

SSP KONSTANTER 62 N and 64 N

Series SSP 500, SSP 1000, SSP 2000 and SSP 3000
Programmable Power Supplies

3-349-262-03
5/1.10



Series 62 N



Series 64 N

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I Initial Inspection

Immediately after receipt, unpack the KONSTANTER and all included accessories, and inspect for damage and completeness.

Unpacking

- Other than the usual care exercised in handling electronic equipment, no additional precautions are required when unpacking the instrument.
- The KONSTANTER is delivered in recyclable packaging, which provides for adequate protection during transport as substantiated by testing. If the instrument is repacked at a later point in time, the same packaging, or its equivalent, must be used.

Visual Inspection

- Compare the order number or type designation included on the packaging and/or the serial plate with the particulars shown in the shipping documents.
- Make sure that all accessory components have been included (→ Kap. 1.3, "Options and Accessories").
- Inspect the packaging, as well as mechanical instrument and accessory components for possible transport damage.

Complaints

If damage is discovered, immediately file a claim with the freight forwarder (save the packaging!). If other defects are detected, or in the event that service is required, inform your local representative, or contact us directly at the address included in the last page of this handbook.

II Warnings and Safety Precautions

The KONSTANTER has been manufactured and tested in accordance with the electrical safety regulations listed in the technical data as a safety class I device, and has been shipped from the factory in flawless technical safety condition. In order to maintain this condition and to assure safe operation, users must observe all notes and warnings included in these operating instructions. These are identified with the following headings:

Caution!

A note concerning operation, practical advice or other information which must be adhered to in order to prevent damage to the KONSTANTER, and to assure correct operation.

WARNING!

An operating procedure, practical advice or other information which must be adhered in order to assure safe operation of the KONSTANTER, and to prevent personal injury.

The most important warnings are summarized below. Reference is made to these warnings at appropriate points within the operating instructions.

Important Warnings

WARNING I – Protective Grounding

The KONSTANTER may only be placed into operation after the protective conductor has been connected. Interruption of the protective conductor, either inside or outside of the KONSTANTER, or disconnection of the protective conductor terminal may transform the KONSTANTER into a source of potential danger. Intentional interruption is prohibited.

62N: The device is connected to the mains by means of a 3 conductor cable with mains plug. The plug may only be inserted into a suitable outlet with earthing contact. This safety precaution must not be defeated though the use of an extension cable without protective conductor.

64N: These devices are permanently connected to the mains with a 5-pole terminal block for 3-phase current (5 conductor).

WARNING II – Impaired Safety

If it can be assumed that safe operation is no longer possible, the KONSTANTER must be removed from service and secured against inadvertent use. It must be assumed that safe operation is no longer possible:

- If the KONSTANTER demonstrates visible damage
- If the KONSTANTER no longer functions
- After lengthy periods of storage under conditions which deviate from specified storage conditions
- After extraordinary stressing due to transport

WARNING III – Opening Housing Panels

Voltage conducting parts may be exposed when housing panels are opened, as long as the KONSTANTER is connected to supply power.

Any contact with these exposed conductive parts is life endangering.

For this reason, housing panels may only be opened and/or removed by trained personnel who are familiar with the dangers involved.

WARNING IV – Repair by Trained Personnel

Voltage conducting parts may be exposed when housing panels are opened, as long as the KONSTANTER is connected to supply power.

Maintenance and repair work, as well as internal balancing, may only be performed by trained personnel who are familiar with the dangers involved.

The KONSTANTER must be disconnected from all external power sources before work of this type is performed, in as far as this is possible. A 5 minute waiting period must be observed after disconnection in order to allow internal capacitors to discharge to safe voltage levels.

WARNING V – Fuse Replacement

Only specified fuse types with the specified nominal current rating may be used to replace blown fuses (see Technical Data and specifications on the serial plate).


Tampering with fuses or fuse holders is prohibited ("repairing" fuses, short-circuiting fuse holders etc.).

Significance of Symbols

 Indicates EC conformity

 Observe EGB directives

 Warning concerning a source of danger (attention: observe documentation!)

 This device may not be disposed of with the trash. Further information regarding the WEEE mark can be accessed on the Internet at www.gossenmetrawatt.com by entering the search term 'WEEE'.

1 Technical Description

1.1 Features and Range of Applications

SSP KONSTANTERs (single-output system power supplies) are manual and remote controllable DC power supplies for laboratory and system use. Despite high output power, the power supplies are small and lightweight.

The floating output features "safety electrical separation" from the mains input as well as optional computer interfaces, and is classified as a safety extra-low voltage circuit (SELV) in accordance with VDE/IEC. Wide ranging nominal power values are available from the voltage and current controlled output.

The devices are generally equipped with a control panel and display, as well as an analog interface.

An additional interface can be plugged into the device for integration into computer controlled systems. Two interface variants are available to this end, as described in chapter 1.3. Manual adjustment of voltage and current is accomplished by means of two rotary knobs with selectable adjusting sensitivity. Numerous additional functions can be activated with various keys (see table below).

Two 4-place digital LED displays read out measured values and settings. LEDs indicate the current operating mode, selected display parameters and the status of device and interface functions.

The analog interface can be used to set output voltage and current with the help of external control voltages, and also serves to link several devices for master-slave operation. Deactivation of the output, control panel disabling and individual or sequential retrieval of saved settings can be controlled via the floating optocoupler input.

1.2 Functions

Adjustable functions:

- Voltage and current setpoint values
- Voltage and current limit values (soft-limits)
- Activate / deactivate the output
- Overvoltage protection trigger value
- Overcurrent response (limiting with or without shutdown)
- Delay time for overcurrent protection
- Starting performance (power-on status)
- Reset device settings
- Save device settings
- Recall device settings individually or sequentially
- Control panel disabling
- Function selection for trigger input
- Round off measured value for display
- Service request masks (SRQ masks) ¹
- Activate/deactivate digital displays ¹
- Self-triggering when mains power is switched on ¹

Retrievable information:

- Momentary measured voltage and current values
- Minimum and maximum measured voltage and current values
- Momentary output power
- Current device settings (individual or complete)
- Current device status (control mode, overtemperature, busy) ¹
- Occurred events (mains or phase failure, overtemperature, overvoltage, overload, programming error) ¹
- Device D I ¹

Additional Functions

- Sensor terminals protected against polarity reversal and automatic switching to auto-sensing
- Overtemperature protection
- Output protected against reverse polarity

- Backup battery for device settings memory
- Recognition of mains or phase failure
- Inrush current limiting

¹⁾ Via computer interfaces only

1.3 Options and Accessories

Devices can be equipped with a plug-in interface module (2 variants) for integration of SSP KONSTANTERs into computer controlled systems.

Variant 1 includes **one** digital computer interface:

- One V.24 / RS 232C bit-serial interface
This interface is provided in minimized format only (conductors: RxD, TxD, GND).

Variant 2 includes **two** digital computer interfaces:

- One IEC 625 bit-parallel, byte-serial interface
This interface fulfills all requirements of the IEEE 488 standard and is commonly designated as a GPIB (general purpose interface bus) or an HP-IB (Hewlett Packard interface bus).
- One V.24 / RS 232C bit-serial interface
This interface is provided in minimized format only (conductors: RxD, TxD, GND).

Programming of all device functions, as well as querying of measured and configured parameters is possible via both interfaces. The IEC bus interface provides several additional, specific interface functions.

The interface option is supplied as a separate plug-in module and can be easily plugged into the device at the rear.

Included accessories:

- 1 set operating instructions
- 1 mounting kit for rack installation
- 1 mains power cable with earthing contact plug (for 62 N only)

Additionally available accessories:

- RS 232 bus cable
- IEEE – IEEE bus cable
- Device driver for LabView software
- Device driver for LabWindows / CVI software
- Device driver for HPVVEE / VXI PnP software

1.4 Functional Principle

Figure 1.4 shows a schematic diagram of the SSP-KONSTANTER. The delineations indicate distribution of the circuit to the individual printed circuit boards, as well as subdivision of

the mains power circuit, the control and interface circuit, and the output circuit.

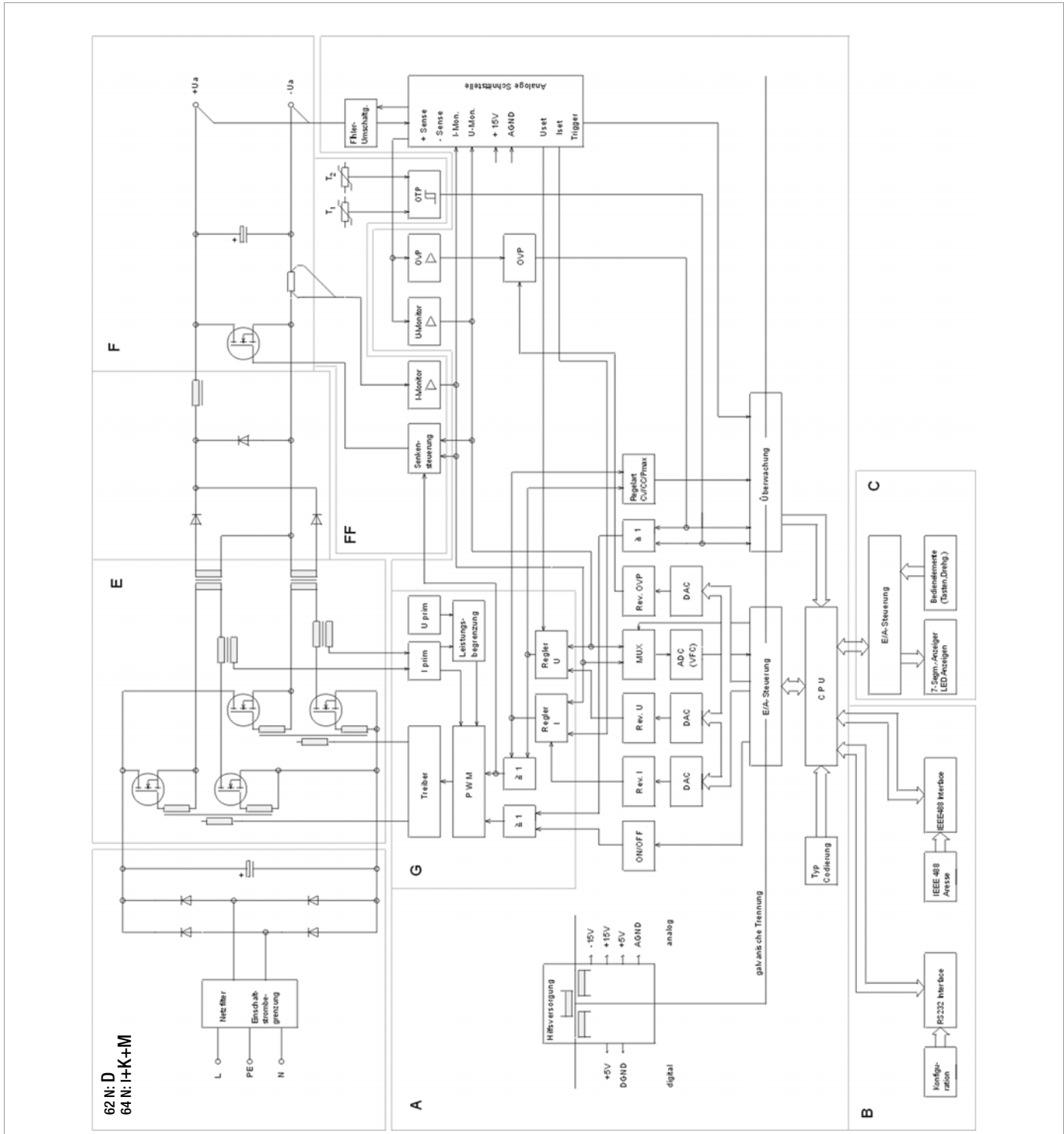


Figure 1.4 Schematic Diagram of the SSP KONSTANTER

Printed Circuit Board Functions Overview

- PCB A: Central processing unit
- PCB B: IEEE 488 – RS 232C interface (optional)
- PCB C: Control panel and display
- PCB D: Mains input circuit, 0.5 / 1 KW (filter, rectification, screening)
- PCB E: Chopper and power transformer
- PCB F: Power output circuit (rectification, filtering, sink)
- PCB G: Regulator
- PCB H: HF output filter
- PCB I: Mains input circuit, 2 / 3 KW (filter, rectifier, screening)
- PCB K: Mains input circuit, 3 KW (filter, rectification, screening)
- PCB M: Line filter choke

Power Supply

Required DC supply power is generated for each respective circuit from mains power which has been fed to the power pack via an interference suppression filter, a wire fuse, the mains switch and inrush current limiting. Series 64 N SSP KONSTANTERs are supplied with power from a 3-phase mains system (relative to the neutral conductor).

Central Processing Unit (CPU)

Overall control of the SSP-KONSTANTER is accomplished by means of the CPU on PCB A. It uses an 80C32 8-bit microcontroller with 64 kilobytes of program memory and 32 kilobytes of battery-backed CMOS RAM.

An 11 MHz pulse generator establishes the clock frequency for the processor, and creates a time reference for the measuring function and the serial interface.

A watchdog circuit monitors processor activity and disables access to battery-backed RAM in the event of supply power failure.

Operation

The SSP-KONSTANTER can be operated with the controls at the front panel, or by means of the optional IEEE 488 and RS 232C plug-in interface module.

Displays and Control Panel

The two 4-place, 7-segment displays and the keys at the front panel are managed by a controller module in multiplex mode. The individual LEDs are driven statically via a register, and the rotary pulse encoders control increment-decrement counters relative to direction of rotation. Each time an adjusting element is activated, an interrupt occurs at the CPU which then causes an appropriate response.

Interface Option

If the SSP-KONSTANTER is equipped with a plug-in interface module, the device can also be controlled either via the IEEE 488 bus or the RS 232C serial interface.

Remote Control

Device messages received by the interface are forwarded to the CPU where they are first saved to RAM. After receiving an end-of-message character, data are checked for correct syntax, plausibility and limit values. Valid commands are subsequently executed.

Setup Procedure

Setup data are processed and forwarded to the respective function unit via I/O control and an optocoupler assuring electrical isolation. Each setting value for output voltage, output current or overvoltage protection triggering is converted to a proportional control voltage by a 12 bit DAC, and is fed to the respective controller or comparator as a setpoint or a reference quantity.

Actual output voltage is ascertained by a voltage monitor, whose automatic sensor switching inputs are connected either to the output terminals or the sensor terminals.

Actual output current is acquired as a voltage drop at a shunt located in the negative output conductor, and is amplified by the current monitor to a scaled signal.

In order to achieve rapid downward adjustment of output voltage even with minimal output load, the device is equipped with a limited sink function (limited to approximately 25 W per 1000 W output power) for discharging the output capacitor. This function is activated as long as output voltage exceeds the current setpoint value (also in the event of energy recovery from a parallel connected voltage source).

The source and sink function is enabled when the output On / Off controls are set to ON, and the source function is disabled when controls are set to Off and the sink setpoint is set to Unominal after approximately 300 ms (high impedance for $U_{out} < U_{nominal}$).

Measuring Procedure

Monitor amplifier output signals, which are proportional to actual output voltage and current, are fed to an analog multiplexer (MUX) which switches one of the two signals to the input of the analog-digital converter (ADC) depending upon the desired measured quantity. The ADC functions in accordance with the synchronous voltage-frequency conversion principle, and makes a square-wave signal available at its output whose frequency is proportional to the measured quantity fed to the input. An optocoupler is used to assure electrically isolated signal transmission to a binary counter whose 40 ms gating time is derived from the quartz controlled pulse frequency of the CPU by means of an additional counter. After gating time has elapsed, the CPU acquires the counter value and calculates a measured value which is saved to RAM as a decimal number. Depending upon the circumstances, the measured value display is refreshed, an extreme value comparison is performed for the Min-Max function or the measured value is made available at the computer interface's data output buffer.

Monitoring Functions

- Control Mode Recognition and Overload
An electrically isolated digital signal is derived from the output signals of the voltage and current regulators, which indicates the currently active control mode (constant voltage or constant current mode), as long as overload protection is not active. "Overload" indicates that power limiting has been triggered as a result of selected parameter settings and prevailing load. These operating conditions are evaluated by the CPU (e.g. for OCP function), are indicated with LEDs and are used to generate status and event registers for computer control.
- Overvoltage Monitoring
If the voltage monitor is bypassed, device output voltage is additionally compared to an adjustable limit value within a range of 3 V to 120% nominal voltage by a comparator, and the output is deactivated if the limit value is exceeded and an OVP message is generated (LED display, status and events register).
- Temperature Monitoring
Temperature is converted to a proportional electrical signal by PTC resistors at representative points (conductor bar, diode stack, choke and additional switching transistors (for series 62 N, 500 W)) and are fed to a two-step threshold trigger. The lower threshold value corresponds to a temperature of approximately 75° C, and the upper threshold value is approximately 85° C. As soon as the lower threshold is exceeded at any of the temperature sensors, the fan(s) is/are switched to high speed by the fan controller. The device can be operated at any output load up to the maximum specified operating temperature after this ventilation has been activated. If ventilation is impeded, or at excessive ambient temperatures, temperature at the sensor may reach the upper threshold. If this is the case, an overtemperature message is entered to the status and events register. After 5 seconds, the OTP LED is activated and the output is shut down by the CPU. After sufficient cooling has occurred, the status message is cleared and a ready for operation message is entered to the event register. If the POWER-ON function is set to "Recall", the output is reactivated automatically. If the POWER-ON function is set to "Standby" or "Reset", the output remains deactivated and can only be reactivated by pressing the OUTPUT key, or by means of a command from the control computer. After actual temperature has fallen to below the lower threshold value, fan speed is reduced automatically.

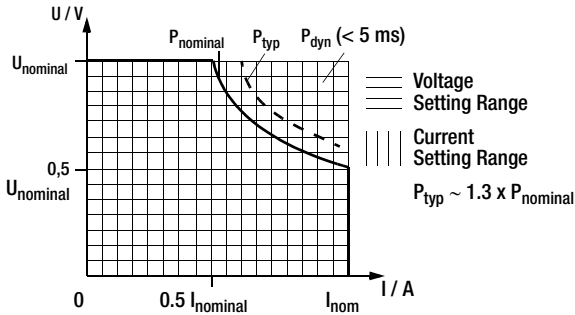
1.5 Technical Data

1.5.1 General Data

Output

| | |
|-------------------|--|
| Regulator type | Primary switched-mode regulator |
| Operating modes | Adjustable constant voltage / constant current source with automatic sharp transition |
| Output insulation | Floating output with "safe electrical separation" from the mains input and computer interfaces Max. allowable potential, output to ground: 120 V Capacitance, output to ground (housing) Series 62 N: 500 W / 1000 W: typ. 90 nF Series 64 N: 2000 W / 3000 W: typ. 180 nF |

Output operating range



Analog Interface

| | |
|-----------|---|
| Functions | <ul style="list-style-type: none"> - Auto-sensing mode - Programmable trigger input - Voltage control input (0 ... 5 V) - Current control input (0 ... 5 V) - Voltage monitor output (0 ... 10 V) - Current monitor output (0 ... 10 V) - Master-slave parallel operation - Master-slave series operation |
|-----------|---|

IEC 625 – IEEE 488 interface (common option with RS 232, variant 2)

Interface functions

(see chapter 6.2 for description of functions.)

| | |
|--------|-------------------------------|
| SH1 | - SOURCE HANDSHAKE |
| AH1 | - ACCEPTOR HANDSHAKE |
| T6 | - TALKER |
| L4 | - LISTENER |
| TE0 | No extended talker function |
| LE0 | No extended listener function |
| SR1 | - SERVICE REQUEST |
| RL1 | - REMOTE / LOCAL |
| DC1 | - DEVICE CLEAR |
| PP1 | - PARALLEL POLL |
| DT1 | - DEVICE TRIGGER |
| C0 | - No controller function |
| E1 / 2 | - Open collector driver |

Codes / formats per IEEE 488.2

Max. setting rate approx. 40 settings per second

Max. sampling rate approx. 15 measurements per second

V.24 – RS 232C Interface (optional, variant 1 or 2)

Transmission mode half-duplex, asynchronous

Baud rate 110 ... 19,200 baud, adjustable

Codes / formats Per IEEE 488.2

Max. setting rate Approx. 2 settings per second

Max. sampling rate Approx. 2 measurements per second

Power Supply

| | |
|----------------|---|
| Line voltage | 62 N: 230 V ~ +10 / -15%, 47 ... 63 Hz |
| | 64 N: 3 x 400 / 230 V ~ +10 / -15%, 47 ... 63 Hz |
| Inrush Current | Max. 50 A _s |
| Fuse | 62 N: 1 ea. M 15 A / 250 V (6.3 x 32 mm), UL |
| | 64 N: 3 ea. M 15 A / 250 V (6.3 x 32 mm), UL |

Electrical Safety

| | | |
|-----------------------|---|----------------------------|
| Safety class | I | |
| Overvoltage category | II for mains input I for output and interfaces | |
| Fouling factor | 2 | |
| Earth leakage current | 62 N: <3 mA _{eff} | 64 N: <1 mA _{eff} |
| Electrical Isolation | Rated Voltage | Test Voltage |
| Output – mains | 280 V _{eff} | 4 kV ~ (type test) |
| Output – bus / ground | 120 V _S | 1.5 kV ~ |
| Mains – bus / ground | 230 V _{eff} | 2.2 kV – |
| Bus – ground | No electrical isolation | |

IEC 61010-1: 1990 + A1: 1992

DIN EN 61010-1: 1993

VDE 0411-1: 1994

DIN VDE 0160: 1988 + A1: 1989 class W1

VDE 0805: 1990

EN 60950: 1992

Protection IP 00 at device terminals and interface terminals
IP 20 at housing

Electromagnetic Compatibility

Product standard EN 61326-1: 1997 + A1: 1998

Interference emission

EN 55022: 1998 class A

Interference immunity

EN 61000-4-2: 1995, feature B
EN 61000-4-3: 1996 + A1: 1998, feature A
EN 61000-4-4: 1995, feature C
EN 61000-4-5: 1995, feature B
EN 61000-4-6: 1996, feature B
EN 61000-4-11: 1994, feature A

Ambient Conditions

Climatic category KYG per DIN 40 040

Temperature range Operation: 0 to 40° C

Storage: -20 to +70° C

Relative humidity Operation: ≤ 75%,

no condensation allowed

Storage: ≤ 65%

Cooling

With integrated fan
(2-step temperature control)

Inlet vent: side panel

Outlet vent: rear panel

Operating noise

Noise pressure level at a distance of 30 cm with fan set to low / high

| | | |
|----------------|-------------|-------------|
| | 62 N: | 64 N: |
| front | 18 / 28 dBA | 20 / 30 dBA |
| rear | 23 / 35 dBA | 26 / 38 dBA |
| left and right | 20 / 30 dBA | 26 / 36 dBA |

1.5.2 Mechanical Data

Module Type

Benchtop device, suitable for rack mounting

Dimensions (W x H x D)

See also dimensional drawings.

62 N: 19" x 2 std. height units x 500 mm

64 N: 19" x 4 std. height units x 500 mm

Weight

62 N: 500 W: approx. 12 kg
1000 W: approx. 13 kg

64 N: 2000 W: approx. 22 kg
3000 W: approx. 28 kg

RS 232C interface (optional) approx. 0.1 kg

IEEE 488 – RS 232C interface (optional)
approx. 0.14 kg

Terminals (rear panel)

Main input

62 N: 10 A IEC inlet plug with earthing contact (L + N + PE)

64 N: 5-pole screw terminal block for cable connection, 0.75 ... 2.5 mm² (3 L + N + PE)

Output

Bus bars with drill holes for M8 screws and 4 mm diameter drill holes

Analog interface

14-pin plug connector with screw clamps

Interface Options:

a) RS 232C

b) IEEE 488 / RS 232C

RS 232C interface (option a, b)

9-pin subminiature connector socket
DIN 41652

Connector Pin Assignments

Pin 2: TXD (transmit data)

Pin 3: RXD (receive data)

Pin 5: GND (ground)

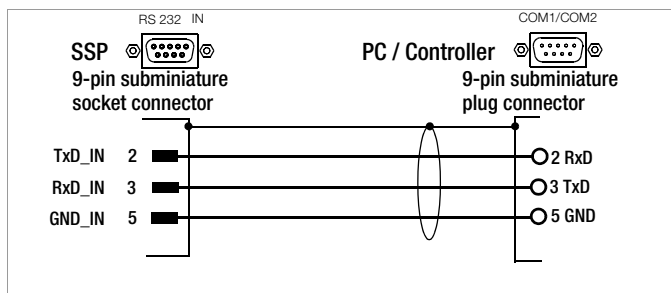


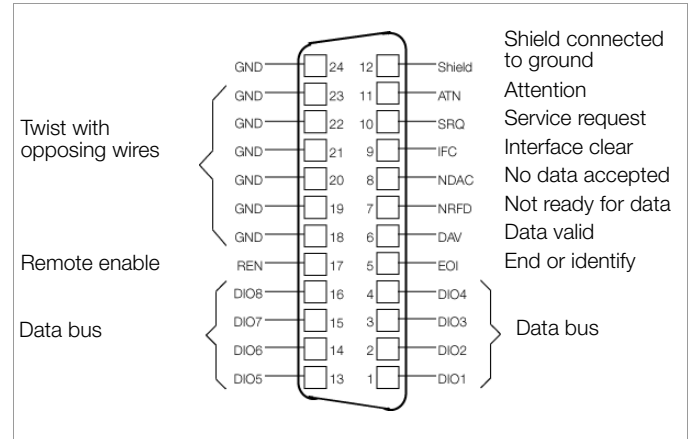
Figure 1.5.2 Connector Cable for Serial Interface

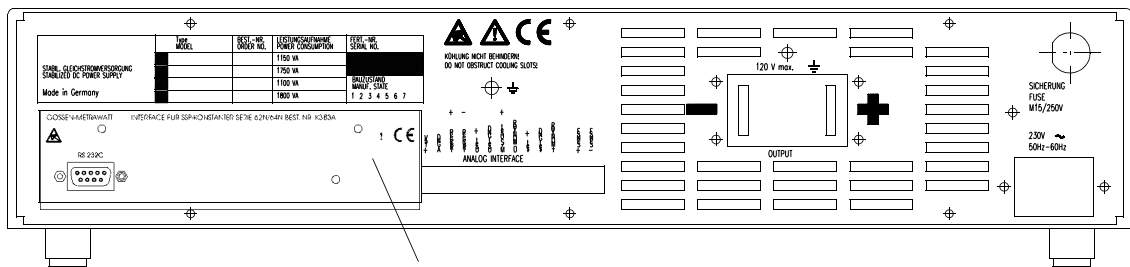
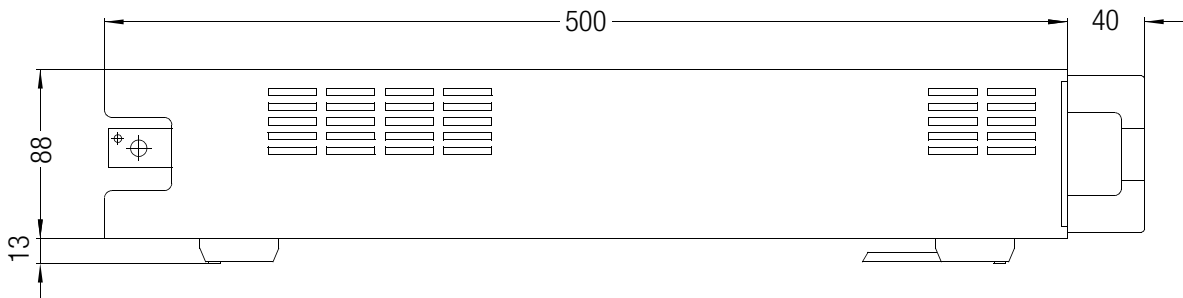
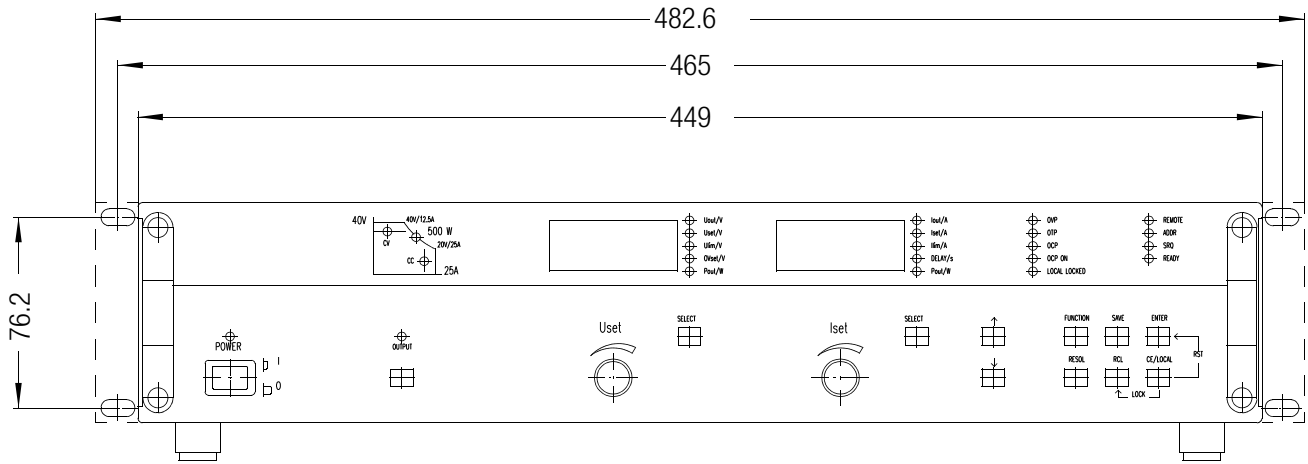
IEC 625 – IEEE 488 Interface (option b)

24-pin IEEE 488 socket connector

IEC 625.1, IEEE 488.1

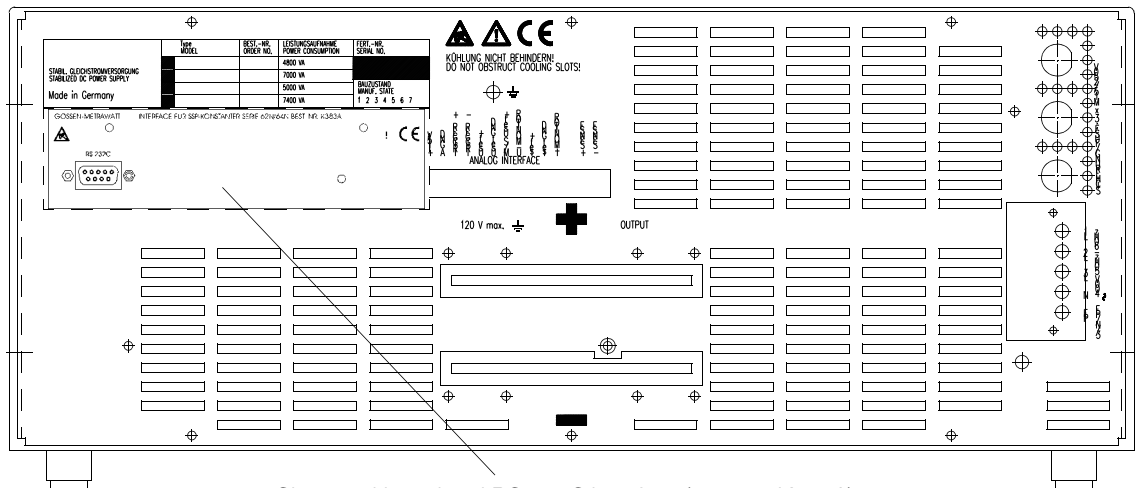
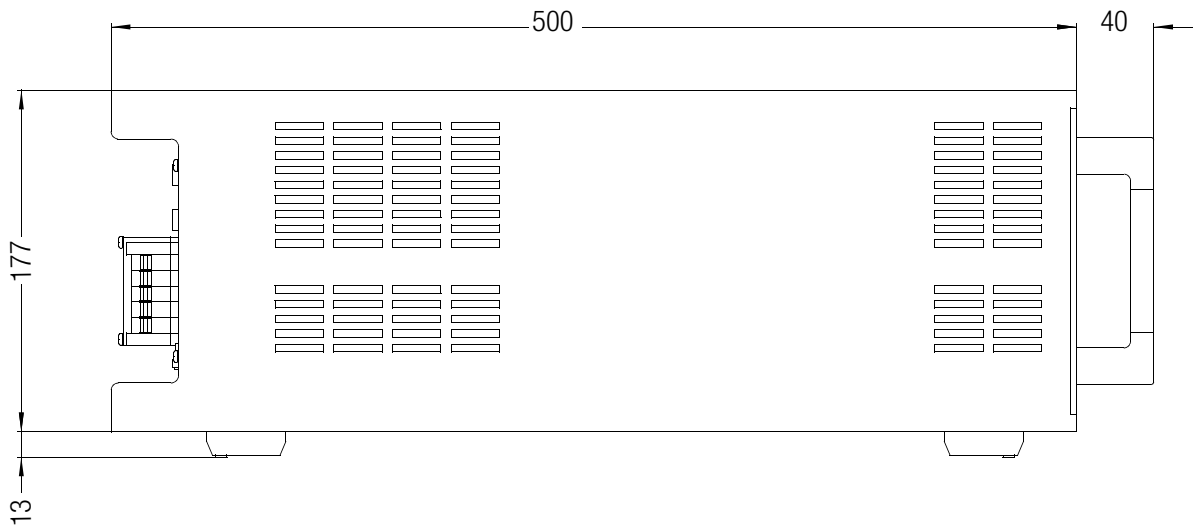
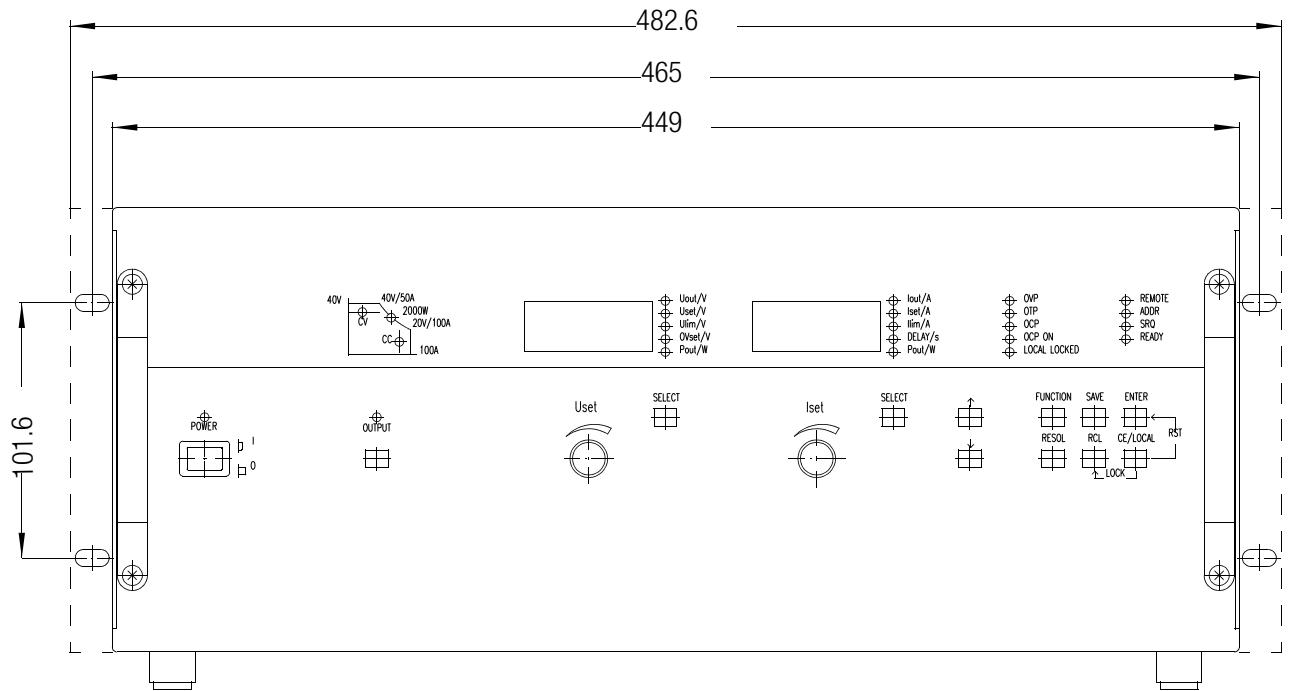
Connector Pin Assignments





Slot for optional IEEE-488 – RS 232C or RS 232C interface, IEEE-488 – RS 232C interface is shown here (part no. K382A).

All dimensions in mm



Shown with optional RS 232C interface (part no. K383A).

All dimensions in mm

1.5.3 Electrical Data

Electrical Data for 52 V Models: xx N 52 RU ...

Unless otherwise specified, entries are maximum values and apply within an operating temperature range of 0 to 50° C after a warm-up period of 30 minutes.

| Article Number | | K344A | K345A | K352A | K362A |
|--|-------------------------------------|--|--|---|---|
| Type | | 62 N 52 RU 25 P | 62 N 52 RU 50 P | 64 N 52 RU 100 P | 64 N 52 RU 150 P |
| Nominal output data | Voltage setting range | 0 ... 52 V | 0 ... 52 V | 0 ... 52 V | 0 ... 52 V |
| | Current setting range | 0 ... 25 A | 0 ... 50 A | 0 ... 100 A | 0 ... 150 A |
| | Power | max. 500 W | max. 1000 W | max. 2000 W | max. 3000 W |
| Output characteristics (ppm and percentage values make reference to the respective setting or measuring range) | | | | | |
| Setting resolution | Voltage | 16.7 mV | 16.7 mV | 16.7 mV | 16.7 mV |
| | Current ¹⁾ | 6.25 mA | 12.5 mA | 25 mA | 40 mA |
| Setting accuracy (at 23 ± 5° C) | Voltage | 0.1 % +17 mV | 0.1 % +17 mV | 0.1 % +17 mV | 0.1 % +17 mV |
| | Current | 0.2 % +25 mA | 0.2 % +50 mA | 0.25 % +100 mA | 0.3 % +150 mA |
| Temperature coefficient of the setting Δ / K | Voltage | 50 ppm +0.2 mV | 50 ppm +0.2 mV | 50 ppm +0.2 mV | 50 ppm +0.2 mV |
| | Current | 100 ppm +0.2 mA | 100 ppm +0.2 mA | 100 ppm +0.4 mA | 100 ppm +0.6 mA |
| Static system deviation with 100% load fluctuation | Voltage ²⁾ | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV |
| | Current | 0.05 % +10 mA | 0.05 % +20 mA | 0.05 % +40 mA | 0.05 % +60 mA |
| Static system deviation with 15% line voltage fluctuation | Voltage | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV |
| | Current | 0.03 % +8 mA | 0.03 % +15 mA | 0.03 % +30 mA | 0.03 % +40 mA |
| Residual ripple | | | | | |
| U ₀ | Ripple 10 Hz ... 300 Hz | 12 mV _{SS} | 15 mV _{SS} | 20 mV _{SS} | 20 mV _{SS} |
| | Ripple 10 Hz ... 300 kHz | 30 mV _{SS} | 30 mV _{SS} | 30 mV _{SS} | 30 mV _{SS} |
| I ₀ | Ripple + noise 10 Hz ... 10 MHz | 50 mV _{SS} / 10 mV _{eff} | 50 mV _{SS} / 10 mV _{eff} | 50 mV _{SS} / 10 mV _{eff} | 50 mV _{SS} / 10 mV _{eff} |
| | Ripple + noise 10 Hz ... 10 MHz | 15 mA _{eff} | 25 mA _{eff} | 80 mA _{eff} | 120 mA _{eff} |
| Output voltage transient recovery time with load step within range of 20 to 100% I _{nominal} | Tolerance | 80 mV | 80 mV | 80 mV | 80 mV |
| | ΔI = 10 % | 100 μs | 100 μs | 100 μs | 100 μs |
| | ΔI = +80 % | 300 μs | 300 μs | 300 μs | 300 μs |
| | ΔI = -80 % | 900 μs | 300 μs | 300 μs | 300 μs |
| Output voltage over and undershooting with load step within range of 20 to 100% I _{nominal} | ΔI = 10 % | 150 mV | 150 mV | 150 mV | 150 mV |
| | ΔI = 80 % | 500 mV | 750 mV | 750 mV | 750 mV |
| Output voltage response time ³⁾ where U _{set} step = 0 V → U _{nominal} where U _{set} step = U _{nominal} → 1 V | Tolerance | 80 mV | 80 mV | 80 mV | 80 mV |
| | No load, nominal load | 6 ms, 12.5 ms | 6 ms, 12.5 ms | 6 ms, 12.5 ms | 6 ms, 12.5 ms |
| | No load, nominal load | 150 ms, 12.5 ms | 150 ms, 12.5 ms | 150 ms, 12.5 ms | 150 ms, 12.5 ms |
| Output capacitor discharging circuit | Nominal value | 2000 μF | 2000 μF | 4000 μF | 6000 μF |
| | Power | 25 W | 25 W | 50 W | 75 W |
| Measuring Function | | | | | |
| Measuring Range | Voltage | -2.666 ... +58.770 V | -2.666 ... +58.770 V | -2.666 ... +58.770 V | -2.666 ... +58.770 V |
| | Current | -0.48 ... +26.68 A | -1.92 ... +53.37 A | -3.84 ... +106.74 A | -5.76 ... +160.12 A |
| | Power | 0 ... >550 W | 0 ... >1100 W | 0 ... >2200 W | 0 ... >3300 W |
| Measuring resolution: local, remote | Voltage | 10 mV, 3.3 mV | 10 mV, 3.3 mV | 10 mV, 3.3 mV | 10 mV, 3.3 mV |
| | Current | 5 / 10 mA, 5 mA | 10 mA, 10 mA | 20 mA, 20 mA | 2 / 100 mA, 20 mA |
| | Power | 1 W, 0.1 W | 1 W, 0.1 W | 1 W, 0.1 W | 1 W, 0.1 W |
| Measuring accuracy (at 23 ± 5° C) | Voltage | 0.05% +20 mV | 0.05% +20 mV | 0.05% +20 mV | 0.05% +20 mV |
| | Current | 0.3 % +20 mA | 0.3 % +30 mA | 0.4% +60 mA | 0.4% +90 mA |
| | Power | 0.4% +1 W | 0.4% +1.5 W | 0.5 % +2.5 W | 0.4% +4 W |
| Measured value temperature coefficient Δ/K | Voltage | 80 ppm +0.2 mV | 80 ppm +0.2 mV | 80 ppm +0.2 mV | 80 ppm +0.2 mV |
| | Current | 150 ppm +0.2 mA | 150 ppm +0.2 mA | 150 ppm +0.4 mA | 150 ppm +0.6 mA |
| Protective functions | | | | | |
| Trigger value for output overvoltage protection | | | | | |
| Response time | Setting range | 3 ... 62.5 V | 3 ... 62.5 V | 3 ... 62.5 V | 3 ... 62.5 V |
| | Setting resolution | 100 mV | 100 mV | 100 mV | 100 mV |
| | Setting accuracy | 0.3% + 100 mV | 0.3% + 100 mV | 0.3% + 100 mV | 0.3% + 100 mV |
| Reverse polarity protection load capacity | Continuous | 30 A | 55 A | 110 A | 170 A |
| Reverse voltage withstand capacity | Continuous | 60 V – | 60 V – | 60 V – | 60 V – |
| Additional Functions | | | | | |
| Sensing mode operation | Compensatable voltage drop per line | 1 V | 1 V | 1 V | 1 V |
| General | | | | | |
| Power Supply | Line voltage | 230 V~ + 10 / - 15% 47 ... 63 Hz | 230 V~ + 10 / - 15% 47 ... 63 Hz | 3 x 400 / 230 V~ + 10 / - 15 % 47 ... 63 Hz | 3 x 400 / 230 V~ + 10 / - 15 % 47 ... 63 Hz |
| | Power consumption | At nom. load At no load | 1100 VA, 650 W 50 VA, 25 W | 1800 VA, 1200 W 50 VA, 25 W | 5000 VA, 2800 W 150 VA, 40 W |
| Max. power loss | | 150 W | 200 W | 700 W | 1000 W |
| Efficiency | At nom. load | > 75 % | > 80 % | > 72 % | > 75 % |
| Switching frequency | Typical | 100 kHz | 200 kHz | 200 kHz | 200 kHz |
| Inrush current | Max. | 50 A _s | 50 A _s | 50 A _s | 50 A _s |
| Fuses | | 1 ea. M 15 A / 250 V (6.3 x 32 mm, UL) | | 3 ea. M 15 A / 250 V (6.3 x 32 mm, UL) | |
| MTBF | At 40° C | > 50,000 h | > 47,000 h | > 33,000 h | > 29,000 h |

1) Current setting values are rounded off at the digital display to multiples of 10 mA (< 100 A) or 100 mA (> 100 A).

2) In sensing mode at the output terminals

3) At maximum current setting not including processing time for the previous voltage setting command

| Article Number | | K341A | K343A | K351A | K361A |
|---|-------------------------------------|--|--|---|---|
| Type | | 62 N 80 RU 12.5 P | 62 N 80 RU 25 P | 64 N 80 RU 50 P | 64 N 80 RU 75 P |
| Nominal output data | Voltage setting range | 0 ... 80 V | 0 ... 80 V | 0 ... 80 V | 0 ... 80 V |
| | Current setting range | 0 ... 12.5 A | 0 ... 25 A | 0 ... 50 A | 0 ... 75 A |
| | Power | max. 500 W | max. 1000 W | max. 2000 W | max. 3000 W |
| Output characteristics (ppm and percentage values make reference to the respective setting or measuring range) | | | | | |
| Setting resolution | Voltage | 20 mV | 20 mV | 20 mV | 20 mV |
| | Current ¹⁾ | 3.125 mA | 6.25 mA | 12.5 mA | 20 mA |
| Setting accuracy (at 23 ± 5 °C) | Voltage | 0.1 % +20 mV | 0.1 % +20 mV | 0.1 % +20 mV | 0.1 % +20 mV |
| | Current | 0.2 % +15 mA | 0.2 % +25 mA | 0.25 % +50 mA | 0.3 % +80 mA |
| Temperature coefficient of the setting Δ / K | Voltage | 50 ppm +0.4 mV | 50 ppm +0.4 mV | 50 ppm +0.4 mV | 50 ppm +0.4 mV |
| | Current | 50 ppm +0.2 mA | 100 ppm +0.1 mA | 100 ppm +0.2 mA | 100 ppm +0.4 mA |
| Static system deviation with 100% load fluctuation | Voltage ²⁾ | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV |
| | Current | 0.05 % +10 mA | 0.05 % +10 mA | 0.05 % +20 mA | 0.05 % +30 mA |
| Static system deviation with 15% line voltage fluctuation | Voltage | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV | 0.01 % +5 mV |
| | Current | 0.03 % +5 mA | 0.03 % +10 mA | 0.03 % +20 mA | 0.03 % +30 mA |
| Residual ripple | | | | | |
| U ₀ | Ripple 10 Hz ... 300 Hz | 35 mV _{SS} | 35 mV _{SS} | 35 mV _{SS} | 35 mV _{SS} |
| | Ripple 10 Hz ... 300 kHz | 50 mV _{SS} | 50 mV _{SS} | 50 mV _{SS} | 50 mV _{SS} |
| | Ripple + noise 10 Hz ... 10 MHz | 60 mV _{SS} / 10 mV _{eff} | 80 mV _{SS} / 15 mV _{eff} | 80 mV _{SS} / 15 mV _{eff} | 80 mV _{SS} / 15 mV _{eff} |
| I ₀ | Ripple + noise 10 Hz ... 10 MHz | 15 mA _{eff} | 20 mA _{eff} | 30 mA _{eff} | 60 mA _{eff} |
| Output voltage transient recovery time with load step within range of 20 to 100% I _{nominal} | Tolerance | 160 mV | 160 mV | 160 mV | 160 mV |
| | ΔI = 10 % | 100 μs | 100 μs | 100 μs | 100 μs |
| | ΔI = +80 % | 700 μs | 400 μs | 400 μs | 400 μs |
| | ΔI = -80 % | 700 μs | 800 μs | 800 μs | 800 μs |
| Output voltage over and undershooting with load step within range of 20 to 100% I _{nominal} | ΔI = 10 % | 200 mV | 200 mV | 200 mV | 200 mV |
| | ΔI = 80 % | 500 mV | 650 mV | 650 mV | 650 mV |
| Output voltage response time ³⁾ | Tolerance | 160 mV | 160 mV | 160 mV | 160 mV |
| where U _{set} step = 0 V → U _{nominal} | No load, nominal load | 5 ms, 15 ms | 5 ms, 10 ms | 5 ms, 10 ms | 5 ms, 10 ms |
| where U _{set} step = U _{nominal} → 1 V | No load, nominal load | 300 ms, 15 ms | 300 ms, 15 ms | 300 ms, 15 ms | 300 ms, 15 ms |
| Output capacitor discharging circuit | Nominal value | 2000 μF | 2000 μF | 4000 μF | 6000 μF |
| | Power | 25 W | 25 W | 50 W | 75 W |
| Measuring Function | | | | | |
| Measuring Range | Voltage | -4.00 ... +88.16 V | -4.00 ... +88.16 V | -4.00 ... +88.16 V | -4.00 ... +88.16 V |
| | Current | -0.48 ... +13.34 A | -0.96 ... +26.68 A | -1.92 ... +53.37 A | -2.88 ... +80.06 A |
| | Power | 0 ... >550 W | 0 ... >1100 W | 0 ... >2200 W | 0 ... >3300 W |
| Measuring resolution: local, remote | Voltage | 10 mV | 10 mV | 10 mV | 10 mV |
| | Current | 2 / 10 mA, 2 mA | 5 mA, 10 mA | 10 mA, 10 mA | 10 mA, 10 mA |
| | Power | 1 W, 0.1 W | 1 W, 0.1 W | 1 W, 0.1 W | 1 W, 0.1 W |
| Measuring accuracy (at 23 ± 5 °C) | Voltage | 0.05% +40 mV | 0.05% +40 mV | 0.05% +40 mV | 0.05% +40 mV |
| | Current | 0.3 % +10 mA | 0.3 % +20 mA | 0.3 % +30 mA | 0.4 % +40 mA |
| | Power | 0.4% +1 W | 0.4% +1.5 W | 0.4% +2.5 W | 0.4% +4 W |
| Measured value temperature coefficient Δ / K | Voltage | 80 ppm +0.4 mV | 80 ppm +0.4 mV | 80 ppm +0.4 mV | 80 ppm +0.4 mV |
| | Current | 150 ppm +0.1 mA | 150 ppm +0.1 mA | 150 ppm +0.2 mA | 150 ppm +0.4 mA |
| Protective functions | | | | | |
| Trigger value for output overvoltage protection | Setting range | 3 ... 100 V | 3 ... 100 V | 3 ... 100 V | 3 ... 100 V |
| | Setting resolution | 100 mV | 100 mV | 100 mV | 100 mV |
| | Setting accuracy | 0.3% + 100 mV | 0.3% + 100 mV | 0.3% + 100 mV | 0.3% + 100 mV |
| Response time | | 200 μs | 200 μs | 200 μs | 200 μs |
| Reverse polarity protection load capacity | Continuous | 30 A | 55 A | 110 A | 170 A |
| Reverse voltage withstand capacity | Continuous | 100 V – | 100 V – | 100 V – | 100 V – |
| Additional Functions | | | | | |
| Sensing mode operation | Compensatable voltage drop per line | 1 V | 1 V | 1 V | 1 V |
| General | | | | | |
| Power Supply | Line voltage | 230 V~ + 10 / – 15% 47 ... 63 Hz | 230 V~ + 10 / – 15% 47 ... 63 Hz | 3 x 400 / 230 V~ + 10 / – 15 % 47 ... 63 Hz | 3 x 400 / 230 V~ + 10 / – 15 % 47 ... 63 Hz |
| Power consumption | At nom. load | 1150 VA, 680 W | 1750 VA, 1150 W | 4800 VA, 2500 W | 7000 VA, 3800 W |
| | At no load | 50 VA, 25 W | 50 VA, 25 W | 150 VA, 40 W | 160 VA, 55 W |
| Max. power loss | | 150 W | 200 W | 700 W | 1000 W |
| Efficiency | At nom. load | > 74 % | > 85 % | > 80 % | > 80 % |
| Switching frequency | Typical | 100 kHz | 200 kHz | 200 kHz | 200 kHz |
| Inrush current | Max. | 50 A _s | 50 A _s | 50 A _s | 50 A _s |
| Fuses | | 1 ea. M 15 A / 250 V (6.3 x 32 mm, UL) | | 3 ea. M 15 A / 250 V (6.3 x 32 mm, UL) | |
| MTBF | at 40 °C | > 50,000 h | > 47,000 h | > 33,000 h | > 29,000 h |

1) Current setting values are rounded off at the digital display to multiples of 10 mA (< 100 A) or 100 mA (> 100 A).

2) In sensing mode at the output terminals

3) At maximum current setting not including processing time for the previous voltage setting command

2 Initial Start-Up

2.1 Preparing for Operation

Note: Numbers in brackets refer to figures in chapter 3.

2.1.1 Installing the Optional IEEE 488 – RS 232C Interface Module

Variant 1 or 2, see chapter 1.3.

Caution!

The device must be switched off when installing the interface module. The interface module may be damaged by electrostatic discharge. Observe guidelines for handling electrostatic sensitive devices. Do not touch electrical contacts or PCB components.

1. Unscrew the cover plate at the left-hand side of the rear housing panel.
2. Carefully insert the interface module into the open slot and press it onto the plug connector.
3. Fasten the interface module with the screws taken from the cover plate.

2.1.2 Installation to 19" Device Racks

The SSP-KONSTANTER housing allows for use as a benchtop instrument, as well as for installation to a 19" rack.

The benchtop instrument can be quickly converted to a rack mount device:

1. Unscrew the handles at the front.
2. Pull out the filler strips at the sides and replace them with the included rack-mount fastening tabs.
3. Replace the front handles (if you prefer to leave the handles out, turn M4 screws with a maximum length of 8 mm in to the open threaded holes.)
4. Unscrew the feet from the bottom of the housing.
5. Save all loose parts for possible future use.

Attention!

The device must be attached to guide rails at both sides of the rack. The guide rails, as well as the front panel mounting screws, are rack-specific and must be procured from your rack supplier.

2.1.3 Connection to the Mains

Observe **WARNING !!**

Caution!

Before switching the SSP KONSTANTER on, it must be assured that available mains power complies with the supply power values specified at the mains connection on the back of the device.

- Series 62 N (500 W, 1000 W) :
These devices require 230 V supply power and are connected to a mains outlet with earthing contact with the included power cable via the mains connector plug [35] at the rear panel.

- Series 64 N (2000 W, 3000 W):

WARNING!

These devices may only be connected to mains supply power by a qualified electrician.

These devices require 3-phase 120/400 V supply power with neutral and phase conductors (3 L + N + PE).

A 5-conductor power cable with a minimum wire cross-section of 1.5 square mm is required for connection to mains supply power, and is connected to the terminal block [35] at the rear panel:

L1: Phase
L2: P hase
L3: P hase
N: N eutral conductor
PE: Pr otective conductor

The cable must be secured with the cable clamp [38] for reliable strain relief.

2.1.4 Connecting Power Consumers

The output leads are connected to the output terminal bars [33] at the rear panel by means of ring-type cable lugs. The terminal bars are equipped with drill holes for M8 screws to this end. 4 mm drill holes are included as well, which can be used for connecting measurement cables, ground cables or cable shields.

Connection:

- Remove the safety cap.
- Connect the output leads to the terminal bars with suitable screws and washers.
- Make sure that the utilized cables have an adequate cross-section, and that polarity is not reversed. It is advisable to twist the output leads and to identify polarity at both ends.
- Avoid exerting of force at the terminal bars.
- Arrange the leads such that they can be fed through the opening in the safety cap.
- Snap the safety cap back into place.

In order to be able to take advantage of highly constant output voltage at the consumer even if long leads are used, sensing leads can be used to compensate for voltage drops within the output leads (→ chapter 5.2).

2.1.5 Connection to Computer Interfaces

If the device is used within computer controlled systems, one of the two connections described below must be established via the optional interface.

Comment

The device cannot be remote controlled via both interfaces simultaneously. The interface which first initiates action after mains power has been switched on is activated, and the other remains inactive.

In order to assure that existing bus activity is not interfered with, all affected devices should be switched off while establishing the bus connection.

Both interfaces are equipped with a common ground (GND), and are electrically isolated from the output in accordance with specified electrical safety regulations.

Connection

Configure the interface as described in chapter 4.7.4 before connecting.

a) IEC Bus

Up to 15 IEC bus controlled devices (including controllers) can be interconnected to create a system.

These devices are connected to the bus with suitable, commercially available cables with 24-pin plug connectors. If your IEC bus system is equipped with the previously common 25-pin subminiature plug connectors, you will need a suitable adapter cable.

Both cable types are available as accessories (see last page). In order to assure reliable data transmission, cable length between devices should not exceed 2 m, and overall length should not exceed 15 m.

Double shielded connector cable is recommended if bus devices are operated in proximity to strong sources of interference or their power cables.

b) RS 232C Interface

Only two devices can be connected to each other with this serial interface, namely a controller and the device to be controlled.

If you intend to control several devices with a single controller, the controller must be equipped with suitable interfaces. Most controllers include two serial ports which are commonly designated COM1 and COM2, and which are equipped with 25 or 9-pin subminiature plug connectors.

Suitable cable is available in various lengths from commercial outlets for connecting the SSP-KONSTANTER to the controller. Appropriate adapters are available as well, in the event that your controller is equipped with a 9-pin plug connector.

If you intend to fabricate the connector cable yourself, you will need a 3-conductor shielded cable in order to establish the connection as shown in Figure 1.5.2.

2.2 Switching the Instrument On

After the described preparations have been completed, the device can be switched on.

- Press the mains switch [4] at the front panel until it snaps into place in order to turn the device on.

Power-Up Test

After switching the device on, the POWER lamp [5] lights up and the fan is started. The microprocessor included in the device then starts a power-up test. The following operations are performed during the test routine (duration approximately 8 seconds):

- Reset all functional units (except battery-backed configurations memory)
- ROM test
- RAM test
- Initialize computer interfaces if installed
- Ascertain device type
- Check the ADC timer
- Recall last settings if required

The READY lamp [22] blinks while this routine is running, and all other LEDs and all digital display segments light up (display test). If the device has been equipped with the “IEEE 488 – RS 232 computer interface” option, the selected IEC bus device address then appears briefly at the display (example: “Addr 12”).

After successful completion of the self-test, the READY lamp is continuously illuminated and the display is switched to measured value indication for voltage (Uout) and current (Iout).

If this status is not achieved despite a correctly selected device address (0 to 30), even after repeatedly switching the device on and off with abbreviated self-test, the device is probably defective. If this is the case, contact your local representative.

Abbreviated Power-Up Test

In order to shorten power-up time, or if problems occur with the normal power-up test, an abbreviated power-up test can be used:

- With the device switched off, press and hold the <ENTER> key.
- Turn the mains switch on.
- Release the <ENTER> key after approximately 1 second.

If this procedure is used, only essential initialization steps are run during power-up.

After initial power-up, the device has the following basic configuration:

| | |
|---------------------------------|---|
| • Interface functions | Standard “pon” status |
| • Device functions | |
| – Output status | Inactive |
| – Voltage setpoint | 0 V |
| – Current setpoint | 0 A |
| – Voltage setting limit | Nominal output voltage |
| – Current setting limit | Nominal output current |
| – OVP trigger value | 62.5 V (for 52 V models) 100 V (for 80 V models) |
| – Current limiting mode | Limiting without shutdown |
| – Shutdown delay | 0 ms |
| – TRIGGER input | Inactive |
| – Min-Max measured value memory | Off |
| – Power ON mode | Reset configuration |
| – Manual operation | Enabled |
| – Memory contents | Deleted |

The desired settings can be selected starting with this basic configuration.

After a warm-up period of approximately 30 minutes, the instrument operates at maximum accuracy.

When the device is powered up again at a later point in time, active device configuration depends upon the last setting selected for the POWER_ON function (—> page 70):

- Default settings or
- Last used device settings or
- Last used device settings and inactive output

Power-Up with RESET

In order to assure that the connected power consumer is not endangered by any previous device settings, the device can be initialized with the “POWER_ON RST” function by pressing and holding the <CE/LOCAL> key during the power-up routine.

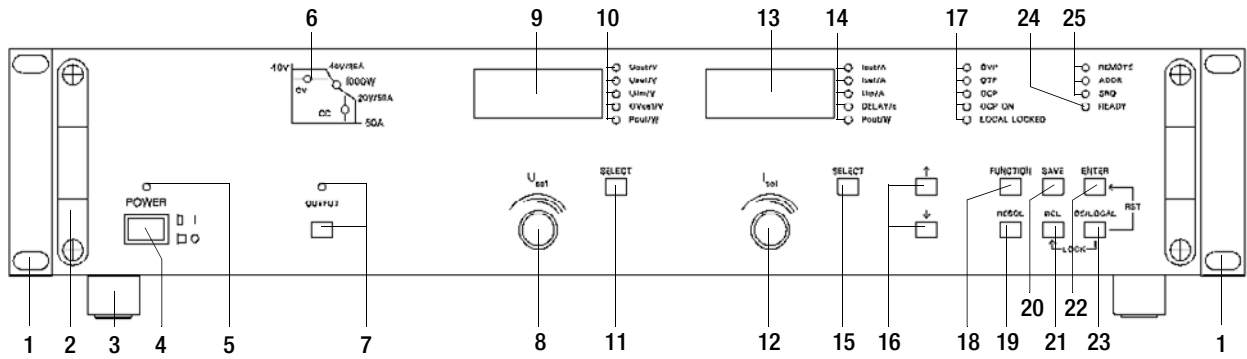
In order to switch the device off, activate the mains switch once again. The device is then disconnected from mains power and the output is deactivated. The last device configuration, as well as any settings which have been saved to battery-backed configurations memory, are retained.

Caution!

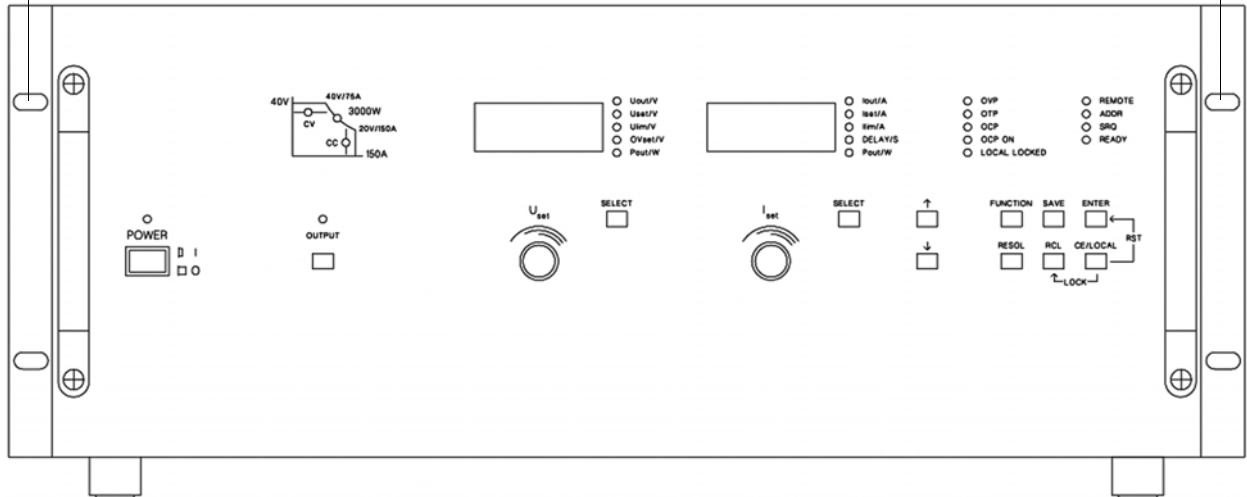
Avoid switching the device on and off in a rapid, repeated fashion. This temporarily impairs the effectiveness of the inrush current limiting function, and may result in a blown fuse.

3 Controls, Display Elements and Terminals

Series 62N
19" Rack

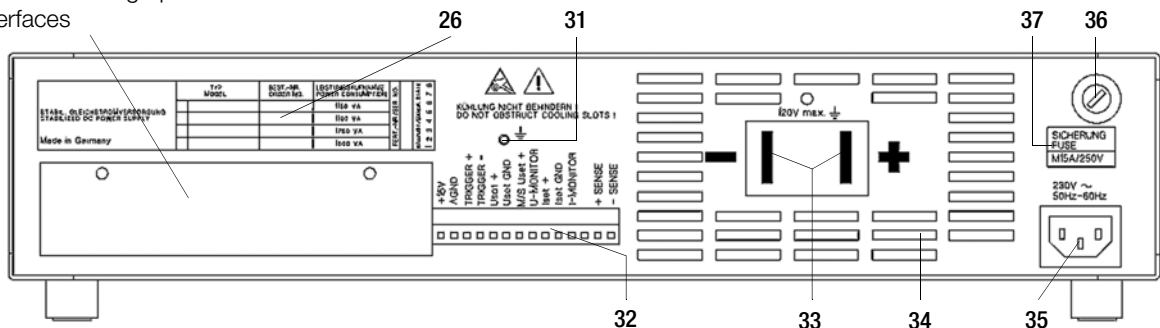


Series 64N
19" Rack



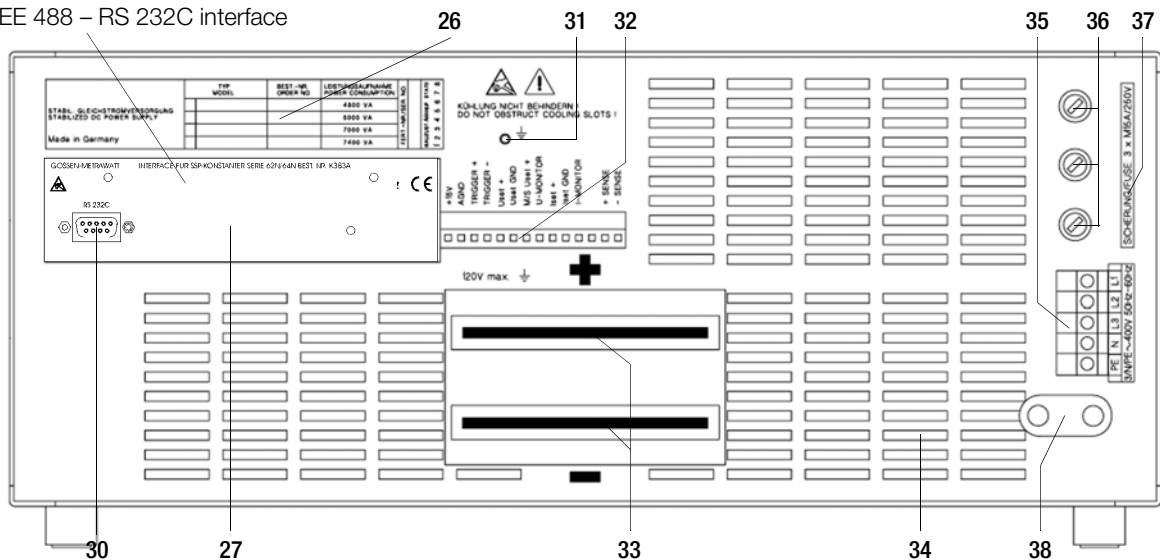
Slot for installing optional
interfaces

Series 62N
Rear Panel



Shown with optional
IEEE 488 – RS 232C interface

Series 64N
Rear Panel



Note: Numbers in brackets make reference to figures on page 19.

[1] Rack mounting tabs (included accessories)

for mounting to a 19" rack

Assembly:

- Unscrew the handles at the front.
- Pull out the filler strips at the sides and replace them with the included rack-mount fastening tabs.
- Replace the front handles.

[2] Front handles

For carrying the device or pulling it from the 19" rack

The handles can be removed if desired (turn M4 screws with a maximum length of 8 mm into the empty threaded holes).

[3] Device feet

For use as a benchtop instrument

The device can be tilted back slightly by folding the front feet out.

As a rule, the feet must be removed in order to install the device to a 19" racks.

[4] Mains switch

For turning the device on and off

After switching the device on, a self-test is performed with a duration of approximately 8 seconds. After successful completion of the self-test, the "POWER-ON" function configures the device with predetermined settings and the device is ready for use.

When the device is switched off, it is disconnected from mains power and the output is immediately deactivated. The last device configuration, as well as any settings which have been saved to battery-backed configurations memory, are retained.

[5] POWER indicator lamp

Indicates that the device is switched on (power on).

[6] Control mode display

The illuminated LED indicates the current operating status (control mode) of the output, as long as it is active:

- Green "CV" LED lights up: constant voltage mode ($U_{out} = U_{set}$),
- Green "CC" LED lights up: constant current mode ($I_{out} = I_{set}$)
- Yellow "Pmax" LED lights up: electronic power limiting is active ($P_{out} > P_{nominal}$)
- No LEDs illuminated: output is inactive

[7] Output On-Off key <OUTPUT>

The power output can be activated and deactivated by pressing the <OUTPUT> key. The respective LED is illuminated as long as the output is active.

No significant output voltage overshooting occurs when the output is activated and deactivated.

The output capacitor is rapidly discharged by a sink when the output is deactivated. After approximately 350 ms (500 ms for 80 V models), the output becomes highly resistive, but it is not isolated from the output terminals.

[8] Rotary knob for adjusting voltage

Voltage is adjusted in the usual fashion with the rotary knob. However, the adjusting element is not a potentiometer, but rather a rotary pulse encoder which generates 24 pulses per revolution, and whose step size per pulse (setting resolution) can be adjusted to either coarse, medium or fine with the <RESOL> key [19]. This allows for convenient, precise adjustment on the one hand, and also assures that no change occurs to the selected value when switching between remote control and manual operation.

When the voltage adjusting knob is turned, the left display is first switched to the U_{set} display and the current voltage setpoint appears. After approximately 0.4 seconds, one of the decimal places starts blinking at the display in order to indicate the selected adjusting sensitivity. From this point on, turning the rotary knob changes the display value, and thus the setpoint value, at the selected decimal place. Clockwise

rotation increases the value, and counterclockwise rotation decreases the value. If no adjustment is made for a period of 10 seconds, the display automatically returns to measured voltage value U_{out} . The display can be immediately switched to the U_{out} value by pressing the <ENTER> or the <CE/LOCAL> key.

[9] Left-hand display with

[10] Display parameter indicators and

[11] Display selector key <SELECT>

As a default setting, measured output voltage value U_{out} appears in volts at the left-hand display. The display can be switched to any of the following values by (repeatedly) activating the respective <SELECT> key:

- U_{set} = Output voltage setpoint in volts
- U_{lim} = Upper setting range limit for U_{set}
- OV_{set} = Trigger value for output overvoltage protection in volts
- P_{out} = Momentary measured output power in watts (calculated as $U_{out} \times I_{out}$)

The LEDs assigned to the display indicate the type of displayed values (green LEDs = measured values, yellow LEDs = setting values).

If no adjustment is made for a period of 10 seconds during the display of a setting value, the display returns to U_{out} . Measured power P_{out} can be indicated at the left, as well as at the right-hand display. This makes it possible to evaluate output power relative to output voltage or output current. Additional device functions can be selected with the <FUNCTION>, <SAVE> and <RCL> keys. The function code appears at the left-hand display in this case. "Err" appears as an identifier for system messages.

[12] Rotary knob for adjusting current <Iset>

The same applies to this rotary knob with reference to output current, as is also the case with the voltage adjusting knob [8].

[13] Right-hand display with

[14] Display parameter indicators and

[15] Display selector key <SELECT>

As a default setting, measured output current value I_{out} appears in amperes at the right-hand display. The display can be switched to any of the following values by (repeatedly) activating the respective <SELECT> key:

- I_{set} = Output current setpoint in amperes
- I_{lim} = Upper setting range limit for I_{set}
- DELAY = Shutdown delay time for the OCP function in seconds
- P_{out} = Currently measured output power in watts (calculated as $U_{out} \times I_{out}$)

The LEDs assigned to the display indicate the type of displayed values (green LEDs = measured values, yellow LEDs = setting values).

If no adjustment is made for a period of 10 seconds during the display of a setting value, the display returns to I_{out} . Additional device functions can be selected with the <FUNCTION>, <SAVE> and <RCL> keys. The respective setting parameter or measured value appears at the right-hand display in this case. "Err" appears as an identifier for system messages (see chapter 8.6).

[16] Parameter adjusting keys <↑> and <↓>

In order to prevent operator errors to the greatest possible extent, the two rotary knobs, [8] and [12], are used exclusively for adjusting output voltage and output current. These two keys are used for the selection and adjustment of parameters for all other adjustable device functions according to the following method:

a) Adjusting numeric parameters

After selecting the function to be adjusted with the <SELECT>, <SAVE> or <RCL> key, the current numeric

value for the selected parameter appears at the display. This value can be increased <↑> or decreased <↓> within predefined limits with the parameter adjusting keys. Pressing the key briefly results in a single step, and if the key is pressed and held the value is advanced through a series of consecutive steps. The setpoint value is changed simultaneously along with the display value.

b) Selecting text parameters (setting alternatives)

After selecting the function to be adjusted with the <FUNCTION> key, the current parameter status appears at the display in text format. Any of the alternative settings can be selected by repeatedly pressing the <↑> or the <↓> key. The parameter blinks at first to indicate that the displayed alternative has not yet become effective. The selected parameter value does not become effective until it is acknowledged with the <ENTER> key. If acknowledgement does not ensue, the device function is exited and the respective setting remains unchanged.

c) Browsing through the SEQUENCE register

→ chapter 4.11 RCL and chapter 4.8 SELECT

[17] Protective functions status display

These indicators provide information concerning the setting status (yellow LED) or triggering (red LED) of protective functions. Illumination of the respective LEDs has the following significance:

OVP (overvoltage protection)

Overvoltage protection has been triggered, because output voltage has exceeded the selected trigger value (OVSET).

The output is deactivated.

Causes:

- Voltage setpoint USET has been set too high manually, or as a result of memory recall, programming error or Uset control signal to the analog interface
- Voltage transients caused, for example, by switching inductive power consumers (perhaps too little difference between selected USET and OVSET values)
- During auto-sensing: Sensing lead polarity is reversed, or an output lead is/was interrupted or was not taken into consideration when adjusting OVSET, so that the voltage at the output terminals which is relevant for the OVP function is increased by the amount to be compensated for at both leads, and is higher than USET voltage as controlled by the sensors at the load side (too little difference between selected USET and OVSET values).
- Unipolar power recovery from the connected power consumer (e.g. DC motor)
- A device error or defect has occurred.
After the cause of triggering has been eliminated, the output can be reactivated with the OUTPUT ON command.

OTP (overtemperature protection)

Overtemperature protection has been triggered because the device has overheated. The output is deactivated.

Causes:

- Impaired cooling, e.g. air inlet or exhaust vents are obstructed.
- Excessive ambient temperature The device is capable of continuously supplying nominal power at ambient temperatures of up to 50° C (measured at the air inlet vents). Approximately 120 to 130% nominal power can be drawn intermittently (triggering point for electronic power limiting). Continuous operation at these levels may cause triggering of the overtemperature protection function.
- One or more fans have failed.
- Output "fluctuates". In the case of complex loads, control fluctuations may occur (→ chapter 5.2) which result in increased power loss and thus causes overheating.
- A device error or defect has occurred.

As long as the latter has no occurred, the output can be reactivated after an adequate cool-down period. If the POWER-ON function has been set to "RCL", the output is reactivated automatically.

OCP (overcurrent protection)

Overcurrent protection has been triggered because the output has been operated in the current limiting mode (current control) for a duration greater than the DELAY value with activated OCP ON function.

Causes: → page 26 and page 68

The output can be reactivated with the OUTPUT ON command.

OCP ON

Overcurrent shutdown is enabled.

→ page 26 and page 68

LOCAL LOCKED

The front panel controls are disabled, and are thus protected against unauthorized or inadvertent adjustment.

This display only applies to disabling of the front panel controls by means of manual adjustment or a control signal applied to the TRIGGER input (for T_MODE TRG). It does not indicate disabling of manual switching to local control by means of the IEC bus LOCAL LOCKOUT command.

[18] Function selector key <FUNCTION>

No special key is assigned to device functions which are normally seldom adjusted or used. These functions are set in a menu-driven fashion by means of the following procedure:

1. Select the desired device function

with the <FUNCTION> key:

- Scroll forward: <FUNCTION> + <↓> or <FUNCTION> alone
- Scroll back: <FUNCTION> + <↑>
 - Left display: Device function code
 - Right display: Currently selected parameter setting or saved measured value

2. Select the desired function parameter

by (repeatedly) activating the <↑> or the <↓> key (→[16]).

- Left display: Unchanged
- Right display: For adjusting the selected function parameter (blinking indicates that adjustment has not yet been executed)

3. Acknowledge and execute the selected setting

by pressing the <ENTER> key.

→ Both displays return to default values Uout and Iout.

If the rotary knobs or other function keys are activated, the function menu is exited and settings remain unchanged.

Exceptions:

<OUTPUT> is autonomously active.

<RESOL> remains active for numeric parameters, and is otherwise inactive.

Function parameters which do not blink in their entirety are accepted without acknowledging with <ENTER>.

The last open menu appears when the functions menu is reopened.

[19] Resolution selection key <RESOL>

This key can be used to vary step size (setting resolution) for device functions with numeric parameter settings, whose displayed values can be increased or decreased with the rotary knobs, or the <↑> and <↓> keys.

The decimal place to be increased or decreased blinks.

Blinking can be positioned at any one of the three lowest (right-most) decimal places by repeatedly pressing the <RESOL> key, thus allowing for the selection of fine, medium or coarse setting resolution.

A different resolution can be selected for the left and right-hand displays, and settings remain valid until a new resolution is selected, or until the device configuration is reset. Manual resolution adjustment after reset (*RST): fine (right-most decimal place)

[20] Save key <SAVE> and

[21] Recall key <RCL>

The memory function is controlled with these two keys (→ chapter 4.11 and page 62).

[22] <ENTER> key

The parameter value selected for a given device function setting is acknowledged and executed by pressing this key.

[23] <CE/LOCAL> key

This key has several functions:

1. Abort an operation

If the <CE/LOCAL> key is activated while a device function is displayed for adjustment, the display returns to its default value and no change is made to the selected device setting.

2. Switch from remote to local control

If the device is being remote controlled via one of the computer interfaces (REMOTE LED illuminated), all of the control panel elements are disabled except for the mains switch and the <CE/LOCAL> key. The device can be returned to manual operation and the control panel elements can once again be enabled by pressing the <CE/LOCAL> key (→ REMOTE LED off), without causing any changes to current device settings.

If the device is being controlled via the IEC bus, the <CE/LOCAL> key can be disabled with the LOCAL LOCKOUT command, making key-operated return to manual mode operation impossible.

3. RST – reset device settings (RESET)

The reset command is triggered by pressing and holding the <CE/LOCAL> key and simultaneously activating the <ENTER> key. This command returns most device functions to their predefined default settings. Default settings are described in chapter 4.16 and on page 62.

4. Disabling front panel controls

By pressing and holding the <CE/LOCAL> key and simultaneously activating the <RCL> key, all control panel elements are disabled except for the mains switch and the <CE/LOCAL> key, and the LOCAL LOCKED LED lights up. Disabling front panel controls prevents unauthorized or inadvertent adjustment of device settings.

In order to reactivate the controls, the <CE/LOCAL> key must be pressed and held for at least 4 seconds (→ LOCAL LOCKED LED off).

The <CE/LOCAL> key can also be disabled by applying a signal to the TRIGGER input at the analog interface and selecting the appropriate setting for the T_MODE function, thus preventing manual reactivation of the front panel controls.

[24] READY indicator

Indication of ready for operation:

- LED on: The device is ready for operation and the controls are enabled.
- Blinking LED: The device is performing a self-test and cannot be operated at the moment, or the SEQUENCE mode is active (→ page 36 and page 71).
- LED off: The device is not ready for operation.

[25] Interface status displays: REMOTE, ADDR and SRQ

Indication of computer interface operating status:

- REMOTE LED on: Device is being remote controlled, front panel controls are disabled.
- ADDR LED on: The device has been addressed and is receiving or transmitting data (applies to IEC bus operation only).
- SRQ LED on: The device is transmitting a service request (applies to IEC bus operation only).

[26] Device serial plate

For identification of the device

Contains particulars regarding the manufacturer, device type, type designation, order number, serial number, hardware revision level and power consumption.

[27] IEC 625 bus interface

For remote control of device functions via the IEC 625 bus (= IEEE 488 bus) (→ chapter 2.1.5).

Caution!

The electrical contacts of this interface are connected to components which may be damaged by electrostatic discharge. Ground yourself by grasping the housing before touching these contacts!

[28] —

[29] —

[30] RS 232C interface

For controlling device functions via the RS 232C serial port (→ chapter 2.1.5).

Caution!

The electrical contacts of this interface are connected to components which may be damaged by electrostatic discharge. Ground yourself by grasping the housing before touching these contacts!

[31] Ground terminal

The output or cable shields can be grounded here if shielded output cables or control cables for the analog interface are used.

The ground terminal is connected to the housing and the earthing contact at the mains connection.

[32] Analog interface

The analog interface facilitates the following functions:

- Remote adjustment of output voltage and current with analog control voltages ranging from 0 to 5 V (→ chapter 5.3 / chapter 5.4)
- External measurement or recording of output voltage and current based on monitor signals 0 to 10 V (→ chapter 5.5 / chapter 5.6)
- Connection of sensing leads for the compensation of voltage drops within the output leads (→ chapter 5.2)
- Linking of several devices for master-slave operation (→ chapter 5.8 / chapter 5.9)
- Varying internal output resistance (→ chapter 5.10)
- Control of a selected device function via the floating TRIGGER input (→ chapter 5.7)

Caution!

The electrical contacts of this interface are connected to components which may be damaged by electrostatic discharge. Ground yourself by grasping the housing before touching these contacts!

[33] Power output +/-

Terminals for connecting the power consumer

This is a floating output and can be grounded with the positive or the negative pole. A detailed functional description of the output and possible connection options is included in chapter 5.

The outputs of all device models are classified as “safety low-voltage circuits” (SELV) by the specified electrical safety regulations (voltage in the event of error: < 120 V–).

However, contact protection measures are required for the outputs of the 80 V models.

The output should always be deactivated before connecting consumers in order to prevent sparking and induced voltage transients.

[34] Air vents

Exhaust vents for the integrated fan

In order to assure adequate device cooling, exhaust vents may not be obstructed.

The fan(s) is/are equipped with a 2-step temperature controller.

[35] Mains connection

Connection for mains supply power.

[36] Line fuse(s)

Fusing for mains supply power

[37] Fuse ratings**WARNING!**

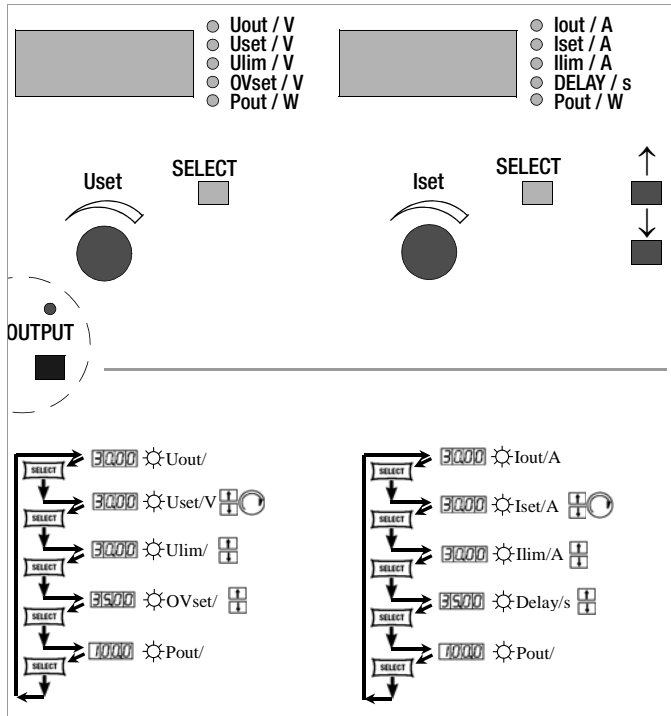
Only fuses of the type and nominal current rating specified here may be used when replacing blown fuses.

Tampering with fuses or fuse holders is prohibited (“repairing” fuses, short-circuiting fuse holders etc.).

[38] Power cable strain relief

(for series 64 N only)

4 Manual Operation and Device Functions



Important menu functions can be selected directly with the <SELECT> keys.

4.1 Menu Structure

After the power-up sequence has been completed, the device is switched to the basic operating mode – indicated by the illuminated READY LED – by means of which the device's basic functions can be executed, such as:

- Select desired output voltage Uset
- Select desired output current Iset
- Adjust allowable working range with soft-limits Ulim and Ilim
- Adjust overvoltage and overcurrent protection

Additional setup menus can be accessed with the function key. These include:

- SEt (setup) Extended setup functions
- AnIF (analog interface) Analog interface settings
- SEq (sequence function) Sequence function settings
- bUS (computer interface) Interface configuration settings

After selecting the desired setup menu with the function key, the respective menu level appears at the display.

The function and arrow keys are used to scroll through the respective menu levels and select the desired settings.

The CE/Local key can be used to shift back up one level at a time, until the basic operating menu once again appears.

4.2 Setting Output Voltage Uset and Output Current Iset

There are two ways to set output voltage and output current:

- **Direct selection**
Changes become immediately effective when this method is utilized, assuming the output is active.
- **Pre-selected settings**
Output voltage or current is preset with the arrow keys to the desired value. The selected value is activated at the output after acknowledging with the ENTER key.

4.2.1 Direct Selection (rotary knobs and arrow keys)

The operating concept allows for direct selection of output voltage and/or output current with the rotary knobs, with immediate activation of the new values at the output.

In the default configuration, momentary output values appear at the display with voltage at the left and current at the right-hand side. This is indicated by means of the two LEDs to the right of the display. If the output is active (indicated by illumination of the red LED above the OUTPUT key), the LEDs in the diagram indicate the control mode. Depending upon the selected output quantities and the load situation, either output voltage or output current is regulated. CV (constant voltage) stands for voltage regulation, and CC (constant current) stands for current regulation.

If the working point is not within the allowable control range, the power LED lights up.

The display can be switched to a representation of the corresponding setpoint by slightly turning one of the rotary knobs (Uset or Iset). This change is indicated by the respective LED to the right of the display. The blinking decimal place indicates the resolution with which adjustment will take place. Resolution can be changed with the RESOL key.

The setting can then be changed to the desired value with the rotary knob.

As soon as the selected setpoints have been activated, they can also be adjusted with the arrow keys, in which case resolution can also be pre-selected.

The setting mode can also be accessed with the SELECT key. The LEDs next to the display indicate the selected function.

Initializing the Procedure

☞ Slightly turn (1) the Uset knob (see Figure 4.2.1 a).

! The display is switched from **Uout** (measured voltage value) to **Uset** (voltage setpoint). The **decimal place** for the selected setting resolution **blinks**.

! The **green Uout/V LED** goes out, and the **yellow Uset/V LED** lights up.

Selecting a Resolution

! **3 step widths** are possible: **0.01 V, 0.1 V or 1 V**.

! The **blinking decimal place** indicates which **step width** will be used for setpoint adjustment.

☞ Repeatedly press the <RESOL> key [19] until the desired decimal place blinks at the display.

Executing the Procedure

! Values become immediately active during adjustment.

☞ Adjustment (2) with the Uset rotary knob (see Figure 4.2.1 a):
Clockwise rotation → Increases the value
Counterclockwise rotation → Decreases the value
All intermediate values are run through semi-linearly, and are read out to the output (assuming it is active).

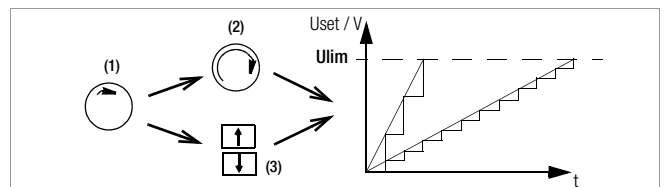


Figure 4.2.1 a Continuous Adjustment of Uset

☞ Adjust (3) with the <↑> or the <↓> key:

<↑> (increment) → Increases the value

<↓> (decrement) → Decreases the value

! Each time the key is pressed, output voltage is changed by an amount which corresponds to the value selected with the resolution setting function.

! Pressing and holding the respective key results in rapid scrolling, regardless of the step width.

Attention! Uset may not be set to a value which exceeds Ulim!

Uset – Selecting a Setpoint for Output Voltage

Function

- Adjustment with the **Uset rotary knob** [8] is not enabled until 0.4 seconds after the digital display [9] has been switched to the respective function. This **delay time** prevents **inadvertent changes** to **Uset** during selection of the **Uset** display. The rotary knob must be adjusted after this time period has elapsed in order to change the **Uset** setting.
- After **delay time** has elapsed, output voltage is adjusted directly as the knob is rotated if the output is active. The currently active setpoint appears continuously at the display [9].
- If no adjustment is made for a period of 10 seconds, the display automatically returns to measured voltage value U_{out} . The display can be **immediately switched** to the U_{out} value by pressing the **<CE/LOCAL>** key.
- There are two ways to adjust **Uset** manually:
 - **Adjustment with immediate activation of the new value:**
Adjustment of the setpoint has an immediate effect on load output quantities.
 - **Setpoint adjustment:**
Adjustment of the setpoint does not effect load output quantities until after activation.

Iset – Selecting a Setpoint for Output Current

The procedure for selecting output current I_{set} is identical to the procedure for selecting output voltage U_{set} (page 22).

However, the following controls and displays must be substituted:

- I_{set} rotary knob (chapter 3 [12])
- Right-hand display (chapter 3 [13])
- Yellow I_{set}/A LED (chapter 3 [14])
- **Setting resolution:**
3 step widths are possible: 0.01 A, 0.1 A or 1 A.

Attention: I_{set} may not be set to a value which exceeds I_{lim} !

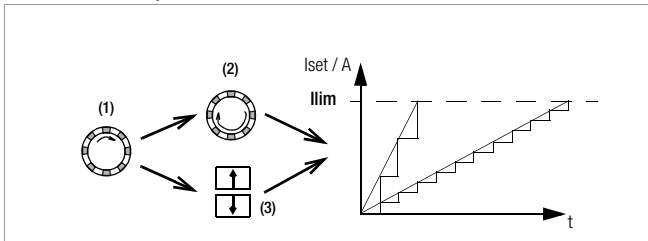


Figure 4.2.1 b Continuous Adjustment of U_{set}

4.2.2 Pre-selected Setting (ENTER, arrow keys)

If the application requires that switching to a new setpoint takes place in a single jump by pressing a key (without semi-continuous adjustment), this can be accomplished as follows.

Proceed to the basic setting menu using the **CE/LOCAL** key, i.e. to the display of momentary output values. Press the **ENTER** key in order to switch to the pre-selection setting mode. After switching to this mode, the currently valid setpoint values appear at both displays (indicated by the LED to the right of the display). As a default function, voltage adjustment is always activated first, which is indicated by a blinking decimal place at the corresponding display. Repeatedly press the **ENTER** key in order to switch back and forth between current adjustment and voltage adjustment.

The new setpoint can be selected with the arrow keys (and only with the arrow keys), after selecting voltage or current setpoint adjustment and the desired resolution. The **SET** LED blinks in order to indicate that a change has been made but not yet activated. The new setpoint is activated after acknowledging with the **ENTER** key.

Pre-selecting a Setpoint

- ☞ Press the **<ENTER>** key [15].
- ! The display [5] is switched from **Uout** (measured voltage value) to **Uset** (voltage setpoint). The **decimal place** which corresponds to the selected resolution setting **blinks**.
- ! The green **Uout/V LED** goes out, and the yellow **Uset/V LED** [6] lights up (as long as the **Uset/V LED is continuously illuminated**, direct adjustment with immediate activation of the new value can be executed with the rotary knob [7]).
- **Setting resolution:**
 - ! **3 step widths** are possible: **0.01 V, 0.1 V or 1 V**.
 - ☞ Repeatedly press the **<SELECT>** key [13] until the desired decimal place (**step width**) blinks at the display.
- **Output Voltage:**
 - ☞ Press either the **<↑>** key or the **<↓>** key [11]!
 - <↑>** (increment) → Increases the value
 - <↓>** (decrement) → Decreases the value
 - ! The yellow **Uset/V LED** [5] blinks. This indicates that **new values are displayed but not activated** during adjustment. The old **Uset** value remains active.
 - ☞ Press the **<↑>** key or the **<↓>** key [11] until the desired value appears at the display [5].
 - ! Each time the key is pressed, the pre-selected setpoint value is changed by an amount which corresponds to the value selected with the resolution setting function.
 - ! Pressing and holding the respective key results in rapid scrolling, regardless of the step width.
 - ☞ Acknowledge the selected value with the **<ENTER>** key [15]. The new value is now activated at the output [4], and the yellow **Uset/V LED** [6] is continuously illuminated.
 - ☞ Repeatedly press the **<ENTER>** key [15] in order to switch back and forth between **Uset** and **Iset**.

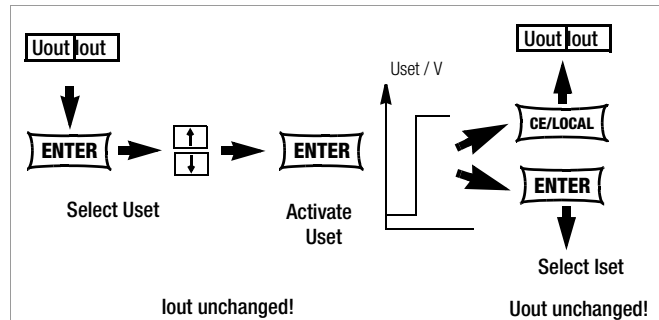


Figure 4.2.2 a Adjusting U_{set} with a Specified Fixed Value

- Output voltage jumps from the old value to the new value in a single step (no intermediate values).

Attention: U_{set} may not be set to a value which exceeds U_{lim} !

4.3 Switching the Power Output On and Off

The <OUTPUT> key [7] (chapter 3) functions independently of the current operating state of the KONSTANTER.

Further details regarding how the device reacts when the <OUTPUT> key [7] is activated are included in chapter 3.

Closed Loop Control Mode

The power output can be activated or deactivated by pressing the <OUTPUT> key [7].

OUTPUT OFF ↔ OUTPUT ON

REMOTE status (remote control)

(chapter 3 [25], page 69)

The <OUTPUT> key is disabled and has no function.

LOCAL LOCKED status (front panel controls disabled)

(chapter 3 [17], chapter 4.12)

The <OUTPUT> key is disabled and has no function.

trG out (T_MODE OUT) and External Trigger Active

The output can be activated and deactivated with the trigger signal (trG parameter OUT selected).

If the power output has been disabled by applying an **external trigger signal** to the analog interface, it cannot be switched on, neither by means of a command nor with the keys. The corresponding command is not executed, and bit 4 in event register B is set (output-on error). "Err 25" also appears briefly at the display as a warning in the event of manual operation.

The status of the power output (chapter 3 [33]) is indicated by the **red LED** above the <OUTPUT> key:

LED on = output activated
LED off = output deactivated

In the case of **OUTPUT OFF**, the control mode displays are also switched off (chapter 3 [6]).

If the output has been deactivated as a result of **overtemperature protection**, the **red OTP LED [17]** in the control mode display lights up. The output cannot be activated until the KONSTANTER has returned to its normal operating temperature.

If the **Pon RCL** function is active, the output is automatically reactivated after the device has returned to its normal operating temperature.

Functions which may influence the status of the output include:

| Functions | Meaning | Manual Operation | Remote Operation |
|----------------|------------------------|------------------|------------------|
| OVP (OVSet) | Overvoltage protection | page 24 | page 69 |
| OCP | Overcurrent protection | page 26 | page 68 |
| Pon (POWER_ON) | | page 27 | page 70 |
| SEq | Sequence | chapter 4.7.3 | page 71 |
| trG (T_MODE) | | page 29 | page 74 |

4.4 Limiting the Allowable Working Range: Ulim, Ilim

Allowable setting ranges for voltage and current can be limited in order to assure ideal matching to the working ranges of the connected power consumer. The Ulim and Ilim setting functions are provided to this end.

Setting options can be selected with the respective <SELECT> key. Setting resolution is selected with the <RESOL> key. The setting itself is entered with the arrow keys. New settings become immediately active.

Attention!

These settings represent so-called soft limits. This means that values which lie within these limits can be selected both manually and via the computer interface, and that a corresponding error message is otherwise generated.

Attention!

The actual output quantity is the sum of the digitally selected setpoint value and the setpoint value specified via the analog interface. This makes it possible to select values which exceed the specified soft limit.

Ulim – Setting the Upper Voltage Limit Value

Function

- **Upper setting limit** (soft limit) for **Uset**
- Prevents inadvertent violation of the maximum voltage value when adjusting **Uset**.
- **Protection** for the connected power consumer
- **Ulim** has higher priority than **Uset**.
- Manual and computer-aided settings for **Uset** may not exceed **Ulim**.
- **Ulim** cannot be set to a value which is less than a previously selected **Uset** value. **Uset** must be reduced far enough to allow for the new **Ulim** setting.

Settings

The setting procedure is described in chapter 4.8.1.

Ilim – Setting the Upper Current Limit Value

Function

- **Upper setting limit** (soft limit) for **Iset**
- Prevents inadvertent violation of the maximum current value when adjusting **Iset**.
- **Protection** for the connected power consumer
- **Ilim** has higher priority than **Iset**.
- Manual and computer-aided settings for **Iset** may not exceed **Ilim**.
- **Ilim** cannot be set to a value which is less than current setpoint **Iset**. **Iset** must be reduced far enough to allow for the new **Ilim** setting.

Settings

The setting procedure is described in chapter 4.8.1.

4.5 Description of OVP and OCP Protection Functions

Protection for the connected power consumer and the KONSTANTER by means of the following functions:

OVP – overvoltage protection

Function

- **Protection** for the connected power consumer
- If voltage at the output terminals exceeds the selected **OVSET** value, the power output is deactivated.
- Triggering of overvoltage protection causes immediate (< 200 µs) deactivation of the output (**OUTPUT OFF**). The HF power transmitter is disabled, and the electronic sink for discharging the output capacitors over a period of approximately 350 ms is activated. In addition, bit 4 (OVPA) is set in event register A. Bit 4 remains set in status register A for as long as the trigger value is exceeded.
- The **OVP** LED lights up as soon as overvoltage protection is triggered (see also chapter 3 [17]), and the **red OUTPUT** LED goes out.
- As soon as the shutdown condition no longer exists, the power output can be reactivated by pressing the **<OUTPUT> key**, by transmitting a **trigger signal** to the analog interface or by means of **computer control** (“**OUTPUT ON**” ⇒ red **OUTPUT** LED lights up).

Settings

The setting procedure is described in chapter 4.8.1.

Note

- The **OVP** trigger value (OVSET) should be set at least 1 V higher than the desired **USET** output voltage in order to prevent undesired triggering of the **OVP** function resulting from overshooting due to sudden output discharging (minimum values: chapter 1.5.3)!
- The **OVP** trigger value makes reference to the prevailing voltage value between the output terminals of the SSP. This voltage is increased by the **USET** parameter during sensing mode operation (remote sensing) by an amount equal to voltage drop at the output leads. For this reason, the above defined difference between **OVSET** and **USET** must be correspondingly increased during sensing mode operation.
- The triggering threshold for overvoltage protection is identical to the displayed value, and is always active!
- Overvoltage protection response time is less than 200 µs. Output voltage generated by the device may exceed **OVSET** for the duration of this response time. Maximum overshooting can be approximately calculated as follows:
$$U_{out} = I_{SET} [A] \times 200 [\mu s] / C_{out} [\mu F]$$
$$I_{SET} = \text{selected current setpoint}$$
$$C_{out} = \text{capacitance of the output capacitor}$$
Subsequent discharging time for the output capacitor depends upon load, and corresponds to the specified values for response time at $U_{nom} \rightarrow 1$ Volt included in chapter 1.5.3.
- Possible causes for triggering overvoltage protection are listed in chapter 3 [17].

OCP – Overcurrent Protection

Functions

- **Protects** the power consumer from continuous overcurrent.
- Deactivates the power output when load current **Iset** has been reached, and the output is switched to the **current regulating mode**.
- Current can nevertheless be allowed to exceed **Iset** for specified, short periods of time by specifying a delay time (see below), for example:
 - ! Starting current for electric motors
 - ! In-rush current for capacitive power consumers
 - ! For testing the breaking performance of circuit breakers, motor protecting switches, fuses etc.
 - ! For determining the short-term load capacity of contacts and cables, as well as electrical and electronic components

! In order to maintain short response times when programming voltage increases

- The **red OCP** LED lights up as soon as **OCP** is triggered (see also chapter 3 [17]), and the **red OUTPUT** LED goes out.
- The power output can be reactivated at any time by pressing the **<OUTPUT> key**, by transmitting a **trigger signal** to the analog interface or by means of **computer control** (**OUTPUT ON** ⇒ red **OUTPUT** LED lights up).

Settings

See description on page 26.

DELAY – Output Off Delay for OCP

Functions

- Delay time prior to deactivation of the power output after triggering of current regulating (**Iout = Iset**)
- Only enabled with activated **OCP** function (**OCP ON**)
- If output current **Iout** drops below **Iset** before **DELAY** time elapses, the shutdown sequence is aborted.
- If current regulation is triggered again, the routine is started once again (at 00.00).
- The default setting after **RESET** (*RST) is 00.00.

Settings

The setting procedure is described in chapter 4.8.1.

4.6 Display of Momentary Output Values Uout, Iout and Pout

Uout – Display Momentary Measured Voltage Value

- Appears at the **left-hand display** [9]
- The **green Uout/V** LED [10] lights up and indicates display of the momentary measured voltage value.
- The measured voltage value is automatically displayed again approximately 10 seconds after the last setting has been made.
- The momentary measured voltage value is displayed immediately if the user exits the device functions setting mode by pressing the **<CE/LOCAL>** key [23].

Iout – Display Momentary Measured Current Value

- Appears at the **right-hand display** [13]
- The **green Iout/A** LED [14] lights up and indicates display of the momentary measured current value.
- The measured current value is automatically displayed again approximately 10 seconds after the last setting has been made.
- The momentary measured current value is displayed immediately if the user exits the device functions setting mode by pressing the **<CE/LOCAL>** key [23].

Pout – Display Momentary Output Power

Repeatedly press the **<SELECT>** key [11] or the **<SELECT>** key [15] until the respective Pout LED lights up. Momentary output power, based upon measured Uout and Iout values, appears at the corresponding display ([9] or [13]).

UI_ – Display Measured Values in U/I Min-Max Memory

Functions

- Reads out stored values for **Umin**, **Umax**, **Imin** and **Imax** at the display, or via the computer interface.
- Stored Min-Max values can be read out regardless of the status selected for the **MINMAX** function.

Settings

See description on page 28.

4.7 Operating Menu via the FUNCTION Key

The **FUNCTION** menu consists of the following functions for configuring the KONSTANTER's parameters:

| Function group | Function | Parameter (numeric / text) |
|----------------------------|----------|---|
| ■ Setup | SEt | TP: oFF / on |
| | Pon | TP: rSt / SbY / rcL |
| | UI_ | TP: oFF / on / rSt |
| | rnd | TP: 0 / -1 / -2 |
| ■ Analog Interface | AnIF | trG TP: oFF / out / rcL / SEq / LLO / UI_ |
| ■ Sequence Function | SEq* | tSEt NP: xx.xx |
| | | tdEF NP: xx.xx |
| | | Strt NP: xxx (11 ... 252) |
| | | StoP NP: xxx (12... 253) |
| | | reP NP: xxx (cont. or 1 ... 255) |
| | | SEq** TP: Go, Strt, StoP, hold, StEP, cont. |

* Sequence function: appears at left-hand display, right-hand display is blank.

** Parameter selection for sequence control: appears at left-hand display, selected parameter appears at right-hand display.

■ Interface Configuration

| | | |
|-----|------|--|
| bUS | Addr | NP: 0 / 1 / ... / 13 / ... / 30 / (UNL) |
| | bAUd | NP: 50 / 75 / 150 / 200 / ... / 4800 / 9600 / 19200 |
| | dbit | NP: 7 / 8 |
| | Pbit | TP: nonE / ZERo / EVEn / odd / onE |
| | Sbit | NP: 1 / 2 |

NP: Numeric Parameters

- Can be selected as a specified value or as a value within an interval with corresponding resolution.
- Adjust **resolution** (decimal place) by pressing the **<RESOL>** key.
- Select the value with the **<↑>** key or the **<↓>** key.
- Displayed value = selected value.

TP: Text Parameters

- Select parameters with the **<↑>** key or the **<↓>** key.
- Acknowledge your selection by pressing the **<ENTER>** key.

Settings

- ☞ Press the **<FUNCTION>** key at the front of the KONSTANTER.

If no settings have yet been changed via the FUNCTION menu after switching the device on, the SEt function group is accessed by pressing the <FUNCTION> key.



If settings have already been changed in the function menu, the last edited function group or function is accessed automatically.

- **Accessing the last edited function:**
 - ☞ If you want to configure a function included in the current function group, select the function group by pressing the **<FUNCTION>** key. Detailed information is included in the respective section of this chapter.
 - ☞ If you want to configure a function from another function group, first return to the **function group menu** by pressing the **<CE/LOCAL>** key.
- **Exit the function menu completely:**
 - ☞ Press the **<CE/LOCAL>** key once again.
 - ! Device is returned to **Uout / Iout** display.

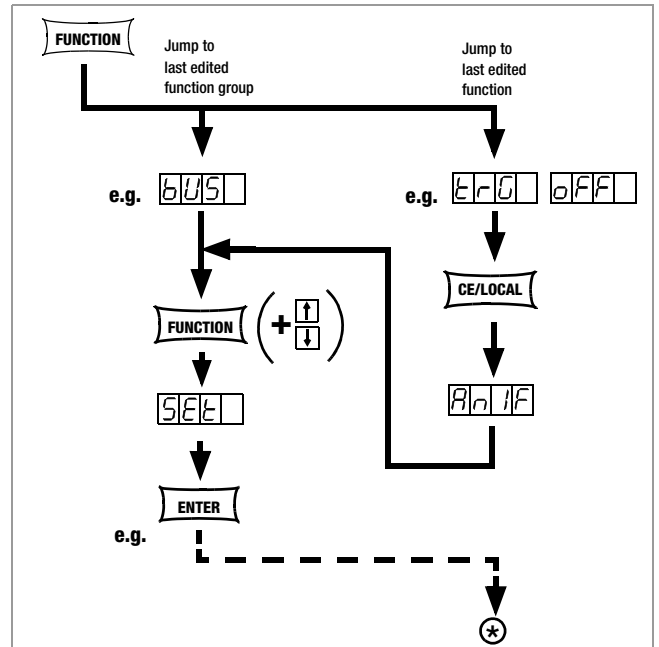
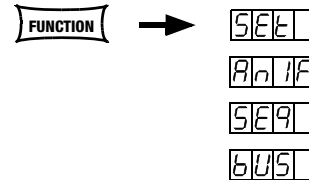


Figure 4.7 a Accessing the Functions Submenu

- ☞ If the function group menu is currently open, you can access the following function groups:



- ☞ If the desired function group does not appear immediately at the left-hand display, repeatedly press the **<FUNCTION>** key until the name of the desired function group appears at the **left-hand display** (SEt in this example).
- **Forward scrolling** through function groups in this menu:
 - ☞ Repeatedly press the **<FUNCTION>** key or
 - ☞ Press and hold the **<FUNCTION>** key and repeatedly press the **<↓>** key at the same time.
- **Reverse scrolling** through function groups in this menu:
 - ☞ Press and hold the **<FUNCTION>** key and repeatedly press the **<↑>** key at the same time.
- Accessing functions in the selected function group:
 - ☞ Press the **<ENTER>** key.

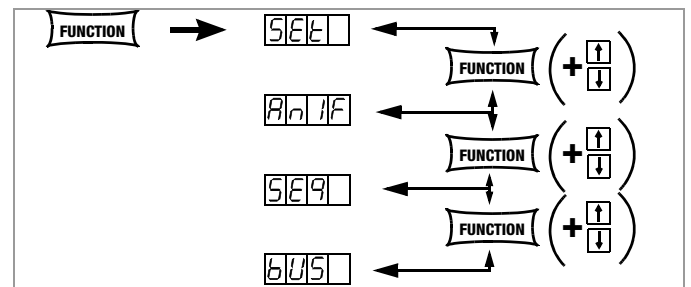


Figure 4.7 b Switching Amongst Individual Function Groups

Note

The order in which the commands are explained in the following sections corresponds to the actual sequence for manual operation of the SSP KONSTANTER. This makes it easy to configure device functions and parameters without leaving back and forth through the instructions!

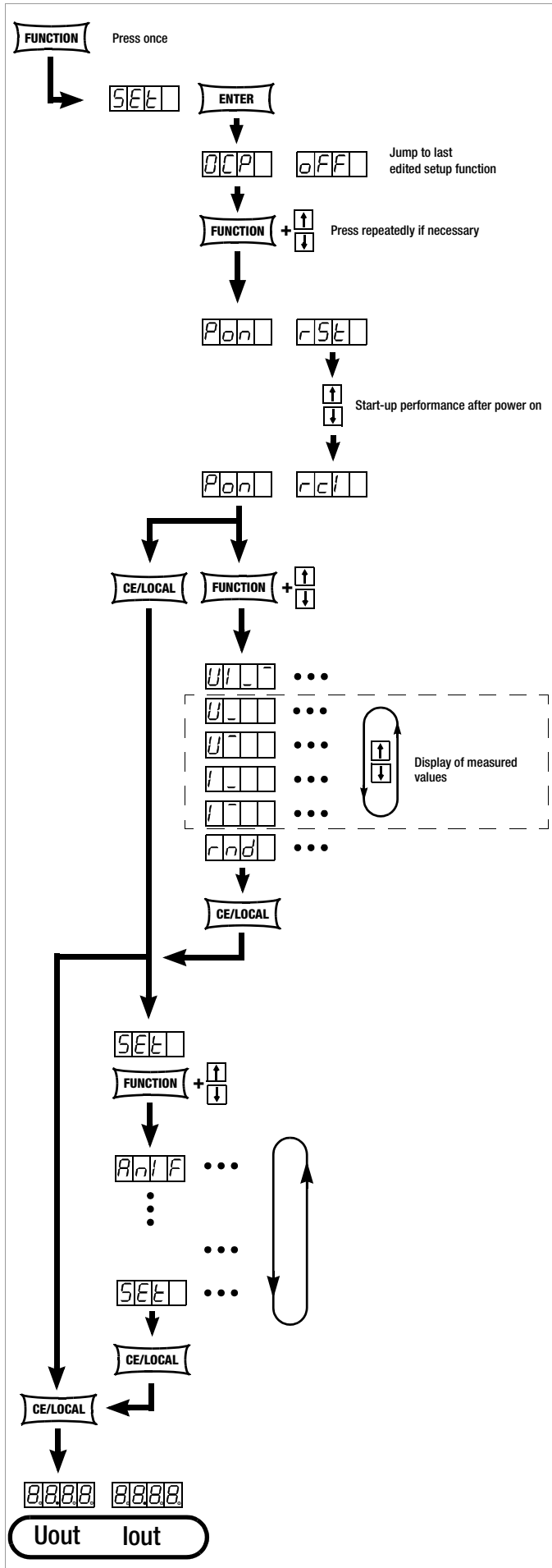


Figure 4.7.1 a Path to Pon Settings and other setting options in the Set menu

OCp – Activate Overcurrent Protection

Functions

See functions description on page 24.

Setting Parameters

- ☞ **OFF** (default setting after RESET (*RST))
OCp function inactive
 Continuous current limiting (current regulation)
- ☞ **ON**
OCp function activated
 The output is deactivated as soon as current limiting has been active for the specified **DELAY** time.

Settings

☞ The procedure for configuring **OCp** is described in principle in chapter 4.7 and in Figure 4.7.1 a.

- ! However, the **OCp** display and a related text parameter appear in the setup function window. * **OCP** **on**
- ☞ The selected text parameter does not become active until the **<ENTER>** key is pressed! **off**

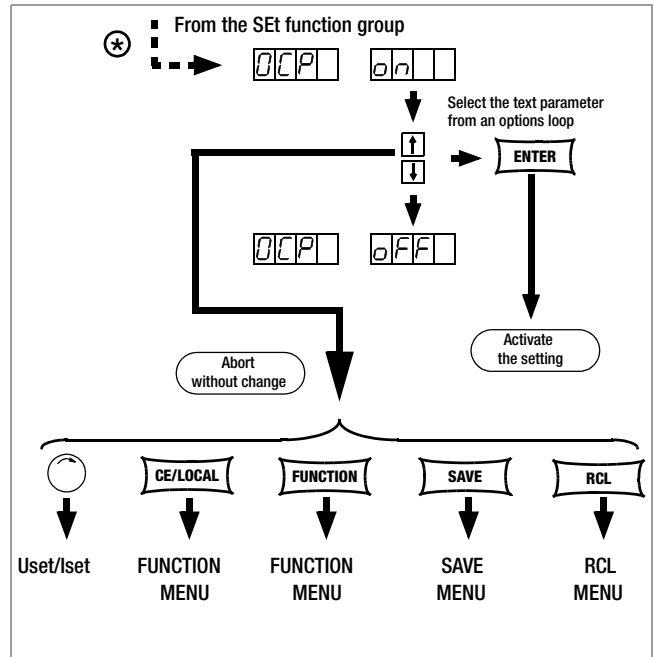


Figure 4.7.1 b Path to Selection of the OCP Text Parameter

Note

Load current for the output capacitor is also acquired by the current regulator, and is limited to a value of **Iset** – load. If the **OCp** function has been activated and **ISET** and **DELAY** have been set to low values, the output may even be deactivated if output voltage is increased. For this reason, **DELAY** must at first be set somewhat higher than the resulting output voltage response time.

Pon – Output Switching Status, Response After Power On

Functions

- Automatically determines KONSTANTER configuration after power on.

Setting Parameters:

- rSt (RESET):** Factory default settings are utilized.
- SbY (STANDBY):** Same settings as prior to shutdown, power output remains inactive (**OUTPUT OFF**). Disabled front panel controls are re-enabled after power on. As from firmware version 3.006: Disabled front panel controls remain disabled after power on.
- rcl (RECALL):** Same settings as prior to shutdown. Disabled front panel controls remain disabled after power on.

Settings

- The procedure for configuring Pon is described in principle in chapter 4.7 and in Figure 4.7.1 a.
- ! However, the Pon display and a related text parameter appear in the setup function window.

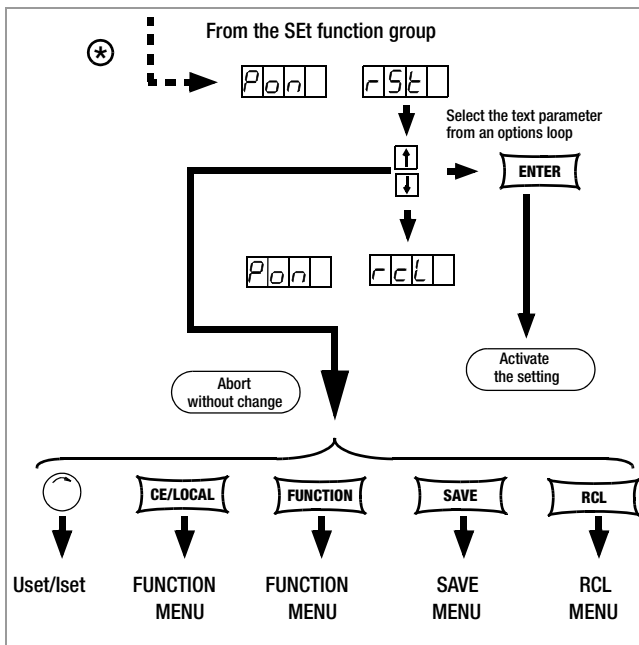


Figure 4.7.1 c Path to Selection of the Pon Text Parameter

Note

- The status of the Pon function is not saved as a device setting to SETUP memory with the <SAVE> key.
- The following settings are recommended, depending upon how the KONSTANTER is used:
 - ! Pon rSt: use in computer controlled systems
 - ! Pon SbY: common laboratory use
 - ! Pon rcl: applications which must continue in an unchanged fashion after power failures.

UI_ – Configure U/I Min-Max Measured Value Memory (MINMAX)

Functions

- Save minimum and maximum measured voltage and current values.
- Reads out stored values for **Umin**, **Umax**, **Imin** and **Imax** at the display, or via the computer interface.
- The MINMAX function can be temporarily set to **OFF**, for example before deactivating the output when changing devices under test. Stored values are then no longer updated, nor are they automatically reset.
- Stored Min-Max values can be read out regardless of the status selected for the MINMAX function.
- Stored Min-Max values can always be reset with the **UI_ RST** command.
- Stored Min-Max values can also be reset with the ***RST** command, or with the key combination <CE/LOCAL> + <ENTER> (= RESET).
- The status of the MINMAX function is also saved to SETUP memory by pressing the **SAVE** key.
- If h& Pon function is set to **SbY** or **rcl**, the MINMAX function is activated upon power-up, but previously measured Min-Max values are lost when the KONSTANTER is switched off.
- The MINMAX function can also be controlled via the trigger input at the analog interface (see page 29).

Setting Parameters

- OFF:** Storage of Min-Max values is deactivated.
- ON:** Storage of Min-Max values is activated.
- RST:** Contents in the Min-Max memory are reset or replaced with momentary measured values:

| | |
|-------------|-------------|
| Umin = Uout | Umax = Uout |
| Imin = Iout | Imax = Iout |

Settings

- The procedure for configuring UI_ is described in principle in chapter 4.7 and in Figure 4.7.1 a.

- ! However, the UI_ display and a related text parameter appear in the setup function window.

- Default setting after RESET (*RST): OFF!

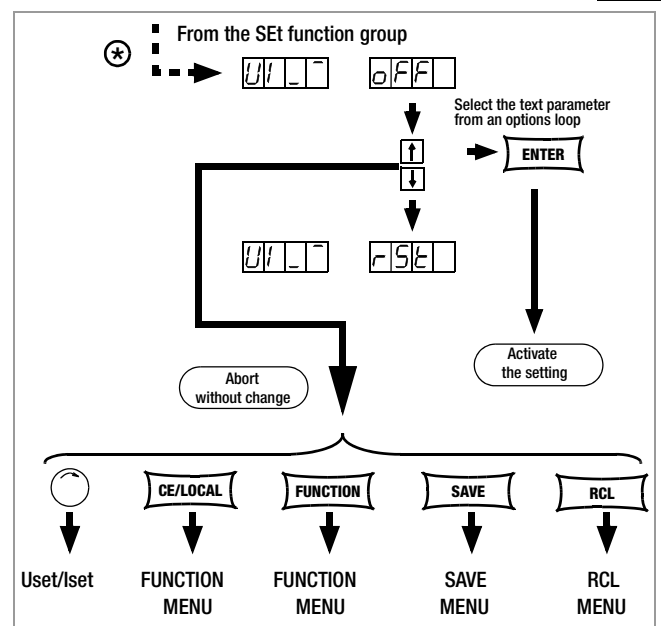
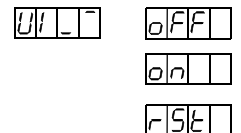


Figure 4.7.1 d Path to Selection of the Pon Text Parameter

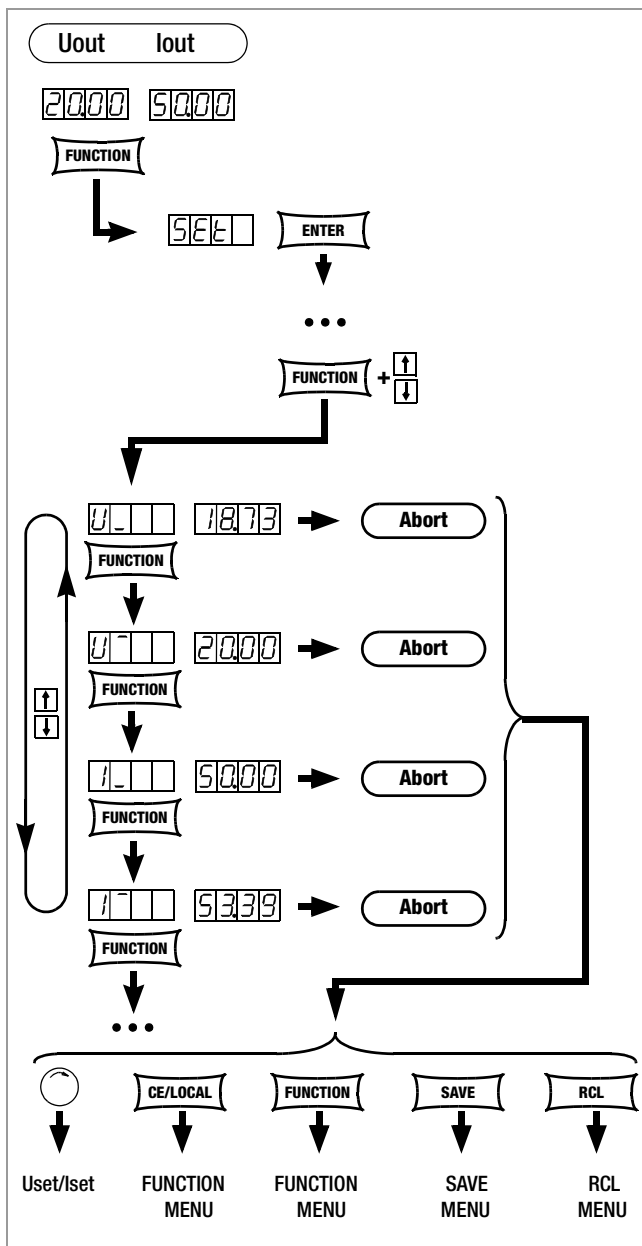
U_l – Display Measured Values in U/I Min-Max Memory

Functions

- Reads out stored values for **U_{min}**, **U_{max}**, **I_{min}** and **I_{max}** at the display, or via the computer interface.
- Stored Min-Max values can be read out regardless of the status selected for the **MINMAX** function.

Settings

- ☞ Select from the Set menu with the <FUNCTION> key.
- ☞ After **U_l**, **U_l⁻**, **I_l** or **I_l⁻** is displayed for the first time, browsing amongst these values is possible with the <↓> and <↑> keys.
- ! **U_l**, **U_l⁻**, **I_l** or **I_l⁻** appears in the setup function display, and the corresponding measured value appears at the left-hand display.
- ☞ Default setting after **RESET (*RST)**: Measured value memory is cleared!



rnd – Rounding Off the Displayed Measured Value

Applications

The ROUND function can be used where fluctuating measured values are to be expected due to the application (e.g. in manufacturing), which may cause unnecessary concern.

Functions

The ROUND function defines how many decimal places will be displayed for measured U_{out} and I_{out} values.

Setting Parameters

- ☞ 0: no rounding
- ☞ -1: rounded off by one decimal place
- ☞ -2: rounded off by two decimal places

Settings

- ☞ The procedure for configuring Rnd is described in principle in chapter 4.7 and in Figure 4.7.1 a.

- ! However, the **rnd** display and a related text parameter appear in the setup function window.

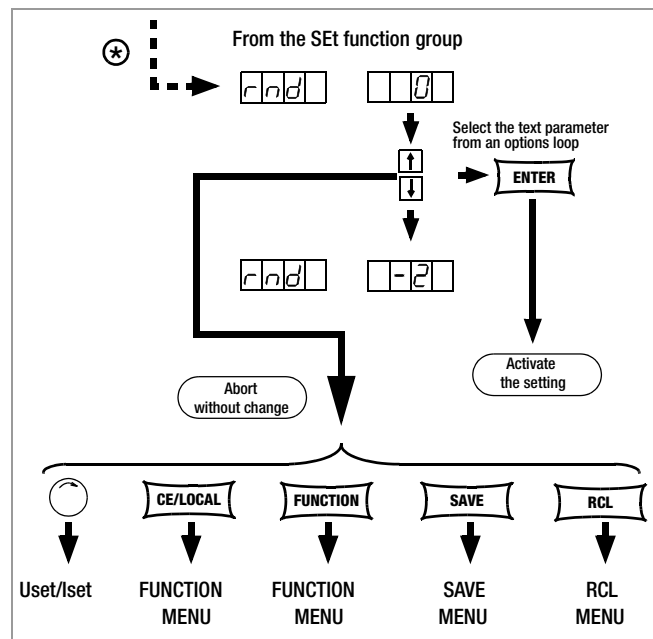
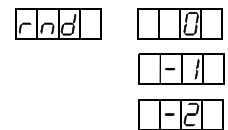


Figure 4.7.1 e Path to Selection of the rnd Text Parameter

- ☞ Default setting after **RESET (*RST)**: unchanged

4.7.2 AnIF – “Analog Interface” Function Group

The analog interface allows for remote control of the KONSTANTER. A floating digital control input with several selection functions (**TRG IN+** / **TRG IN-**) is available in addition to analog setting options (chapter 5).

trG – Function Selection for Trigger Input

Functions

- **Floating** optocoupler input (**TRG IN**) at the analog interface
- The trigger input is controlled with a digital signal (low: 0 V, high: 4 ... 26 V).
- Response time is approximately 1 to 15 ms.

Setting Parameters

- ☞ **OFF:** Trigger input function is deactivated, signals at the trigger input are ignored.
- ☞ **OUT:** Trigger input influences **OUTPUT:** output On / Off

| TRIGGER Signal | Influence on OUTPUT Status |
|---|---|
| Low | Status depends upon manual setting or programming command. |
| LOW \uparrow HIGH | OUTPUT remains OFF or OUTPUT is switched OFF. |
| HIGH | OUTPUT is in the OFF state and cannot be switched on – neither manually nor with a programming command. |
| HIGH \downarrow LOW | OUTPUT is activated, Except in the event of OTP or OVP . |

- ☞ **RCL:** Memory recall from defined start to defined stop address (step-by-step sequence control)

| TRIGGER Signal | Influence on Step-by-Step Control |
|---|---|
| Edge Low \rightarrow High | Start trigger signal |
| HIGH | <ul style="list-style-type: none"> • The trigger signal is a high pulse with a duration of 11 to 800 ms. • A high pulse with a duration > 1.0 s resets the address counter to the start address at any point in time, and execution begins with the next trigger signal. |
| Edge High \rightarrow Low | <p>The high \rightarrow low edge of the (short) trigger signal results in step-by-step control of the currently selected sequence, regardless of the specified time and number of repetitions.</p> <p>Recall of the memory's contents begins with the START address. Each trigger signal increases the address by 1, until the STOP address is reached. The next pulse once again causes execution of the contents of the START address.</p> |

- ☞ **SEQ:** Control execution of the SEQUENCE function
- SEQUENCE:** Sequential execution of specified values for Iset, Uset and dwell time (see also chapter 4.7.3). The SEQUENCE function group must be set to **SEQUENCE ON** for this function.

| TRIGGER Signal | Influence on SEQUENCE Status |
|---|---|
| LOW \uparrow HIGH | The SEQUENCE function is started beginning with the start address, SEQUENCE GO . |
| HIGH \downarrow LOW | Ends sequence execution by jumping to the stop address. |

- ☞ **LLO LOCAL LOCKED:** Operation via front panel controls is disabled.

| TRIGGER Signal | Influence on Front Panel Controls |
|----------------|---|
| Low | All front panel controls are functional. |
| HIGH | All front panel controls are disabled, except for the mains switch, activation is not possible with the LOCAL key. |

- ☞ **UI_Min-Max** function: Storage of Min-Max values for U and I is controlled by the trigger, Min-Max function active, (UI $\bar{\text{ON}}$)

| TRIGGER Signal | Influence on Min-Max Status |
|---|--|
| LOW | The Min-Max function is active. |
| LOW \uparrow HIGH | The Min-Max function is deactivated. Values in the in Min-Max memories remain unchanged. |
| HIGH | The Min-Max function is inactive. |
| HIGH \downarrow LOW | Values in the Min-Max memories are reset and replaced with momentary output values. The Min-Max function is activated. |

- ☞ The status of the **trG** function is not saved as a device setting with the **SAVE** key.

Settings

- ☞ **Procedure for configuring trG** \rightarrow see also chapter 4.7

- ☞ The **trG** display appears in the **AnIF** menu along with a related text parameter.

- ☞ Default setting after RESET (*RST): **unchanged**

EFG OFF
 OUT
 RCL
 SEQ
 LLO
 UI

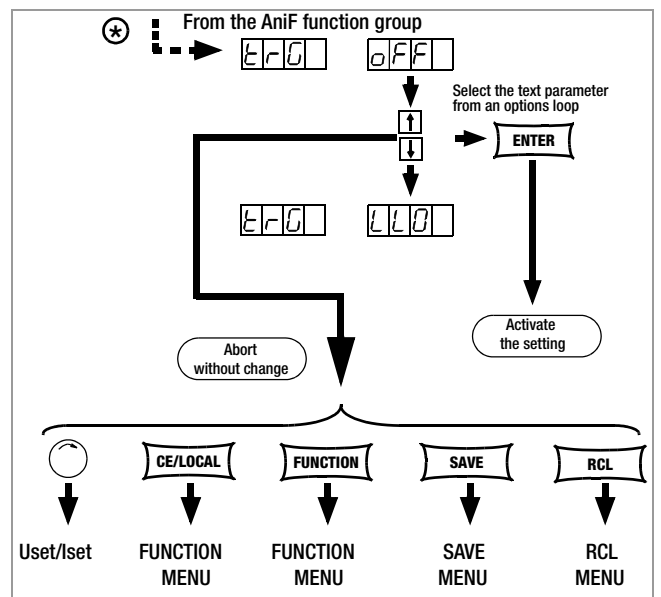


Figure 4.7.2 Path to Selection of the trG Text Parameter

4.7.3 SEq – The “Sequence” Function Group

Description

Test sequences can be generated with the **SEQUENCE** function group (in accordance with DIN if desired). Setpoints are specified for voltage (**Uset**) and for current (**Iset**), as well as for the associated time intervals (**tset**) to this end.

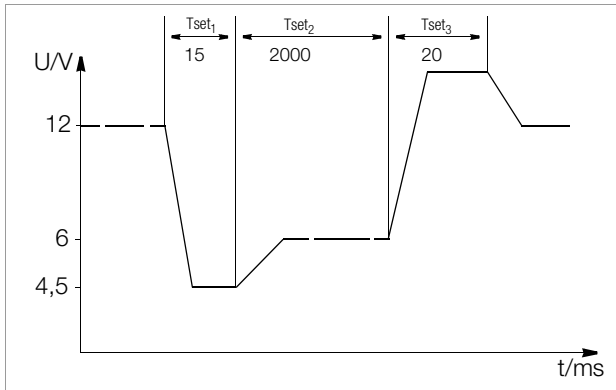


Figure 4.7.3 Test Signal for Electrical System Simulation During Start-Up

Test sequences can be saved, and changed as required. The test sequence (**SEQUENCE**) automatically runs through all specified values after it has been started, beginning with a specified start address, and ending with a specified stop address. The number of sequence repetitions can be selected. The sequence can be stopped at any time, and then resumed. The sequence can also be run step-by-step (manual control), independent of programmed time intervals.

Functions

- Allows for automated, reproducible execution of a series of USet, ISet and tSet values which have been stored to memory with the <SAVE> function.

Memory Occupancy

- A defined memory location (addresses 11 through 255) is assigned to a test step including specified setpoints USet, ISet and tSet.
- A SEQUENCE consists of at least one test step.
- The entire range of memory locations for the sequence may only be occupied by a single sequence.
- Several smaller sequences may also be generated over the entire range of memory locations.
- New sequences can also be generated consisting of sub-segments of occupied memory location ranges by selecting new start and stop addresses.

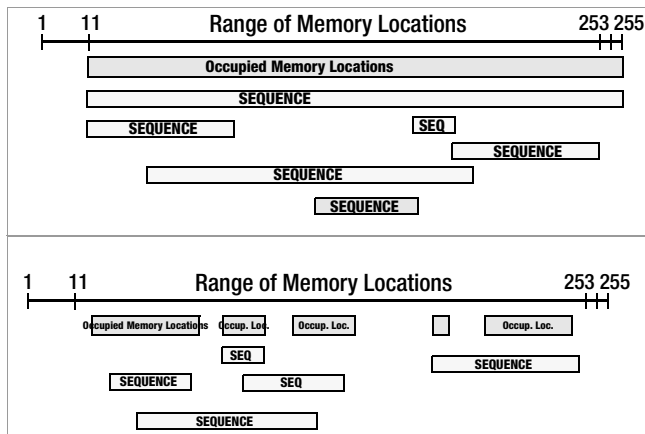


Figure 4.7.3 a Range of Memory Locations and Sequence

Responses to Sequence Start and Stop Commands

- The power output is automatically activated (OUTPUT ON) when the SEQUENCE function is initialized (automatic sequence run and step-by-step control).
- The power output can be controlled at all times with the OUTPUT function during execution of the sequence, and during pauses.
- Stopping the sequence has not effect on the contents of the sequence memory locations.
- The contents of the memory location with the StoP address are executed as the last function. The sequence can then be ended, or can be started over again at the start address, depending upon the number of repetitions and the contents of the stop address location.
- If the memory location assigned to the stop address contain setpoints (i.e. if it is not empty), the output remains active (OUTPUT ON) using the stop address setpoints after the sequence has been completed.
- If the memory location assigned to the stop address is empty, the output is deactivated automatically at this point in time (OUTPUT OFF).
- The fact that a sequence run is active can be determined by querying bit 7 SEQB (= SEQUENCE Busy) in condition register A (CRA). The end of the sequence is indicated by 7 SEQI in event register A (ERA).

Number of Repetitions and Remaining Repetitions Counter

- A sequence can be run 1 to 255 times, or indefinitely until it is stopped manually (see also page 33).
- If automatic sequence repetitions have been programmed, (rREP = 1 ... 255 or 0 = continuous), the pointer jumps directly to the “Strt” memory location after the contents of the “StoP” memory location have been executed, and the sequences is continued.
- When the sequence jumps from the stop to the start address during an automatic sequence run, the remaining repetitions counter is reduced by 1 (rrep = rrep - 1).
- When the sequence jumps from the stop to the start address during step-by-step control, the remaining repetitions counter is not reduced (rrep = rrep).

Response to Empty Memory Locations

- Empty memory locations at the beginning of a sequence are skipped. The first memory location with valid setpoints is executed.
- Empty memory locations may be included between the start and stop addresses, but these are skipped.
- Empty stop address:
 - **rrep > 1**: If a remaining number of repetitions has yet to be run, the empty memory location assigned to the stop address is skipped. The memory location assigned to the start address is then executed.
 - **rrep = 1**: After the last repetition has been run, the empty memory location assigned to the stopped address results in an OUTPUT OFF status.

FSEt - memory location-specific voltage or current function

Function

- This parameter determines which function is to be performed during the transition to this memory location..
- This command has been available as from firmware version 03.004.

Setting parameters

| | |
|----|---|
| nF | SEQUENCE values USET, ISET, TSET without additional function |
| rU | Voltage ramp from the previous to the new voltage setpoint value, duration TSET and/or TDEF |
| rl | Current ramp from the previous to the new current setpoint value, duration TSET and/or TDEF |

Settings

- ☞ **Procedure** for selecting FSEt: see chapter 4.7 - Settings.
- ! The display of the SEq function shows the value for **FSEt** and the associated alphanumerical parameter.
- ☞ Set the parameter with key <↓> or <↑>
- ☞ The parameter is accepted upon acknowledging with the <ENTER> key.
- ☞ After selecting the value, jump to the next or the previous sequence function by pressing the <FUNCTION> key, or by simultaneously pressing the <FUNCTION> key and the <↓> key or the <↑> key.

tSEt – Memory Location-Specific Dwell Time

Functions

Special dwell time (see also Figure 4.7.3):

- For the voltage-current value pair at a specific memory location within a **SEQUENCE**

Setting Range

| | |
|--------------------|--|
| 00.00 s | The tdEF value is used. |
| 00.01 s to 99.99 s | Maximum resolution: 0.01 s |
| 99.99 s | Assignment of the specified time to several consecutive SEQUENCE memory locations with identical voltage and current values |

- ☞ The values include **rise time** and **decay time** (see also Figure 4.7.3). Edge times are only assured within a **limited load impedance range** (see also **Technical Data**).

Settings (see sequence settings and execution on page 35)

- ☞ **Procedure** for selecting tSEt: see also chapter 4.7 - **Settings**.
- ! The **tSEt** display appears in the window for the **SEq** function, along with a related numeric parameter [s].

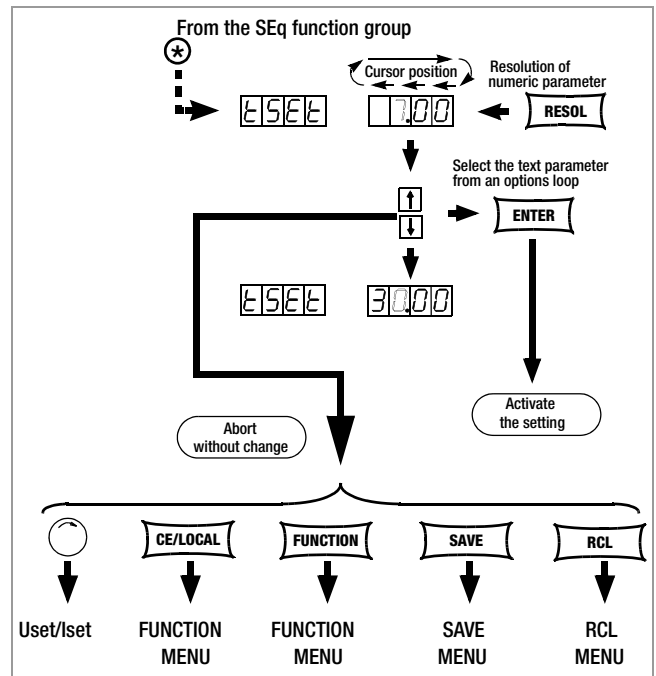


Figure 4.7.3 b Path to tSEt Settings

- ☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter by repeatedly pressing the <RESOL> key.
- ☞ Enter dwell time based on the previously entered resolution value using the <↓> key or the <↑> key.
- ☞ After selecting the value, jump to the next or the previous sequence function by pressing the <FUNCTION> key, or by simultaneously pressing the <FUNCTION> key and the <↓> key or the <↑> key.
- ☞ The last selected and displayed value for the numeric dwell time parameter is used as a default setting.

tdEF – Dwell Time Independent of Memory Location

Functions

- Default dwell time for all voltage-current value pairs included in a sequence to whose memory locations **no special dwell time has been assigned (tSet = 00.00)**
- **tdEF** is used primarily to speed up programming if the value for a certain dwell time is used repeatedly within a given **SEQUENCE**.

Setting Range

0.01 s to 99.99 s Maximum resolution: 0.01 s

Settings (see sequence settings and execution on page 35)

☞ Do not enter **tdEF** until all **Uset**, **lset** and **tset** values have been assigned to all necessary memory locations!

☞ **Procedure** for selecting **tdEF**: see also chapter 4.7 - **Settings**.

! The **tdEF** display appears in the window for the **SEq** function, along with a related numeric parameter [s].

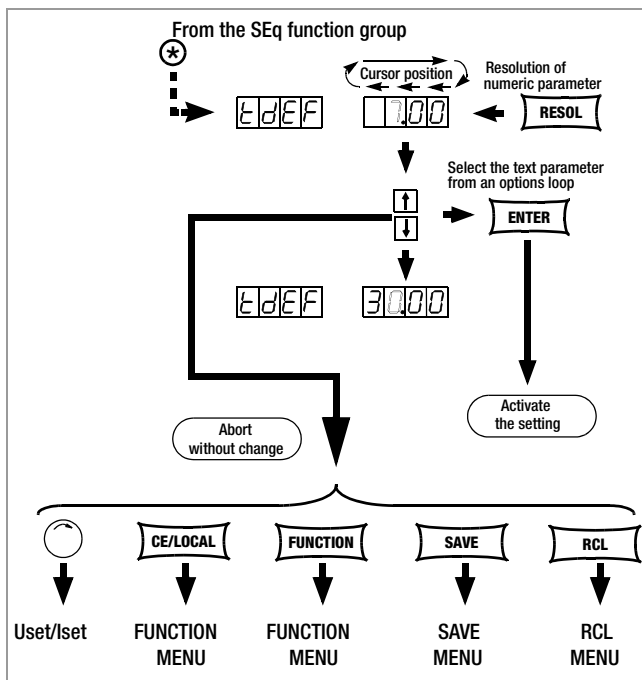


Figure 4.7.3 c Path to tdEF Settings

- ☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter by repeatedly pressing the **<RESOL>** key.
 - ☞ Enter dwell time based on the previously entered resolution value using the **<↓>** key or the **<↑>** key.
 - ☞ After selecting the value, jump to the next or the previous sequence function by pressing the **<FUNCTION>** key, or by simultaneously pressing the **<FUNCTION>** key and the **<↓>** key or the **<↑>** key.
- ! The last selected and displayed value for the numeric dwell time parameter is used as a default setting.

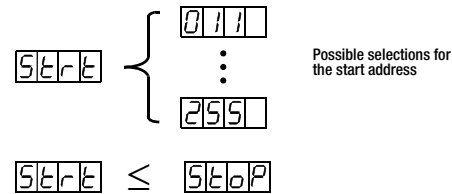
Strt – Sequence Start Address

Functions

- The beginning of a range within which memory locations or content will be deleted or added
 - The **SEQUENCE** is always **defined by means of a start address and a stop address**.
 - The address of the memory location from which the **SEQUENCE** will start
 - **The start address** can correspond to **any memory location from 11 to 255**.
 - The **start address** is selected immediately **prior to initially starting a new SEQUENCE**.
 - The **last selected start** address is always valid for any give **SEQUENCE**, regardless of the point in time at which the **SEQUENCE** is started.
 - The start address for a **SEQUENCE change** can be selected independent of the stop address.
- ! The contents of the memory location with the **Strt** address are executed as the first function.

Setting Parameters

- 11 Lowest possible **Strt** address
- 255 Highest possible **Strt** address



Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **Strt**: see also chapter 4.7 - **Settings**.

! The **Strt** display appears in the window for the **SEq** function, along with a related numeric parameter.

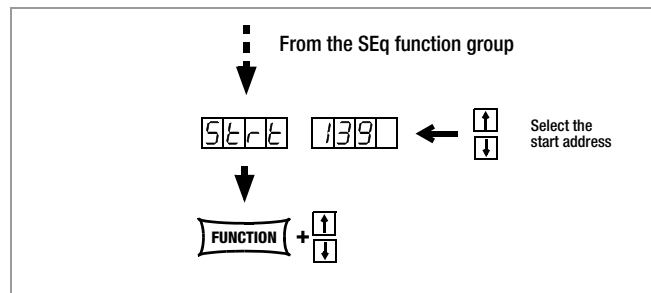


Figure 4.7.3 d Path to Start Address Selection

- ☞ Select the desired memory location with the **<↓>** or the **<↑>** key.
 - ☞ After selecting the value, jump to the next or the previous sequence function by pressing the **<FUNCTION>** key, or by simultaneously pressing the **<FUNCTION>** key and the **<↓>** key or the **<↑>** key.
- ! The last selected and displayed value for the **Strt** address is used as a default setting.

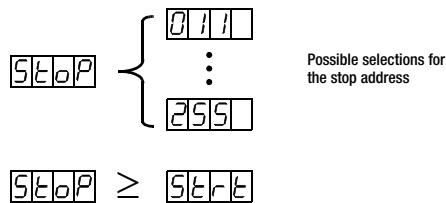
StoP – Sequence Stop Address

Functions

- The end of a range within which memory locations or content will be deleted or added
- The **SEQUENCE** is always **defined by means of a start address and a stop address**.
- Memory location at which a **SEQUENCE** will be ended
- The **stop address** can correspond to **any memory location from 11 to 255**.
- The **stop address** is selected immediately **prior to initially starting a new SEQUENCE**.
- The **last selected stop** address is always valid for any given **SEQUENCE**, regardless of the point in time at which the **SEQUENCE** is started.
- The stop address for a **SEQUENCE change** can be selected independent of the start address.
- ! The contents of the memory location with the **Stop** address are executed as the last function ($reP \neq \infty$).

Setting Parameters

- 11 Lowest possible **Stop** address
255 Highest possible **Stop** address



Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **StoP**: see also chapter 4.7 - **Settings**.

- ! The **StoP** display appears in the window for the SEq function, along with a related numeric parameter.

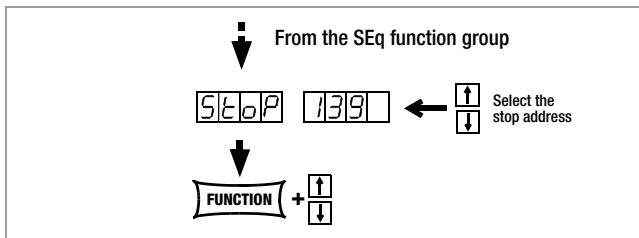


Figure 4.7.3 e Path to Stop Address Selection

- ☞ Select the memory location with the $\langle \downarrow \rangle$ key or the $\langle \uparrow \rangle$ key.
- ☞ After selecting the value, jump to the next or the previous sequence function by pressing the **<FUNCTION>** key, or by simultaneously pressing the **<FUNCTION>** key and the $\langle \downarrow \rangle$ key or the $\langle \uparrow \rangle$ key.
- ! The last selected and displayed value for the numeric stop address parameter is used as a default setting.

rEP – Sequence Repetitions

Functions

- Defines the number of **SEQUENCE** repetitions from the **start** address to the **stop** address.
- The **SEQUENCE** is run from the selected start address to the stop address. If repetitions have been programmed, the pointer automatically jumps from the stop address back to the start address, and the sequence is started over again.
- The **rEP** value is stored to **SETUP** memory as a device setting with the **<SAVE>** key.

Setting Parameters

- cont Continuous repetition until the **SEQUENCE** is stopped manually (page 36 and page 36) or by means of computer control (page 71)
1 ... 255 Number of possible repetitions

Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **rEP**: see also chapter 4.7 - **Settings**.

- ! The **rEP** display appears in the window for the SEq function, along with a related numeric parameter [s].

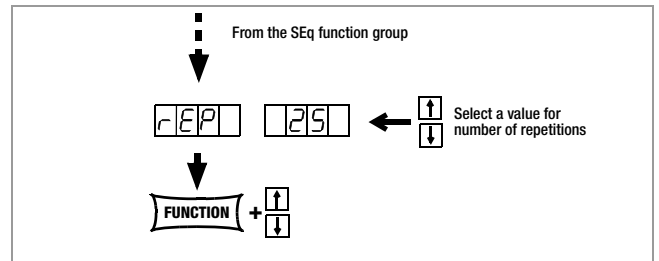


Figure 4.7.3.5 a Path to rEP Setting

- ☞ Select the desired number of repetitions with the $\langle \downarrow \rangle$ key or the $\langle \uparrow \rangle$ key.
- ☞ After selecting the value, jump to the next or the previous sequence function by pressing the **<FUNCTION>** key, or by simultaneously pressing the **<FUNCTION>** key and the $\langle \downarrow \rangle$ key or the $\langle \uparrow \rangle$ key.
- ! The last selected and displayed value for the numeric parameter (number of repetitions) is used as a default setting.

SEq – Sequence Control

Functions

- Controls automatic and step-by-step sequence runs.

Setting Parameters

- Strt:** activate sequence control, jump to start address (status: RDY → HOLD)
Execute command with the <ENTER> key.
- GO: SEQUENCE** begins at start address (status: RDY → RUN)
Execute command with the <ENTER> key.

Additional Setting Parameters

with running or suspended sequence, and in step-by-step mode

- hold:** SEQUENCE stops at current address (status: RUN → HOLD)
Execute command with the <ENTER> key.
- cont:** SEQUENCE is resumed at next address (status: HOLD → RUN)
Execute command with the <ENTER> key.
- StEP:** Execute next memory location and activate step-by-step control, (status: HOLD → HOLD)
Execute command with the <ENTER> key.
- StoP:** SEQUENCE is stopped and jumps to stop address (status: RUN → RDY or HOLD → RDY)
Execute command with the <ENTER> key.

Settings (see sequence settings and execution on page 35)

- Procedure** for selecting SEq: see also chapter 4.7 - Settings.
- !** The SEq display appears in the window for the SEq function.
- Press the <ENTER> key in order to switch to the SEQUENCE menu.
- Repeatedly press the <FUNCTION> key (max. 6 times) until the SEq Go function appears.

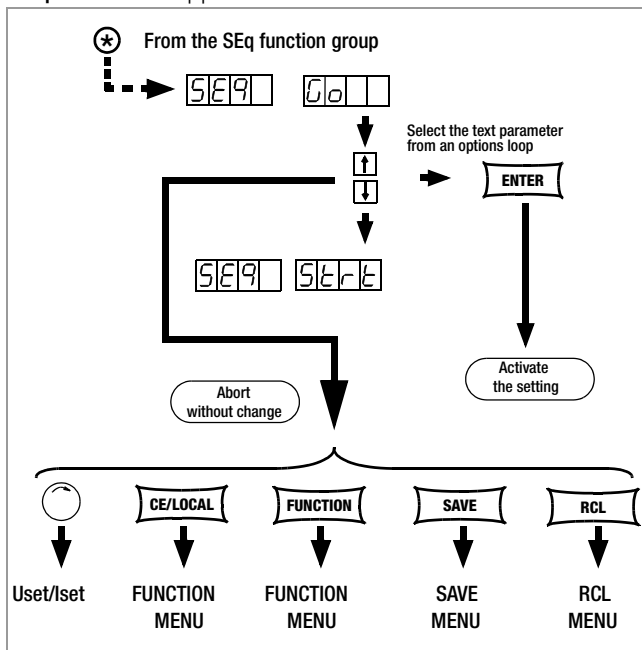


Figure 4.7.3 f Selecting Automatic or Step-by-Step Sequence Control

- Acknowledge your selection with the <ENTER> key.

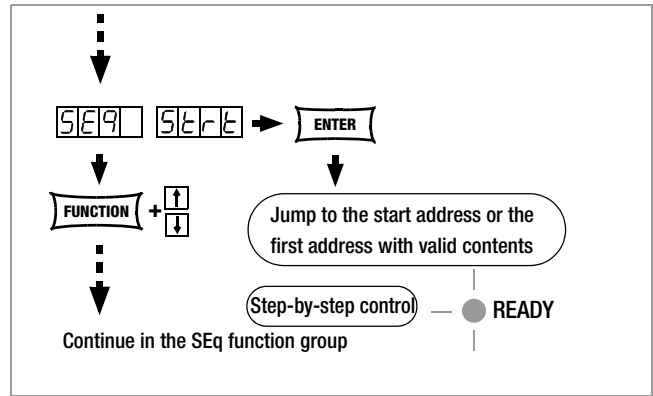


Figure 4.7.3 g Preparing for Step-by-Step Control

- !** The first valid memory location is now executed, and the values saved to this location (**Uset** and **Iset**) are read out to the power output and the signal output.

The READY LED blinks slowly — ● READY

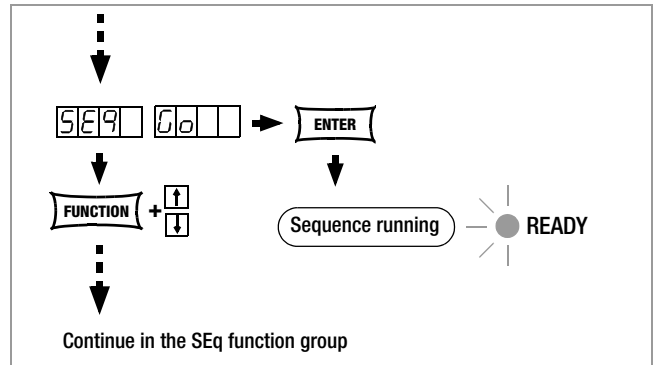


Figure 4.7.3 h Preparing for Automatic SEQUENCE Control

- !** In this case, all memory locations are executed, one after the other, from the start address to the stop address, and the respective values saved to each location (**Uset**, **Iset** and **tdef/tset**) are read out to the power output and the signal output.

The READY LED blinks rapidly — ● READY

Note

- !** Automatic and step-by-step sequence control (external trigger or setting command) are **not interlocked**.
- !** After the SEQUENCE has been started, various **error messages** may appear for a period of approximately 1 second (see also page 36 and the appendix).
- !** If an error occurs during execution of the SEQUENCE, bit 5 SEQE (SEquence Error) is set in event register B (ERB).

Setting all Required Values for a Sequence

Read the detailed explanations included in chapter 4.6 and 4.7.3 first.

- ① Press the <FUNCTION> key.
- ② The **function group** or **function** menu appears.
- ③ If the function menu is not displayed, press the <CE/LOCAL> key in order to return to the function groups menu.
- ④ If the functions menu is displayed, repeatedly press the <FUNCTION> key until **SEq** appears at the left-hand display (the right-hand display remains blank).
- ⑤ Press the <ENTER> key to access the **SEQUENCE** functions menu. **tSEt** appears at the left-hand display.
- ⑥ Adjust **Uset** and **Iset** with the rotary knob and/or the <↓> and <↑> keys if necessary.

[Uset and Iset values can be adjusted at any time, and assigned to a memory location by pressing the <SAVE> and <ENTER> keys.] The display can be returned immediately to the previously edited function (in this case tSEt) by pressing the <FUNCTION> key.

- ⑦ Select a **tSEt** value with the <↓> key or the <↑> key if necessary, and continue by pressing the <FUNCTION> key.
- ⑧ ...
- ⑨ Press the <SAVE> key. The memory location (**Sto**) is displayed.
- ⑩ Select the desired memory locations (between **11** and **255**) with the <↓> key or the <↑> key.
- ⑪ Press the <ENTER> key. The setting is stored to the memory location and the **memory address is automatically increased by 1**.
- ⑫ Enter the next setting for **Uset**, **Iset** and **tset**, and continue until all values have been entered for the entire **SEQUENCE**. Use rotary knobs for **Uset** and **Iset** settings only. Press the <FUNCTION> key for **tset** settings.

- ⑬ After saving the last step of the **sequence loop** (13a) with the <SAVE> and <ENTER> keys, press the <FUNCTION> key in order to continue to the **tdEF** setting.
- ⑭ Enter a **tdEF** value if necessary, acknowledge by pressing the <FUNCTION> key and/or jump to the next function.
- ⑮ **Strt** - Entry of a **SEQUENCE** start address is prompted.
- ⑯ Select a start address with the <↓> key or the <↑> key if necessary, acknowledge by pressing the <FUNCTION> key and/or jump to the next function.
- ⑰ **StoP** - Entry of a **SEQUENCE** stop address is prompted.
- ⑱ Select a stop address with the <↓> key or the <↑> key if necessary, acknowledge by pressing the <FUNCTION> key and/or jump to the next function.
- ⑲ **rEP** - Entry of the number of **SEQUENCE** repetitions is prompted.
- ⑳ Select the desired number of repetitions with the <↓> key or the <↑> key if necessary, acknowledge by pressing the <FUNCTION> key and/or jump to the next function.
- ㉑ **Seq Go** blinks at the displays, indicating that the **SEQUENCE** can now be started.
- ㉒ Press the <ENTER> key. The sequence is run using the selected values.

Jump from **Uset / Iset** settings to the last edited function, or from any given function to the next function by pressing the <FUNCTION> key.

Press the <FUNCTION> key and the <↑> key to jump back to the previous function.

The **READY LED** blinks to indicate that a sequence is running.

The example included here is only intended to demonstrate reliable sequence programming. You can use other procedures as well, which may be easier or faster for you.

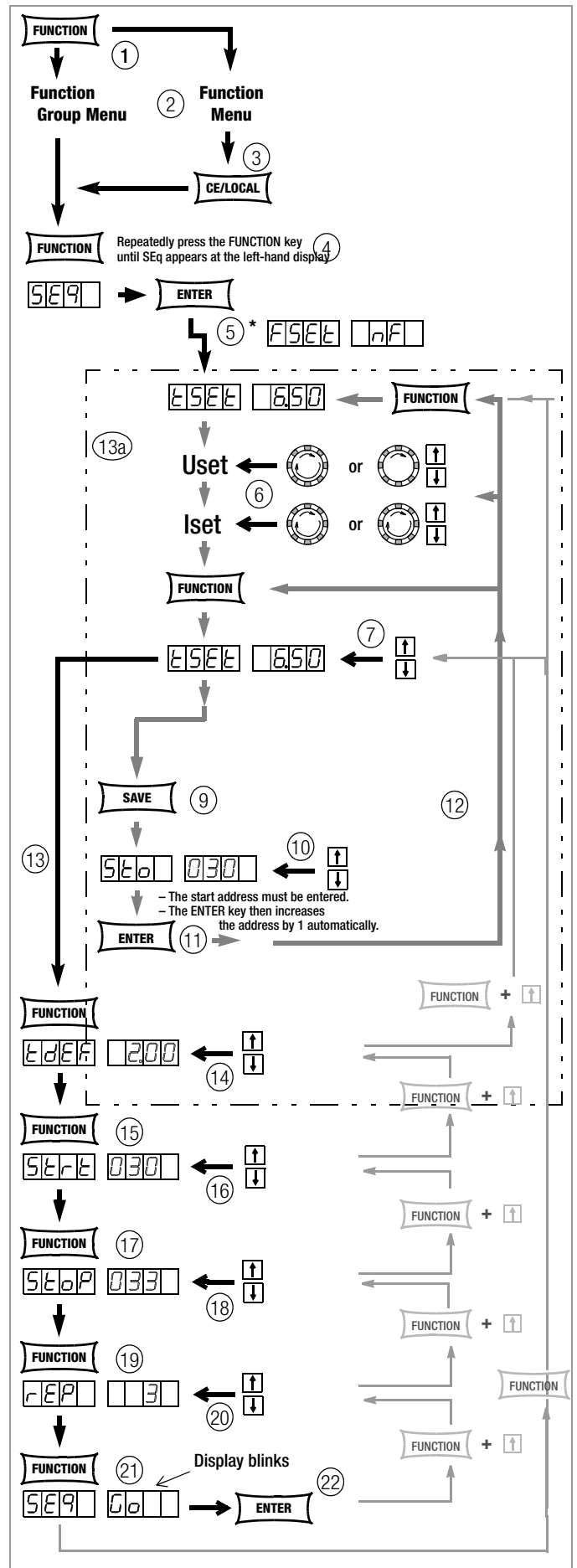


Figure 4.7.3 i Setting all Required Values for a **SEQUENCE**

* From firmware version 03.004 onwards, start with selecting parameter FSEt by pressing <↓> or <↑> and then acknowledge with <ENTER>

Checking the Sequence

Functions

! The following parameters can be checked at the display menu while the **SEQUENCE** is running, or when it has been suspended:

- > **Pout** = max. output power
- > **rcl** = address of the current memory location
- > **rrEP** = number of repetitions yet to be executed
- > **USEt** = momentary output voltage
- > **ISET** = momentary output current
- > **tSET** = execution time for the current address (**tSET** or **tdEF**) no display of remaining time

Checking the Sequence with Manual Operation

- ☞ Press the <SELECT> key and browse through the display menu.
- ☞ Further information is included in chapter 4.8.

Checking the Sequence with Remote Querying

The status of the sequence can be queried by means of remote command (see page 71).

Possible responses to text: "RUN", "HOLD", "RDY"

- RUN: active sequence
- HOLD: sequence suspended
- RDY: device in initial state

Numeric value for number of repetitions yet to be executed (rrep)

Numeric value for current memory address (rcl)

Influencing Step-by-Step Control

Step-by-step control is used to test Uset and Iset setpoint values in a time-independent fashion before a sequence is run automatically. Step-by-step control is activated by executing the **SEQUENCE START** command, or by initial execution of the **SEQUENCE STEP** command.

Executing the Start Address and Beginning Step-by-Step Control (status: HOLD → HOLD or RUN → HOLD)

Functions

- ! The start address can be selected at any time from a suspended or a running **SEQUENCE**. The setpoints saved to the start address are executed. Selected dwell times of the exited and the new memory address are not taken into consideration.
- ! The device is switched from automatic sequence to step-by-step control the first time this step is executed.
- The output is switched to the On status.

Procedure:

- ☞ With **suspended** or **running SEQUENCE**,
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **start** appears,
 - and execute the command with the <ENTER> key.
- ! The **SEQUENCE** executes the start address.
- ! If the sequence is in the HOLD status, the selected dwell time is irrelevant.
- ! The READY LED blinks slowly in the HOLD status.

Executing the Next Address (status: HOLD → HOLD)

Functions

- ! The next or the previous memory location can be selected at any time from a suspended **SEQUENCE** – in the step-by-step control mode. The setpoints saved to the next or the previous memory location are executed. Selected dwell times of the

exited and the new memory address are not taken into consideration.

- The output retains its previous switching status (output On or Off).
- When jumping from the start address to the stop address or back again, the remaining repetitions counter (rrep) remains unchanged.

Procedure:

- ☞ With **suspended SEQUENCE**,
 - press the <ENTER> key (next address), or
 - the <↑> key (next address)
 - the <↓> key (previous address) or
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **step** appears
 - and execute the command (next address) with the <ENTER> key.

! The **SEQUENCE** executes the next, or the previous address.

! If the sequence is in the HOLD status, the selected dwell time is irrelevant.

! The READY LED blinks slowly in the HOLD status.

- Start automatic sequence run from the current memory location: see resuming the sequence from the HOLD status in the following chapter.
- Start automatic sequence run: see sequence restart in the following chapter.
- Jump to the stop address: see ending the sequence at the stop address in the following chapter.
- End step-by-step control at the current address: see ending the sequence at the current address in the following chapter.

Influencing the Automatic Sequence Run

Stop the sequence manually – end at stop address (status: RUN → RDY)

Functions

- ! A **SEQUENCE** can be stopped (ready status) at any time while it is running (run status), or when it has been suspended (hold status).
- ! The sequence jumps to the stop address when interrupted.
- If the memory location assigned to the stop address is empty, the Uset and Iset values from the last executed address are retained. If the memory location assigned to the stop address is not empty, Uset and Iset are changed to the corresponding values. Selected dwell time Tset of the last executed memory location is not taken into consideration.
- ! The output retains its switching status (output On or Off) if the memory location assigned to the stop address is not empty. The output is switched to the off status if the memory location assigned to the stop address is empty.

Procedure:

- ☞ Press the <FUNCTION> key.
- ! SEq **StoP** blinks at the display.
- ☞ Press the <ENTER> key.
- ! The contents of the stop address are executed. The sequence is ended.

Stopping The Sequence at the Current Address (status: RUN → HOLD)

Functions

- ! A running **SEQUENCE** can be suspended for an indefinite period of time.
- Uset and Iset retain the values specified in the current memory location. Selected dwell time Tset of the current memory location is not taken into consideration.

- The output retains its switching status (output On or Off).
- The **SEQUENCE** can be **resumed** (cont) at the next memory location, **or ended at the current address** <CE/LOCAL> or **the stop address** (stop) or **restarted** (go).
In addition, **step-by-step control** can be started at the **next address** (Step) or at the **start address** (Start) as well.

Procedure:

- ☞ With **running SEQUENCE**,
 - press the <ENTER> key or
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **hold** appears and execute the command with the <ENTER> key.

- ! The **SEQUENCE** stops at the current address.
- ! The READY LED blinks slowly in the HOLD status.

Resuming the Sequence from the HOLD Status (status: HOLD → RUN)

Functions

- ! A suspended **SEQUENCE** can be resumed at any time.
- The output retains its switching status (output On or Off). The selected dwell time of the exited memory location is not taken into consideration.
- ! The sequence is now resumed starting with the next address, and the values stored to the respective memory location (**Uset**, **Iset** and **tdef/tset**) are read out to the power output.
- ! In the case of very long dwell times, you can advance prematurely to the next memory location by **pressing the <ENTER> key twice (status: RUN → HOLD → RUN)**.

Procedure:

- ☞ With **suspended SEQUENCE**,
 - press the <ENTER> key or
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **cont** appears and execute the command with the <ENTER> key.

- ! The **SEQUENCE** is resumed starting with the next memory location.
- ! The READY LED blinks rapidly in the Run status.

Ending the Sequence at the Stop Address (status: HOLD → RDY)

Functions

- ! A suspended **SEQUENCE** can be ended at any time by executing the stop address.
- If the memory location assigned to the stop address is empty, the Uset and Iset values from the hold address are retained. If the memory location assigned to the stop address is not empty, Uset and Iset are changed to the corresponding values. Selected dwell time Tset of the current memory location is not taken into consideration.
- The output status is determined by the contents of the stop address. The output retains its switching status (output On or Off) if the memory location assigned to the stop address is not empty. The output is switched to the off status if the memory location assigned to the stop address is empty.

Procedure:

- ☞ With **suspended SEQUENCE**,
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **stop** appears and execute the command with the <ENTER> key.

- ! The **SEQUENCE** is ended and the output status is determined by the contents of the stop address.
- ! The READY LED does not blink in the RDY status.

Ending the Sequence at the Current Address (status: HOLD → RDY)

Functions

- ! A suspended **SEQUENCE** can be ended at the current address at any time.
- Uset and Iset retain the values specified in the current memory location. Selected dwell time Tset of the current memory location is not taken into consideration.
- The output retains its switching status (output On or Off).

Procedure:

- ☞ With **suspended SEQUENCE**,
 - press the <CE/LOCAL> key.

- ! The **SEQUENCE** is ended and the output status is determined by the content of the current address.
- ! The READY LED does not blink in the RDY status.

Restarting the SEQUENCE (status: HOLD → RUN or RUN → RUN)

Functions

- ! A suspended or running **SEQUENCE** can be restarted at any time.
- The output is switched to the output On status.
- ! In this case, all memory locations are executed, one after the other, from the start address to the stop address, and the respective values saved to each location (**Uset**, **Iset** and **tdef/tset**) are read out to the power output and the signal output.

Procedure:

- ☞ With **interrupted or running SEQUENCE**,
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **go** appears and execute the command with the <ENTER> key.

- ! The **SEQUENCE** is restarted.

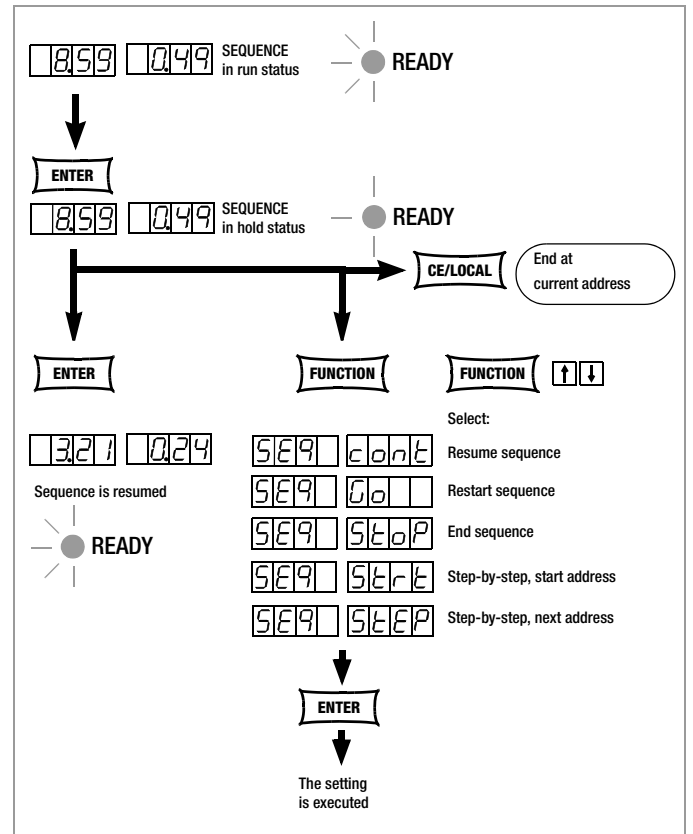


Figure 4.7.3 j Suspending and Resuming a Sequence

Executing the Next Address and Beginning Step-by-Step Control

(status: HOLD → HOLD)

Functions

- ! The next memory location can be selected at any time from a suspended **SEQUENCE**. The setpoints saved to the next memory location are executed. Selected dwell times of the exited and the new memory address are not taken into consideration.
- ! The device is switched from automatic sequence to step-by-step control the first time this step is executed (see page 36).
- The output retains its switching status (output On or Off).
- When jumping from the stop address to the start address, the remaining repetitions counter (rrep) remains unchanged.

Procedure:

- ☞ With **suspended SEQUENCE**,
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **step** appears and execute the command with the <ENTER> key.
- ! The **SEQUENCE** executes the next address.
- ! Selected dwell times of the new and the exited memory address are not taken into consideration.
- ! The READY LED blinks slowly in the HOLD status.

Executing the Start Address and Beginning Step-by-Step Control (status: HOLD → HOLD or RUN → HOLD)

Functions

- ! The start address can be selected at any time from an interrupted or a running **SEQUENCE**. The setpoints saved to the start address are executed. Selected dwell times of the exited and the new memory address are not taken into consideration.
- ! The device is switched from automatic sequence to step-by-step control the first time this step is executed (see page 36).
- The output is switched to the output On status.
- The remaining repetitions counter is reset to the initial value (rrep = rep).

Procedure:

- ☞ With **interrupted or running SEQUENCE**,
 - press the <FUNCTION> key and then browse with the <↑> key, the <↓> key or the <FUNCTION> key until SEq **start** appears, and execute the command with the <ENTER> key.
- ! The **SEQUENCE** executes the start address.
- ! Selected dwell times of the new and the exited memory address are not taken into consideration.
- ! The READY LED blinks slowly in the HOLD status.

4.7.4 buS – The “Interface” Function Group

The KONSTANTER can be set up for data transmission to a computer in the interface configuration function group. In this case, all of the settings previously selected with DIP switches are entered via menu functions.

The serial port (RS 232) or the parallel port (IEEE 488) is used for communication.

Addr – Selecting the Device Address (IEEE 488)

- An address must be assigned to the SSP KONSTANTER in order to assure that it functions correctly together with other devices on the IEC bus.
- If the KONSTANTER receives its own address from the computer, it interprets subsequent data and executes the respective commands.
- If it receives the address of another device, all subsequent data are ignored until it receives its own address.

Settings

- ☞ **Procedure** for selecting **Addr**: see also chapter 4.7 - **Settings**.
- ☞ Press the <FUNCTION> key in order to access the **FUNCTION** menu.
- ! The last edited function or function group is accessed automatically.
- ☞ Select **buS** configuration if necessary by pressing the <FUNCTION> key, or the <FUNCTION> key and the <↓> key or the <↑> key simultaneously.
- ! **buS** appears at the left-hand display.
- ☞ Acknowledge by pressing the <ENTER> key.
- ! The **buS** function menu appears.
- ☞ Select the **Addr** function by pressing the <FUNCTION> key, or the <FUNCTION> and the <↓> key or the <↑> key simultaneously.
- ! **Addr** appears at the left-hand display, and the last selected parameter appears at the right-hand display.
- ☞ Select an address for the SSP KONSTANTER with the <↓> key or the <↑> key.
- ! Any address within a range of 0 to 31 may be selected.
- ! The selected address must be the same as the address selected for the SSP KONSTANTER at the computer.
- ! Address 0 is usually assigned to the controller.
- ! Address 31 means unL (unlist).
- ☞ Acknowledge your selection with the <ENTER> key.

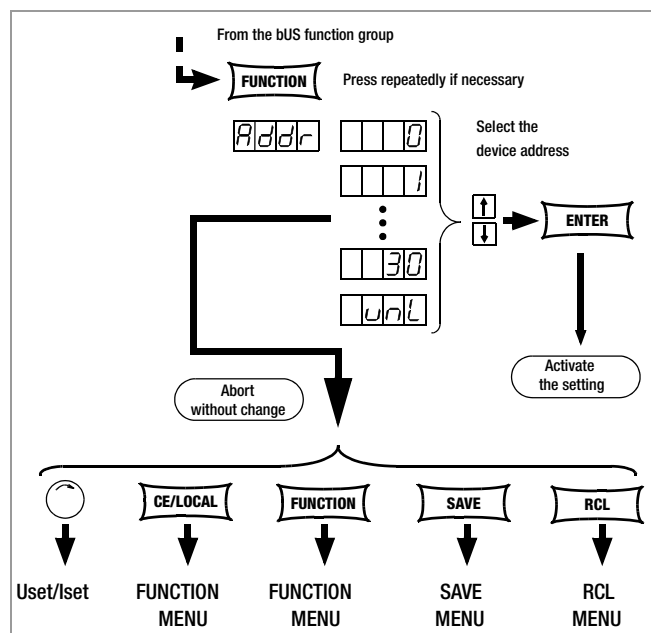


Figure 4.7.4 a Path to Device Address Selection

bAud – Setting Transmission Speed (RS 232C)

- Specifies transmission speed in bits per second.
- The baud rate is an operating parameter of the serial interface.
- A low baud rate should be used in the case of large distances between communicating devices and in EMC-critical environments.
- Settings at the SSPKONSTANTER and the controller must be identical.
- The baud rate can be set to one of the following values: 50, 75, 150, 200, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 or 19,200 bits per second.

Settings

☞ **Procedure** for selecting **bAud**, and setting the desired transmission speed (see chapter 4.7).

! **bAud** appears in the **bUS** display along with the related parameter (transmission speed).

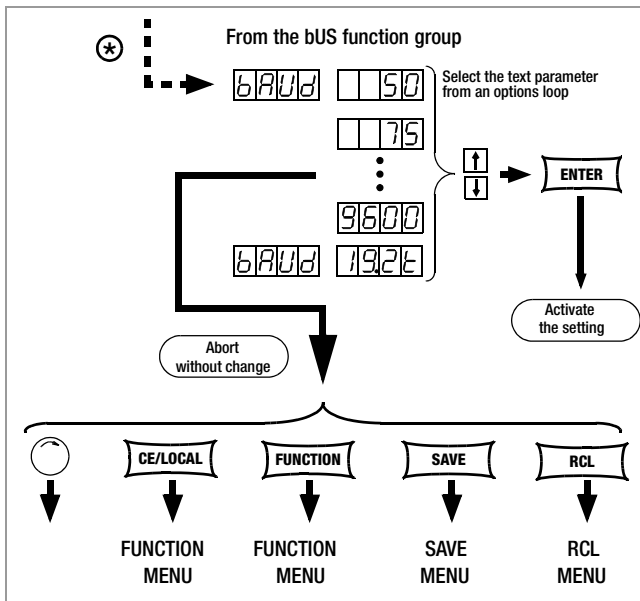


Figure 4.7.4 b Path to Selection of the bAud Text Parameter

dbit – Selecting the Number of Data Bits (RS 232C)

- Either 7 or 8 data bits can be used.
- Settings at the SSPKONSTANTER and the controller must be identical.

Settings

☞ **Procedure** for selecting **dbit** and the desired number of data bits (see also chapter 4.7).

! **dbit** appears in the **bUS** display along with the related parameter (number of data bits).

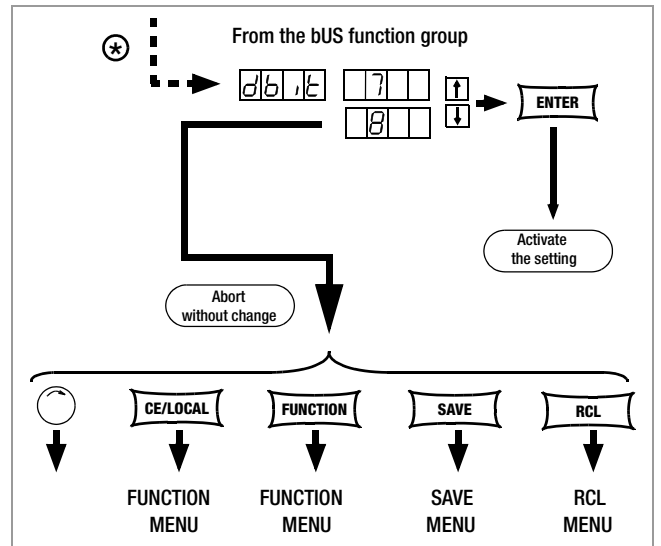


Figure 4.7.4 c Path to Selection of the dbit Text Parameter

Pbit – Setting the Parity Bit (RS 232C)

- Parity or check bits are used to detect transmission errors.
- They are added to the character string so that the sum of H or L is even or odd as defined.
- The parity bit can be set to one of the following values:

| | |
|-------------|---------------|
| none | no parity bit |
| ZErO | always 0 |
| EVEn | even numbered |
| odd | odd numbered |
| nonE | always 1 |

! A parity bit should always be used in EMC-critical environments.

! Settings at the SSP KONSTANTER and the controller must be identical.

Settings

☞ **Procedure** for selecting **Pbit** and setting the parameter (see also chapter 4.7).

! **Pbit** appears in the **bUS** display along with the related parameter (parity bit).

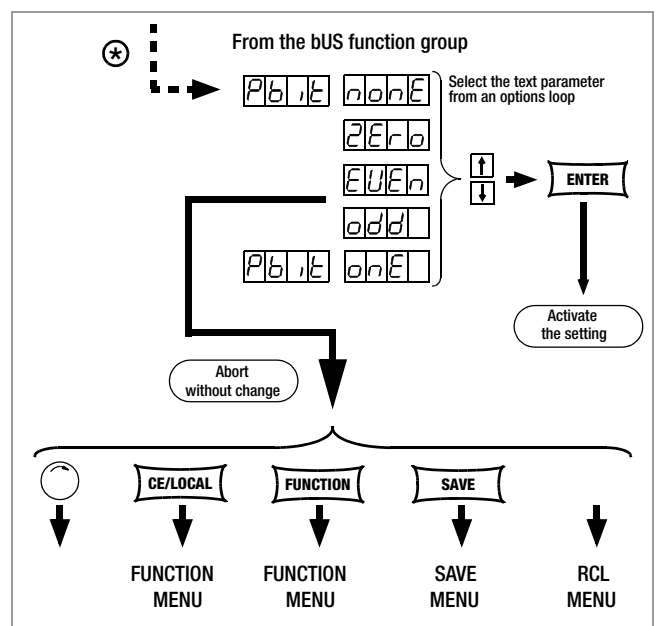


Figure 4.7.4 d Path to Selection of the Pbit Text Parameter

Sbit – Selecting the Number of Stop Bits (RS 232C)

- Either 1 or 2 stop bits can be used.
- ! Settings at the SSP KONSTANTER and the controller must be identical.

Settings

- ☞ **Procedure** for selecting **Sbit** and setting the parameter (see also chapter 4.7).
- ! **Sbit** appears in the **bUS** display along with the related parameter (number of stop bits).

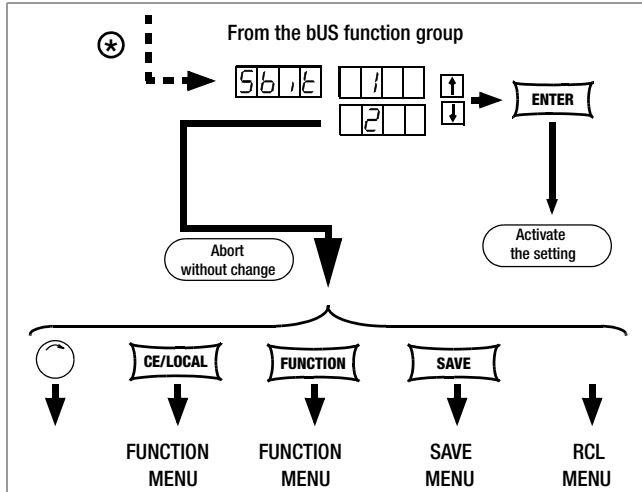


Figure 4.7.4 e Path to Selection of the Sbit Text Parameter

4.8 Settings with the <SELECT> Key

Depending upon settings in the **FUNCTION** menu, the <SELECT> keys make 3 different functions available:

4.8.1 In the Basic Function

The READY LED is continuously illuminated. After pressing the <SELECT> key, the following measured values and setting values appear at the 7-segment Uout / Iout display:

| | | |
|-------|-------|--|
| Uout | Iout | Measured voltage and current values |
| Uset | Iset | Voltage and current setpoints |
| Ulim | Ilim | Voltage and current limit values |
| OVset | Delay | Overvoltage setpoint and overcurrent delay |
| Pout | Pout | Output power |

Setting Procedure

- ☞ Repeatedly press the <SELECT> key until the LED for the desired function lights up and the setting value appears at the display.
- **Resolution (cursor position)** for the numeric parameter [V]:
 - ☞ Repeatedly press the <RESOL> key [19]. The cursor advances in a **loop from right to left**.
 - ☞ The cursor blinks allowing for identification of its current position.
- **Select a value for the desired function:**
 - ☞ With the <↑> key (increase value) or the <↓> (decrease value) key, independent of resolution!
 - ! The last selected value becomes immediately active.
- **Abort** the procedure:
 - ☞ By slightly turning a rotary knob ([5] or [8]).
 - ☞ With the **CE/LOCAL**, **SAVE**, **RCL** or **FUNCTION** key.

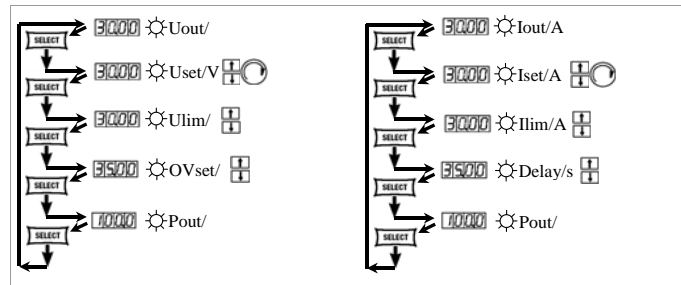


Figure 4.8.1 Accessing Various Displays with the SELECT Key

4.8.2 Automatic Sequence Run and Step-by-Step Sequence Control

The READY LED blinks when the **SEQUENCE** function is active. The **SELECT** menu is expanded. It doesn't matter whether the **SEQUENCE** function is in the **RUN** or the **HOLD** status.

| | | |
|------|------------|---|
| Uout | Iout | Measured voltage and current values |
| Uset | Iset | Voltage and current setpoints |
| Pout | Pout | Output power |
| tSet | xx.xx | Programmed dwell time (tSet or tDEF) for current address, no remaining time |
| rcL | xxx number | Current address, memory location |
| rrEP | xxx | Number of remaining sequence repetitions |

Selection of output quantities and setpoints is indicated by the respective LED. Uset, Iset and tSet are the displayed setpoints of the sequence memory location which is currently being executed.

4.8.3 Displaying Stored Data Upon Execution of <RCL>

Displaying Data Stored to Setup Memory (1 ... 10) Upon Execution of <RCL>

After executing the <RCL> command, selecting a memory location (<↓> or <↑> key) and pressing the <ENTER> key, the device is switched to the read-out mode. Values saved to setup memory blink at the display. The basic settings stored to the selected memory location can now be browsed by pressing the <SELECT> key:

| | | |
|-------|-------|--|
| Uset | Iset | Voltage and current setpoints |
| Ulim | Ilim | Voltage and current limit values |
| OVset | Delay | Overvoltage setpoint and overcurrent delay |
| outP | | Output switching status after power on |
| OCp | | Overcurrent protection |
| UI_ | | Min-Max value recording |
| tDEF | | Dwell time independent of memory location |
| tSet | | Programmed dwell time |
| Strt | | Start address |
| StoP | | Stop address |
| rEP | | Number of repetitions |

Displaying Data Stored to Sequence Memory (11 ... 255) Upon Execution of <RCL>

After executing the <RCL> command, selecting a memory location (<↓> or <↑> key) and pressing the <ENTER> key, the device is switched to the read-out mode. Values saved to sequence memory blink at the display. The settings stored to the selected memory location can now be browsed by pressing the <SELECT> key:

| | | |
|------|------|-------------------------------|
| Uset | Iset | Voltage and current setpoints |
| tSet | | Programmed dwell time |

4.9 Setting Resolution with the <RESOL> Key

Numeric parameters can be set to varying degrees of accuracy. Set the cursor to the desired decimal place within the display to this end. The corresponding decimal place blinks in order to indicate the current cursor position.

Resolution can be set for the following parameters:

- Uset, Iset, Ulim, Ilim, OVset, Delay, tset and tdef

Settings

- Select the desired parameter.
- The parameter value blinks at the last selected decimal place.
- Press the <RESOL> key. The cursor (blinking decimal place) is moved one place to the right.
- Repeatedly press the <RESOL> key until the cursor is positioned at the desired decimal place.
- Set the parameter to the desired value with the <↓> key or the <↑> key using the selected resolution.

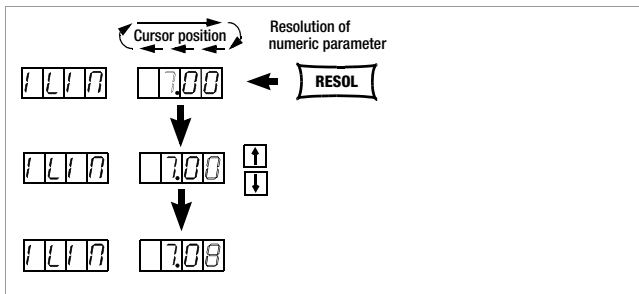


Figure 4.9 Selecting Setting Resolution with the RESOL Key

4.10 Storing Data with the <SAVE> Key

The <SAVE> key is used for the following functions:

- Saving basic device settings
- Saving data to a memory location
- Deleting all data within a defined memory range from address 11 to 255
- Inserting additional data to a **SEQUENCE**
- Deleting an individual **SEQUENCE** memory location

4.10.1 Saving Basic Device Settings

- Basic device settings can be saved to memory locations 1 through 10.
- These settings are saved to battery-backed memory. Settings for all of the following parameters can be saved to this memory:

| | | |
|------------|-------|--------|
| USET/ISET | OVSET | TSET |
| OCP | TDEF | |
| DELAY | START | OUTPUT |
| MINMAX | STOP | ULIM |
| REPETITION | ILIM | |

Settings

- Select values for the desired parameters.
- Press the <SAVE> key.
- ! Sto appears at the left-hand display, and the last selected memory location number appears at the right-hand display.
- Select the desired memory location (1 to 10) with the <↓> or the <↑> key.
- Acknowledge by pressing the <ENTER> key.
- Exit the **SAVE** function by pressing the <CE/LOCAL> key.
- Switch to the respective function by pressing the <FUNCTION> key, the <SELECT> key or the <RCL> key, or by slightly turning the **current or voltage** adjusting knob.

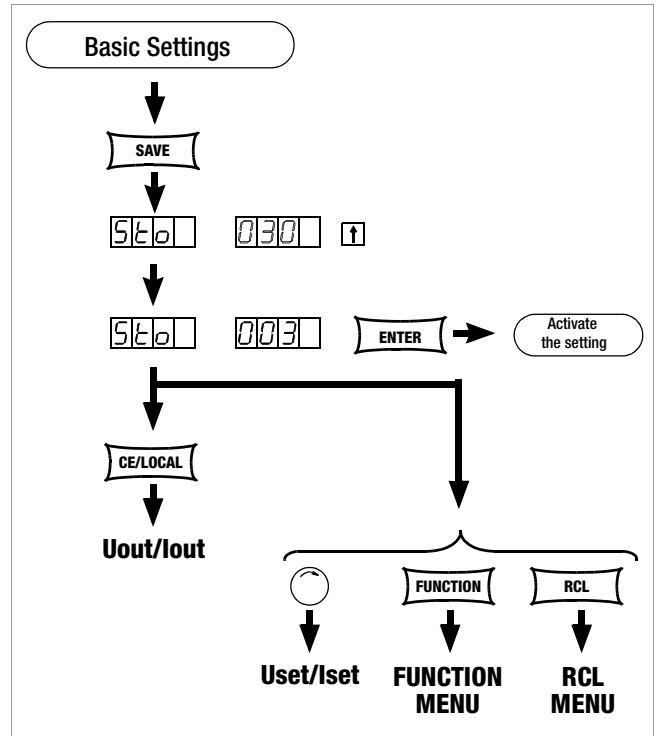


Figure 4.10.1 Saving Device Settings

4.10.2 Saving Data to a Memory Location

Functions

- SEQUENCE** data can be saved to memory locations 11 through 255.
- These settings are saved to battery-backed memory.
- Uset, Iset and Tset values can be saved.

Settings (see also page 35)

- Select values for the desired parameters.
- Press the <SAVE> key.
- ! Sto appears at the left-hand display, and the last selected memory location number appears at the right-hand display.
- Select the desired memory location (11 to 255) with the <↓> key or the <↑> key.
- Acknowledge by pressing the <ENTER> key.

4.10.4 Inserting a Memory Location

The start and stop addresses define the working range for the command described below. Memory locations which do not lie within this range are protected against access when executing this command. Each time an empty memory location is inserted, the contents of the previous stop address are lost.

Functions

- Starting with the target address, previously saved data are shifted to the next highest address number.
- Memory location content located at memory address N prior to insertion, is shifted to memory address N+1.
- Data which were previously stored to the memory location with the stop address are lost.
- The target address has no content after initial insertion.

Attention: Currently selected start and stop addresses and start and stop addresses saved to setup memory are not corrected automatically!

Settings

- ☞ Select a start address and a stop address with the help of the sequence submenu.
- ☞ Press the **<SAVE>** key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired target address with the **<↓>** key or the **<↑>** key.
- ☞ Simultaneously press the **<SAVE>** and **<↑>** keys.
- ! An **i** (for insert) appears in the right-hand display next to the selected address number.
- ☞ Execute the insert command by pressing the **<ENTER>** key.
- ! An empty memory location is added at the selected memory address.
- ! The address numbers of all memory locations above the selected address are increased by 1.

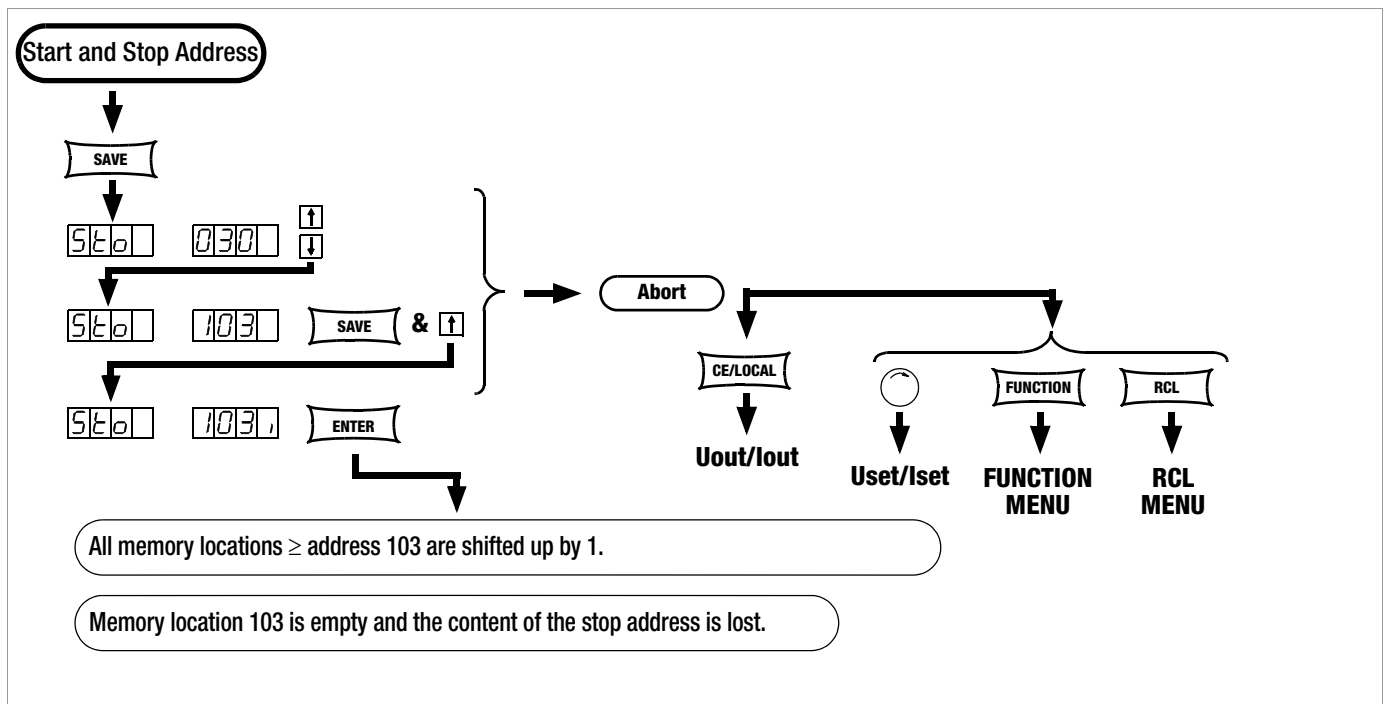
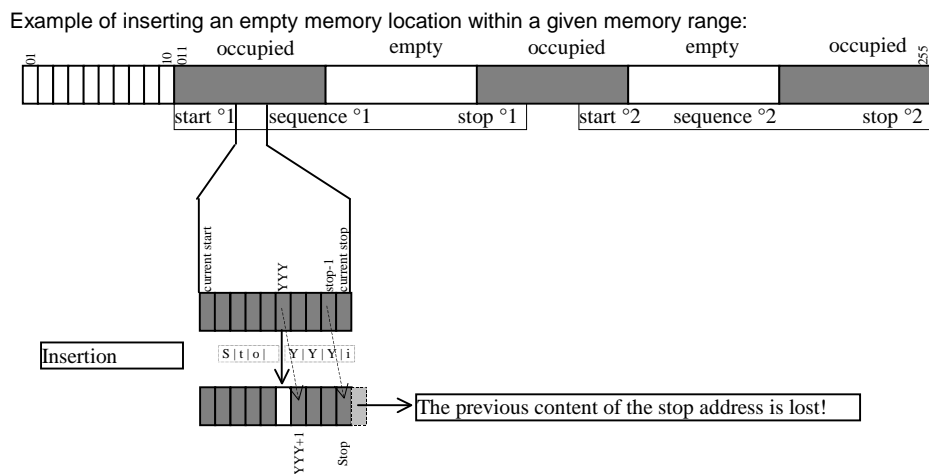


Figure 4.10.4 Inserting a Memory Location Within a Given Range



4.10.5 Deleting a Memory Location

The start and stop addresses define the working range for the command described below. Memory locations which do not lie within this range are protected against access when executing this command. Each time a memory location is deleted, an empty memory location is inserted at the stop address.

Functions

- Starting with the target address, previously saved data are shifted to lower address numbers.
- Memory location content located at memory address N prior to deletion is shifted to memory address N-1.
- Data which were previously stored to the memory location with the target address are lost.
- The stop address has no content after initial deletion.

Attention: Currently selected start and stop addresses and start and stop addresses saved to setup memory are not corrected automatically!

Settings

- ☞ Select a start address and a stop address with the help of the sequence submenu.
- ☞ Press the <SAVE> key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired target address with the <↓> key or the <↑> key.
- ☞ Simultaneously press the <SAVE> and <↓> keys.
- ! A **d** (for delete) appears in the right-hand display next to the selected memory address.
- ☞ Execute the delete command by pressing the <ENTER> key.
- ! The address numbers of all memory locations within the start to stop address range above the selected address are decreased by 1.

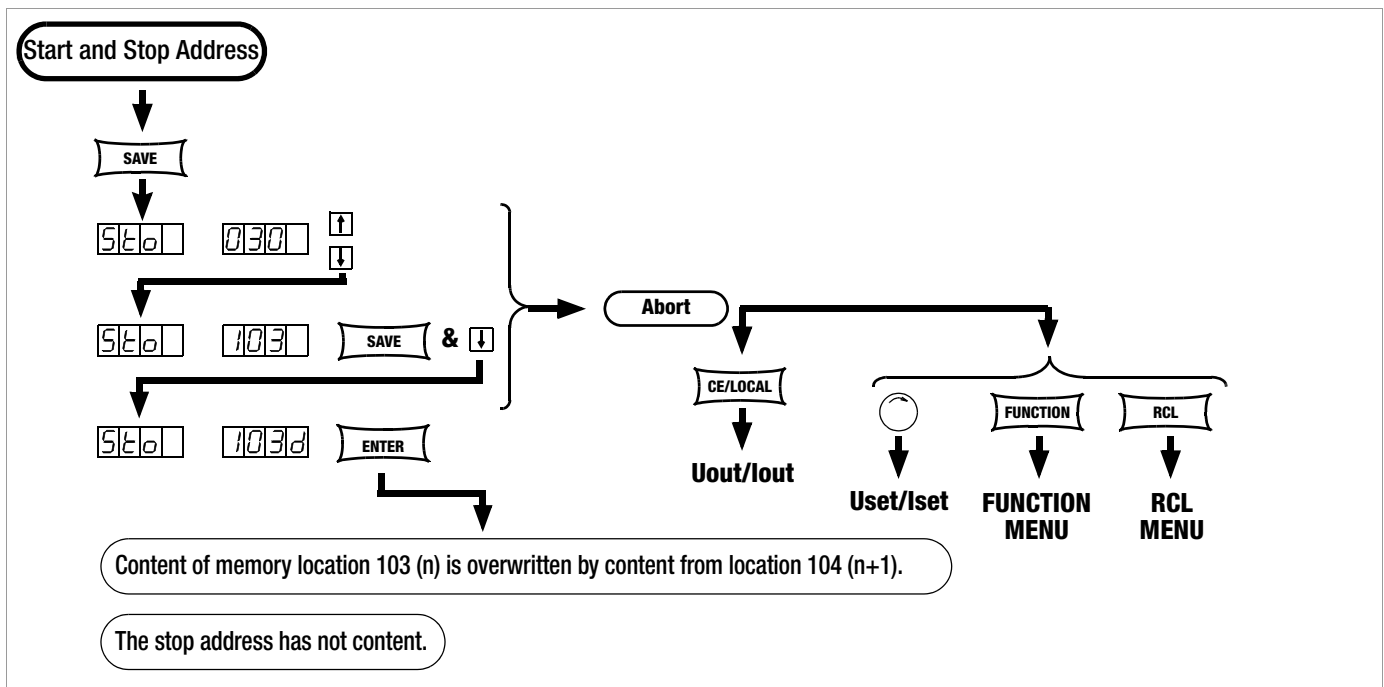
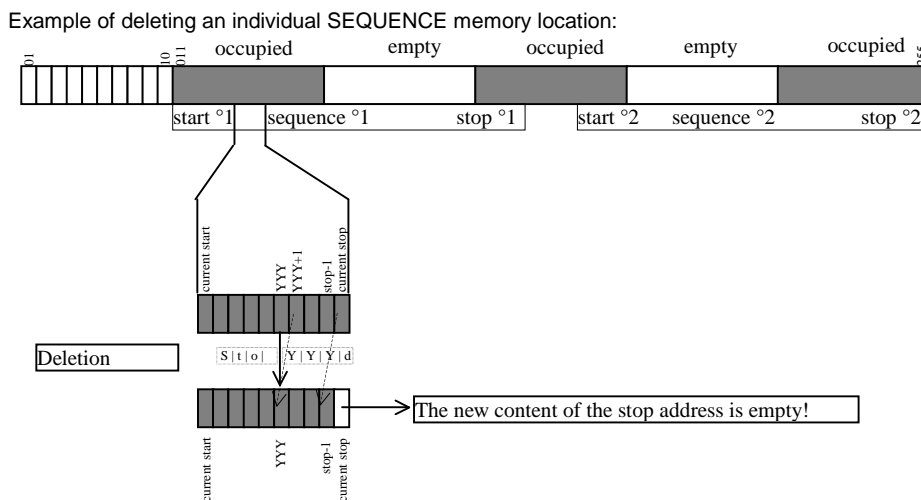


Figure 4.10.5 Deleting an Individual SEQUENCE Memory Location



4.10.6 Deleting the Contents of a Memory Location

Functions

- The contents of any desired individual memory location from address 11 through 255 can be deleted.
- This has no effect on other memory location addresses.

Settings

- ☞ Press the **<SAVE>** key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired address with the **<↓>** key or the **<↑>** key.
- ☞ Simultaneously press the **<SAVE>** and **<CE/LOCAL>** keys.
- ! A **c** (for clear) appears in the right-hand display next to the selected memory location address number.
- ☞ Execute the delete command by pressing the **<ENTER>** key.

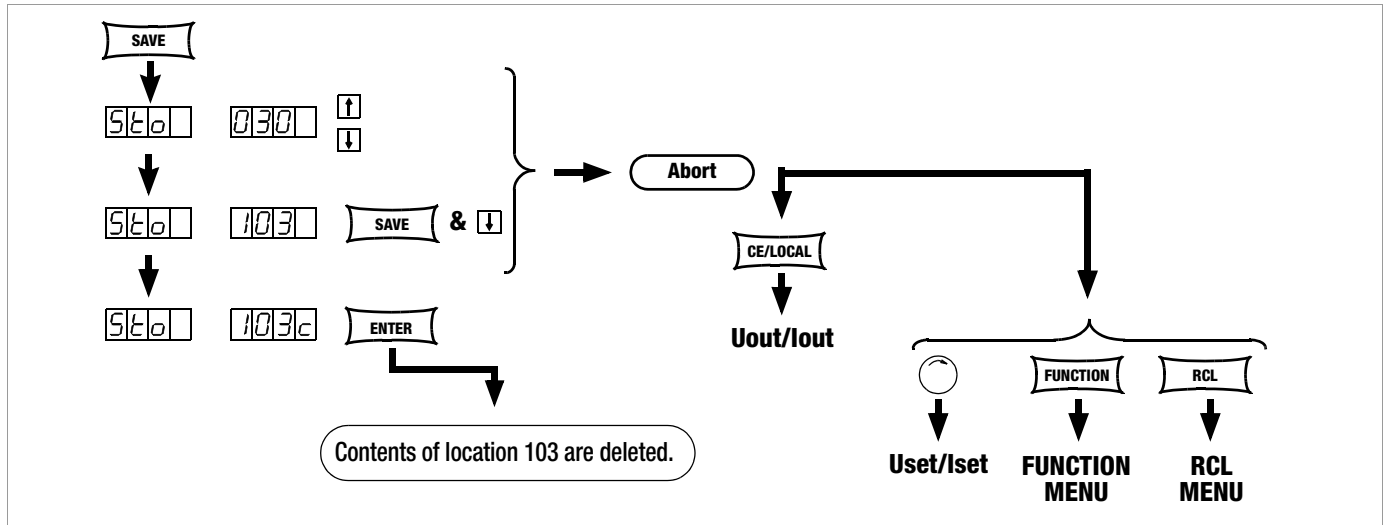
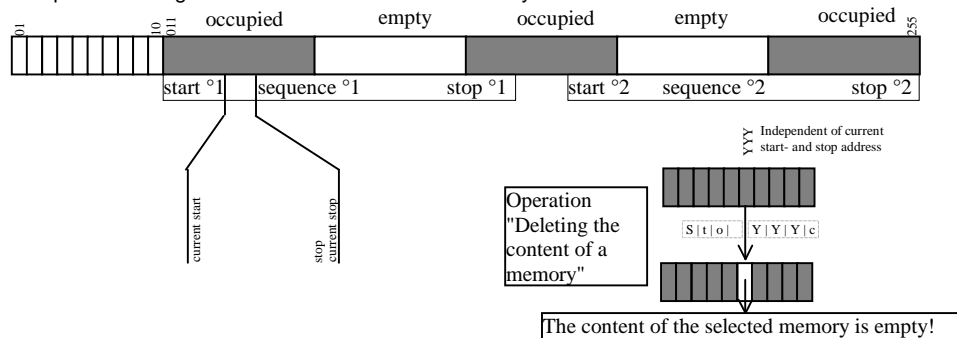


Figure 4.10.6 Deleting the Contents of an Individual Memory Location

Example of deleting the content of an individual memory location:



4.11 Memory Recall with the **<RCL>** Key

- All device settings saved to memory with **<SAVE>** or **STORE** can be recalled with the **<RCL>** key (**RECALL**), e.g. in order to reconfigure the device. This memory is battery-backed.
- Empty memory locations are displayed as "----" "----", and cannot be recalled.
- **RCL** can also be controlled via the analog interface (see page 29 and chapter 5.7).

4.11.1 Recall from SETUP Memory

| Addr. 1 to 10: Complete basic device settings | | | |
|---|--------|--------|------------|
| USET | OVset | OCp | START |
| ISET | Ulim | DELAY | STOP |
| Tset | Ilim | MINMAX | REPETITION |
| | OUTPUT | Tdef | |

Settings

- ☞ Press the **<RCL>** key.
- ! **rcl** appears at the left-hand display, and the last selected memory location number appears at the right-hand display.
- ☞ Select the desired address [1 ... 10] by pressing the **<↓>** key

or the **<↑>** key.

- ☞ Press the **<ENTER>** key.
- ! Iset and Uset settings saved to this address blink at the display.
- ☞ Browse through this memory location with the **<SELECT>** key in order to view the respective parameter settings (see chapter 4.8).
- ☞ All of the data saved to this memory location can now be loaded as basic settings by once again pressing the **<ENTER>** key.
- ☞ Press the **<CE/LOCAL>** key to abort the **RECALL** function.
- ☞ Press the **<RCL>** key in order to return to the memory location selection function.
- ☞ The **RECALL** function can be exited by pressing any other function key, or by turning the adjusting knob.

4.11.2 Recall from SEQUENCE Memory

Addr. 11 to 255: Uset, Iset and tSet values for the sequence function

- ☞ Data from memory locations 11 through 255 can be recalled at any time during programming.

- ☞ Press the <RCL> key.
- ! rcl appears at the left-hand display, and the last selected memory location number appears at the right-hand display.
- ☞ Select the desired address (11 ... 255) by pressing the <↓> key or the <↑> key.
- ☞ Acknowledge your selection with the <ENTER> key.
- ! Iset and Uset settings saved to this address blink at the display.
- ☞ Browse through this memory location with the <SELECT> key in order to view the respective parameter settings (see chapter 4.8).
- ☞ All of the data saved to this memory location can now be loaded by once again pressing the <ENTER> key.
- ! If one of the recalled Uset or Iset values exceeds the currently valid soft limit (Ulim and Ilim), execution of the command is aborted, **Err 21** id displayed briefly and bit 5 is set in event register B.
- ! Only Uset and Iset are executed: tset is loaded as a current setting value and is not executed.
- ☞ Another memory location can be immediately accessed with the <↓> key or the <↑> key while the previous function is being executed.
- ☞ Press the <CE/LOCAL> key to abort the **RECALL** function.
- ☞ Press the <RCL> key in order to return to the memory location selection function.
- ☞ The **RECALL** function can be exited and another function accessed by pressing any other function key, or by turning the adjusting knob.

4.12 Disabling Front Panel Controls

The front panel controls can be disabled against inadvertent changes to selected values and settings.

The behaviour during power on is also determined by the selected power-on status parameter Pon (page 27).

Disabling

- ☞ Simultaneously press the <CE/LOCAL> and <RCL> keys.
- ! The front panel controls are now disabled.
- ! The yellow **LOCAL LOCKED** LED lights up.

Enabling

- ☞ Press and hold the <CE/LOCAL> key for at least 4 seconds, or until the **LOCAL LOCKED** LED goes out.

Disabling and Enabling via the Analog Interface

- ☞ The <CE/LOCAL> key can also be disabled by applying a signal to the trigger input at the analog interface and selecting the appropriate setting for the **T_MODE** function, thus preventing manual reactivation of the front panel controls.

4.13 The <ENTER> Key

The <ENTER> key is used to execute various functions in combination with the respectively selected operating mode.

Pre-Selecting Setpoints (fixed value selection)

- 1) <ENTER>: change display from Uout/lout to Uset*/Iset.
- 2) <↓> or <↑>: preselect Uset, Uset LED blinks.
- 3) <ENTER>: activate Uset value.
- 4) <ENTER>: change to Iset*.
- 5) <↓> or <↑>: preselect Iset, Iset LED blinks.
- 6) <ENTER>: activate Iset value.

* The adjustable <RESOL> decimal place blinks.

See also page 22, Pre-Selected Settings.

Activating Parameter Values

Textual or numeric parameter values are activated with the <ENTER> key during device setup.

Executing Commands

- <SAVE>: save data to the selected address.
- <RCL>: recall data saved to the selected address. After pressing the <ENTER> key the first time, the selected data blink at the display, and are then executed after pressing the <ENTER> key once again.
- Sequence control: execution of SEq xxxx commands.
- Function group selection: access parameter settings for the selected function group.

Sequence and Step-by-Step Control

- A running sequence can be suspended by pressing the <ENTER> key.
- Status change: RUN → HOLD

- A suspended sequence can be resumed by pressing the <ENTER> key.
- Status change: HOLD → RUN

The next memory location can be executed by pressing the <ENTER> key in the step-by-step control mode.

4.14 The <CE/LOCAL> Key

The <CE/LOCAL> key is used to execute a specific function in combination with the respectively selected operating mode.

RESET Device Settings

See chapter 4.16.

Disable and Enable Front Panel Controls

See chapter 4.12.

Switch from REMOTE to LOCAL

See chapter 4.17.

Abort an Operation

Uset / Iset Entry

- ☞ <CE/LOCAL> key
Switch to display of measured Uout and Iout values.

<SELECT> Display

- ☞ <CE/LOCAL> key
Switch to display of measured Uout and Iout values.

<SAVE> / <RCL> Function

- ☞ <CE/LOCAL> key
Abort <SAVE> and <RCL> functions, switch to display of measured Uout and Iout values.

Function Group Selection

- ☞ <CE/LOCAL> key
Return to display of measured Uout and Iout values from function group selection.

Function Selection

- ☞ <CE/LOCAL> key
Abort function selection, return to function group selection.

Text Parameters

- ☞ <CE/LOCAL> key
Abort selection, switch to display of selected text parameter.

Sequence Control

☞ <CE/LOCAL> key

Abort a suspended sequence or step-by-step control at the current memory location.

4.15 INCR <↑> and DECR <↓> Keys

The increment and decrement keys execute various functions depending upon settings.

• Parameter Selection

Text parameters

<↑> or <↓> displays next or previous parameter.

Acknowledge the respective text parameter with the <ENTER> key.

Abort with rotary knob <CE/LOCAL>, <RCL>, <SAVE> or <FUNCTION>.

Numeric parameters

<↑> or <↓>: increase or decrease the value of the parameter at the cursor position.

<RESOL> is used to move the cursor.

The respective numeric parameter is activated automatically.

Exception:

Settings for **Uset** and **Iset** initialized with the <ENTER> key (setpoint settings) and selected with the <↑> key < or the <↓> key, must also be acknowledged with the <ENTER> key.

• Memory Location Selection

After Pressing <RCL> or <SAVE>

<↑> or <↓> selects next or previous memory location.

Address by address preview of stored setpoints:

After pressing <RCL> → <↑>/<↓> 11 ... 255 → <ENTER>:

Blinking display of USET, ISET and TSET setpoints, can be selected with <SELECT>, browse through addresses in the background with selected setpoint using <↑> or <↓>, the respective stored setpoint is displayed.

• Browsing through Submenus

Function menu

<FUNCTION> + <↑> or <↓>

Switch to next or previous function or function group.

• Browsing through Min-Max Memory

After querying U₋, U₊, I₋ or I₊ in the SET menu, these values can be browsed using <↑> or <↓>.

• Executing the Next or the Previous Memory Location in Step-by-Step Control Mode

After executing SEQ Strt or SEQ StEP with a running or a suspended sequence, the next or the previous memory location can be executed with <↑> or <↓>.

4.16 Device RESET

Most device functions can be returned to a defined default value with the reset command (see chapter 8.1 and page 62).

☞ Press and hold the <CE/LOCAL> key, and then press the <ENTER> key.

4.17 Selecting Remote and Local Control Modes

After switching mains power on, the manual operating mode is always active (local state): All front panel controls are enabled and the device can be operated manually.

a) LOCAL → REMOTE

– Switching from manual to remote control

Switching to remote control occurs:

Via the IEC bus interface

– When the REN line is activated by the controller and

– The device is addressed as a listener

Via the serial interface

– As soon as data are transmitted to the device.

b) REMOTE → LOCAL

– Switching from remote to manual control

The device is returned to manual operation:

Manually

– By activating the <CE/LOCAL> key, as long as it has not been disabled by the controller during IEC bus operation (→ c)

– Via the IEC bus

– By transmitting the addressed GTL (GO TO LOCAL) interface command to the device (selective switching to manual operation),

Programming example (HP Basic): **LOCAL 712** or

– If the REN line is deactivated by the controller (switches all devices to manual operation),

Programming example (HP Basic): **LOCAL 7**

c) LOCAL LOCKOUT

– Disabling manual return to local operation

(only relevant for control via the IEC bus)

The IEC bus controller can disable the LOCAL key at the device with the LLO (LOCAL LOCKOUT) universal interface command, preventing manual return to the local operating mode (remote state with lock).

Programming example (HP Basic): **LOCAL LOCKOUT 7**

Comment

The "REMOTE" LED indicates the momentary control mode:

LED on = remote mode

LED off = manual mode

Switching back and forth between the two control modes does not cause any changes to current device settings or stored parameters.

Exception when switching from REMOTE → LOCAL: If the display has been switched off it is reactivated (DISPLAY OFF → DISPLAY ON).

IEC bus control: The device is capable of receiving programming data in the manual operating mode, but they are not executed.

5 Analog Interface

5.1 Pin Assignments

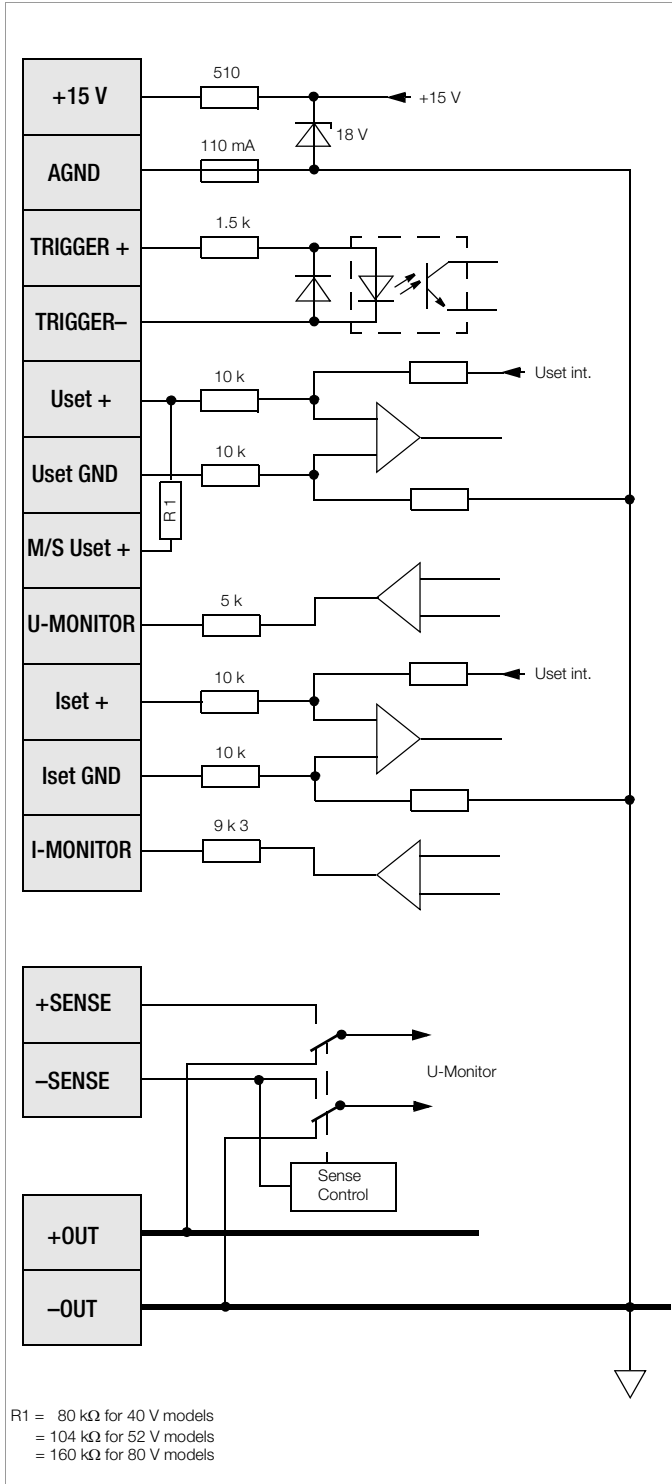


Figure 5.1 Auto-Sensing Mode

+15 V (output)

Internal auxiliary voltage (+15 V ± 3% with reference to AGND) is connected to this terminal via a protective resistor with a value of 510 Ω. It can thus be used to drive the TRIGGER input, or to supply power to external components such as reference elements for the generation of control voltages. The output is short-circuit proof to AGND.

AGND (analog ground)

Reference point for analog control inputs and outputs. This terminal is internally connected to the minus pole of the power output via an auto-reversible fuse with a rating of 110 mA.

TRIGGER+, TRIGGER- (input)

Floating digital control input, whose function (output On/Off or memory recall) can be selected with the front panel controls.

Low signal: $0 \text{ V} \leq U_S \leq 1 \text{ V}$

High signal: $4 \text{ V} \leq U_S \leq 26 \text{ V}$, $I_S = (U_S - 2 \text{ V}) / 1.5 \text{ k}\Omega$

The input is reverse-polarity protected to -26 V.

Uset+, Uset GND (input)

Analog (differential) voltage input with reference to AGND for controlling output voltage. The following applies when the output is activated:

$$U_{out} = U_{set} + U_{su} * k_u$$

U_{out} = output voltage in constant voltage regulating mode

U_{set} = Uset voltage value selected either manually or via interface control

U_{su} = external control voltage (0 ... 5 V ≅ 0 ... $U_{out \text{ nom}}$)

k_u = control coefficient = $U_{out \text{ nom}} / 5 \text{ V}$

M / S Uset+ (input)

Analog control input with reference to AGND for series master-slave connection.

U-MONITOR (output)

Analog voltage output signal, proportional to output voltage acquired by the sensing leads (0 ... 10 V ≅ 0 ... $U_{out \text{ nom}}$). The short-circuit proof output is referenced to AGND and has an internal resistance of 5 kΩ.

Iset+, Iset GND (input)

Analog (differential) voltage input with reference to AGND for controlling output current. The following applies when the output is activated:

$$I_{out} = I_{set} + U_{si} * k_i$$

I_{out} = output current in constant current regulating mode

I_{set} = current value selected either manually or via interface control

U_{si} = external control voltage (0 ... 5 V ≅ 0 ... $I_{out \text{ nom}}$)

k_i = control coefficient = $I_{out \text{ nom}} / 5 \text{ V}$

I-MONITOR (output)

Analog voltage output signal, proportional to output current (0 ... 10 V ≅ 0 ... $I_{out \text{ nom}}$). The short-circuit proof output is referenced to AGND and has an internal resistance of 9.3 kΩ.

+SENSE, -SENSE (input)

For connection of sensing leads for 4-wire operation – allows for compensation of voltage drops (to 2 * 2 V) at long output leads. Switching to 4-wire operation takes place automatically when the -SENSE lead is connected to the respective negative output pole.

5.2 Auto-sensing mode

Functions

Output voltage values required for voltage measuring and control circuits can be acquired directly at the power consumer instead of at the output terminals with the help of the +SENSE and –SENSE sensing lead terminals at the analog interface. Sensing mode operation (remote sensing) offers the following advantages:

- In the constant voltage regulating mode, current related voltage drops occurring in the output leads have practically no effect on voltage supplied to the power consumer. Voltage at the output terminals is automatically increased to compensate for voltage drops.
- In the constant current regulating mode, voltage limiting at the power consumer is independent of output current.
- Since the voltage value provided by the measuring function is relative to the voltage value acquired at the sensing leads, load parameters such as power consumption and load resistance can be more accurately determined.

The parameters and limit values included in Figure 5.2 and in chapter 1.5.3, Electrical Data, apply for operation with the sensing leads.

Connection

The two sensing lead terminals at the analog interface (+SENSE and –SENSE) must be connected to their respective output poles at the desired point (generally speaking as close to the power consumer as possible).

It is advisable to twist and/or shield the sensing leads in order to minimize interference (connect the shield to the ground terminal of the negative output pole).

Long output and sensing lead impedances may result in control fluctuations at the output, especially with capacitive power consumers. This effect can be counteracted by connecting capacitors (C_{S+} , C_{S-}) between the SENSE and output terminals (see Figure 5.2). If the output leads are twisted, their impedance can be reduced as well.

Incorrect connection of the sensing leads does not damage the device, although it results in the following reversible events:

- Sensing leads with reversed polarity or interrupted output lead: If output voltage is not being limited at the device by means of current regulation, it climbs to well above the selected value which finally triggers overvoltage protection and immediately deactivates the output.
- Interrupted +SENSE lead: Voltage between the output terminals increases by approximately 7%.
- Interrupted –SENSE lead: The sensing terminals are deactivated (automatic return to local sensing). If the sensing leads have been connected incorrectly, increasing voltage between the output terminals is not acquired by the measuring function.

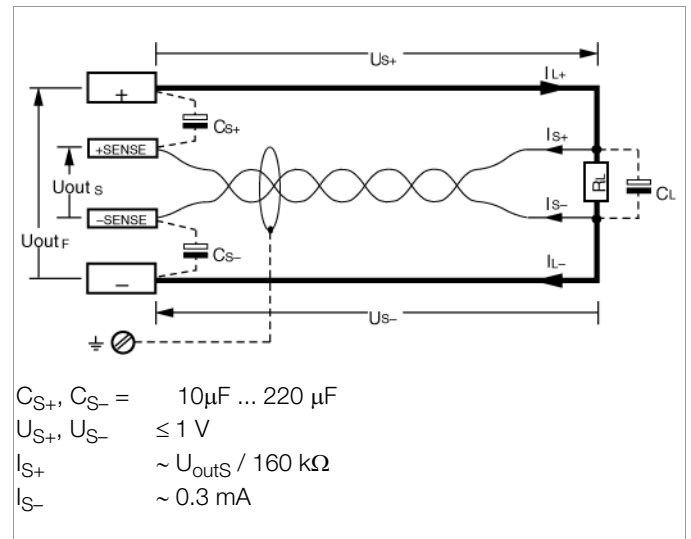


Figure 5.2 Connecting the Power Consumer for Sensing Mode Operation

Switching the Instrument On

The remote sensing mode function is activated automatically after the –SENSE terminal has been connected to the corresponding output pole. The function is deactivated by once again interrupting this connection.

5.3 Regulating Output Voltage

Functions

The control inputs Uset+ (non-inverting) and Uset GND (inverting) allow for adjustment of output voltage Uout with an external control voltage USU.

The following applies in the constant voltage regulating mode:

$$U_{out} = U_{SET} + U_{SU} \times k_{SU}$$

USET = voltage setpoint selected manually or via interface
 kSU = voltage control coefficient = Uoutnom / 5 V

Max. adjusting error: ± 0.05% Unom ± 0.2% setpoint value

The voltage control input functions as a differential voltage input:

Uset+ = non-inverting input:
 USU = 0 ... +5 V for Uout = 0 V ... Uoutnom
 Uset GND = inverting input:
 USU = 0 ... -5 V for Uout = 0 V ... Uoutnom

Input resistance is 10 kΩ in both cases.

Note:

The control inputs are not floating inputs: Their reference point, AGND, is connected to the negative output pole. Connecting grounded circuits to the control input may result in erroneous adjustments due to leakage current or ground loops.

If the reference point of control voltage USU is connected to the negative output pole at the load side, the inverting input must be connected to this point in order to prevent influences due to voltage drops at the output lead (connection b in Figure 5.3a). If control voltage is isolated from the output, Uset GND must be connected with AGND (connection a in Figure 5.3a).

USU can also be applied as an alternating voltage, for example in order to superimpose manually selected direct voltage USET with interference signals. The maximum operating frequency of modulated output voltage depends upon voltage amplitude, the current limiting setting and load, and thus cannot be defined with a simple formula. It is increased as amplitude is decreased, and as current limiting and load are increased.

If remote output voltage adjustment is to be accomplished by means of a potentiometer, wiring can be configured as shown in the example in Figure 5.3b.

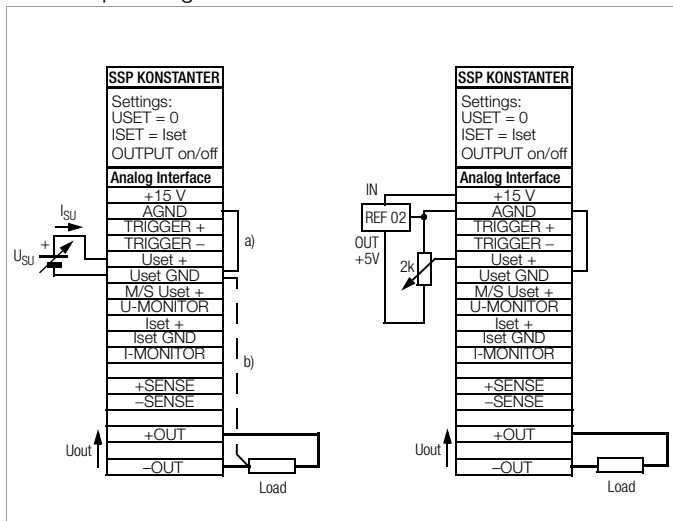


Figure 5.3a Wiring for Voltage Regulation with External Voltage

Figure 5.3b Wiring for Voltage Regulation with External Potentiometer

5.4 Regulating Output Current

Functions

The control inputs Iset+ (non-inverting) and Iset GND (inverting) allow for adjustment of output current Iout with an external control voltage USI.

The following applies in the constant voltage regulating mode:

$$I_{out} = I_{SET} + U_{SI} \times k_{SI}$$

ISET = current setpoint selected manually or via interface
 kSI = current control coefficient = Ioutnom / 5 V

Max. adjusting error: ± 0.1% Unom ± 0.3% setpoint value

The current control input functions as a differential voltage input:

Iset+ = non-inverting input:
 USI = 0 ... +5 V for Iout = 0 A ... Ioutnom
 Iset GND = inverting input:
 USI = 0 ... -5 V for Iout = 0 A ... Ioutnom

Input resistance is 10 kΩ in both cases.

Note:

The control inputs are not floating inputs: Their reference point, AGND, is connected to the negative output pole. Connecting grounded circuits to the control input may result in erroneous adjustments due to leakage current or ground loops.

If the reference point of control voltage USI is connected to the negative output pole at the load side, the inverting input must be connected to this point in order to prevent influences due to voltage drops at the output lead (connection b in Figure 5.4a). If control voltage is isolated from the output, Iset GND must be connected with AGND (connection a in Figure 5.4a).

USI can also be applied as an alternating voltage, for example in order to superimpose manually selected direct current ISET with interference signals. To a great extent, the maximum operating frequency of modulated output current depends upon the output current value, as well as the voltage amplitude which results from the prevailing load, and thus cannot be defined with a simple formula. It is increased as amplitude is decreased, and as load is increased.

If remote output current adjustment is to be accomplished by means of a potentiometer, wiring can be configured as shown in the example in Figure 5.4b.

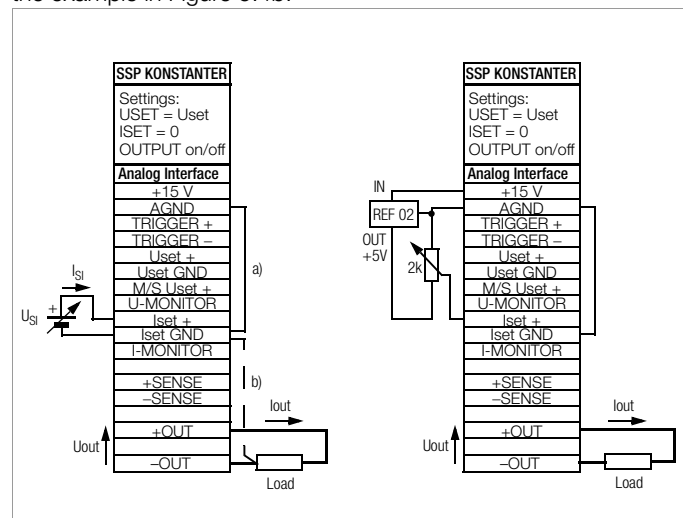


Figure 5.4a Wiring for Current Regulation with External Voltage

Figure 5.4b Wiring for Current Regulation with External Potentiometer

5.5 Voltage Monitoring Output

Functions

The U-MONITOR terminal reads out a voltage with reference to AGND, which is proportional to output voltage U_{out} . This is used as a control voltage for master-slave series connection (see 5.9.2). However, it can also be used for external measuring, monitoring and recording.

Note:

The monitor output is not a floating output: Its reference point, AGND, is connected to the negative output pole. Connecting grounded measuring circuits to the monitor output may result in erroneous measurements due to leakage current or ground loops.

The voltage monitoring output makes reference to output voltage acquired at the sensing leads (see 5.2).

The monitor output is short-circuit proof. It has an internal resistance of $5\text{ k}\Omega$.

$$U_{MU} = U_{out} \times k_{MU} = 0 \dots 10\text{ V}$$

$$k_{MU} = 10\text{ V} / U_{outnom}$$

$$= 0.25 \quad \text{for } 40\text{ V models}$$

$$= 0.192 \quad \text{for } 52\text{ V models}$$

$$= 0.125 \quad \text{for } 80\text{ V models}$$

$$R_i(\text{U-MONITOR}) = 5\text{ k}\Omega$$

Max. error for U_{MU} : $\pm 0.5\text{ mV} \pm 0.2\%$

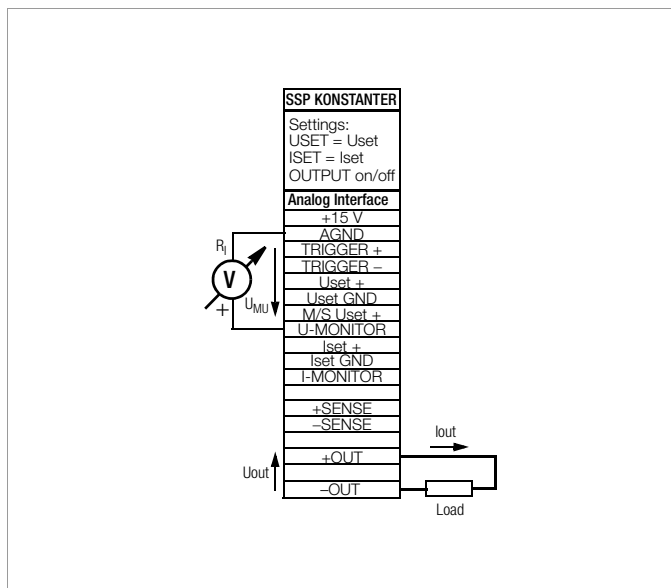


Figure 5.5 Voltage Monitor Wiring

5.6 Current Monitoring Output

Functions

The I-MONITOR terminal reads out a voltage with reference to AGND, which is proportional to output current I_{out} . This is used as a control voltage for master-slave parallel connection (see 5.8.2). However, it can also be used for external measuring, monitoring and recording.

Note:

The monitor output is not a floating output: Its reference point, AGND, is connected to the negative output pole. Connecting grounded measuring circuits to the monitor output may result in erroneous measurements due to leakage current or ground loops.

Monitor voltage is derived from voltage drop at the internal current sensing resistor (shunt), which is connected to the negative output conductor upstream from the output capacitor. In this way, the current monitor also acquires dynamic charging and discharging current at the output capacitor when output voltage is increased or decreased, or when the output is activated and deactivated.

The monitor output is short-circuit proof. It has an internal resistance of $9.3\text{ k}\Omega$.

$$U_{MI} = I_{out} \times k_{MI} = 0 \dots 10\text{ V}$$

$$k_{MI} = 10\text{ V} / I_{outnom}$$

$$R_i(\text{I-MONITOR}) = 9.3\text{ k}\Omega$$

Max. error for U_{MI} : $\pm 0.5\text{ mV} \pm 0.3\%$

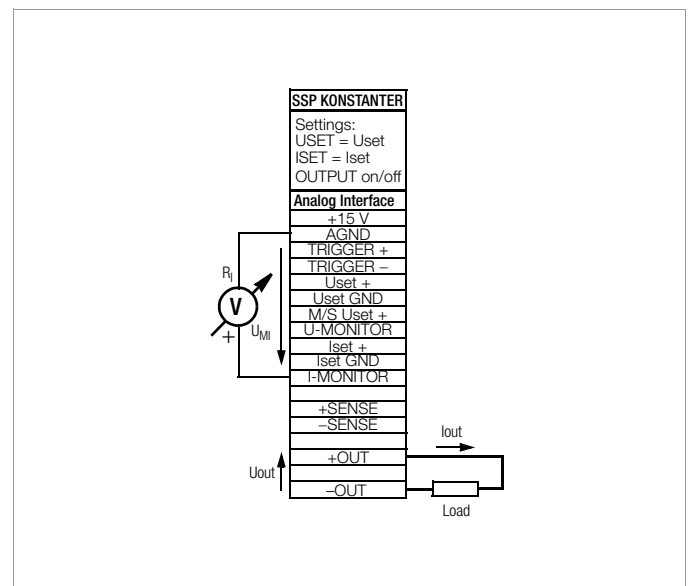


Figure 5.6 Current Monitor Wiring

5.7 Trigger Input

Functions

The floating TRIGGER + input with optocoupler allows for remote control of a device function by means of a binary signal. The function to be controlled is selected with the T_MODE setting (in the trG display).

A detailed description is included on page 74.

Connection

Connect the control signal to TRIGGER + and TRIGGER -. Refer to the table below for the respective signal level.

| Signal | U_S | I_S |
|--------|---------------|---|
| High | 4 ... 26 V DC | $(U_S - 2 \text{ V}) / 1.5 \text{ k}\Omega$ |
| Low | 0 ... 1 V DC | 0 mA |

The TRIGGER input can be driven with the + 15 V output at the analog interface via any desired switch (Figure 5.7a).

Warning!

The TRIGGER + input is a floating input and is functionally isolated from the output current circuit.

This functional isolation is not equivalent to “safety separation” as specified in electrical safety regulations.

Note

Trigger signal pulses must have a minimum duration of 14 ms in order to assure reliable recognition.

A delay of 1 to 15 ms may occur between application of the control signal and triggering of the controlled function.

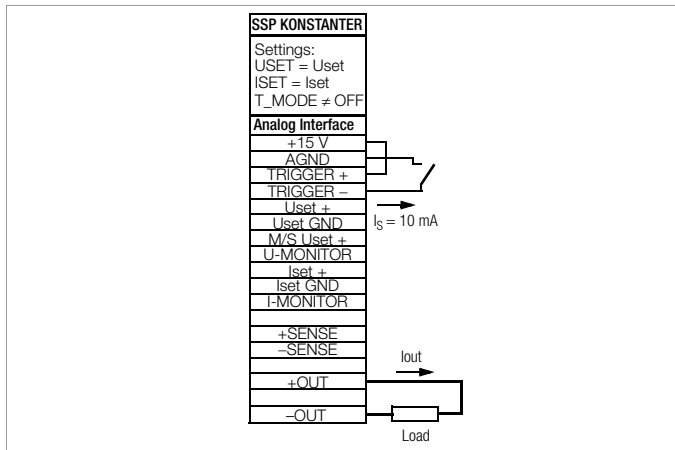


Figure 5.7a Driving the TRIGGER Input with a Switch Contact

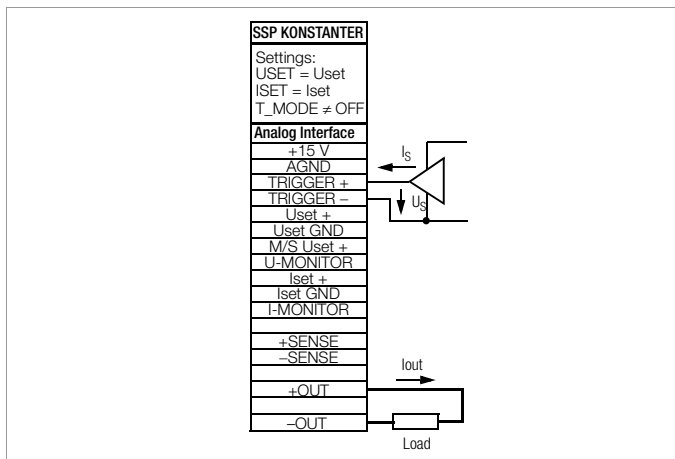


Figure 5.7b Driving the TRIGGER Input with an External Signal

Trigger Function setting Parameters

| Parameter | Meaning | |
|-----------|--|--|
| OFF | Trigger input function is deactivated, trigger signals have no effect. | |
| OUT | OUTPUT | |
| | Low | OUTPUT depends upon manual setting or programming command |
| | Edge Low → High | OUTPUT remains OFF or OUTPUT is switched OFF |
| | High | OUTPUT is OFF and cannot be activated (neither manually nor by means of a program command). |
| | Edge High → Low | OUTPUT is activated, exception: OTP or OVP |
| RCL | RECALL | Memory recall (step-by-step sequence control) |
| | Edge Low → High | Start trigger signal |
| | High | – The trigger signal is a high pulse with a duration of 11 to 800 ms. – A pulse with $t_{\text{high}} > 1.0 \text{ s}$ resets the address counter to the start address at any point in time, and execution begins with the next trigger signal. |
| | Edge High → Low | The high → low edge of the (short) trigger signal results in step-by-step control of the currently selected sequence, regardless of the specified time and number of repetitions. Recall of the memory's contents begins with the START address. Each trigger signal increases the address by 1, until the STOP address is reached. The next pulse once again causes execution of the contents of the START address. |
| SEQ | SEQUENCE | Sequence execution control |
| | Edge Low → High | The SEQUENCE function is started beginning with the start address (SEQUENCE GO). |
| | Edge High → Low | Ends sequence execution by jumping to the stop address |
| LLO | LOCAL LOCKED | Front panel control disabling |
| | Low | All front panel controls are functional. |
| | High | All front panel controls are disabled except for the mains switch, and activation is not possible with the LOCAL key. |
| MIN | MINMAX | Storage of Min-Max values for U and I is controlled when the MINMAX function is activated (MINMAX ON)(UI_ ON). |
| | Low | The Min-Max function is active. |
| | Edge Low → High | The Min-Max function is deactivated. Values in the Min-Max memories remain unchanged. |
| | High | The Min-Max function is inactive. |
| | Edge High → Low | Values in the Min-Max memories are reset and replaced with momentary output values. The Min-Max function is activated. |

5.8 Parallel Connection

If output current from a single KONSTANTER is insufficient for the respective application, the outputs of any number of KONSTANTERs can be parallel connected.

Caution!

If outputs with different nominal voltages are parallel connected, all outputs must be limited to the lowest utilized nominal voltage value. The ULM parameter is used to select this setting.

5.8.1 Direct Parallel Connection

Functions

Easiest way to provide the power consumer with more current than is available from a single KONSTANTER.

KONSTANTERs with differing nominal output voltages can be used. However, all voltage setpoints must be set or limited to the same value.

This setup is less suitable for the constant voltage regulating mode.

Wiring

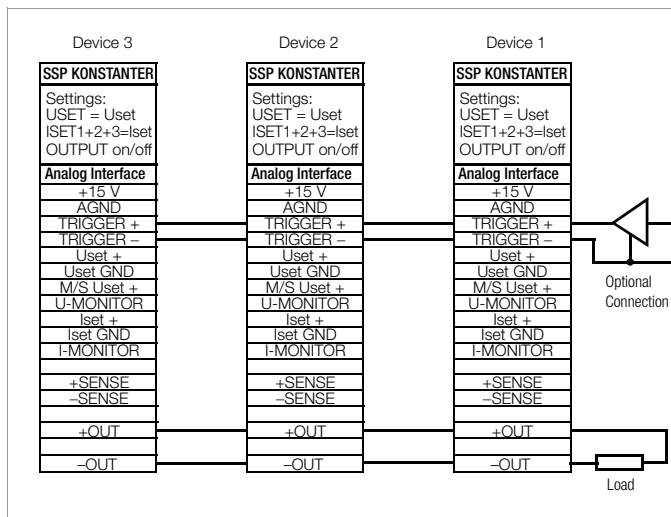


Figure 5.8.1a Wiring for Direct Parallel Connection

Settings

Deactivate all outputs.

Adjust voltage setpoint USET of all parallel connected KONSTANTERs to approximately the same value:

$$Uset = USET1 = USET2 = USET3 = USETn$$

Adjust the current setpoints ISET such that they add up to the desired cumulative current value Iset:

$$Iset = ISET1 + ISET2 + ISET3 + \dots + ISETn$$

Activate the outputs.

Functional Principle

After switching the outputs on, load current is initially supplied by the KONSTANTER with the highest voltage setting.

If load resistance is continuously reduced, load current is continuously increased.

When load current reaches the ISET value selected for the output which is momentarily supplying power to the consumer, current limiting is activated for this output.

If load resistance is further decreased, current regulation reduces output voltage until the voltage value of the output with the next lowest setting is reached.

As of this point in time, this KONSTANTER also supplies a portion of the load current.

This procedure is continued until load current triggers current regulating at the output with the lowest voltage setting when the setpoint value for cumulative current is reached.

This output maintains constant load current until the load resistor is short-circuited.

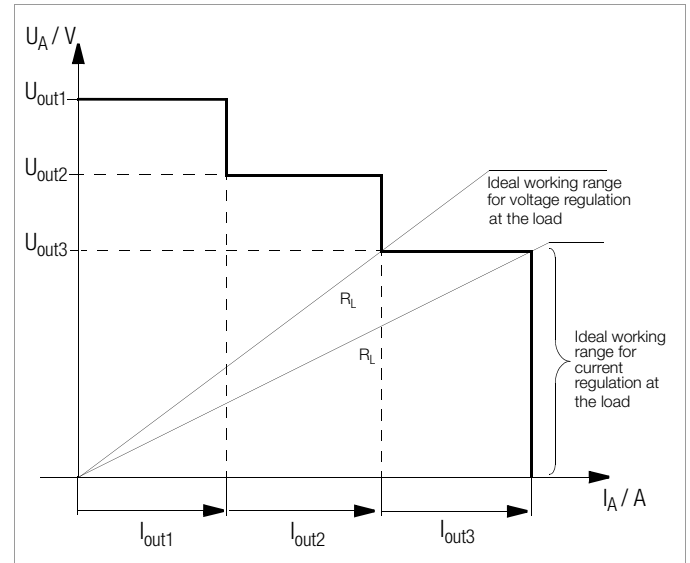


Figure 5.8.1b U / I Diagram for Direct Parallel Connection

Note:

Slightly varying voltages occur at the individual outputs as a result of setting tolerances.

In the event of larger voltage differences, an electronic sink is activated at the outputs with lower voltage settings.

The sink controller attempts to reach the lower voltage value by limiting power consumption.

Neither the KONSTANTER nor the power consumer are damaged as a result.

If problems occur with the measurement of load current, the KONSTANTERs should be linked by means of master-slave parallel connection (see also chapter 5.8.2).

Outputs can be simultaneously activated and deactivated by connecting the TRG inputs (setting: trG out) in parallel (Figure 5.8.1a, optional connection) or in series (see also page 74).

5.8.2 Master-Slave Parallel Connection

Functions

As opposed to direct parallel connection, master-slave parallel connection offers significant advantages:

- Equally suitable for voltage and current regulation
- Output parameters (output voltage, cumulative current limiting) are set entirely by the master device.
- All interconnected KONSTANTERs are equally loaded.

Wiring

Define one power supply as a master device.

Connect master and slave devices as shown in Figure 5.8.2.

Connect the output leads (refer to chapter 2.1.4).

Balance the individual output current values. Keep connector cables as short as possible, and use the largest possible conductor cross-section. Perform balancing with R_{sym} .

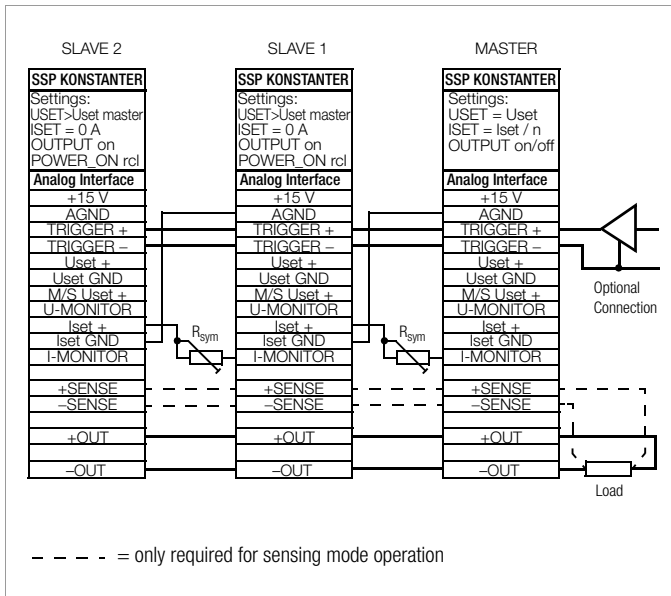


Figure 5.8.2 Wiring for Master-Slave Parallel Connection

Settings

Initial power-up:

Short circuit the load.

Switch **master** on (mains) and configure settings:

(Pon rcl) If desired

OUTPUT off

USET = **Uset** Desired output voltage

ISET = **Isoll / n** Isoll: Desired cumulative current
n: Number of devices
Only valid if nominal data are identical for all devices, see notes

Switch **slave 1** on (mains) and configure:

(Pon rcl) If desired

USET > **USET_{master}** The voltage setpoint at the slave devices must be set at least 1% higher than at the master device, e.g. to maximum.

ISET = **0 A** The ISET rotary knob can be deactivated if desired by setting ILIM to 0 A.

Use the same procedure for additional slave devices.

Press the OUTPUT ON key at the slave(s) and the master.

Check output current at the slave device displays.

Output current at each of the slaves can be precisely matched to master output current by adjusting R_{sym} . Changes appear immediately at the respective display.

Undo short-circuiting of the load.

From this point on, setting and regulation of (cumulative) output parameters are controlled entirely by the master device.

Power-up after initial settings have been made:

Devices can be switched on and off in any desired order.

Functional Principle

The master controls output current of the downstream device (slave 1) via the slave's current control input with the help of the current monitoring signal.

Slave 1 functions as a master device for the next downstream slave (slave 2), and so forth.

Cumulative output current is thus always proportional to master output current.

Outputs can be simultaneously activated and deactivated by connecting the TRG inputs (setting: trG out) in parallel (Figure 5.8.2, optional connection) or in series (see also page 74).

Note:

KONSTANTERs with Differing Nominal Values

The KONSTANTER with the smallest nominal voltage value must always be used as the master device.

The voltage setting range of the other KONSTANTERs must be limited to this lowest value with the ULIM parameter.

Slave output current $I_{out,Slave}$ corresponds to master output current $I_{out,Master}$ as a percentage only, relative to respective nominal output current I_{nom} .

Example:

| | | | | | |
|-----------------|-------------|--------------|------|--------------|-------------|
| Master: | SSP 1000-52 | U_{nom} | 52 V | I_{nom} | 50 A |
| | Settings: | USET: | 12 V | ISET: | 15 A (30%) |
| Slave 1: | SSP 1000-52 | U_{nom} | 52 V | I_{nom} | 50 A |
| | Results in | Uout: | 12 V | Iout: | 15 A (30%) |
| Slave 2: | SSP 1000-80 | U_{nom} | 80 V | I_{nom} | 25 A |
| | Results in | Uout: | 12 V | Iout: | 7.5 A (30%) |

General

A wire connection can be used instead of R_{sym} if no precise setpoint value is required for cumulative output current. In this case, each slave device supplies slightly more current than the master device.

If analog interface connector cables and the sensing leads are longer than 1 meter, shielded cable should be used.

The shield is connected to the ground terminal on the housing or to -OUT.

The master device's measuring function acquires commonly generated output voltage for all interconnected KONSTANTERs, but only acquires its own output current.

The individual measured current values for each of the interconnected KONSTANTERs must be added together in order to arrive at cumulative output current.

5.9.2 Master-Slave Series Connection

Functions

As opposed to direct series connection, master-slave series connection offers significant advantages:

- Equally suitable for voltage and current regulation
- Output parameters (cumulative output voltage, current limiting) are set entirely by the master device.
- All interconnected KONSTANTERs are equally loaded.

Wiring

Define one power supply as a master device.

Connect master and slave devices as shown in Figure 5.9.2.

Connect the output leads to the series circuit phase terminals.

Balance the individual output voltage values with R_{sym} .

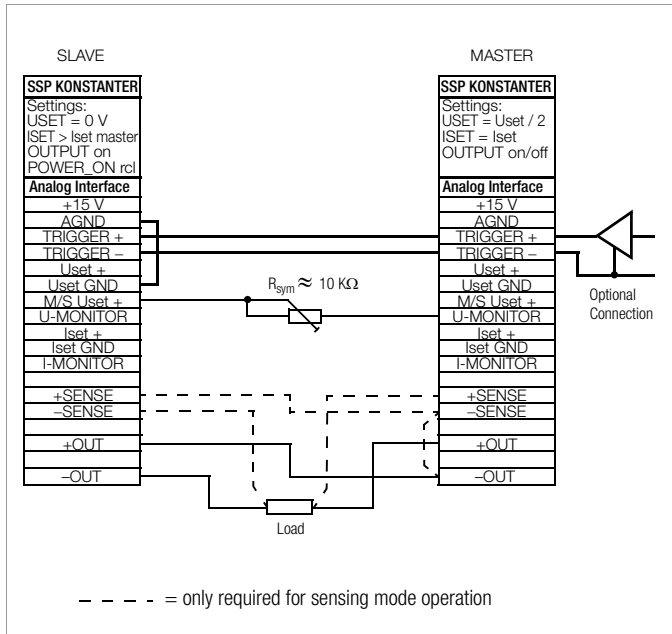


Figure 5.9.2 Wiring for Master-Slave Series Connection

Settings

Initial power-up:

Do not load the outputs (idle).

Switch **master** on (mains) and configure settings:

(Pon rcl) If desired

OUTPUT off

USET = Uset / n Uset: Cumulative output voltage
n: Number of devices
Only valid if nominal data are identical for all devices, see notes

ISET = Iset Current limit value

Switch **slave 1** on and configure:

(Pon rcl) If desired

USET = 0 V The USET rotary knob can be deactivated if desired by setting ULIM to 0 V.

ISET > ISET_{master} The current setpoint at the slave devices must be set at least 1% higher than at the master device, e.g. to maximum.

Use the same procedure for additional slave devices.

Press the OUTPUT ON key at the master.

Check output voltage at the device displays.

Output voltage at each of the slaves can be precisely matched to master output voltage by adjusting R_{sym} . Changes appear immediately at the respective display.

Connect the load.

From this point on, setting and regulation of (cumulative) output parameters are controlled entirely by the master device.

Power-up after initial settings have been made:

Devices can be switched on and off in any desired order.

Functional Principle

The master controls output voltage of the downstream KONSTANTER (slave 1) via the slave's voltage control input with the help of the voltage monitoring signal.

In the same way, slave 1 functions as a master for the next downstream device (slave 2) and so forth. Cumulative output voltage is thus always proportional to master output voltage. Outputs can be simultaneously activated and deactivated by connecting the TRG inputs (setting: trG out) in parallel (Figure 5.9.2, optional connection) or in series (see also page 74).

Note:

KONSTANTERs with Differing Nominal Values

The KONSTANTER with the smallest nominal current value must always be used as the master device.

The current setting range of the other KONSTANTERs must be limited to this lowest value with the ILIM parameter.

$U_{out,Slave}$ corresponds to $U_{out,Master}$ as a percentage only, relative to U_{nom} .

Example:

| | | | | | | |
|-----------------|-------------|--------------|--------------|--|--------------|------|
| Master: | SSP 1000-80 | U_{nom} | 80 V | | I_{nom} | 25 A |
| | Settings: | USET: | 24 V (30%) | | ISET: | 3 A |
| Slave 1: | SSP 1000-52 | U_{nom} | 52 V | | I_{nom} | 50 A |
| | Results in | Uout: | 15.6 V (30%) | | Iout: | 3 A |
| Slave 2: | SSP 1000-52 | U_{nom} | 52 V | | I_{nom} | 50 A |
| | Results in | Uout: | 15.6 V (30%) | | Iout: | 3 A |

General

If analog interface connector cables and the sensing leads are longer than 1 meter, shielded cable should be used. The shield is connected to the ground terminal on the housing, or to -OUT. The same current value is available from all KONSTANTERs. For this reason, current measured at the master device only is sufficient for the measurement of load current. The individual measured voltage values for each of the interconnected KONSTANTERs must be added together in order to arrive at cumulative output voltage.

5.10 Varying the Internal Output Resistance Value

Functions

In the voltage regulating mode, internal output resistance has a value of close to 0 Ω.

The internal output resistance value can be increased for certain applications, for example simulation of long output cables or weak automotive batteries. The selected (open-circuit) output voltage is reduced in proportion to increasing load (Figure 5.10a).

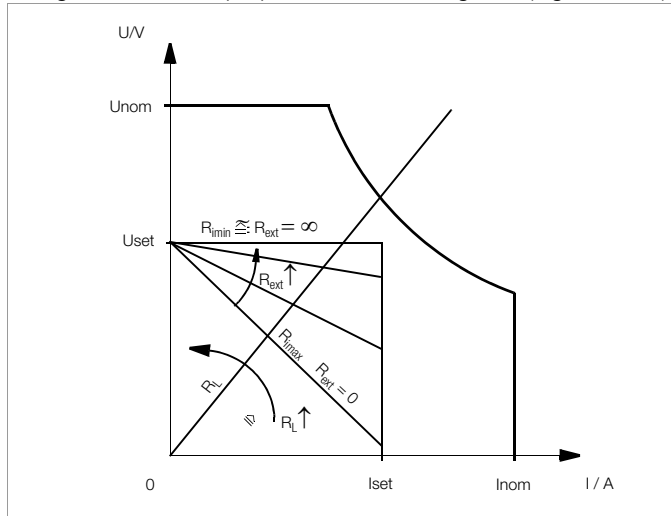


Figure 5.10a Output Voltage Relative to Load

Standardization

The standard characteristic curve shown in Figure 5.10b is valid for all KONSTANTER models.

Quick and easy determination indicating which output resistance R_i correlates to any given control resistance R_{ext} is made possible with the curve.

$$R_i = R_{i_{max}} \cdot \text{display value}$$

80 V models:

$$\frac{R_i}{R_{i_{max}}} = \frac{25.68 \text{ k}\Omega}{R_{ext} + 25.68 \text{ k}\Omega} ; R_{i_{max}} = 1.281 \cdot \frac{U_{nom}}{I_{nom}}$$

52 V models:

$$\frac{R_i}{R_{i_{max}}} = \frac{24.82 \text{ k}\Omega}{R_{ext} + 24.82 \text{ k}\Omega} ; R_{i_{max}} = 1.251 \cdot \frac{U_{nom}}{I_{nom}}$$

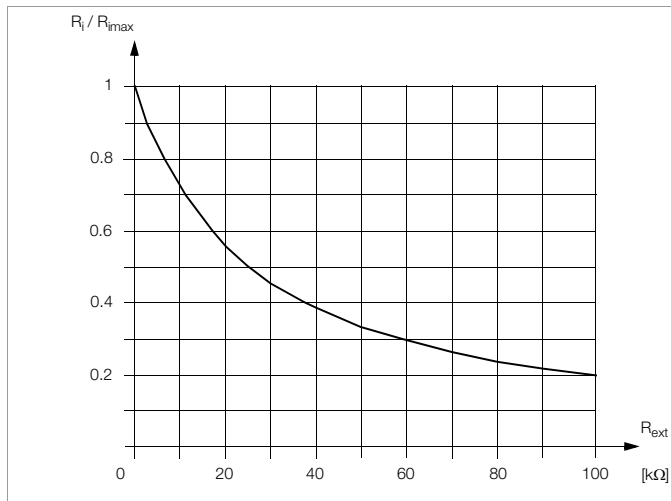


Figure 5.10b Standardized Curve for Determining Internal Output Resistance for a Specified Control Resistance

Connection

Connect the analog interface as shown in Figure 5.10c. The following relationship between internal resistance R_i and control resistance R_{ext} applies with this wiring configuration:

80 V models:

$$R_{ext} = \frac{33.12 \text{ k}\Omega}{R_i} \cdot \frac{U_{nom}}{I_{nom}} - 25.86 \text{ k}\Omega$$

52 V models:

$$R_{ext} = \frac{31.04 \text{ k}\Omega}{R_i} \cdot \frac{U_{nom}}{I_{nom}} - 24.82 \text{ k}\Omega$$

Example: $U_{nom} = 80 \text{ V}$, $I_{nom} = 25 \text{ A}$, R_i is 0.5Ω
 $\implies R_{ext} = 186.108 \text{ k}\Omega$

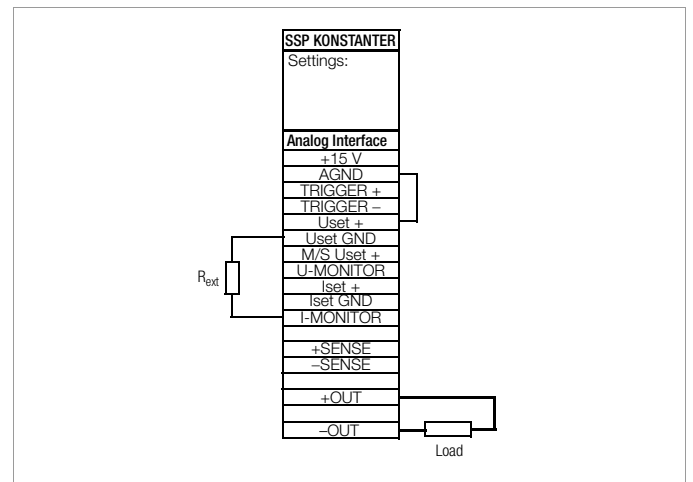


Figure 5.10c Wiring for Varying Internal Resistance

Table of $R_{i_{max}}$ Values for All KONSTANTER Models

| Device Type | $R_{i_{max}} (\Omega)$ |
|-------------------|------------------------|
| 62 N 52 RU 25 P | 2.602 |
| 62 N 52 RU 50 P | 1.301 |
| 64 N 52 RU 100 P | 0.651 |
| 64 N 52 RU 150 P | 0.434 |
| 62 N 80 RU 12.5 P | 8.198 |
| 62 N 80 RU 25 P | 4.099 |
| 64 N 80 RU 50 P | 2.05 |
| 64 N 80 RU 75 P | 1.366 |

6 Operating Commands

Nearly all of the functions of the SSP KONSTANTER can be remote controlled via the IEEE 488 interface (= IEC 625), or the RS 232C interface.

With the exception of a few functions specific to the IEC bus, all device settings and device responses are triggered with character strings which are transmitted in ASCII code. Transmission of device messages is accomplished as follows:

- Byte-serial via the IEC bus with a specific 3-wire handshake
- Bit-serial via the RS 232C interface in consideration of selected operating parameters (→ chapter 4.7.4).

Detailed information regarding the respective data transmission operating modes can be found in the applicable standards, or in the interface description included with your controller.

The layout of device messages complies in general with “Code, Format, Protocol and General Command Accords” in accordance with IEEE 488.2 and IEC 625-2.

Standard commands for programmable instruments (SCPI) used by some manufacturers do not apply to this device.

6.1 Syntax

The commands are named according to the English designations for the corresponding functions. For example, the command:

```
USET 12
```

is used to set the output to a voltage value of 12 V.

All commands used to query device settings or measured values are identified with a question mark (?) at the end. Thus the query command:

```
USET?
```

is used to determine the presently selected voltage value.

Each command consists of a header, and one or more parameters as required. Differentiation is made between numeric parameters and text parameters. Headers and text parameters can be entered either as upper case or lower case letters, or as a combination of both.

At least one blank must be entered between the header and the parameter.

If several parameters are included they are separated by commas (,), and a blank can be entered before and after each parameter as well.

Examples:

```
OUTPUT ON  
Output on  
START_STOP 20,110
```

Abbreviated Commands

Commands which can be abbreviated are identified through the use of mixed typefaces. The portion of the command which does not appear in boldface can be left out. However, the question mark (?) must always be transmitted with query commands.

Example 1:

The following abbreviations can be used for the “OUTPUT” setting command:

```
OUTPUT  
OUTPU  
OUTP  
OUT  
OU
```

Example 2:

The following abbreviations can be used for the “DELAY?” query command:

```
DELAY?  
DELA?  
DEL?  
DE?
```

Query Commands

All query commands are identified with a question mark (?) at the end. The device makes a response available to the control computer in response to query commands. If the IEEE 488 interface is used, the status byte can be queried or serial polling can be initialized in order to determine whether or not a device message is available. If this is the case, bit 4 (16 decimal) is set in the status byte register (MAV: message available).

Text Parameters

Text parameters are parameters which begin with a letter. Selection can be made from a group of text parameters for all commands which use text parameters.

Example:

```
DISPLAY ON  
DISPLAY OFF
```

In the example above, “DISPLAY” is the header, and “ON” and “OFF” are the group of allowable text parameters.

Numeric Parameters

Numeric parameters can be entered as whole numbers, or as fixed or floating decimal point numbers with or without exponent. The exponent can have up to two places, and the entire parameter may not exceed a length 30 places. An upper or a lower case letter can be used for the exponent symbol “E”. A blank can be entered to the left and to the right of the exponent symbol, and the leading plus sign can be left out. If several parameters are included they are separated by commas (,), and a blank can be entered before and after each parameter as well.

Example:

Parameter to be entered: 12.5 (twelve + decimal fraction)

```
12.5  
0012.5  
1.25E1  
+1.25 E+01  
1.25e1  
1250.0e -2
```

Commands per IEEE 488.2 with Asterisk

Standard commands are used for programming device and interface functions included with the SSP KONSTANTER which are described in the IEEE 488.2 (and 625-2) standard.

These commands are identified with an asterisk (*) (2A_h) at the beginning of the header. The asterisk is part of the header and must be transmitted with the command.

Please read the applicable sections of the specified standard for detailed information concerning these commands.

Stringing Commands Together

Several commands can be strung together in a row and transmitted as a command string. If several parameters are included they are separated by semicolons (;), and a blank can be entered before and after each semicolon as well.

Example:

```
USET 10; OUTPUT ON; IOUT?
```

Comment

The individual commands are executed in the order they were received.

Setting and query commands can be mixed in a single command string.

If a string contains several query commands, semicolons (;) are inserted between the requested parameters in the response string as well.

If a string contains a faulty command, the respective command is ignored, and the corresponding error bit is set in the event standard register (ESR), but all remaining commands are nevertheless executed.

Terminating Device Messages

a) For IEEE 488 remote control

The following end-of-text characters can be used for data receive:

NL New line = line feed = (0A_h)

NL & EOI EOI = end or identify

DAB & EOI DAB = last data byte

The still common end-of-message character combination CR LF (0D_h followed by 0A_h) should no longer be used according to the standard. Although it is accepted by the device for data receive, it should be used in combination with EOI.

The following end-of-message character is used when transmitting the response string:

NL & EOI.

b) For RS 232C remote control

The following end-of-text characters can be used for data receive:

NL (0A_h) = new line = line feed

CR (0D_h) = carriage return

CR LF Carriage return and line feed

ETB (17_h)

ETX (03_h)

The following end-of-message character is used when transmitting the response string:

NL (0A_h) = new line = line feed

6.2 IEEE 488 Functions

| Abbreviation | Term | Meaning |
|--------------|--------------------|---|
| SH1 | SOURCE HANDSHAKE | Handshake source function |
| AH1 | ACCEPTOR HANDSHAKE | Handshake sink function |
| T6 | TALKER | Talker function with series polling and automatic unlisting, without secondary address and without talk-only mode |
| L4 | LISTENER | Listener function with automatic unlisting without secondary address and without listen-only mode |
| TE0 | | No extended talker function |
| LE0 | | No extended listener function |
| SR1 | SERVICE REQUEST | Service request function |
| RL1 | REMOTE/LOCAL | Switching to and from manual and remote operation, with local lockout |
| DC1 | DEVICE CLEAR | Rest function including selected device clear |
| PP1 | PARALLEL POLL | Parallel polling function with remote configuring |
| DT1 | DEVICE TRIGGER | Trigger function |
| C0 | | No controller function |
| E1 / 2 | | Open collector driver |

6.3 Overview

The following table provides an overview of device-specific setting and query commands.

A detailed description of the respective device function is included in the next chapter, arranged in alphabetical order.

Command Overview According to Application

| IDENTIFICATION / CONFIGURATION | | | |
|---|--|--|---|
| • *IDN? | | | |
| BASIC FUNCTIONS | Extended BASIC FUNCTIONS | MONITORING AND PROTECTION Functions | |
| Setpoints <ul style="list-style-type: none"> • USET • ISET • OUTPUT • POWER_ON Measured Value Query <ul style="list-style-type: none"> • UOUT • IOUT • POUT | <ul style="list-style-type: none"> • *RST • *SAV • *RCL • *LRN <ul style="list-style-type: none"> • T_MODE • DISPLAY • WAIT | <ul style="list-style-type: none"> • ULIM • ILIM • OVSET <ul style="list-style-type: none"> • MINMAX • UMIN • UMAX • IMIN • IMAX | <ul style="list-style-type: none"> • OCP • DELAY <ul style="list-style-type: none"> • MODE • CRA • ERA • ERB |
| SEQUENCE and STEP-BY-STEP CONTROL FUNCTIONS | Time Dependent FUNCTIONS, External CONTROL | Special COMMANDS | STATUS and EVENT MANAGEMENT |
| Sequence Control <ul style="list-style-type: none"> • SEQUENCE • START_STOP • REPETITION • TDEF • TSET Memory Management <ul style="list-style-type: none"> • STORE • *SAV • *RCL | <ul style="list-style-type: none"> • T_MODE <ul style="list-style-type: none"> • OCP • DELAY <ul style="list-style-type: none"> • *DDT • *TRG <ul style="list-style-type: none"> • WAIT | <ul style="list-style-type: none"> • *TST <ul style="list-style-type: none"> • HID_TST <ul style="list-style-type: none"> • IFC • SDC • DCL • *WAI | <ul style="list-style-type: none"> • *CLS <ul style="list-style-type: none"> • *STB, *SRE • *ESR, ESE • *IST, PRE <ul style="list-style-type: none"> • *OPC • *PSC Condition and Event Register <ul style="list-style-type: none"> • CRA • ERA, ERAE • ERB, ERBE |

6.4 Description

All setting, query, register management and interface commands are listed alphabetically in the following pages (*A..., *B..., *C..., ..., A..., B..., C..., ...). In addition to the application-specific overview in the previous chapter, setting, query and status commands are included in the appendix arranged according to function.

*CLS – Clear Status

Functions

The *CLS command Clears all event registers and the status byte register, except for the MAV bit. Any existing service requests are cancelled.

| | |
|--|----------------------------|
| Addressing status | Unchanged |
| Input and output buffers | Unchanged |
| Service request SRQ | Cleared |
| Status byte register STB | Cleared except for MAV bit |
| Event registers ESR, ERA, ERB | Cleared |
| Enable registers ESE, ERAE, ERBE, SRE, PRE | Unchanged |
| Set or stored parameters | Unchanged |

Programming

Programming example (HP Basic):

```
OUTPUT 712; "CLS"
```

*DDT, *DDT? – Define Device Trigger

Functions

A list of commands including up to 80 characters can be entered to a register with the define device trigger command. The command list is executed after receiving the *TRG device message or the IEC bus command GET (GROUP EXECUTE TRIGGER).

Programming

a) Setting

Syntax

```
*DDT command[/command[/command] ...
| —max. 80 char.—|
```

Parameter

Command

All specified device messages (setting and query commands) are allowable except for the *TRG command.

Default parameter according to power-on or *RST:

DDT register cleared

A slash (/) must be used as the delineating character between commands in the DDT string instead of a semicolon (;).

Programming example (HP Basic):

```
OUTPUT 712;"*DDT USET 10/ISET 5.6/OUT ON"
OUTPUT 712;"USET 0"
:
OUTPUT 712;"*TRG"
OUTPUT 712;"USET?; ISET?"
ENTER 712;A$
DISP A$
→Display: USET +010.000;ISET +005.600
```

b) Query

The content of the DDT register can be read out with the *DDT? query command.

The delineating slashes (/) appear once again as semicolons (;) in the response string.

Query command: *DDT?

Sample response string: USET 10;ISET 5.6;OUT ON

Maximum response string length: 80 characters

Comment

In order to prevent the generation of query errors, a blank (space) is returned if the DDT register is empty.

The *TRG command may not be entered to the DDT command string. If it were entered it would set bit 4 (EXE, execution error) in the standard event register, and bit 3 (DDTE, define device trigger error) in event register B.

If the maximum DDT string length is exceeded, all characters in excess of the allowable number are ignored and an execution error message is generated.

The received command list is not checked for correct syntax and limit values until the trigger command is received.

If an execution error occurs, the DDT register can be read out with the *DDT? command, but its content cannot be executed (execution error message is generated again).

The DDT register is not changed or cleared when the trigger command is executed.

*ESE, *ESE?, ERAE, ERAE?, ERBE, ERBE?, *SRE, *SRE?, *PRE, *PRE? – Enable Registers

Functions

The enable registers determine which bit(s) from the corresponding event or status byte register is/are capable of influencing the respective group message. The respective group message remains set (1 = TRUE), as long as at least one bit which has been enabled to this end has a status of TRUE.

This allows for selective enabling or disabling of an SRQ and/or the individual status message "IST" due to an occurred event (masking).

Programming

The device is furnished with five enable registers. They can be written to and read separately. Queries, the *CLS command and device functions do not cause any changes to the contents of these registers. The registers can be cleared by entering a value of "0" (e.g. *ESE 0). The enable registers are non-volatile, and are only cleared by means of device shutdown if the non-volatile PSC flag is set to 1.

| Designation | Setting Command | Query Command |
|---------------------------------------|-----------------|---------------|
| Event standard enable register (ESE) | *ESE <i>n</i> | *ESE? |
| Event enable register A (ERAE) | ERAE <i>n</i> | ERAE? |
| Event enable register B (ERBE) | ERBE <i>n</i> | ERBE? |
| Service request enable register (SRE) | *SRE <i>n</i> | *SRE? |
| Parallel poll enable register (PRE) | *PRE <i>n</i> | *PRE? |

n = decimal equivalent of register content (0 ≤ *n* ≤ 255).

*ESR?, ERA?, ERB? – Event Register Query

Functions

The event registers provide information concerning events which have occurred within the device since the last query. They acquire and save status changes which have occurred for specific device functions. The corresponding bit is set to 1 in the event register (1 = TRUE), when the respective function status

– is changed from FALSE to TRUE (for input $_ _$) or

– is changed from TRUE to FALSE (for input $_ _$).

For example, the CME command error bit is set in the ESR event standard register upon receipt of an incorrect programming command. This bit remains set, even if correct commands are subsequently transmitted to the device. The CME bit is not reset until the ESR register is queried.

Programming

The device is furnished with three 8-bit event registers, each of which can be individually queried. When an event register is queried, its content is deleted. The *CLS command (CLEAR STATUS) can be used to clear all event registers.

| Designation | Query Command |
|-------------------------------|---------------|
| Event standard register (ESR) | *ESR? |
| Event register A (ERA) | ERA? |
| Event register B (ERB) | ERB? |

Each response consists of a whole number $0 \leq n \leq 255$, where n corresponds to the decimal equivalent of the content of the respective register.

An enable register is assigned to each event register.

*IDN? – Device Identification Query

Functions

In response to this query, the device identifies itself by providing information regarding manufacturer, type designation, serial number, hardware revision level and firmware revision level.

Programming

Query command: *IDN?

Response string:

manufacturer,type,serial_number,hardware_revision,software_revision

Fixed response string length: 49 characters

Example:

```
GOSSEN-METRAWATT,SSP62N052RU050P,  
EM0000233,03.001
```

*IST? – Individual Status Query

Functions

- Command for directly querying parallel poll information (see also chapter 6.2 and table “Query Command for Status and Events Management” on page 87).
- Current status of the device’s IEEE488.1 “IST” message.
- Content is not changed by the query.
- An ASCII coded byte is returned as a response.

When using the RS232 interface **without** the IEEE488 interface, value 1 is generally returned as a response.

Programming

Query command: *IST?

Response string: 0 : “Local message is false”

1 : “Local message is true”

Length: 1 character, fixed

Example (HP Basic):

```
OUTPUT 713;"IST?"  
ENTER 713;A$  
DISP A$
```

→ Display: 0

*LRN? – Complete Configuration Query (LEARN)

Functions

In response to the *LRN? query command, the device supplies a complete list of all adjustable functions along with current parameter settings.

Applications

This function allows the controller to acquire manually configured device settings, and to use this information for evaluation or for remote configuration via the interface.

In this way, for example, a test sequence can first be executed with all involved devices in the manual operating mode. The device settings required for the individual test steps are queried by the controller with the *LRN? command. The response string received by the controller can then be entered to the test program in an unchanged fashion, and can be subsequently transmitted to the respective device as a command string.

Programming

Query command: *LRN?

Sample response string:

```
ULIM +035.000;ILIM +050.000;OVSET +050.0  
;OCP OFF;DELAY 12.00;USET +021.300;ISET  
+048.000;OUTPUT ON;POWER_ON RST;MINMAX  
ON;TSET 00.10;TDEF 10.00;REPETITION  
000;START_STOP 020,115;T_MODE OUT;  
DISPLAY OFF
```

Fixed response string length: 202 characters

*OPC, *OPC? – Operation Complete Flag Query

Functions

The operation complete flag (OPC) allows for synchronizing the controller and the device in two different ways:

- The OPC bit is set in the ESR event standard register **with the *OPC command** after all previous commands have been executed. This can be used to generate an SRQ message which synchronizes the controller. Since the SRQ line is only available at the IEC bus, this method cannot be used for programming via the serial interface.
- In response to the *OPC? query command**, “1” is written to the output buffer and the MAV bit is set in the status byte register after all previous commands have been executed. Synchronization can be accomplished by reading out this response, or – in the case of IEC bus operation – by responding to the SRQ message triggered by the MAV bit, if appropriate masking exists.

Programming

a) Setting

Setting command: *OPC

Programming example (HP Basic):

```
OUTPUT 712;"*ESE 1; *SRE 32"  
!OPC bit is enabled for SRQ  
:  
:  
OUTPUT 712;"*CLS 1; *RCL 2; *OPC"  
!SRQ is signaled after  
!recalled device setting from  
!memory # 2 has been set
```

b) Query

Query command: *OPC?

Response string: 1

The response to the *OPC? query command is always “1”, because it is not processed until all previous commands have been executed.

*PSC, *PSC? – Power-On Status Clear Flag Query

Functions

The power-on status clear flag (PSC) determines whether or not the contents of the non-volatile enable registers will be cleared when the device is shut down.

Programming

The PSC flag can be set and queried:

a) Setting

Setting command: ***PSC n**

| Parameter: | n | Meaning |
|------------|---|--------------------------------------|
| | 0 | Enable registers will not be cleared |
| | 1 | Enable registers will be cleared |

b) Query

Query command: ***PSC?**
Response string: "0" or "1"

Comment

The PSC flag setting is retained, even after the device has been switched off or execution of the *CLR command.

*RCL – Recalling Stored Settings

Functions

Settings which have been previously saved to battery-backed memory with the *SAV command (SAVE) can be recalled and activated with *RCL (RECALL). Differentiation must be made between complete device settings which are saved to register numbers 1 through 10, and USET, ISET and TSET values for the SEQUENCE function which are saved to addresses 011 through 255.

Syntax

***RCL** register number

Parameter

Register number

Parameter type: number (whole number)

Selection can be made from the following alternatives for the register number parameter:

1 through 10

Recalls a parameter set from SETUP memory. Settings stored to the selected register for the following parameters are activated at the device:

| | | |
|------|-------|--------|
| USET | ISET | OVSET |
| ULIM | ILIM | OUTPUT |
| OCP | DELAY | MINMAX |
| | TSET | TDEF |

REPETITION START_STOP

Settings for POWER_ON, T_MODE and DISPLAY remain unchanged.

11 through 255

Recalls a parameter set from the SEQUENCE memory. Settings stored to the selected register for the following parameters are activated at the device:

| | | |
|------|------|------|
| USET | ISET | TSET |
|------|------|------|

All other device settings remain unchanged.

Default setting after RESET (*RST):

| | |
|--------------------|----------------|
| Register number: | does not apply |
| Register contents: | unchanged |

a) Manual Operation

See description on page 29.

b) Programming

Execution command:

***RCL** register number

Example (HP Basic):

```
OUTPUT 712; "RCL 1"
```

```
! Recall and activate device setting  
! from SETUP register 1
```

Comment

Data can be recalled from registers 11 through 255 during programming, even if the SEQUENCE function has not been initialized.

If an attempt is made to open an invalid (empty) register from the SEQUENCE memory, the command cannot be executed. "Err 24" appears briefly at the display and bit 5 (SEQE, SEQUENCE error) is set in event register B (ERB).

If the USET or the ISET parameter setting recalled from the SEQUENCE memory exceeds momentarily active ULIM or ILIM soft-limits, execution of the command is aborted, "Err 21" appears briefly at the display and bit 5 (SEQE, SEQUENCE error) is set in event register B (ERB).

The RECALL function can also be controlled via the trigger input at the analog interface after selecting device setting T_MODE RCL (→ chapter 5.7, page 74).

*RST – Reset Device Settings

Functions

After activating the reset function, the device is returned to its default settings.

| | |
|--|---------------------------|
| Addressing status | Unchanged |
| Input and output buffers | Unchanged |
| Service request SRQ | Unchanged |
| Status byte register STB | Unchanged |
| Event registers ESR, ERA, ERB | Unchanged |
| Enable registers ESE, ERAE, ERBE, SRE, PRE | Unchanged |
| Stored parameters | |
| SETUP registers 1 through 10 | Unchanged |
| SEQUENCE register | Unchanged |
| DDT register | Cleared |
| Min-Max memory (UMIN, UMAX, IMIN, IMAX) | Reset |
| Parameter settings | Reset to default settings |

Note: After entering command *RST a waiting time of approx. 30 ms should be observed before entering the next command.

Default settings:

| | |
|----------------|---|
| OUTPUT OFF | Output deactivated |
| USET 0 | Voltage setpoint = 0 V |
| ISET 0 | Current setpoint = 0 A |
| OVSET max | Max. overvoltage protection trigger value |
| ULIM unom | USET limit value = nominal voltage |
| ILIM inom | ISET limit value = nominal current |
| OCP OFF | Current limiting by means of current regulation |
| DELAY 0 | No output off delay |
| MINMAX OFF | Storage of measured min-max values disabled |
| TSET 0 (=tdef) | SEQUENCE dwell time = default duration |
| SEQUENCE OFF | SEQUENCE function deactivated |
| DISPLAY ON | Display activated |
| POWER_ON | Unchanged |
| T_MODE | Unchanged |
| TDEF | Unchanged |
| REPETITION | Unchanged |
| START_STOP | Unchanged |

Manual Operation

- Press the <CE/LOCAL> and <ENTER> keys.

Programming

Programming example (HP Basic):

```
OUTPUT 712; "RST"
```

*SAV – Saving Device Settings

Functions

Current device settings can be saved to battery-backed memory with the *SAV (SAVE) command.

Syntax

***SAV** *register number*

Parameter

Register number

Parameter type: number (whole number)

Selection can be made from the following alternatives for the register number parameter:

0

The *SAV 0 command (display for manual operation: "Sto clr") deletes the contents of the SEQUENCE register from the start address to the stop address.

1 through 10

Current device settings are saved to the selected SETUP register. Each SETUP register includes the following parameters:

| | | |
|------------|------------|--------|
| USET | ISET | OVSET |
| ULIM | ILIM | OUTPUT |
| OCP | DELAY | MINMAX |
| | TSET | TDEF |
| REPETITION | START_STOP | |

11 through 255

Current settings for the parameters

| | | |
|------|------|------|
| USET | ISET | TSET |
|------|------|------|

are saved to the selected SEQUENCE register.

Default setting after RESET (*RST):

| | |
|--------------------|----------------|
| Register number: | Does not apply |
| Register contents: | Unchanged |

a) Manual Operation

Saving settings to a SETUP register:

See description in chapter 4.10.1.

Saving settings to a SEQUENCE register:

See description in chapter 4.10.2.

Clearing the entire SEQUENCE memory:

See description in chapter 4.10.3.

Deleting a single SEQUENCE register (manual operation only):

See description in chapter 4.10.5.

Adding a memory location (manual operation only):

See description in chapter 4.10.4.

Deleting the contents of a memory location (manual only):

See description in chapter 4.10.6.

b) Programming

Execution command:

***SAV** *register number*

Example (HP Basic):

OUTPUT 712;"*SAV 3"

! Save device setting to register 3.

Comment

Data can be saved to SEQUENCE registers 11 through 255 during programming, even if the SEQUENCE function has not be initialized.

All data stored with the SAVE function are retained in battery-backed memory when the device is switched off.

Stored settings can be recalled (reactivated) in two different ways:

- *RCL: Recalls an individual setting from the SETUP or the sequence register
- SEQUENCE GO: Automatic sequential recall of settings from all sequence registers defined with the START_STOP function.

*STB? – Status Byte Register Query

Functions

The status byte register STB contains

- The status of group messages from the three event registers (bits 2, 3 and 5)
- The status of the output buffer (empty → MAV bit = 0, not empty → MAV bit = 1)
- The status of MSS group messages masked with the SRE enable register from internal bits 0 through 5
- Bits 0, 1 and 7 are not used, and are always set to "0".

When using the RS232 interface **without** the IEEE488 interface, the invalid value 127 is generally returned as a response.

Programming

Register content can be read out:

a) With the *STB? command:

The response is a data string consisting of a whole number $16 \leq n \leq 127$, where n corresponds to the decimal equivalent of the register's content.

With this querying method, the value of n is always ≥ 16 , because, as a minimum, the response string was saved to the output buffer, and the MAV bit was thus set.

b) By means of serial polling (IEC bus only):

The device responds with its status byte as a "one byte message" in reply to addressed interface command SPE (SERIAL POLL ENABLE).

With this querying method, bit 6 indicates the RQS status, and is reset to "0" after completion of serial polling.

The *CLS (CLEAR STATUS) command clears the status byte register except for the MAV bit, and cancels any SRQ messages.

*TRG – Device Trigger Function

Functions

A specified operation can be triggered with the device trigger command, either for an individual device with the *TRG device message, or in combination with other devices and simultaneously by the IEC bus controller with the addressed interface command GET (GROUP EXECUTE TRIGGER). In the case of the SSPKONSTANTER, a command or a list of commands which has been previously defined by means of the *DDT string (DEFINE DEVICE TRIGGER) is executed after these commands.

Programming

The device accepts this command:

- a) Via both interfaces as a *TRG device message (setting command)

Programming example (HP Basic):

OUTPUT 712;"*TRG"

- b) Via the IEC bus interface as addressed interface command GET (GROUP EXECUTE TRIGGER)

Programming examples (HP Basic):

```

TRIGGER 712      !triggers the device
                   !with address 12

TRIGGER 7       !all listener addressed
                   !devices will be triggered

```

Comment

If trigger action has not been defined (empty DDT memory), bit 4 (EXE, execution error) is set in the standard event register upon receipt of the device trigger command.

The *TRG command may not be used as part of the DDT command.

The DDT register is not changed or cleared when the trigger command is executed.

*TST?, HID_TST? – Starting the Self-Test

Functions

Upon receipt of the *TST? or HID_TST? query command, the device starts a self-test and reads out test results to the output buffer as a response string.

The *TST? query generates a response of either "0" (= test passed) or "1" (= test failed).

The response string for the HID_TST? query consists of a comprehensive list of test results for the individual test steps.

a) ROM Test

The processor acquires the checksum for the ROM module (program memory), and compares it with the specified value. If these two values are not identical, correct functioning of the device cannot be assured and the test failed message appears (FAILED). If this is the case, the device must be tested at a service center and repaired if necessary.

b) RAM Test

RAM modules are tested for defective memory locations. If defective memory locations are detected, correct functioning of the device cannot be assured and the test failed message appears (FAILED). If this is the case, the device must be tested at a service center and repaired if necessary.

c) ADC Timer Test

Analog-digital conversion (ADC) for acquiring measured values is based upon the voltage-frequency conversion principle (VFC). The frequency signal is fed to a counter in the CPU. Gating time is checked at this counter during the ADC timer test. If gating time is not within the prescribed tolerance, measuring function accuracy cannot be assured and the test failed message appears. If this is the case, the device must be tested at a service center and repaired if necessary.

d) DAC/ADC Test

no longer available for firmware version 03.002 and as from March 2004.

Triggering and Query via the Interfaces

- a) Query command: ***TST?**
 Response string: 0 = test passed
 1 = test failed
 Fixed response string length: 1 character

- b) Query command: **HID_TST?**

Sample response string:

```

"X-ROM-TEST PASSED (0B800H); X-RAM-TEST
PASSED; ADC-TIMER-TEST PASSED; DAC-ADC-
TEST PASSED (00000000); END TEST"

```

Fixed response string length: 111 characters

Comment

Starting the self-test does not cause any changes to current device settings or stored parameters.

The self-test sequence is started immediately after receipt of the corresponding query command and has a duration of approximately 6 seconds. The "READY" LED blinks during the self-test triggered with the HID_TST? command.

As long as the test is running, no data can be transmitted to the device and manual operation is disabled.

Programming Notes

Do not transmit the *TST? or HID_TST? command together with other settings and/or query commands in a single string.

Enter a waiting period of approximately 6 seconds between transmission of the query commands and read-out of the response string, or in the event of IEC bus operation:

Completion of the self-test can be recognized by means of cyclical querying and evaluation of the status byte (serial polling) (test completed → MAV-Bit = 1). The self-test is not influenced by serial polling.

If the self-test is failed, the "TSTE" bit is set in event register B. An SRQ is generated in the event of appropriate masking by means of enable registers ERDE and SRE.

*WAI – Wait to Continue

Functions

The *WAI command is of no significance for programming the KONSTANTER.

It serves to synchronize the interface protocol in accordance with the IEC 488.2 standard.

CRA? – Condition Register Query

Functions

The condition register provides information concerning the momentary status of specific device functions at the time the query was executed.

For example, if the output is switched to constant current regulation, the appropriate CCR bit is set in condition register A (CRA) (condition TRUE → condition bit = 1).

This bit remains set until the current regulating mode is exited. The condition register can be queried as often as desired during this time, without causing any change to its content. The corresponding bit is not reset until the output is no longer operating in the current regulating mode (condition FALSE → condition bit = 0).

Programming

The device is furnished with an 8-bit condition register. It can be read out, but direct overwriting and deletion are not possible.

| Designation | Query Command |
|----------------------------|---------------|
| Condition register A (CRA) | CRA? |

The response consists of a whole number $0 \leq n \leq 255$, where n corresponds to the decimal equivalent of the register's content.

DCL, SDC – Device Clear Function

Functions

The device clear command clears the input and output buffers at the interfaces (e.g. requested data which has not yet been picked up). Interface-internal waiting times and lockouts are cleared. The device is ready to receive data.

Addressing status
 Input and output buffers

Unchanged
 Cleared

| | |
|--|----------------------------------|
| Service request SRQ | Unchanged |
| Status byte register | MAV bit = 0, otherwise unchanged |
| Event registers ESR, ERA, ERB | Unchanged |
| Enable registers ESE, ERAE, ERBE, SRE, PRE | Unchanged |
| Set and stored parameters | Unchanged |

Programming

The device accepts this command:

- a) Via both interfaces as device message "DCL" or "SDC" (setting command)

Programming example (HP Basic):

```
OUTPUT 712;"DCL"
```

- b) Via the IEC bus interface as addressed command SDC (SELECTED DEVICE CLEAR)

Programming example (HP Basic):

```
CLEAR 712
```

- c) Via the IEC bus interface as universal command DCL (DEVICE CLEAR) for all bus users

Programming example (HP Basic):

```
CLEAR 7
```

DELAY – Output Off Delay for OCP

Functions

DELAY defines the delay time which must elapse before the power output is switched off after current regulation has been triggered (IOUT = ISET) with activated OCP function. If output current drops back below the selected ISET value before this delay time has elapsed, the shutdown sequence is aborted and is started again the next time current regulation is triggered. If the OCP function has not been activated, the DELAY setting is of no significance.

Syntax

```
DELAY value
```

Parameter

Value

Parameter type: real number

Setting range: **00.00** [s] – **99.99** [s]

Resolution: 10 ms

Default setting after RESET (*RST): **00.00** [s]

a) **Manual Operation**

See description on page 24.

b) **Programming**

Setting

Setting command:

```
DELAY value
```

Example (HP Basic):

```
OUTPUT 712;"DELAY 10.7"
```

```
!Output off delay: 10.7 seconds
```

Setting query

Query command:

```
DELAY?
```

Response string:

```
DELAY value
```

Parameter format *value*: **nn.nn**

Fixed response string length: 11 characters

Example (HP Basic):

```
OUTPUT 712;"DELAY?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→Display: DELAY 10.70

Comments → page 68 OCP function

DISPLAY, DISPLAY? – Activate / Deactivate Digital Displays

Functions

The 7-segment displays can be deactivated during remote control operation with the DISPLAY function.

Applications

Since displays need not be refreshed when deactivated, slightly shorter measuring and response times can be achieved during interface operation.

Syntax

```
DISPLAY status
```

Parameter

Status

One of the following alternatives can be selected from the group of possible text parameters:

| Status | Description |
|------------|-------------------------------|
| OFF | 7-segment display deactivated |
| ON | 7-segment display activated |

Default setting after RESET (*RST): ON

Programming

Setting

Setting command: **DISPLAY status**

Example (HP Basic):

```
OUTPUT 712;"DISPLAY OFF"
```

```
! deactivate 7-segment display
```

Setting query

Query command: **DISPLAY?**

Response string: **DISPLAY status**

Possible response parameters for *status*:

"**OFF**" 7-segment display deactivated

"**ON**" 7-segment display activated

Fixed response string length: 11 characters

Example (HP Basic):

```
OUTPUT 712;"DISPLAY?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→ Display: DISPLAY ON

Comment

If the "REMOTE" operating mode is exited, the 7-segment display is automatically reactivated.

FSET, FSET? – Sequence Function Parameter

Function

In addition to USET, ISET and TSET, FSET is the fourth parameter for defining the sequence memory.

It determines which function will be executed upon transition to the respective memory location.

Execution of the parameter is only possible during the course of a running sequence (similar to the TSET parameter).

When the FSET parameter is transmitted, the current FSET setting is determined and is saved to the respective specification by means of the SAVE n command.

The parameters for the FSET command are also part of the STORE command.

Setting Command

Syntax:

```
FSET txt
```

Default setting

or after RESET (*RST): NF

Query Command

Syntax: FSET?
Sample response string: FSET NF

Parameter list

| Parameter | Content | Meaning |
|-----------|---------|--|
| txt | NF | SEQUENCE-values USET, ISET, TSET without additional function |
| | RU | Voltage ramp, duration TSET or TDEF |
| | RI | Current ramp, duration TSET or TDEF |

IFC – Resetting the IEC Bus Interface (interface clear)

Functions

The IEC bus interface at the device is re-initialized with the IFC (INTERFACE CLEAR) bus interface command, and is returned to the standard default settings.

| | |
|--|---------------|
| Addressing status | Not addressed |
| Input and output buffers | Unchanged |
| Service request SRQ | Unchanged |
| Status byte register STB | Unchanged |
| Event registers ESR, ERA, ERB | Unchanged |
| Enable registers ESE, ERAE, ERBE, SRE, PRE | Unchanged |
| Set and stored parameters | Unchanged |

Programming

Programming example (HP Basic): **ABORT 7**

ILIM, ILIM? Current Setting Limit Value

Functions

ILIM defines the upper setting limit (soft-limit) for current setpoint value ISET.

The limit can be used to assure that output current is not inadvertently set above a specified value.

Syntax

ILIM *value*

Parameter

Value

Parameter type: real number

| Device Type Nom. Current [A] | Setting Range | | Step Size | |
|------------------------------------|---------------|---------------------------|-----------------------------|-----------------------------|
| | Min. [A] | Max. ^{a)} [A] | Remote ^{b)} [A] | Manual ^{c)} [A] |
| 12,5 | 0.00 | 12.50 | 0.001 | 0.01/0.1/1.0 |
| 25 | 0.00 | 25.00 | 0.001 | 0.01/0.1/1.0 |
| 50 | 0.00 | 50.00 | 0.001 | 0.01/0.1/1.0 |
| 75 | 0.00 | 75.00 | 0.001 | 0.01/0.1/1.0 |
| 100 | 0.00 | 100.0 | 0.001 | 0.01/0.1/1.0 |
| 150 | 0.00 | 150.0 | 0.001 | 0.01/0.1/1.0 |

Default setting after RESET (*RST): nominal current

- However, ILIM cannot be set to a value of less than the momentary current setpoint ISET.
- If the selected value is not a whole number multiple of the step size, it is rounded off accordingly. If necessary, the numeric value is rounded off once again for the 4-place digital display.
- Can be selected by (repeatedly) pressing the <RESOLUTION> key. The blinking decimal place at the display indicates the selected step size.

a) Manual Operation

See description on page 23.

b) Programming

Setting

Setting command:

ILIM *value*

Example (HP Basic):

OUTPUT 712;"ILIM 20"

!Current setting range limit: 20 A

Setting query

Query command:

ILIM?

Response string:

ILIM *value*

Parameter format *value*: **+nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic):

OUTPUT 712;"ILIM?"

ENTER 712;A\$

DISP A\$

→Display: ILIM +020.000

Comment

If an attempt is made to set ILIM to a value lower than ISET, the setting command is not executed and bit 1 is set in event register B (limit error), as is bit 4 in the standard event register (execution error).

The ILIM function does not effect the adjustment of ISET by means of a control signal via the analog interface.

IMAX? – Maximum Measured Current Value

Functions

The IMAX function reads out the highest output current value which was measured by the IOUT measuring function and saved to Min-Max memory while the MINMAX function was set to ON.

Syntax

IMAX?

Measuring range: current measuring range as per IOUT

If the measured current value has exceeded the measuring range limit at least once with the MINMAX function set to ON, "+OL" appears at the display for IMAX and "+999999." is entered to the data string. The Min-Max memory value can be reset to the momentarily measured value with MINMAX RST (for all 4 parameters at once).

a) Manual Operation

See description on page 28.

b) Programming

Measured Value Query

Query command: **IMAX?**

Response string: **IMAX** *value*

Response parameter format *value*: **±nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"IMAX?"**

ENTER 712;A\$

DISP A\$

→Display: IMAX +045.440

Comment

→ page 67 MINMAX function

IMIN? – Minimum Measured Current Value

Functions

The IMIN function reads out the lowest output current value which was measured by the IOUT measuring function and saved to Min-Max memory while the MINMAX function was set to ON.

Syntax

IMIN?

Measuring range: current measuring range as per IOUT

If the measured current value has fallen below the lower measuring range limit at least once with the MINMAX

function set to ON, “-OL” appears at the display for IMIN and “-999999.” is entered to the data string. The Min-Max memory value can be reset to the momentarily measured value with MINMAX RST (for all 4 parameters at once).

a) Manual Operation

See description on page 28.

b) Programming

Measured value query

Query command: **IMIN?**

Response string: **IMIN value**

Response parameter format *value: ±nnn.nnn*

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"IMIN?"**

ENTER 712;A\$

DISP A\$

→Display: IMIN -000.010

Comment

→ page 67 MINMAX function

IOUT? – Querying the Momentary Current Value

Functions

The IOUT function triggers measurement of the momentary current value. The measured value is acquired over a period of 40 ms in a continuous fashion.

Syntax

IOUT?

Measuring Range

| Device Type | Measuring Range | | Resolution | |
|-------------|------------------|------------------------|------------------------|-------------|
| | Nom. Current [A] | Min. ^{a)} [A] | Max. ^{b)} [A] | Remote [mA] |
| 12.5 | -0.478 | 13.342 | 2 | 2 / 10 |
| 25 | -0.960 | 26.685 | 5 | 5 / 10 |
| 50 | -1.92 | 53.370 | 10 | 10 |
| 75 | -2.880 | 80.060 | 10 | 10 |
| 100 | -3.840 | 106.740 | 20 | 20 / 100 |
| 150 | -5.760 | 160.120 | 20 | 20 / 100 |

a. Measured values which violate the measuring range lower limit are identified at the display as “-OL”, and in the data string as “-999999.”.

b. Measured values which exceed the measuring range upper limit are identified at the display as “+OL”, and in the data string as “+999999.”.

a) Manual Operation

See description on page 24.

b) Programming

Measured value query

Query command: **IOUT?**

Response string: **IOUT value**

Response parameter format *value: ±nnn.nnn*

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"IOUT?"**

ENTER 712;A\$

DISP A\$

→Display: IOUT +031.510

Comment

→ page 67 MINMAX function

ISET, ISET? – Current Setpoint

Functions

ISET defines the output current setpoint value.

Syntax

ISET value

Parameter

Value

Parameter type: real number

| Device Type | Setting Range | | Step Size | |
|------------------|---------------|------------------------|--------------------------|--------------------------|
| | min. [A] | max. ^{a)} [A] | Remote ^{b)} [A] | Manual ^{c)} [A] |
| Nom. Current [A] | | | | |
| 12.5 | 0.00 | 12.50 | 0.003125 | 0.003125/0.0125/0.1 |
| 25 | 0.00 | 25.00 | 0.00625 | 0.00625/0.1/1.0 |
| 50 | 0.00 | 50.00 | 0.0125 | 0.0125/0.1/1.0 |
| 75 | 0.00 | 75.00 | 0.02 | 0.02/0.1/1.0 |
| 100 | 0.00 | 100.0 | 0.025 | 0.025/0.1/1.0 |
| 150 | 0.00 | 150.0 | 0.04 | 0.04/0.2/1.0 |

Default setting after RESET (*RST): 0.00 [A]

- However, ISET cannot be set to a value of greater than the momentary current limit value ILIM.
- If the selected value is not a whole number multiple of the step size, it is rounded off accordingly. If necessary, the numeric value is rounded off once again for the 4-place digital display.
- Can be selected by (repeatedly) pressing the <RESOLUTION> key. The blinking decimal place at the display indicates the selected step size.

The standard display format is: “XX.XX”. The current display format is automatically changed to “X.XXX” for values < 10.00 A for 12.5 A models, and to “XXX.X” for values as of 100 A for 150 A models (manual setting resolution is reduced to 0.2 A as well). The displayed setpoint is rounded off to the display format. Thus if the smallest step size has been selected, minor setpoint adjustments made with the keys or the rotary knob may not be visible at the display.

a) Manual Operation

See description on page 22.

b) Programming

Setting

Setting command: **ISET value**

Example (HP Basic): **OUTPUT 712;"ISET 11.3"**

!Current setpoint: 11.3 A

Setting query

Query command: **ISET?**

Response string: **ISET value**

Parameter format *value: +nnn.nnn*

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"ISET?"**

ENTER 712;A\$

DISP A\$

→Display: ISET +011.300

Comments

If an attempt is made to set ISET to a value higher than ILIM, the setting command is not executed and bit 1 is set in event register B (limit error), as is bit 4 in the standard event register (execution error).

MINMAX, MINMAX? – Min-Max Storage for Measured U and I Values

Functions

The MINMAX function saves minimum and maximum measured voltage and current values to memory. The saved values, UMIN, UMAX, IMIN and IMAX, can then be displayed or queried via the interfaces.

Syntax

MINMAX status

Parameter

Status

One of the following text parameters can be selected:

OFF

Storage of Min-Max values deactivated

ON

Storage of Min-Max values activated

RST

Contents of Min-Max memory are reset, i.e. are replaced with the momentary measured value for the corresponding parameter:

Umin = Uout

Umax = Uout

Imin = Iout

Imax = Iout

Default setting after RESET (*RST): **OFF**

a) Manual Operation

See description on page 28.

b) Programming

Setting

Setting command: **MINMAX status**

Example (HP Basic):

```
OUTPUT 712;"MINMAX ON;MINMAX RST"  
!Activate MINMAX function and  
!overwrite stored Min-Max values  
!with momentary measured values
```

Setting query

Query command: **MINMAX?**

Response string: **MINMAX status**

Possible response parameters (*status*):

"**OFF**" Storage of Min-Max values deactivated

"**ON**" Storage of Min-Max values activated

Fixed response string length: 10 characters

Example (HP Basic):

```
OUTPUT 712;"MINMAX?"  
ENTER 712;A$  
DISP A$
```

→Display: MINMAX ON

Comment

The MINMAX function can be temporarily set to "OFF", for example before deactivating the output when changing devices under test. Stored values are then no longer updated, nor are they automatically reset.

Stored Min-Max values can be read out regardless of the status selected for the MINMAX function.

Stored Min-Max values can always be reset with the MINMAX RST command. Stored Min-Max values can also be reset with the *RST command, or with the key combination <CE/LOCAL> + <ENTER> (= RESET).

The status of the MINMAX function is saved to the setup registers with the "SAVE" command.

If the POWER_ON function is set to "SBY" or "RCL", the MINMAX function is activated upon power-up, but previously measured Min-Max values are lost when the device is switched off.

The MINMAX function can also be controlled via the trigger input at the analog interface (→ page 74 T_MODE).

MODE? – Querying the Momentary Control Mode

Functions

The device responds with the momentarily active operating mode (control mode) in response to the MODE? query command.

Applications

In addition to evaluating the CRA condition register, the momentary control mode can be directly queried with MODE?.

Syntax

MODE?

a) Manual Operation

See description in chapter 3.

b) Programming

Query command: **MODE?**

Response string: **MODE control mode**

Possible response parameters for *mode*:

"**OFF**" Output deactivated

"**CV**" Constant voltage regulation

"**CC**" Constant current regulation

"**OL**" Overload (power limiting)

Fixed response string length: 8 characters

Example (HP Basic): **OUTPUT 712;"MODE?"**

```
ENTER 712;A$
```

```
DISP A$
```

→Display: MODE CV

OCP, OCP? – Overcurrent Protection

Functions

The OCP function specifies how the power output will respond if load current climbs to the selected ISET value, i.e. if current regulating is activated at the output.

Applications

As a rule, the OCP function is designed to protect interconnected power consumers in the event of continuous overcurrent, although, for example, intermittently high current is required:

- in order to maintain short response times when increasing output voltage (capacitor charging current)
- as starting current for motors
- as in-rush current for capacitive consumers.

The OCP function also makes it possible to subject power consumers to a selectable current value (ISET) for a precisely defined period of time (DELAY), e.g.

- for testing the breaking performance of fuses, circuit breakers, motor protecting switches etc.
- for determining the short-term load capacity of contacts and cables, as well as electrical and electronic components.

Syntax

OCP status

Parameter

Status

One of the following text parameters can be selected:

OFF

OCP function deactivated:
continuous current limiting (current regulation)

ON

OCP function activated:
The output is deactivated as soon as the specified DELAY period has elapsed after current limiting is triggered.

Default setting after RESET (*RST): **OFF**

a) Manual Operation

See description on page 26.

b) Programming

Set

Setting command: **OCP status**

Example (HP Basic):

```
OUTPUT 712;"OCP ON"
```

```
!Activate OCP function.
```

Setting query

Query command: **OCP?**

Response string: **OCP status**

Possible response parameters for (*status*):

"**OFF**" OCP function deactivated

"**ON**" OCP function activated

Fixed response string length: 7 characters

Example (HP Basic):

```
OUTPUT 712;"OCP?"
ENTER 712;A$
DISP A$
```

→Display: OCP OFF

Comment

The setting status of the OCP function is indicated by the yellow "OCP ON" LED at the front panel.

Deactivation of the power output initiated by the OCP function is indicated by the red "OCP" LED at the front panel, and bit 3 is simultaneously set in event register A (OCFA, overcurrent protection activated).

After OCP shutdown has occurred, the output is reactivated with OUTPUT ON.

If the OCP function has been activated and ISET and DELAY have been set to low values, the output may even be deactivated if output voltage is increased. This is due to the fact that charging current for the output capacitor is also acquired by the current regulator, and is limited to a value of Iset – Iload. For this reason, DELAY must be set to a value higher than the resulting output voltage response time.

OUTPUT, OUTPUT? – Activate / Deactivate the Output

Functions

The power output can be activated and deactivated with the OUTPUT function.

Activation sequence: Current and voltage values of "0" are specified initially for a period of approximately 2 ms with activated output for transition from the "highly resistive" condition. The output is then adjusted to the selected voltage and current setpoints.

Deactivation sequence: Current and voltage setpoints are set to 0 V and 0 A for a period of approximately 350 ms (500 ms for 80 V nominal voltage). The sink is thus activated. The sink discharges the output capacitors as far as possible. The sink is then deactivated so that the output becomes highly resistive for parallel connected direct voltage sources of less than nominal voltage. However, the output terminals are not electrically enabled.

Syntax

OUTPUT *status*

Parameter

Status

The desired *status* can be selected with one of the following text parameters:

OFF

Deactivate the output.

ON

Activate the output.

Default setting after RESET (*RST): **OFF**

a) Manual Operation

The power output can be switched on and off by activating the <OUTPUT> key.

b) Programming

Setting

Setting command: **OUTPUT** *status*

Example (HP Basic): **OUTPUT 712;"OUT ON"**
!Activate output

Setting query

Query command: **OUTPUT?**

Response string: **OUTPUT** *status*

Possible response parameters for (*status*):

"**OFF**" output deactivated

"**ON**" output activated

Fixed response string length: 10 characters

```
OUTPUT 712;"OUTPUT?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→ Display: OUTPUT ON

Comment

The setting status of the OUTPUT function is indicated by the red "OUTPUT" LED at the front panel.

LED on = output activated

LED off = output deactivated

The control mode displays are inactive when the status is set to OUTPUT OFF.

If an attempt is made to activate an output which has been disabled by an external trigger signal to the analog interface in the T_MODE OUT operating mode by means of a command or a key operation, the setting command is not executed and bit 4 is set in event register B (output-on error). "Err 25" also appears briefly at the display as a warning in the event of manual operation.

Additional functions which may influence the status of the output include:

- OTP, overtemperature protection (→ chapter 3)
- OVP, overvoltage protection (→ chapter 3, page 24, page 69)
- OCP in the event of "OCP ON" (→ chapter 3, page 26, page 68)
- SEQUENCE function (→ chapter 4.7.3, page 71)
- T_MODE function (→ page 29, page 74)
- POWER_ON (→ page 27, page 70).

OVSET, OVSET? – Overvoltage Protection Trigger Value

Functions

OVSET is used to define the trigger value (threshold) for the overvoltage protection function. If voltage at the output terminals exceeds the selected value, the power output is deactivated.

Syntax

OVSET *value*

Parameter

Value

Parameter type: real number

| Device Type | Setting Range | | Step Size | |
|-------------|------------------|----------|-----------|--------------------------|
| | Nom. Voltage [V] | Min. [V] | Max. [V] | Remote ^{a)} [V] |
| 40 | 3.00 | 50.00 | 0.1 | 0.1 / 1.0 |
| 52 | 3.00 | 62.50 | 0.1 | 0.1 / 1.0 |
| 80 | 3.00 | 100.00 | 0.1 | 0.1 / 1.0 |

Default setting after RESET (*RST): Maximum

a. If the selected *value* is not a whole number multiple of the step size, it is rounded off accordingly. If necessary, the numeric value is rounded off once again for the 4-place digital display.

b. Can be selected by (repeatedly) pressing the <RESOLUTION> key. The blinking decimal place at the display indicates the selected step size.

a) Manual Operation

See description on page 24.

b) Programming

Set

Setting command: **OVSET** *value*

Example (HP Basic): **OUTPUT 712;"OVSET 35.0"**

!Overvoltage protection trigger value: 35 V

Setting query

Query command: **OVSET?**

Response string: **OVSET** *value*

Parameter format *value*: **+nnn.n**

Fixed response string length: 12 characters

Example (HP Basic): **OUTPUT 712;"OVS?"**

```

ENTER 712;A$
DISP A$
→ Display: OVSET +035.0

```

Comment

Overvoltage protection can be triggered by:

- USET ≥ OVSET (due to manual setting, programming command, memory recall or Uset control signal to the analog interface)
- Sensing leads with reversed polarity
- Interrupted output lead during sensing mode operation
- Interference from the power consumer
- Parallel connected voltage sources
- Dynamic output voltage overshooting
- Device malfunction or defect

Overvoltage protection triggering is indicated by means of the red OVP LED, and results in immediate deactivation of the output (OUTPUT OFF), as well as disabling of the HF power transmitter and activation of the electronic sink for a period of approximately 350 ms (500 ms for 80 V device) in order to discharge the output capacitor. In addition, bit 4 (OVPA) is set in event register A. Bit 4 remains set in status register A for as long as the trigger value is exceeded.

As soon as the shutdown condition no longer exists, the power output can be reactivated by means of OUTPUT ON. The OVSET trigger value should be set at least 1 V higher than the desired output voltage USET in order to prevent undesired triggering of overvoltage protection resulting from overshooting due to sudden output discharging (see values in 1.5.2, Electrical Data).

The OVSET trigger value makes reference to the prevailing voltage value between the output terminals of the SSP KONSTANTER. This voltage is increased by the USET parameter during sensing mode operation (remote sensing) by an amount equal to voltage drop at the output leads. For this reason, the above defined difference between OVSET and USET must be correspondingly increased during sensing mode operation. Overvoltage protection response time is less than 200 µs. Output voltage generated by the device may exceed OVSET for the duration of this response time. Maximum overshooting can be approximately calculated as follows:

$$\Delta U_{out} = ISET [A] \times 200 [\mu s] / C_{out} [\mu F]$$

ISET = selected current setpoint
 C_{out} = capacitance of the output capacitor
 → chapter 1.5.3)

Subsequent discharging time for the output capacitor depends upon load, and corresponds to the specified values for response time at U_{nom} → 1 Volt included in chapter 1.5.3.

POUT? – Querying the Momentary Current Value

Functions

Momentary values for output voltage and output current are acquired by means of the POUT function. These two quantities are multiplied in order to arrive at the measured power value POUT. Approximately 90 ms are required to acquire and process the measured values.

Syntax

POUT?

Measuring Range: Due to the fact that the UOUT and IOUT measuring functions are utilized, the respective measuring ranges apply for power measurements as well. If one or both of the measured quantities UOUT and IOUT violate their respective measuring ranges, the product of POUT (UOUT x IOUT) is displayed as “-OL” or “+OL”, and “-99999.” or “+99999.” is

entered to the response string.

a) Manual Operation

See description on page 24.

b) Programming

Measured Value Query

Query command: **POUT?**
 Response string: **POUT value**
 Parameter format *value*: **±nnnn.n**
 Fixed response string length: 12 characters
 Example (HP Basic): **OUTPUT 712;"POUT?"**
ENTER 712;A\$
DISP A\$
 →Display: POUT +0662.7

Comment

See UOUT and IOUT measuring functions (→ page 76, page 67)

POWER_ON, POWER_ON? – Output Switching Status, Response After Power On

Functions

The POWER_ON function determines the status of device settings after mains power has been switched on.

Syntax

POWER_ON status

Parameter

Status

One of the following text parameters can be selected for specification of the desired *status*:

| Status | Description |
|------------|--|
| RST | RESET: Defined default settings are utilized (→ “Default Settings” in chapter 4.3.5, *RST) |
| RCL | RECALL: Same settings as prior to last mains shutdown |
| SBY | STANDBY: Same as RECALL except that the power output remains deactivated (OUTPUT OFF) |

Default setting after RESET (*RST): unchanged

a) Manual Operation

See description on page 27.

b) Programming

Setting

Setting command: **POWER_ON status**

Example (HP Basic):

```

OUTPUT 712;"POWER_ON RST"
! Device is set to default
! settings after power-up.

```

Setting query

Query command: **POWER_ON?**

Response string: **POWER_ON status**

Possible response parameters for *status*:

"RST" Default settings
"RCL" Last used device settings
"SBY" Last used device settings, deactivated output

Fixed response string length: 12 characters

Example (HP Basic):

```

OUTPUT 712;"POW?"
ENTER 712;A$
DISP A$

```

→Display: POWER_ON RST

Comment

The status of the POWER_ON function is not saved as a device setting with the “SAVE” command.

The following settings are recommended, depending upon how the device is used:

- POWER_ON RST for use in computer controlled systems
- POWER_ON RCL for applications which should continue in an unchanged fashion after mains failures
- POWER_ON SBY for common laboratory use

REPETITION, REPETITION? – Number of Repetitions for SEQUENCE Function

Functions

The REPETITION parameter defines how often a sequence will be repeated, from the start to the stop address.

Syntax

REPETITION *number*

Parameter

Number

Parameter type: whole number (integer)

| Setting Range | Description |
|---------------|--------------------------------|
| 0 | Continuous repetition |
| 1 to 255 | Number of sequence repetitions |

Default setting after RESET (*RST): unchanged

a) Manual Operation

See description on page 33.

b) Programming

Set

Setting command: **REPETITION** *number*

Example (HP Basic): **OUTPUT 712;"REPETITION 100"**
!100 repetitions

Setting query

Query command: **REPETITION?**

Response string: **REPETITION** *number*

Parameter format *number*: **nnn**

Fixed response string length: 14 characters

Example (HP Basic): **OUTPUT 712;"REPETITION?"**

ENTER 712;A\$

DISP A\$

→Display: REPETITION 100

Comment

The value selected for the REPETITION parameter is saved to the setup memory as a device setting with the SAVE command.

SEQUENCE, SEQUENCE? – Automatic Sequential Recall of Stored Settings

Functions

The SEQUENCE function allows for automatic sequential recall of USET, ISET and TSET values saved to memory addresses 11 through 255 with the *SAV (save) function in accordance with the TDEF, REPETITION, START and STOP parameter settings selected under SEQUENCE ON.

Syntax

SEQUENCE *status*

Parameter

Status

The following alternatives are available for the status text parameter:

| Status | Description |
|--------|---|
| GO | Start the SEQUENCE (condition: SEQUENCE function initialized) |

| | |
|--------------|---|
| HOLD | Pause, suspend sequence at current memory location |
| CONT | Resume automatic sequence run with the next valid memory location. |
| STRT* | Execute the first valid memory location, output is activated, step-by-step control |
| STEP* | Execute the next valid memory location |
| STOP* | Execute the stop address and end the automatic sequence run or step-by-step control |

Default setting after RESET (*RST):

STOP is executed for a running sequence and the RDY status becomes active.

* **Step-by-step control**, similar to external trigger function / **T_MODE RCL**

If no executable data have been saved to the stop address, the last setting remains valid and the output is deactivated.

a) Function and manual operation

See explanation on page 34.

b) Programming

Set

Setting command: **SEQUENCE** *status*

Example (HP Basic) **OUTPUT 712;"SEQUENCE GO"**
!Start SEQUENCE run.

Setting query

Query command: **SEQUENCE?**

Response string: SEQUENCE *txt,n1,n2*

Length: 21 characters, fixed

Parameter: *txt (status)*

n1,n2

(*number of repetitions, current address*)

Possible responses to text: "RUN", "HOLD", "RDY"

RUN: active sequence

HOLD: sequence suspended

RDY: device in initial state

Possible responses for number of repetitions:

000: Device in initial state,
No sequence running

001 ... 255: Current number of remaining repetitions

999: Continuous repetition,
no specified number of repetitions

Example (HP Basic): **OUTPUT 713;"SEQUENCE?"**

ENTER 713;A\$

DISP A\$

→ Display: SEQUENCE RUN,237,111

RUN: active sequence

237: current number of remaining repetitions

111: current address (memory location)

SRQ – Service Request

Functions

The controller is requested to read out specific information regarding device conditions or events by means of the SRQ. The IEC bus is equipped with a common SRQ interrupt line which can be activated by any of the bus users.

The conditions under which the SRQ message will be triggered can be selected by the user for the SSP KONSTANTER. Any of the messages which occur in the event registers can be selected, as well as the "message available" message (MAV).

Which event message or messages are capable of generating an SRQ message is determined by setting the enable registers accordingly (SRQ masking).

Applications

Example: An SRQ is to be triggered if an incorrect command is received (unrecognized or non-executable):

Assume that the event registers had an initial value of "0". After receiving an incorrect command, the device sets either bit 5 (command error CME) or bit 4 (execution error EXE) in the event standard register ESR (see Figure 6.5). Accordingly, bits 4 and 5 must also be set in the respective ESE enable register, so that the ESR group message can be forwarded to the status byte register (STB). The corresponding SRE enable register must in turn be set to TRUE (= 1) at bit 5, so that the MSS group message (master summary status) can be generated by the ESR bit, after which it is then entered to bit 6 of the status byte itself, and indicates that there is at least one reason to generate an SRQ message. The SRQ message is then triggered by the downstream service request function.

The respective commands for setting the assumed SRQ conditions are thus: ***ESE 48; *SRE 32.**

Service calls from the ERA and ERB event registers or the MAV message are generated in the same way.

Comment

It is usually advisable to enable at least the following events for SRQ message triggering, because even if only one of these events occurs, the device is no longer capable of executing the desired settings:

| | |
|-----------------------|-----------------------------------|
| CME, command error | EXE, execution error |
| QYE, query error | OTPA, OTP activated |
| TSTE, self-test error | LIME, limit error |
| OVPA, OVP activated | OCPA, OCP activated |
| PHF, phase failure | SEQE, sequence error |
| OUTE, output error | DDTE, define device trigger error |

The setting commands required to this end read as follows:

***ESE 52; ERAE 56; ERBE 190; *SRE 52.**

The control computer may execute serial polling at the IEC bus in response to the SRQ message (→ chapter 6.2), in order to pinpoint the affected device and determine the reason.

If all utilized devices with SRQ capability are equipped with parallel polling as well, it may be possible to identify the device which generated the SRQ message more quickly by means of this function, assuming they have been configured accordingly. The service request function is not available via the RS 232C serial interface, but similar results can be obtained by querying (either cyclically and/or after each data transmission to the device) and evaluating the individual status message (IST) after previously setting the parallel poll enable register (PRE) (→ page 60 and page 61).

START_STOP, START_STOP? – Memory Location Start and Stop Addresses for the SEQUENCE Function

Functions

The parameters settings for START and STOP addresses define the beginning and the end of the sequence to be executed. The following applies: start address ≤ stop address.

Syntax

START_STOP *start address, stop address*

Parameter

Start address, stop address

Parameter type: number (whole number)

| | Setting Range | |
|----------------------|------------------------------|--------------------------------|
| <i>Start address</i> | 11 through 255 | Start address |
| <i>Stop address</i> | 11 through 255 | Stop address (≥ start address) |

Default setting after RESET (*RST): both unchanged

a) Manual Operation

See description on page 32 ff.

b) Programming

Set

Setting command: **START_STOP** *start address, stop address*

Example (HP Basic):

```
OUTPUT 712;"STA 20,115"
! Sequence start = register 20
! Sequence end = register 115
```

Setting query

Query command: **START_STOP?**

Response string: **START_STOP** *start address, stop address*

Parameter format *start address, stop address: nnn*

Fixed response string length: 18 characters

Example (HP Basic):

```
OUTPUT 712;"STA?"
ENTER 712;A$
DISP A$
```

→Display: START_STOP 020,115

Comment

In the case of programming via the interface, the start and stop parameters are combined into a single unit: "START_STOP". If an attempt is made to set the start address to higher value than the stop address, the command is not executed and bit 4 (EXE, execution error) is set in the standard event register ESR. Selected START and STOP address values are saved to setup memory as a device setting with the SAVE command.

STORE, STORE? – Transferring Parameters Directly to Memory

Functions

- The **STORE** command and its parameters can only be queried via an interface with appropriate programming.
- It immediately overwrites all values of the memory location with the new parameter data.
- Memory location contents are **not** shifted.

Note: If more than 15 STORE commands are to be transmitted in blocks, a string length of at least 25 characters per command is recommended (see response format for STORE?).

Syntax

STORE *n, v1, v2, v3, txt*

Parameter

n, v1, v2, v3, txt (memory address, USET, ISET TSET, CLEAR / no function)

Parameter type: integer, real, real, real, character

| | Setting Range | |
|------------|----------------------------------|---|
| <i>n</i> | 11 through 255 | Memory address |
| <i>v1</i> | 0 ≤ v1 ≤ USETmax | |
| <i>v2</i> | 0 ≤ v2 ≤ ISETmax | |
| <i>v3</i> | TSET: 00.01 [s] ≤ v3 ≤ 99.99 [s] | |
| <i>txt</i> | CLR, NF*, RU*, NC** | CLR: deletes the entire memory location regardless of other data) |

* From firmware version 03.004

** ON, OFF and NC: Setpoints are transferred, the text parameter is set internally to NC.

Programming

Set

Setting command: **STORE** *n, v1, v2, v3, txt*

Example (HP Basic):

```
OUTPUT 713;"STORE 14,15.5,3,9.7,NC"
{overwrite memory location 14 with
the following data:
Uset = 15.5 V; Iset = 3 A;
Tset = 9.7 s; no function}
```


Comment

- As opposed to ***SAV**, the **STORE** command allows for significantly faster and more direct programming of the required memory locations for a sequence.
- The txt parameter is optional from this point on. If the txt parameter is omitted, the comma between the last numeric parameter and the txt parameter is omitted as well. The NC txt parameter is treated like the non-transmitted txt parameter.
- Response to the txt parameter

| Transmitted txt Parameter | Response from SSP32N | |
|---------------------------|-------------------------|---|
| | Memory Location, Before | Memory Location, After |
| None or NC* | Valid setpoints | New setpoints are transferred, text parameter remains unchanged |
| | Empty | New setpoints are transferred, text parameter is set to NC |
| CLR | Any | Memory content is deleted |
| NF | Any | SEQUENCE values USET, ISET, TSET without additional function |
| RU | Any | Voltage ramp, duration TSET and/or TDEF |
| RI | Any | Current ramp, duration TSET and/or TDEF |

* ON, OFF: setpoint values are accepted, an internal text parameter is set for NC (this is tolerated for compatibility reasons with the SSP32N series)

Setting query

Recall data for address n from sequence or limit value memory:

Programming

| | Command | Value Range | Meaning |
|---|------------------|--------------------------------|--|
| a | Store? | | Query contents of a memory range from the start address to the stop address (AAA and EEE) |
| b | Store? n | n = 11 ... 255 | Query contents of memory location n |
| c | Store? n1,n2 | n1, n2 = 11 ... 255 n2 ≥ n1 | Query contents of a memory range from address n1 to address n2 |
| d | Store? n1,n2,tab | n1, n2 = 11 ... 255 n2 ≥ n1 | Query contents of a memory range from address n1 to address n2, delimiter between output parameters: Tabulator character = 09h, decimal point = decimal comma, line break = 0Ah |

Query command: a) **STORE?**

b) **STORE? n**

c) **STORE? n1,n2**

Response string: a/c) STORE AAA/n1, v1, v2, v3, txt; ... ; STORE EEE/n2, v1, v2, v3, txt

b) STORE n, v1, v2, v3, txt

Length: Case b): 37 characters, fixed
Case a/c): ((n2-n1+1)x38)-1 character

Parameter: n, v1, v2, v3, txt
(nnn,+000.000,+000.000,00.00,CLR)
(memory address, USET, ISET TSET, CLEAR / no function)

If the response is CLR, the queried memory location is empty.

Example b) (HP Basic):

OUTPUT 713; "STORE? 14"
ENTER 713; A\$
DISP A\$

→ Display: STORE 014,015.000,003.000,09.70, N C

Example a/c)

(HP Basic (in case a), start address 11 and stop address 13 apply):

a) OUTPUT 713; "STORE?"

c) OUTPUT 713; "STORE? 11,13"

ENTER 713; A\$

DISP A\$

→ Display:

STORE 011,+015.000,+003.000,09.70, NC;
STORE 012,+010.000,+004.000,01.50, NC;
STORE 013,+020.000,+007.000,02.30, NC

Example d) (HP Basic):

OUTPUT 713; "STORE? 11,13,tab"

ENTER 713; A\$

DISP A\$

→ Display:

STORE→011→+015,000→+003,000→09,70→ NC,␣
STORE→012→+010,000→+004,000→01,50→ NC,␣
STORE→013→+020,000→+007,000→02,30→ NC,␣

Significance of delineators:

→ = ASCII 09h tabulator

␣ = ASCII 0Ah line feed

TDEF, TDEF? – Default Time for SEQUENCE Function

Functions

The TDEF parameter setting defines the dwell time default setting for a voltage-current value pair to be recalled. TDEF is used instead of TSET if TSET has not been set to any specific value, or if it has been set to 00.00 [s].

Applications

Use of TDEF is advantageous if one or several identical dwell times occur within a given sequence whose values need to be changed frequently.

Syntax

TDEF value

Parameter

Value

Parameter type: real number

| | |
|----------------|-----------------------|
| Setting Range: | 00.01 [s] – 99.99 [s] |
| Resolution: | 10 ms |

Default setting after RESET (*RST): unchanged

a) Manual Operation

See description on page 32.

b) Programming

Set

Setting command: **TDEF value**

Example (HP Basic): **OUTPUT 712;"TDEF 5.0"**
!Default time: 5 seconds

Setting query

Query command: **TDEF?**

Response string: **TDEF value**

Parameter format value: **nn.nn**

Fixed response string length: 10 characters

Example (HP Basic):

OUTPUT 712;"TDEF?"
ENTER 712;A\$
DISP A\$

→Display: TDEF 05.00

Comment

The selected TDEF value is saved to setup memory as a device setting with the SAVE command.

See also chapter 4.7.3, SEQUENCE Function.

T_MODE, T_MODE? – Trigger Input Function Selection

Functions

The T_MODE parameter assigns the floating trigger input with optocoupler (at the analog interface) to a selected device function.

Syntax

T_MODE *action*

Parameter

Action

Selection can be made from any of the following text parameters:

| Action | Description |
|------------|--|
| OFF | Trigger input function deactivated |
| OUT | Trigger input acts upon the OUTPUT: output On/Off |
| RCL | RECALL: memory recall (single step) |
| SEQ | SEQUENCE: sequential memory recall (SEQUENCE GO) ^{a)} |
| LLO | LOCAL LOCKED: control panel disabling |
| MIN | MINMAX: Min-Max memory for measured values |

Default setting after RESET (*RST): unchanged

a. If the SEQUENCE function has not first been initialized, an active trigger signal results in error message "Err 27", which is displayed for approximately 1 second, and bit 5 (SEQ) is set in event register B (ERB). "RCL" or "SEQ" settings can only be executed if the SEQUENCE function has been fully initialized (see page 71).

A detailed description of trigger input functions is included in chapter 5.7.

a) Manual Operation

See description on page 29.

b) Programming

Set

Setting command:

T_MODE *action*

Example (HP Basic):

```
OUTPUT 712;"T_MODE LLO"
```

```
! Trigger input causes control panel  
! disabling / enabling.
```

Setting query

Query command:

T_MODE?

Response string:

T_MODE *action*

Possible response parameters for *action*:

| | |
|------------|------------|
| OFF | OUT |
| RCL | SEQ |
| LLO | MIN |

Fixed response string length: 10 characters

Example (HP Basic):

```
OUTPUT 712;"T_MODE?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→Display: T_MODE LLO

Comment

The status of the T_MODE function is not saved as a device setting with the "SAVE" command.

TSET, TSET? Dwell Time Specific to Memory Location for the SEQUENCE Function

Functions

The TSET parameter setting defines memory location-specific dwell time for a voltage-current value pair to be recalled. If no specific value or a value of 00.00 [s] is assigned to TSET, TDEF is used as a default value for execution of the sequence function.

Syntax

TSET *value*

Parameter

Value

Parameter type: real number

| | |
|----------------|--|
| Setting Range: | 0 (= TDEF) or 00.01 [s] – 99.99 [s] |
| Resolution: | 10 ms |

Default setting after RESET (*RST): 0 (= TDEF)

a) Manual Operation

See description on page 31.

b) Programming

Set

Setting command:

TSET *value*

Example (HP Basic):

```
OUTPUT 712;"TSET 0.2"
```

```
! Specific dwell time: 0.2 seconds
```

Setting query

Query command:

TSET?

Response string:

TSET *value*

Parameter format *value*: **nn.nn**

Fixed response string length: 10 characters

Example (HP Basic):

```
OUTPUT 712;"TSET?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→Display: TSET 00.20

Comment

Dwell times of greater than 99.99 seconds per setting can be achieved if total dwell time is distributed to several consecutive sequence registers with identical current and voltage settings. If the selected dwell time for a specific sequence register needs to be read out, the respective register must first be queried from memory with the RCL function.

The selected TSET value is also saved to the setup register as a device setting with the SAVE command.

ULIM, ULM? – Voltage Setting Limit Value

Functions

ULIM defines the upper setting limit (soft-limit) for voltage setpoint value USET.

This limit can be used to assure that output voltage is not inadvertently set above a specified value.

Syntax

ULIM *value*

Parameter

Value

Parameter type: real number

| Device Type | Setting Range | | Step Size | |
|-------------|------------------|----------|------------------------|--------------------------|
| | Nom. Voltage [V] | Min. [V] | Max. ^{a)} [V] | Remote ^{b)} [V] |
| 52 | 0.00 | 52.00 | 0.001 | 0.01/0.1/1.0 |
| 80 | 0.00 | 80.00 | 0.001 | 0.01/0.1/1.0 |

Default setting after RESET (*RST): Nominal voltage

- However, ULIM cannot be set to a value of less than the momentary voltage setpoint USET.
- If the selected value is not a whole number multiple of the step size, it is rounded off accordingly. If necessary, the numeric value is rounded off once again for the 4-place digital display.
- Can be selected by (repeatedly) pressing the <RESOLUTION> key. The blinking decimal place at the display indicates the selected step size.

a) Manual Operation

See description on page 23.

b) Programming

Set

Setting command:

ULIM *value*

Example (HP Basic):

```
OUTPUT 712;"ULIM 28"
```

```
!Voltage setting limit value: 28 V
```

Setting query

Query command:

ULIM?

Response string:

ULIM *value*

Parameter format *value*: **+nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic):

```
OUTPUT 712;"ULIM?"
```

```
ENTER 712;A$
```

```
DISP A$
```

→Display: ULIM +028.000

Comment

If an attempt is made to set ULIM to a value lower than USET, the setting command is not executed and bit 1 is set in event register B (limit error), as is bit 4 in the standard event register (execution error).

The ULIM function does not effect the adjustment of USET by means of a control signal via the analog interface. However, direct monitoring of maximum output voltage can be configured with overvoltage protection trigger value OVSET (→ page 24 OVSET).

UMAX? – Maximum Measured Voltage Value

Functions

The UMAX function reads out the highest output voltage value which was measured by the UOUT measuring function and saved to Min-Max memory while the MINMAX function was set to ON.

Syntax

UMAX?

Measuring Range:

Voltage measuring range as per UOUT

If the measured voltage value has exceeded the upper measuring range limit at least once with the MINMAX function set to ON, "+OL" appears at the display for UMAX and "+999999." is entered to the data string. The Min-Max memory value can be reset to the momentarily measured value with MINMAX RST (for all 4 parameters at once).

a) Manual Operation

See description on page 28.

b) Programming

Measured Value Query

Query command: **UMAX?**

Response string: **UMAX** *value*

Response parameter format *value*: **+nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"UMAX?"**

```
ENTER 712;A$
```

```
DISP A$
```

→Display: UMAX +030.450

Comment

→ page 67, MINMAX function

UMIN? – Minimum Measured Voltage Value

Functions

The UMIN function reads out the lowest output voltage value which was measured by the UOUT measuring function and saved to Min-Max memory while the MINMAX function was set to ON.

Syntax

UMIN?

Measuring Range:

Voltage measuring range as per UOUT

If the measured voltage value has fallen below the lower measuring range limit at least once with the MINMAX function set to ON, "-OL" appears at the display for UMAX and "-999999." is entered to the data string. The Min-Max memory value can be reset to the momentarily measured value with MINMAX RST (for all 4 parameters at once).

a) Manual Operation

See description on page 28.

b) Programming

Measured value query

Query command: **UMIN?**

Response string: **UMIN** *value*

Response parameter format *value*: **+nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"UMIN?"**

```
ENTER 712;A$
```

```
DISP A$
```

→Display: UMIN -000.000

Comment

→ page 67, MINMAX function

UOUT? – Querying the Momentary Voltage Value

Functions

The UOUT function is used to measure momentary output voltage. The measured value is acquired over a period of 40 ms in a continuous fashion.

Syntax

UOUT?

Measuring Range

| Device Type Nom. Voltage [V] | Measuring Range | | Resolution | |
|------------------------------------|---------------------------|---------------------------|-------------------------|-----------------|
| | Min. ^{a)} [V] | Max. ^{b)} [V] | Response String [mV] | Display [mV] |
| 52 | -2.666 | 58.770 | 3.3 | 10 |
| 80 | -4.000 | 88.160 | 10 | 10 |

a. Measured values which violate the measuring range lower limit are identified at the display as "-OL", and in the data string as "-999999".

b. Measured values which exceed the measuring range upper limit are identified at the display as "+OL", and in the data string as "+999999".

a) Manual Operation

See description on page 24.

b) Programming

Query command: **UOUT?**

Response string: **UOUT value**

Parameter format *value*: **±nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"UOUT?"**

ENTER 712;A\$

DISP A\$

→Display: UOUT +021.300

Comment

→ page 28, ROUND function

USET, USET? – Voltage Setpoint Value

Functions

USET defines the output voltage setpoint value.

Syntax

USET value

Parameter

Value

Parameter type: real number

| Device Type Nom. Voltage [V] | Setting Range | | Step Size | |
|------------------------------------|---------------|---------------------------|-----------------------------|-----------------------------|
| | Min. [V] | Max. ^{a)} [V] | Remote ^{b)} [V] | Manual ^{c)} [V] |
| 52 | 0.00 | 52.00 | 0.0167 | 0.01/0.02/0.1/1.0 |
| 80 | 0.00 | 80.00 | 0.02 | 0.02/0.1/1.0 |

Default setting after RESET (*RST): **0.00** [Volt]

a. However, USET cannot be set to a value of greater than the momentary voltage limit value ULIM.

b. If the selected value is not a whole number multiple of the step size, it is rounded off accordingly.

c. Can be selected by (repeatedly) pressing the <RESOLUTION> key. The blinking decimal place at the display indicates the selected step size.

a) Manual Operation

See description on page 22.

b) Programming

Set

Setting command: **USET value**

Example (HP Basic): **OUTPUT 712;"USET 12.5"**

!Voltage setpoint value 12.5 V

Setting query

Query command: **USET?**

Response string: **USET value**

Parameter format *value*: **±nnn.nnn**

Fixed response string length: 13 characters

Example (HP Basic): **OUTPUT 712;"USET?"**

ENTER 712;A\$

DISP A\$

→Display: USET +012.500

Comment

If an attempt is made to set USET to a value higher than ULIM, the setting command is not executed and bit 1 is set in event register B (limit error), as is bit 4 in the standard event register (execution error).

WAIT – Additional Waiting Time

Functions

Additional waiting time between execution of two commands.

This function can be used to add additional waiting time within a command string (linked commands) for processing or execution. For example, this allows for defined programming of a specified power-on status / start-up edge within a command string with execution time in the ms range.

Programming

Setting command: **WAIT v**

Parameter: *v (value)*

Parameter type: real number

Setting Range: 0.001 <s> ≤ w ≤ 9.999 <s>

Resolution: 1 ms

Comment

The length of the command string may not exceed 255 characters (= buffer length), because an unspecified pause would otherwise occur as a result of the additional data transmission.

Attention:

Receive data are not processed during waiting time, and the input buffer is disabled, i.e. the display readings are not updated during this time either.

Example

"USET 0; ISET 5; OUTPUT ON; WAIT 0.001; USET 3; WAIT 0.003; USET 7; WAIT 0.003; USET 10"

(or "US 0; IS 5; OU ON; W .001; US 3; W .003; US 7; W .003; US 10" with decoupled command name)

6.5 Status and Events Management

The device is furnished with special registers which can be queried by the controller for the recognition of programming errors (e.g. receipt of an incorrect command), device status (e.g. voltage regulating mode) or separate events (e.g. output has been deactivated by OCP function).

Overview

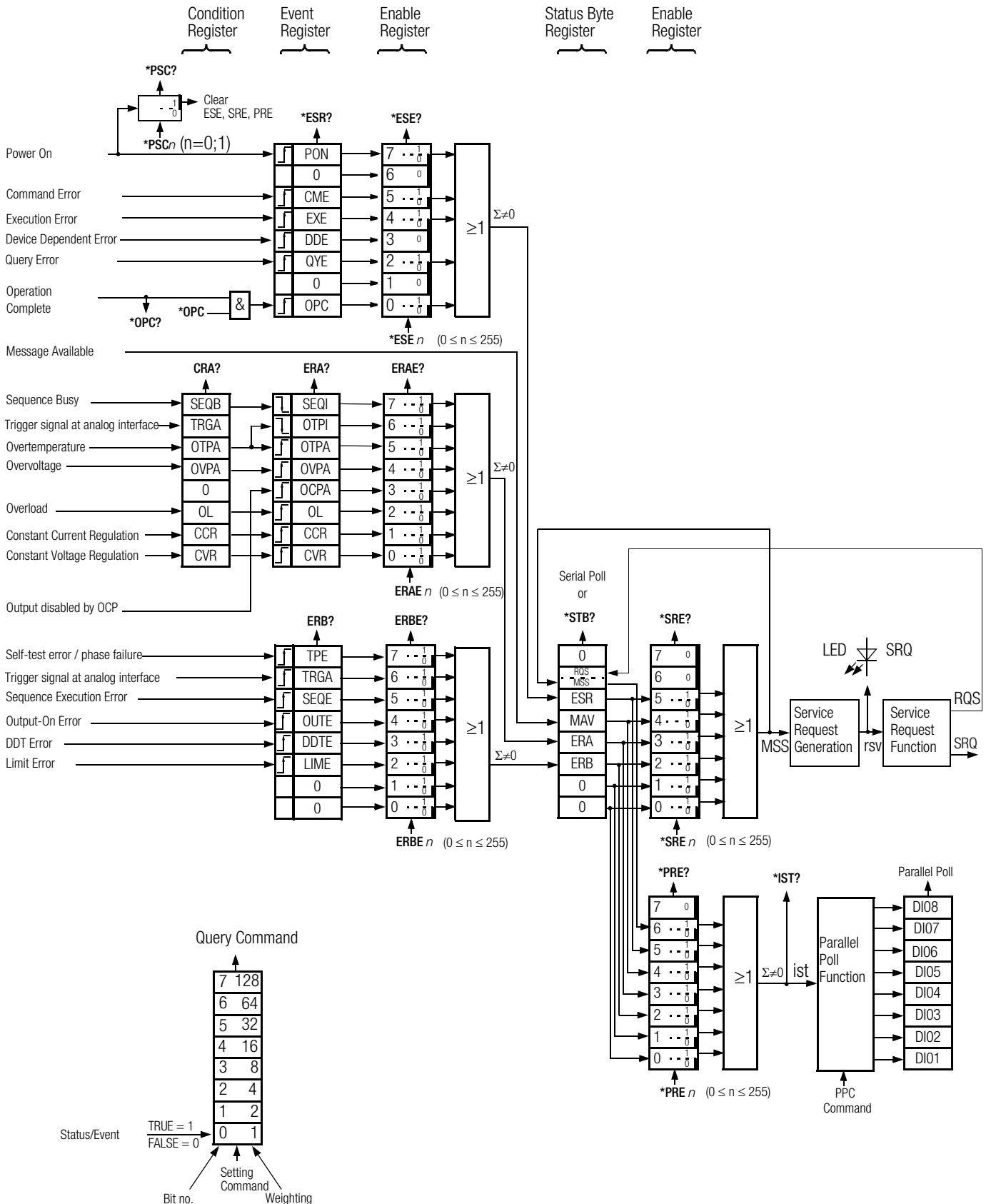


Figure 6.5 Status and Events Management

Significance of Register Contents

| Register Name | Meaning |
|---------------|--|
| CCR | Output is/was in current regulating mode |
| CVR | Output is/was in voltage regulating mode |
| CME | Unrecognized command, syntax error, standard limit values for numeric parameters exceeded |
| DDTE | Define device trigger function error message: – *DDT command string > 80 characters or – *TRG command included in *DDT command string |
| EXE | Command-specific parameter limits exceeded, a command or parameter is incompatible with present operating state |
| LIME | Error message after setting command USET, ISET, ULIM, ILIM: An attempt has been made – to select a voltage or current setpoint which is higher than the defined limit value, or – to select a limit value which is lower than the momentary voltage or current setpoint. |
| MAV | Error message following a query command: The requested information is available at the output buffer. The MAV bit should only be queried by means of serial polling during IEC bus mode operation. |
| OCPA | Output deactivated by OCP function. Reactivate with OUTPUT ON. |
| OL | Overload message: Power limiting has been triggered. |
| OPC | Ready message: Commands preceding the *OPC command have been executed (time synchronization). |
| OTPA | Overtemperature message: The device is overheated, e.g. due to obstructed vents. The output is deactivated 5 seconds after this message appears. The OUTPUT ON setting command is ignored as long as this condition persists, and causes repeated setting of the OTPA bit in the event register. |
| OTPI | Ready for operation message after OTPA overtemperature message: The device has cooled back down. If the POWER ON function is set to standby or reset, the output remains deactivated. If the POWER ON function is set to recall, the output is automatically reactivated. |
| OUTE | Error message after OUTPUT ON command: Activation of the output is disabled by an OUTPUT OFF signal at the trigger input of the analog interface. Display: "Err 25" |
| OVPA | Overvoltage protection has been triggered and the output has been deactivated. Reactivate with OUTPUT ON. |
| TPE | Error message: Error or mains phase failure detected during self-test (only for devices with 3-phase mains connection) |
| PON | The device was switched off for an interim period of time. |
| QYE | Error message after addressing as talker: No message is (yet) available at the output buffer. |
| SEQB | Status message: Sequence function active (run, hold) |
| SEQL | Ready message: The SEQUENCE has been completed, or was aborted (inactive, ready). |
| SEQE | Error message after SEQUENCE GO: – A voltage or current setpoint value which has been recalled from SEQUENCE memory is higher than the respective limit value (USET > ULIM or ISET > ILIM). Display: "Err 21" or – No executable values exist within the storage area defined by the START and STOP addresses. Display: "Err 22" The SEQUENCE is aborted after the error message appears. |
| TRGA | Trigger at analog interface: Trigger signal detected at analog interface. |

n = decimal equivalent of register content ($0 \leq n \leq 255$).

Condition Register (→ page 64)

Condition Register A (CRA)

The individual bits of the condition register reflect the momentary status of a specific device function:

0 = condition does not apply (FALSE)

1 = condition applies (TRUE)

The content of the condition register can be read out, but direct overwriting and deletion are not possible.

Event Registers (→ page 60)

Standard event register (ESR)

Event register A (ERA)

Event register B (ERB)

The event registers acquire and save status changes which have occurred for specific device functions. The corresponding bit is set to 1 in the event register (1 = TRUE), when the respective function status

– is changed from FALSE to TRUE (for input $\downarrow F$) or

– from FALSE to TRUE (for input $\downarrow L$).

The three event registers can be individually queried. When an event register is queried, its content is deleted. Setting command ***CLS** clears all event registers.

An enable register is assigned to each event register.

Enable registers (→ page 60)

Standard event enable register (ESE)

Event enable register A (ERA)

Event enable register B (ERBE)

Service request enable register (SRE)

Parallel poll enable register (PRE)

The enable registers determine which bit(s) from the corresponding event or status byte register is/are capable of influencing the respective group message. The respective group message remains set (1 = TRUE), as long as at least one bit which has been enabled to this end has a status of TRUE.

The five enable registers can be written to and read separately. Queries, the *CLS command and device functions do not cause any changes to the contents of these registers. The registers can be cleared by entering a value of "0" (e.g. ***ESE 0**). Exception: The enable registers are non-volatile, and are only cleared by means of device shutdown if the non-volatile PSC flag is set to 1.

Status Byte Register (STB) (→ page 63)

The status byte register contains:

- The status of group messages from the three event registers (bits 2, 3 and 5)
- The status of the output buffer (empty → MAV (bit 4) = 0, not empty → MAV = 1)
- The status of MSS group messages masked with the SRE enable register from internal bits 2, 3, 4 and 5 (bit 6).
- Bits 0, 1 and 7 are not used, and are always set to "0".

Register content can be read out:

- With the ***STB?** command, or
- With the "serial poll" interface command in the event of IEC bus operation. If this is the case, bit 6 indicates the RQS status, which is reset (0) after completion of serial polling.

The *CLS command clears the status byte register except for the MAV bit, and cancels any SRQ messages.

Power-On Status Clear Flag (PSC) (→ page 62)

The power-on status clear flag determines whether or not the contents of the non-volatile enable registers, ESE, SRE and PRE, will be cleared when the device is shut down.

The PSC flag can be set and queried:

Set: ***PSC n** $n = 0$: ESE, SRE and PRE are not cleared

$n = 1$: ESE, SRE and PRE are cleared

Query: ***PSC?** response: "0" or "1"

The PSC flag setting is retained, even after the device has been switched off.

Operation Complete Flag (OPC) (→ page 61)

A ready message can be triggered with the operation complete flag after one or several transmitted commands have been executed by the device.

The OPC bit is set in the standard event register by means of the ***OPC** command, because it is not processed until after all previous commands have been executed.

The response to query command ***OPC?** is always "1", because it is not processed until all previous commands have been executed.

7 Adjusting the SSP KONSTANTER

Warning!

The housing cover must be removed in order to balance the device and voltage conducting components are thus exposed. For this reason, the work described in this chapter may only be performed by trained personnel who are familiar with the dangers involved!

Operating the device without connecting the protective conductor is prohibited!

Balancing components:

| Trim Potentiometers | On PCB: | Designation | Balancing Parameter |
|---------------------|---------|---------------|------------------------------|
| R124 | FF | I Monitor 0 | Current monitor zero-point |
| R130 | FF | I Monitor max | Current monitor final value |
| R554 | G | Uset 0 | Voltage setpoint zero-point |
| R549 | G | Uset max | Voltage setpoint final value |
| R529 | G | Iset 0 | Current setpoint zero-point |
| R524 | G | Iset max | Current setpoint final value |
| R657 | A | Uout 0 | Measured voltage zero-point |
| R651 | A | Uout max | Measured voltage final value |
| R669 | A | Iout 0 | Measured current zero-point |
| R663a | A | Iout max | Measured current final value |

Required measuring instruments:

a) For direct voltage measurement

| Digital Voltmeter: | Uncertainty | at Measured Value: |
|--------------------|-------------|--------------------|
| | < 0.02 % | 40 V / 52 V / 80 V |
| | < 0.02 % | 40 ... 150 mV |
| | < 0.2 mV | 0 ... 10 mV |

Input resistance > 1 M Ω

b) For direct current measurement < 1 A

| Digital Multimeter: | Uncertainty | at Measured Value: |
|---------------------|-------------|--------------------|
| | < 2 % | 10 ... 200 mA |

Voltage drop < 1 V

c) For direct current measurement > 1 A

| Digital Voltmeter Same as a) plus calibrated shunt resistor: | Device Nominal Current | Shunt |
|--|------------------------|----------------------|
| | 12.5 A / 25 A | 6 m Ω , 25 A |
| | 50 A / 75 A | 2 m Ω , 75 A |
| | 100 A / 150 A | 1 m Ω , 150 A |

Overall measuring uncertainty at nominal current: < 0.07 %

Balancing conditions:

| | |
|-------------------------|---------------|
| Ambient temperature | 23 \pm 2° C |
| Relative humidity | 20 ... 80% |
| Mains voltage tolerance | \pm 3% |
| Warm-up time | 10 minutes |

Balancing the I Monitor Zero-Point

Device settings: OUTPUT ON; USET 2.00; ISET 2.00

Output: Idle

- Connect digital voltmeter to I monitor (+) and AGND (–) at the analog interface.
- Balance measured voltage $U_{I-Monitor}$ with R124 to:
 - 5 mV < $U_{I-Monitor}$ < + 5 mV

Balancing the I Monitor Final Value

Device settings: OUTPUT ON; USET 2.00; ISET = I_{nom}

Output: Shorted with shunt

- Connect digital voltmeter as described above and measure voltage $U_{(-)Monitor}$ (must be approx. 10 V).
- Current I_s at shunt R_s is adjusted by turning R130, voltage $U_{-Monitor}$ remains constant. Determine current I_s by measuring shunt voltage U_s and balance to:

$$I_s = I_{nom} \times U_{-Monitor} / 10 \text{ V} \pm 0.5\%$$

Balancing the Current Setpoint Zero-Point

Device settings: OUTPUT ON; USET 2.00;

ISET = 0.012 where $I_{nom} = 12.5 \text{ A}$
 = 0.025 where $I_{nom} = 25 \text{ A}$
 = 0.050 where $I_{nom} = 50 \text{ A}$
 = 0.080 where $I_{nom} = 75 \text{ A}$
 = 0.100 where $I_{nom} = 100 \text{ A}$
 = 0.160 where $I_{nom} = 150 \text{ A}$

Output: shorted with shunt or via ammeter

- Balance measured current I_s with R529 to:

$$I_s = \text{ISET} \pm 20\%$$

Balancing the Current Setpoint Final Value

Device settings: OUTPUT ON; USET 2.00; ISET = I_{nom}

Output: Shorted with shunt

- Measure current I_s at shunt R_s and balance with R524 to:

$I_s = 12.50 \text{ A} \pm 25 \text{ mA}$ where $I_{nom} = 12.5 \text{ A}$
 = 25.00 A \pm 45 mA where $I_{nom} = 25 \text{ A}$
 = 50.00 A \pm 90 mA where $I_{nom} = 50 \text{ A}$
 = 75.00 A \pm 210 mA where $I_{nom} = 75 \text{ A}$
 = 100.00 A \pm 230 mA where $I_{nom} = 100 \text{ A}$
 = 150.00 A \pm 410 mA where $I_{nom} = 150 \text{ A}$

Balancing the Measured Current Zero-Point

Device settings: OUTPUT ON; USET 2.00; ISET 2.00

Output: Idle

- Balance the Iout value which appears at the right-hand display with R669 to:

– 0.01 \leq Iout \leq 0.006 where $I_{nom} = 12.5 \text{ A}$
 – 0.01 \leq Iout \leq 0.01 where $I_{nom} = 25 \text{ A}$
 – 0.01 \leq Iout \leq 0.02 where $I_{nom} = 50 \text{ A}$
 – 0.02 \leq Iout \leq 0.02 where $I_{nom} = 75 \text{ A}$
 – 0.04 \leq Iout \leq 0.04 where $I_{nom} = 100 \text{ A}$
 – 0.04 \leq Iout \leq 0.06 where $I_{nom} = 150 \text{ A}$

Balancing the Measured Current Final Value

Device settings: OUTPUT ON; USET 2.00; ISET = I_{nom}
 Output: Shorted with shunt

- Measure current I_s at shunt R_s and balance the measured lout value which appears at the right-hand display with R663a to:

| | |
|-----------------------------------|----------------------------------|
| $I_{out} = I_s \pm 28 \text{ mA}$ | where $I_{nom} = 12.5 \text{ A}$ |
| $= I_s \pm 58 \text{ mA}$ | where $I_{nom} = 25 \text{ A}$ |
| $= I_s \pm 105 \text{ mA}$ | where $I_{nom} = 50 \text{ A}$ |
| $= I_s \pm 220 \text{ mA}$ | where $I_{nom} = 75 \text{ A}$ |
| $= I_s \pm 300 \text{ mA}$ | where $I_{nom} = 100 \text{ A}$ |
| $= I_s \pm 470 \text{ mA}$ | where $I_{nom} = 150 \text{ A}$ |

Balancing the Voltage Setpoint Zero-Point

Device settings: OUTPUT ON; USET 0.10; ISET 2.00
 Output: Idle

- Measure output voltage U_A with the digital voltmeter and balance with R554 to:

| | |
|------------------------------------|--------------------------------|
| $100 \text{ mV} \pm 5 \text{ mV}$ | where $U_{nom} = 40 \text{ V}$ |
| $100 \text{ mV} \pm 8 \text{ mV}$ | where $U_{nom} = 52 \text{ V}$ |
| $100 \text{ mV} \pm 10 \text{ mV}$ | where $U_{nom} = 80 \text{ V}$ |

Balancing the Voltage Setpoint Final Value

Device settings: OUTPUT ON; USET = U_{nom} ; ISET 2.00

| | |
|---|--------------------------------|
| $U_A = 40.00 \text{ V} \pm 30 \text{ mV}$ | where $U_{nom} = 40 \text{ V}$ |
| $= 52.00 \text{ V} \pm 43 \text{ mV}$ | where $U_{nom} = 52 \text{ V}$ |
| $= 80.00 \text{ V} \pm 60 \text{ mV}$ | where $U_{nom} = 80 \text{ V}$ |

Balancing the Measured Voltage Zero-Point

Device settings: OUTPUT ON; USET 0.00; ISET 0.00
 Output: Shorted

- Balance measured voltage value U_{out} , which appears at the left-hand display, with R 657 to:

| | |
|--------------------------------|--|
| $-0.01 \leq U_{out} \leq 0.01$ | where $U_{nom} = 40 \text{ V}$ |
| $-0.02 \leq U_{out} \leq 0.02$ | where $U_{nom} = 80 \text{ V}$ or 52 |

V

Balancing the Measured Voltage Final Value

Device settings: OUTPUT ON; USET = U_{nom} ; ISET 2.00

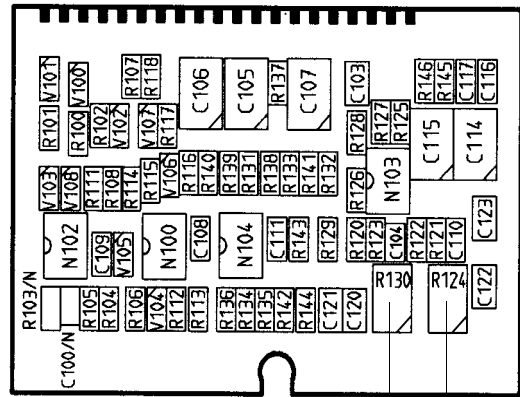
Output: Idle

- Connect the digital voltmeter to the output and measure voltage U_A .

- Balance measured voltage value U_{out} , which appears at the left-hand display, with R 651 to:

| | |
|-----------------------------------|--------------------------------|
| $U_{out} = U_A \pm 20 \text{ mV}$ | where $U_{nom} = 40 \text{ V}$ |
| $U_{out} = U_A \pm 23 \text{ mV}$ | where $U_{nom} = 52 \text{ V}$ |
| $U_{out} = U_A \pm 40 \text{ mV}$ | where $U_{nom} = 80 \text{ V}$ |

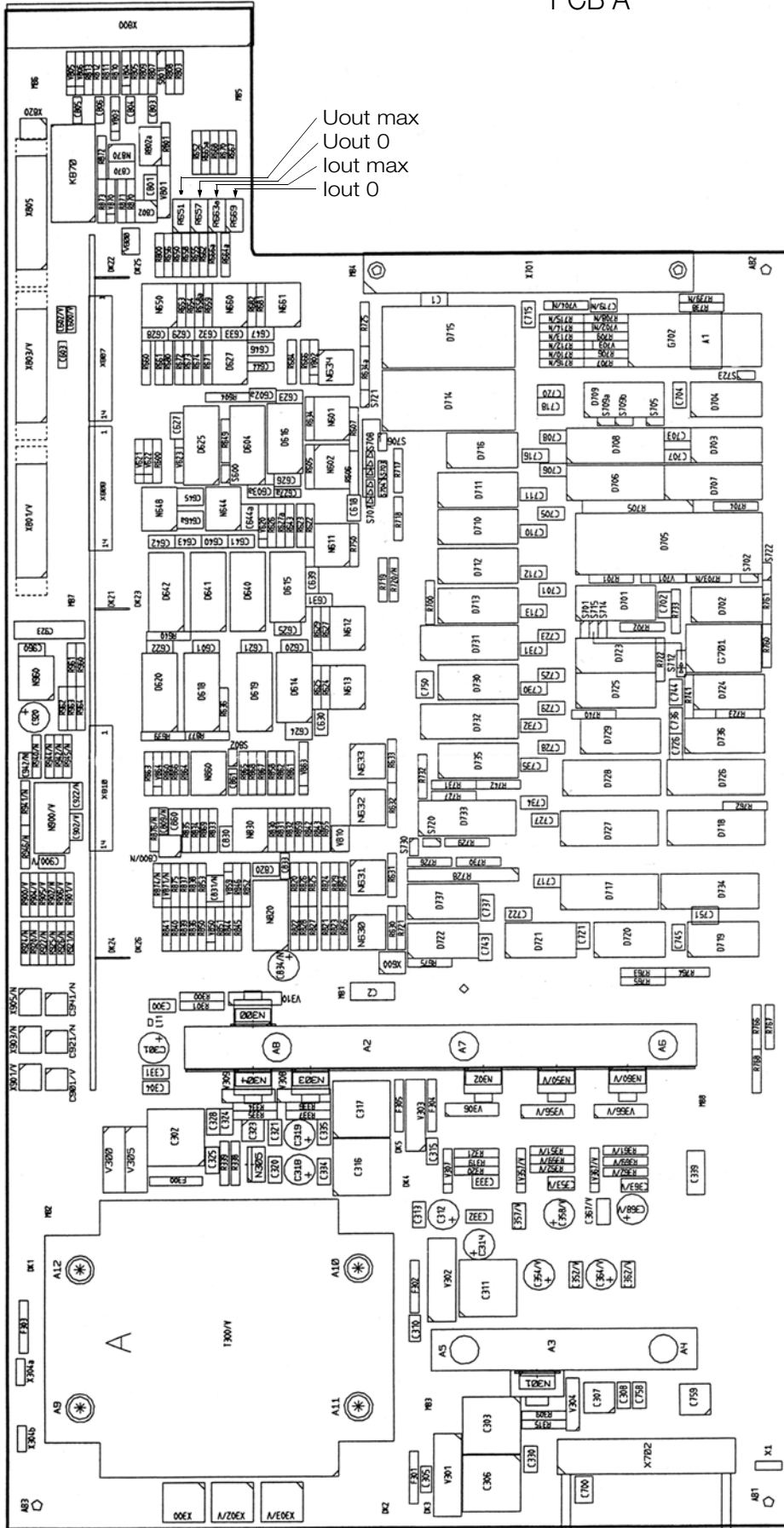
PCB FF



I monitor max.

I monitor 0

PCB A



8 Appendix

8.1 Adjustable Functions and Parameters

| Setting Command | Significance / Effect | Setting saved with *SAV n: | | | | | Default setting after RESET *RST: | Explanation in chap. on page |
|---------------------------------|---|---------------------------------|----------|---------|----------|------------|-----------------------------------|------------------------------|
| | | Manual setting or via interface | | | | | | |
| | | Manual | IEEE 488 | RS 232C | n=1...10 | n=11...255 | | |
| <i>Addr n</i> | Set device address for RS 232 or IEEE 488 (interface configuration) | X | | | | | unchanged | p. 38 |
| <i>bAUd txt</i> | Set transmission speed (interface configuration) <i>txt</i> : 50; 75; 150; ... ; 4800; 9600; 19.2t (transmission speed in bits per sec) | X | | | | | unchanged | p. 39 |
| <i>dbit txt</i> | Set number of data bits (interface configuration) <i>txt</i> : 7; 8 | X | | | | | unchanged | p. 39 |
| DELAY v | Output off delay for OCP <i>v</i> : 0; 0.01; ... , 99.99 (delay time in seconds) | X | X | X | X | | 00.00 | p. 24 p. 65 |
| DISPLAY txt | Activate / deactivate the 7-segment displays <i>txt</i> : ON, OFF (display on, display off = shorter measuring and setting rate via the interface) | | X | X | | | ON | p. 65 |
| FSET txt | Sequence function parameter <i>txt</i> : NF / RU / RI | X | | X | | X | NF | p. 65 |
| ILIM v | Current setting limit (soft-limit) <i>v</i> : 12.00 (example: 12.00 A) | X | X | X | X | | I_{nom} | p. 23 p. 66 |
| ISET v | Current setpoint <i>v</i> : 10.75 (example: 10.75 A) | X | X | X | X | X | 000.000 | p. 22 p. 67 |
| OCP txt | Response selection for current limiting (overcurrent protection) <i>txt</i> : OFF (limiting by means of current regulation) ON (limiting by deactivating the output after DELAY time elapses) | X | X | X | X | | OFF | p. 26 p. 68 |
| OUTPUT txt | Output On/Off <i>txt</i> : OFF, ON (output deactivated, output activated) | X | X | X | X | | OFF | p. 23 p. 69 |
| OVSET v | Overvoltage protection trigger value <i>v</i> : 32.5 (example: 32.5 V) | X | X | X | X | | OVSETmax | p. 24 p. 69 |
| <i>Pbit txt</i> | Set parity bit (interface configuration) <i>txt</i> : nonE no parity bit ZEro always 0 EVEN even numbered odd odd numbered onE always 1 | X | | | | | unchanged | p. 39 |
| <i>Pon txt</i> | Device setting selection after power-up | X | | | | | unchanged | p. 27 |
| POWER_ON txt | <i>txt</i> : RST (default setting) RCL (last used settings) SBY (last used setting, output deactivated) | | X | X | | | | p. 70 |
| <i>rEP n</i> | Set number of repetitions for the SEQUENCE function | X | | | X | | unchanged | p. 33 |
| REPETITION | <i>n</i> : 0 <i>n</i> (continuous repetition) 1; 2; ... , 255 (number of sequence repetitions) | | X | X | | | | p. 71 |
| <i>rnd txt</i> | Round off the displayed measured value (setup) <i>txt</i> : 0; -1; -2 (no rounding, round by one or two decimal places) | X | | | | | unchanged | p. 28 |
| <i>Sbit txt</i> | Set number of stop bits (interface configuration) <i>txt</i> : 1; 2 | X | | | | | unchanged | p. 40 |
| <i>SEq txt</i> | Sequence, automatic memory recall | X | | | | | running sequence STOP | p. 34 |
| SEQUENCE txt | <i>txt</i> : Go (start); (off, on (close / end, open)) hold (pause/suspend); cont (resume); strt, step, stop (step-by-step control) | | X | X | | | | p. 71 |
| <i>Strt m</i> | Start and stop memory address for the SEQUENCE function | X | | | | X | unchanged | p. 32 |
| <i>StoP n</i> | <i>m</i> : 11; 12; ... , 255 (start address = beginning of sequence) | | | | | | | p. 32 |
| START_STOP m, n | <i>n</i> : 11; 12; ... , 255 (stop address = end of sequence, $n \geq m$) | | X | X | | | | p. 72 |
| STORE n, v1, v2, v3, txt | Direct transfer of parameter data to memory <i>n</i> : 11; 12; ... ; 255 (memory address) <i>v1</i> : voltage setpoint <i>v2</i> : current setpoint <i>v3</i> : memory location-specific dwell time <i>txt</i> : NC: no function, CLR: complete deletion of memory location data; NF / Ru / RI | | X | X | | | no effect | p. 72 |
| TDEF v | Set default time for the SEQUENCE function (TDEF is used instead of TSET if TSET has not been set to any specific value, or if it has been set to 0.) <i>v</i> : 0.01; 0.02; ... , 99.99 (delay time in seconds) | X | X | X | X | | unchanged | p. 32 p. 73 |

| Setting Command | Significance / Effect | Setting saved with *SAV n: | | | | | Default setting after RESET *RST: | Explanation in chap. on page |
|--------------------------|---|---------------------------------|----------|---------|------------|--------------|--------------------------------------|------------------------------|
| | | Manual setting or via interface | | | | | | |
| | | Manual | IEEE 488 | RS 232C | n=1 ... 10 | n=11 ... 255 | | |
| <i>trG txt</i> | Function selection for the trigger input at the analog interface | X | | | | | | p. 29 |
| T_MODE <i>txt</i> | <i>txt</i> : OFF (input disabled) OUT (input deactivates or activates the output (OUTPUT OFF / ON)) RCL (input triggers step-by-step memory recall) SEQ (input starts or stops sequential memory recall (SEQUENCE GO / STOP)) LLO (input enables or disables front panel controls (LOCAL LOCKED)) MIN (input sets Min-Max storage function (MINMAX OFF / RST or ON)) | | X | X | | | unchanged | p. 74 |
| TSET <i>v</i> | Set memory location-specific default time for the SEQUENCE function <i>v</i> : 0; 0.01; ... , 99.99 (delay time in seconds) | X | | X | X | X | unchanged | p. 31 p. 74 |
| <i>UL_ txt</i> | Min-Max storage for measured U and I values | X | | | X | | OFF | p. 27 |
| MINMAX <i>txt</i> | <i>txt</i> : OFF, ON, RST (min-max value storage off / on / reset) | | X | X | | | | p. 67 |
| ULIM <i>v</i> | Voltage setting limit (soft-limit) <i>v</i> : 15.0 (example: 15.0 V) | X | | X | X | | U _{nominal} | p. 23 p. 75 |
| USET <i>v</i> | voltage setpoint <i>v</i> : 12.5 (example: 12.5 V) | X | | X | X | X | 000.000 | p. 22 p. 76 |
| WAIT <i>v</i> | <i>Additional waiting time</i> <i>v</i> : 0.001;0.002 ... 9,999 (waiting time in seconds) | | X | X | | | | p. 76 |
| *CLS | Clear status command | | X | X | | | no effect | p. 60 |
| DCL, SDC | DEVICE CLEAR: Clear input and output buffers (all settings and register contents remain unchanged) | | X | X | | | | p. 64 |
| *DDT <i>txt</i> | DEFINE DEVICE TRIGGER: Definition of function to be executed after receiving the *TRG command or IEC bus signal GET (group execute trigger) <i>txt</i> : USET 12 / ISET 8.5 / OUT ON / IOUT? (example) <i>txt</i> ≤ 80 characters, use "/" instead of ";", as a delineator within <i>txt</i> ! | | X | X | | | DDT memory cleared | p. 60 |
| ERAE <i>n</i> | Device dependent event register A enable command | | X | X | | | no effect | p. 60 |
| ERBE <i>n</i> | Device dependent event register B enable command | | X | X | | | no effect | p. 60 |
| *ESE <i>n</i> | Standard event enable command | | X | X | | | no effect | p. 60 |
| IFC | INTERFACE CLEAR: Rest and initialize the IEC bus interface (all settings and register contents remain unchanged) | | X | X | | | | p. 66 |
| *OPC | Operation complete command | | X | X | | | no effect | p. 61 |
| *PRE <i>n</i> | Parallel poll enable register command | | X | X | | | no effect | p. 60 |
| *PSC <i>n</i> | Power-on status clear command | | X | X | | | no effect | p. 62 |
| <i>rcl n</i> | RECALL: Recall and activate a device setting which has been stored with the *SAV command | X | | | | | | p. 45 |
| *RCL <i>n</i> | <i>n</i> : 1 ; 2 ; ... , 10 (memory location number) 11 ; 12 ; ... , 255 (memory location number, only available with SEQUENCE function set to ON) | | X | X | | | | p. 62 |
| *RST | RESET: Reset device to default settings | X | | | | | | p. 47 p. 62 |
| *SRE <i>n</i> | Service request enable command | | X | X | | | no effect | p. 60 |
| SRQ | Service request | | | X | | | no effect | p. 71 |
| <i>Sto n</i> | SAVE: Save momentary device settings to battery-backed memory | X | | | | | | p. 41 |
| *SAV <i>n</i> | <i>n</i> : 0 *SAV 0 clears the content of memory locations <i>n1</i> to <i>n2</i> by using the address parameters of the sequence function defined by START_STOP <i>n1</i> , <i>n2</i> 1 ; 2 ; ... , 10 (memory location number) 11 ; 12 ; 255 (location number for SEQUENCE function, only available with SEQUENCE function set to ON) | | X | X | | | Memory contents unchanged | p. 63 |
| *TRG | TRIGGER: Execute command(s) specified by means of *DDT | | X | X | | | | p. 63 |
| *WAI | Wait to continue command | | X | X | | | no effect | p. 64 |

Abbreviated commands: Commands can be abbreviated with letters shown in boldface. Letters not printed in boldface can be left out, for example: "OUTPUT ON" = "OU ON"
As a rule, letters can be entered in upper or lower case.

Stringing commands together: Several commands in a single data string must be separated by semicolons ";", for example: "USET 12; ISET 8.5; OUTPUT ON"

Numeric parameter formats:

m, n: Whole number (integer)

v: Whole number, fixed or floating decimal point number with or without exponent, for example:
"12.5", "0012.5", "1.25E1", "+1.25 e+01"

8.2 Queriable Functions and Parameters

| | | Read out via interface | | | Response string for remote operation (example): | | | Resp. string length | Explanation in chap. on page | |
|---|------------------------------------|--|---|----------|---|--|---------------|---------------------|------------------------------|----------------|
| | | Front panel ¹⁾ | RS 232C | IEEE 488 | 10 characters | 10 characters | 10 characters | | | |
| Measured Value Query | I ⁻ IMAX? | Max. measured current value from Min-Max memory [A] | X | X | X | IMAX +045 . 440 | | 13 | p. 28 p. 66 | |
| | U ₋ IMIN? | Min. measured current value from Min-Max memory [A] | X | X | X | IMIN -000 . 010 | | 13 | p. 28 p. 66 | |
| | Iout LED IOUT? + display | Momentary measured current value [A] | X | X | X | IOUT +031 . 510 | | 13 | p. 24 p. 67 | |
| | CV/CC/Pmax LED MODE? | Momentary output operating mode (control mode) CV = constant voltage, CC = constant current OL = overload, OFF = output deactivated | X ²⁾ | X | X | MODE CV | | 8 | p. 16 p. 68 | |
| | Pout + Display LED POUT? | Momentary measured power value [W] | X | X | X | POUT +0662 . 7 | | 12 | p. 24 p. 70 | |
| | U ⁻ UMAX? | Max. measured voltage value from Min-Max memory [V] | X | X | X | UMAX +021 . 310 | | 13 | p. 28 p. 75 | |
| | U ₋ UMIN? | Min. measured voltage value from Min-Max memory [V] | X | X | X | UMIN +021 . 280 | | 13 | p. 28 p. 75 | |
| | Uout + Display LED UOUT? | Momentary measured voltage value [V] | X | X | X | UOUT +021 . 300 | | 13 | p. 24 p. 76 | |
| | Function-Specific Device Queries | DELAY + Display LED DELAY? | Selected delay time for OCP function | X | X | X | DELAY 12.0 0 | | 11 | p. 24 p. 65 |
| | | DISPLAY? | On-off status of the 7-segment displays | X | X | X | DISPLAY O N | | 11 | p. 65 |
| FSEt | | Sequence function parameter | X | | | | | | p. 31 | |
| FSET? | | | X | X | | FSET NF | | 9 | p. 65 | |
| Ilim + Display LED ILIM? | | Selected current setting range limit [A] | X | X | X | ILIM +050 . 000 | | 13 | p. 23 p. 66 | |
| Iset + Display LED ISET? | | Selected current setpoint value [A] | X | X | X | ISET +048 . 000 | | 13 | p. 22 p. 67 | |
| U ₋ MINMAX? | | Min-max memory enable status | X | X | X | MINMAX ON | | 10 | p. 27 p. 67 | |
| OCP OCP? | | Selected current limiting function | X | X | X | OCP OFF | | 7 | p. 26 p. 68 | |
| OUTPUT LED OUTPUT? | | Output on-off status | X ²⁾ | X | X | OUTPUT ON | | 10 | p. 23 p. 69 | |
| OVset + Display LED OVSET? | | Selected overvoltage protection trigger value [V] | X | X | X | OVSET +050 . 0 | | 12 | p. 24 p. 69 | |
| Pon POWER_ON? | | Selected power-on status | X | X | X | POWER_ON R ST | | 12 | p. 27 p. 70 | |
| reP REPETITION? | | Selected number of repetitions for the SEQUENCE function | X | X | X | REPETITION 000 | | 14 | p. 33 p. 71 | |
| READY LED ⁴⁾ SEQUENCE? | | SEQUENCE function status | X | X | X | SEQUENCE H OLD, 255, 11 1 | | 21 | p. 36 p. 30 p. 71 | |
| Strt StoP START_STOP? | | Selected start and stop memory addresses for the SEQUENCE function | X ³⁾ | X | X | START_STOP 020, 115 | | 18 | p. 32 p. 32 p. 72 | |
| STORE? | | Recall data from start address to stop address from SEQUENCE memory | ⁵⁾ | X | X | | | | | p. 40 |
| STORE? n | | Recall data from address n from SEQUENCE memory | | X | X | | | | | p. 45 |
| STORE? n1,n2 | | Recall data from address n1 to address n2 from SEQUENCE memory | | | | | | | | |
| STORE? n1,n2,txt | | Recall data from address n1 to address n2 from SEQUENCE memory with tab n, n1, n2: 11, 12, ... 255 (memory address), n2 ≥ n1, optional txt: tab (optional) | | | | STORE 014, +015.500, + 003.000, 09 .70, NC | | 37 ⁶⁾ | | p. 72 |
| tdEF TDEF? | | Selected default time for the SEQUENCE function | X | X | X | TDEF 10.00 | | 10 | p. 31 p. 73 | |
| trG T_MODE? | | Selected trigger input function | X | X | X | T_MODE OUT | | 10 | p. 29 p. 74 | |
| tSEt TSET? | | Selected dwell time for the SEQUENCE function | X | X | X | TSET 00.10 | | 10 | p. 31 p. 74 | |
| Ulim + Display LED ULIM? | | Selected voltage setting range limit [V] | X | X | X | ULIM +035 . 000 | | 13 | p. 23 p. 75 | |
| Uset + Display LED USET? | | Selected voltage setpoint value [V] | X | X | X | USET +021 . 300 | | 13 | p. 22 p. 76 | |

| | | Read out via interface | | Response string for remote operation (example): | | | Resp. string length | Explanation in chap. on page | |
|------------------------|-----------------|--|---|---|---|--|--|------------------------------|-------|
| | | Front panel 1) | | 10 characters | 10 characters | 10 characters | | | |
| | | | | RS 232C | IEEE 488 | | | | |
| General Queries | *DDT? | DDT function memory content (response string for empty memory →: " " (1 blank space)) | X | X | US 10.5; IS | 12; OUT ON | ; IOUT? | 1 ... 80 | p. 60 |
| | *IDN? | Device ID (manufacturer, type designation, serial no., hardware and software revision) | X | X | GOSSEN-MET 0P,XXXXXX | RAWATT,SSP XX,03.001 | 62N052RU05 | 49 | p. 61 |
| | *LRN? | Complete settings | X | X | ULIM +035. SET +050.0 ;USET +021 OUTPUT ON ; ON;TSET 0 TITION 000 T_MODE OUT | 000;ILIM + ;OCP OFF;D .300;ISET POWER_ON R ST;MINMAX ; 0.10;TDEF ;START_STO ;DISPLAY | 050.000;OV ELAY 12.00 +048.000;O P 020,115; ON | 202 | p. 61 |
| | *TST? | Trigger self-test event query (0 = error-free, 1 = faulty) | X | X | 0 | | | 1 | p. 64 |
| | HID_TST? | Start self-test and query results (duration: approx. 5 s) | X | X | X-ROM-TEST RAM-TEST P T PASSED; (----- | PASSED; ADC DAC-ADC-TE); END TES | B800H); X- -TIMER-TES ST ----- | 111 | p. 64 |

1) Or front panel display selectable / possible

2) LED

3) *Start n* or *Stop n*

4) Status indicated with blinking READY LED, rrep and rcl via <SELECT> key

5) Manual: RCL *n* and scroll through parameters with [SELECT] key (indirect)

6) in general: length = ((n2-n1+1)×38)-1 character, with n1, n2 also as start/stop address

Terminating device messages: The following end-of-text characters can be used for data receive:

For IEC bus operation: NL (hex: 0A) or NL & EOI or DAB & EOI

For RS 232C remote control: NL or CR (hex: 0D) or ETB (hex: 17) or ETX (hex: 03).

The following end-of-message character is used when transmitting the response string:

With IEC bus control: NL & EOI;

For RS 232C remote control: last received end-of-message character

Abbreviated commands: Commands can be abbreviated with letters shown in boldface. Letters not printed in boldface can be left out, for example: "**OUTPUT** ?" = "OU?"
As a rule, letters can be entered in upper or lower case.

Stringing commands together: Several commands in a single data string must be separated by semicolons ";", for example: "USET?; ISET?; OUTPUT?"

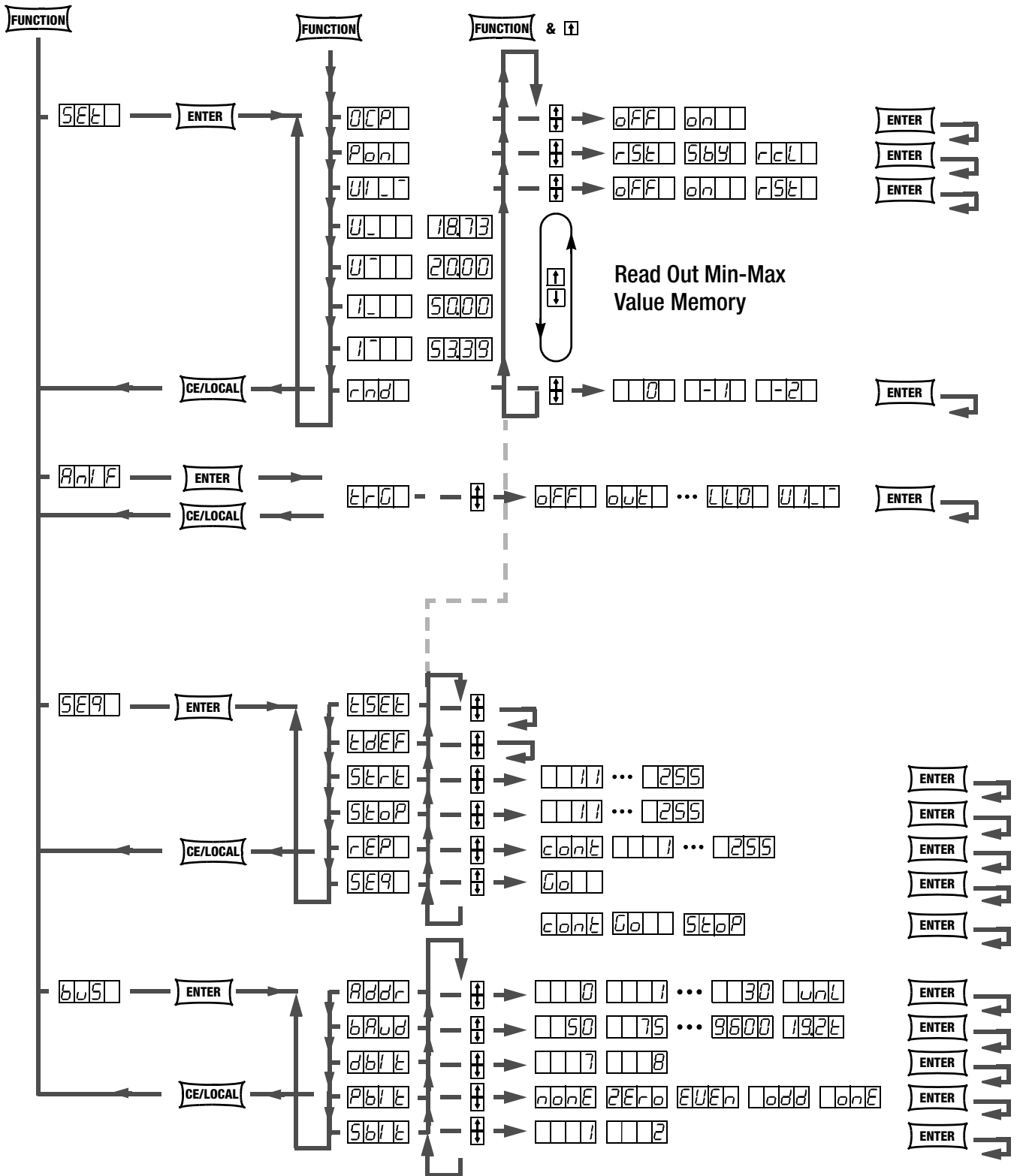
8.3 Query Command for Status and Events Management

| | | Read out via interface | | Response string for remote operation (example): | Resp. string length | Expla- nation in chapter on page | | |
|----------------------------------|---|--|-----------------|--|---------------------------|---|-------|-------|
| | | RS 232C | IEEE 488 | | | | | |
| Query Status and Event Registers | CRA? | Condition register A query | | X | X | 002 | 3 | p. 64 |
| | D7: SEQB | Status message: sequence function active (run, hold) | | | | | | |
| | D6: TRGA | Signal at analog interface trigger input | | | | | | |
| | D5: OTPA | Overtemperature | | | | | | |
| | D4: OVPA | Overvoltage protection triggered | | | | | | |
| | D3: 0 | | | | | | | |
| | D2: OL | Overload | | | | | | |
| | D1: CCR | Output in current regulating mode | | | | | | |
| | D0: CVR | Output in voltage regulating mode | | | | | | |
| | ERA? | Device dependent event register A query | | X | X | 032 | 3 | p. 60 |
| | D7: SEQI | Sequence function completed (inactive) (ready) | | | | | | |
| | D6: OTPI | Ready for operation message after OTPA | | | | | | |
| | D5: OTPA | Overtemperature message | | | | | | |
| | D4: OVPA | Overvoltage protection triggered | | | | | | |
| | D3: OCPA | OCP function triggered: | | | | | | |
| | D2: OL | Overload has occurred | | | | | | |
| | D1: CCR | Current regulation has occurred | | | | | | |
| | D0: CVR | Voltage regulation has occurred | | | | | | |
| | ERAE? | Device dependent event register A enable query | | X | X | 032 | 3 | p. 60 |
| | ERB? | Device dependent event register B query | | X | X | 128 | 3 | p. 60 |
| D7: TPE | Self-test error or phase failure | | | | | | | |
| D6: TRGA | Signal at analog interface trigger input | | | | | | | |
| D5: SEQE | SEQUENCE function error message | | | | | | | |
| D4: OUTE | Error message after OUTPUT ON, disabling via trigger input at analog interface | | | | | | | |
| D3: DDTE | Define device trigger function error message | | | | | | | |
| D2: LIME | Limit error; ULIM < USET or ILIM < ISET | | | | | | | |
| D1: 0 | | | | | | | | |
| D0: 0 | | | | | | | | |
| ERBE? | Device dependent event register B enable query | | X | X | 128 | 3 | p. 60 | |
| *ESE? | Standard event status enable query | | X | X | 032 | 3 | p. 60 | |
| *ESR? | Standard event status register query | | X | X | 144 | 3 | p. 60 | |
| D7: PON | Power On | | | | | | | |
| D6: 0 | (URQ user request) | | | | | | | |
| D5: CME | Command Error | | | | | | | |
| D4: EXE | Execution Error | | | | | | | |
| D3: DDE | Device Dependent Error | | | | | | | |
| D2: QYE | Query Error | | | | | | | |
| D1: 0 | (RQC request control) | | | | | | | |
| D0: OPC | Operation complete | | | | | | | |
| *IST? | Individual status query | | X ¹⁾ | X | 0 | 1 | p. 61 | |
| *OPC? | Operation complete query | | X | X | 1 | 1 | p. 61 | |
| *PRE? | Parallel poll enable register enable query | | X | X | 012 | 3 | p. 60 | |
| *PSC? | Power-on status clear query | | X | X | 0 | 1 | p. 62 | |
| *SRE? | Status request enable query | | X | X | 012 | 3 | p. 60 | |
| *STB? | Read status byte query | | X ²⁾ | X | 034 | 3 | p. 63 | |
| D7: 0 | | | | | | | | |
| D6: RQS MSS | | | | | | | | |
| D5: ESR | Standard event register | | | | | | | |
| D4: MAV | Message Available | | | | | | | |
| D3: ERA | Event register A | | | | | | | |
| D2: ERB | Event register B | | | | | | | |
| D1: 0 | | | | | | | | |
| D0: 0 | | | | | | | | |

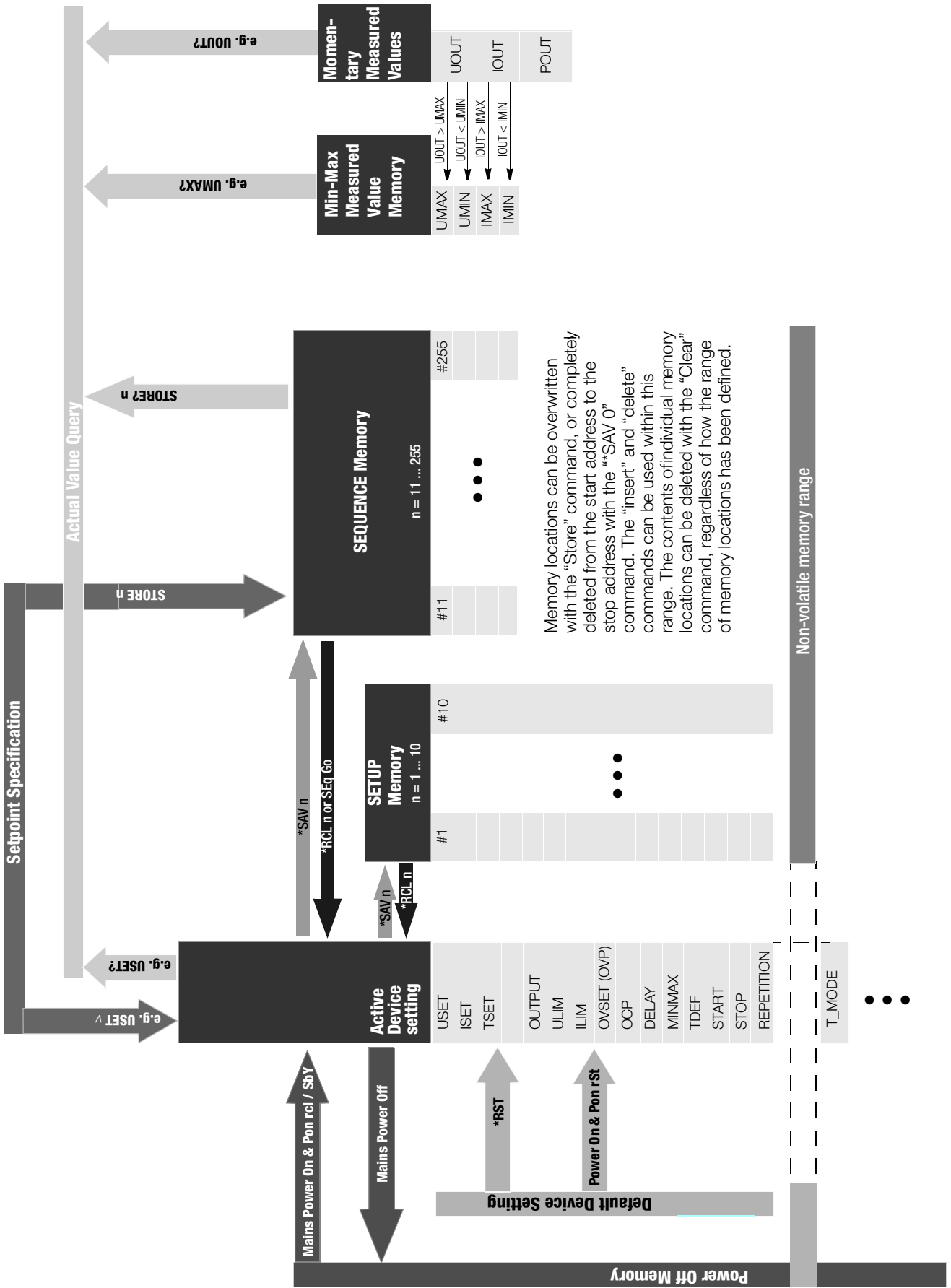
¹⁾ When using the RS232 interfaces **without** the IEEE488 interface, value 1 is generally returned as a response.

²⁾ When using the RS232 interface **without** the IEEE488 interface, the invalid value 127 is generally returned as a response.

8.4 Overview of Menu Functions



8.5 Memory Structure



8.6 System Messages

Error messages may appear at the digital display immediately after the device is switched on, or after triggering certain functions manually or via remote control.

| Code | Meaning / Cause | Remedy |
|----------|---|---|
| Err 1 | ROM checksum error . ROM memory test failed. | The device must be tested at a service center and repaired if necessary. |
| Err 2 | RAM write/read error. RAM memory test failed. | The device must be tested at a service center and repaired if necessary. |
| Err 3 | Write/read error. Initialization of the IEC bus interface failed. | The device must be tested at a service center and repaired if necessary. |
| Err 5 | An unspecified self-test sub-function has failed. | The device must be tested at a service center and repaired if necessary. |
| Err 7 | Serial interface disabled, impermissible configuration, e.g. 8DB, PE, 2SB, or 7DB, PN, 1SB. The error message is displayed during the power-up routine, or under the "BUS" menu item after each entry. | |
| Err 20 | Attempted delete and insert outside of the defined memory range (from start to stop address). | |
| Err 21 | Error message during SEQUENCE function operation, or after RECALL: The (next) voltage or current setpoint value to be recalled from the SEQUENCE memory is higher than the respective limit value (USET > ULIM or ISET > ILIM). For this reason, memory recall cannot be executed. The SEQUENCE is aborted. | Check the contents of the SEQUENCE to be executed, and coordinate setpoints and limit values. |
| Err 22 | Error message after SEQUENCE GO: No executable values exist within the storage area defined by the START and STOP addresses for the SEQUENCE. The SEQUENCE cannot be started. | Check the selected START and STOP addresses, as well as the contents (USET, ISET and TSET) of the memory locations defined by these parameters. |
| Err 24 | Attempted recall of an invalid value (remote: *RCL xxx, where 011 ≤ xxx ≤ 255). | |
| Err 25 | Error message after OUTPUT ON: Activation of the output is disabled by an OUTPUT OFF signal at the trigger input of the analog interface. | In order to activate the output, either the trigger control signal must be set to low, or the effect of the trigger input must be set to another function, after which the OUTPUT ON command must be re-executed. |
| LnE FAIL | Error message for series 64 N devices: At least one of the three supply power phases has failed. The output is deactivated immediately after this message is generated, and the device is disabled against further use. | Switch the device off and inspect for correct connection of supply power at the mains terminals at the back of the device, as well as for correct fuse ratings and intact fuses. Due to the fact that the device is capable of handling the failure of a single phase without affecting operation, this message does not appear until after the failure has persisted for several seconds. |

| Code | Meaning / Cause | Remedy |
|------------|---|--------|
| +OL or -OL | Display indicating measuring function over-ranging: If a measured output voltage U _{OUT} or output current I _{OUT} violates the specified range (→ chapter 1.5.3), +OL or -OL appears at the display. The appearance of this message always indicates that the specified limit values for output voltage or current have been violated. Examples: U_{OUT} indicates +OL: e.g. caused by overdriving output voltage with an analog control signal applied to the analog interface. U_{OUT} indicates -OL: due to incorrectly connected sensing leads. I_{OUT} indicates +OL: e.g. caused by overdriving output current with an analog control signal applied to the analog interface. POUT indicates +OL: Since POUT is calculated by multiplying U _{OUT} and I _{OUT} , it can be assumed that one of the above listed causes is responsible for this message. | |

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9 Order Information

| Type | Description | Article Number |
|-------------------------------|----------------------------|----------------|
| 62 N 52 RU 25 P | SSP-KONSTANTER 500-52 | K344A |
| 62 N 52 RU 50 P | SSP-KONSTANTER 1000-52 | K345A |
| 64 N 52 RU 100 P | SSP-KONSTANTER 2000-52 | K352A |
| 64 N 52 RU 150 P | SSP-KONSTANTER 3000-52 | K362A |
| 62 N 80 RU 12,5 P | SSP-KONSTANTER 500-80 | K341A |
| 62 N 80 RU 25 P | SSP-KONSTANTER 1000-80 | K343A |
| 64 N 80 RU 50 P | SSP-KONSTANTER 2000-80 | K351A |
| 64 N 80 RU 75 P | SSP-KONSTANTER 3000-80 | K361A |
| IEEE 488/ RS 232 interface | Option for SSP 62N/64N-BZ3 | K382A |
| RS 232 interface | Option for SSP-62/64N-BZ3 | K383A |

Software

| Type | Designation | Article No. |
|-------|--|-------------|
| K930D | LabView, device driver for SSP KONSTANTER series 120, 240, 320 and series 500, 1000, 2000, 3000 | K930D |
| K930E | LabWindows / CVI, device driver for SSP KONSTANTER series 120, 240, 320 and series 500, 1000, 2000, 3000 | K930E |
| K930F | HPVee / VXI PnP, device driver for SSP KONSTANTER series 120, 240, 320 and series 500, 1000, 2000, 3000 | K930F |

Mounting

| Description | Note | Article No. |
|----------------------------|---|---------------------|
| RS 232 bus cable, 2 m | For connecting a device to an RS 232 interface (extension cable, 9-pin socket / 9-pin plug connector) | GTZ3241 000R0001 |
| IEEE - IEEE bus cable, 2 m | For connecting a device to the IEEE 488 bus system | K931A |

10 Repair and Replacement Parts Service, Calibration Center* and Rental Instrument Service

If required please contact:

GMC-I Service GmbH
Service Center
Thomas-Mann-Str. 20
90471 Nuremberg, Germany
Phone +49 911 817718-0
Fax +49 911 817718-253
E-mail service@gossenmetrawatt.com

This address is only valid in Germany.

Please contact our representatives or subsidiaries for service in other countries.

* **DKD** Calibration Laboratory for Electrical Quantities DKD – K – 19701 accredited per DIN EN ISO/IEC 17025:2005

Accredited quantities: direct voltage, direct current value, direct current resistance, alternating voltage, alternating current value, alternating current active power, alternating current apparent power, DC power, capacitance, frequency, temperature

Competent Partner

GMC-I Messtechnik GmbH is certified in accordance with DIN EN ISO 9001:2000. Our DKD calibration lab is accredited by the Deutscher Kalibrierdienst (German Calibration Service) in accordance with DIN EN ISO/IEC 17025:2005 under registration number DKD-K-19701.

We offer a complete range of expertise in the field of metrology: from **test reports** and **factory calibration certificates**, right on up to **DKD calibration certificates**.

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Our service department includes an **on-site DKD calibration bench**. If errors are discovered during calibration, our specialized personnel are capable of completing repairs using original replacement parts.

As a full service calibration lab, we can calibrate instruments from other manufacturers as well.

11 Product Support

If required please contact:

GMC-I Messtechnik GmbH
Product Support Hotline
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Fax +49 911 8602-709
E-mail support@gossenmetrawatt.com