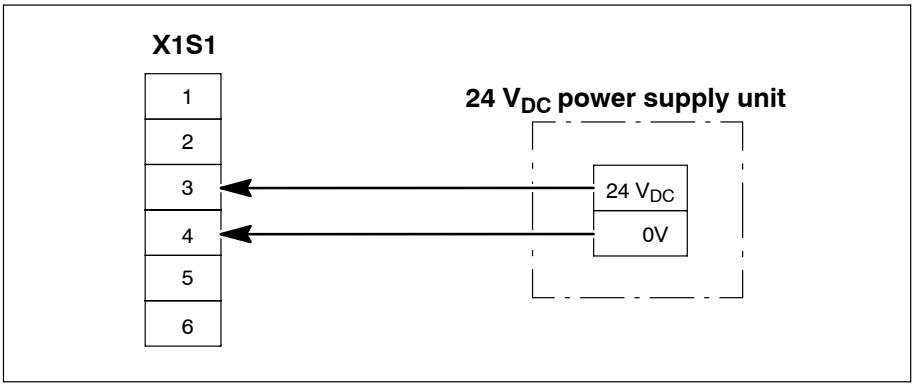
Electrical connection

7.2 24 V_{DC} logic supply

Connection:	to X1S1; STKK, grid 3.5 mm, 6-pole, max. 1.5 mm. Mating connector is comprised in the delivery.
Cable length	max. 10 m at 0.75 mm^2 max. 75 m at 1.5 mm^2
Cable type:	unshielded, VDE 0281, 0812 (e.g.: Ölflex)

☞ **For technical data, refer to page 4–1.**

Power infeed for the timer logic and external 24V fan.



Logic supply

★ Any external voltage sources used must be designed according to the principles of ”safety separation” in accordance with the Low-Voltage Directive (72/23/EEC, 93/68/EEC and 93/44/EEC).

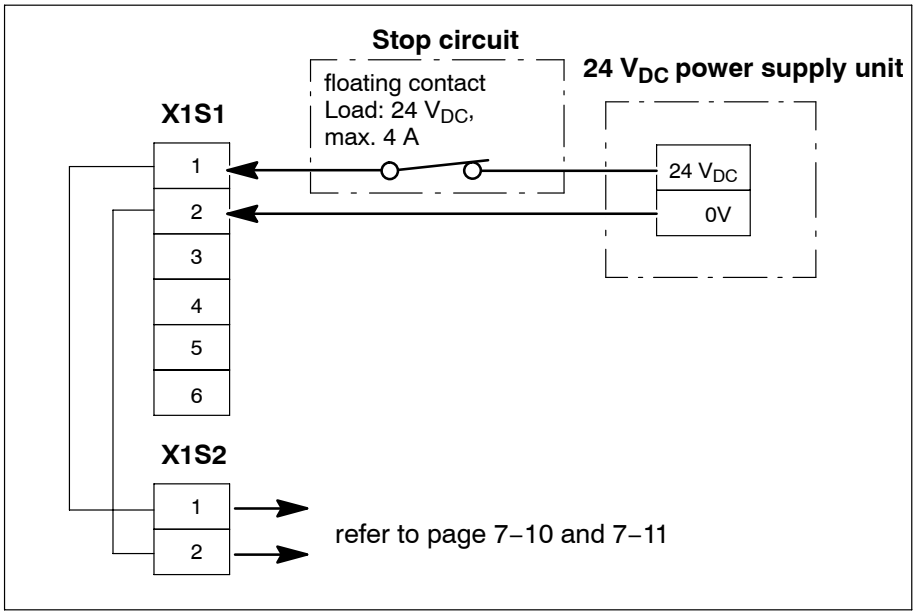
Electrical connection

7.3 I/O field supply

Connection:	to X1S1; STKK, grid 3.5 mm, 6-pole, max. 1.5 mm^2. Mating connector is comprised in the delivery.
Line length:	(from power source to consumer) max. 10 m at 0.75 mm^2 max. 75 m at 1.5 mm^2
Cable type:	unshielded, VDE 0281, 0812 (e.g. Ölflex)

☞ **For technical data, refer to page 4–1.**

Power infeed for the I/O field.



I/O field supply input

★ You should ensure that the proper functioning of the **stop circuit** is guaranteed!
In the event of dangerous conditions at the welding system or the intentional switch-off of the weld timer, the inputs and outputs of the I/O field must be set to LOW level. For this purpose, an external monitoring device must open the floating contact and thus interrupt power supply (X1S1, pin 1 and 2).
If the stop circuit is open, the timer signals: ”Stop / No 24V”. This message is self-acknowledging, i.e. it automatically disappears when the stop circuit is closed.

★ Any external voltage sources used must be designed according to the principles of ”safety separation” in accordance with the Low-Voltage Directive (72/23/EEC, 93/68/EEC and 93/44/EEC).

★ If potential separation is necessary between the I/O field and the timer, the timer and the I/O field must be operated via different 24 V_{DC} power supply units!

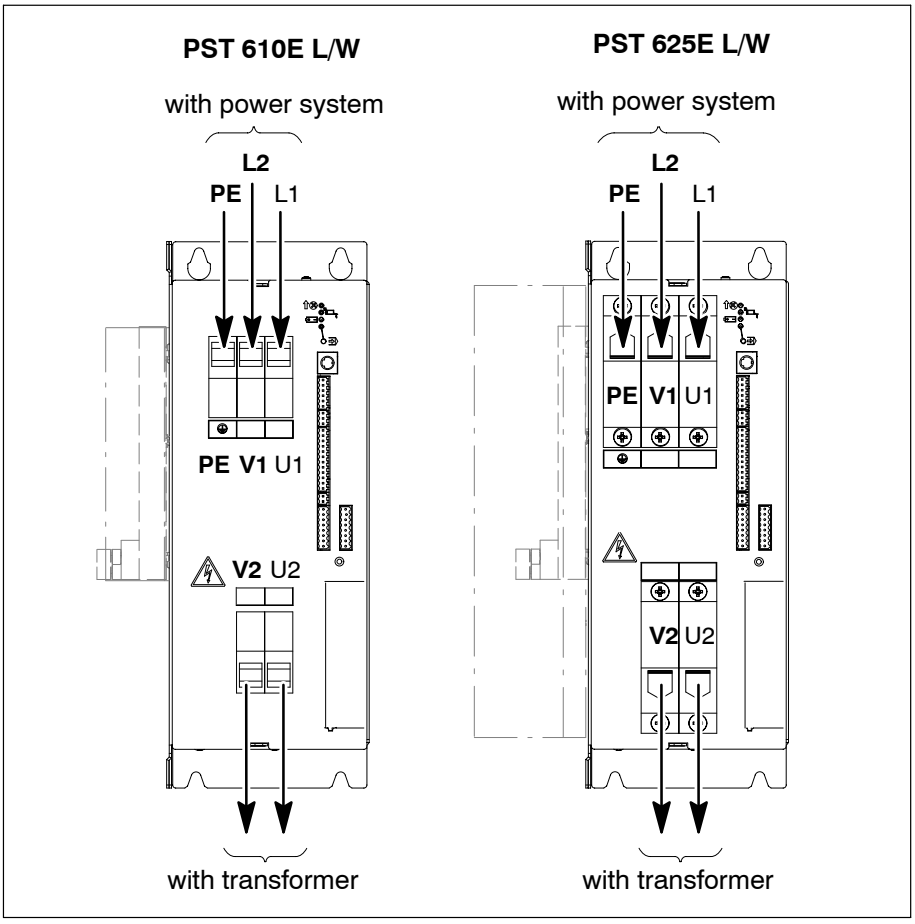
Electrical connection

7.4 Mains supply and welding transformer

Connection: with frame terminals.
PST 610E L/W: max. 50 mm^2
PST 625E L/W: max. 95 mm^2

☞ **For technical data on the mains connection, refer to page 4–1.**

Mains supply: U1, V1 and PE
Transformer connection: U2, V2



Mains supply and transformer connection

★ It must be ensured that the contact areas are bare, i.e. free from paint, plastic coats and dirt/oxidation.

★ All conductor areas should be rated in accordance with the installed load.

★ Connect the PE terminal to a suitable grounding point .

★ Connect U1 to mains phase L1.

★ Connect V1 to mains phase L2.

★ Connect U2 and V2 to a suitable welding transformer.

Electrical connection

7.5 Pressure control, electrode force

Connection:	to X2U; STKK, grid 3.5 mm, 3-pole, max. 1.5 mm^2. Mating connector is comprised in the delivery.
Cable length:	max. 50 m at 0.5 mm^2 max. 100 m at 0.75 mm^2
Cable type:	shielded (e.g.: NFL 13, Metrofunk; LiYCY)

Analog output signal (0 to +10 V; max. 20 mA) which can be used for controlling a proportionate control valve (in connection with pneumatic guns) or for controlling the setpoint input of a servo gun.

☞ **The sizes which influence the amount of the output voltage will be given starting on page 3–32.**

The timer behavior is dependent on the timer functionality switch (refer to page 2–8):

- When set for **machine applications**:
  - the output signal at X2U is output immediately after selection of a welding program.
- When set for **manual gun applications**:
  - the output signal X2U is only output when the welding program is started and remains active until another program is started.

Whether and which sensors are used by the welding gun for feedback is dependent on the respective application. The following cases may occur:

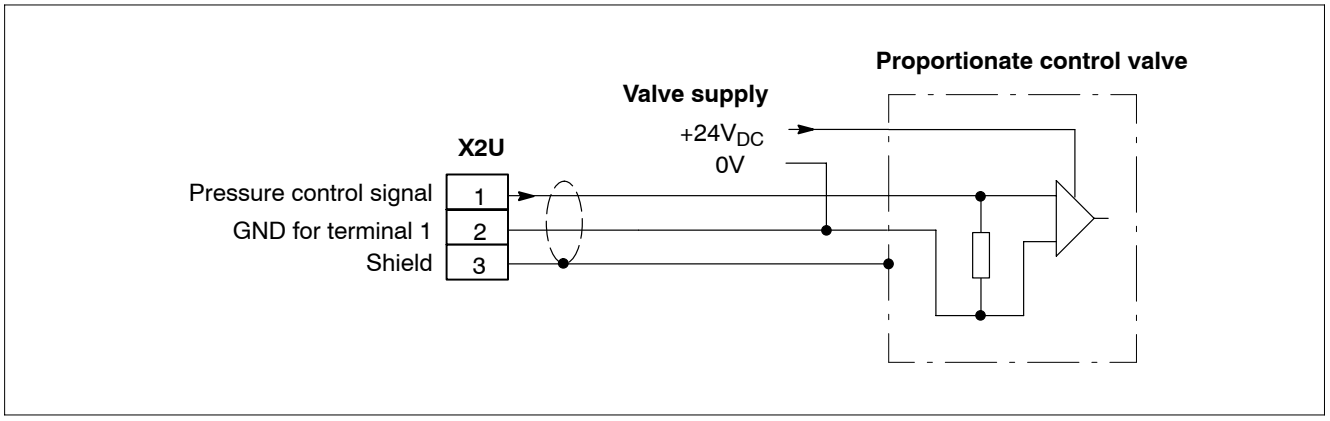
- No feedback
- Feedback to weld timer
- Feedback to PLC or robot

☞ **In order to indicate to the timer that the gun is closed or the setpoint force has been reached, the discrete ”Pressure contact” input signal must be signaled as high!**

No feedback

★ In case of systems without feedback signal, make sure that the parts to be welded are pressed together optimally before starting the weld time. Sufficient squeeze times have to be programmed for this purpose. If squeeze times are too short, this leads to great welding splashes! This may result in damage to electrodes and workpieces.

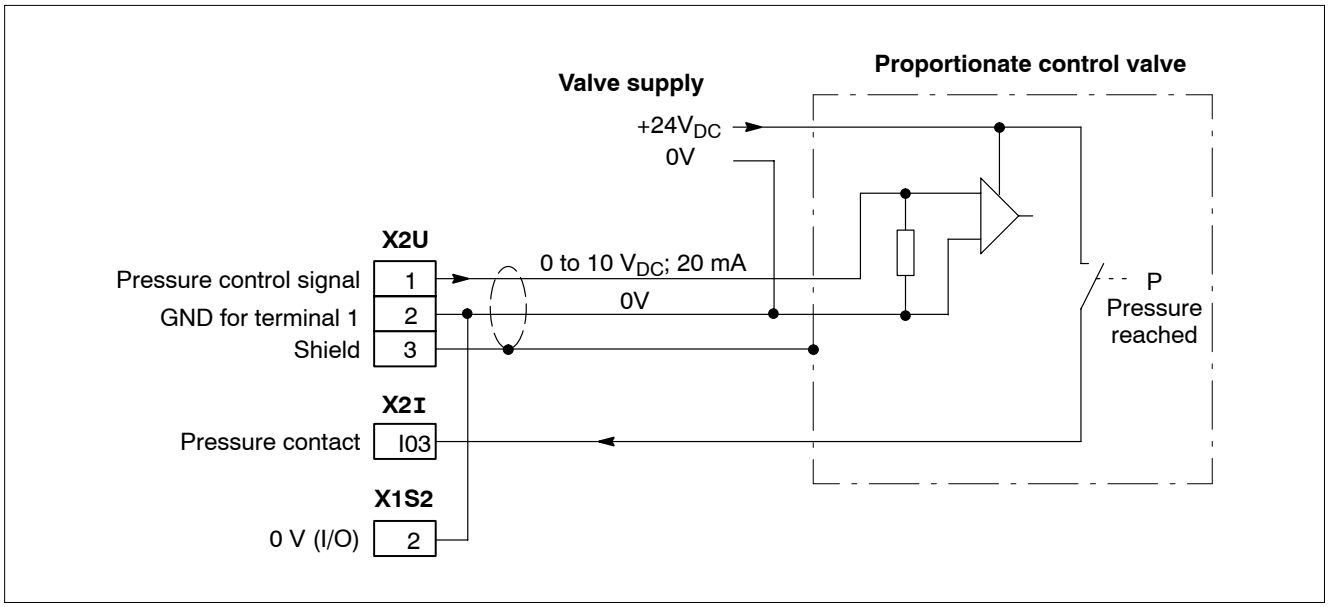
Electrical connection



Example: connection of a proportionate control valve without feedback

Feedback to weld timer

★ Make sure that the ”Pressure contact” input is triggered correctly (refer to page 7–9).



Example: connection of a proportionate control valve with feedback via ”Pressure contact” input signal

Feedback to PLC or robot

★ After evaluation of the feedback via PLC or robot, the PLC may only start the welding program when the proper status of the welding gun has been ensured.
Once this is ensured, it is possible to program the shortest possible SQZ (1 mains cycle) in all welding programs.

Electrical connection

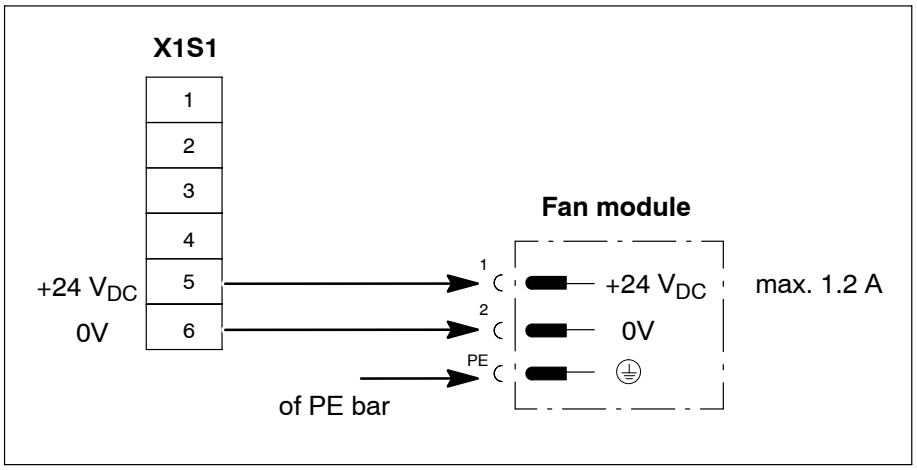
7.6 External fan

Connection:	to X1S1; STKK, grid 3.5 mm, 6-pole, max. 1.5 mm. Mating connector is comprised in the delivery.
Cable length:	max. 10 m at 0.75 mm^2 max. 75 m at 1.5 mm^2
Cable type:	unshielded, VDE 0281, 0812 (e.g. Ölflex)
Switching threshold:	Fan ON: greater than/equal to 55 degrees Centigrade Fan OFF: less than/equal to 40 degrees Centigrade (with respect to heat sink temperature)

☞ **For technical data, refer to page 4–1.**

For connection of an external 24 V_{DC} fan.

☞ **The connection of an external fan may be necessary in air-cooled unit types, depending on their capacity and duty cycle. Cf. load diagram.**



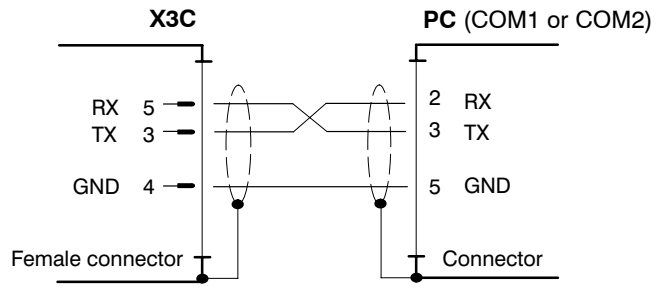
Connecting an external fan module

Electrical connection

7.7 Connection for programming terminal

Connection:	to X3C; Mini-DIN female connector.
Cable length:	max. 20 m (with recommended cable type)
Cable type:	shielded, core area min. 0.2 mm^2, Capacitance max. 2.5 nF (e.g.: 3 x 2 x 0.2 mm^2 LifYCY, Metrofunk)
Transmission rate:	19200 bit/s
Parameter:	8E1 (8 data bits, even parity, 1 stop bit)
Transmission:	PS5000 block protocol with CRC16

Point-to-point interconnection is used for linking the programming terminal (PC, laptop).
For information on the matching connecting cord, refer to section 14.



Screen continuity through large-area connection to metal housing of the plug connection

☞ **The optional Ethernet module is available for networking the timer (e.g. with administration, diagnostics, archivation, backup).**
Features: – more rapid data transmission
– programming of several timers via BOS

Electrical connection

7.8 Discrete signals (I/O field)

Connection: STKK, grid 3.5 mm, max. 1.5 mm^2.
X2O (outputs): 12-pole
X2I (inputs): 16-pole
X1S2 (supply and reference potential): 2-pole
Mating connectors are comprised in the delivery.

Cable length (O00–O03):
max. 30 m at 0.5 mm^2
max. 50 m at 1.0 mm^2
max. 100 m at 1.5 mm^2
(Voltage drop max. 10%)

Cable length (I00–I15, O04–O11):
max. 100 m at 0.5 mm^2

Cable type: unshielded, VDE 0281, 0812
(e.g.: Ölflex)

☞ **For technical data, refer to section 4.1 from page 4–1**

The I/O field is used

- for communication between the weld timer and the higher level PLC or robot
- for connection of a control panel (switches, buttons and LEDs).

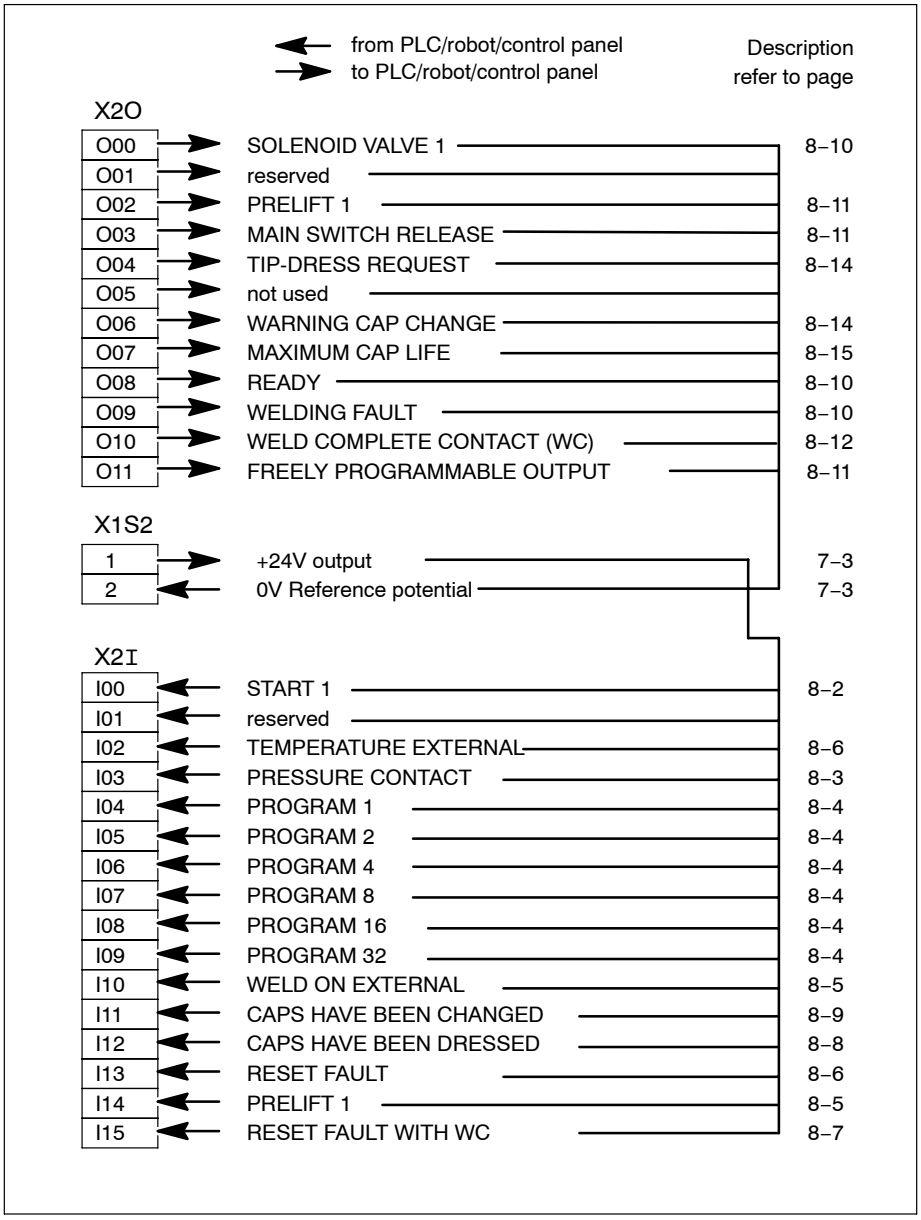
The assignment of the I/O field is dependent on the timer functionality switch (refer to page 2–8):

- For signal assignment in the **machine application setting,** refer to section 7.8.1 page 7–10.
- For signal assignment in the **manual gun setting,** refer to section 7.8.2 page 7–11.

☞ **The description of all signals is given:**
- **for machine applications: in section 8**
- **for manual gun applications: in section 9**

Electrical connection

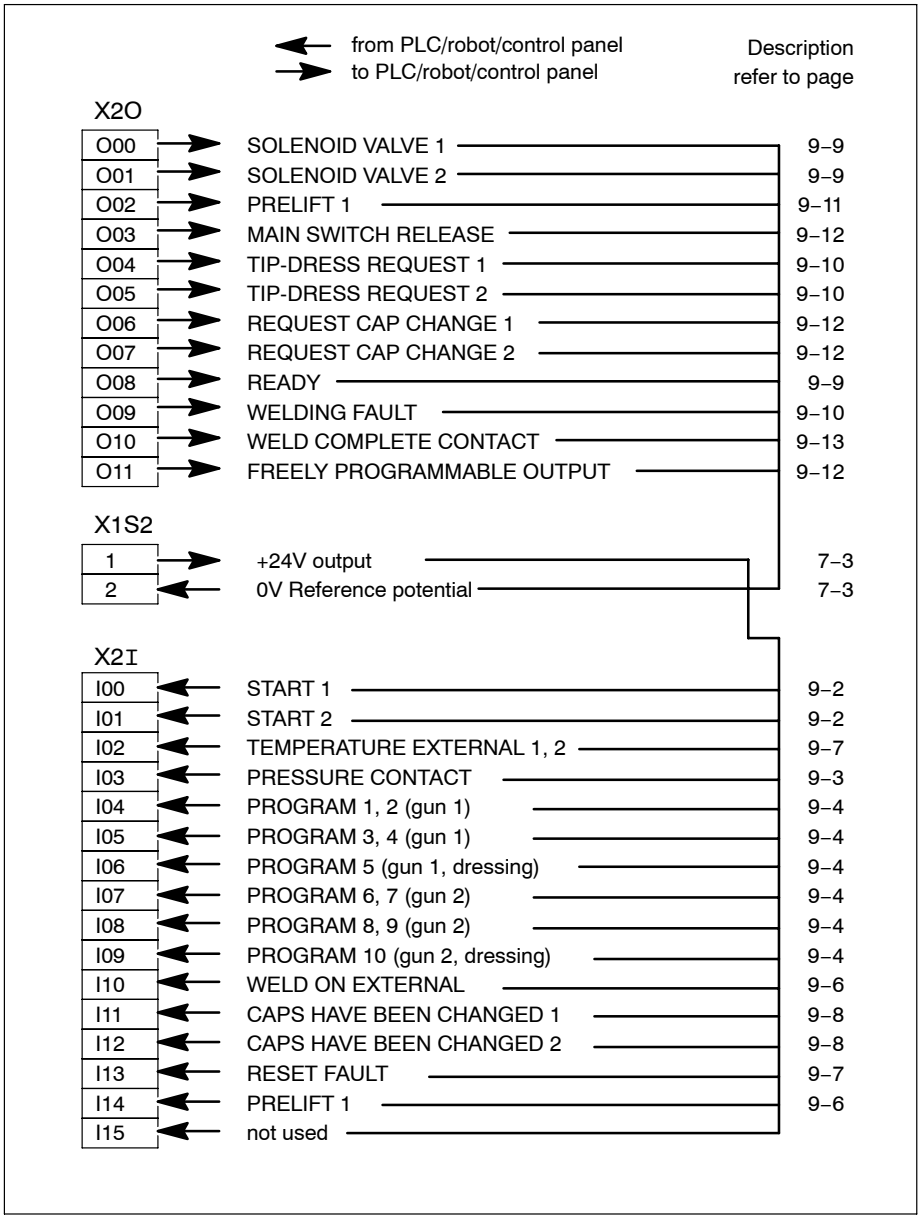
7.8.1 I/O field for machine applications



Pin assignment I/O field (machine applications)

Electrical connection

7.8.2 I/O field for manual gun applications



Pin assignment I/O field (manual gun applications)

Electrical connection

Notes:

8 I/O signals for machine applications

☞ **The assignment of the I/O field is dependent on the timer functionality switch (refer to page 2–8):**

☞ **For assignment of the I/O field in the machine application setting, refer to section 7.8.1 page 7–10.**

In the following text, the signal names are marked by quotation marks (”signal name”) or capital letters (SIGNAL NAME).

8.1 Alphabetic overview

I/O signals for machine applications

8.2 Input signals

8.2.1 Start 1

A positive edge triggers the taking over of the current selected program (”Program selection”, refer to page 8–4), if the timer is in ”Ready” status (refer to page 8–10) and the input ”Prelift” (refer to page 8–5) has not been chosen.

☞ **”Start 1” is interlocked against ”Prelift 1”.**

☞ **At start and during the sequence, the timer checks if the temperature (refer to page 8–6) is ok. If not, a corresponding message is displayed.**

Sequence:

1. The welding program starts. At the same time, the output ”Solenoid valve” (refer to page 8–10) is set.
   If programmed, the 1.SQZ will be processed.
2. SQZ starts.
   Until the end of SQZ, the welding schedule can be cancelled by resetting ”Start”.

☞ **The start of SQZ is dependent on the signal ”Pressure contact” (refer to page 8–3).**

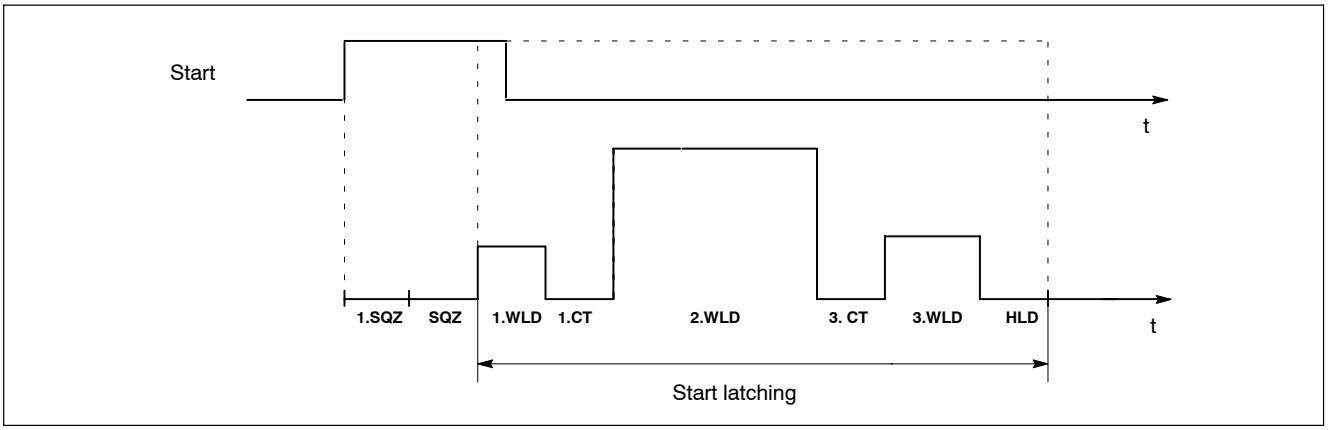
3. If ”Start” is active beyond the end of SQZ, latching will begin in single spot and repeat mode. In the latching status, the 1. to 3.WLD will be executed even after reset of ”Start”.
   When ”Start” is reset in seam mode, only the current cycle that has already begun will be executed.

☞ **Latching can only be cancelled by opening the stop circuit (refer to page 7–3).**

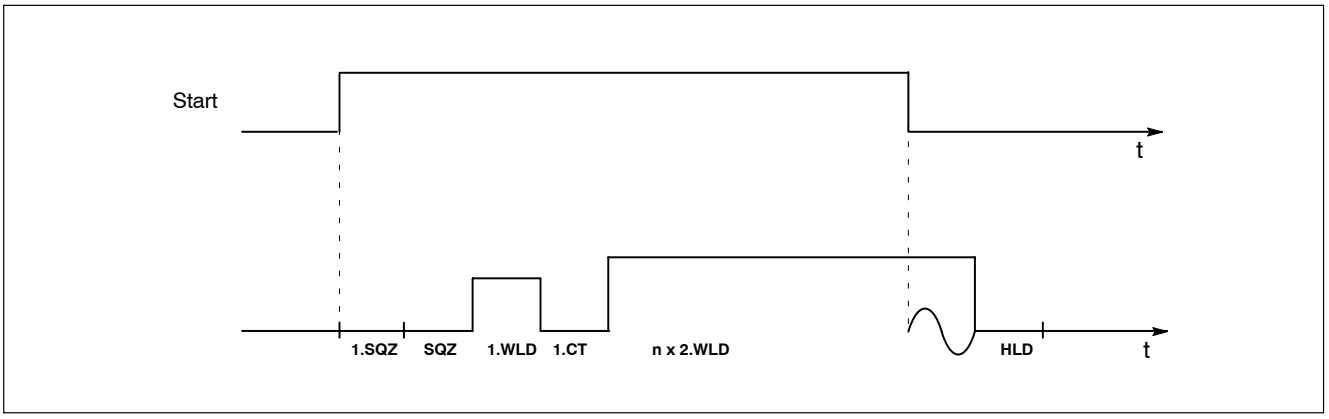
☞ **Whether the weld times are executed with or without welding current depends on the input signal ”Weld on external” (refer to page 8–5).**

4. HLD is executed.
5. Output ”Weld complete contact” (refer to page 8–12) acknowledges the execution.
6. Output ”Solenoid valve” (refer to page 8–10) is reset.

I/O signals for machine applications



Latching in single spot and repeat



Reset of "Start" during the 2.WLD in seam mode

8.2.2 Pressure contact

The input indicates to the timer – depending on the sensors used

- a closed welding gun (limit switch at the gun mechanics)
- the reaching of the setpoint pressure at the output of the proportionate control valve (feedback through output at control valve)
- the reaching of the setpoint force at the electrodes (force sensor).

The execution of the programmed squeeze time SQZ is delayed as long as the input "Pressure contact" is high.

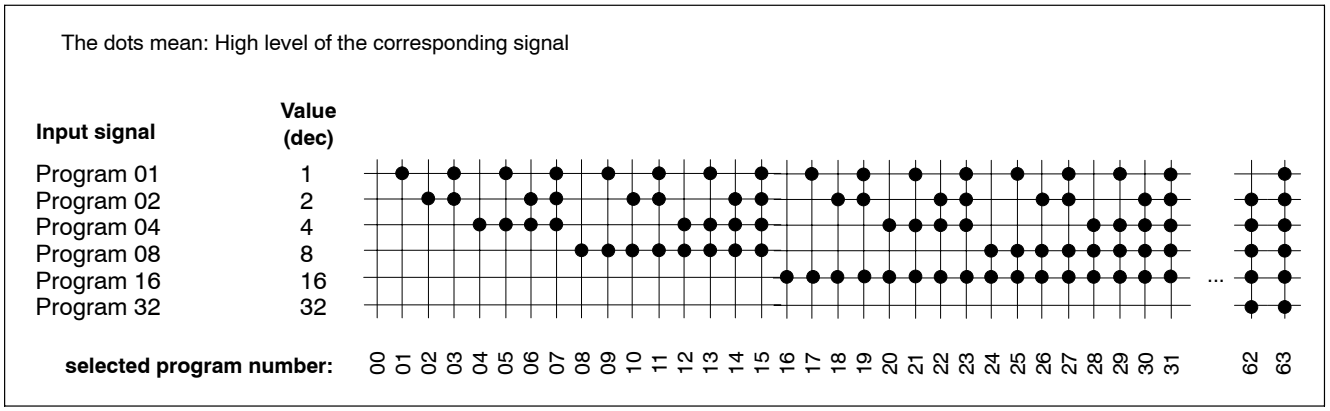
★ In case of systems without feedback from the process, make sure that the parts to be welded are pressed together optimally before starting the weld time!
Sufficient squeeze times have to be programmed for this purpose.
If squeeze times are too short, this leads to great welding splashes!
This may result in damage to electrodes and workpieces.

I/O signals for machine applications

8.2.3 Program selection

Six input signals are available for selection of the required welding program in binary code. For an example, refer to the figure.

☞ **Immediately after selection of a welding program, the timer outputs an output voltage at X2U corresponding to the programmed set-point pressure (refer to page 7–5).**



Selection of a program (an electrode) in binary code using the input signals ”Program x”

I/O signals for machine applications

8.2.4 Weld on external

Sometimes it is necessary to execute the welding programs without welding current (e.g. for adjustment/testing purposes).

An external unit (robot, PLC, key switch at the operating panel) can therefore specify by means of this input signal

1. whether the timer should generally execute all welding programs without current, or
2. whether the timer may influence this decision (with or without current) on the basis of parameter settings.

Regarding item 1.:
If ”Weld on external” is **not set**, all welding programs in the timer will always be executed without current – regardless of the remaining parameters set in the timer. In this case, the power unit will not be operated.

Regarding item 2.:
If ”Weld on external” **is set**, the response depends on the following parameters:

- Weld on internal (acts globally on all programs in the timer) and
- program-related weld on (is part of each welding program and is only effective in the respective program).

The execution of a welding program **with current** is only possible if

- ”Weld on external” and
- Weld on internal and
- the program-related weld on are activated.

8.2.5 Prelift 1

Effects the setting of the output signal ”Prelift 1” (refer to page 8–11), as long as the input is HIGH.

☞ **”Prelift 1” is interlocked against ”Start 1”.**

I/O signals for machine applications

8.2.6 Temperature external

Serves for temperature feedback to the weld timer. The following applies:

- High level: Temperature ok
- Low level: Temperature too high

The input is requested directly following the start and during the subsequent execution.
If the input signal is missing, the timer will generate the message ”Temperature external too high”.

8.2.7 Reset fault

☞ **For basic information on faults, please refer to page 12–1!**

A positive signal edge has the effect
1. ”Reset fault”.

The signal is used exclusively to restore the ”Ready” status of the timer. In the ”Ready” status, the following applies:

- a new welding sequence can be started
- the green READY LED on the front panel is lit (refer to page 2–7)
- the ”Ready” output signal is set (refer to page 8–10).

The timer does not execute any other actions.

☞ **If the fault occurred during a welding sequence, the welding gun may still be closed.**

I/O signals for machine applications

8.2.8 Reset fault with WC

☞ **For basic information on faults, please refer to page 12–1!**

A positive signal edge has the effect

1. ”Reset fault” and subsequent
2. setting of the signal ”Weld complete contact”, if the input signal ”Start” is still active.

DANGER
Dangerous machine movement is possible!
The signal ”Weld complete contact” initiates the positioning motion at the robot to the next spot weld.
Therefore make sure that ”Reset fault with WC” does not lead to any hazardous situation on the system!

☞ **”Reset fault with WC” can be triggered via user interface (BOS).**

”Reset fault with WC” is used

- in connection with robots and
- all faults except for ”Current too low” or ”Series of welds below lower threshold point”.

When a fault occurs during the processing of a part, the robot will normally still be in welding position with closed welding guns. Using ”Reset fault with WC” it is now possible

- to continue processing at the next spot weld.

CAUTION
The present spot weld is defective!
Therefore, the part has to be checked!

I/O signals for machine applications

8.2.9 Caps have been dressed

Positive edge informs the timer that the tip dressing requested via ”Tip-dress request” (refer to page 8–14) has been completed.

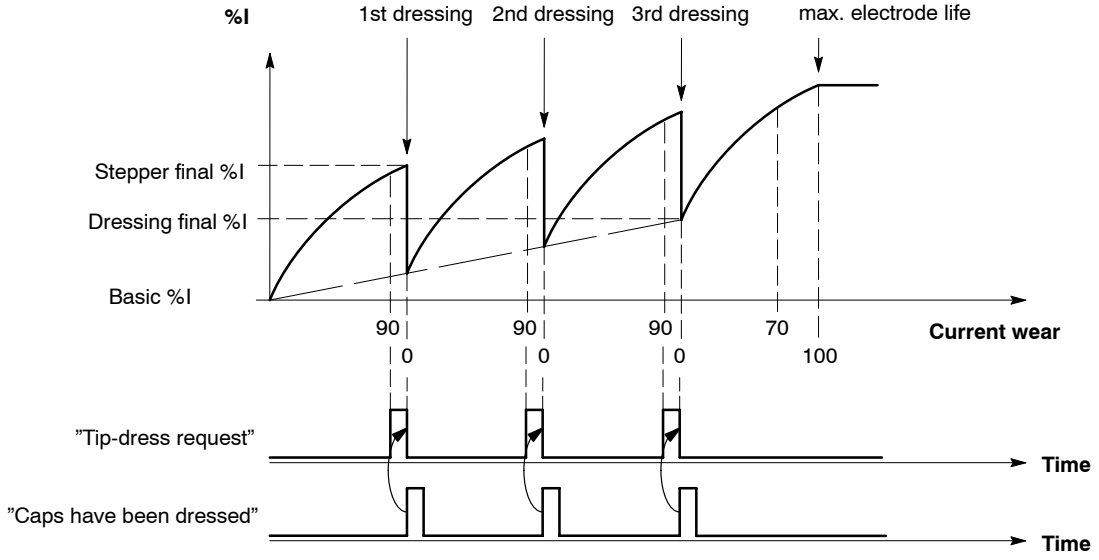
Sequence:

1. The timer first determines the relevant electrode number. That is the electrode number programmed in the presently selected program.
2. The corresponding tip dress counter is incremented.
3. The respective wear counter is set to value 0.
4. ”Tip-dress request” for the relevant electrode is reset.

☞ **If electrode number ”0” has been programmed in the presently selected program, the actions 2. and 3. will be triggered together for all electrodes!**

Example. The following settings are used:

Stepping:	on
Stepper:	active (if stepper final %I > basic %I)
Dressing:	on (if max. dressings > 0. Here: max. dressings = 3)
Dressing curve:	active (if dressing final %I > basic %I)
Count factor:	1.0
Wear starting range (offset):	0
Wear stepper range:	100
max. wear:	100 (= wear stepper range – offset)
Tip-dress request:	10 (= 10 before max. wear)
Warning:	30 (= 30 before max. wear)



Example: sequence tip dressing

I/O signals for machine applications

8.2.10 Caps have been changed

Positive edge informs the timer that the electrode change requested via ”Warning cap change” (refer to page 8–14) or ”Maximum cap life” (refer to page 8–15) has been completed.

☞ **The completed electrode replacement can, alternatively, also be acknowledged via the user interface (BOS) using the function ”Counter reset”.**

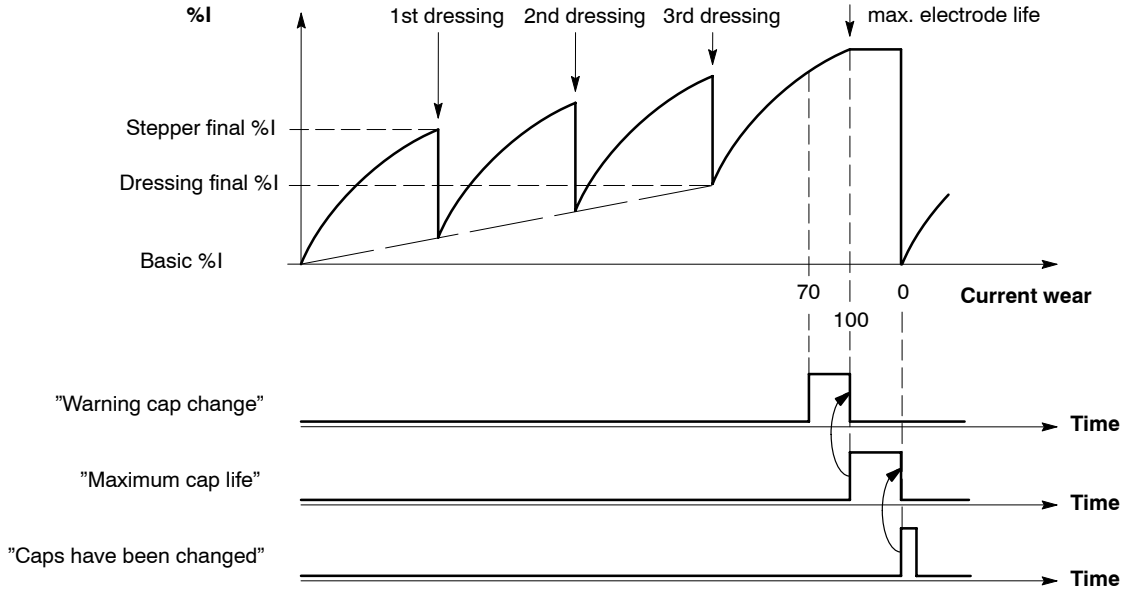
Sequence:

1. The timer first determines the relevant electrode number. That is the electrode number programmed in the presently selected program.
2. The respective tip dress counter is set to value 0.
3. The respective wear counter is set to value 0.
4. ”Warning cap change” or ”Maximum cap life” for the relevant electrode is reset.
5. When ”Dress new electrode” (initial dressing; refer to page 3–30) has been activated, the output ”Tip-dress request” (refer to page 8–14) is activated.

☞ **If electrode number ”0” has been programmed in the presently selected program, the actions 2. and 3. will be triggered together for all electrodes!**

Example. The following settings are used:

Stepping:	on
Stepper:	active (if stepper final %I > basic %I)
Dressing:	on (if max. dressings > 0. Here: max. dressings = 3)
Dressing curve:	active (if dressing final %I > basic %I)
Count factor:	1.0
Wear starting range (offset):	0
Wear stepper range:	100
max. wear:	100 (= wear stepper range – offset)
Tip-dress request:	10 (= 10 before max. wear)
Warning:	30 (= 30 before max. wear)
Stop when tip life expired:	Off



Example: sequence electrode change

I/O signals for machine applications

8.3 Output signals

8.3.1 Ready

The output signal indicates that the timer is ready to weld.
In this status

- a new welding sequence can be started (refer to page 8–2)
- the green READY LED on the front panel is lit (refer to page 2–7).

In the event of an error, the timer will be ”blocked”.
In this status

- no welding schedule can be started
- the red READY LED on the front panel is lit (refer to page 2–7).
- the ”Ready” output signal is reset.

☞ **For fault and status messages, please refer to ”Error list PS5000/PS6000” (No.: 1070 087 001).**

In order to restore the ”Ready” status of the timer after a fault, you may proceed according to one of the following alternatives:

1. positive edge at the ”Reset fault” input signal (refer to page 8–6)
2. operation via BOS (trigger ”Reset fault...”).

8.3.2 Welding fault

In the event of an error during the welding process,

- the timer sets the output ”Welding fault”, and
- cancels the output signal ”Ready”.

Further welding schedules can only be started when all existing faults have been corrected and acknowledged. For more information, refer to ”Reset fault” starting on page 8–6 and section 12.

☞ **For fault and status messages, please refer to ”Error list PS5000/PS6000” (No.: 1070 087 001).**

☞ **Whether or not an event is interpreted as a fault or a warning depends on the parameter setting (BOS, fault allocation).**

8.3.3 Solenoid valve 1

Serves for controlling a solenoid valve.
The output is set within the following time period:

- from the start of the 1.SQZ
- till the end of the HLD.

☞ **In case of repeat mode: the output signal is not set during the OFF time.**

☞ **For information on the triggering of an additional solenoid valve or another peripheral (e.g. for counterpressure generation), refer to output signal ”Freely programmable output”, page 8–11.**

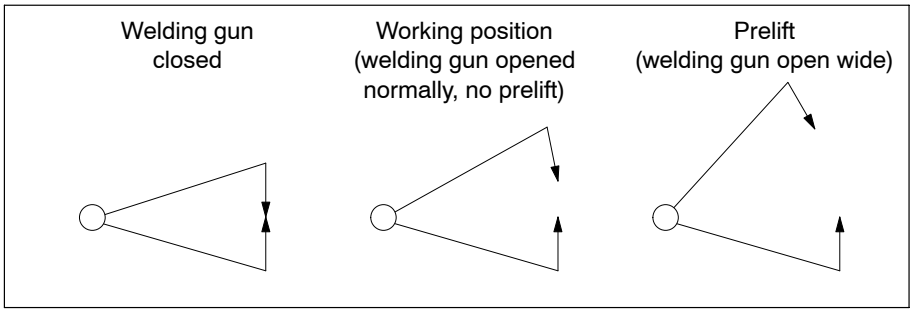
I/O signals for machine applications

★ Observe the safety instructions in section 1.8 with respect to electrode/ workpiece movement!

8.3.4 Prelift 1

Facilitates or permits positioning of the welding gun at the workpiece. The output serves to control the additional welding gun cylinder which is used to open the gun wider than usually.

The status of the output signal is dependent on the input signal ”Prelift 1” (refer to page 8–5).



Prelift

★ Observe the safety instructions in section 1.8 with respect to electrode/ workpiece movement!

8.3.5 Freely programmable output

The output serves to control an additional solenoid valve (signal ”Solenoid valve” refer to page 8–10) or another peripheral.
This way it is possible, e.g. to generate a counterpressure or a brief pressure increase.

The temporal sequence of the signal can be influenced through max. 3 freely programmable on/off times.
It can be set earliest with the start of SQZ. The timer forcefully resets the output at the end of HLD at the latest.

8.3.6 Main switch release

The release of the main switch is provided to ensure system and personal safety.

The output is cancelled if a voltage is present between the primary circuit terminals of the welding transformer that has not been initiated by the timer (message: Main switch tripped).
The cause may be e.g. defective thyristors. In these cases, dangerous continuous currents at the welding transformer may occur.

If main switches with suitable functionality are used, the signal will, if suitably wired, lead to the automatic release of the main switch and thus to the switching off of the power supply.

I/O signals for machine applications

8.3.7 Weld complete contact (WC)

The output signal ”Weld complete contact” indicates that a program sequence has been completed.
This allows the next step of the processing sequence to be initiated. The logic to generate the WC becomes active in the following cases:

1. single-spot and repeat mode after each spot
2. seam mode at the end of the seam
3. after ”Set WC” (only possible via BOS)

☞ **For how long WC remains set is dependent on the input signal ”Start”. Refer to ”WC period”.**

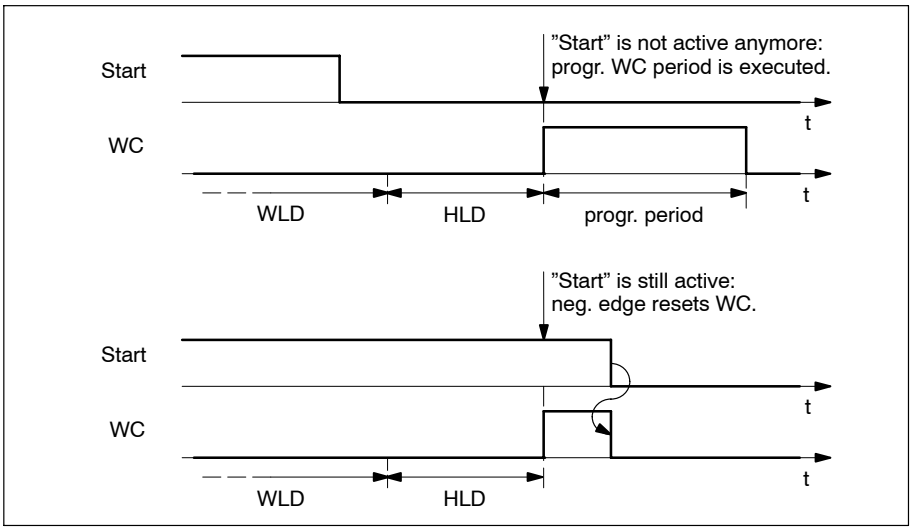
In cases 1. to 2. you have the possibility to make different settings via parametrization (BOS) for adjustment of the WC to your application:

- automatic output of the WC only after a correct or also after a defective weld.
- Time when the WC is to be set (refer to ”WC start time”).

WC period

Normally, the timer resets the signal ”Weld complete contact” automatically when it detects a negative edge at the input ”Start”.
However, system statuses may occur in which the signal ”Start” has already been reset prior to setting WC. Triggering after the negative edge of ”Start” is not possible in this case. For this reason, the timer checks if ”Start” is still active when WC is set, and responds as follows:

- ”Start” has been set:
  WC is only reset with the negative edge of ”Start”
- ”Start” has not been set: WC is only reset when the parametrized WC period (BOS; presetting: 1 cycle) has elapsed.



WC period in dependence on signal ”Start”

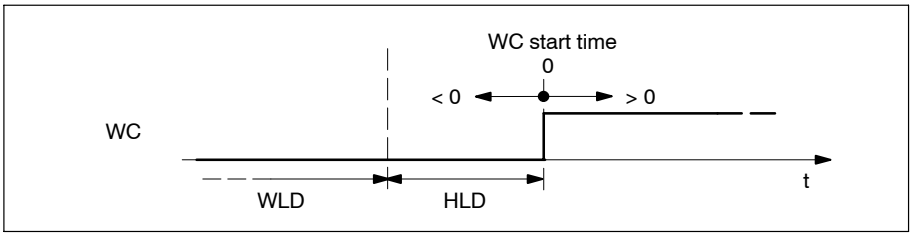
☞ **The programmed WC period is also executed in case of start simulation (BOS)!**

I/O signals for machine applications

WC start time

The time when ”Weld complete contact” is to be output can be parametrized, **in relation to the end of HLD,** in the range of +/–50 cycles (restriction: the output of WC is possible 1 cycle after the start of HLD at the earliest).

As a result, the start time of WC can be pulled into the HLD as well as delayed.



Shifting the WC start time

Example: ”high-speed robot communication”

If ”Weld complete contact” is used as command for positioning on the next spot, the bringing forward of the WC start time may compensate constant response times (triggered by the signal processing in the robot, drive or PLC area). The consequence is shorter cycle times.

CAUTION
Damage to the system is possible by positioning movement with closed welding gun!
Therefore, make sure that the electrodes are open when you start the robot drives!

I/O signals for machine applications

8.3.8 Tip-dress request

Informs the PLC/the robot that an electrode needs to be dressed as soon as possible (dressing, refer to page 3–30).
The signal is set when the parametrizable count value is reached, if a another tip dressing is still permitted at that time.

☞ **The output represents the status of the electrode which is allocated the currently selected program.**

When the robot detects ”Tip-dress request”, the relevant electrode has to move to the dressing station at the latest when its maximum wear is reached. Depending on the setting of parameter ”Stop when tip life expired” (BOS), the timer blocks, indicates ”Dressing necessary” and waits for the input signal ”Caps have been dressed” (refer to page 8–8).
”Caps have been dressed” resets the electrode-specific status ”Tip-dress request”.

☞ **The time when the robot detects an existing ”Tip-dress request” depends on its programming!**
In many cases, the relevant robot inputs are only checked prior to the beginning of a new part and not during the processing of a part after each spot. This behavior requires that the period of time between the output of the signal ”Tip-dress request” and the reaching of the maximum wear is specified so that it is long enough. This is the only way to ensure that the welding process on the part can be completed before maximum wear is reached.

8.3.9 Warning cap change

This signal is set when a parametrized count value is reached. The output signal indicates to the PLC/the robot that an electrode will soon reach its maximum life and an electrode change is therefore necessary.

☞ **The output represents the status of the electrode which is allocated the currently selected program.**

Positive edge of ”Maximum cap life” (refer to page 8–15) or ”Caps have been changed” (refer to page 8–9) resets the electrode-specific status ”Warning cap change”.

I/O signals for machine applications

8.3.10 Tip life expired

This signal is set when a parametrized count value is reached. The output signal indicates to the PLC/the robot that an electrode has reached its maximum life and has to be changed.

☞ **The output represents the status of the electrode which is allocated the currently selected program.**

☞ **Whether further welds are possible after the maximum life is exceeded depends on the parametrization of the timer (parameter ”Stop at end of Stepper”).**

When the robot detects ”Maximum cap life”, the relevant electrode has to move to a position suitable for electrode change (e.g. reset) at the latest when the maximum wear is reached. Depending on the setting of parameter ”Stop when tip life expired” (BOS), the timer blocks and waits for the input signal ”Caps have been changed” (refer to page 8–9).

”Caps have been changed” resets the electrode-specific status ”Tip life expired”.

☞ **The time when the robot detects an existing ”Max. electrode life” depends on its programming!**
In many cases, the relevant robot inputs are only checked prior to the beginning of a new part and not during the processing of a part after each spot. This behavior requires that the period of time between the output of the signal ”Tip life expired” and the reaching of the maximum wear is specified so that it is long enough. This is the only way to ensure that the welding process on the part can be completed before maximum wear is reached. As an alternative (taking into account sufficient ”electrode reserve” however!) it is also possible to switch off the function ”Stop at end of Stepper”.

I/O signals for machine applications

Notes:

9 I/O signals for manual gun applications

☞ **The assignment of the I/O field is dependent on the timer functionality switch (refer to page 2–8):**

☞ **For assignment in the manual gun application setting, refer to section 7.8.2 page 7–11.**

In the following text, the signal names are marked by quotation marks (”signal name”) or capital letters (SIGNAL NAME).

9.1 Alphabetic overview

I/O signals for manual gun applications

9.2 Input signals

9.2.1 Start 1 / 2

A positive edge at the respective input triggers the taking over of the corresponding, correctly selected program (”Program selection”, refer to page 9–4), if the timer is in ”Ready” status (refer to page 9–9) and the input ”Prelift” (refer to page 9–6) has not been chosen.

The following applies:

- ”Start 1”: Start signal for programs 1 to 5
- ”Start 2”: Start signal for programs 6 to 10

☞ **”Start 1”and ”Start 2” are interlocked against each other.**

☞ **”Start 1” is interlocked against ”Prelift 1”.**

☞ **At start and during the execution, the timer checks if the temperature (refer to page 9–7) is ok. If not, a corresponding message is displayed.**

☞ **The execution of the dressing program (5, 10) completes the tip dressing requested by ”Tip-dress request gun x” (refer to page 9–10).**
For information on dressing, refer to the section ”Dressing programs” on page 9–4.

Sequence:

1. The welding program starts. At the same time, the output ”Solenoid valve” (refer to page 9–9) is set.
   If programmed, the 1.SQZ will be processed.
2. SQZ starts.
   Until the end of SQZ, the welding schedule can be cancelled by resetting ”Start”.

☞ **The start of SQZ is dependent on the signal ”Pressure contact” (refer to page 9–3).**

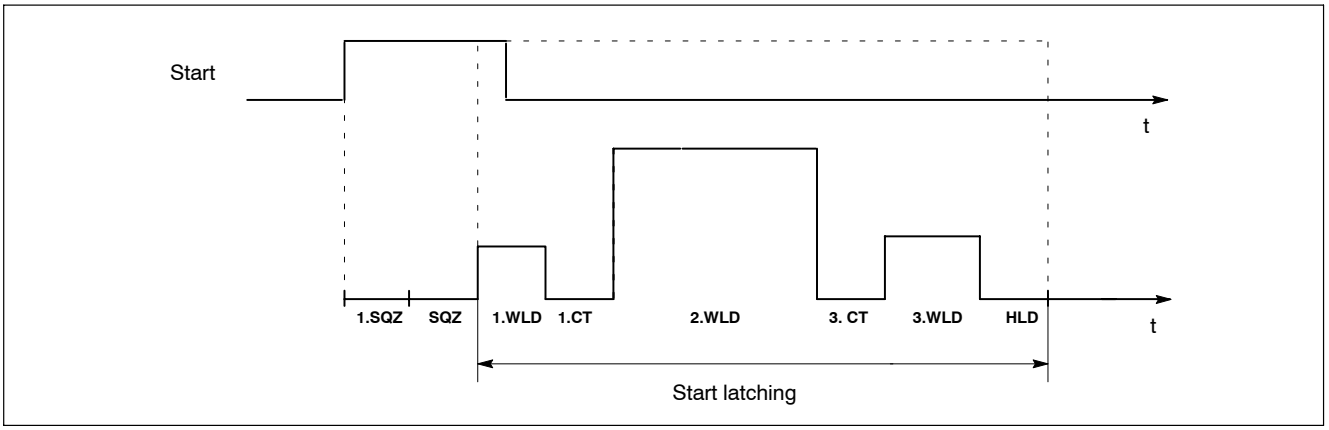
3. If ”Start” is active beyond the end of SQZ, latching will begin in single spot and repeat mode. In the latching status, the 1. to 3.WLD will be executed even after reset of ”Start”.
   When ”Start” is reset in seam mode, only the current cycle that has already begun will be executed.

☞ **Latching can only be cancelled by opening the stop circuit (refer to page 7–3).**

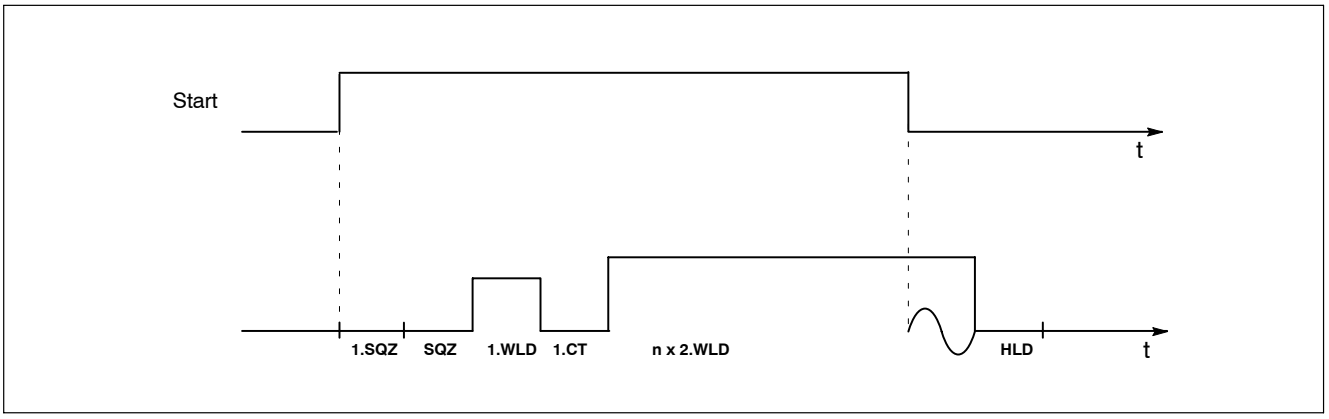
☞ **Whether the weld times are executed with or without welding current depends on the input signal ”Weld on external” (refer to page 9–6).**

4. HLD is executed.
5. Output ”Weld complete contact” (refer to page 9–13) acknowledges the execution.
6. The output ”Solenoid valve” (refer to page 9–9) is reset.

I/O signals for manual gun applications



Latching in single spot and repeat



Reset of "Start" during the 2.WLD in seam mode

9.2.2 Pressure contact

The input indicates to the timer – depending on the sensors used

- a closed welding gun (limit switch at the gun mechanics)
- the reaching of the setpoint pressure at the output of the proportionate control valve (feedback through output at control valve)
- the reaching of the setpoint force at the electrodes (force sensor).

The execution of the programmed squeeze time SQZ is delayed as long as the input "Pressure contact" is high.

★ In case of systems without feedback from the process, make sure that the parts to be welded are pressed together optimally before starting the weld time!
Sufficient squeeze times have to be programmed for this purpose.
If squeeze times are too short, this leads to great welding splashes!
This may result in damage to electrodes and workpieces.

I/O signals for manual gun applications

9.2.3 Program selection

The input signals are used to select the required program.
A selected program is started with the corresponding start signal. For this purpose, the inputs must be activated in accordance with the table below.

Prog. No.	Welding gun	Note	Start signals		Signals for program selection					
			Start 1	Start 2	Program 1, 2	Program 3, 4	Program 5	Program 6, 7	Program 8, 9	Program 10
1	1	Selection and start program 1	1	0	0	0	0	x	x	x
2	1	Selection and start program 2	1	0	1	0	0	x	x	x
3	1	Selection and start program 3	1	0	0	1	0	x	x	x
4	1	Selection and start program 4	1	0	1	1	0	x	x	x
5	1	Selection and start program 5 (= dressing program for electrode 1)	1	0	x	x	1	x	x	x
6	2	Selection and start program 6	0	1	x	x	x	0	0	0
7	2	Selection and start program 7	0	1	x	x	x	1	0	0
8	2	Selection and start program 8	0	1	x	x	x	0	1	0
9	2	Selection and start program 9	0	1	x	x	x	1	1	0
10	2	Selection and start program 10 (= dressing program for electrode 2)	0	1	x	x	x	x	x	1

1: high level; 0: low level; x: any signal status

Dressing programs

☞ **The allocation between program number and electrode is mandatory and may not be changed via user interface!**

Programs 5 and 10 are provided for tip dressing.

- The start signal triggers the relevant solenoid valve, and the corresponding welding gun in the dressing unit closes.
- The dressing times corresponds to the total of the programmed sequence parameters SQZ + WLD + HLD.
  Then the welding gun is opened again via the solenoid valve.
- Other required parameter settings of a dressing program:
  Electrode number: 0
  Weld on/weld off: OFF
  Stepping: OFF
  Sequence: SINGLE SPOT
  Start inhibit: OFF
  Basic pressure: required force for dressing

The execution of a dressing program leads to the following behavior:

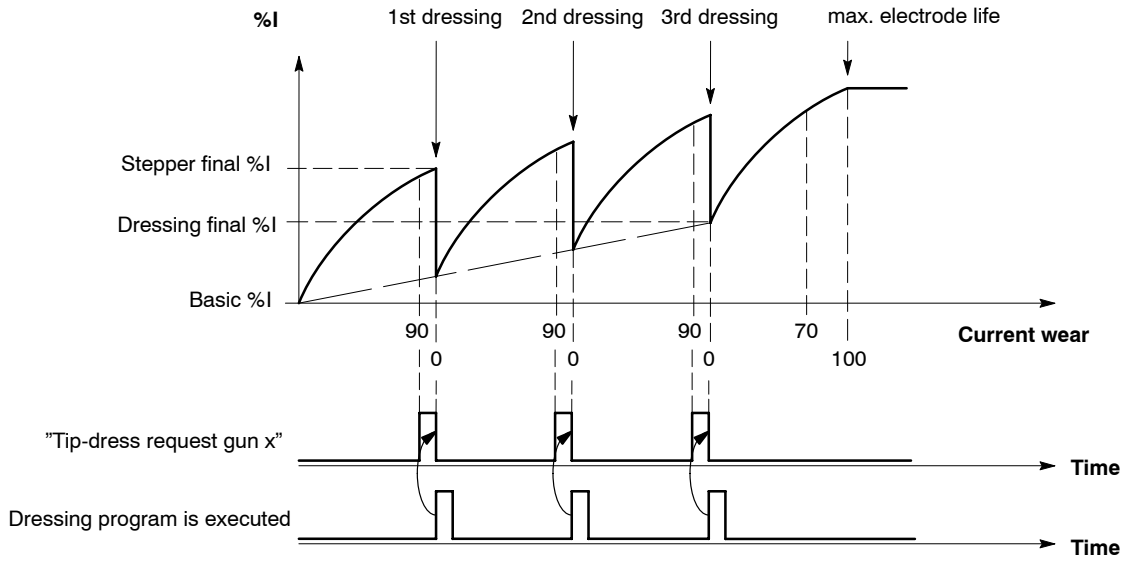
1. The tip-dress counter of the corresponding electrode is incremented.
2. The wear counter of the corresponding electrode is set to value 0.

I/O signals for manual gun applications

3. ”Tip-dress request gun x” for the relevant electrode (refer to page 9–10) is reset.

Example. The following settings are used:

Stepping:	on
Stepper:	active (if stepper final %I > basic %I)
Dressing:	on (if max. dressings > 0. Here: max. dressings = 3)
Dressing curve:	active (if dressing final %I > basic %I)
Count factor:	1.0
Wear starting range (offset):	0
Wear stepper range:	100
max. wear:	100 (= wear stepper range – offset)
Tip-dress request:	10 (= 10 before max. wear)
Warning:	30 (= 30 before max. wear)



Example: sequence tip dressing

I/O signals for manual gun applications

9.2.4 Weld on external

Sometimes it is necessary to execute the welding programs without welding current (e.g. for adjustment/testing purposes).

An external unit (robot, PLC, key switch at the operating panel) can therefore specify by means of this input signal

1. whether the timer should generally execute all welding programs without current, or
2. whether the timer may influence this decision (with or without current) on the basis of parameter settings.

Regarding item 1.:
If ”Weld on external” is **not set**, all welding programs in the timer will always be executed without current – regardless of the remaining parameters set in the timer. In this case, the power unit will not be operated.

Regarding item 2.:
If ”Weld on external” **is set**, the response depends on the following parameters:

- Weld on internal (acts globally on all programs in the timer) and
- program-related weld on (is part of each welding program and is only effective in the respective program).

The execution of a welding program **with current** is only possible if

- ”Weld on external” and
- Weld on internal and
- the program-related weld on are activated.

9.2.5 Prelift 1

Effects the setting of the output signal ”Prelift 1” (refer to page 9–11), as long as the input is HIGH.

☞ **”Prelift 1” is interlocked against ”Start 1” input signal.**

9.2.6 Temperature external 1, 2

Serves for temperature feedback to the weld timer. The following applies:

- High level: temperature ok
- Low level: temperature too high

The input is requested directly following the start and during the subsequent execution.
If the input signal is missing, the timer will generate the message ”Temperature external too high”.

9.2.7 Reset fault

☞ **For basic information on faults, please refer to page 12–1!**

A positive signal edge has the effect

1. ”Reset fault”

The signal is used exclusively to restore the ”Ready” status of the timer. In the ”Ready” status, the following applies:

- a new welding sequence can be started
- the green READY LED on the front panel is lit (refer to page 2–7)
- the ”Ready” output signal is set (refer to page 9–9).

The timer does not execute any other actions.

☞ **If the fault occurred during a welding sequence, the welding gun may still be closed.**

I/O signals for manual gun applications

9.2.8 Caps have been changed 1 / 2

Positive edge informs the timer that the electrode change requested via ”Request cap change” (refer to page 9–12) has been completed.

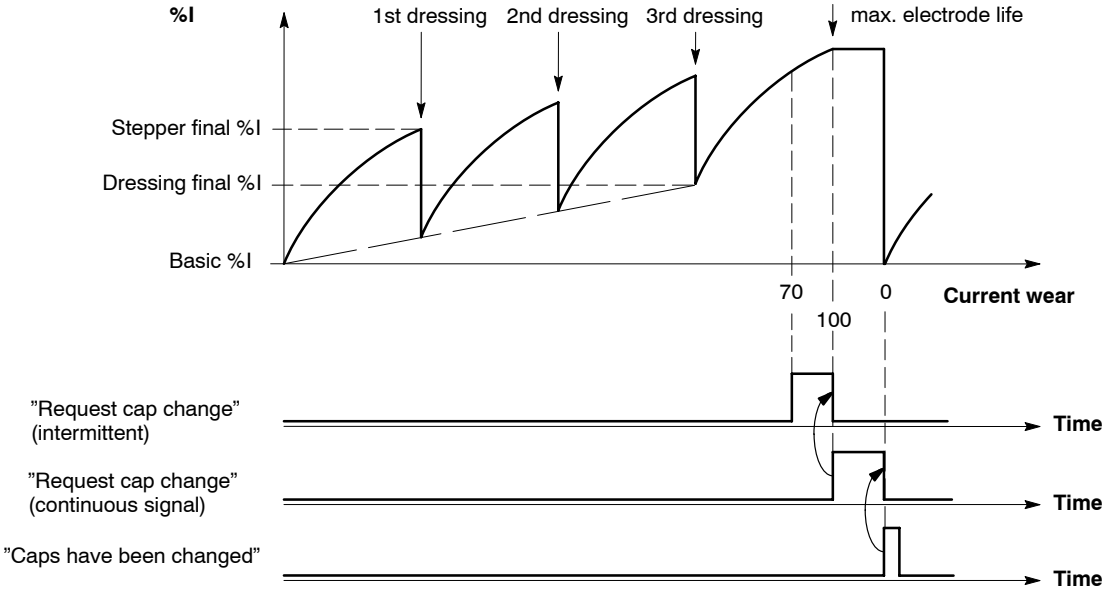
☞ **The completed electrode replacement can, alternatively to ”Caps have been changed”, also be acknowledged via the user interface (BOS) using the function ”Counter reset”.**

Sequence:

1. The tip-dress counter of the corresponding electrode is set to value 0.
2. The wear counter of the corresponding electrode is set to value 0.
3. ”Request cap change” for the relevant electrode is reset.
4. When ”Dress new electrode” (initial dressing; refer to page 3–30) has been activated, the output ”Tip-dress request gun x” (refer to page 9–10) is activated.

Example. The following settings are used:

Stepping:	on
Stepper:	active (if stepper final %I > basic %I)
Dressing:	on (if max. dressings > 0. Here: max. dressings = 3)
Dressing curve:	active (if dressing final %I > basic %I)
Count factor:	1.0
Wear starting range (offset):	0
Wear stepper range:	100
max. wear:	100 (= wear stepper range – offset)
Tip-dress request:	10 (= 10 before max. wear)
Warning:	30 (= 30 before max. wear)
Stop when tip life expired:	Off



Example: sequence electrode change

I/O signals for manual gun applications

9.3 Output signals

9.3.1 Solenoid valve 1 / 2

Serves for controlling a solenoid valve
(”Solenoid valve 1”: gun 1; ”Solenoid valve 2”: gun 2).
The output is set within the following time period:

- from the start of the 1.SQZ
- till the end of the HLD.

☞ **In case of repeat mode: the output signal is not set during the OFF time.**

☞ **For information on the triggering of an additional solenoid valve or another peripheral (e.g. for counterpressure generation), refer to output signal ”Freely programmable output”, page 9–12.**

★ Observe the safety instructions in section 1.8 with respect to electrode / workpiece movement!

9.3.2 Ready

The output signal indicates that the timer is ready to weld.
In this status

- a new welding sequence can be started (refer to page 9–2)
- the green READY LED on the front panel is lit (refer to page 2–7).

In the event of an error, the timer will be ”blocked”.
In this status

- no welding schedule can be started
- the red READY LED on the front panel is lit (refer to page 2–7).
- the ”Ready” output signal is reset.

☞ **For fault and status messages, please refer to ”Error list PS5000/PS6000” (No.: 1070 087 001).**

In order to restore the ”Ready” status of the timer after a fault, you may proceed according to one of the following alternatives:

1. positive edge at the ”Reset fault” input signal (refer to page 9–7)
2. operation via BOS (trigger ”Reset fault...”).

I/O signals for manual gun applications

9.3.3 Welding fault

In the event of an error during the welding process,

- the timer sets the output ”Welding fault”, and
- cancels the output signal ”Ready”.

Further welding schedules can only be started when all existing faults have been corrected and acknowledged. For more information, refer to ”Fault reset” starting on page 9–7 and section 12.

☞ **For fault and status messages, please refer to ”Error list PS5000/PS6000” (No.: 1070 087 001).**

☞ **Whether or not an event is interpreted as a fault or a warning depends on the parameter setting (BOS, fault allocation).**

9.3.4 Tip-dress request gun 1 / 2

Indicates that

- the electrode tip must be dressed as soon as possible, or
- dressing at start is necessary.

☞ **For information on dressing, also refer to page 3–30.**

”Tip-dress request gun 1” is allocated to electrode 1, ”Tip-dress request gun 2” to electrode 2.

The signal is set when the parametrizable count value (BOS) is reached, if a new tip dressing is still permitted at that time.

The relevant electrode must – depending on the programming of parameter ”Stop at end of Stepper” – be dressed when the maximum is reached, at the latest.

To do this, the electrode-specific dressing program (refer to ”Program selection” section ”Dressing programs, page 9–4) must be selected and started on the timer.
At the end of the dressing program, the timer automatically resets ”Tip-dress request gun x”.

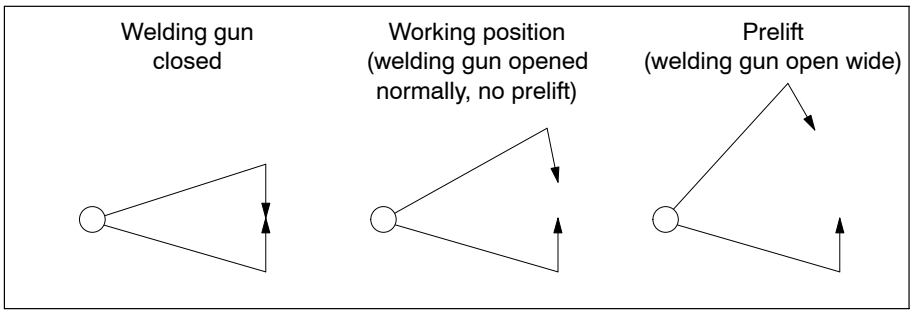
If no tip-dressing has been performed when maximum wear is reached, the timer will – depending on the programming of parameter ”Stop at end of Stepper” – block and display ”Dressing necessary”.

I/O signals for manual gun applications

9.3.5 Prelift 1

Facilitates or permits positioning of the welding gun at the workpiece. The output serves to control an additional welding gun cylinder which is used to open the gun wider than usually.

The status of the output signal is dependent on the input signal ”Prelift 1” (refer to page 9–6).



Prelift

★ Observe the safety instructions in section 1.8 with respect to electrode/ workpiece movement!

I/O signals for manual gun applications

9.3.6 Request cap change 1 / 2

The timer uses the output signal ”Request cap change” to indicate that

- an electrode change has to be performed ”soon” (intermittent output signal, warning) or
- that the maximum electrode life is reached and an electrode change is necessary (continuous output signal).

☞ **The time for output of the intermittent signal can be parametrized (BOS) as wear prior to reaching the maximum electrode life. If tip dressing is activated, the timer will only output the intermittent signal when no further dressing is permitted.**

☞ **Whether further welds are possible after the maximum life is exceeded depends on the parametrization of the timer (function ”Stop at end of Stepper”).**

The output signal is reset by ”Caps have been changed” (refer to page 9–8).

9.3.7 Freely programmable output

The output serves to control an additional solenoid valve (signal ”Solenoid valve” refer to page 9–9) or another peripheral.
This way it is possible, e.g. to generate a counterpressure or a brief pressure increase.

The temporal sequence of the signal can be influenced through max. 3 freely programmable on/off times.
It can be set earliest with the start of SQZ. The timer forcefully resets the output at the end of HLD at the latest.

9.3.8 Main switch release

The release of the main switch is provided to ensure system and personal safety.

The output is cancelled if a voltage is present between the primary circuit terminals of the welding transformer that has not been initiated by the timer (message: Main switch tripped).
The cause may be e.g. defective thyristors. In these cases, dangerous continuous currents at the welding transformer may occur.

If main switches with suitable functionality are used, the signal will, if suitably wired, lead to the automatic release of the main switch and thus to the switching off of the power supply.

I/O signals for manual gun applications

9.3.9 Weld complete contact (WC)

The output signal ”Weld complete contact” indicates that a program sequence has been completed.
This allows the next step of the processing sequence to be initiated. The logic to generate the WC becomes active

1. in single-spot and repeat mode after each spot
2. seam mode at the end of the seam
3. after ”Set WC” (only possible via BOS)

☞ **For how long WC remains set is dependent on the input signal ”Start”. Refer to ”WC period”.**

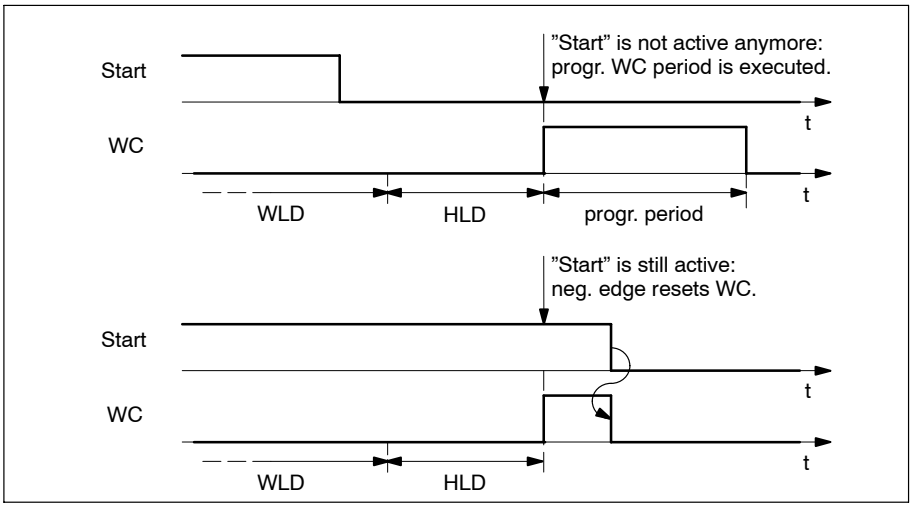
In cases 1. to 2. you have the possibility to make different settings via parametrization (BOS) for adjustment of the WC to your application:

- automatic output of the WC only after a correct or also after a defective weld.
- Time when the WC is to be set (refer to ”WC start time”).

WC period

Normaly, the timer resets the signal ”Weld complete contact” automatically when it detects a negative edge at the input ”Start”.
However, system statuses may occur in which the signal ”Start” has already been reset prior to setting WC. Triggering after the negative edge of ”Start” is not possible in this case. For this reason, the timer checks if ”Start” is still active when WC is set, and responds as follows:

- ”Start” has been set:
  WC is only reset with the negative edge of ”Start”
- ”Start” has not been set: WC is only reset when the parametrized WC time (BOS; presetting: 1 cycle) has elapsed.



WC period in dependence on signal ”Start”

☞ **The programmed WC period is also executed in case of start simulation (BOS)!**

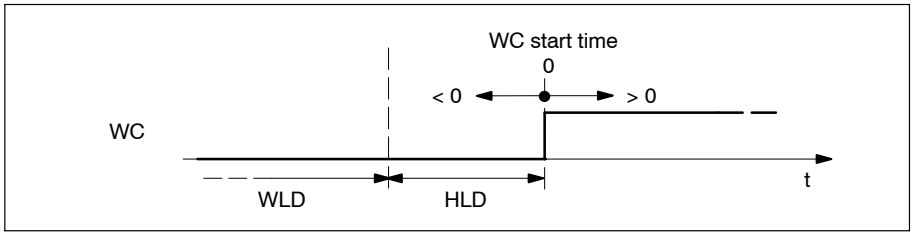
I/O signals for manual gun applications

WC start time

The time when ”Weld complete contact” is to be output, can be parametrized, **in relation to the end of HLD,** in the range of +/–50 cycles.

Restriction:
The output of WC is possible at the earliest 1 cycle after the start of HLD.

As a result, the start time of WC can be pulled into the HLD as well as delayed.



Shifting the WC start time

Commissioning

10 Commissioning

DANGEROUS ELECTRICAL VOLTAGE
Danger of life caused by touching of live components!
In the course of commissioning, the unit may be accessible when the switch cabinet is open!
Therefore, you must ensure that unauthorized persons cannot handle the unit.

Prerequisite for commissioning is the proper installation and function

- of the entire mechanics of the welding equipment
- of all emergency stop devices
- of the electrical connection including all required sensors
- of the compressed air supply and cooling units.

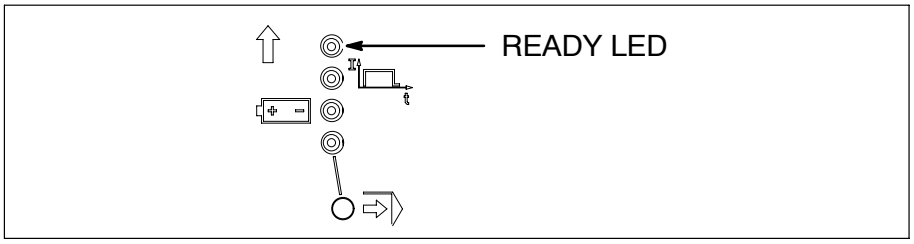
★ Make sure that the above mentioned prerequisites for commissioning are met.

★ Activate the compressed air supply and the cooling units, should this have to be done manually.

Switching on the compact weld timer

★ Check whether the timer functionality switch (refer to page 2–8) is correctly set according to your requirements.

★ Turn the 24 V supply on.
The red READY LED on the front panel of the timer must now be lit (power supply is still turned off at this point in time).



★ Check, if

- the I/O signals for communication with robot, PLC or control panel have been output and entered correctly, and
- the communication with a higher-level welding computer / programming terminal works.

★ Check the correct programming of the welding programs used (e.g. weld times, heat values, etc.).

★ Turn the power supply (mains) on.
If no fault has occurred, the green READY LED is now lit.

★ Check all emergency stop devices for correct function.

Commissioning

Switching off the compact weld timer

★ Turn the power supply (mains) off.
The red READY LED on the front panel of the timer is now lit until the 24 V supply is also switched off.

DANGEROUS ELECTRICAL VOLTAGE
Prior to working on the mains or transformer connection, make sure that the unit is de-energized.
Verify safe isolation from supply using suitable testers and appropriate methods.
When the power supply has been switched off, you should wait for at least 5 minutes before working on the mains or transformer connection.

Maintenance

11 Maintenance

DANGEROUS ELECTRICAL VOLTAGE
Prior to working on the mains or transformer connection, make sure that the unit is de-energized.
Verify safe isolation from supply using suitable testers and appropriate methods.
When the power supply has been switched off, you should wait for at least 5 minutes before working on the mains or transformer connection.

★ Please note the general maintenance requirements in Section ”Safety instructions” starting on page 1–15.

11.1 Regular maintenance work

★ Include the following activities in the regular maintenance schedule:

- Check the functionality of all protective devices in intervals not exceeding six months.
  This refers to, in particular, the operativeness of the protective conductor wiring and (if used) the ground fault protection device and the ground fault protection resistor.
  Error states must quickly release the system’s main switch.
- In case of water-cooled units: Check the cooling water circuit for leaks and proper functioning. Corrosion or condensation may not occur.
  Use suitable cooling water additives, e.g., in order to avoid algae growth.
- In case of air-cooled units: remove dust and other contamination from the air-cooling system.
- Check terminal and clamp connections of all cables for damages and firm sit.
  Replace defective parts immediately.

Maintenance

11.2 Battery

A battery is integrated into the unit for buffering the main memory (containing all parameter settings with all welding programs) and the internal clock.

Battery type:	Lithium
Battery size:	AA
Voltage:	3.6 V
Order no.:	1070 914446

The timer generates a fault or warning (can be parametrized) when the remaining battery power becomes critical. The BATTERY FAULT LED on the front panel lights up (refer to page 2–7).
Welding is not possible if the event is defined as a fault message.

★ Include battery replacement in the regular maintenance schedule of the plant!
Replacement: at least every 2 years.

CAUTION
Damages through improper handling of electronic components!
Therefore, batteries must be replaced by authorized technical personnel!

CAUTION
Loss of data!
If not supply voltage is present and when the batteries have been removed, data buffering is guaranteed for max. 24 hours only.
Therefore, have a new battery ready at hand for replacement and insert the new battery immediately after removing the spent battery.

Replacing the battery

The battery may be replaced while the timer is switched on.

1. Remove the cover on the right side of the enclosure of the timer (refer to page 2–8) and take out the spent battery.
2. Slightly hit the new buffer battery (of the same type!) on a firm surface in order to destroy the internal oxide layer.
3. Insert the new battery with the positive pole pointing to the right (refer to figure on page 2–8).
4. Slide the cover back on.

Maintenance

11.3 Firmware

Upon delivery, the most current firmware is installed on the timer. You may display the firmware version using the programming terminal (BOS).

Type	BOS display	Timer function
PST 610Ex G	1070 090 298–firmware edition	Manual welding gun
PST 625Ex G	1070 090 299–firmware edition	Manual welding gun
PST 610Ex M	R911 170 701–firmware edition	Machine
PST 625Ex M	R911 170 704–firmware edition	Machine

In rare cases, it may be necessary to update the firmware.

CAUTION
Damages through improper handling.
Therefore, firmware updates may only be performed at our request and by authorized personnel only!

The following software tools are available:

- **WinBlow** (refer to section 11.3.1):
  - for firmware update of the timer via V24 interface (X3C).
- **FWUpdate** (refer to section 11.3.2):
  - for firmware update of the timer via fieldbus interface Ethernet.

11.3.1 Firmware update via ”WinBlow”

The following is needed to perform a firmware update

- a pointed object for operating the ”Boot” button (for position, refer to description on page 2–7),
- a PC with the ”WinBlow” software installed,
- a suitable connecting cable (timer <–> PC; for wiring, refer to page 7–8) and
- the firmware as *.hex file.

★ Proceed as follows:

1. Connect a V24 interface of your PC (COM1 or COM2) to X3C of the timer.
2. Start the ”WinBlow” software. Select the desired language and the V24 interface used.
3. Select the path and file name of the firmware. Firmware files have the filename extension ”.hex”.
4. Click on ”Load backup – firmware – restore” command button. You are prompted to set the bootstrap mode on the unit.

☞ **Welding is not possible if you proceed!**
If you want to exit the bootstrap mode at this point, you have to interrupt the 24 V_{DC} power supply of the timer (refer to page 7–2).

5. Press the recessed Boot button on the front side of the timer. Thus, the unit is switched from operating to bootstrap mode. This condition is indicated by the Boot LED above the button.

☞ **When the next step has been initiated, the power supply must not be interrupted until the complete firmware has been loaded.**

6. Confirm at the PC that the bootstrap mode has been activated. The firmware is now loaded. A bar indicates the current status of the process.
7. Wait until the PC signals the end of the transmission.
8. Interrupt the 24 V_{DC} power supply of the timer for at least 5 seconds (pull out X1S1).
   Then reinstall X1S1.
   The timer is booted with the new firmware.
9. Check the firmware version using the programming terminal (BOS).

11.3.2 Firmware update via ”FWUpdate”

The following is needed to perform a firmware update

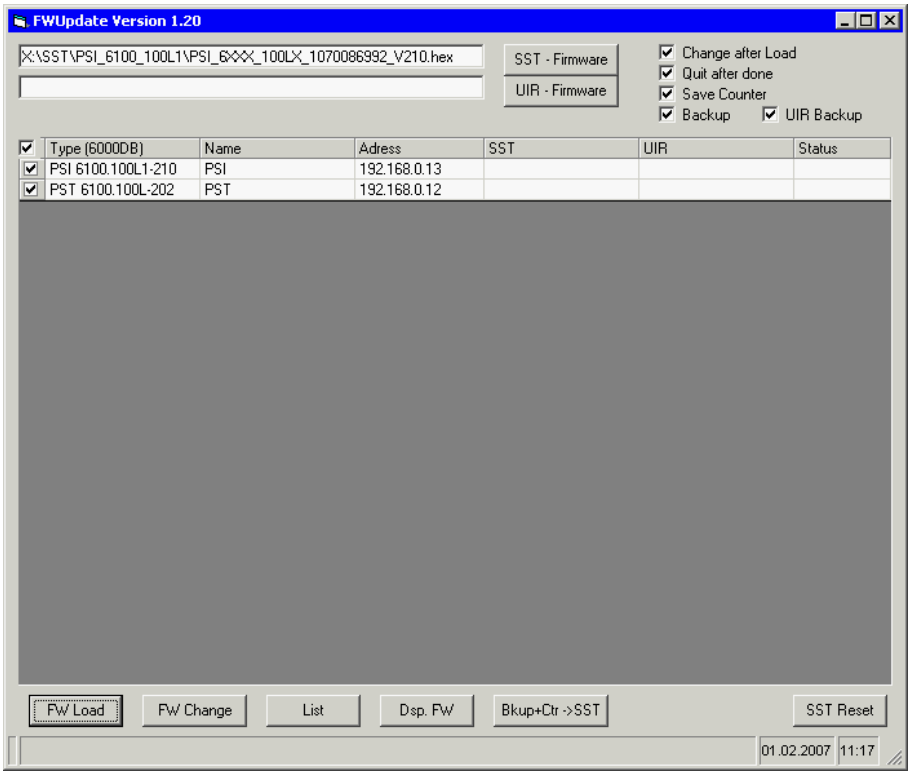
- a PC with the ”FWUpdate” software installed,
- an operative connection of the PC via fieldbus interface Ethernet,
- a BOS database existing on the PC with valid timer reference (BOS 6000 installed), and
- the firmware as *.hex file.

★ Proceed as follows:

1. Start the ”FWUpdate” software.

   During start, the software looks for a valid timer reference (it is read from the BOS6000 database) and shows you the respective linked timers in form of a table.

Maintenance



2. Use the ”SST firmware” command button to select the path and file name of the desired firmware.
   Firmware files have the filename extension ”hex”.

   The current selected firmware file is shown in the corresponding input fields.
3. Select the timers in which the firmware is to be implemented via the checkbox in the left margin.
   If you wish to select/deselect all timers together, use the left checkbox in the header bar of the table.
4. Select the desired options for the firmware update via checkbox. The selected options will apply to all timers selected.

   The following are available:

   - ”Change after Load”:
     The system triggers the reprogramming of the timer-internal flash memory (after backup procedures, if activated; refer to option ”Save Counter”, ”Backup”. In this process, the timer copies the content of a special reserved RAM area in the flash memory, described by the ”FW Load” command button.
     If ”Change after Load” is not activated, the copying procedure has to be started manually via the ”FW Change” command button in the course of the firmware update.

☞ **Only use ”Change after Load” if all the weld timers involved are not actively part of the production process for the time it takes to perform the entire firmware update!**

- ”Quit after done”:
  The program is exited automatically after the firmware update of all timers selected (and an activated Restore, if applicable; refer to options ”Save Counter”, ”Backup”).
- ”Save Counter”:
  All actual counter statuses (electrode and tip-dress cutter blade life, if applicable) are saved on the programming terminal before the flash memory is programmed and rewritten to the timer after a timer reset.
- ”Backup”:
  All welding parameters are saved on the programming terminal before the flash memory is programmed and rewritten to the timer after a timer reset.
- ”UIR Backup”:
  Without function here.

5. Check if communication with the timers selected for firmware update is possible.
   Click on the ”List” command button.

   The communication works properly if the currently active firmware versions are displayed after a few seconds in the newly opened ”SW Version” window.
   Close the ”SW version” window after this.

   The communication is disturbed if the following text appears instead of the firmware version: ”--N/A---”.
   If that is the case, check if the respective timer is properly connected and has been completely booted. A firewall running on the programming terminal may also block communication.
   Close the ”SW version” window after this, and the check the communication again.

6. Click on the ”FW load” command button.

   The currently selected firmware file (refer to step 2.) is loaded by the programming terminal in a special reserved RAM area of the timer. The progress is indicated by a status bar in the field ”SST” (Weld timer).

   When the loading process has been completed, the system will show you the loaded firmware version in the field ”SST” (Weld timer).

   If the loaded firmware is in principle suitable for the timer, the background of the field ”SST” (WT) will be green, otherwise it will be red. Only suitable firmware versions can be programmed in the flash memory of the timer in the further process.

7. If activated (refer to step 4.: Options ”Save Counter”, ”Backup”), the relevant data will be saved on the programming terminal automatically.

   During this process, the text ”Backup” will be displayed in the ”Status” field.

8. If ”Change after load” is activated (refer to step 4.), reprogramming of the flash memory is triggered automatically in the timer.
   If the option is not activated, you can start reprogramming using the ”FW Change” command button.

Maintenance

☞ **During reprogramming of the flash memory,**

- **the power supply of the timers involved may not be interrupted.**
- **no welding is possible**
- **”Ready” is reset.**

The ”Wait” window appears at the start of reprogramming. Wait until the ”Wait” window closes automatically (duration: approx. 100 s). After reprogramming (duration: approx. 60 s), an automatic reset triggers a rebooting of the timer.

9. If activated (refer to step 4.: Options ”Save Counter”, ”Backup”), the data saved in step 7. are automatically loaded back to the timer by the programming terminal.
   During this process, the text ”Restore” will be displayed in the ”Status” field.

The firmware update is completed.

★ Check whether the firmware update of all selected timers has been implemented correctly.
Click on the ”List” command button. All currently active firmware versions are displayed a in the newly opened ”SW version” window.
Close the ”SW version” window and the ”FWUpdate” software.

☞ **A firmware version loaded in the timer’s reserved RAM area can be displayed using the ”Dsp.FW” command button in the ”SST” (”Weld timer”) field.**

☞ **In addition to the procedure described, the timer data saved last can be also be loaded to the timer manually using the ”Bkup+Ctr –> SST” command button.**

☞ **In addition to the procedure described, a timer reset can also be triggered manually using the ”SST Reset” command button.**

Maintenance

Notes:

12 Status and fault messages

You are informed by the timer of all control-relevant events that might occur during operation via

- faults and
- warnings.

Whether or not an event is interpreted as a fault or a warning depends on the parameter setting in the timer (BOS, fault allocation).

In the "Ready" status (= no fault active)

- a new welding sequence can be started
- the green READY LED on the front panel is lit (refer to page 2–7)
- the "Ready" output signal is set.

In the event of faults

- no welding schedule can be started
- the red READY LED on the front panel is lit
- the "Timer ready" output signal is reset.

In the event of warnings

- more welding sequences are permitted.

Both faults and warnings may be "self-resetting".

"Self-resetting" means that events are automatically reset by the timer when the cause of the fault or the warning has been corrected. Therefore, they do not require **fault reset**.

Examples of self-resetting faults include:

- Stop / No 24V
- Power voltage off/too low
- Synchronization/mains voltage error

A required fault reset is performed alternatively via

- software (BOS) or
- a positive edge of the "Reset fault" input signal.

The timer only uses code numbers for signaling faults and warnings. These code numbers are supplemented by plain text in the programming terminal or the line PC. This is designed to save memory resources of the timer and to reduce communication times.

☞ **For fault and status messages, please refer to "Error list PS5000/PS6000" (No.: 1070 087 001).**

Status and fault messages

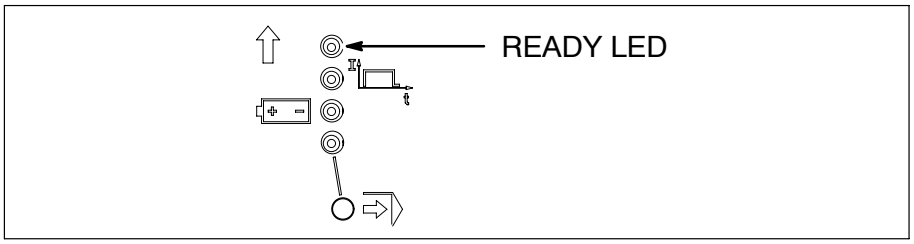
Notes:

13 Failures

The units have a robust design. Nevertheless, failures may occur in exceptional cases, e.g. as a result of

- overvoltage in the system,
- insufficient cooling or overload,
- exceeding of the maximum current values (parameter setting) or monitoring values.

In case of failure, the red READY LED on the front panel is lit



Detailed information on the fault that occurred will be provided

- through diagnostics or error display of the BOS (**B**edien**O**berfläche **S**chweißen) user interface.
- via control terminal (BTxxx).

☞ **For fault and status messages, please refer to "Error list PS5000/PS6000" (No.: 1070 087 001).**

Temperature monitoring responds

The AC power unit indicates temperatures greater than/equal to 65° C (+5° C) to the integrated weld timer.

- As a result, the weld timer stops all further sequences.
- The red READY LED on the timer front panel is lit and the "Thyristor temperature" error is displayed.

Possible causes	Action
Contaminated heat sink	Clean heat sink.
Ambient temperature too high.	Check installation room cooling for proper installation and functioning.
Rating of the AC power unit too low.	Calculate duty cycle and check selection on the basis of the load diagram.
Cooling water too warm or cooling water flow too low.	Check flow and/or temperature of cooling water.
Forced ventilation of air-cooled units is defective.	Check forced ventilation.

Failures

Notes:

14 Part numbers and accessories

☞ **All items listed below are not included in the standard scope of delivery of the PST 6xxE types!**

Description	Explanation	for type	Part number
V24 cable (Mini-DIN)	For linking of a programming terminal (PC) to interface X3C		R 911 296 710
Lithium battery	AA, 3.6 V; Buffering of RAM and internal clock. Position, refer to page 2–8.		1070 914 446
Insert for plug connectors	With smaller core cross-section; for mains and welding transformer connection.	PST 610E L/W	1070 918 779
		PST 625E L/W	1070 918 466
Assembly kit	For installation on rear panel. For dimensioned drawing, refer to page 6–3.		R 911 170 864

Part numbers and accessories

Notes:

CE Marking

15 CE Marking

Konformitätserklärung

Im Sinne der EG-Richtlinie 89/336/EWG (EMV-Richtlinie), 73/23/EWG (Niederspannungsrichtlinie) und 98/37/EG (Maschinenrichtlinie)
(einschließlich 93/68/EWG und 93/44/EWG)

Rexroth
Bosch Group

Electric Drives and Controls

Produkt/Product/produit: PST 6XX E

1070 090531-101_474
2007-03-05

Declaration of Conformity as per directives 89/336/EEC, 73/23/EEC and 98/37/EC
Declaration du fabricant conformément aux directives 89/336/CEE, 73/23/CEE et 98/37/CE

Hiermit erklären wir in alleiniger Verantwortung, dass das Produkt	Assuming sole responsibility, we herewith declare that the product	*Par la présente, nous* declarons sous notre propre et unique responsabilite que le produit

1. **Produkt: / Product: / Produit:** Schweißsteuerung PST 6XX E
2. **Hersteller: / Manufacturer: / Constructeur:** Bosch Rexroth Electric Drives and Controls GmbH, Berliner Str. 25, D-64711 Erbach - Germany
3. **Typ/Type:** gemäß beiliegender Liste
4. **ab Herstelldatum: / from the date of manufacture: / à partir de la date de fabrication:** 2007
5. **Angewendete Normen / Applicable Standard / Normes utilisees**

Norm / Standard / Norme	*Titel / Title / Titre*	*Ausgabe / Edition*
EN 50178	Electronic equipment for use in power installations	1998
EN 60204-1	Safety of machinery – Electrical equipment of machines	1998
EN 50240	EMC product standard for resistance welding equipment	2004

einschließlich des erforderlichen Zubehörs den Bestimmungen der EG-Richtlinie 89/336/EWG, 73/23/EWG und 98/37/EG entspricht.
Erläuterungen:
Dieses Produkt ist eine Einbaukomponente, die auf Grund ihrer Einbaueigenschaften nicht allein den Vorschriften für Endgeräte, Maschinen oder Anlagen entsprechen kann. Es darf daher nur zu Einbauzwecken verwendet werden.
Die Bewertung der elektrischen und mechanischen Sicherheit, der Umwelteinflüsse (Fremdkörper, Feuchtigkeit) muss im eingebauten Zustand am Endprodukt erfolgen.
Im eingebauten Zustand können sich die EMV-Eigenschaften dieses Produktes ändern.

including the accessories required, complies with the requirements specified by EC directive 89/336/EEC, 73/23/EEC and 98/37/EC.
Explanatory notes:
This product is a built-in unit which, owing to its installation characteristics, is not able to comply with the regulations for complete apparatus, machines or installations from the outset. For this reason, it may only be used for built-in purposes.
The product may only be assessed with regard to its electrical and mechanical safety as well as to environmental effects (foreign bodies, moisture) after it has been installed in the product intended for the final user.

les accessoires necessaires compris, satisfait aux dispositions de la directive CE 89/336/CEE, 73/23/CEE et 98/37/CE.
Ce produit est un composant devant être encastré et qui, en tant que tel, peut ne pas correspondre aux prescriptions imposées pour appareils finaux, machines ou installations. En conséquence, ce produit ne doit être utilisé, qu'à l'état encastré.
L'evaluation de la sécurité électrique et mécanique ainsi que celle de l'influence exercée par des conditions ambiantes extérieures (corps étrangers, humidité) doivent être effectuées sur l'appareil final, après encastrement du produit.

Erbach Ort/location/localité — den 5.03.07 Datum/date

1. Unterzeichner - für Fertigung **(Haag – technische Betriebsleitung)**

2. Unterzeichner - für Entwicklung **(Müller – Leiter Entwicklung Widerstandsschweißen)**

Änderungen im Inhalt der Konformitätserklärung sind vorbehalten. *Derzeit gültige Ausgabe auf Anfrage.*
We reserve the right to make changes in the conformity declaration. Presently applicable edition can be obtained upon request.
Le fabricant se reserve le droit de modifier le contenu de la déclaration. Edition actuellement en vigueur sur demande.

Firmensitz/Headquarters: Stuttgart, Registrierung/Registration: Amtsgericht Stuttgart HRB 23192
Vorstand/Executive Board: Manfred Grundke, Vorsitzender/President: Dr. Georg Haneri; Reiner Leipold-Büttner
Vorsitzender des Aufsichtsrats/Chairman of the Supervisory Board: Dr. Siegfried Dais

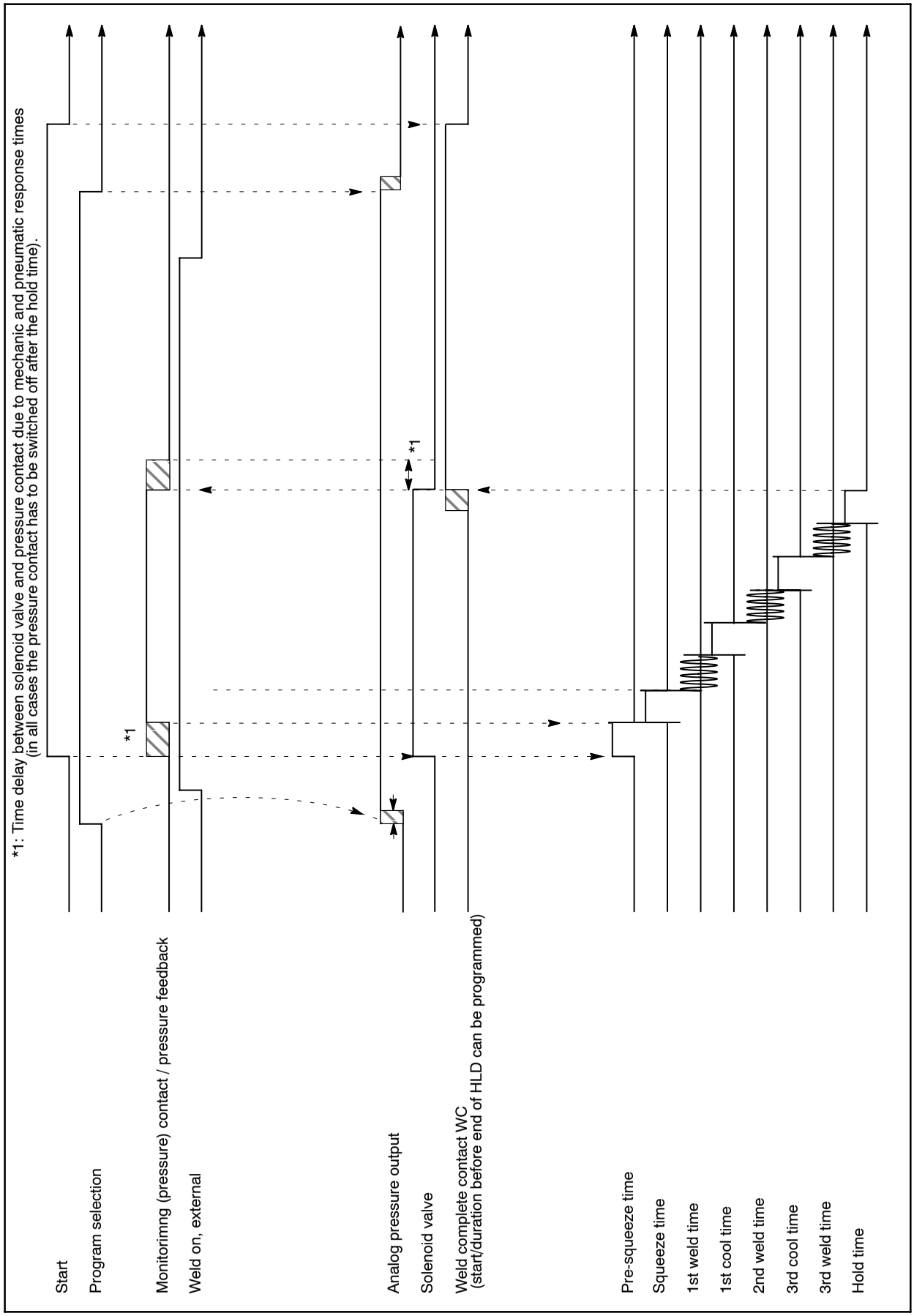
CE Marking

Notes:

16 Timer diagrams

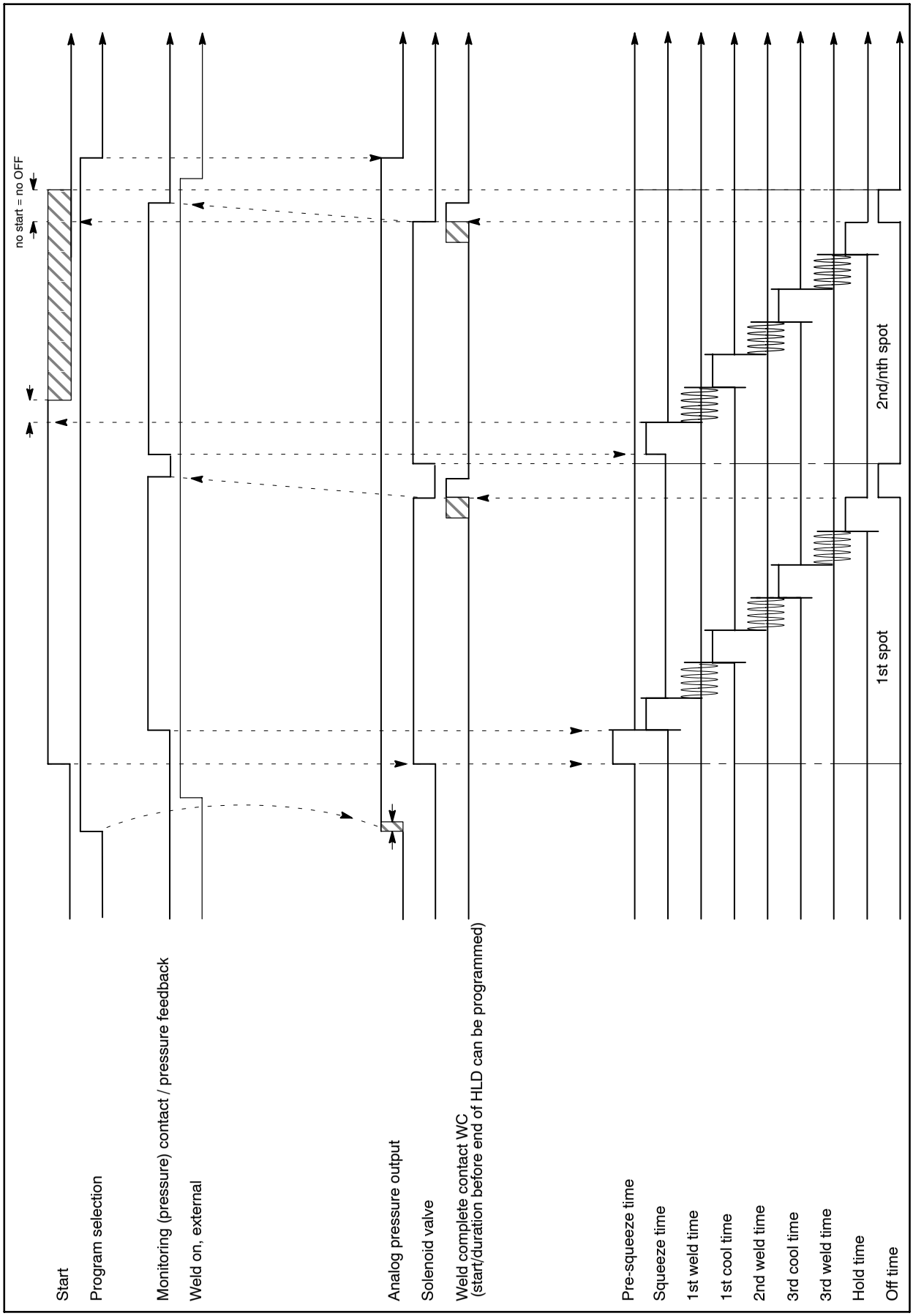
Examples of several timer diagrams are shown on the following pages.

Timer diagrams (for machine application)



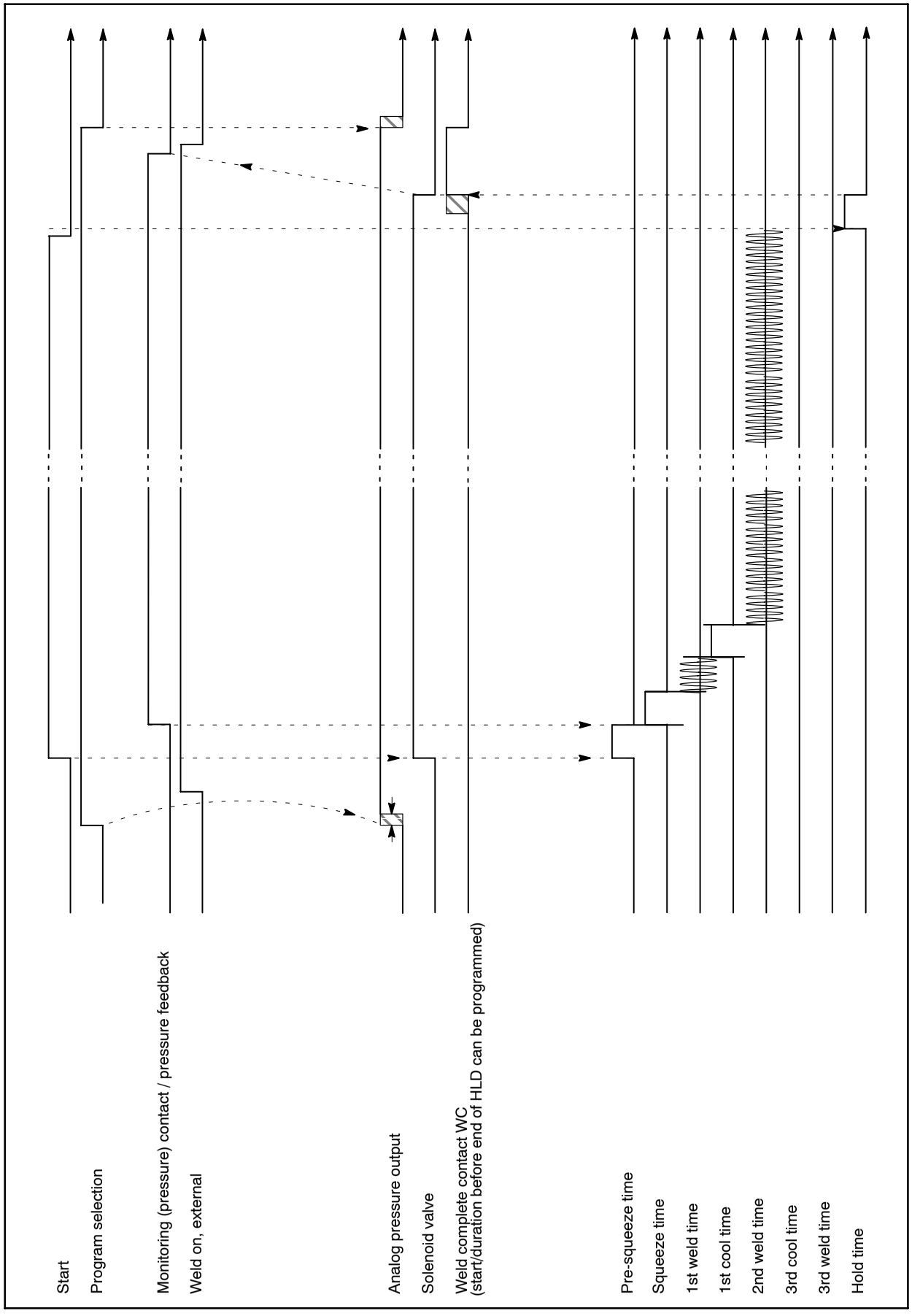
Example of normal sequence, single spot (for machine application)

Timer diagrams (for machine application)



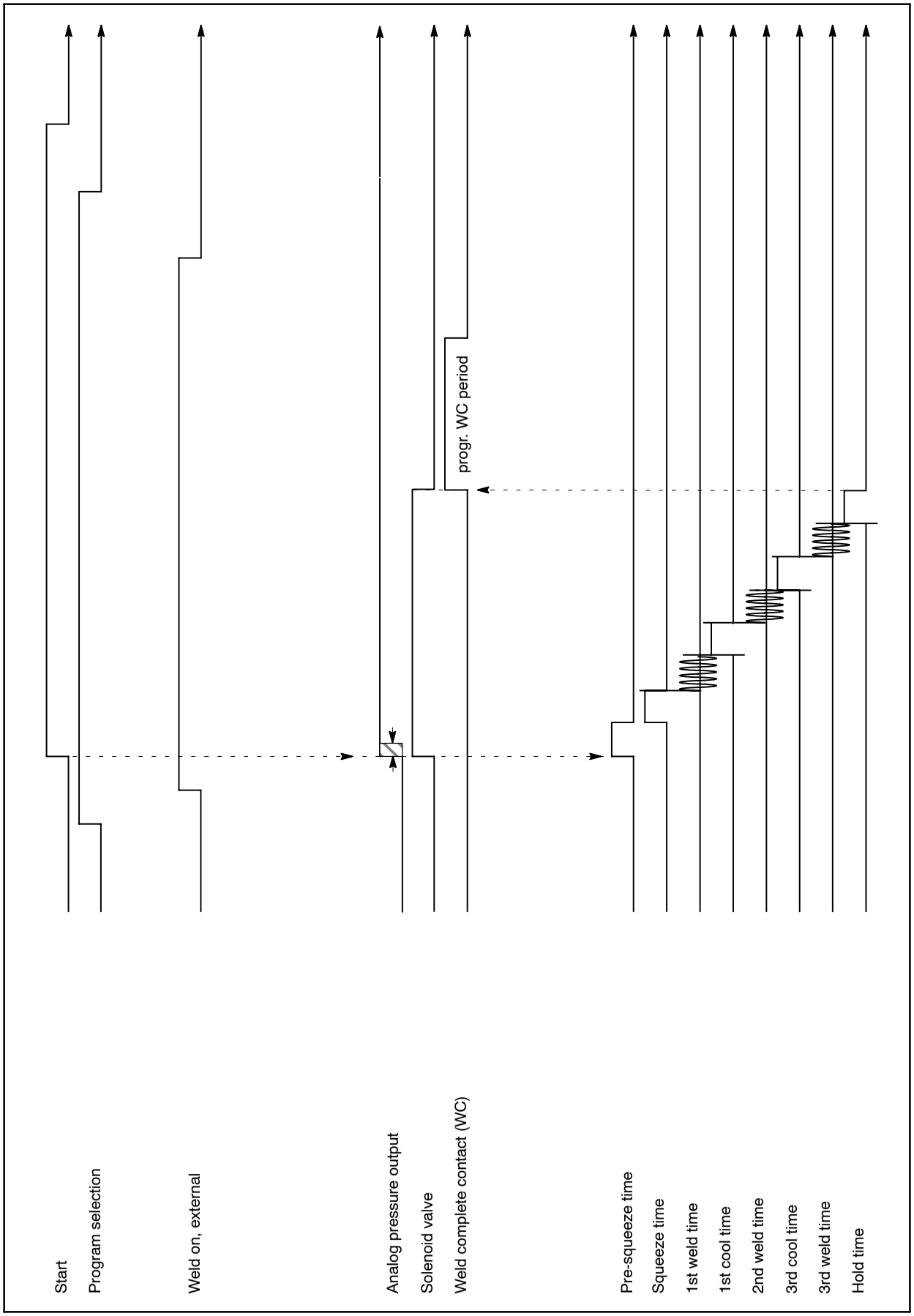
Example of normal sequence, repeat (for machine application)

Timer diagrams (for machine application)



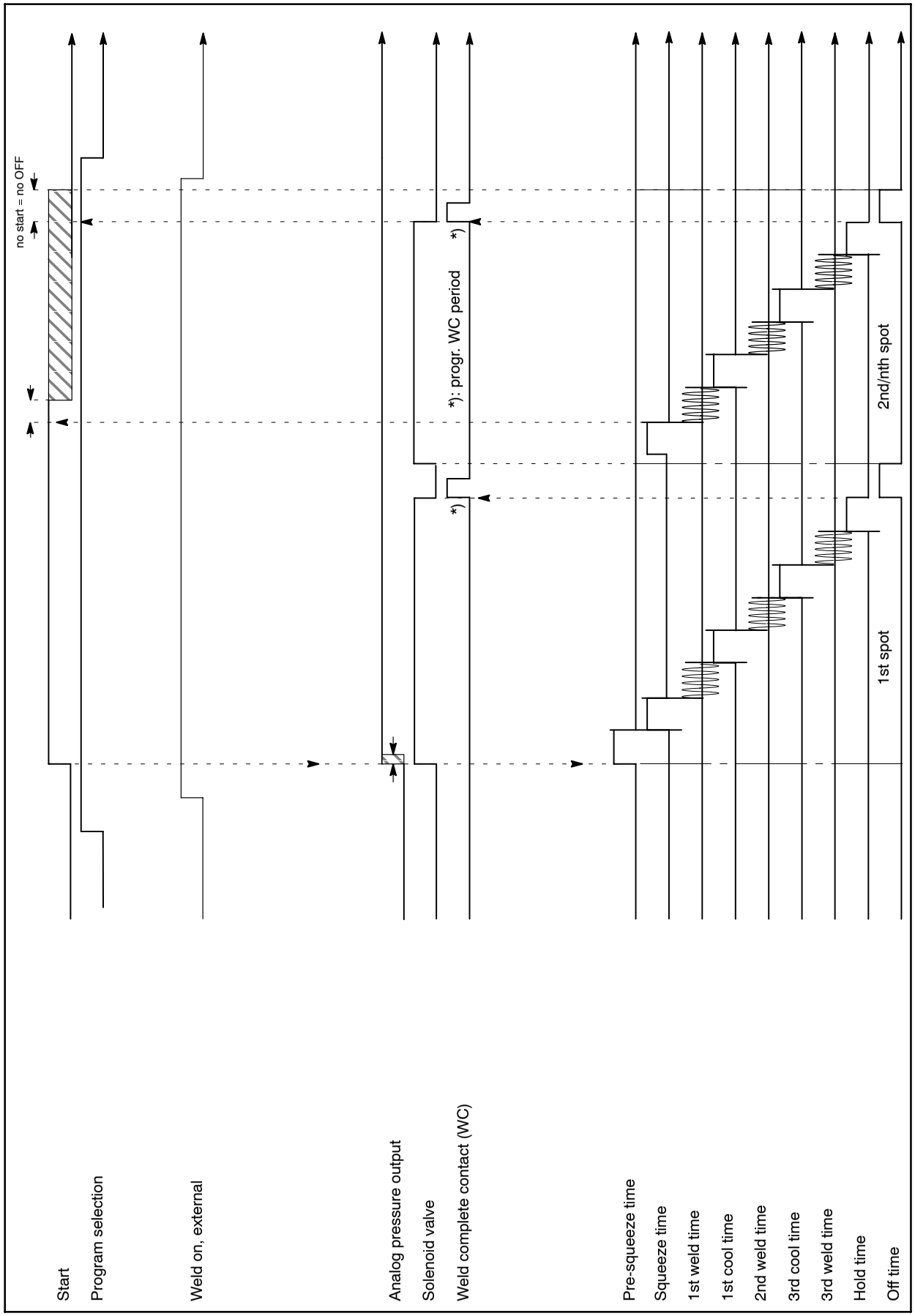
Example of normal sequence, seam (for machine application)

Timer diagrams (for manual welding gun application)



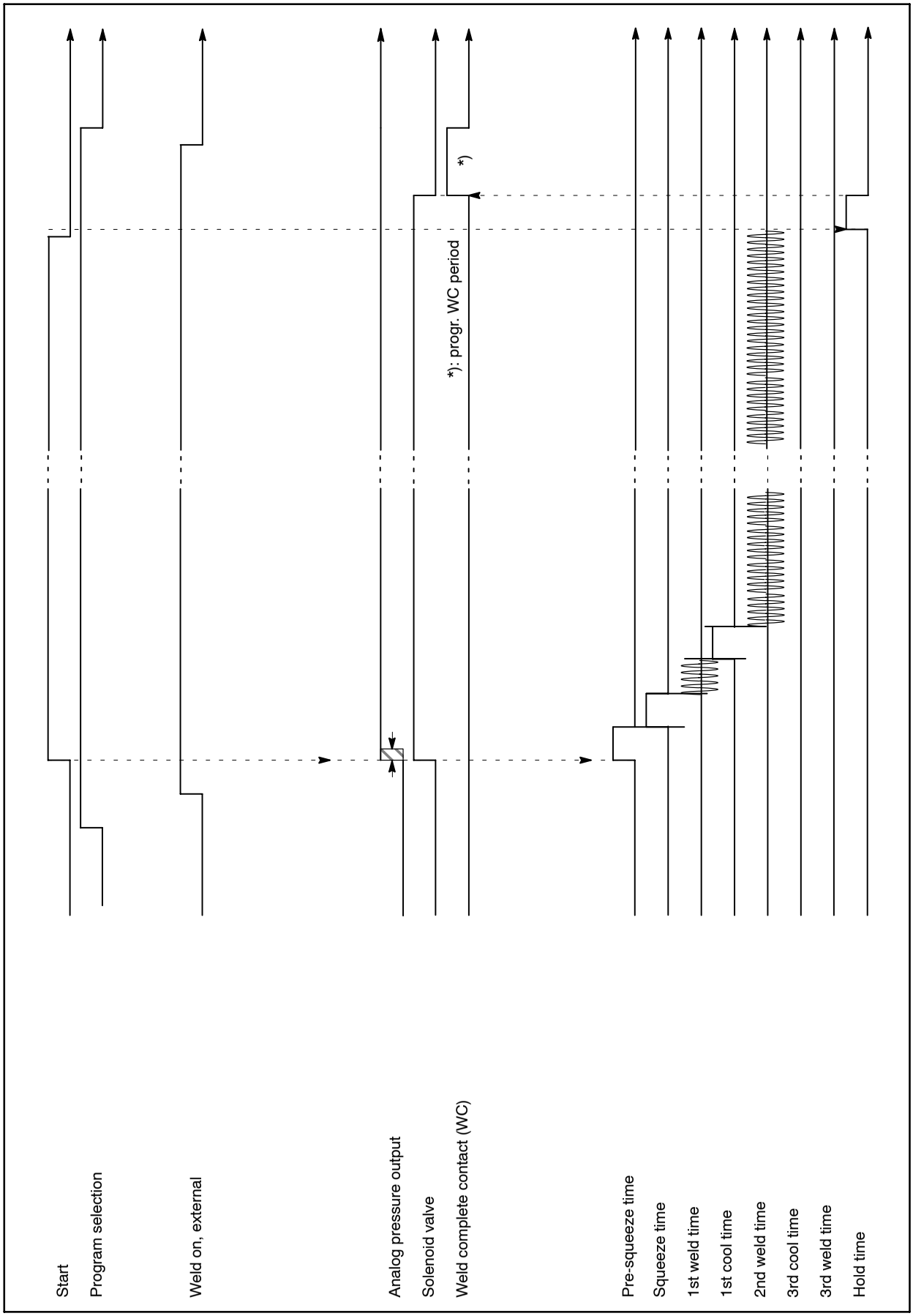
Example of normal sequence, single spot (for manual welding gun application)

Timer diagrams (for manual welding gun application)



Example of normal sequence, repeat (for manual welding gun application)

Timer diagrams (for manual welding gun application)



Example of normal sequence, seam (for manual welding gun application)

Timer diagrams (for manual welding gun application)

Notes:

Annex

A Annex

A.1 Abbreviations

%I	General abbreviation for current, can be measured in kA or in SKT (scale values)
AC	Alternating Current
CT	Cool time, time between the current impulses/blocks (1st, 2nd, 3rd CT)
DC	Direct Current
DST	Downslope time. Time in which the %I decreases until the end of the 2.WLD.
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge, abbreviation for all terms that concern electrostatic discharges, e.g. ESD protection, ESD hazard, ESD-sensitive components
ext.	External, e.g. in connection with a +24V voltage for signal transducers (switches) and actuators (valves) outside the timer.
FPO	Freely programmable output. Not available with all timers.
GUI	Graphical user interface
HEAT, Ht	For current, power of welding. Can refer to SCV (scale values) or kA.
HLD	Hold time, time after the last weld time, in which the welded part can cool down.
HSA	Main Switch Trip
IMP	Number of impulses that form the 2.WLD
kA	Kilo-Ampere
KSR	Constant current regulation. Keeps the current in the welding circuit constant.
LT	Power supply unit (thyristor or inverter)
MC	Monitoring or pressure contact, e.g. for monitoring the pressure inside the cylinder that closes the electrodes or monitoring of the electrode position, e.g. ”gun closed”
MF	Medium frequency
ms	milliseconds
NBS	see WI
NWZ	Post–heating time. Also called the 3rd WLD
OFF	Off time, time between two spot welds in which the solenoid valve is not triggered. Relevant for Repeat mode only.
P	Periods (mains cycles). At 50 Hz mains frequency: 1 P –> 20 ms.
PE	Protective Earth
PG	Programming device / welding computer
PHA	Phase angle (shift)
PLC	Programmable Logic Controller
RA (RO)	Relay output
REPEAT	Repeat mode. Mode for manually operated systems only
SCV	Scale values. Measure for the electrical phase angle.
SING	Single spot mode. For automatic and manual welding machines
Slope	Current ramp, current increases/decreases from an initial to a final current value
Solenoid	Solenoid valve, controls the cylinders for closing the electrodes
SQZ	Squeeze time. Time that runs before the weld time. The electrodes squeeze the parts to be welded together.
Stepper	Current stepping for compensation of electrode wear
Temp.	Temperature
UST	Up-slope time. Time in which the %I increases from the beginning of the 2.WLD.
VWZ	Preheating time, also referred to as 1.WLD
WC	Weld complete. Signal is output after the end of the welding schedule.
Weld / No weld	Ignition, firing pulses for triggering the power unit are switched on and off
WI	Mains load limitation control (Welder interlock), monitors and influences the mains load
WLD	Weldtime. There are three types: 1st WLD (preheating weldtime), 2nd WLD (main welding weldtime) and 3rd WLD (postheating weldtime). The times and power of all 3 weldtimes can be programmed differently. Impulses and slopes can be programmed only in the 2nd WLD.
WT	Weld timer, also referred to as timer, or resistance weld timer

Annex

A.2 Index

Annex

Annex

Annex

X

Annex

Notes:

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